

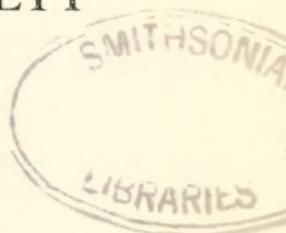




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PROCEEDINGS
of the
ENTOMOLOGICAL SOCIETY
of
WASHINGTON



Volume 81

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A REVIEW OF THE LEAFHOPPER GENUS *COFANA* (HOMOPTERA: CICADELLIDAE)¹

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Abstract.—The Old World genus *Cofana* is redescribed. A list of species with synonyms and distributions includes 10 new combinations, 8 new synonyms and the following 9 new species: *hoogstraali*, *jedarfa*, *lata*, *maai*, *medleri*, *polaris*, *separata*, *sotoi* and *yasumatsui*. A key to 17 of the 19 known species and illustrations of many of the key characters are included.

The genus *Cofana* is part of the leafhopper tribe Cicadellini, of the Old World, that is under study by the author. Because of requests for identifications, often involving unpublished synonymy, new combinations, and undescribed species, it is considered advisable to present this review before the remainder of the work. Coded bibliographic references to works before 1956 (e.g., Kirkaldy 1905b:319) may be found in the Metcalf (1964) work cited in the Literature Cited section in this paper, the number after the colon referring to the page.

Institutional abbreviations used in the text are as follows: AMNH, American Museum of Natural History; BM, British Museum; BPBM, Bernice P. Bishop Museum; CAS, California Academy of Sciences; HNHM, Hungarian Natural History Museum; MHNP, Museum National d'Histoire Naturelle; MMB, Moravian Museum in Brno; NCS, North Carolina State University; RMS, Riksmuseet, Stockholm; USNM, United States National Museum; ZIL, Zoological Institute, Lund; ZIMH, Zoologisches Institut und Museum, Hamburg.

Genus *Cofana* Melichar

Cofana Melichar, 1926a:345. Type-species: *Tettigonia quinque-notata* Stål, which is a junior subjective synonym of *Tettigonia eburnea* Walker, by subsequent designation of China, 1938d:185.

Yasumatsuus Ishihara, 1971:18. Type-species: *Kolla mimica* Distant (mis-determined), by original designation and monotypy, which is *Cofana yasumatsui*, new species, described below. NEW SYNONYMY.

Description.—Length of male 5.3–11.8 mm, of female 5.3–13.0 mm.

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Head not strongly produced, median length of crown from $4/10$ to slightly more than $3/4$ interocular width, and from $1/4$ to slightly more than $6/10$ transocular width, anterior margin varying from narrowly (*eburnea* (Walker) and *sotoi*, new species) to broadly rounded in dorsal view; ocelli usually aligned with anterior eye angles, or slightly more posteriorly in most species (exception: female of *C. separata*, new species), each closer to adjacent anterior eye angle than to median line of crown (exceptions: the new species *minima* and *jedarfa* in which they are equidistant from adjacent anterior eye angle and median line); crown with or without a concavity across ocelli, disk not sculptured, lateral clypeal sutures extending onto crown and attaining ocelli; antennal ledges not protuberant, in lateral view with anterior margins varying from rectilinear to convex or concave and from vertical to oblique; clypeus usually very broadly and slightly convex medially, or flattened medially (shallowly concave in *eburnea* (Walker)), granulate or not sculptured medially, muscle impressions distinct or not (varying interspecifically), transclypeal suture entire (usually) or interrupted medially; clypellus in profile continuing contour of clypeus or with its apical portion more nearly horizontal, without pubescence.

Thorax with pronotal width varying in comparison to transocular width of head, broader in most species (narrower in *eburnea*, *albida* (Walker), equal to width of head in *unimaculata* (Signoret), and variable within *jedarfa*, new species), pronotum with lateral margins convergent anteriorly, dorsopleural carinae almost always incomplete, posterior margin shallowly concave, posterior portion of disk transversely rugulose or not; scutellum occasionally transversely rugulose on posterior portion. Forewing usually hyaline and without a membrane (exception: *subvirescens* (Stål) which is coriaceous except for apical membrane), veins usually distinct, often fuscous, with 3 anteapical cells of which innermost, or middle one, or both, may be open basally; outer margin (wings at rest) of 1st apical cell occasionally curved toward commissural margin so that apex of 1st apical cell does not attain apical margin; forewings of female in rest position exceeding apex of ovipositor. Hindleg with femoral setal formula 2:1:1, or occasionally 2:1:1:1; 1st tarsomere approximately equal in length to 2 distal tarsomeres, with 2 parallel rows of plantar setae and setae of one of the rows longer than those of other row.

Male genitalia with pygofer moderately produced with posterodorsal margin convex, posteroventral margin oblique, with a number of large macrosetae near apex and parallel to posteroventral margin, usually with a group of microsetae parallel to ventral margin, without setae on disk, pygofer processes absent; pygofer without more lightly sclerotized areas of flexion. Plates triangular, with uniserrate macrosetae from base to apex. Style short, with distinct lateral lobe on shank, apex truncate, often with a minute angle on mesal margin before apex (not shown in accompanying illustrations).

Connective short, triangular or trapezoidal. Aedeagus with dorsal apodemes well developed, shaft cylindrical (exception: *C. lata*, new species) and without processes (exception: *C. yasumatsui*, new species, which has paired short apical processes); aedeagus not articulated with connective, shaft directed posteriorly or posteroventrad. Paraphyses absent.

Sternal abdominal apodemes well developed in male but length and shape not always consistent within species.

Female abdominal sternum VII produced with posterior margin varying interspecifically; broadly convex, slightly narrowed and truncate, slightly narrowed and emarginate, or gradually narrowed to narrowly rounded apex. Genital chamber without sclerites. Ovipositor 2nd valvulae very broad beyond basal curvature, with ventral margin slightly convex and dorsal margin more strongly convex to anteapical portion which is slightly concave to apex which is located dorsoapically; dorsal margin with quadrate primary teeth except at base, smaller near base, larger apically, each bearing a number of secondary denticles, anteapical portion with numerous denticles, without apicoventral denticles. Pygofer broadly convex dorsoapically with a few macrosetae in a group near apex and a short distance anteroventrally near margin.

Specimens of *Cofana* are lightly sclerotized and require much less time in KOH for maceration (four hours in concentrated solution without heating) than in other genera of Cicadellini. Longer exposure of females to KOH results in twisting of the 2nd valvulae of the ovipositor. The male genitalia are not very useful for identification in most species.

Discussion.—*Cofana* is in the leafhopper subfamily Cicadellinae, tribe Cicadellini of which the New World representatives were treated recently by Young (1977). It belongs to the *Cicadella* generic group discussed in that work. Of the genera in that group, *Cofana* is very similar in appearance to *Plesiommata*. Both of the genera also have conspicuous sternal abdominal apodemes. *Cofana* lacks the basal aedeagal processes found in *Plesiommata* and the paraphyses found in the other genera of the *Cicadella* generic group.

Specimens belonging to *Cofana* Melichar have been examined from New Britain, the Solomon Islands, New Caledonia, Fiji Islands, northern Australia, New Guinea, Borneo, Celebes, Java, Sumatra, Okinawa, the Philippines, Malaya, Singapore, Thailand, Laos, Cambodia, Viet Nam, South China, Formosa, Japan, Korea, Burma, Sikkim, Bengal, Nepal, W. Pakistan, NE. and S. India, Ceylon, Yemen, Iran, Madagascar, Eritrea, Ethiopia, Chad, Senegal, Sierra Leone, Liberia, Ivory Coast, Ghana, Upper Volta, Cameroons, Gabon, Principe Island, French Equatorial Africa, Nigeria, Uganda, Belgian Congo, Tanganyika, Angola, Northern and Southern Rhodesia, Transvaal, Natal and Cape Province.

My interpretation of *Tettigonia albida* Walker is based on the holotype, a specimen from Port Natal, Africa, from which the abdominal apex and the

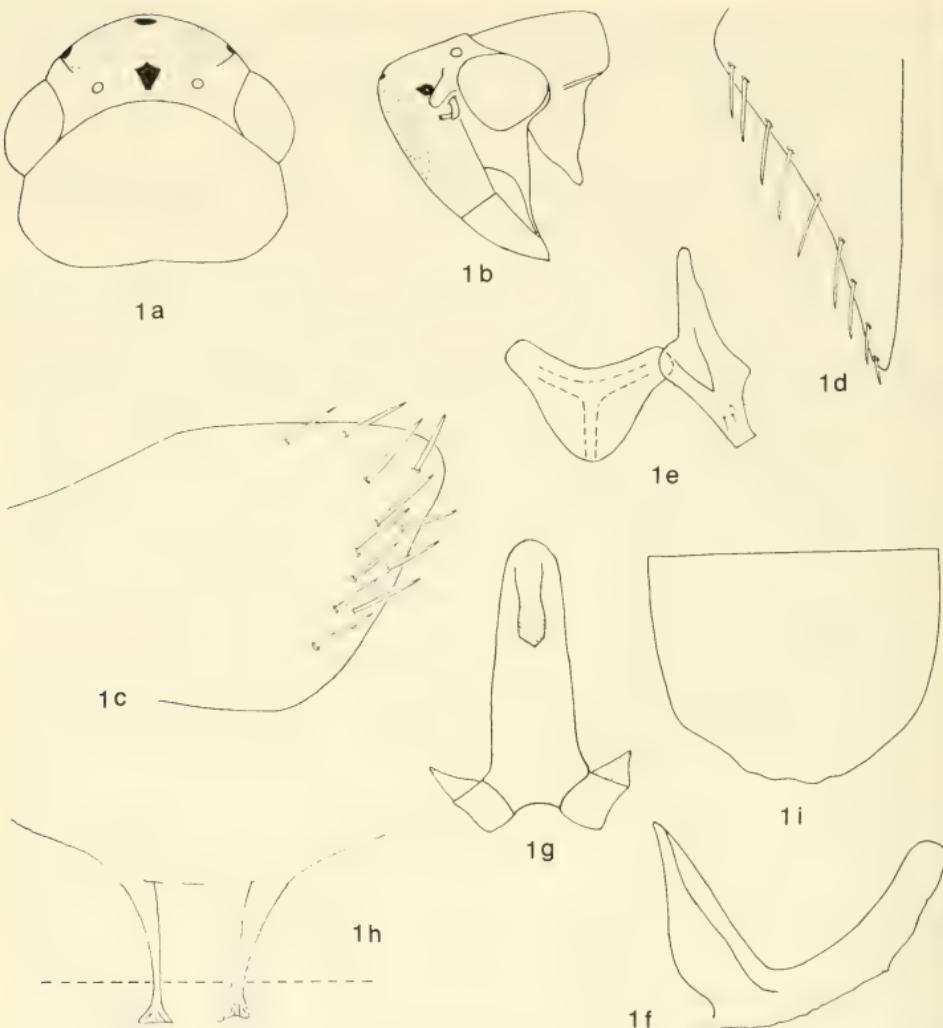


Fig. 1. *Cofana spectra*: a, head and pronotum, dorsal view; b, same, lateral view; c, male pygofer, lateral view; d, male plate, ventral view; e, style and connective, dorsal view; f, aedeagus, lateral view; g, aedeagus, caudoventral view; h, apodemes of male abdominal sternum II (broken line represents conjunctiva); i, female abdominal sternum VII, ventral view (asymmetry is actual) (a-g from intercession; h from specimen from Queensland, Australia; i from NW. New Guinea).

right forewing are missing. It agrees closely in form with a series of specimens in BPBM from Palawan in the Philippines and British North Borneo, differing only in that the holotype has only a discal small black spot on the crown, while the Palawan specimens also have a very small black apical spot on the head and a very small black scutellar spot. I cannot account for the discrepancy in localities between the holotype and the other specimens

(Perhaps the holotype was taken aboard ship?). I have seen no other specimen from Africa at all similar to the holotype. The species is very close to *C. eburnea* (Walker).

My interpretation of *Tettigonia eburnea* Walker rests on the male lectotype of which the male genitalia are very similar to the illustrations of *Cofana spectra* (Distant) (Fig. 1). *Cofana eburnea* is a highly variable species with the lectotypes of *Tettigonia quinque-notata* Stål and *Tettigoniella whiteheadi* Distant lying within the limits of variation.

I have not seen type-material of *Tettigonia fuscivenis* Bergroth. Bergroth's original description did not mention an apical spot on the head. I have seen seven specimens from Madagascar from MMB and two from RMS, all without an apical spot on the head and all belonging to *Cofana unimaculata* (Signoret) as interpreted in the present work. Nevertheless, without having seen Bergroth's specimens, I am unwilling to synonymize the two names, although the probability is that they should be synonymized.

I have seen a paratype of *Poecilocarda grisea* Evans, but it was not at hand as this was written. There is no doubt that it belongs in *Cofana*.

I have seen no type-specimen of *Kolla lineatus* Distant. Two specimens in MMB were determined by Melichar as a variety of *Cicadella spectra* (Distant). A number of specimens at hand fit the original description well, except that all are smaller than Distant stated (5.4–6.6 mm vs. 7 mm), and I have seen no other species from Ceylon that would fit the description.

Although I selected a lectotype of *Tettigonia nigrilinea* Stål in RMS, my knowledge of *Cofana* at that time was only sufficient to place it generically. There are four species with a size range of males fitting the original description and with a conspicuous dark median line on the pronotum and scutellum (*jedarsa*, new species, *lineata* (Distant), *perkinsi* (Kirkaldy), and *nigrilinea*): only one occurs in the Philippines. I have determined this species as *nigrilinea*.

Kirkaldy (1905b:319) wrote a key to the cicadelline species that he included in that paper. The species are numbered in the key, with the new species *perkinsi* being number 2. He then proceeded to describe the species in numerical order with the number and name of each species in its center-head. There is no species numbered "2," but a centerhead: "koebelei, sp. nov." appears between "1. *albida* (Walker)" and "3. *pasiphae*, sp. nov." One concludes that the description *koebelei* applies to the species "2. *perkinsi* sp. nov." of the key. Both names are available, but *perkinsi* has line priority. I have seen no specimens of this species from Australia (type-locality Cairns, Queensland), but I have based my determination on a specimen from Port Moresby, New Guinea that agrees with the original description of *koebelei* and with Evans' 1966a:144, Fig. 23D illustration.

I have identified *Tettigoniella spectra* Distant in the sense of the lectotype in BM. Distant proposed this name as a substitute name for *Tettigonia*

albida Signoret. But Signoret's *albida* was merely a misdetermination of the Walker species, not a separate proposal, and therefore not a homonym, and there was no type-series. Distant's "new name" actually constituted a separate proposal, and I therefore designated a lectotype for *spectra* (Young, 1965:194).

My identification of *Tettigonia subvirescens* Stål agrees with the lectotype. This species is easily recognized by the somewhat coriaceous greenish forewings.

At the time I designated the lectotype of *Tettigonia unimaculata* Signoret, I recognized the species as a close relative of *Cofana spectra* (Distant). Signoret pointed out the significance of the lack of an apical black spot on the head in his original description. Although some specimens of other species share this character (see key), it is important in species recognition. I have seen the types of the nominal species listed in synonymy in the accompanying list of species, except *Kolla tripunctifrons* Banks which Metcalf (1965:430) placed in *Cofana*. A specimen from Luzon determined by Melichar as *tripunctifrons* is the same as *unimaculata* Signoret.

A number of authors have reported *Cofana spectra* (Distant) from economic plants including rice, barley, wheat, sugarcane and sorghum. Misra (1920a:229) reported it from grass. Esaki and Ito (1954a:16) reported it also from "rush" and from mulberry. But all this information needs to be verified in the light of refinements in our knowledge of species recognition. Clausen (1931a:45) reported *C. subvirescens* (Stål) from sugarcane. Most of these accounts fail to state that the species observed was very important economically, even though feeding, or occurring on, economic plants. Undoubtedly several species occur commonly in paddies, and one apparently has been observed to oviposit on rice plants. Ishihara (1971:18) reported *Yasumat-sius mimicus* Distant (misdetermination = *Cofana yasumatsui*, new species described herein) as a pest of rice and illustrated the last instar nymphs.

SPECIES OF *COFANA*

albida (Walker), 1851b:767 (*Tettigonia*). Philippines: Palawan; Br. N. Borneo. NEW COMBINATION.

eburnea (Walker), 1857b:168 (*Tettigonia*). Philippines: Luzon, Mindoro, Negros, Leyte, Palawan, Mindanao; Borneo: Br. N. Borneo, Sarawak; W. Sumatra. NEW COMBINATION.

quinquenotata (Stål), 1870c:734 (*Tettigonia*). NEW SYNONYMY.

whiteheadi (Distant), 1908f:142 (*Tettigoniella*). NEW SYNONYMY.

fuscivenis (Bergroth), 1894a:2 (*Tettigonia*). Madagascar. NEW COMBINATION.

grisea (Evans), 1955b:9 (*Poecilocarda*). Belgian Congo. NEW COMBINATION.

- hoogstraali*, NEW SPECIES. Dutch New Guinea, New Britain.
- jedarfa*, NEW SPECIES. Belgian Congo, Uganda.
- lata*, NEW SPECIES. S. China, Viet Nam, Java.
- lineata* (Distant), 1908g:224 (*Kolla*). Nepal, NE. India, S. India, Ceylon, Java. NEW COMBINATION.
- maai*, NEW SPECIES. NE. New Guinea.
- medleri*, NEW SPECIES. Liberia, Nigeria, Chad, Gabon, Principe Is., Fr. Equatorial Africa, Belgian Congo, Rhodesia, Transvaal.
- nigrilinea* (Stål), 1870c:735 (*Tettigonia*). Formosa; S. China; Viet Nam; S. India; N. and S. Malaya; Singapore; Sarawak; N. Borneo; Philippines; Palawan, Negros, Mindanao; Dutch New Guinea; NE. New Guinea; Papua; New Britain; Bougainville; Guadalcanal. NEW COMBINATION.
- perkinsi* (Kirkaldy), 1906c:319 (*Tettigonia*). New Guinea; Papua; [Australia: Queensland]. NEW COMBINATION.
- koebeliai* (Kirkaldy) *loc. cit.* (*Tettigonia*). NEW SYNONYMY.
- polaris*, NEW SPECIES. Liberia, Upper Volta, Nigeria, Belgian Congo.
- separata*, NEW SPECIES. Is. of New Britain.
- sotoi*, NEW SPECIES. Sierra Leone.
- spectra* (Distant), 1908g:211 (*Tettigoniella*). Fr. Equatorial Africa; Senegal; Sierra Leone; Liberia; Ghana; Nigeria; Cape Province; Natal; Transvaal; Chad; Rhodesia; Tanganyika; Uganda; Ethiopia; Eritrea; Yemen; Iran; W. Pakistan; Nepal; Sikkim; Formosa; S. China; Burma; Shan States, Tenasserim; Laos; Thailand; Viet Nam; Bengal; Calcutta; S. India; Ceylon; Malaya; Java; Sumatra; Okinawa; Philippines; Luzon, Mindoro, Negros, Leyte, Palawan, Mindanao; N. Borneo; Sarawak; N. Celebes; Dutch New Guinea, NE. New Guinea, Papua; Australia; N. Territory, Queensland; New Britain; New Caledonia; Fiji Is.; Guadalcanal. NEW COMBINATION.
- subvirescens* (Stål), 1870c:734 (*Tettigonia*). W. Pakistan; S. China; Ceylon; Viet Nam; Burma; Thailand; Malaya; Pahang, Malacca; Sumatra; Java; Philippines; Luzon, Negros, Misamis, Mindanao; New Guinea. NEW COMBINATION.
- unimaculata* (Signoret), 1854a:26 (*Tettigonia*). Fr. Equatorial Africa; Senegal; Sierra Leone; Liberia; Ghana; Upper Volta; Nigeria; Br. Cameroons; Gabon; Belgian Congo; Uganda; Tanganyika; Northern Rhodesia; Transvaal; Natal; Madagascar; S. China; NE., NW. and S. India; Ceylon; Nepal; Formosa; Laos; Cambodia; Viet Nam; W. Pakistan; Burma; Rangoon, Tenasserim; Malaya; Singapore; Java; Philippines; Luzon, Mindoro, Negros, Cebu, Samar, Palawan, Mindanao; Borneo; Dutch New Guinea; Australia; Queensland. NEW COMBINATION.
- punctum* (Taschenberg), 1884a:445 (*Tettigonia*). NEW SYNONYMY.
- mimica* (Distant), 1908g:225 (*Kolla*). NEW SYNONYMY.

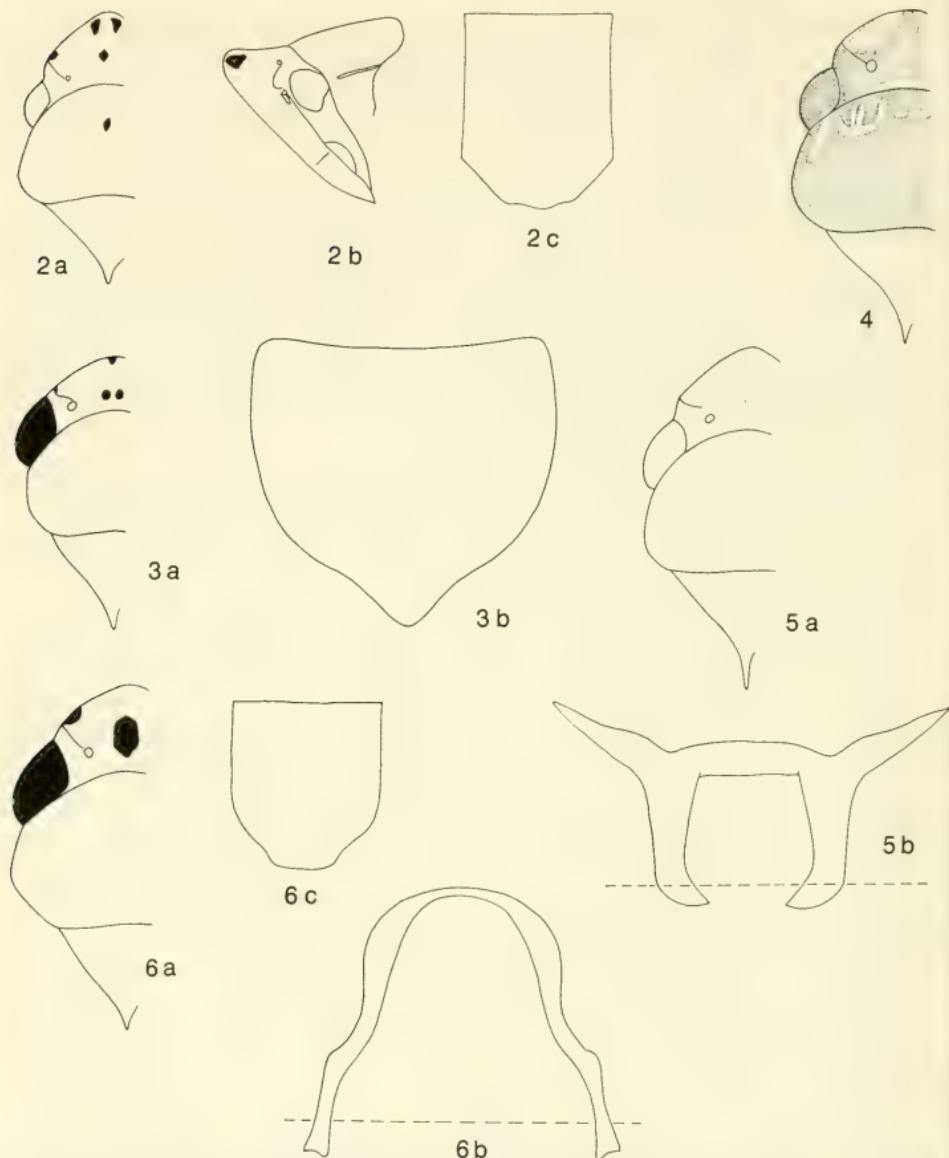


Fig. 2. *Cofana eburnea*: a, anterior dorsum; b, head and pronotum, lateral view; c, female abdominal sternum VII (all from lectotype of *Tettigonia quinquevittata* Stål, from Philippine Islands). Fig. 3. *Cofana maaei*: a, anterior dorsum; b, female abdominal sternum VII (both from holotype). Fig. 4. *Cofana separata*, anterior dorsum (holotype). Fig. 5. *Cofana hoogstraali*, male: a, anterior dorsum; b, sternal abdominal apodemes (broken line represents conjunctiva) (from specimen from Dutch New Guinea). Fig. 6. *Cofana unimaculata*: a, anterior dorsum; b, sternal abdominal apodemes of male (broken line represents conjunctiva) (from specimen from eastern Negros Island, Philippines); c, female abdominal sternum VII (from specimen from Gabon).

tripunctifrons (Banks), 1910a:51 (*Kolla*). NEW SYNONYMY.
differentialis (Baker), 1914a:420 (*Tettigoniella*). NEW SYNONYMY.
hopinensis (Distant), 1918b:3 (*Tettigoniella*). NEW SYNONYMY.
yasumatsui, NEW SPECIES. S. China, Viet Nam, Thailand, Sarawak, Borneo, Java.

KEY TO SPECIES OF *COFANA*

(*C. grisea* (Evans) and *C. fuscivenis* (Bergroth) not included)

1. Head with transocular width less than greatest width of pronotum 2
- Head with transocular width equal to or greater than greatest width of pronotum 3
2. Forewing with inner anteapical cell closed basally *albida* (Walker)
- Forewing with inner anteapical cell open basally (Fig. 2) *eburnea* (Walker)
3. Crown with paired discal spots or with a discal transverse marking (Fig. 3) *maai*, new species
- Crown with one discal spot or a longitudinal line, or without discal marking 4
4. Head without a median apical black spot 5
- Head with a median apical black spot 9
5. Length of male 9.2 mm or more; of female 10 mm or more 6
- Length of male 5.3–8.0 mm; of female 5.3–9.4 mm 7
6. Crown and pronotum dark, marked with yellow (New Britain) (Fig. 4) *separata*, new species
- Crown and pronotum usually unmarked (crown rarely with a dark median discal spot) (New Britain and Dutch New Guinea) (Fig. 5) *hoogstraali*, new species
7. Head with a median pale spot at transition from crown to face 8
- Head without such a spot (Fig. 6) *unimaculata* (Signoret)
8. Pronotum and scutellum with a conspicuous dark line *polaris*, new species
- Pronotum and scutellum unmarked *sotoi*, new species
9. Large specimens, length usually 10 mm or more; female abdominal sternum VII truncate apically but slightly convex medially (Fig. 7) *subvirescens* (Stål)
- Without above combination of characters; length almost always less than 10 mm 10
10. Crown with a median posterior longitudinal dark marking that continues as a median pronotal dark stripe without interruption 11
- Crown not so marked, with a broader median discal spot 12

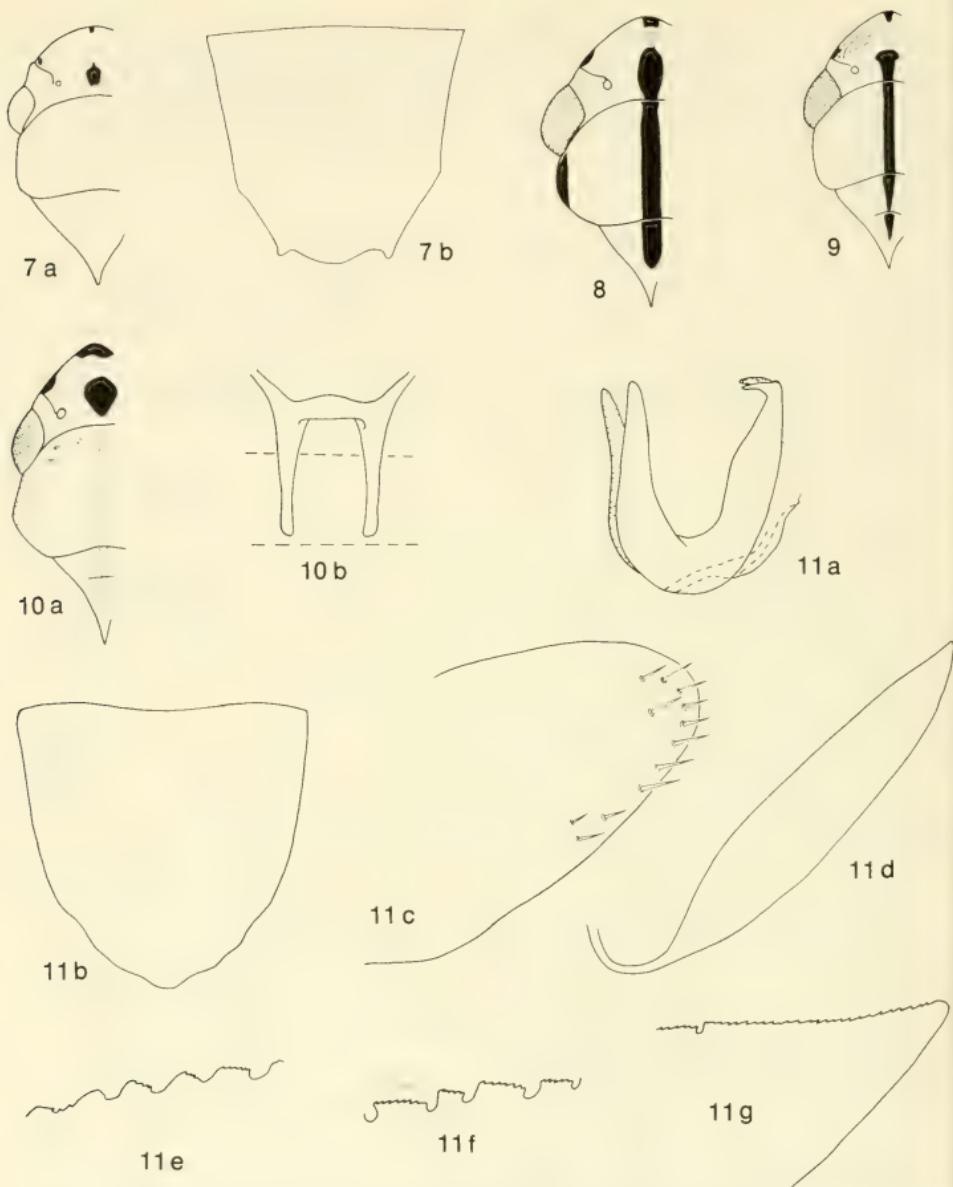


Fig. 7. *Cofana subvirescens*, lectotype: a, anterior dorsum; b, female abdominal sternum VII. Fig. 8. *Cofana perkinsi*, anterior dorsum (from specimen from Port Moresby, New Guinea). Fig. 9. *Cofana jedarfa*, holotype, anterior dorsum. Fig. 10. *Cofana lineata*: a, anterior dorsum; b, apodemes of male abdominal sternum II (from specimen from Kandy, Ceylon). Fig. 11. *Cofana yasumatsui*: a, holotype, aedeagus, lateral view; b, female abdominal sternum VII; c, female pygofer, lateral view; d, second valvula of ovipositor; e, teeth near base of second valvula; f, teeth near middle of same; g, apex of second valvula (b-g from topotype).

11. Lateral pronotal margins dark, in dorsal view (Papua, N. Australia) (Fig. 8) *perkinsi* (Kirkaldy)
- Lateral pronotal margins not dark-bordered in dorsal view (Central Africa) (Fig. 9) *jedarfa*, new species
12. Head produced and triangular; specimens smaller (length of male 5.4–5.9 mm; of female 6.0–6.6 mm); head with median length $\frac{6}{10}$ interocular width or more; with a median pronotal line continuing onto scutellum (Fig. 10) *lineata* (Distant)
- Head less produced, more broadly rounded at apex; specimens larger (length at least 6.3 mm in male; 7.7 mm in female); head with median length less in relation to interocular width; with or without median pronotal line that continues onto scutellum 13
13. Forewing with middle anteapical cell open basally; male with a pair of short apical aedeagal processes (Fig. 11) *yasumatsui*, new species
- Forewing with middle anteapical cell usually closed basally; male without aedeagal processes 14
14. Pronotum with 3 parallel brown longitudinal lines on disk, all extending onto scutellum; aedeagal shaft broad in lateral view (Fig. 12) *lata*, new species
- Pronotum with only one line extending onto scutellum, or none; aedeagal shaft cylindrical, not broader in lateral than in ventral view 15
15. Specimens more robust; female abdominal sternum VII with posterior margin slightly undulate, but broadly convex (much as in *yasumatsui*, Fig. 11) (Fig. 1) *spectra* (Distant)
- Specimens more slender; female abdominal sternum VII narrowed and truncate or emarginate apically 16
16. Head with median discal spot usually larger; often with a median pronotal dark stripe extending onto scutellum; female abdominal sternum VII narrowed and truncate apically (Palaearctic, Oriental, Australian) (Fig. 13) *nigrilinea* (Stål)
- Head with median discal spot usually smaller; without such a pronotal stripe; female abdominal sternum VII narrowed and emarginate apically (Ethiopian) (Fig. 14) *medleri*, new species

Cofana maai Young, NEW SPECIES
Fig. 3

Description.—Length of female 7.9–8.2 mm.

Head with median length of crown approximately $\frac{4}{10}$ interocular width and from $\frac{1}{4}$ to slightly more than $\frac{1}{4}$ transocular width, anterior margin broadly rounded in dorsal view; ocelli behind a line between anterior eye angles; crown with a slight transverse concavity between ocelli; antennal

ledges in lateral view with anterior margins oblique and concave; clypeus flattened and granulate medially, muscle impressions distinct, transclypeal suture interrupted medially, clypellus with contour of its lower portion very slightly more nearly horizontal than profile of clypeus.

Pronotum with greatest width less than transocular width of head, dorsopleural carinae incomplete, posterior portion of disk weakly transversely rugulose; scutellum not transversely rugulose; forewing with veins fuscous, with antepical cells closed basally.

Male genital characters much as in *C. spectra* (Fig. 1). Female abdominal sternum VII with posterior margin converging obliquely to narrowly convex apex.

Crown with a pair of fuscous close-set spots near median line (type) between ocelli or with a transverse fuscous marking, apex of head usually (holotype) with a small fuscous median spot bordered with yellow; pronotum unmarked (type) or with a faint median fuscous line; scutellum unmarked. Face with a small fuscous spot on each side bordering margin of antennal ledge at transition from face to crown, median portion of clypeus pale, areas of muscle impressions darker; remainder of face, thoracic venter and pleura, abdominal venter, and legs dull yellow except dark bases of tibial setae.

Material Examined.—Holotype ♀, Maprik, NE. New Guinea, 150 m, Dec. 29, 1959-Jan. 17, 1960 (T. C. Maa); 1 ♀, Sepik, Maprik area, NE. New Guinea, 160 m, Aug. 23, 1957 (D. Elmo Hardy); and 1 ♀, Sepik River, Pagwi area, 5 m, Aug. 25, 1957 (D. Elmo Hardy) (BPBM); 2 ♀ and 4 ♂, Hollandia, New Guinea, March, 1945 (K. L. Knight) (USNM).

Diagnosis.—This species can be separated from all other species of *Cofana* by the distinctive form of the female abdominal sternum VII.

Etymology.—The species is named in honor of the collector of the holotype, whose collections have contributed much to the knowledge of the Cicadellinae.

Cofana separata Young, NEW SPECIES
Fig. 4

Description.—Length of male 9.9 mm, of female 11.5 mm.

Head with median length of crown approximately $\frac{6}{10}$ interocular width and slightly less than $\frac{4}{10}$ transocular width, anterior margin broadly rounded in dorsal view; ocelli on (male) or before (female) a line between anterior eye angles, each approximately equidistant from median line and adjacent anterior eye angle; crown with a slight transverse concavity between ocelli; antennal ledges in lateral view with anterior margins oblique and convex; clypeus convex and granulate medially, clypellus with contour of its lower portion slightly (male) or greatly (female) more nearly horizontal than profile of clypeus.

Pronotum with greatest width approximately equal to transocular width of head, dorsopleural carinae incomplete, posterior portion transversely rugose, scutellum transversely rugulose behind transverse impression; forewing with veins fuscous, with antecapital cells closed basally, outer margin of inner apical cell curved towards commissural margin and apex of inner apical cell not attaining wing apex as a result.

Male genitalia as in generic description. Female abdominal sternum VII with posterior margin gradually and regularly convex.

Crown and pronotum dark except area including muscle impressions (which are also dark) and narrow area adjacent to posterior margin on crown, and a group of irregular submarginal markings near anterior margin of pronotum, which are dull yellow; scutellum of female very pale with median area narrowly dark in basal $\frac{1}{2}$, expanded to include all of portion behind transverse impression; basal portion of scutellum obscured medially by pin in male, apical portion concolorous with remainder. Clypeus of male black except yellow lines between muscle impressions; clypeus of female as in male except lower portion and broad lateral portion adjoining gena on each side, which are yellow; clypellus and posterior portion of genae dull yellow; proepimeron dark beneath dorsopleural carina; mesepimeron dark in male; male with legs dark beyond knees (femoro-tibial joints), female with prothoracic legs broken off at knees, mesothoracic legs dark beyond knees, metathoracic legs pale except ventral apices of tibiae and 2 apical tarsomeres, which are dark.

Material Examined.—Holotype ♂, Sio, N. coast, New Britain, 600 m, July 24, 1956 (E. J. Ford, Jr.), and 1 ♀, Gazelle Peninsula, Bainings, St. Paul's, New Britain, 350 m, Sept. 6, 1955 (J. L. Gressitt) (BPBM).

Diagnosis.—*Cofana separata* differs from other species in the genus by the distinctive markings of the anterior dorsum and by the shape of the head.

Cofana hoogstraali Young, NEW SPECIES

Fig. 5

Description.—Length of male 9.2–9.5 mm, of female 10.0–10.2 mm.

Head with median length of crown from slightly less than $\frac{6}{10}$ to almost $\frac{7}{10}$ interocular width and from slightly more than $\frac{1}{3}$ to more than $\frac{4}{10}$ transocular width, anterior margin well produced for the genus; ocelli aligned with anterior eye angles; crown with a slight concavity between ocelli; antennal ledges in lateral view with anterior margins oblique and concave; clypeus convex medially and smooth, muscle impressions distinct, transclypeal suture entire, clypellus with contour of its lower portion continuing profile of clypeus or slightly more nearly horizontal than profile of clypeus.

Pronotum with greatest width less than transocular width of head, dor-

sopleural carinae incomplete, posterior portion of pronotum transversely rugulose; scutellum transversely rugulose behind transverse impression; forewing with veins concolorous with remainder of wing, with anteaapical cells closed basally.

Male genital characters much as in *C. spectra* (Fig. 1). Female abdominal sternum VII with posterolateral margins oblique, convergent, apex subtruncate (much as in illustration of *C. eburnea* (Walker), Fig. 2).

Crown and pronotum yellowish-green (in some specimens, Fig. 5, with a discal coronal black spot), scutellum and forewings pale yellowish-white. Clypeus greenish-yellow, at least medially, remainder of face, thoracic venter and pleura, legs and abdominal venter dull yellow; femora without black spots at bases of macrosetae.

Material Examined.—Holotype ♀, Keravat, New Britain, May 17, 1956 (G. Dun); 1 ♂, Gazelle Peninsula, Upper Warangoi, Illugi, New Britain, 230 m, November 25–26, 1962 (J. Sedlacek); 1 ♂ and 2 ♀, Malmalwan-Vunakanau, Gazelle Peninsula, New Britain, May 4, 6, and 8, 1956 (J. L. Gressitt); 1 ♂, Guega, W. of Swart Valley, Dutch New Guinea, November 15, 1958 (J. L. Gressitt) (BPBM). Seven ♂, 250 ft., January 31, March 19, May; 2 ♂ and 2 ♀, kundi grass, Cyclops Mts. foothills, 500 ft., March 7; 3 ♂ and 1 specimen without abdomen, edge of kunar grass and forest, 1800 ft., March 15; 1 ♂, rain forest, February 9, all Hollandia, New Guinea, 1945 (H. Hoogstraal) (NCS).

Diagnosis.—The produced crown and the (usual) lack of dark markings will distinguish *C. hoogstraali* from other species of *Cofana*.

Etymology.—The species is named in honor of Harry Hoogstraal who collected most of the specimens at hand.

Cofana polaris Young, NEW SPECIES

Description.—Length of male 5.3–6.3 mm, of female 5.3–7.2 mm.

Head with median length of crown from $\frac{6}{10}$ to $\frac{8}{10}$ interocular width and from slightly less than $\frac{4}{10}$ to almost $\frac{1}{2}$ transocular width; ocelli on or slightly behind a line between anterior eye angles, each closer to adjacent anterior eye angle than to median line of crown; crown usually with a slight transverse concavity between ocelli; antennal ledges in lateral view with anterior margins oblique and either rectilinear or convex; clypeus convex and granulate medially; transclypeal suture interrupted medially, clypellus with contour a continuation of profile of clypeus.

Pronotum with greatest width less than transocular width of head, dorsopleural carinae incomplete, posterior portion of disk transversely rugulose; forewing with veins fuscous, middle anteaapical cell open or closed basally.

Female abdominal sternum VII gradually narrowed to concave apex (much as in illustration of *C. unimaculata* (Signoret), Fig. 6) but with posterior margin concave.

Crown dull yellow to greenish gray, with a median black spot on posterior portion partly or completely surrounded by pale yellow; apical median area dark between 2 dorsal areas of muscle impressions in some specimens (holotype); pronotum dull yellow to fuscous, with a black median line continuing over scutellum to a varying extent (to apex in holotype), basal angles of scutellum dark (holotype) or not; face with a median basal yellow spot surrounded by fuscous, a black spot surrounded by yellow adjoining each antennal ledge; clypeus and clypellus yellow to brown, with median line pale and with pale arcs on area of muscle impressions, clypellus dark medially; lora yellow with dark markings, or black; proepisternum usually black, proepimeron with dorsopleural carina dark-bordered or not; hindlegs as in *jedarfa* (new species below) or with dark areas much less distinct (holotype).

Material Examined.—Holotype ♂, Genewonday, Liberia, "2-17-58-19" roadside (C. Blickenstaff); 1 ♀, K. State, N. Bussa, Nigeria, December 1, 1970 (J. T. Medler); 1 ♀, Gangala Na Bodio, Belgian Congo, April 29, 1955 (Baker and Schmidt); 1 ♀, 9 mi S. Nobera, Upper Volta, 11°26'N, 1°10'W, November 8-9, 1968, AMP, light trap, 6 PM-6 AM (USNM). One ♂, 40 mi E. of Matadi, Belgian Congo, July 29, 1957 (E. S. Ross and R. E. Leech) (CAS). One ♀, "Savane de Mbouma," March 12, 1968 (Michel Boulard) (MHNP). One ♂ and 1 ♀, Zaria, November 2, 1975; 2 ♀, Zaria, November 5, 1975; 1 ♂, Zaria, September 13, 1974; 1 ♀, Ibadan, December 15-19, 1975; 2 ♂, near Kafanchan, Kagoro Forest, November 13, 1976, all N. Nigeria (all J. C. Deeming) in collection of Institute for Agricultural Research, Samaru, Nigeria.

Diagnosis.—The presence of the pale apical head-spot and the longitudinal dark line of the pronotum are diagnostic for *C. polaris*.

Cofana jedarfa Young, NEW SPECIES
Fig. 9

Description.—Length of male 7.3 mm, of female 7.2-7.8 mm.

Head with median length of crown from slightly less than $6/10$ to slightly less than $2/3$ interocular width and from slightly less than $4/10$ to approximately $4/10$ transocular width; ocelli on a line between anterior eye angles; crown with a slight transverse concavity between ocelli; antennal ledges in lateral view with anterior margins oblique and concave; clypeus flattened and granulate medially, transclypeal suture entire, clypellus with contour a continuation of profile of clypeus.

Pronotum with greatest width less than transocular width of head, dorsopleural carinae incomplete, posterior portion of disk transversely rugulose; forewing with veins fuscous, middle anteapical cell open or closed basally.

Female abdominal sternum VII gradually narrowed to concave apex (much as in illustration of *C. subvirescens*, Fig. 7).

Dorsum pale tan with a black spot at apex of head; a median dark spot close behind it on crown between muscle impressions; and a black spot between ocelli narrowing and extending to posterior margin of head and continuing through pronotum and onto scutellum almost to its apex; forewing with veins fuscous; face with the black apical head-spot bordered with yellow, with a black spot on each side contiguous with anterior margin of antennal ledge or nearly so, clypeus brown with a narrow yellow median line extending laterally on each side above transclypeal suture then dorsally along lateral clypeal suture and expanding to surround black spot next to antennal ledge, with narrow transverse yellow lines on each side in area of muscle impressions, clypellus yellow with a dark median line, genae and lora yellow, each lorum with a dark margin that gives off a branch across the adjacent gena to its posterior margin; with a black spot on proepimeron surrounding the dorsopleural carina, and another near dorsal margin of mesepisternum, anterior margins of femora of metathoracic legs, in rest position, dark, bases of tibial setae of row 3 dark, remainder of pleura and venter pale.

Material Examined.—Holotype ♂, Faradje, Congo, 29°40'E, 3°40'N, January 1913 (Lang and Chapin) (AMNH); 1 ♀, Katona, Uganda, August 1913 (Majenje) (HNHM); one parasitized ♂, Ankole, Kichwamba, Uganda, April 23–29, 1968 (P. J. Spangler) (USNM).

Diagnosis.—In appearance, *C. jedarfa* is similar to *C. polaris* and *C. perkinsi*, *C. nigrilinea* and *C. lineata* and from all of which it may be separated by the characters in the key. The pronotum of *jedarfa*, in lateral view, has a dark border above and below the dorsopleural carina; but the pronotum does not appear dark-bordered laterally from a dorsal view, as in *C. perkinsi*. The female abdominal sternum VII of *C. perkinsi* is similar to that found in *C. spectra*.

Cofana yasumatsui Young, NEW SPECIES

Fig. 11

Description.—Length of male 6.4–7.5 mm, of female 7.2–8.0 mm.

Head with median length of crown from slightly more than $\frac{1}{2}$ to $\frac{6}{10}$ interocular width and from $\frac{3}{10}$ to almost $\frac{4}{10}$ transocular width; ocelli on (female) or behind (male) a line between anterior eye angles; crown usually with a slight transverse concavity between ocelli; antennal ledges in lateral view with anterior margins oblique and convex; clypeus flattened and granulate medially, muscle impressions distinct or not, transclypeal suture entire, clypellus with contour of its lower portion continuing profile of clypeus or slightly more horizontal.

Pronotum with greatest width less than transocular width of head, pos-

terior portion of disk rugulose; scutellum not rugulose; forewing with veins fuscous, with middle anteaapical cell usually open basally.

Male pygofer, styles and connective much as in illustration of *Cofana medleri* (Fig. 14); aedeagus in lateral view with a pair of short apical acute processes directed towards bases of dorsal apodemes. Female abdominal sternum VII gradually narrowed and convex apically, with posterolateral margins slightly undulate (much as in *C. spectra*).

Crown with a large median black spot, apex with a smaller median black spot narrowly bordered with yellow; pronotum unmarked or with a faint median fuscous stripe (type). Face with a black spot on each side bordering margin of antennal ledge at transition from face to crown, with a dark stripe on each side of clypeus over area of muscle impressions and narrowing below, clypellus with median line dark, remainder of face, thoracic pleura and venter tan to sordid yellow; legs tan to dull yellow, hindlegs with anterior margins of femora, in rest position, and with bases of tibial setae of row 3, dark.

Material Examined.—Holotype and 4 additional ♂ and 3 ♀ Fyan, Viet Nam, 1200 m, July 11–August 9, 1961 (N. R. Spencer); 3 ♂, 10 ♀ and 1 specimen without abdomen, same data except 900–1000 m; 2 ♀, DaLat, Viet Nam, 1500 m, September 26–27, 1960 (C. M. Yoshimoto); 1 ♀ and 1 specimen without abdomen, same data as last preceding except collector (J. L. Gressitt); 1 ♀, DaLat, Viet Nam, September 11, 1960, 1550 m (J. L. Gressitt); 3 ♂, 6 km S. of DaLat, Viet Nam, June 9–July 7, 1961 (N. R. Spencer); 1 ♀, Van Gia, N. of Nha Trang, Viet Nam, November 29–December 5, 1960 (C. M. Yoshimoto); 1 ♀, Ap Hung Long, 21 km NW of Di Linh, Viet Nam, November 29–December 5, 1960 (C. M. Yoshimoto); 2 ♂, Di Linh (Djiring), September 27–October 14, 1960 (C. M. Yoshimoto); 1 ♂ and 2 ♀, NW. of Chiangmai, Doi Suthep, Thailand, 1278 m, March 29–April 4, 1958 (T. C. Maa); 1 ♀, Chiangmai, Fang, NW. Thailand, 500 m, April 12, 1958 (T. C. Maa); 2 ♂ and 1 ♀, Sarawak, Nanga Pelagus, near Kapit, Borneo, 180–585 m, August 7–14, 1958 (T. C. Maa); 1 ♂, Sarawak, Marirai, V., Kapit Dist., Borneo, 30–300 m, August 1–6, 1958 (T. C. Maa); 3 ♂ and 1 ♀, Sarawak, Sedong, Kampong Tapuh, Borneo, 300–450 m, July 10, 1958 (T. C. Maa); 1 ♂, same data as last preceding except date, July 4–9, 1958; 1 ♂ and 1 ♀, Sarawak, Bau District, Pangkallen Tebang, Borneo, 300–450 m, September 6, 1958 (T. C. Maa); 1 ♀, Keningan, British N. Borneo, Jan. 12–17, 1959 (T. C. Maa) (all in BPBM). Also, one pair *in copula*, S. Halimoen, Java, November, 1938 (ZIL). One ♂ Yin Na San, E. Kwantung, China, June 16, 1936 (L. Gressitt) (NCS).

Diagnosis.—*Cofana yasumatsui* is the species upon which Dr. Ishihara based his genus *Yasumatsuus*. The aedeagus differs from all other species in its short apical processes.

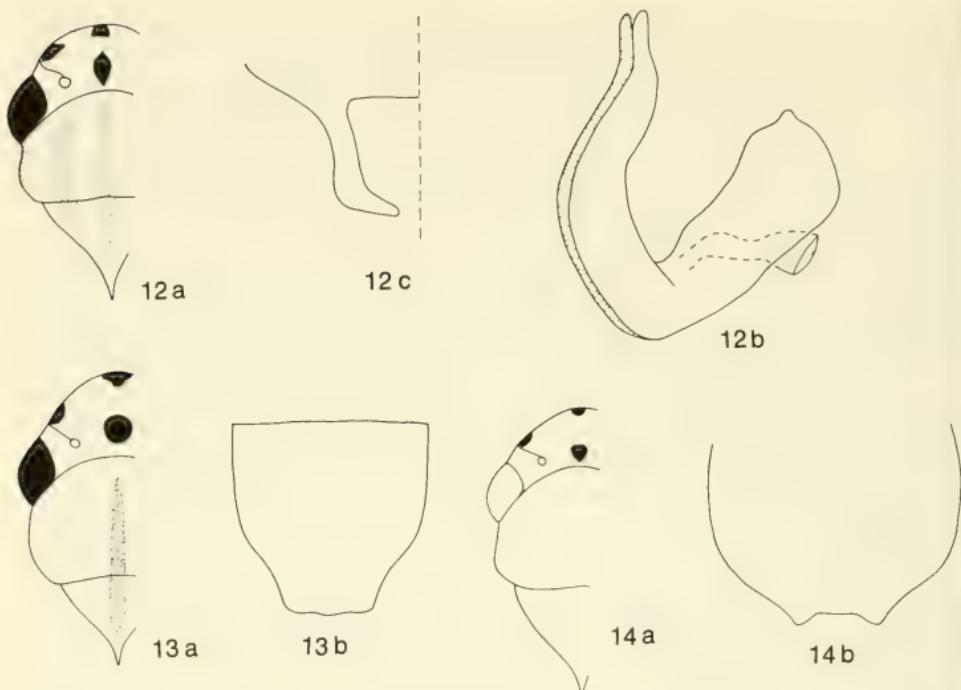


Fig. 12. *Cofana lata*, holotype: a, anterior dorsum; b, aedeagus, lateral view; c, left apodeme of male abdominal sternum II (broken line is median). Fig. 13. *Cofana nigrilinea*: a, anterior dorsum; b, female abdominal sternum VII (a from specimen from Mindanao; b from Sarawak). Fig. 14. *Cofana medleri*: a, anterior dorsum; b, female abdominal sternum VII (a from Stanleyville, b from Lukolela, both Belgian Congo).

Cofana lata Young, NEW SPECIES Fig. 12

Description.—Length of male 8.3 mm, of female 8.4–9.7 mm.

Head with median length of crown between $\frac{5}{10}$ and $\frac{6}{10}$ interocular width and from $\frac{3}{10}$ to slightly less than $\frac{4}{10}$ transocular width, anterior margin broadly rounded in dorsal view; ocelli on or behind a line between anterior eye angles; crown with a transverse concavity between ocelli; antennal ledge in lateral view with anterior margin oblique, either convex or concave; clypeus broadly convex and granulate medially, muscle impressions distinct, transclypeal suture complete, clypellus with contour of its lower portion very slightly more nearly horizontal than profile of clypeus.

Pronotum with greatest width less than transocular width of head, dorsopleural carinae incomplete, posterior portion of disk weakly transversely rugulose; scutellum not transversely rugulose; forewing with veins fuscous, with anteaapical cells closed basally.

Male with aedeagal shaft much broader than in other species of the genus, other male genital characters much as in *C. spectra* (Fig. 1). Female abdominal sternum VII with posterior margin much as in *C. subvirescens* (Fig. 7).

Crown with a median discal black spot between ocelli and a median black spot bordered with yellow at apex; pronotum and scutellum with ground color concolorous with crown, with 3 longitudinal brown stripes over disk of pronotum extending onto scutellum, the median one attaining apical $\frac{1}{2}$ of scutellum, the lateral ones ending just behind posterior pronotal margin, lateral pronotal margin narrowly bordered with brown; forewing with veins fuscous. Face with clypeus and clypellus marked as in *C. yasumatsui* but with dull yellow arcs in the dark area of the muscle impressions; pleura, venter, and legs as in *yasumatsui*.

Material Examined.—Holotype ♂, Wong Sa Shui, S. Kiangsi, China, June 12, 1936 (L. Gressitt) (NCS); 1 ♀, Tisolak, Java (RMS); 1 ♀, 17 km E. of Phanthiet Rd., Viet Nam, October 6, 1960 (C. M. Yoshimoto), and 1 ♀, Fyan, Viet Nam, 1200 m, July 11–August 9, 1961 (N. R. Spencer) (BPBM). Holotype on indefinite loan to USNM.

Diagnosis.—*Cofana lata* is more similar externally to *C. spectra* than to other species in the genus, but may be separated from it, and from other species by the pronotal stripes in combination with either the form of the aedeagus in the male or, with the form of the seventh abdominal sternum of the female.

Cofana medleri Young, NEW SPECIES
Fig. 14

Description.—Length of male 7.3–7.9 mm, of female 9.0–9.3 mm.

Head with median length of crown from $\frac{1}{2}$ to almost $\frac{6}{10}$ interocular width and from $\frac{3}{10}$ to slightly less than $\frac{4}{10}$ transocular width, anterior margin broadly rounded in dorsal view; ocelli usually located behind a line between anterior eye angles; crown with or without a transverse concavity between ocelli; antennal ledges in lateral view with anterior margins oblique and rectilinear; clypeus convex and granulate medially, muscle impressions distinct, transclypeal suture usually entire, clypellus with contour of its lower portion continuing profile of clypeus.

Pronotum with greatest width less than transocular width of head, dorsopleural carinae incomplete, posterior portion of disk transversely rugulose; scutellum rugulose or not on its posterior portion; forewings with veins not fuscous, with antepical cells closed basally.

Male genitalia much as in *Cofana spectra*, but with styles slightly longer. Female abdominal sternum VII with posterior margin tapered on each side of shallowly excavated median portion.

Crown with ground color of anterior $\frac{1}{2}$ tan, of posterior $\frac{1}{2}$ paler tan to

dull white, disk with a small median black spot near posterior margin, apex of head with a small median black spot bordered with white; pronotum and scutellum concolorous with posterior $\frac{1}{2}$ of crown, unmarked. Face with a black spot bordering margin of antennal ledge at transition from face to crown, clypeus and clypellus marked as in *Cofana yasumatsui*; thoracic pleura, venter, and legs tan to yellow, without black markings.

Material Examined.—Holotype and two additional ♀ Umuahia, CRIN EC State, Nigeria, April 10, 1973 (J. T. Medler); 1 ♂, Benin NIFOR MW State, April 1, 1975 (J. T. Medler); 1 ♂ and 1 ♀, Cape Vert, Senegal, French West Africa (Fred Morrison) (NCS). One ♀, Lukolela [Belgian Congo], July 17, 1909 (Lang and Chapin); 1 ♀ Stanleyville, Belgian Congo, $25^{\circ}10'E$, $0^{\circ}30'N$, August 10, 1909 (same collectors); 1 ♂ and 1 ♀, Matadi, Belgian Congo, $13^{\circ}30'E$, $6^{\circ}0'S$, June 24, 1909 (same collectors) (AMNH). One ♂ and 1 ♀, Benin, Asaba, Nigeria, Jan. 3, 1949 (B. Malkin); 3 ♀, Lokoja, Kabba Province, Nigeria, February 24–28, 1949 (B. Malkin) (CAS). One ♂ and 1 ♀, Yaba-Lagos, Nigeria, August 1, 1964 (Mir S. Mulla) (University of California, Riverside). Two ♂ and 1 ♀, Douala, Cameroons, May 8, 1954, 1 ♀, same locality, December 2, 1956, 1 ♀, same locality, August 20, 1956; 1 ♂ and 1 ♀, Abidjan, Ivory Coast, June 16, 1957; 1 ♂ and 1 ♀, Abidjan, Ivory Coast, January 23, 1959; 1 ♀, Monrovia, Liberia, May 5, 1957; 1 ♂ and 2 ♀, Lagos, Nigeria, February 2, 1956; 3 ♂ and 1 ♀, Port Gentil, Gabon, Feb. 23, 1956 (all F. Zielinski) (all ZIMH). Also, 1 ♂, Orendo, nr. Libreville, French Equatorial Africa, April 11, 1954; 1 ♀, Pointe Noire, March 10, 1955; 1 ♀, Cabinda, Angola, August 15–20, 1954 (all E. Zielinski) (ZIMH). One ♂ and 1 ♀, Principe Island, September 25, 1949 (G. R. Gradwell and D. Snow).

Diagnosis.—Except for the pale crown, males of *C. medleri* are indistinguishable from males of *C. spectra*. The females, in addition to the pale crown, have a distinctive abdominal sternum VII.

Cofana sotoi Young, NEW SPECIES

Description.—Length of male 6.8 mm, of female 7.6–7.9 mm.

Head moderately produced, median length of crown from slightly less than $\frac{6}{10}$ to $\frac{3}{4}$ interocular width and from $\frac{4}{10}$ to slightly more than $\frac{4}{10}$ transocular width, anterior margin narrowly rounded in dorsal view; ocelli aligned with anterior eye angles; crown with a slight median concavity across ocelli; antennal ledges oblique and rectilinear or convex in lateral view; clypeus broadly and slightly convex and granulate medially, muscle impressions distinct, transclypeal suture entire or interrupted medially; profile of clypellus a continuation of contour of clypeus.

Pronotum with width approximately equal to transocular width of head, dorsopleural carinae complete or not, posterior portion of disk transversely rugulose, scutellum weakly transversely rugulose or not; forewing with veins fuscous, antepapical cells closed basally.

Female abdominal sternum gradually narrowed to truncate apex, which is slightly convex. Crown, pronotum and scutellum pale greenish-yellow, crown with a median black spot before the ocelli; face with a median basal pale spot, a black spot adjoining each antennal ledge, remainder pale greenish yellow except arcs on areas of muscle impressions, a longitudinal line on each side of median area on clypeus, and median area of clypellus, all pale brown; dorsopleural carina very narrowly dark, remainder of pleural region concolorous with face; metathoracic legs with bases of tibial setae of row 3 dark, remainder of legs pale.

Material Examined.—Holotype and three additional ♀ and 1 ♂, "Rukupr.," Sierra Leone, December 18, 1975 (P. E. B. Soto), on rice (Institute for Agricultural Research, Samaru, Nigeria).

Diagnosis.—*Cofana sotoi* is close to *C. polaris* from which it may be separated readily by the characters used in the key.

Etymology.—The species is named for the collector of the type-series.

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I am grateful to the curatorial personnel of the institutions listed in the introduction for their ever generous cooperation in lending specimens, and to most of them for courtesies extended during my visit to their institutions in 1962–3.

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A NEW GENUS AND A NEW SPECIES OF BOREIDAE
FROM OREGON (MECOPTERA)

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Abstract.—*Caurinus dectes*, a new species and a new genus, is described from the Coast Range of Oregon, USA. *Caurinus* possesses some diagnostic boreid characters (clasper-like forewings of male, fusion of basal sclerites of maxillae and labium into zygotipes) but also characters unusual or otherwise unknown for the Mecoptera, including: Armored body, anterior abdominal segments synscleritous; minute size (1.4–1.8 mm); genitalia concealed in both sexes; non-rostrate head; and short mandibles with a strongly developed molar blade. The female possesses unfused cerci and lacks the elongate ovipositor typical of other boreids.

Because of the divergence of *Caurinus* from other Boreidae, 2 subfamilies are recognized here: CAURININAE (new subfamily), including only *C. dectes*, and BOREINAE, including the genera *Boreus* and *Hesperoboreus*.

The Boreidae comprise 23 described species in two genera (*Boreus* and *Hesperoboreus*) (Svensson, 1972; Penny, 1977). These are insects of uniform, rather bizarre habitus, with an aggregate distribution limited to the Holarctic Zone. The insect described here, although related to the other boreids, is so distinctive that it was not at first recognized as a mecopteran on the basis of the external structure of the female alone. The considerable morphological-taxonomic distance from other living Mecoptera and the presence of some probably plesiomorphic characters not found in *Boreus*, justify its recognition as a new subfamily of the Boreidae.

Caurinus Russell, NEW GENUS

Diagnosis.—*Adult*: Strongly sclerotized, compact boreid. Head with short broad rostrum. Mandibles short, with large molar blade. First abdominal tergum fused to pterothorax, without free median sclerite; forewings short, slender, forceps-like in male; oval and pad-like in female; hind wings absent. Abdominal segments 2–6 synscleritous; segments 7 and 8 divided normally, sternum 9 forming hypandrium in male. Terminal segments, including gonopods of male, retracted. Aedeagus with complex sclerotized structures. Cerci 1-segmented in female, absent in male. Female with sclerotization of ovipositor limited to short median lobe of eighth sternum.

Larva: Curculionoid, similar to *Boreus* in structure but orthosomatic; head with 7 ocelli on each side, vertex angulate medially; thoracic legs reduced to short 1-segmented papillae.

Type Species.—*Caurinus dectes*, new species.

Description of Male (Figs. 1–3).—Color: Head and thorax reddish brown, abdomen chestnut brown, lateral and dorsal portions of abdominal segments 2–6 and hypandrium infuscated with black; eyes dark purplish brown; legs and forewings testaceous.

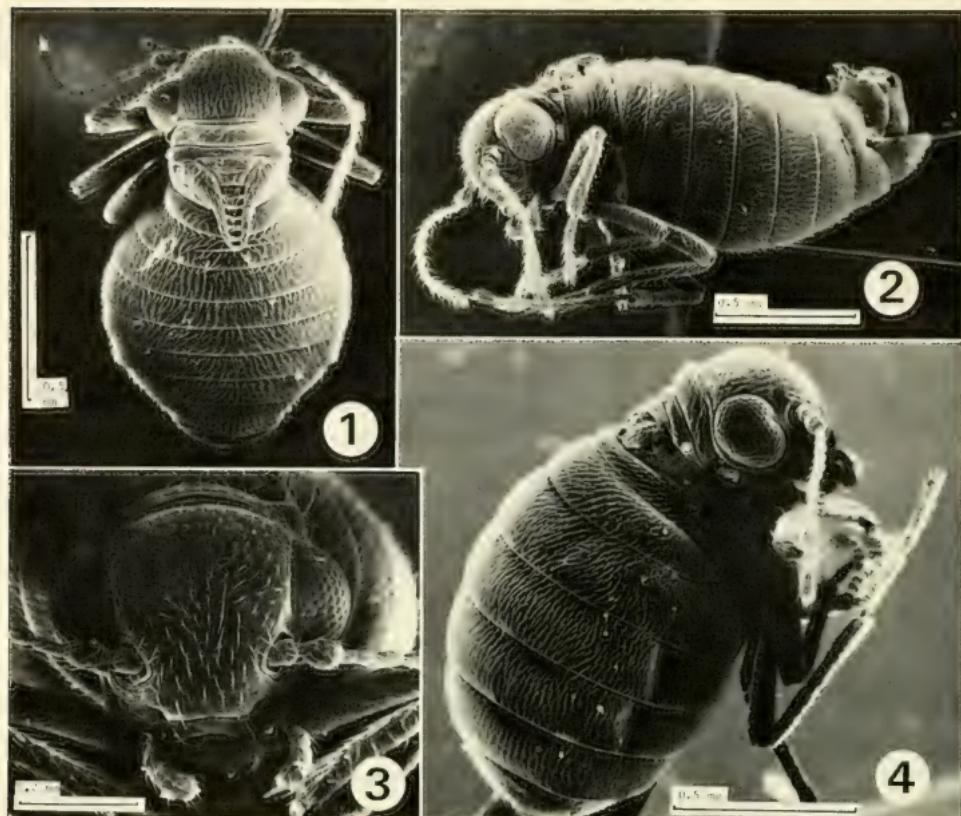
Vestiture and sculpture: Body and appendages clothed with moderately long pale pubescence, semierect on frons and vertex, decumbent elsewhere. Pterothoracic pleura and 2nd abdominal venter with shorter, much denser pubescence. Clypeus with pair of long lateral setae near base; pronotum with variable number of long, erect setae on inflexed lateral portion. Body surface between punctures obscurely microreticulate, shining.

Head: As broad as long (vertex to apex of labrum); frons and vertex convex. Eyes large, oval, convex, coarsely faceted, emarginate opposite antennal bases. Ocelli absent. Antennae approximately $\frac{1}{2}$ body length, 16-segmented, inserted laterally on frons, slightly thickened near apex. Scape stout, cylindrical; pedicel large, pyriform; 3rd segment cylindrical; segments 4–15 elongate-ovoid. Last antennomere small, about $\frac{1}{2}$ length and width of penultimate. Membrane of antennal socket recessed, much reduced in area.

Epistomal suture angulate medially, deeply impressed. Clypeolabral suture parallel to epistomal suture; clypeus transverse, chevron-shaped. Labrum broadly arcuately emarginate, not strongly sclerotized. Clypeogenal and subgenal sutures short; subgena confined to lateral surface of head. The occiput produced caudad as median, broadly triangular lobe. Postorbital ridge strongly developed as laterally prominent thin ridge adapting to anterior margin of prothorax. Hypostomal bridge long (.64 vertical diameter of eye); occipital foramen divided by corporatentorium.

Mandibles short, falcate, with 3 large acute teeth and hatchet-blade shaped mola (Fig. 8). Maxillae: Zygostipes transverse, crescentic, without median suture; palps 5-segmented; 4th segment inflated, with membranous concave medial surface; apical segment acicular, as long as 4th (Fig. 3). Prementum rhomboidal with narrow basal stalk; labial palps 2-segmented.

Thorax: Cervical membrane concealed. Lateral cervical sclerite slender, almost horizontal. Pronotum transverse, expanded forward over the occiput, partly covering propleura ventrally, with deep transverse furrow at posterior $\frac{1}{3}$. Mesothoracic spiracle large, at caudal margin of pronotum $5\times$ its diameter above ventral pronotal border. Propleuron subequally divided by propleural suture which is obsolete ventrally; proepisternum deeply incised at middle of anterior margin to receive cervical sclerite. Prosternum nearly as in *Boreus*, with paired short precoxal lobes, and slender furcal arms dorsally reaching strong pleural apodemes; procoxae contiguous at midline.



Figs. 1-4. Scanning electron photomicrographs of *Caurinus dectes*. 1, Dorsal view of male, genitalia retracted. 2, Lateral view of male, genitalia extruded. 3, Frontal view of male. 4, Lateral view of female. Numbers beside scale bars give scale in mm.

Pterothoracic segments fused with 1st abdominal tergum. Mesonotum large, alate; scutum transverse; scutellum quadrate, convex; area behind wing bases extensively membranous. Metascutellum large, rhomboidal, with strong posterior median keel; metanotum otherwise membranous. Mesopleuron excavated below wing bases; mesopleural suture vertical, extending only short distance from coxa; suture between mesepimeron and metepisternum indicated only by the small metathoracic spiracle. Metapleural suture only partially evident externally, directed obliquely anteriad for $\frac{1}{2}$ metacoxal diameter. Metepimeron limited posteriorly by weak phragma; a short internal longitudinal plica present at posterior margin of pterothorax at level of metathoracic spiracle; rudimentary 1st abdominal spiracle above the anterior end of this plica.

Mesosternum broadly exposed between coxae, these separated by $\frac{1}{3}$ coxal diameter at midline; metasternum exposed anterior and posterior to contiguous metacoxae. Meso- and metafurcae poorly developed, mesopleural

apophysis developed only ventrally near coxae; metapleural apophysis absent.

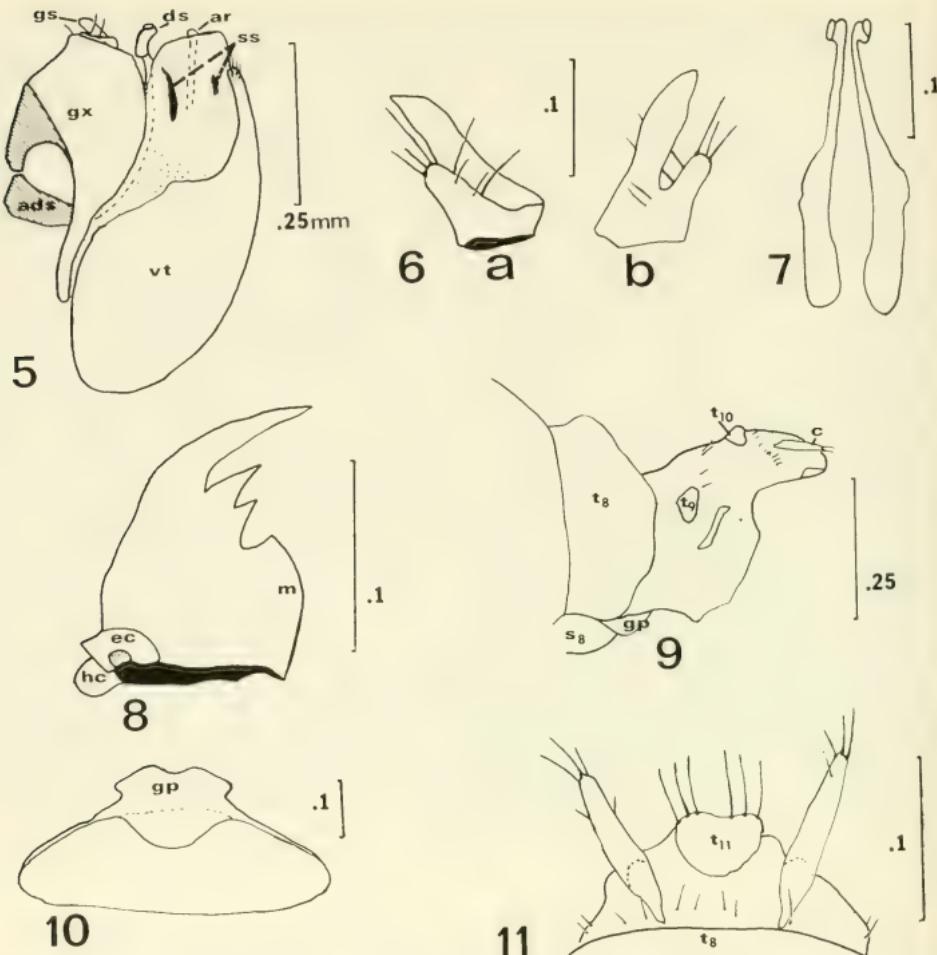
Mesothoracic wings modified as clasping organs as in male *Boreus*, but relatively much shorter, only reaching anterior margin of 2nd abdominal tergum; apical $\frac{2}{3}$ bearing 6 evenly spaced stout spines, proximal spine shorter than other 4, terminal one much longer; with wings in repose, each spine crossing contralateral spine at midline. Metathoracic wings absent.

Legs short, increasing in length from pro- to metathorax; coxae moderate in length, oriented vertically; procoxae slender, base above level of ventral margin of eye; pterothoracic coxae stouter, metacoxae much the larger. Meron not recognizable in any coxa. Trochanters, femora, and tarsi unmodified, apical $\frac{1}{2}$ of tibia and ventral surface of 1st tarsomere each bearing several spines. Tarsi 5-segmented, tarsomeres 1–4 of decreasing length. Pro- and mesotarsi shorter than corresponding tibiae; metatarsi longer than tibiae, basitarsus elongate, pretarsal claws small, simple.

Abdomen: Large, dorsal surface flattened; widest at segments 4 and 5; narrowed to broadly rounded hypandrium. Tergum 1 entire, fused with pterothorax, with strong median keel. Sternum 1 not sclerotized. Segments 2–6 annular, synscleritous, subequal in length, capable of slight telescoping. Segments 7 and 8 discleritous, pleural membranes concealed when genital capsule is retracted; terga 7 and 8 meet sterna in line ascending caudad when hypandrium is closed against tergum 8. Tergum 9 unsclerotized, membrane incorporated in genital capsule. Abdominal spiracles 2–6 small, set in segmental rings above middle of sides. Spiracles 7 and 8 at midlength of terga, distant from pleural membrane. Segments 10 and 11 (proctiger) slender; membranous, except for small transverse sclerite (possibly tergite 10). Cerci absent.

Genital capsule (Fig. 5) comprising 2-segmented gonopods, aedeagus with ventral sclerotized trough and strong arcuate dorsal sclerite; and proctiger. Gonocoxites not fused, robust, tapering basally to elongate lateral process; articulating by medial basal apodeme with basal apodeme of dorsal sclerite. Gonostyles (Fig. 6) flattened, deeply incised; basal tooth with 2 long setae on ectal surface and several smaller setae apically and on mesal surface; surface without coarse granules. Dorsal sclerite apically free from aedeagal membrane in spoon-shaped process; basally forming stout, laterally expanded apodeme. Lateral membranes of aedeagus bearing 2 pairs of spinose sclerites (Fig. 5). Distal portion of gonoduct with paired linear sclerites (aedeagal rods, Fig. 7).

Description of Female (Fig. 4).—Similar to male; more robust, abdomen stout, ovoid. Mesothoracic wings reduced to oval pads, shorter than mesonotum, sparsely pubescent; mesonotal sclerites less differentiated than in male, mesopleuron less excavated; metascutellum and abdominal tergum 1 medially convex, but not keeled. Abdomen subglobose, more evenly convex



Figs. 5-11. *Caurinus dectes*. 5, Genital capsule of male, left lateral view (shaded areas are apodemal). 6, Left gonostyle; a, anterior view and b, medial view. 7, Aedeagal rods, dorsal view. 8, Left mandible, anterior view. 9, Female terminal segments of abdomen, segments 9-11 extruded, in dorsolateral view. 10, Eighth sternum of female, internal view. 11, Dorsal view of female abdomen, segment 11 only extruded. Abbreviations: *ads*, basal apodeme of dorsal sclerite; *ar*, aedeagal rods; *c*, cercus; *ds*, dorsal sclerite of aedeagus; *ec*, epicondyle; *gp*, gonapophyses; *gs*, gonostyle; *gx*, gonocoxite; *hc*, hypocondyle; *m*, molar process; *s*, sternum; *ss*, spinose sclerites; *t*, tergum; *vt*, ventral trough of aedeagus. Numbers beside scale bars give scale in mm.

dorsally than that of male. Segments 2-6 annular as in male; segment 7 strongly tapered posteriorly, sternum and tergum equal. Segment 8 small; tergum inflexed, enclosing sides of sternum. Sternum 8 narrow, with apical process (gonopophyses) emarginate medially (Fig. 10). Segments 9-11 slender, normally retracted (shown extended in Fig. 9), largely membranous,

with weakly sclerotized tergite and linear laterotergites on segment 9, small median tergite 10, and tergum and sternum 11. Segments 9 and 10 bear subapical transverse series of setae. Tergum 9 may be entire, but is usually sclerotized only laterally. Cerci (Fig. 11) short, 1-segmented, articulated at base, separated by tergum 11.

Holotype.—♂, 1.58 mm long, collected II-22-76; 35 ♂ and 32 ♀ paratypes, collected I-22-76 to IV-4-76, VI-16-76, X-11-76, to IV-3-77, all from Marys Peak, Benton County, Oregon, USA, on the northeast ridge at 600 m elevation, collected by L. K. Russell, P. J. Johnson, G. L. Peters, and R. L. Westcott. Also designated as paratypes are specimens from OREGON: *Tillamook County*: Cascade Head, summit, 490 m elevation, XI-25-76, Johnson, collector (1 ♂); XII-19-76, Russell (1 ♀); Little Nestucca County Park, III-6-77, Russell (1 ♂); *Yamhill County*: Hanchet Creek, 12 km W Grand Ronde Agency, 185 m, XII-19-76, Russell (1 ♂); *Lincoln County*: Depot Creek, 8 km N Toledo, near sea level, III-6-77, Russell (1 ♀); *Lane County*: Klickitat Mountain, 520 m, I-23-77, Johnson (1 ♂); Cape Ridge, 7 km E Cape Perpetua, 430 m, I-9-77, Russell (1 ♀). The range of length is 1.4 to 1.75 mm (males) and 1.5 to 1.9 mm (females).

The holotype and a female paratype are deposited in the California Academy of Sciences, San Francisco. Paratotypes are deposited in the British Museum of Natural History, Canada Department of Agriculture collection, Ottawa; Museum of Comparative Zoology, Harvard University; Oregon Department of Agriculture, Salem; Oregon State University, Entomology Museum; Snow Entomological Museum, University of Kansas; and United States National Museum. Other specimens and dissections are in my private collection, and in those of P. J. Johnson and G. L. Peters, Corvallis, Oregon, and K. W. Cooper, Riverside, California.

Habitat.—All *Caurinus* habitats are moist forested sites, with abundant epiphytic and terrestrial bryophytes, in the central Coast Range of western Oregon. The initial Marys Peak collections, and all from other sites, were obtained by Berlese funnel extraction from moss samples. Most Marys Peak specimens were collected by beating mossy stems of vine maple (*Acer circinatum* Pursh), or were washed from moss samples and recovered on #25 soil screens which retained particles larger than 0.7 mm diameter. *Rhytidadelphus loreus* (Hedw.) Warnst. (Rhytidaceae), *Metaneckera menziesii* (Hook.) Steere and *Neckera douglasii* Hook. (Neckeraceae) are the most abundant epiphytic mosses on stems with *Caurinus*, but many other bryophytes occur in this community. An abundant epiphytic liverwort, *Porella navicularis* (L. & L.) Lindb. (Porellaceae) is a favored food of adults and an oviposition site for *Caurinus*. *Hesperoboreus brevicaudus* (Byers) is also abundant at the Marys Peak site; both boreids appear to breed in epiphytic, rather than terrestrial, bryophytes at this locality.

At Cascade Head, *Caurinus* was found in terrestrial mosses (mostly *Rhy-*

tidiadelphus loreus) at the edge of a dense stand of young Sitka spruce (*Picea sitchensis* (Bong.) Carr.) within 2 km of the Pacific Ocean. Other localities are generally comparable to the Marys Peak site.

Etymology.—The generic name is derived from the Latin *caurinus*, "northwestern," referring to the northwest wind Caurus, and is analogous to *Boreus*, named for the Greek and Roman god of the north wind. *Dectes*, Greek, "a biter," refers to the strongly developed mandibles.

Discussion.—*Caurinus* differs from previously known boreids in many important characters. Of these the mouthparts, the abdominal structure and genitalia, and the virtually legless larvae are especially significant. The head of *Caurinus* is of normal proportions for a generalized mandibulate insect, and can hardly be termed "rostrate," while the rostrum of *Boreus* is unusually long for a plant-feeding mecopteran (Byers, 1968). *Brachypanorpa* (Panorpidae) and the Nannochoristidae are the only other Mecoptera with a short rostrum, but in these groups the rostrum is markedly narrowed apically. The clypeolabral suture is present in *Caurinus*, but absent from all other adult Mecoptera (Hepburn, 1969). The short, strongly toothed mandibles contrast with those of all other Mecoptera. Byers (1968) characterized the Boreidae as having "short, thick mandibles," but the width/length ratio of the *Caurinus* mandible is about .58 while that of a robust *Boreus* mandible (e. g., *B. nivoriundus* Fitch) is near .30. The strong, arcuate molar blade of *Caurinus* is unlike any mandibular structure in other Mecoptera. Most Mecoptera, including *Boreus* and *Hesperoboreus*, lack cutting teeth or blades on the proximal half or more of the mandible; a cutting structure is best developed in *Brachypanorpa*, which has a thin, straight serrulate molar blade (Otanes, 1922).

A number of characters related to the extensive sclerotization and compactness of *Caurinus* contribute in large part to the peculiar habitus of this genus. These include the proportionately very small thorax and short appendages, particularly the extreme reduction of the notal and pleural structures of the metathorax. The abdominal structure of *Caurinus* is unique in the synscleritous anterior segments and discleritous posterior segments (7–11 in both sexes). The opposite pattern of abdominal fusions is common in other Mecoptera: Segments 2–5 are always discleritous; the synscleritous state may occur in any of segments 6–10 in males, and in segment 10 only of females. In *Boreus* and *Hesperoboreus*, all the pregenital segments are discleritous; in males, fusions occur only in segments 8 or 9 (Cooper, 1973), and in females only segment 10 can be considered synscleritous (Mickoleit, 1975). The retraction of the terminalia in both sexes of *Caurinus* is apparently related to the protective armor. Judging from the unfused and relatively unmodified cerci of female *Caurinus*, however, the lack in this genus of an exserted ovipositor formed from structures of segments 9–11 may be primary rather than a reduction. The terminal segments are partly retracted

in females of other mecopteran families, with each segment partly telescoping into the next anterior one (Mickoleit, 1975), rather than being withdrawn as a unit as in *Caurinus*.

In a review of the phylogeny of extant mecopteran families, Penny (1975) cited four characters in which boreids differ by reduction from the condition in supposed panorpid-like ancestors: in body size, wing development, number of antennal segments, and in size of male tergum 9. Each of these characters in *Caurinus* appears in a more specialized (reduced) state than any other known boreid. The legless larva and general extension of sclerotization in the adult also suggest that *Caurinus* has evolved through further specialization from a *Boreus*-like ancestor.

Caurinus is more similar to *Boreus* and *Hesperoboreus* in ecological and behavioral characteristics than in morphology. *Caurinus dectes*, like other boreids, has a winter adult emergence; and it feeds on bryophytes. When disturbed, *Caurinus* adults may hop several centimeters, usually landing with appendages drawn in, in the death-feigning posture typical for Boreidae. This avoidance hop is less constant than in most species of *Boreus* and *Hesperoboreus*; individuals of *Caurinus* may simply grip the substrate and remain immobile, or fall vertically, when they are touched.

Caurinus appears more generalized than other boreids in such characters as the free cerci of the female, the sutures of the head, sclerotization of the aedeagus, and the more complex larval eye. These, together with the numerous divergent characters listed above, make a paraphyletic origin of *Caurinus* within the *Boreus-Hesperoboreus* lineage unlikely. The many differences between *Caurinus* and other boreids appear to justify a separation at higher than generic level. To accommodate this morphological gap, I propose the recognition of 2 subfamilies of Boreidae: CAURININAE (NEW SUBFAMILY), presently including only *C. dectes*, and BOREINAE, which includes all other known boreids. The subfamilies and genera of the Boreidae may be separated by the following key:

KEY TO THE SUBFAMILIES AND GENERA OF THE BOREIDAE

1. Head not rostrate; male gonopods and female segments 9–11 enclosed in abdomen (1 species, Oregon, USA) (CAURININAE) *Caurinus*, new genus
- Head strongly rostrate; male gonopods exposed; female with abdominal segments 9–11 forming conspicuous, sclerotized ovipositor (BOREINAE) 2
2. Males with a series of stout spines on outer margin of forewing; females with abdominal tergum 10 lacking caudal spiniferous extensions, tergum 10 much longer than tergum 9 (21 species, Holarctic) *Boreus* Latreille

- Males with no outer spines on forewing; females with tergum 10 bearing caudal spiniferous extensions, tergum 10 at dorsal midline no longer than tergum 9 (2 species, Pacific Coast, USA) ellipsis *Hesperoboreus* Penny

Penny (1977) suggested a Nearctic origin for the Boreidae, apparently because of the representation in North America of *Hesperoboreus* and the relatively plesiomorphic *nivoriundus* group of *Boreus*. Five of 6 species of the latter group are American; 1 species, *B. beybienkoi* Tarbinsky, occurs in central Asia (Penny, 1977).

Caurinus, like *Hesperoboreus* and *Boreus elegans* Carpenter, appears to be restricted to the Pacific coastal region of North America, in areas with moist, mild winters (Cooper, 1974; Penny, 1977). It is possible that *Caurinus* and *Hesperoboreus*, at least, diverged before boreids became adapted to areas with more rigorous, continental climates.

The inclusion of *Caurinus* in the Boreidae makes the modified male forewings and the maxillo-labial fusion (presence of zygotipes) the most diagnostic characters for adults of this family. It is not clear whether other structures which are characteristic of the Boreinae, including the ovipositor and the large peg-like spines of the maxillae, evolved after separation of *Caurinus* or were lost in the evolution of the latter genus. Ongoing studies of the biology and morphology of *Caurinus* and *Hesperoboreus* may help to clarify the origin and evolution of the Boreidae.

ACKNOWLEDGMENTS

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NOTE

Pinnaspis caricis, New Synonym of *Pinnaspis aspidistrae*
(HOMOPTERA: DIASPIDIDAE)

Pinnaspis caricis Ferris (1957. Proc. Hawaii. Entomol. Soc. 16(2):212) was described from specimens collected on *Ophiopogon japonicus* (Thunb.) Ker-Gawl. (=*Mondo japonica* (Thunb.) Farw.) at Honolulu, Hawaii. According to the description, the median lobes are fused into a single lobe. Because of this character, Ferris compared the species with *Pinnaspis uniloba* (Kuwana) which has fused median lobes but does not otherwise closely resemble *P. caricis*. Ferris also stated that the male of *P. caricis* is not known.

In the type-specimens of *P. caricis* that I examined, the median lobes are not fused but are closely appressed. *Pinnaspis caricis* is identical with *Pinnaspis ophiopogonis* Takahashi (1952. Misc. Rpt. Res. Inst. Nat. Resources Japan. 27:11), which is currently considered a junior synonym of *Pinnaspis aspidistrae* (Signoret) (1869. Ann. Entomol. Soc. Fr. (ser. 4) 9:443) (Takagi. 1970. Insecta Matsumurana. 33(1):106). Although *P. caricis* and *P. ophiopogonis* are apparently parthenogenetic and restricted to few host-plants such as *Liriope* sp., *Ophiopogon* sp. and *Rohdea* sp., there is no reliable morphological character to differentiate them from *P. aspidistrae*. Therefore, until a reliable morphological distinction is found, I think *P. caricis* is best treated as another junior synonym of *P. aspidistrae* (NEW SYNONYM).

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DO DANCE FLIES FEED ON CADDISFLIES?—FURTHER EVIDENCE (DIPTERA: EMPIDIDAE; TRICHOPTERA)

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Abstract.—Discovery of pupae of unidentified hemerodromiine Empididae in cocoons and pupal cases of *Neatopsyche obliqua* Flint (Rhyacophilidae) and *Mortoniella wygodzinskii* (Schmid) (Glossosomatidae) in Argentina provide further evidence that the larvae of these Diptera feed on caddisfly immatures.

In 1971 we reported the first evidence that certain dance flies (Empididae) feed on pupae of caddisflies (Trichoptera). This was based on the discovery of pupae of *Neoplasta* (Hemerodromiinae) in 10 cocoons of *Cailloma* (Trichoptera: Rhyacophilidae) collected in Chile and of pupae of an undetermined species and genus of Hemerodromiinae in several cocoons of *Mortoniella apiculata* Flint (Trichoptera: Glossosomatidae) collected in Ecuador. The cast larval skins and remnants of the pupae of the caddisflies were found inside their apparently intact cocoons. Each cocoon contained one dance fly pupa.

Two additional collections further substantiate the feeding of Hemerodromiinae larvae on Trichoptera pupae. The pupa of an unidentified hemerodromiine was found inside a cocoon of *Neatopsyche obliqua* Flint (Trichoptera: Rhyacophilidae) at Arroyo Rosales, near San Martin de los Andes, Neuquen Province, Argentina, on January 22, 1974 by O. S. Flint, Jr. This was a small stream about 1 meter wide by up to 10 centimeters deep. The water was very clear and cool to the touch, with alternate pools and riffles, and a sand and gravel bottom. The stream flowed through old pastures, and its margins were generally overhung by bushes and scattered trees. Although the region was generally green and sparsely forested, it was an area of rather low (around 20–30 inches), primarily winter, rainfall.

A pupa of another unidentified hemerodromiine was found inside the case, but outside the cocoon of *Mortoniella wygodzinskii* (Schmid) (Trichoptera: Glossosomatidae) on October 18–19, 1973, at Rio Ambato, El Rodeo, Catamarca Province, Argentina, by O. S. Flint, Jr. This habitat is in a dry zone with mostly grasses and large cacti called the "Provincia Prepuñena."

The stream was up to 2 meters wide by 5 to 10 centimeters deep. The water was clear and cold, flowing over a substrate of gravel and boulders with very little organic matter. The stream was mostly riffles and cascades with very few pools.

The cocoons reported in the earlier paper appeared to be intact, without tears or openings, and we speculated that either (1) the newly hatched dance fly larva attacked the caddisfly larva but did not feed until the caddisfly pupated, or (2) the predaceous larva penetrated the cocoon, making an indistinguishable hole, or (3) the adult dance fly oviposited onto or into the caddisfly cocoon. However, both of the recently collected caddisfly cocoons have a slight tearlike opening just before one end. This may indicate that the dance fly larva penetrated the cocoon, or the hole may have been caused by the anterior integumentary horns of the pupa during its exit or attempted exit from the cocoon.

Unfortunately, in neither additional case was the dance fly pupa developed and pigmented enough to allow a more precise identification than to the subfamily *Hemerodromiinae*.

Both of the newly discovered *Hemerodromiinae* pupae have pairs of long, slender spiracular gills on the prothorax and on abdominal segment 1-7, as do other *Hemerodromiinae*. These structures provide an extensive surface for diffusion of oxygen when the pupa is submerged and permit entrance of oxygen without significant water loss when outside the water. The elongate spiracular gills also may aid in catching or snagging the pupae on projections after they have left the caddisfly cocoons, and thus prevent them from being swept far downstream in their torrential habitats.

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SUBSPECIES OF THE TRANSATLANTIC SPECIES,
BAETIS MACANI (EPHEMEROPTERA: BAETIDAE)¹

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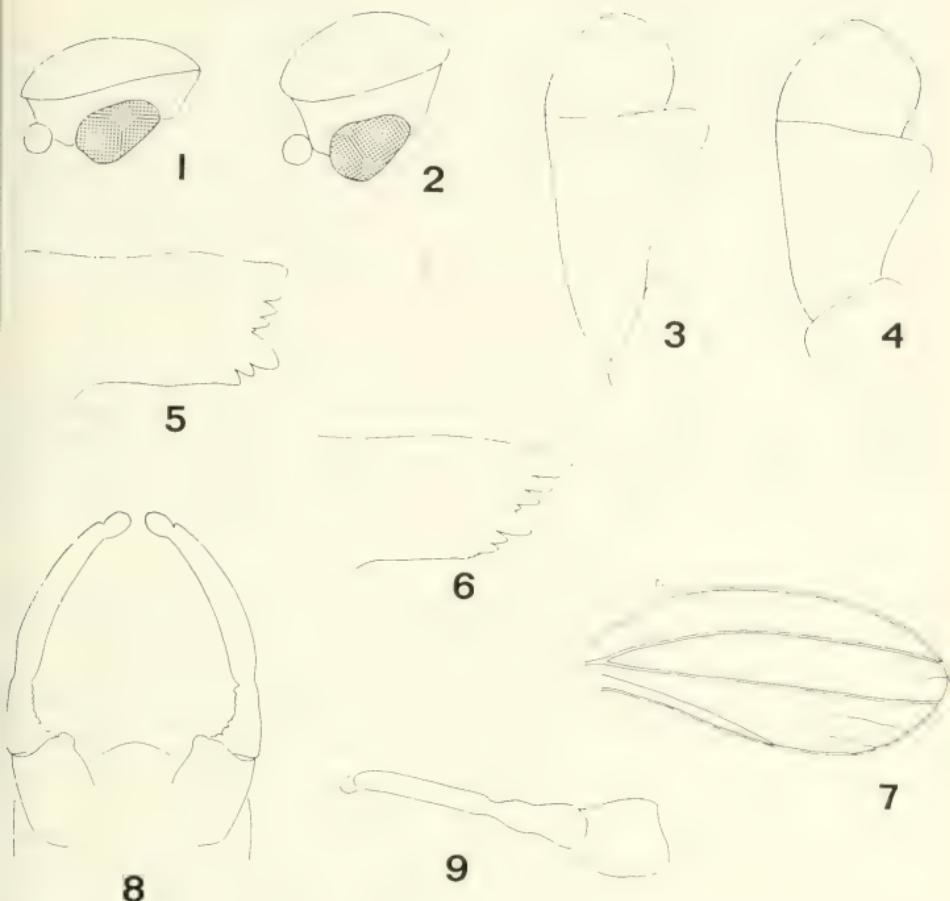
Abstract.—Based on an examination of adults and larvae from Canada and Europe, *Baetis bundyae* Lehmkuhl is placed as a subspecies of *Baetis macani* Kimmins: *Baetis macani bundyae* (new status). Morphological diagnosis and variation of both subspecies are discussed, including the first description of reared adults of *B. m. bundyae*. Ecological characters of the two subspecies appear to support the revised classification.

Baetis macani Kimmins was originally described from a small series of reared specimens collected from a lake in North Finland. Adults were described by Kimmins (1957), and the larvae were subsequently described by Macan (1957). On the basis of morphologically similar males, *B. macani* has appeared to be most closely related to a more southern European species, *B. vernus* Curtis. Both species have been studied taxonomically in detail (Müller-Liebenau, 1969), and the adults may be separated with difficulty by the shape of the turbinate eyes. The larvae, however, of *B. vernus* and *B. macani* differ significantly both in structure and habitat. *Baetis vernus* larvae live exclusively in lotic waters, the typical habitat of the genus *Baetis*, whereas *B. macani* is frequently found in still water. Thus, *B. vernus* and *B. macani* are considered distinct.

Lehmkuhl (1973) described *B. bundyae* from a series of larvae collected at the edges of tundra ponds in northern central Canada. *Baetis bundyae* has appeared to be quite similar to *B. macani*, being distinguishable only by the shape of the labial palpi and body length (Brittain, 1975). Adults from Canada were recently reared by Lehmkuhl and are herein described for the first time.

Because of fundamental morphological and ecological similarities and yet because of distinct geographic segregation and some slight morphological differences, we designate the European and North American populations respectively as the subspecies *B. macani macani* and *B. macani bundyae*, NEW STATUS.

¹ Purdue Agricultural Experiment Station Journal Series No. 7113.



Figs. 1-2. Lateral view of male adult eyes. 1, *Baetis m. macani*. 2, *B. m. bundyae*. Figs. 3-4. Labial palpi. 3, *B. m. macani*. 4, *B. m. bundyae*. Figs. 5-6. Left mandibular incisors. 5, *B. m. macani*. 6, *B. m. bundyae*. Figs. 7-9. *B. m. bundyae*, male. 7, Hindwing. 8, Ventral view of forceps. 9, Lateral view of forceps, dorsal side up.

Baetis macani macani Kimmins

Baetis macani Kimmins, 1957. 37:27; Macan, 1957. 37:58; Müller-Liebenau, 1969. 48/49:112.

Diagnosis.—No adult characters have been found which consistently distinguish the nominate subspecies from *Baetis macani bundyae*. The following two characters show differences in most individuals: *B. m. macani* is slightly larger, body length is usually between 5–7.5 mm, forewing length is between 6–8 mm; in *B. m. bundyae* body length is usually between 5–6 mm and forewing length is between 5–7 mm; the turbinate eyes of *B. m.*

macani are less elevated than those of *B. m. bundyae* (Figs. 1 and 2) although this may be the result of postmortem changes.

The larvae are more easily separated on the basis of mouthpart structure. The terminal segment of the labial palpi in *B. m. macani* is $\frac{1}{2}$ the length of the subterminal segment (Fig. 3) whereas in *B. m. bundyae* it is $\frac{2}{3}$ as long (Fig. 4). The width of the outermost mandibular tooth of the incisors in *B. m. macani* is twice that of the adjacent tooth (Fig. 5); in *B. m. bundyae* the two outermost mandibular teeth of the incisors are subequal in width (Fig. 6). Larval body lengths do not provide a good taxonomic character.

Distribution.—*Baetis m. macani* occurs in northern Europe south to approximately 60°N (Müller-Liebenau, 1969:187).

Discussion.—Although *B. m. macani* may appear to be easily distinguishable from *B. m. bundyae* both in the adult and larval stages, each character discussed in the diagnosis, with the exception of the labial palpi, is subject to enough variation to result in overlapping character states between the two subspecies in question. The differences in the labial palpi are not distinct enough to warrant specific status.

Macan (1957) gave a remarkable account of adult survival which may indicate greater dispersal capabilities in this species than is otherwise considered possible for mayflies in general.

Material Examined.—One larva, LuLpm. Siluluoberl, 12.7.60, Lok. 55; 1 larva, Material Brinck, LuLpm. 3. Koskatsj u. Koskatsj strand, 29.6.60; 2 paratype male adults, Mt. Sanna, N. Finland, VIII-15-1956. T. Macan.

Baetis macani bundyae Lehmkühl, NEW STATUS

Baetis bundyi Lehmkühl, 1973. 105:343.

Description of Male Adult.—Lengths—body 5–6 mm; forewing 5–7 mm; cerci 11 mm. Head, thorax and coxae dark brown; turbinate eyes paler, grey to yellow brown, medium-large in size (see McDunnough, 1923:40). Legs brown, paler than thorax. Wings hyaline except for translucent costal and subcostal cells of forewings, veins pale; hindwings with 3 longitudinal veins and marginal intercalaries (Fig. 7). Abdomen light brown, segments 2–6 translucent, segments 7–10 opaque, segment 10 often darker brown; sterna same color as terga; abdominal tracheation sometimes pigmented black; forceps (Figs. 8 and 9) with basal segment brown, apical segments paler, constriction between segment 1 and 2 of forceps often weak, most distinct dorsally from lateral perspective (Fig. 9). Cerci pale with brown articulations.

Distribution.—*Baetis m. bundyae* has been collected only in the tundra of central Canada (N.W.T.).

Discussion.—*Baetis m. bundyae* and *B. m. macani* regularly occur in extremely cold lentic conditions and both overwinter strictly as eggs

(Lehmkuhl, 1973; Brittain, 1975). These similarities in habitat and life cycle are atypical for *Baetis* in general. In addition to ecological and morphological evidence, the subspecific designations presented herein are also justified nomenclaturally in light of maximum information content concerning close relationship between these two taxa and their geographic isolation.

Material Examined.—Five larvae and 3 male adults, Canada, N.W.T., Keewatin, Rankin Inlet, 62.45 N, 94.27 W, 26 July 1973, Char River. D. M. Lehmkuhl; 1 larval exuvium, 1 larva and 1 male adult, same location, 28 July 1973, D. M. Lehmkuhl.

ACKNOWLEDGMENTS

Loans of *B. m. bundyae* by Dr. D. M. Lehmkuhl of the University of Saskatchewan and *B. m. macani* by Dr. J. M. Elliott of the Freshwater Biological Association, Ambleside, Westmorland, England, and Dr. I. Müller-Liebenau of the Max-Planck-Institut für Limnologie, Plön, West Germany, are greatly appreciated.

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NEW RECORDS FOR SEVERAL FLEA (SIPHONAPTERA) SPECIES IN
THE UNITED STATES, WITH OBSERVATIONS ON SPECIES
PARASITIZING CARNIVORES IN THE
ROCKY MOUNTAIN REGION

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Abstract.—New flea distribution data are discussed, and the fleas parasitizing certain carnivorous animals infrequently examined for ectoparasites are listed. *Ceratophyllus scopulorum* Holland is reported from the U.S. for the first time. *Stenoponia americana* (Baker), *Nearctopsylla princei* Holland and Jameson, *Amphipsylla sibirica washingtona* Hubbard, *Ctenophthalmus pseudagyrtes* Baker, *Chaetopsylla floridensis* (I. Fox) and *Eptesicopsylla vancouverensis* (Wagner) are reported from Colorado for the first time.

The bird flea, *Ceratophyllus scopulorum* Holland, can be added to the species of fleas known to be present in the United States. Thirty specimens were recovered from nests of the cliff swallow, *Petrochelidon pyrrhonota*, near Drayton, Pembina County, North Dakota, 16 August 1975 by G. C. Smith. The same collector took two females and a male of the species from a cliff swallow nest near Hallock, Kittson County, Minnesota, 16 August 1975. *Ceratophyllus scopulorum* has been previously reported only from Yukon Territory and New Brunswick in Canada, also from cliff swallow nests.

The flea, *Stenoponia americana* (Baker), is common on a variety of small rodents (chiefly *Peromyscus* and *Microtus*) in the eastern United States. To our knowledge, it has not been previously reported from Colorado. Our collections indicate it is present on the eastern slope of the Rockies. Records include: 1 female ex dog, Larimer County, Colorado, 26 February 1975, G. C. Smith; 13 females, 8 males ex *Peromyscus maniculatus*, Custer County, Colorado, 4 October 1975, A. M. Barnes, E. G. Campos and G. O. Maupin.

Two female *Nearctopsylla princei* Holland and Jameson were removed from a *Mustella frenata*, 17 December 1974, in the Rocky Mountain National Park, Larimer County, Colorado, W. S. Archibald and G. O. Maupin. Fleas of this genus parasitize shrews and moles and the carnivores which

Table 1. Fleas recovered from marten, *Martes americana*, Larimer County, Colorado.

| No. Fleas | Species | F | M | Usual Hosts |
|--------------------------------------|--|----|----|--------------------------|
| Three marten, October–November, 1976 | | | | |
| 2 | <i>Pulex</i> sp. | 2 | 0 | Wide Host Range |
| 2 | <i>Foxella ignota</i> | 1 | 1 | Pocket Gophers |
| 7 | <i>Orchopeas sexdentatus</i> | 6 | 1 | <i>Neotoma</i> |
| 2 | <i>Orchopeas caedens</i> | 2 | 0 | <i>Tamiasciurus</i> |
| 1 | <i>Monopsyllus wagneri</i> | 1 | 0 | <i>Peromyscus</i> |
| 5 | <i>Monopsyllus vison</i> | 3 | 2 | <i>Tamiasciurus</i> |
| 3 | <i>Ctenophyllus armatus</i> | 1 | 2 | <i>Ochotona princeps</i> |
| 1 | <i>Oropsylla idahoensis</i> | 0 | 1 | <i>Spermophilus</i> |
| 1 | <i>Opisocroftis labis</i> | 0 | 1 | <i>Spermophilus</i> |
| 1 | <i>Megarthroglossus</i> sp. | 1 | 0 | Cricetine Rodents |
| 21 | <i>Chaetopsylla floridensis</i> | 8 | 13 | <i>Martes americana</i> |
| Two marten, October, 1977 | | | | |
| 22 | <i>Chaetopsylla floridensis</i> | 15 | 7 | <i>Martes americana</i> |
| 2 | <i>Thrassis stanfordi</i> | 1 | 1 | <i>Marmota</i> |
| 2 | <i>Tarsopsylla octodecimdentata</i> <i>coloradensis</i> | 2 | 0 | <i>Tamiasciurus</i> |
| 1 | <i>Megarthroglossus</i> sp. | 1 | 0 | Cricetine Rodents |
| 1 | <i>Amphipsylla sibirica</i> | 1 | 0 | <i>Microtus</i> |

prey on them. *Nearctopsylla princei* has been known only from California, its usual host being the shrew, *Sorex trowbridgei*.

Two subspecies of the largely Palaearctic genus *Amphipsylla* have been reported from North America. *Amphipsylla sibirica washingtona* Hubbard has been known only from Washington and Idaho, to our knowledge. *Amphipsylla sibirica pollionis* (Rothschild) has been taken in Alaska, the Yukon, Alberta and Labrador. We have taken the following specimens of *A. s. washingtona* from the Rocky Mountain National Park, Larimer County, Colorado: 1 male ex *Peromyscus maniculatus*, 21 December 1975, R. G. McLean; 1 male ex *Microtus montanus*, 21 December 1975, R. G. McLean; 1 male ex *Clethrionomys gapperi*, 5 March 1975, E. G. Campos; and 2 females ex *M. montanus*, 27 February 1975, E. G. Campos. A single female *A. sibirica* was taken from a marten, *Martes americana*, in October 1977, in Larimer County, Colorado, by George Stewart.

Ctenophthalmus pseudagyrtes Baker is commonly found in the eastern United States but is rare in the West. We know of no reports of this flea from Colorado previous to the following: 1 male ex *Microtus* sp., 24 April 1970, Spring Creek Dam, Larimer County, Colorado, E. G. Campos; and 1 female ex *Rattus norvegicus*, Fort Collins, Larimer County, Colorado, 3 August 1976, City-County Health Department.

Table 2. Fleas recovered from 7 bobcat, *Lynx rufus*, Larimer County, Colorado, December 1975–March 1976.

| No. Fleas | Species | F | M | Usual Hosts |
|--------------|-------------------------------|----|----|-------------|
| 99 | <i>Cediopsylla inaequalis</i> | 62 | 37 | Rabbits |
| 11 | <i>Hoplopsyllus glacialis</i> | 7 | 4 | Rabbits |
| 21 | <i>Odontopsyllus dentatus</i> | 4 | 17 | Rabbits |
| 1 | <i>Pulex irritans</i> | 0 | 1 | Carnivores |

The range of the flea, *Eptesicopsylla vancouverensis* (Wagner), which parasitizes several species of bats has been extended eastward from the west coast of the United States and Canada by the recovery of specimens in Colorado: 1 male, 1 female ex *Plecotus pallescens*, Boulder County, Colorado, 19 January 1977, C. J. Mitchell; and 1 male ex *P. pallescens*, Boulder County, Colorado, 6 January 1978, C. J. Mitchell. We have also seen a male taken from *Euderma maculatum* in Nevada, but the slide has been mislaid and more specific collection data are not available.

The Nevada and Colorado specimens differ somewhat from the west coast *E. vancouverensis*. For example, the former have a reduced number of frontal spiniforms on the head, no mid-dorsal hump on the movable process of the male clasper and reduced setation on the male sternum VIII. The differences are believed to be no more than subspecific in nature.

We have had an opportunity to study fleas from five *Martes americana* trapped in Larimer County, Colorado, in October and November of 1976–77. One marten was taken November 5, 1976 in the Rocky Mountain National Park by Dr. R. G. McLean; the others were secured by Mr. George Stewart, professional trapper, elsewhere in Larimer County. The 14 species taken from martens are listed in Table 1. Of these, only *Chaetopsylla floridensis* (I. Fox) can be characterized as a true marten flea.

Chaetopsylla floridensis, previously unreported from Colorado, bears an unfortunate specific name. It was described from material in the U.S. National Museum purported to be "from garden truck leaf mold" taken in Gainesville, Florida. In light of its present known distribution from Alaska (Hopla, 1964) to Colorado, one is tempted to speculate that the type-material was mislabeled. We have observed that the flea is well-adapted to cold weather and remains active at below 0°F on trapped martens which have been frozen for hours.

Two specimens of a rare flea were recovered from a marten. *Tarsopsylla octodecidamentata coloradensis* (Baker) was described from Colorado on *Tamiasciurus hudsonicus*. We know of but two additional records of the species in the state. We have not seen it in recent years, even though numerous *T. hudsonicus* and their nests have been examined in connection with

Table 3. Fleas recovered from 4 ringtailed cat, *Bassaricus astutus*, Bernalillo County, New Mexico, November–December 1977.

| No. Fleas | Species | F | M | Usual Hosts |
|--------------|---------------------------------------|----|----|-----------------------------|
| 30 | <i>Megarthroglossus bisetis</i> | 21 | 9 | <i>Neotoma</i> |
| 24 | <i>Anomiopsyllus novomexicanensis</i> | 12 | 12 | <i>Neotoma</i> |
| 2 | <i>Stenistomera alpina</i> | 2 | 0 | <i>Neotoma</i> |
| 6 | <i>Atyphloceras echis</i> | 5 | 1 | <i>Neotoma</i> |
| 4 | <i>Epitedia stanfordi</i> | 1 | 3 | <i>Peromyscus</i> |
| 1 | <i>Micropsylla sectilis goodi</i> | 1 | 0 | <i>Neotoma</i> |
| 1 | <i>Meringis arachis</i> | 1 | 0 | <i>Dipodomys</i> |
| 2 | <i>Diamanus montanus</i> | 1 | 1 | <i>Spermophilus</i> |
| 2 | <i>Malaraeus sinomus</i> | 0 | 2 | Cricetine Rodents |
| 2 | <i>Thrassis aridis</i> | 1 | 1 | <i>Spermophilus</i> |
| 1 | <i>Monopsyllus wagneri</i> | 0 | 1 | <i>Peromyscus</i> |
| 1 | <i>Orchopeas neotomae</i> | 1 | 0 | <i>Neotoma</i> |
| 3 | <i>Pulex simulans</i> | 1 | 2 | <i>Cynomys</i> , Carnivores |
| 4 | <i>Echidnophaga gallinacea</i> | 2 | 2 | Wide Host Range |

Colorado tick fever studies in the Rocky Mountain National Park. Hopla (1964) reports taking the species in Alaska from *T. hudsonicus*, *Mustela erminea*, *Glaucomys sabrinus* and *Clethrionomys rutilus*. We consider *T. O. coloradensis* to be truly a rare flea in Colorado. Due to its scarcity on *Tamiasciurus hudsonicus*, it has been considered a nest flea.

It is apparent from the plethora of flea species found on certain carnivores that they may play an important role in the natural history of bubonic plague, primarily by transferring infected fleas from an infected rodent aggregate to uninfected rodents of the same or different species. With comparatively large home ranges, carnivores should be capable of rapidly spreading plague in rodents.

The Mustelidae are much more likely to have a large variety of flea species on them than other common carnivores in the Colorado Rocky Mountain area. Fox and coyote are frequently heavily infested with *Pulex irritans*, with only occasional rabbit or rodent fleas seen on them. As shown in Table 2, seven bobcat recently examined were infested exclusively with rabbit fleas, with the exception of a single *Pulex irritans*.

The number and diversity of rodent fleas found on the marten is a reflection of the wide host range of these animals and the energetic manner in which they investigate nests of both burrowing and arboreal rodents. The relatively small size of the Mustelidae enables them to actually enter many rodent burrows and pick up predominantly nest fleas.

Noticeable by their absence from the extensive list of fleas from marten are rabbit fleas. Even if they do not feed on rabbits, rabbit fleas are so common

in the Rocky Mountain area that we have picked them up from the ground with flannel drags used for collecting ticks.

An impressive number of flea species have recently been seen off four animals representing another carnivore family, the Procyonidae. A total of 83 fleas, representing 14 species, were removed from two ringtailed cat, *Bassaris astutus*, trapped November 18, 1977 and two taken December 5, 1977, by U. S. Air Force preventive medicine personnel in Bernalillo County, New Mexico (Table 3). As with the marten, this extensive list of flea species from ringtailed cat does not include rabbit fleas.

We appreciate the assistance given by Dr. George W. Holland, Research Branch, Agriculture Canada, Ottawa, Canada, and Dr. Robert Traub, Department of Microbiology, University of Maryland, Baltimore, Maryland, in the specific determination of certain of the fleas treated in this paper.

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A NEW SPECIES OF *HYDROPTILA* FROM VIRGINIA
(TRICHOPTERA: HYDROPTILIDAE)

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Abstract.—The adult male of *Hydroptila anisoforficata*, new species, is described and figured. The new species is briefly compared to similar species in the genus.

During a recent survey of the aquatic insect fauna of Stony Creek, Virginia, an unknown species of Trichoptera was discovered. Subsequent examination of material collected previously near the Maury River produced additional specimens.

Hydroptila anisoforficata Parker and Voshell, NEW SPECIES

Adult male.—Length of forewing, 2.0–2.5 mm. Color of specimens in alcohol, brown. Seventh (and occasionally 6th) sternum with short, pointed apicomosal process. Eighth segment with numerous very long setae. General appearance similar to others in genus. *Genitalia*: Ninth segment retracted into 8th and part of 7th segments; prolonged posteriorly as a broad setose lobe that covers base of clasper. Tenth tergum (Fig. 1B) arises from 9th as a narrow, heavily sclerotized process that widens gradually before forking at about midlength; each fork twisted and bent (Fig. 1A), the right fork longer than the left and bending dorsad, the left bending ventrad. Clasper rectangular at base in lateral view; becomes slender and bladelike dorsomesally and curves mesoventrad, overlapping the other clasper before curving laterad and ending in a narrow apex (Fig. 1C); with several stout setae, more numerous apically. Mesal membranous lobe of 9th segment projects beneath 10th tergum, closely appressed to it; 2 setae project ventrad near apex; aedeagus exits between fork of 10th tergum and mesal lobe of 9th segment. Aedeagus (Fig. 1D) with enlarged base; slender tapering process arises just before midlength and spirals posteriad clockwise one revolution; constricted beyond midlength, ending apically as a slender finger; ejaculatory duct reticulated and looped at midlength.

Remarks.—*Hydroptila anisoforficata* appears to be similar to *H. waukesiana* Betten (1934) and allies because of the long, forked 10th tergum. The complete sclerotization of the 10th tergum is found in *H. eramosa*

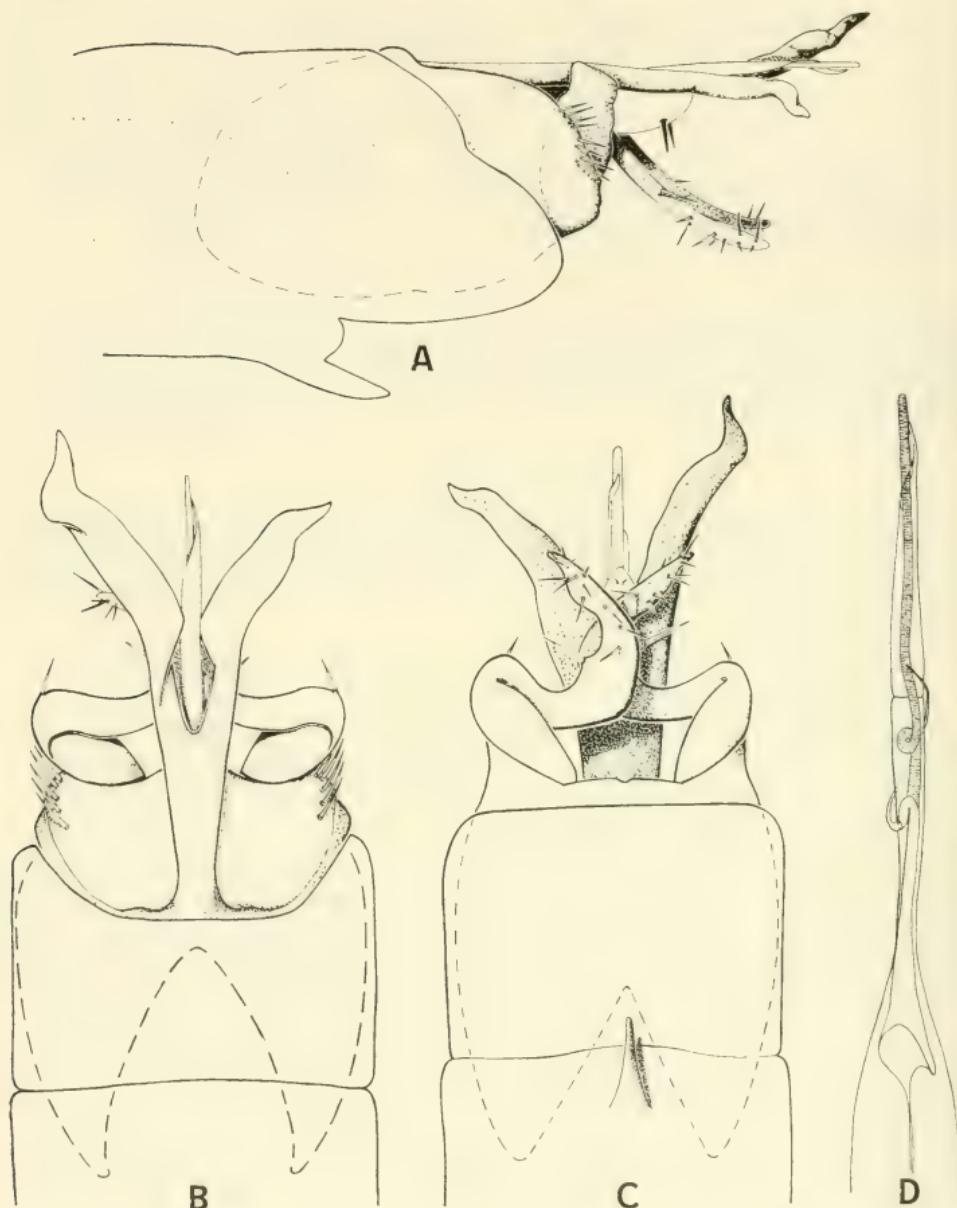


Fig. 1. *Hydroptila anisoforficata*, male genitalia. A, Lateral. B, Dorsal. C, Ventral. D, Aedeagus.

Harper (1973). The long, curved claspers are suggestive of *H. xera* Ross (1938), *H. berneri* Ross (1941), *H. salmo* Ross (1941), *H. tusculum* Ross (1947) and *H. melia* Ross (1938). However, *H. anisoforficata* is easily separated from other species by the asymmetrically forked 10th tergum and sinuate claspers which overlap midway and diverge apically.

Etymology.—The name is derived from *aniso-* (Greek, unequal) and *forficat-* (Latin, forked) and refers to the distinctive 10th tergum.

Types.—*Holotype*, ♂: Virginia, Giles Co., Stony Creek between Olean and Interior, 650–670 m elevation, black light trap, 13 July 1977, Sharon Johnson. *Paratypes*: Same data as holotype, 2 ♂. Virginia, Rockbridge Co., Maury River, Goshen Pass, 440–460 m elevation, black light trap, 8 September 1976, Walter Knausenberger, 4 ♂. Holotype and 2 paratypes deposited in the United States National Museum; remainder of paratypes deposited in the Royal Ontario Museum and the collection of the Department of Entomology, Virginia Polytechnic Institute and State University.

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The authors thank Ms. Sharon Johnson for her diligent collecting during the summer of 1977 and Mr. Walter Knausenberger for donating specimens which he had previously collected. The assistance of Dr. Oliver S. Flint, Jr., Smithsonian Institution, and Dr. Glenn B. Wiggins, Royal Ontario Museum, in examining specimens and reviewing the manuscript is greatly appreciated.

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TWO NEW SPECIES OF *CORTICEUS* FROM FLORIDA AND THE WEST INDIES (COLEOPTERA: TENEBRIONIDAE)

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Abstract.—Two new species of *Corticeus*, *C. tensicollis* from Florida, Cuba, Puerto Rico, Haiti and Dominican Republic and *C. tuberculatus* from Cuba, are described. Characters which separate them from other large, Neotropical species of *Corticeus* are presented.

Anticipating an eventual review of the Western Hemisphere components of the genus *Corticeus*, I wish to make known the following two new species at this time.

Grateful acknowledgment is expressed to a number of curators and institutions for the loan of specimens upon which this paper is based. The institution, abbreviation used in the text and curator(s) in charge are as follows: United States National Museum of Natural History, Washington, D.C. (USNM), T. J. Spilman; Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts (MCZC), J. F. Lawrence; American Museum of Natural History, New York (AMNH), Lee H. Herman, Jr.; Florida State Collection of Arthropods, Gainesville, (FSCA), R. E. Woodruff; Carnegie Museum, Pittsburgh, Pennsylvania (ICCM), George Wallace; Zoologische Sammlung des Bayerischen Staates, Munich, West Germany (ZSBS), Gerhard Scherer; The Ohio State University Collection of Insects and Spiders, Columbus (OSUC), C. A. Triplehorn.

Corticeus tensicollis Triplehorn, NEW SPECIES

Holotype, male.—Elongate, very slender, subcylindrical, dark reddish brown, glabrous, shining. Head uniformly finely and densely punctured; clypeus well defined and swollen medially; antennae with segments 5–10 short but broadly expanded laterally, apical segment lighter in color, longer and rounded apically; eyes coarsely faceted, separated dorsally by almost 3× the observed dorsal diameter of one eye and ventrally by much less than the observed ventral diameter of one eye; ventral surface of head with only a few fine, widely separated punctures. Pronotum long and narrow (width = 0.7 length), convex, lateral margins parallel, marginal bead very fine, apical margin strongly rounded, angles abruptly acute and prominent, base feebly

rounded, prominently beaded, angles obtuse; surface finely and sparsely punctured, most punctures separated by at least their own diameters. Elytra slightly wider than pronotum, with distinct rows of fine, closely spaced punctures forming striae, only the 1st and 2nd (adjacent to suture) lying in sulci, lateral striae obsolete; intervals subconvex near suture, becoming flat laterally, with a single row of minute punctures on each; pygidium finely and densely punctured. Ventral surface concolorous with dorsum, legs somewhat lighter in color; flanks of prothorax coarsely but shallowly and densely punctured; prosternum finely punctate with wavy, transverse sculpturing; prosternal process narrow between coxae, expanded apically into 2 prominent lobes; mesosternum and mesepisternum coarsely and confluently punctured; metasternum with obvious though weak carina progressing obliquely caudad from mesocoxa and becoming vague posteriorly, sparsely and minutely punctured except laterally where punctures are coarser and shallower but still widely separated; abdominal sterna with deep lateral grooves, basal 3 sterna finely and sparsely punctured except on flattened median area on segments 1 and 2 where punctures are larger, 4th segment more coarsely and densely punctured, 5th segment still more coarsely, almost confluently punctured. Length 6.2 mm; width 1.5 mm.

Types.—Holotype, Paradise Key, Florida, 9 March (no year or collector indicated); 4 paratypes, Miami, Florida, 15 November 1947; 4 paratypes, Miami, Florida, June 1948; 4 paratypes, Homestead, Florida, 16 November 1931; 2 paratypes, Biscayne Bay Florida (no date or collector); 1 paratype, Broward County, Florida (no date); 1 paratype, Dade County, Florida, June, 1930. Holotype in USNM; paratypes in FSCA, MCZC, USNM, OSUC, ICCM, AMNH, and ZSBS. Additional specimens studied (26) Cayamas, Cuba, 14 January to 11 February, (no year indicated), E. A. Schwarz, on ceiba; (2) Cayamas, Cuba, Baker (no date), (3) Higueral, Dominican Republic, 12 April 1913, J. R. Johnston; (1) Port au Prince, Haiti, R. J. Crew, all in USNM; Upper Ovando River, eastern Oriente Province, Cuba (1000–2000 ft.), 17–20 July 1936, Darlington; (2) Soledad, Cienfuegos, Cuba, 28 October 1926, Darlington; (3) San Juan de los Remedios, Cuba, H. Bryant; (7) Jarabacoa, Dominican Republic (1500–4000 ft.), August, 1938, Darlington, all in MCZC; (1) Cayey, Puerto Rico, 1920, G. N. Wolcott; (3) Higueral, Santo Domingo; (1) Cuba, all in AMNH.

Discussion.—There is obvious sexual dimorphism involving the basal two abdominal sterna and the pro- and metathoracic legs. The male has the middle portion of the first abdominal sternum (sometimes the second sternum also) flattened or concave, with distinctly coarser punctures than the outer portions of the sclerite; in the female these two sterna are uniformly convex with punctures subequal throughout. The male protibia has long, dense, golden setae on the anterior surface, with the ventral surface obviously incurved along apical three-fourths; the metatibia is stouter, sud-

denly though slightly narrowed near base. The female protibia has much shorter golden setae on the anterior surface, with the ventral surface almost straight; the metatibia is slenderer and evenly narrowed from apex to base.

Measurements.—Length 5.0–7.5 mm; width 1.2–1.8 mm.

The presence of this large, elongate species of *Corticeus* in Florida has been known for a long time. It has been misidentified as *C. mexicanus* (Reitter) in several collections, perhaps as a result of the listing of that species in the Leng Catalogue from Florida, even though the name was preceded by a question mark.

Through the courtesy of Dr. Gerhard Scherer, Zoologische Sammlung des Bayerischen Staates, Munich, Germany, I was able to borrow a Reitter cotype of *C. mexicanus* and verify the identity of that species. I was aware that the Florida species differed markedly from specimens I had on hand from Central America and which I presumed to be *C. mexicanus*. Examination of the cotype and study of an adequate series from Central America confirmed my suspicions that the Florida species was undescribed.

Corticeus mexicanus is of stouter proportions than *C. tensicollis*, the pronotum is shorter (width = 0.8 length) and the ventral surface is more coarsely punctured. Males of *C. mexicanus* are very distinct in having the medial portion of the basal abdominal sternum flattened and rugosely sculptured between and behind the metacoxae with a distinct median carina ending in a tubercle. In addition, there is a dense, conspicuous patch of short, pale setae on the prosternum immediately behind the head. These two structures are absent in the female of *C. mexicanus* and in both sexes of *C. tensicollis*. Both structures were clearly visible on the cotype studied even though it was glued dorsal side up on a card.

I have seen specimens of *C. mexicanus* from Mexico, Guatemala, Nicaragua, Panama and Colombia.

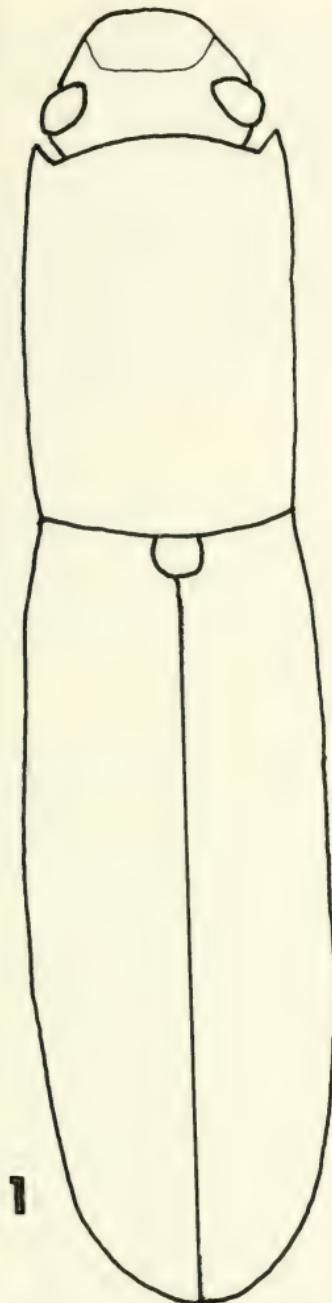
Corticeus tensicollis is more similar to *C. rufipes* (Fabricius) than to any other New World species. The two may be separated by several characters in addition to the male genitalia. *Corticeus rufipes* is usually larger (up to 10 mm in length), the eyes are separated ventrally by about $1.5 \times$ the ventral diameter of one eye, and the elytral striae are better defined, at least 5 discal striae on each side of the suture situated in distinct sulci with convex elytral intervals.

I have seen specimens of *C. rufipes* from Mexico, Guatemala, Costa Rica, Panama, British Honduras, Nicaragua, Venezuela, Bolivia, Brazil and Trinidad.

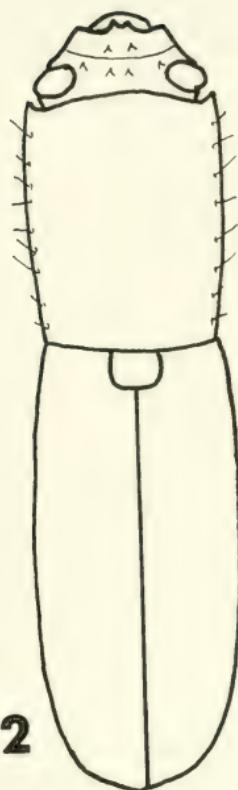
Corticeus tuberculatus Triplehorn, NEW SPECIES

Figs. 2–3

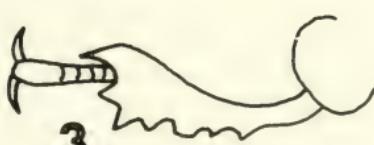
Holotype, sex undetermined.—Elongate, stout, subcylindrical, dark reddish brown, shining; dorsal surface with scattered, widely separated, erect,



1



2



3

Fig. 1. *Corticeus tensicollis*, body outline in dorsal view. Figs. 2-3. *C. tuberculatus*. 2. Body outline in dorsal view. 3, Left prothoracic leg.

pale setae. Head with clypeus trapezoidal, sides straight, finely crenulate and distinctly reflexed, anterior angles prominent, epistoma subtruncate with 2 small, almost contiguous marginal tubercles, 2 similar, slightly separated tubercles at base of clypeus; interocular area smooth and shiny with 6 small tubercles; posterior portion of head coarsely and densely punctured, a transverse impression between eyes; antennae dark reddish brown, stout, subfusiform, segments 5–10 transverse, terminal segment narrower, elongate, rounded apically; eyes moderate, coarsely faceted, separated ventrally by almost $2\times$ the observed ventral diameter of one eye; ventral surface of head with a few coarse but very shallow punctures, transversely impressed between eyes. Pronotum large (0.6 length of elytra), strongly convex; lateral margins straight and divergent from base to apex, apical margin truncate, strongly and abruptly deflexed medially, angles finely acute and prominent, basal margin nearly straight, basal angles rounded; lateral and basal margins finely beaded; surface coarsely and deeply punctured, punctures well separated on disc, much closer laterally, punctures more or less elliptical; lateral setae quite long. Elytra equal in width to base of pronotum, sides parallel, surface shallowly punctate-striate, intervals flat and minutely punctulate; elytral setae vaguely arranged in longitudinal rows, best seen in anterior or posterior views, longest near lateral margins; pygidium very finely punctate. Ventral surface finely and densely punctured, somewhat alutaceous, especially metasternum; prosternal process narrow between coxae, strongly expanded behind, truncate apically; legs light reddish brown; profemur expanded apically, grooved ventrally for reception of protibia; protibia expanded apically, outer margin strongly denticulate (Fig. 3); inner margin densely clothed with golden setae, apical spur large and strongly deflexed; dorsal surface of mesotibia finely denticulate; metatibia with large subapical tooth on dorsal surface. Length 3.5 mm; width 0.9 mm.

Types.—Holotype and 5 paratypes, Cayamas, Cuba, 14 January (no year indicated), E. A. Schwarz, on ceiba; 2 paratypes, same locality and collector but 21 January. Holotype and paratypes in USNM; paratype in OSUC.

Discussion.—There is not much variation in the type-series. Three of the specimens have a single epistomal tubercle instead of two and the number and arrangement of other tubercles on the head vary slightly (as few as 4 as in Fig. 2). The denticulations on the dorsal edge of the protibia are irregular, some large teeth and some small teeth on the same tibia, and with different combinations on the right and left tibia of a specimen.

Measurements.—Length 3.2–3.7 mm; width 0.82–0.96 mm.

This species has at least three unique characters, any one of which will distinguish it from all other known *Corticeus* in the Western Hemisphere: Head tuberculate, outer margin of profemur denticulate and anterior margin of pronotum deflexed. It is totally unlike any species known to me, and I am unable to speculate on its affinities.

A NEW NEOTROPICAL GENUS OF PREDACEOUS MIDGE,
WITH A KEY TO THE GENERA OF HETEROMYIINI
(DIPTERA: CERATOPOGONIDAE)

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Abstract.—**Physohela**, a new genus of predaceous midges of the tribe Heteromyiini, is described and illustrated. It includes the type-species, *Neurohelea oedidactyla* Ingram and Macfie, from Argentina, and *N. turgidipes* Ingram and Macfie, from Chile. A key and phylogeny are presented for the Heteromyiini, and phylogenetic relationships within the tribe are discussed.

Ingram and Macfie (1931) described *Neurohelea oedidactyla* and *N. turgidipes* from Patagonia and South Chile, respectively. In their excellent paper they remarked that these two species resembled both *Clinohela* Kieffer and *Neurohelea* Kieffer in possessing a swollen front fifth tarsomere. They distinguished *Clinohela* from these two species by: "all femora are slender and unarmed, the costa is not prolonged beyond R5, the median fork is broadly sessile, and on the four posterior legs of the female the fourth tarsal segment is armed, and the claws are very unequal." They concluded that these two species more closely resembled *Neurohelea* because "the only difference to be found is apparently in the femora, all of which in *Neurohelea* are slender and unarmed. We have therefore referred the two species described here to this genus, assuming that, as only a single species is known, the armature of the femora may not be in this case a character of generic importance."

We consider the allocation of these two species to *Neurohelea* by Ingram and Macfie at the time a prudent decision. However, since the publication of their paper in 1931, another species of *Neurohelea*, *N. nigra*, has been described by Wirth (1952). An additional species, *N. macroneura*, originally described by Malloch (1915) in *Johannsenomyia* and later allocated to *Neurohelea* by Johannsen (1943), was apparently unknown to Ingram and Macfie. The type species of *Neurohelea*, *N. luteitarsis* (Meigen), occurs in the

Palaearctic Region while the above two species are Nearctic. These three species of *Neurohelea* are very similar morphologically with but minor differences at the species level, and it now appears that they comprise a rather well-defined genus, apparently Holarctic in distribution.

Recently, we discovered in the material in the U.S. National Museum a specimen of *Neurohelea turgidipes* collected in Patagonia by R. and E. Shannon in 1926 on the same expedition during which F. and M. Edwards collected the type-series of *N. turgidipes* and *N. oedidactyla*. Unfortunately much of Shannon's collection was not made available for study when the British Museum (Natural History) published its series on the Diptera of Patagonia and South Chile. Through the courtesy of Richard Lane and the trustees of the British Museum (Natural History), we were able to borrow the type-series of *N. oedidactyla* and *N. turgidipes*. The female holotypes of both species were mounted on slides in balsam by Ingram and Macfie and are in excellent condition. After comparing the type-material of *N. oedidactyla* and *N. turgidipes* with other species of *Neurohelea*, we feel it necessary to propose a new genus for them.

In this paper we are also revising the recently published key (Wirth et al., 1974) to the tribe Heteromyiini, to include this new genus and to correct some problems in classification. In addition we are including a section on the phylogenetics of the Heteromyiini to elaborate on our evaluation of characters in this tribe. For an explanation of general terminology of Ceratopogonidae see Wirth (1952) and Wirth et al. (1977). We are grateful to Ethel L. Grogan for preparing the illustrations.

KEY TO THE GENERA OF HETEROMYIINI (FEMALES)

1. Media barely sessile, forking at level of r-m crossvein; fourth tarsomere of hind leg cordiform 2
- Media broadly sessile, forking proximal to r-m crossvein; fourth tarsomere of hind leg bifid or greatly elongated, not cordiform 4
2. One radial cell; claws of hind leg without basal inner tooth
Neurobezzia Wirth and Ratanaworabhan
- Two radial cells; claws of hind leg with basal inner tooth 3
3. Front femur bearing 5-12 spines; fifth tarsomere of front leg elongate, greatly inflated; claws moderately small, less than $\frac{1}{2}$ length of fifth tarsomeres *Physohelea*, new genus
- Front femur without spines; fifth tarsomere of front leg shorter than those of middle and hind legs, slightly inflated; claws moderately large, more than $\frac{1}{2}$ of length of fifth tarsomeres .. *Neurohelea* Kieffer
4. Fourth and fifth tarsomeres of hind leg greatly elongated; hind claw greatly elongated 5
- Fourth tarsomere of hind leg bifid, spinose; fifth tarsomere of hind

- leg about as long as those of front and middle legs; hind claw not greatly elongated 7
- 5. Front femur greatly swollen, bearing 20–30 spines; claws of front and middle legs with basal inner tooth *Heteromyia* Say
- Front femur slender with less than five spines; claws of front and middle legs without basal inner tooth 6
- 6. Inner claw present on hind leg; fourth tarsomere of front and middle legs bifid, spinose; wing fasciate *Tetrabezzia* Kieffer
- Inner claw absent on hind leg; fourth tarsomere of front and middle legs cordiform, without spines; wing hyaline *Pellucidomyia* Macfie
- 7. Claws of front leg unequal; eyes broadly contiguous *Metahelea* Edwards
- Claws of front leg equal; eyes broadly separated 8
- 8. One radial cell; anterior scutal spine strongly developed *Ceratobezzia* Kieffer
- Two radial cells; anterior scutal spine poorly developed or absent *Clinohelea* Kieffer

Physohelea Grogan and Wirth, NEW GENUS

Type-species, *Neurohelea oedidactyla* Ingram and Macfie, by present designation.

Diagnosis.—As genus of predaceous midges of the tribe Heteromyiini distinguished from all other ceratopogonid genera by the following combination of characters: Fifth tarsomere of front leg elongate, greatly inflated; front femur slightly swollen and bearing 5–12 spines; wing slightly infuscated, with 2 radial cells, the costa extending beyond R₄₊₅ to 0.87–0.91 of wing length; media barely sessile, forking at level of r-m crossvein; claws moderately small, less than ½ length of 5th tarsomeres, equal in size and possessing basal inner teeth; 4th tarsomeres cordiform. Male unknown.

Physohelea keys to couplet 9, the tribe Heteromyiini, and couplet 36, *Neurohelea* Kieffer, in Wirth et al. (1974) but differs from that genus by several characters. *Neurohelea* has shorter, stouter legs and the front femur lacks spines, the front fifth tarsomere is shorter than the others and just slightly inflated, the claws are much longer, more than ½ the length of the fifth tarsomeres, the costa extends far beyond R₄₊₅ to more than 0.97 of the wing length, and the flagellum is much shorter and stouter. *Heteromyia* Say differs from *Physohelea* in having a greatly swollen fore femur bearing 20–30 spines, fasciate wings with a broadly sessile media, hind fourth and fifth tarsomeres greatly elongated and hind claws greatly elongated. *Neurobezzia* Wirth and Ratanaworabhan, the only other heteromyiine genus with a media forking at the level of the r-m crossvein, differs readily from *Physohelea* in having only a single radial cell. All other genera in the tribe

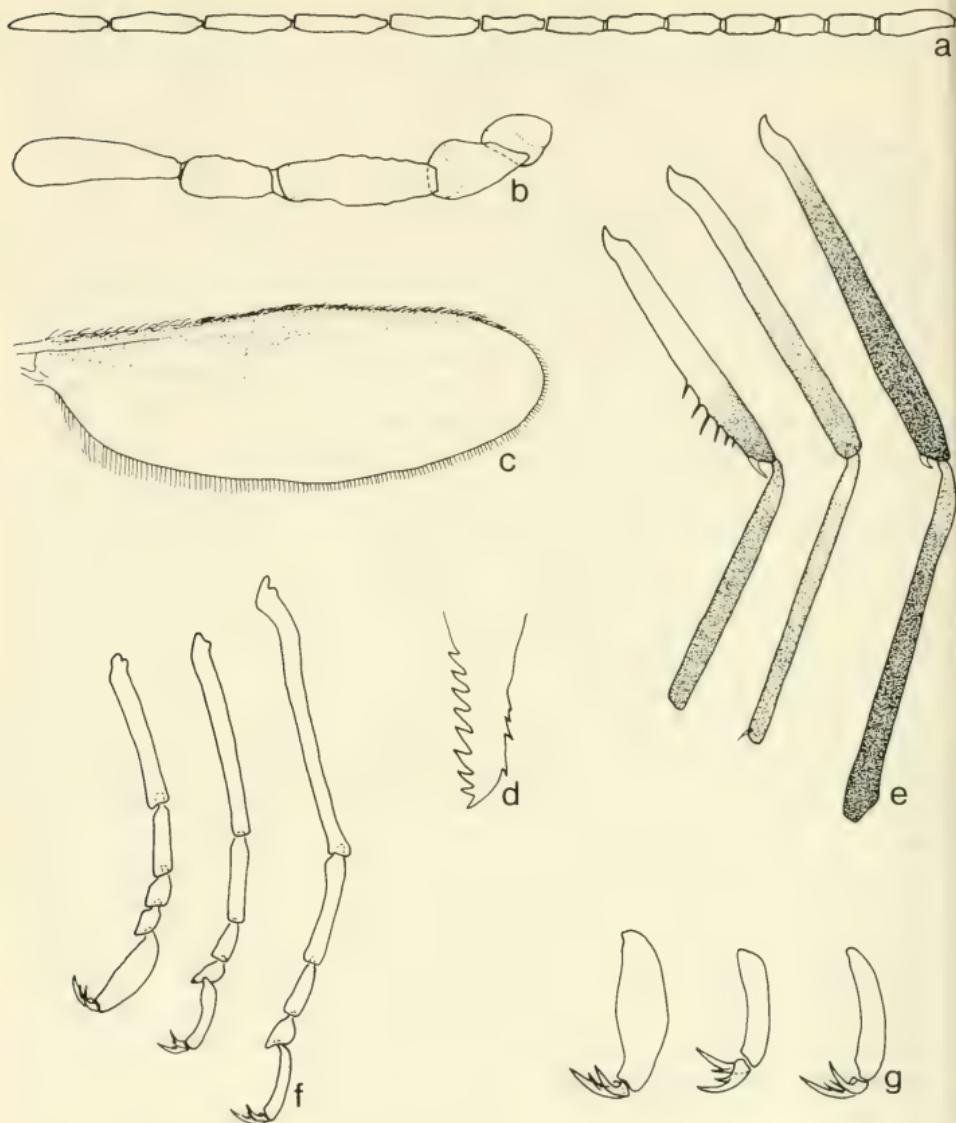


Fig. 1. *Physohelea oedidactyla*, female. a, flagellum; b, palpus; c, wing; d, mandible; e, leg pattern; f, tarsi; g, fifth tarsomeres and claws.

Heteromyiini differ from *Physohelea* in having a broadly sessile media and the hind fourth tarsomeres either greatly elongated or bifid and spinose.

Etymology.—The generic name is a combination of Greek *physo* (inflated) and *heleios* (marsh dweller) and refers to the characteristic inflated front fifth tarsomeres of this genus.

Physohelea oedidactyla (Ingram and Macfie), NEW COMBINATION
Figs. 1, 2a

Neurohelea oedidactyla Ingram and Macfie, 1931:212 (female; Argentina); Wirth, 1974:48 (in catalog of Neotropical Ceratopogonidae).

Diagnosis.—A species of *Physohelea* characterized by its dark brown legs with the proximal $\frac{1}{2}$ of the front and middle femora and base of the hind femur yellowish; scutum brownish.

Female.—For a complete description see Ingram and Macfie (1931). To that description may be added the following: Wing length 2.46 mm; breadth 0.86 mm. Antenna with lengths of flagellomeres (Fig. 1a) in proportion of 19-12-12-13-14-15-15-16-23-23-22-23-25; antennal ratio 1.00. Palpus (Fig. 1b) with lengths of segments in proportion of 7-8-15-9-15; palpal ratio 3.0. Mandible (Fig. 1d) with 8-9 large coarse teeth on inner margin; outer margin with 3-4 small, widely-spaced teeth. Legs (Fig. 1e) with dark brown femora and tibiae except yellowish on proximal $\frac{1}{2}$ of front and middle femora and base of hind femur; front femur with 5-7 spines; tarsi (Fig. 1f) yellowish on proximal 3 tarsomeres, brown on distal 2 tarsomeres; 5th tarsomere of fore leg (Fig. 1g) elongated and greatly inflated, shorter and slender on middle and hind legs; claws small, equal sized, with basal inner teeth. Wing (Fig. 1c) slightly infuscated, surface with microtrichia only; 2 radial cells; costa extending beyond R₄₊₅ to 0.87 of wing length; media barely sessile, forking at the level of r-m crossvein; cubitus forking at level of r-m crossvein. Abdomen with genitalia as in Fig. 2a; 9th sternum with truncate anterior margin; posterior margin cleft; 8th sternum with a pair of bifid arms; 10th sternum with a deeply cleft anterior margin and 6 pairs of large setae. Two or three small, spheroid, subequal spermathecae with narrow, moderately long necks, the largest measuring 0.067 by 0.052 mm.

Male.—Unknown.

Distribution.—Argentina; known only from the type-locality, which is plotted in Fig. 3.

Type.—Holotype, female, Argentina, Rio Negro Province, Bariloche, December 1926, F. and M. Edwards, in British Museum (Natural History), London.

Physohelea turgidipes (Ingram and Macfie), NEW COMBINATION
Fig. 2b-c

Neurohelea turgidipes Ingram and Macfie, 1931:214 (female; Chile); Wirth 1974:48 (in catalog of Neotropical Ceratopogonidae).

Diagnosis.—A species of *Physohelea* very similar to *P. oedidactyla* but differing from that species by its mostly yellowish legs with the distal $\frac{1}{4}$ of the femora and tibiae brown and with large yellowish anterolateral spots on the scutum.

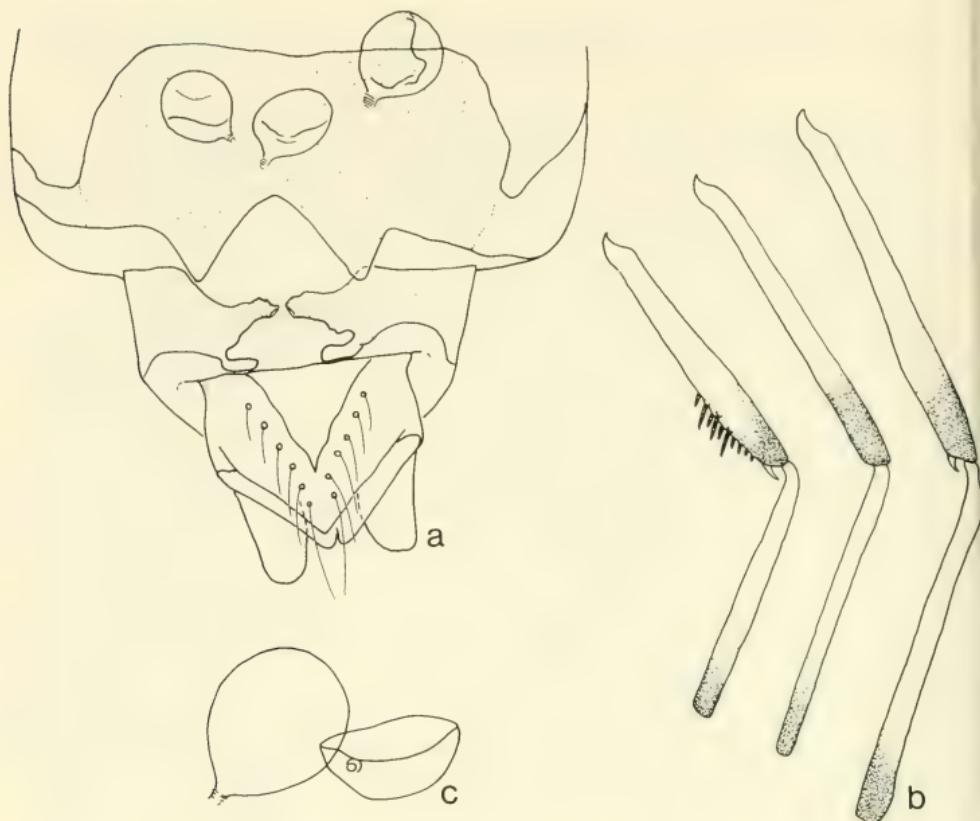


Fig. 2. *Physohelea oedidactyla* and *P. turgidipes*, females. a, genitalia of *P. oedidactyla*; b and c, leg patterns and spermathecae, respectively, of *P. turgidipes*.

Female.—For a complete description see Ingram and Macfie (1931). To that description may be added the following: Wing length 2.50–2.79 mm; breadth 0.86–0.90 mm. Antenna with lengths of flagellomeres in proportion of 19-13-13-14-14-15-17-17-26-27-26-26; antennal ratio 1.07–1.21. Palpus with lengths of segments in proportion of 6-9-13-7-15; palpal ratio 2.55–2.60. Legs (Fig. 2b) yellowish except brown on distal 1/4 of femora and tibiae; front femur with 6–12 spines. Costa of wing extending to 0.89–0.91 of wing length. Two slightly larger spermathecae (Fig. 2c), the largest measuring 0.076 by 0.055 mm.

Male.—Unknown.

Distribution.—Southern Chile; locality records plotted in Fig. 3.

Type.—Holotype, female, Chile, Chiloe Province, Mechueque Island, 23 December 1926, F. and M. Edwards, in British Museum (Natural History), London.

Additional Material Examined.—CHILE: Chiloe Province, Isla Chiloe, Ancud, December 1926, R. and E. Shannon, 1 female, on slide, in USNM.



Fig. 3. Locality records of *Physohelea oedidactyla* (open circle) and *P. turgidipes* (closed circles) in southern Chile and Argentina.

PHYLOGENETIC RELATIONSHIPS

Downes (1977) has presented the only phylogenetic diagram of the tribes of the Ceratopogoninae to date. His diagram is rather simplified and is based to a large extent on the feeding habits, but we agree with its general arrangement and branching sequence of the tribes. Within the Ceratopogoninae, Downes placed the Heteromyiini in that group in which the female captures and devours the male during the mating process. He also indicated from his diagram that the Heteromyiini arose from a Ceratopogonini-Stilobezziini ancestor. We believe that the Stilobezziini is probably the more logical ancestor of the Heteromyiini.

Figure 4 presents a proposed phylogeny for the genera in the tribe Heteromyiini. We believe that this tribe is a monophyletic group having in common apotypic character state 1, an inflated front fifth tarsomere. This character is better developed in some genera than in others; nevertheless, it along with some other apotypic characters indicates that the Heteromyiini are monophyletic in origin.

Branch A in Fig. 4 includes *Physohelea*, *Neurohelea* and *Neurobezzia*, and these three genera are thought to be the most plesiomorphic in the tribe. They share apotypic character state 2, a barely sessile media, that is, forking

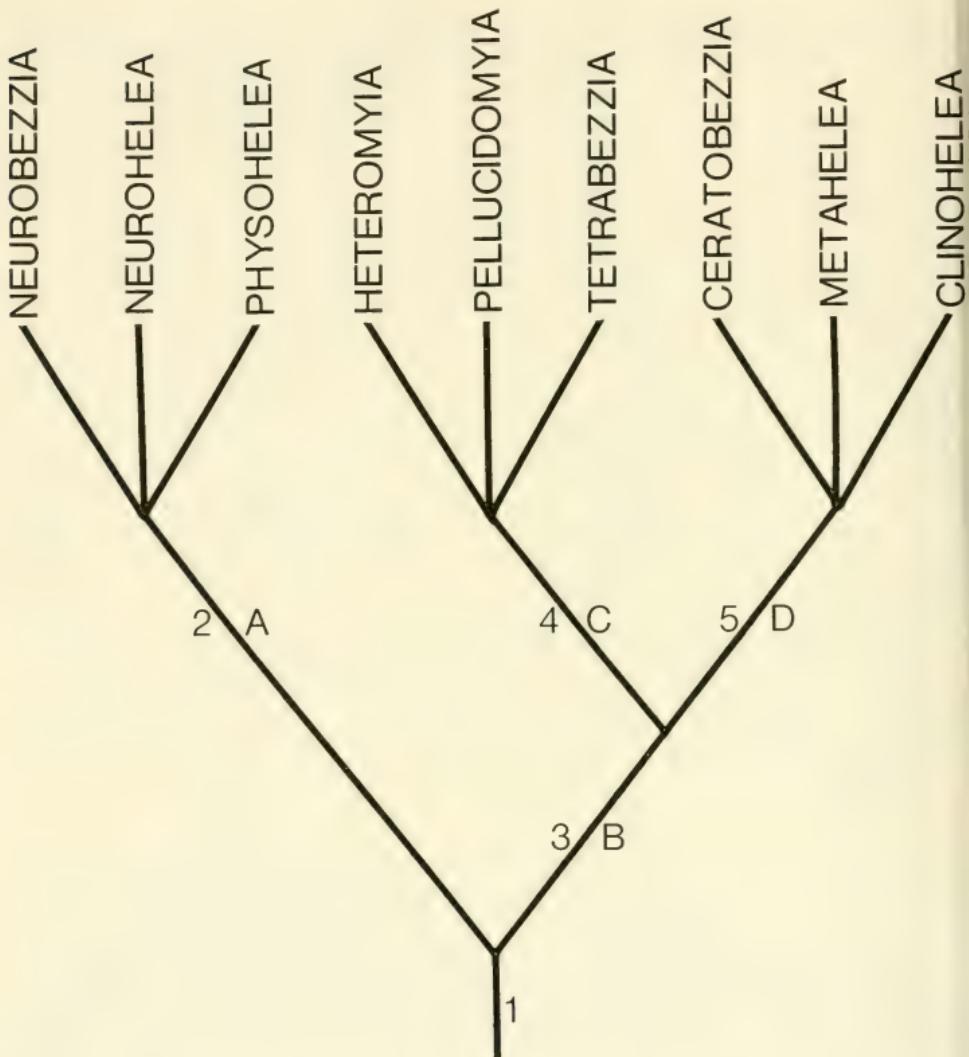


Fig. 4. Phylogeny of the genera in the tribe Heteromyiini. Apotypic character states are: 1, inflated 5th tarsomere of front leg; 2, media barely sessile, forking at level of r-m crossvein; 3, media broadly sessile, forking proximal to level of r-m crossvein; 4, greatly elongated hind 4th and 5th tarsomeres and claws; 5, bifid, spinose, hind 4th tarsomere.

at the level of the r-m crossvein, and are the only genera in the family that possess this character. This character probably represents an intermediate condition between the plesiomorphic petiolate media of the Stilobezziini and the broadly sessile media (apotypic character state 3) present in the other six genera in the Heteromyiini (branch B), and the Sphaeromiini, Palpomyiini, and Stenoxenini. The genera in branch A also share several plesiomorphic characters such as the cordiform fourth tarsomeres and equal-sized

claws usually with basal inner teeth. *Heteromyia* (branch C) is apparently the only other genus to have retained the plesiomorphic condition of claws with basal inner teeth.

Branch B in Fig. 4 includes in the Heteromyiini those genera which share apotypic character state 3, a broadly sessile media. This character is also found in all of the higher ceratopogonid genera, as stated previously. The genera in branch B exhibit several unusual modifications such as bifid, spinose fourth tarsomeres and greatly elongated hind claws, characters unique to the Heteromyiini.

Branch C in Fig. 4 includes *Heteromyia*, *Pellucidomyia* and *Tetrabezzia*, all of which share apotypic character state 4, greatly elongated hind fourth and fifth tarsomeres and claws. These characters are unique to these three genera, which are apparently closely associated, and probably represent modifications for specialized feeding behavior. However, nothing is presently known of the feeding or mating habits of these genera.

Branch D in Fig. 4 includes *Ceratobezzia*, *Metahelea* and *Clinohellea*, all of which share apotypic character state 5, hind fourth tarsomere bifid and spinose. The fourth tarsomeres of the front and middle legs of *Clinohellea* and *Metahelea*, and the middle leg of *Ceratobezzia*, are bifid and spinose as well. These structures may be used for holding prey. *Tetrabezzia* (branch C) also has the fourth tarsomeres of the front and middle legs bifid and spinose. This may indicate that *Tetrabezzia* might have developed this character independently from those genera in branch D or that branches C and D are paraphyletic. At present we are uncertain as to what sort of hind fifth tarsomere the ancestor of branches C and D possessed. We may be better able to determine the relationships of these two groups if new characters are discovered or when we know more of their biologies.

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**ORTHOYTUS TRANSLUCENS: TAXONOMIC STATUS AND
CORRECTION OF PUBLISHED MISIDENTIFICATIONS
(HEMIPTERA: MIRIDAE)¹**

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Abstract.—The type-specimen of *Orthotylus translucens* Tucker 1907 has been examined. Although the condition of the type is poor, we are following Kelton and are regarding Tucker's species as a junior synonym of *Diaphnocoris provancheri* (Burque). Records of *O. translucens* in faunal lists probably should refer to *D. pellucida* (Uhler) and *D. ulmi* (Knight), as well as to *D. provancheri*. Published host records from onion and mesquite refer to *Labopidea allii* Knight and *Orthotylus vigilax* Van Duzee, respectively.

Elbert S. Tucker was F. H. Snow's student and museum assistant at the University of Kansas during the early years of this century (Hyder, 1953). He published a number of papers on economic entomology while employed as a special field agent by the U.S. Department of Agriculture. From extensive spare-time collecting he amassed considerable material from Colorado, Kansas, Louisiana and Texas and helped to catalogue the insects of Kansas. He identified much of his own material but usually had specialists verify his determinations. Tucker felt sufficiently confident to describe several new species of Diptera and Hymenoptera; his taxonomic work in Hemiptera was limited to the 1907 description of a new mirid, *Orthotylus translucens*.

Tucker described *O. translucens* from a male he collected in July 1894 near Colorado Springs, Colorado, which O. Heidemann had noted was most closely related to the European *O. prasinus* (Fallén). Tucker hesitated to describe a new species based on a single specimen but did so "to avoid listing a species as unknown."

In helping to complete the mirid fascicle for the forthcoming catalogue of

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the Hemiptera of America north of Mexico, we found that there is confusion surrounding the identity of Tucker's species. We discovered that Van Duzee (1916) had redescribed *translucens* without examining Tucker's type-specimen; that H. H. Knight at one time confused *translucens* with related orthotyline mirids; that the host plant records published under the name *O. translucens* by Glenn (1923) and Jones (1932) probably were based on misidentifications; and that Kelton (1965) synonymized *translucens* under *Diaphnocoris provancheri* (Burque) without indicating whether he had seen Tucker's type. We have examined the type and the specimens of Glenn, Jones, Knight and Van Duzee in order to clarify the taxonomic status of *O. translucens* and to correct published host plant records based on misidentifications.

TUCKER'S TYPE AND METATYPES

Dr. P. D. Ashlock, Department of Entomology, University of Kansas, kindly permitted us to borrow Tucker's type-specimen from the Snow Entomological Museum. The specimen is badly faded with little hint of green and no fuscous tinge; its condition is poor. The antennae (except the right 1st segment) are missing and the genitalia are glued to a 2nd point beneath the specimen, but only the right paramere is visible. The specimen is suggestive of *Diaphnocoris provancheri*, or *D. pellucida* (Uhler), but as pointed out by Kelton (1965), these two species are at best difficult to separate. Kelton (1965) synonymized *translucens* under *D. provancheri*, probably as a practical way to dispose of a long troublesome name and apparently without studying the Tucker type-specimen. Tucker's specimen clearly belongs in the genus *Diaphnocoris*, and its general form most closely resembles specimens determined as *D. provancheri* from the eastern U.S. Because of its poor condition, it is impossible to identify the type with certainty; Tucker's specimen may well represent a species distinct from other known *Diaphnocoris*. We believe it best, however, to follow Kelton's disposition of *translucens* owing to the condition of Tucker's type-specimen.

Tucker's metatypes, four females collected at Kansas City, Missouri, May 13 and 20, could not be located. His description of this green orthotyline mirid strongly suggests the honeylocust plant bug, *D. chlorionis* (Say), based on the short rostrum (failing to attain mesocoxae), antennae (III-IV infuscated), and membrane (very slightly dusky). The collection of the metatypes from "trunks of locust trees" further supports our conclusion if the host indeed was honeylocust rather than black locust.

VAN DUZEE'S AND KNIGHT'S CONCEPT OF *ORTHOYTLUS TRANSLUCENS*

In his 1916 monograph of the genus *Orthotylus* in North America, Van Duzee redescribed *O. translucens* based on a pair collected at Buffalo, New York and two males taken at Elma, New York (near Buffalo). He did not ex-

amine Tucker's type but thought that based on the original description he had correctly placed Tucker's species. Van Duzee's specimens from Buffalo (6-27-08) and Elma (Aug-25-12) were located in the collection of the California Academy of Sciences and were borrowed through the courtesy of Dr. P. H. Arnaud, Jr. These specimens cannot be referred to either *D. pellucida* or *D. provancheri* or to the similar-appearing *D. chlorionis*. Van Duzee's specimens appear to be *D. ulmi* (Knight).

H. H. Knight apparently was unsure of the identity of *O. translucens* and did not include Tucker's species in his major works of 1923, 1941 and 1968. He did, however, occasionally identify specimens as *translucens*. In material submitted by C. J. Drake and H. Osborn from their survey of the Hemiptera of Cranberry Lake, New York, Knight identified *D. pellucida*, *D. provancheri*, and *O. translucens?*, all taken on yellow birch (*Betula lutea*) at Barber Point during July and August. He also identified *translucens* from Batavia, New York (Knight, 1928) and Raleigh, North Carolina (Brimley, 1938). In addition, his personal collection, now housed at the U.S. National Museum of Natural History (USNM), contains a series of specimens standing under the name *O. translucens*. Three species comprise this series: *D. pellucida*, *D. provancheri*, and *D. ulmi*. The specimen from Lawrence, Kansas, noted by Knight (1922) to be closely related to *translucens* but evidently undescribed, appears to be *D. pellucida*.

HOST PLANT RECORDS BASED ON MISIDENTIFICATIONS

Glenn (1923) reported on seasonal history, damage and control of a mirid on wild garlic and cultivated onions in the vicinity of Olney, Illinois. C. S. Spooner misidentified Glenn's species as *O. translucens*. In the family Miridae we were aware of only *Allium* spp. serving as hosts of *Labopidea* spp. We located a specimen from Olney (June 1915, on onion) in the USNM collection that Knight had determined as *L. allii*. Knight (1941) lists *L. allii* from Olney, Illinois.

Jones (1932), based on Van Duzee's determination, recorded *O. translucens* from mesquite (*Prosopis glandulosa* and *P. velutina*) in southeastern Arizona. He reported that feeding by large numbers of mirids apparently was responsible for failure of a large percentage of leaves and flowers to develop on time. Some of his specimens from Cochise Co., Arizona, labeled "ex. mesquite," have been borrowed from the California Academy of Sciences; the species fits the description of *O. vigilax* Van Duzee. Knight (1968) reported *O. vigilax* from mesquite in California.

ACKNOWLEDGMENTS

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C. Froeschner, Department of Entomology, Smithsonian Institution, for allowing us to examine specimens in the H. H. Knight collection and J. L. Herring, Systematic Entomology Laboratory, IIBIII USDA, c/o U.S. National Museum, for letting us examine specimens under his care. K. C. Kim, Pennsylvania State University, kindly reviewed the manuscript and endorsed it for publication.

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DESCRIPTION OF THE NYMPH OF *OPHIOGOMPHUS HOWEI* (ODONATA: GOMPHIDAE)

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Abstract.—The nymph of the little known dragonfly *Ophiogomphus howei* Bromley is described for the first time. It is distinguished from other members of the genus by its small size (19.0–22.5 mm in length), the absence of dorsal hooks and the vestigial nature or absence of lateral spines on abdominal segment 7. The geographical range of *O. howei* is extended from the Susquehanna River in Pennsylvania to the New River in Virginia and North Carolina where it is a significant component of the benthic fauna. The nymphal habitat, species associations, food preference and emergence patterns are reported along with some observations of adult behavior.

The holotype description of *Ophiogomphus howei* Bromley (1924) was made based on one female adult. Likewise, Calvert (1924) described the male of *O. howei* based on one specimen. Until its recent discovery in a section of the New River in Virginia only one other *O. howei* specimen had been recorded since the original descriptions. This was a teneral female taken in 1967 from the Susquehanna River near Halstead, Pennsylvania (Thomas W. Donnelly, personal communication). Despite the fact that *O. howei* has been one of the most sought after species in North America it has eluded collectors and its nymph has remained undescribed for over 50 years (M. J. Westfall, personal communication).

As part of a study to determine species composition of the benthic invertebrate fauna in the New River, a mature *Ophiogomphus* nymph was collected in December 1976, a few meters upstream of St. Rt. 721 bridge, Carroll County, Virginia. The nymph was reared in facilities at Virginia Polytechnic Institute and State University; and in February 1977, a female *O. howei* emerged. Additional nymphs were reared and the exuviae were conspecific with exuviae collected from the Susquehanna River near Halstead, Pennsylvania. The morphological terminology given by Corbet (1953) and Snodgrass (1954) is used in the following description of the *O. howei* nymph.

Mature Nymph.—Body length 19.0–22.5 mm (20.5 aver.), abdominal width 5.6–6.1 mm (5.6 aver.), head width 4.5–4.9 mm (4.7 aver.).

In general the mature nymph is a greenish brown. Earlier instars have more of a yellowish-brown body. Preserved nymphs are a light brown. Body is covered with coarse cuticular granules.

There are 4 antennal segments. The length to width ratio of antennal segment 3 is less than 2.0 (1.86–1.95). The labium is as shown in Fig. 2A. The distal margin of the median lobe is evenly arcuate with 32–36 blunt teeth and 61–68 piliform setae. The distal margin of each palpus possesses 11–13 rectangular dentations. Setae are present on lateral margins of the thorax. Wing pads, 4.5–5.0 mm long, extend to the base of abdominal segment 4. The legs have prominent setae present on femora, tibia and tarsal segments.

Abdominal tergal segments 2–9 in profile are somewhat arched longitudinally with a blunt rounded apical projection but no dorsal prominences (Fig. 2B). The abdominal terga in addition to well-marked submedian and lateral rows of spots have a dark pigmented blotch on segment 6. This characteristic may fade in preserved specimens. Subequal lateral spines are present on segment 8–9. A lateral spine may weakly be present on abdominal segment 7. Cerci are slightly less than $\frac{2}{3}$ of the epiproct length. Cerci basal width is approximately $\frac{5}{8}$ their length.

The nymph of *O. howei* is easily distinguished from all other *Ophiogomphus* nymphs by its small size and lack of any dorsal hooks or prominences. The absence of a lateral spine on segment 7 is also diagnostic for this species. However, this trait is variable and in approximately 40% of the examined specimens a weak spine was present.

Material examined.—6 nymphs and 26 last instar exuviae from Virginia Carroll Co., New River, near Galax. 10 last instar exuviae from North Carolina: Alleghany Co., New River. 4 exuviae from Pennsylvania: Susquehanna Co., Susquehanna River. Last instar exuviae and adult specimens have been deposited in U.S. National Museum, Washington, D.C.; Florida State Collection Insects and Arthropods, Gainesville, Florida; Department of Entomology, University of Michigan, Ann Arbor, Michigan; Department of Entomology, Purdue University, West Lafayette, Indiana; and Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts.

Range.—Nymphs and adults of *O. howei* were collected from a 39.1 km section of the New River which flows through North Carolina (Alleghany Co.) and Virginia (Grayson, Carroll Co.). Elevation ranges from 732 m (2400 ft) to 640 m (2100 ft) above sea level in this area. The New River near Galax, Virginia ($36^{\circ}39.5'N$, $80^{\circ}59'W$) is a site nearly central to the distribution of *O. howei*. Exuviae were also collected from the Susquehanna River in Pennsylvania (Susquehanna Co., $41^{\circ}57.5'N$, $75^{\circ}40'W$). The original descriptions

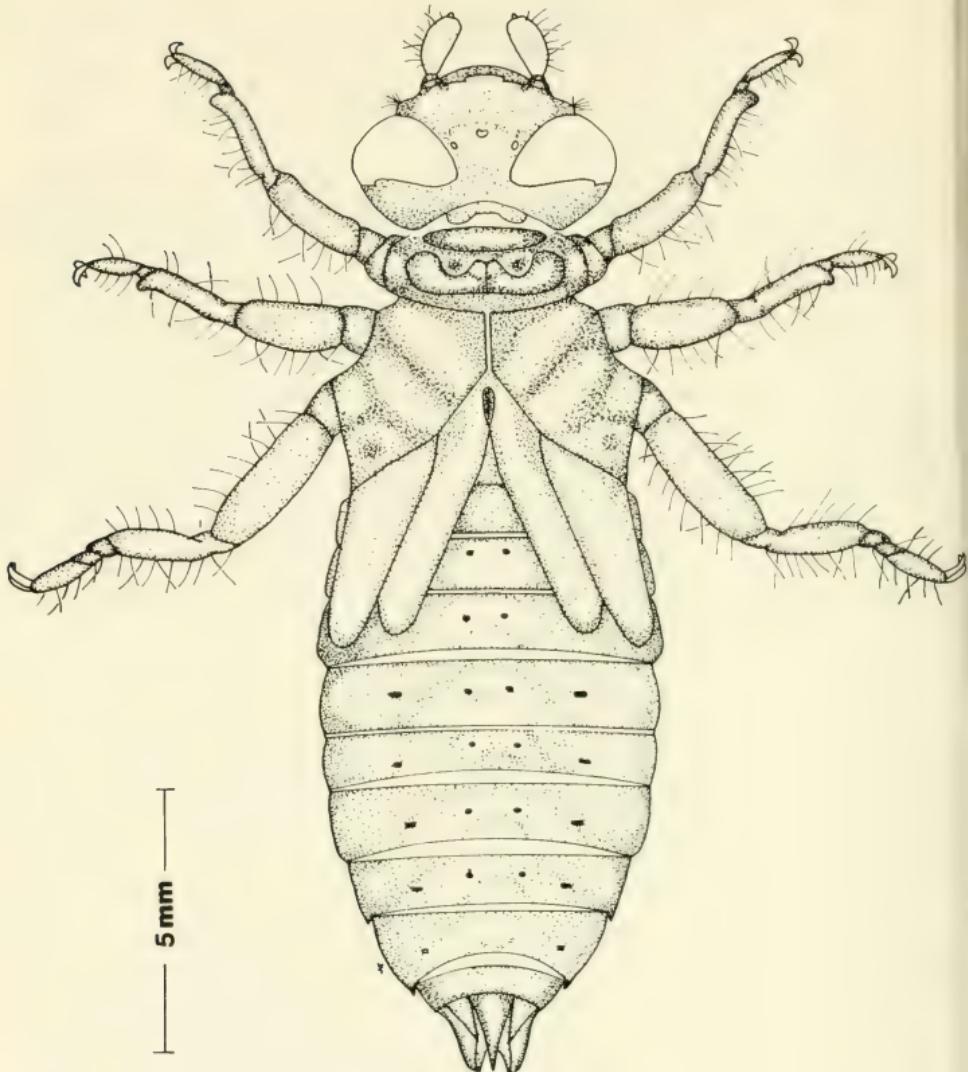
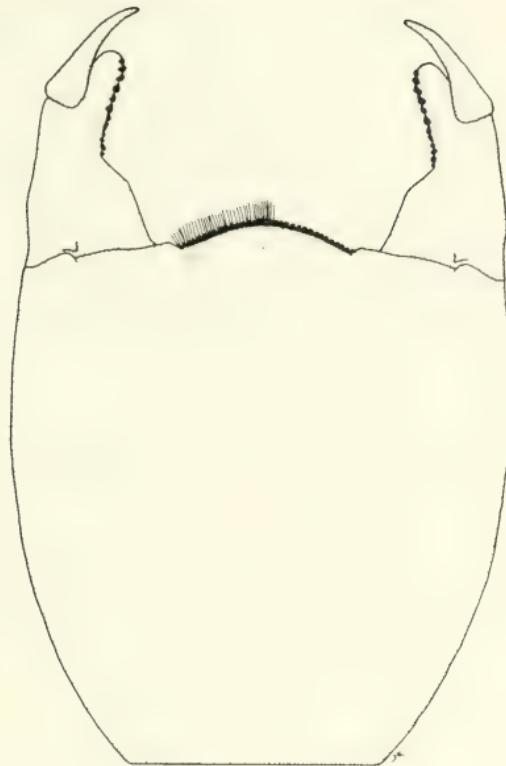


Fig. 1. *Ophiogomphus howei*, dorsal view.

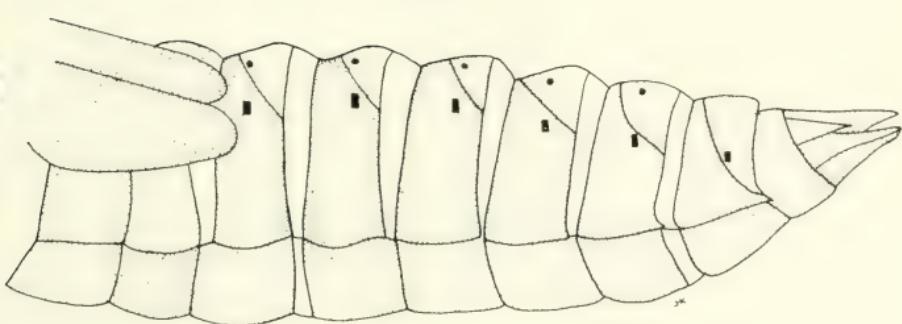
of the adults were from specimens taken in Amherst, Massachusetts and Lemoyne, Pennsylvania near the Connecticut and Susquehanna Rivers, respectively.

Ecology.—Nymphs were found in sand and gravel in swiftly flowing water. The average annual flow of the New River near Galax, Virginia is 51 m³/sec. The New River is approximately 200 m wide and 0.30 m deep in this section. The flow, depth, width and substrate characteristics of the



mm

B



5 mm

Fig. 2. *Ophiogomphus howei*. A, Labium (note $\frac{1}{2}$ piliform setae are deleted to show tooth structure of median lobe). B, Abdomen, lateral view.

Susquehanna River near Halstead, Pennsylvania are similar to the New River.

Physical and chemical properties of the New River within the distribution range of *O. howei* were monitored monthly from 1970 to 1975 at three locations. Ranges of selected physical and chemical parameters are as follows: Calcium, 2.00–6.50 ppm; magnesium, 0.80–2.10 ppm; sulfate 0.00–7.40 ppm; chloride, 0.30–5.40 ppm; pH, 6.10–8.45; hardness, 9.90–22.40; Biological Oxygen Demand (BOD) 0.01–6.15 ppm; and nitrate 0.304–3.49 ppm. Dissolved oxygen (D.O.) was always near the saturation point. Water quality in this area of the New River is excellent because the drainage basin has few major industrial sites (Benfield and Cairns, 1974). Comparable water chemistry data from the Susquehanna River are not available. However, two spot surveys done by the Pennsylvania Fish Commission indicate the Susquehanna has a greater hardness (46–82 ppm) (Clark Shiffer, personal communication). Further reliable comparisons between the New and Susquehanna Rivers are not possible.

Odonata nymphs sympatric with *O. howei* in both the Susquehanna and New rivers included *Gomphus (Gomphurus) vastus* Walsh, *G. (Tylurus) spiniceps* Walsh, *Macromia illinoiensis* Walsh and *Neurocordulia yamaskanensis* Provancher. *Ophiogomphus rupinsulensis* (Walsh) was associated with *O. howei* in the Susquehanna and *Ophiogomphus aspersus* Morse in the New River.

Emergence on the New River in 1977 began 30 April and continued through the first part of May. Peak emergence occurred 4–5 May. The last exuviae were picked up 15 May 1977. *Ophiogomphus howei* emergence in 1978 began 21 May 1978. Water temperature at the time of emergence in 1977 and 1978 was approximately 19°C.

The nymphs were observed climbing out of the river and up vertical mud banks. Emergence either occurred while clinging to the exposed mud bank or in the grassy vegetation on the top of the bank. Emergence occurred between early morning and early afternoon. Teneral *O. howei* kept alive up to seven days have yellow markings. They are devoid of the green thoracic coloration typical of other eastern species of *Ophiogomphus*.

Foregut contents of 5 *O. howei* mid-instar nymphs collected during the summer of 1977 revealed water mites (Arachnida: Acari: Prostigmata) mayfly nymphs (Ephemeroptera: Baetidae) and midge larvae (Diptera: Chironomidae: Tanytarsini). Two distinct size classes of *O. howei* were collected from the New River suggesting a 2 year life cycle.

Adults are strong fliers and were observed migrating into trees after emergence. Active *O. howei* adults were observed 7–10 m high in trees in the late afternoons until dusk. Ovipositing was not observed in the New River. However, adults were observed to leave their perches high in trees and fly

very fast over the surface of the Susquehanna River late in the afternoon (Thomas W. Donnelly, personal communication).

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SEVENTY-THREE NAMES VALIDATED IN "ICHNEUMON" AND
"EVANIA" (HYMENOPTERA: ICHNEUMONIDAE) IN
POSTHUMOUSLY PUBLISHED LETTERS
WRITTEN BY CUVIER

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Abstract.—Dalla Torre did not catalog the names of "*Ichneumon*" and "*Evania*" species which were validated in 1833 in posthumously published letters written by Cuvier in 1790 and 1791. Those Cuvier names are listed and discussed (homonymy, etc.) for the convenience of systematists not having ready access to Sherborn's Index Animalium. No names of well-known species are junior primary homonyms of the Cuvier names discussed. However, such is not the case for all of the junior primary homonyms which Dalla Torre neglected to suppress. Consequently, it is important for Hymenopterists producing comprehensive catalogs or revisions to consult Sherborn's Index Animalium.

Following the death of Georges Cuvier in 1832, two letters which he had written to P. I. Hartmann in 1790 and 1791 were sent by G. L. Duvernoy to G. Silbermann, founder and editor of *Revue Entomologique*. Silbermann thought the letters to be of historical interest with respect to the beginning of Cuvier's career (Cuvier wrote the letters at age 21) as an extraordinary scientist; and, accordingly, he published them in *Revue Entomologique* (Cuvier, 1833a and 1833b). Although some of the names validated by virtue of publication of those letters pertain to Coleoptera (Carabidae and Staphylinidae), the majority (73) apply to an assortment of Ichneumonoidea, Chalcidoidea and Proctotrupoidea. The Ichneumonoidea were described in *Ichneumon* (68 species) and the Chalcidoidea and Proctotrupoidea were described in *Evania* (5 species). Cuvier's collection is apparently no longer in existence.

None of the names of Cuvier (1833a and 1833b) were cited in the pertinent volumes of Dalla Torre's Catalogus Hymenopterorum (1898a, 1898b, 1901–1902). Dalla Torre's (1898b:297) citation of "*Evania Silbermann*" in the synonymy for *Torymus* would appear to indicate that Dalla Torre was aware of the Cuvier names but regarded them as unavailable. I encountered the Cuvier names in Sherborn (1902, 1922–1933), in the process of checking for

homonymy of names treated by Carlson (in press). Because Sherborn's volumes would not be readily available to many taxonomists working with parasitic Hymenoptera, it seems worthwhile to present a summary of the information I have assembled concerning Cuvier's (1833a and 1833b) names of Hymenoptera. Following the alphabetized specific names are enumerations of the pages on which they occur in volume 1 of *Revue Entomologique* and parenthetical comments on the status of the names. Listing the literature citations for the original descriptions of the homonyms or synonyms discussed would unnecessarily lengthen this paper; accordingly, most of those citations are not listed.

Ichneumon: *affinis*, p. 158 (preoccupied by Fabricius, 1793); *anonymus*, p. 203 (preoccupies Heinrich, 1961); *I. anonymus* Heinrich is being replaced by Carlson [in press, p. 522]; "apectator, L. F.", p. 160 (lapsus for *assector* Linnaeus); *armillatorius*, p. 156 (preoccupied by Gravenhorst, 1807, and Thunberg, 1822); *armillatus*, p. 203 (preoccupies Wesmael, 1845); *I. armillatus* Wesmael is apparently a species of *Cratichneumon* [see Hellen, 1946, p. 2-3] for which the female is not yet known); *autumnalis*, p. 157; *barbatus*, p. 207; *bicolor*, p. 157 (presumably not the intended spelling); *bicultrator*, p. 208 (as "bicolatorem, nob[is]"; *nomen nudum*, because name regarded by Cuvier as a synonym of *I. "formicator"* Linnaeus [lapsus for *formicatus*])); *bipunctatus*, p. 203 (preoccupied by Gmelin, 1790); *brachiacanthos*, p. 210; *brachigaster*, p. 210; *cadomensis*, p. 156; *carduorum*, p. 158; *cerasi*, p. 203 (preoccupied by Linnaeus, 1771); *cinctus*, p. 158 and 203 (preoccupied by Linnaeus, 1758, and Geoffroy, 1775); *coecus*, p. 209; *cognator*, p. 156 (preoccupied by Thunberg, 1822); *crassipes*, p. 159 (preoccupied by Geoffroy, 1785, Rossi, 1790; and Gmelin, 1790); *cyanops*, p. 207; *dimidiatus*, p. 159; *elegans*, p. 205 (preoccupied by Gravenhorst, 1829); *erytrostoma*, p. 206 (presumably not the intended spelling); *femoralis*, p. 205 (preoccupied by Geoffroy, 1785); *femorator*, p. 156 (preoccupied by Fabricius, 1793 and Kirby, 1802); *fimetarius*, p. 206; *gallicanus*, p. 201; *Geoffroii*, p. 157 (junior objective synonym [n. syn.] of *I. vorax* Geoffroy by virtue of Cuvier's statement "Syn. . . . Geoff. Ichn. 52," a reference to species 52 of Geoffroy [1762, p. 344], which Geoffroy [1785, p. 411] named *vorax*; the latter name may correctly apply to *Pterocormus discriminator* [Wesmael]); *globosus*, p. 210; *Hartmanni*, p. 157; *humeralis*, p. 206 (preoccupied by Lichtenstein, 1796; regarding the status of the names of Lichtenstein [1796], see Bohart and Menke [1976, p. 117]); *incrassatus*, p. 204; *latepetiolatus*, p. 204; *lateralis*, p. 206 (preoccupies Kriechbaumer, 1887; according to Constantineanu [1959, p. 812-814] *I. lateralis* Kriechbaumer is a species of *Barichneumon* that is known only from the male); *leucogaster*, p. 209; *leucospis*, p. 202; *lucidus*, p. 159; *luctuosus*, p. 208 (preoccupied by Gravenhorst, 1820); *macroceros*, p. 210; *Marschallii*, p. 207 (*nomen nudum*); *maxillosus*, p. 204; *melanostygma*, p. 207 (apparently preoccupies *melan-*

ostigma Kriechbaumer, 1882, if article 58 (2) of the "Code" [Stoll et al., 1964, p. 57] is heeded; according to Aubert [1962, p. 126], *melanostigma* Kriechbaumer is a junior synonym of *Pterocormus novemalbatus* [Kriechbaumer], the latter being misspelled *nonoalbatus* by Aubert); *militator*, p. 206; *nanus*, p. 208 (preoccupies Ratzburg, 1848 and Cresson, 1877; *I. nanus* Cresson and its replacement name, *Amblyteles nanodes* Cushman, are junior synonyms of *Cratichneumon scitulus* [Cresson]; *I. nanus* Ratzburg is apparently a *nomen dubium*); *nebulosus*, p. 208; *normannicus*, p. 157; *ochropsis*, p. 202; *ochropus*, p. 204 (preoccupied by Gmelin, 1790); *orthacanthos*, p. 210; *pallifrons*, p. 204 (preoccupied by Gravenhorst, 1829); *pectoralis*, p. 159 (preoccupied by Say, 1829); *personatus*, p. 207 (preoccupied by Gravenhorst, 1829); *pictus*, p. 207 (preoccupied by Schrank, 1776 and Gmelin, 1790); *proximus*, p. 207; *psetosus*, p. 205 (as *psetosi*, genitive case in Latin text); *4-dentatus*, p. 203 (*nomen nudum*); *recentissimus*, p. 202; *recurvicauda*, p. 206; *romenilianus*, p. 209; *rufescens*, p. 209 (preoccupied by Retzius, 1783; Gmelin, 1790; and Rossi, 1794); *ruficollis*, p. 205 (preoccupies Stephens, 1835; *I. ruficollis* Stephens is a junior synonym of *Barichneumon sanguinator* [Rossi]); *rufoscutellatus*, p. 205; *scutellarius*, p. 156; *semicaudatus*, p. 206; *sequamensis*, p. 204; *serratularum*, p. 203; *stuttgardiensis*, p. 156; *tricolor*, p. 205 (preoccupied by Schrank, 1776 and Fabricius, 1793); *tristis*, p. 158 (preoccupied by Gravenhorst, 1829); *vallemonitanus*, p. 202; *varius*, p. 209 (preoccupied by Pontoppidan, 1763; Müller, 1776; Gmelin, 1790 [two species] and Fabricius, 1793); *vicus*, p. 204 (preoccupies Boyer de Fonscolombe, 1847; and Cresson, 1864; the disposition of *I. vicinus* B. de F. is to be decided by Dr. Klaus Horstmann in a forthcoming paper; regarding *I. vicinus* Cresson, see Carlson [in press, p. 528]); *wurtemburgicus*, p. 157; *xanthoceros*, p. 208.

Evania: *cynipedis*, p. 154 and fig. 12; *clavicornis*, p. 153 and fig. 7; *podagraria*, p. 152 and fig. 6; *saltatrix*, p. 152 (unnecessary new name for *Vespa minuta* Linnaeus); *subclavata*, p. 153 and fig. 8.

Twenty-one of the Cuvier (1833) names which were validated in *Ichneumon* are junior primary homonyms. Seven of them are senior primary homonyms, and all of the junior homonyms in these cases are presently suppressed in synonymy, are *nomina dubia*, or pertain to species that are little known and of indefinite taxonomic status. Consequently, I have not proposed replacement names for any of them here.

It seems appropriate to point out here that Dalla Torre disregarded primary homonymies in cases for which two or more primary homonyms had been subsequently placed in different genera or families. In most of these cases of primary homonymy, the senior homonyms, at least, were usually validated before 1850 and can, therefore, be found in Sherborn (1902, 1922-1933). Incognizance of the need for consulting Sherborn's volumes is illustrated by two examples (many could be cited) from recent catalogs: 1)

Townes and Townes (1973, p. 236) failed to suppress the name *Ichneumon rubidus* Tosquinet, 1896, which is preoccupied by Rossi, 1794; 2) Shenefelt (1974, p. 1076) failed to suppress *Ichneumon circulator* Gravenhorst, 1807, which is preoccupied by Panzer, 1801. Is it now too late for those who are able to begin using the remarkable compendium which Sherborn completed 45 years ago?

ACKNOWLEDGMENTS

I thank George Steyskal for assistance in interpreting parts of Cuvier's letters. Arnold Menke's constructive criticism of the manuscript is greatly appreciated.

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BREEDING TESTS SUPPORT SYNONYMY OF *APANTELES*
MELANOSCELUS AND *APANTELES SOLITARIUS*
(HYMENOPTERA: BRACONIDAE)

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Abstract.—The satin moth (*Stilpnotia salicis* (L.)) and the gypsy moth (*Lymantria dispar* (L.)) were accidentally introduced into North America. Classical biological control projects led to the introduction of two closely related braconid parasites, *Apanteles solitarius* (Ratzeburg) and *A. melanoscelus* (Ratzeburg), which were recently synonymized. Hybridization tests were conducted to confirm this synonymy with an *A. solitarius* colony collected from the satin moth in British Columbia in 1975 and an *A. melanoscelus* colony collected from the gypsy moth in Connecticut. Mating occurred readily under laboratory conditions, and fertile hybrid female progeny were produced in the F₁ and the backcross generations.

The satin moth (*Stilpnotia salicis* (L.)) and the gypsy moth (*Lymantria dispar* (L.)) are exotic pests and have been the targets of classical biological control programs in North America, but with differing results (Burgess and Crossman, 1927; Howard and Fiske, 1911; Crossman, 1922; Jones et al., 1938; Brown, 1931; Reeks and Smith, 1956; and Dowden, 1962). The effort against the satin moth has been considered successful (McGugan and Coppel, 1962); the current impact of the satin moth in the northeastern United States is insignificant, whereas the gypsy moth remains a significant problem. One approach that might yield improved control of the gypsy moth is genetic improvement of a parasite through hybridization of different geographical strains (Hoy, 1975a and 1975b).

Apanteles melanoscelus (Ratzeburg) was introduced into New England from Europe in 1911. It is primarily a parasite of gypsy moth larvae but occasionally attacks other moths including the satin moth. In 1927, a species of *Apanteles* determined as *solistarius* (Ratzeburg) was also introduced into New England from Europe. This species is primarily a parasite of the satin

moth but is apparently able to develop on the gypsy moth in the laboratory. From the earliest days of the gypsy moth and satin moth programs there has been confusion about the identities of these two *Apanteles* species (Parker, 1935). Specialists in braconid taxonomy have always had difficulty in distinguishing *melanoscelus* from *solitarius*, and in 1974 the two species were synonymized on the basis of morphological characters (Nixon, 1974). Breeding tests either have not been done or, when done (Parker, 1935), did not provide the sex ratios of the progeny which are necessary in arrhenotokous species.

Therefore we hybridized in the laboratory two colonies obtained from geographically distant sources to determine if these colonies were reproductively isolated or whether *solitarius* could provide an additional gene pool for incorporation into a breeding program of *melanoscelus* (Hoy, 1975a and 1975b).

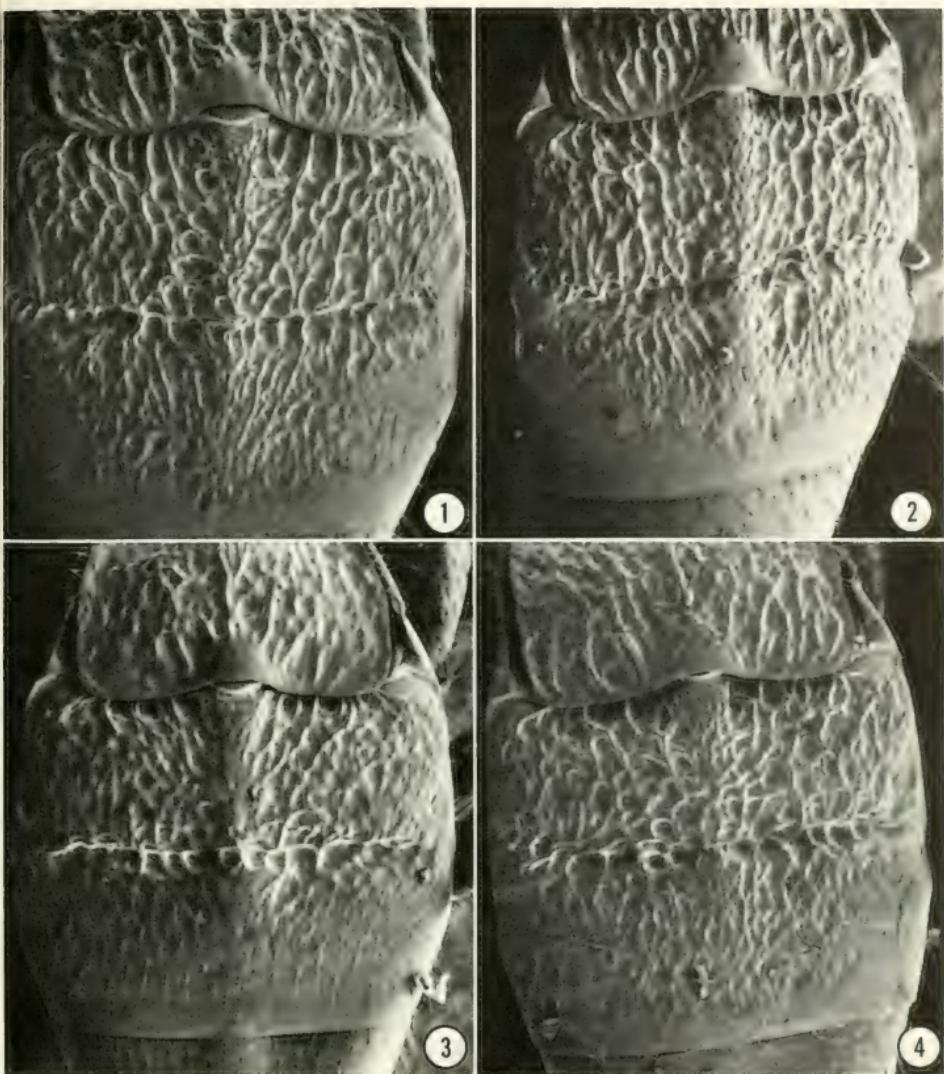
MATERIALS AND METHODS

Colony Sources and Culture Methods.—The breeding tests were conducted with an *A. melanoscelus* colony from Connecticut (CT) collected from and maintained on the gypsy moth. The *A. solitarius* colony (SOL) from the satin moth was received from British Columbia as cocoons in June 1975. After adults emerged, they were allowed to mate and were given gypsy moth hosts, which they readily parasitized. The colony was subsequently maintained on gypsy moth hosts. This colony (SOL) was classified *solitarius* on the basis of its original host and its geographic source. A few overwintering *A. solitarius* cocoons collected by D. E. Leonard from satin moth hosts in Maine provided three females that were also crossed with CT colony males.

Rearing of *A. solitarius* and *A. melanoscelus* was conducted as previously described (Hoy, 1975a), except that 20 to 25 host larvae were reared in 16 oz. untreated paper food cartons with clear plastic lids, rather than in petri dishes.

Breeding Experiments.—Crosses were made with virgin females isolated as cocoons in No. 000 Lilly¹ gelatin capsules. Newly emerged females were placed into 16 oz. containers with honey, water, and males for mating. After two days, females were given hosts at least twice during their lifetime. At least 10 reciprocal crosses were made between the CT and SOL colonies. Data obtained for individual females included the number of progeny and the F₁ sex ratio. Virgin F₁ females were obtained and were used for reciprocal backcrosses. Again, sex ratio and number of progeny were obtained for each female.

¹ The use of trade, firm, or corporation names is for the information and convenience of the reader and does not imply endorsement or approval by the Forest Service or the Department of Agriculture.



Figs. 1-4. Dorsal view of abdominal terga 2 and 3. 1, Specimen determined as *Apanteles solitarius* from gypsy moth in Massachusetts, 1927, yellow hind femur. 2, Specimen determined as *A. solitarius* from satin moth in Massachusetts, 1930, yellow hind femur. 3, Specimen determined as *A. melanoscelus* from gypsy moth in Massachusetts, 1930, black hind femur. 4, Specimen determined as *A. solitarius* from satin moth in Hungary, 1926, yellow hind femur.

Morphological Examinations.—After crosses had been made and progeny obtained, adult CT and SOL parasites and their F₁ and backcross progeny were preserved in 70% alcohol and studied for morphological variability. Traits particularly examined included the color of the hind femur and the degree of sculpturing on the second and third abdominal terga. About 500

Table 1. Hybridization of *Apanteles melanoscelus* and *A. solitarius*.

| Cross No. | Cross ♂ × ♀ | Number of crosses | Number of crosses yielding females | % females from total progeny |
|-----------|--------------|-------------------|------------------------------------|------------------------------|
| 1 | CT × CT | 11 | 9 | 79 |
| 2 | SOL × SOL | 10 | 9 | 54 |
| 3 | CT × SOL | 36 | 14 | 59.8 |
| 4 | SOL × CT | 29 | 12 | 40.4 |
| 5 | CT × SOL/CT | 11 | 5 | 75 |
| 6 | SOL × SOL/CT | 17 | 6 | 61.6 |
| 7 | CT × CT/SOL | 15 | 9 | 55.7 |
| 8 | SOL × CT/SOL | 21 | 21 | 50.4 |

specimens reared from the two hosts in Europe and New England since 1925 were compared with about 150 specimens resulting from our hybridization tests.

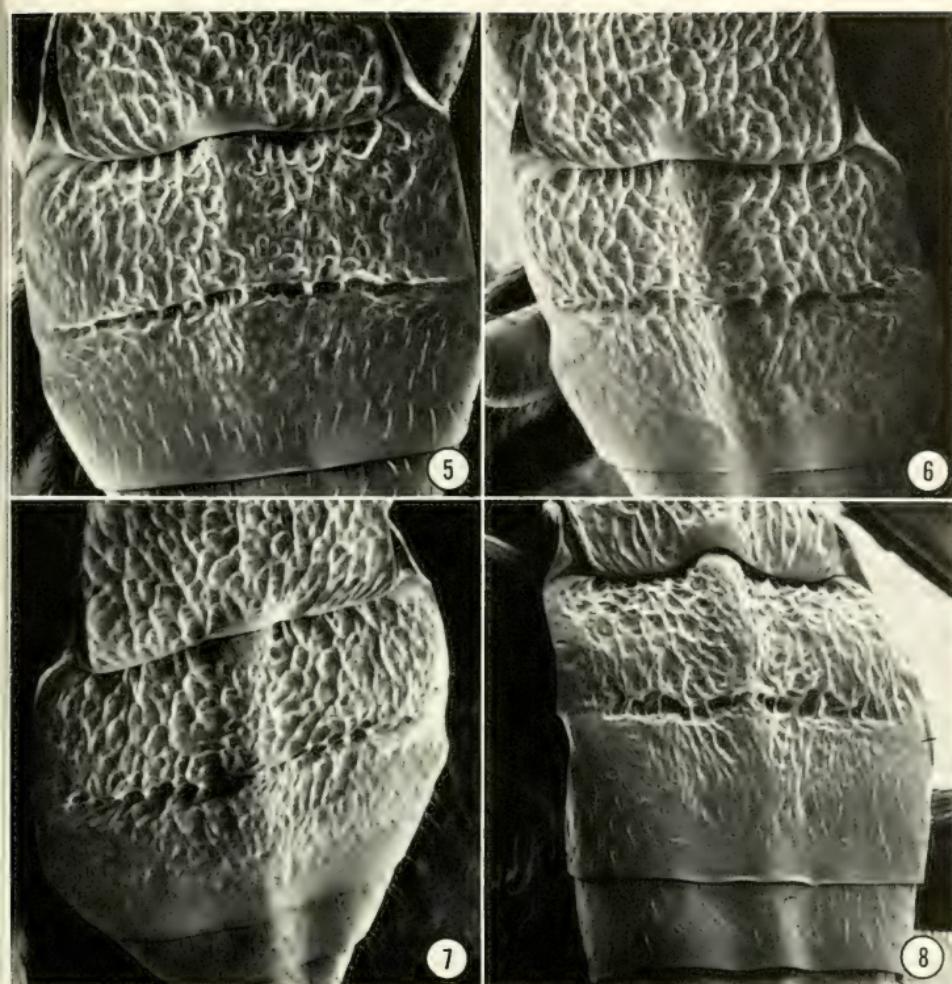
RESULTS

Breeding Tests.—As shown in Table 1, *A. melanoscelus* and *A. solitarius* mated in the laboratory and produced fertile hybrid F_1 females (Table 1, crosses 3, 4). However, the number of crosses in which F_1 female progeny were not produced is significantly different² for the homogametic crosses (crosses 1, 2) compared to the heterogametic crosses (crosses 3, 4), which may indicate some type of genetic or behavioral isolation. Under these conditions, some all-male progenies probably result from a failure of the parent male to inseminate, rather than from hybrid sterility, and the high proportion of females in one of the backcrosses (cross 8) suggests that any genetic or behavioral isolation could be lost quickly.

The three Maine *A. solitarius* females crossed with CT *A. melanoscelus* males yielded at least one F_1 female in each of two crosses, suggesting reproductive compatibility although backcrosses were not done.

Morphological Examinations.—*Apanteles solitarius* and *A. melanoscelus* were both described by Ratzeburg in 1844. He distinguished the two species mainly by the color of the hind femur, that of *solitarius* being "at least light on basal half" and that of *melanoscelus* being "completely or nearly completely black." Obviously, a problem arises immediately as to what name to give a specimen with a partly black (or partly yellow) hind femur. Ratzeburg further distinguished the species by the degree of sculpturing on the second and third abdominal terga, that of *solitarius* being more extensive than *melanoscelus*. The characters used by Ratzeburg have since been shown to be among the most variable and difficult to interpret in the genus *Apanteles*.

² Chi-square test was used.



Figs. 5-8. Dorsal view of abdominal terga 2 and 3. 5, *Apanteles melanoscelus* female from Connecticut colony used in breeding experiments, hind femur pale brown edged with black. 6, *A. solitarius* female from British Columbia colony used in breeding experiments, hind femur pale brown edged with black. 7, F₁ female from SOL female × CT male cross. 8, F₁ female from CT female × SOL male cross.

The color of the hind femur of the specimens we examined ranges from entirely black to entirely yellow, each color variant having degrees of abdominal sculpturing, and there is no correlation between any of these variations and the host on which the specimen had been reared. The degree of difference in sculpturing between *melanoscelus* and *solitarius* is subtle or nonexistent (Figs. 1-8) and there is no correlation between the sculpturing and the hind femur coloration or the host species.

DISCUSSION

In organisms that reproduce sexually, species must be separated by at least one reproductive isolating mechanism, including hybrid inviability or sterility, or by ethological or ecological isolation (Dobzhansky, 1972). The production of viable, fertile F_1 hybrid and backcross females by reciprocal crossing in the laboratory of the British Columbia colony and the CT *A. melanoscelus* colony demonstrates that these geographically isolated populations are not reproductively isolated. Since *A. solitarius*, the satin moth parasite, developed apparently normally in the gypsy moth under laboratory conditions, they apparently are not separated by host specificity. Differences in the production of female progeny (Table 1) suggest that there are some genetically based differences, but these do not appear to have achieved species status.

This study provides additional support for Nixon's (1974) synonymy of *A. melanoscelus* and *A. solitarius*, although future field studies could indicate that *A. melanoscelus* and *A. solitarius* are actually reproductively isolated where both hosts coexist because of their hosts' separate phenologies.

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REVIEW OF THE GENUS *CORTICORIS* WITH DESCRIPTIONS OF
TWO NEW SPECIES FROM MEXICO (HEMIPTERA:
MIRIDAE: ISOMETOPINAE)

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Abstract.—The Nearctic genus *Corticoris* McAtee and Malloch is reviewed and compared to the Palearctic genus *Isometopus* Fieber. The two new species, *Corticoris infuscatus* and *C. mexicanus* from Mexico are described and the species *C. libertus* (Gibson), *C. pulchellus* (Heidemann), *C. signatus* (Heidemann) and *C. unicolor* (Heidemann) are redescribed. Figures of all adult females and known males, male genitalia of *C. pulchellus* and *C. signatus*, and a key to the species are provided.

Work on the New World Isometopinae is scant, even when compared to the relatively few studies on Old World isometopines. Of the 77 species described, only 15 are known from the Western Hemisphere (Eyles, 1971, 1974; Henry, 1977). More recently, however, with the recognition of additional predaceous tendencies in the group (Wheeler and Henry, 1978), new interests have evolved. By sorting undetermined material and soliciting specimens from various institutions, we have discovered several unique isometopines which justly deserve description.

In this paper, we are presenting a review of the genus *Corticoris* McAtee and Malloch, with descriptions of two new Mexican species. A revised key to the species based on females, figures of the known males and their genitalia and illustrations for all adult females are provided.

The following abbreviations are used for institutions cited in this paper: FSCA, Florida State Collection of Arthropods, Florida Department of Agriculture, Gainesville; PDA, Pennsylvania Department of Agriculture, Harrisburg; TAM, Texas A & M University, College Station; TTU, Texas Tech University, Lubbock; USNM, U.S. National Museum of Natural History, Washington, D.C.

Corticoris McAtee and Malloch

Type-species.—*Corticoris pulchellus* (Heidemann), 1908:128.

Description.—Oval to suboval species; females more oval, generally with

conspicuous dorsal markings; males more elongate, usually without conspicuous dorsal markings. Head much broader than long, triangular from frontal aspect slightly narrower than anterior width of pronotum; front broadly rounded, often punctate; posterior margin carinate; vertex wide, greater than or subequal to dorsal width of an eye in most species; eyes large, finely pubescent, somewhat reniform, interoposterior angles often emarginate; ocelli set near inner margin of eyes just in front of emargination. Antennae arising well below and in front of eyes, segment I short, often visible from dorsal aspect, thicker than segment II in females, thinner than segment II in males, segment II longest, curved, gradually thickened to apex, stouter in males, thickly set with dark setae, segments III and IV slender, III longest, combined lengths as long or longer than $\frac{1}{2}$ the length of segment II. Rostrum long, reaching beyond metacoxae to 2nd or 3rd abdominal segment. Pronotum trapeziform, with a distinct but narrow collar, width at base about $2 \times$ length, disc punctate, calli and disc distinctly convex, separated by a transverse impressed line, impression expanded at posterior angles of calli, lateral margins flattened, distinctly carinate, basal margin nearly straight to distinctly emarginate on either side of median line. Mesoscutum set under posterior margin of pronotum. Scutellum triangular or heart-shaped, distinctly raised above hemelytra, middle of basal area often depressed, apex not extending beyond claval commissure. Hemelytra translucent, more opaque in females; broadly rounded, more elongate in males, embolium distinct, wide, somewhat reflexed; cuneus slightly wider than long, membrane entire with 2 closed cells, one large, the other smaller and often indistinct. Legs slender, hind femora saltatorial, tibial spines weakly formed.

Remarks.—Males of the genus *Corticoris*, unlike those of most other mirid genera, are difficult to associate with females and, at this time, associations can be made only by collecting the two sexes together in the field. The known males are slender with a relatively narrow vertex, proportionately large ocelli, thickened antennae and translucent hemelytra which lack definite markings or color patterns; females are more broadly oval with a relatively wide vertex, proportionately smaller ocelli, slender antennae and opaque hemelytra which usually exhibit distinct markings and color patterns.

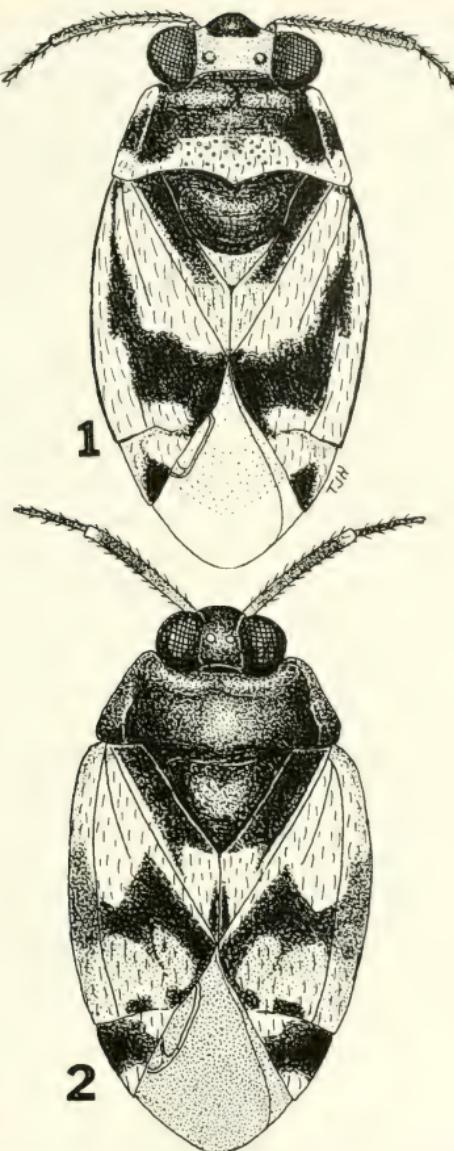
Reuter (1912) was the first to comment that *Isometopus* of Heidemann was distinct from Fieber's *Isometopus*. McAtee and Malloch (1922) also recognized that *Isometopus* of American authors was not congeneric with *Isometopus* Fieber; thus, they proposed the new name *Corticoris* and designated *pulchellus* Heidemann as the type of the genus. Bergroth (1924) objected to the new name *Corticoris*, claiming it to be "half dog-latin, half greek" and offered the new name *Dendroscirtus*. McAtee and Malloch (1924) replied by noting that no nomenclatorial code permitted "such name tinkering" and cited examples of other generic names derived from "bar-

barous languages," including such personal dedications as *Bergrothia* and *Rothbergia*. All subsequent authors have continued using the name *Corticoris*.

Although there has been considerable confusion between *Corticoris* (New World) and *Isometopus* (Old World), these two genera are relatively easy to separate. In *Isometopus* the head is distinctly quadrate from the frontal aspect; the front, tylus and vertex are punctate; the antennae arise well below the eyes on either side of the tylus (1st segment not visible from the dorsal aspect); the pronotum is subquadrate and uniformly punctate (including the calli), the base is deeply emarginate on either side of the median line, the lateral margins are weakly and narrowly flattened; the calli are not raised or separated from the disc by a deeply impressed line; the mesoscutum is depressed medially and raised laterally to meet the base of the scutellum, the scutellum is longer than wide, transversely convex and narrowly tapered apically to the apex of the clavus; the hemelytra are distinctly punctate with only the basal half of the embolium broadly flattened and strongly reflexed.

KEYS TO THE SPECIES OF *CORTICORIS* (FEMALES)

1. Dorsum uniformly dark brown (Fig. 12) *unicolor* (Heidemann)
- Dorsum not unicolorous, hemelytra with extensive pale areas 2
2. Hemelytra largely pale or whitish with only a few small, fuscous points (Fig. 3) *pulchellus* (Heidemann)
- Hemelytra pale or testaceous, but with large fuscous or black areas .. 3
3. Pronotum uniformly shiny black; background color of hemelytra pale or whitish 4
- Pronotum testaceous on posterior ½; background color of hemelytra more testaceous 5
4. Second antennal segment pale on dorsal aspect; vertex as wide or wider than eye; apex of cuneus usually fuscous or black (Fig. 7) *signatus* (Heidemann)
- Second antennal segment paler on basal ½ and apex; vertex much narrower than eye; apex of cuneus usually pale (Fig. 2) *infuscatus* new species
5. Head largely black, venter dark brown to black, scutellum testaceous; posterior margin of pronotum nearly straight (Fig. 11) *libertus* (Gibson)
- Head largely testaceous with only tylus shiny black, venter largely testaceous, scutellum black, only apex testaceous; posterior margin of pronotum distinctly emarginate on either side of median line (Fig. 1) *mexicanus* new species



Figs. 1-2. *Corticoris* spp. 1, *mexicanus*, female habitus. 2, *infuscatus*, female habitus.

Corticoris infuscatus Henry and Herring, NEW SPECIES
Fig. 2

Holotype.—♀, length 2.20 mm, width 1.14 mm, generally black with pale hemelytra, clothed with recumbent, brown to golden pubescence. Head: Length 0.24 mm, width 0.54 mm, shiny black, pale around and between antennal bases, front punctate, basal angles between eyes pale, vertex clothed

with recumbent, golden setae, front with more silvery, sericeous pubescence; vertex 0.20 mm across basal margin of head, 0.14 mm across ocelli; dorsal width of eye 0.18 mm, strongly emarginate behind ocelli, ocelli 0.10 mm apart (measured from middle), 0.10 mm from base of head (measured from middle of ocelli). *Rostrum*: Length about 1.16 mm (bent out from venter), dark brown, 4th segment fuscous, reaching 3rd or 4th abdominal segment. *Antennae*: I, length 0.08 mm, brown, apex paler; II, length 0.48 mm, slender, very gradually enlarged to apex, brown to testaceous, apical $\frac{1}{3}$ fuscous, extreme apex pale; III, length 0.18 mm, slender, fuscous; IV, length 0.14 mm, fuscous. *Pronotum*: Length 0.36 mm, width at base 0.96 mm, black, shiny; disc punctate, calli raised, smooth, shiny; flattened lateral margins pale (base of meson pale on paratype), basal margin on either side of median line emarginate. Mesoscutum and scutellum black, thickly clothed with recumbent, golden setae. *Hemelytra*: Largely pale to distinctly white, clavus fuscous on basal $\frac{1}{2}$ and along inside margin of apical $\frac{1}{3}$, corium fuscous across middle (much like *C. signatus*) (Fig. 7) with 2 fuscous points bordering cuneus, embolium translucent, infuscated, whitish on basal $\frac{1}{3}$; cuneus black, paracuneus and apex pale; membrane fumate, veins paler. *Venter*: Shiny black, ostiolar peritreme yellow to yellowish brown, clothed with recumbent pale to brownish pubescence. *Legs*: Coxae pale to yellowish brown, infuscated through middle; femora fuscous, apex pale to yellowish brown; tibiae brown to testaceous, basal $\frac{1}{3}$ fuscous; tarsi and claws brown to fuscous.

Types.—*Holotype*: ♀, Mexico, Oaxaca, 5.5 mi northeast Huajuapan de León, July 14, 1974, Clark, Murry, Ashe and Schaffner collectors (USNM Type No. 75225). *Paratype*: 1 ♀, Mexico, 4.3 mi northeast Ixtapan, July 6, 1974, Clark, Murry, Ashe and Schaffner collectors (TAM).

Remarks.—Females of *C. infuscatus* most closely resemble *C. signatus* in wing pattern but can be separated by the tendency of the fuscous marks on the corium to fade apically and into the embolium. The narrow vertex, the more elongate form of the eyes and proclivity for the base of the head to overlap the anterior margin of the pronotum suggest a close relationship with *C. pulchellus*.

Corticoris libertus (Gibson)

Fig. 11

Isometopus libertus Gibson, 1917:76.

Dendroscirtus libertus, Bergroth, 1924:8.

Corticoris libertus, McAtee and Malloch, 1924:79.

Holotype.—♀, length 2.30 mm, width 1.12 mm, generally testaceous with fuscous on the head, pronotum and hemelytra; clothed with recumbent pale setae. *Head*: Length 0.26 mm, width 0.72 mm, fuscous, pale or testaceous between eyes through ocelli and through antennal bases; front clothed with

silvery, silky pubescence; vertex across ocelli 0.26 mm, across posterior margin 0.36 mm; dorsal width of eye 0.23 mm; ocelli 0.18 mm apart, 0.16 mm from posterior margin of head. *Rostrum*: Length 1.26 mm, fuscous, reaching to 3rd abdominal segment. *Antennae*: I, length 0.10 mm, fuscous; II, length 0.54 mm, fuscous, apex pale; III and IV broken. *Pronotum*: Length 0.40 mm, width at base 0.98 mm, fuscous, testaceous on posterior $\frac{1}{2}$, lateral margins straight, basal margin nearly straight, weakly indented on either side of median line. Calli and disc separated by deeply impressed line, calli raised, shiny, smooth, disc black punctured; mesoscutum fuscous, scutellum shiny, testaceous, basal $\frac{1}{2}$ slightly more brown (scutellum uniformly testaceous in Arizona specimen), median area depressed, weakly rugose. *Hemelytra*: Shiny, testaceous, apical $\frac{1}{3}$ of corium and narrow area through apical $\frac{1}{3}$ of embolium fuscous, clothed with recumbent, golden setae; cuneus fuscous, paracuneus pale or testaceous; membrane fumate (darker than in *C. unicolor*). *Venter*: Shiny, fuscous to black, ventral margin of procoxal cleft pale, ostiolar peritreme fuscous. *Legs*: Fuscous, apices of femora and tibiae pale; tarsi and claws fuscous.

Specimens Examined.—Arizona: 1 ♀, Richfield, 8-7-1902 (USNM). New Mexico: 1 ♀ (holotype), Las Vegas HS, 14-8, Barber and Schwarz colls., USNM Type No. 21592.

Remarks.—McAtee and Malloch (1924) suggested that *C. libertus* might be a color form of *C. unicolor*. After closely remeasuring and comparing the holotype and one additional specimen of *C. libertus* with *C. unicolor* and other members of the genus, we find *C. libertus* distinct.

Corticoris libertus can be separated from *C. unicolor* by the largely testaceous dorsum (including the scutellum), the fuscous apical $\frac{1}{3}$ of the corium, the darker membrane and the more slender form. This species is most similar to *mexicanus* but may be separated by the darker membrane, the uniformly fuscous venter, the largely fuscous head and legs, the more deeply punctured pronotal disc and the nearly straight basal margin of the pronotum.

Corticoris mexicanus Henry and Herring, NEW SPECIES
Fig. 1

Holotype.—♀, length 2.24 mm, width 1.10 mm, generally testaceous and distinctly marked with black, clothed with pale to golden pubescence. *Head*: Length 0.26 mm, width 0.66 mm, testaceous, impunctate, tylus and area between antennal bases and eyes shiny black, front and vertex set with silvery recumbent setae; vertex 0.28 mm across ocelli, 0.32 mm across posterior margin; dorsal width of eye 0.20 mm; ocelli 0.18 mm apart, 0.08 mm from posterior margin. *Rostrum*: Length about 1.04 mm, testaceous, apical segment fuscous, reaching 2nd or 3rd abdominal segment. *Antennae*: I, length 0.10 mm, fuscous, apex pale; II length 0.56 mm, brown to fuscous on ventral aspect, pale or testaceous on dorsal aspect, curved and gradually enlarged to

apex; III, length 0.18 mm, fuscous; IV, length 0.14 mm, fuscous. *Pronotum*: Length 0.40 mm, width at base 0.92 mm, anterior margin and lateral margins straight, basal margin strongly emarginate on either side of median line, disc punctate; testaceous, calli and a wide vitta extending back on either side of disc shiny black, dark areas clothed with silvery, silky pubescence. *Mesoscutum* black, scutellum shiny black, apex testaceous. *Hemelytra*: Pale to testaceous, clavus fuscous, pale along corial margin and apical $\frac{1}{3}$, embolium wide, largely fuscous along subcostal vein and across apical $\frac{1}{2}$ of corium; cuneus translucent, inside $\frac{1}{2}$ fuscous, paracuneus testaceous; membrane and veins smoky or fumate. *Venter*: Largely testaceous, pleura black, testaceous posteriorly and along hind margin of coxal cleft, sternum and anterior margins of abdominal segments fuscous. *Legs*: Largely pale to testaceous, coxae pale, bases lightly infuscated; femora pale, apical $\frac{1}{3}$ with a broad fuscous ring; tibiae brown, darker on basal $\frac{1}{2}$, tarsi and claws brownish.

Type.—Holotype ♀, Mexico, Oaxaca, 3.2 mi S. of Ocotlan, July 20, 1974, Clark, Murray, Ashe and Schaffner collectors (USNM Type No. 75226).

Remarks.—*Corticoris mexicanus* is most similar to *C. libertus* but can be separated by the testaceous head with the fuscous tylus, the distinctly emarginate basal margin of the pronotum, the black scutellum having only the apex pale, the largely testaceous venter and the more finely punctured pronotal disc.

Corticoris pulchellus (Heidemann)

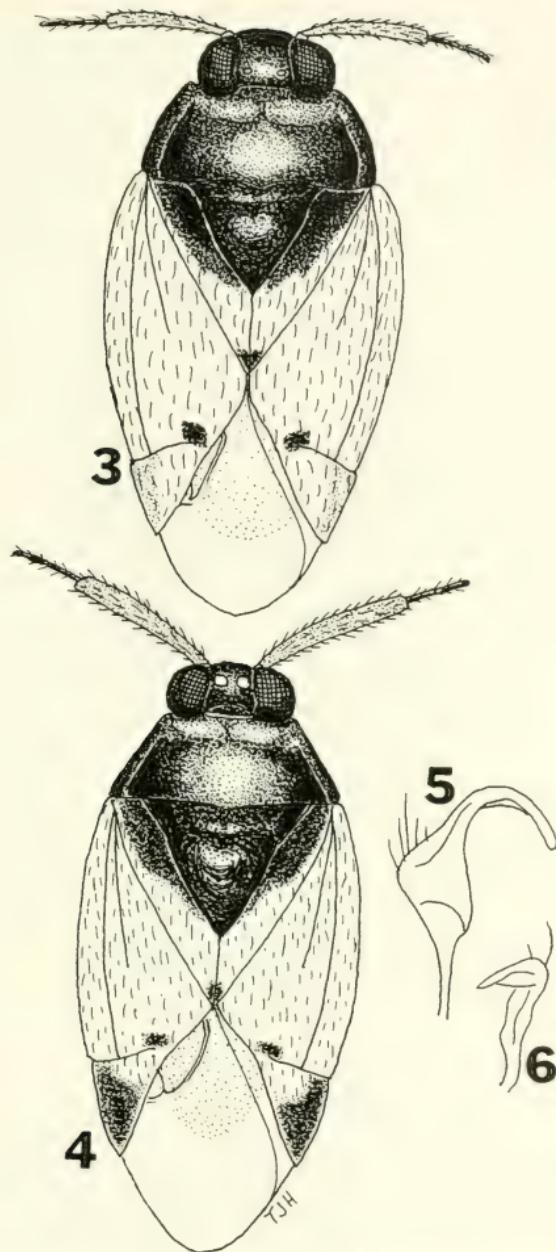
Figs. 3–6

Isometopus pulchellus Heidemann, 1908:128.

Corticoris pulchellus, McAtee and Malloch, 1922:95.

Dendroscirtus pulchellus, Bergroth, 1924:8.

Female.—Length 2.30 mm, width 1.18 mm, suboval, more slender than *C. signatus*, head and pronotum dark with hemelytra pale. *Head*: Length 0.22 mm, width 0.56 mm, shiny black, front finely punctate, clothed with suberect black to brown setae; posterior margin largely overlapping anterior margin of pronotum; vertex 0.18 mm across ocelli, 0.20 mm across posterior margin; dorsal width of eye 0.16 mm, distinctly emarginate behind ocelli; ocelli 0.10 mm apart, 0.10 mm from posterior margin of head. *Rostrum*: Length about 1.04 mm, pale, segments 3 and 4 brown, reaching 3rd abdominal segment. *Antennae*: I, length 0.10 mm, black, not visible from dorsal aspect; II, length 0.54 mm, apical $\frac{1}{3}$ pale, sometimes with a fuscous annulus; III, length 0.16 mm, fuscous; IV, length 0.14 mm, fuscous. *Pronotum*: Length 0.40 mm, width at base 0.96 mm, shiny black, disc finely punctate, calli smooth, shiny, lateral margins weakly rounded, base weakly emarginate on either side of median line, set with fine recumbent, brown setae. Mesoscutum and scutellum shiny black, middle and base of scutellum somewhat depressed, middle weakly rugose. *Hemelytra*: Opaque white to off-white, basal $\frac{1}{2}$ and extreme apex of clavus black, a black spot at apex of corium just above paracuneus,



Figs. 3-6. *Corticoris pulchellus*. 3, Female habitus. 4, Male habitus. 5, Left paramere, lateral view. 6, Right paramere, lateral view.

cuneus pale; membrane opaque white, veins distinct. *Venter*: Shiny black, ostiolar peritreme and abdominal segments invaded by white, especially genital segments. *Legs*: Coxae pale or white, base lightly infuscated; femora pale or white; tibiae testaceous, paler apically; tarsi and claws testaceous.

Male.—Length 2.44 mm, width about 0.92 mm (wings spread); very similar to females in color and markings, except for the fuscous cuneus. As in all *Corticoris* males, the general body form is longer but more slender, the head is more slender, the eyes and ocelli are proportionately larger than in females, and the antennae are considerably more thickened. *Head*: Length 0.20 mm, width 0.56 mm; vertex across ocelli 0.18 mm, across posterior margin 0.22 mm; dorsal width of eye 0.18 mm; ocelli 0.12 mm apart, 0.06 from posterior margin. *Rostrum*: Length about 0.98 mm (bent). *Antennae*: I, length 0.08 mm; II, length 0.64 mm, apical width about 0.08 mm, pale to testaceous, apical ring indistinct, thickly pubescent; III, length 0.12 mm; IV, length 0.14 mm. *Pronotum*: Length 0.38 mm, width at base 0.92 mm.

Specimens Examined.—Illinois: 1 ♀, Pulaski, June 28, 1909, cypress swamp, W. L. McAtee collection (USNM). New York: 1 ♀, Long Island (USNM). Pennsylvania: 1 ♀, Bedford Co., Aug. 24 (USNM); 3 ♀, State College, Centre Co., Aug. 5, 1975, D. J. Shetlar coll., taken on trunk of sugar maple, *Acer saccharum* (PDA); 1 ♀, State College, Centre Co., Sept. 8, 1976. D. J. Shetlar coll., taken on trunk of sugar maple (PDA); 1 ♂, State College Centre Co., July 13, 1977, A. G. Wheeler, Jr. coll. on trunk of *Acer saccharum* (PDA). Virginia: ♀ (holotype), Falls Church, Aug. 2, N. Banks collection, USNM Type No. 11368; 2 ♀, same data as holotype, July 27 (USNM). West Virginia: 1 ♀, Aurora, Aug. 3, 1904, O. Heidemann (USNM).

Remarks.—*Corticoris pulchellus* can be separated from other *Corticoris* by the black head and thorax and white hemelytra having fuscous markings only at the base and apex of the clavus and apex of corium.

Corticoris signatus (Heidemann)

Figs. 7–10

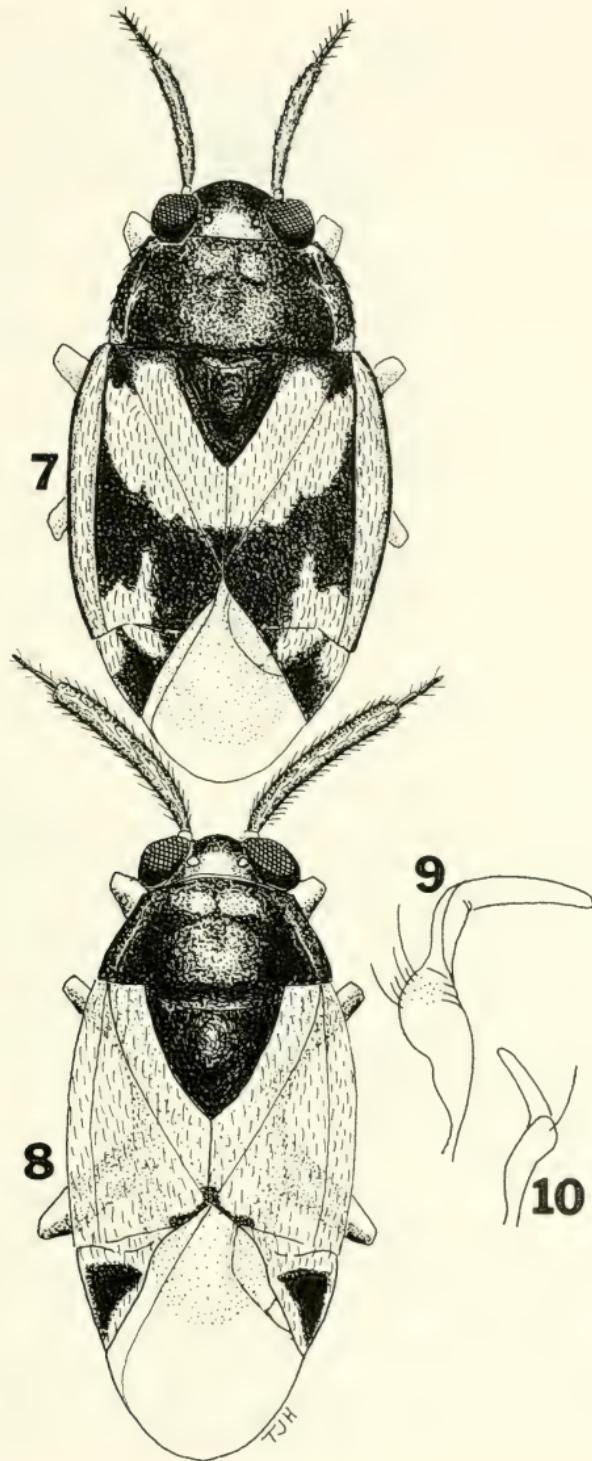
Isometopus signatus Heidemann, 1908:129.

Dendroscirtus signatus, Bergroth, 1924:8.

Corticoris signatus, McAtee and Malloch, 1924:79.

Holotype.—♀, length 2.24 mm, width 1.10 mm, generally black, suboval species, with fuscous on white hemelytra, clothed with erect and suberect pale pubescence. *Head*: Length 0.24 mm, width 0.64 mm, black, shiny, area between and posterior to ocelli pale, front punctate; vertex 0.26 mm across

Figs. 7–10. *Corticoris signatus*. 7, Female habitus. 8, Male habitus. 9, Left paramere, lateral view. 10, Right paramere, lateral view.



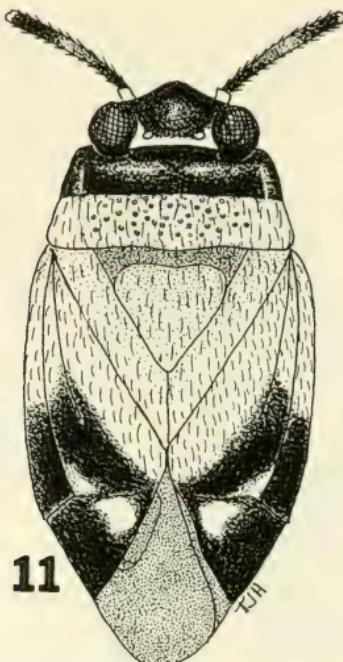


Fig. 11. *Corticoris libertus*, female habitus.

ocelli, 0.34 mm across posterior margin; dorsal width of eye 0.20 mm, emarginate behind ocelli; ocelli 0.18 mm apart, 0.08 mm from posterior margin of head. *Rostrum*: Length about 1.24 mm reaching near 3rd abdominal segment. *Antennae*: I, length 0.10 mm, black, apical $\frac{1}{3}$ pale, visible from dorsal aspect; II, length 0.50 mm, fuscous to black on ventral aspect, dorsal aspect pale; III, and IV broken (both segments black on other specimens). *Pronotum*: Length 0.40 mm, width at base 0.94 mm, shiny black, calli shiny, smooth and raised, lateral margin weakly rounded, anterior and posterior margins nearly straight, posterior angles pale. *Mesoscutum* and *scutellum* shiny black. *Hemelytra*: Opaque white, embolium wide, translucent, lateral edge black-margined; clavus pale, black at base and apex and frequently along inner margin to near apex of scutellum; corium pale, black at base and across middle; cuneus black, pale at base; membrane smoky translucent, veins indistinct. *Venter*: Shiny black, ostiolar peritreme pale. *Legs*: Yellowish, bases of coxae infuscated; femora pale with subapical black band; tibiae brownish, more black on basal $\frac{1}{2}$; tarsi and claws fuscous.

Male.—Length 2.84 mm, width 0.64 mm. *Head*: Length 0.18 mm, width 0.70 mm, coloration much as in females; vertex 0.30 mm across ocelli, 0.34 mm across posterior margin; dorsal width of eye 0.22 mm, ocelli 0.20 mm apart, 0.10 mm from posterior margin of head. *Rostrum*: Length 1.32 mm,

reaching 3rd abdominal segment. *Antennae*: I, length 0.10 mm, black, paler at extreme apex; II, length 0.90 mm, width at apex 0.10 mm, testaceous to fuscous, thickly pubescent; III, length 0.12 mm, fuscous; IV, length 0.10 mm, fuscous. *Pronotum*: Length 0.44 mm, width at base 1.10 mm, shiny black, lateral margins flattened but more narrowly than in females. *Mesoscutum* and *scutellum* shiny black.

Specimens Examined.—District of Columbia: 1 ♀, 29-7, P. R. Uhler collection (USNM). Florida: 1 ♀, Ormond, Mrs. A. T. Slosson, Ac 26226 (FSCA); 1 5th-instar nymph, DeLeon Spring, C. R. Roberts coll., 5-II-1958, citrus paradise (FSCA). Pennsylvania: 1 ♂, 4 ♀, Lancaster Co., Erb Bros. Nurs., June 3, 1976, J. F. Stimmel coll., taken on *Quercus palustris* (PDA); 15 ♂, 15 ♀, Lancaster Co., Erb Bros. Nurs., June 7, 1976, T. J. Henry and A. G. Wheeler, Jr. colls., taken on *Quercus palustris* infested with obscure scale (PDA); 4 ♂, Dauphin Co., Harrisburg, 2301 North Cameron St. (Agr. Bldg.), June 28, 1976, K. McIntosh, coll., taken on *Quercus coccinea* (PDA); 4 ♀, Lancaster Co., Lancaster, June 11, 1977, R. T. Schuh and A. G. Wheeler, Jr. colls., on *Quercus palustris* infested with obscure scale (PDA); 3 ♀, Centre Co., University Park, July 13, 1977, A. G. Wheeler Jr. coll., on trunk of *Quercus borealis* (PDA). Texas: 1 ♀ (holotype) San Diego, 29-4, E. A. Schwarz coll., USNM Type No. 11364; 1 ♀, San Diego, 25-5 (with label *Ancaenhiodes* (*Isometopus signatus* OH. ms. Uhler)) (USNM); 1 ♀, Beeville, 22-4, P. R. Uhler collection (USNM); 3 ♀, Goliad, E. A. Schwarz coll. (USNM); 1 ♀, Victoria, 10-4, E. A. Schwarz coll. (USNM); 1 ♀, Sabinal, IV-1910, Pierce and Pratt coll. (USNM); 1 ♀, Gillespie Co., V-6-1946, D. J. and J. N. Knull colls. (USNM).

Remarks.—*Corticoris signatus* (Fig. 7) closely resembles *C. infuscatus* (Fig. 2) but is separated by the distinct hemelytral markings, broader head, wider vertex and pale femora.

The size of *C. signatus* varies. Specimens from Pennsylvania, especially those of the 1st generation, are larger than those from the southern states (Florida and Texas), yet the two size forms appear conspecific.

Corticoris unicolor (Heidemann)
Figs. 12-13

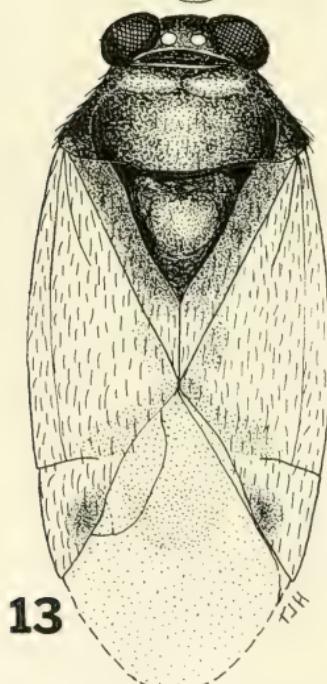
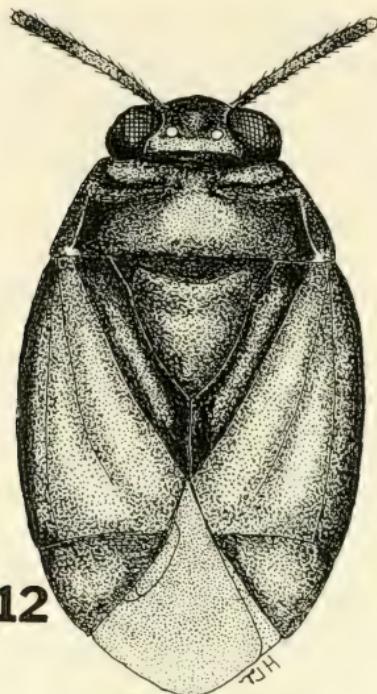
Isometopus unicolor Heidemann, 1908:130.

Myiomma media Gibson, 1917:75.

Dendroscirtus unicolor, Bergroth, 1924:8.

Corticoris unicolor, McAtee and Malloch, 1924:79.

Holotype.—♀, length 2.38 mm, width 1.34 mm; broadly rounded, generally uniformly dark brown, clothed with erect and suberect, golden pubescence. Head: Length 0.24 mm, width 0.70 mm, dark brown, area along posterior margin, between ocelli and compound eyes and area around and between



Figs. 12-13. *Corticoris unicolor*. 12, Female habitus. 13, Male habitus.

antennal bases testaceous, front clothed with recumbent, silvery setae; vertex across ocelli 0.28 mm, across posterior margin 0.40 mm; dorsal width of eye 0.22 mm; ocelli 0.18 mm apart, 0.08 mm from posterior margin of head. *Rostrum*: Length about 1.28 mm, dark brown, reaching 3rd or 4th abdominal segment. *Antennae*: I, length 0.12 mm, dark brown; II, length 0.62 mm, brown darker on apical $\frac{1}{3}$ and base, apex pale; III and IV broken. *Pronotum*: Length 0.42 mm, width at base 1.10 mm, shiny, dark brown, basal angles paler, calli and disc separated by a deeply impressed line, impressed area expanded laterally, lateral margins weakly flattened (less than in other species). Mesoscutum and scutellum shiny, dark brown. *Hemelytra*: Uniformly dark brown, corium somewhat lighter; cuneus dark brown, apical $\frac{1}{2}$ more translucent; membrane fumate to dark translucent brown, veins similarly colored. *Venter*: Shiny, dark brown, sternum lighter brown, ostiolar peritreme testaceous. *Legs*: Coxae light brown or testaceous; femora dark brown, apices pale to testaceous; tibiae fuscous, gradually paler towards apex, apex pale; tarsi and claws brown to fuscous.

Male.—(holotype of *Myiomma media*), length about 2.60 mm, (membrane bent under), width 1.20 mm; form similar to males of *C. pulchellus* and *C. signatus*, general color much as in females (dark brown, not distinctly black as in other species). *Head*: Length 0.18 mm, width 0.72 mm, distinctly dark brown as in females, tylus and sides more reddish brown; vertex 0.24 mm across ocelli, 0.34 mm across posterior margin; dorsal width of eye 0.24 mm; ocelli 0.16 mm apart, nearly touching inside margin of eyes, 0.08 mm from posterior margin of head. *Rostrum*: Broken on holotype (Mexican specimen: Length 1.24 mm, reaching 3rd or 4th abdominal segment). *Antennae*: Broken on holotype (Mexican specimen: I, length 0.10, black; II, 0.88 mm, fuscous to black, extreme apex pale; III and IV broken). *Pronotum*: Length 0.41 mm, width at base 1.00 mm, dark brown, lateral margins flattened, more widely on basal $\frac{1}{3}$, mesoscutum and scutellum dark brown. *Hemelytra*: Translucent brown, darker brown of clavus, apex of corium and cuneus. *Venter*: Reddish brown. *Legs*: Broken, except for reddish-brown front femur (Mexican specimen: Femora brown, hind femora darker, apices pale, tinged with red; tibiae brown, paler apically; tarsi and claws brown).

Specimens Examined.—8 ♀ (including holotype, USNM Type No. 11370), Williams, Arizona, July 27, Barber and Schwarz collectors (USNM). 1 ♂ (holotype of *M. media*, USNM Type No. 21591), Williams, Arizona, Aug. 7, Barber and Schwarz collectors. 1 ♂, 2 ♀, Mexico, Durango, 2 mi N. of Cerro Gordo, 6600', VII-1-1971, O'Briens, Marshall and Brothers coll., taken on *Prosopis* (Mesquite Project) (TTU).

Remarks.—We have examined two females and one male of *C. unicolor* collected together on *Prosopis* (Ward, et al., 1977 as *Corticoris* sp.) and Gibson's type of *Myiomma media* and can now safely agree with McAtee and Malloch (1924) that *M. media* is actually a male of *C. unicolor*.

Corticoris unicolor is one of the easiest *Corticoris* to recognize; the uniformly dark brown color and broad form distinguish this species.

ACKNOWLEDGMENTS

We thank D. E. Foster (TTU), F. W. Mead (FSCA) and J. C. Schaffner (TAM) for kindly lending specimens used in this study; and A. G. Wheeler, Jr. (PDA) for reading the manuscript and making useful comments.

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ISCHYROPTERON BIGOT REVISITED (DIPTERA: TEPHRITIDAE)

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Abstract.—The headless female holotype of *Ischyropteron nigricaudatum* Bigot from near Rio de Janeiro, Brazil, is described in detail; and speculations are made on its generic and supergeneric relationships. It is believed to belong to the trypetine tribe *Adramiini*, which has never been heretofore reported from the New World.

In 1889, J. M. F. Bigot described *Ischyropteron nigricaudatum* from a single female specimen collected in Teresopolis, a suburb of Rio de Janeiro, Brazil (Bigot, 1889a). Apparently believing that his name was preoccupied by *Ischyroptera* Pokorny 1887, he unnecessarily proposed *Calopteromyia* for this monotypic genus later the same year (Bigot, 1889b). The name *Ischyropterum* of authors is either an error or an unjustified emendation.

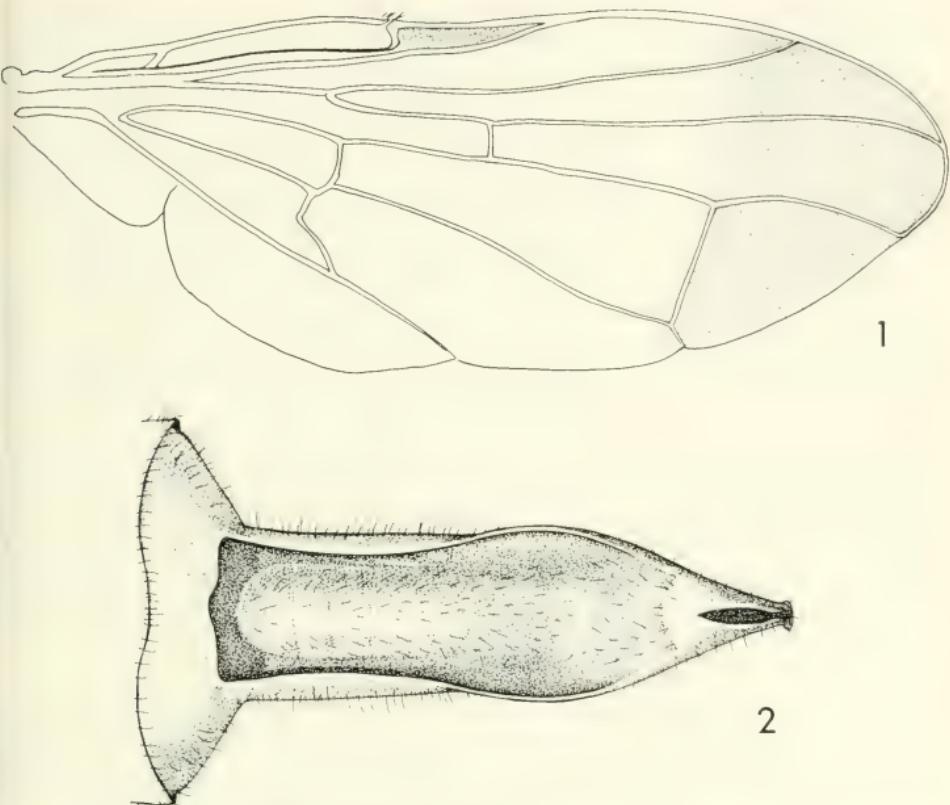
This unusual fly is redescribed here because its relationship with other genera is obscure (see Discussion below). It is hoped that additional specimens may be found, thus making available other characteristics that will relate the species properly to others, either in the Neotropical Region or elsewhere.

Ischyropteron nigricaudatum Bigot

Description.—Female. Head entirely missing, but Bigot describes it as follows (1889a: xxix): "Antennis basi vicinus, segulo tertio oblongo, angusto, apice rotundato, usque ad orem fere elongato, chaeto nudo; fronte conica, prominula, superne macrochaetis, parce sed longe, instructa, facie obliqua et, genis, nudis; haustello modice exerto, labris haud perspicuis; palpis elongatus, apice parum dilatatis . . . antennis sordide fulvis, basi parum infuscatus; palpis haustelloque pallide fulvis; fronte, utrinque, superne, fusco-diffuse uni-notata, et, facie, fulvo pictis, genis, infra oculos, fusca nigro ini-maculatis . . ."

Thorax uniformly yellowish brown, scutum ornamented with dark brown markings as follows: Paired fasciae extending from anterior margin to level of anterior supra-alars, narrowing in region of transverse suture, then widening posterior to suture before terminating, these fasciae separated by a distance equal to the width of one fascia; paired eggshaped spots laterad of

median fasciae, situated between a transverse line through humerals and a point immediately anteriad of transverse suture and separated from median fascia by $\frac{1}{2}$ the width of spot; a 3rd pair of elongate, rounded spots between a point immediately posteriad of transverse suture and one slightly posteriad of dorsocentrals, and a 4th pair of smaller black spots immediately behind wing bases. Scutellum concolorous with thorax, posterior $\frac{1}{3}$ of postnotum darkened. Scapulars not evident; 1 pair humerals, 2 pairs notopleurals, 1 pair anterior supra-alars, 1 pair postalars, 1 pair intra-alars, 1 pair acrostichals, 2 pairs anepisternals, the lower pair about $\frac{2}{3}$ as long as the upper, 1 pair anepimerals, all the foregoing bristles black, shining. Two pairs long shining black scutellars approximately equal in length; scutum and scutellum beset with slender, sharply pointed, black setulae about $0.1\times$ as long as presutural bristle. Pleurae almost entirely devoid of setulae except in a small triangular area immediately below notopleurals and the 6-8 notopleural setulae, which are shorter, colorless. *Wing* (Fig. 1) Length-to-width ratio 2.6:1, appearing longer and wider than usual in the family, the clear membranes with a yellowish cast and the veins in unpatterned areas of disk distinctly brown, 2nd costal cell about $5.6\times$ as long as its greatest width, subcostal cell dark, at least $3\times$ as long as wide, wedge shaped, vein R1 rather straight, no prominent bristles present at subcostal break, vein r-m situated basad of middle of discal cell and pointing to about the middle of subcostal cell, veins r-m and dm-cu almost parallel, base of distal extension of basal cubital cell about $\frac{1}{2}$ as wide as the cell itself, the extension triangular; little longer than its own width; anal lobe rather prominent; pattern comprising an evenly brown area in apical $\frac{1}{4}$ of wing distad of vein dm-cu, its inner transverse margin parallel with that vein, vein R5 haired to level of vein dm-cu above, bare below. *Legs* Unusually long and slender, fore coxa about $\frac{1}{2}$ as long as fore femur, fore femur with a few short dorsal setulae instead of a "comb," a single dark seta posteroventrally on distal $\frac{1}{4}$, fore tibia without outstanding setae; mid femur without outstanding setae, apical $\frac{1}{2}$ of mid tibia slightly enlarged, a short black posterior bristle at middle, 2 long, stout apical bristles; apical $\frac{1}{4}$ of hind femur with one or a pair of black apical bristles and a single black dorsolateral bristle immediately proximad; hind tibia with a small dark anterior bristle immediately beyond middle; tarsomeres 3-5 on all legs dark brown, tarsomere 2 and at least apical $\frac{1}{4}$ of tarsomere 1 on middle and hind legs also dark brown. *Abdomen* Terga and sterna light brown, each slightly darkened on basal $\frac{2}{3}$, abdominal terga 1 and 2 apparently fused, together almost as long as remaining terga, tergum 6 about $\frac{1}{2}$ as long as tergum 5, setulae about as long and numerous as on scutum but light yellowish brown or colorless; ovipositor sheath (Fig. 2) $\frac{1}{2}$ as long as abdomen, with configuration as shown in the figure, flattened condition possibly due to drying, ovipositor not visible through integument of sheath.



Figs. 1-2. *Ischyropteron nigricaudatum*, female. 1, Right wing, dorsal view. 2, Ovipositor sheath, dorsal view.

Discussion.—Among the Neotropical Tephritidae, *I. nigricaudatum* has no close morphological relationships. Its long, broad wings and long, very slender legs are not at all characteristic of other New World fruit flies; and, together with the head characters stated by Bigot, in fact relate it more closely with the Richardiidae than with any other group of flies outside the family. However, G. C. Steyskal (personal communication) states that it is definitely not a richardiid, due principally to the sharply upturned subcostal vein.

Morphologically, *Ischyropteron* somewhat resembles some species of *Euphranta*; but the wing pattern is quite different, the subcostal cell is much longer and narrower, and vein r-m is situated proximad of the middle of the discal cell. In correspondence, D. E. Hardy has suggested that *Ischyropteron* may relate to several genera of Xyphosiini, but most members of that tribe as defined by Hering (1947) have essentially dark wings with yellow or white spots and/or stripes and have quite a different habitus.

Ischyropteron rather closely fits the concept of the tribe Adramiini as discussed by Hardy (1974) in that the body bristles are rather delicate; dorsocentrals, presuturals and katepisternals are not present; the abdomen is long, comparatively narrow and straight sided; and the wing is exceptionally long in comparison to body length. Generically, however, the genus appears to be distinct, differing by at least one character from each of the 8 Oriental adramiine genera discussed by Hardy (1973, 1974) and from each of the 5 known Afrotropical genera.

It is hoped that specimens with heads become available for study. If so, the suprageneric relationships of *Ischyropteron* can be made clear. If in fact this genus is eventually shown to be an adramiine as discussed above, the presence of this tribe in the New World will be recorded for the first time.

ACKNOWLEDGMENTS

I hereby express my gratitude to J. W. Ismay, Hope Department of Zoology (Entomology), University of Oxford, for making the holotype (and only specimen) of *nigricaudatum* available for study. My gratitude is also hereby expressed to D. E. Hardy and G. C. Steyskal, who discussed with me the possible relationships of this species. Ms. Ellen Paige executed the figures.

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**LABOULBENIA FORMICARUM THAXTER (ASCOMYCOTINA:
LABOULBENIALES) ON ANTS (HYMENOPTERA: FORMICIDAE) IN
RALEIGH, NORTH CAROLINA WITH A NEW HOST RECORD¹**

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Abstract.—A survey of ant species on the campus of North Carolina State University was conducted during 1971-73. Several species collected were found to be infested with the Ascomycete fungus *Laboulbenia formicarum* Thaxter. Ants were studied with light microscopy and scanning electron microscopy (SEM). One of the species, *Acanthomyops murphyi* (Forel), represents a new host record for the fungus-ant relationship and SEM micrographs are presented.

The fungus *Laboulbenia formicarum* Thaxter is an ectoparasite of ants in the subfamily Formicinae. Smith (1961) reported that 17 species in five genera have been recorded as hosts. There have been no observed detrimental effects on infected ants which were attributable to the fungus. *Laboulbenia formicarum* was the first species in the genus proven dioecious (Benjamin and Shanor, 1950a). They detailed its development from ascospore germination to mature individuals (Benjamin and Shanor, 1950b). In Raleigh, North Carolina, the fungus was first collected by Z. P. Metcalf on all castes of (*Lasius alienus* Foerster) (=*Lasius niger* var. *americanus* Emery) (Smith, 1928). Recently, the fungus was again encountered in Raleigh during a survey of the various ant species on the campus of North Carolina State University (Nuhn, 1977).

Two species of ants were photographed by Scanning Electron Microscopy (SEM), one of which represents a new host record of the fungus-ant relationship.

MATERIALS AND METHODS

Over 500 collections of ants were made on or adjacent to the campus of North Carolina State University, Raleigh, primarily from September 1971

¹ Paper No. 5691 of the Journal Series of the North Carolina Agricultural Experiment Station, Raleigh, North Carolina. The use of trade names in this publication does not imply endorsement by the North Carolina Agricultural Experiment Station of the products named nor criticism of similar ones not mentioned.

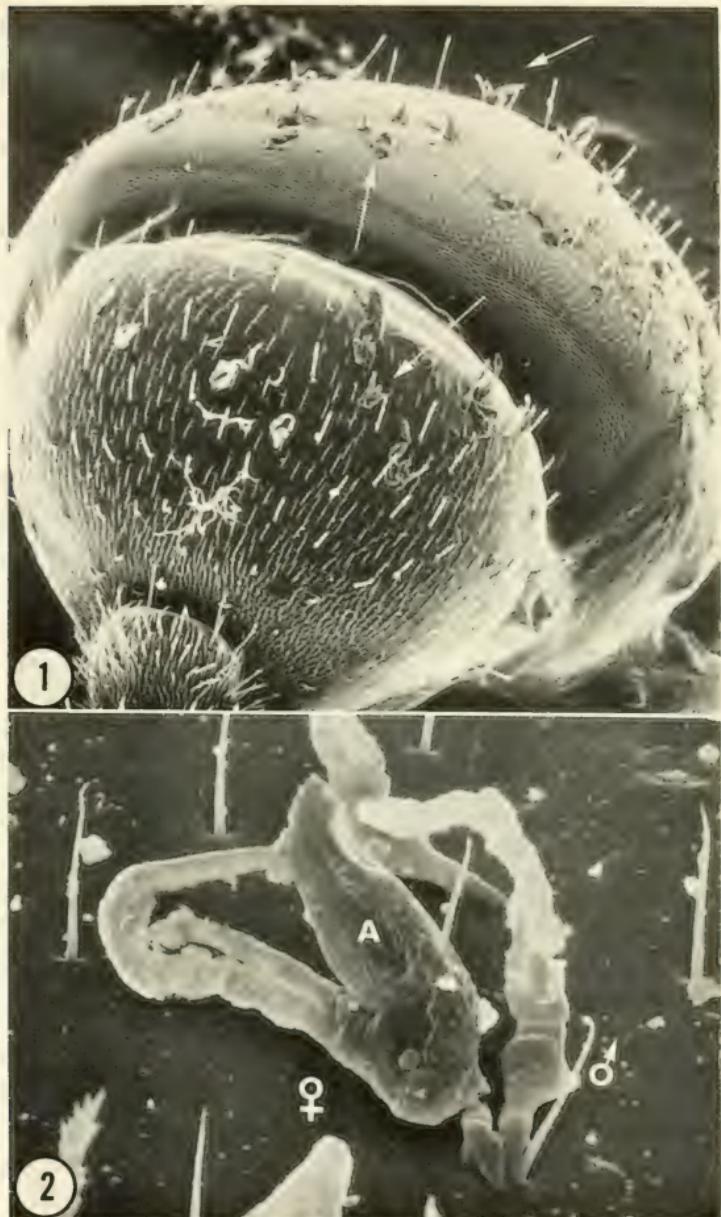


Fig. 1. The abdomen of a specimen of *Acanthomyops murphyi* as seen with SEM. The arrows point to a few of the individual fungal structures of *Laboulbenia formicarum*. (90 \times)
Fig. 2. A close-up view of *Laboulbenia formicarum* on the body of *Acanthomyops murphyi*. The female (♀) portion of the fungus is to the left and the male (♂) portion to the right. Another fungal individual in the early developmental stage is behind this pair. The ascus (A) of the fungus is associated with the female portion. (1,000 \times)

through August 1973, during a study of the species composition of ants in landscaped suburban habitats. Most of the ants were collected with an aspirator and placed in 70% ethyl alcohol; others were obtained with pitfall traps.

Specimens of *Acanthomyops murphyi* (Forel) stored in 70% ETOH were subsequently dehydrated in ethanol and a graded ethanol-Freon series and critical-point dried in Freon 13. The dried specimens were mounted on stubs, coated with gold, and observed and photographed using an ETEC Autoscan microscope.

RESULTS

The fungus *Laboulbenia formicarum* was found on the exoskeleton of four species of ants, representing four different genera. The percent of collections with infested ants for each species was as follows: *Lasius neoniger* Emery 44% (38 of 86 collections); *Formica pallidefulva* Latreille 5 1/4% (1 of 19 collections); *Prenolepis imparis* (Say) 2 1/2% (1 of 40 collections); and *Acanthomyops murphyi* (Forel) 20% (1 of 5 collections). The collection of *Acanthomyops murphyi* represents a new genus and species host record for *L. formicarum*.

Figure 1 shows the fungus-ant relationship as seen with SEM; the abdomen has numerous fungal individuals, as did other ant parts. Figure 2 shows the morphology and dioecious nature of the fungus. The fungal structures are somewhat collapsed, which perhaps occurred while the ants were in 70% alcohol for several years. These represent the first published SEM micrographs of *L. formicarum*.

DISCUSSION

Species of *Acanthomyops* have long been considered as potentially acceptable hosts for *Laboulbenia formicarum* (Smith, 1946). Species of *Acanthomyops* were suspected of being temporary social parasites of the closely related genus *Lasius*, a common host of *L. formicarum* (Wing, 1968). Such a situation would facilitate transfer of the fungus from one host species to another. For example, the fungus has been found on various species in the genus *Formica* and on certain social parasites of *Formica* in the genera *Formica* and *Polyergus* (Smith, 1946).

Of 41 collections of ants infested with *Laboulbenia formicarum*, 38 (93%) were from *Lasius neoniger*. Also, the incidence of fungus within each species was over twice as high for *L. neoniger* as for any other species. This suggests that the fungus may prefer *L. neoniger* over the other acceptable hosts. It would be interesting to establish whether the fungus shows a preference for specific ant species and whether the relative prominence of *Lasius neoniger* in Raleigh affects the infestation rates between different species.

ACKNOWLEDGMENT

We gratefully acknowledge confirmation of the fungus identification by Dr. R. K. Benjamin.

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RECOGNITION CHARACTERS AND DISTRIBUTION RECORDS FOR
SPECIES OF *CONOTRACHELUS* (COLEOPTERA: CURCULIONIDAE)
THAT DAMAGE AVOCADO FRUITS IN MEXICO
AND CENTRAL AMERICA

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Abstract.—Three species of *Conotrachelus* are known or suspected pests of commercially grown avocado fruits in Mexico and Central America: *C. aguacatae* Barber, *C. perseae* Barber and *C. serpentinus* (Klug). These species form part of a poorly known species group. Diagnoses and keys are given for their recognition, and distribution records are summarized.

In recent years, some concern has arisen about importation of avocado fruits into the United States, and field surveys have been made in Mexico to locate possible pest-free areas. Three species of *Conotrachelus* Schoenherr appear to damage commercially grown avocado fruits in Central America, and at least two are of economic importance (Garcia Arellano, 1975). When Barber (1919, 1923) published his comments on these species, their geographic distributions seemed to be allopatric. However, all three are now known to occur in central Mexico. Therefore, diagnostic characters are given for their recognition, and distribution records are summarized.

Specimens of at least a dozen other *Conotrachelus* species, most as yet undetermined, have been submitted as a result of these surveys. However, these species are not closely related to the pest species discussed here, and I have no information to implicate them as avocado pests.

I thank Mike Shannon (APHIS, USDA) for pertinent information, and I thank Wayne Clark (Auburn University), and F. C. Thompson and R. W. Hodges (Systematic Entomology Laboratory), for constructive criticism.

RECOGNITION CHARACTERS

Adults of the avocado pests trace to "group r" in Champion's (1904) key to Central American *Conotrachelus*. Members of this group are distinguished from other *Conotrachelus* by the following diagnosis: Mesosternum and anterior part of metasternum depressed along midline but not forming part of rostral canal, mesosternum not conspicuously binodose; elytra with alternate intervals costate, costae of intervals 3&5 evanescent in anterior 1/3 or 1/2, costae of intervals 7&9 entire; femora clavate, unidentate ventrally.

Group r' includes *C. conicicollis* Champion 1904, *C. incanus* Champion 1904, *C. octocostatus* Champion 1925, *C. sulcipectus* Champion 1904, several apparently undescribed forms, and the avocado pests discussed here. This paper is intended only to facilitate recognition of the avocado pests, as I have seen insufficient material of the other species to justify a revision of this poorly known complex. The three pest species are distinguished from other members of the group by the following diagnosis: Elytra narrow (width/length = 0.64–0.72), widest at humeri, strongly converging posteriad toward apex; pronotal punctures coarse, nearly uniform, interstices lacking smaller punctures; elytral vestiture coarse, long, largely fulvous or brownish (not uniformly pale); striae punctures each with slender, elongate, white scale; beak not more than 1.5 (male) or 1.8 (female) times longer than pronotum; front coxae clearly separated, front and middle coxae with vestiture recumbent. See Barber (1923) for illustrations of male genitalia.

KEY TO THE AVOCADO-EATING SPECIES OF *CONOTRACHELUS*

1. Abdominal sterna 3&4 coarsely punctate; pronotum strongly transverse (length/width less than 0.80), strongly constricted in front, conical; beak with antennal insertion near apical 0.30–0.35 in male, near apical 0.40–0.45 in female; front coxae narrowly separated. Florida, West Indies, Mexico, Central America, South America
..... *serpentinus* (Klug)
- Adbominal sterna 3&4 finely punctate; pronotum less transverse (length/width more than 0.80), strongly constricted in front or not, conical or subconical; beak with antennal insertion at or beyond apical 0.25 in male, at or beyond apical 0.40 in female; front coxae widely separated. Mexico, Central America 2
2. Beak with antennal insertion near apical 0.18–0.20 in male, near apical 0.25 in female; uncus of male front tibia simple, acute; uncus of male hind tibia short, dentate; pronotum feebly constricted in front, conical. Mexico *aguacatae* Barber
- Beak with antennal insertion near apical 0.25 in male, near apical 0.35–0.40 in female; uncus of male front tibia dilated, truncate or bifid; uncus of male hind tibia short, blunt, recurved; pronotum strongly constricted in front, conical or subconical. Mexico to Costa Rica. *perseae* Barber

Conotrachelus aguacatae Barber 1923. This species damages avocado in central Mexico. MEXICO: Coahuila (Ciudad Acuña, Saltillo), Jalisco (Huascata), Michoacan (Uruapan), Nayarit (Tepic), Queretaro (Queretaro).

Conotrachelus perseae Barber 1923. Described as a pest of avocado in Guatemala, this species is now known to range from central Mexico (see also Garcia Arellano, 1975) southward to Costa Rica. Costa Rican speci-

mens differ by having a more conical pronotum, male tibial uncus truncate rather than bifid, beak in both sexes relatively slender and elongate, and male phallus more broadly rounded apically—characters here regarded as geographic variation. Study of additional material may indicate that this form is a distinct species. MEXICO: Michoacan (Uruapan). GUATEMALA: Alta Verapaz (Coban), Guatemala (Guatemala). HONDURAS: Morazan (Zamorano). COSTA RICA: San Jose (San Jose, San Pedro de Montes de Oca).

Conotrachelus serpentinus (Klug) 1829. [*Balaninus serpentinus* Klug 1829 = *Conotrachelus serpentinus* Germar of Boheman 1837, a secondary usage according to Kuschel (1955); *C. ventralis* LeConte 1878 = *C. serpentinus*, according to Barber (1919) and other authors.] Barber (1919) suggested that distribution records cited by Champion (1904) might have been based on misidentifications, but Champion's description of this species and the records given here suggest that his identifications and distribution records were correct. Not generally regarded as a pest of commercial avocado, this species attacks various native species of *Persea* (Barber, 1919); however, the Queretaro specimen cited below was taken from avocado along with specimens of *C. aguacatae*. Therefore, this species is here regarded as at least a potential avocado pest. In addition to the records cited from Mexico, I have seen specimens from Florida, the Bahamas, Cuba, and Haiti; see Champion (1904) for additional distribution records. MEXICO: Queretaro (Queretaro), Veracruz (Tampico), Yucatan (Yaxcopolil).

There probably are many additional *Persea*-eating *Conotrachelus* species belonging to this complex. I have seen three apparently undescribed ones from Central America that closely resemble *C. perseae*. One female (Turrialba, Costa Rica) differs by having a very long beak, about 2.0 times longer than the pronotum and extended nearly to the apex of ventrite 1. Two females (San Jose, Costa Rica) have the front coxae nearly contiguous, the front and middle coxae with tufted, suberect vestiture. Two males (Barro Colorado Island, Panama, and Hermitage Res., Jamaica) have the front coxae narrowly separated, front and middle mucrones normal, and the hind tibial mucrone greatly enlarged.

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**PYGMEPHORUS ATHIASAE WICHT: A REDESCRIPTION OF
THE HOLOTYPE (ACARI: PYEMOTIDAE)**

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Abstract.—*Pygmephorus athiasae* Wicht, 1970 is redescribed; and illustrations are given for the dorsal and ventral surfaces of the body and legs I–IV of the female.

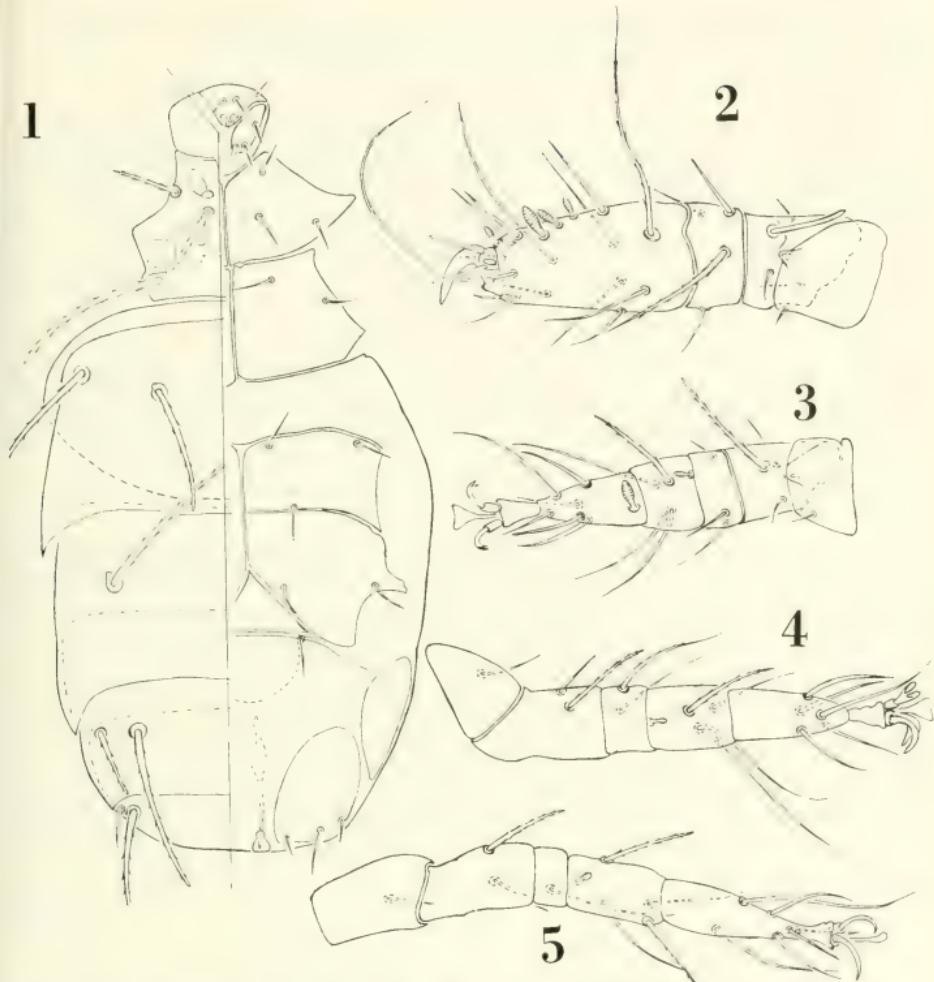
I examined the holotype of a mushroom mite, *Pygmephorus athiasae* Wicht while studying *Pygmephorus* species of the Western Hemisphere. Wicht's (1970) description and illustrations do not provide enough details of the morphological characteristics to allow for recognition of the species. Because of the economic importance of *Pygmephorus* mites to the mushroom industry (Hussey et al., 1969) and because females of several pygmephorids are dimorphic (Rack, 1974; Cross and Moser, 1975; Moser and Cross, 1975; Kosir, 1975; Smiley and Moser, 1976), it is essential to illustrate and describe all species so that accurate determinations can be provided. The higher classification of the Pyemotoidea and Pygmephoidea (Mahunka, 1970) requires further study because of the confusion caused by the occurrence of dimorphic females and because some taxa overlap. Accurate descriptions and illustrations are needed to design a workable classification.

Pygmephorus athiasae Wicht
Figs. 1–5

Pygmephorus athiasae Wicht, 1970:266.

Holotype Female.—USNM, collected at Citeaux, France, date unknown, by Madame C. Athias; no other data available.

Female.—Gnathosoma oval, wider than long, dorsoventrally with 2 pairs of simple setae. *Dorsum*: Propodosomal shield subrectangular, longer than wide, lightly punctate; with 3 pairs of conspicuous spiculate setae, anterior and medial pairs subequal, posterior pair longest, more than 2× as long as others. Pseudostigmatic organ globelike, without spicules. Hysterosoma lightly punctate with conspicuous spiculate setae; 1st (anterior) tergite largest, with lateral and medial pair of spiculate setae; 2nd tergite with pair of medial spiculate setae; longer than medial setae of 1st tergite; 3rd tergite with medial and lateral pairs of spiculate setae, lateral pair about ½ length



Figs. 1-5. *Pygmephorus athiasae*, female. 1, Dorsal and ventral view. 2, Right leg I. 3, Right leg II. 4, Right leg III. 5, Right leg IV.

of medial pair; 4th tergite with lateral setae short and simple, medial setae subequal in length to medial setae of 3rd tergite. Venter: Posteromedial plate between legs IV wider than long, spade shaped distally, with pair of simple setae. Coxal setal formula: 3-2-3-2. Leg I robust, with strong, distally recurved claw. Setation on femur, genu, and tibiotarsus I: 3+1 rod-like seta -4-12+4 eupathidia +4 solenidia; leg II with bifurcate claws, setation on femur, genu, tibia and tarsus: 3-3-4+1 small solenidion -6+1 solenidion; leg III with bifurcate claws, setation on femur, genu, tibia, and tarsus: 2-2-4+1 small solenidion -5; leg IV with uncinate claws and not enlarged, setation on femur, genu, tibia, and tarsus: 2-1-4+1 small so-

lenidion —6. Posterior plate with 3 pairs of terminal setae. Body 326 μ long, 147 μ wide.

Male.—Unknown.

Distribution.—This species is known only from the type-locality. According to Wicht (1970) it is found in various places in mushroom houses and actually on mushrooms.

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**SPHECID WASPS OF THE WORLD: ERRORS AND OMISSIONS
(HYMENOPTERA: SPHECIDAE)**

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Abstract.—Errors of omission and commission in the book "Sphecid Wasps of the World" (1976) by Bohart and Menke are corrected.

Since our book "Sphecid Wasps of the World" was published in 1976, various mistakes and omissions have been found. Fortunately, most of these are minor spelling errors, incorrect dates or improper gender endings on species names. The serious errors include overlooked species names, incorrect tribal spellings, wrong gender determinations for a few genera, mistakes in key couplets and omissions of several lines of text. With the realization that we dealt with over 14,000 names the errors are few, but they are regretted nonetheless, especially because so many people painstakingly proofed galley copy. We would appreciate being informed of any additional mistakes or omissions, especially any names published before 1976 that were not included in the book. Hopefully, all errata can be inserted in future editions.

We would like to thank the various people that have brought some of these items to our attention, but we want to thank especially George Steyskal, Systematic Entomology Laboratory, USDA, SEA, AR, Washington, D.C. and H. D. Cameron, Dept. of Classical Studies, University of Michigan, for checking scientific names in the book for grammatical correctness. Some of their revelations involve changes in spelling and gender which upset traditional usage.

Abbreviations used below are: RC = right column, LC = left column, MC = middle column, L = line. The page number is given first in each citation. Repetitive changes are listed in groups to save space.

TRIBAL NAMES

The following spellings should be adopted:

Sceliphronini for Sceliphronini
Prionychina for Prionyxina

Trypoxylini for Trypoxylonini
 Aphilanthopini & -ina for Aphilanthopsini & -ina

MASS CHANGES OF DATES, ETC.

Change 1896 to 1897a as follows: 28, LC, L 35; 38, LC, L 13; 40, RC, L 22; 41, RC, L 12; 42, RC, L 15; 43, LC, L 7; 44, LC, L 25; 45, LC, L 44; 51; 46, LC, L 46; 46, RC, L 24; 48, RC, L 55; 52, RC, L 62; 54, RC, L 37; 216, LC, L 11; 217, RC, L 14; 222, LC, L 13, 30; 308, LC, L 18; 350, LC, L 21; 352, RC, L 50; 607, LC, L 24.

Change 1896 to 1897 as follows: 42, RC, L 17, 21; 45, LC, L 33, 45, 52; 46, LC, L 48; 46, RC, L 25; 220, RC, L 28; 322, RC, L 23.

Change 1864 to 1863 as follows: 41, RC, L 10–11, 13; 106, RC, L 22; 164, LC, L 45; 186, RC, L 38; 245, RC, L 33; 247, RC, L 29; 585, LC, last L.

Change 1838 to 1839 as follows: 43, RC, L 16–17, 20; 55, RC, L 1, 3–5; 134, RC, L 12; 144, LC, L 43; 153, LC, L 58; 245, RC, L 52; 256, LC, L 53; 267, LC, L 26; 273, RC, L 17; 274, LC, L 8; 275, RC, L 19; 291, LC, L 16–17; 367, RC, L 54; 368, LC, L 45; 521, LC, L 16; 526, RC, L 3; 527, RC, L 14; 545, RC, L 46, 49; 547, LC, L 31; 549, LC, L 21, 39; 564, RC, L 34; 566, LC, L 44; 566, RC, L 39; 578, RC, L 48; 580, RC, last L; 582, LC, L 16, 18–19; 587, RC, L 42; 588, LC, L 8; 588, RC, L 5.

Change 1893 to 1894 as follows: 213, LC, L 13; 244, LC, L 3, 6; 258, RC, L 16, 22, 26; 259, LC, L 21; 259, RC, L 42, 45–46; 265, LC, L 13; 272, LC, L 37, 45, 50; 272, RC, L 2–5, 9; 273, LC, L 37, 43; 273, RC, L 33; 274, LC, L 3; 275, LC, L 13–14, 17, 36; 275, RC, L 37, 39; 276, RC, L 25; 277, LC, L 19, 27, 41; 299, LC, L 26; 311, LC, L 12, 33; 496, RC, L 3.

Change 1858 to 1857 as follows: 45, RC, L 33–34, 38; 74, LC, L 4; 78, RC, L 23; 106, RC, L 21; 114, RC, L 13; 172, RC, L 34; 237, RC, L 16, 50; 248, LC, L 34; 264, LC, L 6; 336, RC, L 7; 337, LC, L 13; 410, LC, L 14; 531, RC, last L.

Change 1895 to 1896 as follows: 53, LC, L 34; 501, LC, L 41; 503, LC, L 24, 55; 506, RC, L 35; 508, LC, L 6; 516, RC, last L; 517, LC, L 1; 520, RC, L 52, 59; 521, LC, L 12.

Delete "new synonymy by R. Bohart" and "new status by R. Bohart" as follows (see Bohart and Grissell, 1975): 564, RC, L 9–10, 42–45, 47; 565, LC, L 28–29, 33–36; 565, RC, L 23, 26–28; 566, LC, L 3–4, 6–9, 19–20, 26–27, 56–59; 566, RC, L 14–15, 57–58; 567, RC, L 1–3; 576, RC, L 23–24; 577, RC, last two L; 578, RC, L 16; 579, LC, L 42; 580, RC, L 34–35, 56–57; 581, RC, L 5, 45–46; 584, RC, L 33, 35; 586, RC, L 23–24; 588, RC, L 57; 591, RC, L 29–30; 592, LC, L 5–7, 9; 592, RC, L 3.

KOHL "1896"

F. Kohl's "Die Gattungen der Sphegiden" which has always been cited as published in 1896 actually appeared in early 1897, probably in March. The major effect of this discovery is that the citation of *Nitelopterus* Ashmead

must be changed as follows: 45, LC, L 31 should read: (*Nitelopterus*) Ashmead, 1897:22. Delete L 34-37.

FABRICIUS "1781"

Fabricius' "Species Insectorum" bears the date 1781 on the title page, however, the work was published in 1782 according to the author in his autobiography (see Hope, 1847). The only consequence of this for our book is that 1781 should be changed to 1782 (species names on pp. 77, 103, 105, 106, 115, 139, 291, 401, 427, 526 & 566).

ERRATA SHEET

- L 35: *Oryttus* is correct (p. 485)
- L 50: delete entire entry (p. 655)
- L 52: *jamaicensis* is correct (p. 661)

FIGURE 15

Letters used in legend were not placed on the figures. They apply left to right, top to bottom.

TEXT

(page number is first entry)

- | | |
|---------------|--|
| 5, LC, L 20: | New Zealand not Nigerian |
| 6, LC, L 1: | <i>montana</i> is correct |
| 9, LC, L 32: | <i>Deinomimesa</i> is correct |
| 28, LC, L 45: | 1894e is correct |
| 31, RC, L 32: | add parenthesis after <i>Psammaletes</i> |
| 33, RC, L 15: | 7,633 is correct |
| RC, L 17: | 84 is correct |
| RC, L 30: | <i>Tachytes</i> —265 is correct |
| 33, Table 3: | change figures as indicated below: Larrinae 2,070 |
| | <i>Bembix</i> —328 |
| | <i>Philanthinae</i> 1,097 + (2) |
| | <i>Pemphredoninae</i> 717 |
| | <i>Cerceris</i> —857 + (1) |
| | <i>Psenulus</i> —122 |
| 38, LC, L 8: | courtesy is correct |
| 39, LC, L 56: | delete "recte kirbyi" |
| RC, L 3, 14: | <i>kirbii</i> is correct |
| 41, RC, L 59: | <i>africanum</i> is correct |
| 43, LC, L 13: | <i>reticulatus</i> is correct |
| LC, L 28, 39: | <i>appendiculatus</i> is correct |
| LC, L 60: | <i>argentatus</i> is correct |
| RC, L 41: | 1894a is correct |
| 44, RC, L 59: | 1893b is correct |

- 45, LC, L 53, 54, 55: these should be indented to align with lines
61–63
- RC, L 5: 1893b is correct
- 50, RC, L 33: *Ceratocolus* is correct
- 52, LC, L 31, 32: 1894a is correct
- 54, RC, L 4: 1897b is correct
- RC, L 5: 1897 is correct
- RC, L 14–15: delete “new synonymy by Menke and Pulawski”
(see Kazenas, 1974)
- 59, LC, L 63: change (Astatinae) to (Astatinae and Xenosphe-
cinae)
- RC, L 2: change 19 to 20
- RC, L 5–7: delete “, midtibia with two apical spurs in both
both sexes”
- RC, L 10–12: delete “, females with two midtibial spurs but
males with none . . . Dinetini, p. 251” and
substitute: “. . . 19”
- RC, insert the following revised couplet after L12:
19. Forewing with three submarginal cells, episternal sulcus
essentially absent, New World. *Xenosphecini*, p. 439
- Forewing with two submarginal cells, episternal sulcus long,
reaching venter, Old World. *Dinetini*, p. 215
- RC, L 13: change 19 to 20
- RC, L 16: delete 20 and substitute: *Laphyragogini*, p. 219
- RC, 18–23: delete entire couplet
- 70, RC, L 37: delete Westwood (for consistency)
- 98, RC, L 30: *cyclocephala* is correct
- 103, LC, L 27: *ommissum* is correct. The spelling *ommissum*
dates from Kohl, 1906 (*Sceliphron*). Out of al-
phabetical order, place after L 36
- 105, LC, L 38: *jamaicense* Fabricius is the proper name for the
species listed by us as *annulatum* (L 36) [see
Art. 59 (b) (ii)]
- 106, LC, insert after L 54: *bruininii* (W. F. Kirby), 1880 (Zoo. Rec.) (*Pelo-*
paeus), emendation. Insert in index
- 109, Fig. 25E: *kirbii* is correct
- 114, LC, L 29: *plumifer* is correct
- RC, L 54: *argentifer* is correct
- 116, LC, L 24: *melanopus* is correct. Add “nec Dahlbom,
1843” to end of line
- RC, L 47: *integer*, not *integrus*
- 117, LC, L 3: *erythropus* is correct
- 128–132: change the species name *kirbyi* to *kirbii*

- 130, LC, L 45: hindtibial is correct
 133, LC, L 34: *erythrogastera* is correct
 LC, L 53: *indus* is correct
 LC, L 54: *indostanus* is correct
 LC, L 58: *englebegi*. . . . 1898 is correct
 RC, L 2: *kirbii* is correct
 RC, insert after L 6: *kirbyi* Dours, 1874 (*Paraspheci*), emendation
 RC, L 14: delete parenthesis in front of Berland
 RC, L 36: *melas* is correct
 134, LC, L 13: *albospinifer* is correct
 139, RC, L 47: *erythrocephala* is correct
 145, RC, L 49, 56: *luteus* is correct
 146, LC, RC: *Eremochares* is a masculine noun (Art. 30a(i)(2).
 Change species names ending in -a to -us
 147, RC, L 22: *lobicollis* out of chronological sequence, place
 after *velutina*
 153, LC, L 48: Šnoflák is correct
 RC, L 12: Geoffroy in Fourcroy, 1785 is correct
 RC, L 53: Frivaldszky, 1877 is correct. Change in index also
 RC, L 54: delete entire line
 RC, insert after L 56: *mocsarii* W. F. Kirby, 1880 (Zoo. Rec.), emen-
 dation. Insert in index
 155, RC, L 29: 718 is correct
 158, LC, L 7, 11: Psenini and Pemphredonini should not be in
 italics
 RC, L 23: 334 is correct
 159, LC, L 22: delete "except S. America"
 LC, L 55: *Odontopsen* is correct
 RC, L 13: *Mimumesa* Malloch is correct
 163, RC, L 37: *pacifica* is correct
 164, LC, L 43: *reticulata* is correct
 165, LC, L 52: *chrysomalla* is correct
 RC, L 20: 79 is correct
 166, LC, L 4: van Lith, 1959 is correct
 LC, L 5: *erythropus* is correct
 LC, L 8: One species, *barthi*, is correct. Membraci-
 dae should not be in italics
 RC, L 9: *erythropus* is correct
 RC, L 10: *erythropus* is correct
 RC, L 35: *matalensis* is correct
 RC, insert after L 26: ssp. *formosensis* Tsuneki, 1965; Taiwan
 167, LC, L 26–27: *mandibularis* is proper subspecies name; *tsu-*
 nekii is valid only if *Mimumesa* is considered

- to be congeneric with *Psen* (see Art. 59c)
Delete "nec H. Smith, 1906"
- 171, RC, L 5, 20:
 RC, L 8: 122 is correct
172, LC, L 34:
 LC, insert after L 48: *aztecus* Bohart and Grissell, 1969; Mexico
 RC, L 7: *brevitarsis* is correct
 RC, L 22: *bismarckensis* is correct
 RC, L 33: *corporaali* is correct
173, LC, L 20:
 LC, L 21: *salomonensis* is correct
 jalapensis is a nomen nudum. It is a lapsus for
 mayorum. (see below)
 LC, insert after L 39: *mayorum* Bohart and Grissell, 1969; Mexico
 LC, L 50: delete "Sri Lanka"
 RC, L 4: Java is correct
 RC, L 6: *tristis* is correct
 RC, L 50: *sandakanensis* is correct
178, LC, L 35:
179, LC, L 47:
 RC, L 31: *leguminifer* is correct
180–182:
 181, RC, L 9–10:
 182, LC, L 36:
 LC, L 44:
 LC, L 48:
 RC, L 20:
184, LC, L 33:
 RC, L 13:
 RC, insert after L 29:
186, RC, L 51:
191, LC, L 16:
 LC, L 41:
193, RC, L 7:
 RC, L 44:
194, LC, L 29, 31, 36:
 LC, L 35–36, 51:
195, Fig. 47A:
- Neotropical—2 is correct
chrysidid is correct
leguminifer Cockerell in Cockerell and Fox,
1897 is correct
spinifer is correct
Pemphredon is a feminine Greek noun. Change
species names ending in *-us* to *-a* here and in
index
delete "new synonymy by Bohart" (see Lom-
holdt, 1975)
put parens around Dahlbom. Insert "(*Cemo-*
nus)" after 1844
sedula is out of alphabetical order, place after
L 45
tenera is correct
22 is correct
Cockerell in Cockerell and Fox, 1897 is correct
longiceps is correct
turanicus Gussakovskij, 1952; sw. USSR
deserticola is correct
(Turner), 1917 (*Stigmus*) is correct
saigusai is correct
exspectata is correct
minutissima is correct
ceanothae is correct
africanum is correct. Gender of *Xysma* is neuter
ceanothae is correct

- 208, RC, L 24: peculiar is correct
 212, LC, L 45: Cockerell in Cockerell and Fox, 1897 (*Astatus*)
 is correct
 RC, L 55: *mexicana* is out of alphabetical order, place
 ahead of *miegii*
 215, LC, L 16: *aspera* W. Fox, 1894 (*Astatus*) is correct
 LC, L 17: delete entire entry
 229, RC, footnote 5: *tenebrosus* is correct
 234, Fig. 63G: *argentatus* is correct
 236, Fig. 64B, Q: *odontophorus* is correct
 Fig. 64C: *argentatus* is correct
 Fig. 64E: *ciliatus* is correct
 Fig. 64K: *subtessellatus* is correct
 Fig. 64O: *aurulentus* is correct
 238-248: *Liris* is masculine (Art. 30a(i)(1), the river
 Garigliano) and all species names ending in -a
 should be changed to -us (except *montezuma*,
 antaka, *ancara*, *antaca*, *argenticauda*, *flavivena*,
 basilissa, *cleopatra*, *erythropyga*, *erythrotoma*,
 fuscistigma, *gryllicida*, *melania*, *namana*,
 argyropyga, *palumbula*, *pitamawa*,
 primania, *regina*, *sabrina*, *samoae*, *hova*,
 sericosoma, *silvicola*, & *muspa*); *erythropoda*
 should be *erythropus*; *nigra* should be *niger*;
 and the suffix -a should be dropped from
 dyscheira, *dasycheira*, *gastrifera*, *setigera*, *rufifera*
 and *spathulifera*. Make same changes in
 index and addendum
- 243, LC, L 7: Turner (1916b, d) is correct
 249, Fig. 67A: *argentatus* is correct
 250, RC, L 3: *facetus* is correct. *Paraliris* is masculine
 253, Fig. 69F: *distinctum* is correct
 258, Fig. 71C: *punctulatum* is correct
 RC, L 12: (Cockerell) in Cockerell and Fox, 1897 (*Ancistrstromma*) is correct
- 259-260: *Ancistromma* is neuter. Change species names
 ending in -a to -um (except *aurantia* and *socia*).
 Change *laevidorsis* to *laevidorse*. Make same
 changes in index
- 260, RC, L 27: 265 is correct
 261, LC, L 2: 24 Neotropical is correct
 263, RC, L 9: *alacer* is correct
 RC: delete L 36-37 (*antillarum* and *apiformis*)

- RC, L 46: *melanopyga* is correct
264, RC, L 47: N. & C. America is correct
265, LC: delete L 17 (*fervens*)
LC last L: *harpax* should not be indented
266, RC, L 56: *setiger* is correct
267, LC, L 23: *tabrobanae* is correct
LC, L 28: *turcomanicus* is correct
LC, L 35: *testaceinervus* is correct
distinctum is correct
271, Fig. 74A: *brullei* Kirchner, 1867 (*Tachytes*), emendation
272, RC, insert after L 53: 1914 is correct
273, LC, L 11: Frivaldszky, 1877 is correct. Change in index
275, LC, L 16: *Tachytes fucatus* is correct
279, Fig. 76 G: *soikai* is correct
297, Fig. 84J: e. N. America is correct
299, RC, L 46: *frontalis* is correct
301, LC, L 24: 1899 is correct
306, LC, L 23: delete "new synonymy by Menke" (see Sielfeld,
313, RC, L 46: 1975)
328, LC, L 11: 1894e is correct
332, LC, L 16: 1968a is correct
335, RC, L 5: *argentatum* is out of alphabetical order, place
ahead of *ashmeadi*
346, LC, L 36: *gardineri* is correct
LC, L 37: 1901 is correct
LC, L 55: *majus* is correct
LC, L 58: *minus* is correct
347, LC, L 37: 1901 is correct
348, LC, L 8: *sinuosiscute* is correct
LC, L 40: Gussakovskij is correct
RC, L 53: *johannis* is out of alphabetical order, place ahead
of *lactitarse*
349, LC, L 4: place dagger (†) at beginning of line. Add "nec
Kohl, 1883" after Brasil,
1894e is correct
350, LC, L 20: 1894e is correct
355, RC, insert after L 22: carina paralleling outer orbit from mandible
base to upper angle of eye; occipital carina
meeting hypostomal
363, LC, L 22: *trilineata* is correct
366, RC, L 53: *frondiger* is correct
367, RC, L 3: *conifer* is correct
368, RC, L 14: *linguifer* is correct
RC, L 17: *spinifer* is correct
374, LC, L 55: *hindtibia* is correct

- 389, LC, L 35: *tibiale* is correct. Change in index
 393, LC, L 33: *imbellis* is correct
 400, RC, L 15: *bougainvilleae* is correct
 RC, L 32: *yezo* is correct
 401, RC, L 24: *nipponis* is correct
 402, LC, L 13: *maculipennis* (F. Smith), 1856 (Crabro); is correct
 LC, last L: *unicus* is the proper name for *nelli*. Transfer to p. 403
 403, LC, L 25: 1954; s. India (Cro) is correct
 LC, L 29: *riparius* is correct
 LC, L 56: *spiniger* is correct
 RC, L 11: *sugiharai* is correct
 RC, L 39: *tyuzendyianus* Tsuneki, 1955 is correct
 RC, L 46: delete "J. Leclercq"
 414, LC, L 29: *pilifer* is correct
 420, RC, L 35–36: 1901 is correct
 427, RC, L 26: insert "(Crabro)" after 1866
 428, LC, L 32: (Cl) is correct
 LC, L 55: *spinifer* is correct
 430, RC, L 42: *alacris* is correct
 448, RC, L 12: 1894d is correct
 449, LC, L 40: 1780 is correct
 LC, L 43, 45: Geoffroy in Fourcroy, 1785 is correct
 RC, L 17: *sabulosus* is correct
 RC, L 24: "(Geoffroy) is Fourcroy, 1785 (*Vespa*); locality?" "May be a *Cerceris*" is correct
 457, LC, L 49: 1894b is correct
 458, RC, L 39: 1894c is correct
 RC, L 55: *botsharnikovi* is correct
 469, LC, L 41: *erythropus* is correct
 LC, L 46: 1971 is correct
 LC, L 48: *ganglbaueri* is correct. Change in index
 470, RC, L 42: change distribution to: Africa: Mali
 492, RC, L 14: *cruciger* is correct
 RC, L 24: 1780 is correct
 495, RC, L 17: 55 is correct
 496, LC, insert after L 30: *guichardi* (Beaumont), 1968 (*Gorytes*); Canary Is. Insert in index also
 LC, L 44: *alicantinus* is correct
 RC, L 17: 1909, not 1910
 500, RC, L 30: *Macropsis* is correct
 501, RC, L 50: *anceps* is out of chronological order, place ahead of *intercedens*

- 504, LC, L 2:
 508, RC, L 4, 6:
 510, RC, L 2:
 511, LC, L 2:
 512, RC, L 18:
 513, LC, L 7, 50:
 525, LC, L 53:
 526, LC, L 3:
 RC, L 34:
 531, LC, L 36:
 RC, L 3:
 535, RC, L 51:
 537, RC, L 43:
 RC, L 55:
 539, LC, insert after L 47: *monodonta* Say, 1825 (*Bembex*), lapsus
 541, RC, L 10:
 542, LC, insert after L 37: *gorgonensis* (Cheesman), 1928 (*Monedula*); Co-
 lombia
 543, LC, L 30:
 546, LC, L 17:
 RC, L 33–34:
 RC, L 54:
 547, LC, L 41:
 560, LC, L 32:
 564, RC, L 46:
 566, LC, L 5:
 566, RC, L 5:
 RC, L 18:
 577, LC, L 35–36:
 579, RC, insert after L 8: *copiapensis* Sielfeld, 1972; Chile
 581, RC, L 38:
 584, LC, L 46:
 586, RC, L 41:
 RC, L 49:
 587, LC, insert after L 49: *schariniensis* Kazenas, 1972; sw. USSR: Kazakh
 SSR
 RC, L 3–4:
 589, RC, insert after L 28: *zoellneri* Sielfeld, 1972; Chile
 592, LC, L 4, 8:
 LC, L 11:
 procernum is correct
 laminifer (Cockerell) in Cockerell and Fox,
 1897 (*Gorytes*) is correct.
 Dow (1942b) is correct
 1909, not 1910
 spinifer is correct
 spinifer is correct
 Stizus is correct
 for 1941 read 1942a
 1793, not 1804
 Frivaldszky, 1877 is correct. Change in index
 1954 is correct
 22 is correct
 oribates is correct
 delete entire entry
 monodonta Say, 1825 (*Bembex*), lapsus
 27 is correct
 gorgonensis (Cheesman), 1928 (*Monedula*); Co-
 lombia
 328 is correct
 delete entire entry (*diformis*)
 Cameron, 1901 is correct
 jordanica is correct
 maldivensis Cameron, 1901 is correct (*maldi-*
 viensis is a lapsus from Zoological Record
 for 1902)
 1897b is correct
 Kohl, 1884 is correct
 delete "ssp."
 Thunberg is correct
 Geoffroy in Fourcroy, 1785 is correct
 1780 is correct
 copiapensis Sielfeld, 1972; Chile
 delete entire entry
 chagatai is correct
 1839 is correct
 delete entire entry
 schariniensis Kazenas, 1972; sw. USSR: Kazakh
 SSR
 delete both entries
 zoellneri Sielfeld, 1972; Chile
 delete "ssp"
 Cockerell and Rohwer in Rohwer, 1908 is cor-
 rect

- 597, RC, L 8: add hyphen after "Ré"
 598, LC, L 36: nests is correct
 600, LC, L 26: change 1941 to 1942a
 LC, L 28: change 1942 to 1942b
 602, RC, L 11: 1894a is correct. Place reference after L 14
 RC, L 12: 1893b is correct
 RC, L 14, 17, 20, 23: change as follows: 1894a to 1894b, 1894b to 1894c, 1894c to 1894d, 1894d to 1894e.
 604, LC, L 58: chinesische is correct
 RC, L 2: 599–699 is correct
 RC, L 32: 657–942 is correct
 606, LC, L 47: delete "(12)4:489–516" and substitute: Le genre
 LC, L 50: *Passaloecus* (Shuckard)
 divores is correct
 607, LC, L 10: 77–194, 317–462 is correct
 LC, L 26: 1897b is correct
 618, LC, L 24: entry should read: Les *Sphecius* paléarctiques.
 Ann. Soc. Ent.
 LC, L 26: paléarctiques is correct
 LC, L 27: Mém. and (Zool.) are correct
 619, RC, L 5: change 1858 to 1857
 RC, L 9: change 1864 to 1863
 620, LC, L 2: change 1838 to 1839
 625, RC, last L: Munksgaard is correct
 628, RC, L 52: *majus* Kohl and *minus* Beaumont are correct
 629, LC, L 18: *colombicus* is correct
 LC, L 26: *crenulifer* is correct (noun)
 634, MC, L 9: *africanum* is correct
 MC, L 56: *alacris* is correct, place after L 58
 MC, L 58: *alacer* is correct, place after L 56
 RC, L 65: *albospinifer* is correct
 635, LC, L 27: *alicantinus* is correct
 636, RC, L 22: delete 263
 637, MC, L 2: *argentifer* is correct
 RC, L 25: delete "and W. Fox"
 638, LC, L 15: *aspera* is correct
 LC, L 17: delete entire entry
 LC, insert after L 25: *aspites* van Lith, Psen, 166
 639, LC, insert after L 53: *aztecus* Bohart and Grissell, *Psenulus*, 172
 640, MC, L 65: delete 587
 RC, L 38: delete "and W. Fox"
 RC, L 40: delete "and W. Fox" and add parens after Cock-
 erell
 RC, L 41: change 50 to 508

- 641, LC, L 44: bismarckensis is correct
RC, L 5: botsharnikovi is correct
- 642, LC, insert after L 64: brullei (Kirchner), Tachysphex, 272
- 644, LC, L 1: catharinae is correct, place on p. 643 before catherinae
MC, L 32: chagatai is correct, place after L 7
RC, L 16: delete "and W. Fox)" and add parens after Cockerell
- 645, LC, L 5: chrysomalla is correct
- 646, MC, L 48-49: transfer to RC after L 15; *conifer* Arnold is correct
- 647, LC, insert after L 17: copiapoensis Sielfeld, Cerceris, 579
LC, L 62: corporaali is correct
RC, L 41: 629 is correct
- 648, LC, L 3: cruciger is correct
LC, L 5: delete "and W. Fox)" and add parenthesis after Cockerell
MC, L 25: cyclocephala is correct
- 649, LC, L 2: defiguratus is correct
MC, L 17: deserticola is correct
MC, L 69: delete entire entry
- 651, RC, L 13: englebegi is correct
- 652, LC, L 22: erythopus is correct
LC, L 30: erythrocephala is correct
LC, L 44-45, 47-48: erythropus is correct
RC, L 40: exspectata is correct, place after L 48
- 653, LC, L 42: substitute (Geoffroy) for (Fourcroy)
RC, L 4: delete 265
- 654, LC, L 33: flavipes is correct
RC, insert after L 25: formosensis Tsuneki, Psen, 166
- 655, LC, last L: substitute (Geoffroy) for (Fourcroy)
MC, L 5: delete entire entry
MC, L 9: frondiger is correct
MC, L 39-43: insert i after ful-
- 656, MC, L 5: gardineri is correct
RC, L 65: delete entire entry
MC, L 66: substitute (Geoffroy) for (Fourcroy)
MC, L 72: gobiensis is correct
- 657, LC, insert after L 25: gorgonensis (Cheesman), Stictia, 542
- 659, RC, L 64: illabefactus is correct
RC, last L: imbellis is correct
- 660, MC, L 5: indus is correct, insert after L 23
MC, L 21: indostanus is correct, insert after L 22

- MC, L 48: ifranensis is correct, place on p. 659 after idzekii
- MC, L 54–55: delete entire entry
- MC, L 56: substitute (Geoffroy) for (Fourcroy)
- RC, L 67: integer is correct, place after L 58
- 661, RC, L 54: jordanica is correct
- 662, MC, L 34, 37: insert 133 after Prionyx
- 663, MC, L 65: laminifer is correct, place after L 63
- 664, LC, L 65: leguminifer Cockerell is correct entry
- 665, LC, L 59: longipes should read longiceps, place after L 40
- 666, RC, L 5: majus is correct, place after L 10
- RC, L 23: maldivensis is correct
- 667, MC, insert after L 56: mayorum Bohart and Grissell, Psenulus, 173
RC, L 21: delete entire entry
- RC, L 27: Megistommum and 503 should be in boldface
- RC, L 30: melas is correct, not melaenus, place on p. 668
after melas M. Muller
- RC, L 69: melanopus is correct, transfer to p. 668, LC,
after L 5
- 668, LC, L 5: melanopus is correct
- LC, L 6: melanopyga is correct
- LC, L 14: melanostictus is correct
- 669, LC, L 38: minus is correct, place after L 52
- LC, L 55: delete entire line
- LC, L 61: minutissima is correct, place after L 58
- 672, MC, L 57: nipponis is correct
- 673, RC, L 69: odontophorus is correct, place after last L
- 674, MC, L 28: oribates is correct
- MC, L 69: delete entire entry
- 676, RC, L 46: substitute (Geoffroy) for (Fourcroy)
- 677, MC, L 4: pilifer is correct
- MC, L 25: insert after pimarum: Cockerell and
- RC, L 34: plumifer is correct
- 678, MC, L 48: procerum is correct, place after L 44
- 680, LC, L 53: quadrifasciatus is correct, place after L 57
- 681, RC, L 3: riparius is correct
- 683, LC, L 40: put parenthesis around Dahlbom
- MC, last L: saigusai is correct
- RC, insert after L 17: salomonensis van Lith, Psenulus, 173
- RC, L 35: sandakanensis is correct
- 685, MC, L 27–28: setiger is correct
- 686, MC, L 22: sinuosiscute is correct
- MC, L 49: delete 587

- RC, L 20: salomonensis is correct (insert on p. 683 as noted above)
- 687, LC, L 55-58: spinifer is correct, place after L 52
- LC, L 65: spiniger is correct, place after L 60
- 688, RC, L 6: sugiharai is correct
- RC, L 41: sungarai is correct
- 689, RC, L 31: tenera is correct
- 690, LC, L 14: testaceinervus is correct
- 691, MC, L 31: Bicyrtes, 537 is correct
- RC, L 24: tristis is correct
- 692, LC, insert after L 31: turanicus Gussakovskij, Passaloecus, 184
- LC, L 42: turcomanicus is correct
- 695, MC, L 10: yezo is correct
- RC, insert after L 27: zoellneri Sielfeld, Cerceris, 589

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SOME UNUSUAL BRACONIDAE (HYMENOPTERA)¹

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Abstract.—Figures are presented to show features which may be useful in determining relationships of *Gnathobracon babirussa* A. Costa, *Pseudodicrogenium monstrosum* Fahringer and *Bequartia gigantea* Fahringer. Two new species, *fuliginosa* and *promisca*, are described in *Bequartia*. A new rogadine genus, *Dimorphomastax*, is described with *peculiaris* as a new species. A system for naming areas of the mandible is proposed.

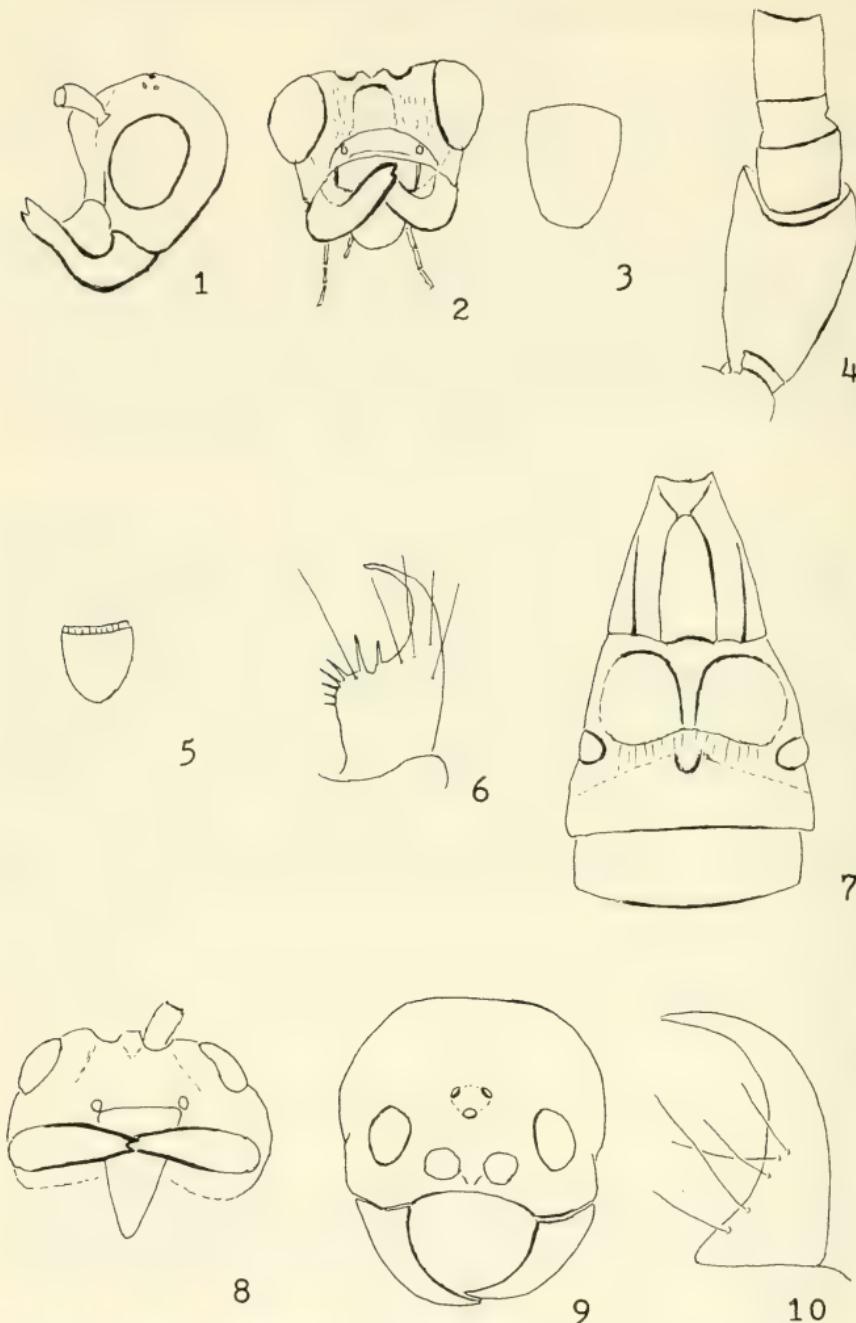
One of the most difficult problems in the taxonomy of Braconidae remains that of the suprageneric classification. Individuals beginning to work with the family soon realize that the segregations between subfamilies or between tribes are far from being clear and that characters overlap or do not hold. Part of the problem lies in the fact that classifications originally proposed for material from particular areas simply do not fit when the fauna of other regions is explored. Part is due to our lack of knowledge of the features of species incompletely described long ago, and some of it is due to our failure to visualize correctly specimens upon reading descriptions. Figures are often lacking and occasionally are so inaccurate as to be misleading. The combined result of these factors is a great need to restudy type-specimens and to publish the data regarding them before attempting to either confirm or restructure the higher categories within the family. The notes and diagrams which follow are presented in order to help provide bases for clarification of certain questions. The diagrams were made by use of an ocular grid and squared paper.

Gnathobracon babirussa A. Costa Figs. 1-7

One of the subfamilies, the Gnathobraconinae, established by Szépligeti in 1904 and based upon *Gnathobracon babirussa* described by A. Costa in 1864 from the northern part of South America, has long been an enigma.

Through the kindness of Prof. G. Viggiani, it became my privilege to

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Figs. 1-7. *Gnathobracon babirussa*. 1, Head, antero-lateral. 2, Head, frontal. 3, Labrum. 4, Base of antenna. 5, Outline of scutellum and prescutellar furrow. 6, Outer claw posterior leg. 7, abdominal terga 1-4. Figs. 8-10. *Pseudodicrogenium monstrosum*. 8, Head, front view. 9, Head, dorsal view. 10, Outer claw middle leg.

study and photograph the unique type which is in the collection of the Institute and Museum of Zoology, University of Naples. Though I had been unable to visualize the specimen from the descriptions, actually both those by Costa and Szépligeti were good and stressed salient features. The problem lay in the fact that the insect is so different from what people who look at braconids are accustomed to seeing.

The type female carries Costa's label. Labels bearing the Museum No. 8768 and indicating that it is the specimen studied and published upon by Szépligeti are alongside. The specimen is about 13 mm long, with the ovipositor adding about 10 mm more. Forewing length is 13 mm.

Description.—Head black, polished above; thorax dark reddish brown and polished above, black below. Wings banded, pale at base, a dark band just before stigma, yellowish behind stigma, apex dark. Stigma yellow. Fore coxae reddish, middle and posterior coxae piceous. Anterior and middle legs testaceous with posterior femora infuscated on distal half and posterior tibiae infuscated on apical $\frac{1}{8}$. Abdomen testaceous through tergum 4, black beyond.

Head immargined, no scrobes *per se*, but front depressed ahead of anterior ocellus and a groove runs from it to between antennae. Both antennae broken but at least 57 segments remain in the right antenna, segments beyond 4th flagellar at least as wide as long. Scape and pedicel as shown in Fig. 4. Face flattened, impressed below a transverse ridge located below antennae. Not cyclostome, clypeus insunken between anterior tentorial pits, slightly raised at apex to form a low rim which becomes higher and roll-like at side. Labrum from in front appears as a great flat plate which hangs down between and behind mandibles. Enormous mandibles start out normally but then curve upward, forward and mediad, the apices crossing (see Figs. 1-2). A large open space left in front of the labrum and clypeus. Mandible, in cross section, flat on inside, rounded on outer side but becoming quite flat after bending, the upper tooth longer than the lower. Maxillary palpus 6-segmented, labial 4. Relative measurements: Malar space 10, eye height 45, eye length (anteroposteriorly) 35, temple length 20.

Wing venation typical of Braconinae, i.e., submediellian cell short, nervulus interstitial. Relative lengths: 1st abscissa radius 4, 2nd 15, 3rd 30; 1st intercubitus 9, 2nd 7.5; upper abscissa of basal 5, lower 10. Radiellian cell does not broaden apically; 1st abscissa of mediella 10, second 30, basella 8.

No prepectal carina or sternaulus. Notaulices very faintly impressed, indicated mostly by lighter color. Scutellum low, not marginated, shaped as in Fig. 5. Propodeum smooth, with long, fine, whitish hairs which also occur on metapleuron and hind coxa. No chaetobothria. Outer claw of posterior leg as in Fig. 6. Major abdominal features as sketched.

Pseudodicogenium monstrosum Fahringer
Figs. 8-10

In 1936 Fahringer erected the subfamily Pseudodicogeniinae for his monobasic genus *Pseudodicogenium*. Van Achterberg (1976) in his key (couplet 3, p. 40) points out that "exceptionally the face takes part in the hypoclypeal depression (Tribe Pseudodicogeniini), resulting in a concave face and flat clypeus," and on p. 77 he presents drawings. On p. 35 he places the tribe in the Braconinae.

There are two specimens of *monstrosum*, the lectotype and paralectotype respectively, in the Musée Royal de l'Afrique Centrale at Tervuren. Based upon these specimens, whether the genus should be placed in the Braconinae or not might be questioned. The species is not cyclostome in the usual sense. The face is impressed, and the clypeus is bent inward and not raised at all. The labrum, continued in almost the same line as the clypeus, forms an elongated triangle which extends back between and behind the mandibles; and it is not concave anteriorly. The massive mandibles project forward and appear to arise on a projection which is the extended gena; and a space is left between the mandibles and the labrum. The front tibia carries very numerous characteristic robust reddish "hairs" or chaetobothria, most of which are about as long as the diameter of the tibia. These structures occur on the inner front aspect and, toward the apex of the tibia, tend to form into transverse rows; they are broad and appear much like the apical transverse row.

It would appear that the genus is sufficiently different from the cyclostome forms that it might be held separately as Fahringer handled it.

Bequartia gigantea Fahringer
Figs. 11-15

Fahringer described the genus *Bequartia* (sic) in 1936 based upon a single male from Elizabethville. The specimen, which he named *gigantea*, had been collected by Dr. M. Bequaert. While Fahringer spelled the name incorrectly both in the generic name and in giving the collection data, it is obvious that an error occurred as it is written *Bequaertia* on the determination label. However Schouteden had used *Bequaertia* in 1913 for an hemipterous genus and Pic in 1914 used *Bequaertiella* for a coleopterous genus. Other comparable names have been used (see Neave, 1939), and therefore it appears best to accept the generic name as it appeared originally.

Through the kindness of Dr. J. Decelle, I was able to examine and photograph the unique type which is housed in the Musée Royal de l'Afrique Centrale. While the genus belongs to the Rogadinae as Fahringer indicated, certain corrections should be made in the original description. The maxillary palpi are 6-segmented; and the terminal segments are normal, not as Fahringer drew them. The prescutellar furrow is crenulate and is crossed by

carinae. The radius emerges at about the basal one-third of the stigma, and the stigma is relatively narrow. The area just behind the stigma is deeply pigmented; and, at first glance, the stigma appears much wider than it actually is. Because of the color pattern, one must sometimes look closely to see where the radius actually emerges. The first abscissa of the radius is decidedly thickened at the base but rapidly becomes more slender as illustrated in Fig. 13. The sculpture of the abdomen is much finer than Fahringer's diagram would indicate and is rather typical. The claws are finely pectinate, and the posterior tibial spurs straight.

Six additional specimens (including two females) of *gigantea* in the British Museum of Natural History in London, an additional female from the collection in Tervuren, and four specimens representing two additional species enable further characterization of the genus. In addition to the usual rogadine features, the thickened base of the radius and the strongly incrassate hind tarsi are distinctive. (In the female the posterior tarsus, while thickened, is less so than in the male.) The prepectal carina is present. On the base of the propodeum occurs a most unusual structure which is more highly developed in males than in females, although its degree of development in the males varies some. In the female this structure is like a pair of horizontal, flat, rimmed areas, with the posterior rim being highest near their juncture in the middle. The flat area is covered by very dense pile-like hair. In the males the pile-covered area is much larger, the maximum development being as indicated in Fig. 11. It is tumescent, raised centrally; and at its apex the pile-covered surface appears to slide under the regular propodeal covering. The propodeum is decidedly raised (bulged) on each side behind the pile-bearing area.

Two females and four males collected by S. A. Neave at Mlanje, Nyasaland in Oct. 1912, Jan. 1913 or Dec. 1913 are in the British Museum of Natural History and one female taken by F. G. Overlast at Lulua: Riv. Luisa X-1933 is in Tervuren.

Bequartia fuliginosa Shenefelt, NEW SPECIES

Differs from *gigantea* primarily in having the wings infuscated, excepting only the very base of the stigma and the parastigma which are testaceous.

Holotype.—♂, "Coll. Mus Congo. Ruanda: Rukoma (cheff.) Terr. Nyanza I-1953, P. Basilewsky" in the Musée Royal de l'Afrique Centrale at Tervuren.

Description.—Length 16 mm. Forewing length 14 mm. Wings dark brown excepting lighter base of stigma, parastigma and adjacent part of basal. Eyes, antennae, anterior pretarsi, middle tarsi, posterior tibiae and tarsi black. Otherwise ferruginous.

Paratypes.—TERVUREN: "Musée du Congo. Katanga: Kansenya XI-1930, G. F. de Witte" 1 ♂. BRITISH MUSEUM (NATURAL HISTORY):



11



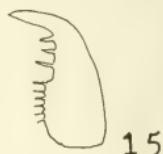
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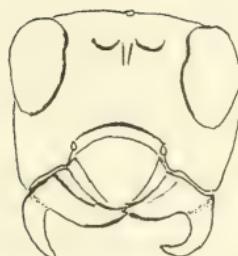
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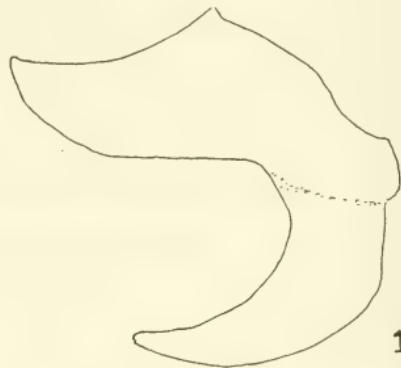
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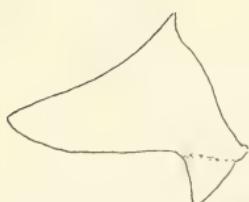
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19



20

Figs. 11-15. *Bequartia gigantea*. 11. Propodeum of male showing pile covered area at base. 12. Same in female. 13. Stigma, bases of radius and basal. 14. Palpi of male (first

"Salisbury Mashonaland. Nov. 1899, G. A. K. Marshall. '124'. Marshall Coll. 1909-323," 1 ♂.

Bequartia promisca Shenefelt, NEW SPECIES

Differs from *gigantea* and *fuliginosa* in its smaller size, in the wings being infuscated excepting the testaceous parastigma, a pale spot surrounding the juncture of the recurrent and the cubitus and a pale transverse band extending across the posterior half of the radial cell, the base of the third cubital cell and into the second discoidal.

Holotype.—♀, "Uganda, Sukh Plains, Nr. Nepal Pass 1931. Dr. E. B. Worthington. Cambridge Univ. Exp. B. M. 1931-545" in the British Museum (Natural History).

Description.—Length 13 mm. Forewing length 12 mm. Wings brown except as indicated above. Head and thorax testaceous, abdomen ferruginous. Eyes and antennae black. Anterior pretarsi, middle tarsi, posterior tibiae and tarsi dark brown. Antennae distinctly longer than body, with 90 segments in flagellum.

Dimorphomastax Shenefelt, NEW GENUS

To describe the structure involved here, it is necessary to review the structure of the mandible and to propose certain new terms. Each mandible is articulated anteriorly and posteriorly and is attached to the ventral margin of the cranial wall by membrane between the articulations. At the anterior articulation, a process from the subgena fits into a cavity of the mandible called the acetabulum, which is located on the inner basal angle of the mandible. (Imms calls this the ginglymus of the mandible.) At the posterior articulation, the mandible carries a projection known as the condyle (=postartitis). This bulbous structure fits into a socket of the subgenal wall near the distal end of the hypostomal carina. Each mandible may be regarded as essentially a hollow tetrahedral structure. If the base of the bottom triangle is thought of as being formed by the portion between the acetabulum and the condyle and this is regarded as the outside, the adductor muscle is attached at approximately the apex. Actually, the outer surface of the mandible, extending distally from what we have been calling the base of the bottom triangle, may be bowed outward or bent in other shapes. Likewise the upper inner face, extending distad from the side of the basal triangle

←

segment not shown on maxillary palpus). 15, Outer claw of hind leg, from type. Figs. 16-20. *Dimorphomastax peculiaris*. 16, Head of type from front. 17, Outline of left mandible of type male. 18, Outline left mandible of allotype female. 19, Outer hind claw of type. 20, Inner spur of posterior tibia of male.

from the acetabulum to the apex, may be invaginated (bent toward the middle of the mandible in cross section) so the mandible becomes concave on the inner aspect. The third side of the bottom triangle, from the condyle to the apex, serves as the base of the underside of the mandible or the lower inner surface. The angles between the three sides vary considerably from species to species both in sharpness and in degree, and the mandible is often twisted in such a way that the teeth of the mandibles meet each other in a vertical instead of a horizontal plane, or the mandible may be modified in other ways. With downward extension of the postgena, the acetabular-condylar line may become practically vertical so the anterior articulation of the mandible appears dorsal.

Obviously a structure such as that described and used for biting or crushing needs strengthening. And the mandible is very often braced by a sharp edge or carina which can be called the *condylar carina* as it runs from the condyle along the lower edge of the outer face of the pyramid to the lower tooth or a little above it. A similar carina may be developed along the upper (anterior) edge of the mandible and proceeds from the acetabulum to or nearly to the upper tooth. This may appropriately be called the *acetabular carina*. The carinae tend to be most robust near their origins. On either or both sides of the carinae grooves may appear, especially along the condylar. When this occurs, a bracing ledge is formed which may be quite plate-like and which serves as a buttress. Between the two carinae the outer face of the mandible may be sculptured in various ways. In contrast, the upper inner face is normally smooth. The lower surface or third face of the pyramid, i.e., that portion extending from the condylar carina to the smooth, usually concave portion, is often flat and is usually much narrowed near the teeth and suddenly broadened toward the base where the adductor muscle is attached. Frequently a thickening of the mandibular wall occurs around the basal margin. This reinforcement is normally set off by a shallow groove around the margin and is most evident along the base of the lower side. While the lower side may carry sensoria and hairs, it has been utilized very little in classification.

In *Dimorphomastax* the condylar carina has undergone strange development. In the male the base of the carina has been produced outwards to such an extent that it appears like a sickle, and the two projections together appear like a second set of mandibles. In the female the outgrowth is limited to a lamellar, triangular tooth. This modification of the base of the condylar carina will at once separate the genus from all other rogadine genera. The prepectus is margined; the recurrent enters the first cubital cell; the antennae are multiarticulate; the propodeum is not armed; there are three cubital cells; the first abscissa of the mediella is longer than the second; the spiracles of the first abdominal tergite are normal; the tarsi are normal; the first ab-

dominal tergum is broadened posteriorly; the suturiform articulation is distinct; the claws are coarsely pectinate; the sternaulus is absent.

Type for the Genus.—*Dimorphomastax peculiaris*, new species.

Dimorphomastax peculiaris Shenefelt, NEW SPECIES

Figs. 16–20

Holotype.—♂, "6 mi. S. Durango, Dgo. MEX. 6100' July 14, 1964, W. R. M. Mason." In the Canadian National Collection at Ottawa.

Description.—Length 4.8 mm. Forewing length 5.0 mm. Head, excepting testaceous to brown mouthparts, black. Antennae brown. Mesonotum black, metanotum and apex of scutellum margined with testaceous, remainder of thorax brownish to piceous. Legs, including coxae, testaceous; pretarsi darkened. Abdomen testaceous. Face finely granular. Both antennae broken but 41 segments remain in flagellum of left antenna. All flagellar segments longer than wide. Notaulices distinct. Mesonotal sculpture of ovoid pits separated by about their diameter and surrounded by shining plaquettes which mostly appear as 2 rows on the intervals between the pits. Propodeal spiracle oval. Propodeum finely granular-rugose, with a median carina on basal $\frac{1}{4}$. Scutellum covered by fine shining plaquettes which are smaller than those between the pits on the mesonotum. Sternaulus absent. Mesopleuron punctulate on lower $\frac{1}{3}$, roughened below anterior wing base, mesopleural fovea and speculum distinct. Wings lightly infuscated. Radius emerging beyond middle of stigma, inner margin to outer margin as 4:3. First abscissa of discoideus shorter than 2nd (as 13:16). Radiellan cell widening distally, postnervellus present, 1st abscissa of mediella longer than 2nd (as 32:25). Abdominal terga 1, 2 and basal $\frac{1}{2}$ of 3 longitudinally strigose with shining spots along the irregular carinae and with a median carina. Boss at base of 2 short, about $\frac{1}{12}$ as long as the tergum, and extending across middle $\frac{1}{3}$. Terga 4–7 depressed anteriorly and with dense bands of long golden hairs across the middle. Tergum 5 with a fringe of apical hairs. Posterior tibial spurs blunt.

Allotype.—♀, "MEX. Dgo. 7 mi. W. Durango, 7000' 29 July 1964, W. R. M. Mason." In the Canadian National Collection at Ottawa.

Differs from the ♂ in having the condylar carina produced only into a triangular tooth at base, in having the posterior tibial spurs pointed and in having terga 4–7 alutaceous, sparsely hairy, not impressed. Tergum 5 lacks the fringe of apical hairs. The flagellum has 46 segments; the apical one conical at the tip. The ovipositor sheath is dark and is approximately as long as the second segment of the middle tarsus.

Paratypes.—CANADIAN NATIONAL COLLECTION in Ottawa: 7 mi. W. Durango MEX. 29.VII.64 L. A. Kelton, 1 ♂; Santa Lucia, Sin. MEX. 4-VIII-1964 4000', J. F. McAlpine, 1 ♂ and 1 ♀; MEX. Sin. 15 mi. W. El

Palmito, 5000' 11 July 1964, W. R. M. Mason, 1 ♂. MUSEUM d'HISTOIRE NATURELLE in Genéve: Mexiq. Orizaba, 1 ♂. RIJKSMUSEUM van NATUURLIJKE HISTORIE in Leiden: Meseum Leiden. MEXICO, Veracruz, Fortin, 900 m 1.XII.1962, C. & O. Epping, 1 ♂. ENTOMOLOGY MUSEUM, UNIVERSITY OF MICHIGAN at East Lansing: Rio Blanca, V. C., Mex. 11-13-57, R. & K. Dreisbach, 1 ♂. AMERICAN ENTOMOLOGICAL INSTITUTE at Ann Arbor, Michigan: Portal, Ariz. VIII-26-1974, H. & M. Townes, 1 ♂; Portal, Ariz. VIII-24-1974, IX-2-1974, IX-5-1974 and IX-9-1974, H. & M. Townes, 4 ♀♀.

Discussion.—In the paratype males the outgrowth from the condylar carina varies in width from nearly as wide as the base of the mandible to only about $\frac{1}{4}$ the width and in length from about $\frac{3}{4}$ to longer than the mandible. The 'tooth' on the female also varies in size. The thorax is mostly testaceous in two of the males. In size the males vary from a little less than 5 mm to over 7 mm.

ACKNOWLEDGMENT

I am deeply indebted to Dr. W. R. M. Mason for calling the peculiar mandibles to my attention and then loaning his material so that I could describe it. Thanks are also due to the individuals and institutions in which I found specimens for their so willingly allowing me to borrow them.

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MACROLEPIDOPTERAN MOTHS LIGHT-TRAPPED IN A NEW JERSEY OAK FOREST (LEPIDOPTERA)

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Abstract.—Light trapping was conducted for five years in a virgin oak forest on the New Jersey Piedmont Plateau. A total of 410 species of moths were recorded from 14 families. This includes about a third of all the species of macrolepidopteran moths recorded in New Jersey. The total catch of each species is listed, and the species are ranked within family by abundance. The most abundant species, *Lithacodia carneola* Gn., represented about 8% of the total catch, and the top 15 species represented about 50%.

A five year study was conducted to quantify the taxonomic structure and phenology of the moth community in a small forest in central New Jersey. The objectives of the study were to examine ecological aspects of the community and to evaluate the stability of the community in the wake of an expected gypsy moth outbreak. The latter did not materialize (Moulding, 1977), but the first objective has been achieved.

This paper describes the taxonomic composition of the macrolepidopteran moths collected by light-trapping in the forest from 1973 to 1977 during the seasons extending from early March to mid-October.

METHODS AND RESULTS

The collecting site was Hutcheson Memorial Forest (HMF), located on the New Jersey Piedmont Plateau near the town of East Millstone, Somerset County ($40^{\circ}30'N$, $74^{\circ}34'W$). It is a mature (over 250 years old), mixed-oak forest of 65 acres surrounded by old fields in various stages of abandonment and cultivated fields of corn, soybean and winter rye. Monk (1961) characterized the upland part of the forest (82% of the area) as having a mixed-oak canopy, flowering dogwood understory and maple-leaved viburnum shrub layer. Frei and Fairbrothers (1963) in an extensive inventory of the flora of the forest and edge recorded 40 species of trees, 39 of shrubs and 232 of herbs; 71 of the total were considered exotic (non-native) species. The forest is believed to have had a minimum of human interference since

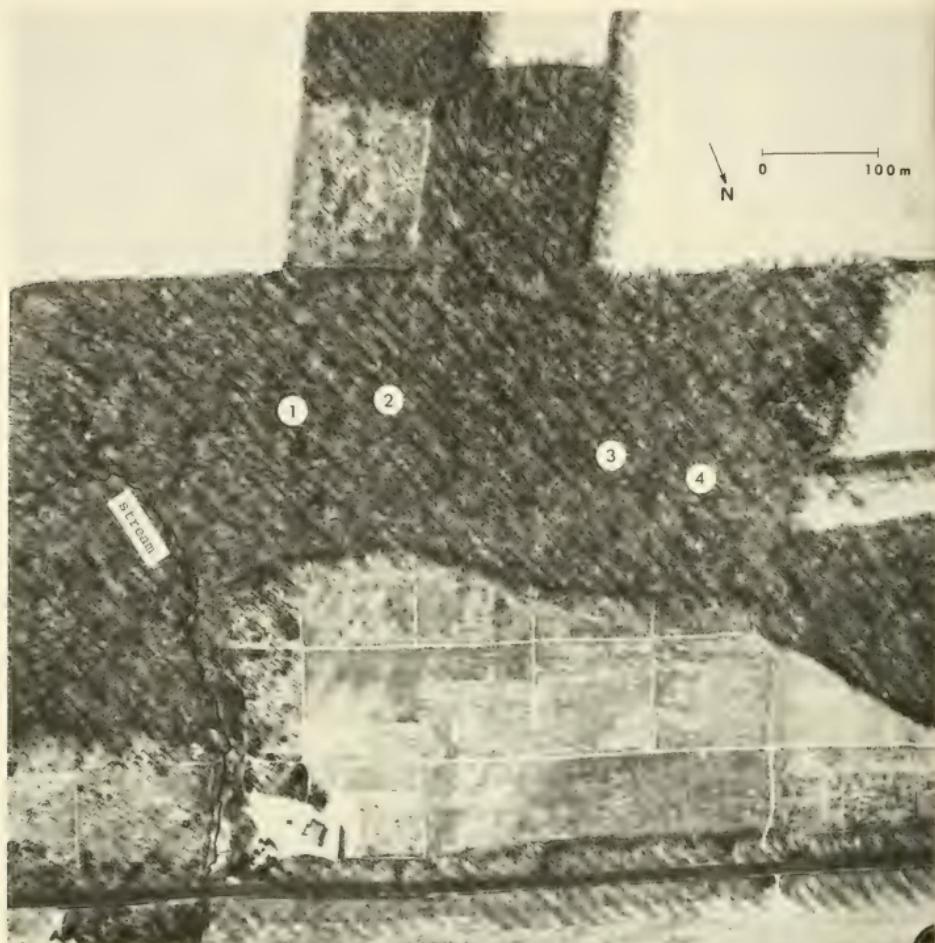


Fig. 1. Moth light-trap sampling sites. (Aerial photography flown on 9 February 1976.)

colonial times. No fires or significant cutting have apparently occurred since the early 1700's. Under Rutgers' study since 1948 and ownership since 1955 it has been established as an ecological preserve; and insecticides are known never to have been applied.

Moths were collected by four 6-watt, photo-cell-controlled, UV light traps (Ellisco Co., Philadelphia, Pennsylvania) located at permanent sampling sites in the central part of the forest (Fig. 1). A weekly sampling regime was established, and the nights were chosen to avoid rain, wind and unseasonably low temperatures in order to minimize non-seasonal environmental variables. Moon effects were avoided as much as possible by choosing cloudy nights when practical. Collections were made during the years 1973-

Table 1. Seasonal sampling intensity.

| | Total number of nights trapped | | |
|-----------|--------------------------------|-----|------|
| | Early | Mid | Late |
| March | 2 | 1 | 2 |
| April | 0 | 3 | 2 |
| May | 2 | 2 | 3 |
| June | 2 | 4 | 2 |
| July | 5 | 5 | 7 |
| August | 5 | 5 | 4 |
| September | 5 | 3 | 3 |
| October | 4 | 3 | 0 |

1977, with the collecting season varying somewhat from year to year as shown in Table 1. In 1973, all traps were placed at a height of 1.8 m above the ground. During the remaining years, the middle two traps were raised on pulleys attached to white oaks to a height of 18 m.

Moths were identified by comparison with specimens in the insect museum of the Rutgers' Department of Entomology and Economic Zoology, and voucher specimens from the trapping were put into the collection. Only moths belonging to the division Macrolepidoptera were tallied by species.

From a total of 293 trap-nights, 22,880 individual moths were collected and represented 410 species in 14 families. These are listed by family in Table 2; the species within a family are ranked in decreasing order of abundance. Scientific nomenclature is based on McDunnough (1938) as amended in recent years.

DISCUSSION

Exclusive of sub-species and infrasub-specific variants, there are 1258 species of macrolepidopteran moths recorded from New Jersey (Smith, 1909; Muller, 1965, 1968, 1973, 1976). Some of the species listed by Smith may have since been extirpated in New Jersey due to habitat destruction; other species are being added to the record at a rate of about 10 per year by Muller, who to our knowledge is the only New Jersey worker active in this area. The present study adds six new species to the published record of New Jersey species. Five of these are represented by New Jersey specimens already in the Rutgers' insect museum and so have probably been merely overlooked or confused with closely related species in the past. Our specimen of *Callopistria floridensis* Gn. is to our knowledge the first record for New Jersey. This, however, is not ecologically significant since it is described as a sometimes-greenhouse-pest from Florida and thus it probably is not viable as a resident in the New Jersey climate.

Table 2. Listing by family of species caught in forest traps. Species are ranked within family in order of decreasing abundance.

| Species | Total Catch | Species | Total Catch |
|---------------------------------------|----------------|---|----------------|
| NOCTUIDAE | | | |
| <i>Lithacodia carneola</i> Gn. | 1565 | <i>Graphiphora badinodis</i> Grt. | 33 |
| <i>L. muscosa</i> Gn. | 619 | <i>Philometra eumelusalis</i> Wlk. | 33 |
| <i>Graphiphora c-nigrum</i> L. | 465 | <i>Tarachidia candefacta</i> Hbn. | 33 |
| <i>Odoconta cinereola</i> Gn. | 313 | <i>Hormisa orciferalis</i> Wlk. | 32 |
| <i>Palthis asopialis</i> Gn. | 284 | <i>Leucania ursula</i> Forbes | 31 |
| <i>Zanclognatha cruralis</i> Gn. | 282 | <i>Phalaenostola larentiooides</i> Grt. | 31 |
| <i>Agrotis ypsilon</i> Rott. | 237 | <i>Platysenta videns</i> Gn. | 31 |
| <i>Spragueia leo</i> Gn. | 186 | <i>Tetanolita floridana</i> Sm. | 31 |
| <i>Ochropleura plecta</i> L. | 180 | <i>Amphipyra pyramidoides</i> Gn. | 30 |
| <i>Cosmia calami</i> Harv. | 175 | <i>Catocala micronympha</i> Gn. | 30 |
| <i>Phoberia atomaris</i> Hbn. | 171 | <i>Apamea americana</i> Speyer | 27 |
| <i>Anorthodes tarda</i> Gn. | 143 | <i>Galgula partita</i> Gn. | 27 |
| <i>Plathypena scabra</i> Fabr. | 140 | <i>Orthosia rubescens</i> Wlk. | 27 |
| <i>Pseudaletia unipuncta</i> Haw. | 139 | <i>Metaxaglaea inulta</i> Grt. | 26 |
| <i>Euplexia benesimilis</i> L. | 116 | <i>Elaphria versicolor</i> Grt. | 25 |
| <i>Xanthoptera nigrofimbria</i> Gn. | 110 | <i>Zale horrida</i> Hbn. | 24 |
| <i>Epizeuxis aemula</i> Hbn. | 102 | <i>Crocigrapha normani</i> Grt. | 22 |
| <i>Palthis angulalis</i> Hbn. | 95 | <i>Orthodes crenulata</i> Butl. | 22 |
| <i>Papaipema marginidens</i> Gn. | 93 | <i>Acronicta exilis</i> Grt. | 21 |
| <i>Orthosia hibisci</i> Gn. | 91 | <i>Autographa precationis</i> Gn. | 21 |
| <i>Papaipema harrisi</i> Grt. | 89 | <i>Caenurgina crassiuscula</i> Haw. | 21 |
| <i>Orthodes cynica</i> Gn. | 86 | <i>Leuconycta diphteroides</i> Gn. | 21 |
| <i>Lacinipolia renigera</i> Steph. | 82 | <i>Papaipema impecuniosa</i> Grt. | 21 |
| <i>Cerastis tenebrifera</i> Wlk. | 78 | <i>Leuconia multilinea</i> Wlk. | 20 |
| <i>Phalaenophana pyramusalis</i> Wlk. | 75 | <i>Neoerastria apicosa</i> McD. | 19 |
| <i>Tarachidia erastrioides</i> Gn. | 73 | <i>Polygrammate hebraicum</i> Hbn. | 19 |
| <i>Catocala amica</i> Hbn. | 67 | <i>Renia factiosalis</i> Wlk. | 19 |
| <i>Zanclognatha pedipilalis</i> Gn. | 66 | <i>Leuconia phragmatidicola</i> Gn. | 18 |
| <i>Bomolocha baltimorensis</i> Gn. | 58 | <i>Panopoda rufimargo</i> Hbn. | 17 |
| <i>Pseudorthodes vecors</i> Gn. | 58 | <i>Rivula propinqualis</i> Gn. | 15 |
| <i>Lithacodia synochitis</i> G. & R. | 57 | <i>Schinia arcigera</i> Gn. | 15 |
| <i>Elaphria grata</i> Hbn. | 56 | <i>Tricholita signata</i> Wlk. | 15 |
| <i>Sunira bicolorago</i> Gn. | 55 | <i>Catocala ultronia</i> Hbn. | 14 |
| <i>Lascoria ambigualis</i> Wlk. | 54 | <i>Peridroma margarita</i> Haw. | 14 |
| <i>Nephelodes emmedonia</i> Cram. | 52 | <i>Proicus modica</i> Gn. | 14 |
| <i>Acronicta modica</i> Wlk. | 47 | <i>Spargaloma sexpunctata</i> Grt. | 14 |
| <i>Zanclognatha jacchusalis</i> Wlk. | 47 | <i>Psaphida grotei</i> Morr. | 13 |
| <i>Choephora fungorum</i> G. & R. | 46 | <i>Redectis vitrea</i> Grt. | 13 |
| <i>Zanclognatha ochreipennis</i> Grt. | 42 | <i>Zanclognatha lituralis</i> Hbn. | 13 |
| <i>Renia salusalis</i> Wlk. | 40 | <i>Graphiphora bicarnea</i> Gn. | 12 |
| <i>Spodoptera ornithogalli</i> Gn. | 38 | <i>Proxenus miranda</i> Grt. | 12 |
| <i>Graphiphora smithi</i> Snell | 35 | <i>Balsa malana</i> Fitch | 11 |
| <i>Protolampra brunneicollis</i> Grt. | 34 | <i>Orthosia revicta</i> Morr. | 11 |
| <i>Epizeuxis americanalis</i> Gn. | 34 | <i>Paectes oculatrix</i> Gn. | 11 |
| | 33 | <i>Zanclognatha protumnusalis</i> Wlk. | 11 |
| | | <i>Epizeuxis lubricalis</i> Geyer | 10 |

Table 2. *Continued.*

| Species | Total Catch | Species | Total Catch |
|--|----------------|--|----------------|
| <i>Rhynchagrotis anchocelioides</i> Gn. | 10 | <i>Farontia diffusa</i> Wlk. | 4 |
| <i>Achatodes zae</i> Harr. | 9 | <i>Feltia subgothica</i> Haw. | 4 |
| <i>Feltia ducens</i> Wlk. | 9 | <i>Harrisimemna trisignata</i> Wlk. | 4 |
| <i>Lithophane antennata</i> Wlk. | 9 | <i>Morrisonia evicta</i> Grt. | 4 |
| <i>Stirioides obtusa</i> H.-S. | 9 | <i>Nedra ramosula</i> Gn. | 4 |
| <i>Zanclognatha laevigata</i> Grt. | 9 | <i>Pangrapta decoralis</i> Hbn. | 4 |
| <i>Agrapha aerea</i> Hbn. | 8 | <i>Zale lunata</i> Dru. | 4 |
| <i>Amolita fessa</i> Grt. | 8 | <i>Z. lunifera</i> Hbn. | 4 |
| <i>Baileya levitans</i> Sm. | 8 | <i>Acronicta hasta</i> Gn. | 3 |
| <i>Chamyris cerintha</i> Treit. | 8 | <i>Agroperina dubitans</i> Wlk. | 3 |
| <i>Eupsilia sidus</i> Gn. | 8 | <i>Catocala andromedae</i> Gn. | 3 |
| <i>Phosphila turbulentia</i> Hbn. | 7 | <i>Cryphia villificans</i> B. & McD. | 3 |
| <i>Renia discoloralis</i> Gn. | 7 | <i>Lacinipolia lorea</i> Gn. | 3 |
| <i>Scolecocampa liburna</i> Geyer | 7 | <i>Leucania pseudargyria</i> Gn. | 3 |
| <i>Spodoptera frugiperda</i> J. E. Smith | 7 | <i>Papaipema cerussata</i> Grt. | 3 |
| <i>Acronicta afflita</i> Grt. | 6 | <i>P. nebris</i> Gn. | 3 |
| <i>Agrotis venerabilis</i> Wlk. | 6 | <i>Procas exhausta</i> Sm. | 3 |
| <i>Chytolita morbidalis</i> Gn. | 6 | <i>P. mactata</i> Gn. | 3 |
| <i>Epidelta metonalis</i> Wlk. | 6 | <i>Schinia marginata</i> Haw. | 3 |
| <i>Eupsilia morrisoni</i> Grt. | 6 | <i>Zale aeruginosa</i> Gn. | 3 |
| <i>Feltia herilis</i> Grt. | 6 | <i>Acronicta caesarea</i> Sm. | 2 |
| <i>Hyppa xylinoides</i> Gn. | 6 | <i>Anagrapha falcifera</i> Kby. | 2 |
| <i>Leucania commoides</i> Gn. | 6 | <i>Anticarsia gemmatalis</i> Hbn. | 2 |
| <i>Marathysa inficita</i> Wlk. | 6 | <i>Baileya dormitans</i> Gn. | 2 |
| <i>Metalectra discalis</i> Grt. | 6 | <i>B. ophthalmica</i> Gn. | 2 |
| <i>Mocis texana</i> Morr. | 6 | <i>Bomolocha toreuta</i> Grt. | 2 |
| <i>Parallelia bistriaris</i> Hbn. | 6 | <i>Catocala conubialis</i> Gn. | 2 |
| <i>Platysenta vecors</i> Gn. | 6 | <i>C. ilia</i> Cram. | 2 |
| <i>Polia subjuncta</i> G. & R. | 6 | <i>Celiptera frustulum</i> Gn. | 2 |
| <i>Pyreferra hesperidago</i> Gn. | 6 | <i>Charadra deridens</i> Gn. | 2 |
| <i>Amphipyra tragopoginis</i> L. | 5 | <i>Eucirrhoedia pampina</i> Gn. | 2 |
| <i>Bleptina caradrinalis</i> Gn. | 5 | <i>Euherrichia monetifera</i> Gn. | 2 |
| <i>Catocala grynea</i> Cram. | 5 | <i>Heliothis zea</i> Harr. | 2 |
| <i>Eueretagrotis sigmoidea</i> Gn. | 5 | <i>Isogona natatrix</i> Gn. | 2 |
| <i>Graphiphora tenuicula</i> Morr. | 5 | <i>Leucania linita</i> Gn. | 2 |
| <i>Hormisa litophora</i> Grt. | 5 | <i>Lithophane hemina</i> Grt. | 2 |
| <i>Perigea xanthioides</i> Gn. | 5 | <i>L. laticinerea</i> Grt. | 2 |
| <i>Zale lineosa</i> Wlk. | 5 | <i>L. petulca</i> Grt. | 2 |
| <i>Acronicta haesitata</i> Grt. | 4 | <i>Morrisonia confusa</i> Hbn. | 2 |
| <i>A. ovata</i> Grt. | 4 | <i>Panopoda carneicosta</i> Gn. | 2 |
| <i>Apamea velata</i> Wlk. | 4 | <i>Papaipema duovata</i> Bird | 2 |
| <i>Baileya australis</i> Grt. | 4 | <i>Parathisanotia grata</i> Fabr. | 2 |
| <i>Balsa labecula</i> Grt. | 4 | <i>Plusiodonta compressipalpis</i> Gn. | 2 |
| <i>B. tristrigella</i> Wlk. | 4 | <i>Polia distincta</i> Hbn. | 2 |
| <i>Chytonix palliatricula</i> Gn. | 4 | <i>Procas crytora</i> Franc. | 2 |
| <i>Crambodes talidiformis</i> Gn. | 4 | <i>Renia flavipunctalis</i> Geyer | 2 |
| <i>Cryphia pervertens</i> B. & McD. | 4 | <i>Schinia lynx</i> Gn. | 2 |

Table 2. *Continued.*

| Species | Total Catch | Species | Total Catch |
|--------------------------------------|----------------|---|----------------|
| <i>Spodoptera exigua</i> Hbn. | 2 | <i>Protocryphia secta</i> Grt. | 1 |
| <i>Tetanolita mynesalis</i> Wlk. | 2 | <i>Protorthodes oviduca</i> Gn. | 1 |
| <i>Ulolonche culea</i> Gn. | 2 | <i>Psaphida resumens</i> Wlk. | 1 |
| <i>Zale galbanata</i> Morr. | 2 | <i>Pseudeva purpurigea</i> Wlk. | 1 |
| <i>Acontia aprica</i> Hbn. | 1 | <i>Pseudoplusia oo</i> Cram. | 1 |
| <i>Acronicta americana</i> Harr. | 1 | <i>Pyrrhia umbra</i> Hufn. | 1 |
| <i>A. brumosa</i> Gn. | 1 | <i>Raphia frater</i> Grt. | 1 |
| <i>A. interrupta</i> Gn. | 1 | <i>Schinia nundina</i> Dru. | 1 |
| <i>A. lithospila</i> Grt. | 1 | <i>S. obscurata</i> Stkr. | 1 |
| <i>A. vinnula</i> Grt. | 1 | <i>Xylomyges alternans</i> Wlk. | 1 |
| <i>Agriopodes teratophora</i> H.-S. | 1 | <i>Xystopeplus rufago</i> Hbn. | 1 |
| <i>Allotria elonympha</i> Hbn. | 1 | <i>Zale minerea</i> Gn. | 1 |
| <i>Anaplectoides prasina</i> Schiff. | 1 | | |
| <i>Anathix ralla</i> G. & R. | 1 | | |
| <i>Bomolocha bijugalis</i> Wlk. | 1 | | |
| <i>Caenurgina erechtea</i> Cram. | 1 | | |
| <i>Callopistria floridensis</i> Gn. | 1 | | |
| <i>Catabena lineolata</i> Wlk. | 1 | | |
| <i>Catocala gracilis</i> Edw. | 1 | | |
| <i>C. minuta</i> Edw. | 1 | | |
| <i>C. muliercula</i> Gn. | 1 | | |
| <i>Chytolita petrealis</i> Grt. | 1 | | |
| <i>Cucullia asteroides</i> Gn. | 1 | | |
| <i>Dypterygia scabriuscula</i> L. | 1 | | |
| <i>Epizeuxis denticulalis</i> Harv. | 1 | | |
| <i>E. forbesi</i> French | 1 | | |
| <i>Euagrotis illapsa</i> Wlk. | 1 | | |
| <i>Eurois occulta</i> L. | 1 | | |
| <i>Euthisanotia unio</i> Hbn. | 1 | | |
| <i>Feltia annexa</i> Treit. | 1 | | |
| <i>Graphiphora normaniana</i> Grt. | 1 | | |
| <i>Haploolophus mollissima</i> Gn. | 1 | | |
| <i>Heptagrotis phyllophora</i> Grt. | 1 | | |
| <i>Hypsorophra hormos</i> Hbn. | 1 | | |
| <i>Lacinipolia meditata</i> Grt. | 1 | | |
| <i>Ledaea perditalis</i> Wlk. | 1 | | |
| <i>Lithacodia musta</i> G. & R. | 1 | | |
| <i>Lithophane bethunei</i> G. & R. | 1 | | |
| <i>Loxagrotis acclivis</i> Morr. | 1 | | |
| <i>Metalectra tantillus</i> Grt. | 1 | | |
| <i>Paectes abrostoloides</i> Gn. | 1 | | |
| <i>Papaipema maritima</i> Bird | 1 | | |
| <i>Phlogophora periculosa</i> Gn. | 1 | | |
| <i>Phosphila miseliooides</i> Gn. | 1 | | |
| <i>Polia adjuncta</i> Bdv. | 1 | | |
| <i>P. detracta</i> Wlk. | 1 | | |
| <i>Procus fractilinea</i> Grt. | 1 | | |
| | | | |
| | | GEOMETRIDAE | |
| | | | |
| | | <i>Nematocampa limbata</i> Haw. | 1354 |
| | | <i>Hypagyrtis subatomaria</i> Wood | 953 |
| | | <i>Eupithecia miserulata</i> Grt. | 850 |
| | | <i>Itame pustularia</i> Gn. | 607 |
| | | <i>Pero honestarius</i> Wlk. | 530 |
| | | <i>Anacamptodes ephyraria</i> Wlk. | 446 |
| | | <i>Eugonobapta nivosaria</i> Gn. | 398 |
| | | <i>Anavitrinella pampinaria</i> Gn. | 365 |
| | | <i>Xanthorhoe lacustrata</i> Gn. | 287 |
| | | <i>Hyperetis nepiasaria</i> Wlk. | 266 |
| | | <i>Bapta vestaliata</i> Gn. | 221 |
| | | <i>Nycterosea obstipata</i> Fabr. | 174 |
| | | <i>Hyperetis amicaria</i> H.-S. | 167 |
| | | <i>Lygris diversilineata</i> Hbn. | 134 |
| | | <i>Abbottana clemataria</i> J. E. Smith | 125 |
| | | <i>Pleuroprucha insulsaria</i> Gn. | 117 |
| | | <i>Campaea perlata</i> Gn. | 116 |
| | | <i>Cosymbia packardaria</i> Prout | 115 |
| | | <i>Ectropis crepuscularia</i> Schiff. | 113 |
| | | <i>Nemoria bistriaria</i> Hbn. | 111 |
| | | <i>Scopula limboundata</i> Haw. | 100 |
| | | <i>Phigalia denticulata</i> Hulst | 94 |
| | | <i>Melanolophia canadaria</i> Gn. | 90 |
| | | <i>Euphyia centrostrigaria</i> Woll. | 88 |
| | | <i>Prochoerodes transversata</i> Dru. | 86 |
| | | <i>Synchlora aerata</i> Fabr. | 85 |
| | | <i>Xanthotype sospeta</i> Dru. | 69 |
| | | <i>Metarranthis homuraria</i> Grt. | 59 |
| | | <i>Melanolophia signataria</i> Wlk. | 58 |
| | | <i>Ennomos subsignarius</i> Hbn. | 57 |
| | | <i>Tetracis cachexiata</i> Gn. | 53 |
| | | <i>Euchlaena decisaria</i> Wlk. | 44 |
| | | <i>Plagodis fervidaria</i> H.-S. | 44 |

Table 2. Continued.

| Species | Total Catch | Species | Total Catch |
|---|-------------|--|-------------|
| <i>Epimecis hortaria</i> Fabr. | 43 | <i>P. phlogosaria</i> Gn. | 2 |
| <i>Timandra amaturaria</i> Wlk. | 38 | <i>Semiothisa continua</i> Wlk. | 2 |
| <i>Chlorochlamys chloroleucaria</i> Gn. | 37 | <i>S. ocellinata</i> Gn. | 2 |
| <i>Antepione thisoaria</i> Gn. | 36 | <i>Anagoga occiduaria</i> Wlk. | 1 |
| <i>Xanthorhoe ferrugata</i> Clerck. | 35 | <i>Chlorissa pistaciaria</i> Gn. | 1 |
| <i>Apicia confusaria</i> Hbn. | 33 | <i>Europhila vasiliiata</i> Gn. | 1 |
| <i>Besma quercivora</i> Gn. | 28 | <i>Eubaphe mendica</i> Wlk. | 1 |
| <i>Phigalia titea</i> Cran. | 27 | <i>Euchlaena irraria</i> B. & McD. | 1 |
| <i>Sicya macularia</i> Harr. | 25 | <i>Hydriomena pluviata</i> Gn. | 1 |
| <i>Hyperetis alienaria</i> H.-S. | 24 | <i>Lambdina athasaria</i> Wlk. | 1 |
| <i>Cosymbia pendulinaria</i> Gn. | 23 | <i>Metarranthis duaria</i> Gn. | 1 |
| <i>Paleacrita vernata</i> Peck | 23 | <i>M. obfirmaria</i> Hbn. | 1 |
| <i>Orthofidonia tintaria</i> Wlk. | 19 | <i>Nyrdria prunivorata</i> Ferg. | 1 |
| <i>Euchlaena serrata</i> Dru. | 16 | <i>Paleacrita merricata</i> Dyar. | 1 |
| <i>Heterophleps triguttaria</i> H.-S. | 16 | <i>Priocycla armataria</i> H.-S. | 1 |
| <i>Phigalia strigataria</i> Minot | 16 | <i>Protitame virginalis</i> Hlst. | 1 |
| <i>Euchlaena amoenaria</i> Gn. | 15 | <i>Semiothisa bisignata</i> Wlk. | 1 |
| <i>Scopula inductata</i> Gn. | 13 | <i>Tornos scolopacinarius</i> Gn. | 1 |
| <i>Dichorda iridaria</i> Gn. | 11 | | |
| <i>Haematopis grataria</i> Fabr. | 11 | | |
| <i>Dyspteris abortivaria</i> H.-S. | 8 | NOTODONTIDAE | |
| <i>Metarranthis hypochraria</i> H.-S. | 8 | <i>Heterocampa guttivitta</i> Wlk. | 202 |
| <i>Neodezia albovittata</i> Gn. | 8 | <i>H. biundata</i> Wlk. | 164 |
| <i>Itame coortaria</i> Hulst | 7 | <i>Nadata gibbosa</i> J. E. Smith | 89 |
| <i>Semiothisa aemulataria</i> Wlk. | 7 | <i>Lophodonta angulosa</i> J. E. Smith | 34 |
| <i>Anacamptodes larvaria</i> Gn. | 6 | <i>Schizura unicornis</i> J. E. Smith | 10 |
| <i>Biston betularia</i> Gn. | 6 | <i>Oligocentria lignicolor</i> Wlk. | 9 |
| <i>Euchlaena johnsonaria</i> Fitch | 6 | <i>Heterocampa manteo</i> Dbldy. | 7 |
| <i>Hydrelia albifera</i> Wlk. | 6 | <i>Schizura ipomoeae</i> Dbldy. | 6 |
| <i>Semiothisa multilineata</i> Pack. | 6 | <i>Heterocampa varia</i> Wlk. | 5 |
| <i>Plagodis phlogosaria</i> Pears. | 6 | <i>Datana contracta</i> Wlk. | 4 |
| <i>Protoboarmia porcelaria</i> Gn. | 5 | <i>Hyperaeschra georgica</i> H.-S. | 4 |
| <i>Sterrha demissaria</i> Hbn. | 5 | <i>Nerice bidentata</i> Wlk. | 4 |
| <i>Syssaura puber</i> G. & R. | 5 | <i>Fentonnia marthesia</i> Cram. | 3 |
| <i>Anacamptodes humaria</i> Gn. | 4 | <i>Symmerista canicosta</i> Franc. | 3 |
| <i>Coryphista meadi</i> Pack. | 4 | <i>Glaphisia septentrionalis</i> Wlk. | 2 |
| <i>Euphyia intermediata</i> Gn. | 4 | <i>Schizura leptinoides</i> Grt. | 2 |
| <i>Lytrosis unitaria</i> H.-S. | 4 | <i>S. semirufescens</i> Wlk. | 2 |
| <i>Deuteronomus magnarius</i> Gn. | 3 | <i>Datana integerrima</i> G. & R. | 1 |
| <i>Eupithecia</i> spp. | 3 | <i>D. major</i> G. & R. | 1 |
| <i>Metarranthis broweri</i> Rupert | 3 | <i>Ellida caniplaga</i> Walk. | 1 |
| <i>Tetracis crocallata</i> Gn. | 3 | <i>Heterocampa bilineata</i> Pack. | 1 |
| <i>Thysanopyge gausaparia</i> Grt. | 3 | <i>Ichthyura albosigma</i> Fitch | 1 |
| <i>Heliomata cycladata</i> Grt. | 3 | <i>Schizura badia</i> Pack. | 1 |
| <i>Horisme intestinata</i> Gn. | 2 | | |
| <i>Mellilla xanthometata</i> Wlk. | 2 | ARCTIIDAE | |
| <i>Plagodis alcoolaria</i> Gn. | 2 | <i>Halisdota tessellaris</i> J. E. Smith | 997 |
| | | <i>Diacrisia latipennis</i> Stretch | 187 |

Table 2. *Continued.*

| Species | Total Catch | Species | Total Catch |
|--|----------------|---|----------------|
| <i>D. virginica</i> Fabr. | 115 | <i>M. disstria</i> Hbn. | 105 |
| <i>Cycnia tenera</i> Hbn. | 90 | <i>Tolype velleda</i> Stoll. | 48 |
| <i>Estigmene congrua</i> Wlk. | 71 | | |
| <i>Euchaetis egle</i> Dru. | 41 | | |
| <i>Eubaphe opella</i> Grt. | 38 | DREPANIDAE | |
| <i>Isia isabella</i> J. E. Smith | 33 | <i>Oreta rosea</i> Wlk. | 32 |
| <i>Hyphantria textor</i> Harr. | 6 | <i>Drepana arcuata</i> Wlk. | 2 |
| <i>Apantesis phalerata</i> Harr. | 5 | <i>Eudeilinia herminiata</i> Gn. | 2 |
| <i>A. virgo</i> L. | 2 | | |
| <i>Hyphantria cunea</i> Dru. | 2 | | |
| <i>Crambidia pallida</i> Pack. | 1 | THYATIRIDAE | |
| <i>C. uniformis</i> Dyer | 1 | <i>Euthyatira pudens</i> Gn. | 3 |
| <i>Cycnia inopinatus</i> Hy. Edw. | 1 | <i>Pseudothyatira cymatophoroides</i> Gn. | 2 |
| <i>Phragmatobia assimilans</i> Wlk. | 1 | <i>Habrosyne scripta</i> Gosse | 1 |
| <i>P. lineata</i> Donahue | 1 | | |
| | | SATURNIIDAE | |
| | | <i>Automeris io</i> Fabr. | 3 |
| | | <i>Actias luna</i> L. | 1 |
| | | <i>Antheraea polyphemus</i> Cram. | 1 |
| | | <i>Dryocampa rubicunda</i> Fabr. | 1 |
| | | | |
| | | NOLIDAE | |
| <i>Paonias excaecatus</i> J. E. Smith | 18 | <i>Sarbena minuscula</i> Zell. | 186 |
| <i>P. myops</i> J. E. Smith | 7 | <i>Celama triquetra</i> Fitch | 3 |
| <i>Ceratomia undulosa</i> Wlk. | 6 | | |
| <i>Deidamia inscripta</i> Harr. | 4 | | |
| <i>Cressonia juglandis</i> J. E. Smith | 1 | APATELODIDAE | |
| <i>Darapsa pholus</i> Cram. | 1 | <i>Olceclostera angelica</i> Grt. | 85 |
| <i>Eumorpha satellitia</i> L. | 1 | <i>Apatelodes torrefacta</i> J. E. Smith | 5 |
| | | | |
| | | EPIPLEMIDAE | |
| <i>Lymantria dispar</i> L. | 328 | <i>Calledapteryx dryopterata</i> Grt. | 155 |
| <i>Orgyia leucostigma</i> A. & S. | 255 | | |
| <i>O. definita</i> Pack. | 10 | | |
| | | CTENUCHIDAE | |
| | | <i>Cisseps fulvicollis</i> Hbn. | 90 |

The relative abundance of each species as shown in Table 2 must be interpreted with some caution. Sampling intensity and trapping efficiency were not equal at all seasons. Temperature was the most important uncontrolled environmental factor affecting the size of the catch. During the fall and early spring, night temperatures often fell below the 5°C (40°F) activity threshold. The adequacy of the catch as a proportional representation of the existing moth community therefore depended upon the ability to capitalize on the few and randomly occurring warm nights during these seasons. If there was snow cover, any winter moths dormant in the leaf litter would be prevented from flying even if the air temperature was high enough. Late fall

moths may not have been adequately sampled. Trapping was discontinued in mid-October when the hunting (poaching) season began and falling leaves tended to block the trap funnels. This was too early to catch the fall cankerworm (*Alsophila pometaria* Harr.) which is known to be present in the forest. It should be recognized also that, while almost all moths will come to light, they may have differential responses to the attraction such that trapping efficiency would vary among the species. This has been demonstrated for the *Catocala* (Sargent, 1976).

It is difficult to delineate the exact physical boundaries of the community from which the species in this study were drawn. The placement of the traps, a minimum of 100 m back from the edges of the surrounding fields, undoubtedly limited the catch to the moths present in the forest. The lights were not visible from the fields during most of the season, and the attractant range of even larger blacklight traps has been found not to exceed 30 m (Hartstack et al., 1971). However, a number of the species caught are wide-ranging migrants; and others may have been blown into the forest from other habitats, thereby being non-residents of the community within the forest. Occurrences with strong stochastic elements such as these contribute in part to the tally of species represented by only one individual.

An analysis of the comparative richness of the HMF community is hampered by the lack of available studies in similar environments. The closest known study is one conducted for four years at Orono, Maine over a shorter season but with somewhat greater sampling intensity (Dirks, 1937). From 56,131 specimens, Dirks recorded 344 species of macrolepidopteran moths, 120 of which are shared with the HMF community. Williams (1939), collected 356 species involving 76,755 specimens at Rothamsted, England over four years. Preston (1948) gives data for two other unpublished moth light-trapping studies: King in Saskatchewan, Canada reported 277 species from 87,110 specimens over 22 years; and Seaman in Alberta, Canada reported 291 species from 303,251 specimens over 22 years. The greater species richness of the HMF collection may be directly or indirectly attributable to the warmer climate and greater plant species diversity of the eastern North American deciduous forest biome.

ACKNOWLEDGMENTS

Appreciation is expressed to J. P. Reed and R. F. Denno for help in identifying some specimens and to F. H. Rindge for reviewing the nomenclature of the Geometridae. This study was funded in part by a USDA sponsored program entitled "The Expanded Gypsy Moth Research and Development Program," U.S. Forest Service, Cooperative Agreement No. 42-165. This is a paper of the Journal Series, New Jersey Agricultural Experiment Station, Cook College, Rutgers University, New Brunswick, New Jersey.

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SOCIETY MEETINGS

851st Regular Meeting—May 4, 1978

The 851st Regular Meeting of the Entomological Society of Washington was called to order by President Sutherland at 8:00 pm on May 4, 1978, in the Ecology Theater of the National Museum of Natural History. Twenty-two members and 7 guests were present. The minutes of the April meeting were read and approved.

Membership chairman Utmar read for the first time the names of the following new applicants for membership:

James F. Matta, Department of Biological Sciences, Old Dominion University, Norfolk, Virginia.

Loren Russell, Department of Entomology, Oregon State University, Corvallis, Oregon.

President Sutherland announced that our editor, Manya Stoetzel, would attend the meeting of the Council of Biological Editors, to be held in Toronto, Canada. Program chairman Adler asked the Society for suggestions for speakers, particularly for the October meeting. President-elect Davis passed out announcements for the Annual Banquet and encouraged the membership to purchase tickets as soon as possible. William Bickley reminded the Society of the banquet of the Washington Academy of Sciences. Richard Foote, a member of our Society, will be their speaker.

President Sutherland introduced the principal speaker for the evening, Dr. J. C. M. Jonkman, Attaché for Health and Environmental Protection, Royal Netherlands Embassy. Dr. Jonkman spoke on the biology and ecology of the leaf-cutting ant *Atta vollenweideri* and its impact in Paraguayan pastures. The talk was well illustrated with kodachrome slides and was followed by a question and answer period.

NOTES AND EXHIBITIONS

Manya Stoetzel circulated a recent publication entitled "Aphids on Juglandaceae in North America" that was written by Ted Bissell of our Society.

The meeting adjourned at 10:05 pm, after which punch and cookies were served.

Wayne N. Mathis, *Recording Secretary*

852nd Regular Meeting—June 1, 1978

The Entomological Society of Washington and Insecticide Society of Washington Joint Annual Banquet was held on June 1, 1978, at the Fort McNair Officers' Club, Washington, D.C. Dale Parish was host, Don R.

Davis and Jack Plimmer were the banquet chairmen, and Victor Adler was the Master of Ceremonies.

After the social hour and dinner, Dr. and Mrs. Oliver S. Flint, Jr. and Dr. Wayne N. Mathis spoke on "Expedicion a Chile." Afterwards, Jack Plimmer conducted the drawing for door prizes, of which there were many.

Mrs. Floyd E. Smith planned and made the floral arrangements.

Approximately 115 members and guests attended.

Wayne N. Mathis, *Recording Secretary*

853rd Regular Meeting—October 5, 1978

The 853rd Regular Meeting of the Entomological Society of Washington was called to order by President Sutherland at 8:05 pm on October 5, 1978, in the Ecology Theater of the National Museum of Natural History. Thirty members and 10 guests were present. The minutes of the May and June meetings were read and approved.

Memberships chairman Utmar read for the first time the names of the following new applicants for membership:

Jeffrey K. Barnes, Department of Entomology, Cornell University, Ithaca, New York.

Lynda D. Corkum, Department of Zoology, University of Alberta, Edmonton, Alberta, Canada.

Raymond D. Eikenbary, Entomology Department, Oklahoma State University, Stillwater, Oklahoma.

J. D. Moulding, U.S. Army Corps of Engineers, Jacksonville, Florida.

Donald R. Perry, 247 Bicknell Apt. C, Santa Monica, California.

Barbara L. Peterson, Department of Entomology, University of Maryland, College Park, Maryland.

Richard G. Robbins, Department of Entomology, Smithsonian Institution, Washington, D.C.

John E. Rawlins, Department of Entomology, Comstock Hall, Cornell University, Ithaca, New York.

Owen D. V. Sholes, Division of Natural Sciences and Mathematics, Assumption College, Worcester, Massachusetts.

James F. Stimmel, Bureau of Plant Industry, Harrisburg, Pennsylvania.

Stephen J. Taft, Department of Biology, University of Wisconsin, Stevens Point, Wisconsin.

G. W. Wolfe, Department of Zoology, University of Tennessee, Knoxville, Tennessee.

President Sutherland announced that the Executive Committee had recently met and had reviewed and approved the amendments proposed to the Society's bylaws as submitted and explained by the bylaws committee.

President Sutherland then asked Chris Thompson of the bylaws committee to briefly explain the need for the changes and what the changes are. A handout was given to all in attendance to further explain the proposed changes. At the November meeting, there will be a vote of the membership regarding these changes.

Program chairman Adler requested suggestions from the Society for speakers at future meetings.

President Sutherland announced that Don Anderson, Dale Parrish, and Oliver S. Flint, Jr., have been asked to serve on the auditing committee and that Terry Erwin and John Kingsolver have been asked to serve on the nominating committee.

The principal speaker for the evening was Dr. Edward M. Barrows, Department of Biology, Georgetown University. Dr. Barrows spoke on the mating behavior of bees and wasps. Several kodachrome slides illustrated his talk and an interesting question and answer period followed.

NOTES AND EXHIBITIONS

J. H. Fales reported taking the European Skipper, *Thymelicus lineola* (Ochsenheimer) in Rock Creek Park, Washington, D.C., on June 10, 1978. This is the first record of this species in the District. A. B. Gurney exhibited a new book, compiled by Pamela Gilbert and published by the British Museum, "A compendium of the biographical literature on deceased entomologists," 1977. He also discussed briefly Serie II, 1864-1900, of Index Literaturae Entomologicae, 5 volumes, published 1963-1975 in Berlin, which is a continuation of the well known work published under the leadership of Walther Horn, 1928-29.

President Sutherland announced that Carl F. W. Muesebeck of our Society was recently presented with the L. O. Howard award at the Eastern Branch Meetings of the Entomological Society of America in New York.

Dee Houston announced that an international pollination symposium will be held at the University of Maryland, October 11-13.

Following the introduction of guests, President Sutherland adjourned the meeting, after which punch and cookies were served.

Wayne N. Mathis, *Recording Secretary*

854th Regular Meeting—November 2, 1978

The 854th Regular Meeting of the Entomological Society of Washington was called to order by President Sutherland at 8:00 pm on November 2, 1978, in the Ecology Theater of the National Museum of Natural History. Twenty-seven members and 18 guests were present. The minutes of the October meeting were read, corrected, and approved.

Membership chairman Utmar read for the first time the names of the following new applicants for membership:

Ibrahim J. Al Gboory, Baghdad University, Abu-Ghraib, Iraq.

Thomas Richard Beck, 12607 Cedarbrook Lane, Laurel, Maryland.

Mignon M. Davis, Department of Entomology, Smithsonian Institution, Washington, D.C.

Paul H. Freytag, Department of Entomology, University of Kentucky, Lexington, Kentucky.

Hans J. Hannemann, Zoologisches Museum, Humboldt University, Berlin, DDR, East Germany.

Carl H. Kaster, Department of Biology, University of Louisville, Louisville, Kentucky.

James L. Skaptason, 11164 Forest Edge Dr., Reston, Virginia.

Rebecca F. Surdick, Department of Biology, University of Utah, Salt Lake City, Utah.

John Trumble, Department of Biology, Virginia Polytechnic Institute State University, Blacksburg, Virginia.

T. R. White, Department of Entomology and Economic Zoology, Clemson University, Clemson, South Carolina.

President Sutherland announced that the third member of the nominating committee is John Davidson.

President Sutherland asked Chris Thompson, chairman of the bylaws committee, to again explain why the bylaws committee was convened and their proposed amendments, which were presented and passed by the executive committee for presentation to the general membership at a regular meeting. Ray Gagne moved that the amendments to the bylaws be accepted unanimously. Three objections to the wording of the proposed amendments were raised by George Steyskal and explained by Chris. These were discussed. The motion was seconded and passed by a three-fourths majority.

John Kingsolver, member of the nominating committee, announced their slate of nominees for 1979. They are:

| | |
|-------------------------|-----------------------|
| President-elect | Theodore J. Spilman |
| Recording Secretary | Wayne N. Mathis |
| Corresponding Secretary | Mignon B. Davis |
| Treasurer | F. Christian Thompson |
| Program Chairman | Michael Faran |
| Membership Chairwoman | Joyce A. Utmar |
| Editor | Manya B. Stoetzel |
| Custodian | Sueo Nakahara |

President Sutherland introduced the principal speakers for the evening, Dr. John Davidson, Department of Entomology, University of Maryland;

and Mr. Stan Gill, Extention Agent, Montgomery Co. They spoke on integrated pest management of urban ornamental plants and presented numerous kodachrome slides to illustrate their talk.

NOTES AND EXHIBITIONS

Mignon Davis passed around a new book entitled "Magnificent Foragers," which is a photo-written account of the field activities of the scientists at the National Museum of Natural History.

Maynard Ramsay showed a new edition of Fundamentals of Applied Entomology, Robert Pfadt editor.

Manya Stoetzel exhibited a new book entitled "Whitefly of the world, a systematic catalogue of the Aleyrodidae (Homoptera) with host plant and natural enemy data" by L. A. Mound and S. H. Halsey, British Museum (Natural History), London, 1978. [John Wiley & Sons, Ltd., England 13.50.]

John Kingsolver announced that Herb Ross had died (2 Nov.) and gave a brief biography of his life.

Following the introduction of many guests, the meeting was adjourned at 9:40 pm.

Wayne N. Mathis, *Recording Secretary*

855th Regular Meeting—December 7, 1978

The 855th Regular Meeting of the Entomological Society of Washington was called to order by President Sutherland at 8:00 pm on December 7, 1978, in the Ecology Theater of the National Museum of Natural History. Forty members and 28 guests were present.

The minutes of the November meeting were read and approved.

Membership chairman Utmar read for the first time the names of the following new applicants for membership:

Rick Borchelt, Department of Entomology, University of Maryland, College Park, Maryland.

Mark A. Deyrup, Department of Entomology, Purdue University, West Lafayette, Indiana.

Deborah R. McGann, 5497 Lighthouse Lane, Lake Braddock, Burke, Virginia.

O. P. Negrobov, Faculty of Biological Sciences, Voronesh University, Voronesh, USSR.

President Sutherland reported that the Society had completed the year in good condition and asked the membership chairman, editor, and treasurer to give their reports, which they did. Summary reports will be published in the April issue of the Proceedings.

President Sutherland then presented the slate of nominees for the Society's elected offices as announced previously. They are:

| | |
|-------------------------|-----------------------|
| President-elect | Theodore J. Spilman |
| Recording Secretary | Wayne N. Mathis |
| Corresponding Secretary | Mignon B. Davis |
| Treasurer | F. Christian Thompson |
| Program Chairman | Michael Faran |
| Membership Chairwoman | Joyce A. Utmar |
| Editor | Manya B. Stoetzel |
| Custodian | Sueo Nakahara |

It was moved and seconded that the slate be adopted as presented. The motion passed unanimously. President Sutherland also announced that Helen Sollers-Riedel has again agreed to be hospitality chairwoman for the coming year.

On behalf of the Society, President Sutherland presented an engraved bowl to Mrs. Floyd Smith in appreciation for years of service to the Society in making floral displays for the annual banquets.

The principal speaker for the evening was Dr. Don Davis, Department of Entomology, Smithsonian Institution. Dr. Davis spoke on African entomology, "A Trip Report." His talk was illustrated by numerous kodachrome slides of insects, other wildlife, and the terrain. The excellence of the slides is in part a credit to Mignon Davis. Dr. Davis also brought along a drawer of insects collected on the trip and a vial of *Polypedilum vanderplanki* Hinton, the indestructable chironomid fly.

NOTES AND EXHIBITIONS

John Kingsolver showed the first fascicle of the North American Coleoptera Catalog. John explained how the information can be updated and said that the catalog will be completed during the next 10 years.

Don Davis announced that Doris Blake, a longtime member of the Society, had passed away on December 3rd. Doris worked on the taxonomy of chrysomelid beetles and had been associated with the museum for over 40 years.

T. J. Spilman showed the 43rd edition of The Naturalists' Directory and Almanac (International), compiled and edited by Ross H. Arnett, Jr.

T. J. Spilman reported the death of Henry Dietrich of Cornell University on November 8th and the hospitalization and recovery of Curtis Sabrosky and Ashley Gurney.

Following the introduction of many guests, President Sutherland turned the gavel over to Don Davis who adjourned the meeting.

Punch and cookies were served afterward.

Wayne N. Mathis, *Recording Secretary*

SECOND INTERNATIONAL CONGRESS OF SYSTEMATIC AND
EVOLUTIONARY BIOLOGY
(ICSEB-II)

The Second International Congress of Systematic and Evolutionary Biology (ICSEB-II) will be held at The University of British Columbia, Vancouver, Canada, 17-24 July 1980.

The provisional list of symposia topics include:

1. Arctic refugia and the evolution of Arctic biota
2. Origins and evolution of the North Pacific marine biota
3. Evolution of reproductive strategies
4. Evolutionary epigenetics
5. Evolution of community structure
6. Green algae and land plant origins
7. Macromolecular mechanisms in evolution
8. Allozymes and evolution
9. Coevolution and foraging strategy
10. Evolution of colonizing species
11. Rare species and the maintenance of gene pools
12. Paleobiology of the pacific rim

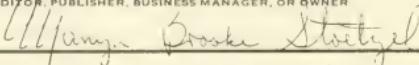
Additional symposia may be included.

Sessions for contributed papers and for papers in specialized fields, taxonomic as well as methodological, will also be organized.

Those interested in receiving an information circular in the spring of 1979, should write to the following:

Dr. G. G. E. Scudder
Department of Zoology
The University of British Columbia
2075 Wesbrook Mall
Vancouver, B.C. V6T 1W5
Canada.

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- ANNOUNCEMENT: Second International Congress of Systematic and Evolutionary Biology (ICSEB-II)

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PROCEEDINGS

of the

ENTOMOLOGICAL SOCIETY

of WASHINGTON



DEPARTMENT OF ENTOMOLOGY
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WASHINGTON, D.C. 20560

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TAXONOMY AND BIOGEOGRAPHY OF WEEVILS OF THE GENUS
SIBINIA GERMAR (COLEOPTERA: CURCULIONIDAE)
ASSOCIATED WITH *PROSOPIS* (LEGUMINOSAE:
MIMOSOIDEAE) IN ARGENTINA

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Abstract.—Five species in the *sulcifera* group of the genus *Sibinia* Germar occur in the semiarid Monte and Chaco biotic provinces of Argentina and have hosts in the plant genus *Prosopis* (Leguminosae). *Sibinia asulcifera* Clark, newly recorded from *P. argentina*, *P. flexuosa*, and *P. torquata* and *S. concava* Clark, now known from *P. flexuosa*, *P. nigra*, and *P. alba*, are confirmed as a seed-bud predator microsympatric pair. Three Argentine species, *S. mastuerzo* from *P. strombulifera*, *S. tintitaco* from *P. torquata*, and *S. algarobilla* from *P. seriacantha* are newly described. A key to the Argentine *sulcifera* group members is presented, and the position of the new species in a modified version of a previously reconstructed *sulcifera* group phylogeny is discussed. Zoogeography of the group is considered in light of various hypotheses put forth to explain similarities in the floras of the disjunct arid regions of North and South America. The *sulcifera* group is apparently unusual among animals associated with plants in these areas in having closely related species in both regions.

This paper is based on a study of 17 specimens of the weevil genus *Sibinia* sent to the United States National Museum of Natural History (USNM) for identification by Hugo Cordo of the U.S. Department of Agriculture. The specimens were collected in western Argentina, in the Monte and Chaco phytogeographic provinces, as part of an effort to find agents for biological control of *Prosopis*. In view of the current interest in *Prosopis* as an important component of New World desert ecosystems (Simpson, 1977) and *Prosopis*-associated insects, both from the standpoint of their natural history and ecology (Kingsolver et al., 1977), and as potential biological control agents in North America (Ward et al., 1977), it is desirable to review what is known about *Prosopis*-associated species of *Sibinia*.

Five species of *Sibinia*, all members of the *sulcifera* group of the subgenus *Microtychius*, are represented in the series collected by Cordo. Two

of the species, *S. asulcifera* Clark and *S. concava* Clark, have been described (Clark, 1978). The other three are described for the first time herein. The specimens were collected on six different species of *Prosopis*: *P. argentina* Burkart, *P. flexuosa* de Candolle, *P. nigra* (Grisebach) Hieronymus, and *P. seriacantha* Hooker and Arnott of the section *Algarobia*, and *P. strombulifera* (Lamarck) Bentham, and *P. torquata* (Lagasca) de Candolle of the section *Strombocarpa*.

Although direct information on the life histories of these species of *Sibinia* is not available, it is possible to infer the probable site of larval development of each. The host plants of all of the 127 previously described members of the subgenus *Microtychius* are known to be, or are suspected to be, mimosoid legumes (Clark, 1978). Larvae of some species of *Microtychius* develop in seeds of these plants (seed predators), whereas larvae of others develop in the flower buds (bud predators). Adults of the seed predators are generally easily distinguished from adults of bud predators by their larger size, more prominent structural features, and frequently more distinctive scale patterns. Thus, although the larval developmental site of only one *sulcifera* group member, the bud predator *S. setosa* (LeConte) is known (see Rogers et al., 1975), it is inferred that the *sulcifera* group contains both bud and seed predators.

Another important characteristic of species of *Microtychius* is the frequent synchronous occurrence of individuals of two or more species on the same plant. I refer to this situation as "microsympatry," distinguished from "sympatry," or the occurrence of individuals of different species of *Microtychius* at a given locality on different plant species. In *Microtychius* it is common for individuals of a seed predator to be microsympatric with individuals of one, or sometimes two or more, bud predators. The members of these microsympatric bud-seed predator pairs frequently belong to the same species group, and appear to be limited to one or a few closely related host plant species. These attributes appear to characterize the *sulcifera* group.

With this as background, it is possible to discuss the *sulcifera* group in greater detail. The species descriptions and line drawings were prepared using techniques described previously (Clark, 1978). All 17 of the specimens received from Cordo are deposited in the USNM collection. In addition to locality and host labels, each of the specimens bears a label, presumably affixed by the collector, with a unique combination of numbers and letters. The specimens are referred to by this combination at certain places in the text.

THE *SULCIFERA* GROUP

Members of the *sulcifera* group have the following diagnostic features (modified from Clark, 1978:128): Eyes relatively small, flattened, hind mar-

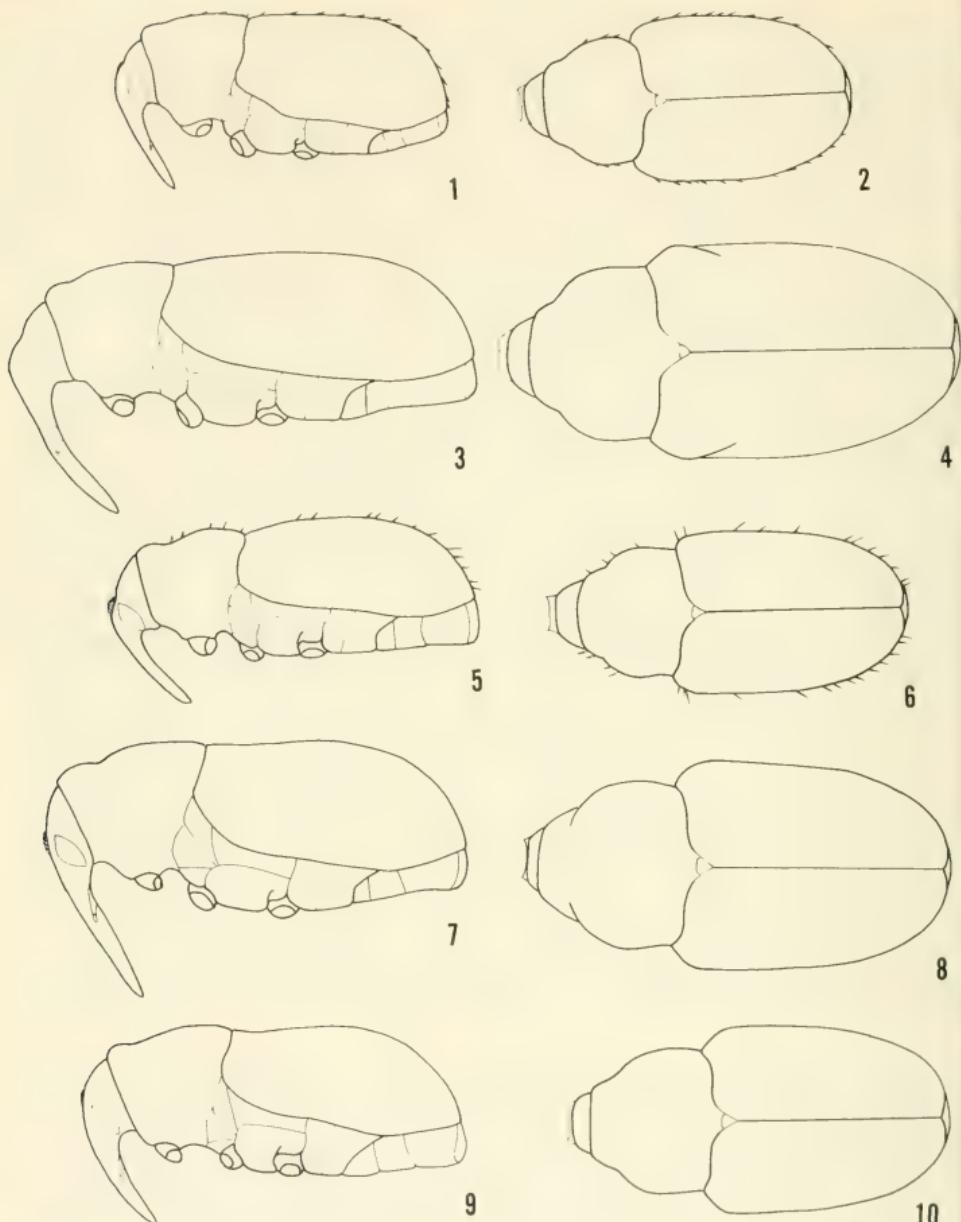
gins not raised; frons distinctly wider than rostrum at base; vertex of head, rostrum, pronotum, elytra, and femora with large, round to subquadrate, imbricated scales which are strongly concave in most species, and with elongate, narrow scales which are erect and acuminate in some species (absent from the pronotum in some).

Four of the nine species in the *sulcifera* group are North American. These are *S. transversa* (Casey) of the southwestern United States, and *S. cuauhtemoc* Clark of southern Mexico, both on *Acacia*; *S. setosa* (LeConte) of the southwestern United States, Mexico, and the West Indies, on *Prosopis* (see Rogers et al., 1975; Clark, 1978:135–137, 140–141), and *S. sulcifera*, presumably of Mexico, but known only from specimens intercepted in quarantine at the U.S.-Mexico border, on unknown host(s). The remaining five species are known only from Argentina. These are *S. asulcifera*, *S. concava*, and three species described herein on *Prosopis*.

The North American *sulcifera* group members are distinguished from each other by the characters in the key to North and Central American *Sibinia* (Clark, 1978). Three of the Argentine species, *S. asulcifera*, *S. tintitaco*, and *S. mastuerzo*, trace to *S. asulcifera* in the key to South American *Sibinia* (Clark, 1978). The other two Argentine species, *S. concava* and *S. algarobilla*, trace to *S. concava* in the same key. The Argentine species are distinguished from each other in the following key:

KEY TO SPECIES OF THE *SIBINIA SULCIFERA* GROUP FROM ARGENTINA

1. Round to subquadrate recumbent scales biseriate on all elytral interspaces; pronotum without elongate narrow scales; narrow scales, if present on elytra, short, recumbent, or raised only slightly on declivities 2
- Round to subquadrate recumbent scales uniserial on major portions of even-numbered elytral interspaces; pronotum and elytra with prominent, narrow, attenuate, erect bristlelike scales (Figs. 1–2, 5–6, 19) 4
2. Distal portion of rostrum more or less cylindrical (Figs. 1, 3, 5, 7) ... 3
- Distal portion of rostrum acuminate (Fig. 9) ... *S. tintitaco*, new species
3. Recumbent scales on pronotum and elytra not or only feebly concave; rostrum nearly straight (Fig. 7); sternum 5 of female abdomen strongly constricted, posteromedian portion distinctly produced ... *S. mastuerzo*, new species
- Recumbent scales on pronotum and elytra distinctly concave; rostrum curved (Fig. 3); sternum 5 of female abdomen only feebly constricted, posteromedian portion not produced *S. asulcifera* Clark
4. Round to subquadrate recumbent scales uniserial on even-numbered elytral interspaces; even interspaces devoid of bristlelike scales *S. concava* Clark



Figs. 1-10. *Sibinia* spp., habitus. (1) *S. algarobilla*, female, holotype, lateral view; (2) the same, dorsal view; (3) *S. asulcifera*, female, paratype, Andalgala, Catamarca, Argentina, lateral view; (4) the same, dorsal view; (5) *S. concava*, female, paratype, Andalgala, Catamarca, Argentina, lateral view; (6) the same, dorsal view; (7) *S. mastuerzo*, female, holotype, lateral view; (8) the same, dorsal view; (9) *S. tintitaco*, female, holotype, lateral view; (10) the same, dorsal view.

- Round to subquadrate recumbent scales uniserial on elytral interspace 4 and on basal portions of interspaces 6 and 8, biseriate on odd-numbered interspaces and on remainder of even-numbered interspaces; even-numbered interspaces with prominent, erect bristle-like scales *S. algarobilla*, new species

Sibinia (Microtychius) asulcifera Clark

Figs. 3, 4

Sibinia (Microtychius) asulcifera Clark, 1978:129. Holotype, ♂, 50 km W Andalgala, Catamarca, Argentina (USNM).

Diagnosis.—Distal portion of rostrum cylindrical (Fig. 3); concave recumbent scales biseriate on odd- and even-numbered elytral interspaces; odd-numbered elytral interspaces with median row of short, narrow, recumbent scales, these dense and conspicuous on declivities; pronotum without narrow scales.

Description.—See Clark, 1978:129.

Discussion.—This relatively large *Microtychius* is probably a seed predator. Although members of the type-series were collected on non-mimosoid plants (*Cassia* and *Zuccagnia*; Leguminosae, subfamily Caesalpinoideae), it was predicted (Clark, 1978:135) that the weevil would have a *Prosopis* host(s) because of its close resemblance to the *Prosopis*-associated bud predator *S. concava*. The receipt of three *S. asulcifera* specimens collected on *Prosopis* confirms that prediction. Furthermore, the fact that one specimen of *S. asulcifera* (D-457b) and a specimen of *S. concava* (D-457a) bear identical label data is evidence that the two species may, as was also predicted, occur in microsympatry. Another specimen of *S. asulcifera* (D-543) appears to have been taken in microsympatry with the bud predator *S. tintitaco* (D-545a, D-545b). The *Prosopis* spp. on which the *S. asulcifera* specimens were collected belong to two of the six generic sections recognized by Burkart (1940), *Algarobia* and *Strombocarpa*.

The specimens received from Cordo were taken in San Juan Province, at localities and on dates and hosts as follows (see Fig. 22): D-457b. Rt. 40, 39 mi N San Juan City, 26 November 1976, sweeping *Prosopis flexuosa*. D-509. Rt. 40, 51 mi N San Juan City, 26 November 1976, sweeping *Prosopis argentina*. D-543. Rt. 40, 10 mi N Jachal, 27 November 1976, sweeping *Prosopis torquata*.

Sibinia (Microtychius) mastuerzo Clark, NEW SPECIES

Figs. 7, 8, 12, 15

Holotype.—♀, Argentina: Mendoza Province, Rt. 40, 10 mi N Mendoza City, 24 November 1976, sweeping *Prosopis strombulifera*, D-377a. (USNM Type no. 75852).

Paratype.—Same label data as holotype (1 ♀, D-377b).

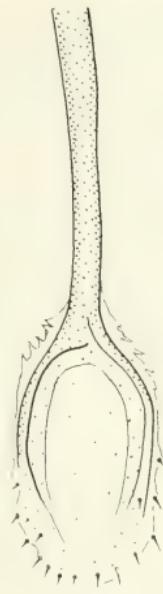
Diagnosis.—Rostrum of female nearly straight, distal portion cylindrica (Fig. 7); recumbent scales on elytral interspaces flat or feebly concave uniformly biserrate; odd-numbered interspaces with median row of short stout, apically blunt scales which are recumbent on dorsum, erect, but inconspicuous on declivites.

Description.—*Length*: 1.86–2.08 mm. *Width*: 0.92–1.06 mm. *Eye*: Height about $1.5 \times$ length. *Frons*: Rounded continuously with head (Fig. 7); scales on sides forming low superocular tuft. *Rostrum*: 0.88–0.94 × pronotal length; in dorsal view tapered slightly to antennal insertions, subparallel sided to tip; in dorsal profile broadly curved at base, nearly straight from just distad of base to tip; distal portion long, 55–59% of total rostral length, slender, glabrous, smooth. *Prothorax*: Pronotum and pleuron with round to subquadrate recumbent scales only, these not or only slightly concave; white, fulvo ferruginous, and ferruginous scales present, white scales forming incomplete, posteriorly-widened dorsomedian vitta, ferruginous scales forming broad lateromedian vittae, posterolateral portions and pleuron with white scales and ferruginous or fulvo ferruginous scales intermixed. *Elytra*: Interspaces subequal in width; round to subquadrate recumbent scales not or only feebly concave, broadly imbricated; short, recumbent narrow scales forming irregular mediobasal macula and sutural vitta, intermixed among fulvo ferruginous or ferruginous scales on remainder, especially dense laterally and on declivities. *Abdomen*: Median portion of sterna 1–5 feebly convex, sternum 5 strongly constricted subapically, posteromedian portion of segment slightly produced and distinctly flexed downward. *Spiculum ventrale*: See Fig. 12. *Spermatheca*: See Fig. 15.

Discussion.—Roughly comparable to *S. asulcifera* in size, *S. mastuerzo* is probably, like that species a seed predator. Its host is *Prosopis strombulifera*.

Etymology.—The name *mastuerzo*, a Spanish vernacular name of the host (Rowell, 1969), is also generally applied to South American members of the section *Strombocarpa* (commonly known as "screwbeans" in North America (Burkart and Simpson, 1977)). The masculine noun stands in apposition to the feminine generic name.

Figs. 11–18. *Sibinia* spp., external genitalia. (11) *S. algarobilla*, paratype, D-690a, spiculum ventrale; (12) *S. mastuerzo*, paratype, D-377b, spiculum ventrale; (13) *S. tintitaco*, paratype, D-545b, spiculum ventrale; (14) *S. algarobilla*, paratype, D-690a, spermatheca; (15) *S. mastuerzo*, paratype, D-377b, spermatheca; (16) *S. tintitaco*, paratype, D-545b, spermatheca; (17) *S. algarobilla*, paratype, D-690b, median lobe of male genitalia, ventral view; (18) *S. tintitaco*, paratype D-640b, median lobe of male genitalia, ventral view.



11



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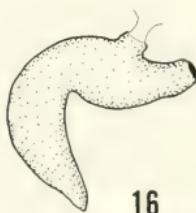
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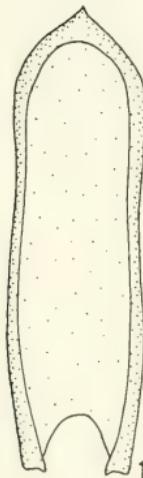
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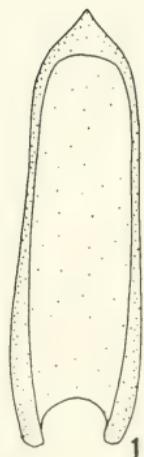
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18

Sibinia (Microtychius) tintitaco Clark, NEW SPECIES
Figs. 9, 10, 13, 16, 18, 20

Holotype.—♀, Argentina: San Juan Province, Rt. 40, 10 mi W Jachal, 20 November 1976, sweeping *Prosopis torquata*, D-545a (USNM Type no. 75851).

Paratypes.—Argentina: La Rioja Province, Rt. 40, 20 mi NE Pangancillo, 20 November 1976, sweeping *Prosopis torquata* (1 ♀, D-640a; 1 ♂, D-640b); same label data as holotype (1 ♀, D-545b).

Diagnosis.—Distal portion of rostrum acuminate (Fig. 9); recumbent scales biseriate on each elytral interspace; odd-numbered interspaces with median row of short, narrow scales which are feebly raised on declivities; pronotum without such scales.

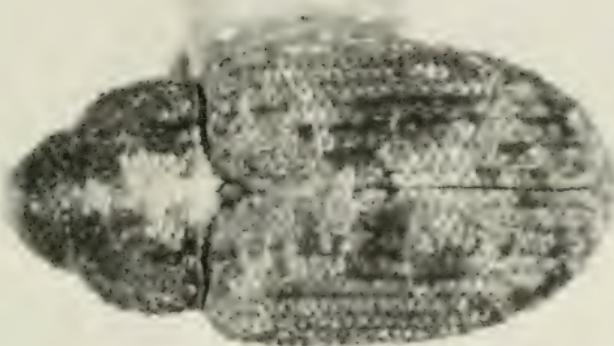
Description.—*Length*: ♂, 1.56 mm; ♀, 1.78–1.82 mm. *Width*: ♂, 0.78 mm; ♀, 0.94–0.96 mm. *Eye*: Height about $1.6 \times$ length. *Frons*: In profile rounded continuously with head; erect scales on sides forming a low but distinct superocular tuft. *Rostrum*: ♂, $0.81 \times$; ♀, $0.82–0.93 \times$ pronotal length; in dorsal view strongly tapered to antennal insertions, finely acuminate distally, especially in ♀; in dorsal profile, broadly rounded at base, broadly, evenly curved from just distad of base to tip; distal portion in ♂ short, 52% of total rostral length, stout; in lateral view tapered, lateral sulcus obsolete; in ♀, distal portion longer, 58–61% of total rostral length, smooth, shining. *Prothorax*: Pronotum with round, concave, imbricated scales only; white scales present in incomplete, posteriorly-widened dorsomedian vitta which is bounded on each side by broad, irregular vittae of ferruginous scales, the latter darkest on posterior portion; lateral portions of dorsum and pleuron with fulvous and paler whitish scales admixed. *Elytra*: Interspaces subequal in width; recumbent scales on interspaces round to subquadrate, concave, broadly imbricated, biseriate; white, fulvous, and darker ferruginous scales present in irregular pattern; white scales forming broad anteromedian macula and narrower posteromedian macula (Fig. 20); maculae separated by irregular transverse band of ferruginous scales; ferruginous and fulvous scales also variably intermixed mediobasally, elsewhere fulvous and whitish scales intermixed. *Abdomen*: In ♂, sterna 1–4 shallowly, broadly concave medially, sternum 5 more deeply impressed, but not foveate medially; in ♀, subapical constriction of sternum 5 distinct but posteromedian portion of segment not produced. *Median lobe*: See Fig. 18. *Spiculum ventrale*: See Fig. 13. *Spermatheca*: See Fig. 16.

Discussion.—This relatively small *Microtychius* is probably a bud predator of *Prosopis torquata*. It apparently occurs in microsympatry with the seed predator *S. asulcifera*, at least at the type-locality.

The only significant variation noted in the small series examined is in the relative proportion of light fulvous and whitish scales and darker ferruginous scales on the pronotum and elytra.



19



20

Figs. 19–20. *Sibinia* spp., habitus. (19) *S. concava*, paratype, female, Andalgala, Catamarca, Argentina, dorsal view; (20) *S. tintitaco*, female, holotype, dorsal view.

Etymology.—The name *tintitaco*, a Spanish vernacular name of *P. torquata* (Rowell, 1969; Burkart and Simpson, 1977), is a masculine noun standing in apposition to the feminine generic name.

Sibinia (Microtychius) concava Clark

Figs. 5, 6, 19

Sibinia (Microtychius) concava Clark, 1978:135. Holotype, ♀, 11 km W Las Cejas, Tucuman, Argentina (C. W. O'Brien collection).

Diagnosis.—Distal portion of rostrum cylindrical (Fig. 5); concave recumbent scales biseriate on odd-numbered elytral interspaces, uniserrate on even-numbered interspaces; pronotum and odd-numbered elytral interspaces with prominent, acuminate, erect bristlelike scales, even-numbered interspaces devoid of such scales.

Description.—See Clark, 1978:135.

Discussion.—This relatively small *Microtychius* is probably a bud predator. One of the paratypes (from Las Termas, Santiago del Estero Province, Argentina) was collected on *Prosopis alba* Grisebach. Cordo's specimens were taken on two species of *Prosopis* (listed below), both of them, like *P. alba*, members of the section *Algarobia*. The apparent microsympatry of *S. concava* and the seed predator *S. asulcifera* on *P. flexuosa* is discussed in the section dealing with *S. asulcifera*.

The specimens received from Cordo were collected at the localities on dates and plants as follows (see Fig. 22): D-226. San Luis Province, Rt. 7, 4 mi W San Luis City, 20 November 1976, sweeping *Prosopis nigra*. D-369. Mendoza Province, Rt. 40, 10 mi S Mendoza-San Juan border, 24 November 1976, sweeping *Prosopis flexuosa*. D-457a. San Juan Province, Rt. 40, 39 mi N San Juan City, 26 November 1976, sweeping *Prosopis flexuosa*. D-675. La Rioja Province, Rt. 38, 6 mi SE Patquia, 20 November 1976, sweeping *Prosopis flexuosa*. D-684. La Rioja Province, Rt. 38, 27 mi SE Patquia, 30 November 1976, sweeping *Prosopis flexuosa*.

Sibinia concava is also known from Andalgala, Catamarca Province (Clark, 1978:135).

Sibinia (Microtychius) algarobilla Clark, NEW SPECIES

Figs. 1, 2, 11, 14, 17

Holotype.—♀, Argentina: La Rioja Province, Rt. 38, 8 mi W border La Rioja-Cordoba, 30 November 1976, sweeping *Prosopis seriacantha*, D-691 (USNM Type no. 75853).

Paratypes.—Same label data as holotype (1 ♀, D-690a; 1 ♂, D-690b).

Diagnosis.—Distal portion of rostrum attenuate, not acuminate (Fig. 1); recumbent scales on elytral interspace 4 and on basal portions of interspaces 6 and 8 uniserrate, otherwise scales biseriate; pronotum and odd- and even-numbered elytral interspaces with prominent, erect, attenuate bristlelike scales; whitish and fulvous scales intermixed on pronotum and elytra.

Description.—Length: ♂, 1.78 mm; ♀, 1.60–1.66 mm. Width: ♂, 0.88 mm; ♀, 0.84–0.88 mm. Eye: Height about $1.4 \times$ length. Frons: Rounded separately from head (Fig. 1); erect scales forming a distinct superocular tuft. Rostrum: ♂ and ♀, $0.9 \times$ pronotal length; in dorsal view distinctly tapered from base to antennal insertions, slightly narrowed just distad of insertions, then subparallel to tip; in dorsal profile, moderately rounded at base, nearly straight from just distad of base to tip; distal portion of male

rostrum moderately long, 52% of total rostral length, slender, in lateral view slightly tapered, sulci obsolete; in female, distal portion longer, 50–58% of total rostral length, smooth, shining. *Prothorax*: Pronotum with round, concave, imbricated scales, and short, narrow, erect scales intermixed; pleuron with round, recumbent scales only; white scales present in large postero-median macula on dorsum; a few ferruginous scales present in large posteromedian macula and posterolaterally; fulvous and pale whitish scales intermixed elsewhere; scales on pleuron whitish. *Elytra*: Odd-numbered interspaces slightly wider than even-numbered ones; recumbent scales biserrate on each odd-numbered interspace and on interspace 2 posteriorly, mostly uniserrate on even-numbered interspaces; each odd-numbered interspace and interspace 2 with median row of short, narrow, erect scales; other even-numbered interspaces without erect scales, or these sparse; white, fulvous, and ferruginous scales present in irregular pattern; white scales forming broad anteromedian macula and narrower, posteromedian macula; maculae separated by irregular transverse band of ferruginous scales; ferruginous and fulvous scales also variably intermixed mediobasally, elsewhere fulvous and whitish scales intermixed. *Abdomen*: Sterna 1–4 nearly flat medially in ♂, feebly convex in ♀; sternum 5 of ♂ not depressed medially; subapical constriction of sternum 5 of ♀ obsolete. *Median lobe*: See Fig. 17. *Spiculum ventrale*: See Fig. 11. *Spermatheca*: See Fig. 14.

Discussion.—Like *S. concava*, which it closely resembles, this minute *Microtychius* is most likely a bud predator of its *Prosopis seriacantha* host. In addition to the diagnostic characters listed, *S. algarobilla* is distinguished from *S. concava* by its shorter, stouter body form (cf. Figs. 1, 2, 5, 6).

Etymology.—The name *algarobilla* is one of the vernacular names of the host (Rowell, 1969). It is the diminutive form of algarobo, the vernacular name applied in South America to all *Prosopis* with arched or straight fruits (Burkart and Simpson, 1977), most of which, like *P. seriacantha*, belong to the section *Algarobia*. The diminutive is appropriate for this very small weevil.

PHYLOGENY

In a reconstruction of the phylogeny of the New World species of *Sibinia* (Clark, 1978) five character states were hypothesized to indicate sister group relationships within the *sulcifera* group (numbers as on Figure 443 of that work):

- 23—spiculum ventrale with elongate, broadly forked base;
- 24—elytra with transverse diamond-shaped mediobasal fascia;
- 25—hosts in plant genus *Prosopis*;
- 26—Spermatheca as in Fig. 27 (of Clark, 1978); and
- 27—distal portion of female rostrum elongate, slender, cylindrical, smooth.

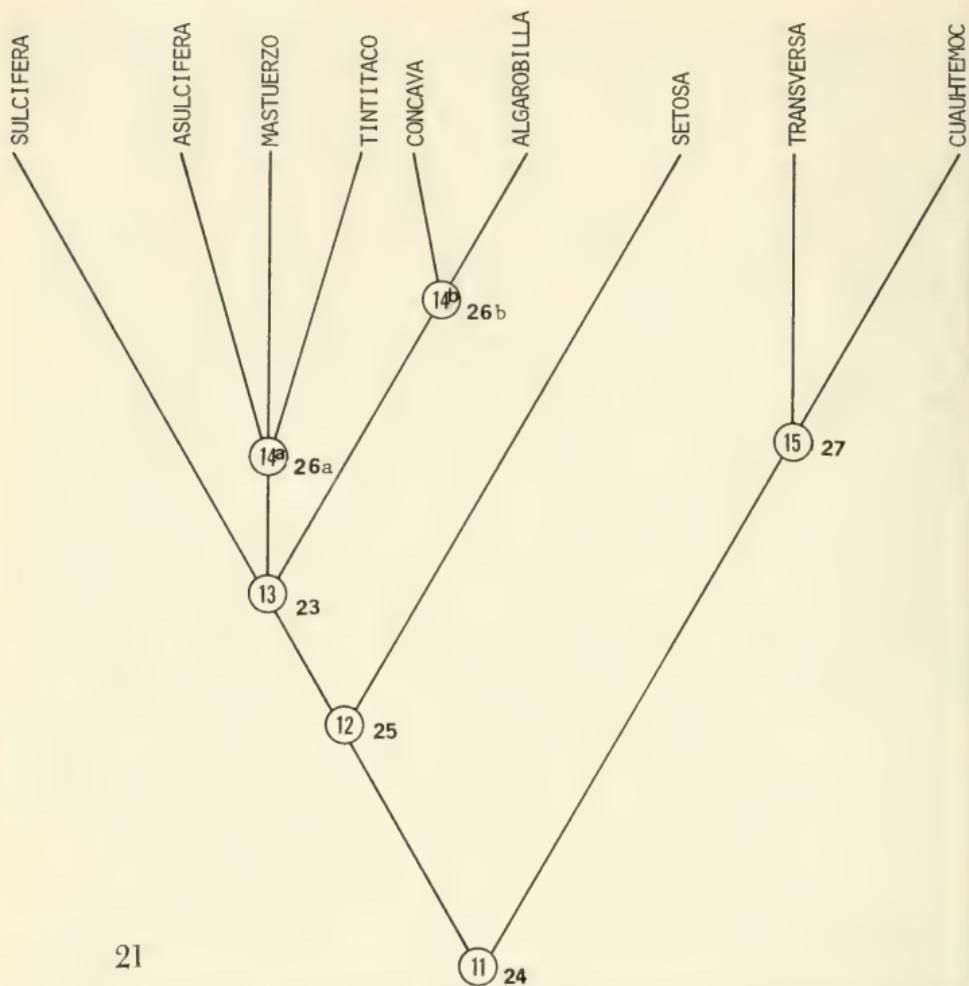


Fig. 21. Cladogram of phylogenetic relationships of *slucifera* group of genus *Sibinia*. Numbers at nodes designate hypothetical ancestors referred to in the text and in Clark (1978); numbers beside nodes designate apotypic character states referred to in the same places.

A modified, apparently more parsimonious cladogram (Fig. 21), which also depicts relationships of the three new species from Argentina is now proposed. This arrangement requires assumption of loss of apotypic state 24 in *S. sulcifera*, rather than reversal or loss of state 23 in *S. setosa*, *S. transversa*, and *S. cuauhtemoc* required by the previously proposed system. Inference of the *Prosopis* host association in ancestor 12 requires assumption that *S. sulcifera* will be found to have a *Prosopis* host. All of the new Argentine species possess apotypic states 23, 24, and 25, but not 26. The latter state is probably a weak indication of relationship, however. Spermathecal shape in *S. asulcifera* and *S. concava* does not really differ greatly.

from that in *S. sulcifera* (Clark, 1978, Fig. 26) and in the new Argentine species (Figs. 14–16, herein). Instead, a system based on two additional apotypic states inferred in ancestors 14a and 14b (Fig. 21) is now proposed:

- 26a—pronotum without elongate, narrow scales, and
- 26b—round to subquadrate scales uniserrate on major portions of even-numbered elytral interspaces.

No evidence of sister-group relationships among any two of the three different lines depicted as arising from each of ancestors 13 and 14a was found. Further collecting and search for apotypic states in the *sulcifera* group is important and desirable in light of the existence in the group of species in arid regions of both North and South America. The significance of these relationships in view of the amphitropical similarities of the floras of these disjunct regions is discussed below.

BIOGEOGRAPHY

The apparent amphitropical disjunct distribution of *sulcifera*-group members in arid regions of Argentina and North America brings to mind the well-known similarities of the disjunct floras of arid regions of North and South America, particularly the North American Sonoran Desert and the Argentine Monte. This is all the more intriguing because of the *Prosopis* host association of North and South American members of the *sulcifera* group. *Prosopis* is one of the major components of the floras of the arid regions of both continents (see Simpson, 1977). Various theories advanced to explain similarities in the floras of the Sonoran Desert and the Monte were reviewed by Solbrig et al. (1977). These authors concluded that at the family and generic levels the similarities had their origins "in the process of parallel or convergent evolution towards arid adaptations from common or closely related, more mesic ancestors." They cite Raven and Axelrod (1974), however, in describing the hypothesis that similarity in at least one element of the biotas whose relationships are closer than the generic level, the *Larrea divaricata*-*L. tridentata* disjunction, is the result of derivation from a transtropic ancestor which was widespread during periods of greater aridity in Pleistocene time.

Raven (1963) suggested that one line of evidence which could be used to test hypotheses of long-range dispersal of plants against hypotheses of former interconnection between disjunct arid areas of North and South America would be examination of the phylogenetic relationships of insects associated with the plants. He reasoned that if the similarities resulted from former interconnectedness the insects associated with the plants should be related, but that if long range dispersal were involved this probably would not be so. After review and comparison of distribution patterns of several different animal groups in the Sonoran Desert and Monte regions, Solbrig

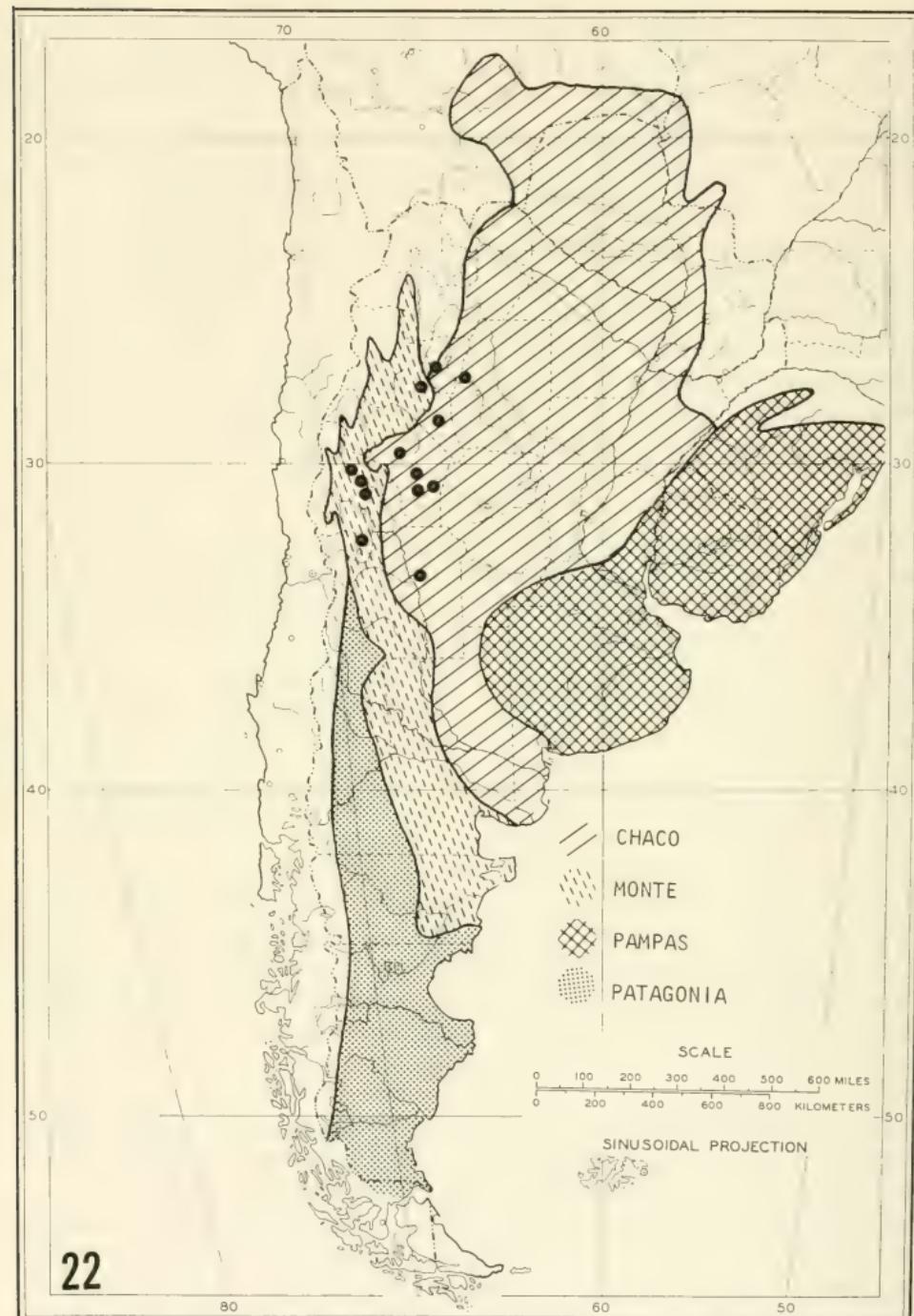


Fig. 22. Map of southern South America showing composite distribution of members of the *sulcifera* group; outline of biotic provinces (redrawn from Blair et al. 1976).

et al. (1977) concluded that the faunas are "much less related phylogenetically" than the floras. Raven and Axelrod (1975) went so far as to state that even when associated with the same sorts of plants, the animals of the two regions are "very different." Hurd and Linsley (1975) concluded that dissimilarity of the bee faunas north and south of the New World tropics, including those associated with *Larrea*, suggests lack of dispersal between the two regions.

A comparable dissimilarity has been described in at least one other group of insects, the seed beetles or Bruchidae. The host associations of these insects are similar to those of *sulcifera*-group members. Stange et al. (1976) noted that bruchids attacking the dominant legume shrubs in the Monte and Sonoran Desert regions (*Acacia*, *Cassia*, *Cercidium*, *Mimosa*, and *Prosopis* spp.) belong to different genera, with the exception of three which are widely distributed throughout the Americas. Kingsolver et al. (1977) emphasized the fact that this distinction also holds for the *Prosopis*-associated bruchids. According to these authors the bruchid species in the two disjunct regions are entirely different. They also state that distinct genera with apparent independent origins have radiated separately on *Prosopis* on the two continents. They do note the existence of two "sister genera" of *Prosopis*-associated bruchids, *Algarobius* of North America, and *Scutobruchus* of South America.

It would appear, then, that occurrence of very closely related members of the same genus of herbivorous insects in the disjunct Sonoran Desert and Monte regions represents an anomalous situation. Such is the case, however, with the *sulcifera* group.

It should be noted that like most animal groups reviewed by Solbrig et al. (1977), the *sulcifera* group contains species which occur outside the limits of the Sonoran Desert and Monte regions. Furthermore, like most of the bruchids reviewed by Kingsolver et al. (1977), some *sulcifera* group members have hosts other than species of *Prosopis*, namely species of *Acacia*. The only North American *sulcifera*-group member known to be associated with *Prosopis*, *S. setosa*, occurs throughout the southwestern United States and on the Mexican Plateau, in the semi-arid Valley of Oaxaca of southern Mexico, and in the West Indies (Clark, 1978). North American *sulcifera*-group members with *Acacia* hosts occur, for the most part, in the same areas of the United States and Mexico, although none is known from the West Indies (Clark, 1978).

Conversely, South American *sulcifera*-group members are known only from *Prosopis* and only from the Argentine Monte and adjacent portions of the Chaco (Fig. 22). Their potential distributions are much more extensive, however. South American *Prosopis* spp. occur throughout the Chaco region of Argentina, Bolivia, and Paraguay, as well as in related plant formations in Uruguay and western Brazil and in the arid inter-Andean valleys of Bo-



Fig. 23. North and South America showing the generalized distribution of the genus *Prosopis* in the New World (redrawn from Simpson and Solbrig, 1977).

livia, Peru, and Colombia. Their ranges thus extend at interrupted intervals throughout the length of the continent. Some also occur in northern Venezuela and along the Pacific Coast of Middle America from the Isthmus of Panama to southern California (Fig. 23). Thus the *sulcifera* group has an almost continuous potential distribution between the regions in which it is now known. Considering the possibility that these arid and semiarid "stepping stones" were more extensive at intervals during the Pleistocene, it seems possible that the apparent disjunction is not and never has been a

reality. If this is so, however, we may wonder about the apparent lack of corollary relationship among the *Prosopis*-associated bruchids.

The paucity of collection records for members of the genus *Sibinia* from much of South America, and especially from the Andean corridor, is regrettable. Further collecting of weevils and bruchids on mimosoids, especially *Prosopis*, in Central and South America is needed. *Prosopis* plants have been sampled at a few stations along the Pacific Coast in Chiapas, Mexico, and in Panama, as well as on the tip of the Yucatan Peninsula, where no *Sibinia* were found. More concerted efforts at different times of the year may change this. Further collecting on *Prosopis* and other mimosoids in the Monte itself, in the Chaco, and particularly along the Andean cordillera, promises to provide valuable evidence which may help answer previously posed questions about *Sibinia* phylogeny (Clark, 1978), and may even shed further light on the history and nature of the floristic similarities of the disjunct arid regions of North and South America.

ACKNOWLEDGMENTS

Thanks are extended to B. B. Simpson and W. N. Mathis (Smithsonian Institution) and J. M. Kingsolver and D. R. Whitehead (Systematic Entomology Laboratory SEA, USDA) for critical reviews. Habitus photos (Figs. 19–20) were taken by D. M. Anderson (Systematic Entomology Laboratory SEA, USDA). The study reported here was carried out at the USNM, and I thank the Department of Entomology, Smithsonian Institution, for providing working space, equipment, and access to the collections.

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EDITOR'S NOTE

Contributors of articles to the *Proceedings* are advised that illustrations are kept for one year after they are published. If an author does not request the return of his or her illustrations within that one year, the illustrations will be discarded. Authors are reminded that illustrations are returned at the authors' expense.

The editor has a stack of illustrations from several past volumes. These illustrations will be discarded on December 1, 1979, unless otherwise claimed.

THREE NEW SPECIES OF *HYDROPORUS* (COLEOPTERA: DYTISCIDAE) FROM THE SOUTHEASTERN UNITED STATES

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Abstract.—Three new species of *Hydroporus*, *jenniferae*, *jeanneae*, and *folkerti*, are described from Tennessee and Alabama. All three species are placed in the *pulcher* group of *Hydroporus*.

During the past three years, extensive collecting in Tennessee has revealed two new species of *Hydroporus*, which are rather common and widespread in central Tennessee. A third species, generously provided by Dr. G. W. Folkerts, is known only from the type-locality in Jefferson Co., Alabama. All three species are placed in the *pulcher* group of *Hydroporus* based on their narrow form, prosternal setae (in two of the species), and apically bifid aedeagus. The importance of the apically bifid aedeagus in characterizing species of the *pulcher* group has previously been pointed out by Leech (1949). Fall (1923) keyed and discussed all previously described species in the *pulcher* group, except *H. laetus* which was described by Leech in 1949.

Hydroporus jenniferae Wolfe and Matta, NEW SPECIES

Diagnosis.—*Hydroporus jenniferae* is most closely related to *Hydroporus ohionis* and will key to that species in Fall's (1923) revision. It is easily distinguished from *H. ohionis* by its larger average size and paler more yellowish head. In addition the tip of the aedeagus of *H. jenniferae* is much more hook shaped than in *H. ohionis*.

Description of holotype.—♂, length 3.3 mm, width 1.7 mm, L/W 1.94. Form elongate evenly oval, with pronotum and elytra in continuous outline, widest at middle. Lateral margins of pronotum evenly rounded toward anterior angles, lateral bead distinct, at maximum width about equal to width of the 4th antennal segment. Prosternal setae evident but somewhat sparse. Prosternal prominence evidently angulate but not distinctly protuberant; prosternal file present; prosternal process broadened, narrowly lanceolate

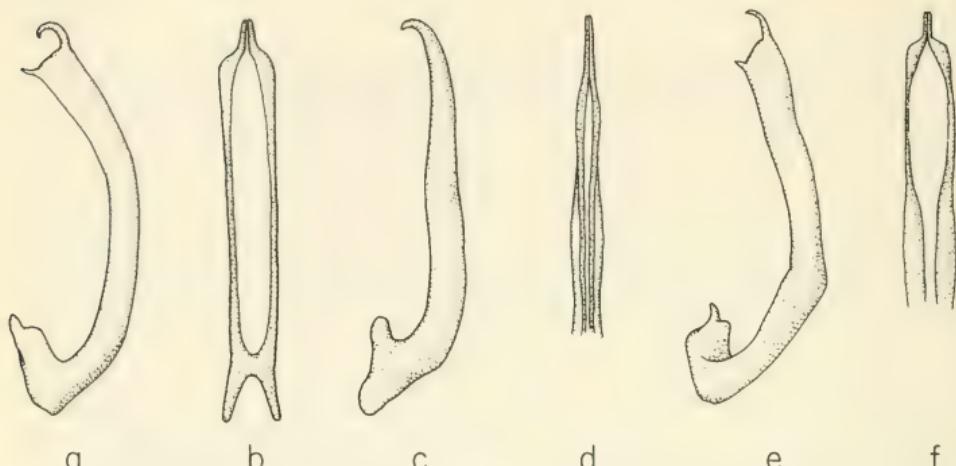


Fig. 1. Aedeagus of: *Hydroporus jenniferae*, a) side b) dorsal; *H. jeanneae* c) side d) dorsal; *H. folkerti* e) side f) dorsal.

posterior to anterior coxae; with median area rounded, lateral margins taper toward bluntly rounded apex.

Not strongly shining dorsally. Head pale yellow, vaguely infuscate at occiput, antenna pale yellow with 11th segment infuscate. Pronotum with an even broad black band along entire anterior margin. Posterior margin of pronotum with a black band of variable width, narrower on each side, expanding medially in undulating fashion and coalescing with anterior band at areas of maximum width. Paler isolated discal areas of pronotum reddish yellow. Elytra with 2 rather broad undulating narrowly connected blackish-brown fascia, the anterior fascia at middle of elytra, the 2nd in posterior $\frac{1}{3}$. Dark sutural stripe extending from apex to base then extending about $\frac{1}{2}$ width of elytral base. Ventral surface primarily reddish yellow with mesosternum, lateral edges of metaepisternum, metacoxae, and abdominal sterna slightly infuscate.

Dorsal surface with perceptible reticulate microsculpture. Punctuation of head sparse and fine. Pronotum with line of coarser and denser punctures posterior and adjacent to anterior margin, discally punctures sparser and finer; along posterior pronotal areas punctures coarser, these being restricted to posterior infuscation. Elytral punctuation fine and sparse, coarsest discally and finer laterally and apically, a very poorly defined longitudinal series of denser punctures is discernible in discal area of each elytron. Ventrally metacoxae rather coarsely punctate, metasternum even more so, medial punctures finer on both metacoxae and metasternum. Abdominal punctures fine, except on sterna 1 and 2 which are coarser.

Pro- and mesotarsi relatively short and broad, articles 1 and 2 with small

palettes, anterior protarsal claw modified, more strongly curved at base and slightly sinuate on inside, posterior claw modified but less so than anterior claw. Aedeagus apically bifid and shaped as in Fig. 1a, b.

Allotype.—♀, length 3.6 mm, width 1.8 mm, L/W 2.00. Similar to male but slightly longer and broader, pro- and mesotarsi less dilated, anterior protarsal claw not modified, evenly curved and tapered. Abdominal sterna more infuscate.

Variation.—Males (n = 20); $\bar{L} = 3.3$ mm (3.4–3.0), $\bar{W} = 1.6$ mm (1.7–1.4), $\bar{L}/\bar{W} = 2.06$. Females (n = 23); $\bar{L} = 3.4$ mm (3.7–3.1), $\bar{W} = 1.7$ mm (1.7–1.6), $\bar{L}/\bar{W} = 2.00$. Anterior and posterior pronotal bands vary from narrowly connected to broadly separated. Some specimens have elytral fascia so reduced that they are separated from each other and the sutural stripe. Females are more alutaceous and are generally more infuscate ventrally. The ventral infuscation varies from practically none to almost completely darkened sterna.

Habitat.—So far known only from central Tennessee, its presence in central Kentucky is likely. The large type-series is from a small stream (8 to 10 feet wide) with expansive slabs of bedrock. The beetles were found, among leaves and filamentous algae, in fissures and depressions in the bedrock which contained one to several inches of water. *Hydroporus jenniferae* was also taken from small and medium sized intermittent streams with gravel or gravel and sand substrates, usually among leaves and/or algae.

Etymology.—This species is named for the senior author's daughter, Jennifer, who has accompanied him on many field trips and has assisted in many of the collections.

Type-data.—Holotype and allotype: TENNESSEE: Trousdale Co., Rocky Cr. approximately 1 mi N Barthelia on Hwy. 231-10, 20 June 77, G. W. Wolfe and Jennifer and Jeanne Wolfe. Paratypes: Same locality data; 164 specimens. Lincoln Co., Cane Cr. at Old Fishing Ford Bridge, 0.8 mi from Hwy. 431, 7 May 77, 2 specimens, G. W. Wolfe and J. Louton. Spring Cr. off county road 4281 approximately 1 mi N Blakeville, 5 May 77, 10 specimens, G. W. Wolfe, G. S. Schuster, B. Wunderlin. Marshall Co., Tributary to East Fork Globe Cr. 2 mi E jct. I-65 and Hwy. 50A, 25 July 76, 35 specimens, G. W. Wolfe and J. L. Louton. Spring Creek at county road 4278 ridge just off Hwy. 99, 25 July 76, 14 specimens, G. W. Wolfe and J. L. Louton. Dekalb Co., Dry Cr. 7 air mi W of Smithville, 13 Sept. 77, 9 specimens, G. W. Wolfe, B. H. Bauer, and D. Nieland. Maury Co., Flat Cr. at Hwy. 99, 22 June 77, 7 specimens, G. W. Wolfe. Summner Co., Dry Fork Cr. at Hwy. 31 E, 3 Aug 77, 8 specimens, G. W. Wolfe. Williamson Co., Rutherford Cr. at Hwy. 431-10, 22 June 77, 10 specimens, G. W. Wolfe.

Deposition of type-material.—The holotype and allotype are deposited in the United States National Museum of Natural History (NMNH) Type no. 75498. Also deposited in the NMNH are one male and one female paratype

from Trousdale Co., Tenn. One male and one female paratype from the type-locality (Trousdale Co.) have been deposited with each of the following: Snow Museum, University of Kansas; Michigan State University; California Academy of Sciences (San Francisco); Dr. W. L. Hilsenhoff, University of Wisconsin; Dr. W. U. Brigham, Illinois Natural History Survey; Dr. J. R. Zimmerman, New Mexico State University; Dr. F. N. Young, University of Indiana; Mr. R. E. Roughly, University of Alberta; Dr. G. W. Folkerts, Auburn University; Hugh B. Leech, Angwin, California; Fredrico Angelini, Francavilla Fontana, Italy. The 35 paratypes from Marshall Co. are deposited with Dr. J. F. Matta, Old Dominion University. All other type-material is deposited with the senior author.

Hydroporus jeanneae Wolfe and Matta, NEW SPECIES

Diagnosis.—*Hydroporus jeanneae* keys to *Hydroporus oppositus* in Fall (1923). It may be separated from *H. oppositus*, and all other species of the *pulcher* group, by its unique dorsal color pattern which consists of a pale yellowish fascia in the basal one third and apical one fifth of the elytra and a single larger dark brownish fascia in the posterior two thirds. It might be confused with the darker forms of *H. oppositus* which are sometimes almost completely infuscated dorsally (especially specimens from the northeastern United States); however, in these specimens the dark fascia is more reddish and almost covers the entire dorsal surface of the elytra.

Description of holotype.—Length 3.4 mm, width 1.7 mm, L/W 2.00. Form as in *H. jenniferae*. Lateral bead of pronotum distinct and approximately $\frac{4}{5}$ as wide as 4th antennal segment. Prosternal setae distinct and dense. Prosternal prominence distinctly angulate and more acutely produced than in *H. jenniferae*. Prosternal process essentially as in *H. jenniferae*.

Not strongly shining dorsally. Head light brownish yellow and vaguely infuscate on each side of head between eyes and at occiput. Antennae light reddish yellow with 11th segment infuscate. Pronotum entirely dark reddish brown, slightly darker anteriorly. Elytra with 1 large dark fascia in posterior $\frac{2}{3}$, pale yellow band across basal $\frac{1}{3}$ and at apical $\frac{1}{5}$, restricted pale circular areas are also evident in lateral areas of dark discal fascia. Dark brownish sutural stripe extending from apex to base of elytra then laterally along $\frac{2}{3}$ basal width, expanding at middle of base. Ventral surface orangish.

Dorsal surface with perceptible reticulate micro-sculpture. Punctuation on head sparse and fine. Pronotal punctuation finer discally, elytral punctuation slightly coarser than in *H. jenniferae* and vague discal longitudinal series of denser punctures evident; ventral punctuation as in *H. jenniferae* but slightly finer and denser.

Protarsi as in *H. jenniferae*. Anterior protarsal claw rather strongly modified; strongly bent at base, thickened and distinctly sinuate internally. Pos-

terior protarsal claw less distinctly modified than anterior claw. Aedeagus distinct, apically bifid and deeply cleft (Fig. 1c, d).

Allotype.—♀, length 3.3 mm, width 1.7 mm, L/W 1.90. Similar to male but slightly more alutaceous. Anterior tarsi narrower and anterior claw evenly curved and tapering. Abdominal sterna more infuscate.

Variation.—Males (n = 11), $\bar{L} = 3.3$ mm (3.4–3.1), $\bar{W} = 1.7$ mm (1.7–1.6), $\bar{L}/\bar{W} = 1.90$. Females (n = 12), $\bar{L} = 3.4$ mm (3.5–3.3), $\bar{W} = 1.7$ mm (1.8–1.7), $\bar{L}/\bar{W} = 2.00$. The large discal dark fascia is of variable size, sometimes isolated from lateral and basal areas of elytra. At maximum extent it reaches the lateral edges and is connected to the dark basal area by a narrow dark stripe on each elytron. The ventral color varies from orangish to reddish brown.

Habitat.—The same as for *H. jenniferae*, however, this species is usually found in fewer numbers.

Etymology.—This species is named after the senior author's wife, Jeanne, who has encouraged and assisted him continuously during his studies.

Type-data.—Holotype and allotype: TENNESSEE: Trousdale Co. same locality as for *H. jenniferae*. Paratypes: Trousdale Co. same locality data, 21 specimens. Summner Co. same data as for *H. jenniferae*, 3 specimens. Dekalb Co., stream at base of cliff at Hwy. 141 by Center Hill Dam, 26 June 77, 1 specimen, G. W. Wolfe and J. Louton. Marshall Co., Spring Cr. at county road 4278 bridge just off Hwy. 99, 25 July 1976, 1 specimen, G. W. Wolfe and J. L. Louton. Tributary to east fork of Globe Creek, 2 mi E of Junction I-65 and Hwy. 50A, 25 July 76, 2 specimens, G. W. Wolfe and J. L. Louton.

Deposition of type-material.—The holotype and allotype are deposited in the United States National Museum of Natural History (NMNH) as Type no. 75499. Also deposited in the NMNH are one male and one female paratype from the type-locality. One male and one female paratype from the type-locality are deposited with each of the following: Dr. G. W. Folkerts, Auburn University; Dr. F. N. Young, University of Indiana; Hugh B. Leech, Angwin, California; Dr. J. R. Zimmerman, New Mexico State University; California Academy of Sciences (San Francisco); Dr. J. F. Matta, Old Dominion University. All other type-material is retained by the senior author.

Hydroporus folkerti Wolfe and Matta, NEW SPECIES

Diagnosis.—This species keys to couplet 7 in Fall (1923) but does not fit any of the alternatives given at the couplet. It may be separated from *H. pulcher*, *H. cocheconis* and *H. laetus* by its coarser dorsal punctuation. In addition the pronotum is infuscate along the anterior and posterior edges and is yellow discally and laterally. *Hydroporus laetus* has the pronotum

uniformly reddish brown while both *pulcher* and *cocheconis* have the posterior infuscation reduced.

Description of holotype.—♂, length 3.1 mm, width 1.5 mm, L/W 2.07. Body quite elongate oval, widest at middle, lateral edges of elytra nearly parallel in basal $\frac{1}{3}$. Lateral edges of pronotum evenly rounded toward anterior angles, lateral bead distinct and slightly broader than 4th antennal segment. Prosternal setae are absent. Prosternal prominence angulate but reduced, more so than with previous 2 species, prosternal file present. Prosternal process as in previous 2 species.

Rather strongly shining dorsally. Head entirely pale yellow. Antennae pale yellow with segments 8 to 11 becoming gradually infuscate. Pronotum with evenly broad brownish infuscation along anterior margin, posterior infuscation restricted to middle $\frac{1}{3}$ with anterior edge undulating, discal and lateral areas pale yellow. Elytra with 2 unconnected irregular fascia, the anterior fascia 2× as broad as the posterior one. Sutural stripe extending from apex to base then along $\frac{1}{3}$ the width of base. Ventral surface entirely yellowish.

Dorsal surface with perceptible reticulate microsculpture which is less evident on elytra. Punctuation of head sparse and fine, denser in occipital area. Pronotum with narrow area of finer denser punctures just posterior to and parallel to anterior edge, discal punctures slightly coarser. Coarsest punctures along posterior edge in posterior infuscation. Elytra with rather coarse and sparse punctures, somewhat less coarse laterally and apically; a vague longitudinal series of finer punctures evident in discal area and adjacent to suture. Ventrally metacoxae coarsely and somewhat sparsely punctate, more so than previous species. Metasternal punctures coarser, finer medially. Abdominal sterna finely punctate except sterna 1 and 2.

Male pro- and mesotarsi not distinctly expanded, but with palettes. Anterior protarsal claw slightly thickened and more strongly bent at base. Aedeagus apically bifid and distinctive (Fig. 1e, f).

Allotype.—♀, length 3.3 mm, width 1.5, L/W 2.09. Almost identical to male, not duller. Protarsi slightly less broad, claws evenly curved and tapering.

Variation.—Males (n = 4), $\bar{L} = 3.1$ mm, (3.2–3.1), $\bar{W} = 1.4$ mm (1.5–1.4), $\bar{L}/\bar{W} = 2.21$. Females (n = 3), $\bar{L} = 3.3$ mm, (3.4–3.0), $\bar{W} = 1.6$ mm (1.7–1.5), $\bar{L}/\bar{W} = 2.08$. The small series available is very constant in most characters. In some specimens the posterior fascia is somewhat reduced, even being separated from the sutural stripe. At maximum size this fascia may be scarcely connected to the more anterior fascia. The light areas of the pronotum vary from pale yellow to orangish.

Habitat.—The type-locality is a small woodland stream (3 to 8 feet wide) with gravel-rock-rubble bottom. All specimens were taken along margins in overhanging grass and among leaves.

Etymology.—This species is named in honor of Dr. George W. Folkerts who called our attention to this species.

Type-data.—Holotype and allotype: ALABAMA, Jefferson Co., woodland stream 1.5 mi N of Praco on county road 81, 18 December 77, Jeanne, Jennifer and G. W. Wolfe. Paratypes: Same locality data, 5 specimens. Same locality 31 January 70, 4 specimens, G. W. Folkerts.

Deposition of type-material.—The holotype and allotype are deposited in the United States National Museum of Natural History (NMNH) as Type no. 75500. One male and one female paratype are also in the collection of each of the authors and all other specimens are deposited with Dr. G. W. Folkerts, Auburn University.

ACKNOWLEDGMENTS

We are especially grateful to Dr. G. W. Folkerts who called our attention to the previously undescribed species (*H. folkerti*) from Jefferson Co., Alabama. Dr. F. N. Young has generously provided specimens of the *pulcher* group from his collection, which included representatives of *H. jeanneaee* and *H. jenniferae*. We thank Dr. G. S. Schuster, Mr. J. A. Louton, and Ms. Belinda Wunderlin for their assistance on several extended field trips. Dr. P. J. Spangler was especially helpful in reviewing the manuscript.

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A TAXONOMIC REVIEW OF THE SUBGENUS *PHYTOHELEA* OF *FORCIPOMYIA* (DIPTERA: CERATOPOGONIDAE)

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Abstract.—The subgenus *Phytohelea* Remm of the genus *Forcipomyia* Meigen is reviewed, with a diagnosis and a key to species. On the basis of female characters 18 of the 22 known species are divided into three taxonomic groups; good specific differences are found in the males and immature stages. The larvae live in water found in the leaf axils of a wide variety of plants in the tropics and subtropics and feed on detritus. Apparently they are readily transported in such plants by commerce, especially in pineapples and other bromeliads. Three new species are described: **belkini** from New Zealand, **dominicana** from Dominica, W.I., and **tzaneenensis** from South Africa and Ghana. *Lasiohelea natalia* de Meillon from Natal is synonymized with *F. bacoti* (Ingram and Macfie) (NEW SYNONYMY). A lectotype is designated for *F. bacoti*.

There has been no previous attempt to review the subgenus *Phytohelea* Remm largely because of a paucity of material, especially of the immature stages. The adults are drab little creatures, and all look more or less alike. The male genitalia, which show such striking specific differences in other subgenera of the genus *Forcipomyia* Meigen, are of limited value and often have to be dissected and stained for their structure to be revealed. Many specimens from museums are on slides, some many years old, and to dissolve them off, reprepare, dissect, and stain if necessary, is laborious and risky because the small structures are easily lost.

For many years it has been known that the immature stages of *Forcipomyia* often provide striking specific differences when adults do not (Saunders, 1925; Mayer, 1933), and the latter author attempted to construct a key to the then known immature stages of six species of *Phytohelea*. The correct

assiation of immatures with the adult has been a constant problem. The pupa can, in the most cases, be accurately assigned because the tough pupal exuviae may be readily recovered along with the associated reared adult. The larva, on the other hand, sheds a diaphanous, fragile, colorless skin that is difficult to handle and indeed even difficult to find. It is well known that more than one species may frequent the same habitat so great care has to be taken in assigning any particular larva unless a direct association has been made by rearing the adult.

The subgenus *Phytohelea* is now known from the tropics and subtropics of the Americas, Africa, Southeast Asia, and the Pacific. There is little doubt that it will be found to be widespread and the species fairly common in these regions. Apparently the immature stages are readily transported in leaf axils of plants over long distances, and some species may have extended their distribution thusly through commerce (Tokunaga, 1961).

The subgenus is of no medical or veterinary importance since adult females do not take blood meals. In agriculture the larva of *F. brevis* (Johannsen) was reported by Johannsen (1927) as damaging the tender leaves of pineapple, thus allowing onset of bacterial rot, which may kill the plant. Later, however, Illingworth (1934) stated that there was no conclusive evidence that the larvae induced the infections.

Taxonomic material has been made available by the National Museum of Natural History (abbreviated USNM), the British Museum (Nat. Hist.) (BMNH), the South African Institute of Medical Research (SAIMR), and Cornell University (CU). A species described below as new was collected by the senior author at Tzaneen, South Africa, in 1976.

Though the material available has allowed no more than a preliminary review, it has been found possible to divide 18 of the 22 known species into three species groups, thus bringing some order into the taxonomy of the subgenus. Unfortunately the main features that allow this division are peculiar to females; no male or immature characters have so far been found in support. For this reason the following species, known only in the male sex, *fijiensis* Macfie, *hamaticauda* Tokunaga, *keilini* Saunders, and *sabroskyi* Tokunaga, are not included in the keys but they are compared with the males of other species where relevant.

An explanation of the terminology used in this paper can be found in the excellent basic papers by Saunders (1924, 1925, 1956) and Tokunaga and Murachi (1959).

Forcipomyia subgenus *Phytohelea* Remm

Forcipomyia, subgenus *Phytohelea* Remm, 1971:189. Type-species, *Ceratopogon bromelicola* Lutz (original designation).
Apelma Kieffer of Saunders, 1925:252.
Trichohelea Goetghebuer of Saunders, 1956:695.

REFERENCES: Saunders, 1925:252 (all stages; habits; revision; as *Apelma*); Saunders, 1956:695 (revision, all stages; as *Trichohelea*); Chan and LeRoux, 1971:754 (figures; all stages; as *Trichohelea*).

Diagnosis.—Tarsal Ratio 2.0–3.2. Basal flagellar segments of female antenna compressed, some may be missing in some species. Palpus 5-segmented; 4th and 5th segments fused or not; 3rd segment with definite sensory pit. Empodium present in female; present, absent, or vestigial in male. Wing with sparse macrotrichia, iridescent, unmarked; costa ending at or near middle of wing; 2nd radial cell open in female, longer than in subgenus *Forcipomyia*. Spermathecae 1 or 2. Male genitalia with 9th sternum broad and short; aedeagus variably shield shaped; parameres spatulate, joined by stout crossbar, with a pair of stout anterior processes extending back from basistylar apodemes, the complex appearing as an H-shaped structure in ventral view.

Immature stages.—Larva with head flattened, prognathous, roughly rectangular in dorsoventral view; antenna reduced to circular windows on front corners of head, containing minute sensoria; body elongate, vermiform, dorsoventrally flattened, with many fine lateral chaetae often "finned," few dorsal; characteristic dorsal pair of chaetae arising from sclerotized crossbar (dorsal plate) on posterior margin of penultimate segment; prothoracic pseudopod conical, bearing many curved hairlike and broader hooklets beyond a row of short, stout hooks; anal pseudopod provided with thornlike hooks and slender, hyaline hooklets, the outermost usually stouter and serrate on inner surface; body ending in a dorsal, median, bluntly conical point regarded as a cauda; 2 pairs of anal blood gills often bifurcate, fine pointed; cuticle devoid of armature.

Pupa elongate, agile, never retaining larval exuviae; chaetae few to none on thorax, tubercles mostly armed with spines and short setae on abdomen; prothoracic respiratory horn small with narrow base, a U-shaped row of spiracular openings at tip; terminal rami widely spaced, short or long and attenuated, with a small or large seta on outer surface; genital processes of male ventral.

Habits.—Larvae are found living submerged in water-filled leaf axils of water-holding plants such as bromeliads, *Dracaena*, *Pandanus*, *Colocasia*, *Alocasia*, *Cordyline*, and *Musa*. The pupa leads an active submerged life. When the imago is ready to emerge, vigorous writhing motions bring the pupa up out of the water.

Illingworth (1934) reported on the biology of *F. brevis* in Hawaii as follows: "Investigating pests of pineapples, I discovered the larvae of these tiny midges usually present in water which collects in the axils of the central leaves. Apparently these larvae feed upon wind-borne, decomposing organic matter that naturally washes down into their retreat. I should note, however,

that the mouth of the larva is provided with a pair of needle-like hooks, which it uses in pulling itself forward. These hooks are capable of puncturing the tender white tissue at the bases of the leaves, and possibly they do this in the ordinary movements of the maggot. But there are no visible abrasions of the epidermis and we have no conclusive evidence that they cause infections."

Illingworth further noted the oviposition habits and life-history of this species: "Tracing the life history I found difficulty, at first, in locating the eggs of the fly. Later, however, I discovered that they are not placed down in the water pockets, as one might expect, but higher up on the leaf blade—at about the lower edge of the green area where it joins the white. The eggs are cigar shape and quite dark in color, about one-half millimeter in length. The incubation period lasts four days, when the larva splits the shell down over half its length, and crawls out. After feeding for twenty-eight to forty-five days the larvae pupate in the water pockets, and emerge as flies four days later. Thus the whole life cycle requires a period of only thirty-six to fifty-three days—and there is a continual series of development throughout the year."

Distribution.—Pantropical.

Included species (with stages known: male (m), female (f), larva (l), pupa (p), all stages (all)):

- alocasiae* Tokunaga, 1961:120. New Britain (all).
antiguensis Saunders, 1956:700. Antigua, W.I. (all).
bacoti (Ingram and Macfie), 1923:55 (*Apelma*). Sierra Leone (m, f, p).
belkini, NEW SPECIES. New Zealand (all).
brevis (Johannsen), 1927:205 (*Apelma*). Hawaii (all).
bromelicola (Lutz), 1914:84 (*Ceratopogon*). Brazil (all).
caribbeana Saunders, 1956:696. Trinidad (all).
comis Johannsen, 1931:409. Sumatra, Java, Bali (all).
crinume (Tokunaga), 1932:1 (*Dasyhelea*). Japan (all).
dominicana, NEW SPECIES. Dominica (all).
edwardsi (Saunders), 1925:260 (*Apelma*). Brazil (all).
fijiensis (Macfie), 1945:1 (*Apelma*). Fiji (m).
grandis Chan and LeRoux, 1971:758. Singapore (all).
hamaticauda Tokunaga, 1959:212. Caroline Islands (m).
jocosa Saunders, 1956:701. Trinidad (all).
keilini (Saunders), 1925:266 (*Apelma*). Brazil (m, l, p).
magna (Saunders), 1925:266 (*Apelma*). Brazil (all).
marksae Tokunaga, 1961:117. New Guinea (all).
natalia (de Meillon), 1936:158 (*Lasiohelea*). Zululand. Synonym of *bacoti* (Ingram and Macfie). NEW SYNONYMY.
nicopina Chan and LeRoux, 1971:754. Singapore (all).

- oligarthra* Saunders, 1956:698. Puerto Rico (all).
sabroskyi Tokunaga, 1959:211. Caroline Islands (m).
tzaneenensis, NEW SPECIES. South Africa, Ghana (all).

KEY TO THE SPECIES GROUPS IN *PHYTOHELEA*

1. Female with 1 spermatheca; pupa with caudal rami about as long, or longer, than abdominal segment IX *comis* Group
- Female with 2 spermathecae; pupa with caudal rami usually shorter than segment IX 2
2. Female antenna with 11 segments *oligarthra* Group
- Female antenna with 15 segments *bromelicola* Group

THE *COMIS* GROUP

The species of this group are *alocasiae*, *comis*, *grandis*, and *tzaneenensis*. Females of the *comis* Group are characterized by having a single spermatheca. All pupae of this group have the caudal rami very long and finely attenuated and the caudal seta minute or even absent. This is not a unique characteristic of this group as it is shared by pupae of *marksae* and *dominicana* of the *bromelicola* Group.

With the exception of some small differences in the male genitalia it has not been found possible to separate the adults of the species in this group. The following examples will serve to illustrate the similarity of different species. Tarsal ratio of the hind leg (numbers of specimens examined in parentheses): *comis* 2.9 (2); *tzaneenensis* from Ghana 2.4–3.0 (7), from Tzaneen 2.0–2.5 (5); *grandis* 2.3–3.2 (4); *alocasiae* 2.8–3.0 (number examined not stated). Antennal ratios (male iii–xi/xii–xv, female iii–x/xi–xv) remarkably constant; in male 1.0–1.2 and in female 0.6–0.7. The wing length in millimeters varies as follows: *tzaneenensis* 0.8–1.0; *comis* 1.0–1.1; *grandis* 0.7–0.8; *alocasiae* 1.0. In all specimens the costa reaches to about the middle of the wing. No palpal differences of any moment could be detected but in *tzaneenensis* the sensory pit was a little deeper than in the other species.

Until such time as adults are reared and larval and pupal skins preserved the state of knowledge of this group will remain uncertain. With the material and descriptions of authors at hand the following tentative key is presented:

KEY TO SPECIES OF THE *COMIS* GROUP

1. Pupal respiratory horn with more than 20 apical spiracular openings *comis* Johannsen
- Pupal respiratory horn with less than 20 spiracular openings 2
2. Larva with lateral seta of anal segment modified; male paramere pointed and sclerotized apically 3

- Larva with lateral seta of anal segment not modified; male paramere smoothly rounded apically (Fig. 1) *tzaneenensis*, new species
- 3. Larva with lateral seta of anal segment leaflike, serrated *grandis* Chan and LeRoux
- Larva with lateral seta of anal segment flattened but not serrated *alocasiae* Tokunaga

The paucity of material plus the inadequacy of some illustrations in the literature have prompted us to provide figures to aid in future studies. Figures 4 and 8 illustrate the genitalia of a *comis* male identified by Johannsen. The difference in the shape of the parameres of *tzaneenensis* is obvious though the aedeagi are very similar in the two species.

Forcipomyia (Phytohelea) alocasiae Tokunaga

Forcipomyia (Trichohelea) alocasiae Tokunaga, 1961:120 (all stages; New Britain; figs.).

Types.—Holotype ♀, allotype ♂, paratype ♂♂, larvae, and pupae, Vudal, SW of Keravat, New Britain, 21.iv.1958 (Marks), in axils of *Alocasia* at edge of primary rainforest (types in Bishop Museum, Honolulu; University of Queensland, Brisbane; and Entomology Laboratory, Kyoto Prefectural University, Kyoto, Japan).

Specimens examined.—None available.

Forcipomyia (Phytohelea) comis Johannsen
Figs. 4, 8

Forcipomyia (Apelma) comis Johannsen, 1931:409 (male, female; S. Sumatra, Middle and East Java, Bali; fig. male genitalia).

Apelma comis (Johannsen); Mayer, 1933:225 (larva, pupa; figs.; distribution; larval habitats and biology).

Types.—Syntypes (in BMNH) from Bali (east of Baturiti, 790 m), Java (Lake Bedali in East Java; Lake Ngebel and Nglekok in Middle Java, and Buitenzorg Botanical Garden in West Java); South Sumatra (Kapala Tjurup), all taken in leaf axils of *Colocasia* by A. Thienemann.

Specimens examined.—INDONESIA: Sumatra, 1928–9, A. Thienemann, in *Colocasia*, 2 ♂, 1 ♀ (det. O. A. Johannsen) (BMNH, syntypes). NEW HEBRIDES: Port Patrick, 1.iii.1953, M. Laird, in leaf axils of taro, 1 larva (USNM). SW Espirito Santo, Namatasopa, 2500 ft., M. Laird, in leaf axils of taro, 2 larvae (USNM). SOLOMON ISLANDS: Guadalcanal, Talamu, 8.vii.1953, 3030 ft., M. Laird, in leaf axils of *Colocasia*, 1 larva, 2 pupae (USNM). Guadalcanal, Tuturahitoko, 1900 ft., 6.viii.1953, M. Laird, in leaf axil of *Alocasia*, 1 larva (USNM).

In the Laird collections the pupae were not mature so together with the

larvae their identification remains uncertain. Mayer (1933) described the larva and pupa of *F. comis* from material from Indonesia provided by Thienemann. The larvae and pupae in the Laird collections differ significantly from Mayer's descriptions, and it is unlikely that they are *comis* (Laird, 1956).

Forcipomyia (Phytohelea) grandis Chan and LeRoux

Forcipomyia (Trichohelea) grandis Chan and LeRoux, 1971:758 (all stages; Singapore; figs.).

Types.—Holotype, pupa, Wallace Way, Singapore, v.1962, K. L. Chan, collected in watery detritus in leaf axils of *Colocasia* sp. (deposited in Lyman Entomology Museum, McDonald College, Quebec). Paratypes, 9 larvae, 2 pupae, 1 ♂, 1 ♀ (Chan collection).

Specimens examined.—Wallace Way, Singapore, x.1961, leaf axils of *Colocasia*, K. L. Chan, 4 ♂, 2 ♀ (topotypes, USNM).

Forcipomyia (Phytohelea) tzaneensis de Meillon and Wirth,
NEW SPECIES

Figs. 1-3, 5-7, 9-13, 27

The following description is from the male holotype; the figures in parentheses are the ranges in 5 paratypes. A small dark species with legs paler as commonly seen in the genus.

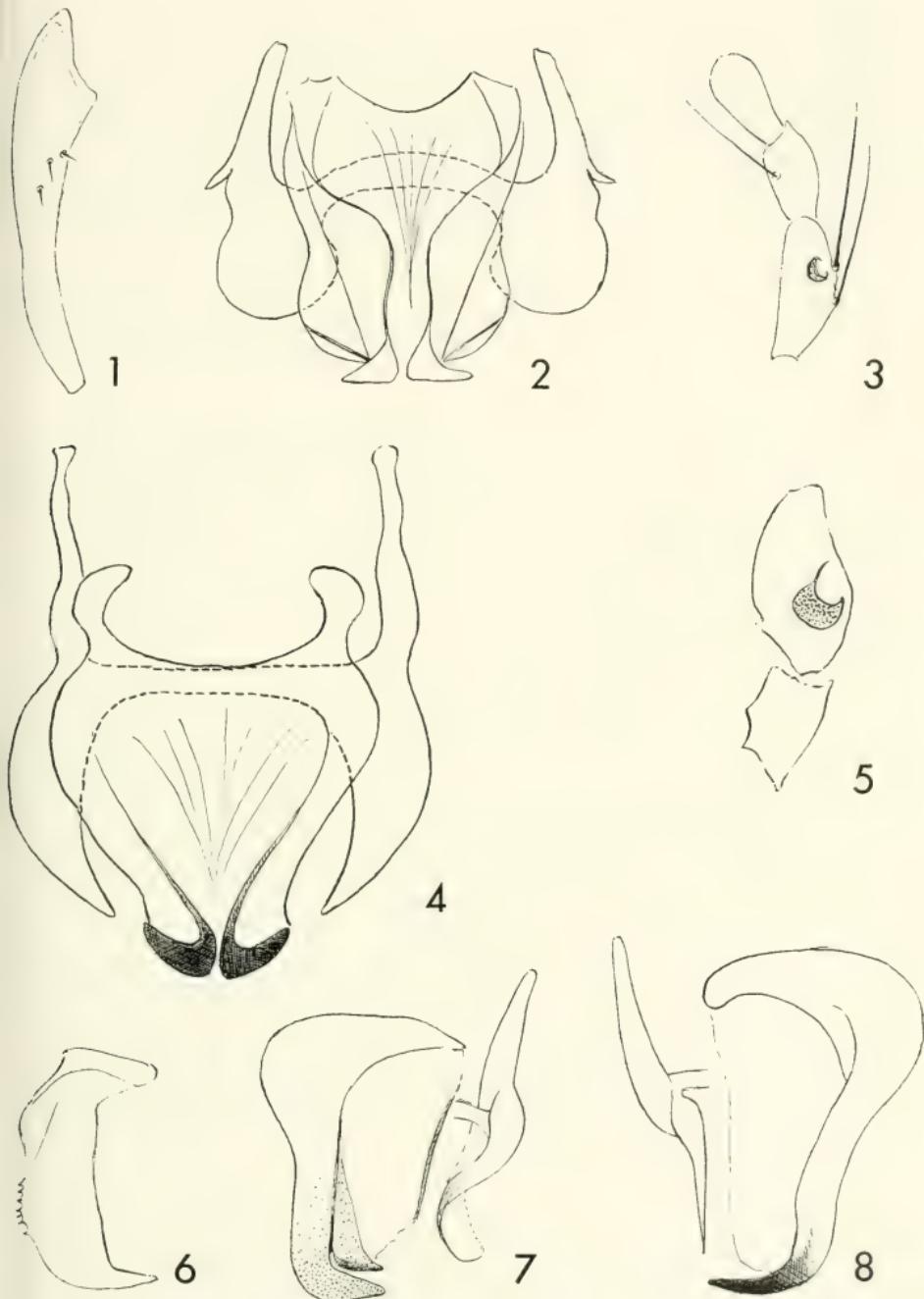
Male.—Wing length, measured from the arculus 0.95 (0.90-1.00) mm.

Head: Dark brown, eyes narrowly separated, bare. Palpus (Fig. 3) with lengths of segments II-V in proportion of 30-45-30-28 (25-30, 40-50, 25-30, 25-30); 3rd segment slightly swollen with a moderately deep sensory pit. Antenna with segments IV-XI wider than long, gradually narrowing to XI which is about as long as wide; XII-XV with lengths in proportion of 53 (50-60), 70 (60-80), 60 (55-60), 80 (65-80) (including the apical papilla); antennal ratio (III-XI/XII-XV) 0.9 (0.8-1.0).

Thorax: Scutum, scutellum, postnotum and pleuron except for membranous parts, dark brown. Wing with ratio of costa to wing length 0.45 (0.44-0.46); 1st radial cell a mere slit seen in stained specimens, 2nd radial cell open, well developed as usual in the subgenus. Legs pale brown, without any darker margins; tarsal ratios of front, middle, and hind legs respectively:

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Figs. 1-3. *Forcipomyia tzaneensis*. 1, Dististyle of holotype, ventral view. 2, Aedeagus and parameres of holotype, ventral view. 3, Segments III-V of male palpus. Fig. 4. *F. comis*, aedeagus and parameres of a male identified by Johannsen, ventral view. Figs. 5-7. *F. tzaneensis*. 5, Segments II-III of female palpus. 6, Side view of aedeagus showing small teeth on ventral side. 7, Aedeagus and parameres of holotype, side view. Fig. 8. *F. comis*, aedeagus and parameres of a male identified by Johannsen, side view.



2.3 (2.0–2.3), 2.3 (2.0–2.5), 2.3 (2.0–2.5); empodium absent; claws only slightly curved.

Abdomen: Dark brown dorsally, venter a shade paler. Genitalia (Fig. 1) with basistyle parallel sided, 3× as long as wide; dististyle in ventral view gradually tapering to a rounded point but more pointed when viewed from another angle; aedeagus (Fig. 2) shield shaped, with a pair of dorsally directed sclerotized hooks apically, this and the sclerotized dorsal portion of the shield best seen in side view (Fig. 7); parameres (Figs. 2, 7) fused as usual, each apical process rather membranous, short and well rounded, the precise shape difficult to see unless dissected free of the 9th segment. In some Ghana specimens the aedeagus showed a few minute dorsal teeth along the ventral side (Fig. 6); such specimens could not be separated from the others by any other features.

Female.—Wing length measured from the arculus 0.80–0.85 mm.

Head: Eyes narrowly separated, bare. Palpus (Fig. 5) with lengths of segments II–V in proportion of 25-40(45)-30-25; 3rd segment swollen with a deep sensory pit (some variation in this character is apparent in Ghana specimens). Antenna (Fig. 27) with lengths of segments XI–XV in proportion of 35-40-40-40-65; IV–X transverse, about 2× as wide as long; antennal ratio (III–X/XI–XV) 0.5–0.6.

Thorax: As in male. Wing with ratio of costa to wing length 0.4–0.5; radial cells as in male. Legs with tarsal ratios of front, middle, and hind legs, respectively: 2.3–2.5, 2.3, 2.6; empodium developed; claws moderately curved.

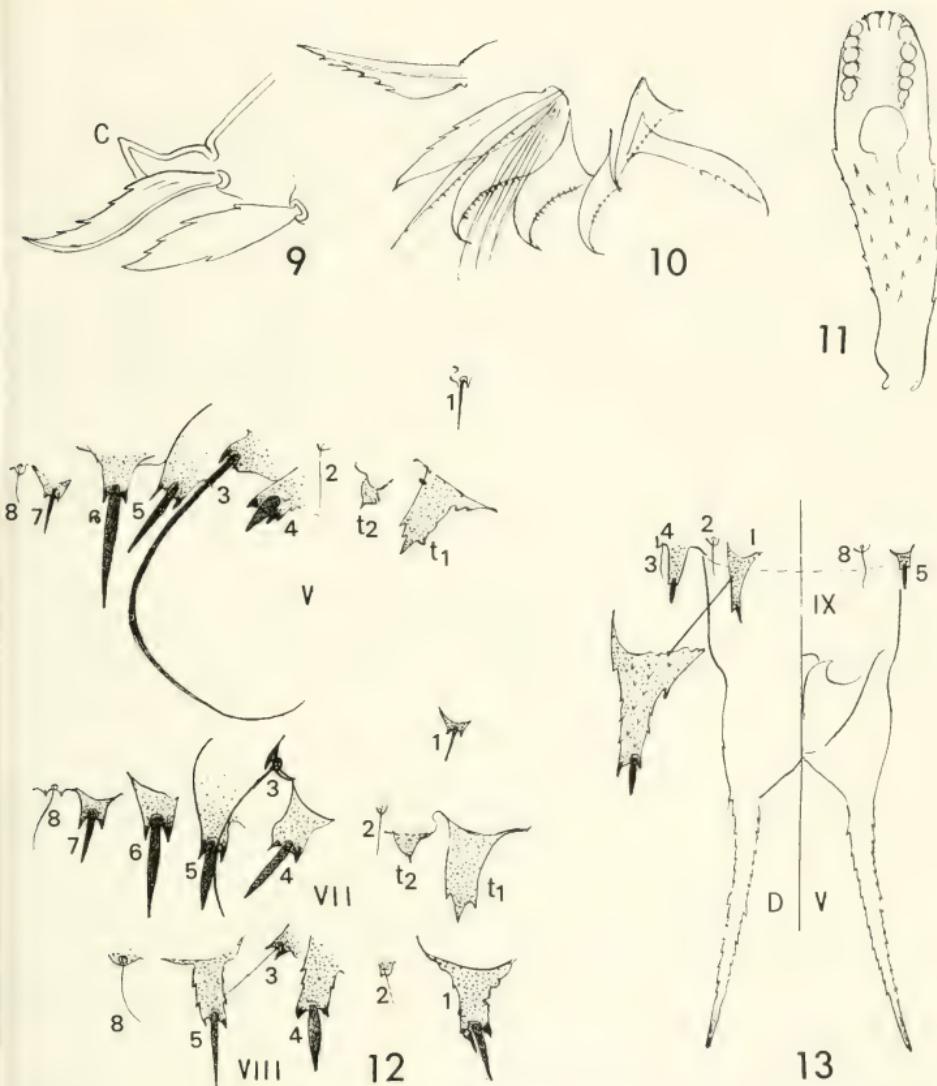
Abdomen: Spermatheca single, pear shaped; sclerotized, and including the neck measuring 0.062 by 0.039 mm.

Pupa (Figs. 11–13).—Described from the pupal exuviae of the holotype.

Cephalothorax: Very faintly pigmented, some shagreen dorsally where there are 4 small raised tubercles; operculum with 3 larger tubercles. Respiratory horn more or less straight sided, measuring 0.20 mm long by 0.04 mm at its widest (Fig. 1); spiculate with 16–17 apical spiracular openings. Abdomen¹ nearly colorless; the noteworthy features are: (1) setae 3 and 4 of segment V on separate tubercles; (2) tubercles 1 and 2 well developed; (3) caudal rami longer than segment IX, caudal seta minute or apparently absent (Fig. 13). There is some variation in the size of tubercles *t*₁ and *t*₂, but on the whole as figured (Fig. 12).

Larva.—According to Saunders (1925) the larva of *Forcipomyia* has 3 thoracic and 8 abdominal segments, segment VIII being divided into 2 portions, the terminal portion of which bears the posterior pseudopod. We refer to the penultimate portion as the VIIth segment, and the terminal as the

¹ Here as elsewhere we use the notation of de Meillon (1936) for the setae with addition of "t" for tubercles without spines or hairs.



Figs. 9-13. *Forcipomyia tzaneenensis*. 9, Larva, portion of anal segment showing upright cauda and two leaflike serrated setae of one side (*c*, cauda). 10, Larva, tail end showing some of the modified setae on one side. 11, Pupal respiratory horn. 12, Pupa, tubercles and setae of abdominal segments V, VII, and VIII (for legend, see text). 13, Pupa, abdominal segments VIII and IX, dorsal left, ventral right.

anal segment to facilitate the descriptions. The descriptions and the figures are from several Tzaneen specimens including exuviae of reared adults. Whole larvae are poorly preserved and mounted so little use is made of them.

Head light brown, slightly longer than broad, setae all small, delicate, and

simple. Prothoracic pseudopod apparently of the usual type though not well displayed in any of the specimens. Abdominal setae all small, short and delicate; the 2 setae on the dorsal plate of segment VIII shorter than anal segment; dorsal apex of anal segment without the pair of short, stout setae seen in larvae of many species; cauda (Saunders, 1925) well developed and erect as shown in Fig. 9. Anal pseudopod consisting of the usual fine spines, long lanceolate setae, and shorter, broader, saw-toothed setae as shown in Fig. 10. The number of these setae is difficult to determine and appears to vary from specimen to specimen. Anal gills simple.

Types.—Tzaneen, N. Transvaal, South Africa: Holotype ♂ (in SAIMR) with its pupal exuviae on same slide. Paratypes, 5 ♂, 1 with larval and pupal exuviae and 4 with pupal exuviae only; 3 ♀, 1 with larval and pupal exuviae and 2 with pupal exuviae only. In addition: 2 ♂ with pupal exuviae on the same slide; 1 ♀ pupa, 2 ♂ and 1 ♀ pupae on the same slide, 1 immature pupa, 1 larval exuviae; 5 larvae on 1 slide and 3 on another. All material collected in leaf axils of *Colocasia* by B. de Meillon, 1976. (1 ♂, 1 ♀ paratypes deposited in USNM).

Tafo, Ghana: 26 ♂, 22 ♀, 1 pupa, 14 pupal exuviae, 2 larvae, from leaf axils of aroid, lily, and *Musa*, collected by L. G. Saunders 15.iv.1963. The association of the larvae with the pupal exuviae and the adults is not certain. (USNM).

THE OLIGARTHRA GROUP

Four species have been described in which the female has 2 spermathecae and the antenna is 11-segmented: *bacoti*, *brevis*, *nicopina*, and *oligarthra*.

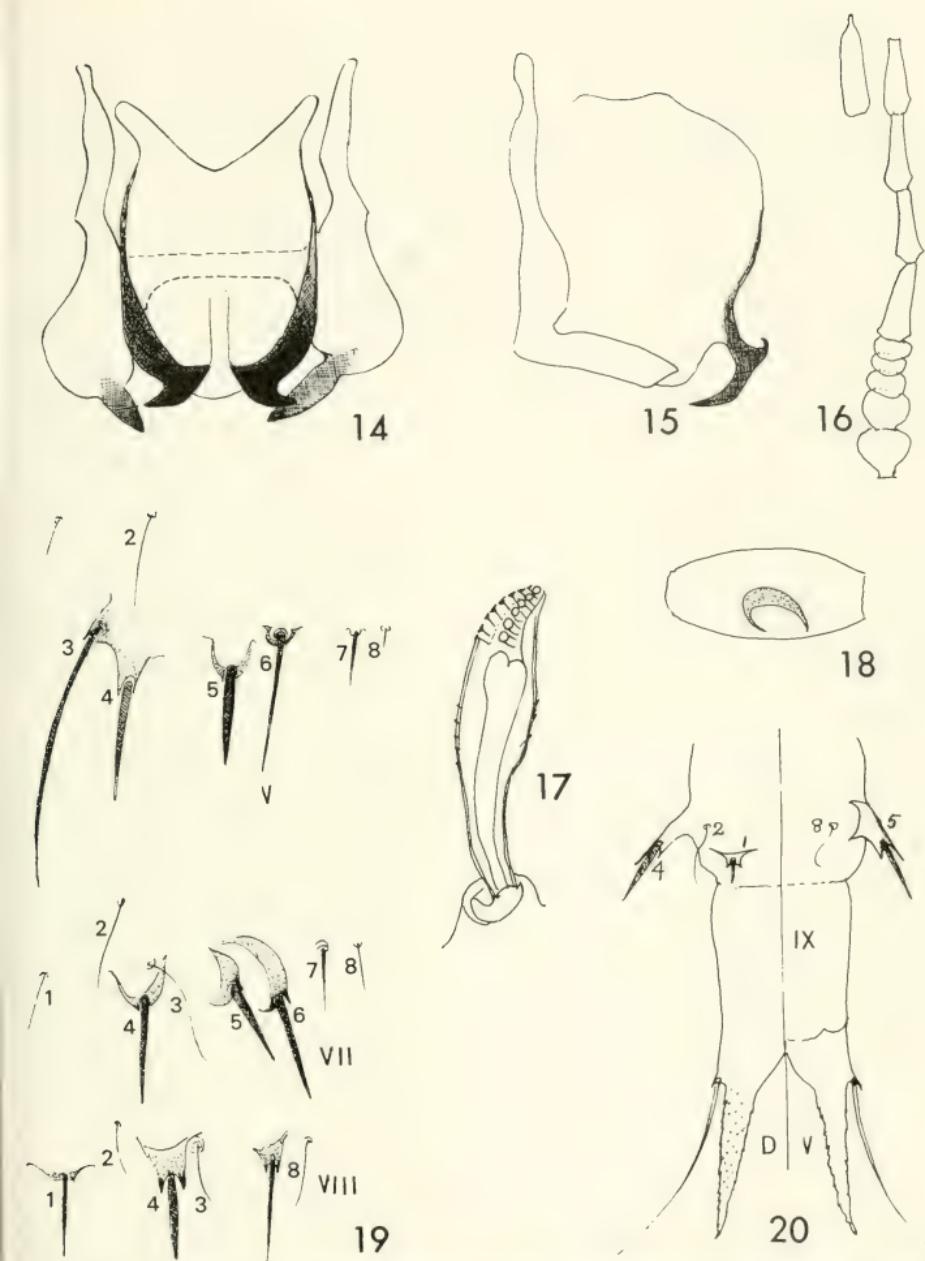
KEY TO SPECIES OF THE OLIGARTHRA GROUP

1. Paramere of male genitalia drawn out distally at more or less right angles to a spinelike sclerotized point (Figs. 11, 15) *bacoti* (Ingram and Macfie)
- Paramere pale, broad, and not spinelike distally 2
2. Third palpal segment with a deep sensory pit; anal gills of larva forked *oligarthra* Saunders
- Third palpal segment with pit shallow; anal gills long and simple (paucity of material does not allow separation of these species) ...
..... *brevis* (Johannsen)
nicopina Chan and LeRoux

Forcipomyia (Phytohelea) bacoti (Ingram and Macfie)

Figs. 14–20

Apelma bacoti Ingram and Macfie, 1923:55 (♂; Sierra Leone; fig. wing, genitalia).



Figs. 14-20. *Forcipomyia bacoti*. 14, Male aedeagus of lectotype, ventral view. 15, Male aedeagus and parameres of a Ghana specimen, side view. 16, Antenna of a female from Ghana. 17, Pupal respiratory horn of a specimen from Ghana. 18, Third palpal segment of a female from Ghana. 19, Tubercles, spines, and setae of a pupa from Zululand. 20, Abdominal segments VIII and IX of a pupa from Ghana, dorsal left, ventral right.

Lasiohelea natalia de Meillon, 1936:158 (♂, ♀, pupa; Zululand; figs.). NEW SYNONYMY.

Types.—Syntypes of *bacoti*, 3 ♂, Freetown, Sierra Leone, 1915, A. Bacot, "reared from larvae found in leaf axils of "cocked-hat" tree (*Dracaena* sp.)" (BMNH). Holotype ♂, of *natalia*, Eshowe, Zululand, iii.1935, B. de Meillon; 4 ♂ and 3 ♀ paratypes, same data (SAIMR).

Thanks to the cooperation of the trustees of the British Museum (Natural History) it has been possible to examine and remount a male syntype of *F. bacoti*. A holotype has apparently never been selected or labelled as such, so at the suggestion of Richard Lane (BMNH) the male syntype mentioned above is here selected as the LECTOTYPE. It bears the following 4 original labels: (1) Apelma *bacoti*; (2) Cotype; (3) Sierra Leone, Freetown, A. Bacot 1915-356; (4) Larvae in leaf axil of "cocked hat tree. *Dracaena* sp." This last is in what can be recognized as the handwriting of the late F. W. Edwards. Paratype material of *F. natalia* was made available by the Director, South African Institute for Medical Research (SAIMR). In addition we have the collection made by L. G. Saunders in Ghana during 1963 which is now deposited in the National Museum of Natural History (USNM) in Washington. As a result of remounting the male genitalia of the specimen selected as the lectotype of *bacoti*, and finding nothing to the contrary in other characters, the above synonymy became evident.

Macfie (1939) described from Uganda what he thought to be the female of *F. bacoti* from a specimen with a single spermatheca. He regarded two spermathecae and the reduced female antenna of *natalia* as being abnormal. Macfie's female is definitely not *bacoti* but belongs in the *comis* Group and cannot be differentiated with any certainty from *F. tzaneenensis*. One of Macfie's slides shows a female with two spermathecae and the reduced antenna of the *oligarthra* group. Why he chose to assign the specimen with the single spermatheca and the 15-segmented antenna to *bacoti* is puzzling.

As a result of the new synonymy, however, the female and pupa of *bacoti* are known from their description under *natalia*. We are now able to correct and supplement the description of *bacoti*. The male genitalia of the lectotype are described and figured (Figs. 14, 15) and a fuller account with figures is given of the pupa and the female (Figs. 16-20).

Male.—Wing length from basal arculus 0.95-1.10 mm (8 ♂).

Head: In some otherwise normal specimens the sensory pit on the 3rd palpal segment is quite deep; this is unfortunate as the depth of this organ is usually regarded as of specific importance. Antennal ratio (III-XI/XII-XV) varies from 1.0 to 1.2 in specimens from all sources. There is, however, some variation in the mean relative lengths of XII-XV as follows (in parentheses, the number examined): Lectotype and 1 other 100-106-86-96 (2); Ghana 100-110-93-100 (7); Eshowe, Zululand 100-100-100-125 (2).

Thorax: Costa reaching to about middle of wing in all specimens. Legs with tarsal ratios of front, middle, and hind legs respectively 2.3–3.0, 2.1–2.8, and 2.6–3.1.

Abdomen: Genitalia (Figs. 14, 15) drawn from the lectotype and a Ghana specimen; the pair of sclerotized hooks at tip of aedeagus quite apparent; parameres sclerotized apically and drawn to a strong pointed process which is especially noticeable in side view.

Female.—Wing length measured from arculus 0.8–0.9 mm; description based on 5 specimens. General coloration as in the male.

Head: Eyes and palpus (Fig. 3a) as in ♂ but sensory pit deeper (Fig. 18). Antenna (Fig. 16) 11-segmented; according to Saunders (1956) the 1st segment after the 2nd represents the amalgamation of III–VII and this is acceptable; antennal ratio (III–X/XI–XV) 0.3–0.4; segments XI–XV with relative lengths 3.0–4.0, 3.5–7.5, 3.5–7.5, 3.0–3.5, 4.0–5.0 (including the nipple on XV).

Thorax: Coloration as in the ♂ but perhaps more pronounced. Wing with costa extending to middle of wing in all specimens; 1st radial cell not apparent, even in stained specimens, 2nd radial cell well formed. Legs with ratios of 1st to 2nd tarsomeres of front, middle, and hind legs respectively, 2.5–2.7, 2.7–2.8, and 2.8–3.0; claws small, simple, slightly curved; empodium well developed.

Abdomen: Spermathecae 2, one slightly larger than the other; moderately well sclerotized, measuring 0.062 by 0.050 mm and 0.056 by 0.044 mm.

Pupa.—The following description is based on a specimen from Ghana from which a typical male was dissected and from several pupal exuviae of "natalia" from Eshowe. Pupal exuviae generally brown, especially those from Zululand. Respiratory horn (Fig. 4) 0.15 mm long by 0.05 mm greatest breadth; with few imbrications and with 14 spiracular openings at the tip.

Abdomen (Figs. 19, 20): Seta I–V a small delicate hair; seta 2–V rather similar and difficult to find; seta 3–V a long, strong seta placed on a single tubercle with 4–V; t_1 minute or absent, t_2 absent; setae 5–V and 6–V separated; seta 7–V smaller but stiff and spinelike; seta 8–V a delicate hair. On segment VIII seta 3–VIII minute or absent; seta 3–VII a long delicate hair; seta 3–VI well developed as in 3–V. Segment IX with caudal rami about as long as segment; caudal setae reaching beyond tip of the rami.

Specimens examined.—GHANA: Tafo, 15.iv.1963, L. G. Saunders, from *Musa*, pineapple, and lily leaf axils, 16 ♂, 5 ♀, larvae, pupae (USNM). NATAL: Eshowe, Zululand, 1935, B. de Meillon, from hole in a tree fern, 2 ♂, 10 pupal exuviae (SAIMR). SIERRA LEONE: Freetown, 1915–356, A. Bacot, larva in leaf axils of "cocked hat tree" (*Dracaena* sp.), 1 ♂ (selected here as LECTOTYPE) (BMNH). UGANDA: Kampala, viii.1931, E. G.

Gibbins, 3 ♂, 5 ♀ (BMNH). Fort Portal, 25.ix.1931, E. G. Gibbins, 4 ♂ (BMNH).

Forcipomyia (Phytohelea) brevis (Johannsen)

Apelma brevis Johannsen, 1927:205 (all stages; Hawaii; on pineapples); Illingworth, 1934:542 (figures all stages; life history; on pineapples); Williams, 1944:172 (notes; Hawaii).

Forcipomyia (Trichohelea) brevis (Johannsen); Hardy, 1960:179 (redescribed; Hawaii; figs.).

Types.—Holotype ♂, allotype ♀, Waipahu, Oahu, 7-8-27, J. P. Illingworth, ex pineapple leaf sheath (Type no. 75308, USNM). Paratypes, all stages, in USNM and CU.

Specimens examined.—HAWAII: Kunia, Oahu, 1.x.1945, 18th Laboratory, W. W. Wirth, light trap, 1 ♀ (USNM). Schofield Barracks, Oahu, 10.xi.1945, W. W. Wirth, light trap, 1 ♀ (USNM). Waipahu, 7-8-27, J. P. Illingworth, holotype and allotype (pinned, USNM); 1 ♂, 1 ♀ (pinned), 3 ♂, 2 ♀, 2 larvae, 2 pupae (slides) (CU). NEW YORK: In pineapple (Plant Quarantine) from Hawaii, xii.1968, 2 larvae, 2 pupae (USNM).

Forcipomyia (Phytohelea) nicopina Chan and LeRoux

Forcipomyia (Trichohelea) nicopina Chan and LeRoux, 1971:754 (all stages; Singapore; figs.).

Types.—Holotype, fourth-instar larva, Wallace Way, Singapore, v.1962, K. L. Chan, in watery detritus in apical leaf axils of pineapple plants (in Lyman Entomological Museum, Macdonald College, Quebec). Paratypes, 2 larvae, 3 pupae, 2 ♀, 9 ♂, and 31 associated pupal exuviae, same data (in Chan collection).

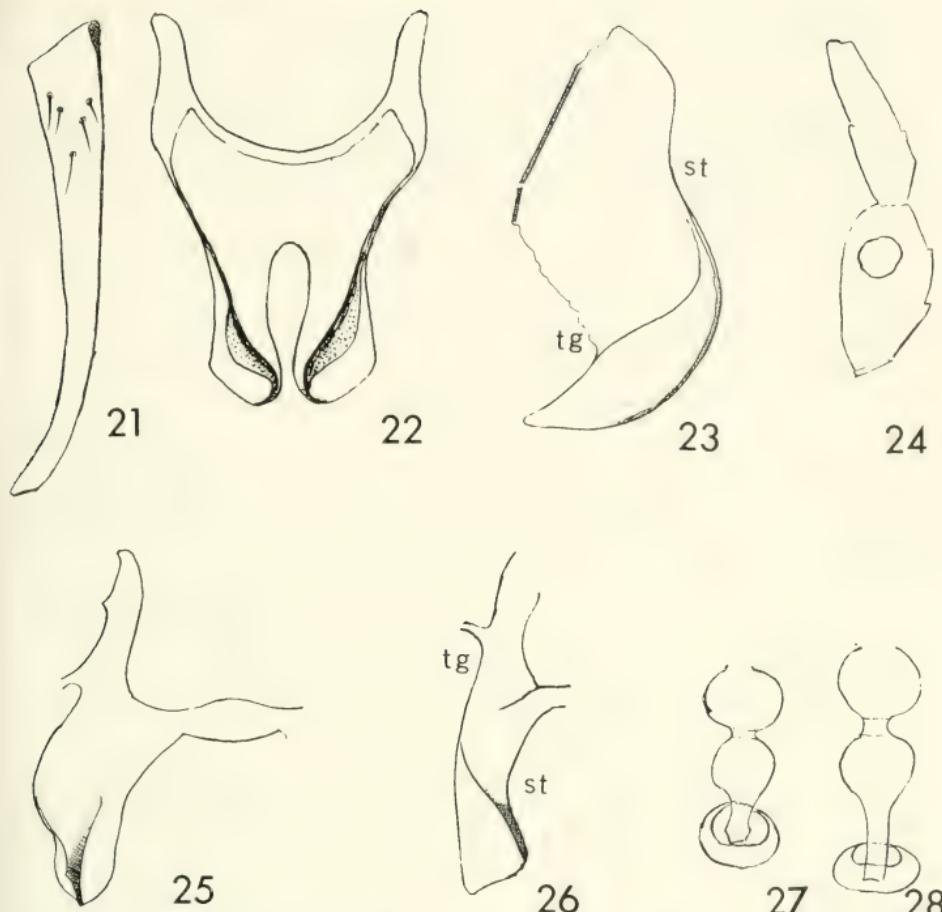
Specimens examined.—SINGAPORE: Wallace Way, ix.1961, K. L. Chan, in water in axils of pineapple plant, 1 ♂, 2 ♀ (topotypes, USNM).

Discussion.—We cannot separate this species from *F. brevis* on the basis of our rather inadequate material. From the descriptions, the larvae may be separated by the yellow-brown head and 3-branched anal blood gills in *nicopina*, and the whitish head and simple (unbranched) anal blood gills in *brevis*.

Forcipomyia (Phytohelea) oligarthra Saunders

Forcipomyia (Trichohelea) oligarthra Saunders, 1956:698 (all stages; Puerto Rico; figs.); Tokunaga and Murachi, 1959:209 (redescribed; Caroline Islands; fig. female); Tokunaga, 1961:115 (all stages; New Britain; figs.; larvae in axils of cultivated banana).

Types.—Holotype ♀, allotype ♂, Corcega Beach, Puerto Rico, 22.ii.1953, L. G. Saunders, reared from larvae in leaf axils of terrestrial bromeliads, *Bromelia pinguin* L. (deposited in Canadian National Collection, Ottawa).



Figs. 21–26. *Forcipomyia dominicana*. 21, Male dististyle. 22, Male aedeagus, ventral view. 23, Male aedeagus, lateral view (st, sternal side; tg, tergal side). 24, Palpal segments III–V of female. 25, Male paramere of one side, ventral view. 26, Male paramere in side view. Figs. 27–28. Antennal segments II–IV of female. 27, *F. tzaneenensis*. 28, *F. dominicana*.

Paratypes, many, all stages, Puerto Rico, Montserrat, Dominica, Guyana, from pineapple.

Specimens examined.—FLORIDA: Sebring, 15–27.xi.1927, M. R. Osburn and M. DuPree, pineapple plants, 1 ♂, 1 ♀ (USNM). PUERTO RICO: San Juan, 25.vi.1962, L. G. Saunders, in pineapple, 6 ♂, 5 ♀ (USNM). SINGAPORE: 1.x.1952, D. H. Colless, pineapple leaf axils, 2 ♂, 2 pupal exuviae, 1 larva (USNM).

Note.—Saunders (1956) recorded *oligartha* from British West Indies, Guyana, Mexico, and Cuba. Tokunaga (1961) reported the species from

New Britain in leaf axils of banana. Tokunaga and Murachi (1959) also recorded it from Palau in Micronesia.

THE *BROMELICOLA* GROUP

The species belonging to this group in which the females have two spermathecae and 15-segmented antennae are *antiguensis*, *belkini*, *bromelicola*, *caribbeana*, *crinum*, *dominicana*, *edwardsi*, *jocosa*, *magna*, and *marksae*.

KEY TO SPECIES OF THE *BROMELICOLA* GROUP

1. Male with well-developed empodium 2
- Male with empodium reduced to a single thread or absent 3
2. Hind tarsal ratio 2.0; female palpal segments IV and V completely fused; pupa with a spherical, spinose tubercle on operculum *jocosa* Saunders
- Hind tarsal ratio near 3.0; female palpal segments IV and V partly or wholly separated; pupa without such tubercle *crinum* (Tokunaga)
3. Hind tarsal ratio 2.0; pupa with caudal setae $\frac{1}{2}$ as long again as the rami; larva with lateral setae arising from papillae *antiguensis* Saunders
- Hind tarsal ratio larger; pupa with caudal setae shorter than or about as long as the rami; lateral setae of larva not on papillae 4
4. Lateral setae of larva finned; pupal respiratory horn expanded before apex; spermatheca without sclerotized neck 5
- Lateral setae of larva unmodified; respiratory horn of pupa not expanded; spermatheca with slender sclerotized neck (except in *bromelicola*) 6
5. Sensory pit of female palpus shallow, depth less than diameter of opening *caribbeana* Saunders
- Sensory pit of female palpus deep, depth equal to or more than diameter of opening { *magna* (Saunders)²
 edwardsi (Saunders)}
6. Sensory pit of female palpus deep (see couplet 5) 7
- Sensory pit of female palpus shallow 8
7. Male aedeagus with apical pair of slender, sclerotized hooks; pupal respiratory organ with 20–25 spiracular openings; pupal caudal rami long, 1.3× as long as base of segment IX *marksae* Tokunaga

² Material at hand does not permit the separation of these two species. Saunders (1925) gives the size of the spermathecae of *edwardsi* as 0.053 by 0.041 mm, but in 4 specimens, including syntypes, measured by us the mean size of the larger spermatheca was 0.081 by 0.067 mm (range 0.075–0.088 by 0.062–0.081 mm). The spermathecae of *magna* are even larger, measuring 0.094 by 0.081 mm and 0.088 by 0.069 mm. If these differences in size are stable they will allow separation of the two species.

- Male aedeagus with apical pair of broadly rounded lobes; pupal respiratory organ with 15 spiracular openings; pupal caudal rami short, $0.8 \times$ as long as base of segment IX *belkini*, new species
- 8. Female palpus with sensory pit located in middle of 3rd segment; female spermathecae without sclerotized necks; pupa with caudal rami stout and as long as or shorter than base of segment IX
..... *bromelicola* (Lutz)
- Female palpus with sensory pit located at distal 0.7 of 3rd segment; female spermathecae with slender sclerotized necks; pupa with caudal rami attenuated, slightly longer than base of segment IX
..... *dominicana*, new species

Forcipomyia (Phytohelea) antiguensis Saunders

Forcipomyia (Trichohelea) antiguensis Saunders, 1956:700 (all stages; Antigua; figs.).

Types.—Holotype ♀, allotype ♂, Falmouth Harbour, Antigua, B.W.I., 2.v.1953, L. G. Saunders, reared from larvae in epiphytic bromeliads (in Canadian National Collection, Ottawa).

Specimens examined.—None available.

Forcipomyia (Phytohelea) dominicana de Meillon and Wirth,
NEW SPECIES
Figs. 21–26, 28–33

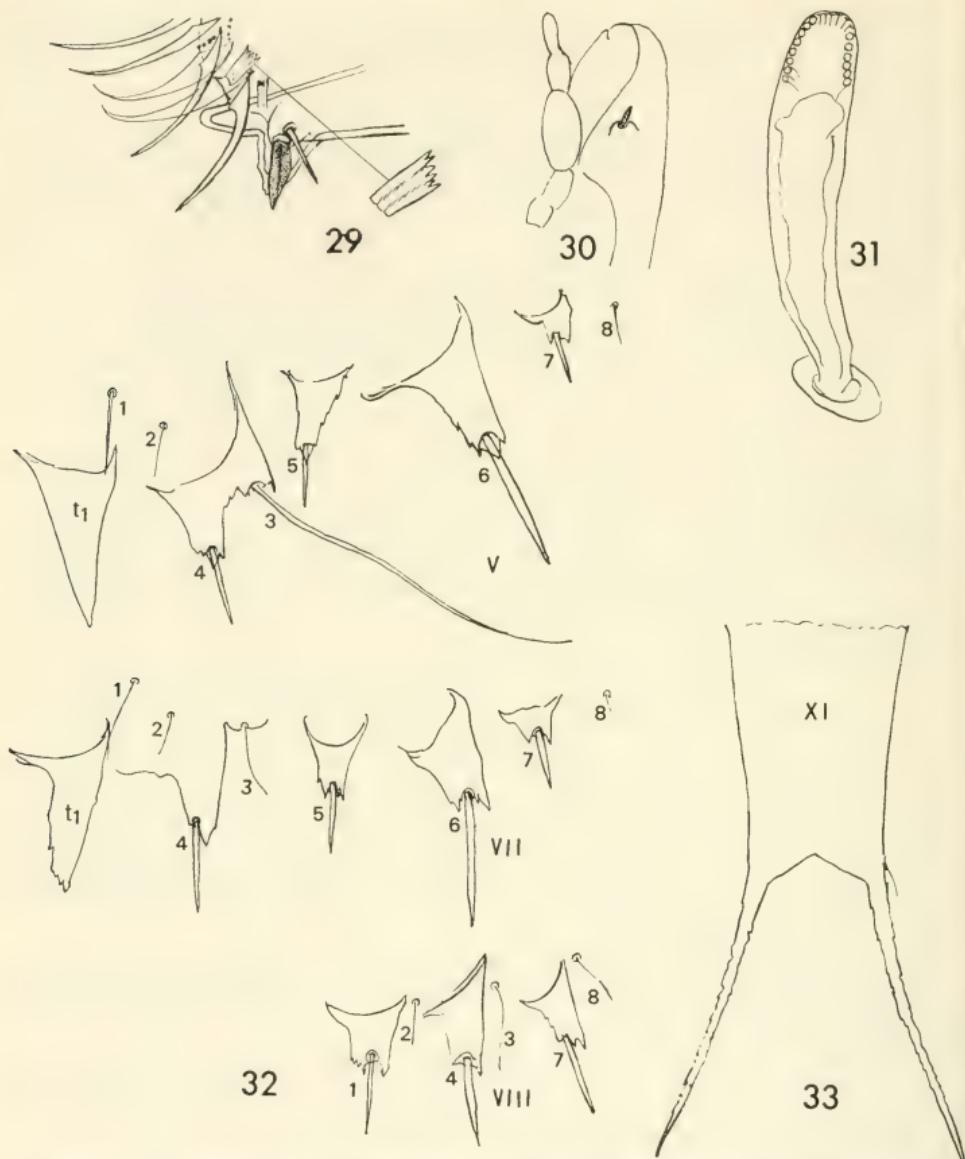
In general appearance as in most species of the subgenus, that is, dark brown with paler legs and no striking markings anywhere. The description is from the holotype; any differences worth mentioning are in parentheses and relate to 1 other specimen.

Male.—Wing length measured from the basal arculus 0.9 mm.

Head: Eyes narrowly separated, bare. Palpus with relative lengths of segments II–V as 20-40-25-25; segments IV and V partially fused; 3rd segment with a large sensory pit on distal $\frac{1}{2}$ of segment as in ♀. Antenna with unusually long neck on segment III; IV–IX about as long as wide, X and XI slightly longer; relative lengths of XII–XV as 70-60-50-65 (70 in paratype); antennal ratio (III–XI/XII–XV) 1.1.

Thorax: Wing with ratio of costal length to wing length 0.5; radial cells, if present, not visible due to excessive clearing. Tarsal ratios of front, middle, and hind legs as 2.7, 2.7, 2.25; claws only slightly curved; empodium absent.

Abdomen: Genitalia (Figs. 21–23, 25–26) described from the dissected and stained genitalia of the paratype; basistyle as usual in the subgenus, parallel sided and about $3 \times$ as long as wide; dististyle (Fig. 21) slightly shorter, rather slender and only slightly wider basally; aedeagus (Fig. 22) shield-



Figs. 29-33. *Forcipomyia dominicana*. 29, Dorso-apical angle of anal segment of larva. 30, Clypeal plate of pupa in side view showing short, stout spines. 31, Respiratory horn of pupa. 32, Pupa, tubercles, and setae of abdominal segments V, VII, and VIII. 33, Pupa, segment IX and rami.

shaped, not strongly sclerotized, divided apically into 2 slightly expanded lobes, in side view each lobe seen to project dorsally to an unsclerotized point, the only sclerotization occurring apically on the ventral face as shown in figure; parameres unsclerotized except ventrally as shown (Figs. 23, 25).

Female.—Wing length 1.0 mm. Described from 2 paratypes, one of which has its associated pupal exuviae.

Head: Eyes as in ♂. Palpus (Fig. 24) with relative lengths of segments II–V as 25-40-25-20; IV and V partly fused and III with a large but shallow sensory pit on distal $\frac{1}{2}$ of segment. Antenna with an unusually long neck on segment III; segments IV–VII rather broadly joined as described by Tokunaga (1961) for *marksae*; antennal ratio (III–X/XI–XV) 0.4; relative lengths of XI–XV as 25-25-25-25-35 including terminal nipple.

Thorax: Wing with costa reaching to middle; 2nd radial cell apparently open. Legs with tarsal ratios of front, middle, and hind legs respectively 3.0, 2.4, 2.75 (the higher ratio of 3.0 in the front leg in both specimens is unusual); claws only slightly curved; empodium well developed.

Abdomen: Spermathecae 2, pyriform; measuring (with a short sclerotized neck excluded) 0.056 by 0.044 mm and 0.050 by 0.047 mm in 1 female, and 0.062 by 0.050 mm and 0.056 by 0.050 mm in the other; as usual in the subgenus the genital sclerotizations are ill defined.

Pupa.—Described from 2 exuviae on 2 slides, each with its corresponding adult. Pale (in our experience the color of the pupal exuviae is a variable character) with some very minor shagreening on the operculum. Respiratory horn (Fig. 31) clear yellowish without any spicules, 20 spiracular openings present apically. Clypeal plate (Fig. 30) with a pair of very stout but short spines (which in other species appear as a pair of very fine delicate (and often minute) hairs). Abdomen (Figs. 32, 33) with segment IX bearing a pair of very long, attenuated caudal rami, caudal setae minute and difficult to locate; segment VIII with normal setation but tubercles much enlarged; VII with normal setation but *t*1 greatly enlarged, *t*2 absent or unapparent; V as in VII but seta 3 greatly elongated and placed on the same basal tubercle as 4, *t*1 greatly enlarged, *t*2 absent.

Larva.—Described from 3 whole larvae presumed to be those of *dominicana*. Head a little longer than broad. Thorax of normal appearance and this includes the thoracic pseudopod. Abdomen with setae all fine, unmodified, and reduced in size; setae of dorsal plate on VIII shorter than the elongated anal segment, lateral setae unmodified; 2 pairs of dorso-apical setae, the more lateral one a short, thick, stout spine, the other near the dorsal margin and short, greatly expanded, bladelike (Fig. 29). Pseudopod truncate (as previously described for *comis*, *crinume*, *jocosa*, and *belkini*); the spines surrounding the pad all more or less similar, narrow and with or without very fine teeth; combs present.

Types.—Holotype ♂, Dominica, W.I., Calibishie, 16.iii.1965, W. W. Wirth, reared from *Heliconia* sp. (Type no. 75306, USNM). Paratypes, 1 ♂, 1 ♀, 2 ♀ with associated pupal exuviae, 3 pupae, and 3 larvae (USNM), same data.

Remarks.—This species is undoubtedly closely related to *marksae* but

separable therefrom as shown in the key. It is of interest to note that *Heliconia* is indigenous to New Britain where *marksae* was found in *Alocasia* and *Colocasia*.

Forcipomyia (Phytohelea) belkini de Meillon and Wirth,
NEW SPECIES
Figs. 34–41, 45–46

A member of the *bromelicola* Group sharing with *edwardsi*, *fijiensis*, and *marksae* a deep sensory pit on the 3rd palpal segment. The female of *fijiensis* is unknown, but the species probably belongs here and differs from *belkini* significantly in palpal and genital characters (Figs. 42–44). The larger than usual 2nd palpal segment and deep sensory pit of *belkini* is reminiscent of *sabroskyi* which is also known only in the male adult; but here again the male genitalia differ markedly from the description given by that author.

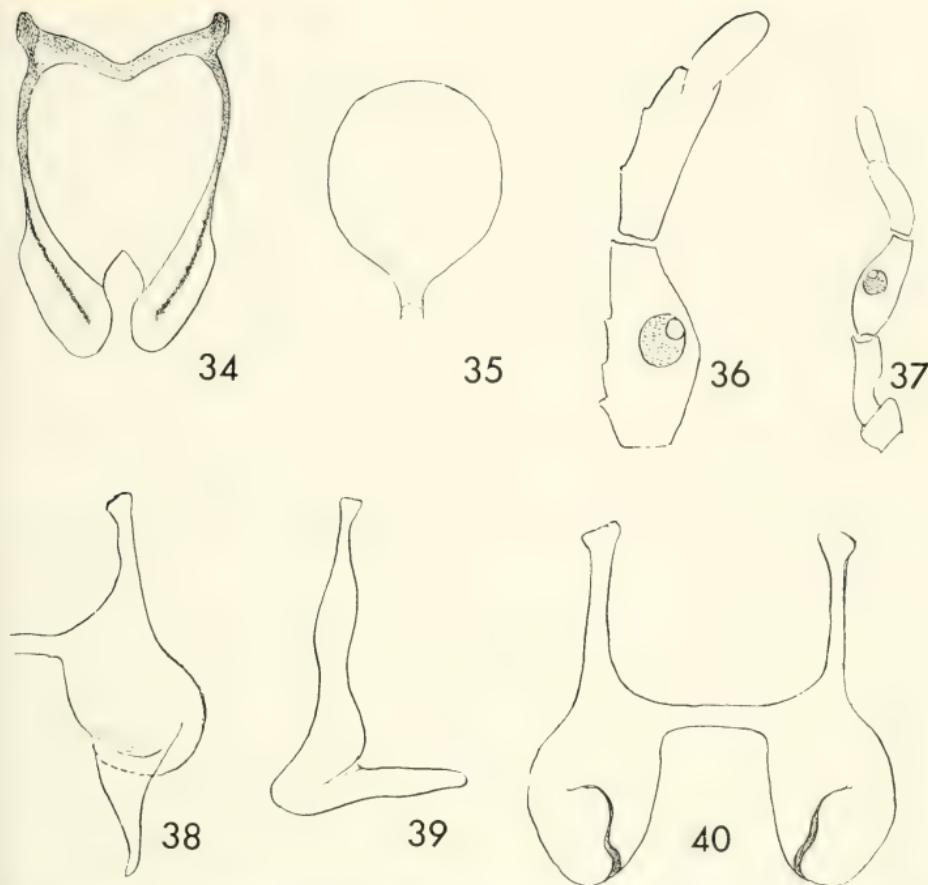
The description of *F. belkini* is from slide material in the National Museum of Natural History. The adults are brown with pleuron slightly paler anteriorly; the abdominal sterna are markedly pale and contrast sharply with the terga; scutellum and legs pale.

Male.—The description is from the holotype with figures in parentheses taken from 8 other ♂. Wing length measured from the basal arculus 0.9 mm (0.85–1.00).

Head: Eyes narrowly separated in front, bare. Palpus (Fig. 37) longer than proboscis; 3rd segment slightly swollen in middle, sensory pit deep, circular, sclerotized and with a small opening; segments IV and V partly fused; segment II longer than usual; relative lengths of segments II–V in proportion of 20–30–40–50 (15–20, 30, 40–50, 50–60). Antenna with relative lengths of segments XII–XV including terminal papilla as 50 (50–60), 60 (60–70), 55 (50–60), 65 (60–75); segments IV–XI mostly about as wide as long; antennal ratio (III–XI/XII/XV) 1.0.

Thorax: Scutum brown with shoulders and pleuron a shade paler, scutellum pale; postnotum dark. Wing as usual in the subgenus; costa 0.48 (0.47–0.50) of wing length. Legs with femora and tibiae brown, tarsi a shade paler; ratios of 1st and 2nd tarsomeres of front, middle, and hind legs 2.3 (1.9–2.3), 1.9 (1.9–2.3), 2.4 (2.2–2.5); empodium undeveloped; claws slightly curved.

Abdomen: Brown above, pale below. Genitalia (Figs. 34, 38–40) with aedeagus (Fig. 34) shield shaped, borders sclerotized, apex with 2 lobes separated by a deep cleft; *in situ* and without undue pressure each paramere appears to consist of a bulbous lobe but when dissected it is seen in side view to have a long, strong, pointed process directed ventrally (Fig. 38); when pressure is applied to paramere its process appears as in Fig. 40; basistyle, dististyle, tergum, and sternum as usual in the subgenus.



Figs. 34-40. *Forcipomyia belkini*. 34, Male aedeagus, ventral view. 35, Female spermatheca (one of two). 36, Female palpus, segments III-V. 37, Male palpus (not to same scale as Fig. 36). 38, Male paramere of one side, slightly crushed and flattened. 39, Male paramere in side view. 40, Male parameres, ventral view, in natural position.

Female.—Described from 2 paratype specimens; coloration as in ♂. Wing length measured from the arculus 0.8 mm.

Head: As in ♂. Palpus (Fig. 36) with segments IV and V partly fused; III distinctly swollen in middle, with characteristic deep sensory pit, the size of the opening to the pit appearing to be variable. Antenna with segments IV-X transverse, slightly wider than long; XI-XIV subequal, each measuring about 30 units, XV including the nipple just over 50 units; ratio of III-X/XI-XV 0.7.

Thorax: Wing with costa ending at the middle; nature of the radial cells could not be determined precisely but they appear to be typical of the subgenus. Legs with ratios of 1st and 2nd tarsomeres of front, middle, and hind

legs as 2.6, 2.0–2.5, and 2.7; claws short, moderately curved; empodium present.

Abdomen: Spermathecae (Fig. 35) 2, pyriform, with a short length of the duct sclerotized; including the duct measuring 0.056–0.063 mm by 0.044–0.047 mm in the 2 specimens.

Note.—The immature stages associated with the adults and from the same habitat are 2 larvae and 2 male pupae; 1 larva, 1 male pupa, and 3 pupal exuviae; and 2 larvae and 1 female pupa, on 3 slides. The presence of the male pupa makes the association definite for this sex. The female pupa unfortunately has the terminal segment missing, but the spermathecae and what can be seen of the palpus leave little room for doubt that it is also the same species.

Pupa.—Pupal skin pale in color without imbrications or nodules of any note. Respiratory horn of the usual shape for the subgenus, measuring 0.17 mm long and 0.04 mm in greatest breadth; 15 spiracular openings in a horse-shoe formation; not heavily imbricated but a shade darker than the rest of the pupa. Clypeal plate with a pair of minute, delicate hairs as usual in the subgenus and in sharp contrast to those of *dominicana* n. sp. Abdomen (Figs. 45–56) with *t*1 greatly enlarged on segments III–VII, *t*2 absent; spine 1 on VIII subterminal on a large tubercle; seta 3 on VIII unusually long and well developed; seta 8 on III–VIII a long delicate hair; seta 2 on VII–VIII minute; seta 1 on III–VII about the same, short and stiff; segment IX with relatively short caudal rami, the setae shorter than the rami.

Larva.—There are 5 larvae which under the circumstances may safely be regarded as belonging to the species. Head light brown and about same color as body; slightly longer than broad; setae all very small, delicate and hard to find. Prothoracic pseudopod not very different from that of *bromelicola*. Abdomen with the usual dorsal and lateral setae which are shorter than the width of the body, delicate, inconspicuous, and unmodified; dorsal sclerotized plate on posterior margin of penultimate segment with a pair of strong, dark, curved setae shorter than the segment itself; anal segment only slightly shorter than penultimate, with lateral setae unmodified, short and fine; cauda upturned as figured, 1 pair of dorsal setae short and stout, flattened with a few serrations near the apex or none; posterior pseudopod (Fig. 41) truncate and provided with peripheral combs between the setae as in *dominicana* and some others.

Types.—Holotype ♂, paratypes 8 ♂, 2 ♀, 7 larvae, 4 male pupae, 2 female pupae, 3 pupal exuviae, all labelled: New Zealand, Amwaniwa Falls, Gisborne Province, Dist. Nat. Park near Urewera, 27.xii.1963, Belkin and Schroeder, ex leaf axil of *Cordyline australis* Hooker in Podocarp-beech forest (Type no. 75307, USNM).

Discussion.—The species is named for Professor John A. Belkin, University of California in Los Angeles, in appreciation of his interest in the collection and study of ceratopogonid midges.

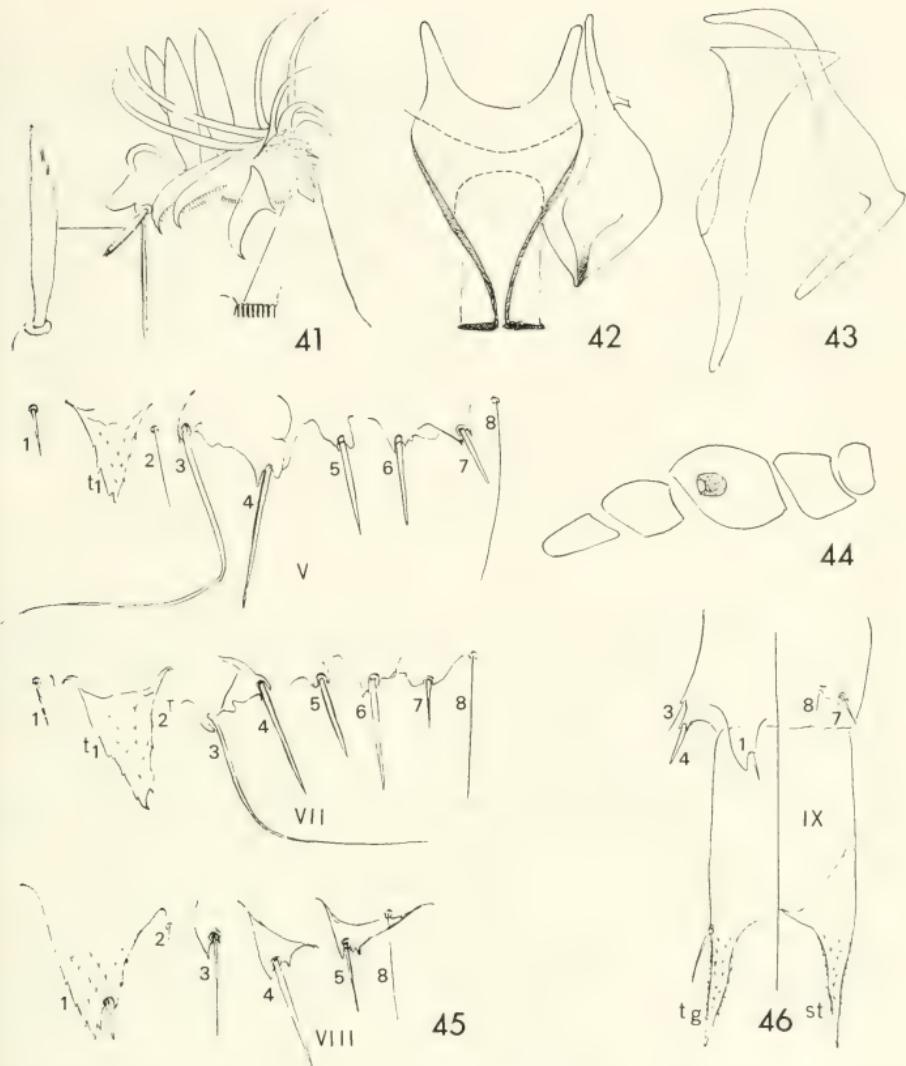


Fig. 41. *Forcipomyia belkini*, posterior end of larva in side view. Figs. 42–44. *F. fijiensis*. 42, Male aedeagus and one paramere of holotype, ventral view. 43, Male aedeagus and paramere in side view. 44, Male holotype, palpus. Figs. 45–46. *F. belkini*. 45, Pupa, setae, and tubercles of abdominal segments V, VII, and VIII. 46, Pupa, segments VIII and IX, dorsal left, ventral right.

Forcipomyia (Phytohelea) bromelicola (Lutz)

Ceratopogon bromelicola Lutz, 1914:84 (♀; Brazil; fig. wing).

Apelma bromelicola (Lutz); Saunders, 1925:263 (combination; all stages re-described; figs.; Brazil).

Lasiohelea bromelicola (Lutz); Floch and Abonnenc, 1942:2 (French Guiana; combination; redescribed; fig. wing, palpus, tarsus); Lane,

1945:360 (δ , ♀ redescribed from Lutz' types; Brazil); Cavalieri, 1962:360 (comparative notes).

Forcipomyia (Phytohelea) bromelicola (Lutz); Wirth, 1974:9 (combination).

Types.—Lectotype δ (designated by Lane, 1945), Ilha do Governador, Rio de Janeiro, Brazil, A. Lutz, reared from bromeliads (on pin; in Instituto Oswaldo Cruz). Allotype ♀, same data, on slide.

Specimens examined.—BRAZIL: Rio de Janeiro, 23.vii.1923, L. G. Saunders, from small bromeliads on rocks in Rio Bay, 1 δ , 1 larva (BMNH). TRINIDAD: Tabaquite, Charuma Forest, iv.v.1955, T. H. G. Aitken, ex bromeliad *Aechmea nudicaulis* Grisebach, 1 δ , 1 pupa (USNM).

Notes.—Saunders' excellent redescription and figures were made from material he collected in Rio Bay and compared by him with two males and one female types from the Lutz collection.

Forcipomyia (Phytohelea) caribbeana Saunders

Forcipomyia (Trichohelea) caribbeana Saunders, 1956:696 (all stages; Trinidad; figs.).

Types.—Holotype ♀, allotype δ , Mount St. Benedict, Trinidad, 12.v.1953, L. G. Saunders, reared from larvae in fallen epiphytic bromeliad in forest (Canadian National Collection). Paratypes, all stages, from Trinidad, Guyana, Tobago (Saunders collection).

Specimens examined.—BRAZIL: Bahia, Ilhéus, CEPEC, 8.iv.1977, D. Fish and S. Soria, reared from leaf axils of bromeliad, 3 δ , 4 ♀, 4 larvae, 3 pupae. GUYANA: Georgetown, 20.v.1953, L. G. Saunders, 1 ♀, 1 pupal exuviae, 3 larvae, all marked "paratype" (USNM).

Forcipomyia (Phytohelea) crinume (Tokunaga)

Dasyhelea crinume Tokunaga, 1932:1 (all stages; Japan; figs.).

Forcipomyia crinume (Tokunaga); Tokunaga, 1934:469 (larva, pupa redescribed; figs.; combination); Saunders, 1956:704 (compared with *jocosa*).

Types.—Holotype δ , allotype ♀, paratypes (in alcohol), Setto, Wakayama Prefecture, Japan, 17.vi.1930, M. Tokunaga, reared from rainwater between the leaves of *Crinum* lilies along seashore (deposited in Entomological Laboratory, Kyoto Prefectural University, Japan).

Specimens examined.—None available.

Forcipomyia (Phytohelea) edwardsi (Saunders)

Apelma edwardsi Saunders, 1925:260 (all stages; Brazil; figs.).

Forcipomyia (Trichohelea) edwardsi (Saunders); Saunders, 1956:698 (combination; compared with *caribbeana*).

Types.—Syntypes, numerous examples of all stages, from small brome-

liads on rocks in Río Bay and on Island of Paquetá, Brazil, 23.viii.1923; also in terrestrial bromeliads in woods behind Pernambuco (Dois Irmãos), Brazil, 10.ix.1923, L. G. Saunders (BMNH).

Specimens examined.—BRAZIL: Río and Pernambuco, viii(ix).1923, L. G. Saunders, in terrestrial bromeliads, 1 ♂, 4 ♀, 4 pupal exuviae, 3 larvae, labelled "cotypes" (BMNH). TRINIDAD: No locality, ix.1963, R. W. Williams, from bromeliad *Guzmania* sp., 1 ♂, 6 ♀ (USNM).

Notes.—This species is quite similar to *F. caribbeana* and *magna*. In *caribbeana* the larval head is shorter ($1.45\times$ as long as broad) and the sensilla of the female palpus are not borne in a pit; while in *edwardsi* the larval head ratio is 1.70 and the palpal sensilla are borne in a deep pit. *Forcipomyia magna* differs from *edwardsi* most notably in its larger size (wing length 1.24 mm compared with 1.0).

Forcipomyia (Phytohelea) jocosa Saunders

Forcipomyia (Trichohelea) jocosa Saunders, 1956:701 (all stages; Trinidad; figs.).

Types.—Holotype ♀, allotype ♂, Mount St. Benedict, Trinidad, 13.v.1953, L. G. Saunders, reared from terrestrial *Bromelia pinguin* L. (in Canadian National Collection). Paratypes, 1 ♂, 7 ♀, 6 larvae, 2 pupae, same data.

Specimens examined.—None available.

Notes.—This species resembles *comis* in the truncate structure of the tail end of the larva, but *comis* has a normal cauda flanked by the usual bladelike chaetae, while in *jocosa* the tail end is squarely truncate, forming a terminal disc rimmed with four pairs of comblike plates projecting outwards, one pair of lateroventral papillate prominences, and one median ventral pad or cushion bearing symmetrically disposed black studs. In the larva of *crinum* the cauda is still larger and "pineapple-like"; the ventral studded pad is tightly packed with rounded papillae, but the disc is not rimmed with combs.

Forcipomyia (Phytohelea) magna (Saunders)

Apelma magna Saunders, 1925:266 (all stages; Brazil; figs.).

Forcipomyia (Trichohelea) magna (Saunders); Saunders, 1956:701 (combination; compared with *antiguensis*).

Types.—Syntypes, 4 larvae, 4 pupae, 2 ♂, 1 ♀ (alcohol), from terrestrial bromeliads in woods behind Pernambuco (Dois Irmãos), Brazil, ix.1923, L. G. Saunders (BMNH).

Specimens examined.—BRAZIL: Pernambuco, 10.ix.1923, L. G. Saunders, from bromeliads, 1 ♀, 2 pupal exuviae, 2 larvae, labelled "cotypes" (Saunders collection in USNM); 1 ♂, larval head, and pupal exuviae (BMNH).

Forcipomyia (Phytohelea) marksae Tokunaga

Forcipomyia (Trichohelea) marksae Tokunaga, 1961:117 (all stages; New Guinea; figs.).

Types.—Holotype ♀, allotype (sic) ♀, paratypes, 5 ♀, 2 ♂, Subitana, Port Moresby, New Guinea, 3.iv.1958 (Casey) (deposited in Bishop Museum, University of Queensland, and Kyoto Prefectural University, Japan).

Specimens examined.—NEW SOUTH WALES: Tilba Tilba, 14.xii.1953, B. McMillan, bred from *Alocasia*, 2 ♂, 4 ♀, 2 larvae, 3 pupae (USNM). QUEENSLAND: Boldery Park, 2.iii.1957, E. N. Marks, from *Alocasia macrorhiza* Schott, 2 ♂, 3 ♀, 4 pupal exuviae (USNM).

Unplaced *Forcipomyia (Phytohelea)* species

The following four species of *Phytohelea* cannot be placed in a species group because only the male is known.

Forcipomyia (Phytohelea) fijiensis (Macfie)
Figs. 42–44

Apelma fijiensis Macfie, 1945:1 (♂; Fiji; fig. genitalia).

Type.—Holotype ♂, Korobaba, Fiji, 21.vii.1943, R. A. Lever, “*Pandanus axil*” (on slide, in BMNH).

Discussion.—Through the courtesy of Richard Lane and the Trustees of the British Museum (Natural History), we were privileged to borrow the holotype male and to remount it for close examination of the genitalia. As noted by Macfie (1945), the male palpus (Fig. 44) is unusually short and stout, and the 3rd segment bears a deep sensory pit with a small opening. The empodium is present only as a slender, threadlike filament with a slight terminal swelling. The aedeagus (Fig. 42) is slightly broader proximally than figured by Macfie, while the apices of the distal processes appear truncate in ventral view. In ventral view the distal lobes of the parameres appear as broad, leaflike, obtusely pointed plates, each with a darkened ventral carina, and in lateral view this carina is seen to bend abruptly ventrad from the main body of the paramere.

Forcipomyia (Phytohelea) hamaticauda Tokunaga

Forcipomyia (Trichohelea) hamaticauda Tokunaga, in Tokunaga and Murachi, 1959:212 (♂; Caroline Islands; figs.).

Type.—Holotype ♂, Melekeiok, Babelthuap I., Palau Is., 22.v.1957, C. W. Sabrosky, light trap (Type no. 64597, USNM).

Specimens examined.—CAROLINE ISLANDS: Palau (holotype ♂). The holotype in the USNM was unfortunately mounted in Hoyers' medium and is now in very bad condition, unsuitable for examination.

Forcipomyia (Phytohelea) keilini (Saunders)

Apelma keilini Saunders, 1925:265 (larva, pupa, male; Brazil; figs.).

Forcipomyia (Phytohelea) keilini (Saunders); Wirth, 1974:9 (combination).

Types.—Syntypes, 3 larvae, 3 pupae, 1 ♂ (alcohol) from terrestrial bromeliads in woods behind Pernambuco (Dois Irmãos), Brazil, 10.ix.1923, L. G. Saunders (BMNH).

Specimens examined.—None available.

Forcipomyia (Phytohelea) sabroskyi Tokunaga

Forcipomyia (Trichohelea) sabroskyi Tokunaga, in Tokunaga and Murachi, 1959:211 (♂; Caroline Islands; figs.).

Types.—Holotype ♂, Ngaremlengui, Babelthuap I., Palau Is., 1.vi.1957, C. W. Sabrosky, light trap (Type no. 64596, USNM).

Specimens examined.—CAROLINE ISLANDS: Palau (holotype ♂). As in *F. hamaticauda*, the type of *F. sabroskyi* was also mounted in Hoyers' medium. It has turned opaque and is unsuitable for examination.

ACKNOWLEDGMENTS

We are grateful to Richard Lane and the trustees of the British Museum (Natural History) for allowing us to examine the holotype of *F. fijiensis* which confirmed our opinion regarding the status of *F. belkini* as a new species and for the loan of other museum material including type-material of *F. bacoti* Ingram and Macfie. The director of the South African Institute of Medical Research in Johannesburg kindly supplied type-material of *F. natalia* de Meillon. We are grateful to L. L. Pechuman for the loan of type-material of *F. brevis* in the Johannsen collection in Cornell University, and to Marshall Laird for collections from the South Pacific, and to John A. Belkin for the submission of the material of *F. belkini* from New Zealand.

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DEVELOPMENT AND SURVIVAL OF *MEGASELIA SCALARIS* (DIPTERA: PHORIDAE) AT SELECTED TEMPERATURES AND PHOTOPERIODS

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Abstract.—Newly eclosed *Megaselia scalaris* larvae were placed on commercially available *Drosophila* media to determine developmental time and survival to the adult stage at temperatures of 21°, 27°, and 32°C and at LD:12-12 and LD:16-8. With few exceptions, the developmental time and percentage survival decreased with increasing temperature. Mean developmental time of insects reared at 21°C showed an increase of approximately 300% over those reared at 32°C. The survival fluctuated from a low of 50.0% at 32°C to a high of 82.0% at 21°C. Photoperiod significantly affected development at the lower temperatures.

Megaselia scalaris (Loew.) is a small yellowish-brown phorid of nearly cosmopolitan distribution (Robinson, 1971). Larvae have been reported developing on a wide variety of host materials, including: Decaying meat; decomposing insects; feces from many sources; milk; plant materials; and in one case, boot polish (Patton, 1922; Robinson, 1975). The occurrence and control of this fly in cockroach colonies was reported by Robinson (1975). Adult and immature stages of this species have been adequately described (Grandi, 1914; Patton, 1922; Semenza, 1953; Haider, 1956; Borgmeier, 1964; and Robinson, 1978).

Although *M. scalaris* has been used in genetic studies (Burisch, 1963; Mainx, 1964), and the larvae have been known to cause myiasis in man and animals (Haider 1956), little is known about its basic biology. Because of the potential of this species as a medical problem and pest in insect colonies, this study was undertaken to increase the basic knowledge available on the survival and development of this insect.

METHODS AND MATERIALS

Megaselia scalaris adults were obtained from laboratory colonies maintained in the Department of Entomology, Virginia Polytechnic Institute and

State University. Approximately 50 adults were allowed to oviposit for 12 hours on commercially available *Drosophila* media and moistened cheesecloth. Eggs were collected from the surface of the media with a double "0" paint brush and placed on moistened filter paper. Eggs laid on cheesecloth were collected by rinsing the cheesecloth in a small beaker of tap water and pouring the water and dislodged eggs through a funnel lined with filter paper. All eggs were sealed in a small plastic container maintained at 27°C. After 24 hours newly eclosed larvae were placed on freshly prepared media in sterile quadrant petri dishes. Two of the four compartments in the petri dishes were left empty to allow the larvae dry surfaces on which to pupariate.

Five replicates of 10 larvae per container were allowed to develop in each of three temperature-photoperiod chambers set for 21°, 26°, and 32°C ($\pm 1^\circ\text{C}$), respectively. Photoperiod was maintained at light-dark (LD):12-12 for all chambers. This test was repeated using the same sample sizes and temperatures in chambers set for a photoperiod of LD:16-8.

Larvae were examined at 12 hour intervals. Newly formed puparia were removed, placed in 25 dram snap cap containers with moistened filter paper and returned to the same chamber from which they had been removed. Puparia were examined at 12 hour intervals; emergence and the sex of the adults were recorded.

RESULTS AND DISCUSSION

The survival rate of *M. scalaris* was influenced by both temperature and photoperiod (Table 1). In general, a photoperiod of LD:12-12 permitted a more uniform survival for each temperature than LD:16-8. Although this trend could be seen in development before and after pupariation, survival was obviously more uniform in LD:12-12 when the total developmental time was considered. Statistically, the only significant differences (*t*-test; $P < 0.05$) in mortality between photoperiods occurred at 21°C; the percent survival of: 1) larvae developing until pupariation and 2) insects developing to the adult stage was significantly greater at LD:12-12 than LD:16-8.

With few exceptions, survival increased with decreasing temperature. However, significant differences in survival for the total developmental time were found only in LD:12-12; survival at 32°C was significantly different (Least Significant Range Test, $P < 0.05$) from both 27°C and 21°C.

Because the data on the developmental rates of *M. scalaris* were not normal and could not be completely normalized with transformations, contingency tables measuring differences in frequency of occurrence throughout the ranges were used to statistically compare growth rates. A factorial analysis of variance (attempted for comparative purposes) found the same relationships, with one exception: Photoperiod did not significantly influence development at 27°C.

Table 1. Mean percent survival of *Megaselia scalaris* at selected photoperiods and temperatures.

| Developmental Interval | Temperature °C | Photoperiod | |
|------------------------|----------------|-------------------------|-------------|
| | | LD:12-12 | LD:16-8 |
| Pre-pupariation | 32 | 64.0 ± 8.9 ¹ | 67.5 ± 12.6 |
| | 27 | 78.0 ± 8.4 | 80.0 ± 10.0 |
| | 21 | 88.0 ± 8.4 | 64.0 ± 16.7 |
| Post-pupariation | 32 | 82.8 ± 25.5 | 72.0 ± 19.6 |
| | 27 | 97.8 ± 4.9 | 75.0 ± 17.9 |
| | 21 | 93.5 ± 9.3 | 93.5 ± 9.3 |
| Total development | 32 | 52.0 ± 14.8 | 50.0 ± 21.6 |
| | 27 | 76.0 ± 5.5 | 60.0 ± 17.3 |
| | 21 | 82.0 ± 8.4 | 60.0 ± 18.7 |

¹ Based on 5 replicates of 10 L each, ±SD; except at 32°C and LD:16-8 which was based on 4 replicates of 10 L each.

Based on contingency table analysis, temperature affected developmental times significantly ($P < 0.05$); the rate of development increasing with increasing temperature (Table 2). Also, growth rates were significantly faster ($P < 0.05$) in LD:12-12 for larvae developing until the onset of pupariation at 21°C. Development was not significantly different between photoperiods at 27°C or 32°C. Analysis of photoperiodic effects on development after pupariation and on the total developmental time found significant differences

Table 2. Range and mean developmental time in days for *Megaselia scalaris* at selected temperatures and photoperiods.¹

| Developmental Interval | Tempera-ture °C | Photoperiod | | | |
|------------------------|-----------------|--------------|-------------|--------------|-------------|
| | | LD:12-12 | | LD:16-8 | |
| Pre-pupariation | 32 | 5.39 ± 1.06 | 3.75–7.25 | 6.00 ± 0.88 | 3.75–7.75 |
| | 27 | 6.85 ± 1.07 | 5.25–10.25 | 7.02 ± 0.79 | 5.75–8.75 |
| | 21 | 16.67 ± 2.87 | 12.25–21.75 | 14.92 ± 1.84 | 11.75–17.75 |
| Post-pupariation | 32 | 7.31 ± 0.36 | 6.75–7.75 | 7.33 ± 0.41 | 6.75–7.75 |
| | 27 | 10.45 ± 1.18 | 9.25–16.25 | 10.83 ± 0.60 | 9.25–11.75 |
| | 21 | 20.14 ± 0.82 | 17.75–21.25 | 18.75 ± 0.62 | 17.75–20.25 |
| Total development | 32 | 13.53 ± 1.09 | 11.25–15.75 | 12.99 ± 1.00 | 11.25–14.75 |
| | 27 | 17.37 ± 0.69 | 16.25–18.25 | 18.30 ± 0.92 | 16.25–20.25 |
| | 21 | 36.95 ± 3.29 | 31.75–42.75 | 33.33 ± 2.09 | 29.25–37.25 |

¹ Based on at least 26 insects per temperature.

($P < 0.05$) in growth rates between photoperiods at 21°C and 27°C, but not at 32°C.

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NEW SYNONYMY AND NEW COMBINATIONS PRIMARILY IN AMERICAN TAXA (COLEOPTERA: ANOBIIDAE)

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Abstract.—Examination of types in the Museum National d'Histoire Naturelle in Paris has led to new synonyms and new combinations. Among species described by Maurice Pic, five are synonymized with *Tricorynus herbarius* (Gorham), and eight are generically reassigned. Five species described by A. Solier in the genus *Anobium* are generically reassigned. The genus and species *Alvarenganiella seabrai* (both proposed by Viana and Martinez in 1971) are synonymized with *Dasytanobium monstrosum* (both validated by Pic in 1910). A species described from Mexico by White is newly synonymized, and a genus described by White from Florida is noted as a possible synonym. An Hawaiian species described by Perkins is generically reassigned, and the Lepesme genus *Picatoma* is synonymized with *Protheca*. Several lectotypes are designated.

During a recent trip to the Museum National d'Histoire Naturelle in Paris, I examined type-material of many species of American Anobiidae that were described by M. Pic, A. Solier, and P. Lepesme. The Pic collection is by far the most important to my studies, for he named about 265 species and subspecies of American Anobiidae. Rarely can his species or subspecies be recognized from the exceedingly brief descriptions (some consisting of 5 to 10 words) provided for them, so examination of types is the only reliable means of correctly assigning the names.

In Paris I saw type-specimens of about 150 of the Pic taxa of Anobiidae. Type-specimens of roughly 90 taxa were not available to me because they had been loaned many years ago and were never returned to the museum. However, the data that I accumulated and the specimens that I borrowed will enable me, in time, to make considerable progress with certain genera of American Anobiidae.

Major problems often accompany examination of Pic types. Most of his types are in the Museum National d'Histoire Naturelle, but when a certain

type seems to be missing, there is usually no way of knowing if that type is in another museum, lost, or mislaid. Pic generally gave no indication in print where types were deposited.

The haste and general lack of care with which Pic worked is well reflected by his handwriting, labeling, and arrangement of the material. Most types are marked by both his small, yellow, handwritten type-label, and by a capitalized, red museum type-label. Where a Pic type-label is on a specimen I have accepted that as the type. I have designated lectotypes herein for species when I felt sure that a particular specimen was the type, but was not clearly labeled as such. Some boxes of the collection were so badly crowded by Pic (especially those containing genera with many species) that the chaos therein, and the lack of care in labeling, make it difficult to sort out types from non-types. In my examination of the Pic collection of Anobiidae I found three instances in which there were evidently two types of a species; in one instance the data on neither apparent type agreed with that published for the species. It often is impossible to know whether Pic had a series of specimens when he described a species, and if some of the series might be in museums other than the Paris museum. Even after my careful examination of the Pic collection, the possibility remains that there may have been before me types that I wished to examine, but which were indistinguishable as types because they were not adequately labeled.

Following are the changes resulting from my studies. All types referred to herein are in the Museum National d'Histoire Naturelle in Paris.

PIC CATORAMA SPECIES
Tricorynus herbarius (Gorham)

Cathorama herbarium Gorham, 1883:207.

Catorama latipennis Pic, 1927b:9. NEW SYNONYM.

Catorama claveri Pic, 1923:5. NEW SYNONYM.

Catorama minasensis Pic, 1927b:8. NEW SYNONYM.

Catorama goudoti Pic, 1927b:8. NEW SYNONYM.

Catorama venezuelensis Pic, 1927b:9. NEW SYNONYM.

The fact that four of these unnecessary names were validated in the same paper offers a commentary on Mr. Pic's approach to taxonomy.

The type of *goudoti* bears: Colomb Goudot, Type, TYPE, Goudoti n. sp.; the type of *minasensis* has: Capress Bresil (undecipherable word), 2810, Dang un livre 1931, C. *minasensis* Pic; the type of *venezuelensis* bears: Venezuela, Type, TYPE, *venezuelensis* n. sp.; the pin bearing the name *claveri* has 6 specimens mounted consecutively, I hereby designate the top one as LECTOTYPE, the pin bears the data: Colombie Ibague Fr. Claver, TYPE, C. *Claveri* n. sp.; the Pic specimen of *latipennis* has: Belmont Trinidad IX, ambion, *latipennis* n. sp. I hereby designate this specimen as LECTOTYPE.

Tricorynus hogei (Pic)*Catorama hogei* Pic, 1927b:10.*Tricorynus partinitidus* White, 1967:22. NEW SYNONYM.

Examination of the Pic type of *hogei* shows that these two names apply to the same species; Pic's original description did not allow recognition of his species. Data on the type follow: Mexico (Hoge), Type, Hoge n. sp.

Mirosternus jacobsoni (Pic), NEW COMBINATION*Catorama jacobsoni* Pic, 1927a:50.

I have examined a specimen that I hereby designate as LECTOTYPE (with the data: Fort de Kock [Sumatra] 92 M. 1925, leg E. Jacobson), and find the above change to be necessary.

PIC *XYLETINUS* SPECIES

Pic described 25 American species and one subspecies that he placed in *Xyletinus*; I have seen all but two of the types of these. Most species actually do belong in *Xyletinus*, but a number do not. I have earlier placed *X. wagneri* Pic in *Hadrotinus* (White, 1973:846); I below assign an additional six species and one subspecies to different genera and designate a lectotype for one species.

Tricorynus robusticollis (Pic), NEW COMBINATION*Xyletinus robusticollis* Pic, 1922:4.

The type bears: Republ. Argentina, Chaco de Santiago, Del Estero, Rio Salado, Type, TYPE, *robusticollis* n. sp.

Calymmaderus inaequalicollis (Pic), NEW COMBINATION*Xyletinus inaequalicollis* Pic, 1932:11.

The type has Loja, Type, TYPE, *inaequalicollis* n. sp. Loja is a province of Ecuador.

Xyletomerus griseopubens (Pic), NEW COMBINATION*Xyletinus griseopubens* Pic, 1915b:8.

Data on the type follow: Mineiro Loyaj, Type, TYPE, *griseopubens* Pic. The locality is in Brasil.

Xyletomerus semisericeus (Pic), NEW COMBINATION*Xyletinus semisericeus* Pic, 1915a:13.

The type-data are identical with that on *griseopubens* except for the species label.

Hadrotinus inermicollis (Pic), NEW COMBINATION*Xyletinus inermicollis* Pic, 1902a:18.

The type has the data: S. Antonio da Barra, Pr. de Bahia, Gounelle, 11.12.88, An. Belg. 1902, p. 18, Type, *inermicollis* Pic.

Hadrotinus distinctevesitus (Pic), NEW COMBINATION*Xyletinus distinctevesitus* Pic, 1902c:21.

The type-data are: Jataby, Prov. Goyas, Bresil, Sept. a Nov. 97, Le Nat. No. 352, Journ. 1902, p. 21, Type, *Xyletinus distinctevesitus* Pic.

Hadrotinus distinctevesitus hirsutus (Pic), NEW COMBINATION*Xyletinus distinctevesitus hirsutus* Pic, 1915a:13.

Three type-specimens are mounted on one pin (two on one card, one above on another card); I hereby designate the uppermost as the LECTOTYPE. The collection data are: Républ. Argentine, Chaco de Santiago, Del Estero, Rio Salado, Type, TYPE, *distinctevesitus* v. *hirsutus* Pic. It is worth noting that reference to this subspecies was not included in the Black-welder catalog (1945).

OTHER TAXA DESCRIBED BY PIC
Dasytanobium monstrosum Pic*Dasytanobium monstrosum* Pic, 1910:60.

Alvarenganiella seabrai Viana and Martinez, 1971:123. NEW GENERIC and SPECIFIC SYNONYMY.

I have compared the Pic type of *D. monstrosum* with the illustrations and description of *A. seabrai* and they agree so closely in nearly all details that I am convinced they are identical. The only difference that I found is that the antennal serration of Pic's type is somewhat greater than is the serration shown in the illustration of the antenna of *A. seabrai*. However, the angle at which the antenna was drawn could explain the apparent difference. An attempt to borrow a specimen of *A. seabrai* was met with no response, so I have not seen a specimen of this species.

Dasytanobium inaequale Pic

Examination of the type of *D. inaequale* Pic (type-species of *Dasytanobium*; Pic, 1902b:23) shows that it differs greatly from the type of *D. monstrosum*. The latter has the coxa, trochanter, femur, and tibia of a front leg each greatly elongated (two or more times normal length) and arcuate. In *inaequale* the above segments of a front leg are not elongated, but are similar to the segments of the other legs. It is possible that the unique leg adaptations of *D. monstrosum* are male characters, and that *monstrosum*

is actually the male of *D. inaequale*. If it is found that the two names apply to a single species, the correct name will be *inaequale*, for it was published earlier than was *monstrosum*. A more complete series than I have seen of *monstrosum* and *inaequale* will be needed to decide whether or not the two names apply to the sexes of one species.

The type of *D. monstrosum* is labeled: Espirito-Santo Brasil ex. coll. Fruhstorfer, Type, TYPE, Dasytanobium monstrosum Pic. The type of *D. inaequale* is labeled: Caraca (Minas Geraez) Bresil, E. Gounelle 1.2.1885, Dasytide?, L-Exchange no. 209, Type, TYPE, Dasytanobium inaequale Pic.

Viana and Martinez (1971) erected the new subfamily Alvarenganiellinae for their new genus and species; I am in agreement that a new subfamily is appropriate so it remains unchanged.

In addition to *D. monstrosum* and *inaequale*, the Hawaiian species *Xyletobius timberlakei* Perkins (1921:505) belongs in Alvarenganiellinae.

Dasytanobium timberlakei (Perkins), NEW COMBINATION

This is a provisional assignment, for the species shows notable differences (most obvious in the antennal form) from both *monstrosum* and *inaequale*, and likely deserves a genus by itself.

Pseudodorcatoma Pic

Pseudodorcatoma Pic, 1905:171.

Cryptoramorphus White, 1966:959. SYNONYM?

Unfortunately, I have not seen Pic's type of the type-species (*P. ornata* Pic), but I have examined a specimen determined by P. Lepesme as *P. ornata* Pic. If Lepesme's identification is correct, then my *Cryptoramorphus* is a synonym of *Pseudodorcatoma*. Also, on the basis of Lepesme's identification, the original, brief description of *Pseudodorcatoma* may be in error in stating that the antennae are 8 or 9 segmented (they are 11 segmented in the Lepesme specimen); and, *Pseudodorcatoma* seems to be not closely related to *Dorcatoma* Herbst, to which Pic compared it.

SOLIER ANOBIUM SPECIES

Solier described nine Anobiidae from Chile that he placed in *Anobium*; I have seen the types of seven of these. Most of the species belong to genera that were not yet described when Solier did his work; the species are below reassigned generically or their generic status is discussed. None of the specimens was designated in print as type and only one bears a type-label, so I below designate lectotypes for six species.

I below assign two of Solier's species to *Xyletomerus*. M. Pic described eight Chilean anobiids in *Xyletomerus*; unfortunately, none of the types of these species was available to me in Paris. It is likely that certain of Pic's

species are synonyms of Solier species. Two of the species below do not belong to genera with which I am familiar. Further study may show that new genera should be described for these two species.

Xyletomerus cylindricus (Solier), NEW COMBINATION

Anobium cylindricum Solier, 1849:472.

The LECTOTYPE that I hereby designate bears the data: *Anobium cylindricum* Sol. Chile.

Xyletomerus fumosus (Solier), NEW COMBINATION

Anobium fumosum Solier, 1849:471.

The data on the holotype are: Museum Paris, Chile, Cl. Gay 1845, *Anobium fumosum* Sol. Santiago, TYPE.

Xyletinus oblongus (Solier), NEW COMBINATION

Anobium oblongum Solier, 1849:471.

The LECTOTYPE that I hereby designate has the data: *Anobium oblongum* Ziegel. Chile Coquimbo.

Euvrilletta nigra (Solier), NEW COMBINATION

Anobium nigrum Solier, 1849:470.

The data on the specimen I hereby designate as LECTOTYPE are: *Anobium nigrum* Sol. Sa Rosa. This species does not agree well in general form with other members of *Euvrilletta*, but it is better placed here than in any other genus known to me.

Trichobiopsis spinolae (Solier), NEW COMBINATION

Anobium spinolae Solier, 1849:469.

Nicobium spinolae (Solier), Pic, 1912:32.

The specimen I hereby designate as LECTOTYPE (with data: *Anobium spinolae* Sol., Illapel), from Chile, is damaged with most appendages missing; and it is badly encrusted with foreign material. From what I can see of the morphology, the species most likely belongs in *Trichobiopsis* (White, 1973:846), but does not exhibit the generic characters to the same degree as does the type-species, *T. excavata* White. That is, the sternal groove is less deep and less strongly marked off, the abdominal sutures are weak medially but not obliterated as in *T. excavata*, and only the last segment of the labial palpus is notched, and not also the last segment of the maxillary palpus as in *excavata*.

Anobium lunatum Solier*Anobium lunatum* Solier, 1849:472.

The specimen I here designate as LECTOTYPE has: *Anobium lunatum* Sol. Chile. This species belongs in Xyletininae, but I am not sure to what genus.

Anobium acutangulum Solier*Anobium acutangulum* Solier, 1849:470.

The LECTOTYPE that I here designate has the data: *Anobium acutangulum* Sol., Coquimbo, Coquimbo. This species belongs in the Anobiinae near the genus *Priobium* Motsch., but exhibits notable differences from that genus. I am uncertain to what genus this species belongs.

Lepesme's *Picatoma**Protheca* LeConte, 1865:241.*Picatoma* Lepesme, 1947:224. NEW SYNONYM.

I have compared the type-species of *Protheca* (*P. hispida* LeConte) with specimens determined by Lepesme as *Picatoma guadalupensis* (Pic), the type-species of *Picatoma*; and I found that they are distinguishable on a species level only.

ACKNOWLEDGMENTS

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THE TYPE-SPECIES OF THE GENUS *LEPTOPHLEBIA* WESTWOOD (Ephemeroptera: Leptophlebiidae)

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Abstract.—The type-species of the genus *Leptophlebia* Westwood is *Ephemerella vespertina* L., not *Ephemerella marginata* L. as has been commonly supposed.

The identity of the type-species of any genus is of crucial importance to the taxonomy of that genus because the type-species serves as the basis for any definition of the genus; any redefinition or modification of the generic limits must take into account the type-species. It is therefore important to understand the correct concept of the type-species of a genus before any taxonomy (at least at the generic level) or systematics involving that genus is begun. Any errors in the present concept of the identity of a type-species may well be transformed into greater errors in work of the future if left uncorrected today.

One such error has persisted in the literature since it was first introduced in 1881. The genus *Leptophlebia* Westwood, 1840, is one of the largest genera of Ephemeroptera and is the type-genus of the family Leptophlebiidae which contains about one-quarter of the extant genera of mayflies. The type-species has generally been thought to be *Ephemerella marginata* Linnaeus, 1767.

Eaton (1871) in his Monograph on the Ephemeridae listed no type-species for the genus *Leptophlebia*. However, he divided the genus into 4 "series" and gave a type-species for each. "Series 3," which included *Leptophlebia vespertina* Linnaeus, 1758, and eight other species, was given *Ephemerella marginata* for a type-species. Following this Eaton (1881) restricted the definition of the genus *Leptophlebia sensu stricto* to coincide with "series 3". The type-species of "series 3", *Ephemerella marginata*, was retained by Eaton as the type-species of *Leptophlebia* (restricted). Since this time, all major works treating the Leptophlebiidae which list type-species (e.g., Eaton, 1884; Needham, Traver, and Hsu, 1935; Grandi, 1960; Landa, 1969; Peters and Edmunds, 1970; Edmunds, Jensen, and Berner, 1976) have con-

sistently given *Ephemera marginata* as the type-species of the genus *Leptophlebia*, apparently following Eaton (or each other).

An investigation of the original establishment of *Leptophlebia* (Westwood, 1840) however, reveals that the genus was erected for *Ephemera vespertina* L., and "the allied species." The present International Code of Zoological Nomenclature requires that the type-species of a genus be one of the originally included nominal species, and that if only one nominal species is originally included, it is the type-species by monotypy. Thus, *Ephemera vespertina* L., 1758, must be regarded as the type-species of *Leptophlebia* Westwood, 1840 (type by indication: monotypy), not *Ephemera marginata* as has been commonly, but erroneously, accepted.

There is little doubt as to the identity of *Leptophlebia vespertina* or to the fact that it is the species which Westwood had in mind when he established *Leptophlebia*. He both mentioned it by name and referred to the figure of DeGeer's (1771) "Ephémere noire à ailes blanches" which has been shown by Bengtsson (1912) to be Linnaeus' *Ephemera vespertina*. The figures, descriptions, and distributions given by Linnaeus (1758), DeGeer (1771), and Westwood (1840) are all compatible with the present concept of *Leptophlebia vespertina*.

Leptophlebia vespertina is a senior synonym of *Leptophlebia meyeri* Eaton, 1884, and *Ephyurus albitarsis* Bengtsson, 1909 (see Lestage, 1917, for a fuller discussion of these specific synonymies). *Ephyurus albitarsis* is the type-species by monotypy of *Ephyurus* Bengtsson, 1909, making the latter a junior synonym of *Leptophlebia* as suggested by Lestage (1917).

This clarification of the true type-species of the genus *Leptophlebia* will induce no change in any of the present prevailing concepts of the genus, but may well prevent taxonomic confusion in the future.

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SEASONAL HISTORY AND DISTRIBUTION OF *CARULASPIS MINIMA*
(TARG.-TOZZ.) IN PENNSYLVANIA
(HOMOPTERA: DIASPIDIDAE)

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Abstract.—The biology and distribution of the univoltine scale insect *Carulaspis minima* (Targ.-Tozz.) was studied at Harrisburg, Pennsylvania, during 1974-75 and its seasonal history compared to that of juniper scale, *C. juniperi* (Bouché). Fertilized adult females overwintered and began oviposition April 30 and May 23 of the two years studied. Eggs hatched in one week and peak crawler emergence occurred May 30 both years. Second instars appeared June 12, adult males and females, at the end of June. Adult males were most abundant the first two weeks of July, when they fertilized the females then died. The seasonal histories of *minima* and *juniperi* were similar. The distribution survey revealed that *C. minima* infests seven Pennsylvania counties, mainly in the southeastern portion of the state. The only hosts harboring *minima* during the survey were *Juniperus* spp. Natural enemies encountered during the study included the hymenopteran parasites *Aphytis* sp., *Aspidiotiphagus* sp., and *Prospaltella* sp., and the neuropteran predator *Aleuropteryx juniperi* Ohm.

Two species of the genus *Carulaspis* MacGillivray are found in the United States: *Carulaspis juniperi* (Bouché), juniper scale, and *Carulaspis minima* (Targioni-Tozzetti), the so-called minute cypress scale. Both species are believed to be introduced, with Ferris (1937) stating that *juniperi* is European, and King (1902) suggesting *minima* to be Oriental. Both species are economically important. Naegele (1953) described severe damage to native junipers in Bermuda from exploding populations of juniper scale. In 1975 the number of quarantines levied against both scales on ornamental junipers in Pennsylvania was second only to the number imposed against black vine weevil on *Taxus*.¹ In 1958, *C. minima* was reported heavy on eastern red

¹ From the nursery inspection records of the Bureau of Plant Industry, Pennsylvania Department of Agriculture, Harrisburg, Pennsylvania.

cedar, *Juniperus virginiana*, in Oklahoma (USDA, 1958). Recently, Dekle (1976) recognized that *minima* is economically important on juniper in Florida.

The first record of *C. minima* from the U.S. is King's (1902) collection on *Thuja* in Massachusetts. It has since been recorded from California, Florida, Georgia, Hawaii, Kansas, Louisiana, New Mexico, North Carolina, Oklahoma, Pennsylvania, Texas, Vermont, Virginia, and Washington. The identification of this scale in Pennsylvania (USDA, 1974) was made during the initial stages of a study of the arthropod fauna of ornamental juniper by Bureau of Plant Industry entomologists. I had been making preliminary observations on a population of scale thought to be *C. juniperi* but which I found to be *C. minima* with the aid of McKenzie's (1956) key. I began a more detailed investigation of *C. minima* because of the lack of published information on this species, probably the result of failure by workers to separate *minima* from *juniperi*. Also, a survey was initiated to determine its distribution and host range in Pennsylvania.

METHODS

An ornamental planting of *Juniperus chinensis* cv. 'Hetzii' on the grounds of the Pennsylvania Department of Agriculture, Harrisburg, Dauphin County, was selected. The planting, about 46 m long by 3 m wide, harbored a heavy infestation of *C. minima*. Weekly samples were taken from March through October 1974 and 1975. Each sample consisted of a randomly selected, scale-infested 15-cm terminal which was cut from the host plant and taken to the laboratory. The first 100 living scale forms encountered (including eggs) were removed from the host material, mounted five at a time on microscope slides in Hoyer's medium, and examined through a phase-contrast microscope to determine the stage of each specimen. The stage and sex (except first instars, which were not sexed) of nearly 4,500 specimens were recorded, and the percentage of each stage in the total sample was calculated.

Counts of deposited eggs were made by lifting the coverings of adult females and counting the eggs beneath. Most females carried additional undeposited eggs, and these were counted when the slide-mounted specimens were examined under phase-contrast. No attempt was made to determine total fecundity of the females since empty chorions were not counted.

Male scales and parasites were collected by the mailing tube and glass vial method described by Stoetzel and Davidson (1971). These were labeled and preserved in 70% ethyl alcohol in 2-dram vials.

Field observations were in themselves unsatisfactory for determining the number of annual generations. Overwintering females oviposited over a long period, a fact which would obscure oviposition by first generation females, should it occur. The number of generations was determined by transferring

active first generation crawlers to scale-free hetz junipers (potted 10-inch plants). After these had settled and matured (to first generation adults), they were observed periodically in order to detect any subsequent oviposition, which would indicate the onset of a second generation. The absence of such oviposition would suggest that the first generation adults overwinter.

The distribution survey for the two *Carulaspis* spp. in Pennsylvania utilized Bureau of Plant Industry inspectors, entomologists, and the author. Small clippings from *Juniperus* and *Thuja* plantings harboring what appeared to be juniper scale were taken and delivered to the laboratory in Harrisburg, where specimens were mounted on slides for identification.

To compare the seasonal history of *C. minima* with that of *C. juniperi*, a nearby population of *C. juniperi* on *J. chinensis* cv. 'Hetzii' from Camp Hill, Cumberland County, was monitored weekly during 1975. Approximately 20 specimens per week were mounted on slides in Hoyer's medium for phase-contrast studies.

SEASONAL HISTORY

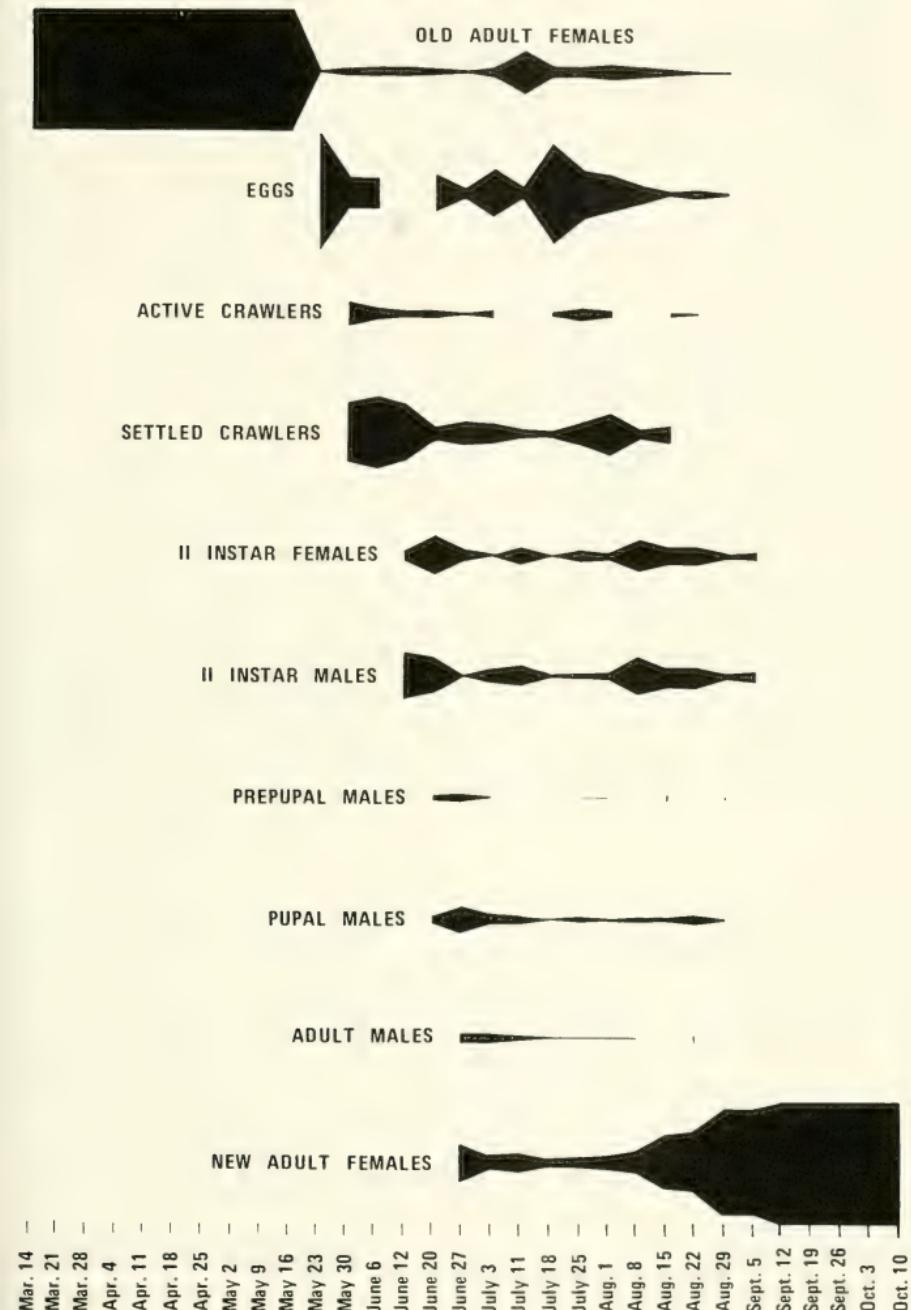
Fig. 1

Carulaspis minima is a univoltine species which overwinters as fertilized adult females. In southcentral Pennsylvania, the females began to swell in late March, and eggs could be seen in the bodies of slide-mounted specimens in the middle of April. Oviposition began April 30 in 1974 and May 23 in 1975, and peak oviposition occurred around the third week of May both years. Deposited eggs averaged 20 per individual, but the total number of eggs probably was more than 35 since slide-mounted females contained an average of 15 undeposited eggs, and empty chorions were uncounted. Most eggs hatched in seven days, although the incubation period ranged from five to eight days.

As the first-instar scales hatched, they emerged from beneath the parent scales and searched for suitable feeding sites. The crawlers settled in a short time (no crawlers survived more than 24 hours without feeding), inserted their mouthparts to feed, and became permanently attached to the host. This was the "settled crawler" or immobile phase of the first instar. Peak crawler emergence occurred around May 30 both years.

Second instars of both sexes began to appear in the samples June 12, two weeks after appearance of active and settled crawlers. The second stadium lasted about two weeks, during which both sexes had developed pygidia. Females attained a turbinate shape with no evidence of eyes, while males became elongate and developed easily visible eyespots. Incorporation of wax secretions into the scale cover began during the second stadium, and seemed to follow that described for *C. juniperi* by Stoetzel (1976). Female scale covers were usually smooth and circular, while male covers were

PERCENT IN SAMPLE

Fig. 1. Seasonal history of *Carulaspis minima* in 1975.

elongate and faintly tricarinate. The male covering was completed during the second instar.

First generation ("new") adult females appeared at the end of June, two weeks after the appearance of second instars. They differed from the second instars by the presence of a vulva surrounded by five clusters of perivulvar pores. New adult females were differentiated from old (overwintering) adult females by the absence of internally developing eggs, and they often had the mouthparts still in the crumena or coiled ready to descend into the crumena. This first generation overwintered and produced the following year's eggs.

Prepupal males were found one week after the appearance of second instars, about June 20. The prepupal period was short and did not last more than several hours. The pupal period (pupae were found in the same week's sample as the prepupae) lasted about a week. Neither prepupae nor pupae had functional mouthparts.

The emergence of the adult males began at the end of June and coincided perfectly with the maturation of the new adult females. Males immediately began to search out and fertilize the virgin females by wandering about and probing beneath the scale covers with their long genitalia. Laboratory observations of newly emerged males showed that they were short-lived. All lived at least eight hours, but none survived more than 40 hours. High numbers of males were present the first two weeks of July. After mid-July their numbers dropped quickly, but a small percentage of males could be found in the weekly samples until the middle of August. After late August, the population consisted primarily of fertilized adult females.

HOSTS AND DISTRIBUTION IN PENNSYLVANIA

In Pennsylvania *C. minima* was found only on *Juniperus* spp. with *J. chinensis* cv. 'Hetzii' the most common host (Table 1). Only *C. juniperi* was collected on *Thuja* and *Chamaecyparis*.

Of 165 scale samples collected in the distribution study only 16 contained *C. minima*. It was found mainly in the southeastern portion of the state and was present in only seven counties: Berks, Blair, Bucks, Cumberland, Dauphin, Snyder, and York (Fig. 2). Infestations of *C. minima* were most frequently encountered in the Cumberland-Dauphin-York county area.

NATURAL ENEMIES

Three parasitic species were encountered during the sampling. Two, *Aspidiotiphagus* sp. and *Prospaltella* sp., were internal parasites, feeding entirely within the female scale. At death the scales seemed to mummify, and the parasites' pupae could clearly be seen inside the derm of the scales. The third, *Aphytis* sp., fed externally on adult females (beneath the scale cover). Rate of parasitism by all species was low, reaching a maximum of 18% in

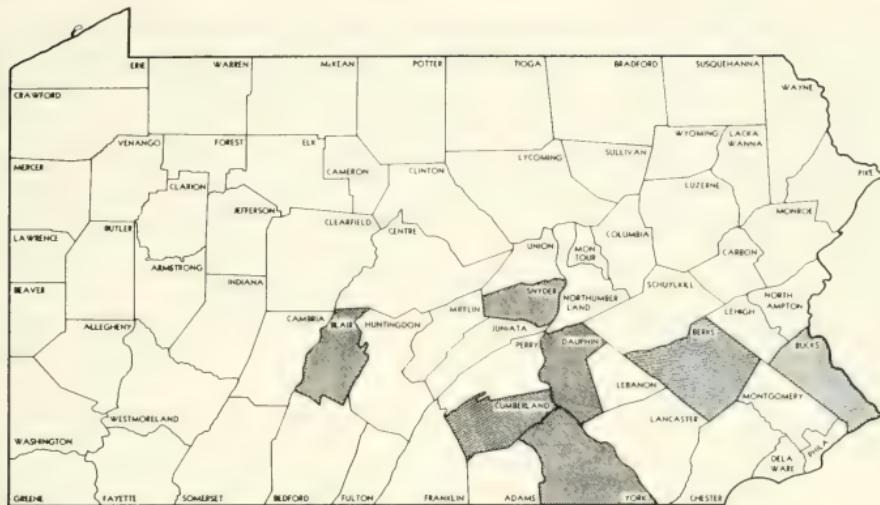


Fig. 2. Distribution of *Carulaspis minima* in Pennsylvania.

mid-July. Parasites were present from mid-May to mid-September, although no dramatic parasite emergence periods were observed.

Aleuropteryx juniperi Ohm, an introduced coniopterygid first reported from North America by Henry (1976), proved to be an important predator of *C. minima*. Both adults and larvae fed on all stages of the scale. This species reduced the scale population more than any other natural enemy in the experimental planting.²

DISCUSSION

Field and laboratory observations indicate that *C. minima* is a univoltine species in Pennsylvania, although Baccetti (1960) report *C. minima* to have two generations per year in Italy. Scale transfer studies showed that only about 2% of the new females oviposited late in the summer. None of the progeny of this late oviposition survived the winters since no forms other than adult females were found in the early spring. Johnson and Lyon (1976) stated that adult males are active during late summer and fall. I found that by far the greatest percentage of males emerged during the first two weeks of July, and only small numbers were present into late summer. No adult males of either species were found in the samples after August 22. Comparison of the life histories of these two species showed them to be similar,

² Personal communication, T. J. Henry, Bureau of Plant Industry, Pennsylvania Department of Agriculture, Harrisburg, Pennsylvania.

Table 1. Numbers of collections of *Carulaspis juniperi* and *C. minima* taken from various hosts in Pennsylvania, 1974-75.

| Host | <i>Carulaspis minima</i> | <i>Carulaspis juniperi</i> |
|---|------------------------------|--------------------------------|
| <i>Chamaecyparis</i> sp. | 0 | 1 |
| <i>Juniperus chinensis</i> | 2 | 35 |
| <i>J. chinensis</i> cv. 'Hetzii' | 5 | 43 |
| <i>J. chinensis</i> cv. 'Pfitzeriana' | 1 | 30 |
| <i>Juniperus communis</i> | 1 | 3 |
| <i>Juniperus excelsa</i> | 1 | 3 |
| <i>Juniperus horizontalis</i> cv. 'Plumosa' | 1 | 1 |
| <i>Juniperus procumbens</i> | 0 | 1 |
| <i>Juniperus scopulorum</i> | 0 | 1 |
| <i>Juniperus virginiana</i> | 1 | 9 |
| <i>Juniperus</i> sp. | 4 | 16 |
| <i>Thuja occidentalis</i> | 0 | 6 |

as hatching dates, growth rates, and adult emergence dates were nearly identical. This disagrees with Boratynski (1957) who found that in Britain the seasonal history of *C. minima* lagged up to two weeks behind that of *C. juniperi*. Both species developed later in Britain than in Pennsylvania; *C. juniperi* and *C. minima* developed two and four weeks later, respectively, in Britain than my studies indicate for Pennsylvania. Baccetti's studies of *C. juniperi* in Italy show only one generation per year.

The crawlers of *C. minima* normally settled away from the parent scale, so infestations were only one layer thick and did not build up to a multilayered crust as do some armored scales, such as obscure scale, *Melanaspis obscura* (Comstock) (Stoetzel and Davidson, 1971). During the 2-year sampling period the scales infested only the lower portions of the hosts and populations did not move upward significantly. This suggests that *C. minima* crawlers do not move great distances and have a limited ability to disperse upward, except when branches are touching.

In Pennsylvania *C. minima* was found only on *Juniperus*, although McKenzie (1956) lists these additional hosts: cypresspine, *Callitris articulata*; cypress, *Cupressus* sp.; redwood, *Sequoia sempervirens*; and arborvitae, *Thuja* spp. Johnson and Lyon (1976) seemed to suggest that *C. minima* is restricted to *Thuja*, with no mention of any additional hosts. Workers should not attempt to separate the two species solely by host information, since both species apparently attack *Juniperus* and *Thuja*.

Carulaspis minima is probably more common than previously thought because of the difficulty in separating it from *C. juniperi*. I am certain that additional sampling in Pennsylvania and other states would prove that the range of *C. minima* is greater than previously indicated.

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NOTES ON *APTEROMECHUS* FAUST OF AMERICA NORTH OF MEXICO (COLEOPTERA: CURCULIONIDAE: CRYPTORHYNCHINAE)

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Abstract.—A generic diagnosis is given for the primarily Neotropical genus *Apteromechus*. The first key to the four currently recognized taxa in America north of Mexico is given, using simple, previously ignored characters. Distribution records are briefly summarized. A historical summary includes comments about past errors, present interpretations, and possible future problems associated with the systematics of these four taxa.

The cryptorhynchine genus *Apteromechus* Faust, largely Neotropical, is represented in America north of Mexico by four nominate taxa: *A. ferratus* (Say), *A. longus* (LeConte), *A. microstichus* Fall, and *A. texanus* Fall. Some of the characters previously used to distinguish them are superficial or difficult to use. I here give the first key to these four taxa, using some conspicuous but previously unexploited characters; and I append some additional notes. I do not attempt a detailed revision of the species, partly because generic limits are ill-defined and partly because it appears that study of Neotropical material not yet available will be needed to reach satisfactory conclusions.

RECOGNITION CHARACTERS FOR *APTEROMECHUS* FAUST

Kissinger's (1964) key to genera of North American Cryptorhynchinae does not work satisfactorily for *Apteromechus*. One species, *A. longus*, does key through rubric 29 to *Apteromechus*. Kissinger traced the other species to *Apteromechus* through couplets 31 and 33 as if the mandibles were prominent when closed. However, the mandibles are not prominent. These *Apteromechus* species trace more readily through couplet 31 to couplet 35, where distinguished from other genera by having the scutellum not or only minutely exposed and by having the pronotum sparsely rather than densely squamose. The following diagnosis distinguishes Nearctic *Apteromechus* from other Nearctic Cryptorhynchinae, but it is only a first approximation with respect to Neotropical members of the subfamily.

Diagnosis.—*Head:* Rostrum short, feebly curved to nearly straight, mandibles not prominent when closed; antenna inserted near middle of rostrum, funicle 7-segmented, club ovate and with distinct sutures; interocular distance varied from nearly as great as width of rostrum to much shorter; eyes partly exposed when head is in repose. *Pronotum:* Rounded at sides, deeply bisinuate at base, median lobe partly filling scutellar cavity; coarsely, closely punctate, not densely squamose; ocular lobes moderately reduced. *Scutellum:* Hidden or minutely exposed. *Elytra:* Stria 10 abbreviated, not extended beyond hind coxa; intervals 3, 5, and 7 varied from convex to feebly elevated to strongly carinate. *Legs:* Femora feebly unidentate ventrally, or front femur with tooth obsolete; in most species front femur with sharply defined, glabrous ventral sulcus in which both tibia and tarsus are received in repose; tibiae rounded at base externally, outer margin even, straight, not serrate; tibia 3 with apical comb formed of single row of spines, comb angulate or broken; in most species tarsi not dimorphic; claws free, simple. *Venter:* Rostral canal extended into mesosternum to point in line with front margin of middle coxae; mesosternum prominent, feebly emarginate; distance between middle coxae slightly to considerably less than apical width of rostrum; metasternum long, distance between middle and hind coxae greater than length of antennal club; metepisternal suture distinct, metepisternum moderately broad; abdominal ventrite 2 a little longer than 3 or 4 but much shorter than 3+4.

KEY TO APTEROMECHUS OF AMERICA NORTH OF MEXICO

1. Front femur without ventral sulcus, tarsus not received in repose; most specimens with scutellum minutely exposed *ferratus* (Say)
- Front femur with glabrous ventral sulcus, tarsus received in repose; scutellum not exposed 2
2. Front and vertex densely punctate; middle coxae separated by distance much less than width of rostrum *longus* (LeConte)
- Frons and vertex minutely, sparsely punctate, densely squamose immediately around eyes, surface alutaceous; middle coxae separated by distance nearly as great as width of rostrum 3
3. Ventrites 3 and 4 with punctures arranged in 1 or 2 nearly regular rows on each ventrite *texanus* Fall
- Ventrites 3 and 4 with punctures more confused, at least in part arranged in 3 rows on each ventrite *microstichus* Fall

DISTRIBUTION RECORDS

Records are by state, using postal abbreviations, to facilitate use in the USDA "A catalog of the Coleoptera of America north of Mexico" now in preparation.

Apteromechus ferratus—eastern, not subtropical: AL, CT, DC, FL, GA, IL, LA, MI, NC, NJ, NY, OH, PA, SC, TN, VA.

Apteromechus longus—southeastern: AR, FL, TX.

Apteromechus microstichus—southeastern: FL, GA. Subtropical, extending northward to southeastern Georgia. A specimen in USNM labelled New York is suspect.

Apteromechus texanus—extreme southern Texas: TX. Subtropical; specimens from Tampico, Veracruz are probably conspecific with those from Brownsville.

DISCUSSION

Champion (1906) was first to recognize *Apteromechus* in the United States fauna. He cited a specimen labelled *Cryptorhynchus ferratus* from a series collected by H. F. Wickham at Brownsville, Texas, but I am convinced that this series was entirely composed of the subsequently described *Apteromechus texanus*.

Apteromechus, as presently understood, is somewhat heterogeneous. Probably, *Apteromechus* should remain defined broadly enough to include *A. ferratus*. However, *A. ferratus* lacks the specialized femoral sulcus characteristic of most other members of the genus, and I know of no other shared, derived character state that can be used to define the genus so broadly. Kissinger (1964) emphasized the peculiar divided comb of tibia 3 as characteristic of the genus, but this character needs extensive study. Examination of several Neotropical species leads me to conclude that the comb is composed of a single row of setae, in some species simply angulate rather than broken as Kissinger described for *A. ferratus* and *A. longus*.

The closely related taxa *A. microstichus* and *A. texanus* may be conspecific (Fall, 1925). I make no attempt to analyze this matter now, because there is a complex of closely related, poorly known forms in Mexico and Central America. Superficial differences among the various samples are minor, and geographically intermediate samples are needed to determine extent of variation.

Kissinger (1964) reassigned *Cryptorhynchus longus* to *Apteromechus*. This species is not closely allied with any other species I have examined, but it shares with *A. texanus*, *A. microstichus*, and most tropical species the peculiar, presumably synapotypic sulcus of the front femur.

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DISTRIBUTION OF ORB-WEAVERS (ARANEIDAE : ARANAEAE) IN HOMOGENEOUS OLD-FIELD VEGETATION

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Abstract.—Dispersion patterns of araneid spiders were random, based on nearest-neighbor distances in two oldfields with apparently homogeneous vegetation structure. All structural types of vegetation, and hence potential web sites, were aggregated in both fields when measured with variance/mean ratios from 2×2 m quadrats. Plant aggregations were often indistinct, forming a complex and fine-textured habitat in which spiders built webs. Significant correlations between quadrat counts of spiders and of plant stems indicated that spiders responded to plant density when selecting web sites. In addition, webs were attached to plants in proportions significantly different from expected based on relative abundance of plant types. Observations suggested that spiders differentially retained types of attachment plants via behavioral kinesis.

Studies of spatial distribution in spiders have usually emphasized the importance of habitat structure (Cherrett, 1964; Colebourne, 1974; Duffey, 1972; Enders, 1973, 1976; Riechert, 1974; Riechert et al., 1973; Tolbert, 1976). Other factors, including wind, rain, temperature, humidity and prey availability, have been considered less often (Eberhard, 1971; Muma and Muma, 1949; Nørgaard, 1951; Riechert and Tracy, 1975; Robinson and Robinson, 1974; Tolbert, 1976; Turnbull, 1964, 1973). Most studies dealing with the response of spiders to physical structure of the habitat have considered sites with major differences in vegetation structure. In these sites, spiders were aggregated (Cherrett, 1964; Duffey, 1972; Enders, 1977; Post and Riechert, 1977; Riechert, 1974; Riechert et al., 1973; Tolbert, 1976; Turnbull, 1966).

Few workers have dealt with relatively homogeneous vegetation. Three species of *Lycosa* Latreille were aggregated in three of eleven sites in which the vegetation structure appeared slightly heterogeneous; they were randomly distributed in the other eight sites (Kuenzler, 1958). Two other wolf

spiders, *Trochosa terricola* Thorell and *Pardosa pullata* (Clerck), were usually regularly distributed in two Polish meadows, perhaps a result of territorial interactions. During the period of mating, adults were distributed randomly (Syrek and Janusz, 1977). The funnel-web spider *Agelenopsis aperta* (Gertsch) was aggregated in sites containing a mixture of lava beds, grassland, and rangeland. In sites containing only one type of favorable habitat, the spiders were distributed uniformly, having interacted with one another and spaced themselves out (Riechert, 1974; Riechert et al., 1973).

In 1974, we measured the distribution of 29 orb-weavers (Araneidae) in an apparently homogeneous oldfield, and found it to be random (Sholes and Rawlins, unpublished). To clarify this result, we expanded the study using two other oldfields, chosen for their apparently homogeneous vegetation structure. We hoped to approach the scale of the spider's perceived environment, to measure their distribution in a fine-grained, small-scale mosaic of vegetation, and then to compare our results with other studies on orb-weavers done in more strongly heterogeneous vegetation (Cherrett, 1964; Enders, 1973, 1976, 1977; Tolbert, 1976).

STUDY FIELDS

Both fields were in Tompkins County, near Ithaca, New York. Field 1 was southeast of Ithaca in the Town of Caroline ($76^{\circ}21'W$, $42^{\circ}22'N$) at an elevation of 425 m, situated at the base of a hill. The slope of the site was about 5%, facing to the west. Field 2 was northeast of Ithaca in the town of Dryden ($76^{\circ}26'W$, $42^{\circ}30'N$), 340 m above sea level, with slope of 3% facing north. Soils in both fields were moderately well drained, medium textured, not very fertile, and acidic (Neeley, 1965). The study area within Field 1 was L-shaped, containing 616 m^2 ; the study area in Field 2 was a 176-m^2 rectangle.

METHODS

We searched both fields visually for the webs of large female araneids on 8 September (Field 1) and 18, 19 September (Field 2) 1977, disturbing the webs and vegetation as little as possible. Webs of *Araniella displicata* (Hentz), *Tetragnatha laboriosa* Hentz, and immature *Acanthepeira stellata* (Walckenaer) were too small for reliable discovery and were excluded from consideration. We marked every web within the sites, and all those outside that were nearest neighbors of those inside. For each web, we measured the height of the highest attachment point, the distance between upper attachments, the vertical diameter of the orb, and the height of the diurnal position of the spider (hub of web or retreat). We identified the spider, the attachment plants, and the plant used for a retreat (if present).

The fields were marked out in grids of $2 \times 2\text{-m}$ quadrats, and the coor-

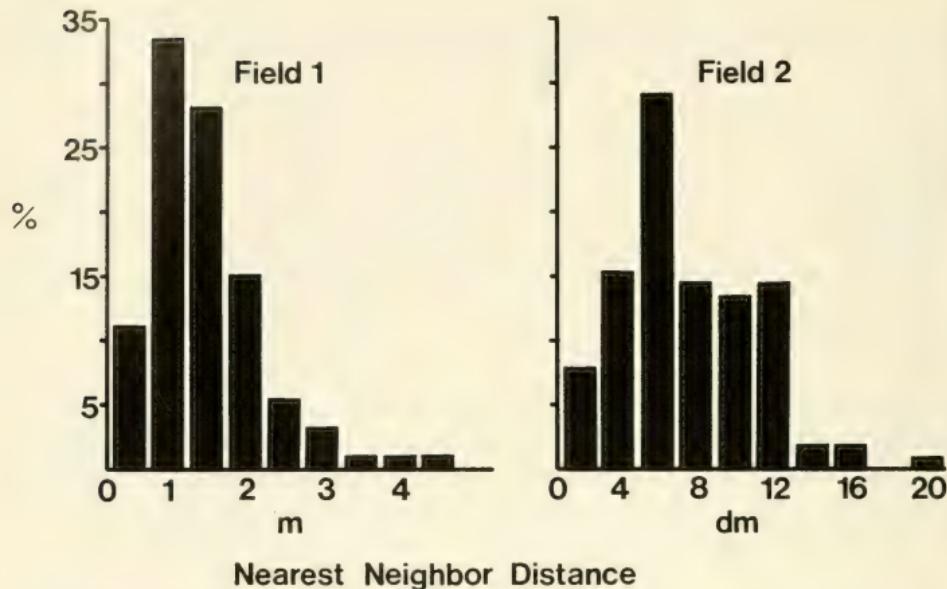


Fig. 1. Frequency distribution of nearest-neighbor distances for large araneid spiders in each field. Both distributions are unimodal, allowing nearest-neighbor analysis of dispersion without risk of spurious results (see text).

dinates of each spider at its diurnal position were measured to the nearest decimeter. We censused the vegetation in each quadrat by counting the number of stems or culms of different structural types of plants (grass, milkweeds, and non-milkweed forbs in Field 1; grass, forbs, and shrubs in Field 2), and by estimating the percent cover of grass (taken as the percent of the quadrat covered by dense matted grass, or percent of the quadrat not under a closed "canopy" of taller vegetation). Species included in the stem categories were: Grasses—*Dactylis glomerata* L., *Phleum pratense* L., *Carex* sp., and scapes of *Plantago lanceolata* L.; non-milkweed forbs—*Solidago* spp., *Aster* spp., *Arctium minus* (Hill), *Cichorium intybus* L., *Daucus carota* L., *Achillea millefolium* L., and tall *Linaria vulgaris* Hill; milkweeds (Field 1)—*Asclepias syriaca* L., and small *Rhus typhina* L.; shrubs (Field 2)—*Viburnum recognitum* Fernald, *V. lentago* L., and *Cornus racemosa* Lamarck (nomenclature as in Fernald, 1950). Species not extending above the mat of grass were included in the percent cover estimates.

Intra- and interspecific nearest-neighbor distances were calculated for spiders from the coordinate values, and then used to determine the distribution patterns of the spiders (Clark and Evans, 1954). Underwood's (1976) objections to the nearest-neighbor method, based on Pielou (1959), do not apply to our data, and we did not have the difficulties with nearest-neighbor results experienced by Payandeh (1970).

Table 1. Intraspecific and interspecific dispersion patterns of araneid spiders based on nearest-neighbor distances, analyzed as in Clark and Evans (1954).

| | Field 1 | | | | Field 2 | | | |
|------------------------------|---------|---------------|----------------|--------------------|---------|-------------|------|------|
| | N | \bar{r}_a^1 | R ¹ | c ¹ | N | \bar{r}_a | R | c |
| <i>Araneus trifolium</i> | 51 | 1.83 | 1.05 | 0.71 | 9 | 2.70 | 1.22 | 1.27 |
| <i>Argiope trifasciata</i> | 18 | 2.19 | 0.75 | -2.03 ² | 89 | 0.73 | 1.04 | 0.66 |
| <i>Argiope aurantia</i> | 9 | 4.23 | 1.02 | 0.13 | 0 | | | |
| <i>Neoscona arabesca</i> | 9 | 4.94 | 1.19 | 1.19 | 2 | | | |
| <i>Mangora gibberosa</i> | 5 | 7.61 | 1.37 | 1.59 | 1 | | | |
| <i>Acanthepeira stellata</i> | 0 | | | | 2 | | | |
| All spiders | 92 | 1.24 | 0.96 | -0.70 | 103 | 0.67 | 1.03 | 0.49 |

¹ \bar{r}_a is the average actual nearest-neighbor distance; R is the ratio of \bar{r}_a/\bar{r}_e , with \bar{r}_e being the average expected distance; c is the standard normal variate for the quantity ($\bar{r}_a - \bar{r}_e$). If c is significantly greater than zero, the distribution is aggregated; if c is significantly less than zero, the distribution is regular. Distances are in meters.

² Significant departure from random, $P < 0.025$; one-tailed test.

On 9 September 1977 at Field 1, strong winds destroyed all or part of many webs. That afternoon, we recorded the degree of web destruction for each marked web (intact; orb destroyed, frame intact; frame and orb destroyed). On 11 September, we returned and observed whether the webs were rebuilt and whether the spiders were present at their original sites.

RESULTS

Distributions.—Data were collected on adult females of *Araneus trifolium* (Hentz), *Argiope aurantia* Lucas, *Argiope trifasciata* (Forskal), *Neoscona arabesca* (Walckenaer), *Mangora gibberosa* (Hentz), and *Acanthepeira stellata*.

In all but one case, the individual species were distributed randomly within each field (on Field 1 *Argiope trifasciata* was regularly distributed). Considering all species together, the distributions on both fields were random (Table 1). The frequency distribution of the nearest-neighbor distances (Fig. 1) shows that the data fit the unimodal requirement of the nearest-neighbor method, and thus, the results are not spurious (Clark and Evans, 1954). All species pairs show symmetry and no segregation (*sensu* Pielou, 1961) in their occurrence as nearest-neighbors (Table 2).

Based on the index of dispersion, variance/mean (Greig-Smith, 1964), all structural types of vegetation on both fields were aggregated (Table 3).

Spearman Rank Correlations between density of vegetation types and of the dominant spider species in each field were computed after removing all quadrats with no spiders (103 of 154 quadrats on Field 1, and 5 of 44 quadrats on Field 2 were omitted). *Araneus trifolium* density in Field 1 was negatively correlated with abundance of non-milkweed forbs; *Argiope trifasciata* in

Table 2. Proportional occurrence of araneid species as nearest neighbors. All comparisons of observed with expected show no significant difference (chi-square test, $P > .05$). Expected values for species are based on the proportion of all individuals which could possibly occur as nearest neighbors; a spider cannot be its own neighbor. Classes were lumped to obtain a minimum expected value of 1.0 spider.

| Field 1 | Neighboring Species | | | | | | | | | | χ^2 (classes) |
|----------------------------|--------------------------|------|----------------------------|------|-------------------------|------|--------------------------|------|--------------------------|------|-----------------------|
| | <i>Araneus trifolium</i> | | <i>Argiope trifasciata</i> | | <i>Argiope aurantia</i> | | <i>Neoscona arabesca</i> | | <i>Mangora gibberosa</i> | | |
| Species | obs. | exp. | obs. | exp. | obs. | exp. | obs. | exp. | obs. | exp. | |
| <i>Araneus trifolium</i> | 0.59 | 0.55 | 0.16 | 0.20 | 0.06 | 0.10 | 0.14 | 0.10 | 0.06 | 0.06 | 2.18 (5) |
| <i>Argiope trifasciata</i> | 0.50 | 0.56 | 0.22 | 0.19 | 0.00 | 0.10 | 0.28 | 0.10 | 0.00 | 0.06 | 8.69 (5) |
| <i>Argiope aurantia</i> | 0.33 | 0.56 | 0.22 | 0.20 | 0.44 | 0.09 | 0.00 | 0.10 | 0.00 | 0.06 | 2.11 (3) |
| <i>Neoscona arabesca</i> | 0.56 | 0.56 | 0.22 | 0.20 | 0.00 | 0.10 | 0.00 | 0.09 | 0.22 | 0.06 | 0.09 (3) |
| <i>Mangora gibberosa</i> | 0.60 | 0.56 | 0.20 | 0.20 | 0.00 | 0.10 | 0.20 | 0.10 | 0.00 | 0.04 | 0.03 (2) |
| All species | 0.54 | 0.55 | 0.19 | 0.20 | 0.08 | 0.10 | 0.14 | 0.10 | 0.05 | 0.05 | 2.30 (5) |

| Field 2 | Neighboring Species | | | | | | | | | | χ^2 (classes) |
|----------------------------|--------------------------|------|----------------------------|------|--------------------------|------|--------------------------|------|------------------------------|------|-----------------------|
| | <i>Araneus trifolium</i> | | <i>Argiope trifasciata</i> | | <i>Neoscona arabesca</i> | | <i>Mangora gibberosa</i> | | <i>Acanthepeira stellata</i> | | |
| Species | obs. | exp. | obs. | exp. | obs. | exp. | obs. | exp. | obs. | exp. | |
| <i>Araneus trifolium</i> | 0.22 | 0.08 | 0.78 | 0.87 | 0.00 | 0.02 | 0.00 | 0.01 | 0.00 | 0.02 | 0.62 (2) |
| <i>Argiope trifasciata</i> | 0.10 | 0.09 | 0.84 | 0.86 | 0.05 | 0.02 | 0.00 | 0.01 | 0.01 | 0.02 | 3.98 (4) |
| All species | 0.11 | 0.09 | 0.85 | 0.86 | 0.04 | 0.02 | 0.00 | 0.01 | 0.01 | 0.02 | 3.99 (5) |

Field 2 was positively correlated with percent grass cover, and negatively correlated with forb abundance (Table 4). All other comparisons between spiders and vegetation were not significantly correlated ($P > .05$).

Web sites.—The numbers of web attachments observed on different structural types of vegetation were compared with the expected numbers based on the percentages of vegetation types counted in each field (Fig. 2). In both fields, only the numerically dominant species attached its webs to plants in proportions significantly different from expected. There were also significant departures from expected when considering all spiders together.

The mean heights of spiders and of web attachments for each species

Table 3. Dispersion patterns of structural types of vegetation based on variance/mean ratio (s^2/\bar{x}) (Greig-Smith, 1964) of stem densities from 2×2 -m quadrats.

| | Field 1 (n = 154) | | | Field 2 (n = 44) | | |
|---------------------|-------------------|---------------|---------------------|------------------|---------------|--------------------|
| | \bar{x} | s^2/\bar{x} | χ^2 | \bar{x} | s^2/\bar{x} | χ^2 |
| Percent grass cover | 80.3 | 3.26 | 498.8 ¹ | 67.3 | 5.38 | 231.3 ¹ |
| Grass stems | 11.0 | 16.50 | 2524.5 ¹ | 43.8 | 9.07 | 390.0 ¹ |
| Non-milkweed forbs | 34.9 | 19.15 | 2930.0 ¹ | 59.2 | 9.50 | 408.5 ¹ |
| Milkweed | 9.9 | 5.72 | 875.2 ¹ | — | — | — |
| Shrubs | — | — | — | 9.32 | 2.17 | 93.3 ¹ |

$$\text{Chi-square} = (n - 1)s^2/\bar{x}.$$

¹ Significant departure from randomness, $P < .01$.

were higher on Field 2 than on Field 1, while the mean distance between attachments was less on Field 2 (Table 5).

Natural web destruction and rebuilding.—Wind damage to webs on Field 1 was classified into three categories: No damage, orb destroyed, and orb plus frame destroyed. Rebuilding occurred less often on more heavily damaged webs (Table 6). A higher percentage of *Araneus trifolium* webs were rebuilt and occupied than were *Argiope* webs.

Damage level and rebuilding were related to the type of attachments for *Araneus trifolium* webs (Table 7). Webs between two milkweeds or between two non-milkweeds suffered the least amount of destruction. A larger percentage of rebuilding occurred when milkweed was the retreat plant than when a non-milkweed plant contained the spider's retreat.

Table 4. Spearman Rank Correlation coefficients between quadrat counts of spiders and of vegetation types, including only the dominant spider species in each field, and excluding quadrats with no spiders.

| Spider | Structural Vegetation Type | | | | |
|---|----------------------------|-------------|---------------------|---------------------|--------|
| | Percent Grass Cover | Grass Stems | Non-milkweed Forbs | Milkweed | Shrubs |
| <i>Araneus trifolium</i> (Field 1; 51 quadrats) | -0.021 | 0.100 | 0.364 ² | -0.328 ¹ | — |
| <i>Argiope trifasciata</i> (Field 2; 39 quadrats) | 0.438 ² | 0.155 | -0.407 ¹ | — | -0.106 |

¹ Significant correlation, $P < .05$.

² Significant correlation, $P < .01$.

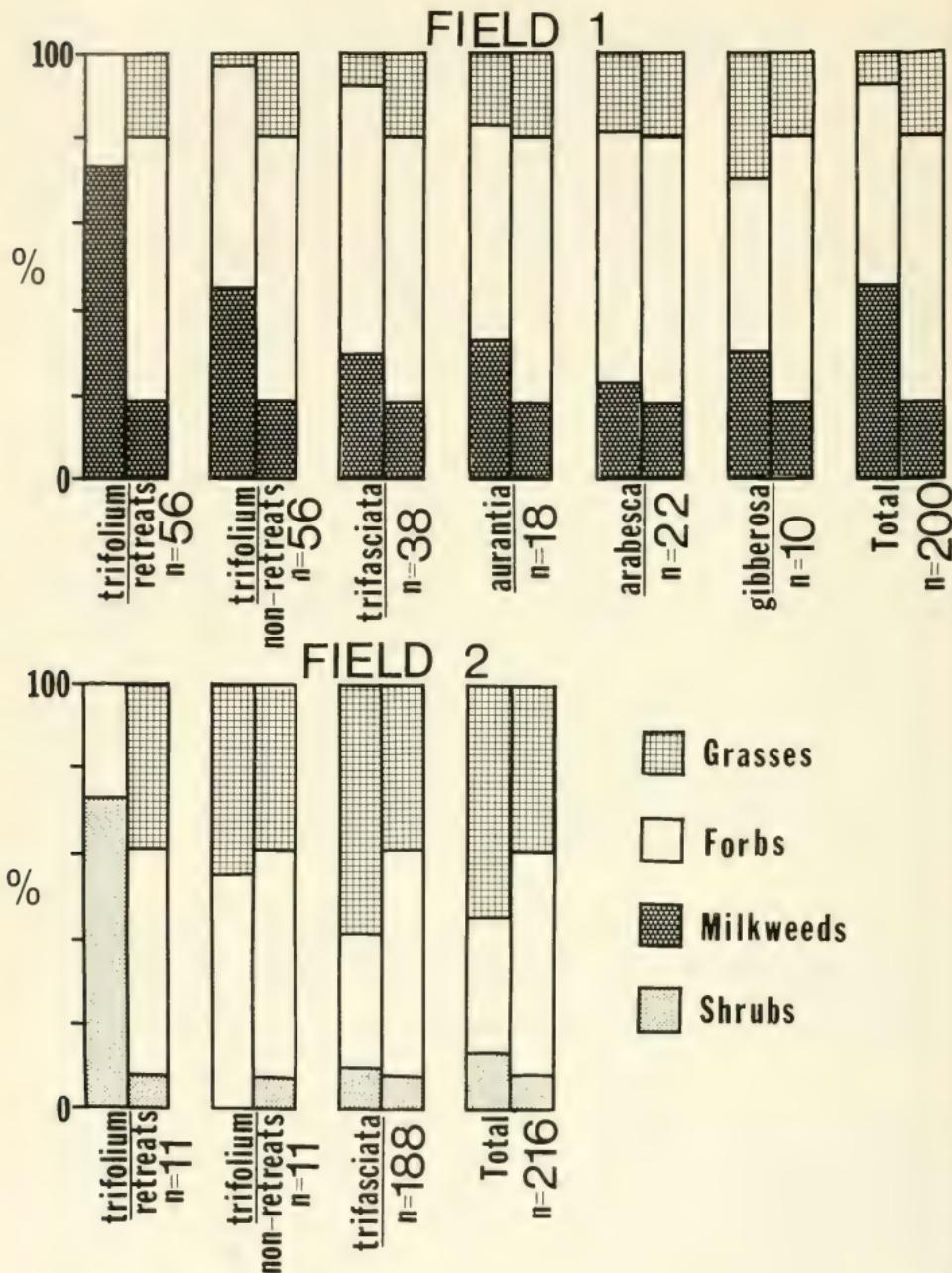


Fig. 2. Percent of araneid web attachments on each structural type of plant (left-hand column of each pair) and percent of each plant type in both fields (right-hand columns). Chi-square comparisons of web attachments (observed) and plant types (expected) showed significant differences ($P < .05$) for *A. trifolium* (retreat and non-retreat) on Field 1, *A. trifasciata* on Field 2, and total spiders on both fields.

Table 5. Web measurements (cm) for araneid spiders in two old fields ($\bar{x} \pm S.D.$).

| | <i>Field 1</i> | <i>Field 2</i> | <i>Aranæus trifolium</i> | <i>Argiope trifasciata</i> | <i>Argiope aurantia</i> | <i>Neoscona arabesca</i> | <i>Mangora gibberosa</i> | <i>Acanthepeira stellata</i> |
|------------------------------|----------------|----------------|--------------------------|----------------------------|-------------------------|--------------------------|--------------------------|------------------------------|
| Height of spider | 66.5 ± 15.8 | 73.1 ± 10.7 | 43.3 ± 7.9 | 58.6 ± 11.9 | 48.8 ± 7.6 | 66.7 ± 19.9 | 40.2 ± 5.1 | |
| Height of highest attachment | 76.2 ± 15.6 | 80.3 ± 8.2 | 65.8 ± 12.0 | 73.9 ± 20.0 | 72.8 ± 11.3 | 73.1 ± 16.4 | 57.6 ± 14.9 | |
| Distance between attachments | 61.9 ± 26.5 | 35.8 ± 13.0 | 39.8 ± 15.6 | 31.5 ± 9.2 | 51.0 ± 15.3 | 53.7 ± 25.0 | 35.6 ± 18.8 | |
| Vertical orb diameter | 25.1 ± 5.1 | 25.1 ± 3.8 | 33.9 ± 6.2 | 33.4 ± 7.4 | 32.4 ± 5.9 | 26.0 ± 7.5 | 16.4 ± 4.0 | |
| Sample size (n) | 56 | 11 | 18 | 95 | 11 | 11 | 5 | 0 |
| | | | | | | | | |
| | | <i>Field 2</i> | | | | | | |
| Height of spider | | | 73.1 ± 10.7 | 58.6 ± 11.9 | 84.5 ± 3.5 | 45 | 50.0 ± 4.2 | |
| Height of highest attachment | | | 80.3 ± 8.2 | 73.9 ± 20.0 | 93.5 ± 2.1 | 59 | 66.0 ± 2.8 | |
| Distance between attachments | | | 35.8 ± 13.0 | 31.5 ± 9.2 | 30.0 ± 12.7 | 23 | 29.0 ± 7.1 | |
| Vertical orb diameter | | | 25.1 ± 3.8 | 33.4 ± 7.4 | 24 | 23 | 19.5 ± 6.4 | |
| Sample size (n) | | | (n = 9) | (n = 94) | (n = 1) | 2 | 1 | 2 |

Table 6. Rebuilding of webs two days after destruction by wind (Field 1). Values in parentheses are percentages of total webs examined for each species.

| | No Damage | Orb Destroyed | Orb & Frame Destroyed | Total |
|--------------------------|--------------|------------------|--------------------------|----------|
| <i>Araneus trifolium</i> | | | | |
| Rebuilt | 0 | 19 (35) | 17 (32) | 36 (67) |
| Not rebuilt | 0 | 6 (11) | 12 (22) | 18 (33) |
| Total | 0 | 25 (46) | 29 (54) | 54 (100) |
| <i>Argiope</i> spp. | | | | |
| Rebuilt | 6 (23) | 2 (8) | 0 | 8 (31) |
| Not rebuilt | 5 (19) | 3 (12) | 10 (38) | 18 (69) |
| Total | 11 (42) | 5 (19) | 10 (38) | 26 (100) |

DISCUSSION

Large araneid spiders were distributed randomly in both fields. In contrast, the structural types of vegetation were always aggregated. Based on the importance of vegetation structure to spiders, amply demonstrated in the literature (see introductory remarks), we conclude that the potential web sites were also aggregated. Our data and the results of other workers have led us to two hypotheses for explaining the difference in distribution pattern between the spiders and their potential web sites. One is based on spider interactions, and the other on random dispersal into a surplus of potential web sites.

Spider interaction.—Riechert et al. (1973) showed that the funnel-web spider *Agelenopsis aperta* was uniformly distributed within areas of favorable vegetation for web construction. They suggested that interactions between spiders acted to space spiders apart. Perhaps interaction between spiders

Table 7. Relation of type of attachment plant to web destruction and web rebuilding for *Araneus trifolium*, Field 1. Values are percentages of total webs for that row.

| Total Webs | Original Attachment Plants: Retreat to Non-retreat | Structures Destroyed | | Rebuilding | |
|---------------|---|-------------------------|----------------|-----------------|-----------------|
| | | Orb Only | Orb & Frame | Rebuilt | Not Rebuilt |
| 20 | Milkweed to milkweed | 60 | 40 | 80 | 20 |
| 20 | Milkweed to non-milkweed | 40 | 60 | 72 ¹ | 28 ¹ |
| 4 | Non-milkweed to milkweed | 25 | 75 | 50 | 50 |
| 11 | Non-milkweed to non-milkweed | 46 | 54 | 36 | 64 |

¹ Two web sites were destroyed by recreational vehicles before rebuilding could be observed.

in our fields acted to space them further apart than were suitable web sites actually spaced. Spacing would shift the spiders away from an aggregated toward a regular distribution until interactions were reduced. In our sites, this could have produced a random pattern of spiders in a clumped pattern of potential sites.

We think this interaction hypothesis unlikely for two reasons. First, species-specific repulsion seems a likely consequence of interactions intense enough to produce increased spacing. In our fields, all species occurred as nearest-neighbors to themselves and to each other as often as expected simply by their proportional abundance in each field, indicating an absence of species-specific repulsions. Interactions between spiders can occur at the densities in our sites (Enders, 1974), but there is no indication that they produced any spacing of spiders analogous to that found by Riechert et al. (1973) or by Syrek and Janusz (1977).

Second, it appears that web sites were not limiting in these fields. Araneid spiders perceive very little beyond the tactile stimuli reaching the web and its attachment plants (Tolbert, 1975; McCook, 1889). The area within perception distance of a spider can be approximated by an ellipse, with the web hub at the center and the long axis extending the distance between attachments. The short axis extends perpendicularly from the hub, and was estimated by twice the depth of the primary barrier web used by *Argiope trifasciata* (Tolbert, 1975). The distance between attachment plants slightly underestimates the long axis because plants extend beyond the point of attachment and can themselves transmit vibrations to the web. Twice the barrier web depth, however, overestimates the width of the ellipse because *A. trifasciata*'s primary barrier webs are on only one side of the main orb, and secondary barrier webs are infrequent. Barrier webs are rarely used by adult *A. aurantia* (Tolbert, 1975), and not all by the other species. Therefore, the overestimated width more than compensates for the underestimated length because changes in width affect ellipse area more than changes in length.

With a mean distance between attachments of about 28 cm, the barrier web is about 9 cm (Tolbert, 1976) or one-third the length of the long axis. Using this ratio for all spiders, the estimated average area perceived by spiders was 0.16 m^2 on Field 1 and 1.71 m^2 on Field 2, so that 2.4% (Field 1) and 3.1% (Field 2) of the total area was occupied by large araneid spiders. These values are quite close to the percentages of total stems used for web attachments in each field: 2.1% (Field 1) and 4.2% (Field 2). Based on this generous estimate of area occupied, it does not appear that the available web sites were nearly saturated. This is true not only for adults, but also for juveniles. Though juveniles are more abundant than adults will be later in the same season, juvenile webs and space requirements are smaller

than those of adults. Consequently, there are many more available sites for juveniles than for adults within the same field.

Random dispersal and surplus web sites.—Araneids emerge from egg sacs which may contain hundreds of eggs (Kaston, 1948). From this highly aggregated beginning, spiderlings disperse by aerial ballooning, setting silk lines over vegetation, or walking (Bristowe, 1971; Kaston, 1948; Tolbert, 1977). As they grow they continue to disperse, moving less frequently, but covering greater distances in each move (Enders, 1975). Essentially all of their dispersal within "reasonably" homogenous environments appears to be random (Enders, 1975, 1976, 1977; Laing, 1937; Tolbert, 1977; Turnbull, 1964).

The vegetation into and through which the spiders disperse, and hence the potential web sites, are aggregated. However, the potential web sites in these fields far outnumber the spiders using them. Thus, when a spider stops moving and initiates web-building, the site it is in will very likely be suitable and unoccupied. The result is a distribution of spiders not significantly different from random. A closer examination of the mechanisms of web site selection and retention reveal the importance of vegetation structure to spider distributions.

Web site selection and retention.—As a spider enters a web site, few *a priori* evaluations of the site are possible. A spider can build a web at that site if there are sufficiently sturdy attachment plants, space for the web, and, in retreat builders such as *Araneus trifolium*, a location on one attachment plant for a retreat. Where vegetation is sparse (Field 1) there is a premium on attachment plants; not surprisingly, *A. trifolium* abundance was positively correlated with non-milkweed forb density in the quadrats of Field 1. In dense vegetation (Field 2) there is a premium on space; as expected, *Argiope trifasciata* numbers were positively correlated with percent grass cover (open space) and negatively correlated with forb density in Field 2.

Araneus trifolium on Field 1, being negatively correlated with milkweed abundance, appears not to agree with our predictions on space and attachment plant requirements. Clones of milkweed, however, were often so dense that leaves from adjacent stems overlapped considerably. Even in relatively sparse vegetation, space is apparently limiting for araneids within such clones.

Sites of marginal quality, instead of being abandoned, can be ameliorated by the spider's use of silk. *Araneus trifolium*, for example, maintained the same orb diameter in both fields, but fit its web into the different densities of vegetation by changing the length of the upper frame thread (Table 5).

Once a web is built, its continued occupation may depend on prey availability (Turnbull, 1964; but see Enders, 1976, 1977; Tolbert, 1976), thermal conditions, humidity, or destruction by wind or rain (see introductory re-

marks). Whatever the factor involved in web site retention, araneids appear to respond to them by kinesis (Marler and Hamilton, 1966).

One such example of a kinetic response appeared after wind destroyed all or part of each *A. trifolium* web on Field 1 (Table 7). Destruction of webs was more severe when the webs were attached between structurally different plants than when attached between similar ones. Plants of similar structure differ less in flexibility, inertial mass, and wind resistance than plants of differing structure (i.e., large milkweeds as opposed to forbs). Structural similarity would increase the ease by which the two attachment plants are held in synchronous motion by the web when exposed to wind.

As found by other workers (Bristowe, 1971; McCook, 1889; Savory, 1952), webs with frames intact are more likely to be rebuilt than those with frames destroyed. However, rebuilding was more frequent when *A. trifolium*'s retreat was one milkweed than when on another type of plant. A kinesis would tend to increase the proportion of webs between two milkweeds, but only slowly because there are slight advantages for webs between two non-milkweeds (less destruction), and a moderate disadvantage for having a retreat on milkweed when the second attachment is another species (more destruction). It is also possible that immatures do not prefer milkweeds over other vegetation types. We did find a disproportionately large number of *A. trifolium* web attachments to milkweed (Fig. 2). However, only 20 of 55 *A. trifolium* were situated between two milkweeds, and this at the end of the growing season.

As araneids age, they tend to change web sites less often (Enders, 1975, 1976). This might reflect a decrease in the response to environmental influences that would have initiated dispersal in younger spiders. Enders (1977) suspected that the cost of dispersal is quite high for araneids, so that older spiders of higher reproductive value would be under considerable selection pressure to remain at a site until the costs of doing so outweighed those of dispersing. On the other hand, a reduced frequency of site changes with age might also indicate an increase in web site quality as a result of a kinetic response. Marked *Agelenopsis aperta* individuals that moved between web sites tended to move from sites of lower quality to those of higher quality, based on scores of the sites in a discriminant analysis (Riechert, 1976). This evidence further supports the hypothesis that web site "selection" is the result of a kinetic response to web site quality, i.e., web site retention (Enders, 1975, 1976; Tolbert, 1977; Turnbull, 1964).

Vegetation heterogeneity.—We chose our study fields for the apparent structural and physiognomic homogeneity of their vegetation. Nevertheless, we found every structural type of plant to be aggregated on both fields based on 2 × 2-m quadrats. On a scale approaching that of single web sites, our impressions of these and other oldfields are that vegetation clumps are often indistinct, overlapping, or absent in some parts of the fields. Coloni-

zation, cloning, disturbance, interaction, and extinction of many plant species in oldfields produce an enormous number and diversity of potential sites for web building.

The result of random movement by spiders through a fine-grained, mostly unoccupied habitat is a random distribution. This does not mean that spiders are not reacting to vegetation structure; the correlations with vegetation types and the disproportionate use of attachment plants show a clear response to vegetation. However, the response is not as strong as in situations with striking vegetation heterogeneity (see introductory remarks).

In summary, potential web sites for large araneid spiders in oldfields are aggregated because of the aggregation of vegetation. Though spiders seem to prefer and/or avoid certain types of vegetation, the random nature of spider dispersal, the fine texture of the vegetation mosaic, the adaptability of spider silk in web supports, and the surplus of potential web sites all combine to produce a distribution of large araneid spiders not significantly different from random.

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REDISCOVERY OF BOTH SEXES OF THE ENIGMATIC
ZOPHINA EISENI (TOWNSEND) (DIPTERA: TABANIDAE) IN
BAJA CALIFORNIA SUR¹

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Abstract.—The little-known tabanid fly *Zophina eiseni* (Townsend) is redescribed and figured. It is placed in the primitive section of the Pangoniini and appears nearest *Asaphomyia* and *Protosilvius*.

Dr. Gustav Eisen, a vigorous collector of insects in southern Baja California before the turn of the century, took in September a "wholly blackish" male fly of what Townsend (1895) described as "*Apatolestes* (or nov. gen.) *eiseni*." His guess at that time, based on the male, was remarkably good. As recounted by Philip (1954), Townsend, in later unpublished manuscript notes, decided this fly belonged in a new genus, to which Philip gave the name *Zophina*. Its relationships among generalized Pangoniinae still remained enigmatic, however, because of the unfortunate destruction of the type in the California Academy of Sciences during the great San Francisco earthquake and fire in 1906.

Townsend had received, from Eisen, three more topotypic specimens, including a "poorly preserved" female but only one badly pest-damaged male survived among Townsend's collection. This specimen, now in the British Museum (Natural History) was adequate only for meager generic characterization on further study by Philip (1954). He later made a special trip in September 1972 to the type-locality, San José del Cabo, in an effort to secure additional specimens. He was not successful, although both a net and canopy trap were used, probably because the places of search were in conventional tabanid habitats, such as meadows occupied by livestock, and in vegetation along a nearby stream. It was a gratifying surprise when each

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sex was recently taken by others (incidental to other insect collecting) in the vicinity of San José del Cabo, again in September, which enabled the present definitive studies. Dr. J. A. Chemsak of the University of California, Berkeley, netted two males while collecting cerambycid beetles, one 3 km N of town. A female was taken by Dr. R. L. Westcott about 10 km SW of town; he reported it to us as resting in a xerophytic bush in the dune area bordering the sandy beach where he also was collecting beetles. The fly was not teneral, but appeared fresh as though recently emerged from below the bush, and resting before taking wing. Townsend's "poorly preserved" female may have been teneral after capture under similar circumstances. We are indebted to Drs. Chemsak and L. L. Pechuman of Cornell University for the loan of these specimens.

The descriptions below confirm the primitive relationship in Tribe Panganinii, discussed in detail following the formal description.

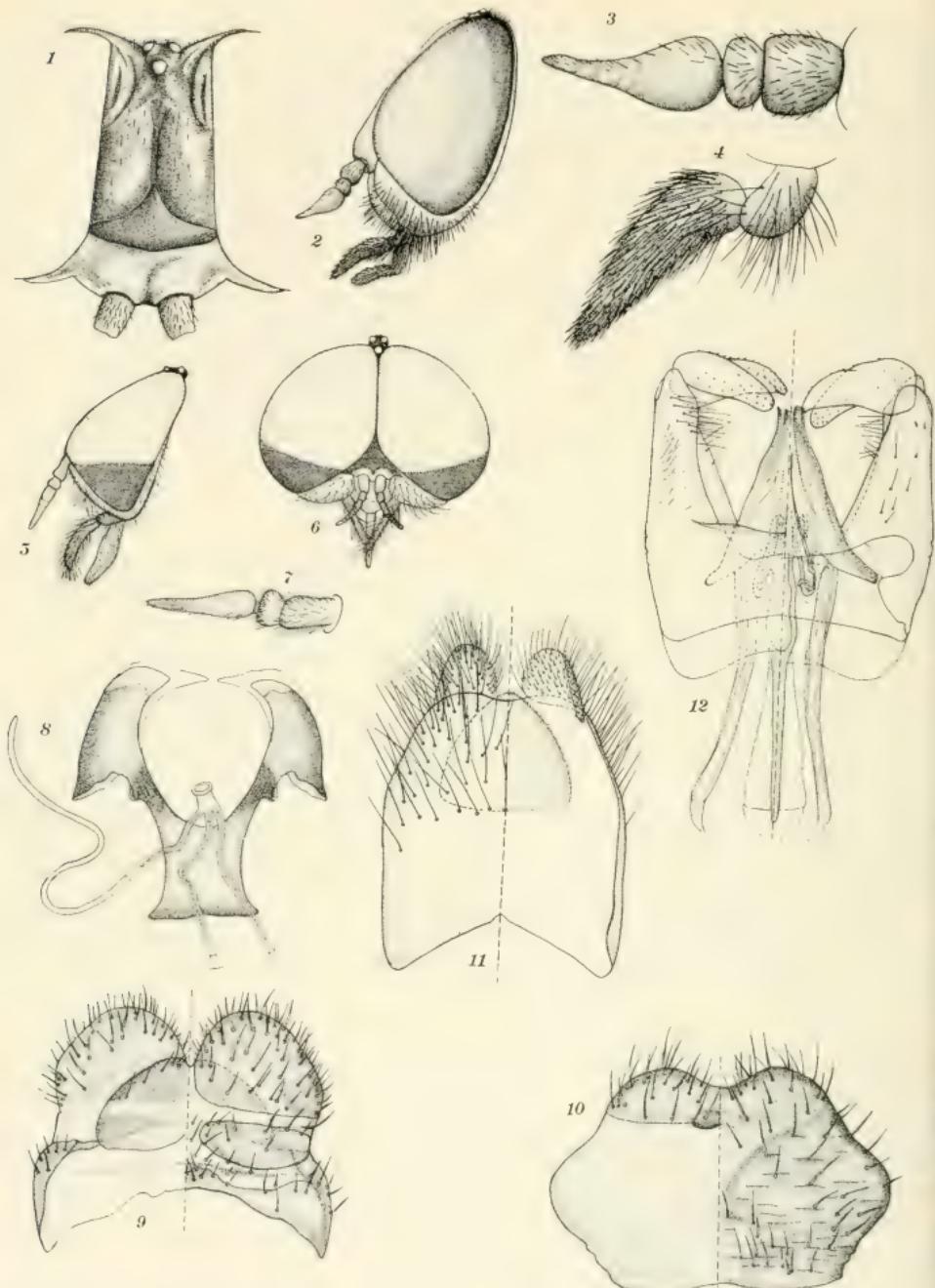
Zophina eiseni (Townsend)

Female.—Length of body 10.5 mm; of wing, 8.5 mm. Eyes bare, iridescent greenish violet, unbanded. Frons (Fig. 1) slightly widened below, index (height/basal width) 1.7, blackish subshiny, with 3 large ocelli at vertex, basal callus black, wide and flat, not well-differentiated from the dark frons; subcallus shiny black and bare. Antennae, palpi and face brownish-gray pollinose with black hairs, the latter very dense on palpi. Proboscis short and membranous, without sclerotized reinforcements. Face short, profile of head as figured (Fig. 2). Scape robust, little longer than wide; pedicel longer than $\frac{1}{2}$ its own width. Style composed of a basal plate and 5 annuli, sutures between the segments indistinct (Fig. 3). Second palpal segment elongated, without bare areas or sensorial pits (Fig. 4).

Thorax and abdomen dark brownish without ornamentation. Wings blackish with very short appendix on R_4 . Legs blackish brown with black hairs. Posterior tibiae with 2 short apical spurs.

Genitalia.—Cerci subtriangular with apical borders rounded, tergite X divided, with few setae, and tergite IX undivided, hypoproct with sparse subapical setae (Fig. 9). Sternite VIII wider than long with apical margin excavated, gonapophyses well-sclerotized (Fig. 10). Genital fork without teeth on the combs and straight basally. Basal portion of spermathecal ducts with small but evident chitinous thickenings, though without mushroom-like expansions; distal portions of spermathecal ducts with membranous ampullae, not sclerotized nor expanded (Fig. 8).

Male.—Similar in size and coloration to the ♀. Head with area of enlarged facets covering most of eye surface, bare, and with very large ommatidia (Figs. 5, 6). Ocellar tubercle higher than eyes, the 3 ocelli well-developed; frontal triangle black, shiny. Antennae (Fig. 7) grayish brown, the styles paler; whole antenna more slender than in ♀, with scape 2× as long as wide



Figs. 1-12. *Zophina eiseni*. 1, Frons of ♀. 2, Head, ♀, lateral view. 3, Antenna, ♀. 4, Left palpus, ♀. 5, Head, ♂, lateral view. 6, Head, ♂, frontal view. 7, Antenna, ♂. 8, ♀, genital fork and spermatheca. 9, ♀, tergites IX-X and hypoproct. 10, ♀, sternite VIII and gonapophyses. 11, ♂, tergite IX, cerci and hypoproct. 12, ♂, basistyle, dististyle and aedeagus.

and style with basal plate more slender, the 5 to 7 segments of style not clearly demarcated. Palpi more slender than in female, its shape obscured by dense hairs.

Genitalia.—Basistyle inwardly concave, dististyle strongly bifid; aedeagus robust, subtriangular (Fig. 12). Cerci subcircular, tergite IX undivided, shield-shaped, with a deep basal concavity; hypoproct subtriangular (Fig. 11).

Specimens examined.—Mexico, Baja California Sur, San José del Cabo, 11–12 September 1967, coll. J. A. Chemsak, 1 ♂; 3 km N San José del Cabo, 11–13 September 1967, coll. Chemsak, 1 ♂; 6.5 mi (10 km) SW San José del Cabo, 22 September 1976, coll. R. L. Westcott, 1 ♀.

Discussion.—The following characters show that this species belongs in Pangoniinae: ♂, tergite IX a single shield, dististyle bifid. Female, tergite IX undivided, basal portion of spermathecal ducts without mushroom-shaped expansions distally, sternite VIII very wide medially with a deep concavity on the distal margin. Within the Pangoniinae it fits best in the Tribe Pangoniini, as it has dististyle bifid, ocelli present, proboscis short and basal annulations of antennal flagellum partially (♂) or entirely fused (♀). The appendix on fork of R_4 is short in the female, absent in the males. The presence of enlarged and bare upper eye facets in the ♂ is a very peculiar character, uncommon in Pangoniini. The palpi are as in *Veprius presbiter* Rondani and *Protodasyapha hirtuosa* (Philippi) without special sensorial areas such as found on the apical portion in *Stonemyia tranquilla* (Osten Sacken), *Protodasyapha (Curumyia) lugens* (Philippi) or *Apatolestes* spp., or special pits as in *Chaetopalpus annulicornis* Philippi, *Fairchildomyia penai* Coscaron and Philip or *Brennania hera* (Osten Sacken). The closest genus structurally appears to be *Asaphomyia* Stone. *Asaphomyia texensis* Stone, illustrated by Stone (1953) and the genitalia by Mackerras (1955:463), differs slightly in the shapes of the ♀ sternite VIII and ♂ tergite IX, and more noticeably in the shape of the antennae, which in *A. texensis* has an orbicular or disc-shaped basal plate and slender, abruptly narrowed flagellum of 2 or 3 poorly demarcated, elongate annuli. In *A. floridensis* Pechuman (1974), the styles of the ♂ genitalia are more deeply bifid, the ventral ramus being more hooked. The antennae of *A. floridensis* are similar to those of *A. texensis* and both species share with *Zophina* the bare, enlarged upper eye facets and lack of palpal sensory areas in the male.

Apatolestes spp. are very close in most features of the genitalia, but the cerci are more acute, the frons is more swollen basally, and the palpi have apical sensory areas.

Protosilvius as treated by Fairchild (1962), also contains species, such as *priscus* Fairchild and perhaps *termitiformis* Enderlein, which have a number of features in common with both *Asaphomyia* and *Zophina*, such as bare, enlarged upper eye facets in ♂ *priscus*, antennae somewhat interme-

diate in structure between *Asaphomyia* and *Zophina*, and ♂ genitalia of at least *priscus* and *mackerrasi* quite similar to those of *Zophina*. The structure of the spermathecae, so far as known, is rather different in *Protosilvius*, and none of the species has as broad a frons as *Zophina* or *Asaphomyia*, nor any vestige of a frontal callus.

The Nearctic genera *Brennania*, *Stonemyia*, and *Pilimas* are less similar, differing notably in both genitalic and external features.

It is obvious that this group of generalized genera has much in common, and their disjunct, mainly subtropical distribution further suggests that all may represent an earlier stage in the development of the Pangoniinae, as was postulated by Mackerras (1955). We believe that a more detailed comparative study of the structure of not only *Zophina*, *Asaphomyia*, *Apatolestes*, and *Protosilvius*, but including also such genera as *Ectenopsis* (Australia) and the group of southern Neotropical genera recently discussed by Coscaron (1976) should be undertaken. There appears to have been much more recognition of differences among this group in the New World, about 13 supraspecific categories versus about six in the Australian region, and a reassessment of the characters used to separate these taxa seems in order.

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A FURTHER DESCRIPTION OF *HERMATOBATES BREDINI*
HERRING AND A NEW RECORD FOR CUBA
(HEMIPTERA: HERMATOBATIDAE)

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Abstract.—*Hermatobates bredini* Herring is recorded for the first time from Cuba. An erroneous description of the caudal process of the metasternum is corrected.

The genus *Hermatobates* occupies an uncertain position in the heteropteran hierarchy. Various authors have considered it to be either a gerrid or a separate family. Matsuda (1960) revised the higher rank taxa of the Gerridae and excluded Hermatobatinae, leaving it *incertae sedis*. Andersen and Polhemus (1976) treated the Hermatobatidae as a family in their work on marine water striders, and we follow this interpretation pending a more complete analysis to be published later by the first author and others.

In 1965 *Hermatobates bredini* Herring was described from a unique male from Dominica, the only record for the genus in the Atlantic Ocean system. Herring figured the ventral features of *bredini* while the specimen was immersed in alcohol and did not notice the peculiar folded caudal extension of the metasternum. An amended description of this structure follows.

Hermatobates bredini Herring

Hermatobates bredini Herring 1965. Proc. U.S. Nat. Mus. 117:124. Type, male, Dominica, British West Indies (USNM Type No. 66875).

Apterous male.—Caudal margin of metasternum sharply elevated into a ridge, prolonged caudad in a sinuate flap-like process embracing the distal part of abdominal segment 9 and terminating as a ventrally directed lamina (Fig. 1).

Specimens examined.—Holotype, ♂ (data given above); 1 ♂ CUBA, Corrientes Bay, IV-9-1937, P. Bartsch, in Polhemus collection.

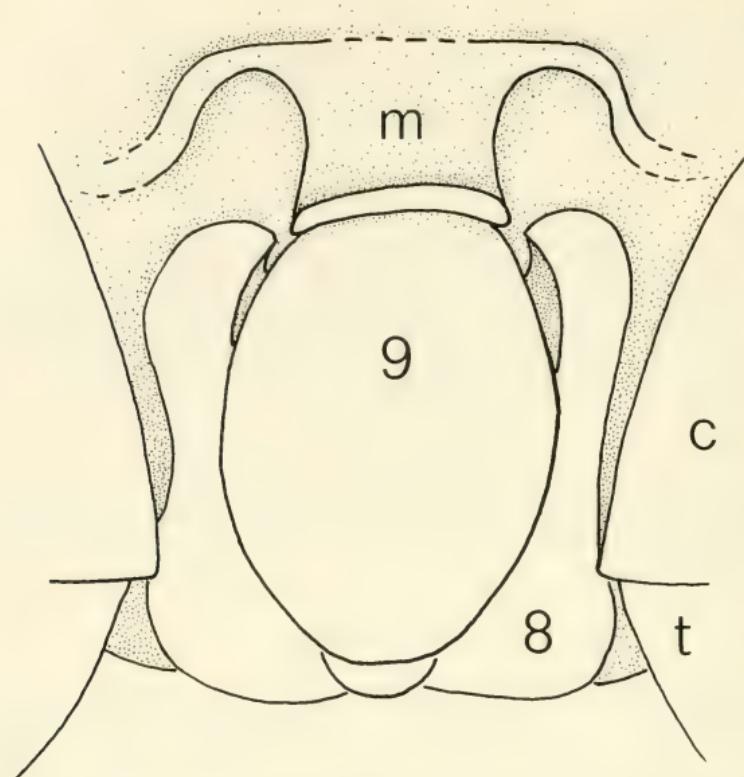


Fig. 1. *Hermatobates bredini*. Ventral view of distal part of abdomen: c, posterior coxae; m, metasternum; t, posterior trochanter; 8, tergite 8; 9, tergite 9.

Discussion.—This is the second record of *bredini* for the Caribbean region, and as Dominica and Cuba are widely separated, it is likely that *bredini* occurs along other West Indian islands. The female is still unknown, and its discovery is much to be desired.

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REFERENCE OF *CEPHALIA FULVICORNIS* AND *CEPHALIA MACULIPENNIS* (DIPTERA: OTITIDAE) TO THE GENERA *EUXESTA* (DIPTERA: OTITIDAE) AND *RIVELLIA* (DIPTERA: PLATYSTOMATIDAE)

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Abstract.—Examination of the type-specimens reveals that *Cephalia fulvicornis* Bigot should be known as *Euxesta fulvicornis* (Bigot), new combination (Otitidae) and that *C. maculipennis* Bigot should be known as *Rivellia maculipennis* (Bigot), new combination (Platystomatidae), with *Rivellia maculosa* Namba, new synonym. *Euxesta fulvicornis* (Bigot) is characterized. Both species are North American and have been cited in the North American catalogue as unrecognized.

The type-specimens of *Cephalia fulvicornis* and *C. maculipennis*, both described by Bigot (1886) from North America, were examined through the kindness of the authorities of the University Museum, Hope Department of Zoology (Entomology), University of Oxford, England. The results of the examination follow.

Euxesta fulvicornis (Bigot), NEW COMBINATION

Cepahlia fulvicornis Bigot, 1886:386.

The type is in good condition, pinned through the thorax with a little verdigris extruding from the points pierced by the pin. Although Bigot stated that the unique type is a male, the specimen sent is clearly a female, but it agrees otherwise well with his description, and I believe it may be accepted as the type. The label, not affixed to the same pin as the specimen, reads "C. fulvicornis. ♂/ Calif. J. Bigot" (with arrowhead of the sex symbol directed downward). Dr. Ismay, of the Oxford Museum, tells me that the next specimens in the Bigot collection are two on one pin labelled *C. bicolor*, from "Celan."

The Bigot specimen agrees well with three specimens in the United States National Museum collection taken at Temecula, California, by A. L. Melan-

der. I had considered these specimens to be an undescribed species of *Euxesta*. They may be distinguished from other species of *Euxesta* by the following combination of characters: Wing with costal cells wholly dark brown, a small brown streak in cell R_1 anterad of fork of R, and a brown mark filling tips of cells R_1 , R_3 , and R_5 , the mark a little shorter than broad; vein M ending at wing tip; lunule, face, and clypeus wholly tawny; costa not enlarged; scutellum black; abdomen largely black with metallic sheen, at most a little brown basally; mesoscutum with weak tomentosity between humeri and before scutellum.

Rivellia maculipennis (Bigot), NEW COMBINATION

Cephalia maculipennis Bigot, 1886:385.

Rivellia maculosa Namba, 1956:35. NEW SYNONYM.

The Bigot type is in fairly good condition, with antennae and most of the bristles missing. It is glued to a cardboard point on a pin bearing a label reading "C. maculipennis, ♂/ am. Sept./ Mts. Roch./ J. Bigot." The locality was cited in Bigot's publication as "Rocky-Mount." The Rocky Mountains are Les Monts Rocheux in French. There can hardly be any doubt that the specimen is Bigot's type, even though the tip of the abdomen, close against the cardboard, seems to be that of a female.

Comparison of Bigot's specimen with paratypes and other specimens of *Rivellia maculosa* in the United States National Museum make it quite evident that Namba's species is a synonym. The fact that one of the paratypes of *Rivellia maculosa* is from Alberta (Waterton Lakes National Park) makes Bigot's locality plausible enough, even though the other known localities of the species are in the southeastern United States.

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PALEARCTIC MIRIDAE IN NORTH AMERICA: RECORDS OF
NEWLY DISCOVERED AND LITTLE-KNOWN SPECIES
(HEMIPTERA: HETEROPTERA)

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Abstract.—The Palearctic mirids *Orthotylus viridinervis* (Kirschbaum), *Psallus betuleti* (Fallén), and *Sthenarus rotermundi* (Scholtz) are reported in North America for the first time, and additional locality records are given for four previously reported Palearctic species. *Orthotylus viridinervis* was discovered in Ontario, Canada on *Ulmus americana*; *P. betuleti* was taken at one locality in Pennsylvania on *Betula populifolia* and is also recorded from Alaska, based on museum specimens; and *S. rotermundi* was found at two localities in Pennsylvania feeding on the seeds of *Populus grandidentata* and *P. tremuloides*, and in Ontario, Canada on *P. alba*. *Megalocoleus molliculus* (Fallén), previously recorded from Massachusetts, Wisconsin and Ontario, Canada, is reported for the first time from Pennsylvania and West Virginia breeding on yarrow, *Achillea millefolium*, and from Connecticut and New Jersey, based on museum specimens. *Camptozygum aequale* (Villers) and *Plagiognathus vitellinus* (Scholtz) are recorded for the first time in Canada, based on collections from Ontario on *Pinus banksiana* and *Picea pungens*, respectively; and a single specimen of *Orthotylus nas-satus* (F.) was taken on *Acer pseudoplatanus* in Bucks Co., Pennsylvania. Seasonal occurrence and diagnoses are given for *M. molliculus*, *O. viridinervis*, *P. betuleti*, and *S. rotermundi*. Illustrations of the adult and 5th instar of *M. molliculus* and *S. rotermundi* and the male genitalia of *O. viridinervis* are provided. Nursery stock is considered the most likely means of introduction for most of these species.

In the course of our studies on the mirid fauna of Pennsylvania and eastern North America we have collected three Palearctic species previously unrecorded from North America, *Orthotylus viridinervis* (Kirschbaum), *Psallus betuleti* (Fallén) and *Sthenarus rotermundi* (Scholtz), as well as a fourth species, *Megalocoleus molliculus* (Fallén), reported as an introduced species from Massachusetts (Knight, 1922) and not mentioned again in the

North American literature until 1972. Our distribution records and biological observations for these four mirids, with additional notes on three other previously reported Palearctic Miridae (Wheeler and Henry, 1973; Henry and Wheeler, 1973; Henry, 1977), are made available for inclusion in the forthcoming catalogue of the Hemiptera-Heteroptera of America north of Mexico. Characters of the adults are given, and descriptions and illustrations of the adults and fifth instars of *M. molliculus* and *S. rotermundi* and genitalia for *O. viridinervis* are provided to facilitate recognition of these species in the Nearctic fauna.

Megalocoleus molliculus (Fallén)

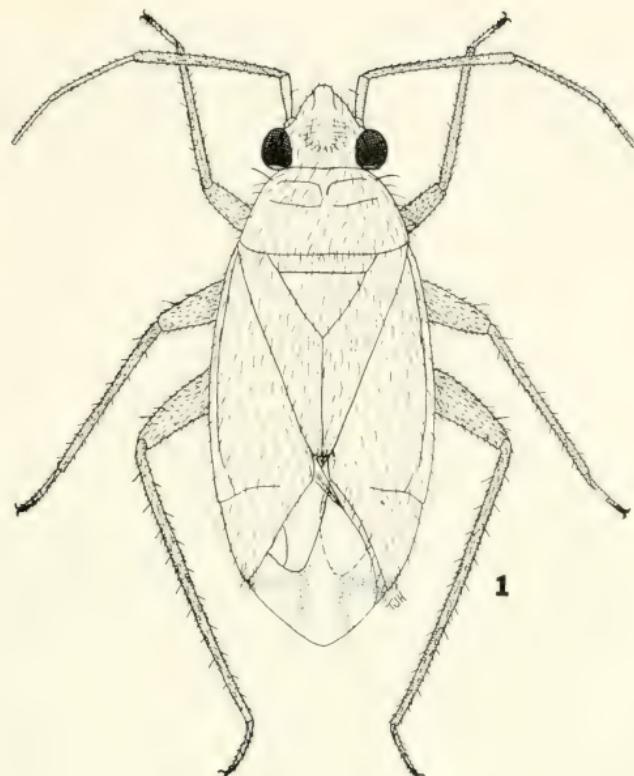
Figs. 1-2

This species is widely distributed throughout much of Europe and Great Britain and is known to occur in northern Africa (Carvalho, 1958; Wagner, 1975). *Megalocoleus molliculus* breeds on composites, mainly yarrow, *Achillea millefolium* L., but other composites such as *Anthemis tinctoria* L., *Artemisia* spp., *Matricaria maritima* L., and *Tanacetum vulgare* L. may also serve as hosts (Kullenberg, 1944; Stichel, 1956). Adults feed in the flower heads of yarrow where they blend in with the color of the involucres. Eggs deposited in the flower stalks hatch in early June in England. Adults mature in early July and are present until September (Butler, 1923; Southwood and Leston, 1959).

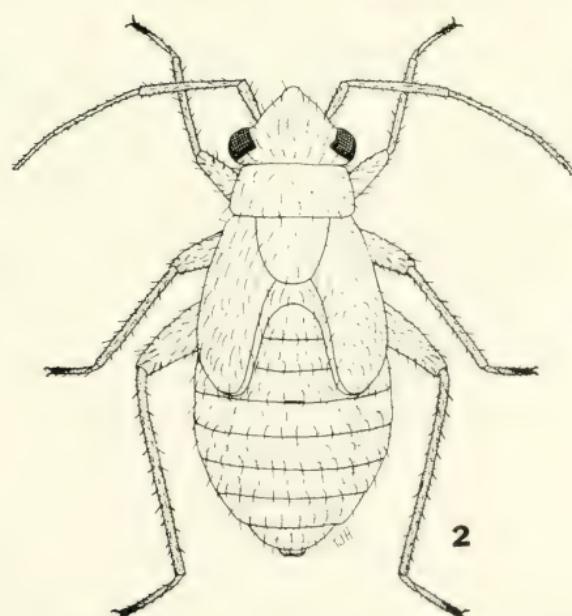
Kullenberg (1944) described the egg and illustrated the fifth instar nymph. Several workers, including Reuter (1875) and Southwood and Leston (1959), have described the adult. Kullenberg (1941) and Wagner (1975) figured male genitalia.

Knight (1922) first reported *M. molliculus* from North America based on specimens collected during 1916-17 by H. M. Parshley and C. E. Olsen at Beach Bluff (Essex County, near Marblehead) on the coast of Massachusetts and subsequently included it in his "Miridae (Capsidae) of Connecticut" (1923). This mirid was not recorded again from North America until Akingbohungbe et al. (1972) reported it from Wisconsin and Reid et al. (1976) mentioned taking specimens by sweeping goldenrod, *Solidago canadensis* L., in Ontario. J. A. Slater (personal communication) has collected this species in Connecticut (Mansfield Center, June 19, 1957). We found specimens in the U.S. National Museum of Natural History (USNM) from New Jersey (Newark, B/L Ser. #991, 7/1/64) and Pennsylvania (Springbrook, Lackawanna Co., VII-11, 1945, Sailer, DDT Exp.) The Pennsylvania State University collection contains an additional specimen from Pennsylvania (Centre Co., State College, 7-30-76, L. E. Adams).

In 1977 and 1978 we collected large numbers of *M. molliculus* in Pennsylvania on flowers of yarrow growing along roadsides and in old fields. We found this phyline in 10 counties: Allegheny (Allison Park, 6 July 77), Centre



1



2

Figs. 1-2. *Megalocoleus molliculus*. 1, Adult female. 2, 5th instar nymph.

(Scotia Barrens, 26 July 77), Clarion (Rts. 36 & 208 near Tylersburg, 25 July 78), Crawford (Rt. 8, 2.3 mi S of Tillotson, 25 July 78), Dauphin (Bow Creek Rd. 1.5 mi N of Grantville, and Jonestown Rd., Shellsville, 15 July 77), Erie (Presque Isle and Erie, 26 and 27 July 78), Montgomery (Montgomeryville, 19 July 78), Northumberland (Dornsife and 2 mi S of Augustaville, 12 July 77, 1 August 78), Somerset (Thomas Mills, 8 July 77), and Venango (Rt. 36 just W of Forest Co. line, 25 July 78).

Only adults were taken in Pennsylvania, but we collected a few fifth instars with larger numbers of adults in mid-July at higher elevations in West Virginia (Tucker Co., Dolly Sods Wilderness Area, 17 July 77, on yarrow). Adults were also taken in Greenbrier Co., West Virginia (I-65 near Alta exit, 16 July 78, on yarrow).

Adult male.—Length 4.58 mm, width 1.66 mm, generally pale yellowish green, thickly clothed with erect, brown to golden setae. *Head*: Width 0.92 mm, vertex 0.42 mm. *Rostrum*: 2.28 mm, reaching base of genital segment. *Antennae*: Testaceous; I, length 0.32 mm; II, 1.30 mm; III, 0.42 mm; IV, 0.20 mm. *Pronotum*: Length 0.68 mm, width at base 1.40 mm. *Hemelytra*: Pale yellowish green, clavus, embolium, middle of corium and cuneus often tinged with pale brown or golden yellow; membrane brownish to golden yellow. *Venter* yellow. *Legs*: Yellowish to testaceous; tibial spines brown to fuscous; tarsi brown, last segment and claws fuscous.

Females are similar to males in coloration, although they are distinctly broader and the head is more strongly convex and produced than in males, which gives them a superficial resemblance to *Amblytylus nasutus* (Kirschbaum).

Fifth instar.—Length 3.00 mm, pallid yellow, dorsum clothed with erect, stout, black setae. *Head*: Pale yellow, eyes red, frons strongly produced in front of eyes; antennae uniformly pale, clothed with erect, black setae, segments II and III subequal; rostrum pale to testaceous, apex fuscous, reaching middle of abdomen. *Pronotum*: Pale yellowish, width at base about 2× length at middle, wing pads and scutellar area pale yellow, pads reaching 3rd abdominal segment. Abdomen pale yellow, dorsal scent gland opening weakly pigmented, not easily visible. *Venter* pale yellow. *Legs*: Pale; femora clothed with erect, black setae, especially near apices; tibiae pale, spines stout, black; tarsi testaceous, apical ½ of last segment and claws fuscous.

Orthotylus viridinervis (Kirschbaum)

Fig. 3a-c

Orthotylus viridinervis is also a common species throughout Europe and Great Britain (Carvalho, 1958). Wych or Scotch elm, *Ulmus glabra* Huds., is the most common host (Butler, 1923), but it has also been taken on *Alnus*, *Corylus*, *Quercus*, and *Salix* (Stichel, 1957). In Britain eggs overwinter and adults are found from early July until late August (Southwood and Leston, 1959). Southwood (1953) figured male and female genitalia.

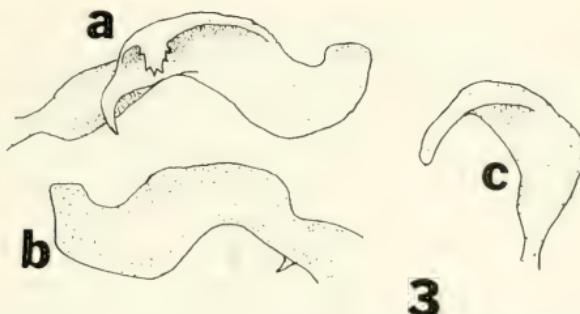


Fig. 3a-c. *Orthotylus viridinervis*. a, Right paramere, inside lateral view. b, Right paramere, lateral view. c, Left paramere, inside lateral view.

Our only record of *viridinervis* in North America is from Niagara Falls, Ontario, Canada, June 17, 1978 on American elm, *Ulmus americana* L., heavily infested with woolly elm aphid, *Eriosoma americanum* (Riley). Six males and two females were collected; three of these were teneral. *Camptylomma verbasci* (Meyer), *Deraeocoris aphidiphagus* Knight, and *Microphylellus modestus* Reuter were also found on the same trees.

Adult male.—Length 5.80 mm, width 1.76 mm, generally translucent green, clothed with erect, pale setae. **Head:** Width 0.86 mm, vertex 0.42 mm, testaceous, frequently tinged with green. **Rostrum:** Length 1.64 mm, reaching metacoxae. **Antennae:** Testaceous; I, length 0.58 mm, II, 2.00 mm; III, 1.00 mm; IV, 0.68 mm, fuscous. **Pronotum:** Length 0.68 mm, width at base 1.28 mm, greenish, mesoscutum and scutellum pale green. **Hemelytra:** Uniformly translucent green, clothed with erect pale setae; membrane transparent, veins and spot inside large areole green. **Venter and legs:** Pale greenish, tibial spines brownish, apex of last tarsal segment and claws fuscous. **Genitalia:** See Fig. 3.

The female is very similar to the male in color and form. Length 5.83 mm, width 1.84 mm. **Head:** Width 0.88 mm, vertex 0.46 mm. **Rostrum:** Length 1.72 mm, reaching metacoxae. **Antennae:** I, length 0.60 mm; II, 2.32 mm; III, 1.16 mm; IV, 0.64 mm. **Pronotum:** Length 0.72 mm, width at base 1.40 mm.

Remarks.—This is our only large green *Orthotylus* that breeds on elm. *Orthotylus viridinervis* keys to *basicornis* Knight in Knight (1941) but differs in the uniformly testaceous antennae, the longer rostrum which reaches the metacoxae, and the unique genitalia.

Psallus betuleti (Fallén)

Like *M. molliculus* and *O. viridinervis*, *P. betuleti* is a widely distributed species in Europe and Great Britain (Carvalho, 1958). Birches, especially *Betula alba* L., serve as the principal hosts, although this mirid has been

taken on alder (*Alnus glutinosa* (L.) Gaertn.) and willows (*Salix* spp.). On willow *P. betuleti* is associated with the flowers and fruits (Kullenberg, 1944). *Psallus betuleti* is both phytophagous and predacious (Kullenberg, 1944; Southwood and Leston, 1959). Eggs deposited in young wood of birch hatch in late April or early May in England; adults mature in late May or early June and are present until August (Southwood and Leston, 1959; Wagner, 1975).

Kullenberg (1944) described and figured the egg and both Kullenberg (1944) and Butler (1923) described and illustrated the fifth instar. Reuter (1875) and Southwood and Leston (1959) illustrated the adult. Wagner (1975) included a figure of male genitalia.

Our only collections of *P. betuleti* were made at Wilkes-Barre, Luzerne Co., Pennsylvania, during May 1977 and June 1978. On May 5, two fifth instars were beaten from gray birch, *Betula populifolia* Marsh., growing on coal spoil banks. Ten adults (five males, five females) were taken on the same trees on May 19 and three adults were taken at the same locality on June 7, 1978.

Although the occurrence of *P. betuleti* in North America has not previously been published, we found that R. I. Sailer had made an earlier collection from Alaska in 1948. The USNM has eight specimens (six males, two females) with the following data: Nabesna, Alaska, 15 mi W, 13-VII-48, R. I. Sailer; Alaska Insect Project.

Adult male.—Length 5.00 mm, width 1.83 mm, generally fuscous to black, clothed with silvery, sericeous pubescence intermixed with semierect, simple, black setae. *Head*: Black, eyes red, width 0.92 mm, vertex 0.38 mm. *Rostrum*: Length 1.42 mm, reaching middle of mesocoxae. *Antennae*: Black; I, length 0.32 mm; II, 1.50 mm; III, 0.68 mm; IV, 0.46 mm. *Pronotum*: Length 0.82 mm, width at base 1.64 mm, shiny black; mesoscutum and scutellum black. *Hemelytra*: Uniformly fuscous to black; cuneus black (sometimes largely tinged with red), pale along cuneal fracture, more reddish at apex. *Venter*: Black, ostiolar peritreme pale. *Legs*: Fuscous to dark reddish brown; pro- and mesofemora dark with a row of black spots on anterior surface, hind femora with 2 rows of black spots, apices of all femora frequently more reddish; tibiae yellow to reddish yellow with large black spots at bases of black spines; tarsi and claws largely fuscous.

Females differ from males by being more broadly formed and having red largely replacing black or fuscous on pronotal disc, scutellum, clavus, embolium, cuneus, abdomen, all femora and the outer and inner margins of the corium.

Remarks.—In Knight (1941) females of *betuleti* will key most closely to *alnicola* Douglas and Scott (although the dorsum is not distinctly flecked with fuscous), and males will key somewhat poorly to the couplet containing *strobicola* Knight and *bakeri* (Bergroth). *Psallus betuleti* can be distin-

guished from all other *Psallus* species by its large size (rivaled only by *parshleyi* Knight), the black antennae, the reddish cuneus in males and the reddish pronotal disc, scutellum, corium (in part), and cuneus in females, and the fuscous and red legs with black spots. The sexual dimorphism in this species is so great that the two sexes could be mistaken for different species if collected separately.

Sthenarus rotermundi (Scholtz)

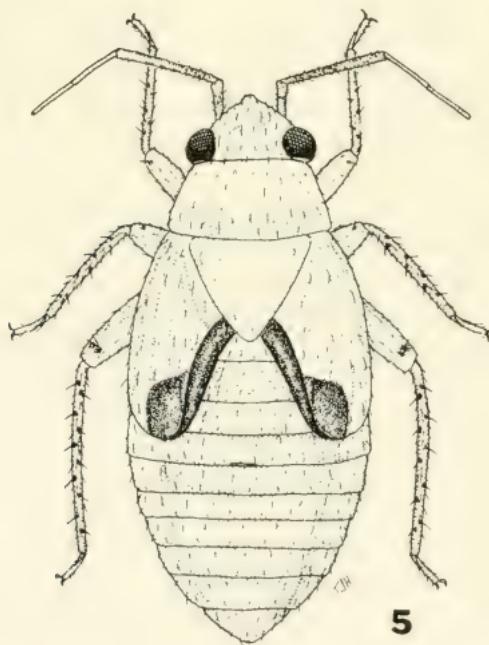
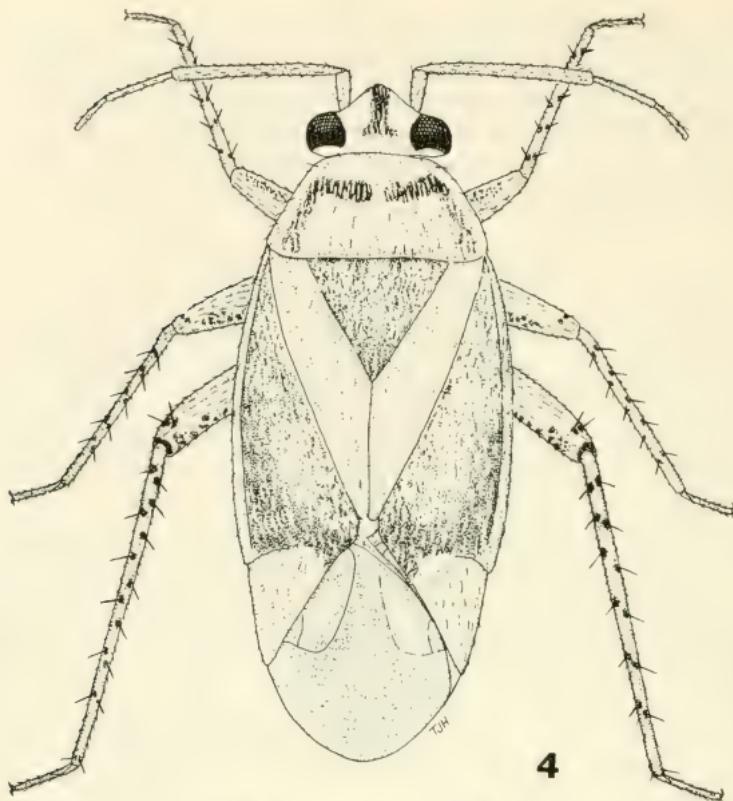
Figs. 4-5

This phyline mirid occurs throughout most of Europe and Great Britain and in Algeria (Carvalho, 1958; Wagner, 1975). White or silver poplar, *Populus alba* L., is the main host plant; *P. canescens* Smith, and *Alnus glutinosa* are additional hosts. The eggs overwinter and in England adults are present from late June until mid-August or September (Butler, 1923; Southwood and Leston, 1959).

Butler (1923) briefly described the egg, Reuter (1878) and Southwood and Leston (1959) illustrated the adult, and Wagner (1975) figured male genitalia.

Our records of *S. rotermundi* in North America are based on collections from western and eastern Pennsylvania and Ontario, Canada. At Monroeville, Allegheny Co., Pennsylvania, four males and three fifth instars were beaten from large-toothed aspen, *Populus grandidentata* Michx., during May 24-26, 1977. On May 7, 1978, a population of several hundred individuals was found on *P. grandidentata* near Wilkes-Barre in Luzerne Co. Late instars and adults were feeding on the seeds and were well camouflaged against the white pubescence of the capsules. Only a few adults were taken on quaking aspen, *P. tremuloides* Michx., growing among the large-toothed aspens. At Niagara Falls, Ont., a few adults and large numbers of fifth instars were found June 17, 1978, on seeds of silver poplar, the principal host of this mirid in Europe.

Adult male.—Length 3.80 mm, width 1.76 mm, generally grayish brown to fuscous, thickly clothed with silvery, sericeous pubescence (which gives a pale, silvery brown appearance). *Head*: Width 0.46 mm, vertex 0.24 mm, median line from vertex to tylus fuscous or black. *Rostrum*: Length 1.20 mm, reaching middle of mesocoxae. *Antennae*: Testaceous; I, length 0.28 mm, lightly fuscous at base; II, 1.16 mm, clothed with recumbent, golden setae; III, 0.48 mm, lightly infuscated at base; IV, 0.36 mm. *Pronotum*: Length 0.38 mm, width at base 0.76 mm, grayish brown, calli black with a lateral black ray extending back to base of disc; mesoscutum and scutellum black. *Hemelytra*: Grayish brown, corium, apex of clavus and paracuneus fuscous (thickly set silvery sericeous setae often mask fuscous coloration), cuneus pale grayish brown, often tinged with red. *Venter*: Mostly fuscous, ostiolar peritreme pale, genital segment frequently orange red. *Legs*: Grayish brown; pro- and mesofemora with a row of fuscous spots on either side;



metafemora with 2 rows of large fuscous spots (these spots made up of clusters of very small spots) on either side, apex frequently tinged with red or orange; tibial spines black with distinct black spots at bases; last tarsal segment and claws fuscous.

Females are very similar to males in color and pubescence and differ mainly by their broader form.

Fifth instar.—Length 3.52 mm, pale grayish green, shaded with more testaceous yellow, clothed with suberect and erect pale to golden setae. *Head*: Pale yellowish green, eyes reddish, antennae pale yellow, basal $\frac{1}{2}$ of 2nd antennal segment with a few fuscous spots at bases of more prominent setae. *Pronotum*: Pale green, basal $\frac{1}{3}$ more testaceous, wing pads testaceous, streaked with darker brown, apical area fuscous, hind wing pads fuscous. *Abdomen*: Pale green, dorsal scent gland opening narrow, weakly pigmented. *Venter*: Pale green. *Legs*: Pale green, tibial spines brownish, with distinct fuscous spots at bases, these fading apically.

Remarks.—*Sthenarus rotermundi* will key to the genus *Psallus* Fieber in Knight (1941) but does not fit smoothly in the species key.¹ This distinct mirid can be separated from all other phylines in our fauna by the brown dorsum thickly clothed with silvery white, sericeous pubescence, the infuscated calli, the translucent or red-tinged cuneus and the stout, black tibial spines with distinct spots at the bases.

NOTES ON PREVIOUSLY REPORTED SPECIES

Henry (1977) first reported *Orthotylus nassatus* (F.) from Dauphin and Lehigh counties in eastern Pennsylvania, based on single specimens from each county. A third specimen was discovered in Bucks Co., Pennsylvania, Danboro, along Rt. 611, July 26, 1973, by T. J. Henry and A. G. Wheeler, Jr. on *Acer pseudoplatanus* L.; thus, this record helps to confirm the establishment of this interesting species in the United States.

Two additional conifer-inhabiting species previously reported from Pennsylvania (Wheeler and Henry, 1973; Henry and Wheeler, 1973), were collected at Niagara Falls, Ontario, June 18, 1978. A few late-instar nymphs of *Camptozygum aequale* (Villers) were taken on Jack pine, *Pinus banksiana* Lamb., and both nymphs and adults of *Plagiognathus vitellinus* (Scholtz) were common on Colorado spruce, *Picea pungens* Engelm. These

¹ In Knight's key, couplet 2, choice 2 should be modified to read "Second antennal segment black or entirely pale." Otherwise, at least one species included in that key cannot be properly keyed (i.e., *strobicola* Knight, with the 2nd antennal segment entirely yellow).

records represent a considerable range extension and are the first known Canadian records for both species.

DISCUSSION

Interest in the origin of the Palearctic insect fauna of North America has been stimulated by Lindroth's (1957) general review and recent papers on Hemiptera-Heteroptera (Slater, 1974) and ichneumonoid parasites (Mason, 1978). Slater (1974) analyzed the heteropteran fauna of the northeastern United States and recorded 43 species of Miridae as Holarctic in distribution, with 22 representing definite or probable introductions by man. It should be noted that a number of mirids previously thought to have been introduced to the Nearctic fauna have been shown distinct from their Palearctic congeners and have been described as new species (Wagner and Slater, 1952). Conversely, a number of species described as new from this continent may actually be invaders from abroad; detailed examination of specimens in North American and European museums may reveal such synonymies.

Often it proves impossible to determine whether a species recently discovered in North America is truly Holarctic or an artificial introduction. A disjunct distribution that fits Lindroth's (1957) "geographic criterion," usually in habitats modified by human habitation, might normally suggest that a species has been introduced via man's commerce. However, a conclusion regarding origin may prove incorrect if based on inadequate collecting. The discovery of *Pithanus maerkeli* (Herrich-Schaeffer) along the eastern coast of the U.S. and in Nova Scotia (Olsen, 1915; Parshley 1916), and its further recovery on the coast of British Columbia (Parshley, 1919), led early workers to regard this species as a European introduction. Further collecting of this mirid from undisturbed habitats of Canada and the United States suggests that *P. maerkeli* is genuinely Holarctic (Kelton, 1966).

Our discovery of *Orthotylus viridinervis*, *Psallus betuleti*, and *Sthenarus rotermundi* in the U.S. or Canada brings the number of known Holarctic Miridae to approximately 51. Despite the problems mentioned in determining the origin of a particular taxon in North America, *O. viridinervis* and *S. rotermundi* most likely represent fairly recent invaders, probably having gained entrance as eggs inserted in stems of nursery stock. Other mirids discussed in this paper (*Camptozygum aequale*, *Orthotylus nassatus*, and *Plagiognathus vitellinus*) have also been thought to have become established in the same manner (Wheeler and Henry, 1973; Henry and Wheeler, 1973; Henry, 1977). The distribution of *P. betuleti* in eastern North America, one locality in Pennsylvania, again suggests a recent introduction by commerce. Its occurrence in Alaska, however, may indicate that this species long ago crossed the Bering Sea land bridge into North America (Sailer, 1978).

ACKNOWLEDGMENTS

We give special thanks to J. A. Slater (University of Connecticut, Storrs) for lending examples of Palearctic species used to verify our findings of species reported in this paper and for his record of *M. molliculus* in Connecticut, and to J. L. Herring (Systematic Entomology Laboratory, SEA, USDA) for the loan of additional specimens which helped to expand our distributional data. We also thank our colleague Karl Valley (Pennsylvania Department of Agriculture) for reviewing the manuscript and making useful comments.

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DIFFERENTIAL PREY SELECTION FOR THE SEX OF
OFFSPRING IN THE CICADA KILLER *SPHECIUS*
SPECIOSUS (HYMENOPTERA: SPHECIDAE)

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Abstract.—Data originally obtained by Dow (1942) were reanalyzed and showed that female cicada killers, *Sphecius speciosus*, knew, in advance of the hunt, the sex of the egg they would lay. Consequently, they provisioned 12 male cells in most cases with a single cicada of the smaller species *Tibicen canicularis*, and more often than not the sex of the cicada was the smaller male. Each of the six female cells was provisioned with two female cicadas of both the larger and smaller species *T. canicularis* and *T. lyricen* 50% of the time. The finding by various observers that more female cicadas were captured than male cicadas is now explained because most female cells receive two large female cicadas because they are the heavier sex. Male cells nearly half the time receive small female cicadas. Weight rather than number of prey is critical since some female cells as shown by Dambach and Good (1943) were provisioned with a single large female cicada of *T. lyricen* while others received three cicada prey. Two male cells were provisioned with two cicadas, a male and female of the lighter species. Some female cicada killers specialize in producing all male nests; others produce both sexes and possibly all female nests.

According to Krombein (1967) female wasps or bees know in advance before storing the cell with food, the sex of the egg which she will place in the cell prior to sealing it. With the Vespidae where the egg is laid before the cell is provisioned, the wasp still controls and knows the sex of the egg she has laid, because she brings in a large number of caterpillars if it is to be a female or a small number if it is to be a male. Krombein further stated that females of all vespid wasps and most sphecid wasps and bees, lay a series of female eggs in larger cells before a series of male eggs in larger cells before a series of male eggs in nests where both sexes are produced. Krombein was speaking in connection with solitary wood-nesting predaceous wasps and bees. However, there are reasons to believe that this remains true of many ground-nesting sphecid wasps and bees. Evans (1971)

stated that production of females in larger cells containing more prey is probably common in ground nesters, though it has been clearly demonstrated only in *Sphecius speciosus* (Drury) (Dow, 1942). However, Dow did not comment on size differences, if any, between cells. Evans (1971) in studying *Cerceris fumipennis* Say found that cells were of two sizes: Large cells 25 to 30 mm long and small cells approximately 20 mm long. When provisioned with large buprestids (*Dicera*), large cells typically contained four; small cells, two. When provisioned with *Argilus*, large cells contained 16 to 32; small cells, 8 to 12. Large cells contained larger larvae that made larger cocoons. It seemed probable that the small cocoons would produce males and the large ones females. The female *C. fumipennis* is considerably larger than the male, and there is relatively little overlap in size. Evans (1971) found that the majority of nests were provisioned with *Argilus* and that the use of the larger buprestids was mainly confined to a few females that took them in considerable numbers, indicating that they learned where to find the larger buprestids.

In the cicada killer, male eggs are typically provisioned with one cicada, and female eggs are typically provisioned with two cicadas (Dow, 1942).

Usually, there are more than one species of annual cicada in an area, and female wasps prey upon more than one species (Dow, 1942; Dambach and Good, 1943; Lin, 1979).

Examination of Table 1, data taken from Dow (1942), shows that two species of cicadas were preyed upon in Berkley, Massachusetts, *Tibicen canicularis* and *Tibicen lyricen*. The male sex is often the lighter, and *T. canicularis* is a smaller species than *T. lyricen*. To get an estimate of the weights of the cicadas, Dow captured a specimen of each cicada and found the male *T. canicularis* to weigh .93 g, the female 1.12 g and the male *T. lyricen* to weigh 1.39 g, the female 1.94 g.

Table 1 shows that when provisioning 12 male cells, only a single prey species was used in each cell with the exception of two which each received a male and a female cicada of the smaller *T. canicularis*. Also, the sex of the cicada was male in six cells, and female in four cells; and, of course, in two cells both male and female. The prey species in nine of the twelve cells was the small *T. canicularis*. Of the three exceptions, two were the lighter males of *T. lyricen* and only one was a female of the latter species. Regarding the female cells, if selection of prey by the female wasp was not the case, then the probability of the contents of the six female cells would have been exceedingly low. Each of these six cells first received a female cicada; and then again, each received an additional female cicada making the probability of consecutively receiving twelve female cicadas. The female cicada received was, in half the cases, the smaller species and in half the cases, the larger species. Thus, two cells received two *T. canicularis*, and two cells received two *T. lyricen*, and two cells received one of each species.

Table 1. Data pertaining to the cells from which adults were reared.¹

| Number of cicadas in cell | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2? | 2 | 2 | 2 | 2 | 2 |
|----------------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| <i>Tibicen canicularis</i> | ♂ | ♂ | ♂ | ♂ | ♀ | ♀ | ♂ | ♂ | ♂, ♀ | ♂, ♀ | ♀, ♀ | ♀, ♀ | ♀, ♀ | ♀, ♀ |
| <i>Tibicen lyricen</i> | | | | | | | | | | | | | | |
| Length of cocoon (mm) | 24.0 | 29.5 | 29.5 | 29.5 | 29.5 | 29.5 | 31.0 | 32.0 | 31.0 | 32.0 | 40.0 | 39.0 | 39.5 | 40.5 |
| Weight of cocoon (g) | 0.67 | 1.05 | 1.30 | 1.25 | 1.14 | 1.28 | 1.37 | 1.39 | 1.59 | 1.48 | 1.30 | 1.62 | 2.96 | 3.40 |
| Weight of adult (g) | 0.13 | 0.25 | 0.28 | 0.43 | 0.27 | 0.36 | 0.38 | 0.36 | 0.42 | 0.39 | 0.43 | 0.44 | 0.63 | 0.69 |
| Sex of adult | ♂ | ♂ | ♂ | ♂ | ♂ | ♂ | ♂ | ♂ | ♂ | ♂ | ♂ | ♂ | ♀ | ♀ |

¹ Table modified from Dow, 1942.

The weight of the cocoon in the six female cells ranged from 2.96 g to 3.40 g. In the cicada killer, there is seldom overlap of size, and females are considerably heavier than males (see Lin, 1979, for an exception). The weight of the cocoon in the 12 male cells including the two provisioned with two cicadas ranged from .67 g to 1.62 g. The weight of the adult males ranged from .13 g to .44 g, the weight of the adult females ranged from .61 g to 1.09 g.

The cocoon weights are rough estimates of the prey weights and the adult weights (Table 1). When the female cocoon weights were divided in half for comparison with those male cocoons which received one prey species, they were as follows: 1.48 g, 1.48 g, 1.58 g, 1.58 g, 1.67 g, and 1.70 g. Only two male cocoon weights weighed as much or more than one-half a female cocoon. These were a male cocoon whose prey was a female *T. lyricen* which weighed 1.48 g, the two lowest values of the female cocoon weights; and a male cocoon provisioned with a male *T. lyricen* weighing 1.59 g. With the exception of these two cases, one-half the weights of all cocoons destined to become females weighed more than all cocoons destined to become males. In the cases of the two exceptions, it is quite possible that the first female prey species in each of the female cells weighed more than just one-half the female cocoon and consequently weighed more than the male cocoon prey. These findings generally support the view that heavier female prey individuals were used when rearing a female wasp as opposed to a male wasp. In the two cases of male cocoons each receiving a male and female cicada, one-half the weight of the cocoons was only .81 g and .65 g, respectively.

The data presented here confirm that females know the sex of the egg she will lay before going on the hunt; it is clear that the hunting female engages in prey selection of a complex sort. If she is to lay a female egg, she hunts for two female cicadas, and presumably specimens on the heavier side, judging from the species of cicada, its sex, cocoon weight, and the adult weight (see Table 1). If she is to lay a male egg, she hunts for lighter prey, this being in most cases the capture of the smaller prey species *T. canicularis* and often the lighter male sex is "selected."

Davis (1920) found that more female cicadas were taken as prey than male cicadas and in doing so called attention to the erroneous idea prevalent among naturalists that *Sphecius* secure its prey by hunting only singing males. Dow (1942) also found more female prey, 24 males to 44 females; and Dambach and Good (1943) found the same: of 703 captured cicadas, only 204 were males. The writer studied a population of *Sphecius* in Pineville, Louisiana in 1977 and found eight of ten cicadas captured by *Sphecius* to be female. Various hypotheses have been put forth to explain why more female cicadas are taken than male cicadas.

According to Dambach and Good (1943), "The disproportionate sex ratio

may be due to the greater susceptibility of females to the hunting system employed by the wasp. Male cicadas are probably more readily disturbed than are ovipositing females."

Dow (1942) has suggested that, ". . . it might be that the females are less active (hence more susceptible to capture), longer lived (therefore more abundant during the nesting period of the wasp), or more likely to occur where the wasp will find them. There is also the possibility that there is some selection on the part of the wasp."

The last hypothesis apparently provides the answer to the question. Data presented here indicate that it is indeed the case that there is selection on the part of the wasp, as Dows' data show (Table 1). Each female cell was provisioned with two female cicadas, one-half being the heavier *T. lyricen*. Male cells were typically provisioned with one cicada, the lighter female of *T. canicularis* or male cicadas which are also light; only three of twelve male cells received a *T. lyricen*. Thus, Table 1 shows 18 captured female cicadas as compared to eight male cicadas. The reason for the female bias in cicadas is now clear; it is due to the fact that female cells each receive typically two female cicadas because they are heavier, while male cells receive, probably depending on chance, approximately one-half male and one-half lighter female cicadas; there were 8 ♂♂:6 ♀♀ cicadas in the male cells.

Dambach and Good (1943) found that 47 cells containing small larval cases were found to be provisioned with one cicada. Cells containing large larval cases were found to have been provisioned with two cicadas in 19 cells and with three cicadas in five cells. Only two large larval cases were found with single cicadas, and each of these had a large female *T. lyricen*. Presumably, small larval cases were male and large ones female. Dow (1942) also found three cells provisioned with three cicadas each; however, none contained cocoons.

It would be a decided advantage for the female wasp to know in advance the sex of the egg to be laid so that especially in the cicada killer enough prey of the right sex and hence weight are brought in for the larger female host. If this were not the case, a female cell might receive one or two male cicadas possibly also of the lighter species *T. canicularis* as prey, and this would not be sufficient for rearing an adult female. Under ordinary conditions a female cell must receive two female prey of sufficient weight to rear an adult female. As Dambach and Good's (1943) data already indicated it is not the quantity of prey per cell which is of major importance but the approximate weight of the prey which the cell holds. According to Dambach and Good (1943): ". . . in hunting, the wasp approaches a tree or shrub and slowly circles closely about the trunk, gradually working its way up through the limbs and branches. It sometimes alights on the bark and continues the search on foot."

During the summer of 1964, I saw numerous instances of females circling the lower trunks of trees in Lawrence, Kansas. Dambach and Good (1943) cited the method of attacking the cicada when located. Mr. Conrad Roth witnessed the capture of a *T. pruinosa* at close range. "The wasp darted backward and forward in front of the cicada several times meanwhile bending the tip of the abdomen downward and forward. It then hit the cicada viciously and injected the sting." The cicada buzzed shrilly and immediately ceased struggling. "The wasp managed to hold its prey to the limb of the tree and pulled it up on the top side of the limb." The wasp turned the cicada over on its back, grasped it in the usual carrying position and flew off with it. Color probably plays a major role in locating the cicada. In 52 instances in the Parade Grounds in Brooklyn, New York, when a female dropped or was deprived of her prey, she was seen to fly repeatedly backward and forward over pieces of green glass apparently mistaking them for prey before finding her prey. Females never showed such responses to brown glass or other objects. A boy who assisted me in my work in the Parade Grounds had captured a large green tobacco horn worm whose color is similar to a cicada's and left it in a small jar in his backyard across the street from the Parade Grounds. A female *Sphecius* entered the jar, and I was shown the jar containing the captured female wasp and the horn worm. Dambach and Good (1943) reported an account by J. N. Knull that *Sphecius* may take its prey in full flight. They point out, however, that this is not the usual method as evidenced from the apparent safety enjoyed by cicadas observed flying to and from trees 10 feet to 25 feet in height while cicada killers were busy searching the lower limbs in the usual methodical manner. Dambach and Good (1943) suggested that should a cicada attempt escape by flight after being located, pursuit and probably capture would result. Thus, by carefully locating its prey, a female *Sphecius* would probably be able to "judge" its weight so as to bring back a light cicada for male prey and a heavy cicada for female prey. While Davis (1920) showed that *Sphecius* does not secure its prey by hunting only singing males, he did not, however, prove that sound is sometimes not used by *Sphecius*. Arnold (1929) reported on the South African *Sphecius milleri* which preys on large cicadas such as *Munza furva*, *Platyleura quadraticollis*, *P. lindiana* and *P. marshalli* which live largely on small mopanin trees (*Copaifera mopani*). The *Sphecius* circles round these trees and makes a sudden swoop at its prey and stings it on the ground. It is found that when a *Sphecius* comes within a foot or so of the trees, the vociferous din of the cicadas ceases quite suddenly, suggesting that *Sphecius* might sometimes locate male prey by their song.

Some female cicada killers in the Brooklyn populations produce all male nests, and others produce nests containing both sexes. Some females may produce all female nests (Lin and Michener, 1972). In this regard, Savin (1923) found the greater number of cells uncovered contained two cicadas.

All females discussed have been mated (Lin and Michener, 1972). Since females are considerably larger than males and there is almost no overlap in sizes, the sex of the offspring of various nests can be determined by the size of the emergence hole made by the eclosing wasps the following season.

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THE GENUS *DISSOMPHALUS* IN NORTHWESTERN SOUTH AMERICA
(HYMENOPTERA: BETHYLIDAE)¹

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Abstract.—The genus *Dissomphalus* has not previously been reported from northwestern South America. The following eight species are here described, all from the male sex: *D. megomphalus* (Ecuador), *D. obliquus* (Colombia), *D. bicavatus* (Venezuela), *D. vallensis* (Colombia), *D. hastatus* (Ecuador), *D. napo* (Ecuador), *D. fungosus* (Ecuador), *D. gilvipes* (Colombia).

The genus *Dissomphalus* is unique in having a diversity of paired pits and hair mats or pencils on the second tergite of the male. I presented a generic diagnosis in 1964 and at that time recognized 39 species from the Americas (Evans, 1964). I later added three more species from South America and presented a key to males from that continent (Evans, 1966). In 1969 I described four species from the West Indies (Evans, 1969a, 1969b). In the same year I described eight species from Argentina, and presented a key to species known from that country (Evans, 1969c). However, no species have been reported from Ecuador, Colombia, or Venezuela; and I take this opportunity to describe several striking species that have recently been made available to me from those countries, bringing the total recognized American species to 62.

The function of the tergal pits remains obscure, but considering the distinctive form of these pits in each species, it seems safe to assume that they play a role in mating. I suspect they are glandular and that the female somehow comes in contact with them during phoretic copulation. Females have been associated with only a few species, and the present paper is concerned with males only.

Terminology is the same as that used in my 1964 synopsis. Abbreviations are as follows: HE = height of eye, lateral view; LH = length of head, full frontal view; OOL = ocello-ocular line; WF = width of front, at its mini-

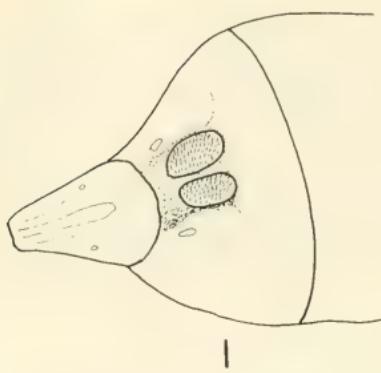
¹ This paper is part of a survey of American Bethylidae, supported by a grant from the National Science Foundation, DEB75-17142.

mum; WH = width of head at its maximum, including eyes; WOT = width of ocellar triangle, including lateral ocelli. The tergal pits, on the second metasomal segment, may be located in concavities which are simply spoken of as depressions.

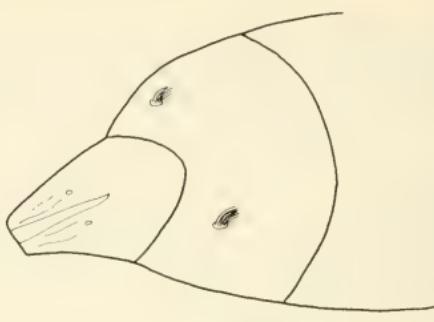
The material on which this paper is based is in large part housed in the Florida State Collection of Arthropods, Gainesville, Florida (abbreviated FSCA in the text). Other material is in the U.S. National Museum (USNM) and some paratypes have been placed in the Museum of Comparative Zoology at Harvard University (MCZ).

KEY TO THE NEW SPECIES OF *DISSOMPHALUS* (MALES)

1. Anterior face of 2nd tergum nearly vertical, bearing 2 large, subcontiguous pits, this tergum also with a pair of much smaller depressions laterad of the large pits (Fig. 1) *megomphalus*, new species
- Anterior face of 2nd tergum more sloping, pits smaller and not subcontiguous (though they may share a common depression), this tergum without additional depressions 2
2. Depressions of 2nd tergum ovoid or linear, much longer than wide (Figs. 2, 3) 3
- Depressions or pits of 2nd tergum more or less circular (Figs. 4–8) .. 4
3. Tergal depressions linear, oblique, each with a series of close-set, short setae (Fig. 2); 3rd antennal segment about $1.4 \times$ as long as wide *obliquus*, new species
- Tergal depressions ovoid, each with a pit on its mesal margin (Fig. 3); 3rd antennal segment barely longer than wide *bicavatus*, new species
4. Clypeus with an acute median tooth, laterad of which the margin may be somewhat sinuate but without other processes; tergal pits rather close to the midline (Figs. 4, 8) 5
- Clypeus tridentate; tergal pits more widely spaced (Figs. 5–7) 6
5. Tergal pits located on the sides of a common, bowl-shaped median depression (Fig. 4); head slightly wider than high *vallensis*, new species
- Tergal pits each located in a separate depression, the depressions separated by less than their own width (Fig. 8); head slightly higher than wide *hastatus*, new species
6. Mandibles bidentate; antennal segment 3 barely longer than wide; coxae and femora dark brown *napo*, new species
- Mandibles quadridentate; antennal segment three $1.3\text{--}1.4 \times$ as long as wide; legs largely or wholly testaceous 7
7. Tergal pits fairly large, each giving rise to a group of short, closely matted setae (Fig. 6); clypeal carina straight in profile *fungosus*, new species
- Tergal pits small, bowl-shaped, each with a small pencil of setae that



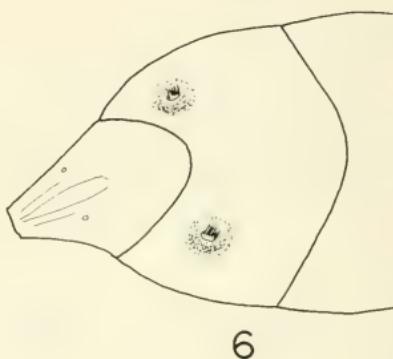
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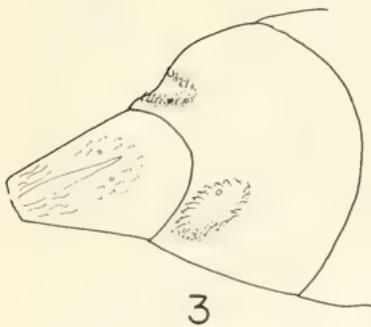
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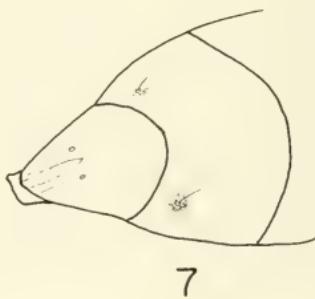
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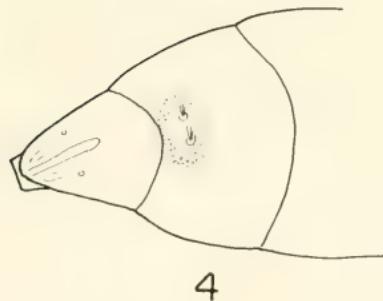
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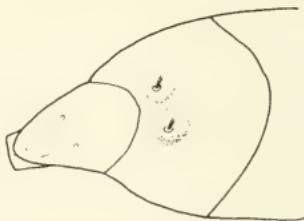
3



7



4



8

is directed caudad (Fig. 7); clypeal carina, in profile, arched toward the base but somewhat depressed toward the apex
..... *gilvipes*, new species

Dissomphalus megomphalus Evans, NEW SPECIES

Type.—♂, ECUADOR: Limoncocha, on Rio Napo, Napo Prov., 18 March 1974 (Boyce A. Drummond III, Malaise trap) (FSCA).

Description of male type.—Length 3.0 mm; fore wing 2.4 mm. Head and thorax black, abdomen dark brownish fuscous, shining; mandibles rufotestaceous; clypeus dull, dark ferruginous; basal $\frac{1}{4}$ of antenna testaceous, remainder dark brown; legs dark brown except tarsi testaceous and tibiae largely so; wings hyaline. Mandibles tridentate; clypeus trilobed, with a strong median carina which is nearly straight in profile. WH 1.03 × HE; WF 1.15 × HE, eyes diverging above; sides of head rounded behind eyes to a weakly arched vertex; OOL and WOT subequal. Front alutaceous, moderately shining, with an abundance of large but very shallow punctures; eyes strongly hairy. First 4 antennal segments in a ratio of 14:4:4:5, segment three 1.4× as long as wide. Pronotal disc with a strong anterior, transverse carina; propodeal disc wholly covered with coarse, foveolate sculpturing. Abdomen robust; 2nd tergum rising abruptly above the 1st, its median anterior face nearly vertical, slightly concave, bearing 2 very large, subcontiguous pits which are densely filled with very short setae; tergum 2 also with a pair of much smaller, somewhat pale depressions laterad of these larger pits (Fig. 1).

Paratypes.—ECUADOR: 122 ♂, same data as type except various dates, 28 December 1973–28 September 1974 (FSCA, USNM, MCZ). COLOMBIA: 1 ♂, Mun. Candelaria, Finca San Luis, 1010 m, Dept. Valle, 25–28 July 1975 (R. C. Wilkerson, Malaise trap, tropical dry forest) (FSCA).

Variation.—Length varies from 2.6 to 3.8 mm. In some males the basal antennal segments and outer parts of the legs are more brownish than in the type, but on the whole there is little variation in color or sculpture. The tergal pits of the Colombia specimen are slightly smaller than in any of the Ecuador males, but there is close agreement in all other features.

Dissomphalus obliquus Evans, NEW SPECIES

Type.—♂, COLOMBIA: Dept. Valle, Central de Anchicaya, 30 km E Buenaventura, 560 m, 10 June 1975 (R. Wilkerson, Malaise trap) (FSCA).

Description of male type.—Length 3.7 mm; fore wing 2.6 mm. Piceous;

←

Figs. 1–8. Basal two abdominal segments of *Dissomphalus* species, dorsolateral aspect. 1, *megomphalus*. 2, *obliquus*. 3, *bicavatus*. 4, *vallensis*. 5, *napo*. 6, *fungosus*. 7, *gilvipes*. 8, *hastatus*.

mandibles ferruginous on apical $\frac{1}{2}$; antennae rufotestaceous, slightly suffused with brown on apical $\frac{1}{2}$; coxae and femora brown, legs otherwise rufotestaceous; wings subhyaline. Mandibles bidentate; clypeus with a median carina which is straight in profile and at the end of which the clypeal margin is angulate; clypeal margin also with a pair of weak, rounded lobes laterad of the median angulation. WH and LH subequal; WF $1.27 \times$ HE, eyes diverging above; ocelli in a compact triangle, OOL $1.1 \times$ WOT; vertex weakly arched. Front strongly alutaceous, rather weakly shining, punctures numerous but small and inconspicuous. First 4 antennal segments in a ratio of 3:1:1:1, segment three $1.4 \times$ as long as wide. Pronotum short, without a transverse carina; propodeal disc coarsely sculptured except smooth and shining posteriorly, median carina strong, attaining the transverse carina. Second abdominal tergum with a pair of large, oblique depressions dorso-laterally, each depression with a series of close-set, short setae that are directly caudad (Fig. 2).

Paratype.—COLOMBIA: 1 ♂, same data as type except dated 14–16 July 1975 (FSCA).

Variation.—The paratype is slightly larger than the type (fore wing 2.8 mm) but is similar in every other respect.

Dissomphalus bicavatus Evans, NEW SPECIES

Type.—♂, VENEZUELA: Zulia, El Tucuco, 45 km SW Machiques, 5–6 June 1976 (A. Menke and D. Vincent) (USNM).

Description of male type.—Length 3.0 mm; fore wing 2.6 mm. Piceous; mandibles testaceous, tips rufous; antennae testaceous, much darkened on apical $\frac{1}{3}$; legs bright testaceous except front coxae and hind femora suffused with brown; wings hyaline. Mandibles bidentate; median clypeal carina arched in profile, apical margin angulate at end of carina, margin also with 2 rounded projections laterad of the median angulation. Head very slightly wider than high; WF $1.2 \times$ HE; ocelli in a compact triangle, OOL $1.2 \times$ WOT; vertex nearly straight. Front strongly alutaceous, weakly shining, with an abundance of very shallow punctures. First 4 antennal segments in a ratio of 15:5:4:5, segment 3 barely longer than wide. Pronotal disc short, without a transverse carina; propodeal disc coarsely reticulate except merely alutaceous posteriorly, median carina barely reaching transverse carina. Second abdominal tergum with deep, ovoid depressions anterolaterally, each with a circular, setigerous pit on its mesal margin, the depressions fringed with short setae (Fig. 3).

Paratypes.—VENEZUELA: 1 ♂, same data as type; 1 ♂, Aragua, 2 km N Ocumare de la Costa, 21–22 June 1976 (A. Menke and D. Vincent) (USNM).

Variation.—The male from Aragua is small, fore wing 1.9 mm, and is

paler in color than the Zulia males, the thorax and abdomen being castaneous, the head fuscous.

Dissomphalus vallensis Evans, NEW SPECIES

Type.—♂, COLOMBIA: Peñas Blancas, 10 km W Cali, Dept. Valle, 26–28 1975 (R. Wilkerson, Malaise trap) (FSCA).

Description of male type.—Length 3.8 mm; fore wing 3.1 mm. Head and thorax black, abdomen deep brown; apical ½ of mandibles ferruginous; scape testaceous, antennae otherwise dark brown; legs medium brown variegated with lighter brown, especially the tarsi; wings subhyaline. Mandibles tapered to an acute apex above which are 2 minute teeth; clypeus sharply angulate medially, at end of median carina, margin otherwise without projections. Head slightly wider than high: WF 1.4 × HE; vertex passing straight across a short distance above eye tops; ocelli in a compact triangle, OOL 1.4 × WOT. Front shining, rather weakly alutaceous, with weak, shallow, inconspicuous punctures. First 4 antennal segments in a ratio of 16:6:6:7, segment three 1.5× as long as wide. Pronotum of moderate length, without a transverse carina but somewhat coarsely sculptured at crest of anterior slope; median carina of propodeum not reaching transverse carina, posterior part of disc smooth and polished. Abdomen fusiform, slightly depressed, rather slender basally; 2nd tergum with a pair of small, setigerous pits rather close to the mid-dorsal line and located on the sides of a common, shallow, bowl-shaped depression (Fig. 4).

Paratypes.—COLOMBIA: 5 ♂, same data as type except dated 29 October 1974, 31 January 1975, 12–28 February 1975 (FSCA, USNM).

Variation.—The paratypes vary but slightly in size and standard measurements. Three specimens have the mandibles mostly ferruginous and the basal three antennal segments more or less testaceous.

Dissomphalus hastatus Evans, NEW SPECIES

Type.—♂, ECUADOR: Limoncocha, on Rio Napo, Napo Prov., 30 December 1973 (Boyce A. Drummond III, Malaise trap) (FSCA).

Description of male type.—Length 2.4 mm; fore wing 2.3 mm. Deep castaneous, head nearly black; mandibles and basal 2 antennal segments testaceous, remainder of antenna dark brown; femora medium brown, coxae slightly suffused with brown, legs otherwise testaceous; wings hyaline. Mandibles slender, acuminate, with 2 minute teeth on the inner margin a short distance back from the apex; clypeus with an acute median tooth at the apex of the median carina, margin laterad of the tooth somewhat sinuate. WH 0.95 × LH; WF 1.1 × HE, eyes weakly diverging above; head roundly narrowed a short distance behind eyes to a weakly convex vertex; OOL 1.2 × WOT, front angle of ocellar triangle less than a right angle. Front

somewhat alutaceous but moderately shining, punctures shallow and inconspicuous. First 4 antennal segments in a ratio of 11:4:4:4, segment 3 about $1.5 \times$ as long as wide. Pronotal disc without a transverse carina; propodeal disc with basal triangle depressed, alutaceous and with a median carina and a pair of additional, short carinae; disc smooth and polished behind, median carina not attaining the transverse carina. Abdomen slender basally, subpetiolate; 2nd tergum with a pair of shallow, bowl-shaped depressions close to the median line, separated by less than their own width; each depression gives rise to a small pencil of setae; there are no other pits or prominent setae on this tergum (Fig. 8).

Paratypes.—ECUADOR: 2 ♂, same data as type except dated 22 January 1974 (FSCA, USNM).

Variation.—The paratypes resemble the type closely in all respects. Leg color varies somewhat, one specimen having the legs almost entirely testaceous to straw colored.

Dissomphalus napo Evans, NEW SPECIES

Type.—♂, ECUADOR: Limoncocha, on Rio Napo, Napo Prov., 19 March 1974 (Boyce A. Drummond III, Malaise trap) (FSCA).

Description of male type.—Length 3.9 mm; fore wing 2.8 mm. Head and thorax black, abdomen deep castaneous; mandibles and clypeus dusky ferruginous; antennae light brown except much darkened on apical $\frac{1}{2}$; coxae and femora dark brown, legs otherwise testaceous; wings hyaline. Mandibles bidentate; clypeus trilobed, with a median carina which is nearly straight in profile. WH and LH subequal; WF $1.2 \times$ HE, eyes weakly diverging above; sides of head rounded behind eyes to a nearly straight vertex; OOL $1.25 \times$ WOT, ocelli in a compact triangle well below top of vertex. Front alutaceous, covered with large but shallow punctures which are separated for the most part by less than their own diameters; eyes with scattered, very short hairs only. First 4 antennal segments in a ratio of 14:5:4:5, segment 3 barely longer than wide. Pronotal disc without a transverse carina; propodeal disc wholly covered with coarse reticulations, slightly depressed in the basal triangle. Abdomen fusiform; 2nd tergum with a pair of widely spaced, circular depressions, rather small in size, each giving rise to a small cluster of setulae which are directed strongly caudad, this tergum also with a few very short lateral setae (Fig. 5).

Paratypes.—ECUADOR: 55 ♂, same data as type except dates 28 December 1973–1 May 1974 (FSCA, USNM, MCZ).

Variation.—The paratypes vary in length from 3.4 to 4.0 mm, but there is otherwise no variation worthy of note in this series.

Dissomphalus fungosus Evans, NEW SPECIES

Type.—♂, ECUADOR: Limoncocha, on Rio Napo, Napo Prov., 1 April 1974 (Boyce A. Drummond, Jr., Malaise trap) (FSCA).

Description of male type.—Length 3.0 mm; fore wing 2.8 mm. Head and thorax black, abdomen dark brown, shining; mandibles dull ferruginous; antennae testaceous basally, gradually infuscated over apical $\frac{2}{3}$; legs rufotestaceous except coxae and femora weakly suffused with brown; wings subhyaline. Mandibles quadridentate, with 3 minute teeth in a series above the large apical tooth; clypeus trilobed, median tooth acute and located at the end of a carina which is straight in profile. Head barely wider than high, with a broad, weakly arched vertex; WF $1.2 \times$ HE; OOL $1.35 \times$ WOT. Front strongly alutaceous, weakly shining, covered with strong punctures which are separated by about or somewhat less than their own diameters. First 4 antennal segments in a ratio of 15:5:4:5, segment 3 about $1.4 \times$ as long as wide. Pronotal disc short, with rather rough surface sculpturing but without a transverse carina; propodeal disc and posterior slope wholly covered with coarse reticulations. Second tergum with a pair of large, circular depressions dorsolaterally, each giving rise to a large group of closely matted setae (Fig. 6).

Paratypes.—ECUADOR: 3 ♂, same data as type except two collected 27 January and 13 February 1974 (FSCA, USNM).

Variation.—None worthy of note.

Dissomphalus gilvipes Evans, NEW SPECIES

Type.—♂, COLOMBIA: Dept. Valle, Central de Anchicaya, 30 km E Buenaventura, 560 m, 14–16 July 1975 (R. Wilkerson, Malaise trap) (FSCA).

Description of male type.—Length 2.6 mm; fore wing 2.0 mm. Head and thorax black, abdomen deep brown, shining; mandibles testaceous and scape largely of this color, but flagellum dark brown; legs entirely bright testaceous; wings subhyaline. Mandibles with an apical tooth above which are 3 small teeth; clypeus with a median apical angulation laterad of which are 2 small, rounded and slightly elevated processes; median clypeal carina weakly arched in profile basally, but somewhat depressed just before the apex. Head barely wider than high; WF $1.25 \times$ HE; vertex nearly straight; OOL $1.2 \times$ WOT. Front moderately shining, somewhat alutaceous, punctures minute and inconspicuous. First 4 antennal segments in a ratio of about 13:5:4:4, segment three $1.3 \times$ as long as wide. Pronotum without a transverse carina; propodeum with strong reticulations, median carina only faintly reaching transverse carina. Second tergum with a pair of widely spaced, small, bowl-shaped depressions, each giving rise to a pencil of setae that is directed caudad (Fig. 7).

Paratypes.—COLOMBIA: 2 ♂, same data as type (USNM, FSCA).

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THE TAXONOMIC POSITION OF THE NEW ZEALAND GENUS *PROSOCHAETA* MALLOCH (DIPTERA: SCIOMYZIDAE)¹

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Abstract.—The monotypic New Zealand genus *Prosochaeta* Malloch is redescribed incorporating morphological characters of the abdomens of the male and female. *Prosochaeta* is placed in a new tribe, **Prosochaetini**, and the definition of the subfamily *Huttonininae* Steyskal (Diptera: Sciomyzidae) is expanded to receive this tribe. The relationships of *Prosochaeta* and the other *Huttonininae* to other sciomyzid taxa are discussed.

The taxonomic position of the monotypic New Zealand genus *Prosochaeta* Malloch has never been satisfactorily determined. Malloch (1935) referred it to the Sciomyzidae. Harrison (1959) retained it in the Sciomyzidae and considered it to be most closely related to the New Zealand genus *Xenosciomyza* Tonnoir and Malloch. Steyskal (1965) did not include *Prosochaeta prima* Malloch in his subfamily classification of the Sciomyzidae because he was unable to examine sufficient material. Griffiths (1972) removed *Prosochaeta* from the Sciomyzidae and referred it to his new family Helosciomyzidae along with *Huttonina* Tonnoir and Malloch, *Helosciomyza* Hendel, *Xenosciomyza*, and *Polytocus* Lamb. I have examined male and female specimens of *Prosochaeta prima*, and I believe that the following revised generic definition lists the attributes that are most important for characterizing the genus and for determining its taxonomic position.

The following abbreviations are used for institutions holding specimens: AIM = Auckland Institute and Museum, Auckland, New Zealand; ATI = Abteilung Taxonomie der Insekten, Institut für Pflanzenschutzforschung, Eberswalde, German Democratic Republic; CU = Cornell University, Ithaca, New York, U.S.A.; FRI = Forest Research Institute, Rotorua, New

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Zealand; MAF = Ministry of Agriculture and Fisheries, Levin, New Zealand; NZNAC = National Arthropod Collection, Department of Scientific and Industrial Research, Auckland, New Zealand; NZNM = National Museum, Wellington, New Zealand.

Prosochaeta Malloch

Prosochaeta Malloch, 1935:95 [type-species: *Prosochaeta prima* Malloch, by monotypy]; Harrison, 1959:37.

Arista pubescent, arising near apex of 3rd antennal segment. Antenna short. Lunule largely concealed. Three fronto-orbital bristles present; 2 anterior bristles somewhat proclinate; posterior bristle somewhat reclinate. Ocellar bristles weak. Postvertical bristles short and parallel to slightly convergent. Face concave. Oral vibrissae absent. Clypeus visible in profile when proboscis withdrawn, not separated from epistoma by large membranous area.

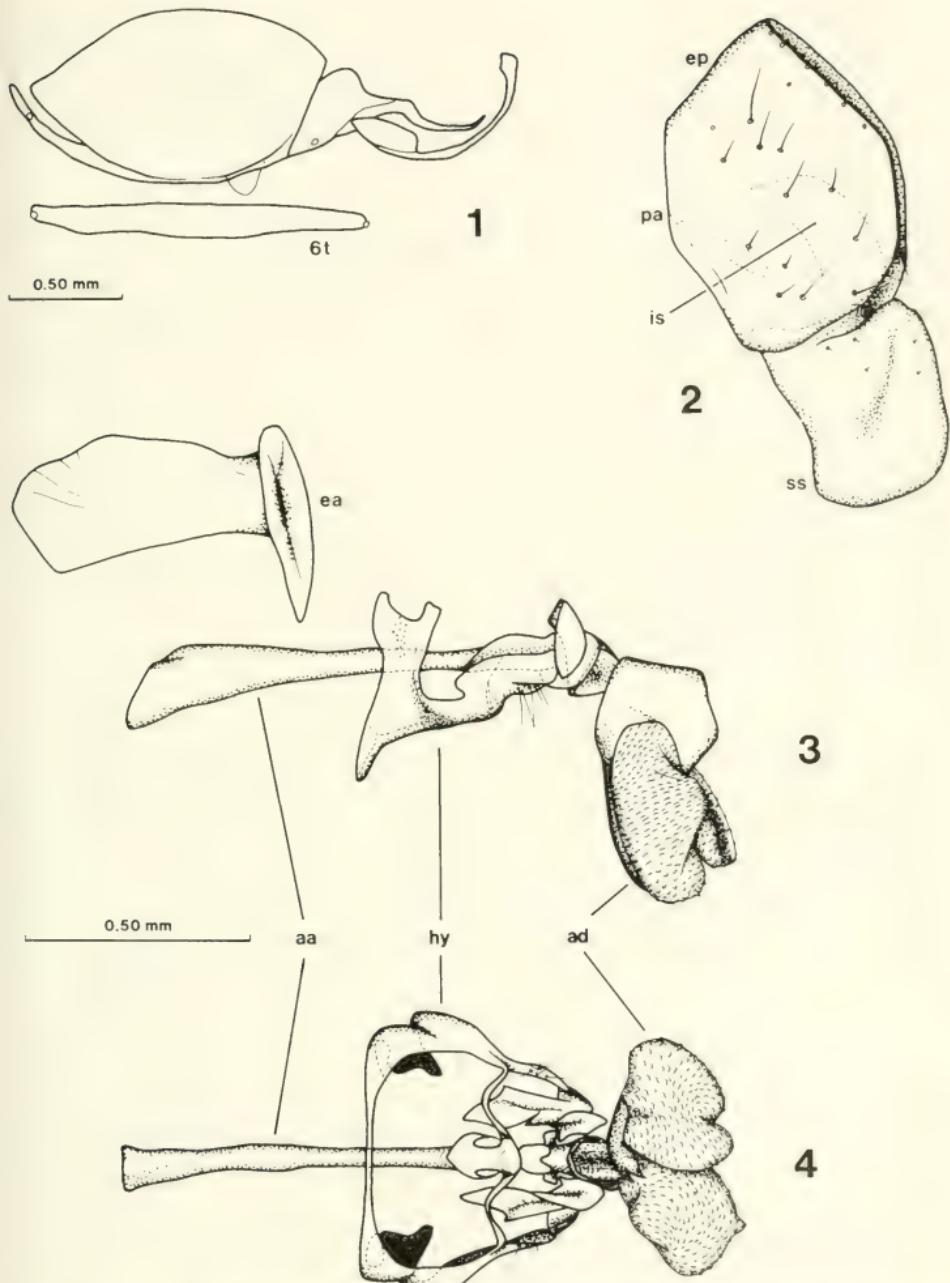
Mesonotum setulose, with 1 humeral, 2 notopleural, 1 supra-alar, 2 postalar, 1 dorsocentral bristle; presutural bristles absent. Scutellum with 1 lateral and 1 apical bristle, otherwise bare. Propleural bristle well developed. Mesopleuron with scattered, fine setae posteriorly. Pteropleuron and hypopleuron bare. Sternopleural bristles present. Prosternum bare, free from propleuron.

Costa and subcosta complete. Costa without rows of strong spines. Anal [basal cubital] cell with acute dorso-apical angle and distinctly obtuse ventro-apical angle [see Malloch (1935, Fig. 2) and Harrison (1959, Fig. 43) for wing venation]. Anal vein abruptly terminated about three-quarters distance to wing margin. Femora simple, without strong bristles or spines. Tibiae simple, with pre-apical dorsal bristles.

Suture between 1st and 2nd abdominal segments indistinct.

Male.—Abdominal spiracles 2 to 5 situated within respective tergites, at lateral margins. Postabdomen asymmetrical. Protandrium as in Fig. 1. Sixth tergite nearly symmetrical, narrow, about $\frac{1}{4}$ length of 5th tergite, not fused to protandrium. Vestige of 7th tergite represented by a narrow band fused to anterior end of 8th sternite [dorsal sclerite of 8th segment; see Griffiths (1972:51)]. Vestige of 8th tergite absent. Sixth sternite narrow, best developed on left side where it is closely approximated to 7th sternite. Seventh sternite narrow, best developed on left side where it is fused to 8th sternite. Sixth spiracles at lateral margins of 6th tergite. Seventh right spiracle situated within 7th tergite; 7th left spiracle situated within 7th sternite; left spiracle displaced dorsally and right spiracle displaced ventrally with respect to corresponding 6th-segment spiracles. [Hennig (1958, Fig. 125) incorrectly showed the 6th and 7th right spiracles completely within the membrane.]

Andrium and proctiger as in Fig. 2. Epandrium bearing 1 pair of discrete, movable surstyli with sparse, fine setae on inner and outer surfaces. Internal



Figs. 1-4. *Prosochaeta prima*, male. 1, Protandrium, dorsal view, drawn as if split ventrally and laid flat. 2, Andrium and proctiger, lateral view. 3-4, Hypandrium, aedeagus, and associated structures, lateral and anteroventral view, respectively. Figures 2, 3, and 4 same scale. Abbreviations: aa, aedeagal apodeme; ad, aedeagus; ea, ejaculatory apodeme; ep, epandrium; hy, hypandrium; is, internal sclerotized plate; pa, point of attachment between hypandrium and epandrium; ss, surstylos; 6t, 6th tergite.

sclerotized plate [interparameral sclerotization; Griffiths (1972:35)] present, extending from bases of surstyli and posteroventral edge of epandrium over inner copulatory apparatus and linked with hypandrium on left and right sides. Cerci scarcely differentiated; a few fine setae present on posteroventral edge of epandrium between surstyli.

Hypandrium, aedeagus, and associated structures as in Figs. 3 and 4. Hypandrium nearly symmetrical, with a few fine setae posteroventrally. Ejaculatory apodeme large, flattened, fan-shaped anteriorly. Aedeagal apodeme long, rodlike, linked to hypandrium by 2 long, narrow arms extending between posterior end of aedeagal apodeme and inside ventral margins of hypandrium. Aedeagus large, asymmetrical, bilobed, mainly membranous, densely covered with fine scale-like structures, able to be swung through wide arc against aedeagal apodeme to anteriorly directed rest position.

Female.—Abdominal spiracles 2 and 3 in respective tergites, at lateral margins. Abdomen posterior to segment 3 as in Figs. 5 and 6. Fourth and 5th terga membranous; 4th and 5th spiracles displaced dorsally. Sixth and 7th tergites and sternites fused to form 2 completely annular somites; 6th and 7th spiracles well within respective sclerites. Two spermathecal ducts present, each with 2 apical spermathecae, as in Fig. 7.

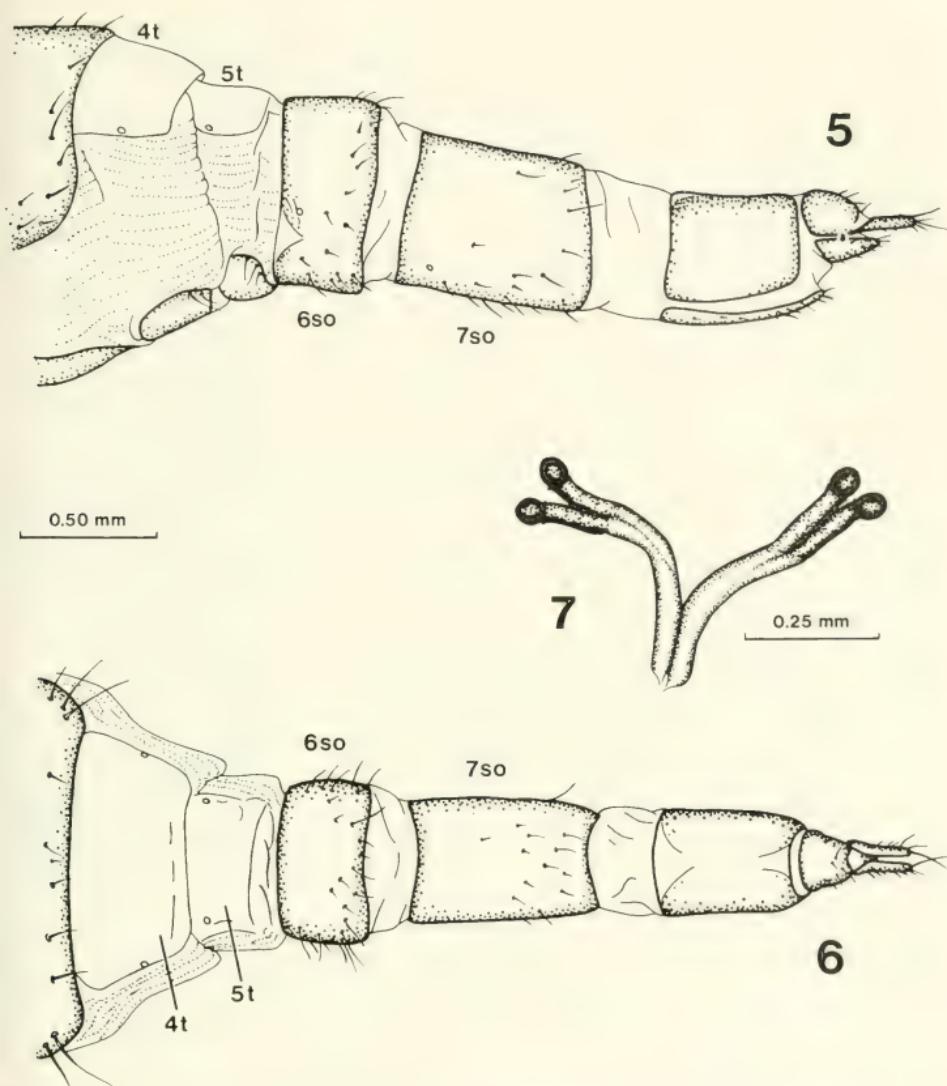
Immature stages.—Unknown.

Prosochaeta prima Malloch

Prosochaeta prima Malloch, 1935:95–96, plate XIV, figs. 1–2 [holotype: Auckland, New Zealand; Abteilung Taxonomie der Insekten, Institut für Pflanzenschutzforschung, Eberswalde, German Democratic Republic]; Harrison, 1959:37, 39, figs. 43, 46, 47, 52.

I have not attempted to redescribe the species because this would only duplicate the accurate descriptions given by Malloch (1935) and Harrison (1959). The holotype and other specimens agree well with these descriptions.

Specimens examined.—*North Island*. Auckland, ♂, holotype, coll. Oldenberg, coll. Osten Sacken, ATI. Titirangi; 27.xii.1942, ♀; -iv.1947, ♀; M. W. Carter, NZNAC. Huia, in house, 8.i.1967; ♂, CU; ♀, NZNAC; B. M. May. Kaimanawa North State Forest 90, 10.i.-, ♀, Anon., FRI. Ohakune, ♀, J. W. Campbell, CU. Between Kakatahi and Ohakune, in car, 20.i.1974, ♀, L. G. Morrison, MAF. Kaitawa, 19.xii.1922, sex unknown, Ethel Richardson, NZNM. *South Island*. Nelson, Belton, 20.xii.1940, ♀, E. S. Gourlay, CU. Mt. Arthur, Gordon's Pk., 2.iii.1927, ♀, A. Philpott, NZNAC. Nelson Lakes National Park, L. Rotoiti, Kerr Bay Motor Camp, 9.iii.1977, ♀, J. K. Barnes, CU. Greymouth; ♂, coll. Lichtwardt, ATI; sex unknown, coll. Osten Sacken, coll. Oldenberg, ATI. Christchurch, Dyer's Pass, 29.i.1924, ♀, Anon., AIM. Otago, ♀, coll. Lichtwardt, ATI. No data; ♂, coll. Miller, NZNAC; ♀, coll. Oldenberg, coll. Osten Sacken, ATI.



Figs. 5-7. *Prosochaeta prima*, female. 5-6. Abdomen posterior to segment 3, lateral and dorsal view, respectively. 7. Spermathecae and ducts. Figures 5 and 6 same scale. Abbreviations: 4t, 4th tergum; 5t, 5th tergum; 6so, 6th somite; 7so, 7th somite.

The female that I collected was taken from a marshy area of *Sphagnum* and *Carex* surrounded by *Nothofagus* forest by beating the vegetation with an insect net.

THE TAXONOMIC POSITION OF *PROSOCHAETA*

A summary of the distribution of some characters of the five subfamilies of Sciomyzidae (*sensu* Steyskal) and *Prosochaeta* is presented in Table 1.

Characters

| | Prosochaeta | Huttonininae | Helosciomyzinae | Phaeomyzinae | Salticellinae | Sciomyzinae |
|--|-------------|--------------|-----------------|--------------|---------------|-------------|
| 1. Arista preapical (+); not preapical (-) | ■ | ■ | ■ | ■ | ■ | ■ |
| 2. Clypeus small (+); large (-) | ■ | ■ | ■ | ■ | ■ | ■ |
| 3. Postverticals parallel or convergent (+); divergent (-) | ■ | ■ | ■ | ■ | ■ | ■ |
| 4. Propleural bristle absent (+); present (-) | ■ | ■ | ■ | ■ | ■ | ■ |
| 5. Costa spinose (+); not spinose (-) | ■ | ■ | ■ | ■ | ■ | ■ |
| 6. Ventroapical angle anal cell distinctly obtuse (+); otherwise; | ■ | ■ | ■ | ■ | ■ | ■ |
| 7. Anal vein abbreviated (+); complete (-) | ■ | ■ | ■ | ■ | ■ | ■ |
| 8. Suture on abdominal tergites 1 + 2 indistinct (+); distinct (-) | ■ | ■ | ■ | ■ | ■ | ■ |
| 9. Abdominal spiracles 2-5 in tergites (+); in membrane (-) | ■ | ■ | ■ | ■ | ■ | ■ |
| 10. ♂ 6th tergite fused to protandrium (+); free (-) | ■ | ■ | ■ | ■ | ■ | ■ |
| 11. ♂ 7th left spiracle in 7th sternite (+); in membrane (-) | ■ | ■ | ■ | ■ | ■ | ■ |
| 12. Anteroventral corner epandrium extended (+); not extended (-) | ■ | ■ | ■ | ■ | ■ | ■ |
| 13. Surstyli fused to epandrium (+); free (-) | ■ | ■ | ■ | ■ | ■ | ■ |
| 14. Aedeagus bilobed, membranous, scaled (+); otherwise (-) | ■ | ■ | ■ | ■ | ■ | ■ |
| 15. ♀ 4th and 5th terga membranous, (+); sclerotized (-) | ■ | ■ | ■ | ■ | ■ | ■ |
| 16. ♀ 6th abdominal tergite and sternite fused (+); separate (-) | ■ | ■ | ■ | ■ | ■ | ■ |
| 17. ♀ 7th abdominal tergite and sternite fused (+); separate (-) | ■ | ■ | ■ | ■ | ■ | ■ |
| 18. ♀ 6th abdominal spiracle in sclerite (+); in membrane (-) | ■ | ■ | ■ | ■ | ■ | ■ |
| 19. ♀ 7th abdominal spiracle in sclerite (+); in membrane (-) | ■ | ■ | ■ | ■ | ■ | ■ |
| 20. Number of spermathecae | 4 | 3 | 3 | 3 | 4 | 2 |

■ = +

□ = -

■ = Character found in some, but not all, species

Table 1. Distribution of some characters in *Prosochaeta* and the subfamilies of Sciomyzidae *sensu* Steyskal.

The black rectangles indicate characters that are interpreted as apomorphous groundplan conditions of the given taxon. Plesiomorphous groundplan conditions are indicated by white rectangles. If an apomorphous character is present in some, but not all, members of a taxon, and it therefore may or may not be interpreted as an apomorphous groundplan condition, it is indicated by a cross-hatched rectangle.

Prosochaeta shares more apomorphous groundplan characters with the monotypic New Zealand subfamily Huttonininae than it does with any other subfamily of the Sciomyzidae. The following characters, interpreted as apomorphous with respect to the groundplan of the Sciomyzoidea and Scio-

myzidae, are apparently sufficient to establish the taxon consisting of the genera *Prosochaeta* and *Huttonina* as a monophyletic group:

- (1) Postvertical bristles short and parallel or slightly convergent;

Steyskal (1965) characterized the Helosciomyzinae as also having parallel or slightly convergent postverticals. My observations of the New Zealand species of *Helosciomyza*, *Xenosciomyza*, and *Polytocus* indicate that the trend toward convergence is poorly defined. Indeed, I believe the Helosciomyzinae should be characterized as having postverticals parallel to slightly divergent. The postverticals are also long and well developed in the Helosciomyzinae. It is unlikely that the condition of the postverticals in *Prosochaeta*, *Huttonina*, and the Helosciomyzinae can be attributed to synapomorphy.

- (2) Anal [basal cubital] cell enclosed by a curved cross vein forming an acute dorso-apical angle and a distinctly obtuse ventro-apical angle (see Tonnoir and Malloch, 1928, Fig. 27; Malloch, 1935, Fig. 2; Harrison, 1959, Figs. 43, 58-64);
- (3) Anal vein abruptly terminated about three-quarters distance to wing margin;

The anal vein is also abbreviated in *Colobaea* Zetterstedt, *Parectinocera* Becker, and a few species of *Pherbellia* Robineau-Desvoidy (Sciomyzinae: Sciomyzini), but it is unlikely that this is due to synapomorphy with *Prosochaeta* and *Huttonina* because most members of the Sciomyzini have the more plesiomorphous condition of a complete anal vein.

- (4) Suture between 1st and 2nd abdominal segments indistinct;

Among the families of Sciomyzoidea this character is also found in the Dryomyzidae and Sepsidae, according to McAlpine (1963, Table 1).

- (5) Aedeagus bilobed, mainly membranous, covered with fine scale-like structures;

Griffiths (1972) used the presence of a bilobed aedeagus to support placement of *Prosochaeta* and *Huttonina* in his family Helosciomyzidae, along with *Helosciomyza*, *Xenosciomyza*, and *Polytocus*. I have examined the aedeagi of all New Zealand species of the latter three genera. In most species they cannot be characterized as bilobed, they are not membranous, and they are not covered with fine scale-like structures.

- (6) Female with 7th abdominal tergite and sternite fused to form a completely annular somite; 7th abdominal spiracle well within the sclerotization of this somite.

A character that is interpreted as plesiomorphous with respect to the groundplan conditions of the Sciomyzoidea and Sciomyzidae and occurs in one or both of the genera *Prosochaeta* and *Huttonina* is considered a ple-

siomorphous groundplan condition of the taxon consisting of *Prosochaeta* and *Huttonina*. Among these are the following: Arista not pre-apical, clypeus not reduced, propleural bristle present (but much reduced in *Huttonina*), costa not spinose, abdominal spiracles 2 to 5 in membrane, male with 6th tergite free, anteroventral corner of epandrium not extended, surstyli unilobate and movable, female with 4th and 5th terga not membranous, female with 6th tergite and sternite separate, female with 6th abdominal spiracles in membrane, spermathecae 2+1.

Prosochaeta also possesses several apomorphic characters that are not interpreted as groundplan conditions for any family of Sciomyzoidea nor, in most cases, for any previously characterized subfamily of the Sciomyzidae, including the Huttonininae:

- (1) Arista pre-apical;

Tetanura Fallén (Sciomyzinae: Sciomyzini) also has a pre-apical arista, but this condition cannot be interpreted as a synapomorphy.

- (2) Female with 4th and 5th terga membranous, and corresponding spiracles displaced dorsally;
- (3) Female with 6th tergite and sternite fused, forming completely annular 6th somite;
- (4) Spermathecae 2+2.

Two apical spermathecae on each of two spermathecal ducts can also be found in *Salticella fasciata* (Meigen) (Salticellinae). It is unlikely that this can be interpreted as a synapomorphous condition of *Prosochaeta* and *Salticella* Robineau-Desvoidy because there is little other evidence to indicate that these genera are monophyletic. The four spermathecae of *Prosochaeta* probably arose from the condition of three spermathecae as found in *Huttonina* and in the presumed groundplan of the Schizophora (Hennig, 1958), whereas the four spermathecae of *Salticella* may have arisen from either the two-spermathecal condition of the groundplan of the Sciomyzinae or from the more plesiomorphous three-spermathecal condition (Hennig, 1965).

It is apparent from the above discussion that *Huttonina* may be regarded as the sister-genus of *Prosochaeta*. However, these two genera differ in several important features, and they should be referred to different higher taxa of at least tribal rank. On the other hand, assigning them to separate subfamilies of the Sciomyzidae may only serve to confuse further the taxonomic relationships within a family whose higher taxonomy is not yet well understood. I have therefore chosen to expand the definition of the subfamily Huttonininae to include *Prosochaeta* and to describe a new tribe to receive this genus.

Huttonininae Steyskal

Huttonininae Steyskal, 1965:593 [type-genus: *Huttonina* Tonnoir and Malloch, by monotypy].

Arista pubescent and sometimes arising near apex of 3rd antennal segment. Antenna short. Lunule largely concealed. Two or 3 fronto-orbital bristles present. Ocellar bristles weak. Postvertical bristles weak and parallel to slightly convergent. Face concave. Oral vibrissae absent. Clypeus well developed, not separated from epistoma by large membranous area, visible in profile when proboscis withdrawn.

Mesonotum setulose. Presutural bristles and presutural dorsocentral bristles present or absent; 1 or more postsutural dorsocentrals present; prescutellar acrostichal bristles absent; 1 humeral, 2 notopleural, 1 supra-alar, 2 postalar bristles present. Scutellum with 1 lateral and 1 apical bristle, otherwise bare or setulose. Propleural bristle well developed or minute. Mesopleuron setulose. Pteropleuron and hypopleuron bare. Sternopleuron with 1, 2, or 3 strong bristles. Metastigmatal bristles absent. Prosternum bare, free from propleuron.

Wings hyaline or with brown pattern. Costa and subcosta complete; costa without rows of strong spines. Anal [basal cubital] cell enclosed by curved cross vein forming acute dorso-apical angle and distinctly obtuse ventro-apical angle. Anal vein abruptly terminated about three-quarters distance to wing margin. Femora simple, without strong bristles or spines. Tibiae simple, with pre-apical dorsal bristles.

Suture between 1st and 2nd abdominal segments indistinct. Abdominal spiracles 2 to 5 situated within membrane or within respective tergites, at lateral margins.

Male.—Postabdomen asymmetrical. Sixth tergite narrow, free or fused to protandrium. Vestige of 7th tergite present or absent. Vestige of 8th tergite absent. Sixth and 7th sternites narrow, better developed on left side. Seventh sternite fused to 8th sternite on left side. Sixth spiracles situated within membrane, within sclerotization of protandrium, or at lateral margins of 6th tergite. Seventh left spiracle situated within 7th sternite, displaced dorsally with respect to 6th left spiracle. Seventh right spiracle situated within sclerotization of protandrium, displaced ventrally with respect to 6th right spiracle. Epandrium bearing 1 pair simple, lobulate surstyli, movable or fused to epandrium. Internal sclerotized plate [interparameral sclerotization; Griffiths (1972:35)] present, extending from bases of surstyli and posteroventral edge of epandrium over inner copulatory apparatus and linking with hypandrium on left and right sides. Cerci small. Hypandrium nearly symmetrical, with a few fine setae posteroventrally. Aedeagal apodeme long, rodlike, linked to hypandrium by 2 long, narrow arms extending between posterior

end of aedeagal apodeme and inside ventral margins of hypandrium. Aedeagus asymmetrical, bilobed, mainly membranous, covered with fine scale-like structures, able to be swung through wide arc against aedeagal apodeme to anteriorly directed rest position.

Female.—Fourth and 5th terga membranous or sclerotized. Seventh tergite and sternite fused to form completely annular 7th somite; 6th tergite and sternite fused or separate; 6th and 7th spiracles situated within sclerotization of annular somite or in membrane. Spermathecae 2+1 or 2+2.

Immature stages.—Unknown.

KEY TO THE TRIBES OF HUTTONININAE

- Arista not pre-apical. Propleural bristle not well developed. Abdominal spiracles 2 to 5 in membrane. Male 6th tergite fused to protandrium; surstyli not movable, fused to epandrium or delimited only by a partial suture. Female 4th and 5th terga sclerotized; 6th abdominal tergite and sternite separate; spermathecae 2+1 Tribe Huttoninini Steyskal
- Arista pre-apical. Propleural bristle well developed. Abdominal spiracles 2 to 5 in respective tergites, at lateral margins. Male 6th tergite not fused to protandrium; surstyli movable, not fused to epandrium. Female 4th and 5th terga membranous; 6th abdominal tergite and sternite fused, forming completely annular somite. Spermathecae 2+2 Tribe Prosochaetini, new tribe

THE TAXONOMIC POSITION OF THE HUTTONININAE

Tonnoir and Malloch (1928) considered *Huttonina* to be an "aberrant genus" and only tentatively referred it to the family Sciomyzidae. Harrison (1959) considered the genus to be intermediate between the Sapromyzidae (=Lauxaniidae) and the Sciomyzidae. He apparently based this conclusion upon the fact that *Huttonina* possesses an abbreviated anal vein and parallel or slightly convergent postvertical bristles. However, an abbreviated anal vein and convergent postvertical bristles occur in many and diverse groups of cyclorrhaphous Diptera. There is little evidence to indicate that the occurrence of these characters in *Huttonina* and in the Lauxaniidae is due to synapomorphy.

Furthermore, Harrison stated that "the male genitalia are not particularly modified and are comparable to the normal genitalia of both the Sciomyzidae and Sapromyzidae." In the Lauxaniidae, however, the males possess repeatedly branched accessory glands, a character that is apparently peculiar to this family (Sturtevant, 1926; Griffiths, 1972). I examined the male accessory glands in *Huttonina scutellaris* Tonnoir and Malloch and found them to be simple and unbranched. Griffiths (1972) presented evidence that

indicates that the male postabdomen of *Huttonina* approaches more closely that found in the Sciomyzidae than that of the Lauxaniidae. Indeed, he does not believe that the Sciomyzoinea (=Sciomyzoidea + Cremifaniidae + Megamerinidae) and Lauxanioidea are monophyletic. The arrangement of the postabdominal sclerites and the structure of the aedeagus are fundamentally different in the two groups.

Hennig (1965) supported the view that *Huttonina* is more closely related to the Sciomyzidae than to the Lauxaniidae. He suggested that the fusion of the sixth tergite to the protandrium may be a synapomorphous condition of the Huttonininae and Sciomyzinae. It is now apparent, however, that this condition cannot be ascribed to the groundplan of either subfamily because there are members of both subfamilies in which the sixth tergite of the male is found in its plesiomorphous, "free" state (*Prosochaeta prima* among the Huttonininae; *Pteromicra* spp. and *Pherbellia albocostata* (Fallén) among the Sciomyzinae). This character, therefore, cannot be used to support the contention that the Huttonininae and Sciomyzinae constitute a monophyletic taxon.

Griffiths (1972) removed *Huttonina* and *Prosochaeta* from the Sciomyzidae and referred them to his family Helosciomyzidae along with the Helosciomyzinae (*Helosciomyza*, *Xenosciomyza*, and *Polytocus*). He supported his decision by stating that the Helosciomyzidae are characterized in their groundplan by five conditions that are apomorphous with respect to the groundplans of the Sciomyzoinea and Muscoidea: (1) postvertical bristles parallel to slightly convergent; (2) male 6th tergite reduced, less than one-third length of 5th tergite; (3) vestiges of male 7th and 8th tergites lost and 7th right spiracle lying at margin of 8th sternite; (4) male 7th left spiracle lying within 7th sternite; and (5) aedeagus bilobed distally. I have already pointed out that conditions (1) and (5) are of doubtful value for supporting the view that the Helosciomyzidae are a monophyletic group. Condition (3) cannot be considered a groundplan condition for the Helosciomyzidae or the Huttonininae because the seventh tergite of the male is retained in *Prosochaeta*, and the seventh right spiracle lies within this tergite (Fig. 1). Condition (2) also occurs in other families of Sciomyzoidea; on its own it does not support the argument that the Helosciomyzidae are a monophyletic group. Only condition (4) seems to support the argument for monophyly. Among the other Sciomyzoidea the same condition is found only in the Phaeomyiinae (=Phaeomyiidae *sensu* Griffiths). The taxonomic position of the Huttonininae remains uncertain.

The Sciomyzoidea have never been satisfactorily characterized as a monophyletic group on the basis of apomorphous conditions. The group is maintained primarily as a taxonomic convenience because there is no evidence that the included taxa are more closely related to taxa outside the

Sciomyzoidea. The same can be said of the Sciomyzidae *sensu* Steyskal. Although the taxon consisting of the Sciomyzinae and Salticellinae (=Sciomyzidae *sensu* Griffiths) appears to be well characterized as a monophyletic group (Knutson et al., 1970; Griffiths, 1972), the placement and relationships of the Huttonininae, Helosciomyzinae and Phaeomyiinae remain uncertain. Knutson et al. (1970) expressed the opinion that the group consisting of the Sciomyzinae, Salticellinae, and Phaeomyiinae is monophyletic. The fact that in these subfamilies the clypeus is separated from the epistoma by a large membranous area and is not visible in profile when the proboscis is withdrawn may support their opinion. The Helosciomyzinae are the only sciomyzids with rows of large costal spines and an anteroventral extension of the epandrium (lacking in some species of *Helosciomyza* and in *Xenosciomyza prima* Tonnoir and Malloch). These apomorphic characters may indicate affinities with other families of Sciomyzoidea that also show one or both of the characters, but further investigation is required. It may be of interest that the suture between the first and second abdominal segments is indistinct in the Huttonininae. Elsewhere in the Sciomyzoidea this condition is known only in the Dryomyzidae and Sepsidae (McAlpine, 1963).

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STUDIES OF THE GYPONINAE WITH SIX NEW SPECIES OF
POLANA (HOMOPTERA: CICADELLIDAE)

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Abstract.—Six new species of *Polana* are described. Four new species, **helvola**, **sana**, **melalbida**, and **melella** are placed in the subgenus *Polanana*. One new species, **putara**, is placed in *Bohemannella*; and one new species, **solida**, is placed in *Polanella*.

The genus *Polana* was described by DeLong (1942). A synopsis of *Polana* treating 87 species was published by DeLong and Freytag (1972). Six new species are described in this paper.

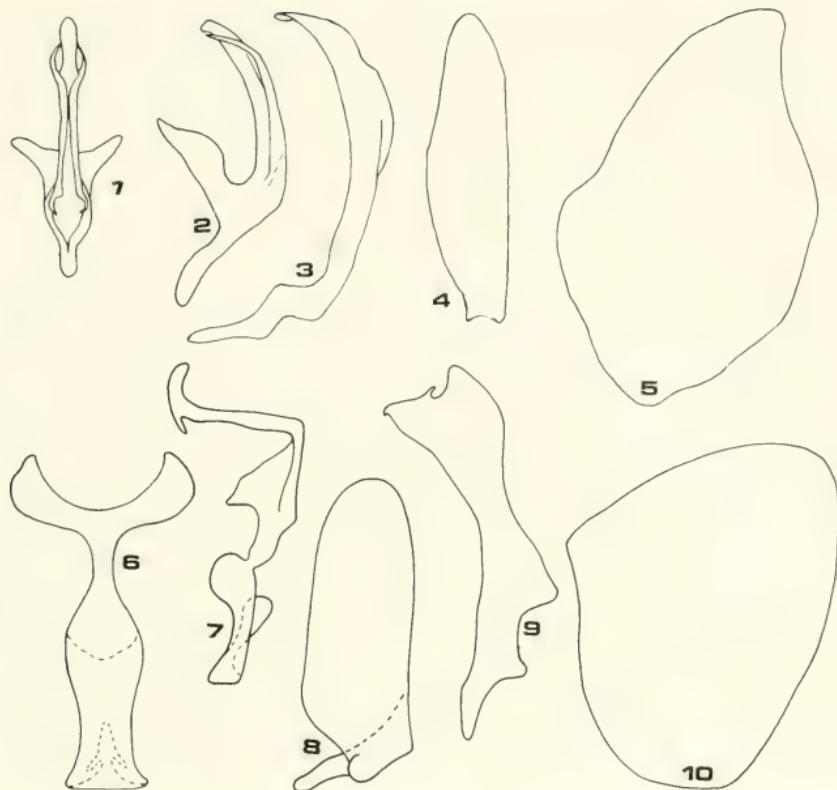
Polana putara DeLong, NEW SPECIES
Figs. 21-25

Length of male 7.5 mm, female unknown. Crown broadly rounded, more than $2\times$ as wide at base between eyes as median length. Ocelli about equidistant between eyes and median line. Conspicuous striae on and just above margin. Color, crown pronotum and scutellum pale brown, irregularly tinged with dark brown. Forewings dark brown with 2 black elongate spots on 1st and 2nd claval veins at commissure.

Male genitalia with plates $2\frac{1}{2}\times$ as long as median width, apex rounded. Style with blade convexly curved on ventral margin, apical tip spinelike extending dorsally. Aedeagal shaft in ventral view appearing narrow, parameres a little broader, each side; in lateral view the aedeagal shaft is long and slender, curving ventrally. Parameres curve dorsally with a constriction just before transversely broadened apex, rounded on apical margin and sharp pointed dorsally and ventrally. The parameres are two-thirds as long as shaft and reach to apex of shaft. Pygofer tapering to bluntly pointed apex.

Holotype ♂, Bolivia, Dept. Beni, Rio Manore at mouth of Rio Ibare, VIII-18-20, 1965. J. K. Bouseman coll., in the American Museum of Natural History.

Polana putara is placed in the subgenus *Bohemannella* and is nearest *chifama*.



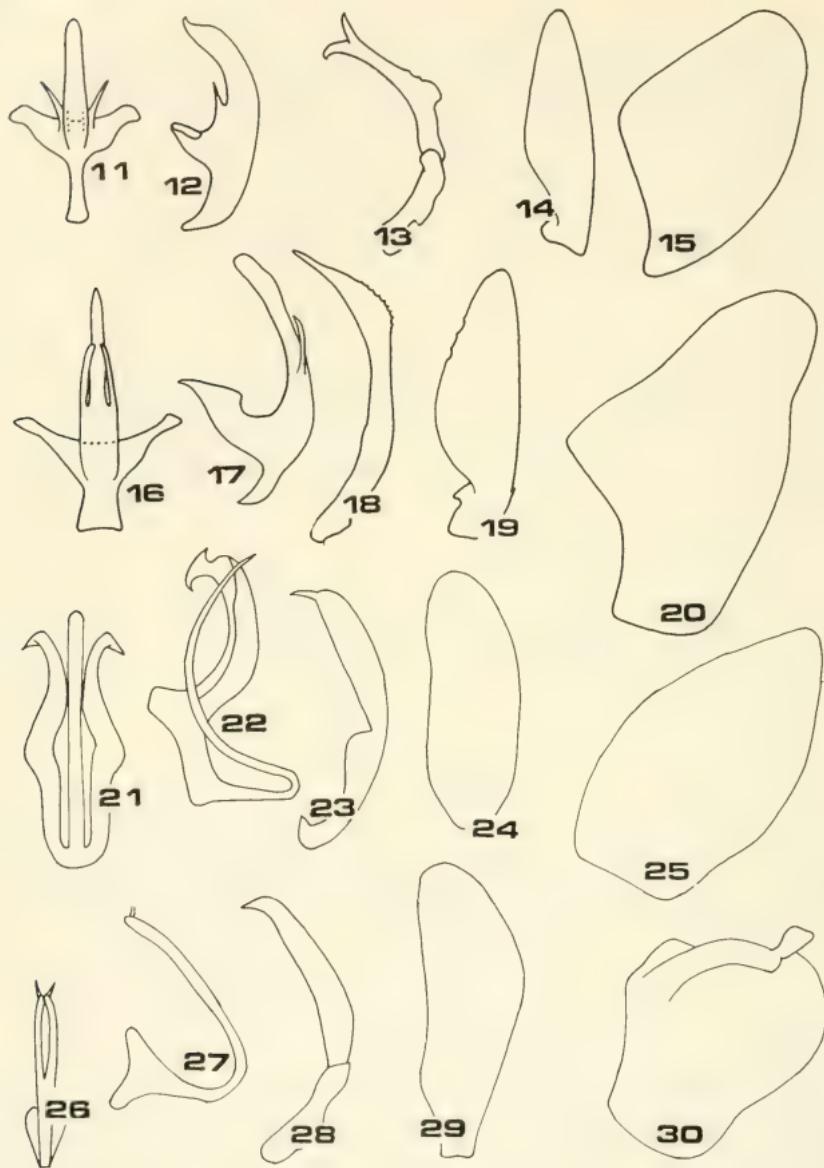
Figs. 1-5. *Polana helvola*. 1, Aedeagus ventrally. 2, Aedeagus laterally. 3, Style laterally. 4, Plate ventrally. 5, Pygofer laterally. Figs. 6-10. *P. sana*. 6, Aedeagus ventrally. 7, Aedeagus laterally. 8, Plate ventrally. 9, Style laterally. 10, Pygofer laterally.

Polana sana DeLong, NEW SPECIES

Figs. 6-10

Length of male 8.5 mm, female unknown. Crown broadly rounded, not quite $\frac{1}{2}$ as long at middle as basal width between eyes; ocelli about equidistant between eyes and median line. Color brown, scutellum with basal angles darker brown. Forewings brown, subhyaline, claval vein reddish brown: Veins anterior to claval vein dark brown, cross veins on disc dark brown, apex smoky.

Male genitalia with plates more than $2\times$ as long as median width, apices rounded. Style with blade broad, narrowed at middle, apical $\frac{1}{3}$ broad almost truncate, a small rounded notch near middle of apex. Aedeagal shaft in ventral view vaselike, forming a narrow "neck" at two-thirds its length then with two "arms" extending laterally, between which the central apical



Figs. 11-15. *Polana melalbida*. 11, Aedeagus ventrally. 12, Aedeagus laterally. 13, Style laterally. 14, Plate ventrally. 15, Pygofer laterally. Figs. 16-20. *P. melella*. 16, Aedeagus ventrally. 17, Aedeagus laterally. 18, Style ventrally. 19, Plate laterally. 20, Pygofer laterally. Figs. 21-25. *P. putara*. 21, Aedeagus ventrally. 22, Aedeagus laterally. 23, Style laterally. 24, Plate ventrally. 25, Pygofer laterally. Figs. 26-30. *P. solida*. 26, Aedeagus ventrally. 27, Aedeagus laterally. 28, Style laterally. 29, Plate ventrally. 30, Pygofer laterally.

portion is broadly concave. In lateral view the shaft appears long and narrow with an inverted "foot" apically. Pygofer broadly rounded apically.

Holotype ♂, Tingo Maria, Peru, VIII-12-1960. D. A. Young coll. in the North Carolina University Collection.

Polana sana is placed in the subgenus *Polanana* and is nearest to *quadrilabes*.

Polana melalbida DeLong, NEW SPECIES

Figs. 11-15

Length of male 7.5 mm, female unknown. Crown broadly rounded, almost parallel margined, two-thirds as long at middle as basal width between eyes; ocelli much closer to proximal eye than median line. Head rounded to front, clypeus inflated. Color, face white tinged with yellow, crown pale yellow. Pronotum pale yellow with a smoky area behind each eye and a round black spot behind each eye at one-third length of pronotum. Scutellum yellow, a small black spot in each basal angle. Forewing white with numerous brown irregular spots; a large spot on anterior portion of disc, a small round spot on clavus each side near apex of scutellum and a spot about middle of clavus near commissure; a series of small spots are on anterior side of claval vein.

Male genitalia with plates almost $3\times$ as long as median width. Style with blade enlarged on ventral margin at more than one-third its length, apex bifid, each portion bluntly pointed. Aedeagal shaft short, $6\times$ as long as broad, a long spine, one-third length of shaft, arising each side at base of shaft. In lateral view the shaft appears bluntly pointed at apex. Pygofer narrowed, broadly rounded apically.

Holotype ♂, Sante Fe, Darien Prov., Panama, V-29-67, DeLong and Triplehorn colls., in the DeLong Collection, the Ohio State University.

Polana melalbida is placed in the subgenus *Polanana* and is nearest *quadrilabes*.

Polana helvola DeLong, NEW SPECIES

Figs. 1-5

Length of male 8 mm, female unknown. Crown rounded appearing almost parallel margined, without a distinct margin. Color pale yellow, pronotum with a round black spot behind each eye at one-third length of pronotum. Forewings yellowish, subhyaline, veins yellow, 2 transverse rows of pale brown spots across clavus.

Male genitalia with plates more than $3\times$ as long as median width, apices narrow, rounded. Style with blade slightly broadened on apical $\frac{1}{2}$, apex curved dorsally, pointed. Aedeagal shaft slender, blunt at apex, a pair of processes arise each side at base, remain contiguous with shaft, extending almost to apex and curving dorsally around each side of shaft subapically.

Holotype ♂, Rurrenaba que, Beni, Bolivia, December 1921, Wm. M. Mann coll., Mulford Biol. Exped. 1921-1922, in the U.S. National Museum.

Polana helvola is placed in the subgenus *Polanana* and is nearest to *venosa*.

Polana melella DeLong, NEW SPECIES

Figs. 16-20

Length of male 7 mm, female unknown. Crown broadly rounded, almost parallel margined, $\frac{1}{2}$ as long at middle as width at base between eyes. Ocelli nearer eyes than median line. Color, crown yellow, ocelli red. Pronotum yellow, a round black spot behind each eye at one-third length of pronotum. Scutellum pale yellow. Forewings white, tinged with yellow, anterior $\frac{1}{2}$ of costa bright yellow. A broken brown band represented only by spots extends from middle of costa to middle of clavus, represented on clavus by brown spots at apices of claval veins.

Male genitalia with plates $3\times$ as long as median width, apices narrowed, rounded. Style with blade slightly enlarged on ventral margin and serrate at two-thirds its length, apical $\frac{1}{5}$ tapered and pointed. Aedeagal shaft blunt at apex; a process one-fourth length of shaft arising each side at one-third length of shaft. Pygofer narrowed and broadly rounded at apex.

Holotype ♂, Tingo Maria, Peru, VIII-12-60, O. Vargas coll., in the North Carolina State University collection.

This species is placed in the subgenus *Polanana* and is nearest *truncata*.

Polana solida DeLong, NEW SPECIES

Figs. 26-30

Length of male 8 mm, female unknown. Crown broadly rounded, more than $3\times$ as broad at base between eyes as median length. Ocelli closer compound eyes than median line. Crown without distinct margin. Color dark brown, forewings brown, subhyaline, a small brown spot at apex of each claval vein at commissure.

Male genitalia with plates $2\frac{1}{2}\times$ as long as median width, apices rounded. Style with blade almost uniform in length, apex pointed, curved dorsally. Aedeagal shaft bifid on apical $\frac{1}{2}$, contiguous at apex, each portion bearing a short spine. Pygofer with a process arising dorsally near middle, curving caudally to caudal margin of pygofer and with a slightly enlarged apex.

Holotype ♂, Mt. Duida, Venezuela, III-5-24, Ac. 29500 Tate No. 837, in the American Museum of Natural History.

This species is placed in the subgenus *Ponanella*. It is not closely related to any described species but nearest to *sereta*.

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NOTE

Three Sphecid Wasps Previously Unrecorded from Tahiti
(Hymenoptera: Sphecidae)

The following records are based on a small collection of insects made on the island of Tahiti in the Society Islands in December of 1976 by Gary Hevel of the Smithsonian Institution. Three species representing two genera of the larrine tribe Trypoxylini were taken by Mr. Hevel. All of the species are new records for Tahiti and one is of particular interest because it is a Neotropical wasp. All material is in the U.S. National Museum.

Trypoxylon (Trypargilum) nitidum Smith is a common Neotropical species which apparently has become established on Tahiti fairly recently. Hevel obtained one female at Vaimahuta Falls on the Vapuu River. This is the only species of *Trypoxylon* known on Tahiti and it represents the first Old World record for a member of the endemic Neotropical subgenus *Trypargilum*.

Three species of the genus *Pison* have been reported from Tahiti: *tahitense* Saussure, *impunctatum* Turner, and *ignavum* Turner (Cheesman, 1928. Ann. Mag. Nat. Hist. (10)1:169-194). Cheesman also recorded two other species from the Society Islands: *iridipenne* Smith (Bora Bora) and *hospes* Smith (Raiatea). Two species of *Pison* are represented in Hevel's material, *iridipenne* and *insulare* Smith, which brings the total number of species of this genus known from Tahiti to five. *Pison insulare* was previously known from New Hebrides and Hawaii. All of Hevel's *Pison* were collected between Lake Vaihiria and Otiaroa road, and all specimens are females.

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THE GENUS *EUDIAGOGUS* (COLEOPTERA: CURCULIONIDAE:
LEPTOPIINAE), WITH TWO NEW SPECIES ON THE
WEED *SESBANIA* (LEGUMINOSAE)

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Abstract.—In the New World genus *Eudiagogus* (Coleoptera: Curculionidae), two new species, *pogo* from Georgia and *maryae* from Florida, are described; the lectotype of *E. pallidevittatus* is designated; and *E. albolimbatus* is synonymized under *E. rosenschoeldi*. A new key, illustrations, distributions, and host records are given for all six species of *Eudiagogus*. The adults of these species defoliate *Sesbania*, a weed that competes with soybeans.

The species of the weevil genus *Eudiagogus* live almost exclusively on species of *Sesbania* (Leguminosae). *Sesbania* spp., commonly known as hemp sesbania, Drummond rattlebox, purple sesbania, and bagpod sesbania, are very troublesome weeds competing with soybeans on several hundred thousand acres in the Mississippi River Delta of Arkansas, Louisiana, and Mississippi. These weeds produce large quantities of seeds which persist in the soil for years.

In 1840, Schoenherr described the new genus *Eudiagogus* and included three species, *episcopalalis*, type by original designation, from Brazil, *rosenschoeldi* Fahraeus from Nova Aurelia [New Orleans, Louisiana, USA] and *pulcher* Fahraeus from Mexico. Lucas, in 1859, described *E. pallidevittatus* from Peru. In a discussion of the genus Horn (1876) mentioned but did not formally name two varieties of *pulcher*, one from Florida and one from Texas.

Horn's variety from Florida is described below as a new species. Also a species from Georgia is described as new.

Eudiagogus Schoenherr

Eudiagogus Schoenherr, 1840:307 [type-species: *Promecops episcopalalis* Schoenherr 1834:164, by original designation].

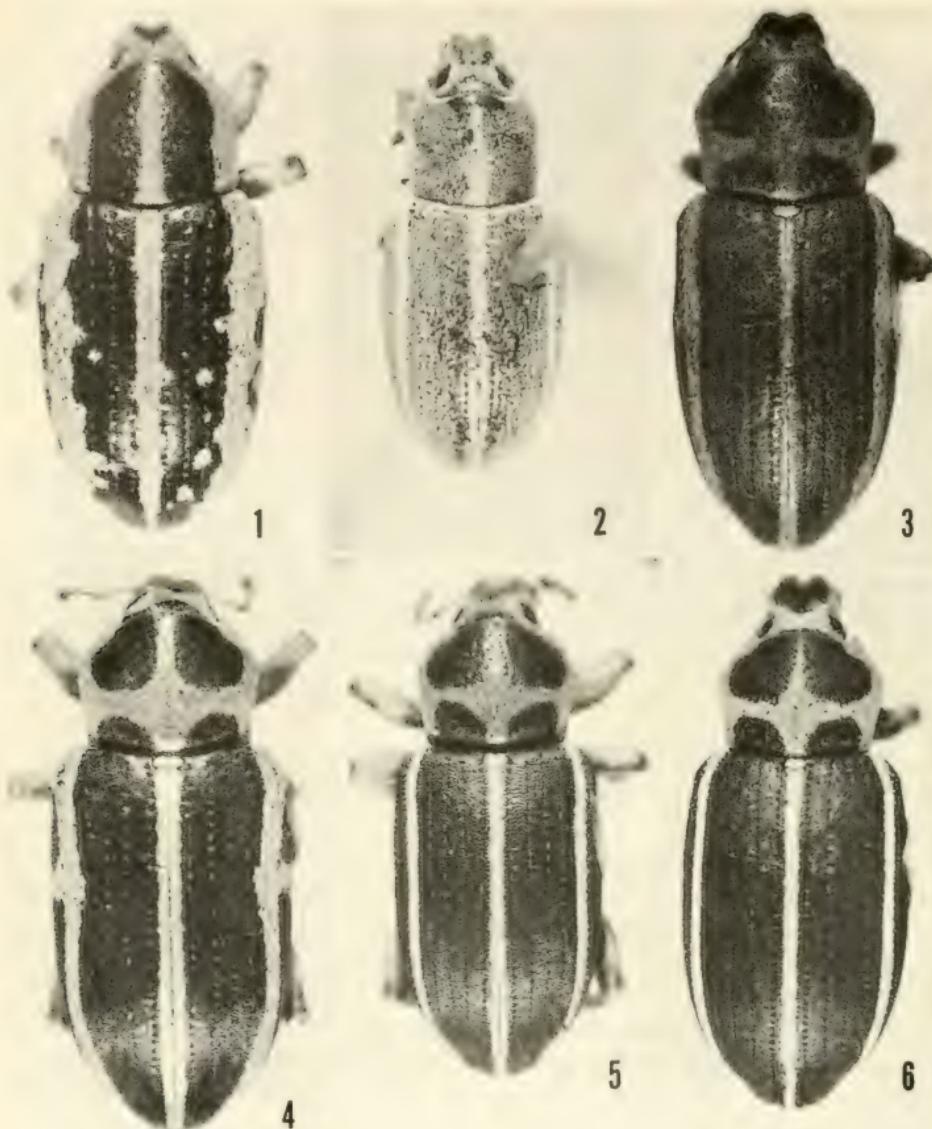
Diagnosis.—Form convex, oblong, subovate, densely scaly. Rostrum as long as head, stout, medially furrowed; submentum pendunculate, deeply emarginate; mentum small, retracted. Scrobes narrow, well defined, passing immediately beneath and slightly beyond lower border of eye, not continued beneath rostrum. Eyes oval, pointed toward the posterior border of antennal scrobe. Antennae moderately long; scape slightly arcuate, gradually clavate, passing slightly beyond anterior border of eye; funicle 7-segmented. Pronotum broader than long, narrowed basally; ocular lobes very prominent. Scutellum transverse. Elytra oblong; base slightly wider than thorax; humeri oblique; sides parallel. Mesosternum not protuberant; metasternum short, metasternal suture well defined. Second visible abdominal sternum longer than 3 and 4 united, 1st suture arcuate. Posterior tibiae with corbel closed; claws free.

The genus *Eudiagogus* belongs in the tribe Promecopini. In this tribe the rostrum is short, stout, dilated or not (*Eudiagogus*) in front, apex emarginate; antennae moderately long, scape passing eye or not. Thorax with very large ocular lobes; deeply emarginate beneath; scutellum distinct. Tibiae mucronate; tarsal claws free or connate. The genus *Eudiagogus* may be distinguished from others of the tribe (*Coleocerus*, *Aracanthus*, and *Promecops*) by the absence of erect setae on the elytra, the large and transverse scutellum (except in *rosenschoeldi*), and by the acute emargination of the submentum.

Eudiagogus maryae Warner, NEW SPECIES

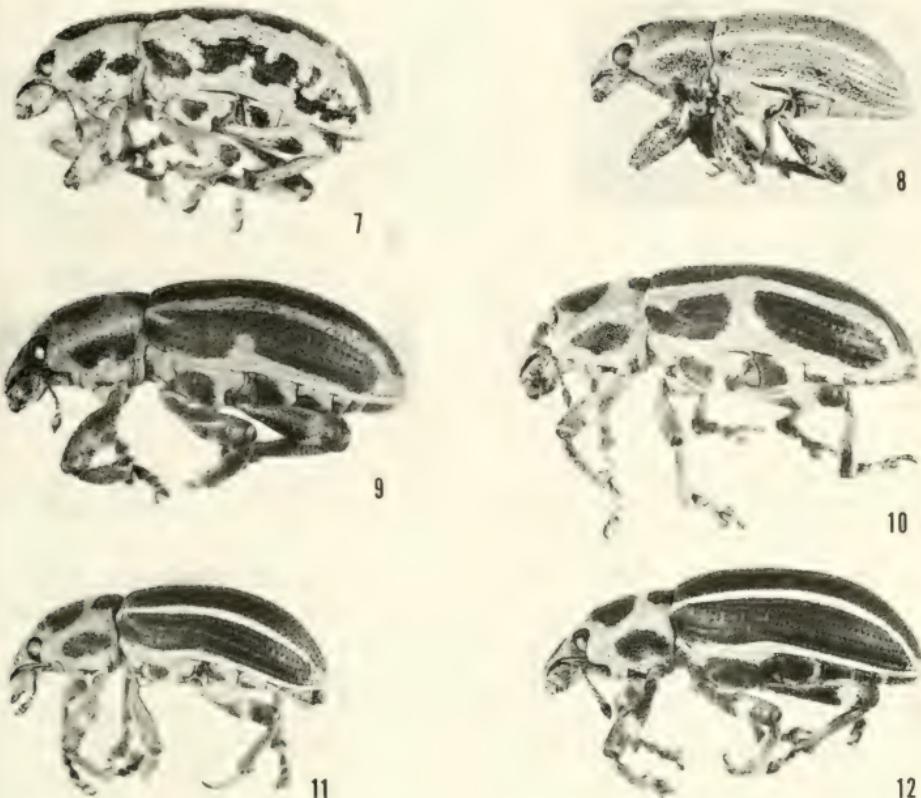
Figs. 5, 11, 16, 21, 26, 31c, 35, 38c

Holotype.—♂. Length 5.81 mm, width 2.32 mm. Integument black, shiny, antennae and legs dark brown. Vestiture of closely appressed shiny black, metallic copper, and yellow scales that conceal the integument. Head with black and copper scales; convex copper scales covering frons and encircling eyes; flat, black scales covering rest of head. Eyes large. Frons continuous with rostrum, medially with large deep, round fossa at base of rostrum. Rostrum stout, thick (0.664 mm), wider than long (0.966–0.747 mm), dorsally rounded; with dense appressed, black and whitish scales, except scales on apex metallic green and copper; apex emarginate, with 3–4 long silvery, hairlike setae; scrobes deep, sharply defined, curving downward in front of eye, passing eye but not extending under rostrum. Antennae moderately long; scape and funicle with fine hairlike silvery greenish scales; club densely pubescent, dark brown. Pronotum in dorsal view about as wide as long (1.82 mm–1.66 mm), narrowing to base; postocular lobes well developed, projecting; surface sparsely and finely punctate; vestiture dense, of closely appressed shiny, black, striate scales and convex nonstriate copper scales; copper scales present on lateral margins and on disc forming a median lon-



Figs. 1-6. *Eudiagogus* spp., dorsal view. 1, *rosenschoeldi*. 2, *pallidevittatus*. 3, *pogo*.
4, *pulcher*. 5, *maryae*. 6, *episcopalalis*.

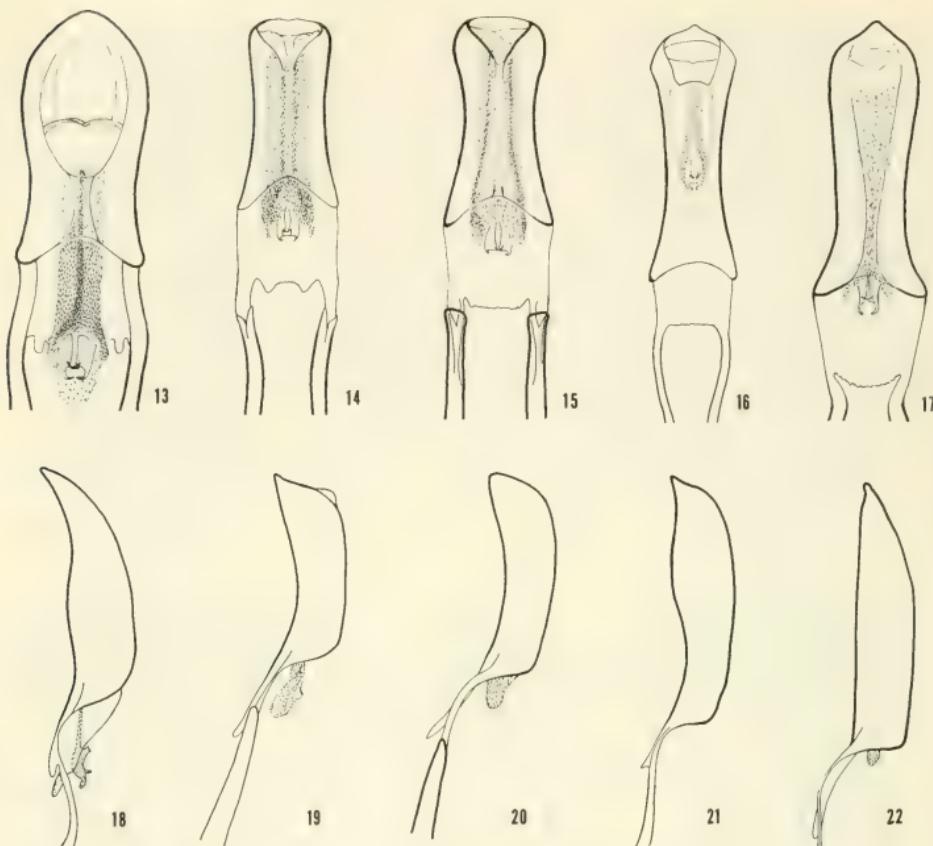
itudinal and a posterior transverse bar that divide the disc into 4 dark areas, anterior dark area larger; hypomeron with a large spot of black scales. Scutellum large, transverse; densely covered with metallic yellow scales. Elytra with black vestiture as on prothorax, and with bright yellow scales forming longitudinal stripes from base to apex on intervals 1 and 6 and on



Figs. 7-12. *Eudiagogus* spp., lateral view. 7, *rosenschoeldi*. 8, *pallidevittatus*. 9, *pogo*.
10, *pulcher*. 11, *maryae*. 12, *episcopalensis*.

lateral margins (Figs. 5, 11); parallel sided to beyond middle then gently rounded to apex; intervals of equal width; striae of fine deep punctures; each puncture with a minute black seta. Legs with dense vestiture of greyish-white striate scales intermixed with small white setaelike scales; femur with a ring of large, bright metallic yellowish scales; tibia straight, mucro strong, corbel of posterior tibia closed and clothed with a single row of erect yellowish setaelike scales; tarsus normal, dorsally clothed with greenish setaelike scales, ventrally densely pubescent, segment 4 long, slender, claws free. Venter with dense white scales, visible abdominal sternum 5 less scaly but with numerous erect hairlike setae; each sternum with lateral black spot; visible sterna 1 and 2 medially concave, visible sternum 5 at apex slightly convex. Genitalia as figured (Figs. 16, 21).

Allotype.—♀. Length 5.8 mm, width 2.4 mm. Differing from male by the evenly convex visible abdominal sterna 1 and 2, and the shorter visible sternum 5. Spermatheca and sternum 8 as figured (Figs. 26, 31c).



Figs. 13-22. *Eudiagogus* spp., median lobe of male genitalia, dorsal and lateral views. 13 and 18, *rosenschoeldi*. 14 and 19, *pogo*. 15 and 20, *pulcher*. 16 and 21, *maryae*. 17 and 22, *episcopaloris*.

Paratypes.—Length 3.98–6.31 mm, average length 4.03. Like holotype and allotype except some specimens with metallic scales on pronotum, elytra, and venter sometimes greenish, deep copper, yellow, or a mixture of these colors, black scales sometimes brownish or with a greenish sheen.

Described from holotype ♂, allotype ♀, USNM Type no. 73811, and 49 paratypes, 17 ♂ and 10 ♀, from Tampa, Hillsborough Co., Florida, 24-V-44, Tuthill collector, on *Glottidium vesicarium* (=*Sesbania vesicaria* (Jacq.) Ell.) leaves, USDA no. 44-14959; 14 ♂ and 8 ♀, same data as holotype except, 25-V-44, Link and Tuthill, USDA no. 44-14960.

Also, 87 nonparatypic specimens were studied from the following localities: ALABAMA. Montgomery Co. Auburn Co.: Auburn. SOUTH CAROLINA. Horry Co.: Myrtle Beach; Charlestown Co.: McClellanville. NORTH CAROLINA. Columbus Co.: Chadburn; Brunswick Co. GEOR-

GIA. Spalding Co.: Experiment; McIntosh Co.: Darin; Chatham Co.: Savannah. FLORIDA. Lee Co.: Fort Meyers; Dade Co.: Hialeah; Duval Co.: Jacksonville; Manatee Co.: Oneco; Hillsborough Co.: Seddon Island, Tampa; Pinellas Co.: St. Petersburg; Seminole Co.: Sanford; Volusia Co.: DeLand; Alachua Co.: Gainesville. The geographic distribution is shown in Fig. 35 and the seasonal distribution in Fig. 38c, these figures are based on the specimens examined.

This species is very similar to the South American species, *episcopalalis*. It can be readily separated from *episcopalalis* by its smaller size, by the more sparse and less coarsely punctured rostrum and pronotum, and by the larger, deep, round fossa at the base of a deep, fine, rostral groove. In *episcopalalis* the size is larger, the punctures of the rostrum and pronotum are coarser and denser, the more shallow, oblong fossa is located at the base of a broader, more shallow rostral groove, and the shape of the median lobe of the male genitalia is especially different (Figs. 17, 22). The species *maryae* is easily separated from the North American species by the median lobe of the male genitalia and by the other characters given in the key.

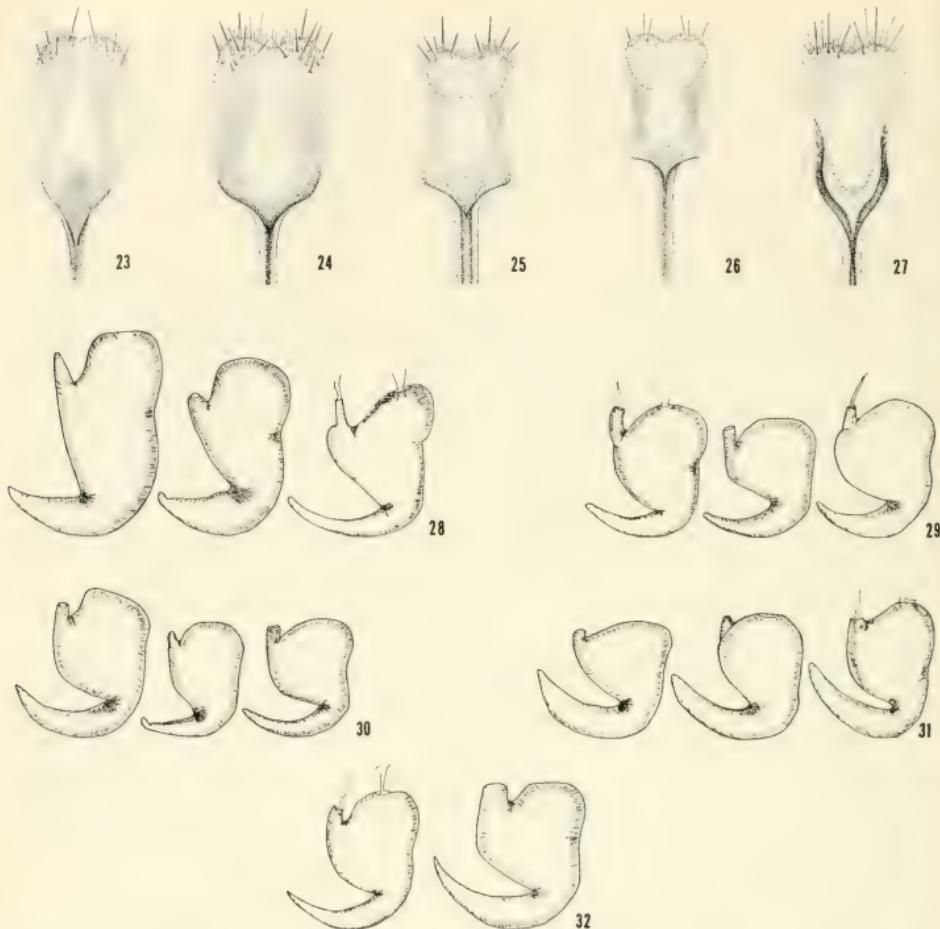
Etymology.—*Eudiagogus maryae*, for my sister Mary in whose honor this species is named.

Biology.—Nothing is known of the life history of this species, but specimens have been found feeding on and defoliating species of *Sesbania*. The following records are from labels pinned with specimens studied: In pepper blossom; on okra; on corn; on butterbeans; on squash; on coffee weed; feeding on *Cassia* sp.; false indigo; spanish needle; black-eyed pea leaf, stem and pod; bagpod sesbania, *Sesbania vesicaria* (Jacq.) Ell., hemp sesbania, *Sesbania exaltata* (Ref.) Cory, and in soybean fields.

Eudiagogus pogo Warner, NEW SPECIES

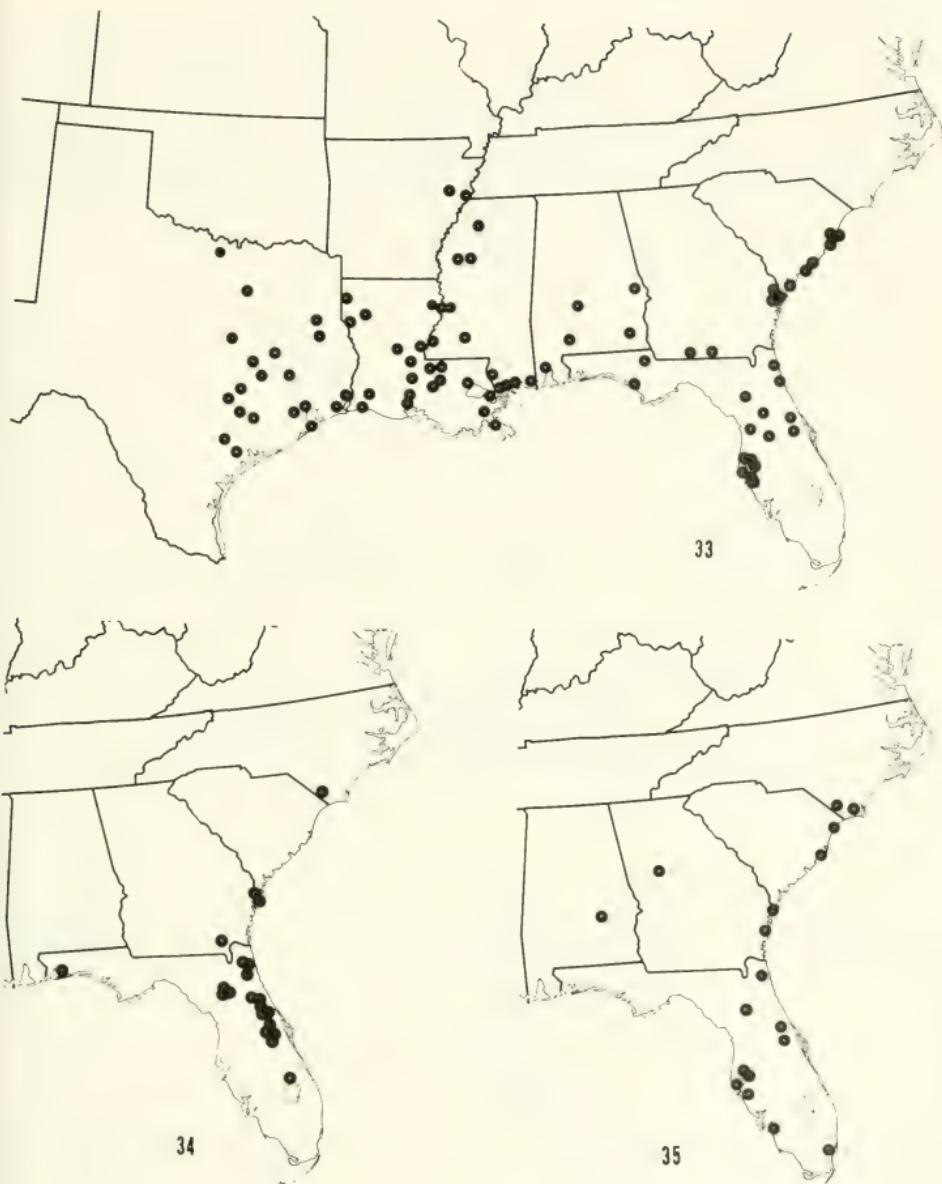
Figs. 3, 9, 14, 19, 24, 29, 34, 38b

Holotype.—♂. Length 7.97 mm, width 3.15 mm. Integument black. Vesture of dense, closely appressed, small, dull brownish-black scales, convex tannish scales, and a few scattered greenish metallic scales. Head covered with convex tan and brown, nonmetallic scales. Eyes large. Frons continuous with rostrum, medially with a small pit. Rostrum stout, thick (0.83 mm), almost as wide as long (0.83–0.91 mm); dorsally flat; deeply and broadly grooved from frontal pit to emarginate apex, with black, tan, and a few scattered greenish-metallic scales from base to apex, 2–3 stout setae, each arising from a puncture, on either side of broad apical sulcus; scrobes deep, well defined, from apex, then passing downward in front of eye and continuing a short distance under rostrum. Antennae moderately short, scape curved to fit into scrobe; funicular segments shiny, sparsely clothed with fine silvery setae. Pronotum in dorsal view wider than long (2.49–1.83 mm), expanding behind well-developed ocular lobes then narrowing to base; with



Figs. 23-32. *Eudiagogus* spp., sternum 8 and spermatheca of female. 23 and 28, *rosen-schoeldi*. 24 and 29, *pogo*. 25 and 30, *pulcher*. 26 and 31, *maryae*. 27 and 32, *episcopalil*.

sparse, large punctures; vestiture dense, of closely appressed, brownish black, and tan scales, tan scales present on lateral and anterior margins, and forming on disc a median longitudinal and a posterior transverse bar dividing the disc into 4 dark areas, anterior dark area larger; hypomeron with a large spot of black scales. Prosternum covered with tan scales. Scutellum large, transverse, densely covered with tan scales. Elytra with black and tan vestiture as on prothorax, dull tan scales forming a narrow longitudinal stripe from base to apex on interval 1 and 6 and on lateral margins, stripe on lateral margin broadening at a point opposite posterior coxae and partially dividing the lateral black area (Fig. 9); parallel sided in basal $\frac{1}{3}$ then gently rounded to apex; intervals of equal width; striae of fine, shallow punctures, each puncture with minute black seta.



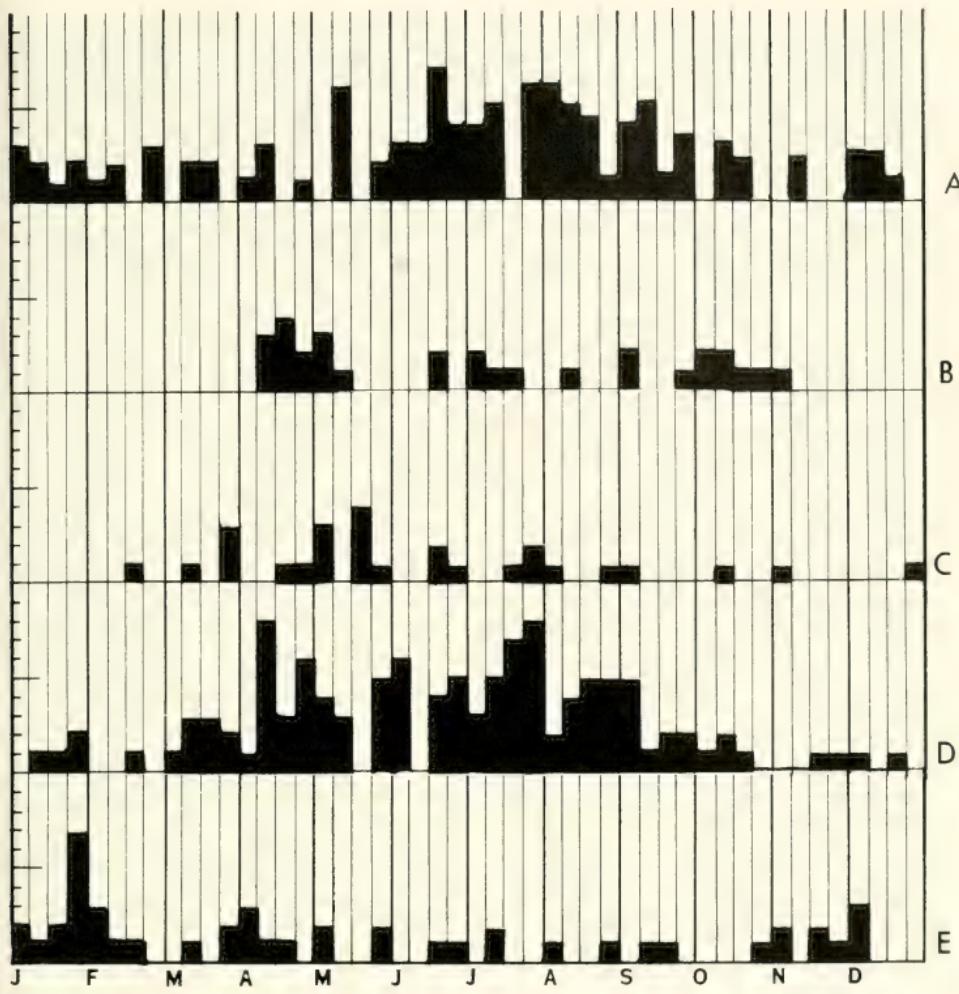
Figs. 33–35. *Eudiagogus* spp., geographical distribution. 33, *rosenschoeldi*. 34, *pogo*. 35, *maryae*.

Legs stout; femur short, thick; tibia stout, curved toward apex, mucro strong, corbel of posterior tibia closed, broad, anterior and distal combs composed of stout black spines, anterior spines shorter; clothed with erect silvery scales and light tan and brown appressed scales, not covering integ-



Figs. 36-37. *Eudiagogus* spp., geographical distribution. 36, *pulcher*. 37, *episcopalalis* and *pallidevittatus*.

ument; larger metallic copper and nonmetallic tan scales forming a ring on femora, ring more evident on posterior femora. Venter with appressed, black, whitish, and metallic golden scales, visible abdominal sterna 1-4 with whitish scales broader and denser along posterior margin, and submetallic



38

Fig. 38. *Eudiagogus* spp., seasonal distribution. A, *rosenschoeldi*. B, *pogo*. C, *maryae*. D, *pulcher*. E, *episcopalis*.

yellowish scales denser along lateral margins, and with lateral spot of brownish-black scales, visible sternum 5 with brownish-black scales (a few white scales laterally) and with numerous erect silvery hairlike setae that are longer and more numerous toward apex; sterna 1–2 medially concave; sternum 5 convex, finely, densely punctured; pygidium coarsely punctured. Genitalia as figured (Figs. 14, 19).

Allotype.—♀. Length 6.97 mm, width 2.16 mm. Differing from the ♂ only in the slightly smaller size, the less concave sterna 1–2. Spermatheca and sternum 8 as figured (Figs. 24, 29).

Paratypes.—Length 4.99–8.00 mm, average length 6.00 mm. Like holotype.

Table 1. Host plants of *Eudiagogus* species (records were not found for the South American species *pallidevittatus*). North America (NA), South America (SA), Mexico (M), Central America (CA). Upper case letters indicate the host was recorded more than once for that species; lower case letters indicate only one record. All scientific and common names of weeds were checked in Standardized Names of Weeds (1971) and Cabrera (1967).

| | pul- cher | rosen- schoeldi | episco- palis | pogo | maryae |
|---|--------------|--------------------|------------------|------|--------|
| <i>Sesbania exaltata</i> (hemp sesbania) | NA | NA | | NA | NA |
| <i>Sesbania vesicaria</i> (bagpod sesbania) | | NA | | | na |
| <i>Sesbania drummondii</i> (Drummond rattlebox) | NA | | | | |
| <i>Sesbania punicea</i> ("acacia mansa") (purple sesbania) | | NA | SA | | |
| <i>Sesbania virgata</i> ("acacia" "cafe") | | | SA | | |
| <i>Daubentonia texana</i> (coffee weed) | na | NA | | | na |
| <i>Cassia occidentalis</i> (coffee senna) | NA | NA | | | |
| <i>Cassia marilandica</i> (wild senna) | | | NA | | |
| <i>Cassia obtusifolia</i> (sicklepod) | NA | NA | | | |
| <i>Cassia</i> sp. (senna) | | | | NA | NA |
| <i>Sesbania tomentosa</i> (sesbania) | | | | | NA |
| <i>Baptisia tinctoria</i> (wild indigo) | | na | | | |
| <i>Erythrina crista-galli</i> (cockspur coral bean) | | | sa | | |
| <i>Bidens bipinnata</i> (spanish needle) | | NA | | | na |
| <i>Solanum tuberosum</i> (nightshade) | na | na | | | |
| <i>Acacia</i> sp. ('acacia') | na | | | | |
| <i>Crotalaria intermedia</i> (crotalaria) | | | na | | |
| <i>Casuarina equisetifolia</i> (horsetail, beefwood) | na | | | | |
| <i>Xanthium</i> sp. (cocklebur) | na | | | | |
| <i>Artemisia</i> sp. (wormwood) | | | na | | |
| <i>Beta vulgaris</i> (sugar beet) | NA | | | | |
| <i>Gossypium</i> sp. (cotton) | m na | | | | |
| <i>Aster sericeus</i> (devilweed) | na | | | | |
| <i>Hibiscus esculentus</i> (okra) | m | | | | na |
| <i>Cattleya</i> (orchid) | m | | | | |
| <i>Musa</i> sp. (banana) | ca | | | | na |
| <i>Sorghum vulgare saccharatum</i> (sorghum) | m na | na | | | |
| <i>Saccharum officinarum</i> (sugar cane) | m | | | | |
| <i>Lactuca</i> sp. (lettuce) | m | | | | |
| <i>Capsicum</i> (pepper) | | | | | na |
| <i>Vigna unguiculata</i> (black-eyed pea; cowpea) | | | | | na |
| <i>Cucurbita</i> sp. (squash) | | | | | na |
| <i>Phaseolus lunatus</i> (lima bean) | | | na | | na |
| <i>Crataegus</i> sp. (hawthorn) | na | | | | |
| <i>Rudbeckia amplexicaulis</i> (coneflower) | na | | | | |
| <i>Medicago sativa</i> (alfalfa) | na | | | | |
| <i>Phaseolus vulgaris</i> (green bean) | na | | | | |
| <i>Xanthoxylum clava-herculis</i> (prickly ash) | NA | NA | | | |
| <i>Carex</i> sp. (sedge grass) | | NA | (roots) | | |
| <i>Hymenocallis</i> sp. (spider lily) | | na | | | |
| <i>Tillandsia usneoides</i> (spanish moss) | | na | | | |
| <i>Rubus</i> sp. (dewberry) | na | | | | |

type and allotype except some specimens with elytral stripes and lateral stripes of abdominal sterna formed of pinkish scales.

Described from holotype ♂, and allotype ♀, USNM Type no. 73810, and 58 paratypes, 38 ♂ and 20 ♀, from Billy's Island, Okefenokee Swamp, Charlton Co., Georgia, 9-VIII-1926, C; C. Sperry collector, on *Sesbania macrocarpa* (=*S. exaltata* (Raf.) Cory).

Also, 352 nonparatypic specimens were studied from the following localities: FLORIDA. Volusia Co.: Enterprise, DeLand; Duval Co.: Jacksonville; Seminole Co.: Sanford; Alachua Co.: Gainesville; Putnam Co.: Crescent City; Osceola Co.: Kissimmee; Orange Co.: Orlando; Hillsborough Co.: Tampa; Clay Co.: Green Cove Springs; Okeechobee Co.: Shore of Lake Okeechobee, 6 mi. South Okeechobee; Escambia Co.: Pensacola: Florida, no other locality. GEORGIA. Chatham Co.: Tybee Island, Savannah; Georgia, no other locality. NORTH CAROLINA. Columbia Co.: Chadbourn, (S.C., is on label with the specimens, but Chadbourn is in southern North Carolina, 52 miles west of Wilmington on the North-South Carolina border). Specimens in the Casey Collection USNM, labeled L, the symbol L does not appear in Casey's code of localities and cannot be placed. The geographic distribution is shown in Fig. 34 and seasonal distribution in Fig. 38b, these figures are based on the specimens examined.

This species is similar to *pulcher* in general appearance. It differs from *pulcher* by the stout legs, the dull scales of the maculations, the incomplete narrow lateral transverse bar on the elytra, and the straight longitudinal stripe on elytral interval six. In *pulcher* the legs are more slender, the scales of the maculations have a metallic sheen, the lateral transverse bar on the elytra is wider and completely divides the lateral elytral area, and the stripe on elytral interval six undulates and by the other differences given in the key.

Etymology.—It gives me great pleasure to name this species after the classic comic strip character 'Pogo' created by the late Walt Kelly. Pogo was a 'possum' who lived in Okefenokee Swamp; his antics and those of his swamp friends brought delight to readers young and old.

Biology.—Nothing is known of the life history of this species. Specimens were found feeding on hemp sesbania, *Sesbania exaltata*, in Okefenokee Swamp. The following records are from the labels pinned with the specimens studied; only two series of specimens had 'host' labels: Feeding on *Cassia* sp., and resting on stems of a leguminous weed, presumably *Cassia* sp.

Eudiagogus pallidevittatus Lucas

Eudiagogus pallidevittatus Lucas, 1859:158.

This species is represented by four specimens in the Museum National D'Histoire Naturelle, Paris. These four are without question the type-series.

All the specimens, males, have green labels, Museum Paris, Pampa de Castel . . . , a green disc with number 10/47 on the underside, and an identification label, *E. pallidevittatus* Cat. Mus. Pampa del Sacramento M. de Castelnau. The number 10/47, according to information supplied by Mlle. Hélène Perrin, indicates that the insects were collected on the Mission Sarayaci (Riviere Ucayale), Pampa del Sacramento [Peru] from the voyage of M. de Castelnau. As there is no type-designation for this species, I have selected and labeled one of the four specimens in the above series as the LECTOTYPE.

Eudiagogus rosenschoeldi Fahraeus

Eudiagogus rosenschoeldi Fahraeus, 1840:309.

Eudius albolimbatus Chevrolat, 1881:38, NEW SYNONYMY.

Eudiagogus albolimbatus (Chevrolat), Kuschel, 1955:302.

I have seen the type of *Eudius albolimbatus*, described from "Amer. mer." [South America?], and I am convinced that this locality is wrong and that the type of this species represents merely a rubbed female specimen of *Eudiagogus rosenschoeldi*.

KEY TO SPECIES OF *EUDIAGOGENS*

1. Prothorax dorsally divided by longitudinal stripe of light-colored scales into 2 dark areas (Figs. 1, 2) 2
- Prothorax dorsally divided by transverse and longitudinal stripes of light-colored scales into 4 dark areas, anterior areas larger (Figs. 3–6) 3
2. Pinkish-white stripes on elytral intervals 1 and 6 and elytral margins wide, stripes very uneven. Male with metasternum and visible abdominal sternum 1 medially with dense, long, erect, silvery hairs; visible sternum 1 of females with scales. Length: 4.15–7.14 mm, average 5.83 mm. Genitalia as figured (Figs. 13, 18, 23, 28). South-eastern and Gulf Coast states (Figs. 1, 7, 33, 38a) *rosenschoeldi* Fahraeus
- Pale-green elytral stripes on elytral intervals 1 and 6 and elytral margin narrow, stripes even. Male with metasternum not as above; females not seen. Species covered with flat, metallic green scales, ventrally scales denser and less metallic. Length: 4.43–5.16 mm (Figs. 2, 8, 37) Peru *pallidevittatus* Lucas
3. Lateral elytral black area entirely or partially divided by a transverse bar of light-colored scales connecting stripes on elytral interval 6 and lateral margin (Figs. 9–10) 4
- Lateral elytral black area entire, not divided by a transverse bar of light-colored scales (Figs. 11–12) 5

4. Lateral transverse bar narrow, of varying length and partially dividing black area; stripe of light dull tan, convex scales on elytral interval 6 straight; ventrally with sparse, slender scales (laterally scales sometimes denser and with a few scattered metallic scales), in male visible abdominal sternum 5 convex, with long, erect setae, 1 and 2 concave; in female, 5 less convex, 1 and 2 convex. Rostrum dorsally rounded. Legs stout. Robust species. Length: 4.98–8.13 mm, av. 6.83 mm. Genitalia as figured (Figs. 14, 19, 24, 29) North Carolina, Georgia and Florida (Fig. 34) *pogo*, new species
- Lateral transverse bar wide, connecting stripe on elytral margin with stripe on interval 6 and completely dividing lateral area; stripe on elytral interval 6 sinuous; scales of maculations flat, bright, shiny yellowish copper, pink or reddish metallic; ventrally densely covered with large, appressed, white scales medially and yellowish-green metallic scales laterally, visible abdominal sternum 5 in male convex, coarsely punctured, large punctures each with a long, fine erect seta. Rostrum dorsally flat. Legs slender. Slender species. Length: 3.9–8.00 mm, av. 6.70 mm. Genitalia as figured (Figs. 15, 20, 24, 30). Gulf coast states, Arizona and California, Mexico, Honduras, Costa Rica (Figs. 4, 10, 36, 38d) *pulcher* Fahræus
5. Ventrally with dense, flat, broad white scales that conceal integument. Rostrum almost straight, shallowly sulcate medially from large, deep round frontal pit to apical emargination. Femur annulation not very distinct. Visible abdominal sternum 5 in both sexes with numerous, long, fine silvery setae. Smaller species, length: 3.95–6.31 mm, average 4.03 mm. Genitalia as figured (Figs. 16, 21, 26, 31). North Carolina, South Carolina, Georgia, Florida, and Alabama (Fig. 35) *maryae*, new species
- Ventrally with sparse, blackish and silvery, narrow scales that do not conceal integument. Rostrum gently curved, deeply and broadly sulcate medially from oblong frontal pit to apical emargination. Femur annulation distinct, of broad, shiny, golden metallic scales. Visible abdominal sternum 5 in both sexes with numerous stout, brownish, erect setae. Large species, length: 4.6–7.2 mm, av. 6.1 mm. Genitalia as figured (Figs. 17, 22, 27, 32). Argentina, Brazil, Paraguay, Uruguay, Bolivia (Figs. 6, 12, 37, 38e) *episcopalidis* (Schoenherr)

The life history and biology are basically similar for all species of *Eudiagogus*. Adults defoliate the host plant. It is not known where the eggs are laid, but the larvae are in the soil, feed on roots, pupate, and emerge as adults usually in spring or early summer. Adults of all species feed exclusively on plants in the family Leguminosae, and in particular the species of

the genera *Sesbania*, *Cassia*, and *Daubentonina*. An extensive study of the feeding habits of two species, *pulcher* and *rosenschoeldi*, conducted in south-central Texas (Doyle McKey, personal communication) showed that these beetles were associated almost exclusively with three species of *Sesbania*, *vesicaria* (bagpod sesbania), *drummondii* (Rydb.) Cory (Drummond rattlebox), and *exaltata* (hemp sesbania). The species *pulcher* was commonly found on *drummondii* and *exaltata* and *rosenschoeldi* was even more restricted, being most common on *vesicaria*. The amount of damage done to leaves was extensive. It was very common for a large portion of leaves to be 20 to 60 percent eaten. However, all *Sesbania* species grow extremely fast when they have enough water and good soil, and plants that are heavily damaged can easily grow quite large and produce an abundance of seeds in spite of the damage.

Eudiagogus rosenschoeldi was found to be predominantly nocturnal. Five times as many were found on the same individual plant at midnight as during the day. The species copulated almost exclusively at night. When distributed, the specimens usually dropped from the plant. *Eudiagogus pulcher*, in contrast, was found on a plant in about the same numbers throughout the day and night; and they were found *in copulo* as often during the day as during the night. When distributed, the specimens responded by running around on the plant, not dropping to the ground.

According to Mitchell and Pierce (1911:50) and Pierce (1907:256) these two species were found in abundance on *Cassia occidentalis* L., coffee senna; and they appeared in such great numbers that they quickly defoliated the senna. Pierce also observed them defoliating *Xanthoxylum clavaherculis* L., hercules club prickly ash, and *Sesbania vesicaria*. Schwarz (1884:84) recorded the food plants of these two species as *Cassia occidentalis* and *C. obtusifolia* L., sicklepod. *Eudiagogus pulcher* was much more abundant and defoliated large tracts of the weeds. McConnell (1915:551) observed the larvae of *E. rosenschoeldi* feeding on the nodules on the roots of *Sesbania macrocarpa* (=*S. exaltata*) in Mississippi. The larvae gnawed into the one side of a nodule and out the opposite end. All that was left of the nodule was a convex ring of epidermal tissue. Practically all the plants were destroyed in this way. The larvae also feed on the roots.

As indicated by the labels attached to the specimens, *Eudiagogus* adults overwinter under bark and in crevices of various species of trees, dried corn stalks, crevices of telephone poles, under bark of red-cedar (*Juniperus*) fence posts, in prickly ash (*Xanthoxylum*), in dried okra pods, in trunk of mesquite tree, in Spanish moss, and in dried cotton bolls.

Since the species *maryae* and *pogo* have not been separated from *pulcher* before, it is not now possible to tell, in the areas where the species overlap, to which species the recorded host plants refer.

Eudiagogus episcopalis lives almost exclusively on *Sesbania punicea* (Cav.) commonly known as purple sesbania, "acacia mansa," and "acacia negro." The species is very common on this plant which it inhabits preferably close to rivers. George Vogt (personal communication) found this species causing heavy damage to *Sesbania virgata* (Cav.) Pers., "rama negro," 20-II-75, growing on the marshy shores of Rio de las Palmas, Buenos Aires, Argentina; on *Sesbania* sp. along the margins of backwaters of Rio Paraguay, north of Asuncion, Paraguay, 30-III, 3-IV-75; along the bank of a drainage canal in Campos, Rio de Janeiro, heavily damaging leaves of *Sesbania* sp. growing on fairly high ground on the deltaic island of Rio Guaiba, 7-II-75, Ilha do Pavao, Brazil; and damaging leaves of *Sesbania exaltata* near Guayaquil, Ecuador. The species was collected at Rocha, Uruguay, 11-II-75, on *Sesbania* sp. leaves by Hugo Cordo.

Numbers of individuals were plotted against the time they occurred throughout a twelve-month period (Fig. 38). Differences in seasonal distribution are obvious from these bar graphs.

ACKNOWLEDGMENTS

I wish to extend my thanks to the following individuals and their institutions for the loan of material used in this study.

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I am most grateful to my colleagues Theodore J. Spilman, who carefully

read the manuscript and suggested numerous improvements, and Donald M. Anderson for the fine photographs of the adult weevils.

To all these, my sincerest appreciation.

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A NEW SPECIES OF THE MAYFLY GENUS *STENONEMA*
TRAVER FROM EASTERN UNITED STATES
(EPHEMEROPTERA: HEPTAGENIIDAE)

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Abstract.—Nymphal and adult stages of a new species, *Stenonema sinclairi*, from Tennessee are described.

A new species belonging to the mayfly genus *Stenonema* was found among two separate collections of mayflies from Sequatchie and Marion Counties, Tennessee.

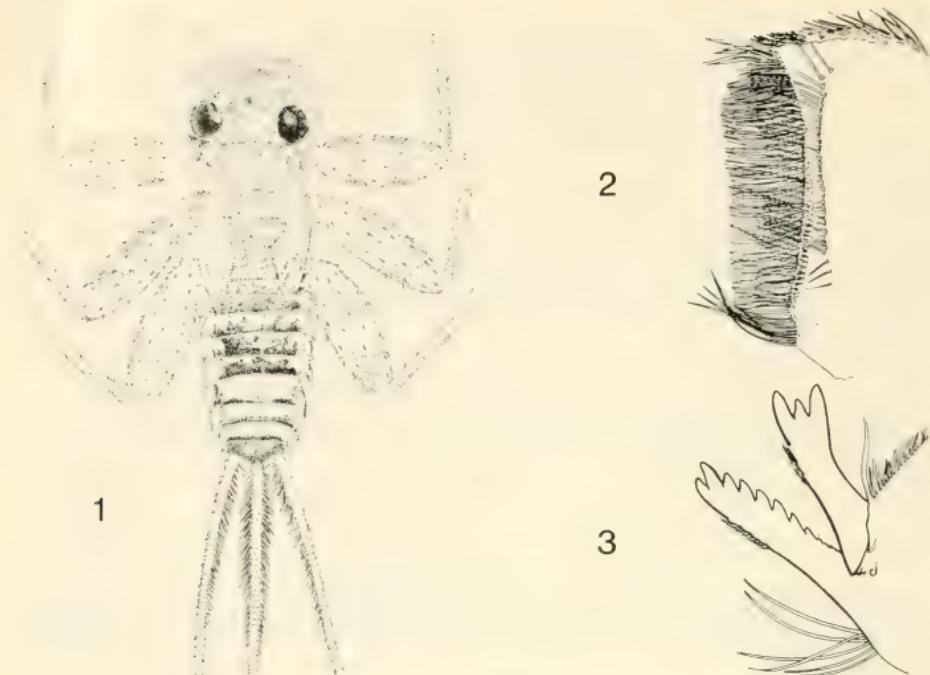
Stenonema sinclairi Lewis, NEW SPECIES

Nymph (Fig. 1).—Length of body, 10–12 mm.

Head: Brown with minute freckle-like white dots, often coalescing to form small spots anterior to eyes; white band running from anterolateral angle of each compound eye to lateral margin; area posterior to eyes mostly white; each ocellus surrounded by a large white spot. Scapes of antennae dusky, remainder of antennae light tan. Maxillae (Fig. 2) with armature on crowns consisting of 3 pectinate spines and 30–50 setae; ventral surface of galea-laciniae with 30–40 lateral setae. Mandibles (Fig. 3) with 8–10 teeth on inner margin of each outer canine; inner canine of right mandible with 3 sharp teeth on inner margin. Lacinia mobilis lanceolate, undivided at tip.

Thorax: Light brown with large white spots near anterior margin of pronotum and in center of mesonotum, lateral margins of pronotum entirely white. Femora white with 2 irregular brown bands across dorsal surface (when an apical brown band is also present the dorsal surface is predominantly brown); tibiae pale with basal and median brown bands present; tarsi brown in middle and pale at both ends; claws not pectinate.

Abdomen: Terga 1, 2, 4, 7, and 8 white with brown posterior margins; terga 5 and 9 about equally brown and white; and terga 3, 6, and 10 brown with a few white dots on meson and larger white spots at lateral margins (Fig. 1). Venter entirely pale on segments 1 to 7 except for occasional spec-



Figs. 1-3. *Stenonema sinclairi*, nymph. 1, Dorsal view. 2, Left maxilla, ventral view. 3, Left mandible.

imens with brown shading in sublateral and median areas at posterior margins of more posterior segments; sternum 9 with posterolateral angles brown (Fig. 4). Abdominal segments 3 to 9 produced as posterolateral spines. Gills 1 to 6 truncate at apices, each with brownish-purple tracheae; 7th gill with fringe of hairs, but without tracheae. Caudal filaments yellow tan with circle of strong spines at alternating joints; a row of setae only on mesal margin of each (Fig. 1).

Male imago.—*Length*: Body, 11 to 12 mm; fore wing, 11 mm; tails, 30 mm.

Head: Gray-brownish white in frontal portion below eyes; vertex dark brown, ocelli ringed with black at bases; pedicels of antennae tan, each flagellum purple in basal $\frac{1}{2}$, becoming white at tip.

Thorax: Light brown on pronotum, gradually darkening posteriorly so that mesoscutellum is dark brown; pleura tan with patches of dark brown pigment near base of each leg. Legs yellowish gray; brown median bands on each femur; fore tarsal ratio 3.5. Fore wings hyaline with light brown veins; cross veins about evenly spaced throughout the wing (not crowded in bulla area) (Fig. 5); white stain in costal and subcostal interspaces in stigmatic area. Hind wing hyaline with light brown cross veins.

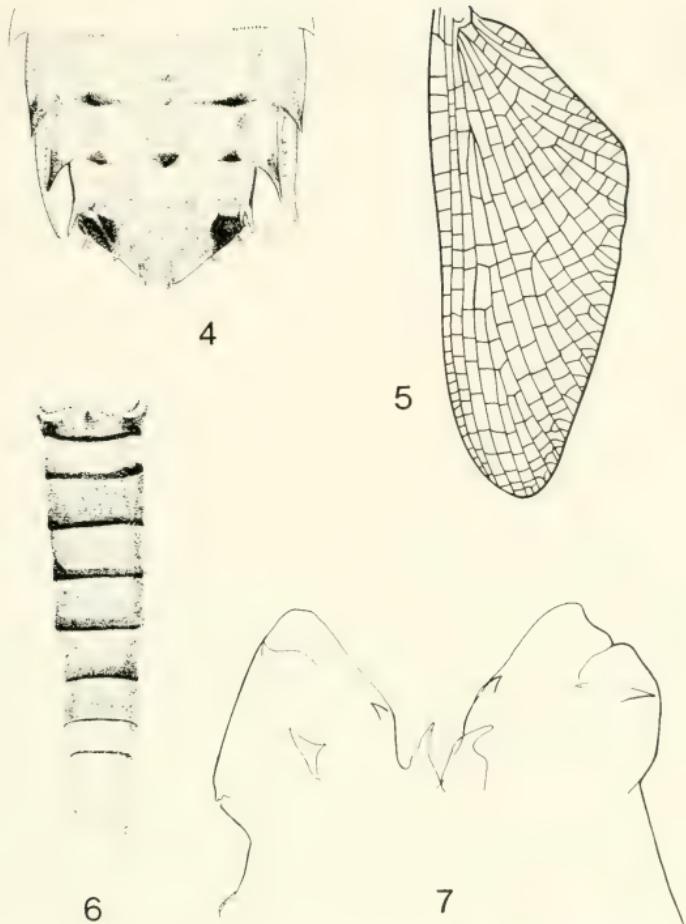


Fig. 4. *Stenonema sinclairi*, nymph, posterior sterna. Figs. 5-7. *Stenonema sinclairi*, male imago. 5, Fore wing. 6, Dorsal view of abdomen. 7, Genitalia.

Abdomen: Segments 1 to 8 rusty brown throughout (Fig. 6); terga 9 and 10 yellow brown; posterior margins of terga 1-8 with narrow black bands; no dark spiracular spots. Genitalia (Fig. 7) with large discal spine and small apical spine on each penis lobe; penis lobes not as boot-shaped as in most *Stenonema* species. Caudal filaments tan with reddish-brown joints; covered with short setae and fringed on mesial sides with long setae.

Holotype.—♂ imago; Spring Brook of Gladys Fork Creek, Sequatchie County, TENNESSEE 30-IV-76 (Reared 1-V-76); collected by R. Sinclair, Jr. and J. Rossman; deposited at U.S. National Museum of Natural History, Washington, D.C. (USNM Type no. 75942).

Paratypes.—♀ imago; same data as Holotype; deposited at National Mu-

seum of Natural History. Four nymphs; Gladys Fork Creek, Bledsoe County, TENNESSEE 10-VII-75; collected by R. Sinclair, Jr.; deposited at Florida A&M University Museum, Tallahassee. One ♂ imago, 1 ♂ subimago, and 2 ♀ imagoes; Spring Brook of Gladys Fork Creek, Saquatchie County, TENNESSEE 30-IV-76; collected by Ralph Sinclair, Jr. and Joe Rossman; deposited at Florida A&M University Museum.

Additional nymphs of this species were examined from Kellys Creek, Marion County, TENNESSEE (Collected 10-24-78 by Wendell L. Pennington).

Ecology and distribution.—The small streams from which the nymphs were collected flow through an area that was strip-mined many years ago. These soft-water streams are cold and slow-flowing with stream beds composed of smooth stones, cobble, and sand over underlying sandstone bedrock. At the times of collection the water temperature ranged from 13 to 26°C, the dissolved oxygen was between 6.0 and 9.0 ppm, the pH ranged from 5.5 to 7.8, and the alkalinity as CaCO_3 was less than 6 mg/l.

This species has been collected only from the very small tributaries of the Sequatchie River in Tennessee.

Discussion.—*Stenonema sinclairi* is closely related to *S. fuscum* Clemens and *S. pudicum* Hagen. The male imago keys to *S. fuscum* (couplet 24) and the nymph keys to *S. pudicum* (couplet 24) in Lewis (1974).

The fore tarsal ratio (3.5) of the male will separate *Stenonema sinclairi* from all other *Stenonema* except *S. vicarium* Walker. The characteristic penis lobes which are only slightly boot-shaped and the large discal spines distinguish this species from all other members of the *vicarium* complex (including *S. fuscum* and *S. pudicum*). Both males and females lack the crowded cross veins in the bulla region and the dark hind wing margins so characteristic of *S. pudicum* and *S. carlsoni* Lewis.

The nymph is separated from *S. pudicum* by having fewer than five pectinate spines on the crown of each maxilla compared to five to eight in *S. pudicum*. The absence of dark bands on the sterna of segments 4 to 8 also appears to be diagnostic. The nymph of *S. sinclairi* differs from *S. fuscum* in lacking dark posterior margins on sterna 2 to 8.

Etymology.—The name is in honor of Ralph Sinclair, Jr., who collected and reared the species during a water pollution study in Southeast Tennessee, and sent the type-material for examination.

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PROC. ENTOMOL. SOC. WASH.
81(2), 1979, p. 325

NOTE

The Gender of *Nosopon* Hopkins (Mallophaga)

The genus *Nosopon* was erected by Hopkins in 1950 (Ann. Mag. Nat. Hist. (12) 3:239) with the sole species indicated as *Menopon "fulvofasciatum* var." *minor* Piaget. No new combination was made nor was a statement made regarding either gender or derivation of the generic name. A few authors have placed additional species in the genus. The latest of these is Price (1976. J. Kans. Entomol. Soc. 49:23-26) who describes a new species and includes four other species in his key to the genus; viz., *N. australiensis* Price, *N. casteli*, *N. chanabensis*, *N. clayae*, and *N. lucidum*, the latter four without citation of authors' names.

It seems evident that the generic name is analogous to *Menopon*, inasmuch as no other reasonable derivation for it can be found in lexicons. Erichson (*In* Agassiz. 1846. Nomenclator Zoologicus. Fasc. 9 & 10. Epizoа:1) derived *Menopon* from Greek *menos* 'force, strength' + *ōps* 'face, aspect.' The name therefore has a suffix or termination *-on* appended to it. This changes its gender from that of *ops* to neuter (Internat'l. Code of Zool. Nomencl., Art. 30.a.i.3). *Nosopon* may be derived from Greek *nosos* 'disease, distress + *ōps* + *on*. Inasmuch as *-on*, as used in these names, is generally associated with neuter gender, both *Menopon* and *Nosopon* should be considered of neuter gender, as the former generally has been. Two of the species of *Nosopon* bearing adjectival species epithets should be in the neuter form; viz., *N. chanabense* and *N. australiense*. *Nosopon lucidum* is correctly neuter, and the other two epithets are in the genitive case. The neuter form of the epithet *minor*, incidentally, is *minus*.

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NOTE

A New Distribution Record for *Podocinum pacificum*
Berlese (Acarine: Mesostigmata)

A single female *Podocinum pacificum* Berlese was extracted from six soil samples collected on the Rob and Bessie Welder Wildlife Foundation in San Patricio County about 8 miles north of Sinton, Texas. The soil samples were collected 15 June 1978 in the riparian forest bordering the Aransas River; each sample was placed in a Berlese funnel under continuous illumination from 80-watt lamps for 10 days. The extracted material was preserved in 70% ETOH for sorting and identification.

Evans and Hyatt (1958. Ann. Mag. Nat. Hist. Ser. 12, X:913-932) discussed the zoogeography of the genus *Podocinum* and noted its restriction to regions within latitudes 30°N and 30°S, respectively. Accordingly, the genus is cosmopolitan in distribution with the exception of *P. pacificum* whose distribution also includes temperate zones. In the United States, a female *P. pacificum* was collected at Berkeley, California, 29 October 1951 by W. C. Bentinck (in Evans and Hyatt. 1958. Op. cit.). Our record for *P. pacificum* originated at latitude 28°00'N and extends the known distribution of the species in the United States to Texas and established a zoogeographical link between California and Argentina (Evans and Hyatt. 1958. Op. cit.).

Podocinum pacificum does not seem abundant in the microarthropod fauna of forest soils; the museum collections examined by Evans and Hyatt (1958. Op. cit.) normally contained only a single specimen or, at most, four individuals.

The Texas specimen of *P. pacificum* originated from a riparian forest community; the major forest species and their frequency of occurrence along 20 100-foot line transects were hackberry (*Celtis* spp.) 100%, anaqua (*Ehretia anacua* (Terán and Berland.)) 30%, persimmon (*Diospyros texana* Scheele) 70%, and ironwood (*Bumelia lycioides* (L.) Pers.) 100%. Mustang grape (*Vitis candicans* Engelm.) drapes many of the trees and provides additional foliage cover to the overstory shading a complex understory of brush, forbs, and grasses. The soils are also complex because of periodic flooding by the adjacent Aransas River. Generally, the soils are of the Sinton complex and Odem fine sandy loam groups; sandy terraces frequently intersect the heavier soils at these sites.

We are indebted to David Fischer for use of his unpublished vegetational data.

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81(2), 1979, pp. 327-328

NOTE

Mallophaga from Some North American Anatidae

During an ongoing survey of the helminth parasites of anatids, particularly in central and eastern Canada (Bain and Threlfall. 1977. Proc. Helminthol. Soc. Wash. 44:219-221; Mahoney and Threlfall. 1978. Can. J. Zool. 56:436-439; Noseworthy and Threlfall. 1978. J. Parasitol. 64:365-367; Turner and Threlfall. 1975. Proc. Helminthol. Soc. Wash. 42:157-169), Mallophaga were collected whenever they were seen. However, no systematic study of birds was made for these organisms. The specimens were fixed and stored in 70% alcohol and later mounted in Rubin's solution (Rubin. 1951. Stain Technol. 26:257-260) or stained with carbol fuchsin and mounted in Canada Balsam. Lapage (1961. Parasitology. 51:1-109; reprinted 1962. Wildlife Dis. (26), 3 microcards (109 p.)) listed the Mallophaga that had been recovered from members of the family Anatidae, while Emerson (1972. Checklist of the Mallophaga of North America (North of Mexico). Part IV. Bird host list. Deseret Test Center, Dugway, Utah. 216 p.) gathered together records for North American anatids. The classification of the Mallophaga follows the scheme of Emerson (1964. Checklist of the Mallophaga of North America (North of Mexico) Part I. Suborder Ischnocera, 171 p. Part II, Suborder Amblycera, 104 p. Dugway Proving Ground, Dugway, Utah), while that of the avian hosts follows the A.O.U. Checklist of North American Birds (1957. American Ornithologists' Union, Port City Press, Inc., Baltimore, Maryland. 691 p.) and its thirty-second supplement (1973. Auk. 90:411-419).

The following annotated list contains records of Mallphaga that we recovered from the anatids we examined, host origin (Newfoundland (NFLD), New Brunswick (NB), Ontario (ONT)), the location on the host (when known), and their status (- previous records.* new host record). No attempt was made to identify the majority of the lice to the subspecific level, due to the doubtful validity of many of the aforesaid taxa.

Ischnocera

Anaticola crassicornis (Scopoli, 1763): *Anas crecca*, NFLD, body, -; *Anas discors*, ONT, back, -; *Aythya collaris*, ONT, -, *; *Melanitta deglandi*, NB, -, -; *Melanitta perspicillata*, NB, -, -; *Mergus serrator*, ONT, -, -.

Anatoecus cygni (Denny, 1842): *Olor columbianus* (birds obtained after mass die-off due to lead poisoning), ONT, gular, nape and head regions, -; *Bucephala clangula*, ONT, head, *(stragglers?); *Clangula hyemalis*, ONT, head, *(stragglers?).

Anatoecus dentatus (Scopoli, 1763): *Anas platyrhynchos*, ONT, head, -; *Anas rubripes*, NB, head, *; *Ay. collaris*, ONT, -, *; *Somateria mollissima*, NFLD, head, -; *Lophodytes cucullatus*, ONT, head, *; *M. serrator*, ONT, -, -.

Anatoecus icterodes (Nitzsch, 1818): *A. rubripes*, NB, head, *; *Ay. collaris*, ONT, -, *; *Histrionicus histrionicus*, NFLD, -, *; *L. cucullatus*, ONT, head, *; *M. serrator*, ONT, -, -.

Anatoecus spp. (immatures and females only): *A. discors*, ONT, -, *; *Aythya americana*, ONT, head, -; *Bucephala albeola*, ONT, head, *.

Ornithobius waterstoni reconditus Timmermann, 1962: *O. columbianus*, ONT, head, -.

Amblycera

Ciconiphilus cygni Price and Emerson, 1965: *O. columbianus*, ONT, head, -.

Holomenopon loomisii (Kellogg, 1896): *M. serrator*, ONT, -, -.

Pseudomenopon sp. (immatures and females only): *L. cucullatus*, ONT, -, *; *M. serrator*, ONT, -, *.

Trinoton anserinum (J. C. Fabricius, 1805): *O. columbianus*, ONT, head, -.

Trinoton querquedulae (Linnaeus, 1758): *A. rubripes*, NB, head, -; *A. crecca*, NFLD, -, -; *Ay. collaris*, ONT, head, *; *B. clangula*, ONT, head, *; *L. cucullatus*, ONT, head, -; *M. serrator*, ONT, -, -.

During this study it became obvious that while much work has been done on the taxonomy of the Mallophaga of anatids, relatively few studies have been made of the population dynamics, and effects, of these parasites on their hosts. The authors feel that this is a fertile field where much more detailed work can be performed.

William Threlfall and Charles E. Bourgeois, Department of Biology, Memorial University, St. John's, Newfoundland, Canada, A1B 3X9; and Geoffrey A. Bain, Department of Zoology, University of Western Ontario, London, Ontario, Canada, N6A 5B7.

NOTE

Some New Synonymy in the Dolichopodidae (Diptera)

I examined the following types of Dolichopodidae in the United States National Museum, Washington, D.C. As the results of the study three new synonyms have been established.

1. *Hydrophorus signiferus* Coquillett (1899, in Jordan, Fur Seals 4:344). *Hydrophorus magnicornis* Frey (1915, Acta Soc. Fauna Flora Fenn. 40(5):70) is a NEW SYNONYM of *signiferus* Coquillett.

2. *Rhaphium dispar* Coquillett (1898, Proc. U.S. Nat. Mus. 21:319). *Porphyrops argyroides* Parent (1926, Encyc. Entomol. (B) 2 Dipt. 3:137) is a NEW SYNONYM of *dispar* Coquillett.

3. *Porphyrops nudus* Van Duzee (1924, Proc. U.S. Nat. Mus. (1923). 63(21):9). This species is a NEW SYNONYM of *Rhaphium nasutum* (Fälén) (1823, Monogr. Dolichopod. Sveciae :6 (*Hydrochus*)).

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Fig. 1

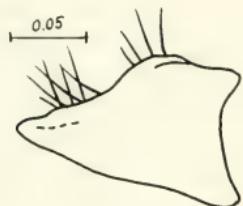


Fig. 2

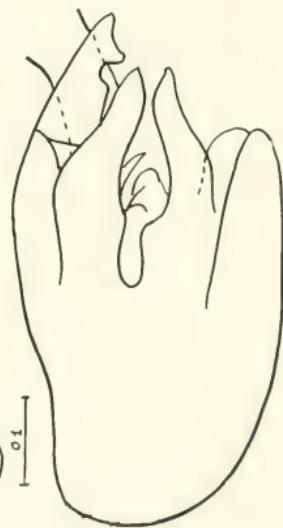
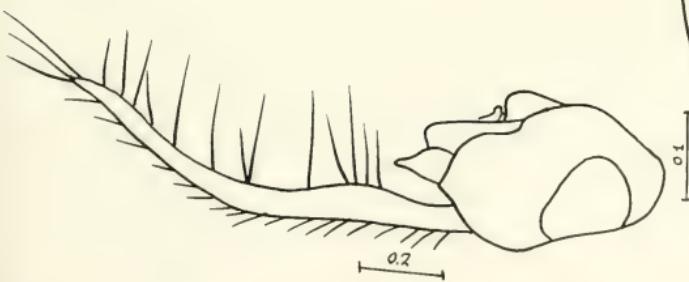


Fig. 3



Figs. 1-3. *Rhaphium dispar*. 1, Gonopod, lateral. 2, Hypopygium, ventral. 3, Hypopygium, lateral.

BOOK REVIEW

Record of My Life-Work in Entomology. 1903-1904. By C. R. Osten Sacken. With an appreciation and introductory preface by K. G. V. Smith. E. W. Classey, Ltd. Classica Entomologica No. 2, fascimile edition, 240 pp. plus addenda and corrigenda and postscripts, 3 plates and a frontispiece. Cost £7.50.

Carl Robert Romanovich, Baron von der Osten Sacken has been called the Father of North American Dipterology, and well he deserves the title. His own contribution, spanning 50 years, included description of 456 Nearctic species. Perhaps of even greater significance were his cooperative endeavors, particularly with the German dipterist Hermann Loew, which resulted in an additional 1,276 species. His catalogs, published in 1852 and 1878, were the first for the North American fauna and provided a then up-to-date framework on a par with the better studied European fauna. In view of Osten Sacken's contribution, it is fitting that his entomological autobiography be reprinted in its entirety and be made more widely available.

"Record of My Life-Work in Entomology," as implied by the title, is Osten Sacken's own account of his dealings and associations in entomology. Classey's reprinted edition is complete, including postscripts and addenda and corrigenda. In addition, Classey's edition includes Osten Sacken's portrait, taken in 1902, as a frontispiece.

Many details of Osten Sacken's life, especially before his residence in the United States, were not dealt with in his autobiography and were not generally known. In this regard, K. G. V. Smith's preface to the reprinted edition contains many details of Osten Sacken's life, including his ancestry, family, and pertinent events of his youth and education.

Osten Sacken's association with other biologists, not just dipterists, adds to the value of his work. His insights into the personalities and whim of many nineteenth century entomologists is enlightening as well as fascinating. Osten Sacken's biased but candid assessment of his contemporaries is in many cases our most informative account of their work. His assessment also tells us much about his own abilities and perspective.

The underlying element of Osten Sacken's entomological autobiography, including his evaluation of others, is Hermann Loew, and in many respects the book is more of a critique of Loew than an autobiography. Although Osten Sacken admired Loew's "working power" "tenacity at work" and even admitted that Loew excelled in his predilection of *minutiae*, particularly within the domain of the Acalypterata, he was critical of Loew's mastery of the subject and his "unpardonable and studied disregard of his contemporaries in dipterology." Osten Sacken felt that Loew was "less gifted with a spontaneous insight into natural affinities of Diptera than his contem-

poraries, Robineau-Desvoidy and Rondani.¹¹ Despite their differences, the liaison between Osten Sacken and Loew was fruitful and established the foundation of North American dipterology.

Classey's reprinted edition is a good reproduction of the original, and they are to be congratulated for their efforts in making valuable but scarce works, such as this, more generally available. I only wish that something besides the shiny white cover had been used; I would have preferred a color and luster more along the lines of a Russian Baron.

I am grateful to Alan Stone for providing the number of species-group names proposed by Osten Sacken and Loew.

Wayne N. Mathis, *Department of Entomology, NHB 169, Smithsonian Institution, Washington, D.C. 20560.*

OBITUARY



ERNEST NEAL CORY, SR.
Honorary Member ESW
1965-1979

Ernest Neal Cory was born in 1886 in New York State and came to Takoma Park with his family at an early age. He entered Maryland Agricultural College, now the University of Maryland, and graduated in entomology in 1909. His teachers were Thomas B. Symons, Arthur B. Gahan, and Leonard M. Peairs. Peairs left Maryland but he and Cory remained close friends many years.

Cory was at once employed at Maryland in nursery inspection, Experiment Station research, Extension and teaching. In 1913 he earned the Master's degree. In 1914 on Dr. Symons appointment as Director of Extension, he became State Entomologist, which entailed regulatory work, and Head of the Department of Entomology and Zoology, which entailed research and teaching.

There were the old pests, San Jose scale, codling moth, mosquitoes and house fly to engage his attention. Then a succession of new ones: oriental fruit moth, Mexican bean beetle, European corn borer, Japanese beetle and alfalfa weevil. San Jose scale as an orchard pest had made the State of Maryland insect conscious and brought about the establishment of the State Horticultural Board and active entomological work. Possibly his "favorite" pests were those of shade trees and shrubs because he loved gardens and helped to beautify homesteads with azaleas.

In 1926 he was awarded the PhD degree in entomology by American University.

Dr. Cory's principal interest was teaching. In 42 years he had 150 graduates. On retirement in 1956 he said, "You can work on a problem and save someone thousands of dollars, and it's all over. The real satisfaction comes in teaching men who go out and make names for themselves in the field."

I remember Dr. Cory's teaching me to mount aphids and mites and to study "red spider" in the greenhouse. He gave me freedom to rearrange the beetle collection, which seemed to me very big. And finally he spent considerable time teaching photography to Elizabeth Hook (the first four-year co-ed at Maryland), Toady Riggs, and me.

He joined the Entomological Society of Washington in 1911. He took his students to meetings frequently and made short talks. I remember going with him to a meeting in 1920; I believe it was in the large auditorium at the Smithsonian. Dr. Cory was elected President in 1942 and Honorary member in 1965.

The American Association of Economic Entomologists long claimed Cory's activity. He was elected to membership in 1910 and served on many different committees and boards—beekeeping, nursery inspection, the Journal. He served as secretary, and business manager of the Journal of Economic Entomology 1936 to 1952. In 1947 he was President and gave as his retiring address, "Totalitarian Insects," comparing the totalitarian nations

of Europe and Asia, defeated in World War II, to the social insects—honeybee, ants, and termites.

Dr. Cory with his wife, Bess, were gracious entertainers at their home and clubs. He excelled in Maryland cuisine. Two other interests endeared him to his associates, these were orchids and painting. Ernest became an expert in orchid culture and helped other growers over the country with insect and mite pests.

He painted both in oils and watercolors, following the talent of his father Azro J. After retirement he painted some 125 Christmas cards annually. He honored me with 15 cards on successive Christmases.

Dr. Cory's wife, the former Elizabeth Colton Elder, died in 1965. Dr. Cory spent his last years with his son, Ernest, Jr., and his wife, Ann, at their home on Corn Islands, Anne Arundel County, Maryland. Dr. Cory died January 27, 1979. His ashes were placed in the family plot at St. John's Episcopal Church, Beltsville.

Theodore L. Bissell, *3909 Beechwood Road, Hyattsville, Maryland.*

SUMMARY REPORTS OF SOCIETY OFFICERS FOR 1978

Treasurer
(1 November 1977 to 31 October 1978)

| SUMMARY: | General Fund | Special Publication Fund | Total |
|--------------------------|--------------|--------------------------|-----------|
| On hand, 1 November 1977 | 3,583.42 | 24,928.29 | 28,511.71 |
| Total receipts | 33,429.93 | 3,722.53 | 37,152.46 |
| Total disbursements | 26,233.45 | 0.00 | 26,233.45 |
| On hand, 31 October 1978 | 10,779.90 | 28,650.82 | 39,430.72 |

Editor
(Calendar Year 1978)

Four numbers of the *Proceedings* were published in 1977. The 672 pages printed represented 60 scientific articles, 15 notes, 10 book reviews, 1 obituary, 2 announcements, and the minutes for 10 meetings of the Society. Editorial charges were waived for 7 articles totaling 89 pages. Full editorial charges were paid for immediate publication of 1 article of 12 pages. Several lengthy articles included full editorial charges for 49 pages.

The Society partially covered the expenses for the Editor to attend the Annual Conference of the Council of Biology Editors, May 21-24, 1978, Toronto, Ontario, Canada. The conference dealt with the new copyright law and its effects, the use of new technology, the concept of a total information system, and several approaches to scientific writing.

Publications Committee: Earlene Armstrong, Wayne E. Clark, Ashley B. Gurney, George C. Steyskal, and Manya B. Stoetzel (*Editor*).

BYLAWS OF THE ENTOMOLOGICAL SOCIETY OF WASHINGTON¹

| | |
|---------------------------------|--|
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| Article II—Objectives | Article IX—Publications |
| Article III—Membership | Article X—Dissolution |
| Article IV—Fees | Article XI—Limitation and General Publications |
| Article V—Officers | Article XII—Amendments |
| Article VI—Executive Committee | |
| Article VII—Standing Committees | |

Article I.—Name

The name of this organization is "The Entomological Society of Washington."

Article II.—Objectives

Section 1.—The objectives of the Society are to promote the study of entomology in all its aspects and to cultivate mutually advantageous relations among those in any way interested in entomology. The Society is organized and operated exclusively for scientific and educational purposes.

Article III.—Membership

Section 1.—Members shall be persons who have demonstrated interest in the science of entomology.

Section 2.—Applications for membership shall be made to the Membership Committee in writing. They shall be accompanied by brief statements of qualifications.

Section 3.—Election of members shall be the responsibility of the Membership Committee in accordance with the procedure outlined in Article VII, Section 2.

Section 4.—Any member whose fees are paid in full may become a Life Member by paying \$150.00. Fees for a Sustaining Member are \$750.00 for a 5-year period. Life Members are exempt from paying further fees.

Section 5.—Members of 15 years or more standing, not in arrears for dues or otherwise indebted to the Society when retiring from income-producing employment, may request, and be continued by, the Executive Committee

¹ The last revision of the Bylaws was published in the Proceedings, vol. 73 (3): 348-354, Sept. 1971. Amendments since then are noted in vols. 75 (2): 251, June 1974; 76 (1): 96, March 1975; 78 (2): 223, April 1977; 78 (4): 495, Oct. 1977; and 79 (3): 494, July 1978. Further amendments were adopted at the regular meeting of November 1978, these being proposed by the undersigned committee during its preparation of these Bylaws for publication.—*Ad hoc Committee on Bylaws*, Douglass R. Miller, Douglas W. S. Sutherland, T. J. Spilman, F. Christian Thompson, Chairman.

as Emeritus Members without further payment of dues. Members thus relieved of the payment of dues will not be sent copies of the Proceedings.

Section 6.—The Society may elect Honorary Members in recognition of long and meritorious effort to advance entomological science. Individuals so recognized shall be approved unanimously by the Executive Committee and by two-thirds vote of members present at any regular meeting. Honorary members shall be elected for life, shall pay no fees, and shall be accorded all privileges of members. The number of honorary members carried concurrently on the membership roll shall not exceed three, except when an honorary member is chosen Honorary President, in which case there may be four.

Section 7.—A membership list shall be published at least once every three years in the Proceedings of the Society.

Article IV.—Fees

Section 1.—The annual fees, which include membership dues and subscription fee, shall be payable by January 1. Annual membership dues shall be two dollars and the member's subscription rate shall be eight dollars. Members residing outside of the United States may be charged a supplement to cover the increased cost of postage; the amount and nature of this supplement to be determined by the Treasurer and approved by the Executive Committee. Members elected prior to June shall receive all numbers of the Proceedings for that year. Members elected after June shall be exempt from fees for the calendar year in which they are elected and shall receive the Proceedings beginning with January of the next year.

Section 2.—The Treasurer shall notify those members one year in arrears for fees. If fees have not been paid one month after notice had been sent, the member's name shall be removed from the mailing list for the Proceedings. The member shall be notified of such action by the Corresponding Secretary. A member who is two years in arrears for fees may be dropped from membership by vote of the Executive Committee two months after a final notice had been sent.

Section 3.—A member shall be considered to be one year in arrears if he/she has not paid his/her fees by January of the year in which they are payable.

Section 4.—Members dropped for non-payment of fees, or those who have resigned, may be reinstated by payment of fees for the current year and by payment at membership rate for all copies of the Proceedings for which they are delinquent.

Article V.—Offices

Section 1.—The elected Officers of the Society shall be a President, a President-Elect, a Recording Secretary, a Corresponding Secretary, a Treas-

surer, an Editor, a Custodian, a Program Chairman, and a Membership Chairman. These shall be chosen from resident members.

Section 2.—The President or, in his/her absence, the senior officer present (as listed in the previous Section) shall preside at all meetings of the Society and of the Executive Committee. The President or his/her substitute shall have authority to and shall appoint any standing or special committees whose services are required in the interests of the Society. He/she shall conduct such correspondence as should appropriately bear his/her signature as presiding officer. He/she shall represent the Society on the Board of Managers of the Washington Academy of Sciences; or he/she may appoint a substitute for him/her. The President shall deliver an address on some subject pertinent to the objectives of the Society at the first or second meeting subsequent to the completion of his/her term of office.

Section 3.—The President-Elect shall automatically succeed to the Presidency at the close of the annual meeting, or whenever the President is unable to complete his/her term of office.

Section 4.—The Recording Secretary shall make a record of the proceedings of the Society and of the meetings of the Executive Committee, and shall submit a record of the Society's proceedings to the Editor for publication.

Section 5.—The Corresponding Secretary shall conduct all official correspondence of the Society except as otherwise provided, shall keep a list of all members and subscribers together with their addresses, and shall be responsible for the mailing of the Proceedings.

Section 6.—The Treasurer shall have charge of and be responsible for all funds and investments of the Society, and shall make routine disbursements. Unusual disbursements and investments shall be made only at the direction of the Executive Committee. He/she shall collect all sums due to the Society from any source, notify all members and subscribers who are in arrears, and shall present to the Executive Committee an annual report on the financial status of the Society, and conduct such correspondence as is necessary to carry out these duties. The fiscal year of the Society shall be November 1 to the following October 31. The Treasurer shall close his/her books at the end of the fiscal year so the accounts of the Society may be audited prior to its annual meeting.

Section 7.—The Editor shall be responsible for editing all publications of the Society and shall conduct such business as is necessary to carry out this responsibility.

Section 8.—The Custodian shall have charge of the reserve stock of the Society's publications, shall make such sales as lie within the interests of the Society, and shall be responsible for preserving such records, papers, or items of the Society as shall be deemed necessary by the Executive Committee.

Section 9.—The Program Chairman shall be responsible for arranging, with the assistance of the members of the Program Committee, the program of each meeting of the Society and for notifying the resident members of the Society of all meetings. Those members living in metropolitan Washington and nearby areas shall be considered resident members.

Section 10.—The Membership Chairman shall be responsible for activities of the Membership Committee as provided for in these Bylaws. He/she shall notify the Corresponding Secretary of the names and addresses of new members, and cooperate with that officer and the Treasurer in maintaining an accurate membership list.

Section 11.—At the annual meeting, having before it the list of candidates submitted by the Nominating Committee, the membership present may make other nominations from the floor. A separate election by written ballot shall be held for each officer for which there are two or more candidates, the ballots being distributed, collected and counted by tellers appointed by the President. When only one candidate for an office is before the Society, election shall be *viva voce* on motion and second from the floor and in that case two or more offices may be treated in one motion.

Section 12.—The officers shall serve for one year and until their successors are elected. They shall assume their duties at the end of the Annual (December) Meeting except the Treasurer who shall assume his/her duties as soon as arrangements can readily be made with his/her predecessor and the banks for transfer of Society funds. The Executive Committee may ask for such reports of officers as are deemed necessary. Except for the President and President-Elect, who cannot be re-elected to these offices in consecutive years, there shall be no limitation as to the number of terms to which an officer may be elected.

Section 13.—Vacancies in any office except President and President-Elect shall be filled through appointment by the Executive Committee. Members selected to fill such vacancies shall hold office only until their successors are elected. If the office of President-Elect becomes vacant, the position will be filled by a special election in accordance with regular nomination procedures.

Article VI.—Executive Committee

Section 1.—The activities of the Society shall be guided by an Executive Committee. The Committee membership shall consist of all officers and the last available past president.

Section 2.—The Executive Committee shall assume the responsibility for and shall conduct the activities of the Society, direct finances, and provide for meetings and publications. As provided elsewhere in these Bylaws, the Committee shall report fully to the Society once each year, on its conduct of the Society's business, either through the different officers or by a spe-

cially approved representative. The report shall include an approved audit of the Treasurer's accounts. The Committee shall also consider and present to the Society proposals for change or improvements, and shall transact all other business requiring attention and not otherwise assigned.

Section 3.—The Executive Committee shall hold such meetings as are required to transact the business of the Society during the year. One of these shall be sufficiently prior to the Annual Meeting to permit consideration and approval of a summary report for presentation by the President at the Annual Meeting on the state of the Society and the work of the officers. Other meetings of the Executive Committee may be called at any time by the President or his/her substitute and shall be called promptly by the presiding officer on request of any three members of the Committee other than the presiding officer. The presence of five members of the Executive Committee at any meeting shall establish a quorum.

Article VII.—Standing Committees

Section 1.—The standing committees of the Society shall consist of a Membership Committee, a Program Committee, a Publications Committee, a Finance Committee, and a Nominating Committee. New non-elective members of these committees shall be appointed by the incoming President each year. The Committees shall report to the Society at one of its meetings or to the Executive Committee as may be required.

Section 2.—The Membership Committee, consisting of the elected chairman and four appointed members, shall search for prospective new members of the Society among professional workers, students and amateurs in entomology, see that their applications are properly executed and by majority vote approve the candidates' qualifications for membership. The name of each new electee shall be reported by the Membership Committee at a regular meeting; and, in the absence of adverse notice from the members, the electee's name shall be read as a new member at the next regular meeting, and if feasible he/she shall be introduced by a sponsoring member. If the committee receives an adverse notice concerning an electee, the candidate's name shall be referred to the Executive Committee and final approval shall be by majority vote of that committee with formal announcement of membership to be made in the usual manner at the next regular meeting following action by the Executive Committee.

Section 3.—The Program Committee, with the elected Program Chairman serving as head, shall arrange for the programs and meeting places of all regular meetings of the Society. This Committee shall consist of the Chairman and three members, the latter to be appointed each year.

Section 4.—The Publications Committee shall consist of the Editor as Chairman and at least three appointed members. The appointed members shall assist the Editor. The committee shall consider and put into execution

plans for promoting the sales of Society publications. It shall make recommendations to the Executive Committee regarding publication of Memoirs and any other special publication. Terms for appointed members of the Publication Committee shall be at the discretion of the Editor and President.

Section 5.—The Finance Committee, consisting of the Treasurer as Chairman, the Editor, the Custodian, and the Program Chairman, shall assist the Treasurer in matters of finances of the Society and make recommendations to the Executive Committee relative to these matters. It shall be a particular duty of this Committee to prepare for the Executive Committee at the beginning of each year a statement of the income and expenditures of the preceding year and to prepare a budget based on the estimated receipt and disbursements of the coming year, with such recommendations as seem desirable. No financial obligation against the Society may be contracted by any officer or member except as specified in the annual budget or as provided for by special action of the Executive Committee upon recommendation of the Treasurer and Finance Committee.

Section 6.—The Nominating Committee of three members shall prepare a list of candidates comprising one nominee for each office, except the office of President, for presentation to the membership at the regular meeting one month before the annual meeting. The committee shall secure the acquiescence of each candidate before presentation.

Section 7.—The Auditing Committee of three persons shall be appointed by the President not later than October of each year. It shall inspect the accounts of the Treasurer and report to the Society at its next annual meeting.

Article VIII.—Meetings

Section 1.—The regular meeting of the Society shall be held, unless otherwise ordered by the vote of the Society or of the Executive Committee, on the first Thursday of each month except June, July, August and September. The annual meeting for the election of officers shall be the regular meeting for the month of December. Special and field meetings may be called by the Executive Committee. The Program Committee or committees appointed for special meetings may, with the approval of the Executive Committee, incur reimbursable expenses. Twenty members shall constitute a quorum.

Section 2.—The suggested order of business at the regular meetings, except the annual meeting, shall be as follows:

1. Reading and approval of minutes.
2. Reports of officers and committees.
3. Introduction of new members.
4. Miscellaneous business.
5. Presentation of notes and exhibition of specimens.

6. Presentation of announced topics.
7. Introduction of visitors.
8. Adjournment.

Section 3.—The suggested order of business at the annual meeting in December shall be:

1. Reading and approval of minutes.
2. Introduction of new members.
3. Presentation by the President of a summary report on the state of the Society and the work of the retiring officers.
4. Election of new officers.
5. Miscellaneous business.
6. Presentation of notes and exhibition of specimens.
7. Presentation of announced topics.
8. Introduction of visitors.
9. Installation of newly elected President.
10. Adjournment.

Section 4.—Either the first or the second regular meeting following the annual meeting shall be set aside for the delivery of the annual address of the retiring President.

Article IX.—Publications

Section 1.—Publications of the Society shall consist of a periodical to be known as the Proceedings of the Entomological Society of Washington which shall contain the proceedings of the Society and such papers as are accepted for publication in it, a series of Memoirs, and such miscellaneous handbooks or other special publications as may be deemed desirable. Each member in good standing, except Emeritus Members relieved of payment of fees, is entitled to one copy of each issue of the Proceedings (see Art. IV, Sec. 2).

Section 2.—Financial support of the Proceedings shall be provided from subscription revenues, from the sale of complete or partial sets of the Proceedings, from the fees of life and sustaining memberships, from editorial charges, and from such other funds as the Executive Committee shall determine.

Section 3.—The Society shall maintain a separate fund to be known as the Special Publication Fund. At the discretion of the Executive Committee, any unrestricted portion of the Special Publication Fund may be used for publishing Memoirs, handbooks, or other special publications. In any one year, a sum not exceeding the previous five years' income from interest on the Fund monies may be taken from this Fund and applied toward the publication of the Proceedings, such sum to be returned to the Special Pub-

lication Fund at the discretion of the Executive Committee. The Special Publication Fund will be derived from bequests and gifts, from the sale of Memoirs, handbooks, or other special publications, and from such other funds as the Executive Committee shall determine.

Section 4.—The publications of the Society shall be of the highest quality and content. To ensure this the Editor shall require review of all manuscripts before their acceptance for publication.

Article X.—Dissolution

If the Society should be dissolved or terminated, all its assets remaining after payment of all liabilities of the Society shall be transferred by the Executive Committee, upon recommendation of the Executive Committee and approved by the membership of the Society, to one or more non-profit organizations that have scientific and educational purposes, preferably with the same object as the Society, and that qualify as exempt organizations under Section 501 (c) (3) of the Internal Revenue Code, or under corresponding successor provisions.

Article XI.—Limitation and General Prohibitions

Section 1.—The objectives of the Society are listed in Article 2 of the Bylaws. Lobbying or activities specifically designed to influence legislation are not among the objectives of the Society and no official group within the Society shall engage in such activity.

Section 2.—Notwithstanding any provision of the Bylaws which might be susceptible to a contrary construction:

- a. no part of the net earnings of the Society shall or may under any circumstances inure to the benefit of any private shareholder or individual;
- b. no substantial part of the activities of the Society shall consist of carrying on propaganda, or otherwise attempting to influence legislation;
- c. the Society shall not participate in, or intervene in (including the publishing or distributing of statements) political campaigns on behalf of any candidate for public office;
- d. the Society shall not be organized or operated for profit;
- e. the Society shall not:
 - 1) lend any part of its income or corpus, without the receipt of adequate security and a reasonable rate of interest, to;
 - 2) pay any compensation, in excess of a reasonable allowance for salaries or other compensation for personal services actually rendered, to;
 - 3) make any part of its services available on preferential bases, to;
 - 4) make any purchase of securities or any other property, for more than adequate consideration in money or money's worth from;

- 5) sell any securities or other property for less than adequate consideration in money or money's worth to; or
- 6) engage in any other transactions which result in substantial diversions of its income or corpus to

any officer, member of the Executive Committee, or substantial contributor to the Society. The prohibitions contained in this subsection (e) do not imply that the Society may make such loans, payments, sales or purchases to anyone else, unless such authority be given or implied by other provisions of the Bylaws.

Article XII.—Amendments

These Bylaws may be amended at any regular meeting by a two-thirds vote of the members voting, if the total number voting represents a quorum, provided that such amendment has been passed by a two-thirds vote of the Executive Committee and presented to the Society in written form at the meeting prior to the meeting at which the vote is taken.

**PUBLICATIONS FOR SALE BY THE
ENTOMOLOGICAL SOCIETY OF WASHINGTON**

MISCELLANEOUS PUBLICATIONS

| | |
|--|---------|
| Cynipid Galls of the Eastern United States, by Lewis H. Weld | \$ 5.00 |
| Cynipid Galls of the Southwest, by Lewis H. Weld | 3.00 |
| Both papers on cynipid galls | 6.00 |
| Identification of Alaskan Black Fly Larvae, by Kathryn M. Sommerman | 1.00 |
| Unusual Scalp Dermatitis in Humans Caused by the Mite <i>Dermatophagooides</i> , by Jay R. Traver | 1.00 |
| A Short History of the Entomological Society of Washington, by Ashley B. Gurney | 1.00 |
| Pictorial Key to Species of the Genus <i>Anastrepha</i> (Diptera: Tephritidae), by George C. Steyskal | 1.50 |

MEMOIRS OF THE ENTOMOLOGICAL SOCIETY OF WASHINGTON

| | |
|---|---------|
| No. 1. The North American Bees of the Genus <i>Osmia</i> , by Grace Sandhouse. 1939 | \$15.00 |
| No. 2. A Classification of Larvae and Adults of the Genus <i>Phyllophaga</i> , by Adam G. Boving. 1942 | 15.00 |
| No. 3. The Nearctic Leafhoppers, a Generic Classification and Check List, by Paul Wilson Oman. 1949..... | 15.00 |
| No. 4. A Manual of the Chiggers, by G. W. Wharton and H. S. Fuller 1952 | 15.00 |
| No. 5. A Classification of the Siphonaptera of South America, by Phyllis T. Johnson. 1957 | 15.00 |
| No. 6. The Female Tabanidae of Japan, Korea and Manchuria, by Wallace P. Murdoch and Hiroshi Takahashi. 1969 | 15.00 |
| No. 7. Ant Larvae: Review and Synthesis, by George C. Wheeler and Jeanette Wheeler. 1976 | 11.00 |

Back issues of the Proceedings of the Entomological Society of Washington are available at \$15.00 per volume to non-members and \$9 per volume to members of the Society.

Prices quoted are U.S. currency. Dealers are allowed a discount of 10 per cent on all items, including annual subscriptions, that are paid in advance. All orders should be placed with the Custodian, Entomological Society of Washington, c/o Department of Entomology, Smithsonian Institution, Washington, D.C. 20560.

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PROCEEDINGS

of the

ENTOMOLOGICAL SOCIETY

of WASHINGTON



DEPARTMENT OF ENTOMOLOGY
SMITHSONIAN INSTITUTION
WASHINGTON, D.C. 20560

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TWO NEW SPECIES OF THE GENUS *CAMPTOPTEROHELEA* WIRTH
AND HUBERT FROM SOUTHEAST ASIA
(DIPTERA: CERATOPOGONIDAE)

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Abstract.—Two new species are described in the Oriental genus *Camptopterohelea* Wirth and Hubert: **javanensis** from Java and **tokunagai** from Malaysia. Notes and a key are presented to distinguish them from *C. hoogstraali* Wirth and Hubert from the Philippines, the only previously known species. Reasons are discussed for shifting *Camptopterohelea* from the tribe Ceratopogonini to the tribe Stilobezziini.

Heretofore the genus *Camptopterohelea* Wirth and Hubert (1960) has been known only from the unique holotype of *C. hoogstraali* Wirth and Hubert from Mount McKinley, Mindanao, Philippines. The purpose of this paper is to describe two similar but distinct new species of these minute biting midges from two widely separated localities in Southeast Asia. The males and immature stages of these midges are still unknown.

Wirth and Hubert (1960) and Wirth et al. (1974) placed *Camptopterohelea* in the tribe Ceratopogonini, near *Baeohelea* Wirth and Blanton and *Lepiohelea* Wirth and Blanton, which also have a reduced number of palpal segments and greatly modified wing venation. A study is now underway, however (Wirth and Grogan, in preparation), in which the tribal assignments of genera in the Ceratopogonini and Stilobezziini are re-evaluated, giving emphasis to some characters that have previously been given little attention. In the forthcoming study the size of the second radial cell, and along with this the length of the costa relative to the length of the wing, the length of the stem of the medial fork, and the presence or absence of macrotrichia on the wing membrane are not given primary importance in the separation of the two tribes. Instead, the presence of sensory pits (sensilla coeloconica) on some of the flagellar segments of the antenna will be given primary importance for recognition of the Ceratopogonini, and secondary emphasis

will be placed on the usual presence of hairy eyes and equal-sized tarsal claws in this tribe. *Camptopterohelea* lacks sensilla coeloconica and has only a single tarsal claw on each leg, and on all these counts must be assigned to the Stilobezziini, where it will key out (Wirth et al., 1974) near *Parastilobezzia* Wirth and Blanton, *Fittkauhelea* Wirth and Blanton, and *Parabezzia* Malloch. It is readily distinguishable from all of these by its short costa and the presence of only one sclerotized spermatheca.

Genus *Camptopterohelea* Wirth and Hubert

Camptopterohelea Wirth and Hubert, 1960:89. Type-species: *Camptopterohelea hoogstraali* Wirth and Hubert (original designation).

Diagnosis.—Only female known. Eyes bare, broadly separated. Antenna 15-segmented, long and slender, last 5 segments not longer than others. Palpus 3-segmented, proximal segment with sensory pit. Proboscis reduced, mandible with or without fine microscopic teeth. Thorax stout, humeral pits present. Legs moderately stout; 4th tarsomeres on front and middle legs slightly cordiform; only a single moderately long tarsal claw on each leg. Wing greatly modified, broad on basal $\frac{1}{2}$ and tapering distally; 2 radial cells present, 1st well developed, 2nd small; media and r-m crossvein absent; anterior portion of wing with a large transverse area with dense coarse microtrichia, other areas of spinelike microtrichia sometimes present; macrotrichia absent. One spermatheca present.

KEY TO SPECIES OF *CAMPTOPTEROHELEA*

1. Wing with a distinct patch of coarse dark spinelike microtrichia on distal portion, separate from the patch extending caudad from area of radial cells; 2nd tarsomere of hind leg with 4 palisade setae in comb 2
- Wing without patch of dark spinelike microtrichia on distal portion; 2nd tarsomere of hind leg with only 2 palisade setae in comb; (mandibular teeth present; vein M_{3+4} extending to wing margin, vein Cu_1 halfway to margin; patch of coarse spinelike microtrichia behind radial cells with a small cell-like area of small microtrichia)
..... *javanensis*, new species
2. Wing with distal patch of coarse microtrichia large and extending nearly to wing tip; mandibular teeth absent; vein M_{3+4} absent, Cu_1 represented by 2 parallel linear areas of coarse microtrichia extending to wing margin *hoogstraali* Wirth and Hubert
- Wing with distal patch of coarse microtrichia restricted to a small rounded subapical area; mandibular teeth present; veins M^{3+4} and Cu_1 both extending about halfway to wing margin *tokunagai*, new species

Camptopterohelea hoogstraali Wirth and Hubert
Fig. 1g-h

Camptopterohelea hoogstraali Wirth and Hubert, 1960:90 (♀; Philippines; figs.).

Type.—Holotype, ♀, east slope of Mount McKinley, 3300 ft, Davao Prov., Mindanao, Philippines, 25 September 1946, F. G. Werner, at light (on slide; deposited in Field Museum of Natural History).

Notes.—Through the courtesy of the Field Museum of Natural History the junior author borrowed the type of *C. hoogstraali* in order to make a closer comparison with our two new species. We were able to confirm that in *C. hoogstraali* there is no trace of mandibular teeth, there are four sharp palisade setae on the second tarsomere of the hind leg (Fig. 1g), there is a large area of coarse spinelike microtrichia on the distal portion of the wing (Fig. 1h), and the distal arms of the mediocubital fork are not complete, the anterior arm is apparently entirely absent, and the posterior arm is represented by two parallel linear areas of coarse spinelike microtrichia extending to the wing margin.

Camptopterohelea javanensis Wirth and Wada, NEW SPECIES
Fig. 1a-f

Female.—A minute dark brown midge without distinctive markings. Wing length 0.85 mm (holotype) and 0.71 mm (paratype); breadth 0.43 mm (holotype) and 0.35 mm (paratype).

Head (Fig. 1b): Eyes very broadly separated, by about the diameter of 7 ommatidial facets; bare between facets. Vertex with small hairs in interocular space. Antenna (Fig. 1a) 15-segmented; 1st segment concealed in head capsule, approximately 0.036 by 0.064 mm, higher than broad, with 2-3 small setae; 2nd segment greatly swollen, 0.051 mm long, breadth nearly equal to length; distal segments forming a 13-segmented flagellum 0.50 mm long. Lengths of flagellar segments in holotype in proportion of 12-11-11-11-12-14-14-12-14-14-14-16-25, in paratype 12-11-10-10-11-11-11-9-11-11-12-13-20; antennal ratio (XI-XV/III-X) 0.8-0.9; all flagellar segments with a proximal whorl of 4-5 long verticils and a distal pair of short, curved, hyaline sensilla trichodea; in addition segments III-IX each with 3 long, straight, hyaline sensilla trichodea in middle of segment, and segments XI-XV with a few scattered long fine hairs. Palpus (Fig. 1c) short, degenerated from a 5-segmented condition; 1st and 2nd segments absent; distal 3 segments not clearly separated; 3rd segment (apparent 1st) moderately swollen on distal 0.6, 0.036 mm long and 0.023 mm wide, bearing a small, round, shallow, sensory pit; 4th segment short, 0.013 mm long and 0.018 mm wide; 5th segment slender, parallel sided, 0.028 mm long and 0.005 mm wide. Head

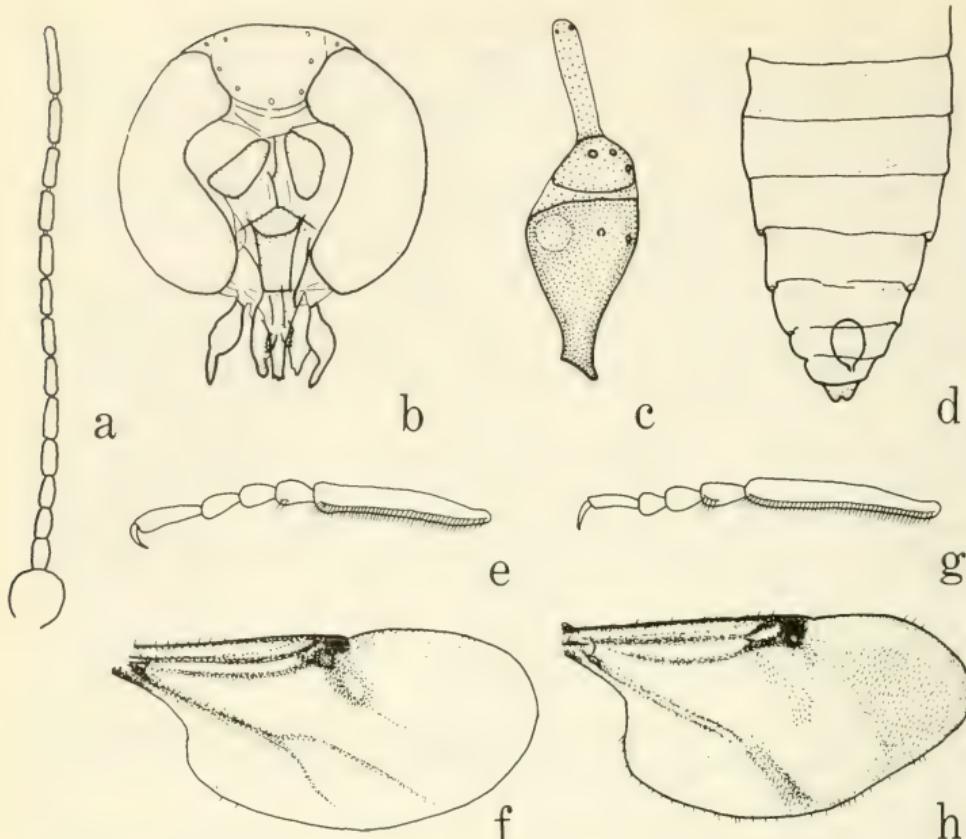


Fig. 1a-f. *Campptopterohelea javanensis*. a, Antenna; b, anterior view of head; c, palpus; d, abdomen; e, hind tarsus; f, wing. Fig. 1g-h. *C. hoogstraali*. g, Hind tarsus; h, wing.

height (from tormae to interocular setae) 0.16 mm in holotype and 0.12 mm in paratype. Mouthparts short; proboscis length (from tip of labrum-epipharynx to tormae) 0.07 mm in holotype and 0.06 mm in paratype. Mandible with 10 teeth, distal ones larger. Labrum-epipharynx with a flap extending beyond 2 blunt, short, terminal teeth, without lateral teeth. Hypopharynx with 4 slender teeth.

Thorax: Scutum dark brown, with a submedian pair of oval hyaline pits toward anterior margin; with short scattered bristly hairs. Scutellum dark brown, with 5-6 bristles. Legs moderately stout, dark brown. Femora with apical pale bands and tibiae with basal pale bands. Front tibia with a lanceolate spur and compact comb of bristly hairs; mid tibia without spur or comb; hind tibia without spur but with a comb of bristly hairs. Hind basitarsus with a row of sharp palisade setae ventrally, and 2nd tarsomere with 2 (rarely 3) sharp palisade setae (Fig. 1e). Claws single, long (0.03-0.04

mm), slightly curved, $\frac{3}{4}$ as long as 5th tarsomere. Proportions of legs as follows (scale: 0.01 mm):

| <i>Holotype</i> | Femur | Tibia | Tarsomere | | | | |
|-----------------|-------|-------|-----------|----|-----|----|---|
| | | | I | II | III | IV | V |
| Fore | 26 | 25 | 11 | 3 | 3 | 3 | 6 |
| Mid | 31 | 32 | 14 | 4 | 3 | 3 | 5 |
| Hind | 33 | 30 | 15 | 4 | 3 | 3 | 5 |

| <i>Paratype</i> | Femur | Tibia | I | II | III | IV | V |
|-----------------|-------|-------|----|----|-----|----|---|
| Fore | 22 | 20 | 10 | 4 | 3 | 3 | 5 |
| Mid | 25 | 25 | 12 | 3 | 2 | 2 | 4 |
| Hind | 30 | 24 | 13 | 3 | 2 | 2 | 4 |

Wing (Fig. 1f) uniformly light brown; venation greatly modified as in figure; vein M_{3+4} complete to wing margin, vein Cu_1 obsolete on distal $\frac{1}{4}$; costa extending to 0.56 of wing length; macrotrichia absent, large spinelike microtrichia present surrounding a small oval bare area in upper middle part of wing, more numerous between this area and end of costa. Halter light brown.

Abdomen (Fig. 1d): Dark brown. A single large oval spermatheca present, measuring 0.115 by 0.087 mm, including a short, slender, sclerotized neck.

Male.—Unknown.

Distribution.—Indonesia.

Types.—Holotype, ♀, Manggis, Sukabumi, West Java, Indonesia, elevation about 500 m, 25 June 1977, T. Suzuki, by light trap at chicken farm (USNM Type no. 73564). Paratype, 1 ♀, same data as holotype (deposited in National Science Museum, Tokyo, Japan). The types are mounted each on a glass slide with phenol-balsam.

Discussion.—*Camptopterohelea javanensis* resembles the type-species of *Camptopterohelea* in all respects except that the mandibles are toothed and vein M_{3+4} is present in the wing. Additional characters for separation of the species of this genus are found in the key.

Camptopterohelea tokunagai Wirth and Wada, NEW SPECIES Fig. 2

Female.—Wing length 0.69 mm; breadth 0.40 mm. Closely resembling *C. javanensis*, but differing as follows: Antenna (Fig. 2a) with lengths of flagellar segments in proportion of 11-10-11-11-12-12-12-13-14-14-15-15-20, antennal ratio 0.85. Measurements (length vs width in mm) of palpal segments as follows: 3rd, 0.044 by 0.025; 4th, 0.012 by 0.018; 5th, 0.025 by 0.007 (Fig. 2b). Proboscis (Fig. 2e) 0.33 as long as height of head; mandible (Fig. 2d) with 10 fine teeth. Wing (Fig. 2c) with veins M_{3+4} and Cu_1 evanescent about

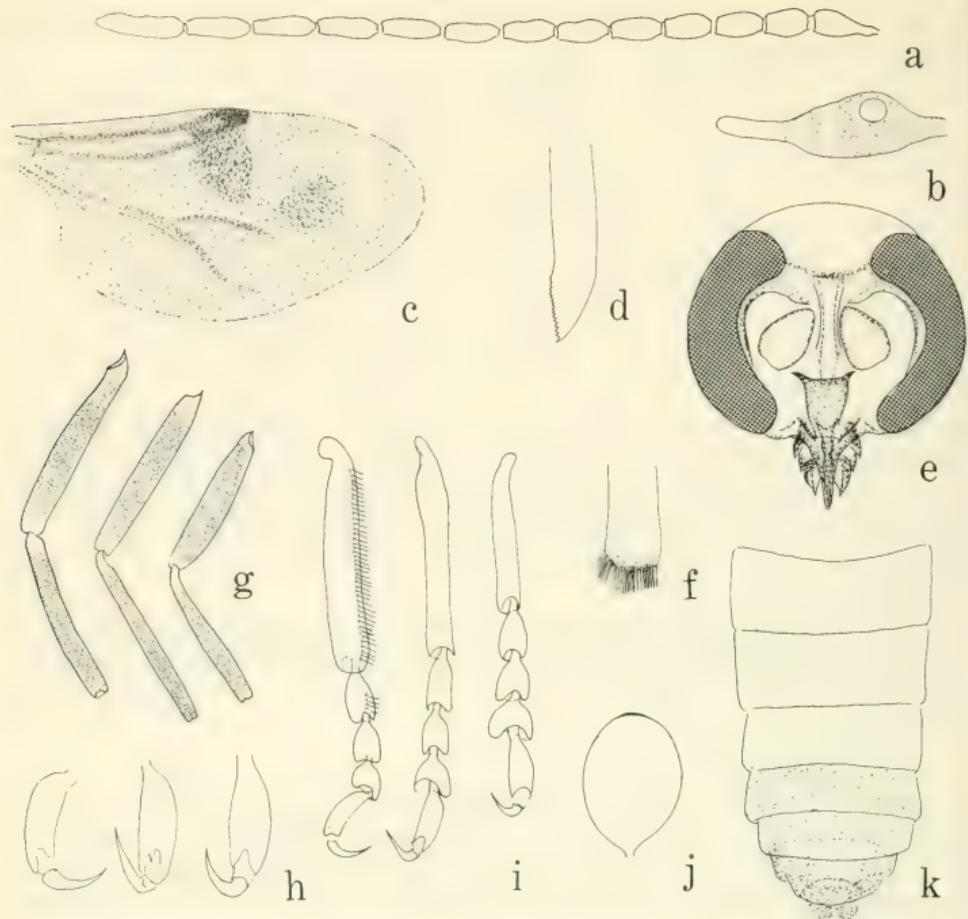


Fig. 2. *Camptopterohelea tokunagai*. a, Antenna; b, palpus; c, wing; d, mandible; e, anterior view of head; f, hind tibial comb; g, femora and tibiae; h, fifth tarsomeres and claws of (left to right) hind, mid, and fore legs; i, tarsi (left to right) of hind, mid, and fore legs; j, spermatheca; k, abdomen, dorsal view.

halfway from base of fork to wing margin; coarse spinelike microtrichia forming 2 large dark brown areas, a larger slightly transverse patch behind radial cells, and a 2nd rounded smaller patch about midway between posterior margin of the former and the wing tip. Halter pale brown. Second tarsomere of hind leg (Fig. 2i) with 4 palisade setae in a comb on distal $\frac{1}{2}$; claws (Fig. 2h) shorter, each about $\frac{1}{2}$ as long as 5th tarsomere. Spermatheca (Fig. 2j) measuring 0.133 by 0.097 mm.

Male.—Unknown.

Distribution.—Malaysia.

Type.—Holotype, ♀, on slide, Kuala Lumpur, Selangor, Malaysia, Ke-

pong Forest Reserve, March–April 1960, R. Traub, light trap (USNM Type no. 73563).

Discussion.—This species is named for Dr. Masaaki Tokunaga of Kyoto, Japan, in recognition of his monumental work on the classification of Asian and Pacific biting midges.

ACKNOWLEDGMENTS

We are grateful to Dr. Eric H. Smith, Field Museum of Natural History, Chicago, Illinois, for loaning the holotype of *C. hoogstraali* for comparison, and to Dr. T. Suzuki, Vector and Rodent Control Research Unit, WHO, Jakarta, Indonesia, for submitting the specimens of *C. javanensis*. We are very much indebted to Dr. Niphan C. Ratanaworabhan, Applied Scientific Research Corporation of Thailand, Bangkok, for the illustrations of *C. tokunagai*.

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The editor has a stack of illustrations from several past volumes. These illustrations will be discarded on December 1, 1979, unless otherwise claimed.

PRELIMINARY ANNOTATED LIST OF THE WASPS OF SAN
SALVADOR ISLAND, THE BAHAMAS, WITH A NEW
SPECIES OF *CERCERIS* (HYMENOPTERA:
TIPHIIDAE, SCOLIIDAE, VESPIDAE,
POMPILIDAE, SPHECIDAE)

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Abstract.—Twenty-three species of Aculeate Hymenoptera were collected from San Salvador Island, the Bahamas, between November 1975 and June 1978. Collection records for these species are compared with museum records and the literature to determine the source of the island's wasp fauna. A new species, *Cerceris watlingensis*, is described. Behavioral notes on *Stictia signata* and *Tachysphex alayoi* are included.

Aculeate Hymenoptera have been little studied in the Bahama Islands. Bahamian species and subspecies have been treated in taxonomic revisions, as, for example, in Bequaert's and Salt's (1931) and Bequaert's (1948) works on various Vespidae, Krombein's (1942) revision of the Myzininae (Tiphiidae), and Bradley's (1928) study of *Campsomeris* (Scoliidae). Krombein's (1953) paper on the aculeates of Bimini is one of the few works representing an extensive study of a particular island in the Bahamas. Since the Bimini group lies only about 50 miles off the coast of Florida, it would be expected to show many affinities with the Floridian fauna. But Krombein (1953) reported a large percentage of the Bimini wasps to be endemic species or subspecies, with only a small percentage of the species North American in origin. Many species considered endemic to the Biminis may be found on other islands in the Bahamas as they are explored. A similar study on one of the outer islands of the Bahamas would be instructive in providing further information about the origin of the Bahamian wasp fauna.

Since 1975 we have been collecting and observing aculeates on San Salvador Island in the Bahamas. This island, located about 400 miles southeast of the coast of Florida, is vegetated largely by subtropical scrub (Smith, 1975), with many brackish inland lakes.

Our paper lists collection records for wasps from the island and compares these records with those obtained from museum specimens and a survey of the literature. Higher taxonomic groups are arranged phylogenetically according to Muesebeck et al. (1951), and species are arranged alphabetically. Behavioral notes are included on certain of the species, and a new species, *Cerceris watlingensis* is described.

Representatives of the species collected and the types of *Cerceris watlingensis* have been deposited in the United States National Museum. Paratypes of *Cerceris watlingensis* have been deposited in the Cornell University collection. Duplicate specimens have been retained in the collections at the authors' institutions.

Abbreviations of institutions are given in Acknowledgments.

TIPHIIDAE

Myzinum apicale Cresson. ♀♀: 26 Nov. 1976, nr. Polaris; 7 Dec. 1976, Farquharson's Plantation; 6 June 1978, dump. ♂♂: 23 Nov. 1977, East Beach; 28 Nov. 1977, nr. Polaris (4); 29 Nov. 1977, Cockburntown; 9 June 1978, dump.

These individuals cannot be assigned to any of Krombein's (1942, 1953) subspecies. The males have only the last abdominal tergite ferruginous, whereas in typical *M. a. apicale* and *M. a. cazieri* Krombein (1953), the last two are ferruginous. The other subspecies of *M. apicale* described by Krombein (1942) lack ferruginous markings on the abdomen. Krombein (1953) reported Bahamian collection records for this species as follows: *M. apicale breve* from Rum Cay and New Providence; *M. a. eleuthera* from Eleuthera, and *M. a. jamaicense* from Turk's Island. He described *M. a. cazieri* from the specimens collected on Bimini.

Myzinum ephippium bahamense Krombein. ♂♂: 26 Nov. 1975, no specific locality; 23 Nov. 1977, Blacklands.

This species has previously been collected from Mariguana and Grand Bahama Island, but was not reported from the Biminis (Krombein, 1953).

SCOLIIDAE

Campsomeris trifasciata nassauensis Bradley. ♀♀: 24 Nov. 1975; 24 Nov.-4 Dec. 1976, no specific locality; 9 Dec. 1975, 7 Dec. 1976, Farquharson's Plantation; 9 Dec. 1976, High Cay; 6 Dec. 1976, Snow Bay; 20 Nov. 1977, CCFL Base; 28 Nov. 1977, nr. Polaris; 1 Dec. 1977, Jake Jones' Road; 5 Dec. 1977, Sandy Hook; 12 Dec. 1977, nr. sinkholes. ♂♂: 21 Nov.-8 Dec. 1975 (28), 24 Nov.-1 Dec. 1976 (2), 28 Nov. 1977, no specific locality; 1 Dec. 1975 (3), 5 Dec. 1977 (2), Sandy Hook; 9 Dec. 1975, Farquharson's Plantation; 22 Nov.-11 Dec. 1976 (3), 14 June 1978, CCFL Base; 24-25 Nov. 1976 (3), 15 Dec. 1976 (1), 1 Dec. 1977 (8), 10 June 1978 (1), Jake Jones' Rd; 26 Nov. 1976, nr. Polaris; 22-25 Nov. 1977 (2), 6-9 June 1978

(4), dump; 23 Nov. 1977, Blacklands (2); 5 Dec. 1977, nr. French Bay; 5 Dec. 1977, Sandy Pt.

Males of this species are frequently collected on flowers along paths into the island's interior. Bradley (1928) described the subspecies from specimens collected at Nassau, and Krombein (1953) reported it from the Biminis. In addition, we have examined a series of two females and nine males from Mangrove Cay, Andros (CU).

VESPIDAE

Polistes exclamans picturatus Bequaert and Salt. ♀♀: 20 Nov.-8 Dec. 1975 (17), 23 Nov. 1976 (1), 23 Nov. 1977 (2), no specific locality; 20 Nov. 1976, nr. French Bay; 22-24 Nov. 1976 (8), 2 Nov. 1977 (1), CCFL Base; 24-25 Nov. 1976 (3), 1 Dec. 1977 (1), Jake Jones' Rd; 28 Nov. 1976 (1), 28 Nov. 1977 (2), nr. Polaris; 2 Dec. 1977, Watlings' Castle; 2 Dec. 1977, Guana Cay (2); 5 Dec. 1977, Sandy Pt; 8 Dec. 1977, trail to N. Granny L. ♂: 23 Nov. 1977, no specific locality.

While our specimens agree in general with Bequaert's and Salt's (1931) description of the holotype of this subspecies, there is variation among our specimens not accounted for in the original description. Bequaert and Salt (1931) listed the presence of four longitudinal yellow bars on the mesonotum as one of the distinguishing characteristics of the subspecies. In several specimens of *P. e. picturatus* from San Salvador, the lateralmost pair of bars is reduced or lacking. There is also variation in the extent of yellow on the propodeum. This subspecies has previously been reported from San Salvador (Krombein, 1953), and from other Bahamian localities including Acklin, Mariguana, Rum Cay, Crooked Island, Long Island and Cat Island.

Polistes major (Palisot de Beauvois). ♂♂: 22 Nov.-6 Dec. 1975 (12), 22 Nov. 1976 (1), 23 Nov. 1977 (1), no specific locality; 24 Nov. 1976, Jake Jones' Rd; 30 Nov. 1976, Sandy Hook; 2 Dec. 1976, Watlings' Castle; 7 Dec. 1976, Farquharson's Plantation; 8 Dec. 1976, High Cay (2); 20 Nov. 1977, CCFL Base; 22-23 Nov. 1977, dump (4); 23 Nov. 1977, East Beach; 28 Nov. 1977, nr. Polaris.

Krombein (1953) noted that this species had previously been collected on Eleuthera in the Bahamas, but did not report it from Bimini.

Mischocyttarus cubensis Saussure. ♀♀: 23 Nov.-9 Dec. 1975, no specific locality (12); 24 Nov. 1976 (1), 24 Nov.-1 Dec. 1977 (2), Jake Jones' Rd; 26 Nov. 1976, nr. Polaris; 21 Nov. 1977, CCFL Base (2); 22 Nov. 1977, dump; 5 Dec. 1977, limestone pit nr. French Bay.

The collection records for museum specimens of this species indicate a range which includes localities in Florida, South Carolina, Texas, Cuba (USNM), and Honduras (CU). Bahamian records are from Bimini, Nassau (USNM), New Providence, Eleuthera and Watlings' Island (MCZ).

Zethus bahamensis Bequaert and Salt. ♂: 30 Nov. 1976, Sandy Hook.

Bequaert and Salt (1931) described this species from specimens collected at Nassau. We have examined an additional specimen from Cat Island (MCZ).

Pachodynerus nasidens (Latreille). ♀: 30 Nov. 1977, Sandy Hook.

Collection records for museum specimens of this species include Cuba, Mexico, Brazil, Peru, Argentina, Guyana, Surinam, and Canal Zone (CU). Bequaert (1948) reported that New Providence was the only Bahamian locality from which the species had been collected. Krombein (1953) did not include the species in his list of Bahamian wasps.

Pachodynerus scrupeus (Zavattari). ♀♀: 1–2 Dec. 1975 (6), 30 Nov. 1976 (2), 30 Nov. 1977 (1), Sandy Hook; 6 Dec. 1975, 14 Dec. 1976, no specific locality; 6 Dec. 1976, nr. Pigeon Creek; 22 Nov. 1977, dump. ♂♂: 1–2 Dec. 1975 (6), 5 Dec. 1977 (1), Sandy Hook; 3–4 Dec. 1975 (2), 25 Nov. 1976 (1), no specific locality; 2 Dec. 1977, Guana Cay; 6 June 1978, dump; 16 June 1978, CCFL Base.

Pachodynerus scrupeus var. *bahamensis* Bequaert and Salt. ♀♀: 1–2 Dec. 1975 (4), 30 Nov. 1976 (1); 30 Nov. 1977, Sandy Hook; 21 Nov.–4 Dec. 1975, no specific locality; 24–25 Nov. 1976 (4), 24 Nov.–1 Dec. 1977 (3), Jake Jones' Rd; 26 Nov. 1976, 28 Nov. 1977, nr. Polaris; 2 Dec. 1977, Guana Cay; 5 Dec. 1977, Sandy Pt.; 8 Dec. 1977, trail to N. Granny L. ♂♂: 1–2 Dec. 1975 (2), 30 Nov. 1976 (2), Sandy Hook; 22 Nov. 1976, CCFL Base.

Bequaert and Salt (1931) described the variety *Pachodynerus scrupeus bahamensis* from a single specimen collected at Mangrove Cay, Andros. This variety was distinguished from typical *P. scrupeus* by having the basal portion of the first abdominal tergite red. Bequaert (1948) reported additional individuals of the typical form from Cuba, Cat Island, New Providence, Rum Cay and Eleuthera; he reported the Bahamian subspecies from New Providence, Cat Island, Long Island and Watlings Island, now San Salvador. Krombein (1953) reported both forms from South Bimini. On San Salvador both forms have been collected from the same population. Thus this variation should be considered a case of polymorphism, and the variety *P. s. bahamensis* should be considered invalid.

POMPILIDAE

Episyron conterminus posterus (Fox). ♂: 6 June 1978, dump.

This is a widely distributed species with its range extending from California and New York to Guatemala according to Muesebeck et al. (1951).

Anoplus fulgidus (Cresson). ♀♀: 12 Dec. 1975, Jake Jones' Rd; 2 Dec.

1977, Guana Cay; 8 Dec. 1977, trail to N. Granny L. (3); 10 Dec. 1977, no specific locality. ♂♂: 8 Dec. 1977, trail to N. Granny L. (2).

According to Muesebeck et al. (1951), the range of this species includes the Greater Antilles, as well as Mexico, Texas, Florida, Utah and California, but it was not reported from Dominica by Evans (1972), nor did Krombein (1953) include it among the Pompilidae previously collected from the Bahamas. Museum specimens examined came from the following non-Bahamian localities: Jamaica (USNM, BMNH, MCZ), St. Croix, St. Thomas, Peru, Bolivia, Honduras, Texas (USNM), Puerto Rico (USNM, MCZ), Florida, Guatemala (USNM, BMNH), Mexico (BMNH), Haiti, Cuba (USNM, MCZ). The only Bahamian specimens we examined came from Androstown, Andros (USNM, MCZ).

Anoplius insignis bahamas Krombein. ♀♀: 2 Dec. 1975 (2), 30 Nov. 1977, Sandy Hook; 6 Dec. 1976, Snow Bay.

This species was described by Krombein (1953) with the holotype and allotype specimens from Nassau. Additional collection records listed by Krombein included South Bimini and Moraine Cay.

SPHECIDAE

Tachytes tricinctus (F.). ♀♀: 6–17 June 1978, CCFL Base. ♂♂: 6 June 1978, dump; 19 June 1978, Graham's Harbor to Barker's Pt (2).

Krombein (1953) described a subspecies, *Tachytes cubensis bimini* from a series of males collected in Bimini. Bohart and Menke (1976) treated *T. cubensis* as a synonym of *T. tricinctus*, and transferred Krombein's subspecies to a different species, *T. distinctus*. Specimens of *T. tricinctus* which we examined were collected from Cuba (USNM).

Tachysphex alayoi Pulawski. ♀♀: 6–9 June 1978, dump (2); 6–17 June 1978, CCFL Base (5). ♂♂: 6–9 June 1978, dump; 10–16 June 1978, CCFL Base (8).

Pulawski (1974) included the following localities in the known geographic distribution of this species: Cuba, Jamaica, Puerto Rico and the Virgin Islands. Bohart and Menke (1976) added Florida to its known range. Thus this is apparently the first published record of the species' occurrence in the Bahamas. Krombein (1953) reported *Tachysphex terminatus* (Smith) from North Bimini. While that species is primarily North American in distribution, Pulawski (1974) reported its occurrence in South America as well.

Three females of *T. alayoi* were collected with roaches, all individuals of *Symploce* sp. nr. *munda* Gurney; one was an adult male, the other two were nymphs. In all cases these females were collected on the ground, having flown down from nearby vegetation. The ratio of weights of the prey to those of the females varied from 1.98 to 2.76:1.

Liris antilles Krombein. ♀♀: 22–29 Nov. 1975, CCFL Base (3); 6 Dec. 1975, 25–26 Nov. 1976 (2), 23 Nov.–1 Dec. 1977 (2), no specific locality; 9 Dec. 1976, High Cay. ♂♂: 30 Nov.–6 Dec. 1975 (2), 23 Nov. 1976 (1), 30 Nov. 1977 (1), 6–10 June 1978 (2), CCFL Base; 1 Dec. 1975, no specific locality; 8 Dec. 1977, trail to N. Granny L.

This species was described by Krombein (1953) from holotype and allotype specimens collected on South Bimini. He reported other individuals of the species from New Providence, Cat Island, and Cuba.

Liris argentata (Beauvois). ♀: 22 Nov. 1975, CCFL Base. ♂♂: 29 Nov. 1975, CCFL Base; 6 Dec. 1975, no specific locality.

While this species is primarily North American in its distribution, Bohart and Menke (1976) included Cuba, the Bahamas and Hawaii in its distribution. Krombein (1953) reported its occurrence on South Bimini.

Sphex jamaicensis (Drury). ♀♀: 22 Nov. 1975 (2); 23 Nov.–15 Dec. 1976 (2), 21 Nov.–14 Dec. 1977 (4), 14–15 June 1978 (2), CCFL Base; 22 Nov.–10 Dec. 1975, no specific locality (9); 29 Nov. 1975 (1), 24 Nov.–13 Dec. 1976 (2), 24 Nov.–1 Dec. 1977 (2), Jake Jones' Rd; 30 Nov. 1976, nr. French Bay; 30 Nov. 1977, Sandy Hook; 6 Dec. 1976, Snow Bay; 22 Nov. 1977, dump. ♂♂: 19 Nov.–4 Dec. 1975, no specific locality (2); 6 Dec. 1975, CCFL Base; 6 Dec. 1976, Snow Bay (2); 26 Nov. 1977, nr. Polaris.

Museum records indicate that this species is found in Florida (CU, MCZ, USNM), Jamaica (BMNH, USNM), and Cuba (USNM). These records agree with the distribution of the species as reported by Bohart and Menke (1963). Bahamian records include the following: Nassau (BMNH, MCZ, USNM), Long Island, Crooked Island, Rum Cay, S. Eleuthera, Cat Island (MCZ), Andros (MCZ, USNM), and the Biminis (USNM).

Prionyx thomae (F.). ♀♀: 22 Nov.–6 Dec. 1975 (5), 7–12 June 1978 (3), CCFL Base; 24 Nov.–15 Dec. 1975, no specific locality (6); 1–2 Dec. 1975 (6), 30 Nov. 1976 (2), Sandy Hook. ♂♂: 24 Nov.–6 Dec. 1975 (6), 23 Nov. 1976 (2), 11–13 June 1978 (4), CCFL Base; 26 Nov. 1976, nr. Polaris (2); 28 Nov. 1978, no specific locality.

This species was recorded by Bohart and Menke (1976) as occurring in western and southeastern United States, Central and South America, and the West Indies. Our studies of museum specimens substantiate this wide distribution. Bahamian records of specimens we examined included the following localities: Rum Cay, New Providence, and Simons, Long Island (MCZ). The species, however, was not listed by Krombein (1953) among those occurring in the Bahamas.

Sceliphron jamaicense (F.). ♀♀: 3 Dec. 1975, no specific locality; 8 June 1978, dump; 12 June 1978, CCFL Base; 19 June 1978, nr. N. Point.

Krombein (1953) reported this species from South Bimini. Museum specimens we examined included individuals from Cuba, Dominican Republic (BMNH, CU), Turks and Caicos Islands, and Jamaica (BMNH).

Stictia signata (L.). ♀♀: 24 Nov.-8 Dec. 1975 (15), 26 Nov.-7 Dec. 1976 (2), 23-27 Nov. 1977 (3), no specific locality; 24 Nov. 1976, 9 June 1978, Jake Jones' Rd; 22 Nov.-9 Dec. 1976, CCFL Base (4); 26 Nov. 1976, nr. Polaris (3); 2 Dec. 1976, Watlings' Castle; 15-16 Dec. 1976 (6), 22 Nov. 1977 (2), 9 June 1978 (1), dump; 23 Nov. 1977, Blacklands (2); 30 Nov. 1977, Sandy Hook; 19 June 1978, Graham's Harbor to Barker's Pt. ♂♂: 20-24 Nov. 1975 (5), 22 Nov. 1976; 23 Nov. 1977, no specific locality; 23 Nov. 1976, CCFL Base; 30 Nov. 1976, Sandy Hook.

This is a widespread tropical species, as indicated by collection records on museum specimens from Peru, Brazil, Venezuela, Paraguay, Panama, Dominican Republic, Mexico, Jamaica, St. Vincent, Grenada, Martinique (USNM), Guyana, Cuba, Puerto Rico (CU, USNM). Bahamian records include the following localities: Andros (CU, MCZ, USNM), Arthurstown, Cat Island, Clarencetown, Long Island, Crooked Island (MCZ) and Nassau (USNM). Krombein (1953) reported this species from Bimini.

One of us (S.C.) studied nesting and predatory behavior of *Stictia signata*. This is one of the few tropical species on which previous behavioral studies have been published (Evans, 1966, 1972; Richards, 1937).

One female was observed digging a nest in sandy soil at the edge of the softball field at the CCFL base at about 1500 on 27 November 1976. The nest was in progress when observations were begun, and the female was making successive digging trips below the surface. She reentered the nest nine times, spending between 40 and 49 ($\bar{x} = 43.2$) sec inside the burrow each time. She then backed out and distributed accumulated sand. Having completed the burrow, she backed out of the entrance and scraped sand backward into the entrance, filling it completely. Then she leveled the talus that had accumulated outside the burrow. Following completion of leveling, she made short flights around the area, pulling small pebbles away with the forelegs and mandibles. Finally she flew away to hunt. In about 15 min, she returned with prey, carrying it with the second and third pairs of legs. She opened the nest and entered directly, spending 10 min below the surface. Then she spent 4 min reclosing the entrance before flying away to hunt.

All of the provisioning females we observed entered their nests directly except for one female with a very large sarcophagid. This prey was deposited near the entrance while the female opened and entered it. She exited, and approached the nest again, digging at the surrounding sand as she did so. The prey was partly covered with sand in the process. She entered the nest again, then exited and uncovered the prey, and moved it closer to the

entry. Then she reentered the nest. Finally she reappeared in the entrance, head first, and pulled the prey backwards into the nest.

Females varied in the completeness of temporary nest closures and tumulus leveling. In the case mentioned above, the nest was filled completely and the tumulus fully leveled before the female flew away to hunt. On 1 December 1976, another female was observed carrying prey to her nest. When first observed, she was making a temporary closure by scraping sand into the entrance. Within six minutes, she returned with prey, repeated the temporary closure and flew away again. Upon her return to the nest, 21 min later, she left the nest partly open. In 3½ min she returned with prey, entered, and made a more complete closure upon leaving. She returned 28 min later, and left the nest with virtually no closure. During the next two returns to the nest, she made rudimentary closures of 6 and 3 sec duration. Another female we observed spent 51 sec making a closure. Thus there is variability between individuals and between successive closures by the same female.

Females hunted at various sites to which the flies they preyed upon were attracted. We observed females hunting at the garbage dump near Graham's Harbor and near vertebrate carrion. Evans (1966) reported their capturing flies near livestock. Perhaps such attraction explains the annoyance these wasps cause by flying at humans in the tropics and subtropics. Indeed, Richards (1937) reported that a female *Stictia* captured a tabanid from the neck of one of the observers in his party.

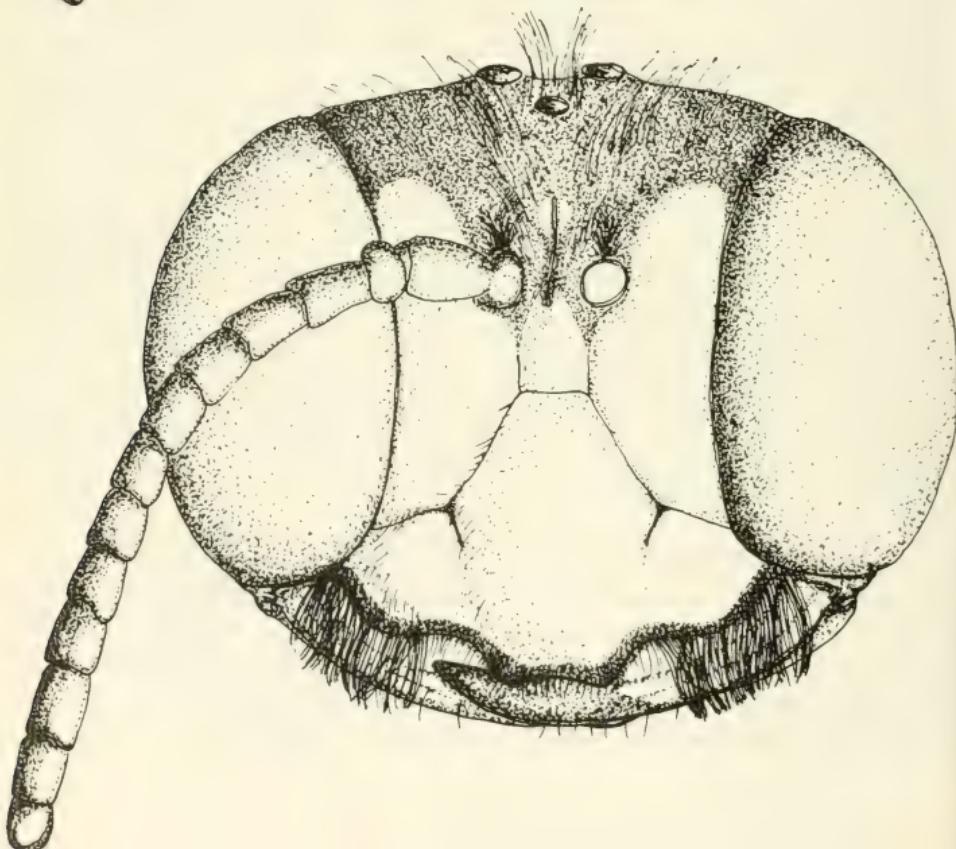
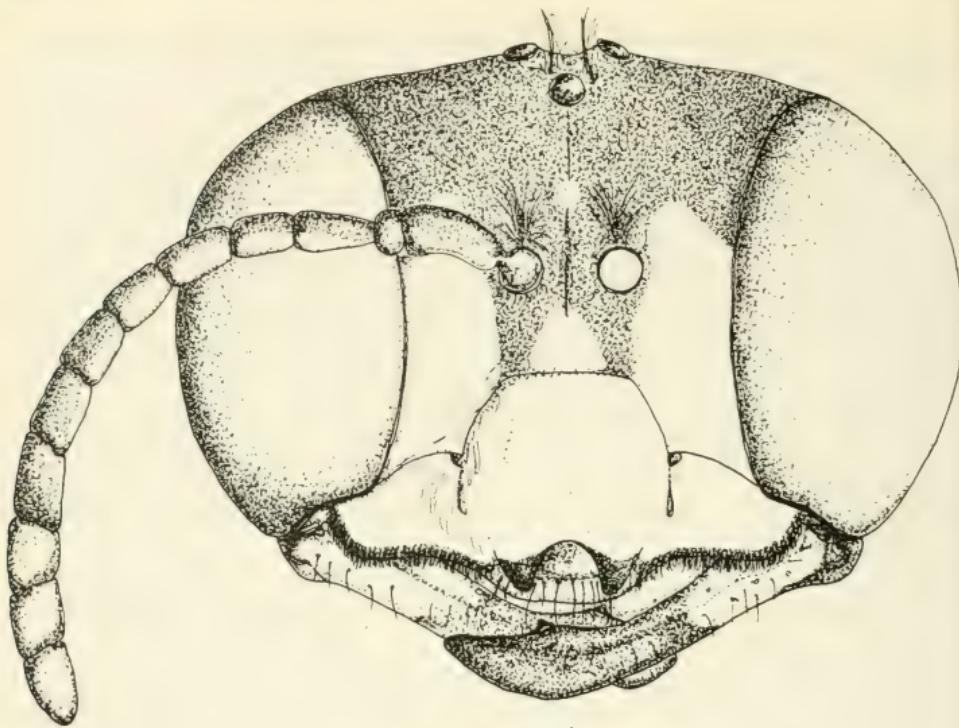
A hunting female approached a would-be prey, grabbing it with the fore and middle legs. The sting was inserted while the female was in flight. She then flew away with the sting still inserted in the fly.

While excavating nests of other sphecid wasps, we discovered several old cells of *S. signata*. One cell was located at a depth of 25 cm; it was 25 mm long and 15 mm high, and contained debris from at least 11 flies, as indicated by a count of head capsules. Another was at a depth of 27 cm and contained at least six head capsules. A third was found 13 cm below the surface; it was 4.2 cm long, 2.0 cm high, and 1.4 cm wide. It contained a cocoon which was 2.3 cm long and 0.9 cm in diameter. Chief families of Diptera utilized as prey by *S. signata* on San Salvador included Syrphidae, Muscidae, Sarcophagidae, and Calliphoridae.

Cerceris watlingensis Elliott and Salbert, NEW SPECIES

A new species of *Cerceris* was collected during the studies on San Salvador. We propose the name *watlingensis* for the old name for San Salvador Island, and for Watlings' Castle, one of the localities on the island from which it has been collected.

Female.—*Length:* 10.1 mm–18.5 mm.



Head: Frons, clypeus whitish yellow, punctate with whitish appressed setae; setae on lateral margins of clypeus longer, silvery and appressed ventrally. Clypeal process bidentate; teeth and ventral margin of process black. Interantennal ridge black, terminating between 2 minute yellow spots on the vertex. Vertex black, granular, punctate, with sparse erect setae. Gena behind eye bearing yellow macula. See Fig. 1.

Thorax: Pronotum black at base with swollen yellow posterior margin; pronotal lobe, tegula mostly yellow; scutum black; metanotum black except for 2 minute yellow spots. Scutellum largely yellow except lateral portion adjacent to wing attachment. Propodeum yellow dorsolaterally, but black area surrounds propodeal enclosure; propodeum punctate with erect setae; propodeal enclosure triangular, black at base and apex, but largely yellow; finely and shallowly punctate. All coxae black with yellow maculation; trochanters largely yellow; femora black; foretibiae and tarsi yellow; mid- and hindtibiae yellow at base, black apically; tarsi dark. Lateral margins of hindtibiae coarsely toothed with a row of setae. Larger of hindtibial spurs pectinate.

Abdomen: First abdominal tergite with broad yellow band, narrowed medially; 2nd through 5th tergites with successively narrower yellow bands; all but most posterior concave anteriorly. Pygidium granular, coarsely punctate. Abdominal sternites mostly black, 2nd and 3rd with small lateral yellow spots.

The females in the type-series agree in general with the above description of the holotype. The color of the frons and vertex varies from deep yellow to whitish; a few females have the setae in these areas reduced or lacking. Otherwise there is variation in the extent of yellow markings on the tegulae and propodeal enclosure. Terminal flagellomeres are ferruginous in a few females.

Male.—*Length:* 9.5–10.5 mm.

Head: See Fig. 2. Frons and clypeus yellow, smooth, punctate with whitish erect setae. Frontoclypeal suture clearly defined; suture around tentorial pits divides clypeus into three parts. Golden hairs on lateroventral margin of clypeus form brush-like structure. Interantennal ridge black, ending just behind a yellow spot on the vertex. Vertex granular, punctate, with scattered setae.

Thorax: Thorax black except as noted below. Posterior margin of pronotum yellow and swollen as in female. Central portion of tegula yellow. Median portion of scutellum yellow. Propodeum black, shining with yellow



Figs. 1, 2. *Cerceris watlingensis*, frontal view of head. 1, Female, upper figure. 2, Male, lower figure. (Drawn by Thomas Caperna, Syracuse University.)

lateral maculae, large, well-spaced punctures with erect setae; propodeal enclosure with more closely-spaced, but shallow punctures, triangular, entirely black. All coxae black with yellow maculation; trochanters yellow; femora black; fore and mid-tibiae and tarsi yellow; basal $\frac{1}{2}$ of hindtibiae yellow; apical $\frac{1}{2}$ black; hind tarsi dark.

Abdomen: Abdominal tergites 2 through 4 with subapical yellow bands complete, slightly narrowed medially; tergites 5 and 6 with yellow band incomplete medially. Pygidium shining, with a few widely scattered punctures. Abdominal sternites mostly black; sternites 2 through 5 with postero-lateral yellow markings.

Genitalia: See Fig. 3. Aedeagus elongate, with head of valves simple, lacking teeth or setae; volsella short, stout and simple, gonostyle elongate, slender and bearing a few scattered setae on distal $\frac{1}{3}$.

The males of the paratype series agree with the description of the allotype male except for slight variation in color pattern. Only a few males have the yellow spot on the vertex near the posterior extent of the interantennal ridge; a few males have the hindtarsi distinctly black. One male has two small yellow markings on the propodeal enclosure.

Types.—*Holotype female*: 28 Nov. 1977, dump. *Allotype male*: 14 Dec. 1977, dump. *Paratypes*: ♀♀: 30 Nov. 1977, Sandy Hook; 1 Dec. 1977, Jake Jones' Rd; 6–14 Dec. 1977, dump (10); 8 Dec. 1977, trail to N. Granny Lake. ♂♂: 21 Nov.–14 Dec. 1977, dump (6).

Distribution.—The species is known only from specimens collected on San Salvador Island, but studies on neighboring islands may show that it occurs there as well. Other localities on San Salvador from which the species has been collected include Sandy Point, Watlings' Castle and the CCFL Base.

Discussion.—This species is distinguished from the various Cuban species we have examined on the basis of clypeal characteristics of the female. *Cerceris festiva* Cresson has a more extensive yellow pattern on the face, and its clypeal process forms a shallow inverted U rather than a deep V-shaped notch as in *C. watlingensis*. Females of *C. hatuey* Alayo have the face more deeply punctate, and although the clypeus is raised, it is not toothed. *Cerceris triangulata* Cresson has the face and vertex entirely yellow, and the clypeal process consists of two cuticular pieces. *Cerceris zonata* Cresson (=*cubensis*), which is very small in comparison with *C. watlingensis*, has a slightly swollen clypeus, but no clypeal process. We have examined only males of *C. cerverae* Giner Mari, but this species is distinguished by the black clypeus of the male with its central yellow marking and an elongate yellow stripe on the scape. We were unable to examine two additional Cuban species, but these are also distinct from *C. watlingensis*. *Cerceris flavocostalis* Cresson lacks the deeply incised clypeal process, as

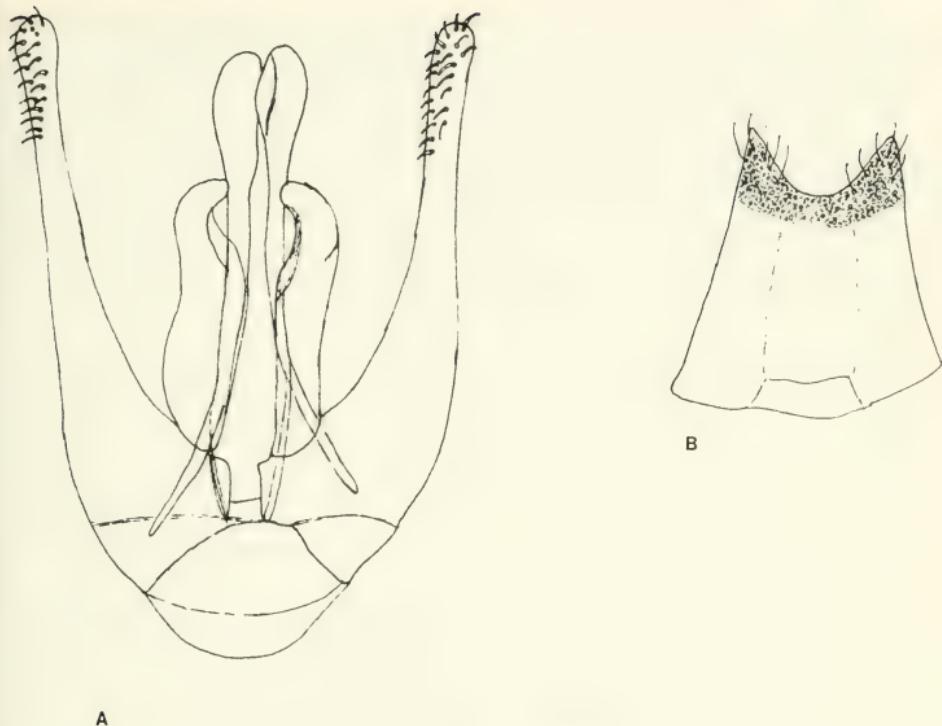


Fig. 3. *Cerceris watlingensis*, male genitalia. A, Genitalia. B, Subgenital plate.

does *C. trinitaria* Alayo. The latter also has a rounded keel surrounding the clypeal process (Alayo, 1968).

Cerceris zonata Cresson. ♀♀: 10 June 1978, dump; 17 June 1978, CCFL Base. ♂: 13 June 1978, CCFL Base.

This species was not reported from the Bahamas by Krombein (1953); Bohart and Menke (1976) reported it only from Cuba.

Ectemnius auriceps (Cresson). ♂: 26 Nov. 1977, dump.

This species was reported from the Bahamas by Pate (1947). It was not collected from Bimini (Krombein, 1953). Bohart and Menke (1976) included Cuba and the Bahamas in the species distribution.

DISCUSSION

A total of 23 species of Aculeate Hymenoptera were collected during our studies on San Salvador. Eleven of these (48%) were also reported from Bimini (Krombein, 1953). One new species, *Cerceris watlingensis*, has been described as a result of our collections. It cannot be considered endemic to

San Salvador, however, because of lack of collection data from the nearby islands. The largest percentage of species we collected (30%) may be considered West Indian in their distributions (*Myzinum apicale*, *Pachodynerus scrupeus*, *Sceliphron jamaicense*, *Liris antilles*, *Tachytes tricinctus*, *Cerceris zonata*, *Ectemnius auriceps*); 17% have been collected only from the Bahamas (*Campsomeris trifasciata nassauensis*, *Myzinum ephippium bahamensis*, *Zethus bahamense*, *Anoplius insignis bahamas*). Three of the names listed in the latter group belong to Bahamian subspecies of West Indian species with wider distributions, however. Five species (*Mischocyttarus cubensis*, *Pachodynerus nasidens*, *Anoplius fulgidus*, *Sphex jamaicensis*, and *Tachysphex alayoi*) have been reported from the West Indies and southern United States. Several species are more widely distributed. *Polistes major*, *Stictia signata*, and *Episyron conterminus posterus* are distributed from the southern United States through Central and South America. *Prionyx thomae* and *Liris argentata* are widely distributed in North America. Our paper apparently reports the first Bahamian collection records for *Tachytes tricinctus*, *Tachysphex alayoi*, and *Cerceris zonata*.

We found that seasonality is a factor in the distributional flight patterns of the wasps on San Salvador. Since the weather is satisfactory for wasp activity throughout the year, we had expected many of the same species to be active at all times. A collecting trip to study sphecids in June 1978 proved that this was not the case. Three species of sphecids, which we had not collected in November and December, were active at this time. They were *Tachytes tricinctus*, *Tachysphex alayoi*, and *Cerceris zonata*. *Sceliphron jamaicense*, which we had collected once in December, was more common in the summer. Other species, including *Stictia signata*, *Prionyx thomae*, and *Sphex jamaicensis*, seemed to be active at approximately the same level at both times of year. *Cerceris watlingensis* individuals were present in June, but their level of activity was much lower than in November and December.

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ETHOLOGY OF *HOLCOCEPHALA FUSCA* IN VIRGINIA
(DIPTERA: ASILIDAE)

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Abstract.—*Holcocephala fusca* Bromley foraged primarily from twig tips on the edges of forest clearings. Prey were captured and immobilized in flight. The preferred prey consisted of Hymenoptera and Diptera. While *in copula* the male assumed a position similar to that observed in *Leptogaster* spp., with his head down and dorsal surface facing the same way as the female's ventral surface. Collected eggs had hexagonal sculpturing on the chorion. Grooming behavior and nocturnal resting position are similar to that described for other species of Asilidae.

In the United States there are three described species in the robber fly genus *Holcocephala* (Martin, 1965): *H. abdominalis* (Say), *H. calva* (Loew), and *H. fusca* Bromley. To date only the ethology of *H. abdominalis* has been described in some detail (Johnson, 1976) and limited ecological observations have been made for the other two species.

The present paper adds to our knowledge of the ethology and ecology of *H. fusca*. This species was studied intermittently for a two week period from August 21 to September 5, 1976, in a forested area in Fairfax, Virginia, at an elevation of approximately 152 m above sea level. The habitat consisted of a mixed stand of pine (*Pinus* sp.), oak (*Quercus* sp.) and a few hickory (*Carya* sp.) trees, with a dense shrub understory of blackberry (*Rubus* sp.), greenbrier (*Smilax* sp.), and rose (*Rosa* sp.). *Holcocephala fusca* were mostly found on the edge of the forested area near its juncture with lawn areas of apartment buildings. A few asilids were also observed on the edge of small clearings in the forest, but they seemed to prefer and were most abundant near large, open areas. This species was never observed in the darker more thickly vegetated areas of the forest. Both *H. abdominalis* and *H. calva* have generally been reported to occur in moist edges of meadows, woodland areas and marshy lakes which contain sedges

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and grasses (Baker and Fischer, 1975; Brimley, 1922; Bromley, 1931, 1946, 1950a, 1950b; Hull, 1962; McAtee and Banks, 1920). Scarbrough (1974) reported these species to occur in dry fields composed of shrubs and trees, a stream margin in a wood-field and along a sunlit path in some woods. Also, Johnson (1976) found *H. abdominalis* to occur in an open field. It is of interest to note that when *H. abdominalis* and *H. calva* occurred simultaneously within a habitat, *H. calva* were far less numerous (Baker and Fischer, 1975; Bromley, 1931; McAtee and Banks, 1920). This may indicate that interspecific competition can keep *H. calva* populations at relatively low levels.

RESTING BEHAVIOR

Holcocephala fusca rested on the vegetation in the shade or sun, with its body parallel to the ground or the twig it was on, or with its body at a 45° angle to the vertical like *H. abdominalis* (Johnson, 1976). The asilids almost always faced open areas where there was lower growing vegetation than their resting place. Also, they rarely faced areas shaded by vegetation, but faced sunlit areas or directly into the sun. This position presumably made it easier to see the outline of their prey. Melin (1923) stated that asilids "... often catch their prey against the sun . . ." A few non-foraging individuals, mostly males, were observed on twig tips 230 cm above the ground. These males were usually "resting" between searching flights for receptive females with which to mate. *Holcocephala fusca* were never observed to land on the ground.

FORAGING AND FEEDING BEHAVIOR

Holcocephala fusca generally foraged from the tips of vegetation (mostly blackberry and rose twig tips) 30 to 120 cm above the ground. However, when the wind blew in excess of 3.2 km/hr the asilids moved closer to the ground and foraged at heights between 7.5 and 60 cm above the ground.

During flight *H. fusca* held their fore legs in a modified "chair-like" position up against the body, slightly extended, and bent between the femora and tibia. The mid and hind legs were held in a similar position, but with the femora at a 60° to 90° angle to the body and a more pronounced bend between the femora and tibia. A similar positioning of the legs has been reported for *H. abdominalis* (Johnson, 1976) and *Leptogaster* spp. (Dennis and Lavigne, 1976b; Hobby, 1931a; Melin, 1923; Parmenter, 1952; Scarbrough and Sipes, 1973; Seguy, 1950).

As has been reported for other species of Asilidae (Dennis and Lavigne, 1975), *H. fusca* would often make several forage flights from the same twig tip before changing its foraging site. Then they would generally fly 60 to 90 cm to another location and resume foraging.

While this species was engaged in foraging activity and while it was feed-

ing, it continued to observe other insects, as indicated by rapid movements of its head and body. According to Melin (1923), these movements allow asilids to obtain a larger field of vision. In addition, it probably allows them to see their prey with the central ommatidia of their eyes. Melin demonstrated that these ommatidia probably have a greater intensity of vision than the surrounding ommatidia.

Holcocephala fusca usually made forage flights and captured prey in sunlit areas, although a few prey were captured in the shade of vegetation. Forage flights into sunlit areas were for distances of 12.5 to 90 cm, whereas forage flights into shaded areas were much shorter (usually 12.5 to 30 cm). It is assumed that the asilids made longer forage flights in sunlit areas because of increased visual acuity.

Although forage flights were made for distances up to approximately 90 cm from an asilid's foraging position, prey were observed to be successfully captured only within 12.5 to 30 cm of the asilid. Like *H. abdominalis* (Johnson, 1976), all prey were captured in the air either to the side or in front of an asilid. However, most prey were captured directly in front of the asilid and 10 to 15 cm above its foraging position. It is assumed that the manner in which *H. fusca* carried its legs in flight enabled it to more readily capture its prey. The positioning of the legs in flight has also been associated with prey capturing methods of *Leptogaster* (Dennis and Lavigne, 1976b; Martin, 1968; Melin, 1923).

Holcocephala fusca made frequent forage and investigatory flights. During the latter type flights the asilids would either chase insects without coming into contact with them, or make contact with potential prey, manipulate them with all six tarsi and then release them. According to Dennis and Lavigne (1975), investigatory flights probably help asilids discriminate between suitable and unsuitable prey before actually attacking. Also, asilids which release prey may have poorer powers of vision than asilids which capture prey and do not release them. However, it is possible that prey may be rejected for other reasons, such as odor or toughness of the integument (e.g., Coleoptera).

Holcocephala fusca made frontal captures which resulted in the prey's head being directly underneath the asilid's head following capture. Once prey were captured, the asilid would either immediately insert its hypopharynx or manipulate the prey with all six tarsi for 15 to 25 seconds before insertion. During manipulation the asilid would often move 30 to 90 cm from the capture site before landing to feed. The hypopharynx was always observed to be inserted into the dorsum of the prey's thorax or in the intersegmental membrane between the head and thorax. These points of insertion are the ones most frequently reported in the literature. Johnson (1976) observed that *H. abdominalis* also inserted its hypopharynx in the mouth and anus of Formicidae.

Not all prey were immobilized as soon as the asilid inserted its hypopharynx. Prey, in particular Formicidae, often remained active for 20 to 25 seconds before being completely immobilized. This may have resulted from the hypopharynx either not penetrating a ganglion or not being inserted close enough to one of the anterior nerve centers. In addition, *H. fusca* and asilids in general, may be able to regulate the amount of neurotoxin which is injected into prey and small amounts may not immobilize prey as fast as large amounts.

After prey were captured, *H. fusca* often returned to its previous foraging site. If this position was in a sunlit area, they would then frequently move into a shaded area where the temperature was 2 to 3°C lower than that in the sun. Lavigne and Dennis (1975) observed that such behavior probably helps asilids maintain their normal body temperature by reducing exposure to the sun's rays.

As *H. fusca* fed, prey were manipulated with all six legs as the asilid hovered 7.5 to 10 cm around its feeding station. The hypopharynx was removed and reinserted during the hover after which the asilid settled down and continued feeding. Hovers generally lasted for 7 to 8 seconds and during this period the asilid often moved 30 to 90 cm from its former feeding position before settling down. It is of interest to note that prey manipulation was rarely observed, possibly because the small size of the prey did not necessitate it. Johnson (1976) never observed *H. abdominalis* to manipulate prey and also speculated that this was due to the small size of the prey. Hovering and manipulating prey has been observed quite frequently in the subfamily Asilinae, but not in the Dasypogoninae, to which *H. fusca* belongs (Dennis and Lavigne, 1975; Lavigne and Holland, 1969).

During feeding prey were allowed to hang free and were frequently observed to balloon. However, like *H. abdominalis* (Johnson, 1976), abdominal pumping by *H. fusca* was never observed. Prey ballooning has been attributed to asilids pumping digestive enzymes and digested material in and out of the prey (Lavigne and Holland, 1969).

Holcocephala fusca fed on prey for an average of 10 minutes 54 seconds with a range between 1 minute and 29 minutes 30 seconds. There was a positive correlation between the time spent feeding and the length of the prey. Prey with an average length of 1.25 mm, such as *Bradysia* sp., were fed on for approximately 9 minutes 30 seconds; whereas winged reproductive *Myrmecina americana* Emery, which averaged 3.0 mm in length, were fed on for 20 to 24 minutes.

At the completion of feeding prey were usually pushed off of the asilid's hypopharynx with the fore tarsi. However, some prey were discarded as the asilid withdrew its hypopharynx without touching the prey. Some prey were also allowed to drop off the asilid's hypopharynx as it flew to a new location, began to forage for other prey or captured another prey. Johnson

Table 1. Relation between length of *Holcocephala fusca* and that of its prey.

| Sex | Predator Length (mm) ^a | | | Prey Length (mm) | | | No. of Prey Measured | Mean Ratio of Predator to Prey |
|---------------------------|-----------------------------------|---------|------|------------------|---------|------|----------------------|--------------------------------|
| | Minimum | Maximum | Mean | Minimum | Maximum | Mean | | |
| Male | 5.0 | 6.5 | 5.9 | 0.5 | 3.0 | 1.5 | 27 | 3.9 |
| Female | 5.0 | 7.0 | 5.9 | 0.5 | 3.5 | 1.9 | 77 | 3.1 |
| Unidentified ^b | — | — | — | 3.0 | 3.0 | 3.0 | 1 | — |
| Total | 5.0 | 7.0 | 5.9 | 0.5 | 3.5 | 1.7 | 105 | 3.5 |

^a 10 predators of each sex were measured.^b Unidentified indicates that the sex of the predator was not determined.

(1976) observed *H. abdominalis* to always discard prey at the completion of feeding by pushing prey off its hypopharynx with its fore tarsi.

The time between feedings (interfeeding time) varied between 0 and 22 minutes 30 seconds, with an average of 9 minutes 42 seconds. The 0 minute interfeeding time was for flies which dropped prey they were feeding on and immediately captured another victim.

As with other species of Asilidae, it is possible to calculate the theoretical number of prey an individual *H. fusca* could feed on in one day if one assumes, (1) the asilid continually engages in foraging and feeding between 10:30 AM and 7:30 PM (the observed major period of foraging and feeding activity), and (2) the asilid captures and feeds on one prey every 20 minutes 36 seconds (based on the average feeding and interfeeding times). Thus, over a 9 hour period this species could feed on approximately 26 prey per day. Other investigators have estimated that asilids feed on from 4 to 35 prey per day (Dennis and Lavigne, 1975, 1976a, 1976b; Lehr, 1964).

Table 2. Number and percent composition of different orders of prey taken by *Holcocephala fusca*.

| Order | Male | | Female | | Total | |
|-------------|--------|---------|--------|---------|------------------|---------|
| | Number | Percent | Number | Percent | Number | Percent |
| Coleoptera | 1 | 3.2 | 9 | 10.1 | 10 | 8.2 |
| Diptera | 18 | 58.1 | 33 | 37.1 | 51 | 41.8 |
| Hemiptera | 0 | 0.0 | 1 | 1.1 | 1 | 0.8 |
| Homoptera | 6.5 | 1 | 1.1 | 3 | 2.5 | 2 |
| Hymenoptera | 10 | 32.3 | 39 | 43.8 | 51 ^a | 41.8 |
| Lepidoptera | 0 | 0.0 | 1 | 1.1 | 1 | 0.8 |
| Psocoptera | 0 | 0.0 | 5 | 5.6 | 5 | 4.1 |
| TOTAL | 31 | | 89 | | 122 ^a | |

^a Includes two Hymenoptera for which the predator sex is unknown.

The mean predator to prey size ratio for this species is 3.5 (Table 1). Both male and female *H. fusca* had the same mean length, however, females caught larger prey. Thus, females have a smaller mean predator to prey size ratio than do males (i.e., 3.1 and 3.9, respectively).

Holcocephala fusca appears to be fairly selective in its choice of prey. Diptera and Hymenoptera made up approximately 84 percent of the total number of prey (Table 2). Coleoptera, Hemiptera, Homoptera, Lepidoptera and Psocoptera made up 8.2, 0.8, 2.5, 0.8 and 4.1 percent of the prey, respectively. Females preyed on insects from seven orders, whereas males preyed on insects from only five orders. Both males and females preyed on similar species within an order, however males seemed to prefer Diptera (58.1 percent) and females preyed more heavily on Hymenoptera (43.8 percent). *Holcocephala abdominalis* has also been reported to feed primarily on Hymenoptera and Diptera (Bromley, 1950b; Johnson, 1976; McAtee and Banks, 1920). Johnson (1976) found that both sexes of *H. abdominalis* fed on approximately the same percentage of prey belonging to these two orders.

As has been reported for other species of Asilidae (Dennis and Lavigne, 1975; Hobby, 1931a, 1931b; Lavigne, 1970; Lehr, 1958a, 1958b; Poulton, 1906; Richards, 1927), more females were captured with prey than males. This phenomenon has been attributed to, (1) the female's need for additional nourishment for development of her eggs (Hobby, 1931a), (2) males spending less time foraging and feeding, and more time searching for and mating with females, (3) in some populations of asilids there may be more females than males, and (4) females may have shorter feeding and interfeeding times and thus catch more prey than males (Dennis and Lavigne, 1975).

The following is a list of prey taken by *H. fusca*. All prey were collected in Fairfax, Virginia, between August 21 and September 5, 1976, by capturing the asilids in a baby food jar. In some instances prey are identified only to the family or subfamily level since specific identifications are not available. D. M. Anderson (Scolytidae), R. J. Gagné (Cecidomyiidae, Sciaridae), G. Gordh (Aphelinidae, Encyrtidae, Eulophidae, Eupelmidae, Pteromalidae), R. D. Gordon (Orthoperidae), J. L. Herring (Anthocoridae), J. M. Kingsolver (Cryptophagidae, Languriidae, Ptilidae), P. M. Marsh (Ceraphronidae, Scelionidae), A. S. Menke (Cynipidae), C. W. Sabrosky (Anthomyzidae, Chloropidae), D. R. Smith (Formicidae), G. Steyskal (Sphaeroceridae), M. B. Stoetzel (Aphididae, Aleyrodidae), F. C. Thompson (Dolichopodidae, Simuliidae), R. White (Chrysomelidae), and W. W. Wirth (Ceratopogonidae, Chironomidae, Phoridae) of the Systematic Entomology Laboratory, IIBIII, Agric. Res., Sci. and Educ. Admin., USDA, Washington, D.C. and Beltsville, Maryland, D. R. Davis (Gracillariidae) of the National Museum of Natural History, Smithsonian Institution, Washington, D.C., and E. L. Mockford (Ectopsocidae, Psocidae) of the Illinois State University, Normal,

Illinois, are thanked for the prompt identification of their respective groups. The number and sex (if known) of the predator is indicated in parentheses following the prey record.

COLEOPTERA, Chrysomelidae: *Chaetocnema* sp. prob. *pulicaria* Melsheimer, IX-4-76 (♀); Cryptophagidae: *Anchicera* sp., VIII-21-76 (♀); Languriidae: *Corticaria* sp., IX-4-76 (2 ♀); Orthoperidae: *Orthoperus* sp., VIII-22-76 (♀, ♂); Ptilidae: *Achratrichis* sp., VIII-21-76 (♀); Scolytidae: *Pityophthorus* sp. nr. *rhois* Swaine, VIII-22-76 (♀); Staphylinidae: Unidentified, VIII-21-76 (♀), VIII-30-76 (♀). DIPTERA, Anthomyzidae: *Anthomyza* sp., IX-4-76 (♂); Cecidomyiidae: *Cecidomyia piniinopis* O.S., VIII-30-76 (♂), *Clinodiplosis* sp., VIII-22-76 (♂), *Dasineura* sp., VIII-22-76 (♂), *Lestodiplosis* spp., VIII-21-76 (♀), VIII-22-76 (♂), VIII-29-76 (2 ♀), VIII-30-76 (♂), *Neolasioptera* sp., VIII-22-76 (♀), *Peromyia* sp., VIII-22-76 (2 ♀, ♂), *Porricondyla* sp., VIII-30-76 (♀); Ceratopogonidae: *Culicoides paraensis* (Goeldi), VIII-21-76 (♀); Chironomidae: *Cricotopus* sp., VIII-22-76 (♀), Orthocladiinae, VII-22-76 (♂); Chloropidae: *Monochaetoscinella nigricornis* (Lw.), VIII-21-76 (2 ♀), VIII-22-76 (♀, ♂), *Oscinella umbrosa* (Lw.), VIII-21-76 (♀); Dolichopodidae: *Chrysotus* sp., VIII-30-76 (♀, ♂); Phoridae: *Megaselia* sp., VIII-21-76 (♀), *Puliciphora* sp., VIII-21-76 (♂), VIII-22-76 (♀); Sciaridae: *Bradyia* sp., VIII-21-76 (♀, ♂), VIII-22-76 (♀, 3 ♂), VIII-29-76 (♀), VIII-30-76 (♀, ♂), IX-4-76 (2 ♀), IX-5-76 (♂); Simuliidae: *Simulium (Phosterodoros)* sp., VIII-21-76 (3 ♀), VIII-22-76 (4 ♀, ♂); Sphaeroceridae: *Leptocera* sp., VIII-22-76 (2 ♀), IX-4-76 (♀); unidentified VIII-21-76 (♀). HEMIPTERA, Anthocoridae: *Orius insidiosus* (Say), VIII-22-76 (♀). HOMOPTERA, Aleyrodidae: Unidentified, VIII-22-76 (♂), IX-4-76 (♀); Aphididae: *Cinara* sp., VIII-29-76 (♂). HYMENOPTERA, Aphelinidae: Unidentified, IX-5-76 (♀); Ceraphronidae: *Ceraphron* sp., IX-4-76 (♀); Cynipidae: Eucoilinae, VIII-21-76 (♀), *Kleidotoma* sp., VIII-22-76 (♀); Encyrtidae: *Copidosoma* sp., VIII-29-76 (♂), IX-5-76 (♀), *Tachinaephagus zealandicus* Ashmead, VIII-21-76 (♀), VIII-22-76 (♀), IX-4-76 (♀); Eulophidae: *Tetrastichus* sp., VIII-21-76 (♀); Eupelmidae: *Lutnes* sp., IX-4-76 (♀); Formicidae: *Lasius* sp., VIII-21-76 (♀), *Myrmecina americana* Emery, VIII-21-76 (♀), VIII-22-76 (8 ♀, 1 ♂, 1 no sex), VIII-29-76 (11 ♀), IX-4-76 (3 ♀, 2 ♂), IX-5-76 (2 ♀, 2 ♂, 1 no sex), *Ponera pennsylvanica* Buckley, VIII-22-76 (2 ♂), VIII-29-76 (♀); Pteromalidae: *Eupteronotus* sp., VIII-30-76 (♂), *Halticoptera* sp., VIII-21-76 (♀); Scelionidae: *Telenomus* sp. (?), VII-22-76 (♂), *Trimorus* sp., IX-4-76 (♀). LEPIDOPTERA, Gracillariidae: *Phyllonorycter* sp., VIII-21-76 (♀). PSOCOPTERA, Ectopsocidae: *Ectopsocusis cryptomeriae* (Enderlein), VIII-22-76 (♀), IX-4-76 (3 ♀), *Trichadenotecnum alexanderae* Somm., VIII-21-76 (♀).

Bromley (1950b) recorded *H. fusca* as preying upon *Culicoides* spp., *Phortica* sp., and a scolytid beetle.

While in the baby food jar *H. fusca* frequently exhibited thanotosis or lay

on their dorsum with one or both wings spread and kicked their legs. Dennis and Lavigne (1975) reported that several species of asilids they studied exhibited thanotosis. Also, as has been reported for *Leptogaster parvoclava* (Dennis and Lavigne, 1976b), one male of *H. fusca* dropped its prey off its hypopharynx and carried the prey around in its hind tarsi as it tried to escape from the jar.

MATING BEHAVIOR

The only behavior associated with premating exhibited by *H. fusca* was male searching flights. These flights consisted of the males flying in an irregular path 60 to 240 cm above the ground for periods of 25 to 120 seconds. In flight the males' legs were held in a position similar to that of foraging *H. fusca*. As the males searched for receptive females with which to mate they frequently hovered in front of seeds on vegetation and briefly landed on rose or greenbrier thorns. However, males were never observed to hover in front of females or exhibit a more complex type of courtship. This is in sharp contrast to the apparent courtship behavior of *H. abdominalis*. Johnson (1976) reported that the males of this species hover in front of females, but without any obvious epigamic display (i.e., signaling with the legs).

In addition to briefly landing on inanimate objects during searching flights, males frequently landed on other males and females. A male would locate another asilid, land on its dorsum facing the same direction, curve his abdomen to the right or left of the asilid's abdomen, and then try to clasp the asilid's genitalia from below. When a male or a non-receptive female was contacted, the asilids would avoid mating by raising and spreading their wings over their dorsum, curve their abdomen down, and kick at or push the male away with their hind legs. Non-receptive asilids also frequently held their hind legs up behind their wings in order to prevent males from landing on them. These agonistic postures were performed even when a male was hovering over a non-receptive asilid, thus making it physically impossible for the male to land on the asilid. Mating attempts were also discouraged when the accosted asilids flew off, flattened themselves against or crawled around the vegetation. Males exhibited this behavior more frequently than wing spreading. Similar agonistic postures and methods of avoiding copulation have been observed for *H. abdominalis* (Johnson, 1976) and other species of Asilidae (Dennis and Lavigne, 1975, 1976b).

Males often attempted to mate several times with the same asilid before resuming their searching flights. In addition, they attempted to mate with asilids which were feeding on prey, as well as those engaged in foraging or resting on vegetation.

No complete matings were seen and only two mating pairs were observed. Both pairs were approximately 1 m above the ground on vegetation at 3:03.5 PM and 5:00 PM when the air temperature at the asilid's height were 31.5

and 29°C, respectively. The latter mating pair were in the shade where it was approximately 2°C cooler than in a nearby sunlit area.

This species assumed a mating position quite similar to that of *H. abdominalis* (Johnson, 1976) and *Leptogaster* spp. (Dennis and Lavigne, 1976b; Melin, 1923; Scarbrough and Sipes, 1973). Females held onto vegetation while the males hung free in a head down position with their wings folded over their dorsum and their dorsal surface facing the same direction as did the females' ventral surface. The female of one mating pair held onto the vegetation with the fore and mid legs while the hind legs hung free. While in this position, the female frequently kicked her hind legs or rubbed both abdomens and genitalia with her hind legs. Males of both mating pairs held their legs up against their body or slightly extended.

One mating pair was lost to sight when they flew into the forest after being observed for 4 minutes. The other mating pair was observed to fall onto vegetation on the ground and separate, after being watched for only 30 seconds. The female then flew back to the twig tip where mating had occurred and the male flew onto vegetation 10 to 12 cm above the ground.

OVIPosition

Oviposition by female *H. fusca* has not been observed. However, since their genitalia do not have apical spines it is assumed that this species oviposits in or on vegetation, or that they drop their eggs while resting on vegetation or while in flight, as has been observed for *Leptogaster* spp. (Bromley, 1946; Dennis and Lavigne, 1976b; Melin, 1923; Parmenter, 1952; Scarbrough and Sipes, 1973; Skidmore, 1966). Johnson (1976) speculates that *H. abdominalis* females oviposit by broadcasting the eggs during flight. According to Melin (1923), asilids like *H. fusca* which have yellow or brownish eggs, drop their eggs in flight or deposit them in open hiding places.

Eggs of *H. fusca* were collected from two females which oviposited in vials. One female deposited 3 eggs in a vial and the other female deposited 46 eggs. The eggs were quite similar in appearance to those of *H. abdominalis* (Johnson, 1976) and *Leptogaster* spp. (Dennis and Lavigne, 1976b; Lavigne, 1963; Melin, 1923; Newkirk, 1963; Parmenter, 1952; Scarbrough and Sipes, 1973; Skidmore, 1966) (Fig. 1). All eggs were a light to dark amber. At 100× hexagonal sculpturing was easily visible on the chorion where the yolk material had pulled away from the chorion. The yolk material at the same magnification appeared to consist of a gelatinous-fibrous or granular material. The eggs were slightly oval with an average width and length of 0.175 and 0.263 mm, respectively. The range in width was from 0.160 to 0.184 mm and the range in length was from 0.240 to 0.280 mm. All asilid eggs which have been described in the literature are oval or oblong, however, chorionic sculpturing has not been frequently reported. According

to Parmenter (1952) asilid eggs may have bumps or ridges, but they lack fine sculpturing like that found on Lepidoptera eggs. Melin (1923) reported that *Laphria* spp. and *Dioctria* spp. have eggs with "facet-like ridges" and diagrammed part of an egg with five-sided ridges. Scarbrough (1978) found similar ridges on the eggs of *Cerotainia albipilosa* Curran and Johnson (1976) observed pentagonal and hexagonal sculpturing on the eggs of *Holcocephala abdominalis*.

GROOMING

All Asilidae studied to date appear to groom in much the same way, with species specific variations in the sequence and relative frequency of grooming (Dennis and Lavigne, 1975, 1976b). *Holcocephala fusca*, evidently like *H. abdominalis* (Johnson, 1976), spent more time grooming its wings, abdomen, and hind legs. The only time they generally groomed their fore legs and face was immediately after feeding. This species typically rubbed its fore and hind tarsi together before grooming its face and abdomen (this includes the wings), respectively. After rubbing the hind tarsi together *H. fusca* would groom the abdomen and wings with one or both hind tarsi from anterior to posterior. Oftentimes the abdomen was curved downward during grooming and one wing or side of the abdomen was then groomed. When the asilids groomed one side at a time they appeared to be scratching themselves. *Leptogaster parvoclava* has also been observed to groom one wing at a time while the wing is bent downward, at a right angle to its body (Dennis and Lavigne, 1976b). Most Asilidae however appear to groom both wings simultaneously.

NOCTURNAL RESTING POSITION

Holcocephala fusca typically began settling down for the night when the entire study area was enveloped in shade. This generally occurred at approximately 7:45 PM. At this time the asilids became less active and most of them merely stood up on all six legs on twig tips. Within 15 to 20 minutes the asilids made stepping movements with their legs and then flattened themselves against the twig tips or moved backwards 1 to 3.5 cm and flattened themselves against the top or side of the twig. They remained in this position throughout the night.

COMPARATIVE BEHAVIOR OF ASILIDAE

Throughout this paper and in other publications on Asilidae (in particular those by Dennis and Lavigne, 1975, 1976a, 1976b; Lavigne and Holland, 1969; Melin, 1923) emphasis has been placed on comparing behavior patterns and other characteristics of species in the same genera and subfamilies. As more species are studied it is becoming evident that taxonomically related species have similar behavior patterns. However, these species can be

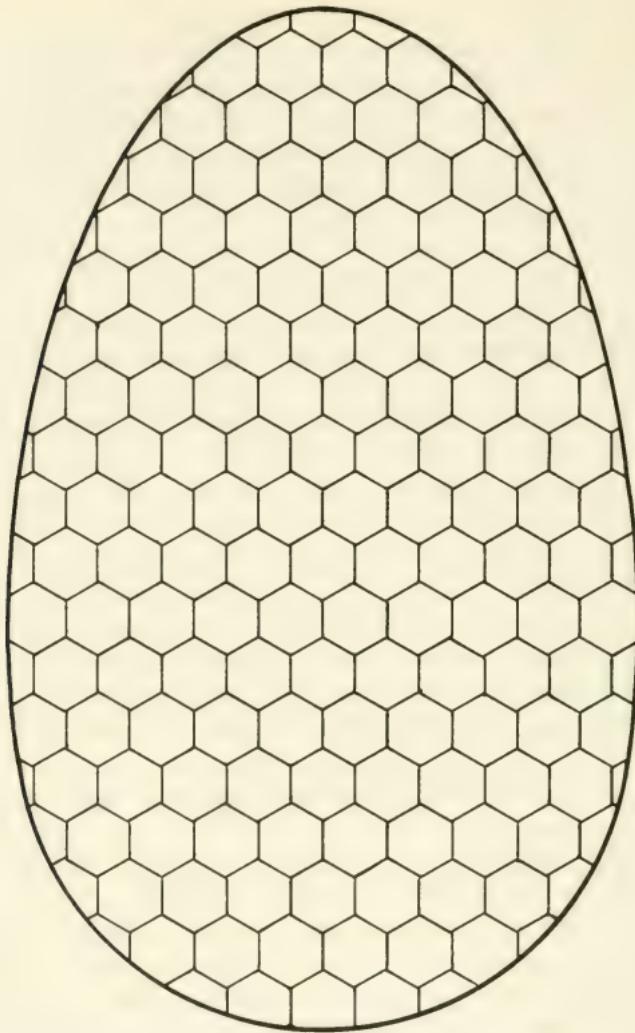


Fig. 1. Diagrammatic representation of egg of *Holcocephala fusca* (approximately 470× normal egg size).

distinguished by slight variations in their behavior, such as the methods of prey manipulation or oviposition.

It is hoped that ultimately studies of asilid behavior will yield information on the evolutionary trends of morphological characteristics, which may in turn reveal phylogenetic relationships of various taxa. This may be particularly useful in determining the validity of the family status given the subfamily Leptogastrinae by Martin (1968). Martin proposed to give this group family status based on certain morphological and behavioral characteristics. However, comparative data for *Holcocephala* spp. (*Dasytopogonini*

nae) and *Leptogaster* spp. (Leptogastrinae) presented in this paper, indicate the possibility of a close phylogenetic relationship between the Leptogastrinae and other asilid species. For example, the eggs of many asilids are oblong and white; whereas, the eggs of *Leptogaster* and *Holcocephala* are oval or semi-oval and amber or yellowish brown (the eggs of *Dioclea* spp. are also semi-oval and reddish brown, Melin, 1923). Both *Leptogaster* and *Holcocephala* hold at least their fore legs in front of their body during flight, other asilids hold the legs under their body. In addition, these two genera have a similar mating position not reported for other genera of Asilidae. The female rests in a position vertical to the ground on vegetation, while the male hangs free or else supports himself below on vegetation with his dorsal surface facing the same way as the female's ventral surface. In other asilids the two sexes are either facing the same direction with the male remaining on top of the female (male over female position), or they face in opposite directions with their dorsal surfaces facing the same direction (tail-to-tail position).

Certainly more than the aforementioned characteristics are needed before such information can be used for taxonomic purposes. However, more detailed ethological and ecological observations should help clarify the present system of classifying Asilidae and related groups, which is based primarily on morphological characteristics.

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EMERGENCE PATTERNS OF FALL AND WINTER STONEFLIES
(PLECOPTERA: FILIPALPIA) IN NORTHWESTERN
SOUTH CAROLINA¹

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Abstract.—Fall and winter stoneflies were collected from November 23, 1976 through April 12, 1977 from a mountain and an upper piedmont stream in South Carolina to determine the species composition, emergence patterns, and seasonal distribution of the adults.

Allocapnia aurora Ricker demonstrated early seasonal emergence and appeared only at the upper piedmont creek. *Allocapnia recta* (Claassen) demonstrated early seasonal emergence at both creeks. *Leuctra ferruginea* (Walker) demonstrated a continuous emergence at the upper piedmont creek, but depicted the late seasonal pattern at the mountain creek. *Tae-niopteryx maura* (Pictet) demonstrated mid-seasonal emergence at both localities. Although the emergence periods did overlap, peak emergence for each species was separated clearly at both creeks.

Studies of Plecoptera in South Carolina have been limited to a report of one species by Needham and Claassen (1925) and a list of 52 species in 17 genera by McCaskill and Prins (1968) and McCaskill (1967, 1973). Investigations of emergence patterns of fall and winter stoneflies have occurred only in more northern latitudes.

The objectives of this study were to determine the species composition, emergence patterns, and seasonal distribution of fall and winter stoneflies from the upper piedmont and mountain regions of South Carolina. Also, an equally important objective was to examine influence of air and water temperature on emergence.

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DESCRIPTION OF THE STUDY AREA

Limber Pole Creek

Limber Pole Creek is located approximately 14 km north of Salem in Oconee County, South Carolina. It is a relatively small headwater mountain creek at an altitude of about 395 m above sea level. Limber Pole Creek flows in a southeasterly direction until its confluence with Howard Creek, which eventually empties into Lake Jocassee.

The substrate of the creek varies from silt and sand with large boulders to sheer rock bottom with some silt and sand deposits. The large boulders in the stream are covered with algae and mosses. The creek also contains large deposits of logs, limbs, and leaves. The terrain can generally be described as mountainous with steep slopes. The surrounding vegetation consists of hickory (*Carya*), holly (*Ilex*), oak (*Quercus*), pine (*Pinus*), mountain laurel (*Kalmia*), and rhododendron (*Rhododendron*).

Limber Pole Creek supports a great diversity of animal life. Fish are abundant, as are populations of Plecoptera, Ephemeroptera, Diptera, Trichoptera, and other benthic insects.

The trapping site was located 0.8 km from the mouth in a relatively shallow area (3 to 15 cm deep). Discharge ranged from near 0 to 24 cms, with an average velocity of 1.5 m/sec.

Wildcat Creek

Wildcat Creek is located in Pickens County, South Carolina, 9 km northwest of Clemson. It is situated in the Issaqueena Forest, part of the Clemson University Experimental Forest. The creek has been subjected to little agricultural pollution, although the area around Issaqueena Forest has been extensively farmed. Logging occurs periodically within the forest, and an old logging road yielded access to the study site.

Wildcat Creek varies in altitude from 213 to 286 m above sea level. It is a small piedmont stream with southwesterly flow and a total length of 2.5 km. Wildcat Creek enters Six Mile Creek, which then empties into Lake Issaqueena. Discharge under normal conditions ranged from near 0 to 19 cms, with an average velocity of around 1.2 m/sec.

The substrate of Wildcat Creek includes silt, fine to coarse sand, boulders covered with mosses and algae, and granite ledges. Large logs, limbs, and deposits of detritus were common within the stream. Microhabitats included pools, riffles, and moderate waterfalls. Small unknown fishes were observed within the creek as well as large populations of Plecoptera, Ephemeroptera, Diptera, Odonata, Trichoptera, and Coleoptera.

The terrain is typically piedmont with rolling hills. The vegetation consists of pine, redbud (*Cercis*), holly, oak, and hickory. Mountain laurel lined the creek as did a variety of other shrubs and vines.



Fig. 1. Photograph of Tent Trap at Limber Pole Creek.

The study site was 1.15 km above the mouth in riffle areas of the creek which were about 20 cm deep.

METHODS

Stoneflies from the two study sites were collected from November 23, 1976 through April 12, 1977. Collections at Wildcat Creek were made 4 to 6 times per week, while those at Limber Pole Creek were made twice per week.

On each collection date, the following methods were employed: (1) Removal of adults and exuviae from the tent traps at the study sites; (2) examination of rocks, logs, and banks for adult stoneflies; and (3) collections of adults with a Tropics® net on bank vegetation along both sides of the creek. All adults were counted in the field and the number recorded. The specimens were preserved in 70% ETOH.

Two tent traps were erected at Wildcat Creek. The traps were constructed from two large cotton and polyester sheets and were approximately 5.5 m long and 1.3 m wide. Trap no. 1 was tied on top at the center and at both ends to stakes 1.3 m high which had been driven into the creek bed. The trap was anchored by ropes tied to rocks at five places along its perimeter. One lengthwise edge overlapped the stream margin by about 20 cm to retain any adults that emerged after climbing onto the bank. Trap no. 2 was suspended over two large tree limbs overhanging the creek, and attached to

rocks within the creek. A similar tent trap was erected at Limber Pole Creek and was anchored in the same manner as trap no. 1 at Wildcat Creek (Fig. 1).

Boulders, sand, and leaves were added under all tent traps whenever collections were made. The added material increased the amount of nymphal habitat and increased the stability of the traps.

The tent traps appeared to retain adequately the stoneflies as long as collections were made frequently. Spiders and webs were destroyed on each visit to reduce predation on the stoneflies. Heavy rains and high winds occasionally jarred the stoneflies into the water. The short life span of the stoneflies also necessitated frequent collections, as the dead adults that fell from the trap into the creek were lost.

Nymphal collections were made approximately once per month in both creeks. These samples were made to determine if the adult collections were giving a thorough representation of the species present in the creeks.

The rearing of fully developed nymphs was conducted in the field in order to associate nymphs and adults. Only one nymph was placed in each rearing container, and after emergence both adult and exuviae were preserved. The rearing container used in this study was designed by Müller-Liebenau (1969) and simplified by Peters (1969). It consisted of a 250 cc plastic cup with two net-covered openings in the lower portion.

Water and air temperature at the time of collection were measured. Dissolved oxygen, pH, turbidity, alkalinity (CaCO_3), nitrates (NO_3), ammonia (NH_3), and total phosphates were measured with a Hach Kit®. Daily maximum and minimum air temperatures, maximum and minimum humidity, and precipitation were provided by Kish (1977, personal communication).

RESULTS AND DISCUSSION

Species Composition

Four species of fall and winter stoneflies were collected from Wildcat Creek, and three of these species were collected also from Limber Pole Creek (Table 1). *Allocapnia recta* (Claassen) was collected only at Wildcat Creek. *Allocapnia aurora* Ricker was collected from both creeks in large numbers. *Leuctra ferruginea* (Walker) was reported for the first time in South Carolina, and *Taeniopteryx maura* (Pictet) was reported as a new record for Oconee County.

Approximately 90% of the specimens were collected in the tent traps. The remainder of the specimens was collected by sweeping and searches of the substrate. *Taeniopteryx maura* was the only species not collected by sweeping.

Emergence Behavior

Emergence behavior of the various species was observed. When ready to emerge, the nymphs climbed out of the water and attached to the substrate

Table 1. Adult fall and winter stoneflies collected at Wildcat Creek and Limber Pole Creek, South Carolina, emergence periods and number of specimens by sex.

| Species | Locality | Emergence Period 1976-1977 | Number of Specimens | | | | Total | |
|------------------------------------|-------------------|-------------------------------|---------------------|----------|------|----------|-------|--|
| | | | Sex | | Male | % Female | | |
| | | | % Male | % Female | | | | |
| <i>Allocapnia recta</i> (Classen) | Limber Pole Creek | — | | | | | | |
| | Wildcat Creek | Nov. 23-Mar. 19 | 287 | 56 | 226 | 44 | 513 | |
| <i>Allocapnia aurora</i> Ricker | Limber Pole Creek | Nov. 24-Mar. 20 | 348 | 61 | 224 | 39 | 572 | |
| | Wildcat Creek | Nov. 23-Feb. 19 | 935 | 55 | 749 | 45 | 1684 | |
| <i>Leuctra ferruginea</i> (Walker) | Limber Pole Creek | Nov. 24-Mar. 12 | 81 | 47 | 90 | 53 | 171 | |
| | Wildcat Creek | Nov. 23-Mar. 6 | 45 | 66 | 23 | 34 | 68 | |
| <i>Taeniopteryx maura</i> (Pictet) | Limber Pole Creek | Jan. 2-Mar. 23 | 28 | 44 | 36 | 56 | 64 | |
| | Wildcat Creek | Jan. 30-Mar. 26 | 4 | 50 | 4 | 50 | 8 | |

with their claws. The exoskeleton split longitudinally along a dorsal suture and the teneral adult emerged.

Exuviae of *A. recta* and *A. aurora* were found 5 to 8 cm above the water surface on the tents, while exuviae of *L. ferruginea* were found 30 to 40 cm above the water on the side of the trap. Most nymphs of *T. maura* climbed to the top of the trap before emerging.

The teneral adults usually required about 2 hours to reach maturity. Adults of *Allocapnia* and *Leuctra* folded their wings over their back while in the teneral phase, but the teneral adults of *Taeniopteryx* lifted their wings into a tentlike position similar to that of mayflies and changed the wings to the usual position when maturation was completed.

Seasonal Emergence

The fall and winter stoneflies are unique because of their emergence habits during the cold months of the year. However, detailed studies of their emergence have been rare and the present study is the first to examine emergence in the South.

Aquatic insects exhibit various types of emergence patterns that are correlated directly to the life cycle of a particular insect. Corbet (1964) recognized four basic temporal emergence patterns: Continuous, rhythmic, sporadic, and seasonal. Continuous emergence, with relatively little fluctuation in rate, is considered to be the simplest condition from which other emergence patterns are derived. Rhythmic emergence shows cyclical fluctuation in rate which is apparently based on lunar phases. Sporadic emergence is characterized by short bursts of emergence separated by irregular intervals of a few days during which no emergence occurs. In seasonal emergence, a species emerges primarily during one of the four seasons of the year. Corbet also divided seasonal emergence into early, mid, and late seasonal categories. The time at which peak emergence occurs determines the sub-category to which a species belongs.

Allocapnia aurora and *A. recta* (Figs. 2A, 2B, 3A) apparently illustrated early seasonal emergence. This pattern is characterized by a rapid increase in numbers of specimens emerging to a peak in the late fall or early winter, followed by a slow decline. Previous studies by Carlson (personal communication) at Wildcat Creek indicated that while emergence was initiated before November 23, the observed pattern would not be affected greatly.

Allocapnia recta and *A. aurora* emerged in largest numbers in December, with the midpoint of emergence for *A. recta* occurring 2 to 3 weeks before that of *A. aurora*. *Allocapnia recta* completed emergence approximately one month before *A. aurora*. *Allocapnia aurora* had similar emergence periods and patterns at both creeks.

Known distributional records for *A. aurora* include USA: Alabama, Georgia, Maryland, North Carolina, South Carolina, Tennessee, and Virginia.

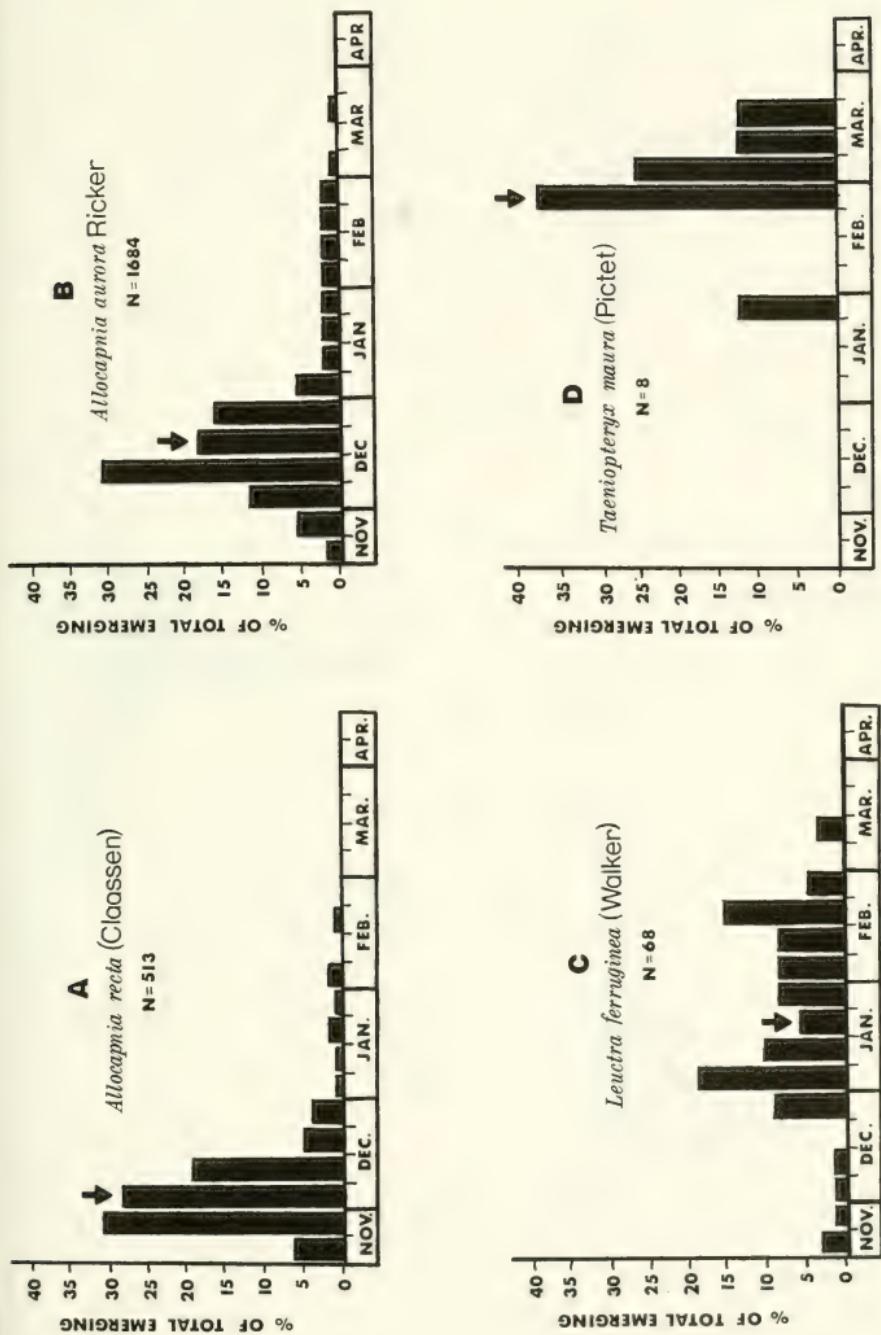


Fig. 2. Emergence patterns of the four species of stoneflies collected from Wildcat Creek. The midpoint of emergence is indicated by the arrow. N indicates total number collected.

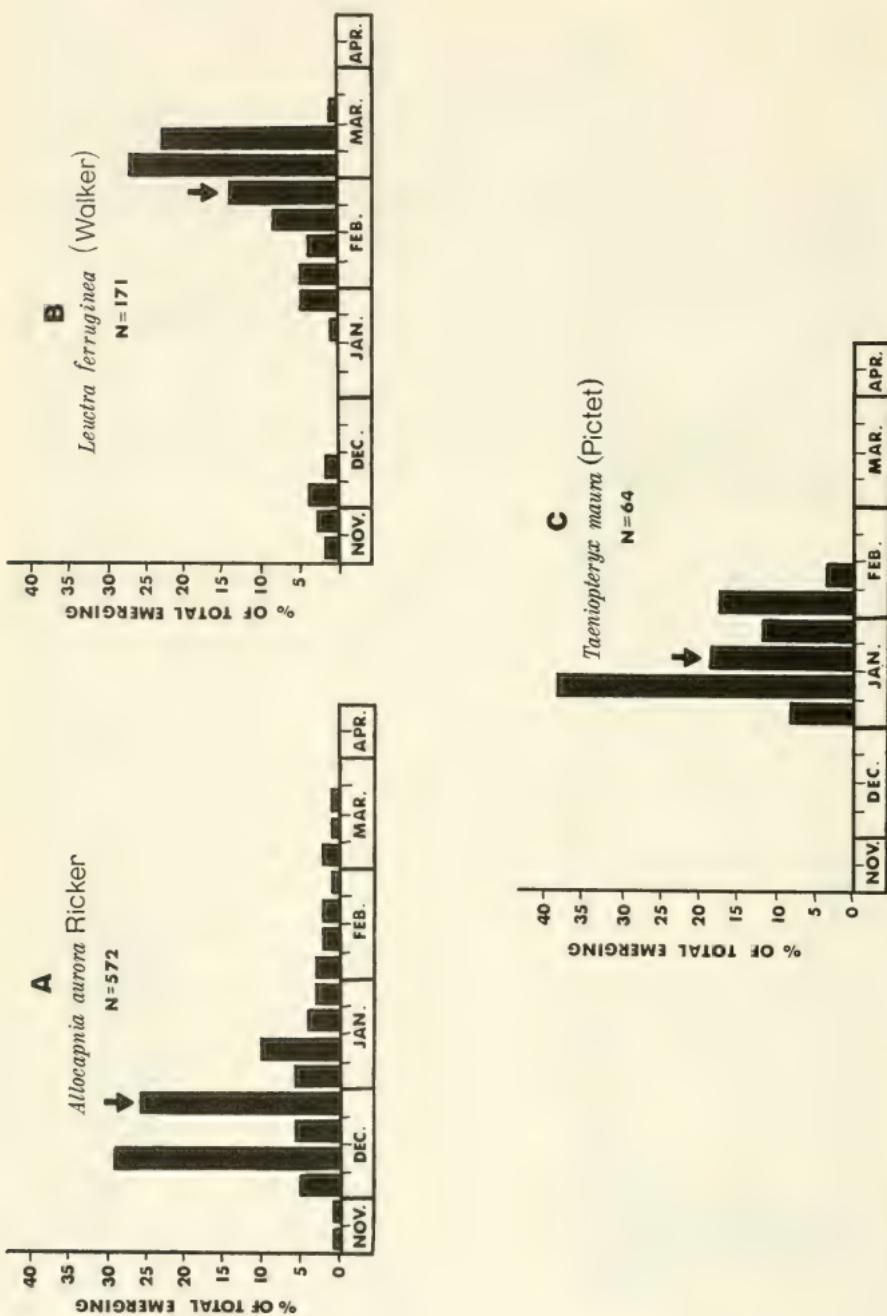


Fig. 3. Emergence patterns of the three species of stoneflies collected from Limber Pole Creek. The midpoint of emergence is indicated by the arrow. N indicates total number collected.

Allocapnia recta has been reported from Canada: Nova Scotia, Ontario, and Quebec; USA: Alabama, Connecticut, District of Columbia, Georgia, Illinois, Indiana, Kentucky, Maine, Maryland, Massachusetts, Mississippi, New Hampshire, New York, North Carolina, Pennsylvania, South Carolina, Tennessee, Vermont, Virginia, and West Virginia.

Leuctra ferruginea at Wildcat Creek (Fig. 2C) exhibited a pattern which was most similar to the continuous seasonal emergence pattern. However, there were small increases in emergence in late January and late February. The pattern of *L. ferruginea* at Limber Pole Creek (Fig. 3B) was apparently the late seasonal type. Emergence probably began prior to November 23, 1976, but no specimens of *L. ferruginea* were collected from mid-December to mid-January. However, during this period without emergence, there were extremely high winds; and the tent trap was stolen on one occasion and collapsed on another. Therefore it is possible that some adults emerged but were not collected, although this is unlikely because collections of *Taeniopteryx maura* were not affected.

Leuctra ferruginea had a slightly longer emergence period at Limber Pole Creek than at Wildcat Creek, with the midpoint of emergence occurring the last week in February at Limber Pole Creek, five weeks earlier than at Wildcat Creek. The species showed peak emergence at Limber Pole Creek the beginning of March but showed no peak emergence at Wildcat Creek. No specimens were collected in the traps after March 6 at Wildcat Creek, although earlier collections by Carlson (personal communication) have shown the species to be present as late as June 6.

Illies (1966) and Zwick (1973) record the distribution of *L. ferruginea* as Canada: Nova Scotia and Quebec; USA: Maine south to Florida, west to Minnesota and Illinois.

Taeniopteryx maura illustrated the mid-seasonal pattern (Figs. 2D, 3C). In this pattern the number of species emerging increases to a peak in mid-winter then decreases slowly.

Taeniopteryx maura began emerging January 2, 1977 at Limber Pole Creek but was not collected at Wildcat Creek until January 30, 1977. However, *T. maura* completed emergence at both creeks during the third week of March. It emerged in greatest numbers at Limber Pole Creek in January, whereas the few specimens from Wildcat Creek were taken primarily in late February and March.

There were only eight specimens of *T. maura* collected at Wildcat Creek. This species was collected in the traps only after a heavy rainfall. Catastrophic drift may have caused displacement of the nymphs to the study site from upstream. Further studies should be made to determine if catastrophic drift was responsible for the appearance of *T. maura* at this study site. If catastrophic drift was responsible, the emergence pattern may be different.

Taeniopteryx maura has been reported from Canada: New Brunswick,

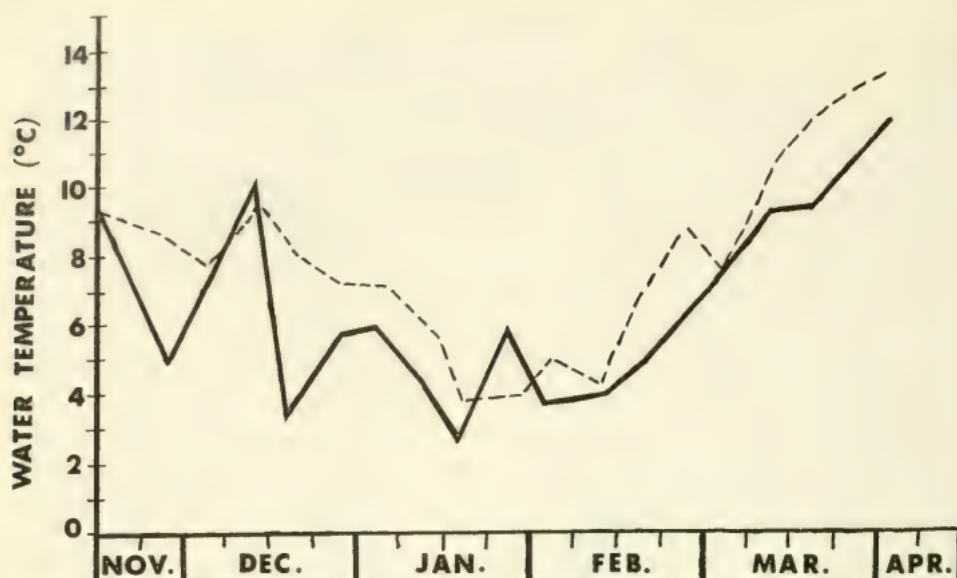


Fig. 4. Average weekly water temperature at the Limber Pole Creek study site (solid line) and Wildcat Creek study site (dotted line).

Nova Scotia, and Ontario; USA: Alabama, Arkansas, Connecticut, Georgia, Indiana, Kentucky, Maryland, Minnesota, Mississippi, New York, North Carolina, Ohio, Pennsylvania, South Carolina, Tennessee, Virginia, and West Virginia according to Illies (1966) and Zwick (1973).

There was temporal separation of peak emergence in all species at both creeks. *Allocapnia recta* demonstrated peak emergence at Wildcat Creek the last week in November and the first week in December. *Allocapnia aurora* followed with peak emergence during mid-December at both creeks. At Limber Pole Creek, *T. maura* showed peak emergence in January and *L. ferruginea* in late February and early March. *Taeniopteryx maura* showed peak emergence in February at Wildcat Creek, while *L. ferruginea* emerged at a steady rate from November through March.

Environmental Factors

Temperature and photoperiod acting independently or together are seasonally variable factors which most likely are responsible for differences in the duration of emergence from one habitat to another. There was a sharp decrease in water temperature at Wildcat Creek from early January through mid-February, which was accompanied by a distinct decrease in emergence (Fig. 4). *Allocapnia aurora* showed a decrease in emergence during that period of approximately 12% (Fig. 2B). Limber Pole Creek showed low water temperatures during the third week in December, when the emergence

of *A. aurora* decreased by 25% (Fig. 3A), and the third week in January when the emergence of this species declined by 6%, and the occurrence of *T. maura* decreased by 20% (Fig. 3C). Generally water temperatures of 7 to 10°C caused maximum emergence during the late fall and winter, as was shown by *A. aurora* at both creeks during November and December (Figs. 2B, 3A).

The fall and winter stoneflies in this study emerged at water temperatures as low as 2.5°C, although the number of specimens was sharply reduced (Fig. 3). Khoo (1964) showed that a rise in water temperature stimulates the emergence of stoneflies, and this fact was demonstrated by all species in this study.

The extremely cold weather and unusually heavy snowfall during the 1976-77 winter must be considered when interpreting the data from this study. Air temperatures during the month of January were the lowest recorded since 1880 and were accompanied by decreases in water temperature to 2.5°C. The unusual weather conditions may have caused atypical emergence behavior.

There were no major differences in the water quality parameters measured at Wildcat Creek and Limber Pole Creek. Both streams had slightly acidic water of high quality that indicated minimal organic pollution.

The emergence periods of species found at both biogeographical areas in this study showed no major differences. The similarity of emergence reflects the similarity in altitude, temperature, water quality, and proximity of the two sites. However, differences in emergence based on biogeographical region may be considerable because of the wide range of the species involved in this study. *Allocapnia recta* exhibited maximum abundance at Wildcat Creek during the last week of November and first two weeks of December. Near Oakwood, Illinois, this species exhibits maximum abundance during the last week in January and the first week in February (Frison, 1935). Therefore the emergence of *A. recta* occurs later in the northern latitudes than it does in the more southerly latitudes, implying that temperature or other environmental factors strongly influence emergence.

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PREDATORY BEHAVIOR AND PREY OF *DIOGMITES MISSOURIENSIS*
BROMLEY IN ARKANSAS (DIPTERA: ASILIDAE)¹

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Abstract.—*Diogmites missouriensis* Bromley was concentrated in areas of the study site where prey and prey activities were maximized. The asilids perched on low vegetation and surveyed the immediate area for prey using characteristic head and body movements. Foraging flights were usually short and unsuccessful. Prey were usually captured in flight and carried to perches where they were immobilized. Feeding times and number of prey manipulations were correlated with prey characteristics. Hymenoptera and Diptera were most frequently taken as prey. Over 90% of the prey were 14 mm or less in length. Females were larger, took larger prey, and had a wider range of prey than males. Males captured primarily Hymenoptera, especially halictid bees.

Diogmites missouriensis Bromley is a medium sized (17–26 mm) pale reddish-gold robber fly. It is recognized by three black mesonotal stripes of which the central one is divided longitudinally for its entire length and extends to, or almost to, the pronotum (Bromley, 1951). *Diogmites missouriensis* is similar to *D. salutens* Bromley, but differs in having darker mesonotal markings and lacking the blackish bands on the dorsum of the abdomen (Artigas, 1966). The species has been found in weedy areas, cotton fields, and vegetable gardens (Bromley, 1951; Scarbrough, 1972). *Diogmites missouriensis* was described by Bromley in 1951 but was mentioned in an earlier publication (Bromley, 1950). A recent morphological description of the species and a key to the genus *Diogmites* in the eastern United States are given by Artigas (1966).

STUDY SITE AND METHODS

Diogmites missouriensis was studied at two locations on the outskirts of Jonesboro, Craighead Co., Arkansas. General observations on predation

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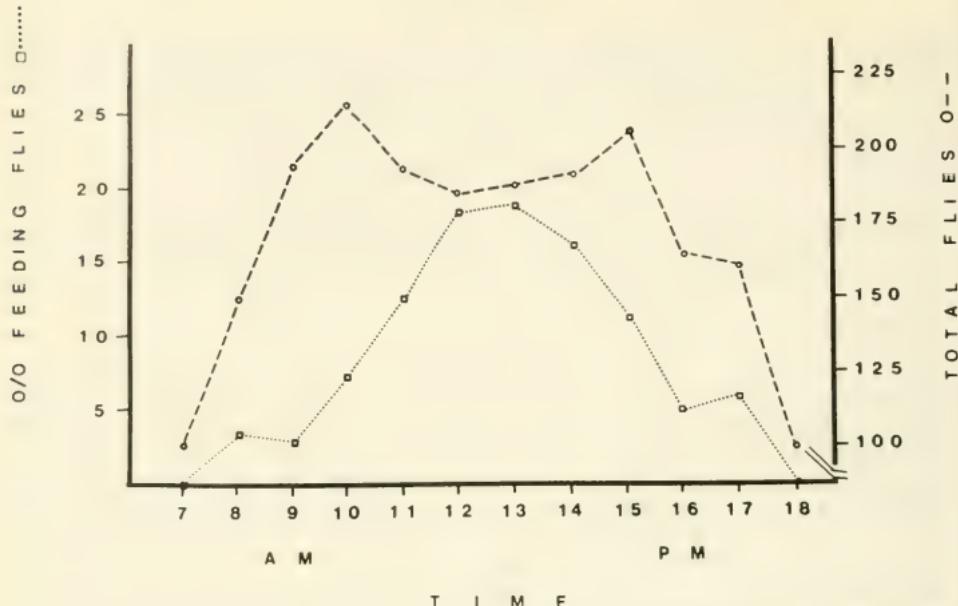


Fig. 1. Percent feeding and total numbers of *Diogmites missouriensis* during a 5-day hourly census between 28 July and 8 August 1978.

were taken in weedy fields along Christian Creek in southwestern Jonesboro during the summers of 1963 and 1964. More extensive observations on predation were taken from July 26 to August 8, 1978, in a 22-acre plot, located on the south-side of Jonesboro. The plot was once part of a large cultivated field which has been subdivided recently into small plots and zoned for commercial development. It is bordered by commercial roads (Jonesboro Bypass, Caraway, and Young Roads) and other underdeveloped commercial plots. The portion of the plot in which most observations were taken was dominated by several herbaceous plants, common to old field succession. Most plants ranged from 30–90 cm in height, forming a dense vegetative mat. Dominant plants, *Digitaria* sp., *Polygonum* sp., *Allium vineale* L., and *Stellaria* sp., formed large, continuous mats; *Erigeron canadensis* (L.), *Ambrosia bidentata* Michx., *Campsis radicans* (L.) Seem., and *Xanthium spinosum* L. formed small isolated clumps. About one-fourth of the 22-acre plot contained open woods in which *Quercus* spp. were abundant.

This study was conducted under bright sunlit conditions and temperatures ranging from 25 to 39°C. All observations began at 0700 hrs and continued until 1900 hrs. During 1978, a census was taken of individuals every hour during a 5-day period by slowly walking along a designated route of about 600 m through the study plot. All asilids observed and their behaviors were recorded. Prey captured by *D. missouriensis* were recorded and captured,

whenever possible, by netting individuals with prey. Most prey captured were pinned, later identified, and then measured from the frons to the tip of abdomen for body length. A total of 50 specimens of *D. missouriensis* was collected, sexed, and measured. Observations were also made on predatory behavior on occasions other than during the census.

PREDATORY BEHAVIOR

Diogmites missouriensis occurs among herbaceous vegetation in open, sandy, well-drained fields during July and August in northeastern Arkansas (Scarborough, 1972). The asilids were abundant in the study area (Fig. 1), with 20 or more flies during most census periods. Like several bee-and-wasp killing asilids (Linsley, 1960, 1972), *D. missouriensis* was concentrated in areas of the study site where prey and prey activities were maximized around flowering plants of *Polygonum* sp. and *Stellaria* sp. The asilids apparently conducted all behaviors in open areas of the study site and were not seen to move into adjacent wooded areas.

Diogmites missouriensis usually perched in a foraging position on low vegetation ($N = 2060$ observations, range 1–105 cm in height; 92% below 60 cm) in full view of its surroundings. Upon landing, the asilids oriented their bodies with their heads facing the sun or with their bodies positioned at a right angle to the sun's rays. This behavior was followed by rapid vertical and lateral head movements. Intermittently between head movements, the asilids moved their bodies slightly to the right or left of their original position. Head movements followed each body shift. In effect, the asilids shifted their bodies 360°, and surveyed the immediate area around a perch for prey. If movements of a potential prey were detected, the predator directed its head toward the prey and shifted its body weight forward into an attack posture. *Diogmites angustipennis* Loew (Lavigne and Holland, 1969) displays similar head and body movements on its foraging perch. These behaviors apparently enhance the asilids' ability to detect prey movements within the immediate area surrounding a perch and, consequently, reduce the need for more frequent flights.

Normal flight patterns were associated with foraging, disturbance, and searching behaviors. Most flights were short ($\bar{x} = 210$ cm, range 7–1615, $N = 480$) and a few cm (about 2–5) above the vegetation. Disturbed flies varied greatly although they usually flew longer distances ($\bar{x} = 782$ cm, $N = 30$) between perches and higher (>6 cm) above the vegetation. In search of females with which to mate, males flew slowly with legs outstretched in a manner similar to that described for *D. angustipennis* (Lavigne and Holland, 1969). These flights were erratic, often combined with hovers, and followed the contours of the vegetation. Distances between perches were variable but a male frequently traveled 20 or 30 m before perching.

Observations of individual flies revealed that the frequency of changing

perches was variable, depending upon the time of day and prey availability. Although prey densities were not determined, it can be assumed that feeding rates are directly related to prey availability. In early afternoon (1200–1500 hrs) when feeding rates were high, *D. missouriensis* changed perches frequently ($N = 20$ flies, $\bar{x} = 18/\text{hr/fly}$, range 9–29/hr). In late afternoon (1630–1830 hrs) when feeding rates were low, they changed perches less frequently ($N = 20$ flies, $\bar{x} = 6/\text{hr/fly}$, range 0–12/hr; $P < .05$). Flies rarely flew after 1730 hrs and usually crawled below a leaf or into a plant's interior where they remained overnight.

Observation of 12 different flies (1200–1300 hrs) revealed that foraging behaviors consisted of short darting flights ($N = 156$, $\bar{x} = 10.2$ cm, range 3.0–47.0). General attack strategies of *D. missouriensis* consisted of direct dart flights from perches or indirect flights in which the asilid flew slowly from a perch, hovered, and then darted toward the prey. In both strategies *D. missouriensis* sometimes approached prey by short flights, landing on a series of perches.

The above observations also revealed that *D. missouriensis* foraged frequently ($N = 156$, $\bar{x} = 13/\text{hr/fly}$) but seldom captured a prey. Only seven prey were captured during these observation periods. The asilid behaved similarly in late afternoon (1630–1730 hrs) with only two successful flights ($N = 10$ flies, 21 flights, $\bar{x} = 2.1/\text{hr/fly}$) but foraged less frequently. Combined data during the study supported these results with 99 or 12% ($N = 832$) of the flights successful.

Foraging success was directly related to the potential prey's association with vegetation and the inability of *D. missouriensis* to detect and to navigate around vegetation during an attack. Prey were invariably crawling on or flying near vegetation. When the asilid foraged, it ($N = 35$, 22% of 156 flights) frequently flew into the vegetation, missing its prey. In most instances (78%), it landed as soon as the prey disappeared among vegetation.

Like *D. angustipennis* (Lavigne and Holland, 1969), *D. missouriensis* captured over 96% of its prey ($N = 197$) in flight. The remaining 4% were captured crawling on vegetation. On each occasion, the asilid grasped the prey with one fore tarsus while supporting itself with the remaining tarsi. It subsequently grasped the prey with the remaining tarsi before flying to a new perch. *Diognites misellus* Loew (Bromley, 1946) and *D. angustipennis* (Lavigne and Holland, 1969) sometimes capture crawling prey.

Upon capture, live prey were carried in flight suspended below the asilid's body with all tarsi to a perch. There, the asilids perched below a leaf or stem, suspended by their right or left fore leg. Live prey were then manipulated with the remaining tarsi into a position where the hypopharynx was inserted, and they were subsequently immobilized. Prey were often removed from the asilid's hypopharynx during feeding and manipulated with the free tarsi, and the hypopharynx was inserted at a new location.

The time spent feeding and the number of manipulations were highly variable and were related to prey size. Small halictid bees ($N = 24$, $\bar{x} = 5.5$ mm, range 4.5–7.5) were fed upon for an average of 15.2 min ($N = 20$ prey, range 7–19 min) and manipulated three times ($N = 20$ prey, range 1–5). In contrast, large asilid prey ($N = 25$, $\bar{x} = 17.9$ mm, range 15.0–21.3) were fed upon for 48.2 min ($N = 11$, range 40–62 min) and manipulated six times ($N = 11$, range 3–9 times).

During feeding, *D. missouriensis* sometimes flew to new perches. They removed the prey from their hypopharynx and carried them as described previously. Most flights were short ($N = 62$, $\bar{x} = 4.0$ m, range 0.5–9.0), and were usually initiated by other insects, strong winds, or myself. Prey were invariably manipulated at the new perch before feeding resumed.

Over 77% of the prey ($N = 197$) were immobilized by inserting the hypopharynx into the dorsal regions of the victims, e.g., head, cervix, and thorax. Lavigne and Holland (1969) reported that *D. angustipennis*, whose diet is also predominantly Hymenoptera, behaves similarly by immobilizing its prey in these regions; and they suggested that it enables the asilid to avoid the prey's sting.

Diogmites missouriensis employed specific strategies to immobilize beetles, *Anisodactylus sanctaecrucis* Fab. and *Neoclytus scutellaria* (Oliver); pentatomids, *Holcostethus limbolarius* (Stål.) and *Solubea pugnax* (Fab.); and large flies, *Diogmites missouriensis* and *D. plathypterus* Loew. Beetles and pentatomid prey were penetrated through the softer posterior end of the abdomens. This behavior was apparently in response to "hard" dorsal surfaces of these prey. When large dipterous prey (>17 mm) were attacked, the pair dropped into the vegetation where the asilids pinned their prey to the substrate and, subsequently, inserted the hypopharynx into their heads. Although feeding was sometimes completed at this location, prey were usually carried to a new location.

Specimens of *D. missouriensis* were observed feeding ($N = 253$) during most census periods, the earliest being at 0847 hrs and the latest at 1710 hrs (Fig. 1). However, over 83% of the feeding asilids were found between 1030 and 1500 hrs. The absence or limited feeding by *D. missouriensis* during early or late periods was influenced by at least three factors. One, higher rates of feeding occurred when prey were active and concentrated around flowering plants. Major prey items (bees, wasps, and flies) were most abundant on flowering plants between 1100 and 1430 hrs when a greater number of predators were observed feeding (Fig. 1). Two, environmental factors, such as heavy dew, influenced the onset of predation. On two mornings (6 and 7 August) when vegetation was "dripping" with water, neither foraging flights nor predators with prey were observed until after 1000 hrs when most of the vegetation had dried. This is in contrast to other days when dews were minimal or absent and vegetation was dry. Foraging flights were ob-

Table 1. Dietary composition and body lengths of prey taken by *Diogmites missouriensis* in Jonesboro, Arkansas during August 1978.

| Prey Orders | Total Prey | % Diet | Prey Measured | Prey length (mm) | | |
|-------------|------------|--------|---------------|------------------|------|-----------|
| | | | | \bar{x} | S.D. | Range |
| Hymenoptera | 122 | 48.1 | 49 | 7.43 ± 2.61 | | 4.1–12.70 |
| Diptera | 57 | 22.7 | 35 | 13.41 ± 3.71 | | 6.0–18.75 |
| Coleoptera | 39 | 15.5 | 19 | 8.98 ± 2.25 | | 5.6–10.60 |
| Hemiptera | 28 | 11.1 | 16 | 7.16 ± 1.35 | | 5.0–8.70 |
| Misc. | 7 | 2.6 | 4 | 10.31 ± 4.09 | | 6.8–15.00 |
| | 253 | 100.0 | 123 | 9.56 ± 3.90 | | 4.1–18.75 |

♀ Predator (N = 25; $\bar{x} = 18.49 \pm 1.53$ S.D.)

♂ Predator (N = 25; $\bar{x} = 17.23 \pm 1.12$ S.D.)

served as early as 0815 hrs on these days. Presumably wet conditions delayed flight activities of major prey in the study area and resulted in delayed predatory activity by *D. missouriensis*. Three, in early morning (0700–0930 hrs) males flew slowly around and over the vegetation actively searching for females with which to mate. Searching behaviors and matings undoubtedly displaced predatory activities of males and interrupted that of females. Other studies (Dennis and Lavigne, 1976; Scarbrough and Norden, 1977; Scarbrough, 1978a, b; Hespenheide, 1978) have shown that predatory behaviors decrease as reproductive behaviors increase.

At the completion of feeding, most prey (N = 142) were dropped when *D. missouriensis* was in the act of manipulation. A few prey (N = 36) were dropped in flight as the asilids moved to new locations, foraged, or when they were disturbed. Also, some prey (N = 19) were pushed off the asilid's hypopharynx with the fore tarsi at the feeding site. The latter is the usual method by which several asilid species remove prey (Lavigne and Holland, 1969; Dennis and Lavigne, 1975).

PREY

Table 1 shows the dietary composition and body lengths of prey by orders taken from feeding *D. missouriensis* during this study. Hymenoptera formed the major prey category with Diptera, Coleoptera, and Hemiptera following in order of importance. The results also show a limited prey selection within each of the four major insect orders, with as few as nine genera taken from Hymenoptera, nine from Diptera, five from Coleoptera, and four from Hemiptera. These results agree with the general statement that most *Diogmites* spp. (Bromley, 1936) feed primarily on aculeate Hymenoptera. *Diogmites misellus* feeds on small Hymenoptera and Diptera (Bromley, 1946) and sometimes takes honey bees (Bromley, 1936). More recently, *D. angustipennis* (Lavigne and Holland, 1969) has been shown to take prey from

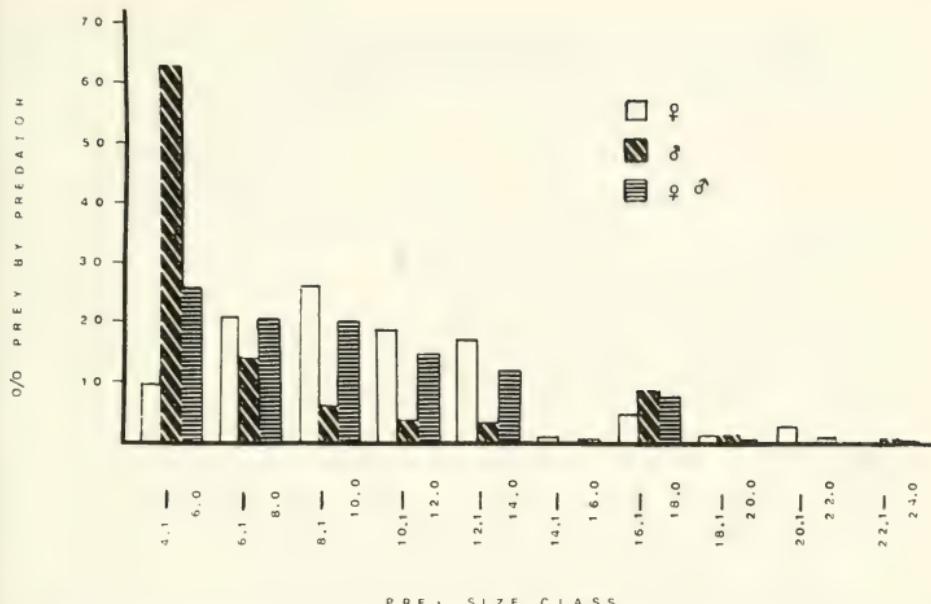


Fig. 2. Prey of *Diogmites missouriensis* arranged according to size classes (mm).

a limited number of insect orders but selected primarily aculeate Hymenoptera.

The mean size of prey taken by *D. missouriensis* was 9.56 mm and ranged from 4.1 to 18.75 mm (Table 1). However, an analysis of variance showed that mean prey body lengths of the four important orders were significantly different ($P < .01$) with Diptera being the largest prey taken (Scheffe' F-Test; $P < .01$). No significant difference in mean body lengths was found between other comparisons of prey orders.

The mean predator to prey size for *D. missouriensis* is 2.04. This indicates that the asilids were over two times larger than their prey. Females are larger (two-way analysis of variance; $F = 7.07$, $P < .05$) than males and catch larger prey ($N = 88$, $\bar{x} = 9.88 \pm 3.51$ mm; $F = 10.38$, $P < .05$) than do males ($N = 35$, $\bar{x} = 7.6 \pm 4.26$ mm). Females thus have a smaller mean predator to prey size ratio than do males, 1.87 and 2.27, respectively.

Figure 2 shows prey of *D. missouriensis* arranged according to size classes. Over 90% of the prey were 14 mm or less in length with larger prey items consisting of asilids, tachinids, tiphiid wasps, acridid grasshoppers, and staphylinid beetles. Males selected a disproportionately larger sample of prey (77.7% of diet) in size classes 4.1 to 8.0 mm than females (31.8% of diet). Eighty-four percent of the prey captured by females fell within size classes 6.1 to 14.0 mm. A small proportion of the prey captured by males fell within the larger sizes, indicating that they are capable of capturing

Table 2. Prey of *Diogmites missouriensis* arranged according to sex of the predator. All prey were collected or observed in the 22-acre plot in south Jonesboro, Arkansas, between July 2 and August 8, 1978. In some instances specific identification was not possible due to the poor condition of the prey, or the prey was not collected.

| Prey Taxa | Sex of Predator | |
|---|-----------------|------|
| | Female | Male |
| COLEOPTERA | | |
| Carabidae: <i>Selenophorus</i> near <i>planipennis</i> LeC. | 4 | 2 |
| <i>Anisodactylus sanctaecrucis</i> Fabr. | 20 | 4 |
| Cerambycidae: <i>Neoclytus scutellaria</i> (Oliver) | 1 | — |
| Cleridae: <i>Phyllobaenus</i> sp. | 1 | — |
| Scarabaeidae: <i>Onthophagus hecate hecate</i> (Panzer) | 6 | — |
| Staphylinidae: Unidentified | 1 | — |
| DIPTERA | | |
| Unidentified | 4 | — |
| Asilidae: <i>Diogmites missouriensis</i> Bromley | 7 | 2 |
| <i>D. platypterus</i> Loew | 5 | 1 |
| <i>Psilocurus birdi birdi</i> Hull | — | 1 |
| Callophoridae: Unidentified | 4 | 1 |
| Syrphidae: <i>Palpada vinetorum</i> (Fabr.) | 1 | — |
| <i>Toxomerus marginatus</i> (Say) | 13 | 3 |
| Tabanidae: <i>Silvius</i> sp. | 1 | — |
| Tachinidae: <i>Archytas apicifer</i> (Walker) | 12 | 2 |
| Unidentified | 1 | — |
| EPHEMEROPTERA | | |
| Neophemeridae: Unidentified | 1 | — |
| HEMIPTERA | | |
| Corizidae: Unidentified | 1 | — |
| Lygaeidae: <i>Eremocoris</i> sp. | 1 | — |
| Unidentified | 4 | — |
| Pentatomidae: <i>Solubea pugnax</i> (Fabr.) | 5 | 1 |
| <i>Holcostethus limbolarius</i> (Stål.) | 10 | 5 |
| HOMOPTERA | | |
| Membracidae: <i>Thelia</i> sp. | — | 2 |
| HYMENOPTERA | | |
| Apidae: <i>Apis mellifera</i> L. | 15 | 3 |
| Braconidae: Unidentified | 3 | — |
| Chrysidae: <i>Holopyga ventralis</i> (Say) | 6 | — |
| Formicidae: <i>Formica</i> sp. | 3 | — |
| Halictidae: <i>Dialictus versatus</i> (Robertson) | 8 | 38 |
| Pompilidae: <i>Anoplius illinoensis</i> (Robertson) | 13 | 4 |
| <i>Priocnemis cornica</i> Say | 2 | 6 |
| Sphecidae: <i>Astate</i> sp. | 1 | — |
| Tiphidae: <i>Tiphia</i> sp. | 8 | 3 |
| <i>T. popilliavora</i> Rohwer | 7 | 1 |

Table 2. *Continued.*

| Prey Taxa | Sex of Predator | |
|----------------------------------|-----------------|------|
| | Female | Male |
| NEUROPTERA | | |
| Chrysopidae: <i>Chrysopa</i> sp. | 1 | — |
| ORTHOPTERA | | |
| Acrididae: Unidentified nymphs | 3 | — |

some large prey when the opportunity exists. An analysis of prey orders showed that hymenopterous prey taken by males were significantly smaller ($N = 27$, $\bar{x} = 5.79 \pm 1.50$ mm; $F = 6.57$, $P < .001$) than those taken by females ($N = 27$, $\bar{x} = 7.86 \pm 2.65$ mm). Furthermore, males captured mostly halictid bees, whereas females captured a wider range of hymenopterous and other prey types (Table 2). No significant differences were found between sizes of the remaining prey orders captured by the two sexes.

Why do females select a wider range of prey than males? Field observations showed that males and females fed at the same times during the day. Thus, prey taken by females were equally available to males. Females probably have significantly greater metabolic requirements than do males due to a larger body and the continuous production of eggs. Females then can less afford to specialize on specific prey taxa or on prey whose bodies can contribute a limited amount of energy.

Like other asilids (Lavigne and Holland, 1969; Dennis and Lavigne, 1975), *D. missouriensis* became prey for other predaceous arthropods and sometimes for members of its own species, e.g., cannibalism. *Diogmites missouriensis* fell victim to *Phidippus clarus* Keyserling (Araneida: Salticidae), *D. platypterus* (Diptera: Asilidae), and *D. missouriensis*, 1, 6, and 10 times, respectively.

ACKNOWLEDGMENTS

Confirmation of my identification of *Diogmites missouriensis* was made several years ago by the late Charles H. Martin, T. L. Erwin, United States National Museum (Carabidae), and J. M. Kingsolver (Scarabaeidae), J. L. Herring (Pentatomidae), S. W. T. Batra (Halictidae), F. C. Thompson (Syrphidae), and A. S. Menke (Pompilidae, Chrysididae), all of the Systematic Entomology Laboratory, Agric. Res., Sci. and Educ. Admin., USDA, identified the prey.

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REVIEW OF THE *CERATOCAPSUS LUTESCENS* GROUP, WITH
DESCRIPTIONS OF SEVEN NEW SPECIES FROM THE
EASTERN UNITED STATES
(HEMIPTERA: MIRIDAE)¹

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Abstract.—The generic boundaries of *Ceratocapsus* are redefined and the species belonging to the *lutescens* group are presented. Of the 23 species treated **blatchleyi**, **knighti** and **pubescens** from Georgia, **cecilsmithi** and **hirsutus** from Georgia and New Jersey, **piceatus** from the eastern U.S., and **wheeleri** from North Carolina are described as new. Lectotypes are designated for *insperatus* Blatchley and *modestus* (Uhler), and a neotype is selected for *advenus* Blatchley. Male genitalia of all species and adults of *pubescens*, *rubricornis*, and *vicinus* are illustrated, and a key to species is provided.

Reuter (1876) erected the genus *Ceratocapsus* for the species *lutescens* from Texas and *punctulatus* from Cuba. Kirkaldy (1906) fixed *lutescens* as the type. Since Reuter's original proposal, numerous species have been described in *Ceratocapsus*, but several species described by other early workers were placed in different genera (e.g., *Trichia* Reuter, 1876, type *punctulatus*; *Dermarata* Distant, 1884, type *villosa*; *Melinna* Uhler, 1887, type *modesta*) and later transferred to *Ceratocapsus*.

The generic boundaries of *Ceratocapsus* as previously understood have been rather broad. After considering the general body form, antennae, structure and surface development of the pronotum and the form of the genital capsule and genitalia, I have determined that the true *Ceratocapsus* are

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much fewer than the present assignment of 67 species would indicate. At least four species groups should have their own generic status.

This paper is the beginning of a revisional study of the *Ceratocapsus*. For this work, I have examined type-material of nearly all the North American species and numerous undetermined specimens from North, Central and South America. In this paper, I am redefining the generic limits of *Ceratocapsus* and reviewing the *lutescens* group, one of 3 distinct species groups that I am retaining in the genus. The species treated in this group are, for the most part, limited to eastern North America. Of the 23 species presented, 7 are described as new, and lectotypes are designated for *insperatus* Blatchley and *modestus* (Uhler). A neotype is selected for *advenus* Blatchley. Male genitalia of all species and adults of *pubescens*, *rubricornis*, and *vicus* are illustrated; and a key to species is provided.

The following abbreviations are used for institutions cited in this paper: AMNH, American Museum of Natural History, New York; PDA, Pennsylvania Department of Agriculture, Harrisburg; PSU, Pennsylvania State University, University Park; PU, Purdue University, West Lafayette, Indiana; TJH, T. J. Henry collection; UG, University of Georgia, Athens (including the C. L. Smith collection); USNM, U.S. National Museum of Natural History, Washington, D.C. Diameter is abbreviated as diam.

Ceratocapsus Reuter, 1876:87

Type-species: *Ceratocapsus lutescens* Reuter (designated by Kirkaldy, 1906:127).

Description.—Medium-sized mirids, length 3.0–5.8 mm, generally subparallel to broadly oval; dorsum pallid or testaceous to black; impunctate to strongly punctured; pubescence silky or tomentose, simple recumbent, long, erect or pilose. Head much broader than long, base nearly straight, touching anterior margin of pronotum, base of vertex distinctly carinate, eyes granulate (more so in ♂), often pubescent, vertex and front often with weak median groove, front sometimes weakly and transversely striated, surface smooth to finely granulate. Rostrum reaching mesocoxae to just beyond metacoxae. Antennae set into eye emarginations on either side of base of tylus; segment I shortest and thickest; II, longest, about 3× segment I, gradually enlarged apically, apex often approaching diam of I; III and IV subequal, III always slightly longer; clothed with thickly set recumbent setae, sometimes intermixed with or replaced by longer, erect setae. Pronotum trapeziform, base 2× or more width of apex, lateral margin straight, base broadly rounded, anterior margin with narrow, but distinct flattened collar, calli indistinct, at most weakly raised, surface finely granulate to distinctly punctate; mesoscutum narrowly exposed, often not visible from dorsal aspect, scutellum subequilateral, length of base only slightly longer

than sides. Hemelytra well developed, embolium and radial veins distinct, width of cuneus subequal to length, pubescence tomentose (on scutellum, clavus, and corium), simple, recumbent or pilose; membrane well developed with 2 closed cells, surface often finely pubescent. Claws typically orthotyline with convergent parempodia.

Genital opening large; parameres well developed, often spined and clothed with long, pilose setae; left paramere usually 3-pronged, basal prong usually shortest and straight or curved distally or basally, sometimes apically bifurcate, middle prong longest, curved up or back towards base, apical prong bent distad, often twisted, apex acutely produced, truncate or broadly flared; right paramere stout, usually simple, gradually bent, usually with a basal process, apex and basal process sometimes strongly produced forming a C-shaped structure or basal process single or doubled and extending back and around stouter base; phallotheca generally elongate with the apex acutely produced, truncate or bifurcate.

Remarks.—The species I have included in the *lutescens* group are easily distinguished from other *Ceratocapsus* by the impunctate dorsum (sometimes appearing finely punctured or alutaceous), the finely pubescent membrane (thickly clothed with simple microsetae which to the eye appear as a fine scale-like covering) and the male genitalia. The left paramere is 3-pronged; the basal prong is usually short and stout, acutely produced or bifurcate and often armed with short spines; the middle prong is usually the largest and may be curved up or back towards the base; the apical prong is generally long and slender, twisted at the middle and apically truncate. The right paramere is generally short and stout, with the apex curved and often acutely and narrowly produced; the basal process is usually short and blunt, but may be spine-like, bifid or broadly truncate (note: figures of the right paramere are drawn so that the basal process is most visible). The phallotheca is slender and acutely produced at the apex; the dorsal subapical edge is often finely serrate.

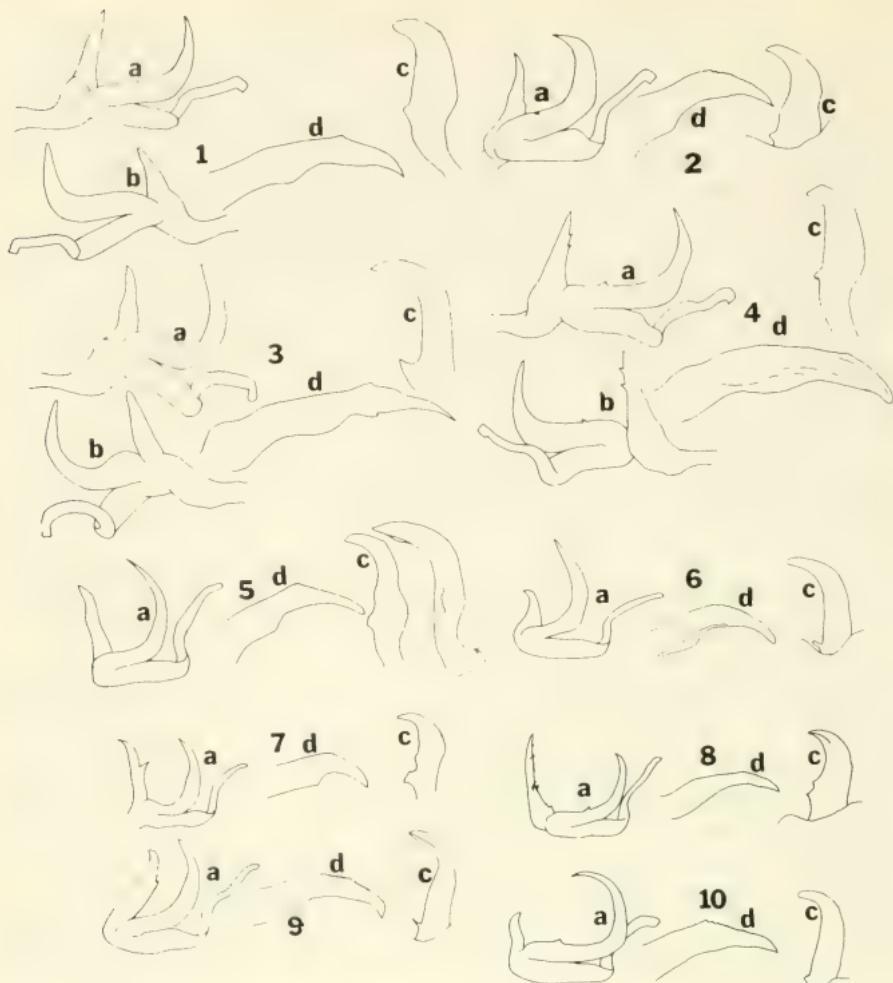
KEY TO SPECIES OF *CERATOCAPSUS LUTESCENS* GROUP²

1. Dorsum clothed with only simple, erect, semierect or pilose setae . . . 2
- Clavus and middle of corium clothed with silky or tomentose pubescence intermixed with simple, erect, semierect or pilose setae . . 15

² *Ceratocapsus mcaleei* Knight (1927:151) is known only from three females and seems to fit into the *C. lutescens* group; however, I can not be totally certain until males are examined. This species is easily separated from all other *Ceratocapsus* by the brown head, darker brown, impunctate pronotum, pale hemelytra, reddish cuneus, the pale testaceous legs with only the metafemora red, the short, sparsely set, simple setae on the dorsum, and the length of the rostrum which reaches the posterior margin or just beyond the metacoxae.

2. Dorsum pale testaceous or off white; head scarlet red, antennae, at least in part, scarlet red 3
- Dorsum brown, dark brown or black, head sometimes paler, but never distinctly red 5
3. Head and all antennal segments red; setae on hemelytra semierect, few, if any pilose setae (Fig. 26); ♂ genitalia (Fig. 12); host: *Quercus* spp. *rubricornis* Knight
- Head and only apical ¼ of antennal segment 2 red; setae on hemelytra semierect or largely pilose 4
4. Dorsum very pale, testaceous or off white; hemelytra distinctly and uniformly pilose; ♂ genitalia (Fig. 11); host: probably *Quercus* spp. *bifurcus* Knight
- Dorsum more testaceous; hemelytra not distinctly pilose, setae shorter, more semierect; ♂ genitalia (Fig. 14); host: probably *Quercus* spp. *lutescens* Reuter
5. Hemelytra and pronotum thickly pubescent, setae sometimes giving a woolly appearance; eyes distinctly pubescent (Fig. 27) 6
- Pronotum nearly glabrous, hemelytra sparsely set with pilose setae and/or short, recumbent setae; eyes, at most, with only a few extremely short setae 8
6. Strongly pubescent, setae on eyes subequal to length of setae on front and tylus (Fig. 27a); appendages thickly pilose, setae on 2nd antennal segment and tibiae longer than diam of segment (Fig. 24), tibial spines obscured by pilosity; ♂ genitalia (Fig. 3); host: probably *Pinus* spp. *pubescens*, new species
- Setae on eyes much shorter than setae on front or tylus; appendages pubescent, but not pilose, setae never longer than diam of segments, tibial spines not obscured by pilosity 7
7. Uniform yellow brown, clothed with semierect, golden pubescence; antennal segments pale or testaceous; eyes bearing only short setae (Fig. 27c); ♂ genitalia (Fig. 6); host: *Pinus rigida* *cecilsmithi*, new species
- Fuscous, clavus and corium more brown, thickly clothed with semi-erect and erect, brown pubescence; antennal segments brown; eyes with rather long setae (Fig. 27b); ♂ genitalia (Fig. 5); host: *Pinus virginiana* *barbatus* Knight
8. Hemelytra clothed with only short, sparsely set, recumbent setae, scutellum occasionally bearing a few pilose setae 9
- Hemelytra and scutellum clothed with pilose setae, intermixed with short, recumbent setae 12
9. Length 4.4 mm, width 1.7 mm; yellow brown, some specimens approaching black, but with head, base of pronotum and apex of scutellum, clavus and base of corium paler; 2nd antennal segment

- distinctly longer than basal width of pronotum; ♂ genitalia (Fig. 1); host: *Quercus* and *Vitis* *modestus* (Uhler) 10
- Length less than 4.0 mm or general color uniformly dark brown to fuscous; 2nd antennal segment subequal to or shorter than basal width of pronotum 10
10. Length 4.0–4.4 mm; color very dark brown to nearly black, especially on pronotum, cuneus frequently fusco-reddish; length of 2nd antennal segment subequal to basal width of pronotum; ♂ genitalia (Fig. 23); host: *Quercus* spp. *wheeleri*, new species 11
- Length 3.3–3.7 mm; hemelytra with paler brown or reddish-brown areas, especially on clavus; cuneus generally fuscous; length of 2nd antennal segment less than basal width of pronotum 11
11. Length 3.4–3.7 mm; hemelytra sparsely clothed with very short, recumbent setae; antennae pale or testaceous with 3rd and 4th and apical 3rd of 2nd segment reddish; length of 1st segment distinctly greater than width of vertex; ♂ genitalia (Fig. 8); host: unknown *blatchleyi*, new species 12
- Length slightly smaller, 3.3 mm; hemelytra rather thickly clothed with recumbent and a few semierect setae; antennae testaceous or brown; length of 1st segment subequal to width of vertex; ♂ genitalia (Fig. 22); host: unknown *knighti*, new species
12. Large, slender species, length 5.8 mm, width 2.0 mm; hemelytra and, sometimes pronotal disc, set with pilose setae; 2nd antennal segment fuscous or black, clothed with fine, short, recumbent setae; ♂ genitalia (Fig. 4); taken on *Platanus* *spinosus* Henry
- Smaller species, not over 5.0 mm; genitalia not as in Fig. 4 13
13. Antennae yellow, thickly clothed with erect, pale setae; ♂ genitalia (Fig. 15); host: unknown *seticornis* Knight
- Antennae reddish brown or fuscous, thickly clothed with short, recumbent setae 14
14. General color usually brown or chestnut; right paramere slender, basal process spinelike, basal prong of left paramere apically curved and bent in towards middle prong (Fig. 9); host: unknown *insperatus* Blatchley
- General color largely fuscous or black, especially pronotum, scutellum, cuneus and abdomen; right paramere and basal process stoutly produced, basal prong of left paramere straight and erect, not leaning towards middle prong (Fig. 2); host: numerous deciduous trees, including *Alnus* and *Quercus* *piceatus*, new species
15. Dorsum clothed with pilose setae 16
- Dorsum with only shorter, more recumbent setae 19
16. Appendages dark brown or reddish brown 17
- Appendages yellowish or pale testaceous 18



Figs. 1-10. Male genitalia of *Ceratocapsus*; a, left paramere, lateral view; b, left paramere inside lateral view; c, right paramere, lateral view; d, phallotheca, lateral view. 1, *modestus*. 2, *piceatus*. 3, *pubescens*. 4, *spinosus*. 5, *barbatus*. 6, *cecilsmithi*. 7, *advenus*. 8, *blatchleyi*. 9, *insperatus*. 10, *husseyi*.

17. Pronotum, scutellum and cuneus brown or reddish brown; venter reddish brown, 3rd and 4th antennal segments thickened, subequal to diam of 1st segment; ♂ genitalia (Fig. 7); host: probably *Pinus* spp.
- *advenus* Blatchley
- Pronotum, scutellum and cuneus fuscous or black, venter mostly fuscous to black; 3rd and 4th antennal segments slender, not equal to diam of 1st segment; ♂ genitalia (Fig. 21); host: unknown
- *hirsutus*, new species

18. Second antennal segment yellowish or testaceous, apex fuscous; ♂ genitalia (Fig. 10); host: *Prunus* *husseyi* Knight
- Second antennal segment uniformly yellowish or testaceous; ♂ genitalia (Fig. 16); taken on *Quercus* *sericus* Knight
19. Length 4.5 mm or more, general color fuscous to black, head often paler with a reddish tinge; antennae dark reddish brown to fuscous; ♂ genitalia (Fig. 13); host: *Carya* *nigellus* Knight
- Length not over 4.0 mm, color yellowish or reddish brown to orange red; antennae mostly pale or testaceous 20
20. Dorsum reddish brown, cuneus and apical ½ of corium dark brown or fuscous (Fig. 25), venter reddish brown, abdomen fuscous or black; membrane pale, apical ½ infuscated; 2nd antennal segment uniformly yellowish, segments 3 and 4 reddish; ♂ genitalia (Fig. 19); host: *Quercus* *vicinus* Knight
- Dorsum yellowish brown, reddish or orange red; abdomen never fuscous, apex of 2nd antennal segment pale, red or fuscous 21
21. Dorsum yellow brown, legs testaceous; 2nd antennal segment testaceous, apex brown to reddish brown, segments 3 and 4 red to reddish brown; ♂ genitalia (Fig. 17); host: *Picea* and *Pinus*
..... *luteus* Knight
- Dorsum reddish or reddish orange, appendages light yellowish 22
22. Dorsum bright orange to orange red, length 3.4 mm; apex of 2nd antennal segment, apical ½ of 3rd and all of 4th reddish; ♂ genitalia (Fig. 18); host: unknown *aurantiacus* Henry
- Dorsum reddish to light brownish red, length 3.1 mm or less; all antennal segments, except reddish 4th, uniform light yellow; ♂ genitalia (Fig. 20); host: *Taxodium distichum* *taxodii* Knight

Ceratocapsus advenus Blatchley, 1926:823

Fig. 7

Ceratocapsus advenus was described from Dunedin, Florida where it was taken on branches of a recently felled pine and apparently from a specimen from Crescent City, Florida. I have examined single males from Highlands Co. at Sebring, VIII-10-1930, C. T. Parsons coll. (AMNH) and the Archbold Biological Station, May 1, 1977, B. Stinner coll., at BLT (PDA).

Neither the specimen from Dunedin or Crescent City could be located in the Purdue University collection. Because *C. advenus* is known from only two specimens and they are apparently lost, I am designating the above American Museum specimen from Sebring as a NEOTYPE to preserve Blatchley's concept of this species.

Blatchley (1926) suggested this species was related to *C. nigrocephalus* Knight, but I have studied the type of *C. nigrocephalus* and have found that the two species are considerably different, both in general body form and

male genitalia. *Ceratocapsus advenus* more closely resembles *C. modestus* or *C. insperatus*, but can be separated by the combination of tomentose and pilose setae and the male genitalia.

Ceratocapsus aurantiacus Henry, 1978:385

Fig. 18

This species is known only from the Archbold Biological Station, Highlands Co., Florida where it was taken at light traps, May 3–5, 1967 by S. W. Frost (PSU). *Ceratocapsus aurantiacus* resembles *C. taxodii* but can be separated by the larger size, brighter orange color and male genitalia.

Ceratocapsus barbatus Knight, 1927:150

Figs. 5, 27b

Ceratocapsus barbatus was described from the District of Columbia, Maryland, and Virginia and is known to breed on *Pinus virginiana*. Wheeler and Henry (1975) showed that Uhler's (1887) description of *Melinna modesta* was actually of *C. barbatus* (see discussion under *C. modestus*). Wheeler and Henry (1977) pointed out that several of the specimens from pine recorded by Wirtner as *Melinna modesta* Uhler were actually *C. barbatus*.

Ceratocapsus barbatus resembles *C. cecilsmithi* and *C. pubescens* but is easily separated by the intermediate-type pubescence and coloration and the male genitalia.

Ceratocapsus bifurcus Knight, 1927:144

Fig. 11

Ceratocapsus bifurcus is known only from Florida. I have examined numerous specimens collected at Highlands Co., Archbold Biological Station, May 5, 1977, B. Stinner, at light (PDA, TJH). I have studied the *Ceratocapsus* Frost (1964) listed as *C. lutescens* and find them to be *C. bifurcus*; Blatchley's (1926) record of *C. lutescens* from Florida probably also refers to *C. bifurcus*.

This species is most closely related to *C. lutescens* and *C. rubricornis* but can be separated from these species by the paler, almost whitish, dorsum, pilose setae on the hemelytra, and by the male genitalia.

Ceratocapsus blatchleyi Henry, NEW SPECIES

Fig. 8

Holotype male.—Length 3.36 mm, width 1.40 mm, generally dark brown to fuscous with very short recumbent setae. Head: Length 0.40 mm, width 0.80 mm, rufotestaceous, tinged with fuscous, front finely granulate, weakly and transversely striate; vertex 0.24 mm, dorsal width of eye 0.28 mm. Rostrum: Length 1.34 mm, brown, reaching middle of metacoxae.

Antennae: Pale or testaceous, 3rd and 4th and apical 3rd of 2nd segment reddish; I, length 0.34 mm, II, 1.08 mm; III, 0.54 mm; IV, 0.50 mm. **Pronotum:** Length 0.68 mm, width at base 1.18 mm, fuscous, lighter brown along posterior margin, surface finely granulate; mesoscutum not visible from dorsal aspect, scutellum black, brown at apex, transversely rugose. **Hemelytra:** Fuscous to black, clavus and basal area of corium more brown to reddish brown; membrane smoky translucent to fumate, paler along cuneal border. **Venter:** Shiny, fuscous to black, genital segment more brown, ostiolar peritreme reddish brown, abdomen with rather short, semierect setae, those on genital segment longer. **Legs:** Testaceous, coxae tinged with red, hind tibiae reddish brown. **Genitalia:** See Fig. 8.

Female.—Unknown.

Types.—*Holotype*: ♂, Georgia, Clarke Co., Stonehenge 5/IX/1973, C. L. Smith, at light (USNM type no. 75741). *Paratype*: ♂. New Jersey, Cape May Co., 1 mi W of Rio Grande, 11–18/VII/1976, C. L. Smith at black light trap (UG).

Remarks.—*Ceratocapsus blatchleyi* is similar to a smaller *C. modestus* but is easily separated by the small size, pale red-tinged antennae, and distinctive left paramere. It also resembles *C. hirsutus* and *C. knighti* in general size and color but is easily separated by the short, recumbent setae on the dorsum and the long, slender, spined basal prong of the left paramere. The paratype from New Jersey closely resembles the Georgia holotype in all respects, except for the absence of the stout spine on the dorsal margin of the middle prong on the left paramere.

I have named this species after W. S. Blatchley whose efforts on the *Heteroptera of Eastern North America* (1926) greatly helped students of hemipterology.

Ceratocapsus cecilsmithi Henry, NEW SPECIES
Figs. 6, 27c

Holotype male.—Length 4.20 mm, width 1.80 mm. Generally uniform yellowish brown, head slightly more reddish; clothed with short, recumbent, pale pubescence. **Head:** Length 0.40 mm, width 0.86 mm, rufotestaceous, front transversely striated, striae weakly raised, tinged with red; vertex 0.32 mm; dorsal width of eye 0.28 mm. **Rostrum:** Length 1.38 mm, reaching posterior margin of mesocoxae, testaceous, apical segment fuscous. **Antennae:** Testaceous; I, length 0.38 mm, II, 1.24 mm, slender, slightly enlarged to apex, clothed with semierect, pale setae; III, 0.58 mm, brown; IV, 0.48 mm, brown. **Pronotum:** Length 0.78 mm, width at base 1.44 mm, surface shallowly roughened, not distinctly punctured; calli vaguely raised, surface more grainy than disc; clothed with semierect, pale pubescence; mesoscutum visible only at lateral angles (from dorsal aspect); scutellum uniformly yellow brown, rugose, clothed with pale, semierect setae. **Hemelytra:** Uni-

form yellow brown, closely set with semierect, pale setae; membrane smoky brown, veins indistinct, colored as membrane. *Venter*: Shiny yellow brown, abdomen strongly tinged with red; mesopleura with a glaucous bloom; abdomen sparsely set with pale, semierect setae, these longer on genital segment. *Legs*: Yellowish brown or testaceous. *Genitalia*: See Fig. 6, similar to *C. barbatus* in general form but differing in the shorter, curved basal prong of the left paramere.

Allotype female.—Length 4.08 mm, width 1.88 mm. *Head*: Length 0.38 mm, width 0.84 mm, vertex 0.38 mm, dorsal width of eye 0.24 mm. *Rostrum*: Length 1.40 mm, reaching posterior margin of mesocoxae. *Antennae*: I, 0.36 mm; II, 1.26 mm; III, 0.60 mm; IV, 0.48 mm. *Pronotum*: Length 0.78 mm, width at base 1.40 mm.

The female is very similar to the male in coloration and pubescence, but is more broadly formed.

Types.—*Holotype*: ♂, Georgia, Madison Co., 1 mi NW of Hull, 16/VI/1971, at light, C. L. Smith coll. (USNM type no. 75738). *Allotype*: ♀, same locality as holotype, 23/VI/1971 (USNM). *Paratypes*: 9 ♂, 5 ♀, same locality as holotype, 16–23/VI/1971 (UG, USNM, TJH); 1 ♂, 2 ♀ (reared), New Jersey, Atlantic Co., nr. New Gretna, June 13, 1977, taken on *Pinus rigida*, T. J. Henry and A. G. Wheeler, Jr. coll. (TJH, PDA); 1 ♀, Lakehurst, New Jersey, July 4, 1909, C. E. Olsen (AMNH).

Remarks.—In color, *C. cecilsmithi* resembles a larger, broader *C. luteus* without tomentose pubescence; in vestiture, it is most similar to *C. barbatus* and *C. pubescens* but has shorter setae.

I have dedicated this species to Cecil L. Smith (UG) who has provided me with many interesting mirids, including this species and representatives of several other new species used in this study.

Ceratocapsus hirsutus Henry, NEW SPECIES

Fig. 21

Holotype male.—Length 3.48 mm, width 1.48 mm, dark brown, clothed with long, erect setae. *Head*: Length 0.40 mm, width 0.78 mm, brown, undersurface paler, tinged with red, front clothed with several long, erect setae; vertex 0.30 mm, dorsal width of eye 0.24 mm. *Rostrum*: Length 1.24 mm, reddish brown, apical segment brown, nearly reaching apex of metacoxae. *Antennae*: Brownish, apex of 2nd, 3rd, and 4th segments reddish brown; I, 0.34 mm; II, 1.12 mm; III, 0.58 mm; IV, 0.50 mm. *Pronotum*: Length 0.66 mm, width at base 1.20 mm, shiny fuscous to black, clothed with pilose brown setae; mesoscutum not visible from dorsal aspect, scutellum fuscous, pale apically, transversely rugose. *Hemelytra*: Dark brown, cuneus more fuscous, clothed with very short, tomentose setae, especially along margin of scutellum and clavus, intermixed with long, erect, brown setae; membrane black or fumate, pale along cuneal border. *Ven-*

ter: Shiny, fuscous to dark reddish brown, abdomen clothed with long, semierect setae. Legs: Testaceous, tinged with reddish, tibiae darker reddish brown. Genitalia: See Fig. 21.

Allotype female.—Length 3.60 mm, width 1.56 mm. Head: Length 0.36 mm, width 0.76 mm, vertex 0.34 mm, dorsal width of eye 0.20 mm. Rostrum: Length 1.28 mm, reaching middle of metacoxae. Antennae: I, 0.34 mm; II, 1.14 mm; III, 0.64 mm; IV, broken. Pronotum: Length 0.60 mm, width at base 1.20 mm. Very similar to males in color and pubescence.

Types.—*Holotype*: ♂, Georgia, Oconee Co., Durham Farm, 20/VII/1971, C. L. Smith, at light trap (USNM type no. 75837). *Allotype*: ♀, Georgia, Clarke Co., 5 mi W of Athens, 7–13/VIII/1977, C. L. Smith at light (USNM). *Paratype*: ♀, Georgia, Clarke Co., Whitehall Forest, 5–10/VII/1975, R. Turnbow, black light trap (UG).

Remarks.—*Ceratocapsus hirsutus* can be separated from other *Ceratocapsus* by the dark color, small size, brown to reddish-brown antennae, the long pilose setae on the dorsum sparsely intermixed with tomentose pubescence and by the male genitalia.

Ceratocapsus husseyi Knight, 1930:196

Fig. 10

The single male from Michigan that Knight used to describe *husseyi* was first described as the male (allotype) of *C. sericus* (Knight, 1923). Knight (1941) later reported *C. husseyi* from Illinois. I have one male from Pennsylvania collected in Cambria Co. on *Prunus* sp., July 24, 1975 by A. G. Wheeler, Jr. and 9 males and 1 female and nymphs from Butler Co., on a plum, *Prunus* sp., July 13, 1978 by A. G. Wheeler, Jr. (PDA). I also have 6 specimens from Clinton, Cumberland, and Indiana counties taken in August and September on *Pinus* sp. and 6 specimens from Patton, Cambria Co., taken (by M. Wirtner) July 22 on pine.

The male genitalia provide the most reliable way to separate *C. husseyi* from *C. sericus*. The basal prong of the left paramere is short and sharply curved in towards the middle prong. Knight suggested that *C. husseyi* could also be separated from *C. sericus* by the apically infuscated 2nd antennal segment; this specific character is also present on all the Pennsylvania specimens.

Ceratocapsus insperatus Blatchley, 1928:12

Fig. 9

Ceratocapsus insperatus was described from 2 males taken at Dunedin, Florida; only one specimen is in the Blatchley collection at Purdue University. Since Blatchley did not designate a type for *insperatus* and because only a single Blatchley specimen remains, I am designating this single male as the LECTOTYPE of *insperatus*; it is labeled: "Dunedin, Fla., W.S.B.



Figs. 11-23. Male genitalia of *Ceratocapsus*: a, left paramere, lateral view; b, left paramere inside lateral view; c, right paramere, lateral view; d, phallotheca, lateral view. 11, *bifurcus*. 12, *rubricornis*. 13, *nigellus*. 14, *lutescens*. 15, *seticornis*. 16, *sericus*. 17, *luteus*. 18, *aurantiacus*. 19, *vicinus*. 20, *taxodii*. 21, *hirsutus*. 22, *knighti*. 23, *wheeleri*.

coll., 3-18-25"; "Purdue Blatchley collection"; "Lectotype: *Ceratocapsus insperatus* Blatchley, Det. T. J. Henry 1978" (red label). Blatchley (1928) noted his Florida record for *C. modestus* (Blatchley, 1926) refers to this species. I have one additional male taken in Highlands Co. at the Archbold

Biological Station, 10 mi south of Lake Placid, March 30, 1969 at U-V light by A. G. Wheeler, Jr. (PDA) and 5 males from Madison and Clarke counties, Georgia taken from June 1, 1971 to May 3, 1975 at lights by C. L. Smith (PDA, TJH, UG).

Ceratocapsus insperatus resembles *C. advenus* and *C. hirsutus* in general color and body form but can be separated by the larger size, by the lack of tomentose pubescence on the dorsum, and by the male genitalia. Blatchley (1928) noted that *C. insperatus* resembled *C. modestus* and would run to couplet "e" in his key for group I of *Ceratocapsus* (Blatchley, 1926:821). This species keys out with *C. piceatus* but can be distinguished by the lighter brown color, by the longer, pilose setae on the dorsum, and by the male genitalia.

Ceratocapsus knighti Henry, NEW SPECIES

Fig. 22

Holotype male.—Length 3.28 mm, width 1.36 mm, general color dark brown, appendages paler. *Head*: Length 0.30 mm, width 0.82 mm, reddish brown, vertex 0.30 mm, dorsal width of eye 0.26 mm. *Rostrum*: Length 1.20 mm, brownish, 1st segment reddish brown, apical segment fuscous, reaching middle of metacoxae. *Antennae*: Brown, 1st segment paler, thickly set with recumbent brown setae; I, length 0.30 mm; II, 0.92 mm; III, 0.48 mm; IV, 0.40 mm. *Pronotum*: Length 0.62 mm, width at base 1.14 mm, shiny, dark brown or fuscous, very finely punctate, sparsely clothed with recumbent brown setae; mesoscutum (only lateral angles visible from dorsal aspect) and scutellum dark brown, setae short, recumbent. *Hemelytra*: Dark brown (but lighter than pronotum), embolium and clavus sometimes paler, cuneus fuscous; thickly clothed with recumbent brown setae, especially on clavus and middle of corium; membrane fumate, transparent along border of cuneus. *Venter*: Shiny reddish brown. *Legs*: Testaceous, apex of hind femora and tibiae sometimes tinged with red. *Genitalia*: See Fig. 22.

Allotype female.—Length 3.40 mm, width 1.52 mm. *Head*: Length 0.34 mm, width 0.78 mm, vertex 0.34 mm, dorsal width of eye 0.22 mm. *Rostrum*: Length 1.20 mm, reaching middle of metacoxae. *Antennae*: I, 0.28 mm; II, 0.92 mm; III, 0.48 mm; IV, 0.40 mm. *Pronotum*: Length 0.64 mm, width at base 1.22 mm. The female is very similar to males in pubescence and color and differs mainly in the broader form.

Types.—*Holotype*: ♂, Georgia, Clarke Co., Stonehenge, 8–14/VIII/1975, C. L. Smith at light (USNM type no. 75838). *Allotype*: ♀, Georgia, Oconee Co., Durham Farm, 15/VII/1971, C. L. Smith, at light (USNM). *Paratypes*: 4 ♂, Georgia, Clarke Co., Stonehenge, 27–28/VIII/1973, 8–14/VII/1974, 1–7/VIII/1975, C.L.S., at light (PDA, TJH, UG).

Remarks.—*Ceratocapsus knighti* can be separated from other *Ceratocapsus* by its small size, by the dark brown dorsum clothed with recumbent brown setae, by the testaceous legs, and by the male genitalia.

I have named this species in honor of the late H. H. Knight, a man who had a remarkable perception of mirid taxonomy and whose many fine contributions to miridology clearly made him North America's greatest mirid specialist.

Ceratocapsus lutescens Reuter, 1876:87

Fig. 14

Ceratocapsus lutescens was originally described from Texas. Since then it has been recorded from Florida to Kansas and north to New York and Wisconsin, but these records may be based on misidentifications of *C. bifurcus* and *C. rubricornis*. All the specimens I have examined from the east are *C. rubricornis* and those from Florida are *C. bifurcus*.

I have examined the holotypes of *C. bifurcus* and *C. rubricornis* and 2 specimens of *C. lutescens* from Texas (determined as *C. lutescens* by Knight). *Ceratocapsus lutescens* can be separated from *C. rubricornis* by the partially (rather than totally) red antennae and from *C. bifurcus* by the short, semierect (rather than pilose) setae on the dorsum. The male genitalia are distinct for each species.

Ceratocapsus luteus Knight, 1923:527

Fig. 17

Ceratocapsus luteus was originally described from New York and West Virginia and later reported from Ohio (Watson, 1928) and Illinois (Knight, 1941). This species is common throughout Pennsylvania on both *Pinus* spp. (mostly *sylvestris*) and *Picea* spp. (mostly *abies*).

Although Knight (1923) suggested *C. luteus* resembled *C. lutescens*, it now can be more closely associated with *C. cecilsmithi*. It can be separated from both species by the smaller, more slender form, uniform yellow-brown color, tomentose pubescence, and distinctive male genitalia.

Ceratocapsus modestus (Uhler), 1887:69

Fig. 1

There has been considerable confusion over the identity of *C. modestus*. Uhler clearly noted that the species he was describing was common on pine trees. Blatchley (1926) noticed a problem when he noted that Uhler's description of the pronotum as being "coarsely unevenly punctate" did not agree with specimens Knight had determined as *C. modestus*. Knight, possibly not aware of the *C. modestus* problem, apparently based his concept of *C. modestus* on the single female in the USNM type collection and not on Uhler's description. Wheeler and Henry (1975) have shown that Uhler's

original description was actually of the species Knight described as *C. barbatus*. Although Uhler did not make holotype selections, someone (most likely Heidemann) selected a specimen from Uhler's mixed "type series" to represent *C. modestus*. This specimen has served to form the concept Knight and subsequent hemipterists have had of *C. modestus*. Since I could not find a better specimen of *C. modestus* from the Uhler collection and to preserve this accepted thinking, I am designating the following specimen as the LECTOTYPE. Lectotype female in USNM type collection with labels: "PR Uhler collection"; *Megacoelum modestum* Uhler"; "Megacoelum modestum Uhler, Det. Uhler"; "Lectotype: *Ceratocapsus modestus* (Uhler), ♂, USNM type no. 75742" (red label).

Ceratocapsus modestus is known from most of eastern North America (see Carvalho, 1958) and breeds mainly on *Quercus* spp. and *Vitis* sp. This species may be separated from other *Ceratocapsus* by the lack of pilose or tomentose pubescence on the hemelytra, the overall yellowish-brown color with the more fuscous pronotum, scutellum and apical portion of the hemelytra, and the male genitalia.

Knight (1941) mentioned that some specimens bear a few pilose setae on the clavus and corium. I have examined several hundred specimens (including freshly reared and collected specimens) and none has this type pubescence (rarely some may have a few erect, but not long, setae on the clavus). However, the dark form of *C. modestus* that Knight (1923) refers to when describing *C. nigellus*, in most cases is *C. piceatus*, a species that has long, erect setae on the clavus and corium. Knight probably confused *C. modestus* with this dark, pilose species.

Ceratocapsus nigellus Knight, 1923:528
Fig. 13

Ceratocapsus nigellus was described from Georgia, Maryland, Minnesota, North Carolina, New Jersey, and New York on *Carya* sp. and later reported from Ohio (Watson, 1928) and Illinois (Knight, 1941). I have also examined specimens from Indiana (PU), Iowa (TJH), Massachusetts and Virginia (AMNH). In Pennsylvania, this species is also occasionally found on *Quercus* spp. The *Ceratocapsus* sp. listed by Wheeler and Henry (1977:155) from Patton, Pa. (July) is *C. nigellus*.

This species resembles *C. piceatus* and darker forms of *C. modestus* but can be separated by the fuscous to black dorsum and paler red-tinged head, the thickly set tomentose pubescence, and the male genitalia.

Ceratocapsus piceatus Henry, NEW SPECIES
Fig. 2

Holotype male.—Length 4.48 mm, width 1.72 mm. Generally fuscous to black; clothed with brown, pilose setae. Head: Length 0.44 mm, width

0.84 mm; vertex 0.32 mm; dorsal width of eye 0.26 mm; fuscous, nearly black, jugum more brownish; middle of front vaguely impressed, base distinctly carinate, surface finely granulate. *Rostrum*: Length 1.52 mm, reaching apices of mesocoxae, brown to fuscous. *Antennae*: I, length 0.50 mm, testaceous, invaded by fuscous; II, 1.46 mm, dark, reddish brown, gradually enlarged to apex, finely clothed with short, recumbent setae; III, 0.92 mm, reddish brown; IV, 0.60 mm, reddish brown. *Pronotum*: Length 0.90 mm, width at base 1.44 mm, black, surface finely granulate; calli barely raised, roughened; collar flattened, shiny; lateral margins straight, base gently rounded; mesoscutum black, hardly visible from dorsal aspect; scutellum black, apex brown, transversely rugose. *Hemelytra*: Fuscous, cuneus black, clavus lighter brown; sparsely set with very short, recumbent brown setae; clavus, inside $\frac{1}{3}$ of corium and inside margin of paracuneus set with brown, pilose setae; membrane fumate or smoky brown, veins similarly colored. *Venter*: Fuscous to black, abdomen sparsely clothed with short, recumbent brown setae, these longer near genital segment; mesopleura with a glaucous sheen. *Legs*: Dark brown or fuscous, tibiae darker, metacoxae with a glaucous sheen, sparsely clothed with short, brownish setae, apical $\frac{1}{4}$ of protibiae thickly pubescent beneath. *Genitalia*: See Fig. 2.

Allotype female.—Length 4.56 mm, width 1.80 mm, similar to male in color and pubescence. *Head*: Width 0.84 mm, vertex 0.36 mm, dorsal width of eye 0.24 mm. *Rostrum*: Length 1.64 mm, reaching hind coxae. *Antennae*: I, length 0.48 mm; II, 1.56 mm; III, 0.70 mm; IV, 0.66 mm. *Pronotum*: Length 0.84 mm, width at base 1.44 mm.

Types.—*Holotype*: ♂, Pennsylvania, Erie Co., Presque Isle, 27 July 1978 A. G. Wheeler, Jr. coll., on *Alnus rugosa* (USNM type no. 75739). *Allotype*: ♀, same data as holotype (USNM). *Paratypes*: (sex?), District of Columbia, July 21, N. Banks (AMNH); 1 ♂, Georgia, Madison Co., 1 mi NW of Hull, 23/VI/1971, at light, C. L. Smith (UG); 1 ♀, Massachusetts, Wareham, July 20–31, 1898, O'Bangs (AMNH); 6 ♂, New Jersey, Cape May Co., 1 mi W of Rio Grande, 11–18/VII/1976, black light trap, C. L. Smith (UG, TJH); 1 ♀, New York, Ft. Montgomery, Aug. 6, 1923, F. M. Schott (det. as *modestus* by Knight) (AMNH); 1 ♀, New York, Tompkins Co., Ithaca, Cornell Campus, 20 Aug. 1978, A. G. Wheeler, Jr. coll., on *Gleditsia triacanthos* (PDA); 1 ♂, 2 ♀, Pennsylvania, Northampton Co., Hellertown, Christ Luterhan Cemetery, Aug. 9, 1973, on *Liriodendron tulipifera* (PDA); 1 ♀, Pennsylvania, Erie Co., I 90 & Rt. 19, 25 July 1978, A.G.W. coll., on *Populus tremuloides* (PDA); 2 ♂, Pennsylvania, Erie Co., Fairview, July 31, 1975, July 26, 1978, H. Wolff, A. G. Wheeler, Jr., on *Quercus palustris* and *Betula pendula* (PDA).

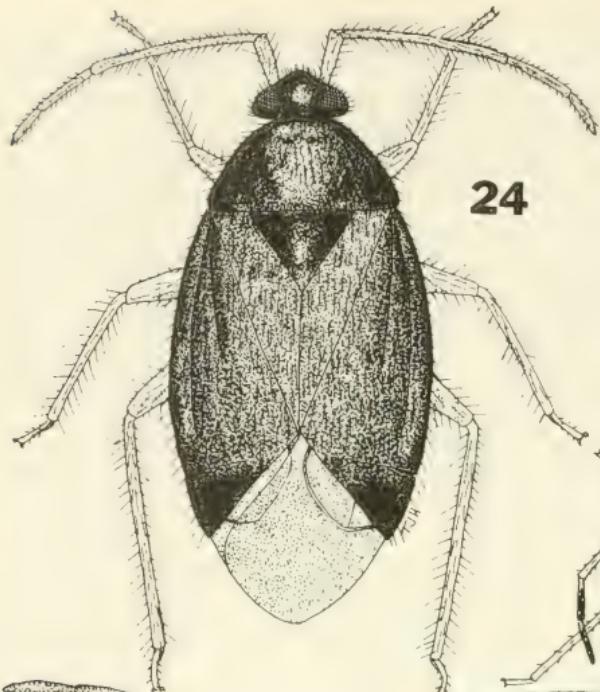
Remarks.—*Ceratocapsus piceatus* has been somewhat of an enigma and, in many cases, is what Knight considered the dark variety of *C. modestus*,

but is clearly separated from *C. modestus* by the presence of pilose setae on the hemelytra and to a lesser extent by the male genitalia. This new species is very similar to *C. insperatus* and may be difficult to separate. The characters of *C. piceatus* most useful for distinguishing it from *C. insperatus* are the stoutly formed right paramere (rather than very slender), the erect basal prong of the left paramere (rather than curved in towards the middle prong and apically curved with a subapical spine), and the nearly black color frequently found on the head, pronotum, cuneus, and abdomen (rather than dark brown or chestnut coloration).

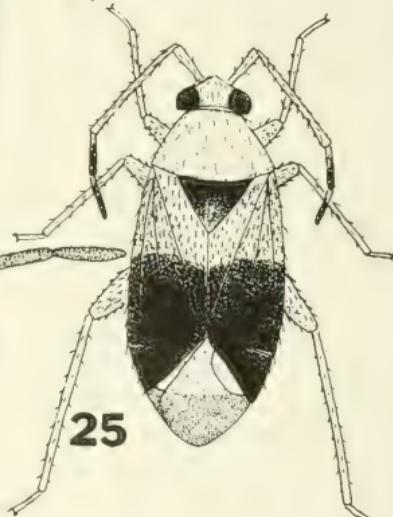
I also have material of what may be *C. piceatus* from Indiana, Michigan, and Minnesota; but I hesitate in including them as paratypes because I suspect there are several other undescribed species involved in this difficult complex of species. More careful collecting of host data and biological observations may be needed to fully clarify the relationship of these dark, pilose mirids.

Ceratocapsus pubescens Henry, NEW SPECIES
Figs. 3, 24, 27a

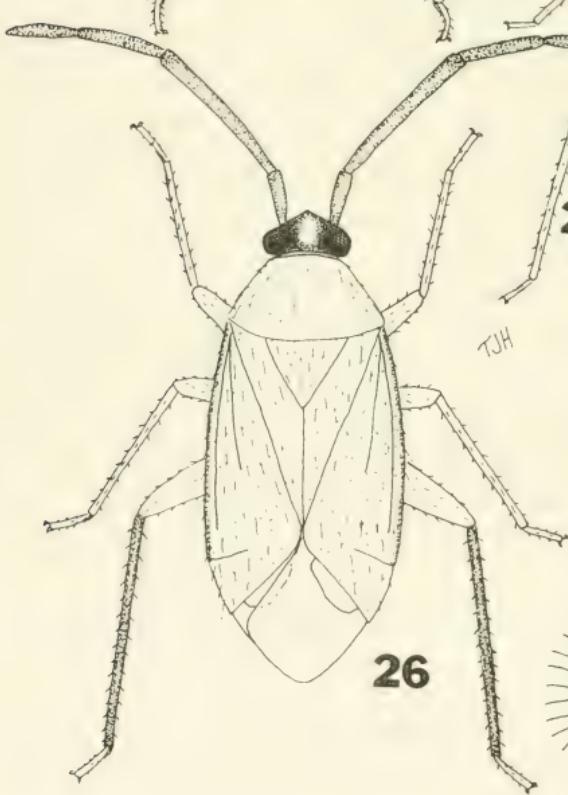
Holotype male.—Length 5.00 mm, width 2.04 mm. Generally fuscous with testaceous appendages; strongly pubescent. *Head*: Length 0.50 mm, width 0.92 mm, dark brown, somewhat lighter than pronotum, base distinctly carinate, front weakly depressed and roughened; vertex 0.34 mm; dorsal width of eye 0.28 mm, reddish. *Rostrum*: Length 1.68 mm, reaching middle of metacoxae, testaceous to brown, basal segment reddish. *Antennae*: Testaceous; thickly clothed with erect, pale setae; segment I, length 0.50 mm; II, 1.64 mm, gradually thickened to apex, clothed with erect, pale setae $1.5-2.0 \times$ diam of segment; III, 0.64 mm, red tinged; IV, 0.56 mm, red tinged. *Pronotum*: Length 0.88 mm, width at base 1.56 mm, shiny fuscous, basal area more brown, calli weakly raised and roughened, disc indistinctly punctured; lateral margins straight, base softly rounded; clothed with erect, pale to brownish pubescence, especially around margins; scutellum dark brown, apex paler, clothed with erect, pale setae, transversely rugose. *Hemelytra*: Dark brown, somewhat lighter brown around apex of clavus and adjacent area of corium, cuneus approaching fuscous; thickly clothed with erect, pale setae; membrane fumate, veins similarly colored, small areole indistinct. *Venter*: Dark brown to reddish brown; pleura more fuscous, sternum and abdomen reddish brown, metapleura with a glaucous sheen. *Legs*: Uniformly testaceous, meso- and metatibiae darker brown, especially on basal $\frac{1}{2}$, clothed with pale, pilose setae, tibial spines masked by thickly set pilose setae longer than diam of segment. *Genitalia*: See Fig. 3, typical of genus; left paramere, basal prong stout, apex recurved, middle prong long, slender, and recurved towards base, distal prong curved around and away from base, apex truncate, bent down; right paramere,



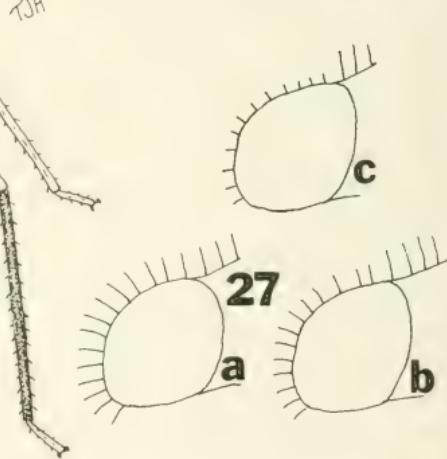
24



25



26



27

a

b

c

elongate, stouter at base, gently curved forward on apical $\frac{1}{3}$, basal node distinct, acutely produced; theca as figured, apex slender, acutely produced.

Allotype female.—Length 5.33 mm, width 2.33 mm. Head: Length 0.46 mm, width 0.94 mm, vertex 0.42 mm, dorsal width of eye 0.38 mm. Rostrum: Length 1.76 mm, reaching anterior margin of metacoxae. Antennae: I, length 0.50 mm; II, 1.76 mm; III, 0.68 mm; IV, 0.60 mm. Pronotum: Length 0.92 mm, width at base 1.68 mm.

Both the male and female have similar coloration and pubescence, but the female is slightly larger and broader.

Types.—*Holotype* ♂, Georgia, Madison Co., 1 mi NW of Hull, 23/VI/1971, at light, C. L. Smith coll. (USNM type no. 75740). *Allotype*: ♀, same data as holotype (USNM). *Paratypes*: 1 ♂, 4 ♀, same data as holotype (UG, 1 ♀ TJH); 12 ♂ same locality as holotype, 17–19/VI/1971 (UG, 2 ♂ USNM, 2 ♂ TJH); 1 ♂, Georgia, Clark Co., Stonehenge, 22–29/VII/1974, at light, C. L. Smith coll. (UG).

Remarks.—*Ceratocapsus pubescens* is one of our most distinct *Ceratocapsus*. It is most similar to *C. barbatus* and *C. cecilsmithi* but differs in the more uniform, dark brown color, thickly pubescent dorsum (which gives a woolly appearance), eyes (where the setae are subequal to those on the front and tylus), antennae and legs (where the setae are distinctly longer than the diameter of these segments), and the male genitalia.

Ceratocapsus rubricornis Knight, 1927:145
Figs. 12, 26

Ceratocapsus rubricornis was originally described from Mississippi and later recorded from the District of Columbia and Illinois on *Tilia americana*. I have examined numerous specimens from Pennsylvania, taken on *Quercus* spp. and *Castanea mollissima*, July 18, 1973–Aug. 15, 1974, T. J. Henry and A. G. Wheeler, Jr. coll. (PDA).

The figure of the left paramere by Knight (1941:110) shows the basal prong abruptly truncate with a sharply curving apical process. My Pennsylvania specimens all have a bifurcate basal prong, not too dissimilar from *C. bifurcus*. After comparing specimens to Knight's holotype, it appears that his original specimen has the longer, more slender subapical spine broken (Fig. 12). I studied several dozen males from Pennsylvania and finally found one specimen with this process broken in a similar fashion.

Ceratocapsus rubricornis can be separated from *C. bifurcus* and *C. lu-*

←

Figs. 24–26. Dorsal habitus of *Ceratocapsus*. 24, *pubescens*. 25, *vicinus*. 26, *rubricornis*. Fig. 27. Dorsal view of eyes of *Ceratocapsus*; a, *pubescens*. b, *barbatus*. c, *cecilsmithi*.

tescens by the uniformly red antennal segments, the semierect, simple pubescence on the hemelytra, and the distinctly formed male genitalia.

Ceratocapsus sericus Knight, 1923:530

Fig. 16

This species was originally described from two females taken in New Jersey, a male (allotype) taken in Michigan and a third female from New York. Knight (1930) later decided the male allotype represented another species, *C. husseyi*; thus, the Michigan record for *C. sericus* actually refers to *C. husseyi*. I have examined the holotype and three specimens from Dauphin and Cambria counties, Pennsylvania taken on *Quercus rubra* (July 14–Aug. 21) (PDA).

Ceratocapsus sericus is very similar to *husseyi*, but may be easily separated by the uniform yellow second antennal segment (especially useful for separating females), the overall darker color and by the male genitalia.

Ceratocapsus seticornis Knight, 1953:510

Fig. 15

Ceratocapsus seticornis was described from a single male taken at Holcomb, Missouri. I have examined the holotype which appears most similar to *C. piceatus* and *C. spinosus*. It can be separated from both species by the polished dorsum, and a combination of the yellow second antennal segment clothed with long erect setae, the smaller size, the pilose setae on the pronotum and the male genitalia.

Ceratocapsus spinosus Henry, 1978:383

Fig. 4

Ceratocapsus spinosus was described from western Pennsylvania from two males taken at light traps. I have seen one additional specimen collected in Chester Co., Pa., July 9, 1976 by E. E. Emel on *Platanus occidentalis* (PDA). This is our largest *Ceratocapsus*, measuring more than 5.8 mm. It can be separated from other species on size alone; but the dark color, pilose pubescence, and the distinctive male genitalia will aid in identifying this species.

Ceratocapsus vicinus Knight, 1923:529

Figs. 19, 25

This species was originally described from New Jersey and New York and later reported from Illinois (Knight, 1941) and Missouri (Froeschner, 1949). I have examined seven specimens from New Jersey and New York (AMNH) and single males taken July 18 at Odenton, Maryland, N. Banks (AMNH) and Aug 15, 1974, Millersville, Lancaster Co., Pennsylvania on *Quercus phellos*, T. J. Henry and W. Blosser (PDA).

Ceratocapsus vicinus keys out most closely to *C. luteus* but can be separated from this and other species by the reddish-brown dorsum (with the apical half of the hemelytra and membrane fuscous) and antennal segments, the black abdomen, and the male genitalia.

Ceratocapsus wheeleri Henry, NEW SPECIES
Fig. 23

Holotype male.—Length 4.00 mm, width 1.60 mm, generally very dark brown to black, clothed with short, sparsely set, recumbent setae. *Head*: Width 0.86 mm, fuscous or black, vertex 0.34 mm, dorsal width of eye 0.26 mm, eyes reddish. *Rostrum*: Length 1.58 mm, reaching middle of metacoxae, fuscous. *Antennae*: Brown to fuscous; I, length 0.42 mm, brown, set with 3 stout, black setae; II, 1.42 mm, gradually enlarged to apex, thickly clothed with recumbent, pale setae (except at base); III, 0.74 mm; IV, 0.62 mm. *Pronotum*: Length 0.86 mm, width at base 1.40 mm, fuscous to black; (basal area sometimes paler in some specimens), impunctate, finely granulate, weakly shining, calli weakly raised; mesoscutum fuscous, narrowly visible; scutellum fuscous, transversely rugose, set with 2 or 3 pilose setae. *Hemelytra*: Uniformly fuscous (some specimens are dark brown, but not quite fuscous and the cuneus is frequently fusco-rufous), clothed with sparsely set, very short, recumbent setae; membrane and veins fumate to black. *Venter*: Fuscous to distinctly black, ostiolar peritreme opening and metapleura more brown. *Legs*: Coxae brown; femora brown, hind femora darker brown; tibiae brown, hind tibiae somewhat reddish brown; tarsi and claws brown. *Genitalia*: See Fig. 23.

Allotype female.—Length 4.40 mm, width 1.80 mm, very similar to the male in color and pubescence. *Head*: Width 0.84 mm, vertex 0.40 mm, dorsal width of eye 0.22 mm. *Rostrum*: Length 1.64 mm, reaching base of metacoxae. *Antennae*: I, length 0.50 mm; II, 1.44 mm; III, 0.72 mm; IV, 0.60 mm. *Pronotum*: Length 0.90 mm, width at base 1.40 mm.

Types.—*Holotype*: ♂, North Carolina, Mecklenburg Co., Rt. 51, 1 mi W of Rt. 16, nr. Matthews, 15 June 1975, A. G. Wheeler, Jr. collector, taken on *Quercus stellata* (USNM type no. 76046). *Allotype*: ♀, same data as holotype (USNM). *Paratypes*: ♂, North Carolina, Union Co., Rt. 74, 1.6 mi N of Monroe, 14 June 1975, A.G.W. coll., taken on *Quercus stellata* (PDA); 2 ♂, 2 ♀, same data as holotype (PDA); 6 ♂, 5 ♀, same data as holotype, 13–17 June 1978, A.G.W. coll., taken on *Quercus alba*, and *Q. stellata* (PDA).

Remarks.—*Ceratocapsus wheeleri* keys to *C. modestus* but can be separated by its more uniform fuscous coloration and the shorter second antennal segment which is subequal to the basal width of the pronotum. This species is also similar to *C. blatchleyi* and *C. knighti* but is easily distin-

guished by its larger size, darker color, proportionately longer second antennal segment, and the male genitalia.

I am naming this species after Dr. A. G. Wheeler, Jr. who has a phenomenal ability to collect rare or new Miridae, including the species described above.

ACKNOWLEDGMENTS

I wish to thank J. L. Herring (Systematic Entomology, Laboratory, Agric. Res., Sci. and Educ. Admin., USDA), A. V. Provonsha (PU), R. T. Schuh (AMNH) and C. L. Smith (UG) for loaning specimens used in this study; also I thank R. C. Froeschner (USNM) for allowing me to examine the H. H. Knight collection. K. R. Valley (PDA) and A. G. Wheeler, Jr. (PDA) made valuable comments for improving the manuscript. I am very grateful to K. C. Kim (PSU) for loaning specimens, reviewing the manuscript, and endorsing it for publication.

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PROC. ENTOMOL. SOC. WASH.
81(3), 1979, p. 423

NOTE

Lutzomyia vexator (Coquillett) The Correct Designation for *Lutzomyia vexatrix* of Authors (Diptera: Psychodidae)

The biting fly described by Coquillett in 1907 as *Phlebotomus vexator* has been referred to in recent literature as *Lutzomyia vexatrix* (Coquillett) since Theodor (1932. Proc. 7th Reunion Soc. Argentina Patol., Regional del Norte, Tucuman, 5-7 Oct. 1931:764-786; and 1965. J. Med. Entomol. 2:171-197) recognized the subgenus *Lutzomyia* Franca, 1924 as of generic status. In the 1965 paper Theodor made the combination *L. vexatrix*, but I have not been able to consult the 1932 paper, which concerned South American species. Eads (1978. Proc. Entomol. Soc. Wash. 80:539-542) used *L. vexatrix* and later, concerned about the incorrect form of the name, requested me to comment upon it. Inasmuch as the originally proposed name *vexator* is a noun and therefore not subject to gender concord, it must not be changed when transferred to a genus of different gender. It is something like changing "king of the beasts" to "queen of the beasts" because *Felis leo* is in a feminine genus.

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STUDIES IN THE TIPHIIDAE, XII.¹ A NEW GENUS OF
METHOCHINAE WITH NOTES ON THE SUBGENERA OF
Methocha LATREILLE (HYMENOPTERA ACULEATA)

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Abstract.—A key is presented to the genera and subgenera of Methochinae. Synonymical notes are included for the subgenera of *Methocha* Latreille, and the new genus **Karlissa** is described with *Methoca* (!) *rugosa* Cameron, 1897, as the type-species. *Stenomethoca* Hamann, 1960, is synonymized under *Methocha* subg. *Dryinopsis* Brues, 1910.

This contribution is published in advance of a monographic treatment of the Ceylonese Tiphidae to provide part of the higher classification to be used in that work. A key is included for differentiation of the genera and subgenera of Methochinae, synonymies are included for the various genus-group names proposed previously, and the new genus *Karlissa* is described for the unique specimen of *Methoca* (!) *rugosa* Cameron.

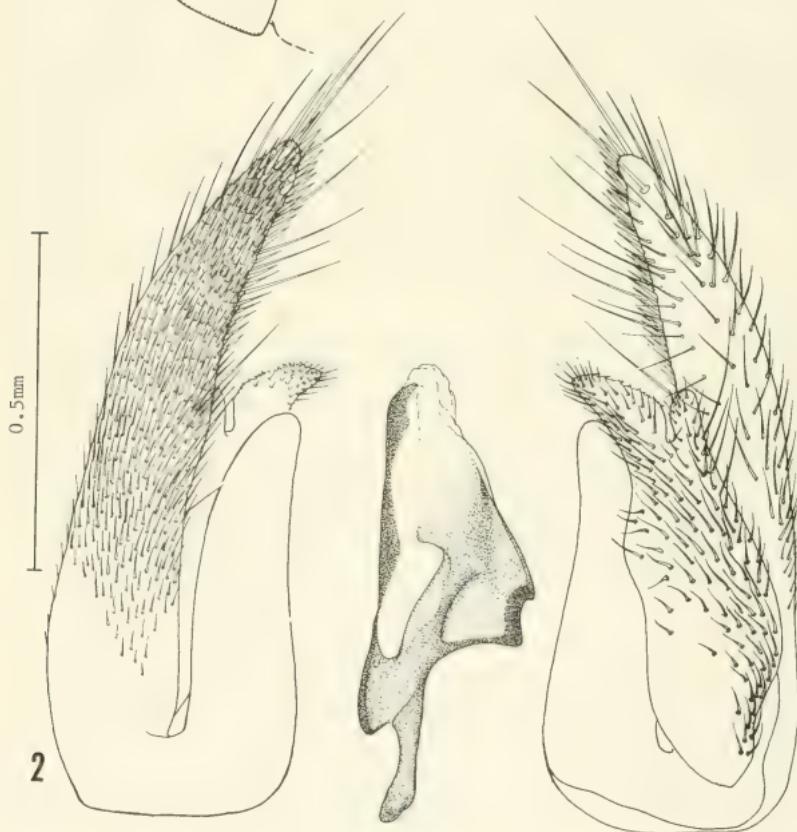
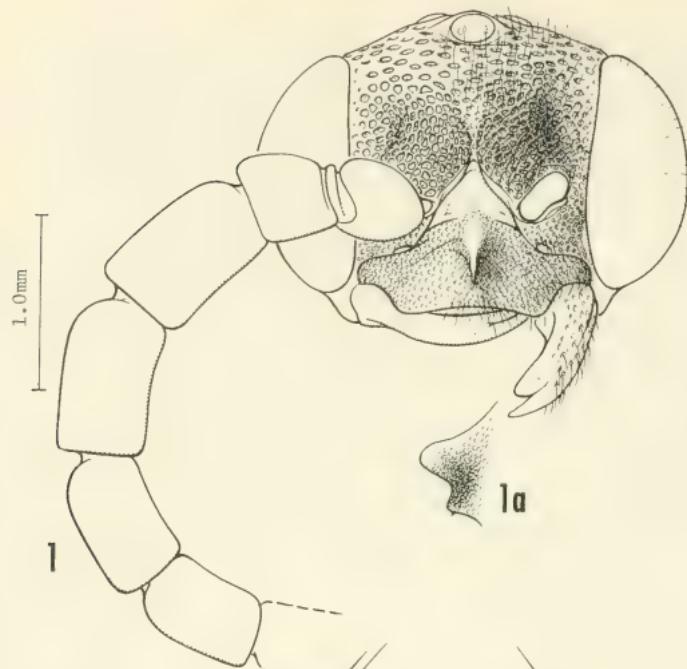
KEY TO THE GENERA AND SUBGENERA OF METHOCHINAE²

1. Females; wingless and antlike in appearance; abdomen 6-segmented; antenna 12-segmented; *Methocha* Latreille 2
- Males; winged, slender, much larger than females; abdomen 7-segmented, the last sternum a recurved aculeus; antenna 13-segmented . 4
2. Scutum, viewed in profile, convex, not depressed below level of scutellum; antenna not clavate toward apex; viewed from above the front above antennae evenly convex between compound eyes, the latter not noticeably enlarged and bulging from sides of head; chiefly Holarctic, but with a few Neotropical and Oriental representatives

¹ Part XI of this series was published in Proc. Entomol. Soc. Wash. 78:361-368, 10 figs.

² *Karlissa*, new genus, is known only from the male. It is presumed that the unknown female will be wingless and antlike as in *Methocha*. The male of *Karlissa* is much more coarsely sculptured and rugose than *Methocha* males, and the female may differ similarly from *Methocha* females which are usually quite delicately sculptured.

- *Methocha* subg. *Methocha* Latreille
- Scutum, viewed in profile, flat; viewed from above the front concave between inner margin of compound eye and frontal protuberance which is occasionally lacking; compound eyes noticeably enlarged and bulging from sides of head 3
 - 3. Scutum, viewed in profile, noticeably depressed below level of scutellum; antenna clavate toward apex; Oriental species
..... *Methocha* subg. *Dryinopsis* Brues
 - Scutum, viewed in profile, not depressed below scutellum; antenna not clavate; Ethiopian species *Methocha* subg. *Andreus* Ashmead
 - 4. Flagellar segments more strongly flattened, shorter, 1st flagellar segment as long as wide, the 2nd through 5th each more than $\frac{1}{2}$ as wide as long; pronotum elongate, median length of dorsum 0.8 times that of scutum; metasternum at apex with pair of ligulate, narrowly separated processes, each overlying inner ventral angle of hind coxa; posterior surface of propodeum abruptly declivous from dorsal surface which has a strong transverse carina at apex; genitalia (Fig. 2), paramere slender, dorsal and ventral margins tapering gradually to apex, volsella with digitus *Karlissa* Krombein, new genus
 - Flagellar segments not so flattened, longer, 1st flagellar segment 1.5 or more times as long as wide, succeeding segments twice or more as long as wide; pronotum shorter, median length of dorsum not more than $\frac{1}{2}$ the length of scutum; metasternum not so armed at apex, at most with a pair of small tubercles; dorsal surface of propodeum rounding gradually into posterior surface, not separated from it by a strong transverse carina; genitalia (Figs. 3-5), paramere stouter, ventral margin rounded out or emarginate in middle; *Methocha* Latreille 5
 - 5. Mesopleuron with a median ovate, impressed, densely haired area, anteriorly and above with submarginal grooves; carina on upper inner surface of hind coxa expanded into a lamella at base; clypeus with a median tuberculate process; ocelli in an obtuse triangle; malar space usually well-developed, more or less quadrate; parapsides and notauli present, the latter short; genitalia (Fig. 3), ventral margin of paramere deeply emarginate in middle, volsella with digitus; chiefly Holarctic, but with a few Neotropical and Oriental representatives
..... *Methocha* subg. *Methocha* Latreille
 - Mesopleuron without such an impressed area; ocelli usually arranged in an equilateral or acute triangle; malar space usually very short, linear, rarely elongate; parapsides present, notauli absent; genitalia (Figs. 4-5), ventral margin of paramere rounded out in middle 6
 - 6. Mesopleuron always with an anterior submarginal groove, occasion-



- ally with a superior groove also; front without a median keel above antennal insertions; clypeus with a median process; genitalia (Fig. 4), volsella with digitus; Oriental Species
 *Methocha* subgen. *Dryinopsis* Brues
- Mesopleuron sometimes with an anterior groove, dorsal groove absent; front with a short median keel above antennal insertions; clypeus without a median process; genitalia (Fig. 5), volsella without digitus; Ethiopian species *Methocha* subgen. *Andreus* Ashmead

Methocha subgenus *Methocha* Latreille

Fig. 3

Methocha Latreille, 1804:179. Type-species: *Mutilla articulata* Latreille. Monotypic.

Methocha (!) Latreille, 1805:268. Emendation.

Tengyra Latreille, 1809:115. Type-species: *Tengyra Sanvitali* Latreille. Monotypic.

Spinolia Costa, 1858:21. Type-species: *Spinolia italicica* Costa. Monotypic

Most species of the typical subgenus occur in the Holarctic Region, but a few occur in the Neotropical and Oriental Regions.

Methocha subgenus *Dryinopsis* Brues

Fig. 4

Dryinopsis Brues, 1910:16. Type-species: *Dryinopsis simplices* Brues. Monotypic.

[*Methocha*] subgenus *Stenomethoca* Hamann, 1960:35. NEW SYNONYMY. Type-species: [*Methocha*] (*Stenomethoca*) *nigra* Hamann. Monotypic.

Brues originally placed his genus in the Dryinidae. Later, he and Melander (1932:500) assigned it to the Methocidae.

Hamman (1960) published a paper, "Stenomethoca subgen. nov., *nigra* spec. nov." Nowhere does he assign *Stenomethoca* to a genus, but several species of *Methocha* (!) are mentioned in the text, so the presumption is that he intended it as a subgenus of *Methocha*. He did not make a type-designation, but there is type-fixation inasmuch as *nigra* Hamann is the sole included species.

It is quite possible that *nigra* Hamann is a junior synonym of *simplices*

←

Figs. 1, 2. *Karlissa rugosa*. Fig. 1, frontal view of head, Ia, clypeus in profile. Fig. 2, male genitalia, cardo removed; exterior lateral aspect at left, aedeagus in center, internal lateral aspect at right.

Brues. Hamann's specimen came from West Kalimantan, Borneo, and Brues' specimen was from British North Borneo.

All of the known species come from the Oriental Region.

Methocha subgenus *Andreus* Ashmead

Fig. 5

Andreus Ashmead, 1903:156. Type-species: *Andreus abbottii* Ashmead. Original designation and monotypic.

Ashmead's name was not used by subsequent workers (e.g., Turner, Arnold) who placed all of the African species in *Methoca* (sic). So far as I can judge from the few species available for study and from a perusal of the published descriptions and illustrations, all of the Ethiopian species are referable to this subgenus. I have seen no specimens of *Andreus* from outside the Ethiopian Zoological Region.

Andreus Ashmead is not preoccupied by *Andreus* Vosmaer (1887:246), an evident lapsus for *Adreus* Gray, 1867. Vosmaer spells it *Adreus* correctly in the index and gives no indication in the text that he is proposing an emendation.

*Karlissa*³ Krombein, NEW GENUS

A perusal of Cameron's description and consideration of Turner's (1908) remarks convinced me some years ago that *Methocha rugosa* Cameron, 1897, was referable to a group of Oriental and Ethiopian myzinine wasps which I described subsequently as *Hylomesa*, 1968. However, when I first studied Cameron's holotype at Oxford University in 1965, I recognized immediately that it belonged to the Methochinae, not the Myzininae, and that it represented a most unusual new genus.

Karlissa is known only from the male. It is distinguished from *Methocha* males by the following combination of characters: Flagellar segments more strongly flattened, comparatively shorter; pronotum more elongate, much of disk with close, transverse rugulae; mesopleuron below with a deeply impressed, narrow, longitudinal, densely setose fossa; metasternum at apex with a pair of narrowly separated, ligulate processes; and lateral and posterior surfaces of propodeum abruptly declivous from the dorsal surface which is margined posteriorly by a strong carina.

The following generic diagnosis is based on the holotype of *Methocha rugosa* Cameron.

Male.—Maxillary palpus 6-segmented, labial palpus 4-segmented; mandible bidentate at apex, the lower tooth longer; clypeus with a median,

³ I take pleasure in naming this genus for my youngest daughter. The gender is feminine.



Figs. 3–5. Male genitalia, *Methocha* spp., cardo removed, exterior lateral aspect at left, aedeagus in center, internal lateral aspect at right. Fig. 3, *Methocha (Methocha)* sp., Sri Lanka. Fig. 4, *Methocha (Dryinopsis)* sp., Sri Lanka. Fig. 5, *Methocha (Andreus)* *mosotuana* Peringuey, Lesotho.

compressed nasiform process; antenna probably 13-segmented (missing beyond 5th flagellar segment), the basal flagellar segments short, strongly compressed, 1st flagellar segment as wide as long, the 2nd through 5th each more than $\frac{1}{2}$ as wide as long; eye oval, with fine, short setae, inner margin slightly concave above; ocelli 3, not enlarged.

Pronotum very long, along midline 0.8 times as long as scutum, dorsally margined anteriorly by a strong carina, much of the disk transversely rugose; scutum with parapsides but lacking notauli; mesopleuron margined anteriorly and above by a strong carina, on lower third with a deeply impressed, narrow, longitudinal, densely haired fossa; mesosternum with a strong carina before each mid coxa; metasternum at apex with a pair of narrowly separated ligulate processes, each overlying the inner ventral angle of hind coxa; propodeum with sides and posterior surface abruptly declivous, dorsal surface with a strong posterior carina.

Wings badly matted together, but venation apparently as in *Methocha*.

Legs slender, but femora and tibiae heavier than in *Methocha*; formula of tibial calcaria 1-2-2, the outer, shorter spur of hind tibia slender, black and curved on apical $\frac{1}{2}$; (fore missing), mid and hind tarsal claws cleft, the inner ray blunt and larger; hind coxa with dorsal carina along inner margin not raised into a lamella.

Abdomen not petiolate, 2nd through 6th terga and 3rd through 6th sterna each with a deep, curved subbasal groove bearing close, longitudinal rugulae.

Female.—Unknown.

Type-species.—*Methocha rugosa* Cameron, 1897, by present designation and by monotypy.

This peculiar and distinctive genus is still known from only a single male reported to have been captured in Ceylon. Its rarity suggests that perhaps its behavior and preference for an ecological niche may be much different from those exhibited by *Methocha*, the only other genus in the subfamily. Several species of *Methocha* subg. *Methocha* Latreille (*ichneumonides* Latreille, *bicolor* Say and several other species), at least one species of *Methocha* subg. *Dryinopsis* Brues (*violaceipennis* Cameron), and at least one species of *Methocha* subg. *Andreus* Ashmead (*andrei* Arnold) have been reared from *Cicindela* larvae dwelling in burrows in the soil. The antlike *Methocha* females may be found crawling on the ground or occasionally visiting honeydew secretions on foliage near the ground, and the winged males are found on foliage or flying low over the ground. I suspect that *Karlissa* may lead an arboreal existence in the forest canopy, that the females may parasitize the larvae of arboreal, flightless tiger beetles dwelling in pre-existing burrows in branches or twigs, and that the males also usually remain in the canopy, visiting arboreal blooms for nectar or honeydew secretions on foliage. If my presentiment is correct, there would be a striking

analogue in another tiphiid subfamily, the Myzininae. The females of some of those genera are known to parasitize subterranean beetle larvae, but one genus, *Hylomesa* Krombein, has converted to an arboreal existence and parasitizes larvae of Cerambycidae in their burrows in timber.

Karlissa rugosa (Cameron), NEW COMBINATION

Figs. 1, 2

Methoca (!) *rugosa* Cameron, 1897:52-53, pl. 4, fig. 11 (δ ; Ceylon).—
Bingham, 1897:54 (δ ; redescription of type).

Poecilotiphia (?) *rugosa* (Cameron), Turner, 1908:131 (tentative generic assignment).

Methocha rugosa Cameron, 1968:3 (confirmed as Methochinae).

This enigmatic species is still known only from the male holotype in the Rothney Collection, Hope Department of Entomology, Oxford University. The holotype bears only two labels, a small square with a pencilled "11" and Cameron's label "Methoca/rugosa/Cam. Type." It seems probable that the former label refers to the figure accompanying the original description and not to a code indicating the locality. Cameron cites no collector for the specimen. However, it may be presumed to have come from Col. Yerbury who is credited in the same paper with having collected a number of other Ceylonese species described therein.

Despite the great amount of collecting that has been done in Sri Lanka, especially since the mid-1950's, it has never been found again. One would be inclined to question the attribution of the type-locality, were it not for the fact that this strange animal has not been captured elsewhere. A possible explanation that its rarity may be due to a largely arboreal existence is discussed under the generic heading.

The holotype is in reasonably good condition except that most of the flagellar segments are missing (note Cameron's figure) as well as the terminal segment of left fore tarsus, left mid and hind tibiae and tarsi, and the right fore tarsus except for the basal segment. Some vestiture, especially upon the eyes, has been abraded, probably the result of the specimen having been preserved in formalin or some other liquid preservative when collected. It was impossible to relax it satisfactorily and I had to remove the seventh abdominal sternum and aculeus in order to extract the genitalia for study and illustration. The dissected abdominal sterna and remainder of the right antenna (removed to reveal punctuation of some areas of the front and clypeus for illustration) are preserved on a card point beneath the specimen; the genitalia in glycerine are in a small plastic, rubber-stoppered vial also pinned beneath the specimen.

Male (redescribed from the holotype).—Length 15 mm, forewing 9 mm. Black, glossy; mandible, scape, fore trochanter, femur and tibia darker red

than palpi, antennal pedicel and 1st 4 flagellar segments which are lighter red; 5th flagellar segment infuscated at apex above, suggesting that missing section of antenna may be relatively dark at least on upper surface; apex of pronotum narrowly reddened as are outer and hind margins of tegula. Forewing hyaline to basal vein, the apical $\frac{1}{2}$ infuscate. Vestiture on front relatively dense, subappressed and golden, that on thorax sparse, suberect and glittering white; discal vestiture on abdomen sparse, suberect and white except apices of segments with a single row of subappressed black setae; setae on eyes short, probably dense, but now mostly abraded.

Head in frontal view with punctuation and vestiture as figured (Fig. 1); clypeal keel (Fig. 1a) very compressed, relatively elongate, rounded at apex; flagellum compressed, 1st 4 segments relatively shorter and broader than in other male methochines; malar space very narrow; ocelli normal in size, arranged in a low triangle, the lateral ocellar distance $\frac{2}{3}$ the postocellar distance and $\frac{1}{2}$ the ocellocular distance; no groove behind posterior ocelli; the vertex and upper temples with relatively scattered punctures; lower temples and genae closely punctate; head behind hypostomal area transversely rugose.

Pronotum along midline 0.8 times as long as scutum, median length $\frac{2}{3}$ the anterior width, the latter about 0.7 times as wide as width at tegulae, disk anteriorly with strong ridge extending onto sides, anterior $\frac{2}{3}$ of disk and sides with close transverse rugae which become oblique posteriorly on side, posterior $\frac{1}{3}$ of dorsum smooth with scattered small punctures, the pronotal dorsum sloping gradually upward to level of scutum; scutum somewhat irregularly, transversely rugose between parapsides which extend entire length of scutum, area between parapsides and tegulae pitted; scutellum as long as scutum, a median, coarsely pitted triangular area raised above the abruptly declivous smooth sides, the short posterior section also abruptly declivous and with close, relatively small punctures; postscutellum lying below the plane of the scutum-scutellum, anteriorly on median $\frac{1}{2}$ with a narrow, deep depression, posteriorly in middle with small, close pits, laterally declivous and with a few oblique rugulae; mesopleuron anteriorly and above with a strong continuous ridge, upper $\frac{2}{3}$ and posterior $\frac{1}{3}$ coarsely pitted, more or less longitudinally on upper $\frac{2}{3}$, a deeply impressed, narrow, longitudinal, densely haired fossa on median $\frac{1}{3}$ below the upper pitted area; mesosternum slightly concave along midline and with a deep, narrow apical fossa, a few short, transverse rugulae anteriorly, punctate and pitted elsewhere, at apex with short, strong transverse carina before each mid coxa; metapleuron longitudinally rugulose; metasternum at apex with a pair of narrowly separated, short ligulate processes, each overlying the inner ventral angle of hind coxa; dorsum of propodeum flat, lower than postscutellum, a median triangular areola formed by two strong rugulae nearly joined at base and diverging toward apex, area within areola with a few irregularly

transverse rugulae, horizontal area laterad of areola with coarse rugulae forming irregular pits, the horizontal surface posteriorly with a strong, erect ruga; lateral surface of propodeum with strong, relatively close, oblique, somewhat irregular rugulae; posterior surface of propodeum abruptly declivous, with about 12 rugulae radiating outwardly from below, the median rugula the strongest.

Declivous anterior area of 1st abdominal tergum smooth, anterior $\frac{1}{2}$ of dorsal surface irregularly, longitudinally rugulose, the remainder smooth except for an apical row of small punctures and laterally with larger punctures becoming more crowded at side; 2nd through 6th terga each with a deep, curved, subbasal groove bearing close, short, longitudinal rugulae, these terga each with apical row of small punctures, smooth medially and laterally with larger punctures becoming denser toward sides; 7th tergum rounded and with scattered larger punctures, pygidial area absent; 1st sternum anteriorly with strong transverse ridge from which extends a median ridge becoming gradually weaker and ending about $\frac{3}{4}$ the length of segment, the surface elsewhere with coarse, close pits becoming more separated toward apex; 2nd sternum with large, subcontiguous punctures and an apical row of close small ones; 3rd through 6th sterna each with a deep, curved, subbasal groove, wider than those on terga, and each with close, short, longitudinal rugulae, each of these sterna with an apical row of close, small punctures, elsewhere with scattered, larger punctures which are denser anteriorly and laterally; 7th sternum with closer larger punctures, slightly notched apically in middle; punctate at base and with a lateral carina extending $\frac{2}{3}$ the distance to apex; genitalia as figured (Fig. 2).

Female.—Unknown, but undoubtedly wingless and with an antlike habitus.

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C. F. Jacot-Guillarmod, Albany Museum, Grahamstown, South Africa, sent me representatives of several species of *Methocha* subg. *Andreus* Ashmead.

The illustrations are by George L. Venable, Department of Entomology, Smithsonian Institution.

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OBSERVATIONS ON THE NESTING BEHAVIOR OF *ALYSSON CONICUS* PROVANCHER (HYMENOPTERA: SPHECIDAE)

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Abstract.—Brief observations on the nesting behavior of *Alysson conicus* Provancher are presented. Behavioral comparisons are made with *A. melleus* Say, and the only significant difference is the genera of prey.

Except for *A. melleus* Say (Hartman, 1905; Rau and Rau, 1918; Evans, 1966; Kurczewski and Kurczewski, 1971), little is known about the nesting behavior of the Nearctic species of *Alysson*. None of the nine other U.S. species has been reported nesting or taken with prey. Possible reasons for this dearth of information about the Nearctic *Alysson* include their small size, rather secretive behavior, propensity for nesting in damp shaded soils and inconspicuous nest entrances.

Evans (1966) summarized the nesting behavior of *A. melleus* as follows: (1) Semi-gregarious females which nest in relatively cool, moist, friable soils; (2) mostly vertical burrows with off-center entrances surrounded by tumuli of small pellets of moist soil; (3) multicellular nests with cells constructed progressively back toward the entrance; (4) immature or adult cicadellid prey, rarely delphacids, which do not recover from the paralysis; (5) prey transport in flight or partly on the ground, the latter method prior to nest entry; (6) prey grasped by its beak with the mandibles and carried venter-up; (7) direct entry into the open nest without release of the prey unless the entrance has been disturbed; and (8) egg laid longitudinally on the side of the ventral thorax of one of the uppermost prey in the cell after completely provisioning the cell.

Alysson conicus Provancher occurs from Michigan, Ontario, and New Hampshire south to Maryland (Krombein, 1951, 1967). Nothing is known about its biology or ecology.

We observed *A. conicus* nesting in August 1978 at the Cranberry Lake campus of the State University of New York College of Environmental Science and Forestry. Females nested in a firm, moist, sandy and gravelly road paralleling Sucker Brook and Cranberry Lake. Predominant vegetation

surrounding the road was sugar maple (*Acer saccharum*), American beech (*Fagus grandifolia*), yellow birch (*Betula allegheniensis*), wild black cherry (*Prunus serotina*), meadowsweet (*Spirea latifolia*), and various grasses and sedges.

Alysson conicus females were observed nesting in sunlit areas on the road. Nesting activity occurred between about 0900–1100 and 1500–1800 hours on sunny days but more or less continuously on cloudy days. No other species of *Alysson* were found at this site; however, *A. melleus* and *A. oppositus* Say were collected in a sandpit near Wanakena, New York, 5 miles away across the lake at 1015 hours during full sunlight.

Provisioning females of *A. conicus* transported the leafhoppers in flight venter up and head forward, grasping the prey's beak with the mandibles, but they always carried the leafhoppers on the ground in proximity to the nest entrance. They took flight upon the slightest movement, landing briefly and flying away quickly.

Because of the small and inconspicuous entrances, nests of *A. conicus* were difficult to locate. We accidentally unearthed one of the nests while excavating a nest of *Crabro advena* Smith. It contained two small cells at depths of 1.5 and 4.2 cm below the surface. One cell contained 7 *Empoa albicans* Walsh (Cicadellidae), the other 5 *E. albicans* and 2 *E. venusta* (McAtee). The adult leafhoppers were positioned in the cells mostly ventral side upward and head inward. In both cells the egg was destroyed during excavation of the nest. Several other prey taken from females of *Alysson conicus* proved also to be adults of *Empoa albicans* a species common in the low vegetation paralleling the nesting sites. The leafhoppers in the cells appeared to be dead or at least fully paralyzed with no evidence of breathing or appendage movement.

DISCUSSION

Alysson conicus is similar to *A. melleus* in its preference for nesting in damp sand, and in its nearly continuous activity on cloudy days but divided activity during morning and late afternoon on bright, sunny days. The *A. conicus* nest, containing small provisioning cells one more or less above the other, may represent the "typical" *Alysson* nest. However, the two *A. conicus* cells which we found were separated by 2.7 cm, farther apart than any of the reported intranest cells of *A. melleus*. *Alysson melleus* and *A. conicus* are alike in their transport of prey in that both species may fly into the nesting area but proceed on the ground to the nest entrance. The leafhopper prey of both species are killed outright or at least fully paralyzed. The genus *Empoa* (Cicadellidae), the only known prey of *Alysson conicus*, has not been reported as prey of *A. melleus*.

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NOTES ON THE ETHOLOGY OF *PROCTACANTHUS NEARNO*
(DIPTERA: ASILIDAE) IN MEXICO^{1,2}

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Abstract.—*Proctacanthus nearno* Martin was studied in a mesquite savannah near Jimenez, Chihuahua, Mexico, where it foraged from the ground or vegetation. Prey were captured in flight or as they were landing on the ground. The method used by this asilid species in manipulating prey during feeding depended upon prey size. Five prey in the orders Diptera, Homoptera and Orthoptera were recovered. *Proctacanthus nearno* mated in the male-over-female position.

Proctacanthus nearno Martin is a large (about 28 mm long), brownish-black robber fly. Males and females are morphologically similar except for genitalic structure. The male claspers are sparsely white pollinose, whereas the female's ovipositor is shiny, reddish black, and cylindrical with a distinct apical circlet of black spines (Martin, 1962).

The behavior of this species was observed along a dry stream bed at the edge of agricultural land, 7 km north of Jimenez, Chihuahua, Mexico, at an altitude of approximately 1,500 m above sea level. The habitat is a southern desert grassland (with two dominant grass genera, *Bouteloua* and *Aristida*), invaded by mesquite (*Prosopis*).

Proctacanthus nearno foraged from both ground and vegetation, depending upon the temperature of the soil surface. When the temperature of the soil surface was less than 32 to 38°C, this species foraged from the ground in a flattened position, broadside to the sun. As the temperature of the soil surface increased to about 45°C, *P. nearno* took a more or less flattened position, but faced the sun. Once the soil surface temperature exceeded

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45°C, this species stood up on its tarsi with its body held high above the ground or flew to a position on the vegetation about 1 to 2 m above the ground. When on vegetation, *P. nearno* assumed a position similar to that of *P. micans* Schiner (Dennis and Lavigne, 1975), with its body at a 45° angle to the vertical or pressed against the vegetation.

When actively engaged in foraging, *P. nearno* would make several forage flights from the same site. Like *P. micans*, *P. nearno* is a strong flyer and usually made relatively long forage flights of 2 to 6 m. When changing foraging site, specimens generally flew 4 to 7 m to a new location on the ground or vegetation.

Proctacanthus nearno captured most of its prey in flight 2 to 3 m in front of and above its foraging site. However, a few prey were captured as they were landing on the ground, as reported previously for *Efferia varipes* (Williston) (Dennis and Lavigne, 1976). Some potential prey were released shortly after contact was made, presumably because of some undesirable characteristics. When prey were not released, *P. nearno* inserted its hypopharynx into the prey's thorax during a hover flight before landing to feed. Similar behavior during prey capture has been reported for other species of *Proctacanthus* (Baker and Fischer, 1975; Dennis and Lavigne, 1975).

As *P. nearno* fed, the method by which it manipulated prey depended on prey size. Small prey, less than 9.0 mm in length, were manipulated with all tarsi as the asilid hovered above its feeding site. Larger prey, such as Cicadidae (Fig. 1) with a total length of 32.0 mm, were manipulated with a combination of tarsi as the asilid held onto vegetation with one or two tarsi. One female was also observed removing her hypopharynx from her prey during flight and reinserting it prior to landing at a new feeding site. This aspect of asilid behavior has not been recorded previously.

Only two complete feedings were observed. A male *P. nearno* fed on *Eupeodes volucris* Osten Sacken (Syrphidae) for 39 min and a female fed on a Cicadidae for 2 hr, 16 min. A second female was observed to feed on a male *Derotmena haydenii* (Thomas) (Acrididae) for 2 hr, 32 min, before being lost to observer's sight as she changed feeding sites. The extreme length of feeding times suggests that few prey are taken on a given day. Other species of *Proctacanthus* (Baker and Fischer, 1975; Dennis and Lavigne, 1975) have been estimated to feed on 3 to 7 prey per day.

At the completion of feeding, *P. nearno* allowed prey to drop off its hypopharynx either at the feeding site or in flight shortly after leaving the feeding site.

Five prey were recovered from *P. nearno* on May 28, 1973; prey size and predator sex is indicated in parentheses following the prey identification.—DIPTERA, Sarcophagidae: *Sarcophaga* sp. (6.0 mm, ♀); Syrphidae: *Eupeodes volucris* O. S. (8.9 mm, ♂); Tachinidae: *Stomatomyia parvipalpis*



Fig. 1. Female *Proctacanthus nearno* feeding on an unidentified cicada. Fig. 2. Mated pair of *Proctacanthus nearno* resting on vegetation.

(Wulp) (7.2 mm, ♂); HOMOPTERA, Cicadidae: unidentified (32.0 mm, ♂); ORTHOPTERA, Acrididae: *Derotmena haydenii* (Thomas) (20.0 mm ♀).

Other species of *Proctacanthus* feed on a wide variety of prey from the orders Coleoptera, Diptera, Hemiptera, Homoptera, Hymenoptera, Lepidoptera, Neuroptera, Odonata, and Orthoptera (Baker and Fischer, 1975; Bouseman and Maier, 1977; Bromley, 1923, 1931, 1934, 1946, 1947, 1949, 1950; Dennis and Lavigne, 1975; Rogers and Lavigne, 1972).

Only two mating pairs were observed. We did not observe any courtship behavior by either males or females of *P. nearno* prior to mating. However, males probably exhibit searching flights for receptive females as observed for *P. micans* (Dennis and Lavigne, 1975).

The activity pattern of a male was being observed when he flew into dense vegetation, reappeared within a few seconds, and copulated with a female in the male-over-female position. It is assumed that this mating was initiated while the female was resting on a bush. While in the male-over-female position, the male's abdomen curved around either side of the female's abdomen and clasped the genitalia from below. The female's wings were spread at about a 45° angle to her body, whereas the male's wings were closed over his dorsum. In this position, the female's wings passed under the male's fore legs and over his mid legs. The male's fore tarsi rested upon the female's eyes, and his mid and hind tarsi either clasped the female or the vegetation below the female. While in copulo, male *P. micans* rub the females' eyes with their fore tarsi (Dennis and Lavigne, 1975); however, this behavior was not observed for *P. nearno*.

Shortly after the initiation of mating the mating pair assumed the tail-to-tail position (Fig. 2). However, after 12 min, the pair flew into the air, hit some vegetation, and separated. A second mated pair acted similarly, changing from the male-over-female position to the tail-to-tail position after less than a minute. In this instance, initiation of mating occurred in flight and separation occurred 12 min later when the pair, having been disturbed, flew and landed on vegetation only to separate immediately. According to Dennis and Lavigne (1975), the duration of *P. micans'* matings, which are initiated both in flight and on vegetation, were shortened when mating pairs straightened out in the tail-to-tail position. *Proctacanthus nearno* may function similarly, so we question whether the observed matings were complete. The observed matings occurred at 5:32 and 5:55 PM, when the air temperature at the asilids' height was approximately 35.5°C (in sunlight) and 31.5°C (in shade), respectively.

Oviposition by female *P. nearno* was not observed. Like other species of *Proctacanthus* (Bromley, 1946), *P. nearno* females possess spines on their ovipositors and undoubtedly oviposit in the ground, as do females of *P. micans* (Rogers and Lavigne, 1972; Dennis and Lavigne, 1975).

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VARIANTS OF *HEXAGENIA* S.S. SPECIES AFFECTING SUBGENERIC DIAGNOSIS (EPHEMEROPTERA: EPHEMERIDAE)¹

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Abstract.—Adult variants of two species of *Hexagenia* s.s. from eastern North America cannot be identified to the correct subgenus with the use of present keys. Existent differentiating characters of male genitalia and wing venation are qualified by taking into account the described variants and the zoogeography of the subgenera.

Hexagenia Walsh is one of the most common and well known genera of Ephemeroptera in North America. These mayflies are extraordinary because of their relatively large size along with their propensity for occurring in large numbers and mass emergences. Adults are usually identifiable to subgenus and species with the use of published keys.

Spieth (1941) divided the group into two subgenera (Nearctic *Hexagenia* s.s. and Neotropical *Pseudeatonica* Spieth) based on adult morphological differences. The zoogeographic distinctiveness of the subgenera was reaffirmed by McCafferty (1968). Demoulin (1958, 1970) listed *Pseudeatonica* as a subgenus of the African genus *Eatonica* Navas rather than *Hexagenia*, and Kimmins (1960) accorded full generic status to *Pseudeatonica*. Subsequent discoveries of the larval stage of *Pseudeatonica* (McCafferty, 1970) and *Eatonica* (McCafferty, 1971) have clearly shown the latter two classificatory moves to be inappropriate and have substantiated Spieth's original concept. *Pseudeatonica* larvae are essentially symmorphic with those of *Hexagenia* s.s.

Spieth (1941) distinguished *Pseudeatonica* adults from those of *Hexagenia* s.s. primarily by the former's possession of three rather than four segmented male genital forceps. He also indicated that the fore wings of *Pseudeatonica* had 4-6 A₁ veinlets while those of *Hexagenia* s.s. had 8 or 9. McCafferty (1970) reported 5-14 veinlets (but usually 8 or more) in *Hexagenia* s.s. Edmunds et al. (1976) distinguished the subgenera on the basis

¹ Purdue Agricultural Experiment Station Journal No. 7459.

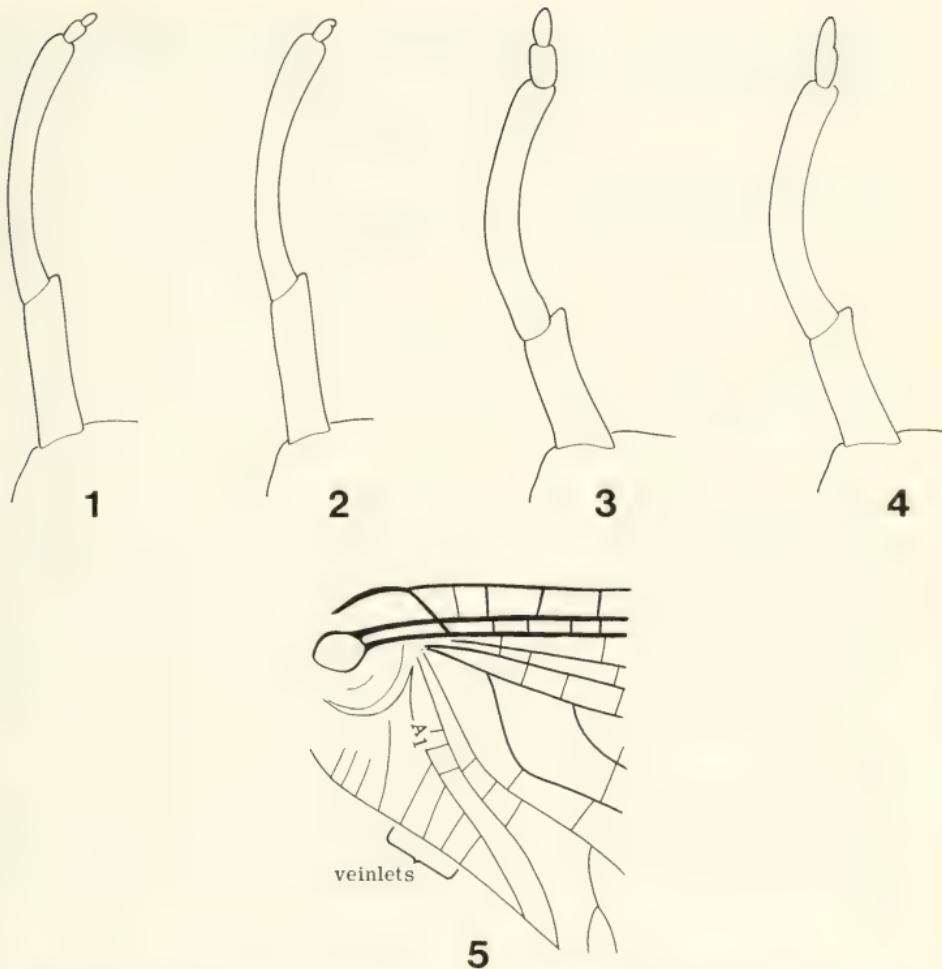
of the above genitalic differences and indicated that *Hexagenia* s.s. had 8 or more A₁ veinlets while *Pseudeatonica* had 6 or fewer.

Examinations of *Hexagenia* specimens from eastern and central North America have revealed that some are not identifiable to subgenus using the above characteristics. Since these characteristics form the basis of Spieth's (1941) key to *Hexagenia* species (first couplet) and the Edmunds et al. (1976) key to *Hexagenia* subgenera and are undoubtedly relied on heavily for species identification, and since samples often exist of only one or a few specimens, it is important to note the exceptions and delineate the subgenera more completely.

One adult male examined from the United States National Museum (Maryland, Worcester Co., Milburn Landing, 29 July 1972, J. & A. Cross) proved to be a typical specimen of *Hexagenia (Hexagenia) munda* Eaton in all characters except the forceps segmentation. It possesses only 1 short terminal segment (Fig. 2). Originally this was considered to be an aberrant individual of little concern. I have since examined *H. munda* material from Wisconsin which show a distinct deterioration of the terminal segmentation of the forceps in about one-third of the males and resemble the Maryland variant. Both four segmented and three segmented forceps occur within the same populations in Wisconsin, and a few individuals are asymmetrical in this regard.

Recently, I have examined another adult male of *Hexagenia* s.s. retained by the Maryland Water Resources Administration and preliminarily identified as *Pseudeatonica* which is also subgenerically problematic. This specimen (Patapsco R., Hollowfield, Maryland, 24 August 78, G. Harman) proved to be *Hexagenia atrocaudata* McDunnough but possesses genitalia (Fig. 4) and A₁ venation (Fig. 5) more typical of *Pseudeatonica*, i.e., the forceps have 1 small terminal segment and the fore wings have 4 A₁ veinlets. Further examination of *H. atrocaudata* specimens (both male and female) from throughout the species' range revealed that the number of veinlets extending from A₁ to the anal margin of the fore wings ranges from 4–8 although there often an additional 1 or 2 small incomplete veinlets (not attached to A₁). The forceps are normally distinctly four segmented. Variants of the genital forceps encountered in *H. munda* and *H. atrocaudata* are shown in Figures 1–4.

The use of A₁ veinlet numbers should be abandoned as a subgeneric distinguishing character. Segmentation of the genital forceps may continue to be regarded as a fundamental subgeneric character but must be qualified as a key character due to occasional variants of *Hexagenia* s.s. Because of the limited number of *Pseudeatonica* adults that I have been able to study, I am reluctant to offer additional characters to delimit the subgenera. I have not yet seen males or females of *Pseudeatonica* which possess bicolorous (divided ventro-laterally) compound eyes as is the condition present in all



Figs. 1–4. Male forceps. 1, *Hexagenia munda*, four segmented. 2, *H. munda*, three segmented. 3, Typical *H. atrocaudata*. 4, Atypical *H. atrocaudata*. Fig. 5. Anal area of fore wing, *H. atrocaudata*.

Hexagenia s.s. males. Also the compound eyes of *Pseudeatonica* are slightly convergent ventrally as seen in facial view, whereas those of *Hexagenia* s.s. tend to be convergent dorsally, especially so in the males. These differences may eventually prove to be consistent. The subgenera are obviously very closely related sister groups (McCafferty, 1973).

The respective geographic ranges of the subgenera are reliably diagnostic in most cases. Only *Hexagenia* s.s. occurs north of Mexico and only *Pseudeatonica* occurs in South America. The occurrence of *Pseudeatonica* in the U.S. or Canada would be extremely improbable. Eventually the subgenera may be found to overlap in southern Mexico and Central America.

For this region both the venational and genitalic characters stated by authors previously can be used with confidence since *H. atrocaudata* and *H. munda* do not occur as far south as Mexico.

ACKNOWLEDGMENTS

I thank Oliver Flint, Department of Entomology, Smithsonian Institution, for allowing me to examine burrowing mayflies housed at the U.S.N.M. I also thank Philip Lewis, U.S.E.P.A., for providing material for examination.

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A NEW ANISOPS FROM KENYA (HEMIPTERA: NOTONECTIDAE)

CHARLES V. REICHART

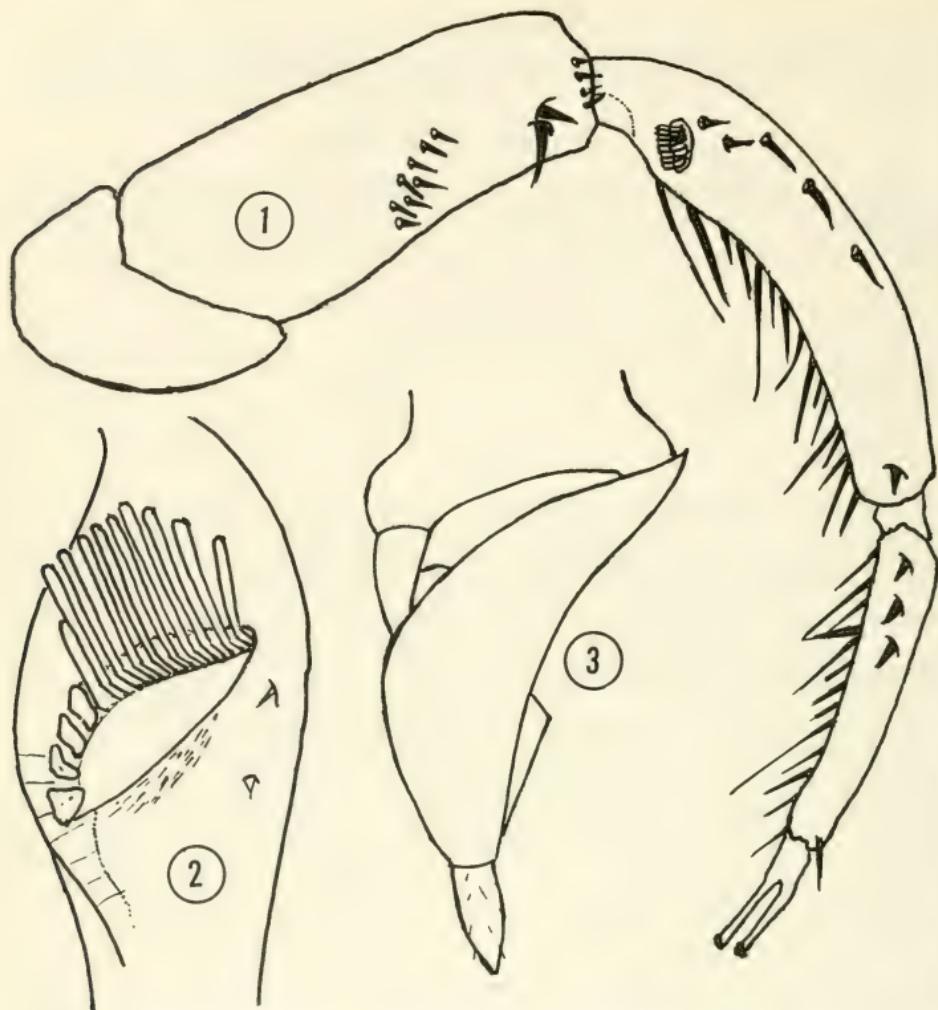
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Abstract.—*Anisops magnadens*, new species, is described from Kiserian, Kenya, East Africa.

Anisops magnadens Reichart, NEW SPECIES

Size.—Male, 7.8 mm in length, greatest body width 2.0 mm; females, 7.8–7.9 mm in length, greatest body width 2.1–2.2 mm. Shape: Subfusiform, stout; greatest body width about midway length of body. Color: General facies stramineous. Eyes light brown. Hemelytra hyaline. Abdominal venter dark brown with keel and segmental margins of connexivum stramineous; external margins of connexivum mottled reddish in fresh specimens.

Male structural characteristics.—Viewed from above, outline of head rounded with anterior margin almost straight and vertex protruding slightly beyond that margin and slightly indented at eye margins, particularly just above tylus; greatest width of head barely less than pronotal humeral width, and 4½ times anterior width of vertex; synthlipsis ⅓ as wide as anterior width of vertex; along median longitudinal axis head approximately same length as median longitudinal axis of pronotum. Humeral width of pronotum ⅔ more than longitudinal median length of pronotum; lateral margins slightly divergent and approximately ⅔ median length; posterior margin convex, medially emarginate; barely perceptible median carina bordered on each side by large shallow depression extending almost ⅔ length of pronotum; anterior end of carina margined by 2 distinctive small pits; point of pronotum inserted between eyes horizontally rugose. Scutellum ⅔ wider than long; large shallow depression anteriorly on each side of median; apex slightly raised. Facial tubercle moderately swollen. Basal width of labrum wider than median length; apex bluntly rounded. Rostral prong (Fig. 3) arises at very apex of 3rd rostral segment and more than twice as long as this segment; broadly expanded with translucent keel on anterior margin of prong; apex bluntly acuminate. Stridulatory comb (Fig. 2) with 10 teeth, 7 of which are approximately same length; distally, these teeth followed by 4 padlike areas. Chaetotoxy of left front leg shown in Fig. 1.



Figs. 1-3. *Anisops magnadens*. 1, Left front leg. 2, Stridulatory comb of tibia. 3, Rostral prong.

Female structural characteristics.—Viewed from above, outline of head rounded, with vertex extending slightly beyond; greatest width of head slightly more than $\frac{5}{6}$ pronotal humeral width and $4\frac{1}{2}$ times anterior width of vertex; synthlipsis wide, only slightly less than $\frac{1}{2}$ anterior width of vertex; along median longitudinal axis head slightly more than median longitudinal axis head slightly more than median longitudinal length of pronotum. Pronotum with humeral width slightly more than median length; lateral margins divergent and slightly less than $\frac{1}{2}$ median length; posterior margin convex, medially emarginate. Scutellum $\frac{4}{5}$ wider than long. Tylus slightly

inflated, smooth, and broadly triangular. Frons almost parallel. Labrum with basal width equal to median length; bluntly rounded.

Types and type-locality.—One male (holotype) and three females (paratypes), 26-X-67, from a small, muddy, roadside pool in the vicinity of Kis-erian, Kenya (C. V. Reichart # 1735).

Comparative notes.—*Anisops magnadens* keys out to couplet 30 (*A. varia* Fieber) in Brooks' monograph (1951). However, it can be readily distinguished from *varia* and all other *Anisops* species by the enormous prong of the male which covers the entire rostrum and is more than twice as long as the third segment. The stridulatory comb is also distinctly different, with ten teeth as compared to approximately 21 in *varia*; the basal two teeth and the distal tooth are shorter than the other seven. Four padlike areas of irregular shape follow the distal tooth. *A. magnadens* also has a striated stridulatory ridge similar to *A. gracilis* Hutchinson.

Deposition of types.—Holotype male, and one paratype female deposited in the National Museum of Natural History, Smithsonian Institution, type no. 76125.

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BIOLOGICAL, ANATOMICAL, AND DISTRIBUTIONAL NOTES ON
THE GENUS *CALLOPISTROMYIA* HENDEL (DIPTERA: OTITIDAE)

GEORGE C. STEYSKAL

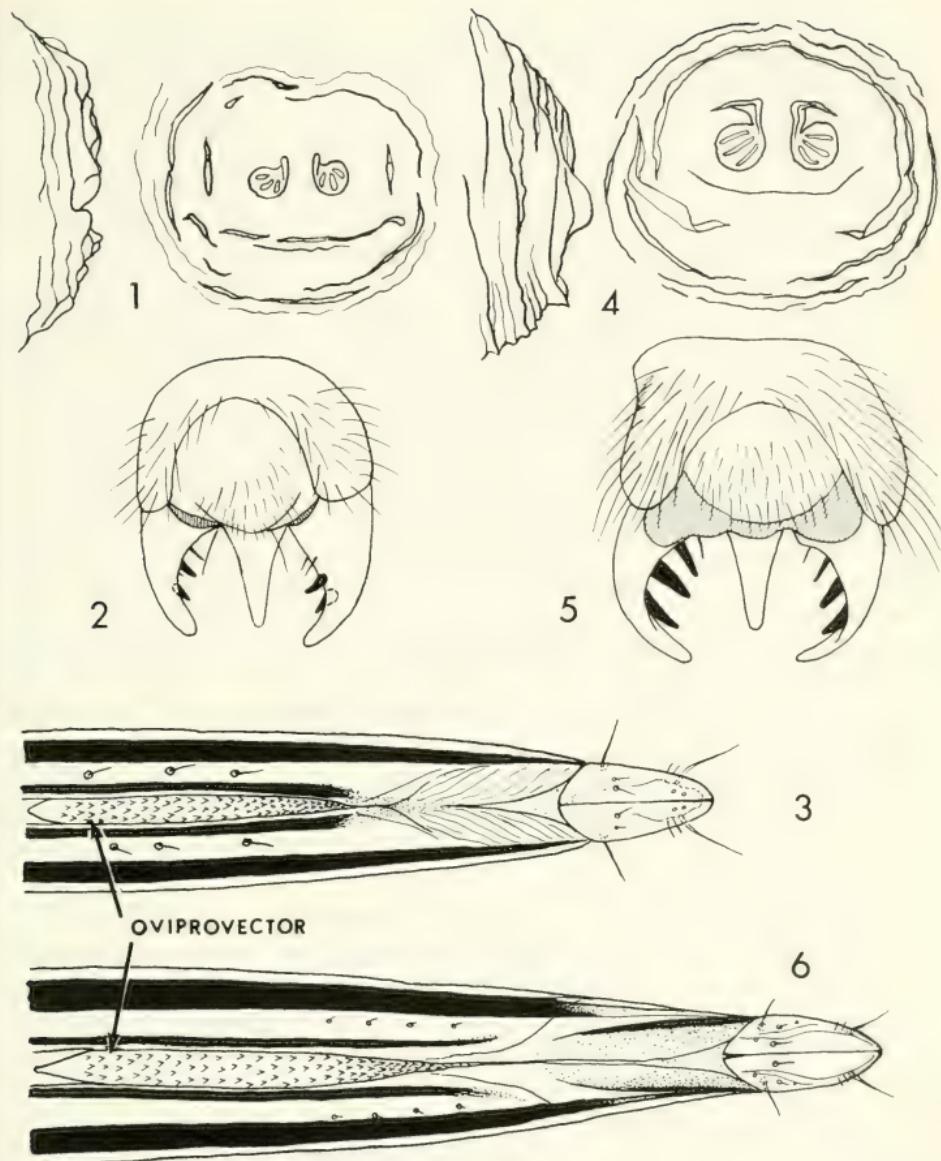
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Abstract.—A review of the biology, anatomy of the puparia and adult postabdomens, and distribution of the two known species of the genus, *Callopistromyia annulipes* (Macquart) and *C. strigula* (Loew), is presented. The immature stages are spent in the decaying cambium of recently dead wood of various trees. A new term, oviprovector, is introduced for a structure in the ovipositor.

Observation of *Callopistromyia annulipes* (Macquart) at Lost River State Park, Hardy County, West Virginia, on 3 September 1978 in such numbers that non-entomologists noticed them prompted the following review of what is known about the two species presently considered to belong to the genus. Until I (Steyskal, 1975) referred *Pterocalla strigula* Loew to *Callopistromyia*, the genus was considered to include only *C. annulipes* (Macquart).

Callopistromyia annulipes (Macquart)

Behavior of the adults.—At Lost River State Park the adults were seen everywhere on exposed surfaces, mostly in the sunlight. They were frequently seen on parked automobiles. No effort to mate was observed, but the peculiar display of the wings noted long ago by Banks (1904) was very evident and performed by both sexes. Banks also mentioned a statement by Harris (1862, p. 620) which apparently refers to this fly. Two cards in the files of the U.S. National Museum, written by J. M. Aldrich, are interesting: "Sept. 1, 1922. I noticed several specimens strutting with wings up-raised like a peacock's tail, on a bridge on Rock Creek Park. One that I captured in the act was a female, the first instance of such display in a female that I know of. I succeeded in mounting the specimen to show the posture pretty well, but the wings are not touching as they should be. The 2 black costal spots blend when the wings are displayed, and are almost central in the circle." "June 22, 1931. Melander and I watched a female strutting on a log above Great Falls. He finally captured her. She did as I have indicated in



Figs. 1-3. *Callopistromyia annulipes*. 1, Posterior end of puparium, lateral and posterior views. 2, Male postabdomen, posterior view. 3, Apical part of ovipositor, ventral view. Figs. 4-6. *Callopistromyia strigula*. 4, Posterior end of puparium, lateral and posterior views. 5, Male postabdomen. 6, Apical part of ovipositor, ventral view.

the other case, and we watched for some time. Another specimen strutted on my shirt-sleeve, and we both saw it, but she got away. Do the males strut at all?" The specimen mounted by Aldrich is still in the Museum collections.

The seasonal distribution of the flies and their attraction to baits are treated in 2 papers by Frost (1928, 1929). Some of the flies observed at Lost River State Park were females with abdomens distended by eggs. Adults have been seen from April to October. It seems likely that there are at least two broods during this period. I found two puparia in decaying cambium of a dead tree of *Acer negundo* Linnaeus (boxelder) on Grosse Ile, Michigan, on 12 April 1954; adults emerged indoors 6 days later. Malloch (1931) stated that the larvae of species of *Pseudotephritis* "live under slightly loose bark of trees and occur frequently along with those of *Callopistromyia*." I (Steyskal, 1951) noted the presence of adults on the bark of trees in Michigan; they were abundant on dying trees of *Populus deltoides* Barr. ex Marsh, ovipositing on dead trees of *Robinia pseudacacia* Linnaeus, and feeding at frass of wood borers in live trees of the latter species.

The puparia of *Callopistromyia annulipes* mentioned in the preceding paragraph, found on Grosse Ile in *Acer negundo*, may be described as follows: 1.5 mm wide by 4.0 mm long; light brown; of cylindrical shape usually among acalyprate Diptera, with head end a little flattened dorsoventrally; venter finely transversely wrinkled; dorsum smooth; segmental margins little constricted; posterior end as in Fig. 1; stigmatophores comma shaped, with 3 short slits, in shallowly depressed area surrounded by undulate ridges and a pair of ligulate processes, each about the diameter of a stigmatophore laterad of each stigmatophore; anal plates together forming a slightly depressed circular area.

Male genitalia.—The great similarity of the male postabdomen to those of the species of *Pseudotephritis* figured by Steyskal (1962) confirms the close relationship of *Callopistromyia* to *Pseudotephritis* and its relatives, as expressed by me previously (Steyskal, 1975). The posterior view of the epandrium, surstyli, and epiphallus ("median peg") shown in Fig. 2, as well as other details of the postabdomen not figured, is very similar to the structures found in *Pseudotephritis corticalis* (Loew).

Female genitalia.—I am aware of no published figure of the ovipositor of any otid of the genera most closely related to *Callopistromyia*, viz., *Pseudotephritis* Johnson and *Pseudotephritina* Malloch. The apical part of the ovipositor of *Callopistromyia annulipes* is shown in ventral view in Fig. 3. A structure which has otherwise been noted only in species of *Pareuxesta* Coquillett (Otitidae Ulidiinae, Galapagos Archipelago; unpublished data) is evident in *C. annulipes*. It is a ridge or process on the ventral surface of the dorsal male of the egg passage and is furnished with many apically directed spicules. It may be presumed that the structure assists in directing

the egg out of the oviduct, and inasmuch as a term for the structure is needed it is here designated *oviprovector* (from Latin *ovum* + *provector*). The total length of the ovipositor in the narrower sense, exclusive of the ovipositibus and the sheath, is 1.65 mm.

Distribution.—The species is widespread in the United States but has been found in only a few places near the southern border of Canada, as listed below.

CANADA: *Ontario* (Niagara, Normandale, Ottawa), *British Columbia* (Robson).

UNITED STATES: *Connecticut* (Fairfield, Tolland Cos.), *District of Columbia*, *Georgia* (Harris Co.), *Idaho* (Gooding, Payette Cos.), *Illinois* (Champaign Co.), *Indiana* (Tippecanoe Co.), *Kansas* (Douglas Co.), *Kentucky* (Knox Co.), *Maine* (Hancock Co.), *Maryland* (Baltimore, Montgomery, Prince George Cos.), *Massachusetts* (Barnstable, Essex, Plymouth Cos.), *Michigan* (Berrien, Branch, Cass, Grand Traverse, Ingham, Kalamazoo, Livingston, Manistee, Monroe, Muskegon, Oakland, St. Joseph, Shiawassee, Wayne Cos.), *Mississippi* (Lafayette Co.), *Montana*, *New Hampshire* (Rockingham Co.), *New Jersey* (Camden, Mercer, Morris Cos.), *New York* (Dutchess, Erie, Nassau, New York, Onondaga, Tompkins, West Chester Cos.), *North Carolina* (Grayson, Haywood, Polk, Swain Cos.), *Ohio* (Athens, Franklin, Muskingum Cos.), *Pennsylvania* (Adams, Allegheny, York Cos.), *Rhode Island*, *Tennessee* (Anderson, Roane, Sevier Cos.), *Utah* (Box Elder, Cache, Salt Lake, Weber Cos.), *Vermont*, *Virginia* (Fairfax, Tazewell Cos.), *Washington* (Yakima Co.), *West Virginia* (Hardy Co.), *Wisconsin* (Dane Co.).

Callopistromyia strigula (Loew)

Behavior of the adults.—The wing of *C. strigula* is much narrower than that of *C. annulipes*; display of the wings of *C. strigula* would therefore produce a much different effect from that given by *C. annulipes*. No mention of wing display is to be found in the literature, and I have no notes nor can I remember any such behavior in connection with my collections of the fly.

Although the species is taken much less frequently than *C. annulipes*, collection dates extend through approximately the same period—21 April to 26 September. I reared adults from puparia found under the bark of a dead *Acer negundo*. The adults emerged indoors on Grosse Ile, Michigan on 21 and 22 April, and adults were seen outdoors a few days later. I am indebted to J. F. McAlpine for the record of a specimen in the Canadian National Collection reared from the same species of tree at Indian Head, Saskatchewan on 15 July. Others in the Canadian collection were taken as adults at “bleeding elm” and “wound on *Acer negundo*.” These are the only biological notes on this species of which I am aware.

The puparia from which I reared the adults on Grosse Ile are very similar in general appearance to those of *C. annulipes*. They are 1.5 mm wide by 4.2 mm long. The most evident differences are in the posterior end (Fig. 4), with larger stigmatophores and longer slits. The configuration of ridges also differs, especially a right-angled ridge extending dorsad from the stigmatophores.

Male genitalia.—Very similar to those of *C. annulipes* (see Fig. 4), but a little larger, with more strongly curved surstyli and larger prensisetae, 3 pairs of which are stout.

Female genitalia.—Also very similar to those of *C. annulipes*. The ovipositor (Fig. 6) is somewhat longer (1.70 to 1.80 mm in total length), with ventral setulae in the region lateral to the oviprovector much smaller and closer together in series.

Distribution.—The area occupied by *C. strigula* may be coincident with that of *Acer negundo*. The following collection records are available.

CANADA: Manitoba (Aweme, Beulah, Winnipeg), Ontario (Ottawa, Richmond, Ruthven), Saskatchewan (Delisle, Estevan, Indian Head, Regina).

UNITED STATES: Colorado, District of Columbia, Georgia ("Georgia," type), Illinois (Champaign Co.), Kansas (Douglas Co.), Maine (Penobscot Co.), Maryland (Montgomery Co.), Michigan (Lapeer, Wayne Cos.), Minnesota (Chisago Co.), Nebraska (Lancaster Co.), New Mexico ("Mogollon"), North Carolina (Swain Co.), North Dakota (Golden Valley Co.), South Dakota (Brookings Co.), Tennessee (Shelby Co.), Utah (Davis Co.).

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ADDITIONS TO KNOWLEDGE OF THE BETHYLID FAUNA OF HISPANIOLA (HYMENOPTERA: BETHYLIDAE)

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Abstract.—Three species of Bethylidae are recorded from Hispaniola (Dominican Republic), two of them new. These are *Rhabdepyris muesebecki* Evans, *Anisepyrus grisselli*, new species, and *Nesepyrus antilleanus*, new species. The last represents the first record of that genus from the West Indies.

Several years ago I tabulated the number of species of Bethylidae known from various West Indian islands and concluded that many more species are to be expected on several of the more poorly-collected islands, including especially Hispaniola (Evans, 1970). I report here on three species previously unreported from that island, two of them new and one representing the first record of its genus, *Nesepyrus*, from the West Indies.

Rhabdepyris muesebecki Evans

I described this species from Honduras (Evans, 1965) and have recently recorded it as far south as Bolivia and as far north as Missouri and Florida (Evans, 1978). I have recently studied a male from DOMINICAN REPUBLIC: 30 km N Cabo Rojo, Prov. Pedernales, 20 June 1976 (E. E. Grissell, on *Catalpa longissima*) [Florida State Coll. Arthropods, Gainesville]. This represents only the second record of this genus from the West Indies, *R. versicolor* Evans having been described from St. Croix (Evans, 1970). Both belong to the subgenus *Rhabdepyris* as I have interpreted it.

Anisepyrus grisselli Evans, NEW SPECIES

Holotype.—♀, DOMINICAN REPUBLIC: 30 km N Cabo Rojo, Prov. Pedernales, 20 June 1976 (E. E. Grissell, on *Catalpa longissima*) [Florida State Coll. Arthropods, Gainesville].

Description of female type.—Length 8.0 mm, fore wing 4.9 mm. Head, thorax, and front coxae and femora brilliant metallic green; propodeum greenish laterally, bluish dorsally; first 2 abdominal segments black, remainder of abdomen rufous; mandibles fuscous, ferruginous apically; scape

fuscous, with purple reflections; flagellum fuscous above, light brown below; middle and hind coxae and femora black, all tibiae dark brown, tarsi testaceous; wings uniformly tinged with brown. Mandibles broad, with a sharp apical tooth and 4 blunt teeth above it, most basal tooth rather small. Clypeus broadly subangulate, with a high median keel. Antennal scrobes carinate; eyes strongly hairy, vertex slightly concave medially. Width of head $1.04 \times$ length of head; width of front $1.3 \times$ eye height. Ocelli in a compact triangle at level of eye tops, well below vertex crest, ocello-ocular line $1.5 \times$ width of ocellar triangle. Front alutaceous, weakly shining, closely covered with small but well defined punctures. Third antennal segment $1.3 \times$ as long as wide. Pronotal disc alutaceous and punctate like front, but punctures absent along a median strip; anterior margin strongly carinate, but sides of disc more weakly so, the carinae fading out well before reaching posterior margin, latter paralleled across dorsum by a prominent groove. Propodeal disc $1.5 \times$ as wide as long, 5-carinate, irregularly reticulate between carinae; posterior angles foveolate. Mesopleura with upper fovea large, fully enclosed, lower fovea not at all defined on upper margin. Middle tibiae with only scattered short, weak spines; claws trifid.

Allotype.—♂, DOMINICAN REPUBLIC: Boca del Soca, Prov. La Romana, 13 June 1976 (E. E. Grissell, dry scrub) [Florida State Coll. Arthropods, Gainesville].

Description of male allotype.—Length 4.8 mm, fore wing 3.4 mm. Head, thorax, and propodeum blue green, abdomen black except apical 2 segments brownish; mandibles testaceous; antennae dark brown; front coxae black, legs otherwise rufotestaceous; wings subhyaline. Mandibles with 5 sharp teeth; clypeus as in female; scrobes not carinate; eyes with short hairs. Width of head $1.15 \times$ length of head; width of front $1.2 \times$ eye height; ocelli slightly enlarged, ocello-ocular line $0.8 \times$ width of ocellar triangle. First 4 antennal segments in a ratio of 20:4:3:20. Sculpturing of front and pronotum much as in female, but lateral pronotal carinae reaching posterior margin. Propodeal disc $1.6 \times$ as wide as long, sculpturing as in female but posterior angles only very obscurely foveolate. Upper margin of lower mesopleural fovea broadly incomplete, as in female; claws trifid as in that sex.

Paratype.—1 ♂, same data as allotype [U.S. National Museum].

Remarks.—The paratype is closely similar to the allotype but slightly larger, fore wing 3.7 mm. This is an anomalous species, falling in most respects in the *aurichalceus* group as I have defined it (Evans, 1966). However, the tibiae of the female are unusually weakly spinose, the scrobes carinate, and the posterior angles of the propodeum foveolate. In these respects the female would fit better in the *excisus* group (also West Indian), but the mandibles are not typical of that group. The male also appears intermediate between these two groups, having weakly foveolate posterior propodeal angles. There are several differences from *A. darlingtoni* Evans,

described from Haiti: The female has quite different mandibles and more strongly margined scrobes, the male ecarinate scrobes and different propodeal sculpturing; both sexes differ with respect to the trifid claws and the more intense coloration of the propodeum.

Nesepyris antilleanus Evans, NEW SPECIES

Holotype.—♀, DOMINICAN REPUBLIC (On Verawood log, 20 November 1934, Mann, New York, no. 30418 [presumably intercepted at quarantine]) [U.S. National Museum].

Description of female type.—Length 1.8 mm, fore wing 1.3 mm. Body dark brown, also antennae and legs to tibiae; tarsi light brown; mandibles largely testaceous; wings hyaline, veins and stigma light brown. Mandibles slender, bidentate; clypeus, in anterior view, with a flattened, triangular area, in dorsal view truncate; malar space about $\frac{1}{3}$ as long as width of mandibles at their base. Head elongate, widest at eyes and very gradually narrowed behind eyes to a straight vertex; width of head $0.77 \times$ length of head; eyes large, width of front only $0.9 \times$ eye height; eyes removed from vertex crest by very slightly more than their own height. Ocelli in an acute triangle, ocello-ocular line $1.4 \times$ width of ocellar triangle. First 4 antennal segments in a ratio of 7:3:2:2, segment 3 slightly longer than wide. Front and thoracic dorsum evenly alutaceous, moderately shining; propodeal disc approximately as long as wide, median carina weakened behind but reaching transverse carina, disc smooth and polished posterolaterally. Fore wing essentially as figured for *virginianus* by Evans, 1964, Fig. 110. Abdomen shining, slightly depressed.

Remarks.—This species is known only from the type, which will run to *virginianus* Evans in my key to *Nesepyris* (Evans, 1964) except for the relatively larger eyes and narrower front. As compared to that somewhat larger species, *antilleanus* has a complete median propodeal carina, slightly longer flagellar segments, and the eye tops closer to the lateral ocelli and to the vertex crest. This is the first report of the genus from the West Indies.

ACKNOWLEDGMENTS

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IDENTIFICATION OF LARVAE OF TWO EUROPEAN SPECIES OF
CEUTORHYNCHINAE (COLEOPTERA: CURCULIONIDAE) FOUND
IN *CARDUUS MACROCEPHALUS* DESFONTAINES (COMPOSITAE)

D. M. ANDERSON AND P. E. BOLDT

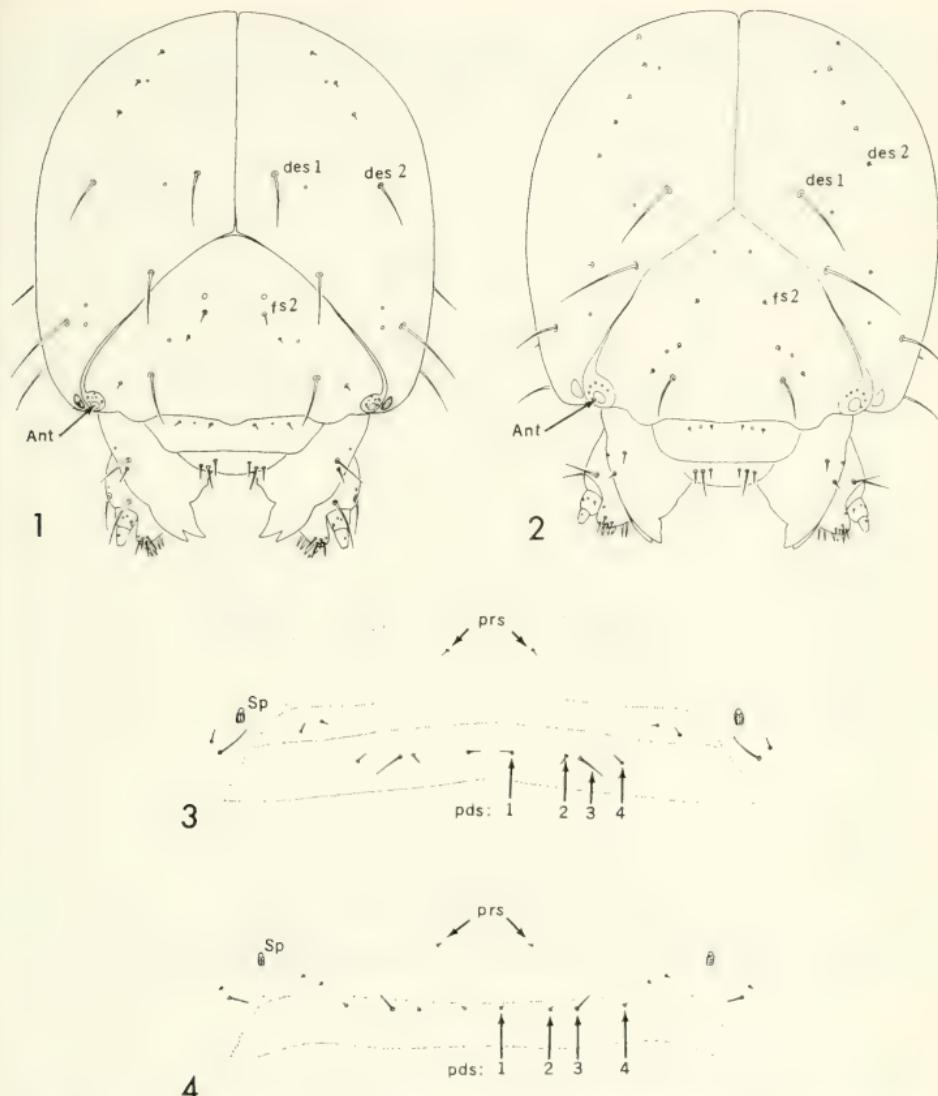
(DMA) Systematic Entomology Laboratory, IIBIII, Agric. Res., Sci. and Educ. Admin., USDA, % U.S. National Museum, Washington, D.C. 20560; (PEB) Sci. and Educ. Admin., International Program Staff, Biological Control of Weeds Laboratory-Europe, Via Vincenzo, Monti, 4, 00152 Rome, Italy.

Abstract.—Larvae of *Ceutorhynchus trimaculatus* Fabricius and of *Ceuthorhynchidius horridus* (Panzer), both potential biocontrol agents against the thistles *Carduus macrocephalus* Desfontaines and *C. thoermeri* Weinmann, were difficult to separate on the basis of feeding habits because they are found together in the crowns of the rosettes, but now they can be identified on the basis of anatomical characters presented in a key and table of measurements. The separation of these larvae from those of other weevils known to attack these thistles is also discussed.

Ceuthorhynchidius horridus (Panzer) and *Ceutorhynchus trimaculatus* Fabricius are potential biocontrol agents against *Carduus macrocephalus* Desfontaines and *C. thoermeri* Weinmann in North America. *C. horridus* has already been released in Virginia (Kok et al., 1975), and *C. trimaculatus* is currently being studied in Europe (Boldt, 1978) and in Virginia (Kok, 1978), in order to gain approval for its release in the United States. The larvae of both species are found together in the crowns of the thistle rosettes, and therefore cannot be identified to species by their location in the plants. To study the biology of these weevils and to evaluate their biocontrol potential under natural field conditions in Europe, it is necessary to know the taxonomic characters by which their larvae can consistently be separated. Therefore, taxonomic comparisons of larvae of the 2 species were undertaken, and the resulting key, measurements, and discussion are presented in this paper.

MATERIALS AND METHODS

Adults of *C. trimaculatus* and *C. horridus* were field collected on rosettes of *C. macrocephalus* near Rome, Italy, in November and December, 1976.



Figs. 1-2. Heads of larvae, front view. 1, *Ceuthorhynchus trimaculatus*. 2, *Ceuthorhynchidius horridus*. Figs. 3-4. Abdominal segment 2 of larvae, dorsal view, flattened by slide-mounting. 3, *Ceuthorhynchus trimaculatus*. 4, *Ceuthorhynchidius horridus*. Abbreviations: Ant, antenna; des 1, dorsal epicranial seta 1; des 2, dorsal epicranial seta 2; fs 2, frontal seta 2; pds, postdorsal setae; prs, prodorsal setae; Sp, spiracle.

Females were separated by species and caged for oviposition on bouquets or on small thistle plants held in the laboratory. Live eggs, 0-48 hours old, and head capsules of larvae preserved in 70% alcohol, were measured at 50 \times with an ocular micrometer in a stereoscopic microscope. A few larvae of each instar were dissected, macerated in a warm NAOH solution, slide-

mounted in glycerine, and examined with a compound microscope at 100–400 \times . Undissected specimens were studied with a stereoscopic microscope. Illustrations were made from slide-mounted and unmounted mature (3rd instar) larvae. The larval terminology used in the key and illustrations follows that of Anderson (1947).

The larvae upon which the key is based are in the National Museum of Natural History, Washington, D.C. All of the larvae and eggs from which measurements were taken are in the collection of the Biocontrol of Weeds Laboratory, USDA, in Rome, Italy.

MEASUREMENTS

Measurements of head capsule width indicated the presence of three larval instars. The egg and head capsule size in mm were as follows:

| | Mean \pm S.D. | No. | Min. | Max. |
|------------------------------------|-----------------|-----|------|------|
| <i>Ceuthorhynchus trimaculatus</i> | | | | |
| Eggs: Length | 0.66 \pm 0.04 | 59 | 0.58 | 0.71 |
| Width | 0.36 \pm 0.02 | | 0.34 | 0.37 |
| 1st instar | 0.32 \pm 0.02 | 36 | 0.29 | 0.36 |
| 2nd instar | 0.48 \pm 0.03 | 35 | 0.43 | 0.52 |
| 3rd instar | 0.69 \pm 0.03 | 41 | 0.62 | 0.72 |
| <i>Ceuthorhynchidius horridus</i> | | | | |
| Eggs: Length | 0.53 \pm 0.03 | 44 | 0.45 | 0.58 |
| Width | 0.34 \pm 0.03 | | 0.31 | 0.41 |
| 1st instar | 0.28 \pm 0.02 | 79 | 0.24 | 0.32 |
| 2nd instar | 0.43 \pm 0.02 | 17 | 0.40 | 0.47 |
| 3rd instar | 0.66 \pm 0.03 | 12 | 0.62 | 0.71 |

The egg and head capsule widths at each instar of the two species are similar although *C. trimaculatus* specimens average slightly larger than *C. horridus*. Head capsule widths for *C. horridus* are similar but slightly larger than measurements by Kok, et al. (1975).

KEY TO SEPARATE LARVAE OF *CEUTORHYNCHUS TRIMACULATUS* AND *CEUTHORHYNCHIDIUS HORRIDUS*

Successful use of this key requires dissection and clearing of the specimens and preparation of slide mounts of the heads and skins, so that the characters mentioned can be studied with a compound microscope.

- Dorsal epicranial seta 2 (des 2) of the head long, subequal in length to dorsal epicranial seta 1 (des 1); frontal seta 2 (fs 2) of head short but clearly visible (Fig. 1); prodorsal setae (prs) and postdorsal setae (pds) 1, 2, and 4 of abdominal segments 1–7 approximately $\frac{1}{2}$ the length of postdorsal seta 3 (Fig. 3) *Ceuthorhynchus trimaculatus* Fabricius

- Dorsal epicranial seta 2 of head very small, appearing absent at low magnifications, and much shorter than epicranial seta 1; frontal seta 2 of head very short, visible only at high magnifications (Fig. 2); prodorsal setae and postdorsal setae 1, 2, and 4 of abdominal segments 1-7 very short, much less than half the length of postdorsal seta 3 (Fig. 4) *Ceuthorhynchidius horridus* (Panzer)

DISCUSSION

The foregoing key is intended for use in areas of Europe and North America where larvae of the two species treated are known to occur in the crowns of musk thistles. Larvae of other curculionid genera may also be found attacking various parts of *Carduus macrocephalus* plants (Boldt and Campobasso, 1978), but these larvae are normally not found in the crowns. The larvae of *Apion* and *Lixus* species are usually found burrowing in the stems above the crowns; larvae of *Rhinocyllus* and *Larinus* species are usually found in flower heads, and those of *Cleonus* species usually burrow in the roots below the crown. In addition to the clue provided by the part of a *Carduus* plant attacked by the larvae, an anatomical character that can be used to distinguish larvae of *Ceutorhynchus* and *Ceuthorhynchidius* species from those of the other genera mentioned is the shape of the accessory appendage of the antenna. As described by van Emden (1952) in his key to larvae of major groups of Curculionidae, the accessory appendage of the antenna (or "antenna" of van Emden) has a semi-globular shape in all larval Ceutorhynchinae versus a distinctly more elongate or more compressed shape in larvae of other groups of weevils. In larvae of *C. trimaculatus* and *C. horridus*, this character is as shown in Figs. 1 and 2 (Ant). The antennae of larvae of species of *Apion*, *Lixus*, *Rhinocyllus*, *Larinus*, and *Cleonus* have subconical or spindle-shaped accessory appendages, as in figures published by Scherf (1964) of heads of larvae of those genera.

ACKNOWLEDGMENTS

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BIOSYSTEMATIC STUDIES OF CEYLONSE WASPS, VI.¹ NOTES
ON THE SCLEROGIBBIDAE WITH DESCRIPTIONS OF TWO
NEW SPECIES (HYMENOPTERA: CHRYSIDOIDEA)

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Abstract.—*Sclerogibba embiidarum* (Kieffer), 1925, from Sri Lanka is redescribed, as well as two new species, *S. taprobanana* from Sri Lanka and *S. citipes* from Sri Lanka, South India, and Burma.

Members of the Sclerogibbidae are unique among Chrysidoidea (*olim* Bethyloidea) in having many more antennal segments than the normal 12 or 13 and in having nymphs of Embioptera as their hosts. Females (Figs. 1-3) cannot be confused with those of any other family of aculeate wasps. The many-segmented antennae and enormously expanded fore femora are unique. The winged males are also readily recognized, for they have many-segmented antennae and the fore femora are enlarged though not so greatly as in females.

The only sclerogibbid described from Ceylon is *Mystrocnemis embiidarum* Kieffer, 1925, which is currently placed in *Sclerogibba* Rigg. and Stef.-Perez. During my field work in Sri Lanka we collected both sexes of one new species and females of a second new species, as well as a female of *S. embiidarum*.

Richards (1939) placed five genera in the synonymy of *Sclerogibba*, and retained *Probethylus* Ashmead as the only other valid genus of Sclerogibbidae. Probably some of these genera will have to be resurrected when a generic reclassification is based on the numerous and as yet unstudied sclerogibbids collected or reared by E. S. Ross during his field work on Embioptera.

Two genera are represented among the Ceylonese species, but I am describing all in *Sclerogibba* because of the uncertain status of *Mystrocnemis* Kieffer. Two species known only from females, *S. embiidarum* and *S. tap-*

¹ The preceding number in this series is "A Monograph of the Ampulicidae (Hymenoptera: Sphecoidea)," Smithson. Contrib. Zool. 298, in press.

robanana, n. sp., may belong to typical *Sclerogibba*; both have tarsal claws with a tiny erect subbasal tooth, bidentate mandibles, and lack a pair of anterolateral pitlike parapsides on the scutum. *S. citipes*, n. sp., may belong to *Mystrocnemis* Kieffer, a genus placed in synonymy by Richards, but until the holotype of *M. erythrothorax* Kieffer can be relocated or topotypic material made available, certain ambiguities in his original description cannot be clarified. Both sexes of *S. citipes* have the tarsal claws cleft apically with the inner tooth smaller, females have tridentate mandibles and a pair of anterolateral pitlike parapsides, and males have a small discoidal cell, making a total of six closed cells in the forewing. The male of *S. crassifemorata* Rigg. and Stef.-Perez, the type-species of *Sclerogibba*, has simple tarsal claws and five closed cells in the forewing, the discoidal cell lacking.

The holotype of *S. embiidarum* was reared from a specimen of *Oligotoma greeniana* Enderlein from Colombo, a locality where the annual rainfall is 100–150 inches. We found a second specimen of *S. embiidarum* associated with a colony of *Aposthonia ceylonica* (Enderlein) beneath the loose bark of an ehala tree (*Cassia nodosa*) in Colombo. My two new species were collected in several localities in the Dry Zone where the annual rainfall ranges from 50 to 75 inches. The two males of *S. citipes* were collected in a Malaise trap, and the females of *S. taprobanana* and *S. citipes* were found crawling on the ground among leaf litter. Three species of Embioptera were collected in a yellow pan trap placed among leaf litter at Palatupana, where both female species were collected. The former were *Oligotoma humbertiana* (Saussure), *O. saundersii* (Westwood) and *Aposthonia ceylonica* (Enderlein); all of these are potential hosts of the two sclerogibbids. E. S. Ross informed me that most species of Embioptera are opportunistic in their habitat, breeding among leaf litter in areas of low rainfall and beneath loose bark on trees in areas of higher rainfall. It appears that the sclerogibbids may be equally adaptable, for we collected the Ceylonese specimens of *S. citipes* among leaf litter in the Dry Zone, and Ross found his Burmese specimens of the same species beneath loose bark.

Considering the cryptic habitats preferred by sclerogibbids, I believe that other species still remain to be collected in Sri Lanka, particularly in the Wet Zone areas of much higher rainfall.

Sclerogibba citipes Krombein, NEW SPECIES
Figs. 1–5

Sclerogibba embiidarum (Kieffer), Richards, 1939:219 (specimens from Mangalore, India misidentified).—? Richards, 1958:17 (specimens from Madras, India).

The female of this species is separated at once from those of the other two Ceylonese species by having all tarsal claws cleft with the inner tooth

smaller. *S. citipes* also differs in having tridentate rather than bidentate mandibles, a pair of anterolateral parapsidal pits on the scutum, a strong median groove on the propodeum, and in the different formula of the short, stout setae of the tibial apex and first three tarsal segments.

The sex association in *S. citipes* is made on the basis of both sexes having cleft tarsal claws. The dentition of the tarsal claws appears to be of generic significance as noted in the introductory remarks.

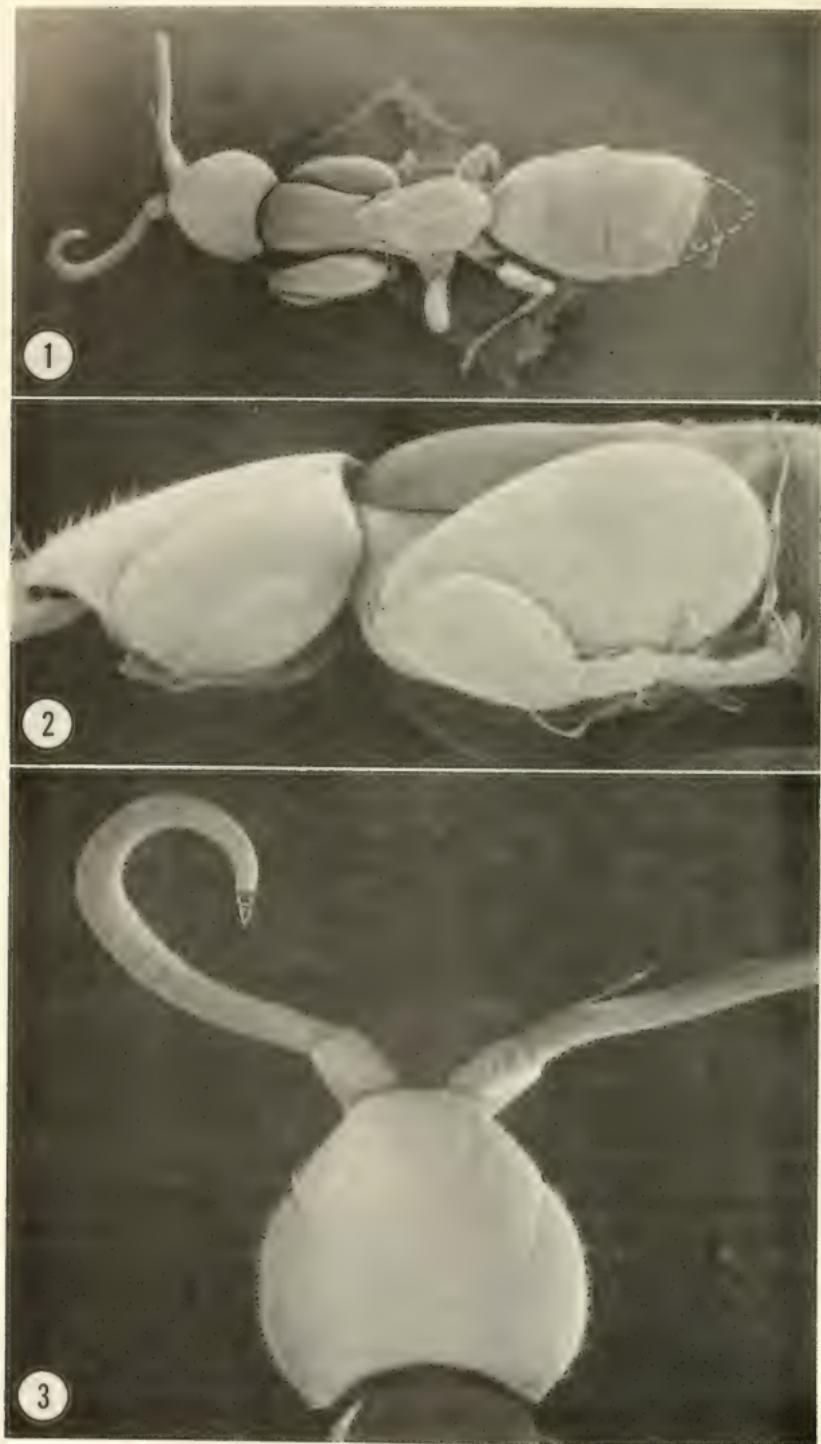
I have seen a male from Bangalore, India (BM) which has cleft teeth on the tarsal claws and six closed cells in the forewing as does the male of *S. citipes*. It is very similar to the type-series of *S. citipes* in body proportions and sculpture, but the marginal cell is only 0.9 times as long as the submarginal rather than 1.2 times as long.

In Sri Lanka *S. citipes* occurs in Dry Zone areas of low rainfall (50–75 inches annually) where I found females crawling on the ground among leaf litter. Both males were captured in a Malaise trap. Presumptive hosts in Sri Lanka may be the embiopterans *Oligotoma humbertiana* (Saussure), *O. saundersii* (Westwood) and *Aposthonia ceylonica* (Enderlein), all of which were captured in yellow pan traps set in the same leaf litter where females of *S. citipes* occurred at Palatupana. Ross found three females of *S. citipes* in a culture of *O. saundersii* beneath bark in Rangoon, Burma.

Eventually *S. citipes* may be placed in *Mystrocnemis* Kieffer. The type-species, *M. erythrothorax* Kieffer, was described from Rangoon, Burma, but the type cannot be located in the Genoa Museum which houses the Magretti collection. Kieffer's species has a cleft tarsal claw as does *S. citipes*. However, he says that the antenna is 22-segmented and that ocelli are lacking. The latter character may be a misinterpretation, but two species are known which have only posterior ocelli, so Kieffer may have been correct in his statement. It is not possible to decide whether *S. citipes* and *M. erythrothorax* are congeneric, until the type of the latter can be located or topotypic material obtained. The two species are clearly not conspecific for Kieffer states that the head of *M. erythrothorax* is much longer than wide, that the eye is as long as the cheek, and that the sides of the propodeum converge posteriorly.

The specific name is formed from the Latin *citatus*, and means swift-footed.

Female.—Length 3.2–4.0 mm. Black; the following dull red—palpi, mandible, anterior $\frac{1}{2}$ of head above, scape, flagellum beneath, dorsum of thorax except pronotum and propodeum in middle becoming brownish to a variable extent, side of pronotum, fore tibia and all tarsi; the following dark brown to a variable extent—sides of mesopleuron and propodeum, rest of legs. Appressed vestiture on all of body cinereous to brownish, dense, very short, and fine; dorsum of head also with longer, dark, more scattered, suberect setae; eye with short erect silvery microtrichiae.



Head finely shagreened, rather dull, in dorsal aspect (Fig. 3) with median length subequal to greatest width; mandible tridentate; antenna with 23–27 segments; front with small, shallow median pit anteriorly; eye 3.3–4.1 times as long as dorsal width; eyes noticeably longer than cheeks, converging posteriorly, lower interocular distance 1.4–1.5 times least interocular distance; postocellar line (POL) 1.3–1.6 times lateral ocellar line (LOL), and 2.2–2.6 times ocellocular line (OOL); eyes and posterior ocelli only slightly separated from occipital margin.

Dorsum of thorax (Fig. 1) sculptured similarly to head; pronotum shallowly concave along midline, sides converging posteriorly, anterior width 1.2–1.4 times posterior width and 0.7–0.8 times length along midline; scutum with a pair of anterolateral pits; propodeal dorsum usually with a well-developed groove along midline (weak in two Burmese specimens), sides diverging posteriorly, posterior width 1.3–1.5 times anterior width and 0.9 times length; inner surface of fore tibia with an oblique row of 7 short stout setae running from spur to apex; fore basitarsus with irregular anterior row of 13–14 short stout setae, 2nd and 3rd tarsal segments each with 3 such setae at apex of segments; tarsal claws cleft, the inner tooth smaller.

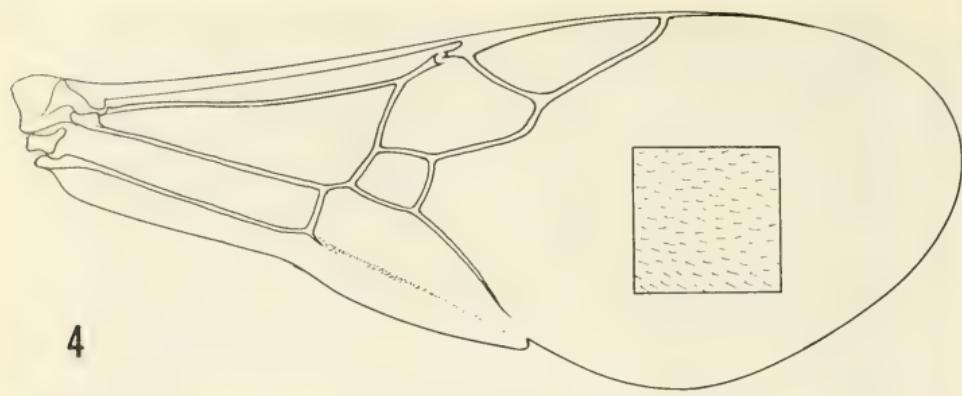
Male.—Length 3.0–3.5 mm. Black; the following light red—palpi, mandible, basal 6 segments of antenna and foreleg; the following light to dark brown—remainder of antenna, tegula, mid and hind legs but tarsi very light brown. Wings colorless, costal and subcostal veins medium brown, other veins colorless. Vestiture short, silvery, moderately dense, mostly decumbent except on dorsum of head where it is suberect; eye with very short, erect silvery microtrichiae.

Head rather dull, finely shagreened; width 1.1 times the length; mandible bidentate; antenna 25–27 segmented; eye 4.6 times as long as dorsal width, converging posteriorly, the lower interocular distance 1.2 times interocular distance at posterior ocelli; ocelli in a low triangle, POL 1.7 times both LOL and OOL; posterior ocelli separated from occiput by diameter of an ocellus, posterior margin of eye separated from occiput by half that distance.

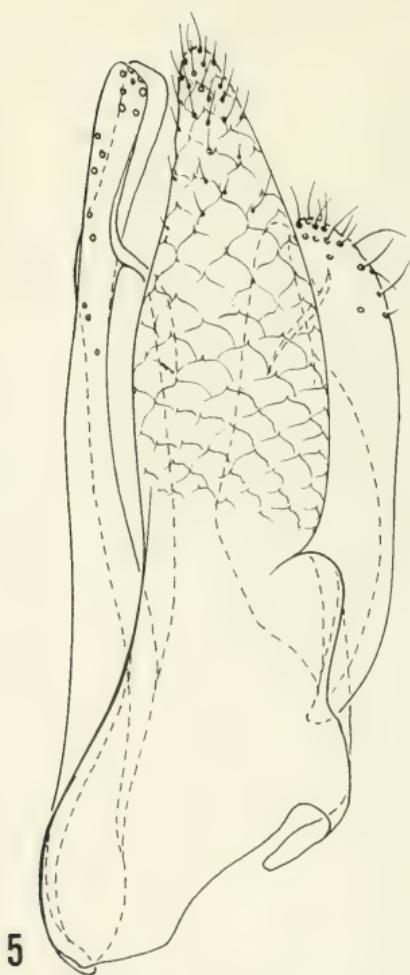
Thorax shinier and more delicately shagreened than head, especially mesopleuron; pronotum with sides diverging slightly, posterior margin broadly arcuate, posterior width 3.7 times median length; scutum with parapsides and notalices complete, converging slightly posteriorly; propodeal dorsum rounding gradually into posterior aspect, surface with a strong median ridge and delicate rugulosoreticulations of small mesh; lateral aspect of propo-



Figs. 1–3. *Sclerogibba citipes*, ♀. 1, Dorsal view (terminal antennal segments lacking, 4th abdominal segment displaced and 5th and 6th lacking; scutal pits not visible), 23×. 2, Lateral view, head, prothorax and fore leg, 69×. 3, Dorsal view, head, 62×.



4



5

Figs. 4-5. *Sclerogibba citipes*, ♂. 4, Forewing. 5, Lateral aspect, genitalia.

deum shagreened and with a strong, oblique polished ridge across middle; tarsal claws cleft, the inner tooth shorter; forewing (Fig. 4) with 6 closed cells including 1 submarginal and 1 discoidal, marginal cell 1.2 times as wide as submarginal.

Abdomen shining with relatively scattered, tiny punctures, dorsum flattened; genitalia in lateral aspect (Fig. 5).

Types.—*Holotype*: ♀; Sri Lanka, Southern Province, Hambantota District, Palatupana Tank, 10–20 m, 27–29 September 1977, K. V. Krombein and P. B. Karunaratne, USNM Type No. 76075. *Allotype*: ♂, Sri Lanka, Eastern Province, Trincomalee District, Trincomalee, China Bay Ridge Bungalow, 0–100 ft, in Malaise trap, 16–17 May 1976, K. V. Krombein, P. B. and S. Karunaratne, D. W. Balasooriya. *Paratypes*: 4 ♀, same data as holotype. 1 ♀, Sri Lanka, Uva Province, Monaragala District, Angunakolapelessa, 100 m, 1 October 1977, K. V. Krombein. 1 ♂, same data as allotype. 2 ♀, India, Mysore State, Mangalore, J. C. Bridwell (USNM, BM). 3 ♀, Burma, Rangoon, 20 December 1978 (1 ♀) and 9 February 1979 (2 ♀), E. S. Ross, in culture of *Oligotoma saundersii* (Westwood) (CAS). A pair of paratypes has been deposited in the Colombo Museum; female paratypes are in (CAS) and (BM).

One female with the same label data as the holotype is excluded from the type-series because it is most likely a teratological specimen. It agrees with females of *S. citipes* in all details except that the posterior margin of the first abdominal tergum has a median angular emargination.

Sclerogibba embiidarum (Kieffer)

Mystrocnemis embiidarum Kieffer, 1925:236–237 (♀; Colombo, Ceylon; type stated to be in Deutsch. Ent. Inst., Dahlem).

Sclerogibba embiidarum (Kieffer), Richards, 1939:219 (♀ type only; ♀ specimens Mangalore, India misidentified).—Richards, 1958:17 (Israel ♀ misidentified; Madras ♀ correctly identified?).

Females of *S. embiidarum* and *S. taprobanana*, differ from those of *S. citipes*, in lacking a pair of anterolateral pits on the scutum, in having the tarsal claws with a small erect subbasal tooth, bidentate mandibles, and in having fewer short stout setae on the apex of inner surface of the fore tibia and first three fore tarsal segments. These two species may be assigned incorrectly to *Sclerogibba*. If the unknown males have the same dentition of the tarsal claws as the females, the two species probably belong to another genus. The male of *S. crassifemorata*, type-species of *Sclerogibba*, has simple tarsal claws.

Sclerogibba embiidarum differs from *S. taprobanana* in having a shallow median groove on the propodeal dorsum, in having LOL 1.9 times POL rather than 1.4, and in having POL 3.3 times OOL rather than 2.2. The

yellow color of the unique type is lighter than in any other sclerogibbid I have seen. Inasmuch as it is a reared specimen, the pale color may be due to its having been killed as a newly emerged teneral individual. A second female captured recently in Colombo is darker as detailed below.

The females from Mangalore, India (Richards, 1939:219) are actually specimens of *S. citipes*. A female from Israel (Richards, 1958:17) appears to be a new species related more closely to *S. taprobanana* than to *S. embiidarum*. I have not seen the female from Madras identified as *S. embiidarum* (Richards, 1958:17) which was reared from a nymph of *Pseudembia flava* Ross.

Holotype.—♀; Colombo, Ceylon, September 1924; K. Friedrich; parasite of *Oligotoma greeniana* End.; now deposited in Institut für Pflanzenschutzforschung, Eberswalde, D.D.R.

Female.—Length 3.5 mm. Black; the following pale yellow—mandible, clypeus, antenna, anterior ½ of front becoming somewhat reddened halfway to occiput, thorax and legs except for dark spot on mesopleuron, and narrow apices of first 3 abdominal terga; the following brownish—posterior ½ of head, narrow area anterior to yellow apices of first 3 terga, and apices of remaining terga. Vestiture closely appressed to body (due to preservation in fluid?), color not determinable; eye with short, erect, silvery microtrichiae.

Head shagreened, length and width subequal; mandible bidentate; antenna 24-segmented; front with small shallow pit anteriorly; eye 4.2 times as long as dorsal width; eyes longer than cheeks, converging posteriorly, lower interocular distance 1.5 times least interocular distance; POL 1.9 times LOL, and 3.3 times OOL; eyes and posterior ocelli only slightly separated from occipital margin.

Thorax sculptured similarly to head; pronotum slightly concave along midline, sides converging posteriorly, anterior width 1.2 times posterior width and 0.6 times length along midline; scutum without anterolateral pits; propodeal dorsum with a weaker groove along midline than in *S. citipes*, sides diverging posteriorly, posterior width 1.4 times anterior width and 0.9 times length; inner surface of fore tibia with an oblique row of 7 short stout setae running from spur to apex; fore basitarsus with anterior row of 12 short stout setae, 2nd and 3rd tarsal segments each with 2 such setae at apex; tarsal claws with a small erect subbasal tooth.

Male.—Unknown.

P. B. Karunaratne collected a second female of *S. embiidarum* in the Museum Garden, Colombo, 27 February 1979, beneath loose bark of an ehala tree (*Cassia nodosa*) in association with a colony of *Aposthonia ceylonica* (Enderlein). It appears to be smaller but the terminal abdominal segments are telescoped. It is much darker than the holotype, but the latter

may be a teneral. Otherwise it agrees in all details with the preceding diagnosis except as noted below:

Black; the following dull red—palpi, mandible, clypeus, antenna, anterior $\frac{1}{3}$ of front, anterior edge and posterior $\frac{1}{2}$ of pronotum, scutellum, upper $\frac{1}{2}$ of mesopleuron; the following yellowish—posterior $\frac{2}{3}$ of propodeum and coxae; the following light red—mid and hind tibiae and tarsi; all femora and fore tibia brown. Appressed vestiture cinereous to light brown, dense, very short and fine; dorsum of head also with longer, dark, more scattered suberect setae.

Head shinier; frontal pit evanescent; lower interocular distance 1.4 times least interocular distance; POL 1.7 times LOL and 2.7 times OOL.

Anterior pronotal width 1.4 times posterior width and 0.8 times length along midline; posterior propodeal width 1.3 times anterior width; inner surface of fore tibia with a row of 6 short stout setae.

Sclerogibba taprobanana Krombein, NEW SPECIES

This species is known from two females. It differs from *S. citipes*, and *S. embiidarum* as noted in the discussion under *S. embiidarum*. Both specimens were collected at Palatupana Tank in the Dry Zone of Sri Lanka, crawling on the ground among leaf litter.

The specific name is based on Taprobane, the Roman name for ancient Lanka.

Female.—Length 2.8–3.9 mm. Black; the following light red—palpi, mandible, clypeus, antenna, anterior $\frac{2}{5}$ of head, thorax except dark areas of varying extent on mesopleuron and propodeum, legs and very narrowly on apices of first 5 abdominal segments. Appressed vestiture dense, short and silvery; dorsum of head also with longer, light brown suberect setae; eye with more scattered, short, erect silver microtrichiae.

Head finely shagreened, rather dull, length and width subequal; mandible bidentate; antenna with 24 and 27 segments; front with small shallow pit anteriorly; eye 3.3–3.5 times as long as dorsal width; eyes converging posteriorly, lower interocular distance 1.4–1.7 times least interocular distance; POL 1.4 times LOL and 2.6–2.8 times OOL; eyes and posterior ocelli only slightly separated from occiput.

Thorax duller and more strongly shagreened than head; pronotum shallowly concave along midline, sides converging posteriorly, anterior width 1.2–1.3 times posterior width and 0.7–0.8 length along midline; scutum without anterolateral pits; propodeal dorsum flat, without median groove, sides diverging posteriorly, posterior width 1.3 times anterior width and 0.6 times length; inner surface of fore tibia with an oblique row of 7 short stout setae running from spur to apex; fore basitarsus with anterior row of 12 short

stout setae, 2nd and 3rd tarsal segments each with 2 such setae at apex; tarsal claws with a small suberect subbasal tooth.

Male.—Unknown.

Types.—*Holotype*: ♀; Sri Lanka, Hambantota District, Palatupana Tank, 10–20 m, 27–29 September 1977, K. V. Krombein and P. B. Karunaratne, USNM Type No. 76076. *Paratype*: 1 ♀, same locality and collectors but 22 June 1978. The paratype has been deposited in the Colombo Museum.

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E. S. Ross, California Academy of Sciences (CAS), San Francisco, identified several specimens of Embioptera, lent Burmese specimens of *S. citipes*, and furnished much helpful information.

Figures 1–3 are by Susann G. Braden, Scanning Electron Microscope Laboratory, Smithsonian Institution, Washington, D.C. (SI).

Figures 4–5 are by George L. Venable, Department of Entomology (SI).

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REVISION OF *ACROTOCARUS* BANKS
(ACARI: CANESTRINIIDAE)

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Abstract.—The genus *Acrotocarus* Banks, 1915, is redefined and its type-species, *A. mirabilis* Banks, is redescribed. Two additional species are placed in this genus: *A. alutaceus* (Turk), new combination, and *A. cratae-pus*, new species.

The canestriniid genus *Acrotocarus* Banks, 1915, based on *A. mirabilis* Banks, has been overlooked by later students of these beetle-associated mites because the author himself misinterpreted the structure of the holotype male. The diagnostic feature of this genus is given in the original description as follows: ". . . body in front with a T-shaped process, the front part of which bears a large, bilobed, hyaline membrane." This interpretation of the caudal appendages as mouthparts and the upside down illustration probably happened because, on the imperfectly cleared type-specimen, the gnathosoma was folded under and hidden by opaque pedal musculature.

An allied species was subsequently described as *Amansia alutacea* by Turk, 1948. Turk assigned his species to *Amansia* Oudemans, 1937, as based on *Dermaleichus chrysomelinus* Koch. The present study of *Acrotocarus mirabilis* Banks indicates that *Acrotocarus* is the first name applied to those species with males having wide caudal flaps. We believe *Amansia alutacea* Turk is a congener and therefore assign *Amansia alutacea* to *Acrotocarus*.

The genus *Acrotocarus* Banks is restructured to include *A. mirabilis* Banks, *A. alutaceus* (Turk) and one new species.

Acrotocarus Banks

Acrotocarus Banks, 1915, 26:152-153.

Description.—Broad-bodied mites having very weakly sclerotized dorsal integument, with 1 small, inconspicuous prodorsal plate. Generic assignment based principally on several peculiarities of males. Very distinctive is the pair of membranous caudal flaps attached to main body by constricted stalk or peduncle. Caudal flaps bear 1 pair of ultralong, flagelliform setae.

Elongate anal aperature of males lies very close behind genitalic parts, almost surrounded by a horseshoe-shaped sclerite. Conspicuous anal suckers lacking. Inclusive counts of setae and special sensilla on legs I-IV: Tarsi 12-7-4-5, tibiae 1-1-1-1, genua 3-3-1-0, femora 1-1-0-0. Tarsi of legs I-IV bear 1 unpaired spurlike ventral seta at their distal ends; all of these setiform in females; those on legs III and IV of males may be enlarged and clawlike. Four podomeres on leg III of males bear apophyses in form of ridges or spines; leg IV conventional in form. Apodemata I not joined at mid-line.

Type-species.—*Acrotocarus mirabilis* Banks, by original designation.

Remarks.—The recognition of the genus and the distinctions between the three known species rest essentially on the form of the caudal flaps of males. Females of *Acrotocarus* are apt to be difficult to distinguish from females of other genera of the Canestriniidae, but the identity and distribution of host beetles may assist with their identification. The canestriniids taken from various chrysomelid beetles were specifically identified only when such samples or series contained at least one male specimen.

The modification of the opisthosoma of males complicates the matter of homologizing some of the setae with those of other canestriniids. The setae on the podosoma and appendages of these mites are designated according to terminologies developed by Grandjean (1935) and Zachvatkin (1941) as summarized by Hughes (1959). However, the names and abbreviations applied to setae on the opisthosoma are improvised, with no certainty as to equation with setae of allied forms.

Measurements of dried and compressed specimens collected from dead beetles do not give trustworthy data for comparative purposes. Consequently, the few measurements given (micrometers, in parentheses) are for parts selected as likely to give reasonably reliable data.

We are grateful to R. E. White, Systematic Entomology Laboratory, IIIBIII, Agric. Res., Sci. and Educ. Admin., USDA, for lending the collection of *Physonota* spp. in the United States National Museum, Washington, D.C.

Acrotocarus mirabilis Banks

Figs. 1, 2

Acrotocarus mirabilis Banks, 1915, 26:152-153.

Male.—Dorsal integument irregularly crinkled, with a very small prodorsal plate. Dorsal setae comprise 3 size groups. Four pairs ultralong, smooth, too attenuated and coiled to allow acceptable measurements. These are: external scapulars (*sce*), external humerals (*he*), sacrals (*sa*) and lateral caudals (*lc*). Internal verticals moderately long (55). All other dorsomedian and dorsolateral body setae uniformly minute (ca. 8), rigid, blunt-tipped. Only 2 pairs of minute dorsomedian setae. Minute postanal setae (*mpa*) situated

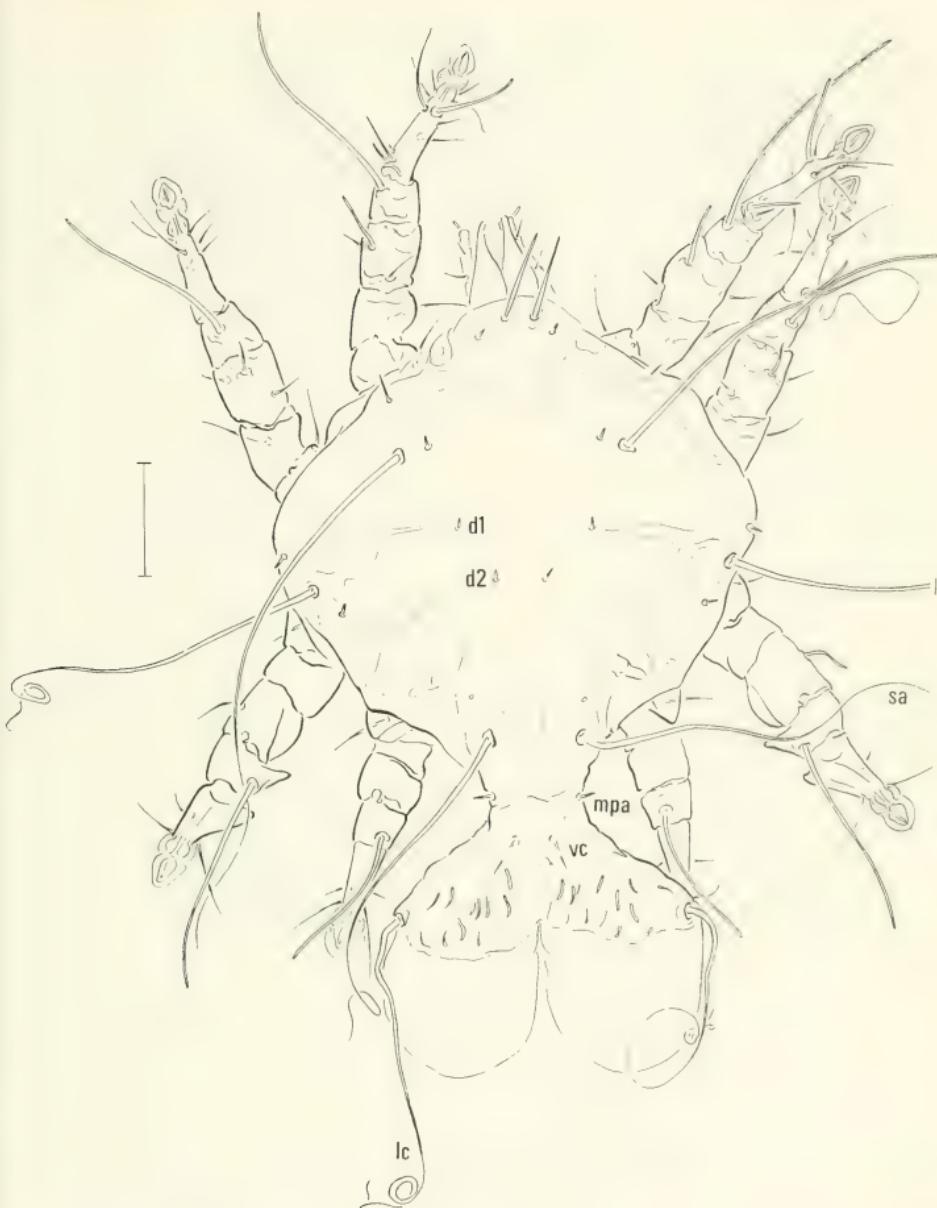


Fig. 1. *Acrotocarus mirabilis*, male, dorsal.

on narrowest portion of caudal peduncle. V-shaped apodeme associated with coxa IV bears a laterally-directed, slipper-shaped, hollow arm, its closed end pointed outward. Boundary between fleshy basal part of opisthosoma and hyaline caudal flaps comprises (roughly) a transverse line be-

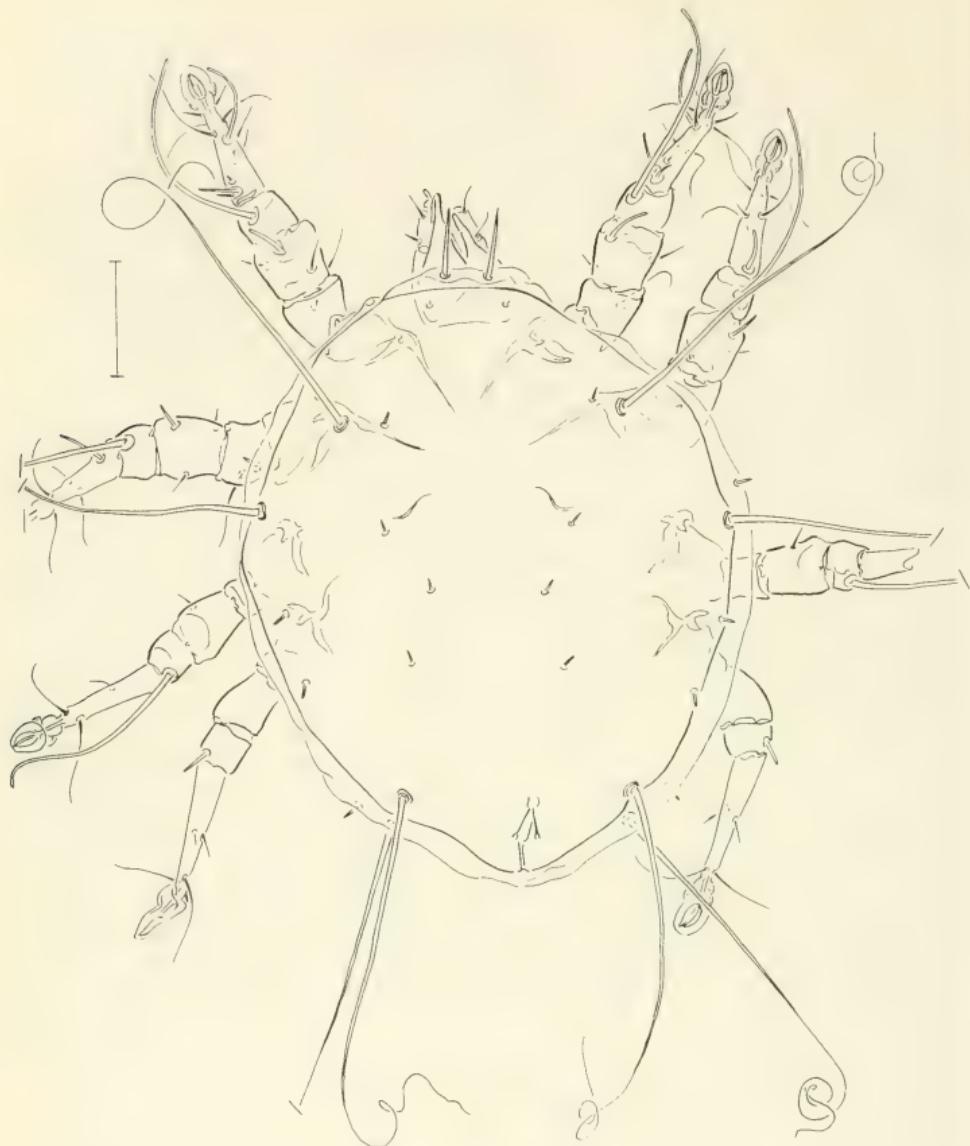


Fig. 2. *Acrotocarus mirabilis*, female, dorsal.

tween insertions of lateral caudal setae; basal portion with 20–30 short, crescentic elevations on upper surface, elevations oriented longitudinally; hyaline lobes rounded behind, without distinctive ornamentation. Lateral folds or investiture of genital parts thinly sclerotized, open in front. Four pairs anogenital setae: 2 pairs paragenitals, 2 pairs paranals. Anterior paragenitals (45) flagelliform, longer than posterior paragenitals (30). Anterior

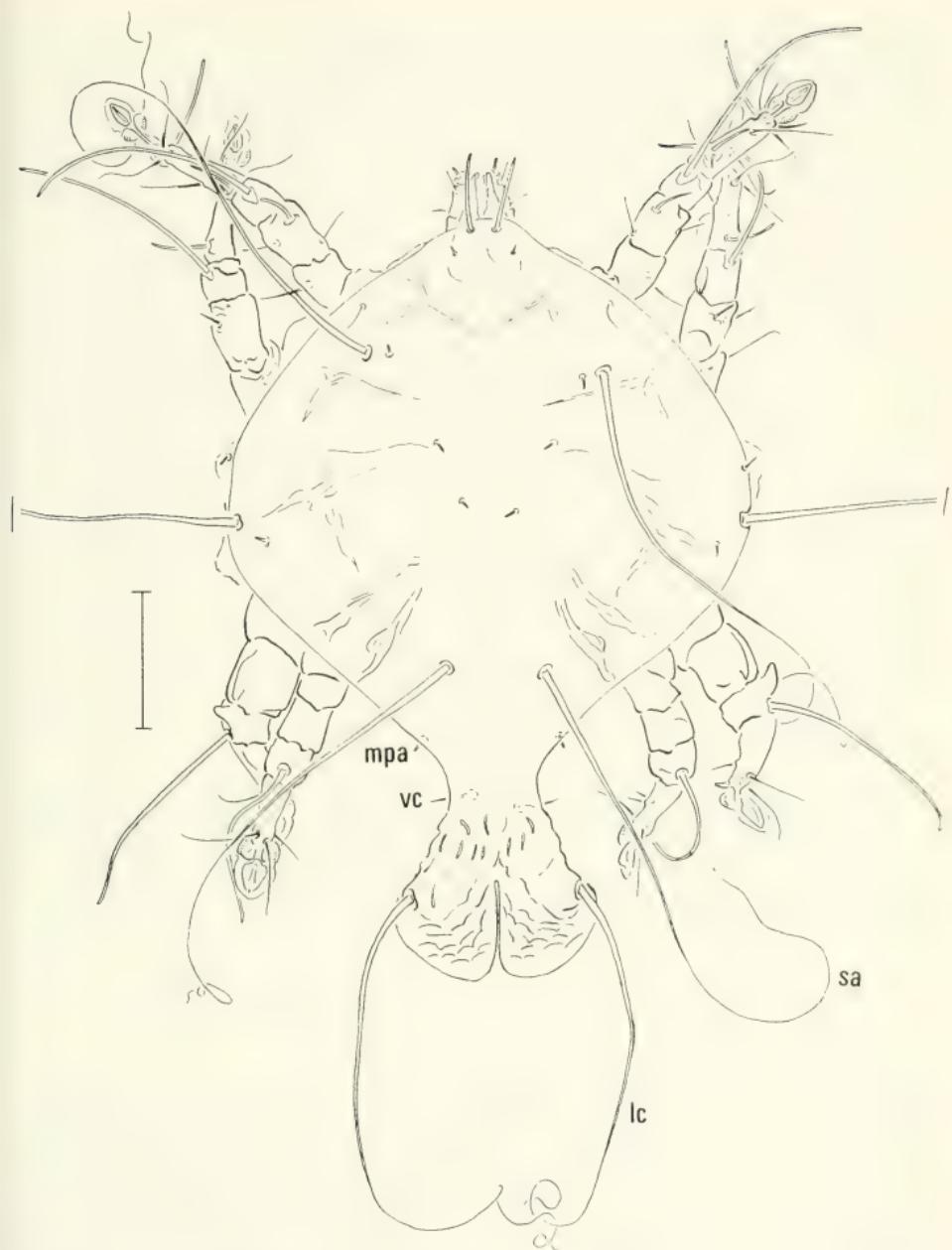


Fig. 3. *Acrotocarus alutaceus*, male, dorsal.

paranal setae set much farther apart than posterior pair, setae of both pairs acicular, equal in length (25). Ventral caudal setae (28) set close together behind narrowest part of caudal peduncle. Length or dimensions of several parts: w_1 43, w_3 66, ϕI 198, ϕIII 179, ϕIV 117, d_1 8, vi 55, width of caudal flaps between lateral caudal setae 251, length of each hyaline flap from lateral caudal seta to posterior rim 137.

Female.—Idiosoma a wide oval, with no peculiar caudal extension. Two additional pairs of minute dorsal setae appear in females: d_3 and lp . Minute setae mpa set far apart on ventrolateral integument. Two pairs of ultralong setae on posterior border of opisthosoma. Ovipore and associated paragynial folds placed in mid-ventral section of idiosoma, remote from anus. A pair of ventral (sternal) setae situated in front of male genitalia not recognizable as such in females. Two pairs of paragenital setae, both pairs flagelliform, setae of posterior pair aligned in a crossrow with genital suckers. Four pairs of paranal setae disposed in 2 groups: 2 pairs closer to front end of anal slit, 2 pairs closer to rear end of slit. Anal slit flanked by 2 pairs of very small ringlike structures each having a peg at its center; anteriormost of these structures aligned with second pair of paranal setae. Chaetotaxy of appendages not noticeably different from males except ϕIV very much reduced. Leg III resembles other legs, i.e., not armed with spines or crest-like apophyses. Infraterminal setae on tarsi III and IV not enlarged or claw-like. Length or dimensions of several parts ($n = 1$) w_1 35, w_3 59, ϕI 176, ϕIII 172, ϕIV 16, d_1 8, vi 51.

Distribution.—MEXICO: Pte. de Ixtla, on *Physonota alutacea* Boheman; Veracruz, on *Physonota* sp.; Las Chiapas, Lago Catemaco, Acayuccan, on chrysomelids. GUATEMALA: Cayuga, on *Physonota* sp.; Secanguin, on unidentified host. COSTA RICA: Turrialba, on *Physonota alutacea*.

Originally described from Cordoba, Mexico, on chrysomelids (Banks, 1915).

Acrotocarus alutaceus (Turk), NEW COMBINATION

Fig. 3

Amansi alutacea Turk, 1948, 118:88.

Male.—General conformation of body closely resembles *A. mirabilis*; unmistakable specific differences relate to tail flaps and genitalia. Caudal flaps much smaller than in *A. mirabilis*, rounded rather than angular at insertions of lateral caudal setae; fleshy portion of tailpiece bilobular or excavate posteriorly; hyaline lobes ornamented with about 6 concentric rows of scalloped ridges. Ventral caudal setae (25) on narrowest portion of peduncle whereas minute postanal (mpa) arise higher on tapered part of opisthosoma. Deep-lying genital sclerites enclosed within a quadrangular investiture, this closed in front, reinforced at each anterior corner. Sternal

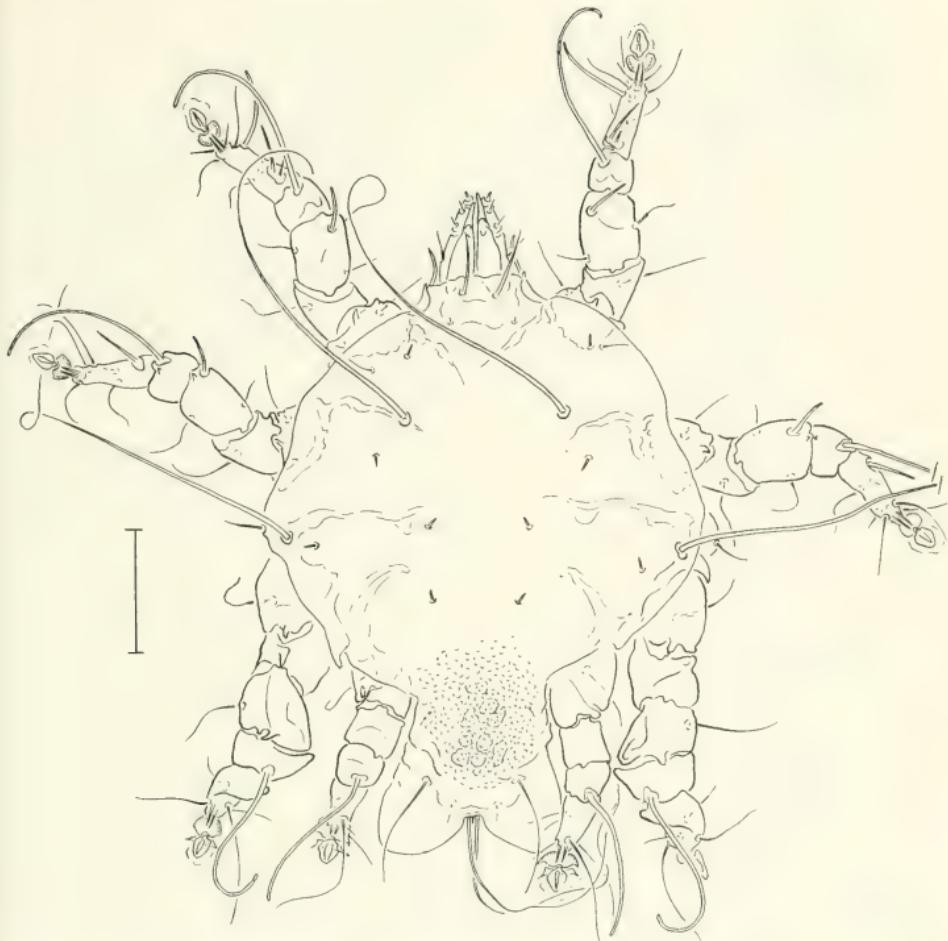


Fig. 4. *Acrotocarus crataepus*, male, dorsal.

setae lie anterior to genitalia by a distance equal to length of these setae. Two pairs of paragenital setae, 2 pairs paranal setae. Second paragenital setae placed considerably behind posterior genital suckers. Posterior apodeme of leg IV nearly a straight bar having a shallow bubble-like lateral outgrowth near its middle. Length or dimensions of several parts: w_1 28, w_3 62, ϕ_I 164, ϕ_{III} 148, ϕ_{IV} 98, d_1 8, v_i 43, width of caudal flaps between lateral caudal setae 152, length of each hyaline lobe from lateral caudal seta to tip 74.

Female.—We have not discovered reliable criteria of form or size by which the female can be distinguished from that of *A. mirabilis*.

Distribution.—MEXICO: San Raphael Jicaltepec, on *Physonota aluta-*

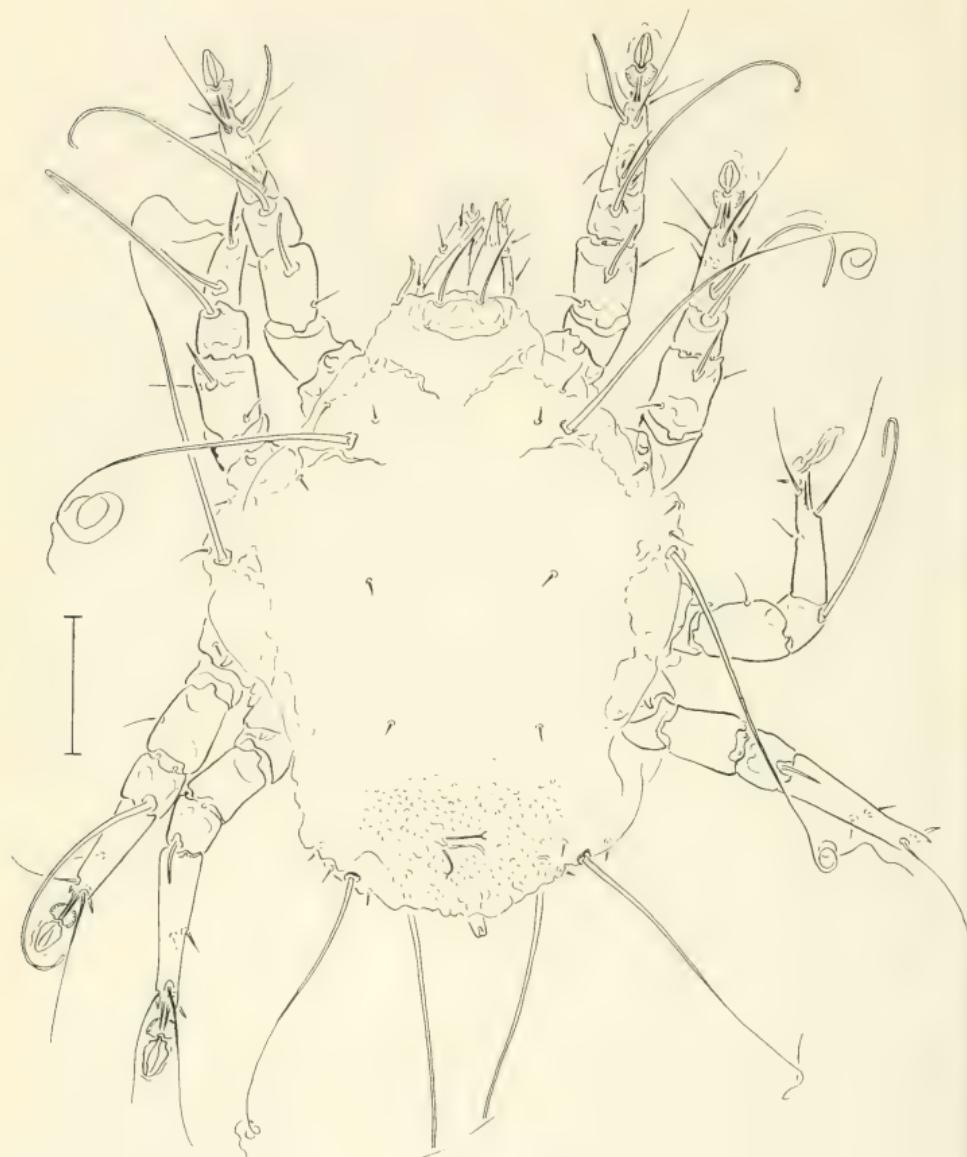
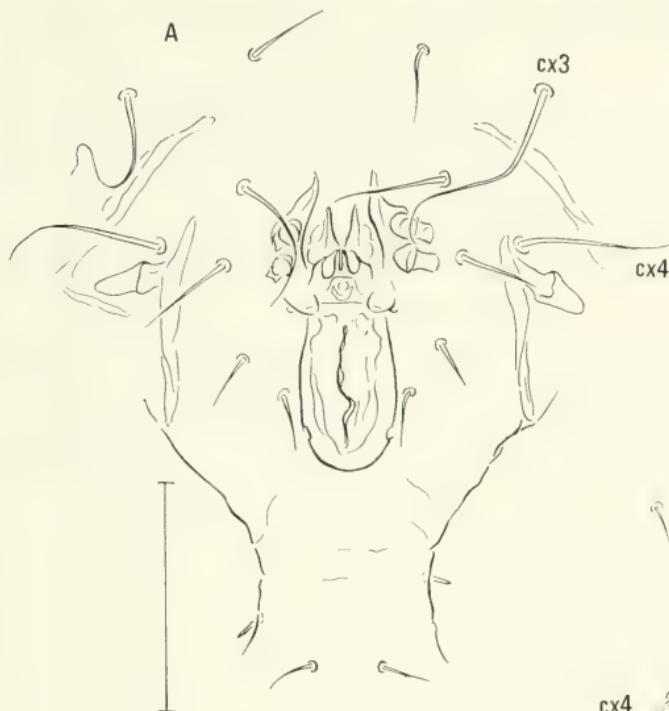
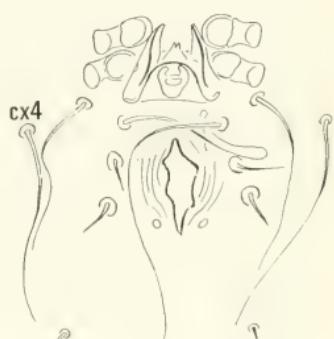
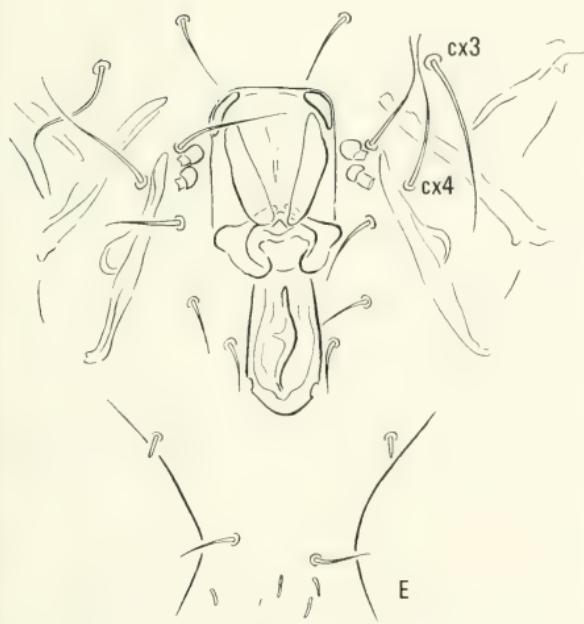
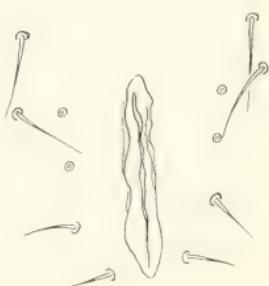


Fig. 5. *Acrotocarus crataepus*, female, dorsal.

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Fig. 6. A, Anogenital area of male, *Acrotocarus mirabilis*. B, Dorsal aspect of left tarsus I, *A. mirabilis*, male. C, Anogenital area of *A. crataepus*, male. D, Anal region of female showing 2 pairs of ring-like structures, *A. mirabilis*. E, Anogenital area of male, *A. alutaceus*. Figures A, C, E drawn to same scale. All index lines represent 0.1 mm. Setae labeled cx3 and cx4 are the ventral setae of their respective coxae.

A**B****C****E****D**

cea; St. Lucrecia, Veracruz, on *Platycycla deruta* Boheman; Los Chorros, on *Physonota gigantea* Boheman; Veracruz, Tinajas, Matias Romero, on chrysomelids.

First described from Trinidad, on *Physonota alutacea* (Turk, 1948).

Three cotypes of *Amansia alutacea* were loaned to us by Dr. Turk. The cotypes were taken from a cassid beetle, *Physonota alutacea*, St. Augustine, Trinidad, host plant—*Cordia cylindrostachya* R. & S.

Acrotocarus crataepus Summers and Schuster, NEW SPECIES
Figs. 4, 5

Male.—Dorsal integument plain on podosoma, minutely pebbled on opisthosoma. Minute internal scapular setae placed considerably anterior to ultralong external scapulars. Three pairs of minute dorsomedian setae. Ventral humeral seta blunt-tipped, approx. $2\times$ as long as $d1$. Opisthosoma a stubby projection terminating in a pair of caudal flaps but without a narrowed peduncle; axes of flaps somewhat divergent, flaps separated by a shallow median notch, with a granular texture on upper surfaces. Opisthosoma bears 4 pairs of setae: 2 pairs of small setae ventrally, 1 pair moderately long dorsal setae on flaps, 1 pair ultralong setae deep within median notch between flaps. Genital parts compact, intromittent organ inconspicuous. Two pairs of paragenital setae in postgenital position, almost in a crossrow, setae of both pairs subequal, very long, flagelliform. Two pairs of paranal setae, all subequal, acicular, relatively short (16). Leg IV lacks an obvious posterior apodeme. Empodial claw of tarsus III and IV with a shallow cuff-like armature below. Length or dimensions of several parts: $w1$ 35, $w3$ 66, $d1$ 10, vi 47, width of caudal flaps between dorsal setae on flaps 78, length of each flap from dorsal setae to posteriormost border 66.

Female.—Dorsal integument on opisthosoma with minutely pebbled surface. Three pairs of marginal setae on opisthosoma grouped close to the 2 pairs of ultralong terminal setae; 2 pairs of these small setae may be homologous with the minute setae placed farther forward on body margins of *A. mirabilis* (possible *la*, *lp* of acarids). Copulatory pore (vulva) borne at the tip of a fingerlike, protrusible lobule not noticed in other congeners. No paired ringlike structures beside the anal aperture.

Types.—Holotype male, one paratype female, locality, data and collector unknown, from *Physonota dilata* Kirsch; both types deposited in the Entomology Collection, Department of Entomology, Cornell University, Ithaca, New York 14853. We are greatly indebted to Dr. B. M. O'Connor for permission to describe this species.

KEY TO MALES OF *ACROTOCARUS*

1. One pair of ultralong setae within shallow notch between caudal flaps, setae of this pair very close together *crataepus*, new species

- No ultralong setae within deep cleft separating caudal flaps 2
- 2. Membranous investiture of unpaired genital parts open in front ...
..... *mirabilis* Banks
- Membranous investiture of unpaired genital parts closed in front,
each anterior angle with a strong sclerotic brace *alutaceus* (Turk)

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A KEY TO THE SPECIES OF *ECTEMNIUS* IN AMERICA NORTH
OF MEXICO WITH NOTES AND DESCRIPTION OF A NEW
SPECIES (HYMENOPTERA: SPHECIDAE)

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Abstract.—The 27 species of *Ectemnius* known from America north of Mexico are keyed and many of the structural characters are figured. Taxonomic notes on several of the species are presented along with one new species, *nigellus* Bohart from the western U.S. New synonyms are *proletarius*, placed under *borealis*; *yosemite* placed under *sexcinctus*, and *corrugatus*, *pauper*, *operus* and *drymocallidus*, placed under *atriceps*. A neotype is established for *trifasciatus* (Say).

Ectemnius is the second largest genus in the Crabroninae after *Crossocerus*. Some of its approximately 160 species are found in each of the zoological regions. In America north of Mexico 27 species are known. Discussions of the generic characters, subgenera and/or species groups, and species synonyms were given by LeClercq (1954) and Bohart (1976). Morphological features which when taken together separate *Ectemnius* from related genera are: Low ocellar triangle, well developed verticulus, trough shaped (usually) female pygidial plate, indistinct orbital foveae, evenly punctate upper frons, and recurrent vein joining submarginal cell beyond its distal third (rare exotic exceptions). In North America the only genera with which it might be confused are *Crabro*, which has the recurrent vein ending before the distal third of the submarginal cell; *Crossocerus* which has the ocellar triangle nearly equilateral; and *Lestica*, in which the orbital foveae are distinct and punctuation of the upper frons is irregularly coarse.

Ectemnius species vary considerably in markings, and a number of subspecies have been named as a result. The value of such names is questionable, even when there is some correlation with geography. Criteria for the more definitive varieties are given in the notes following the key.

For brevity we have used F for flagellomere (F-I, F-II, etc.) and T for tergum (T-I, T-II, etc.). Drawings were designed to supplement the key and were made by the junior author.

KEY TO *ECTEMNIUS* OF AMERICA NORTH OF MEXICO

1. Pygidial plate absent (males) 2
- Pygidial plate present and nearly flat (Fig. 54) or incurved and troughlike (Fig. 55) (females) 28
2. Forefemur basoventrally with a sharp ridge, which may be U-shaped (Fig. 48-a) or linear (Fig. 34), or a carinate tooth (Figs. 47-a, 49-a, 50-a); F-III and/or IV somewhat concave and prolonged beneath (Fig. 18) 3
- Forefemur without a sharp ridge or tooth basoventrally, carinae (if any) extending ventrad from dorsal surface; F-III and/or IV modified or not 11
3. Terga II-IV without complete pale bands or median transverse spots, hindbasitarsus often dark, F-I depressed basoventrally (Fig. 18), pronotum with 1 or 2 transverse carinae 4
- Terga II-IV (or at least one of them) with a complete pale band or median transverse spot, hindbasitarsus and F-I various, pronotum with 1 strong transverse carina ending laterally in humeral angle ... 7
4. Pronotum with a posterior cariniform ridge and an anterior carina which ends laterally in humeral angle (as in Fig. 4); spots on T-V widely separated or absent 5
- Pronotum with 1 transverse carina which extends across middle of dorsal surface and ends laterally back of humeral angle (as in Fig. 1); spots on T-V often close together or coalesced 6
5. Occipital carina strong, a pitted groove along it in front; mandible with subbasal tooth of cutting edge smaller than either apical tooth (Fig. 16) *borealis* (Zetterstedt)
- Occipital carina moderate, a smooth groove (or nearly so) along it in front; mandible with subbasal tooth of cutting edge larger than either apical tooth (Fig. 17) *nigellus* Bohart
6. Pronotum projecting strongly laterally and dorsally, corner of transverse carina in posterior view nearly forming a right angle (Fig. 2), forebasitarsus broadened, flattened and bearing 3 or 4 dentiform setae ventrally (Fig. 43) *dives* (Lepeletier and Brullé)
- Pronotum moderately prominent, corner of transverse carina in posterior view broadly rounded (Fig. 5); forebasitarsus slender and without ventral, dentiform setae (Fig. 44) *atriceps* (Cresson)
7. Forebasitarsus about 3 times as long as broad (Fig. 40) 8
- Forebasitarsus 4 or more times as long as broad (Fig. 39) 9
8. Midbasitarsus hardly twice as long as broad (Fig. 45), mid- and hindfemora essentially black and yellowish *dilectus* (Cresson)
- Midbasitarsus at least twice as long as broad (Fig. 46), mid- and hindfemora usually mostly red and yellowish *rufifemur* (Packard)

9. F-I depressed basoventrally (Fig. 15), carinate angle of forefemur at about basal $\frac{1}{10}$ (Fig. 49-a) *arcuatus* (Say)
- F-I not depressed basoventrally (Fig. 12), angle of forefemur at about basal $\frac{1}{4}$ (Figs. 47, 50) 10
10. Foretrochanter globular (Fig. 50); usually with terga II-VII and several terminal sterna extensively yellow; legs dark red, black, and yellow; hindbasitarsus dark *centralis* (Cameron)
- Foretrochanter lengthened, not globular (Fig. 47) markings various *rufipes* (Lepeletier and Brullé)
11. F-III-IV simple (Fig. 7) 12
- F-IV (or apparent III) somewhat misshapen and prolonged beneath (Figs. 9, 13, 14) 15
12. Scutum with distinct longitudinal microridging in posterior $\frac{1}{2}$, inner orbital silvery pubescent marks narrow 13
- Scutum not microridged in posterior $\frac{1}{2}$, inner orbital silvery pubescent marks almost meeting medially 14
13. Forefemur with a sharp, retrorse, ventral spine near middle (Fig. 36); head dorsally with longitudinal ridging in front of ocelli, transverse ridging behind compound eyes; F-II depressed basoventrally (Fig. 7) *maculosus* (Gmelin)
- Forefemur unspined; head dorsally without ridging; F-II not depressed ventrally *cephalotes* (Olivier)
14. Foretrochanter with an angle bearing a pointed brush of hairs (Fig. 35), S-II mostly or all dark *decemmaculatus* (Say)
- Foretrochanter without an angle or pencil of hairs, S-II yellow with a sublateral dark spot *alpheus* Pate
15. F-I (actually I-II fused) with 2 strong ventral projections (Figs. 13, 14), F-I depressed basoventrally 16
- F-I-II without ventral projections, F-I not depressed basoventrally 18
16. Flagellum with 2 strong ventral projections (Fig. 13) *lapidarius* (Panzer)
- Flagellum with 4 strong ventral projections (Fig. 14) 17
17. Most basal flagellar projection with an apical hair tuft *sexcinctus* (Fabricius)
- Most basal flagellar projection without unusual hair *ruficornis* (Zetterstedt)
18. Humeral angle absent, or present and part of transverse carina (Fig. 6), or essentially so (Fig. 3) 19
- Humeral angle present but well in front of transverse carina (as in Fig. 1) 23
19. Humeral angle absent or blunt 20
- Humeral angle present and sharp, sometimes small 22

20. T-V yellow banded, T-I coarsely punctate *excavatus* (W. Fox)
 - T-V with well separated yellow spots or all dark, T-I rather finely
 punctate 21
21. T-V with lateral yellow spots, apical margin of median clypeal lobe
 more narrowly rounded (view from beneath, Fig. 22)
 *stirpicola* (Packard)
- T-V dark, apical margin of median clypeal lobe more nearly truncate
 (view from beneath, Fig. 20) *paucimaculatus* (Packard)
22. Pronotum with transverse carina ending laterally in a strongly projecting humeral angle (Fig. 6), ocellar triangle narrower than ocellocular distance *sonorensis* (Cameron)
- Pronotum with transverse carina practically joining humeral angle
 which forms part of a short, inwardly directed carina (Fig. 3); ocellular triangle with breadth about equal to ocellocular distance
 *satan* Pate
23. T-I mostly with coarse, separated punctures, T-V banded 24
- T-I mostly with fine and well spaced punctures, T-V banded or not 25
24. Clypeus with median lobe not protruding much, if any, in front of a line drawn along free edge of clypeus laterally (Fig. 33)
 *scaber* (Lepeletier and Brullé)
- Clypeus with median lobe protruding well in front of a line drawn along free edge of clypeus laterally (Fig. 30) .. *odyneroides* (Cresson)
25. Clypeal median lobe protruding about $\frac{1}{2}$ of clypeal length in front of a line drawn across at mandible base (Fig. 31), a complete or medially interrupted yellow band usually present on at least one of T-II-IV 26
- Clypeal median lobe protruding only slightly in front of a line drawn across at mandible base (Fig. 32); T-II-IV nearly always with lateral yellow or ivory spots, no bands 27
26. Midtarsomere II in lateral view with a thornlike distal projection which is stronger than on III-IV (Fig. 38) *continuus* (Fabricius)
- Midtarsomere II in lateral view with a weak projection which is not noticeably stronger than on III-IV (Fig. 37) *trifasciatus* (Say)
27. Pronotum strongly raised, unusually broad, humeral angle strongly projecting; markings usually yellow *spinifer* (W. Fox)
- Pronotum moderately raised, humeral angle small; markings ivory
 *besseyae* (Rohwer)
28. Clypeus apicomediad produced into a strong truncate or somewhat excised snout (view from in front and below), flanked by a secondary tooth or angle (Figs. 19, 29) 29
- Clypeus beveled, abbreviated, or rounded apicomediad (Figs. 24, 25, 27, 28) 34

| | |
|--|--------------------------------------|
| 29. F-I about twice as long as II or longer (Fig. 10), humeri rounded off | 30 |
| — F-I distinctly less than twice as long as II, humeri sharply pointed | 32 |
| 30. Clypeus distinctly incised at apex, pygidial plate yellow except distally, sterna with considerable yellow | <i>sexcinctus</i> (Fabricius) |
| — Clypeus at most with a slight angled incision, pygidial plate black, sterna black or nearly so | 31 |
| 31. Posterior face of propodeum more satiny and less reflective, fine transverse microridging close and nearly complete | <i>ruficornis</i> (Zetterstedt) |
| — Posterior face of propodeum more polished and reflective, microridging more coarse, irregular and incomplete | <i>lapidarius</i> (Panzer) |
| 32. Pronotum with 2 transverse carinae, more anterior one ending laterally in humeral angle (about as in Fig. 4) | <i>borealis</i> (Zetterstedt) |
| — Pronotum with 1 transverse carina which ends laterally a little in back of humeral angle (Fig. 1) | 33 |
| 33. Scape usually all pale in front, mandible usually maculate | <i>dives</i> (Lepeletier and Brullé) |
| — Scape partly or all dark in front, mandible usually all dark | <i>atriceps</i> (Cresson) |
| 34. Scutum with transverse microridging in front (at least anterolaterally), longitudinal microridging posteriorly | 35 |
| — Scutum without complete microridges | 36 |
| 35. F-I more than twice as long as broad (Fig. 11), clypeus with a large polished bevel (Fig. 27), spots of T-V widely separated | <i>maculosus</i> (Gmelin) |
| — F-I less than twice as long as broad (Fig. 8), clypeus without a significant bevel, T-V with a broad pale band | <i>cephalotes</i> (Olivier) |
| 36. Clypeal apex distinctly beveled (bearing a smooth area on a deflected plane) (Figs. 25, 26, 28) | 37 |
| — Clypeal apex rather thin, not or only minutely beveled | 43 |
| 37. Pygidial plate triangular, nearly flat (Fig. 54) | 38 |
| — Pygidial plate narrowed well before apex, somewhat depressed and channeled (Fig. 55) | 39 |
| 38. Scutum closely but moderately and rather evenly punctate, femora mostly black and whitish, other markings usually whitish | <i>dilectus</i> (Cresson) |
| — Scutum coarsely and rather unevenly punctate, femora often extensively reddish | <i>rufifemur</i> (Packard) |
| 39. Clypeal bevel transverse, midlength about $\frac{1}{4}$ that of clypeus (Fig. 26) | 40 |

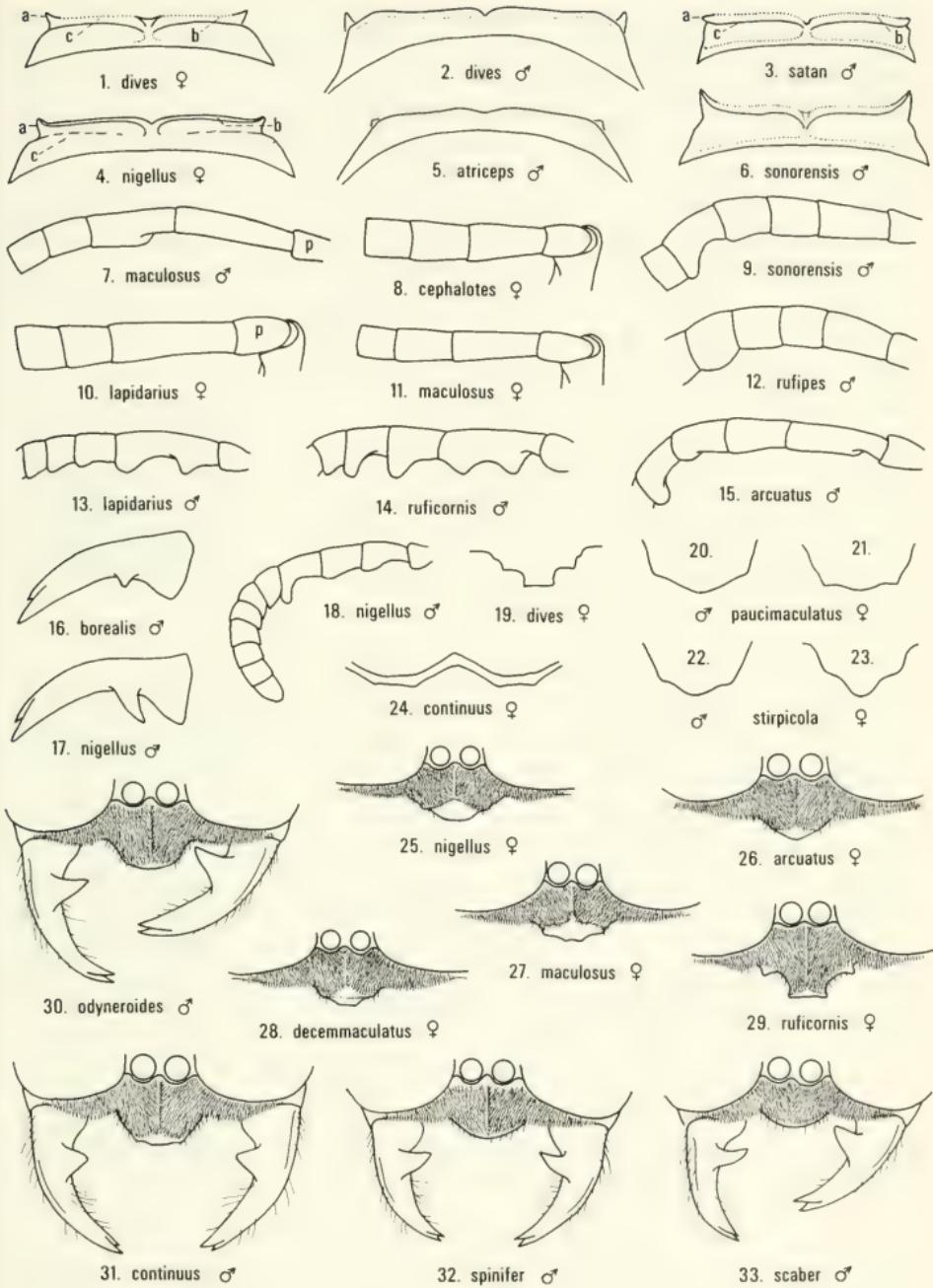
- Clypeal bevel roughly triangular, midlength about $\frac{1}{3}$ that of clypeus (Figs. 25, 28) 41
- 40. F-I more than twice as long as broad, T-I finely and closely punctate, legs mostly black and yellow *arcuatus* (Say)
- F-I slightly less than twice as long as broad, T-I moderately and closely punctate, legs mostly red and yellow .. *sonorensis* (Cameron)
- 41. Area of frons in back of scapes polished and occupying about $\frac{1}{2}$ of lower frons, small species with all dark mandible and basitarsi; terga with widely separated whitish spots *nigellus* Bohart
- Area of frons in back of scapes almost completely covered with pubescence; large species with maculate mandible and basitarsi; terga banded or with yellowish spots 42
- 42. Sterna dark, terga black with yellow spots or T-I-II extensively red *decemmaculatus* (Say)
- Sterna yellow with a round, black, sublateral spot on S-II; terga yellow banded *alpheus* Pate
- 43. Humeral angle absent or blunt 44
- Humeral angle present and sharp, sometimes small 46
- 44. Terga rather unevenly and coarsely punctate, coarsest on I; T-V usually banded, or if not, T-I-II reddish *excavatus* (W. Fox)
- Terga rather evenly and finely punctate, T-V all dark or laterally spotted 45
- 45. Clypeus with anterior edge of median lobe with a produced and rounded central lobe (Fig. 23), hindbasitarsus yellow, T-V usually with large yellow spots or a band *stirpicola* (Packard)
- Clypeus with anterior edge of median lobe slightly undulate (Fig. 21), hindbasitarsus usually dark, T-V usually dark or with a tiny lateral spot *paucimaculatus* (Packard)
- 46. T-I coarsely punctate (Fig. 53) 47
- T-I with medium fine to fine punctuation 49
- 47. Humeral angle in front of transverse pronotal carina (about as in Fig. 2) *scaber* (Lepeletier and Brullé)
- Humeral angle part of transverse pronotal carina (about as in Fig. 6) 48
- 48. Last few sterna black, metanotum closely punctate, hindbasitarsus yellow, femora mostly red or red and yellow *rufipes* (Lepeletier and Brullé)
- Last few sterna yellow, metanotum mostly polished toward middle, hindbasitarsus dark, femora mostly dark *centralis* (Cameron)
- 49. Clypeal apex obtusely rooflike in edge-on view (Fig. 24), punctures of T-I extremely fine and well separated, pronotal lobe distinctly punctate 50

- Clypeal apex straight or curved in edge-on view, punctures of T-I and pronotal lobe various 51
- 50. Posterior face of propodeum more smooth, with close and transverse microridges, many of which extend between scattered punctures to midline (use magnification of 25–50 times), imparting an overall smooth and somewhat silky appearance (Fig. 41) *continuus* (Fabricius)
- Posterior face of propodeum more rough, partly shiny, with some well separated oblique ridges among punctures and reticulation, not at all silky (Fig. 42) *trifasciatus* (Say)
- 51. Pronotal transverse carina practically touching humeral angle laterally, latter a part of a short inwardly directed carina; pale spots of T-III as close together or closer than those on T-II; bands usually present on T-I–IV–V, narrowly separated spots on T-II–III *satan* Pate
- Pronotal transverse carina plainly behind humeral angle laterally; pale spots of T-III, when present, farther apart than those on T-II 52
- 52. T-I with medium-sized punctures, pronotal lobe appearing closely punctate at 27 \times magnification; T-III all dark or with a small lateral spot, T-II–IV–V usually banded *odyneroides* (Cresson)
- T-I with fine to very fine punctures, pronotal lobe appearing smooth at 27 \times magnification; T-II–V with lateral spots 53
- 53. Pronotum with a sharp humeral angle which projects forward and somewhat outward, markings usually yellowish ... *spinifer* (W. Fox)
- Pronotum with a small humeral angle, markings whitish or rarely pale yellow *besseyae* (Rohwer)

Ectemnius atriceps (Cresson)

The rather "difficult" *Ectemnius* s.s. group contains *dives*, *atriceps*, *borealis*, and *nigellus*. In Bohard (1976:424) *atriceps* from Colorado was considered a senior synonym of *brunneipes* (Packard) from Pennsylvania, and *foxii* Kincaid from Washington state. On the other hand, *corrugatus* (Packard) from western Virginia was considered a senior synonym of *pauper* (Packard) from West Virginia, *operus* (Rohwer) from New Mexico, and

Figs. 1–2, 5–6. Pronotum, dorsal; (a) humeral angle, (b) anterior carina (solid line) or rounded margin (dotted line), (c) transverse carina (solid line) or cariniform ridge (broken line). Figs. 3–4. Pronotum, oblique posterior view. Figs. 7–15. Pedicel of antenna (p) and basal flagellomeres, lateral. Figs. 16–17. Mandible, inner lateral view. Fig. 18. Pedicel and flagellum of antenna. Figs. 19–23. Clypeal margin, ventral. Fig. 24. Clypeal apex, edge-on view. Figs. 25–29. Clypeus to show pubescence and apical bevel, front view. Figs. 30–33. Clypeus and mandibles, front view.



drymocallidus (Rohwer) from Colorado. We have examined material from various parts of the country and have reached the conclusion that a single species accounts for all of the above names (NEW SYNONYMY). There are regional differences in maculation, as would be expected, but structural characters of the propodeum, pronotum, male legs, and female clypeus, as given in the key, all seem to agree. If subspecific names are applied, *atriceps* should refer to specimens with the scape black or nearly so, and tergal markings whitish; *foxii* should be restricted to material with dark scape but yellow tergal markings; and *corrugatus* would refer to specimens with extensively yellow scape and yellow tergal markings. Typical *atriceps* occurs from Wyoming to northern New Mexico to California at moderate to high altitudes or at lower elevations in mountainous localities. The variety *foxii* occurs in southern Oregon and northern California, and variety *corrugatus* ranges from the Dakotas east to the Atlantic Coast. Geographical boundaries of so-called subspecies are by no means clearcut. I have seen several specimens from Oregon and British Columbia which have scapal markings intermediate between *foxii* and *corrugatus*. Conversely, one of three females in our collection from Maine has the scapes all dark and would fall into *foxii*.

Ectemnius borealis (Zetterstedt)

Crabro borealis Zetterstedt, 1838. Insecta Lapponica, p. 443.

Crabro proletarius Mickel, 1916. Trans. Am. Entomol. Soc. 42:426. NEW SYNONYMY.

Specimens determined by various European specialists as *nigrinus* (Herich-Schaeffer), 1841 (=*borealis* Zetterstedt, 1838) appear to be identical with Nearctic material previously called *proletarius* (Mickel). *Ectemnius borealis* thus occurs widely in the Holarctic Region and most commonly in the Boreal Life Zone. We have seen long series from Canada, including Yukon Territory and Northwest Territories, and many specimens from mostly mountainous localities in the United States.

Ectemnius decemmaculatus (Say)

In the typical form (type-locality: Missouri) which occurs in eastern U.S. and Mexico, the terga are black with yellow spots. Pate gave the subspecies name *tequesta* to the Floridian variety with T-I-II red.

Ectemnius excavatus (W. Fox)

In the typical variety from Florida the body is rather extensively red marked and T-III-V of the female may be all black. In most other localities east of the 100th meridian T-I and/or II-IV have yellow spots and V is banded. For those who wish to recognize this form as a subspecies, the

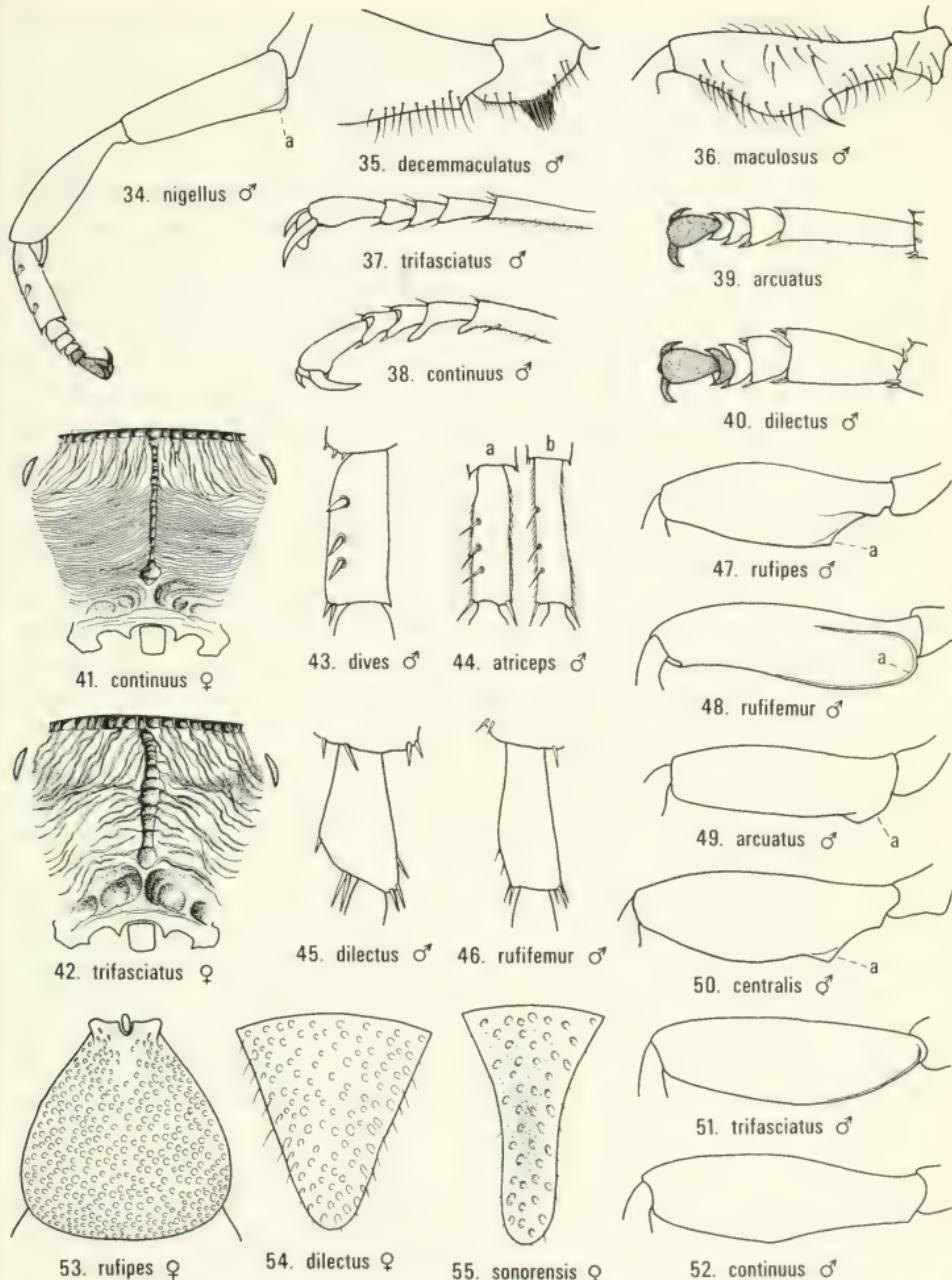


Fig. 34. Foreleg, inner profile. Fig. 35. Foretrochanter and base of forefemur. Fig. 36. Foretrochanter and forefemur. Figs. 37-38. Middatarsus. Figs. 39-40. Foretarsus. Figs. 41-42. Propodeum, posterior. Figs. 43-44. Forebasitarsus, ventral; from (a) Utah, and (b) Virginia. Figs. 45-46. Midbasitarsus, profile. Figs. 47-50. Forefemur, inner profile. (a) basoventral tooth. Figs. 50-52. Forefemur, outer view. Fig. 53. Punctuation of tergum I, dorsal. Figs. 54-55. Pygidial plate.

name *banksi* Rohwer is available. A third and unnamed color form occurring in Arizona has the body with extensive ivory markings.

Ectemnius nigellus Bohart, NEW SPECIES

Figs. 4, 17, 18, 25, 34

Female holotype.—Length 7 mm. Black with whitish markings as follows: pronotal collar except medially, pronotal lobe and spot behind, transverse metanotal spot, distal dots on fore- and midfemora, outer stripes on tibiae, small lateral spots on terga I and IV, larger but well separated ones on II-III, closest on II; wings brown stained. Pubescence pale, mostly inconspicuous. Punctuation fine, rather close on upper frons, vertex, and scutum but some punctures separated by a puncture diameter or more; scapal basin, clypeal bevel, gena ventrally, scutellum medially, tergum I, and pygidial plate extensively polished; scutum with weak longitudinal ridging; mesopleural side and scutellum, except medially, closely ridged; propodeal enclosure with weak, well separated, and mostly longitudinal ridges; propodeum posteriorly punctate, laterally with fine close ridging. Mandible with inner subbasal tooth about as large as largest apical tooth; clypeus weakly and broadly projecting medially; bevel broad, relatively large, triangular, nearly as long as median clypeal carina (Fig. 25), a weak tooth on margin next to bevel; F-I twice as long as pedicel; scapal basin rather sharply margined above; occipital carina fine, slightly raised, not pitted in front; pronotal collar with a sharp anterior carina ending laterally in an acute humeral angle, also a partly cariniform posterior ridge extending laterally toward pronotal lobe (Fig. 4-c); pygidial plate incurved laterally, somewhat troughlike (about as in Fig. 55).

Male.—Length 5.5–6.0 mm. Markings as in female except foretarsomeres I-II pale, mesopleural spot and those of terga I and IV sometimes absent, lateral spot on V sometimes present. Antenna with F-I basoventrally concave, III prolonged beneath, II and IV somewhat modified (Fig. 18); clypeal bevel triangular and covering an area equal to midocellus; mandible with large basal tooth (Fig. 17), foreleg (Fig. 34), basitarsus flattened and ventrally with 2 or 3 dentiform setae; sculpture of propodeal enclosure and posterior slope more coarsely ridged than in female.

Types.—Holotype ♀ (U. C. Davis), Sagehen Creek, Nevada County, California, June 14, 1974 (R. M. Bohart). Paratypes, 16 ♂, 44 ♀, from Upper Sonoran to Boreal Life Zone localities in California from Modoc to San Diego counties: nr. Cedarville, Lava Bed National Monument, Johnsville, nr. Sierraville, Independence Lake (Sierra Co.), Sagehen Creek (Nevada Co.). Tioga Pass and Sonora Pass (Mono Co.), Columbia, Chinese Camp, Angels Camp, China Flat, Yosemite, Icehouse Road, and Echo Lake (El Dorado Co.), Luther Pass and Winnemucca Lake (Alpine Co.), San Francisco, Samuel Springs (Napa Co.), Mt. Diablo (Contra Costa Co.), Mt. Bullion (Mar-

iposa Co.), Coalinga, Pinnacles National Monument, Three Rivers, Mt. Pinos (Ventura Co.), San Jacinto Mts. (Riverside Co.), Mt. Laguna (San Diego Co.). Out-of-state specimens (not paratypes) are from mountainous localities in Idaho (Galena Summit, Blaine Co.; Slate Creek Ranger Station, Bear Creek Pass), Oregon (Blue Mts., Crater Lake), Utah (Weber Co., Salt Lake Co.), and Wyoming (28 mi. sw. Lander).

Remarks.—*Ectemnius nigellus* belongs to the *dives* species group which is sometimes called subgenus *Ectemnius*. Species of this group have the following characteristics in both sexes: size small, usually shorter than 10 mm; abdominal dorsum with lateral spots, occasionally joined posteriorly; scapal basin forming a high rectangle which is non-setose and rather distinctly margined above; humeri sharp; mandible with a moderate sized to small subbasal tooth on cutting edge. Male characters are: clypeus somewhat projecting medially, forefemur with a cariniform basal angle (Fig. 34-a). Female characters are: clypeus sharply truncate (except in *nigellus*) and with a flanking tooth; pygidial plate narrow and troughlike (as in Fig. 55). As indicated in the key, *nigellus* and *borealis* are similar. Males of both have F-III produced ventrally and more strongly than F-IV (Fig. 18), whereas in *dives* and *atriceps* F-III is hardly produced. The pronotal collar is flattened and bears two transverse carinae or cariniform ridges (Fig. 4-b, c). The two species are separated by characters given in the key. The short and extensively beveled female clypeus of *nigellus* is particularly characteristic (Fig. 25).

Ectemnius paucimaculatus (Packard)

We have been puzzled by the similarities between this species and *stirpicola*. On the whole, *paucimaculatus* is less extensively yellow marked. However, maculation is notoriously variable in *Ectemnius* and the two forms have much the same range in the U.S. east of the 100th meridian. For the present we have separated them on the somewhat narrower clypeal production in both sexes of *stirpicola* (Figs. 22, 23) along with some differences in abdominal pattern as given in the key. Significant differences in nesting were noted by Krombein (1964:75) which suggest that these are indeed discrete species.

Ectemnius rufipes (Lepeletier and Brullé)

Synonymy of this species with *texanus* (Cresson) was indicated by Bohart (1976:427). The type-locality for *rufipes* was given as "Caroline" but the type has been lost. A neotype female was established by Bohart (1976:627) from Decatur, Alabama. In the typical form from Texas, Oklahoma, Alabama, northern Florida to the Carolinas T-II, IV-VI are yellow marked. In the more southern Floridian form, which Pate called *ais*, T-II (rarely also I), and IV-VI are reddish.

Ectemnius satan Pate

Typical *satan* from Arizona and New Mexico (type-locality: McKinley Co., New Mexico) has ivory markings. A widespread variety from California has the maculation deep yellow.

Ectemnius sexcinctus (Fabricius)

In Bohart (1976:428) *yosemite* Pate was listed as a distinct species. It now appears that it simply represents the first record of New World material of *sexcinctus* (Fabricius), and *yosemite* should be added to the long list of synonyms under the widespread palearctic species (NEW SYNONYMY). Most characteristic is the hair tuft under the basal flagellar projection in the male. Females have the clypeal apex incised. Our material is from Lake Tahoe and Sonora Pass, California, and Logan, Utah, all collected in August to October.

Ectemnius trifasciatus (Say)

This species was originally based on a male from Northwest Territories, Canada. Since its identity has sometimes been questioned and the type is non-existent, we are designating a NEOTYPE male in the Canadian National Collection, Ottawa. It bears the following data: Norman Wells, Northwest Territories, July 13, 1949 (W. R. M. Mason). *E. trifasciatus* is fairly common and widespread in Canada and its range there includes Newfoundland (Codroy) and Labrador (Goose Bay). In United States its distribution is essentially northern and boreal. Throughout its range it occurs with *continuus*, a closely related and more abundant species with holarctic distribution. Characters of the male midtarsi (Figs. 37, 38) as given in the key afford easy separation. Females are much closer, but the more coarsely sculptured posterior propodeal area (Fig. 42) and the usually whiter markings of *trifasciatus* will help distinguish them. It should be noted that some California females have bright yellow tergal markings.

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A NEW SPECIES OF *PARANTHRENE* (LEPIDOPTERA: SESIIDAE)¹

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Abstract.—A new clearwing moth species, *Paranthrene pellucida*, is described. This species is morphologically similar to *P. simulans* (Grote), from which it differs in the degree of scaling on the forewing and breeding season. Differences in the chemical structure of their sex pheromones may also exist.

Sex pheromones of two clearwing moths (Lepidoptera: Sesiidae) have been isolated, identified, and synthesized (Tumlinson et al., 1974). The compounds are ZZ- and EZ- isomers of 3,13-octadecadien-1-ol-acetate, hereafter referred to as 3,13-ODDA. Recent evidence suggests that these and other chemically related compounds are the major components of the sex pheromones of many Nearctic sesiids (Greenfield, 1978; Underhill et al., 1978). Because of their attractiveness to the males of many species, the various compounds are valuable in probing the ecology and evolution of Sesiidae. One area in which these compounds are particularly useful is the recognition of cryptic species in the family (Duckworth and Eichlin, 1977a; Purrington and Nielsen, 1977). In this paper we describe a new sesiid species in the genus *Paranthrene* Hübner, morphologically similar to *Paranthrene simulans* (Grote), discovered through field trapping with 3,13-ODDA isomers in Wisconsin.

Paranthrene pellucida Greenfield and Karandinos,
NEW SPECIES
Fig. 1

Male.—Antenna bipectinate-ciliate ventrally, with an apical tuft; slightly clavate; black dorsally throughout, brown ventrally at proximal end, be-

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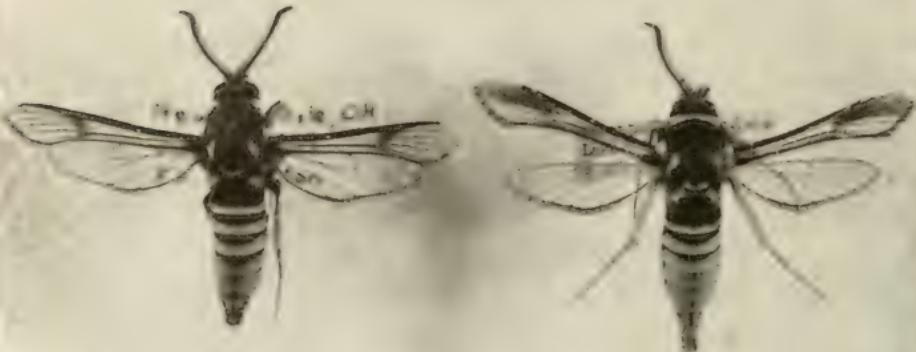


Fig. 1. *Paranthrene pellucida*, male (left) and *Paranthrene simulans*, male (right). (Specimens courtesy of F. F. Purrington, O.A.R.D.C., Wooster, Ohio.)

coming more orange distally. Proboscis well developed. Labial palpus roughened and yellow ventrally, black dorso-exteriorly, segment 3 pointed and $\frac{1}{2}$ the length of segment 2. Head with vertex black; front black, with yellow laterally; occipital fringe black dorsally, yellow laterally. Thorax primarily black dorsally with yellow patches directly anterior to and below forewing; tegulae yellow posteriorly and a transverse yellow band posteriorly on mesonotum; collar yellow laterally and dorsally on posterior portion, black dorsally on anterior portion; metathorax black dorsally with yellow patches laterally. Forewing mostly hyaline, except for a brown streak, in center of anterior transparent area, extending proximally from discal spot; wing base black; discal spot brown; costal and anal margins black dorsally, yellow orange ventrally; veins and fringes brown black. Hindwing hyaline, save costal and anal margins, discal spot, fringes, and veins brown dorsally, yellow orange ventrally. Legs with prothoracic coxae mostly yellow, but with black mesally, femora yellow orange with black proximally and rough yellow scales ventrally, tibiae yellow orange with rough yellow scales dorsally, tarsi yellow orange; mesothoracic legs with coxae black proximally, yellow distally, femora black anteriorly, yellow orange mixed with black posteriorly, yellow orange ventrally and dorsally, tibiae yellow orange with rough yellow scales dorsally, tibial spurs yellow orange, tarsi yellow orange; metathoracic legs with coxae black proximally,

yellow distally, femora mostly black, but with yellow ventrally, tibiae yellow proximally and with rough yellow scales dorsally, yellow orange distally, tibial spurs yellow orange, tarsi yellow orange. Abdomen black and yellow, segment 1 entirely black, venter of segments 2-7 each with anterior $\frac{2}{3}$ black and posterior $\frac{1}{3}$ yellow, dorsum of segments 2-4 each with anterior $\frac{1}{2}$ black and posterior $\frac{1}{2}$ yellow, dorsum of segment 5 with anterior $\frac{1}{3}$ black and posterior $\frac{2}{3}$ yellow, dorsum of segment 6 with anterior $\frac{1}{6}$ black and posterior $\frac{5}{6}$ yellow, dorsum of segment 7 entirely yellow. Genitalia indistinguishable from those of *P. simulans*, figured in Engelhardt (1946). Alar expanse 29 mm.

Female.—Antenna simple. Mesonotum lacking transverse yellow band posteriorly. Meso- and meta-thoracic legs with femora exhibiting more yellow than male. Maculation otherwise similar to male. Alar expanse 32 mm.

Host.—In Lake Co., Ohio and in Cromwell, Connecticut, F. F. Purrington and R. E. B. Moore, respectively, obtained adults from cuttings of *Quercus palustris* in which the larvae had bored. In Wisconsin, all locations at which specimens were captured in 3,13-ODDA-baited traps supported stands of *Quercus velutina*, indicating a possible host association with this oak species also.

Distribution.—Wisconsin, Ohio, New York (based on a specimen in the NMNH with label data: Bronx Park, N.Y., July 24, 1957), Connecticut.

Similar species.—*Paranthrene simulans* is very similar in size and overall appearance, but the region of its forewing distad of the discal spot is covered with brown scales, except for a hyaline area (window) between M_2 and Cu_2 . This degree of suffusion by scales on the forewing is found in the holotype of *P. simulans* and in the holotypes of the forms *P. simulans luggeri* (Henry Edwards, 1891) (*Trochilium*) and *P. simulans palmii* (Henry Edwards, 1887) (*Fatua*). *Paranthrene pellucida* has the entire distal region of the forewing hyaline.

Types.—*Holotype*: ♂, Arena, Iowa Co., Wisconsin, VI-26-1977, Coll. M. D. Greenfield, deposited in the University of Wisconsin Insect Research Collection, Madison, Wisconsin. *Paratypes*: 14 as follows: 1 ♀, Cromwell, Connecticut, emerged from *Quercus palustris* VII-18-1977, Coll. R. E. B. Moore, 1 ♂, Mazomanie, Dane Co., Wisconsin, trapped with a 1:9 blend of ZZ-EZ-3,13-ODDA between VI-30-1977 and VII-8-1977, Coll. M. D. Greenfield, and 1 ♂, New Carlisle, Lake Co., Ohio, emerged from *Quercus palustris* cutting between VI-14-1977 and VI-21-1977, Coll. F. F. Purrington, all deposited in the University of Wisconsin Insect Research Collection, Madison, Wisconsin; 1 ♂, Blue River, Grant Co., Wisconsin, trapped with a 2:8 blend of ZZ-EZ-3,13-ODDA between VI-8-1977 and VI-17-1977, Coll. M. D. Greenfield, deposited in the collection of Cornell University, Ithaca, New York; 1 ♂, Mazomanie, Dane Co., Wisconsin, trapped with a 2:8 blend of ZZ-EZ-3,13-ODDA between VI-30-1977 and VII-8-1977, Coll. M. D.

Greenfield, deposited in the Los Angeles County Museum (Natural History), California; 1 ♂, Mazomanie, Dane Co., Wisconsin, trapped with a 2:8 blend of ZZ:-EZ-3,13-ODDA between VII-8-1977 and VII-15-1977, Coll. M. D. Greenfield, and 1 ♂, Arena, Iowa Co., Wisconsin, trapped with a 4:6 blend of ZZ:-EZ-3,13-ODDA between VI-30-1977 and VII-8-1977, Coll. M. D. Greenfield, genitalia slide by M. D. Greenfield, both deposited in the USNMNH; 3 ♂, Arena, Iowa Co., Wisconsin, trapped with a 3:7 blend of ZZ:-EZ-3,13-ODDA between VI-30-1977 and VII-8-1977, Coll. M. D. Greenfield, all deposited in AMNH; 1 ♂, Arena, Iowa Co., Wisconsin, trapped with a 3:7 blend of ZZ:-EZ-3,13-ODDA between VII-8-1977 and VII-15-1977, Coll. M. D. Greenfield, and 1 ♂, Blue River, Grant Co., Wisconsin, trapped with a 5:5 blend of ZZ:-EZ-3,13-ODDA between VII-8-1977 and VII-15-1977, Coll. M. D. Greenfield, both deposited in the Field Museum, Chicago, Illinois; 1 ♂, Mazomanie, Dane Co., Wisconsin, trapped with a 4:6 blend of ZZ:-EZ-3,13-ODDA between VI-30-1977 and VII-8-1977, Coll. M. D. Greenfield, and 1 ♂, Mazomanie, Dane Co., Wisconsin, trapped with a 3:7 blend of ZZ:-EZ-3,13-ODDA between VI-30-1977 and VII-8-1977, Coll. M. D. Greenfield, both deposited in the Snow Entomological Museum, Lawrence, Kansas.

Etymology.—We have named this species *pellucida* because of its hyaline forewings.

DISCUSSION

Morphologically similar species are common among insects (Mayr, 1970). Behavioral and ecological characters that allow these cryptic species to be distinguished from one another include host preference, time of day and season for mating, and sex communication signal. In insects using chemical sex communication signals, the chemical structure of the pheromone can be used to separate cryptic species. Purrington and Nielsen (1977) report a case of cryptic species in the sesiid genus *Podosesia* in which the two species have different, non-overlapping breeding seasons and appear to use different pheromones, although their host plants are identical. Another pair of morphologically similar sesiid moths, *Synanthedon fatifera* Hodges and *Synanthedon viburni* Engelhardt, exhibit an analogous relationship in which both species bore in *Viburnum* sp., yet appear to use different sex pheromones (Greenfield and Karandinos, *in press*).

Field trapping in Wisconsin with 3,13-ODDA isomers, singularly and in various isomeric combinations, provided data on the temporal activity and spatial distribution of the various sesiid species (Greenfield and Karandinos, *in press*). Adults of *P. pellucida* are active during late June and July in Wisconsin, as opposed to the earlier (late May and early June) activity of *P. simulans*. The seasonal activity periods of these species overlap negligibly.

Paranthrene pellucida males were maximally attracted by a 2:8 blend of ZZ-:EZ-3,13-ODDA, whereas *P. simulans* males exhibited maximum attraction to 100% ZZ-3,13-ODDA. The combination of seasonal and pheromonal separation reproductively isolates *P. pellucida* and *P. simulans*.

We also studied the diel activity of these two cryptic species and found that males of both respond to sex attractant compounds between 17:00 and 19:00. Both species are biennial, and in Wisconsin adults of both emerge only during odd years. Their spatial (habitat) distributions also overlap in Wisconsin, although *P. pellucida* appears to be restricted to xeric oak barrens supporting stands of *Quercus velutina*. *Paranthrene simulans*, known to bore in the trunks of several species of *Quercus* (Engelhardt, 1946), was trapped in a wide variety of habitats, including xeric oak barrens, dry-mesic oak forests, and wet lowland forests. Our interpretation of these data is that *P. pellucida* and *P. simulans* have overlapping host preferences.

Several thousand specimens of *P. pellucida* and *P. simulans* from Wisconsin were examined and the morphological difference (forewing scaling) between them is consistent. No intermediate forms were seen. Our observation of the similarity in genitalic structure between *P. pellucida* and *P. simulans* agrees with the overall genitalic uniformity among species of *Paranthrene*, noted by Duckworth and Eichlin (1977b). *Paranthrene simulans* tends to display more yellow on the dorsum of the abdomen, but this character is inadequate for distinguishing *P. pellucida* from *P. simulans*, since both species exhibit much color polymorphism. This type of polymorphism is found in one of the two cryptic species of *Podosesia*; and morphologically, these latter two species can only be differentiated through characters of their immature forms (Purrington and Nielsen, 1977). Further field investigations with 3,13-ODDA isomers and related compounds may help reveal a general pattern of speciation in Sesiidae.

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NOTE

Some Notes on Two Species of Stelidine Bees from
Indiana (Hymenoptera: Megachilidae)

A recent paper by Parker and Bohart (1979. J. Kans. Entomol. Soc. 52:138–153) gives the first record of a stelidine from Indiana: *Dolichostelis louisae* (Cockerell). This and two other species are expected because of their known distributions (Mitchell. N.C. Agric. Exp. Stn. Tech. Bull. 152. 557 pp.).

As part of a continuing study of the Megachilidae in the Putnam Co. area of Indiana (west central part of the state), I have taken two species: *Dolichostelis louisae* and *Stelis (Microstelis) lateralis* Cresson. The latter was not previously recorded specifically from Indiana. I collected a male on 17 May 1977 in a malaise trap at Greencastle (Putnam Co.). This specimen is #5579 in the DPU collection.

I have taken five specimens of *D. louisae* in Putnam Co.: ♂, 14 July 1976 on *Campanula americana* (#4378); ♀, 13 August 1976 on *Vernonia noveboracensis* (#4990); ♂, 20 June 1977 from a malaise trap (#6262); ♀, 25 August 1977 on *Vernonia noveboracensis* (#7965); ♀, 20 July 1978 on *Melilotus alba* (#9042). All specimens are in the DPU collection.

These specimens show some interesting variations from the description given by Mitchell (1962. Op. cit.) (he called it *Stelis costalis costalis* Cresson) and in Parker and Bohart (1979. Op. cit.) (who sorted out the name confusion). Mitchell describes this species as having numerous yellowish markings including those on the vertex, on the meso- and metapleura, and a broadly interrupted band on tergum II. The specimens all have modifications of these markings as described below.

None, except ♀ #9042, has any yellow on the vertex. Furthermore, ♂ #4378 and ♀ #4990 also lack the maculations of the meso- and metapleura. The ♀ #7965 and ♂ #6262 also lack the mesopleural blotch but have a small reddish metapleural spot. The ♀ #7965 also has a small yellow spot medially on tergum II. A similar spot occurs on ♀ #9042, which has the “typical” pattern.

Both Mitchell (1962. Op. cit.) and Parker and Bohart (1979. Op. cit.) indicate that the Floridian population (identified as *Stelis costalis floridana* Graenicher by Mitchell) of *D. louisae* has more extensive colored areas than the northern forms. The specimens described here seem to indicate that *D. louisae* may have a color pattern that grades from much maculated south to relatively less maculated north.

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NOTE

Further Spread of the Palearctic *Berytinus minor* in
North America (Hemiptera: Berytidae)

In recent years more attention has been focused on detecting exotic insects in North America. Improved modes of transportation increase the chances of invasions, and it is apparent that quarantine procedures cannot entirely prevent foreign species from entering the country. Of the more than 70 species of Heteroptera in the northeastern United States that are known to have a Holarctic distribution, 23 to 36 are believed to represent inadvertent introductions with man's commerce, probably with ship ballast or nursery stock (Slater. 1974. Mem. Entomol. Soc. Conn. 1974:145-213). Nearly all these emigrant species of Heteroptera are reported soon after their discovery in North America, but if they are innocuous insects, they are often forgotten so that any subsequent spread is difficult to trace.

Berytinus minor (Herrich-Schaeffer) is a Palearctic stilt bug regarded as artificially introduced into North America early in this century. (Recently I found among unsorted material in the U.S. National Museum collection a specimen of *B. montivagus* (Meyer) intercepted at New York City, March 10, 1937, on shamrocks from Ireland.) Walley (1935. Can. Entomol. 67:159-160) first reported *B. minor* in North America based on a specimen collected in 1929 from Prince Edward Co., Ontario, Canada. The first United States record was that of Harris (1941. Bull. Brooklyn Entomol. Soc. 36:105-109) from Chebogan Co., Michigan. Wheeler (1970. Can. Entomol. 102:876-886) summarized the distribution, which at the time included Connecticut, Massachusetts, New Hampshire, New Jersey, New York, Ohio, and Quebec. This stilt bug offers an opportunity to compare the spread of a ground-inhabiting heteropteran with that of "weed species" whose capacity for rapid dispersal is well known (Slater. Op. cit.).

The following additional records of *B. minor* in North America have now become available: MAINE: Eagle Lake, 26 July 1966; MICHIGAN: Bay Co., 17 July 1958, R. R. Dreisbach. NEW JERSEY: Haddonfield, 18 Oct. 1970, M. D. Leonard. NEW YORK: Boston, Mar. 1973. G. Gorecki: Corning, 15 May, J. Bauer; Dryden, 27 April 1970, D. B. Smith; McLean Reserve, 16 May 1963, J. Williams. PENNSYLVANIA: Bucks Co., Horseshoe Bend, Neshaminy Creek NE of Jamison, June 1956, W. Ivie; Bucks Co., Jamison, 19 July 1973, beaten from *Picea abies*, J. F. Stimmel; Dauphin Co., Harrisburg, 1 Sept. 1972, T. J. Henry and 24 Jan. 1973, in duff under Andorra juniper, T. J. Henry; Erie Co., North East, 26 May, 4-11 Aug., 18 Aug., 15-22 Sept. 1972, in pitfall traps, G. L. Jubb, Jr. and E. C. Mas-

teller; Lebanon Co., nr. Lickdale, 3 May 1978, sweeping winter wheat, A. G. Wheeler, Jr.; Mifflin Co., Reedsville, 14 July 1976, M. A. Farrell; Montgomery Co., Dresher, in duff under *Picea pungens*, F. Stearns. WEST VIRGINIA: Pocahontas Co., Cranberry Visitors Center, 16 Sept. 1978, beaten from *Picea glauca*, A. G. Wheeler, Jr.

The distribution of *B. minor* in North America is extended to the south by more than 200 miles to include Pennsylvania and West Virginia. This berytid lives mainly under mats of white clover and is most frequently taken in spring and fall when adults are dispersing from or moving to their overwintering sites. The spread potential of the Berytidae is small when compared to many other heteropteran families (Leston, 1957. Syst. Zool. 6:41-46), so one would not consider *B. minor* a likely candidate for the nearly transcontinental dispersal that has occurred in some of the introduced weed-feeding Miridae. The apparent abundance of this species in southern Canada along Lake Ontario, in parts of New England, and in the vicinity of Ithaca, N.Y. suggests that some natural dispersal has occurred.

The collection of this berytid at nearly 4,000 ft in the Monongahela National Forest of West Virginia is difficult to account for by natural dispersal. A specimen was taken on an ornamental white spruce on the landscaped grounds of the Cranberry Visitors Center; the surrounding Cranberry Glades botanical area (750 acres) lies in an undisturbed high mountain valley. The ground-dwelling habits of *B. minor*, coupled with its winter collection from duff under ornamental conifers, suggest that it has reached the West Virginia mountains and spread to other parts of its known range mainly by commerce, most likely with the movement of plant material.

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LARVAE AND PUPAE OF *CENTRONOPUS CALCARATUS* AND
CENTRONOPUS SUPPRESSUS (COLEOPTERA: TENEBRIONIDAE),
WITH AN ESSAY ON WING DEVELOPMENT IN PUPAE

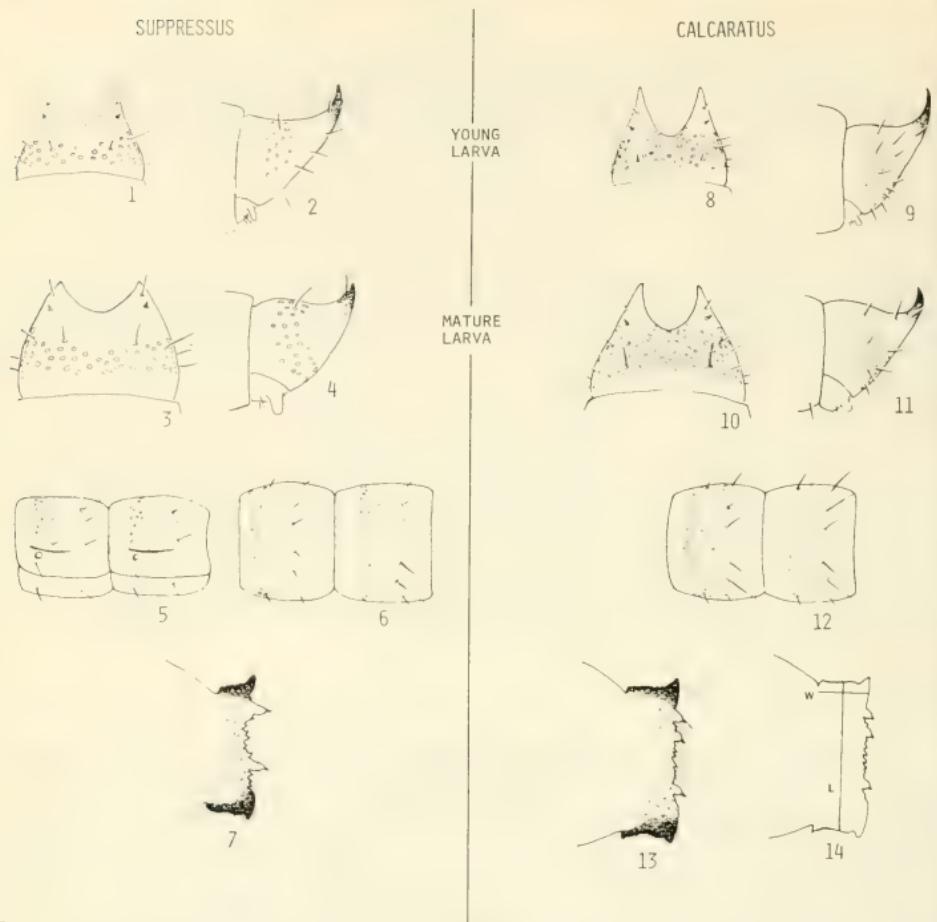
T. J. SPILMAN

Systematic Entomology Laboratory, IIBIII, Agric. Res., Sci. and Educ. Admin., USDA, % U.S. National Museum of Natural History, Washington, D.C. 20560.

Abstract.—The larvae and pupae of *Centronopus calcaratus* (Fabricius) from eastern United States and Canada and *C. suppressus* (Say) from Mexico are described and illustrated, and a determination key is provided. Adult wing length and pupal wing sheath length are studied and correlated. A short pupal wing sheath in a species indicates widespread winglessness in adults of the higher taxon.

The genus *Centronopus* Solier, a member of the Tenebrionini, contains 10 species, all found in the Western Hemisphere under bark of logs. I reviewed the species recently (1962:1-19) but, except for a few host records of larvae, discussed only adults. Prior to my review the genus was usually known by the generic name *Scotobates*. Until now only the species *C. calcaratus* (Fabricius), from the eastern United States and Canada, was known in the larval and pupal stages. St. George (1924:11) included *Centronopus* (= *Scotobates*) based only on *calcaratus*, in his key to the North American larvae of the Tenebrionini, then called Tenebrioninae; he illustrated (Figs. 45-48) the hypopharyngeal sclerome, the prothoracic and mesothoracic legs, and the apex of the abdomen of *C. calcaratus*. Craighead (1950:217) included the genus, based on *C. calcaratus*, in a key to the larvae of the more common wood- and fungus-infesting Tenebrionidae in the eastern United States; he presented (Fig. 45D) a lateral view photograph of the larva. Daggy (1947:259) included *Centronopus* (= *Scotobates*) *calcaratus* in his key to the pupae of the Tenebrionidae of Indiana, illustrating (Pl. 3, Fig. 13) a lateral abdominal process.

The immature stages of another species, *Centronopus suppressus* (Say), have come to light. In the Museum of Comparative Zoology this species is represented by two larvae, two pupae, and two adults, collected together under bark of *Pinus* sp., 10 miles south of Las Vigas, Veracruz, Mexico,



Figs. 1-6. *Centronopus suppressus*, larva. 1. Apex of abdomen of young larva, dorsal view. 2. Same, lateral view. 3. Apex of abdomen of mature larva, dorsal view. 4. Same, lateral view. 5. Second and third abdominal segments, lateral view. 6. Same, dorsal view. Fig. 7. *Centronopus suppressus*, pupa, third lateral abdominal process, dorsal view.

Figs. 8-12. *Centronopus calcaratus*, larva. 8. Apex of abdomen of young larva, dorsal view. 9. Same, lateral view. 10. Apex of abdomen of mature larva, dorsal view. 11. Same, lateral view. 12. Second and third abdominal segments, dorsal view. Figs. 13-14. *Centronopus calcaratus*, pupa. 13. Third lateral abdominal process, dorsal view. 14. Same, diagram for measurements, W—width, L—length.

at 10,000 feet, on 15 July 1971, by A. Newton. The adults were determined by me: the larvae and pupae were easily determined to belong to *Centronopus* by using the keys mentioned and were then assumed to be *C. suppressus* because of their association with the adults. (The following Mexican localities, from specimens in the Ohio State University Collection, can be added to the known distribution of *C. suppressus*: Puebla: Xometla, 1 mi

E of Chalchicomula, 8000 ft, pineland, base of Orizaba, Veracruz: 11 mi NE of Perote, pineland at 7000 ft; 11 mi N of Perote, 8000 ft; 2-3 mi W of Acultzingo, 7000 ft; 1 mi N of Fortin, in banana grove; Jalapa. The following are in the California Insect Survey Collection at Berkeley: Veracruz: 15 mi W of Jalapa, 7600 ft; 8 km SE of Las Vigas, 2200 m, under bark *Pinus*; 5 km SW of Las Vigas, 2440 m, ex *Quercus* stumps; 5 mi SE of Las Vigas, 7500 ft; 18 km SE of Las Vigas, 2200 m, under bark *Quercus*.)

According to my classification of adults (1962), the genus is composed of two subgenera, *Centronopus* (including *C. suppressus*) and *Menechides* Motschulsky (including *C. calcaratus*). Until larvae and pupae of additional species are described, it is impossible to determine if differences are of subgeneric or only of specific rank. At present these characteristics can be used only to differentiate species, not to classify.

KEY TO LARVAE OF *CENTRONOPUS*

- Anterior abdominal terga with coarse punctures dense on anterior $\frac{1}{3}$ but sparse or absent on posterior $\frac{2}{3}$ (Fig. 6). Seta present dorsoposteriorly to spiracle and dorsal to lateral line on abdominal segments 1-2 but absent on segments 3-8 (Fig. 5) *suppressus* (Say)
Anterior abdominal terga with coarse punctures dense on anterior $\frac{2}{3}$ (Fig. 12). Seta present dorsoposteriorly to spiracle and dorsal to lateral line on abdominal segments 1-8 *calcaratus* (Fabricius)

The presence of two large, simple, sharp urogomphi and many coarse punctures on the 9th abdominal tergum are characteristic for *Centronopus*. The size of these urogomphi varies both ontogenetically and interspecifically in the genus. In both species the urogomphi are relatively slenderer and longer in younger instars than in older instars (Figs. 1-4, 8-11). The interspecific differences, given below, are not used in the determination key because of ontogenetic variation.

Larvae of this genus do not have on the thoracic and abdominal terga the transverse anterior sulcus that is present on many tenebrionid larvae; this sulcus is usually sharply marginated anteriorly but not marginated posteriorly. Nevertheless, the meso- and metathoracic terga and anterior abdominal terga have a weak transverse depression; the coarse punctures are usually denser in the depression than on the remainder of the tergum.

Larvae of *C. suppressus*.—Prothoracic tergum without coarse punctures; meso- and metathoracic terga and anterior abdominal terga with coarse punctures dense on anterior $\frac{1}{3}$ but sparse or absent on posterior $\frac{2}{3}$ (Fig. 6), then coarse punctures becoming denser on posterior $\frac{2}{3}$ on posterior terga until quite dense on terga 6-8; tergum 9 with coarse punctures dense on base, very sparse between urogomphi, and absent on urogomphi (Figs. 1-4). Punctures finer and pigmentation surrounding punctures less extensive

than in *C. calcaratus*. Dorsoposteriorly to each spiracle and dorsal to lateral line a seta is present on abdominal segments 1-2 but absent on segments 3-8 (Fig. 5). Urogomphi (Figs. 1-4) stouter and shorter than in a comparable instar in *C. calcaratus*; each urogomphus with a few transverse wrinkles accompanying setiferous punctures.

Larva of *C. calcaratus*.—Thoracic and abdominal terga with coarse punctures dense on anterior $\frac{2}{3}$ (Fig. 12); punctures slightly denser on anterior $\frac{1}{3}$ on all but prothoracic and 9th abdominal terga; punctures unevenly distributed on posterior area, leaving a few bare spots; tergum 9 with coarse punctures dense on entire surface and extending onto bases of urogomphi. Punctures coarser and pigmentation surrounding punctures more extensive than in *C. suppressus*. Dorsoposteriorly to each spiracle and dorsal to lateral line a seta is present on abdominal segments 1-8. Urogomphi (Figs. 8-11) slenderer and longer than in a comparable instar in *C. suppressus*; each urogomphus smooth except for punctures.

KEY TO PUPAE OF *CENTRONOPUS*

- Lateral abdominal process excurred on medial area of posterior border (Fig. 7); processes relatively narrow, for example, width of 3rd process 27% of length; posterior border of pronotum incurved *suppressus* (Say)
- Lateral abdominal process incurved on medial area of posterior border (Fig. 13); process relatively broad, for example, width of 3rd process 34% of length; posterior border of pronotum bisinuate *calcaratus* (Fabricius)

Measurements of the lateral abdominal processes are made as follows (Fig. 14): Width is measured along an imaginary line (W), perpendicular to the longitudinal axis of body, from medial end of sclerotized anterior edge of process to lateral edge; length is measured along imaginary line (L), parallel to longitudinal axis of body, at middle of width (W), from anterior edge of process to posterior edge.

The key is adequate for separation of species; formal descriptions are not given. The size, number, and distribution of tubercles on lateral abdominal processes (Figs. 7, 13) are variable and should not be used for identification.

In *Centronopus*, as in other insects with exarate pupae, many adult characteristics of shape can be seen on the pupa—I do not mean here the adult which can often be seen inside of and through the pupal skin—but small details like punctuation, setation, color, and even larger features that might be distorted by pupal habitus cannot usually be seen on the pupa. In the two species under consideration the small specific adult differences cannot be seen in the pupae, but two of the four subgeneric differences are apparent. The adults of *Centronopus* are grouped into two subgenera by the

following: *Centronopus* (with *C. suppressus*): 1—posterior pronotal border incurved, 2—metathoracic wings short and spatulate, hereafter called brachypterous, 3—metasternum short, 4—elytra narrow at base and humeri rounded; *Menechides* (with *C. calcaratus*): 1—posterior pronotal border bisinuate, 2—metathoracic wings long and broad, hereafter called winged, 3—metasternum long, 4—elytra broad at base and humeri subangulate. (Incidentally, the last three characteristics could actually be considered as one because they usually occur together in brachypterous and wingless Tenebrionidae and many other Coleoptera. Though the elytra must be lifted if one is to be certain of the presence of wings, a prediction of brachyptery or winglessness usually can be made on the basis of length of metasternum and width of elytral base.) As to the presence of subgeneric structures in these pupae, the first and third can be seen on the pupa, the fourth cannot be seen on the pupa because the mesothoracic wing sheaths are quite narrow and curved around the side of the body, and the second can be seen in part on the pupa. This last mentioned, the condition of the mesothoracic wing sheaths of the pupae, is discussed in the following essay.

WING DEVELOPMENT IN PUPAE

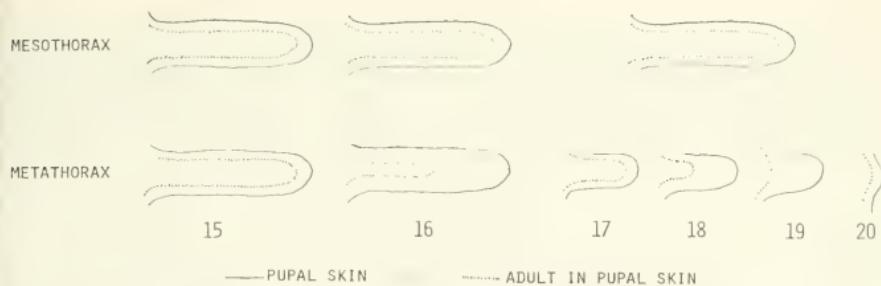
Beetles with long elytra and long wings have in their pupal stage long elytral sheaths and long wing sheaths. The long elytra and wings of the adult fill the cavities of the pupal sheaths. That is the condition in the pupa of *Centronopus (Menechides) calcaratus*, a fully winged species. On the other hand, in the pupa of *Centronopus (Centronopus) suppressus*, a brachypterous species, the wing sheath is long, even though the short spatulate adult wing fills only a small part of the wing sheath. It would seem, at first glance, that a short pupal wing sheath would have developed.

In an excellent study on the structure and development of flightless Coleoptera by Smith (1964) and an earlier study on rudimentary wings by Waddington (1942) the morphological description of the development of various conditions of wings in the Ptinidae helps toward an understanding of the wings of *Centronopus*. From Smith it can be inferred that in the Ptinidae the condition of adult wing development [completely formed, reduced (brachypterous), or absent] proceeds in five different ways by the development in the larva of the imaginal discs and/or by the development in the pupa of the adult wing within the wing sheath. (1) In a fully winged species the wing develops from a fully-developed imaginal disc, becomes a large wing in a large pupal wing sheath, and develops normally in that sheath. (2) In a brachypterous species the wing develops from a large imaginal disc, becomes a large wing in a large pupal wing sheath, and finally degenerates to less than full size in the sheath; or (3) in a brachypterous species the wing develops from a small imaginal disc, becomes a small wing

in a small pupal wing sheath, and degenerates to an even smaller wing in the sheath. (4) In a completely wingless species the wing develops from a tiny imaginal disc, becomes a tiny wing in a very small pupal wing sheath, and degenerates completely in the sheath; or (5) in a wingless species the wing is absent in the pupa because of the absence of an imaginal disc in the larva and the pupal wing sheath is absent. Undoubtedly the condition of the adult wing and pupal wing sheath in *Centronopus calcaratus* corresponds to the first condition described by Smith in the Ptinidae and that of *Centronopus suppressus* to the second condition.

My observation of pupal wing sheaths of *Centronopus* and the article by Smith led me to wonder about the pupae of other wingless or brachypterous tenebrionids. In beetles with fully-developed elytra and wings, the wing sheath is as long as the elytral sheath, so I have given the length of the pupal wing sheath as compared with the length of the elytral sheath. *Meracantha contracta* (Palisot) (Meracanthini) has the pupal wing sheath similar in length, shape, and thickness to the elytral sheath; and the adult wing is very short and spatulate. *Eleodes* sp. (Eleodini), *Blaps polychresta* (For-skål) (Blaptini), and *Zopherus nodulosus haldemani* Horn (Zopherini) have pupal wing sheaths approximately two-thirds the length of, narrower than, and much thinner than the elytral sheaths; species of *Eleodes* and the other two known species have adult wings that are very short and spatulate. *Asidopsis* sp. (Asidini) has the pupal wing sheath approximately one-third the length of, as broad as, and much thinner than the elytral sheath; and the adult wing is absent in the genus. To be sure, the sample studied is very small for a family the size of the Tenebrionidae: the reason, of course, is that pupae of beetles are seldom collected and preserved.

Wing sheaths of pupae of other families of beetles that were examined were measured in the same way. The following data represent five types of pupal wing sheaths and adult wings; the numbering system is not comparable to that given in my discussion of Smith's findings. 1—The pupal wing sheath is long, and the adult wing is spatulate (Fig. 16): Curculionidae: *Trachyphloeus* sp. (Otiorhynchinae, Trachyphloeini), *Nemocestes* sp. (Otiorhynchinae, Peritelini), *Graphognathus* sp. (Brachyderinae, Naupactini), *Epicauter aurifer* Boheman (Brachyderinae, Barynotini), *Calomycterus setarius* Roelofs (Eremninae, Cyphicerini), *Dyslobus alepidotus* Ting (Leptopiinae, Leptopiini); Carabidae: *Carabus nemoralis* Müller (Carabinae, Carabini). 2—The pupal wing sheath is short, and the adult wing is short (Fig. 17): Curculionidae: *Otiorhynchus sulcatus* (F.) and *O. ovatus* (L.) (Otiorhynchinae, Otiorhynchini). 3—The pupal wing sheath is short, and the adult wing is very short (Fig. 18): Curculionidae: *Premnotrypes solani* Pierce (Septopiinae, Premotrypini). 4—The pupal wing sheath is very short, and the adult wing is absent (Fig. 19): Curculionidae: *Pseudocneo-*



Figs. 15–20. Diagrammatic scheme of pupal wing sheaths of beetles, showing length of meso- and metathoracic adult wings and pupal sheaths; mesothoracic wings and sheaths long in all cases; metathoracic wings and sheaths. 15. Adult long, pupa long. 16. Adult short, pupa long. 17. Adult short, pupa short. 18. Adult very short, pupa short. 19. Adult absent, pupa very short. 20. Adult absent, pupa absent.

hinus bifasciatus Roelofs (Eremninae, Cyphicerini); Salpingidae: *Aegialites californicus* (Motsch.) (Aegialitinae). 5—The pupal wing sheath is absent, and the adult wing is absent (Fig. 20); Curculionidae: *Brachycerus albidentatus* Gyll. (Brachycerinae, Brachycerini). Again, the sample is small, but some speculations on the occurrence of short or absent pupal wing sheaths are possible. In the Ptinidae described by Smith (1964) and in the Tenebrionidae and many of the other groups described by me, the short or absent pupal wing sheath occurs in those subfamilies or tribes in which brachyptery or winglessness is very widespread or total, as in the Gibbinae of the Ptinidae and in the Eleodini and Asidini of the Tenebrionidae. On the other hand, the long pupal wing sheath and brachyptery occur in those subfamilies or tribes in which brachyptery is infrequent, such as the Tenebrionini (*Centronopus*) and Meracanthini of the Tenebrionidae and the Carabini of the Carabidae.

Thus, if the adult beetle is brachypterous or wingless, one might predict from the length of the pupal wing sheath the approximate frequency of brachyptery or winglessness in the group to which the species belongs. More succinctly, in the case of wingless adults, a short or absent wing sheath indicates widespread winglessness in the higher group, such as tribe or subfamily, and a long pupal sheath indicates occasional winglessness. Briefly, in a brachypterous or apterous species the length of the pupal wing sheath is correlated with the frequency of winglessness within the higher taxa.

How does this phenomenon exhibit itself, if at all, in other kinds of winglessness? In beetles the tribe Necydalini of the Cerambycidae is a good starting point; adults of this tribe, like those of the Staphylinidae, have the elytra very short and the wings long. The pupa of *Ulochaetes leoninus*

LeConte has short elytral sheaths. This is not surprising, for the adult characteristic of short elytra is found throughout the tribe.

Intraspecific wing polymorphism was considered; I had only two kinds before me. The first concerns the caste system of ants, wherein most species have winged adult sexual forms and completely wingless adult workers. Pupae of both castes of *Camponotus conspicuus* (F. Smith) (Formicidae) were examined; the sexual form had two pairs of fully developed wing sheaths and the worker had absolutely no wing sheaths. This was to be expected because this kind of winglessness is widespread in ants. The second type concerns both sexual and temporal wing polymorphism. In the caddisfly *Dolophilodes distinctus* (Walker) (Philopotamidae) females that emerge in winter and spring are almost wingless, having both pairs of wings very small or atrophied. Females in other parts of the year, like males throughout the year, are fully winged. The pupae of winter and spring females have both pairs of wing sheaths almost as long as those of fully winged forms; inside these wing sheaths can be seen the very small adult wings. This condition in the pupa is as expected: temporal adult polymorphism, evidently an exception to the rule, has not greatly altered the pupal wing sheaths.

One might reason that a species having a brachypterous adult and a pupa with short wing sheaths is more efficient than a species having a brachypterous adult and a pupa with long wing sheaths. The development of a long wing in the pupa and then its subsequent degeneration into a short wing seems to be inefficient. The extra energy needed to form the unnecessary long wing and long sheath is wasted. It therefore seems obvious that selection would favor short pupal wing sheaths in a brachypterous species. If a taxon had evolved from the fully winged adult condition to the brachypterous or wingless condition far in the past, it would have had time to eliminate the development-degeneration phase of the adult wing in the pupal stage and to eliminate the long pupal sheath. If, on the other hand, a taxon had evolved from the fully winged condition to the brachypterous or wingless condition rather recently, it would not have had time to eliminate the development-degeneration phase of the adult wing in the pupal stage and would retain the long pupal sheath.

The above is only a preliminary investigation. Many other forms of winglessness in the Holometabola should be studied. Perhaps such studies could indicate whether or not a wingless condition was developed recently or far in the past. Other reduced or absent appendages or structures in insects should be observed in the pupal stage. The four-footed butterflies (Nymphalidae) come to mind; the prothoracic legs of the adult are much reduced. I'm sure many other possible fields of investigation could be suggested by other systematists and morphologists. In addition, we need to know the

effect on the pupa of genetic manipulation, such as that done on *Drosophila* and *Tribolium*. Finally, it follows that an investigation into the genetic control of pupal wing sheath and adult wing development is needed; is it governed by a single gene working in a simple Mendelian fashion, or how?

ACKNOWLEDGMENTS

I thank John F. Lawrence of the Museum of Comparative Zoology for allowing me to study specimens of *Centronopus suppressus*. Many of my Washington colleagues have helped with the wing development study, especially O. S. Flint, Jr., D. R. Smith, R. E. Warner-Spilman, and most especially T. L. Erwin and D. R. Whitehead. D. S. Smith of the University of Miami (Florida) and J. T. Doyen of the University of California (Berkeley) were very helpful in reading my manuscript. Nevertheless, all errors of fact, judgement, or opinion are to be credited me.

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STUDIES OF NEOTROPICAL CADDISFLIES, XXIV.
THE GENUS *MACRONEMA* IN MESOAMERICA
(TRICHOPTERA: HYDROPSYCHIDAE)

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Abstract.—Five species of *Macronema* are reported from Mexico and Central America. Three, *M. burmeisteri* Banks, *M. chalybeoides* Ulmer, and *M. ulmeri* Banks were previously known; but two, *M. luteipenne* and *M. variipenne* are described as new. Distributions and illustrations of the genitalia and wings are given. The Neotropical species of the genus *Macronema* are divided into the *hyalinum* and *percitans* groups.

The genus *Macronema* as presently defined is almost worldwide in distribution. Only the Holarctic Region of Europe and Asia appears to be without any representatives of the genus. Southern Africa, Sundaland, and South America, however, appear to be centers of diversity.

Mexico and Central America do not have either a very large nor diverse fauna in comparison to South America, although it is distinctly more diverse than is the North American fauna. Up to now five species, of which two are herein described as new, have been taken in this area, as compared to three in eastern North America, two in the Greater Antilles, and over three dozen in South America. Two of the Mesoamerican species, *M. ulmeri* and *M. burmeisteri*, appear to be broadly distributed in northern South America, reaching their northernmost limits in southern Central America. The two new species, *M. variipenne* and *M. luteipenne*, appear to be primarily Mesoamerican species, being distributed from Mexico south throughout Central America and into northern South America. The fifth species, *M. chalybeoides*, is known only from a single old collection made in Cuernavaca, Mexico; and thus it may be either narrowly endemic or perhaps follow all or part of the pattern of the last two species.

Adults of the species herein treated only rarely come to lights at night, and most of those that do so are females or teneral specimens. They are

most frequently found on sunny days, resting on foliage over the stream or flying in small groups in the bright sunlight.

We have neither taken nor seen any larvae from Mesoamerica that are assuredly of this genus. We do have a few unassociated larvae of the type described by Marlier (1964:122) under the name *Centromacronema*. However, since there is still no firm association between larval and adult stages for these larvae, there is always the slight chance that these are in fact larvae of species in the *percitans* group of *Macronema*. The larvae of *M. ulmeri* were described by Marlier (1964:136) under the name *M. siolii*. These are typical *Macronema* larvae with a carina around the front of the head. *Macronema ulmeri*, however, belongs to a very distinct section of the genus; and the larvae may appear quite different from larvae of the *percitans* group.

The material here reported upon is from many collections, abbreviated as follows: AMNH—American Museum of Natural History, New York; BM—British Museum (Natural History), London; MCZ—Museum of Comparative Zoology, Cambridge; NMW—Naturhistorisches Museum Wien, Vienna; UCR—University of California, Riverside; UM—University of Michigan, Ann Arbor; UNAM—Universidad Nacional Autonomia de Mexico, Mexico City; and USNM—National Museum of Natural History, Washington, D.C.

KEY TO SPECIES OF *MACRONEMA*

1. Forewing membrane with a strongly contrasting pattern of dark brown and hyaline *ulmeri* Banks
- Forewing without a strongly contrasting pattern in membrane, colors generally due to scales 2
2. Forewing unicolorous fuscous; head orange *chalybeoides* Ulmer
- Forewing generally with a pattern of marking in apical $\frac{1}{2}$, or, if unicolorous, pale golden; head brown or yellow brown with green and silver hairs 3
3. Forewing brown with a transverse whitish band apically
..... *burmeisteri* Banks
- Forewing either almost unicolorous pale golden, or with basal $\frac{1}{2}$ green with apex mottled brown and gold 4
4. Male aedeagus with apicolateral processes borne from near ventral margin and pointed apically; forewing generally with apex strongly maculate and contrasting with green base, rarely uniformly golden *variipenne*, new species
Male aedeagus with apicolateral process borne from near center, rounded apically; forewings with apex only indistinctly maculate and not contrasting with golden basal region *luteipenne*, new species

The *hyalinum* Group

There is a group of species, here called the *hyalinum* group, which are united by the coloration of the forewings and general form of the male genitalia. The coloration of the forewings is due primarily to the strongly contrasting pattern in the wing membrane, and this pattern is rather generally spread over the entire wings rather than limited to the apical half. The male genitalia, of those species whose genitalia are known, tend to be very similar, with a two-segmented clasper, elongate, simple, tenth tergum, and elongate, simple, apically bulbous aedeagus.

To this group the following species belong: *Macronema arcuatum* Erich., *M. braueri* Bks., *M. erichsoni* Bks., *M. hyalinum* (Pict.), *M. maculatum* Perty, *M. negrense* Flint, *M. santaeritae* Ulm., *M. surinamense* Flint, *M. tuberosum* Ulm., *M. ulmeri* Bks., and possibly others too imperfectly known to place with certainty. The majority of species in other regions of the world (certainly the three from eastern North America) appear to belong to this group.

Macronema ulmeri Banks

Figs. 1, 2, 22

Macronema hyalinum Pict., var. Ulmer, 1907b:76; 1913:395. Martynov, 1912:20.

Macronema ulmeri Banks, 1913:237. Fischer, 1963:199. Flint, 1967:11; 1974:107; 1978:388.

Macronema siolii Marlier, 1964:136. Flint, 1978:388.

This is a widespread species throughout southern Central America and northern South America. It was recorded by Flint (1978) from Honduras, Costa Rica, and Panama without detailed locality, as well as from Colombia, Ecuador, Peru, Venezuela, Surinam, and Brazil.

The immature stages were described by Marlier (1964) under the name *M. siolii* Marlier.

Material.—HONDURAS, ATLANTIDA: Tela, Dakota Farm, 19 May 1923, T. H. Hubbell, 1 ♀ (UM). COSTA RICA: Pedregoso (Prov. unknown), Feb., 2100 ft, D. L. Rounds, 1 ♀ (MCZ). PUNTARENAS: Esquinas near Golfito, P. & D. Allen, 1 ♀ (MCZ). LIMON: Guapiles, 6 July 67, M. J. Westfall, 3 ♂ (USNM). PANAMA: BOCAS DEL TORO: Rio Changena, 2400 ft, 16 & 20 Sept. 1961, G. B. Fairchild, 2 ♂ (MCZ & USNM). CHIRIQUI: Volcan de Chiriqui, 25–4000 ft, Champion, 7 ♂ (BM & MCZ). COCLE: El Valle, 20 May, G. B. Fairchild, 1 ♂ (MCZ). CANAL ZONE: Barro Colorado Island, 7 Jan. 1929, C. H. Curran, 1 ♂ (AMNH); same, but 18 Jan. 1935, M. Bates, 1 ♂ (MCZ); same, but 12 Mar. 1967, M. E. Irwin, ♂♂, ♀♀ (UCR & USNM); same, but 23 July 1924, N. Banks, 1 ♀ (MCZ).



Fig. 1. Partial distribution of *Macromesia ulmeri*.

The *percitans* Group

The second major grouping of Neotropical *Macromesia* species is hereby called the *percitans* group. In this group the head and thorax dorsally and the basal half or two-thirds of the forewing are covered by small emerald green scales, which region is usually bounded laterally by a band of silvery-white scales. On the forewing the green basal area is bounded outwardly by a band of contrasting color with the apex variously mottled. All of this coloration is due basically to small scales or hairs, with only a minor contribution from the underlying membrane. In this group the male genitalia are quite varied; but the claspers appear to be undivided, the tenth tergum is shorter and often bears lobes and process, as does the apex of the aedeagus.

To this group belong *M. argentinatum* Ulm., *M. burmeisteri* Bks., *M. exophthalmum* Flint, *M. fragile* Bks., *M. gundlachi* Bks., *M. hageni* Bks., *M. lachlani* Bks., *M. matthewsi* Flint, *M. muelleri* Bks., *M. pennyi* Flint, *M. percitans* Walk., *M. pertyi* Bks., *M. picteli* Bks., *M. reinburgi* Nav., and the two new species described herein, *M. variipenne* and *M. luteipenne*.

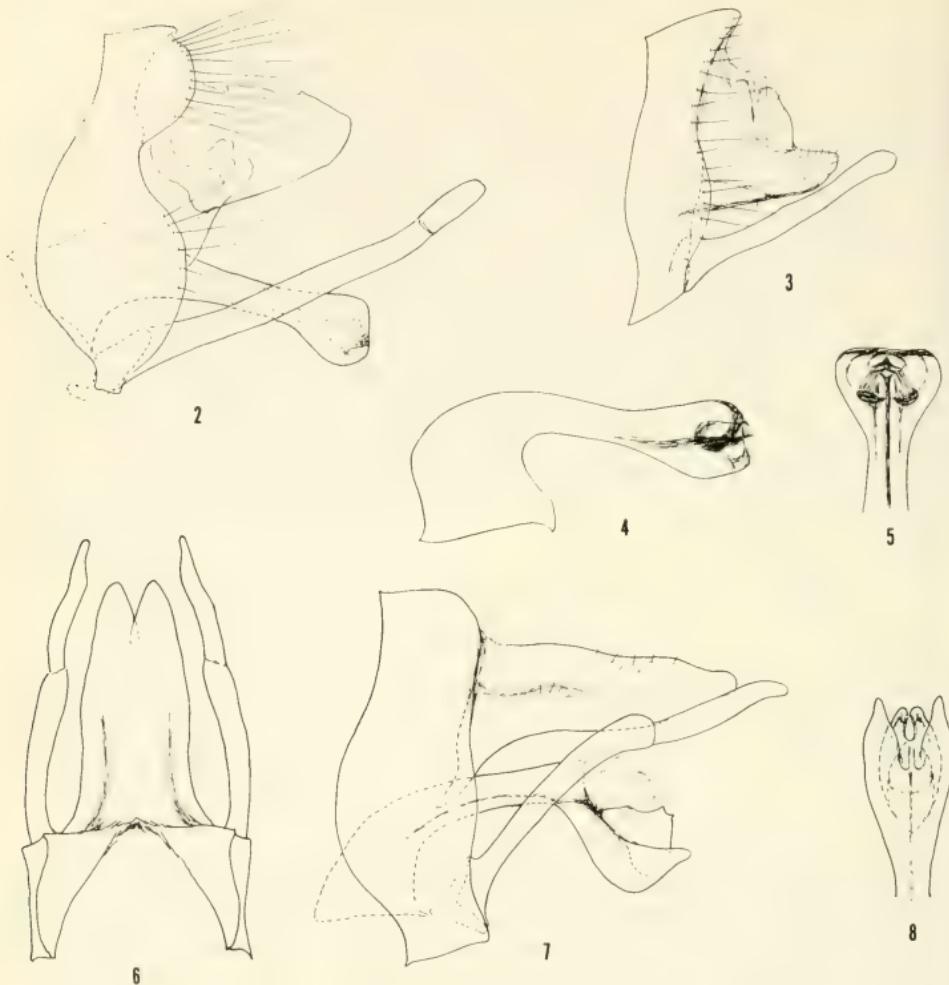


Fig. 2. *Maconema ulmeri*, male genitalia, lateral. Figs. 3-5. *Macronema burmeisteri*. 3, Male genitalia, lateral. 4, Aedeagus, lateral. 5, Tip of aedeagus, dorsal. Figs. 6-8. *Macronema chalybeoides*. 6, Male genitalia, dorsal. 7, Same, lateral. 8, Tip of aedeagus, ventral.

M. amazonense Flint, *M. bifidum* Flint, *M. fraternum* Bks., and *M. paliferum* Flint appear to form a well defined subgroup of the *percitans* group as noted previously (Flint 1978:403). In addition there are a number of other species that will probably have to be placed here when they are better known. In contrast to the *hyalinum* group which appears to have representatives in other regions of the world, there does not appear to be any certain representatives of this group outside of the Neotropical Region.



Fig. 9. Partial distribution of *Macromesia burmeisteri*.

Macromesia burmeisteri Banks

Figs. 3-5, 9, 23

Macromesia burmeisteri Banks, 1924:452. Fischer, 1963:178. Flint, 1967:9; 1978:393.

Macromesia burmeisteri is known from Brazil, Ecuador, and Peru. However, we are identifying these few specimens from Central America as *M. burmeisteri*, albeit with some hesitation. The typical *M. burmeisteri* from the Amazon Basin has more darkly colored forewings with the subterminal band a bright golden yellow. These examples have the basal region of the forewing shading from paler to darker brown at the pale subterminal band which is stramineous in color. However, the pattern of spots along the costal margin and the male genitalia apparently are identical in all examples. The photo of the wings and drawing of the male genitalia are from the Panamanian male.

Material.—NICARAGUA, CHONTALES: Puente Quinama, east of Villa Somoza, 29 July 1967, O. S. Flint, Jr., 1 ♂ (USNM). PANAMA, PANAMA: La Chorrera, May 12, August Busck, 1 ♂, 1 ♀ (USNM).



Fig. 10. Distribution of *Macronema variipenne*.

Macronema variipenne Flint and Bueno, NEW SPECIES

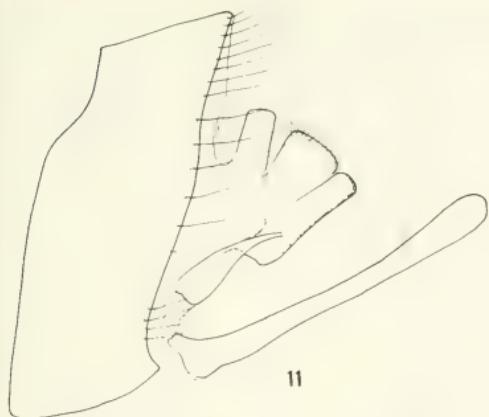
Figs. 10, 11-15, 24-27

Macronema fulvum Ulmer, 1905a:80 (in part, example from Chiriquí).

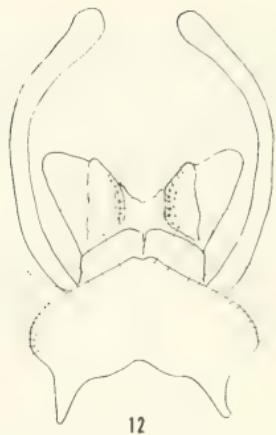
Macronema percitans Walker: Ulmer, 1907b:74 (in part, examples from Chiriquí).

This species is widespread, but seldom abundant, from northeastern Mexico, south through Panama, apparently as far as Ecuador. The coloration of the species is, however, very variable, not only in degree of contrast between the markings, but also between sexes. The material from the Canal Zone is the palest from Central America. However, the Ecuadorian example is totally yellow without pattern and is inseparable by color from *M. luteipenne*.

Figs. 11-15. *Macronema variipenne*. 11, Male genitalia, lateral. 12, Same, dorsal. 13, Tip of aedeagus, lateral. 14, Same, dorsal. 15, Same, ventral. Figs. 16-20. *Macronema luteipenne*. 16, Tip of aedeagus, lateral. 17, Same, dorsal. 18, Same, ventral. 19, Male genitalia, lateral. 20, Same, dorsal.



11



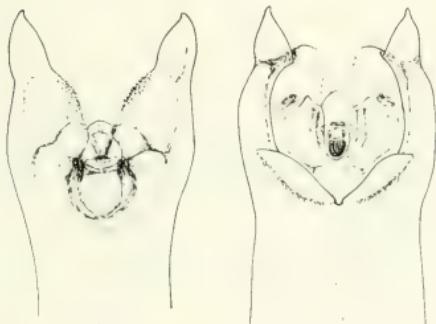
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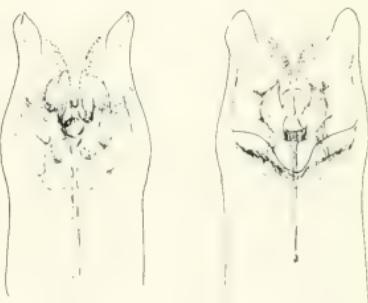


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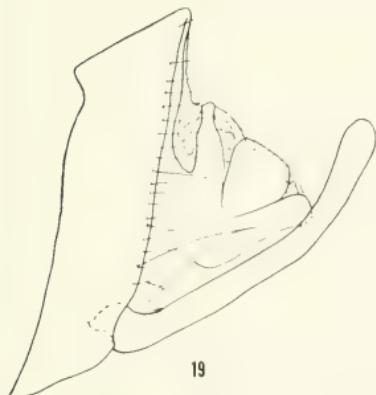
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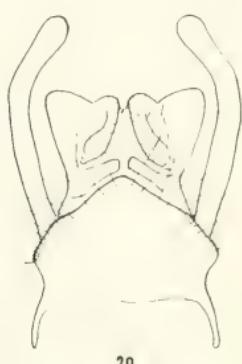


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19



20



Fig. 21. Distribution of *Macromesma luteipenne* and *M. chalybeoides*.

penne. In general, the color of *M. variipenne* is darker and with sharper contrasts than the color of *M. luteipenne*.

The definitive differences between the two species lie in the male genitalia, specifically the aedeagus. In *M. variipenne* the lateroventral processes are borne from the ventral half of the tip and are distinctly pointed. In *M. luteipenne* these lobes are more nearly from the middle of the apex and are rounded apically.

Adult.—Length of forewing, 13–14 mm (male), 11–13 mm (female). Eyes of male small, about $\frac{1}{3}$ width of dorsal interocular distance. Maxillary palpi very long, 5th segment longer than basal 4 segments. Head, thorax, and abdomen brown, appendages pale brown; with a band of silver scales lat-

Figs. 22–28. Wings. 22, *Macromesma ulmeri*, Bocas del Toro, Panama. 23, *M. burmeisteri*, La Chorrera, Panama. 24, *M. variipenne*, holotype. 25, *M. variipenne*, ♀ topotype. 26, *M. variipenne*, Cerro Azul, Panama. 27, *M. variipenne*, Latacunga, Ecuador. 28, *M. luteipenne*, Villa Colon, Costa Rica.



22



23



24



25



26



27



28

erally on head, pronotum, mesonotum, dorsomesally on scape, and in costal cell of forewing to stigma; basal $\frac{2}{3}$ of forewing, and central area of head and thorax covered with small emerald-green scales, beyond which wing bears a narrow transverse white line, bordered outwardly by brown and gold mottled with white spots, apical brown area with a central white or golden spot of variable size (larger in male than female), with a small crescentic white spot on apical margin. Fifth sternum with an elongate antero-lateral boss. *Male genitalia:* Ninth segment annular, produced posterodorsally. Tenth tergum heavily sclerotized ventrolaterally with a narrow erect sclerotized band basad, and a rounded lobe apicad. Clasper terete, apical segment not differentiated, in ventral aspect almost semicircular. Aedeagus short, with basal $\frac{1}{2}$ at right angles to stem; apex with a rounded spiculate lobe posteriorly, developed into a lateroventral process with a distinct apicodorsal angle, open posteroventrally with a complex of inner sclerites and structures.

Material.—*Holotype ♂:* MEXICO, SAN LUIS POTOSI, near Huichihuayan (Rt. 85, km 399, 25 mi N of Tamazunchale), 7 Aug. 1966, O. S. Flint, Jr. USNM Type No. 76174. *Paratypes:* Same, but 3–4 Aug. 1963, Duckworth & Davis, 2 ♀ (USNM). VERACRUZ: Rio Tacolapan (Rt. 180, km 551), 25–26 July 1966, Flint & Ortiz, 1 ♂, 2 ♀ (USNM); La Palma (near Sontecomapan), Los Tuxtlas, 5 Dec. 1975, C. M. & O. S. Flint, Jr., 1 ♀ (USNM); same, but 19 July 1977, J. Bueno, 1 ♂ (UNAM); Laguna Escondida (near Sontecomapan), Los Tuxtlas, 5 Dec. 1975, C. M. & O. S. Flint, Jr., 1 ♂ (USNM). OAXACA: Uxpanapan, 29 Sept. 1977, J. Bueno, 2 ♂, 1 ♀ (UNAM). CHIAPAS: Rio Chacamax, Palenque, 6 Dec. 1975, C. M. & O. S. Flint, Jr., 1 ♀ (USNM). NICARAGUA, CHONTALES: Puente Quinama, E. Villa Somosa, 29 July 1967, O. S. Flint, Jr., 1 ♀ (USNM). PANAMA, CANAL ZONE: Rio Agua Salud, Navy Reserve (Pipeline Road), 30 Mar. 1965, S. S. & W. D. Duckworth, 5 ♂, 4 ♀ (USNM); same, but 8–12 July 1967, Flint & Ortiz, 2 ♂, 3 ♀ (USNM); Barro Colorado Island, 20–23 May 1964, S. S. & W. D. Duckworth, 1 ♀ (USNM). PANAMA: Cerro Azul, 7 July 1967, Flint & Ortiz, 4 ♂, 4 ♀ (USNM). ECUADOR, COTOPAXI: 133 km W Latacunga, 1080 ft, 2 July 1975, Langley & Cohen, 1 ♂ (USNM).

Macronema luteipenne Flint and Bueno, NEW SPECIES
Figs. 16–20, 21, 28

This species, which is very closely related to the preceding *M. variipenne*, appears to have a range more restricted to southern Central America. It seems to be more closely restricted to the Pacific Coast area of deciduous scrub forest, whereas *M. variipenne* is usually taken in wetter evergreen forest regions.

Macronema luteipenne is much paler than the average specimen of *M.*

variipenne, although a few examples of the latter are as pale as any *M. luteipenne*. The shape of the apicolateral processes of the aedeagus offers the only certain distinction between the two, these being rounded apically and borne from near the middle of the tip in *M. luteipenne*.

Adult.—Length of forewing, 12–14 mm (male), 10–12 mm (female). Eyes of male small, about $\frac{1}{3}$ width of dorsal interocular distance. Maxillary palpi very long, 5th segment longer than 4 basal segments. Head, thorax, and abdomen brown, appendages pale brown, with a band of silver scales laterally on head, pronotum, mesonotum, dorsomesally on scape, and in costal cell to stigma; basal $\frac{2}{3}$ of forewing golden brown with scattered emerald-green scales, beyond which the wing is very indistinctly mottled with lighter and paler shades of golden brown. Fifth sternum with a small elongate, dorsolateral boss. *Male genitalia*: Ninth segment annular, produced posterodorsally. Tenth tergum heavily sclerotized ventrolaterally with a narrow erect sclerotized band basad, and a rounded lobe apicad. Clasper terete, apical segment not differentiated, in ventral aspect almost semicircular. Aedeagus short, with basal $\frac{1}{2}$ at right angles to stem; apex produced into rounded lateral lobes, spiculate dorsomesally, open posteroventrally with a complex of inner sclerites and structures.

Material.—*Holotype* ♂: PANAMA, CANAL ZONE, Rio Agua Salud, Navy Reserve (Pipeline Road), 8–12 July 1967, Flint & Ortiz. USNM Type 76175. *Paratypes*: Same data, 4 ♂ (USNM). MEXICO, CHIAPAS: Arriaga, 22 Aug. 1965, P. J. Spangler, 2 ♂ (USNM); near Tonala (Rt. 200, km 46), 9 June 1967, Flint & Ortiz, 1 ♀ (USNM). COSTA RICA, GUANACASIE: Bagaces, Rio de las Piedras, 27 July 1967, O. S. Flint, Jr., 13 ♂ (USNM); Las Canas, Rio Corobici, 26 July 1967, O. S. Flint, Jr., 5 ♂, 3 ♀ (USNM); 10 mi NW Liberia, 25 July 1965, P. J. Spangler, 1 ♀ (USNM); 1.5 mi S Potrerillos, 27 July 1967, O. S. Flint, Jr., 1 ♀ (USNM); Arenal, Quebrada Tronadorecita, 24 July 1967, O. S. Flint, Jr., 4 ♀ (USNM). PUNTARENAS: Pacuare, Rio General, 1 July 1967, Flint & Ortiz, 6 ♀ (USNM); Villa Colon, 16 mi S Palmar Sur, 3 July 1967, O. S. Flint, Jr., 1 ♂ (USNM); Palmar, P. & D. Allen, 1 ♂ (MCZ). Pedregoso (Prov. unknown), 1200 ft., Feb., D. E. Rounds, 9 ♂, 2 ♀ (MCZ). PANAMA, CHIRIQUI: Lino, Fassl, 1 ♀ (MCZ).

Macronema of Unplaced Grouping

The following species, *M. chalybeoides* Ulm., is quite unusual in both appearance and genitalia. The apparently unmarked dark wings and rather peculiar form of the genitalia are quite different from either group proposed previously. In the sum of its characteristics it would seem to be closer to the *hyalinum* group than the *percitans* group, but it is left unplaced at this point.

Macronema chalybeoides Ulmer

Figs. 6-8, 21

Macronema chalybeum (Ulmer nec Hagen): Ulmer, 1905b:83; 1907a:164; 1907b:81; 1913:408.*Macronema chalybeoides* Ulmer, 1951:202, 349. Fischer, 1972:158.

For a long time this species was identified as *Macronema chalybeum* Hagen from Cuba. However, recent studies have shown that Hagen's species is a true *Phylloicus* (Ross, 1952; Flint, 1967). Recognizing this fact, Ulmer (1951) proposed the name *chalybeoides* for the species of *Macronema* from Mexico that he had called *M. chalybeum* in earlier works.

The senior author has studied three of the eight reported specimens in the type-series of *M. chalybeoides*, located in the Vienna Museum. The most complete specimen is labelled LECTOTYPE, but the designation has not been published before. This is a reasonably complete example, lacking forelegs and hindwings, but with an abdomen which is now cleared and here illustrated. The descriptions by Ulmer (1905b; 1907b) are good, as are his figures of the venation.

This is a rather puzzling species. In general appearance it looks like a species of *Centromacronema*, but it does not have the enlarged spur apically on the foretibia, although it does have a short spine ventrally from the tibia. The genitalia are distinctly different from all other species of New World *Macronema*.

Material.—*Lectotype* ♂: "Mexico, Cuernavaca, 1871, Bilimek," "chalybeum det. Brauer," "chalybeum det. Ulmer," "Lectotype *Macronema chalybeoides* Uml. By Flint 1975" (NMW). *Paralectotypes*: Same, but lacking "Cuernavaca," 2 without abdomens: the series reportedly contains an additional 5 specimens, all in the Vienna Museum.

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EDITOR'S NOTE

I have been associated with the *Proceedings* for five years, the last three as Editor. I am tempted to give several suggestions to authors, reviewers, etc.; but I have decided to refrain from such a self-serving undertaking. I will remind contributors that illustrations are kept for one year after they are published. The stack of illustrations in my office will be discarded on December 1, 1979, unless claimed.

To the staff of the Systematic Entomology Laboratory, HBII, AR, SEA, USDA, my sincere appreciation for your help, support, understanding, and tolerance during my tenure as Editor. To the staff of Allen Press, Inc., thank you for the help and patience you have shown a novice. To the ESW Publication Committees of 1977, 1978, and 1979, thank you for your ideas and comments on various manuscripts and editorial matters. To the many reviewers who have given unselfishly of their time in order to improve the *Proceedings*, my gratitude. To authors who have submitted manuscripts for publication in the *Proceedings*, I am beholden for copy to fill the issues and from many hours of interesting reading on subjects I might not have otherwise considered. To those authors who have not agreed with nor accepted my decisions and/or actions on their manuscripts, I wish for you the possibility of serving as gratis editors, in your spare time. To those authors who have written to me to express their appreciation for my help with their manuscripts or their delight with the printed product, I am much obliged. Last but most important, to the members of the Entomological Society of Washington, I will be forever grateful for the opportunity to serve the Society.

Dux femina facti!

Manya B. Stoetzel
Editor
September 11, 1979

**HYDRAMARA ARGENTINA, A DESCRIPTION OF ITS
LARVA AND A REPORT ON ITS DISTRIBUTION
(COLEOPTERA: HYDROPHILIDAE)**

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20560.

Abstract.—The larva of the water scavenger beetle, *Hydramara argentina* (Knisch), is described, illustrated, and interpolated into the most recent key to hydrophilid larvae. The habitat of the adult and larva is noted, distribution data are listed, and the known range of the species is depicted on a map.

This species was described as *Hydrobius (Hydramara) argentina* by Knisch (1925) because it had some characters in common with members of the genus *Hydrobius*. However, it differed enough from *Hydrobius* that Knisch created a new subgenus, *Hydramara*, for it. D'Orchymont (1942) raised *Hydramara* to generic status, which it warrants both on adult and larval characters. The genus is presently known only from the single included species, *Hydramara argentina*. The adult is a large, distinctive hydrobiine hydrophilid which was described from seven specimens from Argentina (Mendoza Province; Punta del Agua and Tala).

Hydramara argentina is now known to occur in the provinces of Catamarca, Cordoba, Mendoza, San Luis, Salta, and Tucuman. The three adults and one larva in the National Museum of Natural History, Smithsonian Institution were collected in small montane streams by Dr. Oliver S. Flint, Jr., in October 1973. He found the specimens incidentally as he turned over rocks, driftwood, and similar debris in his search for larvae of Trichoptera.

Although I have had the larva, which I am confident is that of *H. argentina*, for almost six years, I deferred its description hoping that I could collect more larvae and confirm the identity by rearing. However, during recent fieldwork in southcentral Chile (Osorno Province) I failed to find *H. argentina* in mountain streams where I had hoped to find it. Instead, I was delighted to find an adult, larva, and pupa of an undescribed hydrobiine genus (Spangler, *in press*). Because I did not find additional specimens of *H. argentina*, I decided to describe the larva without further delay to help

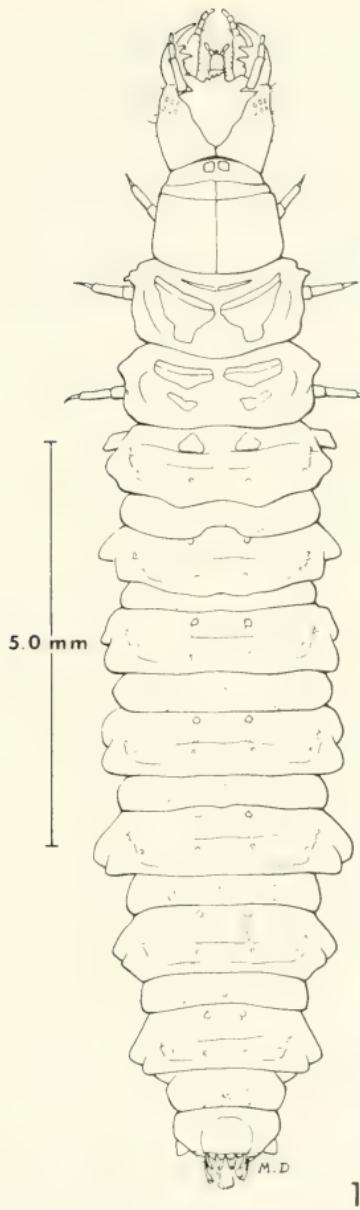
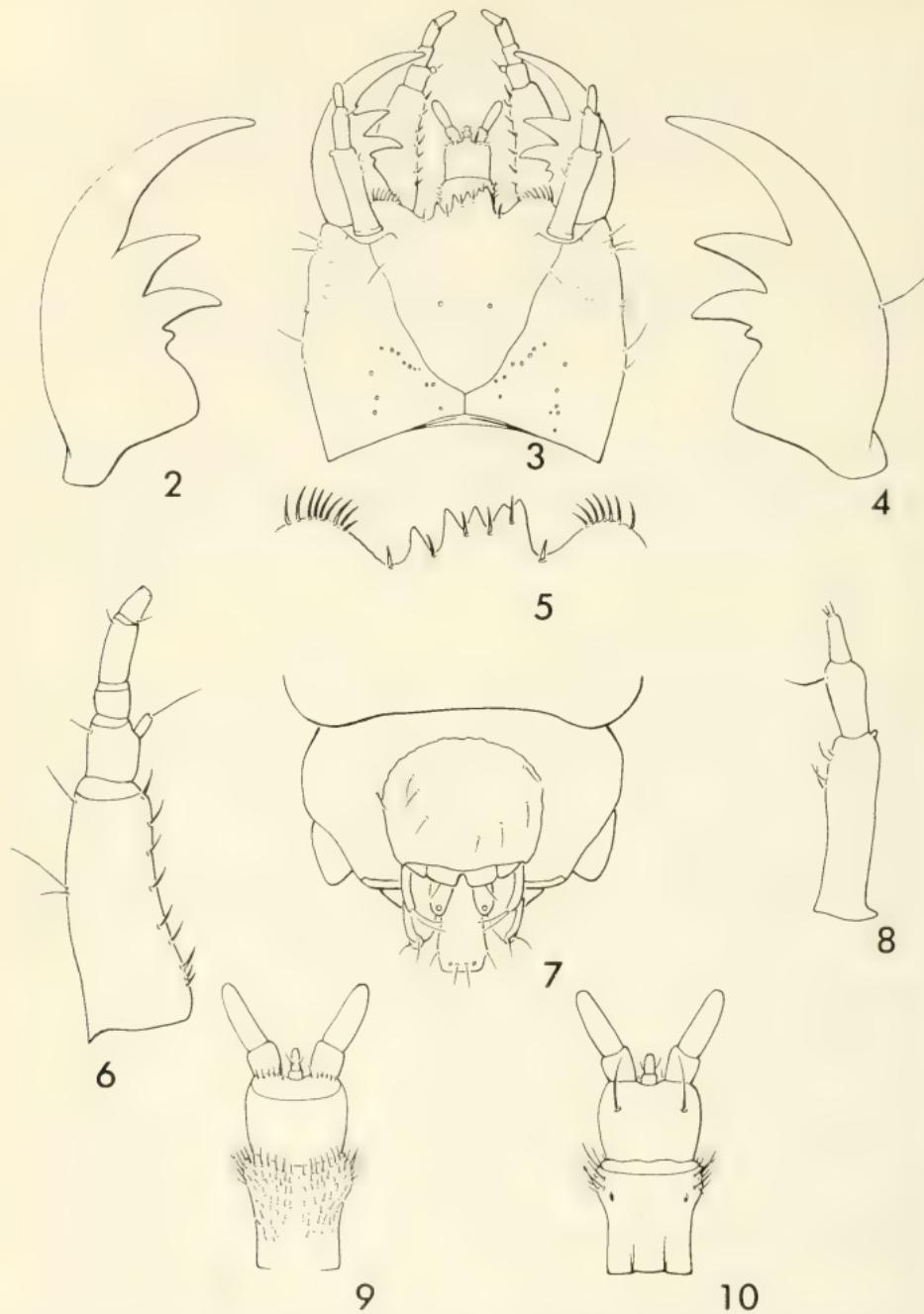


Fig. 1. *Hydramara argentina*, habitus view.

increase our knowledge of the poorly known larvae of the South American hydrophilid genera. Presently, larvae of 24 of the 40 known South American genera of hydrophilids remain to be described.

The larva described below has been identified by the elimination of known



Figs. 2-10. *Hydramara argentina*. 2, Left mandible, dv. 3, Head, dv. 4, Right mandible, dv. 5, Labroclypeus, dv. 6, Left maxilla, dv. 7, Stigmatic atrium, dv. 8, Antenna, dv. 9, Labium, dv. 10, Labium, vv. (dv = dorsal view; vv = ventral view.)



Fig. 11. *Hydramara argentina*, known distribution.

larvae of known genera, by its presence in the same biotopes as the adults of *H. argentina*, by the rarity of other hydrophilids in similar lotic habitats in Argentina, by the large size of the adults and the larva, and by its larval characters which place it near *Hydrobius* and related hydrobiine hydrophilids.

Larva of *Hydramara argentina* (Knisch) Figs. 1-11

Body elongate (Fig. 1). Total length, 13.5 mm; width of prothorax 1.3 mm. Color of integument light creamy yellow. Sclerotized head capsule, thoracic and abdominal sclerites, spiracles, legs, abdominal tubercles, and spiracular atrium testaceous. Integument covered dorsally with fine, whitish, branchialike setae; integument of abdominal segments with coarser, longer, testaceous setae interspersed among regularly arranged patches of short dark asperities.

Head (Fig. 3) quadrangular; 1.5 mm wide, 1.0 mm from labroclypeus to occipital foramen. Frontoclypeal suture feebly indicated. Frontal sutures united near base of head forming an epicranial suture. Frons sagittate. Cer-

vical sclerites present, slightly trapezoidal. Ventral surface of head glabrous except 5 setae laterally at about midlength; 1 seta laterally near base of mandible, and 3 setae at midlength on each side of midline; with 2 deep, posterior tentorial pits medially, a short distance behind gula.

Labroclypeus (Fig. 5) prominent, asymmetrical. With 5 large, medial teeth; left tooth shortest and separated more widely from other four. Teeth of labroclypeus progressively longer from left to right side of head; each tooth separated from the next tooth by a stout yellow seta. Anterolateral projections of epistoma as long as shortest (left) tooth; both projections rounded anteriorly, each bearing 10 large, stout yellow setae apically.

Ocular areas each with 6 distinct ocelli arranged in an ellipse; anterior 3 ocelli slightly larger and closer together; posterior 3 ocelli smaller, ventrolateral one smallest and separated from posterior two.

Antenna (Fig. 8) moderately short, cylindrical, extending to base of 1st segment of maxillary palpus; 1st segment longest, $2\times$ as long as penultimate segment; penultimate segment with small apicolateral tubercle and 2 long slender apicomедial setae; ultimate segment slender, parallel sided, about $\frac{1}{2}$ as long as penultimate, bearing a slender distal seta and a minute apicolateral appendage.

Mandible (Figs. 2, 4) symmetrical, prominent, stout, sharply pointed apically; each with 2 large well-defined medial and 1 small, basal inner teeth; molar area rounded.

Maxilla (Fig. 6) with stipes stout, elongate, tapering distally, bearing a row of 7 stout setae on inner margin and 3 long slender yellow setae laterally and 3 more ventrolaterally before midlength. Palpifer segmentlike; with slender sclerotized appendage on apicomедial angle about $\frac{1}{3}$ as long as palpifer; bearing 1 long apical seta ventrolaterally; appendage of palpifer bearing an apical seta. Palpus tapering distally; 1st segment short, slightly more than $\frac{1}{2}$ as long as palpifer; penultimate segment longest, slightly more than $2\times$ as long as basal segment, bearing 1 long slender lateral seta at about apical $\frac{1}{3}$; ultimate segment conical, about $\frac{1}{2}$ as long as penultimate segment.

Labium (Figs. 9, 10) extending about to midlength of stipes. Penultimate segment of palpus short and broad; ultimate segment $3\times$ as long as penultimate segment. Ligula distinct, short, about $\frac{3}{4}$ as long as basal segment of labial palpus, bearing a long basal seta at each lateral corner dorsally. Mentum quadrangular, glabrous dorsally except numerous setae apically on membranous area; ventrally glabrous except apicolateral corners each with 1 long seta. Submentum apically slightly wider than mentum, narrowed medially, wide posteriorly, dorsal surface spinose; with numerous long stout setae apicolaterally; ventral surface glabrous except long apicolateral setae.

Gula pentagonal, rounded posteromedially.

Prothorax with sides nearly straight but diverging posteriorly; postero-

lateral angles broadly rounded, with a few short setae; anterolateral angles each with a few long setae and a few short setae; sagittal line present. Prosternal sclerite large, subrectangular, with no indication of sagittal line.

Mesothorax wider than prothorax and almost as long (measured on mid-line) as prothorax; with 2 very narrow, straplike, anterior sclerites and 2 large, subtriangular mesotergal sclerites; margins apicolaterally each with an elongated spiracular tubercle followed by a setiferous lobe; sagittal line present.

Metathorax slightly wider than and slightly shorter than mesothorax; anterior metatergal sclerites transverse, larger than posterior sclerites, and roughly elliptical; posterior sclerites small and narrow, each sclerite with a seta-bearing tubercle at each corner; sagittal line present.

Legs 4-segmented; procoxae large, separated by about length of a trochanter; trochanter about as long as femur (viewed ventrally); femur about as long as tibiotarsus; tarsal claw single, with two stout robust setae ventrally at basal $\frac{1}{3}$.

Abdomen of 8 distinct segments, 9th and 10th segments reduced; 1st abdominal segment with 2 moderately large anterior sclerites; remaining segments also with sclerites but each becoming increasingly smaller; terga similar to each other. True segmentation obscured by additional transverse folds on segments, segmented folds continued onto sternum. Each segment with 4 folds; anterior fold with 3 patches of asperities, 2nd fold with 2 patches of asperities, 3rd fold with 4 tubercles each surrounded with minute asperities and each with a long seta apically; 4th fold without patches of asperities or tubercles. A large spiracular tubercle present laterally between 2nd and 3rd folds on abdominal segments 1–7. Epipleurites and hypopleurites prominently lobed. Eighth tergum represented by superior valve of stigmatic atrium (Fig. 7), beneath which lies the 8th pair of abdominal spiracles. Ninth tergum trilobed; middle lobe large, with 4 short, stout setae, 1 seta on each side of median line on caudal margin, and 1 seta on apicolateral angles; lateral lobes smaller, about $\frac{2}{3}$ as wide as median lobe, each bearing 1 dorsal and 2 ventral setae on caudal margin.

The single larva described above came from: ARGENTINA, Salta Province, Cañada la Gotera, Rt. 59, km 23.5, 16–17 Oct. 1973, O. S. Flint, Jr., deposited in the National Museum of Natural History, Smithsonian Institution.

The larva of *Hydramara argentina* traces to *Hydrobius* in couplet 29 in Bertrand's (1972:264) generic key to hydrophilid larvae. However, *Hydramara* may be distinguished from *Hydrobius* by interpolating the following couplet there.

29a Ligula long, 2× as long as basal segment of labial palpus

- *Hydramara* Knisch
Ligula short, about $\frac{3}{4}$ as long as basal segment of labial palpus
..... *Hydrobius* Leach

KNOWN DISTRIBUTION

The description of the larva of *Hydramara argentina* above provided this opportunity to report the distribution data based on adults, as well as the larva, which I have accumulated during the past 10 years. It is obvious from the following data that the species is not common in collections. However, I believe this reflects a limited amount of collecting within the range of the species just as the concentration of records on the map (Fig. 11) in the Tucuman area reflects greater collecting activity by the entomological staff and visitors to the Instituto Miguel Lillo in Tucuman. The distribution data suggest that the species occurs primarily in montane habitats. In several instances, on old specimens, provinces only were given on specimen labels. In these cases, a question mark was used in the province to indicate a province record but without more specific locality indicated. Also, d'Orchymont (1942) reported a specimen of *Hydramara argentina* from Paraguay but I consider this record doubtful and, therefore, have not included it on the map. The 13 specimens seen are in the following institutions: Instituto Miguel Lillo, Tucuman, Argentina (IML); Museo de la Plata, La Plata, Argentina (MLP); and the U.S. National Museum of Natural History, Smithsonian Institution, Washington, D.C. (USNM). In addition, I have included the seven specimens Knisch mentioned when he described this taxon but I have not seen his type-material.

Specimens examined (13).—ARGENTINA: Catamarca: El Rodeo, 18–19 Oct. 1973, O. S. Flint, Jr., 1 (USNM). Cordoba: Apr. 1928, J. M. Bosq, 2 (MLP). Mendoza: Punta del Agua, and Tala, 7 (fide Knisch, 1925). Salta: Angastaco, 12 Oct. 1973, O. S. Flint, Jr., 1 (USNM); Cafayate, 1944, K. J. Hayward, 3 (IML); Cañada la Gotera, Rt. 59, km 23.5, 16–17 Oct. 1973, O. S. Flint, Jr., 1 larva (USNM); Depto. Rosario de la Frontera, El Morenillo, Mar. 1936, 1 (IML); La Zanja, west of Chicoana, 13 Oct. 1973, O. S. Flint, Jr., 1 (USNM). San Luis: Merlo, 24–27 Jan. 1958, Willink and Tomsic, 1 (IML). Tucuman: Horco Molle, 22 Dec. 1965, L. Strange, 1 (IML); Tipas, J. M. Bosq, 1 (MLP).

ACKNOWLEDGMENTS

I extend my thanks to my friend and colleague, Dr. Oliver S. Flint, Jr., for his collecting efforts on my behalf and especially for the adults and larva of *Hydramara argentina* which instigated the preparation of this article.

For financial assistance which contributed to this report, I am very grateful to the administrators of the Smithsonian Institution's Fluid Research

Fund for support to study types and other specimens in some European museums in 1966 and to the Smithsonian Research Foundation for Grant SG 063310 in 1969 for fieldwork and study in South American museums. Both grants contributed data which are included above.

I also thank Mr. Michael Druckenbrod, Smithsonian Institution staff artist, for preparing the line drawings of the larva.

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NOTES ON THE ETHOLOGY OF *EFFERIA ARGYROGASTER*
(DIPTERA: ASILIDAE) IN MEXICO^{1,2}

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Abstract.—The behaviors exhibited by *Efferia argyrogaster* (Macquart) in Mexico differed very slightly from those exhibited by other species of *Efferia*. Foraging efficiency was poor. Prey manipulation occurred occasionally while the asilid hovered above the feeding site. The list of recorded prey was dominated by Hymenoptera, which is unusual among *Efferia* species. Males exhibited simple undulating search flights for females, which resulted in the typical male atop female copulatory position when contact was made. Females deposited eggs in available niches in dead dry vegetation.

Efferia argyrogaster (Macquart), which was described in 1846 from specimens collected in Merida, State of Yucatan, Mexico, by M. Pilate, was originally assigned to the genus *Erax*. The only other reference to this species was a subsequent description based on a single male from Tehuantepec, Mexico, by Hine (1919), who suggested that *E. triton* and *E. argyrogaster* might be the same species. The specimens, upon which this paper is based were identified by Dr. Joseph Wilcox, 7551 Vista del Sol, Anaheim, California 92805, who is the leading taxonomist on the *Efferia* of the New World.

Nothing has been reported concerning the behavior of *E. argyrogaster*. The following observations were made during a five day stay (March 24-28, 1972) in the vicinity of Santa Cruz de la Solidad, State of Jalisco, Mexico, near Chapalla. The population studied was encountered in an abandoned rocky field, which had, at some previous time, been plowed and planted to maize (Fig. 1). The population appeared to be limited to the immediate area

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Fig. 1. Abandoned field habitat of *Efferia argyrogaster*, Santa Cruz de la Solidad, Mexico.

and the total number probably did not exceed 25 individuals. Population counts made on two different days provided a male to female sex ratio in percent, of about 40:60 on those days.

As with other species of *Efferia*, foraging efficiency of *E. argyrogaster* was poor. Individuals usually made several forage flights before successfully ensnaring prey. Prey were collected only from the air; and, in all cases where prey capture was observed, prey were already impaled on the asilid's proboscis when it landed. Most forage flights were 1.5–3 m in length, however a few were shorter, such as when a male took a spider in the act of jumping off a rock. Movement discrimination in this species seemed to be excellent, as evidenced by asilids turning to face birds flying overhead.

Once captured, prey were infrequently manipulated during the feeding process. The asilid would hover 2–5 cm above the substrate and manipulate the prey with all six tarsi. Prey could be manipulated as many as three times during a single feeding. This type of manipulation is typical of all *Efferia* which have been studied (Lavigne and Holland, 1969; Lavigne and Dennis, 1975; Dennis and Lavigne, 1976; Lavigne et al., 1976) and is probably a generic trait.

Most prey were relatively small, were not manipulated, and during feeding

would remain impaled on the predator's proboscis with no tarsal support. During feeding, the prey were commonly ballooned, as described for *Efferia helena* (Bromley) by Lavigne and Holland (1969).

Upon completion of feeding, prey were handled in much the same manner as that used by *Efferia benedicti* (Bromley) (Lavigne et al., 1976). In most cases, prey were dropped off the proboscis on site, presumably by a movement of the mouthparts. In one instance, however, the fore tarsi were used to accomplish this. On another occasion, a female flew out 2.5 cm from the feeding site, hovered, and dropped the prey; while in two other instances, asilids dropped the prey en route to new foraging sites.

In the following prey records, the sex of the predator is indicated in parentheses following the prey record.

Prey taken by *Efferia argyrogaster*: ARANEIDA: Unidentified, III-28-72 (♂). COLEOPTERA, Bruchidae: *Stator vachelliae* Bottimer, III-28-72 (♂); Chrysomelidae: *Babia tetraspilota* LeConte, III-25-72 (♀), III-26-72 (♀), III-27-72 (1 ♂, 1 ♀); Scarabaeidae: *Aphodius vittatus* Say, III-28-72 (♀). DIPTERA, Bombyliidae: *Poecilanthrax arethusa* (Osten Sacken), III-25-72 (♀); Muscidae: *Musca domestica* L., III-25-72 (♀), III-27-72 (1 ♂, 2 ♀); Tachinidae: *Acroglossa hesperidarum* (Williston), III-28-72 (♀); *Deopalpus hirsutus* Townsend, III-25-72 (♂). HEMIPTERA, Alydidae: *Alydus eurinus* (Say), III-24-72 (2 ♀), III-27-72 (♀); *Stachyocnemus apicalis* (Dallas), III-25-72 (♀), III-27-72 (2 ♂); Lygaeidae: *Ligyrocoris litigiosus* (Stål), III-26-72 (♂); Rhopalidae: *Arhyssus lateralis* (Say), III-24-72 (♂); *Niesthrea sidiae* (Fabricius), III-24-72 (♀). HOMOPTERA, Cicadellidae: *Acinoptera* sp., III-27-72 (♀), undetermined, III-25-72 (♂). HYMENOPTERA, Pompilidae: *Ageniella arcuata* (Banks), III-27-72 (♀); *Ageniella* sp., III-25-72 (♀); *Cryptochelus pallidipennis* (Banks), III-24-72 (♀); Sphecidae: *Dryudella caerulea* (Cresson), III-28-72 (♀); *Tachysphex* sp., III-27-72 (♂); Vespidae: *Polybia occidentalis* (Oliver), III-24-72 (♀), III-25-72 (♂); III-27-72 (2 ♂, 4 ♀), III-28-72 (2 ♂, 2 ♀). LEPIDOPTERA, Lycaenidae: *Hemiargus ceraunus* (Fabricius), III-26-72 (♀); Lyonetiidae: *Bucculatrix* sp., III-27-72 (♀); Noctuidae: *Laciniopolia* sp., III-27-72 (♂); Nymphalidae: *Phyciodes campestris* (Behr), III-28-72 (♀); Pieridae: *Eurema lisa* Boisduval and LeConte, III-27-72 (♂); *Eurema nicippe* (Cramer), III-28-72 (♂); Pyralidae: *Tetralopha robustella* (Zeller), III-26-72 (♂); Scythridae: *Scythris* sp., III-26-72 (♂).

Like most other *Efferia* studied (Lavigne and Holland, 1969; Lavigne and Dennis, 1975; Dennis and Lavigne, 1976; Lavigne et al., 1976), *E. argyrogaster* is euryphagous. The prey taken by 21 males and 29 females represent seven orders, 21 families, and 26 genera. Of the 50 recorded prey, 34% belong to the order Hymenoptera, 18% to the order Hemiptera, 16% to the order Lepidoptera, 14% to the order Diptera, 12% to the order Coleoptera,

Table 1. Orders of insects preyed upon by *Efferia argyrogaster* (%) based on sex of the predator.

| Predator | Coleoptera | Diptera | Hemiptera | Homoptera | Hymenoptera | Lepidoptera | Araneae |
|----------|------------|---------|-----------|-----------|-------------|-------------|---------|
| Male | 9.5 | 9.5 | 19 | 4.7 | 28.6 | 24 | 4.7 |
| Female | 13.8 | 17.2 | 17.2 | 3.5 | 37.9 | 10.4 | 0 |
| Mean | 12 | 14 | 18 | 4 | 34 | 16 | 2 |

4% to the order Homoptera, and 2% to the spiders (Araneae). Unlike for other *Efferia* species, the list of recorded prey is dominated by stinging Hymenoptera, which apparently this species of *Efferia* can overpower due to its large size. Thirteen (26%) prey were the vespid, *Polybia occidentalis*.

When prey records are separated at the order level on the basis of sex of the predator, there seems to be little difference in preference between sexes. Females showed a slightly greater preference for Diptera and Hymenoptera, whereas males showed a slight preference for Lepidoptera (Table 1).

The mean predator to prey size ratio for *E. argyrogaster* is 2.5 (Table 2). While females are larger than the males, they tend to catch slightly smaller prey than do the males. Females thus have a larger mean predator to prey size ratio than do males (i.e., 2.8 and 2.2, respectively).

Mating behavior in this species is very simple and is not preceded by courtship maneuvers in the immediate vicinity of the female. Like other *Efferia* (Lavigne and Holland, 1969; Lavigne and Dennis, 1975; Dennis and Lavigne, 1976; Lavigne et al., 1976), males do exhibit an undulating flight in search of females, landing intermittently. When another asilid flies by, the male flies after it and makes contact. If the contacted individual is a male, the pair separate and they fly off in different directions. If the encountered individual is a female, the pair grapple and fall, with copulation taking place on the soil surface. The position taken is that of male-over-female with the female's wings spread about 45° and male's fore tarsi resting on the female's eyes (Fig. 2).

Two matings were observed in their entirety. One was initiated at 10:24

Table 2. Relation between length of *Efferia argyrogaster* and that of its prey.

| Sex | Predator Length (mm) | | | Prey Length (mm) | | | No. of Prey Measured | Mean Ratio of Predator to Prey |
|--------|----------------------|------|------|------------------|------|------|----------------------|--------------------------------|
| | Min | Max | Mean | Min | Max | Mean | | |
| Male | 17.8 | 22.1 | 20.4 | 3.3 | 21.5 | 9.2 | 21 | 2.2 |
| Female | 20.8 | 25.6 | 22.9 | 3.3 | 16.1 | 8.3 | 29 | 2.8 |
| Mean | 17.8 | 25.6 | 21.5 | 3.3 | 21.5 | 8.7 | 50 | 2.5 |

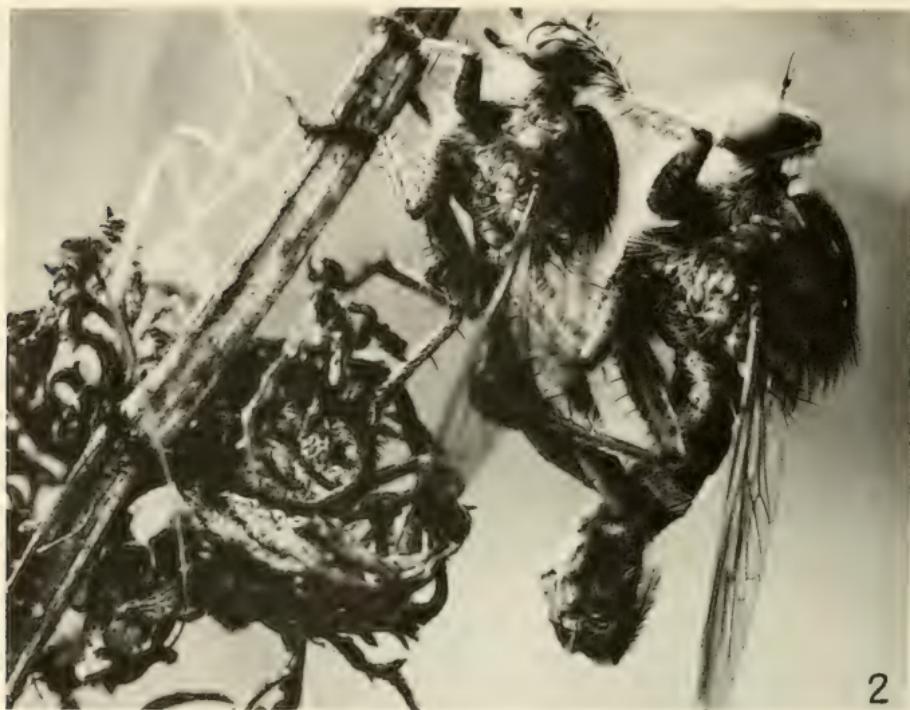
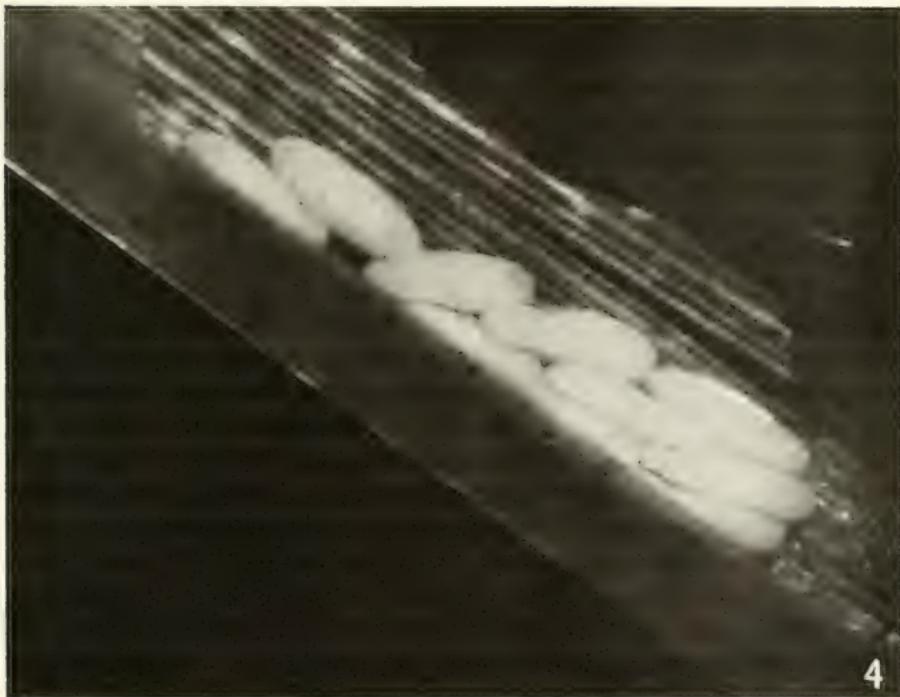


Fig. 2. Mating pair of *Efferia argyrogaster*.

AM and lasted 6 minutes; the other was initiated at 11:51½ AM and lasted 7½ minutes. Once the mating position was achieved, both pairs flew to dead maize stalks where they took up a resting position at a height of about 20 cm. Temperatures at that height were 26.7°C and 30°C, respectively. Four other mated pairs were observed on stalks, ranging in height from 2.5 cm to 30 cm. Temperatures at these heights at the times the mated pairs were observed were 28.3°C (11:57 AM), 31°C (12:42 PM), 32.2°C (3:04 PM) and 32.2°C (4:15 PM).

Little movement occurs during copulation. Just prior to the completion of mating, the male starts to move his hind legs slowly, rubbing them against the sides of the basal abdominal segments of the female. While this is occurring, the male initiates an extended audible wing vibration. In one instance, the buzzing lasted about 10 sec, in another about 45 sec and in a third instance, the male buzzed his wings 3 sec, stopped, buzzed 30 sec,

Fig. 3 Female *Efferia argyrogaster* ovipositing between leaf and stalk of broken grass plant.
Fig. 4. Eggs of *Efferia argyrogaster* deposited between leaf and stalk of grass plant.



stopped, and buzzed the wings about 1 sec. At the end of the wing buzzing, the male released his hold on the female, fell off to the side, released his claspers, and flew away.

As would be expected from the shape of the ovipositor (long, narrow, and laterally compressed), *E. argyrogaster* females deposited eggs in available niches in dead, dry vegetation. The commonest site chosen was between the leaf sheath and stem of grass plants (Fig. 3). However, some eggs were deposited inside a circlet of dried sepals of a forb, between bract and stem of a woody plant, and inside a curled dried leaf. In one instance, a female utilized a hollowed out seed, inserting the eggs through the opening left by an unknown seed predator. Prior to oviposition, females used their ovipositors to probe for suitable sites, beginning near the bottom and working their way up dead stalks. Most eggs were deposited at heights of 5–18 cm above the soil.

Individual ovipositions took from 30 to 90 seconds. Eggs were cemented together and their numbers varied from 2–19 per clutch. On one occasion, the same female was observed making six egg depositions over a period of 18 minutes, having previously probed several stalks for 50 minutes. The number of eggs deposited at each site was 5, 10, 4, and 22, for a total of 41 eggs.

Observed oviposition behavior occurred between 11:45 AM and 2:00 PM, with one exception at 3:26 PM. Temperatures at the height of egg deposition varied between 31–33°C.

Efferia argyrogaster eggs are creamy white. They vary in length from 1.0 to 1.3 mm with an average of 1.2 mm. The average width is 0.4 mm (Fig. 4).

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REVIEW OF THE NEW WORLD SPECIES OF *MYIOMMA* WITH
DESCRIPTIONS OF EIGHT NEW SPECIES
(HEMIPTERA: MIRIDAE: ISOMETOPINAE)

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Abstract.—The genus *Heidemannia* Uhler is reaffirmed as a synonym of *Myiomma* Puton. *Myiomma cixiiforme* (Uhler) is redescribed; and *M. brasiliandum*, *M. capitatum*, *M. rubrooculatum*, *M. schuhi*, and *M. semipallidum* from Brazil, *M. fusiforme* and *M. mexicanum* from Mexico, and *M. ornatum* from Panama are described as new. All adults, except *M. fusiforme* and *M. surinamense* (Carvalho and Rosas), are illustrated. Male genitalia of *M. cixiiforme* and *M. mexicanum* are figured, and a key to the New World species is provided.

Recent studies have shown that the Isometopinae are not nearly as rare as early investigators once suggested (Wheeler and Henry, 1978). With the increasing interest in biology and the recent descriptions of several new species (Brailovsky, 1977; Henry, 1977; Henry and Herring, 1979), it is apparent that continuing studies are needed if future workers are to successfully identify and study unknown forms. Concern over replacing pesticides with biological control agents certainly justifies more detailed work on these largely scale-feeding predators, especially those found in the southwestern United States, Mexico, and South America where tree bugs appear to be most prolific, but very little known.

Uhler (1891) described the first Nearctic isometopine, *Heidemannia cixiiforme*, in his paper "Observations on some remarkable forms of Capsidae" but overlooked the presence of ocelli. Heidemann (1908) clarified the position of this unusual mirid by placing it in the Isometopinae and described the 5th-instar nymph. After comparing *Heidemannia* with *Myiomma* Puton, Reuter (1912) synonymized Uhler's genus under *Myiomma*. McAtee and Malloch (1924) still regarded *Heidemannia* as a distinct genus and stated: "We are not unmindful of what Reuter said . . .," but they concluded that the "nearly holoptic condition" of *Heidemannia* compared to Puton's (1872) figures of *Myiomma fiebri* (type of the genus) was evidence enough

to retain both genera. Bergroth (1925) abrasively attacked McAtee and Malloch's efforts and rather tactlessly pointed out that *Heidemannia* was an obvious synonym of *Myiomma*. Blatchley (1926) followed Reuter's opinion and redescribed the Nearctic *cixiforme*. McAtee and Malloch (1932), apparently convinced of this synonymy and without further explanation, used *Myiomma* and listed *Heidemannia* as a junior synonym. However, Eyles (1971) in his checklist of the Isometopidae of the World again used *Heidemannia*. Because of the inconsistent usage of these two names, I feel it is important to clarify the status of *Heidemannia*.

In this paper, I am considering the Nearctic genus *Heidemannia* a synonym of the Palearctic genus *Myiomma* and am describing five new species from Brazil, two from Mexico, and one from Panama. Adults of *M. brasiliandum*, *M. capitatum*, *M. cixiforme*, *M. mexicanum*, *M. ornatum*, *M. rubrooculatum*, *M. schuhii*, and *M. semipallidum* are illustrated, male genitalia of *M. cixiforme* and *M. mexicanum* are figured and a key to the New World species is provided.

The following abbreviations are used for institutions cited in this paper: AMNH, American Museum of Natural History, New York; BM, British Museum (Natural History), London; PDA, Pennsylvania Department of Agriculture, Harrisburg; TAM, Texas A&M University, College Station; UC, University of Connecticut, Storrs; USNM, U.S. National Museum of Natural History, Washington, D.C.

Myiomma Puton

Type-species *Myiomma fiebri* Puton.

Heidemannia Uhler, 1891:119. NEW SYNONYMY.

Paramyiomma Carvalho, 1951:381.

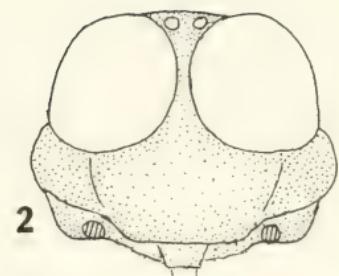
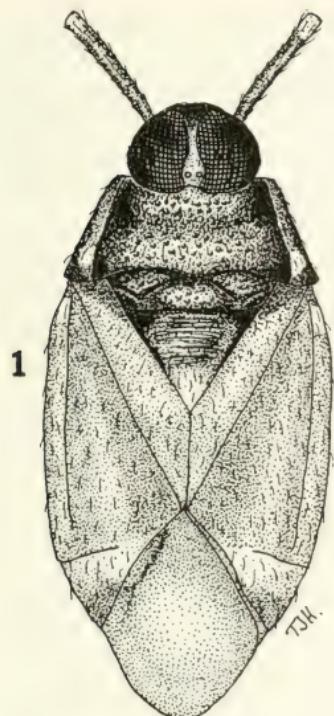
Description.—Generally oblong-oval mirids, length 1.90–3.00 mm, color pale brownish to black. Head much wider than long; eyes covering large part of head, distinctly separated to largely contiguous in front; vertex always possessing ocelli, sometimes larger in males; front broadly rounded, gena widely produced laterally (forming cheeks); antennal bases set below eyes at lateral angles (not visible from dorsal aspect). Antennal segment I usually shortest, II longest, thickest, cylindrical, generally thicker in males, clothed with short recumbent setae in females, clothed with longer more erect setae in males, segments III and IV very slender, subequal in length, segment IV somewhat fusiform. Rostrum 4-segmented, generally reaching hind coxae or beyond. Pronotum trapezoidal, basal width about 2.5× length, anterior margin with a narrow but distinct collar, lateral margins weakly rounded, distinctly and, usually entirely, carinate, frequently flattened and weakly reflexed; posterior margin sinuate; surface smooth, finely granulate or distinctly punctate, calli only moderately distinct, sometimes separated

from disc by a weak impression; mesoscutum broadly exposed, lateral $\frac{1}{3}$ often raised and flattened, median area usually depressed; scutellum equilateral, reaching to middle of clavus, transversely rugose to distinctly punctate, basal $\frac{1}{2}$ frequently raised. Hemelytra entire, generally punctate on clavus and corium; embolium wide and flattened, often reflexed, radial vein reaching at least to middle of corium, cuneus about long as wide, membrane with 1 closed cell. Hind femora saltatorial. Male genital parameres simple, left paramere largest with the base swollen, slender, and curved beyond; right paramere short, simple, usually acutely produced.

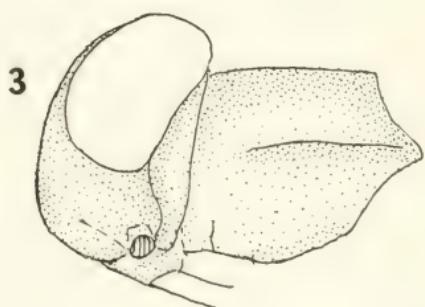
Remarks.—The genus *Myiomma* is somewhat difficult to delimit but generally can be separated from other genera by the oval form, the relatively large head with a narrow vertex, a wide frons, projecting genae and large encompassing eyes that may be nearly contiguous, and the trapezoidal pronotum that is flattened and distinctly carinate laterally and about 2.5 times as wide as long.

KEY TO THE NEW WORLD SPECIES OF *MYIOMMA*

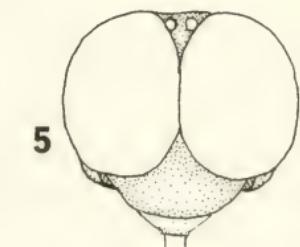
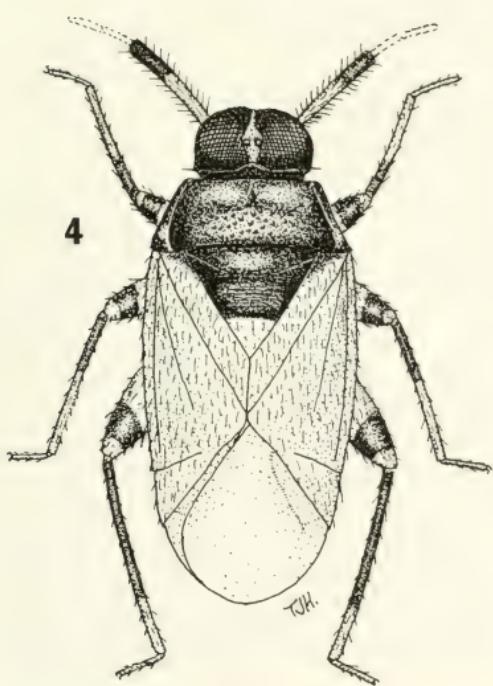
1. Dorsum and legs largely fuscous or black 2
- At most, head, pronotum, and scutellum fuscous or black, hemelytra lighter brown or with pale areas on clavus 4
2. Length 2.00 mm or less; only apical $\frac{1}{3}$ of mesofemora fuscous *mexicanum*, new species
 - Length 2.5 mm or more; femora uniformly fuscous 3
3. Second antennal segment of female strongly inflated, diameter 0.12 mm (Fig. 12); male unknown but 2nd segment probably at least as thick; apex of scutellum white *fusiforme*, new species
- Second antennal segment of female slender, diameter 0.06 mm (Fig. 11); male segment thickened, diameter 0.10 mm (Fig. 10) but not as greatly as Fig. 12; apex of scutellum sometimes paler brown, but not white *cixiiforme* (Uhler)
4. Eyes bright red and spread or flattened over anterior margin of pronotum (in males at least) (Figs. 22, 24) *rubrooculatum*, new species
 - Eyes not bright red (although they may be tinged with red) and not flattened or spread over anterior margin of pronotum 5
5. Eyes contiguous or only separated by a width less than the diameter of an ocellus on frontal aspect (Figs. 5, 20) 6



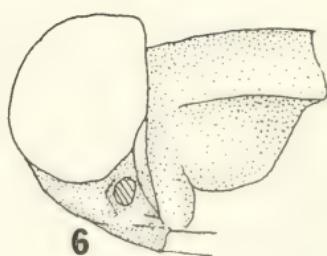
2



3



5



6

- Eyes not contiguous in front, width between equal to or much greater than diameter of an ocellus 7
- 6. Rostrum nearly reaching genital segment; gena well developed (Fig. 20); lateral margins and base of pronotum pale, scutellum pale with the median line black *ornatum*, new species
- Rostrum reaching only 3rd or 4th abdominal segment; gena reduced (Fig. 5); pronotum and scutellum uniformly black or fuscous *capitatum*, new species
- 7. Second antennal segment pale at apex; membrane smoky brown or fumate 8
- Second antennal segment fuscous at apex; membrane clear 9
- 8. Hemelytra uniformly dark brown; coxae mostly pale *brasiliandum*, new species
- Hemelytra largely pallid with fuscous on embolium, base of clavus and outer margin and apical $\frac{1}{3}$ of corium; coxae largely fuscous .. *semipallidum*, new species
- 9. Hemelytra brown, embolium, cuneus, and apical area of corium transparent, base of cuneus with ivory white patch; femora fuscous, tibiae fuscous except at apex; rostrum reaching only 3rd or 4th abdominal segment *schuhi*, new species
- Hemelytra pale yellow, inside base of clavus and outer margin of embolium darkened, cuneus apparently without an ivory white patch; legs pale; rostrum reaching genital segment *surinamense* (Carvalho and Rosas)

Myiomma brasiliandum Henry, NEW SPECIES

Figs. 1-3

Holotype female.—Length 2.48 mm, width 1.12 mm, generally black with the hemelytra lighter colored, clothed with short, recumbent, golden setae (Fig. 1). *Head*: Width 0.60 mm, vertex 0.12 mm, ocelli 0.08 mm apart, dark brown, sides fuscous, frons roughened, eyes brownish, tinged with red (Figs. 2-3). *Rostrum*: Broken, stylets 1.16 mm, reaching 3rd abdominal segment. *Antennae*: I, length 0.06 mm, slightly longer than broad, brown; II, 0.56 mm, fuscous, pale at apex and on basal $\frac{2}{3}$ of ventral aspect, setae short, recumbent; III and IV, broken. *Pronotum*: Length 0.38 mm, width at base 0.96 mm, shiny black with a clear spot near posterior angles, calli and disc punctate, lateral margins widely flattened and recurved, basal margin sinuate, clothed with recumbent, golden setae; mesoscutum shiny black, punctate; scutellum shiny black, apex pale, transversely rugose. *Hemelytra*: Uniformly dull or satiny dark brown, base of embolium and paracuneus pale, clothed with recumbent, golden setae; membrane smoky brown or fumate, finely pubescent, veins indistinct. *Venter*: Fuscous to black, pro-

pleura shiny black with a narrow pale mark across posterior end, punctate, anterior lobe of ostiolar plate white, remainder fuscous, abdomen fuscous, sparsely set with short, recumbent setae. *Legs:* Broken, coxae pale, brownish at bases.

Holotype.—♀, Brazil, Goias, Jataí, November 1972, F. H. Oliveira collector (AMNH).

Remarks.—*Myiomma brasiliandum* is most similar to *M. schuhi* but can be separated by the larger size (although I only have one female to compare to a male of *M. schuhi*), the pale second antennal segment with the basal two-thirds of the dorsal aspect fuscous, the more strongly punctate propleura, protruding frons, and the dark membrane.

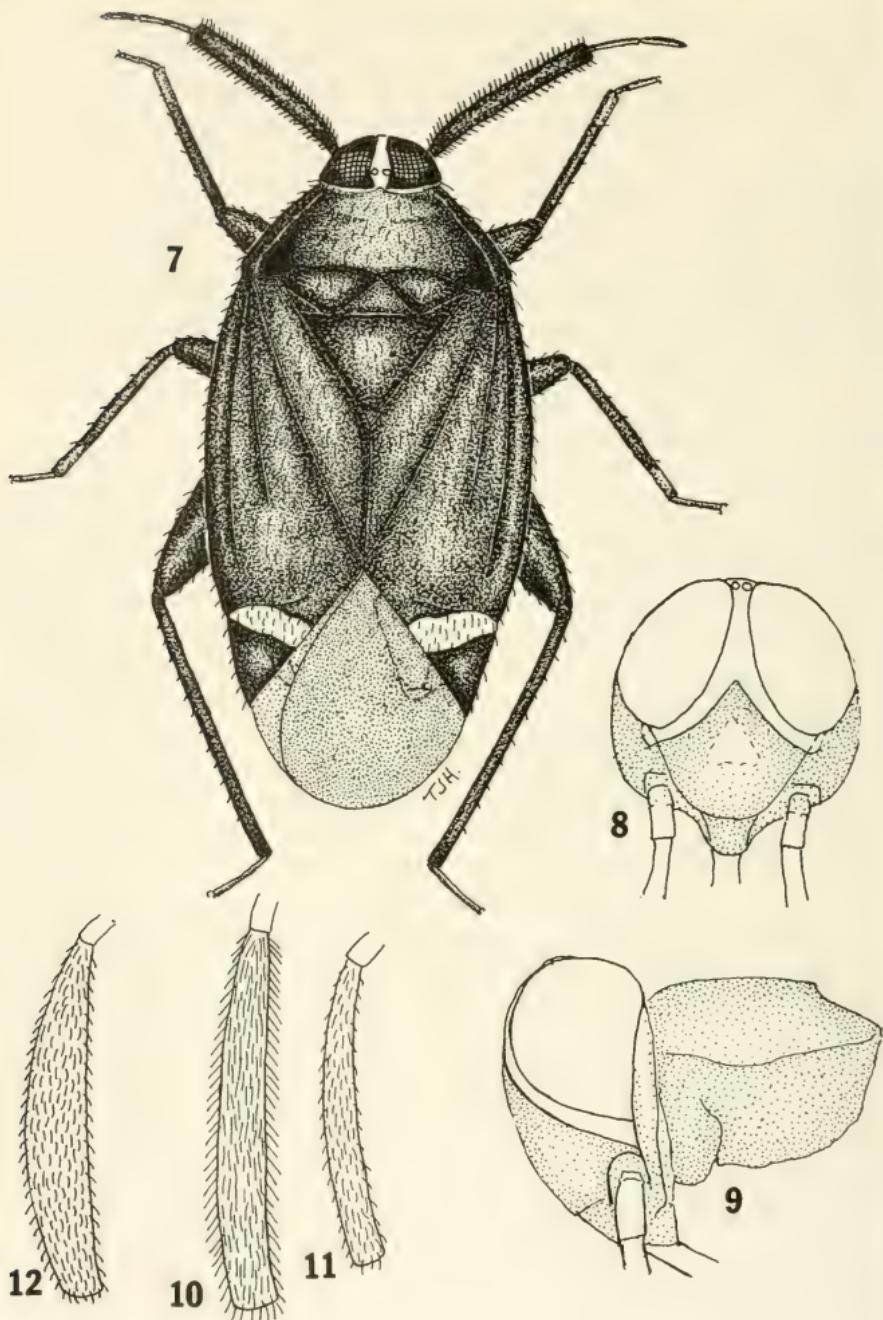
Myiomma capitatum Henry, NEW SPECIES

Figs. 4–6

Holotype male.—Length 2.04 mm, width 0.88 mm, head and pronotum black, hemelytra paler, clothed with semierect golden setae (Fig. 4). *Head:* Width across ocelli 0.50 mm, vertex 0.10 mm, ocelli 0.06 mm apart, contiguous with compound eyes; fuscous, eyes large, rounded, touching in front and nearly touching at base, covering most of head (Figs. 5–6). *Rostrum:* Partly broken, but glued to point (in part), about 0.94 mm, reaching 3rd or 4th abdominal segment (based on estimated length), 1st segment testaceous, remaining segments darker brown. *Antennae:* I, length 0.06 mm, testaceous, lightly infuscated; II, 0.64 mm, pale or testaceous, apical 4th fuscous, clothed with erect pale setae; III and IV, broken. *Pronotum:* Length 0.30 mm, width at base 0.82 mm, shiny fuscous to black with a pale spot at posterior angles, clothed with recumbent, golden setae, calli slightly raised, smooth, shiny, disc distinctly punctate, lateral margins narrowly flattened and weakly recurved; mesoscutum fuscous, depressed at middle; scutellum fuscous, pale (color of hemelytra) on apical $\frac{1}{3}$, transversely rugose. *Hemelytra:* Pale brownish, outer edge of embolium and cuneus pale yellowish brown, clothed with semierect, pale to golden setae; membrane translucent, smoky brown, finely pubescent, veins barely detectable, greatly reduced. *Venter:* Shiny fuscous, propleura finely punctate with a large pale spot posteriorly, ostiolar plate pale on anterior raised lobe, remainder fuscous. *Legs:* Coxae pale testaceous; femora pale or testaceous, fuscous on apical $\frac{1}{4}$ to $\frac{1}{3}$, hind femora pale at apex; tibiae fuscous, paler apically; tarsi and claws testaceous.

Holotype.—♂, Brazil, Para, 8 km E of Belem, Ananindeua, June 3, 1973, R. T. Schuh collector, at light (AMNH).

Remarks.—This species is most easily distinguished by the large encompassing eyes which cover most of the head and are contiguous in front. The



Figs. 7-11. *Myiomma cixiiforme*. 7, Adult male. 8, Head, frontal view. 9, Head and prothorax, lateral view. 10, Second antennal segment, male. 11, Second antennal segment, female. Fig. 12. *Myiomma fusiforme*, second antennal segment, female.

pale femora with the fuscous apical band will also help to separate *M. capitatum* from other species of *Myiomma*.

Myiomma cixiiforme (Uhler), NEW COMBINATION

Figs. 7-11, 27-28

Heidemannia cixiiforme Uhler, 1891:121

Adult male.—Length $\bar{x} = 3.02$ mm (5), 2.88-3.20 mm, width 1.28 mm, generally black, clothed with recumbent black setae (Fig. 7). *Head*: Width 0.50 mm, vertex across ocelli 0.12 mm, dorsal width of eye 0.16 mm, fuscous, vertex and narrow margin around eyes pale or white, frons frequently with a central whitish patch, posterior margin of eyes set with several pilose setae (Figs. 8-9). *Rostrum*: Length 1.36 mm, fuscous reaching 3rd abdominal segment. *Antennae*: Fuscous, I, length 0.20 mm; II, 0.78 mm, diameter at middle 0.10 mm, thickly clothed with erect, black setae (Fig. 10); III, 0.20 mm; IV, 0.20 mm. *Pronotum*: Length 0.38 mm, width at base 1.04 mm, uniformly black, finely roughened, calli weakly raised; mesoscutum and scutellum black, finely granulate, extreme apex of scutellum occasionally paler. *Hemelytra*: Uniformly black, base of cuneus pale or white, clothed with semierect black pubescence; membrane fumate to black, with a single distinct closed cell. *Venter*: Fuscous to black, thorax with only a few scattered setae, abdomen thickly set with suberect pale setae. *Legs*: Uniformly fuscous or black, extreme apex of hind femora and apical $\frac{1}{3}$ of tibiae pale yellowish. *Genitalia*: See Figs. 27-28.

Adult female.—Length $\bar{x} = 2.82$ mm (5), 2.80-2.88 mm, width 1.32 mm, very similar to males in color and pubescence and differing mainly by the broader form and more slender 2nd antennal segment. *Head*: Width 0.50 mm, vertex 0.10 mm, dorsal width of eye 0.20 mm. *Rostrum*: Length 1.44 mm, reaching 4th or 5th abdominal segment. *Antennae*: I, length 0.20 mm; II, 0.58 mm, diameter at middle 0.06 mm (Fig. 11); III, 0.24 mm; IV, 0.16 mm. *Pronotum*: Length 0.32 mm, width at base 1.04 mm.

Remarks.—Many authors have argued to retain *M. cixiiforme* in the genus *Heidemannia*, but I agree with Reuter (1912) and other authors that this genus is congeneric with the type of the genus, *Myiomma fiebri*. Actually the question should not be if the genera are distinct; instead, it should be how to separate *M. cixiiforme* and *M. fiebri*.

I have a single female of *M. fiebri* from Hyères [France] Bell. 21 th., Saunders Coll., Brit. Mus. 1910-357 (BM) that has the following measurements: length 2.64 mm, width 1.24 mm; head width 0.52 mm, vertex 0.12 mm, dorsal width of eye 0.20 mm; rostrum imbedded in glue, appearing to reach just beyond hind coxae; antennal segment I, length 0.22 mm; II, 0.72 mm; III and IV broken; pronotum length 0.42 mm, width at base 1.10 mm. This species differs from *M. cixiiforme* mainly by the lighter brown color,

the pale anterior and posterior marks on the median line of the pronotum, the pale apical $\frac{1}{3}$ of the scutellum and the distinctly punctate calli, disc of the pronotum and scutellum.

Myiomma cixiiforme also resembles *M. fusiforme* and to a lesser extent, *M. mexicanum*. It can be separated from *M. fusiforme* by the more slender 2nd antennal segment and from *M. mexicanum* by the larger size, white-marked vertex, and the uniformly fuscous femora (except for the apex of the hind femora).

Wheeler and Henry (1978) described the 5th-instar nymph and showed that this species is clearly a predator of obscure scale, *Melanaspis obscura* (Comstock), on *Quercus* spp. in Pennsylvania. In addition to previous records of this species from Delaware, Washington, D.C., New York, Pennsylvania, Virginia, West Virginia, and Quebec, I have examined the following specimens: 2 males, Florida, Putnam Co., III-19-30, D. B. Webb collector (USNM); 1 female, Texas, Brazos Co., Bryan, April 11, 1976, J. D. Moody collector (TAM).

Myiomma fusiforme Henry, NEW SPECIES

Fig. 12

Holotype female.—Length 2.68 mm, width 1.32 mm, black, clothed with recumbent black setae. *Head*: Width 0.48 mm, vertex across ocelli 0.10 mm, dorsal width of eye 0.18 mm, fuscous, narrow border around eyes white, central area of frons with a white patch, ocelli surrounded by fuscous, posterior margin of eyes with a row of 4 or 5, erect, black setae. *Rostrum*: Fuscous, glued to triangle, appearing to reach near base of ovipositor. *Antennae*: I, length 0.06 mm, fuscous; II, length 0.72 mm, diameter at middle 0.12 mm, swollen (Fig. 12), black, extreme apex testaceous, clothed with rather stout, recumbent, black setae; III, 0.18 mm, brown; IV, 0.16 mm, brown. *Pronotum*: Length 0.34 mm, width at base 1.06 mm, black, roughened, indistinctly punctate; mesoscutum black; scutellum black, apex white, basal $\frac{1}{2}$ raised. *Hemelytra*: Uniformly black, base of cuneus narrowly white or pale; clothed with suberect black setae; membrane fuscous, with a single distinct cell. *Venter*: Fuscous, abdomen clothed with suberect pale setae. *Legs*: Broken, coxae fuscous.

Holotype.—♀, Mexico, Durango, 11 mi W of El Salto, VI-29-30, 1964, Paul J. Spangler collector (USNM Type No. 76050).

Remarks.—*Myiomma fusiforme* is very similar to *M. cixiiforme* and would be rather difficult to distinguish if it were not for the strongly inflated or fusiform second antennal segment. Also, none of the 30 specimens of *M. cixiiforme* I have before me have the apex of the scutellum distinctly white as it is in *M. fusiforme*.

Myiomma mexicanum Henry, NEW SPECIES
Figs. 13–15, 29–30

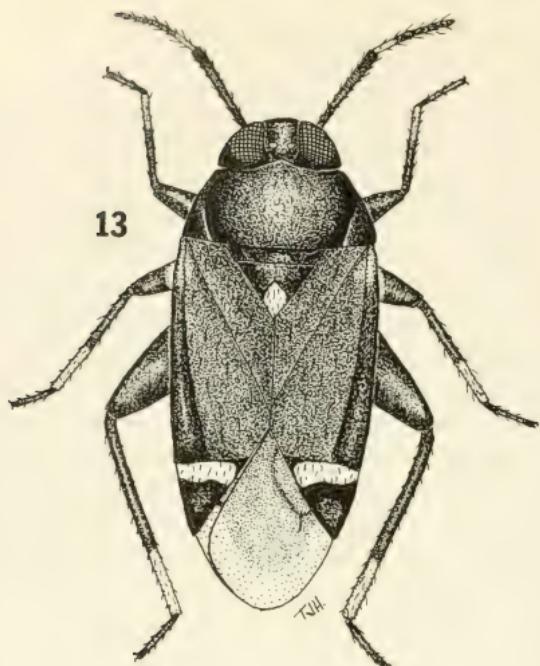
Holotype female.—Length 1.94 mm, width 0.90 mm, generally fuscous to black, clothed with short, erect bristle-like setae (Fig. 13). *Head*: Width 0.48 mm, vertex (across ocelli) 0.12 mm, ocelli 0.08 mm apart, fuscous, eyes dark reddish brown (Figs. 14, 15). *Rostrum*: Length 0.90 mm, reaching 3rd or 4th abdominal segment, fuscous, basal segment more reddish brown. *Antennae*: I, length 0.06 mm, fuscous; II, 0.46 mm, fuscous at base, apex and dorsal $\frac{1}{2}$, ventral aspect pale between fuscous bands; III, 0.22 mm, fuscous, pale on basal $\frac{1}{2}$; IV, 0.10 mm, fuscous. *Pronotum*: Length 0.26 mm, width at base 0.78 mm, shiny black, transversely roughened across disc, posterior angles flattened, lateral angles distinctly carinate, clothed with short, semierect, golden setae; mesoscutum black; scutellum convex, shiny black, apical $\frac{1}{2}$ pale cream colored. *Hemelytra*: Generally dull fuscous, clothed with semierect black, bristle-like setae, embolium, cuneus, and paracuneus more shiny black, base of embolium and corium pale, basal $\frac{1}{2}$ of cuneus enamel white; membrane largely brown or fumate, transparent around margins. *Venter*: Shiny reddish brown to black, ostiolar plate pale. *Legs*: Procoxae fuscous, meso- and metacoxae pale; profemora fuscous, narrowly pale at base and on anterior apical spot, mesofemora pale, fuscous on apical $\frac{1}{3}$, metafemora fuscous, narrowly pale at base, strongly saltatorial; tibiae fuscous, pale on apical $\frac{1}{3}$ to $\frac{1}{2}$; tarsi and claws fuscous.

Allotype male.—Length 2.12 mm, width 0.88 mm. *Head*: Width 0.50 mm, vertex 0.14 mm, ocelli 0.08 mm apart. *Rostrum*: Length 0.96 mm, reaching 4th abdominal segment. *Antennae*: Broken (measurements from paratype male, segment I, 0.08 mm; II, 0.50 mm). *Pronotum*: Length about 0.34 mm, width at base 0.08 mm. *Genitalia*: See Figs. 29, 30.

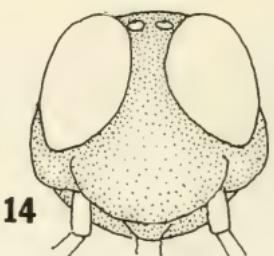
Types.—*Holotype*: ♀, Mexico, Oaxaca, 12 mi W Tehuantepec, July 11, 1971, taken at light, Clark, Murray, Hart, Schaffner collectors (USNM Type No. 76047). *Allotype*: ♂, Mexico, Oaxaca, 2.7 mi northwest of El Cameron, July 13, 1971, taken at light, Clark, Murray, Hart, Schaffner collectors (USNM). *Paratypes*: 1 ♀, Mexico, Oaxaca, 32.8 mi northwest of Jalapa de Marques, July 13, 1971, Clark, Murray, Hart, Schaffner collectors (TAM); 2 ♂, 1 ♀, Mexico, Oaxaca, 9 mi W Tehuantepec, June 25, 1965, Burke, Meyer, Schaffner collectors (2 TAM, 1 USNM).

Remarks.—The male of *M. mexicanum* is more slender than the female, has thicker second antennal segments, is less intensely colored, the pale mark on the scutellum is limited to the apex and the mark across the base of the cuneus is pale translucent rather than enamel white.

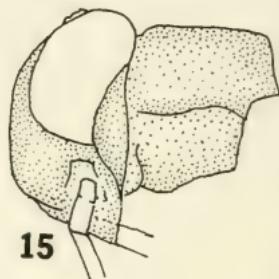
Myiomma mexicanum, in general, resembles a miniature *M. cixiiforme* or *M. fusiforme* but can be separated from these species by its smaller size and pale-marked legs.



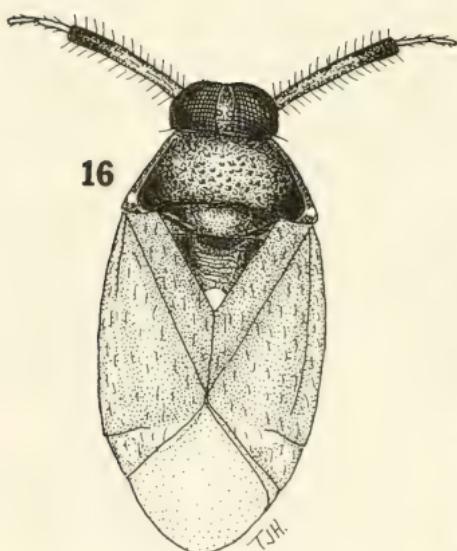
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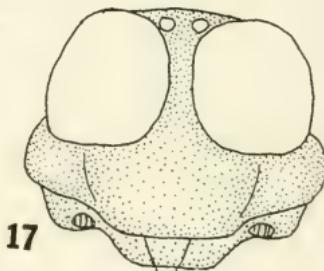
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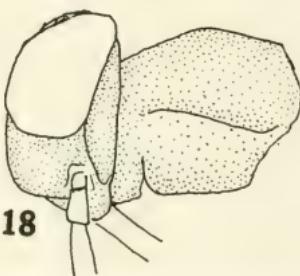
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Figs. 13-15. *Myiomma mexicanum*. 13. Adult female. 14. Head, frontal view. 15. Head and prothorax, lateral view. Figs. 16-18. *Myiomma schuhii*. 16. Adult male. 17. Head, frontal view. 18. Head and prothorax, lateral view.

Myiomma ornatum Henry, NEW SPECIES
Figs. 19-21

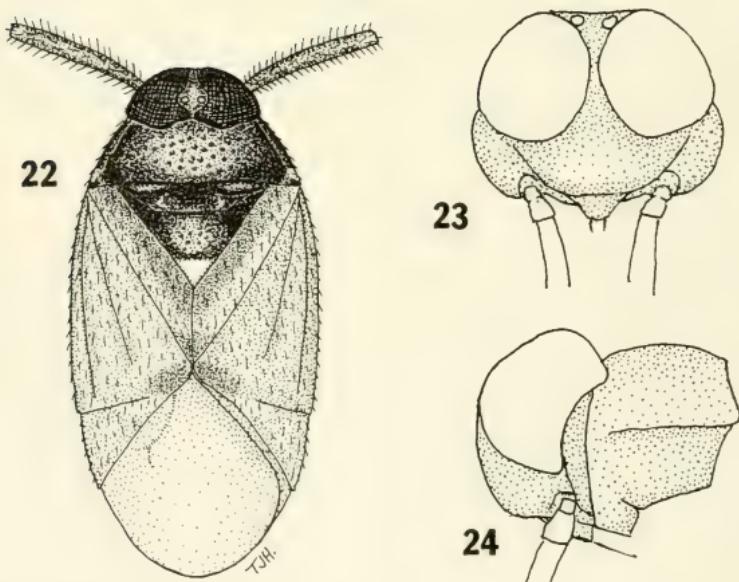
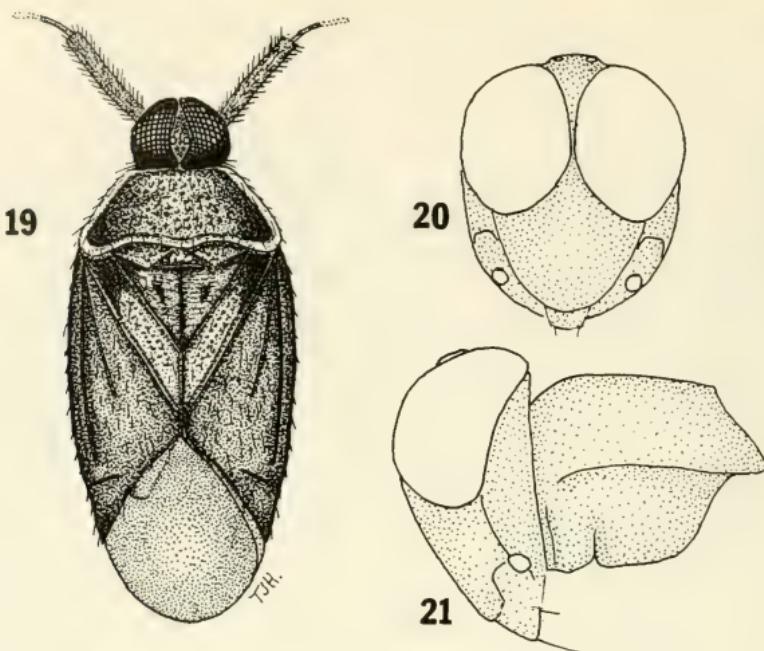
Holotype male.—Length 2.12 mm, width ca 0.88 mm, generally dark with pale areas, clothed with semierect setae (Fig. 19). *Head*: Width 0.46 mm, vertex across ocelli 0.14 mm, dorsal width of eye 0.18 mm, black, sides brown to reddish brown, eyes red (Figs. 20, 21). *Rostrum*: Length 1.34 mm, testaceous, nearly reaching genital segment. *Antennae*: I, length 0.08 mm, testaceous; II, 0.50 mm, testaceous, thickly clothed with erect pale setae; III, 0.16 mm, testaceous; IV, broken. *Pronotum*: Length 0.16 mm, width at base 0.84 mm, shiny black, narrowly yellow along base and lateral margins, punctate, more finely on calli, lateral margins weakly rounded, base strongly sinuate, clothed with semierect golden setae; mesoscutum punctate, yellowish orange on flattened plates; scutellum pale, black along median line and apex and triangular spots on either side of median, transversely rugose, weakly punctate. *Hemelytra*: Largely black, base of embolium and apical $\frac{3}{4}$ of clavus pale, pale areas black punctured, clothed with semierect dark to light setae; membrane fuscous. *Venter*: Black, lateral carinae and all marginal areas of propleura pale or yellowish. *Legs*: Coxae pale brown, mesofemora fuscous or brown, pale on dorsal aspect and apical $\frac{1}{3}$ of ventral aspect, mesotibiae brownish, darker on apical $\frac{1}{2}$; tarsi and claws brownish (front and hind legs broken).

Holotype.—♂, Panama, Las Cumbres, 09°06'N, 79°32'W, V-11-1974, light trap, H. Wolda collector (UC).

Remarks.—*Myiomma ornatum* is very easy to separate from other species by the pale-bordered pronotum, pale clavus and scutellum, long rostrum, and nearly contiguous eyes.

Myiomma rubrooculatum Henry, NEW SPECIES
Figs. 22-24

Holotype male.—Length 1.92 mm, width 1.00 mm, generally, brown to fuscous, eyes red, clothed with semierect, golden pubescence (Fig. 22). *Head*: Width 0.46 mm, vertex 0.08 mm across ocelli, ocelli about 0.06 mm apart, fuscous, eyes red, indented or wrinkled at middle, nearly touching on frons, posterior margin overlapping anterior margin of pronotum (giving appearance that eyes were melted and poured over head and pronotum) (Figs. 23, 24). *Rostrum*: Length about 0.82 mm, reaching 3rd or 4th abdominal segment. *Antennae*: I, length 0.08 mm, dark brown, cylindrical; II, 0.56 mm, brownish, paler at apex, clothed with erect, brownish setae; III and IV broken. *Pronotum*: Length (from base of eyes) 0.24 mm, width at base 0.88 mm, shiny black with a pale indistinct spot at posterior angles, uniformly punctate, calli not easily discernible, lateral margins flattened, weakly recurved, clothed with rather long, erect and semierect, golden setae:



Figs. 19-21. *Myiomma ornatum*. 19, Adult male. 20, Head, frontal view. 21, Head and prothorax, lateral view. Figs. 22-24. *Myiomma rubrooculatum*. 22, Adult male. 23, Head, frontal view. 24, Head and prothorax, lateral view.

mesoscutum shiny black, finely punctate, depressed at middle; scutellum shiny black, pale brown at apex, depressed at middle of base, finely punctate, pubescence as on pronotum. *Hemelytra*: Light brownish with an indication of a reddish-yellow tinge, clavus, cuneus, and apical area of corium darker brown, clothed with long, erect, golden setae; membrane smoky translucent, finely pubescent, veins indistinct and brownish. *Venter*: Shiny brown to fuscous; propleura shiny black, punctate, posterior apex pale; anterior lobe of ostiolar plate pale, flattened posterior lobe brown. *Legs*: Broken, coxae brownish, apices paler.

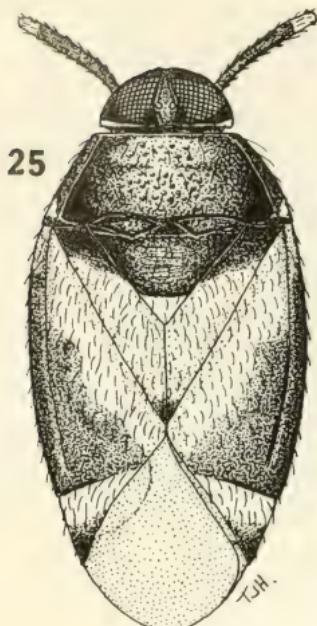
Holotype.—♂, Brazil, Bahia, Encruzilhada, 980 m, Nov. 1974, M. Alvarenga collector (AMNH).

Remarks.—*Myiomma rubrooculatum* is, perhaps, the most unusual of the New World *Myiomma* species with the globular red eyes that appear melted onto the head and pronotum. The general body structure and this peculiar formation of the eyes will separate *M. rubrooculatum* from all other species in our fauna.

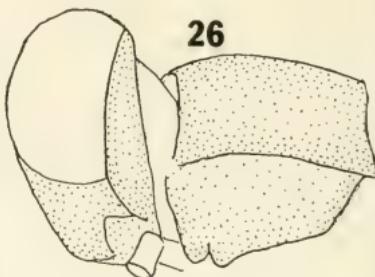
Myiomma schuhi Henry, NEW SPECIES

Figs. 16–18

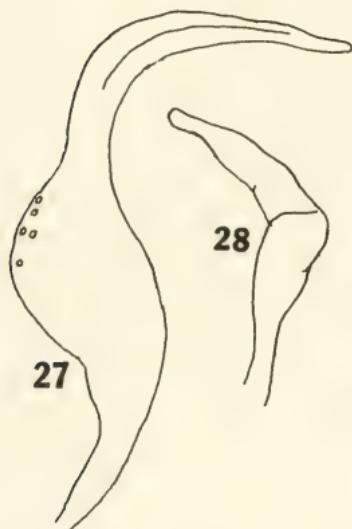
Holotype male.—Length 2.20 mm, width 0.92 mm, generally fuscous with hemelytra paler, clothed with recumbent, golden setae (Fig. 16). *Head*: Width 0.48 mm, vertex 0.10 mm, ocelli 0.06 mm apart, touching compound eyes; eyes reddish, vertex fuscous fading to brownish yellow on frons and lower portion of head (Figs. 17, 18). *Rostrum*: Length 0.92 mm, reaching 4th abdominal segment, 1st segment brownish yellow, remaining segments more fuscous. *Antennae*: I, length 0.06 mm, nearly as broad as long, fuscous; II, 0.62 mm, fuscous, pale on basal $\frac{2}{3}$ of dorsal aspect, clothed with long, erect pale setae; III, 0.16 mm, pale, very slender; IV, 0.12 mm, fuscous, slender. *Pronotum*: Length 0.36 mm, width at base 0.82 mm, shiny black with a pale spot at posterior angles, punctate, calli impunctate, lateral margins narrowly flattened and recurved, basal margin weakly sinuate, clothed with recumbent, golden setae; mesoscutum fuscous, punctate; scutellum fuscous, pale at apex, punctate, pubescence as on pronotum. *Hemelytra*: Smoky gray or brown, base of clavus fuscous, embolium and most of cuneus clear or translucent, anterior portion of cuneus (paracuneus) white; membrane clear to translucent brown, finely pubescent, veins hardly detectable. *Venter*: Fuscous, propleura finely punctate with a pale mark posteriorly, ostiolar plate largely yellowish, posterior portion of flattened area fuscous, abdomen clothed with recumbent, golden setae. *Legs*: Coxae pale, tinged with brown; femora fuscous, pale at extreme apex and on basal $\frac{1}{4}$; pro- and mesotibiae pale, fuscous on basal $\frac{1}{3}$; metatibiae fuscous, pale on apical $\frac{1}{4}$; tarsi and claws pale.



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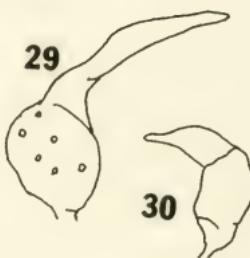


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Figs. 25-26. *Myiomma semipallidum*. 25, Adult female (with head tilted back into normal position). 26, Head and prothorax, lateral view (head as positioned on holotype). Figs. 27-28. *Myiomma cixiforme*. 27, Left paramere. 28, Right paramere. Figs. 29-30. *Myiomma mexicanum*. 29, Left paramere. 30, Right paramere.

Holotype.—♂, Brazil, Para, 8 km E Belém, Ananindeua, June 2, 1973, R. T. Schuh collector, at light (AMNH).

Remarks.—*Myiomma schuhi* most closely resembles *M. brasiliandum*, but can be separated from this and other species by the second antennal segment being pale on the dorsal two-thirds and fuscous at the apex, the shiny punctate pronotum, the translucent brown membrane and the uniquely colored legs.

I am naming this species after my good friend and collector of this species, Dr. R. T. Schuh, who has generously loaned me several of the new species used in this study.

Myiomma semipallidum Henry, NEW SPECIES
Figs. 25–26

Holotype female.—Length 2.24 mm, width about 1.08 mm, generally fuscous with extensive pallid areas on hemelytra, clothed with recumbent golden setae (Fig. 25). *Head*: Width 0.54 mm, vertex across ocelli 0.12 mm, dorsal width of eye 0.22 mm, black, eyes reddish, basal margin behind eyes pale (Fig. 26). *Rostrum*: Broken. *Antennae*: I, length 0.08 mm, black; II, 0.50 mm, fuscous, apex pale, thickly clothed with recumbent golden setae; III and IV broken. *Pronotum*: Length 0.34 mm, width at base 0.92 mm, shiny black with a pale spot at posterior angles, lateral angles straight, distinctly but narrowly flattened and recurved, basal margin sinuate, disc strongly punctate, calli more sparsely punctured, weakly raised, clothed with recumbent pale golden setae; mesoscutum black, finely punctate; scutellum shiny black, apical $\frac{1}{3}$ whitish, transversely rugose, finely punctate, clothed with recumbent golden setae. *Hemelytra*: Largely pallid or pale testaceous, base of clavus, embolium, outer margin and apical $\frac{1}{3}$ of corium and apex of cuneus dark brown to fuscous, clothed with recumbent pale to golden setae; membrane smoky, veins weakly defined. *Venter*: Shiny black, abdomen more fuscous, propleura shiny black with a posterior white mark, finely punctate, raised anterior lobe of ostiolar peritreme plate pale or whitish, abdomen clothed with recumbent pale setae. *Legs*: Coxae fuscous, pale at apices; profemora fuscous, pale at apices and at extreme bases, protibiae fuscous, paler on apical $\frac{1}{3}$, protarsi and claws fuscous, remaining legs broken.

Holotype.—♀, Brazil, Minas Geraes, Pedra Azul, 900 m, November 1972, M. Alvarenga collector (AMNH).

Remarks.—*Myiomma semipallidum* is most similar to *M. brasiliandum*, *M. schuhi*, and *M. surinamense* but is easily distinguished by a combination of the fuscous, apically pale second antennal segment, extensive pallid areas on the hemelytra, and the fuscous legs (at least prolegs).

Myiomma surinamense (Carvalho and Rosas)*Paramyiomma surinamense* Carvalho and Rosas, 1962:419

Carvalho and Rosas (1962) described this species from the coastal plain of Surinam, South America from more than 50 specimens taken in light traps. The authors characterized this species by the dark head, pronotum and scutellum, pale hemelytra and legs, the long rostrum which reaches the genital segment, and by the male genitalia.

This species appears to be very close to *M. brasiliandum* and *M. schuhi*. Since no females are known from *M. surinamense*, it is difficult to suggest its relationship to my *M. brasiliandum* (known only from a single female), but it appears that the differently marked second antennal segment and the darker dorsum will separate the two species. *Myiomma schuhi* can be separated by the shorter rostrum, the pale mark at the base of the cuneus, and the fuscous femora and tibiae.

Carvalho (1951) erected the genus *Paramyiomma* on the basis of the formation of the eyes and the position of the ocelli for several African and Asian species and later included *M. surinamense*. Smith (1967) concluded that these characters were not consistently distinct for all the species involved and synonymized Carvalho's genus under *Myiomma*. However, the South American fauna, as with much of the Old World fauna, differs considerably from the "typical" *Myiomma fiebri* of the Palearctic. Slater and Schuh (1969) suggested that male and female genitalia may have the greatest value for defining genera, although I find these characters at a specific level to be limited. A careful study of the genus *Myiomma* on a world basis will be required before a sound evaluation of generic limits and species relationships can be made.

ACKNOWLEDGMENTS

I am greatly indebted to J. L. Herring (USDA, SEA), R. T. Schuh (AMNH), J. C. Schaffner (TAM), and J. A. Slater (UC) for lending valuable material which contained new species and to W. L. Dolling (BM) for lending the specimen of *M. fiebri* for comparison. Also I thank my colleague, A. G. Wheeler, Jr. (PDA) for reviewing this manuscript and making helpful suggestions.

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**POLISTES WASPS (HYMENOPTERA: VESPIDAE) SHOW
INTERFERENCE COMPETITION WITH OTHER
INSECTS FOR KERMES SCALE INSECT
(HOMOPTERA: KERMESIDAE) SECRETIONS**

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Abstract.—Twenty-one marked *Polistes fuscatus* (F.) females repelled other insects from kermesid scale insects *Kermes kingi* Cockerell for from 1 to 4 days. These wasps drove away conspecifics and other insects in at least eight other families that attempted to feed on scale secretions. When flower nectar became abundant, *P. fuscatus* and other insects except ants abandoned the scales and visited flowers.

Hymenopterans show different degrees of association with their lepidopteran and homopteran trophobionts (Wilson, 1971). For example, Darwin (1859) noted that ants obtain "sweet excretions" from "aphides"; later investigators have found that ant species are either facultative or obligative associates with aphids (Auclair, 1963; Way, 1963). Some ants protect their aphid herds from parasites and predators (Nault et al., 1976) and exhibit interference competition (Case and Gilpin, 1974) in driving away other honeydew-feeding insects. Wasps also feed on homopteran honeydew as reported by Jirón and Salas (1975), Salas and Jirón (1977), and Barrows (1978). However, there appears to be no literature regarding the vespid wasp *Polistes fuscatus* (F.) feeding on "honeydew secretions" of kermesid scale insects *Kermes kingi* Cockerell; hence, I report my findings concerning this subject. These wasps showed long-term (over 24 hr) individual constancy to these scales; and like ants, they showed interference competition with other insects when chasing them away from the scales.

MATERIALS AND METHODS

Field observations were made on the property of the University of Michigan Biological Station, Cheboygan County, Michigan; the study site is described by Barrows (1978). I observed individual *P. fuscatus* for periods of at least 15 min from one to six times per day between 0600 and 2300 hours

on almost every day from 25 July to 4 August 1977. Wasps were individually marked on their scuta with fast-drying enamel paints while they guarded or took food from scale insects. Nests of marked wasps could not be found. Branchlets of *Quercus rubra* L. with scales were also individually marked with paints. In 1978 from mid-June to mid-August, I did not find *P. fuscatus* on the same saplings where they were found in 1977 nor on hundreds of other saplings in the area. In 1978, the saplings that were examined in 1977 harbored *K. kingi* that were tended by ants; and *K. kingi* were somewhat common on nearby saplings. Means, standard deviations, and medians are given in parentheses after ranges.

RESULTS AND DISCUSSION

Wasps visited *K. kingi* on only a few saplings in a stand of hundreds, even though *K. kingi* were on dozens of saplings. Twenty-one marked wasps were seen from 1 to 5 days (2.8 ± 1.30 , 3) (Table 1 and Fig. 1). Wasps were constant to particular scale groups for from 1 to 4 days (2.1 ± 1.06 , 2) and were present both day and night. Wasp-U was seen at scale group-15 on 29 and 31 July but not on 30 July; however, in the data compilation, she was assumed to be at group-15 for 3 successive days. In three cases, two marked wasps were at the same scale groups (on branches-4, -12, -14) at different times of the same day. Nine wasps were at two or three different scale groups during the study period.

Wasps guarded 17 branchlets with from 1 to 18 scales (4.8 ± 4.40 , 3). Distances between the closest edges of the most distant scales in each guarded group were from 0 to 67 mm (18.7 ± 23.74 , 4). The "groups" contained only one scale, only scales that touched one another, or at least two scales that did not touch one another. Defended groups were from 14 to 92 cm (54.2 ± 25.28 , 53) above the ground. Altitudes of scale groups were approximated by measuring distances from the ground to the center of the highest scale in a group. For a statistical analysis with equal sample sizes, I located another 17 branchlets with unguarded scales that were less than 1 m above the ground, and on the same saplings that had wasps or on nearby saplings. These branchlets had from 1 to 7 scales (2.4 ± 1.73 , 2), and individuals or groups of scales were from 14 to 95 cm (58 ± 29.32 , 59) above the ground. Distances between the edges of the most distant scales in each unguarded group were from 0 to 80 mm (15.9 ± 24.21 , 2). There were no significant differences between number of scales in guarded and unguarded groups ($P > 0.05$, Mann-Whitney U-test). Furthermore, the data did not show even trends toward correlations between duration of wasp constancy and number, altitude, or dispersion of scales, so they were not subjected to regression analysis. Thus, from these data, it is not evident why wasps chose certain scale groups rather than others. Other factors such as secre-



Fig. 1. A female of *Polistes fuscatus* guarding six *Kermes kingi* on a branch of *Quercus rubra*.

tion quality and quantity of the scales should be examined in view of the facts that honeydew of coccid scales is known to differ slightly during the season, and the frequency of honeydew secretion varies among larval instars (Takaki and Kawai, 1966; Kawai and Takaki, 1969).

Polistes fuscatus showed interference competition with other insects for scale secretions. These wasps fought with and warded off many insects that landed or crawled near the scales, e.g., *Episyron quinquenotatus* (Say), *Evagetes subangulatus* (Banks), and other pompilid wasps; *Camponotus nevadensis* (Fitch), *Formica subsericea* (Say), and *Myrmica brevispinosa discontinua* Weber ants; *Vespula*, chrysidid, chalcidoid, evaniid, and eumenid wasps; calliphorid and other flies; and other *P. fuscatus* of un-

Table 1. Locations of individually marked *Polistes fuscatus* (A-U) on oak branchlets with *Kermes kingi*. UM's refer to unmarked wasps.

| Branch- let | No. <i>Kermes</i> | July | | | | | | | August | | |
|----------------|----------------------|------|----|------|----------|------|----|----|--------|---|----|
| | | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 1 | 2 | 4 |
| 1 | 8 | A | A | A | - | - | - | B | UM | - | - |
| 2 | 3 | C | - | - | - | D | - | - | - | - | - |
| 3 | 4 | E | E | E | - | - | - | - | - | - | - |
| 4 | 1 | F | F | - | G, H, UM | G | UM | - | - | - | - |
| 5 | 3 | I | I | I | - | - | - | - | - | - | - |
| 6 | 3 | J | J | - | - | UM | - | - | - | - | - |
| 7 | 3 | K | K | F | L | L | L | UM | - | - | - |
| 8 | 8 | M | UM | G | UM | A | - | - | - | - | - |
| 9 | 10 | N | N | N | N | - | - | - | - | - | - |
| 10 | 8 | O | O | O | O | - | - | - | - | - | - |
| 11 | 18 | UM | UM | - | - | P | - | D | - | - | - |
| 12 | 1 | - | Q | F | R | R, O | UM | UM | - | - | - |
| 13 | 2 | - | R | R | - | UM | UM | UM | S | S | UM |
| 14 | 2 | - | T | T, Q | UM | - | - | - | - | - | - |
| 15 | 3 | - | - | - | - | U | - | U | - | - | - |
| 16 | 2 | - | - | - | - | O | S | - | - | - | - |
| 17 | 2 | - | - | - | - | O | S | - | - | - | - |

known relationships to scale defenders. *Polistes fuscatus* may have driven away parasites of *K. kingi* because chalcidoid wasps are parasites of Kermitidae (D. W. Miller, personal communication). These wasps defended the scales by landing near intruders, chasing, trying to bite, or biting them. They tended to guard only the spaces that were encompassed by scale groups. Two marked *P. fuscatus* (O, Q) that guarded particular scales for at least 1 day previously retained their scales after fights with conspecific wasps that vied for the scales.

On 5 August 1977, and during the following week, I found no *P. fuscatus* at scales. However, most scales that were abandoned by the wasps were tended by ants which indicated that the scales were still producing honeydew. Wasp visitation of scales may have been related to a scarcity of floral nectar during the unusually hot, dry summer of 1977. During the study period, there were very few wildflowers in bloom within 500 m of the study site. In late July, many *Solidago* and *Mentha* began to bloom, and by early August *Solidago* was frequently visited by *P. fuscatus* and other hymenopterans that imbibed its nectar. One marked *P. fuscatus* was found on *Solidago*. Wasps may have left the scales because flowers were a higher quality resource. It is unclear why *P. fuscatus* were not seen at scales in 1978;

however, extreme summer drought did not prevail in this year, and wild-flowers were more common. In this year, *P. fuscatus* licked aphids on *Asclepias syriaca* L.

In conclusion, this investigation revealed an apparently previously unreported type of interference competition involving *Polistes* wasps and other insects that feed on kermesid scale honeydew. Continual or continuous food production over many days by scales evidently made it worthwhile for wasps to visit and guard them during nectar scarcity. The wasps stood over or near scales and repelled conspecifics and other insects. They did not appear to waste time and energy in protecting spaces that were larger than those that contained particular scales, and they apparently left scales when floral nectar became abundant. It is likely that the wasps were opportunistic users of the honeydew in 1977 and that they are not usual associates of the scales.

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A NEW SPECIES OF *DASYMETILLA* FROM FLORIDA
(HYMENOPTERA: MUTILLIDAE)

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Abstract.—*Dasymutilla archboldi*, new species, appears to be restricted to a small area around Archbold Biological Station, Florida. Geographical and biological data pertaining to the species are presented.

In March of 1976 and 1978 and in October of 1978 numerous female specimens of a new species of *Dasymutilla* were collected in Highlands Co., Florida. We describe the species here.

Dasymutilla archboldi Schmidt and Mickel, NEW SPECIES

Female.—Ferruginous except for pair of coalescent yellow spots on posterior $\frac{1}{2}$ of 2nd tergum, 3rd through 5th terga mahogany; pubescence of head and legs pale golden, that of terga 3-5, and of all sterna pale, glittering; eyes extremely prominent; propodeal spiracles narrow, elevated, prominent; scutellar scale narrow, prominent; anterior $\frac{1}{2}$ - $\frac{2}{3}$ of disk of 2nd metasomal tergum with brush of short, stiff light ferruginous pubescence; pygidium strongly longitudinally striate; apices of middle and hind femora rounded; length 6.4 mm.

Head clothed with sparse appressed erect pale golden pubescence; eyes very prominently bulging; distance between eye and occipital margin slightly greater than $\frac{1}{2}$ greatest length of eye; from above occipital margin very shallowly concave; mandible acuminate at apex with minute tooth within at point $\frac{1}{5}$ of distance from apex; anterior margin of clypeus very feebly bidentate, almost straight; anterior $\frac{1}{2}$ of clypeus glabrous, impunctate, separated from posterior $\frac{1}{2}$ by transverse sinuate carina, posterior $\frac{1}{2}$ of clypeus punctate, clothed with long pale ferruginous pubescence, latter forming clypeal fringe; scape with moderate punctures above, clothed with very pale pubescence, 1st flagellar segment slightly longer than 2nd, length approximately $1.5 \times$ width at apex; antennal scrobes not at all carinate; front with coarse, shallow confluent punctures; vertex and gena with moderate, sep-

arated punctures; posterolateral angle of head rounded; head and mesosoma same width.

Mesosoma longer than wide, dorsum and posterior face of propodeum clothed with recumbent ferruginous pubescence, and especially anteriorly and laterally with long sparse erect pale glittering hairs; dorsum anteriorly with large reticulo-foveate punctures, each containing a short hair, spaces between punctures becoming asperate posteriorly near scutellar scale; scutellar scale narrow, prominent, from posterior view its height as great as width; pubescence of pleural region pale, glittering; propleura coarsely foveo-punctate; anterior $\frac{1}{2}$ of mesopleura smooth, micropunctate, with very fine appressed glittering pubescence, posterior $\frac{1}{2}$ coarsely punctuate; metapleura coarsely punctured at ventral margin, indistinctly punctured dorsally; lateral surfaces of propodeum mostly smooth with few large shallow punctures, posterior face vertical, rounding dorsally, dorsum asperate, with smooth areas between the asperities, posterior face smooth, bare; propodeal spiracles distinctly elevated, prominent.

Metasoma with anterior $\frac{1}{2}$ – $\frac{2}{3}$ of 2nd tergum clothed with brush of short, stiff ferruginous pubescence, pubescence of terga 3–5 pale, glittering; 1st tergum short, nodose, with coarse punctures subapically, disk glabrous with spot of dense pale glittering pubescence, apical fringe very thin, almost lacking; 2nd tergum $1.3 \times$ as long as wide; punctures of 2nd tergum moderate, confluent, each containing a short seta, setae becoming longer and more erect anteriorly. Pubescence within yellow spots golden; sides of 2nd tergum with coarse, more confluent punctures than disk, pubescence within longer, pale; apical fringe of 2nd tergum pale, glittering, interrupted medially with black pubescence; 3–5 terga with small, close punctures and pale, glittering pubescence; pygidium distinct with 7–12 prominent irregular striations extending to distal margin; pubescence of all sterna pale and glittering, longer than that on terga; 1st sternum possessing a low, weakly bidentate carina; 2nd sternum with moderate, separated punctures; sterna 3–5 with close, fine punctures; hypopygium with fine, very close punctures.

Legs ferruginous, tarsi and tibiae slightly darker than femora; pubescence of legs, except tarsi, pale, glittering; calcaria dark ferruginous.

Holotype.—♀, Archbold Biological Station, Highlands County, Florida, March 24–25, 1978 (Schmidt and Hook), in the Smithsonian Institution, USNM Type No. 75944. Paratypes (all females): From type-locality: 11, March 15–17, 1976 (Schmidt and Schmidt); 49, March 20, 24–25, 1978 (Schmidt and Hook); 6, 4 mi W Sebring, Highlands County, Florida, March 24, 1978 (Schmidt and Hook); 38, October 20–22, 1978 (Schmidt); 1, Lake Placid, Highlands County, Florida, April 1, 1954 (Krombein); 1, Lake Placid, Florida, June 26, 1962 (Krombein); 1, Polk County, Florida, March 25, 1954 (Weems). Paratypes are in the Smithsonian Institution, the American Museum of Natural History, Los Angeles County Museum of Natural His-

tory, and collections of the University of Georgia, the University of Florida, the University of Minnesota, and Archbold Biological Station.

In Mickel's (1936) key to the *Dasymutilla*, *D. archboldi* keys to couplet 70, *D. vesta sappho*, from which it is easily distinguished by the conspicuously asperated dorsal face of the propodeum, the greatly elevated propodeal spiracles, the narrower scutellar scale, the more bulging eyes, and the brush-like appearance of the pubescence on the second metasomal tergum. It can be easily separated from *D. chattahoochei* Bradley by the absence of conspicuously carinate posterolateral angles of the head, the narrower scutellar scale, and the smoother, more glabrous posterior face of the propodeum. The taxonomic position of *D. archboldi* in the genus is uncertain, though it perhaps belongs in the *caneo* group (Mickel, 1928).

Etymology.—We are proud to name this species in honor of Richard Archbold who pioneered in natural history exploration and who established the biological station where the type was collected.

DISCUSSION

Dasymutilla archboldi was by far the dominant species of mutillid wasp taken at the type-locality in March of 1976 and 1978 and in October 1978. In spite of extensive personal collecting in Florida by the first author and careful examination of specimens of *D. vesta sappho* from the collections of the University of Georgia, the Smithsonian Institution, the University of Minnesota, the Archbold Biological Station, and the authors' personal collections, only one specimen outside of Highlands County, Florida was found: that was taken in neighboring Polk County, Florida. To date all specimens were collected in early spring or mid-to-late fall.

All specimens collected by the first author and his fellow collectors were taken on very well drained coarse light-colored sand described on the 1962 General Soil Map of Florida, Florida Agricultural Experiment Station as "No. 1 Soil—excessively drained soil dominated by thick acid sand." This type of soil is restricted in range mainly to patches in Highlands County with one large area in Ocala National Forest, Marion County, Florida. Extensive collecting in the latter area in late March to mid-April 1978 in a variety of successional habitats yielded 68 females of Mutillidae, including 19 *D. vesta sappho*, 19 *D. chattahoochei*, and none of the new species. Thus, *D. archboldi* appears restricted to the small upland well-drained area around Archbold Biological Station, an area it shares with *D. v. sappho* and several other species.

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A METHOD FOR REARING THE SAND COCKROACH, ARENIVAGA TONKOWA (DICTYOPTERA: POLYPHAGIDAE)

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Abstract.—A simple method is described for the laboratory culture of the sand cockroach *Arenivaga tonkowa* Hebard. By use of this method the colony is increasing in size and has successfully passed through three generations in the laboratory.

Insects which have adapted to life in very dry environments represent a physiologically and ecologically important group of animals. Cockroaches of the genus *Arenivaga* fall in this category, and have been used in such studies (Cochran, 1976; Edney, 1966; 1968; Friauf and Edney, 1969). As with any group of animals the ability to establish and maintain a laboratory colony of these insects greatly facilitates their use as experimental animals. Past experience in my laboratory has shown that attempts to rear one member of this genus (*A. investigata* Friauf and Edney) by methods used for other cockroach species have uniformly resulted in the expiration of the colony within a few weeks. The purpose of this paper is to describe a method which has been developed for the continuous laboratory culture of *A. tonkowa* Hebard.

MATERIALS AND METHODS

The cockroaches used in this study were collected from very dry soil along the banks of the Guadalupe River north of San Antonio, Texas in July of 1977 and 1978. They were transported to the laboratory and placed in culture. The original collections numbered about 25 in 1977 and 15 in 1978.

The culture method is based upon an observation made at the collection site in 1977. The cockroaches were living in the soil under an abandoned metal drum. This appeared to be a more or less closed system with little exposure to light. To simulate these conditions a one gallon cardboard ice cream container with closely fitting lid was used as the rearing cage. Into it was placed dry sandy soil to a depth of 3–5 cm. The unsterilized soil was previously passed through a #7 USA Standard Testing Sieve in order to

remove extraneous materials. Onto the surface of the soil was placed a circular watch glass 5 cm in diameter with its concave side up. This served as the receptacle for the watering device and prevented capillary action by the soil, which otherwise would have rapidly drained the water reservoir.

The watering device was a 2 dram shell vial with lip. After filling the vial with water, its open end was closed with a piece of wet sponge cut to give a tight fit. The sponge was box shaped and measured about $4 \times 2.5 \times 2.5$ cm. When properly in place, it allowed slow withdrawal of water from the vial. The vial was laid flat on the soil surface with the wet sponge end on the watch glass. The reservoir was replenished at approximately weekly intervals, while the sponge had to be replaced periodically.

Food was supplied to the cage in the form of commercial dog food. One or two pellets were placed on the soil surface well removed from the source of water. Rearing was conducted in a room with the temperature controlled between 21–26 C at ambient relative humidity. The light intensity in the cages was very low except when the lid was removed for servicing.

RESULTS

The cockroaches were placed on the surface of the soil and immediately began burrowing into it. Within a few seconds they were completely out of sight. This appears to be their normal pattern, except for adult males and small nymphs which occasionally were found on the surface of the soil at times of servicing the cages. Additionally, when the cages were opened for servicing the cockroaches sometimes emerged from the soil and began climbing the cage walls. This is probably a positive phototropic response to a suddenly increased light intensity. Presumably, such a situation would not normally occur in the natural habitat.

Under the rearing conditions described here the colony was stabilized. Within a few weeks adults were in evidence, and oothecae were subsequently found in the soil. While detailed life-history studies have not yet been conducted, this species went from adult to adult in about 5 months. The colony has now passed through 3 generations in the laboratory, and currently numbers about 100 individuals.

DISCUSSION

The method described here has proven successful for the laboratory culture of *A. tonkowa*. It appears that it should also be adaptable to the culture of other members of this genus. Where possible, it would seem desirable to use soil collected from the natural habitat.

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**XERANOBIUM LATICEPS (COLEOPTERA: ANOBIIDAE) REARED
FROM HAPLOPAPPUS TENUISECTUS (COMPOSITAE),
WITH DESCRIPTION OF THE LARVA¹**

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Abstract.—Adults and larvae of *Xeranobium laticeps* Fall were removed from roots and root crowns of living *Haplopappus tenuisectus* (Greene) Blake in southern Arizona. Larvae were reared on an artificial diet for confirmation of larva-adult association. The larva is described.

Burroweed, *Haplopappus tenuisectus* (Greene) Blake, is an invader of depleted range lands and disturbed areas at lower elevations (2000–5500 ft) in southern Arizona, southern New Mexico, southwestern Texas, and northern Mexico. It often is abundant over large areas, sometimes the dominant vegetational cover, and is of primary concern to ranchers when it displaces grasses in heavily grazed areas. While sampling burroweed for insects in Pima and Pinal Counties, southern Arizona, we removed three adults and a number of larvae of anobiid beetles from roots and root crowns and took two adults from foliage. The beetles proved to be *Xeranobium laticeps* Fall.

MATERIALS AND METHODS

Haplopappus tenuisectus plants were dug from the soil with a 5-lb mattock. About 40 larvae were removed from the root systems and either placed in 1-oz plastic cups containing an artificial diet (Shorey and Hale, 1965) for rearing or preserved in KAAD (Peterson, 1948) and stored in 95% ethyl alcohol. Six larvae have been reared to the adult stage. They are slow in developing and may take well over a year to complete their life cycle in nature. Some that were incubated at 30 C were still feeding nearly two years after the time of their collection, but the artificial diet may lack an important nutrient, retarding larval growth.

Nine larvae, representing three general collecting sites, have been dis-

¹ University of Arizona Agricultural Experiment Station Publication No. 2939.

sected and examined for distinguishing characters. For this examination the epipharynx, maxillae, labium, and antennae were cleared in KOH solution and mounted in Hoyer's medium on microscope slides.

DISCUSSION

The biology and larvae of many Anobiidae are known; but, of the genus *Xeranobium*, only the immature of *X. macrum* Fall has been described (Böving, 1954) and associated with a food plant, the composite *Spirostachys occidentalis* Walson. The adults of this rearing were apparently transferred to *X. californicum* White by White (1971). We have removed larvae and adults of a second *Xeranobium* species from the root system of *Haplopappus tenuisectus*. Larvae were in living tissue in the root crowns and upper portions of the tap roots of both young and healthy and old and declining plants (root crown diameters from about 10 mm to 70 mm). They were not abundant and caused little damage to their host, because of their small size.

White (1971), in his revision of the genus *Xeranobium*, provides one key for the separation of males of 23 species and another for nine species of definitely known females. Of the eleven *Xeranobium* adults we reared or collected, only three were males and can assuredly be determined to species. These, based primarily on genitalia and antennal structure, belong to *X. laticeps* Fall. The females do not fit any description closely enough for a reliable identification, mainly due to extreme variation in antennal segments 4–8. The form of these segments ranges from serrate to pectinate. For example, in one female segment 4 is 0.95 times as wide as long and segment eight 1.13; in another segment 4 is 1.38 and segment eight 2.17 times as wide as long. Although these females cannot be accurately determined by the use of an adult key, they must logically be associated with the *laticeps* males because of similarity in characters exhibited by all larvae examined and by the fact that all specimens were taken from the same part of the same host species in the same area.

Böving (1927, 1954) and Parkin (1933) have treated several larval Anobiidae in detail, and we have chosen to base the description of the immature stage of *X. laticeps* on the characters used by these authors, to permit comparison.

DESCRIPTION

General (Fig. 1).—Larva (presumably full grown) scarabaeiform, up to 12 mm long, and clothed with long, fine, golden setae, these longer and denser on hypopleural folds and not obscuring surface. Color, including head capsule, near white. Thorax swollen to $1.26 \times$ width of abdomen. Abdominal segments 1–6 uniform in width, terminal segments slightly wider. Asperities present on metathorax and abdominal segments 1–7. All spiracles with accessory chambers. These vary markedly in number, size, and positioning.

even in the 2 spiracles on 1 segment. In general, they are on the anterior margin of the mesothoracic spiracles and on the posterior margin of all 8 abdominal pairs.

Head.—Head capsule perpendicular to longitudinal axis of body, broadest at $\frac{2}{3}$ below vertex, truncated at epistome, with sides evenly rounded, and covered with long, fine, golden setae which become shorter at vertex. Epistome (Fig. 6) darkly pigmented except in a median area about width of labrum, with setae along base of clypeus, and with a tuft of fine, longer setae above and mesal to each antenna. Ocelli absent. Antennae (Fig. 4) minute, bearing 1 lightly sclerotized conical appendix and 2 darker basiconical processes that have 2 minute setae near the base. Labrum emarginate, narrower than clypeus, and fringed with fine setae. Epipharynx (Fig. 2) covered on apical $\frac{1}{3}$ with long, curved setae directed mesad; those in remaining $\frac{2}{3}$ becoming a row on each side of midline, several deep, and fewer and shorter until only a few anteriorly pointed setae are present between tips of tormae; lateral marginal setae pointed with remaining setae blunt. Midline naked. Tormae darkly sclerotized. Mandibles (Fig. 3) large, dark brown to black, with 2 teeth on lower leading edge (anterior margin), and 2 groups of setae: proximal aboral group of about 15 long, fine setae arranged in vertical column, and distal group of about 5 stouter, slightly shorter setae set in a large, deep, central pit. Marginal brush absent. Anterior margin above teeth smooth, nearly straight, and with a slight bulge before rounding off above. Labial palpi 2-segmented, lightly sclerotized, and with no setae (Fig. 5). Mentum mostly membranous, rounded trapezoidal, with a band of fine setae, its basal margin lightly sclerotized. Submentum membranous, with a transverse band of fine setae on apical $\frac{1}{2}$ and a few scattered setae on basal $\frac{1}{2}$. Maxillary palpi 3-segmented; basal segment with fine setae about apex, 2nd segment with only 2 or 3 very small setae apically. Galea with stout, inward curving, sharp-pointed setae and with lower $\frac{2}{3}$ of outer edge forming a heavily sclerotized, comma-shaped support. Lacinia shorter than and about as wide as galea, densely margined with long, straight, stout setae. Stipes straight-sided, slightly longer than cardo, its basal $\frac{2}{3}$ with many fine, appressed setae, and apical $\frac{1}{3}$ with longer erect setae that reach to tip of palpus. Stipital rods darkly sclerotized, Y-shaped, with 1 branch extending into base of galea. Cardo elongate, about 4× as long as wide, lightly sclerotized at base, naked.

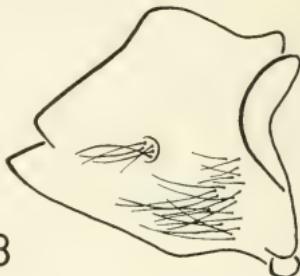
Thorax.—Legs clothed with long, fine setae and ending in a single claw. Pleural folds bulging between sulci and meso- and metathorax divided approximately in $\frac{1}{2}$ by a sinuate, longitudinal depression. Prothorax with narrow, elliptical, mesothoracic spiracles in pleural fold at its posterior edge, and with 1 notal fold. Mesothorax with 1 notal fold. Metathorax with a large prenatal fold bearing asperities on its anterior face, in 3 rows dorsally and scattered below.



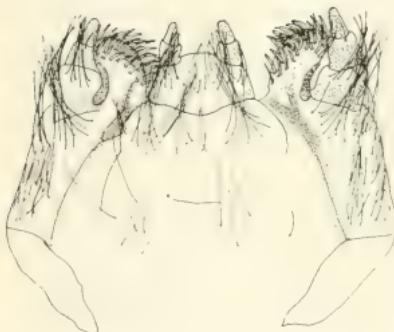
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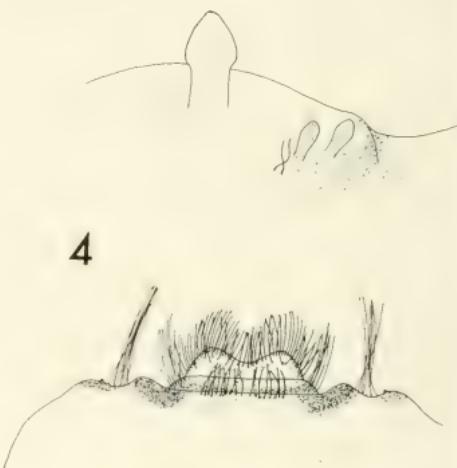
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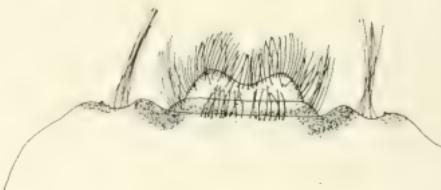
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5



4



6

Figs. 1-6. Larval *Xeranobium*. 1. Full grown larva, 8.3 \times . 2. Epipharynx, ventral view, 116 \times . 3. Left mandible, anterior view, 71 \times . 4. Antenna, 790 \times . 5. Maxillae and labium, ventral view, 5.3 \times . 6. Epistome, dorsal view, 36 \times .

Abdomen.—Segments 1–7 with broad prenatal folds bearing asperities in 2 or 3 rows dorsally, scattered below, and segments 1–6 with narrow postnatal folds. Asperities on segments 1–5 in broader bands than those on segments 6 or 7. Segment 8 cylindrical, without folds. Terminal segment with a crescent of asperities laterally.

All specimens are being held in the insect collection at the University of Arizona, Tucson.

The most noticeable differences between larvae of *Xeranobium laticeps* and *X. californicum* lie in the labrum, epipharynx, and spiracles. Böving's description of *californicum* states that the labrum is approximately circular, that some posterior setae of the epipharynx (between tips of tormae) are fan-shaped, others hook-shaped, and that the spiracles lack accessory chambers. In *X. laticeps*, the labrum is emarginate, all posterior epipharyngeal setae are blunt and similar, and all spiracles have accessory chambers. In addition, there is no pigmentation on the epistome of *X. californicum*, while more darkly pigmented areas exist on that of *X. laticeps*. No mention is made of a heavily sclerotized comma-shaped structure in the lateral edge of the galea in *X. californicum*, such as exists in *X. laticeps*. The mandibles are similar in outline but differ in the size and number of setae contained in each of the two groups. *Xeranobium laticeps* is larger, about 12 mm. compared with 7 mm for *X. californicum*.

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THE CORRECT NAME FOR *TEROSCOPUS MICATOR* OF AUTHORS
(HYMENOPTERA: ICHNEUMONIDAE)

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Abstract.—Recently, the name *Theroscopus rufulus* (Gmelin) has been incorrectly applied to the species long misidentified as *Theroscopus micator* (Gravenhorst). The correct name for the species in question is *Theroscopus oxyphymus* (Gravenhorst).

From the original description, Carlson (1979:423) determined that the name *Ichneumon micator* Gravenhorst (1807) could not possibly apply to *Theroscopus micator* of authors and presumed that misidentifications of the species had evolved from Gravenhorst's (1829) expanded definition of *micator*. Sawoniewicz (1978) studied the material identified as *micator* in the Gravenhorst collection, selected a lectotype which apparently agrees with the original description, and transferred *micator* to the genus *Aclastus*. For *Theroscopus micator* of authors, Sawoniewicz used the name *Theroscopus rufulus* (Gmelin) and suppressed a number of names, including *Hemiteles oxyphymus* Gravenhorst (the holotype of which he studied), as new synonyms of *T. rufulus*.

Sawoniewicz's usage of the name *rufulus* is based upon a specimen in the Gravenhorst collection which Sawoniewicz implied as having been labeled by Gravenhorst as *Cryptus rufulus*. That specimen agrees with Gravenhorst's (1829, v. 2, p. 622) usage of Gmelin's name (cf. Gravenhorst, 1829, v. 3, pp. 1086-1087). Unfortunately, that usage of the name *rufulus* is incorrect.

Gmelin proposed the name *Ichneumon rufulus* for *Synistata* species 311 of Zschach (1788), Zschach having published descriptions of numerous insects for which he provided no names. Zschach's *Synistata* species 366 and 312 through 316 were treated by Gmelin as varieties of *rufulus* and were designated by Greek letters rather than names, the usage of Greek letters for varieties being in the Linnean tradition (see Stearn, 1957:90-94). Because the specimens upon which Gmelin's varieties of *rufulus* are based do not qualify as syntypes of the name *rufulus* (see Stoll et al., 1964, p. 75,

art. 72 [a]), the name is restricted to species 311 of Zschach. The Gravenhorst-Sawoniewicz usage of the name *rufulus* is incorrect because it is based upon species 316 of Zschach (*rufulus* var. ζ of Gmelin) and because it disagrees in critical respects with Zschach's description of species 311. *Theroscopus oxyphymus* (Gravenhorst) is the correct name for *Theroscopus micator* of authors and *Theroscopus rufulus* sensu Sawoniewicz. Zschach's description of species 311 disagrees with *T. oxyphymus* by indicating that the mouth (clypeus and/or mandibles?) is red, that abdominal tergite 3 is red (rarely entirely red, but often entirely black, in *oxyphymus* females), and that the legs are red (Zschach's wording "geniculis posticis fuscis" with respect to his species 316 [not 311] being a major point of agreement between 316 and *oxyphymus*). The complete synonymy for *T. oxyphymus* is given below.

Theroscopus oxyphymus (Gravenhorst), revised status

Ichneumon sp. Zschach, 1788:68, no. 316. ♀.

Ichneumon rufulus var. ζ Gmelin, 1790:2717. ♀.

Cryptus rufulus: Gravenhorst, 1829, v. 2, p. 622; misapplication of name
Ichneumon rufulus Gmelin to *rufulus* var. ζ Gmelin.

Hemiteles luteiventris Gravenhorst, 1829, v. 2, p. 812. ♂. NEW SYNONYM.

Hemiteles oxyphymus Gravenhorst, 1829, v. 2, p. 815. ♂.

Hemiteles micator: Gravenhorst, 1829, v. 2, p. 833; misidentification, in part, of *Ichneumon micator* Gravenhorst, 1807:260.

Hemiteles ruficoxus Provancher, 1874:331. ♂, ♀. NEW SYNONYM.

Phygadeuon cornutus Provancher, 1882:334, 356. ♀. NEW SYNONYM.

Hemiteles politus Bridgman, 1883:146. ♀.

Phaeogenes recticornis Provancher, 1886:42. ♂, ♀. NEW SYNONYM.

Aenoplegimorpha phytonomi Viereck, 1912:147. ♂.

Hemiteles (Eriplanus) metacomet Viereck, 1917:340. ♀.

Phygadeuon silesiacus Habermehl, 1919:104. ♀. NEW SYNONYM (uncertain; placed as a synonym of *micator* by Habermehl, 1926:331).

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A KEY TO THE SPECIES OF *PATRITIUS* STAL WITH THE
DESCRIPTION OF FOUR NEW SPECIES FROM SOUTH
AMERICA (HEMIPTERA: LYGAEIDAE)¹

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Abstract.—The genus *Patritius* Stål is characterized. Ten of the eleven known species occur in South America, one is found in Cuba. A key to all species is included. Four new species are described—*P. fuligineus*, *P. ischnodemoides* and *P. englemani* from Brazil and *P. breviauris* from Peru. Notes are included on the status of *P. laevis* Stål and *P. colombianus* Slater and Wilcox. Dorsal view figures are included for *P. englemani*, *P. fuligineus*, and *P. breviauris*.

The members of the genus *Patritius* Stål are large robust blissine bugs characterized by having all femora multispinose, usually elongate scent gland auricles, eyes protruding on short lateral head extensions, terete antennae, straight apical corial margins, and closed fore coxal cavities. The pruinosity patterns are variable.

The systematic position of the genus within the Blissinae and a preliminary cladistic analysis of the species will be included in a forthcoming general analysis of the Blissinae. The present paper provides a key to all of the known species and describes four new species from South America. Though these species are described from only one or two specimens, they are all quite distinct from each other and from any of the described species. Further, their descriptions are important as they include what I believe to be the "most plesiomorphic" and "most apomorphic" species within the genus.

A summary of the history of the genus is given by Slater and Wilcox (1966) and is not repeated here. A new key to species is provided to include the new species described below. All measurements given are in mm.

Ten of the eleven known species occur only in South America and the

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other on Cuba. This pattern occurs in other taxa of Heteroptera and probably indicates a vicariant event in that part of Cuba may well have been the only area in the West Indies that was not submerged sometime during the middle Tertiary.

KEY TO THE SPECIES OF *PATRITIUS*

1. Metathoracic scent gland auricle short and lobate, not extending dorso-laterally to middle of metapleuron; legs completely light yellow (Fig. 3) *breviauris*, new species
- Metathoracic scent gland auricle elongate extending far dorso-laterad of middle of metapleuron, or if somewhat shorter then distal ends of femora black 2
2. Metathoracic scent gland auricle curving posteriorly 3
- Metathoracic scent gland auricle curving anteriorly 6
3. Pronotum with alternating bands of shining and dull pruinose surface texture *alternatus* Slater and Wilcox
- Pronotum entirely shining black 4
4. Entire scutellum completely shining, non-pruinose (Fig. 1) new species
- Median carina of scutellum shining, remainder pruinose 5
5. Either antennal segment 2 or 3 considerably longer than any individual labial segment *colombianus* Slater and Wilcox
- Either 2nd or 3rd antennal segment subequal to or shorter than any individual labial segment *cubensis* Barber
6. Pronotum posteriorly completely pruinose between humeri *longispadix* Slater and Wilcox
- Pronotum posteriorly with extensive shining non-pruinose areas present between humeri 7
7. Pronotum posteriorly with a narrow pruinose area separating elongate median transverse shining areas from ovoid shining humeral areas *grossus* Haglund
- Pronotum posteriorly with a completely shining stripe across humeri 8
8. Shining areas on anterior pronotal lobe extending broadly over and slightly below lateral margins of pronotum; labial segment 2 considerably longer than segment 3 *fuscovenosus* Stål
- Shining areas of anterior pronotal lobe not broadly attaining lateral margins, if approaching margins then labial segment 2 shorter than segment 3 9

Fig. 1. *Patritius englemani*, dorsal view.



9. Labium more elongate extending well between or slightly beyond fore coxae, 2nd segment longer than segment 3 *laevus* Stål
- Labium very short not or scarcely extending posteriorly to fore coxae, segment 2 shorter than segment 3 10
10. All tibiae and femora dark chocolate brown; length of 2nd antennal segment greater than or subequal to interocular distance; veins of membrane black, strongly contrasting with infuscated dark coloration on membrane surface (Fig. 2) *fuligineus*, new species
- All tibiae and femora uniformly pale yellow; interocular space considerably greater than length of 2nd antennal segment; veins of membrane concolorous in infuscated portion of membrane surface *ischnodemoides*, new species

Patritius englemani Slater, NEW SPECIES

Fig. 1

Description.—General coloration black to dark castaneous, surface strongly polished and shining. Clavus and corium a strongly contrasting bright yellow, latter suffused with dark chocolate brown along apical margin. Membrane black basally becoming an admixture of yellow and black to chocolate brown over most of surface. Tibiae, tarsi, and an obscure ovoid spot on humeri castaneous. Labium light yellow. Body with pruinosity limited to prosternum anterior to fore coxae where it tapers mesially from dorsal margin of underside of head to just before and below anterior acetabula.

Head with eyes small, semi-transverse, set on short narrow stalks, vertex strongly convex, tylus almost attaining distal end of 1st antennal segment, length head .96, width across eyes 1.32, interocular space .80. Pronotum broad, transverse impression obsolete mesially, lateral margins sinuately arcuate, posterior margin very shallowly concave, anterior lobe nearly impunctate, posterior lobe with scattered small punctures but impunctate between humeri, length pronotum 1.44, width 2.04. Scutellum with T-shaped elevation, length scutellum .80, width .60. Hemelytra with lateral corial margins markedly tapering caudad of level of abdominal tergum 2, membrane reaching only onto anterior portion of terga 7, abdominal connexivum broadly exposed for most of length, distance apex clavus—apex corium 1.52, distance apex corium—apex abdomen 2.32. Metathoracic scent gland auricle slightly curved posteriorly, very similar in appearance to that of *P. colombianus*. All femora strongly incrassate and armed below with 2 rows of sharp spines, fore femora with a very large spine near distal end of outer row. Labium extending between but not beyond mesocoxae 1st segment reaching base of head; length labial segments I .60, II .58, III .68, IV .64. Antennae only moderately stout, terete, length antennal segments I .28, II .60, III .62, IV 1.12. Total length 7.20.

Holotype.—♂. BRAZIL: Mato Grosso 10°25'S, 59°28'W, 17–22.III.[19]77; 300 m (D. Engleman). In American Museum of Natural History, New York.

Remarks.—This species is most closely related to *P. colombianus* agreeing with the latter in the possession of a completely shining pronotum, a similarly shaped scent gland auricle, and markedly projecting semistalked eyes. *Patritius englemani* is readily separable from *P. colombianus* by virtue of the completely shining non-pruinose scutellum and relatively much longer third labial segment which is longer than either segments two or four, whereas in *P. colombianus* segment three is subequal in length to segments two and four. This elongation of the third labial segment will also separate *P. englemani* from *P. cubensis*.

Patritius ischnodemoides Slater, NEW SPECIES

Description.—General coloration a combination of reddish brown, gray, and pale testaceous. Head, pronotum, and scutellum largely gray pruinose. Tylus, a pair of large subtriangular calli patches well separated mesially and not attaining lateral margins, a complete narrow band posteriorly across pronotum, and a narrow longitudinal mesal stripe on distal $\frac{3}{4}$ of scutellum contrastingly shining. Hemelytra variegated, clavus nearly uniformly dark red brown, very narrowly pale along claval suture, corium pale yellow with median vein, entire distal $\frac{1}{3}$ of corium, and apical corial margin dark red brown; membrane chiefly dark brown with a contrasting irregular yellow macula adjacent to apex of each corium. Pleural and ventral surfaces of head and prothorax completely pruinose. Meso- and metapleura pruinose but mesosternum broadly shining as is posterior lobe of metapleuron. Anterior acetabula pruinose, meso- and meta-acetabula shining. Legs and antennae uniformly bright orange yellow. Abdomen reddish brown, becoming paler along connexival margins. Head, pronotum, and scutellum evenly conspicuously punctate, a few scattered inconspicuous semidecumbent sericeous hairs present.

Head very slightly declivous, tylus reaching at least to middle of subglobose 1st antennal segment; eyes set on very slightly produced lateral head extensions, vertex moderately convex, length head .64, width .88; interocular space .58. Pronotum nearly evenly tapering from humeral area to anterior margin, weakly sinuate, posterior margin shallowly concave, transverse impression shallow but present, length pronotum 1.28, width 1.60. Length scutellum .70, width .82. Hemelytra with lateral corial margins very slightly sinuate, broadest a short distance posterior to distal end of claval commissure, radial vein elevated and shining on proximal $\frac{3}{4}$, membrane reaching only to distal end of abdominal tergum 6, connexivum broadly exposed laterally, distance apex clavus—apex corium 1.40, distance apex corium—apex abdomen 3.0. Metathoracic scent gland auricle elongate, linear, slightly enlarged and curving anteriorly at distal end. All femora moderately

incrassate, armed below with spines, those on fore femora large and with a very prominent spine on inner rank $\frac{1}{3}$ way from distal end. Labium short, 3rd segment barely attaining base of head, 4th segment extending over anterior portion of prosternum, length labial segments I .30, II .16, III .20, IV .24. Antennae terete, 4th segment very elongate, length antennal segments I .18, II .44, III .42, IV .86; total length 7.52.

Holotype.—♀. BRAZIL: Pirassununga, São Paulo (Schubart). In Museu Nacional, Rio de Janeiro, Brazil.

Remarks.—This is a remarkable species and in general habitus closely resembles members of the *Ischodemus tibialis* group, much more so than other species of *Patritius*. It is elongate, slender, not markedly robust, with rather short legs and antennae. However, this specimen should be referred to the genus *Patritius* as it has all of the essential generic characters. This is particularly true of the metathoracic scent gland auricle which is elongate, slender, and curves slightly forward just as it does in a number of other species of *Patritius*. Also the slightly stalked eyes, the very elongate fourth antennal segment, and, of course, the multispinose middle and hind femora are all characteristic of the genus *Patritius*. Unfortunately, no males of this species are available to ascertain the condition of the sperm reservoir.

Patritius fuligineus Slater, NEW SPECIES

Fig. 2

Description.—General coloration dark reddish brown. Head, pronotum, and scutellum chiefly gray pruinose. Tylus, a pair of large quadrate calli spots confluent mesially but not attaining lateral margins, a large broad complete transverse stripe across posterior portion of pronotal area, and median longitudinal elevation on posterior $\frac{3}{4}$ of scutellum polished and shining. Calli area black, remaining shining areas castaneous to bright reddish brown. Hemelytra completely pruinose except for shining proximal $\frac{4}{5}$ of radial vein; clavus and corium chiefly testaceous to reddish brown; cubital and medial veins darker brown; corial surface becoming suffused with reddish distally and with apical margin darkened for entire length. Membrane ground color pale yellow with veins nearly black, a broad reddish-brown area present adjacent to apical corial margin marked with a large brown macula, present on most of membrane caudad of level of apices of coria, these 2 darkened areas on membrane separated by a broad yellow lunate vitta near level of apex of corium. Below completely pruinose on head, pronotum, and prothorax, meso- and metapleuron also pruinose but mesosternum broadly shining as are all acetabula and posterior lobe of metapleuron. Abdomen, femora, and tibiae uniformly castaneous, with abdominal connexivum and tarsi yellow. Antennal segments 1, 2, and 3 dark castaneous, segment 4 almost black. Dorsal surface with numerous small inconspicuous punctures present.



Fig. 2. *Patritius filigineus*, dorsal view.

Head nondeclivous, eyes not produced laterad on short stalks, tylus reaching midway to distal end of 1st antennal segment, length head .60, width 1.03; interocular space .60. Pronotum similar to *P. laevus* in shape, strongly converging anteriorly; calli swollen, raised above level of rest of pronotum; transverse impression complete but shallow, posterior margin deeply concave, length pronotum 1.58, width 2.05. Length scutellum .95, width 1.03. Hemelytra with lateral corial margins straight; distance apex clavus—apex corium 2.03, distance apex corium—apex abdomen 2.6; membrane extending onto middle of 7th abdominal segment. Metathoracic scent gland auricle slender, elongate, moderately directed dorso-anteriorly. All femora strongly incrassate and spined below, hind femora particularly strongly incrassate, fore femora armed below with 2 rows of spines, middle spine of inner row extremely elongate. Labium very short, not or scarcely reaching fore coxae, 2nd segment remote from base of head, length labial segments I .33, II .20, III .25, IV .30. Antennae conventionally elongate, terete, 4th segment narrowly fusiform, length antennal segments I .28, II .63, III .65, IV 1.05; total length 8.70.

Holotype.—♂. BRAZIL: Minas Geraes, Passa Quatro, XII-1972 (F. Oliveira). In American Museum of Natural History, New York.

Paratype.—♂, same data as for holotype. In J. A. Slater collection.

Remarks.—There is almost no variation between the holotype and paratype specimens. *Patritius fuligineus* can be readily separated from *P. fuscovenosus* because of the lack of elongate hairs on the dorsal surface of the body, the much smaller size, the much shorter labium, and the dark colored membrane. In *P. fuscovenosus* the dorsal surface contains numerous elongate hairs which are also present on the appendages, the labium extends well between the fore coxae, and the membrane is pale yellow with the exception of the somewhat infuscated light tan veins and a dark reddish-brown area along the apical corial margin. Actually *P. fuligineus* is much more closely related to *P. laevus* which also occurs in the province of Minas Geraes and which has similar shining calli patches (although in *P. laevus* they are well-separated mesally), a very similar scent gland, similarly shaped pronota, eyes, etc. From *P. laevus*, *P. fuligineus* may be readily separated since *P. laevus* has a nearly uniformly pale testaceous hemelytra including the membrane, a much longer labium which extends well between or slightly beyond the fore coxae, and the tibiae and femora are either pale yellow or at most infuscated with castaneous on the distal portions of the femora.

Patritius laevus Stål

This species as currently understood may be composite or show considerable geographic variation. I have recently examined three specimens from Santa Barbara (Minas Geraes), Brazil taken at 1450 m in the Serra do Caraco

that have relatively much shorter and distally truncate metathoracic scent gland auricles than do other specimens studied. Usually the auricle of *P. laevis* is elongate and curves anteriorly in a long arc. However, there is considerable variation in shape. These Santa Barbara specimens also have dark caudolateral angles to abdominal connexiva 4, 5, and 6, infuscations on the membrane, and more strongly contrasting hemelytral punctures than do other specimens. They may represent a distinct species but more material will be necessary to determine this.

Patritius brevauris Slater, NEW SPECIES

Fig. 3

Description.—General coloration bright yellow. Head and anterior pronotal lobe except collar strongly contrasting black. Distal portion of tylus pale yellow. Head (except tylus), anterior portion of anterior pronotal lobe, and a broad band across mesal area of pronotum pruinose. A broad shining black stripe across area of calli including lateral margins of pronotum and broadly confluent mesally and a pale broad complete shining humeral band. Scutellum non-pruinose. Hemelytra chiefly pale yellow to nearly white marked with dark chocolate brown on cubital and medial veins. Distal portion of corium (extending as a diffuse line to level of apex of claval commissure adjacent to pale radial vein) and entire apical margin dark chocolate brown. Membrane with ground color yellow but strongly and irregularly suffused with dark brown over most of surface, veins chocolate brown. Pleural and ventral surfaces chiefly pruinose including anterior acetabula but shining on mesosternum, as an anterior stripe on mesopleuron, and all of posterior lobe of metapleuron. Abdomen bright reddish brown with connexivum pale yellow. Legs uniformly pale yellow. First antennal segment pale yellow, 2nd segment reddish brown, 3rd and 4th segments dark castaneous. Clothed with scattered semi-upright hairs especially a long series of setae-like hairs present distally along apical corial margin. Head, pronotum, and hemelytra with small inconspicuous punctures present, those on scutellum larger.

Head moderately declivent, tylus extending to distal $\frac{1}{3}$ of rather globular 1st antennal segment; eyes produced on short, thick, upturned stalks; vertex moderately convex; length head .45, width .95; interocular space .63. Pronotum with lateral margins strongly sinuate moderately tapering anteriorly, lateral margins of anterior lobe somewhat globose, transverse impression shallow but complete; posterior margin deeply concave; length pronotum 1.40, width 1.8. Scutellum with a well raised median elevation; length scutellum .98, width .90. Hemelytra with lateral corial margins straight; radial vein shining, prominently elevated; distance apex clavus-apex corium 1.52, distance apex corium-apex abdomen 2.48. Membrane extending midway over 7th abdominal tergum. Metathoracic scent

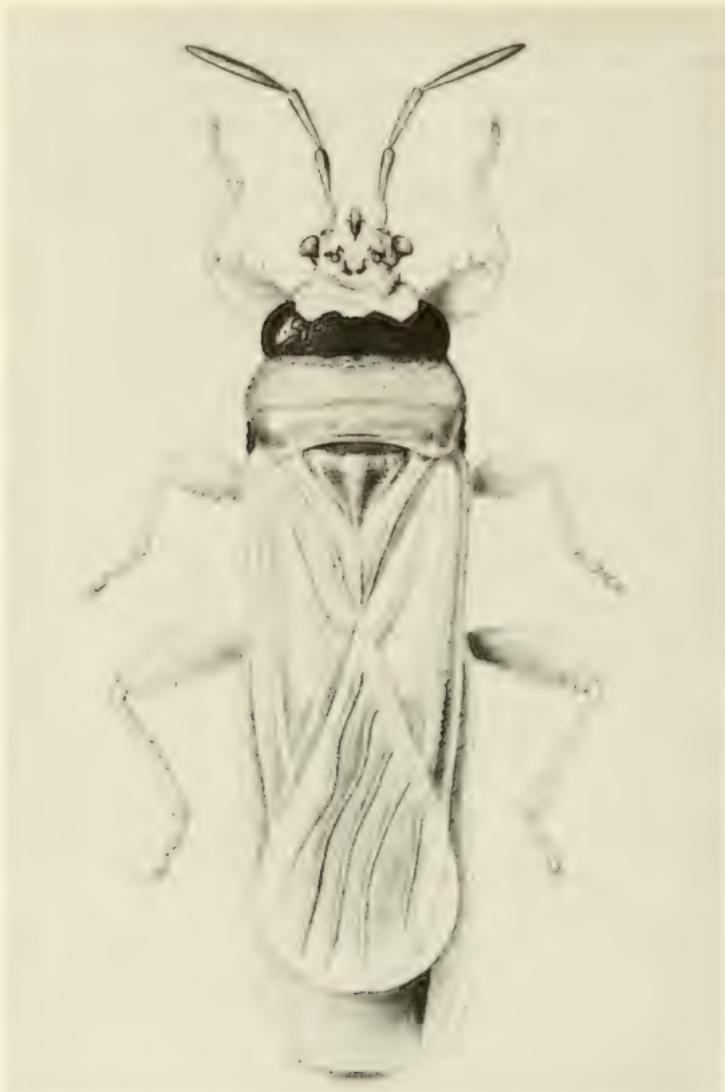


Fig. 3. *Patritius breviauris*, dorsal view.

gland auricle short, stout, lobate, slightly angled anteriorly but not strongly curving. All femora moderately incrassate armed below with sharp spines, those on middle and hind femora in a simple row, those on fore femora in 2 rows of large coarse sometimes bifurcating spines. Labium extending to or nearly to posterior margin of fore coxae, 2nd segment exceeding base of head; length labial segments I .33, II .30, III .25, IV .33. Antennae robust, conventionally terete, 4th segment elongately fusiform; length antennal segments I .20, II .53, III .53, IV 1.0. Total length 7.8.

Holotype.—♀. PERU: Quincemil, Sept. 1952 (L. E. Pena). In National Museum of Natural History, Washington, D.C., USNM Type No. 73794.

Remarks.—This species is not closely related to any of the other members of the genus. Unfortunately no males of this species are known. The very short subauricular scent gland auricle is quite unlike that found in any other member of the genus *Patritius* and makes the affinities obscure.

Patritius alternatus Slater and Wilcox

This species was described by Slater and Wilcox (1966) from a single female in the Berlin-Humboldt Museum from Colombia. We (p. 41) commented on the importance of examining a male to ascertain whether or not genal "tusks" were present, this feature being characteristic of the Papuan genus *Dentisblissus* whose members *Patritius alternatus* resembles in general habitus and in pruinosity pattern.

Through the kindness of Dr. R. M. Baranowski, I examined a male taken August 8, 1978 at Morne Bleu, Trinidad. This male resembles the holotype female very closely in color and structure. It lacks genal tusks, and thus I presume the pruinosity pattern similarities between this genus and species of *Dentisblissus* are the result of convergent, or perhaps better, parallel evolution.

ACKNOWLEDGMENTS

My sincere appreciation is extended to the following for the loan of material: Dr. R. M. Baranowski (University of Florida, Homestead); Dr. J. C. M. Carvalho and Mr. J. Becker (Museu Nacional, Rio de Janeiro); Dr. Dodge Engleman (Coco Solo Hospital, Canal Zone); Dr. R. E. Froeschner (National Museum of Natural History, Washington, D.C.) and Dr. R. T. Schuh (American Museum of Natural History, New York).

I am grateful to Mr. Steven Thurston (University of Connecticut, Storrs) for preparation of the illustrations.

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ECUADORIAN PARASCATELLA (DIPTERA: EPHYDRIDAE)

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Abstract.—Two new species of *Parascatella* Cresson are described from Ecuador: *P. ecuadorensis* (type-locality: Pujili, Cotopaxi, Ecuador); *P. spangleri* (type-locality: Santo Domingo [79.6 km E], Pinchincha, Ecuador). These are the first known species of *Parascatella* from Ecuador and represent the northernmost distribution records for the genus. *Parascatella ecuadorensis* is closely related to *P. spinicrus* Mathis and Shewell (the *pilifera* group), and *P. spangleri* is closely related to *P. brunnea* (the *brunnea* group). A key and figures of the wing, head, thorax, and male terminalia are provided.

Since publication of the revision of *Parascatella* Cresson by Mathis and Shewell (1978), two additional species have been collected in Ecuador and are being described here. This brings the total number of species in the genus to 12, although there are undoubtedly many others from the temperate regions of South America that remain to be discovered. The species described here are the first Ecuadorian species and represent the northernmost distribution records of the genus. Members of the genus were previously known to occur in Argentina, Chile, and southern Peru. Extrapolating from these data, I would expect to find representatives of *Parascatella* throughout most of the cordilleran system of western South America, where higher elevations provide for temperate climates. This area would include most of northern Peru, Bolivia, Colombia, and perhaps some of Venezuela.

Like species occurring farther south, those from Ecuador were collected primarily from higher elevations, all above 2500 m and frequently within the paramo vegetational zone. Immatures were not collected nor observed, and we still do not know anything about the natural history of the species except for descriptive notes regarding the general habitats where they were collected.

The descriptions of new species follow the same format Mathis and Shewell (1978) used in their revision.

I am grateful to L. Michael Druckenbrod for rendering the habitus illustrations, to Hollis B. Williams for preparing the distribution map, to Victor Krantz for the wing photographs, to Noreen Connell for typing the manuscript, and to Willis W. Wirth for reviewing the manuscript. For the loan of specimens from the California Academy of Sciences (CAS) I thank Paul H. Arnaud, Jr.

Parascatella Cresson

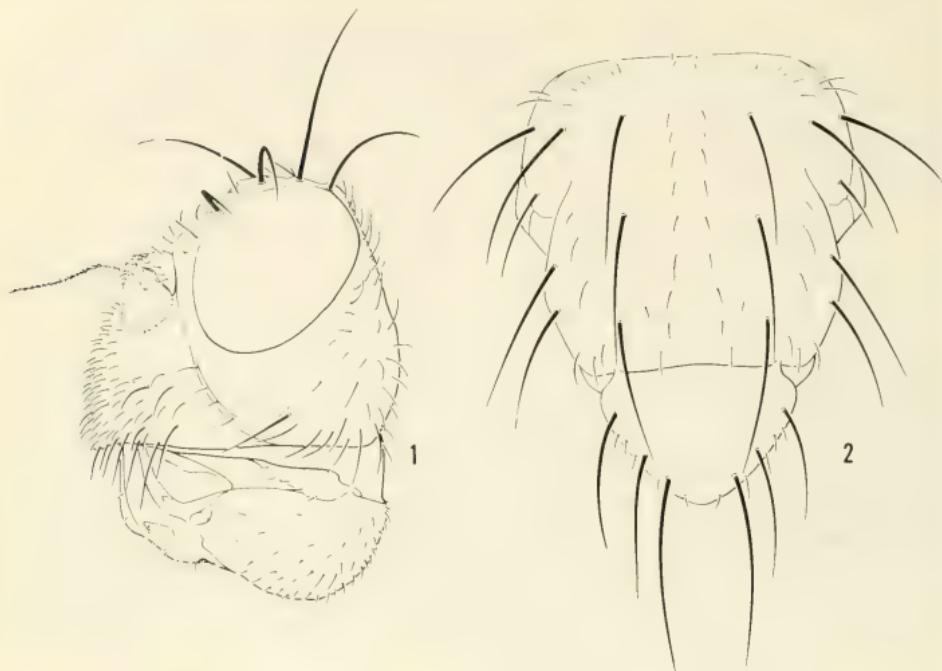
Parascatella Cresson, 1935:357 [type-species: *Scatella pilifera* Cresson, by original designation]. Mathis and Shewell, 1978:1-44 [revision].

Diagnosis.—Resembling other genera of the *Scatella* group of related genera but differing by the following combination of character states: 2 pairs of larger lateroclinate fronto-orbital bristles; lacking an outstanding pair or pairs of distinctly larger upcurved facial bristles, especially toward posteroventral corner of face; 3 pairs of dorsocentral bristles (1 + 2); acrostichal setae seriated into 2 rows and usually moderately well developed to scutellum, often with a slightly larger pair of setae at level of transverse suture; supra-alar bristle subequal in length to postalar bristle; aedeagal apodeme flattened laterally, generally teardrop-shaped; surstyli evident at venter of epandrium as lobelike setulose processes.

Discussion.—A more complete description of *Parascatella* is provided in Mathis and Shewell (1978) and need not be repeated here. Likewise, a general discussion of the phylogeny and zoogeography of the genus is included in Mathis and Shewell (1978), and I have only tried to incorporate the species treated here within the framework established in their revision.

KEY TO ECUADORIAN SPECIES OF *PARASCATELLA*

- Face unicolorous, mostly brownish; interfoveal carina, in profile, not projecting markedly forward; scutellum with 3 pairs of lateral bristles; front femur with row of spinelike setae along posteroventral surface; wing cell R_3 with 2 small white spots aligned parallel with posterior crossvein; cell R_5 with 1 distinct but small white spot
..... *ecuadorensis*, new species
- Face distinctly bicolored, antennal foveae and area dorsal of interfoveal carina silvery white to white, contrasting with dark brown coloration on remainder of face; interfoveal carina, in profile, distinctly projecting anteriorly; scutellum with 2 pairs of lateral bristles; front femur lacking row of closely set setae; wing cell R_3 with 2 large white spots, one more or less aligned with posterior crossvein, the other in apical $\frac{1}{5}$ of cell; cell R_5 with 3 white spots
..... *spangleri*, new species



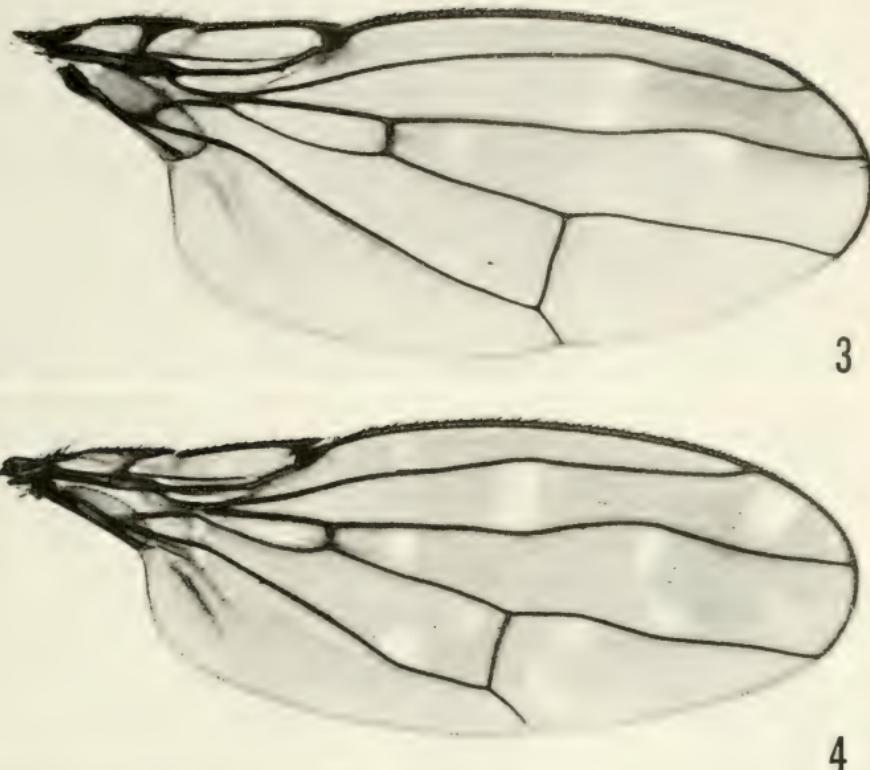
Figs. 1-2. *Parascatella ecuadorensis*. 1, Head, lateral view. 2, Thorax, dorsal view.

Parascatella ecuadorensis Mathis, NEW SPECIES

Figs. 1-3, 5

Diagnosis.—Specimens of *P. ecuadorensis* are similar to those of *P. spinicrus* Mathis and Shewell, *P. pilifera* (Cresson), and *P. lanicrus*, all of which have a row of close set, more or less spinelike setae along the posteroventral surface of the front femur. Specimens of *P. ecuadorensis*, however, may be distinguished from those of similar congeners by the following combination of character states: Face mostly unicolorous; interfoveal carina with dorsal crease but not conspicuously projecting anteriorly; dorsalmost postocular setae and acrostichal setae small, generally inconspicuous; front femur with row of spinelike setae along posteroventral margin only; wing of both sexes similar, cell R_3 with 2 small white spots, both aligned with posterior crossvein; 1 small white spot apicad of posterior crossvein in cell R_5 , this abutting vein R_{4+5} .

Description.—Medium-sized to moderately large shore flies, length 3.46 to 4.03 mm; head and thorax generally brown, faintly subshiny to shiny dorsally; abdomen brownish to slightly greenish gray, mostly pollinose, appearing dull. **Head** (Fig. 1): Mesofrons shiny, with brownish black to black luster; parafrons pollinose, brown toward vertex, becoming gradually green-



Figs. 3-4. Wing. 3, *Parascatella ecuadorensis*. 4, *Parascatella spangleri*.

ish brown toward facial suture; fronto-orbits slightly darker colored than parafrons, faintly subshiny; dorsalmost postocular seta small, subequal with others; fronto-orbits with 3-4 small setae in addition to 2 pairs of larger fronto-orbital bristles. Antenna mostly unicolorous, 1st and 2nd segments slightly lighter, brown to greenish brown, appearing dull; 3rd segment brownish black to black, becoming rather densely invested with macropubescent pile apically. Face unicolorous brown, becoming very gradually darker and shinier ventrally; interfoveal carina with distinct dorsal crease; gena more or less concolorous with face, especially antennal fovea. Thorax (Fig. 2): Mesonotum pollinose to subshiny, mostly brown but with blackish vittae, these not well differentiated posteriorly; scutellum less pollinose, appearing shinier. Notopleuron mostly concolorous with mesonotum; mesopleuron and pteropleuron concolorous, olivaceous brown, faintly subshiny; sternopleuron grayer and duller; front coxa mostly gray to whitish gray. Legs concolorous; femora greenish black with grayish pollinose vestiture, large areas on anterior and dorsal surfaces thinly pollinose, subshiny.

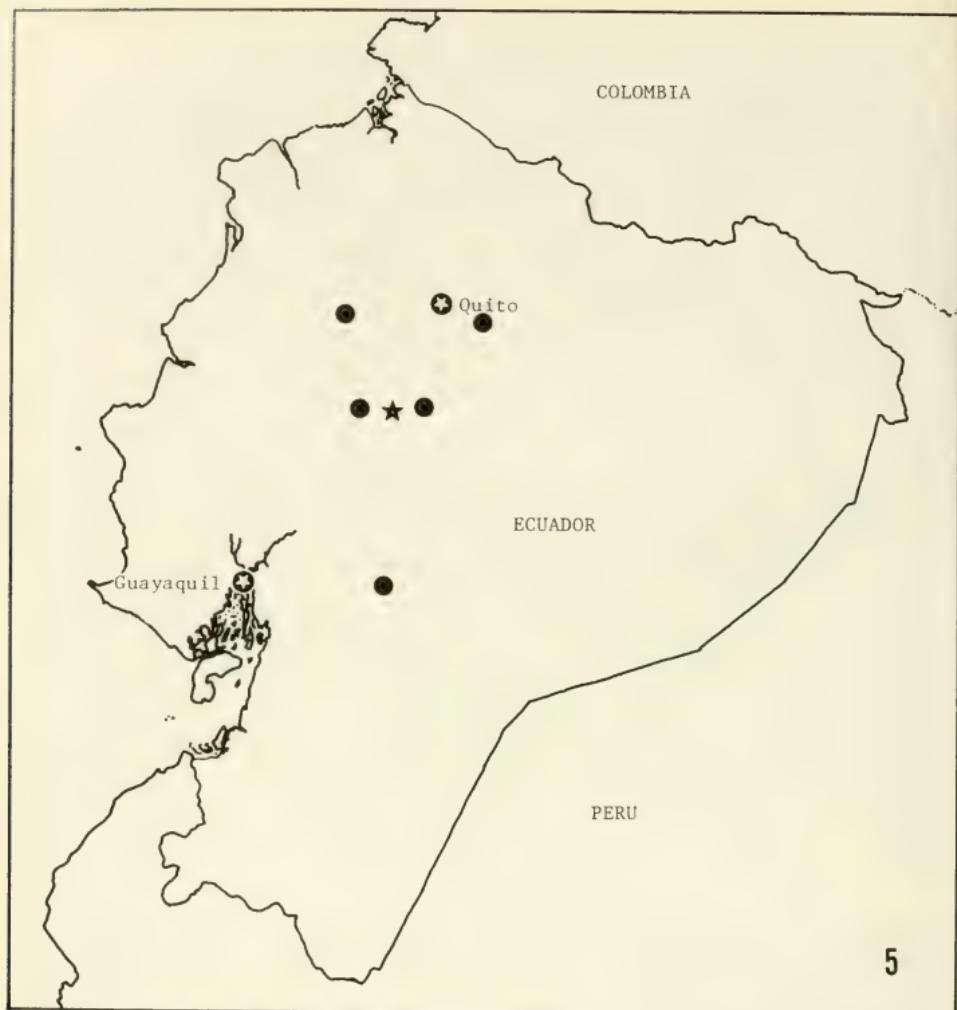


Fig. 5. Distribution map. Dots = *Parascatella spangleri*, star = *Parascatella ecuadorensis*.

to shiny; tibiae darker colored than femora; tarsi mostly blackish; front femur with row of close set spinelike setae along posteroventral margin. Wing (Fig. 3) generally infumated, brownish; costal margin with evenly spaced spinelike setae; vein R_{2+3} and R_{4+5} sinuate; pattern of white spots as follows: Cell R_3 with 2 white spots aligned just slightly apicad of posterior crossvein, anterior 1 slightly better developed; cell R_5 with 2 white spots, 1 near base of cell, other at about apical $\frac{2}{3}$ of vein R_{4+5} ; base of wing mostly pale. Abdomen: Mostly grayish with some brownish or greenish-blue coloration; greenish-blue areas slightly subshiny, otherwise mostly pollinose, appearing dull; terga 2-4 of male subequal in length, 5th slightly longer than combined length of 3rd and 4th terga; terga 1-5 about subequal in females.

Types.—Holotype ♂, allotype ♀, and 1 ♂ paratype, labeled: "Ecuador: Cotopaxi Pr[ovince] Pujili (34 km. W.) 3650 m. elev. 15 Jan 1978 WNMathis." The type-series is in the National Museum of Natural History, Smithsonian Institution, USNM Type No. 76121. The holotype specimen is double mounted (minute nadel) and is in good condition.

Geographic distribution (Fig. 5).—This species is only known from the type-locality as listed previously.

Natural history.—I collected the species by sweeping through the sparse vegetation and over muddy areas along a small waterfall and creek. The locality is situated at 3650 m elevation and the surrounding vegetation is typical of the paramo zone.

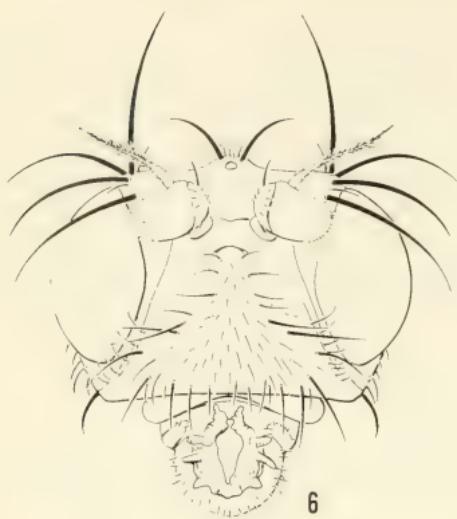
Etymology.—The specific epithet, *ecuadorensis*, refers to the country where this species occurs.

Discussion.—This species belongs to the *pilifera* group, as characterized by Mathis and Shewell (1978), and it is similar and probably closely related to *P. spinicrus*.

Parascatella spangleri Mathis, NEW SPECIES Figs. 4–10

Diagnosis.—Specimens of *P. spangleri* most closely resemble those of *P. brunnea* but may be distinguished from the latter or other congeners by the following combination of character states: Antennal foveae and face dorsad of interfoveal carina white to silvery white; arista tapering gradually to tip, with branching rays almost to tip; 2nd and 3rd tarsomeres of front leg of male highly modified, explanate (see figures); mesonotum vittate, especially anteriorly; wing veins R_{4+5} and M_{1+2} conspicuously sinuate; cell R_3 with 2 white spots; cell R_5 with 3 conspicuous white spots; aedeagal apodeme higher, not more than 2× as wide as high.

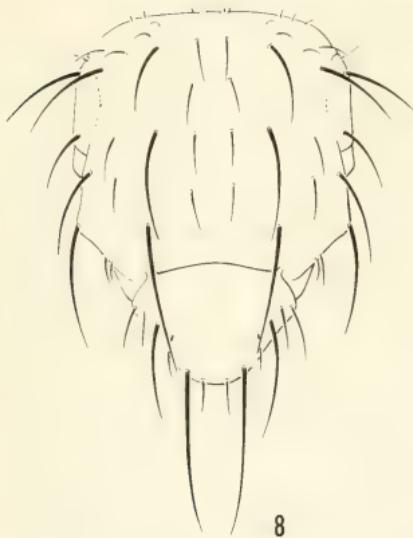
Description.—Moderately small shore flies, length 2.21 to 2.62 mm; grayish brown to blackish brown, mesonotum and mesofrons subshiny, otherwise mostly dull; densely pollinose. Head (Figs. 6–7): Mesofrons subshiny to shiny, with metallic brassy brown luster; parafrons pollinose, mostly dull charcoal brown to brown, becoming lighter, more brownish anteriorly; fronto-orbits slightly less pollinose than parafrons, darker in general; postocular setae all small. Antenna mostly unicolorous brownish black to black, 3rd segment invested with macropubescent scattered pile; arista tapering gradually to apex, with branching rays along dorsum nearly to apex. Face distinctly bicolored; antennal foveae and dorsum of face dorsad of interfoveal carina silvery white to white, conspicuously contrasting with blackish-brown color on remainder; becoming slightly more pollinose ventrally; interfoveal carina distinctly creased dorsally; longest facial setae about equal to length of 3rd antennal segment; gena appearing more pollinose and slight-



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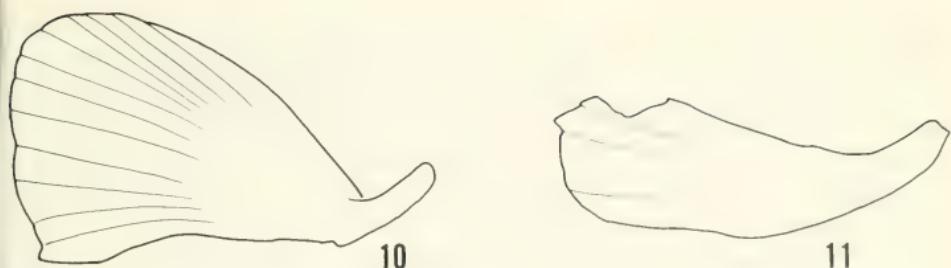
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Figs. 6-9. *Parascatella spangleri*. 6, Head, anterior view. 7, Head, lateral view. 8, Thorax, dorsal view. 9, Front leg of male, anterior view.

ly lighter in color, grayer and tannish. Thorax (Fig. 8): Generally pollinose, dorsum dimly subshiny to distinctly subshiny. Mesonotum with 3 vittate markings anteriorly, these becoming weaker posteriorly, many specimens with only median 1 continuing to scutellum; vittae lighter in color, tannish, otherwise mesonotum brownish black, becoming shinier posteriorly; scu-



Figs. 10–11. Aedeagal apodeme. 10, *Parascatella spangleri*. 11, *Parascatella brunnea*.

tellum with only 2 larger lateral bristles, but with 3–4 pairs of setae in addition; propleuron decidedly lighter in color, yellowish tan to brown; notopleuron more or less concolorous with mesonotum; posterodorsal portion of mesonotum and anterior portion of pteropleuron mostly concolorous, brown; remaining pleural areas becoming grayer. Legs more or less concolorous; femora mostly grayish black, frequently with some faint greenish to olivaceous tinges; tibiae and tarsi mostly black; front tarsi of male modified (Fig. 9), 2nd and 3rd tarsomeres with median explanate projections. Wing (Fig. 4) shape and pattern of white spots similar in both sexes; with evenly spaced, spinelike setae along anterior margin; most veins conspicuously sinuate, particularly around white spots; generally infumated, brownish; pattern of white spots as follows: Cell R_3 with 2 spots, 1 aligned with posterior crossvein subrectangular and extending across cell, apical 1 circular and not abutting any veins; cell R_5 with 3 spots, 2 apicad of posterior crossvein and more or less in line with each other, posterior 1 slightly more apicad than anterior spot; discal cell with 1 spot along posterior margin in apical $\frac{1}{3}$ of cell; cell M_2 with 2 faintly developed spots more or less aligned parallel with posterior crossvein. Abdomen: Generally unicolorous, brownish black, faintly subshiny; terga 2–4 of male more or less subequal in length, 5th tergum as long as combined length of terga 2–4; female with terga 1–5 more or less subequal. Aedeagal apodeme (Fig. 10) relatively high, flattened laterally.

Types.—Holotype ♂, allotype ♀, and 49 paratypes (25 ♂, 24 ♀), labelled: "ECUADOR: Pinchincha (Province) Santo Domingo (79.6 km. E.) 2545 m. elev. 7 Jan 1978 WNMathis." Other paratypes as follows: ECUADOR: Chimborazo Province, Alausí, 40 mi S. 20 Feb 1955, E. I. Schlinger and E. S. Ross collectors (1 ♀, CAS); Cotopaxi Province, Latacunga, 16 mi N. 3000 m elev., 21 Feb 1955, E. I. Schlinger and E. S. Ross collectors (18 ♂, 7 ♀; CAS); Pujili, 65.3 km W. 3795 m elev., 15 Jan 1978, W. N. Mathis (5 ♂, 2 ♀; USNM). Napo Province, Papallacta, 4 km W. 18 Jan 1978, W. N. Mathis (1 ♀; USNM). The holotype, allotype, and paratypes from the type-locality are in the National Museum of Natural History, Smithsonian Insti-

tution, USNM Type No. 76122. The holotype specimen is double mounted (minute nadel) and is in excellent condition. Paratypes will also be deposited in the Canadian National Collection, Ottawa; British Museum (Natural History), London; and American Museum of Natural History, New York.

Geographic distribution (Fig. 5).—This species is known to occur only in Ecuador, in the three provinces listed previously. Each of these localities is in the Andes Mountains above 2500 m elevation.

Natural history.—I collected the specimens from the type-locality in the cloud forest just west of Quito on the road descending from there to Santo Domingo. The day was overcast, and there was an occasional sprinkle of rain. The specimens were swept from vegetation, mostly grasses, around small pools of accumulated water on an old road bed.

Etymology.—It is my pleasure to name this species after my colleague and companion during the collecting trip which resulted in most of the type series, Dr. Paul J. Spangler.

Discussion.—This species is the sister species of *P. brunnea* and together these two species comprise the *brunnea* group, as characterized in Mathis and Shewell (1978:25). Like *P. brunnea*, specimens of *P. spangleri* have only two lateral scutellar bristles and the surstyli, although quite evident, are not as distinctly separated from the ventral margin of the epandrium. In addition, the face of members of this group is less setulose.

Unlike species of the *pilifera* group, the configuration of the aedeagal apodeme seems to be a distinguishing character at the species level in the *brunnea* group. This structure, in males of *P. spangleri*, is considerably higher and appears to be more robust than in males of *P. brunnea*.

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KEYS TO SPECIES OF THE GENUS *PICTURAPHIS* (HOMOPTERA:
APHIDIDAE) WITH DESCRIPTIONS OF NEW SPECIES¹

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Abstract.—*Picturaphis pojani*, *P. venezuelensis*, and *P. venezuelensis meridensis* are described as new from Venezuela. Keys are given for the apterous and alate viviparae of *Picturaphis* in South America and Puerto Rico.

The genus *Picturaphis* was described by Blanchard (1922:44) with *P. vignaphilus* as the type-species. *Picturaphis brasiliensis* was described by Moreira (1925:26), and *P. puertoricensis* was described by Smith (1970:686). Eastop (1968:128) used *Picturaphis* as a subgenus of *Micromyzus*. Eastop and Hille Ris Lambers (1976:354) used *Picturaphis* as a subgenus of *Microparsus* Patch. We think *Picturaphis* deserves generic rank. In *Microparsus* the siphunculi are tapering, being distinctly wider at the base than at the apex. In *Picturaphis* the siphunculi are cylindrical or slightly swollen on the distal half (see Smith, 1970 for key and discussion of related genera).

The following abbreviations are used: a.s.—antennal segment; h.t.—hind tarsomere; p.t.—processus terminalis; R IV + V—rostral IV + V; t.ch.—tarsal chaetotaxy. Collectors initials refer to: MCL—Mario Cermeli L.; CKS—Crystle K. Smith; CFS—Clyde F. Smith.

All measurements are in millimeters, the first measurement is that of the holotype. Measurements in parentheses represent the range for five specimens, unless indicated otherwise.

Picturaphis pojani Cermeli and Smith, NEW SPECIES

Apterous viviparous female.—*Color of living specimens:* Shiny brown, paler toward head and pronotum. Dusky to black on antennae, distal end of tibiae, tarsi, and siphunculi. Cauda pale to dusky.

¹ Paper no. 5924 of the Journal Series of the North Carolina Agricultural Research Service, Raleigh, North Carolina 27607.

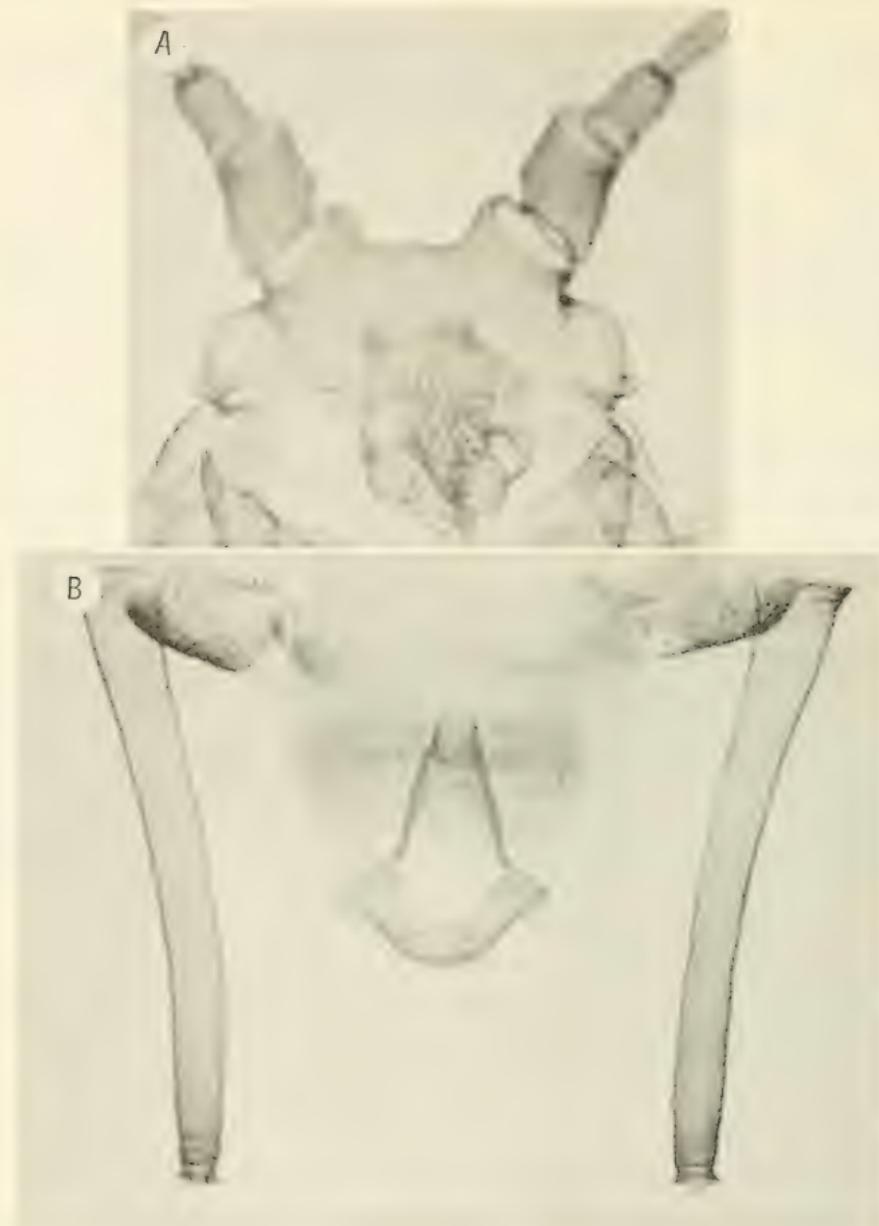


Fig. 1. *Picturaphis pojani*, aptera. A, Head and a.s. I, II. B, Tip of abdomen with spinules and cauda.

Color of cleared specimens: Dark on head, a.s. I-II, base of a.s. III, distal $\frac{1}{2}$ of a.s. V and VI, hind femora, apices of tibiae, tarsi, siphunculi, and post-siphuncular sclerites. Abdomen pale except for post-siphuncular sclerites, lateral sclerites on tergum VIII surrounding spiracles and dark bar on tergum VIII.

Morphological characters: Head with well developed frontal tubercles, parallel on inner sides, strongly spinulose. Antennae as long or slightly longer than body, a.s. I-II strongly spinulose; III bearing 0-1 secondary rhinaria near base, generally shorter than p.t. Rostrum reaching beyond coxae III; R IV + V equal to slightly longer than h.t. II, bearing 6 secondary setae. Coxae and femora spinulose. T.ch. 3-3-3. Siphunculi long, approximately $\frac{1}{3}$ length of body, slightly swollen, imbricated, with few apical striae. Tergum VIII generally with 5 (4-6) setae. Cauda conical to tapering, approximately $\frac{1}{4}$ length of siphunculi, bearing 5-6 setae.

Measurements: Length of body 1.83 (1.63-1.83); width of head 0.42 (0.39-0.43); a.s. III 0.53 (0.47-0.53), IV 0.35 (0.34-0.37), V 0.37 (0.31-0.37), VI 0.17 (0.15-0.18); R IV + V length 0.13 (0.13), width .055; hind tibia 1.34 (1.17-1.38); hind tarsus 0.13 (0.12-0.13); siphunculus 0.61 (0.51-0.63); cauda length 0.16 (0.13-0.17).

Alate viviparous female.—*Color of living specimens:* Dark shiny brown, paler toward head. Black on a.s. I, II, distal end of a.s. V, a.s. VI, distal end of tibiae, tarsi, and distal end of siphunculi. Pale on remainder of antennae, legs, and cauda. Wing veins strongly bordered.

Color of cleared specimens: Dark on head, antennae, thorax, coxae, trochanters, femora except base, tibiae, tarsi, lateral, intersegmental and post-siphuncular sclerites, abdominal terga VII and VIII, siphunculi, and genital plate.

Morphological characters: Head with frontal tubercles well developed, parallel sided; spiculose ventrally and caudad, slightly spiculose to smooth dorsally. Cephalic setae shorter than .011. Antennae equal to slightly longer than body, strongly spiculose on a.s. I-II; a.s. III usually shorter than p.t. Rostrum reaching coxae III. R IV + V as long or longer than h.t. II, bearing 4-6 secondary setae. Wing veins strongly bordered with black halo, hind wings with 1 oblique vein. Coxae and femora spinulose. Lateral and intersegmental sclerites well developed, lateral tubercles not evident. Ante-siphuncular sclerites reduced to small spots or absent, post-siphuncular sclerites well developed and surrounding more than $\frac{1}{2}$ base of each siphunculus. Siphunculi dark, slightly swollen, more imbricated toward tip with a few preapical striae. Tergum VIII with sclerotic bar, bearing 4-5 short setae. Cauda tapering, bearing 5-6 setae.

Measurements: One specimen. Length of body 2.05; width of head 0.45; a.s. III 0.57, IV 0.45, V 0.37, VI .15 + .54; R IV + V length .13; hind tibia 1.45; hind tarsus 0.12; siphunculus 0.57; cauda length 0.15.

Type-locality.—San Antonio, MI., Venezuela.

Types.—*Holotype*: Apterous vivipara on a slide with an alate vivipara (from coll. no. 75-93) in U.S. National Museum of Natural History, Washington, D.C. *Paratypes*: In the USNM(NH); British Museum (Natural History), London; Florida State Collection of Arthropods, Gainesville; North Carolina State University, Raleigh; and the collections of the authors.

Collections.—On unidentified fern, El Atravesado, Colonia Tovar, AR., 28/XII/67, MCL; S. Antonio, MI., 9/XI/74, 23/VIII/75, MCL, 2/XI/75, CKS-CFS-MCL (Coll. #75-25, 75-26), 26/XI/75, CKS-CFS-MCL (Coll. #75-93).

Chief distinguishing characters.—Strongly spiculose head, rostrum, coxae and femora in apterae. Long siphunculi, about 0.30 length of body, with preapical striae. Wing veins strongly bordered, hind wing with 1 oblique vein.

Diagnosis.—This species is not a typical *Picturaphis* (see characters in keys); however, it fits with this group of species better than with any other species with which we are acquainted.

Etymology.—This species is named in honor of Giovanni Pojani, who owned the property where this aphid was collected.

Picturaphis venezuelensis Cermeli and Smith, NEW SPECIES

Apterous viviparous female.—*Color of living specimens*: Greenish to bluish black, pruinose. Black on a.s. I-II, a.s. III at joints, distal $\frac{1}{2}$ of a.s. V, a.s. V-VI, distal $\frac{1}{4}$ of femora and tibiae, and tarsi. Pale on a.s. III, basal $\frac{1}{2}$ of a.s. IV, coxae, trochanters, basal $\frac{3}{4}$ of femora and tibiae, base of siphunculi, and cauda.

Color of cleared specimens: Black on a.s. I-II, apex of a.s. III, distal $\frac{1}{3}$ of a.s. IV, a.s. V-VI, frontal tubercles, around base of antennae, rostrum, distal $\frac{1}{5}$ of femora, apices of tibiae, tarsi, distal $\frac{1}{2}$ of siphunculi, cauda, and anal plate. Dark on coxae, around spiracles and lateral abdominal tubercles, and ante-siphuncular sclerites, terga VII-VIII, and genital plate.

Morphological characters: Frontal tubercles well developed, diverging, rough on inner sides, bearing short, stout setae apically, about .011 long. Head with frontal median process prominent, smooth dorsally, spiculated toward frontal tubercles and ventrally. Spicules on ventral side arranged as a V, the arms starting on frontal tubercles and vertex toward clypeus. Ventral cephalic setae pointed, about .011 long. Dorsal cephalic setae somewhat longer. A.s. I-II spiculose, a.s. I rough on inner side, bearing tiny setae on vertex and ventral side, a.s. III bearing 1, rarely 2, secondary rhinaria at

Fig. 2. *Picturaphis venezuelensis*, aptera. A, Head and a.s. I, II. B, Tip of abdomen with siphunculi and cauda.



base. Rostrum reaching coxae III, R IV + V longer than h.t. II, bearing generally 2 (1-3) secondary setae. Ventral abdominal integument finely striated. Lateral abdominal tubercles present on terga II-IV, surrounded by variably sized pigmented areas. Intersegmental sclerites seldom present. Ante-siphuncular sclerites variable in size and shape. Tergum VII with pigmented sclerotic bar, often broken medially. Tergum VIII with pigmented sclerotic bar, bearing 6-8 setae. Cauda conical, often slightly constricted medially, bearing 6-8 setae.

Measurements: Length of body 2.6 (1.8-2.6); width of head 0.50 (0.43-0.50); a.s. III 0.71 (0.49-0.71), IV 0.60 (0.44-0.60), V 0.55 (0.38-0.55), VI 0.16 (0.13-0.17) + 0.89 (0.65-0.89); R IV + V length 0.15 (0.15-0.16); hind tibiae 2.0 (1.57-2.0); hind tarsi 0.14 (0.12-0.14); siphunculi 0.45 (0.39-0.50); cauda length 0.18 (0.18-0.27).

Alate viviparous female.—*Color of living specimens:* Green to bluish black, pale toward head. Black on antennae, eyes, distal $\frac{1}{2}$ of femora, distal $\frac{1}{3}$ of tibiae, tarsi, and distal $\frac{2}{3}$ of siphunculi. Pale on coxae, trochanters, basal $\frac{1}{2}$ of femora, basal $\frac{2}{3}$ of tibiae, basal $\frac{1}{3}$ of siphunculi, and cauda.

Color of cleared specimens: Dark brown to black on antennae, head, thorax, distal $\frac{1}{3}$ of femora, apices of tibiae, tarsi, lateral, dorsal, ante- and post-siphuncular sclerites, terga VII-VIII, distal $\frac{1}{2}$ of siphunculi, cauda, anal and genital plates.

Morphological characters: Head similar to apterae but spiculose on ventral side only. Antennae 1.14 length of body, a.s. III bearing 6 (3-8) secondary rhinaria. Rostrum reaching coxae II, otherwise as in apterae. Coxae and femora spiculose. Ventral and dorsal abdominal setae pointed, not longer than $\frac{2}{3}$ basal diameter of a.s. III. Lateral abdominal sclerites well developed, bearing tubercles on terga II-IV. Terga I-III with short transverse spinal bars. Ante-siphuncular sclerite semilunar, post-siphuncular sclerite well developed. Terga VII-VIII with sclerotic bars. Siphunculi swollen on distal $\frac{2}{3}$, pale on basal half, slightly imbricated, generally with 1-2 preapical striae. Tergum VIII usually with 7 setae. Cauda finger-like to conical, constricted medially, bearing 7-8 setae.

Measurements: Length of body 2.05; width of head 0.46; a.s. III 0.60, IV 0.55, V 0.48, VI 0.16 + 0.87; R IV + V length 0.15; hind tibiae 1.65; hind tarsus 0.13; siphunculus 0.37; cauda length 0.20.

Type-locality.—La Soledad, BA., Venezuela.

Types.—*Holotype:* Apterous vivipara on a slide at 1 o'clock with 3 other apterous vivipara, near La Soledad, BA., Venezuela (from coll. no. 75-46) in the U.S. National Museum of Natural History, Washington, D.C. *Paratypes:* In the USNM(NH); British Museum (Natural History), London; North Carolina State University, Raleigh; and the collections of the authors.

Collections.—*Desmodium* sp. (Pega-pega), El Consejo, AR., 23/X/73, MCL; Colonia Tovar, AR., 5/XI/75, CKS-CFS-MCL (75-38); near La So-

ledad, ME., 11/XI/75, CKS-CFS-MCL (75-46); Pueblo Llano, ME., 16/XI/75, CKS-CFS-MCL (75-78).

Diagnosis.—This species can be separated from other species of *Picturaphis* by characters given in the keys.

Etymology.—This species is named for Venezuela.

Picturaphis venezuelensis meridensis
Cermeli and Smith, NEW SUBSPECIES

Apterous viviparous female.—*Color of living specimens:* Brown to reddish brown, somewhat paler toward head. Black on distal $\frac{1}{4}$ of a.s. V–VI, distal $\frac{1}{4}$ of femora and tibiae, tarsi, and distal $\frac{1}{2}$ of siphunculi. Tan on a.s. III–IV, base of V, remainder of legs, base of siphunculi, and cauda.

Color of cleared specimens: Dusky. Dark brown to black on frontal tubercles, a.s. I–II, a.s. III at joints, distal $\frac{1}{4}$ of a.s. IV, apices of femora and tibiae, tarsi, dorsal intersegmental and ante-siphuncular sclerites, distal $\frac{1}{2}$ of siphunculi, terga VII–VIII, cauda, and anal plate. Brown on head, rostrum, and coxae. Pale on remaining segments of antennae and legs.

Morphological characters: Frontal tubercles well developed, divergent, strongly spinulose, bearing short, stout setae about .011 long. Head with distinct median frontal process, spiculose ventrally, cephalic setae .011–.022 long, pointed. Antennae 1.05 length of body, a.s. I rough on inner sides, bearing numerous tiny setae on inner and ventral sides, spiculose, a.s. III, bearing 1–2 basal secondary rhinaria, antennal setae short, inconspicuous, about .011 long. Rostrum reaching coxae III, R IV + V longer than h.t. II, bearing 2–4 secondary setae. Coxae finely imbricated, femora spiculose. Ventral integument reticulated. Intersegmental sclerites usually present, may be faint or absent in teneral specimens. Lateral abdominal tubercles present on terga II–IV, surrounded by small pigmented area. Dorsal abdominal setae short, as on antennae, ventral setae as on head. Ante-siphuncular sclerites variable in size and shape. Siphunculi imbricated, swollen on distal $\frac{2}{3}$, pale at base, about 0.19 length of body. Tergum VII with sclerotic bar, generally broken medially, bearing 4–5 setae. Tergum VIII with entire sclerotic bar bearing 6–8 setae. Cauda slightly tapering, bearing 8–10 setae.

Measurements: Length of body 2.02 (2.0–2.29); width of head 0.46 (0.46–0.51); a.s. III 0.55 (0.55–0.61), IV 0.49 (0.46–0.54), V 0.40 (0.39–0.44), VI 0.13 (0.13–0.15) + 0.89 (0.72–0.93); R IV + V length 0.15 (0.14–0.15); hind tibia 1.52 (1.52–1.66); hind tarsus 0.13 (0.12–0.14); siphunculus 0.41 (0.41–0.45); cauda length 0.22 (0.22–0.26).

Alate viviparous female.—*Color of living specimens:* Head yellowish brown. Dusky on a.s. I–II, pale at base of III, remainder black. Brown to black on thorax. Dark brown abdomen with black lateral sclerites. Tan on femora and tibiae except apices, siphunculi except distal $\frac{1}{2}$, and cauda. Black on apices of femora and tibiae, and distal $\frac{1}{2}$ of siphunculi.



B



Morphological characters: Head and frontal tubercles as in apterae, but spicules scarce, confined to frontal tubercles only. Antennae about 1.20 length of body, a.s. I-II similar to those of apterae, a.s. III bearing 5-8 secondary rhinaria. Rostrum as in apterae. Abdomen pale except for well developed lateral sclerites, bearing lateral tubercles on II-V. Ante-siphuncular sclerites small, post-siphuncular sclerites well developed. Siphunculi slightly imbricated, pale at base, swollen on distal $\frac{2}{3}$, with few preapical striae. Terga VII-VIII with sclerotic bars, the latter bearing usually 6 setae. Cauda conical, slightly constricted medially, about .53 length of siphunculi, usually bearing 8 setae.

Measurements: One specimen. Length of body 2.03; width of head 0.44; a.s. III 0.61, IV 0.53, V 0.47, VI 0.14 + 0.91; R IV + V length 0.14; hind tibia 1.67; hind tarsus 0.13; siphunculus 0.40; cauda length 0.20.

Type-locality.—Pueblo Llano, ME., Venezuela.

Types.—*Holotype*: Apterous vivipara, from coll. no. 75-77, with an alate vivipara in U.S. National Museum of Natural History, Washington, D.C. *Paratypes*: In the USNM(NH); British Museum (Natural History), London; North Carolina State University, Raleigh; and the collections of the authors.

Collections.—*Desmodium adscendens* (Guacarillo), Las Piedras, ME., 12/XI/75, CKS-CFS-MCL (75-53). *Desmodium sericophyllum* (Pega-pega), Las Piedras, ME., 12/XI/75, CKS-CFS-MCL (75-57). *Desmodium* spp. (Pega-pega), Las Piedras, ME., 12/XI/75, CKS-CFS-MCL (75-56); Pueblo Llano, ME., 12/XI/75, CKS-CFS-MCL (75-59); Pueblo Llano, ME., 16/XI/75, CKS-CFS-MCL (75-77, 75-79); S. Antonio, MI., 26/XI/75, CSK-CFS-MCL (75-88).

Diagnosis.—This subspecies can be separated from other species of *Picturaphis* by characters given in the key.

Etymology.—This subspecies is named for Merida, the state in which the type-locality occurs.

KEYS TO *PICTURAPHIS* OF SOUTH AMERICA AND PUERTO RICO

Apterous Vivipara

- | | | |
|-------|--|------------------------------|
| 1. | Abdominal segment II-IV with lateral tubercles. On Fabaceae . . . | 2 |
| - | Abdominal segment II-IV without lateral tubercles. On fern | |
| | | <i>pojanii</i> , new species |
| 2(1). | Presiphuncular sclerite present | 3 |
| - | Presiphuncular sclerite absent | 5 |



Fig. 3. *Picturaphis venezuelensis meridensis*, aptera. A, Head and a.s. I, II. B, Tip of abdomen with siphunculi and cauda.

- 3(2). R IV + V with 4 accessory setae 4
 - R IV + V with 2-3 accessory setae *vignaphila* Blanchard
 4(3). Abdomen without elongated lateral intersegmental scleroites; living specimens dull bluish black *venezuelensis*, new species
 - Abdomen with elongated lateral, intersegmental scleroites; living specimens dull reddish brown
 *venezuelensis meridensis*, new subspecies
 5(2). Siphunculi 1.1-1.5 times length of cauda *brasiliensis* (Moreira)
 - Siphunculi 1.7-2.0 times length of cauda *puertoricensis* Smith

Alate Vivipara

1. Abdominal segment 2-4 with lateral tubercles. On Fabaceae 2
 - Abdominal segment 2-4 without lateral tubercles. On fern
 *pojanii*, new species
 2(1). Height of antennal tubercle on inner side 0.04-0.05 3
 - Height of antennal tubercle on inner side 0.07-0.08 4
 3(2). Siphunculi 1.4-1.6× length of cauda *brasiliensis* (Moreira)
 - Siphunculi 1.7-2.1× length of cauda *puertoricensis* Smith
 4(2). Setae on vertex, immediately above median ocellus, 0.08-0.09,
 blunt to slightly enlarged at tip 5
 - Setae on vertex, immediately above median ocellus, 0.03, blunt
 to fan-shaped *vignaphila* Blanchard
 5(4). Living specimens (apterae) dull bluish black
 *venezuelensis*, new species
 - Living specimens (apterae) dull reddish-brown
 *venezuelensis meridensis*, new subspecies

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MITES OF THE FAMILY LOHMANNIIDAE (ACARI: ORIBATEI) FROM TEXAS

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Abstract.—Members of the Oribatei family Lohmanniidae were collected from the Gulf Coastal region of south Texas and included a new genus *Pseudocryptacarus* and two new species, *Pseudocryptacarus graminosus* and *Torpacarus gramineus*. The distribution of *Lohmannia banksi* Norton, Metz, and Sharma is extended to include Texas.

During an investigation on the microarthropod fauna of the Rob and Bessie Welder Wildlife Foundation located in the Gulf Coastal region of south Texas, members of the Oribatei family Lohmanniidae were collected and included two new species, a new genus, and an extension of the known distribution of *Lohmannia banksi* Norton, Metz and Sharma. Descriptions are of adults only.

Pseudocryptacarus McDaniel, Norton, and Bolen, NEW GENUS

Diagnosis.—Genital plate with transverse suture; preanal plate broad; 5 adanal setae; anal and adanal plates fused; strong neotrichy over entire notogaster.

Type species.—*Pseudocryptacarus graminosus*, new species.

Pseudocryptacarus graminosus

McDaniel, Norton, and Bolen, NEW SPECIES
Figs. 1-2

Dimensions and color.—Mean total length of 6 specimens 486 μ (range 485-488 μ); mean maximum notogastral width 251 μ (range 250-252 μ). Color, reddish brown. Shape similar to members of the genus *Cryptacarus* Grandjean, flat and elongated with parallel borders (Fig. 1). Transverse band

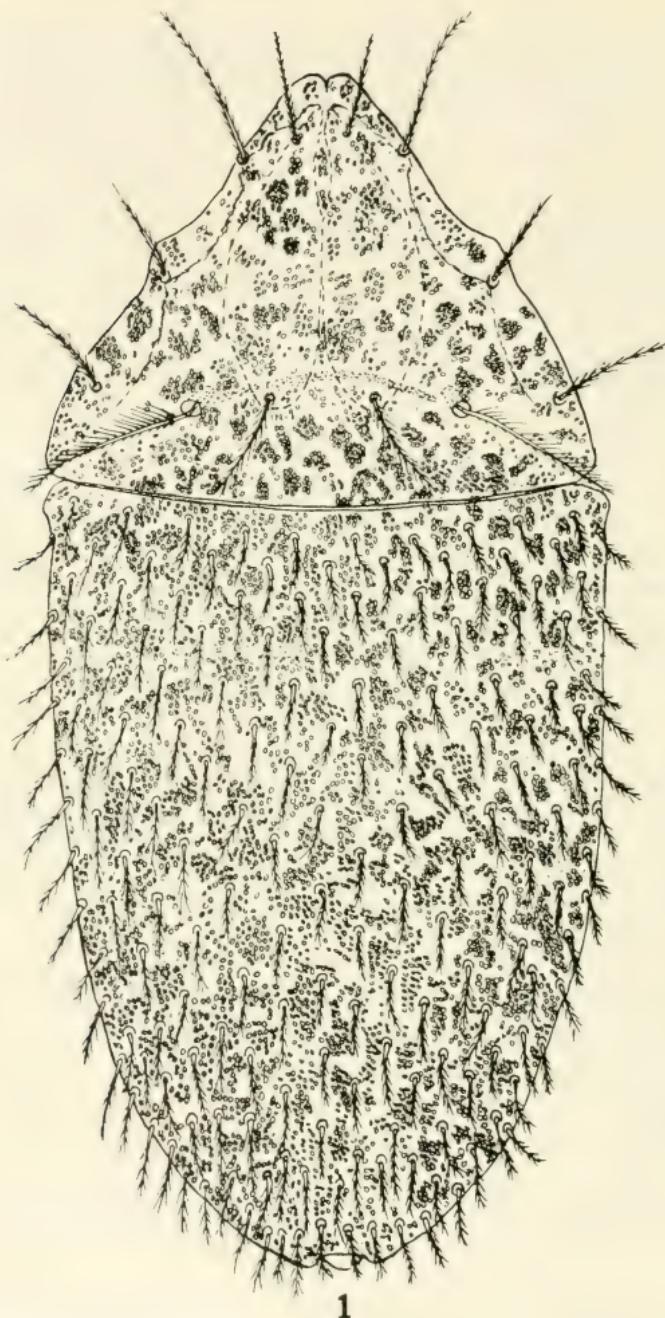


Fig. 1. *Pseudocryptacarus graminosus*, dorsal view, holotype.

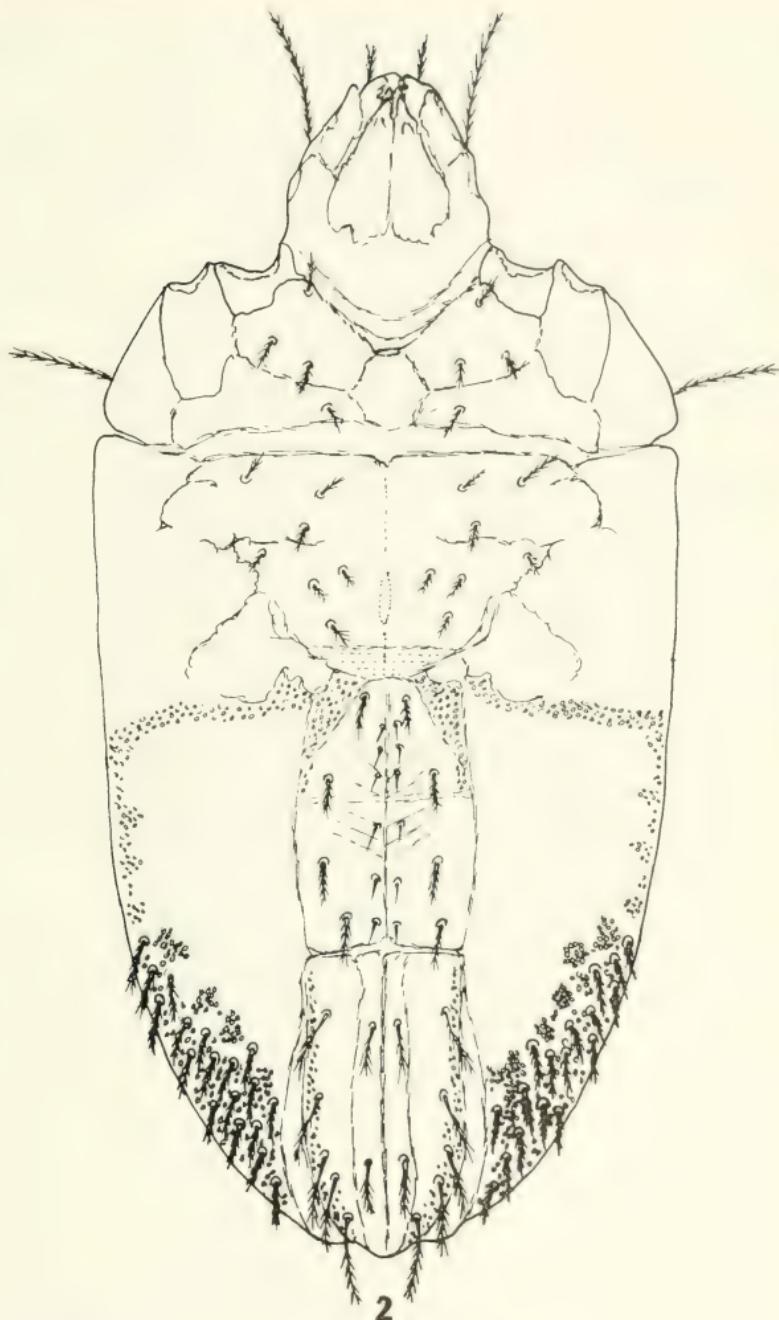


Fig. 2. *Pseudocryptacarus graminosus*, ventral view, holotype.

sb continuous. Rostral (*ro*), lamellar (*le*) and interlamellar (*in*) setae all with long serrations occupying their entire length. Setae *le* slightly longer and more curved than either *ro* or *in*. Anterior (*exa*) and posterior (*exp*) exobothridial setae elongated, serrated, with *exp* slightly longer than *exa*. Sensillus with approximately 20 elongated pectinations on margin, and 6 or 7 smaller pectinations at apex and opposite margin of elongated pectinations (Fig. 1). Sensillus thicker in region of pectinations, narrowing to small stalk at its base.

Notogaster.—With high degree of neotrichy over whole notogaster. Notogastral setae of various shapes.

Ventral region.—With a wide preanal plate and transverse suture on genital plate; genital plates divided, each with 6 short medial setae and 4 longer lateral setae (Fig. 2). Anal and adanal plates fused; 2 anal and 5 adanal setae. Infracapitular setae branched. Apodome I complete, connected to apodeme II by a rounded connection. Apodeme III incomplete. Apodome IV complete. Epimeral setation (epimeres I-IV) 3-1-3-4.

Leg setal formulae, trochanter to tarsus (famulus included, solenidia in parentheses) as follows: Leg I 0-5-3(2)-4(1)-17(2); Leg II 0-6-3(1)-4(1)-11(2); Leg III 2-3-2(1)-2(1)-10; and Leg IV 2-3-2(1)-3(1)-11. Tibial solenidion III short, baculiform, not tactile or piliform like other tibial solenidia.

Types.—Holotype and 2 paratypes collected from San Patricio County on the Rob and Bessie Welder Wildlife Refuge 8 mi N Sinton, Texas, off Monument Road, November 23, 1977 by Eric G. Bolen and B. McDaniel. The slide-mounted holotype will be deposited in the Museum of Comparative Zoology, Cambridge, Massachusetts. Slide mounted paratypes are in the collection of Dr. Roy A. Norton, State University of New York, Syracuse, New York and of the senior author.

Habitat.—The type-series of *P. graminosus* was collected in a mesquite grassland community. The vegetation, analyzed with a point frame and line intercept methods, consists of grasses (35% foliar cover), forbs (10.5% foliar cover), and woody species (29% canopy cover). The four species in each of these groups with the largest amount of cover were, respectively: Texas wintergrass (*Stipa leucotricha*), curlymesquite (*Hilaria belangeri*), white tridens (*Tridens albescens*) and dropseed (*Sporobolus asper*); ragweed (*Ambrosia psilostachya*), cone-flower (*Ratibida columnaris*), wild petunia (*Ruellia* sp.), and broomweed (*Xanthocephalum texanum*); mesquite (*Prosopis glandulosa*), huisache (*Acacia farnesiana*), lote bush (*Condalia obtusifolia*), and spiny hackberry (*Celtis pallida*). The soil is Victoria clay, a heavy and usually poorly drained blackland soil. Whereas the mesquite grassland is the most extensive community on the Welder Refuge, the collection site was in a subunit that was formerly overgrazed for many years; the area is now recovering under a less intensive grazing program but still reflects the

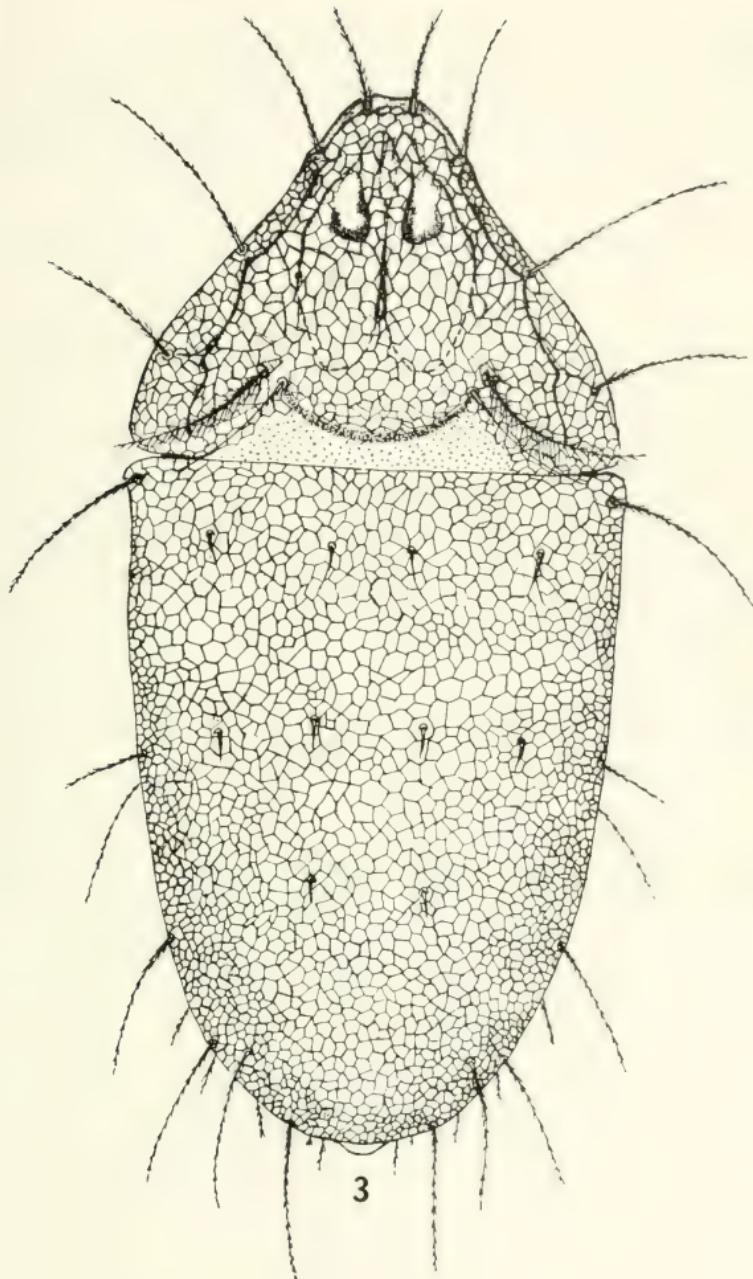


Fig. 3. *Torpacarus gramineus*, dorsal view, holotype.

earlier successional damage to the grassland type (e.g., occurrence of broomweed).

Remarks.—This is the only lohmanniid species known in which a tibial solenidion is present on leg IV. Also, it is unusual in having three setae (*d*, *l'*, *v'*) on tibia IV; other lohmanniids, except *Meristacarus porcula* Grandjean, lack *v'*.

Torpacarus gramineus McDaniel, Norton, and Bolen, NEW SPECIES
Figs. 3-4

Dimensions and color.—Mean total length of 11 specimens 540 μ (range 538-542 μ), mean maximum notogastral width 230 μ (range 229-231 μ). Color, light brown. Dorsal integument completely covered by polygonal reticulations except on anterior tectum of the notogaster which is covered with punctations (Fig. 3). Transverse band sb of prodorsum interrupts reticulation of region between interlamellar (*in*) setae. Transverse bands absent on notogaster. Each polygonal reticulation of both prodorsum and notogaster filled with small circular punctations, similar to those of *T. omittens*. Lines *mt*, *nt*, and *pt* always absent. Rostral (*ro*) and lamellar (*le*) setae barbed their entire length, interlamellar setae with at most 4 barbs (at low magnification appears to be smooth). Sensillus with approximately 19 elongated pectinations on margin, 3-4 smaller pectinations at apex and opposite margin of elongated pectinations. Notogaster setae *c*₁, *c*₂, *d*₁, *d*₂ and *e*₁ short, simple; remainder of setae elongate, heavily barbed, similar to *ro* and *le*.

Ventral region with apodeme 1 complete with "inverted-Y" shaped sternal extension. Apodemes 2 and 3 incomplete medially; the latter with sternal bar extending posteriorly halfway to level of leg IV. Apodeme IV complete. Epimeral setation (epimeres I-IV) 3-1-3-4. Genital plate undivided, each with 6 short medial setae and 4 longer lateral setae (Fig. 4). Adanal plates with 5 setae similar in form to notogastral setae *f*₂.

Palp and leg setation as described by Grandjean (1950) for *T. omittens*.

Types.—Holotype and 10 paratypes collected from San Patricio County, Rob and Bessie Welder Wildlife Refuge 8 mi N Sinton, Texas from mesquite grassland off Monument Road on the Welder Wildlife Refuge, November 23, 1977 by Eric G. Bolen and B. McDaniel. Slide-mounted holotype will be deposited with the Museum of Comparative Zoology, Cambridge, Massachusetts. Slide mounted paratypes are in the collection of Dr. Roy A. Norton, State University of New York, Syracuse, New York and of the senior author.

Habitat.—The habitat for the holotype and paratypes of *T. gramineus* is the same as described earlier for *Pseudocryptacarus graminosus*.

Remarks.—The absence of the polygonal reticulation on the tectum is

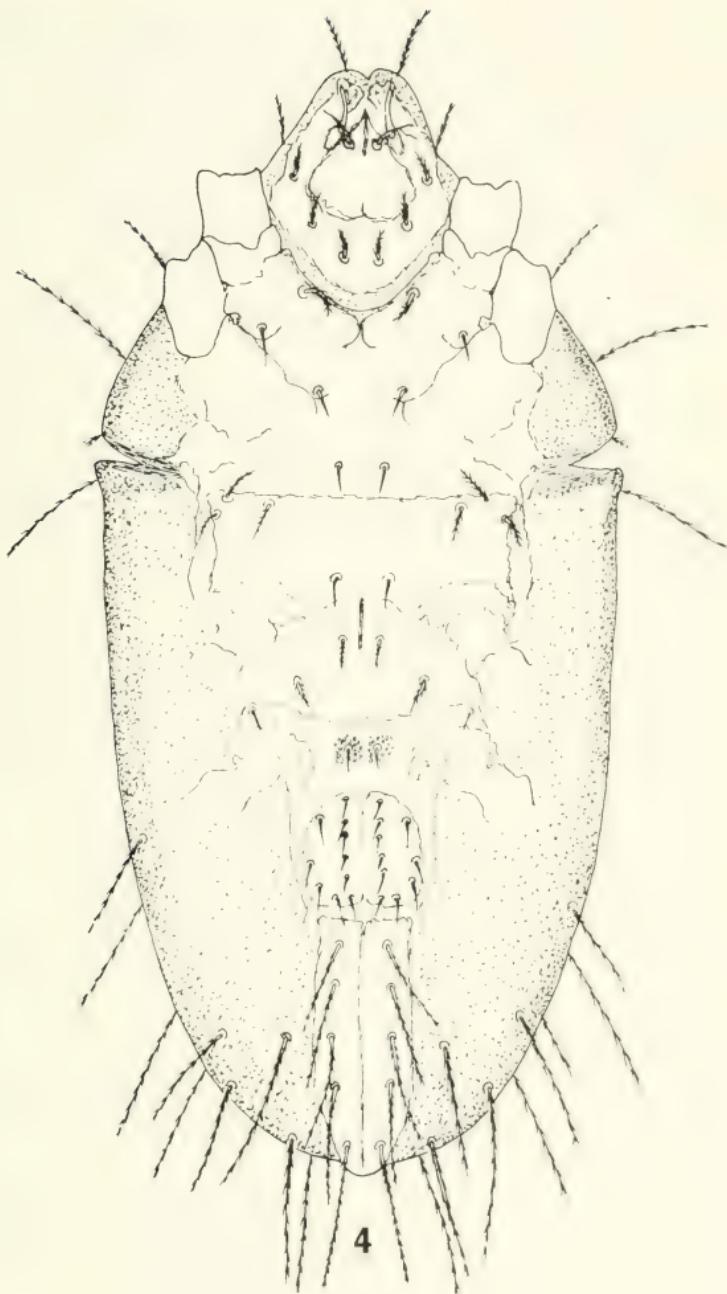


Fig. 4. *Torpacarus gramineus*, ventral view, holotype.

also found in *T. omittens* Grandjean. Lines mt, nt, and pt cannot be distinguished on *T. gramineus* as they are shown by Grandjean (1950) for *T. omittens*. Grandjean (1950) states that the line mt was constant for *T. omittens* but lines nt and pt were variable. In all specimens studied for *T. gramineus*, neither line mt nor lines nt and pt have been observed. Setae c₁, d₁, are similar in size to those found on *T. omittens* but c₂, d₂, and f₁ are much shorter than those found on *T. omittens*. Setae c₂ and d₂ of *T. omittens* extend beyond the margin of the notogaster and past the base of setae c₃ and d₂; in *T. gramineus*, c₂ and d₂ do not extend beyond the margin of the notogaster and do not reach the base of setae c₃ and d₂. Seta f₁ of *T. omittens* is similar in structure and size to f₂. In *T. gramineus* f₁ is very small, similar in size to c₂ and d₂ rather than large like f₂, c₃ and d₃.

In *T. omittens* apodeme 1 according to Grandjean (1950) is complete but with an "inverted U" shaped sternal extension.

Tropacarus gramineus resembles *T. omittens*, but differs in the length of setae c₂, d₂, and f₁ all of which are shorter than those found on *T. omittens*. Also the structure of apodeme 1 of *T. gramineus* forms an "inverted Y" shaped sternal extension; in *T. omittens* apodeme 1 forms an "inverted U" shaped sternal extension.

Discussion.—The collection of *Lohmannia banksi* Norton, Metz, and Sharma from south Texas extends the known distribution of this species from its type-locality of Durham County, North Carolina from a forest floor of a 20-year-old loblolly pine stand to the Texas Gulf Coast mesquite-grassland habitat. From the following collections it appears that *L. banksi* has a fairly wide distribution in Texas: San Patricio County on the Rob and Bessie Welder Wildlife Refuge from mesquite grassland near a mound of harvester ants (*Pogonomyrmex barbatus*) and from a gulf cordgrass (*Spartina spartinae*) community on Aransas clay saline soils; Nueces County near Calallen; and Bee County at the junction of Farm Roads 202 and 2441, both in ungrazed mesquite grassland communities. The collection dates of *L. banksi* ranged from November 23, 1977 from San Patricio County, December 3, 1977 Bee County, December 14, 1977 Nueces County, February 2, 1978 and April 19, 1978 San Patricio County. All three species, *P. graminosus*, *T. gramineus*, and *L. banksi*, were sympatric in the mesquite-grassland habitat on the Welder Foundation Refuge.

The collection of a member of the genus *Tropacarus* constitutes a new record for North America. It was previously known only from central Africa and South America. We are indebted to D. Lynn Drawe for use of his unpublished vegetational data for the mesquite grasslands of the Welder Wildlife Refuge.

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PREDATORY BEHAVIOR AND PREY OF *ATOMOSIA PUELLA* (DIPTERA: ASILIDAE)

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Abstract.—A field study of the predatory behavior and prey of *Atomosia puella* (Wiedemann) is reported. General predatory behavior is discussed and compared with a related species, *Cerotainia albipilosa* Curran. Prey are analyzed and discussed with regard to prey sizes, proportion of major taxa in the diet, and the impact of the localized concentration of species that influence selectivity.

Members of the asilid genus *Atomosia* are primarily found in the Neotropical Region, although four species are known from the Nearctic and one from the Oriental (Hull, 1962). *Atomosia puella* (Wiedemann), the subject of this paper, occurs in the Nearctic Region along the Atlantic seaboard from Connecticut to Florida and inland to Ohio and Texas (Bromley, 1946; Martin and Wilcox, 1965). This asilid is recognized by a small dark robust body, a converging vertex, a strongly and coarsely punctate abdomen, and genitalia which are concealed in a cuplike 6th tergum (Hull, 1962). It can be separated from other species of *Atomosia* by four scutellar bristles, black tibiae, and black-haired apical tarsal segments (Bromley, 1946). This species is similar in behavior and appearance to *Cerotainia albipilosa* Curran (Scarborough, 1978) but can be separated by the convergent vertex (Hull, 1962). Both genera belong to the tribe *Atomosini* (Hull, 1962), and the two species sometimes occur together in the same locality (Scarborough, 1974). This study represents the first behavioral report on a species of the genus *Atomosia*. A second paper will follow covering the diurnal activity rhythm and courtship behavior of *A. puella*.

STUDY SITE AND METHODS

This study was conducted during June and July 1977 and 1978 on a farm located near Bonita Avenue, about 3.3 km NW of Owens Mills, Baltimore County, Maryland. Individuals of *A. puella* were censused 10 times hourly between 0700 and 1400 h EST under sunlit conditions along a study route

of about 400 m. The route was sufficiently long so that the area was sampled only once per hour and allowed the flies sufficient time to resume normal activities. During each census flies were recorded as feeding on prey or involved in other behaviors. Prey were collected by capturing the feeding asilid in a 15 dram snap top plastic vial and releasing it only after the prey was dropped. Prey were later identified and measured from the front of the head to the tip of the abdomen for body length. Altogether, 64 predators were captured, sexed, and measured for length. Observations also were made on predation on occasions other than during the censuses.

PREDATORY BEHAVIOR

Atomosia puella foraged under bright skies from shaded or sunlit perches and at air temperatures above 18°C. The asilid sometimes foraged from horizontal substrates but usually selected vertical ones, perching in a head-downwards position with its head elevated at an angle of 30–40° to the substrate. Most flies (83%, N = 100) perched just above the upper surfaces of the vegetation covering the ground and oriented their heads toward an open area and a bright sky. This position apparently enhances the flies' ability to detect moving objects as they are backlit against a bright sky (Dennis and Lavigne, 1975; Scarbrough, 1978).

When perched, *A. puella* was relatively motionless, showing little or no response toward passing prey. Occasional wing flutters and abdominal and/or body elevations were the only movements observed. However, these movements are not believed to be in response to passing prey since they also occurred when prey were absent. It is more probable that they are associated with the predator adjusting its field of vision in search of prey and/or a technique used for cooling its body when perched on a hot substrate. Head movements and pivoting movements, like those described for *C. albipilosa* Curran (Scarbrough, 1978), were not observed.

General predatory behaviors (e.g., flight patterns, prey capture and immobilizations, sites of inserting the hypopharynx, and location of feeding sites) of *A. puella* are essentially identical to those described for *C. albipilosa* (Scarbrough, 1978). Its behavior differs in that forage flights were directed at prey at shorter distances (range 8 cm–1.5 m), with most captures occurring within 75 cm (89%, N = 652 captures) of the perch, and a larger proportion of flights were successful (29%, N = 2817 flights).

Cerotainia albipilosa manipulated most prey while hovering near a perch (Scarbrough, 1978). In contrast, *A. puella* usually manipulated prey when perched. It disengaged the prey with the front tarsi and re-inserted the hypopharynx at a new location. In some instances prey were "spun" while they were still impaled on the hypopharynx. The front tarsi were used to force the prey into a new position. Large hard bodied prey such as *Ponera*

sp. (>3.5 mm) were sometimes manipulated while the asilid hovered in front of its perch. Unless the asilid was disturbed, feeding was completed during a single perch; and the prey was removed with a front tarsus before or at the time of another forage flight. Most asilid species use both tarsi to disengage prey.

The length of individual feedings was correlated with body size and weather conditions. The average feeding time of all prey was 4.2 min ($N = 312$) but ranged from 1 to 71 min. Aphids and other small prey (1.5–2.5 mm) with bulbous or linear bodies were fed upon for an average of 1.7 min (range 0.7–8.5, $N = 150$) under sunlit skies and air temperatures above 26°C. Larger prey such as termites ($\bar{x} = 4.81$ mm, $N = 14$) were fed upon for an average of 38 min under similar conditions. Feeding rates increased markedly during overcast periods. One female fed on an aphid for 26 min, and another fed on a reproductive ant (*Ponera pennsylvanica* Buckley, 5.0 mm) for 71 min.

Table 1 shows types and sizes of prey taken by *A. puella*. Species of the orders Diptera, Hymenoptera, and Hemiptera-Homoptera were the most important prey items, with Diptera dominant and accounting for over 49% of the diet. Most prey belonged to a limited number of subgroups within these orders (e.g., Nematocera Diptera, small Apocrita Hymenoptera and the Hemiptera-Homoptera families Aphididae, Cicadellidae, and Miridae) and accounted for over 70% of the total diet. Eleven specimens of thrips and four of Strepsiptera were also included among the prey. Thrips have been reported as prey of *Holopogon wilcoxi* Martin (Hespenheide and Rubke, 1977), *Nannocyrtopogon neoculatus* Wilcox and Martin (Hespenheide, 1978) and *C. albipilosa* (Scarbrough, 1978). The latter species has also been reported to take Strepsiptera.

PREY SELECTION

The major prey groups reported for *A. puella* are very similar to those reported for species of *Holopogon* (Dennis and Lavigne, 1975; Hespenheide and Rubke, 1977), *Nannocyrtopogon* (Hespenheide, 1978), *Cerotainia* (Scarbrough, 1978), and *Asilus* and *Proctacanthella* (Dennis and Lavigne, 1975). As in the diet of *A. puella*, dipterous species formed the dominant component (37%) of the diet of *C. albipilosa* (Scarbrough, 1978). In contrast, species of Hemiptera-Homoptera were dominant in the other species of asilids, and accounted for over 40% of their diets (Hespenheide, 1978).

Mean size of all prey was 2.9 mm, with over 89% between 1 and 4 mm (Table 1). Females were significantly larger ($P < .001$, Student's *t*-Test) than males and took slightly larger prey ($\bar{x} = 3.03$ ♀♀, 2.81 ♂♂; $P < .05$), although both sexes took prey in all class sizes. Predator-prey ratios for the sexes were 2.23 and 2.13 for females and males, respectively. Between prey orders, specimens of Isoptera were significantly larger ($P < .001$; Newman-Keuls multiple range test) than all others, while Hymenoptera and Hemip-

Table 1. Prey of *Atomosia puella* in Maryland.

| Taxa | Number | Percent | Measured | Mean ¹ | SD | Range |
|---------------------|--------|---------|----------|-------------------|------|-----------|
| Diptera | 769 | 49.1 | 742 | 2.35 | 1.01 | 0.64-6.39 |
| Nematocera | 509 | 66.2 | 490 | 2.19 | 0.99 | 0.64-6.01 |
| Others | 260 | 33.8 | 254 | 2.49 | 1.01 | 0.99-6.33 |
| Hemiptera-Homoptera | 424 | 27.1 | 393 | 2.66 | 1.05 | 1.12-5.15 |
| Aphididae | 196 | 46.2 | 190 | 1.82 | 0.40 | 1.25-2.75 |
| Cicadellidae | 113 | 26.7 | 113 | 3.95 | 1.01 | 3.13-6.25 |
| Miridae | 82 | 19.3 | 82 | 3.61 | 0.70 | 2.50-5.00 |
| Others | 33 | 7.8 | 33 | 1.34 | 1.03 | 1.12-5.01 |
| Hymenoptera | 197 | 12.6 | 186 | 2.70 | 0.85 | 1.36-4.91 |
| Coleoptera | 66 | 4.2 | 66 | 2.44 | 0.70 | 1.06-4.51 |
| Isoptera | 72 | 4.6 | 72 | 4.81 | 0.64 | 3.61-6.06 |
| Miscellaneous | 39 | 2.4 | 39 | 2.45 | 0.97 | 1.03-3.53 |
| Total | 1567 | 100.0 | 1498 | 2.90 | 0.87 | 0.64-6.39 |

¹ Means compared by Newman-Keuls multiple range test: ♂♂ $\bar{x} = 5.98 \pm 0.35$, range 5.42-6.55; ♀♀ $\bar{x} = 6.76 \pm 0.41$, range 6.06-7.79.

tera-Homoptera were significantly larger ($P < .001$) among the remaining prey. Within prey taxa, Nematocera Diptera were smaller ($P < .001$) than other Diptera, whereas both cicadellids and mirids were larger ($P < .001$) than the remaining Hemiptera-Homoptera.

Other studies (Melin, 1923; Dennis and Lavigne, 1975; Scarbrough, 1978) have suggested that cuticular hardness and flight characteristics of prey are significant factors influencing selectivity in asilids. This study supports these suggestions. Diptera, Hemiptera-Homoptera excluding Cicadellidae, and Isoptera (*Reticulitermes flavipes* (Kollar)) have thin or soft cuticle and poor flight ability and formed over 68% of the diet. The asilid usually inserted its hypopharynx in the dorsum of the thorax of the aforementioned prey. Among the remaining prey, the hypopharynx was inserted in specialized areas of the body which had soft or thin cuticle: e.g., intersegmental membranes and compound eyes of Hymenoptera and below the wings on the dorsal surface of the abdomen of cicadellids and Coleoptera. In the latter prey, the wings had been held in a flight position, which exposes the underlying soft cuticles, where the hypopharynx was inserted.

Figure 1 shows mean prey sizes and proportion of prey types per hour sampled. The size of prey per sample period was variable, with the smallest prey found at 0700 h and the largest at 1200 h. The former was related to an abundance of small Diptera ($\bar{x} = 2.14$, $N = 113$) in the sample, and the latter to a termite ($\bar{x} = 4.81$, $N = 35$) swarm which occurred on one day of the study. When termites are removed from the 1100, 1200 and 1300 h prey

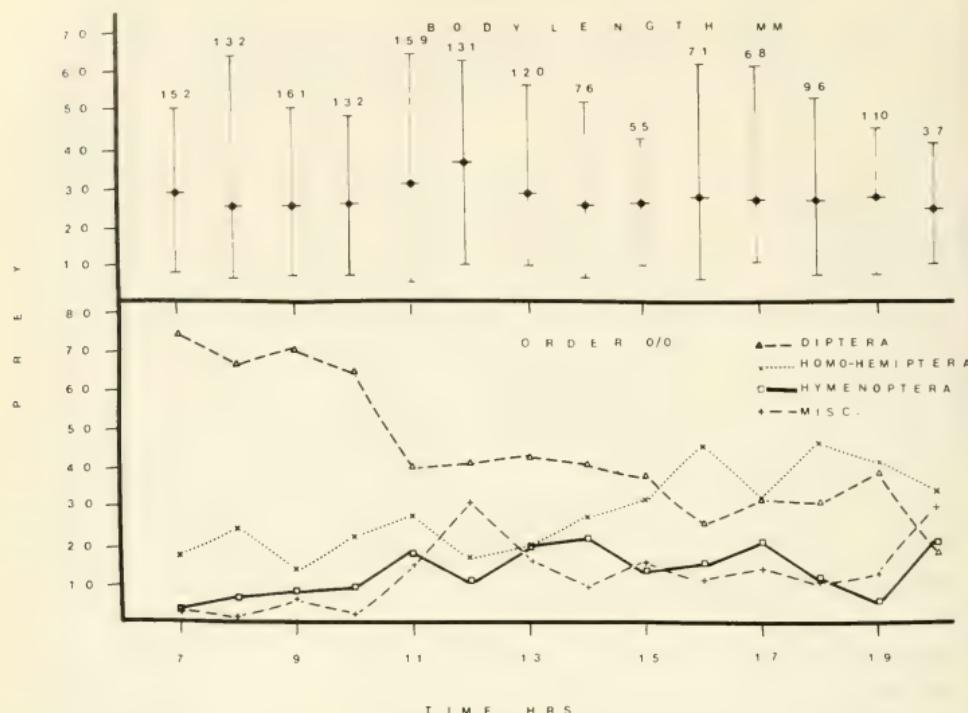


Fig. 1. Mean prey size and proportion of prey types taken per hour of the day. Vertical lines represent ranges, mid-points represent means, and numbers above each hour represent sample sizes.

samples, means are reduced from 2.95, 3.30 and 2.76 to 2.57, 2.69 and 2.55, respectively, and are more consistent with the remaining census periods. However, no significant difference ($P \sim .1$: Newman-Keuls multiple range test) was found between mean prey size per hour sampled.

The proportion of prey types in the diet of *A. puella* changed significantly ($P < .001$) during the day (Fig. 1). Dipterous species were dominant (>82%) during most of the day, although they decreased significantly ($P < .001$) after 1000 h. The remaining prey formed smaller proportions of the diet during most of the day but showed temporary increases (miscellaneous prey, $P < .001$) or gradual increases in mid to late afternoon (Hymenoptera, $P > .05$; Hemiptera-Homoptera, $P < .001$).

An analysis of major taxa, using a 2×7 contingency table to compare two 7-hour periods of the day, revealed that only Hymenoptera, cicadellids, and mirids showed no significant differences in proportions between the two halves of the day (Table 2). Aphids were captured in slightly greater numbers (52.9%; N = 90) in the second half of the day. Both groups of Diptera showed significant differences between the two halves of the day, and

Table 2. Comparison of major prey taxa during two 7 hour periods (700-1300 vs. 1400-2000 h) of the day.

| Prey | Total | χ^2 | Sign. Level |
|---------------------|-------|----------|----------------|
| Diptera | 742 | 60.14 | .001 |
| Nematocera | 553 | 56.33 | .001 |
| Non-nematocera | 229 | 45.41 | .001 |
| Hemiptera-Homoptera | 393 | 20.03 | .01 > P > .001 |
| Aphididae | 170 | 22.05 | .01 > P > .001 |
| Cicadellidae | 120 | 5.35 | N.S. |
| Miridae | 78 | 13.34 | N.S. |
| Hymenoptera | 180 | 14.64 | N.S. |
| Miscellaneous | 180 | 23.14 | .001 |

formed 76.4% of the dipterous prey during the first half with the remaining during the second half of the day. However, nematocerous species formed 71.4% of all dipterous prey with 54.0 and 16.6% being captured in the first and second halves of the day, respectively. Non-nematoceran Diptera formed 20.6 and 8.0% of the dipterous prey during the two halves of the day, respectively.

The appearance of large numbers of specific taxa in the prey sample at certain periods of the day can be attributed to differential activity patterns of those prey taxa. Restriction of an activity pattern, or some aspect of it, in time and space can produce temporary localized concentrations of potential prey species. Other investigators (Bromley, 1934, 1946, 1949; Linsley, 1944, 1972; Dennis and Lavigne, 1975; Knutson, 1978; Scarbrough, 1979) have shown indirectly that when such concentrations exist, some asilid species will exploit them.

Although no attempt was made to determine potential prey densities, localized concentrations of some prey taxa were evident at certain times; e.g., swarms of termites, mating swarms of chironomids and sciarids, feeding aggregations of nematoceran Diptera and cicadellids, and dispersal flights of aphids. *Atomosia puella* perched near concentrations and preyed repeatedly upon them for the duration of the concentration. For example, during a termite swarm, the ratio of termites to other prey increased as the swarm became larger and decreased as the swarm passed—0 vs. 12, 20 vs. 2, 34 vs. 2, 13 vs. 5, 3 vs. 8, 0. vs. 18 for termites and other prey from 1000 to 1500 h, respectively. Similarly, large numbers of major prey taxa appearing in the diet of *A. puella* corresponded to the time and existence of localized prey concentrations.

The following is a list of prey taken by *A. puella* at the study site. In some instances prey are presented only to order or family level since some

prey were damaged, lost, or too numerous for identification. Each notation of prey refers to a single record unless followed by a number in parentheses. Also note that the month and year are recorded only once at the end of a series for each prey taxon. All prey are adults except for Araneida.

ARANEIDA: Unidentified immature 21(3).VI.77, 1.VII.78. ISOPTERA: Rhinotermitidae, *Reticulitermes flavipes* (Kollar) 19.20(70).28.VI.78. PSOCOPTERA: Caeciliidae, *Caecilius* sp. 5.23.VI.77, 26.VI.78; Ectopsocidae, *Ectopsocus* sp. 5.23.24.VI.78; Philopteridae, *Aaronella* sp. 23.24.26.27.VI.78, 1.VII.78. THYSANOPTERA: Unidentified 22(2).VI.77, 21(2).22(4).27.30.VI.78. HEMIPTERA-HOMOPTERA: Anthocoridae, *Oris insidiosis* (Say) 30.VI.77, 25.27.30.VI.78, 1.VII.78; Aphididae, unidentified 3(5).5(3).21(2).22(6).30.VI.77, 1.VII.77, 17(4).19(7).20(5).21(15).22(13).23(13).25(9).26(15).27(10).28(12).29(2).30(18).VI.78, 1(12).VII.78, Cicadellidae, *Acera-tagallia sanguinolenta* (Prov.) 3.VI.77, 27.VI.78, *Agallia constricta* Van D. 22(2).VI.77, 20.29.VI.78, *Amblysellus curtisi* (Fitch) 30(2).VI.77, 19.28(2).VI.78, *Aphrodes flavostriatus* (Donovan) 24.VI.77, 21.VI.78, *Doratura stylata* (Boh.) 5.27.VI.77, 26.VI.78, *Empoasca fabae* (Harris) 3(3).VI.77, 19.VI.78, *E. erigeron* DeLong 5(3).26(4).VI.78, *Graminella nigrifrons* (Forbes) 30(2).VI.77, 27.28.VI.78, *Latalus sayi* (Fitch) 22(2).VI.77, 23.VI.78, *Laevicephalus sylvestris* (Osborn and Ball) 21(3).VI.77, 19(3).22(2).24(3).VI.78, *Oncopsis verticis* (Say) 27(3).VI.77, 21(2).VI.78, 1.VII.78, *Orientus ishidae* (Matsumura) 22(2).VI.77, 21.28.VI.78, *Osbornellus clarus* Beamer 22.VI.77, 1.VII.78, *Paraphlepsius irroratus* (Say) 27.VI.77, 1.VII.77, 17.VI.78, *Planicephalus flavocostatus* (Van D.) 23(3).VI.77, 25.27.VI.78, 1.VII.78, *Polyamia weedi* (Van D.), 21.22.VI.77, 1.VII.77, 26.27.VI.78, *Scaphoideus immistus* (Say) 21(2).VI.77, 25(3).30(4).VI.78, *Scaphytopius acutus* (Say) 22(3).VI.77, 17(2).23(3).VI.78, 1.VII.78, *S. frontalis* (Van D.) 22(2).VI.77, 21.23.24.27(2).30(2).VI.78, *Streptanus aemulans* (Kirsch.) 22(2).VI.77, 21(3).22.VI.78, 1(2).VII.78, *Typhlocybinae* 3(3).VI.77, 22.23.26(4).VI.78, *Typhlocyba cassiopeia* Knull 22(2).VI.77, 23.24.28(2).VI.78, *T. putmani* Knull 24(2).25(2).26.28.30.VI.78, *Xestocephalus pulicarius* Van D. 22.25(2).26.VI.78; Cixiidae, *Cixius* sp. 1.VII.78; Coccoidea, unidentified 21.VI.78; Delphacidae, *Stobaera tricarinata* (Say) 25.VI.78, *Pissonotus* sp. 27.VI.78, *Delphacodes lutuleuta* (Van D.) 1.VII.78; Miridae, *Megalocoleus molliculus* (Fallén) 5(2).30.VI.77, 21(2).22(2).23(5).24(3).26(3).VI.78, 1(8).VII.78, *Plagiognathus* sp. 3.21(2).VI.77, 19(4).20(3).25(5).26(6).27(4).28(4).29.30(3).VI.78, *Reuteroscopus orantus* (Reuter) 19(4).20.25(4).27(3).28.30(2).VI.78; Psyllidae, unidentified 20.VI.78; Saldidae, *Saldula* sp. 20.24.VI.78, 1.VII.78. COLEOPTERA: Unidentified 3.VI.77, 17.20.21(3).22(3).23(2).26(2).28.30.VI.78, 1.VII.78; Anobiidae, *Petalium* sp. 21.24.VI.78; Anthicidae, *Anthicus* sp. 5.VI.77; Chrysomelidae, *Chaetocnema* sp. 26.28.VI.78; Hydrophilidae, *Cercyon* sp. 3.27.30.VI.77; Leptodiridae, unidentified 23.VI.78, 1.VII.78; Lyctidae, unidentified 21(2).VI.78;

Scolytidae, *Hypothenemus* spp. 5(3).VI.77, 19.21(2).22(2).23(9).25.26(2).30(2).VI.78; Staphylinidae, unidentified 30.VI.77, 17.21(2).23.25.27.28(2).30.VI.78, 1(2).VII.78. STREPSIPTERA: Stylopidae, *Pseudoxenos lugubris* (Pierce) 22.VI.77, 27.28.VI.78, 1.VII.78. DIPTERA: Unidentified 30.VI.77, 19.20.21(3).27.28(2).VI.78, 1.VII.78; Agromyzidae, *Agromyza* sp. 27(2).28(2).V.78, *Cerodonta dorsalis* Loew 1.3(8).21(3).30(4).VI.77, 19(2).21(4).27(4).28(6).29.30(3).VI.78, 1(2).VII.78, *C. (Poemyza) muscina* (Meigen) 22(4).24.27.VI.77, 20(2).25(4).VI.78, *Phytomyza* sp. 21.VI.77, 19(2).21(2).25(2).26.27(2).28(6).29.VI.78; Anthomyiidae, *Mumetopia occipitalis* Mel. 3.VI.77, 19.21.27.VI.78; Anthomyzidae, unidentified 21.27(2).30.VI.78; Asilidae, *Apachekolas* sp. 26.VI.78; Cecidomyiidae, *Anarete* sp. 21.22.30.VI.77, 20.22.23.25.VI.78, *Asteromyia* sp. 3(17).30(4).VI.77, 14(3).21(5).23(3).25(10).27(5).28(3).30(6).VI.78, 1(15).VII.78, *Contaria* sp. 19.VI.78, *Dasineura* sp. 25(4).VI.78, *Hyperdiplosis* sp. 17.29.VI.78, *Lestermia* sp. 17.19(2).20.21.25(3).30.VI.78, *Micromya* sp. 22(3).VI.77, 19(3).22(3).24(2).25(9).26.27(3).VI.78, 1(2).VII.78, *Neolasioptera* sp. 14.19.21.VI.78, 1(4).VII.78, *Porricondyla* sp. 24.VI.77, 25(2).27(2).VI.78, 1.VII.78, *Procystiphora* sp. 3.VI.77, 24.VI.78, *Resseliella* sp. 22.VI.77, 27.30.VI.78, *Winnertia* sp. 21.29.VI.78; Ceratopogonidae, *Atrichopogon levis* (Coq.) 3.27.VI.77, 27(5).VI.78, *Culicoides paraensis* (Goeldi) 3.VI.77, 19.25.28.VI.78, 1(2).VII.78, *Dasyhelea* sp. 1(2).VII.78, *Forcipomyia* sp. 1(2).VII.78; Chironomidae, Orthocladiinae, unidentified 3(2).VI.77, 19(2).23(3).28.VI.78, *Anatopynia* sp. 3.VI.77, 20(2).22(4).30(4).VI.78, *Chironomis* sp. 14.20.21.25(6).27.28(2).VI.78, 1(4).VII.78, *Tanytarsus* sp. 21.24.26.VI.78, 1.VII.78; Chloropidae, *Chlorops* sp. 21(2).VI.78, *Conioscinella* sp. 22.23(4).30.VI.78, *Goniopsita catalpae* (Mall.) 19.22.26.VI.78, *Oscinella* sp. 21.VI.77, 22.27.28(4).VI.78, 1(3).VII.78, *O. frit* (L.) 21.VI.78, *O. carbonaria* (L.) 19.27(2).VI.78, 1.VII.78, *Siphonella nigripalpis* (Mall.) 14.28(3).VI.78, 1.VII.78, *Taumatotibia bistrigata* (Wlk.) 23(5).24(2).VI.78, 1.VII.78, *T. glabra* (Mg.) 14(2).VI.78, 1(2).VII.78; Chyromyiidae, unidentified 1.VII.78; Dolichopodidae, *Chrysotus* sp. 17.20(3).22.23(2).25(2).VI.78, *Gymnopternus debilis* Loew 24.VI.77, 27(2).28.29(2).30(2).VI.78, 1(2).VII.78; Drosophilidae, *Scaptomyza* sp. 27.VI.77, *S. pallida* (Zett.) 25.VI.78, *S. adusta* (Lw.) 30.VI.78, *S. wheeleri* Hackman 22.26.VI.78; Empididae, *Euhybus purpureus* Walker 22.23.VI.78; Ephydriidae, *Leptopsylopa nigrimana* (Will.) 30.VI.77, 14.20.23.25(3).VI.78, 1(2).VII.78; Heleomyzidae, unidentified 3.22(4).VI.77, 21(3).23.27.28.29.VI.78, 1.VII.78; Lauxanidae, *Homoneura philadelphica* (Macq.) 21.22(2).28.VI.78, 1.VII.78; Phoridae, unidentified 27.VI.78, *Asteromyia* sp. 27.VI.78, *Dorniphora* sp. 27.VI.78, *Megasilca* sp. 3(2).5.21.22(4).24(3).30.VI.77, 19.21(4).22(2).23(2).24(3).25(2).26(3).27(3).28.30(3).VI.78, 1(9).VII.78; Phytomyzidae, unidentified 24.VI.77; Pipunculidae, *Chalarus* sp. 22.24.VI.77, 19.26.VI.78, 1.VII.78; Psychodidae, *Psychoda* sp. 3(5).22(6).27.30.VI.77, 21(5).23(4).24(2).25.26(6).27(5).28(3).30(3).VI.78,

I(6).VII.78; Scatopsidae, *Scatopsa* sp. 21.22.VI.77, 19.20(3).21(5).24.25(7).27(12).28(6).VI.78, I(8).VI.78, *S. fuscipes* Meigen 14.21(3).25(17).26.27(10).28(27).VI.78, I(17).VII.78; Sciariidae, *Bradysia* sp. 3(4).5.21.22(2).27.30(3).VI.77, 19(5).20(2).21(9).22(2).24(3).26(3).27(5).28.29.30.VI.78, I(4).VII.78; *Sciaria* sp. 3(5).5.22.VI.77, I(11).VII.77, 19(4).21.25.26.27(2).28(10).VI.78; Sepsidae, *Sepsis* sp. 3(3).20.21.24(2).27(2).30.VI.77, *S. punctum* (Fab.) 26.28(2).VI.78; Simuliidae, unidentified 3(3).5.21.22(2).VI.77, 17.21.26.30.VI.78; Sphaeroceridae, *Sphaerocera vaporarium* Haliday 21.VI.77; Syrphidae, *Palpadus* sp. 30.VI.78; Tephritidae, unidentified 24.VI.77, 27.30.VI.78; Tipulidae, unidentified 11.VI.77, 22.VI.78. LEPIDOPTERA: Gelechiidae, *Sitotroga cerealella* (Oliver) 21.22.23.25(3).26.VI.78; Tingidae, *Tinea* sp. 1.VII.77, *Homoseta* sp. 17.24.VI.78. HYMENOPTERA: Aphidiidae, *Praon* sp. 21.VI.77; Braconidae, *Aphaereta* sp. 3(2).5.21(3).22.27(2).30.VI.77, 19.20.21.23.24.25.27.28(3).29.30.VI.78, I(2).VII.78, *A. pallipes* (Say) 3(5).5.21(5).22(3).30.VI.77, 17.19.21(5).22(3).23.24.25.26.27(2).28.29.30.VI.78, I(2).VII.78, *Aspilotata* spp. 3(2).21.VI.77, 20.21.30.VI.78, *Chorebus* sp. 21.VI.77, 22(3).26(2).27.VI.78, I.VII.78, *Euphorielia* spp. 27(2).VI.77, I.VII.77, 23(2).24(2).26(2).27(2).29(2).30(3).VI.78, I(4).VII.78, *Synaldis* sp. 28.VI.78; Ceraphronidae, *Ceraphron* sp. 27.VI.77, 22.VI.78, *Lygocerus* sp. 21.VI.77, 28(2).VI.78; Cynipidae, *Hexacola* sp. 21.27(2).28.VI.78; Diapriidae, *Trichopria* sp. 3.VI.77, 19.21.22.VI.78, I.VII.78; Encyrtidae, *Oencyrtus* spp. 30.VI.77, I.VII.77, 17.19.21(2).24.26.VI.78; Eulophidae, *Aphelinus* sp. 27.VI.77, I.VII.77, 19.20.26.VI.78; Eupelmidae, unidentified 21.VI.78; Eurytomidae, *Eurytoma* sp. 21(2).23.24.26.VI.78; Formicidae, *Formica* sp. (winged reproductives) 3(2).30.VI.77, 23.30.VI.78, *Ponera pennsylvanica* Buckley 5(5).27(4).VI.77, 19.21.VI.78; Halictidae, unidentified 20.VI.77, 21.VI.78; Perilampidae, *Perilampus* sp. 27.VI.77, 20.21(3).24.25.29.VI.78; Pteromalidae, unidentified 3.22.VI.77, 20.21.29.VI.78; Scelionidae, *Gryon* sp. 27(3).VI.78, *Telenomus* sp. 26.VI.78, I(3).VII.78.

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A NEW GENUS AND SPECIES OF ORGILINI (HYMENOPTERA:
BRACONIDAE) FROM NEW GUINEA

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Abstract.—**Economios papuensis**, a new genus and species from New Guinea, is described and compared with *Orgilus* (Braconidae). The new genus differs from *Orgilus* by having a short abdomen and ovipositor, a large notched vannal lobe, a ventral ridge on the hind tarsus, very broad wings, a petiolate discoidal cell, and an open brachial cell.

This genus first came to my attention because of its superficial resemblance to *Apanteles*; but a relationship to Microgastrinae is precluded because the new genus has a sclerotized distal radial sector, eight pairs of abdominal spiracles, and spiracles on tergite I.

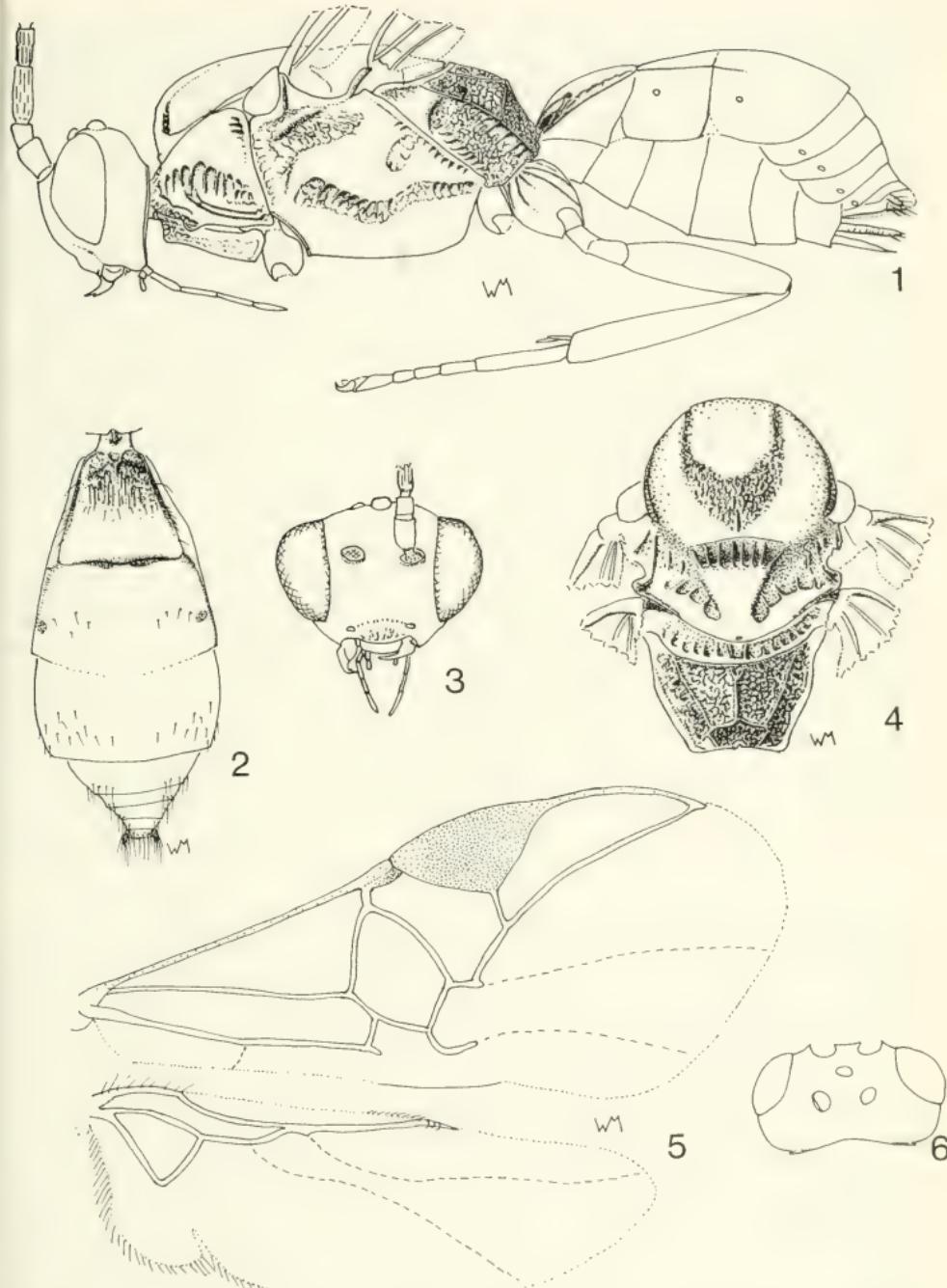
Economios Mason, NEW GENUS
Figs. 1-6

Etymology.—The name is a masculine noun derived from Greek and means a marvel.

Type-species.—*Economios papuensis*, new species.

Description.—Antenna long and thin, all flagellomeres but the 1st and the last few with a false transverse division caused by the placodes being arranged in 2 ranks; apical article acutely pointed. Mandible small, scarcely twisted, tapered to a pair of unusually small teeth; palpi 5-3; maxillary long, the labial very short. Clypeus broad, apically truncate, surface convex; tentorial pits very large; occipital carina strong and complete, joining the hypostomal shortly before lower end. Head transverse, temples narrow and strongly tapered behind, the head not elongated below.

Pronotum very strongly roughened medially, the lower margin bearing a conspicuous projection about mid-way; posterior lobe of propleuron overlapping lower corner of pronotum. Mesoscutum anteriorly vertical, but flattened above, none of the lobes protruding; notauli scarcely depressed, but conspicuously marked by rugose sculpture and joining in a large rugose area posteriorly; sides of scutum margined by a carina; mesopleuron with a long,



Figs. 1-6. *Economios papuensis*. 1. Side. 2. Abdomen, dorsal. 3. Head. 4. Thorax, dorsal. 5. Wings. 6. Head, dorsal.

broad transcostate furrow; prepectal carina complete, passing under lower corner of pronotum. Metapleuron rugose with an ill-defined lobe on lower anterior corner. Propodeum rugose, with a large petiolarea on the apical declivity; and a median and a pair of lateral carinae on the anterior horizontal part.

Tergum I with a flat, broad, apically widening tergite bearing spiracles slightly in front of middle; short dorsolateral carina and laterope present, but no dorsope; tergite I sculptured on basal 0.6, remainder of abdomen smooth and rather short; terga II and III occupying most of abdomen, divided by a fine crease; complete laterotergites on terga I and II, an incompletely separated one on tergum III; very few hairs present on tergite I, small lateral patches on II and III and a single sparse apical row on terga IV-VI. Spiracles on metasomal segments I-VII. Sternite and tergite of metasoma I not fused; sternites II-VI each medially divided; sternite VI short. Ovipositor and sheath straight and short, not exceeding apex of abdomen; ovipositor without a dorsal subapical notch.

Legs and coxae unremarkable, hind tarsus with a median ventral ridge of coalesced hairs; tarsal claws simple; tibial spurs 0.4-0.5 as long as basitarsi. Wings very broad, hyaline with strong, but hyaline veins and large deep stigma; radius (RS) complete, bent at a 120° angle between 1st and 2nd abscissae, the 2 distal elements of (RS) forming a straight line; 2nd intercubitus absent; brachial cell open; apical parts of cubitus (M) and subdiscoides (Cu) present only as creases in wing membrane; interanal (2A) indicated by a crease; vannal lobe large and convex, separated by a deep incision.

Ecnomios papuensis Mason, NEW SPECIES

Female.—Length 3 mm, forewing 3.2 mm, antenna 2.9 mm.

Description.—Flagellum with 29 articles. Mandible with anterior tooth much longer than posterior; mandible rounded in cross-section, swollen subbasally. Clypeus fairly densely punctate, aciculate laterally; apical margin truncate and depressed, with 1 or 2 horizontal striae. Remainder of head mostly smooth, sparsely and finely punctate. Ocelli separated by about their own diameters, the lateral ocellus about 1.5× its own diameter from eye; anterior external angle of ocellar triangle near 100° (Figs. 1, 3, 6).

Posteromedian rugose area of scutum crescentic, concave toward anterior, lobes smooth and closely, but shallowly punctate; entire scutum densely hairy. Scutellar scrobe large, deep and with 6 large transverse costulae; disc of scutellum weakly convex, scarcely raised, polished and moderately punctate and hairy; apical rim of scutellum polished and wide with lateral lunate areas; between them and disc of scutellum transversely costate depressions (Figs. 1, 4).

Tergite I with apical width about equal to length and about 3× basal

width. Length of combined terga II and III about $1.25 \times$ their width, a posteriorly convex transverse suture indicated laterally, the 2 terga about equally long. Laterotergites large and quadrangular; posterior edge of laterotergite II freely moveable and not attached to the partial laterotergite III. Apical part of abdomen abruptly tapering, terga mostly telescoped under III and only protruding about $\frac{1}{2}$ the length of tergum III; tergites laterally and sterna with small patches of hair. Ovipositor sheaths with dull, transversely ridged surface, almost glabrous, but 4 or 5 small hairs at extreme apex below (Figs. 1, 2).

Hind coxa scarcely more than $\frac{1}{2}$ as long as tergite I, its height and width about equal; upper surface with strong oblique ridges basally, concave and smooth apically (Fig. 1).

Color black with smooth parts of scutum, abdominal terga behind first, and head above, castaneous; legs, base of antenna, tegula, lower parts of head, laterotergites and abdominal sternites, and ovipositor fulvous; hind coxa dark brown to black; mandibles except for teeth, and palpi, whitish. Wings with milky appearance, trichiae and veins white, membrane hyaline, stigma brown.

Variation.—Propodeal carinae sometimes partly lost or poorly defined among rugose sculpture; sculptre of tergite I varying from mostly aciculate to mostly rugose-punctate in any combination; clypeal sculpture varying from small separate punctures to a vertically undulate, almost rugose surface.

Types.—Holotype, ♀, New Guinea, Mt. Hagen, 1700 m., Kuk Tea Station, W. Highlands district, 1976, Malaise Trap, C.N.C. No. 15778. Paratypes, 9 ♀♀, same data.

DISCUSSION

The genus is anomalous, but I think best placed in Orgilini (discussion by Muesebeck, 1970). It most resembles *Orgilus*, the dominant genus of the tribe, sharing with it the following characters: 1, Almost all flagellomeres with a false transverse division caused by the placodes being arranged in two ranks on each article; 2, mandibles slim and tapering to a pair of rather small teeth; 3, lower outer corner of propleuron with a lobe extending dorsad and overlapping lower corner of pronotum; 4, prepectal carina complete and passing mesad under lower corner of pronotum; 5, tergite I without a pit at junction of dorsal and dorso-lateral carinae; 6, first intercubitus and second abscissa of radius (2 distal segments of RS) in approximately a straight line; 7, second intercubitus (2r-m) missing.

The following apomorphic characters differentiate *Economios* from *Orgilus*: 1, Palpus formula 5-3; 2, middle of lower margin of pronotum with a large lobe protruding ventrad; 3, abdominal terga IV-IX largely telescoped and mostly hidden under terga II and III; 4, hind tarsus with a median

ventral ridge of closely appressed hairs; 5, brachial cell open (Cu 1b lost); 6, ovipositor without a subapical dorsal notch; 7, ovipositor shorter than tergite I.

Additional characters, probably all plesiomorphic within Orgilini, are useful to distinguish *Economios* from other Orgilini: 1, Mandible only slightly (30°) twisted; 2, lower margin of pronotum without a notch opposite the anterior side of the overlapping propleural lobe; 3, broad convex vannal lobe set off by a deep notch; 4, discoidal cell petiolate (proximal end of RS + M remote from R); 5, wings broad and short. Additionally *Microtypus* and *Stantonia* are readily distinguished from *Economios* by having a second intercubitus (2r-m).

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NOTES ON SYNONYMIES, RECOMBINATIONS, AND LECTOTYPE
DESIGNATIONS IN NATHAN BANKS' SPECIES OF
NOTHRUS (ACARI: ORIBATEI)

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Abstract.—The disposition of Banks' oribatid mite taxa presently placed in *Nothrus* is modified as follows. Three are recombined: *Platynothrus banksi* (Banks), *Platynothrus carinatus* (Banks), and *Trimalaconothrus simplex* (Banks). Four are designated junior synonyms: *Nothrus bipilis* (=*N. palustris*), *N. excisus* (=*Camisia segnis*), *N. rugulosus* (=*C. horrida*), and *N. taurinus* (=*C. spinifer*). Lectotypes are designated for *N. bipilis*, *N. simplex*, and *N. truncatus*.

As pointed out in a previous paper (Norton, 1978), most of the oribatid mites described by Nathan Banks are in need of reinvestigation. Of the ten species assigned to the genus *Nothrus* only one, *N. marinus* Banks, is adequately known, being the type-species of *Hygroribates* (Jacot, 1934).

The following taxonomic judgements are based on examination of Banks' existing original material, all of which is deposited in the Museum of Comparative Zoology (MCZ) at Harvard University. Banks kept most of his oribatid material in alcohol and designated types only in the few instances when a balsam slide was prepared. All alcoholics referred to in this paper are listed as "suspected types" in unpublished MCZ listings. In a number of instances (probably in the early 1930's) the oribatologist A. P. Jacot, recognizable by his characteristic handwriting, mounted one or more of Banks' original series, labelled them "type" or "cotype," and left the remainder in alcohol with no type designation.

The older system of setal nomenclature used by Sellnick and Forsslund (1955) is employed for ease of comparisons. I thank Dr. H. W. Levi for providing access to MCZ specimens.

Nothrus bipilis Banks, 1895a

Although no specimens exist with a type-label, a vial in the MCZ contains three specimens which are undoubtedly those to which Banks referred in

the original description; they are considered by me to be syntypes. The labels bear the published data and are in Banks' handwriting. Since two species are represented by the three specimens, I designate the single adult (964μ total length) as LECTOTYPE. The diagnostic "long, curved, simple hair" (seta K1) mentioned in the original description has been lost on each side, but the mite is otherwise intact. The two "young specimens" to which Banks refers are both *Nothrus* tritonymphs, but only the larger (840μ) belongs to the same species as the adult; the diagnostic seta K1 is present. This specimen is designated a PARALECTOTYPE. The smaller tritonymph (704μ) is a member of another, unidentified *Nothrus* species.

After examination of published descriptions of the European species *Nothrus palustris* C. L. Koch, and specimens from England, Poland, and Germany, I consider *N. bipilis* to be a junior subjective synonym of *N. palustris*. The only noted difference involves notogastral seta PN2. In *N. palustris* this seta is 1.5 to 2 times the length of F2 and has uniform breadth throughout. The lectotype specimen of *N. bipilis* and the four specimens in my collection (all from Long Island) have seta PN2 equal to F2 in length and slightly clavate. On the weight of many similar character states and the clear separation of these two taxa from other *Nothrus* species, the synonymy seems justified.

Nothrus carinatus Banks, 1910

Three specimens with the data of the original description are mounted on a single slide deposited in the MCZ. The label, in Banks' handwriting, designates these as "type"; and all can be considered syntypes. The modern generic placement is indicated on the label below the original name; but to date, recombination has not been mentioned in the literature.

Platynothrus carinatus (Banks) (NEW COMBINATION) is distinguishable from all other known species by having the combination of short setae in the C, D, and E series (barely reaching the insertion of the next posteriad seta) and having a lateral notogastral carina (distinctly longer than the medial carina) which curves laterally to reach the insertion of seta PN2. The three specimens range from $694\text{--}723 \mu$, total length.

Nothrus furcatus Banks, 1895a

Six specimens which apparently comprised Banks' original series are housed in the MCZ. A. P. Jacot mounted three of these in balsam and labeled them as "types"; a note on the label reads "3 out of 6." These, and the remaining alcoholics, can all be considered syntypes.

This species was renamed *Nothrus banksi* by Michael (1898) who noted the homonymy with *N. furcatus* C. L. Koch. Under present generic concepts the species must be recombined to *Platynothrus banksi* (Michael) (NEW COMBINATION). Banks' (1904) subsequently published figure sat-

isfactorily represents the characteristic anterior fusion of the medial notogastral carinae, but his original length measurement of .7 mm is inaccurate; the syntypes range from 790–850 μ ; and specimens in my collection from other areas of central Washington are as large as 920 μ .

Nothrus excisus Banks, 1895a

Apparently none of Banks' original specimens presently exist. There is, however, a mounted specimen in the MCZ, collected in Nebraska in 1938, which is labelled "Camisia excisus Bks" (a combination never used in the literature) in Banks' handwriting. This specimen was examined and found to be *Camisia segnis* (Hermann) sensu Grandjean (1936), a Holarctic species characteristically found on trees.

The length of *N. excisus* given in the original description (.7 mm) is slightly less than the range of *C. segnis* (750–830 μ) given by Grandjean, but Banks' measurements were crude and often inaccurate. Otherwise, Banks' description is consistent with the latter species; and I designate *N. excisus* a junior subjective synonym of *Camisia segnis* (Hermann).

Nothrus rugulosus Banks, 1895a

A slightly damaged balsam slide, with two specimens of this species, and a vial of three alcoholic specimens, all with the original data, are deposited in the MCZ. The slide, labelled by A. P. Jacot, bears a note reading "3 left in vial." All five of the existing specimens can be considered syntypes.

Nothrus rugulosus is hereby designated a junior subjective synonym of *Camisia horrida* (Hermann), sensu Grandjean (1936), a Holarctic species originally described from Europe. This opinion is based on examination of Grandjean's and Sellnick and Forsslund's (1955) redescriptions, as well as specimens from Poland. The type-habitat of *N. rugulosus* (under bark of a dead tree) is consistent with the habitats of *C. horrida* in Europe. The species illustrated by Sengbusch (1951) under the name *N. rugulosus* is a true *Nothrus*, and not Banks' species.

Nothrus simplex Banks, 1895b

A single alcoholic vial with Banks' original labels is present in the MCZ collections and holds three specimens, the examination of which indicates that Banks confused two species under this name. The single adult (762 μ , total length) is a *Trimalaconothrus* species and is missing the left leg I, the right leg II, and most notogastral and prodorsal setae. This specimen is hereby designated the LECTOTYPE and the name is recombined to *Trimalaconothrus simplex* (Banks) (NEW COMBINATION). Based on integumental structure and general facies, the species is similar to and possibly conspecific with *T. glaber* (Michael); but because of the damaged type, further collection is needed.

The other two specimens are clearly nymphs of the family Achipteriidae. Banks erroneously considered these, with the "corrugated epidermis," to be immatures of the species represented by the adult specimen.

Nothrus taurinus Banks, 1906

The single specimen on which the description was based, bearing Banks' original labels, is in alcohol in the MCZ and can be considered the holotype. After examination of this specimen I designate *N. taurinus* a junior subjective synonym of *Camisia spinifer* (C. L. Koch), a common Holarctic species. A study by Pearse (1946), for which Banks identified the mites, recorded this species under the name *Camisia taurinus* Banks (sic).

Banks' original drawing is misleading, since the body outline included the debris adhering to the notogaster. A portion of this debris was removed during my investigation, exposing the characteristic setation and tuberculation of *C. spinifer*.

Nothrus terminalis Banks, 1910

A single balsam-mounted specimen, of about 700 μ total length, is housed in the MCZ. It is labelled in Banks' handwriting and designated "type." Although the number of specimens Banks examined is not indicated in the original description, no others are known to exist; and this specimen can be considered the holotype. The original figure (Plate I, Fig. 8) is misleading; the setae illustrated are more strongly clavate on the holotype.

At least nine described taxa are involved in what can be loosely considered the "biciliatus group"; that is, species with short, clavate setae K1, PN1, and PN2. Monodactyl members include *N. terminalis* (and its subspecies *N. t. caroliniae* Jacot), *N. truncatus* Banks (including its subspecies *N. t. robustus* Jacot and *N. t. silvicus* Jacot) and *N. monodactylus* (Berlese) from North America, and *N. pulchellus* (Berlese) from Italy. Tridactylous members include *N. biciliatus* (C. L. Koch) (sensu Sellnick and Forsslund, 1955) from Europe and North America, and *N. reticulatus* Sitnikova from western Asia. Although detailed investigations have not yet been made, the number of claws in these species may prove to vary within or between populations, as Grandjean (1965) noted for *N. silvestris* Nicolet. As Grandjean has indicated, all *Nothrus* species seem to be apomictic, exhibiting thelytokous parthenogenesis. The validity of taxa in both the "biciliatus group" and the "silvestris group" should eventually be examined with this in mind.

Nothrus truncatus Banks, 1895a

Banks confused two species under this name. A. P. Jacot apparently noted this when mounting five of Banks' original specimens in balsam, leaving four in alcohol. Jacot's label indicates that he identified three of the

mounted specimens as *Nothrus silvestris* and considered the two others as cotypes of *N. truncatus*. The latter specimens have total lengths of 920 and 935 μ , significantly larger than the *N. silvestris* specimens. It is clear from the description that Banks thought the smaller individuals to be immatures of the larger ones. I have selected a LECTOTYPE from among the alcoholic specimens; the remaining alcoholics and two slide-mounted specimens are PARALECTOTYPES.

Nothrus truncatus is the largest of the "biciliatus group," with a robust, truncate notogaster and monodactyl tarsi. Banks (1904) illustrated *N. truncatus* with three claws; but all of his specimens, and others I have collected from sphagnum bogs in upstate New York, are monodactyl. He probably mistook the proral or unguinal setae for lateral claws.

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RHIZOECUS MEALYBUGS OF TEXAS, WITH DESCRIPTION OF A NEW SPECIES (HOMOPTERA: PSEUDOCOCCIDAE)

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Abstract.—*Rhizoecus brevirostris*, a new species of mealybug, is described from Texas. Notes are given for six additional members of the genus, three of which constitute new state records.

This paper contains the description of a new rhizoecine mealybug and notes on six additional species from the state of Texas. Unless otherwise indicated, the mealybugs were collected by R. D. Gordon and D. R. Miller, Systematic Entomology Laboratory, IIIBIII, U.S. Department of Agriculture in May 1976. I am indebted to Dr. Miller for the privilege of studying this collection and for the facilities afforded me during these studies.

Rhizoecus apizacos Hambleton

Collected on *Bouteloua* sp. (Gramineae) at Iron Mt. Ranch, 8 mi N Marathon, Brewster Co., May 12, 1976. Heretofore known only from Tlaxcala State, Mexico, this collection is a new record for the United States.

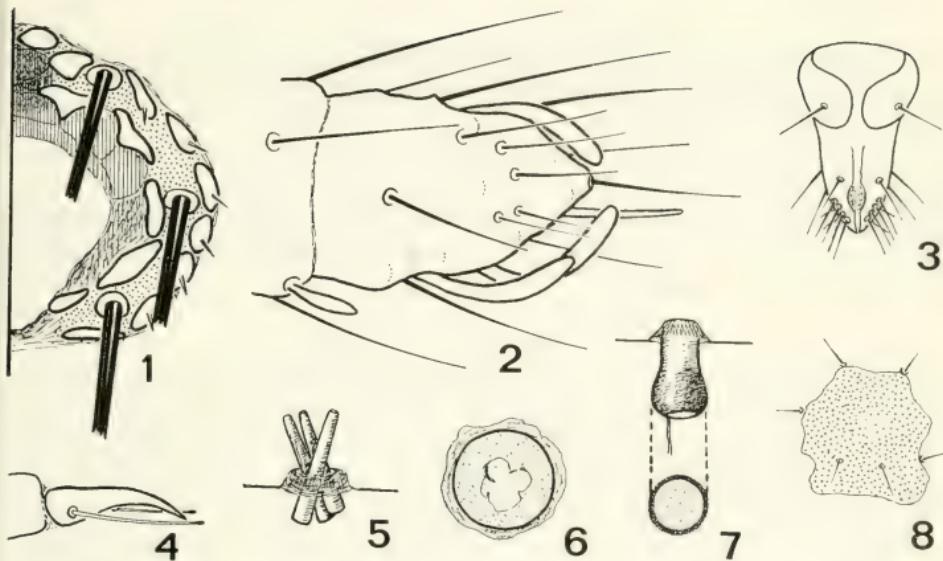
Rhizoecus bicirculus McKenzie

Several specimens collected from roots of *Jatropha dioica* (Euphorbiaceae) at Black Gap Wildlife Management Area, Brewster Co., May 8, 1976. Previously described and recorded from several localities in California.

Rhizoecus brevirostris Hambleton, NEW SPECIES

Figs. 1-8

Adult female.—Elongate oval, much narrowed anteriorly. Length, 1.74 mm; width, 0.71 mm. Antennae short, 6-segmented, narrowly separated: length of segments in microns: I, 22; II, 14; III, 15; IV, 11; V, 10; VI, 28; apical segment almost 2× as long as wide, with 3 rather stout, weakly clavate sensory setae, and 1 spinelike sensory seta near apex; segment V with 1 short, stout sensory seta. Interantennal space equal to length of apical



Figs. 1-8. *Rhizococcus brevirostris*, female. 1. Anal ring, right half. 2. Terminal segments of antenna. 3. Rostrum. 4. Hind claw. 5. Tritubular ceroris. 6. Circulus, dorsal. 7. Tubular duct, lateral and ventral. 8. Cephalic plate.

segment. Eyes small, weakly pigmented. Rostrum small, 42μ long, 28μ wide; rostral loop short, reaching nearly halfway to 2nd coxae. Cephalic plate irregularly quadrate, slightly longer than wide, about 33μ long, with several minute body setae. Dorsal ostioles inconspicuous, their rims narrow, weakly sclerotized.

Legs short, moderately stout, length of segments of hind pair in microns: Trochanter, 22; femur, 53; tibia, 46; tarsus, 28; claw, 14; claw digitules elongate, dilated at tips, extending beyond sharp claws.

Circulus depressed, width across its base 13μ , its orifice 11μ in diameter. Anal lobes unsclerotized, each with 3 elongate setae, the longest about 33μ long, and several body setae. Anal ring 44μ in diameter, its setae about 44μ long, longer and stouter than anal-lobe setae; outer portion of anal ring with 18 oval elongate cells, most with spicules; inner portion of ring with 10-12 larger, more irregular cells, some not clearly defined. Tritubular cerores small, 15 occurring dorsally, 3 on head, 5 on thorax, 2 middorsally and 2-3 submarginally on each side of abdomen, their ducts about 6μ long. Multilocular disk pores absent. Tubular ducts prominent, short, stout, $5-6 \mu$ long, strongly sclerotized, widely distributed over entire body. Trilocular pores more abundant along body margins, sparse intersegmentally, near legs and mouthparts. Body setae inconspicuous, mostly short, evenly distributed.

HOLOTYPE FEMALE

5 mi E Study Butte, Big Bend National Park, Brewster Co., Texas, on *Gutierrezia* sp. (Compositae), May 6, 1976, R. D. Gordon and D. R. Miller. In U.S. National Museum.

Diagnosis.—*Rhizoecus brevirostris* may be distinguished from its closest relatives *R. apizacos* Hambleton by its clavate sensory setae, stouter, more numerous tubular ducts, oval, spiculate anal-ring cells and *R. simplex* (Hambleton) by its depressed circulus and fewer than one half the number of cerores borne only dorsally.

Rhizoecus gracilis McKenzie

Collected from an undetermined grass, Palo Duro, Canyon State Park, Randall Co., May 2, 1976; from *Atriplex* sp. (Chenopodiaceae), 12 mi E Alpine, Brewster Co., May 8, 1976; and from *Gutierrezia* sp. (Compositae), 13 mi N Sierra Blanca, Hudspeth Co., May 9, 1976. *Rhizoecus gracilis* was previously collected at Dumas, Moore Co. (Hambleton, 1976) by D. R. Miller in July 1970. This is one of the most widely distributed species of *Rhizoecus* occurring in the United States. *Rhizoecus gracilis*, originally described from California, is known to occur in 10 U.S. states and Mexico.

Rhizoecus leucosomus (Cockerell)

Collected from roots of an undetermined grass, Palo Duro, Canyon State Park, Randall Co., May 2, 1976. Reported previously at Corpus Christi, Nueces Co., from *Sorghum halepense* (Gramineae) (Hambleton, 1976) by S. Nakahara, August 4, 1971. The preferred hosts of *R. leucosomus* seem to be members of the Gramineae. This mealybug was described from New Mexico, and it occurs from California to Virginia.

Rhizoecus mexicanus (Hambleton)

This species was taken from undetermined grasses at Black Gap Wildlife Management Area, Brewster Co., May 8, 1976, and 50 mi E Sierra Blanca, Hudspeth Co., May 9, 1976. Previously reported from an unknown locality in Texas (Hambleton, 1976). *Rhizoecus mexicanus* was described from specimens intercepted in San Francisco, California, from an unknown locality in Mexico.

Rhizoecus solani (Hambleton)

The first record of this species for the United States is a collection from *Cylindropuntia* sp. (Cactaceae) at Langtry, Val Verde Co., May 13, 1976. Originally described from Guatemala, *R. solani* also is known from Mexico.

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HETEROPTERA IN AN OFT-OVERLOOKED PAPER OF
P. R. UHLER (HEMIPTERA)

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Abstract.—The 12 species of Heteroptera reported in Uhler's (1869) "Notices of the Hemiptera Obtained by the Expedition of Prof. James Orton in Ecuador and Brazil" are listed. The one genus and three species described therein as new are placed taxonomically: *Belonomus annulaticornis* forms a valid genus and species and is here transferred to the tribe Leptoscelidini; *Lygaeus confraternus* is a senior synonym of *Ochrostomus neomodestus* Slater (=*Lygaeus modestus* Stål, preoccupied), new synonymy, and is assigned the new combination *Ochrostomus confraternus*; *Antiteuchus fraternus* is a junior synonym of *Callostethus guttatopunctatus* (Fabricius), new synonymy.

Uhler's (1869) paper entitled "Notices of the Hemiptera Obtained by the Expedition of Prof. James Orton in Ecuador and Brazil" reported 12 species of Heteroptera and five species of Homoptera. The Heteroptera included were Pentatomidae: *Antiteuchus fraternus*, new species; *Edessa cervus* (Fabricius). Coreidae: *Pachylis laticornis* (Fabricius); *Diactor foliaceus* (Fabricius); *Belonomus annulaticornis*, new genus and new species; *Hypselonotus linea* (Fabricius). Lygaeidae: *Lygaeus confraternus*, new species. Pyrrhocoridae: *Dysdercus ruficeps* (Herrich-Schaeffer). Reduviidae: *Zelus* species? Belostomatidae: *Belostoma annulipes* Herrich-Schaeffer. Of all these specimens, only the two holotypes mentioned below have been found in the United States National Museum Heteroptera collection. The frequent overlooking of this article probably resulted from its not being picked up in the early volumes of the *Zoological Record*. Discussion of the three species described therein as new follows.

"*Antiteuchus fraternus*" Uhler, 1869:321-323. Inexact locality, "Taken near Napo River." Apparently one specimen. No type-material in the U.S. National Museum. A junior synonym of *Callostethus guttatopunctatus* (Fabricius), NEW SYNONYMY.

Uhler's species combination was not mentioned by Lethierry and Severin (1894), by Kirkaldy (1909), nor by Ruckes in his (1961) establishment of the

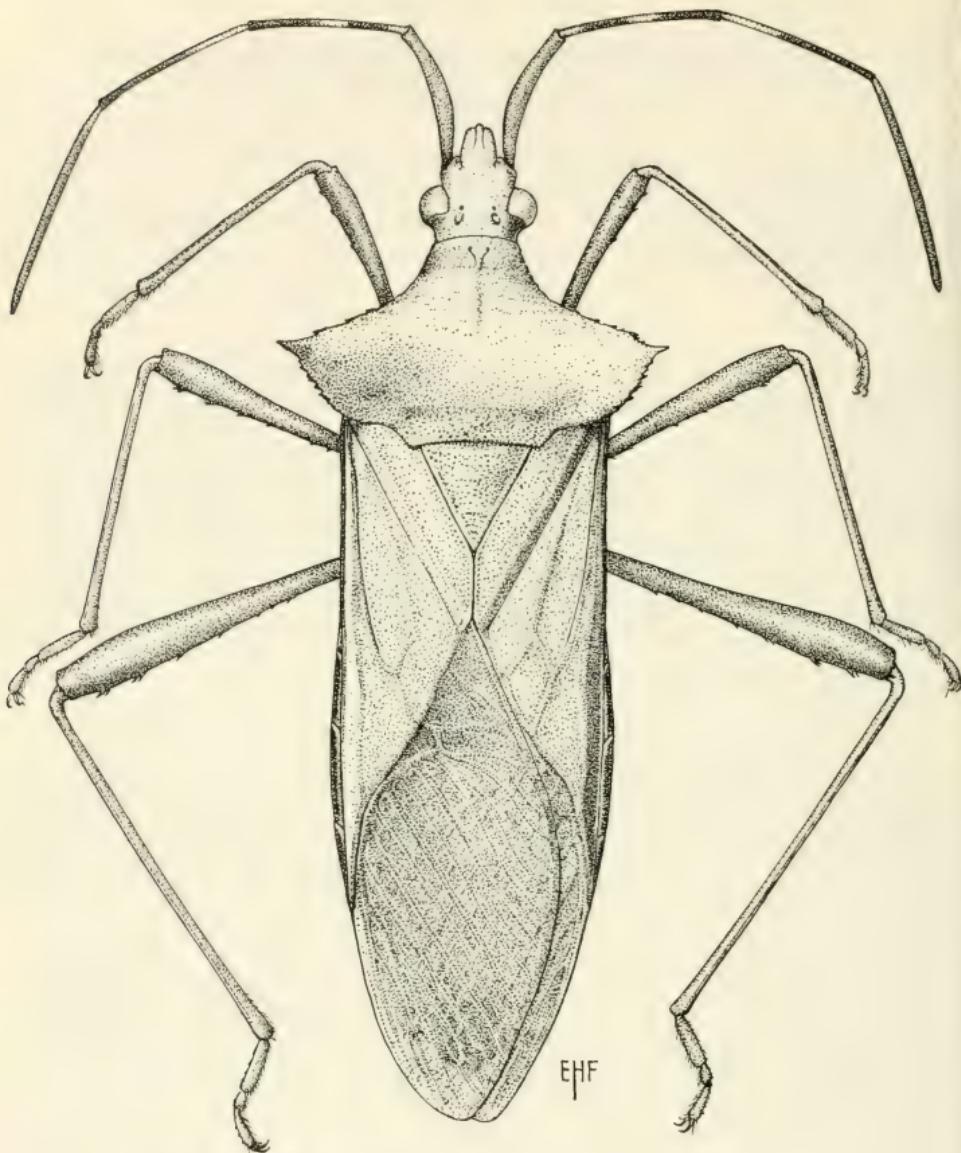


Fig. 1. *Belonomus annulaticornis*, drawn from holotype.

genus *Callostethus* for the lone species *Edessa guttatopunctatus* Fabricius, 1803, or his 1964 revision of *Antiteuchus*. Although the type of neither species was examined during this study, I feel no hesitancy in proposing the above-noted new synonymy because Uhler's description agrees so closely

with specimens of *Callostethus guttatopunctatus* determined by Ruckes who had earlier studied in European Museums and probably saw Fabricius' type.

"*Lygaeus confraternus*" Uhler, 1869:325-326. Inexact locality, "between Napo & Maranon." Apparently one specimen; holotype ♀ in U.S. National Museum. Uhler's species now takes the NEW COMBINATION *Ochrostomus confraternus* (Uhler) and is the senior synonym of the preoccupied *Lygaeus modestus* Stål, 1858:38, for which Slater (1964:157) proposed the replacement name *Ochrostomus neomodestus*; the latter two scientific names are thus junior synonyms of *O. confraternus* (Uhler). My side-by-side comparison of the types of Stål (kindly made available from the Riksmuseum in Stockholm by Dr. P. I. Persson) and of Uhler found the two to be conspecific.

Ashlock (1975:30) redefined the genera of North American Lygaeinae and excluded "neomodestus" from *Ochrostomus* without giving it a generic placement. To avoid a "uninomial" [without generic assignment] in our binomial system and to allow scholars access to all the advantages of Slater's (1964) catalog, I am here keeping the generic placement of that catalog. Undoubtedly, the species will be assigned to a new genus in the near future.

"*Belonomus annulaticornis*" Uhler, 1869:324-326 (Figure 1). Inexact locality, "between Napo & Maranon." Apparently one specimen; holotype ♀ in U.S. National Museum. Uhler included this as the only species in his new genus *Belonomus*. Both the genus and the species appear to be valid.

The only subsequent report of this species I have found is that of Lethierry and Severin (1894:258) who followed Uhler's placement of the genus *Belonomus* in the tribe Anisoscelini. The elongate, nearly porrect head with the tylus and juga greatly surpassing the antennal tubercles would allow this placement, but the posterior tibiae are "simple" (as Uhler described them) and exhibit no dilation, a fact that would prevent its belonging to the tribe Anisoscelini in Stål's (1867:543-551), Barber's (1939:308-310) or Schaefer's (1965:56-57; 1968:187) keys to the tribes of Coreinae. The other two tribes of Coreinae with the elongate nearly porrect head are Chelinideini and Leptoscelidini. The cylindrical antennae and tibiae, rather than triquetreous ones, will keep it out of Chelinideini but will allow its placement in the Leptoscelidini. In that tribe it can be recognized by the following combination of characters: Head without a postocular transverse groove setting off a "neck"; without a callous behind each eye; mesosternum with a broad, shallow but distinct mediolongitudinal groove; and the spiracles located about midway between the anterior and posterior margins of each abdominal segment (except the last where the spiracles are clearly closer to the anterior than to the posterior margin).

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DESCRIPTION OF A NEW SPECIES OF BAT FLEA FROM COLOMBIA (SIPHONAPTERA: ISCHNOPSYLLIDAE)

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Abstract.—The bat flea, *Myodopsylla tropica*, is described and illustrated. This taxon is the first record of the genus *Myodopsylla* from Colombia and the fourth species known from South America.

The new species described below represents the first record of the bat flea genus *Myodopsylla* from the Republic of Colombia. The type-material was collected by the junior author from a single *Myotis oxyotis* at an exit of the cave, La Cueva del Indio, in Cueva de los Guacharos Natural National Park, Departamento de Huila. This site is surrounded by dense undisturbed rain forest in steep terrain with 3-3.5 m of rainfall annually and has a cool climate. In addition to *M. oxyotis*, the bats *Anoura cultrata*, *A. geoffroyi*, *Vampyrops dorsalis*, and *Carollia brevicauda* were also taken inside La Cueva del Indio.

Myodopsylla species show a preference for bats of the family Vespertilionidae (Hopkins and Rothschild, 1956; Lewis, 1974), particularly *Myotis*, a genus known for its wide distribution. With the exception of *Myodopsylla trisellis* Jordan, which occurs in Manchuria, the remaining eleven species of the genus are American. *Myodopsylla borealis* was recently described by Lewis (1978) from northern United States. The new species of *Myodopsylla* described below is the fourth species described from South America.

Myodopsylla tropica Méndez and Lemke, NEW SPECIES

Diagnosis.—This new taxon shares with the Mexican *Myodopsylla globata* Holland (1971), the South American *M. setosa* Johnson (1956), and the Manchurian *M. trisellis* Jordan (1929) the possession of false combs on terga I through III only. The male is clearly distinguished from the last two species, and perhaps from all the other taxa of the genus¹, by its unique

¹ The male of *Myodopsylla globata* Holland is unknown.

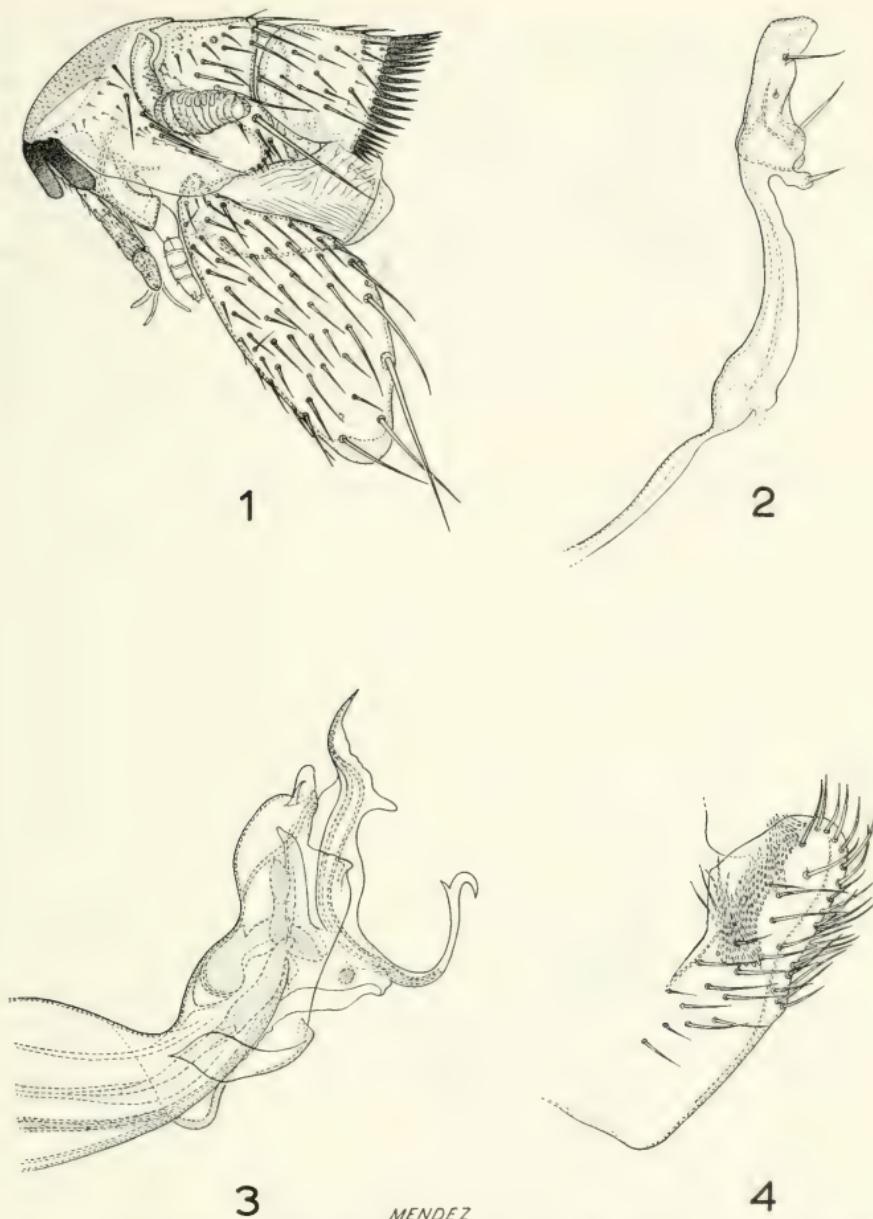
genitalia, particularly the almost trapezoidal movable process of the clasper and the peculiar lower prong of the dorsal arm of the crochet which ends in a sharp, claw-like apex with dorsal spur. The female has hillia of spermatheca more strongly curved cephalad than in the co-indigenous *M. setosa*. In the latter species the false comb on terga II and III has a total of three or four spines, whereas in the new species consists of about eight spines.

Description of male.—*Head* (Fig. 1): Resembles others in the genus. Fracticipit. Margin of frons shallowly sinuate. Rugulose area conspicuous, provided with many micropores and 2 or 3 dermal pits. Clear area with only 2 upper short bristles. First genal tooth smaller and more delicate than 2nd. Preantennal area with several medium size and short bristles. Postantennal area with 3 or 4 rows of bristles of different sizes preceded by series of very short bristles near antennal fossa. First antennal segment with short bristles concentrated mainly on lower dorsal submarginal area. Second antennal segment indistinct, bearing 2 ventral bristles. Club subtruncate, with few short bristles along dorsal margin. Eye vestigial, not well defined. Ocular bristle of moderate length. Genal process moderately extended as a broad flap having sinuous ventral margin gradually attenuated distally, ending in acute tip. Preoral tube well defined, sinuous. Maxillary lobe truncate. Maxillary palp shorter than labial palp, with moderate cover of bristles. Epipharynx and maxillary lacinia delicate, both exceeding length of labial palp.

Thorax: Pronotum having scattered bristles besides ctenidium of about 20 acute spines per side. Proepisternum showing well marked striae. Mesonotum with several bristles on upper $\frac{1}{2}$. Mesepimere having 3 prominent bristles. Metanotum with about 2 dermal pits and 3 definite rows of bristles, dorsal bristles of last row thick and elongate, forming indistinct comb. Metasternum ventrally produced, showing single long upper bristle, 2 or 3 very short inner bristles and 2 minute marginal bristles anteceding anterior ridge. Metepimere with several bristles having irregular distribution and different length.

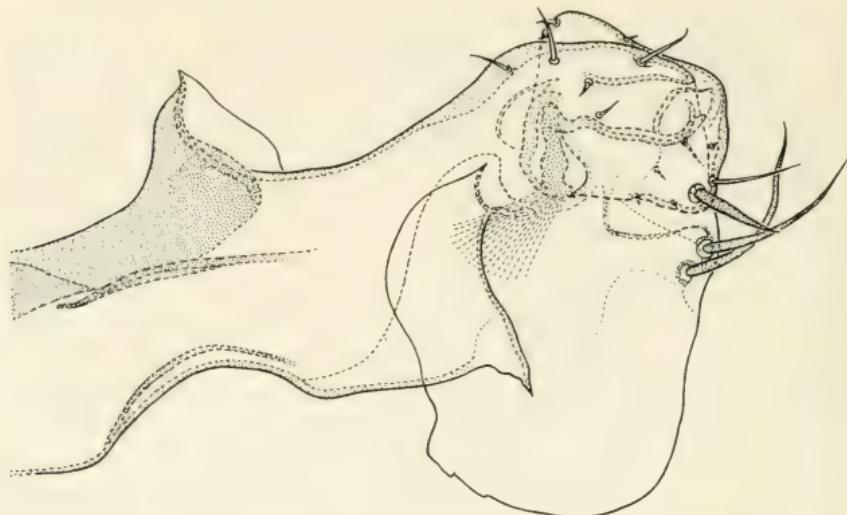
Legs: Procoxa (Fig. 1) with sparsely distributed bristles. Mesocoxa and metacoxa having bristles concentrated mainly along anterior margin. Profemur, mesofemur, and metafemur with posteromarginal row of subequal bristles and several non-marginal bristles. Tibiae characterized by conspicuous dorso-marginal series of moderately long and medium size stout bristles in addition to other marginal and inner bristles.

Abdomen: First tergum with 3 rows of bristles, most dorsal bristles of last row larger and stouter than the rest and inserted close to each other forming a comb-like arch. Second and 3rd terga each bearing 2 rows of bristles in addition to distinct comb of short, thick, subequal spines. Rest of unmodified terga each having 2 rows of various lengths but lacking true combs. Each unmodified sternum with simple group of bristles on ventral area.

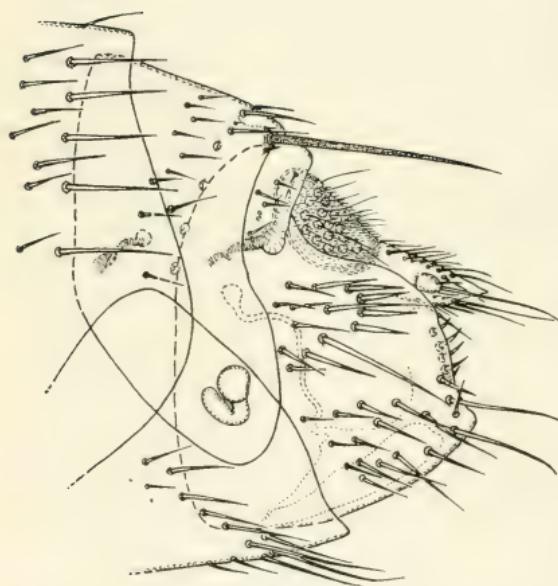


Figs. 1-4. *Myodopsylla tropica* Méndez and Lemke, n. sp. Male: 1. Head, prothorax and procoxa. 2. Distal arm of ninth sternum. 3. Apex of aedeagus. 4. Eighth sternum.

Modified abdominal segments: Seventh tergum provided with 2 rows of bristles before long anteesensillum bristle inserted between 2 very short bristles. Sensillum somewhat elliptical, consisting of about 20 sensory pits. Anal lobe represented by a single prominent subangular process densely covered



5



6



7

MENDEL

by bristles along dorsal $\frac{1}{2}$. Apical bristles of this lobe suggesting a distinct tuft. Eighth tergum broadly expanded beyond spiracle, covering great portion of genitalia, with posterior margin serrate, provided with consistent bristles distributed on upper $\frac{1}{2}$, mainly on and near dorsal margin. Manubrium of clasper large, broad at base, humped ventrally, with heavily incrassated margins tapering towards barely elevated apex which is subrounded. Immovable process of clasper (Fig. 5) somewhat complex, constricted cephalad, slightly expanded caudad, having a broad flap-like expansion with rounded caudal and irregularly sinuated anterior margins. Posterior region of clasper with 2 acetabular bristles of about equal length, inserted near midpoint of margin, below level of movable process. In addition to acetabular bristles there are about 5 non-prominent bristles scattered along anterior $\frac{1}{2}$ of clasper. Movable process of clasper (Fig. 5) broad, subtrapezoidal, having anterior portion larger than posterior. Its chaetotaxy consists of 1 conspicuous caudal bristle preceding a finer marginal bristle of about equal length. In addition, 4 very short bristles are distributed in this process. Eighth sternum (Fig. 4) broad, showing subrounded apex projected upward, sinuous posterior margin and semiangular caudal margin. Ventral division of this sternum at midway of margin, just before series of posteromarginal bristles. Besides marginal and submarginal bristles there are various others spaced on outer surface, as well as a group of them, devoid of spatulate tips, clothing the inner surface of distal $\frac{1}{2}$. Apodeme of aedeagus represented by sinuous blade having elevated proximal spur. Penis rods curved distally but not fully coiled. Apex of aedeagus (Fig. 3) complex, displaying following features: Wall of aedeagal pouch protuberant, shallowly convex, interrupted by apical process. Armature of inner tube represented by highly incrassated depressed plate. Lateral plate of aedeagal apodeme sinuous. Crescent sclerite large, broadly rounded anteriorly, reduced posteriorly, with angular dorsal sinus. Sclerotic inner tube having slightly curved, attenuated apex. Lateral lobe displaying reduced sclerotized process. Upper prong of dorsal lobe of crochet bifurcated into angular projections. Lower prong strongly arched upward with hook-like apex bearing dorsal spur.

Description of female.—Agrees well with the male except for larger size and sexual differences.

Modified abdominal segments (Fig. 6): Seventh tergum arched caudad, reaching beyond abdominal axis, bearing 2 rows of bristles. Antesensilium bristle barely extended beyond dorsal anal lobe, inserted between 2 short lateral bristles. Anal stylet slightly longer than maximum width, bearing 2



Figs. 5-7. *Myodopsylla tropica* Méndez and Lemke, n. sp. Male: 5. Fixed process and movable process of clasper. Female: 6. Modified abdominal segments. 7. Spermatheca.

short dorsal bristles and 1 short ventral bristle. Dorsal anal lobe angular, clothed with several dorsal bristles. Ventral anal lobe shorter than dorsal anal lobe, bearing few uneven bristles. Seventh sternum with posterior margin shallowly sinuous, its chaetotaxy consisting of 12–16 bristles of various sizes. Sternum VIII provided with very sinuous caudal margin presenting submarginal row of bristles of which the majority are short, subequal. Remaining bristles of sternum VIII arranged in 2 groups, some of which are strong, somewhat spinous. Bulga of spermatheca semiglobular, showing rounded dorsal margin and barely undulated ventral margin. Hilla strongly bent cephalad, with distal portion slightly more swollen than basal part. Bursa copulatrix elongated, sinuous, with globular apex.

Length.—Male, 2.67 mm (2.50–2.86). Female, 2.80 mm (2.35–3.01).

Type-material.—♂ holotype, ♀ allotype, 2 ♂ and 3 ♀ paratypes ex ♀ *Myotis oxyotis*, Coll. No. 348, Cueva del Indio, Parque Natural Nacional de la Cueva de los Guácharos, Huila, Colombia, 1900 m, 3 June 1976, Thomas Lemke. Holotype and allotype will be deposited in the U.S. National Museum of Natural History, Washington. One male paratype will be deposited in the British Museum, London. The other paratypes will be retained in the Gorgas Memorial Laboratory collection. The type-host specimen is housed in the Field Museum of Natural History (FMNH No. 58753).

ACKNOWLEDGMENTS

We wish to express our appreciation to Dr. Robert E. Lewis for providing personal information and literature utilized during the preparation of this paper.

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**EUPTEROMALUS VIRIDESCENS (HYMENOPTERA: PTEROMALIDAE),
A NEW PARASITE ASSOCIATION FOR PEDIOBIUS FOVEOLATUS
(HYMENOPTERA: EULOPHIDAE)
AND EPILACHNA VARIVESTIS (COLEOPTERA:
COCCINELLIDAE)¹**

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Abstract.—A native pteromalid, *Eupteromalus viridescens* (Walsh) was discovered while dissecting dead parasitized larvae (mummies) of the Mexican bean beetle (MBB), *Epilachna varivestis* Mulsant, in a study to investigate the parasite, *Pediobius foveolatus* (Crawford). Thirteen hundred twenty-nine of the 1757 MBB larvae that were field collected in Queen Anne and Wicomico Counties, Maryland, in 1977 and 1978, respectively, were parasitized. Nine mummies had *E. viridescens* associated with them, and 8 of these were in conjunction with adult *P. foveolatus*. This is a new host association for *E. viridescens* which appears in this instance to be a hyper-parasite.

A native pteromalid, *Eupteromalus viridescens* (Walsh) was discovered while dissecting dead parasitized larvae (mummies) of the Mexican bean beetle (MBB), *Epilachna varivestis* Mulsant. Six hundred twenty-nine larvae were field collected on 28 and 30 September 1977 in Queen Anne County, Maryland; and 1128 larvae were field collected on 11 and 13 July 1978 in Wicomico County, Maryland. The collections were made from small soybean and snapbean test plots, 1977 and 1978, respectively, being used to investigate the MBB parasite, *Pediobius foveolatus* (Crawford). The larvae were brought to the laboratory on the above dates and held in individual containers until parasite emergence. At time of emergence each mummy was dissected for observation of parasite remains. Data recorded included number and sex ratio of emerged adult parasites, number and sex ratio of

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unemerged adult parasites, and stage at which development of pre-adult forms ceased.

Of the 1757 MBB larvae collected at the two sites, 1349 had parasites associated with them. Of the 1349 mummies, *E. viridescens* was determined to be present in 9 cases. In one case, no parasites had emerged, but upon dissection of the mummy, 4 ♀ *E. viridescens* were discovered along with 8 ♀ and 1 ♂ *P. foveolatus*. In 6 cases both species of parasite emerged successfully from the same mummy: 8 ♀ *E. viridescens* and 4 ♀ *P. foveolatus*, 2 ♀ *E. viridescens* and 9 ♀ *P. foveolatus*, 1 ♀ *E. viridescens* and 2 ♀ *P. foveolatus*, 1 ♂ *E. viridescens* and 6 ♀ *P. foveolatus*, 1 ♂ *E. viridescens* and 8 ♀ *P. foveolatus*, and 1 ♂ *E. viridescens* and 1 ♀ *P. foveolatus*. In another case 15 ♀ *E. viridescens* emerged and upon dissection 2 ♀ *P. foveolatus* were found. In the last case 3 ♂ *E. viridescens* had emerged. In all instances dissection yielded parasite pupal remains. *Pediobius foveolatus* pupal remains are characteristically dark brown black in color. Since light brown pupal remains were found in all mummies associated with *E. viridescens*, either alone or in conjunction with *P. foveolatus* but never found in mummies associated with *P. foveolatus* alone, it is likely that this is characteristic of *E. viridescens*.

Peck (1963) references 44 host records for *E. viridescens*. One species in the order Coleoptera, *Hypera postica* (Gyll.), is listed, although the majority of those mentioned are lepidopterans associated with parasites in the Ichneumonoidea. *Pediobius foveolatus*, a euphorid, and *E. varivestis*, a coccinellid, are not among those given, making this occurrence a new host association for *E. viridescens*.

In addition to references cited in Peck (1963), others have identified *E. viridescens* as a hyperparasite in association with *Bathyplectes curculionis* (Thompson) and *Hypera postica* (Puttler, 1966; Pike and Burkhardt, 1974). Harcourt (1960) cites *E. viridescens* as being reared from *Plutella maculipennis* (= *xylostella*) cocoons and attacking the prepupa and pupa of *Hologenes insularis* (Cress.). The existing relationship between this pteromalid and *Spodoptera frugiperda* when parasitized by *Apanteles marginiventris* (Cress.) indicates parasitization of the primary parasite by *E. viridescens* to be as high as 75% (Hofmaster and Greenwood, 1949). *Apanteles congregatus* (Say), commonly identified as a primary parasite of *Protoparce* (= *Manduca*) spp., also claims *E. viridescens* as a secondary parasite with one adult emerging from every host cocoon (Gilmore, 1938). Furthermore, of the non-parasitic species listed as hosts for *E. viridescens* in Peck (1963), most are recorded in Peck (1951) as hosts for at least one parasitic species found on the former list. Thus in this same vein, it is likely that *E. viridescens* acts as a hyperparasite in its relationship with *P. foveolatus* and *E. varivestis*.

Eupteromalus viridescens was identified to genus by Drs. P. M. Marsh and C. F. W. Meusebeck. Dr. E. E. Grissell made the species determination. All three scientists are with the Systematic Entomology Laboratory, USDA.

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NEW SPECIES OF *DIGLYPHUS*, A WORLD LIST OF THE
SPECIES, TAXONOMIC NOTES AND A KEY TO
NEW WORLD SPECIES OF *DIGLYPHUS* AND
DIAULINOPSIS (HYMENOPTERA:
EULOPHIDAE)

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Abstract.—This paper shows that the type-species of *Diglyphus* is *Cirrospilus chabrias* Walker. Eighteen species of *Diglyphus* are listed with synonymy and zoogeographical distribution given. A key is given to the New World species of *Diaulinopsis* and *Diglyphus* and, taxonomic notes are given for *Diglyphus begini*, *D. carlylei*, *D. intermedius*, *D. isaea*, *D. pulchripes*, and *D. websteri*. New records are given for *D. insularis* (Brazil) and *D. websteri* (Peru). *Diglyphus carlylei* (Girault) is removed from synonymy with *D. intermedius* (Girault). *Diglyphus pedicellus*, new species, is described. The male of *D. pulchripes* is described, and the female is re-described. Hybridization tests between *D. isaea* and *D. intermedius* show that reproductive isolation is incomplete; *D. isaea* has been imported into the United States and release records are given for 1975 and 1976.

In connection with research of leaf-miner parasites being performed at the Beneficial Insects Research Laboratory and several universities in the United States, it has been necessary to taxonomically study the genus *Diglyphus* Walker. This report stems from that taxonomic research.

Presumably *Diglyphus* is cosmopolitan in distribution; but we do not have records of it from Africa, India, or Australia. The Palearctic species have been cataloged by Bouček and Askew (1968); the Nearctic species have been cataloged by Peck (1963). The genus consists of small eulophine wasps that develop as primary parasites of leaf-mining Agromyzidae, Lithocellidae, and Lyonetiidae. *Diglyphus* species are of potential value to biological

control programs, but their effectiveness has not been fully realized. Some biological references include Webster and Parks (1913), Ciampolini (1949; 1952), Doutt (1957) and Clausen (1940). Additional biological notes are provided in this paper under the appropriate species. The agromyzids of economic importance have been treated by Spencer (1973).

Sexual dimorphism in *Diglyphus* is limited. Males are smaller than females and the marginal fringe of the male forewing is correspondingly longer. The general trend of sexual dimorphism in the Eulophinae (dorsal rami on the funicular segments of the male antenna) is not expressed in *Diglyphus*. The absence of rami, the presence of a two-segmented funicle, parallel, longitudinal grooves on the scutellum, and the biology place *Diglyphus* with genera such as *Diaulinopsis*, *Cirrospilus*, and *Zagrammosoma*.

One interesting feature of the life history of *Diglyphus* species is the construction of meconial pillars by the final instar larva immediately before pupation (Fig. 1). This characteristic has been reported in Palearctic species of *Diglyphus* and other eulophid leaf-miner parasites (Viggiani, 1964; Howard, 1882; 1891). Presumably these pillars serve as structural support for the leaf mine surrounding the parasite during pupation.

Genus *Diglyphus* Walker

Diglyphus Walker, 1844. Ann. Mag. Nat. Hist. 14:409.

Type-species—*Cirrospilus chabrias* Walker, 1838. Monotypic.

Diaulus Ashmead, 1904. Mem. Carnegie Mus. 1(4):356–357, 372.

Type-species—*Diaulus begini* Ashmead. Monotypic.

Diaulinus Schulz, 1906. Spolia Hymen., p. 146. Unjustified emendation.

? *Solenotomorpha* Blanchard, 1940. Bol. Inform. Direc. San. Veg. 3(10):25.

Type-species—? *Solenotomorpha pampeana* Blanchard. ? Monotypic.

Cycloscapus Erdös and Novicky, 1951. Acta Biol. Acad. Sci. Hungaricae.

Type-species—*Cycloscapus pusztensis* Erdös and Novicky. Original designation.

There has been some confusion over the type-species of *Diglyphus*. Some publications carry the type-species as *D. poppaea* Walker, 1848. This error probably stems from the citation of *D. poppaea* as the type-species by Ashmead (1904:372) and listed again in Gahan and Fagan (1923:45). However, in an earlier work, Walker (1844) wrote “*Diglyphus Chabrias*, *Cirrospilus Chabrias*, Ann. Nat. Hist. i. 451. Alten, Finmark.” This is the earliest reference that we can find to this name and from the context of the remainder of Walker’s article, it appears to be a new combination. Thus, *Cirrospilus chabrias* Walker should be the type-species of *Diglyphus* by monotypy.

The name *Solenotomorpha pampeana* Blanchard was published by Blanchard (1940) in a list of species with a note that it was an important parasite of agromyzids. It is presumably a manuscript name because we have not been able to find a subsequent taxonomic description, and DeSantis (1967) has no other reference to it in his catalog of the Hymenoptera of Argentina. DeSantis (1966) indicates that it has been recovered from *Liriomyza huidobrensis* (Blanchard), *Phytomyza pampeana* Blanchard, and other unidentified agromyzids.

Girault (1913; 1915) described the genera *Diaulomella*, *Diaulomyia*, *Diglyphomorphella*, *Diglyphomorphomyia*, *Pseudiglyphella*, *Pseudiglyphus*, and *Pseudiglyphomyia* from Australia. We have not seen the type-specimens of these genera; but based on the brief descriptions given by Girault, they appear related to *Diglyphus* and *Diaulinopsis*. Some, most, or all of Girault's genera may be junior synonyms of *Diglyphus* and *Diaulinopsis*.

A WORLD LIST OF *DIGLYPHUS*, DISTRIBUTION AND SYNONYMY

1. *Diglyphus albiscapus* Erdös, 1951. (Palearctic)
2. *D. begini* (Ashmead), 1904. (Nearctic, Neotropical)
3. *D. carlylei* (Girault), 1917. (Nearctic)
4. *D. chabrias* (Walker), 1838. (Palearctic)
5. *D. crassinervis* Erdös, 1958. (Palearctic)
6. *D. cupratus* Ferriere, 1960. (Cape Verde Island)
7. *D. insularis* (Gahan), 1914. (Neotropical)
8. *D. intermedius* (Girault), 1916. (Nearctic, Neotropical)
9. *D. isaea* (Walker), 1838. (Holarctic)
 - Cirrospilus medias* Walker, 1838.
 - C. lycophron* Walker, 1838.
 - Diglyphus bisannulatus* Foerster, 1861.
 - D. clavicornis* Walker, 1872.
 - D. ornatus* Foerster, 1861.
 - Entedon gracilis* Goureau, 1851.
10. *D. minoeus* Walker, 1838. (Palearctic)
 - Cirrospilus abron* Walker, 1838.
 - C. deldon* Walker, 1839.
 - C. myron* Walker, 1838.
 - C. similis* Walker, 1839.
 - Eulophus amelon* Walker, 1839.
11. *D. pachyneurus* Graham, 1963. (Palearctic)
12. *D. pedicellus*, new species. (Neotropical)
13. *D. phytomyzae* (Ruschka), 1921. (Palearctic)
14. *D. poppaea* Walker, 1848. (Palearctic)
15. *D. pulchripes* (Crawford), 1912. (Nearctic)

16. *D. pusztensis* (Erdös and Novicky), 1951. (Palearctic)
 - D. fulvipes* Erdös, 1961.
 - D. tibiscanus* Erdös, 1958.
17. *D. sabulosus* Erdös, 1951. (Palearctic)
18. *D. websteri* (Crawford), 1912. (Nearctic, Neotropical)

A KEY TO THE NEW WORLD SPECIES OF *DIGLYPHUS* AND *DAULINOPSIS*

In the following key, *Diglyphus* and *Diaulinopsis* have been combined because they have the same biological and host-preference characteristics and the primary morphological character used for their separation (notauli) sometimes varies. The males of *Diaulinopsis albiscapus* (Girault) and *Diglyphus carlylei* (Girault) are unknown to us.

- | | |
|--|--|
| 1. Females | 2 |
| - Males | 11 |
| 2. Notauli always complete, extending parallel towards transscutal suture | 3 |
| - Notauli usually incomplete, if complete then shallowly and broadly impressed and diverging anteriorly | 4 |
| 3. Trochanters, femora, and tibiae uniformly pale, nearly white | |
| <i>Diaulinopsis albiscapus</i> (Girault) | |
| - Hind femur with basal 0.75 dusky, fore and middle femora, tibiae pale | <i>Diaulinopsis callichroma</i> Crawford |
| 4. Forewing basal cell densely setose (Figs. 6, 8); stigmal vein and postmarginal vein subequal in length; entire antennal scape always dark | 5 |
| - Forewing basal cell sparsely setose to moderately setose (Figs. 2, 4, 10, 15, 18); stigmal vein shorter or longer than postmarginal vein; antennal scape often with pale markings | 6 |
| 5. Basal 0.25–0.35 of hind tibia metallic colored, coloration fading along middle 0.30 of hind tibiae (Fig. 7) | |
| <i>Diglyphus intermedius</i> (Girault) | |
| - Hind tibia predominantly metallic colored, coloration not fading distally (Fig. 9) | <i>Diglyphus isaea</i> (Walker) |
| 6. Basal portion of middle and hind tibiae each with a dark ring less than 0.20× as long as middle or hind tibiae; antennal scape uniformly dark | 7 |
| - Dusky coloration on middle and hind tibiae more extensive, each dark ring always at least 0.50× as long as middle or hind tibiae; antennal scape white or if metallic, then basal cell of forewing moderately setose | 8 |
| 7. Middle and hind tibiae with apical duskiness separated from basal | |

- ring by pale area *Diglyphus carlylei* (Girault)
- Middle and hind tibiae without apical duskiness
..... *Diglyphus begini* (Ashmead) 9
8. Postmarginal vein of forewing at most slightly longer than stigmal vein, usually shorter than stigmal vein (Figs. 15, 18) 9
- Postmarginal vein of forewing always distinctly longer than stigmal vein (Figs. 4, 10) 10
9. Basal 0.50 of antennal scape white *Diglyphus pulchripes* (Crawford)
- Antennal scape white except apex
..... *Diglyphus pedicellus*, new species
10. Antennal scape entirely white; basal 0.50 of fore tibia metallic, remainder pale; scutellum concolorous with remainder of mesosoma *Diglyphus insularis* (Gahan)
- Antennal scape basally white (0.30–0.50); fore tibia predominantly metallic; scutellum frequently with bronze reflection
..... *Diglyphus websteri* (Crawford) 12
11. Antennal scape inflated (Figs. 12, 14) 13
- Antennal scape not inflated 13
12. Pedicel not enlarged (Fig. 14); tibiae pale yellow; notauli complete *Diaulinopsis callichroma* Crawford
- Pedicel enlarged (Fig. 12); tibiae predominantly dark colored; notauli incomplete *Diglyphus pedicellus*, new species
13. Fore and hindwing submarginal and marginal veins enlarged (Figs. 20, 21) *Diglyphus pulchripes* (Crawford)
- Fore and hindwing submarginal (and marginal) veins not enlarged 14
14. Basal cell of forewing densely setose 15
- Basal cell of forewing sparsely or moderately setose 16
15. Marginal fringe of forewing 3 or more times longer than costal cell length *Diglyphus intermedius* (Girault)
- Marginal fringe of forewing no more than 2× longer than costal cell length *Diglyphus isaea* (Walker)
16. Antennal scape metallic colored; basal colored bands of middle and hind tibiae about 0.2× as long as respective tibiae
..... *Diglyphus begini* (Ashmead) 17
- Antennal scape with some white coloration; middle and hind tibiae with basal colored bands more than 0.2× as long as respective tibiae 17
17. Scape white except apex which is dusky; tibiae at most with basal 0.5 dark colored *Diglyphus insularis* (Gahan)
- Scape with basal 0.3–0.5 white, remainder dusky; tibiae predominantly dark colored *Diglyphus websteri* (Crawford)

Diglyphus begini (Ashmead)

Diglyphus begini (Ashmead), 1904. Mem. Carnegie Mus. 1(4):356, 357, 372 (Figs. 2, 3).

Type-locality.—? Sherbrooke, Canada.

This species may be Holarctic in distribution (Bouček, *in litt.*), and Gordh has recently identified it from Colombia (new record). It was designated, but not described as the type-species of *Diaulus* by Ashmead (1904) in a generic key to the Eulophini. Ashmead indicated that *Diaulus* was a replacement name for *Diglyphis* Thomson. *Diglyphis* has been shown to be a junior synonym of *Dicladocerus* Westwood (Graham, 1959).

The type-locality of *D. begini* is conjecture. Crawford (1912) provided a description for this species, but did not indicate the type-locality. The USNM type-catalog number for this species is 12740 and that entry reads "Diaulus^{n.g.} begini Ashm. Oct. 30, 1 type." On the label of the type-specimen is a tag reading "sh 21-9-96." The type-specimen of *D. begini* is preserved on a card point and the head, antennae, and some legs are on a slide mount in Canada balsam. The slide is labeled in Girault's handwriting "Diaulinus begini Cwfd. ♀ type." The point-mounted body has tags that read "Sh. 21-9-96," "585," "Type No 12740," and "D. begini Ashm." The first label is definitely not in the handwriting of Ashmead (C. F. W. Muesebeck, personal communication).

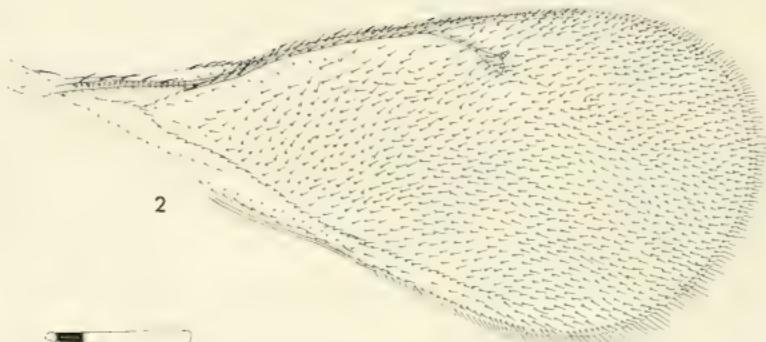
We believe the type-locality of this species is Sherbrooke, Canada because Ashmead (1896) described *Prionopoda begini* based on a single specimen taken by Abbé Begin at Sherbrooke, Canada. Examination of the type-specimen of this ichneumonid reveals that several labels are on the pin. The locality label reads "Sherbrooke, Can" and the label immediately beneath it reads "Aug 6 94." The day is questionable because the pin is through the day on the label. All of the circumstances outlined above suggest that the type-locality of this species is Sherbrooke, Canada.

Diglyphus begini is numerically the most abundant species of the genus in Canada, and in the United States it appears more common in the western states. The dark antennal scape, sparsely setose forewing basal cell, and the short metallic colored rings on the middle and hind tibiae make this a distinctive species.

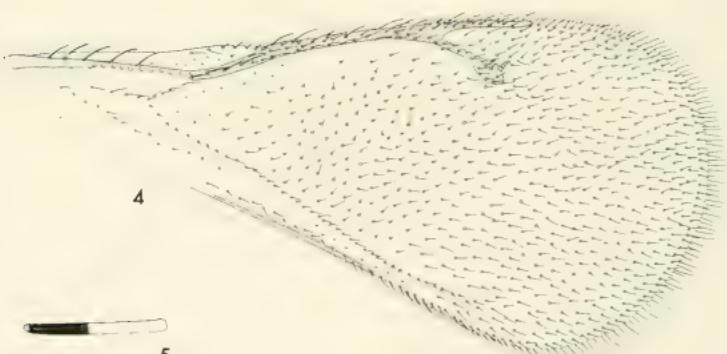
Biological notes on this species have been given by Webster and Parks (1913), Phillips (1914), Corey (1916), Hills and Taylor (1951), and Doutt (1957). The parasite has been reared from several species of agromyzids, including *Phytomyza atricornis* Meigen, *P. aquilegiae* Hardy, *P. albiceps* Meigen, *Paraphytomyza populicola* (Walker), *Agromyza parvicornis* Loew, *A. scutellata* (Fallén), *A. frontella* (Rondani), and *Liriomyza* sp.



D. *intermedius*



D. *begini*



D. *insularis*

Essig (1926) reports that *D. begini* has been reared from *A. scutellata* in several western states. However, Spencer (1973) indicates that *A. scutellata* is a European species. Thus, it would appear that this host association is suspect.

Diglyphus carlylei (Girault)

Diglyphus carlylei (Girault). 1917. Des. Hymen. Chalcidoid. Var. Cum Observ. 3:6. (Privately printed.)

Type-locality.—Alameda Co., California.

Girault (1917) described this species but did not give the number of specimens in the type-series. Girault (1920) listed the catalog number for the specimens as 20862, and the entry reads "Diaulinopsis carlylei gir. Alameda Co., Calif. D. W. Coquillett 3 (spec.) (type on) tags + slide." The USNM collection holds a slide with two coverslips with a crushed head and antenna under one coverslip and an intact antenna (except radicula) and part of a leg under the other coverslip. The other two specimens are apparently missing. It should be noted that the date of publication for species in Girault's (1917) publication is 1 May 1917 for species listed on pages 1–9, and 3 May 1917 for species listed on page 10.

Burks (1958) placed *D. carlylei* in synonymy with *D. intermedius*. In our opinion, the remaining specimen on the point is not *D. intermedius* because the post-marginal vein is more than 1.5 times as long as the stigmal vein, the basal cell is not densely setose, and the marginal fringe is about as long as the costal cell. *Diglyphus carlylei* seems more nearly related to *D. begini*. In fact, the only character Gordh has been able to differentiate between these species is the duskiness on the middle and hind tibiae and a pale area between the duskiness and the basal metallic colored ring on *D. carlylei*. A large series of specimens from California displays this coloration, and these are called *D. carlylei*. It remains to be established whether *D. carlylei* is a distinct species because the tibial character is variable. There are specimens in which the duskiness becomes faint and can only be seen by rotating the specimen so that the legs are seen in different aspects and varying intensities of light. Specimens having this coloration have been recovered from California only (Oxnard, Ventura Co.; Terminus Res., Tulare Co.; Scotia, Humboldt Co.; Pico Cr., San Luis Obispo Co.; and San Diego Co.). *Diglyphus begini* is also found in California, but the specimens never display the duskiness. It is possible that *D. carlylei* is a seasonal coloration variant of *D. begini*.



Fig. 1. *Diglyphus intermedius*, exposed pupa with meconial pillars. Figs. 2–3. *Diglyphus begini*, female. 2, Forewing. 3, Hind tibia. Figs. 4–5. *Diglyphus insularis*, female. 4, Forewing. 5, Hind tibia.

begini. However, we regard these species as distinct for the present because we know nothing of the biology of *D. carlylei* and little about the biology of *D. begini*. Life history studies and hybridization tests should be conducted on topotypical material of both forms.

At casual glance there appears to be an additional difference between *D. carlylei* and *D. begini*. For instance, the basal rings of *D. begini* appear to be paler than those of *D. carlylei*. However, this appears correlated with the age of the specimen. Old specimens lose some of the sharpness of the metallic coloration. A long series of specimens of *D. carlylei* from Oxnard, California have the funicular segments contrastingly pale when compared to the pedicel and club. This character also appears to vary, and some *D. begini* have the first funicular segment somewhat paler than the other antennal segments.

The point mounted specimen in the USNM collection is here designated as LECTOTYPE.

Diglyphus insularis (Gahan)

Diglyphus insularis (Gahan), 1914. Proc. U.S. Natl. Mus. 48(2068):165 (Figs. 4, 5).

Type-locality.—Rio Piedras, Puerto Rico.

This species was described by Gahan and was based on nine females and four males reared from *Japanagromyza inaequalis* (Malloch). Wolcott (1952) reports that it attacks *Agromyza pusilla* Meigen. Spencer (1973) reports that in America many species were confused with *Agromyza pusilla* by early workers and this may be the case with Wolcott's identification. One specimen of this species that was taken at Recife, Brazil (new record) and identified by Burks now stands in the USNM collection. This species is similar to the European *D. albiscapus* in having a white antennal scape and intermediate-length postmarginal vein in the forewing. It can be distinguished from that species by the coloration of the femora and tibiae.

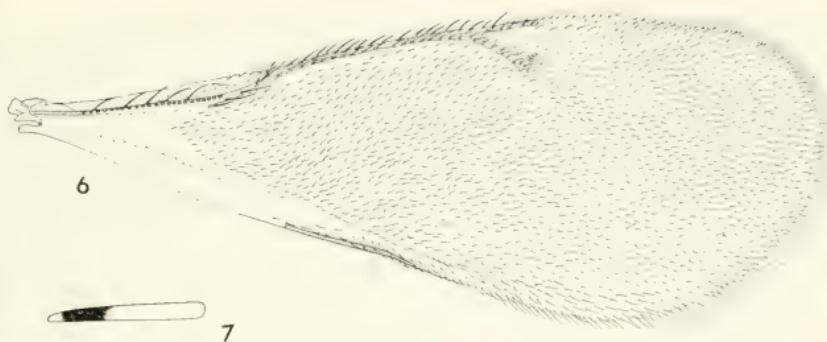
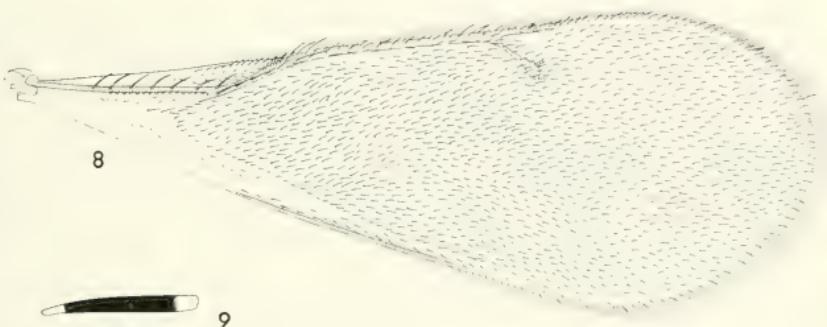
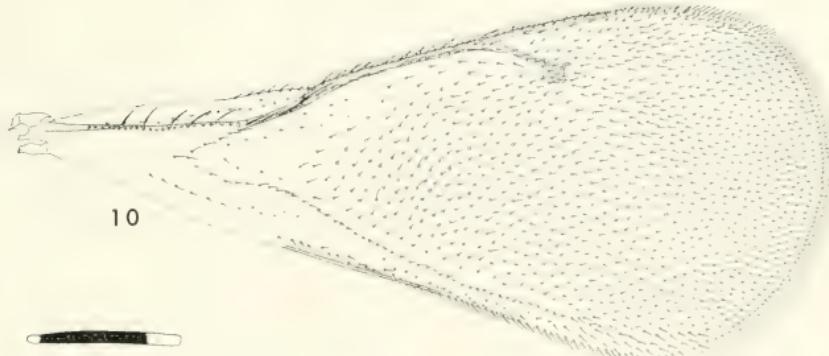
Diglyphus intermedius (Girault)

Diglyphus intermedius (Girault), 1916. Can. Entomol. 48(8):265–266 (Figs. 6, 7).

Type-locality.—Kingston, Rhode Island.

Girault described this species from one female collected during 1916 that was reared from *Phytomyza chrysanthemi* Kowarz [=? *Phytomyza syngen-*

Figs. 6–7. *Diglyphus intermedius*, female. 6, Forewing. 7, Hind tibia. Figs. 8–9. *Diglyphus isava*, female. 8, Forewing. 9, Hind tibia. Figs. 10–11. *Diglyphus websteri*, female. 10, Forewing. 11, Hind tibia.

D. *intermedius*D. *isaea*D. *websteri*

sicc (Hardy)]. The species is widely distributed in North America and has been recovered from Puerto Rico (Essig, 1926; Peck, 1951; Burks, 1958; 1967; unpublished).

This species is similar to the European species *D. isaea*, which was imported into the United States and released in Pennsylvania, New Jersey, and Delaware for the biological control of various leaf-miners on alfalfa. Both species are characterized by a densely setose forewing basal cell and the postmarginal and stigmal veins are subequal in length. However, coloration of the hind tibia seems a reliable character for separating the two. Metallic coloration of the hind tibia fades beyond the basal one-third of the tibia in *D. intermedius*. In some specimens, the ring will become darker along the distal portion of the hind tibia giving the impression of two rings separated by a pale ring. Another potentially useful male character is the absolute length of the forewing marginal fringe and the distance between individual setae that comprise the fringe.

Color characters seem reliable for separating most species of *Diglyphus*, but apparently there is more color variation in *D. intermedius*. Tests were conducted to determine the influence of temperature on the observed variation. *Diglyphus intermedius* immatures were reared at 24°C. The adult stage of these parasites was allowed to oviposit at 24°C, and the F₁ immatures developed at 30°C. Few F₁ progeny emerged, but males that did emerge had darker coloration on the hind tibiae when compared with the parental generation of males.

It is important to distinguish between *D. isaea* and *D. intermedius* because the European species has been imported into the United States for the biological control of leaf-miners on alfalfa. If the extent of reproductive isolation is insignificant and if the two do not differ in host preference or biology, then it seems unlikely that further importation and release of *D. isaea* in North America is justified. Therefore, crossing tests were performed to determine the extent of reproductive isolation. Crosses between *D. isaea* females and *D. intermedius* males were negative (i.e., no females were produced for six replicates). Crosses between *D. isaea* males and *D. intermedius* females produced about 10% F₁ female progeny. Four hybrid F₁ females were crossed with *D. intermedius* males and all of these crosses resulted in F₂ female progeny. The F₁ and F₂ females resembled *D. isaea* females with respect to hind tibial coloration whereas male F₂ progeny had variable hind tibial coloration and two specimens had almost no hind tibial coloration.

These tests suggest that *D. intermedius* and *D. isaea* are closely related genetically and that reproductive isolation is not yet complete. For the present, it does not seem appropriate to synonymize them because we do not have sufficient information concerning their biology. The possibility of hybridization in the field is likely.

The problem with *D. intermedius* may be more complicated than we suspect. Burks identified three male specimens taken at Snowville, Utah as *D. intermedius*. The wing characters are similar to *D. intermedius* except that the basal cell immediately posterior to the forward projecting portion of the submarginal vein is bare and the basal half of the antennal scape is pale. The leg coloration characters are suggestive of *D. carlylei*.

Biological notes for *D. intermedius* are provided by Frost (1924), Michelbacher et al. (1951; 1952), and more recently by Hendrickson and Barth (1978). Although usually solitary, data in the last reference indicate that *D. intermedius* is occasionally gregarious. This parasite has been recovered from *Liriomyza subpusilla* Frost, *L. sativae* Blanchard, *L. brassicae* (Riley), *L. trifoliarum* Spencer, *L. properpusilla* Frost, *Phytomyza atricornis* Meigen, *P. chrysanthemi* Kowarz, and *Agromyza frontella* (Rondani).

Diglyphus isaea (Walker)

Diglyphus isaea (Walker), 1838. Ann. Nat. Hist. 1:386 (Figs. 8, 9).

Type-locality.—Great Britain.

We have not seen the type-specimen of *D. isaea*. Our concept of this species is based on laboratory-cultured material received from L. Dureseau collected in France on alfalfa infested with *Agromyza nana* Meigen and *A. frontella*. This species is similar to *D. intermedius*. See that species for a discussion of the relationship between them.

Details of the biology of *D. isaea* have been published by Ciampolini (1952). The parasite is gregarious and lays 1–4 eggs on the host larva. The parasite pupates in the agromyzid's gallery. Before pupation, the parasite larva deposits meconial pellets around its body or uses fecal pellets of the host to serve as support in preventing the collapse of the gallery.

Below are summarized the release data for this species in the United States. Releases were not made in 1977.

1975

| Number | Locality | Number | Locality |
|--------|----------------|--------|------------------|
| 2700 | Newark, DE | 50 | Kemblesville, PA |
| 2850 | Rancocas, NJ | 600 | Hadley, MA |
| 950 | Oxford, PA | 600 | Concord, NH |
| 2000 | New London, PA | 400 | Port Clinton, PA |
| 2050 | Blairstown, NJ | 400 | Windsor, NJ |

1976

| Number | Locality | Number | Locality |
|--------|--------------|--------|------------------|
| 16,250 | Newark, DE | 2500 | Blairstown, NJ |
| 18,800 | Rancocas, NJ | 2000 | Kemblesville, PA |
| 17,950 | Oxford, PA | 4000 | New London, PA |

Diglyphus pedicellus Gordh and Hendrickson, NEW SPECIES
Figs. 12, 13, 15-17

Female.—1.29 mm long. Body dark metallic blue green; coxae, trochanters, basal 0.75 of femora and tibiae deep reddish brown with faint green reflections; apical 0.25 of femora and tibiae, basal 3 tarsomeres pale. Basal 0.75 of antennal scape pale, remainder of antenna fuscous. Compound eyes red, wings hyaline.

Head in frontal aspect ovoid with striate sculpture and moderate vestiture of pale, thin, short setae on vertex, medial margin of compound eye, malar space, and clypeus; setae on compound eye shorter. Malar space about $0.6 \times$ as tall as compound eye. Toruli at transverse line extending between ventral margins of compound eyes and separated by about $3.0 \times$ torulus width. Antenna (Fig. 13) with a few pale, short setae and longitudinal striae, on scape. Pedicel with conspicuous longitudinal striae and moderate vestiture of long, thin, pale setae; setae along ventral margin at apex short and dark; pedicel slightly shorter than 1st funicular segment; funiculars and club moderately setose and with rhinaria; 1st funicular slightly longer than 2nd; combined length of 1st and 2nd funicular segments slightly less than club length.

Mesosoma subequal in length to metasoma; pronotum with reticulate sculpture and sparse vestiture of short pale setae, longer setae along posterior margin. Notaulices incomplete; mesoscutum sculptured as pronotum and with 6 small setae anteriorly, 2 larger setae medially. Metanotum asebose, polished, with meson broadly V-shaped, elevated from lateron, apex touching anteriomedial margin of propodeum. Propodeum smooth, polished; area between anteriomedial margin and spiracle forming a broad, shallow depression; callus moderately setose with setae long and thin. Forewing (Fig. 15) costal cell with a ventral line of setae extending from base to apex and a short line of setae along anterior margin at distal 0.15 of cell; basal cell nearly asebose, with only a few basal setae on ventral surface; postmarginal vein $1.31 \times$ as long as stigmal vein; marginal fringe as long as costal cell. Hind tibia coloration as figured (Fig. 16).

Metasomal terga 1 and 2 setose laterally, asebose medially; remaining terga each with transverse line of setae. Exposed sterna with moderate vestiture of pale, long, thin setae. Dorso-apical portion of ovipositor with numerous sharp teeth; ovipositor $1.33 \times$ as long as hind tibia, $3.70 \times$ as long as gonostylus.

Figs. 12-13. *Diglyphus pedicellus*. 12, Antenna of male. 13, Antenna of female. Fig. 14. *Diadulinopsis callichroma*, antenna of male. Figs. 15-16. *Diglyphus pedicellus*, female. 15, Forewing. 16, Hind tibia.



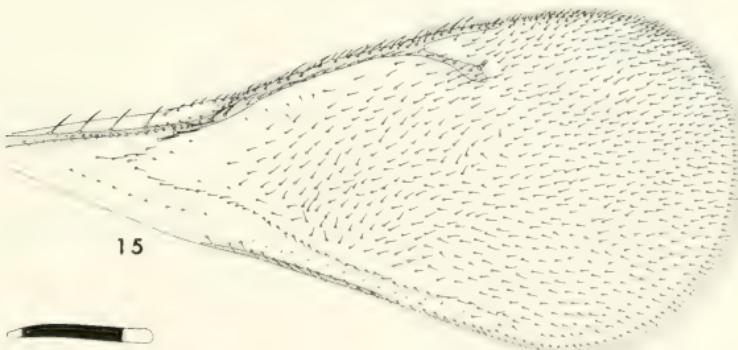
12



13



14

D. *pedicellus*D. *callichroma*

15



16

D. *pedicellus*

Male.—Resembling the female in coloration, habitus, and chaetotaxy. Differing in the following characters: Malar space as tall as compound eye. Antenna reddish brown with faint metallic green reflection; scape and pedicel inflated (Fig. 12); scape $2.3 \times$ longer than tall; medial surface broadly and shallowly concave; lateral surface correspondingly convex; medial surface coarse, asetose; lateral surface with longitudinal striae and setose; pedicel laterally broadened, $2 \times$ longer than wide; dorsal surface broadly convex, ventral surface broadly and shallowly concave such that pedicel and scape form a cup when apposed; ventral surface sparsely setose and coarse; dorsal surface with short, dark, thick setae and longitudinal striae; pedicel $0.60 \times$ as long as flagellum. Funicular segments subequal in length, combined length $0.66 \times$ as long as club; 1st funicular segment setose; 2nd funicular segment and club setose with rhinaria.

Forewing (Fig. 17) with stigmal and postmarginal veins subequal in length; basal cell slightly more setose than in female; marginal fringe $1.5 \times$ longer than costal cell.

Described from 6 females and 11 males. Data labels read "on alfalfa Montevideo Urug, XII-21-46, H L Parker 1364, Lot 46-16462 (1 ♀, 1 ♂)," "No 970-2, X-16-44 Host leaf miner, So. Amer. Paras. Lab. Parker, Lot No. 45-1231 (5 ♀♀, 1 ♂)," "on alfalfa, Montevideo Urug, XII-21-46 H L Parker 1364 (3 ♂♂)," and "Vicia faba, Lupinus albus with larv—13; Sayago, Montevideo Urug, XI-XII-1946, C S Carbonell—16 Lot 43-14434 (6♂♂)."

Holotype female bearing label 970-2 and USNM Type Number 75228. All material deposited in the U.S. National Museum.

Type-locality.—Montevideo, Uruguay.

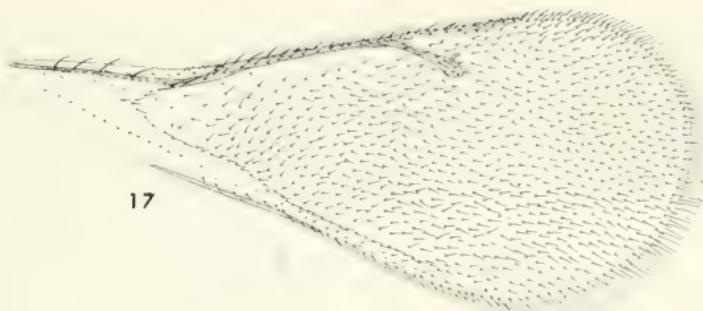
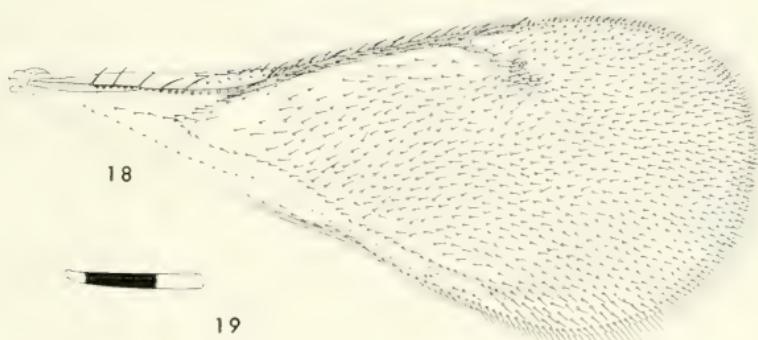
The new species is similar to *Diglyphus pulchripes* and *Diaulinopsis callichroma*. Females of *D. pedicellus* may be distinguished from females of the former species by the coloration of the antennal scape. Males of *D. pedicellus* may be distinguished from males of the latter species by development of the notaulices, enlargement of the pedicel, and extent of coloration on the hind tibia.

Etymology.—The specific epithet is a Latin noun which means pedicel (second antennal segment) and is intended to allude to its enlarged condition.

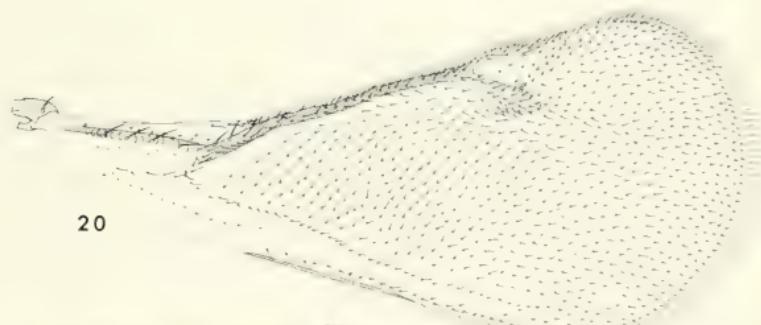
Diglyphus pulchripes (Crawford)

Diglyphus pulchripes (Crawford), 1912. Proc. U.S. Natl. Mus. 43(1927):184 (Figs. 18-21).

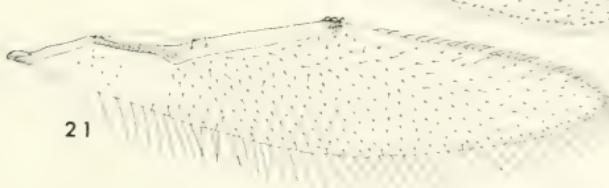
Fig. 17. *Diglyphus pedicellus*, forewing of female. Figs. 18-21. *Diglyphus pulchripes*. 18. Forewing of female. 19. Hind tibia of female. 20. Forewing of male. 21. Hind wing of male.

D. *pedicellus*

19

D. *pulchripes*

20



21

D. *pulchripes*

Type-locality.—Algonquin, Illinois.

Crawford described this species based on the female only. Subsequently, the male has been discovered; and it is described here. Discovery of the male reveals that *D. pulchripes* is similar to the Palearctic species *D. crassinerus* Erdös. We have not seen the type-specimen of this species, but our concept of it is based on the original description and a male and female collected by Dr. Z. Bouček in Italy. Males and females of these species can be distinguished on the basis of marginal fringe length, ratio of postmarginal and stigmal veins, and coloration of the antennal scape.

Female.—Conforms well to Crawford's original description (type-specimen now headless) basal $\frac{1}{2}$ of antennal scape white. Forewing (Fig. 18) stigmal vein slightly longer than postmarginal vein, occasionally subequal; wing blade asetose behind base of marginal vein, marginal fringe as long as costal cell. Base and apical $\frac{1}{3}$ of hind tibia white, remainder metallic blue green (Fig. 19).

Male.—Similar to the female in habitus, sculpture, and chaetotaxy. Fore and hindwing venation strikingly enlarged (Figs. 20, 21); maximal length of forewing marginal fringe subequal in length to costal cell length. Hindwing submarginal vein as long as marginal vein; marginal vein with a line of setae directed anteriad; costal cell asetose.

The males of *D. crassinerus* and *D. pulchripes* have enlarged marginal venation on the fore and hindwing. However, based on the original description of *D. crassinerus*, it is difficult to determine them as synonymous. Moreover, such a move may be unjustified because biologically we know little about the species.

This species has been recovered from several species of agromyzids including *Liriomyza* sp., *L. trifoliarum* Spencer, *Paraphytomyza populicola* (Walker), *Phytomyza aquilegiae* Hardy, *Agromyza parvicornis* Loew, and *Nemorimyza posticata* (Meigen) at several localities in Illinois, Indiana, Iowa, and Massachusetts. It has been reared at the Beneficial Insects Research Laboratory in Newark, Delaware, for release against leaf-miners on alfalfa.

Interestingly, Cole (1931) reports that *D. pulchripes* has been recovered from the stratiomyiid *Macrosargus clavis* Wiedeman. To our knowledge it subsequently has not been reared from this or other species of non-agromyzid Diptera.

Diglyphus websteri (Crawford)

Diglyphus websteri (Crawford), 1912. Proc. U.S. Natl. Mus. 43(1927):183, 184–185 (Figs. 10, 11).

Type-locality.—? Tempe, Arizona.

There is some question about the type-locality of this species. In the original description, Crawford designated the type-locality as Tempe, Ari-

zona. The type-series bears the label, "Tempe, Ariz." and the USNM type-catalog indicates the locality is Tempe, Arizona (but not in the handwriting of Crawford). The Webster number is 7286 and could provide corroborating evidence, but the card corresponding to that number is not available. Moreover, in the same publication (p. 183), Crawford described *Diaulinopsis callichroma* and gave the type-locality as Tempe, Arizona, with the Webster number 7286.

The type-specimen of *D. websteri* was crushed on a slide and mounted in Canada balsam by Girault. This species is similar to *D. pulchripes* but may be distinguished from that species based on the characters given in the key.

Diglyphus websteri is distributed throughout the Nearctic, and Gordh has recently identified it from Peru (NEW RECORD) on *Liriomyza flaveola* (Fallén). The host list for this parasite is extensive and includes *Agromyza parvicornis* Loew, *A. frontella* (Rondani), *Cerodontha dorsalis* (Loew), *Liriomyza* spp., *L. trifollearum* Spencer, *Phytobia* sp. and *Phytomyza obscurella* (Zetterstedt).

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A NEW NEOTROPICAL GENUS OF CHOREUTIDAE
(LEPIDOPTERA: SESIOIDEA)

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20560.

Abstract.—*Zodia*, new genus, is described for five Neotropical species of Choreutidae including: *Zodia plutusana* (Walker) (= *aeneigutta* Felder and Rogenhofer, new synonymy), *Z. scintillana* (Walker), *Z. ochripalpis* (Meyrick), *Z. rutilella* (Walker), and *Z. chrysosperma* (Meyrick).

Several species included in the heterogeneous "Simaethis" or described in *Brenthia* and *Choreutis* have been noted (Heppner, 1977) to belong to a new genus related to *Hemerophila*. The following generic description and revision of the genus are presented here to make the new genus name available for an upcoming publication on the world fauna of the Sesioidae (Heppner and Duckworth, *in press*).

Zodia Heppner, NEW GENUS

Type-species: *Simaethis plutusana* Walker, 1863.

Description.—Adults small, 4–6 mm forewing length. *Head*: Labial palpus upturned, with apical segment slightly shorter than middle segment, tapered; basal and middle segments subequal, relatively smooth scaled. Maxillary palpus small, 2-segmented. Pilifer large. Haustellum well developed, basally scaled. Ocellus large. Vertex relatively smooth scaled, with posterior tufts. Antenna moderate, only somewhat longer than $\frac{1}{2}$ forewing length; long ventral setae in males, short ventral setae in females. *Thorax*: Forewing (Fig. 2) broad with somewhat acute apex (more acute in ♂ than ♀); pterostigma very long, $\frac{4}{5}$ of costal margin; R_1-R_4 to costa with R_1 divergent from radius before mid-wing; R_2-R_5 divergent at end of cell; R_5 to just below apex; M_2 closer to M_3 than to M_1 ; chorda absent; CuA_1 from near base of M_3 ; CuA_2 distant, diverging $\frac{1}{3}$ from end of cell; CuP fold well developed from $\frac{1}{3}$ of wing to wing margin; $A_1 + A_2$ to tornal margin. Hind-wing triangular with acute apex and sharply rounded tornal margin; radius to apex; M_1-M_3 equally spaced with M_3 long stalked to CuA_1 ; CuA_2 distant from CuA_1 ; CuP fold well developed near margin; anal field broad; $A_1 + A_2$



Fig. 1. *Zodia plutusana*, ♀, Amazonas, Brasil (paralectotype of *aeneigutta*) (NHMV).

with basal fork, widely separated from A_3 ; A_4 vestigial. Legs unmodified. *Abdomen*: Male genitalia with uncus absent; anal tube well developed and formed with lateral socius-like enfolding; gnathos absent; valva simple, setaceous, sometimes with an apical claw-like hook; valva with large basal setal area on costal margin curvature, sometimes also on sacculus; vinculum small, usually triangular; saccus absent; anellus as Y-shaped collar; aedeagus short, with phallobase and spicules on vesica; cornutus absent. Female genitalia with ovipositor short, floricomous with setaceous pads; ostium bursae on intersegmental membrane between sternites 7 and 8; ductus bursae long, membranous, sclerotized near ostium; bursa copulatrix ovate, spiculate, with or without small bulbous accessory bursa; signum as large row of teeth-like spines or smaller spines.

Larva and pupa.—Unknown.

Biology.—Unknown.

Distribution.—Neotropical, from Costa Rica to the Amazonian areas of Brasil and Peru.

Diagnosis.—*Zodia* is similar to *Hemerophila*, especially in wing venation and head morphology, but is relatively distinct in genital characters, especially the unusual anal tube arrangement of the male. The pterostigma of *Zodia* is very large and appears to be the longest in Choreutidae.

The genus comprises five species having similar wing maculation and

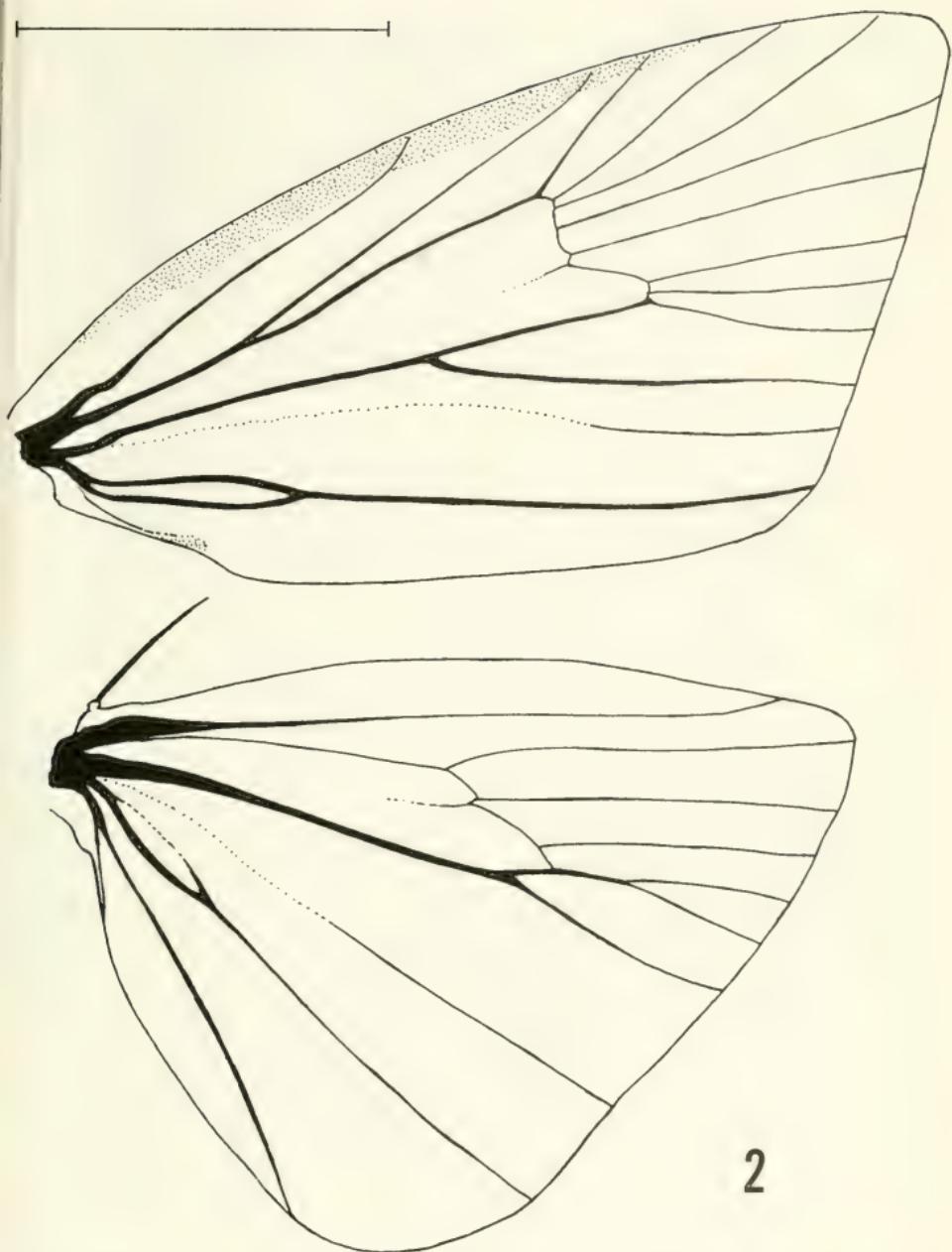
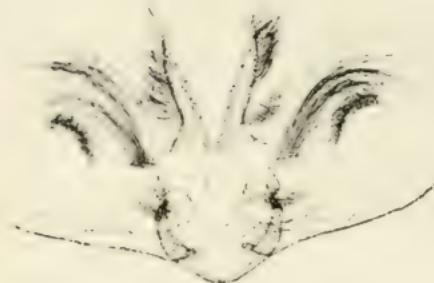


Fig. 2. *Zodia plutusana*, ♂, Costa Rica (USNM), wing venation (slide USNM 77838)
(scale = 2 mm).



4



Figs. 3-4. *Zodia plutusana* (Walker), ♂ lectotype (BMNH), Amazonas, Brasil (slide BM 20224). 3, Male genitalia. 4, Aedeagus (enlarged). Fig. 5. *Zodia scintillana*, ♂ lectotype (BMNH), Amazonas, Brasil (slide BM 20225) [anal tube split]. Figs. 6-7. *Zodia chrysosperma*, ♂ lectotype (BMNH), Amazonas, Brasil (slide JFGC 6550). 6, Male genitalia. 7, Aedeagus (reduced scale).

genitalia, as far as is known. Available specimens are few in number except for a series recently collected in Costa Rica. Tefe, Brasil, is the type-locality of four of the five species in the genus.

Etymology.—*Zodia* is Greek for "little animal."

Zodia plutusana (Walker), NEW COMBINATION

Figs. 1-4, 8

Simaethis plutusana Walker, 1863:453.

Choreutis aeneigutta Felder and Rogenhofer, 1875:6 (pl. 138, fig. 2), NEW SYNONYMY.

Simaethis plutana Meyrick, 1913:37, emendation.

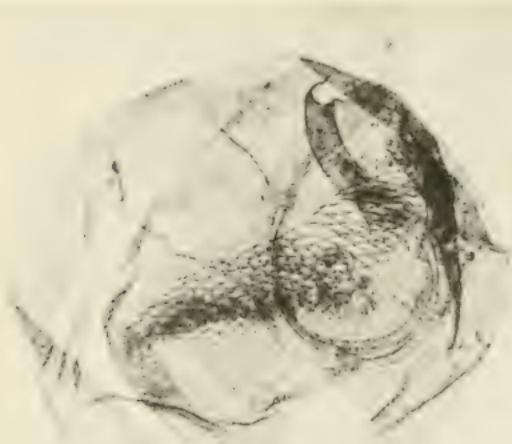
Brenthia aeneigutta. Meyrick, 1913:38.

This species is the largest of the genus and is mainly distinguishable by the genitalia, having very few setae on the male valval costal margin, and a female signum with small spines.

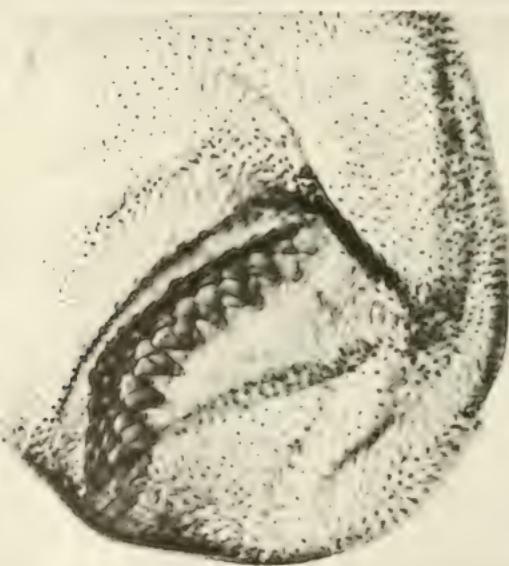
Description.—Size 4.5-6.0 mm forewing length. *Head*: Fuscous with some ochreous on posterior corners and metallic green iridescence on frons. Labial palpus ochreous with some tan on apex. Antenna fuscous with alternating white segments. *Thorax*: Dorsally fuscous with metallic gold iridescent petagia; ventrally metallic green iridescent on mesothorax, less so on metathorax. Forelegs pale ochreous and fuscous, other legs mostly fuscous with white bands on tarsal segments. Forewing (Fig. 1) fuscous with metallic gold to green iridescent (depending on light angle) spots near base and at $\frac{1}{3}$ from base along anal margin; silvery white spots (with some green sheen) mostly elongate, from costal margin at $\frac{1}{3}$ and $\frac{2}{3}$ from base, at end of cell, near tornal angle, and along tornal margin $\frac{2}{3}$ from base; small white spots along distal margin, 4 near apex and 1 on tornus; fringe dark fuscous; venter uniform pale fuscous with distal costal white mark. Hindwing unmarked pale fuscous. Fringe bi-colored with base dark fuscous and outer layer white. Venter uniform pale fuscous. *Abdomen*: Fuscous with silvery scale row on posterior edge of each segment; venter slightly paler. Male genitalia as described for the genus, with the valva (Fig. 3) relatively elongate and dorsal margin only slightly curved and with few scale setae on the margin; no hook on valval apex. Aedeagus as for genus (Fig. 4). Female genitalia as described for genus (similar to *Z. ochripalpis*); apophyses very short; ductus bursae very long, somewhat coiled near bursa; no apparent accessory bursa; signum a large linear spicule field (Fig. 8) of teeth-like spines.

Type-locality.—Ega [=Tefé], Amazonas, Brasil [*plutusana*]; Amazonas, Brasil [*aeneigutta*].

Types.—Lectotype ♂ [*plutusana*] (BMNH), present designation, labelled as follows: LECTOTYPE [round, purple edge] Type [round, red edge; reversed] Ega [round blue label; "57.20" on reverse side] *Simaethis plutusana*



8



9



10



Fig. 8. *Zodia plutusana*, ♀ bursa and signum, Costa Rica (USNM) (slide USNM 77714). Figs. 9–10. *Zodia ochripalpis*, ♀ holotype (BMNH), Pará, Brasil (slide JFGC 6549). 9. Signum. 10. Bursa and signum. (Photos 9 and 10 courtesy of the British Museum (Natural History) and from Clarke, 1969.)

Wkr. ♂ [Durrant label]; TYPE ♂ 1857.20; 9. *Simaethis plutusana* Wkr. 1863, 453/LECTOTYPE ♂. *Simaethis plutusana* Wlk., By Heppner '76 B.M. ♂; Genitalia Slide: No. 20224. Paralectotype: 1 ♂, as above but labelled paralectotype (BMNH).

Lectotype ♂ [*aeneigutta*] (BMNH), present designation, labelled as follows: LECTOTYPE [round, purple edge]/Type [round, red edge; reversed] 302/Sim., *plutosa* [sic], V. aff./Novara CXXXVIII, f.2; *Choreutis*?; *aeneigutta*; Amaz. ♂ n./TYPE [Durrant label]/FELDER'S TYPE [reversed]; LECTOTYPE ♂; *Choreutis aeneigutta* F. & R.; By Heppner '76/B.M. ♂; Genitalia slide No. 20244. Paralectotypes: 2 ♀, same data as lectotype but labelled paralectotypes (NHMV).

Material examined.—*Costa Rica*: Turrialba, Cartago Prov., 17–21 Feb 1965 (4 ♂, 6 ♀), 22–28 Feb 1965 (1 ♂, 1 ♀), 13–17 Mar 1965 (2 ♂), S. S. & W. D. Duckworth (USNM). *Panama*: Barro Colorado Is., Canal Zone, 11 Feb 1929 (1 ♂), S. W. Frost (USNM).

The available specimens show a wide distribution in the northern Neotropical region but present a large gap in distribution records between Panama and the Amazon River of Brasil.

Zodia scintillana (Walker), NEW COMBINATION
Fig. 5

Simaethis scintillana Walker, 1863:454.

This species is very similar to the preceding but in the male genitalia has a more arched dorsal edge on the valva and a larger setal area.

Description.—Size 5–6 mm forewing length. Maculation is the same as in *Z. plutusana*. Male genitalia are as in *Z. plutusana* but the valva is broader, with a more arched dorsal margin, with a well-developed setal field on the curvature (Fig. 5). Aedeagus as for the genus. Female genitalia unknown.

Type-locality.—Ega [=Tefé], Amazonas, Brasil.

Types.—Lectotype ♂ (BMNH), present designation, labelled as follows: LECTOTYPE [round, purple edge]/Ega [round, blue label with "58.6" on reverse side]/*Simaethis scintillana* Wkr.; 28/454; PARATYPE 2/2 [Durrant label]/LECTOTYPE ♂; *Simaethis scintillana* Wlk.; By Heppner '76 B.M. ♂; Genitalia Slide No. 20225 (head missing). The specimen labelled as paratype by Durrant is chosen as lectotype because the other syntype has no abdomen. Paralectotype: 1 ♂, same data as lectotype (BMNH) (no abdomen).

Material examined.—The two syntypes are the only known specimens.

Zodia ochripalpis (Meyrick), NEW COMBINATION
Figs. 9–10

Brenthia ochripalpis Meyrick, 1920:335.

This species is similar to the preceding two species; but in the female genitalia, the signum consists of very large teeth-like spines.

Description.—Size 4–5 mm forewing length. Maculation the same as in *Z. plutusana*. Male genitalia unknown. Female genitalia (Fig. 10) similar to *Z. plutusana* but with longer apophyses, especially the posterior pair; ac-

cessory bursa well developed; signum a linear arrangement of large teeth-like spines (Fig. 9).

Type-locality.—Rio Trombetas, Pará, Brasil.

Type.—Holotype ♀ (BMNH), data as above, Sept, H. H. Parish; B. M. Genitalia Slide JFGC 6549.

Material examined.—In addition to the holotype there are two specimens from Peru tentatively identified as conspecific. *Peru: Jurimaguas [=Yurimaguas], Edo. Loreto, 20 Mar.* H. H. Parish (1 ♂, BMNH; 1 ♂, USNM [no abdomens]).

Zodia rutilella (Walker), NEW COMBINATION

Simaethis rutilella Walker, 1863:453.

The maculation of this species is similar to the preceding species but the white spots have a metallic blue iridescence instead of green or gold and the dorsal margin white spot is absent.

Description.—Size 4.5 mm forewing length. Maculation as in *Z. plutusana* but the spots of the forewing have blue-metallic iridescence and the dorsal margin white spot is absent. Male and female genitalia unknown (abdomen missing).

Type-locality.—Ega [=Tefé], Amazonas, Brasil.

Type.—Holotype ♀, data as above, Bates Coll. (BMNH).

Material examined.—The holotype is unique.

Zodia chrysosperma (Meyrick), NEW COMBINATION

Figs. 6-7

Brenthia chrysosperma Meyrick, 1931:183.

This species is relatively small. It is similar to the other species but has a hook-like spine on the apex of the male valvae.

Description.—Size 4 mm forewing length. Like *Z. plutusana* but with a metallic green iridescent area at the end of the cell of the forewing. Male genitalia as in *Z. plutusana* but with the dorsal margin relatively straight and without a setal field (Fig. 6); apex with a large hook-like spine; aedeagus as in *Z. plutusana* but more elongate (Fig. 7). Female genitalia unknown.

Type-locality.—Teffé [=Tefé], Amazonas, Brasil.

Types.—Lectotype ♂ (BMNH) (designated by Clarke, 1969), data as above, 19 Dec, H. H. Parish; B.M. Genitalia Slide JFGC 6550. Paralecotype: 1 ♂, same data, 20 Jan, H. H. Parish (USNM).

DISCUSSION

It is conceivable that *Zodia ochripalpis*, *Z. rutilella*, and *Z. chrysosperma* may represent only one species but until more material is available and genitalia are examined, this cannot be conclusively determined. The situa-

tion in *Zodia* is typical of innumerable groups of tropical Lepidoptera where cryptic species have been named on the basis of one or the other sex, making further elucidation of valid names impossible until more collections are made.

ACKNOWLEDGMENTS

The research for this revision has been supported in part by the National Science Foundation during the period the author was at the University of Florida (grant DEB 76-12550). The grant allowed a visit to the British Museum (Natural History) (BMNH) to study types. Specimens were also examined at the Naturhistorisches Museum, Vienna, Austria (NHMV). The manuscript was kindly read by J. F. Gates Clarke and Donald R. Davis. Victor Krantz, National Museum of Natural History (USNM), Smithsonian Institution, provided photographic assistance.

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OBITUARY



FRANK LESLIE CAMPBELL

Honorary Member ESW

1898-1979

In the afternoon of July 13, 1979, Frank Leslie Campbell died in George Washington University Hospital, near his home, 2475 Virginia Avenue, Washington, D.C. 20037. He passed on after a long, useful, and adventurous career. He was born in Philadelphia, Pennsylvania September 5, 1898. In preparation for his original and superior contributions to entomology and related sciences, he attended Haverford College and received a degree in Chemical Engineering from the University of Pennsylvania. He first became interested in entomology while working as a chemist for the Japanese Beetle Laboratory in Riverton, New Jersey during the early 1920's and then pursued graduate studies, receiving a Master of Science degree from Rutgers University and a Doctor of Science from Harvard University, both in entomology.

After completing graduate studies at Harvard, Dr. Campbell taught entomology and general physiology (1926-1927) at New York University. In 1927 he was appointed to a research position in the Bureau of Entomology, United States Department of Agriculture, and was located in the Washington area. For the next nine years he was a pioneer and leader in basic research for the application of exact physical and chemical procedures to obtain a better understanding of the structure and behavior of insect pests and their susceptibility to toxic substances. An outstanding contribution that resulted from research conducted in the laboratory under Dr. Campbell's direction, was the development of the so-called "areosol bomb" so widely and effectively used for the control of mosquitoes and other flying insects. During this

period there was also developed an improved method for determining lethal doses of insecticides for leaf eating insects, and a more reliable system for testing quality control of fly sprays. During this period he was a founder of the Insecticide Society of Washington (1934).

From 1936 to 1942 he was a member of the faculty of Ohio State University, directing the work of graduate students in insect physiology and toxicology and assisted in administering the University's research foundation engaged in military research. At this time he served also as a consultant on agricultural chemicals essential for food production for the Office for Agricultural War Relations.

After World War II Dr. Campbell returned to the Washington area to accept a position as editor of the Scientific Monthly of the AAAS and continued in this capacity for the next five years. His highly regarded column in the monthly, "The Brownstone Tower" referred to his office in the Smithsonian Institution Castle Building.

Prior to retirement in 1964, he served for eleven years as Executive Secretary of the Biology and Agriculture Division of the National Academy of Sciences—National Research Council. While holding that position he made many contributions to entomology.

Dr. Campbell was a regular attendant at meetings of the Entomological Society of Washington, serving as President in 1957, and made many outstanding contributions. He was made an Honorary Member of the Society in 1979.

He served as President of the Washington Academy of Sciences in 1959.

Following retirement he continued research, primarily in insect morphology at the University of Vienna, Austria, and performed further work in New South Wales, Australia. During four summers in the 1970's he was visiting professor of entomology at Virginia Polytechnic Institute and State University, Blacksburg, Virginia.

Dr. Campbell rendered distinguished service to the Entomological Society of America and to the Society's Eastern Branch, and was made Honorary Member of ESA in 1969. In 1979 he was elected by ESA as recipient of the highest award of the Eastern Branch, "The L. O. Howard Distinguished Achievement Award."

He was a scholar, an outstanding teacher, and dedicated public servant. Many of his former students have made invaluable contributions to entomology and related biological sciences. For 32 years he took time to keep a diary of exceptional quality. His post-retirement research and impressions while on a two year trip around the world were ably compiled in a diary type summary, "Better Late . . . an Entomologist Post-retirement Renovation," 1973, 371 pages, was printed in a limited edition, 16 copies, at Virginia Polytechnic Institute and State University. His impressive list of publications number more than 85 and cover a span of 56 years.

Frank had special skills as teacher and research advisor. He developed close personal and professional friendships with his former students and research associates that continued until his death. In addition to helping many American entomologists, he freely gave valuable guidance and support to scientists from other countries in the development of their professional opportunities in the United States. It is impossible to summarize fully in a few words the total impact of Frank Leslie Campbell's life in the service of humanity.

He is survived by his wife, Ina, of Washington, D.C., a son, Drew, of Englewood, California, and a daughter, Mrs. Lucile Cooper, of Baton Rouge, Louisiana, and seven grandchildren.

W. Doyle Reed, 4740 Connecticut Avenue, N.W., Washington, D.C. 20008; and Michael Kosztarab, Department of Entomology, Virginia Polytechnic Institute and State University, Blacksburg, Virginia 24061.

PROC. ENTOMOL. SOC. WASH.
81(4), 1979, pp. 696-697

NOTE

The Identity of *Pelopsis nudiuscula* (Acari: Oribatei)

The monotypic oribatid mite genus *Pelopsis* was proposed by Hall (1911. Pomona Col. J. Entomol. 3:504-510) and considered at that time to be a relative of *Pelops* (now in the family Pelopidae). Probably due to gross misinterpretations in the description, which are noted below, neither the genus nor its type-species, *P. nudiuscula* Hall, from Connecticut, have since been mentioned in the primary zoological literature. Balogh (1972. The oribatid genera of the world. Akademiai Kiado, Budapest) listed *Pelopsis* among the Pelopidae, but both misspelled the species epithet and gave its distribution as European, instead of North American. No type-specimen exists, but the figure included in the original description sufficiently allows the following interpretations.

I consider *P. nudiuscula* a junior subjective synonym of *Pelops bifurcatus*, described by Ewing (1909. J. N.Y. Entomol. Soc. 17:116-136) from Illinois (NEW SYNONYMY). This conclusion is based on the examination of a type-specimen of the latter in the USNM collections, several non-type specimens from New York, and Woolley's (1958. Trans. Am. Microsc. Soc. 77:258-279) redescription of *P. bifurcatus*.

Hall (op. cit.) mistook the identity of several structures when describing *P. nudiuscula*. Those characterized as bladelike lamellae, with deeply emarginate cusps, are actually the large, spatulate, bifurcate interlamellar setae

so characteristic of *P. bifurcatus*; Hall claimed that the interlamellar setae were absent. The true lamella are small, narrow, and hidden in dorsal aspect by these large setae. The "stout, curved, pectinate" setae which Hall called the rostrals are actually the lamellar setae, which were also claimed to be absent. The true rostral setae are inserted ventrad of the tutoria; these are the unnamed setae Hall believed were inserted distally on the tutoria (=tectopodium I), which is an error often incurred by not viewing specimens laterally. The "stylettiform" nature of the chelicerae noted by Hall is apparently a similar misinterpretation based on observing the laterally compressed chelate chelicerae only in dorsoventral aspect. Hall also obviously mistook the projection of the lateral body wall, as seen in transmitted light, for the medial limit of the pteromorphs, which are smaller than drawn. The length noted by Hall (.51 mm) is larger than any observed specimen of *P. bifurcatus* (maximum 400 μm) but there are other indications among his works that his measurements were somewhat exaggerated.

The synonymy mentioned above necessitates some generic changes. *Pellops bifurcatus* has been designated type-species for two genera: *Parapellops*, proposed by Jacot (1938. Fla. Entomol. 21:49-57) and its junior objective synonym *Ewingozetes*, proposed by Hammer (1952. Acta Arct. 4:1-108). Although *P. nudiuscula* is a junior synonym, the generic name *Pelopsis* has priority and is considered a senior subjective synonym of both *Parapellops* and *Ewingozetes* (NEW SYNONYMY). The valid combination for its type-species is *Pelopsis bifurcata* (Ewing). The immature instars, which would assist in familial placement, are unknown; but Balogh's (op. cit.) placement of the species in the Mycobatidae seems appropriate.

Pelopsis bifurcata is widely distributed in North America, having been reported by various authors from Connecticut, Florida, Illinois, New York, North Carolina, Tennessee, and the Northwest Territories of Canada. I have unpublished records from Texas and coastal Mississippi. Reported habitats are mostly coniferous forest litter but it has also been found under a log (Ewing, op. cit.) and in beach debris (Hall, op. cit. and unpublished records from New York and Mississippi).

Roy A. Norton, State University of New York, College of Environmental Science and Forestry, Syracuse, New York 13210.

NOTE

A Survey of Shore Bird Lice from Two Wisconsin Counties
with a New Host Record for *Lunaceps holophaeus*
(Mallophaga: Philopteridae)

Along with a survey of shore bird helminths, a louse survey was also undertaken. One hundred twelve birds were collected by shotgun from Marathon and Portage counties in Wisconsin during their spring and fall migrations. Each bird was placed in a separate plastic bag to prevent cross contamination. Birds were skinned and the skins boiled for approximately fifteen minutes in a 10% KOH solution. After cooling, the solution was poured through a 60 mesh screen to collect the lice. Specimens were dehydrated in an ethanol series to xylene and then mounted in Permount.

The following birds were infected as given for each species: Of 15 lesser yellowlegs, *Totanus flavipes* (Gmelin), 1 with only *Actornithophilus totani* (Schrank), 11 having only *Quadraceps falcigerus* (Peters), and 3 with both species; of 2 greater yellowlegs, *Totanus melanoleucus* (Gmelin), 1 had *Actornithophilus paludosus* Clay, and the other *Quadraceps similis* (Giebel); of 12 pectoral sandpipers, *Erolia melanotos* (Vieillot), 4 possessed *Carduiceps zonarius* (Nitzsch), 1 harbored *Lunaceps holophaeus* Carriker (NEW HOST RECORD), 3 were parasitized by both *L. holophaeus* and *C. zonarius*, 1 by *Actornithophilus umbrinus* (Burmeister) and *C. zonarius*, and 3 with all 3 species; 1 semipalmated sandpiper, *Ereunetes pusillus* (Linnaeus), with *A. umbrinus*, *C. zonarius*, *Lunaceps holophaeus* *pusillus* Carriker and *Saemundssonia tringae* (O. Fabricius); 1 western sandpiper, *Ereunetes minor* Cabanis, with *C. zonarius*; of 6 Wilson's snipe, *Capella gallinago* (Linnaeus), 4 harbored *Rhynonirmus scolopacis* (Denny); 4 of 75 American woodcocks, *Philohela minor* (Gmelin), harbored *Rhynonirmus parsonae* Clay.

Lunaceps holophaeus, from the pectoral sandpiper, matches the description of this species from the ruff, *Philomachus pugnax* (Linnaeus), see Timmermann (1954, Ann. Mag. Natl. Hist. Ser. 12, 7:623-637). Emerson (1972, Rep. Deseret Test Center, Dugway, Utah, Part 1:1-200) predicted that *Lunaceps* might occur on pectoral sandpipers.

Voucher specimens of two males and two females of *L. holophaeus* from the pectoral sandpiper are deposited at the USNM, Accession Number 336493. This research was supported in part by Research Grant 5336 from the Wisconsin State University Regents.

Stephen J. Taft and Sharon A. Schaper, Department of Biology, University of Wisconsin-Stevens Point, Stevens Point, Wisconsin 54481.

SOCIETY MEETINGS

856th Regular Meeting—January 4, 1979

The 856th Regular Meeting of the Entomological Society of Washington was called to order by President Davis at 8:00 PM on January 4, 1979, in the Ecology Theater of the National Museum of Natural History. Twenty-three members and 6 guests were present.

The minutes of the December meeting were read and approved.

Membership Chairman Utmar read for the first time the names of the following new applicants for membership:

Michael S. Bodri, 578 Kucher Road, Southampton, Pennsylvania 18966.

Michael D. Greenfield, Smithsonian Tropical Research Institute, Box 2072, Balboa, Canal Zone.

Warren E. Steiner, Jr., Bird-in-Hand Farm, Wittman, Maryland 21676.

The principal speaker of the evening was Dr. John R. Gingrich, Department of Entomology, Walter Reed Army Institute of Research, Washington, D.C. His subject was "Tsetse Flies as Vectors of Rhodesian Trypanosomiasis."

Notes and Exhibitions: William Bickley showed a greeting card from Insect Control and Research on which the words MERRY XMAS had been written by female *Aedes atropalpus* using their eggs.

Theodore Bissell showed a copy of The Literature of Arthropods Associated with Alfalfa. III. Bibliography of the Pea Aphid *Acyrthosiphon pisum* (Harris) (Homoptera: Aphididae), by A. M. Harper et al., 1978.

W. B. Hull asked for registration in the Directory of North American Entomologists and Acarologists, to be published by the Entomological Society of America.

Following the introduction of visitors and adjournment of the meeting, punch and cookies were served.

T. J. Spilman, *Acting Recording Secretary*

857th Regular Meeting—February 1, 1979

The 857th Regular Meeting of the Entomological Society of Washington was called to order by Acting-president Spilman at 8:00 PM on February 1, 1979, in the Ecology Theater of the National Museum of Natural History. Twenty-eight members and 10 guests were present.

The minutes of the January meeting were read and approved.

Membership Chairman Utmar read for the first time the names of the following applicants for membership:

Scott R. Shaw, Department of Entomology, University of Maryland, College Park, Maryland 20742.

Thomas E. Wallenmaier, 116 Lexington Avenue, Staten Island, New York.

Eric E. Grissell, Systematic Entomology Laboratory, IIBIII, USDA, % National Museum of Natural History, Washington, D.C. 20560.

Maynard Ramsay reported that he had done some research pertaining to Past-presidents' certificates and requested information from the membership regarding the names and whereabouts of living Past-presidents.

Acting-president Spilman asked for input regarding the 1979 Entomological Society of Washington/Insecticide Society of Washington Banquet. He also requested suggestions for the lecturer.

Ted Bissell mentioned that Professor E. N. Cory, formerly of the University of Maryland, died last week. Professor Cory became a member of the Society in 1911 and was elected an Honorary Member in 1965. Ted Bissell also showed a picture of Professor Cory taken in 1909 and passed around two of his watercolor paintings. Ted Spilman showed a newspaper clipping of Professor Cory. Others also gave reminiscences. An obituary will be published in the *Proceedings*.

The principal speaker for the evening was Dr. Douglas W. S. Sutherland, previous Past-president of the Society whose lecture was entitled: "Insect Names—Past, Present, and Future." He gave the history of past Common Names Lists, analyzed them, and showed examples.

Notes and Exhibitions: George Steyskal exhibited a humorous error found in a recent copy of *Scientific American*. He also showed a Bio Quip mosquito-rearing chamber, one half of which can serve as part of a McPhail Trap. He showed an article from *Scientific American* depicting a mosquito-rearing chamber designed by Ernest C. Bay. This article may have served as the progenitor for the Bio Quip trap.

Curt Sabrosky reported that Mrs. Melander, wife of the late A. L. Melander, had recently celebrated her 100th birthday.

Following the introduction of guests and visitors, the meeting was adjourned. Punch and cookies were served afterwards.

Hollis B. Williams, *Acting Recording Secretary*

858th Regular Meeting—March 1, 1979

The 858th Regular Meeting of the Entomological Society of Washington was called to order by Acting-president Spilman at 8:00 PM on March 1,

1979, in the Ecology Theater of the National Museum of Natural History. Seventeen members and 12 guests were present.

The minutes of the February meeting were read, corrected, and approved.

Acting Membership Chairman Spilman read for the first time the name of the following applicant for membership:

Laurine Van Wie, Systematic Entomology Laboratory, IBIII, USDA, c/o U.S. National Museum, Washington, D.C. 20560.

Maynard Ramsay reported that a recent meeting of the Washington Academy of Arts and Sciences was very well attended. Dr. Albert Szent-Gyorgyi, a Nobel Laureate, was the speaker.

The principal speaker for the evening was Dr. Charles L. Bailey, Department of Entomology, Walter Reed Army Institute of Research. Dr. Bailey spoke on "Overwintering Ecology of *Culex pipiens* L. and St. Louis Encephalitis Virus." His talk was illustrated with many Kodachrome slides and was followed by a question and answer period.

Notes and Exhibitions: J. H. Fales reported the collecting in 1978 of two hairstreak butterflies, *Satyrium edwardsii* (Saunders), Edward's Hairstreak (23-VI and 30-VI) and *Calycopis cercrops* (F.), Red-banded Hairstreak (10-VI, 8-VIII, and 5-IX) in Rock Creek Park, Washington, D.C. These are probably new records for the District of Columbia.

Following adjournment, pie and punch were available for refreshments.

Wayne N. Mathis, Recording Secretary

859th Regular Meeting—April 5, 1979

The 859th Regular Meeting of the Entomological Society of Washington was called to order by President Davis at 8:00 PM on April 5, 1979, in the Ecology Theater of the National Museum of Natural History. Thirty-one members and 9 guests were present.

The minutes of the March meeting were read and approved.

Membership Chairman Utmar read for the first time the names of the following applicants for membership:

Hector Delgado, Agrobiologicos LTDA, Apartado Aereo 1175, Bucaramanga, Colombia.

Amnon Friedberg, Tel Aviv University, Tel Aviv, Israel.

Jayson I. Glick, Department of Zoology-Entomology, Auburn University, Auburn, Alabama.

Bradley A. Mullens, Rt. 1, Sandpiper Lane, Concord, Tennessee.

T. M. Peters, Department of Entomology, University of Massachusetts, Amherst, Massachusetts.

President-elect Spilman announced plans for the annual banquet to be held Tuesday, June 5, 1979, at the Fort McNair Officers' Club.

Arnold Mallis announced that Harry Clench of the Carnegie Museum had passed away unexpectedly. Ted Spilman announced the death of William N. Sullivan on March 2, 1979. Mr. Sullivan was a coinventor of the aerosol bomb used in insect control and was retired from USDA.

The principal speaker for the evening was Dr. Willis W. Wirth, Systematic Entomology Laboratory, IIIBIII, USDA, % U.S. National Museum, Washington, D.C. Dr. Wirth spoke on "Flies Associated with Hot Springs." His talk was illustrated with many Kodachrome slides and was followed by a question and answer period.

Notes and exhibitions: Ted Spilman discussed the publication *The Japanese Flowering Cherry Trees of Washington, D.C.*, by R. M. Jefferson and A. E. Fusonie (National Arboretum Contribution No. 4). Entomologists played an important role in rejecting and destroying the first gift of 2000 infested cherry trees in 1910 and in accepting 6000 clean trees in 1912; it is a classic case of quarantine, inspection, and identification in the USDA.

Helen Sollers-Riedel submitted the following poem:

Nearly Impossible Things

I wish that I could find
A bedbug happy in a tree,
A mosquito that never would bite me,
A moth that could croak.
A beetle that could sigh,
And a flea that could fly,
A tick that could smile,
And an ant without guile.

Mignon Davis passed around a large lucanid beetle, *Chiasognathus* sp., that was found at Puyehue National Park in Chile while on a collecting trip with Don Davis and Louis Peña last February. It had been mounted for a future display in the "Dynamics of Evolution" hall. Ektachrome slides depicted the male's aggressive stance of directing its formidable mandibles high in the air. The massive tibia of the forelegs no doubt are the major structures for support (Fig. 1). The toothed mandibles are quite strong, being used to grasp other males in battle. *Chiasognathus* is fairly common in the *Nothofagus* forests of the lake region and is usually found on the trunks of trees where it feeds on the sap. The beetles have not been known to live in captivity for more than one week. A book from the Schaus collection, "Insects Abroad" by J. G. Wood (1874) contains an interesting account of the beetles' bizarre structure.



Fig. 1. *Chiasognathus* sp. in aggressive posture.

John Kingsolver exhibited a Seth Thomas shelf clock that had originally belonged to L. O. Howard. Several other entomologists had subsequently used the clock including Mr. Mason, Mrs. Eunice Harveycutter, Miss Grace Glance, Dr. William Anderson, Dr. Reese Sailer, and Dr. Richard Foote. This historic clock is now keeping time in Dr. Ronald Hodges' office in Beltsville.

Ron Hodges passed around E. C. Zimmerman's recently published volume on the microlepidoptera of Hawaii (*Insects of Hawaii*, vol. 9, pts. I & II). Dr. Hodges pointed out several of Zimmerman's observations concerning Lepidoptera and lepidopterists.

President Davis was pleased to note that Ashley Gurney was once again with us after being absent due to illness. Manya Stoetzel announced that the Entomology Club of the University of Maryland would be meeting April 21, 1979.

Following the introduction of guests, the meeting was adjourned at 9:27 PM. Punch and cookies were served afterwards.

Wayne N. Mathis, *Recording Secretary*

PROCEEDINGS
of the
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of
WASHINGTON

Volume 81

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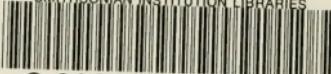


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