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Volume 85

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A REVIEW OF THE *FELICOLA FELIS* COMPLEX (MALLOPHAGA: TRICHODECTIDAE) FOUND ON NEW WORLD CATS (CARNIVORA: FELIDAE)

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Abstract.—*Felicola felis* (Werneck), found on *Felis pardalis,* and *F. spenceri* Hopkins, found on *Felis canadensis,* are redescribed and illustrated. Five new species of *Felicola* are described and illustrated: *F.* ***americanus*** on *Felis rufa, F.* ***braziliensis*** on *Felis colocola, F.* ***neofelis*** on *Felis geoffroyi, F.* ***sudamericanus*** on *Felis tigrina,* and *F.* ***similis*** on *Felis yagouaroundi.* A key is provided for identification of the seven species.

During the review by Emerson and Price (1981) of the species of Mallophaga found on mammals, we found that *Felicola felis* (Werneck, 1934) as defined by Werneck (1948) was actually a complex of five species found on New World cats. In addition, this complex includes *F. spenceri* Hopkins, 1960, as well as specimens of another new species we obtained from the Field Museum of Natural History, Chicago. It is our intent to describe and illustrate the two previously known species and the five new species found on wild cats of the New World and to provide a key for identification of these seven species. *Felicola subrostratus* (Burmeister, 1838), found on the domestic cat, an introduced species from Old World hosts, is not closely related to the *Felicola felis* complex.

All measurements are in millimeters. Scientific and common names of mammals are from Cabrera (1961), Emerson and Price (1981), Hall (1981), and Morris (1965). Paratypes of new species described will be distributed, as quantities permit, to the collections of the authors, the National Museum of Natural History, Washington, D.C., and the British Museum (Natural History), London.

***Felicola felis* (Werneck)**

Figs. 1–3

Trichodectes felis Werneck, 1934: 282. Type-host: "*Felis chibigouazou*" = *Felis pardalis* Linnaeus, the Ocelot.

Felicola felis (Werneck, 1934), Werneck, 1948: 223 (part).

Male.—External morphology and chaetotaxy as in Fig. 1. Head width, 0.39; head length, 0.35; pterothorax width, 0.36; abdominal width, 0.57; and total length, 1.11. Genitalia as in Fig. 2, width, 0.17; distal tips of endomera fused, not separated as illustrated by Werneck (1934); sac with numerous small spines.

Female.—External morphology and chaetotaxy as in Fig. 3. Head width, 0.42;

head length, 0.35; pterothorax width, 0.40; abdominal width, 0.59; and total length, 1.18. Shape and chaetotaxy of gonapophyses (Fig. 3) are unique.

Discussion.—The type-material consists of the holotype male, allotype female, and five female, three male paratypes, all from the type-host collected at "Rio Cuyaba, Mato-Grosso, Brasil." Werneck (1948) also recorded this species for specimens collected off *Felis concolor* Linnaeus, *F. geoffroyi* D'Orbigny and Gervais, "*Felis pajeros* Araza" = *F. colocola* Molina, "*Felis jaguarundi* Fisher" = *F. yaguaroundi* Geoffroy, and "*Lynx rufus* (Schreber)" = *F. rufa* Schreber. We have studied paratypes of *Felicola felis* and specimens from other hosts listed by Werneck in his 1948 paper. The male from *F. concolor* (Werneck slide no. 1861) is damaged so that an assessment of its specific identity cannot be made without more specimens from the Cougar. Specimens from the other hosts will be discussed in detail elsewhere in this review.

Material examined.—1 ♂ and 1 ♀ paratypes (Werneck slides no. 1069 and 1075) and 1 ♀ from *Felis pardalis* collected June 19, 1948, San Pedro Yepocapa, Chimalt, Guatemala.

Felicola braziliensis **Emerson and Price, New Species**

Fig. 6

Felicola felis (Werneck, 1934), Werneck, 1948: 223 (part). Type-host: "*Felis pajerus*" = *Felis colocola* Molina, the Pampas Cat.

Male.—External morphology and chaetotaxy essentially as for *F. sudamericanus* (Fig. 8) but with 2 less setae on posterior margin of abdominal tergites and sternites II–IV. Shape of abdominal tergal and sternal plates as for *F. felis* (Fig. 1). Head width, 0.40; head length, 0.39; pterothorax width, 0.37; abdominal width, 0.56; and total length, 1.23. Genitalia, less sac, as in Fig. 6; width, 0.17; sac as for *F. spenceri* (Fig. 5) but without slender median sclerite.

Female.—External morphology and chaetotaxy essentially as for *F. sudamericanus* (Fig. 9) but with 2 less setae on posterior margin of abdominal tergites and sternites II–IV. Shape of abdominal tergal and sternal plates as for *F. sudamericanus* (Fig. 9). Head width, 0.41; head length, 0.39; pterothorax width, 0.40; abdominal width, 0.53; and total length, 1.27. Posterior margin of gonapophyses convex, each with 7 medium setae and with 4 smaller setae on ventral surface.

Discussion.—The general structure of *F. braziliensis,* including that of the male genitalia, is very close to that of *F. felis.* However, the shape of the endomeral plate of the male genitalia and the shape of the female gonapophyses separate the two species.

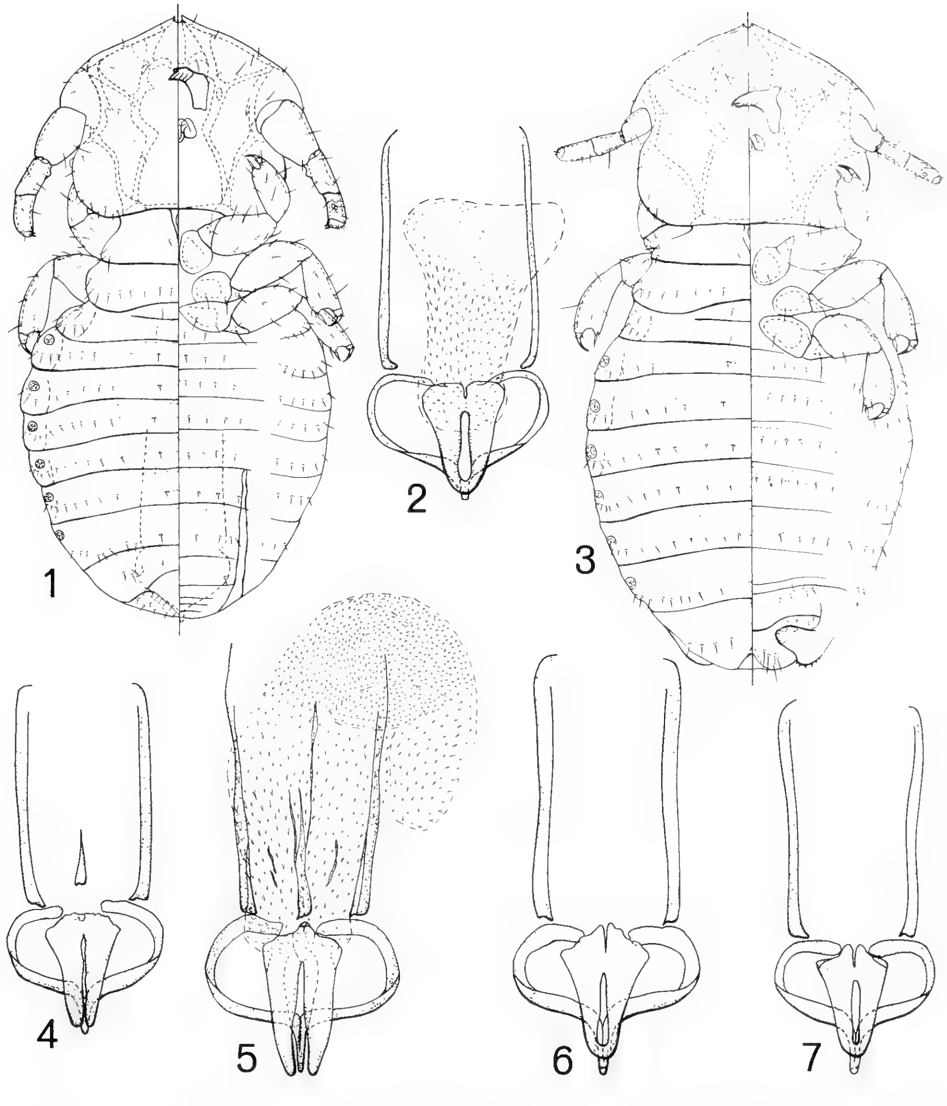
Material examined.—Holotype ♂ (Werneck slide no. 1729) and allotype ♀ (Werneck slide no. 1728) in collection of the Instituto Oswaldo Cruz, Rio de Janeiro, Brazil, with Werneck's original labels of "*Felis pajerus,* Matto-Grosso, Brasil" being retained on each slide; 1 paratype (Werneck slide no. 1730), same data as holotype.

Felicola neofelis **Emerson and Price, New Species**

Fig. 7

Felicola felis (Werneck, 1934), Werneck, 1948: 223 (part). Type-host: *Felis geoffroyi* D'Orbigny and Gervais, the Geoffroy's Cat.

Male.—External morphology and chaetotaxy as for *F. felis* (Fig. 1) except tergal and sternal abdominal plates shaped as for *F. sudamericanus* (Fig. 8). Head width,



Figs. 1–7. 1–3, *Felicola felis.* 1, Male. 2, Male genitalia. 3, Female. Figs. 4–7. Male genitalia (sac shown only on Fig. 5). 4, *F. americanus.* 5, *F. spenceri.* 6, *F. braziliensis.* 7, *F. neofelis.*

0.35; head length, 0.34; pterothorax width, 0.34; abdominal width, 0.53; and total length, 1.04. Genitalia, less sac, as in Fig. 7; width, 0.15; sac small and armed as for *F. spenceri* (Fig. 5) but with short median sclerite as for *F. americanus* (Fig. 4).

Female.—External morphology and chaetotaxy, including tergal abdominal plates, as for *F. sudamericanus* (Fig. 9); sternal abdominal plates smaller, but same shape, as for *F. felis* (Fig. 3). Shape of gonapophyses as for *F. sudamericanus* (Fig. 12) with 9 setae on posterior margin and 3 smaller setae on dorsal surface. Head width, 0.38; head length, 0.36; pterothorax width, 0.36; abdominal width, 0.55; and total length, 1.14.

Discussion.—The shape of the male genitalic endomeral plate and female gonapophyses allies *F. neofelis* with *F. braziliensis* and separates it from *F. felis.*

Felicola neofelis may be recognized from those two species by its smaller dimensions in both sexes and by the different shape of the opening in the male endomeral plate and of the female abdominal tergal plates.

Material examined.—Holotype ♂ (Werneck slide no. 444) and allotype ♀ (Werneck slide no. 443) in collection of the Instituto Oswaldo Cruz, Rio de Janeiro, Brazil, with Werneck's original labels "*Felis geoffroyi,* Russas-Ceara, Brasil."

Felicola spenceri **Hopkins**

Fig. 5

Felicola (*Felicola*) *spenceri* Hopkins, 1960: 80. Type-host: *Lynx canadensis* Kerr = *Felis canadensis* (Kerr), the Lynx.

Male.—External morphology, including shape of abdominal tergal and sternal plates, as for *F. felis* (Fig. 1). Chaetotaxy of abdominal tergites and sternites IV–VII each with 18 short setae. Head width, 0.46; head length, 0.45; pterothorax width, 0.42; abdominal width, 0.70; and total length, 1.51. Genitalia as in Fig. 5; width, 0.18.

Female.—External morphology, including shape of abdominal tergal and sternal plates, as for *F. felis* (Fig. 3). Chaetotaxy of abdominal tergites and sternites IV–VII each with 10 short setae. Head width, 0.49; head length, 0.46; pterothorax width, 0.48; abdominal width, 0.78; and total length, 1.64. Gonapophyses as for *F. sudamericanus* (Fig. 12).

Discussion.—The male of *F. spenceri* is readily distinguished from that of the preceding three species by the separated distal tips of the genitalic endomeral plate; the female is recognized by the combination of its large dimensions and shape of the gonapophyses.

Material examined.—6 paratypes from *Felis canadensis* collected in British Columbia, Canada.

Felicola americanus **Emerson and Price, New Species**

Fig. 4

Felicola felis (Werneck, 1934), Werneck, 1948: 223 (part). Type-host: *Felis rufa* (Schreber), the Bobcat.

Male.—External morphology near that of *F. sudamericanus* (Fig. 8). Abdominal tergal plates III–VIII shaped as in Fig. 8, but each with 22 posteromarginal setae. Abdominal sternal plates III–VII shaped as for *F. sudamericanus* (Fig. 8), each with 20 posteromarginal setae. Head width, 0.39; head length, 0.37; pterothorax width, 0.34; abdominal width, 0.59; and total length, 1.28. Genitalia, less sac, as in Fig. 4; width, 0.15; sac as for *F. felis* (Fig. 2).

Female.—External morphology as for *F. felis* (Fig. 3) except abdominal tergal and sternal plates III–VII wider and not as long. Abdominal tergal plates IV–VIII each with 20 posteromarginal setae. Abdominal sternal plates IV–VII each with 14 posteromarginal setae. Gonapophyses with convex posterior margin, as for *F. sudamericanus* (Fig. 12), each with 9 marginal setae. Head width, 0.43; head length, 0.39; pterothorax width, 0.42; abdominal width, 0.69; and total length, 1.43.

Discussion.—The genitalic features of *F. americanus* ally this species with *F. spenceri,* thereby separating both from the first three species; *F. americanus* differs from *F. spenceri* by its smaller size, its shorter endomeral plate, and smaller genital sac sclerite. The female of *F. americanus* is less distinctive but recognizable by its dimensions, gonapophysis shape, and tergal morphology.

Material examined.—Holotype ♂ and allotype ♀ from *Felis rufa* collected March 3, 1937, Raymondville, Texas (37-6414). These specimens were examined by Werneck (1948) and they are in the National Museum of Natural History. 7 paratypes from *F. rufa* collected March 4, 1971, Ravalli County, Montana.

Felicola sudamericanus **Emerson and Price, New Species**

Figs. 8–12

Type-host.—*Felis tigrina pardinoides* Gray, the Tiger Cat or Little Spotted Cat.

Male.—External morphology and chaetotaxy as in Fig. 8. Head width, 0.36; head length, 0.31; pterothorax width, 0.33; abdominal width, 0.54; and total length, 1.15. Terminal abdominal segments as in Fig. 10. Genitalia as in Fig. 11; width, 0.14.

Female.—External morphology and chaetotaxy as in Fig. 9. Head width, 0.40; head length, 0.34; pterothorax width, 0.39; abdominal width, 0.66; and total length, 1.33. Terminal abdominal segments as in Fig. 12.

Discussion.—The shape of the genitalic endomeral plate of the male *F. sudamericanus,* including the protruding anterior border without a median indentation and the slender pointed posterior tips, is different from that of any of the five preceding species. The female of *F. sudamericanus* is recognizable by the combination of dimensions, shape of the gonapophyses and abdominal tergal plates, and the armature of the vulval surface.

Material examined.—Holotype ♂, allotype ♀, and 10 paratypes collected from *Felis tigrina pardinoides* (KVS 23397) on December 7, 1958, at Cavca, Malvasi, Colombia. Holotype and allotype are in the Field Museum of Natural History.

Felicola similis **Emerson and Price, New Species**

Figs. 13–16

Felicola felis (Werneck, 1934), Werneck, 1948: 223 (part).

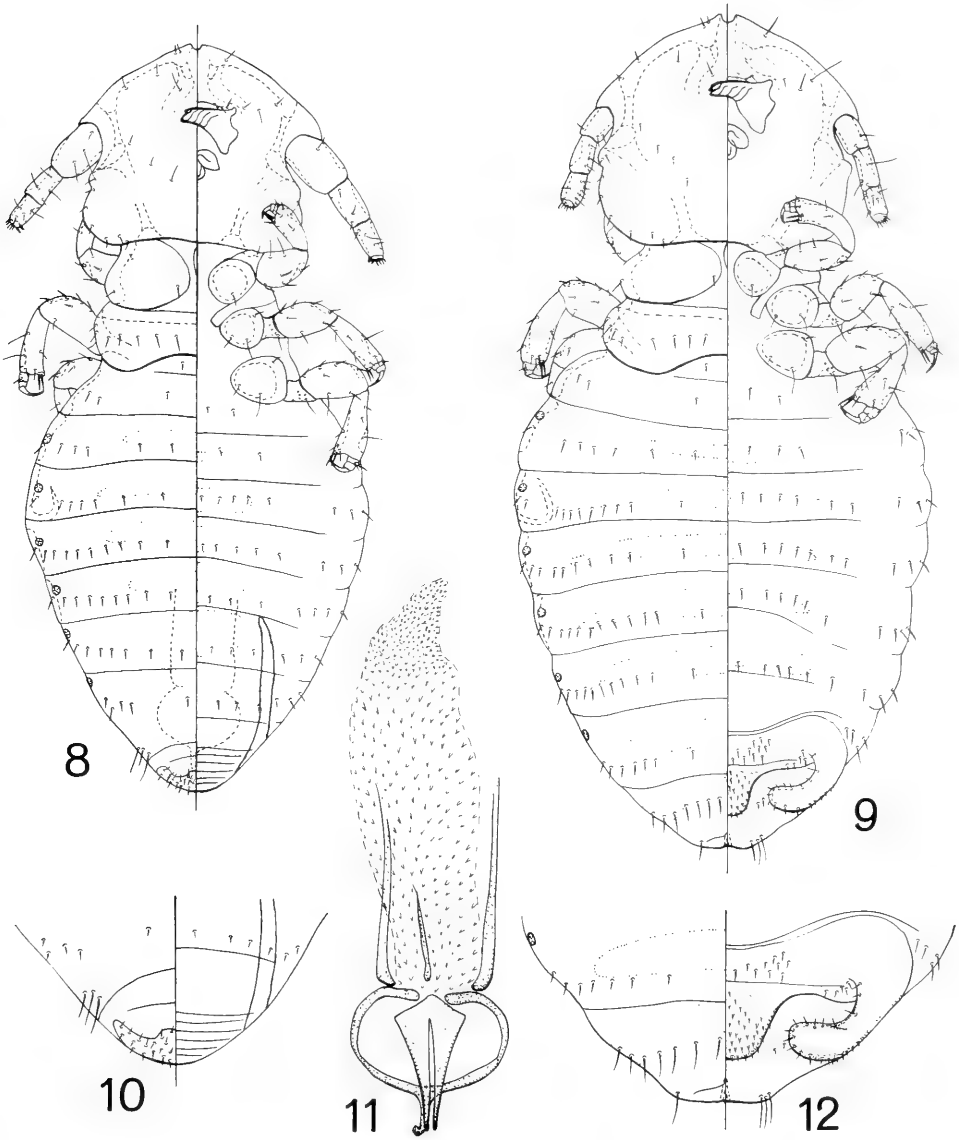
Felicola felis (Werneck, 1934), Emerson and Price, 1975: 52. Type-host: *Felis yagouaroundi* E. Geoffroy, the Jaguaroundi.

Male.—External morphology and chaetotaxy as in Fig. 14. Head width, 0.40; head length, 0.33; pterothorax width, 0.34; abdominal width, 0.54; and total length, 1.21. Genitalia as in Fig. 16: width, 0.13.

Female.—External morphology and chaetotaxy as in Fig. 13. Head width, 0.41; head length, 0.40; pterothorax width, 0.40; abdominal width, 0.63; and total length, 1.39. Vulval region as in Fig. 15.

Discussion.—The male of *F. similis* is separable from all other known species of the complex by the size of the genitalia and details of its endomeral plate. The female of *F. similis* is recognized from all others by its gonapophysis shape and chaetotaxy.

Material examined.—Holotype ♂ and allotype ♀ from *Felis yagouaroundi* (PCT 339) collected on October 1, 1973 at Juan de Zalazar, Boqueron, Paraguay. Paratype ♂ (Werneck slide no. 1659) and paratype ♀ (Werneck slide no. 1656) in collection of the Instituto Oswaldo Cruz, Rio de Janeiro, Brasil, with Werneck's



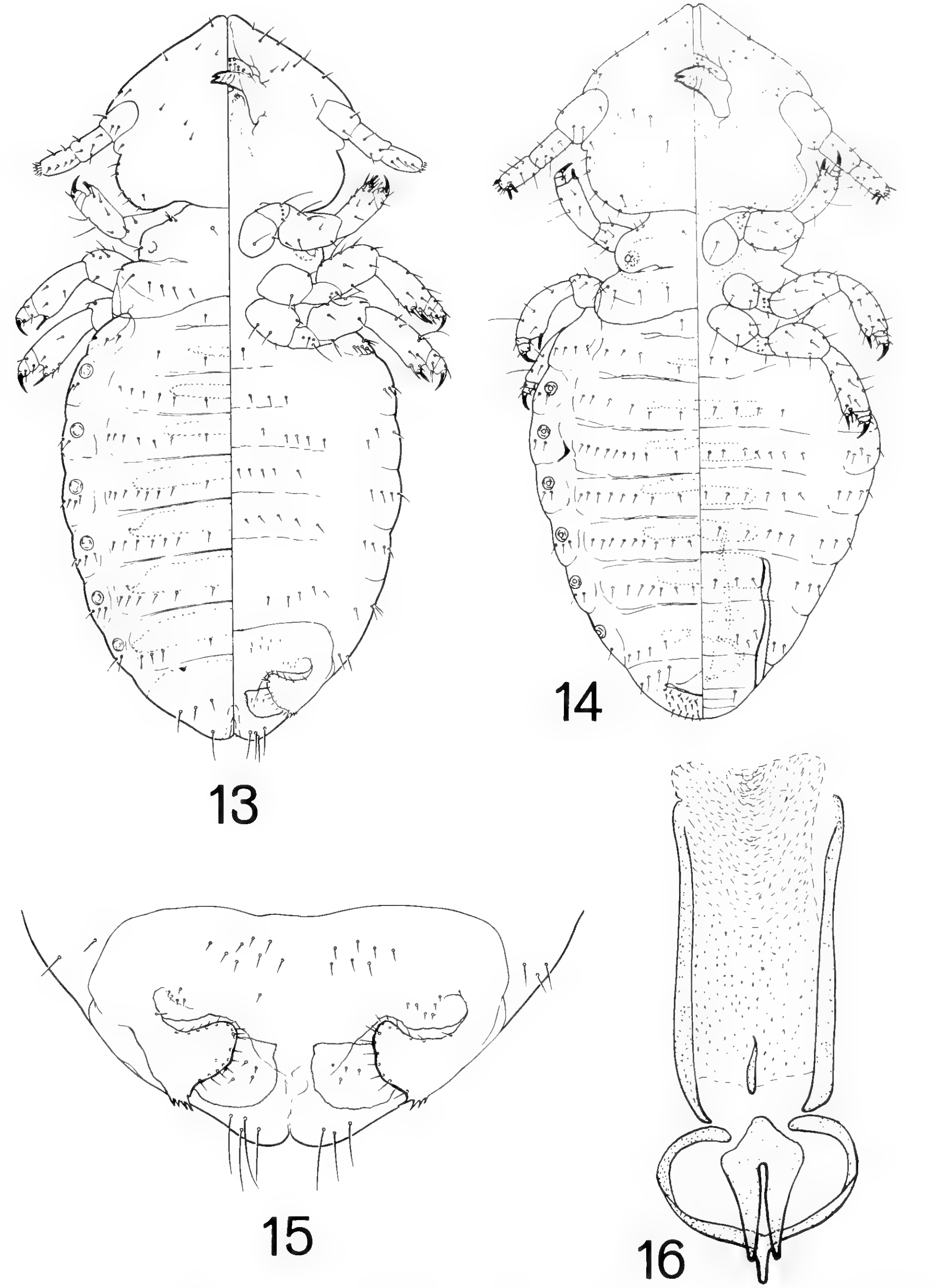
Figs. 8–12. *Felicola sudamericanus.* 8, Male. 9, Female. 10, Male terminalia. 11, Male genitalia. 12, Female terminalia.

original labels "*Felis jaguarundi,* Palma-Goyaz-Brasil." 2 ♀ paratypes and 4 immature specimens from the same host collected June 6, 1968, Mata de Bejuca, Maturin, Monagas, Venezuela (43662).

KEY TO NEW WORLD SPECIES OF THE *FELICOLA FELIS* COMPLEX

Males

1. Endomeral plate with separated distal tips and without median indentation on anterior margin 2



Figs. 13–16. *Felicola similis.* 13, Female. 14, Male. 15, Female ventral terminalia. 16, Male genitalia.

– Endomeral plate with fused distal tips and with median indentation on anterior margin 5
2. Distal tips of endomeral plate pointed (Fig. 11) .... *sudamericanus*, new species
– Distal tips of endomeral plate rounded 3
3. Anterior margin of endomeral plate flat (Fig. 4) .. *americanus*, new species
– Anterior margin of endomeral plate angular 4
4. Endomeral plate not extending beyond tip of fused parameres (Fig. 16); short sclerite associated with genital sac; genitalia smaller, width 0.13 .... *similis*, new species
– Endomeral plate extending slightly beyond tip of fused parameres (Fig. 5); long sclerite associated with genital sac; genitalia larger, width 0.18 .... *spenceri* Hopkins
5. Opening in endomeral plate with parallel sides (Fig. 7) .... *neofelis*, new species
– Opening in endomeral plate expanded in posterior portion 6
6. Anterior margin of endomeral plate flat (Fig. 2) .... *felis* (Werneck)
– Anterior margin of endomeral plate protruding anteriorly (Fig. 6) .... *braziliensis*, new species

FEMALES

1. Shape of gonapophyses as in Figs. 3 or 15 2
– Shape of gonapophyses as in Fig. 12 3
2. Marginal setae distributed evenly on gonapophyses (Fig. 15); total length, 1.39 .... *similis*, new species
– Marginal setae distributed unevenly on gonapophyses (Fig. 3); total length, 1.18 .... *felis* (Werneck)
3. Large species, total length more than 1.60 .... *spenceri* Hopkins
– Smaller species, total length less than 1.50 4
4. Shape of abdominal tergal plates as in Fig. 3 5
– Shape of abdominal tergal plates as in Fig. 9 6
5. Total length more than 1.40 .... *americanus*, new species
– Total length less than 1.20 .... *neofelis*, new species
6. Surface of vulva armed with short spines (Fig. 12); total length, 1.33 .... *sudamericanus*, new species
– Surface of vulva unarmed (Fig. 3); total length, 1.27 .... *braziliensis*, new species

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BIOLOGY AND IMMATURE STAGES OF *SETACERA NEEDHAMI* JOHANNSEN (DIPTERA: EPHYDRIDAE)[1,2]

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Abstract.—Adults of *Setacera needhami* Johannsen are common on algal mats from late March or early April until late May, and again during August and September. The period of aestivation, from June through early August, is spent in the pupal stage. Overwintering occurs in the adult and pupal (possibly pharate adult) stages. Larvae are common throughout the same periods as adults except during the winter at which time they are not found. Mating and oviposition takes place on the algal mats. Egg to adult development time ranges from 15 to 26 days. The species probably undergoes two to three generations by June and may accomplish two more during the late summer and fall. Extended periods of rain and/or cold may serve to regulate population levels, especially during the spring. Pedators include dolichopodid flies, dragonfly naiads, and surface-feeding ducks, among others. The egg, three larval instars, and puparium are described and illustrated using line drawings and scanning electron micrographs.

The genus *Setacera* is represented by eight New World species, seven of which occur in the United States. Most are western in distribution with only two, *Setacera atrovirens* (Loew), which occurs trans-boreally and throughout the midwestern states, and *S. pilicornis* (Coquillett), which is found in Florida, populating the eastern half of the United States (Mathis, 1982). Few biological studies have been conducted on members of the genus.

Sturtevant and Wheeler (1954), in their synopsis of the Nearctic Ephydridae, stated that most of their observations placed *Setacera* in freshwater habitats that had still or rather slow-moving water. In addition, they discussed the characteristic flight pattern of the genus, and Ephydrini in general, in which the adults rarely fly more than a small distance perpendicular to the surface of the water while traveling a considerable distance from the shore. They speculated that this may be one reason why specimens of *Setacera* are relatively rare in collections.

Setacera needhami Johannsen is confined to the far western United States, with specimens being recorded from Arizona, California, Utah, Nevada, Oregon, and Washington (Mathis, 1982). This species is relatively easy to separate from its

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[2] Support for this study was provided by a Grant-in-Aid of Research from Sigma Xi, the Scientific Research Society of North America, and NSF Grant DEB78-08753.

North American congeners, two of which, *S. aldrichi* Cresson and *S. pacifica* (Cresson), are often found sympatrically with *S. needhami* in Washington State localities. Separation of these three species is accomplished by using the length of the dorsal slope of the facial prominence which is longer than its height in *S. aldrichi* and by the lack of a papilla-like prominence on the supraspiracular convexity which occurs in *S. pacifica* but not in *S. needhami*. For a more thorough examination of the taxonomy of this group one should consult the revision of *Setacera* by Mathis (1982).

The designation of the specific name *needhami* is unusual, in that through a misunderstanding it was first described from the immature forms. Johannsen, in preparing for his treatise on aquatic Diptera (Johannsen, 1934, 1935, 1937a, 1937b), had sent adult specimens of *S. needhami,* which he reared, to Ezra T. Cresson, Jr. for determination. Cresson, not realizing that these determinations were to be used in a forthcoming publication, neglected to inform Johannsen that *S. needhami* was a manuscript name. Thus, when first published (Johannsen, 1935) the name *S. needhami* was based on a description of the third larval instar and puparium.

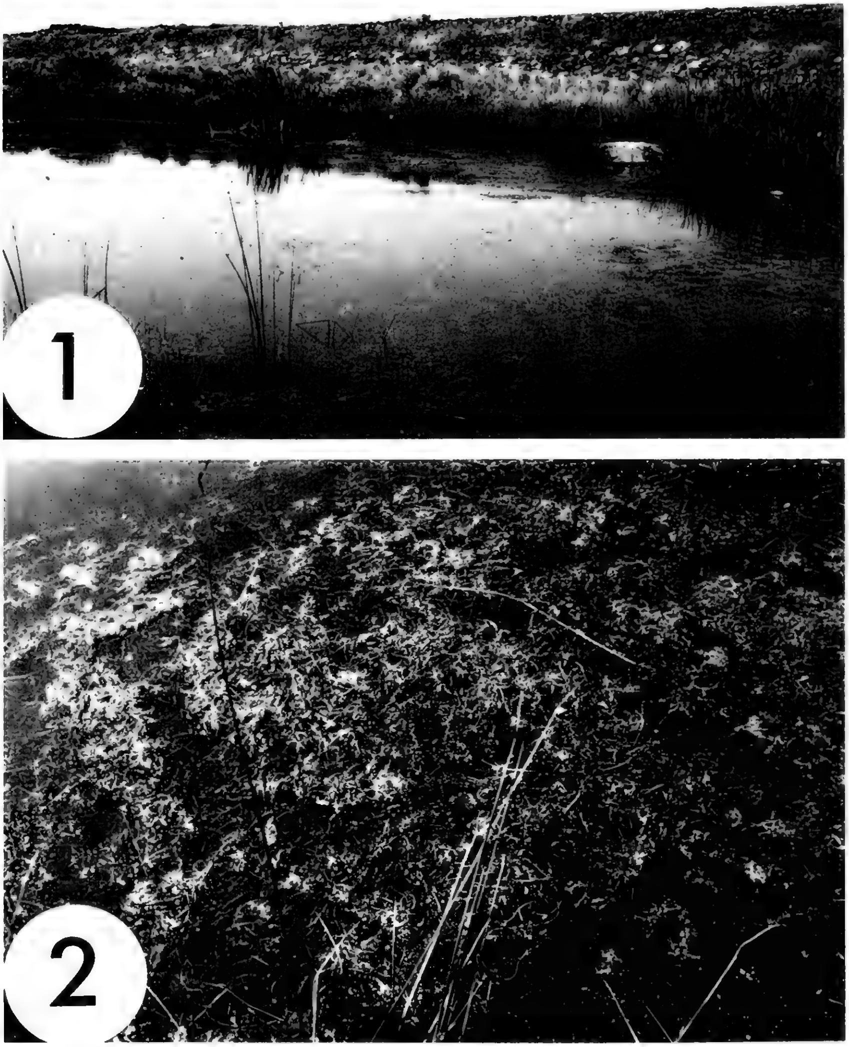
Biological data concerning both adult and immature stages of *S. needhami* are lacking. Johannsen (1935) sketchily described the third larval instar and the puparium of *S. needhami,* as well as the puparium of *S. atrovirens.* In addition, he figured the cephalopharyngeal skeleton of the third larval instar of *S. needhami.* His biological data concerning the species were limited to a recorded rearing from Laguna Beach, California.

Studies related in this paper were conducted in and around the Columbia National Wildlife Refuge (Grant and Adams counties) of east-central Washington. Although the species was occasionally collected at other localities throughout Washington and Oregon, nowhere was it found in such abundance as in the Refuge. Techniques used in this study were the same as those described by Zack (1982, *in press*) in a study of the shore fly *Paracoenia bisetosa* (Coquillett).

LIFE HISTORY

Setacera needhami is apparently confined solely to the algal mat habitat, the adults occurring both on the surface of the mats and on the lower stalks of vegetation (almost exclusively cattail, *Typha* sp.) which occasionally extrude through the mats. In the area of the Columbia Wildlife Refuge the algal mat habitat (Figs. 1, 2) is not necessarily ephemeral or even annual, but may persist through several seasons. As older growth dies it is forced to the bottom of the mat by new material. The mats show a relatively slow growth during the winter, but as the temperatures begin to rise during the early spring the mats change to a rich green and begin to expand. By late March or early April (during a mild year) the algae have taken on a fresh, green appearance as opposed to the rather drab, brown look of winter. Although only infrequent trips were made to the Refuge during the period December through early February, due to the mild climate of this area, the pools were found to contain rarely more than a thin covering of ice.

It may be the relative stability of the algal mat habitat and the mild temperatures of the Refuge which allow for the continued presence of *Setacera needhami* throughout much of the year. On warm days during the winter months, December



Figs. 1, 2. Habitats of *Setacera needhami.*

through February, adults of *S. needhami* were rarely collected on algal mats and along shoreline segments of wrack vegetation. If mild temperatures (7–13°C) persisted for periods of two or three days adults could be found feeding on the algal mats.

Setacera needhami is almost always the first ephydrid to be found in the Refuge once regular collecting began in late February or early March. By late March or early April levels of both adults and immatures seemed to peak and then remained relatively constant until late May. At this time numbers began to decline such that by early June only an occasional adult and no immatures could be located. The only stage that could be found, with some consistency, until late August was the pupa. Between mid-June and late August *S. needhami* adults were rarely collected, and then almost always singly. By late August and early September the number of adults again began to increase until population levels were as high, if not higher, than the levels in early spring. At this same time, the number of immatures located in the mats also began to rise dramatically. Population levels of *S. needhami* remained relatively high until early November when long periods of rain and/or cold temperatures seemed to coincide with their decline. A few adult females were brought into the laboratory in late October and early November, but they did not lay eggs. An examination of ovarian development was not conducted.

Besides overwintering as adults, *S. needhami* also spends the winter in the pupal stage, possibly as pharate adults. This is suggested from collections of numerous pupal cases, both empty and with fully developed adults inside, during the winter and early spring. When the mats were examined at this time only puparia were found. It is possible that pupae and/or pharate adults, still in the puparia, can overwinter in the algal mats with only minor mortality due to freezing water and inclement weather.

The previously mentioned late spring and early summer decline of *S. needhami* coincides with a rise in the level of the *Paracoenia bisetosa* population (Zack 1982, *in press*). During late summer (August and September) just the opposite occurred. That is, as the *S. needhami* population began to increase, the number of *P. bisetosa* declined. By late September and the beginning of October, *S. needhami* would again be extremely abundant on the mats while *P. bisetosa*, although common at pools which did not exhibit luxuriant growths of algae, became less noticeable. Whether any conditions existed in the mats (e.g., changes in the algal composition, temperatures, etc.) which would cause this temporal separation was not determined. How much influence, if any, each species has on the seasonal distribution of the other is unknown. I have found that the populational levels of *S. needhami* exhibit similar temporal fluctuations even in pools that did not harbor large numbers of *P. bisetosa* at any time during the year.

Occurring on the mats with *S. needhami* were the two congeners *S. aldrichi* and *S. pacifica*. Neither was found to be as abundant as *S. needhami*, and the two species combined constituted only 5–10% of the sample at any given time. All three species occurred in the same habitat at the same time and could not be separated in the field or in the laboratory until they could be examined under magnification. To assure that the individuals used in the descriptions of the immatures and puparia were *S. needhami*, I used only laboratory-reared specimens. When gravid females were brought into the laboratory, they were kept in individual oviposition chambers and each batch of eggs was placed in a separate rearing dish (Zack 1982, *in press*). The females were positively identified after eggs were laid.

The number of individuals in the field is probably regulated to a great extent by weather and to a lesser extent by predators and parasites. As was the case with *Paracoenia bisetosa* (Zack, 1982, *in press*), the level of adult *S. needhami* was drastically reduced after extended periods of rain and cold temperatures which are common during the period March through May. Abiotic mortality factors may not affect the immatures as dramatically as the adults because of their relative protection within the algal mats. Indeed, my observations support this contention. On several occasions, after three or four days of rain I found fewer adults but could find no noticeable changes in larval numbers. Only if the mat was somehow destroyed or at least penetrated by heavy rains did the immatures seem to face the possibility of being washed from the habitat. The eggs, which are laid on top of the mats, are probably very susceptible to periods of heavy rain.

Potential predators were common in the algal mats, and several of these have already been discussed in my treatment of *P. bisetosa* (Zack 1982, *in press*). Experiments were conducted in which a few larvae were placed into an oviposition chamber containing three or four adult dolichopodids (Diptera: Dolichopodidae: *Dolichopus* spp.). Adult dolichopodids were found to feed on first and second larval instars in the laboratory. Third larval instars were also used in these tests but it was found that they were too large and cumbersome for the dolichopodids to handle. In the field I observed one *Dolichopus* sp. feeding on a second instar *Setacera* (*?needhami*) sp. Unfortunately, I did not see the predator capture the larva.

Similar experiments were conducted with dragonfly naiads (Odonata: Libellulidae) which were collected from the same algal mats in which *S. needhami* larvae were found. The dragonflies were placed into a large plastic dish and were presented with all three instars of *S. needhami,* which had been impaled on number three insect pins. Larvae were presented to the naiads by moving them back and forth approximately 2–3 cm from the naiad. The dragonflies showed a distinct preference for mature second and third larval instars, probably because of their larger size. In ten trials with each larval instar, the first was attacked only once. Likewise, recently molted second larval instars were rarely accepted (only one of ten larvae tested was attacked and eaten). Mature second and third larval instars were most frequently attacked, in some cases several times, until they were dislodged from the pin and subsequently devoured by the dragonfly.

These tests were conducted under unnatural conditions for the libellulid naiads, which were removed from their normal habitat of entangled vegetation (the algal mats) and placed into a container of water. In the habitat in which both the dragonflies and ephydrids occur, it is likely that the libellulid immatures rely almost entirely on tactile stimuli in prey capture rather than visual cues as has been recorded for most dragonfly immatures. It is improbable that the larvae of *S. needhami* can be visually observed and subesquently attacked by the naiads in the algal mat.

Predation by birds may represent only a minor factor in the overall mortality of *S. needhami* in the Refuge. While many ephydrids such as *P. bisetosa, Ephydra hians* Say, and *E. packardi* Wirth were found along the shoreline or on windrowed vegetation making them more susceptible to predation by birds, the mats on which *S. needhami* occurred were often positioned over one-half m or more of water. This location would tend to keep birds feeding at or near the shoreline, such as sandpipers and killdeers, isolated from the major *S. needhami* populations. My observations indicate that this was the case. I did make some observations, however, which indicated that surface-feeding ducks such as mallards (*Anas platyrhynchos* Linnaeus), green-winged teals (*Anas carolinensis* (Gmelin)), shovelers (*Anas clyeata* (Linnaeus)) and pintails (*Anas acuta* (Vieillot)) may feed on *S. needhami.* At times individuals of these birds were found feeding in or near the mats frequented by *S. needhami.* Although gut sample studies of these species were not conducted by myself, they were by Martin and Uhler (1939), who postulated that several species of ephydrids, especially those inhabiting alkaline pools, are of special importance to ducks. Although *S. needhami* is not one of the brine species, its numbers are sometimes as high as are those of the species occurring on many of the nearby brine pools.

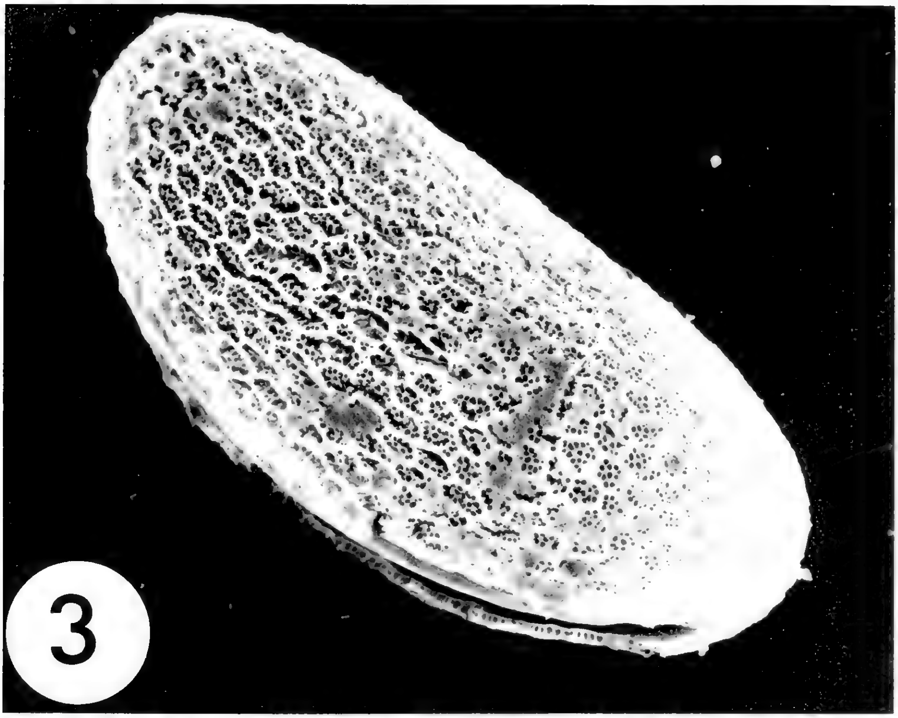
Both adult and immature *S. needhami* were easily found in the field during the early spring and late summer. Adults occurred not only on the algal mats themselves but also peripherally on the vegetation near the surface of the water. Individuals of *S. needhami* were found on algal mats throughout the pools, often at some distance from the shore (Figs. 1, 2). In contrast, the species was rarely found along the immediate shoreline.

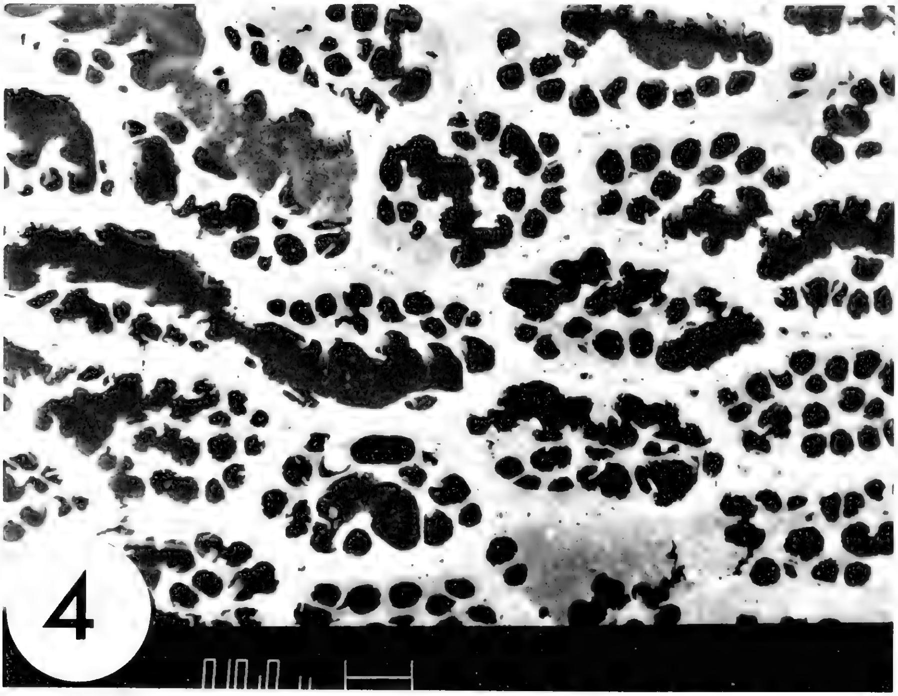
Immatures were located throughout the growing portion of the algal mats, many of which were five or more cm thick. They appeared to prefer the upper layers of the mat where the major algal growth occurred. The simplest and most productive means of obtaining the immatures was to sift through the vegetation by hand. Although first larval instars were difficult to locate, because of their small size, second and third larval instars were common. Using this sifting method I could usually locate three or four larvae per minute. The larvae exhibited no noticeable clumping or aggregating behavior and were never found in the decaying material at the bottom of the mats.

Eggs were rarely collected and those that were, were located by examining the mats where females were seen ovipositing. Ovipositional behavior was also observed in the laboratory. It involved the female extending her abdomen and placing an egg with the long plane parallel to the mat surface. Eggs were laid singly and in no discernible pattern. They were never inserted into the substrate but were always deposited on the surface. For three females brought into the laboratory, over several ovipositional periods, one laid 42 eggs, the second 50, and third 38. The longest-lived of these three females survived 11 days. During a single ovipositional period one of the females laid six eggs while a second laid 14.

Eggs are white when first laid and exhibit a definite sculptured pattern (Fig. 3). Within a day or two they obtain a slight pinkish-tinge, especially in a medial-transverse band. Just prior to eclosion the eggs become transparent and the developed first larval instar is visible within. Eclosion from the egg is accomplished in two to four days ($\bar{x} = 2.5$ days; $N = 52$). Hatching is achieved by the larva rasping at the chorion with its mouthhooks.

Mating was observed in the field on several occasions. Precopulatory behavior is much like that observed in *P. bisetosa* (Zack, 1982, *in press*), and for *Parydra quadrituberculata* Loew and *Ochthera mantis* (DeGeer) (Deonier, 1972; Deonier and Regensburg, 1978). There appears to be little recognizable courtship behavior. In most copulatory attempts, a male simply "pounced" on another fly. In the field I recognized what I thought to be males by their slightly smaller size in relation to the females. What criteria a male uses to recognize a female are unknown. In many instances, I saw what I believed to be a male accost a second fly which also appeared to be male. In all such cases the fly was repulsed. Attempts at mating





Figs. 3, 4. *Setacera needhami.* 3, Scanning electron micrograph of egg. 4, Same, close-up of chorionic sculpturing.

were common in the field, but few are successful. In only four of 50 recorded trials did attempted mating end in success. In one case a single fly approached a second fly seven different times, each ending in failure.

In the four cases in which copulation was successful, the sequence leading to mating seemed no different than those in which attempts at mating failed. Obviously female receptivity is the ultimate factor, but the related circumstances necessary are unknown. The first step in mating apparently involves the male, jumping atop or behind a female, often jumping over her in the process. When he landed atop her, further attempts at copulation were usually discouraged by the female's scurrying-off. If a male landed behind the female, he would quickly turn and attempt to mount her from behind. If receptive, the female would spread her wings and slightly upturn her abdomen. In this way she allowed the male to mount and initiate copulation. If she was not receptive, she simply held her wings over her back or scissored them slightly to effectively prevent the male from mounting. As in the other ephydrids, the male used his forelegs to grasp the female at the bases of the wings and his mid- and hindlegs to grasp her abdomen. For the four cases in which I observed successful mating, copulatory periods ranged from 49 s to 4 min 14 s. Each of these copulating pairs were disturbed by a third individual which caused them to disengage. All observations on mating were conducted at the algal mats.

Females obtained from field-collected pupal cases exhibited premating periods of two to four days ($N = 4$). Mating did take place in the ovipositional chambers, but precopulatory behavior was not observed. Egg production records were kept for only two of the flies with 108 and 92 eggs being laid during lifetimes of 18 and 23 days, respectively. Of the remaining two females, one lived nine days while the second survived 17. For six males which had been collected as pupae in the field, the oldest survived 22 days ($\bar{x} = 14.3$ days).

In the laboratory, batches of eggs were taken from single females and placed into dishes containing agar. Five to ten of these eggs were then placed into rearing dishes supplied with a 1–2 mm thick piece of algal mat. Upon eclosion the first instar began feeding, some burrowed into the mat, while others traveled along the surface for a period of several hours. The first larval instar is covered with microsetulae which give it a rather sooty-looking appearance. However, the larvae did not seem to pick-up a covering of detritus as observed in *Parydra quadrituberculata* by Deonier and Regensburg (1978). The larvae are equipped with well developed claws on the prolegs which aid in movement through the mats. Within two or three hours all of the first larval instars were well within the vegetation and feeding. The first stadium lasted between one and three days ($\bar{x} = 2.1$ days; $N = 44$). Although I obtained cast exuviae from only the algal surface, these were few, and it is doubtful that all molting took place there.

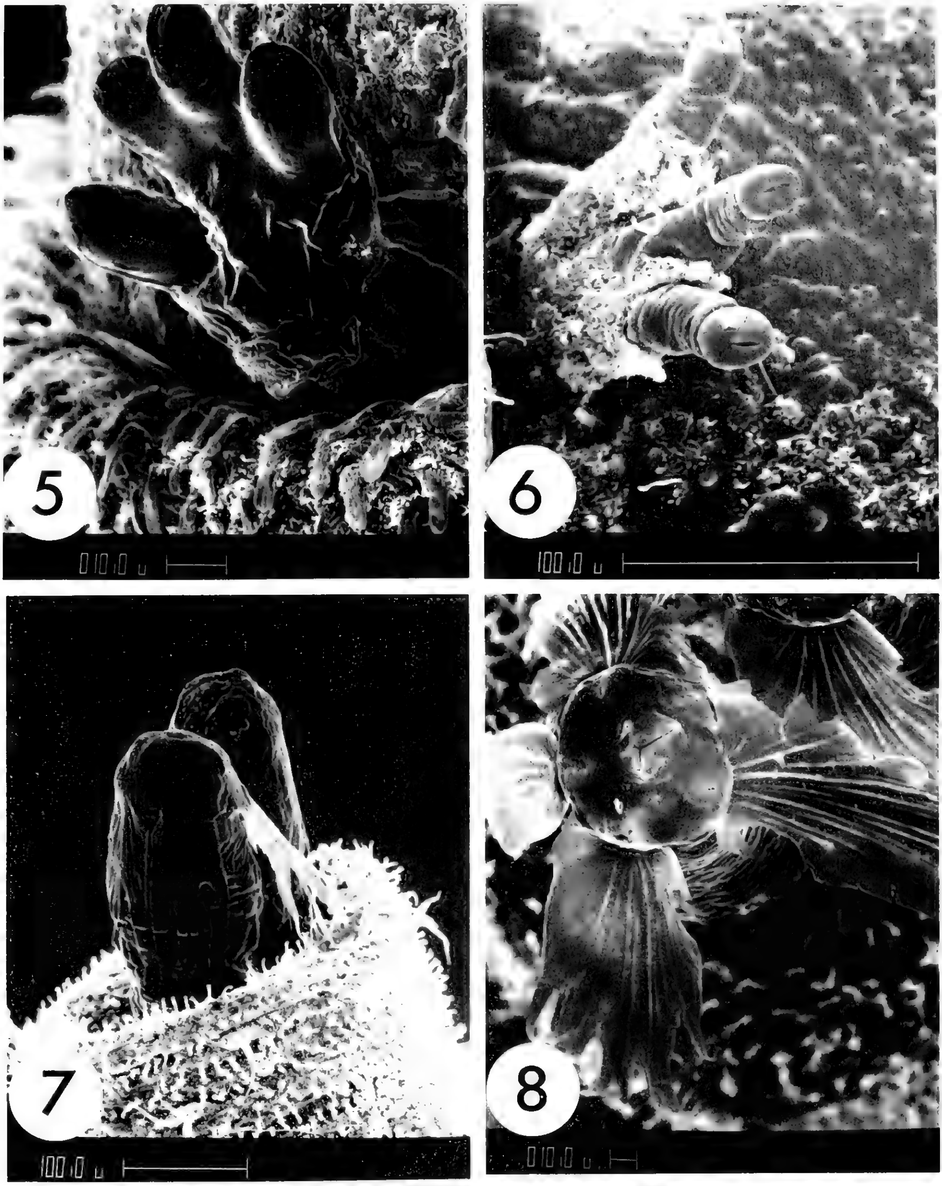
The second larval instar was comparable to the first in appearance except that most were slightly more setulose and distinctly duskier in appearance, especially when viewed dorsally. Within one day after molting the larvae developed a distinct greenish-tinge throughout the digestive tract as they continued to feed. They were also rarely found at the surface of the vegetation and, when removed from it, they quickly reburrowed upon replacement. The second stadium lasted between two to three days ($\bar{x} = 2.4$ days; $N = 34$). Based on recovered cast exuviae, molting took place both at the surface and in the algae.

The third larval instar was very motile and could be found throughout the mats and up to 5–6 cm deep in the field. In the laboratory they were restricted by the depth of the algal material which was rarely more than 2 cm thick. As was the case in the first and second larval instars, the third was also covered with setae, especially dorsally. The third larval instar, however, probably because of its larger size, had a relatively distinct setal pattern (Fig. 15). This pattern varied considerably, especially in intensity. The pattern was relatively indistinct immediately following the molt from the second instar but darkened considerably within the first day of the third stadial period. In rare instances the pattern did not darken, and the larva was found to be lacking many of the setulae found in the normally-appearing individuals.

Most of the third stadial period was spent feeding. Gut examinations of 12 field-collected third larval instars were conducted. Most of the material in their digestive tracts was composed of broken and partially digested strands of filamentous algae. In addition there were large amounts of substance which appeared to be non-algal vegetation. This material was very common in the mats and included fallen shoreline plants and up-rooted bottom plants. Few unicellular algae were found in these samples while no diatoms were discovered. These investigations were conducted by simply opening the larva, removing the digestive tract and examining the material in it at various magnifications. A more refined study of the feeding habits may prove revealing, especially if one considers that there may be competition for preferred foods with other algal mat inhabitants.

The third stadial period lasted between 4–7 days ($\bar{x}$ = 5.1 days; N = 22). During this time the larvae feed voraciously for the first 60–70% of the period. After feeding a larva would settle on top of the mat or just below the surface, and contract in length to about two-thirds the size of a normal larva. As in other species studied (Zack 1982, *in press*), *S. needhami* exhibited yellow pigmentation in the anterior portion of the larva by the time the post-feeding period was attained. The contracting larva would often wrap the anal proleg around a twig or another piece of vegetation in the rearing dish. At other times larvae would hold onto each other. In the field this same grasping phenomenon was found in almost all pupal cases collected and probably serves to anchor the pupal cases in the mat should it undergo a period of flooding. It may also hinder predators attempting to dislodge the pupal cases from the mat. The post-feeding period lasted from one to two days, after which time the puparium was formed. Within two or three days the first indications of the developing adult became visible through the pupal case. Eclosion occurred within six to nine days ($\bar{x}$ = 7.5 days; N = 20).

Based on data obtained in the laboratory, the egg to adult development time of *S. needhami* ranged from 15 to 26 days. This would indicate that during an average year, in which the first adults appeared by mid-March, the species may undergo two to three generations before almost completely disappearing by early to mid-June. The period of aestivation is spent in the pupal state, it being the only stage found consistently in high numbers between the period June to early September. If eclosion from the puparium takes place in September, it is probable that *S. needhami* passes at least two additional broods, the second of which ends with overwintering pupae (pharate adults?) and adults. The adults, as an overwintering stage, may be in a state of reproductive diapause. The pupae apparently overwinter in the algal mats.



Figs. 5–8. *Setacera needhami,* scanning electron micrographs. 5, Anterior spiracle, second instar. 6, Anterior spiracle, third instar. 7, Posterior spiracle, second instar, retracted. 8, Posterior spiracle, second instar, extended.

DESCRIPTIONS OF IMMATURE STAGES

Egg (Figs. 3, 4).—Length 0.47–0.55 mm; maximum width (in dorsal view) 0.15–0.22 mm. Elliptical, more convex dorsally than ventrally. Chorion with an irregular hexagonal pattern (Fig. 4) slightly compressed anteriorly and posteriorly. Micropylar end slightly more blunt than opposite end, micropylar stalk situated in a small depression. Eggs pale white to light pink when first deposited, developing a pink center within 12–24 h, transparent at eclosion, larva distinctly visible within.

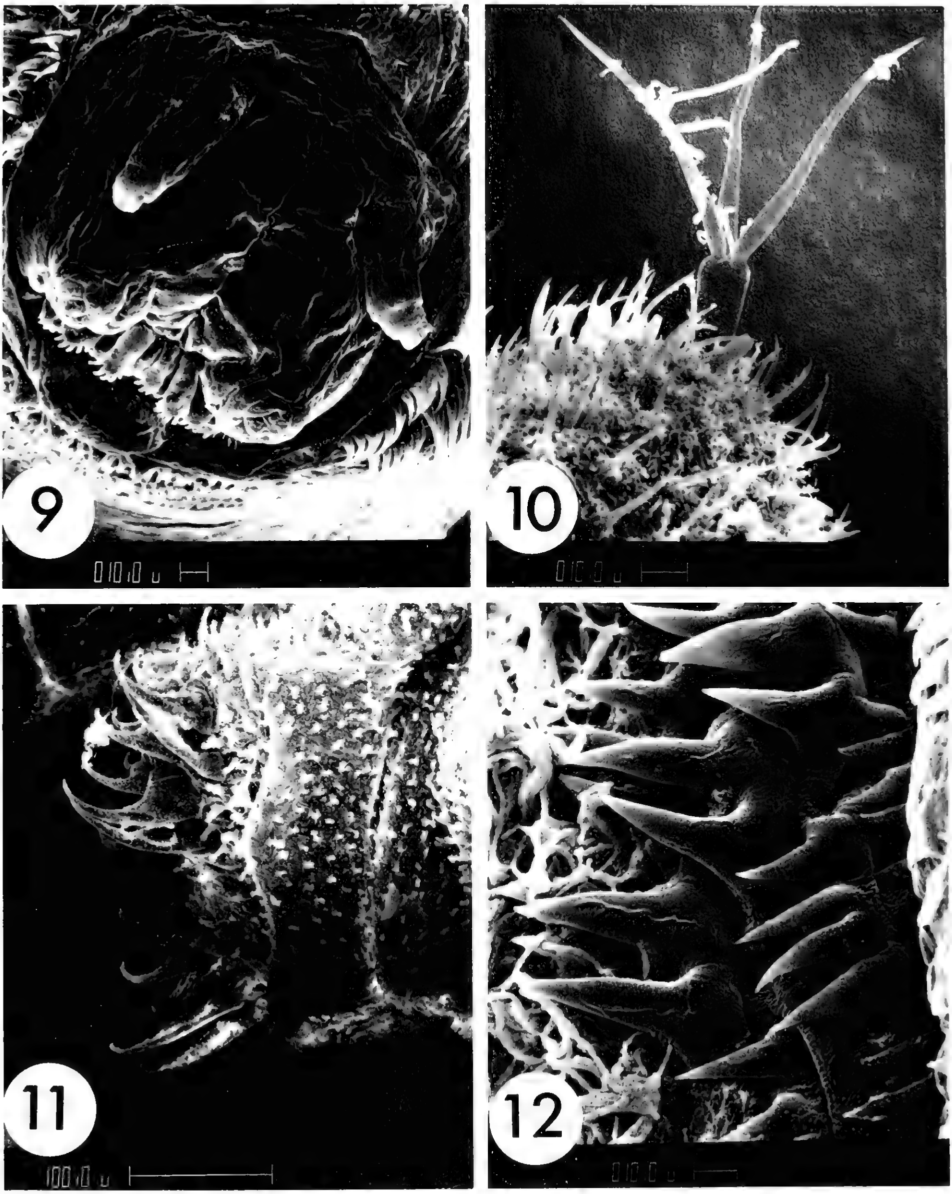
First larval instar.—Total length 1.20–2.10 mm; main body 1.10–1.96 mm; breathing tube 0.23–0.30 mm; maximum width 0.20–0.31 mm. Integument transparent, non-patterned, larva appears bare during early part of stadium but later the fine hairlike spinulae darken and become evident. Similar to 3rd instar except in the following characters: Segment 1 bilobed anteroventrally on either side of atrial opening, each lobe bearing a group of 8–10 elongate, hairlike spinulae; antenna with 2nd lobe lightly pigmented. Segment 2 encircled by a band of fine, dark, hairlike spinulae, most pronounced dorsally and below, weak at sides; anterior spiracles absent. Segments 3–4 encircled by hairs, with a slight indication of banding on the anterodorsal margin; with occasional large, prominent, black hairs above and laterally which may be sensory in function; tubercles absent. Segments 5–11 with prolegs only slightly lobed, claws less pigmented; each segment covered with an irregular arrangement of hairlike spinulae above and laterally becoming more stout ventrally; triannulation only weakly evident beneath; a series of large dark hairs dorsally and laterally, possibly sensory in funtion. Segment 12 with posterior spiracular caps slightly pigmented, each with 2 indistinct spiracular openings which appear to be continuous, spiracular scar absent, hydrofuge lamellae short, projections greater in number, often lightly pigmented. (Based on 12 specimens.)

Cephalopharyngeal skeleton, length 0.20–0.25 mm; lightly pigmented; posterior margins of mouthhooks not broadened, more or less pointed; accessory and ligulate sclerites absent; parastomal bar free from hypostomal sclerite anteriorly; dorsal bridge only slightly broadened medially, apparently without windows; dorsal and ventral cornuae long and slender, simple (without teeth) and apparently lacking windows, slight indication of reticulation, especially on the ventral cornua; dorsal cornua slightly shorter than ventral, both more or less pointed posteriorly, ventral piece bulging slightly at middle.

Second larval instar (Figs. 5, 7–11).—Total length 2.70–3.51 mm; main body 2.61–3.57 mm; breathing tube 0.63–0.75 mm; maximum width 0.60–0.69 mm. Integument translucid, body covered with fine hairs, not patterned. Similar to 3rd instar except in the following characters: Segment 1 (Fig. 9) with oral combs less developed and less pigmented; spinose anteroventral lobes on either side of mouth opening but spines less developed than in 1st instar. Segment 2 with anterior spiracles (Fig. 5) less distinct, with 3 or 4 lobes, less pigmented, lobes not separated from one another as great distally as in 3rd instar. Segments 5–12 with bilobed and trilobed sensillae only slightly evident. Posterior spiracular caps (Figs. 7, 8) with hydrofuge lamellae less developed, each with a darkly pigmented patch medially, spiracular openings indistinct.

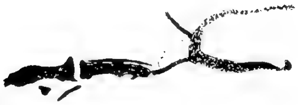
Cephalopharyngeal skeleton (Fig. 13), length 0.40–0.49 mm; slightly less pigmented; parastomal bars medially fused to hypostomal sclerite for only a short distance; hypostomal sclerite not fused to pharyngeal sclerite; dorsal bridge only slightly broadened medially, reticulation not as apparent; dorsal cornua long, slender, lacking toothed appearance, without windows; ventral cornua truncate, broadened posteriorly, without windows, appearing reticulate on posteriorly broadened area. (Based on 10 specimens.)

Third larval instar (Figs. 6, 12, 15, 16).—Total length (breathing tube held at



Figs. 9–12. *Setacera needhami,* scanning electron micrographs. 9, Head segment, second instar. 10, Sensory tubercle on 8th abdominal segment, second instar. 11, Proleg on 3rd abdominal segment, second instar. 12, Spinose band on 1st thoracic segment, third instar.

obtuse angle to main body) 7.31–10.52 mm; main body 7.11–8.69 mm; breathing tube 1.45–2.03 mm long; maximum width 1.11–1.53 mm. Integument translucid; internal structures visible to some degree, posterior ½ of internal tracheal system visible; numerous spines and spinulae covering integument; dorsum patterned, varying greatly in intensity, that of segments 11 and 12 faint or more often lacking (Fig. 15). Shape fundamentally muscoid; anterior ½ tapering slightly to head, caudal segment (12) elongate, forming a telescoping and distally branching breathing tube; segments 1 and 2 retractile; prolegs present on segments 5–12, each bearing rows of well-defined claws. Segment 1 bilobed anteriorly, each lobe bearing an elongate 3- or 4-segmented antenna, basal and 3rd segment non-pigmented; ventrally each lobe bearing a sensory plate. Facial mask with a pyramid-shaped area of rows of posteriorly-facing, comblike structures anterior and lateral to mouth opening, 1st row with 4 combs and each succeeding row with approximately 8 combs, forming a partial semicircle around the atrial opening. Prothorax (segment 2) with anterior band of spinulae (Fig. 12) in 7–9 irregular rows continuing relatively uninterrupted to dorsolateral margin where banding ceases; dorsum moderately spinulose, patterned, but posterolateral and posteroventral areas essentially bare with only some slight spiculation; anterior spiracles (Fig. 6) laterad, located at posterior border, 3 or 4 lobed, dark at tips. Mesothorax (segment 3) with anterior band of 20+ rows of spinulae completely encircling segment, posterior ⅔ of segment spinulose, more so dorsally than ventrally or laterally; segment bearing a series of slightly raised tubercles each bearing a 3- to 4-lobed sensillum, tubercles more evident ventrally and laterally than dorsally. Metathorax (segment 4) with an anterior band of 20+ rows of spinulae completely encircling segment, but coalescing into heavily spinulose dorsum; posterior ¾ of segment only moderately spinulose laterally and below. Segments 5–11 (abdominal segments 1–7) variously wrinkled, but each with 3 somewhat indistinct annuli; each segment densely covered with spinulae and patterned (Fig. 14) except for last 2 segments; segments with an encircling pattern of tubercles arranged medially, each bearing a 3- to 4-lobed sensillum. Prolegs present on each segment, those of segments 6–11 subequal, that of segment 5 approximately ½ as large as others. Prolegs (Fig. 11) well-developed, bilobed, with 2 distinct rows of claws and a 3rd irregular row, claws directed posteriorly, 4 claws/row/side, those of anterior row largest, of 2nd row approximately ⅔ as large, and of 3rd row small, ⅓–½ as large as preceding row; claws surrounded by spinulae which are slightly more robust than those occurring on remainder of segment. Segment 12 (caudal) bearing an elongate bifurcating breathing tube distally and a well-developed bilobed anal proleg ventrally. Each ½ of proleg with 5 irregular rows of claws, approximately 5 claws/row, those of distal-most row largest, of proximally preceding rows progressivley smaller, and approximately ⅔ size of those in preceding row. Perianal pad located ventrally, subcircular, glabrous, bilobed posteriorly, furrowed by medially occurring anal slit, a patch of spinulae posteromedially. Anal proleg bearing tubercles on each side lateral to spinule patch of perianal pad, each tubercle bearing a 3- to 4-lobed sensory papillum (Fig. 10). Segment 12 with 2 pair of well-developed sensory papillae, most anterior pair located on large tubercles at medial (excluding breathing tube), dorsolateral margin of segment, 2nd pair located on smaller tubercles at anteromedial junction of breathing tube with main body. Breathing tube with 3 pair of well-developed sensory tubercles, most proximal pair located ventrolaterally on basal ½, 2nd pair located at middle of breathing tube, ventrolaterally, 3rd pair located just beyond middle, dorsolaterally; tube moderately spinulose on basal ¾, to bifurcation, branches glabrous. Posterior spiracular caps dark amber, rounded apically, each bearing 4 suboval spiracular openings, spiracular scar indistinct, cap bordered basally by 4 groups of hydrofuge lamellae each composed of 6–10 transparent hydrofuge processes.



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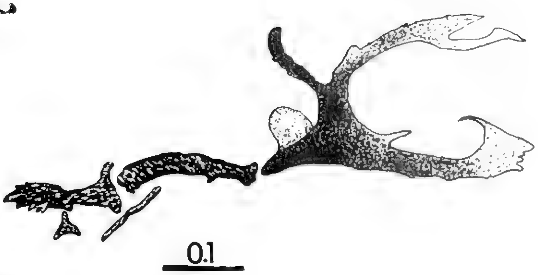

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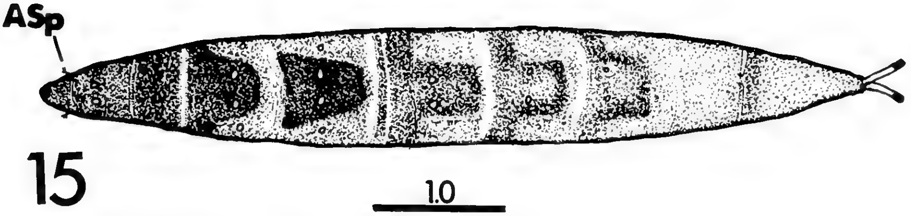

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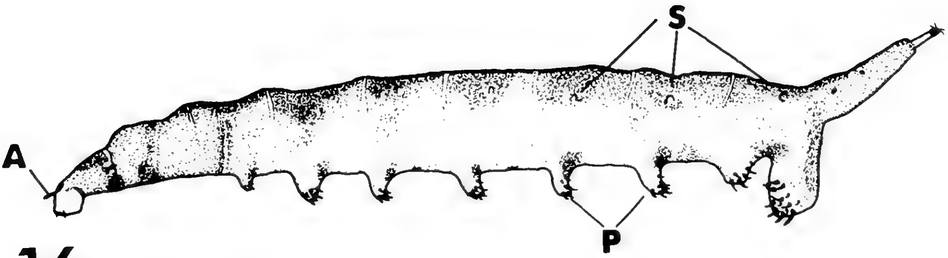

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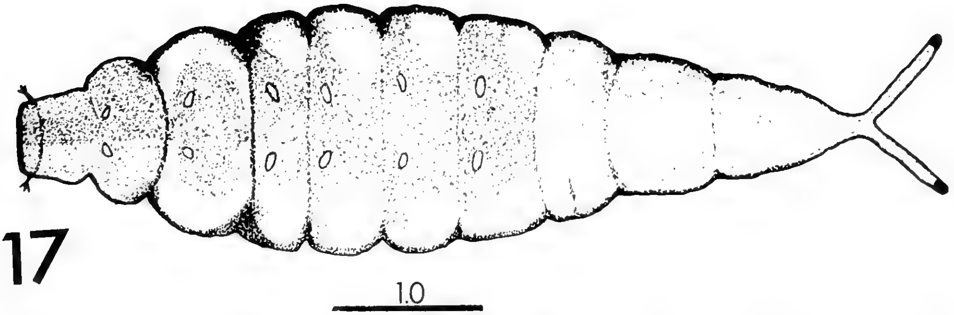

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Figs. 13–17. *Setacera needhami.* 13, Cephalopharyngeal skeleton, second instar. 14, Cephalopharyngeal skeleton, third instar. 15, Third instar, dorsal view. 16, Third instar, lateral view. 17, Puparium, dorsal view. Abbreviations: A = antenna; ASp = anterior spiracle; P = proleg; S = sensory tubercle.

Cephalopharyngeal skeleton (Fig. 14), length 0.69–0.75 mm; amber to darkly pigmented; posterior margins of dorsal and ventral cornuae and lateral pharyngeal process dark amber, remainder black. Mouthhooks paired, not connected, nonfenestrate, length 0.09–0.11 mm; hook part of mouthhook slightly decurved, broad and spoon-shaped, sharply toothed apically with 2 elongate teeth anterodorsally, 5–6 spinelike teeth beneath, most posterior tooth slightly more stout than preceding; base broad, slightly concave and bilobed, inner lobe smaller than outer; posterior margin articulating with anterior of hypostomal sclerite, not fused. Accessory mouth sclerite located ventrolaterad to mouthhooks, roughly V-shaped. Ligulate sclerite paired, thinly rod-shaped, situated ventrad to mouthhooks and anterior to hypostomal sclerite. Hypostomal sclerite paired, length 0.19–0.21 mm; H-shaped in ventral view, consisting of 2 pair of longitudinal sclerites and 2 bridges, expanded anteriorly to articulate with mouthhooks. Anterior hypostomal bridge situated at articulation with mouthhooks, not fused to hypostomal sclerite; posterior hypostomal bridge approximately ⅔ length of hypostomal sclerite from anterior bridge. Epistomal plate broad posteriorly, with 2 large anterior teeth. Pharyngeal sclerite length 0.38–0.45 mm; ventral pharyngeal lamella with 15+ longitudinal ridges running from posteroventral margin of hypostomal sclerite to posteroventral margin of pharyngeal sclerite; forward portion not fused to hypostomal sclerite; paired lateral pharyngeal processes large, flat and rounded dorsally, fused to pharyngeal sclerite; dorsal bridge broadened medially, reticulate, with numerous windows, variously toothed at margins; dorsal cornua long and slender, variously toothed, large toothed process anterodorsally, large open window at posterior margin; ventral cornua thin, elongate, posterior margin with broken (like a snapped tree) outline, large window dorsally which may be open or closed, often varying in the same specimen. (Based on 18 specimens.)

Puparium (Fig. 17).—Total length 6.20–7.31 mm; main body 5.34–5.78 mm; breathing tube 1.36–1.82 mm; maximum width 1.40–1.97 mm. Amber to dark brown, uniformly translucid. Ellipsoidal, truncate anteriorly, tapering posteriorly into an elongate breathing tube. Venter arcuate, dorsum relatively flattened. Anterior segments 1–3 invaginated. Anterior spriacles trilobed (in most cases) arising on anterolateral margin of dorsal cephalic cap. Dorsal cephalic cap truncate anteriorly, line of weakness running dorsolaterally along segments 2–4, curving mesad and forming a transverse line along posterior margin of segment 5. Markings similar to those described for 3rd instar, varying greatly in intensity. Sensory papillae sclerotized, arranged as described for 3rd instar. Puparium, except for area posterior to bifurcation of segment 12, densely spinulose both dorsally and ventrally. Segments 5–12 each bearing ventral prolegs, those on segments 5–9 flat to weakly convex, proleg of segment 11 flat, hidden in convexity between prolegs of segments 10 and 12; lobe of segment 10 elevated, claws facing posteriorly and opposing the anteriorly-facing claws of proleg of segment 12; claws of prolegs of segments 5–9 essentially biserial with light spiculation both posteriorly and anteriorly to major spines; segments 10 and 12 multiserial, claws stronger than those on segments 5–9 and 11, segment 11 with biserial claws. Segment 12 flattened posteriorly with ovid-shaped perianal pad; pad devoid of setae, with anteriorly-facing, broadly-U-shaped convexity arising posteriorly and surrounding the anal slit, spinule patch at posteromedial border. Segment 12 elongate distally forming a breathing tube bifurcating at distal ⅔, angle of bifurcation often exceeding 100°;

large sensory tubercles on anterolateral ¼ of breathing tube; posterior spiracular caps more darkly amber than remainder of puparium, spiracular areas only faintly discernable. (Based on 15 specimens.)

ACKNOWLEDGMENTS

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SEASONAL HISTORY AND HOST PLANTS OF THE PLANT BUG *LYGOCORIS ATRINOTATUS*, WITH DESCRIPTION OF THE FIFTH-INSTAR NYMPH (HEMIPTERA: MIRIDAE)

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Abstract.—The plant bug, *Lygocoris atrinotatus* (Knight), is shown to develop on native and cultivated *Hydrangea arborescens* L. (Saxifragaceae), the first host association for this little-known mirid. The seasonal history is summarized for a western Pennsylvania population occurring on the cultivar 'Annabelle,' and known distribution is reviewed and mapped. An adult diagnosis and a description and illustration of the fifth-instar nymph are provided.

The biology of the plant bug genus *Lygocoris* Reuter is well known compared to that of many other mirid genera, with host plants recorded for all but a few North American species. One poorly known species is *L. atrinotatus* (Knight), described in the genus *Lygus* Hahn by Knight (1917). The holotype and allotype were from Pittsburgh, Pa.; paratypes (single males) were from Black Mountains, N.C. and Washington, D.C. Watson (1928) has since added Ohio to the known distribution, stating that the typical habitat was "along streams"; Henry and Smith (1979) also recorded it from Georgia. In the latest review of the genus, Kelton (1971) noted that the host was unknown.

In reporting *Lygocoris knighti* Kelton from *Viburnum recognitum* Fernald in New York and Pennsylvania, Wheeler (1980) included records from North Carolina and West Virginia based on females collected from *Hydrangea arborescens* L. The later discovery of a large *Lygocoris* population on hydrangea in Pennsylvania has enabled us to associate *L. atrinotatus* with its proper host plant, *H. arborescens* (Saxifragaceae), and refer the North Carolina and West Virginia records to this species. In this paper we review the known distribution, provide the first host association, summarize the seasonal history on cultivated hydrangea, and give a diagnosis of the adult and a description and illustration of the fifth-instar nymph.

DISTRIBUTION

The following represent new state records based on specimens in the National Museum of Natural History, Washington, D.C. (USNM) collection: SOUTH CAROLINA: Rocky Bottom, July 31, 1934, J. M. Todd. TENNESSEE: Cades Cove, Great Smoky Mountains National Park, June 13, 1946, R. R. Dreisbach.

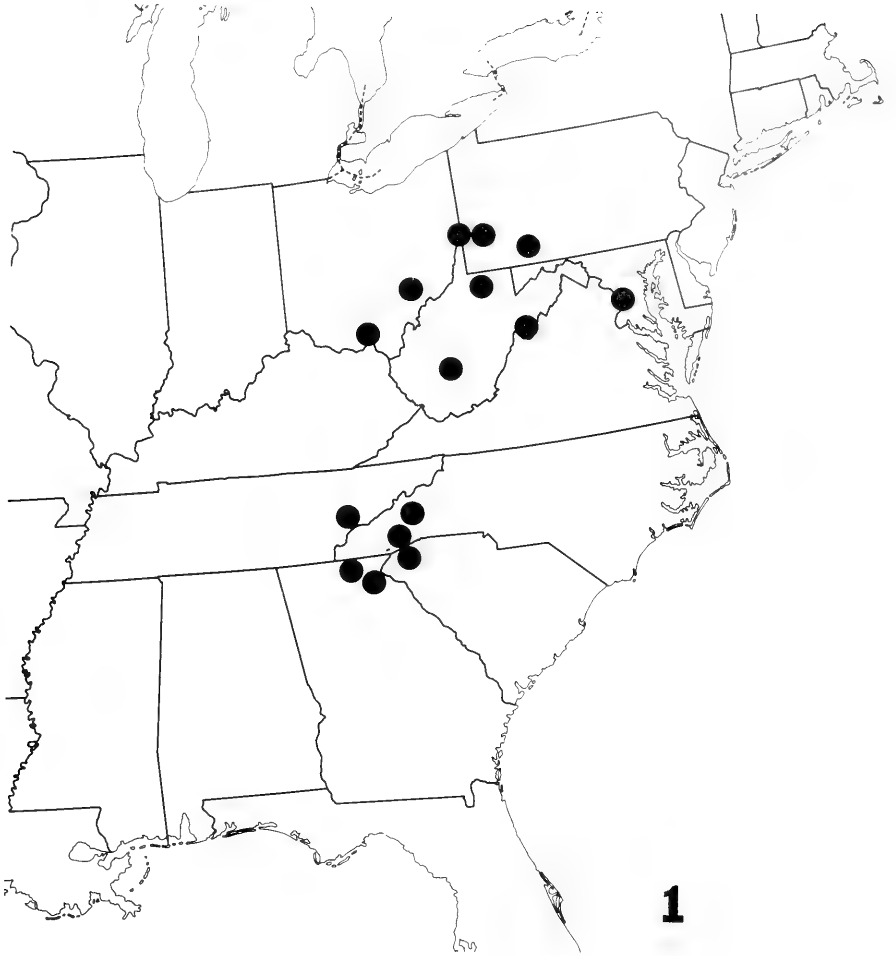

Fig. 1. Distribution of *Lygocoris atrinotatus*.

Watson's (1928) record of *L. atrinotatus* from Ohio apparently was based on Ohio Biological Survey material from Morgan Co., June 24, 1927, and Scioto Co., June 20, 1927 (Ohio State Univ. collection). The Union Co., Georgia record listed by Henry and Smith (1979) is based on a specimen in the University of Georgia collection: Neel Gap, July 5, 1947, P. W. Fattig. Additional Georgia records, based on USNM specimens, are from Clarksville [Habersham Co.], July 19, 1947, P. W. Fattig, and Sarah [Union Co.], July 7, 1945, P. W. Fattig. An additional Pennsylvania record, the site of our seasonal history observations, is Somerset Co., Davidsville, July 5, 1980 and June–July 1981, A. G. Wheeler, Jr. and T. E. Wolf. Wheeler's (1980) records of *L. knighti* from near Brevard, North Carolina, and Hancock and Pendleton counties, West Virginia, should be referred to *L. atrinotatus*. Additional West Virginia records are Monongalia Co., Morgantown, July 16, and Nicholas Co., 10 mi. N. of Fayette Co. line, June 24, 1978, A. G. Wheeler, Jr. and T. L. Mason, Jr.

The known range of *L. atrinotatus* is essentially Appalachian, that is, roughly confined to an area bounded in the north by the margin of Pleistocene glaciation and in the south by the Fall Line (Barr, 1969). Blauch (1975) delineated this region as the Southern Appalachian Highlands. Many of the records are concentrated in the southern Appalachian Mountain area of southeastern Tennessee, northeastern Georgia, and western North and South Carolina (Fig. 1). *Lygocoris atrinotatus* may have originated in the Great Smoky-Blue Ridge Mountain region of the southern Appalachians. This region harbors an interesting fauna that includes many endemic species. In a recent symposium this area was recognized as an important center of distribution, and specialists analyzed the distributional history of several invertebrate groups characteristic of the region (Holt, 1969). *Lygocoris atrinotatus,* based on limited collecting, ranges farther south than *L. knighti,* a closely related, viburnum-feeding mirid known from the Lake of the Woods region of southwestern Ontario, Tompkins Co. in south central New York, and Dauphin Co. in south central Pennsylvania.

Species of *Lygocoris* overwinter as eggs inserted in woody tissue of host trees and shrubs; this habit allows mirids to move easily in shipments of nursery stock (Wheeler and Henry, 1974). Because both *L. atrinotatus* and *L. knighti* develop on plants used in horticultural trade, the movement of ornamental plants may introduce these mirids to new areas, thus blurring the current distinctness in their known ranges. It is possible that some such movement already has taken place.

Host Plants and Seasonal History

The first host records for *L. atrinotatus* became available in 1979 when this mirid was taken on inflorescences of native *Hydrangea arborescens* in North Carolina and West Virginia. Wild hydrangea is a much-branched, often straggling, shrub of the family Saxifragaceae, occurring on rocky slopes and stream banks from southern New York south to Georgia and west to Arkansas (Gleason and Cronquist, 1963). Sevenbark, another common name, refers to the tendency for bark on older stems to exfoliate. *Hydrangea arborescens* ssp. *radiata* is considered an Appalachian endemic (Cooper and Hardin, 1970).

In 1980 we found *L. atrinotatus* on cultivated *H. arborescens* in a nursery in Somerset Co., Pennsylvania. Large numbers were present on the cultivar 'Annabelle,' a plant selected at the University of Illinois for its large flower clusters or corymbs (Dirr, 1977). We have not encountered this mirid on the Asiatic *H. paniculata* Siebold or its commonly planted cultivar 'Grandiflora,' the peegee hydrangea.

On 5 July 1980 at the nursery in western Pennsylvania, adults were abundant on flower clusters along with a few fifth-instar nymphs. Periodic samples were taken from two large *H. arborescens* 'Annabelle' in 1981 to obtain information on phenology. Overwintering eggs began to hatch during late May when flower buds were small and tightly closed. A random sample of 11 nymphs collected on 5 June contained second and third instars with only single specimens of instars I and IV. One week later when flower buds were still tightly closed, instars III–V were found in equal numbers (five specimens each), with one second instar present. By 19 June a collection of 20 specimens contained one third, three fourth, and ten fifth instars and six adults (4 ♂, 2 ♀). Adults of this univoltine mirid were

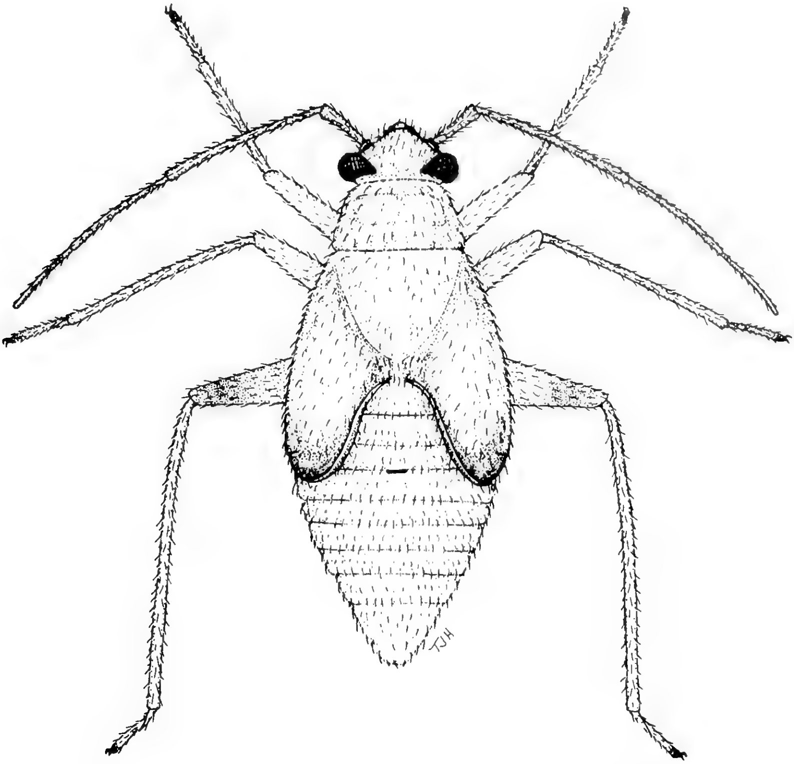

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Fig. 2. *Lygocoris atrinotatus,* fifth instar.

most common during early bloom of *H. arborescens* (late June–early July) and began to decline in numbers by mid-July.

Most species of *Lygocoris* are oligophagous or monophagous and, as Leston (1952) noted, the North American species, even more so than the Old World *Lygocoris* fauna, have developed a specificity for various deciduous trees. *Lygocoris atrinotatus* is a specialist on shrubs of the genus *Hydrangea* on which nymphs feed exclusively on the developing flower buds and later on the opened inflorescences. Inflorescences of many plant species are available only briefly each season, and flower-feeding insects sometimes must utilize other resources to complete their development. Adults of *L. atrinotatus,* however, appear well before full bloom of *H. arborescens* so that no resource switching, e.g. to vegetative tissue, appears necessary.

DESCRIPTIONS OF ADULT AND FIFTH-INSTAR NYMPH

Adult male.—Length 5.42–5.83 mm ($\bar{x} = 5.48$ mm, $n = 4$). Head testaceous, apex of tylus fuscous. Antenna fuscous, except for pale 1st segment. Rostrum reaching middle of metacoxa. Pronotum testaceous with a large, quadrate, fuscous spot behind each callus. Scutellum uniformly testaceous. Hemelytron testaceous with clavus, except lighter brown median line and apical ⅓ of corium and embolium, fuscous; membrane fumate, veins pale testaceous. Venter testaceous to greenish yellow, sides of thorax and abdomen and genital segment fuscous. Legs testaceous; metafemur infuscated on apical ½; tibial spines brown without distinct spots at bases.

Adult female.—Length 5.33–5.83 mm ($\bar{x} = 5.64$ mm, $n = 7$). Similar to male in color and general appearance.

Remarks.—Adults of *L. atrinotatus* are very similar to *knighti* in general appearance, but *atrinotatus* can be separated by the pale first antennal segment (rather than fuscous) and by the much larger and more distinct quadrate spot behind each callus. Male genitalia are quite distinct. In *atrinotatus* the left paramere is typically L-shaped without lateral processes, and the right paramere has the apical arm curved downward and perpendicular to the base; in *knighti,* the left paramere has two lateral processes, and the apical arm of the right paramere is directed upward and parallel to the base. Kelton (1971) figured the parameres for *knighti,* and Knight (1917) figured them for *atrinotatus. Lygocoris atrinotatus* is also similar to *L. canadensis* var. *binotatus* Knight in having large quadrate spots behind the calli, but the genital parameres of the variety *binotatus* are of the same form as *canadensis* Knight and more similar to *knighti* than to *atrinotatus.*

Fifth-instar nymph (Fig. 2).—Length 3.75–4.17 mm ($\bar{x} = 4.06$ mm, $n = 6$). General coloration creamy white with head, anterior ½ of pronotum, and middle of abdominal terga tinged with green. Wing pads pallid with interior margins, outer basal margins, and apices infuscated; claws and apices of tarsi fuscous; apical ½ of metafemur infuscated. Antennal segments II–IV and tibiae sometimes more testaceous. Entire dorsum and appendages sparsely clothed with short, recumbent, dark-brown setae.

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We are grateful to T. E. Wolf (Pennsylvania Department of Agriculture, Altoona) for his help in sampling *L. atrinotatus.* Linda Butler (Department of Entomology, West Virginia University, Morgantown) and C. A. Triplehorn (Department of Entomology, Ohio State University, Columbus) kindly lent specimens from collections in their care. We also thank C. L. Smith (Department of Entomology, University of Georgia, Athens) for supplying data from a Georgia specimen, and E. R. Hoebeke (Department of Entomology, Cornell University, Ithaca, New York) for reading the manuscript.

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THE GENUS *BROMELOECIA* SPULER IN NORTH AMERICA (DIPTERA: SPHAEROCERIDAE: LIMOSININAE)

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Abstract.—The genus *Bromeloecia* is revised for North America. Two new species are described, *B.* ***seltzeri*** from the eastern United States and *B.* ***tarsiglossa*** from Arizona.

Bromeloecia was erected by Spuler (1923), as a subgenus of *Leptocera* (Olivier), to contain a single Mexican species, *Limosina bromelarium* Knab and Malloch. The genus *Leptocera* as treated by Spuler is equivalent to the subfamily Limosininae Frey (=Leptocerinae sensu Hackman, 1969; see Roháček, *in press*). *Bromeloecia,* along with other former subgenera of *Leptocera,* is best treated as a genus. Its affinities with other Limosininae are not clear, but its most probable sister-group is *Trachyopella* Duda with which it shares unusually long postocellar bristles, minute size, a divided female tergite 8, and a simple male sternite 5.

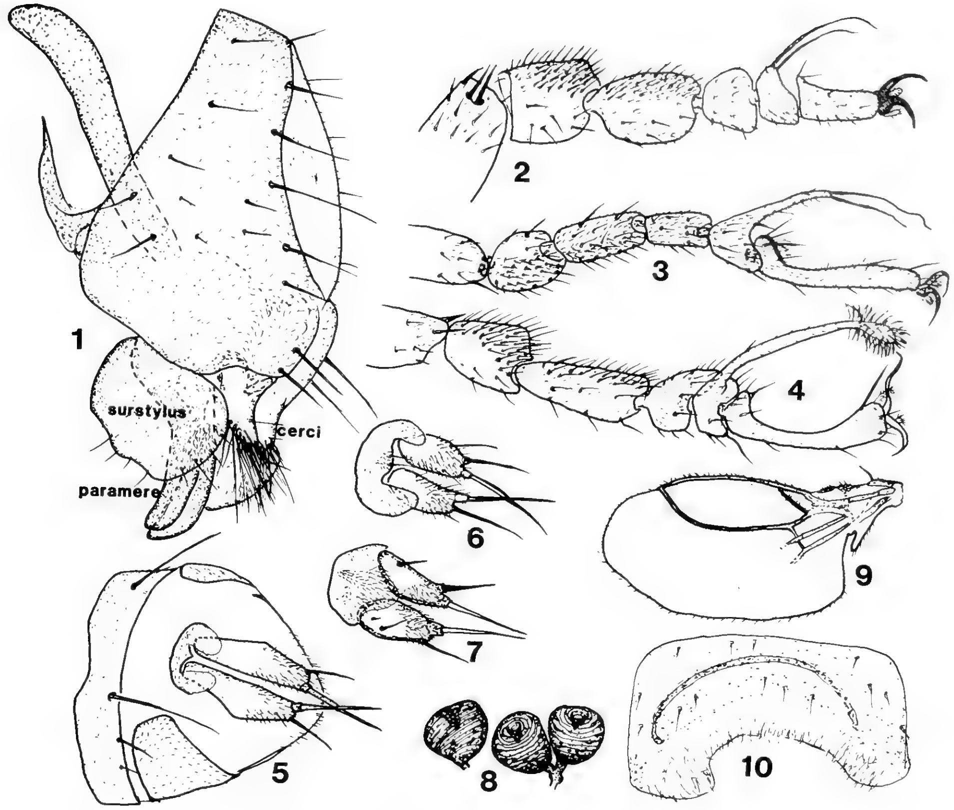
Bromeloecia Spuler, 1923: 375

Type-species.—*Limosina bromelarium* Knab and Malloch, 1912: 413.

Generic diagnosis.—Very small (approx. 1.0 mm long), brown flies. Wing (Fig. 9) with R2+3 very short, running almost directly to wing margin; R4+5 running to ⅔, then turning abruptly to costa; costa not bypassing R4+5; crossveins r-m and m-cu close together, near base of wing; alula narrow. Face and lower frons tuberculate. Postverticals small, much smaller than the large parallel or divergent postocellars. Midtibia with 2 anterodorsal bristles on proximal ½, a long preapical posterodorsal and shorter preapical anterodorsal and an apicoventral. Male postabdomen small, surstyli subovate without spines or lobes; cerci with ventral processes. Female tergites reduced, tergite 7 straplike, tergite 8 split into 2 lateral sclerites. Three spermathecae, invaginated apically.

The North American *Bromeloecia* form a monophyletic group differing from *B. bromelarium* and other (undescribed) Neotropical species as follows: Penultimate segment of hindtarsus of male with long process or processes; apex of cercus of male with dense hair tuft; 7th tergite of female with 2 long bristles; fifth sternite of male simple, without lobes or modified chaetotaxy; eyes small, 2× genal height or less.

With the exception of the female postabdomen and the male hindtarsus, the three North American species appear almost identical.



Figs. 1–10. *Bromeloecia* spp. 1, 2, 6, 9, 10, *B. seltzeri*. 3, 7, *B. winnemana*. 4, 5, 8, *B. tarsiglossa*. 1, Male postabdomen, lateral view. 2–4, Hindtarsi. 5, Terminal portion of female abdomen. 6, 7, Female epiproct and cerci, dorsal views. 8, Spermathecae. 9, Female wing. 10, Male fifth sternite.

Bromeloecia seltzeri **Marshall, New Species**

Figs. 1, 2, 6, 9, 10

Diagnosis.—Penultimate segment of hindtarsus of male with a short process which terminates in 2 long bristles (Fig. 2). Female epiproct with 2 small bristles on a central setulose area (Fig. 6). Eye minutely setulose, very little higher than cheek.

Description.—Interfrontal plate narrow, bordered by 4 pairs of short interfrontal setae, the lower 2 very short. Ocellars, upper orbitals, inner verticals and postocellars large; lower orbitals and outer verticals smaller; postverticals very small. Orbital setulae forming a single row extending to anteroventral eye margin, orbital setulae in front of eye very long. Vibrissa long, subvibrissa minute; genae with a few small setulae only. Eye height slightly greater than cheek height. Prosternum linear; notum with 1 pair of long prescutellar dorsocentrals and 1 pair of short prescutellar setulae; acrostichal setulae long and sparse, forming 3–4 rows between dorsocentral areas. Scutellum rounded, slightly broader than long. Katepisternum with a small posterodorsal bristle and a minute anterodorsal setula. Midtibia with a long preapical posterodorsal, a shorter preapical anterodorsal, and very small anterodorsals at ¼ and ½. Male abdomen as in Fig. 1.

Types.—Holotype ♂ and allotype ♀, Massachusetts, Medford, 11–17.viii.1969, carrion trap, A. Newton (MCZ). Paratypes: 20 ♂, 22 ♀ same as holotype; 22 ♀ same as holotype except in dung trap; 9 ♂, New Brunswick, St. Andrews, Gibson Lake, 11.viii.978, dung/carrion traps, S. A. Marshall; one ♂, New Brunswick, St. Andrews, 18.viii.1978, dead sea gull, S. A. Marshall; 1 ♂, 1 ♀, Tennessee, Henderson Co., Natchez Trace State Park, 1000′, 18.vi–13.vii.1972, dung trap, A. Newton; 1 ♂, 1 ♀, Tennessee, Cumberland Co., 2 mi. E. of Ozone, mixed hardwood forest, 17.vi–14.vii, dung/carrion traps, A. Newton. Paratypes in the Canadian National Collection, Ottawa (CNC), the Museum of Comparative Zoology, Cambridge, Mass. (MCZ), and the author's collection.

Bromeloecia tarsiglossa **Marshall, New Species**

Figs. 4, 5, 8

Diagnosis.—Penultimate segment of hindtarsus of male with a long process terminating in a setulose lobe (Fig. 4). Female epiproct reduced, without bristles (Fig. 5). Eyes bare, 2× as high as cheeks. Also differs from *seltzeri* in having the lower interfrontals longer, sometimes cruciate and in having stronger anterodorsal midtibial bristles at ½ and ¼.

Types.—Holotype ♂, Arizona, Cochise Co., Huachuca Mts., 5600′, Sunnyside Canyon, 13–19.ix.1970, dung traps in juniper/oak woodland, A. Newton (MCZ). Allotype ♀, same data as holotype. Paratypes: 10 ♂, 12 ♀, Arizona, Cochise Co., Huachuca Mts., Ramsay Canyon, 5600′, ix.1971, dung traps in oak woodland, A. Newton; Cochise Co., Chiricahua Mts., 15–21.viii.1978, dung traps, O. Kukal; Santa Cruz Co., Santa Rita Mts., Madera Canyon, 5500′, ix.1972, dung traps in oak woodland, A. Newton; Santa Cruz Co., 8 mi. WNW Nogales, Walker Canyon, 3900′, ix.1972, dung traps in oak woodland, A. Newton; Pima Co., Santa Catalina Mts., Mt. Lemon Hwy., 4900′, ix.1972, dung traps in oak/juniper woodland, A. Newton. Paratypes in CNC and in author's collection.

Bromeloecia winnemana **(Malloch) 1925: 97**

Figs. 3, 7

Diagnosis.—Penultimate segment of hindtarsus of male with a long process (Fig. 3), terminating in 2 long bristles. Fifth segment of hindtarsus very long. Female epiproct without bristles, but centrally lobate (Fig. 7). Eyes bare, slightly less than 2× cheek height.

Specimens examined.—New Jersey, Burlington Co., 3.0 mi. NNE Chatsworth, on N.J. 72, 29.viii–v.ix.1969, carrion traps in open pine/oak forest, A. Newton.

Comments.—The type-series of this species was reared from fungi.

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TWO NEW SPECIES OF BITING MIDGES AND NEW COLLECTION RECORDS OF THE GENUS *CULICOIDES* (DIPTERA: CERATOPOGONIDAE) FROM SRI LANKA

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Abstract.—Two new species, *Culicoides* ***mathisi*** and *C.* ***roswelli,*** are described from Sri Lanka. Previous records of *C. schultzei* from Sri Lanka are corrected to *C. oxystoma* Kieffer. Seven additional species are reported from Sri Lanka for the first time, bringing the total number of species known from that country to 36.

Recently we published a check list of the *Culicoides* species of Sri Lanka (Giles et al., 1981). In this list, which contains 27 species, we wrongly identified specimens as *C. schultzei* (Enderlein). We have re-examined these specimens and have identified them as *C. oxystoma* Kieffer. Studies of additional Sri Lanka material allow us to record the presence of the following additional ten species, two of which are new, bringing the total count of Sri Lanka *Culicoides* species to 36: *C. arakawai* (Arakawa), *C. clavipalpis* Mukerji, *C. mathisi,* n. sp., *C. oxystoma* Kieffer, *C. pampangensis* Delfinado, *C. paraflavescens* Wirth and Hubert, *C. roswelli,* n. sp., *C. sigaensis* Tokunaga, *C. similis* Carter, Ingram, and Macfie, and *C. subpalpifer* Wirth and Hubert.

For explanation of methods of measurement and of ratios used see Giles et al. (1981). The first values presented are those of the holotype followed by the range of variation of the paratypes in parentheses.

The authors thank Karl V. Krombein, Director of the Smithsonian Ceylonese Insect Project, for supplying the material used in this study, and Molly Ryan for making the illustrations.

Culicoides mathisi **Giles and Wirth, NEW SPECIES**

Fig. 1

Female holotype.—Wing length 0.92 (0.87–0.97, $n = 7$) mm.

Head: Brownish; eyes bare, contiguous for a distance equal to diameter of 2 facets (Fig. 1f). Antennal segments 3–8 pale with apices darker, 9–15 light brown; verticils well developed on all segments; flagellar segments (Fig. 1a) with lengths in proportion of 34-24-26-28-29-28-27-28-40-44-46-46-66; antennal ratio 1.07 (1.00–1.10, $n = 7$); sensillar coeloconica present on segments 3, (5), 7, 9, 11–15. Palpus (Fig. 1b) brown; lengths of segments in proportion of 14-36-54-23-22; 3rd segment swollen subapically, sensory pit broad and shallow; palpal ratio 2.46

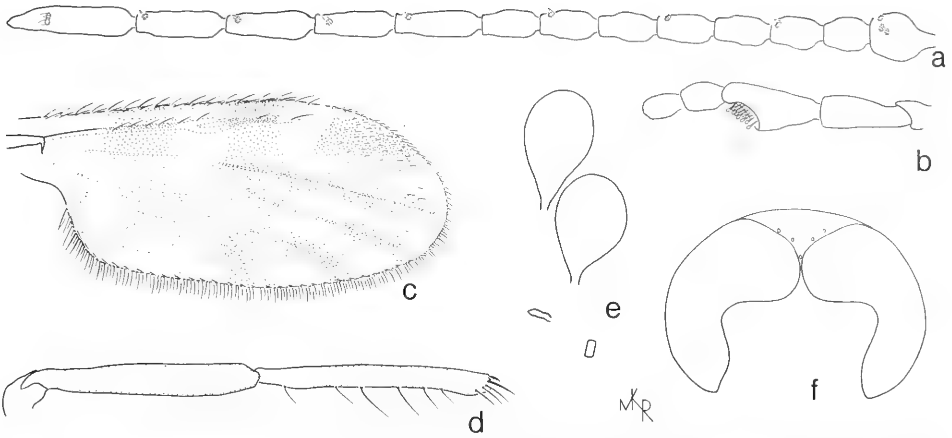

Fig. 1. *Culicoides mathisi,* female. a, Antenna. b, Palpus. c, Wing. d, Hindfemur and hindtibia. e, Spermathecae. f, Eye separation.

(2.45–2.60, *n* = 7). Proboscis brown, moderately long, P/H ratio 0.76 (0.76–0.81, *n* = 7); mandible with 15 (14–16, *n* = 7) well-developed teeth, the proximal and distal teeth in the series slightly larger.

Thorax: Dark brown, pleura paler. Legs (Fig. 1d) brown; femora slightly paler at bases; forefemur with faint subapical pale band, midfemur paler at apex, hindfemur the darkest and concolorous to apex; tibiae with subbasal pale bands; fore- and midtibiae but slightly paler at apices, hindtibia with apical pale band; hindtibial comb with 4 spines (*n* = 6), the second from the spur longest.

Wing (Fig. 1c): Brown with moderately prominent pale spots; pale spot over r-m crossvein extending from about midway in cell M2, expanding laterally in cell Sc and R5 to cover proximal ½ of the 1st radial cell, then narrowing to meet the costa broadly; Rs strong and dark; poststigmatic pale spot in cell R5 quadrate, covering apical ¾ of 2nd radial cell and extending posterad to about ½ the width of cell R5; cell R5 with a faint pale streak emerging from the poststigmatic spot, extending distally and expanding at the wing tip to form a marginal spot; vein M2 straddled in midportion by a pale spot that divides, extends faintly as narrow streaks to apices of cells M1 and M2, expanding apically to form marginal pale spots at wing tip; the 3 apical spots meeting narrowly at the vein apices to form a contiguous pale wing tip; cell M2 with a large pale spot immediately anterad of the mediocubital fork; cell M4 with a large semicircular pale spot at wing margin; anal cell with a large distal spot extending from mediocubital stem to wing margin; base of wing with a large pale area extending about ½ the distance from the arculus to the r-m crossvein and diagonally posterad to about ½ the width of the anal cell. Macrotrichia very sparse on apical ⅖ of wing; costal ratio 0.61 (0.60–0.63, *n* = 7). Halter pale.

Abdomen: Pale brown with 8th and 9th segments darker, cerci pale. Spermathecae (Fig. 1e) 2, slightly unequal, measuring 0.058 by 0.032 mm and 0.051 by 0.033 mm, oval with moderately tapering necks; rudimentary spermatheca and sclerotized ring present.

Male.—Unknown.

Distribution.—Sri Lanka.

Types.—All on slides in phenol-balsam. Holotype ♀, Sri Lanka, Jaffna District, Chundikkulam Sanctuary, 25 ft., UV light, 7 Nov. 1976, coll. G. F. Hevel, R. E. Deitz IV, S. Karunaratne, and D. W. Balasooriya (Type no. 76103, USNM). Paratypes 6 ♀, same data as holotype. Holotype and 4 paratypes deposited in the National Museum of Natural History, Washington, D.C. (USNM); one paratype will be deposited in the Colombo National Museum, Colombo, Sri Lanka, and another deposited in the National Museum at the University of Sri Lanka at Peradeniya.

Discussion.—This species is named for Dr. Wayne N. Mathis of the Smithsonian Institution in recognition of the many courtesies shown to the senior author while on sabbatical leave at the National Museum of Natural History.

The short second radial cell with pale spot covering its apex, pale spot straddling vein M2, contiguous eyes, antennal sensory pattern 3, (5), 7, 9, 11–15, broad third palpal segment with large round shallow pit, and two functional spermathecae with long slender necks place *C. mathisi* in the subgenus *Culicoides,* but its wing pattern is quite unlike other species in this taxon in the following respects: In other species of *Culicoides* s. str. the distal pale spot in cell R5 is usually distinct, transverse, and located well proximad of the apex of the wing, whereas in *mathisi* there is only a rather poorly marked pale area at the tip of the cell; in other species with distal pale spots in cells M1, M2, and M4 are usually rounded and more or less removed from the wing margin whereas in *mathisi* these spots have their broadest portion at the extreme wing margin, more like the condition found in the subgenus *Avaritia.* This species appears to belong in a distinct group of its own in *Culicoides* s. str.

Culicoides roswelli **Giles and Wirth, New Species**

Fig. 2

Female holotype.—Wing length 0.93 (0.80–0.97, $n = 10$) mm.

Head: Dark brown; eyes bare, almost contiguous, interocular space (Fig. 2f) narrowly wedge-shaped. Antenna (Fig. 2a) pale brown, verticils well developed on segments 3–10; flagellar segments with lengths in proportion of 36-20-24-23-24-22-23-27-41-45-46-46-70; antennal ratio 1.25 (1.15–1.29, $n = 7$); sensilla coeloconica present on segments 3–10, usually 2–3 per segment. Palpus (Fig. 2b) pale brown; lengths of segments (of paratype) in proportion of 5-15-27-8-11; 3rd segment markedly swollen from base, sensory pit broad, shallow, located on distal ½; palpal ratio 2.0 (1.59–2.0, $n = 10$). Proboscis brown, short, P/H ratio 0.61 (0.59–0.65, $n = 10$); mandible with 7 (7–9, $n = 10$) well developed teeth increasing in size distally.

Thorax: Dark brown with paler areas on mesonotum; pleuron yellowish brown, darkening posterad. Legs (Fig. 2d) moderately dark brown; femora with broad pale basal bands; fore- and midfemora with broad pale subapical bands; fore- and midfemora with broad pale subapical bands; hindfemur dark to tip; all knee spots blackish; tibiae with broad subbasal pale bands, distal ½ pale; hindtibia slightly darkened at comb, comb with 4 ($n = 10$) spines, the one nearest the spur longest.

Wing (Fig. 2c): Light brown with prominent pale spots; pale spot on r-m crossvein barely covering crossvein proximally, extending from vein M1 anterad and covering ⅚ of 1st radial cell to broadly meet costa, a thin finger of this spot extending distally toward 2nd radial cell and below this a dark projection of vein

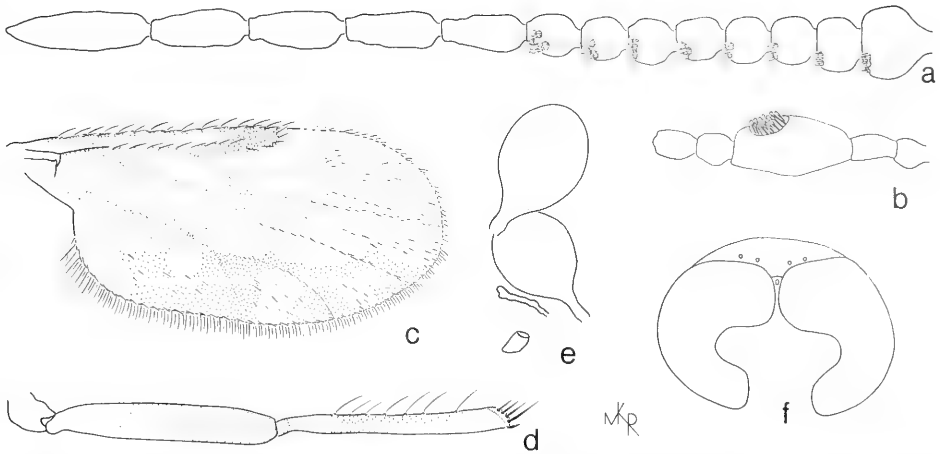

Fig. 2. *Culicoides roswelli,* female. a, Antenna. b, Palpus. c, Wing. d, Hindfemur and hindtibia. e, Spermathecae. f, Eye separation.

Rs extending basally into the spot; a very dark stigma extending to tip of 2nd radial cell; poststigmatic pale spot in cell R5 quadrate and extending faintly posterad to merge with pale spot over the r-m crossvein; cell R5 with a large more or less semicircular distal spot meeting wing margin, emarginate proximad and not reaching vein M1 caudad; a pale spot straddling vein M1 posterad of the poststigmatic spot to merge with a pale streak in cell M1, and merging posterad with pale spot straddling midportion of vein M2; cells M1 and M2 each with rounded distal pale spot attaining wing margin; cell M2 with a pale spot behind medial fork and a large pale spot lying in front of mediocubital fork; midway in cell M4 a large pale spot extending from vein M3 + 4 to wing margin; base of wing with pale area extending posterad from costa, covering the arculus and extending distally along anterior side of mediocubital stem; anal cell with a large pale area covering anal lobe and small round pale spot in distal portion. Macrotrichia abundant along veins and on membrane on distal ½ of wing; costal ratio 0.56 (0.54–0.58, $n = 10$). Halter pale.

Abdomen: Brown, 10th segment and cerci pale. Spermathecae (Fig. 2e) 2, oval with long slender necks; slightly unequal, measuring 0.067 by 0.039 mm and 0.062 by 0.035 mm; rudimentary spermatheca and sclerotized ring present.

Male.—Unknown.

Distribution.—Sri Lanka.

Types.—All on slides in phenol balsam. Holotype ♀, Sri Lanka, Anuradhapura District, Hunuwilagana near Wilpattu, 200 ft., UV light, 28 Oct–3 Nov 1976, coll. G. F. Hevel, R. E. Deitz IV, S. Karunaratne, and D. W. Balasooriya (Type no. 76118, USNM). Paratypes, 31 ♀, same data as holotype. Holotype and 29 paratypes deposited in USNM; 1 paratype will be deposited in the Colombo National Museum, Colombo, Sri Lanka and another deposited in the National Museum at the University of Sri Lanka at Peradeniya. Paratype ♀, Sri Lanka, Kegalle District, Kitulagala Resthouse, 3–5 Feb. 1979, UV trap, coll. K. V. Krombein, P. B. Karunaratne, T. Wijesinhe, S. Siriwardane, and T. Gunawardane (deposited in USNM).

Discussion.—This species is named for Dean David F. Roswell, Loyola College, Baltimore, Maryland, to acknowledge the aid and encouragement given the senior author during his sabbatical leave.

Culicoides roswelli belongs in the *similis* group of the composite subgenus *Oecacta,* where it comes closest to an undescribed species from Laos and Malaysia. The location of the pale spot lying on the distal side of the r-m crossvein, the distal pale spot lying at the extreme apex of cell R5, the absence of sensilla coeloconica on antennal segments 11–15, the stout third palpal segment with broad shallow sensory pit, and the two functional spermathecae with long slender necks are characteristic of the *similis* group. In that group *C. similis* Carter, Ingram, and Macfie has the pale spot straddling vein M2, but the new species is unique in also having a pale spot straddling vein M1 in a slightly more proximal level. In the undescribed species from Laos and Malaysia this latter spot is represented by a pale spot lying just above vein M1 in this location.

LITERATURE CITED

Giles, F. E., W. W. Wirth, and D. H. Messersmith. 1981. Two new species of biting midges and a check list of the genus *Culicoides* (Diptera: Ceratopogonidae) from Sri Lanka. Proc. Entomol. Soc. Wash. 83: 537–543.

PROC. ENTOMOL. SOC. WASH.
85(1), 1983, pp. 41–54

NEW NEOTROPICAL SPECIES OF *OXYETHIRA* (TRICHOPTERA: HYDROPTILIDAE)[1]

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Abstract.—Seventeen new species of *Oxyethira* from the Neotropical Region are described and illustrated. Included are four species from the Santiagensis Group (*O. **dactylonedys*** from Paraguay; *O. **scaeodactyla*** from Ecuador; *O. **arctodactyla*** from Venezuela; *O. **costaricensis*** from Costa Rica), four species from the Macrosterna Group (*O. **colombiensis*** from Colombia and Ecuador; *O. **paritentacula*** from Belize; *O. **merga*** from Venezuela; *O. **bicornuta*** from Brazil), four species from the Pallida Group (*O. **discaelata*** from Venezuela and Brazil; *O. **spissa*** and *O. **brasiliensis*** from Brazil; *O. **circaverna*** from Panama and Ecuador), three species from the Aeola Group (*O. **vipera*** from Chile; *O. **andina*** from Argentina and Chile; *O. **maryae*** from Colombia), one species from the Azteca Group (*O. **parazteca*** from Ecuador), and one species of uncertain affinities (*O. **quinquaginta*** from Ecuador).

The genus *Oxyethira* was previously known in the Neotropical Region from a total of 16 endemic species. A large proportion of these were described from faunal studies of Caribbean Isles, including Cuba (Botosaneanu, 1979), Jamaica (Flint, 1968a), Dominica (Flint, 1968b), and Puerto Rico (Flint, 1964). Similar faunal investigations have been done for Mexico (Mosely, 1939), Surinam (Flint, 1974), Brazil (Mosely, 1937), and Argentina (Flint, 1980). A total of 17 new species from throughout the Neotropical Region are described here, arranged according to species groups adapted from the study by Marshall (1979).

These specimens are from a number of different collecting expeditions and have accumulated at the National Museum of Natural History, Washington, D.C. (USNM). Type-specimens are deposited in that institution. Species are described primarily on the basis of male genitalia. Morphological terms used here are adapted from the work by Nielsen (1957); the major structures are indicated in Figs. 1A, 2A. Although females have been associated for most of these species they will be described in a subsequent paper.

SANTIAGENSIS GROUP

This Neotropical group of *Oxyethira* was previously known only from one species, *O. santiagensis* Flint. Males of this group bear elongate, finger-like clasp-

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ers. The group seems to be a sister lineage of the Macrosterna Group with which it shares in having the ninth segment elongate anteroventrally and the number of antennal segments reduced to 27–31. Four new species are described here.

Oxyethira dactylonedys **Kelley, New Species**

Fig. 1

Diagnosis.—The separation of the claspers by a deep mesal excision places this species closest to *O. santiagensis.* It differs from that species in bearing distinct rodlike processes on segment IX, in having the subgenital plate excised distally, and in the pointed sclerotized process of the aedeagus.

Description.—Male. Length 2.8 mm. Brown color in alcohol. Antenna 28-segmented. Segment VII with ventral apico-mesal process. Segment VIII deeply excised ventrally. Segment IX attenuate dorsolaterally, produced into rodlike process; dorsum lacking; extending anteroventrally to anterior end of segment VII; claspers elongate, finger-like, slightly divergent distally; dorsad of claspers segment IX produced mesally, ending in 2 pointed, divergent, mesal lobes enclosed by 2 blunt lateral lobes. Subgenital plate with distal arms fused; bilobed process present ventrally. Aedeagus membranous distally; distal, sinuate, sclerotized process present dorsally.

Type-material.—Holotype ♂: PARAGUAY, Amambay Dept., Rio Aquidaban, Cerro Cora. 29 Nov 1973. O. S. Flint, Jr. Paratype: same data as holotype, 1 ♂.

Etymology.—Greek: "finger-belly," referring to the long claspers, reminiscent of fingers.

Oxyethira scaeodactyla **Kelley, New Species**

Fig. 2

Diagnosis.—Unlike *O. santiagensis* and *O. dactylonedys* the claspers in this species are proximally contiguous. It also differs in the anteroventral portion of segment IX which extends only midway into segment VII, in the deeply excised dorsum of segment VIII, and the unfused distal arms of the subgenital plate.

Description.—Male. Length 3.0 mm. Brown color in alcohol. Antenna 28-segmented. Segment VII with ventral apico-mesal process. Segment VIII deeply excised ventrally and dorsally. Segment IX extending anteroventrally halfway into segment VII; dorsum lacking; dorsolaterally terminated in paired acute points; claspers finger-like, narrow, contiguous at base; dorsad of claspers segment extending posteriorly, excised mesally, with short membranous processes at lateral corners. Subgenital plate with distal arms blunt, unfused; bilobed process present below subgenital plate. Aedeagus short, with sclerotized band ventrally tapering to distally curved sclerotized process.

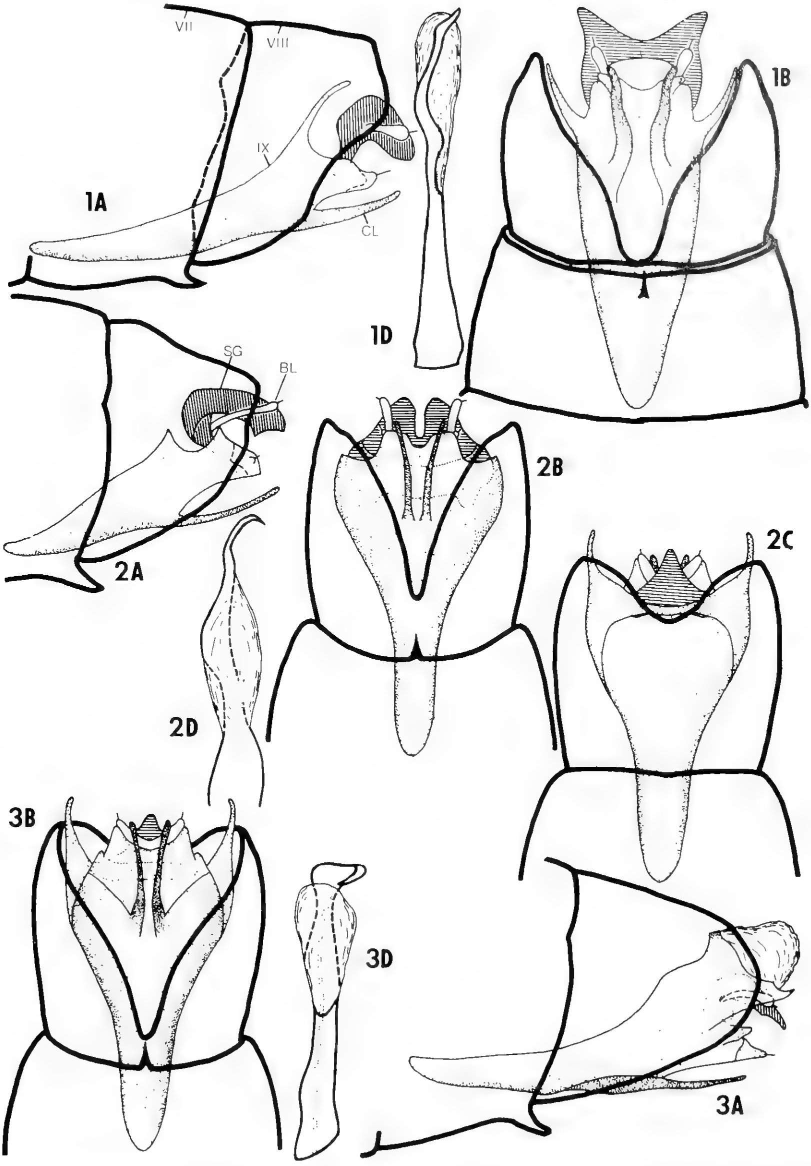
Type-material.—Holotype ♂: ECUADOR, Pastaza Prov., Puyo. 16 May 1977. P. J. Spangler & D. R. Givens. Paratype: same data as holotype, 1 ♂.

Etymology.—Greek: "western-fingered," suggests the species belongs in the Santiagensis Group, with finger-like claspers, in the western part of the continent.

Oxyethira arctodactyla **Kelley, New Species**

Fig. 3

Diagnosis.—This species is closely related to *O. scaeodactyla.* Both the aedeagus and the claspers closely resemble those of that species. Differences can be seen in segment IX which is complete dorsally and bears pointed dorsolateral processes.



Figs. 1–3. Male genital segments. 1, *Oxyethira dactylonedys.* 2, *O. scaeodactyla.* 3, O. *arctodactyla.* A, Lateral view. B, Ventral view. C, dorsal view. D, Aedeagus, dorsal view. BL = bilobed process, CL = clasper, SG = subgenital plate.

Description.—Male. Length 4.0 mm. Brown color in alcohol. Antenna 28-segmented. Segment VII with ventral apico-mesal process. Segment VIII deeply excised ventrally, shallowly excised dorsally. Segment IX with dorsum a narrow band, extending anteroventrally to anterior end segment VII; claspers finger-like, narrow, proximally contiguous; dorsad of claspers meson of segment moderately excised posteriorly. Subgenital plate roughly triangular in shape, with bilobed process present ventrally. Aedeagus short with sclerotized venter tapering to a point, sharply recurved distally.

Type-material.—Holotype ♂: VENEZUELA, Mérida State, Mucujun Valley, 19 km NE Merida. 21 Feb 1976. C. M. & O. S. Flint, Jr. Paratypes: same data as holotype, 3 ♂.

Etymology.—Greek: "northern-fingered," which relates its position as a member of the Santiagensis Group from the northern part of the continent.

***Oxyethira costaricensis* Kelley, New Species**

Fig. 4

Diagnosis.—The lateral processes on segment IX are similar to those of *O. arctodactyla.* However, these processes are distinctly downturned in this species whereas they are horizontal in *O. arctodactyla.* In addition the dorsum of segment IX is absent, unlike *O. arctodactyla.*

Description.—Male. Length 2.9 mm. Brown color in alcohol. Number of antennal segments unknown. Venter VII with apico-mesal process. Segment VIII deeply excised ventrally, shallowly excised dorsally; blunt dorsolateral points present. Segment IX with venter truncate anteriorly, produced to anterior end segment VII; dorsum lacking; laterally produced into attenuate downturned processes; meson of venter moderately excised distally; claspers elongate, finger-like, not basally contiguous. Subgenital plate with distal arms fused; bilobed process present. Aedeagus membranous distally, with sclerotized venter extended into tapering point.

Type-material.—Holotype ♂: COSTA RICA, Heredia Prov., Los Cartagos, in stream. 24 Jun 1967. Spangler.

Etymology.—Latin: "of Costa Rica."

MACROSTERNA GROUP

Three species were previously known from this Neotropical group; *O. jamaicensis* Flint, *O. longissima* Flint, and *O. macrosterna* Flint. Along with the new species described below they share in having the ninth segment elongate anteroventrally at least into segment VI and in bearing paired distal processes bordering the distal membranous region of the aedeagus.

***Oxyethira colombiensis* Kelley, New Species**

Fig. 5

Diagnosis.—The greatly elongate processes of the aedeagus indicate this species to be most closely related to *O. longissima.* However, these paired lateral processes appear hooklike distally and do not recurve back to their bases as in *O. longissima.*

Description.—Male. Length 2.3 mm. Brown color in alcohol. Antenna 26-segmented. Apico-mesal process present on venter VII. Segment VIII excised half its length ventrally, excised to anterior margin dorsally. Segment IX elongate anteroventrally into segment V; dorsum lacking; dorsolateral margins acutely pointed; slightly excised posteroventrally with blunt claspers. Subgenital plate with arms fused distally such that distal margin appears 3-lobed in ventral view; 2 bilobed processes present. Aedeagus greatly elongate, its proximal end at posterior margin of segment II; a pair of long lateral rods present distally, hooklike at ends, membranous distomesal region stomach shaped in lateral view.

Type-material.—Holotype ♂: COLOMBIA, Valle Dept., Rio Raposo. Apr 1964. V. H. Lee. Paratypes: ECUADOR, Los Rios Province, Quevedo (56 km N). 28–

29 Jul 1976. 7 ♂. Jeffrey Cohen. COLOMBIA, Valle Dept., Rio Raposo. Aug 1965. 1 ♂. V. H. Lee.

Etymology.—Latin: "of Colombia."

Oxyethira paritentacula Kelley, New Species

Fig. 6

Diagnosis.—This is one of several species in the Macrosterna Group in which paired dorsolateral processes are present on segment VIII. In this species these processes are stout and widely separated basally.

Description.—Male. Length 2.6 mm. Brown color in alcohol. Antenna 29-segmented. Ventral apico-mesal process of segment VII truncate. Segment VIII excised to proximal end both dorsally and ventrally; paired dorsolateral processes, attenuated distally and widely separated basally. Segment IX elongate anteroventrally into segment VI; dorsolaterally tapered into paired recurved rods; claspers blunt with deep excision between them. Subgenital plate with distal arms fused, distomesally knoblike. Aedeagus with long, tapering, lateral rods; in lateral view rods recurve dorsally.

Type-material.—Holotype ♂: BELIZE, Cayo Dist., Rio Privassion, Blancaneaux Lodge. 9–11 Jul 1973. Y. Sedman.

Etymology.—Latin: "equal feelers," referring to the paired distolateral rods of the aedeagus, which look like tentacles.

Oxyethira merga Kelley, New Species

Fig. 7

Diagnosis.—In most characters this species is similar to *O. paritentacula.* It differs in the forked dorsolateral processes of segment VIII, the forked lateral processes of the aedeagus, and the distolateral spines on segment VIII.

Description.—Male. Length 2.2 mm. Antenna 27-segmented. Ventral apico-mesal process of segment VII truncate. Segment VIII deeply excised ventrally; 3 spines present distolaterally; dorsally the segment appears generally trilobed, the central lobe being divided distally into narrow mesal processes curving laterally and 2 processes laterad of these curving mesally. Segment IX elongate anteroventrally into segment V; attenuated processes dorsolaterally; claspers bluntly triangular. Subgenital plate with distal arms fused and paired distal cusps submesally; bilobed process present. Aedeagus long, with a pair of bifurcate distolateral rods.

Type-material.—Holotype ♂: VENEZUELA, Bolivar State, Rio Cuyuni, El Dorado. 10 Feb 1976. C. M. & O. S. Flint, Jr.

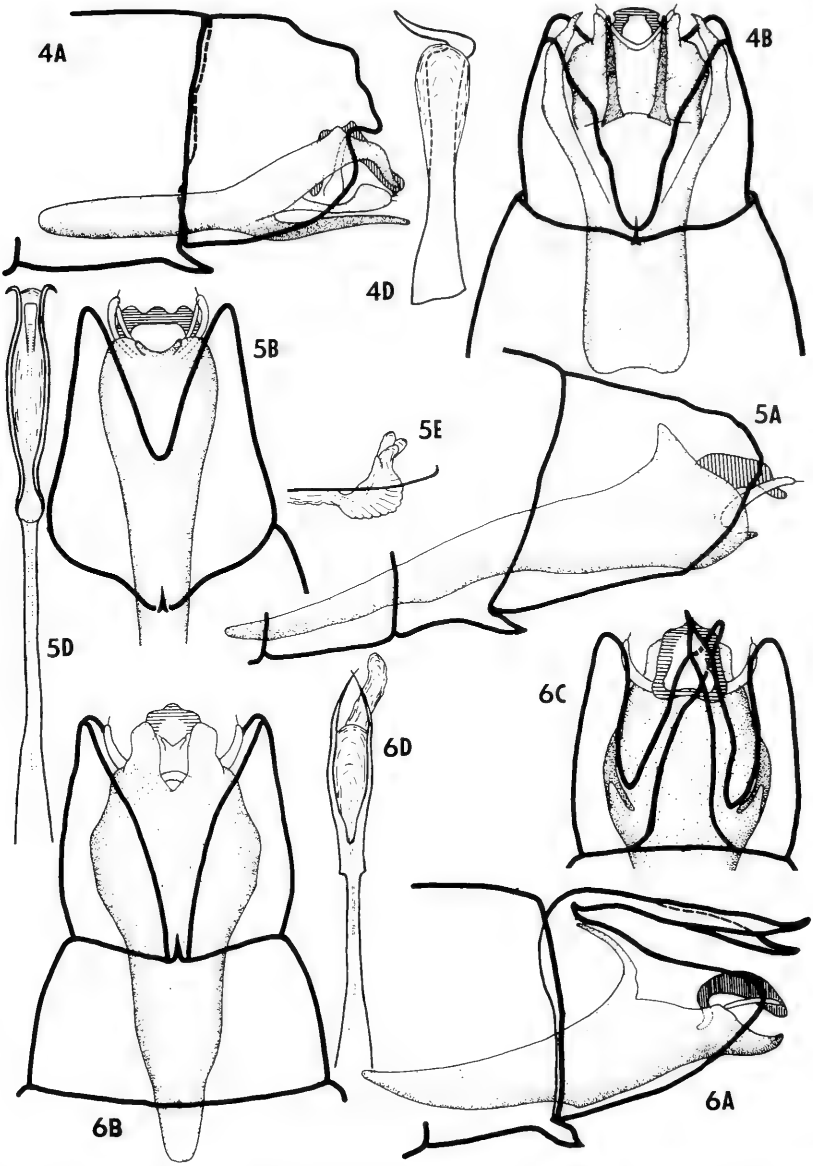
Etymology.—Latin: "pitchfork," referring to the paired, bifurcate rods of the aedeagus.

Oxyethira bicornuta Kelley, New Species

Fig. 8

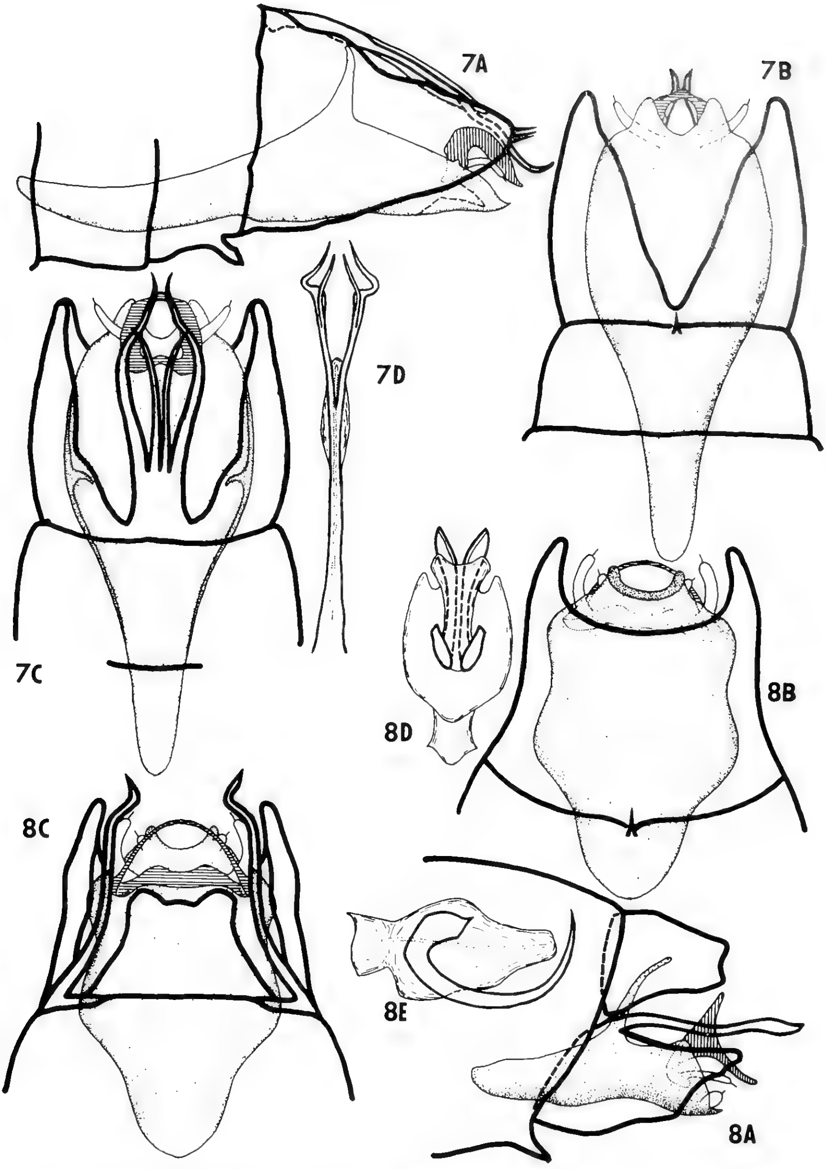
Diagnosis.—An aberrant member of the Macrosterna Group, this species bears a short, stout aedeagus of peculiar structure. The dorsolateral processes of segment VIII, although similar to those of *O. merga* and *O. paritentacula,* are separated by a wide tergum.

Description.—Male. Length 2.3 mm. Brown color in alcohol. Antenna 27-



Figs. 4–6. Male genital segments. 4, *Oxyethira costaricensis.* 5, *O. colombiensis.* 6, *O. paritentacula.* A, Lateral view. B, Ventral view. C, Dorsal view. D, Aedeagus, dorsal view. E, Aedeagus, lateral view.

segmented. Segment VII with ventral apico-mesal process. Segment VIII with sternum only slightly excised ventrally; anterolaterally sternum extended into long narrow processes, slightly widened distally; tergum touching sternum anterolaterally. Segment IX extending into segment VII anteroventrally; laterally tapered into narrow process curving posterodorsally; claspers blunt, short. Subgenital plate with dorsal arms fused and narrowed; 2 bilobed processes. Aedeagus short, bul-



Figs. 7, 8. Male genital segments. 7, *Oxyethira merga.* 8, *O. bicornuta.* A, Lateral view. B, Ventral view. C, Dorsal view. D, Aedeagus, dorsal view. E, Aedeagus, lateral view.

bous; central membranous tube visible dorsally, forked distally; sclerotized lateral processes, strongly curved dorsally.

Type-material.—Holotype ♂: BRAZIL, Amazonas State, Igarape do Mendu, nr. Manaus. 28 Jan 1979. O. S. Flint Jr. Paratypes: BRAZIL, Flores, nr. Manaus. 31 Jan 1979. 1 ♂; Res. Ducke, 26 km E Manaus. 1–5 Feb 1979. 2 ♂. O. S. Flint, Jr.

Etymology.—Latin: "two-horned," because of the sclerotized processes of the aedeagus which are shaped like horns as seen in lateral view.

PALLIDA GROUP

This group is both Nearctic and Neotropical. It is closely related to the Ulmeri Group with which it shares a distinct wing character: fused R_4 and R_5. There are two subgroups. One of these, including *O. pallida* (Banks), *O. maya* Denning, and *O. alaluz* Botosaneanu, is characterized by lateral processes on segment IX. Species of the other, including *O. verna* Ross, *O. arizona* Ross, and *O. tega* Flint, lack lateral processes on segment IX and bear a sclerotized bridge between the distal arms of the subgenital plate. New species are now added to both subgroups.

Oxyethira discaelata **Kelley, NEW SPECIES**

Fig. 9

Diagnosis.—The sclerotized bridge between the distal arms of the subgenital plate and the lateral processes of segment VIII indicate this species to be closely related to *O. arizona.* It can be separated on the basis of the lateral contour of segment VIII, the dorsolateral process of the subgenital plate, and the shape of the distal end of the aedeagus.

Description.—Male. Length 1.8 mm. Brown color in alcohol. Number of antennal segments unknown. Venter of segment VII with apico-mesal process. Segment VIII short, deeply excised ventrally and dorsally; 2 acute points laterally, separated by an excision. Segment IX extending anteroventrally into segment VI; truncate dorsolaterally; dorsum not sclerotized; claspers triangular shaped and diverging. Subgenital plate with sclerotized bridge between distal arms; dorsolateral processes curving mesally; bilobed process present. Aedeagus with bulbous region proximally, tapered distally to sinuous sclerotized process; sclerotized band parallel to sinuous process attached to aedeagus only by membrane.

Type-material.—Holotype ♂. VENEZUELA, Bolivar State, Morichal Tauca, 22 km E Rio Caura. 8–9 Feb 1976. C. M. & O. S. Flint, Jr. Paratype: BRAZIL, Amazonas State, Rio Cuieiras bei der Mündung do Rio Branquiutos, 20 Dec 1961. 1 ♂. Fittkau.

Etymology.—Latin: "poorly covered," for the lack of a sclerotized dorsum on segment IX.

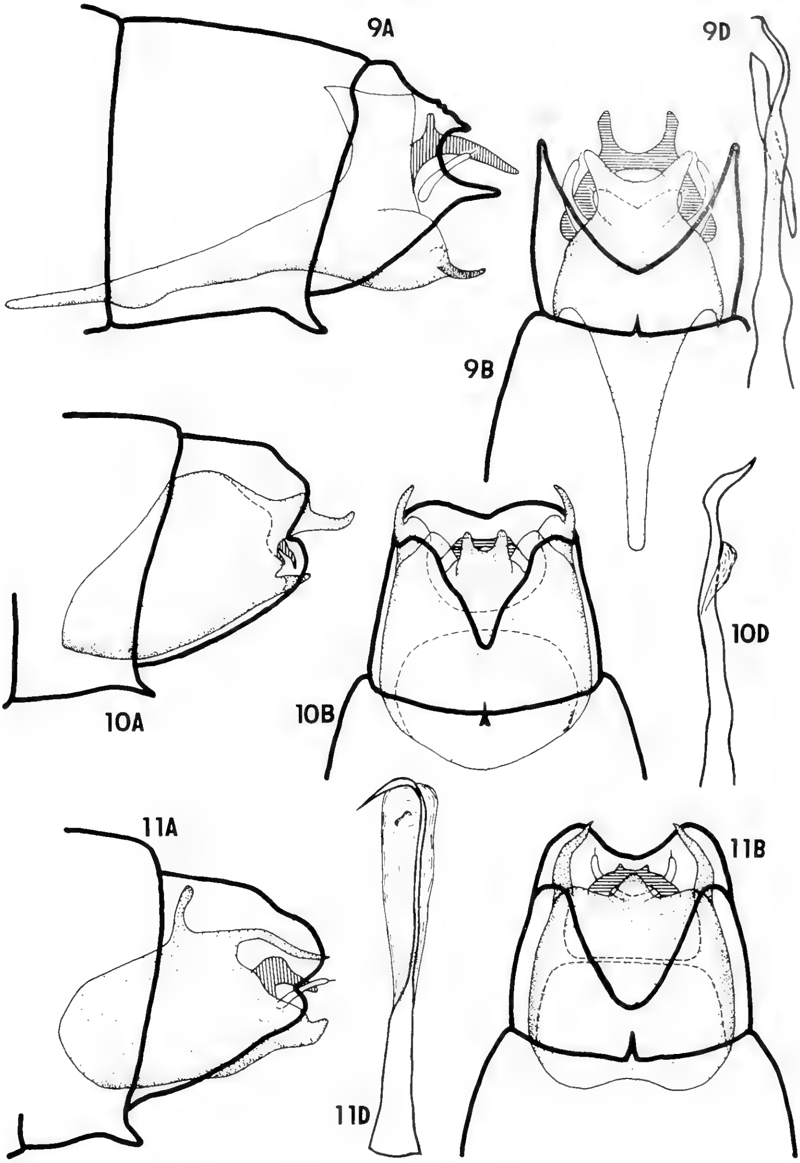
Oxyethira spissa **Kelly, NEW SPECIES**

Fig. 10

Diagnosis.—This species is related to the Pallida Subgroup. It differs primarily in the shape of the posterolateral process of segment IX, which is attenuate, and the truncated anterior margin of venter IX.

Description.—Male. Length 2.3 mm. Brown color in alcohol. Number of antennal segments unknown. Segment VII with apico-mesal process. Segment VIII deeply excised ventrally; 2 blunt lobes laterally. Segment IX extending anteroventrally into segment VII; dorsum reduced to narrow band; posterolateral processes prominent, with rounded knob basally and slightly upturned distally; claspers short. Subgenital plate small, downturned distally, with distal arms fused; bilobed processes present. Aedeagus simple, tapered and curved distally.

Type-material.—Holotype ♂: BRAZIL, Pará State, Rio Cururu, area of Missao Cururu. 3–5 Feb 1961. Fittkau. Paratype: BRAZIL, Amazonas State, Rio Preto, Tiririca. 7 Jul 1962. 1 ♂. Fittkau.



Figs. 9–11. Male genital segments. 9, *Oxyethira discaelata*. 10, *O. spissa*. 11, *O. brasiliensis*. A, Lateral view. B, Ventral view. D, Aedeagus, dorsal view.

Etymology.—Latin: "slow," "late" or "tardy," because in preparing this paper, this species was one of the last to be found.

Oxyethira brasiliensis Kelley, New Species

Fig. 11

Diagnosis.—The two blunt lateral lobes of segment VIII, the fused distal arms of the subgenital plate, and the truncate anteroventral margin of segment IX are all similar to *O. spissa.* However, the claspers are distinctly fused into a mesal triangular lobe.

Description.—Male. Length 2.3 mm. Brown color in alcohol. Antenna 39-segmented. Segment VII with blunt apico-mesal process. Segment VIII complete, deeply excised ventrally; 2 blunt lobes laterally. Segment IX extending antero-ventrally into segment VII; dorsum reduced to narrow band; lateral process curved ventrally; claspers fused into mesal triangular lobe. Subgenital plate with distal arms fused; bilobed process present. Aedeagus with sinuous process distally.

Type-material.—Holotype ♂: BRAZIL, Pará State, Rio Cururu, area of Missao Cururu. 3–5 Feb 1961. Fittkau. Paratype: same data as holotype, 1 ♂.

Etymology.—Latin: "of Brasil."

Oxyethira circaverna Kelley, New Species

Fig. 12

Diagnosis.—Although this species lacks the sclerotized bridge between the distal arms of the subgenital plate, it resembles *O. verna* Ross and *O. arizona* Ross in the dorsolateral processes of segment VIII and the anterolateral elongation of the same segment into segment VII.

Description.—Male. Length 2.6 mm. Brown color in alcohol. Number of antennal segments unknown. Segment VII with ventral apico-mesal process. Tergum VIII with ventrolateral, upturned, hooklike processes, bifurcate distally; sternum with dorsolateral spatulate processes; ventrolateral edges of segment produced anteriorly into segment VII. Segment IX extended into segment VI anteroventrally; dorsum a narrow band; claspers short, parallel, narrowly separated. Subgenital plate with distal arms unfused, diverging. Aedeagus produced into 2 long distal processes, partly entwined.

Type material.—Holotype ♂: PANAMA, Canal Zone, Madden Dam. 10–13 Jul 1967. O. S. Flint, Jr. Paratype: ECUADOR, Napo Prov., Puerto Montufar. 29 Apr 1976 1 ♂. J. Cohen.

Etymology.—Latin: "near verna," named for its similarity to *O. verna.*

AEOLA GROUP

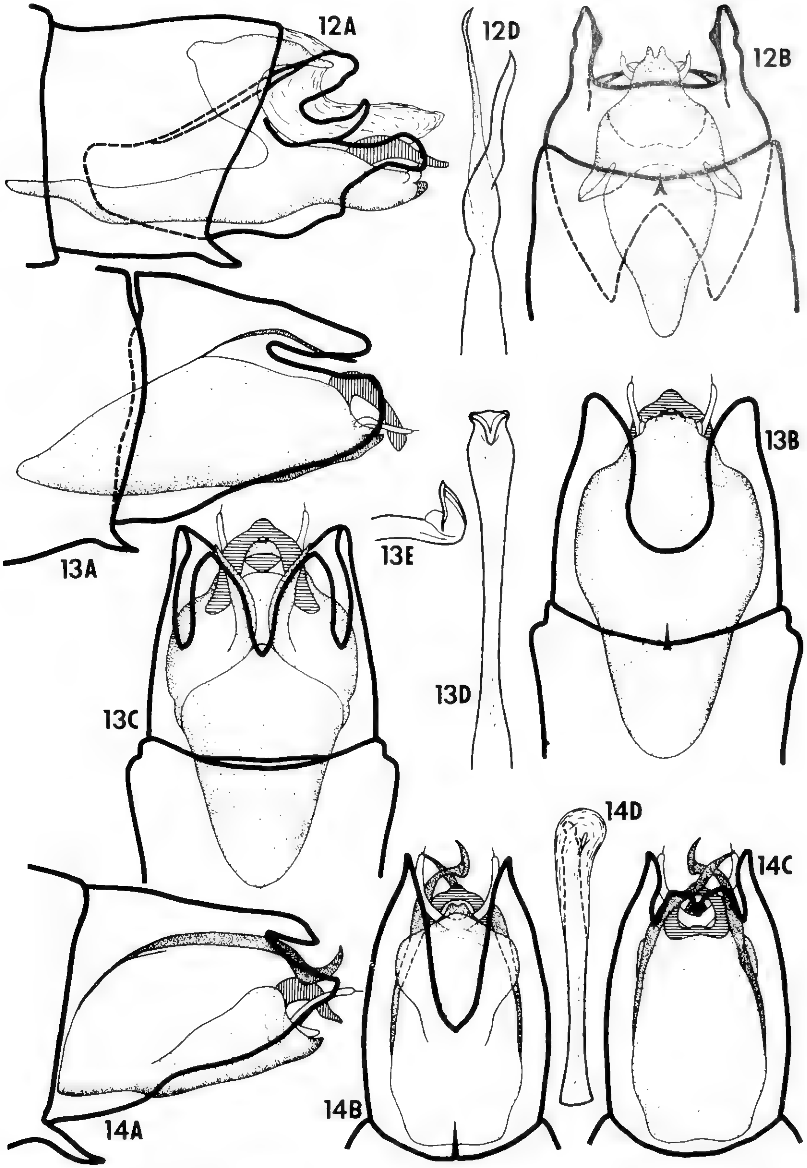
Although most species of this group are Nearctic, one previously known species, *O. bidentata* (Mosely), shares the characteristic dorsolateral rodlike processes of the group. Two new species, closely related to *O. bidentata,* are now described. All three of these species are found in the southern Andes. Closely related to this group is another group of species including *O. dualis* Morton, *O. obscura* Flint, and *O. sininsigne* Kelley. A new species of this group is described here as well.

Oxyethira vipera Kelley, New Species

Fig. 13

Diagnosis.—In both the presence of dorsolateral rodlike processes of segment IX and the bilobed distolateral margin of segment VIII, this species is similar to *O. bidentata.* However, the dorsolateral rods are flattened. Furthermore, venter IX is pointed anteroventrally rather than excised between the bases of the rods.

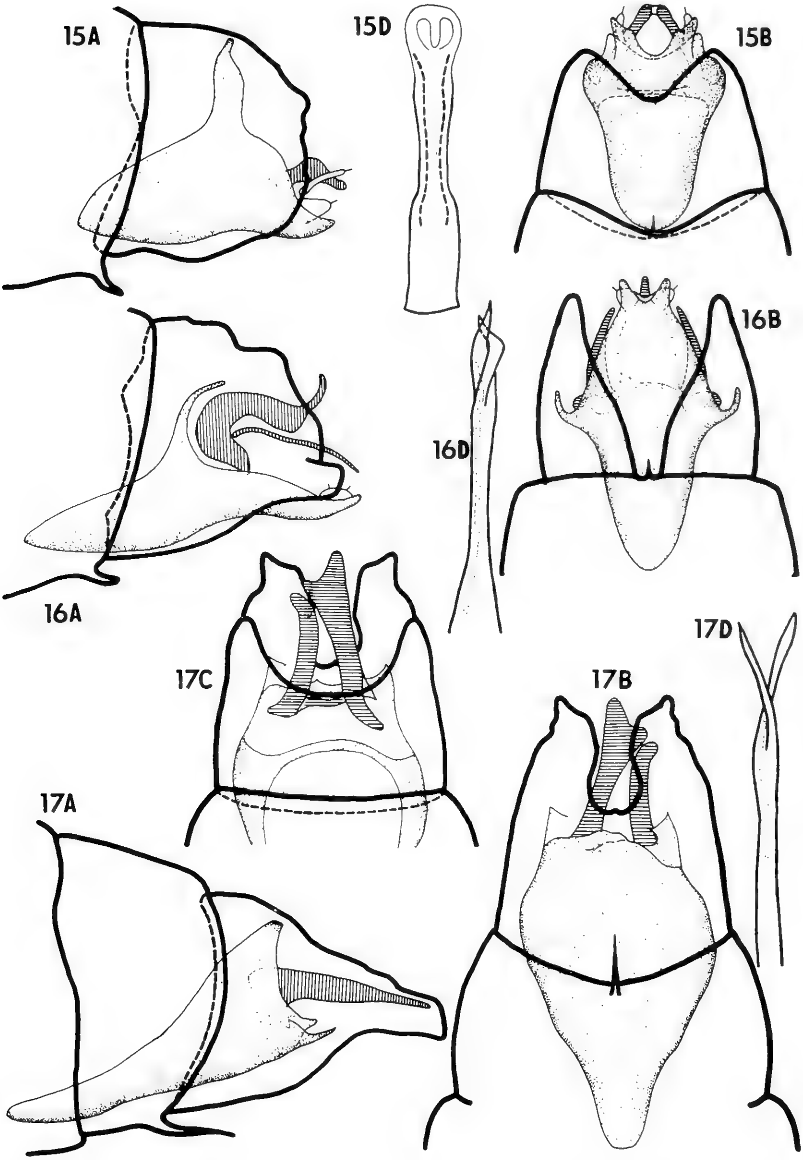
Description.—Male. Length 3.3 mm. Brown color in alcohol. Antenna 34-segmented. Venter VII with apico-mesal process. Segment VIII bilobed laterally; deeply excised ventrally. Segment IX protruded anteriorly into segment VII; dor-



Figs. 12–14. Male genital segments. 12, *Oxyethira circaverna.* 13, *O. vipera.* 14, *O. andina.* A, Lateral view. B, Ventral view. C, Dorsal view. D, Aedeagus, dorsal view. E, Aedeagus, lateral view.

solateral margins extended into a pair of flattened processes subtending the mesal margins of dorsolateral processes of segment VIII; claspers fused medially with distal margin blackened. Subgenital plate with distal arms mesally fused into nipple-shaped point; bilobed process long. Aedeagus widened and upturned distally.

Type-material.—Holotype ♂: CHILE, Valdavia Prov. S of Valdavia. 23 Oct 1969. Flint and Barria.



Figs. 15–17. Male genital segments. 15, *Oxyethira maryae.* 16, *O. parazteca.* 17, *O. quinquaginta.* A, Lateral view. B, Ventral view. C, Dorsal view. D, Aedeagus, dorsal view.

Etymology.—Latin: "snake," because the aedeagus is distally shaped like a snake in dorsal view.

Oxyethira andina **Kelley, New Species**

Fig. 14

Diagnosis.—This species bears the dorsolateral rods of segment IX found in *O. bidentata* and *O. vipera* as well as having the claspers fused mesally. It is distinct in that the rods are not bilaterally symmetrical.

Description.—Male. Length 2.7 mm. Brown color in alcohol. Antenna 38-segmented. Apico-mesal process on venter VII elongate. Segment VIII bilobed laterally; deeply excised ventrally. Segment IX truncate anteriorly; laterally produced into broadly rounded lobe; dorsum lacking; anterior dorsolateral margins produced into elongate asymmetrical rods which cross posteriorly; claspers fused mesally. Subgenital plate with distal arms fused forming nipple-shaped process; bilobed process elongate. Aedeagus membranous distally, sclerotized band ventrally.

Type-material.—Holotype ♂: ARGENTINA, Rio Negro Prov., Rio Guillelmo, Villa Mascardi. 6 Feb 1974. O. S. Flint, Jr. Paratypes: Neuquén Prov., Lago Rucachoroi, W. Alumine. 1–2 Mar 1978. 1 ♂. C. M. & O. S. Flint, Jr. CHILE, Llanquihue Prov., Petrohue. 10 Mar. 1959. 4 ♂. J. F. Clarke.

Etymology.—Latin: "Andean."

***Oxyethira maryae* Kelley, New Species**
Fig. 15

Diagnosis.—The shapes of the dorsum of segment IX and the aedeagus, as well as the unfused arms of the subgenital plate are close to those of *O. sininsigne* Kelley. However, the claspers are distinctly shaped and segment VIII is shorter in length than for *O. sininsigne.*

Description.—Male. Length 2.1 mm. Brown color in alcohol. Antenna 27-segmented. Apico-mesal process on venter VII. Segment VIII with posterolateral margin somewhat irregular; venter shallowly excised. Segment IX rounded anteroventrally; dorsum a narrow band; claspers truncate, with distolateral edges produced into points. Subgenital plate with distal arms nearly fused; bilobed process present. Aedeagus short, distally membranous, with sclerotized ventral band.

Type-material.—Holotype ♂: COLOMBIA, Meta Dept., Refugio Macarena. 10 Jan 1966. C. J. Marinkelle.

Etymology.—This species is named for my daughter, Mary.

Azteca Group

Previously known Neotropical species of this group are *O. azteca* (Mosely), *O. janella* Denning, *O. glasa* (Ross), *O. puertoricensis* Flint, *O. quelinda* (Botosaneanu), *O. dalmeria* (Mosely), and *O. zilaba* (Mosely). They are characterized by an elongate subgenital plate, often subtended by a triangular, partially sclerotized, mesal plate. One new species is now added.

***Oxyethira parazteca* Kelley, New Species**
Fig. 16

Diagnosis.—This species seems to be most closely related to *O. azteca* and *O. dalmeria.* It can be readily separated on the basis of the distal upcurved arms of the subgenital plate and the paired, entwined distal lobes of the aedeagus.

Description.—Male. Length 2.5 mm. Brown color in alcohol. Number of antennal segments unknown. Segment VII with ventral apico-mesal process. Segment VIII ventrally cleft to anterior margin; bluntly excised dorsally; truncate lobe ventrolaterally. Segment IX lacking dorsum; dorsolateral processes curved posterodorsally; extending anteroventrally into segment VII; claspers short. Subgenital plate with distal arms unfused and with distal ends curving dorsally; acuminate, partly sclerotized mesal plate present ventrally to subgenital plate. Aedeagus with paired, entwined, tapering distal lobes.

Type-material.—Holotype ♂: ECUADOR, Cotopaxi Prov., Latacunga (133 km W) 1080′. 2 Jul 1975. At blacklight. Langley & Cohen. Paratype: same data as holotype, 1 ♂.

Etymology.—Latin: "like azteca," because of the similarity of this species to *O. azteca.*

INCERTAE SEDIS

Oxyethira quinquaginta **Kelley, NEW SPECIES**

Fig. 17

Diagnosis.—In many respects this species is aberrant. Aberrations include the elongate process of segment VII, the vestigial claspers, the asymmetrical distal arms of the subgenital plate, and the number of antennal segments. Its position within the genus remains unclear.

Description.—Male. Length 3.3 mm. Brown color in alcohol. Antenna 50-segmented. Segment VII with elongate ventral apico-mesal process. Segment VIII with urn-shaped excision ventrally; tapered to truncate process laterally. Segment IX completely withdrawn within abdomen; extending anteroventrally into segment VI; dorsum reduced to narrow band; posteroventral margin irregular with claspers vestigial. Subgenital plate with left distal arm broad distally and right distal arm tapered to point. Aedeagus with long, paired distal processes.

Type-material.—Holotype ♂: ECUADOR, Pastaza Prov., Puyo, riverside at blacklights. 29 May 1975. Cohen & Langley. Paratype: Pastaza Prov., Puyo (27 km N), Estacion Fluviometrica. 4 Feb 1976. 1 ♂. Spangler et al.

Etymology.—Latin: "fifty," the number of antennal segments.

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Oliver Flint, Jr. has been of great help both in the loan of the specimens described in this paper as well as preliminary identification of many of the specimens as new species. The aid of John Morse in reviewing the paper is also appreciated.

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CLASTOPTERA LAENATA, FIRST EASTERN UNITED STATES RECORDS AND FIRST U.S. HOST ASSOCIATION (HOMOPTERA: CERCOPIDAE)

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Abstract.—The Neotropical spittlebug *Clastoptera laenata* Fowler, previously recorded in the United States from Arkansas, Illinois, and Texas, is reported from Pennsylvania and Tennessee. Notes are given on seasonal history of populations on hackberry, *Celtis occidentalis* L., in south central Pennsylvania. A diagnosis of the adult is provided.

Based on a recent collection of the spittlebug *Clastoptera laenata* Fowler in Pennsylvania (by AGW) and subsequent identification (by JPK), we here provide the first eastern United States records; make the first host associations for the species in the U.S. (hackberry, *Celtis occidentalis* and *C. laevigata* Willd.); and give notes on the seasonal history in south central Pennsylvania. An adult diagnosis is given to facilitate recognition of this species in the cercopid fauna of eastern North America.

Clastoptera laenata Fowler

The genus *Clastoptera* Germar often exhibits intraspecific variation, and the naming of numerous varieties and subspecies by early workers contributed to an unstable classification. Before the revisionary work of Doering (1929, 1941), nomenclature was confused and species identification difficult. Fowler (1897) noted that because members of the genus vary so much in coloration "it is almost impossible to distinguish them by descriptions." One of his own species, *C. laenata* (Fowler, 1898), has presented such problems in interpretation. Ball (1927), uncertain about the identity of *laenata,* considered it a "small dark form" of Fowler's *C. antica,* a species Ball regarded merely as a junior synonym of the widespread *C. obtusa* (Say). Using Fowler's description, Doering (1931) was able to identify specimens tentatively as *C. laenata*; her determination was then confirmed when W. E. China compared her material to the Fowler types in the British Museum (Natural History).

Clastoptera laenata, described from Mexico and Central America, now has been recorded from South America, the West Indies, and the United States (Metcalf, 1962). Doering (1931) gave the first U.S. records, based on six specimens collected by R. H. Beamer and survey party in 1928: three from Bowie Co. in northeastern Texas and three from Polk Co. in southwestern Arkansas. Nixon and McPherson (1977) found a few adults on black walnut, *Juglans nigra* L., in southern Illinois (Massac Co.). Doering (1942) did not list a host in her compilation of plant associations for North American cercopids, and it is probable that the records of Urich (1913) from cashew and *Casuarina* in Trinidad were based on a misidentification of *C. undulata* Uhler. Both cashew and *Casuarina* are known hosts of *C. undulata* in Cuba (Metcalf and Bruner, 1944). The only definite host association for *C. laenata* is that of Garcia-Martell (1974); nymphs and adults were reported to feed on the peduncles of the fruit of cacao, Theobroma cacao L., in southeastern Mexico.

North American distribution.—In addition to the published records from Arkansas, Illinois, and Texas, the following records extend the known North American distribution of *C. laenata.* PENNSYLVANIA: Cumberland Co., Rt. 81, Rest Area southbound between Plainfield and Newville exits, 20 Aug. 1980 and 2, 13 July 1981, A. G. Wheeler, Jr.; Dauphin Co., Hershey, 30 June 1981, A. G. Wheeler, Jr. TENNESSEE: Knox Co., Knoxville, Univ. Tenn. Agric. Campus, 15–17 July 1982, A. G. Wheeler, Jr. Voucher material has been deposited in the collections of the Pennsylvania Department of Agriculture, Harrisburg, and the National Museum of Natural History, Washington, D.C.

Host plants and seasonal history.—Hackberry, *Celtis occidentalis,* was the host of *C. laenata* for all Pennsylvania collections, apparently representing the first association of a spittlebug with *Celtis* in North America. Moser (1965) did not find any cercopids during an ecological study of hackberry insects in New York. The Tennessee specimens (nymphs and adults) were taken on sugarberry, *C. laevigata.*

When this cercopid was first discovered (20 Aug. 1980), a few teneral adults were collected, and spittle masses containing late-instar nymphs were observed on fruit stalks (pedicels) of a mature tree. To learn more about the seasonality of this species, periodic collections were made from the same tree during 1981. At Hershey, supplemental collections and observations were made weekly or biweekly from late May to early July and irregularly into September. During May and June, spittle masses (only one or two because of the small population available) were collected on each sample date.

The five nymphal stages mentioned in the notes on phenology that follow were delineated by sorting under a stereoscopic microscope and confirmed by measuring greatest width of head capsules, including the eyes. The head capsule width of the first-instar nymph is 0.30–0.32 mm ($n = 3$); the second, 0.44 mm (2); the third, 0.64–0.70 mm (3); the fourth, 1.00–1.10 mm (11); and the fifth, 1.60 mm (1).

First-instar nymphs were found in tiny masses of spittle on petioles during the last week of May. The finding of early instars in the apparent absence of adults suggests that *C. laenata* overwinters in the egg stage. First- and second-instar nymphs were present on 2 June, with third and fourth instars found one week later; a random sample contained one third and seven fourth instars. Spittle masses nearly always harbored two and sometimes three nymphs, with two stages often represented. The 16 June sample again contained both third- and fourth-instar nymphs, and by 23 June the first fifth-instar nymph was found. Teneral adults were collected on 30 June, and late-instar nymphs were still common. Nymphs were observed until early July.

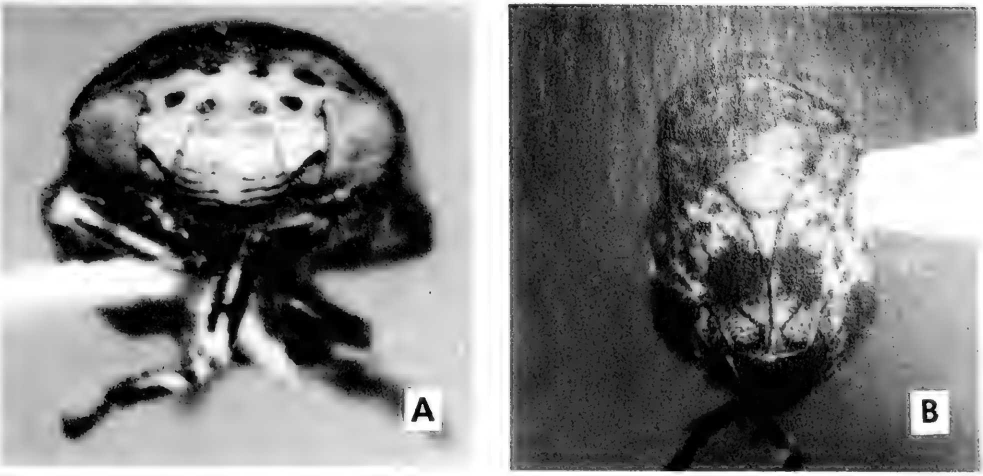

Fig. 1. Distinctive markings on pronotum of *Clastoptera laenata.* A, Six black spots on anterior margin. B, Spots and transverse band across middle.

From the collection of teneral adults and presence of first instars in late August 1980, it was thought that a second generation would develop in late summer 1981. No spittlebugs, however, were observed after mid-July. It is possible that *C. laenata* is bivoltine only in certain years, as has been implied for the pecan spittlebug, *C. achatina* Germar: "Two generations frequently occur in Michigan" (Hanna and Moore, 1966). It is also possible that only a few of the eggs laid during July hatch in late summer and that the majority overwinter; such a small second generation occasionally is found in certain juniper plant bugs (Wheeler and Henry, 1977). Another possibility is that a second generation was present in August 1981 but only on the uppermost, out-of-reach portions of hackberry. Additional observations and collections will be necessary to clarify the voltinism of these populations.

Species Diagnosis.—Males of *laenata* are easily distinguished from other U.S. clastopterans by their pronotal markings; there are 6 black spots on the anterior margin and a black transverse band across the middle which is often broken to form 4 transverse dashes (Fig. 1). The hind margin of the pronotum is variably darkened. Females are similarly marked, but the pronotal spots and band are a less contrasting pale shade of brown. As is usual in the genus, females are larger than males; females range from 3.56 to 4.20 mm ($\bar{x} = 3.88$ mm, $n = 4$) and males 3.40 to 3.50 mm ($\bar{x} = 3.45$ mm, $n = 2$) in the population from Pennsylvania.

ACKNOWLEDGMENTS

We thank J. F. Stimmel, Bureau of Plant Industry, Pennsylvania Department of Agriculture, Harrisburg, for the photographs.

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TWO NEW SPECIES OF PYRALIDAE (LEPIDOPTERA) FROM TEXAS

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Abstract.—Two new moths of the family *Pyralidae* are described from Texas, *Petrophila* ***heppneri*** (subfamily Nymphulinae) and *Eoreuma* ***arenella*** (subfamily Crambinae). The imagines and male and female genitalia are figured.

The first species described below, *Petrophila heppneri,* was taken first by the senior author and recognized as new following the publication of the MONA fascicle on the *Nymphulinae* by Munroe (1972). The junior author later obtained a series of this insect, and still later, received a reprint from Heppner, which indicated that he had previously taken this species in Texas. Heppner (1976), recognized his specimens as new, but had only female examples. The second species, *Eoreuma arenella,* is described from a series taken by the senior author on North Padre Island, Texas.

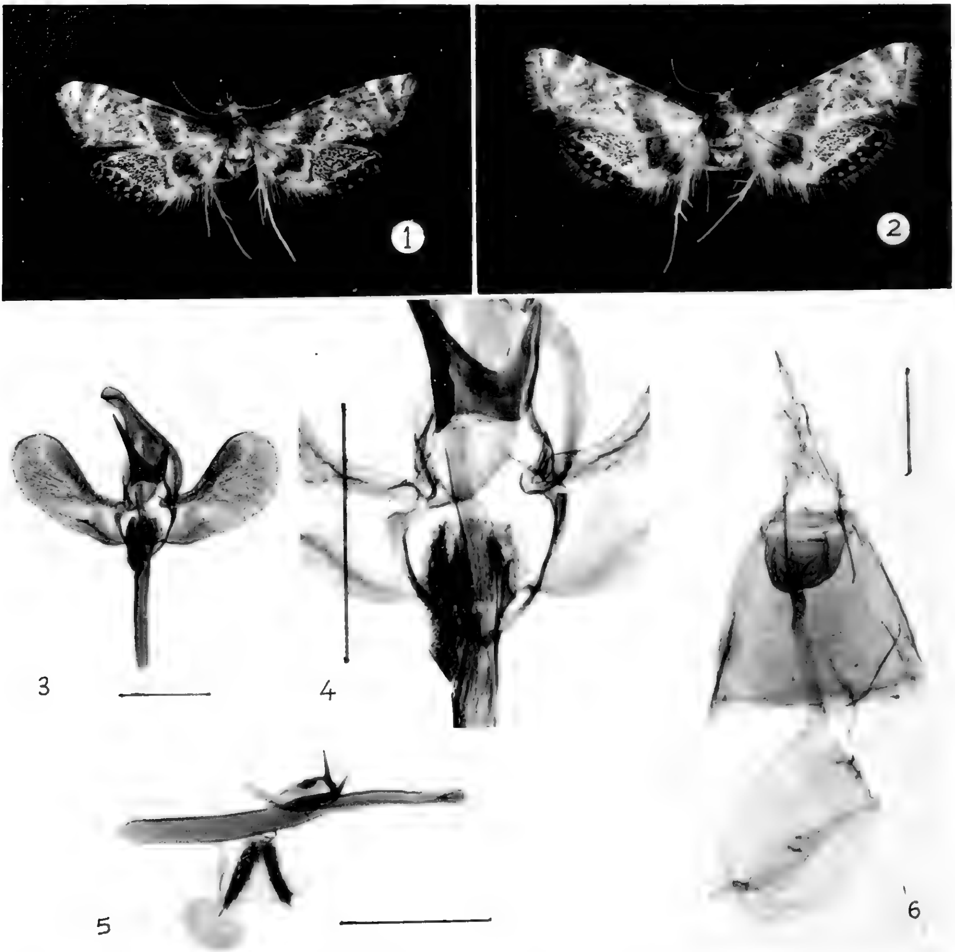
Petrophila heppneri **Blanchard and Knudson, New Species**
Figs. 1–6

Description.—*Head:* Front and vertex ochreous white. Maxillary palpus filiform, ochreous white, exceeding front by ½ eye diameter. Labial palpus ochreous white with some fuscous scales laterally, slightly upturned, exceeding front by 1 eye diameter. Tongue ochreous white. Antenna simple, shortly pubescent in male. Scape whitish, flagellum alternating whitish and fuscous.

Thorax: Patagia and mesonotum ochreous white. Tegula brownish.

Abdomen: Ochreous white with brownish spots along middorsum.

Forewing: Ground white with fuscous, orange, and silver maculation. Basal ¼ heavily dusted with fuscous over costal ½, mainly white over dorsal ½. Antemedial fascia fuscous mixed with orange scales, bordered inwardly with white, and outwardly with white, followed by a dark fuscous line. Antemedial fascia and inner white border straight and slightly angled inwardly from costa. Outer white border and fuscous line produced over cell margins into 2 outwardly directed dentations. Beyond this, ground heavily overlain with fuscous, concentrated toward costa, and extending to apical fasciae and tornal patch. Reniform prominent, pale orange, with a dark fuscous border. Tornal patch orange, with a small silver spot at its dorsal margin. Terminal band orange, narrowly joined to tornal patch. Over apical portion, basad of terminal band, are 3 wedge-shaped fasciae, each broadest at costa. Outer wedge white, with silver patch at apex. Middle wedge orange and inner wedge white. Fringe fuscous, lighter outwardly, except for a small white patch opposite silver tornal spot.



Figs. 1–6. *Petrophila heppneri.* 1, Male holotype, Kerr Co., Texas 10 miles west of Hunt, 1-IX-80. 2, Female paratype, Colorado Co., Texas, Eagle Lake, 27-IV-78. 3, Male genitalia of paratype from Slide ECK 358, Kerr Co., Texas, Kerrville, 15-V-82. 4, Enlargement of preparation in Fig. 3. 5, Aedeagus, with portion of anellus and juxta attached, from holotype, slide ECK 355. 6, Female genitalia of paratype, from slide A.B. 3955, Kimble Co., Texas, Junction, 16-IV-74. The lines in Figs. 3, 4, 5, 6 represent 0.5 mm.

Hindwing: Ground white with no fuscous scaling basad of antemedial fascia. Antemedial fascia from anal angle to near costa, fuscous, with predominantly orange scaling centrally. Outwardly, antemedial fascia bordered by white, and further, by a fuscous line, which begins at anal angle and extends outwardly to near lower end of outer margin, from where it is angled upward, extending to near, but not reaching, costa. Beyond this, subapical ½ heavily dusted with black scales, which do not extend to inner margin. Subterminal row of 5 intense black spots, preceeded by an orange shade, and separated by 5 metallic silver spots. At varying degrees of light incidence, silver spots show purplish or greenish iridescence. Just basad of lowest black subterminal spot is a larger, dull silver patch. Along termen are 6 black and 4 orange bars, 2nd black bar from apex being weakest and 3rd being strongest. Between 2nd and 3rd black bars, there is no orange, but rather a continuation of adjoining silver spot. Fringe fuscous, lighter outwardly.

Length of forewing: Male: $N = 12$, 4.3–7.1 mm, average 5.8 mm; female: $N = 20$, 4.8–9.4 mm, average 6.9 mm.

Male genitalia (Figs. 3–5): Fig. 3 of entire genitalia; Fig. 4 an enlargement of same to show appearance of region of anellus with aedeagus in situ. Two linear mats of fine spines seen on anellus and 2 thornlike cornuti seen on outer surface of, and parallel to, aedeagus. Fig. 5 of a removed aedeagus from holotype. A portion of anellus, bearing 2 rows of spines and juxta still attached. Two cornuti seen in an erected postion, perpendicular to aedeagus.

Female genitalia (Fig. 6): Ductus bursae joined asymmetrically to ostium bursae. Bursa lacking signum.

Holotype.—♂, Kerr Co., Texas, 10 miles west of Hunt, 1-IX-80, genitalia slide ECK 355, collected by E. C. Knudson and deposited in the National Museum of Natural History, Washington, D.C.

Paratypes.—Same data as holotype, 3 ♀; same locality, 22-VIII-81, 3 ♂, 6 ♀; Kerr Co., Texas, Kerrville, 15-V-82, 1 ♂, 1 ♀, all collected by E. C. Knudson; Blanco Co., Texas, Pedernales Falls St. Pk., 4-V-73, 5 ♂, 9 ♀; Kimball Co., Texas, Junction, 3-IV-68, 1 ♂; 16-IV-74, 1 ♀; 18-IV-74, 4 ♀; Colorado Co., Texas, Eagle Lake, 27-IV-78, 1 ♀, all collected by A. & M. E. Blanchard; Kerr Co., Texas, Kerrville St. Pk., 16-VII-74, 3 ♀, collected by J. B. Heppner.

Remarks.—*Petrophila heppneri* is included in a group of mainly smaller species in which the ductus bursae is joined asymmetrically to the ostium. It is distinguished from the other members of this group by the absence of spines in the bursa copulatrix. The moth is very similar to *Petrophila santafealis* (Heppner) (1976), which differs in having most of the orange markings replaced by fuscous. *Petrophila santafealis* is known only from central Florida. The species in the genus *Petrophila* Guilding have until recently been assigned to *Parargyractis* Lange.

The new species is named for Dr. John B. Heppner, who first reported its existence in the literature.

Eoreuma arenella Blanchard and Knudson, New Species

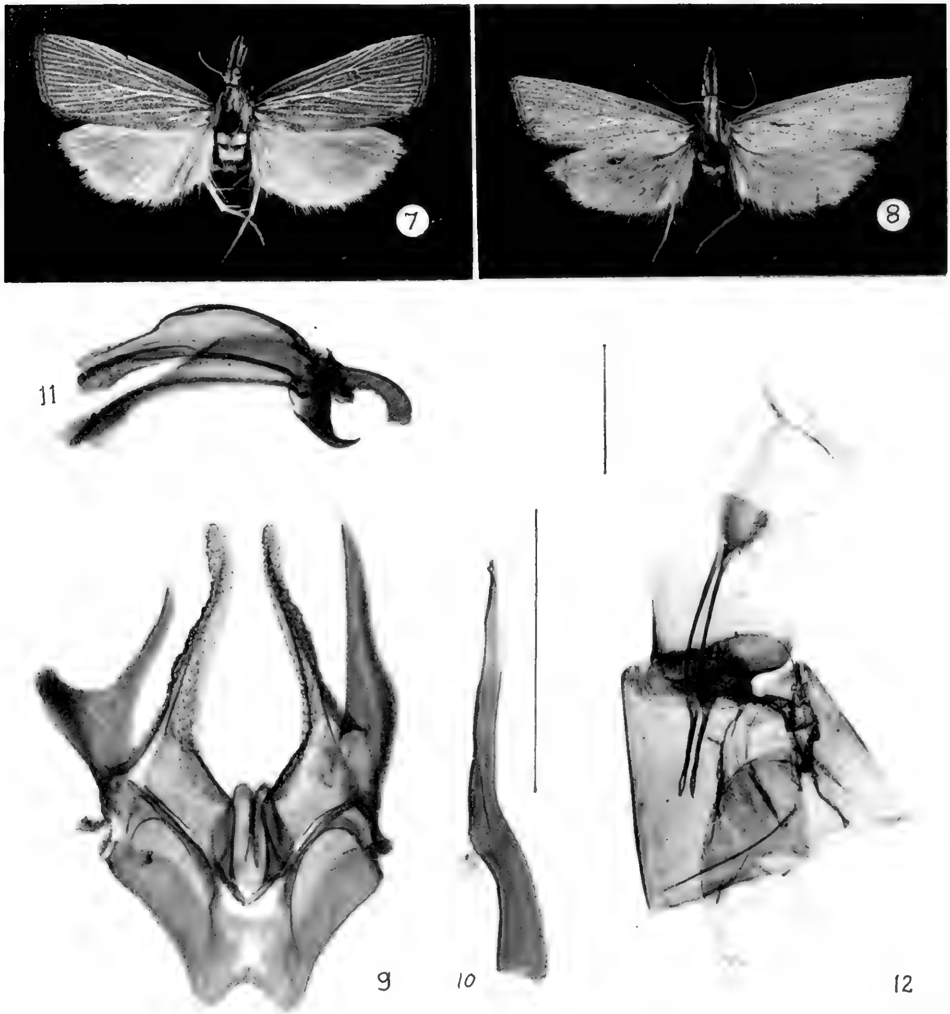
Figs. 7–12

Description.—*Head:* Front rounded. Front and vertex light buff. Maxillary palpus brushlike, light buff, exceeding front by 1 eye diameter. Labial palpus light buff with some fuscous scaling laterally, exceeding front by 4 eye diameters. Antenna simple, thicker in male. Scape light buff with blackish brown spot on inner surface. Flagellum scaled on dorsal surface, light buff, unscaled on lateral and ventral surfaces, pubescent, dark brown.

Thorax: Light buff with darker scales at base of patagia.

Abdomen: Light buff.

Forewing: Ground color shining light brownish gray with veins outlined in creamy white. Costa narrowly creamy white. Intervenular spaces lightly scaled with white. Black intervenular spots at termen. Fringe of 3 scale rows, each row



Figs. 7–12. *Eoreuma arenella.* 7, Male holotype, Padre Island Nat. Seashore, Texas, 19-VII-76. 8, Female paratype, same locality, 8-VI-78. 9, Male genitalia, dorsal view, tegumen, uncus, and gnathos removed, from slide ECK 363, same locality, 20-V-79. 10, Aedeagus of paratype, same preparation as Fig. 9. 11, Tegumen, uncus, and gnathos of paratype, same preparation as Fig. 9. 12, Female genitalia of paratype, lateral view, from slide A.B. 5090, same data as Fig. 2. The lines in Figs 10, 12 represent 1.0 mm. Figs. 9, 10, 11 are the same scale.

buff at base, mid-portion brown, apex whitish. Small dark brown discal spot variably present. Female differs from male in having more elongate forewing with ground color warmer light brown, otherwise like male.

Hindwing: Shining brownish white, veins pure white. Fringe white with faint brown terminal line.

Length of forewing: Male: $N = 20$, 7.4–10.7 mm, average 9.3 mm; female: $N = 2$, both 10.3 mm.

Male genitalia (Figs. 9–11): Fig. 9 a dorsal view of genitalia after removal of aedeagus, tegumen, gnathos, and uncus. Costal processes of valvae asymmetrical, dextral process (shown on left in figure), with 2 arms, dorsal arm consistently much shorter and heavily setose. Fig. 10 of removed aedeagus, lateral view. Fig. 11 a lateral view of removed tegumen, gnathos, and uncus.

Female genitalia (Fig. 12): Figure shows lateral view of entire female genitalia. Ovipositor lobes laterally flattened, bladelike, sparsely setose. Ductus bursae short, narrow, membranous, arising from ventral aspect of bursa. Bursa copulatrix membranous, without signum. Ductus seminalis from bursa near junction of ductus bursae. Seventh segmental tergite large, with striate, partially membranous portion near lateral margin.

Holotype (Fig. 7).—♂, Padre Island National Seashore, Texas, 19-VII-76, with genitalia slide A. B. 3801, collected by A. & M. E. Blanchard and deposited in the National Museum of Natural History.

Paratypes.—Same locality as holotype, 22-IV-76, 1 ♂; 19-V-76, 1 ♂; 24-VI-76, 1 ♂; 19-VII-76, 2 ♂; 16-VIII-76, 4 ♂; 8-VI-78, 10 ♂, 1 ♀; 20-V-79, 4 ♂. Nueces Co., Texas, North Padre Island, 9-IX-74, 1 ♂; 7-VI-78, 2 ♂, 1 ♀; 11-VI-78, 1 ♂, all collected by A. & M. E. Blanchard.

Remarks.—*Eoreuma arenella* is closely related to *E. densellum* (Zeller), a widespread species, which occurs over the eastern half of Texas. *Eoreuma densellum* is somewhat variable in color and maculation, but generally the ground color is decidedly brown and there are usually darker brown scales in the intervenular spaces. The male genitalia are similar, but in *densellum,* the two arms of the costal process of the dextral valve are equal in length, or nearly so, and also nearly equal in width. According to Klots (1970), the ventral arm is usually the shorter in *densellum.* In *arenella,* this costal process is shorter and broader, with the dorsal arm markedly reduced and hirsute. In the authors' series of *arenella,* there is remarkable uniformity of coloration and male genitalia.

Eoreuma loftini (Dyar) has recently been found by the junior author in south and southwest Texas along the Rio Grande River. It is superficially similar to *arenella,* but distinguished by its conical frons and different male genitalia.

The name of the new species is taken from the latin *arena,* meaning sand, referring to the color of the insect, which closely resembles the sands of Padre Island, where it evidently prospers.

Acknowledgments

The authors are extremely grateful to John B. Heppner, Smithsonian Institution, and Douglas C. Ferguson, Systematic Entomology Laboratory, USDA, for examining the type-material and reviewing the manuscript. We are also grateful to the U.S. National Park Service and the Texas Department of Parks and Wildlife for their continued cooperation and assistance.

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A NEW SPECIES OF APHID (HOMOPTERA: APHIDIDAE) FROM *POTENTILLA CANADENSIS*[1]

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Abstract.—Descriptions are given of the apterous vivipara, alate vivipara, and alate male of *Anthracosiphon* ***crystleae***, n. sp. (Homoptera: Aphididae), collected on *Potentilla canadensis* L.; type-locality, Mt. Jefferson State Park, North Carolina.

The genus *Anthracosiphon* was described by Hille Ris Lambers (1947: 195–196) for his single species *A. hertae*. He characterized the genus as follows: "Tergum in apterae viviparae uniformly black sclerotic, in oviparae with the posterior tergites of abdomen sometimes membraneous. Hairs normal. Frontal tubercles well developed, with parallel inner sides and angular, rough inner apices. Antennae long, in apterae and alatae with rhinaria on the IIIrd segment. Siphunculi long, about cylindrical, with at their apices 5–8 rows of very well developed hexagonal reticulations, with well developed flange. Cauda shortly triangular, without constrictions."

Hille Ris Lambers (1947: 195) stated ". . . the frontal tubercles have angular and rough inner sides, a character which does not occur in any *Macrosiphum*-like aphid with reticulated siphunculi, secondarily the tergum in apterae viviparae and in a lesser degree in oviparae is completely and densely black sclerotic. A similar tergum occurs in *Sitobion* Mordv., but there the oviparae have a membraneous tergum, while in the new genus also in oviparae the abdomen is covered by a black shield. The short, triangular, black sclerotic cauda is rather like that of *Rhopalosiphoninus* Baker and very unlike anything occurring in *Macrosiphum* and allied genera."

The cauda of *Anthracosiphon crystleae*, described below, is not "short and triangular" as indicated for the genus *Anthracosiphon*. In other respects, however, *A. crystleae* fits into *Anthracosiphon* better than any other described genus.

Anthracosiphon crystleae Smith, NEW SPECIES

Figs. 1A, 2A

Apterous vivipara (Figs. 1A, 2A).—Color of living specimens: Reddish brown, shiny, paler around base of siphunculi; antenna and siphunculi black. Cleared specimens: Antennal segments I and II dark brown, remainder of antenna black,

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Fig. 1. A, Head of *Anthracosiphon crystleae,* holotype. B, Head of *A. hertae*; on *Potentilla palustris,* Malham Tarn, Yorkshire, England, H. L. G. Stroyan.

so dark it is often difficult to distinguish secondary rhinaria. Head dusky but paler than antennal segment I. Rostral IV + V as dark as antennal segment I. Coxae, trochanters, and basal portion of femora pale, distal ⅓–½ of femora darker, tibiae and tarsi black (tibiae may be slightly lighter on central portion). Dorsum of abdomen sclerotic, may vary with specimens. Cauda pale.

Measurements (11 specimens) (all measurements in mm, first measurement represents the holotype): Body length 1.8 (1.8–2.39), width of head 0.46 (0.45–0.54). Antennal segment III 0.63 (0.55–0.74); IV 0.55 (0.45–0.67), V 0.47 (0.37–0.55), VI 0.14 (0.12–0.18) + 0.84 (0.72–0.97). Metatibia 1.45 (1.28–1.78), metatarsomere II 0.11 (0.10–0.14). Siphunculus 0.63 (0.51–0.70). Cauda 0.26 (0.25–0.32).

Antennal segment III with 3–5 (1–6) secondary rhinaria. Setae on antennal segment III short and blunt, less than ½ diameter of base of antennal segment III. Setae on head stout, pointed, 0.03. Ventral portion of head and antennal tubercles spiculose; dorsum of head smooth. Rostrum attaining metacoxae. Rostral IV + V with 4 accessory setae. Lateral abdominal tubercles may be present. Dorsal abdominal setae blunt, 0.015. Tarsal chaetotaxy 3-3-3. Abdominal terga VIII with 4 (4–6) setae and an occasional medial tubercle. Siphunculus strongly imbricated apically, imbrications fading to faint denticulations basally, distal ⅙–⅐ with 6 or 7 rows of reticulations, flange distinct. Cauda bearing 7–8 setae.

Alate vivipara.—Cleared specimens: Head dusky, may be darker around lateral ocelli. Antenna black, base of antennal segment III may be slightly lighter. Coxae, trochanters, and approximately basal ⅔ of femora light, remainder of legs dark. Anal and cubital veins of forewing shaded slightly and heavier (wider and darker) than media, abdomen pale. Siphunculus black. Cauda dusky.

Measurements (10 specimens, first measurement represents an individual specimen): Body length 2.67 (2.10–2.67), width of head 0.50 (0.45–0.51). Antennal segment III 0.74 (0.74–0.87); IV 0.67 (0.63–0.74); V 0.58 (0.45–0.59); VI 0.18 (0.16–0.18) + 0.90 (0.70–1.00). Rostral IV + V 0.12 (0.11–0.13); metatibia 2.05 (1.70–2.05); metatarsomere II 0.11 (0.10–0.12). Siphunculus 0.70 (0.61–0.70), reticulated area 0.12 (0.10–0.13). Cauda 0.26 (0.26–0.33).

Rhinaria on antennal segment III, 11–16, nearly in a single row over most of length of segment. Rostral IV + V with 7 accessory setae. Tarsal chaetotaxy 3-3-3. Siphunculus with about 7 rows of reticulations apically, remainder of siphunculus imbricated to slightly denticulate basally. Abdominal tergum VIII with 6 setae.

Alate male.—Cleared specimens: Head dusky, slightly darker around the lateral ocelli. Antennal segment I, II, basal $^{1}/_{15}$ of III, and distal ½ of processus terminalis dusky, about same color as head, remainder of antenna black. Coxae, trochanters, and basal $^{9}/_{10}$ of femora pale, remainder of legs black. Thorax dusky. Abdomen pale. Siphunculus and cauda black.

Measurements (10 specimens): Body length 2.25 (1.87–2.46), width of head 0.54 (0.50–0.54). Antennal segment III 0.74 (0.72–0.81); IV 0.70 (0.61–0.77); V 0.63 (0.55–0.69); VI 0.18 (0.16–0.19) + 1.06 (0.94–1.20). Rostral IV + V 0.12 (0.10–0.13). Metatibia 1.89 (1.60–1.98), metatarsomere I 0.12 (0.10–0.12). Siphunculus 0.50 (0.42–0.50), reticulated area 0.12. Cauda 0.18 (0.16–0.19).

Antennal segment III with 32 (30–53) rhinaria, in more or less double row along entire length; antennal segment IV with 10 (10–16) rhinaria and V, with 13 (11–16), primarily on distal ½ of segment. Denticulations on ventral surface of head and antennal tubercles faint. Rostral IV + V with 4 accessory setae. Tarsal chaetotaxy 3-3-3. Abdominal tergum VIII with 4–6 setae. Cauda with 7 setae.

Discussion.—*Anthracosiphon crystleae* differs from *A. hertae* in having shorter antennal setae (less than half the diameter of base of antennal segment III), darker

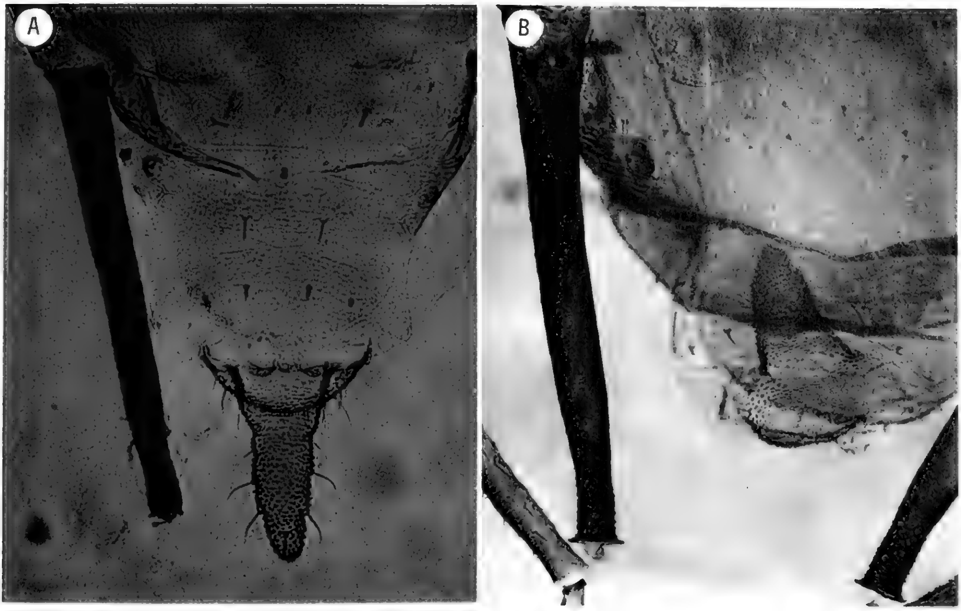

Fig. 2. A, Tip of abdomen of *Anthracosiphon crystleae,* holotype. B, Tip of abdomen of *A. hertae*; on *Potentilla palustris,* Malham Tarn, Yorkshire, England, H. L. G. Stroyan.

antenna and tibiae, a lighter colored abdomen, and an elongate cauda with parallel sides (rather than triangular) (Figs. 1, 2).

Type-locality.—Mt. Jefferson, Mt. Jefferson State Park, North Carolina.

Types.—Holotype apterous vivipara no. 1 from collection no. 76-60, on the runners of *Potentilla canadensis* L., Mt. Jefferson State Park, N.C., 21 Sept. 1976, Crystle K. and Clyde F. Smith, in the National Museum of Natural History, Washington, D.C. Paratypes from the same locality (92 apterous viviparae, 52 alate viviparae, and 27 alate males), 13 Aug. 1976, coll. 76-50, C. F. Smith and M. Cermeli; 21 Sept. 1976, coll. no. 76-60, C. F. Smith and C. K. Smith; 13 Oct. 1976, coll. no. 76-74, C. F. Smith, in the National Museum of Natural History, Florida State Collection of Arthropods, North Carolina State University, Pepper collection in Frost Museum, University Park, Pa., and collection of C. F. Smith.

Collections.—Additional collections on *Potentilla* sp. in North Carolina: Highlands, 9 June 1970, coll. no. 70-31, C. F. and C. K. Smith and C. Sullivan (Parron); on "*Fragaria*" (probably misidentification for *Potentilla* sp.), Boone, 11 Sept. 1963, coll. no. 63-147, C. F. and C. K. Smith, J. O. Pepper, A. N. Tissot; Wilkesboro, 9 Sept. 1963, coll. no. 63-82, C. F. and C. K. Smith, J. O. Pepper, A. N. Tissot; Bamboo, 9 Sept. 1963, coll. no. 63-114, C. F. and C. K. Smith, J. O. Pepper, A. N. Tissot; Blowing Rock (Blue Ridge Parkway, Post 286), 10 Sept. 1963, J. O. Pepper. In Pennsylvania: on "wild strawberry" (probably misidentification for *Potentilla* sp.), State College, 21 June 1971, J. O. Pepper. In the North Carolina State University Collection, Pepper Collection in the Frost Museum, University Park, Pa., and collection of C. F. Smith.

Notes.—A special effort was made to locate oviparous females, 13 Oct. 1978 when males were found but without success. All specimens were found on the distal half of the runners. No specimens were found near the crown of the plant. No damage to the plants was noted. Fundatrices were not found, however, the first collection was made June 9 which could be too late for them.

Etymology.—Named in honor of my wife who has assisted me in collecting aphids for 45 years and who has always offered help and encouragement.

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I greatly appreciate the opinions of H. L. G. Stroyan, Harpenden, Herts., England, and Louise M. Russell (retired) and Manya B. Stoetzel, Systematic Entomology Laboratory, IIBIII, Agricultural Research Service, USDA, Beltsville, Maryland, concerning this species.

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A REVISION OF THE GENUS *PYROTA*. II. THE POSTICA GROUP (COLEOPTERA: MELOIDAE)

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Abstract.—The Postica Group of the genus *Pyrota* Dejean is defined to include the North American species *P. plagiata* (Haag-Rutenberg) and *P. postica* LeConte. The group differs from the closely related Mylabrina Group in having a bifasciate elytral color pattern and in structural characters of the antenna and male maxillary palpus. Seasonal activity, food plants, sexual behavior, and aggregating behavior of adults are considered. Predation of adults of *P. postica* by the asilid fly *Stenopogon abdominalis* (Say) is described. The distribution of *P. postica* in the southwestern United States and Mexico appears to be determined only partially by that of its favored food plant, *Larrea tridentata*; nearly complete allopatry of *P. plagiata* and *P. postica* suggests that interaction between the species may result in a narrowing of ecological tolerances in areas of contact. Complete synonymies are given for both species of the group and both are redescribed, with quantitative analyses of variation in coloration.

The Postica Group is proposed herein for the North American species *Pyrota plagiata* (Haag-Rutenberg) and *P. postica* LeConte. The group ranges from the southwestern United States to the southern end of the Central Plateau of Mexico (Fig. 1). In the adult stage it is immediately distinguished from the Mylabrina Group (Selander, 1982) in having a bifasciate, rather than trifasciate color pattern; indeed, on the basis of coloration alone, *P. plagiata* and *P. postica* are more likely to be confused with species of the Pacifica and Nobilis groups than with those of the Mylabrina Group (Selander, *in press*). Structurally, the Postica Group is distinguished from other groups of the genus by the great length of antennal segment I, the apex of which attains or surpasses the posterior margin of the eye in the male and the middle of the eye in the female. In addition, it differs from the Mylabrina Group in having the antenna more strongly tapered and the male maxillary palpus more elaborately modified. In particular, male maxillary palpal segment III is much larger and more elongated than in any of the species of the Mylabrina Group and segment II has a distinctive triangular shape. *Pyrota plagiata* differs from species of the Mylabrina Group, and at the same time resembles those of the Nobilis Group, in that the posterior marginal area of the sixth abdominal sternum is not curved dorsad. Behaviorally, the Postica Group is distinguished from the Mylabrina Group by the fact the male folds the antennae posteriad during the posterior antennation phase of courtship (Selander, 1964; unpublished data), as in *P. nigrovittata* (Haag-Rutenberg); in all species of the

Mylabrina Group that have been studied behaviorally, the antennae are folded to the sides or (*P. terrestris* Selander) directed anteriad. Still, there is little question but that the Postica and Mylabrina groups are closely related, and it is more or less arbitrary as to whether they are to be treated as separate groups or as subgroups of a common group.

BIONOMICS

Adults of the group appear to be more nearly diurnal than those of many species of the Mylabrina Group. Only one specimen examined (a male of *P. postica*) is labeled as collected at light.

Seasonal activity.—Judged from collection records, the two species of the group have quite similar seasonal distributions of the adult stage. For *P. plagiata* the percentage distribution by month of records of adults is: June 9.7, July 58.1, August 32.2 ($N = 31$). For *P. postica* it is: May 8.2, June 24.5, July 38.8, August 22.4, September 6.1 ($N = 49$).

Food plants.—On several occasions I have found groups of adults of *Pyrota plagiata* feeding on the foliage of *Astragalus mollissimus* in pastures and rangeland in the Davis Mountains of Texas. A specimen from Kansas Settlement, Arizona, and two specimens from Cochise, Arizona, are labeled as taken on alfalfa [*Medicago sativa*]. Werner et al. (1966) reported a series of specimens from a "yellow-flowered composite" in the Chiricahua Mountains, and a specimen from Zacatecas was collected on *Solidago.* In addition, I once found an individual 15 mi. northwest of Durango, Durango, Mexico, feeding on the corolla of a species of *Sphaeralcea* (Malvaceae).

Larrea tridentata (creosote-bush, Zygophyllaceae) has been recorded (either as such or as *L. mexicana*) as the food plant of adults of *Pyrota postica* at five localities in Arizona, two in Texas, three in Durango, and one each in New Mexico and Chihuahua. Aggregations of "many hundreds" of adult beetles on *Larrea* were recorded by Hurd and Linsley (1975). In the course of observing an aggregation of adults on *Larrea* in Durango (see below) I found that feeding was confined to the flowers and that unopened flowers were preferred. In addition to the records of *P. postica* from *Larrea,* there are two from Leguminosae: one from *Melilotus alba* near Portal, Arizona (three adults), and one from mesquite (*Prosopis* sp.) at Laredo, Texas (Werner et al., 1966).

The geographic range of *Pyrota postica* is largely contained within that of creosote-bush. In Fig. 1 I have outlined the range of creosote-bush in North America, as given by García et al. (1961). From the figure it is evident that most of the localities from which *Pyrota postica* has been recorded fall within this range or are sufficiently close to it that they are probably within the actual range of the plant. In at least two regions, however, *P. postica* apparently occurs in its absence. One is in southern New Mexico, where the beetle has been taken in the Sierra Blanca and Sacramento mountains at elevations up to 8000 ft., well above the altitudinal range of *Larrea.* The other is the Texas Gulf Coast, where two localities (Hidalgo County and Kingsville) are well outside its known geographical range. At the same time, much of the range of *Larrea* in North America, including the Sonoran and Mojave deserts, is not inhabited by *P. postica.*

Sexual behavior.—*Pyrota postica* was one of several species treated in my study of sexual behavior in the genus *Pyrota* (Selander, 1964). Subsequent studies

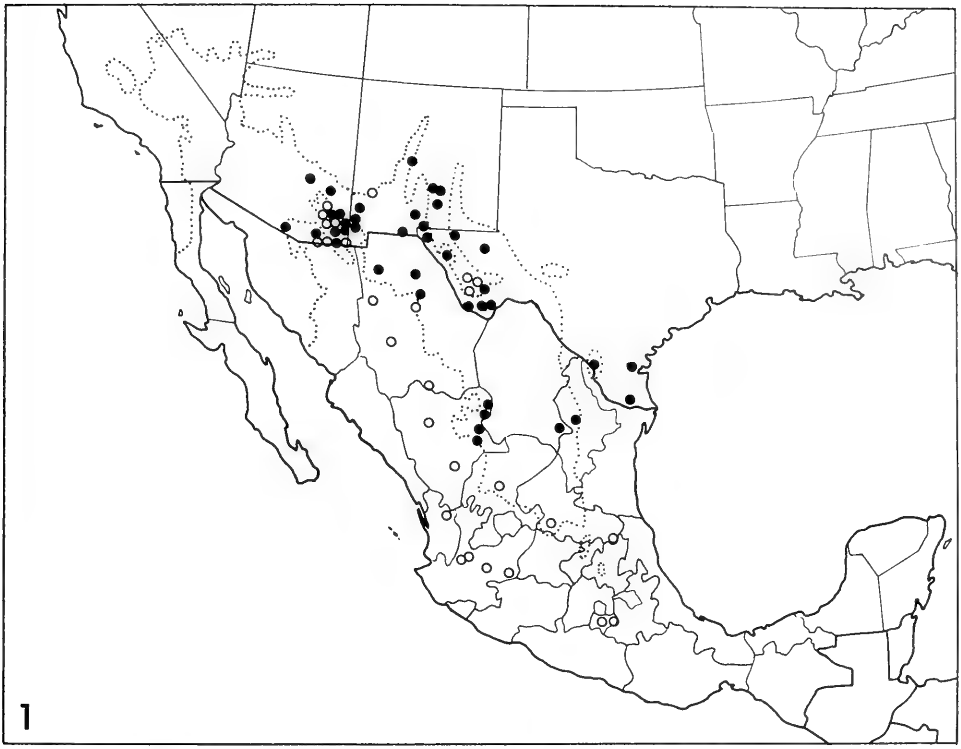


Fig. 1. Geographic distribution of *Pyrota plagiata* (open circles) and *P. postica* (solid circles). Range of *Larrea tridentata* indicated by dotted line.

of the behavior of *P. plagiata,* to be described elsewhere (Selander, unpublished data), demonstrate that the species differ with respect to the number of abdominal strokes performed by the male in the posterior phase of courtship and in other details, although, as indicated above, they agree with respect to the positioning of the male's antennae.

Enemies.—Adults of *P. postica* are attacked by the asilid *Stenopogon* (*Osprioceris*) *abdominalis* (Say), as described in the next section.

An aggregation of *Pyrota postica* adults.—An enormous aggregation of adults of *Pyrota postica* was observed by J. C. Schaffner and myself on 13 and 14 July 1959 at a site 19 miles north of the village of Cuencamé in eastern Durango, Mexico. The locality (Fig. 2) is in an arid, rocky valley between low mountains. The vegetation, which is typical of the northern part of the Central Plateau of Mexico, consists of a xerophytic shrub association, heavily dominated by creosote-bush, which was in flower when our observations were made. We observed the aggregation for two hours before dusk on 13 July and for two hours in the morning on 14 July.

The aggregation included several thousand individuals distributed irregularly over an area of about three acres. Some creosote-bushes held concentrations of 125–150 beetles each, most had only a few beetles, and a great many lacked them entirely. Early in the observations it became apparent that the aggregation was

Fig. 2. Habitat of *Pyrota postica* north of Cuencamé, Durango, Mexico.

drifting slowly northward, parallel to the highway and against a slight breeze. Movement of individuals was accomplished entirely by flight. Movement of the aggregation as a whole was effected by a general tendency for individuals to fly in a northerly direction, not by concerted flight of uniformly oriented individuals. Flights were usually short, taking the beetles only a few feet, from one bush to another. Occasional sustained flights were observed in which beetles left the aggregation; these were undertaken in a very deliberate manner and were almost invariably in a northerly direction.

Females were, for the most part, feeding on the flower buds and flowers of the creosote-bush. Many of the males were engaged in courtship. Often they would make short, hovering flights out from a bush and then back again or to a nearby bush, evidently in search of unattended females. When in flight both sexes appeared to be attracted by the sight of other beetles, and I surmised at the time that visual recognition and attraction played a large part in maintaining the cohesion of the aggregation. On several occasions we stood near a bush and observed the buildup of concentrations of beetles. As this occurred, beetles were continually flying in from nearby bushes, usually from the south. The concentrations were, however, only temporary, as the beetles soon began to disperse and to form new concentrations elsewhere. In the process of movement of the aggregation copulating pairs and occasional single individuals were left behind. It would be interesting to determine if copulating individuals later rejoin the aggregation.

On 13 July the sky was overcast, with the sun breaking through the clouds briefly at intervals. As dusk approached the frequency of flights, particularly sustained ones, increased.

On the morning of 14 July the sky was partly clear when we returned to the site at 9:00 am. By this time the center of the aggregation had moved 100 yards to the north and the beetles had become both less numerous and less active than before. Evidently the beetles had been active for at least several hours during the night, since the rate of movement of the aggregation, as assessed the previous day, was too slow to account for a displacement of 100 yards in the hours since sunrise.

A conspicuous predator accompanying the aggregation was *Stenopogon abdominalis,* an asilid fly about one inch long, with a dark blue-black body and wings and an orange abdomen. The coloration suggests that of a wasp, and this effect is heightened by the fact that the flies, when not in flight, move in a halting manner and incessantly tap the folded wings against the abdomen. According to Linsley (1960), who gives a photograph of a pair of specimens, this fly is a mimic in the southwestern United States of the scoliid wasp *Scolia ardens* Smith.

The *Stenopogon* was easily the second-most conspicuous insect at the locality, numbering perhaps 50 individuals. Many were resting on stems of creosote-bush; others were on stones on the ground or patrolling the area in flight. We observed no actual captures of *Pyrota* adults, but several attacks were seen and four of the flies were found holding and feeding on adults. The attacks were made only when the beetles were moving very actively on the creosote-bush or were flying. We saw several instances of flies sitting within an inch of feeding beetles without paying the slightest attention to them. Conversely, the beetles seemed oblivious to the presence of the flies until they were actually attacked by them.

An attack is made by flying rapidly and directly to the prospective prey, grasping it with the legs, and attempting to insert the proboscis into its body. If the fly cannot insert the proboscis immediately, it abandons its intended victim, never pressing the attack. Attacked beetles thrashed the legs violently, and in all observed cases freed themselves rapidly. Flies that had captured beetles held them with the head oriented forward. In one case the fly had inserted the proboscis in the base of its prey's abdomen, between the elytra. In another the proboscis entered the dorsum of the cervical region. The bodies of captured beetles were extremely limp.

Almost precisely a year later I revisited the locality. Although the creosote-bush was again in flower, I found no adults of *P. postica* in several hours of searching and only one of *Stenopogon abdominalis.* When first observed, the fly was carrying an adult of an unidentified species of *Epicauta,* having inserted the proboscis into the cervical region.

Stenopogon abdominalis apparently specializes in the capture of meloid beetles. It has previously been reported (generally as *Osprioceris abdominalis*) preying on *Lytta biguttata* LeConte (Cockerell, 1905), *Tetraonyx fulva* LeConte (Linsley, 1960), at least five species of *Epicauta* (Linsley, 1960; Rogers and Lavigne, 1972; Pinto, 1980), and *Pyrota palpalis* Champion (Selander, 1982).

ADULT ANATOMY

The Postica Group is characterized anatomically in the adult stage as follows: Elytral pattern bifasciate, consisting of a basal black fascia divided into an oval scutellar spot and a narrower humeral spot (rarely fused) and a large postmedian black fascia; latter fascia centered in apical ⅓ of elytron, usually not extending basad of middle, ⅓ to ⅔ as long as the elytron (sometimes fusing with humeral spot), separated from both sutural and lateral margins. Clothing setae golden except on black areas of legs, where they are black.

Head moderately triangular; cuticle shiny, smooth, finely, very sparsely punctate, each puncture with a minute, erect seta. Antenna strongly tapered, distally very narrow; segments subfiliform, compressed. Eye broad. Pronotum about ⅘ as wide as long, depressed on anterior ½; cuticle as on vertex. Elytron almost as shiny as head and pronotum, feebly microgranulate, finely but distinctly, densely punctate, glabrous (lacking setal punctures) on disk; costulae well marked, complete. Venter shiny, smooth, clothed with moderately long setae, these moderately dense on thorax, sparse on abdomen. Outer hindtibial spur greatly thickened, expanded and obliquely truncate apically, 2–3× as wide as inner spur, which is sticklike. Tarsal pads well developed, dense, undivided on fore- and midleg. Pygidium entire.

Male.—Antenna more slender than in female; segment I greatly elongated, at least attaining posterior margin of eye, its length at least slightly greater than interocular distance (ID), strongly curved, broadened apically; III noticeably longer than IV, ¼ as wide as long, parallel-sided, more strongly compressed than following segments, strongly bowed posteriad, sinuate dorsoventrally; IV–X progressively shorter and narrower, none more than ½ as wide as long; XI very narrow; flagellar segments lacking a ventral ridge and sensory depressions. Maxillary palpal segment III greatly enlarged, elongate-pyriform, with length at least equal to ID and with ventral membranous area covering all but apex; II transverse, produced laterad, its ventral surface densely punctulate and setate. Foretarsus symmetrically expanded; midtarsus not modified. Fifth (visible) abdominal sternum not depressed, entire; sixth broadly, rather shallowly, obtusely emarginate; membranous area curved dorsad or not, covering apical ⅔ or less. Genitalia with gonostyli slender, parallel, not divergent distally, curving dorsad, each expanded laterad at apex; aedeagus with 2 ventral hooks of equal size; dorsal hook moderate in size, weakly curved, strongly, densely spinose.

Female.—Antennal segment I attaining at least middle of eye; III ⅗ as long as I, ⅖ as wide as long, not so strongly bowed as in male. Sixth abdominal sternum shallowly emarginate medianly.

Key to Species Based on Adults

1\. Antennal segment I attaining posterior margin of eye in ♂, middle of eye in ♀; postmedian black fascia of elytron oval, at most ⅔ as wide as long; elytral costulae lying in depressions, the intervals between convex .... *plagiata* (Haag-Rutenberg)

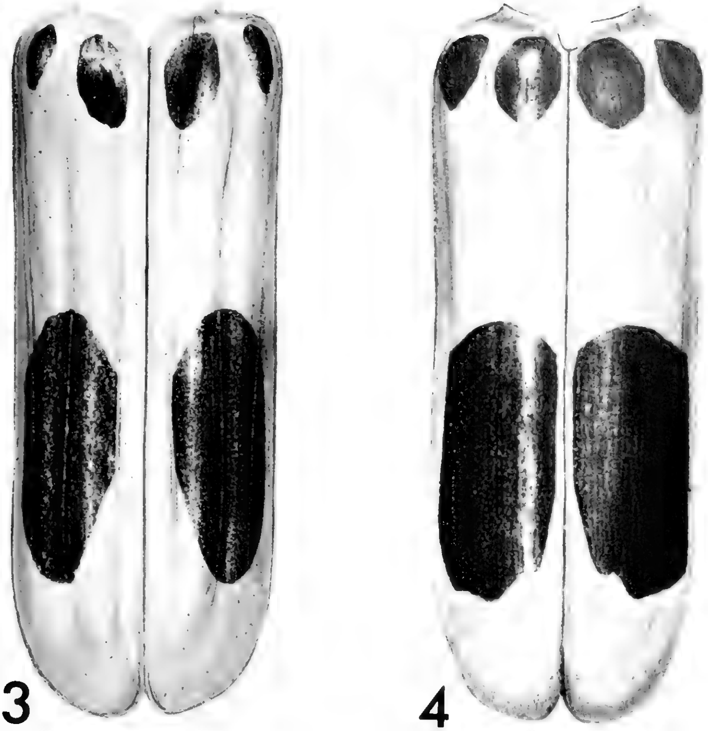
– Antennal segment I surpassing posterior margin of eye in ♂, attaining it in ♀; postmedian black fascia subquadrate, usually at least ⅔ as wide as long; elytral costulae not in depressions, the intervals between flat .... *postica* LeConte

Pyrota plagiata (Haag-Rutenberg)

Figs. 1, 3, 5–6, 8, 10, 12, 14

Cantharis maculata Lacordaire, 1859, pl. 60, fig. 4. [Type locality not given; type said to be in the Berlin Museum (Berg, 1881).]

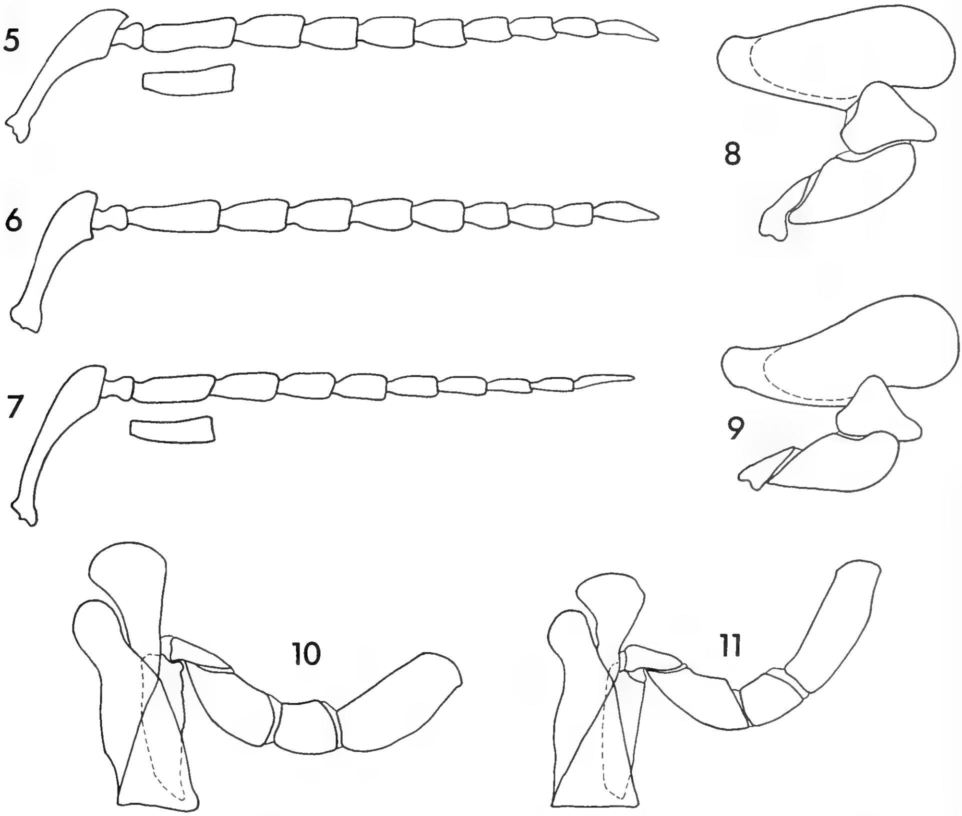
Lytta plagiata Haag-Rutenberg, 1880: 49. [Type locality: Mexico; lectotype (here designated), female, in the Zoologische Staatssammlung in Munich, examined.]



Figs. 3, 4. Elytra. 3, *Pyrota plagiata*. 4, *P. postica*.

Cantharis lacordairei Berg, 1881: 303. [New name for *Cantharis maculata* Lacordaire, not *C. maculata* (Say, 1823–24: 298).]
Lytta divirgata: Berg, 1883: 68 (in part).
Pyrota postica: Champion, 1891–93: 431 (in part: females, "Mexico"). Snow, 1907: 150. Denier, 1934: 64 (in part). Spieth, 1950: 20. Vaurie, 1950: 51.
Pyrota divirgata: Denier, 1934: 60 (in part).
Pyrota plagiata: Werner, 1954: 102–104, figs. 1–2. Werner, Enns, and Parker, 1966: 57.

Description of adult.—Orange; elytra distinctly paler than head and pronotum, varying from a lighter shade of orange to nearly pure yellow. Head sometimes with a black dash or pair of small spots on front between eyes, in heavily marked individuals occasionally with two or more small spots near frontoclypeal suture; occiput usually with a pair of lateral spots and a median spot, or with these spots broadly fused, in which case the black marking may encroach on the vertex; gula usually black. Antenna with segments III–XI black; I and II usually orange, varying to black in heavily marked individuals. Labrum orange to black. Maxillary palpal segment III black, usually with one or both of the preceding segments black also. Labial palpal segment III orange to black. Pronotum with a pair of spots on disk and a spot (usually smaller) on each side, one or both sets of spots very rarely absent. Elytron with scutellar spot frequently shorter than humeral spot, the two rarely fused; postmedian fascia elongate, oval, at most ⅔ and usually less than ½



Figs. 5–11. 5–7, Antennae. 5, *Pyrota plagiata,* male. 6, Same, female. 7, *P. postica,* male. 8, 9, Male maxillary palpi, dorsal views. 8, *P. plagiata.* 9, *P. postica.* 10, 11, Female maxillae, ventral views. 10, *P. plagiata.* 11, *P. postica.*

as wide as long, usually separated from sutural margin by about same distance as from lateral margin (always so if not extended basad of middle of elytron), highly variable in relative length; the shortest fascia observed is ⅓ as long as the elytron, the longest more than ⅔ as long as the elytron and fused with the humeral spot. Venter with black markings variable in extent; in lightly marked individuals, thorax largely black with sclerites broadly margined with orange and first 4–5 abdominal sterna black with a wide area on each side and along posterior margin orange; in the heavily marked extreme the entire venter black. Fore- and midcoxa with or without black basal markings, the forecoxa seldom with black on anterior surface; hindcoxa broadly black laterally. Femora and tibiae usually cleanly tipped with black at apex but varying to entirely black, in which case the coxae and trochanters are black or piceous. Length: 10–25 mm.

Head with ratio of distance between antennal sockets to width at tempora averaging .33 (SE = .03, $N = 10$); cuticle very sparsely if at all micropunctate. Eye width averaging .57 (SE = .07, $N = 10$) length, .87 (SE = .09, $N = 10$) ID. Labrum subquadrate, not strongly rounded laterally, feebly emarginate anteriorly, much more densely punctate laterally than medianly. Labium with segment III

Table 1. Ratio (×100) of length of postmedian fascia of right elytron to length of elytron in *Pyrota plagiata.*

Area	Mean, with 95% C.I.	*N*
Texas	43.0 ± 8.3	4
Arizona, New Mexico	40.6 ± 2.2	53
C. and S. Chihuahua	40.3 ± 2.6	12
W. Chihuahua[1]	54.5 ± 5.3	34
Durango, Zacatecas	55.0 ± 10.8	3
Nayarit	53.9 ± 2.5	17
Jalisco, Morelos	53.4 ± 4.0	10
San Luis Potosí[1]	69.9 ± 0.0	2

[1] Postmedian fascia fused with humeral spot in three specimens from W. Chihuahua and in both from San Luis Potosí. In these specimens the basal limit of the fascia was set arbitrarily as the point where the sides of the fascia would converge if extended without lateral deflection.

expanded, much wider than II. Pronotum with sides weakly divergent from base to anterior ⅓. Elytron with costulae lying in longitudinal depressions, the intervals between costulae distinctly convex. Hindtarsal segment I with pale ventral setae limited to apex or (rarely) absent.

Male.—Antennal segment I with length slightly greater than ID, posterior apical margin just attaining posterior margin of eye, III ½ to ⅔ as long as I. Maxillary palpal segment III with length subequal to ID. Sixth abdominal sternum broadly, moderately deeply emarginate; membranous area weakly sloping, covering apical ⅔, conspicuously setate, the median setae sparser and usually shorter than others. Genitalia with gonostylus weakly expanded at apex.

Female.—Antennal segment I with posterior apical margin attaining middle of eye. Maxillary palpal segment III rather heavy.

Geographic distribution.—San Luis Potosí and Morelos, Mexico, north along the western margin of the Central Plateau of Mexico to southeastern Arizona and southwestern New Mexico, with an apparently isolated population in the Davis Mountains of Texas. Apparently allopatric with *P. postica* except in southeastern Arizona (see discussion of that species). With the exception of Tepatate, San Luis Potosí, at an elevation of about 700 ft., the localities recorded for *P. plagiata* range from 4000 to 7100 ft., with most above 5000 ft. Specimens examined: 193.

Records.—MEXICO: *Chihuahua:* 8 mi. N Gallego; 2 mi. W Pedernales; San José Babícora; Santa Bárbara, Santa Bárbara District. *Durango:* 14 mi. NE Durango; 66 mi. S Hidalgo del Parral [in Chihuahua]. *Jalisco:* Guadalajara; 22 mi. NW La Piedad [in Michoacán]; 10 mi. NW Magdalena; Tequila and 1 mi. N. *Morelos:* Cuautla; Cuernavaca; Xochicalco. *Nayarit:* Jesús María; La Mesa de Nayar. *San Luis Potosí:* 18 mi. W San Luis Potosí; Tepetate. *Zacatecas:* 1.5 mi. W Fresnillo.

UNITED STATES: *Arizona:* Baboquivari Mountains; Chiricahua Mountains; Cochise; Douglas, Kansas Settlement, Cochise County; Palmerlee [=Garces]; mouth of Pinery Canyon, Chiricahua Mountains [Werner, Enns, and Parker, 1966]; 15 mi. W and 40 mi. S Portal; 12 mi. NW Willcox. *New Mexico:* Grant County; Silver City. *Texas:* Ft. Davis and 3 mi. S; Limpia Canyon, Davis Mountains; Marfa.

Discussion.—The color pattern varies greatly in this species, with a generally

Table 2. Variation in color pattern in *Pyrota plagiata,* expressed as percentage of specimens having specified characteristics.

Area	Black Marking(s) Present On				Occipital Spots Fused	Basal Elytral Spots[1]	Mean %	*N*
	Front of Head	Labrum	Ant. seg. I–II	Mesepisternum				
Texas	0.0	60.0	80.0	100.0	0.0	60.0	50.0	5
Arizona, New Mexico	0.0	8.9	14.3	57.1	0.0	57.1	22.9	56
C. and S. Chihuahua	0.0	8.3	25.0	50.0	0.0	66.7	24.8	12
W. Chihuahua	10.3	59.0	79.4	94.9	10.2	100.0	58.9	39
Durango, Zacatecas	33.3	66.7	66.7	66.7	66.7	100.0	66.7	3
Nayarit	47.6	85.7	38.1	38.1	57.1	100.0	61.1	21
Jalisco, Morelos	60.0	80.0	90.0	40.0	50.0	100.0	70.0	10
San Luis Potosí	100.0	100.0	100.0	100.0	100.0	100.0	100.0	2

[1] Spots on each elytron separated by a distance less than width of humeral spot.

high correlation between different parts of the body with respect to the strength of development of black markings. Analyses of variation in several characters of color pattern are presented in Tables 1 and 2.

Variation in the coloration of the abdomen can be described conveniently by use of the color classes defined in Fig. 16. All specimens of *P. plagiata* examined are assignable to class 5 except as follows: in the Arizona-New Mexico area, 1 specimen in class 3 and 2 in class 4; in the Durango-Zacatecas area, 1 specimen in class 6; in the San Luis Potosí area, both specimens in class 6. Through most of the range of the species the coloration of the legs is relatively stable. However, in the sample from western Chihuahua the mean extent of the apical black markings of the femora and tibiae is slightly greater than in samples from adjacent regions, while the two specimens from San Luis Potosí differ from all others in having the legs entirely black.

The available data indicate markedly weaker development of black markings in the population of the northern third of the range of the species (Arizona, New Mexico, Texas, and central and southern Chihuahua) than elsewhere. They are not adequate to demonstrate geographic trends within either of these two large segments of range, although the fact that both specimens from San Luis Potosí show maximal development of black coloration in every character analyzed seems significant.

As far as they go, the data are consistent with Gloger's ecological rule inasmuch as black coloration is least developed in the lowest, more arid portion of the range of the species, i.e., the northern half of the Chihuahuan Desert, at elevations largely between 4000 and 6000 ft. The sudden increase in strength of the black coloration in western Chihuahua is associated with a sharp increase in elevation and, consequently, humidity. The two localities from which the sample of the western Chihuahuan population were drawn, San José Babícora and Pedernales, at 7100 and about 7500 ft., respectively, are in the pine-oak zone of the eastern flanks of the Sierra Madre Occidental. Further south the humidity level remains relatively high even at lower elevations.

I have omitted from the analyses a small female collected at Kansas Settlement, Arizona, 28 July 1955, by G. F. Butler and F. G. Werner. It has the head nearly quadrate, elytra very smooth and shiny, elytral costulae hardly depressed, and antennal segments I-II piceous. Individually these characteristics are within the observed range of variation in *P. plagiata,* but their combination in a single individual is unique.

Haag-Rutenberg described *P. plagiata* from at least two specimens. The syntype that I have designated as lectotype is labeled "Mexico, Bates" and carries Haag-Rutenberg's label "*plagiata* m[ihi]."

Pyrota postica **LeConte**

Figs. 1, 4, 7, 9, 11, 13, 15

Lytta mylabrina [second form]: LeConte, 1858: 22.

Pyrota postica LeConte, 1863–66: 160. [Type locality: Texas; lectotype (here designated), female, in the Museum of Comparative Zoology, Harvard University, Type No. 5103, examined.] Horn, 1885: 113, pl. 5, fig. 15. Casey, 1891: 173. Champion, 1891–93: 431 (in part: males, Villa Lerdo, Durango, Mexico), pl. 20, fig. 5. Townsend, 1894: 101. Cockerell, 1898: 173. Snow, 1906: 174. Fall and Cockerell, 1907: 210. Denier, 1934: 64 (in part). Dillon, 1952: 357. Werner, 1954: 102–104, figs. 3–4. Selander, 1964: 1038 *et seq.,* tbls. I, IV–VIII, figs. 21, 26, 28–29. Selander and Mathieu, 1964: 714, tbl. 3. Werner, Enns, and Parker, 1966: 57. Hurd and Linsley, 1975: 108.

Description of adult.—Orange to yellow-orange; elytra only very rarely distinctly paler than head and pronotum. Antennal segments I–II consistently orange. Labrum very rarely black (2 specimens). Elytron with scutellar and humeral black spots very rarely fused (1 specimen); postmedian fascia subquadrate, with definite corners at least anteriorly, rarely more than ⅖ as long as elytron, usually at least ⅔ as wide as long, extending roughly to middle of elytron, separated from sutural margin by width of sutural swelling and from lateral margin by several times this distance. Venter, on the average, less extensively marked with black than in *P. plagiata,* never entirely black; at the lightly marked extreme, abdomen entirely orange and thorax largely so. Femora and tibiae always orange, cleanly tipped with black at apex. Length: 10–25 mm.

Elytron with costulae not lying in longitudinal depressions, the intervals between costulae flat. Hindtarsal segment I with pale ventral setae usually present from apex to apical ⅓ or more, rarely limited to immediate apex.

Male.—Antennal segment I longer than in *P. plagiata,* its mean length ⅕ greater than ID, posterior apical margin clearly surpassing posterior margin of eye; III ½ to ⅗ as long as I. Maxillary palpal segment III larger, more strongly expanded laterad and more sinuate anteriorly; its width greater than ID. Sixth abdominal sternum more deeply, roundly emarginate; membranous area turned abruptly dorsad at about 45° angle. Genitalia with gonostylus more strongly and abruptly expanded at apex.

Female.—Antennal segment I with posterior apical margin just attaining posterior margin of eye. Maxillary palpal segment III more slender than in *P. plagiata.*

Geographic Distribution.—Southeastern Arizona, central New Mexico, and western and extreme southern Texas south on the Central Plateau of Mexico to eastern Durango and Nuevo León. Specimens examined: 460.

The distributional relationship of *P. postica* and its close relative *P. plagiata* suggests that these species may exert a limiting influence on each other's range. Reference to Fig. 1 shows that the range of *P. plagiata* is peripheral to that of *P.*

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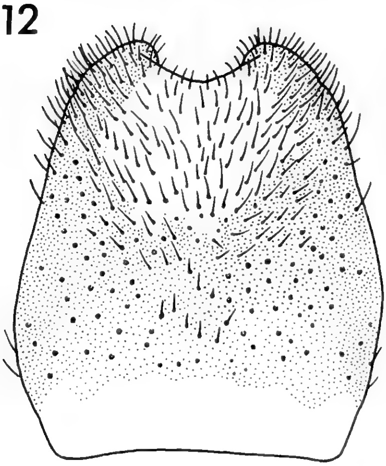

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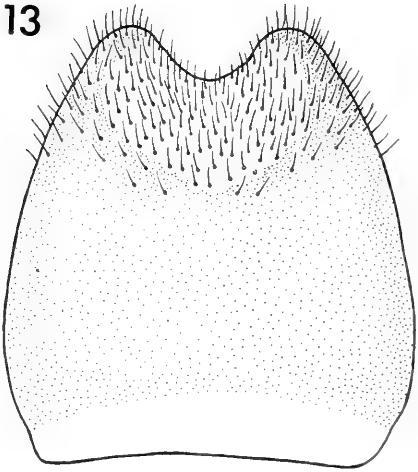

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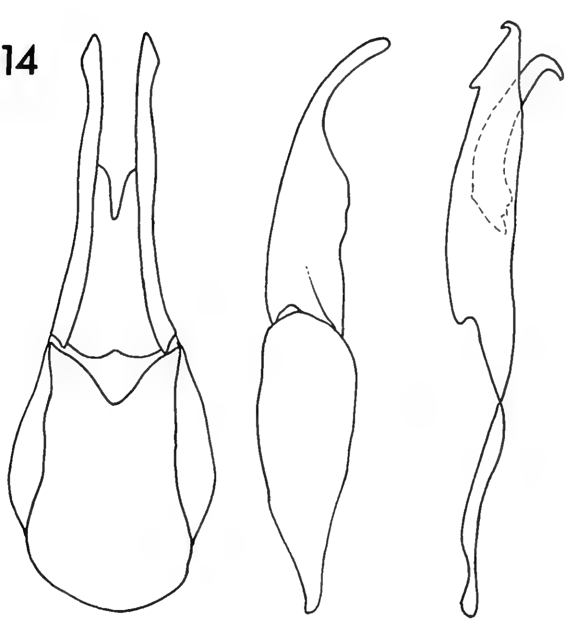

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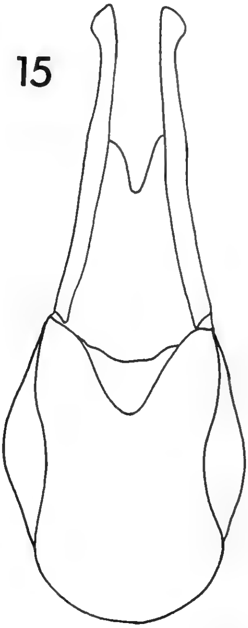

Figs. 12–15. 12, 13, Male sixth abdominal sterna, ventral views. 12, *Pyrota plagiata.* 13, *P. postica.* 14, Male genitalia (ventral and lateral views of gonoforceps, lateral view of aedeagus) of *P. plagiata.* 15, Ventral view of male gonoforceps of *P. postica.*

postica. The distributional picture in southeastern Arizona is complicated, although even in that area there seems to be a high degree of allopatry. The only localities from which both species have been reported are Douglas and Willcox, Arizona. In general, it appears that *P. postica* occurs largely at elevations below 5000 ft. and *P. plagiata* largely at higher elevations. However, there are records of *P. postica* in the Sierra Blanca and Sacramento mountains of New Mexico between 5000 and 8000 ft.

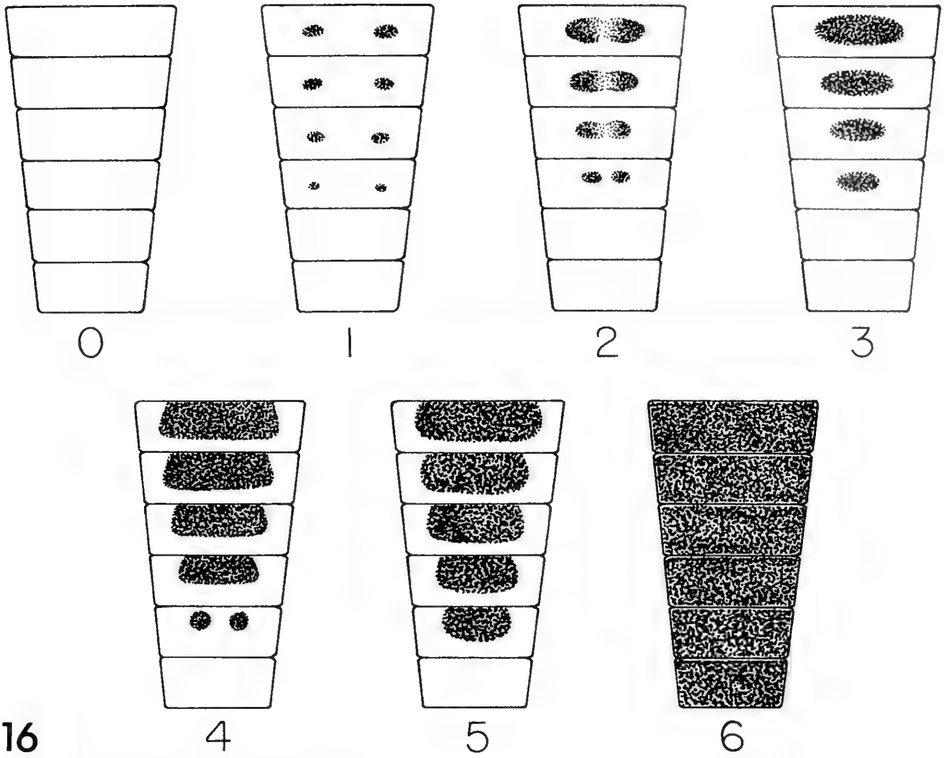

Fig. 16. Abdominal color classes.

As discussed in the section on bionomics, the preferred food plant of *P. postica* is *Larrea tridentata.* Since *P. plagiata* does not feed on this plant, the question arises as to why its range does not overlap that of *P. postica* more extensively. Conversely, although *P. postica* is capable of occurring outside the range of *Larrea,* it seems significant that it apparently does not do so in any area occupied by *P. plagiata.* Moreover, it is perhaps more than coincidental that *P. postica* occurs at elevations well within the altitudinal range of *P. plagiata* only in an area (southern New Mexico) where the latter species is absent. A possible explanation of these relationships is that natural selection resulting from interaction between the species in areas of contact limits the ecological tolerance of each so as to minimize or preclude sympatry. As to the nature of the interaction, current evolutionary theory recognizes two possibilities: production of inferior interspecific hybrids and competition. From their high degree of anatomical similarity as adults and the nature of their courtship behavior, I would guess that if they occurred together, the two species would carry on heterospecific courtship and at least occasional mating. In view of the abundance of *Larrea* over most of the range of *P. postica,* it would seem highly unlikely that this species ever competed seriously with *P. plagiata* for adult food. The possibility exists, of course, that there is or has been intense competition for larval food.

At present the range of *P. plagiata* is apparently disjunct, with at least the population in the Davis Mountains of Texas isolated from the main population of the species by an area of relatively low elevation representing the northern end

Table 3. Variation in color pattern in *Pyrota postica,* expressed as percentage of specimens having specified characteristics.

	Black Marking(s) Present On							
Area	Front of Head	Labrum	Ant. seg. I–II	Mesepisternum	Occipital Spots Fused	Basal Elytral Spots[1]	Mean %	*N*
Arizona, SW. New Mexico	1.9	1.9	0.0	0.0	22.6[2]	84.9	18.6	53
C. and SE. New Mexico	3.1	0.0	0.0	3.1	46.9	96.9	25.0	32
W. Texas	10.9	4.3	0.0[3]	0.0	21.7	82.6	19.9	46
Chihuahua	0.0	0.0	0.0	0.0	14.2	100.0	19.0	7
Durango	40.0	12.3	0.0	44.6	87.6	98.5	47.2	65
S. Texas, Coah., N.L.	68.8	18.8	0.0	37.5	87.5	100.0	52.1	16

[1] Spots on each elytron separated by a distance less than width of humeral spot.

[2] Spots absent in two specimens.

[3] $N = 45$.

of the Central Plateau of Mexico, where the species is replaced by *P. postica.* Distributional relationships of this nature are commonly interpreted in terms of post-Pleistocene climatic changes. Under such a scenario, one would hypothesize that during the last Pleistocene glaciation *P. postica* was confined to the west, perhaps in the region of the Sonoran Desert, while *P. plagiata,* because of the more mesic conditions obtaining at the time, was able to occupy the northern part of the Plateau as a continuous population. Subsequently, as the climate became warmer and drier, *P. plagiata* moved to higher areas to the north and south as *P. postica* moved eastward, forming a wedge that ultimately bisected the range of the former species.

Records.—MEXICO: *Chihuahua:* Colonia Dublán; Colonia Juárez; 12 and 15 mi. S Villa Ahumada; Moctezuma. *Coahuila:* Saltillo. *Durango:* 19 mi. N and 7 mi. SW Cuencamé; Tlahualilo [de Zaragoza]; Villa [=Ciudad] Lerdo. *Nuevo León:* Monterrey.

UNITED STATES: *Arizona:* Bisbee; Bowie; Chiricahua Mountains; Douglas; Far Away River [not located]; Gila Valley; Pima County; Portal and vicinity; Ramsey Canyon, Huachuca Mountains; Safford [Werner, Enns, and Parker, 1966]; San Bernardino Ranch, 15 mi. E Douglas; San Carlos; San Simon; South Fork, Pinery Canyon, Chiricahua Mountains; Willcox. *New Mexico:* Anthony; Bent; Cloudcroft; Las Cruces; Lordsburg; Malpais Spring [mapped as Malpais]; Mescalero; Mesilla Valley [Cockerell, 1898]; Peloncillo Mountains, 18 mi. N Rodeo; Rodeo and vicinity; Socorro. *Texas:* Alpine [Dillon, 1952]; Big Bend region; near Dagger Mountain, Big Bend National Park; 7 mi. NE Dell City; El Paso; El Paso County; Hidalgo County; Kingsville; Laredo; Nine Point Draw, Big Bend National Park; 10 mi. SE Pecos; Presidio; Rosillos Mountains, North Base; Sierra Blanca.

Discussion.—In both this species and *Pyrota plagiata* there is an allometric growth relationship between the width and length of the head, larger individuals of each species tending to have the head more strongly triangular in form than smaller ones.

The color pattern in *Pyrota postica* varies along much the same lines as in *Pyrota plagiata.* The postmedian black fascia of the elytron is comparatively stable

Table 4. Percentage distribution of specimens of *Pyrota postica* in abdominal color classes.

	Classes[1]								
Area	0	1	2	3	4	5	6	Mean	*N*
Arizona, SW. New Mexico	5.8	5.8	9.6	13.5	7.7	57.7		3.8	52
C. and SE. New Mexico			3.1	28.1	3.1	65.6		4.3	32
W. Texas		7.0	7.0	30.2	7.0	48.8		3.8	43
Chihuahua				42.9		57.1		4.1	7
Durango				4.2	2.1	93.8		4.9	192
S. Texas, Coah., N.L.						100.0		5.0	16

[1] Classes are defined graphically in Fig. 16.

in size and shape through the range of *P. postica*. Data on the variation of color pattern on several other parts of the body, comparable with those presented in Table 2 for *P. plagiata*, are given in Table 3. Comparison of these tables suggests that not only is *P. postica* less variable than *P. plagiata* but differs in having antennal segments I and II consistently pale in color and the mesepisternum much less frequently marked with black. Again, in conformity with Gloger's rule, the populations of *P. postica* in Durango and southern Texas, the least xeric part of the range of the species, are characterized by relatively strong develoment of black coloration.

The color of the legs does not vary appreciably. The color pattern of the abdomen, however, is even more variable than in *P. plagiata*. This variation is analyzed in Table 4 using the classes defined in Fig. 16. It is noted that class 6 (entirely black) apparently does not occur in *P. postica*, whereas (as indicated earlier) the lightly marked classes 0–2 are not known to occur in *P. plagiata*. Again, in this character, there is strongest development of black coloration in *P. postica* in the Durango and southern Texas populations. Moreover, the population in central and southeastern New Mexico evidently has, on the average, darker coloration than that in Arizona and southwestern New Mexico.

The most reliable and readily used character for distinguishing *P. postica* and *P. plagiata* is the relative length of antennal segment I. *Pyrota postica* is the only species of the genus in which the segment is so long that it obviously surpasses the eye in the male and attains the posterior margin in the female. In addition, the shape and position of the postmedian elytral fascia provide a basis for consistent interspecific discrimination, as do differences in the shape of maxillary palpal segment III in both sexes and in the form of the male genitalia. *Pyrota plagiata* can generally be recognized by the transverse undulation of the elytral surface, but in occasional specimens the surface is virtually as flat as in *P. postica*. The difference found by Werner (1954) between *P. plagiata* in Chihuahua and *P. postica* in Texas with respect to relative length of the postmedian fascia of the elytra has proved not to be diagnostic.

There has been much confusion regarding the identity of this species, most of which was clarified by Werner (1954). Dugès' (1889) record of *P. postica* from Ahualulco, Jalisco, seems to have been based on specimens of *P. rugulipennis* Champion, not *P. plagiata* as assumed by Werner (1954). The four females from

"Mexico" mentioned by Champion (1891–93) in his treatment of *P. postica* belong to *P. plagiata,* as do the specimens from Chihuahua recorded as *P. postica* by Spieth (1950) and Vaurie (1950).

Pyrota postica was described originally from two females. The specimen designated as lectotype, which is the first in LeConte's series, is labeled with a red disk indicating Texas.

ACKNOWLEDGMENTS

I am grateful to J. C. Schaffner and R. C. Storch for their able help in field studies of *Pyrota* in Mexico; to Alice Prickett for the ink wash paintings of elytra, the drawings of abdominal sterna, and the diagrams defining abdominal color classes; and to an anonymous reviewer for comments and suggestions.

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DESCRIPTIONS OF LARVAL *STENICHNUS* (*CYRTOSCYDMUS*): *S. TURBATUS* AND *S. CONJUX,* WITH NOTES ON THEIR NATURAL HISTORY (COLEOPTERA: SCYDMAENIDAE)

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Abstract.—Larvae of *Stenichnus turbatus* Casey and *Stenichnus conjux* Casey are tenatively associated with adults from berlese extracts of samples of sifted, dry, decaying wood in upstate New York. Both species belong to the subgenus *Cyrtoscydmus* Motschulsky. They do not differ significantly in size, but differ consistently in several chaetotaxic characters which are correlated. We present a detailed description of *S. turbatus* larvae, including illustrations, and compare *S. conjux* larvae which differ in the absence of several structures. Some notes on the natural history of each species are given.

There are few published references to larvae of Scydmaenidae (see Brown and Crowson, 1979, and references therein). For North America, there are only illustrations of *Eumicrus longicollis* Casey and a species assigned to *Euconnus* by Brown and Crowson (1979), both of which were illustrated by Boving and Craighead (1931; cf. plates 16 and 19). Thus, collection of larvae of *Stenichnus* during recent field studies near Ithaca, New York, presented an opportunity to describe two Nearctic scydmaenid larvae as a basis for future studies of these predatory staphylinoid beetles. Both species belong to the subgenus *Cyrtoscydmus* which includes the European species, *S. collaris* (Müller and Kunze) and *S. pusillus* (Müller and Kunze), for which larvae are described (cf. Brown and Crowson, 1979; Paulian, 1941).

We first collected *Stenichnus* larvae (*S. turbatus* Casey and *S. conjux* Casey) from debris and litter in a hollow tree which contained dry, decaying wood and a mouse nest. These materials were sifted and berlesed, and the residue stored in 70% ethanol. Larvae were cleared in Nesbitt's Solution and mounted directly into Hoyer's Medium. A Leitz Dialux-20 compound microscope equipped with differential interference-contrast illumination and a drawing attachment was used to study and illustrate the larvae with magnifications up to 1000×. We identified the larvae to the genus *Stenichnus* with a recent key by Brown and Crowson (1979). Dr. Walter Suter identified the associated adult female as *S. conjux.* A total of six larvae were collected with this female (three *S. conjux*; three *S. turbatus*), with the following collection data: New York, Tioga Co., ca. 2 miles NW Richford, 28 October 1980, J. P. & Q.W. collrs, ex hollow tree with mouse nest, Q.W. Lot #8074. Two larvae, one *S. conjux* and one *S. turbatus,* were sifted from

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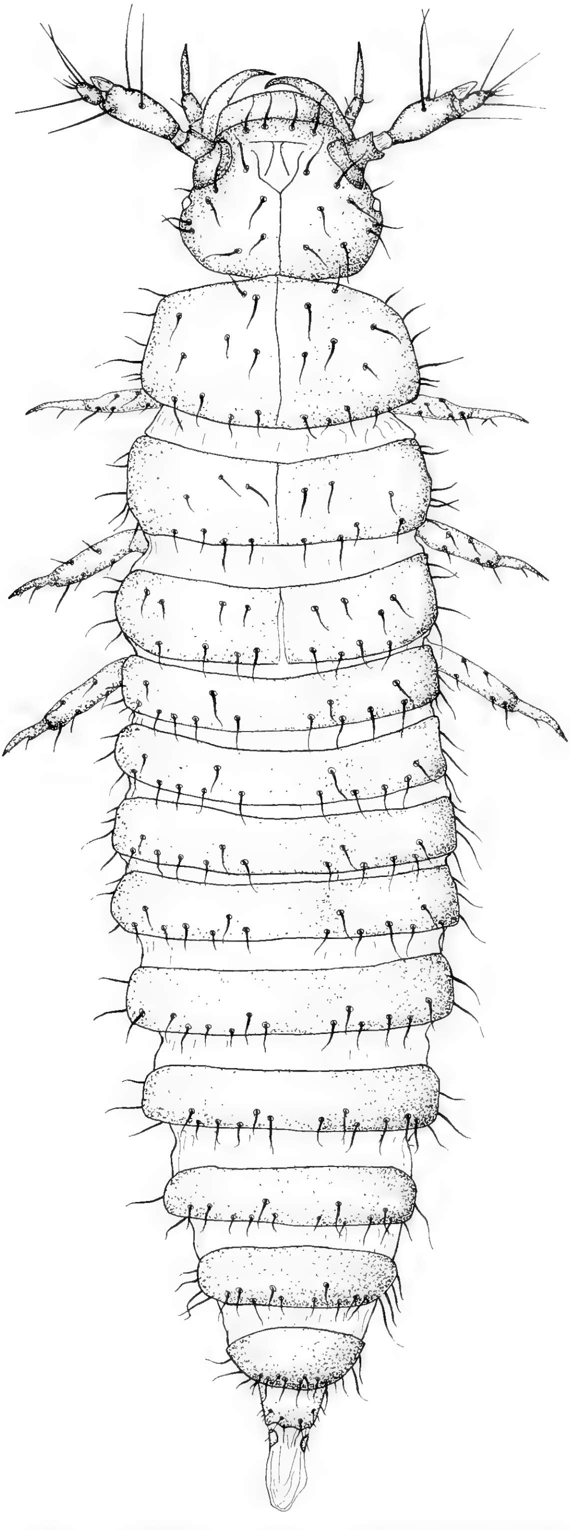


Fig. 1. *Stenichnus turbatus,* larval habitus (dorsal), Tioga County, New York.

Table 1. Measurements (in mm) of selected structures of larvae of *Stenichnus turbatus.*

Structure	Range	Mean
Body length (apex nasale to apex of abdominal segment X)	1.39–1.77	1.57
Metanotum length/metanotum width	.072/.303–.090/.356	.082/.328
Pronotum length/pronotum width	.159/.274–.179/.313	.167/.287
Head length/head width (length at midline/ width at widest point)	.169/.213–.200/.233	.185/.221
Mandible length (along imaginary axis described in text)	.082–.090	.086
Antennal length: antennomere II	.079–.090	.087
antennomere III	.038–.044	.042
Antennal width: antennomere II	.041–.044	.042
Tarsungulus length (along imaginary axis from inner base to apex)	.064–.072	.068

a decaying log with the same data as above. A third series was later collected which included five larvae (all *S. turbatus*) associated with adults, with the following data: New York, Tompkins Co., Ithaca, 9 May 1981, J.P. collr., J.P. Lot #038. Voucher specimens of adults and larvae are deposited in the Cornell University Insect Collections, and representatives retained by J.P.

The following description is based primarily on the Tioga County specimens of *S. turbatus,* and all of the illustrations were made from them. The SEM (Fig. 19) was made from a critical point dried specimen of *S. turbatus* from the "Ithaca" series. Specimens from Q.W. Lot #8074 and J.P. Lot #038 agreed in all characters compared. The identity of *S. turbatus* larvae rests on the association of adults and larvae in J.P. Lot #038, while *S. conjux* larval determination is based on associated adults in the other series combined with elimination of supposed *S. turbatus* larvae. A discussion of *Stenichnus* larvae follows the descriptions.

DESCRIPTIONS OF LARVAL *STENICHNUS*

All observed chaetotaxic characters are present in *S. turbatus,* and all differences seen in *S. conjux* involve the absence of some of these structures. We describe and illustrate *S. turbatus* first, followed by noted differences observed in *S. conjux.* Measurements of selected structures are given in Table 1.

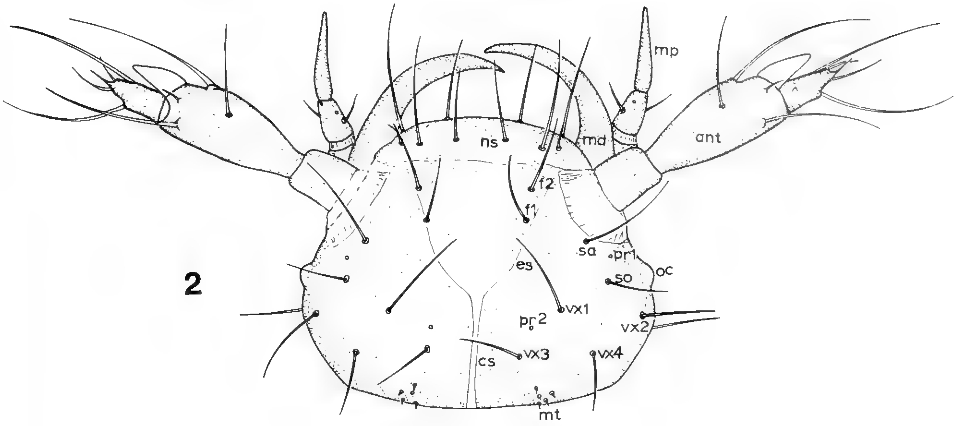
Stenichnus turbatus Casey

Figs. 1–19

With characters of Staphylinoidea (Crowson, 1955), except urogomphi absent; Scydmaenidae (Crowson, 1955); and *Stenichnus* (Brown and Crowson, 1979). Length of midline ca. 1.5 mm ($\bar{x}$ from Table 1); body elongate (Figs. 1, 19), widest at metanotum, gradually narrowed posteriorly; terga wider than sterna, body somewhat onisciform (Fig. 19).

Cranium (Figs. 2, 3). Length (midline)/width (broadest) ca. 0.8; with single pair of ocelli. Coronal suture distinct, long. Epicranial sutures straight, poorly defined anteriorly. Two dorsal and 2 ventral pairs of pores; and 4 vertical, 1 supraantennal,

2



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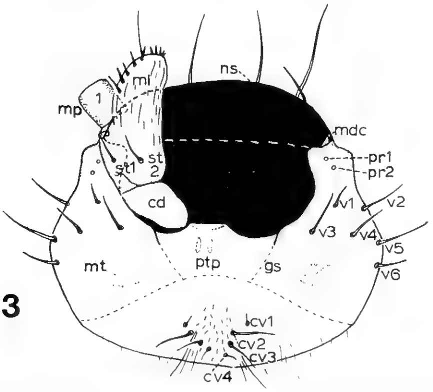


Figs. 2, 3. *Stenichnus turbatus,* larval head. 2, Dorsal view. 3, Ventral view. *ant* = antenna; *cd* = cardo; *cs* = coronal suture; *cv1-cv4* = cervical setae; *es* = epicranial suture; *f1–f2* = frontal setae; *gs* = gular suture; *md* = mandible; *mdc* = mandibular condyle; *ml* = mala; *mt* = microtrichia(e); *mp* = maxillary palpus; *ns* = nasale; *oc* = ocellus; *pr1–pr2* = pores; *ptp* = posterior tentorial pit; *sa* = supraantennal seta; *so* = supraocellar seta; *st1–st2* = stipes setae; *v1–v6* = ventral setae; *vx1–vx4* = vertical setae.

1 supraocellar, 2 frontal, and 6 ventral pairs of setae. Posterior tentorial pits proximal; gular sutures distinct anteriorly, gula short. Microtrichiae present laterad to gula. Cervical membrane ventrally with 4 pairs of setae (middle 2 pairs larger).

Antenna (Fig. 4): Large, prominent (Figs. 1, 2). Sensory appendage large, pointed, anterodorsal relative to antennomere III. Antennomere I short, broad, with 3 dorsal and 2 ventral pores near apex. Antennomere II very long ($\bar{x}$ ca. 0.087 mm), robust, with 3 large and 2 smaller setae; width ($\bar{x}$) ca. 0.042 mm. Antennomere III small ($\bar{x}$ length ca. 0.042 mm), apex terminating in pointed apical process; with 6 setae (Fig. 4).

Nasale and epipharynx (Fig. 7): Nasale transverse, with 2 pairs of large, anterior setae, and 4 pairs of dorsal setae (2 pairs large, 2 pairs smaller). Epipharynx membranous, with 2 pairs of pores and 4 pairs of setae (lateral setae larger), and various microtrichiae.

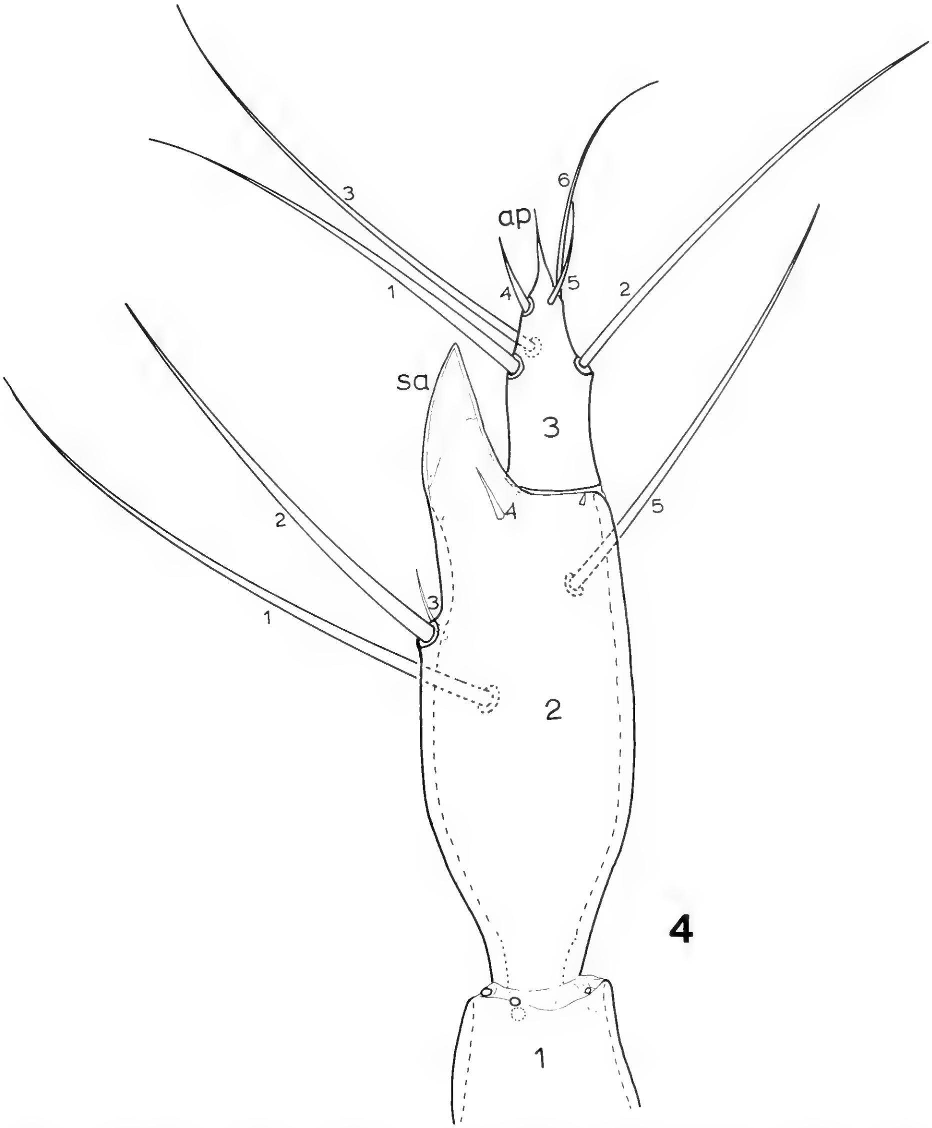
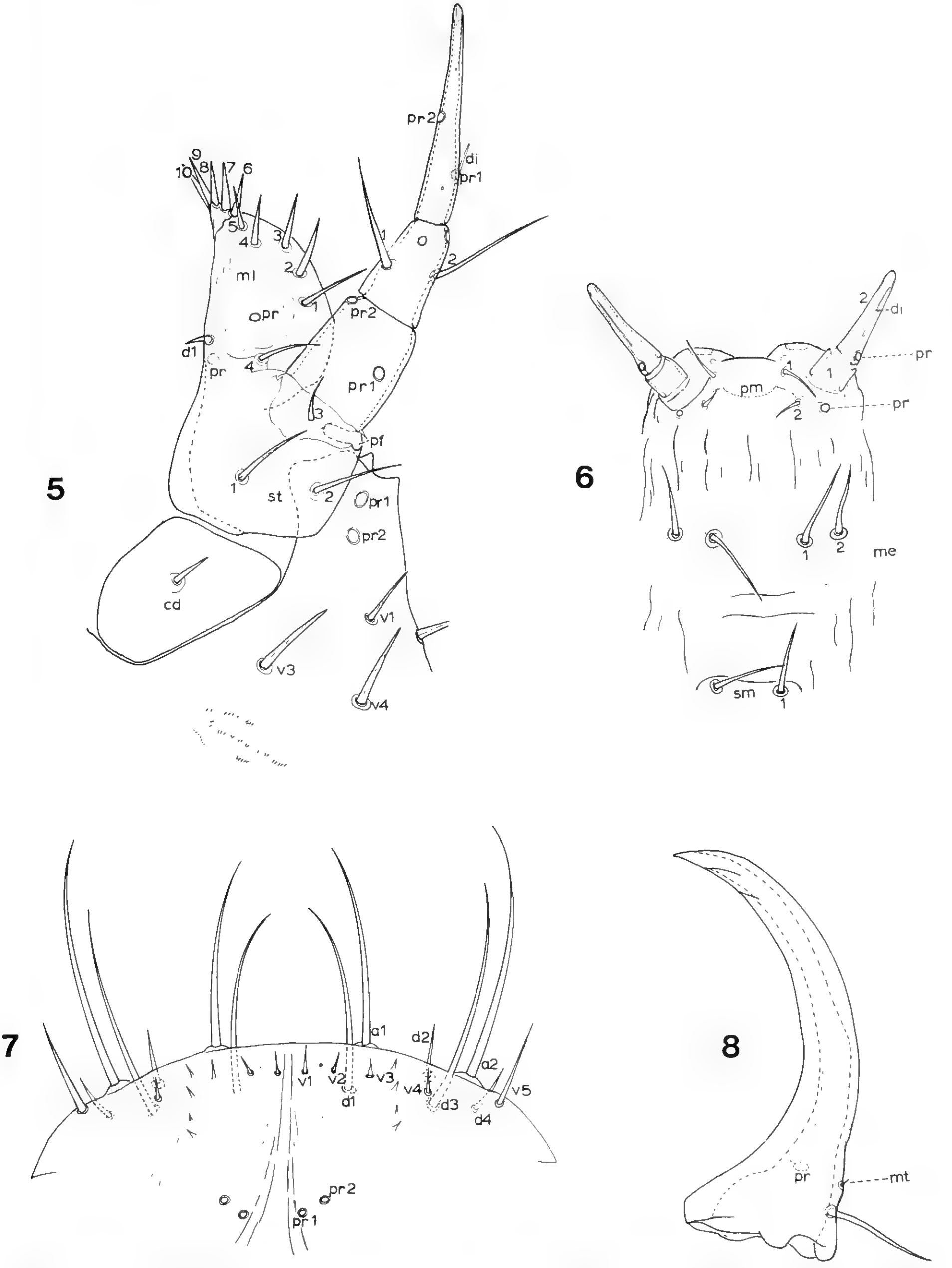


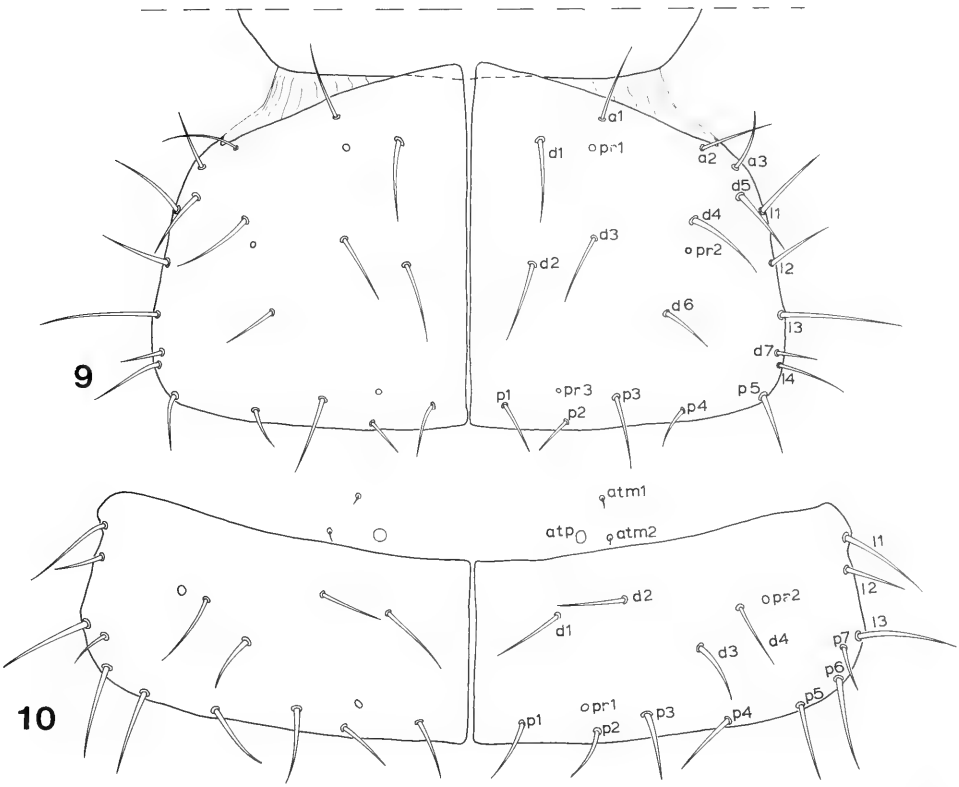
Fig. 4. *Stenichnus turbatus,* larval antenna; large numbers are segments; small numbers are setae; *ap* = apical process; *sa* = sensory appendage.

Mandible (Fig. 8): Mandible falcate, long, narrow, pointed; with single dorsal pore, large basolateral seta, and single lateral microtrichia; $\bar{x}$ length ca. 0.086 mm, measured along imaginary axis drawn from inner margin of base to apex.

Maxilla (Fig. 5): Cardo simple, quadrangular, with single seta. Stipes short, broad, with 2 setae on disc, 2 setae at anterior margin near bases of mala and palpus, and 1 pore at base of mala. Palpifer small. Palpus trimerus. Palpomere I with 2 ventral pores. Palpomere II with 2 setae and 2 pores (1 apicoventral, 1



Figs. 5–8. *Stenichnus turbatus,* larval mouthparts. 5, Maxilla (left, ventral). 6, Labium (ventral). 7, Nasale (ventral). 8, Mandible (left, ventral). *a* = anterior seta; *cd* = cardo; *d* = dorsal seta; *di* = digitiform sensillum; *me* = mentum; *ml* = mola; *mt* = microtrichia(e); *pm* = prementum; *pr* = pore; *sm* = submentum; *v* = ventral seta.

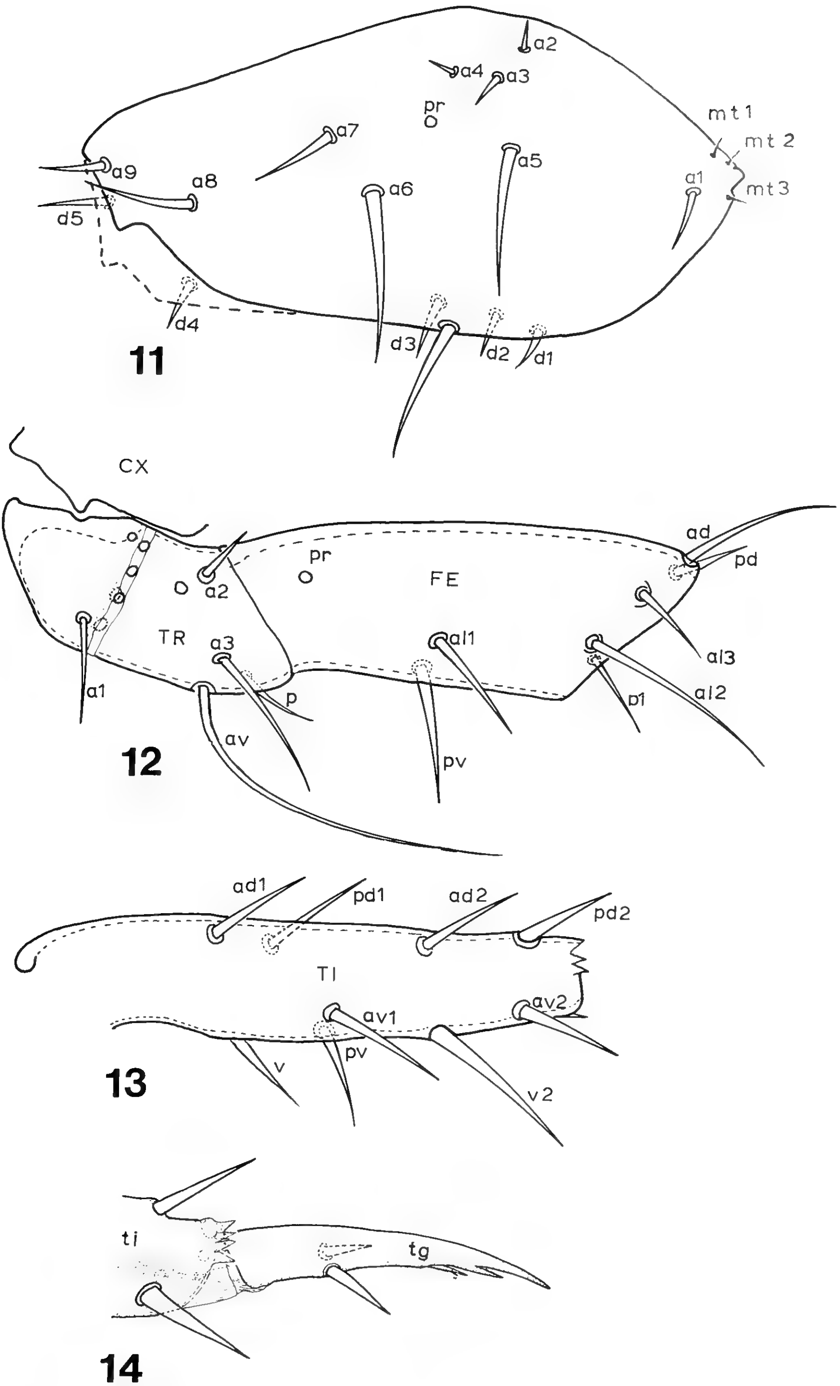


Figs. 9, 10. *Stenichnus turbatus,* larval thoracic nota. 9, Pronotum. 10, Metanotum. *a* = anterior seta; *atm* = acrotergal microtrichia; *atp* = acrotergal pore; *d* = dorsal seta; *l* = lateral seta; *p* = posterior seta; *pr* = pore.

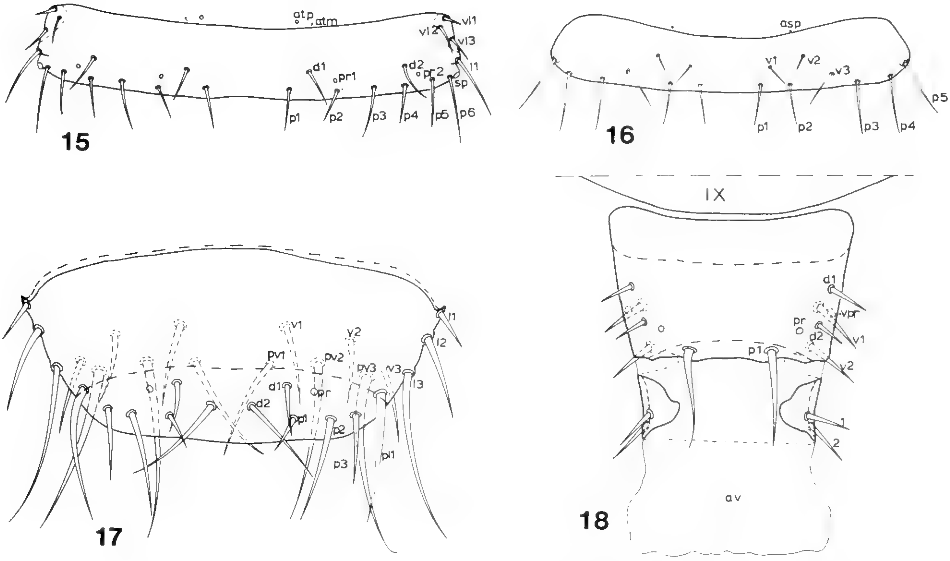
apicolateral), narrower than I but similar in length. Palpomere III long, thin, narrowed apically with single digitiform sensillum dorsally, 1 dorsal seta, and 2 pores (1 ventromedial near middle, 1 dorsolateral near base).

Labium (Fig. 6): Largely membranous. Submentum with 1 seta. Mentum with 2 pairs of setae. Prementum without clearly defined sclerite, with 2 pairs of setae and 1 pair of pores. Palpus bimerous. Palpomere I short, simple. Palpomere II long, thin, narrowed apically, with dorsal digitiform sensillum and basolateral pore. Ligula absent.

Thorax (Figs. 9, 10): Pronotum evenly divided into 2 plates; almost twice as wide as long (ca. 1.7×), broadest at posterior angle; with 19 pairs of setae (cf. Fig. 9: 3 anterior, 7 dorsal, 4 lateral, and 5 posterior pairs) and 3 pairs of pores (pr1 proximal to a1; pr2 to d4; and pr3 to p2). Mesonotum about 4× as wide as long, dorsum divided into 2 plates; with 14 pairs of setae (Fig. 10: 4 dorsal, 3 lateral, and 7 posterior pairs) and 2 pairs of pores (pr1 proximal to p2, pr2 to d4); acrotergite with 1 pair pores, 2 pairs microtrichiae (Fig. 10); venter with numerous minute, rough protuberances (=microtrichiae ?), and 1 pair of setae between coxae, almost on midline; spiracle annular, on stalked protuberance, ventrolateral near anterior margin, with seta on anteromesal margin of spiracular stalk. Metanotum similar to mesonotum; spiracle absent.



Figs. 11–14. *Stenichnus turbatus,* larval leg. 11, Coxa. 12, Trochanter and femur. 13, Tibia. 14, Tarsungulus. *a* = anterior seta; *al* = anterolateral seta; *ad* = anterodorsal seta; *av* = anteroventral seta; *d* = dorsal seta; *CX* = coxa; *pd* = posterodorsal seta; *mt* = microtrichia; *FE* = femur; *TI* = tibia; *tg* = tarsungulus; *v* = ventral seta.



Figs. 15–18. *Stenichnus turbatus,* abdomen. 15, Tergum III (dorsal). 16, Sternum III (ventral). 17, Segment IX (dorsal). 18, Segment X (dorsal). *asp* = acrosternal pore; *atm* = acrotergal microtrichia; *atp* = acrotergal pore; *d* = dorsal seta; *l* = lateral seta; *p* = posterior seta; *pv* = posteroventral seta; *pr* = pore; *v* = ventral seta; *vl* = ventrolateral seta; *vpr* = ventral pore; *av* = anal vesicle.

Leg (Figs. 11–14): Coxa (Fig. 11) large, ovate, with 9 anterior setae, 1 anteroventral seta, 5 ventral setae, 3 basal microtrichiae, and 1 anterior pore. Trochanter (Fig. 12) elongate, divided by unsclerotized "band" which extends around entire circumference and has 3 anterior and 2 posterior pores aligned on it; with single pore and seta on portion basad to band; with 1 pore, 2 anterior setae, 1 anteroventral seta, and 1 posterior seta on distal part. Femur (Fig. 12) elongate; with 3 anterolateral setae, 1 anterodorsal seta, 1 posterodorsal seta, 1 posteroventral seta, and 1 anterior pore. Tibia (Fig. 13) elongate, narrow; with 2 ventral setae, 1 posteroventral seta, and several spinose cuticular processes apically. Tarsungulus (Fig. 14) bisetose (1 seta posterior, 1 anteroventral); with 2 preapical spines on claw.

Abdomen (Figs. 15–18): Terga I–VIII subrectangular, much broader than long at midline; I–V subequal in length, VI–VIII gradually narrowed. Tergum III with anterolateral projection folded so that ventrolateral setae are directed ventrally; with 12 pairs of setae (2 dorsal, 6 posterior, 1 lateral, and 3 ventrolateral pairs of setae) and 2 pairs of pores (1 proximal to p2, 1 about midway between d2 and p5); acrotergite with 1 pair of pores, and 1 pair of microtrichiae (Fig. 15); spiracle inside stalked protuberance, projecting ventrally, arising at posterolateral angle. Spiracles I–VII subequal; spiracle VIII about ½ size of preceding ones. Sternum III with 3 pairs ventral setae, 5 pairs posterior setae; pores absent; acrotergite with 1 pair microtrichiae (Fig. 16). Tergum IX about twice as wide as long, narrowed posteriorly; with 6 pairs of setae (2 dorsal, 2 posterior, and 2 posterolateral pairs). and 1 pair of pores (Fig. 17). Sternum IX much shorter at midline than tergum, about 3× as wide as long; with 6 pairs of setae (3 ventral and 3 posteroventral pairs), pores absent; lateral margins each with 3 setae, progressively

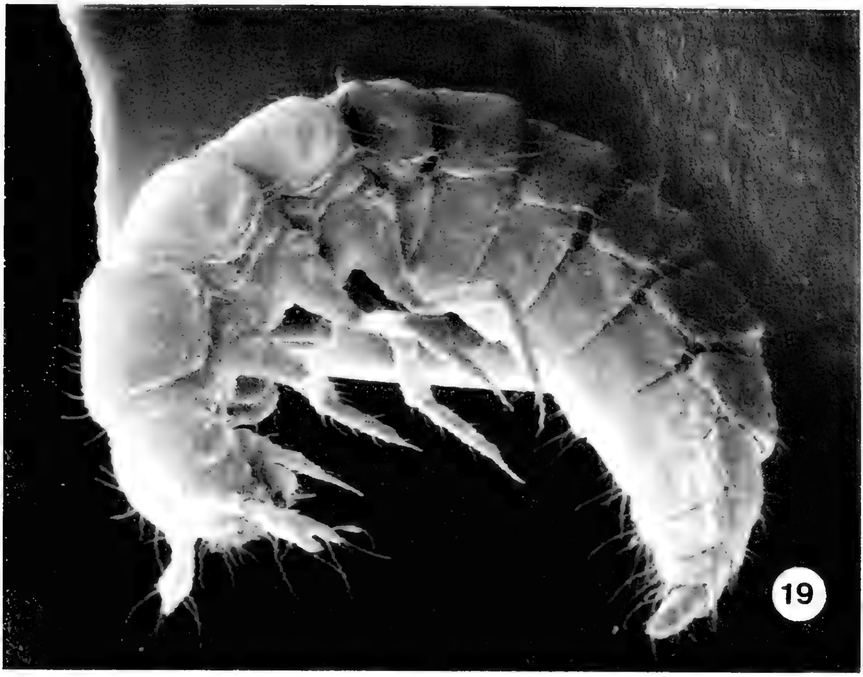


Fig. 19. *Stenichnus turbatus,* lateral habitus, scanning electron micrograph of critical point dried specimen.

longer posteriorly. Segment X narrowed posteriorly; dorsum subquadrate with 2 pairs dorsal setae, 1 pair posterior setae, and 1 pair of pores (Fig. 18); venter much broader than long (ca. 2–3×), with 2 pairs of setae and 1 pair of pores proximal to v1 setae. Anal vesicle large, membranous.

Stenichnus conjux Casey

As in *S. turbatus,* except following structures: cervical membrane with cv3 and cv4 absent (see Fig. 3); pronotum with only 15 pairs of setae (setae p2, p4, d5, and d7 absent, see Fig. 9); mesonotum with only 10 pairs of setae (setae d3, p2, p4, and p7 absent, see Fig. 10); metanotum as mesonotum; tergum III with only 9 pairs of setae (setae p2, p4, and p5 absent, cf. Fig. 15); sternum III with only 7 pairs of setae (seta v2 absent, cf. Fig. 16).

Notes on Natural History

Scydmaenidae are believed to be specialized predators of mites (Crowson, 1981: 490), although there have been few studies on food selection, prey capture, or environmental factors affecting the distribution of scydmaenid beetles (cf. Brown and Crowson, 1979). Both of our larger series of *Stenichnus* were taken from conspicuously dry, decaying wood. Walter Suter indicates that associations of Scydmaenidae with dry habitats may be a more or less widespread phenomenon (personal communication). We made no direct observations of feeding for either collection, but one series (Q.W. Lot #8074) included an abundance of mites. It is interesting that species of the subgenus *Cyrtoscydmus* have been collected repeatedly by us and by Crowson, who has taken *S. collaris* in nearly every month of the year, as compared with other scydmaenid taxa less frequently encountered; *S. turbatus* and *S. conjux* have been taken in equal numbers in the same habitat on two occassions. An abundance of *S. collaris* larvae in September and October suggested to Brown and Crowson (1979) that breeding is primarily in spring or early summer. Our collections of *Stenichnus* in October and May (and Crowson's other collections) indicate that larval overwintering may be a pattern in *Cyrtoscydmus.*

DISCUSSION

We have used the term "pore" for minute, circular, cuticular structures which consist of a round sclerite, separated from the surrounding integument by a narrow, apparently membranous area. These structures may be campaniform sensillae, but until detailed studies are done, and to remain consistent with existing staphylinoid literature, we refer to them simply as "pores." Abdominal segment III was used as an exemplar, and detailed descriptions of the chaetotaxy of other segments were not made. It is possible that additional characters will be found on other segments. Segments IX and X show apparently random variation of patterns of setae, differing among individuals of each species. Our description of these structures is based on a single specimen of *S. turbatus.* We have used a system of letters and numbers, which are explained in the figure captions, to refer to setae, pores, and microtrichiae.

In most respects, *S. turbatus* and *S. conjux* resemble other known species of *Stenichnus* (Brown and Crowson, 1979). They differ from other *Cyrtoscydmus* (*S. pusillus* and *S. collaris*) in having nonserrate mandibles.

Our initial discovery of *Stenichnus* larvae here assigned to both *S. conjux* and *S. turbatus* in a ratio of 1:1 raised a question about what we were dealing with. Were there two species? Could there be two instars? Or, perhaps there were two semaphoronts of a single instar (such as sexual dimorphism). Collecting five specimens of one of these forms in association with adult *S. turbatus* caused us to hypothesize that this form was the larva of *S. turbatus,* and by elimination, that the alternative form was the larva of *S. conjux.* A corollary of this assumption is that both species occur together in the same microhabitats, and that the 50:50 ratios in two small samples were due to chance alone. Additional field collections will help to sort out the possibilities, and rearing may eventually provide a firm resolution. In the meanwhile, our inference seems consistent with the data, and provides relatively detailed descriptions of scydmaenid larvae, which include several characters of likely systematic and phylogenetic value hitherto unstudied. We are not in a position to analyze characters nor state their level of taxonomic importance. Our description does provide a basis for comparison, and emphasizes the great potential for larval studies in the Scydmaenidae.

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THE SUBGENUS *DESUMENOPON* OF *AMYRSIDEA* (MALLOPHAGA: MENOPONIDAE)

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Abstract.—Six species of the genus *Amyrsidea* Ewing subgenus *Desumenopon* Carriker from galliform hosts of the family Phasianidae genus *Odontophorus* Vieillot are described and illustrated. *Amyrsidea praegracilis cumbrensis* Carriker is a new synonym of *A. gujanensis* Carriker. Several new hosts are recognized, and a key is given for the identification of species.

The menoponid genus *Amyrsidea* Ewing, 1927, was recently revised, and six subgenera are recognized (Scharf and Price, 1977). Presented here are descriptions, illustrations, and a key to the six species included in the subgenus *Desumenopon* Carriker. All species described here belong to *Amyrsidea sensu lato* which is described along with keys to the subgenera (Scharf and Price, 1977).

In the following descriptions, numbers of certain head setae are those given by Clay (1969). Measurements are in millimeters. Unless noted, all illustrations are of specimens from the type-host. The nomenclature of the hosts follows Peters (1934).

Subgenus *Desumenopon* Carriker

Desumenopon Carriker, 1954: 25.

Type-species: *Amyrsidea praegracilis* Carriker.

Desumenopon is a group of closely related lice which are known only from the Neotropical genus *Odontophorus* Vieillot (Phasianidae). It is separated from other subgenera by the following combinations of characters:

(1) Head with moderately wide temples; difference between temple and preocular width, 0.09–0.12.

(2) Hypopharyngeal sclerite weakly developed (Fig. 1).

(3) Preocular slit deep (0.04–0.05).

(4) Preocular seta 11 longer than 0.10 and thicker than seta 10.

(5) Four or more dorsal head sensilla (approximately at hypopharyngeal level) between sensilla *c* (Fig. 2).

(6) Terminal antennal segment short and wide, ratio of width to length more than 0.5.

(7) Eyes of moderate size, neither reduced nor prominent.

(8) Sternum I with 2 setae.

(9) Outer medio-anterior metanotal setae shifted anteriorly.

(10) Female without sexually dimorphic enlarged terga.

(11) Female pleura not extended.

(12) Female segment IX with anal fringes and sternal setae similar to Fig. 11; no spiniform setae.

Amyrsidea (Desumenopon) praegracilis Carriker

Figs. 1, 2, 4, 5, 11

Amyrsidea praegracilis praegracilis Carriker, 1950: 509.

Type-host: *Odontophorus gujanensis polionotus* Osgood and Conover (error) = *O. g. marmoratus* Gould.

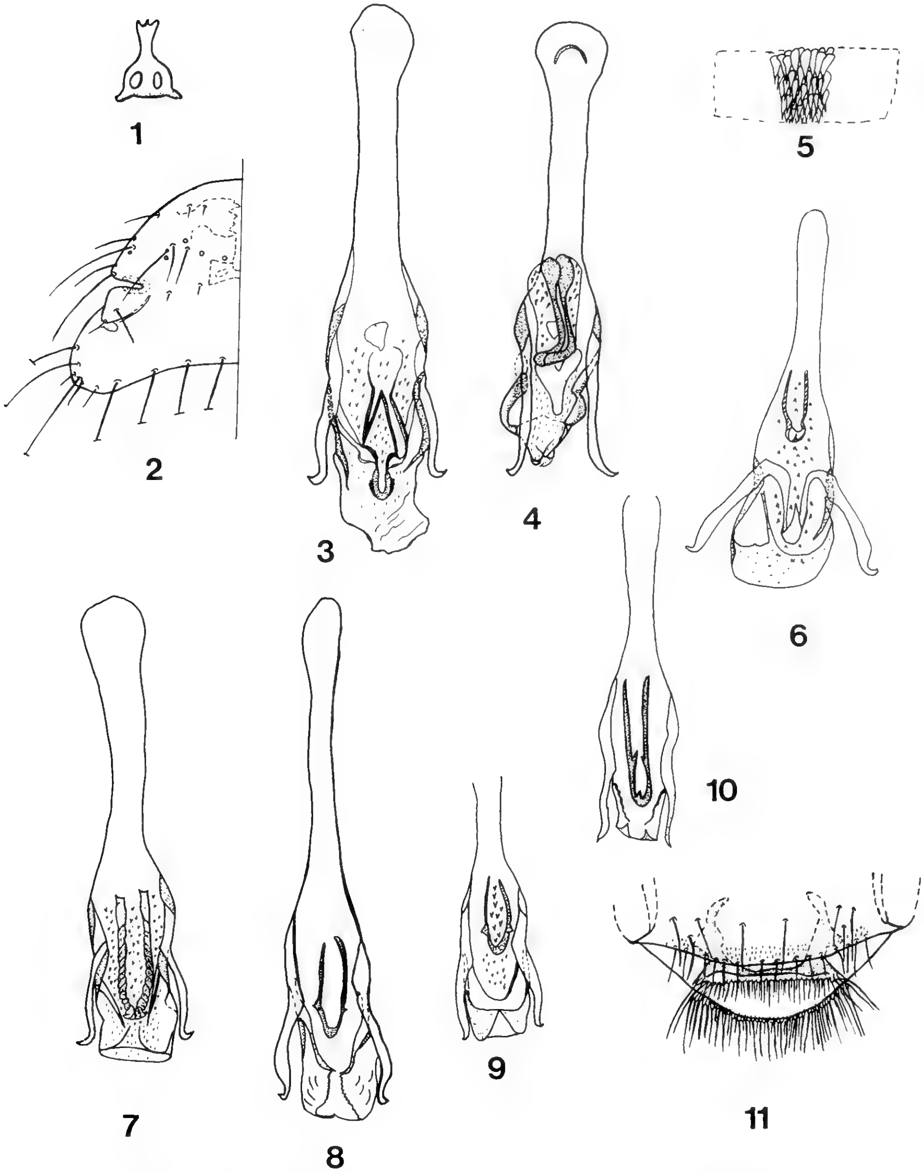
Male.—Postmental setae each side with 1 medium, 1 long, and 2 short lateral setae. Middorsal head setae minute; inner seta 17 slightly anterior to outer 18. With 4–7 dorsal head sensilla between sensilla *c*. Gular plate with 4 + 4 setae. Pronotal margin with 16–18 long and 4 short setae. Metanotal margin with 10–14 long setae; mesosternal and metasternal plates triangular with 10–11 and 8–10 setae, respectively. Venter of each femur III with brush of 14–22 short setae. Marginal abdominal tergal setae: I, 16–18; II, 15–16; III, 18; IV, 22; V, 17–26; VI, 23–24; VII, 21–24; VIII, 13–18. Postspiracular setae long on I–II and very long on III–VIII; all marginal setae between postspiracular setae medium. With 2–4 medium latero-anterior tergal setae on V–VII, none on VIII. Last tergum each side with 2 very long marginal setae with 1 short seta latero-anterior to these, no anterior setae, and 10–15 total inner posterior setae. Pleura normal with 7–9 marginal and 5–7 anterior setae of medium length. Sternal setae: II, 22–27; III, 22–24; IV, 22–26; V, 22–26; VI, 19–23; VII, 13–29; VIII, 24–26. Sternal brushes each side: III, 11–13; IV, 19–22; V, 21–22; VI, 16–24; VII, 15–23. Sterna VIII and IX not fused; IX with 14–20 marginal medium setae on subgenital plate and 16–24 anterior medium setae. Genitalia as in Fig. 4.

Female.—Head and thorax as for male. Marginal abdominal tergal setae: I, 13–18; II, 14–31; III, 19–34; IV, 26–38; V–VII, 36–40; VIII, 21–22. With 4–8 medium latero-anterior setae on V–VII, 2 on VIII. Tergum IX as for male but with 18–21 total inner posterior setae. Sterna VIII and IX fused, with 20–29 anterior and 26–28 setae marginal to the subgenital plate; coarse patch of microtrichia lining vulva (Fig. 5). Anus with 36–50 dorsal and 37–55 ventral fringe setae.

Dimensions.—Preocular width, male 0.31–0.34, female 0.31–0.34; temple width, male 0.41, female 0.41–0.46; prothorax width, male 0.35–0.36, female 0.36–0.39; metathorax width, male 0.41–0.45, female 0.44–0.50; total length, male 1.73–1.77, female 1.61–1.83; male genitalia width 0.10–0.12, length 0.50–0.51.

Remarks.—The single female specimen from *Odontophorus erythrops* Gould has 7–12 more marginal tergal setae each on I–IV and slightly fewer (2–4) sternal setae than do specimens from the type-host; in the absence of males and the presence of distinctive latero-anterior setae on abdominal terga V–VII, it seems prudent to consider it as this species. The L-shaped male genital sclerite is seen to be a double structure when the genitalia are twisted, but even in the several cases of everted genital sacs, the structure remains distinctive and recognizable (Fig. 4).

Material examined.—10 ♂, 11 ♀ (including holotype ♂ and allotype ♀ on slide 68585, USNM, and 3 ♂ and 3 ♀ paratypes), *Odontophorus gujanensis marmoratus,* Colombia, Panama; 1 ♀, *Odontophorus erythrops,* Panama.



Figs. 1–11. *Amyrsidea (Desumenopon)* spp. 1, Weakly developed hypopharyngeal sclerite of *A. praegracilis,* from *Odontophorus erythrops.* 2, *A. praegracilis,* head, from *O. erythrops.* 3, *A. gujanensis,* male genitalia. 4, *A. praegracilis,* male genitalia, from *O. gujanensis marmoratus.* 5, *A. praegracilis,* microtrichia lining female vulva. 6, *A. hyperythra,* male genitalia. 7, 8, *A. complicata,* male genitalia. 9, *A. ricaurtei,* male genitalia. 10, *A. speciosa,* male genitalia. 11, *A. praegracilis,* female terminal segments showing anal fringe, from *O. erythrops.*

Amyrsidea (Desumenopon) gujanensis Carriker

Fig. 3.

Amyrsidea praegracilis gujanensis Carriker, 1950: 509.
Type-host: *Odontophorus g. gujanensis* (Gmelin).
Amyrsidea praegracilis cumbrensis Carriker, 1950: 509. NEW SYNONYMY
Type-host: *O. colombianus* (Gould).

Male.—Essentially as for *A. praegracilis* except more marginal tergal setae II–VIII: II, 26–32; III, 33–36; IV, 36–38; V, 36–41; VI, 40–42; VII, 36–38; VIII, 30–34. With only 2 latero-anterior setae on terga I–VIII (4 on tergum IV of 2 specimens) and with inverted V-shaped sclerotization anteriorly and U-shaped genital sclerite posterior to this (Fig. 3).

Female.—Essentially as for *A. praegracilis* except tergal features as in male and microtrichia lining in vulva finer and sparser.

Dimensions.—As for *A. praegracilis* except total length, male 1.65–1.74, female 1.78–1.87; male genitalia width 0.11–0.13, length 0.52.

Remarks.—The tergal features of both sexes and the U-shaped genital sclerite are the distinctive features of *gujanensis.* The paired L-shaped genital sclerite of *praegracilis* may appear U-shaped if viewed at the right position. However, we have studied a number of different specimens of each species in different degrees of genital sac eversion and are convinced the difference is substantial.

Material examined.—2 ♂, 2 ♀ (including holotype ♂ and allotype ♀ slide 68586, USNM, and ♂ and ♀ paratype), *Odontophorus g. gujanensus,* Venezuela, Peru; 2 ♂, 2 ♀ (paratypes of *A. p. cumbrensis*), *O. columbianus,* Venezuela.

Amyrsidea (Desumenopon) hyperythra (Carriker)

Fig. 6

Desumenopon praegracilis hyperythrus Carriker, 1954: 25
Type-host: *Odontophorus hyperythrus* Gould.

Male.—Essentially as for *A. praegracilis,* except tergum I with fewer marginal tergal setae, (10), no latero-anterior tergal setae on V–VIII, and genitalia with parameres connected and genital sclerite reduced as in Fig. 6.

Female.—Inseparable from females of *A. praegracilis* except tergum I possibly with fewer marginal tergal setae (12) and with no vulval microtrichia.

Dimensions.—Head and thorax slightly smaller in each dimension (by 0.01–0.02) than *A. praegracilis*; total length, male 1.70, female 2.01; male genitalia width 0.14, length 0.38.

Remarks.—The genital sclerite (compare Figs. 4 and 6), the slightly wider (0.01–0.02) and shorter (0.14) size of the genitalia, and the greater total length of the female are the distinguishing features of *hyperythra.* It is known from only one specimen of each sex.

Material examined.—1 ♂, 1 ♀ (holotype and allotype, respectively, of *D. p. hyperythra* on slide 68614 USNM), *Odontophorus hyperythrus,* Colombia.

Amyrsidea (Desumenopon) complicata (Carriker)

Figs. 7, 8

Desumenopon hyperythrus complicatus Carriker, 1967: 35.
Type-host: *Odontophorus melanotus* Gould.

Male.—Essentially as for *A. praegracilis* except for no latero-anterior setae on V–VIII, and long genitalia with genital sclerite having twisted appearance (Fig. 7) or elongate with 2 pointed projections (Fig. 8).

Female.—Unknown.

Dimensions.—As for *A. praegracilis* except total length, 1.52–1.60, and male genitalia width 0.14, length 0.48–0.50.

Remarks.—This species is apparently the shortest member of *Desumenopon* and, in addition to the genital sclerite features described above, it has the longest and widest genitalia of the group.

Material examined.—2 ♂ (including holotype of *D. h. complicatus,* on slide 68243, USNM), *Odontophorus melanotus,* Ecuador, Panama.

Amyrsidea (Desumenopon) ricaurtei **(Carriker)**
Fig. 9

Desumenopon hyperythrus ricaurtei Carriker, 1967: 35.

Type-host: *Odontophorus erythrurus parambae* Rothschild.

Male.—As for *A. praegracilis* except for genitalia with spinous sac and genital sclerite with 2 pointed projections extending laterally (Fig. 9) similar to the variant of *A. complicata* (Fig. 8).

Female.—Unknown.

Dimensions.—As for *A. praegracilis* except total length, 1.61, and male genitalia width 0.11, length 0.37.

Remarks.—The total length is nearly as short as *complicata,* but the genitalia are shorter and slightly slenderer than *complicata* in combination with the distinctive sac and genital sclerite features mentioned above (Figs. 7–9).

Material examined.—1 ♂ (holotype of *D. h. ricaurtei,* on slide 68884, USNM), *Odontophorus erythrurus parambae,* Colombia.

Amyrsidea (Desumenopon) speciosa **(Carriker)**
Fig. 10

Desumenopon speciosa Carriker, 1967: 35.

Type-host: *Odontophorus s. speciosa* Tschudi.

Male.—As for *A. praegracilis* except more marginal tergal setae on each of I–VII, 34–41, no latero-anterior setae on V–VIII, and genital sclerite with 3 pointed projections extending medially (Fig. 10).

Female.—As for *A. praegracilis* except total length, 1.70 and male genitalia width 0.10, length 0.44.

Remarks.—The shape of the genital sclerite is a prominent identifying characteristic.

Material examined.—1 ♂ (holotype of *D. speciosa,* slide 68240 USNM), *Odontophorus s. speciosa,* Peru; 17 ♂, 12 ♀, *O. s. loricatus* (Todd) [=*O. loricatus* (Todd)].

KEY TO SPECIES OF THE SUBGENUS *DESUMENOPON*

1. Latero-anterior setae on terga V–VIII 2
– No latero-anterior setae on terga V–VIII 3
2. With 2 (occasionally 4) latero-anterior setae on each tergum I–VIII; male with U-shaped genital sclerite (Fig. 3); female with sparse vuval microtrichia .... *gujanensis* Carriker

– With 2 latero-anterior setae on terga I–II, none on III–IV, 2–8 on V–VIII; male with paired L-shaped genital sclerites (Fig. 4); female with dense, well-defined area of vulval microtrichia (Fig. 5) .... *praegracilis* Carriker

3. Male genitalia with parameres connected and genital sclerite reduced as in Fig. 6; one female known, without vulval microtrichia .... *hyperythra* (Carriker)

– Male genitalia without parameres connected; and genital sclerites larger; female of *speciosa* with fine vulval microtrichia 4

4. Male genitalia total length 0.48–0.61; genital sclerite either modified with twisted appearance (Fig. 7) or elongate (.12–.16) (Fig. 8); female unknown .... *complicata* (Carriker)

– Male genitalia total length 0.37–0.42; genital sclerite shorter (.08–.10) and not twisted 5

5. Male genitalia with spinous sac and genital sclerite with 2 pointed projections extending laterally as in Fig. 9; female unknown .... *ricuartei* (Carriker)

– Male genitalia apparently without spinous sac and genital sclerite with 3 pointed projections as in Fig. 10; female with sparse, fine vuval microtrichia extending medially .... *speciosa* (Carriker)

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THE NORTH AMERICAN BIOTYPE OF THE OLD HOUSE BORER *HYLOTRUPES BAJULUS* (L.) (COLEOPTERA: CERAMBYCIDAE)

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Abstract.—Results of this study establish the presence of a North American biotype on the old house borer, *Hylotrupes bajulus* (L.). This biotype is based on differences in size and longevity of the life stages and on adult fecundity. The description of this biotype is based on three years of field and laboratory data and comparisons between the European and South African biotypes.

The old house borer (OHB), *Hylotrupes bajulus* (L.), is an important structural insect pest in eastern and southeastern United States. This cerambycid, native to the Atlas Mountains of Northern Africa, has been introduced into all major continents (Becker, 1979). The OHB was first reported in North America over 200 years ago, and now occurs in the Atlantic seaboard and Gulf Coast states (Moore, 1978).

OHB biology and life history in England were reviewed by Hickin (1975) and Parkin (1934); in Germany by Cymorek (1974) and Becker (1942); in Denmark by Rasmussen (1961); and in South Africa by Durr (1954, 1956), and Tooke and Scott (1944). In these countries the OHB is considered an established pest, capable of surviving under natural conditions in unprocessed wood. The life history and habits of the South African and northern European populations vary considerably. Durr (1956) reported female OHB in South Africa to be more fecund than those in Europe. Variations in sizes of adult, larva, and egg and in longevity have also been noted between OHB populations on the different continents (Becker, 1942; Weidner, 1936; Durr, 1956). These individual populations or biotypes have evolved after introduction into areas and subsequent isolation by geographic barriers (Becker, 1979). Gonzalez et al. (1979) and Eastop (1973) define biotypes as populations of similar genetic composition, which vary in biological functions such as behavior, host preference, morphology, or reproductive potential. Durr (1954) noted that the variations between European and South African biotypes are the result of more favorable environmental conditions in South Africa.

The biology and pest status of the OHB in N. Am. were reviewed by Moore (1978), McIntyre and St. George (1961), St. George et al. (1957) and Snyder (1955). However, the biological data found in these reports were based primarily on data originating from South Africa, Europe, and on field observations in the United States. Cannon (1979) reported that the biology and life history of the OHB under N. Am. environmental conditions differs considerably from both the South African and European biotypes.

The objective of the research presented here was to describe and compare the biology and habits of the OHB in N. Am. with data from Europe and South Africa. Results of this research will allow for a precise understanding of the presence and status of a N. Am. population of the OHB.

MATERIALS AND METHODS

A laboratory colony of OHB's was established and maintained from adults and larvae collected throughout Virginia's three geographic regions (Coastal, Piedmont, Mountain). This colony is considered representative of the N. Am. OHB population because of Virginia's midpoint location in the distribution of the OHB in eastern U.S.

Adult OHB were confined in 1 liter, clear plastic containers during their lifetime. Each container was maintained at room temperature (22.1° ± 2°C and 60–80% RH) and provided with oviposition sites consisting of pine (*Pinus* spp.) blocks and filter paper. Eggs were removed from containers daily, counted and incubated in 30 ml plastic cups under similar environmental conditions until eclosion. Larvae were reared to adults in blocks of southern yellow pine (*Pinus* spp.) (50 × 25 × 15 cm), placed in temperature-humidity controlled chambers (30° ± 1° and 65–75% RH). The wood blocks were <1 year old. The laboratory colony was maintained using methods described by Berry (1972).

Parameters used to describe the N. Am. population include the length and width of adults and eggs, longevity of adults, larvae, pupae and eggs, and the adult female fecundity. These parameters were compared with published data from Europe and South Africa.

In this study, longevity of adults was measured in days from the time of emergence to the time of death. Egg longevity was measured in days from deposition to eclosion. Larval longevity was based on homeowner survey data and is expressed as a range of developmental time in years. Pupal longevity was defined as the time between the prepupal molt and emergence of the adult. Oviposition period was defined as the time from deposition of the first egg batch to the time the last egg batch was deposited. Adult length was measured along the dorsal surface, from the mandibles to the last visible segment of the body; width was measured across the humeral region of the elytra. Measurements were made with a vernier micrometer. Eggs and larvae were measured with a microscope ocular micrometer. Egg length was measured from end to end and width recorded across the blunt pole of the egg. Larvae were measured from the mandibles to the end of the last abdominal segment. First-instar larvae were weighed in groups of ten on a Mettler balance. Fecundity was considered to be the total number of eggs oviposited by a female during her life span. Egg viability was calculated as a percentage of egg hatch based on total fecundity.

RESULTS AND DISCUSSION

Adults.—The N. Am. OHB adults ranged from 6.5 to 25.5 mm in length and 2.6 to 6.4 mm in width. Longevity ranged from 4 to 24 days. These data are within the ranges reported for the European and South African OHB biotypes (Table 1). North American females were equal in size to South African females (16.9 ± 0.5 vs. 17.1 mm), but males were slightly larger (12.2 ± 0.5 vs. 11.4

Table 1. Descriptive data on biotypes of the old house borer, *Hylotrupes bajulus.* NA = data not available.

	Location		
Life Stage	North America $\bar{x}$ ± SE	South Africa $\bar{x}$	Northern Europe $\bar{x}$
Adult female			
Length (mm)	16.9 ± .5[1]	17.1[3]	NA[7]
Width (mm)	5.0 ± .1	NA	
Adult male			
Length (mm)	12.2 ± .5	11.4	NA
Width (mm)	3.8 ± .1	NA	
Adult longevity (days)			
Female	9.9 ± 1.1[2]	8.9[4]	8.0
Male	15.5 ± 1.4	16.4[5]	16.0
Fecundity	165.1 ± 15.5	119.4[6]	105.2
Mean no. egg batches/female	4.3 ± .3	2.5	2–8
Oviposition period (days)	5.2 ± .5	3.9	12

[1] Based on 50 adult females and 50 adult males.
[2] Based on 25 adult females and 17 adult males at room temp. (22.1°C ± 2° and 60–70% RH).
[3] Based on 210 adult males and females.
[4] Based on 104 females at room temp. (23°C and 61% RH).
[5] Based on 145 males at room temp. (23°C and 61% RH).
[6] Based on 152 females.
[7] Adults were reported to range in size from 7–24 mm in northern Europe.

mm). More accurate statistical comparisons among the N. Am., European, and South African biotypes are not possible because of the lack of sufficient data and because available data do not include sample size and variation. North American female OHB were consistently larger and shorter lived than males. These findings are in agreement with observations made by Durr (1956) and Hickin (1975).

The most striking difference noted among biotypes was the large number of eggs oviposited by the N. Am. females ($\bar{x}$ = 165.1 range 46–334) (Table 1). The average number of eggs per female in South Africa and Europe was 119.4 and 105.2, respectively. A possible explanation for the high fecundity of N. Am. females may lie in the fact that the OHB is found predominently in new homes ($\bar{x}$ = 6.1 ± 1.0) in N. Am. Becker (1949) and Durr (1956) showed that the nutritional content of wood is a limiting factor in OHB growth and development. New wood (i.e., ≤10 yrs) contains a higher proportion of available protein and vitamins. Larvae feeding in wood of higher nutritional value would be expected to produce larger adults. Becker (1942) showed a positive correlation between size of adult females and egg production. In Europe the OHB is found predominently in old homes (≥10 yrs) (Schuch, 1937) and because of the lower nutritional value of this wood, larvae would be expected to take longer to develop and would produce smaller adults. In South Africa, Durr (1956) reported that the OHB is found primarily in new wood and that females are more fecund than those found in Europe. North American females deposited more egg batches (4.3 vs. 2.5) over a longer period of time (5.2 vs. 3.9 days) when compared to the South African biotype. Corresponding data are not available for the European biotype.

Table 2. Descriptive data on biotypes of the old house borer, *Hylotrupes bajulus*. NA = data not available.

Life Stage	Location North America $\bar{x} \pm$ SE	South Africa $\bar{x}$	Northern Europe $\bar{x}$
Egg length (mm)	1.9 ± .002[1]	2.03[2]	1.2–2.0
Egg width (mm)	.45 ± .001	.58	.5
Incubation period (days)	8.5 ± .3	14.0	9–12
Eclosion rate (%)	85.2 ± .5	83.2	NA

[1] Based on 50 eggs at room temp. (22.1°C ± 2 and 60–70% RH).

[2] Based on 40 eggs at room temp. (23°C and 69% RH).

Eggs.—Eggs of N. Am. females ranged from 1.6 to 2.1 mm in length and 0.41 to 0.51 mm in width (Table 2). They were slightly smaller than eggs from the South African biotype and within the range recorded for the European biotype. Under similar environmental conditions (20–25°C and 60–75% RH) the incubation period for eggs of N. Am. females was 8.5 days which is considerably shorter than South African (14) and European (9–12) biotypes, respectively. There was little difference in the eclosion rates (85.2% vs. 83.2%) of eggs from N. Am. and South Africa, respectively.

Larvae.—The length, head capsule width, and weight of first-instar larvae are presented in Table 3. The N. Am. larvae weighed less than larvae of similar age in South Africa (0.18 vs. 0.22 mg, respectively). This is not unexpected, since similar differences were noted in the comparison between eggs of these two biotypes. The developmental period of OHB larvae under environmental conditions in N. Am. was observed to range from 1–11 years ($\bar{x} = 6.1 \pm 1.0$) (Cannon, 1979) (Table 3). This period is longer than the 1–5 year ($\bar{x} = 3.21$) developmental period reported in South Africa (Durr, 1956) and comparable to the 3–11 year period reported in Europe (Weidner, 1936). Cannon and Robinson (1981) reported that OHB larvae are most efficient in utilizing wood for growth and development at temperatures and relative humidities of 20–30°C and 60–80%, respectively. Ras-

Table 3. Descriptive data on biotypes of the old house borer, *Hylotrupes bajulus*. NA = data not available.

Life Stage	Location North America $\bar{x} \pm$ SE	South Africa $\bar{x}$	Northern Europe $\bar{x}$
First-instar larva			
Length (mm)	1.7 ± .004[1]	NA	NA
Width (mm)	.19 ± .001	NA	NA
Weight (mg)	.183[2]	.222	NA
Larval developmental period (years)	2–7[3]	2–3	3–11
Pupal period (days)	21.7 ± 3.2[4]	29–44	14–21

[1] Based on 50 1st-instar larvae.

[2] Based on 5 representatives of 10 larvae each.

[3] Based on survey data of 32 infested homes throughout Va.

[4] Based on 8 pupae, room temp. 22.1°C ± 2° and 60–70% RH.

mussen (1967), and Cannon and Robinson (1981) showed that the larval developmental period is shortened or extended depending on the range and stability of temperature, relative humidity, and nutritional content of wood. Apparently, the environmental conditions for developing larvae in N. Am. are not so favorable as those in South Africa. However, they do appear to be more favorable than conditions in Europe.

Pupae.—There was little variation in the longevity of the pupal stage (Table 3). The European biotype provided the shortest developmental period (14–21 days) and the South African biotype the longest (29–44 days). Pupae of the N. Am. biotype require a developmental period of 21.7 ± 3.2 days.

Conclusion

The morphological and biological data presented here confirm the existence of a N. Am. biotype of the OHB. This biotype was described from field collected and laboratory reared specimens. An accurate biological data base is now available for evaluating this insect pest. These data, along with data on larval feeding (Cannon and Robinson, 1981) will be useful in developing recommendations for OHB control.

Acknowledgments

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NOTES ON THE HEBRIDAE OF THE WESTERN HEMISPHERE WITH DESCRIPTIONS OF TWO NEW SPECIES (HETEROPTERA: HEMIPTERA)[1]

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Abstract.—*Hebrus* ***longivillus,*** n. sp., and *Hebrus* ***spiculus,*** n. sp., are described from Arizona and Mesoamerica, respectively. *Hebrus amnicus* Drake and Chapman is established as a new junior synonym of *Hebrus beameri* Porter.

This paper is the fifth of a series intended to revise the Hebridae of the Western Hemisphere. A similar scope was intended by Porter (1950) in his unpublished thesis, but this work is outdated and a complete revision would now be necessary even if it had been published. Porter's work nonetheless has been valuable to us, and his contribution is to be commended.

This paper is based mainly on material in the authors' collections and the Chapman collection at the American Museum of Natural History. Type dispositions are given under each species. Institutional and private collection abbreviations are as follows: American Museum of Natural History, New York, AMNH; National Museum of Natural History, Washington, D.C., USNM; California Academy of Sciences, San Francisco, CAS; J. T. Polhemus Collection, JTP; C. N. McKinnon Collection, CNM. Unless otherwise stated, for all measurements 40 units = 1 mm.

Hebrus beameri **Porter**

Fig. 1

Hebrus beameri Porter, 1952, J. Kans. Entomol. Soc. 25: 9 (Kansas).
Hebrus amnicus Drake and Chapman, 1953, Great Basin Nat. 13: 10 (Georgia). NEW SYNONYMY.

The comparison of many specimens of *Hebrus amnicus* with paratypes and topotypes of *H. beameri* leads us to conclude that they are conspecific.

Although the specimens of *H. amnicus* from Georgia have shorter hemelytra than the specimens from Kansas and Indiana (Table 1), we have found that this character varies among different populations as well as within a population. The specimens from Kansas are lighter in coloration and the posterior lobe of the

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[1] Contribution from the University of Colorado Museum, Boulder, Colorado 80309 and Martin Marietta Corporation, Denver, Colorado 80201.

Table 1. Variation among three samples of *Hebrus beameri* (all measurements in mm).

Locality	Character	n	$\bar{x}$	s	Low	High	Sex
Ga.	Length	7	1.87	0.05	1.78	1.92	♂
Ind.	Length	5	1.95	0.08	1.85	2.08	♂
Kans	Length	10	1.82	0.04	1.75	1.89	♂
Ga.	Width	7	0.69	0.03	0.63	0.71	♂
Ind.	Width	5	0.74	0.02	0.72	0.77	♂
Kans.	Width	10	0.71	0.02	0.69	0.75	♂
Ga.	Wing length	7	0.76	0.06	0.63	0.82	♂
Ind.	Wing length	5	0.92	0.07	0.85	1.00	♂
Kans.	Wing length	10	0.98	0.06	0.89	1.05	♂
Ga.	Length	7	2.09	0.10	1.89	2.19	♀
Ind.	Length	3	2.23	0.13	2.08	2.33	♀
Kans.	Length	10	2.05	0.04	1.98	2.14	♀
Ga.	Width	7	0.75	0.03	0.71	0.79	♀
Ind.	Width	3	0.81	0.05	0.76	0.85	♀
Kans.	Width	10	0.78	0.03	0.74	0.82	♀
Ga.	Wing length	7	0.88	0.10	0.76	1.02	♀
Ind.	Wing length	3	1.03	0.16	0.88	1.20	♀
Kans.	Wing length	10	1.05	0.09	0.86	1.18	♀

pronotum is more punctate, but the male genitalia and antennal segments agree well among the three populations.

A redescription and figures of the male genitalia are given below. This should help in separating this species from other brachypterous species.

Brachypterous male.—Moderately long; head fuscous piceous, pronotum and scutellum fuscous; venter black becoming fuscous at connexiva with scattered short pubescence, segment 1 dull, lacking pubescence; rostral canal ridge with long golden setae. Antennal segments I and II short and moderately incrassate, clothed with short setae; segments III–V slender with scattered long golden setae; measurements—I, 10; II, 7; III, 9; IV, 5; V, 9. Rostrum testaceous, extending beyond posterior coxae; bucculae fuscescent, long, extending to prothorax, with locking mechanism; lorum not sutured off from genae, with moderately long setae; genae straight and pronounced. Eyes dark red and coarsely faceted; ocelli small. Head declivent, with 2 anastomosing rows of tiny pits, lacking median sulcus on vertex. Legs moderately long with femora moderately enlarged and clothed with short golden setae. Pronotum twice as wide across humeral angles as median length (27:16); median sulcus as deep as wide, extending well onto posterior lobe, ending anteriorly in a deep pit; pronotal collar encircled with a complete row of tiny pits; anterior and posterior lobes separated by moderate constriction; lobes separated by a transverse line of 6 deep pits; disk of posterior lobe punctate, broadly raised. Scutellum with deeply impressed basal part divided by median carina, edges raised; apex rounded, with small notch, scutellum about twice as wide as median length (13:6). Hemelytra moderately long, not reaching hind margin of connexiva; clavus and corium smoky white; membrane chestnut brown; inner and outer veins fuscous anteriorly becoming piceous posteriorly; inner vein

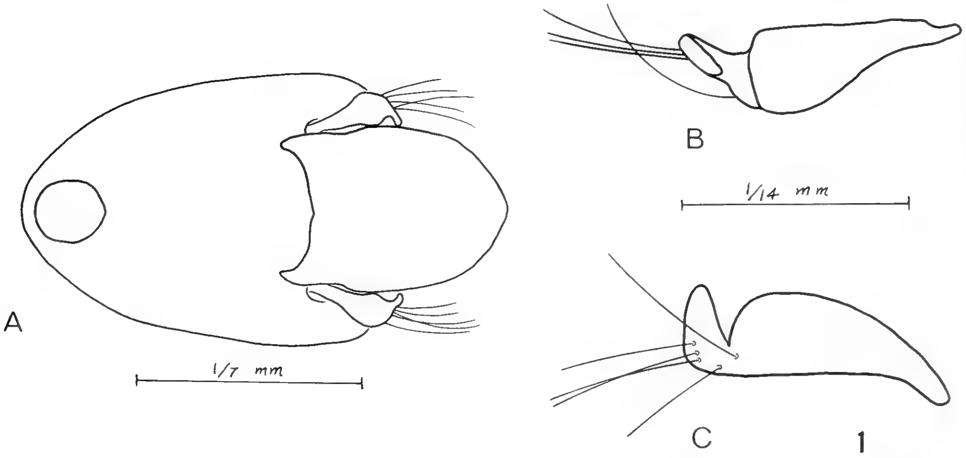

Fig. 1. *Hebrus beameri,* male. A, Genital capsule (short setae not shown). B, C. Right paramere, two views.

produced at distal end; calvus, corium and veins with scattered moderately long setae. Genitalia: Male capsule small, robust, with scattered short setae (Fig. 1A); parameres small, with distal hook (Figs. 1B, C). Length, 1.76 mm; width 0.68 mm across humeri (Kansas).

Female.—Very similar to male, except slightly longer. Length, 2.08 mm; width 0.77 mm across humeri (Kansas).

Macropterous form.—Unknown.

Material.—KANSAS: 7 ♂, 15 ♀, topotypes, Meade Co. St. Pk., IV-28-1979, CL6, C. N. McKinnon (CNM); paratypes of *beameri,* 1 ♂, 2 ♀, Meade Co. St. Pk., VI-7-1950, R. H. Beamer (JTP). INDIANA: 3 ♂, 4 ♀, Monroe Co., II-23-1961, J. C. Schaffner (JTP). GEORGIA: 1 ♂, Calhoun, IV-7-1958, H. C. Chapman; 2 ♂, 2 ♀, Calhoun, VIII-18-1965, H. C. Chapman; 1 ♂, 3 ♀, Calhoun, Sugar Valley, VIII-15-1976, H. C. Chapman (AMNH, JTP). OHIO: 1 ♂, Washington Co., Veto Lk. St. Pk., IX-7-1981, CL51, C. N. McKinnon (CNM).

Comparative notes.—This species is closely allied to *Hebrus obscurus* Polhemus and Chapman and the brachypterous form of *H. consolidus* Uhler. *Hebrus beameri* can be separated from *H. obscurus* by the absence of a deep sulcus on the vertex of the head. The small size and pearly white portion of the clavus of *H. consolidus* separates it from *H. beameri.*

The Kansas specimens were collected from the banks of spring fed streams. Most of the Georgia and Indiana specimens were collected under stones from streams (Drake and Chapman, 1953, 1958; Polhemus and Chapman, 1966). With intensive collecting in similar habitats, this species should be found throughout the eastern states.

Hebrus longivillus **Polhemus and McKinnon, New Species**

Fig. 2

Macropterous male.—Moderately long, head, pronotum and scutellum fuscous piceous; venter black becoming blackish brown on connexiva. Legs and antenna

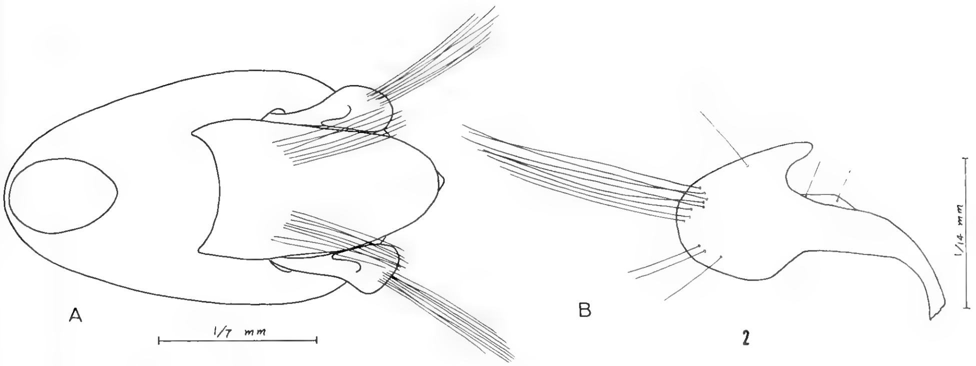

Fig. 2. *Hebrus longivillus,* male. A, Genital capsule (short setae not shown). B, Right paramere.

testaceous. Eye reddish brown, moderately large, coarsely faceted. Antennae moderately long, segments I and II short and moderately incrassate with short setae; III–V, slender and densely clothed with long golden setae; measurements—I, 7; II, 5; III, 7; IV, 5; V, 6. Rostrum testaceous, ending between 2nd and 3rd coxae; bucculae rufous, long with locking mechanism distally; lorum kidney shaped, sutured off from genae; genae straight, not prominent. Legs moderately long, femora moderately enlarged and anteriorly truncate; anterior femur, trochanter clothed with short golden setae, much longer ventrally. Head declivent, with 2 anastomosing rows of pits, lacking a median sulcus on vertex; ocelli small. Pronotum almost twice as wide across humeral angles as median length (30:15); median sulcus depth subequal to width, ending anteriorly in deep pit; row of small pits encircling pronotum just behind collar. Anterior and posterior lobes separated by moderate constriction having 4 moderately deep pits in a transverse line; disk of posterior lobe broadly raised. Scutellum with the deeply impressed basal part divided by median carina, edges raised; apex rounded, with tiny notch. Scutellum width twice median length (17:9). Hemelytra long, reaching hind margin of connexiva; clavus and corium milky white becoming smoky brown posteriorly, membrane smoky brown with numerous small white spots; inner and outer veins light brown anteriorly becoming piceous posteriorly; inner vein not produced distally. Clavus, corium and veins with scattered recumbent golden setae. Venter thickly clothed with short recumbent golden setae, except 1st segment bare; 2 lateral longitudinal patches of long setae (1 + 1), extending across first 3 abdominal sterna. Thoracic pleura each with isolated patch of recumbent golden pubescence. Genital capsule moderately long, with 2 longitudinal rows of long setae extending posteriorly (Fig. 2A); parameres cylindrical and short with point located cephalad of distal end, ending with very long dense tufts of setae (Fig. 2B). Length, 2.26 mm; width 0.93 mm across humeri.

Macropterous female.—Similar to male, but more robust and lacks the 2 long tufts of setae on the first 3 ventral abdominal segments. Length (allotype), 2.23 mm; width 0.93 mm across humeri.

Material.—Holotype, ♂, Arizona, Forestdale, IV-15-65, J. T. Polhemus (JTP). Allotype, ♀, Arizona, Forestdale, VIII-27-80, C. N. McKinnon (CNM). Paratypes as follows, all from Forestdale, Arizona, C. N. McKinnon collector: 3 ♂, 3 ♀, VIII-

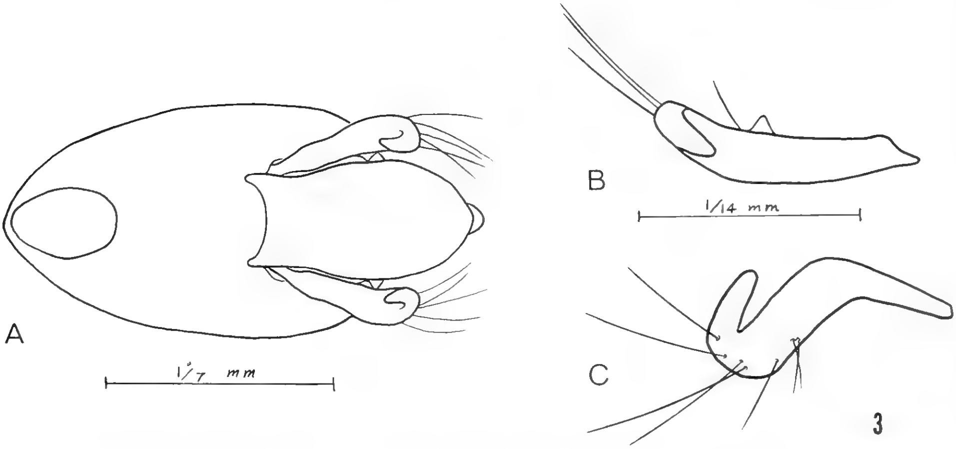

Fig. 3. *Hebrus spiculus,* male. A, Genital capsule (short setae not shown). B, C, Right paramere, two views.

27-80; 1 ♀, Ruin Spring, VII-3-81; 1 ♂, 1 ♀, Spring #1 nr. Trading Post, VII-3-81; 1 ♂, 1 ♀, Spring #2, VII-3-81 (JTP, CNM).

Comparative notes.—This species closely resembles *Hebrus buenoi* Drake and Harris and *H. comatus* Drake and Harris, but can easily be separated by the lack of a median sulcus on the vertex of the head and by the distinctive parameres. In *H. buenoi* the long distal setae on the parameres are shorter proportionally than in *H. longivillus,* and the parameres of the two species differ in shape; the parameres of *H. comatus* are cylindrical distally thus differing greatly in shape from those of either *buenoi* or *longivillus.* The very long setae on the first three ventral abdominal segments is also a good specific character for this species that will separate it from its congeners. These long setae are not present in the other species described here or other *Hebrus* species we have studied except *Hebrus buenoi* Drake and Harris in which they are one-half as long as in *longivillus.*

The Forestdale specimens were collected under rocks and logs along a small spring fed stream in a wooded area. This locality is also the type-locality for *Hebrus obscura* Polhemus and Chapman (1966).

Etymology.—The name *longivillus* (long & villus, Latin, masculine) refers to the long tufts of setae on the parameres and proctiger.

Hebrus spiculus **Polhemus and McKinnon, New Species**

Fig. 3

Macropterous male.—Elongate; head, pronotum and scutellum fusco-rufous with a bluish-green metallic sheen; venter fuscous becoming dark brown on connexiva. Legs, antenna and bucculae testaceous. Eyes reddish brown, moderately large, coarsely faceted. Antenna long, segments I and II slightly incrassate with short pubescence; III–V, slender, clothed with long golden setae, measurements—I, 6; II, 5; III, 7; IV, 4; V, 7. Rostrum testaceous, ending behind posterior coxae; bucculae long with locking mechanism distally; lorum clothed with dense setae; genae straight, not prominent. Legs moderately long with the femora moderately enlarged; clothed with short golden setae; trochanter length twice its median width; head declivent, with 2 anastoming rows of pits, lacking median sulcus on vertex;

ocelli small. Pronotum twice as wide across humeral angle as median length (24:12). Median sulcus weakly pronounced on posterior lobe, ending anteriorly with a deep pit; complete row of small pits encircling pronotum just behind collar. Anterior and posterior lobes separated by a moderate constriction with 2 deep pits in transverse line, demarcated from anterior pit of median sulcus; disk of posterior lobe broadly raised. Scutellum with deeply impressed basal part divided by median carina, edges raised; apex rounded, bifid, fine recumbent golden setae on tip; apex raised, width ¼ greater than the median length (11:7). Hemelytra long, reaching hind margin of connexiva; corium piceous, clavus with a pearly white wedge anteriorly, piceous posteriorly. Membrane brown with a white oval spot next to corium. Corium and clavus with scattered long recumbent golden setae. Venter black, becoming piceous on connexiva, clothed with short recumbent setae. Rostral canal ridges with row of long setae along entire length. Genitalia: Male capsule elongate with scattered short setae (Fig. 3A); parameres with distal hook, inside with a distinct spur (Fig. 3B). Length, 1.63 mm; width 0.65 mm across humeri.

Female.—Similar to male, but slightly longer. Length, 1.78 mm; width 0.73 mm across humeri.

Material.—Holotype, ♂, and allotype, ♀, Costa Rica, San Isidro del General, I-6-1970, CL1302, J. T. Polhemus, in Polhemus Collection. Paratypes as follows, all from COSTA RICA: 1 ♂, 5 ♀, same data as holotype; 2 ♂, 4 ♀, Palmar Norte, I-6-1970, CL1302a, J. T. Polhemus; 2 ♂, 4 ♀, Palmar Norte, XII-28-1969, CL1280, J. T. Polhemus; 1 ♀, Rio de Barranca, I-10-1970, CL1306, J. T. Polhemus; 1 ♂, San Vito de Java, XII-29-1969, CL1285, J. T. Polhemus. PANAMA: 1 ♂, 1 ♀, San Carlos, I-9-1970, CL1300, J. T. Polhemus. COLOMBIA: 1 ♂, Sierra Nevada de Santa Marta, Pueblo Bello (1200m), IV-14&15-1968, Borys Malkin. Paratypes in AMNH, USNM, CAS, and collections of both authors.

Comparative notes.—This species closely resembles *Hebrus consolidus* Uhler, *H. major* Champion, and *H. usingeri* Drake and Harris. *Hebrus spiculus* can easily be separated from these species by the distinct spur on the inner surface of the parameres and by the longitudinal median sulcus of the pronotum. While the paramere of *H. usingeri* has a minute spur on its inner surface, this spur is not prominent as in *spiculus*. *Hebrus major* is much larger and the median sulcus extends onto the pronotal collar, whereas in *H. spiculus* this sulcus ends before the collar. The small size and differently shaped parameres of *H. consolidus* will separate this species from *H. spiculus*.

Etymology.—The name *spiculus* (Latin; masculine) means point which refers to the spur on the inner surface of the paramere.

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A NEW SPECIES OF *DIORYCTRIA* ZELLER (LEPIDOPTERA: PYRALIDAE) FROM TEXAS

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Abstract.—*Dioryctria* ***caesirufella*** is described and male and female imagines and genitalia are figured. Imagines and inflated vesicae of the most closely allied species, *D. pygmaeella* Ragonot, are figured for comparison.

Over the course of several years collecting at various localities on the Edwards Plateau in central Texas, the authors accumulated a large series of a phycitine which bears a strong resemblance to *Dioryctria pygmaeella* Ragonot. Through the kind assistance of Vernon Brou, D. C. Ferguson, and the late Charles P. Kimball, comparative series of this insect were obtained from Louisiana, South Carolina, and Florida. In addition, two examples of *pygmaeella* were collected by the junior author in eastern Texas, near Conroe.

Dioryctria caesirufella **Blanchard and Knudson,** New Species

Figs. 1, 2, 5–13

Description.—*Head:* Front and vertex light ochreous. Labial palpus gray with reddish dusting, upturned, exceeding front by nearly 1 eye diameter. Maxillary palpus small, squamous. Antenna simple, pubescent, gray. First segment of flagellum elongate. Small medial spines arise from 2nd and 3rd segments.

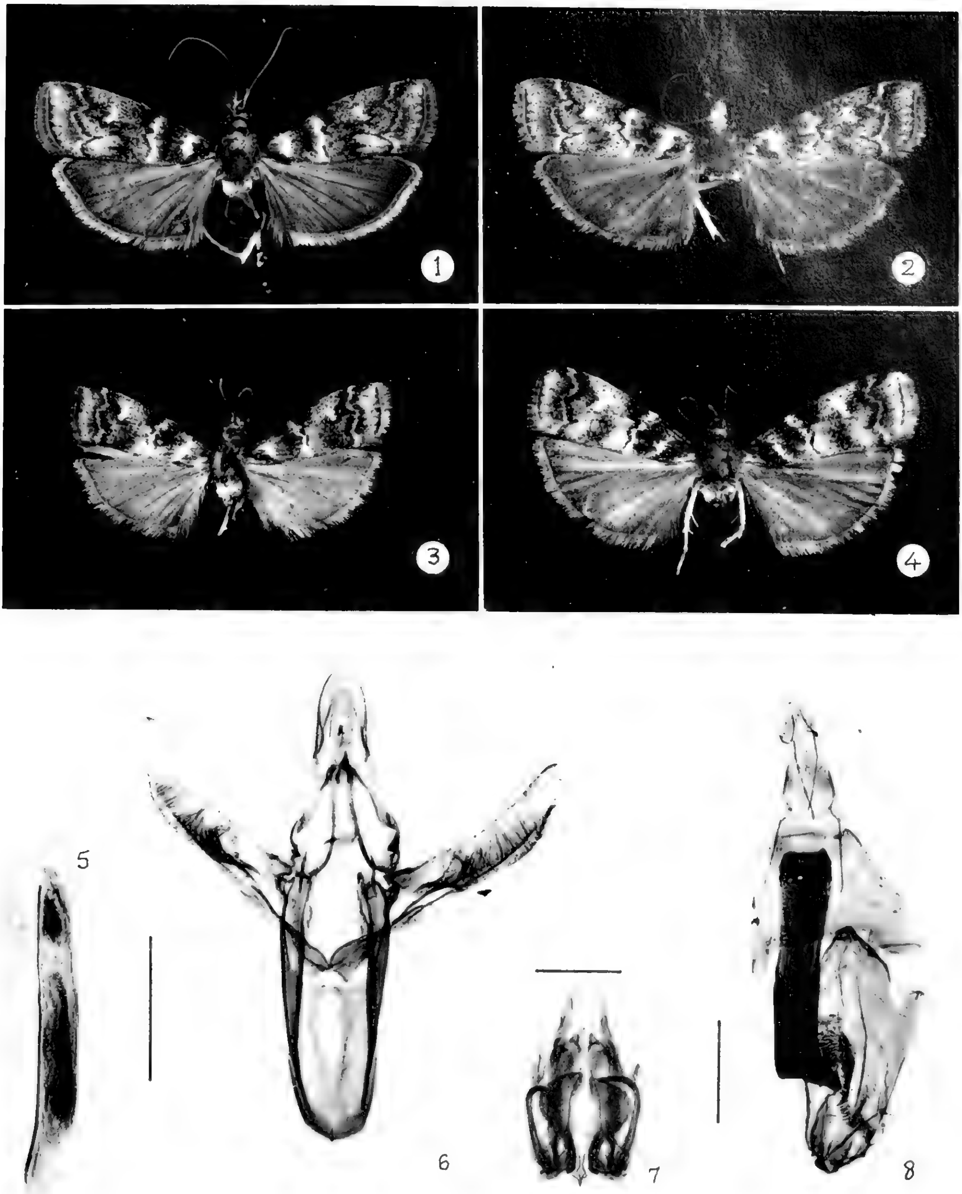
Thorax: Tegula and mesonotum gray with reddish dusting.

Forewing: Ground color bluish gray with reddish dusting, mainly along costa. Antemedial line white, angled shortly outward from costa and inwardly excavate on fold, so that overall course is nearly vertical. Within antemedial line are nearly vertical bands of dull yellow, bright reddish orange, violet brown, white, and blackish brown, respectively, from line toward base. Reddish shade widest and most noticeable, even in worn examples. Antemedial line bordered outwardly with black, merging into a subtriangular costal spot. Cell spot white, crescentic. Subterminal line white, with a sharp inwardly directed cusp at cell and again on fold, margined inwardly with black, outwardly with reddish orange. Terminal line black. Fringe gray.

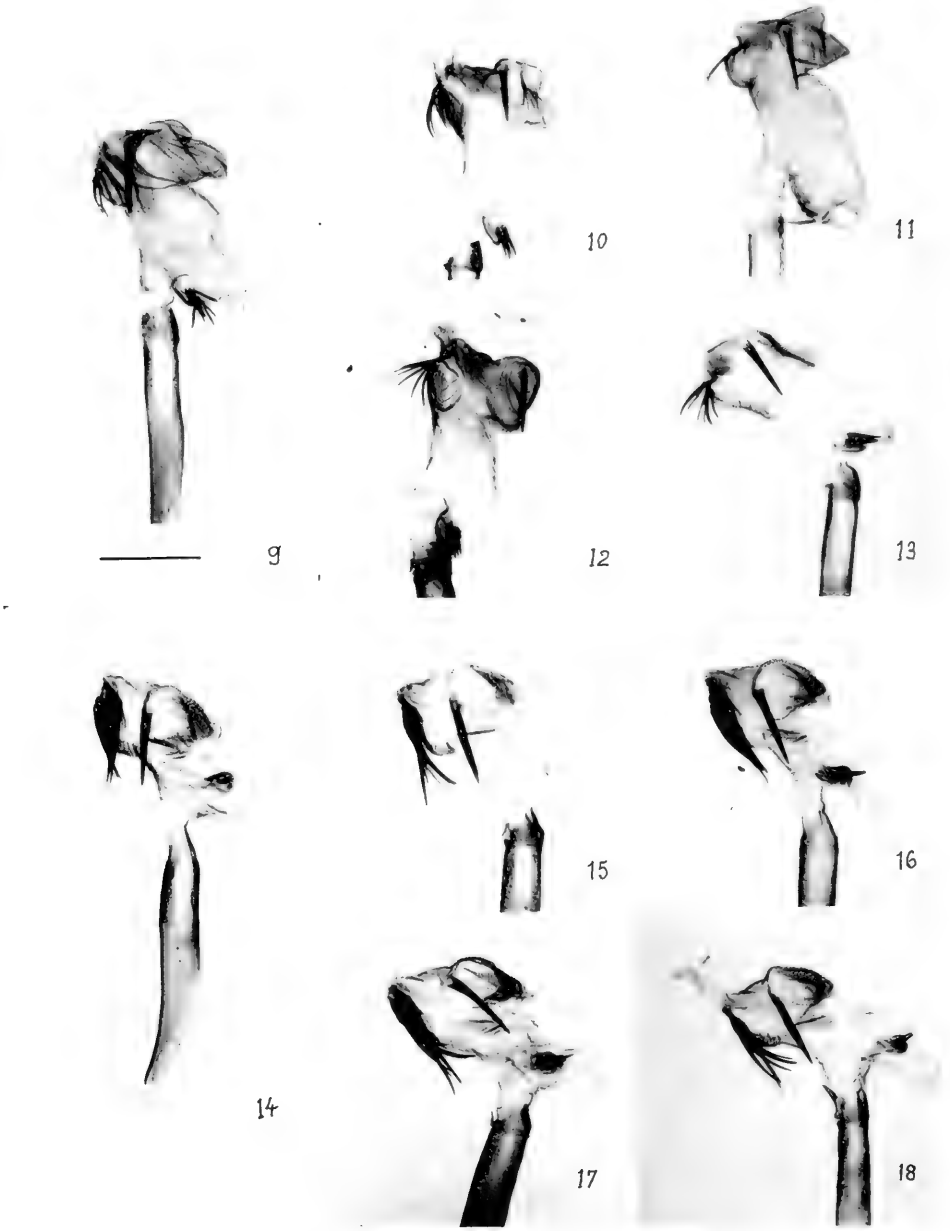
Hindwing: Ochreous gray, darker along outer margin. Fringe light gray.

Length of forewing: Male: $N = 8$, 7.2–10.4 mm, average 8.7 mm; female: $N = 9$, 8.3–10.5 mm, average 9.4 mm.

Male genitalia (Figs. 5–7, 9–13): Extremely similar to *D. pygmaeella,* with major difference in vesica (Figs. 9–13). In both species are 3 groups of cornuti, borne on diverticula. Near proximal end (closest to aedeagus), is a cluster of small cornuti



Figs. 1–8. 1, 2, 5–8, *Dioryctria caesirufella*. 3, 4, *D. pygmaeella*. 1, Male holotype, Kerr Co., Tex., Kerrville St. Pk., 19-VIII-80. 2, Female paratype, same data as holotype. 3, Male, St. John Parrish, La., Edgard. 4, Female, same data as Fig. 3. 5, Aedeagus of paratype, slide ECK 20, same data as holotype. 6, Male genitalia of paratype, slide ECK 20. 7, Compound ventral tufts of paratype male, slide AB 3394, Blanco Co., Tex., Pedernales Falls St. Pk., 4-V-73. 8, Female genitalia of paratype, slide ECK 19, same data as holotype. The lines in Figs. 6–8 represent 1 mm.



Figs. 9–18. 9–13, *Dioryctria caesirufella*. 14–18, *D. pygmaeella*. 9, Inflated vesica of paratype, slide ECK 327, same locality as holotype, 15-V-82. 10, Inflated vesica of paratype, slide ECK 331, same data as Fig. 9. 11, Inflated vesica of paratype, slide ECK 326, same data as Fig. 9. 12, Inflated vesica of paratype, slide ECK 335, same data as Fig. 9. 13, Inflated vesica of paratype, slide ECK 169, Kerr Co., Tex., Hunt, 23-VIII-81. 14, Inflated vesica, slide USNM 56094, McClellanville, S.C., Wedge Plantation, 5-VIII-75. 15, Inflated vesica, slide USNM 56070, same locality as Fig. 14, 30-VII-73. 16. Inflated vesica, slide USNM 56072, same locality as Fig. 14, 31-VII-75. 17, Inflated vesica, slide ECK 370, St. John Parrish, La., Edgard, 2-VII-79. 18, Inflated vesica, slide ECK 55, Montgomery Co., Tex., Conroe, 14-IX-77. The line in Fig. 9 represents 1 mm. Figs. 9–18 are all the same scale.

and a small sclerotized plate. In *caesirufella,* these cornuti number from 5–8. In *pygmaeella* (Figs. 14–18), these cornuti fewer in number or occasionally absent (Fig. 15). Difference in number may reflect fact that cornuti are deciduous. Distally, near ejaculatory duct, is a cluster of from 7–10 curved cornuti on a small diverticulum, and a single straight cornutus on a large diverticulum. In *caesirufella,* curved cornuti much smaller and more delicate than in *pygmaeella,* their average length being ½ of those in *pygmaeella.* Single, separate cornutus in *caesirufella,* averages ¾ the length of that in *pygmaeella.*

Female genitalia (Fig. 8): Not significantly different from *pygmaeella.*

Holotype (Fig. 1).—♂, Kerrville State Park, Kerr Co., Texas, 19-VIII-80, collected by E. Knudson and deposited in the National Museum of Natural History, Washington, D.C.

Paratypes.—Same locality as holotype, 19-VIII-80, 3 ♂, 8 ♀ and 15-V-82, 25 ♂, 18 ♀; Kerr Co., Texas, 10 miles west of Hunt, 22-VIII-81, 2 ♂, 1 ♀; Comal Co., Texas, Canyon Lake, 20-V-79, 2 ♀, all collected by E. Knudson; Blanco Co., Texas, Pedernales Falls State Park, 4-V-73, 1 ♂; Boundary of Hays and Comal counties, Texas, El Rancho Cima, 29-VIII-75, collected by A. & M. E. Blanchard.

Remarks.—Aside from genitalic differences outlined above, there are differences in the imagines of *caesirufella* and *pygmaeella* in color and maculation. *Dioryctria caesirufella* is predominantly bluish gray with a contrasting reddish orange band inside the antemedial line. *Dioryctria pygmaeella* is a darker purplish brown, being much more heavily suffused with red. The reddish shade inside the antemedial line is less contrasting. The reddish shade outside the subterminal line is broader in *pygmaeella* than in *caesirufella.* In *pygmaeella,* the antemedial line tends to be outwardly oblique from the costa, whereas, in *caesirufella,* it is generally vertical. The course of the subterminal line in *pygmaeella* tends to be straighter, the cusps being replaced by shallow indentations. Another difference is size, *pygmaeella* being smaller. The length of the forewing in nine *pygmaeella* males ranged from 6.7–8.6 mm, averaging 7.6 mm; in ten females, from 7.2–8.5 mm, averaging 7.9 mm.

The range of the two species does not overlap, *caesirufella* having been collected in four counties on the Edwards Plateau in central Texas, while *pygmaeella* is widely distributed from the middle Atlantic states through Florida, and thence along the Gulf Coast region into eastern Texas. *Dioryctria pygmaeella* is known to feed on bald-cypress (*Taxodium distichum* (L.) L. C. Rich, Taxaceae), and this is also the presumed foodplant of *caesirufella,* as all specimens were collected in close proximity to this tree. However, there is a gap that occurs in the distribution of bald-cypress in Texas, separating the eastern populations from the Edwards Plateau population by about 200 miles. According to Lynn Lowrey of Conroe, Texas, a recognized expert on Texas trees, "Although there is no recognized subspecific or varietal difference between the eastern populations and central Texas populations of bald-cypress, attempts to transplant individuals of each population to the other region have failed, which indicates, at least, a difference in the growing requirements of the two populations." *Dioryctria caesirufella* seems to have well-defined spring and fall broods, whereas *pygmaeella* appears to be multiple brooded, with records (from Louisiana) covering every month from April through September.

ACKNOWLEDGMENTS

The authors are extremely grateful to D. C. Ferguson, Systematic Entomology Laboratory, USDA, for examining the manuscript and the type-material and his very helpful comments and suggestions. We also commend the remarkable efforts of Vernon Brou in obtaining a large series of *pygmaeella* from Louisiana, which had previously not been known from that state. As always, we are grateful to the Texas Parks and Wildlife Department for their continued cooperation with our work.

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ETHOLOGY OF *LAPHYSTIA RUFOFASCIATA* CURRAN (DIPTERA: ASILIDAE) IN WYOMING[1]

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Abstract.—*Laphystia rufofasciata* Curran has a limited distribution in southern Wyoming. No courtship occurs in this species and males take a simple male over female mating position. This species captures prey in the air and manipulates it with the fore- and hindtarsi while resting on the substrate. The most commonly taken prey belong to the orders Diptera and Homoptera.

Laphystia rufofasciata Curran was described in 1931 from specimens collected in Green River and Rock Springs, Wyoming. Wilcox (1960) added Rangely, Colorado, to its distribution, and in 1978, the senior author collected a series of specimens in an intermittent stream bed 23.9 mi. S. of Wamsutter, Carbon County, Wyoming. So far as is presently known, the species is restricted distributionally to northwestern Colorado and southern Wyoming.

A population of these asilids was located at Thayer Junction, a railroad siding 27 km northeast of Rock Springs in Sweetwater County. Since nothing was known of the behavior of members of this genus, a study was initiated in 1976 (19–26 July), and continued in 1977 (20–21 July) and 1979 (24 July–2 Aug). Adults of *L. rufofasciata* were found within and along the banks of intermittent stream beds (Fig. 1). The dominant vegetation on the banks of the streams was *Sarcobatus vermiculatus* (Hook.) Torr. (black greasewood) and *Chrysothamnus linifolius* Greene (rabbitbrush).

Diurnal short distance migrations are characteristic of this species. Prior to ca. 1000 h, asilids are found resting on sand among plants on the stream bank. Thereafter, as temperatures rise above 38°C, the flies drift downwards to the damp sand along the narrow watercourse, which may or may not contain water, as well as onto various "islands." The bulk of the day is spent in this moderated environment, and, ca. 1700 h, there is a reverse migration to the nocturnal resting place.

Voucher specimens on which this paper is based have been placed in the entomological collection of the Smithsonian Institution, Washington, D.C., as Lot #46.

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FORAGING AND FEEDING BEHAVIOR

Laphystia rufofasciata foraged under sunny skies when soil surface temperatures exceeded 24°C. On cloudy or windy days little or no foraging took place. Unlike many other asilid species which sometimes utilize vegetation, *L. rufofasciata* always initiated flights from sunlit or shaded sand.

Prior to attack initation either the asilid's head only or the entire body is turned towards the organism. Additionally, if large fast-moving insects fly nearby, the same behavior is exhibited by the robber flies.

Approximately half the attacks (52%) are initiated towards potential prey 15–20 cm distant. Most of the remaining observed forage flights (44%) covered distances ranging from 20 to 60 cm. Only 4% exceeded 60 cm. Successful forage flights resulting in prey capture covered distances of 9 to 30 cm with 72% being less than 20 cm. Prey is ordinarily picked out of the air, but on one occasion a female collected a crawling mite and on another a male made two unsuccessful strikes at a small crawling microlepidopteran.

Foraging efficiency appears to be good. The predator averages six forage flights before taking prey, with 30% of the first observed attempts being successful. Unsuccessful attempts to secure prey were caused by the following: 1) The prey either outdistanced the pursuer or exhibited evasive flight; 2) asilids flew towards potential prey but then turned back before making contact; and 3) the insect was contacted, held briefly and then released. The asilids had particular trouble subduing tiny wasps. A female collected a wasp, circled several times, landed, flipped on her back, manipulated the prey with all six tarsi for a short time, and then released it. Within a minute's time she repeated the exercise with the same result.

When contact with prey was made, the asilid would swing back and forth in the air, much in the manner of a courting male *Stichopogon trifasciatus* (Say) (Lavigne and Holland, 1969), but manipulating the prey. The prey was always impaled on the asilid's proboscis when returning from a successful forage flight. Usually the proboscis is initially inserted dorsally or dorsolaterally into the prey's thorax.

Subsequent prey manipulation depended upon the size of prey taken. Prey measuring 2.0 mm or over may be manipulated several times while feeding takes place. Smaller prey are not manipulated. The asilid uses it's fore- and hindtarsi to manipulate the prey. The tip of the abdomen is brought to rest upon the substrate, and in combination with the midtarsi acts as a tripod to steady the asilid during prey manipulation. When feeding is completed, the prey is wiped from the proboscis using the foretarsi, either on site (67%) or in flight (33%) ($N = 39$). *Laphystia rufofasciata* may take flight after prey, with a prey still impaled on its proboscis. If so, the original prey is pushed off before contact is made with the new prey.

Feeding activity has been recorded as early as 0840 h and as late as 1707 h (soil surface temperatures 24° and 34°C, respectively). While feeding activity by females is more or less continuous from 0900 to 1700 h, peaks of feeding were observed between 1200–1300 and 1400–1600 h. Males, on the other hand, apparently spend much of their time searching for females. Of the 130 prey collected where the sex of the predator was ascertained, only 25 (19%) had been taken by males.

Like most asilid species, the length of time *Laphystia rufofasciata* spends feeding

Fig. 1. Intermittent stream habitat of *Laphystia rufofasciata* at Thayer Junction, Sweetwater Co., Wyoming.

on a prey is somewhat variable, but a positive correlation with prey size exists ($r = 0.7$). Large prey such as mosquitoes and dolichopodids (4 mm) were fed upon longer than were aphids and cecidomyiids (2 mm). The average feeding time per prey was 7.77 min ($N = 22$), ranging from 1.5 to 31 min.

During feeding the asilid's abdomen is sometimes rapidly moved up and down, but the function of this behavior is unclear.

PREY SELECTION

Based on the definition used by Lavigne and Holland (1969), we classify *L. rufofasciata* as euryphagic. Of the 137 recorded prey, 59.1% are Diptera, 16.8% are Homoptera, 9.5% are Hemiptera, 7.3% are Hymenoptera, 3.7% are Araneae, 1.5% are Coleoptera, 1.5% are Psocoptera, and 0.6% are Lepidoptera.

Although the predators are fairly uniform in size, with the male ($\bar{x}$ 8.4 mm, $N = 28$) being smaller than the female ($\bar{x}$ 9.4 mm, $N = 7$), the prey size ranged widely. Prey taken by males ranged from 0.8 mm–4.8 mm with the mean size being 1.65 mm ($N = 26$). Prey taken by females ranged from 0.5 mm–6.3 mm with the mean size being 2.19 mm ($N = 97$). The predator to prey ratio is one of the largest for species of Asilidae thus far studied in Wyoming, being 5.09:1 for males and 4.29:1 for females (Table 1). Only *Heteropogon wilcoxi* James has a larger ratio (8.42:1) (Lavigne and Holland, 1969). The size of prey was assumed to be the determining factor of prey selection in this species.

At the site 23.9 mi south of Wamsutter mentioned earlier, adults of both sexes of *L. rufofasciata* were slightly smaller than those at Thayer Junction although

Table 1. Relation between length of *Laphystia rufofasciata* and its prey.

Sex	Predator Length (mm)[1]			Prey length (mm)			No. of Prey Measured	Mean Ratio of Predator to Prey
	Minimum	Maximum	Mean	Minimum	Maximum	Mean		
Male	7.6	8.8	8.4	0.8	4.8	1.6	26	5.1
Female	8.9	9.9	9.4	0.5	6.3	2.2	97	4.3

[1] Predator size: ♂♂ ($N = 28$) $\bar{x} = 8.44 \pm 0.33$, ♀♀ ($N = 7$) $\bar{x} = 9.4 \pm 0.34$.

the male to female size proportions were comparable (♂ $\bar{x}$ 8.2, $N = 10$; ♀ $\bar{x}$ 9.1, $N = 9$). Presumably members of this population took slightly smaller prey.

Separation of prey records on the basis of sex shows that Diptera are the overwhelming choice for both sexes (Table 2), with the second choice being Hymenoptera for males and Homoptera for females.

Since prey were collected from *Laphystia* in two different years, it was of interest to see if there was any difference in prey selection between years. As can be seen in Table 3, Diptera and Homoptera were the most often taken prey in both 1976 and 1979 with Diptera being the most preferred. These data are similar to those presented by Adamovic (1963) for *Dysmachus bilobus* Loew in Yugoslavia.

Herein is presented the list of prey taken by *L. rufofasciata.* Specific identifications are presented where possible, but the state of taxonomic knowledge and/or the condition of the specimen sometimes precluded its identification to definitive levels. The number of observations and sex, when known, of the predator are indicated in parentheses following the prey taxa.

ARACHNIDA, Araneae: undet. vii-21-76 (3 ♀, ?), vii-26-76 (?). COLEOPTERA, Staphylinidae: vii-21-76 (♀), vii-23-76 (?). DIPTERA, Agromyzidae: *Cerodontha dorsalis* (Loew), vii-23-76 (♀); Anthomyiidae: *Hylemya platura* (Meigen), vii-27-79 (♀); Bombyliidae: *Geron* sp., vii-25-79 (♀), *Phthiria* sp., vii-27-79 (♀), undet., vii-20-76 (♂), vii-25-76 (♂); Cecidomyiidae: *Anarete* sp., vii-25-76 (♂), vii-24-76 (♀), *Micromya johannseni* (Felt), vii-25-79 (♀), *Neolasioptera* sp., vii-27-79 (3 ♀), vii-1-79 (♂); Ceratopogonidae: *Dasyhelea mutabilis* (Coquillett), vii-24-76 (♀), vii-25-76 (♂), vii-26-76 (♀), *Leptoconops sublettei* Clastrier, vii-21-76 (♀), vii-26-76 (♂); Chamaemyiidae: undet., vii-21-76 (♀); Chironomidae: *Cricotopus* sp.,

Table 2. Total numbers and percentages of prey of different taxa captured by males and females of *Laphystia rufofasciata.* Does not include 7 prey for which the sex of the predator is unknown.

Taxa	Male		Female		Range (mm)	$\bar{x}$
	No.	%	No.	%		
Araneae	—		3	2.9	0.5–2.5	1.14
Coleoptera	—		1	0.95	2.4	—
Diptera	17	68	61	58.1	0.7–3.9	2.04
Hemiptera	1	4	12	11.4	1.7–3.4	2.32
Homoptera	2	8	20	19.0	0.8–4.0	2.28
Hymenoptera	3	12	7	6.7	0.6–6.3	1.88
Lepidoptera	1	4	—		4.8	—
Psocoptera	1	4	1	0.95	0.8–1.8	1.33
Totals	25	100	105	100	0.5–6.3	2.13

Table 3. Comparison of numbers and percentages of prey of different taxa captured by *Laphystia rufofasciata* in 1976 versus 1979.

Taxa	1976		1979		Total	
	No.	%	No.	%	No.	%
Araneae	5	5.3	—		5	3.6
Coleoptera	2	2.0	—		2	1.5
Diptera	53	54.6	28	70.0	81	59.1
Hemiptera	13	13.4	—		13	9.5
Homoptera	13	13.4	10	25.0	23	16.8
Hymenoptera	9	9.3	1	2.5	10	7.3
Lepidoptera	—	—	1	2.5	1	0.7
Psocoptera	2	2.0	—		2	1.5
Totals	97	100	40	100	137	100

vii-26-79 (♀); Chloropidae: *Conioscinella flavescens* (Tuck.), vii-21-76 (♀), vii-23-76 (2 ♀), vii-24-76 (3 ♀), vii-25-76 (♀), *Meromyza communis* Fed., vii-21-76 (♀), *Olcella* sp., vii-26-76 (♀), *Oscinella frit* (L.), vii-26-76 (?), *Siphonella neglecta* Beck., vii-26-76 (♂, ♀), vii-1-79 (♀), *Thaumatomyia pulla* (Adams), vii-26-79 (♀), vii-27-79 (♀), undet., vii-24-76 (♀); Culicidae: undet. vii-20-76 (?); Dolichopodidae: *Asyndetus* sp., vii-21-76 (♀), vii-24-76 (♀), *Thinophilus* sp., vii-23-76 (2 ♀); Drosophilidae: undet., vii-22-76 (♀); Ephydridae: *Atissa pygmaea* (Haliday), vii-21-76 (♀), vii-24-76 (2 ♂, ♀), vii-25-76 (2 ♂, ♀), vii-26-76 (♂), vii-27-79 (2 ♀); Lonchopteridae: undet., vii-20-76 (♀); Muscidae: undet., vii-21-76 (♀); Pipunculidae: *Pipunculus* sp., vii-31-79 (♀); Scatopsidae: *Scatopse fuscipes* (Meigen), vii-21-76 (♀); Sciaridae: *Bradysia* sp., vii-21-76 (♀), vii-26-76 (♀); Sepsidae: *Sepsis* sp., vii-26-76 (♀); Sphaeroceridae: *Leptocera* sp., vii-24-76 (♀), vii-25-76 (2 ♀); Tachinidae: *Hyalomya aldrichii* Townsend, vii-25-76 (2 ♀, ?), vii-26-79 (4 ♀), viii-1-79 (♂); Tethinidae: *Pelomyia coronata* (Loew), vii-26-79 (♀), undet., vii-25-79 (♀). HEMIPTERA. Anthocoridae: *Orius* sp., vii-26-76 (♀); Miridae: undet., vii-20-76 (4 ♀), vii-21-76 (2 ♀), vii-24-76 (2 ♀), vii-25-76 (♂), vii-26-76 (♀); Saldidae: *Saldula* sp., vii-26-76 (♀). HOMOPTERA, Aphididae: *Aphis* sp., vii-20-76 (♀), undet., vii-25-79 (?); Cicadellidae: *Aceratagallia poudris* Oman, vii-20-76 (♂, 3 ♀), vii-21-76 (3 ♀), *Aceratagallia sanguinolenta* (Provancher), vii-25-79 (5 ♀), vii-26-79 (♀), *Empoasca* sp., vii-27-79 (♀); Cixiidae: *Oliarus* sp., vii-26-76 (♀); Margarodidae: *Craspedolepta nebulosa* (Zetterstedt), vii-21-76 (♂, 2 ♀), *Craspedolepta suaedae* (Crawford), vii-20-76 (♀), ?*Margarodes* sp., vii-25-79 (♀). HYMENOPTERA, Encyrtidae: undet., vii-26-76 (♀); Eulophidae: *Chrysocharis* sp., vii-24-76 (♀), *Chrysonotomyia* sp., vii-21-76 (♀), undet., vii-24-76 (♀); Formicidae: *Formica* sp. (winged reproductive), vii-20-76 (♀); Mymaridae: *Gonatocerus* sp., vii-25-76 (♂). LEPIDOPTERA, undet., vii-31-79 (♂). PSOCOPTERA, Lachesillidae: *Lachesilla* sp., vii-20-76 (♀); Psocidae: *Camelopsocus similis* Mockford, vii-26-76 (♂).

MATING BEHAVIOR

Males are much more active than females which is apparently related to mating behavior. Males come and go rapidly, rarely staying in one spot for more than a few seconds. Searching flights of up to 6 m are made by males in their quest for females. These meandering flights, between plants at about 30–90 cm above the

Fig. 2. Copulating pair of *Laphystia rufofasciata* illustrating the male over female mating position.

substrate, are not exhibited by females. Males chase after almost any insect that circles, following about 30 cm behind. Female *Laphystia,* when chased, exhibit evasive flight, which is obviously an attempt to avoid predation. When a *Laphystia* female lands, the male also lands and then makes a short hop flight, thus confronting the female in a new position in front or to either side. If the female flies off and is lost by the male, he will return repeatedly to the spot where the female was last encountered.

Males flying above an object on the soil surface, often circle it, hovering briefly and then fly off. Should the object be a male *Laphystia,* it will fly up and the two males will circle briefly before flying off in opposite directions, a common occurrence. If the insect is a *Laphystia* and doesn't fly, the male will land on its back and immediately attempt copulation.

Of the 36 recorded male-female copulation attempts, 73% occurred between 1200 and 1600 h. Soil surface temperatures recorded at these times ranged from 33 to 50°C ($\bar{x}$ 37.9). On two occasions, a male was observed to mount and unsuccessfully copulate with the same female three different times in succession. On two other occasions, prior to the attempt at copulation, males hovered briefly in front of females, with the male's body swinging from side to side subtending an arc of 35 degrees. Each time the female flew off with the male in pursuit.

In three years only two pairs were observed, one a complete mating and one incomplete. The complete mating was initiated at 1125 h (VII-25-79) when a male jumped on the dorsum of the female taking the male atop female position (Fig 2). Copulation ensued and the pair separated at 1130 h, with both specimens flying off in different directions. On another occasion at 1233 h (VII-20-77), a mated pair (male atop female) was observed resting on a sandbar. They were disturbed twice by the senior author and then separated. The female flew, followed by the male, and when the female landed copulation reoccurred. The pair remained joined until 1245 h when the male initiated separation by releasing his claspers and flying away. The female remained in place 15–20 sec. and then flew. The substrate temperature under partly cloudy skies was 34.5°C. Soil surface temperatures at which attempted copulations were observed varied from 33°–50°C ($\bar{x}$ 36.6, $N = 13$).

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SUBGENERIC AND SPECIES-GROUP CLASSIFICATION OF THE MAYFLY GENUS *ISONYCHIA* IN NORTH AMERICA (EPHEMEROPTERA: OLIGONEURIIDAE)

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Abstract.—The mayfly genus *Isonychia* Eaton is divided into two subgenera, *Isonychia* s.s. and ***Prionoides,*** new subgenus, based on distinct morphological features of adults and nymphs of the Nearctic species. *Isonychia* s.s. is divided into four species groups based on penes form of male imagoes. Descriptions and keys to these subgenera and species groups are provided. *Isonychia pictipes* Traver is a new synonym of *Isonychia arida* (Say). Preliminary assignment is also given for the Palearctic, Oriental, and Neotropical species.

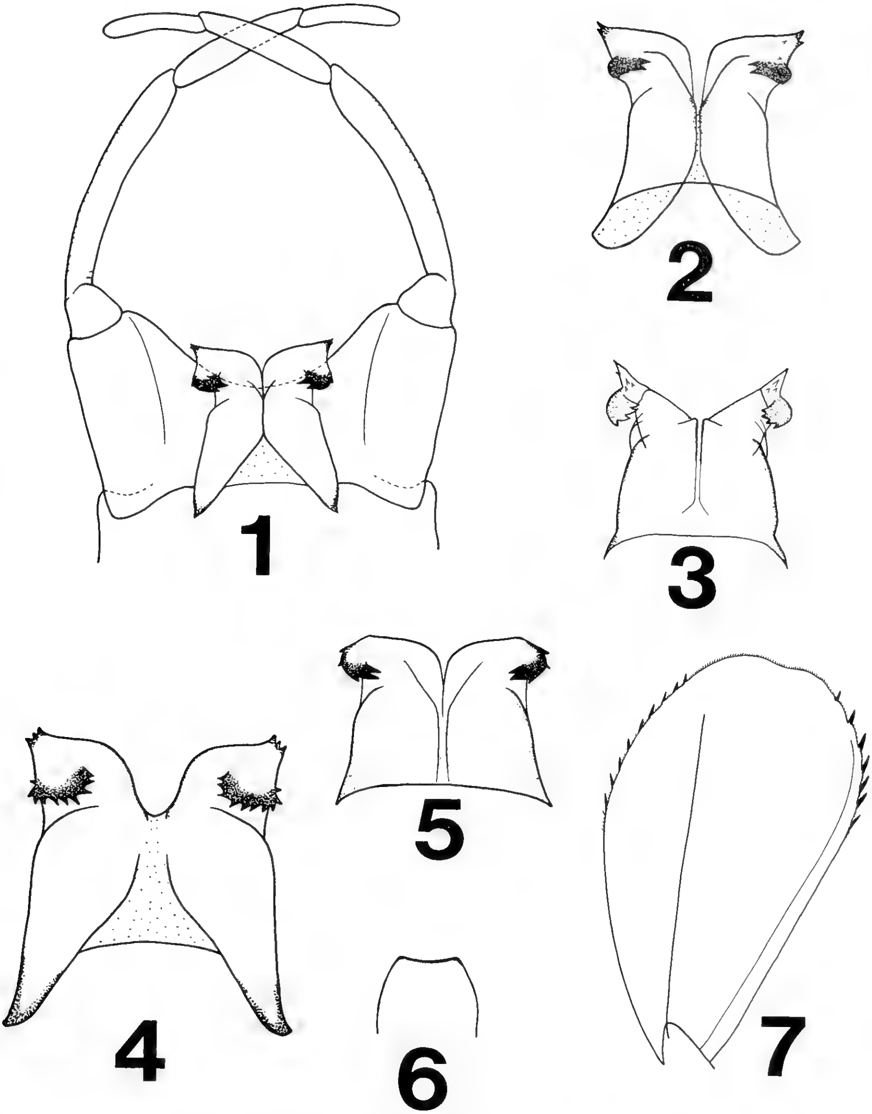
The genus *Isonychia* includes approximately 38 species, of which 27 are Nearctic (Edmunds et al., 1976). The remaining species are Palearctic, Oriental, or Neotropical.

McDunnough (1931) first suggested that the male imagoes of the North American species of *Isonychia* could be readily divided into two distinct groups. Traver (1932) termed these groups the "*arida*" (=*sayi* of Burks, 1953) and the "*albomanicata*" (=*bicolor* of McDunnough, 1931) groups. She further suggested that the "*albomanicata*" group may be subdivided into the *sicca* group using penes form. Traver (1935) and Burks (1953) noted that there were four distinct types of male penes in the Nearctic species.

A revision of the Nearctic species by the authors indicated, after careful study of imaginal, nymphal, and egg characters, that *Isonychia* consists of two monophyletic lineages. Using the criteria of Edmunds (1962), we herein recognize the two lineages as subgenera.

Terminology of egg structure follows Koss and Edmunds (1974). Eggs were removed from associated imago females because eggs of late instar nymphs and subimagoes usually were covered with suprachoronic adhesive layers (Koss and Edmunds, 1974; Kopelke and Müller-Liebenau, 1981). The ratio of the length of the second foretarsal segment to the first foretarsal segment is expressed as the foretarsal ratio. Other morphological terms follow Edmunds et al. (1976). Imagoes and nymphs of all Nearctic species were examined except *I. intermedia* Eaton, in which case only subimagoes and late-instar nymphs were available.

The Palearctic and Oriental species are poorly known. Most available figures of the male genitalia are ventral views, not illustrating important dorsal features. Therefore, the placement of all Palearctic and Oriental species in *Isonychia* s.s. are tentative. *Isonychia alderensis* Lewis is a fossil species from Montana (USA) known from Oligocene sediments.



Figs. 1–7. *Isonychia* (*Prionoides*). 1–5, Male genitalia, dorsal. 1, *I. annulata*. 2, *I. georgiae*. 3, *I. sayi*. 4, *I. serrata*. 5, *I. aurea*. 6, Subanal plate. 7, 7th nymphal gill.

Subgenus *Prionoides* Kondratieff and Voshell, New Subgenus

Type species.—*Isonychia georgiae* McDunnough.

Male imago.—Body length 9–17 mm, forewing 9–16 mm. General body color yellowish brown; median and submedian maculae on abdominal terga brownish or purplish, usually bordering a middorsal stripe; or abdominal terga dark brown with pale yellow anterolateral spots (*I. sayi*). Wings hyaline with veins and crossveins reddish brown to purplish black or with veins and crossveins whitish (*I. sayi*). Prothoracic leg with tarsal ratio .60–.88; femur, tibia, and tarsus brown to purplish brown. Meso- and metathoracic legs yellowish, tarsi sometimes tinged with purple. Caudal filaments dark brown or pale with reddish brown articulations or whitish without dark articulations (*I. sayi*).

Male genitalia.—Subgenital plate broadly concave or with only slight posteromedian emargination (Fig. 1). Forceps sometimes appearing 5-segmented; length of segment 1 ranges from subequal to ½ that of segment 2. Penes, dorsally with incurved medial flap with prominent sclerotized lateral and marginal serrations and large spines; usually with sclerotized acute anterolateral spines or projections (Figs. 1–4).

Female imago.—Body length 9–17 mm, forewing 10–16 mm. Similar maculation as male. Legs colored as male. Subanal plate with no or only a slight broad posteromedian emargination (Fig. 6). Caudal filaments as male.

Egg.—Biconvex with knob-terminated coiled threads closely spaced at center of one side (Figs. 17–20).

Nymph.—Posterior gills without stout sclerotized spines on apical margin (Fig. 7). Single gill at base of each forecoxa, except *I. sayi* with many gill filaments forming a tuft. Middorsal abdominal stripe present or absent.

Etymology.—Feminine; Greek adjective, *Prionoides,* "appearing like a saw," referring to the penial lobes with dorsal incurved flap with sawlike marginal serrations.

Geographic range.—Eastern United States from Maine south to Georgia, except *I. sayi* which occurs from Montana southeast to Illinois, Missouri, Arkansas, Mississippi, and Florida.

Species included.—*Isonychia annulata* Traver, *I. aurea* Traver, *I. georgiae* McDunnough, *I. notata* Traver, *I. obscura* Traver, *I. sayi* Burks, *I. serrata* Traver, *I. similis* Traver, and *I. thalia* Traver.

Discussion.—Male and female imagoes are easily distinguished from *Isonychia* s.s. by: (1) Subgenital plate broadly concave or slightly emarginate; (2) penes armed dorsally; (3) subanal plate with no or only a slight broad posteromedian emargination; (4) biconvex eggs; and (5) usually conspicuous dorsal abdominal color patterns. Mature nymphs may be readily separated by the lack of spines on the apical margin of the posterior gills (Fig. 7) and usually possessing a single gill at the base of each forecoxa (except *I. sayi*).

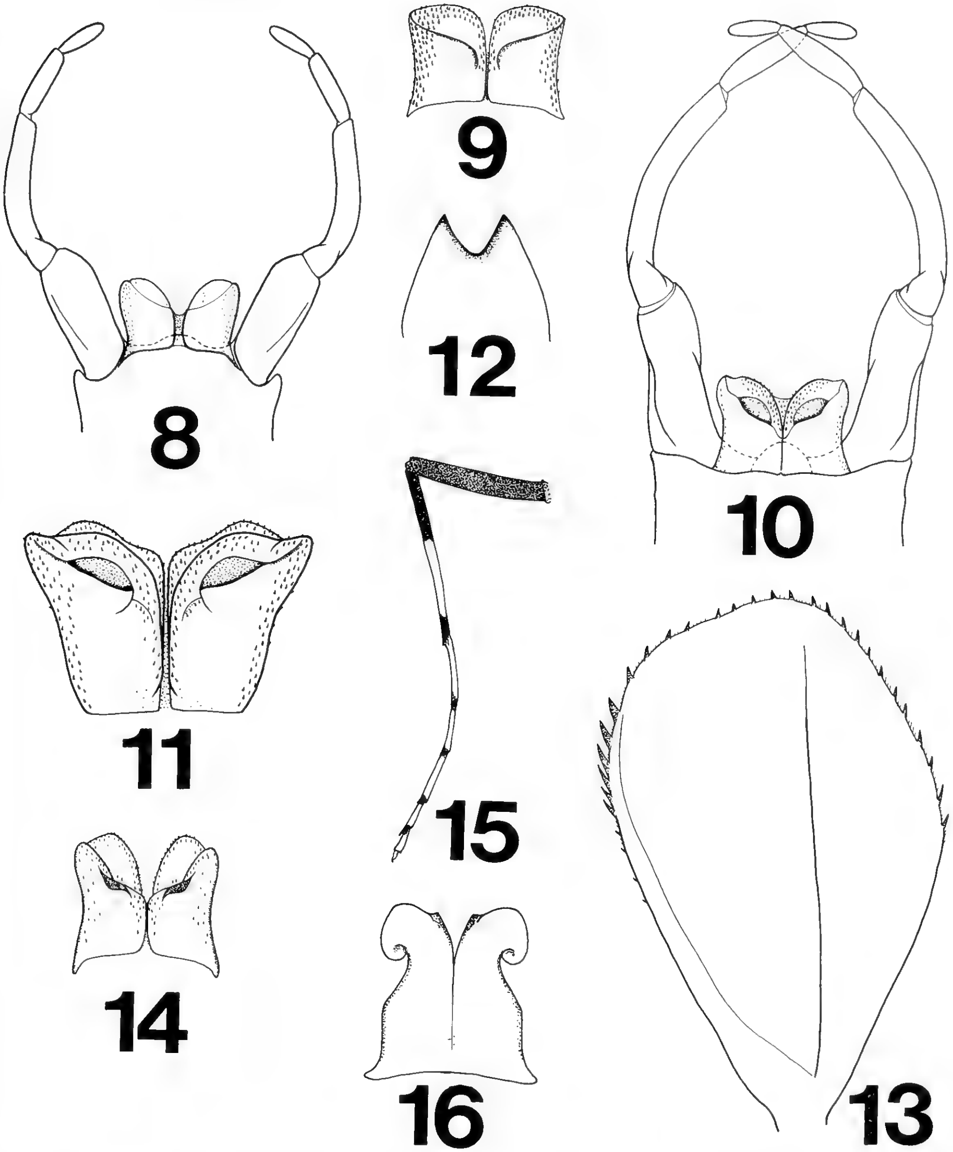
There are two general shapes of penes in *Prionoides. Isonychia annulata, georgiae, notata, obscura, sayi, serrata,* and *thalia* have acute apical lateral projections which are usually toothed (Figs. 1–4). *Isonychia aurea* and *similis* have toothed rounded anterolateral margins instead of the acute lateral projections (Fig. 5).

Subgenus *Isonychia* Eaton, *sensu stricto*

Isonychia Eaton, 1871: 33, 134. Type-species: *I. manca* Eaton. Original designation.

Male and female imagoes of *Isonychia* s.s. are distinguished from *Prionoides* by: (1) Deeply excavated subgenital plate; (2) penes without incurved and serrated medial flap; (3) subanal plate moderately to deeply emarginate; and (4) eggs spherical to subspherical. Mature nymphs possess stout spines on apical margin of all gills (Fig. 13), and gills in tufts at bases of forecoxae.

Isonychia s.s. may be readily divided into four species groups based on male imago penes form. No reliable morphological characters have been found to separate all the female imagoes and nymphs to species group.



Figs. 8–16. *Isonychia* (*Isonychia*). 8–11, 14, 16, Male genitalia, dorsal. 8, *I. campestris* (*sicca* group). 9, *I. sicca* (*sicca* group). 10, *I. tusculanensis* (*bicolor* group). 11, *I. bicolor* (*bicolor* group). 12, Subanal plate (*bicolor* group). 13, 7th nymphal gill (*bicolor* group). 14. *I. arida* (*arida* group). 15, Male foreleg (*arida* group). 16, *I. diversa* (*diversa* group).

Sicca Group

Male imago.—Body length 8–16 mm, forewing 9–15 mm. General body color reddish brown to dark red; posterior margins of terga purplish black or dark brown, sometimes with indistinct whitish middorsal stripe with bordering submedian streaks. *Isonychia intermedia* with abdomen reddish purple with yellowish-white maculae. Wings hyaline, veins and crossveins brown to black, sometimes appearing tinged with light brown; stigmatic area whitish opaque, Prothoracic leg with tarsal ratio 0.76–1.15; femur reddish brown to brownish yellow; tibia brown to yellowish brown, usually darker brown basally and apically; tarsus yellowish with segments tinged with brown. Meso- and metathoracic legs yellowish to white with tarsal segments usually tinged with red or gray. Caudal filaments yellowish to whitish with brown articulations near bases, but occasionally marking entire filament.

Male genitalia.—Subgenital plate with a deep posteromedian emargination, with broadly rounded posterior medial dome (Fig. 8). Forceps 4-segmented sometimes appearing 5-segmented; segment 1, ⅗–¾ length of segment 2. Penes with ventral lobe very broadly rounded or subtruncate; dorsal lobe without flap or roll, at most with a slightly sclerotized median margin (Figs. 8–9). Both ventral and dorsal lobe with minute surface spines. Penes length ⅔–⅘ of width.

Female imago.—Body length 9–16 mm, forewing 9–15 mm. Similar maculation as male. Legs colored as male. Subanal plate with deep posteromedian notch (as Fig. 12). Caudal filaments same as male.

Egg.—Spherical with knob-terminated coiled threads covering entire egg or more densely packed on one hemisphere (Figs. 27–28).

Nymph.—Posterior gills with stout sclerotized spines on apical margins (Fig. 13). Forecoxal gills in tufts. Middorsal abdominal stripe present.

Geographic range.—Western, midwestern, and southen United States. Central Canada, Mexico, and Mesoamerica.

Species included.—*Isonychia campestris* McDunnough, *I. intermedia* (Eaton), *I. manca* Eaton, *I. sicca* (Walsh).

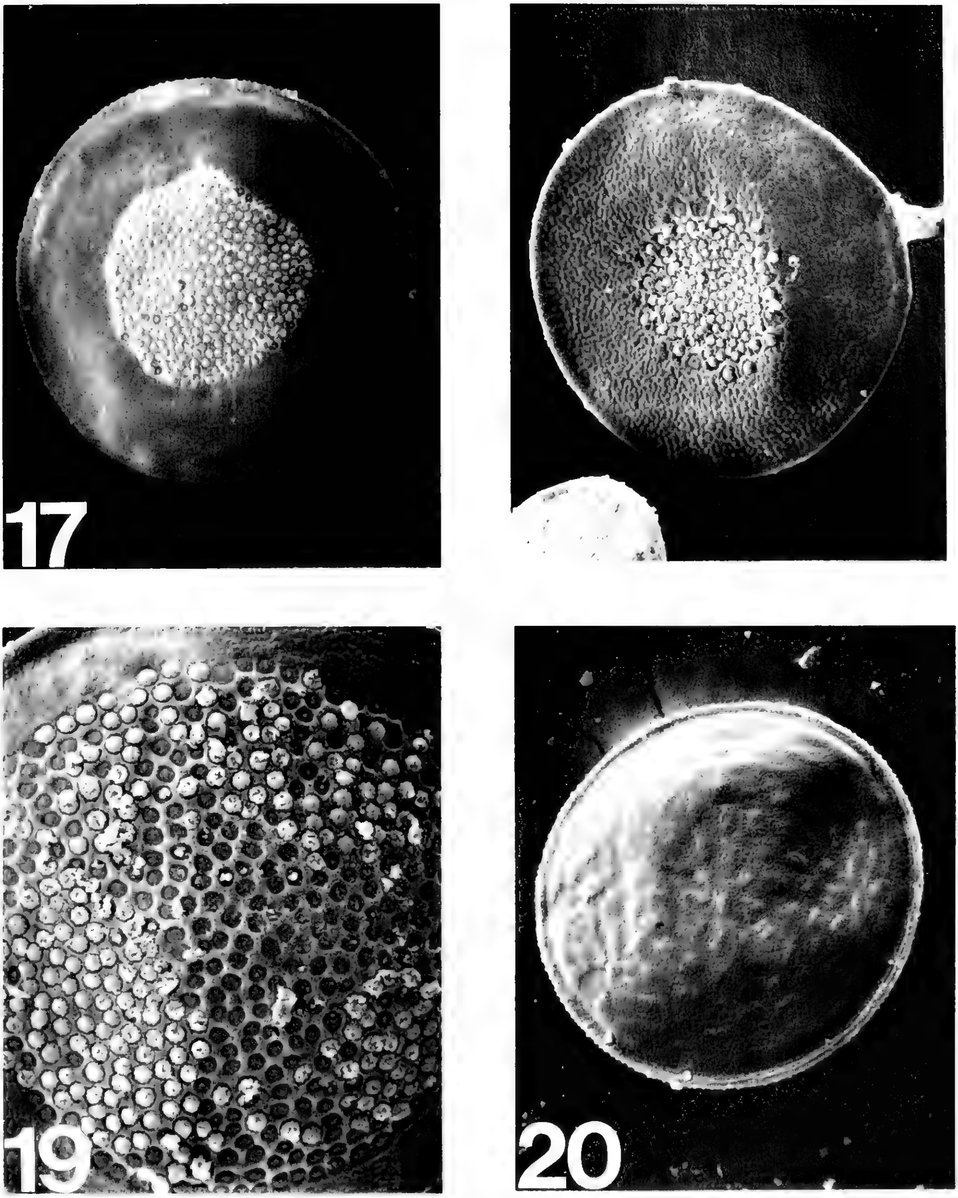
The Pakistan species, *I. khyberensis* (Ali) may belong here.

Discussion.—The relative simple and short penes readily distinguish this species group. The nymphs are very similar to the other species groups of *Isonychia* s.s. and cannot be distinguished presently except by geography. There is apparently an undescribed species from Mexico and Honduras.

Bicolor Group

Male imago.—Body length 9–16 mm, forewing 9–16 mm. General body color yellowish red to dark red; posterior margins of abdominal terga black, sometimes with indistinct whitish middorsal stripe; additional dark middorsal, submedian, and lateral maculae present in *I. velma.* Wings variable; usually ranging from hyaline with veins and crossveins whitish and stigmatic area whitish opaque, to veins and crossveins reddish brown with stigmatic area tinged with reddish brown; *I. tusculanensis* has distal ⅓ of forewing brown and *I. velma* has outer margin of hindwing tinged with red. Prothoracic leg with tarsal ratio .79–.95; femur light to dark brown; tibia ranging from whitish to brownish. Meso- and metathoracic legs whitish to yellowish, sometimes tibia, tarsi and claws tinged with red or gray. Caudal filaments vary from whitish to yellowish without dark articulations except for a few basal segments to completely reddish with articulation darker or lighter in color.

Male genitalia.—Subgenital plate with deep posteromedian emargination; with broadly rounded posterior medial dome (Fig. 10). Forceps 4-segmented, sometimes appearing 5-segmented; segment 1, ⅔–½ length of segment 2. Penes with anterior margin of ventral lobe usually undulate; apices of dorsal lobes somewhat



Figs. 17–20. *Isonychia* (*Prionoides*), eggs. 17, *I. georgiae*, side with knob-terminated coiled threads, 380×. 18, *I. sayi*, side with knob-terminated coiled threads, 350×. 19, *I. annulata*, details of knob-terminated coiled threads, 550×. 20, *I. georgiae*, side without knob-terminated coiled threads showing chorionic tagenoform micropyles, 280×.

divergent, each dorsal lobe with a prominent slightly sclerotized flap or roll on medial edge (Figs. 10–11). Both ventral and dorsal lobe with minute surface spines. Penes length ¾ to subequal as wide.

Female imago.—Body length 9–16 mm, forewing 9–16 mm. Similar maculation as male. Legs colored as male. Subanal plate with moderate to deep posteromedian emargination (Fig. 12). Caudal filaments as male.

Egg.—Spherical to slightly flattened at poles with knob-terminated coiled threads closely spaced in a uniform layer covering entire egg or with some areas slightly more dense than others (Figs. 21–24).

Nymph.—Posterior gills with stout sclerotized spines on apical margin (Fig. 13). Forecoxal gills in tufts. Middorsal abdominal stripe present or absent.

Geographic range.—Eastern and midwestern North America with only one far western species (*I. velma*) from northern California and Oregon.

Species included.—*Isonychia bicolor* (Walker) = (*albomanicata Needham*), *I. christina* Traver, *I. circe* Traver, *I. fattigi* Traver, *I. harperi* Traver, *I. matilda* Traver, *I. pacoleta* Traver, *I. rufa* McDunnough, *I. sadleri* Traver, *I. tusculanensis* Berner, and *I. velma* Needham.

Tentatively most of the other Palearctic and Oriental *Isonychia* may be placed here: *I. formosana* (Ulmer), Formosa; *I. grandis* (Ulmer), Java and Sumatra; *I. ignota* (Walker), Eurasia; *I. japonica* (Ulmer), Japan and Eastern Asia; *I. kiangsinensis* Hsu, China; *I. polita* Bajkova, USSR; *I. sumatrana* (Navas)?, Sumatra; *I. ussurica* Bajikova, USSR; *I. validus* (Navas)?, Japan; *I. winkleri* Ulmer, Borneo.

Discussion.—This large homogenous group of species may be distinguished in the male imago by the characteristic genitalia. Females cannot be readily separated from the *sicca* group without associated males. Within the *bicolor* group most Nearctic species are very similar and are very difficult to distinguish.

Arida Group

Male imago.—Body length 8–14 mm, forewing 8–13 mm. General body color light red to reddish brown; posterior margins of abdominal terga purplish black; usually with indistinct whitish middorsal stripe with submedian streaks. Wings hyaline, veins and crossveins whitish, stigmatic area whitish opaque. Prothoracic leg with tarsal ratio .70–.95; femur brown, sometimes darker apically, usually margined with black apically; tibia bicolored (Fig. 15), whitish medially, dark brown at base and tip. Meso- and metathoracic legs yellowish. Caudal filaments whitish to yellowish without dark articulations, occasionally several basal segments faintly marked with brown.

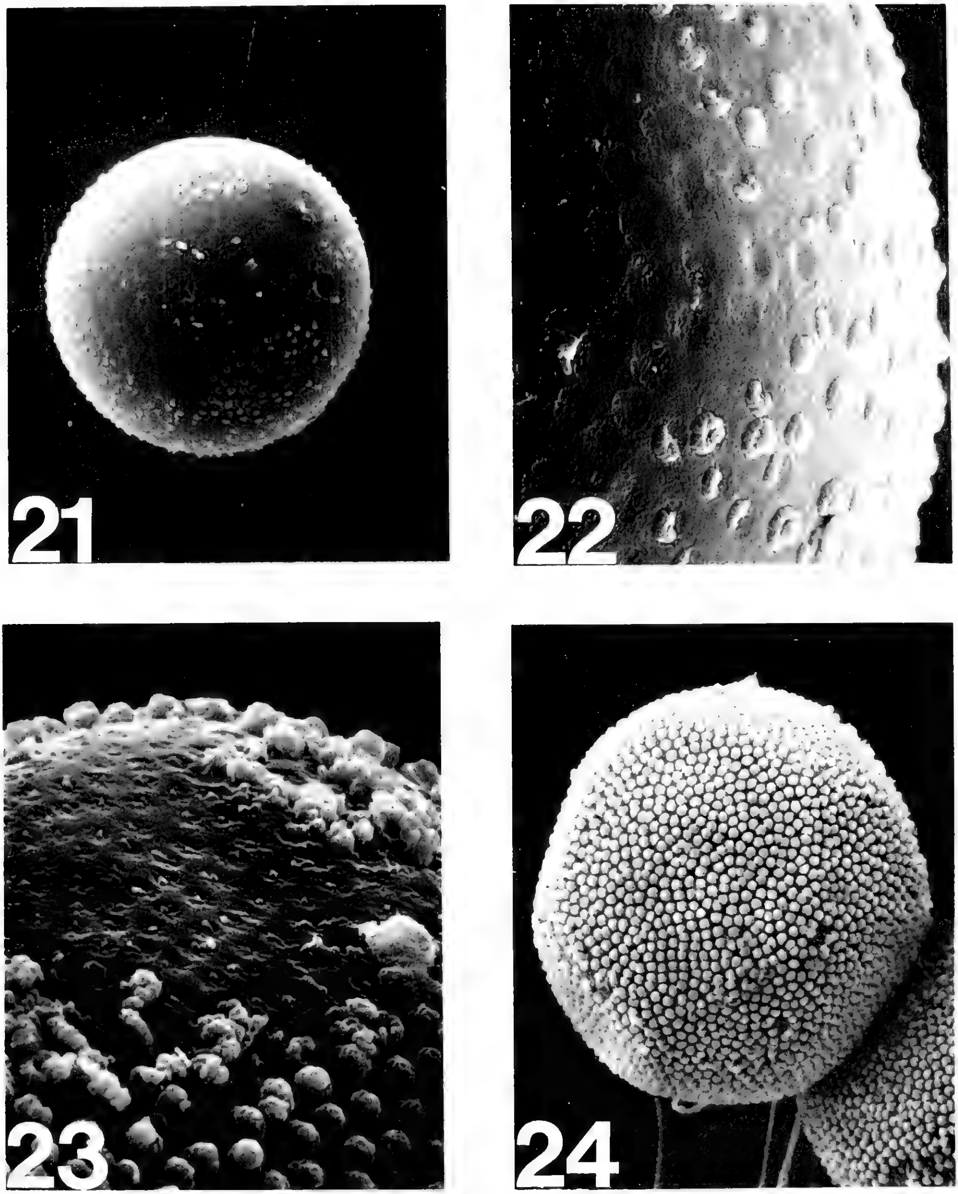
Male genitalia.—Subgenital plate with deep posteromedian emargination; with rounded medial posterior dome. Forceps 4-segmented, with segment 1 subequal to length of segment 2. Penes with ventral lobe broadly rounded apically, dorsal lobes narrowly rounded apically (Fig. 14). Each dorsal lobe with a small medial slightly sclerotized roll. Both ventral and dorsal lobes with minute spines. Penes usually as wide as long.

Female imago.—Body length 11–16.5 mm, forewing 11–16 mm. Similar maculation as male. Legs colored as male. Subanal plate with a moderate to deep median notch as Fig. 12. Caudal filaments as male.

Egg.—Spherical, chorion smooth, with knob-terminated coiled threads spaced uniformly on surface; knob-terminated coiled threads with prominent distinct triangular knobs (Figs. 25–26).

Nymph.—Posterior gills with stout sclerotized spines on apical margins (Fig. 13). Forecoxal gills in tufts. Middorsal abdominal stripe present or absent.

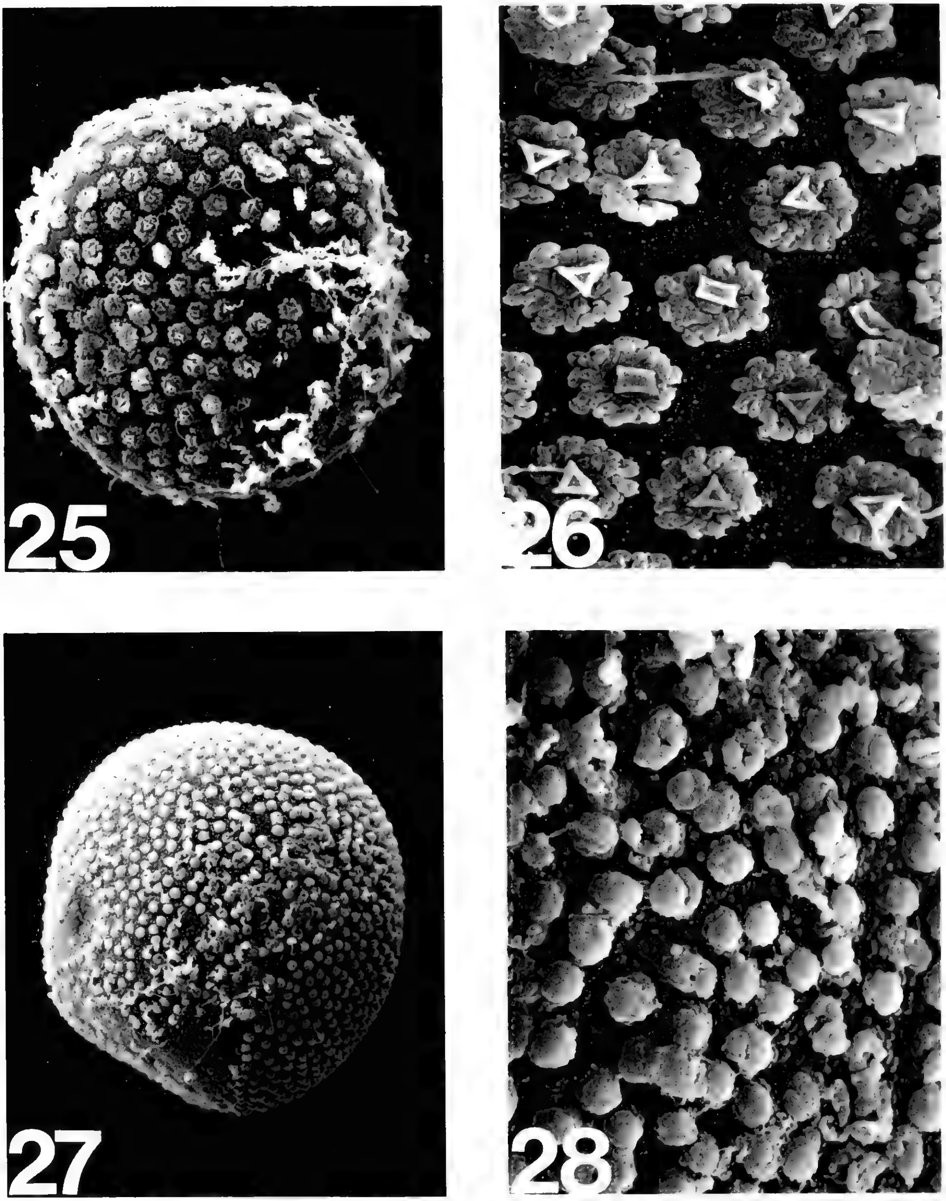
Geographic range.—Virginia south to Florida, west to Mississippi and Illinois.



Figs. 21–24. *Isonychia* (*Isonychia*), eggs of *bicolor* group. 21, *I. bicolor,* 375×. 22, *I. bicolor,* details of knob-terminated coiled threads, 2000×. 23, *I. rufa,* details of knob-terminated coiled threads, 2000×. 24, *I. bicolor,* showing variation of density of knob-terminated coiled threads, 500×.

Species included.—*Isonychia arida* (Say) s.s. Burks, 1953, =*Isonychia pictipes* Traver, **New Synonymy.**

Discussion.—This species may be distinguished by the prominent bicolored foretibiae, males penes, and unusual eggs. The nymphs are similar to the *bicolor* and *sicca* groups and cannot be presently separated.



Figs. 25–28. *Isonychia* (*Isonychia*), eggs. 25, *I. arida* (*arida* group), 500×. 26, *I. arida,* details of knob-terminated coiled threads, 2000×. 27, *I. sicca* (*sicca* group), 500×. 28, *I. sicca,* details of knob-terminated coiled threads, 2000×.

The authors are in agreement with Burks (1953) on the identity of the true *arida* Say, and it is the same as *pictipes* Traver in all particulars.

Diversa Group

Male imago.—Body length 9 mm, forewing 9 mm. General body color brown to reddish brown; posterior margins of terga dark brown with whitish middorsal stripe and submedian dark brown streaks. Wings hyaline, veins and crossveins whitish. Prothoracic leg with tarsal ratio of .73; femur dark red, black at apex; tibia blackish; tarsus light reddish brown. Meta- and mesothoracic legs whitish, femora tinged with red. Caudal filaments whitish without dark articulations.

Male genitalia.—Subgenital plate with a deep posteromedian emargination, with a broadly rounded medial posterior dome. Forceps 4-segmented; segment 1, ¾ as long as segment 2. Base of penes broad, constricted at about ¾ of length, with posterolateral margins of dorsal lobes rounded giving penes a mushroom-like appearance (Fig. 16).

Female imago.—Unknown.

Egg.—Unknown.

Nymph.—Unknown.

Geographic range.—Tennessee.

Species included.—*Isonychia diversa* Traver.

Discussion.—The "mushroom-like" penes readily distinguishes *I. diversa* males from the other groups of *Isonychia* s.s. This species is currently known only from the holotype male from Knoxville, Tennessee collected by Dr. Ainslee. There is an additional subimago male also collected by Dr. Ainslee at the type-locality about three weeks later, but Traver (1934) did not include it as a paratype nor did she include a female imago also from the same locality and time. This badly damaged female imago is not described above since there is no positive association. The subanal plate of this specimen is similar to the *sicca* and *bicolor* groups.

KEY TO THE SUBGENERA AND SPECIES GROUPS

MALE IMAGOES

1. Subgenital plate broadly concave or with only slight posteromedian emargination (Fig. 1); penes dorsally with acute sclerotized lateral and marginal serrations and large spines on incurved flap (Figs. 1–5) .... *Prionoides,* new subgenus
– Subgenital plate with deep posteromedian emargination (Figs. 8, 10); penes dorsally without incurved flap bearing sclerotized teeth or serrations (Figs. 8, 9, 10, 11, 14, 16); subgenus *Isonychia* 2
2. Penes mushroom-like (Fig. 16) .... *diversa* group
– Penes not mushroom-like (Figs. 8, 9, 10, 11, 14) 3
3. Foretibia white, dark brown at base and at apex (Fig. 15); penes as Fig. 14 .... *arida* group
– Foretibia entirely brownish, sometimes darker brown at base and apex; penes as Figs. 8 and 11 4
4. Penes with prominent lightly sclerotized dorsal flap or roll at medial edge; ventral lobe with posterior margin usually undulate (Figs. 10–11) .... *bicolor* group
– Penes without prominent lightly sclerotized dorsal flap or roll at medial edge, at most with only a slightly sclerotized medial margin; ventral lobe, usually very broadly rounded or subtruncate posteriorly (Figs. 8–9) .... *sicca* group

FEMALE IMAGOES

1. Subanal plate with no or only slight broad posteromedian emargination (Fig. 6) .... *Prionoides,* new subgenus

– Subanal plate with a moderate to deep posteromedian emargination (Fig. 12) . . . . subgenus *Isonychia*

MATURE NYMPHS

1. Posterior gills without apical stout marginal spines (Fig. 7); usually 2 diffuse dark spots in outer margin of each gill; forecoxae gills single (except *I. sayi*) . . . . *Prionoides,* new subgenus

– Posterior gills with apical stout marginal spines (Fig. 13); usually diffuse dark spots lacking in outer margin of each gill; forecoxae gills in tufts . . . . subgenus *Isonychia*

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CEROPTERA SIVINSKII, A NEW SPECIES OF SPHAEROCERIDAE (DIPTERA) IN A GENUS NEW TO NORTH AMERICA, ASSOCIATED WITH SCARAB BEETLES IN SOUTHWESTERN UNITED STATES

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Abstract.—*Ceroptera* **sivinskii,** n. sp., is described from specimens found on dung beetles from Florida and Mississippi, and its relationship to Old World species of *Ceroptera* is discussed. This is the first species of *Ceroptera* to be described from the Nearctic Region.

Species of the genus *Ceroptera* Macquart have long been known to cling to the backs of dung-storing scarab beetles and at least one species of the genus has been observed to oviposit in the scarab's dung ball as it is buried (Roubaud, 1916).

Although *Ceroptera* is a widespread genus with several species in Africa and the warm parts of the Palaearctic Region, its presence in the Nearctic Region has not been recorded previously. Knab (1915) observed two species of *Borborus* riding on *Canthon viridis* Beauvais in Florida, but this observation probably pertained to a species of *Copromyza (Borborillus)*, species of which have recently been observed on scarabs (J. Sivinski, personal communication). Neotropical species formerly placed in *Ceroptera* are quite distinct and have been placed in a separate genus, *Archiceroptera* Papp (Papp, 1977).

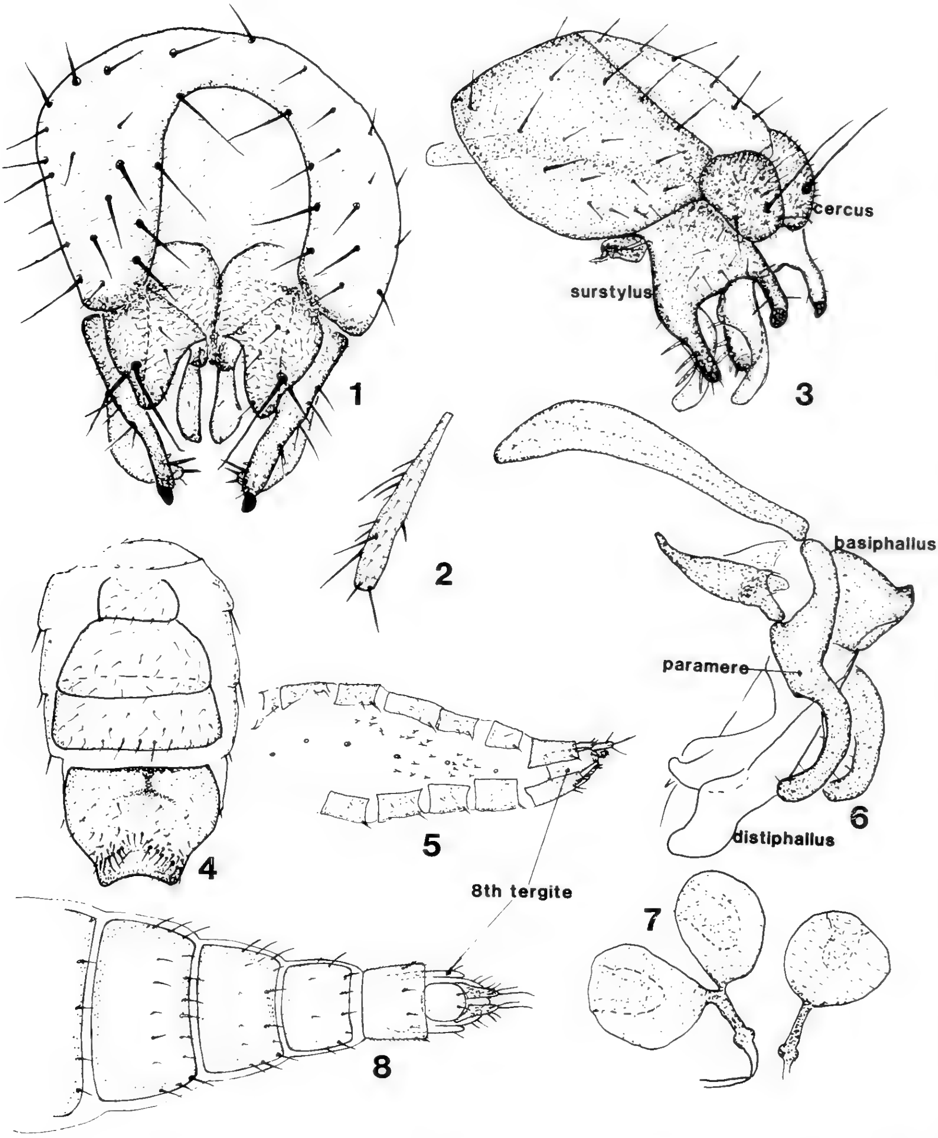
Even though *Ceroptera sivinskii* is very similar to species currently placed in *Limosina* Macquart, it shares a number of important synapomorphies with Old World species of *Ceroptera* and probably represents the plesiomorph sister group to the Old World *Ceroptera.*

Ceroptera sivinskii Marshall, NEW SPECIES

Figs. 1–11

Species of *Ceroptera* can be distinguished from similar North American species by the following characters: Brown with grey dusting, size 2.5 mm. Eyes small; interfrontal bristles in 7–8 pairs; orbital setulae in 2 long rows. Wing without an anal cell; midtibia with a long apicoventral bristle; notum with 1 pair of dorsocentral bristles. Male surstyli with long anterior and posterior lobes; female postabdomen retractile.

Description:—*Head:* Interfrontal area long and narrow, bordered by 7–8 pairs of interfrontal setae (Fig. 10). Two lower orbital bristles, inner vertical bristles, postverticals, and ocellar bristles similar in length; upper orbitals longer; outer verticals and postocellars shorter. Orbital setulae forming 2 rows extending from



Figs. 1–8. *Ceroptera sivinskii.* 1, Male postabdomen, posterior view. 2, Male midtibia, anterior view. 3, Male postabdomen, posterolateral view. 4, male preabdomen, ventral view. 5, Female abdomen, lateral view. 6, Male internal genitalia, posterolateral view (distiphallus not stippled). 7, Spermathecae. 8, Female abdomen, dorsal view.

below the upper orbitals to below the eyes; inner row inclinate, outer row lateroclinate. Face concave and carinate. Eyes small, eye : cheek ratio, 1:1.3. Vibrissal length slightly shorter than ½ face width, subvibrissa ⅕ as long as vibrissa. Gena with 2 rows of setulae.

Thorax: One pair of prescutellar dorsocentrals. Acrostichal setulae forming 8 rows between dorsocentral areas, prescutellar acrostichals not enlarged. Scutellum broadly rounded, slightly wider than long, with 4 marginal bristles. Katepisternum with a large posterodorsal bristle reaching almost to wing base, 1 or 2 small bristles anterior to posterodorsal, and several setulae ventrally.

Legs: All tarsi somewhat elongate and curved (Fig. 9). Midtibia with 3 anterodorsal bristles on proximal ⅓ and 4 anterodorsals on distal ⅓ (Fig. 2); and with a midventral and apicoventral bristle. Hindtibia with a very weak apical spur.

Wings (Fig. 11): Membrane whitish, veins yellow. Ratio of 2nd costal sector to 3rd 3:2 in female; in male 2nd costal sector slightly longer than 3rd; costa ending just beyond R4+5. Halter yellow.

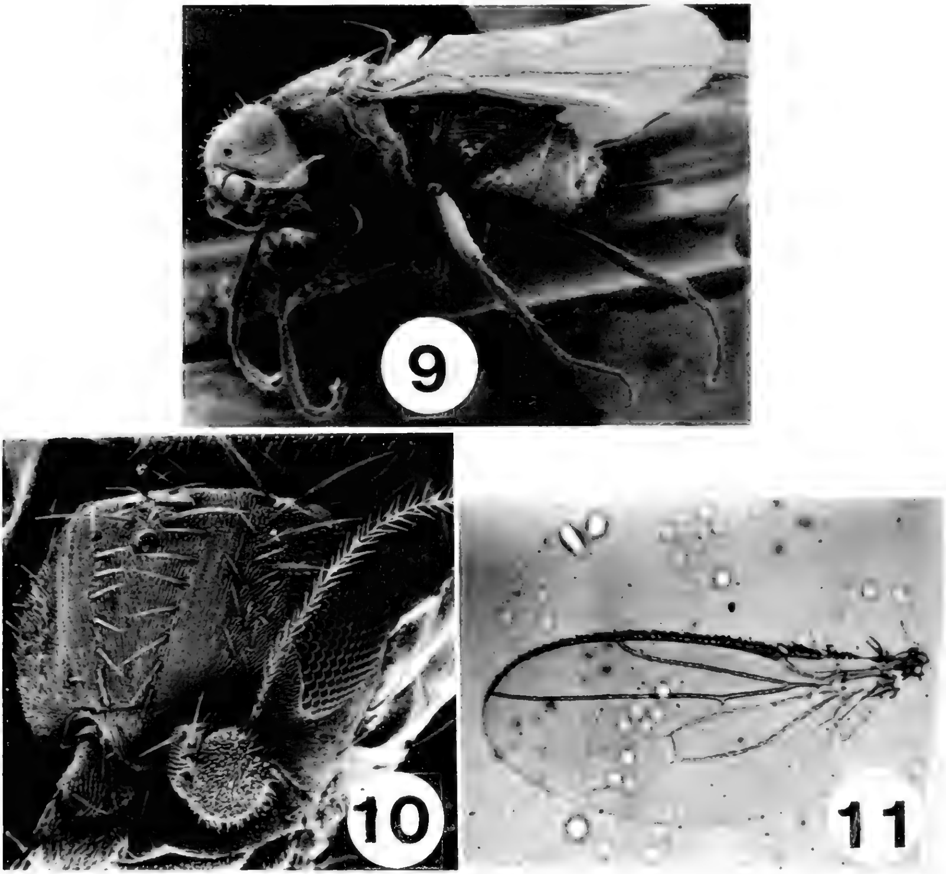
Male abdomen: Sterna as in (Fig. 4), 5th sternum elongate, its distinctive posterior margin covering the genital pouch. Cerci distinct, somewhat bulbous; surstyli deeply cleft, posterior lobe with stout, blunt spur at tip, anterior lobe broader and with numerous bristles (Figs. 1, 3). Internal genitalia as in Fig. 6, distiphallus narrow, elongate, weakly sclerotised but of complex structure. Ejaculatory apodeme apparently absent.

Female abdomen: Pleura with scattered tubercle-based setulae (Fig. 5). Segments 6–10 tapered gradually from rest of abdomen but capable of telescoping. Tergum 8 unsclerotized dorsally, present only as 2 lateral sclerites, these usually telescoped into segment 7. Epiproct and hypoproct small but distinct, cerci digitate with terminal and subterminal bristles.

Types.—Holotype ♂, Florida, Alachua Co., 10.iv.1980, on back of *Canthon,* J. Sivinski (CNC). Allotype ♀, Florida, Alachua Co., 28.ii.1980, on *Geotrupes* approx. 5 cm under cow dung, J. Sivinski (CNC). Paratypes (6 ♂, 4 ♀): Florida, Alachua Co., 18.iii.1980, under cow dung, J. Sivinski (SAM); Alachua Co., 1.iv.1980, under cow dung, J. Sivinski (SAM); Alachua Co., 1.iii.1980, on male *Phaneus vindex* about 3 cm under cow dung, J. Sivinski (SAM); Hernando Co., 2 mi. W. Croom, Withalacoochee State Forest, iv.1971, dung trap in pine forest with scattered oak. A. Newton (MCZ); Clay Co., Orange Park, 25.iii.1952, O. Peck (CNC). Mississippi, Scott Co., Bienville National Forest, Raworth Campground, 10–14.iv.1972, dung trap in pine forest, A. Newton (MCZ). (CNC = Canadian National Collection, Ottawa; MCZ = Museum of Comparative Zoology, Harvard University, Cambridge, Mass.; SAM = S. A. Marshall collection.)

Discussion.—The Nearctic species most similar to *C. sivinskii* are currently placed in *Halidayina* Duda and *Limosina* Macquart. Most North American workers follow Richards (1965) in including *Limosina, Halidayina,* and related taxa as subgenera of *Leptocera* Olivier. If this classification is to be retained, *Ceroptera* would have to be included as a subgenus of *Leptocera. Ceroptera* is more closely related to subgenus *Limosina* than to several other *Leptocera* subgenera. The wing venation of *Ceroptera* is of the derived type (no anal cell, medial veins extending slightly beyond end of discal cell) which is the major synapomorphy for the genus *Leptocera* (sensu Richards, 1965). Characters in common between *C. sivinskii* and *Limosina* include 4 scutellar bristles, an apical ventral bristle on the midtibia, a modified fifth sternum overlapping the straplike sixth sternum, 3 spermathecae, and the basic configuration of the male genitalia. *Ceroptera sivinskii* is also similar in size to *Limosina,* being much smaller than other *Ceroptera.*

Papp (1977) included *Ceroptera* in a subfamily Ceropterinae Vanschutbroeck, largely distinguished on the basis of a small ventroapical spur on the apex of the hindtibia, a retractile, partially desclerotised female abdomen, and the presence of enlarged tarsal claws and pulvilli. *Ceroptera sivinskii* is intermediate in these characters between Ceropterinae and related taxa. Its hindtibial spur is small,



Figs. 9–11. *Ceroptera sivinskii.* 9, Male habitus. 10, Anterodorsal view of head. 11, Wing of male.

barely larger than that in many *Limosina* and the pulvilli and claws are more similar to those of *Limosina* species than those of Old World *Ceroptera.* The female postabdomen of *C. sivinskii* is retractile, but neither desclerotised nor rapidly tapering as in the *Ceroptera* species examined by Papp (1977).

Although *C. sivinskii* differs from Old World *Ceroptera* in the above proposed subfamilial characteristics, numerous synapomorphies provide good evidence for the inclusion of Old and New World forms in the same genus. The abdomen of female *C. sivinskii,* although not rapidly tapering and desclerotised, has tergum 8 divided into lateral plates and telescoped into the 7th segment as is the case in the Palaearctic species *C. rubricornis* Duda. The long, narrow, interfrontal plate bordered by numerous interfrontal bristles, the double row of orbital setulae, the strong facial keel, the eye reduction, the tubercle based setulae on the female abdominal pleurae, and the habit of riding on dung beetles, are more obvious synapomorphies shared by *C. sivinskii* and the rest of *Ceroptera.*

The male postabdomen of *C. sivinskii* is very similar to that of the Palaearctic *C. rubricornis, C. alluadi* Villeneuve, and *C. rufitarsis* Meigen. *Ceroptera rufitarsus,* the type-species of *Ceroptera,* is figured by Hackman (1969), and I have examined males of the other two Palaearctic species. All three Palaearctic species have anterior and posterior surstylar lobes which actually constitute one deeply cleft surstylus with a narrow posterior lobe and a broader, bristled anterior lobe; clearly derivable from the less deeply cleft surstylus of *C. sivinskii.* The internal genitalia of *C. sivinskii* is similar to the three Palaearctic species in that all four species have a very long, narrow distiphallus which is indistinctly separated from the basiphallus. These species also share a short hypandrium and simple, blunt-tipped parameres, however, the Palaearctic species have broader parameres. The basiphallus structure is similar among all four species; however, *C. rubricornis* has a long epiphallus and the basiphallus of all three Palaearctic species is longer and thinner than that of *C. sivinskii.* Based on Hackman's (1965) figures and an examination of one African species (*C. nasuta* Villeneuve), *C. sivinskii* is much more closely related to Palaearctic than to Ethiopian *Ceroptera.* The African males examined have a very long hypandrium, a long, curved epiphallus, and surstyli with anterior and posterior lobes very different from, but probably derived from, the elongate and simple form found in Palaearctic species.

Ceroptera probably evolved from a *Limosina* like ancestor that was associated with scarabs. *Ceroptera sivinskii* is probably the *Ceroptera* species most similar to that ancestor, and could be the plesiomorph sister taxon to the old world *Ceroptera. Ceroptera,* including this new Nearctic species, should be treated at the same categorical level as its close relatives *Limosina* and *Halidayina.* Roháček (*in press*) has monographed the Palearctic *Limosina* and related groups, recognizing them as genera of the subfamily Limosininae Frey (=Leptocerinae Hackman, 1969). The evidence presented here supports the recognition of *Ceroptera* as a genus within that subfamily, and does not support the recognition of a subfamily Ceropterinae.

ACKNOWLEDGMENTS

This species is named after John Sivinski, (University of Florida, Gainesville), who collected most of the type-series and discovered its association with dung beetles. I am also grateful to A. Newton (MCZ) for access to his pitfall trap material, from which I extracted two paratypes of *C. sivinskii.* Thanks are also extended to H. Teskey (CNC) and J. Roháček (Silesian Museum Opava, Czechoslovakia) for their helpful comments on this manuscript.

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A NEW SPECIES OF *OMMATIUS* (DIPTERA: ASILIDAE) FROM SAN SALVADOR, THE BAHAMAS

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Abstract.—A new asilid, *Ommatius* **hanebrinki,** from the island of San Salvador in the Bahamas is described and illustrated. This taxon is the first record of the genus on the island and the third species reported from the Bahamas.

The genus *Ommatius* is a large and widely distributed genus particularly abundant in Africa and the South Pacific (Hull, 1962). Thus far none have been reported in Europe, in North America north of 45° N, or south of Brazil in South America. The islands of the Caribbean have been little explored and have few representatives, with most being reported from Jamaica (Farr, 1965) and Cuba (Bromley, 1929). Presently only *O. abana* Curran (Curran, 1953) has been reported from the Bahamas. In addition, we located a female *O. marginellus* (Fabricius) (14–16 Febr., 1932, Utowana Exp.) from Rum Cay, Bahamas, in the collection of the Museum of Comparative Zoology, Harvard University.

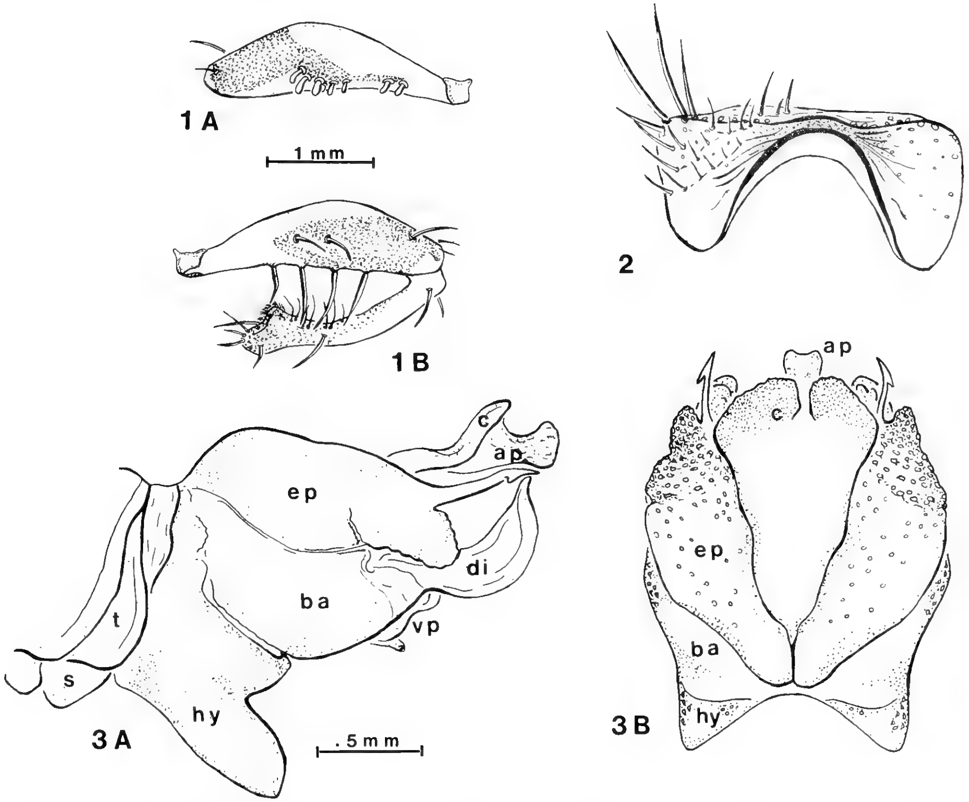
Since 1978 we have been collecting and observing asilids on the island of San Salvador in the Bahamas. Our studies have revealed that at least two undescribed species exist on the island. They will probably be found on other islands as they are explored. This paper reports on a new species of *Ommatius* found on San Salvador.

Ommatius hanebrinki **Scarbrough and Rutkauskas, New Species**

Figs. 1–9

Holotype male (Figs. 1–6).—Length, 12.5 mm. Head dark brown. Face dense yellow tomentose, grading to white below mystax; in lateral view, tomentum yellowish brown at middle and above antennae. Front yellow tomentose, with 4 weak, yellow frontal hairs. Vertex yellowish tomentose grading to whitish yellow posteriorly on occiput. Ocellar tubercle shiny dark brown with scattered yellow tomentum above; 4 dark brown ocellar bristles, posterior 2 very short. Mystax of rather sparse slender bristles, mixed long and short, most abundant on lower ½, bristles whitish, with longer ones (6) pale yellow. Palpi black, 6× longer than wide; hairs white. Proboscis dark brown; whitish to pale brown hairs ventrally from base to middle, pale yellow and short at apex. Beard and occipital hairs long, whitish, somewhat plumose. Subproclinate occipital bristles pale yellow to light brown, with 4 black bristles above.

Antenna dark brown, segments of equal length, with yellow and brown tomentum; yellow except at apex of 2nd and all of 3rd segments where brown is combined



Figs. 1–3. *Ommatius hanebrinki,* male. 1, Segments of left hindleg showing major chaetotaxy and apical bands. 1A, Posterior view of femur. 1B, Anterior view of femur and tibia. 2, Tergum 8. 3A, Hypopygia, lateral view. 3B, Hypopygia, dorsal view. Abbreviations: ap = anal process; ba = basistylus; c = cercus; di = dististylus; ep = epandrium; hy = hypandrium; s = sternum; t = tergum; vp = ventral process of basistylus.

with yellow, producing a golden brown contrasting color at some angles and yellow at others. Anterior (inner) surface of segment 2 with only scattered tomentum. Antennal bristles on all segments dark brownish black except for a few pale yellow or whitish ones below; style length about 2½× the three segments combined, rays of styles 12–13.

Thorax dark brown. Pronotum tomentose greyish white, yellowish medially at base; hairs white to pale yellow. Mesonotum with 3 broad brown vittae, central one divided longitudinally nearly its full length by dark ochreous golden pollen, lateral vittae divided by oblique sutures. Mesonotum with yellowish white to golden ochreous tomentum except on exposed elevated sections, shiny dark brown. Thoracic bristles black: presutural 2 (1st ½ length of 2nd), supra-alar 1, postalar 1 (an additional weak one on the left side); dorsocentrals consisting of 10 short pairs, 2 long, strong, black hairs and 2 thin white ones behind. Several fine whitish hairs below supra-alar bristles, 3 weak black bristles above presuturals. Anatergal slopes and pleurae greyish white tomentose, except yellowish brown anterior to wing bases; hairs sparse, weak, white. Pteropleural bristles absent; laterotergal and anatergal bristles white. Several thin white hairs on scutellar disc, none projecting above rest as conspicuous pairs.

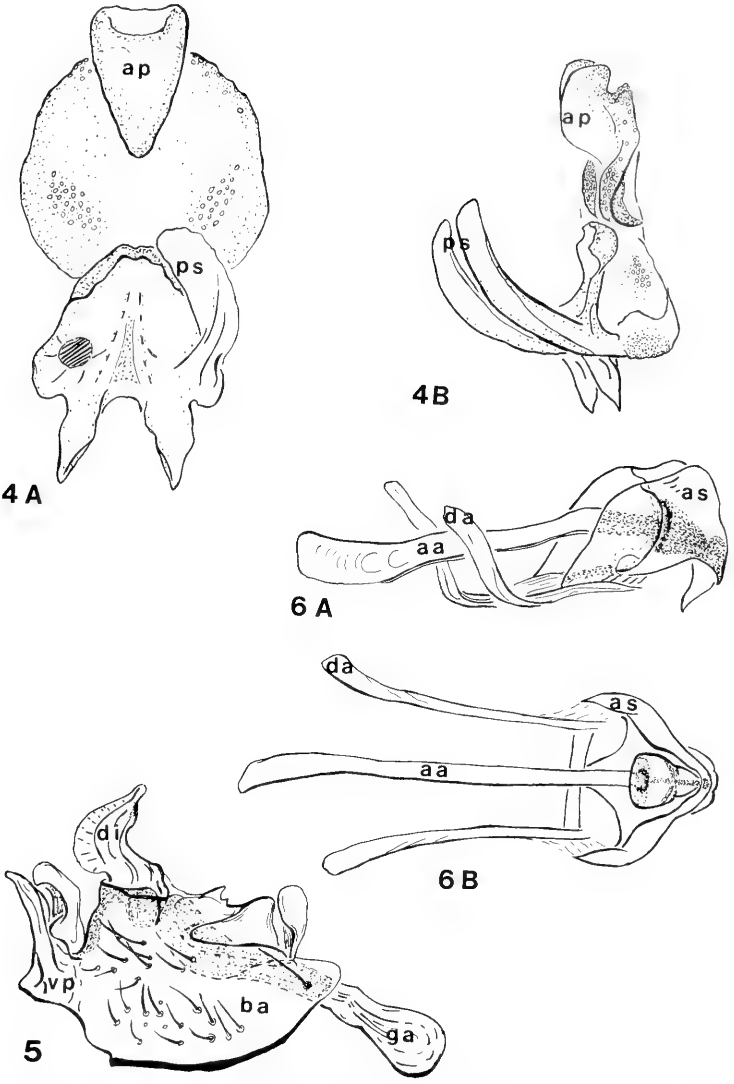
Coxae black with greyish-white tomentum, white hairs and bristles. Legs brownish yellow, fore- and midtibiae slightly paler, apical black bands on all leg segments and a basal band on forefemur; bands narrow on fore- and midtibiae, extensive on hindtibia, covering apical ¾; bands of femora as follows: apical ⅓ and basal ½ of anterior surface of forefemur, apical ⅔ of anterior surface of mid- and hindfemora, bands on posterior surfaces narrow and obsolete below, posterior band of hindfemur extends basally in narrow strip about ¾ length of segment. Fore- and midlegs of normal shape, hindfemur swollen, evenly contoured, hindtibia enlarged apically.

Femora clothed with pale yellow to short white pile, longer below and on dorsal and posterior surfaces of hindfemur, mixed with black on dorsal surface, primarily black on black areas; several prominent spines, singly at apex and on anterior surface and in rows ventrally, pale yellow to white except for 1 black bristle near base of anterior surface of midfemur and 1 or 2 weak apical bristles on all femora and 1 black preapical bristle on midfemur. Forefemur with 1 row of ventral bristles, mid- and hindfemora with 2 rows, often intermixed with long pale pile, posteroventral row of hindfemur slightly curved distally with 6 bristles and 2 basally, bristles flat, short and tips rounded. Vestiture of tibiae pale yellow to white except as follows: scattered, black, appressed setulae on all tibiae, absent ventrally except near apex, 1 short dorsobasal bristle on fore- and midtibiae, several strong black bristles on apical bands of fore- and midtibiae, 1 or 2 weak black bristles on apical band of hindtibia, 1 pale brown dorsal bristle near apical band of midtibia. Sparse long pale yellow pile on all tibiae, most prominent on apical ½ of hindtibia, posterior surface of hindtibia with a longitudinal bare line extending nearly full length of segment, ventral row of weak bristles, bristles primarily pale yellow on fore- and hindtibiae, black on midtibia. Foretibia with anteroventral pad of thick orange hairs, extending from apex to about ⅔ length of segment.

Tarsi dark brown to black, basal segments pale except for narrow black apical band, foretarsus noticably paler than others; tarsi with pad of short orange hairs and black bristles, basal tarsomeres with relatively long pale yellow bristles, 5 on first 3 tarsomeres of foretarsus, 3 or 4 on first 2 or 3 tarsomeres of midtarsus, 2 on tarsomere 1 of hindtarsus; except for 1 on foretarsus, all pale yellow bristles are on posterior surfaces. Claws black except for basal ⅕, orange yellow.

Wings hyaline, veins light brown at basal ⅕, dark brown elsewhere. Costal setae short, dark brown to black; fringe of posterior wing margin golden brown; costal margin without a bulge. Microtrichiae golden brown, present on apical ⅓ of wing and along wing margin to middle of CuA and inner ⅔ of subcosta, densest along anterior margin, less dense along posterior margin, absent medially and basally. Brownish tomentum on veins basally and medially, and on basal ⅓ of subcostal cell. Middle of marginal cell with several brownish vertical streaks. Halter yellow brown, bases and stalks pale.

Abdomen dark brown to black, posterior border of terga light brown. Dorsally, terga mostly brown tomentose with yellow, sides cinereous yellow except the following: tergum 1 and anterior ⅓ of 2, more yellow and less brown above and sides more white than yellow; terga 7 and 8 combined shorter than 6, both shiny



Figs. 4–6. *Ommatius hanebrinki,* male hypopygia. 4A, Sternum 10 and anal process, ventral view. 4B, Sternum 10 and anal process, ventral view. 5, Left gonopod. 6A, Aedeagus, lateral view. 6B, Aedeagus, ventral view. Abbreviations: aa = aedeagal apodeme; ap = anal process; as = aedeagal sheath; ba = basistylus; da = dorsal apodeme; di = dististylus; ga = gonopod apodeme; ps = process of sternum 10; vp = ventral process of basistylus.

black with some yellow tomentum at the midline and on lateral margins; tergum 8 excised anteriorly at middle. Extreme margins of terga 1–5 with prominent narrow line of yellowish-brown tomentum. Bristles of terga usually pale yellow, short, slightly longer at corners; a few black bristles on terga 7 and 8; hairs on terga 1 and 2 whitish. Venter dark brown except for wide bands on posterior margins of sterna 2–4, bands on 5–6 narrow; tomentum cinereous yellow, except sternum 1 and anterior margin of 2 more grey white. Pale white hairs on sterna

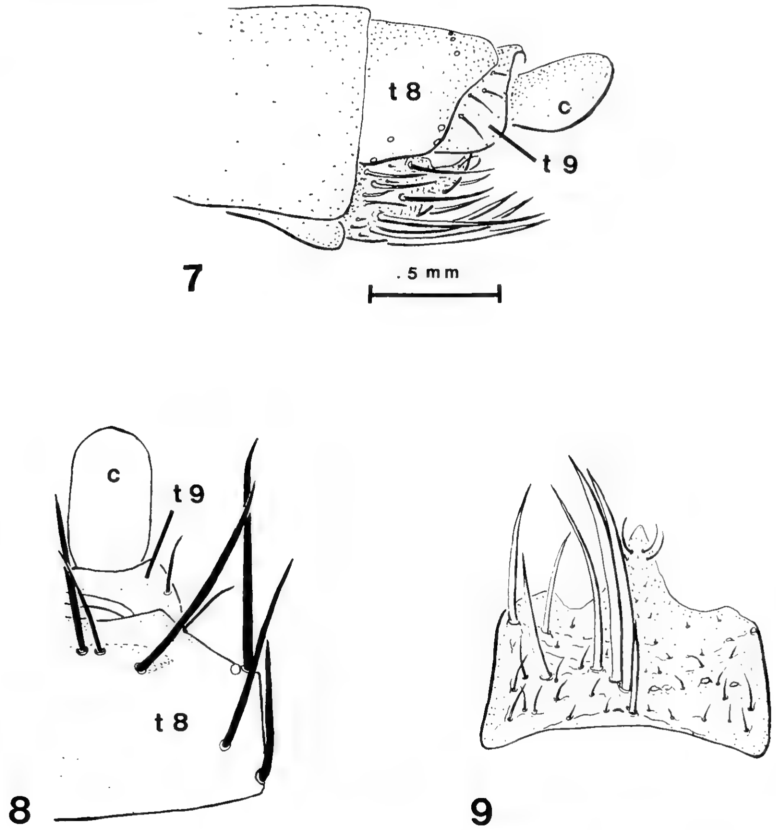
1–4; short, sparse pale yellow bristles on 5–6, more abundant and stronger on 7–8, especially on posterior margins.

Hypopygia longer than terga 6–8 combined, shiny black except as follows: venter and associated appendages, apical ⅓ to ½ of the basistylus and apical ⅓ of the epandrium, brown to orange red. Hypopygial bristles mostly black, sometimes pale yellow or orange red interspersed. Epandrium about 2½× longer than wide, fused basally, apically an elongated harpoon-like structure and a rounded lobe below, bristles scattered near base, dense elsewhere, bristles on apical ⅓ thicker and longer, black to pale yellow with orange red on ventral lobe and margin, black elsewhere. Cerci bipartite, sclerotized brown to reddish brown, joined by membrane. A circular plate below cerci and an elongated anal process which is weakly sclerotized ventrally; hairs pale yellow, abundant along notched margin and 2 posterolateral areas. Hairs at the latter location elongate and bent about midlength at right angles.

Gonopods 2-segmented, basistylus with basally bifurcated ventral process which surrounds the lateral and ventral aspects of the aedeagus; dististylus sickle shaped, orange red. Aedeagus elongate with proximal head recurved, directed dorsally; valve conical, open ventrally, sclerotized except for dorsolateral arms; dorsal apodemes weakly sclerotized, attached laterally to the gonopod apodemes; aedeagal apodeme strongly sclerotized except at distal end. Sternum 10 divided medially along basal margin, with 2 erect leg-like processes which surround the dorsolateral aspects of the aedeagus, and a median groove which receives the aedeagus when not in use. Hypandrium shiny black, consisting of an apical plate and a base which encircles the hypopygium. Bristles short, mostly black, dense on margin of apical plate. Hypandrial plate thick, notched medially, projecting ventrally below basistylus about 45°, with yellow tomentum dorsally and along the midline ventrally.

Allotype female (Figs. 7–9).—Length, 11.3 mm. Similar to male, differing as follows: tomentum of face and front whitish yellow, 4–5 pale brown yellow bristles in upper ½ of mystax; whitish-yellow bristles below only 1st antennal segment, rays of styles 11–12. Three black occipital bristles, dorsal. Mesonotum with 3 strong black dorsocentrals. Pleurae with light yellow tomentum on elevations of anepisternum, katepisternum, and katepimeron. Halter yellowish, darker at base with brown. Wings without brown vertical streaks across middle of marginal cells. Legs darker brownish yellow, more numerous black to pale brown bristles and pile, black dorsobasal bristles longer on mid- and hindtibiae, strong black bristles on apical band of hindtibia and few weak black bristles in ventral row of foretibia. Hindleg slender, without prominent enlargements, posterior band on hindfemur broad, extending almost ½ length of segment, ventral rows of bristles similar. Bristles black except a few pale yellow ones on fore- (2) and midtarsi (4), absent on hindtarsus.

Abdomen with less yellow tomentum anteriorly on segments 1 and 2, golden brown stripes on lateral margins of anterior terga less prominent. Tergum 7 dense tomentose anteriorly and laterally, sparse medially and widened posteriorly; few black bristles along posterior border. Tergum 8 shiny, black medially, brown laterally, longer medially, about ⅔ length of tergum 8; bristles black, yellow pollen limited to median stripe and extreme posterior border. A few strong pale yellow bristles on sterna 4–6; sternum 7 with several (8) short black erect bristles posteromedially, between longer pale yellow ones at corners.



Figs. 7–9. *Ommatius hanebrinki,* female genitalia. 7, Lateral view. 8, Dorsal view. 9, Sternum 8. Abbreviations: c = cercus; t = tergum.

Genitalia about same length as tergum 8. Tergum 9 as a short plate dorsally, longer laterally with margins folded around bases of cerci almost meeting ventrally; shiny dark brown except for yellow tomentum along posterior border and 3–4 short dark bristles. Sternum 8 shiny dark brown, about ⅔ as long as wide, with lateral and posterior borders arched upward; posterior borders rounded at corners, mesally elevated, forming a distal arched process which extends posteriorly toward the genital aperture and cerci bases; arched process reddish brown. Bristles of sternum 8 numerous, usually yellow or yellow brown, as follows: 9–10 stout bristles in anterior ⅓ of sternum, 3–4 bristles near posterior corners, sometimes dark brown or black, numerous short yellow bristles at anterior corners and scattered around bases of stout bristles; numerous short seta-like bristles on posterior ⅓, abundant along midline, except for a few elongated ones located laterally on distal process, sometimes are above or around sides of distal process. Sternum 9 reduced, appearing as 2 horizontal slender sclerites, united mesally, located between lateral margins of tergum 9, dorsal to genital aperture and lying free in membrane. Cercus 1-segmented, about twice as long as wide, and covered with dense, short, yellow pile and primarily long yellow hairs along the margin. Subanal plate similar in shape and vestiture to cercus except smaller and less yellow hairs.

Types.—All specimens were collected among woody scrub vegetation (primarily Jumbay beans, *Leucaena leucocephala* (Lam.) de Wit, Leguminosae) near the CCFL Research Station (College Center of the Finger Lakes, Bahamian Campus) at the north end of the Island of San Salvador in the Bahamas. Most specimens were collected in a Malaise trap while a few were taken with hand nets. Holotype ♂, 7.VI.80, 0.8 km S CCFL. Allotype ♀, 28.V.80, same location. Paratypes (10 ♂, 4 ♀): ♂ 20.XI.1975 (Tracey L. St. John) CCFL; ♂ 4.XIII.1975 (Steve Young) CCFL; ♀ 27.XI.1978 (T. L. Slotzhaner) dump at Graham's Harbor 1.4 km S CCFL; ♂ 1.VI.1979 (A. G. Scarbrough) CCFL Res. Sta.; ♀ 5.XII.1979 (D. Dowling) Rd. to French Bay 0.9 km N CCFL; ♀ 5.XII.1979 (J. Irwin) trail to East Beach 3.5 km E CCFL; ♀ 5. ♂ 7.VI.1980 (A. G. Scarbrough) 0.8 km S CCFL; 6 ♂ 6.7.8.11.12.16.VI.1981 (A. G. Scarbrough and R. Rutkauskas) 0.8 km S CCFL.

The holotype and allotype are deposited in the National Museum of Natural History, Washington, D.C. and the paratypes at the American Museum of Natural History, New York, and the collection of one of the authors (AGS).

Etymology.—The specific epithet is in honor of Earl Hanebrink, Professor of Biology, Arkansas State University, a former advisor who introduced this interesting group of flies to one of the authors (AGS).

Discussion.—Variation among specimens in the type-series is very slight. Most notable differences are as follows: body lengths 11.9–12.8 mm ♂, 10.6–11.3 mm ♀; antennal rays from 10–11 to 14–15 ♂, from 11–12 to 14–15 ♀. Both sexes show some color differences of the legs and in vestiture. Specimens captured in May–June are usually lighter in the intensity of yellow than those captured at other times of the year. Also a few specimens have a narrow line or ring of white tomentum bordering the eyes in the face and the bases of the antennae. In "greased" specimens, the scales on the face retained some recognizable yellow color. Chaetotaxy: dorsal occipital bristles varied from all white to 5 black; second pair of ocellar bristles usually absent; strong dorsocentrals 1 to 4, usually 3; an occasional extra presutural or postalar bristle, always black, weak, unilateral; the dorsal presutural bristles, usually black, sometimes pale and unilateral. In males, the basal dorsoposterior bristles of the hindtibia are sometimes absent and the basal bristles in the ventroposterior row of the hindfemur vary from 1 to 2.

In addition to genitalia, females may be distinguished from males by the presence of 4 to 5 pale brown bristles in the upper half of the mystax, greater number of dark tibial bristles and yellowish tomentum which extends farther down on the pleuron, and the absence of enlarged hindlegs. Males also have a modified posteroventral row of bristles on the hindfemur and pale bristles on the hindtarsus.

Diagnosis.—The two prominent black bands on the forefemur in both sexes, the dark vertical lines in the marginal cell, the combined characters of the hindlegs, and genitalia of males are unique to the species and readily separate *O. hanebrinki* from other described species in the West Indies. The only *Ommatius* species (*O. abana* Curran) endemic to the Bahamas was described from three females collected on South Bimini Island (Curran, 1953). *Ommatius abana* is readily recognized from *O. hanebrinki* by two broad black bands on the hindfemur, a short stylus with only 4 rays near the tip, and appressed black hairs on terga 7–8.

Four Jamaican species (Farr, 1965) exist of which three are distantly related. In addition to the characters above, *O. alexanderi* Farr and *O. reophilus* Farr have two marginal scutellar bristles which are absent in *O. hanebrinki*. *Ommatius* *jamaicensis* Farr has dark orange-brown legs, and the apical band of the foretibia extends along the anteroventral surface almost the full length of the segment; in *O. hanebrinki* the legs are lighter and the dark streak on the foretibia is absent. Furthermore, males of all three Jamaican species have slight to prominent bulges in the costal margins. In Curran's (1928) key to species from the Americas, *O. hanebrinki* does not run down well, but might be forced to *O. ruficauda* Curran. The latter differs from *O. hanebrinki* as follows: a slightly spatulate abdomen, all black occipital bristles, a single apical band on the forefemur, and a row of eight black bristles on the hindfemur.

In Wilcox's (1936) key, *O. hanebrinki* runs to *O. tibialis.* Specimens of *O. tibialis* differ from *hanebrinki* in that they have either the anterior surface of the forefemur wholly black or with a black apex and base which merge by a somewhat lighter dark streak. *Ommatius hanebrinki* is also easily separated from *O. tibialis* by its smaller size, fewer dark bristles in the mystax, lighter abdominal tomentum, and yellowish bristles of the mid- and hindfemora. Males of *O. hanebrinki* also lack a prominent costal bulge.

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85(1), 1983, pp. 152–155

A NEW SPECIES OF SCORPIONFLY (MECOPTERA: PANORPIDAE) FROM NORTH CAROLINA

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Abstract.—*Panorpa* ***ensigera,*** n. sp., described from the coastal area of North Carolina, is similar to *P. helena* Byers, *P. vernalis* Byers, *P. robusta* Carpenter, *P. rufescens* Rambur, and *P. americana* Swederus, particularly by the presence in males of black setae on the apex of the basistyle.

A recent collecting trip to the southeastern states yielded several specimens of a scorpionfly that resembles *Panorpa helena* Byers and *Panorpa americana* Swederus in having several large, black bristles at the apex of the basistyles of the male terminalia, but differ in details of the ventral parameres. After examination by George W. Byers, University of Kansas, it has been determined that these specimens represent a new species.

Panorpa ensigera **Bicha,** NEW SPECIES

Figs. 1–8

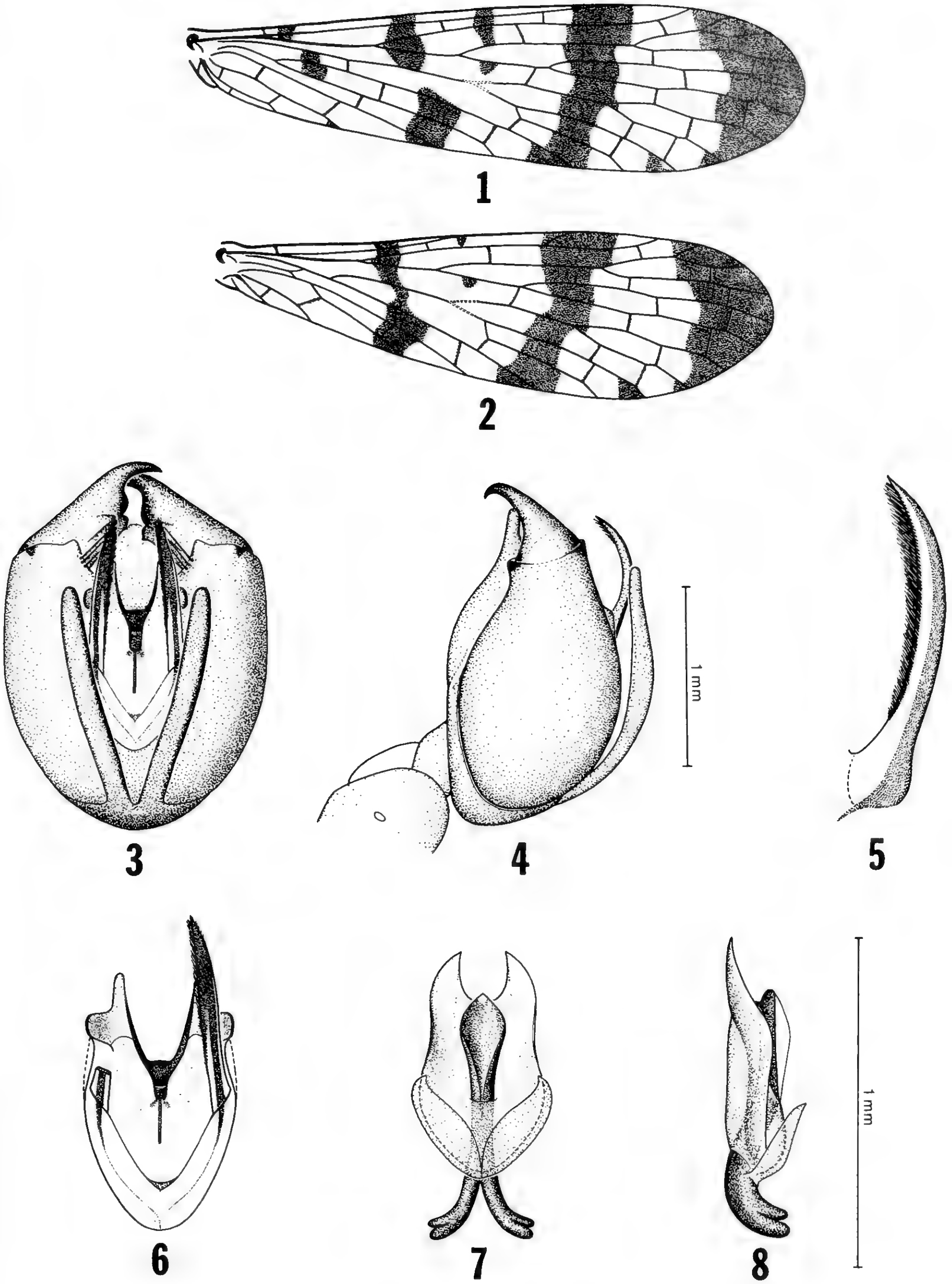
Description.—based on 7 ♂, 2 ♀ pinned and 1 ♂, 1 ♀ preserved in alcohol.

Head: Yellowish brown to amber, posterior surface of rostrum lighter. Eyes purplish brown. Scape and pedicel orangish brown; flagellum black with 39 flagellomeres.

Thorax: Dorsum yellowish orange; pleura yellow. Legs yellow with apical tarsomeres brown.

Forewing length 10.5–11.8 mm. Wing membrane (Fig. 1) strongly tinged with amber, bands and spots dark brown. Stigma beyond pterostigmal band yellowish white. Crossveins margined. Apical band entire. Pterostigmal band usually entire, apical branch of posterior fork reduced to small spot. Two small anterior intermediate spots between pterostigmal and basal bands. Basal band interrupted near midlength in forewing, usually complete but more slender in hindwing (Fig. 2). One marginal and one basal spot present in forewing, both absent in hindwing.

Male abdomen: Terga 2–5 pale yellow to light yellowish brown. Terga 6–9 orange. Pleura white. Notal organ on terga 3 and 4 small. Anal horn present on tergum 6. Genital bulb (Fig. 3) yellowish orange. Hypovalves thin, nearly uniform in width, fused near base of basistyles, extending approximately to base of dististyles. Tergum 9 deeply emarginate apically, ventral surface with protrusible membrane which often protrudes dorsally between dististyles. Dististyles yellowish brown, apices amber to dark brown, falcate, basal cup shallow with dark brown lip. Basistyle with 3 long, black bristles at apex (Fig. 3) extending posteriorly towards basal cups of dististyles. Ventral parameres (Figs. 3–6) in ventral view thin, unbranched, polished amber with white lateral margin, extending slightly



Figs. 1–8. *Panorpa ensigera.* 1, Right forewing, 2, Hindwing. 3, Male genital bulb, ventral aspect. 4, Same, left lateral aspect. 5, Right ventral paramere, mesolateral aspect, slightly enlarged scale. 6, Aedeagus, left ventral paramere removed, ventral aspect, slightly enlarged scale. 7, Female genital plate, ventral aspect. 8, Same, left lateral aspect.

beyond bases of dististyles, reduced at apex to dagger-like point; mesal margin bearing fine setae on apical 4/5; in lateral view, ventral parameres extend outwards (ventrad) from genital bulb. Dorsal parameres (Fig. 6) nearly transparent apically, brown basally, thin, extending slightly beyond bases of dististyles. Ventral valves of aedeagus white.

Female abdomen: Coloration similar to that of male. Genital plate (Figs. 7, 8) 0.88 mm in length. Distal and basal plates fused with slight medial constriction; distal plate concave, deeply emarginate apically. Basal plate rounded basally. Accessory plate covering basal ⅔ of basal plate. Spermethecal apodemes diverging at basal ⅓ of basal plate.

Types.—Holotype, ♂, North Carolina, Richmond Co., 4 mi. S. of Pinebluff, 16 September 1980, W. Bicha; allotype, ♀, and 2 ♂ paratypes 12 June 1981, W. Bicha; 3 ♂ and 2 ♀ paratypes 16 September 1980. One ♂, and 1 ♀ paratypes, North Carolina, Moore Co., 1½ mi. S. of Vass, 16 September 1980, W. Bicha. Holotype and allotype deposited in Snow Entomological Museum, Lawrence, Kansas; paratypes in Illinois Natural History Survey, Champaign, Illinois, and collection of author.

Remarks.—*Panorpa ensigera* resembles *P. americana, P. vernalis* Byers, *P. robusta* Carpenter, *P. rufescens* Rambur, and *P. helena* in having long black bristles at the apices of the basistyles of the male (Byers, 1962, 1973). The forewings of *P. ensigera* differ from those of *P. vernalis* in having distinct dark bands, from those of *P. americana* (Carpenter, 1931: Fig. 79, Pl. 8) in having the marginal and basal spots separate rather than fused, and from those of *P. helena* in having a definite marginal spot. The ventral parameres of *P. ensigera* differ from those of other known species of *Panorpa* by distinctively protruding outward (ventrad) from the genital bulb (Fig. 4), rather than against the ventral surface of the genital bulb as *P. helena, P. robusta,* and *P. rufescens.* In addition *P. ensigera* has no tuft of setae on the lateral apex of each ventral paramere, whereas, *P. robusta* has a distinct tuft. In females, the wing patterns of *P. robusta, P. rufescens,* and sometimes *P. helena* are similar to that of *P. ensigera,* but the genital plate of *P. ensigera* (Fig. 7, 8) appears unique among North American panorpids by the presence of two longitudinal concavities in the distal plate and distinctive accessory plate. The genital plates of *P. robusta* and *P. rufescens* are not constricted medially as in *P. ensigera,* while *P. helena* generally has a shield-shaped genital plate (Thornhill and Johnson, 1974: Figs. 34, 36, p. 42).

At the type-locality, *P. ensigera* was collected from blackberry (*Rubus* sp.), pokeweed (*Phytolacca americana*), and tulip tree seedlings (*Liriodendron tulipifera*) in a roadside ditch, two or three feet above ground level, in direct sunlight. Approximately 30 feet away was a wooded area of gum, oaks, tulip tree, and pine. No individuals were found in or along the edges of the woods, which is a more typical habitat for scorpionflies. *Panorpa ensigera* was seen feeding on fermenting blackberries at one location and pokeweed berries at another. When captured, most individuals regurgitated a reddish juice which stained some of the specimens.

ACKNOWLEDGMENTS

Sincere appreciation is extended to George W. Byers, University of Kansas, Lawrence, and to D. W. Webb, Illinois Natural History Survey, Champaign, for reviewing earlier drafts of this manuscript and for their continual guidance and encouragement. Illustrations were prepared by Arwin Provonsha.

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TWO NEW *EPICAUTA* FROM MEXICO (COLEOPTERA: MELOIDAE)

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Abstract.—Two new species are described, *Epicauta (Epicauta)* ***teresa*** from southern México and *E. (E.)* ***delicata*** from northern México, *Epicauta teresa* has a strong similarity to *E. laevicornis* (Werner) but can be separated from it by the lack of a concavity on the metasternum of the male. *Epicauta delicata* is assigned to the Vittata Group of *Epicauta* and represents an unmodified species of that group, except for its very distinct male genitalia.

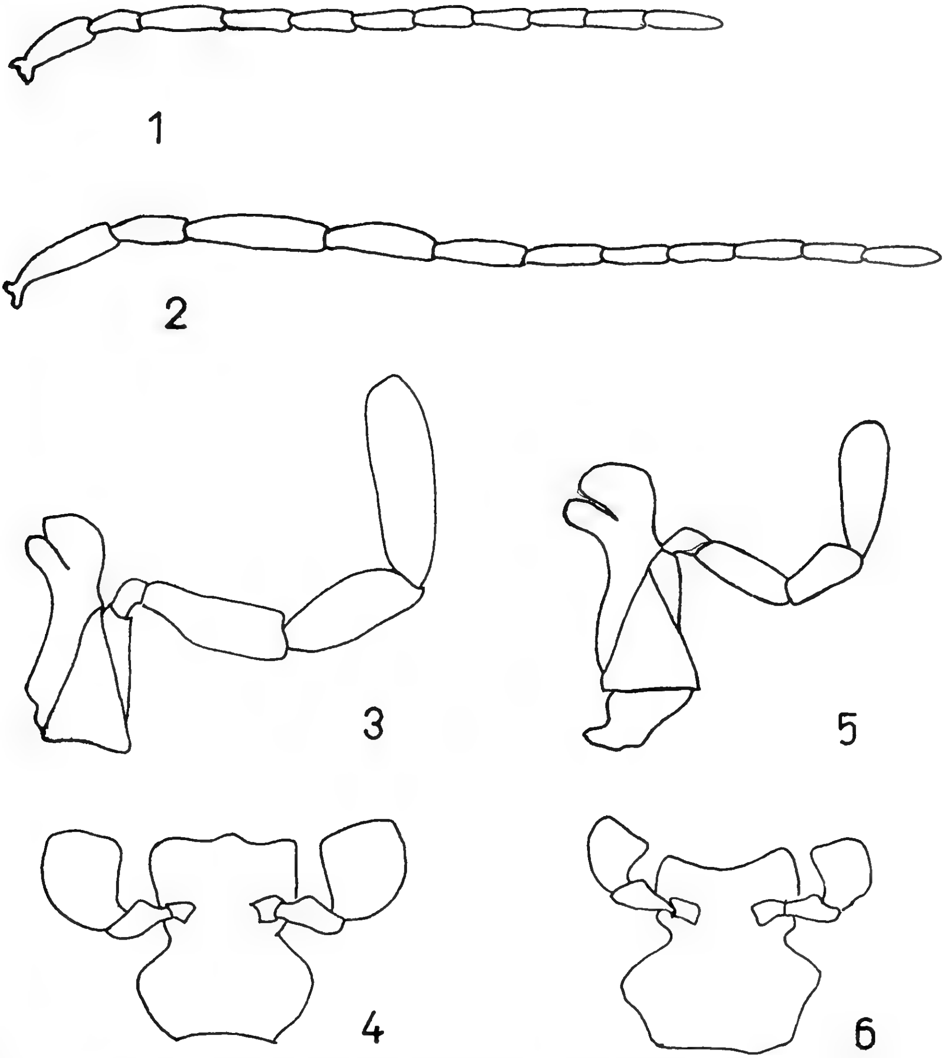
Over 200 species of *Epicauta* have been described from North and Central America. Recently, new and better roads have permitted more extensive collecting in México, resulting in the discovery of new species of Meloidae. Two of these are described below.

Epicauta (Epicauta) teresa **Mathieu, NEW SPECIES**

Figs. 1–6, 10, 11

Ground color black except elytra brown. Head, thorax and abdomen covered with light yellow setae. Antenna moderately long, slender and tapering (Figs. 1, 2), segments 3–5 of male elongate and somewhat flattened; length 15–20 mm.

Holotype male.—Length 18 mm. Head narrowly rounded behind eyes, length from occiput to fronto-clypeal suture 3.1 mm, width behind eyes 3.1 mm; occiput flattened, median impressed line fine but distinct, front shallowly excavated between eyes, calluses denuded and small; surface of head evenly covered with equidistant shallow punctures, narrow intervals of punctures microreticulate. Antenna ca. 11.3 mm, l/w measurements of antenna from base to apex 1.42/0.42, 0.92/0.36, 1.67/0.36, 1.33/0.36, 1.08/0.32, 0.92/0.22, 0.83/0.20, 0.79/0.20, 0.75/0.16, 0.75/0.16, 0.92/0.20 mm; segments 3 to 5 slightly flattened (0.28 mm in thickness): 1–5 shiny, 1 and 2 with stronger and denser setae than 3 to 5 which are clothed with very sparse slender setae; 3 straight, 4 with a slight curvature dorsad; 6 to 11 subequal and slender, more opaque due to a covering of appressed, dense short brown setae, also retaining the sparse longer and slender setae as on segments 3–5. Maxillary palpus (Fig. 3) elongate with dense short setae, 1.0 × 0.30, 0.72 × 0.36, 0.80 × 0.32 mm from apex to base. Labial palpus with apical segment flattened, as wide as long (0.96 × 0.96 mm) (Fig. 4) shiny with only sparse small setae. Pronotum 1.18 (3.16 by 2.67 mm) as long as wide; sides subparallel, gradually convergent from apical ⅓; surface similar to head, setae on surface of middle and hind ⅓ becoming brownish. Elytra 14 mm long, 4.5 mm wide, humeri distinct, nearly parallelsided, widest toward apex; setae brown except along middle and side which has a narrow line of yellow hairs. Legs thin and unmodified, mid- and



Figs. 1–6. *Epicauta teresa.* 1, Right antenna of female. 2, Right antenna of male. 3, Right maxilla of male. 4, Labium of male. 5, Right maxilla of female. 6, Labium of female.

hindtibial spurs spiniform, outer spur ¾ length of inner one; foretibial spurs subequal. Sixth visible sternum slightly excavated. Phallobase and aedeagus (2.24 mm in length) as in Figs. 10, 11.

Female.—Segments 1–5 of antenna appear shinier than rest. Dimorphism evident from measurements taken from a specimen of comparable size to holotype. Antenna: 1.0/0.36, 0.64/0.28, 1.0/0.24, 0.8/0.20, 0.74/0.20, 0.74/0.21, 0.72/0.21, 0.74/0.20, 0.68/0.20, 0.70/0.19, 0.90/0.18 from base to apex (Fig. 1). Maxillary palpus: 0.74/0.30, 0.5/0.22, 0.6/0.22 from apex to base (Fig. 5). Labial palpus: 0.36/0.32, apical segment (Fig. 6).

Adults in this series show little variation in size but some individuals have more light yellow setae in middle of elytra giving appearance of a faint vita.

Holotype.—♂, 10 km NE of Cintalapa, Chiapas, México, 9 August 1975, Alfonso N. García Aldrete. Deposited in the collection of the California Academy of Sciences, San Francisco. Dr. García informs me that the type-locality is at an elevation of 400 m, where the insects were actively feeding on an herbaceous blooming plant of *Capsicum* sp. of about 1 m in height. He collected all individuals (10 ♀, 7 ♂) in a disturbed tropical forest clearing used for grazing.

Remarks.—*Epicauta teresa* is a bicolored species that shared its antennal characters with the black *E. laevicornis* (Werner, 1973), but differs from it in having a smaller head and lacking the metasternal excavation. *Epicauta carmelita* Haag-Rutenberg, which occurs in southern México, has a similar color pattern to that of *E. teresa* but differs in its stout appearance, its unmodified male antenna, and the strongly modified male pygidium.

Epicauta (Epicauta) delicata **Mathieu, New Species**

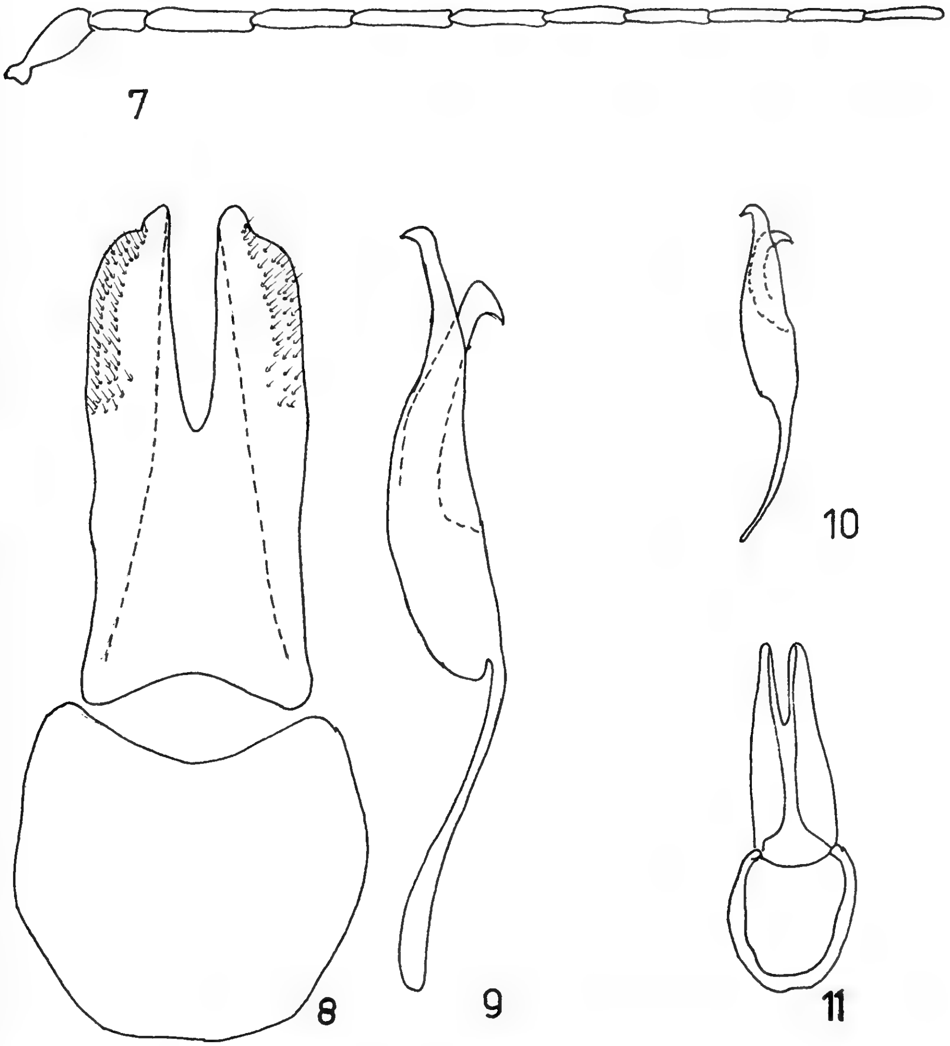
Figs. 7–9

Ground color black throughout, entirely covered with dense yellow setae except tips of femora, tibiae, and tarsi with black setae. Antenna unmodified in male, long and very slender, 3rd segment longest (Fig. 7).

Holotype male.—Length 19 mm. Head evenly rounded, densely covered with yellow setae, no punctures visible. 2.9 mm at its widest point above eyes. Distance between eyes 1.6 mm, occiput rounded, median line not distinct; front flattened between eyes, calluses obsolescent; mandibles strongly curved with front surface flat and shiny, red brown with black tips. Antenna 11.2 mm, slender with unmodified cylindrical segments, l/w measurements of segments from base to apex 1.08/0.36, 0.58/0.28, 1.33/0.28, 1.17/0.28, 1.17/0.24, 1.08/0.24, 1.00/0.22, 1.00/0.20, 0.92/0.18, 0.92/0.16, 0.92/0.16, small appressed black setae cover all segments except inner part of segment 1 which has white setae. Maxillary palpus elongate, covered dorsally with cinereous hair, denuded ventrally, 0.68/0.28, 0.56/0.24, from apex to base, apical segment attaining its widest point about ⅓ from tip. Labial palpus with last segment hatchet shaped 0.40/0.24, with its ventral surface devoid of setae. Pronotum 2.9 mm in length, 2.5 mm wide at base strongly narrowing toward head to 1.1 mm. Elytra 15 mm long, 3.8 mm wide, left elytron damaged on its last ⅓; humeri rounded and marked with black setae, 2 small black dots present on each side of scutellum. Legs thin; foretibia shorter than tarsus, foretarsus with 1st segment twice as wide as other segments and with an enlarged solid pad, other segments with divided tarsal pads. Femora and tibiae black at apex, tarsi with more black setae from basal segments to distal ones, other setae cinereous to light yellow, fore- and midtibiae with spiniform spurs, hindtibiae with stouter spurs and lacking a comb. Phallobase and aedeagus (2.16 mm in length) as in Figs. 8–9.

Holotype.—♂, Paila, Coahuila, México, 31 May 1967, J. Mathieu, at light. Deposited in the collection of the California Academy of Sciences.

Remarks.—This species appears to be related to the Vittata Group of *Epicauta* (Adams and Selander, 1979) by sharing the following characters: antenna slender, tapering distad, enlarged first tarsal segment, and genitalia differentially sclerotized (as explained later). The combination of these characters are present on *E. tamara* Selander and *E. temexa* Selander. *Epicauta vittata* (Fabricius), *E. temexa* and



Figs. 7–11. 7–9, *Epicauta delicata.* 10, 11, *E. teresa.* 7, Right antenna of holotype. 8, 10, Phallobase. 9, 11, Aedeagus.

some other species of the Vittata Group have a Y-shaped line with stronger sclerotization running on the middle of the tegmen from the base toward the internal surface of the divided lobes. These features of the genitalia are present in *E. delicata* along with its distally expanded lateral lobes, clothed with tiny setae (Fig. 8). The two black dots on each side side of the scutellum, could represent incipient vittae. In a study on variation of markings and color on *E. albida* (Say), it was shown that 13% of the specimens studied had developed one or two fine vittae on each of the elytra from humeral spots; the rest presented spots similar to those found on *E. delicata* (Selander and Mathieu, 1969). *Epicauta atrivittata* (LeConte), a species of the Albida Group of the genus *Epicauta,* is the only representative of the eight species of that group which has the vittate condition, indicating that vittae have appeared independently more than once within the genus.

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DESCRIPTION OF THE IMMATURE STAGES AND ADULT MALE OF *NEOLECANIUM CORNUPARVUM* (HOMOPTERA: COCCIDAE)[1]

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Abstract.—The three immature instars of the female and five instars of the male of *Neolecanium cornuparvum* (Thro) are described and illustrated. A key for separation of all developmental stages of the species is included. The male of *N. cornuparvum, Pseudophilippia quaintancii* Cockerell and *Toumeyella parvicornis* (Cockerell) are placed in a newly proposed major Coccidae group, the *Toumeyella* group.

The magnolia scale, *Neolecanium cornuparvum* (Thro, 1903), is a soft scale which commonly infests magnolias in eastern United States. It has been recorded from the states of Alabama, Connecticut, Florida, Georgia, Indiana, Kentucky, Louisiana, Maine, Maryland, Mississippi, New York, North Carolina, Ohio, Pennsylvania, South Carolina, Virginia, West Virginia, and Wisconsin. All specimens from Alabama, Louisiana, and South Carolina seen by us that were identified as magnolia scale, actually were tuliptree scale, *Toumeyella liriodendri* (Gmelin), and therefore were misidentified. This information leaves doubt about the occurrence of the magnolia scale in these three states.

A heavy infestation of the magnolia scale may cause death of its host, but most often damaging populations are localized, resulting in dieback on a portion of the plant. *Neolecanium cornuparvum* has been recorded from *Magnolia acuminata, M. cordata, M. grandiflora, M. liliflora, M. soulangiana,* and *M. stellata.*

Although the magnolia scale was originally described as a species in the genus *Lecanium.* It was later placed in *Neolecanium* by Fernald (1903). It shares many characteristics with members of the genus *Toumeyella.* Steinweden (1929) regarded *Neolecanium, Pseudophilippia* and *Toumeyella* as representing a single genus, but stated that a complete understanding of this group could only be achieved with an examination of a wider range of forms than he studied. Until thorough investigations of the genera *Neolecanium* and *Toumeyella* are completed, we will attempt no further clarification of placement of *N. cornuparvum.*

Previous taxonomic studies of Coccidae have dealt primarily with the adult female, with little attention to other developmental stages. In this paper all developmental stages of *N. cornuparvum* are described and illustrated. The adult female

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was described in detail by Williams and Kosztarab (1972). Our interpretation of the fringe setae and hypopygial setae of the adult female differs from theirs and is as follows: anal fold with one pair of fringe setae and 16 to 20 hypopygial setae. Terminology in the descriptions of the prepupa, pupa, and adult male is taken mainly from Giliomee (1967), while that for the adult female and immature stages is from Williams and Kosztarab (1972).

This study is based on material from the National Museum of Natural History Coccoidea Collection, Beltsville, Maryland (USNM) and the Auburn University Coccoidea Collection (AU). In addition to the material listed below, we have examined a single specimen on a slide (USNM) labeled *Lecanium cornuparvum,* Type, Cornell U., lot 276, sub. 16, no. 162. Collection data presented under material studied include number of slides and their depository in parentheses followed by host and locality records. Measurements (based on 10 specimens) are given in microns and presented as the average followed by the range in parentheses.

KEY TO STAGES OF *NEOLECANIUM CORNUPARVUM*

1. Anal plates present 2
– Anal plates absent 6
2. Anal plates with 1 pair of apical setae longer than length of anal plates; legs and antennae well developed .... first instar
– Anal plates with apical setae less than length of anal plates; legs and antennae greatly reduced 3
3. Anal ring with 6 anal ring hairs; 1 pair of hypopygial setae (which resemble fringe setae) 4
– Anal ring with 8 or 10 anal ring hairs; 2 or more pairs of hypopygial setae (distinct from fringe setae) 5
4. Tubular ducts present on margin around cephalic ¾ of body; body elongate oval .... second-instar male
– Tubular ducts absent; body oval to nearly circular .... second-instar female
5. Anal ring with 10 anal ring hairs; large discoidal pores present anterior to anal plates; ventral tubular ducts present .... adult female
– Anal ring with 8 anal ring hairs; large discoidal pores absent anterior to anal plates; ventral tubular ducts absent .... third-instar female
6. Wings present; legs and antennae distinctly segmented, 2 pairs of eyes and 1 pair of lateral ocelli present; derm with heavily sclerotized areas on head and thorax .... adult male
– Wing buds present; legs and antennae without distinct segments; eyes absent; derm almost entirely membranous 7
7. Legs less than ¼ length of body; penial sheath short, rounded .... prepupal male
– Legs greater than ⅓ length of body; penial sheath elongate, triangular .... pupal male

FIRST INSTAR

Fig. 1

Material studied.—73 (AU), 9 (USNM): *Magnolia acuminata,* Great Belt, Pa. *Magnolia soulangeana,* Allegany Co., Md. *Magnolia* sp., Oakland, Md.; Angelica, N.Y.; Buffalo, N.Y.; Rochester, N.Y.; New York; Cleveland, Ohio; North Bloomington, Ohio; Bethlehem, Pa.; Philipsburg, Pa; Pittsburgh, Pa; Fairmont, W.Va.

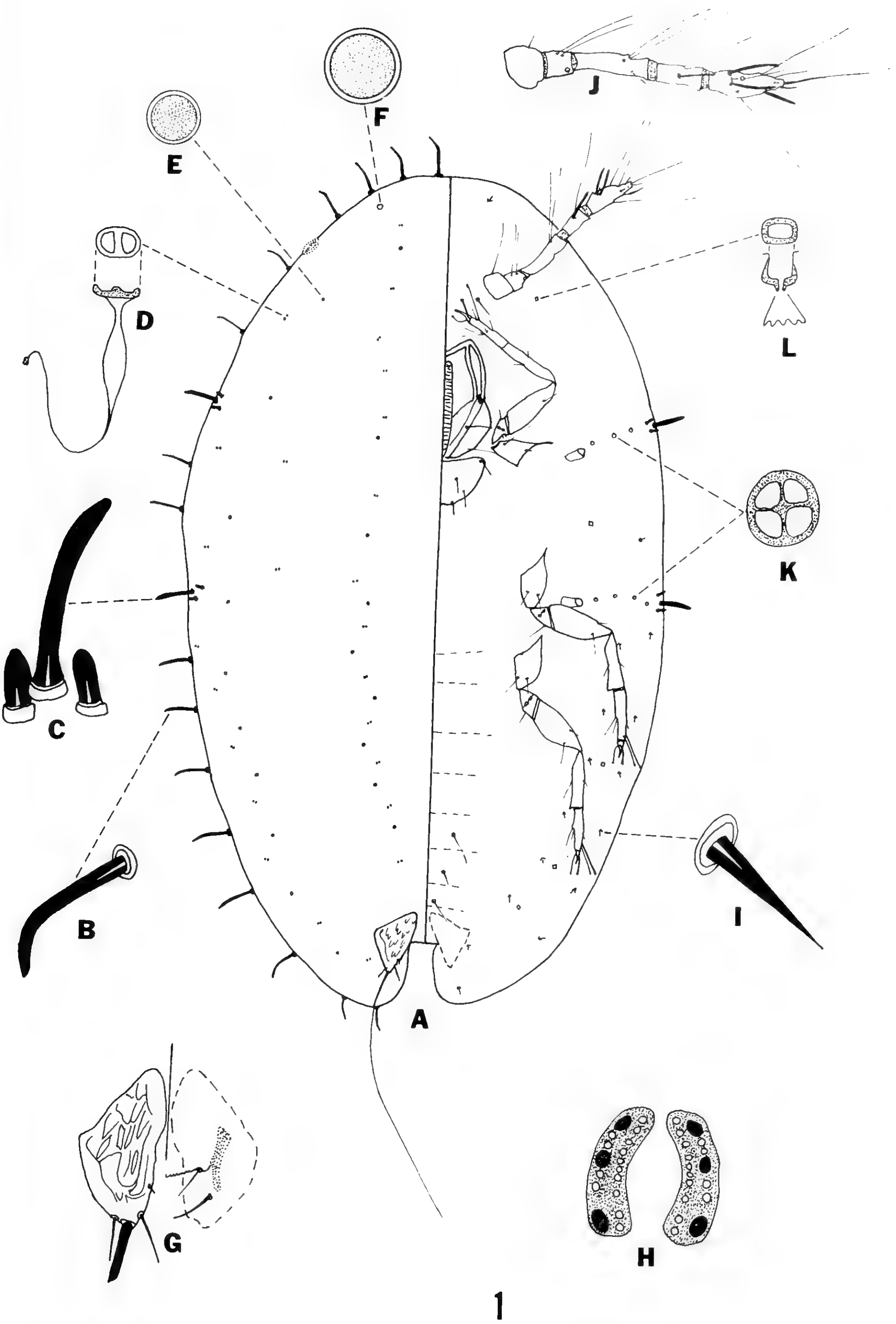

Fig. 1. *Neolecanium cornuparvum,* first instar.

General appearance.—Body (Fig. 1A) flat, elongate oval, membranous. Slide-mounted specimens 520–854 long, 303–482 wide.

Dorsal surface.—Derm membranous. Marginal setae (Fig. 1B) 36 (31–43) long on head tapering to 19 (15–22) long near anal cleft; bristle-like, often bent posteriorly; distributed as follows: 12 between anterior spiracular setae, 2 on each side of body between anterior and posterior spiracular setae, 16 on posterior of body. No body setae detected. Three spiracular setae (Fig. 1C) in each spiracular furrow; median seta 30 (22–34) long, thick, throughout length; lateral setae 10 (9–12) long. Submarginal tubercles absent. Bilocular pores (Fig. 1D) in 4 to 6 longitudinal rows. Simple disc pores (Fig. 1E) in similar pattern on abdomen. Apex of head with 2 large disc pores (Fig. 1F). No ducts detected. Eyes on margin just above level of antennal scape.

Anal plates (Fig. 1G).—Each plate triangular with rounded angles; dorsal surface reticulate; 64 (56–68) long, 33 (31–40) wide; cephalolateral margin 43 (40–46) long, caudolateral margin 42 (37–46) long. Each plate with 4 apical setae, 3 on apex of plate, 1 on median margin; median seta on apex 274 (111–414) long. Each plate with 1 subapical seta. Anal fold with 1 pair of fringe setae. Anal ring (Fig. 1H) quadrate with convex lateral margins, 6 hairs and 2 rows of pores.

Ventral surface.—Ventral submarginal setae (Fig. 1I) short, bristle-like, in a row of 7 setae on each side of abdomen, 1 between spiracular furrows on each side of body, and 1 pair at apex of head; short, bristle-like. Body setae similar to submarginals, in a submedian row on each side of abdomen. One pair interantennal setae. Three pairs of large, posterior, submedian setae, posterior pair longest. Antenna (Fig. 1J) well developed, 5-segmented, 168 (152–176) long. Legs well developed, 261 (244–275) long, without tibiotarsal sclerotization or free articulation; claws without denticle; 2 knobbed claw digitules; 2 slender knobbed tarsal digitules, except prothoracic tarsi with 1 digitule setiform. Spiracular furrows with quadralocular pores (Fig. 1K); each anterior pore band with 3 pores; each posterior pore band with 4 pores. Quinquelocular or multilocular pores occasionally in spiracular furrows. Microducts (Fig. 1L) between submarginal and body setae on abdomen, 1 between spiracular furrows on each side of body, and 1 lateral to each antennal scape. Tubular ducts not detected.

SECOND-INSTAR FEMALE

Fig. 2

Material studied.—8 (AU), 1 (USNM): *Magnolia acuminata,* Cave Forge, Pa; Centre Co., Pa. *Magnolia* sp., Beaver Falls, Pa.; Pittsburgh, Pa.

General appearance.—Body (Fig. 2A) oval to nearly circular. Slide-mounted specimens 1454–1795 long, 928–1528 wide.

Dorsal surface.—Derm membranous. Marginal setae (Fig. 2B) 18 (12–31) long, pointed, often bent posteriorly, 12 to 16 around head, not easily separated from ventral submarginal setae. No body setae detected. Three spiracular setae (Fig. 2C) in each spiracular furrow; median seta 28 (19–56) long, thick, with pointed apex; lateral setae 25 (19–31) long with rounded to acute apices. Submarginal tubercles absent. Bilocular pores (Fig. 2D) with inner filament and simple disc pores (Fig. 2E) scattered over dorsum. No ducts detected. Eyes submarginal just above level of antennal scape.

Anal plates (Figs. 2F1, 2F2).—Each plate triangular with posterior angles broadly

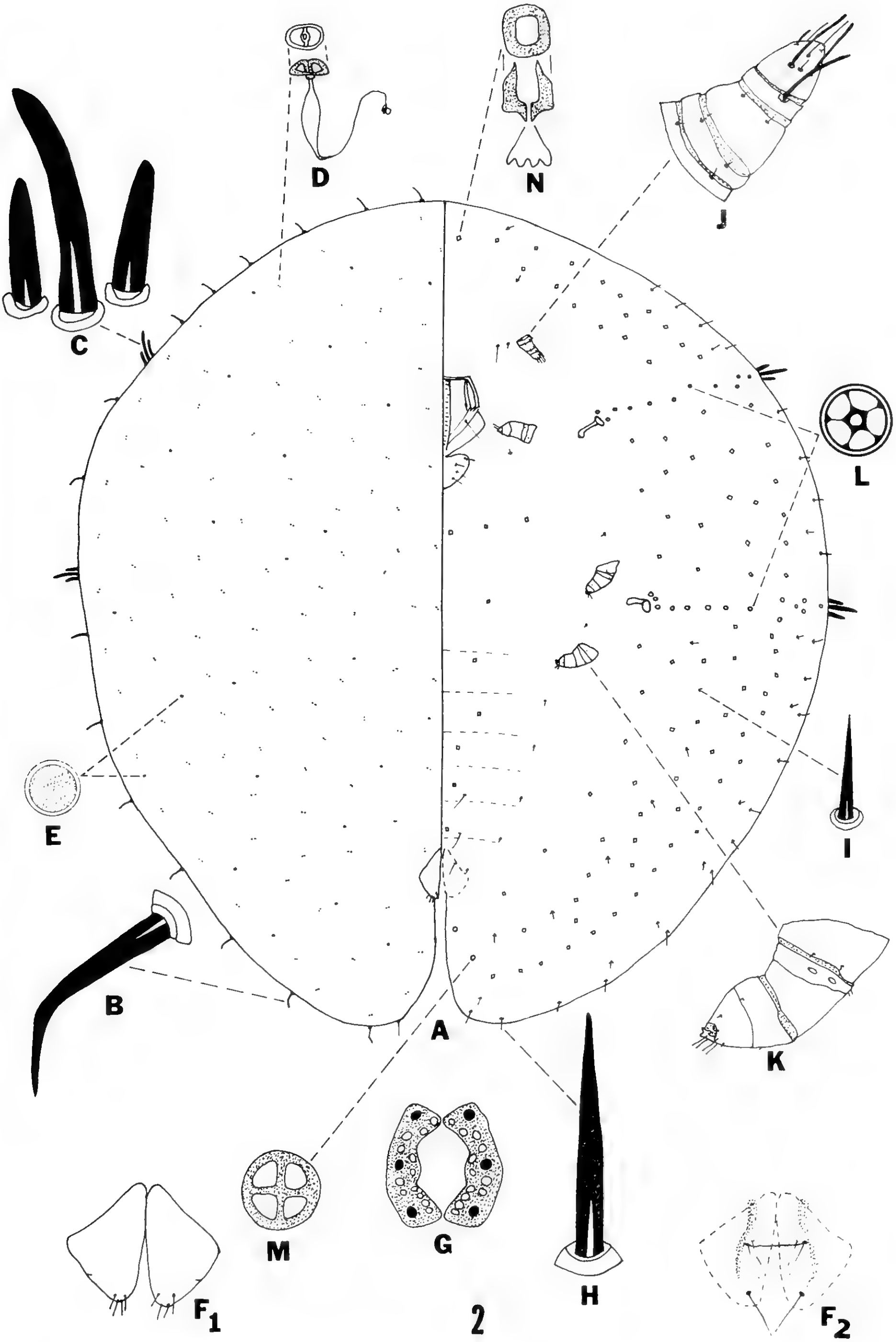

Fig. 2. *Neolecanium cornuparvum*, second-instar female.

rounded; 97 (93–105) long, 70 (62–93) wide; cephalolateral margin 76 (74–80) long, caudolateral margin 71 (62–74) long. Each plate with 4 apical setae and 1 subapical seta. Anal fold with 1 pair of fringe setae and 1 pair of hypopygial setae. Anal ring (Fig. 3G) quadrate, lateral margins convex, with 6 hairs and 2 rows of pores.

Ventral surface.—Ventral submarginal setae (Fig. 2H) bristle-like. Body setae (Fig. 2I) scattered over venter and 1 near each coxa; 2 pairs of bristle-like interantennal setae, median pair longer. Three pairs of posterior submedian setae. Antenna (Fig. 2J) greatly reduced, 5-segmented, 56 (50–74) long. Legs (Fig. 2K) greatly reduced, 72 (43–99) long, without tibiotarsal sclerotization or free articulation; tarsal and claw digitules bristle-like. Spiracular furrows with pore bands 1 or 2 pores wide; each anterior pore band with 7 to 13 pores; each posterior pore band with 11 to 17 pores. Quinquelocular pores (Fig. 2L) in spiracular furrows. Multilocular pores occasionally in spiracular furrows. Usually 3 or 4 quadralocular pores (Fig. 2M) in anal area. Microducts (Fig. 2N) scattered over venter and in submarginal row around body. Tubular ducts not detected.

THIRD-INSTAR FEMALE
Fig. 3

Material studied.—12 (AU), 2 (USNM): *Magnolia* sp., Western Port, Md.; Pittsburgh, Pa.

General appearance.—Body (Fig. 3A) oval to nearly circular. Slide-mounted specimens 1516–2376 long, 1170–2104 wide.

Dorsal surface.—Derm membranous. Marginal setae (Fig. 3B) 19 (15–22) long on head to 25 (20–31) long near anal cleft, pointed, bristle-like, not easily separated from ventral submarginal setae. Dorsal body setae (Fig. 3C) 6 (4–7) long, coniform, scattered over dorsum. Three spiracular setae (Fig. 3D) in each spiracular furrow; median seta 40 (28–52) long, tapering to acute or acutely rounded apex; lateral setae 32 (22–48) long, subconical. Submarginal tubercles absent. Bilocular pores with inner filament (Fig. 3E) and simple disc pores (Fig. 3F) scattered over dorsum. No ducts detected. Eyes submarginal just above level of antennal scape.

Anal plates (Figs. 3G1, 3G2).—Each plate triangular with rounded angles; 150 (117–173) long, 104 (82–114) wide; cephalolateral margins slightly concave, caudolateral margins slightly convex; cephalolateral margin 130 (117–153) long, caudolateral margin 110 (95–127) long. Each plate with 4 apical setae and 3 or 4 subapical setae. Anal fold with 1 pair of fringe setae and 4 to 6 hypopygial setae. Anal ring (Fig. 3H) rounded, with 8 hairs and 2 rows of pores.

Ventral surface.—Ventral submarginal setae (Fig. 3I) similar to marginal setae. Body setae (Fig. 3J) scattered over body and 1 or 2 near each coxa; 2 pairs of interantennal setae, median pair longer. Three pairs of posterior, submedian setae. Antenna (Fig. 3K) greatly reduced, 5- or 6-segmented, 81 (77–86) long. Legs (fig. 3L) greatly reduced, 104 (88–126) long, without tibiotarsal sclerotization or free articulation; tarsal and claw digitules bristle-like. Spiracular furrows with pore bands 1 to 7 pores wide; each anterior band with 25 to 42 pores; each posterior band with 31 to 49 pores. Quinquelocular pores (Fig. 3M) in spiracular furrows and in anal region. Trilocular, quadralocular, and multilocular pores occasionally in spiracular furrows or anal area. Microducts (Fig. 3N) scattered over venter. Tubular ducts not detected.

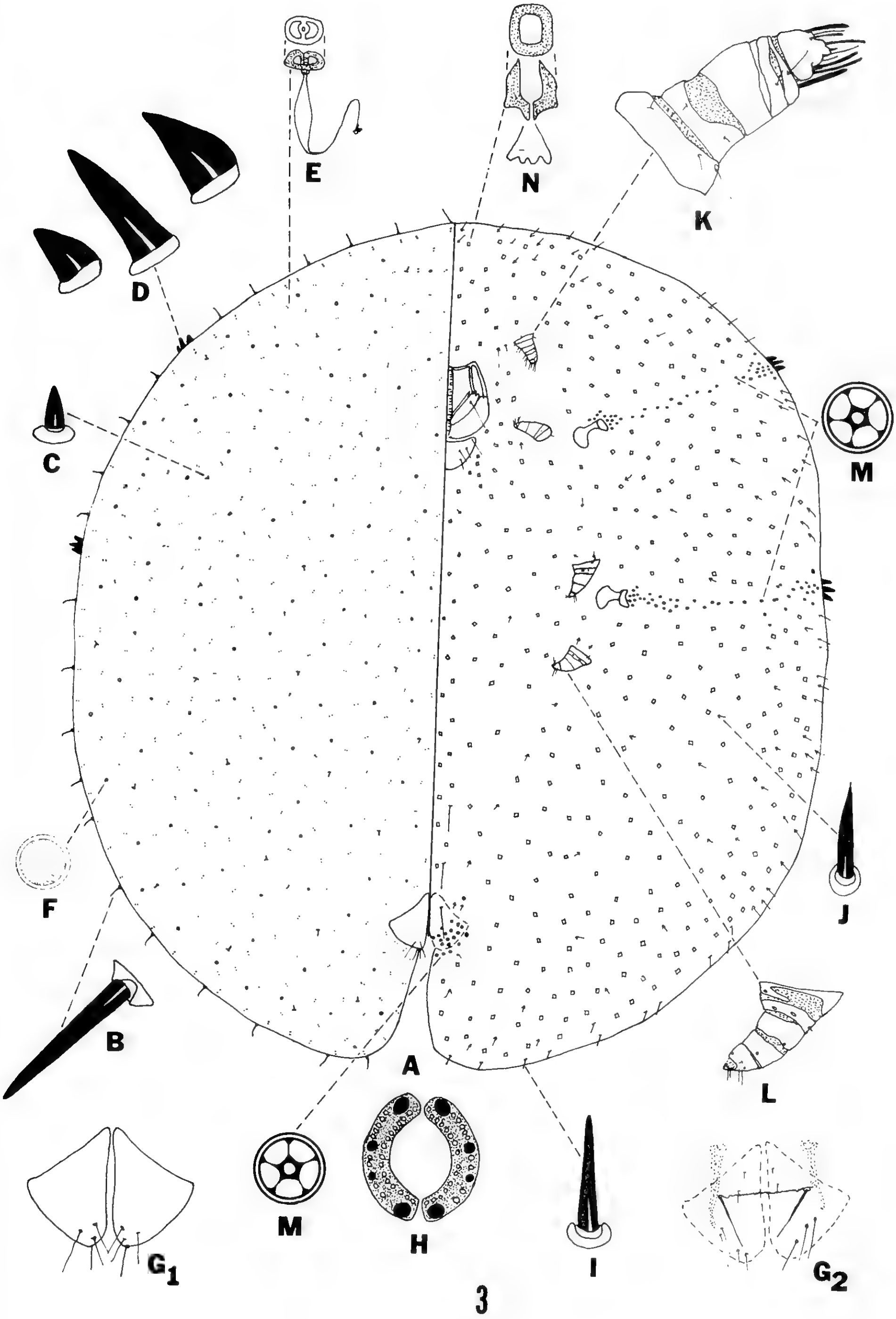

Fig. 3. *Neolecanium cornuparvum,* third-instar female.

SECOND-INSTAR MALE

Material studied.—28 (AU), 3 (USNM): *Magnolia acuminata,* Centre Co., Pa.; Great Belt, Pa. *Magnolia stellata,* Blacksburg, Va. *Magnolia* sp., Western Port, Md.; Jackson City, Miss.; Painesville, Ohio; Bedford, Pa.; Bethlehem, Pa.; Coraopolis, Pa.; Pittsburgh, Pa.

The second-instar male is similar to the second-instar female (Fig. 2), but the male has dorsal tubular ducts, marginally around the cephalic ¾ of the body, a transverse row connecting the posterior ends of the marginal row, and 2 submedian rows extending from the posterior transverse row to above the position of the mouthparts from where they extend diagonally to join the marginal series. Additionally, the body shape of the second-instar male is elongate oval while that of the second-instar female is oval to nearly circular. Second-instar males are longer (1343–2413) and narrower (780–1188) than second-instar females. Other characteristics shown in Fig. 2 are also found in the second-instar male (not figured).

PREPUPAL MALE
Fig. 4

Material studied.—6 (AU), 3 (USNM): *Magnolia* sp., Jackson City, Miss.; Painesville, Ohio; Beaver Falls, Pa.; Bethlehem, Pa.; Pittsburgh, Pa.

General appearance.—Enclosed within a glassy wax test, body (Fig. 4A) membranous. Slide-mounted specimens 1894–1986 long, 736–953 wide.

Dorsum and pleural surface.—Derm membranous. Apex of head with 1 pair of marginal setae. Head with 2 pairs of short, stubby, blunt setae (Fig. 4B); 1 pair of these setae on mesothorax and 5 pairs on abdomen. Pleural abdominal setae (Fig. 4C) on segments II through VII, longest about 38 (33–43) long; becoming larger and more numerous posteriorly. Spiracular setae, submarginal tubercles, eyes, pores, and ducts absent. Wing buds 303 (253–331) long, 177 (175–178) wide on lateral margins of thorax.

Anal plates.—Replaced by 2 quadrate, sclerotized lobes, 57 (49–67) long, 54 (46–65) wide at base. Each lobe with 1 to 3 setae. Anal ring absent. Anal opening near base of well-sclerotized penial sheath; penial sheath with 0 to 4 setae; genital opening near apex of penial sheath.

Venter.—Two bristle-like submarginal setae near apex of head. Four short bristle-like setae between antennal bases. One to 4 short spinelike setae (Fig. 4D) at base of each coxa. Ventral abdominal setae (Fig. 4E) on segments III through VII bristle-like. Antenna elongate, largely membranous, 360 (324–410) long. Legs largely membranous, with poorly defined segments, 320 (242–388) long. Setae and digitules on legs reduced to peglike stubs or sockets. Spiracles with thickened apodeme and areolate base. Each spiracle with 8 to 11 pores (Fig. 4F) near atrium; pores with 4 to 8 locules. Ducts absent.

PUPAL MALE
Fig. 5

Material studied.—27 (AU), 2 (USNM): *Magnolia acuminata,* Great Belt, Pa.; Mercer, Pa. *Magnolia* sp., Western Port, Md.; Painesville, Ohio; Bethlehem, Pa.; Pittsburgh, Pa.; Scottsdale, Pa.; Charleston, W. Va.

General appearance.—Enclosed within a glassy wax test, body (Fig. 5A) membranous. Slide-mounted specimens 1634–2184 long, 606–693 wide.

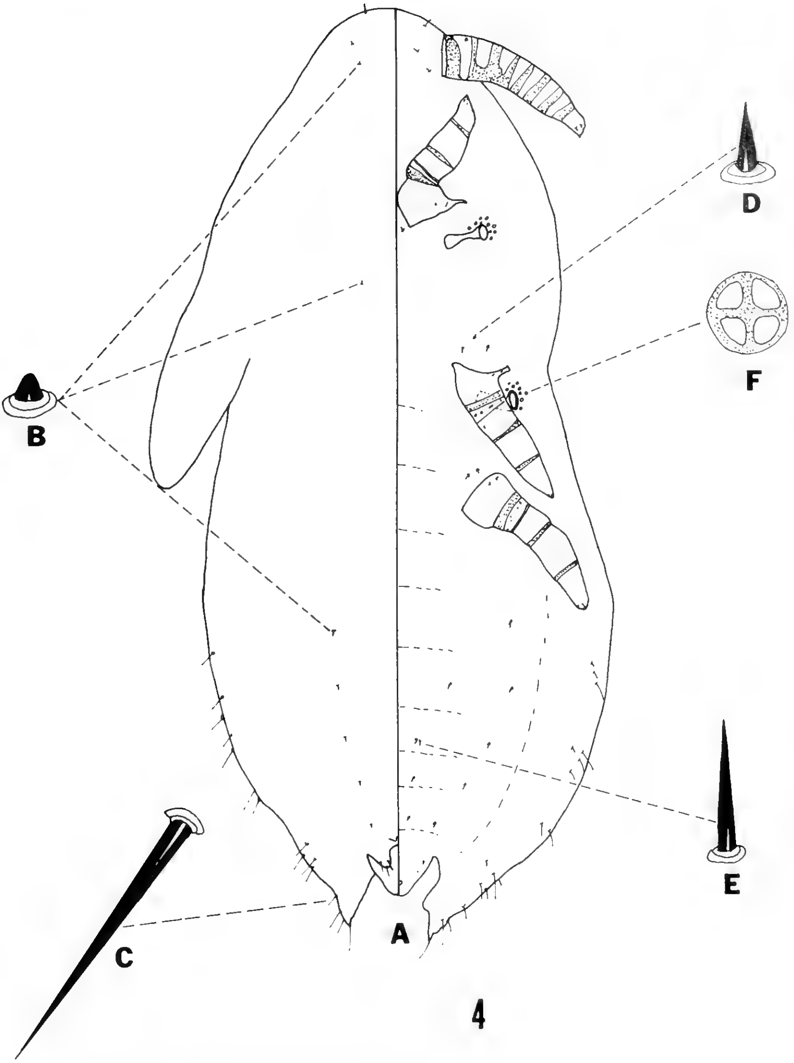

Fig. 4. *Neolecanium cornuparvum,* prepupal male.

Dorsum and pleural surface.—Derm membranous. Apex of head with 1 pair of marginal setae. Head with 3 pairs of bristle-like setae (Fig. 5B); 1 pair of these on mesothorax, and 6 pairs on abdomen. Pleural abdominal setae (Fig. 5C) on segments II through VII, longest about 47 (35–54) long, becoming larger and more numerous posteriorly. Spiracular setae, submarginal tubercles, eyes, pores, and ducts absent. Wing buds on lateral margins of thorax, 474 (439–526) long, 230 (192–266) wide.

Anal plates.—Replaced by 2 quadrate, sclerotized lobes, 63 (57–68) long, 58 (41–84) wide at base. Each lobe with 1 to 4 setae. Anal ring absent. Anal opening near base of large, well-sclerotized penial sheath; penial sheath with 2 pairs of dorsal setae; genital opening near apex of penial sheath.

Venter.—Two bristle-like submarginal setae near apex of head. Four short

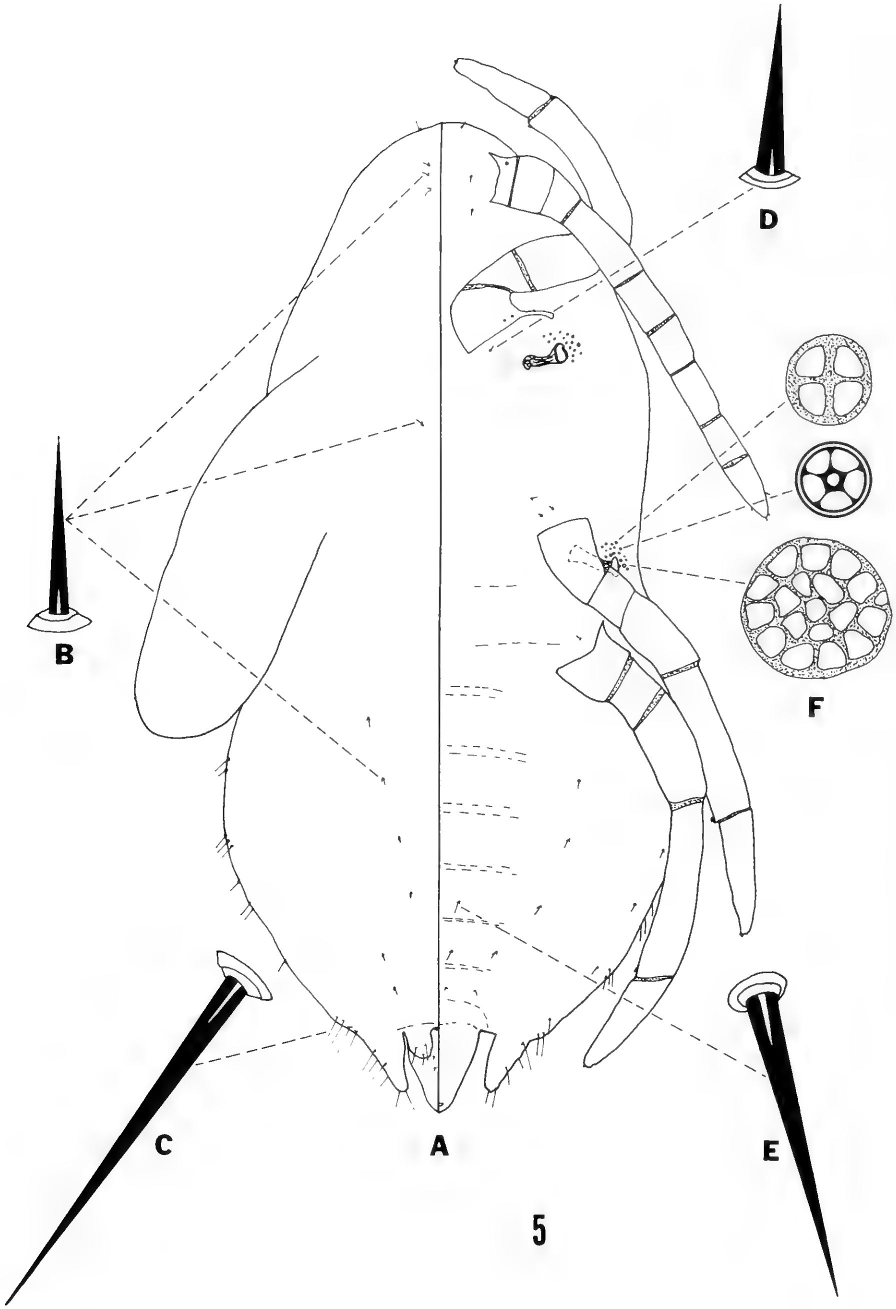

Fig. 5. *Neolecanium cornuparvum,* pupal male.

bristle-like setae between antennal bases. One to 4 short spinelike setae (Fig. 5D) at base of each coxa. Ventral abdominal setae (Fig. 5E) on segments III through VIII, bristle-like. Antenna elongate, largely membranous, 8- or 9-segmented, 786 (721–867) long. Legs largely membranous, with poorly defined segments, 829

(711–998) long. Setae and digitules on legs reduced to peglike stubs or sockets. Spiracles with thickened apodeme and areolate base. Each spiracle with 8 to 19 pores (Fig. 5F) near atrium; pores with as many as 20 locules. Ducts absent.

ADULT MALE
Fig. 6

Material studied.—16 (AU), 4 (USNM): *Magnolia acuminata,* Mercer, Pa. *Magnolia* sp., Western Port, Md.; Rochester, N.Y.; Painesville, Ohio; Bethlehem, Pa.; Coraopolis, Pa.; Pittsburgh, Pa.; Scottsdale, Pa.

General appearance.—Moderately long and robust, with relatively long antennae and long slender legs. Slide-mounted specimens 1640–2005 long, 569–712 wide at mesothorax, wing spread 3626–4059.

Head.—Median crest (mc) sclerotized, polygonally reticulate; with 19–35 hairlike and 11–20 fleshy dorsal head setae (dhs). Midcranial ridge (mcr) ventrally well developed, extending posteriorly to ocular sclerite. Gena (g) large, with cells of polygonal reticulation larger than elsewhere on body; with 10–29 hairlike and 44–73 fleshy genal setae (gs). Two subequal pairs of eyes; corneae of dorsal eyes (dse) 64 (58–74) in diameter; those of ventral eyes (vse) 57 (52–65) in diameter. Ocellus (o) 28 (23–32) in diameter. Ocular sclerite (ocs) well-sclerotized. Preocular ridge (procr) short. Postocular ridge (pocr) undivided. Interocular ridge absent. Dorsal ocular setae (dos) with 0–1 hairlike and 1–6 fleshy setae. Nine to 15 hairlike and 61- 91 fleshy ventral head setae (vhs). Preoral ridge (pror) present. Tendonlike apodeme (t) present. Cranial apophysis long and bifurcate. Tentorium well developed, posterior tentorial arms well developed. Mouth opening irregular. Anterior tentorial pits (atp) present. Antenna filiform, 9-segmented, 1235 (1184–1301) long, ratio of antennal length : total body length about 1.00:1.54 (1.00:1.52–1.00:1.56); pedicel with dorsal, polygonal reticulation; apical segment with 3 capitate subapical setae (sas); segments II through IX with numerous fleshy setae, 0–1 bristle-like setae, and 0–2 sensilla basiconica.

Thorax.—Prothorax with pronotal ridge (prnr) lacking medial weakening. Lateral pronotal sclerites reduced, almost absent. One pair of medial pronotal setae (mpns) posterior to dorsomedial portion of pronotal ridge. Pleural structures typical of Coccidae. Sternum (stn1) with strong transverse ridge and median ridge represented by a basal stalk. Usually 2–6 anteprosternal setae (astn1s) present. Prosternal setae (stn1s) numerous, 1–5 anterior to mesothoracic spiracles and in a continuous band with postmesospiracular setae.

Mesothorax with prescutum (prsc) laterally bounded by prescutal ridges (pscr) and posteriorly by prescutal suture (pscs); with polygonal reticulation. Scutum (sct) with transverse, median membranous area with 15–29 hairlike and 5–11 fleshy setae. Scutellum (scl) without setae. Postnotum (pn2) with anterior margin occasionally overlapped by metathoracic fold; postnotal apophysis (pna) and postalare (pa) well developed. Basalare fused with pleural wing process (pwp). Subalare small. Episternum (eps2) with weak reticulation; subepisternal ridge (ser) well developed. Epimeron (epm2) small. Lateropleurite (lpl) bounded anteriorly by extension from marginal ridge (mr). Basisternum (stn2) large, with heavily sclerotized median ridge (mdr), bounded by heavily sclerotized marginal (mr) and precoxal (pcr2) ridges. Furca (f) well developed. Postmesospiracular setae continuous with prosternal setae. Tegula (teg) well developed with 4–9 hairlike setae.

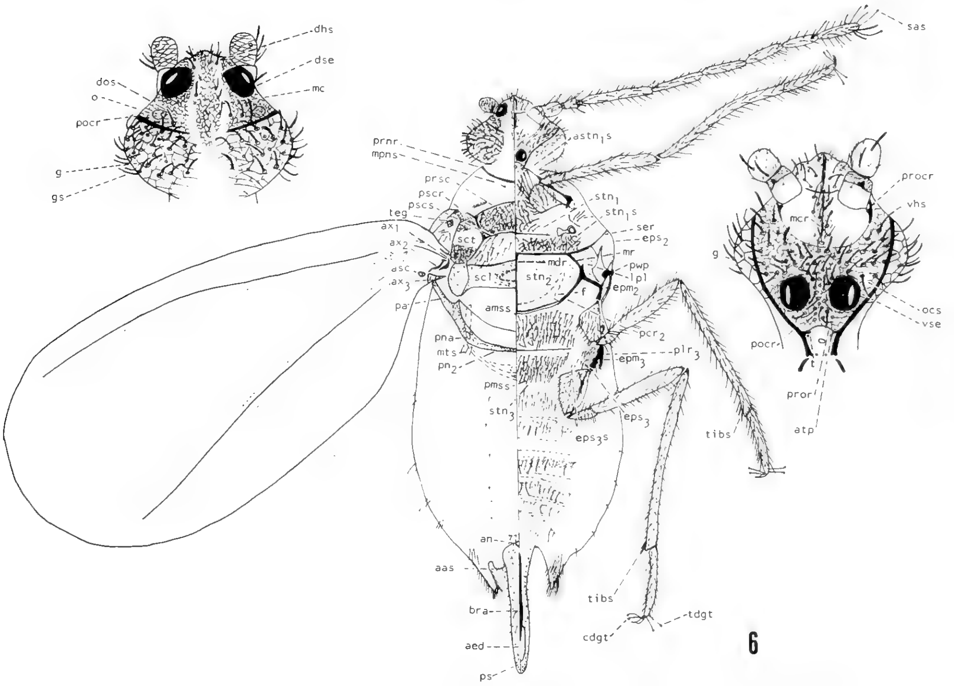

Fig. 6. *Neolecanium cornuparvum,* adult male (see text for explanation of abbreviations).

Axillary wing sclerites (ax1, ax2, ax3) typical of male Coccidae. Additional sclerite (asc) present. Antemetaspiracular setae absent.

Metathorax with suspensory sclerites absent. Postnotum unsclerotized. Metatergal setae (mts) present. Pleural ridge (plr3) well sclerotized. Episternum (eps3) lightly sclerotized; epimeron (epm3) extended posteriorly. Dorsospiracular setae absent. Postmetaspiracular setae (eps3s) numerous. Metasternal plate (stn3) lightly sclerotized. Anterior metasternal setae (amss) and posterior metasternal setae (pmss) numerous.

Wings hyaline; 1618 (1423–1776) long, 758 (625–897) wide. Alar lobe and alar setae absent. Hamulohalter absent.

Legs long and slender; prothoracic 1275 (1054–1431) long; mesothoracic 1270 (1178–1359) long; metathoracic 1503 (1361–1610) long. Each tibia with an apical spur (tibs) and a few smaller spurs near apex. Each tarsus with 2 subequal digitules (tdgt). Claws with small denticle and 2 knobbed subequal digitules (cdgt).

Abdomen.—Segments I through VII with lightly sclerotized or membranous tergites; sternites represented by lightly sclerotized plates on segments II through VII. Caudal extension of segment VII long, sclerotized, with numerous setae on ventral and lateral aspects. Fleshy dorsal setae absent; 2 hairlike setae on segments II through VII. Pleural setae all hairlike, 1–6 on each segment. Two to 25 hairlike and 4–29 fleshy ventral setae on segments II through VII. Segment VIII with transverse tergite and sternite; without caudal extension or glandular pouch. Two dorsolateral lobes analogous with the anal plates representing segment IX; each with 0–4 hairlike antenanal setae (aas).

Genital segment.—Penial sheath (ps) 458 (433–489) long, 118 (104–130) wide at base; about ¼ total body length, ratio 1 : 4.01; lateral sclerotization may or may not be jointed anterior to anus (an). Small setae scattered over sheath; cluster of sensilla occur ventrally near apex of sheath. Relative length of basal rod (bra) much greater than length of aedeagus (aed).

Discussion

The adult male of *N. cornuparvum* is most similar to the *Coccus* group of Giliomee. Of the 34 characters Giliomee listed which separate the major groups of Coccidae which he recognized, *N. cornuparvum* shares 29 character states with the *Coccus* group. Five of these 34 characters have unique character states in the *Coccus* group (exclusive characters of Giliomee). *Neolecanium cornuparvum* shares only three of these "exclusive characters" with the *Coccus* group. Adult males of *N. cornuparvum, Pseudophilippia quantancii* Cockerell, and *Toumeyella parvicornis (Cockerell)* (none of which were studied by Giliomee) are unique among males studied in four characters: antennae with 9 segments, pronotal ridge complete dorsally, absence of a glandular pouch, and the presence of 2 lobes analogous to anal plates representing abdominal segment 9 dorsally As the major groups of Giliomee all have 3–5 "exclusive" or unique character states, we propose that *N. cornuparvum, P. quaintancii,* and *T. parvicornis* represent an additional major group of genera, the *Toumeyella* group.

Acknowledgments

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A NEW SPECIES OF *GLOANNA* NYE (LEPIDOPTERA: NOCTUIDAE) FROM WEST TEXAS

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Abstract.—Gloanna ***hecate*** is described. Imagines and male and female genitalia are figured.

While collecting the Sierra Diablo mountains of western Texas in 1969, the senior author took a small series of a noctuid which later proved to be an undescribed species of *Gloanna* Nye. Seeking to improve on the series, the junior author visited the same locality 13 years later and succeeded in obtaining three additional specimens. The Sierra Diablo lie about 30 miles due south of the Guadaloupe Mountains, rising to just over 6600 feet. The western slopes are gentle, but the eastern slopes drop precipitously nearly 3000 feet to the desert floor below. The upper elevations support an open forest of the pinyon pine, juniper, and several species of oak. The area remained virtually uncollected until investigations by the senior author began in the late 1960's, and it has yielded a number of previously unknown Lepidoptera.

Gloanna hecate **Blanchard and Knudson, New Species**

Figs. 1–5

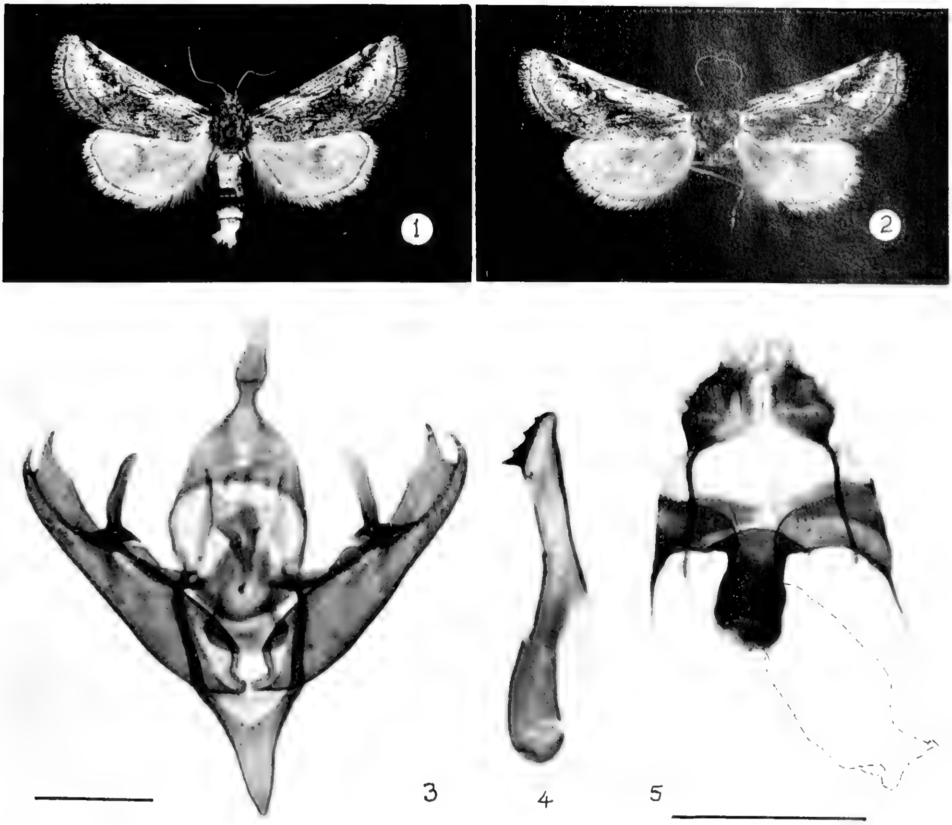
Description.—*Head:* Front and vertex whitish, heavily irrorated with black. Palpi mostly white, upturned, rising to less than ½ eye diameter. Tongue rudimentary. Antenna minutely bipectinate, pectinations heavily setose.

Thorax: Vestiture consists of white scales with black apices. Posterior tuft present. Black scale apices on mesonotum and posterior tuft show purplish blue iridescence at certain angles of light incidence.

Abdomen: Light ochreous gray.

Forewing: Ground color grayish, consisting of pure white scales, white scales with black apices, and dark gray scales with black apices. On costal margin extending to cell, ground color mostly white, with veins outlined in black. Basal ½ line black, outwardly angled from base. Antemedial line black, minutely dentate, outwardly convex. Subterminal line black, smooth, outwardly convex. Orbicular and claviform elongate, white, narrowly edged with black. Reniform white, narrowly edged, and pupilled with black. A black line extends obliquely from reniform to near apex, outwardly broadly edged with white. Terminal line black. Fringe consists of whitish scales with black apices.

Hindwing: Grayish white with dark gray, lunate, discal spot. Terminal line black. Fringe white.



Figs. 1–5. *Gloanna hecate.* 1, Holotype male, Sierra Diablo Wildlife Management Area, Culberson Co., Tex., 11-VI-82, E. Knudson, coll. 2, Paratype female, A. B. 2728, same locality, 7-VI-69, A. & M. E. Blanchard, coll. 3, Male genitalia of paratype, slide A. B. ECK 351, Sierra Diablo Wildlife Management Area, 11-VI-82, E. Knudson, coll. 4, Aedeagus of paratype, slide A.B. 1744, same locality, 8-VI-69, A. & M. E. Blanchard, coll. Fig. 5, Female genitalia of paratype, slide ECK 336, same locality, 11-VI-82, E. Knudson, coll. Lines in Figs. 3 and 5 represent 1 mm.

Length of forewing: Male: $N = 3$, 12.7–14.5 mm, average 13.7 mm; female: $N = 6$, 12.3–14.8 mm, average 13.7 mm.

Male genitalia (Figs. 3, 4): Fig. 3 is of genitalia with aedeagus removed. Fig. 4 shows aedeagus with sclerotized, spined plate on caudal extremity.

Female genitalia (Fig. 5): Ostial chamber heavily sclerotized. Bursa copulatrix membranous. Margins of bursa retouched in figure, as it did not take enough stain.

Holotype.—♂, Sierra Diablo Wildlife Management Area, Culberson Co., Texas, 11-VI-82, collected by E. Knudson and deposited in the National Museum of Natural History, Washington, D.C.

Paratypes.—Same data as holotype, 1 ♂, 1 ♀, collected by E. Knudson. Same locality, 5-VI-69, 3 ♀; 6-VI-69, 1 ♀ (in collection of J. G. Franclemont); 7-VI-69, 2 ♀; 8-VI-69, 1 ♂, all collected by A. & M. E. Blanchard.

Remarks.—This new species is most closely related to *Gloanna grisescens* (Barnes and Lindsey), which was described from Arizona. *Gloanna hecate* differs from it in the forewing pattern; *grisecens* is uniformly darker with more clearly defined maculation. *Gloanna hecate* differs, also, in having reduced pectinations on the antennae. The male genitalia of the two species are quite distinct; *grisescens* has a more elongate clasper, serrated apices of the valvae, and an aedeagus with a single cornutus, lacking the spined external plate. In several respects, *hecate* seems to represent an intermediate species between *Gloanna* and the closely related genus, *Acopa* Harvey. However, the sum of characters, especially the male genitalia favor placement in *Gloanna.*

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A NEW SPECIES OF *ADAMYSTIS* (ACARI: ADAMYSTIDAE) FROM THE SOUTHERN HIGH PLAINS OF TEXAS

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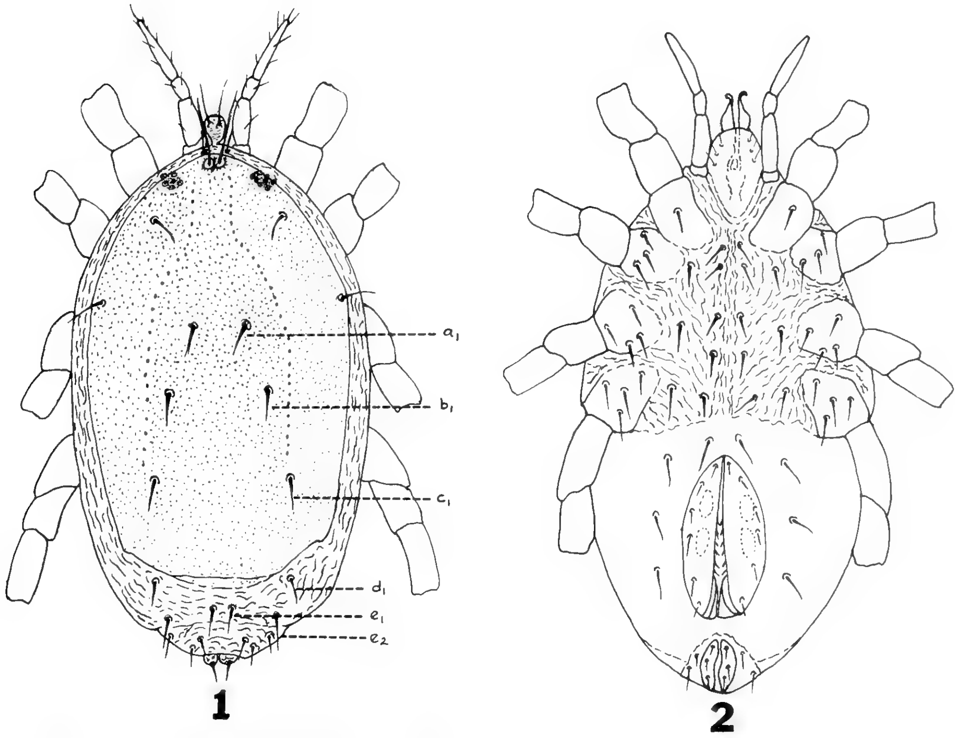
Abstract.—Adamystis ***beckyanneae,*** n. sp. is described from the Southern High Plains of Texas. This extends the distribution of the genus to include Texas.

The genus *Adamystis* Cunliffe was erected for *A. donnae* Cunliffe collected from lodgepole pine cones in California. It was placed in the family Anystidae with the establishment of a new subfamily Adamystinae for *A. donnae.* A second species, *A. sarae* Hunter and Crossley (1968), was discovered from cornfield litter in South Carolina. Following Cunliffe (1957), *A. sarae* was placed in the family Anystidae subfamily Adamystinae. A third undescribed form is mentioned by both Cunliffe (1957) and Hunter and Crossley (1968) from pine-needle duff in North Carolina. This undescribed specimen is similar to *A. sarae* in that it is characterized by Cunliffe (1957) as "possessing lens-like organs on the lateral and posterior margins of the body—6 pairs surround the anal opening." Hunter and Crossley (1968), on the basis of the absence of a seta on the basal segment of the palpus recorded by Cunliffe (1957), were of the opinion that the undescribed specimen represents a third species of *Adamystis* from the United States.

During an investigation on the microarthropod fauna of the Southern High Plains of western Texas, a new species belonging to the genus *Adamystis* was collected. Because of some major morphological characters not found on *A. donnae* that are important in distinguishing between *A. sarae* and the new species collected from Texas, an expanded description of *Adamystis* is included.

Adamystis Cunliff 1957

Palpus without thumb-claw complex; trichobothria on an anteromedian naso; chelicerae with single dorsal seta, moveable chela distal, hooklike; peritreme external, lying under anterior fold of body. Dorsum of body with 1 or 2 pairs of eyes. Lateral eyes present or absent, if present occasionally with a row of anterolateral lenslike structures which extend posteroventrally. Coxae I–IV contiguous or with coxae I–II contiguous but separated from coxae III–IV; tarsi of legs with claws and empodia; sensory setae of tarsus I present and erect. With 2 pairs of genital acetabula.



Figs. 1, 2. *Adamystis beckyanneae.* 1, Dorsal view. 2, Ventral view.

Adamystis beckyanneae **McDaniel and Bolen, New Species**

Fig. 1–2

Idiosoma 450 μ long 225 μ wide between 2nd and 3rd pair of legs. Anterior trichobothria inserted on well-developed naso; stigmata and peritremes located at base of chelicerae; chelicera base broad narrowing to apex, with well-developed hooklike chela with smaller fixed chela; single cheliceral seta located at junction of broad cheliceral base and narrowing apex, another small seta at base of fixed chela. Palpus 4-segmented, terminal segment with 4 solenidia. Naso projecting from narrow base striated with pair of trichobothria; single dorsal shield; lateral eyes absent, dorsal eyes present, these grouped in a cluster of 6 to 8 at anterior portion of dorsal shield and striated integument. Dorsal shield with 5 pairs of setae, a pair of trichobothria located on anterior extension of dorsal shield (Fig. 1). A pair of setae located between dorsal shield trichobothria and naso, these situated on striated integument; 6 setae on striated integument posterior to dorsal shield; a single pair of anal setae located on protruding anal lobes.

Venter with apodome I and II contiguous; apodomes II–III and III-IV separated from one another. Sternal center striae longitudinal. Area of sternum containing coxae with horizontal striae divided in center by longitudinal striae giving appearance of 2 large plates enclosing coxae, this area contains 8 pairs of setae. Intercoxal setation 1-3-4-4. Genital region surrounded by 4 pairs of setae. Genital opening with 6 pairs of very small internal setae; 6 pairs of genital setae; 2 pairs of genital acetabula. Anal plate with 3 pairs of anal setae, surrounded by 2 pairs of anal setae. Tarsus I bears a single erect solenidion; femora I–III each bear a whiplike setae.

Holotype.—♀, Texas, Lamb County, 9.6 km south of Olton, November 2, 1980, B. McDaniel and Eric G. Bolen. Slide mounted holotype will be deposited in the National Museum of Natural History, Washington, D.C. (USNM).

Remarks.—*Adamystis beckanneae* may be distinguished from other species of *Adamystis* by the following key.

KEY TO SPECIES OF ADAMYSTIS CUNLIFF

1. Lateral "eyes" present .... *sarae* Hunter and Crossley
– Lateral "eyes" absent 2
Setae e_1 located on dorsal shield .... *donnae* Cunliff
– Setae e_1 not located on dorsal shield 3
3. Dorsal shield narrowing at posterior region not encompassing setae c_1, d_1 .... *fonsi* Coineua
– Dorsal shield broad at posterior region, encompassing setae c_1, d_1 4
4. Dorsal shield reticulated .... *doumengei* Coineau
– Dorsal shield not reticulated .... *beckyanneae,* new species

Habitat.—Unlike the habitat recorded for other species of *Adamystis* (e.g., pine cones and corn or pine litter), *A. beckyanneae* was collected within 20 cm of the surface of deep, sandy soil. The sands are a major incursion into a region otherwise dominated by loams; they form a ribbon of sandhills running more or less parallel to an intermittent streambed bisecting Lamb County on an east-west axis. The soil is of the Tivoli series, a non-calcareous, fine sand subject to wind erosion and duning. Climax vegetation includes Indiangrass (*Sorghastrum nutans*), big bluestem (*Andropogon gerardii*), little bluestem (*Schizachyrium scoparium*), and side-oats grama (*Bouteloua crutipendula*), but grazing has replaced much of this vegetation with sand sagebrush (*Artemisia filifolia*), skunkbrush (*Rhus trilobata*), and yucca (*Yucca* sp.).

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PROC. ENTOMOL. SOC. WASH.
85(1), 1983, p. 180

NOTE

Ampulex compressa (F.) in Venezuela (Hymenoptera: Sphecidae)

Ampulex compressa (F.), a cockroach predator, is a native of the Oriental Region, and possibly also the Ethiopian Region where it is widespread. Over the years it has been established either accidently or intentionally on a number of islands: Mauritius, Reunion, Chagos Archipelago, Seychelles, the East Indies, New Caledonia, Australia, Midway, Hawaii, Cook, and St. Helena (Bohart and Menke, 1976, Sphecid Wasps of the World, Univ. Calif. Press, Berkeley, ix + 695 pp.). The Hawaiian introduction was intentional in an effort to control household cockroaches.

We report here the first known introduction of *compressa* in the New World. The species has been collected at a number of localities in north central Venezuela where it is obviously firmly established. It is not known when the wasp was first introduced to the country but the earliest record dates from 1978 in the city of Barquisemeto. Most of the 35 specimens that we have seen were collected inside old urban buildings on walls with cracks and holes inhabited by cockroaches, mainly *Periplaneta americana* (L.) and *Blattella germanica* (L.). Wasps were actively mainly in the morning.

The red mid- and hindfemora distinguish *compressa* from other large, metallic green, native Neotropical species of *Ampulex,* all of which have entirely green or black legs.

We have seen material from the following localities (voucher specimens in the Universidad Centro-Occidental, Barquisemeto, and the National Museum of Natural History, Washington D.C.): *Aragua:* Maracay, April 11, 1980, E. Yustiz. *Guarico:* San Juan de los Morros, July 24, 1981, J. Huerta. *Lara:* Barquisemeto, Nov. 5, 1978, Dec. 10, 1979, Jan. 6, 1980, March, 2, 1980, Jan. 25, 1981, Feb. 9, 1981, Feb. 14, 1981, July 15, 1981, Aug. 18, 1981, E. Yustiz; Sept. 12, 1979, F. A. Diaz; March 8, 1980, April 15, 1980, H. Escalona; March 31, 1982, collected on tree trunk, C. Perdomo; March 25, 1982, collected on tree trunk of *Melicocca bijuga,* A. Pinero. Quibor, April 16, 1980. San Pedro, Distrito Torres, 1600 m., Aug. 15, 1981, G. Perez. *Yaracuy:* San Felipe, March 18, 1980, E. Yustiz; Nirgua, Aug. 15, 1981, E. Yustiz.

Arnold S. Menke, *Systematic Entomology Laboratory, IIBIII, Agricultural Research Service, USDA, c/o National Museum of Natural History Washington D.C. 20560; and* Enrique Yustiz, *Dept. de Entomologia—Zoologia, Universidad Centro Occidental, Barquisemeto, Venezuela.*

PROC. ENTOMOL. SOC. WASH.
85(1), 1983, p. 181

NOTE

New Distributional and Host Records for *Arachnopteromalus dasys* Gordh (Hymenoptera: Pteromalidae), an Egg-Sac Parasite of Uloborid Spiders (Araneida)

The spider family Uloboridae is cosmopolitan in distribution (although predominantly tropical) and presently consists of 17 genera. Gordh (1976. J. Kans. Entomol. Soc. 49: 100–104) described a new genus and species of pteromalid, *Arachnopteromalus dasys,* which parasitized the egg-sacs of *Uloborus octonarius* Muma taken in Missouri. In a subsequent revision of the genera of tropical American uloborids, Opell (1979. Bull. Mus. Comp. Zool. 148: 443–549) created a new genus, *Octonoba,* for this species. *Octonoba octonaria* was originally thought to be native to the southeastern United States, but Dr. Opell now believes that it may have been introduced from Taiwan or nearby mainland China (Opell, personal communication).

In 1977, I received for identification two lots of specimens taken in Arizona (Molino Basin; Portal). Both lots were identified as *A. dasys,* with the host of one lot identified as *U. oweni* Chamberlin. This species was transferred to *Philoponella* by Opell (1979). In 1979, I reared *A. dasys* from uloborid egg-sacs taken at the cafeteria of the Instituto Nacional Pesquitas da Amazonia in Manaus, Brazil. At the time I thought the series might be a new species but am now convinced the specimens are conspecific with *A. dasys.*

More recently, I have received specimens from Dr. Opell of *A. dasys* taken from the egg-sacs of *Uloborus glomosus* (Walckenaer) in Virginia (Blacksburg). It would appear that *A. dasys* is specific to uloborid egg-sacs but is not species specific. It has a large geographical distribution and broad climatic tolerance.

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PROC. ENTOMOL. SOC. WASH.
85(1), 1983, pp. 181–182

NOTE

Austrotinodes Schmid (Trichoptera: Psychomyiidae), a First U.S. Record from Texas

Studies of aquatic insects collected in the southwestern United States have produced several interesting records of Trichoptera including a first U.S. record of the genus *Austrotinodes* Schmid based on a larva collected from Texas: Bandera Co., Medina River, 4 mi N Medina at Tex Hyw 16, V-6-1977, W. P. McCafferty, A. V. Provonsha, D. Morihara. *Austrotinodes* was most recently reviewed by Flint (1973. Proc. Biol. Soc. Wash. 86: 127–142) who verified our specimen. Although the specific identification of our specimen is not certain, the larva may be that of

A. mexicanus Flint, which is known from the same physiographic region some 560 miles to the southwest in El Salto, Mexico (the previous most northern generic record). The *Austrotinodes* larval description by Flint (1973) was based on Chilean-group species; however, our specimen, which evidently belongs to the Central American-Mexican-group species, differs significantly from the latter by the absence of teeth on the anal claws and the presence of a small but distinct tooth on the dorso-medial surface of the propleural/trochantoral process. Other features of the larva appear to agree with the general facies presented by Flint. The habitat cited above is a small, cold rapid stream along the roadside in the central "Hills" region of Texas.

R. D. Waltz and W. P. McCafferty, *Purdue University, Department of Entomology, West Lafayette, Indiana 47907.* (Purdue Agricultural Experiment Station Journal Series No. 9191.)

PROC. ENTOMOL. SOC. WASH.
85(1), 1983, p. 182

NOTE

On the Homonymy of *Euschistus luridus* Dallas, 1851 (Hemiptera: Pentatomidae)

In his list of Hemiptera in the British Museum, Dallas (1851. List of the Specimens of Hemipterous Insects in the Collection of the British Museum, Part 1) described two stink bugs with the specific epithet *luridus,* a North American species, *Euschistus luridus* (p. 207) and a South American species, *Agroecus luridus* (p. 200). In a recent revision of the subgenus *Lycipta* Stål of *Euschistus,* Rolston (1982. Proc. Entomol. Soc. Wash. 84: 281–296) transferred *A. luridus* into *Euschistus,* thus inadvertently creating a secondary homonym. This situation is especially confusing since both "*Euschistus luridus*" have the same author and date. Since page priority is not binding, the opportunity is now taken to make the least disruptive nomenclatural change.

Euschistus aceratos Berg (1894, An. Mus. Nac. Hist. Nat. Montev. 1: 13–17), replacement name for *Euschistus luridus* (Dallas) (1851: 200), a secondary homonym of *Euschistus luridus* Dallas (1851: 207).

The South American species has appeared seldom in the literature. It's only known synonym is chosen as a replacement name. The North American form is considered to be a subspecies of the dusky stink bug. It is retained in its trinomial, *Euschistus tristigmus luridus* Dallas. McPherson (1976. Ann. Entomol. Soc. Am. 69: 691–694; 1982. The Pentatomoidea (Hemiptera) of Northeastern North America with Emphasis on the Fauna of Illinois. South. Ill. Univ. Press, Carbondale) discusses the status of these subspecies. Rule 57e of the *International Code of Zoological Nomenclature* 1961) giving precedence to species names over subspecies names does not apply in this instance since both names were originally proposed as full species.

Donald B. Thomas, Jr., *4119 Baldwin No. 3, Lincoln, Nebraska 68504.*

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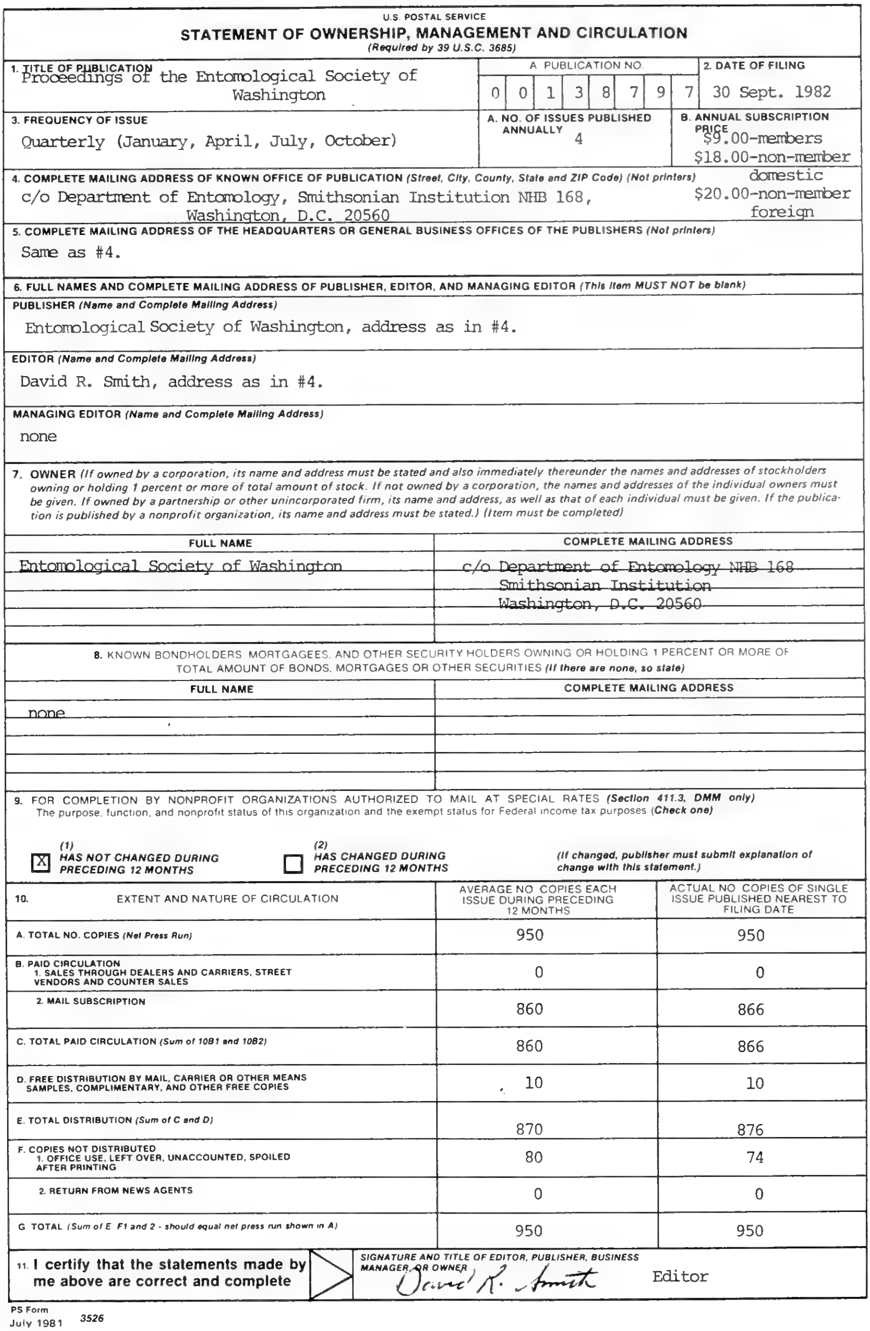

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GYNANDROMORPHISM IN SALTATORIAL ORTHOPTERA, WITH THE DESCRIPTION OF AN ADDITIONAL FIELD-COLLECTED SPECIMEN

David A. Nickle

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Abstract.—A thorough review of gynandromorphism in the saltatorial Orthoptera indicates that of a total of 522 records, 47 specimens are clearly bilateral gynandromorphs. Gynandromorphism has been reported for one species in the Tetrigidae, 24 species in the Acrididae, one species in the Gryllacrididae, six species in the Gryllidae, and 21 species in the Tettigoniidae (including a new case in *Microcentrum retinerve* (Burmeister) described herein). Although it is doubtful that gynandromorphism has adaptive significance, the phenomenon appears in unusually high frequencies for at least two species.

Bilateral gynandromorphism is infrequently reported in the literature and no doubt is uncommon. Most cases involve species that exhibit pronounced sexual dimorphism as in butterflies (Blanchard, 1969; Hessel, 1964; Schmid, 1973; Tweedie, 1965) in which wing color patterns differ between the sexes, and with beetles (Balazuc, 1948, 1952; Balazuc and Donnot, 1953) in which secondary sexual characters such as mandible morphology, head ornamentation, and length of elytra differ between the sexes. Reviews of this morphological anomaly that mention Orthoptera include Hagen (1861), Bertkau (1889), Uvarov (1966) and Chopard (1938).

Among the Orthoptera (*sensu stricto* the saltatorial Orthoptera: grasshoppers, crickets, and katydids) sexual dimorphism is usually much less pronounced. Besides the obvious differences in external genitalia, the only noticeable difference between males and females involves size, females being larger than males in most species. In addition, among the ensiferan Orthoptera, sex differences in the morphology of the tegmina are common for those species that employ tegminal stridulation in pair formation. It is probable that many cases of bilateral gynandromorphism in the Orthoptera have been overlooked by all but the most discriminating specialist. The first case in the Orthoptera was reported by Brisout de Barneville (1847, 1848a, b). Since then, 66 reports have accumulated describing some level of gynandromorphism in Orthoptera.

In this paper, gynandromorphism in the Orthoptera is reviewed: the species are listed; the degree of gynandromorphism is evaluated; the origin of the specimen, i.e., whether field-collected or derived from a laboratory stock or from interspecific genetic crosses, is indicated; and hypotheses for this phenomenon are reviewed. In addition, a field-collected bilateral gynandromorph of the lesser angle-winged bush katydid, *Microcentrum retinerve* (Burmeister), is described and figured for the first time.

REVIEW OF GYNANDROMORPHISM

In general the reports of gynandromorphism in Orthoptera describe three degrees of this phenomenon. The first level involves cases in which the specimen is predominantly one sex but with an accessory structure or structures characteristic of the opposite sex (Ramme, 1926; Pearson, 1929; Paul, 1941; Friauf, 1947). The second level involves specimens having several male and female features arranged either randomly or in a non-symmetrical pattern; for example, a grasshopper with ovo-testes (an ovary with spermatocytic tissue) and external features that reflect both male and female characteristics. Such specimens have been called sexual mosaics or intersexes (Ohmachi, 1932; Suzuki, 1933). The third level involves cases in which sexual differentiation is distinct on either side of the plane separating the left and right sides of the body; this is bilateral gynandromorphism.

To date, gynandromorphism has been reported for 24 species of grasshoppers (Acrididae), one species of grouse locusts (Tetrigidae), one species of camel crickets (Gryllacrididae), six species of crickets (Gryllidae), and 21 species of katydids (Tettigoniidae) (Table 1). Of a total of 522 records, 47 specimens were clearly bilateral gynandromorphs. Nearly all of the other records were intersexes derived from laboratory stocks involved in radiation experiments (Suzuki, 1933, 1934) or from hybrid crosses involving either intersexes and normal individuals of the same species (Ohmachi, 1929, 1932) or two different species (Cousin, 1935). Among the bilateral gynandromorphs 13/21 of the Tetrigidae and Acrididae, 10/14 of the Tettigoniidae, and 2/6 of the Gryllidae were male on the left side, female on the right. Although this suggests that the left side is expressed as male in the majority of individuals, it is not possible to say if this is significant, considering the small numbers involved. A *chi*-square analysis, however, suggests there is nearly a 90% probability that this reflects a trend toward maleness on the left ($\chi^2 = 4.78$, df = 3).

The majority of the reported cases of gynandromorphs are descriptions of the external morphology of the anomolous specimen. Rehn and Hebard (1914) listed a specimen of *Insara elegans consuetipes* (Scudder) as a gynandromorph, but I have seen this specimen at the Academy of Natural Sciences of Philadelphia and believe it was merely deformed slightly during its final moult. Some specimens described as bilateral gynandromorphs showed some degree of dorso-ventral gynandromorphism (Ramme, 1913; Potter, 1940; Friauf, 1947; Pener, 1964). A gynandromorph of *Camnula pellucida* (Scudder) exhibited the left ventral valve and right dorsal and ventral valves of an ovipositor on an otherwise male abdomen (Paul, 1941). The remaining gynandromorphs were either intersexes or typical bilateral gynandromorphs.

Several authors have detected the anomaly before the specimen was killed (see Table 1) and consequently were able to examine and describe both the external and internal morphology. Forty-three gynandromorphs have been studied internally to date. In only three bilateral specimens is the bilaterality reflected completely both internally and externally (Agar, 1940; Joly, 1959; Harz, 1960). There is only one case of a bilateral gynandromorph in which internal female genitalia are completely lacking (Robertson, 1936), although two other gynandromorphs are predominantly male internally, with only a spermatheca (Potter, 1940) or a reduced ovary (Kimura, 1951) internally. Six gynandromorphs lack internal male genitalia (Carothers, 1939; Pener, 1964; Slifer and King, 1967; Suzuki, 1934). The remaining specimens have both male and female structures internally with conspicuous ovotestes on at least one side. Suzuki (1934) obtained 14 gynandromorphs or intersexes through X-ray irradiation of crosses of *Homoeogryllus japonicus* (de Haan) and on the basis of internal genitalic morphology found six types: 1/2 normal ♂ (♀ absent), normal ♂ (♀ absent), normal ♀ (♂ absent), 1/2 normal ♂, 1/2 ovotestes, 1/2 normal ♀, 1/2 ovotestes, and both sides ovotestes.

Six authors were able to identify gynandromorphs early enough to study their behavior. Carothers (1939) described a bilateral gynandromorph derived from an interspecific laboratory cross of *Trimerotropis citrina* (Scudder) ♂ × *T. maritima* (Harris) ♀. The specimen attracted males and also attempted to court females. Pener (1964) described the sexual behavior of two bilateral gynandromorphs of *Schistocerca gregaria* (Forskål). One specimen attempted unsuccessfully to copulate with females on five separate occasions. This specimen showed no characteristic female behavior, although internally it possessed ovaries with mature ova. The second gynandromorph behaved similarly, attempting copulation four different times. Neither specimen had testes, though both exhibited male behavior. This behavior, however, terminated well before their deaths, and mature ova were present at the time of deaths, suggesting a possible switch in behavior based on the internal maturation of female sex organs. Slifer (1966) reported on egg-laying by a gynandromorph of *Melanoplus differentialis* (Thomas). Since the specimen was a virgin bilateral gynandromorph, the eggs were unfertilized. Nevertheless, one egg hatched from a clutch of 52. Harz (1960) reported for the first time on sound production by a tettigoniid bilateral gynandromorph, *Metrioptera brachyptera* (L.). The stridulations resembled those of normal males. This specimen behaved like a male in the presence of females, courting and attempting copulation with a nearby female. It was not attracted to the stridulations of a male of the same species. Omachi (1929) mentions that intersexes (dorsoventral gynandromorphs with male abdomens and female tegmina) of *Homoeogryllus japonicus* also behaved like males, extruding spermatophores, pursuing females, and raising their tegmina as if to stridulate.

The biological causes of gynandromorphism have been reviewed in some detail by Morgan and Bridges (1919). Four interpretations have been advanced. Boveri (1888) suggested the *partial fertilization* hypothesis, in which a spermatozoan might be delayed in penetrating the egg until after cleavage had commenced. Subsequent fertilization of one of the daughter nuclei would result in diploid cells (which would become the female portion of the organism), while the unfertilized daughter nucleus would result in haploid cells (which would become the male portion). Some Hymenoptera gynandromorphs may have originated from partial fertilization (Whiting and Whiting, 1927).

A second interpretation, advanced by Morgan (1905), is *dispermy* (or *polyspermy* of some authors). In this case, the egg might be penetrated by more than one spermatozoan, one of which would fertilize the egg nucleus, forming diploid (= female) daughter cells, while the other spermatozoan would develop on its own, forming haploid (= male) daughter cells.

Doncaster (1914) suggested dispermy of a *binucleated egg.* He observed that some eggs have two nuclei and surmised that if each were united by a spermatozoan, one of the male-producing variety (either Y or no-X) and one of the

Table 1. Published records of gynandromorphs in the saltatorial Orthoptera.

SPECIES	REFERENCE	♂ SIDE	♀ SIDE	DEGREE OF GYNANDROMORPH	SOURCE OF SPECIMEN	DESCRIPTION OF INTERNAL ANATOMY
TETRIGIDAE						
Paratettix texanus Hancock [= *P. cucullatus* (Burmeister)] (Tetriginae)	Robertson 1936	left	right	bilateral	laboratory colony	yes
ACRIDIDAE						
Anacridium moestrum (Serville) (Cyrtacanthacridinae)	Potter 1940	left	right	all male dorsally, bilateral ventrally	laboratory colony	yes
Camnula pellucida (Scudder) (Oedipodinae)	Paul 1941	-	-	mainly male, with female accessory structures	field collected	no
Camnula pellucida (Scudder) (Oedipodinae)	Friauf 1947	left	right	all male dorsally, bilateral ventrally	field collected	no
Chorthippus biguttulus (L.) (Gomphocerinae)	Ebner 1951	-	-	parasite-induced intersex	field collected	no
Chorthippus biguttulus (L.) (Gomphocerinae)	Oschmann 1971	right	left	mainly female, with accessary male structures	field collected	no
Chorthippus longicornis (Latreille) (Gomphocerinae)	Karaman 1959	--	--	mainly female, with accessary male structures	field collected	no
Chorthippus longicornis (Latreille) (Gomphocerinae)	Oschmann 1971	left	right	bilateral	field collected	no
Chorthippus montanus (Charp.) (Gomphocerinae)	Bednarz 1970	right	left	bilateral	field collected	yes
Chrysochraon dispar (Germar) (Gomphocerinae)	Brisout de Barneville 1847, 1848a	-	-	mainly male, with female structures	field collected	no
Euchorthippus pulvinatus gallicus Maran (Gomphocerinae)	Descamp 1968	-	-	parasite-induced intersex	field collected	yes
Locusta migratoria L. (Oedipodinae)	Joly 1959	right	left	bilateral	laboratory colony	yes
Locusta migratoria L. (Oedipodinae)	Verdier 1960	left	right	bilateral	?	no
Locusta migratoria L. (Oedipodinae)	Verdier unpubl. (in Uvarov 1966)	right	left	bilateral	laboratory colony	no
Melanoplus adelogyrus Hubbell (Melanoplinae)	Hubbell 1932	right	left	bilateral	field collected	no
Melanoplus differentialis (Thomas) (Melanoplinae)	Slifer 1966	left	right	bilateral	laboratory colony	yes
Melanoplus differentialis (Thomas) (Melanoplinae)	Slifer and King 1967	left	right	bilateral	laboratory colony	yes
Melanoplus fasciatus (Walker) (Melanoplinae)	White and Rock 1945	right	left	bilateral	field collected	no
Melanoplus mexicanus mexicanus (Saussure) (Melanoplinae)	Severin 1943	left	right	bilateral	field collected	no
Melanoplus mexicanus mexicanus (Saussure) (Melanoplinae)	Severin 1955	left	right	bilateral	field collected	no
Oedaleonotus phryneicus Hebard (Melanoplinae)	Hebard 1919	left	right	bilateral	field collected	no
Oedaleus inornatus Schulthess (Oedipodinae)	Ritchie 1978	-	-	mainly male externally and internally; some female characters in external genitalia	field collected	yes
Oxya velox (F.) (Oxyinae)	Kimura 1951	-	-	all male, with accessory female structure	laboratory colony	yes
Pardalophora phoenicoptera (Burmeister) (Melanoplinae)	Friauf 1947	-	(right)	all male, with accessory female structure	field collected	no
Podisma pedestris L. (Podisminae)	Baccetti 1954	left	right	bilateral	field collected	no
Podisma sapporoense Shiraki (Podisminae)	Natori 1931	-	-	all male, with accessory female structure	laboratory colony	yes

Table 1. Published records of gynandromorphs in the saltatorial Orthoptera (cont.).

SPECIES	REFERENCE	♂ SIDE	♀ SIDE	DEGREE OF GYNANDROMORPH	SOURCE OF SPECIMEN	DESCRIPTION OF INTERNAL ANATOMY
Schistocerca gregaria (Forskål) (Cyrtacanthacridinae)	Dirsh 1957	right	left	bilateral	laboratory colony	yes
Schistocerca gregaria (Forskål) (Cyrtacanthacridinae)	Pener 1964	right	left	all male dorsally, bilateral ventrally	laboratory colony	yes
Schistocerca gregaria (Forskål) (Cyrtacanthacridinae)	Pener 1964	left	right	bilateral	laboratory colony	yes
Schistocerca paranensis (Burmeister) (Cyrtacanthacridinae)	Morales Agacino 1957	right	left	bilateral	field collected	no
Sphingonotus caerulans (L.) (Oedipodinae)	Dirsh 1957	-	-	mainly male, with accessory female structures	laboratory colony	no
Stauroderus [= *Chorthippus*] *rammei* Ebner (Gomphocerinae)	Ebner 1940	-	-	parasite induced intersex; mainly male, with some female features	field collected	no
Trimerotropis citrina (Scudder) x *T. maritima* (Harris) (Oedipodinae)	Carothers 1939	left	right	bilateral	hybrid cross	yes
Valanga irregularis (Walker) (Cyrtacanthacridinae)	White 1968	left	right	bilateral	field collected	yes
TETTIGONIIDAE						
Acridopeza reticulata Guer. (Phaneropterinae)	Agar 1940	right	left	bilateral	field collected	yes
Amblycorypha oblongifolia (De Geer) (Phaneropterinae)	Pearson 1927, 1929	-	-	all male, with internal female structures	field collected	yes
Amblycorypha oblongifolia (De Geer) (Phaneropterinae)	Pearson 1927, 1929	-	-	all male, with internal female structures	field collected	yes
Amblycorypha rotundifolia (Scudder) (Phaneropterinae)	Pearson 1927 1929	left	right	bilateral	field collected	yes
Barbistes constrictus Brunner von Wattenwyl (Phaneropterinae)	Chladek 1968	left	right	bilateral	field collected	no
Barbistes yersini Brunner von Wattenwyl (Phaneropterinae)	Brunner von Wattenwyl 1876	left	right	bilateral	field collected	no
Decticus albifrons (F.) (Decticinae)	Boudou-Saltet 1975	-	-	mainly female, with intersexual characters in abdomen; internally, ovitestis on left, ovary on right	not mentioned, but presumedly field collected	yes
Decticus verrucivorus (L.) (Decticinae)	Ramme 1951	left	right	bilateral	field collected	no
Ephippiger ephippiger (Fiebig) (Ephippigerinae)	Dumortier 1962	(right)	-	mainly female, left ovipositor valves reduced; internally, right normal male, left normal female genitalia	field collected	yes
Ephippiger ephippiger (Fiebig) (Ephippigerinae)	Dumortier 1962	(right)	(left)	mainly female, with male features internally	field collected	yes
Ephippiger terrestris Yersin (Ephippigerinae)	Kheil 1914	right	left	bilateral	field collected	no
Ephippiger vitium Serville [= *E. ephippiger* (Fiebig)] (Ephippigerinae)	Pantel and de Sinety 1908	-	-	not described	field collected	no
Insara elegans consuetipes (Scudder) (Phaneropterinae)	Rehn and Hebard 1914	-	-	discounted, not a gynandromorph	field collected	no
Isophya modesta (Frivaldsky) (Phaneropterinae)	Kiss 1960	right	left	bilateral	field collected	no
Isophya modesta (Frivaldsky) (Phaneropterinae)	Kiss 1960	-	(left)	mainly male, with female structures on left	field collected	no
Isophya modesta (Frivaldsky) (Phaneropterinae)	Kiss 1960	-	-	mainly male, with tegmina similar to female	field collected	no

Table 1. Published records of gynandromorphs in the saltatorial Orthoptera (cont.).

SPECIES	REFERENCE	♂ SIDE	♀ SIDE	DEGREE OF GYNANDROMORPH	SOURCE OF SPECIMEN	DESCRIPTION OF INTERNAL ANATOMY
Isophya pavelii Brunner von Wattenwyl (Phaneropterine)	Brunner von Wattenwyl 1876	left	right	bilateral	field collected	no
Isophya pyrenaea (Serville) (Phaneropterinae)	Dumortier and Paly 1971	right	left	bilateral	field collected	no
Leptophyes punctatissima (Bosc) (Phaneropterinae)	Cappe de Baillon 1924	left	right	bilateral	field collected	yes
Leptophyes punctatissima (Bosc) (Phaneropterinae)	Cappe de Baillon 1932	left	right	bilateral	field collected	yes
Metrioptera brachyptera (L.) (Decticinae)	Cappe de Baillon 1924	left	right	bilateral	field collected	yes
Metrioptera brachyptera (L.) (Decticinae)	Ebner 1940	-	-	male with some characters similar to female	field collected	no
Metrioptera brachyptera (L.) (Decticinae)	Harz 1960	left	right	bilateral	field collected	yes
Microcentrum retinerve (Burmeister) (Phaneropterinae)	Nickle, in this paper	right	left	bilateral	field collected	no
Odontura sp. (Phaneropterinae)	Chadima 1872	left	right	bilateral	field collected	no
Poecilimon elegans Brunner von Wattenwyl (Phaneropterinae)	Ramme 1926	(left)	-	all female, with accessory male structure	field collected	no
Poecilimon orbeliscus Panc (Phaneropterinae)	Harz 1967	right	left	bilateral	field collected	yes
Pycnogaster graëllsi Bolivar (Pycnogastrinae)	Pantel and de Sinety 1908	-	-	not described	field collected	no
Tettigonia viridissima (L.) (Tettigoniinae)	Klapalek 1897	?	?	reference not seen by author	field collected	no
Thmanotrizon [=*Pholidoptera*] *fallax* (Fitsch) (Decticinae)	Ramme 1913	right	left	mainly male dorsally, bilateral ventrally	field collected	yes
GRYLLACRIDIDAE						
Dolichopoda linderi Duf. (Rhaphidophorinae)	Saltet 1968	right	left	bilateral	field collected	yes
GRYLLIDAE						
Gryllus [as *Acheta bimaculatus* De Geer x *campestris* L.) x *bimaculatus* (Gryllinae)	Cousin 1935, 1937	-	-	mainly female, with some intersexual characters on tegmen and genitalia	hybrid cross	yes
Gryllus (*argentinus* Saussure x *capitatus* Saussure) x *capitatus* (Gryllinae)	Cousin 1967	right	left	bilateral	hybrid cross	no
Gryllus bimaculatus De Geer (Gryllinae)	Johnstone 1975	left	right	bilateral, with intersex characters on tegmen	laboratory colony	yes
Gryllus lineaticeps Walker (Gryllinae)	Chopard 1955	-	-	intersex	field collected	yes
Gryllus bimaculatus De Geer x *capitatus* Saussure - back crosses:	Cousin 1963					
1. *BC*♀ x *BB*♂		right	left	bilateral	hybrid cross	yes
2. *BC*♀ x *CC*♂		right	left	bilateral	hybrid cross	yes
Homoeogryllus japonicus (de Haan) (Phalangopsinae)	Ohmachi 1929	-	-	29 specimens: 4 bilaterals (not described), 18 males with female tegmina, 4 males with tegmina having intersexual characters, 3 males with female tegmina and female internal structures	laboratory colony	yes
Homoeogryllus japonicus (de Haan) (Phalangopsinae)	Ohmachi 1932	-	-	405 offspring described as intersexes, in most cases mainly males with female or intersex tegmina	hybrid crosses	yes

Table 1. Published records of gynandromorphs in the saltatorial Orthoptera (cont.).

SPECIES	REFERENCE	♂ SIDE	♀ SIDE	DEGREE OF GYNANDROMORPH	SOURCE OF SPECIMEN	DESCRIPTION OF INTERNAL ANATOMY
Homoeogryllus japonicus (de Haan) (Phalangopsinae)	Suzuki 1933	left	right	bilateral	laboratory colony; x-ray irradiated	no
Homoeogryllus japonicus (de Haan) (Phalangopsinae)	Suzuki 1933	–	(right)	mainly male, with female accessory structures	laboratory colony; x-ray irradiated	yes
Homoeogryllus japonicus (de Haan) (Phalangopsinae)	Suzuki 1934	–	–	14 specimens with 6 types of combinations of male and female gonads	laboratory colony; x-ray irradiated	yes
Madassuma [=*Xenogryllus*]*marmoratus* Haan (nec Bolivar) (Eneopterinae)	Ohmachi 1926	right	left	bilateral, with some intersexual characters	laboratory colony	yes

female-producing variety (X), then all daughter cells would be diploid but give rise to male and female sides.

Morgan (1914) proposed *chromosomal elimination,* for which an abundance of evidence has since accumulated. According to this interpretation, the gynandromorph begins development as a normal female zygote, but during an early cleavage one of the X-chromosomes is eliminated or fails to migrate to the daughter nucleus. This results in all subsequent cells being male (i.e., X-0) while the cells from the normal initial cell will be female (X-X).

Among the cases of gynandromorphism in Orthoptera, ten authors have speculated on the biological origin of their specimens. Carothers (1939) considered the gynandromorph offspring of a cross between *Trimerotropis maritima* and *T. citrina* to be the result of either the chromosomal elimination of an X-chromosome and one or more autosomes or dispermy in which diploidy was restored as in parthenogenesis and one X-chromosome was eliminated or else never doubled when the autosomes did. She felt the first alternative was unlikely to cleave successfully and suggested that the second was more probable. Slifer (1966) suggested that her gynandromorph of *Melanoplus differentialis* began as a female, but early in mitotic cleavages of the zygote an X chromosome was lost from a cell from which most of the left side developed. Since this error in cleavage failed to account for the absence of testes on the left, she considered a second error occurred later, resulting in elimination of cells from which male internal organs are derived. Ohmachi (1926) similarly explained his gynandromorph of *Madasumma marmorata* de Haan.

Johnstone (1975) also combined the elimination of an X chromosome with a second event, in her case, the mingling of male and female cells during gastrulation to form mosaic regions. Pearson (1929) reviewed the four hypotheses to account for gynandromorphism and concluded that either dispermy of binucleated eggs or chromosomal elimination could account for his specimens of *Amblycorypha* species. He suggested that additional gains or losses of autosomes could also influence the expression of sex (see Carothers' specimen as an example). Cappe de Baillon (1924) and Cousin (1963) also suggested that elimination of the X chromosome at an early mitotic division was the cause of their respective gynandromorphs. White (1968), on the other hand, presented evidence for dispermy of a binucleated egg. Since his specimen differed bilaterally not only for sex expression but also for non-sex-linked color pattern, he considered dispermy of a binucleated egg the only possible alternative. Finally, Ebner (1940, 1951) demonstrated that in some cases of specimens displaying secondary sexual characters of the opposite sex, the cause may be attributed to actions of parasites of the specimen at some stage in its development. He described several specimens of grasshoppers that were predominantly male but had tegmina and cerci that were more typically female in structure.

A Gynandromorph of the Lesser Angle-winged Katydid

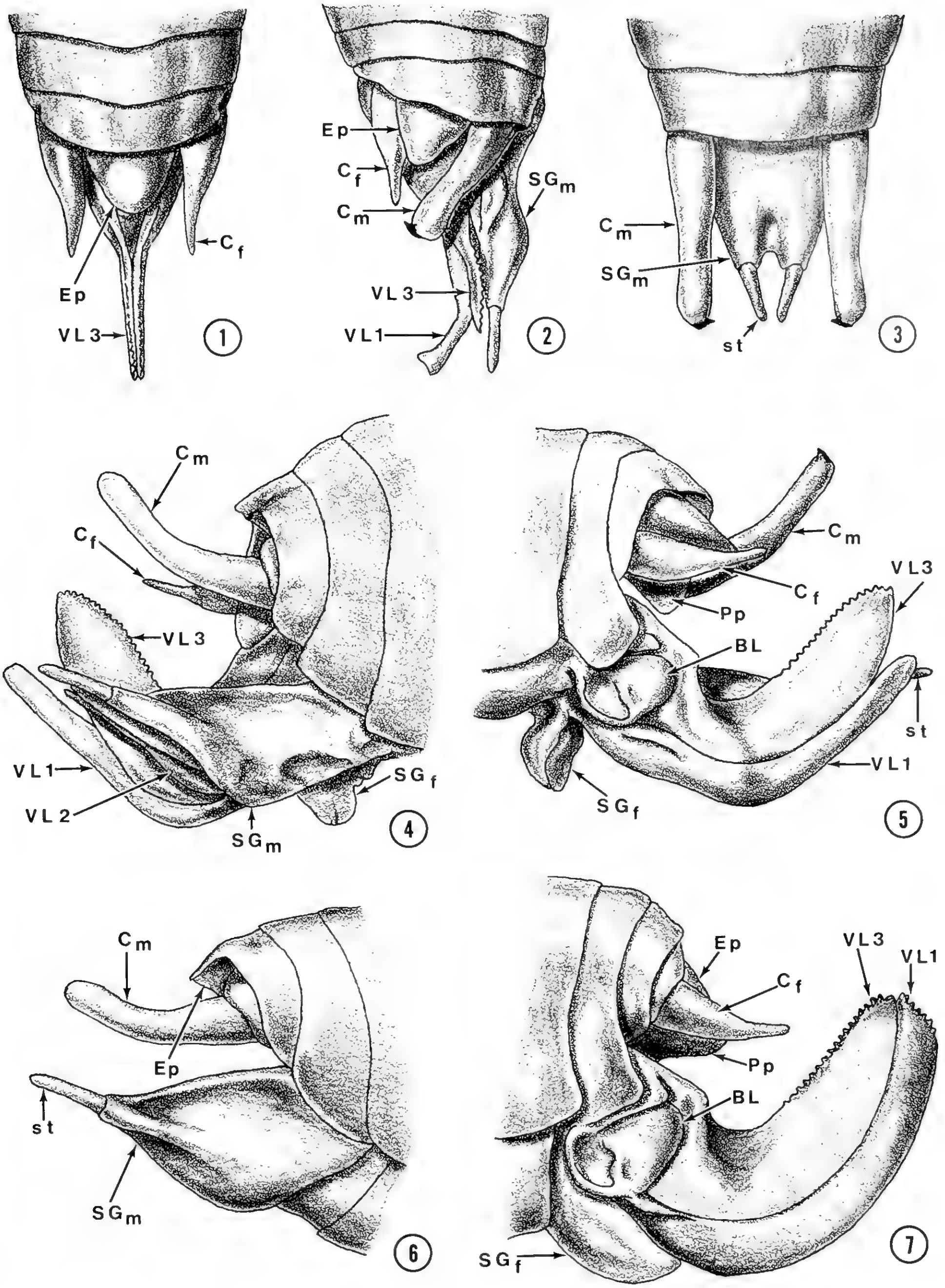
On 4 September 1970 a bilateral gynandromorph of the lesser angle-winged katydid, *Microcentrum retinerve* (Burmeister) [Tettigoniidae; Phaneropterinae], was collected by the author at Lake Drummond, Dismal Swamp, Nansemond Co., Virginia. The specimen was collected along with seven normal males and four normal females at an incandescent light source. It was unfortunately not recognized as a bilateral gynandromorph until after the specimens had been prepared for dry mounting on pins.

The specimen is a well-defined bilateral gynandromorph with male characters on the right side of the body, female on the left. Minor differences in proportion reflecting the expression of each sex occur in the face, pronotum, and abdominal tergites. The distortion of the face is reflected in the typically larger compound eye on the male side which in contrast also has shorter lower facial features than the female side, resulting in torsion of the clypeus and labrum toward the male side.

The tegmina display sexual differences on each side of the body. The right tegmen is typically male, possessing a pars stridens or scraper along the anal margin and a ventrally-located non-functional stridulatory file. Normal males also possess this structure, and no measurable differences are noted between the gynandromorph and normal males for any structures on the right tegmen. The left tegmen is typically female, with a thickened sharp scraper on the anal margin (Nickle and Carlysle, 1975). The tegmina of this katydid show none of the intersexual characteristics described by Johnstone (1975); instead, each tegmen falls within the normal range of variation for its respective sex.

The most apparent gynandromorphic features are expressed in the external genitalia. In a normal male (Figs. 3, 6) the tenth tergite is slightly produced and apically truncate, with the epiproct recessed and articulating ventrally from the tenth tergite. The cercus is long, cylindrical, and tapering distally, with a preapical medially-directed dark tooth. The subgenital plate is broad, with an apical, median U-shaped emargination and two lateral well-developed styles. The normal female abdomen (Figs. 1, 7) also has a truncate terminal tergite with a more posteriorly-directed epiproct. The cercus is simple, distally tapered and lacking a tooth. The ovipositor is moderately developed, nearly as long as the pronotal disc (5–6 mm), acutely upcurved and serrate along the distal half of the dorsal valve and at the apex of the ventral valve. The subgenital plate is basally broad, becoming increasingly constricted distally and apically nearly pointed.

The external genitalia of the gynandromorph (Figs. 2, 4, 5) have all the typical male parts on the right side and female parts on the left, although there are considerable distortion and some size differences compared with normal male and female genitalia. The male tenth tergite is complete but reduced in length on



Figs. 1–7. Abdomens of *Miocrocentrum retinerve.* 1, 7, Normal female. 3, 6, Normal male. 2, 4, 5, Gynandromorph. 1–3 dorsal views; 4, 6 right lateral views; 5, 7 left lateral views. Ep = epiproct; Pp = paraproct; C_m and C_f = cercus of male and female, respectively; VL1, VL2, VL3 = valvula 1, 2, and 3 of ovipositor, respectively; SG_m, SG_f = male and female subgenital plate, respectively; st = style of male subgenital plate; BL = basal lobe of ovipositor.

the female side. Although the male cercus is not distorted, it is only ⅔ as long as a normal male cercus. Only the right half of the male subgenital plate is present, and in structure its base is nearly identical with the base of the female ventral valve of the ovipositor on the left side; distally, it shows all the characteristics typical of a normal male subgenital plate.

The ovipositor of the female side is much distorted, in part from gynandromorphic asymmetry and in part from drying. The distal half of the dorsal valve shows little distortion, but the distal half of the ventral valve bears little resemblance to the normal form, is apically truncate, and completely lacks apical serrations. The basal lobe of the ovipositor is nearly the same in shape but smaller than the normal form. The subgenital plate of the female side is reduced to a cup-shaped plate on the left side and becomes confluent with the subgenital plate on the male side.

Measurements (mm).—Values for ♂ and ♀ are means of 10 individuals for each sex. Length of forefemur ♂ 4.90; ♀ 5.34; ⚥R 4.95; ⚥L 5.27. Length of midfemur, ♂ 7.30; ♀ 7.68; ⚥R 7.53; ⚥L 7.84.

The specimen has been donated to the National Museum of Natural History, Washington, D.C.

Discussion

The occurrence of gynandromorphism in Orthoptera is most likely an aberration with no adaptive significance. Certainly bilateral gynandromorphs are unlikely to reproduce successfully, since copulation is physically not possible, at least for specimens so far examined. Nevertheless, it is possible that a genetic propensity for gynandromorphism could be maintained within a gene pool, if there were selection for heterosis with strong positive pleiotropic effects, and the gynandromorphs were at least as reproductively successful as normal individuals.

Most reports of gynandromorphism are among laboratory crosses (Ohmachi, 1929, 1932; Suzuki, 1934; Pener, 1964; Slifer, 1966; Slifer and King, 1967) or among interspecific hybridization studies (Carothers, 1939; Cousin, 1967), and inbreeding and artificial selection for such a character complex is likely to be common only under such artificial conditions. Nevertheless, in two cases, gynandromorphs or intersexes appear at higher frequencies than one would expect. Ohmachi (1929) listed 25 *Homoeogryllus japonicus* intersexes which were incapable of sound production but apparently capable of producing spermatophores. These specimens apparently were secured from a professional insect breeder. Ohmachi (1932) also demonstrated that when these intersexes were crossed with normal individuals, both normal and intersex offspring were produced. Such specimens in nature would seem to be less likely to be successful than normal calling males in obtaining mates. However, if the density of the population were so high that visual contact were as likely as attraction to conspecific calling signals in getting males and females together, or if such non-singing individuals could compete favorably as interlopers for females responding to singing males, or if selection favored "non-singing" or pantomiming males, as perhaps an adaptation to avoid predation or parasitization from natural enemies with an auditory search image, intersexes of this species may be reproductively successful competitors with normal individuals. This has not been demonstrated in nature, however.

Pearson (1927, 1929) described three field-collected gynandromorphs detected from a rather small sampling of *Amblycorypha rotundifolia* (Scudder) and *A. oblongifolia* (De Geer). Two of these proved to be intersexes that were externally males capable, at least morphologically, of self fertilization and of cross-fertilization with normal females. If self fertilization were possible, its adaptive significance would be similar to animals with facultative parthenogenesis (Nabours, 1919; Roth and Willis, 1956, 1961). Such an adaptation would permit females to produce viable offspring in periods when mates may not be available or when it would be otherwise advantageous for the female to invest completely in her offspring by providing 100% of the genetic material. In species of *Amblycorypha*, populations are frequently low, and species are exploitive, occupying new habitats such as weedy new growth. Finding mates in such situations may be unlikely at times, and dangerous if the time invested in waiting for mates reaches a level such that predation becomes more likely, so that a predisposition toward intersexuality or facultative parthenogenesis may be adaptive. Since Pearson's internal gynandromorphs were externally males, they would not be expected to successfully oviposit eggs, even if they were successful in self fertilization. If the reciprocal gynandromorph were possible, i.e., a female capable of self fertilization internally, successful reproduction could result from such an anomaly. Certainly more research on this group is needed to demonstrate such an adaptation.

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A NEW AFROTROPICAL GENUS OF THE BITING MIDGE TRIBE CERATOPOGONINI (DIPTERA: CERATOPOGONIDAE)

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Abstract.—***Bothahelea*** Grogan and Wirth, a new genus from Zimbabwe closely related to *Brachypogon,* is described and illustrated; it includes two new species, ***phelpsi*** Grogan and Wirth as type-species, and ***gigantostyla*** Grogan and Wirth.

For several years we have been working on a revision of the genera of biting midges that have been placed in the tribes Ceratopogonini and Stilobezziini (see Wirth et al., 1974, 1977). More intensive study of previously described genera, with examination of new characters and differing combinations of characters, has indicated that some genera must be shifted between these tribes or that the tribal separation cannot be maintained (see de Meillon and Wirth, 1979; Wirth and Wada, 1979; Grogan and Wirth, 1980). In addition, new genera have recently been discovered and described whose tribal placement has been difficult (Grogan and Wirth, 1980; de Meillon and Wirth, 1981).

We have recently received for study a collection of biting midges taken by Dr. R. J. Phelps of the University in Zimbabwe in Salisbury that contained two undescribed species of Ceratopogonini that cannot readily be assigned to any of the described genera. To make the names available for discussions on supergeneric taxonomy we are here proposing a new genus for them.

For general terminology of Ceratopogonidae see Wirth (1952) and Wirth et al. (1977); terms dealing with male genitalia are those of Snodgrass (1957); those dealing with antennal sensilla follow Wirth and Navai (1978). We would also refer the reader to an excellent paper on the apparently closely related genus *Brachypogon* Kieffer by Downes (1976) and to a review of that genus by Wirth and Blanton (1970).

Bothahelea **Grogan and Wirth, New Genus**

Type-species, *Bothahelea phelpsi,* by present designation.

Diagnosis.—Small biting midges, wing length 0.9–1.0 mm. Eyes pubescent; separated. Antenna with first flagellomere bearing a single apical sensilla basiconica, not coeloconica; male flagellomeres separate, not fused. Palpus 5-segmented; 3rd segment with well-defined pit. Female claws long, subequal, with long basal inner teeth. Wing with 2 radial cells, 2nd twice as long as 1st; vein M2 complete to base; costa extending 0.65–0.70 of wing length. Fourth tarsomeres cylindrical. One large spermatheca. Male genitalia large and bulbous, without long apicolateral processes on 9th tergum; claspettes divided; aedeagus with 3 or more apical projections.

Discussion.—*Bothahelea* closely resembles some species of *Brachypogon* in having a single spermatheca, and it further resembles that genus in the form of its tarsi and claws. It differs from all species of *Brachypogon,* however, in having sensilla basiconica on the first flagellomere, wing with the second radial cell twice as long as the first, vein M2 complete to base, and the flagellomeres of the male antenna separate, not fused.

Bothahelea is similar to *Ceratopogon* Meigen and *Macrurohelea* Ingram and Macfie by virtue of its wing with two well developed radial cells and the separate flagellomeres of the male antenna. *Bothahelea* differs from those two genera, however, in having only a single spermatheca, cylindrical fourth tarsomeres, and sensilla basiconica on the first antennal flagellomere.

Usually, the genera of the tribe Ceratopogonini possess sensilla coeloconica on the first flagellomere of the antenna. Instead of the typical sensilla coeloconica ringed by fringing setae, *Bothahelea* possesses sensilla basiconica similar to those of the pantropical genus *Nannohelea* Grogan and Wirth (1980). The sensilla basiconica in *Bothahelea* and *Nannohelea* are in the same position on the first flagellomere as the sensilla coeloconica in typical Ceratopogonini. Furthermore, in a recent paper dealing with antennal sensilla of ceratopogonids by Wirth and Navai (1978), they state: "sensilla coeloconica are peg organs sunken into depressions of the body wall. All gradations exist in the depth of the pit and the relative size of the central peg, so this type of organ grades imperceptibly into typical sens. basiconica." Because of this fact, we recognize *Bothahelea* and *Nannohelea* as examples of genera that have undergone just such a modification as described by Wirth and Navai. In our opinion, *Bothahelea* and *Nannohelea* belong to the tribe Ceratopogonini and represent genera in which the sensilla coeloconica have lost their surrounding ring of setae and the central peg has become elongated.

Etymology.—The generic name *Bothahelea* is an eponym in honor of our good friend and colleague Botha de Meillon in recognition of his outstanding contributions to our knowledge of South African Ceratopogonidae during the past 50 years.

Bothahelea phelpsi **Grogan and Wirth, New Species**

Fig. 1, 2a–d

Holotype female.—Wing length, 0.89 mm; breadth, 0.31 mm.

Head: Brown. Eyes (Fig. 1d) narrowly separated, pubescent. Antennal pedicel dark brown; flagellum (Fig. 1a) lighter brown; proximal 6 flagellomeres globose, distal 7 more elongate; 1st flagellomere with a single apical sensilla basiconica; all flagellomeres with a single whorl of sensilla chaetica; proximal 8 flagellomers with central whorl of sensilla trichodea; distal 5 flagellomeres with scattered sensilla basiconica; lengths of flagellomeres in proportion of 10-6-6-6-6-7-8-8-12-12-13-14-20; antennal ratio 1.24. Palpus (Fig. 1c) light brown; lengths of segments in proportion of 4-7-10-6-3; 3rd segment with moderately deep pit containing capitate sensilla; palpal ratio 2.0. Mandible (Fig. 1g) with 9–10 small coarse teeth on inner margin.

Thorax: Brown; scutellum with 3 bristles. Legs (Fig. 1e) light brown; femora

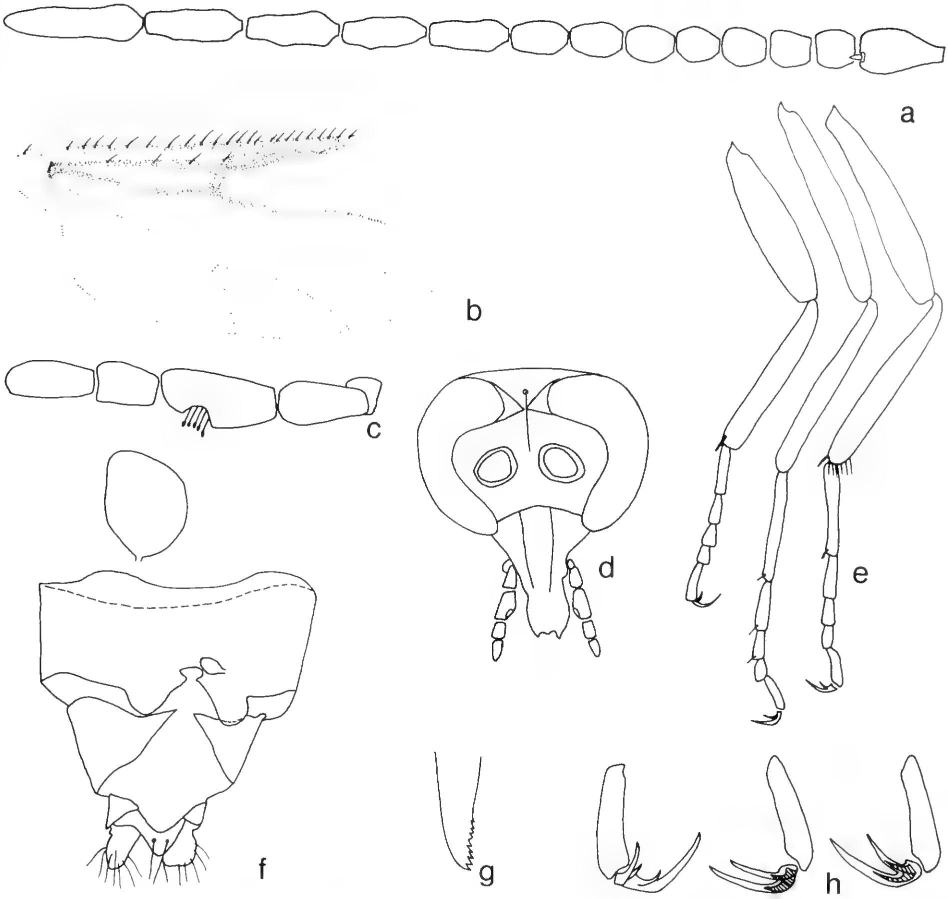

Fig. 1. *Bothahelea phelpsi,* female. a, Antenna. b, Wing. c, Palpus. d, Head, anterior view. e, Fore-, mid-, and hindlegs (left to right). f, genitalia. g, Mandible. h, Fifth tarsomeres and claws of fore-, mid-, and hindlegs (left to right).

and tibiae covered with sparse, scattered, rather stout setae; hindtibial comb with 8–9 large setae; tarsi pale, palisade setae present only on hindbasitarsus; 4th tarsomeres cylindrical; 5th tarsomeres (Fig. 1h) slender with moderately long subequal claws, each bearing a long basal inner tooth. Wing (Fig. 1b) rather broad with rounded tip, hyaline; covered with microtrichia, macrotrichia restricted to fringe and a few sparsely set on radial veins; 2 slender radial cells present, 2nd twice as long as 1st, radial veins rather thickened; media petiolate, forking at level intermediate between radial cells; mediocubital fork at level of r-m cross-vein; 2 very faint anal veins present; anal lobe well developed; costal ratio 0.67. Halter pale.

Abdomen: Light brown. Genitalia as in Fig. 1f. Eighth segment a complete ring as in *Brachypogon,* heavily sclerotized, sternal portion cleft posteriorly with short rounded extensions. Ninth sternum divided into 2 slender pointed arms. Tenth sternum with only a single pair of large setae. A single large spermatheca measuring 0.090 by 0.060 mm with large punctations and short neck. A small vestigial

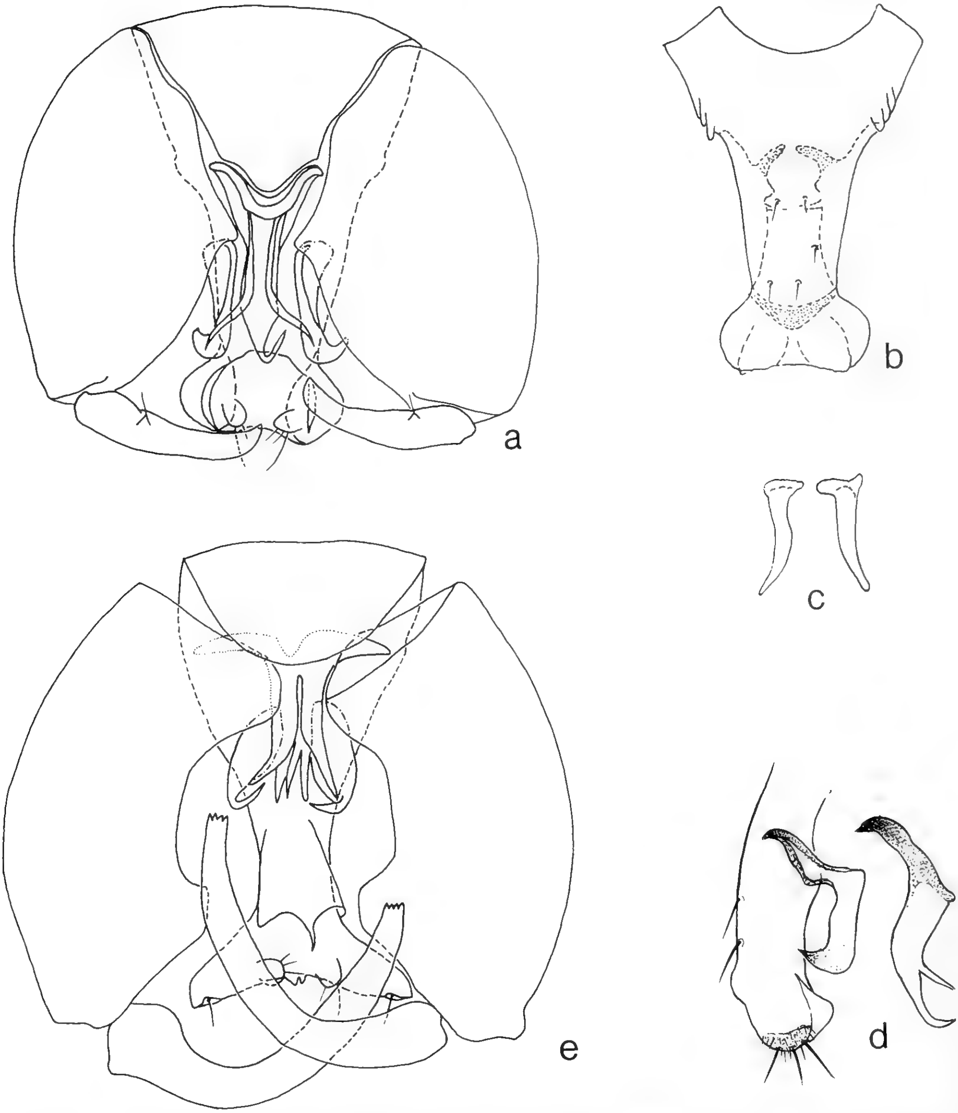

Fig. 2. *Bothahelea* spp., male genitalia. a–d, *B. phelpsi.* e, *B. gigantostyla.* a, e, Genitalia, ventral view. b, Ninth tergum, dorsal view. c, Claspettes, ventral view. d, Aedeagus, claspettes and distal portion of ninth tergum (left to right), side view.

spermatheca also present, measuring 0.020 mm long, with numerous large punctations.

Allotype male.—Wing length, 1.12 mm; breadth, 0.35 mm. Similar to female with following sexual differences: Flagellum with proximal 9 flagellomeres globose, distal 4 elongated; all flagellomeres separate, not fused; plume well-developed, moderately dense. Legs more bristly in appearance due to greater number of coarse setae; claws small, equal-sized, with bent bifid tips. Wing more slender, 2nd radial cell broader; costal ratio 0.61.

Genitalia (Fig. 2a–d): Ninth sternum 1.4× broader than long, base slightly curved; 9th tergum (Fig. 2b) tapering gradually distally to 0.75 of its length, then expanding to a broader clublike tip bearing short cerci and extending just beyond basimeres. Basimere 1.5× as long as broad, nearly straight; telomere about 1/2 length of basimere, tapering slightly distally to a broadly pointed tip. Aedeagus 1.6× longer than broad, basal arch very short, only 0.13 of total length; basal arm heavily sclerotized, slightly recurved; distal portion more lightly sclerotized, with 2 slender lateral subapical extensions and a single slender apical extension that bends under ventrally (Fig. 2d). Claspettes (Fig. 2c–d) separate, lightly sclerotized, consisting of slender arms with a broad tip recurved about 120°.

Distribution.—Zimbabwe; known only from the type-locality.

Types.—Holotype ♀, allotype ♂, Zimbabwe, Gokwe Area, i.1981, R.J. Phelps, truck trap (Type no. 72221, USNM). Paratypes 3 ♀, 21 ♂, same data as types (deposited in British Museum (Nat. Hist.). London; Museum National d'Histoire Naturelle, Paris; Natal Museum, Pietermaritzburg, South Africa; South African Institute of Medical Research, Johannesberg; and National Museum of Zimbabwe, Salisbury).

Discussion.—The species is named in honor of the collector, R. J. Phelps of the University of Zimbabwe in Salisbury, in appreciation of his continued interest in the collection and study of Afrotropical biting midges.

Bothahelea phelpsi is a smaller species than *B. gigantostyla*, the setae on the legs are more strongly developed, spinelike, and the two species differ in many features of the male genitalia, as can be seen by comparing the figures.

***Bothahelea gigantostyla* Grogan and Wirth, New Species**

Fig. 2e

Holotype male.—Wing length, 1.02 mm; breadth, 0.23 mm.

Head: Brown. Eyes narrowly separated, pubescent. Antennal pedicel dark brown; flagellum light brown; proximal 9 flagellomeres globose, distal 4 elongated; proximal 10 flagellomeres with moderately dense plume of long sensilla chaetica, flagellomeres 11 and 12 with sub-basal whorl; 1st flagellomere with a single apical sensilla basiconica; proximal 10 flagellomeres with subapical whorl of sensilla trichodea, distal 3 flagellomeres with a few scattered sensilla basiconica; lengths of flagellomeres in proportion of 22-10-9-8-8-8-8-8-9-11-16-19-23; antennal ratio (13–11/1–10) 0.57. Palpus light brown; lengths of segments in proportion of 4-7-11-6-9; 3rd segment with distinct subapical pit bearing capitate sensilla; palpal ratio 2.4.

Thorax: Dark brown; scutellum with 4 bristles. Legs brown, tibiae paler than femora: femora and tibiae with sparse scattered setae, much fewer in number and shorter than in males of *Bothahelea phelpsi*; hindtibial comb with 8–9 large setae; tarsi pale, palisade setae present only on hindbasitarsus; 4th tarsomeres cylindrical, 5th tarsomeres slender with small equal-sized claws with bent bifid tips. Wing very similar to that of *B. phelpsi* (Fig. 1b), except more slender and 2nd radial cell broader; costal ratio 0.62. Halter pale.

Abdomen: Dark brown. Genitalia (Fig. 2e) with 9th sternum nearly twice as broad as long, base slightly curved; 9th tergum tapering gradually distally then expanding to very broad winglike tip that extends to just below tip of basimeres and bears short cerci. Basimere nearly twice as long as broad, greatly curved with basal and distal mesal projections; telomere 0.67 length of basimere, greatly curved, tapering slightly distally to broad tip bearing 4–5 small points. Aedeagus about as long as broad, basal arch very short, only 0.2 of total length; basal arms heavily sclerotized, recurved 90°; distal portion also heavily sclerotized with 2 curving ventral apical processes and 3 straighter, more dorsal processes. Claspettes divided, lightly sclerotized, consisting of 2 broad straight pieces that taper into slender apical processes recurved ventrally.

Distribution.—Zimbabwe; known only from the type-locality.

Type.—Holotype ♂, Zimbabwe, Gokwe Area, i.1981, R. J. Phelps, truck trap (Type no. 72224, USNM).

Discussion.—The specific epithet *gigantostyla* is from the Greek—*gigas* (*giganto-*) (giant) and *stylos* (a pillar) in reference to the unusual large male genitalia of this species. The distinctive male genitalia are sufficient to distinguish this species from its only known congener, *B. phelpsi.*

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PROC. ENTOMOL. SOC. WASH.
85(2), 1983, pp. 205–211

HYDROPSYCHE BRUNNEIPENNIS, NEW SPECIES, A MEMBER OF THE *SCALARIS* GROUP, FROM THE POTOMAC RIVER NEAR WASHINGTON, D.C. (TRICHOPTERA: HYDROPSYCHIDAE)

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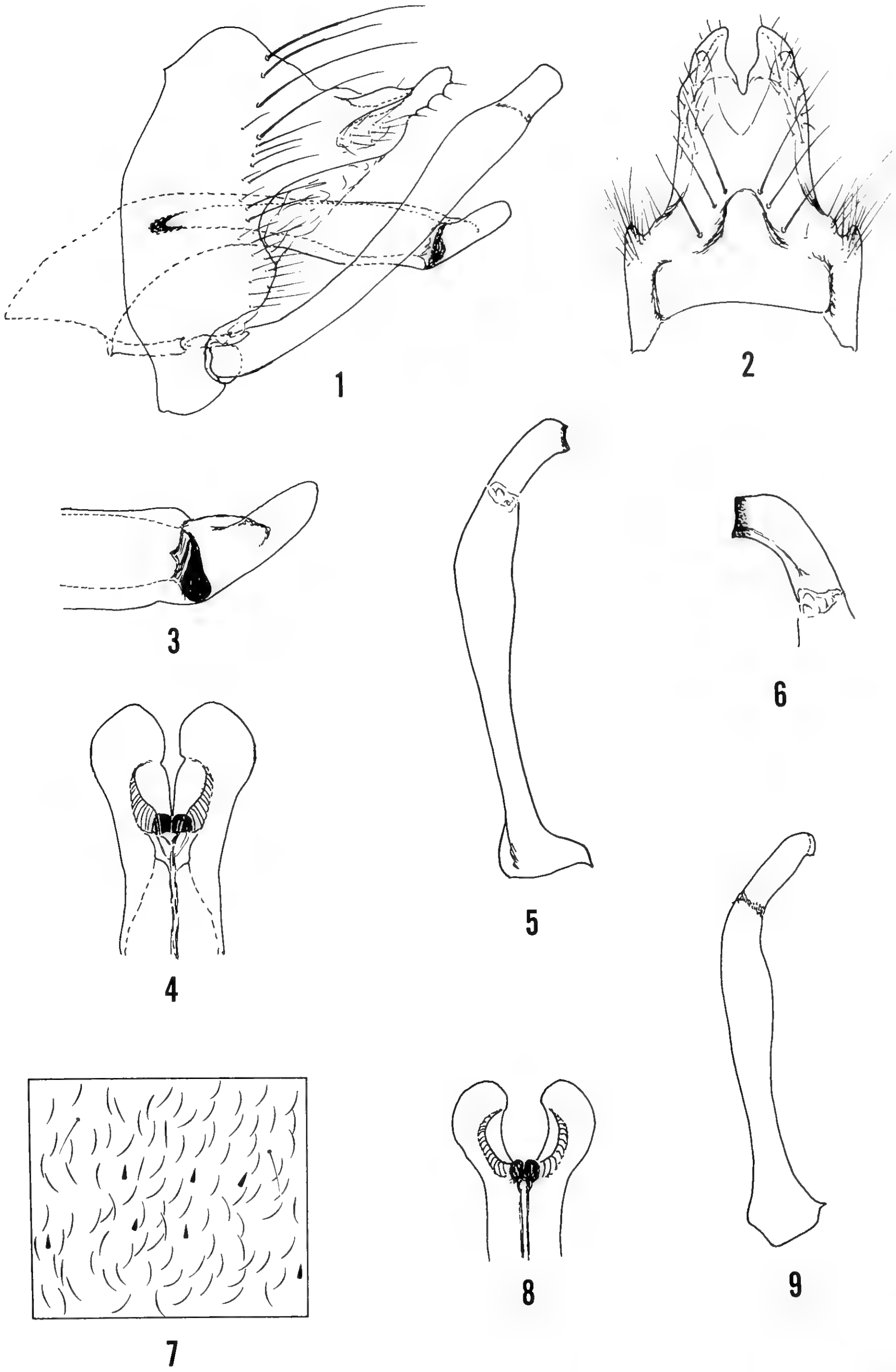
Abstract.—*Hydropsyche* ***brunneipennis***, n. sp., a newly discovered member of the *scalaris* group most closely related to *H. phalerata* Hagen and *H. aerata* Ross, is described from adult males and females and larvae. The larvae are commonly found on large rocks in fast water in the Potomac River above Washington, D.C. A list of associated species of Trichoptera and a summary of physico-chemical data are presented.

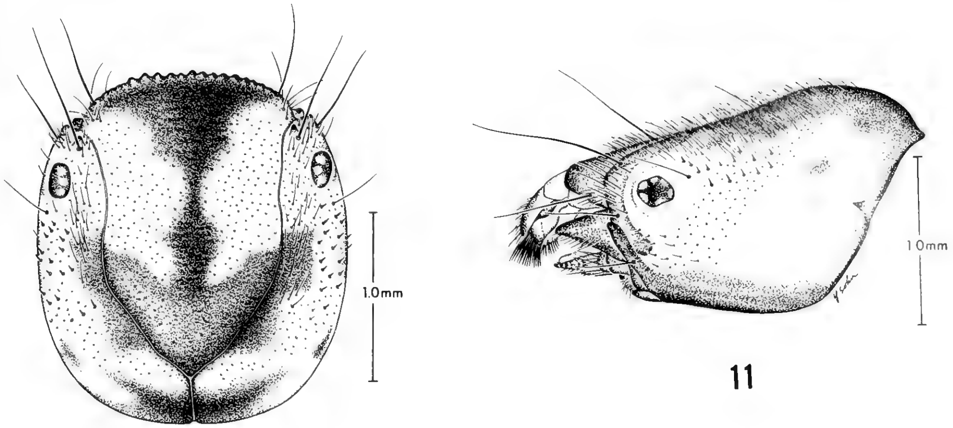
Despite recent (Flint et al., 1979) attempts to revise the *scalaris* group of *Hydropsyche* from the Mid-Atlantic states, new species are still being discovered. Surveys (by WLB) of the benthos of the Potomac River at several localities near Washington produced a distinctive larval form suggestive of *H. aerata* Ross or *H. phalerata* Hagen, but seemingly different from both. Fortunately male metamorphotypes were obtained and these were likewise suggestive of the aforementioned species, but seemed different. A search of the National Collection (by OSF) for adults of this form was unsuccessful, although there were many collections of *phalerata* made along the Potomac River in the early 1900's. Finally we visited the site at Carderock, Montgomery County, Maryland, with a portable ultraviolet light on a warm August evening. Shortly after dark when we turned on the light we were inundated by swarms of caddisflies, including many species of *Hydropsyche.* One species was quickly distinguished because of its distinctive pale brown color, exceedingly long antennae, and rather small size. The following day this species, when examined under the microscope, was found to have genitalia matching those of the male metamorphotypes.

The species was clearly different from *phalerata,* with which it coexists at most of these sites. *Hydropsyche aerata* with its large, bulging eyes in the male seemed to be quite different, as was soon confirmed upon receipt of borrowed topotypes. It was clear that one of the present-day, common, species of *Hydropsyche* near Washington was without a name!

The adult and larva are described, and ecological notes are given for the type-locality. The posterior aspect of the clasper and the ventral aspect of the tip of the phallus of *aerata* are also figured (Figs. 8–9) for comparison, as there is no illustration of the former and the original figure of the latter is a bit inaccurate.



Figs. 1–9. 1–7, *Hydropsyche brunneipennis.* 1, Male genitalia, lateral. 2, Ninth and tenth terga, dorsal. 3, Tip of phallus, lateral. 4, Tip of phallus, ventral. 5, Clasper, posterior. 6, Tip of clasper, dorsal. 7, Portion of cuticle of seventh abdominal tergum of larva, showing types of setae, dorsal. 8, 9, *H. aerata.* 8, Tip of phallus, ventral. 9, Clasper, posterior.



10

11

Figs. 10, 11. *Hydropsyche brunneipennis,* larval head. 10, Dorsal aspect, small hairs removed dorsomesally to better show color. 11, Lateral aspect, with hairs.

Hydropsyche brunneipennis Flint and Butler, New Species

Figs. 1–7, 10, 11

This, the third species of the *Phalerata* subgroup, is probably most closely related to *aerata,* and more distantly to *phalerata* with which it coexists. *Hydropsyche phalerata* differs primarily in having the tip of the clasper produced into a sharp point (see, for example, Flint et al., 1979, figs. 2 or 8), the lateral plates of the phallus are much shorter, approximate on the midline and lacking the small notch. From *aerata, brunneipennis* is immediately distinguished by having small eyes (see Ross 1944, fig. 392 for eyes of *aerata*), and in having longer lateral plates of the phallus which are not so widely separated on the midline nor so evenly concave here. There do not seem to be any discernable differences in the female genitalia of *phalerata* and *brunneipennis.*

Adult.—Length of forewing, ♂ 8 mm, ♀ 7 mm. Color pale brown; head and thorax infuscate, appendages pale brown; forewing of ♂ light brown with a few slightly darker areas, of ♀ darker grayish brown, with several small light spots and 2 large pale spots on anal margin. Antenna of ♂ very long, about 1½ as long as forewing; eyes of a ♂ small, in frontal aspect about ½ that of interocular distance. Male genitalia: 9th segment with anterior margin nearly vertical; with a low dorsomesal crest. Tenth tergum produced into elongate apicolateral lobes, widely divided apicomesally in dorsal aspect. Clasper with basal segment long, slender, and straight; apical segment short, about ⅕ length of basal segment in posterior aspect, tip darkened and truncate in all aspects. Phallus tubular, phallobase slightly enlarged apicad; lateral plate in lateral aspect sharply upturned, extending well above dorsum of phallus, in ventral aspect with mesal cavity shallow, widest basally, widely open posteriad, mesal margins of plates not touching on midline, with a distinct notch at apex of mesal cavity. Female genitalia: Clasper groove not well marked, not produced into a clasper receptacle; in dorsal aspect groove shallow, narrowest anteriorly.

Table 1. Trichoptera larvae collected by surber sampler in the Potomac River. Each figure represents the total number of specimens of the taxon from 9 surber samples, 3 taken on the Maryland side of the river, 3 taken near the middle of the river, and 3 taken at the Virginia side of the river. Data extracted from Miller et al. (1981, appendix B).

Taxa	Little Falls 20-VIII-80	Carderock 20-VIII-80	Seneca 14-VIII-80
Brachycentridae			
Micrasema sp.	1		
Glossosomatidae			
Protoptila sp.		2	
Hydropsychidae			
Cheumatopsyche spp.	291	269	769
Hydropsyche betteni Ross		1	
H. brunneipennis, n. sp.	93	845	144
H. dicantha Ross	63	5	100
H. hageni Banks	90	130	69
H. hoffmani Ross	73	187	89
H. leonardi Ross	67	37	
H. phalerata Hagen	241	390	483
H. scalaris Hagen	3	12	10
Potamyia flava (Hagen)	32	74	69
Macrostemum sp.	913	835	634
Hydroptilidae			
Hydroptila spatulata Morton	1		1
H. waubesiana Betten	4	1	
Leucotrichia pictipes (Banks)	8		
Leptoceridae			
Ceraclea spongillovorax Resh	1		11
Ceraclea sp.			2
Nectopsyche pavida (Hagen)		1	
Oecetis cinerascens (Hagen)	3		
Polycentropodidae			
Cyrnellus fraternus (Banks)	3		
Neureclipsis sp.	4	2	
Psychomyiidae			
Psychomyia flavida Hagen	1		

Larva.—Length to 8 mm, width 1.5 mm. Head yellow with fuscous pattern on dorsum, in the approximate form of a cross with a broad transverse arm, longitudinal arm expanded anteriad to cover anterior margin of frontoclypeus, posterior margin infuscate dorsally; venter fuscous. Head with scattered short, light brown, spinelike setae mostly posteriad to eye; dorsum covered densely with long, thin setae. Anterior margin of frontoclypeus convex, evenly serrate. Labrum yellow basally, infuscate apically and at posterolateral angles; with dense brushes of hair anterolaterally. Mandibles dark castaneous. Thoracic nota yellow, with fuscous lateral and posterior marks. Pronotum with scattered, short, light brown, spinelike setae, and small decumbent pale setae; anteromesally with an area of long, thin setae. Meso- and metanota with many dark, small decumbent setae. Legs yellow;

Table 2. Diversity of macrobenthos in Potomac River. Same comments and source as for Table 1. Diversity indices computed using the Shannon-Weaver Function.

Category	Little Falls 20-VIII-80	Carderock 20-VIII-80	Seneca 14-VIII-80
Total no. of organisms	3127	4523	4164
Total no. of taxa			
Generic level	47	44	46
Specific level	58	56	56
Diversity index			
Ordinal level	2.06	1.82	2.02
Generic level	3.46	3.28	3.62
Specific level	3.99	3.98	4.10

most setae concolorous, forefemur with a patch of fuscous setae ventromesally. Prosternum yellow anteriorly, fuscous posteriorly. Abdomen white, with numerous, short, dark, decumbent setae; segments 1–5 with many small spinules; a few, scattered, erect scale hairs from segment 5 posteriad. Ventral sclerites of segment 8 with black setae; sclerites of segment 9 with many, short, brown, spinelike setae and a fringe of black setae apically. Anal prolegs yellow with dark setae, except for brown, spinelike setae lateroventrally.

Material.—Holotype, ♂: USA, Maryland, Montgomery Co., Potomac River at Carderock, 27 Aug. 1981, Flint and Butler. USNM Type 100221. Paratypes: Same data, 151 ♂, 128 ♀; same, but 21 Sep. 1981, Flint and Bueno, 2 ♂, 42 ♀. Tennessee, Claiborne Co., Powell River at Buchanan Ford, 30 Jun. 1982, J. Louton et al., 1 ♂ (UTK). West Virginia, Pocohontas Co., Greenbrier River, 5 mi. north Marlinton, 29 Jun. 1982, Flint and Mathis, 2 ♂, 5 ♀.

Biology.—The immature stages have been taken in three extensive rapids upstream of Washington. The first was at Little Falls (River Mile 117.6), 0.8 miles below the water diversion dam, the second at Carderock (River Mile 122.9) in front of the Picnic Area, and the third at Seneca (River Mile 134.2) at the end of Violets Lock Road.

The Little Falls transect produced a total of 58 taxa of benthic macroinvertebrates (Table 2), with the caddisflies (19 taxa) representing 60.5% of the total number of organisms collected. *Macrostemum* sp. (probably *zebratum* (Hagen)) was the dominant caddisfly (Table 1), with *Hydropsyche brunneipennis* ranking fifth in abundance with about one-tenth the numbers of *Macrostemum*. At Carderock, 56 taxa were taken with the caddisflies (15 taxa) again dominating the assemblage at 61.7% of the numbers. Here the larvae of *brunneipennis* were the most numerous taxon, but barely surpassing those of *Macrostemum* sp. At Seneca, where there were 56 taxa collected and the caddisflies (12 taxa) still dominated with 57% of the total numbers, *brunneipennis* had dropped back in relative abundance to fourth place at about one-fifth the abundance of the dominant *Cheumatopsyche* spp. larvae. In summary the species here described is a common or even dominant one in the riffle areas of the Potomac River where it crosses the Piedmont.

The physico-chemical data presented in Table 3 indicate that the Potomac

Table 3. Summary of water quality data for Little Falls on the Potomac River, 1974–1980. Data generated by State of Maryland, Office of Environmental Programs.

Parameter	Number of samples	Maximum	Minimum	Average
Temperature (°C)	81	32.	1.7	17.7
Flow (CFS)	70	53,700	700	12,382
Hydrogen ion (pH)	81	9.9	7.3	8.2
Conductivity (μmho/cm)	86	456	110	259
Dissolved solids (mg/l)	71	1272	68	182
Suspended solids (mg/l)	76	270	1	36
Turbidity (FTU)	77	108	1.6	19.6
Dissolved oxygen (mg/l)	85	14.4	5.9	10.0
Chemical oxygen demand (mg/l)	20	30.8	2.03	10.4
Total organic carbon (mg/l)	77	37	.09	11.9
Total chlorophyll-*a* (μg/l)	78	202.5	.15	36.5
Active chlorophyll-*a* (μg/l)	44	114.9	1.07	25.15
Total hardness (mg/l $CaCO_3$)	20	167	64	105
Total acidity (mg/l $CaCO_3$)	19	30.0	1.0	9.1
Total alkalinity (mg/l $CaCO_3$)	28	148	49	77
Total Kjeldahl N (mg/l N)	74	1.00	.12	.43
Organic nitrogen (mg/l N)	78	.97	.06	.39
Ammonia nitrogen (mg/l N)	75	.25	.01	.04
Nitrite N (mg/l N)	74	.031	.002	.010
Nitrate N (mg/l N)	74	3.03	.02	.82
Total phosphorus (mg/l P)	80	.41	.02	.08
Ortho phosphate (mg/l P)	80	.18	.01	.04
Sulfate (mg/l SO_4)	28	66	0.5	29
Total Fe (mg/l)	20	.85	.05	.21

River at Little Falls is a large, warm water stream of moderate hardness with a reasonably good water quality. Mason et al. (1975) summarized the physicochemical data for the years 1962–1973 and concluded that the water quality of this section of the river was good. Certain parameters, most notably dissolved oxygen, indicate that water quality improved during the period 1974–1980. Between 1962–1973 the dissolved oxygen concentrations went as low as 3 mg/l, but between 1974–1980 the concentration never dropped as low as the 5 mg/l lower limit for good fisheries. Although the averages are good in general, the ranges for some parameters suggest periodic water quality problems resulting from human activities. The pH may exceed the upper limit (pH 9) for adequate protection of aquatic life. Likewise the total suspended solids sometime exceed the upper limit of 80 mg/l for moderate protection of aquatic life, and, as pointed out by Miller et al. (1981), the actual maxima (unsampled) probably exceed these readings several fold. The average values of total phosphorus, nitrate nitrogen and total chlorophyll *a* all approach or exceed the levels classified as eutrophic (Mason et al., 1975).

The sampling sites can be characterized as being erosional areas of turbulent, rapid flow with substrates of bedrock and coarse sediments such as cobbles and boulders. The larvae are generally found on large boulders or bedrock in the fastest flows of the river, where their nets may form rows along a suitable niche. The generally favorable water quality and substrate is mirrored in the specific diversity index levels of the benthic macroinverebrates (Table 2) of 3.98 (Carderock), 3.99 (Little Falls), and 4.10 (Seneca).

ACKNOWLEDGMENTS

We acknowledge the help of J. Reese Voshell, Jr. for his aid in the analysis of the physico-chemical data. The male paratype from Tennessee was sent by D. A. Etnier, Department of Zoology, University of Tennessee, Knoxville (UKT), to whose collection it has been returned. Young T. Sohn of the Department of Entomology, Smithsonian Institution, produced the excellent figures (Figs. 8, 10, 11) of the larva of *brunneipennis.*

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85(2), 1983, pp. 212–216

TWO NEW SPECIES OF *GILPINIA* (HYMENOPTERA: DIPRIONIDAE) FEEDING ON *PINUS KESIYA* IN THAILAND

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Abstract.—*Gilpinia* **leksawasdii**, n. sp., and *G.* **paitooni**, n. sp., are described. Larvae of both species feed on *Pinus kesiya* in Thailand. Both are differentiated from other Diprionidae known from Thailand, and *G. leksawasdii* is distinguished from *G. socia* (Klug), a European species with which it has close affinities.

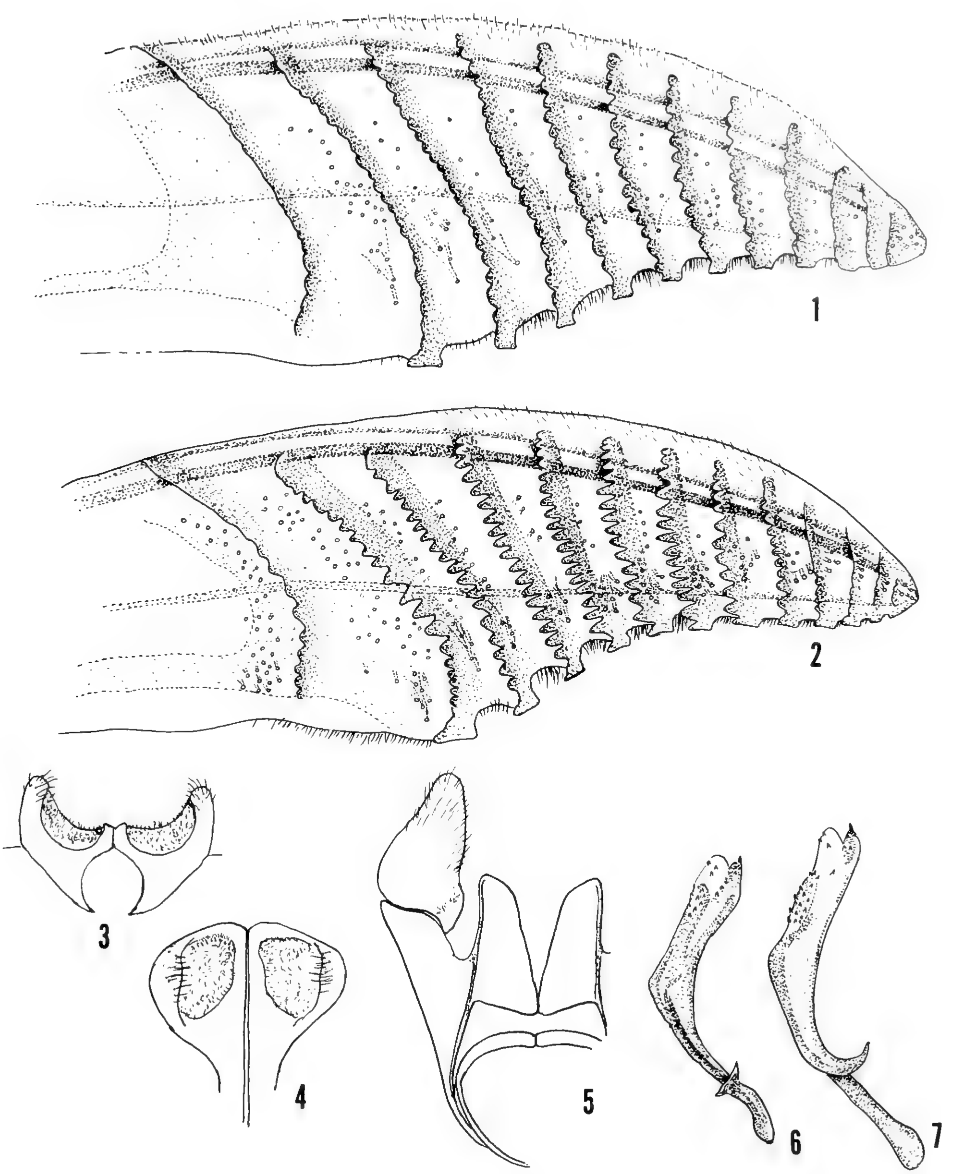
Three species of Diprionidae have been reported from Thailand: *Gilpinia marshalli* (Forsius) and *Nesodiprion biremis* (Konow) (Smith, 1974), and *Diprion hutacharernae* Smith (Smith, 1979). All feed on *Pinus* spp. Two additional species of *Gilpinia,* reared from *Pinus kesiya* Royle ex Gordon, are described here. The specimens were sent to me by Mr. Paitoon Leksawasdi, Biology Department, Faculty of Science, Chiang Mai University, Chiang Mai, Thailand.

Gilpinia leksawasdii Smith, NEW SPECIES

Figs. 1, 3–6

Female.—Length, 7.0–7.5 mm. Orange brown with following black: Antenna (except 1st segment); interocellar area; mesonotum (except lateral margins of lateral lobes and anterior half or most of scutellum in some specimens, and lateral margins of prescutum); sometimes narrow anterior margin of pronotum and mesal margin of cervical sclerite; and basal plates (except lateral margins). Extreme apices of femora and most of tibiae whitish. Wings hyaline; costa amber, remaining veins and stigma blackish.

Antenna serrate, 18–19 segmented, ⅔ width of head, rami of segments 5–13 equal to width of respective segments. Clypeus subtruncate; malar space 2× diameter of an ocellus and equal to ⅔ distance between antennae; postocellar area 1¾× broader than long; ratio of distances between hindocellus and eye, between hindocelli, and between hindocellus and posterior margin of head: 1.0:0.7:0.8. Width of cenchrus 2× distance between cenchri and 2× length of metascutellum. Head and thorax (except mesoscutellum and metascutellum) shining, with widely spaced punctures, distance between punctures more than twice diameter of one; mesoscutellum and metascutellum more densely punctate, distance between punctures equal to or little more than diameter of one and surface with fine microsculpture. Abdomen with fine transverse microsculpture. Hairs on dorsum of head and thorax shorter than diameter of an ocellus. Hindtibial spurs simple. Sheath (Figs. 3, 4) with slender protruding scopae. Lancet (Fig. 1) with 12 annuli; annular spines short; serrulae on segments 2–7 or 8 protruding, rectangular, each truncate at apex.



Figs. 1–7. 1, 3–6, *Gilpinia leksawasdii*. 2, 7, *G. socia*. 1, 2, Female ovipositors. 3, Female sheath, dorsal. 4, Female sheath, posterior. 5, Genital capsule, ventral. 6, 7, Penis valves, lateral.

Male.—Length, 5.0–5.3 mm. Black with following orange brown: Palpi; lateral downturned portions of terga; sterna; and legs beyond 1st or 2nd trochanteral segments. Extreme apex of each coxa may be orange brown; extreme apices of femora and most of tibiae usually whitish. Antenna pectinate, 20–21 segmented; rami on segments 3 to apex, ramus of 6th segment equal to about ⅔ length of antenna. Ratio of distances between hindocellus and eye, between hindocelli, and between hindocellus and posterior margin of head: 1.0:0.8:0.5. Genitalia as in Figs. 5, 6. Other features as for female.

Types.—Holotype ♀, 10 ♀ and 7 ♂ paratypes from a cultivated pine plantation, Ampur Hod, Chiang Mai, Thailand, September 1981, reared from larvae feeding on *Pinus kesiya*; collected by Paitoon Leksawasdi. Holotype and paratypes in the National Museum of Natural History, Smithsonian Institution, Washington, D.C.

Discussion.—*Gilpinia leksawasdii* belongs in the group of *Gilpinia* that have simple hindtibial spurs in the female. The general appearance of the female sheath and ovipositor and male genitalia is similar to that of *G. socia* (Klug), which is found in Europe (one record from Krasnoyarsk, USSR; Gussakovskij, 1947). However, *G. socia* is much larger (female 8.0–9.5 mm and male 7.0–8.0 mm in length), and it is separated from *G. leksawasdii* by the following additional characters: Female antenna about equal to head width; ramus of sixth segment of the male antenna equal to about half the antennal length; ratio of distances between hindocellus and eye, between hindocelli, and between hindocellus and posterior margin of head: 1.0:1.0:0.8; hairs on dorsum of head and thorax dense and long, as long or longer than diameter of an ocellus; punctures on mesopleuron dense, about as close together as diameter of one; mesoprescutum (except center), mesoscutellum, and basal plates (except center) orange brown; mesosternum black; female ovipositor more concave beneath and annular spines longer (compare Figs. 1, 2); and penis valve of slightly different shape (compare Figs. 6, 7).

Gilpinia leksawasdii can be separated from other Diprionidae in Thailand by the slender, protruding scopae of the female sheath, the triangular lancet with the long, truncated serrulae, and the slender penis valve of the male genitalia. The differences in these characters can be seen by comparing figures of the other species (Smith, 1974, 1979) with the figures of *leksawasdii* in this paper. Also, there are the following color differences in the other Thailand Diprionidae: in *Gilpinia marshalli,* the female has a large black area on top of the head and a black mesosternum and the male has a yellow-white pronotum and clypeus; in *Diprion hutacharernae,* the female head (except clypeus), abdomen, thorax (except pronotum and mesoscutellum), and most of the legs are black and the male is black with only the tibiae and tarsi white; in *Nesodiprion biremis,* both sexes are mostly black with whitish tibiae and tarsi and some lateral white spots on the abdomen of the female, and the female antenna has long rami, three or more times the length of their respective segment.

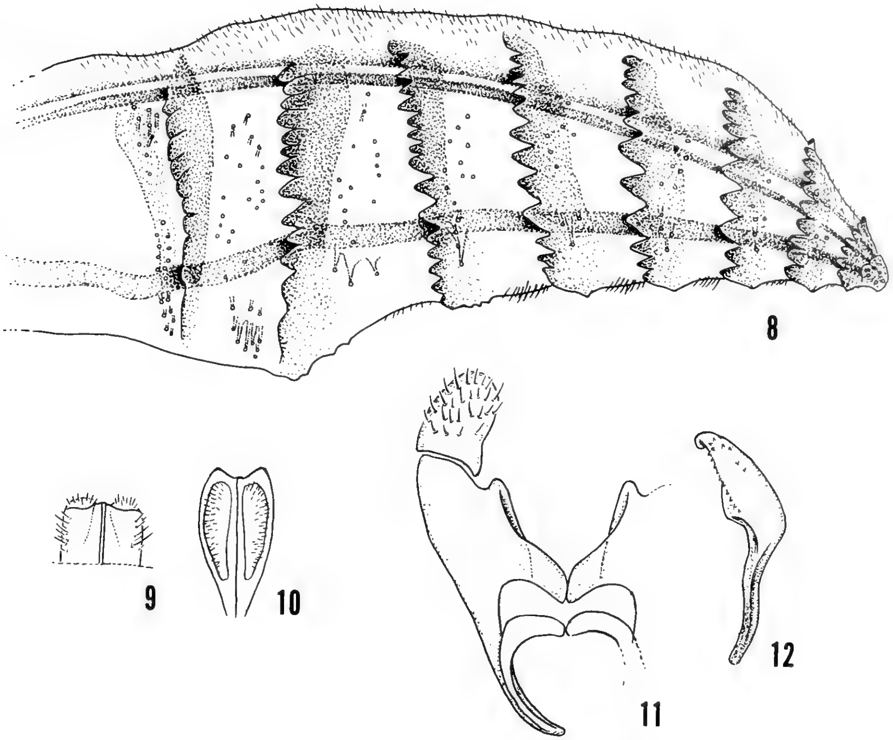
The species is named for the collector, Mr. Paitoon Leksawasdi.

Gilpinia paitooni **Smith, New Species**

Figs. 8–12

Female.—Length, 7.8–8.4 mm. Antenna black, segments 1 and 2 orange brown. Head and body orange to orange brown; mandible dark reddish; margins of ocelli, sutures of mesonotum, and narrow inner margins of lateral lobes of mesonotum black; basal ⅓ of tibiae whitish; abdomen paler orange than head and thorax. Wings hyaline; costa and subcosta light brown, stigma and other veins dark brown to black.

Antenna serrate, 17–18 segmented, 1⅙× head with, rami of segments 5–12 equal to width of respective segments. Clypeus subtruncate; malar space 2× diameter of an ocellus and equal to distance between antennae; postocellar area 2× broader than long; ratio of distances between hindocellus and eye, between hin-



Figs. 8–12. *Gilpinia paitooni.* 8. Female ovipositor. 9, Female sheath, dorsal. 10, Female sheath, posterior. 11, Male genital capsule, ventral. 12, Male penis valve, lateral.

docelli, and between hindocellus and posterior margin of head: 1.0:0.9:0.6. Width of cenchrus 1½× distance between cenchri and almost 2× length of metascutellum. Head and thorax shining between punctures, distance between punctures more than twice diameter of one; paraantennal fields, mesoscutellum, metascutellum, and mesopleuron more densely punctate with distance between punctures equal to or less than diameter of one. Basal plates coarsely reticulate; abdominal dorsum with fine transverse microsculpture, laterally and ventrally with widely spaced punctures farther apart than 2× diameter of one. Hairs on dorsum of head and thorax shorter than diameter of an ocellus. Hindtibial spurs simple. Sheath (Figs. 9, 10) without protruding scopae, scopae stout. Lancet (Fig. 8) with 9 annuli; annuli 2 and 3 divergent; serrulae low, rounded, serrula of 2nd annulus protruding ventrally.

Male.—Length, 5.5–6.0 mm. Black; palpi white; mandible dark reddish; venter of abdomen and legs beyond trochanters dark orange. Antenna pectinate, 21–22 segmented with rami on segments 3 to apex, ramus of 6th segment equal to about $^{3}/_{5}$ length of antenna. Ratio of distances between hindocellus and eye, between hindocelli, and between hindocellus and posterior margin of head: 1.0:1.0:0.5. Genitalia as in Figs. 11, 12. Other features as for female.

Types.—Holotype ♀, 12 ♀ and 4 ♂ paratypes from Pui Mountain, Chiang Mai, Thailand, December 1981, reared from *Pinus kesiya* by Paitoon Leksawasdi. Holotypes and paratypes in the National Museum of Natural History, Smithsonian Institution, Washington, D.C.

Discussion.—The simple hindtibial spurs, almost entirely orange coloration, characters of the lancet (especially the protruding first serrula and low rounded serrulae), and male genitalia identify this species. I know of no other species of *Gilpinia* with which *paitooni* can be confused. *Gilpinia marshalli* is also pale in color, but it is more yellowish and has more black markings on the head, thorax, and legs; in addition the genitalia (see figures in Smith, 1974) are very different.

The species is named for the collector.

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A NEW SPECIES OF *DICTYA* FROM IDAHO (DIPTERA: SCIOMYZIDAE)

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Abstract.—A new species, *Dictya* ***zacki***, is described from Latah County, Idaho. The terminalia of this species shows similarities with *D. hudsonica* Steyskal, *D. lobifera* Curran, *D. pechumani* Valley, and *D. stricta* Steyskal. Illustrations of the new species are included.

The genus *Dictya* is widespread on the North American continent. Twenty-five species are now known to occur north of Mexico, while eight species occur in Mexico, three in Central America, and one in South America. Distributional overlap between countries does occur among certain of these species. The southernmost species, *D. bergi* Valley, has been recorded from Costa Rica and Colombia. *Dictya insularis* Steyskal is known only from Puerto Rico. *Dictya pechumani* Valley is the only species found in Bermuda and the Bahama Islands, and it is also found along the east and gulf coasts of the United States. *Dictya umbrarum* (Linnaeus) is the only recognized Palaearctic species. The above species, 32 in all, constitute the known species of *Dictya* of the world. In addition, several more New World species are recognized by Karl Valley, Pennsylvania Department of Agriculture, Harrisburg, Pennsylvania, and await description.

The first comprehensive taxonomic work on *Dictya* was written by Steyskal (1954). A second in-depth work was by Valley and Berg (1977). Foote (1961) gave distribution and taxonomic notes on the sciomyzids of Idaho. The species of *Dictya* he listed from that state were: *D. expansa* Steyskal, *D. montana* Steyskal, and *D. stricta* Steyskal. Examination of Foote's *D. stricta* material reveals that those specimens must now be assigned to *D. hudsonica* Steyskal. No additional species are known from Idaho. In our correspondence with Karl Valley in 1976, he stated "*Dictya hudsonica* and *D. stricta* have been misidentified and distribution records are not always accurate. These 2 species are largely allopatric, *hudsonica* occurring almost exclusively north of 40° North Latitude and *stricta* occurring most commonly south of 40° North Latitude." Further, all known collecting sites of *D. stricta* are east of 100° longitude.

Dictya is characterized as follows: propleural bristle absent, anal vein clearly reaching wing margin, vallar bristles absent, ocellar and postocellar bristles well developed, wing heavily patterned with black and whitish translucent spots or markings on a grayish background, one parafrontal bristle, and face with a central dark spot. Within the genus, species separation is extremely difficult because of the similarity in external morphology. In most instances determinations can be

Fig. 1. *Dictya zacki,* holotype male. Abdominal segments excised and retained in genitalia vial on pin beneath specimen. Photo by M. E. Badgley, University of California, Riverside.

made only by examination of the genitalia. Written descriptions of genitalia cannot adequately impart comparative differences between closely related species. Therefore illustrations by Steyskal (1954, 1960), Fisher and Orth (1969), and Valley and Berg (1977) should be consulted in order to diagnose, accurately, these differences. In many species, females also possess terminalia characters by which they can be separated.

Dictya zacki **Orth and Fisher New Species**

Figs. 1–4

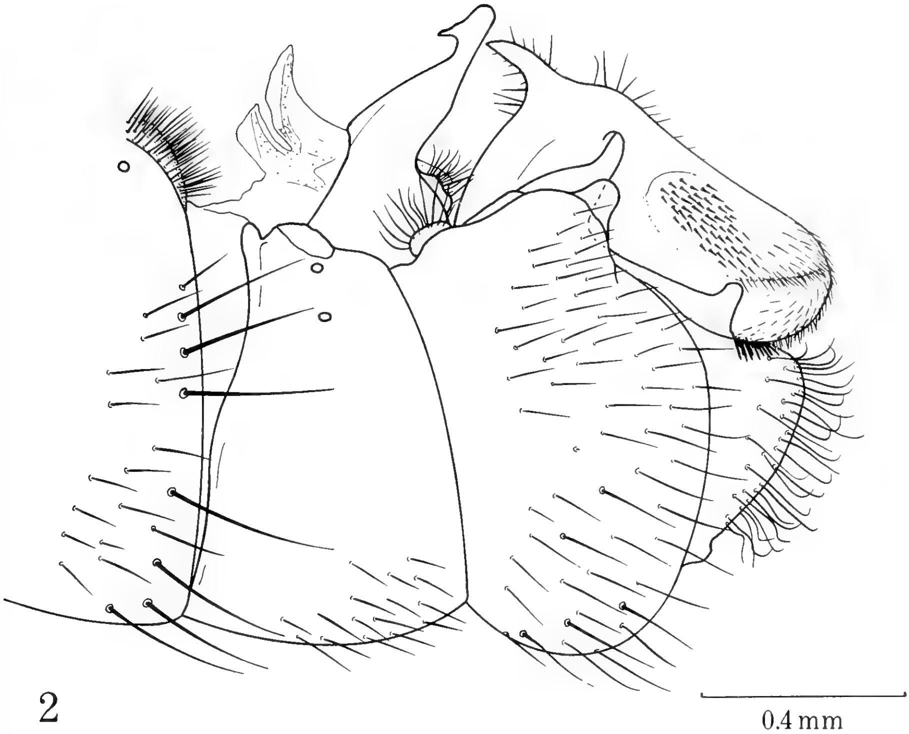
Holotype male.—*Head:* Face white with black, elongate central spot; parafrontal spot brownish; 2nd antennal segment wholly pruinose, as long as high; arista with sparse black hairs.

Thorax: Mesopleuron and pteropleuron each with a strong bristle; prosternum without hairs. Wing length 4.85 mm.

Genitalia: Surstylus with dorsal tip strongly projecting. Ventral process of hypandrium with preterminal lobe sharply pointed, directed moderately anterolaterally. Distal end of hypandrium rounded; ventral processes parallel. Ventral process of epandrium with posterior lobe large, rounded, directed posteroventrally; anterior lobe small, flattened.

Female.—Not known.

Diagnosis.—Species whose terminalia most closely resemble *Dictya zacki* are *D. hudsonica, D. stricta,* and *D. lobifera* Curran. In these species the distal end of the ventral process of the hypandrium is pointed and the preterminal lobe is directed straight forward. However, in *D. zacki* the distal end of the hypandrium



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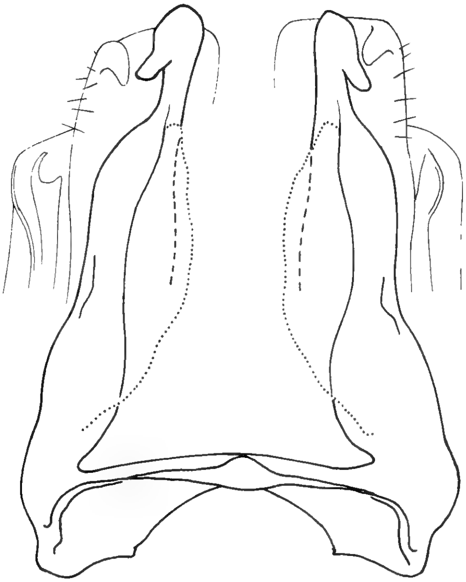

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Figs. 2–4. *Dictya zacki,* holotype male. 2, Postabdomen, lateral view, inverted. 3, Hypandrium, lateral view, inverted. 4, Hypandrium, anterior view, inverted.

is blunted or rounded while the preterminal lobe is directed anterolaterally. The ventral process of the hypandrium of *D. pechumani* also closely resembles that of *D. zacki.* Differences in these two species lie in the surstyli. In *Dictya pechumani* the surstylus has a small, non-projecting dorsal tip, and in *D. zacki* the surstylus has a strongly projecting dorsal tip.

Holotype male.—Idaho: Latah Co., Laird Park, 4mi NE Harvard, VII-16-1978, R. S. Zack, Washington State University. Deposited in the National Museum of Natural History, Washington, D.C.

Etymology.—This species is named after Richard S. Zack, Entomology Department, Washington State University, Pullman, who collected the type-specimen.

Notes.—During the summer of 1981 the senior author had the opportunity to visit the type-locality with R. S. Zack in an effort to collect additional specimens of this new species. Unfortunately the only species of *Dictya* collected at the type-locality was *Dictya montana.* Prior and subsequent collections by R. S. Zack have yielded no further specimens of *D. zacki.*

The type-locality is a small ponded area, roughly hourglass in shape, on a canyon floor bounded by well-forested slopes in the Idaho Panhandle National Forest. The type-specimen was collected by sweep net in *Typha* growing in the isthmus connecting the two main pond areas. There is a slight flow of water through the length of the ponded area. At the lower end it seeps back into an active stream which parallels the ponds but is separated from them by a low broad hummock.

Discussion.—The type-specimen was collected prior to the volcanic eruption of Mt. St. Helens, Washington, May 18, 1980, an event of cataclysmic proportions. The explosion tore an area 1350 feet (411 m) in height from the bulging north face of the mountain. Smoke and ash ascended 60,000 feet (18,288 m) and prevailing winds spread ash over parts of three states. The type-locality of *Dictya zacki* was hard hit by the fine, grey powder ash fallout. It is possible that this rare species will not be seen again due to this upset in nature. It has been observed by us that sciomyzids collected in the field with a cross section of other insects are among the first to die when held in a cage or container, indicating the frailty of some to adverse conditions.

ACKNOWLEDGMENTS

We gratefully acknowledge the assistance of Clifford O. Berg, Cornell University, Ithaca, New York; Benjamin A. Foote, Kent State University, Kent, Ohio; Lloyd Knutson, IIBIII, USDA, Beltsville, Maryland; George C. Steyskal, Systematic Entomology Laboratory, USDA, c/o National Museum of Natural History, Washington, D.C.; Karl Valley, Pennsylvania Department of Agriculture, Harrisburg, and Richard S. Zack, Washington State University, Pullman.

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NOTE

Variation in Chaetotaxy in *Cynomyopsis cadaverina* (Robineau-Desvoidy) (Diptera: Calliphoridae)

Variation in chaetotaxy of muscoid flies has received considerable attention in the past. Hough (1899. Zool. Bul. 2: 283–290) reported that 18% of the *Cynomyopsis cadaverina* (Robineau-Desvoidy) he examined showed some sort of chaetotaxal variation. Most of the variant specimens he examined showed unilateral presence or absence of a macrochaeta with only a very few exhibiting bilateral variation. Hall (1948. Thomas Say Found. Vol. 4, 477 pp.) commented that in a number of reared blow fly specimens obtained from several sources in the United States, reduction and duplication of bristles occurred in the dorsocentral or acrostichal series in less than 5% of the individuals. James (1967. Ann. Entomol. Soc. Am. 60: 706) discussed variation in chaetotaxy in another blow fly, *Phaenicia sericata* (Meigen). He described a series of 22 individuals with a decreased number of postacrostichal bristles. Hall and Townsend (1977. Va. Polytech. Inst. State Univ. Res. Div. Bull. 123, 48 pp.) also reported a number of blow flies with a reduced number of postacrostichals most often occurring unilaterally.

In a study of Mississippi blow flies, several specimens of *C. cadaverina* were found with variant chaetotaxy. A total of five out of 78 carefully examined specimens were found to vary in the number of postacrostichal bristles from the normal two pairs. Four specimens were found with only one pair of postacrostichals and one had three pairs. Often, large individuals of a species have more strongly developed bristles than do small individuals of the same species. Likewise, weak bristles tend to become hairlike and may be overlooked unless searched for carefully. However, in this study the variant specimens are all essentially normal sized.

Available blow fly keys separate *C. cadaverina* from other related Caliphorinae according to the presence of two postacrostichal bristles. One or three postacrostichals separate the flies into two other genera, *Cynomya* and *Cyanus,* respectively. In light of this, taxonomists working with this group should be aware of this type of variation. When doubt exists, the male genitalia should be exposed and compared with the drawings provided by Hall (1948).

I thank Raymond J. Gagné, Systematic Entomology Laboratory, USDA, Washington, D.C., for identifications and for suggestions in preparing the manuscript, and B. R. Norment, Entomology Department, Mississippi State University, for helpful comments.

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MEXICAN REDUVIIDAE II: THE GENUS *HEZA* AMYOT AND SERVILLE, 1843 (HEMIPTERA: HARPACTORINAE)

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Abstract.—The new species *Heza* ***azteca*** is described and compared with allied taxa, and *H. similis* Stål and *H. multiguttata* Champion are recorded from Mexico.

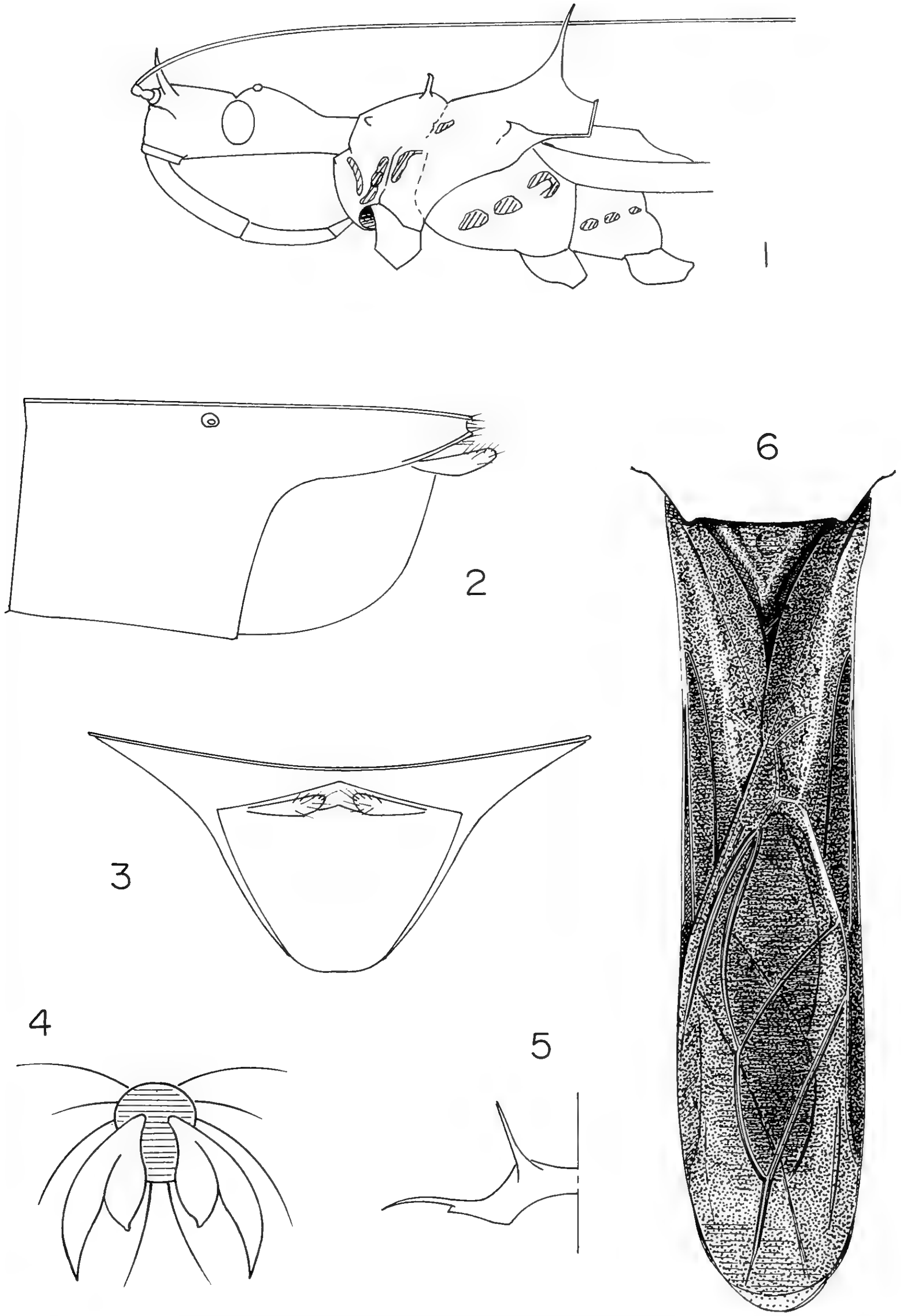
The genus *Heza* was monographed by the senior author in 1976. A second paper by the same author is in press describing four new species for a total of 35 in the genus. In this paper, the authors report three species from Mexico including the new species described below. Specimens come from the collection of the Instituto de Biología, Universidad Nacional Autonoma, Mexico City (IBUNAM), the Museum of Zoology, Universty of Michigan, Ann Arbor (MZUM), and the National Museum of Natural History (NMNH), Washington, D.C. The number of species of *Heza* reported in this paper is low, and considering the number reported from other close areas this number should be perhaps tripled.

The type material is deposited in the NMNH. Measurements are given in mm.

Heza azteca **Maldonado and Brailovsky, New Species**

Figs. 1–6

Male.—Head: anterior lobe pale brownish, posterior lobe slightly darker; ocelli glassy. Beak: 1st segment as anterior lobe of head, 2nd straw color, 3rd blackish. Antenna: 1st antennal segment pale brownish, with 2 postbasal and a preapical longer yellowish annuli, 2 or 3 incomplete short yellowish annuli appearing as a midlength annulus; 2nd segment dark brown, yellowish annulus at midlength, 3rd and 4th dark brown basally, slightly fading to lighter brown towards apex. Pronotum brownish, with a slight greenish tinge; anterior lobe with golden brown rows of short hairs dorsally, laterally lighter, with dense patches of ivory scalelike hairs at each side of acetabular cleft and a more cephalad stripe arching from the front of acetabulum to behind neck of head; posterior lobe dorsally uniformly colored, with poorly defined triangular patch of scalelike hairs behind anterior lobe on each side of median line and another one near base of discal spine of posterior lobe, laterally lighter along margin above pleura; spines on anterior and posterior lobe black; mesopleura and metapleura colored as pronotum, 1st with 2 larger and 3 smaller (these fused in paratype) and 2nd with 3 smaller round patches of ivory-white, scalelike hairs (Fig. 1). Scutellum colored as pronotum, apical spine blackish. Legs mostly brownish; coxae and trochanters irrorate with lighter brown; profemur above, except apically and basally, mostly yellowish, laterally on base and a short annulus before midlength yellowish; tarsi black.



Figs. 1–6. *Heza azteca,* male. 1, Head and pronotum, lateral. 2, Apex of abdomen, lateral. 3, Apex of abdomen, caudal. 4, Claws, foreleg. 5, Spines of posterior lobe of pronotum, caudal. 6, Hemelytra and scutellum.

Meso- and metatibiae inconspicuously irrorate with yellow; mesotibia in addition with blackish postbasal, midlength, and apical blackish annuli, not too outstanding against brown ground color, yellowish along basal outer surface; metatibia as mesotibia, lateral yellowish area extending from base to ⅘ its length. Hemelytra with clavus colored as pronotum; corium, inner cell, inner ½ of 2nd longitudinal cell, and most of discal cell with small grayish irregularly shaped contiguous areas that give them a grayish appearance; outer ½ of 2nd longitudinal cell, outer longitudinal cell, and narrow costal cell brown, remaining longitudinal veins yellowish; with naked eye, corium appears longitudinally striped with yellowish; pterostigma dark reddish brown; membrane transparent on reflected light, with a golden tinge, darker brown towards apices of both cells (Fig. 6).

Abdomen ventrally mostly blackish brown; segments 1–3 under each spiracle with several small light brown areas; sterna 3–5 at about midlength from bottom to connexival margin with 3 or 4 small spots of yellowish scalelike hairs more or less in line; connexival segments blackish, 1st segment light brown before apex; spiracles whitish.

Head: length to margin of pronotum 3.50, width across eyes 1.73, length of eye 0.70, height of eye 0.77, interocular space 0.90, anterior lobe from apex to interocular sulcus 1.40; length of subantennal spine 0.80, slightly inclined forward; width behind eyes 1.25. Antenna: I, 12.1; II, 2.3; III, 10.0; IV, 4.2; glabrous. Beak: I, 1.9; II, 1.4; III, 0.8. Pronotum: length 3.70, width across anterior spines 1.75, humeral width 4.19; length of anterior lobe 1.35, spines of medium length, blunt, median sulcus deep on posterior ¼ and reaching posterior lobe; hind margin of posterior lobe straight above scultellum and slightly roundly produced past each basal angle of the scutellum, area before spines conspicuously transversely corrugate, spines long and sharp (Fig. 5); meso- and metapleurae smooth, plica sharp. Scutellum: width 1.50, length 1.50, margin elevated more or less in a Y-shaped carina, disc with or without a circular depression; apical spine horizontal, short, apex rounded, short haired. Claw of foretarsus as in Fig. 4. Abdomen: narrower basally than apically, connexival margin unspined, sterna finely transversely corrugate. Hemelytra with membrane corrugate, slightly surpassing apex of abdomen. Pilosity: legs with relatively abundant vertical hairs, longer than diameter of segment in meso- and metatibiae only; in addition more abundant shorter fine semidecumbent hairs on all segments; inferior surfaces of profemur, protibia, and mesofemur with a thick mat of short sensory hairs; margin of last 2 connexival segments with a few scattered hairs, upper margin of hypopygium and claspers hairy. Genital capsule as in Figs. 2 and 3; spine of upper margin of hypopygium small, hidden, retracted. Length 21.5 mm.

Holotype.—♂, MEXICO, SLP, El Salto, 8 Aug 1966, O. S. Flint collector, Cat No. 100305, in the NMNH. Paratype ♂, same data, in NMNH.

Remarks.—As *Heza azteca* has the connexival margin unspined, the corium and clavus not tomentose, the spines on the anterior lobe of the pronotum of medium length and blunt, and the abdominal sterna without extensive sericeous areas, it runs to the first part of couplet 24 in the key to species (Maldonado, 1976) together with *H. ferox* Stål as both species have areas of yellowish scalelike hairs on the pleurae. This latter species is the largest in the genus with a length of 29–30 mm and its scaly areas of the thorax are more extensive and not shaped as in *H. azteca.* The narrow abdomen and wings plus the apparent longitudinal yellowish stripe on the hemelytra easily distinguish this species from the others in the genus.

Heza similis Stål, 1859

A male from San Andrés de Tuxtla, Veracruz, and one from Tamazunchale, SLP, are in IBUNAM; a female from Palenque, Chiapas is in MZUM. Reported by Elkins (1951) from Texas.

Heza multiguttata Champion, 1899

A male from San Andrés de Tuxtla, Veracruz, is in IBUNAM.

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PROC. ENTOMOL. SOC. WASH.
85(2), 1983, pp. 226–228

DESCRIPTION OF *TELENOMUS SOLITUS,* N. SP. (HYMENOPTERA: SCELIONIDAE), A NOCTUID EGG PARASITOID

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Abstract.—A new species, *Telenomus* **solitus** from Guatemala, is described on the basis of specimens reared in the laboratory from the eggs of *Trichoplusia ni* (Hübner) (Lepidoptera: Noctuidae).

I present a description of this species of *Telenomus* in order to provide a name to be used in conjunction with the biological studies of Rufina Navasero (University of California, Riverside [UCR]). The description is based upon specimens reared in the laboratory from the eggs of the cabbage looper, *Trichoplusia ni* (Hübner) (Lepidoptera: Noctuidae). This culture was founded by wasps collected by E. R. Oatman (UCR) in Salala, Guatemala, from unidentified noctuid eggs on potato foliage. The terminology used follows that of Johnson (*in press*).

Telenomus solitus **Johnson, NEW SPECIES**

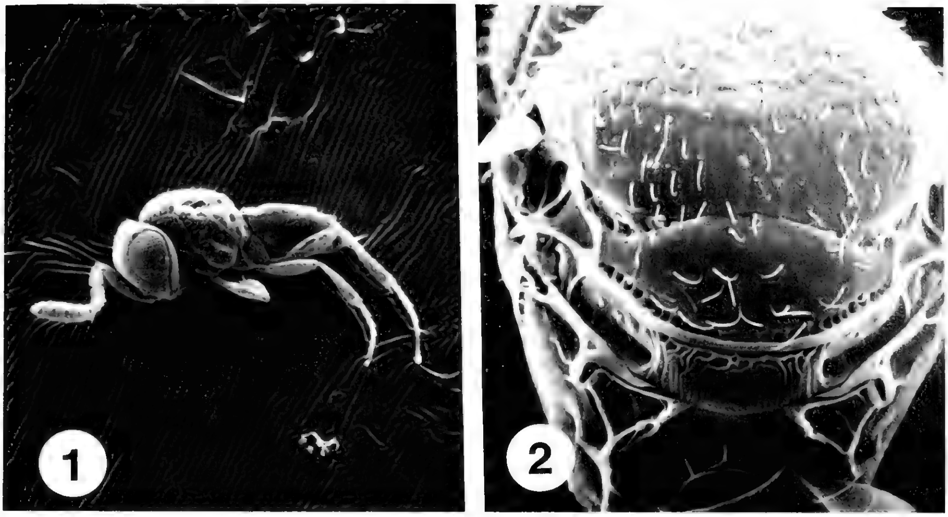
Figs. 1–5

Female.—*Color:* Tarsi yellowish brown; head, body, antenna, legs otherwise dark brown.

Measurements: DCI: 1.82–2.00 ($\bar{x} = 1.89$, SD = 0.05); FCI: 1.06–1.36 ($\bar{x} = 1.22$, SD = 0.07); frons width/eye height: 1.12–1.42 ($\bar{x} = 1.26$, SD = 0.08); W/L T1: 4.0–7.0 ($\bar{x} = 5.3$, SD = 0.9, $n = 17$); L/W T2: 0.72–1.07 ($\bar{x} = 0.90$, SD = 0.08, $n = 17$); L/W metasoma: 1.34–1.81 ($\bar{x} = 1.63$, SD = 0.13); TL: 1.24–1.50 mm ($\bar{x} = 1.31$ mm, SD = 0.06); sample: 20-1.

Head: Vertex smoothly rounded onto occiput, reticulate throughout, sculpture very shallowly impressed; no hyperoccipital carina; sculpture on vertex continuing on occiput to occipital carina; occipital carina complete, irregular medially, simple (i.e., not crenulate); frons smooth, with small punctures at bases of setae; orbital bands present only ventrally, area between lower ½ of eye and antennal insertions shallowly reticulate; ocellar setae absent; no preocellar pit; frontal depression absent or very poorly developed, frons convex between eyes, not bulging between inner orbits and antennal insertions; eyes heavily setose; inner orbits rounded at level of lateral ocelli; temples not bulging, not grooved, reticulate sculpture along posterior orbits extending halfway to occipital carina.

Mesosoma: Mesoscutum convex, shallowly reticulate throughout, setal bases not pustulate; notauli absent; scutellum smooth, setose; dorsellum (Fig. 2) well developed, as long laterally as medially, punctate above, striate below, sculpture



Figs. 1–2. *Telenomus solitus,* female. 1, Lateral habitus, 49×. 2, Dorsellum, 263×.

sometimes effaced medially; acetabular carina simple; episternal foveae absent; width of intercoxal space slightly less than length of forecoxa, 2–3× length of setae arising from its surface; anterior margin of midcoxal cavity not expanded, simple; mesopleural furrow well developed; mesopleural carina absent; acetabular field small, reaching neither intercoxal space nor mesopleural furrow; posterodorsal corner of metapleuron not expanded; metapleural carina indicated by only short spur posteriorly.

Metasoma: T1 with 1 pair of sublateral setae, 2 pairs of lateral setae; greatest length of basal costae on T2 less than medial length of T1.

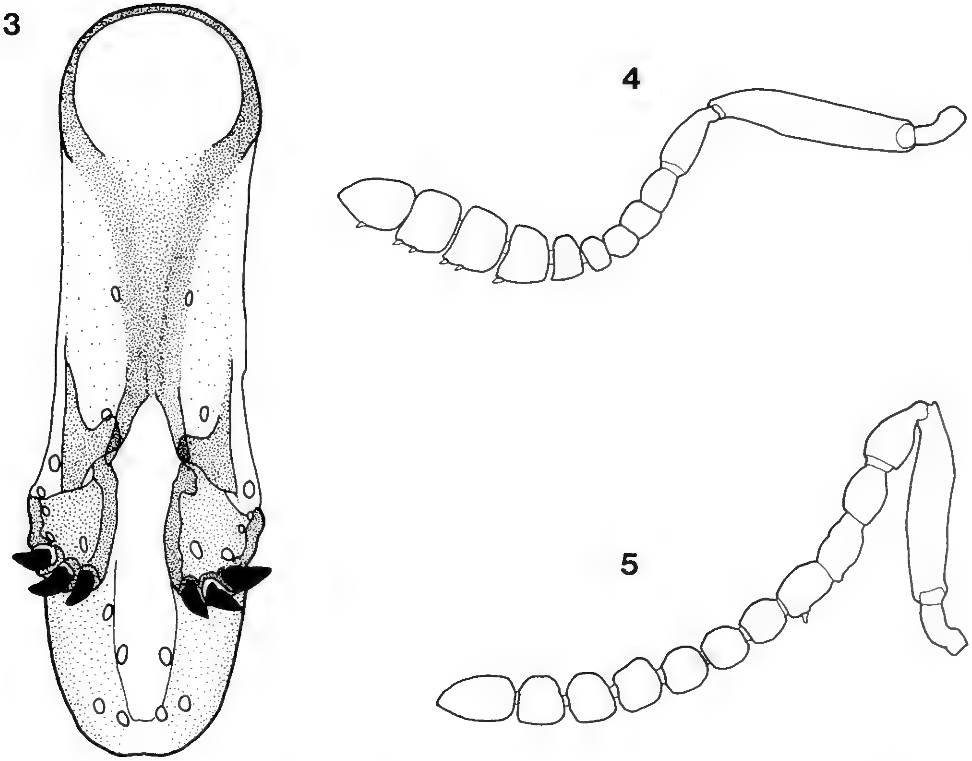
Antenna (Fig. 4) 11-segmented; clava (*sensu* Johnson, *in press*) 5-segmented; claval formula (Bin, 1981): All-A8/1-2-2-1; A6 strongly transverse; L,W A7 < A8; A8–A10 transverse. Wings clear, surpassing apex of metasoma; basal vein weakly pigmented; postmarginal vein longer than stigmal; hindwing narrow, greatest width 0.9–1.8× length of fringe at that point ($\bar{x} = 1.4$, SD = 0.2, $n = 19$).

Male.—*Measurements:* DCI: 1.75–2.28 ($\bar{x} = 1.92$, SD = 0.11); FCI: 1.15–1.39 ($\bar{x} = 1.25$, SD = 0.06); frons width/eye height: 1.12–1.44 ($\bar{x} = 1.32$, SD = 0.08); W/L T1: 3.2–6.2 ($\bar{x} = 4.1$, SD = 0.7, $n = 18$); L/W T2: 0.60–1.07 ($\bar{x} = 0.82$, SD = 0.13, $n = 18$); L/W metasoma: 1.17–1.61 ($\bar{x} = 1.43$, SD = 0.10); TL: 1.05–1.38 mm ($\bar{x} = 1.26$ mm, SD = 0.07); W hindwing/L fringe: 0.9–1.5 ($\bar{x} = 1.2$, SD = 0.1, $n = 18$); sample: 20-1.

Antenna (Fig. 5); genitalia (Fig. 3): laminae volsellares in form of 2 heavily melanized rods, closely approximated 3/4 of their length from base; digital teeth large, heavy, 3/digitus; penis valves weakly melanized; aedeagal lobe large, length 0.4× total length of aedeagovolsellar shaft.

Host.—Unidentified noctuid (wild); *Trichoplusia ni* (laboratory culture).

Material.—Holotype ♀: UCR lab culture, ex: *Trichoplusia ni*; orig. Guatemala, 11.iv.1977, E. R. Oatman, ex: unknown noctuid. Paratypes: 20 ♂, 19 ♀ with same data as holotype. Many more specimens from the same culture were also ex-



Figs. 3–5. *Telenomus solitus.* 3, Male genitalia, ventral view (basal segment removed), 713×. 4, Female antenna, 187×. 5, Male antenna, 187×.

amined. The holotype has been deposited in the collection of the National Museum of Natural History, Washington, D.C.

Remarks.—*Telenomus solitus* belongs to the *californicus* species group of the genus on the basis of the closely approximated, rodlike laminae volsellares and the large digital teeth of the male genitalia (see Johnson, *in press*). This species may be distinguished from the other species of that group by the combination of its small size, more quadrate head (DCI = 1.9 vs. DCI > 2.0), short A3 of the female (L A2 > A3), and, most easily, by the shape of the male genitalia, particularly the large, broad aedeagal lobe and the strongly melanized volsellar region.

The name *solitus,* from the Latin for customary, habitual or usual, refers to the lack of notable external characters in this species.

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KEYS TO NEOTROPICAL SPECIES OF *CALYMMADERUS* SOLIER AND SPECIES OF *CALYTHECA* WHITE, WITH TAXONOMIC NOTES (COLEOPTERA: ANOBIIDAE)

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Abstract.—A study of the available types of the Neotropical species of *Calymmaderus* and the species of *Calytheca* has resulted in a key to 65 species of *Calymmaderus* and a key to three species of *Calytheca*. Taxonomic changes include the following: *Eupactus angustatus* Pic and *E. gounellei* Pic are new synonyms of *Calymmaderus rufescens* (Pic); *Calytheca brunnea* (Pic) is a new combination; *Calymmaderus minasensis* (Pic), *C. subattenuatus* (Pic), and *C. bahiensis* (Pic) each represent a new status; and *Calymmaderus* ***pici*** is a new name for *C. pubescens* (Pic) and *C.* ***brasiliensis*** is a new name for *C. punctatus* (Gorham). Lists that are presented include: Species in the keys along with their synonyms; label data on types including lectotype designations; and *Calymmaderus* species and subspecies of uncertain status. Three instances of possible future species synonymy in *Calymmaderus* are brought out, along with discussion of four species now in *Calymmaderus* that are so distinct that future transferal to new genera might be necessary.

This contribution is similar to my study of tropical species of *Tricorynus* (White, 1981) in that both present a key to aid in the assignment of the names of described species. Most of these names have previously been unassignable because of inadequate original descriptions and an absence of comprehensive treatments.

During this work I have had at hand most types of Pic species that belong in *Calymmaderus* Solier (1849) along with the 11 types of Gorham, the six of Champion, the three of Blair, the three of Fall, and the one of Fisher. However, the types of some Pic species have not been at hand but have been represented by specimens that agree closely with the holotype, and the names of these types have been assigned on the basis of these specimens. Appended is a list of eight species of uncertain status; these evidently belong in *Calymmaderus,* but I have not seen the types. I have also seen the single Pic type of a species of *Calytheca* White (1973).

During construction of the *Calymmaderus* key, there was available but one specimen of most species. Clearly one specimen of a species provided no indication of the variation either within or between the sexes of that species, so doubtless some characters used in the key vary more than indicated. In addition, specimens in poor condition (as with abraded pubescence) may have given a misleading impression of certain characters.

For most of the keyed species in both genera, a number of characters are used rather than just one or two. Where possible, many points of difference are included in couplets along with characters that do not represent differences between species that key closely. The aim has been to more thoroughly describe each species.

My work with species of *Calymmaderus* shows that the presently described 82 species (65 in the key; nine in White, 1974a; and eight of uncertain status) are likely but a fraction of the number of species in the neotropics and that many remain to be described.

Further studies will probably show that certain species now assigned to *Calymmaderus* should be placed in new genera. At least the four species discussed in the note on aberrant species (following) should be considered for removal from *Calymmaderus.*

In the key and descriptions for species of *Calymmaderus* are references to dual punctation and to large and small punctures. For a discussion of these characters see White, 1965: 288. For complete synonymy of *Calymmaderus* see White, 1974b: 423. Characters that distinguish *Calymmaderus* and *Calytheca* are given by White, 1973.

TAXONOMIC NOTES

Calymmaderus minasensis **(Pic), NEW STATUS**

Eupactus minasensis Pic, 1904c: 37.
Calymmaderus minasensis (Pic), Pic, 1912a: 65.
Tricorynus minasensis (Pic), White, 1979: 212 (as synonym of *T. herbarius*).

I have had difficulties in assigning the name *minasensis* because three different species in the Pic collection were determined by Pic as *minasensis,* and all three bear type labels.

My error in establishing *minasensis* as a synonym of *Tricorynus herbarius* resulted from early examination of two specimens (on one pin) determined by Pic as *C. minasensis* and which bear (almost certainly in error) a red museum type label; these specimens are identical with *herbarius.* I now reject these specimens as types because they do not bear a yellow handwritten Pic type label, as do the other two possible types examined later. Most Pic types bear both the yellow handwritten type label and the red, printed, capitalized, museum type label.

Both Pic specimens that bear two type labels and a *minasensis* determination label have locality data that agree with that given in the original description: Minas, Sertao de Diamantina. The eight words published by Pic, 1904c: 37, that validated the name *minasensis* do not allow it to be recognized; however, he does state the length to be 4.5 mm. The possible type that belongs to the genus *Tricorynus* and which is synonymic with *T. fulvopilosa,* is 3.7 mm long. The possible type that belongs to the genus *Calymmaderus* is 4.5 mm long. On this basis alone I accept this specimen as the actual type of *minasensis* Pic, and I hereby designate it as **lectotype**.

Calymmaderus rufescens **(Pic)**

Thaptor rufescens Pic, 1902b: 55.
Eupactus angustatus Pic, 1904c: 37. **NEW SYNONYMY.**
Eupactus gounellei Pic, 1904c: 37. **NEW SYNONYMY.**

I have found only minor external differences between the holotypes of *rufescens* and *angustatus.* The type of *rufescens* has the head densely and finely punctate, nearly punctate-granulate, and clearly less shiny than the remainder of the body, the eyes separated by about the vertical diameter of an eye, and the length of 3.6 mm. The type of *angustatus* has the head less densely punctate and not punctate-granulate, not significantly less shiny than the remainder of the body, the eyes separated by less than the diameter of an eye, and the length is 3.8 mm. In my opinion these minor differences do not justify treating these as distinct species.

The comparative external morphology of the types of *rufescens* and *gounellei* show even fewer substantial differences than those discussed above.

***Calymmaderus bahiensis* (Pic), New Status**

Eupactus theresae bahiensis Pic, 1904c: 37.

Differences between the types of *C. theresae* and *C. t. bahiensis* indicate that they represent two species. *Calymmaderus theresae* has a distinct stria on the disk of each elytron, and the groove of the metasternal lobe extends a little over half the length of the lobe; *C. bahiensis* has no elytral striae and the groove of the metasternal lobe extends a little less than half the length of the lobe.

***Calymmaderus subattenuatus* (Pic), New Status**

Eupactus nigricolor subattenuatus Pic, 1904c: 37.

External differences clearly show that *subattenuatus* is a species distinct from *nigricolor.* In *subattenuatus,* the front of the head is bulbous with the clypeal area depressed, and the metasternal punctures are large and rimmed. In *nigricolor,* the front of the head is evenly convex and the metasternal punctures are small and pointlike.

***Calytheca brunnea* (Pic), New Combination**

Eupactus brunneus Pic, 1904c: 36.

Characters of the type show clearly that this species belongs in *Calytheca.*

Two Name Changes

Calymmaderus pubescens (Pic), 1902b: 55, is a junior secondary homonym of *C. pubescens* (Gorham), 1883: 204, so I offer the replacement *pici,* **New Name.** *Calymmaderus punctatus* (Pic), 1922: 5, is a junior secondary homonym of *C. punctatus* (Gorham), 1883: 203, so I replace it with *brasiliensis,* **New Name.**

Possible Synonymy

The minor differences between the types of *Calymmaderus humilis nitidissimus* (Pic) and *C. rufonitens* (Pic) (see couplet 43 of the key) raises doubts as to whether or not they are actually distinct species as here treated. Examination of more complete series of specimens may show that the two names should be synonymized.

Calymmaderus pupatus (Gorham) and *C. throscoides* (Gorham) are here treated as distinct. However, the types of these species, too, exhibit only minor external differences (see couplet 23). Further study could show that the two names apply to only one species.

The type of *nitescens* (Champion) and a specimen that I compared with the type of *semirufus* (Champion), and which agreed closely with it, are so similar in all characters except color that they could represent one species. A more lengthy series than the two specimens I have seen will be needed to settle the question.

I did not dissect the genitalia of types loaned to me. Because these beetles are small, oval, and the body parts are very tightly fitting, there is always the danger of irreparable damage to a specimen when genitalic dissections are attempted. Some questions of possible synonymy may be settled by genitalic dissections, for male genitalia of Anobiidae are highly diagnostic.

Notes on Aberrant Species

The four species here discussed exhibit significant differences from the other species in *Calymmaderus,* and it may be desirable to erect two new genera to receive them.

The combination of characters of *C. nigronotatus* (Pic) make it unique. The one specimen at hand (compared with type) is 5.8 mm long, the 3rd and 4th abdominal segments are not double, and the terminal 3 antennal segments are about twice as long as the preceding 8 segments combined. In addition, the metasternum bears a deep groove medially for about ⅔ of its length, which receives the last 2 antennal segments, and the elytra bear large, deep punctures that are more or less clearly aligned into 10 striae.

The species *C. comatus* (Champion), *brevissimus* (Pic), and *dejeani* (Pic) are all about the same size (1.5–1.8 mm) and are very similar in morphology. They have the sutures of the 3rd and 4th abdominal segments not double; virtually all other species of *Calymmaderus* have these sutures double. In at least *comatus* and *dejeani,* the least 3 antennal segments are clearly longer than all preceding segments combined; the antennae of the type of *brevissimus* are concealed. It is likely that these three species deserve a genus separate from *Calymmaderus.*

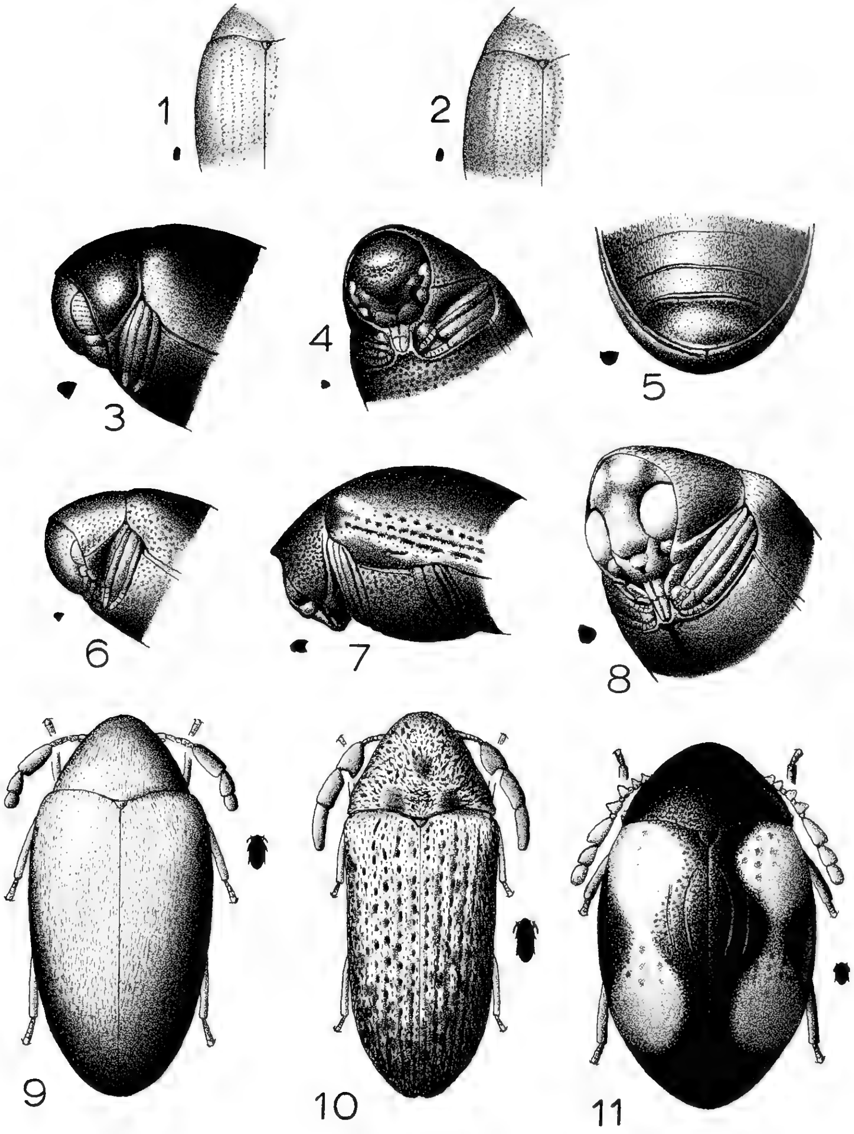
Notes on Key

The following species have been assigned on the basis of specimens that have been compared with types: *attenuatus* Pic, *comatus* (Champion), *funki* (Pic), *germaini* (Pic), *minasensis* (Pic), *nigronotatus* (Pic), *oblongus* (Gorham), *pubescens* (Gorham), *punctatus* (Gorham), *rufomaculatus* Pic, *semirufus* (Champion), *sharpi* Gorham, and *testaceipes* (Pic).

Calymmaderus punctulatus LeConte has been worked into the key on the basis of identified specimens in the USNM, including specimens examined by H. C. Fall for his 1905 revision. I have not examined the type of *punctulatus.*

Key to Neotropical Species of *Calymmaderus*

1. Dorsal surface with hairs, these separated by less than length of a hair 2
– Dorsal surface lacking hairs or with hairs so short that they are separated by more than length of a hair 30
2(1). Hairs of elytra in swirled patches, irregular in direction, or irregular in density 3
– Hairs of elytra not swirled or irregular in direction, always uniform in density 9
3(2). Elytron with 10 distinct striae, impressed throughout, but deepest at



Figs. 1–11. *Calymmaderus* spp. 1, *C. instriatus,* portion of dorsal surface. 2, *C. pubescens,* portion of dorsal surface. 3, *C. bahiensis,* view of anterior half. 4, *C. venezuelensis,* view of anterior half. 5, *C. pupatus,* apex of abdomen. 6, *C. brevissimus,* view of anterior half. 7, *C, nigricolor,* diagonal view of body. 8, *C. subopacus,* view of anterior half. 9, *C. pupatus,* dorsal view. 10, *C. nigronotatus,* dorsal view. 11, *C. substriatus,* dorsal view.

side; hairs short and fine, irregularly changing direction and irregularly reflective; body throughout reddish brown; vertex of head shallowly, longitudinally depressed; apex of 5th abdominal segment depressed before outer margin, depression crescent-shaped; length about 5 mm; Ecuador .... *inaequalicollis* (Pic)

– Elytron never with 10 striae; otherwise not as above; Brazil 4

4(3). Pubescence bicolored, partly yellow or orange, partly white 5

– Pubescence not bicolored 6

5(4). Vertex protuberant on each side of middle and frons not produced; (Fig. 8) body more than 2× as long as wide; eyes large, separated by less than vertical diameter of an eye; pubescence of elytra with golden patches; elytral punctures very fine, much denser than those of other surfaces; length about 5.2 mm . . . . *subopacus* (Pic)

– Vertex not protuberant; frons produced into a pointed tubercle; body slightly less than 2× as long as wide; eyes smaller, separated by about 1.3× vertical diameter of an eye; pubescence of elytra with golden lines; elytral punctation same as that of other surfaces; length about 4.0 mm . . . . *variegatus* (Pic)

6(4). Pubescence of dorsum brown, weakly golden, forming numerous dense patches, and sparse to absent between patches; frons between eyes bluntly produced; body surfaces often with a minutely roughened appearance; abdomen with sides and apex alutaceous; length about 3.8 mm . . . . *tessellatus* (Pic)

– Not as above 7

7(6). Pubescence golden yellow; elytral surfaces very densely, finely punctate and nearly lusterless; frons with a shallow depression above a weak protuberance; eyes separated by about 1.3× vertical diameter of an eye; length about 5 mm . . . . *latipennis* (Pic)

– Pubescence whitish to weakly yellowish; elytral surfaces shiny; frons protuberant but not depressed; eyes separated by about vertical diameter of an eye; length about 3.3–3.4 mm 8

8(7). Elytral pubescence with more than 10 distinctly swirled patches, hairs obscuring but not concealing surface; head between eyes with a distinctly pointed tubercle; body surfaces dark reddish brown; length about 3.3 mm . . . . *sericeomaculatus* (Pic)

– Pubescence of elytra with much fewer weakly swirled patches, hairs concealing surface; head between eyes with a weakly produced tubercle; body surfaces dark brown; length about 3.3 mm . . . . *argentifer* (Pic)

9(2). Pubescence of dorsum bicolored, dull whitish in part and brownish in part; Brazil 10

– Pubescence of dorsum not bicolored, of same color throughout; various localities 12

10(9). Metasternal depression that receives apex of antenna not extending below level of transverse carina; body stout, nearly 1.8× as long as wide; darker pubescence dark brown; eyes separated by about 1.3× vertical diameter of an eye; length about 3.3 mm . . . . *nigromaculatus* (Pic)

– Metasternal depression that receives apex of antenna extending below level of transverse carina; body over 2× as long as wide; darker pubescence orangish brown to reddish brown; eyes separated by less than diameter of an eye; length 3.3–4.0 mm 11

11(10). Dark elytral pubescence forming a broad transverse band, base and apex of elytra with whitish pubescence; length about 3.3 mm . . . . *subnotatus* (Pic)

– Dark elytral pubescence covering most of elytra, interrupted by light pubescence basally, along suture, and diagonally at apex; length 3.4–4.0 mm .... *brunneonotatus* (Pic)

12(9). Elytron with 10 equally distinct striae, formed of deep, elongated to much elongated punctures; length 5.8–6.3 mm 13

– If elytron striate, with striae most distinct laterally or near suture, not as above; length 1.5–6.7 mm 14

13(12). Body with dense, pale yellowish pubescence that more or less conceals surface (Fig. 10); body very densely punctate and nearly lusterless; metasternal groove that receives apex of antennal club nearly attaining hindcoxae; elytral intervals weakly convex; 5th abdominal segment not carinate apically; length about 5.8 mm; Argentina .... *nigronotatus* (Pic)

– Body with very fine and sparse whitish pubescence that does not conceal surface; body shiny, not densely punctate; metasternal groove that receives apex of antennal club much shorter; elytral intervals strongly convex; 5th abdominal segment longitudinally carinate apically; length about 6.3 mm; Brazil .... *cribripennis* (Pic)

14(12). Elytron apically at side with no distinct striae 15

– Elytron apically at side with 1–3 distinct striae 20

15(14). Pubescence of dorsum semi-erect; body reddish brown throughout; elytral disk lacking striae; body about 1.5× as long as wide; 3rd and 4th abdominal sutures not double; eyes separated by vertical diameter of an eye to a little less; vertex carinate; length 1.3–1.5 mm; Guatemala and Nicaragua .... *comatus* (Champion)

– Pubescence of dorsum appressed, not semi-erect; otherwise not as above; various localities; length 2.0–4.4 mm 16

16(15). Elytral disk lacking striae 17

– Elytral disk with feeble to moderately distinct striae 18

17(16). Dorsal surface black and with a distinct, bluish reflection, ventral surface largely dark brown, abdomen reddish brown; length about 2.1 mm; 3rd and 4th abdominal sutures not double; punctures of dorsum large, dense, separated by less than diameter of a puncture; body slightly over 1.5× as long as wide; Panama ..... *caeruleus* (Champion)

– Body reddish brown nearly throughout, abdomen reddish brown; length about 4.4 mm; 3rd and 4th abdominal sutures double; punctures of dorsum small and dense, separated on an average by more than diameter of a puncture; body nearly 2.0× as long as wide; Lower California .... *mixtus* (Fall)

18(16). Front of head broadly protuberant and with an arcuate, transverse band of large punctures (Fig. 4); clypeus depressed; eyes small, separated by over 2× vertical diameter of an eye, distinctly notched; body about 1.6× as long as wide; length about 2.0 mm .... *venezuelensis* (Pic)

– Front of head not protuberant, punctation regular; otherwise not as above; length about 2.3–2.4 mm 19

19(18). Feeble elytral striae formed of weakly impressed grooves (Fig. 2); body red brown; eyes small, separated by about 2× vertical diameter of an eye; pubescence weakly reddish; 5th abdominal segment nearly flat from front to back; Panama and Guatemala .... *pubescens* (Gorham)

– Feeble elytral striae formed of more or less aligned, large, shallow punctures (Fig. 1); body brown; eyes large, separated by about vertical diameter of an eye; pubescence weakly yellow; 5th abdominal segment concave front to back; Brazil ....*instriatus* (Pic)

20(14). Elytron apically at side with a single groove 21

– Elytron apically at side with 2 or 3 grooves 24

21(20). Body in dorsal view stout, about 1.85× as long as wide; in lateral view dorsal outline of body nearly hemispherical; eyes large, separated by about 0.8× vertical diameter of an eye; body very dark brown, nearly black; pubescence gray; punctures at side of pronotum very dense, surface nearly lusterless; length 3.8–4.5 mm; Mexico .... *sharpi* (Gorham)

– Body in dorsal view not stout, 2.0–2.2× as long as wide; otherwise not as above 22

22(21). Stria at side of elytron distinct at apical ½, basally at side with 2–3 more or less distinct rows of punctures forming striae; pubescence yellowish; body red brown; eyes separated by 0.8–1.5× vertical diameter of an eye; 5th abdominal segment narrowly concave before apex; length 3.3–5.6 mm; Mexico .... *oblongus* (Gorham)

– Stria at side of elytron distinct at apical ⅓, with no striae basally at side; otherwise not as above; Mexico to Costa Rica 23

23(22). Fifth abdominal segment clearly concave from front to back (Fig. 5); elytron with weak striae basally near suture; apex of metasternal process that accepts antennal tip not deeply indented, extending less than ½ length of process; length 3.4–5.2 mm; eyes separated by 0.8–1.3× vertical diameter of an eye (Fig. 9); Mexico to Costa Rica .... *pupatus* (Gorham)

– Fifth abdominal segment flat to feebly concave front to back; elytron with no striae basally near suture; apex of metasternal process that accepts antennal tip more deeply indented, extending ½ length of process; length 3.2–3.8 mm; eyes separated by 0.8–1.2× vertical diameter of an eye; Belize and Guatemala .... *throscoides* (Gorham)

24(20). Elytron with 10 striae, 2 to 3 at side distinct, others much less distinct and formed of more or less aligned, elongated punctures, striae often also weakly impressed; eyes large, separated by 0.8–1.4× vertical diameter of an eye; body reddish brown to dark brown throughout; 5th abdominal segment with an arcuate concavity before outer margin; length 3.7–5.3 mm; Galapagos .... *galapagoensis* (Blair)

– Elytron with only 2 lateral striae, otherwise not as above; Brazil and Lower California 25

25(24). Length about 6.7 mm; vertex protuberant each side of middle, protuberances bearing moderately dense, golden hair; elytra shiny, punctation dual, larger punctures very small, smaller punctures minute; body 2.1× as long as wide; 5th abdominal segment shallowly concave front to back; Brazil .... *gibbosiceps* (Pic)

– Length not much over 4.5 mm; vertex not protuberant, lacking golden hair; otherwise not as above 26

26(25). Pubescence of dorsum yellow, reflective, moderately dense, obscuring surface sculpture; length about 2.7–3.0 mm 27

– Pubescence not as above; length 2.7–4.5 mm 28

27(26). Elytral punctation dual, both larger and smaller punctures distinctly impressed, smaller punctures about ½ size of larger punctures; eyes separated by about vertical diameter of an eye; body 1.8× as long as wide; length about 3 mm; Brazil .... *brevipennis* (Pic)

– Elytral punctation dual, but larger punctures distinctly impressed and smaller punctures weakly impressed and about ⅓ size of larger punctures; eyes separated by about 0.7× vertical diameter of an eye; body 1.8× as long as wide; length about 2.8 mm; Brazil .... *multimaculatus* (Pic)

28(26). Dorsal surface black; metasternum dark brown, abdomen reddish brown; pubescence light grayish, denser, obscuring surface sculpture; body about 1.9× as long as wide; eyes separated by about vertical diameter of an eye; length about 3.4 mm; 5th abdominal segment shallowly concave, apex transversely carinate; Brazil ...... *pici* White

– Body reddish brown throughout; otherwise not as above 29

29(28). Body about 2.3× as long as wide; eyes large, separated by a little less than diameter of an eye; metasternum at middle with a distinct, longitudinal groove; metasternum primarily with small punctures only, larger punctures weakly indicated near anterior margin; length 3.5–3.7 mm; Brazil .... *rufescens* (Pic)

– Body about 1.8× as long as wide; eyes smaller, separated by about 1.5× vertical diameter of an eye; metasternum at middle lacking a groove; metasternum throughout with dual punctation, larger punctures dense and distinct throughout; length about 2.7 mm; Lower California .... *nactus* (Fall)

30(1). Elytron apically at side with 2 distinctly impressed striae 31

– Elytron apically at side lacking distinct striae 37

31(30). Dorsum black nearly throughout and with a bluish reflection; ventral surface primarily reddish brown; punctation not dual, formed of large punctures only, these very dense at side of pronotum, on elytra tending to align in series; length about 2.5 mm; Honduras and Panama .... *punctatus* (Gorham)

– Dorsum black to reddish brown, never bluish; otherwise not exactly as above; length 1.8–3.5 mm; various localities 32

32(31). Length about 1.8 mm; eyes large, bulging, separated by 1.8× vertical diameter of an eye; vertex with a blunt, moderately long carina; front with a small flat area; lateral elytral striae indicated to or nearly to level of middle leg; notch of metasternal lobe deep, extending nearly to level of transverse carina; 5th abdominal segment with a broad, shallow, subcircular depression; Mexico ....*donckieri* (Pic)

– Length 2.2–3.5 mm; otherwise not exactly as above; various localities.. 33

33(32). Elytron with 1 or both lateral striae distinctly impressed to base of elytron (Fig. 7); length 3.2–3.5 mm; frons protuberant; Brazil 34

– Elytron with at most 1 stria weakly impressed to near base of elytron; length 2.2–2.7 mm; frons not protuberant; Cuba, Mexico, Bolivia 35

34(33). Dorsum black; eyes separated by about 1.4× vertical diameter of eye; frons between eyes weakly produced; large punctures on metasternum small, distinct anteriorly, becoming obsolete posteriorly; length about 3.4 mm; Fig. 7 .... *nigricolor* (Pic)

– Dorsum reddish brown; eyes separated by about vertical diameter of an eye; frons between eyes distinctly produced; large punctures on metasternum moderate in size anteriorly, smaller but distinct posteriorly; length about 3.2 mm .... *subattenuatus* (Pic)

35(33). Metasternal process that receives apex of antenna indented to level of transverse metasternal carina; eyes separated by 1.6× vertical diameter of an eye; body reddish brown, elytra slightly darker than remainder of body; punctures of dorsum not dual, of 1 size only; 5th abdominal segment broadly concave front to back; length about 2.2 mm; Mexico .... *subvestitus* (Champion)

– Metasternal process that receives antennal apex indented about ½ way to level of transverse metasternal carina; otherwise not as above 36

36(35). Body reddish brown; pronotum with feeble luster, elytra shiny; extreme side of pronotum weakly, evenly rounded; eyes separated by about 1.7× vertical diameter of an eye; length about 2.4 mm; Cuba .... *testaceipes* (Pic)

– Body dark brown to nearly black; pronotum and elytra equally shiny; extreme side of pronotum bulging; eyes separated by over 2× vertical diameter of an eye; length about 2.7 mm; Bolivia ...... *germaini* (Pic)

37(30). Elytra bicolored 38

– Elytra not bicolored 40

38(37). Each elytron black and with 2 large orange-red spots that join near middle of elytron (Fig. 11); pronotum black; elytral disk with 4 arcuate striae; eyes separated by about vertical diameter of an eye; metasternum nearly impunctate; length about 2.0 mm; Brazil .... *substriatus* (Pic)

– Not exactly as above 39

39(38). Elytra primarily dark brown but apically with 2 large orange spots; pronotum reddish brown; elytral disk not striate; head on vertex weakly carinate; length 2.3–3.0 mm; Columbia, Venezuela .... *funki* (Pic)

– Elytra with about basal ⅔ orangish red, apex black; pronotum mostly black; elytral disk with 2 arcuate striae each side of suture; head on vertex not carinate; length about 2.5 mm; Brazil ... *rufomaculatus* Pic

40(37). Elytron near suture with 2 or 3 usually weak striae 41

– Elytron near suture with 1 stria or none 46

41(40). Elytron with 2 or 3 weak striae near suture, formed of discrete, not confluent punctures, innermost stria not or weakly incurved anteriorly 42

– Elytron with 2 strong striae near suture, formed of shallow, largely confluent punctures, innermost stria clearly incurved anteriorly . . . 44

42(41). Length 1.8–2.0 mm; elytron with 3 striae near suture; body dark brown to nearly black, appendages, ventral surface, and often margins reddish brown; eyes separated by about 1.5× vertical diameter of an eye; punctures of dorsum of 1 size; elytral punctures clearly largest and densest at side of elytron; Costa Rica . . . . . *dorcatomoides* (Fisher)

– Length 3.2–3.5 mm; elytron with 2 striae near suture; otherwise not as above 43

43(42). Pronotum black, elytra dark brown; body about 1.9× as long as wide; elytron at side with a row of punctures forming a weak stria; eyes separated by 0.8× vertical diameter of an eye; abdominal segments 2, 3, and 4 near middle with almost no evidence of punctures; metasternum deeply, longitudinally grooved in middle; punctures of dorsum of 1 size; length about 3.5 mm; Peru . . . . *metallicus* (Pic)

– Pronotum dark brown, elytra black; body about 1.7× as long as wide; elytron at side with no stria; eyes separated by 1.2× vertical diameter of an eye; abdominal segments 2, 3, and 4 near middle with distinct punctures; metasternum at middle shallowly depressed; punctures of dorsum of 1 size; length about 3.2 mm; Guatemala . . . . *erythrocephalus* (Champion)

44(41). Length 2.0–2.3 mm; body very dark, nearly black but with red evident, especially ventrally; body stout, from dorsal view 1.5–1.6× as long as wide; eyes separated by about 1.8× vertical diameter of an eye; dorsum with dual punctation, smaller punctures minute; side of pronotum produced into a sharp; diagonal carina; metasternum at middle broadly flattened; apex of 5th abdominal segment bluntly produced; Nicaragua . . . . *striatus* (Gorham)

– Length 3.0–3.7 mm; otherwise not as above; Brazil 45

45(44). Last abdominal segment with punctures small, sparse, and separated on an average by about 4–5× diameter of a puncture; length about 3.0 mm; body reddish brown throughout with abdomen lighter than remainder; body from dorsal view 1.8× as long as wide; eyes separated by about vertical diameter of an eye; punctures of dorsal surface of 1 size . . . . *humilis nitidissimus* (Pic)

– Last abdominal segment with punctures larger, denser, separated on average by about 1–2× diameter of a puncture; length about 3.7 mm; body reddish brown throughout with abdomen lighter than remainder; body from dorsal view 1.8× as long as wide; eyes separated by vertical diameter of an eye; punctures of dorsal surface of 1 size . . . . *rufonitens* (Pic)

46(40). Elytron near suture with 1 distinct stria 47

– Elytron near suture with a weak stria or none 48

47(46). Striae of elytral disk nearly straight; length about 4.5 mm; dorsum black; body 1.7× as long as wide; 5th abdominal segment nearly flat front to back, apex produced; Peru . . . . *theresae* (Pic)

– Striae of elytral disk incurved anteriorly; length about 2.5 mm; elytra very dark brown, pronotum mostly reddish brown; body about 1.8×

as long as wide; 5th abdominal segment weakly convex, apex not produced; Brazil .... *humilis humilis* (Pic)

48(46). Elytral punctures large, shallow, and so dense that they are partially confluent throughout; surfaces with a weak luster; elytra with a feeble indication of striae; eyes large, separated by about ½ vertical diameter of an eye; side of pronotum with a weak, diagonal carina; length about 2.5 mm; Brazil .... *brasiliensis* White

– Elytral punctures never as large and dense; surfaces shiny; otherwise not as above; various localities 49

49(48). Pronotum at side with a produced carina from posterior angle to anterior angle, meeting latter some distance above proepisternum (Fig. 6); length 1.8–2.6 mm 50

– Pronotum at side without a produced carina, but with a distinct groove along posterior margin to above proepisternum, margin behind groove often produced (Fig. 3); length 2.2–4.6 mm 54

50(49). Punctures on pronotal disk shallow and indistinct to obsolete 51

– Punctures on pronotal disk not shallow, distinct 52

51(50). Pronotal punctures at side distinct, not shallow (Fig. 6); body dark brown but with many areas reddish; punctures of elytral disk weakly impressed, shallow; eyes separated by about 2× vertical diameter of an eye; length about 1.7 mm; body about 1.5× as long as wide; Guadeloupe .... *brevissimus* (Pic)

– Pronotal punctures at side indistinct and shallow; body reddish brown throughout; punctures of elytral disk distinctly impressed and not shallow; eyes separated by about 2× vertical diameter of an eye; length about 1.7 mm; body about 1.6× as long as wide; Nicaragua and Panama .... *ovulum* (Gorham)

52(50). Groove of metasternal lobe that accepts antennal apex deeper, extending about ¾ length of lobe; length about 1.8 mm; eyes separated by about 1.2× vertical diameter of an eye; body dark brown, some margins reddish; elytral disk with largest punctures forming weak striae; elytral punctures separated on an average by about diameter of a puncture; Mexico .... *dejeani* (Pic)

– Groove of metasternal lobe that accepts antennal apex shallower, extending less than ½ length of lobe; length about 2.3–2.6 mm; Honduras and Brazil; otherwise not as above 53

53(52). Body reddish brown throughout; punctures of head weakly impressed, obscured by finely alutaceous surface; punctures of 5th abdominal segment of only weakly impressed large punctures, no small punctures; base of elytron near suture with feeble large punctures forming striae; eyes separated by 1.5× vertical diameter of an eye; body 1.6× as long as wide; length about 2.3 mm; Honduras ... *exiguus* (Gorham)

– Body dorsally very dark brown to nearly black, ventrally more reddish; punctures of head strongly impressed, surface not alutaceous; punctures of 5th abdominal segment of distinct dual punctation; eyes separated by 1.5× vertical diameter of an eye; base of elytron near suture with no indication of striae; body 1.6× as long as wide; length about 2.6 mm; Brazil .... *brevis* (Pic)

54(49). Middle of abdominal segments 2, 3, and 4 with fine, sparse punctures, these much smaller and sparser than punctures on 5th segment; body reddish brown to primarily black; punctures of metasternum small and sparse, not clearly dual; eyes separated by 1.0–1.3× vertical diameter of an eye; body about 1.7× as long as wide; length 2.4–3.8 mm; Lower California (southern U.S.) .... *punctulatus* (LeConte)

– Middle of abdominal segments 2, 3, and 4 virtually free of punctures, or punctures distinct and as those on remainder of abdomen 55

55(54). Middle of abdominal segments 2, 3, and 4 nearly free of distinct punctures 56

– Middle of abdominal segments 2, 3, and 4 with distinct punctures 58

56(55). Length about 4.0 mm; body about 1.75× as long as wide; body throughout very dark reddish brown; eyes separated by 1.3× vertical diameter of an eye; dual abdominal sutures 3 and 4 with 2nd groove much deeper and wider than 1st; in lateral view body stout, length 2× depth; pronotum bulging (Fig. 3); Brazil .... *bahiensis* (Pic)

– Length 2.3–2.7 mm; otherwise not as above 57

57(56). Length about 2.7 mm; body about 2× as long as wide; body throughout reddish brown; eyes separated by a little over vertical diameter of an eye; dual abdominal sutures 3 and 4 with each groove of double grooves similar in depth and width; in lateral view body less elongate, length 2.2× depth; St. Vincent .... *laevis* (Gorham)

– Length about 2.3 mm; body about 1.8× as long as wide; body reddish brown but elytra clearly darker than remainder; eyes separated by about 1.2× vertical diameter of an eye; abdominal sutures 3 and 4 with anterior groove of each double groove deeper and wider than posterior groove; in lateral view body elongate, length 2.4× depth; Galapagos .... *alutaceus* (Blair)

58(55). Side of pronotum before posterior angle not bulging to weakly bulging; length 1.8–3.2 mm; usually stouter, about 1.6–1.9× as long as wide; elytral punctures usually sparser, separated on an average by about 2–3× diameter of a puncture; Guadeloupe, Galapagos, Central America and Lower California 59

– Side of pronotum before posterior angle strongly bulging; length 3.6–4.6 mm; more elongate, about 1.9–2.1× as long as wide; elytral punctures denser, separated on an average by 2× diameter of a puncture or less; Argentina and Brazil 64

59(58). Length 2.6–3.2 mm; body about 1.8–1.9× as long as wide 60

– Length 1.8–2.5 mm; body about 1.6–1.7× as long as wide 62

60(59). Length about 3.2 mm; body reddish brown throughout; vertex not carinate, not protuberant; eyes separated by about 1.4× vertical diameter of an eye; pronotum moderately bulging before posterior margin; elytral punctures elongated; head above eye with a feeble, narrow groove; Lower California .... *canonicus* (Fall)

– Length about 2.6–2.9 mm; otherwise not exactly as above; Guadeloupe and Galapagos 61

61(60). Length about 2.9 mm; body reddish brown throughout; vertex finely, longitudinally carinate and not protuberant; eyes separated by about 1.3× vertical diameter of an eye; pronotum weakly bulging before posterior margin; elytral punctures round; head above eye with a shallow, narrow groove, not as wide as 2 eye facets; Guadeloupe .... *dufaui* (Pic)

– Length about 2.6 mm; body reddish brown but with pronotum darker than elytra; vertex finely, longitudinally carinate and protuberant; eyes separated by a little over vertical diameter of an eye; pronotum not bulging before posterior margin; elytral punctures elongated; head above eye with a deep, wide groove as wide as 2 eye facets; Galapagos .... *georgicus* (Blair)

62(61). Body black nearly throughout, some areas and margins may be reddish; eyes separated by 1.2–1.3× vertical diameter of an eye; vertex finely, longitudinally carinate; body about 1.6× as long as wide; pronotum rounded before posterior angle, not bulging; punctures of dorsum of 1 size only; length 2.1–2.4 mm; 5th abdominal segment grooved at apex; Guatemala .... *glaber* (Gorham)

– Body reddish brown throughout or with elytra noticeably darker than remainder; otherwise not as above; Mexico to Panama 63

63(62). Body reddish brown but with elytra noticeably darker than remainder; length 2.1–2.5 mm; elytron near suture lacking a stria; punctures of dorsum of one size; eyes separated by about vertical diameter of an eye; vertex not carinate; body 1.66× as long as wide; pronotum weakly bulging before posterior angle; apex of 5th abdominal segment grooved; Mexico to Panama .... *semirufus* (Champion)

– Body reddish brown throughout; length about 1.8 mm; punctures of dorsum of essentially 1 size, but elytron adjacent to suture with a feeble stria of punctures slightly larger than others on elytron; vertex not carinate; eyes separated by about vertical diameter of an eye; body 1.7× as long as wide; pronotum weakly bulging before posterior angle; apex of 5th abdominal segment grooved; Panama .... *nitescens* (Champion)

64(58). Punctures on head near middle of frons irregular in size and density, smaller ones clearly smaller than those at side of pronotum; elytral punctures with an obscure tendency to form longitudinal bands; length about 4.0 mm; Argentina .... *bruchi* (Pic)

– Punctures of head about same size to a little larger than those at side of pronotum, regular in size and density; elytral punctures not forming bands 65

65(64). Reddish brown throughout; length about 3.6 mm; 5th abdominal segment more shallowly concave from front to back; head adjacent to eyes not shallowly depressed, evenly rounded throughout; punctures of head separated from one another by much less than diameter of a puncture; Argentina .... *attenuatus* Pic

– Dorsum very dark brown, most of ventral surface more reddish; length about 4.5 mm; 5th abdominal segment more deeply concave front to back; head adjacent to eyes shallowly depressed; punctures of head separated by a little less than diameter of a puncture; Brazil . . . . *minasensis* (Pic)

LIST OF SPECIES OF *CALYMMADERUS* IN KEY WITH SYNONYMY

alutaceus (Blair), 1928: 677.
argentifer (Pic), 1904b: 32.
attenuatus Pic, 1912a: 64.
  subattenuatus (Pic), 1911: 122.
bahiensis (Pic), 1904c: 37.
brasiliensis White, new name.
  punctatus (Pic), 1922: 5 (homonym).
brevipennis (Pic), 1900: 68.
brevis (Pic), 1904c: 37.
brevissimus (Pic), 1909: 170.
bruchi (Pic), 1912b: 455.
brunneonotatus (Pic), 1904b: 32.
caeruleus (Champion), 1913: 149.
canonicus (Fall), 1905: 222.
comatus (Champion), 1913: 150.
cribripennis (Pic), 1904b: 31.
dejeani (Pic), 1905b: 115.
donckieri (Pic), 1904a: 19.
dorcatomoides (Fisher), 1927: 49.
dufaui (Pic), 1906: 22.
erythrocephalus (Champion), 1913: 146.
exiguus (Gorham), 1886: 347.
funki (Pic), 1904a: 19.
galapagoensis (Blair), 1928: 676.
georgicus (Blair), 1928: 676.
germaini (Pic), 1907: 338.
gibbosiceps (Pic), 1904b: 31.
glaber (Gorham), 1883: 203.
humilis humilis (Pic), 1904c: 37.
  h. nitidissimus (Pic), 1904c: 37.
inaequalicollis (Pic), 1932: 11.
instriatus (Pic), 1922: 5.
laevis (Gorham), 1898: 327.
latipennis Pic, 1915b: 7.
metallicus (Pic), 1902a: 31.
minasensis (Pic), 1904c: 37.
mixtus (Fall), 1905: 221.
multimaculatus (Pic), 1922: 4.
nactus (Fall), 1905: 220.
nigricolor (Pic), 1904c: 37.
nigromaculatus (Pic), 1904b: 32.
nigronotatus (Pic), 1910: 46.
nitescens (Champion), 1913: 147.
oblongus (Gorham), 1883: 206.
ovulum (Gorham), 1883: 205.
pici White, new name.
  pubescens (Pic), 1902b: 55 (homonym).
pubescens (Gorham), 1883: 204.
punctatus (Gorham), 1883: 203.
punctulatus (LeConte), 1865: 236.
  viticola (Schwarz), 1878: 365.
pupatus (Gorham), 1883: 205.
rufescens (Pic), 1902b: 55.
  angustatus (Pic), 1904c: 37.
  gounellei (Pic), 1904c: 37.
rufomaculatus Pic, 1915b: 7.
rufonitens (Pic), 1904c: 37.
semirufus (Champion), 1913: 147.
sericeomaculatus Pic, 1915a: 9.
sharpi (Gorham), 1886: 348.
striatus (Gorham), 1883: 204.
subattenuatus (Pic), 1904c: 37.
subnotatus (Pic), 1904c: 36.
subopacus (Pic), 1904b: 31.
substriatus (Pic), 1922: 5.
subvestitus (Champion), 1913: 145.
tessellatus (Pic), 1900: 68.
testaceipes (Pic), 1905a: 92.
theresae (Pic), 1902a: 31.
throscoides (Gorham), 1883: 206.
variegatus (Pic), 1900: 68.
venezuelensis Pic, 1904a: 19.

LABEL DATA FROM *CALYMMADERUS TYPES*

The types of Pic are in the Muséum National d'Histoire Naturelle in Paris, those of Gorham, Champion, and Blair are in the British Museum of Natural

History in London, the three of Fall are in the Museum of Comparative Zoology at Harvard University, and the one of Fisher is in the National Museum of Natural History in Washington, D.C.

Below I note discrepancies between published data and data on type specimens.

Most Pic species are represented in his collection by single specimens that bear his handwritten type labels, so there is usually no need to designate lectotypes. In the instances where there was a series of specimens in the Pic collection representing a species (and in the collections of other authors), I have designated lectotypes and have affixed lectotype labels to pins bearing specimens.

C. alutaceus (Blair).—"James Island. Galapagos. In rotten wood. 25. 71 24. St. George Expedn. C. L. Collenette.; Type H. T.; Eupactus alutaceus Bl., Type, det. K. G. Blair."

C. angustatus (Pic).—"S. Antonio da Barra, Pr. de Bahia, Gounelle 11-12.88; Ech. no. 233, 1904, p. 37; type; TYPE: angustatus Pic."

C. argentifer (Pic).—"Caraca (Minas Geraez), Brésil, E. Gounelle I.2.1885; type; TYPE: argentifer Pic; Ech. no. 232."

C. attenuatus Pic.—"Rep. Argent.; TYPE; (undecipherable) = attenuata Pic (undecipherable)."

C. bahiensis (Pic).—"S. Antonio da Barra, Pr. de Habia, Gounelle 11-12.88; Ech. no. 233, 1904, p. 37; type; TYPE; bahiensis Pic."

C. brevipennis (Pic).—"Jatahy, Prov. Goyas. Brésil, Dec. 97–Janv. 98; Le Nat. no. 313, 15 Mars 1900 p. 68; type; TYPE; Th. brevipennis Pic."

C. brevis (Pic).—"Bresil, (Gounelle); accouplement; Ech. no. 233, 1904, p. 37; type; TYPE: brevis Pic."

C. brevissimus (Pic).—"889.; Guadeloupe (Dufau); type; TYPE; Eupactus brevissimus Pic."

C. brunneonotatus Pic.—"S. Antonio da Barra, Pr. de Habia, Gounelle 11-12.88; type; TYPE; brunneovittatus Pic." The published spelling of this name was *brunneonotatus.*

C. bruchi (Pic).—"Rep. Argentina, Proc. Mendoza, 190, *C.* Bruch; Eupactus n. sp.; type; TYPE; Bruchi Pic."

C. caeruleus (Champion).—"David, Chiriqui. Champion.; Sp. figured.; Type; Eupactus caeruleus Ch.; Wrongly named, figured as Lioolius punctatus; Tr. Ent. Soc. L. 1913. det. Champion.; Lioolius punctatus Gorham; B.C.A. Coll. III. (2). Lioolius."

C. canonicus (Fall).—"Santa Rosa Low, Cal, Cal.; 5; canonicus TYPE; M.C.Z. Type 24682; H. C. FALL COLLECTION: Eupactus canonicus Fall."

C. comatus (Champion).—Partial data follow: "Chontales, Nicaragua, Jansen; Type."

C. cribripennis (Pic).—"S. Antonio da Barra, Pr. de Bahia, Gounelle 11-12.88; type; TYPE; cribripennis Pic."

C. dejeani (Pic).—"Teapa; type; Ech. no. 293, 1905, p. 115; Thaptor dejeani Pic."

C. donckieri (Pic).—"151.; Sierra de Durango.; type; TYPE; Eupactus donkieri Pic." For a description of this species see White, 1973: 847.

C. dufaui (Pic).—"Anobium, 234 ter.; 8.; Guadeloupe, (Dufau); type; TYPE; Eupactus Dufaui Pic, n. sp.; Lectotype with L. Eupactus dufaui Pic, by R. White

'80." Two specimens are mounted together on this pin, and I have put an L. beside the specimen that I hereby designate as **lectotype**.

C. erythrocephalus (Champion).—"S. Geronimo, Guatemala., Champion.; Type; Eupactus erythrocephalus Ch.; B.C.A. Coll. III. (2)., Lioolius."

C. exiguus (Gorham).—"Syntype; Type; Honduras; Salle Coll.; Type; Eupactus exiguus Gorh.; Tr. Ent. Soc. L., 1913, det. Champion; Lioolius exiguus Gorh.; B.C.A. Coll., III. (2)., Lioolius." There are two specimens in the series of *C. exiguus*; I have added a lectotype label to the specimen with the above data and hereby designate it as **lectotype**.

C. funki (Pic).—"Cumana; type; TYPE: Eupactus funcki Pic." Correct spelling is *funki.*

C. galapagoensis (Blair).—"Syntype; Type H. T. [upside down]; Galapagos: Charles Island., At light. Sea level., July 1924., St. George Expedn., C. L. Collenette.; Thaptor galapagoensis Blr., Type, det. K. G. Blair." There are nine specimens in the Blair series, and I have added a label to the specimen with the above data and hereby designate it as **lectotype**.

C. georgicus (Blair).—"Charles Island. Galapagos. beaten from vegetation. 30.7.24. St. George Expedn. C. L. Collenette.; Type H. T.; Eupactus georgicus Blair, Type, det. K. G. Blair."

C. germaini (Pic).—"Bolivia, Germain?; [3 obscure or folded labels]; type; TYPE: Eupactus germaini."

C. gibbosiceps (Pic).—"Brésil, ét de Sao Paulo. Val dud Rio Pardo, E. Gounelle, 12-98; type; TYPE: gibbosiceps Pic."

C. glaber (Gorham).—"Duenas, Guatemala, G. C. Champion; Type; Type; Eupactus glaber Gorh.; Tr. Ent. Soc. L., 1913, det. Champion; B.C.A. Coll. III. (2). Lioolius; Syntype." Four specimens represent this species; two are mounted on a card on one pin. I have written an L, below one of these, and it is hereby designated as **lectotype**. The pin bears a lectotype label.

C. gounellei (Pic).—"S. Antonio da Barra, Pr. de Bahia, Gounelle 11-12.88; type; TYPE; Gounellei Pic." I hereby designate the specimen in the Pic series with these labels as **lectotype** and have added a lectotype label to it.

C. humilis humilis (Pic).—"Tijuca (Rio), Bresil, E. Gounelle, 12, 1884; Ech. no. 233, 1904, p. 37; type; TYPE; Humilis Pic."

C. humilis nitidissimus (Pic).—"Tijuca (Rio), Bresil, E. Gounelle, 12, 1884; Ech. no. 233, 1904, p. 37; type; TYPE; nitidissimus Pic."

C. inaequalicollis (Pic).—"Loja; type; TYPE; inaequalicollis n. sp."

C. instriatus (Pic).—"Corumba, Matt. Grosso; type; TYPE; Thaptor instriatus n. sp."

C. laevis (Gorham).—"Type; Sp. figured [upside down]; Type [upside down]; Leeward side, St. Vincent, W.I., H. H. Smith., 53.; W. Indies, 98.237.; Mirosternus laevis Gorh.; belongs to Eupactus Lec. = Lioolius Gorham."

C. latipennis Pic.—"Goyaz, Rio Verde; type; TYPE; latipennis Pic."

C. metallicus (Pic).—"N. Pérou, Prov. Tumbez, G. A. Baer; type; TYPE: metallicus Pic."

C. minasensis (Pic).—"Bresil (Minas), Sertao de Diamantina faz das Melancias E. Gounelle 10-11 1902; TYPE; minasiensis Pic." The spelling that was published is *minasensis.*

C. mixtus (Fall).—"Santa Rosa Low, Cal.; 22; mixtus TYPE; M.C.Z. Type 24683; H. C. FALL COLLECTION."

C. multimaculatus (Pic).—"Bresil (Minas), Campos de Diamantina, Faz. do Riacho Fundo, E. Gounelle 12 1902; Thaptor multimaculatus n. sp." Since this is the only member of the species I have found in the Pic collection, I hereby designate it as **lectotype**, for the specimen bears no type label. The data agree with that given by Pic, 1922: 5.

C. nactus (Fall).—"San Felipe Low, Cal; 6; nactus TYPE; M.C.Z. Type 24684; H. C. FALL COLLECTION; Eupactus nactus Fall."

C. nigricolor (Pic).—"S. Antonio da Barra, Pr. de Bahia, Gounelle 11-12.88; Ech. no. 233, 1904 p. 37; type; TYPE; nigricolor Pic."

C. nigromaculatus (Pic).—"Bresil, (Gounelle); type; TYPE; nigromaculatus Pic." In the original description (Pic, 1904b: 32) the locality is given as San Antonio da Barra. There are no such data on the specimen.

C. nigronotatus (Pic).—"Septembre; Rep. Arg.; type; TYPE; Th. nigronotatus Pic."

C. nitescens (Champion).—"V. de Chiriqui, 25–4000 ft., Champion.; ♀; Type; Eupactus nitescens Ch.; Tr. Ent. Soc. L., 1913., det. Champion.; B.C.A. Coll. III. (2)., Lioolius." In the original description the altitude is given as 3000 feet.

C. oblongus (Gorham).—"Cordova Mexico, Salle Coll.; Type; Type; Thaptor oblongus Gorham; B.C.A. Coll. III. (2)., Thaptor."

C. ovulum (Gorham).—"Chontales., Janson; Type; Syntype; Type; ♀; Eupactus ovulum Gorh.; Tr. Ent. Soc. L., 1913, det. Champion, Lioolius ovulum Gorham; B.C.A. Coll. III. (2)., Lioolius." Though there is but one specimen of this species in the British Museum, there were four specimens mentioned by Gorham, 1883: 205. For that reason I hereby designate this specimen as the **lectotype**.

C. pubescens (Pic).—"Jatahy, Prov. Goyas. Brésil, Dec. 97–Janv. 98; Le Nat. no. 360, 1902, p. 55; type; TYPE; Thaptor pubescens Pic." This is one of two specimens in the Pic collection, and I hereby designate it as **lectotype**.

C. pubescens (Gorham).—"David Chiriqui. Champion; Type; Eupactus pubescens Gorham; B.C.A. Coll., III. (2)., Lioolius."

C. punctatus (Gorham).—"Salle Coll.; Honduras; Type; Type; Eupactus punctatus Gor.; Lioolius punctatus Gorh. Type; Lioolius punctatus Gorham; Tr. Ent. Soc. L. 1913 det. Champion; B.C.A. Col. III (2), Lioolius."

C. punctatus (Pic).—"Corumba, Matt. Grosso; type; TYPE; rugestriatus n. sp.; Thaptor punctatus n. sp."

C. pupatus (Gorham).—"Syntype; Capetillo. Guatemala, C. Champion; Type; Type Sp. figured; Thaptor pupatus Gorham; B.C.A. Coll. III. (2)., Thaptor." There are eight specimens in the type-series; I hereby designate the specimen with the above data as **lectotype** and have so labeled it.

C. rufescens (Pic).—"S. Antonio da Barra, Pr. de Bahia, Gounelle 11-12.88; Le Nat. no. 360, 1902, p. 55; type; Type; Thaptor rufescens."

C. rufomaculatus Pic.—In the original description Pic, 1915, p. 8, gave the data as "Bresil: Tijuca (Gounelle)." I have a specimen that I compared with the type, but neglected to copy the type data when I examined it.

C. rufonitens (Pic).—"Bresil, Gounelle; Ech. no. 233, 1904, p. 37; type; TYPE: rufonitens Pic." In the original description Pic, 1904: 37, gave the datum Nova Friburgo; there is no such datum on the pin.

C. semirufus (Champion).—"Teapa Tabasco. Jan. H.H.S.; 1907-156; Type; Eupactus semirufus; Tr. Ent. Soc. L., 1913, det. Champion; B.C.A. Coll. III. (2)., Lioolius."

C. sericeomaculatus Pic.—"Mineiro, Goyaz; type; TYPE: sericeomaculatus Pic."

C. sharpi (Gorham).—"Jalapa Mexico, Hoege; Type; Thaptor sharpi; B.C.A. Coll. III. (2)., Thaptor."

C. striatus (Gorham).—"Chontales, Janson; Type; Type; Eupactus striatus Gorh.; Tr. Ent. Soc. L., 1913., det. Champion; Lioolius striatus Gorham; B.C.A. Coll. III. (2)., Lioolius; Syntype." There are four specimens in Gorham's series and I hereby designate as **lectotype** the specimen with the preceding labels and have added a lectotype label to the pin.

C. subattenuatus (Pic).—"S. Antonio da Barra, Pr. de Bahia, Gounelle 11-12.88; Exchange no. 233, 1903, p. 37; type; TYPE: subattenuatus Pic."

C. subattenuatus (Pic).—The data for this junior homonym (published by Pic, 1911: 122) are found under the name *attenuatus* (Pic).

C. subnotatus (Pic).—"Brésil; type; Exchange, no. 233, 1904, p. 36; TYPE; subnotatus Pic; Calymaderus (sic) brevicollis Sol.?"

C. subopacus (Pic).—"S. Antonio da Barra, Pr. de Bahia, Gounelle 11-12.88; type; TYPE; subopacus Pic."

C. substriatus (Pic).—"Goyaz, Rio Verde; n. sp. probabl; type; TYPE: Thaptor substriatus n. sp."

C. subvestitus (Champion).—"Mexico city, Höge; Type; Eupactus subvestitus Ch.; Tr. Ent. Soc. L.; 1913, det. Champion.; B.C.A. Coll. III. (2)., Lioolius; Syntype." There are only two specimens in the Champion series; I hereby designate as **lectotype** the specimen with the above labels, and have so labeled it.

C. tessellatus (Pic).—"Jatahy, Prov. Goyas, Bresil, Dec. 97–Janv. 98; Le Nat. no. 313, 15 Mars. 1900, p. 68; type; TYPE: Th. tessellatus Pic."

C. testaceipes (Pic).—I neglected to copy the type data when I examined the type. Pic, 1905a, p. 93, gave the locality as Cuba.

C. theresae (Pic).—"N. Perou, Prov. Tumbez, Grau, G. A. Baer; Anobiidae?; L. Ech. no. 208; type; TYPE; Thaptor; Theresae Pic."

C. throscoides (Gorham).—"Syntype; Capetillo, Guatemala, C. Champion; Type; Thaptor throscoides Gorham; Sp. figured; B.C.A. Coll. III. (2), Thaptor." There are 11 specimens in this series; I hereby designate as **lectotype** the specimen to which I have added a lectotype label.

C. variegatus (Pic).—"Jatahy, Prov. Goyaz. Brésil, Dec. 97–Janv. 98; Le Nat. no. 313, 15 maro(?) 1900, p. 68; type; TYPE: Th. variegatus Pic."

C. venezuelensis Pic.—"Fracatal, Venezuel.; type; TYPE; Eupactus venezuelensis."

CALYMMADERUS SPECIES OF UNCERTAIN STATUS

argentinus Pic, 1928: 99.
atronotatus Pic, 1924: 376.
bibliothecarum Poey, 1851: 228.
humilis latior Pic, 1927: 247.
mexicanus Pic, 1904a: 18.
pudicus Boheman, 1858: 86.
newmani Brèthes, 1919: 27.
suturalis Pic, 1902b: 55.

I have seen no specimens reliably identified as any of the above, so I am unable to assign the names.

SPECIES FORMERLY IN *CALYMMADERUS*

The species listed below were in error placed by their describers in *Calymmaderus* or in genera now synonymic with it. A reference is given to the paper in which each species was transferred to its correct genus.

Calymmaderus aeneus Pic, 1915a: 10; now *Oyarzuna aenea* (Pic) in Chrysomelidae, see White, 1972: 216.

Eupactus barranus Pic, 1904c: 37; now a synonym of *Stichtoptychus diversestriatus* (Pic), see White, 1980: 11.

Calymmaderus brevicollis Solier, 1849: 474; now *Stichtoptychus brevicollis* (Solier), see White, 1974a: 229.

Eupactus brunneus Pic, 1904c: 36; now *Calytheca brunnea* (Pic). Change made herein.

Calymmaderus granulosus Pic, 1923: 7; now *Stichtoptychus granulosus* (Pic), see White, 1974a.

Calymmaderus minutus Solier, 1849: 474; now *Stichtoptychus minutus* (Solier), see White, 1974a: p. 238.

Thaptor verdensis Pic, 1932: 11; now *Stichtoptychus verdensis* (Pic), see White, 1980.

KEY TO THE SPECIES OF *CALYTHECA*

1. Length about 2 mm; eyes small, separated by about 3× vertical diameter of an eye; head produced immediately in front of eyes; body stout, about 1.5× as long as wide; Peru .... *convexa* White
– Length 3–4 mm; eyes large, separated by 1.0–1.3× vertical diameter of an eye; head not produced in front of eyes; body elongate, about 1.8–2.0× as long as wide; Mexico and Brazil 2
2. About 2× as long as wide; each lateral process of antennal segments 4–7 about 2× as long as its segment; length 3.6–4.0 mm; Brazil .. *brunnea* (Pic)
– About 1.8× as long as wide; each lateral process of antennal segments 4–7 about 3–4× as long as its segment; length about 3.0 mm; Mexico .. .. *elongata* White

LIST OF SPECIES OF *CALYTHECA*

brunnea (Pic), 1904c: 36.
convexa White, 1974: 843.
elongata White, 1973: 844.

LABEL DATA ON *CALYTHECA* TYPES

The data on the types of the two species described by White are given in White, 1973. The data on the type of the Pic species are given below.

C. brunnea (Pic).—"Bresil, Et de Rio de Janeiro, Nova Freburgo, E. Gounelle 2-3-4 1903; Ech. no. 233, 1904, p. 36; Type; brunneus Pic."

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THE TYPE SPECIMEN OF *EUSISYROPA BOARMIAE* (COQUILLETT) AND A NEW SPECIFIC NAME FOR THE SPECIES (DIPTERA: TACHINIDAE)

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Abstract.—The correct lectotype of *Eusisyropa boarmiae* (Coquillett) is established from a detailed study of published and unpublished records. *Eusisyropa boarmiae* becomes a synonym of *E. blanda* (Osten Sacken), and *E.* ***sellersi*** is proposed as a new specific name for *boarmiae* of authors.

The problem of determining the correct name-bearing type specimen of *Exorista boarmiae* Coquillett, now in the genus *Eusisyropa,* proved to be such a mixture of zoology and nomenclature, taxonomic and museum practice, misidentifications of hosts and parasites, and labels and notes, that the case should be written up in detail.

The background: The two species involved, *Eusisyropa blanda* (Osten Sacken) and *E. boarmiae* (Coquillett), were classified in the genus *Exorista* at the beginning of this history, and much later in *Zenillia.* They were placed in a new genus *Eusisyropa* by Townsend (1908), and this genus is accepted today.

Coquillett (1897: 95) described *Exorista boarmiae* and listed his type series as follows: "Cotuid [sic] and Boston, Mass.; District of Columbia; and Camden, Ark. Four males and three females. Type No. 3591, U.S. National Museum." On page 13 in a list of rearing records of the species contained in his Revision, he listed the following for *E. boarmiae*: "Boarmia pampinaria *Guen.* Issued September 12, 1883, from a caterpillar received August 13 from J. B. Smith, Cotuid [sic], Mass." "Loxostege similalis *Guen.* Issued July 16, 1886, from a chrysalis received from W. F. Avera, Camden, Ark." In his description of the species he stated "femora usually, and generally the tibiae, yellow;" thus showing by color as well as by the distribution that in terms of present day knowledge his series was a mixture of the northern species *blanda* and the southeastern species *boarmiae.*

The pre-1897 material in the tray of *boarmiae* in the National Museum collection consists of the following (pin labels quoted in exact wording and sequence, with my notes in brackets):

Female: "3193° Par. on Cidaria on cranberry Iss. Sept. 12.83 [old label]/Ex Isturgia truncataria Wlk. [newer label by Aldrich, based on corrected identification by Dyar]/Cotuit, Mass. J. B. Smith/Type No. 3591 U.S.N.M. [old red National Museum label]/This spm. err. call. HT by Ald. but is only a PT. See note by Sellers/Zenillia blanda O.S. Det. Sellers." [This is the specimen recorded as reared from "*Boarmia pampinaria* Guen. (Coquillett 1897: 13). The host was cited as *Cymatophora pampinaria* by Townsend (1908: 98). Dyar's corrected identification of the host was *Epelis truncataria* Wlk.]

Female: "468 L° Nov 14.82/Paratype No. 3591 U.S.N.M. [red Museum label; labeler unknown]/LECTOTYPE ZENILLIA boarmani [sic] (Coq.) by Tns. 1908 [labeler unknown]/Exorista boarmiae Coq. [Coquillett's original label]/Zenillia boarmiae Coq. Det. Sellers." [As recorded by Townsend (1908: 98), this specimen issued on Nov. 14, 1882 from a larva of *Aletia* (now *Alabama) argillacea* (Hübner) received from Oxford, Miss. (C. V. Riley Notes, Bureau of Entomology)].

Female: "78^{o3} April 19/87/No notes at Bur. Ent. [Aldrich handwriting]/Eusisyropa blanda OS. Det. CHTT [Townsend label]/Zenillia boarmiae Coq. Det./Sellers" [Townsend (1908: 98) noted that the specimen was reared "from *Hyphantria textor* at Washington, D.C.," according to Riley Note 78^{o3} that was apparently lost by Aldrich's time. *H. textor* Harris is currently considered a synonym of *H. cunea* (Drury)].

Female: "359° Form a June 1/75/blanda OS sub-sp. No. 2" [No notes found in Bureau of Entomology cards].

Male: "185° Aug. 5.83/blanda OS/Ex[orista] hypenae Coq. MS" [No notes found in Bureau of Entomology cards. However, the locality Washington, D.C. can be established from Howard (1897: 46–47). Howard recorded that "early in August, 1883" larvae of *Hypena humuli* (Harris) were "found very abundantly upon a hop vine in a garden in Washington," and in the following weeks a number of moths were reared. Then, "from our 1883 lot of larvae we reared, on September 5, a Tachina fly to which Mr. Coquillett has given the manuscript name of *Exorista hypenae*." This was never described nor is it even mentioned by Coquillett (1897); apparently he abandoned it in favor of *boarmiae*. The date of August 5 on the label is undoubtedly the date of collection of the larvae. The first pupation of larvae occurred on August 15 and the first emergence of moths on August 24, and the appearance of a parasitic fly on September 5 would be reasonable].

Male: "Camden, Ark./439 L^{o1} Iss. July 16.88 [old label]/Ex Loxostege similalis/Paratype No. 3591 U.S.N.M." [red Museum label] [all labels but the old one are apparently by Aldrich, who recorded in his card file that he had looked up the specimens under Bureau Number 439. The Bureau of Entomology notes under that number confirm that the date was 1888 (cited in error by Coquillett 1897: 13 as 1886) and show that Coquillett first identified the parasites as *Exorista hypenae* Coq.].

Male: "439 L^{o1} Iss. July 16.88:" [See preceding note].

Coquillett's regular procedure was to place the Museum's red "type" label on only one specimen, and thus the other six of his original series of *boarmiae* were unlabeled as part of the type series and can only be deduced from locality or rearing records. The seven specimens that I have listed include three males and four females whereas Coquillett wrote "Four males and three females." The sexes are easily separated and their recognition is not in question. Was the printed statement by Coquillett a lapsus, a reversal of the numbers, or is one male missing here and one of the females not part of the original series? The question cannot be answered and I can only record what I find in the collection. The other male may turn up in another collection, as Aldrich often sent material as a gift or exchange.

The locality and host data are more significant. The female numbered 468 L°, considered "the type specimen" by Townsend (1908), was reared from a larva of *Alabama argillacea* collected at Oxford, Miss., and neither locality nor host is cited for *boarmiae* by Coquillett. On the other hand, Coquillett appears to have put the red type label on this specimen, judging from the testimony of both Townsend (1908) and Aldrich and Webber (1924). The latter stated that the Mississippi specimen "was erroneously labeled as type of *boarmiae,* but was not originally included," and they moved the type label from the Oxford, Miss., specimen to the Cotuit, Mass., specimen ("Obviously this specimen should be the type of *boarmiae,* and we have so labeled it.") In Aldrich's Card Catalogue he wrote on June 5, 1922 that "I changed the type label to this [the Cotuit specimen]."

Aldrich and Webber's "should be" referred to the fact that Coquillett gave the host of *boarmiae* as "*Boarmia pampinaria*" and Aldrich in particular believed that "if the specific name chosen is based on that of the host, the type must be one from that host" (Aldrich Card Catalogue, re type of *boarmiae*). Sellers (1943) maintained that Aldrich and Webber had presented no evidence to prove that the Mississippi specimen "was not one of the three original females" and he considered that their transfer of the type label was "under any circumstances . . . untenable." However, the fact remains that as far as the original description and host list are concerned, the Mississippi specimen "was not originally included" (Aldrich and Webber) and this was the real reason for their rejection. The relationship of name to host was their basis for choosing the Cotuit, Mass., specimen after the Mississippi specimen had been eliminated.

As for the Aldrich and Webber argument that the type "should be" the specimen reared from what was then known as "*Boarmia,*" Sellers wrote that "Similar instances indicate that Coquillett based his names not necessarily on the host rearing from which he selected the type specimen, but on the name of the host from which his records indicated that it was first reared." It could have happened that way, but that is not certain and moreover is irrelevant; the incontrovertible facts are that Coquillett cited the *Boarmia* record in his Revision (p. 13) but not that from *Alabama argillacea,* and that Oxford, Miss., is not listed as one of the original localities or states. The Museum's Type Book, with data entered by Coquillett himself on May 22, 1899, tells us simply "♂♀," "7" [specimens], and "Type." Perhaps the red type label was put on at that time, over a year after publication, and put inadvertently on a specimen not listed—perhaps also inadvertently—in the original publication. But this is speculation. We are confined to the facts as they appear in the publication.

A controversial question also affects this case: the status of the "Type No." system as used by Coquillett and many other authors of that period. Was it or was it not the designation of a single specimen as holotype when several specimens and especially several localities were mentioned? Probably this can be argued either way. I believe that in his "Revision of the Tachinidae" Coquillett recognized and designated a single name-bearing "Type" (i.e., a holotype). Stone and Knight (1955), who found mixed usage of labels in their work on the types of Culicidae, considered that the "Type No." on a single specimen out of two or more did mark the holotype, but stated further that "if this is not considered a validly proposed holotype, acceptance of such a specimen as type in this paper is to be considered as lectotype designation." I followed a similar procedure in dealing with a Coquillett species in the family Chloropidae, designating the "Type No." specimen as lectotype to obviate any further argument (Sabrosky, 1950). Ideally, one should designate as lectotype the specimen labeled as "Type" by Coquillett, thus making the same specimen the name-bearing type whichever side of the question is taken.

For *boarmiae,* however, the "Type No." was originally placed on a specimen that was apparently not originally included. On the basis of that type label, Townsend (1908) regarded the Mississippi specimen as "*the* typical specimen" [italics mine]. However, neither locality nor host was cited by Coquillett. It is possible, or course, that the absence of mention was a lapsus on Coquillett's part, but a lapsus in labeling "Type No." is also possible. Accepting at face value what is published, as I believe we must rather than speculate, I believe that the Mississippi specimen must be rejected as part of the type series, and thus it is ineligible to be considered as either holotype or lectotype. Lectotype designation from among the remaining specimens is necessary. In my opinion, this is not a case for neotype designation: rather, the improper placement of the type label resulted in fact in a series of syntypes.

The next designation is that of Aldrich and Webber (1924). The Cotuit, Mass., specimen that they recognized as type was definitely included by Coquillett, from a locality stated in the original description backed up by the details of date, host, and collector in Coquillett's list of parasites and their hosts. I conclude that the Aldrich and Webber designation must therefore be accepted as the first valid lectotype designation. The effect of recognizing this specimen, which is *Eusisyropa blanda* (Osten Sacken), is that *E. boarmiae* falls as a synonym of the older *blanda.* Inasmuch as *boarmiae* has no available synonyms, a new specific name must be proposed. I name the species *Eusisyropa sellersi* (**new name**), in recognition of Seller's useful revision of *Zenillia* and allies (1943), with the name made available by bibliographic reference to the diagnosis of *boarmiae* in Sellers' key to the species of *Zenillia* (1943: 6–7).

As for the host, the old notes of the Bureau of Entomology reveal the changes in the name. The number 3193 was assigned to a "*Cidaria* sp. on cranberry," a catchall generic name, but the species was later identified as *Boarmia pampinaria* Guénée, as Coquillett cited it. Later, *Boarmia* was considered a synonym of *Cymatophora,* and the latter was used in Townsend (1908). Still later, Dyar identified the host as actually *Epelis truncataria* (Walker), a species cited in the time of Aldrich and Webber (1924) and Sellers (1943) as *Isturgia truncataria.* Specialists in the family have now returned to *Epelis.*

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A NEW SPECIES OF *ACROBASIS* FROM MEXICO (LEPIDOPTERA: PYRALIDAE: PHYCITINAE)[1]

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Abstract.—*Acrobasis* ***mexicana***, n. sp., is described from the mountains of eastern Mexico. The species is closely related to *Acrobasis minimella* Ragonot and *Acrobasis blanchardorum* Neunzig of the United States.

Ragonot described *Acrobasis minimella* in 1889. The food plant of the larva of this species was subsequently determined to be oak (*Quercus* spp.) and the distribution of *minimella* established to be the southeastern United States (Heinrich, 1956). In 1973, I described the closely related species *Acrobasis blanchardorum* whose larval stage also feeds on oak (Neunzig, 1977), but in the southwestern United States. The present paper describes another species of *Acrobasis* collected in Mexico that has close affinities to both *A. minimella* and *A. blanchardorum.* The new species is also thought to feed on oak as a larva.

Acrobasis mexicana **Neunzig, New Species**

Figs. 1–3

Description.—Wing expanse 15–17 mm.

Head mostly fuscous with some reddish-brown scales anteriorly and tan to reddish tan dorsoposteriorly. Labial palpus mostly fuscous and reddish brown with white on inner surface and at basal ¼. Antenna with basal segment fuscous and reddish brown; sensilla trichodea on shaft about as long as width of shaft at sinus; 3 to 4 closely grouped, short, slightly thickened spinelike sensilla at distal aspect of sinus.

Collar reddish tan. Thorax predominately fuscous dorsally. Black sex-scaling absent on thorax.

Forewing with costa straight to slightly convex, mostly fuscous, with a relatively distinct white patch of scales in basal area near scale ridge and costa, and another white patch in anterior median area; additional less conspicuous white-tipped scales forming posterior of antemedial line, postmedial line, and in terminal area; basal area with many reddish-brown scales in addition to white and fuscous scales; triangular costal patch following antemedial line black, sometimes with a few scattered reddish-brown scales; raised-scale ridge black with few reddish-brown

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Fig. 1. *Acrobasis mexicana,* male holotype.

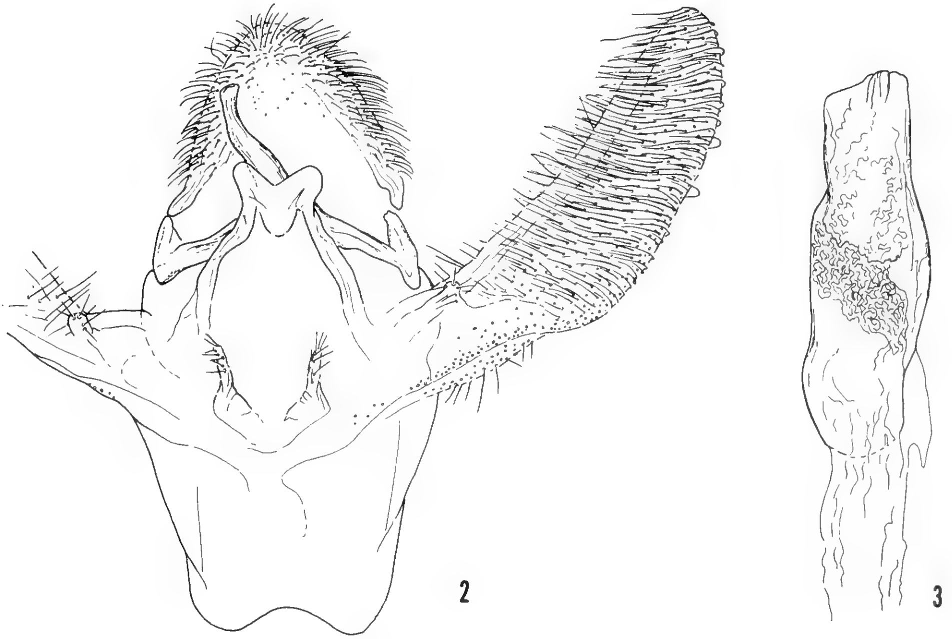
scales; area between scale ridge and antemedial line pale brown; posterior median area with many reddish-brown scales in addition to white and fuscous scales; discal spots separate, distinct; undersurface with short, brownish-white costal streak basally and without black sex-scaling. Hindwing pale smoky fuscous; undersurface without black sex-scaling.

Genitalia with apical process of gnathos a simple, elongate hook; terminal margin of transtilla distinctly concave; anellus a relatively short, slightly wrinkled U-shaped plate; base of valva with more or less half-round prominent protuberance; aedeagus simple.

Holotype.—Mexico: Nuevo Leon, 18 mi. W. of Linares, ♂, 12-IX-76, black light, J. A. Powell and J. A. Chemsak. ♂ genitalia slide HHN 584; in The California Academy of Sciences, San Francisco (on indefinite loan from the University of California, Berkeley).

Paratypes.—Mexico: Nuevo Leon, 2 ♂, 30 km W. of Linares, 29-VII-81, H. H., C. M., and K. M. Neunzig. Mexico: Tamalipas [sic], 1 ♂, 12 mi. SW Ciudad Victoria, 4000′, at lights, 17/18-IX-76, J. A. Chemsak and J. Powell. One of the paratypes collected 29-VII-81 is in the National Museum of Natural History, Washington, D.C., and the other is in the North Carolina State University Insect Collection. The paratype collected 17/18-IX-76, is in the University of California Insect Collection, Berkeley.

Larval Host.—The food plant of the larva of *A. mexicana* is not known. However, in all likelihood it is oak (*Quercus*) because of the great similarity among the adults of *A. mexicana, A. minimella,* and *A. blanchardorum.* Also, I found



Figs. 2, 3. *Acrobasis mexicana.* 2, Male genitalia, aedeagus removed. 3, Aedeagus.

serpentine frass and silk tubes similar to those formed by larvae of *A. minimella* and *A. blanchardorum* on the undersurface of oak leaves at the type-locality and at several other locations in Mexico.

Distribution.—Presently known with certainty only from the Sierra Madre Oriental of Nuevo Leon and Tamaulipas, Mexico. However, it is reasonable to assume that the species occurs throughout most of the moderately high elevations of Mexico where oak is generally a common component of the vegetation; frass and silk tubes probably constructed by *A. mexicana* were found on *Quercus* spp. as far south as El Palomar, Oaxaca, Mexico, in the Sierra de Las Mixtecas.

Discussion.—*Acrobasis mexicana* can be distinguished from all other North American species of *Acrobasis,* except *A. minimella* and *A. blanchardorum,* in that males possess a distinct raised transverse ridge of scales on the forewings in combination with a simple, single-hooked gnathos. All other North American *Acrobasis* with a distinct ridge of scales on the forewings have a trifurcate gnathos.

The most obvious difference separating *A. mexicana* from *A. minimella* and *A. blanchardorum* is the complete absence in males of *A. mexicana* of black sex-scaling on the undersurface of both forewings and hindwings. Both *A. minimella* and *A. blanchardorum* males have a long streak of distinct black scales on the undersurface of the forewings just below the costa and another long black streak in a similar location on the hindwings. In addition, *A. mexicana,* while having a similar color pattern to *A. minimella* and *A. blanchardorum* on the uppersurface of the forewings, is noticeably less brightly colored. Both *A. minimella* and *A. blanchardorum* have obvious red or purple scales on the thorax and forewings; these scales are more brown or reddish brown in *A. mexicana.* In addition, the ochreous patch following the scale ridge of *A. minimella* and *A. blanchardorum* is a dull pale brown in *A. mexicana.* The male genitalia of *A. mexicana, A. minimella,* and *A. blanchardorum* are similar. The terminal margin of the transtilla of *A. mexicana* appears to be more concave than in the other two species.

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THE FIRST RECORD OF *NEMATUS* PANZER FROM SOUTH AMERICA: A NEW SPECIES FROM ARGENTINA (HYMENOPTERA: TENTHREDINIDAE)

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Abstract.—*Nematus* ***desantisi***, n. sp., is described. Specimens were taken from *Salix humboldtiana* in Chubut, Argentina. This is the first South American record for the genus *Nematus*.

The species described below represents the first record of the genus *Nematus* and only the third species of the subfamily Nematinae in South America. The other Nematinae are *Pristiphora brasiliensis* Malaise (1942) and *P. plaumanni* Wong (Wong and Benson, 1965), both from Santa Catarina, Brazil. Wong (1976) also described *P. mexicana* from Oaxaca, Mexico, and gave a key to the three species of *Pristiphora* south of the United States.

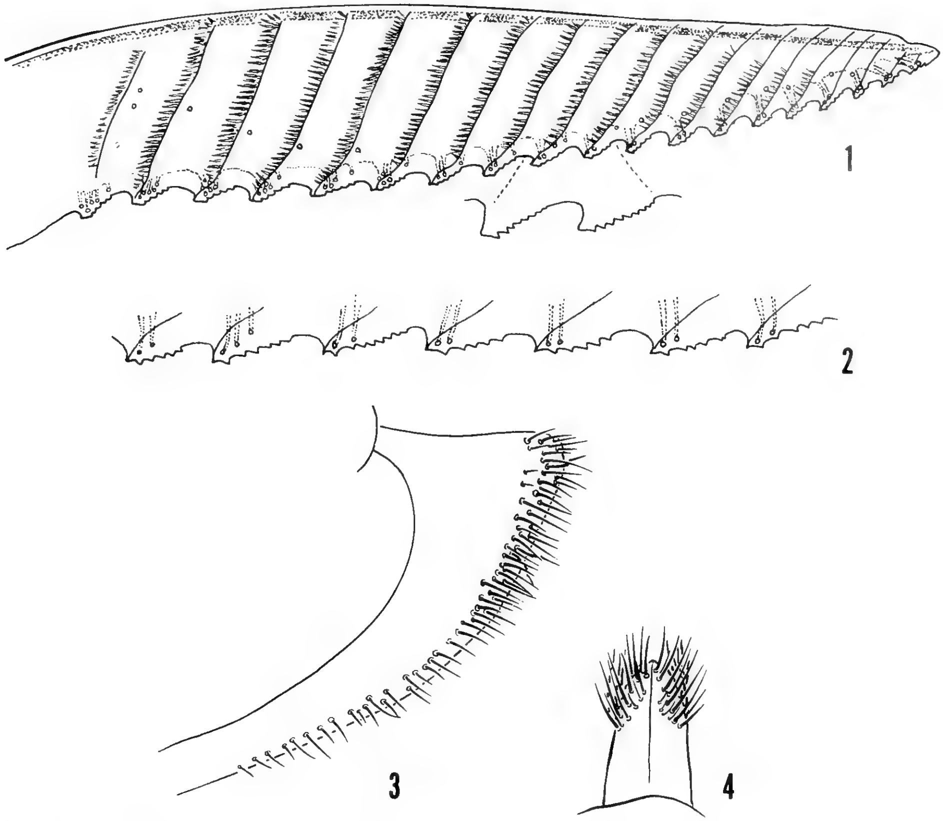
The Nematinae are abundant in the Northern Hemisphere, where they are the dominant sawfly group in the boreal and arctic regions. Only a few species are found in the Southern United States and extreme northern Mexico. The usual hosts for many Nematinae, including *Nematus*, are *Salix* spp. and *Populus* spp. It was therefore surprising, but not entirely unexpected, to discover a species of *Nematus* from Chubut, Argentina, taken from *Salix humboldtiana* Willdn. Though there is the possibility that it is an introduced species, several characteristics separate it from related species in the Northern Hemisphere. These warrant its treatment as a new species and most probably a species endemic to Argentina.

Specimens were sent to me by Ing. Agr. Dr. Luis De Santis, Facultad de Ciencias Naturales y Museo, Universidad Nacional de La Plata, La Plata, Argentina, for whom the species is named.

Nematus desantisi **Smith, NEW SPECIES**

Figs. 1, 3, 4

Female.—Length, 5.2–7.0 mm. Antenna black, undersurface of scape and flagellum brown to reddish brown. Head and body generally orange to pale yellow (probably green when alive), with following darker orange: dorsum of head, mesonotum, metanotum, dorsum of abdomen, tibiae, tarsi, and sheath; following pale yellowish: mouthparts, area below antennae, inner orbits narrowly, pronotum, tegula, thorax laterally and ventrally, abdomen laterally and ventrally, coxae, trochanters, and femora; and following black: mesopostnotum, except laterally, metapostnotum, except laterally, small spot on or most of parapsis, and apical margin of sheath. Wings hyaline; costa and stigma yellow or orange yellow (probably green when alive), remaining veins brownish.



Figs. 1–4. Figs. 1, 3–4. *Nematus desantisi.* Fig. 2. *N. oligospilus.* 1, Lancet, with enlargement of two serrulae. 2, Enlargement of central serrulae. 3, Sheath, lateral view. 4, Sheath, dorsal view.

Antennal length 3× head width; 1st segment as long as broad; 2nd segment broader than long; 3rd segment slightly shorter than 4th segment; segments 4–9 gradually decreasing in length. Clypeus circularly emarginated at center for about ⅓ its medial length, with rounded lateral lobes; malar space about 1⅓× diameter of an ocellus and slightly more than distance between antennae; postocellar area 2× broader than long, rounded behind; ratio of distances between hindocellus and eye, between hindocelli, and between hindocellus and posterior margin of head: 1.4:1.4:1.2; inner margins of eyes subparallel, slightly diverging below, lower interocular distance slightly more than upper interocular distance, lower interocular distance 1⅔× eye length. Head and thorax shining, without microsculpture; abdomen with fine reticulate microsculpture. Hindbasitarsus equal in length to 3 following tarsal segments combined. Sheath (Figs. 3, 4) straight to slightly concave above, rounded below in lateral view; in dorsal view broad at base and tapering to rounded apex with hairs short and straight, not curved inward. Lancet (Fig. 1) with about 20 serrulae; serrulae relatively deep, each truncated at apex, without anterior teeth, and with about 7–9 coarse posterior subbasal teeth; segments curved posteriorly toward dorsal margin, apical 5 or 6 segments without hairs or with hairs only on ventral portion; segmental hairs not dense, not overlapping each other; small notch at apex on dorsum.

Male.—Unknown.

Types.—Holotype ♀ and 22 ♀ paratypes from Valle del Rio Chubut, Chubut, Argentina, host *Salix* spp., 16-II-1981. According to De Santis (personal communication) from *Salix humboldtiana.* Holotype and 12 paratypes returned to Universidad Nacional de La Plata, remaining paratypes in the National Museum of Natural History, Smithsonian Institution, Washington, D.C.

Discussion.—The rather deep serrulae of the lancet, the notch at the apex of the lancet on the dorsum, the mostly orange to yellow-orange coloration (only some black on the parapsis, mesopostnotum, and metapostnotum), and the shining, unsculptured mesopostnotum are features that will distinguish *desantisi.* In most characteristics except the preceding, it is very similar to *N. oligospilus* Foerster, a common holarctic species associated with *Salix* spp.; however, *oligospilus* has relatively shallow serrulae (compare Figs. 1, 2), lacks the notch at the apex on the dorsum, has more black (the vertex, postocellar area, lobes of the mesonotum, metanotum, and spots on the abdominal dorsum), and has fine, striate microsculpture on the mesopostnotum. These characters are more than adequate to separate species of *Nematus* in the Northern Hemisphere and therefore justify *desantisi* as a separate species endemic to South America.

ACKNOWLEDGMENTS

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85(2), 1983, pp. 263–271

LEPYRONIA COLEOPTRATA (L.), A EUROPEAN SPITTLEBUG IN EASTERN NORTH AMERICA: NEW LOCALITY RECORDS AND NEW KEY TO THE NORTH AMERICAN SPECIES OF *LEPYRONIA* AMYOT AND SERVILLE (HOMOPTERA: CERCOPIDAE)

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Abstract.—Recognition features, known distribution, predators, host plants and other aspects of the biology of the introduced Palearctic species, *Lepyronia coleoptrata* (L.), are discussed. New locality records in eastern North America are listed and mapped. A brief diagnosis of the last-instar nymph is given, and a new key to adults of the species of *Lepyronia* in North America is provided. Photographs of the dorsal and lateral habitus of *L. coleoptrata* and the lateral habitus of the three native species are provided. The male genitalia of all species of *Lepyronia* occurring in North America are illustrated.

The spittlebug genus *Lepyronia* Amyot and Serville is represented in America north of Mexico by the native species *angulifera* Uhler, *gibbosa* Ball, and *quadrangularis* (Say), and by *coleoptrata* (L.), an introduced species. The presence of *L. coleoptrata* in North America was first verified by Russell (1962), based on a collection of specimens from various localities in New York State in 1955 and 1961. Those specimens collected in 1961 were submitted for identification by D. D. Hardee, Cornell University, Ithaca, New York.

Previous to Russell (1962), several authors reported *L. coleoptrata* from North America, but these earlier records cannot be confirmed. Oshanin (1906), the first to report *L. coleoptrata* in North America, provided the record "Regio nearctica (America septentrionalis)." A Palearctic and Nearctic distribution for *L. coleoptrata* is also listed in other European works, e.g., Lallemand (1912), Haupt (1922), and Holgersen (1944). In the North American literature, Van Duzee (1917) provisionally listed *L. coleoptrata,* commenting "Oshanin credits this species to North America, but I am unable to trace his authority. If found here it is probably Alaskan." Doering (1930), who provided the first comprehensive review of the North American species of *Lepyronia,* apparently did not examine examples of *coleoptrata.*

Each of the three native species of *Lepyronia* are reasonably well known and aspects of their biology have been discussed by a number of North American workers (Doering, 1923, 1930, 1942; Garman, 1923; Hanna and Moore, 1966). *Lepyronia angulifera,* the smallest North American species (4.0–6.1 mm long), is

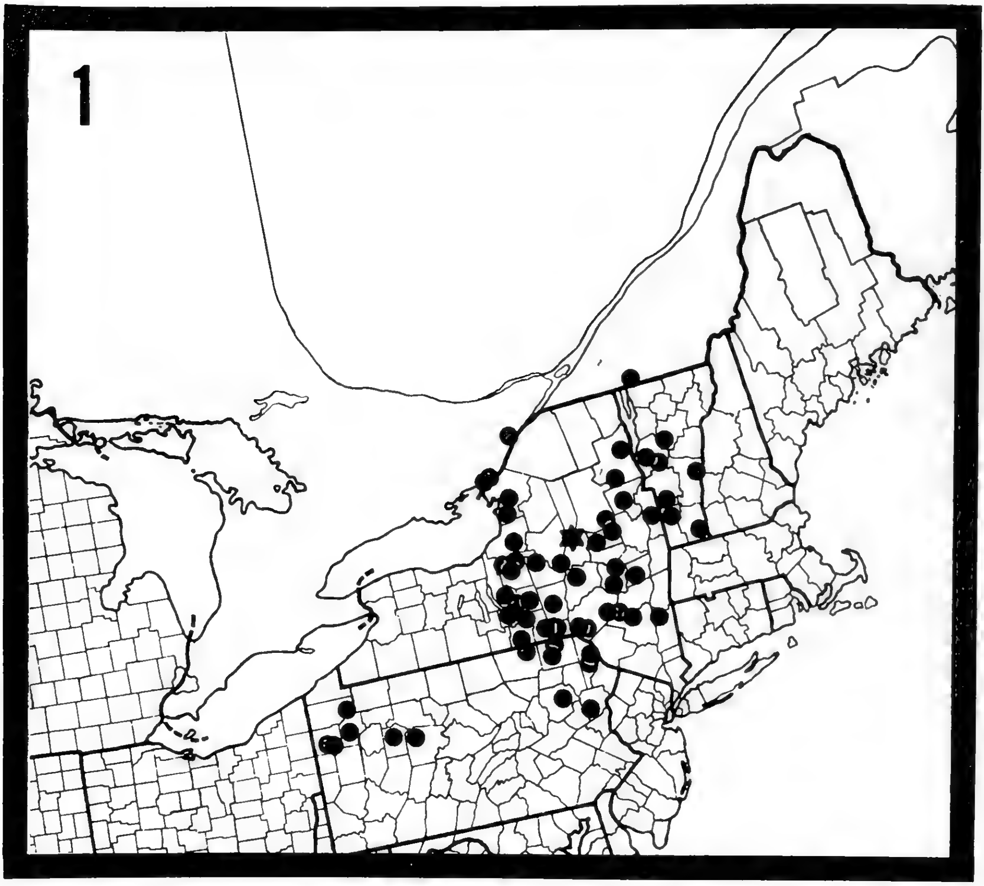


Fig. 1. Known distribution of *Lepyronia coleoptrata* in eastern North America (based on records presented herein; earliest record seen from Cold Brook, N.Y., in 1940 (star)).

found chiefly along the coastal areas of eastern United States from Massachusetts to Florida and from the Great Lakes region (Hanna and Moore, 1966). *Lepyronia gibbosa,* the largest North American species (6.9–9.6 mm long), is found primarily in the central and western U.S., with populations known from the relict prairies of Michigan (Hanna and Moore, 1966). The most commonly collected and widespread species in eastern North America is *L. quadrangularis* (5.8–8.5 mm long).

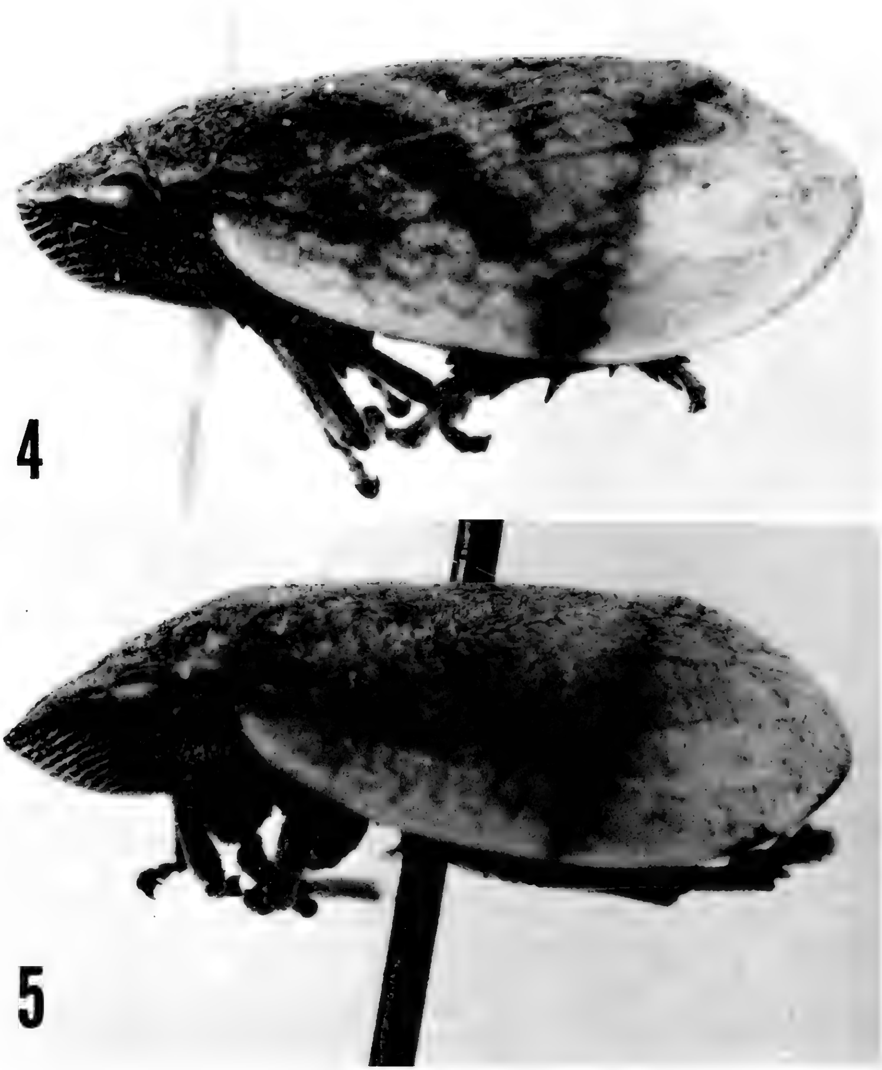
Russell (1962) provided the only detailed information for separating *L. coleoptrata* from the other North American species of *Lepyronia. Lepyronia coleoptrata* (Figs. 2, 3) may easily be distinguished by the broadly curved anterior margin of the head, by the distinctly wider than long tylus, by the strongly inflated frons (Fig. 4), and by the male genitalia (Fig. 8). Because *L. coleoptrata* closely resembles *quadrangularis* in size (5.3–7.9 mm long) and dorsal markings, the two species may be confused; in fact, specimens of *coleoptrata* have been found intermingled with those of *quadrangularis* in various collections in eastern North America.

Figs. 2–3. *Lepyronia coleoptrata,* dorsal habitus of adult. 2, Male. 3, Female.

In the Old World, *L. coleoptrata* is a common and widespread species, occurring throughout Scandinavia; western, central, and southern Europe; northern Africa; and most of Asia (including Asia Minor, China, Russia, Korea, and Japan) (Metcalf, 1962).

New North American records of *L. coleoptrata* have resulted from the USDA-APHIS "High Hazard Pest Survey" program, examination of Cornell student collections now incorporated in the University collection, examination of several institution and university collections in the eastern U.S. and Canada, collections made by or communicated by A. G. Wheeler, Jr. (Pennsylvania Department of Agriculture, Harrisburg, Pa.), and authors' personal collecting. In the list below, the following acronyms identify those collections (institution or personal) from which new records were obtained: USNM (National Museum of Natural History, Washington, D.C.); CNC (Canadian National Collection, Ottawa); CUIC (Cornell University Insect Collection); AGW (A. G. Wheeler, Jr.); ERH (E. R. Hoebeke); and KGAH (specimens observed in the field by K. G. A. Hamilton, but not retained). The USDA-APHIS "High Hazard Survey" program is identified by the acronym (HHS). Collections of the American Museum of Natural History, New York, N.Y., the New York State Museum and Science Service, Albany, N.Y., and The Pennsylvania State University, University Park, Pa., also were checked closely, but no specimens of *L. coleoptrata* were discovered.

Nine New York counties (Broome, Cortland, Delaware, Herkimer, Lewis, Montgomery, Onondaga, Saratoga, and Schenectady) were listed by Russell (1962) as the first confirmed North American records for *L. coleoptrata.* The following



Figs. 4–5. Species of North American *Lepyronia,* lateral aspect. 4, *L. coleoptrata.* 5, *L. gibbosa.*

records extend the known distribution of *L. coleoptrata* in northeastern North America (Fig. 1). The earliest record of *L. coleoptrata* available to us was a specimen collected at Cold Brook, N.Y. (Herkimer Co.) in 1940 (represented by solid star in Fig. 1).

UNITED STATES: NEW YORK: *Albany Co.,* Rensselaerville, July, 1965 and 1980 (CUIC). *Broome Co.,* Binghamton, July, 1979 (KGAH); Windsor, July, 1979 (KGAH). *Cayuga Co.,* Genoa, July, 1974 (CUIC). *Chenango Co.,* Oxford, July, 1975 (CUIC). *Cortland Co.,* Cortland, September, 1980 (CUIC). *Delaware Co.,* Cadosia, June and July, 1977, ex: weeds and parsnip (AGW); East Branch, July, 1979 (KGAH); Hale Eddy, July, 1979 (KGAH); Margaretville, July, 1979

(KGAH). *Dutchess Co.,* Barrytown, July, 1979 (KGAH). *Essex Co.,* Elizabethtown, July, 1979 (KGAH); Schroon Lake, July, 1979 (KGAH). *Fulton Co.,* Sacandaga, July, 1979 (KGAH). *Hamilton Co.,* Wells, July, 1979 (KGAH). *Herkimer Co.,* Cold Brook, June, 1940 (CUIC). *Madison Co.,* Sullivan, August, 1978, ex: corn (HHS). *Onondaga Co.,* Cicero, July, 1979 (KGAH); Plainville, July, 1979 (KGAH); Westvale, June, 1964 (CUIC). *Schoharie Co.,* Esperance, July, 1979 (KGAH); North Blenheim, July, 1979 (KGAH); Sloansville, July, 1955 (CNC); county label only, July, 1974 (AGW). *Tioga Co.,* Lounsberry, July, 1979 (KGAH); Richford, July, 1960, ex: *Asclepias syriaca* (CUIC). *Tompkins Co.,* Brooktondale, July, 1975, ex: *Chrysanthemum leucanthemum* (CUIC); Ithaca, September and October, 1979 and 1981 (CUIC); McLean, June, 1975, 1977, 1978 and July, 1976 (CUIC); Ringwood, July, 1978 (CUIC); Salmon Creek Valley, July, 1980, and June, 1981 (ERH); Virgil, July, 1964 (CUIC). *Ulster Co.,* Boiceville, July, 1979 (KGAH); Highmount, July, 1979 (KGAH). *Washington Co.,* county label only, July, 1971, ex: weeds (CUIC).

The following New York localities, obtained from specimens in the USNM collection, were not listed by Russell (1962), although they were originally collected by D. D. Hardee in July, 1961: *Albany Co.,* Berne. *Chenango Co.,* North Norwich. *Essex Co.,* Minerva. *Fulton Co.,* Oppenheim. *Jefferson Co.,* [Pierrepont] Manor? *Oneida Co.,* Bridgewater. *Oswego Co.,* West Amboy. *Otsego Co.,* West Exeter. *Schoharie Co.,* Livingstonville. *Warren Co.,* The Glen. *Washington Co.,* Argyle.

PENNSYLVANIA: *Bradford Co.,* Windham Twp., August, 1979, ex: hay (HHS). *Clearfield Co.,* nr. Dubois, August, 1981 (AGW). *Crawford Co.,* Titusville, August, 1981 (AGW). *Jefferson Co.,* Brookville, August, 1981, (AGW). *Luzerne Co.,* Rice Twp., July, 1981, ex: sweeping vegetation (AGW). *Mercer Co.,* Grove City, June, 1979 (AGW); Mercer and Cool Spring Twp., August, 1981 (AGW). *Monroe Co.,* Kresgeville, August, 1979, ex: corn (HHS). *Susquehanna Co.,* Dimock, August, 1979, ex: hay (HHS); Great Bend, July, 1981, ex: sweeping vegetation (AGW). *Venango Co.,* Polk, August, 1981 (AGW). *Wayne Co.,* Damascus Twp., July, 1981, ex: *Rhododendron* (AGW); Cherry Ridge Twp., July, 1979, ex: mixed hay (HHS).

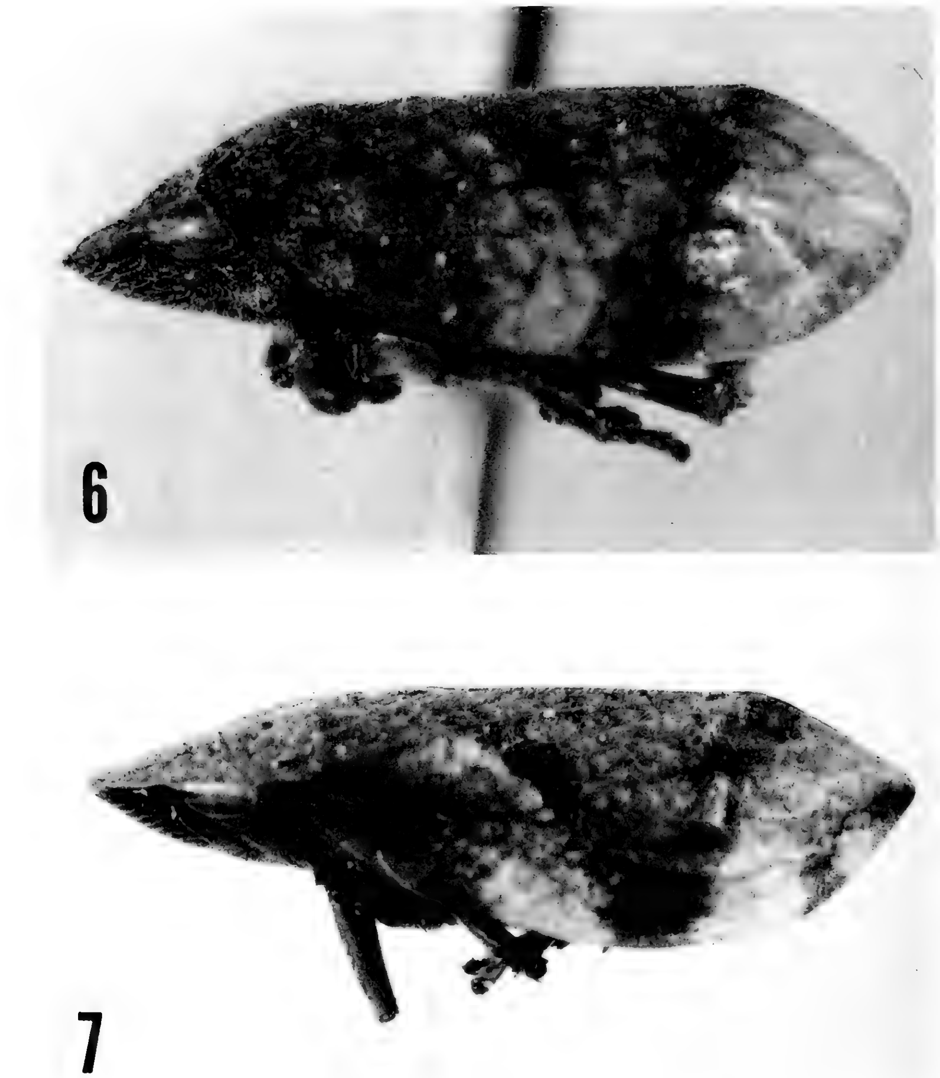
VERMONT: *Addison Co.,* Bridport, June, 1979 (KGAH); Hancock, July, 1979, ex: chickory (CNC); Ripton, July, 1979 (KGAH); Shoreham, June, 1979 (KGAH). *Bennington Co.,* Manchester Depot, June, 1979 (KGAH). *Rutland Co.,* Pawlet, June, 1979 (KGAH). *Washington Co.,* Warren, July, 1979 (KGAH). *Windsor Co.,* White R. Jct., July, 1979, ex: wild strawberries (CNC).

CANADA: ONTARIO: *Grenville Co.,* Spencerville, July, 1979 (CNC). *Leeds Co.* (Thousand Islands), Georgina Isl., August, 1976 (CNC); Grenadier Isl., July, 1975 (CNC); Hill Isl., July, 1979 (KGAH); Mulcaster Isl., June, 1975 and September, 1976 (CNC).

QUEBEC: Frelighsburg, June, 1976, ex: weeds (CNC).

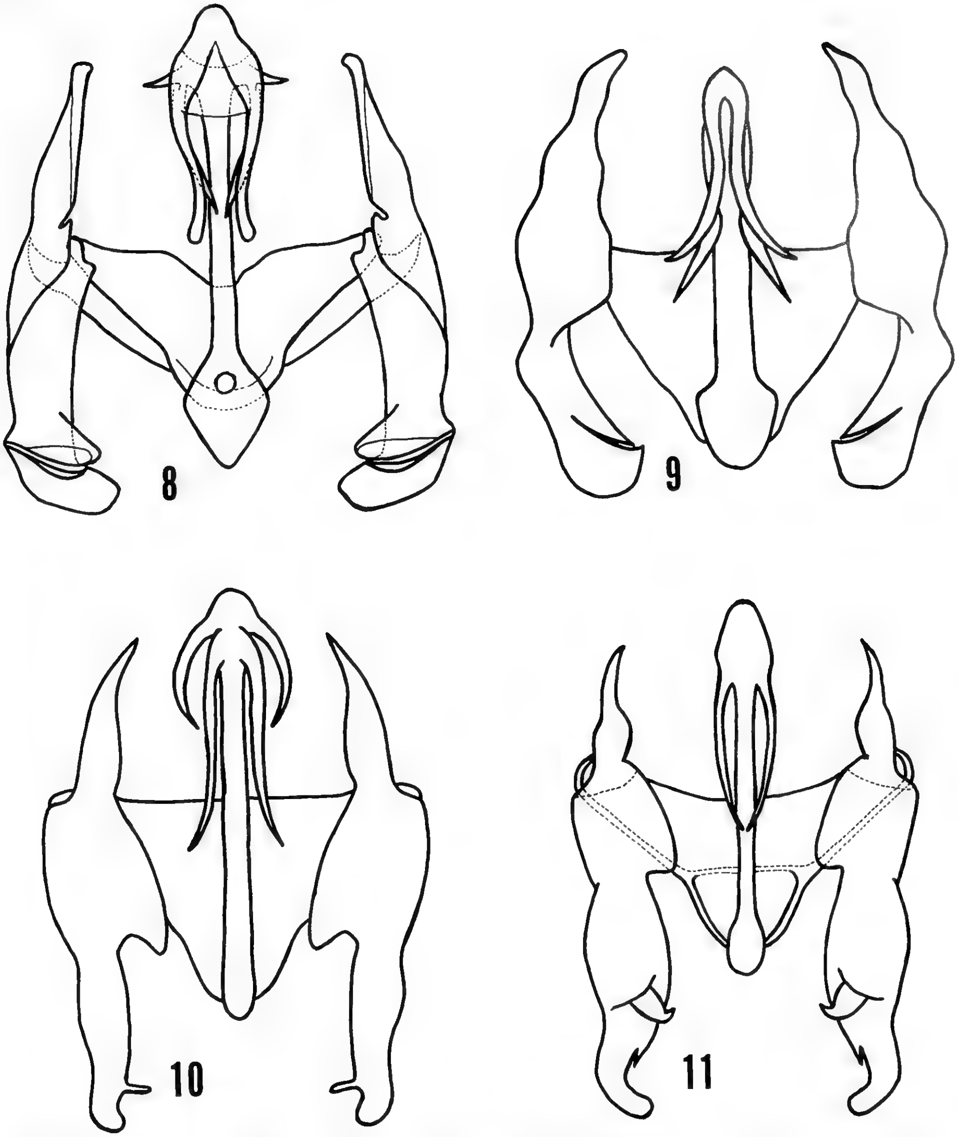
Information on the bionomics and seasonal history of *L. coleoptrata* is available primarily from the European literature. The species is univoltine with adults found from late June to early September (Dlabola 1954; Ossiannilsson 1981). It overwinters in the egg stage (Müller 1957) or in the nymphal stage (Kuntze 1937).

Lepyronia coleoptrata is a general feeder, with numerous host plants recorded in the literature. Haupt (1935) listed willow spp. (*Salix*) and the labiate *Teucrium chamaedrys* L. as food plants. The legume *Spartium junceum* L. and certain



Figs. 6–7. Species of North American *Lepyronia*, lateral aspect. 6, *L. angulifera*. 7, *L. quadrangularis*.

cultivated herbs (including salvia and rosemary) have been recorded as hosts (Silvestri, 1934), while Alkhazishvili (1953) listed cotton (*Gossypium* spp.). Ossiannilsson (1951) provided an exhaustive list of host plants, which included various woody phanerogams (*Salix* spp., especially *S. repens* L.; *Populus tremula* L.; *Betula pubescens* Ehrh.; *Corylus avellana* L.; *Vaccinium myrtillus* L. and *V. uliginosum* L.) and many herbaceous phanerogams (*Carex* spp. and other grasses; species of *Trifolium, Potentilla, Filipendula, Galium, Plantago, Taraxacum* and many others). Linnavuori (1949) added *Phragmites, Solanum dulcamara* L., and *Caltha palustris* L. to the list of host plants. *Lepyronia coleoptrata* was one of



Figs. 8–11. Species of North American *Lepyronia,* male genitalia. 8, *L. coleoptrata.* 9, *L. gibbosa.* 10, *L. angulifera.* 11, *L. quadrangularis.* (Figs. 9–11 redrawn from Doering, 1930.)

several homopterans occurring regularly on alfalfa (lucerne) in Yugoslavia in 1962 (Tanasijevic, 1964). Additional host plant data taken from specimens used in the present study include: brome grass, timothy grass, red and alsike clover, alfalfa, corn, hay, oats, parsnip, *Asclepias syriaca* L., *Chrysanthemum leucanthemum* L. and *Rhododendron.*

At Hancock, Vermont, adults of *L. coleoptrata* were taken (by KGAH) together with nymphs, which had formed many spittle masses on chickory (*Cichorium intybus* L.), including several on single stems. The spittle masses were generally supported by the leaf axils. No masses were observed on the many other weeds, grasses and trees in the area, which appears to indicate a strong food preference for the immatures. The adults, by contrast, were not confined to chickory.

Few parasites or predators of *L. coleoptrata* have been recorded. Grandi (1934) reported that in Italy the nyssonine sphecid *Stizus tridens* F. provisions its nest with this cercopid.

Ossiannilsson (1951) provided a key to separate the nymphal stages of six species (including *L. coleoptrata*) of Cercopidae found in the region of Uppsala, Sweden. The dorsal habitus of the last-instar nymph of *coleoptrata* also was illustrated in Ossiannilsson (1951, 1981). The nymph can be characterized by the following diagnosis: head and thorax sharply marked with black, anterior margin of head also marked with a broad black, transverse stripe, and abdomen with a distinct, light, median stripe throughout its length.

The following new key to adults of North American *Lepyronia,* incorporating those characters that are easiest to use, is drawn predominantly from the characters and measurements given by Russell (1962).

KEY TO NORTH AMERICAN SPECIES OF *LEPYRONIA*

1. Frons moderately to strongly inflated in profile (Figs. 4, 5); elytron strongly curved on costal margin, narrowly curved at apex 2
– Frons flattened or weakly inflated (Figs. 6, 7); elytron moderately curved on costal margin, angular at apex 3
2. Frons strongly inflated (Fig. 4); anterior margin of head broadly curved; elytron usually with a dark brown to blackish V-shaped design with both anterior and posterior arms uniform in width; light to dark brown dorsally, predominantly dark brown to black ventrally; length 5.3–7.9 mm; male genitalia as in Fig. 8; a Palearctic species, in North America known only from Quebec to Pennsylvania .... *coleoptrata* (L.)
– Frons moderately inflated (Fig. 5); anterior margin of head narrowly curved; elytron usually without a distinct V-shaped design, or else anterior arm narrower than posterior arm, or broken, or obscure; light to dark tawny or grayish dorsally, predominantly tawny to dark brown ventrally; length 6.9–9.6 mm; male genitalia as in Fig. 9; known primarily from central and western U.S. .... *gibbosa* Ball
3. Small species, 4.0–6.1 mm long; medium to dark brown dorsally and ventrally; elytron usually with a light spot slightly before, and one at, apex; male genitalia as in Fig. 10; known from coastal areas of eastern U.S., from Massachusetts to Florida; also known from Michigan ..... *angulifera* Uhler
– Large species, 5.8–8.5 mm long; tawny to dark brown or grayish dorsally and ventrally; elytron usually with a dark brown V-shaped design, with anterior arm sometimes broken or obscure; male genitalia as in Fig. 11; widespread throughout eastern N. America .... *quadrangularis* (Say)

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A NEW SPECIES OF *ADELINA* DEJEAN FROM THE BRITISH VIRGIN ISLANDS (COLEOPTERA: TENEBRIONIDAE: ULOMINI)

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Abstract.—*Adelina* **mystax**, new species, is described from Anegada, British Virgin Islands. The remarkable structure of the male clypeus and the aedeagus are illustrated.

Spilman (1973) presented convincing evidence that *Adelina* Dejean is the valid name for a genus of cucujid-like tenebrionids usually listed under the generic name *Doliema* Pascoe.

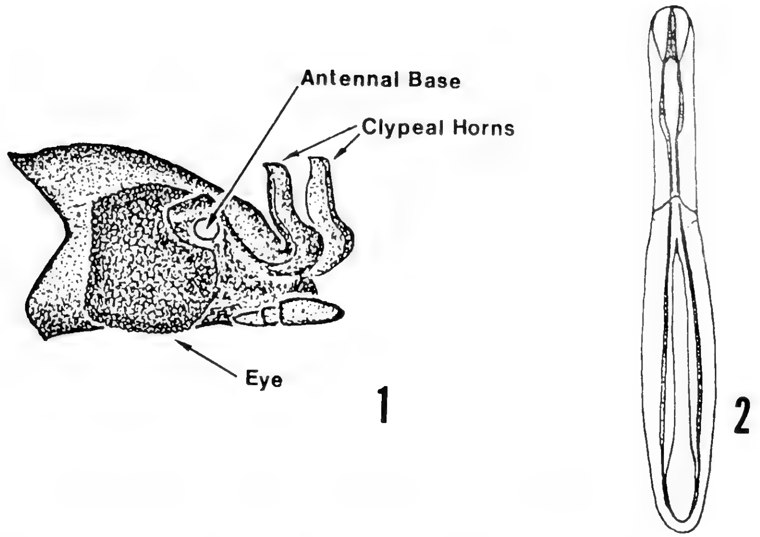
Ardoin (1977) apparently missed Spilman's note, since he described seven new species of the genus, all under the name *Doliema*. We have used Ardoin's key to the males of American species (he did not prepare keys for the females) and find them, along with the illustrations, very usable.

We were surprised, therefore, to find the following new species among *Adelina* collected by the junior author in the Virgin Islands. We wish to describe it at this time to make the name available for inclusion in a subsequent publication on the Virgin Island Tenebrionidae.

Adelina mystax Triplehorn and Ivie, New Species

Types.—Holotype, ♂, allotype ♀, British Virgin Islands, Anegada, 23 August 1980, M. A. Ivie, deposited in the National Museum of Natural History, Washington, D.C. (Type No. 100375).

Description of holotype, male.—Body elongate, parallel-sided, flattened, uniformly light reddish brown, integument translucent. Head with clypeus scarcely delimited from frons except laterally; epistomal margin broadly truncate and with a narrow, tapering, hornlike process arising from each side of clypeus at lateral margin, processes strongly divergent, recurved and directed slightly caudad (Fig. 1); genae above antennal insertions convex and drawn out into acute, toothlike reflexed projections; no toothlike projections beneath the dorsal projections; surface of head rather coarsely and densely punctured between eyes; vertex very minutely punctate; antenna relatively short, extending caudad only about ¼ length of elytra. Pronotum strongly transverse, more than twice as broad as long, sides strongly arcuate and slightly sinuate in basal ⅓; apical margin broadly and deeply emarginate, basal margin bisinuate (straight along anterior margin of scutellum), apical angles obtusely rounded, basal angles almost rectangular; surface finely and sparsely punctate on disc, punctures much coarser laterally, a deep, pigmented fovea on each side near base. Prohypomeron finely colliculate, coarsely, nearly confluently punctate except laterad of procoxae; a series of curved parallel wrinkles



Figs. 1, 2. *Adelina mystax.* 1, Head of male, lateral view. 2, Aedeagus, ventral view.

separating the 2 areas. Tarsi with claws each bearing a blunt tooth midway to tip. Elytra with disc flattened; interneurs shallowly impressed, coarsely punctured; intervals very finely punctate; epipleura concave, extending to base of last visible sternite. Abdominal sternites with distinct depressions laterally, 4th tergite with a near pit, 5th with transverse depression extending across anterior margin, delimiting a distinct bulge immediately behind, bounded posteriorly by a fine margination. Sternites 1 through 3 long, 4th and 5th shorter and together subequal to 2nd. Fifth sternite evenly rounded behind. Aedeagus as in Fig. 2.

Measurements.—Length: 4.8 mm; width 1.9 mm.

Description of allotype female.—Similar to holotype except lacking hornlike processes on clypeus, and genae, while convex above antennal insertions, are not acute apically. Clypeus more coarsely and densely punctate and antenna noticeably shorter.

Measurements.—length; 4.6 mm, width 1.8 mm.

Paratypes.—3 ♂, same data as holotype, two in The Ohio State University Collection of Insects and Spiders, one in the collection of the junior author.

Remarks.—Variation in the secondary sexual characters is considerable. One paratype exhibits a reduction of the epistomal horns, which arise only as small teeth, with the genal projections less acute; another has the horns completely absent. This appears analogous to the major/minor-male situation found in some scarabs and other horned beetles.

The allotype differs from the hornless male in the more rounded epistomal margin that joins the genae at an obtuse angle, rather than the square juncture in the male, and by the rounded, obtuse genal projection over the antennal base.

Diagnosis.—The form of the clypeal horns on the major male will distinguish this species from all other described species of *Adelina.* The other forms (minor males and females) can be distinguished from the sympatric *A. pici* (Ardoin) by that species' flat, narrowly rounded fifth sternite, its lack of lateral depressions on the first sternite, the simple tarsal claws, and the non-wrinkled prohypomeron.

Etymology.—The name is derived from the Greek (a mustache) in reference to the structures of the clypeus in the major male, which bear a strong resemblance to a waxed mustache.

Biology.—The type-locality is on the xeric limestone plain between the Settlement and the airport. The type-series was found in the company of *A. pici* (Ardoin) beneath loose bark of a large (ca. 30 cm diameter) dead limb on a living tree of unknown specific identity, known locally as "logwood."

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PROC. ENTOMOL. SOC. WASH.
85(2), 1983, pp. 275–281

ON DISTINGUISHING *TRUPANEA BISETOSA* (COQUILLETT) FROM *T. NIGRICORNIS* (COQUILLETT) (DIPTERA: TEPHRITIDAE)

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Abstract.—Males of *Trupanea bisetosa* (Coquillett) and *T. nigricornis* (Coquillett) are readily separated morphologically. Most (ca. 70–80%) females of these sexually dimorphic species can be distinguished by the shape of the apical Y-shaped mark in the wing. This mark is squat and thick-based in most *T. bisetosa* females and stretched and thin-based in most *T. nigricornis* females. *Trupanea bisetosa* also has a much narrower range of host plants than *T. nigricornis* in southern California. The former mainly infests capitula of *Helianthus* spp.; whereas, *T. nigricornis* is polyphagous on many different species of Asteraceae. *Trupanea nigricornis* also is more common and widespread in desert areas than *T. bisetosa.* Behavioral differences of adults in insectary cagings are reported, chief among which was the observation that *T. bisetosa* mated in the early morning and *T. nigricornis* in the afternoon. Cross-matings of these species yielded fertile eggs in confined cagings.

In studying the life history of *Trupanea bisetosa* (Coquillett) on the sunflower, *Helianthus annuus* L., in southern California (Cavender and Goeden, 1982), we early encountered the problem of separating the females of this species from those of *T. nigricornis* (Coquillett)—a problem which vexed Foote (1960) as well. We approached its solution by studying separate samples of these flies reared from capitula of different Asteraceae. This paper reports our findings on the morphological, ecological, and biological separation of these sexually dimorphic species in southern California.

Morphology

Foote (1960) noted that the male of *T. nigricornis* is easily recognized by the very dark yellow to black third antennal segment; the distinctly quadrate infuscated spot posterior to the stigma; the presence of a distinct spot centered on vein $M_3 + Cu_1$; and the absence of the posterior arm of the apical Y-shaped mark. In the male of *T. bisetosa,* the third antennal segment is yellow; the infuscated spot posterior to the stigma is slanted towards vein m; there in no dark spot on vein $M_3 + Cu_1$; and the apical Y-shaped mark is uninterrupted. However, Foote (1960) failed to detect any satisfactory means of separating the females of these two species. Foote and Blanc (1963) similarly noted that the females were not separable.

We restricted our morphological examinations to intact, point-mounted spec-

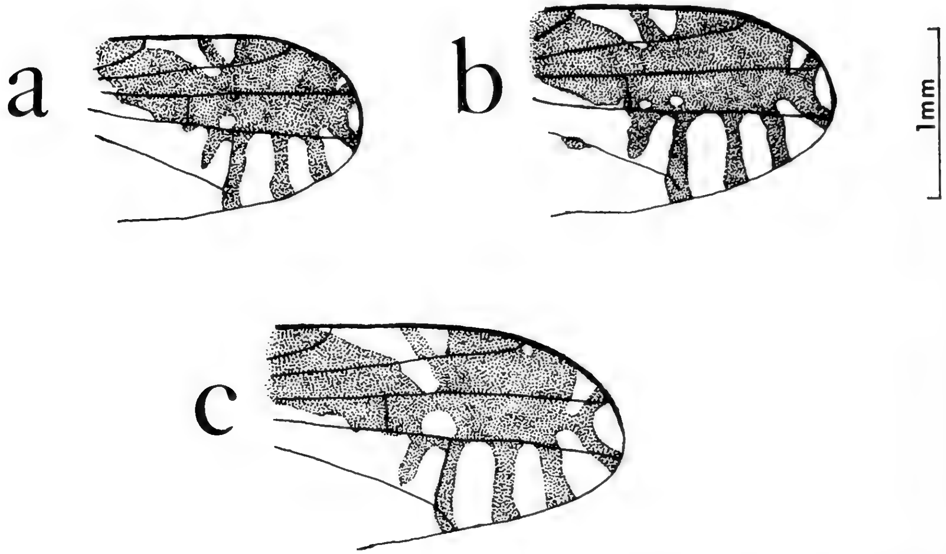

Fig. 1. a, Wing of female *T. bisetosa* showing squat, apical Y-shaped mark. b, Wing of female *T. nigricornis* with intermediate shaped, apical Y-shaped mark. c, Wing of female *T. nigricornis* showing stretched, apical Y-shaped mark.

imens reared as both males and females from capitula of each of several species of Asteraceae in southern California during 1979–82. Of 71 *T. bisetosa* males reared from capitula of *H. annuus,* all had yellow third antennal segments; two (2.8%) showed slight breaks in the posterior arm of the apical Y-mark; two (2.8%) other specimens had faint spots in the center of vein $M_3 + Cu_1$; and two (2.8%) other specimens had subquadrate, infuscated spots posterior to the stigma. Of 71 *T. nigricornis* males reared from capitula of *Encelia farinosa* Gray ex Torrey, all had very dark to black third antennal segments and a quadrate infuscated spot posterior to the stigma; one (1.4%) had a complete, but attenuated posterior arm on the apical Y-mark; but only 13 (18%) had a faint to prominent dark spot centered on vein $M_3 + Cu_1$. Thus, with the exception of the character involving the spot on vein $M_3 + Cu_1$, the characteristics by which Foote (1960) and Foote and Blanc (1963) separated the males of these species proved useful with our material. Only 13 (12.3%) of a total of 106 males of *T. nigricornis* reared from capitula of 15 of the host-plant species besides *E. farinosa* reported below had such a spot, however narrow and light, centered on vein $M_3 + Cu_1$. This character was not associated with males reared from any particular host, as these 13 males were reared from six different plant species representing five separate genera.

One means was found by which most females can be separated morphologically as intact specimens. This involves the gross appearance of the apical Y-shaped mark on the wing, which usually is squat and thick-based (ca. 2× width of the posterior, apical arm) in *T. bisetosa* and stretched and thin-based (ca. = width of the posterior, apical arm) in *T. nigricornis* (Fig. 1). Of 57, presumably all *T. bisetosa* females reared from *H. annuus* capitula in the presence of *T. bisetosa* males and the absence of *T. nigricornis* males, 41 (71.9%) had squat, apical

Y-marks, one (1.8%) had a stretched, apical Y-mark, and 15 (26.3%) were intermediate for this character with *T. nigricornis* females (Figs. 1a, b). Of 57, presumably all *T. nigricornis* females reared from capitula of *E. farinosa* in the presence of *T. nigricornis* males and the absence of *T. bisetosa* males, 41 (71.9%) had stretched, apical Y-marks and 16 (28.1%) were intermediate for this character with *T. bisetosa* females (Figs. 1b, c). Of a total of 101 *T. nigricornis* females reared from capitula of 14 of the host-plant species besides *E. farinosa* reported below, 83 (82.2%) had stretched, apical Y-marks and the remainder were intermediate with *T. bisetosa* females for this character.

In addition to these wing differences, minor but consistent differences were found by R. H. Foote (in litt.) in the postabdomens of the females of these two species, probably a reflection of the differences in their host preferences.

HOST PLANTS

Trupanea nigricornis attacks a much wider range of Asteraceae and different hosts than *T. bisetosa* in southern California. The junior author (RDG) has reared *T. nigricornis* from capitula of the following Asteraceae collected where noted on the dates indicated (new host-plant records according to Wasbauer (1972) are marked with an asterisk (*) and follow the nomenclature of Munz (1974)): *Acamptopappus sphaerocephalus* (Harvey and Gray) Gray*, Snow Creek, Riverside, Co., III-7-81, 2 ♂; *Baccharis sergiloides* Gray*, Howe Spring, New York Mts., San Bernardino Co., IX-9-81, 1 ♂, 2 ♀; *Chrysothamnus nauseosus* (Pallas) Britton ssp. *hololeucus* (Gray) Hall and Clements*, Caruthers Canyon, New York Mts., San Bernardino Co., IX-22-81, 12 ♂, 3 ♀; *Encelia farinosa,* Blythe, Riverside Co., III-17-81, 61 ♂, 62 ♀; *E. frutescens* Gray*, Zzyxx Road, NE San Bernardino Co., IV-29-81, 8 ♂, 9 ♀; *E. virginensis* A. Nelson*, Cima, San Bernardino Co., IV-30-81, 3 ♂, 4 ♀; *Haplopappus acradenius* (Greene) Blake ssp. *eremophilus* (Greene) Hall*, Mountain Springs, Imperial Co., X-14-81, 1 ♂, 1 ♀; *H. laricifolius* Gray*, Cedar Canyon, NE San Bernardino Co., IX-9-81, 13 ♂, 8 ♀; *H. venetus* (Humboldt) Blake spp. *oxyphyllus* (Greene) Hall*, McCain Valley, San Diego Co., X-16-80, 4 ♂, 2 ♀; *H. v.* ssp. *vernonoides* (Nuttall) Hall*, Cardiff-by-the-Sea, San Diego Co., X-15-80, 2 ♂; *Lepidospartum squamatum* (Gray) Gray*, Cajon Junction, San Bernardino Co., IX-2-81, 13 ♂, 13 ♀; *Peucephyllum schottii* (Gray) Gray*, Bradshaw Trail, Riverside Co., II-11-81, 17 ♂, 6 ♀; *Solidago californica* Nuttall*, Kitchen Creek, San Diego Co., IX-9-80, 1 ♀; *S. occidentalis* (Nuttall) Torrey and Gray*, Kennedy Meadows, Tulare Co., IX-26-80, 5 ♂, 5 ♀; *Viguiera deltoidea* Gray var. *parishii* (Greene) Vasey and Rose*, Chino Canyon, Riverside Co., IV-3-80, 15+ ♂, 15+ ♀. Additional records involving fewer adults reared from these plant species at other locations are not reported. Also, the *T. nigricornis* reported at *T. bisetosa* from *Ambrosia dumosa* (Gray) Payne and *A. ilicifolia* (Gray) Payne in southern California by Goeden and Ricker (1976a, 1976b) were misidentified on the basis of what was known of these two species of *Trupanea* at the time.

The senior author (GLC) has commonly reared *T. bisetosa* from capitula of wild and cultivated varieties of *H. annuus* and from *H. ciliaris* Décandolle (Cavender and Goeden, 1982) in southern California. The junior author (RDG) has reared *T. bisetosa* from capitula of two additional Asteraceae collected as follows: *Geraea canescens* Torrey and Gray*, Hidden Springs, Riverside Co., IV-14-81, 2 ♂; *Helianthus niveus* (Bentham) Brandegee ssp. *tephrodes* (Gray) Heiser*, Sand

Hills at Glamis, Imperial Co., I-28-82, 8 ♂, 10 ♀. Thus, *T. bisetosa* apparently is much more restricted in its choice of host plants and shows a marked affinity for *Helianthus* spp. Its incidence in capitula of the so-called "desert sunflower," *G. canescens,* an ephemeral, desert annual (Munz, 1974), was rare and greatly subordinated to 73 *Neotephritis finalis* (Loew) reared from the same sample.

Published host-plant records for *T. bisetosa* and *T. nigricornis* (Wasbauer, 1972) are confused. Cavender and Goeden (1982) suggested that most records for *T. bisetosa* contained in Wasbauer (1972) probably were misidentifications of *T. nigricornis* or suspect "unpublished records" that need verification. Wasbauer (1972) listed *Baccharis glutinosa* Persoon, *Brikellia* [sic] *arguta* Robinson, *Carthamnus tinctorius* L., *Chrysothamnus nauseosus* ssp. *glabratus* [?], *Chrysothamnus viscidiflorus* (Hooker) Nuttall, *Encelia californica* Nuttall, *E. farinosa, Helianthella* sp., *Perezia microcephala* (Décandolle) Gray as host plants of *T. nigricornis.* The new rearing records reported herein confirmed the affinities of this polyphage for several of these host-plant genera. The junior author (RDG) has reared *T. wheeleri* Curran in large numbers, e.g., 128 and 52 flies/sample, from capitula of *E. californica* collected at three widely separated, coastal locations (unpublished data), but never *T. nigricornis,* which suggests that this published, "unpublished," California record for the latter tephritid (Wasbauer, 1972) may have been atypical.

DISTRIBUTION

Distribution maps for *T. bisetosa* and *T. nigricornis* in Foote and Blanc (1963) indicate that these species are sympatric in southern California. Our rearing records confirmed this, but also suggested that *T. nigricornis* is by far the more common and widespread species, like many of its host plants (Munz, 1974). The distribution map for *T. bisetosa* in Foote and Blanc (1963) was based in part on many records for females swept singly or in small numbers without males from non-host plants in desert areas. Most of these specimens probably were *T. nigricornis. Trupanea bisetosa* was reared by one of us (RDG), as reported above, only from two localized species of Sonoran (low elevation) desert plants, never from the native, Mojave (high elevation) Desert Asteraceae sampled during 1979–81, and only from *Helianthus* spp. in coastal and interior valleys in southern California (Cavender and Goeden, 1982). Indeed, up until the time of this writing, when *T. bisetosa* first was reared from *H. niveus* capitula as reported above, this tephritid was considered by us normally not to be a desert species (Cavender and Goeden, 1982). Field data as yet are insufficient to explain these distributional patterns for *T. bisetosa* in southern California, though we suspect that seasonal migrations by adults are involved.

BIOLOGY

Behavioral differences and similarities were observed in insectary cagings of *T. bisetosa* and *T. nigricornis* adults at 26 ± 1°C, 30–60% RH, and a 12-h photophase from 0500 to 1700 h. The behavior of these flies are compared in Table 1 in the manner of Tauber and Toschi (1965). Cavender and Goeden (1982) presented a detailed account of the adult behavior of *T. bisetosa* from which these tabulated data are extracted in part.

The principal difference in the behavior of these two species was their time of

Table 1. Comparison of generalized behavior of *T. bisetosa* and *T. nigricornis* adults in the insectary.

Description of Behavior[1]	*T. bisetosa*[1]	*T. nigricornis*
Premating behavior	Wings of male vibrate while brought forward in unison, to ca. 90° with body; alternating with walking-in-spurts towards female	Wings of male flutter while brought forward in unison, to ca. 45° with body; otherwise, the same
When mating behavior observed	Early morning (0525 to 0800 h)	Afternoon (1330 to 1630 h)
Copulatory positions:		
Head of male	Above and behind juncture of abdomen and thorax, well behind scutellum of female	More posterior along abdomen of female
Rostrum of male	Alternately extended and retracted, but labellum not touching female	Same, but labellum touching dorsum of abdomen of female
Wing position	Male: fully overlapped with occasional alternate wing movements; female: spread apart ca. 45°	Male: only slightly overlapped, without alternate wing movements; female: same
Position of foretarsi	Along pleura of anterior part of abdomen of female	Same
Position of mesotarsi	On posterior part of pleura of abdomen of female	Just behind foretarsi on pleura of abdomen of female
Position of metatarsi	Hanging free behind abdomen of female, often rubbing together	Hanging down and touching the substrate
Ovipositor telescoped outward	+	?
Points of contact	Genitalia; fore- and mesotarsi of male on abdominal pleura of female; foretibia of male on anal margin of wing of female	Genitalia; fore- and mesotarsi of male on abdominal pleura of female; mouthparts of male to abdominal dorsum of female
Postmating behavior	Wings of male held outward at 90° and abdominal pleura distended outward	None observed
Male homosexual behavior	Males court and mount males	Same
Defensive behavior against intruding flies of same sex	Males and females wave forelegs and alternately wave wings at intruders	Males and females wave forelegs at intruders; male holds both wings outward at 90° while facing intruder
Alternate forward wing movements while at rest or walking	+ (males and females)	Same
Windshield-wiper wing movements[1]	+ (males and females)	+ (males) ? (females)
Both wings held outward at 90°	During postmating behavior (males)	During defensive behavior (males)

[1] Described fully in Cavender and Goeden (1982) for *T. bisetosa.*

mating in the insectary (Table 1). In this regard, *T. bisetosa* mates earlier than has been reported for most species of Tephritidae (Bateman, 1972; Cavender and Goeden, 1982). This difference could help to isolate this species, if it also occurred in nature, as was unconfirmed during these studies. Other behavioral differences were noted (Table 1).

A simple experiment also was conducted in the insectary to determine whether these closely related species could cross. One-liter, plastic, ventilated cages, fully described elsewhere (Gilstrap and Goeden, 1974), contained young flowerheads of *H. annuus* and *E. farinosa* and mature virgin flies reared from isolated larvae and puparia dissected from field-collected capitula. Honey was striped on the inner wall of each cage for food and the absorbant cotton plug that secured each bouquet inserted into a water reservoir also acted as a wick and water source. Six cages held 1 ♂ *T. bisetosa* and 1 ♀ *T. nigricornis* each; six cages held 1 ♂ *T. nigricornis* and 1 ♀ *T. bisetosa*; three cages held 1 ♂ and 1 ♀ *T. bisetosa*; three cages held 1 ♂ and 1 ♀ *T. nigricornis* each; two cages contained 1 ♀ *T. bisetosa* each; and two cages held 1 ♀ of *T. nigricornis* each.

After four to five days, the caged flowerheads were examined for eggs, and these eggs for signs of embryonic development, i.e., the cephalopharyngeal skeleton, as evidence of successful mating. Briefly, the isolated females only laid infertile eggs. All three pairs of *T. bisetosa* yielded fertile eggs; two of the three *T. nigricornis* pairs produced fertile eggs, while the third female laid very few, infertile eggs. All six of the *T. bisetosa* females paired with *T. nigricornis* males laid fertile eggs. Two of the six *T. nigricornis* females paired with *T. bisetosa* males laid fertile eggs; two laid infertile eggs; and two laid no eggs. Thus, in confined cagings under insectary conditions these two species successfully crossmated. As larval development in these species only occurs in live capitula (Cavender and Goeden, 1982), these eggs were not reared past eclosion.

Conclusions

These results demonstrated that *T. bisetosa* and *T. nigricornis* are largely, but incompletely separable phenetic groups representing sympatric, potentially interfertile populations that are behaviorally and ecologically isolated reproductively, and, thus, valid species in southern California (Foote and Blanc, 1963; Doyen and Slobodchikoff, 1974). We have never reared males of both species from individual samples of capitula; although, such synphagy is a common characteristic of other California *Trupanea* (Goeden, unpublished data). Flowerheads of *H. annuus* and *E. farinosa* commonly growing in juxtaposition in disturbed chaparral in the Riverside area invariably yielded *T. bisetosa* and *T. nigricornis,* respectively, in insectary rearings (Cavender and Goeden, 1982; Cavender, unpublished data).

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A NEW SPECIES OF *MEGASELIA* IN GROUP VII (DIPTERA: PHORIDAE)

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Abstract.—*Megaselia* (*Megaselia*) ***alsea*** is described as a new species from Oregon. Larvae of this phorid were found associated with the egg masses of the caddisfly *Hydatophylax hesperus* (Banks). Illustrations of the male and female genitalia are provided.

Megaselia alsea is a new species belonging to *Megaselia* (*Megaselia*) Group VII. It is close to *M. modesta* Brues in Borgmeier's (1966) key to North American Group VII species, but can be distinguished by the male and female genitalia. The objective of this paper is to describe the new species (Robinson) and present information on its biology and habits (Wisseman).

Megaselia* (*Megaselia*) *alsea **Robinson,** New Species

Figs. 1–6

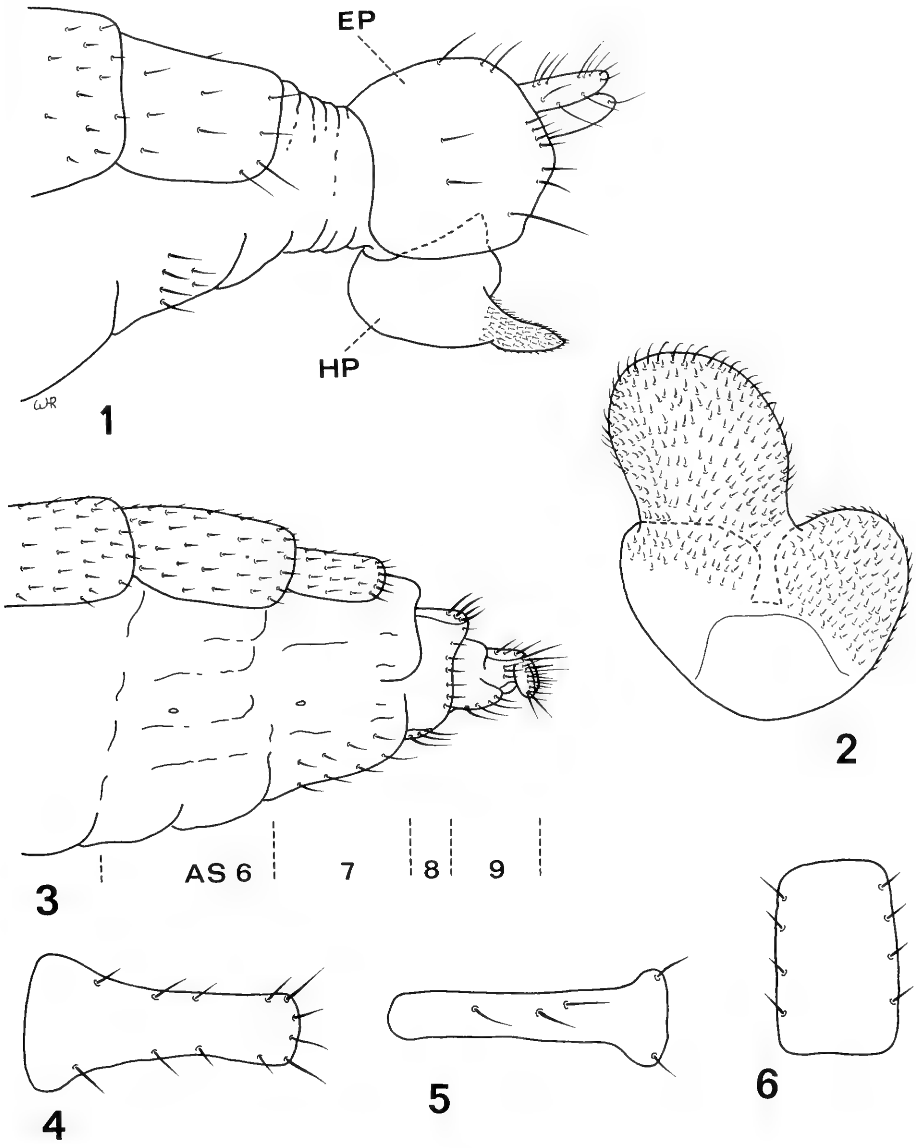
Diagnosis.—This species differs from other Nearctic Group VII species by the character combination: Halter brown; costa 53% of wing length; costals long; frons dull, broader than high. *Terminalia:* Epandrium (Fig. 1) with 9–11 setae laterally, 1 long seta posterolaterally; hypandrium (Fig. 2) setulose, lobe large, and setulose. *Oviscapt:* Tergum VII (Fig. 4) long and narrowed posteriorly; sternum VII (Fig. 5) long and broadened posteriorly.

Description.—Body brown. Frons dull, setulae distinct, distinctly wider than high; supra-antennals subequal; lower fronto-orbital bristle closer to anterior fronto-orbital than to upper supra-antennal. Parafacia of male with 6–10 bristles, female with 10–12 bristles. Palpus pale brown with 6 robust setae, pointed apically.

Thorax brown to dark brown; propleuron with 5 dorsal bristles adjacent to spiracle, and 4 bristles at the ventral margin. Mesopleuron bare. Scutellum with 2 robust bristles.

Abdominal terga and venter brown, terga distinct, subequal in length and width. Male terminalia pale brown, small, with fine setulae, no bristles, proctiger yellowish brown; epandrium (Fig. 1) small, slightly pointed posterolaterally, with 9–11 setae laterally and 1 long seta posterolaterally; hypandrium (Fig. 2) setulose, lobe large and setulose, apical seta long and slightly curved. Female terminalia pale brown, tergum VII (Fig. 4) long and narrowed posteriorly; sternum VII (Fig. 5) long and broadened posteriorly.

Legs pale brown; forefemur deeply grooved ventrally to accept foretibia; fore-



Figs. 1–6. *Megaselia alsea,* terminalia. 1, Male terminalia. 2, Male hypandrium. 3, Female terminalia. 4, Female tergum 7. 5, Female sternum 7. 6, Female tergum 8. Abbreviations: AS 6 = abdominal segment 6; 7 = abdominal segment 7; 8 = abdominal segment 8; 9 = abdominal segment 9; EP = epandrium; HP = hypandrium.

tibia with indistinct antero- and posterodorsal bristles. Midtibia with 6–7 posterodorsal bristles adjacent to hair seam; hair seam extending to ½; midbasitarsus with strong bristle at basal ⅙. Hindfemur with 6 long setae on apical ⅓; hindtibia with 18 weak posterodorsal bristles.

Wing 1.85–1.88 mm long; membrane light brown, veins brown; costa 53% of wing length; ratio of costal divisions 1.0:1.5:2.5; costal bristles as long as costal division III; 3 axillary bristles. Halter brown.

Material examined.—♂ holotype, 2 ♀ paratypes, Flynn Creek, Siuslaw Natl. Forest, Lincoln Co., Oregon, August 19, 1981, B. Wisseman.

Holotype.—♂, Flynn Creek, Siuslaw Natl. Forest, Lincoln Co., Oregon, August 19, 1981, B. Wisseman. Deposited in the National Museum of Natural History, Washington, D.C.

Biology.—Third-instar phorid larvae were found associated with the egg masses of the limnephilid caddisfly *Hydatophlax hesperus* (Banks). Adults of this caddisfly emerge in the summer and oviposit on wood or vegetation at or above the waterline, in forested headwater streams of the Pacific Northwest. The globular egg masses (1.5–3.0 cm diameter) typically contain 200–300 eggs dispersed in an amorphous gelatinous matrix.

Six masses, each hosting from 1–7 phorid larvae, were collected from damp wood (above waterline) at Flynn Creek, Oregon Coast Range. These masses were cultured on wet filter paper at room temperature. Phorid larvae were observed scavenging in the gelatinous matrix. Within 5 days of collection, all larvae had left the gelatinous matrix and formed puparia on the wetted filter paper. Whether the phorid is a parasite on the eggs or hatched caddisfly larvae cannot be determined, since observations to date on larval activity only encompass the stage just prior to pupation.

Group VII Biology

The practice of partitioning the hundreds of *Megaselia* species into eight "artificial" groups, as frequently done by other authors (Lundbeck, 1922; Schmitz, 1956; Borgmeier, 1964) has been followed here. Group VII contains 40 described species in North America. There is information on the larval and/or adult biology for nearly half of the species in the group (Robinson 1971). The species reported associated with fungi include *M. straminipes* (Malloch), *M. flava* (Fallén), *M. lutea* (Meigen), *M. eisfelderae* Schmitz, *M. nigra* (Meigen), and *M. fungicola* (Coquillett). Species known to feed (as larvae) on a variety of decaying plant and animal material include *M. scalaris* (Loew), *M. longipennis* (Malloch), *M. cavernicola* (Brues), *M. pulicaria* (Fallén), *M. rufipes* (Meigen), *M. setacea* (Aldrich), *M. breviterga* (Lundbeck), and *M. picta* (Lehmann). The species reported associated with plants is *M. seticauda* (Malloch), and the species reported associated with caves is *M. glabrifrons* (Wood). *Megaselia alsea* is the only group VII species reported associated with living insects.

Acknowledgments

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NEW SPECIES OF *CERATINOPTERA* COCKROACHES FROM PANAMA AND COSTA RICA (BLATTARIA: BLATTELLIDAE: PLECTOPTERINAE)

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Abstract.—Three new species of *Ceratinoptera* are described: *C.* ***gurneyi*** and *C.* ***estribii*** from Panama and *C.* ***bilunata*** from Costa Rica and Panama. A key to the known species of *Ceratinoptera* is included. These three new species form the *Bilunata* Group, distinct from the rest of the genus.

The genus *Ceratinoptera,* originally proposed by Brunner v. W. in 1865, includes some 13 species as catalogued by Princis (1969). However, Hebard (1916) proposed that the genus be restricted to three species, essentially those for which Saussure (1868) proposed the name *Paraceratinoptera.* Hebard considered *Paraceratinoptera* to be an absolute synonym of *Ceratinoptera.* In agreement with Hebard we would restrict the genus to those species which share the following characters: 1) corneous tegmina, which when overlapping have the concealed area of the right tegmen as colorless as the wings; 2) seventh abdominal tergum of the male with a specialization (gland); 3) limbs stout, ventro-anterior margin of fore-femur with a row of minute piliform setae (Type C) terminated by two large distal spines; 4) tarsi lack pulvilli; tarsal claws slender, symmetrical, simple; arolia lacking or very minute. Reviewing the 13 species listed by Princis we find four were transferred by him from the genus *Temnopteryx,* while five others have one or more characters in disagreement with the generic features listed above or whose brief descriptions do not address any of those key features.

Species of *Ceratinoptera* we include in the restricted definition are as follows (those known to occur in Panama are noted by an asterisk):

1. *C. picta* C. Brunner v. W. 1865*, genotype by original description and selection by Kirby (1904).
   binotata (L. Bruner) 1906, a synonym of *picta* (Princis, 1969: 761).
2. *C. castanea* C. Brunner v. W. 1865, redescribed by Albuquerque and Gurney (1963).
   aequalis (Walker) 1871, a synonym of *castanea* (Albuquerque and Gurney, 1963: 522).
3. *C. nahua* (Saussure) 1868.
   dohrniana (Saussure and Zehntner) 1893, a synonym of *nahua* (Hebard, 1916: 131).
4. *C. tropaia* Hebard 1916.

5. *C. bilunata* Fisk and Wolda, new species*.
6. *C. gurneyi* Fisk and Wolda, new species*.
7. *C. estribii* Fisk and Wolda, new species*.

The new species, *C. bilunata, gurneyi,* and *estribii,* are referred to here as the *Bilunata* Group and have, in the male, between the styles a median projection of the subgenital plate which is equal to or longer than the styles. Also the supra-anal plate is broadly emarginate at the apex, giving it a sinuate, bilobed appearance (Fig. 2). In other *Ceratinoptera,* e.g. *C. picta, nahua, castanea,* and (?)*tropaia,* referred to here as the *Picta* Group, males lack the median projection between the styles and the supra-anal plate is convex posteriorly, without an emargination in the material examined (although Albuquerque and Gurney (1963) describe the lectotype of *C. castanea* as having the supra-anal plate "weakly emarginate at apex"). In our key to the flying cockroaches of central Panama (Fisk and Wolda, 1979) the only *Ceratinoptera* listed was *C. picta.* Unfortunately, the new species *C. estribii* and unmarked *C. bilunata* were not recognized at that time and would key out as *C. picta.* However, the key which follows may be useful in separating all seven species of *Ceratinoptera,* at least the males. Difficulties will be encountered in those species typically having pale pronotal markings because such markings may be reduced or lacking in some populations of *C. picta, nahua,* and *bilunata.* Also reduction in the length of tegmina and wings frequently occurs in individuals of *C. castanea, nahua, picta,* and *bilunata* although these reductions are never so complete as in *tropaia.*

KEY TO SPECIES OF *CERATINOPTERA* COCKROACHES, BASED PRIMARILY ON MALES

1\. Male supra-anal plate convex posteriorly; subgenital plate between styles moderately convex, without appendages; left phallomere (L2vm) sclerotized, curved, with needle-like tip (L2d) (Fig. 19) (*Picta* Group) 2

– Male supra-anal plate with apex broadly emarginate (Fig. 2); subgenital plate between styles produced as a slender median process (Fig. 4); L2vm less sclerotized, straight, tip not sharply pointed (Fig. 6) (*Bilunata* Group) 7

2\. Pronotal disc with characteristic pale markings (both sexes) 3

– Pronotal disc lacks pale markings although lateral margins of pronotum may be pale or transparent 4

3\. Overall length, i.e. distance from front of head (or pronotum if head is covered) to tip of abdomen (or to apex of tegmina if they extend beyond abdomen), 9–11 mm; shining blackish brown; pale spot on pronotal disc crescent-shaped, the points directed anteriorly (Guatemala, Panama, northern South America, including Brazil) ....typical *picta* Brunner

– Overall length of male 11–14 mm, of female 12–14 mm; shining chestnut brown; pale spot circular and suffused with base color of pronotum, the marking may include almost entire disc, be reduced to a mesoposterior blotch or pair of tiny pale dots, or be lacking altogether (Mexico, Guatemala, Costa Rica) .... *nahua* (Saussure)

4\. Relatively large, overall length of male 11–14 mm (see previous couplet) .... unmarked *nahua* (Saussure)

– Somewhat smaller, overall length 10–12 mm 5

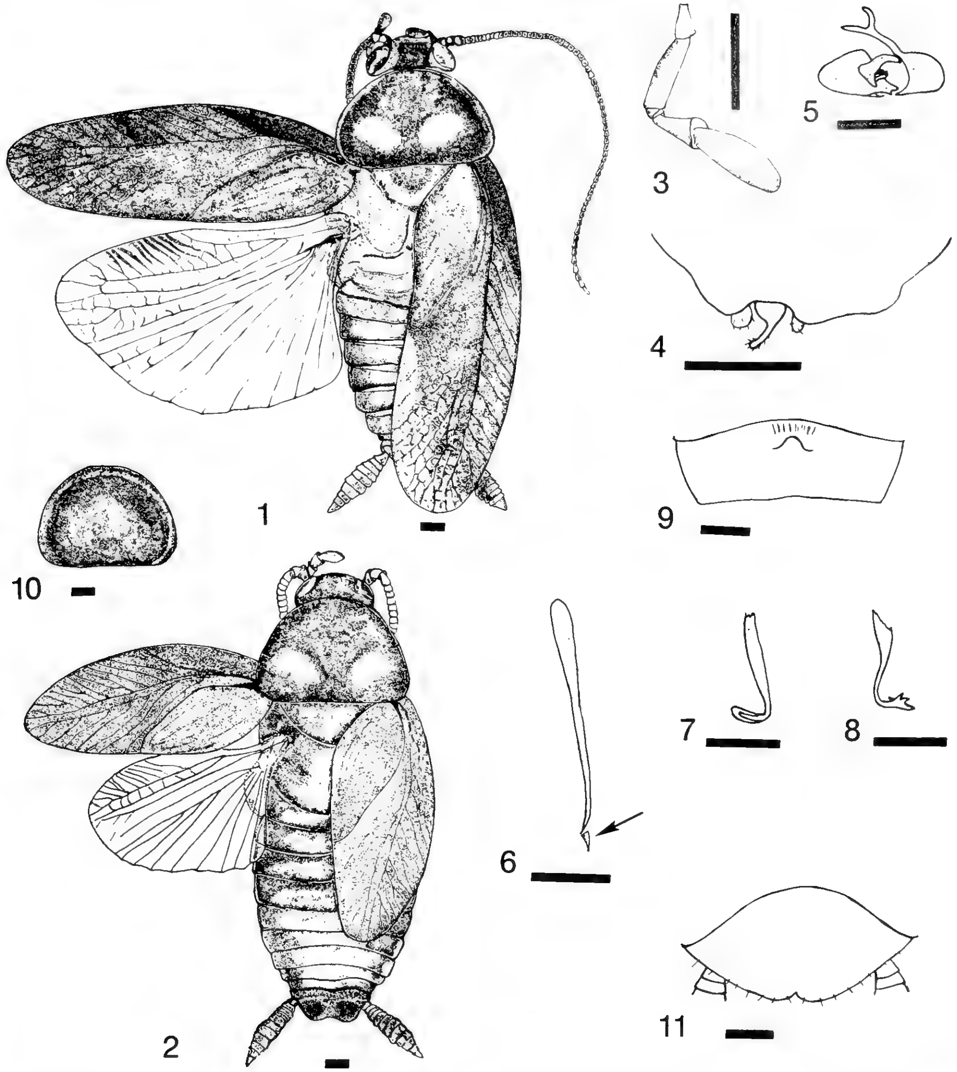
5. Length of male 10 mm; shining chestnut brown; tegmina short, truncate, very little longer than wide, exposing most of abdomen; wings minute; female unknown (Mexico) . . . . *tropaia* Hebard
– Length 9–12 mm; color reddish or blackish brown; tegmina and wings fully formed (especially male) reaching to or beyond tip of abdomen or tegmina and wings reduced in length (especially female), though never so short as above 6
6. Length 9–11 mm; blackish brown above, lighter below; tegmina usually full length, but shortened tegmina may occur in both sexes (Panama) (see also couplet 3) . . . . unmarked *picta* Brunner
– Length 10–12 mm; color blackish brown above, reddish below; shortened tegmina most often found in female (Brazil) . . . . *castanea* Brunner
7. Posterior portion of pronotum with a pair of yellow or nearly white spots 8
– Pronotum unmarked, but may have very narrow pale lateral margin . . . 9
8. Length 9–10.5 mm; uniformly reddish brown to mahogany with a pair of well-defined yellow spots on disc of pronotum, narrow lateral margins of pronotum pale; male specialization on tergum 7 with a few scattered setae anteriorly (Fig. 9), median projection between styles wide at base, narrowing to midpoint with its knobbed tip bent to the right (Costa Rica and Panama) (Fig. 1) . . . . typical *bilunata,* new species
– Length 12–14.5 mm; uniformly reddish brown to nearly black with a pair of diffuse, nearly white spots on pronotal disc (Fig. 12), narrow latero-anterior margins pale; male specialization on tergum 7 with 2 tufts of slender setae anteriorly (Fig. 13); median projection between styles as noted above, but larger and more heavily sclerotized (Fig. 14) (Panama) . . . . *gurneyi,* new species
9. Length 7.5–9 mm; reddish brown to nearly black except that distal ⅗ of tegmina nearly transparent like the wings; male with median projection between styles slender and straight with knoblike tip (Fig. 17) (Panama) . . . . *estribii,* new species
– Length 9–10 mm; uniformly reddish brown to nearly black, including tegmina; median projection between styles as noted in couplet 8 (Fig. 4) (Panama) . . . . unmarked *bilunata,* new species

Holotypes and allotypes of the following species are in the Ohio State University Entomology Museum. Except as noted otherwise, paratypes are divided between the collections of the authors (FWF and HW).

Ceratinoptera bilunata Fisk and Wolda, New Species

Figs. 1–11

Male holotype.—Measurements in Table 1. Head evenly convex, eyes well separated, interocular space nearly 1.5× interantennal space; ocelli present; ultimate (5th) segment of maxillary palpus subequal to 3rd segment and 1.5× 4th segment in length (Fig. 3); head dark reddish brown to a line just below fronto-clypeal junction, pale yellow below this line; length of antenna subequal to overall length. Pronotum broadly rounded anteriorly and laterally, posterior margin truncate; base color of pronotum shining reddish brown with lateral margins pale,



Figs. 1–11. 1–10 *Ceratinoptera bilunata,* male. 1, Habitus of holotype. 2, Habitus of short-winged paratype (specialization on tergum 7 completely hidden under overlapping tergum 6, costal veins on wing should be shown clubbed). 3, Maxillary palpus. 4, Subgenital plate, ventral view. 5, Male genitalia; L1, sclerite of left phallomere. 6, L2d (at arrow) and L2vm, dorsal and ventromedial sclerites of left phallomere. 7, R2 hooked sclerite of right phallomere. 8, R3, sclerite of right phallomere. 9, Tergum 7 specialization. 10, Pronotum of unmarked form. 11, *C. bilunata,* female, supra-anal plate, dorsal view. Scale bars equal to 0.5 mm.

straw colored; posterior ½ of disc with a pair of large semicircular pale yellow spots (Fig. 1). Tegmina and wings fully developed, exceeding abdomen in length but exposing cerci; tegmina shining reddish brown with iridescent reflections, that portion of right tegmen normally covered by overlapping left tegmen nearly transparent as are wings; tegminal venation indistinct, about 12 radial sectors (costal veins), proximal ones moderately clubbed; branches of discoidal sectors (media and cubitus) oblique, anal field wide, veins indistinct. Wings with costal veins clubbed, intercalated triangle small, anal field wide, with numerous unbranched anal veins.

First 6 abdominal terga transverse, pale reddish brown, remaining terga and lateral edges of 1–6 dark reddish brown; specialized tergum 7 also transverse but with proximal portion normally hidden under tergum 6, its anterior margin bearing a few scattered setae; specialization (Fig. 9) consisting of a median, anteriorly directed semicircular white elevation (in dry mounted specimens often only base of this knob exposed); terga 8 and 9 transverse, their combined lengths less than exposed portion of tergum 7; supra-anal plate (tergum 10) triangular, wider than deep, proximal portion pale, distal portion with apex broadly emarginate, sinuate (Fig. 2); posterior margin bears a row of well-spaced large setae; cercus stout, flattened dorsally, 10-segmented.

Subgenital plate asymmetrical (Fig. 4) semicircular with margins strongly recurved and a rounded lobe on left posterior margin; apex of plate having an inverted U-shaped emargination which bears styles and median projection; right style slightly larger than left, both oval, membranous, bearing scattered setae; interstylar space occupied by hinged base of sclerotized median projection; projection widest at base, slender at midpoint and bent to right ending in a spiny knob. Internal genitalia (see McKittrick, 1964, especially Fig. 115, for explanation of terms) include hooked right phallomere (R2) with subapical incision (Fig. 7); short R3, twisted and bent near its spined tip (4 or more spines) (Fig. 8); slender left phallomere (L2vm) with very short wedge-shaped L2d at its apex, L2vm and L2d not fused at their junction (Fig. 6); and complex L1 phallomere with lightly sclerotized claw-shaped process internally (Fig. 5).

Limbs generally stout; forefemur with ventro-anterior margin bearing a row of closely set microspines (Type C armament) ending in 2 stout apical spines; ventroposterior margin bearing small apical spine; mid- and hindfemora with a few scattered spines ending in a single apical spine; tibiae heavily spined; tarsal segments lacking pulvilli, tarsal claws slender, simple and symmetrical, arolia absent (a very minute arolium on left hindtarsus of holotype). Color of coxae and median portions of abdominal sterna pale, of tibiae, tarsi, and lateral margins of abdomen darker, matching general coloration.

Female allotype.—Measurements in Table 1. Left foreleg, right hindleg and left hindtarsus missing, but morphology essentially same as holotype except as follows: ocelli well defined; tergum 7 of abdomen smooth, without specialization; supra-anal plate transverse, weakly bilobed at apex (Fig. 11), similar to that structure in male but color pattern obscure; subgenital plate convex, symmetrical, bilobed at apex; lateral dark margins of abdominal sterna wider than male and subgenital plate wholly dark.

Remarks.—As with other species of *Ceratinoptera, C. bilunata* exhibits variations in length of tegmina and wings as well as coloration. In holotype and allotype the tegmina exceed tip of abdomen, but not cerci, while the Quesada and Quepos male paratypes have shorter tegmina that barely cover the specialization on tergum 7. The distinctive semicircular pronotal spots vary somewhat in size and shape. In the typical form they are always obvious and separated by a dark median area

Table 1. Measurements of *Ceratinoptera bilunata,* in mm.

	Typical Form			Unmarked Form		
	Holotype Male	3 Paratype ♂ (Range)	Allotype Female	Paratype Female	3 Paratype ♂ (Range)	3 Paratype ♀ (Range)
Total length	10.2	9.1–9.3	9.6	9.3	9.0–9.8	9.6–9.7
Maximum width	4.6	4.0–4.5	4.9	4.7	4.9–5.0	4.6–4.8
Pronotum length	2.4	2.3–2.6	2.5	2.7	2.1–2.2	2.4–2.5
Pronotum width	3.2	3.0–3.3	3.2	3.3	2.9	3.0–3.1
Left tegmen length	8.2	5.1–6.0	8.1	8.3	7.0–7.9	7.8–7.9
Left tegmen width	2.8	2.3–2.5	2.7	2.9	2.4–2.5	2.5–2.6
Abdomen length	5.0	5.0–5.5	5.2	—	3.5–4.1	3.7–3.8
Hindtibia length	2.9	2.9–3.2	2.9	3.1	2.5–2.6	2.6–2.9

of varying width. Nymphs of this species have a different color pattern. The base color is the same as adults, but, in addition to larger pronotal spots, there is a wide pale band across the metanotum which includes the proximal half of the wing pads. A median pale area on abdominal terga 4 and 5 is also evident. A population ascribed by us to this species but completely lacking in pronotal spots (Fig. 10) or other obvious pale markings is found on Barro Colorado Island (BCI) where it has been confused with the similar appearing *C. picta.* This unmarked form differs so markedly in color from typical *bilunata* that it might be considered a distinct species were it not that the male specialization on tergum 7 and the male subgenital plate and genitalia are practically indistinguishable from typical *bilunata.* It is characterized as follows: three male paratypes agree with holotype except that general coloration is darker, more uniform, the pronotum lacking pale spots; tegmina and wings fully formed, exceeding tip of abdomen and cerci; scattered setae anterior to specialization on tergum 7 apparently more numerous; subgenital plate with edges strongly recurved (as in many *C. picta*), the inverted U-shaped emargination enclosing styles and median projection more tightly. Females of the unmarked *C. bilunata* cannot be distinguished with certainty from those of *C. picta* found in the same locality, but we have selected three female paratypes based primarily on their somewhat smaller size. They agree in coloration with unmarked males and in morphology with typical females of *C. bilunata.*

The name *bilunata* was suggested for this species by Dr. Ashley B. Gurney because of the two half-moon-shaped light spots on the pronotum.

Types.—Holotype ♂, PANAMA, Bocas del Toro Province, Rio Changuinola, Corriente Grande, coll. HW IV/2/80; allotype ♀, COSTA RICA, Heredia Prov., Puerto Viejo, "La Selva," coll. FWF I/30/74; 4 paratypes: 1 ♂ COSTA RICA, Cartago Prov., Turrialba, coll. S.S. & W.D. Duckworth II/22–28/65 (specimen at USNM); 1 ♂, COSTA RICA, Alajuela Prov., Quesada, coll. FWF VII/29/66; 1 ♂, COSTA RICA, San Jose Prov., 16 km north of Quepos, coll. FWF VIII/7/66; 1 ♀, Cartago Prov., Chitaria, coll. M. Valerio IV/12/30 (specimen at ANSP). Also 3 ♂ and 3 ♀ paratypes of unmarked form, all from PANAMA, BCI, coll. HW between May and Oct., 1977 and 1978 plus 1 ♀ paratype, BCI, coll. HW IV/79. All the above Costa Rican records were listed by Fisk (1971) as "*Ceratinoptera* n. sp."

Table 2. Measurements of *Ceratinoptera gurneyi,* in mm.

	Holotype Male	7 Paratype ♂ (Range)	Allotype Female	Paratype Female
Total length	13.0	12.0–14.4	12.4	12.3
Maximum width	6.1	5.8–6.5	5.2	5.8
Pronotum length	2.8	2.6–3.0	2.8	2.8
Pronotum width	3.7	3.4–4.0	3.5	3.3
Left tegmen length	10.5	10.3–13.8	9.9	9.8
Left tegmen width	3.2	3.5–3.7	3.0	3.1
Abdomen length	5.0	4.2–5.0	5.1	5.0
Hindtibia length	3.4	3.0–4.1	3.4	3.5

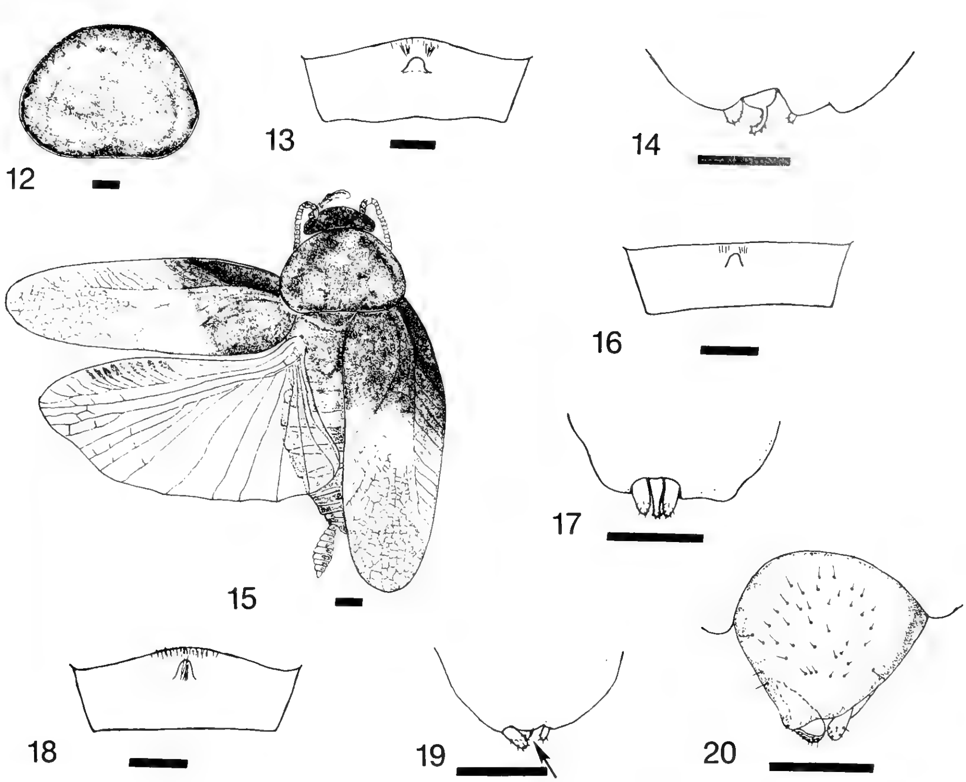
***Ceratinoptera gurneyi* Fisk and Wolda, New Species**

Figs. 12–14

Male holotype.—Measurements in Table 2. Head evenly convex, eyes well separated, the interocular space nearly 1.5× interantennal space; ocelli present; ultimate segment of maxillary palpus subequal to 3rd segment and 1.5× 4th segment in length; antenna subequal to overall length; head coloration similar to *C. bilunata* but darker. Pronotum broadly rounded anteriorly, posterior margin truncate; base color of pronotum shining mahogany with narrow latero-anterior margins pale, posterior ½ of disc with a pair of irregularly shaped yellowish or off-white spots, spots suffused with ground color medially (Fig. 12). Tegmina and wings fully developed, exceeding tips of cerci in length; tegmina shining reddish brown with iridescent reflections except transparent portion of right tegmen normally covered by left tegmen; tegminal venation indistinct; wings transparent with costal veins clubbed, intercalated triangle small. First 6 abdominal terga transverse, tergum 7 less transverse with proximal portion normally hidden under tergum 6, but exposing specialization consisting of a median, anteriorly directed, semicircular white knob surrounded at its tip by a slightly depressed area; anterior to knob are a pair of setal tufts and other scattered setae (Fig. 13); terga 8 and 9 transverse, their combined length less than exposed portion of tergum 7; supra-anal plate triangular, wider than long, darker at its broadly bilobed apex, a row of widely spaced large setae bordering apical margin of plate; cercus stout, flattened dorsally, 10 (or 11) segmented.

Subgenital plate (Fig. 14) circular, asymmetrical, with sides strongly recurved and rounded lobe on left posterior margin; a shallow median emargination bearing greatly modified styles and median projection; styles subequal, right larger than left, oval, membranous, bearing scattered setae, seemingly attached to median emargination by their sides rather than their bases; sclerotized median projection hinged at its base and may extend posteriorly or, more often, be held in a dorsal or anterior position, therefore partly hidden from below; projection larger and darker than with *C. bilunata,* otherwise similar internal genitalia much as in *bilunata* but R3 bears just 3 spines at tip.

Morphology of limbs as for *bilunata* (very minute arolia noted on tarsi of some paratypes); color of limbs and abdominal sterna darker. Female allotype and paratype with coloration and external morphology as described for male except tergum 7 smooth, subgenital plate convex and bilobed at apex, bilobed appearance being enhanced due to apical portion being strongly recurved.



Figs. 12–20. 12–14 *Ceratinoptera gurneyi,* male. 12, Pronotum. 13, Tergum 7 specialization. 14, Subgenital plate, ventral view. 15–17 *C. estribii,* male. 15, Habitus of holotype. 16, Tergum 7 specialization. 17, Subgenital plate, ventral view. 18–20 *C. picta,* male. 18, Tergum 7 specialization. 19, Ventral view of subgenital plate in flattened relaxed position showing sharp tip of L2d exposed (at arrow). 20, Ventral view of subgenital plate in frequently occurring tightly curled position. Scale bars equal 0.5 mm.

Remarks.—This is the largest *Ceratinoptera* species known from Panama. The larger size, limited distribution and somewhat diffuse pronotal spots serve to separate specimens of *gurneyi* from other members of the genus. All but three of the specimens were trapped during mid to late Spring. We name this species for Dr. Ashley B. Gurney, retired specialist of orthopteroid insects, Systematic Entomology Laboratory, USDA, who co-authored a draft description of *C. bilunata.*

Types.—All material collected by HW in light traps at PANAMA, Chiriquí Prov., Fortuna (8°44′N, 82°16′W, elev. 1050 m). Holotype ♂ IV/30/78; allotype ♀ IV/23/79; 7 paratype ♂ IX/6/77, IV/18/78, VII/7/78, IV/18/79, V/7/79, VI/26/79, VII/9/79; 1 paratype ♀ VI/6/79.

Ceratinoptera estribii Fisk and Wolda, New Species
Figs. 15–17

Male holotype.—Measurements in Table 3. Head broad and flat, interocular distance 0.65× width of head and 1.5× wider than interantennal space; ocelli poorly defined; ultimate segment of maxillary palpus inflated with inner surface pale, subequal to 3rd and longer than 4th segment; color of head nearly uniform,

Table 3. Measurements of *Ceratinoptera estribii,* in mm.

	Holotype Male	2 Paratype ♂ (Range)	Allotype Female	2 Paratype ♀ (Range)
Total length	8.7	8.6	8.0	7.8–8.0
Maximum width	4.2	4.0–4.4	4.4	4.0–4.1
Pronotum length	1.9	1.7	2.0	1.9–2.0
Pronotum width	2.7	2.5–2.6	2.7	2.5–2.6
Left tegmen length	6.9	6.5–7.1	6.2	6.2–6.4
Left tegmen width	2.2	2.1–2.2	2.4	2.1–2.2
Abdomen length	3.3	3.6	3.8	3.4–3.5
Hindtibia length	2.4	2.1–2.2	2.1	2.1–2.2

including mouthparts; antenna (of paratype) about 0.8× over-all length. Pronotum broadly rounded anteriorly and laterally, truncate posteriorly; tegmina extending beyond tips of cerci; maximum width of tegmen 0.3× its length; venation indistinct or lacking except for some costal veins; proximal 0.4 of tegmina colored reddish brown to nearly black like rest of body, distal 0.6 of tegmina nearly transparent like wings so outline of abdomen beneath them evident; wings as long as tegmina with veins well marked, costal veins clubbed (Fig. 15). First 6 abdominal terga simple, transverse, tergum 7 with median specialization consisting of slightly raised, transparent round disc bordered anteriorly by a few scattered setae (Fig. 16); posterior margin of tergum 6 usually covering setal patch but not transparent disc; terga 8 and 9 narrowly transverse; supra-anal plate about as deep as tergum 7; its posterior margin transverse, very weakly bilobed, armed with row of widely spaced large setae; cercus stout, 3× longer than wide. Subgenital plate (Fig. 17) semicircular in outline with margins strongly recurved, left margin with lobe halfway between median line and left side; apex of plate strongly emarginate, enclosing bases of short symmetrical simple styles and a narrow straight median projection with slightly enlarged, rounded tip; tips of styles and median projection appear to extend beyond recurved posterior margin of plate for at least ½ their length; morphology of limbs as for *C. bilunata*; abdominal sterna pale centrally, darker laterally; mid- and hindcoxae and all tarsi not so dark as remainder of limbs; distinctive coloration in both sexes confined to tegmina, apical ⅗ being nearly transparent.

Female allotype.—Morphology and coloration as described for male except as follows: abdominal tergal specialization lacking, terga 1 through 7 similar; supra-anal plate transverse, its right and left margins meeting at an oblique (130°) angle, apex rounded; subgenital plate larger than for male, posterior margin rounded, recurved, with shallow median notch; styles and median projection lacking.

Remarks.—This species can be readily separated from other *Ceratinoptera* by the tegmina of both sexes being nearly transparent apically for over half their length, reminiscent of the condition in some *Holocompsa* cockroaches. The styles and median projection of the males are also distinctive. The species is named for Miguel Estribí whose help in the study of Panamanian cockroaches and other light trap collections is deeply appreciated and who prepared many of the drawings for this paper.

Types.—All material collected by HW at light traps in two PANAMA locations:

holotype ♂, Las Cumbres, 16 km north of Panama City, X/24/75; allotype ♀ same location IX/29/76; 4 paratypes: 1 ♂ same location XI/24/76; 1 ♂ BCI IV/18-24/79; 1 ♀ BCI IV/6/78; 1 ♀ BCI X/6/78.

Discussion.—Cockroaches were sampled with light traps in six localities in the Republic of Panama: Las Cumbres, province of Panama, 9°5′36″N, 79°31′54″W, 150 m elev. (see Wolda, 1980, for details); Barro Colorado Island (BCI), Panama Canal Area, 9°9′19″N, 79°45′19″W, 120 m elev. (see Wolda, 1977); Boquete, Chiriquí province, 8°48′N, 82°26′W, 1350 m elev., a small forest remnant surrounded by large coffee plantations; Fortuna, Chiriquí province, 8°44′N, 82°16′W, 1050 m elev., very wet forest; Miramar, province of Bocas del Toro, 9°N, 82°15′W, elev. sea level, in a coastal, rather disturbed habitat of pastures near a wooded slope; and Corriente Grande, Bocas del Toro province, 9°17′30″N, 82°32′41″W, 100 m elev., in old, but recently logged forest.

Ceratinoptera bilunata typical form, was collected in just one Panama locality, Corriente Grande. The unmarked *C. bilunata* was only trapped on BCI. *Ceratinoptera gurneyi* was collected only in Fortuna, all but one of 11 specimens between mid-April and late June; the one exception was trapped in early September. *Ceratinoptera estribii* has been observed only in central Panama, at Las Cumbres and on BCI. In the samples from BCI the unmarked form of *C. picta* is by far the most common species of this genus. It is almost impossible to separate females of *C. picta* from the unmarked form of *C. bilunata.* Both are found on BCI, but the latter is rather scarce. Specimens determined as *picta,* some of which may have been *bilunata,* were found throughout the rainy season. Unmarked *C. picta* were also taken in Las Cumbres (45 km east of BCI), but not in the mountains of Chiriquí province. Some specimens were however collected on the Atlantic side in Bocas del Toro Province, both at Miramar and Corriente Grande. All specimens of *picta* sampled in this study lacked markings on the pronotum, confirming Hebard's (1920) findings that all *C. picta* collected in Panama were of the unmarked form, but these included both long-winged and short-winged individuals.

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A REVISION OF THE GENUS *ASTEROCOCCUS* BORCHSENIUS (HOMOPTERA: CEROCOCCIDAE)

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Abstract.—A new species of scale insect from India, *Asterococcus* ***ramakrishnai,*** is described and illustrated. *Asterococcus pyri* Borchsenius is considered a synonym of *A. muratae* (Kuwana), and redescriptions are provided for *A. ovoides* (Cockerell) and *A. muratae.* A discussion on the generic status of *Asterococcus* and a key for separation of adult females are included.

Borchsenius (1960) proposed the genus *Asterococcus* to include four new species of scale insects (*A. pyri, A. quercicola, A. schimae, A. yunnanensis*) he described from collections made in China and Russia. These species differed significantly from other species of Cerococcinae in adult morphology and test development. Also, he indicated that *Cerococcus muratae* (Kuwana) should be included in the new genus. In a revision of *Cerococcus* by Lambdin and Kosztarab (1977), *C. ovoides* (Cockerell) and *C. muratae* (Kuwana) were transferred to *Asterococcus.* Recently, Wang (1980) provided a brief review of *Asterococcus,* and described a new species, *A. atratus,* from China. The adult females are distinguished from species of related genera by a wide band of pores and ducts extending around the ventral margin of the body. The sacklike test is characterized by the first instar exuvia being retained in the middorsal region, and a tubular projection arising at the base of the test is directed upward.

Reported here are redescriptions for *A. muratae* and *A. ovoides,* description of a new species from India, and key to species of *Asterococcus.* Measurements of morphological characters are given in micrometers; averages are followed by ranges in parentheses. Numbers of specimens studied are presented followed by the slide number in parentheses. Depositories of type-material are abbreviated: BMNH, British Museum (Natural History), London; FAHU, Faculty of Agriculture, Hokkaido University, Sapporo, Japan; FDACU, Florida Department of Agriculture and Consumer Services, Gainesville, Florida; USNM, National Museum of Natural History, Beltsville, Maryland; UT, University of Tennessee, Knoxville; VPISU, Virginia Polytechnic Institute and State University, Blacksburg.

Asterococcus Borchsenius, 1960

Type-species.—*A. schimae* Borchsenius.

Generic diagnosis.—Tests of adult females: globose to dome shaped, first instar exuviae retained on anteromedial area, spiracular furrows lined with white powdery wax, and a slightly curved tubular extension arising at posterior base and projecting dorsad for elimination of excrement.

Adult female.—Body pyriform with well-developed anal lobes and anal cleft, anal ring with 8 fleshy setae, anal shield, bifid posterior spiracular furrows (except *A. ovoides*), bilocular pores, pair of postvulvar setae at apex of anal cleft, simple pores irregularly spaced, tubular ducts most numerous on margin, unsegmented antenna and leg stubs, 3-segmented labium with 8–12 setae, 5 or 7-locular pores dominant at antennal base and spiracular furrows, 8-shaped pores on dorsal and ventral surfaces. Largest 8-shaped pores in marginal band primarily on venter, and in 1–3 transverse bands on dorsal abdominal segments; smallest 8-shaped pores in transverse rows on ventral abdominal segments, but present or absent on dorsal cephalothoracic and anterior abdominal segments.

Remarks.—Body shape, pores, ducts and setal types are similar for species of *Asterococcus, Cerococcus,* and *Solenophora.* The primary characteristics used to differentiate species of the three taxa include size and dorsal arrangement of 8-shaped pores, number of anal ring setae, and tests of adult females. Species of *Cerococcus* have 8-shaped pores in clusters, lattice pattern or evenly spaced on dorsum, 8 anal ring setae, and test without middorsal first instar exuvia or well-developed anal tube. Species of *Solenophora* have dorsal 8-shaped pores restricted to a transverse band on posterior abdominal segments, 6 anal ring setae, and test with first instar exuvia retained middorsally and well-developed anal tube projecting downward. A key to separate *Asterococcus* from related genera was presented by Lambdin and Kosztarab (1976, 1977).

***Asterococcus muratae* (Kuwana)**

Fig. 1

Cerococcus muratae Kuwana, 1907: 180, 1917: 5; Sasscer, 1913: 109; Green, 1919: 270; Sakai, 1935: 298; Borchsenius, 1937: 172, 1950: 131; Tachikawa, 1955: 52; Takahashi, 1956: 4; Tamaki, 1969: 86.
Solenococcus muratae: Sanders, 1909: 36; Howard, 1921: 132.
Solenophora muratae: Cockerell, 1909: 55.
Asterococcus muratae: Borchsenius, 1960: 128; Lambdin and Kosztarab, 1977: 1; Paik, 1978: 277; Kawai, 1980: 173.
Asterococcus pyri Borchsenius, 1960: 118. **NEW SYNONYMY.**

Type-locality.—Tokyo, Japan.

Type-material.—Paratypes: on *Vitis vinifera* L. (Vitaceae), 2(1), Tokyo, Japan, 16 Apr. 1906, S. I. Kuwana coll. no. 6 (USNM). Because the "type" specimen was referred to specifically by Kuwana (1907) as having been deposited in the entomological collection of the Imperial Agricultural Experiment Station (Yokohama, Japan), it is considered the holotype, and the 2 specimens from the type-series are designated paratypes in this study.

Additional material studied.—On *Ilex oldhami* (Aquifoliaceae), 5(1), Korasan, Chikugo, Japan, S. Miyamoto coll., Apr. 1935 (FAHU); *Ficus* sp. (Moraceae), 27(16), Nagasaki, Japan, G. Compere coll. (VPISU no. PL 127 a–g, 172 a–i); *Machilus* sp. (Lauraceae), 1(1), Mt. Takas, Japan, R. Takahashi coll., 16 Jul. 1950 (FAHU); *Viburnum odoratissimum* (Caprifoliaceae), 17(2), Yokohama, Japan, R. Takahashi coll., 26 Sept. 1952 (FAHU); with same data as former, 6(2), (BMNH) 1958, C.I.E. 13815-3021), and 2(1), (FDACU, ABH-402); on *Rosa* sp., 3(1),

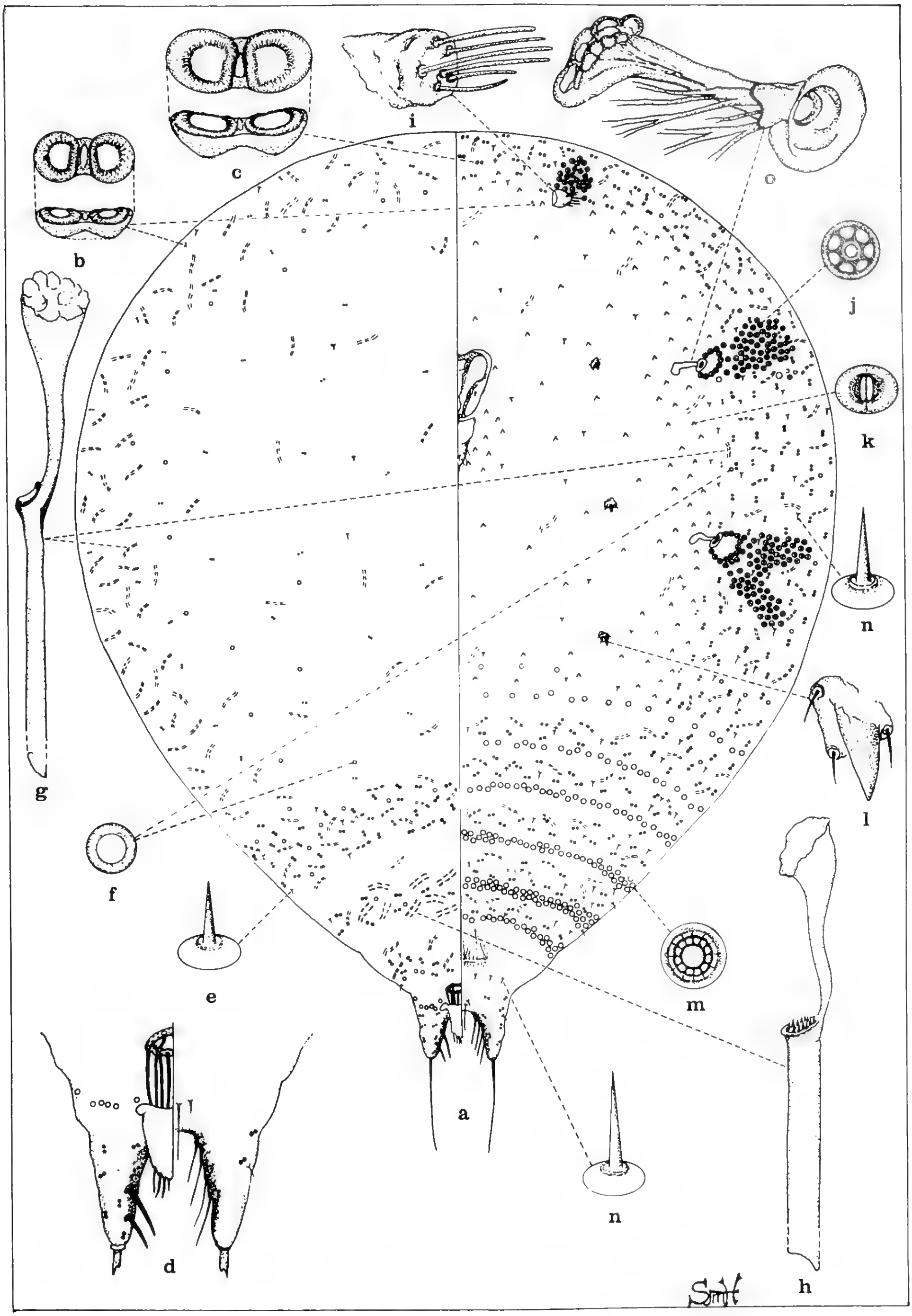

Fig. 1. *Asterococcus muratae,* dorsoventral view of adult female. See text for explanation.

Yokohama, Japan, G. Compere, coll. no. 326 (USNM). On undetermined hosts: 4(1), Nagasaki, Japan, G Compere coll. no. 1281 (USNM); 3(1), Yokohama, Japan, G. Compere coll. no. 313 (USNM).

Female test (as described by Kuwana, 1907).—". . . length 5 to 6 mm, width 4 to 5 mm, height about 3 mm, barnacle shaped, with several white bands which radiate from the cone; mounted with reddish brown exuviae. Subtransparent, brownish red in color. Posterior end of the test with a tube-like projection."

Male test.—Not seen.

Body of adult female (Fig. 1a).—Pear-shaped, 5000 (3264–6414) long, 2435 (1856–3207) wide. Derm membranous with several pore types, ducts and setae.

Dorsum.—8-shaped pores unevenly spaced, 2 sizes present. Smaller pores (Fig. 1b) on cephalothorax and anterior abdominal segments; each 6 (5–6) long, 4 (3–5) wide. Larger pores (Fig. 1c) arranged in 3 transverse bands on posterior abdominal segments above anal lobes; each 8 (6–9) long, 5 (4–5) wide. Anal lobes (Fig. 1d) triangular, heavily sclerotized on inner margin. Each lobe with an apical seta 185 (168–191) long and 2 posterolateral fleshy setae; anterior 37 (29–46) long, posterior 30 (22–41) long. Anal ring (Fig. 1d) located anterior to anal shield, 60 (51–68) long, 48 (40–54) wide; with 8 fleshy setae, each 127 (110–141) long; setae bordered by inner and outer row of evenly spaced translucent pores. Anal shield (Fig. 1d) triangular, often serrated at apex, 78 (54–86) long, 88 (54–98) wide. Cribriform plates absent. A few tacklike setae (Fig. 1e) spaced throughout derm in segmental rows, each 4 (3–6) long. Simple disc pores (Fig. 1f) distributed throughout derm, most numerous above anal lobes, each 2 (2–3) in diam. Tubular ducts (Fig. 1g, h) distributed throughout derm, most numerous on margin, 2 types present, both types with cylindrical base and clavate terminal filament. The dominant type (Fig. 1g) with sclerotized cup without conical spines, 42 (37–54) long, 2 (2) wide; other ducts (Fig. 1h) positioned anterior to anal plate and anal ring in a transverse band, cup heavily sclerotized with spines, each 33 (22–48) long, 4 (3–4) wide.

Venter.—Two sizes of 8-shaped pores (Fig. 1b, c) present on cephalothorax, restricted to marginal-submarginal band 6–9 pores wide. Larger pores in band 6–8 pores wide, each 9 (8–10) long, 5 (5) wide; smaller pores in an irregular row mesad of larger pores, each 7 (6–7) long, 4 (4–5) wide. 8-shaped pores (Fig. 1c) on abdomen arranged in 5 transverse bands, each band 1–3 pores wide; each pore 8 (6–8) long, 4 (4–5) wide. Antenna (Fig. 1i) reduced, unsegmented, 31 (24–39) long, 26 (21–30) wide; with 5–7 fleshy setae; an associated pore band extending laterad from antennal base composed of 26 (17–29) 5 to 10-locular pores, 7-locular pores (Fig. 1j) dominant, each 5 (4–6) in diam. Bilocular pores (Fig. 1k) most numerous in submarginal region, pores restricted to cephalothorax and anterior 1–2 abdominal segments; each 5 (5–6) long, 4 (4–5) wide. Clypeolabral shield 204 (173–249) long, 154 (136–193) wide; with an apical pair of setae ca. 10 long (2 pairs on specimens collected from *Viburnum* sp. and *Vitis* sp.), and usually a medial pair ca. 6 long. Labium triangular, 96 (82–113) long, 89 (74–103) wide: with 5 (5–6) pairs of slender setae on apical and medial segments, 16 (10–30) long; and 1 (0–1) pair on basal sclerite, 4 (2–5) long. Legs (Fig. 1l) reduced to unsegmented stubs, 14 (10–18) long. Microspines most numerous in medial and submedial areas of posterior abdominal segments and leg base. Multilocular pores

(Fig. 1m) primarily 10-locular, arranged in 7 (rarely 8) transverse abdominal rows, each 5 (5–6) in diam. Needle-like setae (Fig. 1n) on cephalothorax and in transverse abdominal rows between 8-shaped pore row, each 7 (4–9) long; a fleshy pair of suranal setae at apex of anal cleft 77 (68–99) long, and an associated pair anterior to latter 13 (8–20) long; anal lobes with 4 slender spinelike setae on inner margin 40 (24–51) long, and 1–2 smaller setae on outer margin 9 (5–15) long. Simple disc pores (Fig. 1f) sparse, shape and size same as those on dorsum. Spiracles (Fig. 1o) on submargin, 78 (63–97) long, 39 (33–49) wide, atrial orifice 18 (14–23) in diam. Spiracular furrows with a band of 7 (5–10)-locular pores 2–6 pores wide. Each anterior furrow with 72 (54–91) pores. Posterior furrows bifid, each furrow with 92 (82–104) pores. Spiracular setae absent, occasionally a seta associated with each spiracular pore cluster. Tubular ducts (Fig. 1g) most numerous in marginal area, shape and size same as those on dorsum.

Affinities.—My observations concur with those by Borchsenius (1960) indicating *A. muratae* to be most closely related to *A. schimae.* Characteristics shared by the two species include 3 pairs of unsegmented leg stubs, 4 setae on inner margin of each anal lobe, 7 transverse abdominal rows of multilocular pores, cluster of 16–29 pores at base of each antenna, and absence of cribiform plates. *Asterococcus muratae* differs from *A. schimae* by the presence of dorsal 8-shaped pores in transverse rows on cephalothorax, more numerous 7-locular pores in spiracular furrows, and absence of trilocular pores in spiracular furrows.

***Asterococcus ovoides* (Cockerell)**

Fig. 2

Pollinia ovoides Cockerell, 1901: 225.
Cerococcus ovoides: Green, 1909: 340; Ferris, 1918: 332; Brain, 1920: 119; Hall, 1935: 219; Munro and Fouche, 1936: 34; Ayyar Ramakrishna, 1936: 145.
Asterococcus ovoides: Lambdin and Kosztarab, 1977: 1.

Type-locality.—Durban, South Africa.

Type-material.—From the syntypes, an adult female on 1 slide is here designated as **lectotype**, and the remaining 3(3) specimens as paralectotypes. All on unknown host, Natal, S. Africa coll. Fuller (USNM).

Additional material studied.—On *Ficus* sp., 1(1), Pietermaritzburg, Natal, S. Africa, 1911, coll. A. Kelley (Brain coll. no. 26) (USNM); 2(1), no data, (USNM).

Female test.—Sacklike, globose, 1.0–1.7 mm long, yellowish brown in color with 1st instar exuvia positioned on middorsal area of test. A pair of white waxy bands visible on each side extending from exuvia to base of test.

Male test.—Elliptical, 1.0–1.4 mm long, 0.4–0.6 yellowish brown in color. Minute median carina composed of 5–6 series of waxy tubercles, and with 5–6 corresponding transverse ridges on anterior ⅔ of test. Anal flap with minute transverse ridges.

Body of adult female (Fig. 2a).—Pyriform, 1273 (1052–1643) long, 1098 (753–1237) wide.

Dorsum.—8-shaped pores widely spaced throughout derm, 2 sizes present. Smaller pores (Fig. 2b) in transverse rows on cephalothorax and anterior abdominal segments; each 6 (5–7) long, 3 (3–4) wide. Larger pores (Fig. 2c) in transverse band 2–3 pores wide on 7th abdominal segment, each 7 (6–8) long, 4 (4–5) wide.

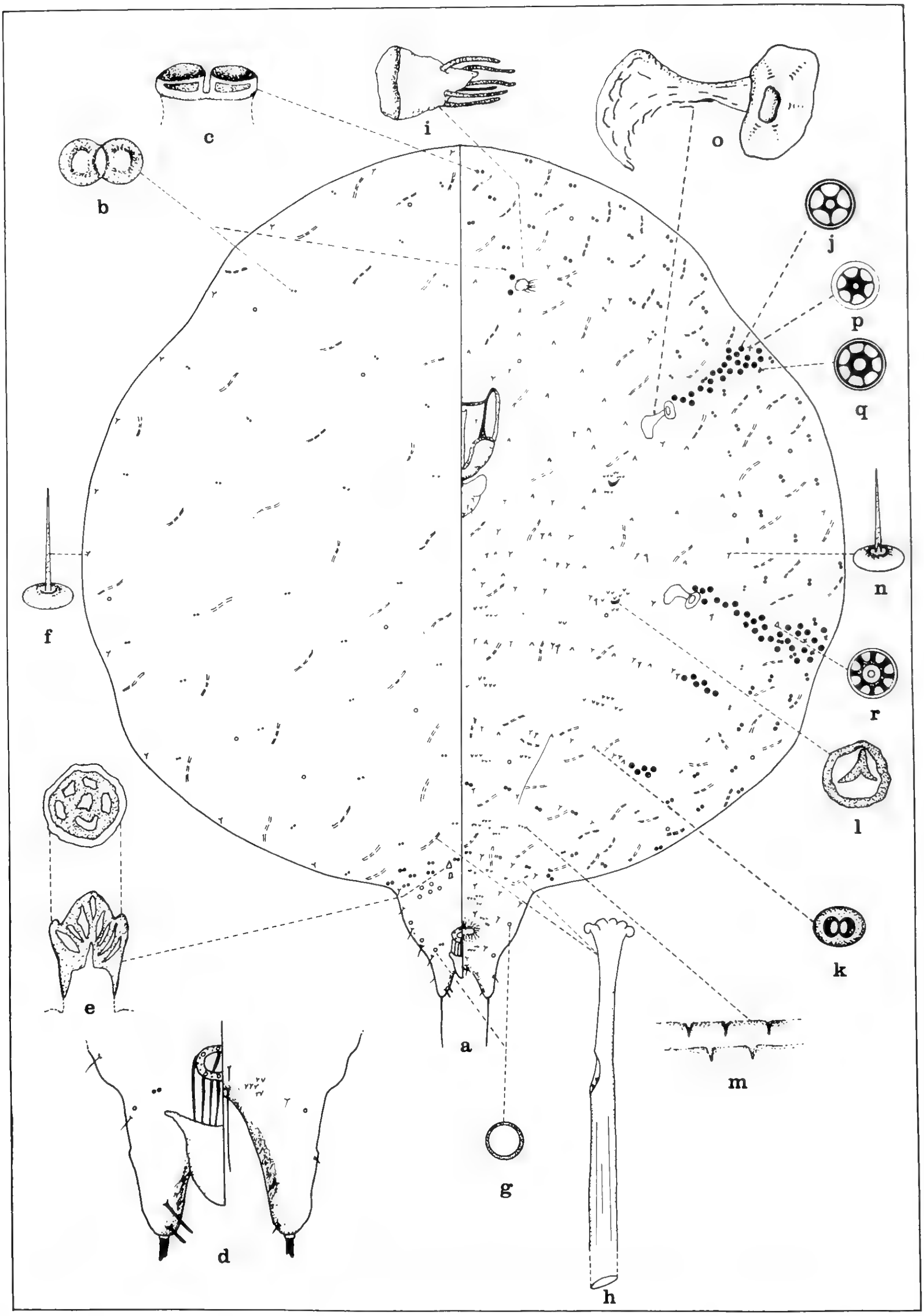

Fig. 2. *Asterococcus ovoides*, dorsoventral view of adult female. See text for explanation.

Anal lobes (Fig. 2d) triangular, lightly sclerotized on inner margin; each lobe with apical seta 118 (101–128) long, and 2 posterolateral fleshy setae, anterior 17 (11–27) long, posterior 10 (9–12) long. Anal ring (Fig. 2a, d) 22 (12–25) long, 19 (18–21) wide; with 8 fleshy setae, each 42 (39–59) long; setae bordered by inner and outer row of pores. Anal shield (Fig. 2d) triangular, 28 (20–34) long, 28 (22–42) wide. Cribriform plates (Fig. 2e) arranged in 2 submedial groups with 2–3 plates per group, plates elevated on derm; each subcircular, unevenly areolated and 11 (9–14) in diam. Dorsal body setae rare, a few slender setae (Fig. 2f) segmentally arranged on margin, each 6 (4–10) long. Simple disc pores (Fig. 2g) distributed throughout derm, most numerous in anal area, each 3 (2–4) in diam. Tubular ducts (Fig. 2h) irregularly spaced throughout derm, each 35 (29–41) long, 2 (2) wide; each duct with a clavate terminal filament and sclerotized cup with 0–2 minute conical spines.

Venter.—Three sizes of 8-shaped pores present. Largest pores (Fig. 2c) in marginal-submarginal band 3–5 pores wide; each 9 (8–11) long, 5 (4–6) wide. Smallest pores (Fig. 2b) in submarginal band 1–2 pores wide mesad of larger 8-shaped pore band; each 6 (5–8) long, 3 (3) wide; a few slightly larger pores scattered in spiracular furrows and in 2 transverse abdominal rows anterior to vulva, each 8 (7–9) long, 5 (4–5) wide. Antenna (Fig. 2i) reduced, unsegmented, 20 (17–25) long, 20 (14–25) wide; each with 6 fleshy setae, and 1–3 associated quinquelocular pores (Fig. 2j) located at base. Bilocular pores (Fig. 2k) in cephalothoracic area and in 2 transverse rows on anterior abdominal segments; each 5 (4–5) long, 4 (3–5) wide. Clypeolabral shield 121 (111–130) long, 103 (86–116) wide, with 1 apical and 1 medial setae. Labium triangular, 65 (45–74) long, 60 (52–74) wide; with 4 pairs of setae, each 13 (6–20) long. Legs absent or reduced to occasional meso- and metathoracic stubs (Fig. 2l), each 3 (1–7) long. Microspines (Fig. 2m) in medial area of abdominal segments and around leg stubs. Multilocular pores absent. Needle-like setae (Fig. 2n) in segmental rows on cephalothorax and abdomen, each 6 (4–11) long; a pair of spinelike suranal setae at apex of anal cleft 47 (41–54) long, and an associated pair of hairlike setae anterior to suranal setae 7 (6–10) long. Each anal lobe with 2 needle-like setae on inner margin and one on outer margin. Simple disc pores (Fig. 2g) sparsely scattered, most common on margin of posterior abdominal segments. Spiracles (Fig. 2o) on submargin, 45 (39–50) long, 23 (21–25) wide, atrial orifice 7 (6–10) in diam. Anterior spiracular furrow with band of 66 (59–81) pores, primarily 5-locular (Fig. 2j); a few (1–3) 6-locular (Fig. 2p), 7-locular (Fig. 2q), and multilocular (Fig. 2r); posterior furrows not bifid, with 63 (58–70) pores. Other 5-locular pores in 4 groups of 5–9 pores each, groups on submargin of anterior 2 abdominal segments. Tubular ducts (Fig. 2h) most numerous in marginal-submarginal area, sparsely scattered throughout remainder of derm, shape and size same as on dorsum.

Affinities.—Adult females of *A. ovoides* are morphologically similar to other species included in the genus. A close relationship to *A. quercicola* is indicated by the reduced number of pores at base of each antenna, absence of multilocular pores on venter, the presence of 4–6 cribriform plates and 4 pairs of labial setae. However, *A. ovoides* differs from *A. quercicola* by having 2, rather than 3, setae on inner margin of anal lobes, non-bifid posterior spiracular furrows, and 8-shaped pores in transverse rows on dorsum of cephalothorax.

Asterococcus ramakrishnai Lambdin, New Species

Fig. 3

Type-locality.—Bombay, Coimbatore, Madras, India.

Type-material.—On Banyan tree (*Ficus* sp., Moraceae), holotype ♀ (1) and 16 paratypes (4), Bombay, India, G. Compere coll. no. 276, 1384, 1385 (USNM). On *Ficus* sp., 2(1), Rhamba nr. Lake Chilka, Madras, India, 5 Mar 1910, Ind. coll. no. 76 (VPISU). On *Ficus religiosa* L., 1(1), Coimbatore, India, 24 May 1931, coll. T. V. Ramakrishna (UT).

Body of adult female (Fig. 3a).—Pyriform, 3233 (1852–5067) long, 3018 (1514–4600) wide.

Dorsum.—Large 8-shaped pores (Fig. 3b) in transverse band on 7th abdominal segment; each 9 (6–11) long, 5 (5–6) wide. Smaller 8-shaped pores (Fig. 3c) on anal lobes and in 2 transverse segmental rows above anal ring; each 7 (7–8) long, 4 (4–5) wide. Anal lobes (Fig. 3d) triangular, heavily sclerotized on inner margin; each lobe with apical seta 122 (114–134) long, and 2 fleshy posterolateral setae 23 (23–36) long. Anal ring located anterior to anal shield; 57 (45–72) long, 51 (40–57) wide; with 8 fleshy setae, each 100 (86–134) long; setae bordered by inner and outer row of pores. Anal shield (Fig. 3d) triangular, serrated at apex, 72 (55–87) long, 91 (76–114) wide. Cribriform plates absent. Setae sparse, tacklike, most numerous on 8th abdominal segment, irregularly spaced in segmental rows, each 12 (9–18) long. Simple disc pores (Fig. 3e) irregularly spaced throughout derm, most numerous on posterior abdominal segments anterior to anal lobes, each 3 (2–4) in diam. Tubular ducts (Fig. 3f) irregularly spaced, most numerous on margin, one type present without teeth in sclerotized cup; each 32 (18–42) long, 2 (1–2) wide.

Venter.—Two sizes of 8-shaped pores (Fig. 3b, c) present. Larger pores in marginal-submarginal band 8–10 pores wide, each 9 (6–11) long, 5 (5–6) wide. Smaller pores in irregular row on cephalothorax between large 8-shaped pore band and bilocular pores, and in 3 transverse rows on posterior abdominal segments; each 7 (6–8) long, 5 (4–6) wide. Antenna (Fig. 3g) reduced, unsegmented, 21 (17–30) long, 27 (14–39) wide at base; with 5 fleshy setae, each 28 (18–36) long; 28 (18–33) 5- to 8-locular pores in band at base of antenna, 7-locular pores (Fig. 3h) dominant, each 4 (2–7) in diam. Bilocular pores (Fig. 3i) most numerous around mouthparts and on submargin of cephalothorax and anterior abdominal segments; each 5 (4–6) long, 4 (2–5) wide. Clypeolabral shield 213 (196–244) long, 169 (156–186) wide; with 3 (2–3) pairs of setae, each 11 (5–16) long. Labium triangular, 115 (100–128) long, 91 (81–121) wide; 6 (5–6) pairs of setae, each 23 (18–28) long. Legs absent, 2 specimens with unsegmented stubs (Fig. 3j) ca. 15 long on metathorax. Multilocular pores (Fig. 3k) in 3 transverse rows on posterior abdominal segments; each with double central apertures, each 12 (12–13) in diam. Needle-like setae (Fig. 3l) in segmental rows on cephalothorax and abdomen, each 11 (8–14) long; a few smaller setae in area around mouthparts and antennae 8 (6–10) long; a fleshy pair of suranal setae at apex of anal cleft 60 (50–67) long, and an associated pair anterior to suranal setae 17 (12–23) long. Anal lobes with 6 pairs of spinelike setae on inner margin, each 30 (19–40) long, and a medial setae 14 (10–16) long. Simple disc pores (Fig. 3m) restricted to marginal-submarginal area of cephalothorax and posterior abdominal segments, each 3 (2–3)

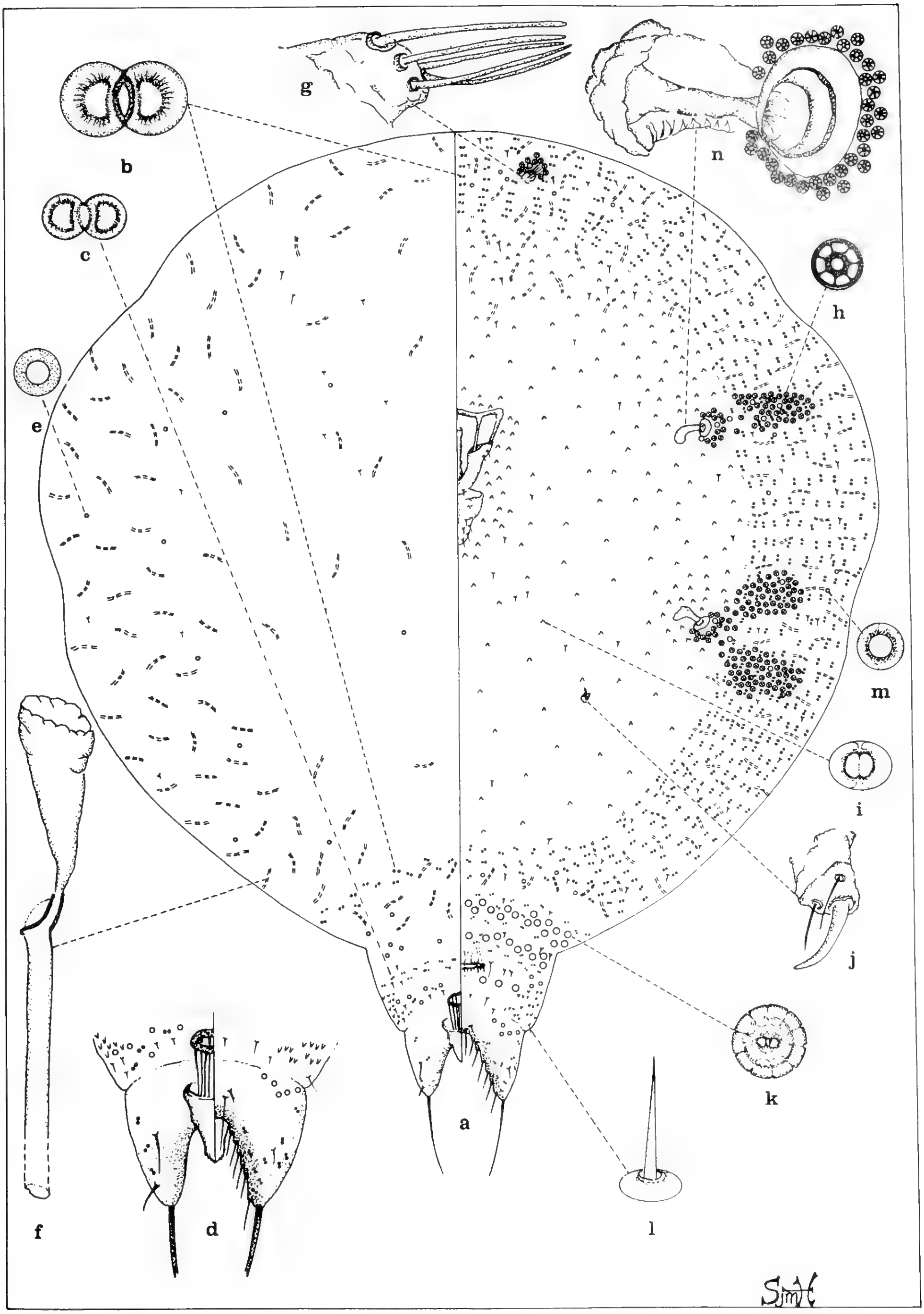

Fig. 3. *Asterococcus ramakrishnai,* dorsoventral view of adult female. See text for explanation.

in diam. Spiracles (Fig. 3n) on submargin, 68 (57–85) long, 39 (22–47) wide, atrial orifice 19 (18–20) in diam. Anterior spiracular furrows with a band of 172 (146–206) 5- to 8-locular pores; posterior furrows bifid, with 210 (122–288) pores; 7-locular pores (Fig. 3h) dominant. Tubular ducts (Fig. 3f) most numerous in marginal-submarginal area, shape and size similar to those on dorsum.

Etymology.—The species epithet is derived from T. V. Ayyar Ramakrishna, a pioneer investigator on scale insects of India.

Affinities.—Adult females of *A. ramakrishnai* are similar to those of *A. muratae, A. schimae,* and *A. yunnanensis* in regard to body shape, type and distribution of pores and ducts, and number of labial setae. Characters that distinguish *A. ramakrishnai* from related species include transverse rows of multilocular pores on the ventral abdominal segments reduced to 3, rather than 7 or 8, each multilocular pore with double central apertures opposed to a central aperture in pores on other species, a wider 8-shaped pore band on margin, and each anal lobe with 6 needle-like setae on inner margin compared with 2 to 4 on other species in the genus.

DISCUSSION

Species of *Asterococcus* are represented in the Ethiopian, Oriental, and Palearctic regions. Tests of adult females are similar to that of *Solenophora*; however, adult females are morphologically similar to species of *Cerococcus.* Similar structures of major significance found in species of the three genera include: size of the 3-segmented labium, 8-shaped pores, bilocular pores, cribriform plates (often present), curved anal shield, pair of suranal setae at apex of anal cleft, spiracular furrows lined with pores (posterior furrows often bifid), tubular ducts with filament, well-developed anal lobes, and anal ring with setae. Characters that differentiate the monotypic genus *Solenophora* from species of *Asterococcus* and *Cerococcus* are: an anal ring with 6 (rather than 8) setae, lack of 5- to 10-locular pores at base of antennae, and simple pores prominent in marginal band of pores and ducts. Species of *Asterococcus* are easily distinguished from those of *Cerococcus* by the wide band of pores and ducts extending around the ventral margin of the body. The presence or absence and arrangement of pores, ducts, and setae, rather than type variation of these structures, often differentiate species of *Asterococcus* from *Cerococcus.*

Borchsenius (1960) stated that *A. pyri* and *A. quercicola* possessed 6 anal ring setae, but paratypes examined have 8 setae. He described *A. pyri* from host material collected in Sukham, Russia, but noted that the species was on plants probably imported from Japan. Major differences observed in *A. pyri* examined from his description include: 7-locular rather than 8-locular pores dominant in spiracular furrows and base of antennae, 4 setae rather than 3 on inner margin of each anal lobe, and 8 rather than 6–8 fleshy setae on anal ring. Borchsenius (1960) noted that specimens of *A. muratae* were not available to him for comparison; thus, he was unaware of various characteristics possessed by *A. muratae* that he attributed to *A. pyri* (e.g. occurrence of leg stubs in *A. muratae*). Because no distinguishable differences exist in the number, type or arrangement of any morphological structure, *A. pyri* Borchsenius is considered a synonym of *A. muratae* (Kuwana).

KEY TO SPECIES OF *ASTEROCOCCUS*

1. Cribriform plates present; 10 or less disc pores at antennal base; multilocular pores absent from abdomen 2
– Cribriform plates absent; 11 or more disc pores at antennal base; multilocular pores present on abdomen 3
2. Leg stubs absent; posterior spiracular furrows bifid; from oak trees in China .... *quercicola* Borchsenius
– Leg stubs on meso- and metathorax; posterior spiracular furrows not bifid; from fig trees in South Africa .... *ovoides* (Cockerell)
3. Multilocular pores in 7 or 8 transverse rows; 4 needle-like setae on inner margin of each anal lobe; from areas other than India 4
– Multilocular pores in 3 transverse rows; 6 needle-like setae on inner margin of each anal lobe; known only from India .... *ramakrishnai,* new species
4. Dorsal 8-shaped pores in transverse rows on cephalothorax; anterior 8-shaped pore band on abdomen 5–8 pores wide 5
– Dorsal 8-shaped pores absent on cephalothorax; anterior 8-shaped pore band on abdomen 2–3 pores wide .... *schimae* Borchsenius
5. Trilocular pores present in spiracular furrows; basal labial sclerite without setae; multilocular pores in 8 transverse rows .... *yunnanensis* Borchsenius
– Trilocular pores absent from spiracular furrows; basal labial sclerite usually with 1 pair of setae; multilocular pores in 7 transverse rows .... *muratae* (Kuwana)

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DISCOVERY OF THE FAMILIES XYELIDAE, PAMPHILIIDAE, BLASTICOTOMIDAE, AND ORUSSIDAE FROM TAIWAN, WITH DESCRIPTIONS OF FOUR NEW SPECIES (HYMENOPTERA: SYMPHYTA)

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Abstract.—Four sawfly families, Xyelidae, Pamphiliidae, Blasticotomidae, and Orussidae are newly recorded from Taiwan, and four new species are described: *Xyela* ***meridionalis*** (Xyelidae), *Blasticotoma* ***smithi*** and *Runaria* ***taiwana*** (Blasticotomidae), and *Orussus* ***brunneus*** (Orussidae). These are among the southernmost records for the families, except for the cosmopolitan family Orussidae, and eleven of the twelve Old World families of Symphyta are now known to occur in Taiwan. The southern records of the first three families are briefly reviewed and the following taxonomic changes are proposed: *Onycholyda subquadrata* (Maa), n. comb. (Pamphiliidae); *Runaria* Malaise, gen. rev., *Runaria reducta* Malaise, comb. rev. and *Runaria flavipes* Takeuchi, comb. rev. (Blasticotomidae).

The Symphyta fauna of Taiwan is doubtlessly very rich but yet insufficiently known. Of the twelve Old World families of Symphyta, only seven have been recorded from this island.

As a result of my recent collecting in central Taiwan and my studies of the sawfly collections in the National Science Museum (Nat. Hist.), Tokyo, and Kobe University, Kobe, I have discovered three additional sawfly families, Xyelidae, Pamphiliidae, and Blasticotomidae. According to our present knowledge, representatives of these families are mainly distributed in the temperate regions, and the records from Taiwan are among the southernmost records for each of the families. A Taiwanese specimen of another family of Symphyta, Orussidae, was found in the collection of the B. P. Bishop Museum, Honolulu, by D. R. Smith. This specimen represents the first record of this widely distributed but rarely found family from Taiwan. With the addition of the four families, eleven of the twelve Old World families of Symphyta are now known to occur in Taiwan. The sawfly families of this island are thus exactly identical with those of Japan.

In this paper I record the four families from Taiwan and describe four new species belonging to Xyelidae, Blasticotomidae, and Orussidae. A brief review of the southern records for each of the families, except for the cosmopolitan family Orussidae, and some taxonomic notes are also given.

XYELIDAE

***Xyela meridionalis* Shinohara, NEW SPECIES**

Figs. 1, 5–9

Holotype female.—Head dull yellow with blackish-brown markings as in Fig. 6; epistomal suture and entire postgena blackish brown; gena dull yellow. Basal 3 segments of antenna brown with 3rd segment becoming blackish dorsally and towards apex; other segments blackish brown. Mouthparts dull yellow. Thorax blackish brown; dorsum with dark yellow markings as in Fig. 5; most of cervical sclerite, mesepisternum (except upper and posterior parts), and inner ½ of mesobasisternum yellow. Legs dark yellow with bases of coxae blackish brown. Wings hyaline with veins and outer margin of stigma translucent dark brown; central part of stigma nearly colorless, translucent. Abdomen blackish brown to black; posterior part of hypopygium, lateroventral sides of 8th and 9th terga, narrow posterior margins of dorsal sides of 8th and 9th terga, 2nd valvifer, base of ventral part and extreme tip of 3rd valvula (= gonostylus), and cercus dark yellow.

Third segment of maxillary palpus much longer than scape of antenna (about 20:13) and wider than 3rd antennal segment. Antenna slightly shorter than thorax and abdomen (without sawsheath) combined or nearly twice as long as sawsheath; relative lengths of segments about 26:9:58:18:16:13:10:10:9:8:6:6. Sawsheath (2nd valvifer + 3rd valvula, Fig. 7) very short, slightly longer than 3 basal segments of antenna combined; 3rd valvula laterally flattened, distinctly shorter than 2nd valvifer (about 0.85:1.00 in lateral view); saw as in Figs. 8–9.

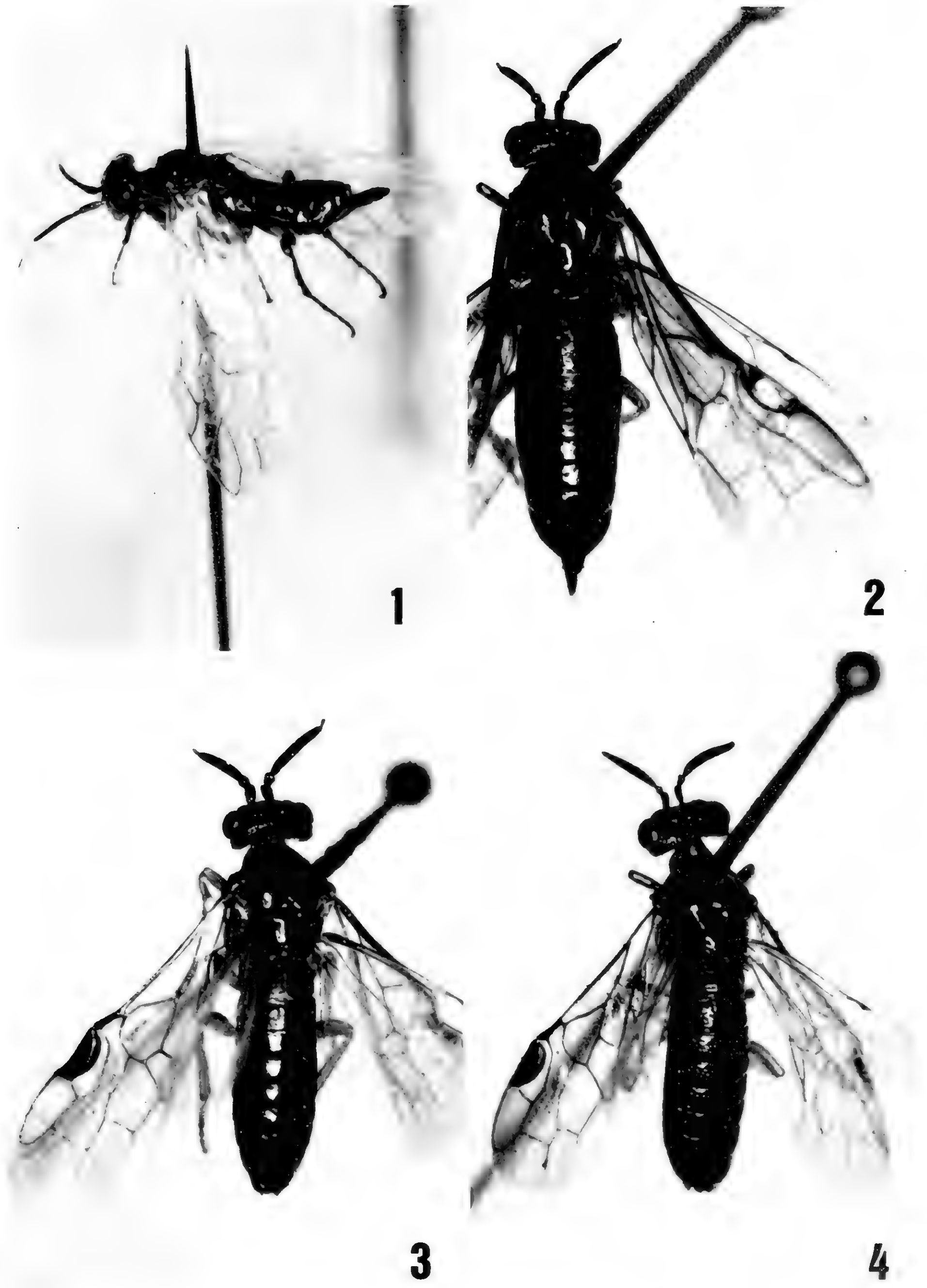
Body length (without sawsheath), 3.1 mm; forewing, 4.0 mm; sawsheath 1.2 mm.

Male and immature stages unknown.

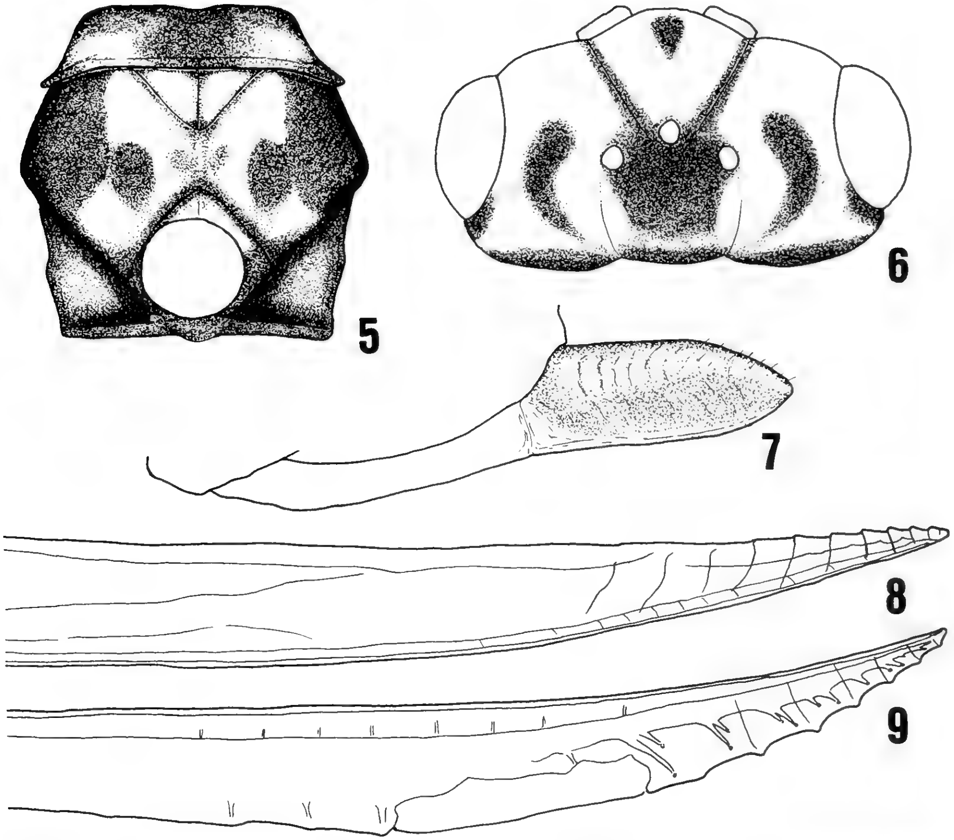
Holotype.—♀, Nanshanchi, nr. Puli, Nantou-Hsien, Taiwan. 15.III.1979. A. Shinohara. Deposited in the Entomological Laboratory, University of Osaka Prefecture, Sakai. The type-locality is a valley about 13 km east of the town of Puli, at about 24.01°N latitude. The holotype was swept from a pine tree (*Pinus* sp.) which was in an open pine grove on the eastern slope of the valley, at about 800 m alt.

Comparative comments.—*Xyela meridionalis* is a peculiar species, well characterized by the exceptionally short sawsheath. It is actually the only species in *Xyela* that has the third valvula (in lateral view) shorter than the second valvifer (Rasnitsyn, 1965). Among the previously known species, *X. menelaus* Benson from Greece has the shortest third valvula, which is, however, distinctly longer than the second valvifer (about 1.1:1.0, Benson, 1960). The ratio between the sawsheath length and the forewing length (about 1.0:3.3) is also very distinctive. *Xyela exilicornis* Maa from northwestern Fukien is known only from the male, and its relationship to *meridionalis* is not entirely certain. Although *exilicornis* differs markedly from *meridionalis* in the characters of the antennae, it is possible that these two are conspecific, because besides the possible sexual dimorphism, the instability of antennal characters in *Xyela* has been pointed out by Burdick (1961). It seems reasonable to me, however, to treat them distinct for the present.

Remarks.—The southernmost records of Xyelidae in Eurasia were those of *Xyela sinica* Maa and *Xyela exilicornis* Maa, both described from the Shaowu area, northwestern Fukien (about 27.21°N) (Maa, 1943, 1949). In North America, *Xyela*



Figs. 1–4. 1, *Xyela meridionalis,* holotype. 2, *Blasticotoma smithi,* holotype. 3, *B. smithi,* male paratype. 4, *Runaria taiwana,* holotype.



Figs. 5–9. *Xyela meridionalis.* 5, Thorax, dorsal view. 6, Head, dorsal view. 7, Sawsheath, lateral view. 8, Lance. 9, Lancet.

bakeri Konow, *X. dodgei* Greenbaum, *X. minor* Norton, *X. obscura* (Strobl), and *Megaxyela major* (Cresson) are known to occur in Florida (Smith, 1978). The southern range of Xyelidae appears, however, much wider than our previous knowledge, since representatives of *Xyela* have been found in Hong Kong and in the state of Michoacán in Mexico (D. R. Smith, personal communication).

PAMPHILIIDAE

***Acantholyda* sp.**

This species is similar to *A. flavomarginata* Maa from Fukien but has a darker color pattern. It may represent a subspecies of *flavomarginata.*

Specimen examined.—1 ♀, Nanshanchi (about 800 m alt., 24.01°N), nr. Puli, Nantou-Hsien, Taiwan. 15.III.1979. A. Shinohara.

The specimen was swept from needles of an unidentified species of *Pinus* at the type-locality of *Xyela meridionalis.*

Remarks.—Records of Pamphiliidae from southern Eurasia are scattered. Maa (1944) described *Acantholyda flavomarginata, Acantholyda dimorpha, Pamphi-*

lius subquadratus, and *Pamphilius wongi* from the Shaowu area (about 27.21°N), northwestern Fukien. *Pamphilius subquadratus* belongs to the genus *Onycholyda* as redefined by Beneš (1972); *Onycholyda subquadrata* (Maa) New Combination; confirmed by D. R. Smith from examination of paratypes. *Pamphilius wongi,* noted as having the structure of the head similar to that of *subquadrata* and the right mandible tridentate, probably belongs to *Onycholyda* too, though the description of the female alone does not allow definite decision. Maa (1949) recorded *A. flavomarginata* from Foochow (= Fuchou, about 26.09°N), eastern Fukien, and Hsiao (1963) added Kiangsi and Hunan to the distribution of both *A. flavomarginata* and *A. dimorpha.* Beneš (1972) described *Onycholyda birmanica* from Kambaiti at 2000 m alt. (about 25.25°N), northern Burma, and reported on the occurrence of "a probably still undescribed species of *Acantholyda* from Burma (cf. *flavomarginata* Maa)" (the details of the locality were not given but probably it is also from Kambaiti). I have seen two females of *Acantholyda* from southeastern China in the collection of the British Museum (Nat. Hist.), London; one (determined by Benson as "*Acantholyda ? flavomarginata* Maa") is from Foochow and another (determined by Benson as "*Acantholyda* n. sp.") is from "Chienlisien, Kwangsi."

In North America, the southernmost records of Pamphiliidae include those of *Acantholyda credita* (Norton) and *A. variegata* (Norton) both from Mexico (Smith, 1971). The exact type locality is not known for *credita* but *variegata* is from Cordova [= Cordoba? 18.55°N]. According to D. R. Smith (personal communication), representatives of *Acantholyda* occur at least as far south as the states of Morelos and Vera Cruz, Mexico. Southern records of the subfamily Pamphiliinae are that of *Onycholyda amplecta* (Fabricius) from Miami (about 25.45°N) and that of *Pamphilius persicus* MacGillivray from Orlando (about 28.33°N), both in Florida (Middlekauff, 1964).

The data enumerated above suggest that *Acantholyda* and *Onycholyda* are the predominant, if not the only, genera of this family in the southern part of its range; other pamphiliid genera are almost missing in the areas south to 30.00°N.

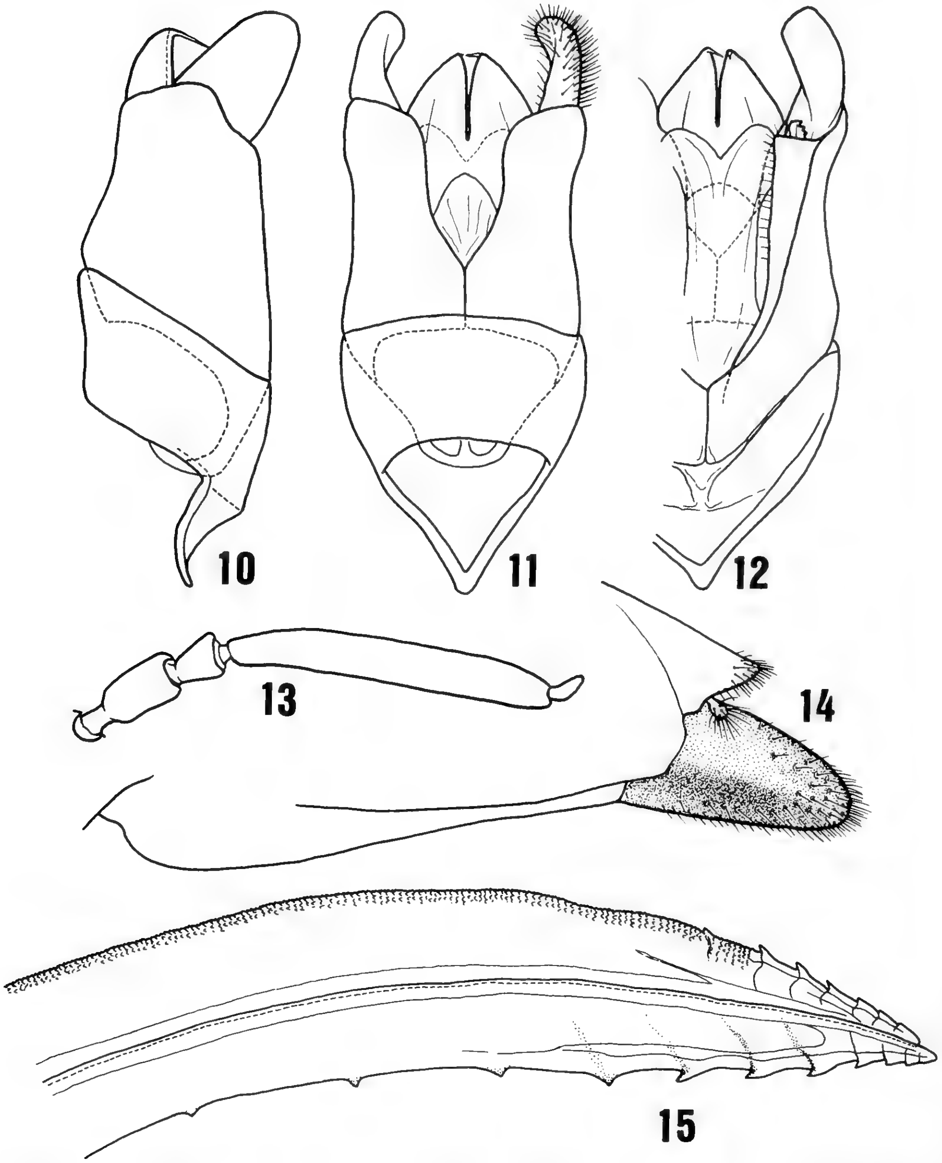
BLASTICOTOMIDAE

Blasticotoma smithi **Shinohara, New Species**

Figs. 2–3, 10–15

Holotype female.—Head and thorax black; antenna slightly brownish; labrum, apex of mandible, and palpi blackish brown to dark ferrugineous; tegula (except basal part) pale brown. Legs dark yellow with coxae and trochanters blackish brown. Forewing infuscated blackish brown, hindwing slightly so; veins and stigma blackish brown. Abdomen dark brown to black; apex of sawsheath pale.

Upper head smooth with slight rugosity and scattered punctures around ocellar area and along posterior margin; paraantennal field, supraclypeal area, clypeus, posterior and lower parts of gena coarsely but shallowly punctured. Fourth antennal segment (Fig. 13) slender, about 0.9× as long as maximum width of 3rd; ratio of 3rd antennal segment length to width of head (through compound eyes) 1.00:1.41. Thorax smooth; upper part of pronotum with shallow punctures and lower part coriaceous and/or aciculate; cervical sclerite with small punctures; ventral ½ of mesepisternum with scattered, distinct punctures, more densely punc-



Figs. 10–15. *Blasticotoma smithi.* 10–12, Genital capsule. 10, Lateral view. 11, Dorsal view. 12, Ventral view. 13, Antenna. 14, Sawsheath, lateral view. 15, Saw.

tured anteroventrally. Dorsal abdomen smooth and impunctate with propodeum distinctly coriaceous; ventral abdomen more or less coriaceous, partly with shallow, indistinct punctures. Sawsheath as in Fig. 14; saw as in Fig. 15.

Body length (excluding sawsheath), 7.5 mm; forewing length, 7.5 mm.

Male.—Similar to female in color and structure but smaller; body length 5.0–6.5 mm, forewing length 4.9–6.2 mm. Antenna relatively longer than in female;

ratio of 3rd antennal segment length to head width (through compound eyes) 1.00: 1.19–1.22. Genitalia as in Figs. 10–12.

Immature stages unknown.

Types.—Holotype ♀, Tattaka [= Sungkang, about 2050 m alt., 24.05°N, Nantou-Hsien], Taiwan, 2.V.1929, K. Sato. Paratypes: 3 ♀, 2 ♂, same data as for holotype. The type-series is deposited in the Department of Zoology, National Science Museum (Nat. Hist.), Tokyo.

Variation (4 ♀ and 2 ♂ examined).—The specimens examined show little variation both in color and in structure. Body length (excluding sawsheath) in females varies from 7.5 to 8.3 mm (mean 7.9 mm). Forewing length in females varies from 7.4 to 8.0 mm (mean 7.7 mm). The ratio of the third antennal segment length to the head width (through compound eyes) in females ranges from 1.00: 1.32 to 1.00:1.41 (mean 1.00:1.38) and that of the second valvifer length to the third valvula length in lateral view ranges from 2.19:1.00 to 2.29:1.00 (mean 2.25: 1.00).

Comparative comments.—This species runs to *B. filiceti pacifica* Malaise from Japan in Takeuchi's (1939) key but differs from it chiefly in the smoother surface sculpture and the sparser punctuation of the body (notably on the mesepisternum) and the slightly brownish coloration of the antennae. There is a difference also in the shape and length of the fourth antennal segment; in *smithi,* it is slender and only slightly shorter than the maximum width of the third segment (0.86–0.93: 1.00, mean 0.91:1.00, $n = 4$), whereas in *filiceti pacifica* it is thick and much shorter than the maximum width of the third segment (0.62–0.67:1.00, mean 0.65:1.00, $n = 7$).

This species is named in honor of Dr. D. R. Smith, U.S. Department of Agriculture.

Runaria taiwana **Shinohara, New Species**

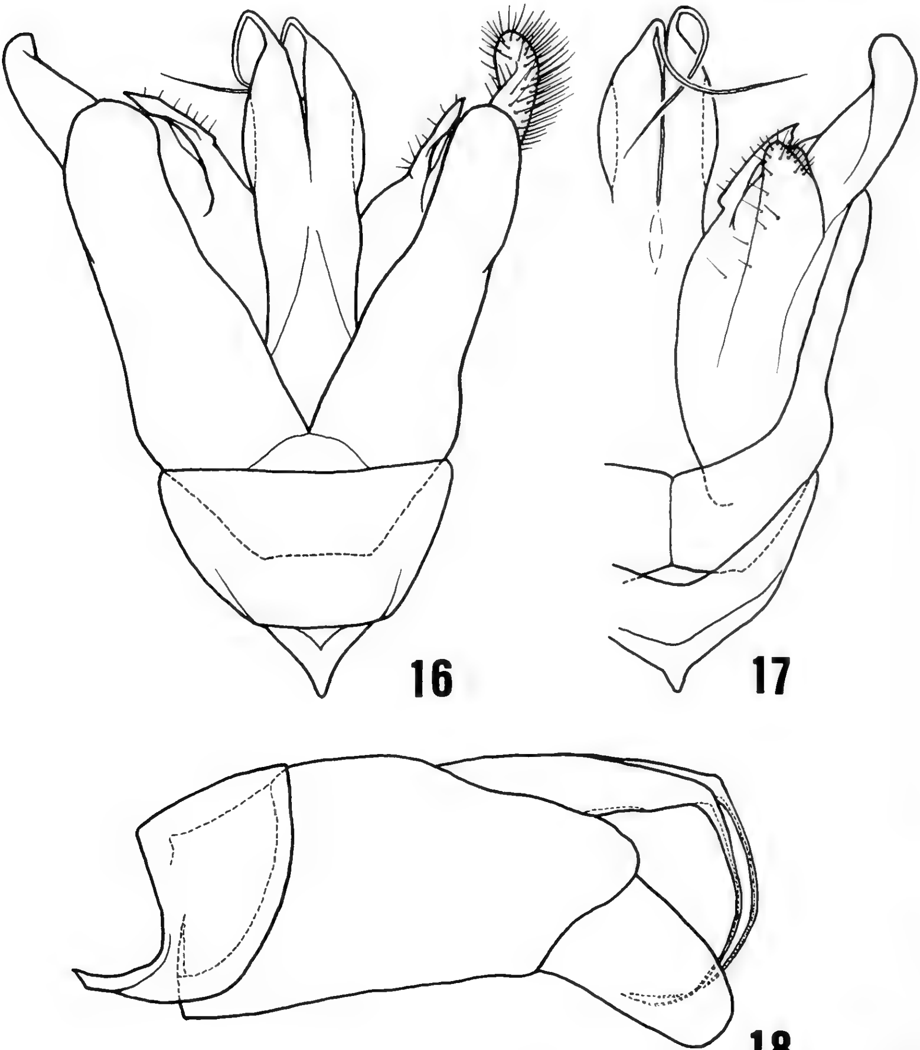
Figs. 4, 16–18

Holotype male.—Head and thorax black; apices of scape and pedicel and most of 3rd antennal segment slightly brownish; labrum pale brown; apex of mandible and palpi dark ferrugineous; tegula blackish brown. Legs dark yellow with coxae (except for apical part of hindcoxa), foretrochanter and forefemur more or less dark brown; midtrochanter and part of hindtrochanter brownish. Wings very slightly infuscated brownish (more so on cell 3R1 of forewing) with veins and stigma blackish brown. Abdomen blackish brown, ventrally slightly paler.

Head shining with irregular, shallow, often indistinct punctures. Mesoscutellum smooth with only a row of distinct punctures along posterior margin. Mesepisternum smooth, not rugose, punctures not dense (in lateral part interspaces between punctures much larger than diameter of each puncture). Dorsal abdomen smooth, propodeum nearly impunctate (with narrow lateral margins densely punctate), 2nd tergum anteriorly with scattered, distinct, large punctures, 3rd to 5th with more dense, distinct, large punctures, 6th to 9th with rather indistinct punctures; ventral abdomen very weakly coriaceous or smooth, distinctly punctate except at apical part of each sternum. Genitalia as in Figs. 16–18.

Body length, 6.0 mm; forewing length, 5.5 mm.

Female and immature stages unknown.



Figs. 16–18. *Runaria taiwana,* genital capsule. 16, Dorsal view. 17, Ventral view. 18, Lateral view.

Types.—Holotype ♂, Tattaka [= Sungkang, about 2050 m alt., 24.05°N, Nantou-Hsien], Taiwan, 2.V.1929, K. Sato. Deposited in the Department of Zoology, National Science Museum (Nat. Hist.), Tokyo. Paratype: 1 ♂, Hokuko-Kaminoshima onsen, Byoritsu-ken [Miaoli-Hsien], 11.IV.1967, T. Shirozu. Deposited in the Entomological Laboratory, Kobe University, Kobe.

Variation (2 ♂ examined).—The paratype differs from the holotype in having the legs (except for the bases of coxae) entirely dark yellow. Body length and forewing length of the paratype are 6.0 mm and 5.5 mm, respectively.

Comparative comments.—As *Blasticotoma smithi, Runaria, taiwana* is well characterized by the smooth surface sculpture and the sparser punctation of the body. Among other features, the very smooth propodeum (where only a few distinct punctures are present except at the densely punctate narrow lateral margins), and the mostly impunctate mesoscutellum (where the punctures are limited to the posterior margin) will easily distinguish *taiwana* from the two known living species, *R. reducta* Malaise and *R. flavipes* Takeuchi, both from Japan. *Bohea abrupta* Maa from northwestern Fukien differs from *taiwana* at least in having the "abdomen coarsely punctate" (Maa, 1944).

Remarks.—The Blasticotomidae are composed of only eight living and one fossil species in four genera in the world (Smith, 1978, and the discussion below). Of the six previously known living species, five occur in the temperate regions of the Far East and Europe, and one species, *Bohea abrupta* Maa, is from the Shaowu area, northwestern Fukien (about 27.20°N). The Taiwanese records (about 24.05°N) extend the southern distribution of this family considerably.

Zhelochovtsev and Rasnitsyn (1972) treated the genus *Runaria* as a synonym of *Paremphytus* Brues, a genus established for a fossil species *P. ostentus* Brues from Florissant, Colorado, USA (Miocene), and following them Smith (1975) transferred *Runaria reducta* Malaise and *Runaria flavipes* Takeuchi to *Paremphytus.* Zhelochovtsev and Rasnitsyn's conclusion is on the basis of "the completely reduced fourth antennal segment, the distal position of 2m-cu crossvein, and the short ovipositor" of *Paremphytus ostentus.* However, "the completely reduced fourth antennal segment" and "the short ovipositor" are not peculiar to *Runaria* and the former feature may be difficult to recognize in the holotype of *P. ostentus* (see citations from Brues in Benson, 1942). The distal position of 2m-cu crossvein alone is not enough to prove the synonymy of *Paremphytus* with *Runaria.* I would rather agree with Benson (1942) who said, "Unfortunately without the claws of the insect it is impossible to tell whether *Paremphytus* is likely to be synonymous with either of the two known recent genera of Blasticotomidae, *Blasticotoma* or *Runaria,*" and treat *Paremphytus* and *Runaria* as distinct genera (*Runaria* Malaise, **gen. rev.**). The two living species of *Paremphytus, reductus* (Malaise) and *flavipes* (Takeuchi) are therefore transferred back to *Runaria*: *Runaria reducta* Malaise, **comb. rev.**, and *Runaria flavipes* Takeuchi, **comb. rev.**

The validity of the monobasic genus *Bohea* is not certain. According to Maa (1944), it is distinguished from *Runaria* only by having the fourth antennal segment "absent"; in *Runaria,* the fourth antennal segment is "present but indistinct." My study of this character in two species of *Runaria* shows that its condition is difficult to define. It could be described either as "absent" or "present but indistinct" according to individual authors. As Maa, when he described *Bohea,* probably had no specimens of *Runaria* for comparison and only referred to Malaise (1931), it is possible that *Bohea* and *Runaria* are synonymous.

ORUSSIDAE

***Orussus brunneus* Shinohara and Smith, NEW SPECIES**

Fig. 19

Holotype female.—Body very dark brown. Head and dorsum of thorax darker, blackish. Mandibles pure black. Distinctly paler are: Anterior margin of frons; basal segments of antenna (becoming darker apically); spot at apex of 9th antennal segment; most of 10th antennal segment (except apex); palpi; trochanters; 7th sternum; and other sterna more or less. Yellowish white are: Spot at dorso-apical

Fig. 19. *Orussus brunneus,* holotype.

part of each femur; oblong spot covering basal ½ of outer surface of foretibia; line on outer surface of midtibia, covering 9/10 of its total length from base; basally widening line covering basal ½ of outer surface of hindtibia (teeth in this line blackish towards apex). Forewing with apical ⅓ and basal ½ (gradually becoming hyaline towards base) infuscated; hindwing slightly infuscated towards apex.

Head coarsely reticulate-punctate. Anterior margin of frons with broad and shallow median notch. Gena with distinct carina along posterior orbit, running beyond upper margin of eye. Lateral ocellus situated between level of 3rd and 4th tubercle. Dorsum of thorax densely, finely punctate, mat; lateral aspect of mesepisternum coarsely reticulate-punctate; ventral aspect of mesepisternum very finely, not very densely punctate, interspaces shining. Mesoscutellum with anterior (except lateral parts) and posterolateral margins impunctate, polished; posterior angle rounded and distinctly less than 90°. Relative lengths of basal, costal, anal, and apical margins of cell 1M about 9:12:17:5.[1] Apex of 8th tergum rather simply, conically projected.

Body length, 5.4 mm; forewing length, 3.6 mm.

Male and immature stages unknown.

Holotype.—♀, Kuraru [= Kentin, Hengchun-Hsien], Taiwan, 5.V.1934, J. L. Gressitt. Deposited in the Department of Entomology, B. P. Bishop Museum, Honolulu.

Comparative comments.—*Orussus brunneus* is very similar to *O. decoomani* Maa, to which it runs in Yasumatsu's (1954) key, and to *O. rufipes* Tsuneki. The

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[1] In Yasumatsu's (1954: 117) description of *O. boninensis,* the relative lengths of margins of the discoidal cell are given "6:12:19:11," but this should be "11:12:19:6," and the following "Apical margin: costal margin" should read "Anal margin: costal margin."

new species, however, may be distinguished by the distinctly brownish coloration of the body and by having the basal half of the forewing distinctly infuscated (gradually becoming hyaline towards base). From *rufipes, brunneus* also differs in the shape of eighth abdominal tergum in female; in *rufipes,* the produced apex of this plate is distinctly flattened laterally, while in *brunneus,* it is rather simple, not distinctly flattened.

Orussus decoomani and its allied forms are in need of revision. *Orussus decoomani* was originally described from a single male collected in northern Vietnam (Tonkin) (Maa, 1950). Later, Benson (1966) identified his Himalayan specimens (2 ♀, 2 ♂) with this species, but the specimens differed from Maa's original description in that "the infuscated stigmatal transverse band is reduced" and "the tibia and tarsi are marked with white." Tsuneki (1963) described *O. rufipes* from Japan,[2] a species apparently close to *decoomani.* These three similar forms (including Benson's Himalayan "*decoomani*" as one) from widely separated localities have not been directly compared and it is possible that all are conspecific or each belongs to a distinct species. *Orussus brunneus* is an addition to this complex of species and its true status is not very certain until more is known about these species. Benson (1966) pointed out that *decoomani* differs from other *Orussus* species known to him (*abietinus* (Scopoli), *occidentalis* (Cresson), *sayi* (Westwood), *thoracicus* (Ashmead), and *unicolor* (Latreille)) in having the lateral ocellus situated between the level of the third and fourth tubercle. *Orussus brunneus, rufipes,* and *boninensis* Yasumatsu, from the Bonin Islands, are similar to *decoomani* in this character.

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OBSERVATIONS ON THE HOST PLANT ADAPTATION OF *BUSSEOLA FUSCA* (LEPIDOPTERA: NOCTUIDAE) IN NIGERIA[1]

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Abstract.—The change of diets in the northern and the southwestern populations of *Busseola fusca* (Fuller) in Nigeria produced high mortality, unbalanced sex ratio, and sterility. When the two populations were crossed, the hybrid adults did not mate with each other, although the gonads of both sexes were mature. These observations seem to indicate that adaptation to different diets is leading to genetic differences in this species.

In May 1980, while investigating the food plants of *Busseola fusca* (Fuller) in Nigeria, I tried to rear this insect on the stems of *Sorghum bicolor* brought to Ibadan (southwest) from Zaria (north). This rearing produced unexpected results; not only was the larval mortality very high, but also the adults were sterile. In my subsequent visit to Zaria, I learned that northern *B. fusca* developed perfectly normally on the diet of sorghum stems, which later proved to be the case in my own laboratory in Ibadan. These findings made me wonder if the northern and southwestern populations actually belonged to the same species. It seemed to me that they represented at least two different races or subspecies. Not only have the investigators of this insect in Nigeria (Harris, 1962; Usua, 1970; Adesiyun, personal communication) treated it as a single species, but they have not even suggested the possible existence of geographical races. Moreover, *B. fusca* has been described as a major pest of both maize and sorghum (Swaine, 1957; Hill, 1975).

This paper presents the results of a preliminary study on the adaptation of *B. fusca* to its major host plants in the two geographical areas of Nigeria mentioned above.

GEOGRAPHICAL DISTRIBUTION

Busseola fusca is said to occur throughout Africa, south of the Sahara (Swaine, 1957; Hill, 1975). In Nigeria, it is found abundantly in and around the northern towns of Kano, Zaria, and Kaduna where the climate is semi-arid, and, for the last few thousand years, the major crop has been *Sorghum bicolor* which thrives in that environment. *Zea mays,* introduced in the 15th century, is occasionally planted, but the practice is limited due to irrigation difficulties and the preference

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[1] IITA Journal Series No. 193.

of sorghum to maize as food by the local inhabitants. *Busseola fusca* is the major pest of sorghum throughout the north.

Busseola fusca populations become more infrequent toward the south so that in the neighborhood of Ibadan, some 360 miles to the southwest from Zaria, it occupies at most 9% of the total maize stemborer populations. In the humid southwest, where *Z. mays* is the main crop and where sorghum is seldom cultivated, the major pests consist of *Eldana saccharina* (Walker) (Pyralidae) (51%) followed by *Sesamia calamistis* (Hamps) (Noctuidae) (30%); the rest are composed of four minor species including *B. fusca* (Kaufman, unpublished data). Maize is also the major crop in the southeast where the climate is even more humid; the occurrence of *B. fusca* in this area is infrequent, as 92% of the maize stemborers are *S. calamistis.*

MATERIALS AND METHODS

About 50 prepupae and pupae of *Busseola fusca* were extracted from the stems of sorghum planted at Amado Bello University's experimental farm in Zaria and were brought to Ibadan. Adults that emerged from the pupae were put into wooden-frame, wire-gauze cages (30 × 30 × 30 cm), each provided with several stems of rice placed in a jar of water for oviposition. Eggs were isolated in petri dishes until they were about to hatch, then half of them were wrapped in soft terminal leaves of young sorghum (planted in the experimental plots of IITA from the seeds brought back from the north), while the rest were enveloped in those of young maize. Both groups were left in this state with no further handling for a week; after one week the hatchlings had grown to 6–7 mm long. Subsequently, 200 of a few thousand larvae were randomly taken from each group and reared separately in two groups of Kilner jars (diam.: 8 cm; height: 15 cm) containing stems of sorghum and maize, respectively. Since *B. fusca* attacks normally young plants, only the stems of preflower food plants, cut into 3 cm long pieces were used for convenience.

In Ibadan, the larvae of *B. fusca* were obtained from the stems of maize planted at the IITA experimental farm. They were fed with young maize stems until pupation and the eggs from the emerged adults were processed in the same way as F1 eggs of Zaria *B. fusca* mentioned above. Initially, therefore, there were four groups of F1 larvae, each consisting of 200 individuals; of these, two groups belonged to the northern and two groups to the southwestern *B. fusca.* Each of the geogrrhical groups was further divided into two dietary units, one with sorghum, and the other with maize (Table 1). The food plants were changed every three days and the body length of the larvae and the number of deaths were recorded at each time. When the larvae stopped feeding, they were removed to other Kilner jars with layers of paper towel for pupation. Pupae were individually weighed using a Roller-Smith precision balance.

For cross breeding, four identical wire-gauze cages described above were set up. Into each of these, ten newly emerged southwestern females and the same number of newly emerged northern males were released simultaneously. Eggs were collected daily from the rice stalks placed in the cages, counted, and put into petri dishes until they were close to hatching. Then, as in the dietary experiments already explained, half of the eggs were wrapped in maize leaves and the other half in sorghum leaves for one week, followed by the rearing of 200 randomly taken larvae from each group on two dietary units of sorghum and maize. Hybrid adults were housed in the cages mentioned, and the dead adults of both sexes were dissected within a few hours of death for spermatozoa and spermatophores.

The experiments described above were first conducted in 1980 and were repeated in 1981. The total number of *B. fusca* larvae subjected to the dietary analysis was 2000, while the number of adults used for the cross breeding experiments totaled 160.

Three generations descended from the F1 hybrids of 1980, and these were reared under similar conditions as to the number of larvae in the beginning; the dietary units and breeding methods were also the same. No backcross could be attempted until May, 1981, since the three generations were bred in the dry season (November to April) during which southwestern *B. fusca* was in diapause. In this backcross, 20 F4 males and 20 southwestern females that developed from diapaused larvae were divided equally in two cages for mating and oviposition. The larvae obtained from this cross were reared on maize only, since sorghum was not yet available in Ibadan. The experiment had to be terminated at the end of June, 1981.

RESULTS

When the young larvae of northern *B. fusca* were offered maize stems, they accepted the food plant without hesitation, developed faster, and the pupae were heavier than those reared simultaneously on the stems of sorghum. However, while the sex ratio of the sorghum-fed group was about equal, that of the maize-fed group consisted predominantly of males. Nonetheless, the F1 adults that developed from the maize diet mated and produced viable eggs. The F2 generation from these eggs yielded an identical or similar sex ratio as in the F1 (Table 1), but the adults were sterile; no mating flight (Kaufmann, unpublished data) took place, sexes were not attracted to each other, and the dissection of the females after death showed that their ovaries were very small with no developed eggs and their bursa copulatrix was empty of spermatophores. Likewise, there were no free spermatozoa in males.

Conversely, when the young larvae of southwestern *B. fusca* were given sorghum stems, the larvae did not begin feeding until starved; development was markedly slow; mortality was high (the great majority of the larvae died during their early instars); their sex ratio was unbalanced; and the gonads of both sexes were immature with the same sexual indifference described above on the northern *B. fusca* (Table 1). Those fed with maize, on the other hand, grew twice as fast; were much heavier in pupal weight; produced an equal sex ratio; adults mated normally, each with 1–5 spermatophores; and females laid viable eggs (Table 1).

The mating between southwestern females and northern males took place readily, and the resulting eggs gave rise to the F1 hybrid larvae. These larvae fed willingly on sorghum as well as on maize. Forty-three (1980) and 40% (1981) of the sorghum group and 50% (1980) and 55% (1981) of the maize group developed into the last-instar larvae which were as large and as vigorous as their southwestern parent, the more vigorous of the two parents. However, these seemingly healthy larvae died shortly before pupation so that only 17% (1980) and 14% (1981) of the original number of the first group and 22% (1980) and 20% (1981) of that of the second group actually pupated (Table 1). The emerged adults of both groups did not mate with each other, although dissection showed that their ovaries were large with mature eggs and vesicula seminales contained free spermatozoa.

Table 1. Effects of sorghum (S) and maize (M) on the development of the northern and southwestern populations of *Busseola fusca* and their F1 hybrids (avg. temp.: 23°C; R.H.: 76%).

	Northern *B. fusca*						Southwestern *B. fusca*				N-SW cross			
	S		M				S		M		S		M	
	F1		F1		F2		F1		F1		F1		F1	
	1980	1981	1980	1981	1980	1981	1980	1981	1980	1981	1980	1981	1980	1981
Incubation period (days)	8	8	8	8	8	8	8	8	8	8	8	8	8	8
Larval period (days)	37	35	25	23	27	24	58	60	28	25	35	37	33	31
Larval mortality (%)	58	61	60	55	77	73	87	85	56	51	83	88	78	80
Pupal period (days)	14	14	14	13	15	14	12	13	14	14	15	14	14	14
Pupal mortality (%)	8	10	3	5	8	6	25	23	4	3	10	9	8	10
Pupal weight (mg)	126	131	195	190	199	195	128	124	200	197	149	143	193	195
Sex ratio (% ♀)	52	31	17	18	17	15	33	30	53	51	40	38	30	32
Fecundity (no. fertilized eggs/♀)	108	127	281	296	0	0	0	0	396	412	0	0	0	0
Adult life span (days)	3	4	5	5	4	5	3	3	7	6	5	5	6	6

Table 2. Effects of sorghum (S) and maize (M) on the descendants of F1 hybrids and the result of backcross of *Busseola fusca* (avg. temp.: 23°C; R.H.: 76%).

	F2 (Parthenogenetic)		F3 (Sexual)		F4 (Sexual)		Backcross (F4 ♂ × SW ♀)	
	S	M	S	M	S	M	S	M
Incubation period (days)	8	8	7	7	7	7	—	7
Larval period (days)	36	33	33	33	23	21	—	21
Larval mortality (%)	99.5	86.0	99.5	93.5	100	82	—	36
Pupal period (days)	14	12	14	14	—	13	—	13
Pupal mortality (%)	0	13	0	7	—	2	—	8
Pupal weight (mg)	113	190	188	196	—	203	—	225
Sex ratio (% ♀)	1 ♀	30	1 ♂	38	—	39	—	63
Fecundity (no. eggs/♀)	0	456	—	392	—	134	—	396
Egg viability (%)	—	60	—	26	—	30	—	14
No. eclosed larvae	—	1970	—	469	—	563	—	4102
Adult life span (days)	7	7	7	6	—	6	—	6

The F1 hybrid females, however, laid unfertilized eggs (221/♀) 30% of which hatched, giving rise to a parthenogenetic F2 generation (Table 2). At this point, mention should be made on parthenogenesis in this species, since this phenomenon in Noctuidae has never been reported. In absence of males, *B. fusca* often produced unfertilized eggs in captivity. The number of these eggs per female was much smaller (½–⅓) than that of bisexual eggs and only about 30% hatched. The parthenogenetic eggs have the following main characteristics: (1) They do not change color shortly before hatching, when they become dark, while bisexual eggs turn from pale yellow to pink after two days, then become dark at the final stage; (2) very high larval mortality (avg. 90%) occurs shortly before pupation, instead of during the first two instars as in bisexually produced larvae; and (3) both sexes are produced. Parthenogenesis in *B. fusca* was first observed in 1979; of 283 unisexual eggs, 85 hatched and only four larvae survived to pupate, giving rise to two males and two females.

The parthenogenetic F2 generation resulted in a F3 bisexual generation and since parthenogenesis in this species yields both sexes as just mentioned, the individuals of this group mated with each other and created another bisexual generation of F4 (Table 2). Two features characterized these abnormal generations, an extremely high level of larval mortality, especially in sorghum-fed groups, and an unbalanced sex ratio.

The F4 males were backcrossed to southwestern females that had emerged in May, 1981 after diapause. As shown in Table 2, larval mortality was significantly less than the previous generations (F2–F4) and the ratio of females rose to 63%. All these females mated, each harboring 1–5 (avg. 2) spermatophores; similarly, all the males contained free spermatozoa. Although only 14% of the fertilized eggs hatched, this backcross showed sufficient "recovery" as to the size of larval population (Table 2).

DISCUSSION

The change in food plants between the northern and the southwestern populations of *B. fusca* resulting in uneven sex ratio and sterility suggests that genetic differences may be developing as a result of evolutionary adaptation to different diets: northern population to sorghum and southwestern population to maize.

Morphologically, the northern type is a little smaller in size and has paler forewings than the southwestern type. Otherwise, the two are indistinguishable, since no differences were found in copulatory apparatus. Moreover, the size difference seems to depend on the nutritional value of sorghum and maize, for when northerners were fed with maize, the resulting adults were as large as southwesterners. Paler wing color may be an adaptation to the arid environment of northern Nigeria. Physiologically, however, the southwestern type is more active, lays a larger number of eggs, and lives longer than the northern type (Table 1). Especially interesting is the fact that the diapause in the southwestern population seems obligatory (Kaufmann, unpublished data), while that in the northern population is facultative, as non-diapausing larvae could be bred merely by providing them with fresh, green food during the dry season. Similar observations on dry period feeding have been reported by Swaine (1957) and Smithers (1960) in Tanzania and Rhodesia, respectively.

That mating between the two populations took place readily and that many hybrids not only survived, but also were as vigorous as the parental stocks until pupation, indicate that the process of genetic differences may have begun rather recently, say, during the past few hundred years after maize was introduced into West Africa from the Americas around the 15th century. I believe that the original host of *B. fusca* was sorghum, indigenous to West Africa, and that some have migrated to the southwest after the introduction of maize, eventually becoming established in the new host plant to the point of no return. However, the restoration of vigor and size of larval population as the result of backcross is suggestive of an existence of a genetically intermediate form somewhere between Zaria and Ibadan where both sorghum and maize may be available. Also, the experimented crosses were exclusively between northern males and southwestern females; limited time did not allow work on the reciprocal crosses, namely between northern females and southwestern males. Therefore, until further investigations of this sort are completed, final conclusions as to the suggested genetic differences derived from host plant adaptations remain unanswered.

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VARIATION IN *OPIUS HIRTUS* FISCHER AND DISCUSSION OF *DESMIOSTOMA* FOERSTER (HYMENOPTERA: BRACONIDAE)

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Abstract.—The *bellus* species-group is removed from *Desmiostoma* and replaced in *Opius*. *Opius hirtus* Fischer, a member of the *bellus* group, is redescribed with emphasis on intraspecific variation in relation to different tephritid hosts.

Desmiostoma was erected by Foerster (1862) for *Opius parvulus* Wesmael, but was characterized in key form only. Foerster (1862) separated *Desmiostoma* from what is currently accepted as *Opius* s.s. because of the absence of an occipital carina (Fischer, 1973, 1977).

Desmiostoma has usually been treated as a synonym of *Opius*, following Marshall (1891), Szépligeti (1904), and Gahan (1915). Fischer (1971) also treated *Desmiostoma* as a synonym of *Opius*, even though he used the combination *Desmiostoma parvulum* (Wesmael) in three papers appearing the previous year (Fischer, 1970a, b, c). Fischer (1973) formally recognized *Desmiostoma* by presenting a diagnosis and discussion of the genus, and erected the new tribe Desmiostomatini to include those genera and species in which the occipital carina is completely absent. Fischer (1977) presented a key to the 19 *Desmiostoma* species described from the New World, transferring many of these to *Desmiostoma* for the first time. Fischer (1977) also noted that *Desmiostoma* was a heterogeneous assemblage. The genus *Desmiostoma* has not been further discussed, and was not recognized as distinct by Wharton and Marsh (1978) pending more critical analysis of relationships within *Opius* s.l.

The *bellum* species-group of *Desmiostoma* contains several very closely related species characterized by the following apomorphic trends: 1) absence of sternaulus, notaulus, and mesonotal midpit; 2) 3rd discoidal segment reduced to a weakly sclerotized stub; 3) wings heavily infumated; 4) pronope (van Achterberg, 1975) well developed. In the type-species *D. parvulum*, however, the sternaulus is well developed, the notauli are represented by short transverse sulci anteriorly, the wings are nearly hyaline, and the pronope is not discernable. The *bellum* group further differs from the type species of *Desmiostoma* in having the recurrent vein antefurcal, the radiellan vein well developed, the genal sulcus absent or nearly so, the propodeum with a median longitudinal carina, and the mandible tapering only very gradually from base to apex. Additional characters useful for defining the *bellum* group, though shared with many other opiines, are: elongate second cubital cell; long, narrow stigma; clypeus weakly convex below, often with trace of median tooth; little or no opening between clypeus and mandibles; and described species primarily black and orange.

Although the shape of the clypeus and the lack of an occipital carina would seem to unite the *bellum* group with *D. parvulum,* the former is a plesiomorphic character state common to many braconid subfamilies and several opiine genera, and the latter is found in several tropical opiine genera (exhibiting parallelism within the Opiinae). The Neotropical *bellum* species-group is therefore removed from *Desmiostoma. Desmiostoma* is here restricted to the group of small leaf-mining parasitoids which lack an occipital carina and generally resemble *D. parvulum* in habitus. There are at least two undescribed species in North America.

There are at least 21 synonyms associated with *Opius* (Fischer, 1971). It is therefore preferable to replace the *bellus* species-group in *Opius* s.l. until the relationships among all Opiinae are better understood, rather than add yet another generic name at this time.

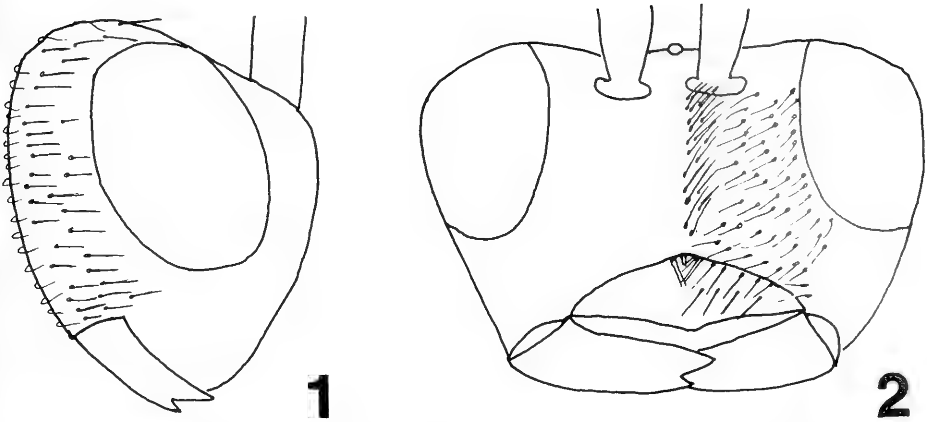
Eleven species are included here in the *bellus* group. Two, *Opius chromaticus* Fischer and *O. fiebrigi* Fischer, known only from males, cannot be adequately diagnosed. The remaining species can be superficially separated into species with short ovipositors (*O. campinaensis* Fischer, *O. cuencaensis* Fischer, *O. cuzcoensis* Fischer) and those with long ovipositors (*O. barrosensis* Fischer, *O. bellus* Gahan, *O. cingulaticornis* Fischer, *O. hirtus* Fischer, *O. johannis* Fischer). Other characters used to separate these species have been limited to coloration and density of pubescence (Fischer, 1977).

***Opius hirtus* Fischer**

Opius (*Opius*) *hirtus* Fischer 1963: 376.

Opius hirtus was originally described from the Dominican Republic (Fischer, 1963). Wharton and Marsh (1978) added Costa Rica to its range. Additional specimens from Central America have since been found, and a brief description of *O. hirtus* is presented to illustrate variation in key characters exhibited by this material. A diagnosis is also provided to distinguish *O. hirtus* from other members of the *bellus* species-group.

Description.—Eye bare; frons with longitudinal rows of 4–6 hairs on each side between eyes and ocelli; occiput and temple moderately hairy (Fig. 1): malar space bare; face densely hairy (Fig. 2). Lower border of clypeus medially varying from very weakly convex to more strongly so with toothlike apex (Fig. 2); when more strongly convex medially, entire lower border appears sinuous as in *Doryctobracon.* Mandible gradually tapering from base to apex; lower tooth distinctly shorter than upper, and twisted so as to lie ventral-mesad of upper tooth. Antenna 38–46 segmented, number of segments increasing only very slightly with body length; antenna slightly longer than body; basal flagellomeres nearly twice longer than wide, succeeding segments gradually shorter; hairs short, decumbent, length less than segment width. Maxillary palp a little shorter than head height. Mesonotum somewhat densely hairy anteriorly and along lateral borders, more sparsely hairy along posterior border, central disc variable, from bare or nearly so in some specimens to 2–3 rows outlining each notaular area in other specimens. Scutellum more sparsely hairy medially than around border; density of hairs varying among specimens. Mesopleuron densely hairy above midcoxa, moderately hairy along anterior and dorsal margins, sparsely hairy medially. Metanotum along midline very short, almost vertical; metapleuron densely hairy throughout. Propodeum with lateral carinae distinct, confluent with propodeal spiracle. Stigma of forewing



Figs. 1, 2. *Opius hirtus.* 1, Side view of head showing moderately hairy temples between occiput and eye. 2, Front view of head showing densely hairy face on specimen with clypeus nearly toothlike at apex.

about 5× longer than wide; 3rd discoidal segment present as a very short pigmented and sclerotized stub, though distinctly longer in one specimen; postnervellus a weakly pigmented crease extending half way to wing margin. Petiole nearly as long as apical width, 1.7–2.0× wider at apex than at base, apical width 2.4–4.0× maximum height; petiole bicarinate, the carinae weakly to very strongly converging medially, carinae unusually well developed on one specimen; spiracle at or just beyond midlength, situated mesad of weak, dorsal-lateral carina. Total ovipositor length slightly more than twice that of thorax. Color of head varying from uniformly black, to orange with only frons, occiput, and vertex darkened; palps light brown to white; female abdomen orange to yellow, male with terga 4–8 brown to dark brown; coxae yellow in Belize specimens, black with base of forecoxa pale in others; rest of legs varying from yellow on tarsi of foreleg of male (female slightly darker) to black on all tibiae and femora. Length: 3.5–5.5 mm.

Material examined.—DOMINICAN REPUBLIC, Mt. Diego de Ocamp, 3–4000 ft., July '38 (1 ♀, holotype, Museum of Comparative Zoology). BRITISH HONDURAS (= BELIZE), Stann Creek, Oct. '70 (2 ♀, 1 ♂). COSTA RICA, San José, VII-59, from guava (1 ♀); San José (1 ♀); Puntarenas, San Vito, June 6, 1980, from coffee (1 ♀, 1 ♂).

Diagnosis.—*Opius cingulaticornis* differs from *O. hirtus* in the possession of a pale subapical ring on the antenna, a more uniformly hairy mesonotum, and pale rather than dark legs. *Opius johannis* is more densely hairy than *O. hirtus,* has a relatively large basal cell (and shorter recurrent vein), and the thorax is black. *Opius bellus* is more similar to *O. hirtus,* but has a distinctly shorter ovipositor (1.6 ± 0.1× longer than the thorax, $n = 5$). *Opius barrosensis* is also very similar to *O. hirtus,* but the head and legs are not black and the mesonotum is not uniformly pale.

Specimens of *O. hirtus* examined for this study were reared from *Anastrepha* sp., *Toxotrypana curvicauda* Gerstaecker, and *Ceratitis capitata* (Wiedemann) (Tephritidae). The observed variation in coloration, pubescence, and petiole sculpture is strongly correlated with host differences and resulting body sizes. Material from *Ceratitis,* for example, is small, dark, and more sparsely hairy than specimens reared from other hosts. More extensive rearings are needed, however, before a cause and effect relationship can be established.

Reared material of *O. bellus* from Costa Rica shows similar variation in patterns of pubescence to that found in *O. hirtus.* Color variation in this species has already been noted by Gahan (1930). Because of such variation, coloration and pubescence must be used very carefully as key characters for species of this group.

Opius bellus and *O. hirtus* are the only members of the *bellus* group recorded from Central America (Fischer, 1977; Wharton and Marsh, 1978). The two species are closely related, and separated most readily by differences in ovipositor length and color. Differences in the stigma width mentioned by Wharton and Marsh (1978) were the result of measurement error. Both *O. bellus* and *O. hirtus* are recorded from *Anastrepha* spp.; and this may be the main host for other species of the *bellus* group.

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NEW SPECIES OF BOLIVIAN *OSBORNELLUS* AND *CHLOROTETTIX* (HOMOPTERA: CICADELLIDAE: DELTOCEPHALINAE)

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Abstract.—Four new species, *Osbornellus* ***amplus***, *O.* ***rostratus***, *Chlorotettix* ***nauticus***, and *C.* ***mansuetus***, all from Bolivia, are described.

The Bolivian species of *Osbornellus* were treated by DeLong (1976) and by DeLong and Martinson (1976). The Neotropical species of both *Osbornellus* and *Chlorotettix* were treated by Linnavuori (1959). The genus *Chlorotettix* was described by Van Duzee (1892). A synopsis of the genus *Chlorotettix* was published by DeLong (1919). A review of the known species of *Chlorotettix* was published by DeLong (1945). New species of Mexican and South American *Chlorotettix* were described by DeLong and Martinson (1974). A synopsis of the genus *Osbornellus* was recently completed by Dr. Candace Martinson (unpublished). Two species of *Osbornellus* and two species of *Chlorotettix* are described at this time. The two species of *Osbornellus* described in this paper are not treated in the Martinson manuscript. All types are in the DeLong collection, Ohio State University.

Osbornellus amplus DeLong, New Species

Figs. 1, 2

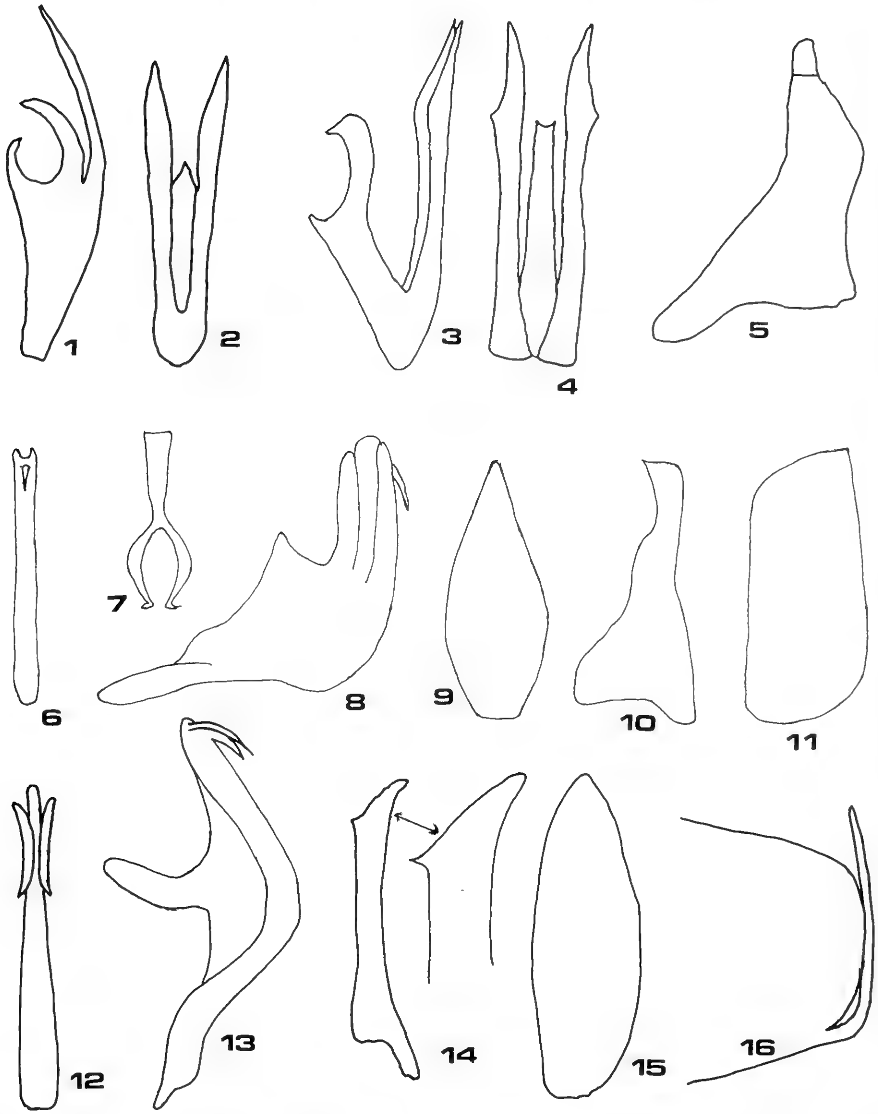
Description.—Length of male 5.0 mm, female 5.5 mm. Crown produced and bluntly angled. Color, crown rather uniform pale brownish with a slight pale yellowish longitudinal line at apex. Pronotum same brownish color as crown. Scutellum tinged with brown. Forewing pale brownish subhyaline, with 3 dark brown spots at ends of claval veins on commissure, 2 spots on cross veins of corium, and 2 spots on apical portion of costa. Veins brownish.

Female 7th sternum with posterior margin slopingly produced to form a triangularly produced lobe on median ⅓.

Male genital plates with elongate slender apices. Style with slender, curved apophysis, apex rounded. Aedeagus broadened at middle (in lateral view), dorsal portion with a deep concavity surrounded by a dorsal, slender, curved process extending caudally, and a longer, broader curved process extending dorsocaudally. Ventral portion with 2 long slender processes extending caudally, slightly broadened near apex, then tapered to pointed apices. Pygofer rounded at apex.

Types.—Holotype ♂, Bolivia, Buena Vista, 14-V-80, D. M. DeLong coll. One paratype ♀, same data as holotype.

Remarks.—*Osbornellus amplus* is related to *O. spinellus* DeLong and Martinson (1976: 429) and can be separated from it by the longer basal half of the aedeagus and the absence of a pygofer spine.



Figs. 1–16. 1, 2, *Osbornellus amplus.* 3–5, *O. rostratus.* 6–11, *Chlorotettix nauticus.* 12–16, *C. mansuetus.* 1, 3, 8, 13, Aedeagus laterally. 2, 4, 6, 12, Aedeagus ventrally. 5, 14, Style laterally. 7, Connective ventrally, 9, 15, Plate ventrally. 10, Style ventrally. 11, 16, Pygofer laterally (16, apical portion).

Osbornellus rostratus **DeLong, New Species**

Figs. 3–5

Description.—Length of male 4.6 mm, female unknown. Crown produced, bluntly pointed, typical of species of *Osbornellus.* Color, crown pale yellowish, unmarked. Pronotum yellowish with pale brownish coloration. Scutellum pale yellowish with pale brown basal angles. Forewings pale brownish subhyaline with dark brown spots on clavus at commissure, on corium, and on apical and costal veins. Apex smoky, veins brown.

Male genital plate with a long slender apical ½. Style elongate with a short, blunt apophysis. Aedeagus with basal portion of shaft rather broad dorsoventrally, apical portion narrowed by broad concave excavation on dorsal margin forming a rounded apex, with a subapical spine on dorso-subapical margin. Two long lateral portions extend caudally from base, each side, beyond the aedeagal shaft. Processes broadened at ¾ their length then tapered to pointed apices.

Types.—Holotype ♂, Bolivia, Santa Cruz, 21-VII-1980 Don L. Foster coll. One paratype ♂, same except 1-VI-1980.

Remarks.—*Osbornellus rostratus* is related to *O. circulus* DeLong and Martinson (1976: 431) and can be separated from it by the more elongate dorsal portion of the aedeagus with very short processes.

Chlorotettix nauticus DeLong, New Species

Figs. 6–11

Description.—Length of male 4.5 mm, female unknown. Crown bluntly angled, more than twice as wide at base between eyes as long at middle. Color, bright, apple green, superficially resembling *C. viridius* Van Duzee but smaller, with central portion of crown and scutellum slightly yellow.

Male genital plates 2½× as long as wide at middle, apices bluntly pointed. Style with apex of apophysis truncate caudally. Aedeagus as broad as long, apical portion $^1/_5$ as broad as long. In ventral view, narrow, elongate, with apex slightly notched and bearing a short, toothlike spine on ventral margin, near apex. Pygofer with apex broad and blunt.

Holotype.—♂, Buena Vista, Bolivia 21-XI-1980, Donald R. Foster coll.

Remarks.—*Chlorotettix nauticus* is related to *C. curvidens* Osborn (in DeLong, 1919: 16) and can be separated from it by the absence of teeth on the apical portion of the pygofer and by the straight apical portion of the aedeagus.

Chlorotettix mansuetus DeLong, New Species

Figs. 12–16

Description.—Length of male 6 mm, female unknown. Crown produced, apex rounded, appearing bluntly pointed, slightly more than twice as wide between eyes at base as long at middle. Color, bright green, unmarked, forewings greenish subhyaline.

Male genital plates almost 3× as long as wide at middle, apices bluntly angled. Style straight, rather broad dorsoventrally, apex bluntly pointed on dorsal margin by the sloping of the apical margin, and bearing a prominent spine on ventral margin, at the point of origin of the sloping portion. Aedeagus with the heavily sclerotized portion forming a curved shaft bearing 2 subapical processes, about ⅓ length of shaft. A portion, scarcely sclerotized, appearing almost membranous, extends across the area formed by the curvature of the shaft proper, or the heavily sclerotized portion. A median finger-like portion extends dorsocaudally. Pygofer broadly rounded apically with a caudal spine arising at the ventrocaudal margin and extending dorsally along and beyond caudal margin.

Holotype.—♂, Bolivia, Puerto Villarall, 12-IV-1981, D. B. Foster coll.

Remarks.—*Chlorotettix mansuetus* can be separated from all other known species of the genus by the slightly sclerotized, but prominent, dorsal portion of the aedeagus.

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SUPERSPECIES *ATRYTONOPSIS OVINIA* (*A. OVINIA* PLUS *A. EDWARDSI*) AND THE NONADAPTIVE NATURE OF INTERSPECIFIC GENITALIC DIFFERENCES (LEPIDOPTERA: HESPERIIDAE)

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Abstract.—Superspecies *Atrytonopsis ovinia* comprises *A. ovinia* (Nicaragua to central Mexico) and *A. edwardsi* (central Mexico to Texas and Arizona); *zaovinia* is a synonym of *ovinia; rupilius,* a *nomen dubium.* Characters of size, antenna, sex behavior, stigma, facies, genitalia, and temporal and spatial distribution define this superspecies; the most distinctive are wing shape and genital characters involving the uncus, aedeagus, and ductus bursae. Wing length and number of segments in the nudum of the antenna vary independently; the former is sexually dimorphic, but the latter is not. (Sexual dimorphism in wing length is greater in *A. edwardsi* than it is in *A. lunus*, even though *lunus* is the larger species.) Those morphologic characters that best separate *ovinia* from *edwardsi* are secondary sex characters: the stigma and some subtle differences in male (uncus) and female (lamella postvaginalis) genitalia. In each of these allopatric and discontinuously distributed species, these (and other) characters show lots of individual—but not geographic—variation. The slight genitalic differences between *ovinia* and *edwardsi* give no evidence of having been directly selected. Such taxonomically useful differences may often be nonadaptive. The data support a punctuational model of speciation.

Atrytonopsis is a compact genus of a dozen species centered in the southwestern United States and Mexico. North of Mexico, it does not approach the West Coast, though it spreads clear to the East Coast via *hianna* (Scudder), which stretches northward to southeastern Saskatchewan and New England, and *loammi* (Whitney), which replaces *hianna* mainly in Florida. Defined by Godman in 1900 with *Hesperia deva* Edwards as its type, *Atrytonopsis* has a distinctive shape that stems primarily from the pointed forewings of males.

I started reviewing *Atrytonopsis* when I saw that *Lychnuchoides frappenda* Dyar must be switched to it. This seemingly big shift, from Evans' (1955) K or *Carystus* Group to his N or *Lerodea* Group, significantly extended the range of variation in facies (though not in genitalic or other morphology) of *Atrytonopsis* (Burns, 1982). *Atrytonopsis frappenda* clusters tightly with *lunus* (Edwards) and *zweifeli* Freeman to form the *lunus* group, a trio of species that looks, from limited locality data, like a superspecies occurring from southeastern Arizona and southwestern New Mexico to central Mexico. I now delimit superspecies *A. ovinia* whose components have not been correctly handled. They come down to a pair of species that stands out both externally (the primaries are more rounded than they are in other species of *Atrytonopsis*) and internally (the genitalia deviate from the *Atrytonopsis* norm, most notably in the form of the uncus and the length of the aedeagus and ductus bursae). This is the southmost group in the genus.

As with the *lunus* group, so with superspecies *A. ovinia*: with an eye to variation, I take up characters (rather than taxa) seriatim, using each, first, to define the superspecies *ovinia* within genus *Atrytonopsis* and then, when pertinent, to distinguish between the two component species. However, I have to begin by establishing correct names for these species; supporting evidence (including critical illustrations of type-specimens) comes after.

SUPERSPECIES *ATRYTONOPSIS OVINIA*

Nomenclature and synonymy.—*Hesperia ovinia* Hewitson (1866: 496) from Nicaragua was the first species of what is now *Atrytonopsis* to be described. Although most species had surfaced by 1900 when Godman created the genus, all of the names besides *ovinia* relating to superspecies *ovinia* appeared in a flurry in the second decade of this century: *Thespieus zaovinia* Dyar (1913: 280) from Tehuacan, Mexico; *Lerodea? rupilius* Schaus (1913: 360) from Guapiles, Costa Rica; and *A. edwardsi* Barnes and McDunnough (1916: 135) from southern Arizona. With types of all three at hand in the National Museum of Natural History (USNM), I had only to get that of *ovinia* from the British Museum (Natural History) to compare all relevant type-material directly.

Barnes and McDunnough (1916: 135 and pl. 8, figs. 9 and 10) described *edwardsi* when they realized that it was an anonymous species "passing under the name of *cestus*" (Edwards), a much rarer *Atrytonopsis* from southern Arizona. Soon after, Lindsey (1921: 95) said:

> I believe that the name [*edwardsi*] will fall before *Hesperia ovinia* Hew., illustrated in the Biologia (Pl. 97, ff.1, 2, 1900) under the name *Thespieus ovinia.* The type of *ovinia* in the British Museum will have to be examined to settle the matter definitely, but even from the figures it is easy to see that the species can hardly belong in *Thespieus.*

A decade later Lindsey et al. (1931: 122) noted:

> The relationship of this species [*edwardsi*] and *ovinia* Hewitson which was mentioned in the first edition of this work is still unsettled.

And so it remained, even after Evans (1955: 385-386), who had seen the type of *ovinia* (but not those of *zaovinia, rupilius,* and *edwardsi*), treated *A. ovinia* as a polytypic species with the two subspecies *ovinia* and *zaovinia* and made *rupilius* and *edwardsi* synonyms of *zaovinia.* His arrangement has always struck me as geographically and biologically anomalous: one subspecies (*ovinia ovinia*) in Nicaragua and the other (*ovinia zaovinia*) both to the north in Mexico plus the southwestern United States and to the south in Costa Rica. The combination *A. ovinia edwardsi* in dos Passos' (1964: 5) checklist was introduced by dos Passos (1960: 28) in anticipation of that list and "justified" as follows:

> Examination of specimens in the American Museum of Natural History collection shows that *edwardsi* is entitled to subspecific rank.

This combination has persisted in important works to the present (MacNeill, 1975: 445; Miller and Brown, 1981: 47). It is not far off the mark. But *edwardsi* is really a separate species from *ovinia.* And *zaovinia,* which has persisted since 1913 as a species (e.g., Hoffmann, 1941: 274) or subspecies (e.g., Evans, 1955: 386; Okano, 1981: 111), is a synonym of *ovinia.* At the end of his original description of *zaovinia* Dyar (1913: 281) said:

> This species is close to *T. ovinia* Hewitson, but the subapical spots of the fore wing are not in line and the spots on the hind wing below are narrow.

These purported specific differences amount to nothing more than routine individual variation.

Using a good color figure of dorsal and ventral aspect as well as words, Schaus (1913: 360 and pl. 54, fig. 10) described *rupilius* from a single female from Guapiles, Costa Rica. But what masquerades as the type of *rupilius* is a female labelled "Guadljara/Mex" which, though very similar in general to the Schaus color figure, actually differs from it in many details. There is no trace of the lady from Guapiles. Were she around, her genitalia would probably fit the *ovinia* mold. As it is, the genitalia of the substitute from Guadalajara belong to *edwardsi.* Because the name *rupilius* cannot be unequivocally tied to a taxon, it becomes a *nomen dubium* and evades synonymy.

At this point, a tangent on type-localities is in order. Hewitson (1866: 496), in his original description, gave the source of *ovinia* as Nicaragua. Both Godman (1900: 521) and Evans (1955: 386) indicated that the three specimens of *ovinia* in BMNH, which include Hewitson's, are from Nicaragua; and Evans also noted specifically that the male type is from Nicaragua. Having borrowed all three specimens, including the type, I have seen their Nicaragua labels for myself. Miller and Brown (1981: 47) erroneously give the type-locality of *ovinia* as "Venezuela."

Barnes and McDunnough (1916: 135) described *edwardsi* from seven dateless specimens (all in USNM) from southern Arizona: 3 ♂ 1 ♀ with no further locality data, 2 ♀ from the Baboquivari Mountains, and 1 ♂ from Redington. The text accompanying the original description, as well as labels on the specimens themselves, clearly designate the Redington male as Type ♂, one of the Baboquivari females as Type ♀, and all other specimens as Paratype ♂ or ♀. To avoid any possible confusion, I am designating the "Type ♂" lectotype. Although the restricted type-locality, "Redington, Arizona," is ecologically out-of-bounds for *edwardsi,* it is eminently reasonable to construe "Redington" as higher ground to the west, to wit, the "Santa Catalina Mountains."

Much of the foregoing may be summarized thus:

Superspecies *Atrytonopsis ovinia*
  A. ovinia (Hewitson), 1866, [*Hesperia*], Nicaragua, holotype ♂, BMNH.
    = *zaovinia* (Dyar), 1913, [*Thespieus*], Tehuacan, Mexico, holotype ♂, USNM.
  A. edwardsi Barnes and McDunnough, 1916, Redington (→ Santa Catalina Mountains), Arizona, lectotype ♂, USNM.
  Nomen dubium: rupilius (Schaus), 1913, [*Lerodea?*], Guapiles, Costa Rica, holotype ♀ missing; substituted phony "type" ♀, Guadalajara, Mexico, USNM.

Size.—With male forewings averaging about 18 mm (Table 1), both members of superspecies *A. ovinia* occupy the upper middle size range of *Atrytonopsis.*

Table 1. Length (mm) of right primary in superspecies *Atrytonopsis ovinia.*

Sample	Sex	*N*	Range	Mean with Standard Error	Standard Deviation	Coefficient of Variation
A. edwardsi						
Arizona						
Santa Catalina Mountains	♂	40	16.5–19.4	17.89 ± 0.11	0.67	3.75
	♀	11	17.9–21.3	19.45 ± 0.36	1.20	6.17
Baboquivari Mountains	♂	52	16.0–20.2	17.93 ± 0.12	0.85	4.74
	♀	33	17.8–20.7	19.41 ± 0.14	0.80	4.12
Texas						
Davis Mountains	♂	28	16.7–19.8	18.09 ± 0.14	0.73	4.04
	♀	15	18.4–20.6	19.41 ± 0.19	0.73	3.76
A. ovinia						
Mexico						
Puebla, Guerrero, Oaxaca,	♂	23	17.0–20.6	18.23 ± 0.19	0.90	4.94
Tabasco, Chiapas	♀	8	18.1–19.4	18.79 ± 0.14	0.39	2.08
Nicaragua	♂	2	20.1–20.4			
	♀	1	20.6			

Sexual dimorphism appears strong in *edwardsi* (though not in *ovinia,* probably owing to sampling error). Indeed, sexual dimorphism is greater in *edwardsi* than it is in *lunus,* even though *lunus* is the larger species: *lunus* males average about 21 mm in wing length and *lunus* females, nearly 1 mm more (Burns, 1982: 549); *edwardsi* males average about 18 mm but *edwardsi* females, about 1½ mm more (Table 1). In all three samples of *edwardsi,* the difference in mean size between males and females is highly significant.

Within each sex, there are no significant differences in size among samples of *edwardsi.* In other words, *edwardsi* seems not to vary geographically in size (at least within the United States).

Nor are there really significant size differences, in either sex, between *edwardsi* and *ovinia,* although, to judge from males (which afford the better sample), *ovinia* may be a trifle larger.

All wing measurements were taken twice (see Burns, 1982: 549).

Antenna.—In true dorsal view, the posterior side of the base of the club is more noticeably pale in superspecies *A. ovinia* than it is in other *Atrytonopsis.*

On average, the apiculus is longer in superspecies *A. ovinia* than it is in any of the other *Atrytonopsis* that usually or always have spots on the dorsal secondary. It looks at least as long as it does in the *lunus* group, which has the longest apiculus among species of *Atrytonopsis* that normally lack spots on the dorsal secondary. Yet the apiculus averages 0.7 segment less in superspecies *A. ovinia* than it does in the *lunus* group. This is manifest when one compares *lunus* and *edwardsi* from Arizona, where samples are large; but limited data from elsewhere suggest a similar difference.

Variation in number of segments in the nudum is demonstrably independent of variation in size: although females of *edwardsi* average significantly larger than males in wing length (Table 1), they do not differ from males in number (and

Table 2. Frequency (%) of nudum variants in males vs. females of *Atrytonopsis edwardsi* from mountain islands in southern Arizona.

Sample	Sex	*N*	Number of Nudum Segments (on Base of Club/on Apiculus)						
			4/6	3/7	3/8	4/7	4/8	4/9	5/8
Santa Catalina Mountains	♂	43		1 (*2*)	4 (*9*)	8 (*19*)	27 (*63*)	2 (*5*)	1 (*2*)
	♀	11			1 (*9*)	2 (*18*)	7 (*64*)	1 (*9*)	
Baboquivari Mountains	♂	80	1 (*1*)	2 (*3*)	1 (*1*)	12 (*15*)	56 (*70*)	6 (*7*)	2 (*3*)
	♀	40		1 (*3*)		5 (*13*)	29 (*72*)	2 (*5*)	3 (*7*)

disposition) of nudum segments (Table 2). I previously found ample sexual dimorphism in size but none in expression of the nudum in *lunus* (Burns, 1982: 551) and in *Erynnis propertius* (Scudder and Burgess) (Burns, 1964: 97, table 14); the data, particularly for *Atrytonopsis,* were fragmentary. Using scattered data from *Erynnis,* I argued once before that wing length and number of nudum segments must vary independently (Burns, 1964: 10).

Nudum variation in superspecies *A. ovinia* is summarized in Table 3, where data from both sexes are pooled. Except for 8 individuals (out of a total of 251 scored), the number of nudum segments surpasses the 10 (disposed 4/6) that Evans (1955: 384) attributed to genus *Atrytonopsis.* Ranging from 10 to 13, the number of segments is usually 11 or 12 in *ovinia* (disposed 4/7 or 4/8) and 12 in *edwardsi* (disposed 4/8). In *lunus,* the number ranges from 11 to 15 and is usually 12, 13, or 14 (disposed 4/8, 5/8, 4/9, or 5/9) (Burns, 1982: 550). As in the *lunus* group, the terminal segment is almost always long.

Clearly, the nudum (which includes the apiculus) is slightly shorter, on average, in *ovinia* from Mexico than it is in *edwardsi* from the United States (Table 3). However, in the few specimens of *edwardsi* I have seen from far down in Mexico (2 from Jalisco, 1 from Veracruz), where they approach the northern limit of *ovinia,* the nudum is 4/7; and in the only specimen of *ovinia* from Nicaragua with an unbroken antenna, the nudum is 4/9.

Though there may be modest geographic variation in the nudum of *edwardsi* between southern Arizona and west Texas, the Davis Mountains sample may be relatively conservative chiefly because 38 of the 43 specimens in it were taken (by my wife and me) in a 1-week period—35 of them from a single local population. Other samples come from many times and populations. Some of the variation in the phenotype of the nudum no doubt reflects "environmental slop," such as differences in weather at critical developmental times.

Sex ratio and behavior.—Although, as a rule, the sex ratio is probably about even in natural populations of skippers, it seldom is in collected material. There the number of males commonly exceeds the number of females—often by 2 (or more) to 1. Both *edwardsi* and *ovinia* fit this pattern (see Tables 1 and 2). But, because *lunus* and *frappenda* completely reverse it (Burns, 1982: 549), I infer important behavioral differences between superspecies *A. ovinia* and the *lunus* group.

Stigma.—The stigma of *Atrytonopsis* extends narrowly and obliquely across the forewing from the middle of vein 1 to about the origin of vein 3. It is tripartite owing to characteristic interruptions in space 1b and at vein 2.

Table 3. Frequency of nudum variants in superspecies *Atrytonopsis ovinia*.

		Number of Nudum Segments (on Base of Club/on Apiculus)							
Sample	*N*	4/6	3/7	3/8	4/7	5/7	4/8	4/9	5/8
A. edwardsi									
Arizona									
Santa Catalina Mountains	54		1	5	10		34	3	1
Baboquivari Mountains	120	1	3	1	17		85	8	5
Texas									
Davis Mountains	43				1	1	37	2	2
A. ovinia									
Southern Mexico	21	2	1		9		9		

For a hesperiine stigma, it is weak. It almost appears to be losing its evolutionary grip: totally lacking in the *lunus* group, it runs the gamut from all to nothing in *deva,* and varies considerably in expression in other species (Burns, 1982: 551). The stigma is as well developed in superspecies *A. ovinia* as it is in any *Atrytonopsis:* I have seen only one male of *ovinia* and one of *edwardsi* in which it is extremely reduced.

The stigma offers the best means of distinguishing (males of) *ovinia* from (males of) *edwardsi.*

In *ovinia* (Figs. 1–5), it is exceedingly narrow but relatively conspicuous because the fine scales that form it are pale enough to contrast sharply with the coarser, dark brown scales all around. It makes a steep, high angle with vein 1. The entire stigma is often straight enough to suggest a ruled broken line. The upper part of it terminates mediad of the medial edge of the spot in space 2—usually at some point roughly equidistant between this spot and the spot in the cell.

By contrast, the stigma of *edwardsi* (Figs. 6–10) is broad but relatively hard to see because it is darker and tends to blend with the surrounding ground. Its upper part is less well aligned with the middle and lower parts and is directed more outward than it is in *ovinia* so that the stigma as a whole makes a lower angle with vein 1. The upper part of the stigma terminates at the medial edge of the spot in space 2. Along the cubital vein immediately above the upper part of the stigma, many coarse scales are raised and turned abruptly downward toward it. The overall result is the most elaborate stigma in the genus. (Such altered scales on the cubitus are missing to, at most, moderately developed in *ovinia.*)

These differences hold through the geographic range of both species.

Facies.—Wings are more rounded in superspecies *A. ovinia* than they are in other *Atrytonopsis.* This is particularly evident in the forewings of males.

Both species of superspecies *A. ovinia* have a bold spot spanning the cell of the primary and at least some spots on the dorsal secondary (Figs. 11–18). In general, the row of spots on the dorsal secondary is not as hypertrophied as it is in *cestus,* not as continuous and straight as it is in *pittacus* (Edwards), but not as uneven as it is in *python* (Edwards) and *margarita* (Skinner).

Fringes of both wings are checkered (rather more clearly in *edwardsi* than in *ovinia*), though not as strongly as they are in *python.*

The gap between the large semihyaline spot in space 2 and the one in the cell is generally a little smaller in *ovinia* than it is in *edwardsi* (Figs. 1–18). This is true especially of males, owing to differences in the form and position of the upper part of the stigma (described above).

On average, the row of spots on the dorsal secondary is slightly less developed and slightly more even in *ovinia* than it is in *edwardsi.* (Comparisons must be made *within* each sex because, in *Atrytonopsis,* this row of spots is better developed, on average, in males than it is in females.) The spots themselves are ever so slightly more rounded in *edwardsi* than they are in *ovinia.*

Genitalia.—Although the genitalia of *Atrytonopsis* are conservative, those of superspecies *A. ovinia* depart relatively widely from the rest. Within the superspecies, however, specific differences are slight and tend to be blurred by a healthy lot of individual variation.

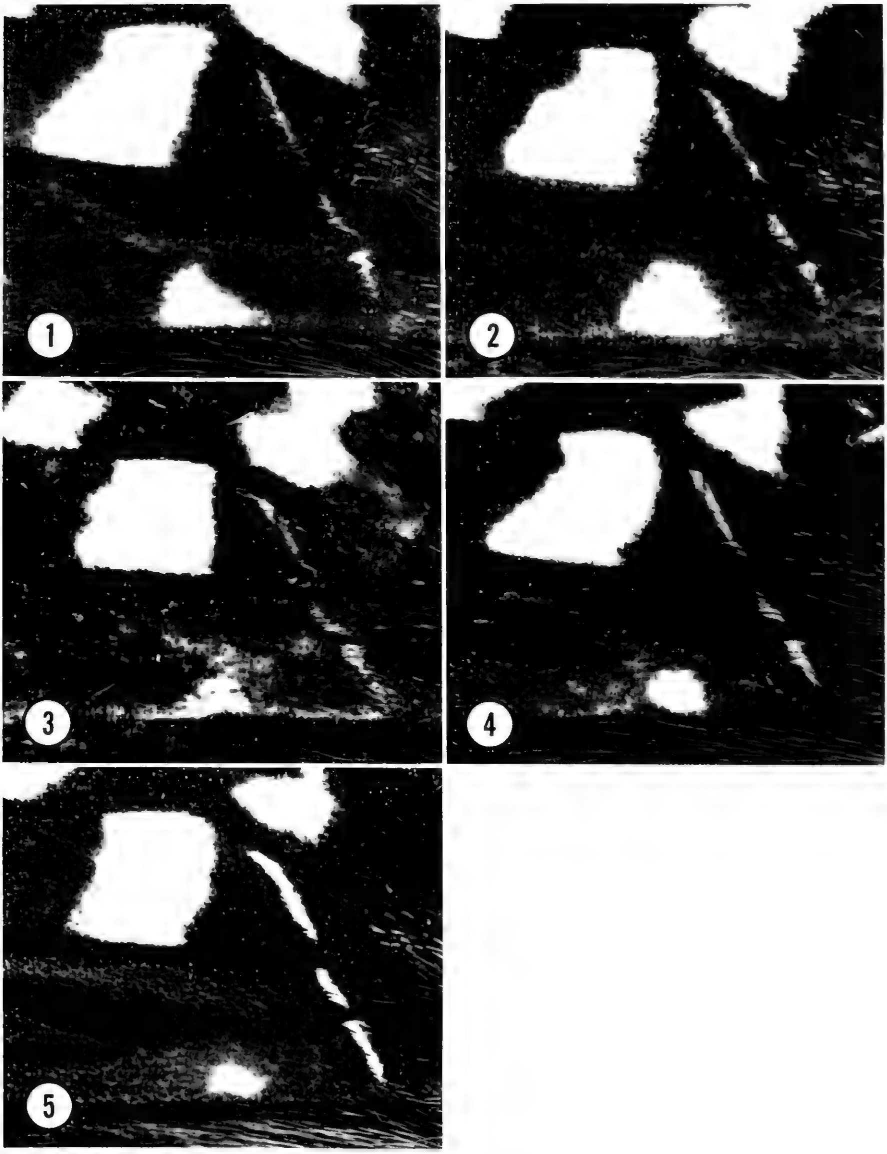
Accordingly, numerous genitalia have been dissected, compared, and stored in 1-dram vials that leave them fully liberated (for procedural details, see Burns, 1982: 557). As before, dissection numbers of drawn individuals appear in figure legends in parentheses.

Male genitalia: The paired uncus prongs, which are long and narrow in all other *Atrytonopsis,* are fused for most of their length and separate only at their tips in superspecies *A. ovinia* (Figs. 19, 22, 25, 28–40). The aedeagus, which is always long in *Atrytonopsis,* is excessively long in superspecies *A. ovinia*—nearly thrice the length of the valva (Figs. 20–21, 23–24, 26–27).

The small notch dividing the tip of the uncus is always a little deeper in *ovinia* than it is in *edwardsi* (cf. Figs. 19, 22, 28–33 with 25, 34–40). The two states of this character are so similar that it is hard to choose between them without seeing both at once. What is worse, both states vary considerably (as Figs. 19, 22, 25, 28–40 try to show). Nevertheless, they do not overlap: the notch between the uncus prongs is decidedly deeper than the basal diameter of either prong in *ovinia* but more or less equal to (or even shallower than) the basal diameter of either prong in *edwardsi.* Another beauty of this subtle character is its location at the distal end of the genitalia where it can often be studied—without having to dissect—by, at most, brushing away a few scales.

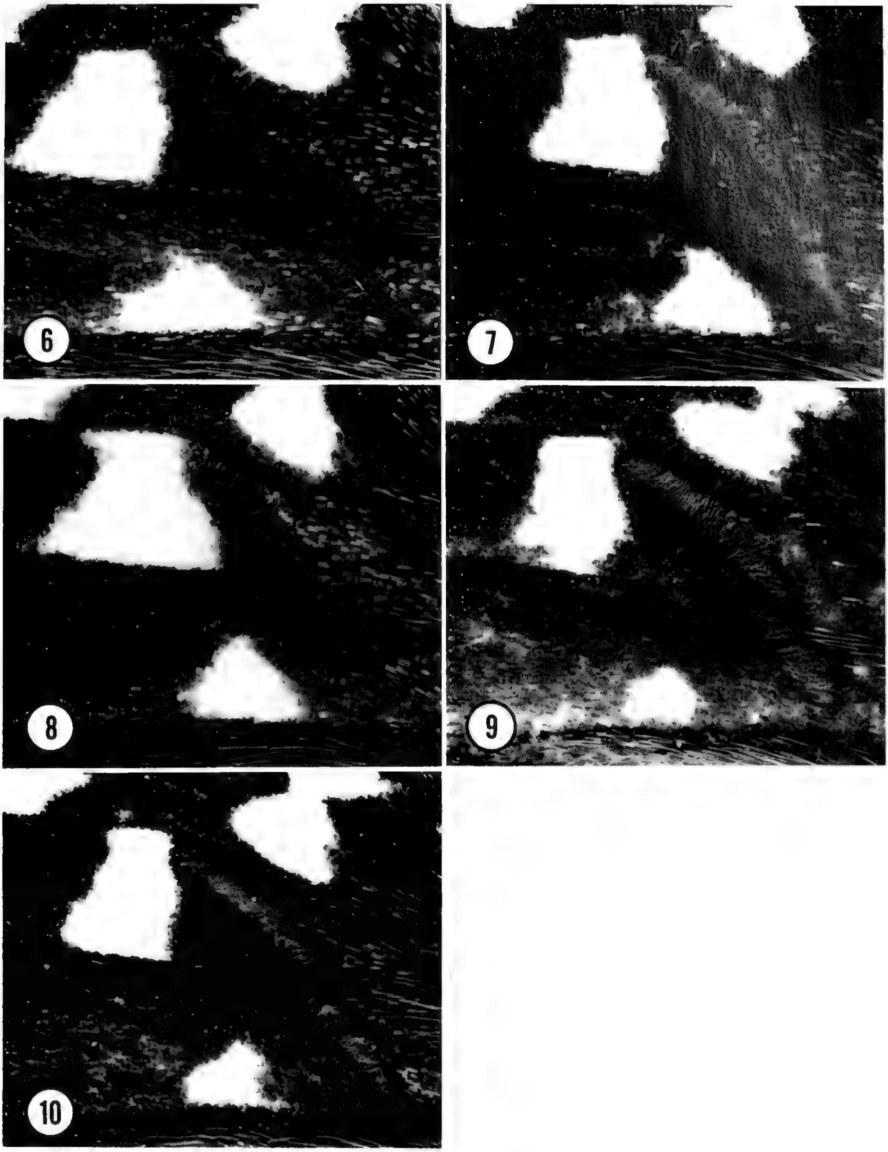
Female genitalia: The lamella postvaginalis is more elongate and more narrowly stalked in superspecies *A. ovinia* than it is in other *Atrytonopsis* (Figs. 41–55). The ventral lip of the ostium bursae is peculiar because it begins at the sides in large, sclerotized, caudally projecting points from which it arcs somewhat forward, giving way midventrally to an area of membrane that gradually and irregularly becomes sclerotized a little farther forward (Figs. 41–55). As in other *Atrytonopsis,* the ductus bursae is heavily sclerotized (Burns, 1982: 562); but it is much longer in superspecies *A. ovinia* than it is in other members of the genus. (In view of the excessively long aedeagus of the corresponding males and the fashionability of coevolution, this comes as no surprise.) At first elliptical to round in cross section, the ductus bursae flattens anteriorly and, before emptying into the corpus bursae, bends to the right in a characteristic way (Figs. 41–55).

Although the lamella postvaginalis is very similar in *ovinia* and *edwardsi* and varies greatly in form within each species (Figs. 41–55), it will serve to distinguish them unequivocally. Seen ventrally, the lamella postvaginalis is essentially lanceolate (with a rounded apex) in *ovinia* but deltoid in *edwardsi.* In *ovinia,* it is



Figs. 1–5. Male stigmas of *Atrytonopsis ovinia* from Nicaragua and Mexico. Vein 1 of the left primary runs along the bottom of each photograph. 1, Holotype of *ovinia,* Nicaragua (BMNH). 2, Las Delicias, Chiapas, 8 August 1975, P. Hubbell (AMNH). 3, Holotype of *zaovinia,* Tehuacan, Puebla, August 1911, R. Müller (USNM). 4, Acahuizotla, Guerrero, August 1958, T. Escalante (AMNH). 5, Mexcala, Guerrero, August 1960, T. Escalante (AME).

much narrower at the base so that, even though it does taper toward the apex, it is more nearly oblong in outline (Figs. 41, 42, 44–47). In *edwardsi,* the lamella postvaginalis is broader—usually much broader—at the base and therefore much more triangular overall (Figs. 43, 48–55); together with its stalk, it sometimes suggests the stylized spearhead symbolizing spades on playing cards.



Figs. 6–10. Male stigmas of *Atrytonopsis edwardsi* from the United States and Mexico. Vein 1 of the left primary runs along the bottom of each photograph. 6, Lectotype of *edwardsi,* "Redington" (probably Santa Catalina Mountains), Arizona (USNM). 7, Limpia Canyon, 1465 m, Davis Mountains, 1.6 km N Ft. Davis, Jeff Davis County, Texas, 1 May 1959, J. M. and S. N. Burns (USNM). 8, Baboquivari Mountains, Pima County, Arizona (USNM). 9, Presidio, Veracruz, June 1942, T. Escalante (AME). 10, Ajijic, Jalisco, 3 September 1966, R. Wind (AMNH).

In superspecies *A. ovinia,* the lamella postvaginalis is so elongate that its distal end, like the end of the uncus, often protrudes enough to show without dissection. Unfortunately, one can rarely see all the way to the base, which is crucial for species discrimination.

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12

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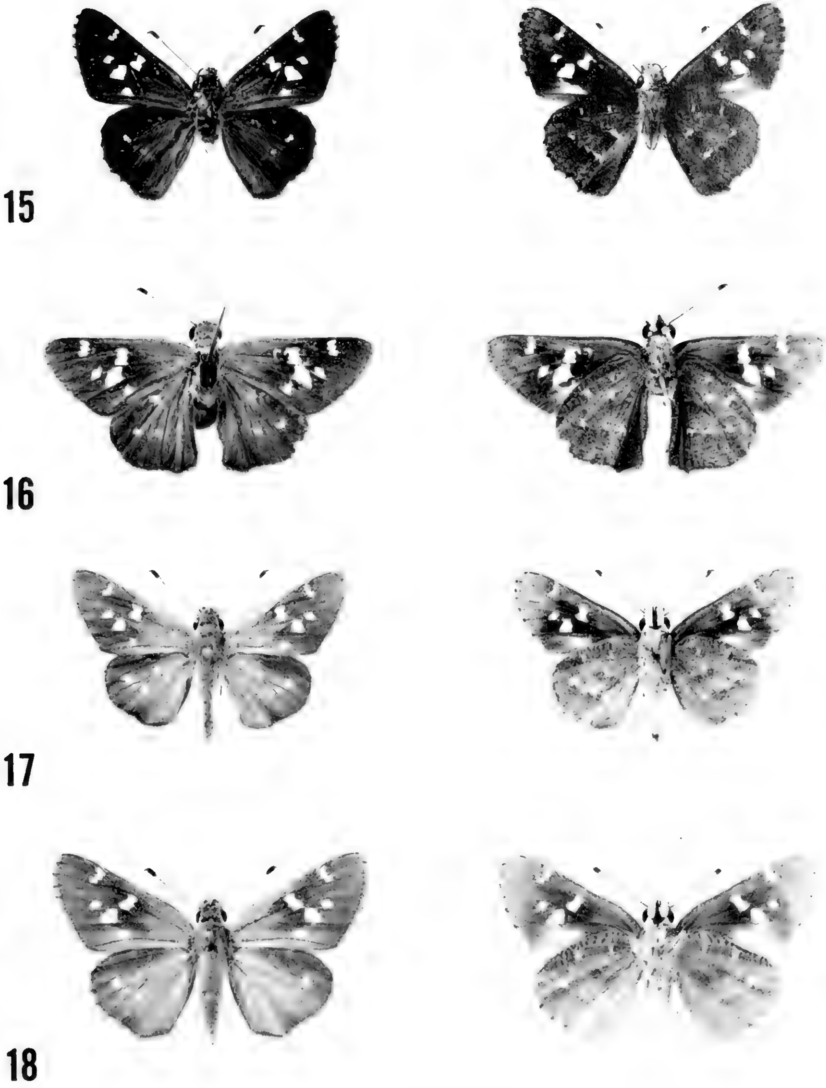
14

Figs. 11–14. Type-specimens relating to superspecies *Atrytonopsis ovinia,* dorsal and ventral view (all ×1). 11, Holotype ♂ of *ovinia,* Nicaragua (BMNH). 12, Holotype ♂ of *zaovinia,* Tehuacan, Mexico (USNM). 13, Lectotype ♂ of *edwardsi,* "Redington," Arizona (USNM). 14, Phony "type" ♀ of *rupilius,* Guadalajara, Mexico (USNM). 11 and 12 belong to *A. ovinia;* 13 and 14, to *A. edwardsi.*

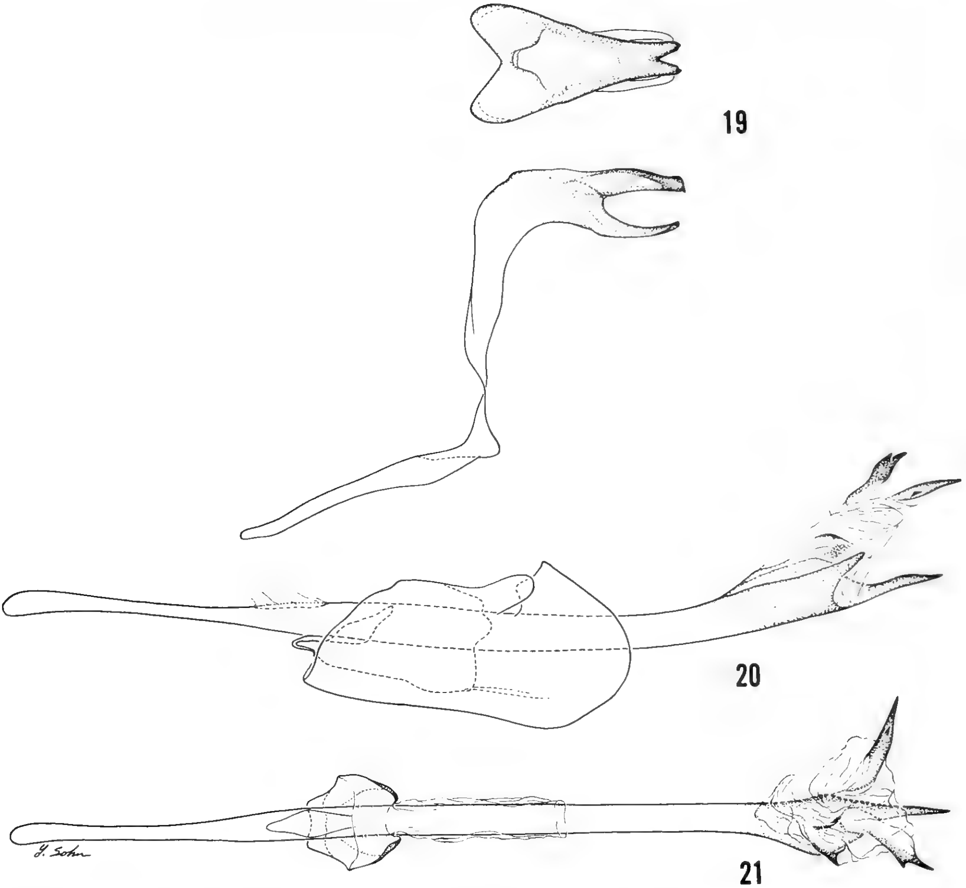
Temporal distribution.—Both members of superspecies *A. ovinia* are multivoltine. Of the 31 dated Mexican specimens of *ovinia* examined, 25 are from July and August; but the remaining 6 are from February, March, June, September, and December, which suggests that this southern species may fly in any month. The records may be concentrated in midsummer simply because most collecting is done then. Of the 261 specimens of *edwardsi* examined, 202 are dated and all



Figs. 15–18. Superspecies *Atrytonopsis ovinia,* dorsal and ventral view (all ×1). 15, *A. ovinia,* ♂, Las Delicias, Chiapas, 8 August 1975, P. Hubbell (AMNH). 16, *A. ovinia,* ♀, Nicaragua (BMNH). 17–18, *A. edwardsi,* Limpia Canyon, 1525 m, Davis Mountains, 6.4 km WNW Ft. Davis, Jeff Davis County, Texas, 1 May 1959, J. M. and S. N. Burns (USNM). 17, ♂. 18, ♀.

but 3 of these are from the United States. The distribution of dates indicates two generations, with adults in spring (variously from March to June) and again in summer to about the beginning of fall (July to September). The second generation is smaller than the first.

Spatial distribution.—Superspecies *A. ovinia* occurs discontinuously from the southwestern United States to central Central America. Its "known" southern

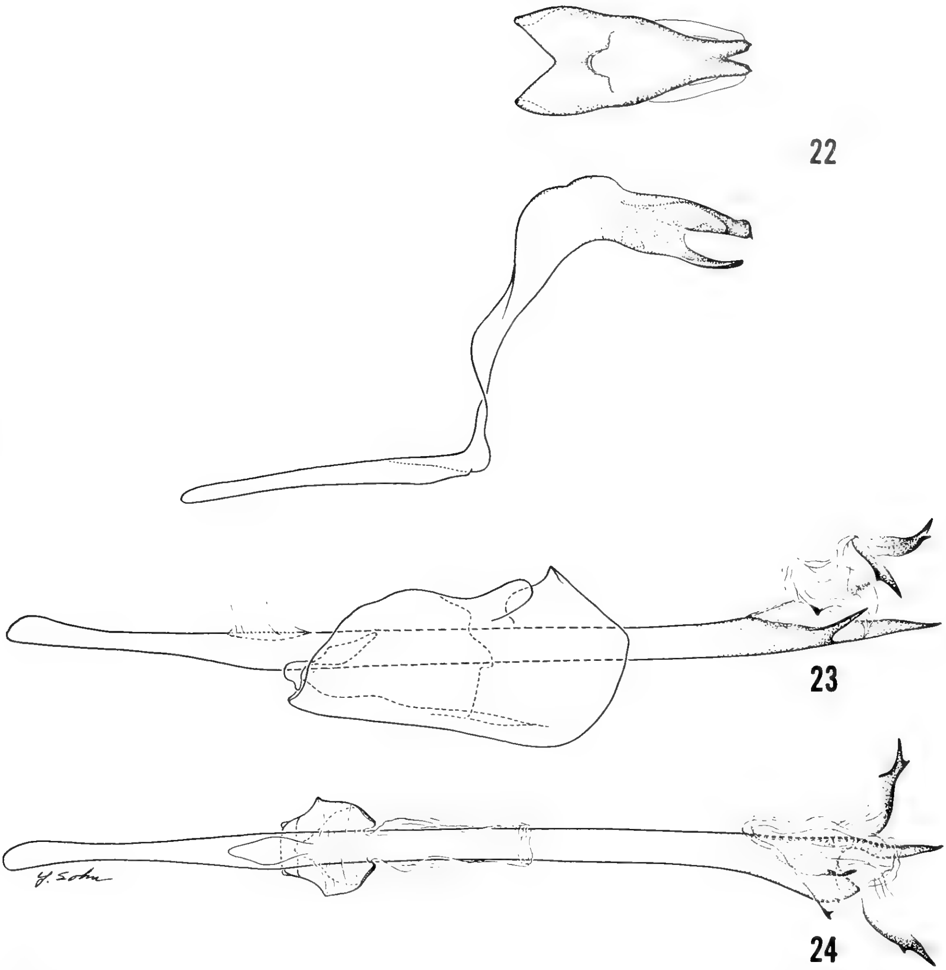


Figs. 19–21. Male genitalia of holotype of *Atrytonopsis ovinia* from Nicaragua (X-1296) (BMNH). 19, Uncus, gnathos, and tegumen in dorsal view and uncus, gnathos, tegumen, vinculum, and saccus in left lateral view. 20, Left valva, aedeagus, and juxta in left lateral view. 21, Aedeagus and juxta in dorsal view.

limit is somewhere in Nicaragua, at least, and probably farther south in northeastern Costa Rica around Guapiles (the source of *rupilius,* according to Schaus; see discussion in Nomenclature and synonymy, above).

The more northern *edwardsi* ranges from the mountain islands of southeastern Arizona (plus immediately adjacent southwestern New Mexico) and those of Trans-Pecos Texas south primarily via the Sierra Madre Occidental and Oriental to Jalisco and Veracruz and the transverse Volcanic Cordillera (Fig. 56). It occurs at lower middle elevations from 850 to 1830 m (2800–6000 ft), but especially from 1220 to 1525 m (4000–5000 ft), and favors rocky canyons in foothill situations from the upper edge of desert, through grassland, to the lower edge of open oak woodland.

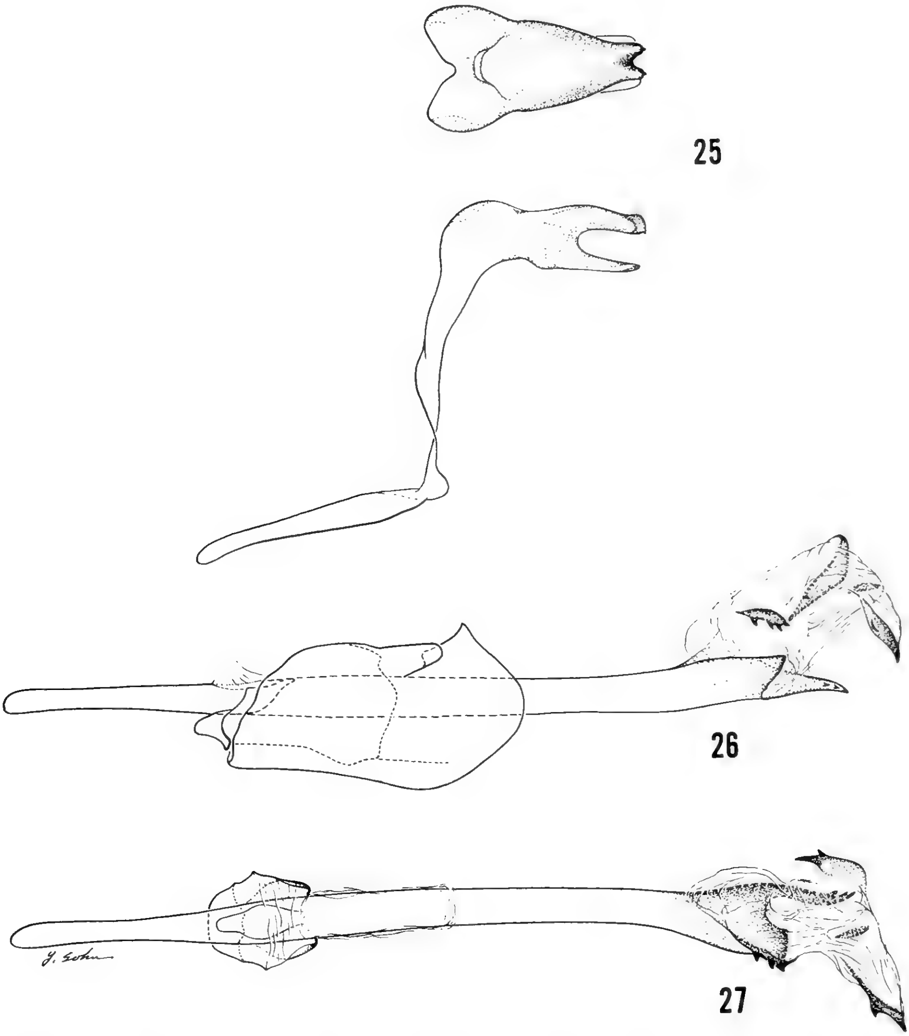
Unexpectedly, the more southern *ovinia* occurs at lower, rather than higher, elevations: points from 550 to 750 m (1800–2460 ft) have been recorded (though the real spread is wider). In Mexico, *ovinia* ranges from Guerrero and southern



Figs. 22–24. Male genitalia of holotype of *Atrytonopsis zaovinia* from Tehuacan, Mexico, August 1911, R. Müller (X-1061) (USNM). 22, Uncus, gnathos, and tegumen in dorsal view and uncus, gnathos, tegumen, vinculum, and saccus in left lateral view. 23, Left valva, aedeagus, and juxta in left lateral view. 24, Aedeagus and juxta in dorsal view.

Puebla (Tehuacan) through Oaxaca and Chiapas and nips the southern edge of Tabasco (Teapa) (Fig. 56). It seems to favor dry, rocky (sometimes limestone) country supporting seasonally dry scrub or thorn forest (L. D. Miller and P. Hubbell, personal communications 1982). It must occur in Guatemala, Honduras, and El Salvador: on the one hand, specimens have been taken at two spots close to the Guatemalan border in the Chiapas Highlands (which continue into Guatemala); on the other, three specimens are known from Nicaragua, and one has been reported from northeastern Costa Rica.

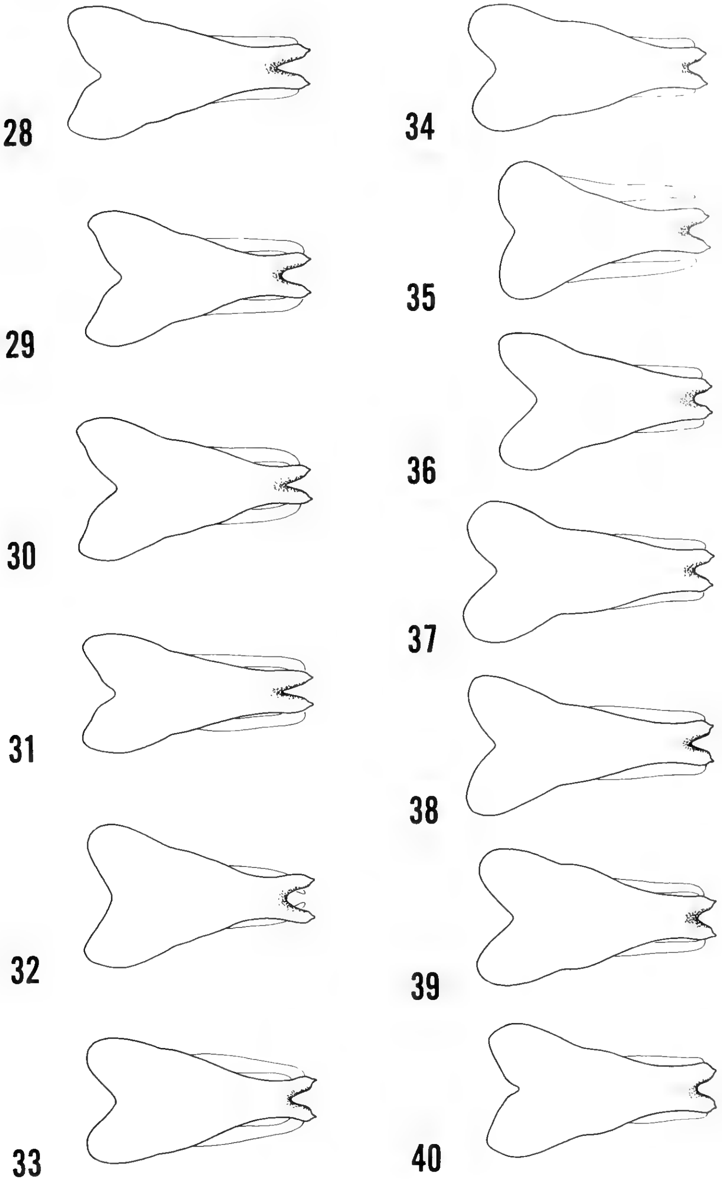
Atrytonopsis ovinia and *edwardsi* appear to be allopatric (there are too few Mexican records to state flatly that these species neither meet nor overlap a little). In general, they are altitudinally displaced. Although elevation is lacking, the specimen of *ovinia* labelled Teapa presumably comes from as low as 300 m (1000



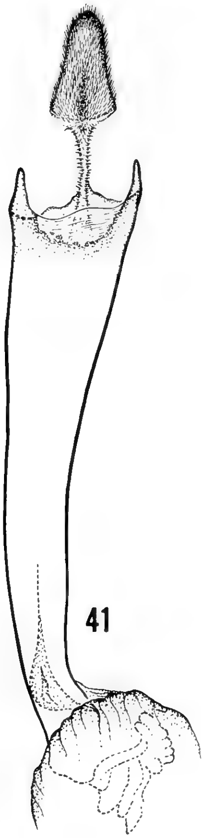
Figs. 25–27. Male genitalia of lectotype of *Atrytonopsis edwardsi* from "Redington" (probably Santa Catalina Mountains), Arizona (X-1295) (USNM). 25, Uncus, gnathos, and tegumen in dorsal view and uncus, gnathos, tegumen, vinculum, and saccus in left lateral view. 26, Left valva, aedeagus, and juxta in left lateral view. 27, Aedeagus and juxta in dorsal view.

ft) or lower; and only the specimens of *ovinia* labelled Tehuacan would seem to be as high as the preferred elevational range of *edwardsi.*

Where *ovinia* and *edwardsi* are closest to each other (Fig. 56), the dot marks Tehuacan, Puebla, and the triangle, Presidio, Veracruz. "Presidio" is the one name that still gave me some latitude when I started plotting symbols: it occurs twice in Veracruz, not only as a larger, more familiar railroad community 28 km southeast of Cordoba, cited in the *Biologia Centrali-Americana* and pinpointed by Selander and Vaurie (1962: 46), but also as a village 20 km north-northwest of Cordoba. I chose the latter because it lies in the pine-oak zone, between 915



Figs. 28–40. Uncus, gnathos, and tegumen of the male genitalia of superspecies *Atrytonopsis ovinia* in dorsal view. 28–33, *A. ovinia* from Mexico. 34–40, *A. edwardsi* from the United States and Mexico. 28, Guerrero, July 1920, R. Müller (X-1057) (USNM). 29, Mexcala, 550 m, Guerrero, 22 July 1956, K. Wilson (X-1066) (AMNH). 30–31, Tehuacan, Puebla, 14 August 1964, H. A. Freeman (X-1064 and 1065) (AMNH). 32, Teapa, Tabasco, December 1912, R. Müller (X-1068) (USNM). 33, Las Delicias, Chiapas, 8 August 1975, P. Hubbell (X-1067) (AMNH). 34–36, Baboquivari Mountains, Pima County, Arizona, 1 to 15 June 1924, 1 to 15 July 1924, and 1924, O. C. Poling (X-1150, 1072, and 1147) (USNM). 37, ca. 29 km W Cananea, Sonora, 26 August 1969, P. Hubbell (X-1069) (AMNH). 38, Limpia Canyon, 1525 m, Davis Mountains, 6.4 km WNW Ft. Davis, Jeff Davis County, Texas, 1 May 1959, J. M. and S. N. Burns (X-1300) (USNM). 39, 3.2 km N Shafter, Presidio County, Texas, 28 May 1973, W. W. McGuire (X-1071) (USNM). 40, Ajijic, Jalisco, 3 September 1966, R. Wind (X-1070) (AMNH).



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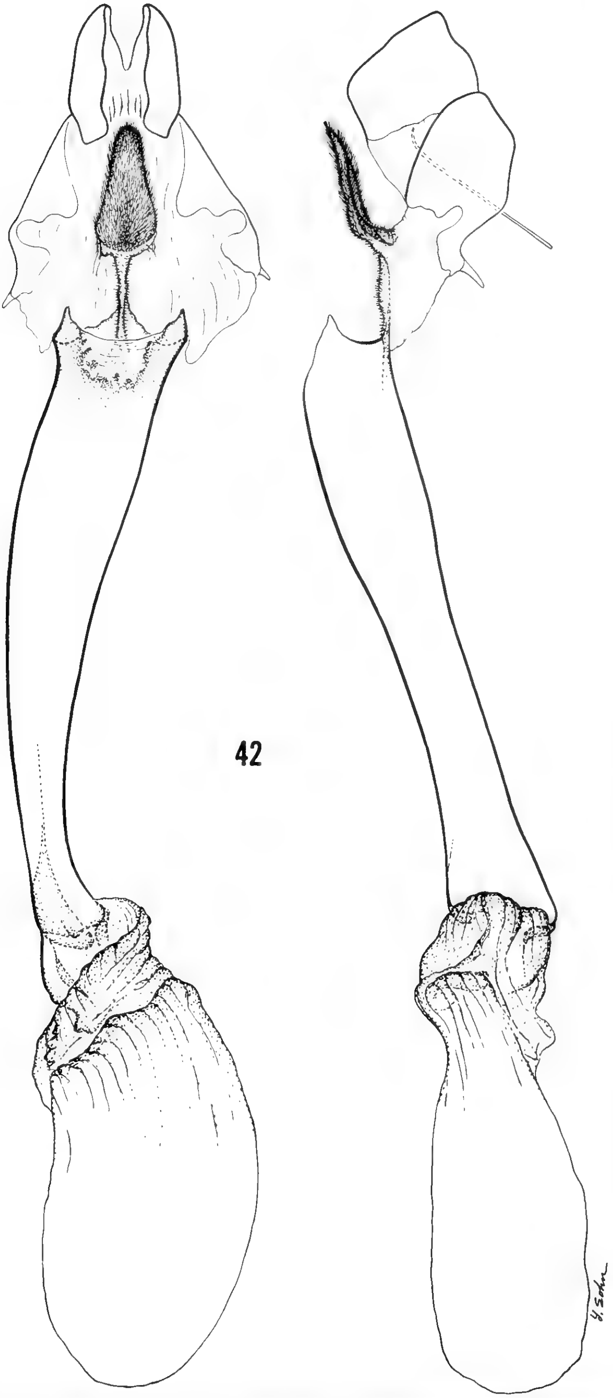

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Figs. 41–42. Female genitalia of *Atrytonopsis ovinia* from extremes of the known geographic range. 41, Lamella postvaginalis, ostium bursae, and ductus bursae in ventral view. Tehuacan, Puebla, 14 August 1964, H. A. Freeman (X-1063) (AMNH). 42, Bursa copulatrix and tip of abdomen in ventral and right lateral view. Nicaragua (X-1297) (BMNH).

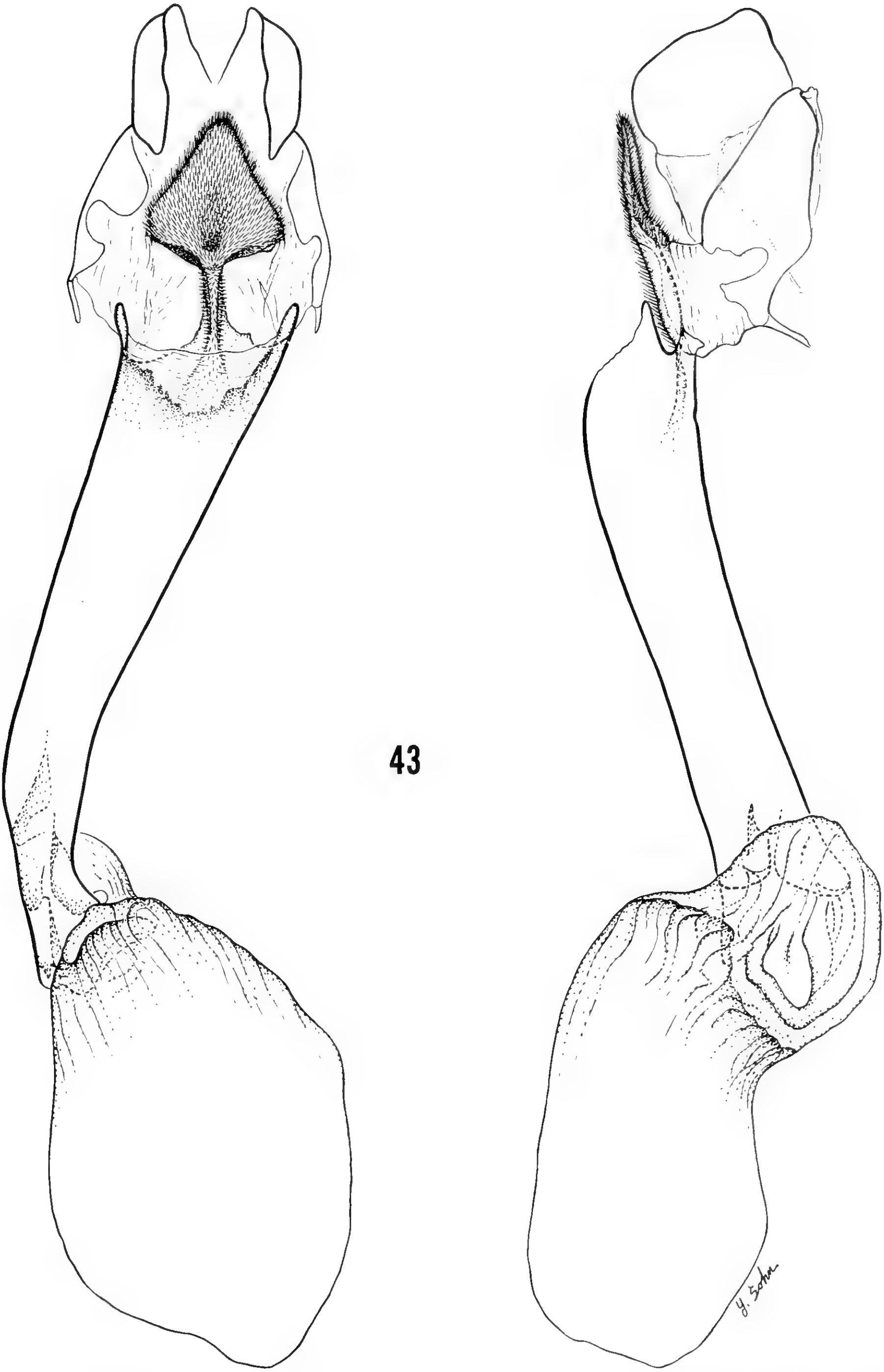

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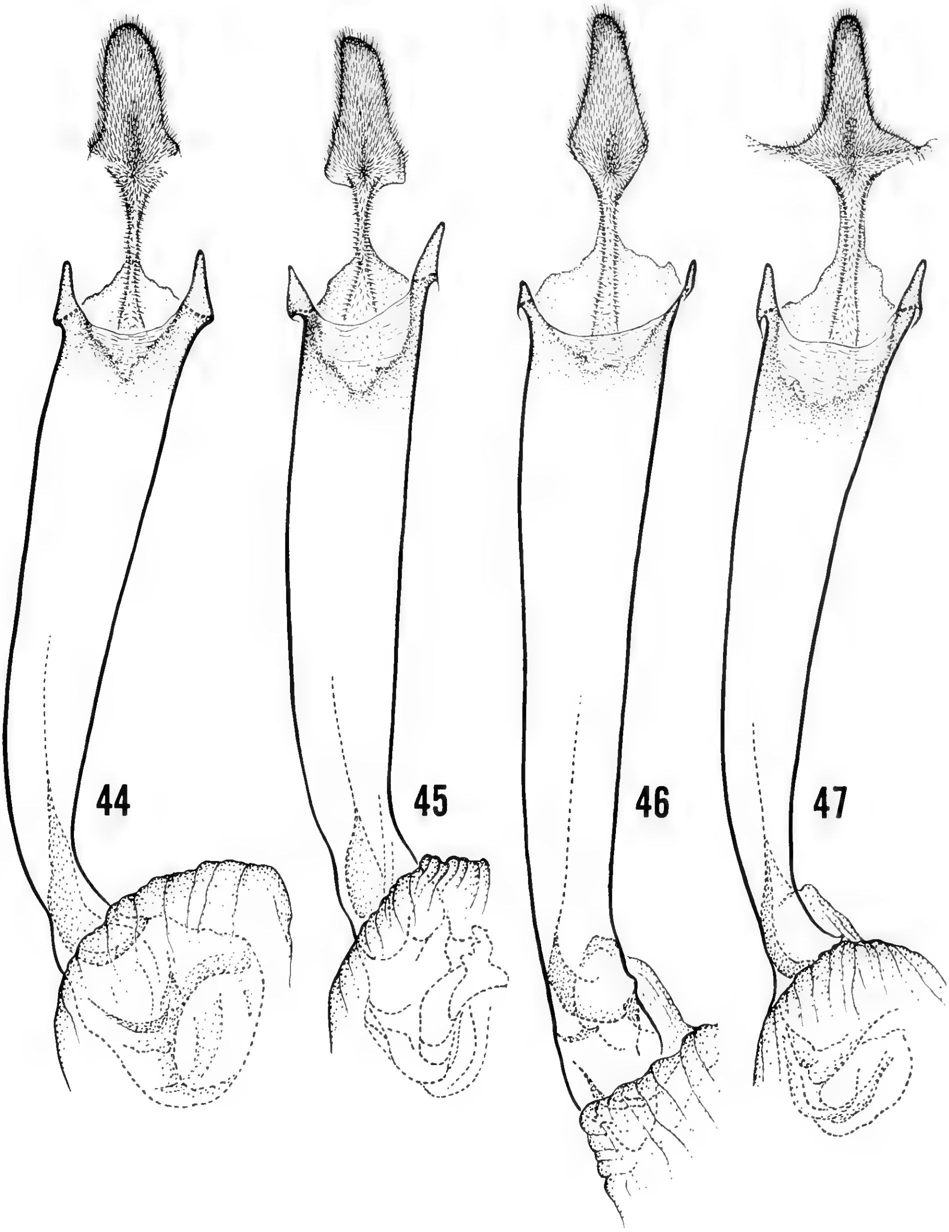
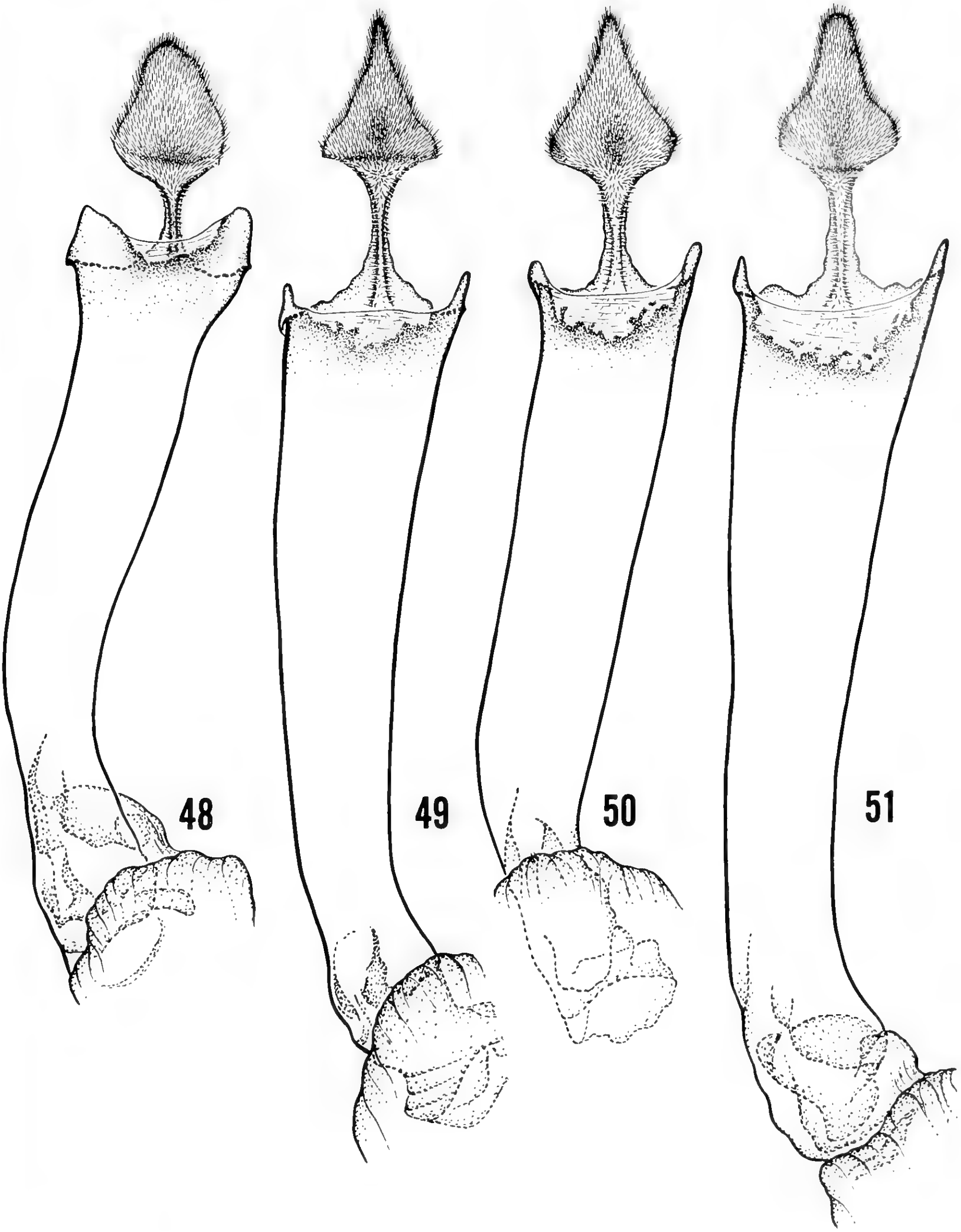
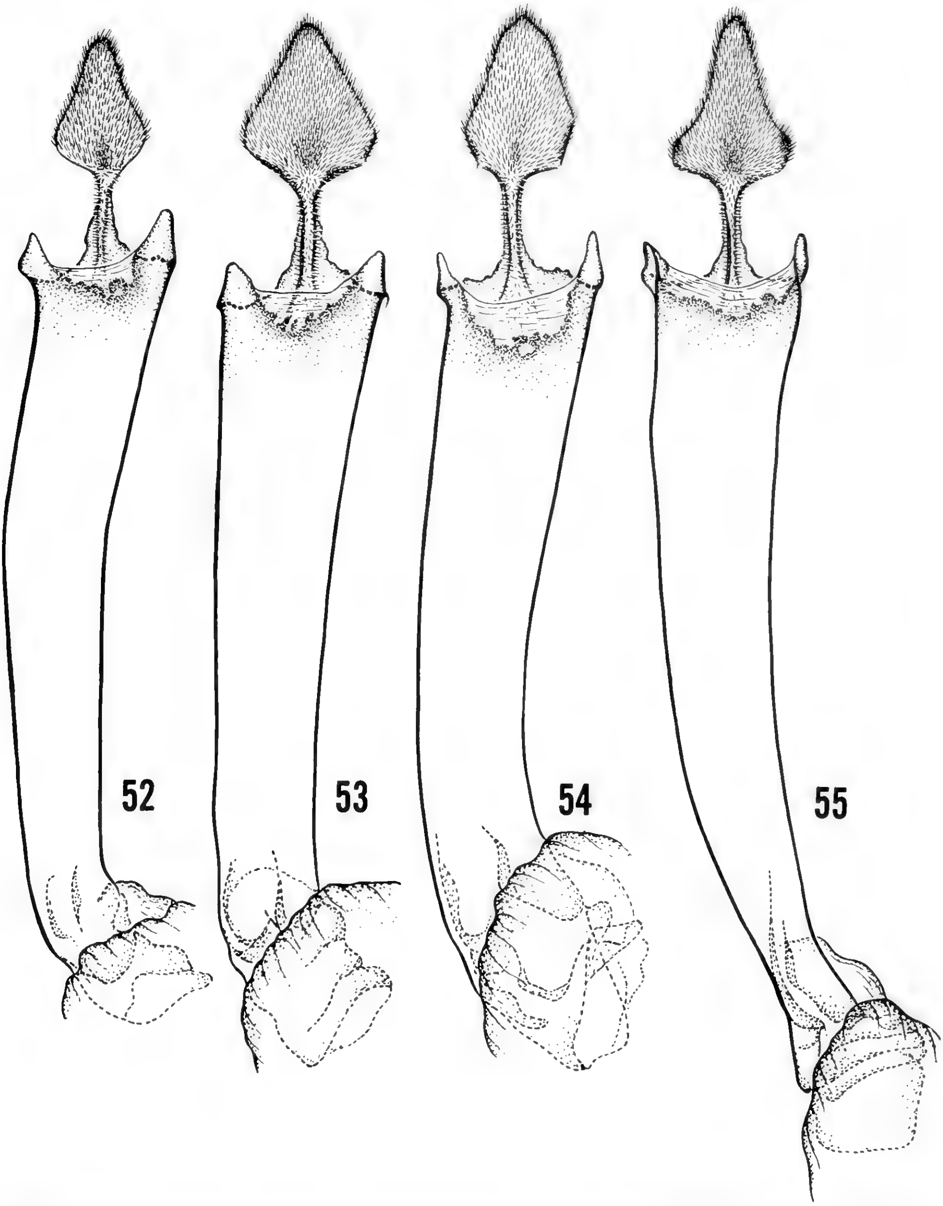
Fig. 43. Female genitalia of *Atrytonopsis edwardsi.* Bursa copulatrix and tip of abdomen in ventral and right lateral view. Limpia Canyon, 1525 m, Davis Mountains, 6.4 km WNW Ft. Davis, Jeff Davis County, Texas, 1 May 1959, J. M. and S. N. Burns (X-1309) (USNM).



Figs. 44–47. Female genitalia of *Atrytonopsis ovinia* from southern Mexico. Lamella postvaginalis, ostium bursae, and ductus bursae in ventral view. 44, Acahuizotla, Guerrero, June 1956, T. Escalante (X-1314) (AME). 45, 19 km E El Camaron, Oaxaca, 7 August 1956, J. W. MacSwain (X-1318) (MacNeill). 46, 32 km E El Camaron, Oaxaca, 20 July 1956, D. D. Linsdale (X-1317) (MacNeill). 47, Bombana, Chiapas, 12 to 18 September 1975, P. Hubbell (X-1319) (MacNeill).



Figs. 48–51. Female genitalia of *Atrytonopsis edwardsi* from the southwestern United States and central Mexico (all USNM). Lamella postvaginalis, ostium bursae, and ductus bursae in ventral view. 48, Limpia Canyon, 1435 m, Davis Mountains, 8 km NE Ft. Davis, Jeff Davis County, Texas, 4 May 1959, J. M. and S. N. Burns (X-1302). 49, Limpia Canyon, 1525 m, Davis Mountains, 6.4 km WNW Ft. Davis, Jeff Davis County, Texas, 1 May 1959, J. M. and S. N. Burns (X-1301). 50, "Redington," Arizona (X-1075). 51, Guadalajara, Jalisco (X-1060)—the phony "type" of *rupilius.*



Figs. 52–55. Individual variation in female genitalia of *Atrytonopsis edwardsi* from the Baboquivari Mountains, Pima County, Arizona (all O. C. Poling, all USNM). 52, Brown's Canyon, ca. 1525 m, 1 to 15 June 1923 (X-1151). 53-54, 1 to 15 June 1924 (X-1074 and 1149). 55, 1 to 15 June 1923 (X-1042).

and 1525 m (3000 and 5000 ft); *edwardsi* has no business hanging around a railroad station in tropical lowland of about 300 m (1000 ft).

With so few Mexican records, it is worth mentioning a pair of *edwardsi* taken at Hermosillo in central Sonora on 20 October 1961 and reported by Miller (1970: 195), following Evans (1955: 386), as *A. ovinia zaovinia.*

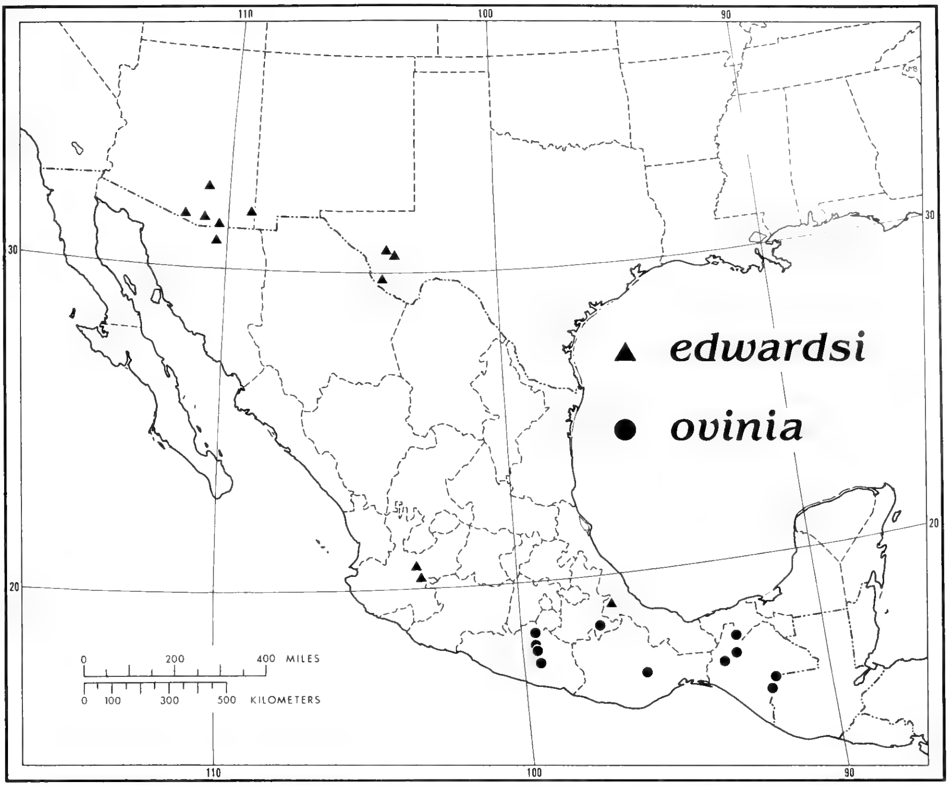


Fig. 56. Geographic distribution of superspecies *Atrytonopsis ovinia* (based on material examined). *Atrytonopsis ovinia* certainly extends to somewhere in Nicaragua, the type-locality, and probably to northeastern Costa Rica.

DISCUSSION

The gross morphologic characters that reliably separate *ovinia* from *edwardsi* are secondary sex characters: the stigma of the male and the genitalia of both sexes. In many sorts of organisms, it is structures like these that change most readily in the process of speciation.

Is such differentiation directly selected, or is it a more or less fortuitous result of other genetic reorganization associated with speciation? In both males and females, the genitalic differences between *ovinia* and *edwardsi* are small—so small, in fact, and so variable, that their potential value in reproductively isolating these forms from one another seems nil. At the same time, differences in the stigma (a structure thought to function in mate recognition) are greater and might constitute a significant isolating mechanism. A crucial point, however, is that *ovinia* and *edwardsi* appear to have arisen allopatrically and to have remained allopatric ever since. It is hard, then, to imagine any direct selection for the observed divergence in these characters. (They do not have to diverge, of course; note, e.g., the lack of differentiation in secondary sex characters among species of the *lunus* group of *Atrytonopsis* [Burns, 1982].) There may be a widespread, genetically based tendency for secondary sex characters to alter in the course of a genetic shake-up occurring in, say, the classic, initially small, (peripherally) isolated population of

Mayr (1954); but this would not be the same as selection directly effecting change. Although sympatric congeners of a speciating population might offer some constraints, selective pressure on secondary sex characters is more likely to come from secondary contact between sister species.

To rephrase the central idea, much of the interspecific morphologic variation (especially in genitalia) that I find so useful as a taxonomist strikes me as "noise" that does not harmonize with the dominant all-is-selected evolutionary theme. I was forced to similar conclusions more than two decades ago when I analyzed evolution in American species of *Erynnis* in detail (Burns, 1964: 4–6 [italics in third paragraph added]):

> To determine specimens of *Erynnis* accurately, it is desirable, and often necessary, to examine their genitalia. The taxonomic value of the male genitalia has been known since Scudder and Burgess (1870) demonstrated the striking asymmetry that pervades these structures; but few workers have taken the trouble to use them. Comparable characters for identifying females have never been worked out. Since the sclerotized aedeagus of the male is, in various species, bent at an angle or oriented off the median dorsoventral plane, or both, the ostium bursae of the corresponding female is asymmetrically placed. The position of the ostium bursae, chiefly with respect to the midventral line (but also relative to the anterior and posterior limits of the sterigma), the form of the opening and adjacent heavy sclerotization, and the form of the sterigma together offer a set of reliable diagnostic characters. . . .
>
> Members of genus *Erynnis* mate in a tandem, posterior-to-posterior position, and therefore an aedeagus directed toward a male's right requires an ostium bursae situated on the female's left. Since, in each sex, an asymmetrically placed organ sometimes lies on the left side, sometimes on the right (depending upon the species), crossing between certain species seems to be mechanically impossible. However, such incompatible species are always phylogenetically distant, whereas those that are closely related are similar to one another in genitalic structure. And in several species, both related and unrelated, aedeagus and ostium bursae lie in, or virtually in, the midline. Hence, asymmetry of these organs can scarcely have evolved as an isolating mechanism of a "lock-and-key" sort. (Among the criteria that I have used in relating species are within-sex similarities in genitalic structure; but because other characters—of which the most convincing is geographic distribution—have simultaneously been considered, the conclusion stated above does not really rest on a circular argument.) . . .
>
> The bizarre configurations and spinose surfaces of the male genitalia suggest an ethologic role involving exchange of tactile stimuli (perhaps in ordered sequence) between male and female in the initial phases of copulation. *Yet it is doubtful that the differing genitalic structure of different species has arisen other than accidentally, or that, once having arisen, it has gained selective advantage by promoting behavioral reproductive isolation;* genitalic asymmetry is exceptional in skippers, and among many of them—notably hesperiines—male genitalia may be extremely similar in form throughout a genus. In *Erynnis,* no genitalic differences mark some closely related species that are partly sympatric (*E. lucilius* and *E. baptisiae*) or at least contiguous (*E. zarucco* and *E. funeralis*),

> while extensive and more or less constant genitalic differences distinguish males of some other closely related forms that are allopatric and contiguous (e.g., *E. horatius* vs. *E. tristis; E. brizo brizo* vs. *E. brizo burgessi*) or even widely separated by stretches of uninhabitable terrain (e.g., *E. propertius* vs. *E. meridianus; E. b. burgessi* vs. *E. b. lacustra*). Species of *Erynnis* with which these forms are broadly sympatric are thought to be sufficiently unrelated to preclude interspecific sexual interest beyond that which is merely tentative and investigatory. *It would appear, then, that the genitalic differences are simply an aspect of general differentiation and divergence undergone by geographically isolated populations.*

Earlier, in reviewing the evolution of mimetic polymorphism in Lepidoptera, I leaned toward a flexible Goldschmidtian approach that considered genetics-and-development (as well as selection) and away from the rigid, excruciatingly cumulative micro selectionism of Fisher and Ford (Burns, 1956: 80–82). Sweeping criticism has lately been leveled at Anglo-American evolutionary biologists of the last forty-odd years for ascribing too much evolutionary change to direct selection (and attendant tight adaptation), as if organisms really were reducible to discrete characters and, therefore, less than integrated wholes (Gould and Lewontin, 1979).

In both *ovinia* and *edwardsi,* the stigma and the male and female genitalia (plus other characters studied) show a lot of individual variation (some of which I have tried to convey in figures) but no detectable geographic variation, even though the range of each species is highly discontinuous. Despite the individual variation, the subtle interspecific differences in genitalia are perceptible throughout the known range of each species. This essential "uniformity" through each sister species suggests differentiation in a small isolate followed by dispersal and expansion of range without further important genetic change, an interpretation consistent with a punctuational model of speciation.

ACKNOWLEDGMENTS

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85(2), 1983, pp. 359–361

CERATOPOGONIDAE (DIPTERA) FROM ALGERIA I. *PARABEZZIA GROGANI*, N. SP. (STILOBEZZIINI)

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Abstract.—*Parabezzia* **grogani**, n. sp., from northern Algeria is described and illustrated. This is the first record of the genus *Parabezzia* from the Palaearctic Region and the fourth species known from the African continent.

The genus *Parabezzia* Malloch of the tribe Stilobezziini is a small group of predaceous midges of the New World and Africa. Three species have been described from the Afrotropical Region: *P. falcipennis* Clastrier (1960) from Zaire (Grogan, 1980, synonymized *P. insolita* Vattier and Adam, 1966, from the Congo Republic), *P. obscura* de Meillon and Wirth (1981b) from the Transvaal, and *P. stagni* de Meillon and Wirth (1981a) from the Transvaal. The description of this new species from northern Algeria is the first record of the genus from the Palaearctic Region.

Parabezzia grogani **Szadziewski and Wirth, New Species**

Figs. 1–3

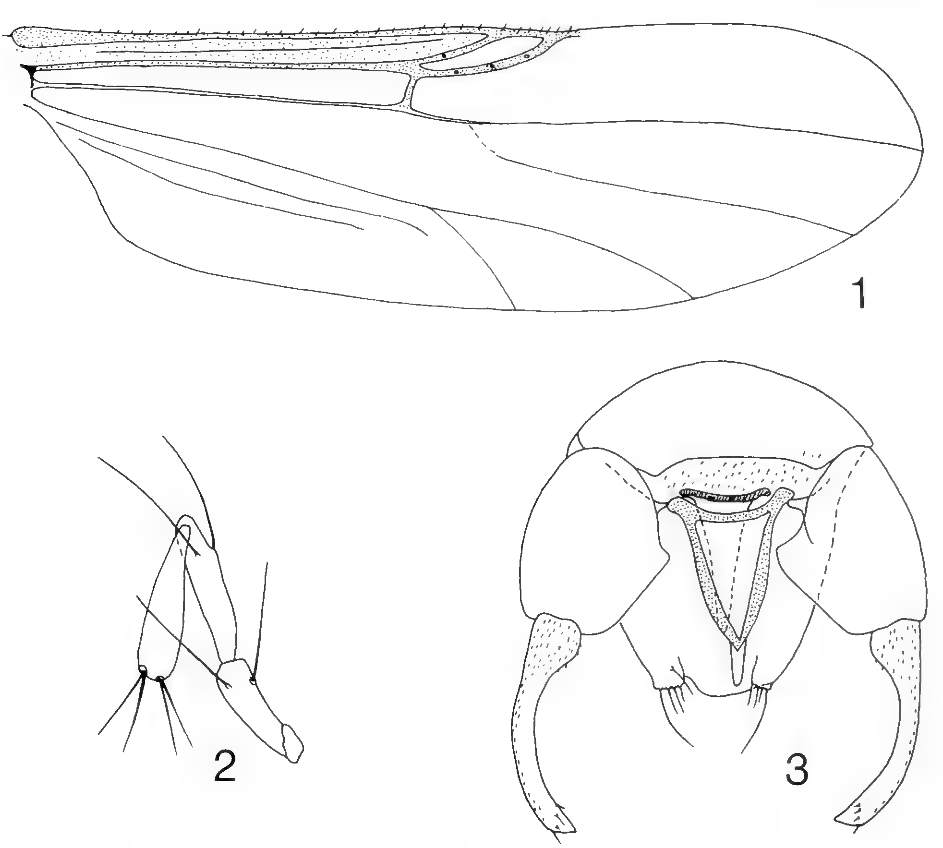
Diagnosis.—A dark brown species known from the male only, distinguished by having the wing with a low, dark, basal, costal swelling, the costal fringe long; palpus 4-segmented; male dististyle curved with tip bluntly pointed; and the aedeagus with main body triangular, lateral margins strongly sclerotized, and the distal process moderately long.

Male.—Wing length, 1.29–1.47 mm; breadth, 0.39–0.47 mm.

Head: Black; antennal pedicel black, flagellum dark brown. Eyes bare. Antenna with lengths of flagellar segments as follows (in μm): 84-44-44-44-44-44-48-48-56-80-128-104-112. Palpus (Fig. 2) brownish; lengths of segments (μm): I + II = 50, III = 62, IV = 68; sensory pit absent.

Thorax: Black, halter knob pale. Legs dark brown; fore- and midcoxae with long spinelike setae; 3 or 4 proximal tarsomeres pale; claws simple and equal, bifurcate on distal end; empodium absent. Lengths of leg segments as follows (μm):

	fe	ti	ta_1	ta_2	ta_3	ta_4	ta_5
foreleg	503	428	173	98	53	30	45
midleg	675	548	300	143	68	45	75
hindleg	668	578	263	143	83	45	90



Figs. 1–3. *Parabezzia grogani,* male. 1, Wing. 2, Palpus. 3, Genitalia.

Wing (Fig. 1) hyaline, anterior veins dark; a single radial cell (184–212 × 24 μm), surface with small microtrichia, macrotrichia absent; costa with long basal swelling, costal fringe with setae sparse and short; costa prolonged somewhat beyond radial cell.

Abdomen: Uniformly dark brown. Genitalia (Fig. 3): Ninth sternum with shallow excavation, membrane covered with small setae. . Basistyle short and simple; dististyle long, with broad, pointed tip, basal portion swollen and covered with small setae, several longer setae present near tip, 1 or 2 rows of small setae along outer margin. Aedeagus triangular, basal arms rather well developed, hyaline distal process about ¼ of total length, distal portions of main body of aedeagus forming a triangle. Parameres fused, reduced to a slender rodlike structure reaching almost to base of distal process of aedeagus.

Female.—Unknown.

Material Examined.—Holotype ♂, Tichi near Benjaia, northern Algeria, sweeping at stream, 8 May 1981, R. Szadziewski leg.; paratype ♂, same data as holotype. Holotype deposited in the Institute of Zoology, Polish Academy of Science, Warsaw; paratype deposited in the National Museum of Natural History, Smithsonian Institution, Washington, D.C.

Discussion.—The species is named for William L. Grogan, Jr., of Salisbury State College, Salisbury, Maryland, in recognition of his contributions to the study of the genus *Parabezzia.*

Parabezzia grogani belongs to the *alexanderi* Group of *Parabezzia* as defined by Grogan and Wirth (1977). The group is characterized by both sexes having wings with a basal swelling on the costa. In this group are known: *P. alexanderi* Wirth (1965) and *P. texensis* Grogan and Wirth (1977) from North America, *P. blantoni* Wirth (1965) and *P. costalis* Wirth (1965) from Panama, *P. spangleri* Wirth (1965) from Puerto Rico, and *P. falcipennis* Clastrier (1960) from Central Africa.

The male of *Parabezzia falcipennis* differs from the male of the new species by having the wing with a much larger costal swelling, covered as in *P. alexanderi* with short, strong spines; the costal fringe is short with only a few setae over the radial cell; the flagellum is yellowish with the last three segments darkened; the male dististyle has a narrow pointed tip, and the distal portion of the aedeagus is longer.

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THREE MORE EXAMPLES OF ABNORMAL SEGMENTATION OF THE ABDOMEN IN *NEOBISIUM CARPATICUM* BEIER, 1934 (ARACHNIDA: PSEUDOSCORPIONES: NEOBISIIDAE)

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Abstract.—Teratological variation in the structure of the abdominal sclerites is reported in three examples of the pseudoscorpion *Neobisium carpaticum* Beier, 1934. The following aberrations of the tergites and sternites are established: hemimery, hemiatrophy, symphysomery, and enlargement of the sclerites, as well as various combinations of these. The pathomorphology and possible origin of the anomalies studied are briefly discussed.

According to Ćurčić et al. (1981), examples of abnormal abdominal segmentation in the Neobisiidae are very sparse in the literature; one of these, a specimen of *Neobisium erythrodactylum* (L. Koch) was mentioned by Kästner (1927). A number of anomalous adult *N. maritimum* (Leach) and *N. muscorum* (Leach) were recorded by Pedder (1965). Only recently, surveys of such abnormalities established to date in different species of pseudoscorpions and descriptions of further anomalies in *N. carpaticum* Beier, *N. fuscimanum* C. L. Koch, and *Roncus lubricus* L. Koch were given by Ćurčić (1980), Ćurčić and Dimitrijević (*in press*), and Ćurčić et al. (*in press*).

Materials and Methods

In a collection of 247 adult *N. carpaticum* made at Čarapićev Brest, Mt. Avala, near Belgrade, Yugoslavia, during October 1981, on an area of about five square meters, three specimens with abnormally segmented abdomens were found; these were obtained by sieving leaf litter in a mixed beech and oak forest. In a subsequent collection of 100 adult specimens from the same area made in November 1981, no specimens showing segmental anomalies were found. In two out of the three abnormal specimens collected in October 1981, both the abdominal tergites and sternites were affected, while in the third pseudoscorpion only the tergites were anomalous, the sternites being normal.

Results

Details of the three abnormal specimens of *N. carpaticum* are as follows:

1. Female (Fig. 1). All tergites, except for the first, are anomalous. Thus, tergite II lacks the mid-region and also lacks pigmentation and setae; tergite III has only the right half, while the left half is missing. The following tergite (IV) is represented by two small sections, one on each side; tergite V is enlarged and fills the place

of the missing parts of tergite IV. Tergites VI and VII are fused on the right, while on the left a small section of tergite VII is unattached. Tergite VIII is damaged on the left, while tergites IX and X are fused from the right to the mid-region.

The chaetotaxy (number and arrangement of setae) of the tergites, except for that of tergite I, is drastically disturbed. In this specimen, the abdominal sternites are normal.

2. Male (Fig. 2). The posterior tergites (Fig. 2A) and sternites (Fig. 2B) are affected by different abnormalities. Thus, tergites VI and VII are fused on the right; the case is similar with tergites VIII–X, which, in addition, are partially reduced on the right. The setal formula of the tergites mentioned is significantly disturbed.

In the same specimen (Fig. 2B), sternite VIII is partially fused on the right with sternite IX; the mid-region of sternite VIII is clearly missing. Sternites IX and X are partially atrophied on the right. Sternites X and XI and tergite XI are fused on the left.

The setal formula of all the anomalous sternites is altered as a result of the abnormalities identified.

3. Female (Fig. 3). In this specimen, the posterior sclerites are also affected by anomalies. Tergite IX is fused with tergites X and XI and with sternite XI, and so their setal formula is disturbed (Fig. 3A). Apart from this, tergite X is reduced and represented by one tergal section on the right.

Sternites VII–IX of the same specimen are fused on the left (Fig. 3B). The arrangement and number of setae on these sternites are altered particularly on the left.

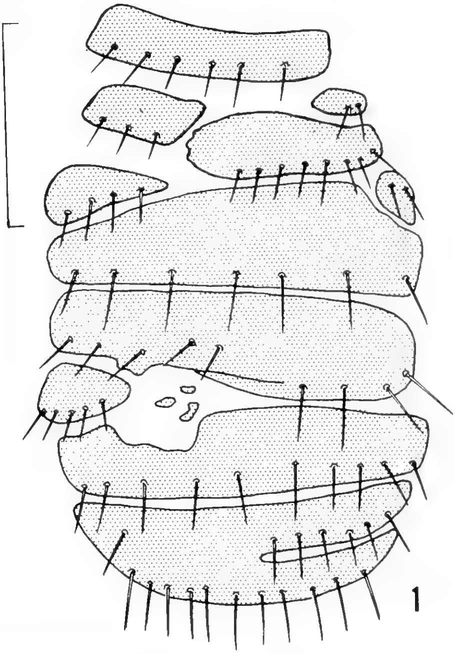
DISCUSSION

Pseudoscorpions with anomalies of the abdominal sclerites constitute 1.16% of the sample of adults collected on Mt. Avala. This is in accordance with the proportion of aberrant specimens in population samples of *N. carpaticum* in other localities (Ćurčić et al., *in press*).

Of the three aberrant specimens of this species of pseudoscorpion, two are females and one a male. Ćurčić and Dimitrijević (*in press*) have found, however, that these anomalies mainly occur in the males of *N. carpaticum.* It thus remains to be investigated, in a greater number of population samples of this species from various localities, the assumed sex-linked nature of the origin of the abdominal abnormalities.

In *N. carpaticum* (Fig. 1), complex deformities affecting all the abdominal tergites, except for tergite I, have been noted. These anomalies are manifested by hemiatrophy, hemimery, enlargement of the tergite, and symphysomery (fusion of sclerites). Thus tergites II–IV and VII are characterized by hemimery and hemiatrophy, tergite V by enlargement, and tergites VI and VII by a combination of atrophy and symphysomery. Symphysomery is also manifested in tergites IX and X. As a result of the anomalies cited, the setal formulae are altered.

In the second specimen (Fig. 2), both the tergites and sternites of the posterior section of the abdomen are aberrant. Thus, two tergites (VI and VII) and three tergites (VIII–X) are fused together. The following anomalies have been found on the sternites of this specimen: hemiatrophy (sternites VIII and IX) and symphysomery combined with atrophy (sternites VIII–XI). The chaetotaxy of the



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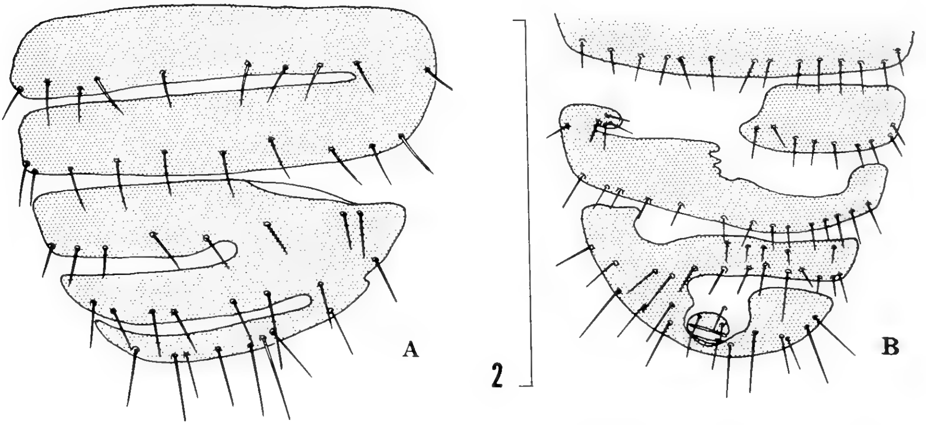

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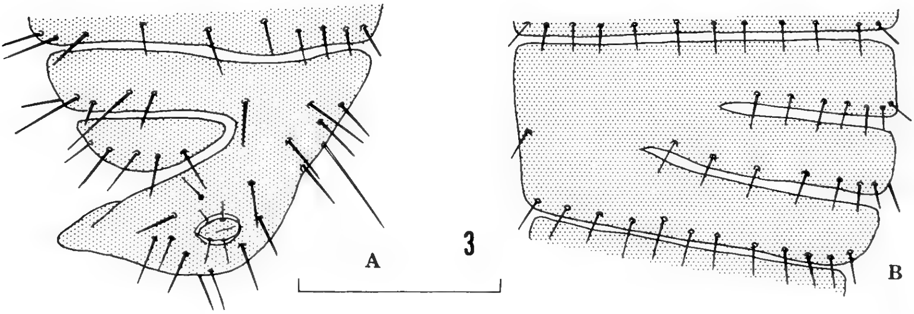

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Figs. 1–3. *Neobisium carpaticum.* 1, Female, Mt. Avala, tergites I–X; scale bar = 0.5 mm. 2A, Male, Mt. Avala, tergites VI–X; scale bar = 1.0 mm. 2B, Same, sternites VII–XI. 3A, Female, Mt. Avala, tergites VIII–XI; scale bar = 0.5mm. 3B, Same, sternites VII–IX.

posterior abdominal segments is considerably disturbed because of these deformities; that is, the number and arrangement of setae differ considerably from those on the normal *N. carpaticum* (Ćurčić, 1977).

In the third specimen (Fig. 3), the posterior part of the abdomen is also affected by anomalies, but here the changes are less pronounced than in the other two specimens. Tergites IX–XI are fused together, while tergite X is reduced (Fig. 3A). In direct correlation with this phenomenon is the symphysomery which occurs on sternites VII–IX; these sternites are fused on the left (Fig. 3B).

The abdominal tergites of the pseudoscorpions analyzed are most frequently affected by hemimery and symphysomery (three cases each); while hemiatrophy and enlargement of the tergite is found in only one case each. Apart from this, combinations of hemimery and symphysomery (two cases), hemiatrophy and symphosomery (two cases), hemiatrophy and symphysomery (one case), and hemimery and enlargement of tergite (one case) have also been observed.

On the sternites of these anomalous pseudoscorpions, symphysomery alone was identified in one case, and combinations of hemimery, hemiatrophy, and symphysomery (one case), as well as of hemiatrophy and symphysomery (one case) were also noted.

Symphysomery was established mainly on the tergites of the posterior part of the abdomen. It is of interest, however, to point out that symphysomery of the ventral side of the abdomen also affects the posterior sclerites. The tergites toward the extremities of the abdomen are more susceptible to hemimery, hemiatrophy, and enlargement of the sclerites than the tergites of the mid-region. Hemimery, symphysomery, and hemiatrophy affecting the sternites were confined to the posterior abdominal segments.

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THE ROHWER SAWFLY TYPES (HYMENOPTERA: SYMPHYTA) IN THE UNIVERSITY OF NEBRASKA STATE MUSEUM

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Abstract.—Twenty-nine species of Symphyta were described by Rohwer in 1908 and 1909 from the University of Nebraska insect collection. Primary types of most of these species are now in the University of Nebraska State Museum, Lincoln, with a few at the National Museum of Natural History, Smithsonian Institution, Washington, D.C. Lectotypes are designated for five species. Data from the type-specimens, location of types, and current taxonomic placement of the species are presented.

Some of the first sawfly species described by S. A. Rohwer (1908, 1909a, b) were from the collection of the University of Nebraska, Lincoln. Rohwer stated that the types were at the University of Nebraska, or in the case of multiple specimens, that cotypes were at the University of Nebraska and in the author's collection. Types of the twenty-nine species involved were essentially unavailable for study for 30–40 years. They were on loan for most of this time, and their location was not known until they were returned to the Nebraska State Museum in the early 1970's. The Rohwer types were not listed in the "Insect types in the collections of the University of Nebraska State Museum" by Muma (1952).

In 1981, I visited the University of Nebraska State Museum and was able to examine the Rohwer type material. Here I document the types, choose lectotyptes for five species, and give notes on their placement.

All specimens regarded as types or cotypes are in the University of Nebraska State Museum (NSM) or in the National Museum of Natural History, Smithsonian Institution, Washington, D.C. (USNM). Specimens from the "author's collection" are now in the USNM. I express appreciation to Brett C. Ratcliffe, Curator of Insects, Systematics Research Collections, University of Nebraska State Museum, Lincoln, for allowing study of the specimens under his care. All types are segregated in separate unit trays in their type collection. I also thank H. R. Wong, Canadian Forestry Service, Northern Forest Research Centre, Edmonton, Alberta, for his opinion on the *Pristiphora,* and D. W. Webb, Illinois Natural History Survey, Champaign, for searching for "missing" specimens.

The following account gives the names as Rohwer proposed them and information from Rohwer's original description; data on the holotype or lectotype; and pertinent comments. Placement of each species as given in the discussions is substantiated by my study of the types. Species are arranged by family and subfamily.

PAMPHILIIDAE

Bactroceros pugnax Rohwer, 1908: 103–104. ♀. "Russell, Costilla Co., Colo., June 25, 1907 (L. Bruner). Type in the entomological collection of the University of Nebraska."

Type.—Holotype ♀, at NSM, labeled "Russell, Colo., June 25," "L. Bruner, Collector," "Bactroceros pugnax Roh., type."

Discussion.—Middlekauff (1964) did not find the type of *pugnax*, but he correctly placed it as a synonym of *Onycholyda multisignata* (Norton). Rohwer (1910) discovered that *B. pugnax* was preoccupied in *Pamphillius* by *P. pugnax* Konow, 1897, and therefore proposed the new name, *Anoplolyda saeva*.

ARGIDAE

Hylotoma grandis Rohwer, 1909a: 14–15. ♀, ♂. "Halsey, Nebr., June, 2 ♂'s, 2 ♀'s. Cotypes in the collection of the University of Nebraska and in the author's collection."

Type.—**Lectotype** ♀ at NSM, labeled "Halsey, Neb.," "June 'O," "Hylotoma grandis Roh., cotype ♀"; present designation.

Discussion.—A paralectotype male is also at NSM, and female and male paralectotypes are in the USNM. This species was correctly placed as a synonym of *Arge humeralis* (Beauvois) by Smith (1979a).

Hylotoma nigrescens Rohwer, 1909a: 13–14. ♂. "West Point, Nebraska, July 1, 1887, "on plum." Type in collection of the University of Nebraska."

Type.—Holotype ♂, at NSM, labeled "West Pt., Neb., 7-87," "on plum, July 1st."

Discussion.—The head is missing. It was placed as a synonym of *Arge clavicornis* (Fabricius) by Smith (1979a).

Schizocerus collaris Rohwer, 1909a: 13. ♀. "Antonito, Conejos Co., alt. 7888 ft., Colorado; also Nebraska, "office window," March 24, 1899, and Harlan, Nebr."

Type.—Lectotype ♀ designated by Smith (1971), labeled "Antonito, Col., 8-5-99," "type No. 13236 U.S.N.M.," "Schizocerus collaris Roh., type," in the USNM.

Discussion.—The specimen from Antonito is labeled "type," but Rohwer did not designate a type in his description. The specimen from "office window" is labeled "paratype" and is in the USNM. I did not find the specimen(s) from Harlan, Nebraska. This is synonym of *Schizocerella pilicornis* (Holmgren) (Smith, 1971).

Schizocerus lineatus Rohwer, 1909a: 12. ♀. "Geneva, Nebraska. Co-types in the collection of University of Nebraska and in the author's collection."

Type.—Lectotypte ♀ designated by Smith (1971), labeled "Geneva, Nebr.," "Schizocerus lineatus Roh. (cotype)," in USNM.

Discussion.—Two other females, labeled cotypes, are in the NSM. This is a synonym of *Schizocerella pilicornis* (Holmgren) (Smith, 1971).

Schizocerus nortoni Rohwer, 1909a: 11–12. ♂. "Brady Island, on Platte River, Nebraska. Type in the collection of the University of Nebraska."

Type.—Holotype ♂ in NSM, labeled "Brady Is., Neb.," "Schizocerus nortoni Roh., type."

Discussion.—This is a synonym of *Sphacophilus nigriceps* (Konow) (Smith, 1971).

TENTHREDINIDAE

Dolerinae

Dolerus femur-rubrum Rohwer, 1909a: 9–10. ♀. "West Point, Nebr., June, 1888. Type in Nebraska University."

Type.—Holotype ♀, in NSM, labeled "West Pt., Neb. 6–88," "Dolerus femur-rubrum Roh., type," "Dolerus apricus (Norton) det Ross."

Discussion.—This is a synonym of *Loderus vestigialis apricus* (Norton) (Ross, 1931; Smith, 1979a).

Dolerus piercei Rohwer, 1909a: 10. ♀. "Lincoln, Nebr., April 19–02, "Immodelle" (W. D. Pierce). Type in the University of Nebraska."

Type.—Holotype ♀, in NSM, labeled "Lincoln, Nebr.," "April 19.02," "Immodelle," "W. D. Pierce Coll.," "Dolerus piercei Roh., type."

Discussion.—This is currently a valid species, (Ross, 1931; Smith, 1979a).

Blenncampinae

Lycaota bruneri Rohwer, 1908: 104–105. ♀. "Ute Creek, Costilla Co., Colo., 9000 ft., June 27, 1907 (L. Bruner)."

Type.—Holotype ♀ in NSM, labeled "Ute Creek, Colo., 9000 ft., June 27," "L. Bruner, Collector," "Lycaota bruneri Roh., type."

Discussion.—This was correctly placed as a synonym of *Blennogeneris spissipes* (Cresson) (Smith, 1979a).

Nematinae

Amauronematus lincolnensis Rohwer, 1909a: 19–20. ♀. "Lincoln, Nebr., May. Type in the Univ. of Nebraska."

Type.—Holotype ♀ in NSM, labeled "Lincoln, Neb., May," "Amauronematus lincolnensis Roh., type."

Discussion.—This is a synonym of *Amauronematus lineatus* (Harrington) (Smith, 1979a).

Amauronematus xanthus Rohwer, 1909a: 18–19. ♀. "Lincoln, Nebr., two ♀'s, one in April. Cotypes in University of Nebraska and in author's collection."

Type.—**Lectotype** ♀ in USNM, labeled "Lincoln Neb., April," "cotype, U.S.N.M. No. 21043," "Amauronematus xanthus Rohwer, cotype"; present designation.

Discussion.—The specimen in the USNM is the only one found that is labeled *xanthus.* In the NSM there is a specimen labeled "Lincoln, Nebr.," "Amauronematus albostomus Roh., cotype" which is probably the other specimen; this is a manuscript name and may be mislabeled, or Rohwer may have intended to describe it as a separate species. The two specimens differ slightly in color, and in the description of *xanthus* Rohwer stated "(in one specimen the basal plates and part of metanotum are black)." This is the color of the "albostomus" specimen. *Amauronematus xanthus* currently stands as a valid species (Smith, 1979a).

Camponiscus albostigmus Rohwer, 1908: 105–106. ♀. "Ute Creek, Costilla Co., Colo., 9000 ft., July 2, 1907 (L. Bruner). Type in the Entomological Department of the Univ. of Nebraska."

Type.—Not located.

Discussion.—I could not find the specimen but did locate a slide of the female ovipositor labeled "Camponiscus albostigmus Roh., Type, Acc. No. 47224, Ute Creek Colo., det. Ross, Ill. Nat. Hist. Sur." This slide, prepared by Ross, is no doubt part of the type-specimen and is in the NSM. This is a valid species, *Fallocampus albostigmus* (Rohwer) (Wong, 1977). It was treated by Smith (1976) in a revision of the genus *Platycampus* where it was previously placed.

Camponiscus smithi Rohwer, 1908: 105. ♀. "Ute Creek, Costilla Co., Colo., 9000 ft., July 1, 1907 (H. S. Smith) . . . . Type in the Univ. of Nebraska."

Type.—Not labeled.

Discussion.—I could not find the specimen but did locate a slide of the female ovipositor labeled "Camponiscus smithii Rohwer, type, lancet, Ute Creek, Colo., Acc. No. 47226, det. Ross, Ill. Nat. Hist. Sur." This slide, prepared by Ross, is probably part of the type-specimen, and is in the NSM. This is a synonym of *Fallocampus americanus* (Marlatt) (Smith, 1976).

Pachynematus nigritibialis Rohwer, 1909a: 17. ♀. "Two ♀'s, West Point, Nebr., June; 1 ♀, Brownville, Nebr., June 5. Cotypes in University of Nebraska and in author's collection."

Type.—**Lectotype** ♀ in NSM, labeled "West Pt., Neb.," "June '0," "Pachynematus nigritibialis Roh., cotype"; present designation.

Discussion.—The female from Brownville is in the NSM and the other female from West Point is in the USNM; both are paralectotypes. This is a valid species of *Pachynematus* (Smith, 1979a).

Pachynematus robustiformis Rohwer, 1908: 108–109. ♀. "Sierra Blanca, Costilla Co., Colo., 10,000–11,500 ft., June 22, 1907 (L. Bruner); also Ute Creek, Costilla Co., Colo., 9000 ft., July 24, 1907 (H. S. Smith)."

Type.—**Lectotype** ♀ in NSM, labeled "Ute Creek, Colo., 9000 ft., July 24," "H. S. Smith, Collector," "*Pachynematus robustiformis* Roh. (paratype)"; present designation.

Discussion.—The female from Sierra Blanca is in the USNM and is a paralectotype; it is labeled "type" on the determination label. Although Rohwer labeled the specimens "type" and "paratype," he did not designate a type in the description. This species was correctly placed in *Pachynematus* (Smith, 1979a). It is in the *vagus* group and is close to *P. corniger* (Norton), but the status of *robustiformis* will have to await a revision of the group.

Pachynematus vernalis Rohwer, 1909a: 18. ♀. "One ♀ labelled as follows: "Sawfly on Willow, Oct. 5, '89./ Feb. 19, '90." Probably from Lincoln, Nebr., and raised from a larva on the Willow. Type in the University of Nebraska."

Type.—Holotype ♀ in NSM, labeled "Sawfly on willow, Oct. 5, '89/Feb. 19, '90," "Sl. No. 46908, saw," "Pachynematus vernalis Rohwer, type."

Discussion.—The ovipositor has been mounted on a slide with the same accession number as on the specimen label. It is a synonym of *Nematus vancouverensis* (Marlatt) (Smith, 1979a).

Pontania utensis Rohwer, 1908: 107. ♀. "Ute Creek, Costilla Co., Colo., 9000 ft. Two ♀♀ June 22, 1907 (R. W. Dawson), one ♀ July 1, 1907 (R. W. Dawson), one ♀ June 22, 1907 (L. Bruner). Cotypes in collection of Univ. of Nebraska and in the author's own collection."

Type.—**Lectotype** ♀ in NSM labeled "Ute Creek, Colo., 9000 ft., June 22," "R. W. Dawson, collector," "Pontania utensis Roh. (cotype)"; present designation.

Discussion.—The remaining three specimens are paralectotyptes. The specimen collected June 22 by Dawson is in the NSM, the ones collected July 1 and "June 22" by Bruner are in the USNM. The specimen collected by Bruner is labeled "June 27"; June 22 may be a misprint. This species is currently *Phyllocolpa utensis* (Rohwer) (Smith, 1979a).

Pristiphora dawsoni Rohwer, 1908: 109. ♀. "Ute Creek, Costilla Co., Colo., 9000 ft., July 4, 1907 (R. W. Dawson) . . . . Type in the collection of University of Nebraska."

Type.—Holotype ♀ in NSM, labeled "Ute Creek, Colo., 9000 ft., July 4," "R. W. Dawson, collector," "Pristiphora dawsoni Roh., type."

Discussion.—This is a synonym of *Pristiphora coactula* (Ruthe) (H. R. Wong, personal communication; Smith, 1979a).

Pristiphora maura Rohwer, 1908: 109–110. ♂. "Ute Creek, Costilla Co., Colo., 9000 ft., July 4, 1907 (R. W. Dawson). Type in collection of the University of Nebraska."

Type.—Holotype ♂ in NSM, labeled "Ute Creek, Colo., 9000 ft., July 4," "R. W. Dawson, collector."

Discussion.—This is a valid species in *Pristiphora* (H. R. Wong, personal communication; Smith, 1979a). The genitalia have been extracted and are in a glycerin vial on the pin below the specimen; the valves are missing and may have been mounted, but I did not locate a slide.

Pristiphore zella Rohwer, 1909a: 20. ♀. "One ♀ from Nebraska, probably from Lincoln, May 5, '03. Type in collection of Univ. of Nebraska."

Type.—Holotype ♀ in NSM, labeled "May 5 '03," "Pristiphora zella Roh., type."

Discussion.—This is probably a valid species of *Pristiphora* (H. R. Wong, personal communication), although listed as a synonym of *P. pallidiventris* (Fallén) by Smith (1979a). The ovipositor has been dissected from the type, but I did not locate a slide.

Pteronus costillensis Rohwer, 1908: 106–107. ♀. "Sierra Blanca, Costilla Co., Colo., 10,000–11,500 ft., June 22, 1907 (L. Bruner). Type in collection of Nebraska University."

Type.—Holotype ♀ in NSM, labeled "Sierra Blanca, Colo., June 22, 10–11,500 ft.," "L. Bruner, collector," "Sl. No. 46907 saw," "Pteronus costillensis Roh., type."

Discussion.—The ovipositor is on a slide labeled with the same accession number as on the specimen label. It is currently *Nematus costillensis* (Rohwer) in the *obligospilus* group (Smith, 1979a).

Allantinae

Emphytus leucostoma Rohwer, 1908: 110. ♂. "Ute Creek, Costilla Co., Colo., 9000 ft., July 4, 1907 (R. W. Dawson). Type in the entomological collection of the University of Nebraska."

Type.—Holotype ♂ in NSM, labeled "Ute Creek, Colo., 9000 ft., July 4," "R. W. Dawson, collector."

Discussion.—This is a synonym of *Ametastegia aperta* (Norton) (Smith, 1979b). Rohwer (1911) discovered that the name was preoccupied by *Emphytus leucostomus* Costa, 1890, and proposed the new name *Emphytina plesia.*

Eriocampa rotundiformis Rohwer, 1909a: 16–17. ♂. "West Point, Nebr., June. Type in the collection of University of Nebraska."

Type.—Holotype ♂ at NSM, labeled "West Pt., Neb.," "June '0," "Eriocampa nigrisoma Roh., type."

Discussion.—"*Eriocampa nigrisoma*" is a manuscript name; the label data agree with the date in the description and the specimen agrees with the description of *rotundiformis.* I believe that this is the type and that Rohwer changed the name of the species in print but did not change the name on the label. It is a synonym of *Eriocampa juglandis* (Fitch) (Smith, 1979b).

Tenthredininae

Macrophya pulchelliformis Rohwer, 1909a: 15. ♂. "Lincoln, Nebr., May. Type in the collection of the University of Nebraska."

Type.—Holotype ♂ in NSM, labeled "Lincoln, Neb., May."

Discussion.—Gibson (1980) did not see the type, but I can confirm his recognition of it as a valid species in *Macrophya.*

Macrophya sambuci Rohwer, 1909a: 15–16. ♀. "Two ♀'s, Lincoln, Nebr., April 19, 1902, "on elder" (Sambucus), (W. D. Pierce); ♀, Nebraska (J. S. H.). Co-types in collection of Univ. of Nebr. and in author's collection."

Type.—Lectotype ♀ in USNM, designated by Gibson (1980), labeled "Lincoln, Nebr.," "April 19.02," "on elder," "W. D. Pierce, coll.," "cotype No. 14268 U.S.N.M.," "Macrophya sambuci Roh., cotype," "Macrophya nebraskensis (= sambuci) Roh., cotype."

Discussion.—The two female paralectotypes are at the NSM. Rohwer (1912) gave this species a new name, *Macrophya nebraskensis,* after discovering that the original name was preoccupied by *Macrophya sambuci* (Latreille), 1805. It is a synonym of *Macrophya pulchelliformis* Rohwer (Gibson, 1980).

Tenthredo ferrugineipes, var. *pikei* Rohwer. 1909b: 107–108. ♀. "Pike's Peak, Colorado, alt. 10,000 ft., July 20, 1906 (L. Bruner). Type in the University of Nebraska."

Type.—Holotype ♀ in NSM, labeled "Pike's Peak, Colo., 10,000 ft., July 20, 1906, L. Bruner, Col.," "Tenthredo ferrugineipes var. pikei Roh., type."

Discussion.—This is currently placed as a synonym of *Tenthredo occidentalis* (Cresson) (Smith, 1979a).

Tenthredo relativus Rohwer, 1909b: 108–109. ♀. "West Point, Nebraska, June 21, 1905 (H. S. Smith). Type in the University of Nebraska."

Type.—Holotype ♀ in NSM, labeled "West Pt. Neb.," "June 21, '05," "H. S. Smith, Collector," "Tenthredo relativus Roh., type."

Discussion.—This is currently considered a valid species in *Tenthredo* (Smith, 1979a).

Tenthredo utensis Rohwer, 1909b: 109–110. ♀. "Ute Creek, Costilla Co., Colorado, alt. 9000 ft., June 22, 1907 (R. W. Dawson). Type in the University of Nebraska."

Type.—Holotype ♀ at NSM, labeled "Ute Creek, Colo., 9000 ft., June 22," "R. W. Dawson, Collector," "Tenthredo utensis Roh., ♀ type."

Discussion.—This is placed as a synonym of *Tenthredo pleuralis* (Cresson) (Smith, 1979a).

Tenthredo zelmirus Rohwer, 1909b: 109. ♂. "Ute Creek, Costilla Co., Colo. alt. 9,000 ft., July 1907 (L. Bruner and R. W. Dawson); Russel, Colo., June 25, 1907 (L. Bruner); and Ft. Garland, Colo., July 12, 1907 (L. Bruner). Type and paratypes in the University of Nebraska, and paratypes in my collection."

Type.—Holotype ♂ in NSM, labeled "Ute Creek, Colo., 9000 ft., July 4," "R. W. Dawson, collector," "Tenthredo zelmirus Roh., type."

Discussion.—Rohwer did not say which specimen was the type, but the above is the only one found labeled "type." Specimens labeled paratypes are in the NSM (five from Ute Creek, one from Russel) and the USNM (two from Ute Creek). I did not find the specimen(s) from Ft. Garland. This is listed as an unassociated male of *Tenthredo* by Smith (1979a).

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USE OF TRAP-BOARDS FOR DETECTING ADULTS OF THE BLACK VINE WEEVIL, *OTIORHYNCHUS SULCATUS* (FABRICIUS) (COLEOPTERA: CURCULIONIDAE)

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Abstract.—Adults of the black vine weevil, *Otiorhynchus sulcatus* (Fabricius), used trap-boards under yews as daytime resting sites. In July monitoring trials, adults were found under trap-boards in all yew plots shown to be infested by visual examination of foliage and litter. Unlike pit-fall traps, trap-boards constructed of tempered hardboard were effective during rainy weather. Trap-boards are recommended for detecting weevils in valuable ornamental beds.

The black vine weevil, *Otiorhynchus sulcatus* (Fabricius), injures many valuable cultivated plants grown in greenhouses, nursery fields, and residential yards. Damage is caused by larvae feeding upon roots and by adults feeding upon foliage. Severe infestations can develop in one growing season because parthenogenetic adults have high fecundity on some plants (Maier, 1981; Nielsen and Dunlap, 1981). Commercial nurserymen usually make preventive insecticide applications to avoid costly problems that might arise from failure to detect weevil infestations (G. Schuessler, personal communication). Although this tactic is usually effective, it results in many unnecessary sprays.

An alternative method of controlling weevils is to monitor for the nocturnal adults and then, if they are detected, to apply an insecticide. Adults can be observed during the day although searches of soil, debris, and foliage are laborious. They can also be detected with funnel or pit-fall traps (Cone, 1963; Emenegger and Berry, 1978; Nielsen et al., 1978), but these devices have inherent problems which will be discussed.

In this paper, I discuss using trap-boards to detect live adult weevils in ornamental plantings. This type of sampling device capitalizes on the diurnal adult behavior of resting in shaded areas, especially under debris near the base of plants (e.g. Smith, 1932).

MATERIALS AND METHODS

From April to October 1981, *O. sulcatus* adults were detected by inspecting trap-boards located on the ground under *Taxus cuspidata* Sieb. and Zucc. in Connecticut. For monitoring trials during July, squares of tempered hardboard (25 × 25 × 0.3 cm thick) were placed on the ground under five yews, one per yew, in each of 33 plots in nurseries and four in residential yards. The canopy diameter of these yews ranged from 0.4–1.5 m. Trap-boards in nursery fields were separated by about 50 m, with two along the northern edge, two along the southern edge, and one equidistant from the other four. In residential yards, they were placed in a straight line, with each board separated by about 3 m. Squares were inspected five days later for adult weevils resting on or under them. The closest yew to each board and debris beneath it were also examined for 2 min for adult feeding notches and live adults, respectively.

To determine if introduced weevils (= immigrants) would rest under trap-boards, mark-release-recapture trials were conducted in two infested yew plots, one in a nursery field and one in a residential yard. On 24 July 1981, one hundred weevils marked on their elytra with paint were released in lots of 20 around each of the five trap-boards in each plot. Weevils were placed under the five yews (four per plant) nearest to the one with the trap-board. Trap-boards were inspected five days later for marked adults.

Twenty pit-fall traps placed in an unsprayed nursery plot were examined between 12 June and 3 July and between 10 and 31 August 1981 to determine what problems were associated with their use. Pit-falls were #10 tin cans that were punctured in the bottom for drainage. Plastic funnels fitted in the open top guided insects into a 250 ml beaker that contained 100 ml of 95% ethyl alcohol. Samples were collected twice weekly during the first sampling period and once weekly during second sampling period.

RESULTS AND DISCUSSION

Weevils rested under trap-boards in all five yew plots in which adults were detected by visual examination of foliage and litter. Fresh feeding scars and live adults were absent in the remaining 32 plots. In infested beds in nurseries (n = 3) and residential yards (n = 2), 20 (87%) of 23 trap-boards under infested plants (two yews were not infested) sheltered unmarked weevils. The number of unmarked adults under these 23 boards averaged 3.2 ± 4.49 (SD). In the two releases of 100 marked weevils, 7 (7%) and 9 (9%) adults rested under boards in the nursery and the residential plot, respectively, after five days.

Pit-fall traps, unlike trap-boards, were ineffective when they were used during rainy weather. Pit-falls placed near yews collected water during rainy periods even though the cans had drainage holes in the bottom. Traps flooded four times between 12 June and 3 July, and this flooding resulted in partial loss of the sample, dilution of the fluid preservative, and soil deposition in the collection container. To prevent trapped insects from decaying in diluted alcohol, the preservative had to be replaced after each rain. Another problem was that during each collection period debris had to be removed from 15–40% of the funnels in the pit-falls. Trap-boards had none of the aforementioned problems because they did not confine insects in containers below ground level. They did become wet during rains and did warp up to 1 cm during the growing season. Nonetheless, weevils still rested under them.

Success of inexpensive hardboard squares (cost in 1981: $0.14–0.17 per 25 × 25 cm square of tempered hardboard) in attracting resident and introduced, marked adults of *O. sulcatus* indicates that they are effective monitoring devices. Trap-boards appear to be superior to pit-fall traps because they are useful in all types of weather. Collectively, my results suggest that trap-boards can assist nurserymen and homeowners in detecting resident and immigrant adults in their valuable ornamental beds. Easy detection of adults should help to improve the timing of insecticide applications for adult control and to reduce the number of unwarranted sprays.

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David Wagner assisted in all phases of the monitoring exercise. Robert Moore, George Schuessler, and Peter Trenchard (Connecticut Agricultural Experiment Station, New Haven) directed me to Connecticut nurseries and participated in discussions about the usefulness of trap-boards.

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TWO NEW SPECIES OF *CULICOIDES* OF THE *PILIFERUS* GROUP (DIPTERA: CERATOPOGONIDAE) FROM THE EASTERN UNITED STATES[1]

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Abstract.—Two new species of *Culicoides* of the *piliferus* group are described and illustrated from specimens collected in Alabama and Maryland. *Culicoides* ***chewaclae*** is described from the female only, while *Culicoides* ***kirbyi*** is described from both sexes.

The *piliferus* group of the genus *Culicoides* Latreille is represented in North America by a complex of small to medium-sized biting midges. Wirth and Hubert (1962) reviewed the *piliferus* group species in eastern North America, describing eight new species, most from what had previously been known as *Culicoides piliferus* Root and Hoffman. Further additions by Jamnback (1965) and Wirth and Blanton (1971, 1974) brought the number of known species in eastern North America to 12. Five species of the *piliferus* group are known from the western United States (Atchley and Wirth, 1975).

The wing pattern of members of the *piliferus* group is variable, often with distinct pale spots straddling the midportion of veins M1 and M2, and along the wing margin at the apices of the cells; or the pattern may be reduced, with the pale spots entirely absent except for those over the r-m crossvein and just distad of the 2nd radial cell. The female antennal sensory pattern is also variable, usually with sensilla coeloconica on flagellar segments 3, 5, 7, 9, and 11–15; some of the sensilla coeloconica on the proximal segments, including segment 11, may be absent, or they may be present on segment 10. The spermathecae are ovoid, subequal to unequal, and usually without sclerotized necks. The male genitalia are remarkably similar and of little value in the separation of species; identification of males is best accomplished by rearings from which associated females can be accurately determined.

During a study of the Ceratopogonidae of Alabama, females of two previously

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[1] This research, supported by Alabama Hatch Project AL-431, is part of a dissertation by the senior author in partial fulfillment of the Ph.D. requirements of the Graduate School of Auburn University.

undescribed species of the *piliferus* group were taken in light traps in east-central Alabama. Both species have also been collected in Maryland.

The descriptions are based on specimens slide-mounted in balsam or Hoyer's medium; measurements were obtained with the aid of an ocular micrometer in the eyepiece of a Zeiss phase-contrast microscope. Wing length is measured from the basal arculus to the wing tip; the costal ratio is obtained by dividing the length of the costa by the wing length. Antennal ratio (A.R.) is determined by the combined lengths of the five distal flagellar segments divided by the combined lengths of the preceding eight. Proportions given for flagellar segments refer to relative lengths and are not absolute measurements. The proboscis to head ratio (P/H) is obtained by dividing the length from the tormae to the end of the labrum-epipharynx by the distance from the tormae to the interocular setal base. The palpal ratio (P.R.) is obtained by dividing the length of the third palpal segment by its greatest width. Variation is given by the mean, followed by the minimum-maximum values and sample size. Line drawings were made with the aid of a Leitz drawing tube attached to a Leitz Dialux 20 phase-contrast microscope. The wing photographs were taken with a Nikon M35S camera attached to a Zeiss phase-contrast microscope.

Types are deposited in the National Museum of Natural History, Smithsonian Institution, Washington, D.C. (USNM); paratypes will be deposited in the USNM and the Auburn University Entomological Museum (AUA).

Culicoides chewaclae **Glick and Mullen, New Species**

Figs. 1, 3a

Diagnosis.—A small, pale brownish species, most similar to *Culicoides alexanderi* Wirth and Hubert and *C. parapiliferus* Wirth and Blanton. Wing pale brownish, with well-defined pale spots over r-m crossvein and on anterior margin just distad of cell M4 and anal cell, other pale markings usually poorly defined. Female distal flagellar segments moderately elongated, proximal segments short; long sensilla chaetica (verticils) on segments 3–10 and 13–15; antennal sensory pattern 3, 5, 7, 9, 13–15; proboscis very short; 3rd palpal segment short and moderately swollen with a shallow sensory pit.

Female.—Wing length 0.95 (0.90–0.98) mm (*n* = 3).

Head: Brown. Eyes (Fig. 1c) narrowly separated by distance ca. ½ width of one ocular facet; bare. Antenna (Fig. 1a) with flagellar lengths in proportion of 16-9-10-10-11-11-11-11-19-19-24-27-34; A.R. 1.36 (1.31–1.44, *n* = 4); very long sensilla chaetica (verticils) on segments 3–10 and 13–15; sensilla coeloconica on segments 3, 5, 7, 9, 13–15, sometimes also on 11. Third palpal segment (Fig. 1b) short and moderately swollen with a moderately large, shallow, rounded, distal sensory pit; P.R. 2.12 (2.05–2.20, *n* = 4). Proboscis very short, P/H 0.58 (0.56–0.61, *n* = 4); mandible (Fig. 1d) with 14 teeth (13–15, *n* = 4).

Thorax: Brown. Legs (Fig. 1e) brown, knees dark brown; fore- and midfemora each with a very faint subapical pale band; tibiae each with a faint subbasal pale band; hindtibial comb (Fig. 1f) with 4 spines, the 2nd from the spur longest. Halter infuscated very pale brown.

Wing (Fig. 3a): Macrotrichia abundant over most of wing, sparse at base of cell M2 and base of anal cell. Wing infuscated pale brown, with a well-defined pale

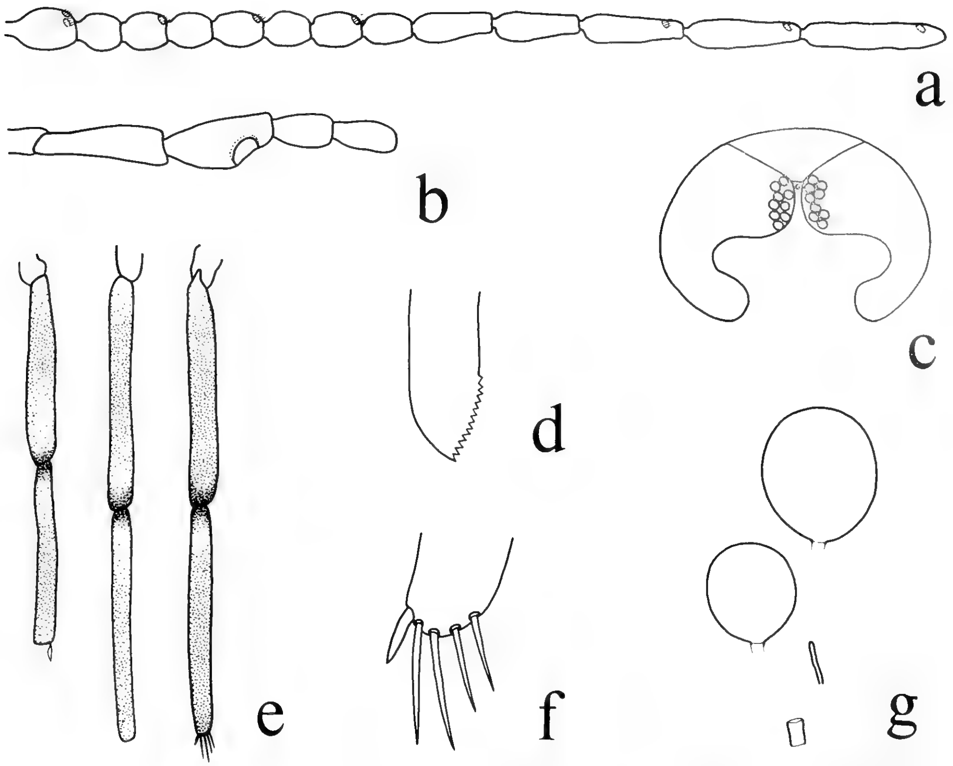

Fig. 1. *Culicoides chewaclae* female. a, Antenna, segments 3–15. b, Palpus. c, Eye separation. d, Mandible. e, Femora and tibiae of (left to right) fore-, mid-, and hindlegs. f, Hindtibial comb. g, Spermathecae.

spot over r-m crossvein and a pale spot on anterior margin just distad of 2nd radial cell; distal portion of cell M4 and anal cell each with a less prominent pale spot; a small pale spot just above cubital fork; apex of cells R5, M1, and M2 each with a faint pale spot; midportion of veins M1 and M2 each with an elongate pale spot; costal ratio 0.61 (0.60–0.61, $n = 3$).

Abdomen: Brown. Spermathecae (Fig. 1g) unequal, ovoid, without sclerotized necks; rudimentary 3rd spermatheca long and narrow; sclerotized ring moderately long; spermathecae measuring 0.053 × 0.045 and 0.040 × 0.034 mm.

Male.—Unknown.

Distribution.—Alabama, Maryland.

Types.—Holotype ♀, Alabama: Lee Co., Chewacla State Park, near Chewacla Pond, J. I. Glick, light trap, 28–30 April 1977 (USNM type no. 100683). Paratypes, 5 ♀, as follows: same data as holotype, 2 ♀; same data, 6 May 1978, 1 ♀. Maryland: Montgomery Co., Colesville, W. W. Wirth, light trap, 21 June 1975, 1 ♀; same data, 22 July 1975, 1 ♀, (Holotype and 2 paratypes in USNM; 3 paratypes in AUA.)

Bionomics.—The immature stages and larval habitat of *Culicoides chewaclae* are unknown.

Culicoides chewaclae appears to be an early spring species in Alabama, where adults were collected by light trap only during the last week of April and the first week of May. In Maryland, *C. chewaclae* was collected by light trap in June and July.

The feeding habits of *C. chewaclae* are unknown. Jamnback (1965) correlated the primary host preference of many species of *Culicoides* with the number of flagellar segments having sensilla coeloconica, with the primarily ornithophilic species having more olfactory pits than those that show a preference for large mammals. On this basis, *C. chewaclae,* having sensilla coeloconica on 7–8 flagellar segments, may be primarily an ornithophilic species.

Discussion.—*Culicoides chewaclae* is one of the smaller members of the *piliferus* group. The wing pattern is reduced and bears some resemblance to that of *C. parapiliferus,* however *C. chewaclae* is paler brown in body and leg coloration, with longer distal flagellar segments, sensilla coeloconica usually lacking on segment 11, narrower eye separation, shorter third palpal segment, and a very short proboscis. *Culicoides alexanderi* is the only other species of the *piliferus* group from Alabama and Maryland with a wing pattern in combination with an antennal sensory pattern of 3, 5, 7, 9, 13–15, but is a larger species with a more prominent wing pattern, shorter distal flagellar segments, longer third palpal segment, and a somewhat longer proboscis. *Culicoides chewaclae* and *C. jamnbacki* Wirth and Hubert are the only members of the *piliferus* group known to have long verticils on the flagellar segments, however, *C. jamnbacki* lacks the prominent wing pattern, with faint pale spots present only over the r-m crossvein and just distad of the second radial cell.

Culicoides chewaclae derives its name from Chewacla State Park, Lee Co., Alabama, which has been a major source of *Culicoides* material during the course of our survey of the Ceratopogonidae of Alabama.

Culicoides kirbyi **Glick and Mullen, New Species**

Figs. 2, 3b

Diagnosis.—A small, dark-brownish species of the *piliferus* group, most similar to *Culicoides testudinalis* Wirth and Hubert. Wing brownish with a small, faint pale spot over r-m crossvein, and a small pale spot on anterior margin just distad of 2nd radial cell. Female distal flagellar segments moderately elongated, proximal segments short; flagellar segments with short sensilla chaetica (verticils); antennal sensory pattern 3, 5, 7, 9, 11, 13–15; proboscis short; 3rd palpal segment short and greatly swollen, with a moderately shallow sensory pit. Male genitalia similar to other members of the *piliferus* group; ventral membrane of 9th sternum sparsely spiculate near lateral margins; median distal process of aedeagus moderately stout with truncate apex; apex of paramere with ca. 6 lateral fringing spines.

Female.—Wing length 0.90 (0.83–0.94) mm ($n = 8$).

Head: Brown. Eyes (Fig. 2d) moderately to broadly separated by a distance of slightly less than width of 1½ ocular facets; bare. Antenna (Fig. 2a) with flagellar lengths in proportion of 17-9-10-10-10-10-11-11-20-20-23-24-34; A.R. 1.31 (1.20–1.41, $n = 8$); segments with short sensilla chaetica (verticils); sensilla coeloconica on segments 3, 5, 7, 9, 11, 13–15, occasionally absent from 11. Third palpal segment (Fig. 2b) short and greatly swollen with a large, moderately shallow,

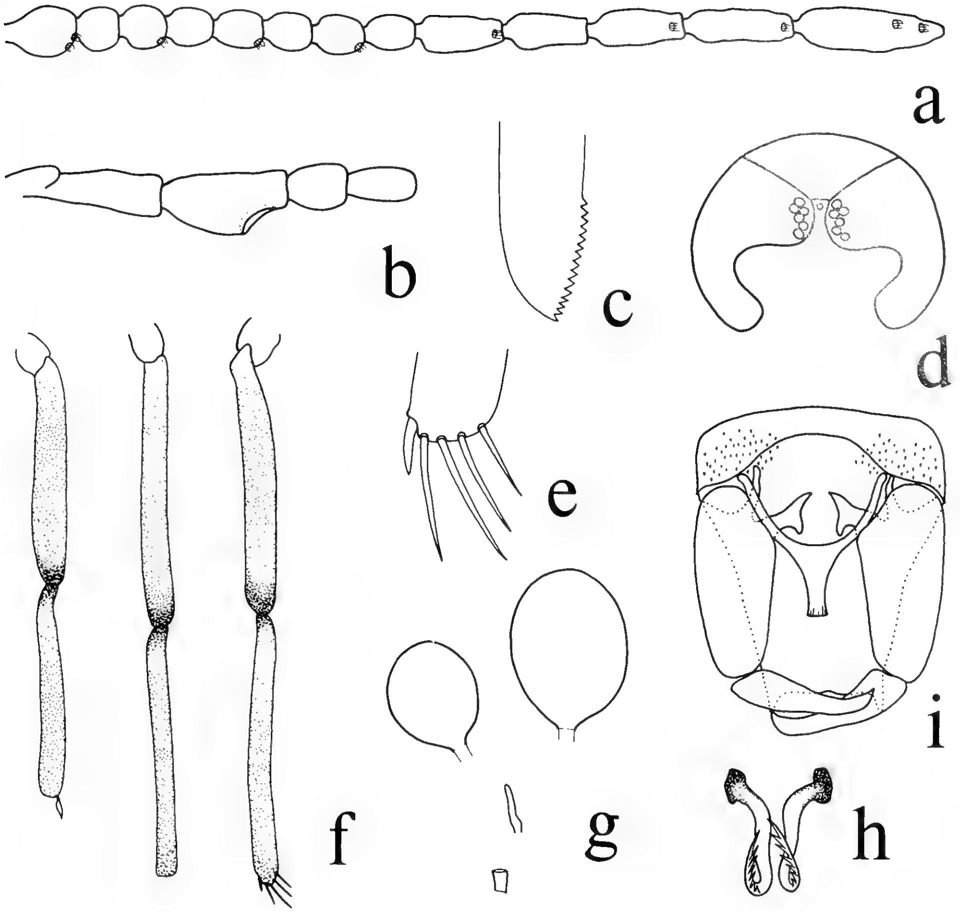

Fig. 2. *Culicoides kirbyi.* a–g, Female, h, i, Male. a, Antenna, segments 3–15. b, Palpus. c, Mandible. d, Eye separation. e, Hindtibial comb. f, Femora and tibiae of (left to right) fore-, mid-, and hindlegs. g, Spermathecae. h, Parameres. i, Genitalia, parameres removed.

rounded, distal sensory pit; P.R. 1.83 (1.72–1.95, $n = 8$). Proboscis short, P/H 0.65 (0.60–0.67, $n = 8$); mandible (Fig. 2c) with 14 teeth (13–15, $n = 8$).

Thorax: Dark brown. Legs (Fig. 2f) brown, knees dark brown; forefemur with a faint subapical pale band; tibiae each with a subbasal pale band; hindtibial comb (Fig. 2e) with 4 spines, the 2nd from the spur longest. Halter infuscated brownish.

Wing (Fig. 3b): Macrotrichia long and abundant over entire wing except at base of cell M2 and base of anal cell. Wing infuscated brownish, with a small, faint pale spot over r-m crossvein and a small pale spot on anterior margin just distad of 2nd radial cell; occasionally distal portion of cell M4 and anal cell each with a very faint pale spot; costal ratio 0.57 (0.55–0.58, $n = 8$).

Abdomen: Dark brown. Spermathecae (Fig. 2g) unequal, ovoid, without sclerotized necks; rudimentary 3rd spermatheca long and narrow; sclerotized ring moderately short; spermathecae measuring 0.056 × 0.040 and 0.038 × 0.032 mm.

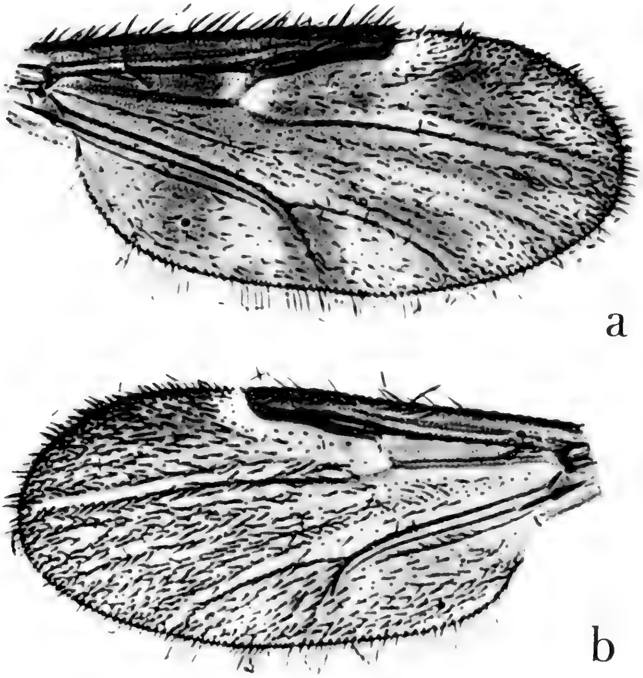

Fig. 3. a, *Culicoides chewaclae* female wing, b, *Culicoides kirbyi* female wing.

Male Genitalia (Fig. 2i). Ninth sternum with a broad, moderately deep caudomedian emargination; the ventral membrane sparsely spiculate near lateral margins. Ninth tergum with tapering sides and moderately long, slender apicolateral processes; caudal margin not cleft. Basistyle with ventral root foot-shaped, dorsal root long and moderately slender; dististyle curved, apex bluntly pointed. Aedeagus with a deep, rounded basal arch; arms slender; median distal process moderately stout with truncate apex. Paramere (Fig. 2h) with strong basal knob; stem moderately slender and sinuate, tapering distally, ventrally recurved to a slender, pointed apex with ca. 6 lateral fringing spines.

Distribution.—Alabama, Maryland.

Types.—Holotype ♀, allotype ♂, Maryland: Prince Georges Co., Patuxent Wildlife Refuge, swamp, W. W. Wirth, Malaise trap, 16 May 1979 (USNM type no. 100684). Paratypes, 47 ♀, 17 ♂, as follows: same data as holotype and allotype, 17 May 1978, 1 ♀; same data, 27 May 1978, 5 ♀; same data, 31 May 1978, 15 ♀; same data, 12 May 1979, 2 ♀, 2 ♂; same data, 16 May 1979, 7 ♀, 9 ♂; same data, 19 May 1979, 1 ♂; same data, 23 May 1979, 5 ♀, 5 ♂; same data, 30 May 1979, 4 ♀. Alabama: Lee Co., Chewacla State Park, near Chewacla Pond, J. I. Glick, light trap, 20–21 April 1977, 2 ♀; same data, 28–30 April 1977, 1 ♀; same data, 5 May 1977, 1 ♀; same data, 26–30 April 1978, 2 ♀; same data, 6 May 1978, 1 ♀; Loachapoka, Loachapoka Hunt Club, J. I. Glick and B. Buxton, light trap, 27 April 1977, 1 ♀. (Holotype, allotype, 39 ♀ and 13 ♂ paratypes in USNM; 8 ♀ and 4 ♂ paratypes in AUA).

Bionomics.—The immature stages and larval habitat of *Culicoides kirbyi* are unknown.

Culicoides kirbyi appears in the early spring along with *C. chewaclae.* Adults were collected by light trap in east-central Alabama during the last week of April and the first week of May. In Maryland, *C. kirbyi* was common in Malaise trap collections at Patuxent Wildlife Refuge during May.

The feeding habits of *C. kirbyi* are unknown, however the high number of flagellar segments with sensilla coeloconica (8) indicates it may be primarily an ornithophilic species, as are many other members of the *piliferus* group.

Discussion.—*Culicoides kirbyi* differs from *C. chewaclae* in the greater number of antennal sensilla coeloconica, more swollen third palpal segment, broader eye separation, and darker wing with usually only two pale spots present. *Culicoides kirbyi* is similar to *C. testudinalis,* but the latter species is larger and darker, with a longer proboscis and third palpal segment, greater number of mandibular teeth, and usually fewer antennal sensilla coeloconica.

We are pleased to name this species in honor of Dr. Kirby L. Hays, Head of the Department of Zoology-Entomology, Auburn University, for his numerous contributions to medical entomology in Alabama.

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HOST SPECIFICITY TESTS OF AN EGG PARASITE, *EDOVUM PUTTLERI* (HYMENOPTERA: EULOPHIDAE), OF THE COLORADO POTATO BEETLE, *LEPTINOTARSA DECEMLINEATA* (COLEOPTERA: CHRYSOMELIDAE)

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Abstract.—In host-specificity tests conducted in our laboratory with a eulophid egg parasite, *Edovum puttleri* Grissell reared from *Leptinotarsa undecimlineata* (Stål) collected in Columbia, South America, the parasite successfully parasitized eggs of the Colorado potato beetle, *L. decemlineata* (Say), a previously unrecorded host. Eggs of ten species of coccinellids and eight species of chrysomelids were exposed to the parasite; however, none was found acceptable except for an occasional egg of *Labidomera clivicollis* (Kirby).

In February and March 1980, Ben Puttler surveyed for and collected a species of eulophid (Eulophidae: Entedontinae: Entedontini) from Colombia, South America. This species was reared from eggs of *Leptinotarsa undecimlineata* (Stål), a beetle that does not occur in the Nearctic but is widely distributed in the Neotropical Region. Specimens of the parasite submitted for identification were examined by E. E. Grissell, who concluded after a further study and in consultation with Z. Bouček that the parasite represented a new genus and species which he described as *Edovum puttleri* Grissell (Grissell, 1981). Initially, *E. puttleri* had been misplaced in the genus *Emersonopsis* and was referred to by Sánchez (1973) and Pasada and Garcia (1976).

The primary purpose of our collecting *Edovum puttleri* was to determine whether the parasite might accept eggs of the Colorado potato beetle, *Leptinotarsa decemlineata* (Say), which does not occur in Colombia, as a host for oviposition and development. If *L. decemlineata* proved acceptable, it would also be necessary to establish the parasite's relationship to other species of Nearctic Chrysomelinae (Chrysomelidae), the subfamily in which *Leptinotarsa* spp. are placed (Wilcox, 1972; Riley and Enns, 1979). We also wanted to know the parasite's reaction to our native species of Coccinellidae. Eggs of these beetles are similar in color, relative size, and shape and are usually laid in clusters (masses) on exposed leaf surfaces of their respective host plants, as are eggs of a number of subfamilies of Chrysomelidae.

Because of the paucity of information on this parasite, we conducted host-specificity tests in an attempt to examine its host range and to determine whether it would parasitize eggs of other spp. of Coccinellidae, including predaceous species. Analogous studies were conducted by Angalet et al. (1968) and Schroder (1979) before the release of exotic natural enemies against the Mexican bean beetle, *Epilachna varivestis* Mulsant.

METHODS AND MATERIALS

Before specificity tests could be conducted, a laboratory colony of the imported parasite had to be established, if possible, on *L. decemlineata* because its original host, *L. undecimlineata,* does not occur in the United States. In our quarantine facility, eggs of *L. decemlineata* were exposed to adult parasites that emerged from imported eggs. Female parasites were readily attracted to the eggs of *L. decemlineata,* oviposited, and the progeny successfully completed development on the new host. Reproduction was adequate and a parasite colony was established on our laboratory culture of *L. decemlineata.*

The potential hosts tested (and the host plants on which they occurred as adults) were all collected in the spring and early summer of 1980 in the vicinity of Columbia (Boone County) Missouri (Table 1). Phytophagous species were placed in either 0.275- or 0.55-liter ice cream cartons containing bouquets of their respective host plant and subsequently covered with a petri dish lid. Predaceous species were treated similarly, except that they were supplied with either green peach aphids, *Myzus persicae* (Sulzer), or pine needle scale, *Chionaspis pinifoliae* (Fitch), to correspond with their preferred food source. The former was available from infestations on potatoes in the laboratory greenhouse and the latter from local infestations on pine. The ice cream cartons were checked daily for eggs of these coleopterans for use in subsequent testing.

Twenty-four- to 48-h-old egg masses were used in the specificity tests. This time element corresponded with the age of the *L. decemlineata* eggs used to maintain the parasite colony. Each test on a particular species was repeated 3–5 times with 1–10 egg masses (range 10–30 eggs/mass) in either a 3-dram shell vial or 10-cm petri dish. Ten to 15 female parasites were placed in the units with the eggs and observed for ½ to 1 h; then an egg mass of *L. decemlineata* was inserted and the unit observed for an additional 15 min. The *L. decemlineata* eggs were then removed and the parasites left with eggs of the test species for 24 h. Parasites were then removed, and the eggs of the test species and those of *L. decemlineata* were held until eclosion or development of the parasite. All tests were conducted in the laboratory at 26°C and 50% RH with a photoperiod of 16L:8D.

RESULTS AND DISCUSSION

During the observational period, the parasites were not strongly attracted to any of the eggs of the test species except *Leptinotarsa decemlineata* (Table 1). Random encounters were observed, but there was no apparent stimulus to oviposit, except for a weak response to *Labidomera clivicollis* (Kirby). In contrast, when *Leptinotarsa decemlineata* eggs were inserted in the units, parasites were readily attracted to them, oviposition was observed, and development was successful. Even after the eggs of the test species had been exposed to the parasite for 24 h, parasitization was not evidenced except for parasitism of an occasional *L. clivicollis* egg; only 2 (<1%) adult parasites were reared from ca. 400 eggs exposed.

These results clearly indicate that *E. puttleri* has a restricted host range, with probable specificity to Chrysomelidae of the genus *Leptinotarsa* or perhaps some

Table 1. Chrysomelid and coccinellid species whose eggs were tested as potential hosts of *Edovum puttleri* (++++ = readily acceptable; + = rarely acceptable; – = not acceptable).

Species	Host Plant or Association	Accepted Host
	Chrysomelidae	
	Chrysomelinae	
	Doryphorini	
Leptinotarsa decemlineata (Say)	*Solanum tuberosum* L. (potato)	++++
Labidomera clivicollis (Kirby)	*Cynanchum laeve* (Michx.) Pers. (climbing milkweed)	+
Zygogramma suturalis casta (Rogers)	*Ambrosia artemisiifolia* L. (common ragweed)	–
	Chrysomelini	
Chrysomela knabi Brown	*Salix babylonica* L. (weeping willow)	–
Gastrophysa cyanea cyanea Melsheimer	*Rumex crispus* L. (curly dock)	–
	Galerucinae	
Pyrrhalta luteola (Müller)	*Ulmus* sp. (elm)	–
	Criocerinae	
Lema trilinea trilinenea White	*Datura stramonium* L. (Jimson weed)	–
	Cassidinae	
	Stolaini	
Chelymorpha cassidae (F.)	*Ipomoea* sp. (morning glory)	–
	Coccinellidae	
	Coccinellinae	
	Coccinellini	
Hippodamia tibialis (Say)	Predaceous on aphids	–
H. convergens (Guérin-Méneville)	Predaceous on aphids	–
H. parenthesis (Say)	Predaceous on aphids	–
Coccinella novemnotata (Herbst)	Predaceous on aphids	–
C. transversoguttata (Falderman)	Predaceous on aphids	–
Coleomegilla maculata (De Geer)	Predaceous on aphids	–
Anatis sp.	Predaceous on scales	–
Adalia bipunctata (L.)	Predaceous on scales	–
	Chilochornini	
Chilochorus stigma (Say)	Predaceous on scales	–
	Epilachninae	
Epilachna varivestis Mulsant	*Phaseolus vulgaris* L. (garden bean)	–

other species of genera in the tribe Doryphorini. Evidence to support this contention was provided by P. W. Schaefer (personal communication), who tested the parasite against eggs of the false potato beetle, *Leptinotarsa juncta* (Germar) and found it to be a readily acceptable host. As a result of these tests, permission was received from the Animal and Plant Health Inspection Service, USDA (APHIS) to release the parasite in Missouri in 1980 to determine the parasite's potential in the biological control of the Colorado potato beetle.

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QUEEN OF THE CAROLINAS (LEPIDOPTERA: NYMPHALIDAE: DANAINAE: *DANAUS GILIPPUS*)

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Abstract.—Although the queen, *Danaus gilippus* (Cramer), has not been recorded from North or South Carolina in major compilations on butterflies, data pulled together from many different published and unpublished sources (including my own fieldwork) place it in one or both of these states in at least 24 of the 84 years from 1899 to 1982—almost always along the coast. This butterfly is known from Beaufort, Charleston, Colleton, Horry, and Jasper counties, South Carolina, and from Beaufort, Brunswick, Carteret, Columbus, Craven, Dare, Moore, New Hanover, Onslow, and Wake counties, North Carolina. (It was even taken once on the shore of Marthas Vineyard island, Massachusetts.) An important larval foodplant on the Carolina coast is the twining milkweed *Cynanchum palustre* (Asclepiadaceae), which is also eaten by the monarch, *Danaus plexippus* (L.). The queen must usually (if not always) reinvade from farther south; but it probably breeds to some extent in the coastal Carolinas in most years, and sometimes for most of the season. Both the queen and the monarch are mobile, both eat the same plants, and both are models for the mimetic viceroy, *Limenitis archippus* (Cramer). Owing to movement, interspecific competition, and other factors, these rather different looking models occur along the Carolina coast in fluctuating and unpredictable proportions which may alter selection pressures affecting mimetic resemblance in the geographically varying viceroy.

My first Carolina queen was unforgettable: as I looked up through the windshield on a back road west of Myrtle Beach in late August of 1967, I recognized it at once; but I drove on for some seconds before realizing, with a jolt, that this was northern South Carolina, not central Texas where I had been routinely accumulating queens for most of that summer in order to count spermatophores in females (Burns, 1968). How I managed to catch this individual without causing an accident does not matter. What does is that none of our modern compilations (Klots, 1951: 79; Ehrlich and Ehrlich, 1961: 85; Howe, 1975: 77; Pyle, 1981: 714; Ferris and Brown, 1981: 291) includes the Carolinas in the distribution of the queen; the closest any comes is southern or coastal Georgia.

Older literature holds reliable records of the queen from both Carolinas. The queen is so different from other Carolinian butterflies that no question of misidentification can be raised. Besides, several reputable entomologists are involved.

Pollard (1910), collecting in North Carolina with Engelhardt in the summer of 1909, noted that the queen, *Danaus gilippus* (Cramer), entirely replaced the monarch, *D. plexippus* (Linnaeus), on Smith Island at the mouth of the Cape Fear River and took one or more specimens. To this record, Brimley (1923: 113) added, "Southern Pines, Beaufort, Whiteville . . . May to August," and then, in *The Insects of North Carolina* (Brimley, 1938: 257), "Southern Pines, May; Beaufort, June, August; Whiteville, Washington, August, September; . . . Raleigh, May, once." None of the supplements to Brimley's book (Brimley, 1942; Wray, 1950, 1967) gave further data. However, the author of the last two, D. L. Wray (personal communication 1969), furnished a photocopy of the North Carolina Department of Agriculture file card on the queen which has helpful extra information relating to the published records, as well as an unpublished one. Assigned to county but chronologically arranged, these full-blown records are Southern Pines, Moore County, 4 May 1908, A. H. Manee; Beaufort, Carteret County, early June 1909, 2 (1 on mainland, 1 on Shackleford Banks), F. Sherman, Jr.; Whiteville, Columbus County, 14 August 1909, 1 seen on flowers in garden at close range, F. Sherman, Jr.; Beaufort, Carteret County, late August 1923, 1, F. Sherman, Jr.; Washington, Beaufort County, 9 September 1934, M. Shelburne; Raleigh, Wake County, 29 May 1935, 1, J. Vestal (specimen seen by C. S. Brimley on 3 June 1935); Wilmington, New Hanover County, no date, W. A. McGirt, Jr. According to Wray, the only specimens in the State Insect Collection are 2 ♀, "in fairly good shape," labelled Beaufort, N.C., early July 1904, F. Sherman, Jr.

Sharpe (1914) found the queen common in and around Charleston, South Carolina, in August ("a few") and especially September and October of 1912 and/or 1913. A file card in the South Carolina Faunal Survey at the Department of Entomology and Economic Zoology, Clemson University (F. McAlister, personal communication 1971) lists three records of the queen in the lower coastal plain between Charleston and the Georgia border: Ridgeland, Jasper County, 13 August 1926, F. Sherman, Jr.; Jacksonboro, Colleton County, 16 August 1933, seen, F. Sherman, Jr., and O. L. Cartwright; Folly Beach, Charleston County, 16 August 1933, O. L. Cartwright. I have examined 2 ♂ (in AMNH) from Coosawhatchie, Jasper County, 19 April 1934 and 1 September 1949, both R. B. Dominick, and 1 ♀ (in USNM) from Hunting Island State Park, Beaufort County, 4 August 1972. In addition I have examined (in USNM) 2 ♀ labelled simply "S.C." plus 2 ♂ 2 ♀ labelled "coast S.C.," one pair of which is dated 2 July 1899 and the other, 5 July 1899; all 6 specimens were in the E. A. Smyth collection and probably hail from the Charleston area. The Charleston Museum contains 3 queens from Charleston County: 1 ♂ 1 ♀, Fort Johnson, October 1967, M. Harrison, and 1 ♂, McClellanville, 19 June 1967, R. B. Dominick and C. R. Edwards (R. B. Dominick and R. R. Gatrelle, personal communications 1971). Four more specimens collected by Dominick and Edwards in the vicinity of McClellanville are in the Wedge Plantation Collection: 2 ♂, 26 November 1966 and 15 June 1967, from The Wedge, and 1 copulating pair, 21 September 1968, from Tibwin Plantation (R. B. Dominick, personal communication 1971). On Bull Island, Charleston County, Richardson (1974) photographed a queen in October 1972. Just W of Charleston, on 3, 4, and 5 December 1973, P. E. Nugent and R. Cuthbert took one queen in a broccoli field at the U.S. Vegetable Breeding Laboratory on the Savannah Highway and another visiting tea plants at the Clemson Experiment Station, and finally saw a third in the broccoli field (Nugent, 1974). Gatrelle (1975: 59) mentioned that the queen occurs in the southern coastal area of South Carolina. Altogether, over the 75-year period from 1899 to 1973, the queen was taken in the southern coastal counties of South Carolina in at least 11 different years.

Exact data for the specimen that catalyzed and introduced this paper are 1 ♂, 9.7 km (6 mi) SSE of Conway on S.C. route 544, Horry County, 28 August 1967, J. M. and S. N. Burns. (This is the only record of the queen in northern South Carolina.) Since then, in the course of nine short field trips (primarily for skippers) to the Carolina coastal plain, I have watched for queens without going out of my way to find them. They have turned up at two spots, both in North Carolina in sandy habitat within sight of the Atlantic Ocean: Brunswick County, Sunset Beach, 18 August 1969, 2 ♂ 2 ♀; 20 August 1969, 1 ♂ 2 ♀; 27 August 1974, 4 ♂ 3 ♀, all J. M. Burns; and Carteret County, Bogue Banks, Fort Macon State Park, 3 October 1982, 2 ♀, J. M. and S. N. Burns.

Brunswick is the southmost county in North Carolina; Sunset Beach, at the southwest corner of Brunswick County, and Smith Island, at its southeast corner, mark one of three sheltered strips of Carolina coast that run essentially east-west. Cape Fear, on Smith Island, projects south of this protected coastline. In the community of Sunset Beach, which is engulfing a short barrier island and some of the closely adjacent mainland, all of my specimens come from one limited area at the east end of the island. Southport is an old coastal town on the Brunswick County mainland opposite Smith Island. At Southport, in the mid-sixties, C. N. Watson, Jr. (personal communication 1982) observed a queen for some time at close range as it moved slowly about weeds along the shore where charter fishing boats are docked; and R. W. Cavanaugh, Jr. (personal communication 1982) caught 1 ♂, 16 August 1981, on *Aster* in sand dunes.

In New Hanover County, which forms a wedge between the estuary of the Cape Fear River and the ocean, R. D. Cuyler encountered several queens in the early fifties: in marshes of the Cape Fear River at Wilmington, 14 September 1950, 1 seen; along the Cape Fear River at Wilmington, 16 August 1952, 2 seen and 1 ♀ caught; at Carolina Beach, 16 August 1952, 2 seen; and in the Kure Beach-Fort Fisher area, 17 August 1952, 1 ♂ caught (J. B. Sullivan, personal communication 1982).

The south edge of Carteret County, comprising Bogue and Shackleford Banks, is another extensive strip of east-west running coast that is guarded on the east—in this case by Cape Lookout. Bogue Banks is a long barrier island; and Fort Macon State Park is at its east end, next to Shackleford Banks off the Beaufort shore. Each of our Fort Macon females was flying and flower-feeding (chiefly on *Solidago*) just behind the barrier dune from the open ocean. Between these recent catches and the early Beaufort records cited above, queens surfaced a number of other times. R. D. Cuyler came across them in the Morehead City-Beaufort-Atlantic Beach area, 16 September 1950, 2 seen and 1 ♀ caught, and at Morehead City, 17 September 1950, 1 seen (J. B. Sullivan, personal communication 1982). Maturo (1953: 154), who studied the butterflies of Carteret County from June 1952 to June 1953, simply included the queen in a checklist of species from there; but in his unpublished master's thesis from which the checklist was derived, he wrote of the queen (J. B. Sullivan, personal communication 1971):

> Beaufort area: June through October.
>
> Occurrence—Found in the same habitats as the Monarch, the Queen is com-

> moner than *Danaus plexippus* during the summer. Though never very numerous it was most often collected during the last half of August on *Verbena brasiliensis* on the west shore of the Newport River. The collection records are too scattered to suggest any conclusion on the number of broods.

C. E. Wood, Jr. (personal communication 1975) repeatedly saw the queen in summer at Swansboro, which is at the mouth of the White Oak River opposite the west end of Bogue Banks, barely within Onslow County; but he could not recall the exact years. In more than a decade at Beaufort, J. B. Sullivan (personal communication 1982) ran into the queen once about 30 km to the northwest in adjacent Craven County, near Havelock and the Cherry Point Marine Corps Air Station, on country road 1717, 24 September 1972, 1 ♀.

The northmost stretch of nearly east-west coast is the south end of Hatteras Island, to the west of Cape Hatteras, from Buxton to Hatteras town in Dare County. Queens occur here, too. I have examined 2 ♂ (in AMNH) labelled Buxton, 24 June 1955, M. de Vinney. S. M. Gifford (personal communication 1982) saw queens several times in Buxton Woods along the protected Pamlico Sound side of the island. Although he kept no records, he thought that the butterflies arrived toward the middle or end of summer in about three different, non-consecutive years and vanished with the cold, without ever breeding. C. E. Wood, Jr. (personal communications 1975 and 1982) saw the queen farther north on Hatteras Island, more than halfway up its exposed limb, at Rodanthe on about 8 to 10 June 1972. R. D. Cuyler found queens common even farther up the Outer Banks in the Nags Head area from 11 to 16 August 1947 and caught several (J. B. Sullivan, personal communication 1982).

Over the 79-year period from 1904 to 1982, the queen was taken or seen in North Carolina in at least 16 different years, 13 of which are distinct from any of the years in which it was picked up in South Carolina.

At one time or another the queen has been found along nearly the entire length of the Carolina coast (Fig. 1). In South Carolina it is known from every coastal county except Georgetown (and only from coastal counties); in North Carolina, from every outer coastal county except Pender in the south, Hyde in the middle, and Currituck in the north. All North Carolina records are from outer or inner coastal counties except for one in Columbus County, which is next to a coastal county, and two decidedly interior records in Moore and Wake counties (Fig. 1).

Larval Foodplant

My limited study area at Sunset Beach, North Carolina (comprising less than a hectare of salt marsh and slightly higher weedy and shrubby sand) supported a tangle of a native asclepiadaceous vine, *Cynanchum palustre* (Pursh) Heller (determined by C. E. Wood, Jr., 1975), on much of the higher ground. Both the queen and the monarch eat this twining milkweed. On 27 August 1974, when adult queens were common, I collected a pupa attached to a stem of *C. palustre* which I stuck in the joint of the rearview mirror in my car; so moved, a ♂ queen emerged in Baltimore, Maryland, six days later. On 20 August 1969, when I caught 3 queens and saw a fourth, I also saw 2 monarchs, one of which oviposited twice on *C. palustre*. On 25 August 1979, when I saw no queens during an hour at the study area, 6 to 8 monarchs kept cruising over it; I watched 1 ♀ at close

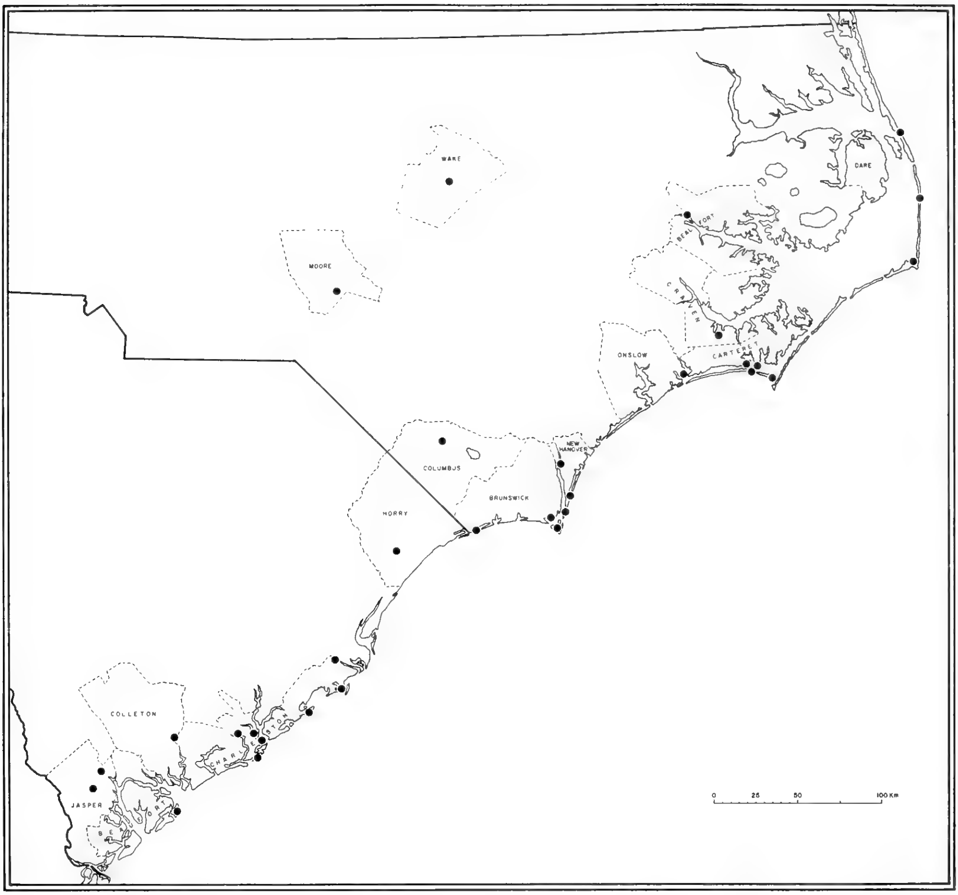

Fig. 1. Occurrence of the queen, *Danaus gilippus,* in North and South Carolina. Most records are coastal. Counties from which this butterfly is known are marked with dashes and named.

range for 10 minutes (1445–1455 EST) as she oviposited repeatedly on *C. palustre,* and I picked up 3 of her eggs. (Over the years, this study area has been almost completely destroyed by developers through a combination of dredging, which has changed the coastline and created some channels behind it, and filling, which has buried most of the foodplant beneath rocks and sand. Beach houses are flourishing now.)

Cynanchum palustre occurs along the coast from North Carolina to Florida and Texas. Dyar (1901: 447) saw larvae of the queen on this plant (reported as *Vincetoxicum palustre*) in January and/or February 1890 in a then-unspoiled beach region on the strip of land between Lake Worth, Florida, and the Atlantic Ocean.

Correll and Johnston (1970: 1235) treat *C. palustre* as a synonym of *C. angustifolium* Pers. which, in Texas, occurs "in and on the edge of salt marshes and in moist sandy soils, local along the Gulf Coast," but which, altogether, occurs not only from North Carolina to Florida and Texas but also in the Bahama Islands and the West Indies.

DISCUSSION

The queen was found in the Carolinas in at least 24 of the 84 years from 1899 to 1982—in 9 of those 24 years, only in South Carolina; in 13, only in North Carolina. In only 2 years was it definitely found in *both* Carolinas, even though in any year in which it occurs in North Carolina it must also occur in South Carolina. This reflects a chronic dearth of fieldwork, observation, and collecting in the Carolinas. The queen is probably much less sporadic in coastal sections than available records might at first suggest.

When all data are ordered chronologically, only three large gaps (of 10 to 12 consecutive years without records) appear; and two of these gaps coincide with the World Wars, when people were apt to be preoccupied. Moreover, a number of strings (1933–35, 1966–69, 1972–74) or clumps (1904, 08–09, 12 and/or 13; 1947, 49–50, 52, 55) of record-bearing years emerge.

Most records are from August and later, which implies reinvasion from farther south (as in various other butterflies, skippers, and so forth). But every string and clump includes one or (usually) more records from June or sooner, which points not only to earlier (and perhaps heavier) northward movement but even to the remote possibility of overwintering in sheltered situations on the Carolina coast itself in the mildest years.

One way or another, some groups of years are particularly favorable for the queen. The best seems to have been 1933–35: the queen was recorded from two points in southern South Carolina in August 1933, and from a third the following April; and, before it was found in an inner coastal county in northern North Carolina in September 1934 and far in the interior at Raleigh the next May, it was caught in good condition on 8 July 1934 at Lambert's Cove on the northwest shore of Marthas Vineyard island, Massachusetts (Jones and Kimball, 1943: 28)!

Clearly, the queen can and does move, Harris' (1972: 291) disclaimer that it "is not much of a wanderer, although an occasional stray may be taken," notwithstanding. After watching the queen in the spring and summer of 1966 and 1967 around Austin, Texas, I characterized it as "a mobile species" (Burns, 1968: 858). To cite just two other disparate examples of its vagility, it turned up in the middle of Ohio, in excellent condition, on 1 July 1959 (Gilbert, 1960); and it has colonized several islands, particularly in the western West Indies (the Bahamas, Cuba, the Caymans, Jamaica, Hispaniola), where some differentiation has taken place (Riley, 1975).

Because the information at hand has to be exceedingly fragmentary, I believe that the queen is neither the casual visitor some think it is nor a potential endangered species now "Rare in S.C." though "Common in S.C. to [the] 1930s" (Brooks et al., 1979: 51) but, instead, a species that actually breeds in the coastal Carolinas in most years. Although queens in the Carolinas no doubt eat various species of *Asclepias,* as they are known to do in Florida (Brower, 1961, 1962) and elsewhere, the most critical foodplant would be *C. palustre* owing to its occurrence along the immediate coast where the climate is peculiarly mild all year and the prevailing southwest wind of spring and summer aids insect movement to the northeast. *Cynanchum palustre,* which reaches its northern limit in North Carolina, is recorded from every coastal county in that state except Hyde and Currituck by Radford et al. (1968: 855); and it is represented in the Gray Herbarium of Harvard University by specimens from all coastal counties except Currituck, in the extreme northeastern corner of the state (C. E. Wood, Jr., personal communication 1982). This foodplant extends as far up the Carolina coast as does the queen (Fig. 1).

At various times from 1909 to 1974, five observers (Pollard, Sharpe, Cuyler, Maturo, and I) found the queen common at a total of six different coastal localities (Charleston, South Carolina; Sunset Beach, Smith Island, Wilmington, Beaufort, and Nags Head, North Carolina). Such local abundance strongly suggests that populations are breeding locally. So does continual observation of the queen over a long period in one place, as from August to October at Charleston by Sharpe and, especially, from June through October at Beaufort by Maturo. And the dozen times that queens have been seen in the Carolinas as early as mid April, May, June, or early July indicate that they may breed locally over most of the season.

In many species of butterflies, females usually mate but once, soon after emergence, so that copulating females can be assumed to have emerged at no great distance from where they are found. Dominick and Edwards took one copulating pair of queens at McClellanville, South Carolina, on 21 September 1968; and I caught one pair and saw another at Sunset Beach, North Carolina, on 18 August 1969. However, queens mate multiply to such an extent (Burns, 1968) that a female *in copula* need not be at it for the first time nor, therefore, of local origin. I dissected and counted spermatophores to determine mating frequency in the three female queens I caught at Sunset Beach on 27 August 1974: two fresh females (with 1 spermatophore apiece) had mated once and probably had emerged in the vicinity; but the third (worn and somewhat torn, with 8, or possibly 9, spermatophores) had mated about nine times and may well have immigrated.

In populations of the queen (whether locally produced, immigrant, or mixed) the sex ratio is even: of the 42 specimens of Carolina queens whose sex is known, 21 are male and 21 are female. An even adult sex ratio is important in the reproduction of the queen because repeated matings—with the transfer of a spermatophore (and perhaps other material) from male to female on each occasion—serve not only to keep females of this long-lived butterfly fertile but also to nourish them (Boggs and Gilbert, 1979).

The distribution and abundance of the queen in the Carolinas is of more than routine interest because the queen is one of two models for the mimetic viceroy, *Limenitis archippus* (Cramer). The viceroy resembles the darker queen to the south in Florida, where queens outnumber monarchs at least as adults (Brower, 1961, 1962); but it resembles the lighter monarch to the north, where the monarch is generally the sole model. The viceroy does not switch abruptly from one phenotype to the other; in much of the southeastern United States, it is variably intermediate. Clark and Clark (1951: 52–54) state that many darkish individuals occur as far up the coast as the southeastern corner of Virginia between the Dismal Swamp and the shore south of Virginia Beach. Does some of this geographic variation in viceroys reflect conflicting, or more diffused, selection pressures in a region where both models occur in fluctuating and unpredictable proportions? And do these models compete interspecifically along the Carolina coast for the shared larval foodplant *Cynanchum palustre,* as they do in interior Florida for species of *Asclepias* (Brower, 1962)? Pollard's (1910) observation that the queen "entirely replaced" the monarch on Smith Island, North Carolina, returns to mind.

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NOTE

The Occurrence of Encyrtiform Eggs in the Tanaostigmatidae (Hymenoptera: Chalcidoidea)

The reproductive systems of adult tanaostigmatids (emerged from galls collected in Pima and Cochise counties, Arizona, August 1982, by J. LaSalle and S. Y. H. Lin) were examined. The ovaries of unmated females were removed and placed in saline solution. The ovarian eggs of *Tanaostigmodes albiclavus* Girault and an undescribed species of *Tanaostigma* were found to be encyrtiform (Fig. 1). Ovarian encyrtiform eggs are "dumb-bell" shaped. The egg consists of two bladders connected by a narrow tube, a structure that aids respiration in the deposited egg and anchors it to its host (Zinna. 1945. Boll. Lab. Entomol. Agraria 'Filippo Silvestri' Portici 18: 45–55; Maple. 1947. Univ. Calif. Publ. Entomol. 8(2): 30–38). Encyrtiform eggs occur throughout, and are typical of the Encyrtidae. Maple (1947: 25) stated "This type of egg, however, is not peculiar to the Encyrtidae, for similar shapes can be found in other chalcidoid families and in other superfamilies of Hymenoptera." Unfortunately, he did not name the other groups in which these eggs occur. Encyrtiform eggs are rare, however, and they are unknown from Eupelmidae which have stalked eggs. Clausen (1940. *Entomophagous Insects.*

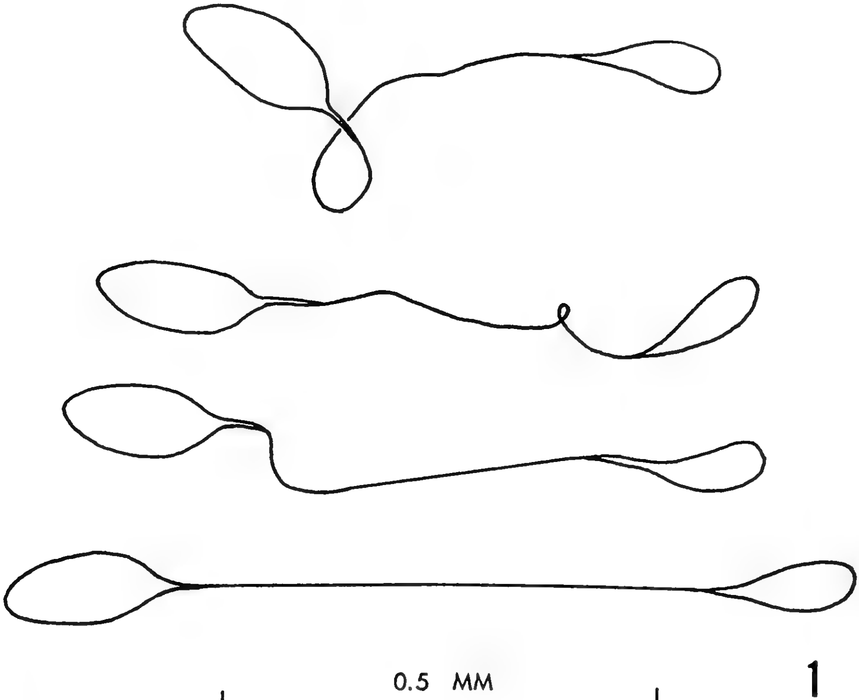

Fig. 1. *Tanaostigmodes albiclavus,* ovarian eggs.

Hafner Publ. Co., N.Y.: 197), in describing eupelmid eggs, stated, "There is little variation in form among the eggs of representatives of this family. The main body of the egg is ellipsoidal and bears a stalk of varying length at the anterior end."

Within the Chalcidoidea, tanaostigmatids, encyrtids and eupelmids form a discrete group which is considered monophyletic. However, the phylogenetic relationships between these three taxa are not clear. Tanaostigmatids have been classified as a family, as a subfamily of the Encyrtidae, and as a subfamily of the Eupelmidae. The presence of encyrtiform eggs in the tanaostigmatids is considered a derived character shared with the encyrtids. The importance of this synapomorphic character taken alone will not be addressed in this note. Rather it is reported because it is of value to future analyses of phylogenetic relationships among these three groups.

John LaSalle and Lynn M. LeBeck, *Department of Entomology, University of California, Riverside, California 92521.*

PROC. ENTOMOL. SOC. WASH.
85(2), 1983, pp. 398–399

NOTE

Abdominal Blotches of *Frankliniella trehernei* and Differentiation of *F. occidentalis* and *F. bruneri* (Thysanoptera: Thripidae)

The diagnostic significance of the grayish brown abdominal blotches in pale species of *Frankliniella* was not fully recognized in early taxonomic studies of some American species of the genus. Clear pale adult specimens without such blotches on abdominal tergites were usually considered teneral, and the presence or absence of such blotches tended to be ignored in the diagnoses. Although most of the pale species bear such blotches, few are completely pale even at maturity. Thus the presence or absence of abdominal blotches have diagnostic value. A small group of such species without abdominal blotches in the *intonsa* series of the *intonsa* group is differentiated from the rest of the series and is called the *runneri* complex. On the other hand, a few widely distributed pale species with abdominal blotches in the cool temperate regions are often fully or partly without them in the warmer subtropic regions. This makes the situations a little complicated. A good example is the pale form of *F. occidentalis* (Pergande). The particular case to be discussed here is of *F. trehernei* Morgan which was synonymized earlier with *occidentalis* by Bryan and Smith (1956. Univ. Calif. Publ. Entomol. 10: 388), based on diagnostic characters not including abdominal blotches.

The type series of *F. trehernei* (USNM) collected at Naramata and its vicinity in southern British Columbia, Canada, consists of 12 specimens which were all excessively treated with KOH, but the abdominal blotches are still feebly to clearly visible on four of them. This indication clearly confirmed the synonymy of *trehernei* with *occidentalis* which is always with abdominal blotches in the pale form of the species in the northern regions. Morgan (1925. Can. Entomol. 57: 144), who received the mounted specimens from R. C. Treherne and had not seen the untreated specimens, however, described the body as "very pale grayish yellow" and did not mention the abdominal blotches. Furthermore, he compared this species with *F. gossypiana* Hood (= *Euthrips gossypii* Morgan) which is also a pale species without abdominal blotches. Moulton (1948. Rev. Entomol., Rio de J. 19: 66, 71, 96, 98), in his revision of the genus, then interpreted *trehernei* as a teneral stage of *F. californica* Moulton (a synonymous name of the dark form of *occidentalis*), and, erroneously assuming it to be a clear pale species without blotches, speculated that *trehernei* was probably conspecific with *F. pseudotritici* Priesner from southern Mexico. However, *pseudotritici* as well as *F. inornata* Moulton was both recently discovered to be synonymous with *F. bruneri* Watson (Sakimura, 1981. Fla. Entomol. 64: 487), which is a pale species without blotches and is not related to *occidentalis.* Many specimens of *trehernei, pseudotritici,* and *inornata* in both the USNM and California Academy of Sciences collections determined by Moulton were found to be a mixture of both *occidentalis* and *bruneri.* It is interesting to note here that the pale form of *occidentalis* in southern Texas and northeastern Mexico quite often lacks abdominal blotches even at maturity, and is nearly as common as *bruneri* there. Consequently, both species look very much similar in Texas and Mexico, and can be segregated only by a few minor diagnostic characters that are often hard to correctly visualize. They are: head dimension about 1.3× as wide as long in *occidentalis* but 1.4× in *bruneri,* occipital striae narrowly spaced in the former but broadly spaced in the latter, and antennal VII decidedly longer than wide in the former, but about as long as wide in the latter. The glandular areas of male sternites of both *occidentalis* and *bruneri* are similarly small transversely rod-shaped, and do not serve for separating the species. The earlier description of the glandular areas for *bruneri* (Sakimura, 1981) is in error and herewith corrected.

K. Sakimura, *B. P. Bishop Museum, Honolulu, Hawaii 96819.*

PROC. ENTOMOL. SOC. WASH.
85(2), 1983, pp. 399–400

NOTE

Initial Host-Plant Records for Five Species of Fruit Flies from Southern California (Diptera: Tephritidae)

Newly discovered host plants in the family Asteraceae initially are reported for five species of nonfrugivorous Tephritidae. The plant nomenclature used follows Munz (1974. A Flora of Southern California. Univ. Calif. Press, Berkeley, Los Angeles, London. 1086 pp); the insect nomenclature, Foote and Blanc (1963. Bull. Calif. Insect Surv. 7, 115 pp.). Rearing records for the flies and their host plants are listed alphabetically.

Euarestoides arnaudi Foote, 1 ♂ reared from a quantity of flower heads of

Baccharis glutinosa Persoon collected near La Jolla, southwestern San Diego Co., on March 27, 1981. Wasbauer (1972. Calif. Dep. Agric. Bur. Entomol. Occas. Pap. 19, 172 pp.) listed "no host information" for this species.

Neaspilota wilsoni Blanc and Foote, 5 ♂ and 8 ♀ reared from a quantity of capitulae of *Haplopappus squarrosus* Hooker and Arnott ssp. *grindeliodes* (Décandolle) Keck collected near Sheephead Mountain, southeastern San Diego Co., on August 28, 1980. Wasbauer (1972) listed "no host information" for this fly.

Paracantha genalis Malloch, 1 ♂ reared from a puparium found in an open tunnel in center of small rosette of *Cirsium californicum* Gray collected 8 km east of Seven Oaks, San Bernardino National Forest, southwestern San Bernardino Co., on May 19, 1981. Wasbauer (1972) also listed "no host information" for this tephritid.

Paroxyna clathrata (Loew), 2 ♂ and 1 ♀ reared from a quantity of flower heads of *H. pinifolius* Gray collected in McCain Valley, southeastern San Diego Co., on October 16, 1980; 9 ♂ reared from a quantity of heads of *Senecio douglasii* Décandolle var. *douglasii* collected in Lark Canyon, southeastern San Diego Co., on October 16, 1980; 4 ♂ and 3 ♀ reared from a quantity of heads of *S. douglasii* var. *monoensis* (Greene) Jepson collected in the Silurian Hills (north of Baker), northeastern San Bernardino Co., on April 29, 1981; 1 ♂ reared from a quantity of heads of *S. integerrimus* Nuttall var. *exaltatus* (Nuttall) Cronquist collected at Jackass Meadow, Sequoia National Forest, Tulare Co., on July 21, 1982. Novak (1974. Melanderia, Vol. 16, 53 pp.) stated that hosts for this fly were "unknown."

Trupanea conjuncta (Adams), 145 ♂ and 135 ♀ reared from a quantity of heads of *Trixis californica* Kellogg collected in Chino Canyon, Riverside Co., on April 9, 1981. Wasbauer (1972) also listed "no host information" for this species.

My sincere thanks to R. H. Foote, Systematic Entomology Laboratory, IIBIII, ARS, USDA, c/o National Museum of Natural History, Washington, D.C., for his encouragement and confirmation of my identification of *Paroxyna clathrata.*

Richard D. Goeden, *Department of Entomology, University of California, Riverside, California 92521.*

PROC. ENTOMOL. SOC. WASH.
85(2), 1983, pp. 400–401

SUMMARY REPORTS OF SOCIETY OFFICERS FOR 1982

EDITOR
(Calendar Year 1982)

A total of 132 manuscripts were received and processed from November 1, 1981 to October 31, 1982. Four numbers of the *Proceedings* were published in 1982. The 872 + viii pages represented 94 scientific articles, 12 scientific notes, 6 book reviews, 1 obituary, 1 announcement, the membership list of the Society, minutes for 9 Society meetings, reports of officers for 1981, table of contents for volume 84, index to new taxa for volume 84, and PS Form 3526.

Editorial charges were waived for 9 articles, 2 notes, and 1 obituary, totaling 86 pages. Full editorial charges were paid for immediate publication of 5 articles totaling 48 pages and 1 note by a non-member of 2 pages. Seven lengthy articles included full editorial charges for 41 pages.

In September, the Society published *Memoir* Number 10, *Recent Advances in Dipteran Systematics: Commemorative Volume in Honor of Curtis W. Sabrosky*, edited by Wayne N. Mathis and F. Christian Thompson. The 227 page *Memoir* is available from the Society at a cost of $11.00.

Publications Committee: E. Eric Grissell, John M. Kingsolver, Wayne N. Mathis, George C. Steyskal, Thomas E. Wallenmaier, and David R. Smith (*Editor*).

TREASURER

(1 November 1981 to 31 October 1982)

Summary	General Fund	Special Publication Fund	Totals
On hand, 1 November 1981	17,515.67	30,132.55	47,648.22
Total receipts	51,125.39	9,829.36	60,954.75
Total disbursements	38,378.97	12,648.11	51,027.08
On hand, 31 October 1982	30,262.09	27,313.80	57,575.89

PROC. ENTOMOL. SOC. WASH.
85(2), 1983, pp. 401–404

SOCIETY MEETINGS

889th Regular Meeting—October 7, 1982

The 889th Regular Meeting of the Entomological Society of Washington was called to order by President Margaret S. Collins at 8:00 PM on October 7, 1982, in the Naturalist Center, National Museum of Natural History. Thirty members and seventeen guests attended.

F. C. Thompson read the names of the following applicants for membership:

Evan John Davis, 432 Ridge Road #3, Greenbelt, Maryland.
Richard D. Goeden, University of California, Riverside, California.
Edward C. Knudson, M.D., 804 Woodstock, Bellaire, Texas.
Nancy Moran, University of Michigan, Ann Arbor, Michigan.
Todd E. Shelly, Dept. of Biology, University of California, Los Angeles, California.
Kenneth J. Tennessen, 1949 Hickory Ave., Florence, Alabama.
John LaSalle, Dept. of Entomology, University of California, Riverside, California.
Steven W. Hamilton, Dept. of Entomology, Fisheries and Wildlife, Clemson University, Clemson, South Carolina.
Richard A. Rochette, Dept. of Biology, New Mexico State University, Las Cruces, New Mexico.

Minutes of the two previous meetings were read and approved with one correction.

T. Bissell reported that Raymond St. George had passed away. President Collins asked M. Stoetzel to head a committee to select a new honorary member.

Our president also appointed an auditing committee to be composed of T. Spilman, Chairman, and George Ludvik and Arnold Menke.

President Collins also designated a nominating committee.

President Collins brought to the members' attention the fact that Earthwatch expeditions has proposed that they would waive all costs except for travel to the site for any entomologist who wished to join one of their expeditions. President Collins suggested that the Society develop a fund, the interest from which could be used to fund the travel of an entomologist to an Earthwatch expedition. It was agreed to discuss this further at the next meeting.

The meeting was marked by a special tribute to Curtis W. Sabrosky from the Society. W. Mathis and F. Thompson presented Dr. Sabrosky with a copy of a special Memoir published by the Society in his honor. *Memoir* Number 10, entitled *Recent Advances in Dipteran Systematics: Commemorative Volume in Honor of Curtis W. Sabrosky,* was published September 30, 1982. Remarks were made by R. Foote, R. Gordon, and L. Knutson. A bouquet of flowers was presented to Mrs. Sabrosky.

The speaker for the evening was Mr. C. L. Morris, Chief of the Forest Insect and Disease Investigations for the Virginia Division of Forestry. His talk was entitled "Current Status of the Gypsy Moth." After giving a short synopsis of forest pest problems in Virginia and their means of control, Mr. Morris discussed gypsy moth damage and attempts to control it. The use of pheromones both for survey and control was discussed. Mr. Morris summarized the important research of the 1970's and noted the successes and the failures of this research. Slides were shown at the conclusion of the talk and various questions were raised by the audience.

Notes and Exhibitions

John Fales called the members' attention to the naming of the Zebra Swallowtail as the official county insect for Calvert County, Maryland.

John Kingsolver displayed a directory of Purdue University entomologists.

T. Bissell noted a recent social gathering of former presidents of the Society at the home of Helen Sollers-Riedel.

Visitors were introduced and the meeting was adjourned at 9:30 PM, after which refreshments were served.

Thomas E. Wallenmaier, *Recording Secretary*

890th Regular Meeting—November 4, 1982

The 890th regular meeting of the Entomological Society of Washington was called to order by President Margaret S. Collins at 8:00 PM on November 4, 1982 in the Naturalist Center, National Museum of Natural History. Thirty-one members and four guests attended.

Minutes of the previous meeting were read and approved with one addition.

Membership Chairman Joyce Utmar read the names of the following applicants for membership:

Brian V. Brown, R.R. 4, Stouffville, Ontario, Canada.
Cheslavo A. Korytkowski, Vice-Rectoria de Investigacion Post-Grado, Universidad de Panama, Estafeta Universitaria, Republica de Panama.
Christine Eason Louton and Jerry A. Louton, Natural History Building WG-12, Division of Fishes, Smithsonian Institution, Washington, D.C.
William J. Turner, Entomology Dept., Washington State University, Pullman, Washington.
Kanjyo Sakimura, 1834 Bertram St., Honolulu, Hawaii.

Raymond Gagné, chairman of the nominating committee, reported the following slate of nominees for Society offices for 1983:

President-Elect	Neal O. Morgan
Recording Secretary	Thomas E. Wallenmaier
Corresponding Secretary	Richard G. Robbins
Treasurer	Thomas J. Henry
Editor	David R. Smith
Program Chairman	Jeffrey R. Aldrich
Membership Chairman	Elizabeth A. Thomas
Custodian	John F. Carroll

President Collins noted that one pledge had been received for the Society's Earthwatch fund mentioned at the previous meeting.

The speaker for the evening was Dr. David A. Nickle, Systematic Entomology Laboratory, USDA. His talk was entitled "Pest Mole Crickets in the United States and Puerto Rico: A Complex Problem Near Resolution." Dr. Nickle's talk focused on the two-clawed mole crickets of the genus *Scapteriscus.* The three species of this genus which occur in the United States are introductions and the date, means of entry, and origin of these species was the subject of Dr. Nickle's investigations. By means of collection records Dr. Nickle was able to pinpoint the place and date of the introductions around the turn of the century, and by collecting in South America he was able to determine the probable origin as Argentina. Studies of shipping procedures at the turn of the century also showed that the use of soil as ballast was the probable means of transporting the mole crickets to the United States. Many other aspects of the biology and distribution of these species were discussed by Dr. Nickle including the specificity of the calling songs of the males and the use of *Larra bicolor* F., a sphecid wasp, as a successful biocontrol agent. Many excellent slides and live specimens were shown.

NOTES AND EXHIBITIONS

Slides of the recent gathering of past presidents of the Society at the home of Helen Sollers-Riedel were shown.

Curtis Sabrosky exhibited a frame of butterfly specimens obtained in Peru.

John Horne showed a cutaway mount of a tree branch containing the nest of a solitary wasp.

John Fales showed the official proclamation designating the Zebra Swallowtail butterfly, *Eurytides marcellus* (Cramer), as the official Calvert County insect.

R. J. Gagné illustrated with a series of slides the life histories of two species of Cecidomyiidae on American elm. The larvae of one, a new species, develops in the spring on opening flowers and prevented the development of any seed on one elm tree on the grounds of the Beltsville Agricultural Research Center campus. Larvae of the other species, *Dasineura ulmea* Felt, feed in and completely replace the lateral buds in which they overwinter. Almost all the lateral buds were killed on a tree on the BARC campus that later succumbed to Dutch elm disease.

The meeting was adjourned at 9:30 PM, after which refreshments were served.

Thomas E. Wallenmaier, *Recording Secretary*

891st Regular Meeting—December 9, 1982

The 891st regular meeting of the Entomological Society of Washington was called to order by President Margaret S. Collins at 8:00 PM on December 9, 1982 in the Naturalist Center, National Museum of Natural History. Thirty members and six guests attended. Minutes of the previous meeting were read and approved.

Membership Chairman Joyce Utmar read the name of the following applicant for membership:

Lewis L. Deitz, Dept. of Entomology, Box 5215, North Carolina State University, Raleigh, North Carolina.

Annual reports were given by Joyce Utmar, Membership Chairman, David Smith, Editor, and F. C. Thompson, Treasurer.

The slate of nominees proposed by the nominating committee for offices in the Society for 1983 was presented. Since no additional nominations were received from the floor, a motion to elect the slate as presented was unanimously carried.

The motion to elect Theodore L. Bissell as Honorary Member of the Society was unanimously carried.

Visitors for the evening were introduced.

The speaker for the evening was Dr. Margaret S. Collins, Department of Zoology, Howard University, and President of the Society. Her talk was entitled "Termite Chemical Defenses." Dr. Collins focused her discussion on the more specialized termites of the families Termitidae and Rhinotermitidae. She discussed morphological adaptations of the head of soldiers to discharge defense secretions, chemical composition of defense secretions, and physiological aspects of secretion production. The relationship of defense secretions to termite phylogeny was shown. Dr. Collins described her work in Guyana on the efficacy of termite defense secretions in repelling predators. Many excellent slides were shown.

After the evening's talk, letters of appreciation were presented to F. C. Thompson, J. Utmar, H. Sollers-Riedel, D. Anderson, R. Harbach, and J. Shaffer.

The gavel was handed over to Dr. Manya Stoetzel as newly-elected President of the Society. Dr. Stoetzel requested members to begin thinking of plans to mark the centennial of the Society in 1984.

Notes and Exhibitions

Mr. Ed Saugstad displayed an unusual substance thought to be insect eggs.

The meeting was adjourned at 9:30 PM, after which refreshments were served.

Thomas E. Wallenmaier, *Recording Secretary*

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 *Dermatophagoides*, 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 *Anastrepha* (Diptera: Tephritidae), by George C. Steyskal	1.50
Taxonomic Studies on Fruit Flies of the Genus *Urophora* (Diptera: Tephritidae), by George C. Steyskal	2.00

Memoirs of the Entomological Society of Washington

No. 1.	The North American Bees of the Genus *Osmia*, by Grace Sandhouse. 1939	$15.00
No. 2.	A Classification of Larvae and Adults of the Genus *Phyllophaga*, by Adam G. Boving. 1942	(out of print)
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 Hirosi Takahasi. 1969	15.00
No. 7.	Ant Larvae: Review and Synthesis, by George C. Wheeler and Jeanette Wheeler. 1976	11.00
No. 8.	The North American Predaceous Midges of the Genus *Palpomyia* Meigen (Diptera: Ceratopogonidae), by W. L. Grogan, Jr. and W. W. Wirth. 1979	12.00
No. 9.	The Flower Flies of the West Indies (Diptera: Syrphidae), by F. Christian Thompson. 1981	10.00
No. 10.	Recent Advances in Dipteran Systematics: Commemorative Volume in Honor of Curtis W. Sabrosky. Edited by Wayne N. Mathis and F. Christian Thompson. 1982	11.00

Back issues of the Proceedings of the Entomological Society of Washington are available at $25.00 per volume to non-members and $13.00 per volume to members of the Society.

Prices quoted are U.S. currency. Postage extra except on prepaid orders. 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, NHB 168, Smithsonian Institution, Washington, D.C. 20560.

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PROCEEDINGS
of the
ENTOMOLOGICAL SOCIETY of WASHINGTON

1884

DEPARTMENT OF ENTOMOLOGY
SMITHSONIAN INSTITUTION
WASHINGTON, D.C. 20560

PUBLISHED QUARTERLY

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(*Continued on back cover*)

THE ENTOMOLOGICAL SOCIETY OF WASHINGTON

ORGANIZED MARCH 12, 1884

All correspondence concerning Society business should be mailed to the appropriate officer at the following address: Entomological Society of Washington, c/o Department of Entomology, NHB 168, Smithsonian Institution, Washington, D.C. 20560.

MEETINGS.—Regular meetings of the Society are held in the Natural History Building, Smithsonian Institution, on the first Thursday of each month from October to June, inclusive, at 8 P.M. Minutes of meetings are published regularly in the *Proceedings*.

MEMBERSHIP.—Members shall be persons who have demonstrated interest in the science of entomology. Annual dues for members are $15.00 (U.S. currency) of which $13.00 is for a subscription to the Proceedings of the Entomological Society of Washington for one year.

PROCEEDINGS.—Published quarterly beginning with January by the Society at Washington, D.C. Members in good standing receive the Proceedings of the Entomological Society of Washington. Nonmember subscriptions are $25.00 per year, domestic, and $27.00 per year, foreign (U.S. currency), payable in advance. All remittances should be made payable to *The Entomological Society of Washington.*

The Society does not exchange its publications for those of other societies.

Please see p. 183 of the January 1983 issue for information regarding preparation of manuscripts.

STATEMENT OF OWNERSHIP

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PROC. ENTOMOL. SOC. WASH.
85(3), 1983, pp. 405–425

NEOTROPICAL *SAPINTUS*, WITH A GENERAL KEY TO SPECIES (COLEOPTERA: ANTHICIDAE)[1]

FLOYD G. WERNER

Department of Entomology, University of Arizona, Tucson, Arizona 85721.

Abstract.—Generic characters of *Sapintus* are discussed, and delimitation of the genus as strictly New World is reaffirmed. Twenty-eight species are recognized, of which 25 are included in a key based largely on characters of the male. Fourteen Neotropical species are described as new: ***alvarengai***, **balteatus**, **capitatus**, **malkini** and ***sentis*** from Brazil; ***golbachi*** and ***lobatus*** from Argentina; ***canaliculatus*** from Venezuela; ***ovalis*** from Peru; ***spinulosus*** from Mexico; ***creber*** from Brazil and Bolivia; ***curvipilosus*** from Bolivia and Argentina; ***subulatus*** from Colombia to Brazil; and ***similis*** from southern USA to Panama. Twelve taxa are transferred to *Sapintus* from *Anthicus*: *amazonicus* Pic, *bogotensis* Pic, *carbonarius* LaFerté, *decerptus* Pic, *diosensis* Pic, *donedai* Bonadona, *duplopunctatus* Heberdey, *foederatus* Champion, *guyanensis* Pic and its var. *surinamensis* Pic, *lutescens* Champion, and *teapensis* Champion. Four new synonymies are proposed: *carbonarius* (LaFerté) [= *bogotensis* (Pic)], *corticalis* (LeConte) [= *foederatus* (Champion)], *lemniscatus* Werner [= *donedai* (Bonadona)], and *teapensis* (Champion) [= *suzelae* Bonadona]. *Sapintus guyanensis* var. *surinamensis* (Pic) is elevated to species rank. All Neotropical species are described, redescribed, or discussed.

Few specimens of Neotropical *Sapintus* have been identified correctly subsequent to the original descriptions of the species. Most of the descriptions could apply equally well to at least several species and only two, those of *teapensis* (Champion) and *suzelae* Bonadona, include mention of critical male secondary sexual characters. This paper is an attempt to establish a better basis for classification. I have seen types of all described species except *duplopunctatus* (Heberdey), *suzelae* Bonadona, and the Nearctic *donedai* (Bonadona), but could not include *diosensis* (Pic) or *taitiensis* (Boheman) in the key to species because I did not have them available for dissection or comparison with other species. All five of these species are assignable to *Sapintus* without question, and *suzelae* Bonadona to synonymy with *teapensis* (Champion) and *donedai* (Bonadona) with *lemniscatus* Werner on the basis of the descriptions and figures.

Species of *Sapintus* are unique in the family in having a large diverticulum on the internal sac of the male genitalia (Fig. 3, div.). Details of the internal sac are unusually difficult to analyze when the sac is retracted, because dense zones of spines conceal other structures. The presence of the diverticulum is usually indicated only by the absence of the primary gonopore and its armature from the

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[1] Arizona Agricultural Experiment Station, Journal Paper No. 3660.

usual terminal position on the sac. Fortunately, a combination of external features correlates with the genitalic character, so that the genus can be defined without reference to the genitalia, at least in the New World fauna. The mesosternum is simple, with the sides gently curved to the middle coxal cavities and not isolating the mesepisterna from the cavities. The first visible abdominal sternum (morphological third) has a pubescence-lined invagination behind each hindcoxa (Fig. 8). The elytra have double pubescence, consisting of normal setae arising from distinct punctures and directed backward, and an under layer of shorter, finer, and more appressed setae, arising from very tiny punctures and usually directed obliquely laterally. Most species are uniformly brown, with a short prothorax and moderately broad head (Fig. 1). Two have a darker band on the elytra. Most of the distinctive features of the species involve the legs and abdomen of the male.

On external characters alone there is one group of *Anthicus* species in the Old World that would meet the generic definition, except for shape and color. This group consists of *Anthicus cohaeres* Lewis and some others, in the Orient and Micronesia (Werner, 1965). A combination of the mesosternal and sternal invagination characters occurs in four North American species of *Anthicus* (Werner, 1964). A combination of the mesosternal and pubescence characters is found in several different assemblages of *Anthicus* species, mainly in the Old World but also in *Anthicus pallidus* Say of the Neotropical fauna. Bonadona (1958 et seq.) has opted to broaden the definition of the genus *Sapintus* to include all species with the mesosternal and pubescence features, and has thereby included *Anthicus oceanicus* LaFerté and some similar species, a variety of species from Madagascar and Africa, and *Anthicus pallidus,* in his concept of the genus *Sapintus.* Almost all of these have a quite different facies from the species included in the genus in its restricted sense, although at least one African species looks very much like a true *Sapintus* externally. Needless to say, I do not agree with Bonadona's expanded grouping, nor with the implication of its Gondwanian origin (Bonadona, 1958: 55).

The external characters occur singly in other groups of Anthicidae. The simple mesosternum is widespread in the family. The invaginations of abdominal sternum 3 are found in *Notoxus,* which shares with *Mecynotarsus* and some other genera a distinctive prothoracic horn, and in scattered genera with normal prothorax. Double elytral pubescence is present in some species of *Acanthinus* and *Leptaleus,* which have the mesosternum expanded.

The general uniformity of body form within the genus poses a problem in description of species. I have made individual descriptions, but I doubt that very many specimens can be identified on the basis of female specimens alone. Each description is based on an individual specimen and includes measurements made with an ocular micrometer, usually at 100 diameters. These are recorded as follows, in 0.01 mm: Head (length from line across hind margin, not including neck, to clypeofrontal suture, over width across eyes and width behind eyes); eyes (length over width, separation across front, and distance from a line across their hind margins to a line across base); antenna (length, often sum of short measurements along a curve, and maximum thickness of segment 10). Prothorax (length on a straight line, including collar, over width at collar, maximum, and across base. Elytra (length from line across base to line across apex, over width where 45° angle touches humeri and maximum width). Elytral setae were measured on a straight line and separation of punctures from center to center. The omoplates and postbasal transverse impression of the elytra are not mentioned if they are only feebly indicated, as seems to be normal for the genus.

Genus *Sapintus* Casey

Sapintus Casey 1895: 732 (type-species *Anthicus pubescens* LaFerté, designated by Werner 1962: 493).

The key presented here is based on males, and does not include *diosensis* (Pic), *duplopunctatus* (Heberdey), or *taitiensis* (Boheman). Females included in type-series and records have been identified by association and comparison with males. I have seen what appear to be several additional South American species, including one from Santiago Province, Chile, that are represented by females only. The genus is not otherwise known from Chile, but ranges from southern Canada to central Argentina. Males can be distinguished from females by possession of an extra exposed abdominal tergum (morphological tergum 8), which is broader than long, above the last fully exposed sternum (morphological sternum 7), and often by truncation and excavation of sternum 7. Sternum 8 is retracted and simple, but sclerotized across the apex.

KEY TO KNOWN *Sapintus* MALES

1\. Apex of front and middle tibiae with a tiny, straight to recurved spine on side facing femur, in addition to the normal 2 tibial spurs (Figs. 4–7) 2

– Apex of front and middle tibiae without a spine 12

2\. Front (and sometimes middle) trochanter spinose (Figs. 4, 5, 7) .. 3

– Neither front nor middle trochanters spinose 7

3\. Tegmen of genitalia 3-lobed at apex (Fig. 28) 4

– Tegmen not 3-lobed at apex 6

4\. Both front and middle trochanters with slender spines. Apex of elytra unique in genus, with a sharp point at suture, in both sexes. Eastern USA .... *caudatus* Werner

– Front trochanters spinose, middle trochanters from simple to angular. Elytral apex without sharp point at suture 5

5\. Tegmen barely twice as long as broad (Fig. 28). Brazil .... *malkini,* new species

– Tegmen ca. 3× as long as broad. Eastern USA .... *pubescens* (LaFerté)

6(3). Both front and middle trochanters with slender spines (Fig. 4). Tegmen narrow, tapered to slender apex from near base (Werner, 1962: Fig. 3). Guatemala to southern Arizona, USA .... *corticalis* (LeConte)

– Front trochanters with short spines, middle trochanters with margin produced but barely angular (Fig. 5). Tegmen of almost even width from base to about apical ⅖, then fairly abruptly narrowed to a slender point (Werner, 1962: Fig. 4). Panama to southern Texas and Arizona, USA .... *hispidulus* Casey

7(2). Prothorax unique in genus, with dense, trichome-like tufts of erect setae arising from large anterolateral pits, in both sexes. Panama to southern Texas .... *lutescens* (Champion)

– Prothorax with neither erect tufts of setae nor pits on anterolateral borders 8

8. Tegmen (Fig. 15) gradually expanded from base to an abrupt truncation at apical ⅖, the apical ⅖ slender and gradually tapered. Spine at apex of front and middle tibiae not recurved (Fig. 6). Argentina . . . . *decerptus* (Pic)

– Tegmen not truncate at apical ⅖. Spine at apex of front and middle tibiae recurved (as in Fig. 4) 9

9. Apex of tegmen narrowly hastate (as in Fig. 20). Eastern USA . . . . *timidus* Casey

– Apex of tegmen not hastate 10

10. Apex of tegmen evenly tapered to a point. Arizona, USA . . . . *arizonicus* Werner

– Apex of tegmen at least slightly expanded laterally 11

11. Apex of tegmen narrowly subspatulate (Fig. 13). Elytral undersetae decumbent, curved, diagonal only near suture in apical ⅓ and near apex. Bolivia, Argentina . . . . *curvipilosus,* new species

– Apex of tegmen with a small knob, almost as broad as long (Werner, 1962: Fig. 5). Elytral undersetae almost appressed, nearly straight, diagonal over most of surface. Eastern USA . . . . *pusillus* (LaFerté)

12(1). Visible abdominal sternum 5 with a thin median lamina set in a mainly glabrous excavation. Eastern USA . . . . *lemniscatus* Werner

– No abdominal sternum with a median lamina 13

13. Visible abdominal sternum 4 with large ventral lobes, 3 and 2 flattened to slightly excavated, 5 concave and almost hidden by 4. Argentina . . . . *lobatus,* new species

– Visible abdominal sternum 4 simple, at most slightly flattened, 5 not hidden by 4 14

14. Visible abdominal sternum 5 at least moderately strongly excavated on the disc 15

– Visible sternum 5 simple, the disc sometimes flat or just perceptibly concave 18

15. Moderate excavation of visible sternum 5 flanked by narrow zones of nearly erect setae that are longer than those of surrounding area. Southern Mexico and Greater Antilles to southern Brazil . . . . *teapensis* (Champion)

– Excavation of disc of visible sternum 5 deep and sharply defined but not flanked by erect setae longer than those of surrounding area . . 16

16. Color almost black. Head punctures very fine and separated by much more than twice their diameters, the intervals flat and smooth. Colombia . . . . *carbonarius* (LaFerté)

– Color brown. Head punctures fine but separated by only their diameters, the intervals smooth but convex 17

17. Apex of tegmen narrowly subspatulate (Fig. 18). Excavation of visible sternum 5 a deep, nearly parallel-sided groove. Venezuela . . . . *canaliculatus,* new species

– Apex of tegmen slender (Fig. 16). Excavation of visible sternum 5 U-shaped. Brazil .... *amazonicus* (Pic)

18(14). Apex of tegmen 3-lobed, with excised lateral expansions (Fig. 12). French Guiana .... *guyanensis* (Pic)

– Apex of tegmen not 3-lobed 19

19. Tegmen with some lateral setae, beyond middle (Fig. 24). Southwestern Mexico .... *spinulosus*, new species

– Tegmen lacking setae 20

20. Elytra darker in an obscure postmedian band, pale from there to apex. Prothorax unusually narrow. Southern Brazil ... *balteatus*, new species

– Elytra without a darker band. Prothorax of usual dimensions (as in Fig. 1) 21

21. Head semicircular behind eyes (Fig. 2). Peru, Ecuador .... *ovalis*, new species

– Head with vertex at least weakly truncate 22

22. Sides of tegmen gently and evenly convex from base to apex, not at all concave beyond middle (Werner, 1962: Fig. 6). Eastern USA, Bahama Islands .... *fulvipes* (LaFerté)

– Sides of tegmen not evenly convex from base to apex, at least slightly concave beyond middle 23

23. Tegmen more than twice as long as phallobase (basal piece), and ca. 5× as long as broad (Fig. 17). Brazil .... *capitatus*, new species

– Tegmen not more than 1.5× as long as phallobase, nor 3× as long as broad 24

24. Gonopore armature with a unique, curved sclerotized tube that is easily seen in a cleared dissection (Fig. 23). Brazil, Bolivia .... *creber*, new species

– Gonopore armature not of this form, often difficult to find among spines of internal sac 25

25. Internal sac with a pair of large lateral groups of heavy spines, near gonopore armature (Fig. 14). Northeastern Brazil .. *sentis*, new species

– Internal sac without lateral groups of heavy spines 26

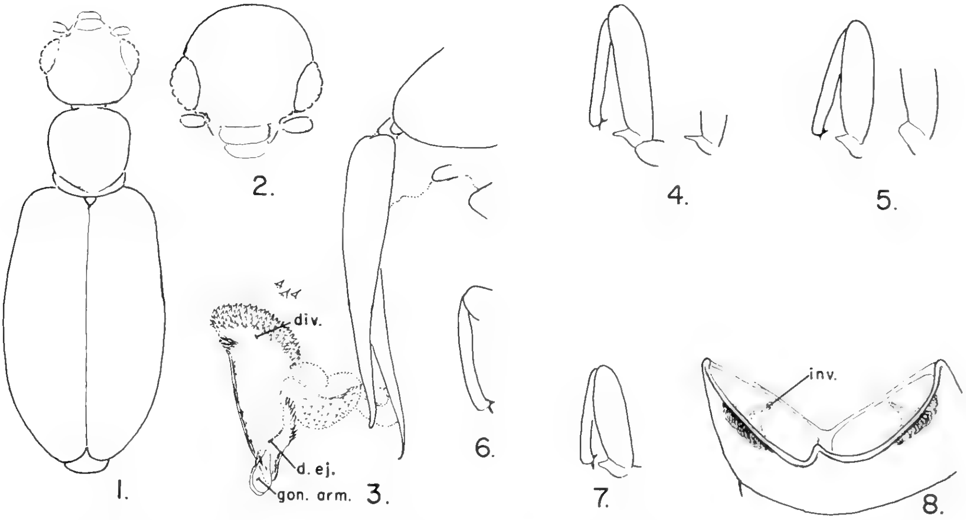
26. Length (head from vertex to clypeofrontal suture, plus prothorax including collar, plus elytra) at least 3.4 mm. Surinam .... *surinamensis* (Pic)

– Length less than 3.0 mm 27

27. Head unusually smooth, with shallow and poorly defined punctures ca. 0.03 mm from center to center, intervals distinctly broader than punctures. Elytral undersetae parallel to oversetae, except diagonal along suture. Argentina .... *golbachi*, new species

– Head not unusually smooth, the punctures well defined, ca. 0.01–0.02 mm from center to center, most of them as broad as intervals or broader. Elytral undersetae diagonal over most of the surface .. 28

28. Tegmen ca. half as broad as long, of nearly equal width from base to just beyond middle, then abruptly narrowed to a slender apex (Fig. 25). Southern Brazil to French Guiana and Colombia .... *subulatus*, new species



Figs. 1–8. *Sapintus* spp. 1, *S. similis,* ♂, Santa Engracia, Mex. 2, *S. ovalis,* holotype, head. 3, *S. similis,* ♂ Villahermosa, Mex., genitalia with internal sac extruded; div. = diverticulum; d.ej. = ductus ejaculatorius; gon.arm. = gonopore armature. 4, *S. corticalis,* ♂, Tamazunchale, Mex., front leg and middle trochanter. 5, *S. hispidulus,* ♂, Alamos, Mex., front leg and middle trochanter. 6, *S. decerptus,* ♂, La Plata, Arg., front tibia. 7, *S. malkini,* ♂ paratype, front leg. 8, *S. ovalis,* holotype, first visible abdominal sternum, removed from body; inv. = invagination behind hindcoxa, visible through cuticle of part of sternum that forms back of hindcoxal cavity.

– Tegmen distinctly less than half as broad as long, not as abruptly narrowed beyond middle (Figs. 22, 27) 29

29. Tegmen distinctly shorter than phallobase (basal piece). Internal sac with a small, dense median cluster of spines near gonopore armature (Fig. 22). Northeastern Brazil .... *alvarengai,* new species

– Tegmen equal to phallobase in length. Internal sac without median cluster of dense spines. Panama to southern USA, Jamaica .... *similis,* new species

Neotropical Species and New Synonymy

Sapintus alvarengai Werner, New Species

Fig. 22

Holotype ♂.—2.49 mm, rufescent brown, legs not paler; head moderately densely punctured, intervals shiny; legs and visible sternum 5 simple; tegmen tapered concavely to narrow tip; internal sac with dense median cluster of strong spines near primary gonopore, a few spines between base and primary gonopore.

Head 40/54, 47, truncate with rounded temporal angles, eyes 33/20, 33 apart, 15 from base. Punctures 2 apart, flat-bottomed, intervals nearly flat, shiny, generally narrower than punctures. Antenna 91 long, 7 thick at segment 10. Prothorax 47/20, 45, 39, punctures slightly denser than on head, partly confluent, intervals narrow, convex, shiny. Elytra 162/69, 91, punctures small, 4 apart, intervals shiny, punctures bearing undersetae barely perceptible; oversetae decumbent, 9, slightly curved, undersetae moderately sparse, 4, subappressed, slightly curved, diagonal.

Types.—Holotype ♂, BRASIL: Rio Grande do Norte: Macaiba (Sept. 1951, M. Alvarenga) in MZSP. Paratypes: 5 ♂, 11 ♀, same data, MZSP and FGW; 2 ♂, 1 ♀, same locality (Dec. 1951, M. Alvarenga) in MNRJ.

Sapintus amazonicus **(Pic), New Combination**

Fig. 16

Anthicus amazonicus Pic 1906: 58 (type-locality: Amazonas). Types in Pic Coll., MHNP, studied. Lectotype ♂, hereby designated, the left specimen on a double card mount, and paralectotype, ♀, on the right.

Lectotype ♂.—2.90 mm, brown, legs and base of antenna dull rufescent; densely punctured and short-pubescent. Legs simple, visible sternum 5 with a distinct U-shaped depression 24 long, 16 wide, ca. 3 deep, its pubescence short, appressed, longitudinal. Tegmen (Barra do Tapirapé specimen) broad at base, evenly tapered to slender apex; internal sac with lateral zone of heavy spines near base, some slender spines near primary gonopore, diverticulum with even covering of small, triangular spines.

Head 42/67, 57, truncate with narrowly rounded temporal angles, and a feeble middle notch ca. 1 deep; eyes 28/24, 37 apart, 15 from base. Punctures small, sharply defined, flat-bottomed, 2 apart, punctures ca. as wide as shiny, slightly convex intervals, those bearing oversetae broader, but almost lost among others. Antenna 100 long, 8 thick at segment 10. Prothorax 64/24, 60, 51, punctures similar to head but denser, intervals only ca. ½ as wide as punctures. Elytra 185/80, 104; punctures small but sharply defined, 4 apart, intervals with tiny punctures bearing undersetae at least 4× as numerous as main series. Oversetae decumbent, ca. 30°, 7, almost straight, undersetae appressed, 3, diagonal.

Remarks.—I have also studied a single ♂ from BRASIL: Mato Grosso: Barra do Tapirapé (Nov. 1964, B. Malkin) in MZSP.

Sapintus balteatus **Werner, New Species**

Fig. 11

Holotype ♂.—3.53 mm, brown, elytra dull rufescent with omoplate area and an obscure postmedian band darker, apical ⅓ lighter; moderately shiny; prothorax unusually slender. Legs and visible sternum 5 simple. Tegmen broad at base, evenly tapered to pointed apex.

Head 58/69, 60, subtruncate, temporal angles broadly rounded, eyes 29/22, 44 apart, 26 from base. Punctures well defined, ca. 1 across, 3 apart, intervals slightly convex, shiny, with very weak small punctures bearing undersetae no more numerous than main series. Antenna ca. 136 long, 10 thick at segment 10. Prothorax 65/27, 60, 53, punctures slightly deeper than on head, ca. 4 apart, intervals convex, shiny, but with numerous small punctures bearing undersetae, ca. ⅓ diameter of main series, making surface irregular, some punctures confluent. Elytra 230/96, 124, omoplates and impression weak but evident, punctures ca. 5 apart, moderately small, intervals slightly convex, shiny, with barely visible punctures bearing moderately sparse undersetae 3 long, almost appressed, diagonal; oversetae decumbent at ca. 45°, almost straight, 11.

Types.—Holotype ♂, BRASIL: Santa Catarina: Nova Teutonia (8.2.1949, Fritz Plaumann) in MZSP. Paratypes: 3 ♀, same data; 2 ♀ same but X.1952; 1 ♂, same but 4 Nov. 1950; in MZSP and FGW collections.

Sapintus canaliculatus Werner, New Species

Fig. 18

Holotype ♂.—3.44 mm, brown, abdomen rufescent, legs, palpi and base of antenna dull luteous; head and prothorax densely, finely punctured. Legs simple, visible sternum 5 with a nearly parallel-sided groove, its flanking lobes arising in basal ¼ and rising to lobes ca. 11 apart and 2 high in apical ½, with dense setae ca. 2 long on mesal face. Tegmen (from paratype) tapered, its apex narrowly subspatulate.

Head 53/65, 56, base almost truncate, temporal angles rounded; eyes 29/24, 35 apart, 18 from base. Punctures bearing oversetae shallow, flat-bottomed, ca. 2 apart, intervals with more numerous fine punctures bearing undersetae. Antenna ca. 107 long, 8 thick at segment 10. Prothorax 71/24, 64, 53, collar short, punctures dense, less than 2 apart, fine but slightly flat-bottomed, slightly wider than intervals. Elytra 220/84, 113; punctures ca. 5 apart, sharply defined, intervals with more numerous very fine punctures bearing undersetae; oversetae decumbent, 9, nearly straight, undersetae moderately dense, 4, appressed, diagonal.

Types.—Holotype ♂, VENEZUELA: Ciudad Bolívar (V.20.1898, E. A. Klages) in CU. Paratypes: 23 ♂, 16 ♀, same data, in CU and FGW collections.

Sapintus capitatus Werner, New Species

Fig. 17

Holotype ♂.—2.58 mm, dull luteous, head darker, moderately sparsely punctured; collar region of prothorax with some denser pubescence laterally and ventrally; undersetae of elytra unusually erect and curved, not diagonal. Legs and visible sternum 5 simple; tegmen tapered to subspatulate apex. Darker individuals have brown elytra, dark brown head, rufescent prothorax and underside, and dull luteous legs.

Head 42/56, 51, truncate with rounded temporal angles and median sulcus ca. 1 deep; eyes 24/19, 35 apart, 15 from base; punctures flat-bottomed but generally poorly defined, 3 apart, intervals smooth with scattered small punctures bearing sparse undersetae. Antenna ca. 96 long, 7 thick at segment 10. Prothorax 53/20, 49, 40; punctures of 2 sizes, ca. 2 apart, smaller bearing undersetae similar to elytra and ½ diameter of larger. Intervals subequal to smaller punctures. Elytra 164/69, 89; punctures small, 4 apart, intervals flat, smooth, with more numerous very fine punctures bearing undersetae; oversetae subdecumbent, 8, gently curved, undersetae more erect, curved to below horizontal at tip, almost all directed backward.

Types.—Holotype ♂, BRASIL: Rio Grande do Norte: Natal (Jan., 1950, M. Alvarenga) in MZSP. Paratypes: 15, all Rio Grande do Norte: Natal, Macaiba, and Ceara Mirim, collected M. Alvarenga, in FGW, MA, MGF, and MNRJ collections.

The following appear to belong to this species but have not been designated as paratypes: Brasil: Minas Gerais: Sete Lagoas (1–15 Feb. 1963, 4 ♀ from light trap run by Adauto Zunti) in MZSP.

Sapintus carbonarius (LaFerté), New Combination

Anthicus carbonarius LaFerté 1848: 173 (type-locality: Nova Granata). Holotype, ♂, LaFerté Coll., MHNP, studied.

Anthicus bogotensis Pic 1907: 134 (type-locality: Bogota, Colombia). Holotype, ♀, Pic Coll., MHNP, studied. New Synonymy.

Holotype ♂.—2.93 mm, black with a brown cast, legs and antenna slightly paler; shiny, intervals between punctures very smooth; pubescence, especially undersetae of elytra, unusually sparse. Legs simple; visible sternum 5 with a well defined, U-shaped, almost horseshoe-shaped, depression, 20 wide, 24 long, ca. 3 deep, with short, decumbent setae directed to midline. Apical 16 of tegmen visible, slender, ca. 5 wide at widest.

Head 47/58, 55, truncate with rounded temporal angles, broadly impressed by ca. 1 at middle; eyes 17/15, 40 apart, 21 from base; punctures small, shallow, 4 apart, intervals shiny, with very sparse tiny punctures bearing undersetae, the combined punctures ca. 2 apart. Antenna ca. 105 long, moderately slender, 7 thick at segment 10. Prothorax 58/25, 55, 49; punctures distinct, flat-bottomed, 1–2 in diameter, 2 apart, intervals smooth and shiny; collar with dense, short pubescence ventrally. Elytra 187/80, 110; punctures deep, 4 apart, intervals slightly convex, shiny, punctures bearing undersetae barely visible at 100 diameters, about as numerous as main series; oversetae subdecumbent at ca. 45°, nearly straight, 9, undersetae decumbent, 4, diagonal but inconspicuous.

Remarks.—Known to me only by the 2 holotypes indicated in the synonymy.

Sapintus corticalis (LeConte)

Fig. 4

Anthicus corticalis LeConte 1851: 154 (type-locality: California, at Colorado River). Lectotype, ♂, designated by Werner 1962: 494, in LeConte Coll., MCZ.

Anthicus foederatus Champion 1890: 249–250 (type-locality: Yzabel or Rio Naranjo, Guatemala). Types in BMNH, examined in 1960. New Synonymy.

Sapintus corticalis: Casey 1895: 739; Werner 1962: 494–495, fig. 3.

This species seems to have a fairly wide distribution but is scarce.

New records.—USA: Arizona: Santa Cruz Co.: Peña Blanca (26 July 1964, UV light, D. R. Smith and C. W. Baker, OSUC collection). MEXICO: San Luis Potosí: Tamazunchale (31 May 1948, light trap, F. Werner and W. Nutting; and 19 July 1970, UV trap, A. Newton). Oaxaca: Juchatengo (4 mi. N., 3300′, 7 Aug. 1970, E. Fisher and P. Sullivan).

Sapintus creber Werner, New Species

Fig. 23

Holotype ♂.—2.52 mm, dull rufescent, head darker, palpi and base of antenna paler. In some individuals the head and prothorax are darker than the elytra. Head truncate, with moderately dense, sharply-defined punctures; collar region of prothorax with denser pubescence ventrally. Legs and visible sternum 5 simple. Tegmen broad at base, tapered to a slender point; internal sac with sparse spines and a unique curved tube as part of the gonopore armature. Most similar to *capitatus* but has the undersetae of the elytra normal, not so strongly curved, the head punctures more sharply defined, and the tegmen tapered to a slender point.

Head 38/54, 49, base truncate with a weak median sulcus, temporal angles rounded; eyes 22/20, 33 apart, 15 from base; punctures flat-bottomed, less than 1 in diameter, ca. 2 apart, intervals shiny, with an approximately equal number of shallow, poorly-defined punctures, ca. ½ diameter of main series, bearing undersetae. Antenna ca. 102 long, 8 thick at segment 10. Prothorax 51/20, 47, 39, punctures flat-bottomed, slightly deeper and denser than on head, less than 2 apart; intervals flat, smooth, lacking punctures. Elytra 163/71, 93; punctures moderately small, 4 apart, intervals feebly convex, with extremely tiny punctures bearing moderately sparse undersetae; oversetae decumbent, 8, almost straight, undersetae nearly appressed, 3, slightly curved, diagonal.

Types.—Holotype ♂, BRASIL: São Paulo: Piracicaba (20 Jan. 1966, UV trap, C. A. Triplehorn) in MZSP. Paratypes, 157: BRASIL: São Paulo: Piracicaba; Fazenda Pau d'Alho (U. Martins). Mato Grosso: Cáceres (M. Alvarenga). Minas Gerais: Sete Lagoas (A. Zunti). Pará: Santarém (F. Werner). Santa Catarina: Rio Caraguela (F. Plaumann). BOLIVIA: Santa Cruz: El Cidral (ca. 100 km NNW Santa Cruz, 450 m, R. Golbach). Paratypes in FGW, IML, MZSP, and OSU collections. Almost all of the specimens were collected at light.

Sapintus curvipilosus Werner, New Species

Fig. 13

Holotype ♂.—2.70 mm, rufescent, head slightly darker, prothorax and legs slightly paler; elytral undersetae rather strongly curved, diagonal only near suture in apical ⅓ and in apical area. Trochanters simple, front and middle tibiae with slender, recurved spine ca. 2 long at apex; tegmen tapered gradually to subspatulate apex.

Head 40/58, 49, truncate with rounded temporal angles; eyes 24/20, 35 apart, 15 from base; punctures fine, shallow, ca. 3 apart, intervals shiny, evenly convex. Antenna ca. 105 long, 8 thick at segment 10. Prothorax 55/23, 47, 42, punctures small, sharply defined, ca. 2 apart. Elytra 176/69, 98, punctures ca. 5 apart; oversetae moderately fine, 9, subdecumbent, gently curved, undersetae 3, decumbent, curved.

Types.—Holotype ♂, BOLIVIA: Los Huecos (ix-23, Harrington) in USNM. Paratypes, 26: BOLIVIA: Los Huecos; Guairui; Santa Cruz: Cambeiti. ARGENTINA: Tucumán: Tucumán; Jujuy: Rio San Lorenzo. Paratypes in FGW, IML, MBR, and USNM collections.

Sapintus decerptus (Pic), New Combination

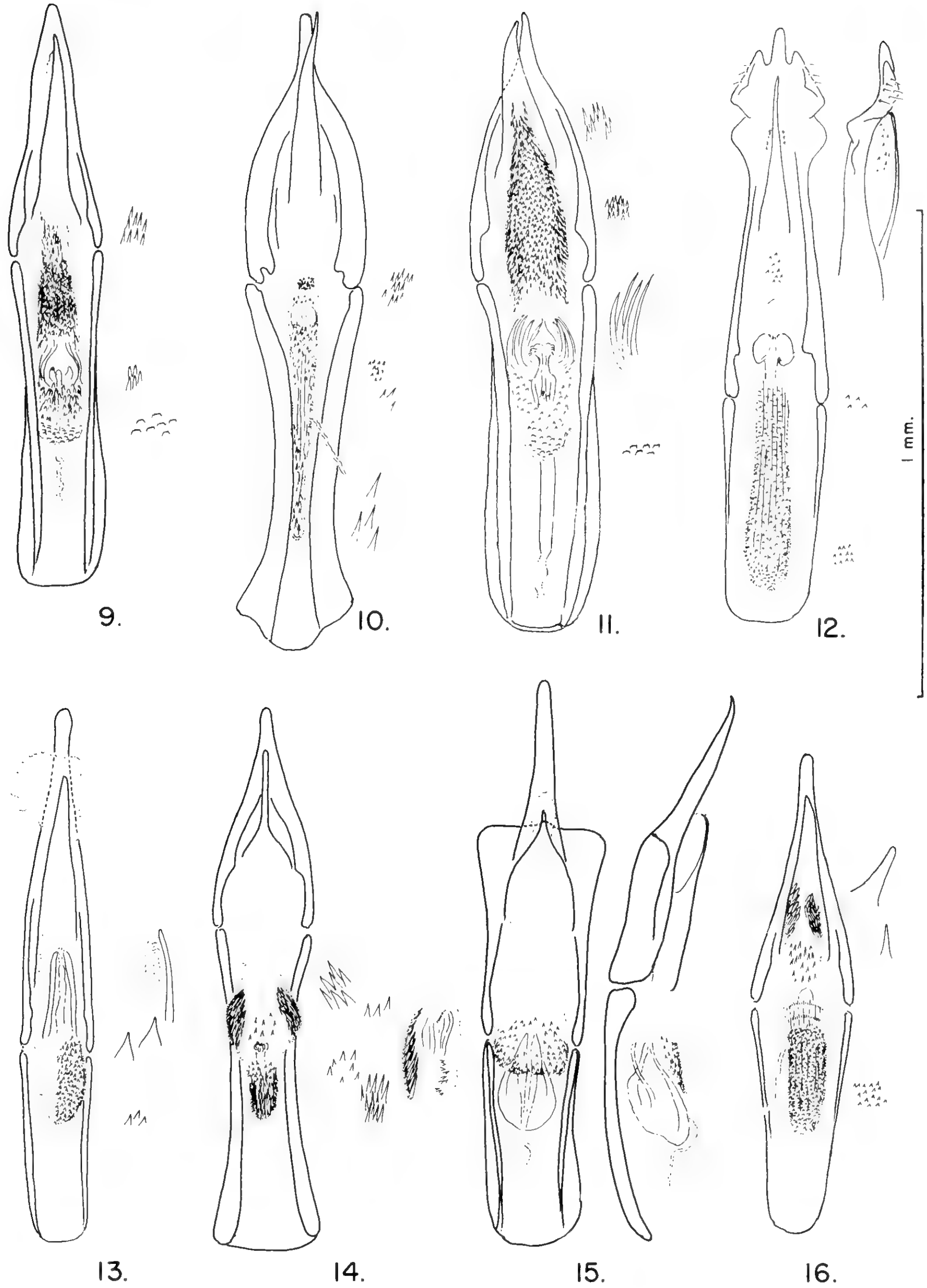
Figs. 6, 15

Anthicus decerptus Pic 1904a: 118–119 (type-locality: Buenos Aires, Argentina). Type in Pic Coll., MHNP, examined in 1960.

Anthicus deceptor Pic 1909: 255 (*lapsus calami* or correction).

♂.—La Plata, Argentina, 2.80 mm, rufescent, elytral suture darker, antenna and legs rufous; pubescence fine and regular. Front and middle tibiae slightly excavated mesally in apical ⅓, with a triangular spine ca. 3 long at apex, this not recurved; trochanters and visible sternum 5 simple. Tegmen (Isla de Santiago specimen) broad at base, abruptly truncate, then with a long, slender apical projection. Some individuals have the elytra uniformly colored.

Head 40/56, 51, truncate with rounded temporal angles; eyes 20/17, 35 apart,



Figs. 9–16. Male genitalia of *Sapintus* spp., ventral views, some with tegmen in left lateral views, details in other views. 9, *S. lobatus,* paratype, Punta Lara, Arg. 10, *S. surinamensis,* Kobelstation, Surinam. 11, *S. balteatus,* holotype. 12, *S. guyanensis,* Saut-Maripa, Guyane. 13, *S. curvipilosus,* holotype, gonopore armature in left lateral view. 14, *S. sentis,* paratype, gonopore armature in left lateral view. 15, *S. decerptus,* Isla de Santiago, Arg. 16, *S. amazonicus,* Barra do Tapirapé, Brazil.

18 from base; punctures fine, indistinct, ca. 4 apart, intervals shiny, evenly convex. Prothorax 56/24, 49, 45, discal punctures as on head but more distinct, with sparse, finer punctures bearing undersetae on intervals. Elytra 184/75, 102; punctures ca. 5 apart; oversetae moderately fine, 9, subdecumbent, gently curved, undersetae fine, appressed, slightly curved, 4, diagonal.

New records.—ARGENTINA: Buenos Aires: Palermo; Campana (7 Feb. 1963, on blossoms *Eryngium eburneum,* M. J. Viana and F. Werner). La Plata: La Plata (on blossoms *Aeschynomene montevidensis,* 16 Jan. 1963, F. Werner; on blossoms *Cynara cardunculus,* 15–28 Jan. 1921, A. A. Marelli); Isla de Santiago. Pic (1909: 255) records it from Bolivia, but all of the localities listed here are from the lower Rio La Plata region. There are specimens in the FGW, MCZ, MLP, and USNM collections.

Sapintus diosensis **(Pic), New Combination**

Anthicus diosensis Pic 1942: 14 (type-locality: "Perou"). Type in Pic Coll., MHNP.

When I had a chance to examine the Pic collection of Anthicidae in 1960, I found the type of *diosensis* and made the note that it differed from what is here described as *ovalis* by having the head truncate. This specimen could not be found when certain Pic types were sent me for study more recently. The Pic collection is in very crowded boxes, with individual specimens hard to locate.

Sapintus duplopunctatus **(Heberdey), New Combination**

Anthicus (*Sapintus*) *duplopunctatus* Heberdey 1938: 257 (type-locality: Brasilien: Santa Catarina: Nova Teutonia, Correio Ità, leg. Plaumann).

Heberdey indicated that the type remained in his collection, but it was apparently lost during World War II because it could not be found in the Heberdey collection in the Vienna Museum. I have not seen any specimens that match the description in Plaumann material in other collections. The double punctures mentioned in the description are found in several species.

Sapintus fulvipes **(LaFerté)**

Anthicus fulvipes LaFerté 1848: 177–178 (type-locality: États-Unis d'Amérique). Type in LaFerté Coll., MHNP, examined in 1960.

Sapintus fulvipes: Casey 1895: 735; Werner 1962: 496, fig. 6, redescription and synonymy.

I have seen no specimens of this species from south of the USA, except for a single specimen from the Bahamas. Previous records from Mexico and the West Indies are probably all referable to other species, especially *similis* in Mexico and *teapensis* in the West Indies.

Record.—B.W.I.: Bahama Islands: South Bimini Island (1 ♂, May 1951, Cazier and Gertsch) in AMNH.

Sapintus golbachi **Werner, New Species**

Fig. 19

Holotype ♂.—2.83 mm, rufescent, shiny, head smooth and feebly punctured. Elytral undersetae longitudinal. Legs and visible sternum 5 simple. Tegmen tapered to a point from a broad base.

Head 45/57, 52, truncate with broadly rounded temporal angles, not impressed at midline; eyes 20/19, 36 apart, 18 from base; punctures small, shallow, poorly defined, ca. 3 apart, intervals evenly convex, smooth and polished. Antenna quite slender, ca. 111 long, 7 thick at segment 10. Prothorax 53/20, 45, 40; punctures small, ca. 1 across, sharply defined, ca. 4 apart, intervals smooth with some punctures that are less than ½ the diameter of the main series on the sides of the disc, bearing undersetae. Elytra 185/69, 115; punctures equal to larger ones on prothorax, 4 apart, intervals slightly convex, smooth, with faint, tiny punctures bearing undersetae; oversetae subdecumbent, 10, nearly straight, undersetae almost parallel to oversetae, 5, some diagonal along suture.

Holotype.—♂, ARGENTINA: Tucumán: Tucumán (March 1959, R. Golbach) in IML.

Sapintus guyanensis (Pic), New Combination

Fig. 12

Anthicus guyanensis Pic 1904b: 121 (described from Guyane française: Camopi and Ouanary, F. Geay, 1900. The specimen marked type in MHNP is hereby designated lectotype. Type-locality restricted to Ouanary). Types studied.

♂.—Oyapock, 3.16 mm, dark brown, legs, palpi, and base of antenna dull rufescent, tibiae darker. Prothorax densely, head more sparsely, punctured. Legs and visible sternum 5 simple. Apex of tegmen uniquely complex, spatulate with deep lateral excisions.

Head 51/64, 59, subtruncate with a median sulcus ca. 2 deep, temporal angles broadly rounded; eyes 27/25, 38 apart, 19 from base; punctures shallow, flat-bottomed, ca. 1 across and 3 apart, missing from midline of front; intervals irregular from more numerous tiny punctures bearing undersetae. Antenna ca. 107 long, 9 thick at segment 10. Prothorax 64/24, 64, 53; collar very short; surface appearing opaque, punctures flat-bottomed, slightly smaller than on head, ca. 2 apart, narrowly separated but not confluent. Elytra 201/89, 118; punctures 4 apart, small but sharply defined, intervals shiny but with very tiny punctures bearing undersetae; oversetae decumbent, 9, almost straight, undersetae fine, appressed, 4, moderately numerous, diagonal.

New records.—FRENCH GUIANA: Saut-Maripa, Oyapock, 4 ♂, 5 ♀, 25 Nov. 1969, Guyane-Mission Balachowsky-Gruner, Oct.–Nov. 1969. One specimen bears the label "Plege lumineux." These are the only specimens seen except for the type-series. Specimens in MHNP and FGW collections.

Sapintus hispidulus Casey

Fig. 5

Sapintus hispidulus Casey 1895: 736–737 (type-locality: Austin, Texas). Types in Casey Coll., USNM, examined in 1950.

This species has been reported previously from eastern Texas and from a state label specimen allegedly from South Carolina. New material indicates that it ranges into the USA from a Mexico-Central America distribution.

New records.—USA: Arizona: Pima Co.: Santa Rita Experimental Range (20 July 1973, UV trap, W. Nutting). MEXICO: Sonora: Alamos (5–13.5 mi. E., 5 mi. W., Aug. and Oct.); Navajoa (10 mi. E., 13 Aug.). Baja California Sur: Santiago

(13 Aug.). Sinaloa: Concordia (5 mi. E., 12 Jul.). San Luis Potosí: Ciudad Mante (12 mi. S., 21 June), El Banito (22 June). Panama: Bocas del Toro: Almirante (16 km. W., 15 Apr.–5 May, H. Wolda). Most of the specimens were taken at UV light, and most of them from Mexico were collected by D. S. Chandler.

Sapintus lemniscatus Werner

Sapintus lemniscatus Werner 1962: 498, figs. 9, 11 (type-locality: E. S. George Reserve, Livingston Co., Michigan). Holotype in FMNH.

Anthicus donedai Bonadona 1978: 73–74, figs. 1, 4–6 (type-locality: E. S. George Reserve, Livingston Co., Michigan). Holotype in P.I.M.E. Entomological Museum, Maryglade College, Memphis, Michigan; not examined. NEW SYNONYMY.

This species is rather unusual in that the undersetae are not very noticeable on the elytra, in that the elytra have a dark midband, and that the male has a median lamina set in a deep excavation of visible abdominal sternum 5. Bonadona's figures leave no doubt as to the synonymy indicated. The type-localities are within the same square mile reserve.

Sapintus lobatus Werner, NEW SPECIES

Fig. 9

Holotype ♂.—3.09 mm, pale rufescent, shiny, head rounded behind, obscurely punctured; visible abdominal sternum 4 with a pair of large ventral lobes, 2 and 3 slightly dished out along middle, 5 concave and almost hidden by 4; legs simple. Tegmen (from Punta Lara specimen) tapered to a slightly swollen apex.

Head 47/58, 51, almost evenly rounded behind eyes but with a feeble truncation; eyes 22/17, 35 apart, 23 from base; punctures moderately fine, shallow, ca. 4 apart, intervals smooth, evenly convex. Antenna ca. 115 long, 10 thick at segment 10. Prothorax 61/27, 55, 47; collar short; punctures distinct, ca. 4 apart, separated by slightly more than their diameters. Elytra 201/76, 109; punctures ca. 5 apart; oversetae subdecumbent, 11, almost straight, undersetae moderately sparse, decumbent, 4. Lobes of visible sternum 4 large, flat, ca. 45 apart in front, to 15 at hind margin, ca. 24 high. These and the excavation of sterna 2 and 3 would enclose the tip of the female body. The excavated surface is finely punctulate and appressed-pubescent; the mesal edge of the lobes bears a dense fringe of slightly curved setae ca. 6 long. Sternum 5 short and concave, apparently overlapped by 4.

Types.—Holotype ♂, ARGENTINA: Tucumán: Alpachiri (29.XII.1946, R. Golbach) in IML. Paratypes: 1 ♂, 1 ♀, same data, IML and FGW. 1 ♂, Buenos Aires: Punta Lara (IX.931, J. Bosq, in Bruch Coll.), MBR.

Sapintus lutescens (Champion), NEW COMBINATION

Fig. 20

Anthicus lutescens Champion 1890: 244–245 (described from Teapa, Tabasco, Mexico and Paso Antonio, Guatemala). Type-series in BMNH, examined in 1960.

♂.—Las Cumbres, Panama, 2.35 mm, tan, pubescence short and even, unique in possession of a trichome-like patch of dense, erect, pale setae from an excavation at each anterolateral edge of prothorax (in both sexes). Apex of front tibia with a slender, slightly recurved spine ca. 2 long; front trochanters slightly bulging; visible sternum 5 simple. Apex of tegmen slender, narrowly hastate.

Head 38/48, 46, evenly semicircular behind eyes, which are 18/15, 31 apart, 17 from base; punctures deep on front, ca. 3 apart, to indistinct on vertex, intervals shiny, convex, with sparse, barely perceptible punctures bearing undersetae. Antenna ca. 91 long, 7 thick at segment 10. Prothorax 47/20, 45, 37; collar distinct, punctures of 2 sizes, their diameters differing by ca. 1:2, ca. 3 apart. Anterolateral "trichomes" lying just in front of widest part, ca. 15 long, 5 wide, their dense setae ca. 5 long and slightly curved. Elytra 149/58, 82; punctures ca. 4 apart; oversetae fine, ca. 8, subdecumbent, moderately curved, undersetae very fine, ca. 3, nearly appressed, diagonal.

New records.—PANAMA: Las Cumbres (12 Feb.–26 Jul. 1975, UV light, H. Wolda); Chepo (12 mi. S., 4 July 1974, O'Briens and Marshall). MEXICO: Vera Cruz: Veracruz (5 mi. S., 30 June 1975, UV light, D. S. Chandler). Sinaloa: Mazatlán (26 Sept. 1971, UV trap, A. Newton). San Luis Potosí: El Banito (22 June 1975, UV light, D. S. Chandler). USA: Texas: Brownsville (11–16 June 1935, P. J. Darlington); S. Pat. Co.: Welder Wildlife Refuge (23 May 1974, C. and L. O'Brien). This seems to be one of the rarest species of the genus in North American light trap collections; only 23 specimens have been seen.

Sapintus malkini Werner, New Species

Fig. 28

Holotype ♂.—2.11 mm, brown, legs, base of antenna, and palpi luteous; visible sternum 5 with a shallow but sharply defined excavation 18 wide, this largely glabrous but with a few mesally directed appressed setae on sides; front trochanter with a triangular spine ca. 2 long, middle trochanter simple; front and middle tibiae excavated in apical ⅓, with an almost invisible erect terminal spine. Tegmen (from paratype) small, trilobed at apex.

Head 36/50, 44, truncate, temporal angles rounded; eyes large, 22/19, 27 apart, 13 from base. Antenna ca. 75 long, 6 thick at segment 10. Prothorax 40/16, 42, 35, punctures ca. 2 apart, flat-bottomed and large enough that they are narrowly separated. Elytra 135/58, 71; punctures ca. 4 apart; oversetae decumbent, ca. 7, almost straight, undersetae ca. 4, appressed, diagonal.

Types.—Holotype ♂, BRAZIL: Mato Grosso: Capitao Vasconselos (on Rio Tuatuari, Upper Xingu Basin, 31 July 1957, Borys Malkin) in CAS. Paratypes: 3 ♂, 3 ♀, same data, CAS and FGW collections.

Sapintus ovalis Werner, New Species

Figs. 2, 21

Holotype ♂.—2.96 mm, rufescent, legs, palpi and antenna paler, head semicircular behind eyes, moderately sparsely punctured, prothorax densely punctured; visible sternum 5 flat or slightly concave; legs simple. Tegmen (of paratype from Rio Chira) tapered to slender, subspatulate apex.

Head 47/57, 49; eyes 24/18, 36 apart, 17 from base; punctures flat-bottomed, 3 apart, intervals about equal to punctures, smooth. Antenna ca. 98 long, 8 thick at segment 10. Prothorax 56/21, 49, 45; collar moderately short; punctures flat-bottomed, 2 apart, intervals generally narrower than punctures. Elytra 195/80, 109, punctures moderately small, ca. 4 apart, intervals smooth but with more numerous extremely fine punctures bearing undersetae; oversetae decumbent, 9, slightly curved, undersetae subappressed, 4, diagonal, fairly sparse.

Types.—Holotype ♂, PERU: Lima: Callao (16 Nov. 1950, Michelbacher and Ross) in CAS. Paratypes: 25, PERU: Lima: Cañete; Lambayeque: Chiclayo; Piura: Piura, Rio Chira; Dept. unknown: Barranca, Casa Grande. ECUADOR: Ferreñafe, Jayania, and at New York port of entry in banana debris from Ecuador. Paratypes in CAS, FGW, and USNM collections. Some of the specimens were collected on alfalfa and on cotton buds.

Sapintus sentis Werner, New Species

Fig. 14

Holotype ♂.—2.71 mm, rufescent brown, legs barely paler and head darker; head moderately densely punctured, intervals shiny; legs simple; visible sternum 5 (paratype) with a very shallow, parallel-sided depression ca. 15 wide, barely more than flattened, surface and setae unmodified; tegmen (same paratype) broad at base, concavely tapered to slender tip, internal sac with lateral patches of heavy spines just below primary gonopore and long spines on diverticulum.

Head 42/58, 50, truncate with rounded temporal angles, impressed ca. 1 at middle; eyes 24/21, 36 apart, 16 from base; punctures flat-bottomed, 2 apart, intervals slightly convex, shiny. Antenna ca. 100 long, 8 thick at segment 10. Prothorax 55/20, 51, 42; punctures slightly denser than on head, intervals narrow, shiny. Elytra 175/76, 98; punctures 4 apart, intervals slightly convex, punctures bearing undersetae feeble but visible at 100 diameters; oversetae decumbent, 9, slightly curved, undersetae moderately sparse, ca. 5, subappressed, slightly curved, diagonal.

Types.—Holotype ♂, BRASIL: Ceará: Fortaleza (Inst. Agron., mercury light trap, 2 April 1963, F. Werner) in MZSP. Paratypes: 1 ♂, 8 ♀, same data, in IAF and FGW collections.

Sapintus similis Werner, New Species

Figs. 1, 3, 27

Holotype ♂.—2.67 mm, rufescent brown with rufescent legs and base of antenna; head with flat-bottomed punctures ca. 3 apart, bearing oversetae, and slightly more numerous shallower punctures ca. ½ their diameter bearing undersetae, intervals flat, shiny; prothorax densely and evenly covered with small, flat-bottomed punctures; legs and visible sternum 5 simple. Tegmen (of paratype, Cd. Valles) fairly broad at base, concavely tapered to fine apex, diverticulum of internal sac with many small spines, region of primary gonopore with a zone of long, slender spines.

Head 40/58, 51, truncate with broadly rounded temporal angles; eyes 26/22, 35 apart, 13 from base. Antenna ca. 84 long, 8 thick at segment 10. Prothorax

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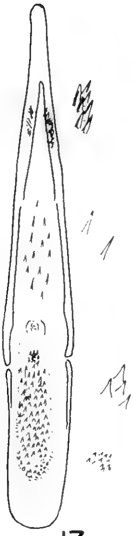
Figs. 17–28. Male genitalia of *Sapintus* spp., ventral views, details in some other views. 17, *S. capitatus,* holotype. 18, *S. canaliculatus,* paratype, gonopore armature in left lateral view. 19, *S. golbachi,* holotype, gonopore armature in ventral view. 20, *S. lutescens,* Las Cumbres, Pan., tegmen in left lateral view, gonopore armature in ventral view. 21, *S. ovalis,* paratype, Rio Chira, Peru. 22,



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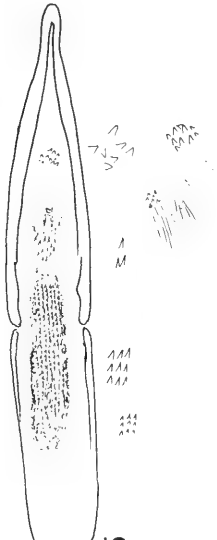

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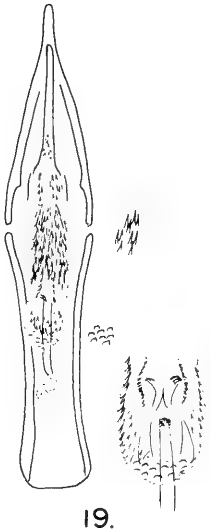

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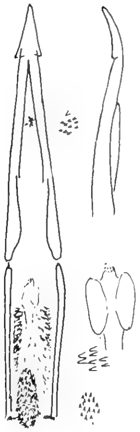

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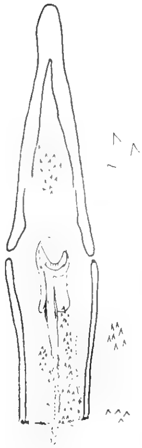

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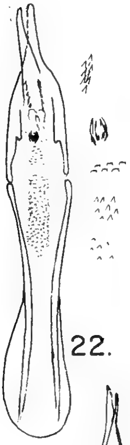

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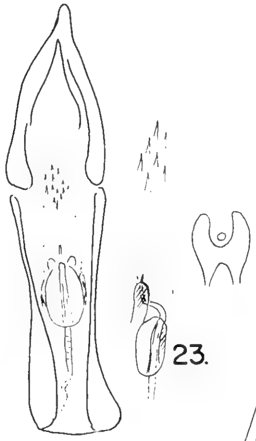

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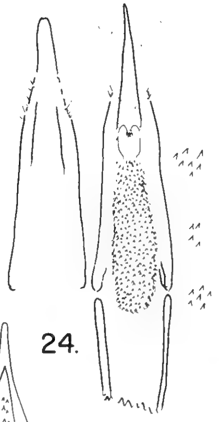

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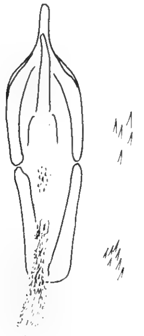

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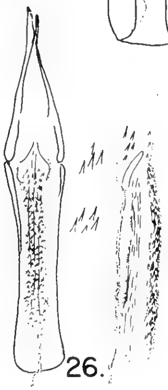

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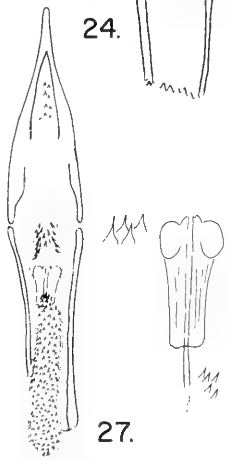

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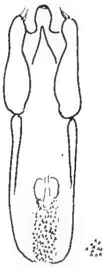

28.

S. alvarengai, holotype. 23, *S. creber,* holotype, gonopore armature in left lateral view; dorsal plate of gonopore armature in dorsal view. 24, *S. spinulosus,* holotype, tegmen in ventral view. 25, *S. subulatus,* paratype, Jacaré, Brazil. 26, *S. teapensis,* Paramaribo, Surinam, gonopore armature and diverticulum in left lateral view. 27, *S. similis,* E. of Cd. Valles, Mex., gonopore armature in ventral view. 28, *S. malkini,* paratype.

55/22, 48, 43; punctures ca. 2 apart, intervals narrower than punctures. Elytra 173/71, 96; punctures small, 4 apart, intervals shiny, punctures bearing undersetae barely visible at 100 diameters; oversetae decumbent, 8, almost straight, undersetae 4, moderately sparse, appressed, diagonal.

Types.—Holotype ♂, MEXICO: San Luis Potosí: El Banito (nr. Cd. Valles, 17 July 1970, UV trap, A. Newton) in USNM. Paratypes: 11 ♂, 7 ♀, same data; 17 ♂, 7 ♀, same locality but 22 June 1975, UV light, D. S. Chandler. Paratypes in USNM, DSC, and FGW collections.

Additional specimens not designated as paratypes are from: HONDURAS: in banana trash from Honduras at Baltimore port of entry. JAMAICA: Spanish Town. MEXICO: Baja California: San Bartolo; Campeche: Campeche; Chiapas: E. of Comitán, S. of Palenque; Morelos: Cuernavaca; Nayarit: San Blas; San Luis Potosí: El. Naranjo, El Salto de Agua, Tamazunchale, E. of Cd. Valles; Sinaloa: Mazatlán, N. of Pericos; Tabasco: S. of Villahermosa; Tamaulipas: Gomez Farias, N. and S. of Cd. Mante, Santa Engracia; Veracruz: Cd. Alemán, El Palmar, N. of Sontecomapan, S. of Veracruz. PANAMA: Las Cumbres, Madden Lake. Panama Canal Zone: Fort Clayton. USA: Arizona: Tucson; California: Alameda, Naples, San Diego; Florida: Winter Park; Louisiana: Harahan. These specimens in CAS, CU, DSC, FGW, MCZ, and USNM collections.

Remarks.—Since it has no really strong specific characters, this is one of the most difficult species to identify with certainty. It appears to be abundant in Mexico and Panama, but rare in the southern USA and in Jamaica. Most of the specimens that Champion (1890) identified as *fulvipes* probably belong here; I have not checked them. The late Robert Silberglied and Mr. Abiello obtained adults and larvae from the egg sac of a *Tetragnatha* spider at Madden Lake, Panama, 20 March 1978.

***Sapintus spinulosus,* New Species**

Fig. 24

Holotype ♂.—2.97 mm, brown, legs and base of antenna rufescent, undersetae moderately dense and conspicuous, directed laterally posterior to weak omoplates; legs and visible sternum 5 simple; tegmen tapered to a blunt point from apical ⅓, the tapered portion slightly concave and bearing some lateral setae; diverticulum of internal sac with an even covering of small, triangular spines, internal sac not otherwise spinose, apparently with a pair of tiny membranous fingers near base.

Head 57/64, 56, truncate with narrowly rounded temporal angles; eyes 28/24, 35 apart, 19 from base; punctures bearing oversetae moderately small, flat-bottomed, 3 apart, intervals flat, shiny but with more numerous punctures ca. ⅓ diameter of larger bearing undersetae. Antenna ca. 111 long, 9 thick at segment 10. Prothorax 58/24, 53, 46; punctures dense, ca. 2 apart, small but well defined, intervals very narrow. Elytra 182/78, 105; omoplates well indicated, accentuated by transverse setae behind and in the shallow postbasal transverse impression; punctures small, sharply defined, 4 apart, intervals flat with numerous tiny punctures bearing undersetae; oversetae decumbent, 9, nearly straight, undersetae appressed, fairly heavy, 4, diagonal where not transverse.

Holotype.—♂, MEXICO: Jalisco: Tecalitlán (26 July 1963, at lights, Ackerman and Whitehead) in USNM.

Sapintus subulatus Werner, New Species

Fig. 25

Holotype ♂.—2.56 mm, rufescent brown, legs luteous; head truncate, with dense, small, well-defined punctures, similar on prothorax. Legs and visible sternum 5 simple; tegmen (Jacaré paratype) broad at base, abruptly tapered to a sharp point from beyond middle.

Head 42/62, 51, truncate with broadly rounded temporal angles, feebly depressed at midline; eyes 25/22, 33 apart, 15 from base; punctures flat-bottomed, well-defined, ca. 1 apart, intervals smooth and ca. ½ diameter of punctures. Antenna ca. 102 long, 7 thick at segment 10. Prothorax 51/23, 53, 47, with punctures almost equal to those on head. Elytra 164/73, 95; punctures small, 4 apart, intervals flat, smooth, punctures bearing undersetae barely visible at 100 diameters; oversetae decumbent, ca. 7, slightly curved, undersetae 4, appressed, almost straight, diagonal.

Types.—Holotype ♂, COLOMBIA: Amazonas: Leticia (15 June 1965, P. R. Craig and J. Robb) in CAS. Paratypes: 13, FRENCH GUIANA: Sikini-Oyapock. TRINIDAD: La Brea. VENEZUELA: Baraquisimeto. BRAZIL: Pará/Amapá: Rio Jari. Goias: Jataí, Santa Isabel. Mato Grosso: Jacaré. Rondônia: Pôrto Velho. Paratypes in MGF, MHNP, MPEG, MZSP, and FGW collections. Specimens were recorded as being taken on vegetation, with only one at light.

Sapintus surinamensis (Pic), New Combination, New Status

Fig. 10

Anthicus guyanensis var. *surinamensis* Pic 1913: 12 (type-locality: Surinam). Type in Pic Coll., MHNP, studied.

♂.—Kobelstation, 3.60 mm, rufous brown, legs and base of antenna rufescent, head and prothorax very densely and evenly punctured. Legs and visible sternum 5 simple; tegmen broad at base, concavely tapered to sharply pointed apex.

Head 53/75, 63, base truncate with rounded temporal angles; eyes 34/30, 38 apart, 15 from base; punctures less than 2 apart, ca. 1 in diameter, flat-bottomed, some confluent, intervals convex, shiny. Antenna ca. 122 long, 9 thick at segment 10. Prothorax 75/27, 71, 57; collar very short; punctures even denser than on head but similar. Elytra 232/91, 118; punctures small but well defined, 4 apart, intervals almost flat, shiny, with very fine punctures bearing undersetae; oversetae decumbent, 11, almost straight, undersetae almost appressed, 4, moderately dense, diagonal in zone along suture.

New records.—SURINAM: Coppename (2 ♂, op gele *Solanum,* Langa soela, 26 July 1943, Geijskes), Kobelstation (1 ♂, 2 ♀, 21 Sept. 1938) in the Surinam Museum, Paramaribo, and FGW collections.

Sapintus taitiensis (Boheman)

Anthicus taitiensis Boheman 1858: 105 (type-locality: "Taiti"). Types in NRS, studied in 1958.
Anthicus (*Sapintus*) *taitiensis*: Krekich 1914: 222–223.
Sapintus taitiensis: Werner 1958: 215–216.

I have previously (1958) recorded a series of measurements of the type of this species. The ♂ lacks modifications of the legs or visible sternum 5. The name cannot be associated with any of the species included in the present paper. The locality of collection was probably somewhere in coastal Ecuador or Puna Island, despite Boheman's indication of Tahiti and that one of the types is marked "California."

Sapintus teapensis (Champion), NEW COMBINATION

Fig. 26

Anthicus teapensis Champion 1890: 249 (described from Frontera, San Juan Bautista and Teapa, Tabasco, Mexico). Type-series in BMNH, examined in 1960.

Sapintus suzelae Bonadona 1981: 278–280, Fig. 6, 12 (type-locality: Duzer, Guadeloupe, Lesser Antilles). Holotype in collection of Dr. F. Chalumeau, Pointe a Pitre, Guadeloupe; not examined. NEW SYNONYMY.

♂.—La Ceiba, Honduras, 2.10 mm, brown with luteous legs, antenna and palpi; head almost as densely punctured as prothorax; visible sternum 5 with shallow but distinct depression 13 wide, depression with longitudinal appressed pubescence, flanked by erect setae 9 long, in patches ca. 6 wide. Legs simple. Tegmen (Paramaribo, Surinam specimen) concavely tapered to a sharp point.

Head 39/53, 45, truncate with rounded temporal angles; eyes large, 22/20, 30 apart, 13 from base; punctures ca. 2 apart, flat-bottomed, only narrowly separated, occasionally confluent, obsolete on vertex; intervals smooth. Antenna ca. 78 long, 7 thick at segment 10. Prothorax 44/19, 42, 35; collar short; punctures slightly denser than on head. Elytra 145/60, 89; punctures ca. 4 apart; oversetae almost decumbent, 7, only slightly curved, undersetae ca. 4, appressed, moderately dense, diagonal.

New records.—MEXICO: Campeche: SW of Escarcega. Vera Cruz: Coatacoalco. HONDURAS: La Ceiba. JAMAICA: Spanish Town, Santa Cruz, Orange Bay. CUBA: Baracoa, Cayamas. HAITI: Desbarrière-Mt. La Hotte, Port-au-Prince. REP. DOM.: Puerto Plata, La Romana, Monte Cristi. BR. GUIANA: Mackenzie (on Demerara River). SURINAM: Paramaribo. TRINIDAD: St. Augustine. BRAZIL: Pará: Belém. Rio Grande do Norte: Macaiba. Espirito Santo: Linhares. São Paulo: Ilha dos Buzios.

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Acronyms used for indicating location of types and other specimens are those proposed by Heppner and Lamas (1982), with a few additions. These are: (AMNH) American Museum of Natural History, New York City; (BMNH) British Museum (Natural History), London, England; (CAS) California Academy of Sciences, San Francisco, California; (CU) Cornell University, Ithaca, New York; (DSC) collection of Donald S. Chandler, University of New Hampshire, Durham; (FGW) collection of the author; (FMNH) Field Museum of Natural History, Chicago, Illinois; (IAF) Instituto Agronómico, Fortaleza, Ceará, Brazil; (IML) Fundación e Instituto Miguel Lillo, Universidad Nacional de Tucumán, San Miguel de Tucumán, Argentina; (MA) collection of Col. Moaçir Alvarenga, Rio de Janeiro, Brazil; (MBR) Museo Argentino de Ciencias Naturales "Bernardino Rivadavia," Buenos Aires, Argentina; (MCZ) Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts; (MGF) Museum G. Frey, Entomologisches Institut, Tutzing, Bavaria, Germany; (MLP) Facultad de Ciencias Naturales y Museo, Universidad Nacional de La Plata, La Plata, Argentina; (MHNP) Muséum National d'Histoire Naturelle, Paris, France; (MNRJ) Museu Nacional, Rio de Janeiro, Brazil; (MPEG) Museu Paraense Emilio Goeldi, Belém, Pará, Brazil; (MZSP) Museu de Zoologia, Universidade de São Paulo, São Paulo, Brazil; (NHMV) Naturhistorisches Museum, Vienna, Austria; (NRS) Naturhistoriska Riksmuseet, Stockholm, Sweden; (OSU) Ohio State University, Columbus; (OSUC) Oregon State University, Corvallis; and (USNM) National Museum of Natural History, Smithsonian Institution, Washington, D.C.

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HARMOSTES FRATERCULUS (HEMIPTERA: RHOPALIDAE): FIELD HISTORY, LABORATORY REARING, AND DESCRIPTIONS OF IMMATURE STAGES

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Abstract.—Seasonal history of the rhopalid *Harmostes fraterculus* (Say) was followed in south central Pennsylvania during 1978–81. Adults of this more southern, apparently migrant species appeared in late July to early August. A first Pennsylvania generation developed in flower heads of the composite *Eupatorium fistulosum* Barratt in August and early September; a second generation was produced on this host and on *E. perfoliatum* L. during mid-September and October. A hypothesis is proposed to explain its migratory flight. Notes on oviposition and mating behavior are given, duration of the egg and nymphal stages is recorded, and all immature stages are described and illustrated.

Harmostes fraterculus, described from Indiana and Georgia in the genus *Syromastes* (Say, 1831), was placed in the largely Neotropical genus *Harmostes* Burmeister by Stål (1870). One of the few widely distributed species of the genus in North America, this rhopalid is uncommon in most collections and apparently is less frequently collected than the wide-ranging *H. reflexulus* (Say). Torre-Bueno (1941) defined the range of *H. fraterculus* as New Jersey south to Florida, west to California and Arizona, and through Mexico into Central America. In a generic revision, Göllner-Scheiding (1978) noted that in the eastern United States she had seen specimens from as far north as Pennsylvania. *Harmostes fraterculus* is known to occur as far south as Guatemala and in South America is replaced by the closely related *H. parafraterculus,* described by Göllner-Scheiding (1978).

With the exception of Yonke and Walker's (1970a, b) study of *H. reflexulus,* the field biology and immature stages of *Harmostes* species are poorly known. Information on *H. fraterculus* is limited to notes on habits and host associations. Rosenfeld (1911) observed adults overwintering in Spanish moss in Louisiana. Blatchley (1926), Froeschner (1942), and Hoffman (1975) reported collections from "boneset" and "Joe Pye weed," plants of the composite genus *Eupatorium.* Nymphs have been found on various ragweed species in southern California: *Ambrosia acanthicarpa* Hooker (Goeden and Ricker, 1974), *A. dumosa* (Gray) Payne (Goeden and Ricker, 1976a), and *A. chenopodiifolia* (Benth.) Payne (Goeden and Ricker, 1976b). In Mexico, Brailovsky and Soria (1981) collected *fraterculus* on composites of the genera *Eupatorium, Haplopappus,* and *Verbesina.*

In September 1978 we found large populations of *H. fraterculus* on *Eupatorium fistulosum* Barratt at two sites near Harrisburg, Pennsylvania. We had not collected this rhopalid previously in the state, and the few Pennsylvania specimens we located in various insect collections had been taken in late summer or early fall. Coupled with its absence from nearby colonies of the same host, we suspected *H. fraterculus* was a migrant in Pennsylvania, populations occurring north of the permanent range only in certain years, as is known for heteropterans like the harlequin bug, *Murgantia histrionica* (Hahn). We began studies in 1979 to elucidate the seasonal history of Pennsylvania populations and to determine whether this rhopalid overwinters in the state. In this paper we present a generalized seasonal history for *H. fraterculus* in Pennsylvania, report on certain aspects of its habits in the laboratory, and describe and illustrate the immature stages.

STUDY AREAS AND METHODS

Field studies.—Seasonal history was observed periodically at two sites near Harrisburg (Dauphin Co.), Pennsylvania, from late September to early November 1978 and at regular intervals at these and additional areas during 1979–81. The main sites for field work, about 10 km apart, were low-lying areas along streams that were dominated by colonies of Joe-Pye weed, *Eupatorium fistulosum,* a perennial herb of moist habitats which, like most members of the genus, has corymbose, discoid heads. Boneset, *E. perfoliatum* L., was common at one of the sites.

During spring and early summer 1979–82 we collected extensively near the study areas to try to find overwintering individuals of *H. fraterculus*; once flower buds of *E. fistulosum* were well developed (late June to early July), we concentrated on sampling the host plants rather than on general collecting. When adult rhopalids appeared on the hosts (late July to early August), we sampled the plants weekly or biweekly through September in 1979 and until mid-October in 1980; periodic observations were continued until November. Samples were taken by tapping flower heads of the host over a small tray, collecting 10 to 20 nymphs (except when first instars were scarce in early samples), and sorting them to stage in the laboratory. The relative proportion of adults to nymphs was estimated in the field at each sample date.

Laboratory studies.—Field-collected adults were placed in small, plastic petri dishes containing florets of *E. fistulosum* and a source of moisture, and were held at 20–22°C under an approximate 12-h photoperiod. We made notes on mating and oviposition behavior and removed eggs to individual dishes to determine incubation times and duration of nymphal stages. We tried to rear *H. fraterculus* on sunflower seeds soaked in water and cracked in half, the technique used by Yonke and Walker (1970a) to rear *H. reflexulus.* The mortality, however, was so great, particularly with early-stage nymphs, that we had to substitute excised disc flowers of Joe-Pye weed. A small portion of the cyme, consisting of 6–8 capitula, was cut from a flower head and the stalk inserted through Parafilm® stretched over the opening of a glass genitalia vial filled with water. Even then, a high mortality prevented us from rearing any individual from egg to adult. Therefore, the developmental times obtained are based partially on determination of instars for field-collected nymphs of various stages.

DESCRIPTIONS

Fifth instar (in alcohol, $n = 5$) (Fig. 1).—Elongate-pyriform, somewhat dorsoventrally flattened, testaceous, mottled or reticulate with brown or reddish brown, often forming small to large testaceous spots, a pale stripe along meson from anterior margin of pronotum onto scutellum. Antenna cylindrical, segment I shorter, broader, II and III distinctly flattened, IV fusiform. Dorsum covered with numerous fine setae, most arising from tubercles or white papillae. Wing pads reaching 3rd or 4th abdominal segment, their apices sometimes dark brown; dorsal abdominal scent glands opening between tergites IV–V and V–VI, surrounded by dark rims; trichobothrial pattern as in Fig. 2. Legs dark brown, femora with small testaceous spots; metafemora with 2 stout spines on ventral aspect near apex.

Length 4.58–6.17 mm, $\bar{x} = 5.55$. Head, length 1.04–1.20 mm, $\bar{x} = 1.16$; width 0.90–1.00 mm, $\bar{x} = 0.95$; interocular space 0.64–0.70 mm, $\bar{x} = 0.66$. Protergal length 0.60–0.64 mm, $\bar{x} = 0.62$; humeral width 1.54–1.64 mm, $\bar{x} = 1.60$. Antennal lengths I, 0.36–0.40 mm; II, 0.66–0.70; III, 0.68–0.74; IV, 0.60–0.64. Labial lengths I, 0.80–0.86 mm; II, 0.70–0.74; III, 0.66–0.78; IV, 0.62–0.70, reaching beyond metacoxae to 2nd abdominal segment.

Fourth instar (in alcohol, $n = 3$ (Fig. 3).—Form and color similar to 5th instar, the white papillae on dorsal surface of abdomen and spines on metafemora less distinct. Wing pads reaching 2nd abdominal segment.

Length 3.84–4.40 mm, $\bar{x} = 4.16$. Head, length 0.94–1.10 mm, $\bar{x} = 1.04$; width 0.76–0.80, $\bar{x} = 0.78$; interocular space 0.52–0.54 mm, $\bar{x} = 0.53$. Protergal length 0.42–0.46 mm, $\bar{x} = 0.44$; humeral width 1.12–1.16 mm, $\bar{x} = 1.13$. Antennal lengths I, 0.30–0.34 mm; II, 0.52; III, 0.54–0.56; IV, 0.50–0.52. Labial lengths I, 0.66–0.70 mm; II, 0.60; III, 0.52–0.60; IV, 0.60–0.64.

Third instar (in alcohol, $n = 4$) (Fig. 4).—Similar to preceding instar, but more elongate, the reddish markings less intense, the tubercles and white papillae less distinct. Mesothoracic wing pads covering metathoracic pads, which extend to 1st abdominal segment. Labium reaching 3rd abdominal segment.

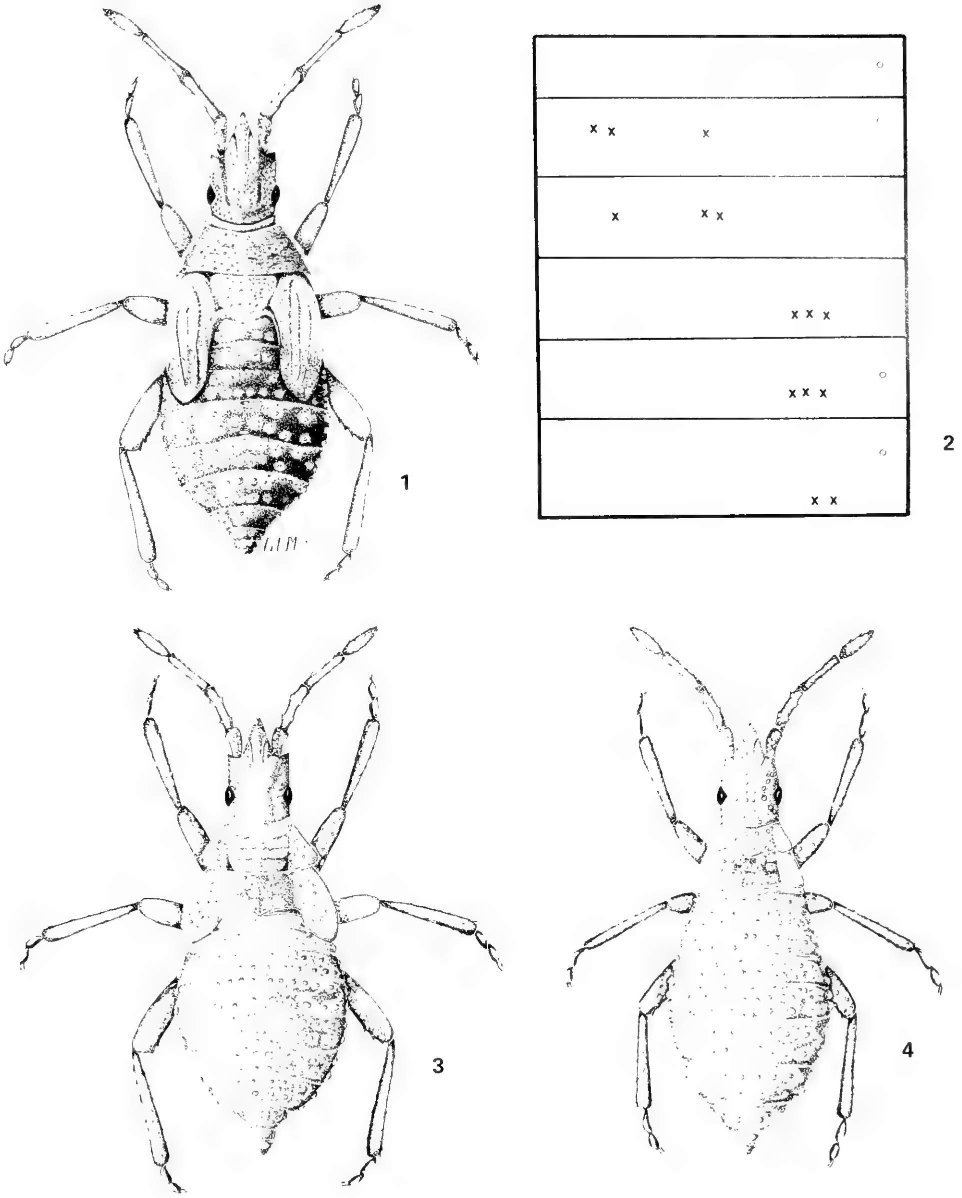
Length 2.60–3.20 mm, $\bar{x} = 2.96$. Head, length 0.74–0.80 mm, $\bar{x} = 0.78$; width 0.60–0.62 mm, $\bar{x} = 0.61$; interocular space 0.42–0.44 mm, $\bar{x} = 0.43$. Protergal length 0.26–0.28 mm, $\bar{x} = 0.27$; humeral width 0.76–1.04 mm, $\bar{x} = 0.85$. Antennal lengths I, 0.20–0.28 mm, II, 0.36–0.40; III, 0.40–0.42; IV, 0.40–0.44. Labial lengths I, 0.50–0.52 mm; II, 0.44–0.46; III, 0.40–0.46; IV, 0.50–0.54.

Second instar (in alcohol, $n = 4$) (Fig. 5).—More pyriform and paler than preceding instar; integument appearing more smooth.

Length 2.04–2.20 mm, $\bar{x} = 2.09$. Head, length 0.58–0.64 mm, $\bar{x} = 0.61$; width 0.40–0.46 mm, $\bar{x} = 45$; interocular space 0.28–0.34 mm, $\bar{x} = 0.33$. Protergal length 0.16–0.18 mm, $\bar{x} = 0.17$; humeral width 0.48–0.68 mm, $\bar{x} = 0.61$. Antennal lengths I, 0.14–0.18 mm; II, 0.24–0.28; III, 0.28–0.30; IV, 0.32–0.34. Labial lengths I, 0.36–0.40 mm; II, 0.34–0.40; III, 0.30–0.32; IV, 0.42–0.44.

First instar (in alcohol, $n = 2$) (Fig. 6).—More elongate, less dorsoventrally flattened than preceding instars; dorsal abdominal scent gland openings indistinct; labium sometimes extending beyond abdomen.

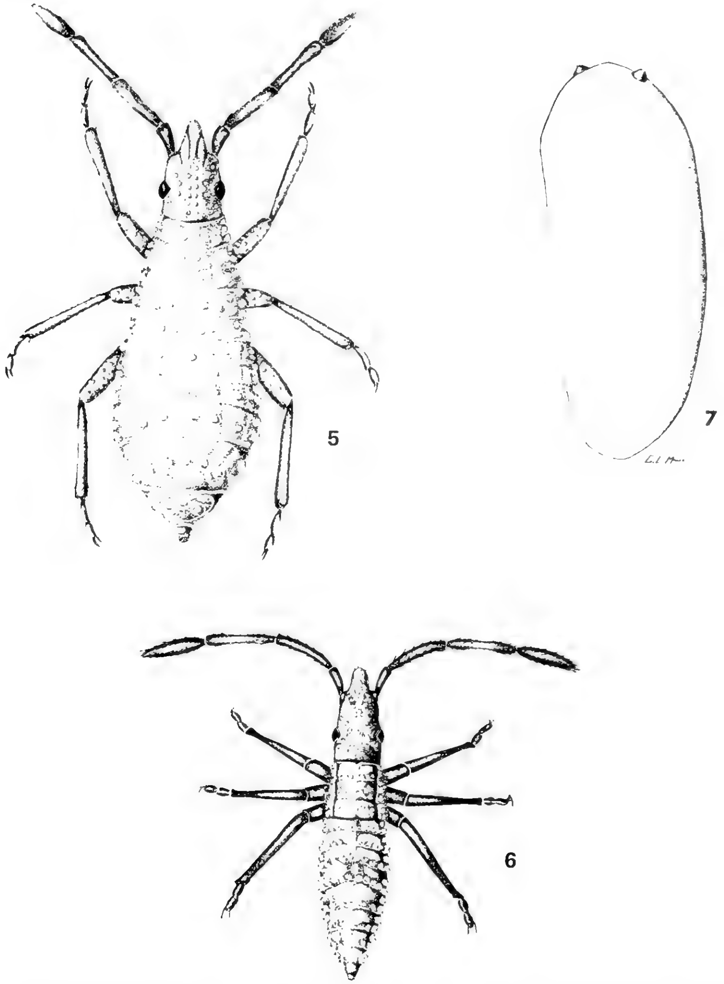
Length 1.40–1.42 mm, $\bar{x} = 1.41$. Head, length 0.42–0.44 mm, $\bar{x} = 0.43$; width 0.34; interocular space 0.24–0.26, $\bar{x} = 0.25$. Protergal length 0.28–0.30 mm, $\bar{x} = 0.29$; humeral width 0.36–0.40 mm, $\bar{x} = 0.38$. Antennal lengths I, 0.14 mm; II,



Figs. 1–4. *Harmostes fraterculus* nymph. 1, Fifth instar. 2, Trichobothrial pattern of fifth instar; diagram represents left side of abdominal sterna II–VII and shows trichobothria (X) and spiracles (O). 3, Fourth instar. 4, Third instar.

0.20–0.22; III, 0.24–0.26; IV, 0.30–0.34. Labial lengths I, 0.34–0.38 mm; II, 0.32; III, 0.30–0.32; IV, 0.40.

Egg ($n = 5$) (Fig. 7).—Length 1.00–1.06 mm, $\bar{x} = 1.03$. Elongate oval, white when deposited, turning orange to dark brown before hatching, distinct sculpturing



Figs. 5–7. *Harmostes fraterculus* nymph and egg. 5, Second instar. 6, First instar. 7, Egg.

apparently absent; 2 distinct micropylar processes or aero-micropyles at anterior pole, the form typical of rhopalid eggs except for absence of a ventral attachment stalk (see Southwood, 1956; Cobben, 1968).

BIOLOGY

Seasonal history.—Adults first appeared on flower heads of their host plants during the last week of July in 1979 and the first week of August in 1980, just as a few flowers of Joe-Pye weed were beginning to open. In both years the seasonality of populations was similar, and the phenological pattern here presented is based on a composite of 1979–80 samples supplemented by observations made in 1978 and 1981.

During the week following their first collection, adults increased noticeably in numbers, and mating pairs were observed on flower heads of *E. fistulosum*. First-instar nymphs were found two to three weeks after the appearance of adults, and

Table 1. Duration (in days) of egg and nymphal stages of *Harmostes fraterculus* reared at 20–22°C.

Stage	No. Observations	Range	Mean ± s[1]	Cumulative Mean Age
Egg	21	8–9	8.2 ± 0.40	—
Nymphal stages				
I	17	3–5	3.3 ± 0.61	3.3
II	12	2–6	3.3 ± 0.98	6.6
III	11	2–5	3.3 ± 0.90	9.9
IV	18	3–7	4.1 ± 1.13	14.0
V	24	4–8	5.4 ± 1.02	19.4

[1] Standard deviation.

by late August populations consisted mainly of third instars. Oviposition apparently continues for several weeks because nymphs of three stages often were present in samples; occasionally all five stages were found. Teneral adults of a first Pennsylvania generation were observed during the first week of September when fourth and fifth instars were predominant in the population.

During mid-September, the number of first-generation adults increased, late-instar nymphs were still common, and eggs and instars I–II of a second generation were observed. With a deterioration of food resources on their hosts, late-maturing, first generation females appeared to oviposit mainly in the few flowering heads that remained; late in the season adults and nymphs were most abundant in heads bearing a few flowers, or in withered heads that had not completely dried. Although the first generation was found only on *E. fistulosum* at the sample sites (and once on the Joe-Pye weed *E. purpureum* L. in a nearby, much drier habitat), the second generation developed partially in heads of boneset, *E. perfoliatum,* occurring near patches of *E. fistulosum.* Boneset flowers usually were available for several weeks after those of Joe-Pye weed had dried up.

Adults of the second generation were observed as early as the last week of September. A few fifth instars were present until mid-October, and adults could be found until late October or early November.

Laboratory studies.—Field-collected pairs mated readily in rearing containers, sometimes remaining *in copula* for several hours. In an apparent absence of elaborate pre-copulatory behavior, the male simply crawled over the female; if receptive, she remained motionless, and he inserted his aedeagus. At first, the pair assumed a side-to-side position, then often oriented tail-to-tail. Mutiple matings were observed for several pairs.

The single female observed in oviposition crawled over and probed the excised florets, and thrust her ovipositor into the disc flowers. Oviposition times ranged from 35 s to 1 min 5 s ($\bar{x} = 53$ s, $n = 5$). Eggs usually were deposited singly into disc flowers and placed on the inner edge of involucral bracts, on ovaries, or on the pappus; a few were laid in clusters of two or three.

The average incubation time was 8.2 days (Table 1). Instars I–III each averaged 3.3 days; the duration of the fourth stage was slightly longer, and the fifth stage was the longest. We were unable to rear *H. fraterculus* from egg to adult, and the average of 19.4 days required for nymphal development is based partly on times determined for field-collected nymphs. Even though our data cannot be compared directly to those of Yonke and Walker (1970a), who reared 67 nymphs of *H. reflexulus* from egg to adult, our 19.4 days is close to the 21.7 days required for the development of *reflexulus* nymphs.

Discussion

Our field studies, although contributing to the biological knowledge of a poorly known species, raise several questions. Is *Harmostes fraterculus* capable of overwintering in south central Pennsylvania? Based on the data now available, we believe this rhopalid migrates into the area during late summer of most years and is near the northern limits of its range. The only evidence tending to negate a migratory theory is the appearance of populations at the sample sites for three consecutive seasons; one might not expect a "fall out" to occur each season in the same colonies of *Eupatorium*. Still, the large size of the colonies under observation and the patchiness of rhopalid populations in nearby areas, coupled with the additional information to be presented, reinforce our original assumption regarding the status of *H. fraterculus* in Pennsylvania.

Pennsylvania specimens of this rhopalid are scarce in the insect collections we examined (American Museum of Natural History—AMNH; Cornell University—CU; New York State Museum—NYSM; and National Museum of Natural History—USNM), and none was taken before August. Göllner-Scheiding's (1978) record is the only published one from the state. In tracking Joe-Pye weed north from the Harrisburg area, we found populations in Columbia and Northumberland counties, but we did not collect specimens in the extreme northern counties or in southern New York. There are no New York specimens in the collections of AMNH, CU, NYSM, or USNM. The Canadian record Göllner-Scheiding (1978) had in mind undoubtedly is that of Provancher (1886), which was based on a misidentification of the lygaeid *Ortholomus scolopax* (Say) (see Van Duzee, 1912: 319; Slater, 1964: 341).

At the two main sample sites and additional areas near Harrisburg we have never encountered adults of *H. fraterculus* before late July, even though extensive surveys have been conducted for this study and as part of projects involving other insects. We have, however, made early-season collections of adults of *H. reflexulus* and have found nymphs developing on yarrow, *Achillea millefolium* L., during June.

It appears that *H. fraterculus* overwinters within 100 miles of Harrisburg. We have seen specimens collected from early April and May in the northern Virginia and Washington, D.C., area (CU, USNM) and one taken "under sign board on tree" at Cape May Courthouse, N.J., on March 29 (AMNH).

Like *H. reflexulus, H. fraterculus* apparently overwinters in the adult stage in its permanent range, at least as far north as the Washington area and southern New Jersey. This rhopalid is closely associated with Joe-Pye weed, not only in Pennsylvania but farther south; we have collected nymphs from *E. fistulosum* (and *Conyza canadensis* (L.) Cronq.) in North Carolina. *Eupatorium* spp. and *C. canadensis* do not bloom until mid- to late summer. What happens to populations of the rhopalid earlier in the season? Have early-season generations been overlooked on a composite of the same tribe or some other composite? Does the bug use a succession of hosts like *H. reflexulus* (Yonke and Walker, 1970a) and the lygaeids *Lygaeus equestris* L. (Solbreck and Kugelberg, 1972) and *L. kalmii* L.

(Hunt, 1979)? Or, in the northern fringes of its range, is *fraterculus* "getting by" on plants of unrelated families before *Eupatorium* comes into bloom? Is it possible that this rhopalid, essentially a southern species that ranges into Central America, does not breed until late summer under more northern photoperiods? The pentatomid *Proxys punctulata* (Palisot de Beauvois) has a similar range, and breeding populations are known from as far north as southern Illinois where adults do not emerge from overwintering sites and begin to reproduce until mid- to late June (Vangeison and McPherson, 1975).

Although further study is needed to clarify some of these points, we believe the following summary provides the most logical explanation of seasonality for *H. fraterculus* in Pennsylvania. Our hypothesis also may be relevant to populations of other rhopalids and to certain species in other families of Hemiptera-Heteroptera.

As a specialist herbivore on flower heads of composites growing in somewhat temporary habitats, *H. fraterculus* engages in migratory or nontrivial flights. Rhopalid adults have been collected by day at heights of 200–5000 ft. (61–1523 m) and at night at 500–5000 ft. (152–1253 m) (Glick, 1939). Southwood and Leston (1959) regard the rhopalid *Liorhyssus hyalinus* (F.) as a migrant insect in England. For *H. fraterculus,* migratory movements, perhaps combining active flight with passive dispersal on convective air currents, could be nonspecific in direction but still adaptive because food resources presumably would be available in all directions and at all distances. As Dingle (1972) and others have noted, most small migrant insects undergo unspectacular movements that make migratory flights difficult to detect. Outbursts or irruptions of *H. fraterculus* in all directions from a "core" population most likely would be detected only in areas north of the permanent range, e.g., Pennsylvania. In most cases of successful colonization of *Eupatorium,* the rhopalid would be able to overwinter. In Pennsylvania there also is the possibility of a late-fall, return flight. In northern areas of its range, the large milkweed bug, *Oncopeltis fasciatus* (Dallas), is thought to migrate south with northerly winds as day length decreases in autumn (Dingle, 1972).

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CELTICECIS (DIPTERA: CECIDOMYIIDAE), A NEW GENUS FOR GALL MAKERS ON HACKBERRIES, *CELTIS* SPP. (ULMACEAE)

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Abstract.—A new genus, ***Celticecis***, is described for ten species of Cecidomyiidae (Diptera) that cause various leaf and twig galls on hackberries, *Celtis* spp. (Ulmaceae) and which were formerly placed in catch-all genera. The type-species of *Cecidomyiaceltis* is shown to belong to the Agromyzidae (Diptera), so the name is unavailable for these gall midges. Ten new combinations are proposed, and a lectotype for *Mayetiola celtiphyllia* Felt is selected.

Ten described species of North American gall midges form spinelike, spherical, or cylindrical galls on leaves and twigs of hackberries, *Celtis* spp. (Ulmaceae). These cecidomyiids are monophyletic but have been placed in catch-all genera. Species known from adults were placed in *Mayetiola* (also known as *Phytophaga* in Felt (1915, 1940)) or *Cecidomyia* but in fact have only distant connections with those genera. Five species known only from galls were originally placed in *Cecidomyiaceltis* but were listed as unplaced Cecidomyiidae by Foote (1965). A new genus is described for these species to characterize them as a discrete group and to separate them from *Mayetiola* in the broad sense.

Cecidomyiaceltis was described by Patton (1897) in partial demonstration of a method for naming galls whose makers were unknown. He formed the name by combining the generic names of the insect (in this case *Cecidomyia* in the broad sense) and plant. Patton chose as type-species of *Cecidomyiaceltis, C. deserta,* n. sp., named for long, hollow swellings of young twigs (see Felt 1940, fig. 189) of *Celtis occidentalis* L. in Orange, Conn. Patton wrote that single "cecidomyian flies" emerged about the first of June from a perforation near the base of the gall. Whether he saw a cecidomyiid fly, or more properly a larva, emerge is unknown. Although that name and others were based only on galls, the *International Code of Zoological Nomenclature* (1964) accepts as valid those names proposed before 1931 if based either on the work of an animal or a bibliographic reference to such. Patton (1897) also named and included in *Cecidomyiaceltis* five species on the basis of complicated leaf and twig galls from Texas described earlier without names by Riley (1890): *Cecidomyiaceltis oviformis, C. semenrumicis, C. pubescens, C. capsularis,* and *C. spiniformis.* Riley's gall material is in the USNM and contains gall midge larvae generically similar to those of species reared and described by Felt and Beutenmüller from other hackberry leaf galls. These larvae are so distinctive that one can confidently assume that adults reared from Patton's species will fit quite well in *Celticecis* as defined here. Whether *Cecidomyiaceltis* was an unavailable name for the complicated leaf and stem gall makers, as well as for the simple stem swelling, depended on what produces the latter.

Wells (1916), in a paper on the morphology of various hackberry galls, showed photographs and drawings of *Cecidomyiaceltis deserta* swellings on *Celtis occidentalis* from Kansas. He thought that the gall could be formed by a lepidopteran but never made a definite connection between any lepidopteran and the gall. I recently discovered that the gall is actually formed by an agromyzid (Diptera). During the second week of April, 1982, in the Washington, D.C., area, I noticed the galls developing on lateral shoots of *C. occidentalis.* Normal shoots lengthened to 10–15 cm or more in about two weeks, but galled shoots remained only 1–4 cm long and swelled considerably. The terminal pair of leaves on galled shoots, the probable entry point of the maggot, soon died and turned brown, but the twig and lateral leaves remained green for several weeks. The agromyzid maggot, one in each gall, fed towards the base of the twig. When the maggots were full grown in the first week in May, they cut a circular hole at the base of the swollen twig, crawled out, and dropped to the duff. Puparia I placed in a rearing chamber were killed by nematodes. The name *Cecidomyiaceltis deserta* refers to that agromyzid, the true gallmaker, and not to a cecidomyiid.

The new genus, *Celticecis,* is in the same large tribe, the Oligotrophini, as *Mayetiola,* but the two are readily separable. In the key to cecidomyiid genera in Gagné (1981), the species on *Celtis* are already separated from *Mayetiola* spp. in the strict sense because the latter have toothed instead of simple claws. In addition to that difference, *Celticecis* spp. have a greatly reduced complement of larval papillae, do not form a puparium, and the adult abdominal sternites are broader than long. In Gagné (1981) the new genus keys to couplet 182 as *Mayetiola,* s.l., where it is combined with three species affecting willow buds. A couplet 182a to differentiate between the hackberry and willow midges of erstwhile *Mayetiola,* s.l., is as follows:

182a. Caudal row of setae on tergites 2–6 continuous; empodia as long as tarsal claws; from leaf galls on *Celtis*; 10 spp. ..... *Celticecis,* new genus [The 5 spp. in unplaced Cecidomyiidae in Foote (1965) were unaccounted for in Gagné (1981).]

– Caudal row of setae on tergites 2–6 interrupted mesally; empodia appreciably longer than tarsal claws; from bud galls on *Salix*; 3 spp. .... *Mayetiola* Kieffer (sensu lato)

***Celticecis* Gagné, NEW GENUS**

Adults.—Eyes large, broadly joined at vertex, the facets closely approximated except laterally. Male flagellomeres 14–21, necks shorter than nodes. Female flagellomeres 14–25, with very short necks. Labellae hemispherical, setose. Palpus 4-segmented, segment 2 widest, 4 longest, all with many setae.

Mesonotum with 4 longitudinal setal rows without scales between. Anepisternum scaled dorsally, anepimeron with setae, no scales. Wing with R_5 straight, joining C at or slightly anteriad of wing apex. Claws simple, narrow, curved beyond midlength. Empodia about as long as claws. Pulvilli about ⅓ as long as claws.

Tergites 1–7 in male and 1–6 in female rectangular, much wider than long, with basal pair of widely separated, long trichoid sensilla (length ca. 5× width of socket, continuous caudal rows of setae, no lateral setae except on tergites 6–7 of male, 6 of female, and covered elsewhere with scales. Male tergite 8 shorter than preceding tergites, sclerotized only basally but with caudolateral and lateral setae, 2 trichoid sensilla, and scattered, sparse scales. Female tergite 7 almost square, with 2 trichoid sensilla, several rows caudal setae, and scattered scales on caudal ½; tergite 8 much longer than wide, entire or divided longitudinally depending on length of ovipositor, with pair of basal trichoid sensilla and scattered short setae caudally, bare elsewhere.

Sternites 2–8 in male, 2–6 in female rectangular, wider than long, with basal pair of closely approximated, long trichoid sensilla, caudal rows of setae and a band of setae, more numerous laterally, across midlength, scattered setae elsewhere. Sternite 7 of female longer than wide, otherwise as for preceding sternites, sternite 8 unsclerotized, with only basal pair of trichoid sensilla. Pleura covered with scales.

Ovipositor long, the distal ½ at least several times as long as tergite 7. Cerci fused, subspherical to elongate. Male genitalia: gonopod long, setose on full length ventrally, distal ⅔ dorsally; gonostylus tapering from wide base to pointed apex, setulose at least basally, striate at least apicodorsally; hypoproct divided caudally, the lobes narrow, parallel sided; aedeagus and claspettes shorter than gonopods; gonocoxal apodeme broad.

Pupa.—Antennal horns not prominent. Pronotal setae and prothoracic spiracles long. Clypeus with 4 papillae in center of sclerite, the 2 uppermost setose. Abdomen dorsally and ventrally uniformly setulose except bare in intersegmental areas.

Larva (last instar).—Robust, stout. Integument pebbled throughout. Spatula broad, developed only cephalically, with 1–3 triangular points cephalad. Lateral papillae reduced to 2 on each side of spatula, the more mesal one with a short seta. Abdominal segments 1–7 each with 2 anterior ventral papillae, 8th segment without ventral papillae; otherwise with basic pattern of papillae. Terminal segment with 4 papillae, 2 per side, each with seta of uniform length.

Type-species.—*Celticecis celtiphyllia* (Felt).

Remarks.—The name *Celticecis* means "Celtis gall." It is of feminine gender. Species included in *Celticecis* (all are New Combinations) are:

C. capsularis (Patton) 1897: 248 (*Cecidomyiaceltis*).

C. celtiphyllia (Felt) 1908: 371 (*Mayetiola*). A lectotype is designated here because Felt's type-series evidently contains 2 species, and I have designated *celtiphyllia* as type-species. Lectotype, ♂, Keokuk, Iowa, emerged V-1900, J. M. Schaffer, C913, USNM Type No. 29325. Paralectotypes, 5 ♂, same data as lectotype, and 3 ♂, Corpus Christi, Texas, 1895, E. A. Schwarz, C918, all in the National Museum of Natural History, Washington, D.C. (USNM).

C. oviformis (Patton) 1897: 248 (*Cecidomyiaceltis*).

C. painteri (Felt) 1935: 7 (*Phytophaga*).

C. pubescens (Patton) 1897: 248 (*Cecidomyiaceltis*).

C. semenrumicis (Patton) 1897: 248 (*Cecidomyiaceltis*).

C. spiniformis (Patton) 1897: 248 (*Cecidomyiaceltis*).

C. texana (Felt) 1935: 8 (*Phytophaga*).

C. unguicula (Beutenmüller) 1907: 388 (*Cecidomyia*).

C. wellsi (Felt) 1916: 190 (*Phytophaga*).

Galls made by *Celticecis* spp. form on new plant growth in spring and soon attain their distinctive and maximum size and shape. When the larvae are full grown in summer, they spin a cocoon within the gall. The galls drop from the leaves some time before normal leaf fall. Adults emerge the following spring. Details on the biology of various species can be found in Felt (1915, 1916), Painter (1935), and especially Moser (1954, 1965). Moser (1965) wrote that more than one species was possibly involved in one kind of gall. He tentatively considered *C. unguicula* (Beutenmüller) a junior synonym of *C. spiniformis* (Patton) because of the galls' similarity, but I am considering the two as separate species here (as they were in Foote, 1965) because of the larval differences Moser noted. The type-series of *C. celtiphyllia* is itself a mixture of two species, one from Iowa, the other from Texas. It is clear that a taxonomic study of the genus will depend on good collections across geographical and host ranges. Fewer species of *Celtis* occur in the United States than south of the U.S.-Mexican border. Moser (1954) presents a complete list. Moser (1965) found "*C. spiniformis*-type" galls on *C. occidentalis, C. laevigata* Willd. and "*C. reticulata* Torr." in the United States and on *C. siniensis* Pers. from Honshu, Japan. Yukawa (1976, 1982) has reported on that and another, slightly different, gall from Japan, but the cecidomyiids have not yet been described. No cecidomyiid galls have been found to date on European *Celtis* spp.

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TYPES OF NEOTROPICAL TELENOMINAE DESCRIBED BY W. H. ASHMEAD AND P. CAMERON (HYMENOPTERA: SCELIONIDAE)

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Abstract.—The status and location of primary types of Neotropical Telenominae described by P. Cameron and W. H. Ashmead are reviewed. Lectotypes are designated for *Phanurus affinis* Ashm., *Telenomus albitarsis* Ashm., *T. cubiceps* Ashm., *T. difformis* Ashm., *T. flaviventris* Ashm., *T. flavopetiolatus* Ashm., *T. flavicornis* Ashm., *T. fuscicornis* Ashm., *T. impressus* Ashm., *T. luteipes* Ashm., *T. magniclavus* Ashm., *T. nigriclavatus* Ashm., *T. pygmaeus* Ashm., *T. smithii* Ashm., and *Trissolcus laticeps* Ashm. The holotypes of *Telenomus confusus* Ashm., *T. fuscipennis* Ashm., *T. meridionalis* Ashm., and *T. monilicornis* Ashm. have been housed in the collection of the National Museum of Natural History, Washington, D.C., since their description. All primary types described from telenomine material collected by H. H. Smith from the Lesser Antillean islands of St. Vincent and Grenada are deposited in the collection of the British Museum (Natural History), London.

The systematics of the subfamily Telenominae (Hymenoptera: Scelionidae) has long been neglected. Most of the work on the New World species was conducted around the turn of the century. The short descriptions by these early workers generally are insufficient to recognize their species. The study of type specimens is therefore of primary importance.

The types of Neotropical telenomines described by William H. Ashmead (1894, 1895a, 1895b) and Peter Cameron (1891, 1913) have been housed in the collections of the National Museum of Natural History (USNM) in Washington, D.C., and the British Museum (Natural History) (BMNH) in London. Masner (1965) and Masner and Muesebeck (1968) have designated lectotypes and summarized information on many proctotrupoid species in these collections. Some species, however, were purposely not discussed in either paper in order to avoid misinterpretation. For others there are discrepancies between published information and the specimens. This paper is intended to resolve these problems and provide a stable nomenclatural base for the taxonomy of Neotropical telenomines. Many of the syntype series discussed below are obviously samples of more than a single species. I have been very conservative in designating paralectotypes because of the difficult taxonomic problems in this subfamily. Except where noted, all holotypes and lectotypes are now deposited in the collection of the British Museum (Natural History). I have therefore cited the USNM type numbers only on those specimens that actually bear the Museum's numbered type labels.

SPECIES DESCRIBED BY P. CAMERON

Telenomus amazonicus Cameron and *Telenomus melanogaster* Cameron

Telenomus (*Phanurus*) *Amazonica* Cameron, 1891: 190, fig. 4, 4a, ♀. Type locality: Amazon valley. Host: hemipteran egg.
Phanurus amazonicus: Dalla Torre, 1898: 521.
Microphanurus amazonicus: Kieffer, 1926: 110.
Telenomus amazonicus: Masner, 1965: 110 (♂!).
Telenomus melanogaster Cameron, 1891: 189, ♂. Type locality: Amazon valley. Host: hemipteran egg.
Microphanurus melanogaster: Kieffer, 1926: 109.
Telenomus melanogaster: Masner, 1965: 116 (♀!).

Telenomus melanogaster was described by Cameron as a unique male with xanthic head and mesosoma and black metasoma. *Telenomus amazonicus* was a chromatically typical female with the head and body entirely black. Cameron referred four female specimens to *T. amazonicus*. When I examined the "holotypes" of these species I found that the color and sex of the two specimens did not match their original descriptions. Under the name *amazonicus* was a bicolored male that agreed with Cameron's short description of *melanogaster*, even to the artifactual discolorations of the head and mesosoma. In addition, three females, mounted together on a single card, were in the general collection identified as *amazonicus*; these specimens are conspecific with the female labelled as *melanogaster* in the type collection. Cameron's determination labels were apparently exchanged between the two holotypes before Masner studied them in 1961. I have attached labels to the holotypes indicating their true identity: the male, *melanogaster*; the female, *amazonicus*. (The correct assignment of names may be a moot question. Both "species" were apparently reared from a single egg mass, and further collections will probably show this to be a single, sexually dichromatic species.)

All the holotypes of other Neotropical telenomine species described by Cameron are in the collection of the BMNH: *Telenomus atripes*, *T. dilophonotae*, *T. longiventris*, *T. pulchricornis*, and *Trissolcus leviventris*.

SPECIES DESCRIBED BY W. H. ASHMEAD

Under the terms of an agreement between the USNM and the BMNH some of the species of parasitic Hymenoptera collected by H. H. Smith in the West Indies were to be described by USNM personnel (Ashmead, 1894, 1895b) and the types deposited in the BMNH. Ashmead did not designate holotypes for his species, but did label some specimens (apparently not all) of most of the series as "Type." For unknown reasons, some of these "types," and even some unique specimens, were not sent to London. The type series from Smith's collections has therefore been split between the two museums. Masner (1965) dealt with some of these species and designated lectotypes where long series existed in the BMNH. He also pointed out the unique specimens (= holotypes) stored in London. Several species, however, have not yet been treated. Through the kindness of Dr. Paul M. Marsh (for access to the collection at the USNM) and Mr. Nigel D. M. Fergusson (BMNH), I have been able to unite the type series for all of Ashmead's species, and from this material to choose lectotypes where they are needed.

Telenomus affinis (Ashmead)

Phanurus affinis Ashmead, 1894: 200–201, ♀. Type locality: St. Vincent. Host: unknown.
Liophanurus affinis: Kieffer, 1912: 61.
Liophanurus affinis: Kieffer, 1926: 79–80.

BMNH: no material. USNM: 1 ♀ from St. Vincent, 1 ♂ without labels (specimens not conspecific). Ashmead's original description was based on two females. **Lectotype** ♀ (here designated): "St. Vincent; W. I.; H. H. Smith. ♀ Type No. 2507; USNM. Phanurus affinis Ashm. ♀ Type. Lectotype ♀, Phanurus affinis Ashm., desig. N. Johnson." Condition of specimen: A10–A11 of right antenna missing; otherwise in good condition; glued to tip of minuten.

Telenomus albitarsis Ashmead

Telenomus albitarsis Ashmead, 1895b: 795, ♂, ♀. Type locality not specified. Host: unknown.
Liophanurus albitarsis: Kieffer, 1912: 61.
Liophanurus albitarsis: Kieffer, 1926: 84.
Telenomus albitarsis: Masner, 1965: 109.

BMNH: 1 ♀ and 1 ♂ from Mt. Gay Estate, Grenada. USNM: 4 ♀ (not conspecific) from Mt. Gay Estate, St. John's River and Balthazar in Grenada. Ashmead's original description cites 1 ♂ and 5 ♀ from Mt. Gay Estate and St. John's River. **Lectotype** ♀ (here designated): "St. J hn's Riv. (sic); (Leeward side); Grenada, W.I.; H. H. Smith; 15. Telenomus albitarsis Ashm.; ♀ Type. Lectotype ♀, Telenomus albitarsis Ashm., design. N. Johnson." Lectotype is in good condition, glued on its side to a card point.

Telenomus confusus Ashmead

Telenomus confusus Ashmead, 1894: 204, ♀. Type locality: St. Vincent. Host: unknown.
Phanurus confusus: Kieffer, 1926: 63.

BMNH: 1 ♀ from St. Vincent. USNM: 1 ♀ from St. Vincent with "unique" type label in Ashmead's handwriting; 1 other ♀ from St. Vincent; 1 ♀, Mt. Gay Estate; 5 ♀, Balthazar (3–4 different species); 1 ♀ Chantilly Estate; 1 unlabelled specimen. Ashmead based his original description on a single specimen. Holotype ♀: "St. Vincent; W. I.; H. H. Smith, 241. ♀ Type; No. 2509; U.S.N.M.; Telenomus confusus Ashm.; ♀ Type; unique." The holotype is in good condition, glued by its venter to a card point.

Telenomus connectans Ashmead

Telenomus connectans Ashmead, 1895b: 792–793, ♂, ♀. Type locality not specified. Host: unknown.
Liophanurus connectans: Kieffer, 1926: 79.
Telenomus connectans: Masner, 1965: 111.

Lectotype selected by Masner (1965); specimen is from Mt. Gay Estate, Grenada.

Telenomus consimilis Ashmead

Telenomus consimilis Ashmead, 1895b: 796, ♀. Type locality: Balthazar, Grenada. Host: unknown.
Microphanurus consimilis: Kieffer, 1926: 108.
Telenomus consimilis: Masner, 1965: 111.
Telenomus consimilis: Johnson, *in press.*

This species was described from a single specimen that is stored in London.

Telenomus convergens Ashmead

Telenomus convergens Ashmead, 1895b: 795–796, ♂, ♀. Type locality not specified. Host: unknown.
Liophanurus convergens: Kieffer, 1912: 61.
Liophanurus convergens: Kieffer, 1926: 83.
Telenomus convergens: Masner, 1965: 111.

Masner (1965) designated a lectotype for this species from Balthazar, on the island of Grenada. I have subsequently treated this name as a synonym of *T. consimilis* (*in press*).

Telenomus cubiceps Ashmead

Telenomus cubiceps Ashmead, 1894: 206, ♂, ♀. Type locality: St. Vincent. Host: unknown.
Liophanurus cubiceps: Kieffer, 1912: 61.
Liophanurus cubiceps: Kieffer, 1926: 81.

BMNH: no material. USNM: 1 ♂ from St. Vincent bearing one of Ashmead's type labels; 1 ♀ from St. Vincent with no determination label. **Lectotype** ♂ (here designated): "St. V., West Indies, Smith. ♂ Type No. 2515 U.S.N.M. Telenomus cubiceps Ashm. ♂ Type. Lectotype ♂, Telenomus cubiceps Ashm., desig. N. Johnson." Lectotype is in good condition, glued to the tip of a minuten; apical tarsomeres of the mid- and hindlegs are missing.

Telenomus difformis Ashmead

Telenomus difformis Ashmead, 1894: 205, ♂, ♀. Type locality: St. Vincent. Host: unknown.
Liophanurus difformis: Kieffer, 1912: 61.
Liophanurus difformis: Kieffer, 1926: 81.

BMNH: 1 ♀ from St. Vincent. USNM: 1 ♂ from St. Vincent. Ashmead stated that he had one male and one female. **Lectotype** ♀ (here designated): "St. Vincent, W. I., H. H. Smith 207; Telenomus difformis Ash. ♀; W. Indies 99–331; Lectotype ♀, Telenomus difformis Ashm., desig. N. Johnson."

Telenomus flaviventris Ashmead

Telenomus flaviventris Ashmead, 1895b: 795, ♀. Type locality: Kingston, Jamaica. Host: unknown.
Liophanurus flaviventris: Kieffer, 1912: 61.
Liophanurus flaviventris: Kieffer, 1926: 81.

BMNH: no material. USNM: 2 ♀ from Kingston. Ashmead based his description on two females. **Lectotype** ♀ (here designated): "Kingston, Jamaica; Lectotype ♀, Telenomus flaviventris Ashm., desig. N. Johnson." The specimen is in good condition; A7–A11 of the right antenna are missing. The second Ashmead specimen (paralectotype) bears a USNM type label No. 6581; this specimen, however, has lost both antennae and the legs are broken. For this reason I have chosen its companion as the lectotype (both housed in USNM).

Telenomus flavopetiolatus Ashmead

Telenomus flavopetiolatus Ashmead, 1894: 207–208, ♂, ♀. Type locality: St. Vincent. Host: unknown.
Liophanurus flavopetiolatus: Kieffer, 1912: 61.
Liophanurus flavopetiolatus: Kieffer, 1926: 82–83.

BMNH: 1 ♂ from St. Vincent. USNM: 6 ♀, 1 ♂ from St. Vincent representing at least 2–3 species. Ashmead stated that his original material consisted of 5 ♀ and 7 ♂ from St. Vincent. **Lectotype** ♀ (here designated): "St. Vincent, W.I.; H. H. Smith. 207. ♀ Type No. 2516 U.S.N.M. Telenomus flavopetiolatus Ashm. ♀ Type. Lectotype ♀, Telenomus flavopetiolatus Ashm., desig. N. Johnson." The lectotype is in good condition, glued on its side to a card point.

Telenomus fulvicornis Dalla Torre

Telenomus flavicornis Ashmead. 1894: 210, ♂, ♀ (not *flavicornis* Wollaston, 1858). Type locality: St. Vincent. Host: unknown.
Telenomus fulvicornis Dalla Torre, 1898: 515 (replacement name).
Liophanurus flavicornis: Kieffer, 1912: 61.
Liophanurus fulvicornis: Kieffer, 1926: 83.

BMNH: 1 ♂. USNM: 3 ♀ from St. Vincent (of 3 different species). Ashmead's description was based on one specimen of each sex. **Lectotype** ♀ (here designated): "St. Vincent, W.I.; H. H. Smith. 241. ♀ Type No. 2516 U.S.N.M. Telenomus flavicornis Ashm. ♀ Type. Lectotype ♀, Telenomus flavicornis Ashm., desig. N. Johnson." The lectotype is in good condition, glued on its back to a card point.

Telenomus fuscicornis Ashmead

Telenomus fuscicornis Ashmead, 1895b: 794–795, ♂, ♀. Type locality not specified. Host: unknown.
Liophanurus fuscicornis: Kieffer, 1912: 61.
Liophanurus fuscicornis: Kieffer, 1926: 83–84.
Telenomus fuscicornis: Masner, 1965: 113.

BMNH: 1 ♂ from Grand Etang, 1 ♀ from Mt. Gay. USNM: 1 ♀ from Mt. Gay, 1 ♀ from St. John's River. Ashmead recorded 1 ♂ and 5 ♀ from Balthazar, Grand Etang, Mt. Gay and St. John's River on the island of Grenada. **Lectotype** ♂ (here designated): "Grand Etang (Windward side) 1900 ft, Grenada W.I., H. H. Smith 13: W. Indies 99–331; Allotype; Telenomus fuscicornis Ashmead, Type; B.M. Type Hym., 9. 2866; Lectotype ♂, Telenomus fuscicornis Ashm., desig. N. Johnson."

I have designated the male as lectotype despite the loss of the metasoma, because of its distinctive smooth mesoscutum.

Telenomus fuscipennis **Ashmead**

Telenomus fuscipennis Ashmead, 1894: 210–211, ♂. Type locality: St. Vincent. Host: unknown.
Liophanurus fuscipennis: Kieffer, 1926: 78–79.

BMNH: no material. USNM: 1 ♂ from St. Vincent bearing "unique" type label. Ashmead stated that this species was described on the basis of a single specimen. Holotype ♂: "St. Vincent, W.I. H. H. Smith 273. ♀ (sic) Type No. 2522 U.S.N.M. Telenomus fuscipennis Ashm. ♂ Type; unique." The holotype has the apical tarsomeres of the hindlegs broken off; otherwise in good condition, glued on its side to a card point.

Telenomus grenadensis **Ashmead**

Telenomus grenadensis Ashmead, 1895: 791–792, ♀. Type locality not specified. Host: unknown.
Microphanurus grenadensis: Kieffer, 1926: 108–109.
Telenomus grenadensis: Masner, 1965: 114.
Telenomus grenadensis: Johnson, *in press.*

The lectotype, from Mount Gay Estate, Grenada, was designated by Masner (1965).

Telenomus impressus **Ashmead**

Telenomus impressus Ashmead, 1894: 204–205, ♂, ♀. Type locality: St. Vincent. Host: unknown.
Liophanurus impressus: Kieffer, 1926: 78.
Telenomus impressus: Nixon, 1940: 503–506, figs. 2, 3, 19, 20, 23.

BMNH: no H. H. Smith specimens. USNM: 2 ♀ from St. Vincent. Ashmead had 1 ♂ and 6 ♀, all from St. Vincent, when he prepared the original description. **Lectotype** ♀ (here designated): "Leeward side St. Vincent, W.I. H. H. Smith 242. Lectotype ♀, Telenomus impressus Ashm., desig. N. Johnson." The lectotype is in good condition, glued by its back to a card point. One paralectotype in USNM.

Telenomus latifrons **Ashmead**

Telenomus latifrons Ashmead, 1895b: 793–794, ♂, ♀. Type locality not specified. Host: unknown.
Microphanurus latifrons: Kieffer, 1926: 109.
Telenomus latifrons: Masner, 1965: 114.

Masner (1965) designated a female from Balthazar, Grenada as the lectotype.

Telenomus longiclavatus **Ashmead**

Telenomus longiclavatus Ashmead, 1895: 792, ♀. Type locality: Balthazar, Grenada. Host: unknown.
Liophanurus longiclavatus: Kieffer, 1912: 61.
Liophanurus longiclavatus: Kieffer, 1926: 80.
Telenomus longiclavatus: Masner, 1965: 115.

Described from a single specimen that was returned to London. The holotype is not in good condition. The metasoma is missing and the legs, venter of mesosoma, right antenna and lower part of the head are embedded in glue.

Telenomus luteipes Ashmead

Telenomus luteipes Ashmead, 1895b: 793, ♂, ♀. Type locality not specified. Host: unknown.
Liophanurus luteipes: Kieffer, 1912: 61.
Liophanurus luteipes: Kieffer, 1926: 80–81.
Telenomus luteipes: Masner, 1965: 115.

BMNH: 1 ♀ from Balthazar, 1 ♂ from St. John's River. USNM: 1 ♀ from Chantilly Estate, 1 ♀ from Balthazar, 1 unlabelled ♂. Ashmead had 1 ♂ and 2 ♀ at the time of his original description. **Lectotype** ♀ (here designated): "Balthazar (Windward side), Grenada, W.I., H. H. Smith, 34; W. Indies, 99–331. BMNH type label. Telenomus luteipes Ashm. ♀ Type. Lectotype ♀, Telenomus luteipes Ashm., desig. N. Johnson."

Telenomus magniclavus Ashmead

Telenomus magniclavus Ashmead, 1894: 205–206, ♂, ♀. Type locality: St. Vincent. Host: unknown.
Liophanurus magniclavus: Kieffer, 1912: 61.
Liophanurus magniclavus: Kieffer, 1926: 82.
Telenomus magniclavus: Masner, 1965: 115.

BMNH: no specimens from St. Vincent. USNM: 1 ♂ from St. Vincent. Ashmead claimed to have both a male and a female upon which the original description was based. The female is lost. **Lectotype** ♂ (here designated): "Windward side St. Vincent, W.I. H. H. Smith. ♂ Type No. 2512 U.S.N.M. Telenomus magniclavus Ashm. ♂ Type. Lectotype ♂, Telenomus magniclavus Ashm., desig. N. Johnson." The specimen is in poor condition: the head, propleura and forelegs have been broken off and glued separately to the minuten. The head has been half eaten away; A8–A12 are missing from the right antenna. The specimen Masner (1965) mentioned as having a type label is from Grenada and, therefore, cannot properly be a part of the type series.

Telenomus medius Ashmead

Telenomus medius Ashmead, 1894: 207, ♀. Type locality: St. Vincent. Host: unknown.
Phanurus medius: Kieffer, 1926: 62–63.
Telenomus medius: Masner, 1965: 116.

Described by Ashmead from a single specimen that has since been housed in the British Museum.

Telenomus meridionalis Ashmead

Telenomus meridionalis Ashmead, 1894: 208, ♀. Type locality: St. Vincent. Host: unknown.
Liophanurus meridionalis: Kieffer, 1926: 79.

BMNH: no material. USNM: a single ♀ from St. Vincent bearing a "unique" type label. Ashmead described this species from a single specimen. Holotype ♀: "St. Vincent, W.I.; H. H. Smith.; 238. ♀ Type No. 2517 U.S.N.M. Telenomus meridionalis Ashm. ♀ Type unique." The specimen is in good condition, mounted on its back to a card point.

Telenomus minutissimus **Ashmead**

Telenomus minutissimus Ashmead, 1895a: 220–221, ♀. Type locality: Trinidad. Host: *Dactylopius virgatus* (Coccidae) (doubtful).
Telenomus minutissimus: Masner and Muesebeck, 1968: 67.

Masner and Muesebeck (1965) designated a female as the lectotype of this species. This material is stored in the USNM.

Telenomus monilicornis **Ashmead**

Telenomus monilicornis Ashmead, 1894: 203–204, ♂. Type locality: St. Vincent. Host: unknown.
Telenomus monilicornis: Kieffer, 1912: 22.
Phanurus monilicornis: Kieffer, 1926: 63.
Telenomus monilicornis: Johnson, *in press.*

BMNH: no material. USNM: male from St. Vincent with "unique" type label. Ashmead's description was based on a single male. Holotype ♂: "St. Vincent, W.I. H. H. Smith 207. ♂ Type No. 2508 U.S.N.M. Telenomus monilicornis Ashm. ♂ Type; unique." The head of the holotype is broken off and glued to the card point separately from the rest of the body. A6–A12 of the right antenna and A8–A12 of the left antenna are missing.

Telenomus nigriclavatus **Ashmead**

Telenomus nigriclavatus Ashmead, 1895b: 794, ♀. Type locality not specified. Host: unknown.
Liophanurus nigriclavatus: Kieffer, 1926: 77.
Telenomus nigriclavatus: Masner, 1965: 117.

BMNH: 1 ♀ from Balthazar. USNM: 1 specimen from Grand Etang (only mesosoma remaining); 2 ♀ from Balthazar; 1 ♂ from Balthazar (not conspecific with females). Ashmead had 8 ♀ from Balthazar, Grand Etang and Mt. Gay Estate at his disposal at the time he described this species. **Lectotype** ♀ (here designated): "Balthazar (Windward side) Grenada, W.I. H. H. Smith 20. Telenomus nigriclavatus Ashm. ♀. Lectotype ♀, Telenomus nigriclavatus Ashm., desig. N. Johnson." The specimen is in good condition, glued on its side to a card point. One paralectotype in USNM. (See discussion of *Telenomus smithii* below.)

Telenomus nigrocoxalis **Ashmead**

Telenomus nigrocoxalis Ashmead, 1894: 211–212, ♀. Type locality: St. Vincent. Host: unknown.
Liophanurus nigrocoxalis: Kieffer, 1926: 77–78.
Telenomus nigrocoxalis: Masner, 1965: 117.

Described by Ashmead from a single female that has since been housed in London.

Telenomus pectoralis Ashmead

Telenomus pectoralis Ashmead, 1894: 206–207, ♂. Type locality: St. Vincent. Host: unknown.
Liophanurus pectoralis: Kieffer, 1926: 78.
Telenomus pectoralis: Masner, 1965: 118 (♂).

USNM: no material. BMNH: 1 ♀ from Grenada in type collection! Ashmead described *T. pectoralis* on the basis of a single male from St. Vincent. The label data of the female "type" do not agree with that cited by Masner in 1965. The specimen in the type collection under the name *Telenomus scaber* is a male bearing the label data recorded by Masner and matches Ashmead's description of *T. pectoralis* fairly well (except for the published length of 3 $^{1}/_{2}$ mm, which I presume was the printer's misreading of $^{3}/_{5}$ mm for 3.5 mm; all lengths cited in Ashmead's paper are presented in the form of fractions). Since the type of *T. scaber* is a ♀ and has been found in the USNM (see below), I conclude that this male is the misplaced holotype of *T. pectoralis.*

Telenomus pygmaeus Ashmead

Telenomus pygmaeus Ashmead, 1894: 208, ♂, ♀. Type locality: St. Vincent. Host: unknown.
Telenomus pygmaeus: Kieffer, 1912: 22.
Phanurus pygmaeus: Kieffer, 1926: 63.

BMNH: no material (!). USNM: 1 ♂ from St. Vincent with type label; 1 ♂, 4 ♀ (of at least 3 spp.) from St. Vincent. Ashmead described *T. pygmaeus* from a single specimen of both sexes. I was able to borrow a female from the British Museum in 1978 and concluded then that both it and the USNM "type" male were conspecific. When I visited London in 1979, however, the specimen was missing from the minuten on which it had been glued. I have therefore designated the male as lectotype. **Lectotype** ♂ (here designated): "St. Vincent, W.I. H. H. Smith. ♂ Type No. 2518 U.S.N.M. Telenomus pygmaeus Ashm. ♂ Type. Lectotype ♂, Telenomus pygmaeus Ashm., desig. N. Johnson." This specimen is in good condition, glued to the tip of a minuten.

Telenomus sanctivincenti Ashmead

Telenomus Sancti-Vincenti Ashmead, 1894: 211, ♂, ♀. Type locality: St. Vincent. Host: unknown.
Liophanurus St.-Vincenti: Kieffer, 1912: 61.
Liophanurus sancti-vincenti: Kieffer, 1926: 80.
Telenomus sanctivincenti: Johnson, *in press.*

In the last paper cited above I designated a female specimen from the British Museum as lectotype.

Telenomus scaber Ashmead

Telenomus scaber Ashmead, 1894: 208–209, ♀. Type locality: St. Vincent. Host: unknown.
Liophanurus scaber: Kieffer, 1926: 77.
Telenomus scaber: Johnson, *in press.*

BMNH: no material. USNM: 1 ♀ from St. Vincent with a "unique" type label. Ashmead's description was based upon a single female. Holotype ♀: "St. Vincent, W.I. H. H. Smith 210. ♀ Type No. 2518 U.S.N.M. Telenomus scaber Ashm. ♀ Type; unique." The holotype is in good condition; both antennae have been broken off, but are embedded in glue on the point. The specimen is glued on its side to the point.

Telenomus smithii Ashmead

Telenomus smithii Ashmead, 1894: 209–210, ♂, ♀. Type locality: St. Vincent. Host: unknown.

Liophanurus smithii: Kieffer, 1926: 78.

BMNH: 1 ♂ from St. Vincent. USNM: 3 ♀ from St. Vincent. Ashmead had 1 ♂ and 6 ♀ at the time he described this species. **Lectotype** ♀ (here designated): Green label with no writing. "St. V. West Indies, Smith. ♀ Type No. 2520 U.S.N.M. Telenomus smithii Ashm. ♀ Type. Lectotype ♀, Telenomus smithii Ashm., desig. N. Johnson." The lectotype is in good condition; A5–A11 of the left antenna, and A11 of the right are missing. The specimen is glued to the tip of a minuten.

The three females (lectotype and two paralectotypes) are representatives of a rather common Neotropical species. *Telenomus smithii* is probably a senior synonym of *Telenomus nigriclavatus.*

Trissolcus laticeps Ashmead

Trissolcus laticeps Ashmead, 1894: 212, ♀. Type locality: St. Vincent. Host: unknown.

Trissolcus laticeps: Kieffer, 1926: 130.

Trissolcus laticeps: Masner, 1965: 126.

BMNH: 4 ♀ (one a *Telenomus*). USNM: 1 ♀. Ashmead described this species from 4 ♀. **Lectotype** ♀ (here designated): "St. Vincent, W.I., H. H. Smith, 210. Type No. 2526, U.S.N.M. Trissolcus laticeps, ♀ Type Ashm. Lectotype ♀, Trissolcus laticeps Ashm., desig. N. Johnson."

Trissolcus megacephalus (Ashmead)

Telenomus megacephalus Ashmead, 1894: 212, ♀. Type locality: St. Vincent. Host: unknown.

Liophanurus megacephalus: Kieffer, 1926: 76.

BMNH: no material. USNM: 1 ♀ from St. Vincent with "unique" type label. Ashmead's description was based on a single female. Holotype ♀: "St. Vincent, W.I., H. H. Smith, 210. ♀ Type No. 2525 U.S.N.M. Telenomus megacephalus Ashm., ♀ Type, unique." The holotype has the metasoma broken off and glued separately to the card point; A9–A11 of the left antenna are missing. Nixon (1935) has synonymized this name with *Trissolcus basalis* (Wollaston), 1858.

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FIVE NEW SPECIES OF CADDISFLIES (TRICHOPTERA) FROM MEXICO

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Abstract.—Five new species of Trichoptera from the tropical region of Mexico, Chiapas and Veracruz states, are described: *Protoptila* ***phyllisae*** (Glossosomatidae), *Chimarra* (*Chimarra*) ***alata*** and *C.* (*C.*) ***crena*** (Philopotamidae), *Zumatrichia* ***longispina*** (Hydroptilidae), and *Helicopsyche* ***tuxtlensis*** (Helicopsychidae). The male genitalia are figured and described.

During a recent study of the material deposited in the collections of the National Museum of Natural History, Washington, D. C. (USNM) and Instituto de Biologia, Universidad Nacional Autonoma de Mexico (IBUNAM), I found five new species of Trichoptera that were collected in different years in Mexico. These species occur mainly in the tropical rain forest area, particularly in the states of Veracruz and Chiapas, where it is common to find small streams and even fairly large rivers with a large caddisfly fauna.

In the studies of the Neotropical fauna, many species from this region have been described by Mosely (1937, 1954), Ross (1956, 1959), Denning (1962, 1964), and Flint (1967, 1974); however, because of the richness and diversity of the Trichoptera fauna, it is believed that many more species remain to be described.

FAMILY GLOSSOSOMATIDAE

Protoptila phyllisae Bueno-Soria, NEW SPECIES

Figs. 1, 2

Diagnosis.—This species is closely related to *Protoptila alexanderi* Ross (1941), from which it differs in the shorter and undivided 8th sternum, the long twisted spine of the aedeagus, and the lateral processes of the 10th tergum.

Adult.—Length of forewing 3 mm. Color uniformly brown in alcohol, faintly paler along anastomosis. Sixth sternum with a pointed apicomesal process. Male genitalia: Eighth tergum with posterior margin bearing a brush of setae; sternum barely produced posteriorly. Ninth segment rounded anteriorly, sternum produced posteriorly. Tenth tergum heavily sclerotized, apical portion narrowed and long, ending rectangularly at apex. Aedeagus somewhat constricted in cylindrical portion, so that ventral margin appears slightly narrowed at this point and the apex somewhat knoblike; with a pari of basoventral processes and paired, long, twisted spines, arising laterally, which extend posteriad beneath ventral margin of the 10th tergum.

Material.—Holotype ♂: MEXICO, Chiapas, Agua Azul, 59 km southwest from

Figs. 1–4. 1, 2, *Protoptila phyllisae.* 1, Male genitalia, lateral. 2, Aedeagus, lateral aspect. 3, 4, *Chimarra* (*C.*) *alata.* 3, Male genitalia, lateral. 4, Clasper, caudal aspect.

Palenque, 23 July 1978, J. Bueno (IBUNAM). Paratypes: Cascada de Misolha, 20 km southwest from Palenque, 18 May 1981, C. M. and O. S. Flint Jr., 3 ♂ (USNM).

I am pleased to name this species for Mrs. Phyllis Spangler.

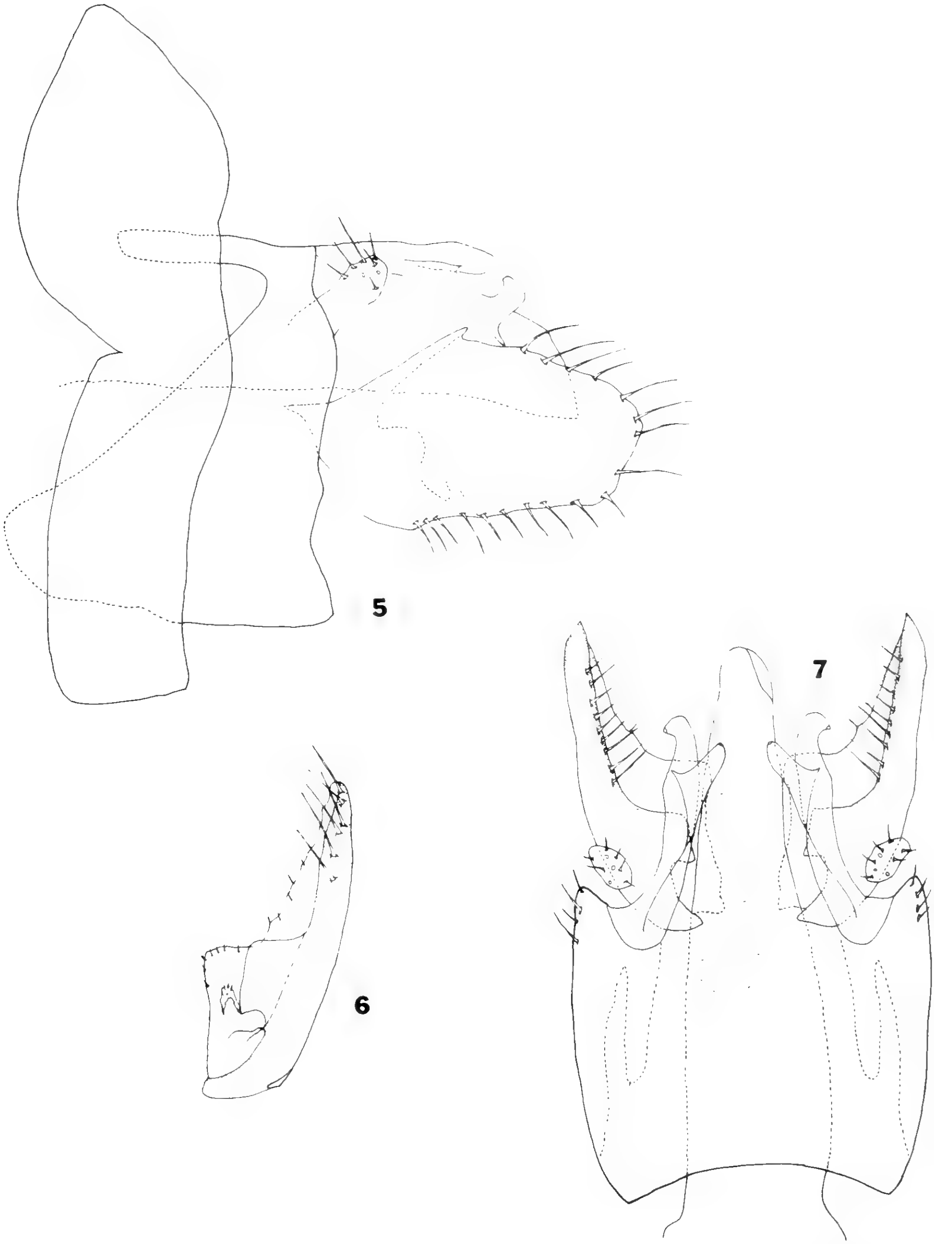
FAMILY PHILOPOTAMIDAE

Chimarra (*Chimarra*) *alata* Bueno-Soria, NEW SPECIES

Figs. 3, 4

Diagnosis.—This species seems most closely related to *Chimarra* (*C.*) *dentosa* Ross (1948). From this species, *Chimarra* (*C.*) *alata* differs in the shape of the clasper in caudal view, which has a wider groove without sclerotized ridges on the mesal face.

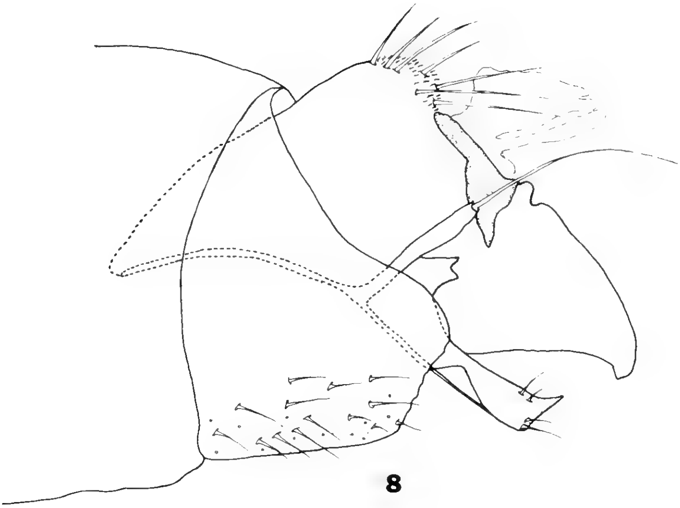
Adult.—Length of forewing 5 mm. Color in alcohol reddish brown. Male genitalia: Ninth segment sinuate, dorsally semimembranous, with a pointed posteroventral keel. Cerci small, rounded, with a short basal stalk. Tenth tergum mostly membranous, narrower mesally with apex rounded. Clasper, triangular from lateral aspect, dorsal portion tapering dorsally to a narrow apex; posteroventral angle projecting at apex; mesal face with a wide groove with almost smooth



Figs. 5–7. *Chimarra* (*C.*) *crena*. 5, Male genitalia, lateral. 6, Clasper, dorsal aspect. 7, Male genitalia, dorsal aspect.

surface. Aedeagus prolonged into a pointed process ventroapically, and internally with 3 short spines.

Material.—Holotype ♂: MEXICO, Chiapas, Bonampak, 350 m, 21 May 1980, J. Bueno (IBUNAM). Paratypes: Chiapas, Rio Contento, 7 km north Ocosingo,



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Figs. 8, 9. *Zumatrichia longispina.* 8, Male genitalia, lateral. 9, Aedeagus, lateral aspect.

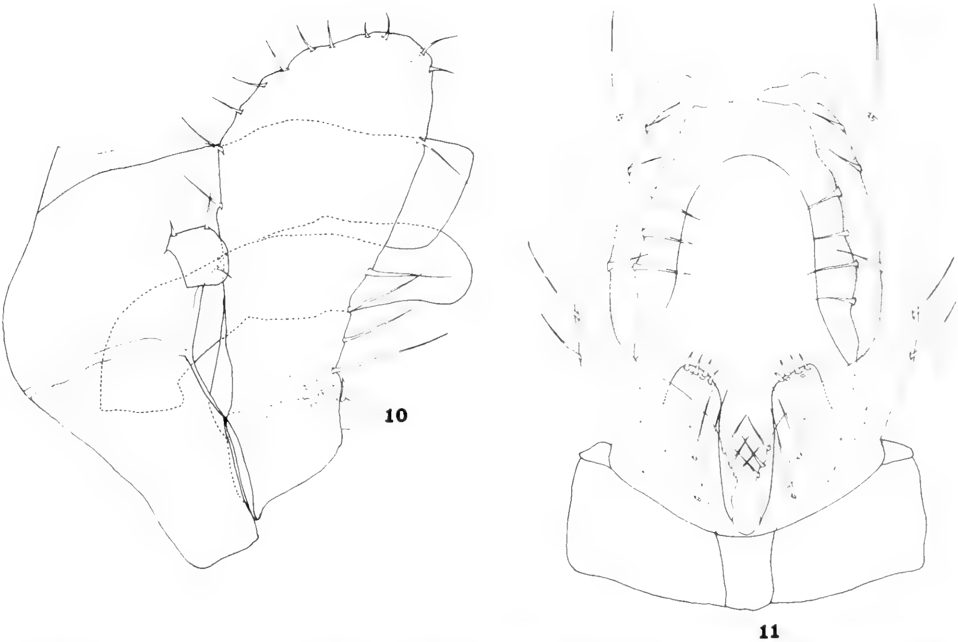
20 May 1981, C. M. and O. S. Flint Jr., 7 ♂ (USNM). NICARAGUA, 5.3 mi east from Matagalpa, 30 July 1967, O. S. Flint, Jr., 11 ♂ (USNM).

***Chimarra* (*Chimarra*) *crena* Bueno-Soria, NEW SPECIES**
Figs. 5, 6

Diagnosis.—This species is related to *Chimarra* (*C.*) *ovalis* Ross (1959), differing in the longer clasper and much higher and outwardly curved ventral lobes of the 10th tergum in dorsal aspect.

Adult.—Length of forewing, 6–7 mm. Color fuscous, bases of legs slightly paler. Male genitalia: Ninth segment with anterior margin oval; with posteroventral process about as long as wide. Lateral lobes of 10th tergum narrow and heavily sclerotized, with 2 terminal processes, 1 ventral and curved outwardly and 1 dorsal and angled dorsad. Claspers fairly long and broad; with a series of long dorsal spines; with a broad projection on basodorsal margin. Aedeagus with 2 spines; dorsal one longer than ventral one.

Material.—Holotype ♂: MEXICO, Veracruz, Rio Jamapa, 6 km east from Coscomatepec, 26 May 1981, J. Bueno and H. Velasco (IBUNAM). Paratypes: Same data as holotype, but 2 May 1981, C. M. and O. S. Flint, Jr., 5 ♂ and 5 ♀ (USNM);



Figs. 10, 11. *Helicopsyche tuxtlensis.* 10, Male genitalia, lateral. 11, Male genitalia, ventral aspect.

26 May 1981, C. M. and O. S. Flint, Jr., 1 ♂ and 8 ♀ (USNM); near Huatusco, 25–26 July 1965, Flint and Ortiz, 31 ♂ and 11 ♀ (USNM); same but 22–24 July 1966, 1 ♂ and 1 ♀ (USNM).

FAMILY HYDROPTILIDAE

Zumatrichia longispina Bueno-Soria, NEW SPECIES

Figs. 8, 9

Diagnosis.—This species is a member of the *filosa* group and is most closely related to *Zumatrichia anomaloptera* Flint (1968), especially in the structure of the 10th segment. However it is abundantly distinct in the shape of the claspers and aedeagus, particularly in the presence of 2 large internal spines.

Adult.—Length of forewing 3 mm. Color brown, with patches of golden-yellow hair. Male genitalia: Eighth sternum with long posterolateral setae, ventrally with a straight posterior margin. Ninth segment with anterolateral angle enlarged; posterolateral lobe slender, with a single, enlarged apical seta. Claspers with basodorsal process short; apically with a short tooth; scooplike in lateral aspect. Aedeagus with usual mesal and basal structures; apically with a well-developed dorsolateral hood produced into an apicomesal point, beneath which is a membranous lobe bearing a dark, apical point; laterally with a pair of membranous lobes each bearing a long, dark spine and with a spinulose inner surface; ventrolaterally a pair of smaller processes with divided tips. Lateral penis sheath broad, and rounded dorsally, apex beaklike.

Material.—Holotype ♂: MEXICO, Veracruz, Los Tuxtlas area, Rio La Palma, 7–14 May 1981, C. M. and O. S. Flint, Jr. (USNM). Paratypes: Same data as holotype, 3 ♂ deposited in USNM and 2 ♂ deposited in IBUNAM.

FAMILY HELICOPSYCHIDAE

Helicopsyche tuxtlensis **Bueno-Soria,** NEW SPECIES

Figs. 10, 11

Diagnosis.—This species is related to the Cuban species, *Helicopsyche hageni* Banks (1938). The males of *Helicopsyche tuxtlensis* may be distinguished by the shape of the claspers, which in ventral aspect show a stout posterodorsal spine, and a mesobasal thumblike lobe, with a few spines.

Adult.—Length of forewing 4 mm. Color dark brown, antenna stramineous, forewing pale brown. Sixth sternum of male with a rounded process, about as long as length of sternum; 3rd through 4th sterna reticulate. Male genitalia: Ninth segment broadly rounded anteriad; ventral strap slightly narrower than dorsal strap. Tenth tergum with a membranous tip, truncate in lateral and shallowly cleft in dorsal aspect. Cercus spheroidal with long spines. Claspers broadly rounded dorsally, ventrally very narrow with an apical beaklike projection in caudal aspect; mesobasal lobe produced as a thumblike lobe in caudal aspect. Aedeagus with base slightly angled and tip rounded.

Material.—Holotype ♂: MEXICO, Veracruz, Balzapote, 3 km north from Estacion de Biologia "Los Tuxtlas," 3 May 1981, R. Arce (IBUNAM). Paratypes: Same date but Los Tuxtlas area, Rio Maquinas, 14 May 1981, C. M. and O. S. Flint, Jr., 1 ♂ (USNM); Puente Rio Tecolapan, east from Tejada, 4 Dec. 1974, C. M. and O. S. Flint, Jr., 1 ♂ (USNM). GUATEMALA, Dept. Izabal, Matias de Galvez, 14–16 Aug. 1965, Flint and Ortiz, 1 ♂ (USNM).

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DESCRIPTIONS OF THE LARVA AND PUPA OF *ANTHONOMUS HUNTERI* AND COMPARISON WITH *ANTHONOMUS GRANDIS* (COLEOPTERA: CURCULIONIDAE)[1]

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Abstract.—The third-instar larva and the pupa of *Anthonomus hunteri* Burke and Cate are described and illustrated. Comparisons with the larval and pupal stages of *Anthonomus grandis* Boheman are made. The pupae of *A. hunteri* and *A. grandis* are easily separated on the difference in length of the rostrum, which is relatively shorter and stouter in *A. grandis* than in *A. hunteri*. Larvae of *A. hunteri* on the average are smaller than those of *A. grandis,* and head capsule widths may be used to separate most individuals, particularly of second and third instars.

Anthonomus hunteri was originally described from southern Mexico on the basis of adult specimens (Burke and Cate, 1979). More recently the immature stages of the species have been collected and associated with adults for positive identification. Since ecological and taxonomic studies are being conducted on *A. hunteri* and *Anthonomus grandis* Boheman in Mexico, it is necessary that the larvae and pupae of these species be sufficiently described and illustrated for identification and comparative purposes. The pupa of *A. grandis* was described by Anderson (1968) and Burke (1968) and the larva of this species by Ahmad and Burke (1972). Similar descriptions of the larval and pupal stages of *A. hunteri* will provide information for identification of these stages in ecological and parasite studies without the necessity of association with adults. Furthermore, this information will be useful in a phylogenetic study now being made on *Anthonomorphus* Dietz, the subgenus to which *A. hunteri* and *A. grandis* are presently assigned.

The terminology used in descriptions of the larva and pupa follows Anderson (1947) and Burke (1968), respectively.

DESCRIPTION OF THIRD-INSTAR LARVA

Figs. 1, 2, 3, 4

Body: Strongly curved (Fig. 2); length ca. 4 mm. Asperities tubercle-like, minute, inconspicuous; more extensively developed on thorax and dorsally on abdomen. Color white except for pronotum which is partially pale reddish brown.

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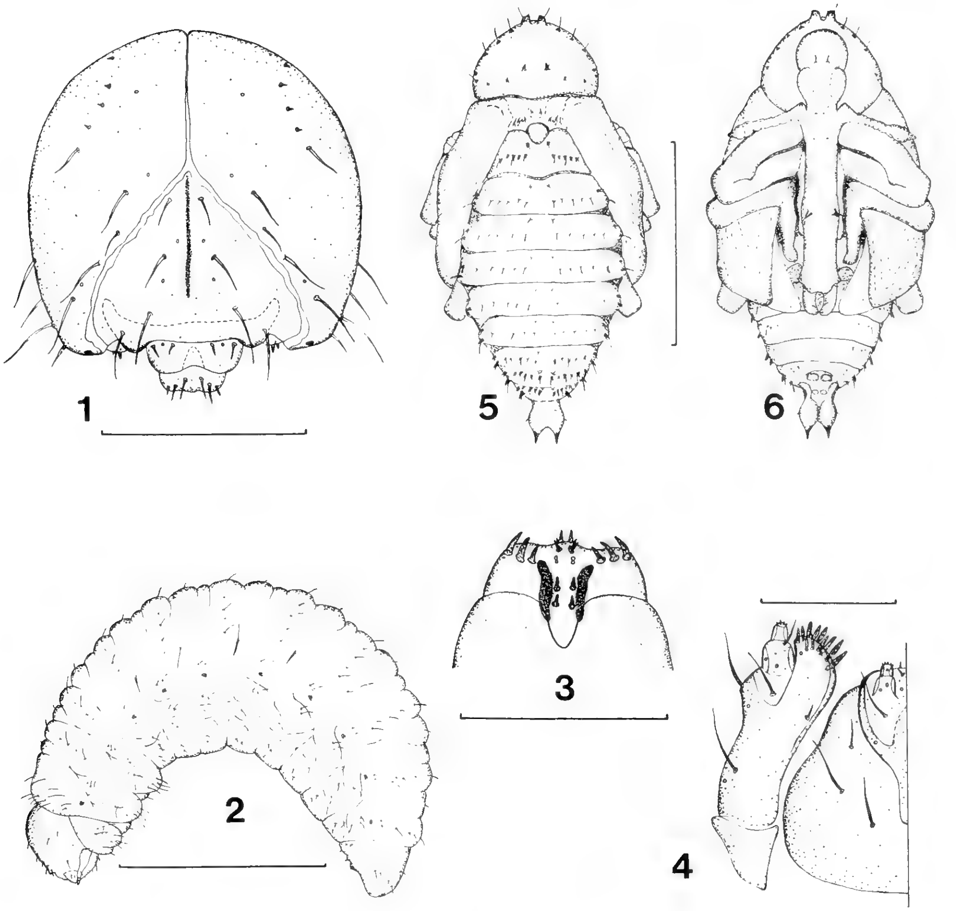
Head (Fig. 1): Yellowish to pale reddish; width 0.60–0.86 mm ($n = 72$). Basal article of antenna bearing conical accessory sensory appendage and 4 setae; one seta ca. ⅔ length of conical appendage; other seta much shorter, not as stout. Endocarina distinct. Epicranial suture slightly less than ½ length of head capsule. Four pairs of frontal setae present; seta 1 about ⅔ to ¾ length of 3; frontal seta 3 distinctly longer than dorsal epicranial seta 3; frontals 4 and 5 about equal in length. Two pairs of frontal sensillae; one pair located near endocarina between frontal setae 1 and 3; one pair located between frontal setae 3 and 4, more or less in line with these setae. Five pairs of dorsal epicranial setae present; seta 1 longer than either 2 or 3, the latter 2 setae about equal in length; dorsal epicranial seta 3 located near frontal suture more or less in line with setae 1 and 4; setae 4 and 5 each longer than other setae. Four pairs of short, peglike postepicranial setae; arranged in an arc with anteriormost seta being located more or less directly above dorsal epicranial seta 2. Three pairs of epicranial sensillae; one pair located between postepicranial setae and epicranial suture; one pair borne dorsomedial of dorsal epicranial setae 1; one pair between dorsal epicranial setae 4 and 5 in line with these setae. Lateral epicranial seta 1 ca. ⅔ length of 2. Ventral epicranial setae 1 and 2 nearly equal in length. Clypeal setae short, equal in length or one pair slightly longer than other; located close to anterior margin of frons. One pair of clypeal sensillae; member of pair on each side situated ½ distance between clypeal setae 1 and 2. Three pairs of labral setae; setae 1 and 2 nearly equal in length; seta 3 much shorter. Epipharnyx (Fig. 3) bearing 3 pairs of anteromedian setae; one pair much shorter than others. Three pairs of stout anterolateral setae present. Labral rods stout, converging slightly posteriorly. Four epipharyngeal sensory pores arranged with 2 pores lying adjacent to each other on each side of midline. Two pairs of stout epipharyngeal median spines present between labral rods. Mandibles each with 2 stout, rather bluntly pointed teeth; mandibular seta 1 distinctly longer than 2. Apical article of maxillary palp (Fig. 4) ca. ⅔ length of basal article; basal article bearing one seta the length of which equals to about width of article. Stipital setae 1, 3, and 4 of equal length; seta 2 much shorter. Mala bearing 6 dorsal and 5 stout ventral setae. Labial palpus consists of 2 articles. Premental sclerite with a long posterior extension. Glossa with 4 short, stout setae. Postmental setae 1 and 2 each much longer than 3.

Thorax (Fig. 2): (Setae described on one side of body only.) Pronotum bearing 10 long setae and 1 or 2 short setae. Air tubes of thoracic spiracle each with 7–8 annuli. Prodorsal seta short. Five postdorsal setae present; setae 1, 3, and 5 distinctly longer than 2 and 4. Spiracular area bearing 3 setae, 2 of which are long and nearly equal in length, 3rd much shorter. Epipleural lobe with 1 moderately long seta. Two long pleural setae present on prothorax; 1 seta on each of meso- and metathorax. Pedal area bearing 4 long setae. Sternal seta much shorter than pedal seta.

Abdomen (Fig. 2): Each of first 7 abdominal segments bearing 3 distinct folds; segment VIII with only 2 well defined folds. Prodorsum of each segment with a short seta. Postdorsum bearing 5 pairs of setae; setae 1, 3, and 5 longer than 2 and 4. Two spiracular setae; seta 1 distinctly longer than 2. Pedal and eusternal setae short, inconspicuous. Anus subterminal, surrounded by 4 lobes. Segment IX subconical; apparently bearing same setae as on other abdominal segments but some are smaller; arrangement of setae also different than those on other segments.



Figs. 1–6. Larva and pupa of *Anthonomus hunteri.* 1, Frontal view of head capsule of larva. 2, Lateral view of third-instar larva. 3, Epipharynx of larva. 4, Ventral view of right maxilla and right half of labium of larva. 5, Dorsal view of pupa. 6, Ventral view of pupa. Line accompanying Fig. 1 = 0.5 mm; Figs. 2, 5, 6 = 2.0 mm; Figs. 3, 4 = 0.2 mm.

Material examined.—72 third-instar larvae from flower buds of *Hampea trilobata* Standley collected 20 mi. E. Celestún, Yucatán, Mexico, September 1981 by D. W. Williams. Determination made on basis of association with adults and by rearing. Other larvae representing first- and second-instars from the same host in the Celestún area were also examined.

Description of Pupa
Figs. 5, 6

Body: Length 3.7–6.1 mm ($n = 22$).

Rostrum: Male rostrum extending slightly past apices of tarsi of mesothoracic legs, that of female extending nearly to apices of metathoracic tarsi. One pair of distirostral setae borne either apically or subapically on conical or cylindrical tubercles; setae fine, slightly longer than tubercles on which they are borne. Three pairs of fine, short basirostral setae, arrangement of which is inconsistent, setae sometimes apparently unpaired.

Head: Supraorbital setae fine, straight; each about ½ length of frontal seta; not borne on tubercles. Frontal setae stouter than supraorbitals, straight to slightly curved; each borne on summit of low tubercle; tubercles separated by distance equal to length of seta.

Prothorax: Prothoracic depressions absent. Pronotal setae straight to slightly curved; setae on anterior margin of pronotum longer and stouter than posterior setae. Anteromedian setae each borne on anterior face of large, bluntly pointed tubercle; length of each seta approximately equal to height of tubercle; a short, fine seta borne near inner anterior margin of tubercle. Anteromedian tubercles narrowly separated. Three pairs of anterolateral setae, each borne on the summit of low, flat-topped tubercle; tubercle 2 more or less spaced equally between 1 and 3; tubercles becoming progressively smaller laterally. Posteromedian setae each borne about ½ distance between base and apex of sharply pointed, feebly curved tubercle; tubercles separated by distance equal to slightly less than length of seta. Four pairs of posterolateral setae usually present, sometimes only 3 pairs; all setae may be borne near bases of acutely pointed tubercles, or 2 outer setae may be located on summits of low tubercles. Posterolateral tubercle nearest midline largest of series; others decreasing in size laterally; tubercles not equidistant from each other as 2 outer ones are located closer together.

Mesonotum: Mesonotal setae usually consisting of 5 pairs of closely grouped slender, straight or curved setae each of which is borne near base of sharply pointed tubercle; occasionally only 3 or 4 pairs present. Mesonotal tubercles in each series usually differ considerably in size; tubercles 1, 3, and 5 often larger and bear longer setae than 2 and 4. One pair of minute anteronotal setae located ca. ½ distance between mesonotal setae and anterior margin of mesonotum; each borne at base of sharply pointed tubercle.

Metanotum: Five pairs of metanotal setae similar to mesonotals except for being more widely separated; setae 2 and 4 much shorter than 1, 3, and 5; each borne at base or near middle of sharply pointed tubercle. One pair of minute anteronotal setae each of which is borne near base of relatively large, sharply pointed tubercle.

Abdomen: Five pairs of discotergal setae present on segments I–VII; segment VIII may bear 3, 4, or 5 pairs, setae 2 and 4 of which are shorter than 1, 3, and 5; discotergal setae on segments VI, VII, and VIII borne at bases of sharply pointed tubercles; on other abdominal segments a seta may occasionally be associated with a minute, sharply pointed tubercle; usually setae not associated with tubercles or borne on summits of low tubercles. One pair of minute anterotergal setae borne on low, rounded tubercles on each of first 8 abdominal segments. Laterotergal setae 1 and 2 borne on each of first 8 terga; seta 1 minute, borne at base of small, sharply pointed tubercle; seta 2 prominent, borne at base of sharply pointed tubercle, the latter becoming progressively larger posteriorly. Spiracles well developed on first 5 abdominal segments; poorly developed on 6th segment. Two pairs of laterosternal setae present on each segment, located directly ventrad of laterotergal seta 2; ventralmost seta ca. 2× longer than other member of pair; both pale and inconspicuous. One pale, sub-laterosternal seta borne on each segment. Segment IX bearing a pair of sharply pointed, widely separated posterior processes; setae on segment minute, including 1 pair dorsally at bases of processes and an oblique line of 3 setae laterally on each side of segment near base.

Material examined.—22 pupae taken from buds of *Hampea trilobata* 20 mi. E. Celestún, Yucatán, Mexico, September 1981 by D. W. Williams.

DISCUSSION

On the basis of adult characters (Burke and Cate, 1979), *A. hunteri* and *A. grandis* appear to be closely related species. They are presently assigned to the subgenus *Anthonomorphus* Dietz, along with *Anthonomus fulvus* LeConte, *Anthonomus peninsularis* Dietz, *Anthonomus texanus* Dietz, and *Anthonomus cognatus* Burke. In addition to those of *A. hunteri* and *A. grandis,* the larvae and pupae of *A. fulvus* and *A. texanus* are known, thus allowing comparison of these stages for the four species.

Larva.—Distinguishing the pupa of *A. hunteri* from that of *A. grandis* may be accomplished easily by comparing the rostrum lengths, but differentiation of larvae of the two species is a more difficult task. The third-instar larva of *A. hunteri* traces to *A. grandis* in a key to anthonomine larvae by Ahmad and Burke (1972), supporting the close similarity of the two as also evidenced by comparison of their pupal and adult stages. One of the problems in distinguishing larvae of closely related weevil species is the lack of information about normal variation in the number, size, and arrangement of setae. Most curculionid larvae have been described on the basis of small series of specimens; however, this meager evidence indicates that there is sometimes considerable intraspecific variation in chaetotaxy, thus greatly reducing the value of setal characters for taxonomic purposes. The larvae of *A. hunteri* and *A. grandis* are so closely similar that the few slight differences noted in locations and relative lengths of setae are likely to be due to individual variation rather than to species differences.

The only consistent differences between the larvae of the two species appear to be in head capsule widths, reflecting the generally smaller size of *A. hunteri.* The measurements of *A. hunteri* reported here were obtained from 96 field-reared larvae. These specimens were reared to establish the number and duration of the various instars. Specimens representing each of the three instars were preserved for the present study. Measurements obtained from these specimens are compared with those reported in the literature on *A. grandis* by Ahmad and Burke (1972) and Parrott et al. (1970). The measurements reported by Ahmad and Burke for third-instar larvae were made on specimens from several host plant species and from different localities. The measurements reported by Parrott et al. were obtained from individuals reared on an artificial diet. In the following comparisons the ranges of widths and number of specimens measured (when known) are included in parentheses following the means.

The mean head width of first-instar larvae of *A. hunteri* is 0.37 mm (0.35–0.40; $n = 8$) as compared to 0.41 mm (0.37–0.42) for *A. grandis* reared on artificial diet. Second-instar larvae of *A. hunteri* average 0.52 mm (0.44–0.57; $n = 9$) in head width in comparison to 0.62 mm (0.55–0.65) for *A. grandis.* Third-instar larvae of *A. hunteri* measured have a mean width of 0.75 mm (0.60–0.86; $n = 72$), while Parrott et al. reported a mean of 0.99 mm for *A. grandis* reared on artificial media. Ahmad and Burke (1972) reported a mean of 1.1 mm (0.96–1.2; $n = 34$) for *A. grandis* larvae from different host species and localities. These data indicate that head capsule width measurements not only will distinguish the three instars of each species but also will serve to separate at least the second- and third-instar larvae of *A. hunteri* from those of *A. grandis.* This character should be especially useful for identification if a series of specimens is available.

Pupa.—The pupa of *A. hunteri* traces to *A. grandis* in the key provided by Burke (1968) for identification of pupae of the anthonomine weevils.

The pupae of *A. hunteri, A. grandis, A. fulvus,* and *A. texanus* collectively are distinguished from almost all other anthonomine pupae known (approximately 55 species) by having five pairs of discotergal setae and a pair of laterosternal setae. Three species (*A. hunteri, A. grandis,* and *A. fulvus*) have anterotergal setae, a pair of minute setae present near the anterior margin of each of the first eight abdominal terga; these setae are not known to occur in any other species of the subfamily. The pupae of *A. hunteri* and *A. grandis* may be separated from those of *A. fulvus* and all other known anthonomine pupae by possessing a pair of median setae (anteronotal setae) on both the mesonotum and the metanotum. In addition to sharing this character, *A. hunteri* and *A. grandis* are the only species of anthonomines known to develop in buds of *Hampea* (Malvaceae).

Since these two species of weevils are quite similar, are sympatric in southern Mexico, and both develop in *Hampea* buds (although apparently not on the same species), it is important to be able to distinguish them in all developmental stages. This can be done with the pupae of the two species with relative ease. Both sexes of pupae of *A. hunteri* have the rostrum extending well past the apices of the tarsi (Fig. 6) of the mesothoracic legs. The pupal rostrum of *A. grandis* is relatively stouter and shorter and does not extend past the apices of these tarsi. This difference should serve to separate pupae of the two species without reference to other characters. However, in case there is some doubt on this point, we also noticed that *A. hunteri* pupae have only one pair of distirostral setae while *A. grandis* pupae often have two pairs. In addition to the above-mentioned differences, pupae of *A. hunteri* usually are smaller than those of *A. grandis*; 22 specimens of *A. hunteri* taken from buds of *Hampea trilobata* in the State of Yucatán, Mexico, ranged in length from 3.7–6.1 mm, with a mean of 4.7 mm. In comparison, 21 pupae of *A. grandis* from buds of *Hampea nutricia* Fryxell collected at Cardenas, Tabasco, Mexico, measured 5.4–6.6 mm, with a mean length of 6.0 mm; eight pupae from *Gossypium barbadense* L. in Yucatán ranged from 5.5–6.8 mm in length, mean 6.4 mm; and 20 from cultivated *Gossypium hirsutum* L. in Briscoe Co., Texas, varied from 5.7 to 8.2 mm, mean 6.9 mm. Although the size of pupae of *A. grandis* is quite variable, depending upon condition of host plants and developmental sites (buds vs. fruits), the measurements presented here indicate a relatively larger size for this species.

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NEW RECORDS FOR PALEARCTIC *PHYTOCORIS* IN WESTERN NORTH AMERICA (HEMIPTERA: MIRIDAE)

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Abstract.—The Palearctic plant bugs *Phytocoris populi* (L.) and *P. varipes* Boheman are reported for the first time in North America, and new locality records are given for two Palearctic species previously recognized from North America. *Phytocoris populi* is reported from British Columbia, Canada, and from specimens collected in Whatcom County, Washington, on trunks and large branches of *Alnus rubra* Bong. *Phytocoris varipes* was taken at numerous localities in western Oregon on dried grasses and herbs. *Phytocoris dimidiatus* Kirschbaum, previously known in North America from a single specimen collected in Nova Scotia, Canada, is reported from Oregon and British Columbia; and *P. tiliae* (F.) is reported for the first time in Oregon. Illustrations of the adult and male genitalia of *P. populi* and *P. varipes* are provided.

Recent collections of Miridae in the Pacific Northwest were found to contain four Palearctic species of *Phytocoris.* Two of these species, *P. populi* (L.) and *P. varipes* Boheman, are new to North America. New locality records are given for *P. dimidiatus* Kirschbaum, previously known in North America only from Nova Scotia, Canada (Knight, 1923), and *P. tiliae* (F.) reported from British Columbia, Canada (Downes, 1924, 1957), New York (Wheeler and Henry, 1976), and Washington (Wheeler and Henry, 1976). Records of these four species are made available for inclusion in the forthcoming catalog of the Hemiptera-Heteroptera of America north of Mexico.

The following abbreviations are used for specimen depositories cited in the locality data: American Museum of Natural History (AMNH); Oregon State Department of Agriculture (OSDA); Oregon State University (OSU); University of British Columbia (UBC). All measurements are in mm.

Phytocoris populi (L.)

Figs. 1–5

Phytocoris populi is widely distributed in the British Isles, continental Europe, and northern Africa (Carvalho, 1959; Southwood and Leston, 1959; Wagner, 1971). It has been reported from a variety of deciduous trees including *Acer, Alnus, Fraxinus, Populus, Pyrus, Quercus, Salix, Tilia* and *Ulmus* (Butler, 1923; Wagner, 1971). Southwood and Leston (1959) noted that *P. populi* is a bark-inhabiting species and is often found resting in a flattened position on trunks of deciduous trees. The nymphs and adults of this species are predominantly pre-

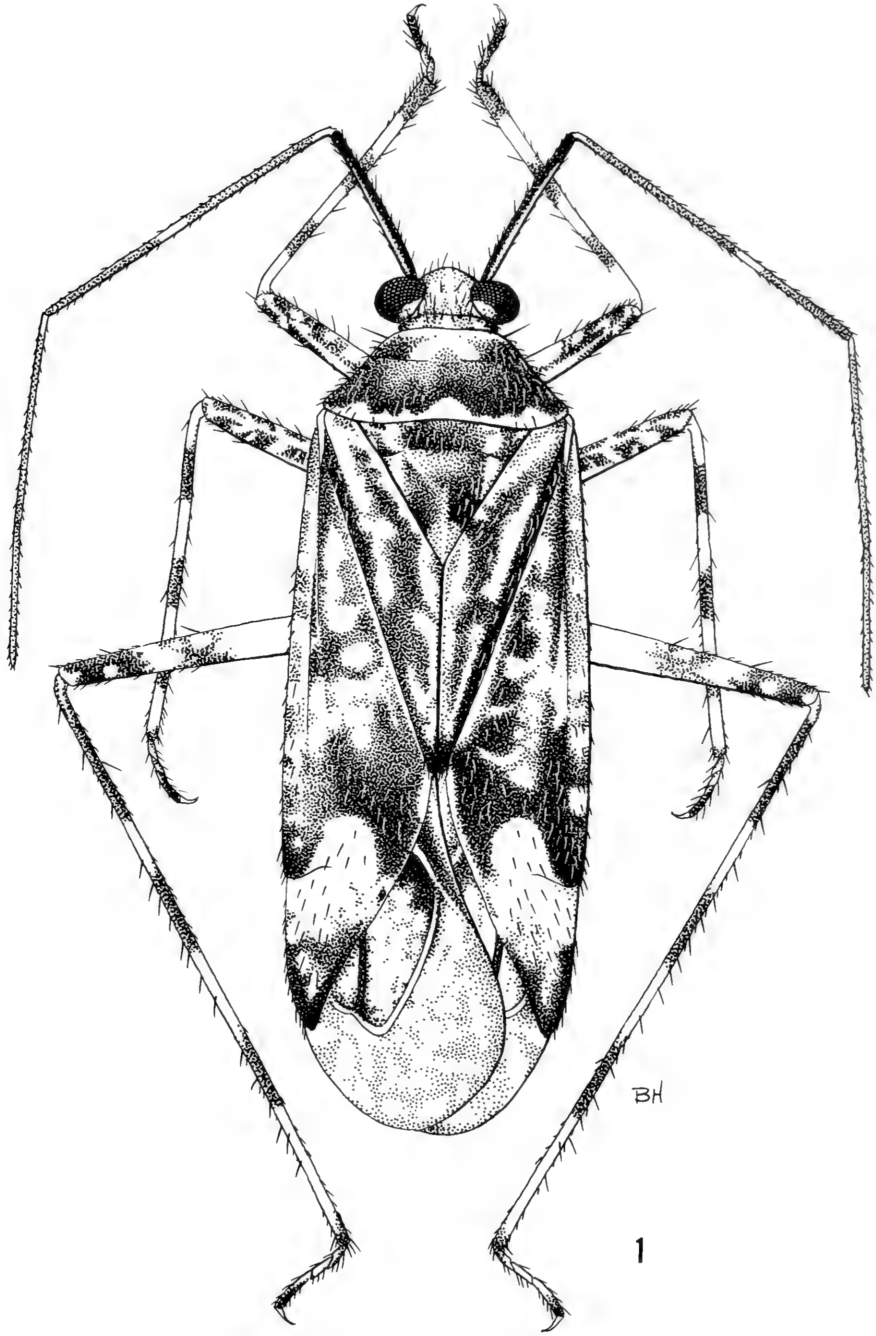


Fig. 1. *Phytocoris populi,* adult male.

daceous and feed on small insects such as Psocoptera and Psyllidae (Southwood and Leston, 1959). The eggs overwinter and hatch in late spring. Adults are found from June to November in England (Butler, 1923).

Saunders (1892) and Wagner (1971) described and illustrated the adult, and Wagner (1971) figured the male genitalia.

In mid-July 1981, nymphs (fourth and fifth instars) and adults of *P. populi* were collected in Bellingham, Whatcom County, Washington, on trunks and large branches of *Alnus rubra* Bong. Additional material was discovered in the collection of the University of British Columbia with label data: Vancouver, B.C., 10 August 1955, W. Downes.

Phytocoris populi is distinguished from other North American *Phytocoris* by the pale, longitudinal stripes on the first antennal segment; absence of tubercles above bases of claspers; and the long, serrulate sclerotized process of the vesica. In Knight (1968), this species keys somewhat poorly to *P. sonorensis* Van Duzee or the couplet containing *P. cercocarpi* Knight and *P. heidemanni* Reuter.

Adult male (Fig. 1).—Length 6.64–7.02, width 2.23–2.39. *Head:* Width across eyes 1.07–1.13, vertex 0.33–0.34; grayish yellow with fuscous markings; frons weakly convex, with 6–8 fuscous striae each side of midline. *Rostrum:* Length 2.75–2.83, extending to 4th or 5th abdominal segment. *Antenna:* Dark brown or black; I, length 1.26–1.46, with 2 or 3 longitudinal, pale stripes; II, length 2.30–2.66, usually with pale, median annulus; III, length 1.44–1.60; IV, length 1.01–1.08. *Pronotum:* mesal length 0.97–1.01, posterior width 1.80–1.87; dark brown, posterior margin narrowly pale; collar and inner angles of calli yellowish. *Scutellum:* Dark brown, anterolateral angles and apex pale. *Hemelytra:* Whitish to grayish yellow, extensively mottled with fuscous, sometimes almost entirely darkened; posteromedial region of corium pale; cuneus fuscous, pale at base; membrane conspurcate. *Venter:* Grayish yellow, genital segment and lateral margins of abdomen infuscated. *Legs:* Coxae grayish yellow; femora white to grayish yellow with fuscous markings; tibiae pale with 3 fuscous bands. *Vestiture:* Pronotal disk, scutellum, and hemelytra with black, simple setae intermixed with silvery, flattened setae. *Genitalia* (Figs. 2–5): Genital segment without tubercles above bases of claspers.

Female.—Similar to male in color and vestiture. Length 6.48–7.02, width 2.38–2.63. *Head:* Width across eyes 1.04–1.12, vertex 0.39–0.43. *Rostrum:* Length 2.95–3.04, extending to 4th or 5th abdominal segment. *Antenna:* I, 1.49–1.76; II, 2.61–2.79; III, 1.62–1.71; IV, 0.99–1.26. *Pronotum:* Mesal length 0.97–1.03, posterior width 1.82–1.96.

***Phytocoris varipes* Boheman**

Figs. 6–10

Phytocoris varipes is a common species throughout the British Isles and continental Europe except the extreme northern regions (Butler, 1923; Southwood and Leston, 1959). Butler (1923) and Wagner (1971) also record this species from Algeria, Turkestan, and the Bol'shoy Kavkaz Mountains in southwestern USSR. *Phytocoris varipes* inhabits a variety of grasses and herbs in Europe and is reported to be principally phytophagous (Kullenberg, 1944; Southwood and Leston, 1959).

Food plants of this species include *Achillea, Anthemis, Bromus, Lathyrus, Phleum, Rumex,* and *Trifolium.* Southwood and Leston (1959) noted that feeding occurs mostly on flowers and unripe fruits. Eggs are deposited in the stems of the host plants and overwinter; adults are found from mid-June to October (Southwood and Leston, 1959; Wagner, 1971).

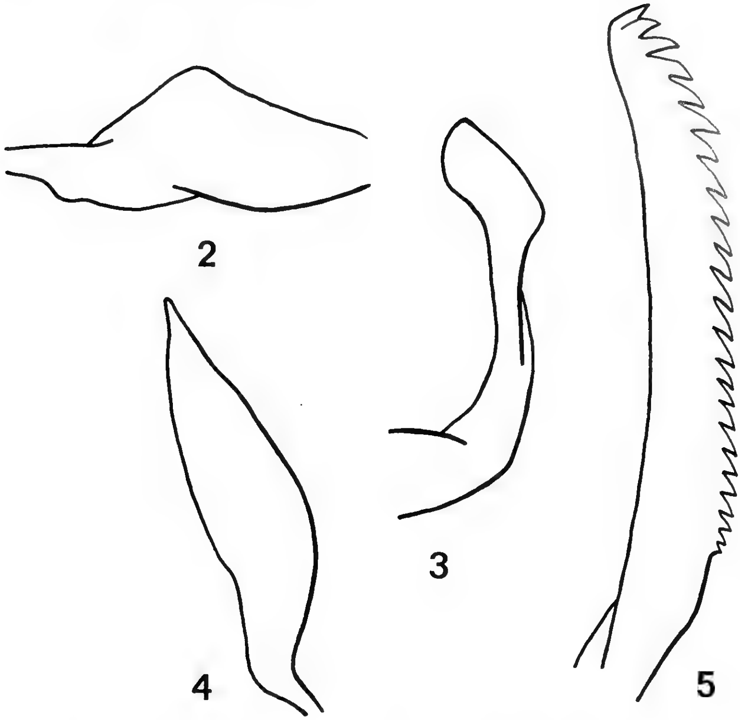
Kullenberg (1944) figured the fifth-instar nymph. The adult has been illustrated by Southwood and Leston (1959) and Wagner and Weber (1964). Illustrations of the male genitalia are provided by Wagner and Weber (1964) and Wagner (1971).

The following represent the first records for *P. varipes* in North America: OREGON. Benton Co.: Corvallis, many dates ranging from June 21 to Aug. 24 (OSU); Finley Wildlife Refuge, July 19, 1972 and Aug. 6, 1976 (Lattin; OSU); 3.5 mi NE Summit, Oct. 17, 1963 (Lattin; OSU); 9 mi NE Corvallis, Aug. 24, 1964 (OSU); 4 mi W Philomath, July 26, 1979 (Stonedahl; OSU); 15 mi SE Alsea, Aug. 12, 1977 (Lattin; OSU). Coos Co.: 2.5 mi W Remote, July 1, 1968 (Westcott; OSDA). Curry Co.: 3 mi S Port Orford, Aug. 11, 1979 (Stonedahl; OSU); 21 mi N Gold Beach, 30 meters, July 12, 1979 (J. Schuh, R. T. Schuh; AMNH). Douglas Co.: 3 mi N Sutherlin, July 19, 1975 (Russell; OSU); 35 mi W Winston, 190 meters, July 12, 1979 (Schuh; AMNH). Lane Co.: Green River, T15S, R9W, Sec. 8, Aug. 10, 1968 (Lattin; OSU); 3 mi N Coburg, July 20, 1956 (Lattin; OSU). Lincoln Co.: 10 mi N Hwy 34 on Grass Mtn Rd, 518 meters, Sept. 16, 1971 (Lattin; OSU); 10 mi ESE Waldport, Aug. 8–15, 1968 (Lattin; OSU); 2.5 mi N Waldport, Aug. 24, 1972 (Musgrave; OSU). Linn Co.: 8 mi E Lacomb, Aug. 17, 1968 (Lattin; OSU); Horse Butte, July 9, 1977 (Eulensen; OSU); Foster, Aug. 5, 1959 (Lattin; OSU). Marion Co.: 1 mi NW Sublimity, July 10, 1957 (Lattin; OSU); Woodburn, July 1, 1965 (Larson; OSDA). Polk Co.: 6 mi E Independence, July 10, 1957 (Lattin; OSU).

Much of the material from the preceding localities was collected at light. Both nymphs and adults were taken at several locations by sweeping herbaceous vegetation.

Phytocoris varipes keys to *P. piceicola* Knight in Knight (1968) but is distinguished from *piceicola* by the yellow and red general coloration, broad vertex, and distinct male genitalia. The combined occurrence of tubercles on the anterior and lateral margins of the male genital aperture will differentiate this species from all other North American *Phytocoris.* Externally, *P. varipes* resembles several native, grass and herb inhabiting species of *Phytocoris* (e.g., *P. fuscipennis* Knight, *P. roseipennis* Knight) but shows no relationship to these species with regard to male genital structures.

Adult male (Fig. 6).—Length 6.10–7.31, width 2.03–2.39. Width across eyes 1.01–1.10, vertex 0.47–0.51; pale yellow to testaceous; buccula, lorum, jugum, and clypeus marked with red; frons strongly convex, with reddish striae each side of midline. *Rostrum:* Length 3.40–3.67, extending to 7th or 8th abdominal segment. *Antenna:* Pale yellow to testaceous; I, length 1.22–1.52, tinged or spotted with red; II, length 2.70–3.14; III, length 2.01–2.28; IV, length 1.14–1.33. *Pronotum:* Mesal length 0.99–1.18, posterior width 1.62–1.94; yellow to pale grayish brown; basal submargin with a dark, sometimes indistinct, transverse band; collar with pair of medial reddish spots. *Scutellum:* Yellow to testaceous, pale median line bordered with red to fuscous. *Hemelytra:* Yellow to testaceous, often with reddish cast; claval vein pale, bordered by fuscous bands; posteromedial region



Figs. 2–5. *Phytocoris populi,* male genital structures. 2, Arm of left clasper, lateral view. 3, Shaft of left clasper, dorsal view. 4, Right clasper, lateral view. 5, Sclerotized process of vesica.

of corium with large, fuscous patch; cuneus marked with red; membrane conspurcate. *Venter:* Yellowish, mottled with reddish brown. *Legs:* Coxae yellow, lightly marked with red; femora yellow, mottled with red or reddish brown; tibiae pale yellow to testaceous; foretibia with 3 dark annuli, bands sometimes indistinct. *Vestiture:* Pronotal disk, scutellum, and hemelytra with dark, simple setae intermixed with golden and silvery, flattened setae. *Genitalia* (Figs. 7–10): Anterior margin of genital aperture with distinct tubercle in addition to tubercles above bases of claspers.

Female.—Similar to male in color and vestiture, hemelytra extending to or slightly beyond end of abdomen. Length 5.67–6.89, width 2.09–2.47. *Head:* Width across eyes 1.01–1.10, vertex 0.54–0.56. *Rostrum:* Length 3.52–3.82, extending to 7th abdominal segment. *Antenna:* I, 1.29–1.50; II, 2.60–3.17; III, 1.82–2.41; IV, 1.14–1.35. *Pronotum:* Mesal length 0.95–1.14, posterior width 1.48–1.84.

Phytocoris tiliae **(F.)**

This species also is widely distributed in the British Isles, continental Europe, and northern Africa (Carvalho, 1959; Southwood and Leston, 1959). It inhabits the bark of many deciduous trees in Europe (Butler, 1923) and is reported to be largely predaceous on mites and small insects (Collyer, 1953; Southwood and Leston, 1959). Eggs overwinter and hatch from early June to early August; adults are present from late June until late October (Southwood and Leston, 1959).

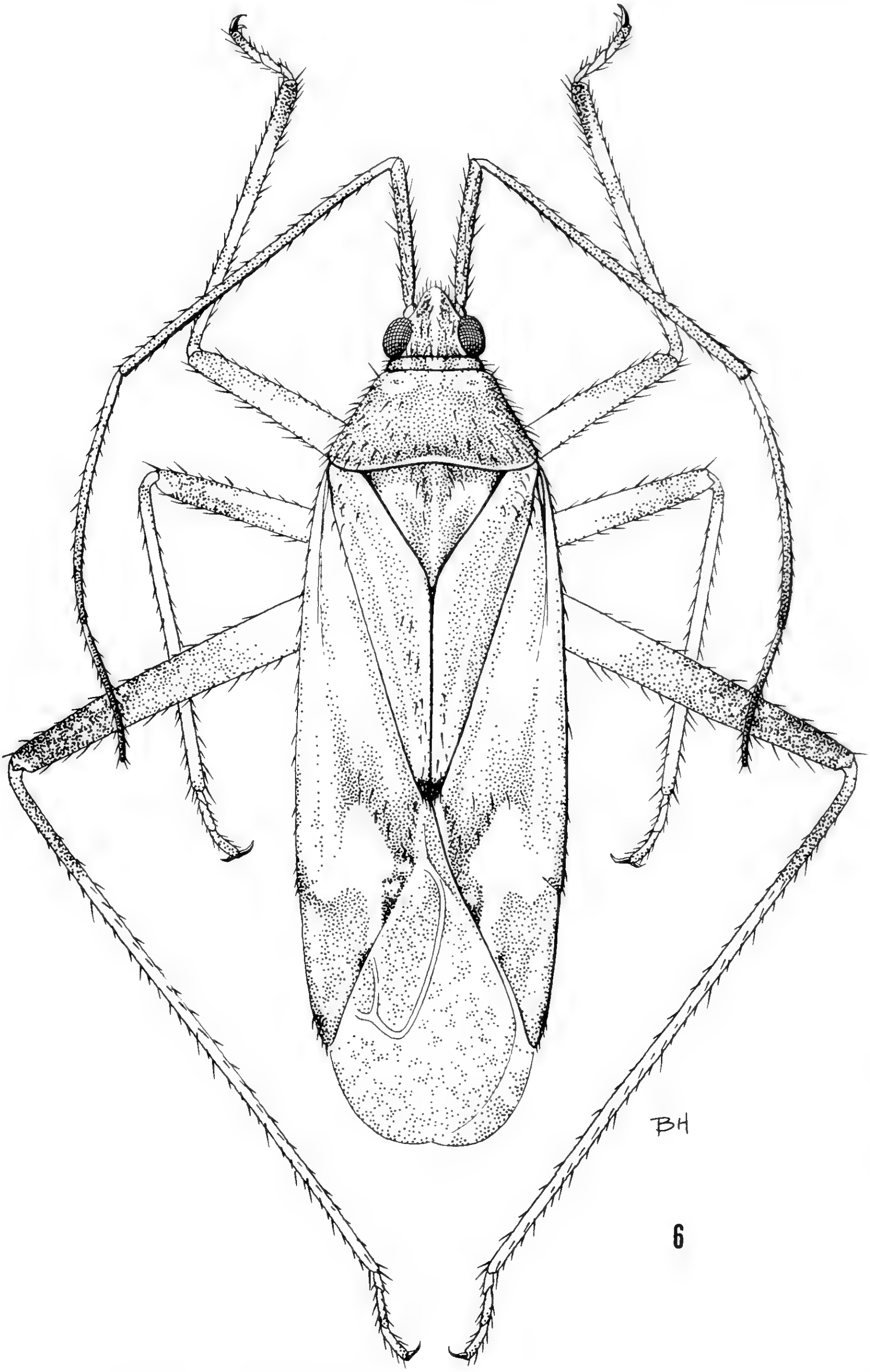
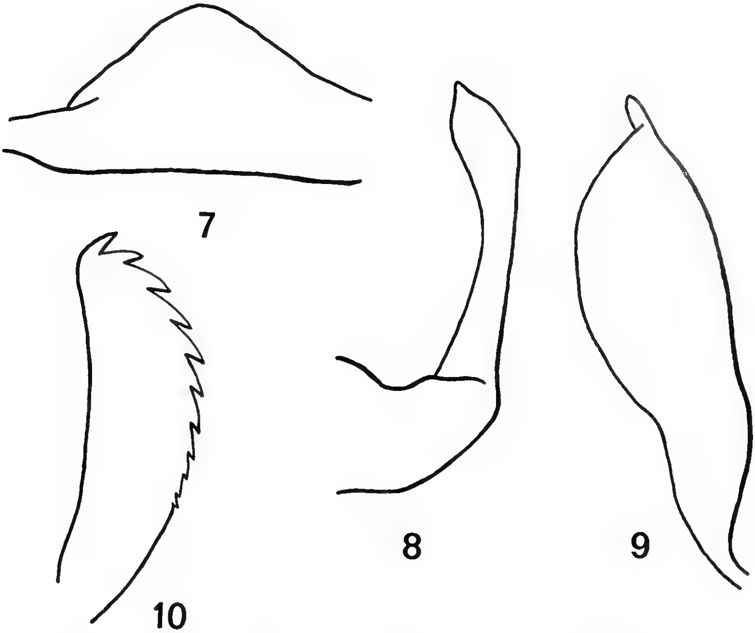


Fig. 6. *Phytocoris varipes,* adult male.



Figs. 7–10. *Phytocoris varipes,* male genital structures. 7, Arm of left clasper, lateral view. 8, Shaft of left clasper, dorsal view. 9, Right clasper, lateral view. 10, Sclerotized process of vesica.

The egg and fifth-instar nymph were described by Butler (1923). Saunders (1892), Southwood and Leston (1959), and Wagner (1971) illustrated the adult. Wagner (1971) also figured the male genitalia.

Phytocoris tiliae was first recorded in North America from Vancouver, British Columbia (Downes, 1924) and later reported from New York and Washington by Wheeler and Henry (1976). *Phytocoris tiliae* is now known from two localities in northwestern Oregon: Benton Co., Corvallis, Arnold Way, Aug. 20, 1981, ex. *Tilia platyphylla* Scop. (Stonedahl; OSU); Linn Co., Albany, 1450 Queen SW, Aug. 21, 1981, ex. *Salix* sp. and *Tilia platyphylla* (Stonedahl; OSU). Adults and nymphs were collected at both localities.

The description and diagnostic characters provided by Wheeler and Henry (1976) will serve to distinguish *P. tiliae* from other North American *Phytocoris.* This species keys with difficulty to *P. commissuralis* Van Duzee in Knight (1968) but differs by the smaller size, grayish white to greenish coloration, and pale pronotum with fuscous lateral margins. The male genital structures of *P. tiliae* are similar to those of *P. dimidiatus* and *P. populi.*

***Phytocoris dimidiatus* Kirschbaum**

Phytocoris dimidiatus is distributed throughout the British Isles and much of continental Europe (Carvalho, 1959; Southwood and Leston, 1959). It also has been reported from Morocco (Lindberg, 1940), Siberia (Carvalho, 1959) and Nova Scotia, Canada (Knight, 1923). Like *P. populi* and *P. tiliae,* this species inhabits deciduous trees such as *Alnus, Fraxinus, Populus, Prunus, Pyrus, Quercus,* and

Salix. The feeding habits of *P. dimidiatus* are not well known, but Wagner (1971) reported that it is at least partially predaceous. The eggs overwinter and hatch in May or early June; adults are found from mid-June to November (Southwood and Leston, 1959).

Butler (1923) described the fifth-instar nymph and Southwood and Leston (1959) illustrated the adult. The male genitalia are figured by Knight (1923) and Wagner (1971).

The only previous record for *P. dimidiatus* in North America is a single male from Kentville, Nova Scotia, Aug. 27, 1917, W. H. Brittain (Knight, 1923). The following represent the first records for this species in western North America: BRITISH COLUMBIA. Lulu Is., Aug. 23, 1954 (Downes; UBC). OREGON. Benton Co.: Corvallis, July 30, 1959, taken at light (Lattin; OSU); Corvallis, Sept. 6, 1980, ex. *Pyrus* sp. (Stonedahl; OSU). Klamath Co.: Klamath Falls, Aug. 4, 1961, taken at light (Goeden; OSU). Multnomah Co.: Portland, July 9, 1940 (Schuh; OSU). Yamhill Co.: McMinnville, July 27, 1958, taken at light (Fender; OSU). WASHINGTON. Whatcom Co.: Bellingham, Aug. 23, 1980, taken on bark of *Pyrus* sp. (Stonedahl; OSU).

Phytocoris dimidiatus closely resembles *P. tiliae* but is distinguished by the darker brownish coloration, pale ventral surface of the first antennal segment, and uniformly brownish pronotum without fuscous lateral margins. Genital structures of the male are very similar to those of *P. tiliae.* The key and description provided by Knight (1923) will serve to separate *P. dimidiatus* from other *Phytocoris* species in eastern North America. In Knight (1968), this species keys to *P. sonorensis* Van Duzee but differs by the larger eyes, absence of tubercles on the lateral margins of the genital aperture, and the long, serrulate sclerotized process of the vesica.

DISCUSSION

Prior to the discovery of *P. populi* and *P. varipes* in the Pacific Northwest, three Palearctic species of *Phytocoris* (*P. dimidiatus, P. tiliae, P. ulmi* (L.)) had been reported from North America (Knight, 1923; Downes, 1924; Wheeler and Henry, 1976). The patchy coastal distributions of *P. dimidiatus* and *P. populi* suggest that these species are artificial introductions and not truly Holarctic. Like *P. tiliae,* these species appear to be recent invaders, possibly gaining entrance on nursery stock. Other Palearctic mirids are believed to have become established in this manner (Henry and Wheeler, 1979). Although more uniformly distributed than the above species, it is likely that *P. varipes* also was artificially introduced, possibly as eggs inserted in stems of non-native grass and/or herb species. A number of Palearctic Miridae have undergone rapid dispersion after being introduced into North America (e.g., *Adelphocoris lineolatus* (Goeze), *Megaloceroea recticornis* (Geoffroy)). These species have become widely distributed in a relatively short period of time and like *P. varipes,* occur in habitats composed largely of introduced grasses and herbs (Slater, 1974).

ACKNOWLEDGMENTS

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BIOLOGY AND IMMATURE STAGES OF *NOSTIMA APPROXIMATA* (DIPTERA: EPHYDRIDAE), A GRAZER OF THE BLUE-GREEN ALGAL GENUS *OSCILLATORIA*[1]

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Abstract.—Information is presented on the life cycle and larval feeding habits of *Nostima approximata* Sturtevant and Wheeler, a relatively rare species of the ephydrid subfamily Notiphilinae and tribe Philygrini. The larvae are highly specialized trophically and are restricted to feeding on the algal genus *Oscillatoria* and certain other related genera of blue-green algae. In northeastern Ohio, the life cycle can be completed in ca. 25 days, and there are at least five generations a year.

The egg, mature larva, and puparium are described and illustrated. A key is given that separates the eggs, mature larvae, and puparia of *N. approximata* from those of *Lytogaster excavata* (Sturtevant and Wheeler) and *Pelina truncatula* Loew, two other ephydrid species whose larvae are known to feed on soil-inhabiting blue-green algae.

The life history of this species is contrasted and compared with those other species of Ephydridae having larvae that feed on blue-green algae. The larval feeding habits are also compared with those of other species of Notiphilinae. It is suggested that the genus *Nostima* and tribe Philygrini would be better placed in the subfamily Parydrinae rather than in the Notiphilinae.

Containing more than 1200 species, the Ephydridae constitute one of the largest families within the acalyptrate Diptera (Rohdendorf, 1974). Over 400 species are recorded from America north of Mexico (Deonier, 1979), and equally rich faunas occur in the other major biogeographic regions. The family obviously has undergone considerable adaptive radiation and has been referred to as a "family of flies in the full flower of its evolution" (Oldroyd, 1964). The larval feeding habits are remarkably diverse, although a majority of the species probably are microphagous on autotrophic and heterotrophic microorganisms. Larvae of many species are known to utilize algae, bacteria, and yeasts. However, other larvae are scavengers on decaying plant and animal remains; are phytophagous in the leaves and stems of higher plants; or are predators of spider eggs, frog eggs, and midge larvae. Perhaps the most interesting trophic story involves the use of algae as a larval food. Species of *Cirrula, Dimecoenia, Ephydra,* and *Setacera* occur in floating algal mats (Aldrich, 1912; Oliveira, 1954, 1958; Wirth, 1971; Simpson, 1979;

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Mathis and Simpson, 1981; Foote, 1982), while those of *Discocerina, Parydra, Paracoenia,* and *Scatella* are frequently encountered in algae-laden substrates of shoreline habitats (Brock et al., 1969; Foote and Eastin, 1974; Deonier and Regensburg, 1978; Zack and Foote, 1978; Thier and Foote, 1980). A broad spectrum of algal taxa is consumed, and evidence is accumulating that certain groups of phycophagous ephydrids are specialized for particular algal taxa. One such specialization involves an array of species that is adapted for using blue-green algae, a group that is generally considered to be quite recalcitrant to grazing by invertebrate animals (Arnold, 1971).

This is the fifth in a series of papers dealing with life histories of species of Ephydridae whose larvae utilize blue-green algae. The first publication (Foote, 1977) was a general discussion of the use of blue-greens by 12 species of the family; the second (Foote, 1981a) was concerned with *Lytogaster excavata* (Sturtevant and Wheeler), a grazer of soil-inhabiting species of *Cylindrospermum,* the third contribution (Foote, 1981b) elucidated the life history of *Pelina truncatula* Loew, another consumer of *Cylindrospermum*; and the fourth paper dealt with *Setacera atrovirens* (Loew), an inhabitant of floating algal mats (Foote, 1982). The present paper elucidates the life cycle, discusses larval food preferences, and describes the immature stages of *Nostima approximata* Sturtevant and Wheeler, a grazer of the blue-green algal genus *Oscillatoria.* In addition, the biology of this species is contrasted and compared with those of other species known to utilize blue-green algae.

The genus *Nostima* is usually placed in the subfamily Notiphilinae and tribe Philygrini along with the genera *Philygria* and *Lemnaphila* (Wirth, 1965). However, Dahl (1959) included it in the subfamily Hydrininae along with the genera *Hyadina* (including *Axysta* and *Lytogaster*) and *Hydrina* (= *Philyria*), stating that *Nostima* was "closely allied to *Hydrina.*" Dahl (1959) referred to a holarctic species, *N. picta* Fallén, as "our most beautiful ephydrid." Both he and Sturtevant and Wheeler (1954) commented upon the rarity of the species of *Nostima* in museum collections.

The world fauna of *Nostima* consists of ca. 28 species, with a preponderance of the species occurring in the Neotropical Region. The Americas south of the United States have 15 described species (Wirth, 1968) and probably contain several additional undescribed species. Rather surprisingly, only three species are recorded from the Afrotropical Region (Cogan, 1980), and none is known from the Oriental Region. Two species have been recorded from the Palearctic Region (Becker, 1926), and eight species are known to occur in North America north of Mexico (Wirth, 1965). Only one of the Nearctic species, *N. picta,* is also recorded from Europe, but four species have ranges that extend into the Neotropics. Only *N. approximata, N. picta, N. quinquenotata* Cresson, and *N. scutellaris* Cresson have been recorded from the northern United States, and apparently only *N. picta* and *N. scutellaris* are known to occur in Canada. In contrast, five of the eight Nearctic species occur in Florida.

MATERIALS AND METHODS

All field and laboratory work was carried out in northeastern Ohio near the city of Kent in Portage County. Laboratory rearings providing life cycle data were carried out in an environmental chamber programmed to give a photoperiod of

15L:9D and a temperature of 22°C (± 1°C). Monocultures used in the larval feeding tests were mostly obtained from The University of Texas Culture Collection of Algae (Starr, 1978). Monocultures of algae utilized in the feeding tests, along with their UTEX strain numbers, are listed below. Species lacking UTEX numbers were obtained from nature or the phycology laboratory at Kent State University. Each algal monculture was established on a nutrient agar substrate in sterile petri plates. Feeding tests were performed as outlined in Zack and Foote (1978).

Cyanophyceae

Anabaena flos-aquae (1444)
Anabaena variabilis (B377)
Cylindrospermum sp. (LB942)
Gloeocapsa alpicola (B589)
Lyngbya spiralis (B1831)
Nostoc commune (584)
Oscillatoria limosa
Oscillatoria tenuis (B428)
Phormidium sp. (1540)
Scytonema sp.
Symploca muscorum (B617)
Synechococcus leopoliensis (625)

Chlorophyceae

Chlamydomonas acidophila

Chlorophyceae (*cont.*)

Chlamydomonas eugametos (9)
Chlorella vulgaris (29)
Cosmarium botrytis (175)
Scenedesmus quadricauda (76)

Euglenophyceae

Euglena gracilis var. *bacillaris* (L884)

Bacillariophyceae

Navicula pelliculosa (668)

Chrysophyceae

Botrydiopsis alpina (295)
Botrydium becherianum (158)

Life History

Adults of *Nostima* are rarely collected but are usually taken in wetland habitats supporting stands of grasses, rushes, and sedges. Deonier (1965) apparently did not encounter *N. approximata* in Iowa but recorded *N. scutellaris* as rare in the sedge-meadow habitat. Scheiring and Foote (1973) similarly reported that *N. scutellaris* was rare in sedge meadows but failed to collect *N. approximata.* Sturtevant and Wheeler (1954) collected specimens of *N. scutellaris* at lights. Dahl (1959) commented that *N. picta* in Scandinavia was a "distinctly hydrophilous species" and occurred in maritime as well as freshwater habitats. I have never encountered adults of *N. approximata* in nature, but larvae were found in algae-laden soil samples taken from the partly shaded borders of a sedge marsh and from a drying drainage ditch that supported a dense stand of grasses and sedges. In all larval substrate samples, blue-green algae, particularly species of *Oscillatoria,* were abundant. Other ephydrid species repeatedly taken in habitats supporting *Nostima* populations were *Hydrellia* spp., *Hyadina* spp., and *Lytogaster excavata.*

Very little information is available concerning seasonal distribution of *N. approximata,* as no adults were collected. Larvae were taken in nature on August 20, September 13, October 10, and October 22. These all formed puparia in the laboratory from which adults emerged several days later. This suggests that adults can occur at least during the late summer and fall in northern Ohio. Judging from the overwintering habits of other northern Ephydridae, *N. approximata* survives the cold season as adults.

Adult longevity in the laboratory rearings varied between 20 and 36 days and averaged 26 days ($n = 8$). Males usually died several days prior to the females, and the longest longevity was obtained for a female that lived for 36 days before succumbing to lethal temperatures when the environmental chamber overheated. Adults fed readily on monocultures of *Oscillatoria limosa* and seemingly required no other food substrates. In contrast, adults placed in cultures of such algal genera as *Anabaena, Chlorella,* and *Navicula* died within five days. Apparently there is no trophic separation in the adult and larval stages of *N. approximata,* as both stages consumed the blue-green algal genus *Oscillatoria.*

The premating period from emergence of both sexes to their first copulation in the laboratory rearings varied from two to three days and averaged 2.5 days ($n = 5$). No overt courtship displays were observed, and males seemingly attempted to mate randomly with any other adult *Nostima* in the rearing dishes. After and between copulations, males usually remained in contact with females in a "riding" position. Riding was observed to last as long as 30 minutes in one pair, although it usually lasted less than 15 minutes. Occasionally, males were seen "riding" other males, although this behavior rarely lasted more than a few minutes. In one case, a riding male repeatedly attempted to copulate with his subordinate male. Parker (1970) reported that similar riding behavior in an anthomyiid fly, *Scatophaga stercoraria* L., served to prevent insemination of the female by later arriving males, thus ensuring that the riding male's sperm would actually fertilize the female's eggs.

The preoviposition period from emergence of a female to her first deposition of eggs, with males constantly available, varied from three to four days ($n = 5$). Females scattered eggs over a suitable algal substrate; rarely were eggs clustered. In the petri dishes females repeatedly oviposited onto growths of *Oscillatoria limosa, Anabaena variabilis,* and *Symploca muscorum,* but failed to oviposit in cultures of *Navicula pelliculosa* and *Botrydiopsis alpina* during the ca. five days they survived in dishes containing those algae. The vast majority of eggs were not buried in the substrate but were placed directly on the algal surface. Very few were scattered over areas of the agar surface lacking an algal growth. It is apparent that females are rather restrictive in their use of potential oviposition sites and in nature probably expend considerable energy in seeking out colonies of *Oscillatoria.* It is possible that only *O. limosa* serves as the oviposition site in northeastern Ohio, as no eggs or larvae of *Nostima* were ever found in such soil algae as species of *Anabaena, Cylindrospermum,* and *Nostoc* even though these algal genera frequently were abundant in the *Nostima* habitats. Even more surprising is the fact that no immature stages of *Nostima* were ever found on the other species of *Oscillatoria* that occurred on exposed muddy and sandy shores near Kent. *Oscillatoria limosa* is "common in stagnant water of ditches and small ponds" (Prescott, 1962) and undoubtedly becomes stranded on moist, vegetation-shaded substrates as water levels recede within drainage channels. The possible restriction of oviposition to this species of alga may go far in explaining the apparent rarity of *N. approximata.* It is probable that the species becomes relatively common only when the host alga becomes exposed and available for oviposition.

The fecundity of females retained in petri dishes containing monocultures of *O. limosa* was quite high, ranging from a low of 216 to a high of 581 eggs ($n = 5$). The female that produced over 500 eggs was killed by a malfunction of the

Table 1. Results of larval feeding tests for *Nostima approximata* using different algal monocultures.

Alga	Percent Reaching Different Life Stages				
	n	2L	3L	P	A
Cyanophyceae					
Anabaena flos-aquae	10	0	0	0	0
Anabaena variabilis	10	80	80	40	20
Cylindrospermum sp.	20	0	0	40	0
Gloeocapsa alpicola	10	0	0	0	0
Lyngbya spiralis	10	100	0	0	0
Nostoc commune	10	0	0	0	0
Oscillatoria limosa	15	100	100	100	100
Oscillatoria tenuis	25	100	92	80	72
Phormidium sp.	10	0	0	0	0
Scytonema sp.	5	0	0	0	0
Symploca muscorum	20	100	100	95	95
Synechococcus leopoliensis	10	0	0	0	0
Chlorophyceae					
Chlamydomonas eugametos	5	0	0	0	0
Chlorella vulgaris	5	0	0	0	0
Cosmarium botrytis	5	0	0	0	0
Scenedesmus quadricauda	5	0	0	0	0
Chlamydomonas acidophila	5	0	0	0	0
Euglenophyceae					
Euglena gracilis	5	0	0	0	0
Bacillariophyceae					
Navicula pelliculosa	5	0	0	0	0
Chrysophyceae					
Botrydiopsis alpina	5	0	0	0	0
Botrydium becherianum	5	0	0	0	0

environmental chamber. Her ovaries still contained 28 recognizable eggs when she was dissected two days after death, suggesting that her total fecundity could have exceeded 600 eggs. This female laid an average of 16 eggs daily during the 36 days she remained alive, with a daily output varying from 0 to 51. The incubation period ranged from three to five days and averaged 4.2 days ($n = 20$).

Table 1 summarizes the results of laboratory feeding tests utilizing unialgal cultures. Larvae completed development and eventually became adults only on the blue-green algal species *A. variabilis, O. limosa, O. tenuis,* and *S. muscorum.* None of the other algal species tested allowed larvae to reach the third instar, suggesting that *N. approximata* is highly specialized trophically. The *Anabaena* results are puzzling, as no eggs or larvae were ever found on colonies of this genus in nature. This, coupled with the low percentage (20%) of larvae that eventually became adults when fed this alga, implies that *Anabaena* is not utilized by *Nostima* in nature. Larvae were also able to complete development on *S. muscorum,* with 95% of the larvae eventually becoming adults. However, at least in northeastern Ohio, this is a very rare algal species and was never encountered in habitats containing larvae of *Nostima.*

Table 2. Developmental times for *Nostima approximata* on monocultures of blue-green algae.

	Larval Period			Pupal Period			Combined Period		
Alga	*n*	$\bar{x}$	*s*	*n*	$\bar{x}$	*s*	*n*	$\bar{x}$	*s*
Anabaena variabilis	4	11.25	0.96	2	9.00	0.00	2	19.50	0.71
Oscillatoria limosa	15	7.80	1.21	15	8.27	0.59	15	16.07	1.62
Oscillatoria tenuis	20	10.00	1.49	18	8.39	0.50	18	18.28	1.60
Symploca muscorum	20	10.50	1.20	19	8.60	0.48	18	19.10	1.24

As Table 2 illustrates, the four blue-green species that were utilized by the larvae resulted in no significant differences in the duration of the developmental period from hatching to adult emergence, although the larval period was somewhat shorter when *O. limosa* served as the larval food.

As described for *L. excavata* (Foote, 1981a), larvae of *N. approximata* fed on the algal surface and did not burrow into the matrix to any extent. However, larvae became partially concealed once feeding began because small pieces of algal material adhered to the dorsal surface of the body. Feeding movements resembled those of *Pelina truncatula* (Foote, 1981b) in that the larvae moved slowly over the algal surface while pulling algal trichomes into the oral aperture. However, *Nostima* (Fig. 3) lacks the distinctive comblike structures so prominent on the facial mask of *Pelina* and thus may be incapable of ripping apart *Oscillatoria* trichomes, a capability that is well developed in both *P. truncatula* and *L. excavata.* The pharyngeal sclerite lacks pharyngeal ridges (Fig. 13), and it is very doubtful if a filtering mechanism such as that described for other species of microphagous Ephydridae (Foote, 1982) exists in this species. Instead, whole trichomes or fragments of trichomes are ingested and passed back into the proventriculus. In this respect, larvae of *Nostima* resemble those of species of *Lytogaster* and *Pelina* which also have poorly developed pharyngeal ridges. However, *Nostima* may represent the culmination of a trend line that involves the progressive reduction of the ridges, as they are completely absent in larvae of *N. approximata.*

Larvae of *Nostima* commonly fed collectively on patches of *Oscillatoria,* and as many as eight larvae were found feeding within a 4 cm^2 area of the host alga in nature. Larvae showed no antagnostic behavior to each other and frequently fed side by side. When a larva wandered off of an *Oscillatoria* mat, it became more active and carried out more turning movements. This behavior usually resulted in the larva re-discovering the food substrate. Examination of the gut contents of field-collected larvae showed a great preponderance of *Oscillatoria* trichomes, with very few if any cells of other algal genera.

The only other insect larvae found in association with *Nostima* on patches of *Oscillatoria* were those of undetermined species of Chironomidae. The guts of the midge larvae contained numerous *Oscillatoria* trichomes, suggesting that larvae of these two insect taxa could be in competition for a possibly limited resource.

The larval period of *N. approximata* under laboratory conditions when *O. limosa* served as the food substrate varied from seven to ten days and averaged nine days ($n = 8$). Fully mature larvae ceased feeding, voided the gut contents,

Table 3. Life cycle data for *Nostima approximata* in northeastern Ohio. All rearings were maintained at 22°C, with *Oscillatoria limosa* serving as the adult and larval food.

Flight period	unknown
Premating period	2–3 days
Preoviposition period	3–4 days
Incubation period	3–5 days
Larval period	7–10 days
Pupal period	7–10 days
Adult longevity	ca. 25 days
Fecundity	ca. 600 eggs/female

and tended to move to somewhat higher and thus drier areas of the algal mat where pupariation occurred. The pupal period ranged from seven to ten days and averaged 8.3 days ($n = 15$).

The only enemy determined for the immature stages of *N. approximata* was a species of diapriid wasp (Hymenoptera: Diapriidae) that was reared from field-collected puparia.

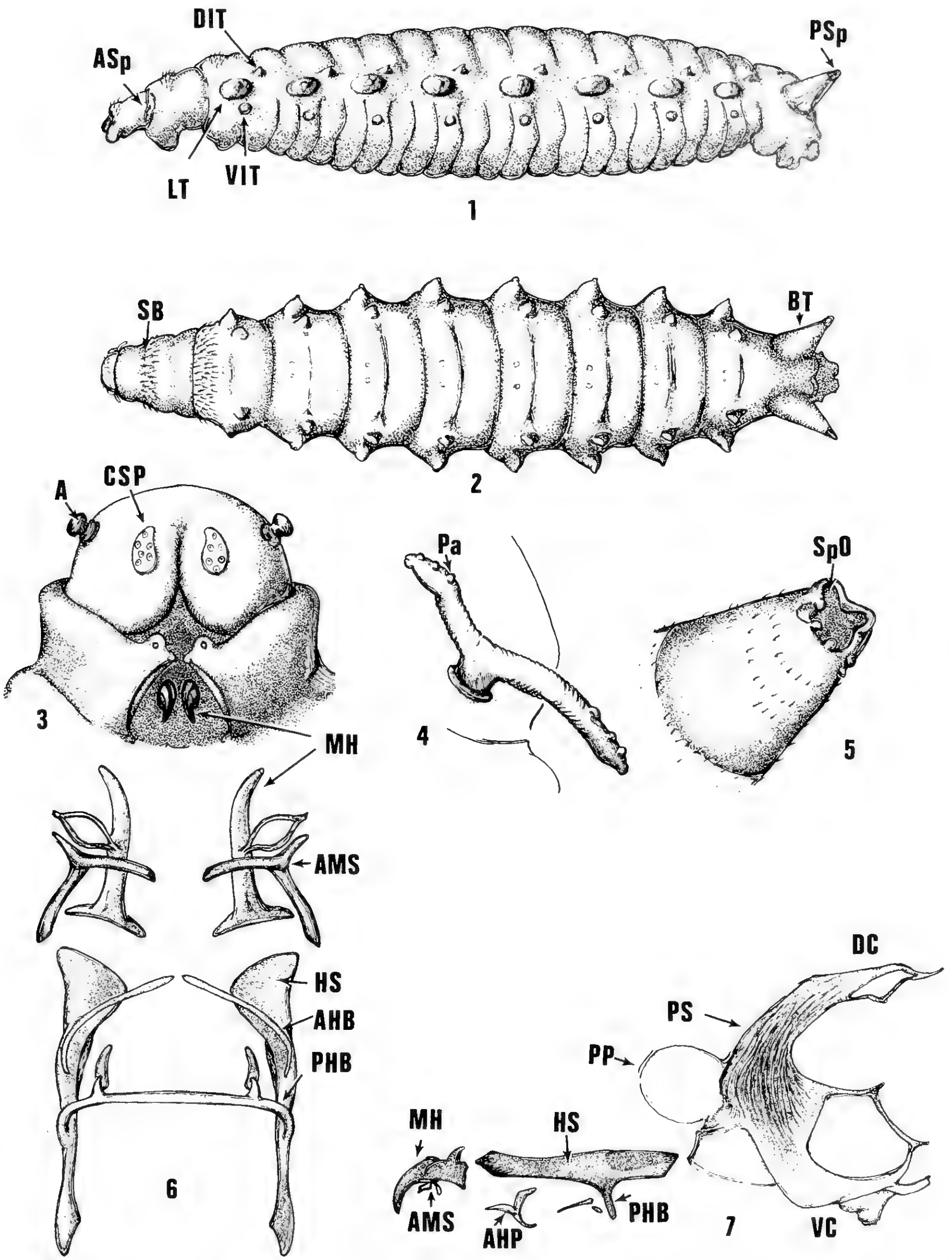
With a preoviposition period of 3–4 days, an incubation period of 3–5 days, and a combined larval-pupal period of 14–20 days, the life cycle can be completed in 20–29 days (Table 3). This suggests that at least five generations could be produced in northern Ohio during a warm season lasting from mid-May to mid-October.

DESCRIPTIONS OF IMMATURE STAGES

Egg (Fig. 12).—Length 0.35–0.40 mm, $\bar{x} = 0.38$; width 0.15–0.18 mm, $\bar{x} = 0.17$ ($n = 10$). Ovoid, ends bluntly rounded; micropylar end (Fig. 12a) with small array of encircling tubercles subapically on dorsal side, opposite end distinctly less tuberculate. Chorion white, distinctly reticulate.

Mature third-instar larva (Figs. 1, 2).—Length 1.8–2.2 mm, $\bar{x} = 2.0$; width 0.6–0.8 mm, $\bar{x} = 0.7$ ($n = 5$). Somewhat flattened dorsoventrally. Anterior end tapering, posterior end bearing 2 strongly diverging breathing tubes; margins of body irregular, bearing 3 rows of low tubercles. Integument lacking bristles and hairs except on anterior few segments.

Segment 1 (pseudocephalic) (Fig. 3) frequently invaginated, bearing antennae anterolaterally and circular sensory plates apicoventrally, facial mask area around oral aperture without rows of comblike structures; antenna short and blunt, appearing 2 segmented; circular sensory plates somewhat elongate, with bordering rims complete, each plate with few short peglike structures. Segment 2 (prothoracic) spinulose, particularly on dorsal and lateral surfaces, bearing deeply bifurcate anterior spiracles posterolaterally; each spiracle (Fig. 4) with 2 strongly diverging branches, each branch bearing 3–4 small sessile papillae along outer surface, base of spiracle arising from lightly pigmented ring. Segments 3–11 (Fig. 1) very similar, lateral margins indented and bearing ventrolateral, lateral, and dorsolateral rows of tapering tubercles, lateral tubercles largest; dorsum of each segment (Fig. 9) with 2 circular clear areas along middorsal line, ventral surface (Fig. 10) with poorly defined creeping welt, welt lacking spinules. Segment 12 bearing perianal pad ventrally and breathing tubes apicolaterally; perianal pad



Figs. 1–7. *Nostima approximata,* third-instar larva. 1, Lateral habitus. 2, Dorsal habitus. 3, Facial mask. 4, Anterior spiracle. 5, Breathing tube and posterior spiracle. 6, Ventral view of cephalopharyngeal skeleton. 7, Lateral view of cephalopharyngeal skeleton. Abbreviations: A = antenna; AHB = anterior hypostomal bridge; AHP = anterior hypostomal plate; AMS = accessory mouth sclerite; ASp = anterior spiracle; BT = breathing tube; CSP = circular sensory plate; DIT = dorsolateral tubercle; DC = dorsal cornu; HS = hypostomal sclerite; LT = lateral tubercle; MH = mouthhook; Pa = papilla; PHB = posterior hypostomal bridge; PP = pharyngeal process; PS = pharyngeal sclerite; PSp = posterior spiracle; SB = spinule ban; SpO = spiracular opening; VC = ventral cornu; VIT = ventrolateral tubercle.

(Fig. 11) somewhat bilobed, surrounded by pale rim, lacking postanal spinule pad. Breathing tubes (Fig. 5) elongate, diverging, and tapering, 2–3× as long as width at base; each tube capped apically by spiracular plate, each plate bearing 3–4 poorly defined spiracular openings, hairlike processes around spiracular openings seemingly lacking.

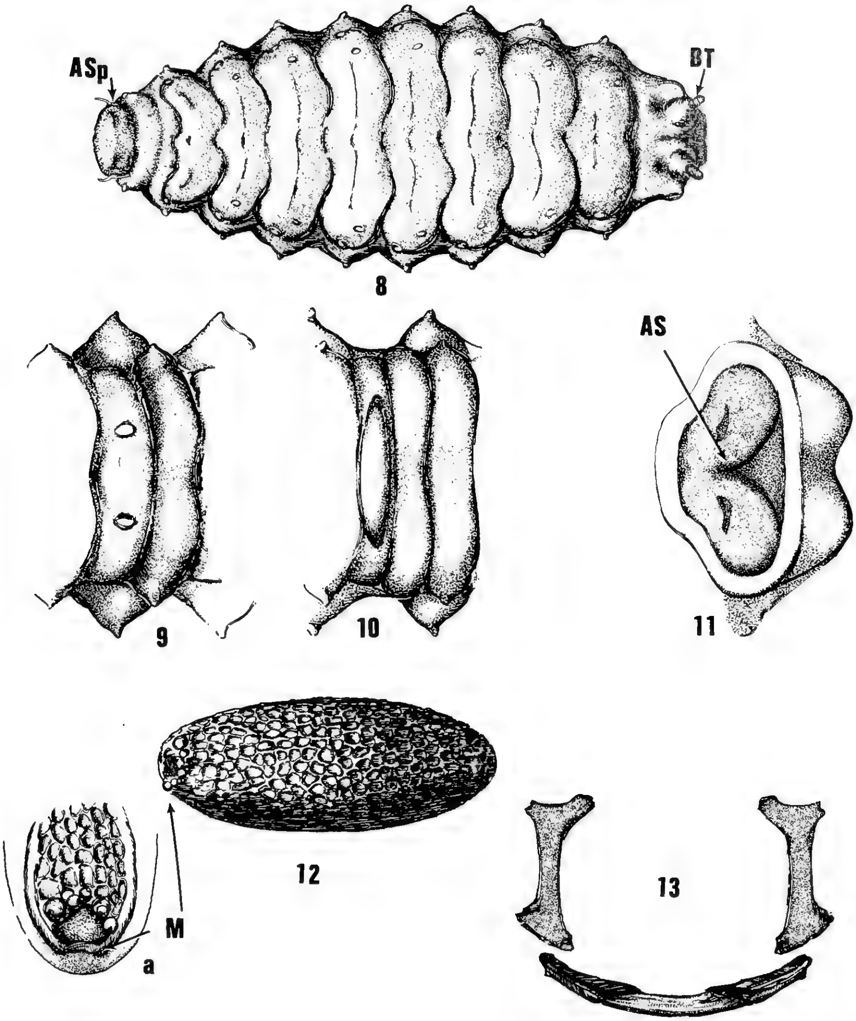
Cephalopharyngeal skeleton (Figs. 6, 7) length 0.38–0.42 mm, $x = 0.40$ ($n = 5$). Mouthhooks (Fig. 6) paired and not connected dorsally; hook part narrow and only slightly curved, lacking accessory teeth; basal part abruptly broadened and lacking window. Accessory mouth sclerite below each mouthhook with 1 short and 2 long branches. Hypostomal sclerite (Fig. 6) composed of 2 lateral rods connected by 2 narrow, arched hypostomal bridges; anterior bridge apparently not completely sclerotized medially; posterior bridge complete, bearing 2 narrow projections on anterior margin; lateral rods distinctly broadened anteriorly; hypostomal sclerite not fused with mouthhooks or pharyngeal sclerite. No apparent epistomal sclerite or parastomal bars. Pharyngeal sclerite mostly deeply pigmented, both dorsal and ventral cornua with large windows apically, dorsal cornua connected anteriorly by poorly defined bridge, pharyngeal processes projecting anteriorly from pharyngeal sclerite large, poorly pigmented and semicircular; floor of pharyngeal sclerite (Fig. 13) lacking pharyngeal ridges.

Puparium (Fig. 8).—Length 1.6–2.0 mm, $\bar{x} = 1.8$; width 0.6–0.8 mm, $\bar{x} = 0.7$ ($n = 10$). Broadest at midlength in dorsal view, gradually tapering to each end, not swollen dorsoventrally at midlength in lateral view, ends of puparium somewhat upturned; anterior end invaginated, bearing bifurcated anterior spiracles apicolaterally; posterior end bearing elongate, diverging breathing tubes apicodorsally; margins of puparium somewhat irregular bearing 3 rows of reduced tubercles along length of puparium. Color uniformly pale brown, without conspicuous blackened scales or spinules; ventral creeping welts very reduced.

Discussion

In contrast to such widely distributed and trophically generalized species of Ephydridae as *Scatella stagnalis* Fallén (Zack and Foote, 1978; Foote, 1979), *N. approximata* must be considered a highly specialized species. It is rare, has a somewhat restricted geographic distribution, probably occurs only in vegetated habitats in which water levels fluctuate, and possibly feeds in nature only on the blue-green algal genus *Oscillatoria.* Thus, its trophic specialization parallels that of species of the hyadinine genera *Lytogaster* and *Pelina* whose larvae apparently are largely restricted to feeding on the algal genus *Cylindrospermum* (Foote, 1981a, 1981b). As Table 4 illustrates, larvae of those two genera seemingly are incapable of utilizing *O. limosa.* Conversely, larvae of *Nostima* cannot develop on *Cylindrospermum.* Thus the hyadinine species and *N. approximata* coexist in the same habitat but are ecologically isolated by utilizing different food resources.

Although little biological information is available for other species of genera of Philygrini, it appears that *N. approximata* is in a unique trophic niche. The only indication of the larval food of a species of *Philygria* is the report of Wheeler (1973) that larvae of *P. debilis* Loew occur in the rotting crowns of alfalfa. The nature of the larval microhabitat suggests that the larvae are ingesting decay products and heterotophic microorganisms rather than algae. Larvae of *Lem-*



Figs. 8–13. *Nostima approximata,* immature stages. 8, Dorsal view of puparium. 9, Dorsal view of segment 9 of third-instar larva. 10, Ventral view of segment 9 of third-instar larva. 11, Perianal pad of third-instar larva. 12, Dorsal view of egg. 12a, Enlargement of micropylar end. 13, Cross section of pharyngeal sclerite. Abbreviations: AS = anal slit; ASp = anterior spiracle; BT = breathing tube; M = micropylar end.

naphila, the only other Nearctic genus of Philygrini, are phytophagous as they are known to mine the floating leaves of duckweed, *Lemna minor* L. (Scotland, 1934, 1940). Generalizing further, no other tribe of the Notiphilinae, the subfamily in which *Nostima* is presently placed, contains species having larval feeding habits similar to those of *N. approximata.* Larvae of *Hydrellia* of the tribe Hydrellini are leaf miners in vascular plants (Deonier, 1971); those of *Typopsilopa* of the Typopsilopini feed on a wide mix of autotrophic and heterotrophic microorganisms but cannot utilize *Oscillatora* (unpublished observations); those of *Notiphila*

Table 4. Comparative utilization of blue-green algae by three species of Ephydridae.

Alga	Percent Reaching Adult Stage		
	N. approximata	*L. excavata*	*P. truncatula*
Order Chroococcales			
Family Chroococcaceae			
Gloeocapsa alpicola	0	0	0
Synechococcus leopoliensis	0	0	0
Order Oscillatoriales			
Family Oscillatoriaceae			
Lyngbya spiralis	0	0	40
Oscillatoria limosa	100	0	0
Oscillatoria tenuis	72	0	30
Phormidium sp.	0	30	0
Order Nostocales			
Family Nostocaceae			
Anabaena flos-aquae	0	0	20
Anabaena variabilis	20	70	100
Cylindrospermum sp.	0	40	100
Nostoc commune	0	0	0

of the Notiphilini engulf anaerobic sediments that are rich in organic detritus (Busacca and Foote, 1978; Deonier et al., 1978); and those of *Dichaeta* (Notiphilini) are generalized consumers of microorganisms in limnic wrack stranded in shoreline habitats (Eastin and Foote, 1971).

The fact that larvae of *N. approximata* utilize blue-green algae suggests that the genus *Nostima,* and probably other genera of the tribe Philygrini, should be placed in the subfamily Parydrinae rather than in the Notiphilinae. The morphology of the mature larva, interestingly, is more similar to that of the hyadinine species than it is to any of the reared species of Notiphilinae. Mathis (personal communication), on the basis of adult morphology, has arrived at a similar conclusion and plans to transfer the Philygrini to the Parydrinae in the forthcoming second volume of the Manual of Nearctic Diptera.

The immature stages of three species of ephydrids utilizing soil-inhabiting blue-green algae can be separated by use of the following key. Characters useful for distinguishing species of *Hyadina* from those of *Lytogaster* have not yet been discovered.

KEY TO IMMATURE STAGES OF *L. excavata, P. truncatula,* AND *N. approximata*

EGGS

1. Ends of egg upturned, chorion striated or reticulated; embryo white . . . 2
– Ends of egg not upturned, chorion papillose; living embryo peach-colored . . . . *P. truncatula* Loew
2. Chorion striated, with longitudinal ridges . . . . *L. excavata* (Sturtevant and Wheeler)
– Chorion reticulated, without longitudinal ridges . . . . *N. approximata* Sturtevant and Wheeler

MATURE LARVAE

1. Dorsum of larva with distinct pattern formed by blackened scales and spinules .... *P. truncatula* Loew
– Dorsum of larvae unpatterned, uniformly colored 2
2. Body length over 3.0 mm; facial mask with several darkened, comblike structures near oral aperture; breathing tubes elongate, at least ⅓ length of body .... *L. excavata* (Sturtevant and Wheeler)
– Body length under 2.5 mm; facial mask (Fig. 3) lacking comblike structures; breathing tubes short, less than ¼ length of body .... *N. approximata* Sturtevant and Wheeler

PUPARIA

1. Dorsum of puparium with dark pattern, as in mature larva .... *P. truncatula* Loew
– Dorsum unpatterned, uniform in color 2
2. Body length over 3.0 mm; breathing tubes elongate, at least ⅓ length of body of puparium .... *L. excavata* (Sturtevant and Wheeler)
– Body length under 2.5 mm; breathing tubes short, less than ¼ length of puparium (Fig. 8) .... *N. approximata* Sturtevant and Wheeler

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NEW SPECIES OF *GLENOSTICTIA* (HYMENOPTERA: SPHECIDAE)

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Abstract.—Seven new species of North American sand wasps of the genus *Glenostictia* are described (Bembicini, Stictiellina). These are ***arizonae*** from Arizona and Chihuahua; ***californica*** from eastern and southern California; ***mexicana*** from Durango; ***nigriloba*** from Arizona, New Mexico, Chihuahua, and Durango; ***parva*** from Arizona, New Mexico, Sonora, and Chihuahua; ***vechti*** from Arizona to western Texas; and ***veracruzae*** from Veracruz.

Glenostictia Gillaspy includes those species of North American sand wasps (Bembicini) with the midocellar remnant depressed and usually longer than broad, raised ring around the midocellus long oval, labrum evenly convex, palpal formula 6–4, male midfemur entire or subapically notched, and arolium well developed. The closely related genus *Stictiella* J. Parker has the ring around the midocellus nearly circular, male femur carinate to serrate beneath, and the arolium small or even undeveloped. The following new species are described so that they can be used in a forthcoming revision of the subtribe Stictiellina. Except as indicated for *mexicana,* holotypes are in the University of California at Davis collection. For brevity terga are abbreviated as T-I, T-II etc.; sterna as S-I etc.; flagellomeres as F-I etc.; and least interocular distance as LID. The signum is a small indentation on the mesopleuron in the middle of the ventral surface.

Glenostictia californica Bohart, New Species

Figs. 20, 21

Male holotype.—Length 12 mm, forewing 8 mm. Black, extensively marked with whitish and clay yellow; whitish are: face about as in Fig. 15, postorbital streak broken at inner eye angle, tergal bands toward middle, gonostyles except laterally and basally; yellowish are: pronotum and pleuron mostly, scutum laterally, broad transverse scutellar band broken medially, metanotum, broadly V-shaped posterior band across propodeal enclosure, propodeum laterally, legs except inner black marks on femora, terga laterally including most of apical bands on T-V–VI, S-I–VI basally; flagellum mostly pale beneath but darker toward apex. Pubescence pale, inconspicuous. Punctation inconspicuous, minute on labrum and clypeus. Facial proportions about as in Fig. 15, galea twice as long as labrum, upper clypeal margin straight and below antennal sockets, F-XI twice as long as broad, clypeus almost evenly convex, midocellar flat area about as broad as long, foretarsus slender, I 7× as long as broad, 5 rake bristles about as long as tarsomere breadth, midtarsus (Figs. 20, 21), midbasitarsus nearly straight; T-VII lateral lobes separated ventrally by length of F-I; S-II not dentate, S-VIII with 3 slender prongs and a medioventral pale thornlike projection.

Female.—Length 11 mm, markings as described for male except 2 large yellow dashes on scutum discally, S-II markings about as in Fig. 4. Forebasitarsus 4× as long as broad, 6 rake bristles.

Holotype.—♂, 14 mi s. Baker, San Bernardino Co., California, IV-22-69 (M. S. and J. S. Wasbauer, U.C. Davis).

Paratypes.—10 ♂, 14 ♀, all CALIFORNIA: Baker (14 mi s., 4 mi s., 15 mi se.), 10 mi ne. Earp, 7 mi sw. Kelso, Darwin and 6 mi nne., Surprise Canyon (Inyo Co.), Panamint Springs (8 mi se., 5 mi nw.), 2 mi ne. Lone Pine. Paratype collectors were R. Bohart, A. Langston, A. Menke, P. Opler, J. Powell, E. Schlinger, L. Stange, and M. and J. Wasbauer. Dates were all in April and May. I have also seen 2 ♀ from Wellton, Arizona, IV-6-35 (A. Melander) that appear to be this species.

Discussion.—As stated under *parva,* the two species are generally similar. Both are small, have a nearly straight upper clypeal margin, little hair beneath the hindfemur, clypeus smoothly convex and evenly colored, and no posterodiscal yellow on scutum. The male of *californica* differs by its essentially straight midbasitarsus, the female by the unevenly colored tergal bands and longer galea. Collecting dates were all in April and May as contrasted with August and September for *parva.*

Glenostictia parva **Bohart,** New Species

Fig. 22

Male holotype.—Length 10 mm, forewing 7 mm. Black, extensively marked with whitish and clay yellow; whitish are: face about as in Fig. 15, postorbital streak broken medially, scutum laterally, broad transverse scutellar band, metanotum, broadly V-shaped posterior band across propodeal enclosure, legs partly and including all of tarsi, terga medially, gonostyles except laterally and basally; yellowish are: short and stout submedian scutal dashes, pleuron mostly, legs except for whitish areas and small black inner basal spots on femora and trochanters, propodeum laterally and posterolaterally, terga laterally and all across on T-IV–VI, S-I–IV mostly but a narrow basal black area on S-II, apical bands on S-V–VI; flagellum dull pale beneath. Punctation inconspicuous, minute on labrum and clypeus. Facial proportions about as in *californica* but labrum a little shorter and galea only 1.5× as long as labrum, upper clypeal margin straight and below antennal sockets, F-XI twice as long as broad, clypeus almost evenly convex, midocellar flat area about as long as broad; foretarsus slender (about as in Fig. 20), I 6× as long as broad, 5 rake bristles as long as tarsomere breadth, midbasitarsus (Fig. 22) with inner edge incurved and bearing small setae beyond middle; T-VII lateral lobes touching ventrally; S-II not dentate, S-VIII with 3 slender prongs and a dark medioventral thornlike projection.

Female.—Length 10–12 mm, markings as in male except 2 large yellow dashes on scutum discally, and tergal whitish confined to T-I–II at most. Forebasitarsus 4× as long as broad, 6 rake bristles. S-II markings about as in Fig. 4.

Holotype.—♂, "Big D Hill" east of Douglas, Arizona, VIII-27-79, on *Eriogonum* (R. M. Bohart, U. C. Davis).

Paratypes.—10 ♂, 25 ♀, topotypes; other paratypes, 9 ♂, 61 ♀, ARIZONA: near Douglas, Rucker and Postoffice Canyons (Cochise Co.), near Dos Cabezas, 4 mi s. Apache, 5 mi e. Portal, Willcox, 11 mi s. Pearce, 13 mi w. Hope, Don Luis, Tucson, Sabino Canyon in Santa Catalina Mts., Sabino Canyon in Baboquivari Mts., 11 mi e. Quartzite; NEW MEXICO: 24 mi s. Gallup, Roadforks (Hidalgo Co.), 20 mi w. Lordsburg, Cotton City, 8 mi w. Animas, Rodeo (7 mi se. and 18 mi n.); TEXAS: Lajitas (Brewster Co.), Alpine. All paratypes were taken in August and September. Collectors were F. Andrews, R. Bohart, R. Brooks, M. Cazier, R. Duffield, E. Fisher, J. Gillaspy, C. Goodpasture, J. Kusche, E. Linsley, C. MacNeill, Rehns and V. Pate, E. Ross, M. Statham, P. Timberlake, E. Tinkham, J. van der Vecht, and H. Weems. Additional specimens have been seen from COAHUILA: Guadalupe, CHIHUAHUA: 5 mi n. Escalon, and SONORA: 30 mi s. Guaymas.

Discussion.—This species is much like *californica* which see. The male basitarsus in *parva* is curved rather than nearly straight. Also, the galea is proportionately shorter in *parva* and the female tergal bands are usually evenly yellow, rarely a little whitish medially on T-I–II.

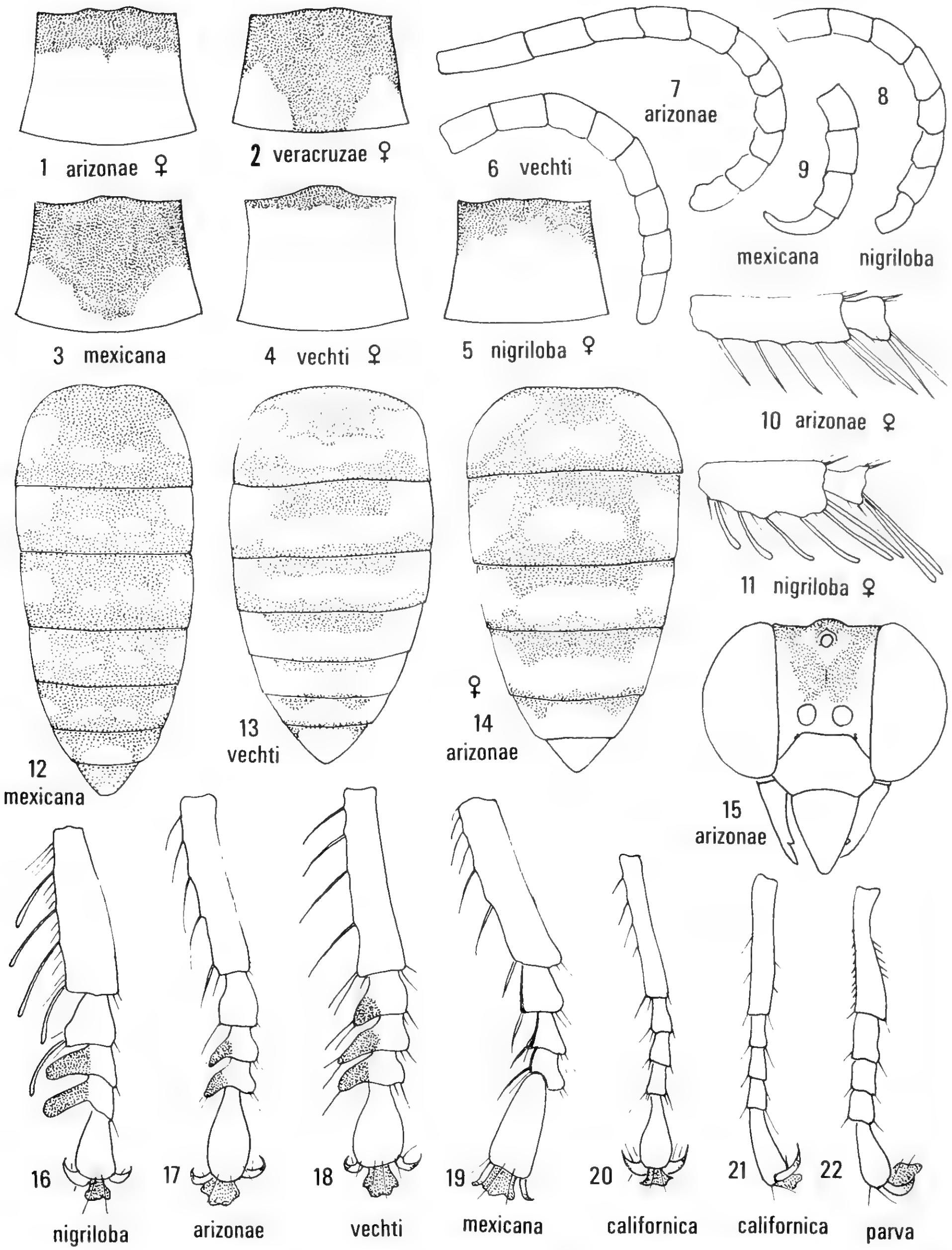
Glenostictia arizonae Bohart, New Species
Figs. 1, 7, 10, 14, 15, 17

Male holotype.—Length 13 mm, forewing 9 mm. Black marked with whitish and yellow; whitish are: V-shaped mark before midocellar scar, pronotal ridge and lobe, lateral scutal line opposite tegula, posterior scutal band broken at middle, narrow metanotal band, transverse double spot on T-I–V, median disconnected spot on T-VI, posterior spot on T-VII, pale sulphur yellow are: clypeus, labrum, mandible, inner orbit, outer orbit to inner dorsal angle of eye, interantennal area, antenna beneath as far as F-VI, segments I–II of palpi distally, prothorax basolaterally, large mark on mesopleuron encircling black signum-bearing area, metapleural spot, propodeum laterally and a pair of posterior dots on enclosure, legs except black marks on each coxa to femur, tarsi except outer edges of foretarsomeres II–IV (Fig. 17), posterior bands narrowed medially on S-I–VI (S-II black basal band angularly projecting medially as in Fig. 1), prongs of S-VIII; wing veins brown to reddish brown, membrane nearly clear. Pubescence moderate, mostly pale. Punctation inconspicuous, scattered punctures toward base of labrum. Facial proportions as in Fig. 15, flagellum rather short and stout, ventrally F-IX about ⅓ as long as F-I, F-XI stout and incurved beneath (Fig. 7), midocellar plane slightly longer than broad; foretarsomere I 4× as long as broad, III–IV with slender black projections (Fig. 17), rake spines rather short, slender and tapering, midtarsomere I strongly curved; S-II not swollen or dentate posteriorly, S-VIII with 3 slender prongs and a medioventral thornlike projection.

Female.—Length 11–13 mm. Pale markings yellow and more extensive than in male, upper ¼ of clypeus deeper yellow, antenna all pale beneath, scape all yellow, 2 submedial yellow dashes toward front of scutum, medial spot of T-II sometimes separate from lateral spot (Fig. 14), vertical part of propodeal enclosure mostly yellow, sterna extensively yellow. Foretarsomere I 3.0–3.5× as long as broad (Fig. 10), S-II as in Fig. 1.

Holotype.—♂, Rucker Canyon, Chiricahua Mts., Cochise Co., Arizona, VIII-16-81 (R. M. Bohart, U.C. Davis).

Paratypes.—59 ♂, 80 ♀, ARIZONA: Chiricahua Mts. (Rucker Cyn., Texas Cyn., Jhus Cyn., Pinery Cyn., Bear Cyn., Onion Saddle, 5–14 mi w. Portal) Hannagan Meadows (Greenlee Co.), Bisbee, Williams, Madera Cyn. (Santa Rita Mts.), Molino Basin (Santa Catalina Mts.), Ruby; NEW MEXICO: Rodeo; CALIFORNIA:



Figs. 1–22. *Glenostictia* spp.; all figures of male holotypes unless otherwise indicated. 1–5, Pattern of S-I. 6–9, Flagellomeres. 10, 11, Tarsomeres I–II. 12–14, Abdominal pattern, dorsal. 15, Face. 16–20, Foretarsus, dorsal. 21, 22, Midtarsus, lateral.

Pine Valley (San Diego Co.); CHIHUAHUA: Santa Barbara Station, Cuiteco, 6 mi s. Villa Matamoros. Collection dates were July 18 (♂) to October 6 (♀). Flowering plants visited were *Hymenothrix wizlizeni, Melilotus alba, Verbesina enceliodes,* and *Eriogonum* species. Collectors were G. Balmer, R. and M. Bohart, R. Brooks, M. Cazier, W. Chamberlin, D. Culver, H. Evans, G. Ferguson, R. Gardner, A. Gilbert, T. Haig, J. Hall, C. MacNeill, J. Marston, D. Miller, E. Ordway, Rehns and V. Pate, T. Sears, N. Smith, J. van der Vecht, B. Villegas, and J. Wilcox.

Discussion.—This species belongs to the group of *pictifrons* (F. Smith). The male of *arizonae* is distinctive by its stout antenna and characteristic forebasitarsus (Figs. 7, 17). Some male paratypes have the median spots on T-II or even T-III separated laterally. The female has the terga yellow and appearing more spotted than banded. In addition the forebasitarsus is longer than usual (three to four times as long as wide), and the mesopleuron is yellow laterally and ventrally but the sigma is in a large black area. In *pictifrons* the signum-bearing area of females is all yellow or black and small. Many females of *pictifrons* have the postocular yellow marks continued across behind the vertex. This does not occur in *arizonae.* Females of *nigriloba* have a broader forebasitarsus and whitish tergal markings. The pattern of S-II is characteristically different from that of other species (compare Fig. 1 with 2–5).

Glenostictia mexicana Bohart, New Species

Figs. 3, 9, 12, 19

Male holotype.—Length 13 mm, forewing 9 mm. Black marked with pale yellow and whitish; pale yellow are: labrum except central streak, large mesopleural spot, fore- and midfemora in front, hindfemur partly; whitish are: mandible, clypeus, frons laterally and below, spot under midocellus, postorbital line ending at inner eye angle, pronotal ridge, scutum with 2 elongate submedian spots and lateral border, scutellum laterally, metanotal band broken medially, small spot on propodeal angle, tibiae except posterior black streak on fore- and hindtibiae, tarsi mostly but foretarsus black bordered behind on II–IV (Fig. 19) and black spotted distally beneath on I–IV, large lateral spots on T-I–V (Fig. 12), median spots on T-VI–VII and S-I, lateral spots on S-II–V of which those on S-II–III are narrowly joined (Fig. 3); gonostyles mostly. Pubescence moderate, pale; hindfemur with a few short hairs beneath. Punctation inconspicuous, quite small on labrum basally and clypeus apically. Facial proportions about as in *arizonae* (Fig. 15) but LID 1.5× scape length instead of 1.7×, galea 1.1× longer than labrum, upper clypeal margin straight and below antennal sockets, flagellum slender, F-XI almost sickle shaped (Fig. 9), clypeus nearly evenly convex, midocellar flat area a little longer than broad, foretarsal I 4.0× as long as broad and with 6 short rake bristles (Fig. 19), other foretarsomeres relatively unmodified, midtarsus with I curved and II–IV flattened as well as blackish beneath, lateral lobes of T-VII large and touching ventrally, S-II not dentate, S-VIII with 3 slender prongs and a short medioventral tooth.

Holotype.—♂ Tequila, Jalisco, Mexico, VII-18-53 (C. and P. Vaurie, American Museum of Natural History, New York).

Discussion.—In many respects *mexicana* is similar to *veracruzae,* especially in the relatively simple male foretarsus. Peculiar to *mexicana* are the more slender

F-XI (Fig. 9), narrower LID, shorter galea, black-bordered foretarsomere II (Fig. 19), divided medial tergal spots (Fig. 12), and short medioventral projection of S-VIII.

Glenostictia nigriloba Bohart, New Species

Figs. 5, 8, 11, 16

Male holotype.—Length 13 mm, forewing 8 mm. Black marked with whitish and yellow; whitish are: face except labrum, postorbital line ending at inner eye angle, pronotal ridge, scutum laterally, broken band across scutellum, metanotum, tarsi mostly except for black marks ventrally on II–V and most of hindtarsal V as well as lobes on foretarsals III–IV (Fig. 16), large lateral spots on T-I–VI, ovoid paired spots down middle of T-I–V, median spots on T-VI–VII, lateral spots on S-V–VI, gonostyles mostly; yellow are: labrum, S-shaped mesopleural spot enclosing black signum-bearing area, 2 large spots on propodeum laterally and an irregular band across enclosure, femora except dark inner spots, tibiae except inner spot on foretibia, bands across S-I–III with that on II large (about as in Fig. 5); flagellum pale beneath toward base. Pubescence moderate, pale; hindfemur with a few short erect hairs beneath. Punctation inconspicuous, scattered on labrum and clypeus. Facial proportions about as in *arizonae* (Fig. 15) but LID twice scape length instead of 1.7×, galea 1.5× length of labrum, upper clypeal margin straight and below antennal sockets, flagellum medium slender, F-IX ventrally about ⅖ as long as F-I, F-XI twice as long as broad as well as moderately incurved (Fig. 8), clypeus almost evenly convex, midocellar flat area about as long as broad, foretarsal I 3.0× as long as broad and with long rake bristles which are thickened apicad (Fig. 16), other tarsomeres short and III–IV laterally with large black lobes, II a little discolored but not black marked (Fig. 16), midtarsus with I curved, lateral lobes of T-VII large and separated ventrally by length of F-I, S-II not dentate but with a posteromedian swelling, S-VIII with 3 slender prongs and a well developed medioventral thornlike projection.

Female.—About 12 mm long, markings as in male but tarsi not maculate, 2 small pale discal streaks on scutum, median tergal spots sometimes joined and occasionally attached to lateral spots on T-II and following. Forebasitarsus 2.5–2.6× as long as broad (Fig. 11). S-II as in Fig. 5.

Holotype.—♂, Dos Cabezas, Cochise Co., Arizona, VIII-27-74, on *Eriogonum* (R. M. Bohart, U.C. Davis).

Paratypes.—12 ♂, 22 ♀, ARIZONA: Apache and 4 mi s., nr. Portal, 7 mi w. Benson, nr. Pirtledale, Pearce; NEW MEXICO: n. of Cotton City, 7 mi sw. Rodeo to 10 mi n., Roadforks (Hidalgo Co.), 21 mi s. Animas, Lisbon, 5 mi s. Hurley, Carlsbad; CHIHUAHUA: 16 mi n. Escalon; DURANGO: Ceballos. Collection dates were August 6 (male) to October 5 (female). Collectors were F. Andrews, G. and A. Bohart, R. Bohart, G. Butler, C. and M. Cazier, M. Favreau, W. Jones, P. Marsh, Rehns and V. Pate, J. and B. Rozen, P. Timberlake, and J. van der Vecht.

Discussion.—The male of *nigriloba* has a distinctive foretarsus with two large black lobes (compare Figs. 16–19). It differs from *vechti, arizonae,* and *pictifrons* also in the longer and somewhat thickened rake setae, and the more bulging apex of S-II. Females have the dorsal abdominal markings more whitish and with free median spots on T-I–III. Both sexes have the forebasitarsus broader than usual, 3.0× as long as broad in male, about 2.6× in female (Fig. 11). Also, the pattern of S-II is characteristic (Fig. 5).

Glenostictia vechti Bohart, New Species

Figs. 4, 6, 13, 18

Male holotype.—Length 12 mm, forewing 7 mm. Black marked with whitish tinged with yellow on labrum, pleuron, terga laterally and sterna; pale are: face mostly including inside of antenna to F-V, postorbital line to inner eye angle, pronotum along ridge and laterally, scutum laterally, scutellar band narrowly broken medially, metanotal band, pleuron mostly, propodeum mostly except a black band basally and a V-shaped medial black mark, coxae mostly, femora except posterior black stripes, tarsi except black lobes on foretarsal II–IV and spots beneath them, bands across terga angularly enlarged laterally (Fig. 13), S-I–III mostly (black mark across base of S-II emarginate medially), S-IV–VII with apical bands, gonostyles mostly. Pubescence moderate, pale; hindfemur with a few short hairs beneath. Punctation inconspicuous. Facial proportions about as in *arizonae* (Fig. 15) but LID a little narrower, galea 1.5× length of labrum, upper clypeal margin straight and below antennal sockets, flagellum slender, F-XI nearly straight and not much enlarged apically (Fig. 6), clypeus almost evenly convex, midocellar flat area a little longer than broad, foretarsal I 4× as long as broad and with 6 slender rake bristles, other tarsomeres short and II–IV with black lateral lobes (Fig. 18), midtarsus I curved, T-VI with lateral lobes a little separated ventrally, S-II not dentate, S-VIII with 3 slender prongs and a medioventral thornlike projection.

Female.—About 11 mm long, markings sulfur yellow but whitish on lower frons and most of clypeus, yellow more extensive than on male, scutum with submedian dashes, mesopleuron nearly all yellow as in male, tergal yellow bands broad, sterna yellow except narrowly toward base of each segment. Forebasitarsus 2.7–2.8× as long as broad. S-II as in Fig. 4.

Holotype.—♂, 4 mi s. Apache, Cochise Co., Arizona, VIII-21-79 (R. M. Bohart, U.C. Davis).

Paratypes.—1 ♀, same data as holotype but collected IX-12-76. Other paratypes, 19 ♂, ARIZONA: 17 mi s. Apache, 5 and 8 mi n. Douglas, Portal and 5 mi e., Pearce, Tombstone, Tucson; NEW MEXICO: 7 mi se. to 10 mi n. Rodeo, 8 mi w. Animas; TEXAS: Lajitas (Brewster Co.). Other males have been seen from COAHUILA: Guadalupe, and DURANGO: 64 mi s. La Zarca. Dates of collection were May (Durango) and July to September. Two ♂ paratypes were taken at flowers of *Koeberlinia spinosa* and another one at *Helianthus*. Collectors were: R. Bohart, G. Butler, C. and M. Cazier, F. Carpenter, R. Duffield, A. and M. Gilbert, J. Gillaspy, E. and J. Linsley, C. Moore, Rehns and V. Pate, E. Ross, P. Timberlake, J. van der Vecht, and F. Werner.

Discussion.—*Glenostictia vechti* seems to be most closely related to *pictifrons* (F. Smith) and the ranges of the two overlap. Both species have the mesopleuron nearly all yellow, and in the male have continuous pale bands on T-II–VII (Fig. 13), similar S-II pattern, foretarsals II–IV with black lateral projections, and the galea about 1.5× as long as the labrum. The male of *vechti* differs from *pictifrons* by the white rather than yellow clypeus, F-XI slender and not thickened apically, hindtarsals III–IV not black marked above, and a smaller average size (12 vs. 14 mm long). The female of *vechti* has the clypeus white (except across the base) rather than yellow, and the average size is smaller. In southeastern Arizona *vechti* may occur along with *arizonae, nigriloba* and *pictifrons* (rarely). The male foretarsus affords easy distinction from *arizonae* and *nigriloba.* In the female of *nigriloba* tergal color is distinctively pale and foretarsal I is broader. *Glenostictia arizonae* has a large black signum-bearing spot on the mesopleuron and the basal black mark of S-II is angularly produced posteromedially rather than emarginate as in *vechti* (Figs. 1, 4).

The species is named for the Dutch expert on Sphecidae, my friend Jack van der Vecht, who collected with me in Arizona.

Glenostictia veracruzae Bohart, New Species

Fig. 2

Male holotype.—Length 13.5 mm, forewing 8.5 mm. Black, marked with whitish and yellow; whitish are: face (about as in Fig. 15) except labrum, postorbital line ending before inner eye angle, pronotal ridge, scutum laterally, scutellar spots, metanotum, broken band across propodeal enclosure, tarsi except black spots on tarsomeres II–V of fore- and midlegs ventrally as well as most of hindtarsal V, large subrectangular spots on T-I–V, median transverse spots on T-I–VII, lateral dots on S-IV–V, long spot on gonostyle; pale yellow are: labrum; oval discal spots on scutum; irregular spots on pronotal side, mesopleuron, metapleuron, and propodeum; tibiae except dots on inner surface of fore- and hindlegs; femora except basally; lateral spots on S-I–III; antenna dark except for whitish in front on basal 3 articles. Pubescence pale, moderate; hindfemur with a few short erect hairs beneath. Punctation inconspicuous, faint on labrum and clypeus, dense on T-VII. Facial proportions about as in *arizonae* (Fig. 15), galea 1.5× length of labrum, upper clypeal margin straight and below antennal sockets, F-XI twice as long as broad, clypeus almost evenly convex, midocellar flat area about as long as broad, foretarsus slender, midtarsus with I curved, lateral lobes of VII large and separated ventrally by length of F-II, S-II not dentate, S-VIII with 3 slender prongs and a well-developed medioventral thornlike projection.

Female.—About 13 mm long, markings about as in male but whitish mostly limited to face below middle of clypeus, discal spots of scutum longer, tarsi not maculate, sternal yellow spots all lateral on S-II–V. Forebasitarsus 3.2× as long as broad and bearing 7 rake bristles, basal one weak. S-II pattern as in Fig. 2.

Types.—Holotype ♂ and 1 ♀ paratype (U.C. Davis) 15 mi ne. Tinajas, Veracruz, Mexico, VIII-18-63 (F. Parker, L. Stange).

Discussion.—This species is clearly in the *pictifrons* group as evidenced by the nearly straight anterior clypeal margin, non-hirsute lower margin of the hindfemur, curved male midbasitarsus, and male foretarsomeres III–IV black marked beneath. It differs from *pictifrons* (W. Fox) and *nigriloba* in the male by the nonlobate foretarsomeres III–IV and the relatively short rake bristles of I. The female differs by having foretarsomere I more than 3× as long as broad, and the abdominal sterna extensively black. Differences from *mexicana* are given under that species.

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SYSTEMATIC RELATIONSHIPS OF THE PEDICULOCHELIDAE (ACARI: ACARIFORMES)

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Abstract.—The enigmatic family Pediculochelidae has in the past been associated with two mite suborders, Prostigmata and Astigmata. Based on a cladistic analysis, we propose that the family represents a sister-group of the Haplochthoniidae and these mites thus should be considered highly derived members of the enarthronote "oribatid" mite superfamily Cosmochthonioidea. Similarities with other taxa of sarcoptiform mites and Astigmata are the result of symplesiomorphy or convergence. *Pediculochelus* Lavoipierre is considered a junior subjective synonym of *Paralycus* Womersley. The family Protoplophoridae is added to the superfamily Cosmochthonioidea; the genera *Nipponiella, Marshallia,* and *Trichthonius* are removed from the Cosmochthoniidae, but not reassigned pending further study. *Paralycus raulti* (Lavoipierre), *P. parvulus* (Price), and *P. lavoipierrei* (Price) are new combinations.

The statement by Price (1973) that mites constituting the monogeneric family Pediculochelidae "do not appear to be closely related to any known family of Acarina" seems to reflect the thoughts of the few acarologists who have studied the group. Thus, when Lavoipierre (1946) first proposed the family no affiliation with established mite suborders was suggested, except for reference to what can be considered superficial resemblance to members of the highly derived family Tarsonemidae (Prostigmata). Also indicative of their historically problematic position within accepted taxonomic frameworks is the opinion of Baker and Wharton (1952), who while including them in the Astigmata suggested that they represent an "intermediate form" between the latter group and "oribatid" mites. A number of subsequent workers (e.g., Dubinin, 1954; Yunker, 1955; Baker et al., 1958; Krantz, 1960) followed suit and included pediculochelid mites in the Astigmata as representatives of an isolated, primitive superfamily, the Pediculocheloidea. Apparently relying on different characters, Krantz (1970) voiced a modern consensus view that the closest relatives of these mites were to be found not among the Astigmata, but among the most primitive Acariformes, specifically the primitive Pachygnathoidea (= Endeostigmata sensu Grandjean, 1939); supportive discussion was not offered.

The present study, using previously unanalyzed characters and cladistic methodology, will support our contention that the nearest extant relatives of Pediculochelidae are in neither of the above taxa, but rather the sarcoptiform mite group known as Enarthronota, specifically certain taxa in the superfamily Cosmochthonioidea. At first, such an association may seem unreasonable due to the absence in Pediculochelidae of a sclerotized integument, erectile notogastral setae, or other features often associated with cosmochthonioid mites. It will be demonstrated, however, that a number of derived (apomorphic) character-states of pediculochelid mites are shared only with this group, and most character-states suggestive of affinities with the Astigmata, Tarsonemidae, or "Endeostigmata" are ancestral (plesiomorphic) or represent convergences.

The Enarthronota is one of six major "oribatid" mite taxa recognized and defined by Grandjean (1969); his studies suggest that it is monophyletic. As noted elsewhere (Norton, 1982) it constitutes a number of seemingly isolated, relict families, most of which are poor in species. Considerable past evolutionary plasticity is disclosed by extant taxa, which exhibit a diversity of character states greater than that of any other major "oribatid" group except perhaps the species-rich Brachypylina. A ptychoid body form, for example, has evolved at least twice within the Enarthronota. It also contains some of the smallest known mites among the free-living Sarcoptiformes, and some with very regressive leg and palp setations.

Before specifically discussing the Pediculochelidae, we will review the status and relationships of the superfamily Cosmochthonioidea Grandjean, 1947. In this discussion we have hypothesized character state polarities using as outgroups several taxa (Pachygnathoidea, Terpnacaridae, Palaeosomata) which are considered to represent earlier derivative lineages in the Sarcoptiformes than that represented by the Enarthronota. Our concept of the superfamily Cosmochthonioidea is similar to that of Grandjean (1969) with the addition of the Protoplophoridae, which he treated as a distinct superfamily. Thus, at present it includes the families Cosmochthoniidae, Protoplophoridae, Sphaerochthoniidae and Haplochthoniidae. Recently, Balogh and Mahunka (1979), without discussion, have elevated the latter two taxa to superfamily rank and restricted the Cosmochthonioidea to the nominate family, thereby producing four monofamilial superfamilies. Although a certain amount of monotypy is expected in higher taxa with many relicts, we feel that their split classification is unjustified; relationships such as those proposed in this paper are masked by redundant categories (Wiley, 1979).

The following six synapomorphic character-states serve to define the Cosmochthonioidea (in the present sense) as a monophyletic group with a high level of confidence. Numbers 1 and 2 are autapomorphic, found in no other acariform mites; 3–6 are shared with a few groups outside the Enarthronota but are not found in earlier derivative enarthronote taxa, such as the Atopochthonioidea and Brachychthonioidea, or any other non-cosmochthonioid Enarthronota.

1. Pharyngeal cupola. The massive muscles which dilate the pharynx of cosmochthonioid mites originate on a thin, oval, plate-like and dorsally convex sclerite. This large internal sclerite occupies much of the proterosoma as seen in dorsoventral view and is easily seen by transparency in the Haplochthoniidae and Protoplophoridae, but may be difficult to observe without dissection in the more ornately sclerotized Cosmochthoniidae and Sphaerochthoniidae. Grandjean (1946b, 1948, 1954a) has illustrated and described this structure in the former

two families and called it the "coupole pharyngienne." It is an apodeme which forms as an internal extension of the dorsal wall of the subcapitulum where it meets the cheliceral frame; as such it appears to be derived from the small capitular apodeme of other sarcoptiform mites (Grandjean, 1954a, 1957a). Certain other arachnid groups have small apodemes in this location (cf. "epistomal apodeme" of Snodgrass, 1948). Inconspicuous, poorly developed homologues of this cupola are found in the Atopochthonioidea (Grandjean, 1948; Trave, 1967; Norton, 1982) and Hypochthonioidea (Grandjean, 1954a).

2. Pharyngeal sclerites. The large dilator muscles strongly taper anteroventrad and terminate in a pair of flat tendons which attach to a small discoidal sclerite on the dorsal wall of the pharynx at a level slightly posteriad of the true mouth opening. It is at this highly circumscribed location that the dilator muscles pull to expand the pharynx during the aspiration of food. Part of the ventral wall of the pharynx opposite this sclerite is also sclerotized and is fixed to the ventral integument of the subcapitulum by sclerotized bars or ligaments.

Such pharyngeal sclerites are unknown outside the Cosmochthonioidea. In sarcoptiform mites other than the Astigmata, the only sclerotized structures in this area are the inferior and superior (paired) commisural indurations (Grandjean, 1957b; Hammen, 1980) which are at the anterior extremity of the pharynx and support the mouth opening. The complex sclerotization of the pharyngeal region in some Astigmata (Akimov, 1979) represents an independent development quite unlike the structure described here. Also the dorsal dilator muscle bundles of other sarcoptiform mites are not similarly tapered and insert on the pharynx over a broad area. If tapered at all, they taper toward their origin on the dorsal wall of the subcapitulum or on a narrow capitular apodeme.

3. Setae of coxisternum II. Adults of all known Cosmochthonioidea have two pairs of setae on coxisternum II. The median pair is always larval and seems to be of sternal origin. The lateral pair is of coxal origin and appears in the protonymph (e.g., Cosmochthoniidae, Sphaerochthoniidae) or larva (Haplochthoniidae). Polarity of this character is difficult to establish due to the differences in development of the coxal fields in the outgroups. A major problem is the pair of sternal setae which may be captured by either coxal fields I or coxal fields II in different outgroups, making simple numerical comparisons inaccurate. In the most distant outgroups examined, the earliest derivative Trombidiformes in the families Sphaerolichidae and Lordalychidae, adults bear two pairs of setae on the coxal areas of coxisterna II. Similarly, in the earliest derivative Sarcoptiformes, the Pachygnathidae and Nanorchestidae, adults bear at least two pairs in this region. This is also the case in some Palaeosomata and in the Alicorhagiidae, although in both groups the number of true coxal setae may be reduced to one pair in some taxa. The situation is complicated by the apparent loss of true coxal setae from coxisternum II in the Terpnacaridae and Oeserchestidae, other early derivative sarcoptiform taxa.

On the basis of these outgroups, it appears that the ancestral condition in the Sarcoptiformes is to have at least two setae on coxisternum II in the adult, indicating that the presence of this state in the Cosmoochthonioidea is primitive. However, when all other groups within the Enarthronota are examined, none are found to possess the lateral setae of coxisternum II at any stage of development. This synapomorphy suggests two hypotheses: either the Cosmochthonioidea is the sister-group of all other Enarthronota, or the presence of true coxal setae on coxisternum II in the Cosmochthonioidea is the result of a reversal. On the basis of a number of other characters to be discussed elsewhere, we believe for the present time that the second hypothesis is more parsimonious. We suggest that this reversal is a synapomorphy which aids in the definition of the Cosmochthonioidea.

4. Posterior genital papillae. As tritonymphs and adults, all members of the Cosmochthonioidea have the most posterior of the ancestral three pairs of genital papillae regressive, either reduced in size or lost altogether (*Amnemochthonius, Cryptoplophora*). All papillae are relatively large in non-cosmochthonioid Enarthronota. Similar trends in the Astigmata and in a few isolated Palaeosomata and Brachypylina are regarded as convergences.

5. Genual solenidia of adult. Cosmochthonioid mites exhibit the highest degree of solenidial regression known in sarcoptiform mites, outside of the very primitive but highly aberrant Nanorchestidae. In particular they have lost the genual solenidia (σ) on all legs and in all instars. They are the only sarcoptiform mites outside the Nanorchestidae which have completely lost σ on genu I (Grandjean, 1964)[1]. Similarly, only the Pterochthoniidae and a few Astigmata share the loss of σ on genu II and only the former, plus a few Nothroidea (Desmonomata), the genus *Micreremus* (Brachypylina) and numerous taxa in the Astigmata share the loss of σ on genu III. All Brachypylina (except *Liodes*), many Nothroidea and Phthiracaroidea (sensu latu), and all Astigmata share the loss of σ on genu IV, but among the Enarthronota and its close outgroups only the Pterochthoniidae exhibit this synapomorphy.

6. Fusion of palpal segments. The palp of cosmochthonioid mites exhibits a tendency to lose the movement between femur and genu. In most of the included taxa, the two segments are separated by a complete suture, but the joint lacks articulating membrane and thus its function. In some genera (*Amnemochthonius, Cryptoplophora*) the dividing suture may be partially effaced. Such a fusion is found in isolated instances in more highly derived sarcoptiform mites, but not elsewhere within the Enarthronota.

INCLUSION OF THE PEDICULOCHELIDAE IN THE COSMOCHTHONIOIDEA

Based in part on the descriptions of Price (1973), but mostly on the study of adult specimens of *Pediculochelus lavoipierrei* Price from California, a related species from Western Australia, and a few adult *P. parvulus* Price, it can be concluded that all six of the synapomorphies discussed above as defining the superfamily Cosmochthonioidea are shared by the Pediculochelidae.

The complex pharyngeal aspiratory apparatus of the Pediculochelidae is quite distinct. The pharyngeal cupola is broad in dorsal aspect although somewhat less strongly convex than in the other cosmochthonioid families. In Fig. 3 its lateral contour is indicated by *vpx*. The pharyngeal sclerites are distinct, especially since

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[1] It appears that Grandjean (1950) overlooked a small solenidial vestige on genu I of *Pterochthonius angelus* (Berlese) which is discernible only in dorsal aspect. All North American specimens we have examined possess this vestige.

they are the most heavily sclerotized parts of the body and the only ones with a brownish coloration. The dorsal disk (*dk*) is small and somewhat oblong; the bases of the tendons are apparent, but the dilator muscles which insert here and originate on the cupola have been destroyed by clearing in all specimens observed. The ventral sclerite (*vs*) and supportive ligaments are much more conspicuous than the disk.

Coxisternum II has two pairs of setae in the adult instar. In *P. lavoipierrei* (but not other described species) the medial pair (which appears to be of sternal origin) is several times the length of the lateral pair. When the second seta appears is not known, but it is absent on the single larval specimen we studied.

The genital papillae of pediculochelid mites are distinctly regressive, both in number and stature. All described species have only two pairs in the adult (it is presumably the posterior pair which is lost) and they are small, disc-like structures. It is also interesting that Grandjean's (1946b, 1948) concept of homeotypy of genital papillae and Claparede's organ of the larva is supported by their states in *P. lavoipierrei*; corresponding to a reduction in size and number of genital papillae of nymphs and adult, Claparede's organ (urstigma) is absent in the larva. Outside the Astigmata, this is the only sarcoptiform mite known where such a loss is complete; a very reduced organ is found in the larva of *Haplochthonius* and Grandjean (1948) hypothesized its loss in *Amnemochthonius,* whose larva is unknown.

The leg solenidial formula (genu to tarsus, legs I–IV) of *P. lavoipierrei* is (0-1-1) (0-0-1) (0-1-0) (0-0-0). It is unlikely that it differs in other species, since intrageneric variation in these characters is unknown elsewhere in the Enarthronota and even intrafamilial variation is rare. All genual solenidia are lost, as in other Cosmochthonioidea, and further losses make this the second most regressive formula yet known in sarcoptiform mites, with only that of *Speleorchestes* (Nanorchestidae) being more regressive.

The palp of pediculochelid mites is similar to that of other cosmochthonioid mites in having a non-functional femur-genu articulation. There is no membrane associated with the joint and the suture is effaced paraxially.

RELATIONSHIPS WITHIN THE COSMOCHTHONIOIDEA

To aid in further substantiating the placement of the Pediculochelidae in the Cosmochthonioidea, a preliminary cladogram will be offered as a hypothesis of phylogeny within the group. A more detailed study of enarthronote phylogeny is in progress and will deal with other characters, including those showing a greater amount of homoplasy, and a reclassification will be proposed. In this section character-state polarities have been hypothesized using as outgroups those mentioned previously and all non-cosmochthonioid Enarthronota. Characters 7–18 are discussed below and support our hypothesis that the Pediculochelidae are most closely related to the Haplochthoniidae. Whether or not the two families can be considered sister groups, or more precisely, whether or not the Haplochthoniidae is monophyletic with respect to the Pediculochelidae, will be addressed in the next section.

7. Scissure ar_1. Grandjean (1946b) used this designation for the band of unsclerotized integument separating the dorsal plates bearing setal rows *c* and *d* of enarthronote mites. From outgroup comparison, this scissure was ancestrally (with

respect to the Cosmochthonioidea) what Grandjean called a "type E" scissure, a simple narrowed, unspecialized band of flexible cuticle. There are some reasons, which will not be addressed here, to believe that this scissure is derived from a "type S" scissure (where a row of erectile notogastral setae is inserted on intercalary sclerites) in which the intercalary sclerites fused to the plate posterior to it. The "type E" scissure, however it originated, is found in the Cosmochthoniidae and Haplochthoniidae. Sphaerochthoniidae and Protoplophoridae possess a further derived "type L" scissure, in which the anterior plate developed a large tectum partially overlapping the posterior plate. There is a relatively broad expanse of flexible cuticle between the plates which is hidden beneath the tectum and provides a telescoping dorsal articulation between the two secondarily formed parts of the notogaster (pronotaspis and pygidium). The character does not exist in pediculochelid mites, which lack sclerotized hysterosomal integument, but there is a definite constriction and a break in cuticular striation between setal rows *c* and *d*.

8. Setal row *d*. Concomitant with the development of a tectum overhanging scissure ar_1, setae d_1 and d_2 of the Sphaerochthoniidae and early derivative Protoplophoridae have become regressive; they are minute and inserted near the anterior margin of the pygidium. In *Cryptoplophora* these setae have been completely lost in the adult instar, but remain as vestiges in the immatures (Grandjean, 1954a). In other Cosmochthonioidea, and all other Acariformes in which "notogastral" setae are present and homologies can be ascertained, setae d_1 and d_2 are exposed and comparable in stature to those of row *c*. The Atopochthoniidae (Enarthronota) is the only possible exception; Grandjean (1948) suggested that setal row *d* was lost in this monotypic family.

9. Scissures ar_2 and ar_3. Outgroup comparisons suggest that these scissures were ancestrally "type S" scissures with large erectile setae. In the Sphaerochthoniidae and Protoplophoridae fusion of the anterior, posterior and intercalary plates associated with the respective scissures has taken place in the adult instar, leaving a raised, transverse carina (state 9a); a simple scissure with no intercalary sclerite is present in immatures. In the Cosmochthoniidae the ancestral condition is retained. We feel the sclerotized adults of haplochthoniid mites have derived secondary type E scissures at ar_2 and ar_3 by the complete fusion of the intercalary sclerites with the respective plate posteriad of them (state 9b). Grandjean (1946b) has illustrated notches in the plates which cause the setae to, in effect, border the unsclerotized integument of the scissures. The Pediculochelidae and the unsclerotized immatures of Haplochthoniidae do not possess these characters. Members of the former family do show constrictions and loss of integumental striations midway between setal rows *e–f* and *f–h,* as illustrated by Price (1973) (his rows *d–e* and *e–f,* respectively), but we believe such constrictions are secondarily derived. Many mites which have evolved an elongated body form also develop secondary constrictions or articulations which allow bending of the hysterosoma (e.g., many Prostigmata, the Mesostigmata family Rhodacaridae and the sarcoptiform mite families Elliptochthoniidae and Gehypochthoniidae).

10. Setal rows *e* and *f*. Outgroup comparisons with the Palaeosomata and other Enarthronota suggest that these setae were ancestrally large and erectile in the Cosmochthonioidea and associated with the type S scissures noted above. They

retain this state only in the Cosmochthoniidae. Erectility has been lost in the other families due to fusion of intercalary sclerites as noted in character 9. The setae may be similar in size and shape to other notogastral setae (Sphaerochthoniidae, Haplochthoniidae, Pediculochelidae) or retain a somewhat larger size (Protoplophoridae).

11. Solenidion ω_2 of tarsus I. When present, this solenidion is formed in the protonymph except in the genus *Hermannia* (Desmonomata), where its appearance is delayed. Ancestrally in sarcoptiform mites, and in all Enarthronota except the Cosmochthonioidea and Brachychthonioidea, ω_2I is present and positioned on the dorso-antiaxial surface of the tarsus (Grandjean, 1963). In the Sphaerochthoniidae and Protoplophoridae ω_2I has moved to a ventral location and is closely coupled to a normal seta, *m″* (state 11a), except in *Cryptoplophora* where *m″* has been secondarily lost. Among other Enarthronota only the Brachychthoniidae have a ventral ω_2I; in these mites it is closely coupled with ω_3I rather than *m″*, which is absent. The latter family is only distantly related to cosmochthonioid mites and we consider this positional similarity a convergence. The Cosmochthoniidae, Haplochthoniidae and Pediculochelidae have lost ω_2I, a regressive state (11b) found elsewhere in sarcoptiform mites only in the genus *Camisia* (Desmonomata) and some groups in the Astigmata. We feel the ancestral condition in sarcoptiform mites noted above is also ancestral in the Cosmochthonioidea; the two apomorphic states exhibited by extant taxa have been derived independently, rather than state 11a giving rise to state 11b after ω_2I had moved ventrad. The latter alternative would require the loss of the solenidion after coupling with *m″* and also the retention of *m″* (Cosmochthoniidae and *Haplochthonius* retain this setae, *Amnemochthonius* and Pediculochelidae have lost it). However, throughout sarcoptiform mites the tendency is the reverse, that is, for the normal seta to be lost (ontogenetically or phylogenetically) after coupling rather than the solenidion; we know of only one example (discussed below) where the solenidion of such an association regresses, leaving the seta alone.

12. Solenidion ω_3 of tarsus I. This solenidion is present in all tested outgroups, notably the non-cosmochthonioid Enarthronota, except the Hypochthonioidea and *Heterochthonius*: we consider it ancestrally present in the Cosmochthonioidea. The Sphaerochthoniidae and Protoplophoridae have retained it, but it is lost in the Cosmochthoniidae, Haplochthoniidae and Pediculochelidae.

13. Anterior and middle genital papillae. These papillae are highly reduced in the Cosmochthoniidae, Pediculochelidae, and Haplochthoniidae except for *Amnemochthonius,* which has lost them altogether. The Sphaerochthoniidae and Protoplophoridae retain the ancestral condition of having normal, large anterior and middle papillae.

14. Genital vestibule. As adults, members of the Cosmochthoniidae and Haplochthoniidae have developed very large, elongated genital plates which cover a genital vestibule, or pregenital chamber, which is several times larger than necessary for containment of the small external genitalia. The vestibule is equally enlarged in the Pediculochelidae, but the integument forming the external valves is not sclerotized. Sphaerochthoniidae and Protoplophoridae retain the ancestral condition of having genital plates and a genital vestibule of normal proportions.

15. Genital tracheae. Adults of the Cosmochthoniidae and the genus *Haplochthonius* possess two distinct pairs of tracheae, with bulbous terminations,

which open into the large genital vestibule at its anterior and posterior limits, respectively. The other known haplochthoniid genus (*Amnemochthonius*) has only the anterior pair, which in the former taxa are always the larger of the two and the first to form in ontogeny. The Pediculochelidae have no genital tracheae, but there is a pair of distinct angular cavities (Fig. 4, *trv*) with a position exactly corresponding to the openings of the anterior tracheae of the above taxa; we believe these are vestiges of the anterior pair. Tracheae opening into the genital vestibule are unknown in other "oribatid" mites (including Sphaerochthoniidae and Protoplophoridae) but have evolved independently in certain other Acariformes (e.g., Bdelloidea, Sphaerolichidae, some Nanorchestidae and some Astigmata).

16. Sclerotization of immature hysterosomal integument. It is usual in the Enarthronota (and here considered ancestral) for the immature instars to have a hysterosomal integument which is at least partially sclerotized dorsally and ventrally; lateral sclerotization may be present or absent. This ancestral condition is found in the immatures of the Sphaerochthoniidae, Protoplophoridae and Cosmochthoniidae. Members of the Haplochthoniidae and Pediculochelidae have completely lost this sclerotization and, as immatures, possess a soft, striated integument over the whole hysterosoma. Members of most other sarcoptiform groups also have immatures with unsclerotized hysterosomal integument, but it normally lacks fine striations. Grandjean (1948) considered all soft striated integument to be "primitive" integument, that is, not a result of secondary desclerotization. Outgroup comparisons with other Enarthronota do not support that conclusion within the Cosmochthonioidea, suggesting the hypothesis that such desclerotization has in fact occurred in the Haplochthoniidae and Pediculochelidae.

17. Rostrum. Stegasimy, the presence of sclerotized rostrum with a well defined tectum, is widespread in the Enarthronota and its presence in both adults and immatures is probably ancestral in the Cosmochthonioidea. In the Sphaerochthoniidae and Protoplophoridae the rostral tectum is similar in ornamentation to the rest of the prodorsum, as it is in non-cosmochthonioid Enarthronota which possess this character state. Members of Cosmochthoniidae have developed a curious fenestrate rostral tectum (state 17a) which has been described by Grandjean (1962). The adults of *Haplochthonius* have the ancestral state, but the immatures of this genus, and all instars of *Amnemochthonius* and the Pediculochelidae, have lost the rostral sclerotization (state 17b), thereby becoming secondarily astegasime (mouthparts not covered by a rostral tectum).

18. Solenidion ϕ of tibia IV. Outgroup comparison suggests that this solenidion was ancestrally present in the Cosmochthonioidea. It is retained by the Sphaerochthoniidae, Protoplophoridae and Cosmochthoniidae but is lost in the Haplochthoniidae and Pediculochelidae. It was also lost, apparently independently, by three other enarthronote taxa (the Hypochthonioidea, Mesoplophoroidea and Heterochthoniidae) and a number of more highly derived sarcoptiform groups (Grandjean, 1964).

The distribution of the character states discussed above (7–18) and summarized in Fig. 1 suggests an early division of cosmochthonioid stock (lineage I) into two principal lineages. Lineage II represents an unnamed taxon defined by three progressive synapomorphies (type L scissure ar_1, fused cariniform scissures ar_2 and

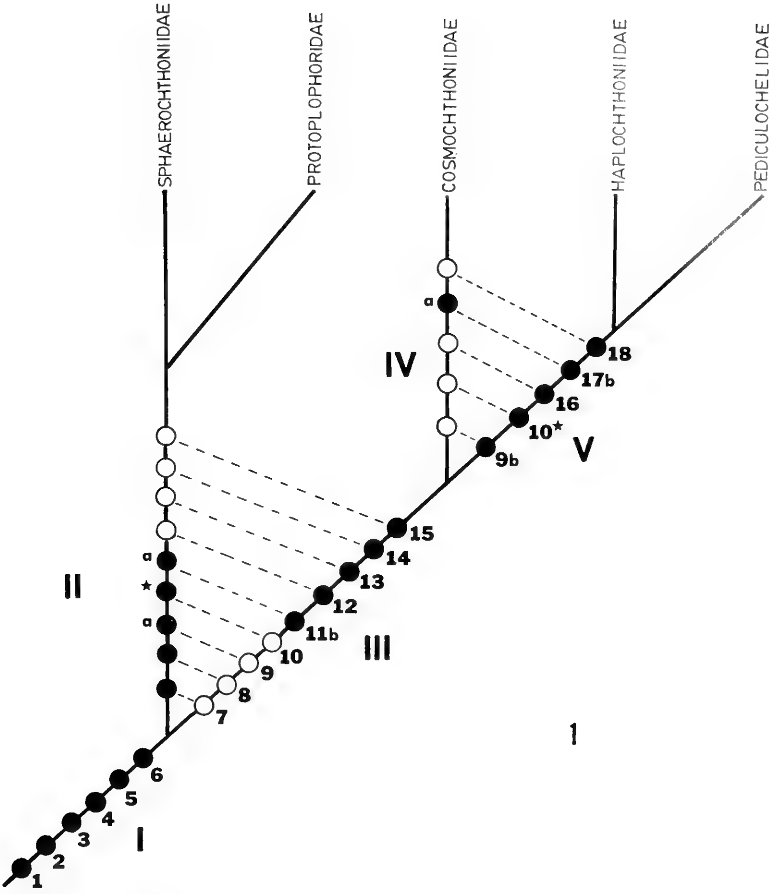


Fig. 1. Cladogram suggesting relationships of families in the Cosmochthonioidea. Numbers correspond to characters discussed in text; apomorphic states represented by ●, plesiomorphic states by ○; letters indicate different apomorphic states of same character; stars indicate convergent development of same apomorphy.

ar_3, and solenidion ω_2I coupled with ventral seta m'') and one regressive synapomorphy (size diminution or loss of opisthosomal setal row d); all are autapomorphic at this level. For the purposes of the present study there is no need to establish the monophyly of the Sphaerochthoniidae and Protoplophoridae. The latter have the conspicuous ptychoid body form, but Grandjean (1954a) has noted variety in the details of its sclerotization patterns. Ontogenetic studies of both families are needed and a detailed redescription of some member of *Hauseroplophora,* which are ptychoid mites with an otherwise sphaerochthoniid facies, would be useful.

Lineage III represents an unnamed taxon defined by two progressive synapomorphies (enlarged genital vestibule, presence of two pairs of genital tracheae) and three regressive synapomorphies (size diminution of anterior and middle genital papillae, loss of solenidia ω_2I and ω_3I); the former two are autapomorphies.

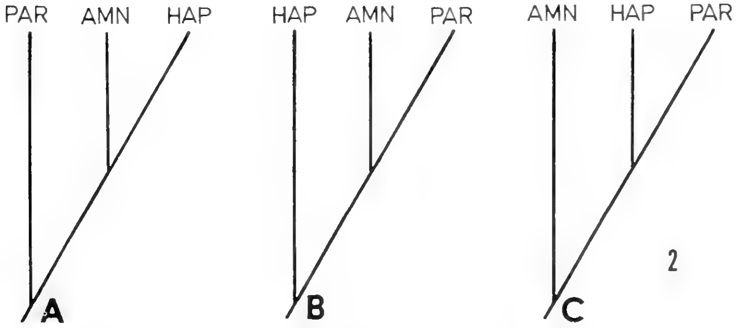


Fig. 2. Possible cladistic relationships of *Paralycus* (PAR), *Haplochthonius* (HAP), and *Amnemochthonius* (AMN). See text for explanation.

Lineage IV represents the Cosmochthoniidae with three nominate genera, *Cosmochthonius, Phyllozetes,* and *Krivolutskiella.* It retains numerous ancestral states but can be tentatively defined by one progressive synapomorphy (the fenestrate rostrum), which is autapomorphic. Genera previously included in the Cosmochthoniidae (Gordeeva, 1980), but removed by us are *Marshallia, Nipponiella* and *Trichthonius*; they share none of the synapomorphies discussed to this point. Placement of these taxa will be suggested in a subsequent paper.

Lineage V represents an unnamed taxon which includes the Haplochthoniidae and Pediculochelidae. It can be defined by three regressive synapomorphies (secondary development of astegasimy in immatures, loss of sclerotization of hysterosomal integument and the loss of solenidion ϕ IV) and one progressive synapomorphy (the partial fusion of intercalary sclerites at ar^2 and ar^3). It could be argued that integumental desclerotization as a whole should be treated as one character state, but hysterosomal and rostral sclerotization do not always occur together (Norton and Metz, 1980; Norton, 1982). There are also numerous losses of leg setae in lineage V; these will be analyzed elsewhere.

Relationships of the Pediculochelidae and Haplochthoniidae

Assuming monophyly of lineage V, the remaining question in this analysis is whether the Haplochthoniidae and Pediculochelidae can be considered sister groups, or whether the Pediculochelidae originated within the Haplochthoniidae. Three genera are involved; *Haplochthonius* and *Amnemochthonius* constitute the Haplochthoniidae; *Paralycus* (see remark #1) represents the monogeneric Pediculochelidae. Three competing hypotheses, indicated by different cladograms (A, B, C) are illustrated in Fig. 2. Cladogram A assumes that the Haplochthoniidae is monophyletic; B and C assume paraphyly in this family, with *Paralycus* more closely related to *Amnemochthonius* (B) or *Haplochthonius* (C).

To aid in choosing the most congruent hypothesis, we have analyzed 48 characters found to be shared by two of the three taxa. Cladogram A is supported by five synapomorphies shared by members of *Haplochthonius* and *Amnemochthonius,* but not *Paralycus.* Three of these states are considered results of progressive evolution: a) there is a medial paired row of five additional notogastral cupules located adjacent to the bases of setae c_1 to h_1, a condition otherwise unknown in the Acariformes; b) the labrum has become very thick, short and blunt, as opposed to the thin, tapered or pointed labrum found in *Paralycus* and other enarthronote taxa; c) the famulus is greatly enlarged relative to the size of tarsus I and has a hollow "root" projecting into the segment, a state unknown in other enarthronote mites. Two of the synapomorphies are considered results of regressive evolution: a) loss (or variable presence) of coxisternum III seta *3c*, a loss found elsewhere in sarcoptiform mites only in the Astigmata and a few Brachypylina and Desmonomata; b) loss of tarsal seta *ft′* on leg II, a seta retained by *Paralycus*. In addition, the general facies of *Haplochthonius* and *Amnemochthonius* are very similar and differ considerably from that of *Paralycus*.

Cladogram B is supported by 42 synapomorphies shared by *Amnemochtonius* and *Paralycus,* but not *Haplochthonius.* All are considered regressive and include: a) loss of the five pairs of ancestral cupules (*ia, im, ip, ih, ips*) in the adult instar; b) loss of Claparede's organ in the larva (presumed in *Amnemochthonius*); c) loss of the posterior pair of genital papillae in nymphs and adult; d) loss of the posterior genital trachea from deutonymph through adult; e) loss of adult rostral sclerotization leading to secondary astegasimy; f) loss of three pairs of genital setae in the adult (four pairs, compared to seven in *Haplochthonius*); g) loss of adanal seta ad_4; h) loss of anal seta an_4; i) loss of coxisternum IV seta *4d*; j) the loss of 27 leg setae (present ancestrally in the adult instar in lineage V) from femur I (*l′*, *l″*), tarsus I (*m″*, *it′*, *it″*, *pv′*), trochanter II (*v′*), femur II (*l′*, *l″*), genu II (*v*), tarsus II (*it″*, *a′*, *a″*, *pv′*), trochanter III (*l′*), femur III (*l″*), genu III (*l″*), tibia III (*l′*), tarsus III (*a′*, *a″*, *pv′*), trochanter IV (*v′*), genu IV (*l″*), tibia IV (*l′*) and tarsus IV (*a′*, *a″*, *ft′*). Character states included in a, b, c and many in j are found only in these two genera, except for some parallel setal losses in the Astigmata.

Cladogram C is supported by a single regressive synapomorphy shared by *Haplochthonius* and *Paralycus*: the loss of seta *l″* on tibia I. The hypothesis it represents can be quickly rejected as being least congruent with the distribution of synapomorphies.

Based only on minimization of homoplasy, cladogram B is most congruent and is supported by seven times as many synapomorphies as cladogram A. However, the fact that all 42 are regressive, and 33 of these are setal losses, detracts somewhat from the influence of these numbers. Grandjean's studies (e.g., 1946a) are replete with information on priorities in setal regression and it is clear that losses usually occur in identical sequences even in different lineages of a major group. Since setal regression has been so widespread in the evolution of sarcoptiform mites, we can expect, and indeed find, that homoplasy is extremely common when dealing with presence or absence of body and leg setae, either in the form of parallelism or, less commonly, convergence. Genital papillae and Claparede's organ also show regressive trends in the Cosmochthonioidea, and it should not be surprising to find parallel continuation of these trends in two different, but closely related lineages. Regressive trends toward secondary astegasimy, loss of posterior genital tracheae, and loss of normal cupules also appear well established in lineage V, since some or all immature instars of *Haplochthonius* exhibit them to some degree; these also might be expected to continue independently in different lineages.

On the other hand, the three unusual progressive states supporting cladogram A are difficult to explain in terms of parallelism or convergence. Nowhere else in the Enarthronota do we find medial cupules, a short, thick labrum or an enlarged "rooted" famulus. It is our contention that cladogram A is least easily rejected despite the relatively large amount of homoplasy it requires.

The simplest explanation for a majority of the synapomorphies shared by *Amnemochthonius* and *Paralycus* is one of neoteny; states ancestrally exhibited by immatures in lineage V are now exhibited by adults of these genera, through the delay or eventual loss of ontogenetic changes. Considering the losses listed above, members of the genera *Amnemochthonius* and *Paralycus* are among the most regressive sarcoptiform mites known, and this is probably a result of the greatest accumulation of neotenic character states. Interestingly, many of the same losses are characteristic of the Astigmata, a later sarcoptiform lineage which exhibits even more extreme neoteny (OConnor, 1981).

Not all setal losses can be thought of in this way, however. For example, the eugenital setae are not found in immature instars, yet are subject to numerical regression in adult mites. The Pediculochelidae have only two pairs of minute eugenital setae (Fig. 4, *eg*) inserted on the walls of the genital vestibule (there is no ovipositor); this is the lowest number known in sarcoptiform mites outside the Astigmata, which lack eugenital setae altogether.

REJECTION OF PREVIOUSLY SUGGESTED RELATIONSHIPS

Price (1973) has summarized the similarities of Pediculochelidae with members of other mite groups. Similarities with the Astigmata include: a) the absence of stigmata and associated tracheae; b) the unsclerotized integument; c) the padlike structure of the ambulacrum. The first is partly the result of symplesiomorphy, partly convergence. The prodorsal stigmata found in most Trombidiformes (= Prostigmata) are restricted to that suborder, and early derivative sarcoptiform mites such as the Enarthronota never possessed the acetabular stigmata found in the Brachypylina, a more highly derived group. There is strong evidence (OConnor, 1981) that the Astigmata were derived from a sarcoptiform mite lineage which did not possess these latter stigmata, so that from one standpoint their absence in the two taxa in question is symplesiomorphic and not useful in determining relationships. The Pediculochelidae have lost the genital tracheae which were once present, however, and from this standpoint the similarity is a result of convergence. Unsclerotized integument in both immatures and adults is a regressive state derived independently in the two taxa. The padlike ambulacrum of pediculochelid mites is, in detail, unlike any found in the Astigmata and cannot be considered a synapomorphy (see remark #2).

Although previous workers have not noted the details, a number of losses of leg setae represent similarities between the Pediculochelidae and Astigmata. Compared with earlier derivative sarcoptiform groups, both of these taxa share the loss of a considerable number of homologous setae. However, these losses are far from being in total agreement. The Pediculochelidae, for example, lack the following setae ancestrally retained in the Astigmata (setal homologies for the Astigmata following OConnor, 1981): genu III (*l′*); tibiae I–II (*v″*); tarsus I (*pl″*, *a′*, *pv′*, *pv″*, *tc′*, *tc″*). Conversely, all Astigmata lack the following setae retained in the Pediculochelidae: femora I–IV (*d*); femur III (*ev′*); genu I (*d*); tibia I (*l′*); tibia II (*d, l′, l″*); tibiae III–IV (*d*); tarsus I (*a″*). The number of non-homologous setal losses in these two groups suggests convergence in the setal regressions shared between them, especially as the lost setae are also commonly regressive in other groups (see above).

Similarities with the "Endeostigmata" noted by Price reflect the paraphyletic nature of that taxon. The "Endeostigmata" has traditionally been considered as part of the suborder Trombidiformes (= *Prostigmata*). OConnor (1981) has analyzed the phylogenetic position of each of the included taxa and hypothesized that most of the families usually included represent the earliest radiations of the Sarcoptiformes, with only two, the Sphaerolichidae and Lordalychidae actually belonging to the Trombidiformes in a phylogenetic sense. Using these hypotheses, it is apparent that most of the character states mentioned by Price as shared between the Pediculochelidae and the "Endeostigmata" represent symplesiomorphies. These ancestral states include a) the presence of prodorsal trichobothria; b) the presence of rutella; c) chelate "mouthparts"; d) simple palps; e) genital papillae. Of the other three character states listed by Price, one, small size, is found in so many different acarine lineages as to be of little value in phylogeny reconstruction. A second, the "segmented" appearance of the body, is ancestral in some "Endeostigmata," notably the Pachygnathidae, but is probably secondarily derived in the Pediculochelidae as noted earlier. Finally, the absence of sclerotized plates is again ancestral in the "Endeostigmata" but apparently secondarily derived through neoteny in the Pediculochelidae.

Similarities with Tarsonemidae (Trombidiformes) noted by Lavoipierre (1946) include segmented appearance and a large (clavate) sensillus. Whether or not the "segmentation" exhibited by pediculochelid mites is derived, it still differs from the pattern found in the Tarsonemidae and neither can be ancestral to the other. Of the three principal dorsal divisions, the Pediculochelidae have the middle one between setal rows *e* and *f,* whereas tarsonemid mites and their close outgroups have these rows on the same plate, the middle division being between rows *d* and *e* (Lindquist, 1977). The various "segments" of the dorsal hysterosoma are therefore not homologous. A clavate form of sensillus has been independently derived a great number of times in acariform mites (including in the Haplochthoniidae) and thus is not, by itself, a reliable indicator of relationships. More significantly, Lindquist (1976) has presented carefully conceived hypotheses on the phylogeny of the Heterostigmata (of which the Tarsonemidae is a part) and its outgroups. Except for a few convergent character states, such as the loss of Claparede's organ (urstigma), the fusion of the palpal femur and genu, and some superficial similarities in the ambulacrum, the Pediculochelidae do not share the synapomorphies of these taxa.

Despite the dissimilarity in facies between the Pediculochelidae and most cosmochthonioid mites, there is substantial accumulation of progressive synapomorphies as we pass from lineage I to III to V in Fig. 1. Especially significant are the autapomorphies associated with the pharyngeal aspiratory apparatus (cupola, musculature and pharyngeal sclerites) and the genital region (vestibule, tracheae). As just noted, the similarities between this family and the Astigmata, "Endeostigmata" and Tarsonemidae can be more easily dismissed as symplesiomorphies, common convergences or misinterpretation of homologies.

REMARKS

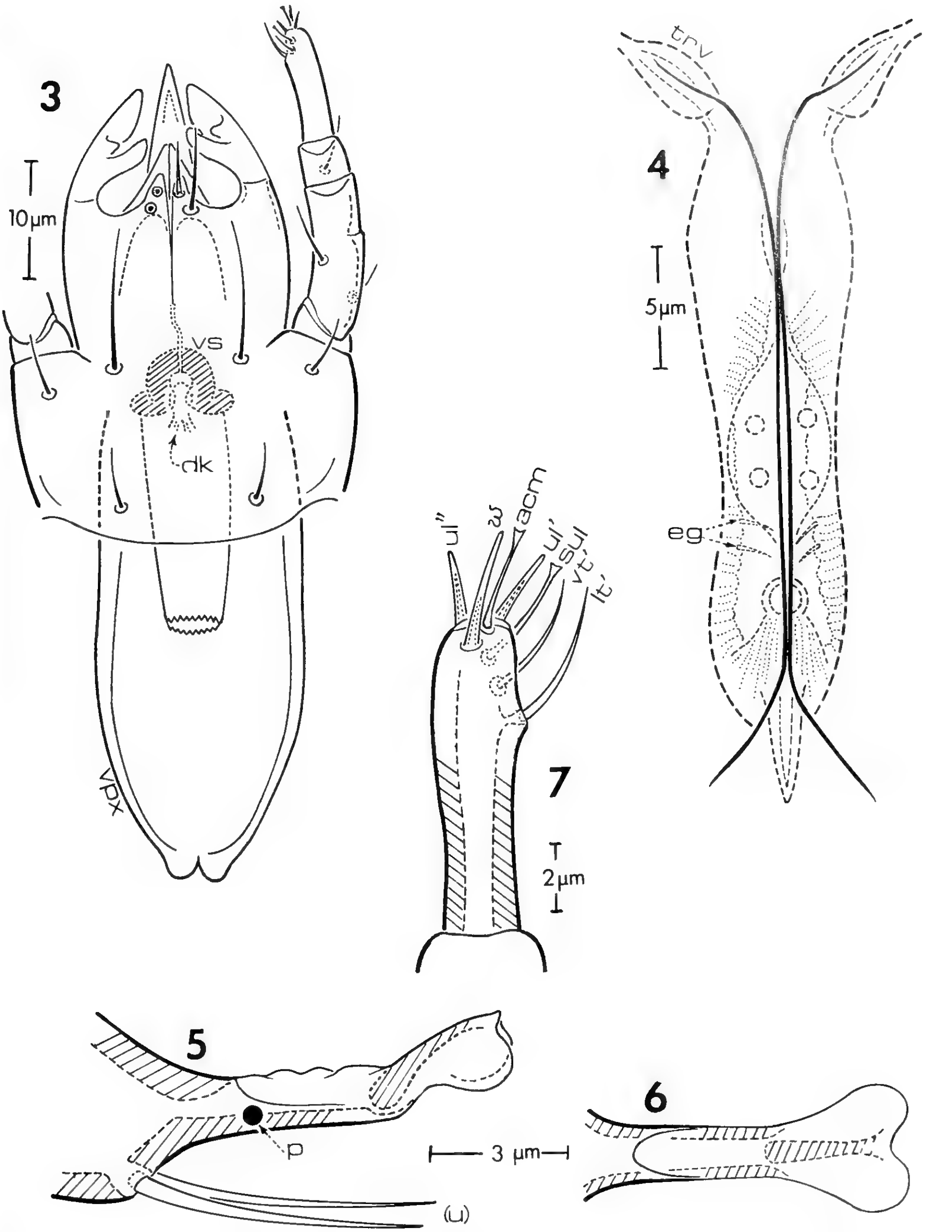
1. Price (1973) has commented on the possible synonymy of the generic name *Pediculochelus* Lavoipierre with *Paralycus* Womersley. He correctly suggested such a synonymy should be reserved until after a reinvestigation of the type specimen of *Alicus* (sic) *pyrigerus* Berlese, which Womersley (1944) designated as type-species of *Paralycus*. One of us (DEJ) has studied this specimen, housed in the Berlese Collection of the Stazione de Entomologia Agraria, Florence, Italy, and the subjective synonymy, first noted by Johnston (1965), is formally proposed here. The nominal species of *Paralycus* now include: *Paralycus pyrigerus* (Berlese), from soil in Italy; *Paralycus raulti* (Lavoipierre) **n. comb.**, collected with bees in South Africa; *Paralycus parvulus* (Price) **n. comb.**, from soil in California; and *Paralycus lavoipierrei* (Price) **n. comb.**, also from soil in California.

2. The small size of the ambulacrum of *Paralycus lavoipierrei* makes interpretation and illustration of minute detail very difficult, but the basic structure is illustrated in Figs. 5 and 6. The distal part of the tarsus forms a long stalk, similar to that of many other cosmochthonioid mites, except that the dorsal half is unsclerotized for almost the whole length of the stalk. The proral setae (*p*) are inserted approximately at the level where the dorsal integument becomes sclerotized. The distal pad has thin, rounded "wing-like" lobes projecting ventrodistad, so that it appears heart-shaped in dorsoventral aspect. The modified empodial claw (hatched in Figs. 5 and 6) provides a thick central support; it is nowhere freely projecting and its distal end blends indiscernibly with the pad rather than ending in a point. The dorsal unsclerotized integument of the tarsal stalk is continuous with that of the pad. Unlike the ambulacrum of the Astigmata (Grandjean, 1943; Atyeo, 1979), there are no condylophores. The latter are absent in all Enarthronota but usually present in more highly derived sarcoptiform mites, including the Astigmata. Whereas the general form of the ambulacrum of the Astigmata suggests that the unsclerotized distal end of the tarsus has become hypertrophied and envelopes the empodial claw (when present), that of *Paralycus* may be a result of winglike outgrowths from the epiostracum of the empodial claw itself.

3. The following are lists of body setae found on adults of *P. lavoipierrei* homologized with those of the system developed for "oribatid" mites in the various studies of Grandjean. Following each in parentheses is the letter-number designation given by Price (1973). Prodorsum: *ro* (v), *le* (p-2), *exa* (p-3), *exp* (p-4), *in* (p-5). Hysterosomal dorsum: c_1(a-1), c_2 (a-2), c_3 (b-2), *cp* (b-1), d_1 (c-1), d_2 (c-2), e_1 (d-1), e_2 (d-2), f_1 (e-1), f_2 (e-2), h_1 (f-1), h_2 (f-2), h_3 (f-3), ps_1 (g-1), ps_2 (g-2), ps_3 (g-3). Anal region: ad_1 (pa-3), ad_2 (pa-2), ad_3 (pa-1), an_1 (an-1), an_2 (an-2). All genital and "paragenital" setae of Price are homologues of genital setae of other cosmochthonioids.

On the basis of our examination of specimens of *P. lavoipierrei,* we have noted several errors or misinterpretations in Price's descriptions. 1) The palps of pediculochelid mites do not have five "free" segments; the femur and genu are immovably fused, although a partial suture delineates them. 2) The "solenidia" which Price found dorsad of palp and leg insertions are the supracoxal setae (*e* and *eI,* respectively) and not solenidia. 3) *Paralycus lavoipierrei* has five pairs of setae on the ventral subcapitulum, not four (Price missed seta or_1).

4. The three setae of the proximal palp segments of *P. lavoipierrei* are easily



Figs. 3–7. *Paralycus lavoipierrei* adult. 3, Subcapitulum (ventral aspect), removed from body. 4, Genital region. 5, Distal portion of tarsus III (antiaxial aspect). 6, Same, dorsal aspect. 7, Palpal tarsus (dorsal aspect).

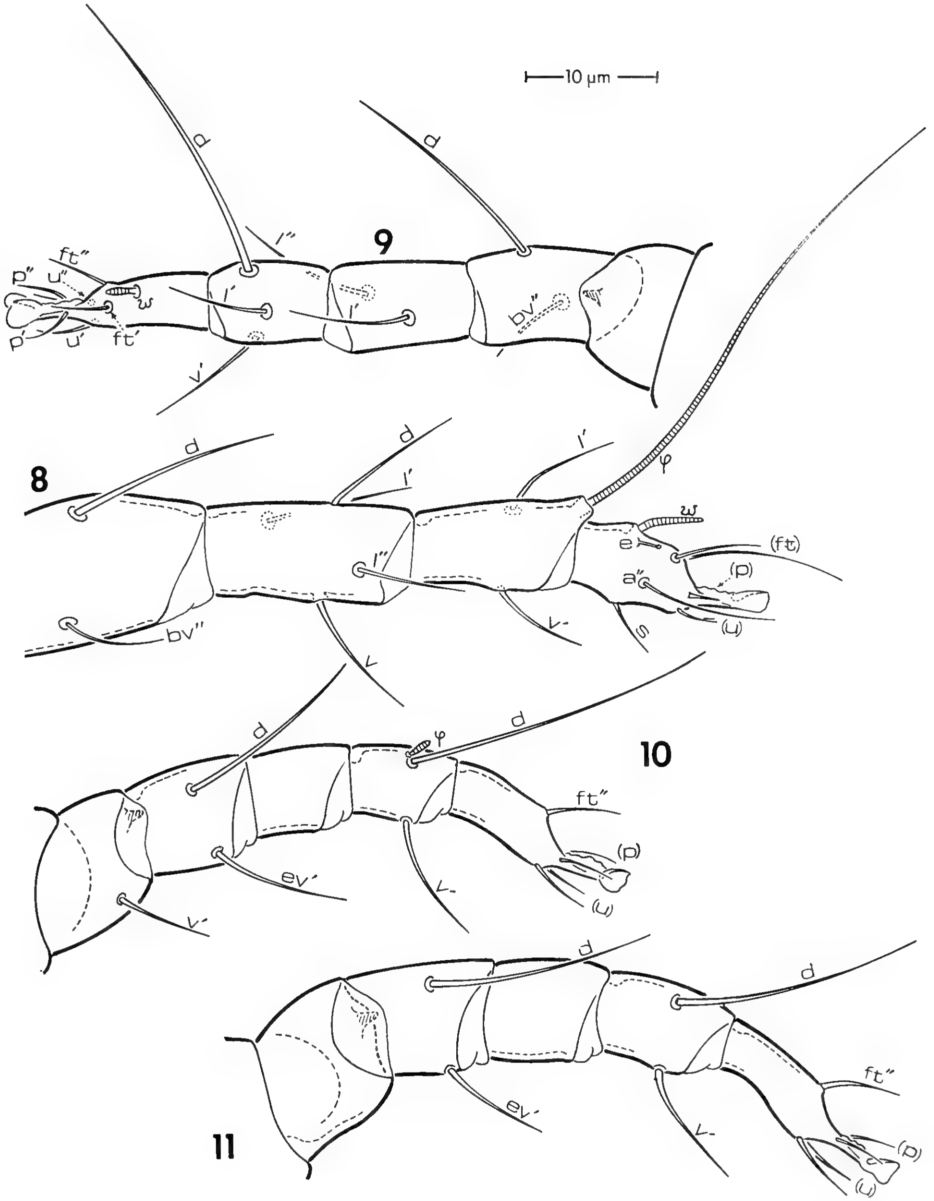
homologized with those of other sarcoptiform mites. The two on the femur are *sup* and *inf* (dorsal and ventroparaxial positions, respectively); the dorsal seta of the genu is *ds*. Seta *inf* of other enarthronote mites is formed in the deutonymph, *sup* is larval. The complete ontogeny of *P. lavoipierrei* is unknown, but *inf* is absent in the larva. *Paralycus parvulus* adults have only *sup* on the palpal femur, a probable neotenic state. Among sarcoptiform mites outside the Astigmata the latter condition, as well as the glabrous genu, is rare (unknown in other Enarthronota); the presence of only *ds* on the tibia (*l′* and *l″* are lost) is apparently unique. Homologies of tarsal setae are less certain, but are postulated in Fig. 7. Next to that of *Fosseremus* (Grandjean, 1965) it is the most regressive sarcoptiform mite palpal setation known to us. Setae *ul′* and *ul″* appear eupathidic, but their canals were not observed. Directly dorsad and ventrad of pair (*ul*) are unpaired setae with expanded tips; these positions are usually occupied by *acm* and *sul,* respectively, and these designations are applied. The single paraxial seta is probably *lt′* and the most proximal ventral seta is positionally comparable to *vt′* of other sarcoptiform mites.

The more proximal dorsal "setiform organ" is most difficult to homologize. There are usually three unpaired dorsal, or nearly dorsal, setiform organs on the palpal tarsus of sarcoptiform mites; the anteroculminal seta (*acm*), which is most distal; the culminal (*cm*), which is usually most proximal; and solenidion ω, which can be exactly dorsal or shifted somewhat antiaxiad. The latter is present as a rule in sarcoptiform mites. The structure in question is hollow, and since *cm* is never eupathidic, nor placed so far anteriad, the latter is apparently lost. Since *acm* is already accounted for, the proximal dorsal setiform organ of this mite is probably solenidion ω; it is so labelled in Fig. 7, but the convention of transversely striating solenidia in illustrations is not followed because of uncertainty. The usual confirmation by examining such organs in polarized light is inconclusive, since none of the normal setae exhibit noticeable birefringence. Only the rutellum and cheliceral digits of *P. lavoipierrei* are clearly birefringent.

5. The leg setation of *Paralycus* is the most regressive of all sarcoptiform mites outside of the Astigmata. Setal formulae (famulus included, solenidia in parentheses) of *P. lavoipierrei* are as follows: leg I, 0-2-4-2(1)-9(1); leg II, 0-2-2-3-6(1); leg III, 1-2-0-2(1)-5; leg IV, 0-2-0-2-5. Shapes and distribution of setae and solenidia are illustrated in Figs. 8–11. The setae remaining in this species are those which are fundamental (larval on I–III, protonymphal on IV) in other sarcoptiform mites. No setae which are typically accessory (added during ontogeny) are present, and many of the usual fundamental setae are themselves lost. Regarding leg setation, neotenic trends are very strong in the Pediculochelidae.

Leg setation of *P. raulti* and *P. parvulus* is similar, except seta *v′* of trochanter III is absent in *P. parvulus.*

As with the palp, setal homologies on proximal leg segments are readily determined; those of some tarsal setae are less obvious. Tarsus IV has only five setae. In contrast, the fundamental setation of tarsus IV in the large majority of sarcoptiform mites comprises seven setae (*ft″*, *p′*, *p″*, *u′*, *u″*, *pv′*, *pv″*). In the few enarthronote genera with five fundamental setae (e.g., *Amnemochthonius, Mesoplophora*), it is the proral pair which is lost, but this is not true of *Paralycus.* The protonymph of *P. lavoipierrei* is undescribed, but from studies of a single larva, and Price's (1973, Fig. 12) illustration of a different larval specimen, there are no setae added to legs I–III during ontogeny, and we assume this is also true of leg IV. It is clearly the primiventral pair (*pv*) which is never formed, a regression otherwise unknown in sarcoptiform mites, and rare in other Acariformes (Grandjean, 1946a).



Figs. 8–11. *Paralycus lavoipierrei*, adult. 8, Leg I, trochanter and part of femur omitted (antiaxial aspect). 9, Leg II (dorsoparaxial aspect). 10, Leg III. 11, Leg IV. Figs. 10 and 11 antiaxial aspect, slightly from above.

Tarsus III has an identical setation. In fact, the only setiform organs of leg III not found on IV are trochanteral seta *v′* and tibial solenidion *φ*, which is imperfectly coupled (in separate alveoli) with seta *d*. Tarsus II is similar to that of legs III and IV, except that seta *ft′* is present, as is solenidion *ω*.

On tarsus I homologies of pairs (*ft*), (*u*), (*p*) and the famulus, *e*, are certain. The prorals appear to be eupathidic, but no canal was observed. The more difficult setae are the remaining more proximal two setae which are in the ventral and antiaxial region. Possible candidates for homologues of the ventral seta are the unpaired subunguinal, *s*, and either of the primiventral pair, *pv′*, *pv″*; because of its exactly midventral position and the regressive tendency of the primiventral pair in the Haplochthoniidae (*pv′* is lost from tarsi I–III of *Amnemochthonius*), we feel the most likely homologue is seta *s*. Candidates for homologues of the antiaxial seta are primilateral seta *pl″* and antelateral seta *a″*. Seta *pl″* has been lost and *a″* is present in both *Haplochthonius* and *Amnemochthonius*; the antiaxial seta of *P. lavoipierrei* is probably *a″*.

6. Seta *d* on each femur, genu and tibia of sarcoptiform mites is a very "strong" seta, in the priority concepts of Grandjean (1946a), unless coupled with a solenidion (genua and tibiae only), in which case it is usually regressive or lost completely, concomitant with hypertrophy of the solenidion, as discussed by Norton (1982). On tibia I of *P. lavoipierrei,* for example, *d* has apparently disappeared; no vestige is visible, such as that found in the Haplochthoniidae. However, on tibiae II and III this post-coupling tendency is not evident. Seta *d* of tibia III is still very large and ϕ is short and clavate. More surprisingly, on tibia II solenidion ϕ has disappeared, rather than seta *d*. It is clear that ϕ was ancestrally present and coupled to *d,* since all other cosmochthonioid mites possess such a state. This is the only instance known to us in which after coupling the solenidion has less priority than the associated seta.

Also surprising is the loss of seta *d* on genu II before the loss of either lateral seta, a state unknown in other sarcoptiform groups except the Astigmata. It might be argued that the seta labelled *l′* in Fig. 9 is simply a seta *d* which has shifted paraxiad, but the alignment with *l′* of tibia II is perfect and if *d* is shifted at all in other sarcoptiform mites, it is to a position slightly antiaxiad of center, not paraxiad.

7. Like their near relatives, the Haplochthoniidae and Cosmochthoniidae, which are common in house and barn debris and periodically dry soils, pediculochelid mites are apparently tolerant of limited environmental moisture. Desiccation tolerance is probably necessary for associations with bees, rats and chickens, such as exhibited by *P. raulti* and the undetermined species reported by Baker and Wharton (1952) and Price (1973). Also, the soils from which members of other species have been collected in California, Italy and Western Australia are subject to long periods of dryness.

It is interesting to compare *Paralycus* with the most dry-adapted of the Palaeosomata, members of the genus *Aphelacarus*. The common species *A. acarinus* (Berlese) has an ecological distribution similar to that of haplochthoniid and cosmochthoniid mites; it is found in periodically or almost constantly dry soils in warm climates and synanthropic situations in some more northerly regions (Grandjean, 1954b). There are several morphological peculiarities which, if not for the weight of previous arguments, might suggest a close relationship between these two taxa. The facies of *Paralycus* is probably closer to that of *Aphelacarus* than any other sarcoptiform mite; it has a similar naso with associated rostral setae, an unsclerotized, elongated body, and even a dorsal division running between setal rows *e* and *f*. Like *Paralycus, Aphelacarus* has two pairs of reduced genital papillae and lacks both hysterosomal cupules and tarsal lyrifissures of legs and palp. *Aphelacarus* possesses an unpaired gland, the long duct of which opens between the bases of the chelicerae. Although undescribed, there is a round, dense "glandular" mass between the cheliceral bases of *P. lavoipierrei*; no duct has been observed. Also surprising is that tibial solenidia of *Aphelacarus* which are closest to setae *d* are in regression and appear almost vestigial. How many of these convergent similarities are associated with adaptation to dry habitats? It seems likely that at least the size and numerical regression of genital papillae can be so categorized. Alberti (1979) has concluded that these papillae function in water absorption in terrestrial acariform mites. Their atrophy or disappearance in *Aphelacarus,* Haplochthoniidae, Cosmochthoniidae, Pediculochelidae, and other groups, such as the Psoroptidia and Hypoderidae (Astigmata), correlates well with preference, or at least tolerance, of environments low in available moisture.

8. The *Paralycus* specimen from Western Australia mentioned above is the first Australian record of the Pediculochelidae. The single adult female examined seemed indistinguishable from Price's California specimens of *P. lavoipierrei.* It is housed in the Field Museum of Natural History, Chicago, and bears the following data: 20 km SW of Exmouth, Goat Cave, Cape Range, 100 meters elev., 29 September, 1976, ex. berlese leaf litter and soil at base of large fig, J. Kethley coll., FMHD #76-352.

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Addendum.—While this paper was in press, Dr. D. C. Lee (South Australian Museum, Adelaide) kindly pointed out an oversight. Since Protoplophoridae Ewing, 1917, is an earlier name than Cosmochthoniidae Grandjean, 1947, Article 36 of the current Zoological Code requires the use of Protoplophoroidea instead of Cosmochthonioidea in the sense used by us.

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A REVIEW OF THE GENUS *SCUTOBRUCHUS* KINGSOLVER (COLEOPTERA: BRUCHIDAE), WITH DESCRIPTIONS OF FOUR NEW SPECIES, AND NEW SYNONYMY

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Abstract.—The genus *Scutobruchus* is found only in South America and the Galapagos Is. and breeds only in seeds of *Prosopis* spp. (Leguminosae). Four new species, ***curtitropis***, ***ferocis***, ***terani***, and ***vinalicola***, are described, and additional host and distributional records for *S. ceratioborus* (Philippi) and *S. gastoi* Kingsolver are included. *Kytorhinus cassivorus* Motschulsky is synonymized with *S. ceratioborus*.

Four new species of *Scutobruchus* have been discovered in southern South America since I described the genus in 1968. Descriptions of these species and additional host and distributional data for *Scutobruchus ceratioborus* (Philippi) and *S. gastoi* Kingsolver, and a key to males of the six species is presented.

Species of *Scutobruchus* breed only in seeds of *Prosopis* spp. (Leguminosae) (mesquite, algarroba, algarobilla), and are apparently restricted to the South American continent although *S. ceratioborus* has apparently been introduced into the Galapagos Islands. Host associations are listed in Tables 1 and 2. Host records are listed verbatim from specimen labels except those generously supplied by Sra. Susana M. L'Argentier indicated by superscript 1 in the tables.

Scutobruchus is remarkable in the development of a longitudinal ventral keel at the apex of the median lobe in the male genitalia (Figs. 4, 6). The consistent and characteristic shape of this keel and of the lateral processes of the median lobe provide the principal bases for species discrimination in this genus. The form and relative position of the internal sac armature in the median lobe also are diagnostic but not necessary for identification if the apex of the median lobe can be seen clearly. The lateral lobes of the male genitalia are not diagnostic.

Specimens of *Scutobruchus* are readily sexed by the presence of a pit on the first visible abdominal sternum (basisternum) in males (Fig. 8) (absent in females), and the pygidial apex reflexed into the emarginate fifth sternum in males (pygidium oblique in females). Antennae are similar in the two sexes (Fig. 5).

Scutobruchus is apparently most closely related to *Algarobius*, also a *Prosopis* seed breeder, but which is distributed from southwestern United States through Mexico and Central America to Colombia and Venezuela. Males in *Algarobius* lack the abdominal pit but the female pygidium is bisulcate. The scutellum in both genera is elongated. Habitus resemblance between individuals of the two genera is striking.

Specimens of *Scutobruchus* cannot be segregated to species with certainty on external characters although both *gastoi* and *ferocis,* new species, lack a lateral metatibial carina (Fig. 26) and are restricted in their geographical and host ranges.

Scutobruchus is tentatively divided into two groups based on male genitalia and retention or loss of the lateral metatibial carina: *gastoi* and *ferocis* form one group; *ceratioborus, vinalicola,* new species, *curtitropis,* new species, and *terani,* new species, form the other although the male genitalia of *terani* suggest that this species is somewhat intermediate between the two groups.

Scutobruchus **Kingsolver**

Description.—Elongate-ovate.

Color: Integument reddish brown to piceous. Vestiture of yellowish-brown, brown, reddish, or gray slender hairs, pattern distinct or not.

Structure: Head rather broad; eyes prominent, deeply emarginate, not sexually dimorphic; antenna of both sexes as in Fig. 5. Pronotum campaniform, lateral margins slightly arcuate, lateral carina obtuse or obsolete; disk convex, slightly channelled mediobasally. Elytra together slightly wider than long; striae regular in course, intervals subequal basally, 3rd, 4th, 5th, and 6th (occasionally 2nd) striae each with small basal denticle. Scutellum longer than wide, bidentate apically. Pygidium sloping at about 30° from horizontal at base but vertical apically; apex in ♂ reflexed to fit emarginate 5th sternum; apex in ♀ not reflexed, 5th sternum not emarginate, slightly bulbous ventrally, face of ♀ pygidium lacking sulci; basisternum of ♂ with small or large oval depression or pit often filled with farinose deposit. Pro- and mesolegs not modified; metafemur incrassate, slightly sulcate ventrally; ventral margin with 1 long and 2 or 3 shorter denticles near apex; metatibia nearly straight, with short, acute mucro and 4 to 6 coronal denticles, lateral carina present or absent. Male genitalia lacking ventral valve but with strongly developed ventral keel and lateral processes. Lateral lobes depressed, rounded apically, cleft between them extending nearly to base. (Description modified from original (Kingsolver, 1968).)

Type-species.—*Bruchus ceratioborus* Philippi, by original designation.

KEY TO SPECIES OF *SCUTOBRUCHUS* BASED ON MALES

1. Metatibia lacking lateral carina (Fig. 26); abdominal pit less than ½ length of basisternum (Fig. 23); ♂ genitalia with lateral processes (alae) of median lobe broad, winglike (Figs. 16, 22); ventral keel rounded apically (Figs. 18, 25) 2

– Metatibia with distinct lateral carina (Fig. 7); abdominal pit large or small; lateral alae and ventral keel of various forms 3

2. Male genitalia with lateral alae and ventral keel as in Figs. 22, 25; northern Chile . . . . *gastoi* Kingsolver

– Male genitalia with lateral alae and ventral keel as in Figs. 16, 18; northern Argentina . . . . *ferocis* Kingsolver, new species

3. Lateral processes at apex of median lobe of unequal length (Fig. 10); ventral keel hooked apically (Fig. 12); abdominal pit less than ⅓ length of basisternum (Fig. 13) . . . . *vinalicola* Kingsolver, new species

– Lateral processes of median lobe of equal length (Figs. 4, 9, 14); ventral keel not hooked; basal pit of various sizes 4

4. Ventral keel elongated, attenuate (Fig. 6); lateral processes at apex of median lobe nearly vertical (Figs. 4, 6); abdominal pit about ½ length of basisternum (Fig. 8) .... *ceratioborus* (Philippi)
– Ventral keel short and rounded, or acute; lateral processes various 5
5. Ventral keel short, acute apically (Fig. 17); lateral processes at apex of median lobe vertical, curved mediad (Fig. 14); abdominal pit small, inconspicuous, less than ¼ length of basisternum (Fig. 15) .... *curtitropis* Kingsolver, new species
– Ventral keel deeply rounded (Fig. 11); lateral processes horizontally alate (Fig. 9); abdominal pit large, deep, ½ length of basisternum (Fig. 8) .... *terani* Kingsolver, new species

***Scutobruchus ceratioborus* (Philippi)**

Figs. 1–8, 27

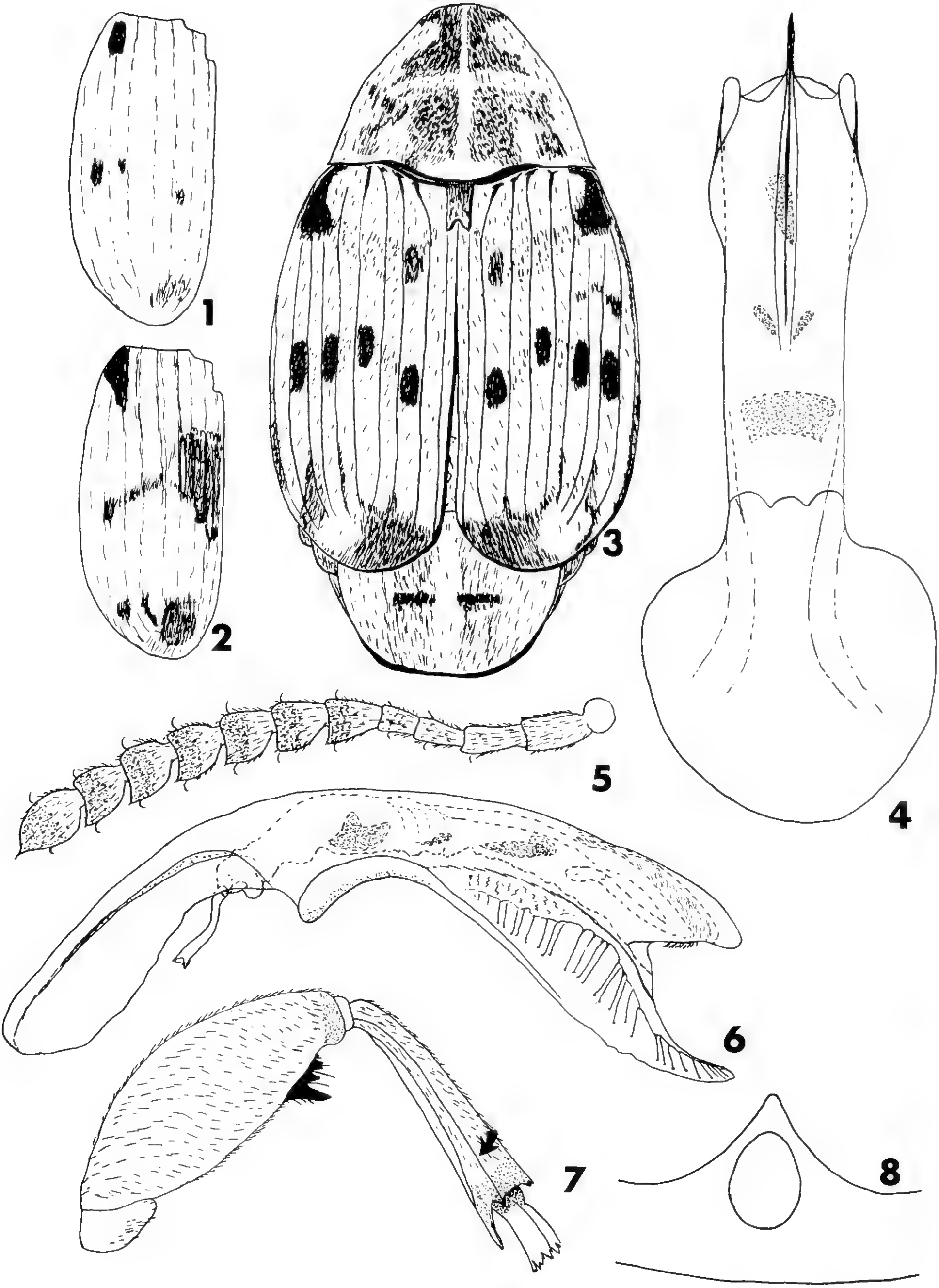
Bruchus ceratioborus Philippi, 1859: 670; Philippi, 1887: 162; Pic, 1913: 20 (as *ceriatoborus*); Porter, 1933: 86.
Algarobius ceratioborus: Olalquiaga Faure, 1949: 89.
Acanthoscelides ceratioborus: Blackwelder, 1946: 759.
Scutobruchus ceratioborus: Kingsolver, 1968: 283; Kingsolver et al., 1977: 115; Koch and Campos, 1978: 87.
Kytorhinus cassivorus Motschulsky, 1874: 207. **NEW SYNONYMY.**
Bruchus crassivorus (sic): Pic, 1913: 23.
Acanthoscelides crassivorus (sic): Blackwelder, 1946: 759.
Bruchus vagenotatus Pic, 1938: 19; Kingsolver, 1968: 283.
Acanthoscelides vagenotatus: Blackwelder, 1946: 761.

Description.—Length, 3.1–4.5 mm; width, 1.6–2.0 mm.

Color: Integument reddish brown to piceous, eyes black; vertex of head with vertical, piceous median stripe sometimes expanded above eyes; clypeus usually darker basally; labrum reddish; antenna with apical ½ of each segment usually darker (Fig. 5); elytra usually reddish brown with darker brown pattern (Fig. 2, 3) varying to nearly unicolorous (Fig. 1). Vestiture of yellowish-brown and brown hairs, hairs paler on venter; pronotum usually with distinct median line of paler hairs (Fig. 3); pygidium with yellowish-gray hairs on darker integument, median stripe of hairs paler.

Salient structural characters: Basal abdominal pit of ♂ about ½ length of basisternum (Fig. 8); metatibia with distinct lateral carina (Fig. 7); median lobe of ♂ with ventral keel elongate, attenuate (Fig. 6), lateral processes flanking apical orifice nearly vertical, slightly flared laterally (Fig. 4).

Distribution.—New locality and host records for *S. ceratioborus* since my 1968 paper are as follows: ARGENTINA: Catamarca Prov.: Rt. 38, 150 km S Andalgalá, 16 February 1971, 10 January 1969, 4 November 1972, *Prosopis nigra*; Mollecito, 10 January 1969, pods of *Prosopis alba* and *nigra*; Rt. 60, 47 mi SE Tinogasta, 25 February 1978, *Prosopis torquata*; Rt. 63, 33 mi N Minas Capillitas, 28 February 1978; Rt. 307, 6 km N Sta. María, 11 January 1980, *Prosopis flexuosa*. Tucumán Prov.: Amaicha del Valle, 8 January 1969, pods *Prosopis torquata*. Santiago del Estero Prov.: Loreto, 14 February 1971, *Prosopis reptans*; Icaño, July 1904; 20 km N Icaño, December 1904; 40 km W Salavina, 1909; Rt. 9, N Rio Saladillo, 24 February 1971; Rt. 34, 31 mi SE La Banda, 6 December 1976,



Figs. 1–8. *Scutobruchus ceratioborus.* 1, Left elytron, light pattern phase. 2, Same, darkest color phase. 3, Habitus, median color phase. 4, ♂ genitalia, median lobe, ventral. 5, Antenna. 6, ♂ genitalia, median lobe, lateral. 7, Left metafemur and metatibia. 8, ♂ basisternum, median portion with outline of basal pit.

Prosopis alba. La Rioja Prov.: Aimogasta, 25 February 1978; Rt. 38, 3 km SE Punta de los Llanos, 14 February 1971, *Prosopis sericantha*; Rt. 9, 9 km N Bazan, 15 February 1971, *Prosopis chilensis*; S nr. Aimogasta, Rt. 9, 15 February 1971, *Prosopis chilensis.* Córdoba Prov.: Rt. 38, Camino a los Mogotes, 25 February 1977, *Prosopis chilensis.* Entre Ríos Prov.: Rt. 126, 9 mi NE La Paz, 15 March 1977, *Prosopis nigra.* Mendoza Prov.: Rt. 40, 8 mi NE Mendoza, 22 February 1977, *Prosopis alpataco*; 8 mi N Tunuyan, 20 February 1977, *Prosopis alpataco*; Rt. 143, 11 mi NW Alvear, 18 February 1977, *Prosopis flexuosa.* San Juan Prov.: Matagusanos, 29 February 1970, *Prosopis ruscifolia*; Rt. 20, 32 mi SE Caucete, 19 February 1970, *Prosopis chilensis*; 82 km E San Juan, 21 April 1967; Rt. 140, 18 mi NE Mendoza-San Juan border, 22 February 1977, *Prosopis flexuosa.* San Luis Prov.: Rt. 7, 12 km SE Mercedes, 19 November 1976, *Prosopis caldenia.* CHILE: Antofagasta Prov.: 5 km N Quillagua, 2 October 1966, 26 September 1967, 6 February 1969. Iquique Prov.: Pica, 28 September 1967. Tarapaca Prov.: Pampa del Tamarugal, 5–15 August 1973, *Prosopis strombulifera.* ECUADOR: Machala, 30 June 1980, pods of *Prosopis juliflora.* Galapagos.—Española Is., E side peninsula at coast, N of summit, 18 April 1970, blacklight; Duncan Is., 1–17 December 1905.

Hosts.—Host records are summarized in Tables 1 and 2.

Remarks.—This is the most widespread species of *Scutobruchus.* Its range extends from Ecuador and the Galapagos (both previously unreported) through Peru and Chile (xeric regions) to most of northern and central Argentina.

The type-locality is Valdivia Prov., Chile, and the male lectotype is deposited in the Museo Nacional de Historia Natural, Santiago, Chile.

Scutobruchus terani **Kingsolver, New Species**

Figs. 9, 11, 28

Scutobruchus sp. G: Kingsolver et al., 1977: 115.

Description.—Length, 3.6–4.1 mm; width, 2.1–2.3 mm.

Color: Integument reddish brown above, slightly darker beneath; head with median T-shaped, piceous mark; antenna dark. Vestiture of yellowish-gray and brown slender hairs in pattern similar to that of *S. ceratioborus* (Figs. 1–3); pygidium with median stripe of setae, vestiture evenly distributed except sometimes with bare patches either side of median line at basal ⅓.

Male genitalia: Median lobe in lateral aspect with ventral keel deep, broadly rounded apically (Fig. 11); in ventral aspect, lateral processes flanking apical orifice slightly expanded horizontally (Fig. 9); armature of internal sac consisting of a single large spine near base of sac and 2 pairs of spines near middle of sac (Fig. 9).

Types.—Holotype ♂, ARGENTINA: Catamarca, Copacabana, 1 December 1968, in seeds of *Prosopis argentina,* A. Terán. Allotype ♀, 9 ♂, 2 ♀ paratypes, same data. Other paratypes: Mendoza Prov.: Rt. 40, 8 mi NE Mendoza, 22 February 1977, in pods *Prosopis alpataco,* 14 ♂, 17 ♀; 35 mi N Tunuyán, 17 February 1978, in pods *Prosopis alpataco,* 1 ♂. Catamarca Prov.: Rt. 60, 21 mi SE Tinogasta, 25 February 1978, in seeds *Prosopis argentina,* 3 ♂, 3 ♀. La Rioja Prov.: January 1970, in *Prosopis abbreviata,* 3 ♂, 2 ♀.

Holotype and paratypes deposited in the Colección Fundación-Instituto Miguel

Table 1. *Scutobruchus* species and their *Prosopis* host plants.

Scutobruchus Species	*Prosopis* Species
S. ceratioborus (Philippi)	*P. abbreviata* Benth.[1], *P. alba* Griseb., *P. alpataco* Phil., *P. caldenia* Burkart, *P. chilensis* (Mo.) Stuntz, *P. flexuosa* DC., *P. juliflora* (Swartz) DC., *P. nigra* (Griseb.) Hieron., *P. reptans* Benth., *P. ruscifolia* Griseb., *P. sericantha* Hook & Arn., *P. strombulifera* (Lam.) Benth., *P. torquata* (Lag.) DC.
S. curtitropis, new species	*P. alba, P. chilensis, P. flexuosa*[1], *P. nigra*
S. ferocis, new species	*P. ferox* Griseb.
S. gastoi Kingsolver	*P. strombulifera, P. tamarugo* F. Phil.
S. terani, new species	*P. abbreviata, P. alpataco* Phil., *P. argentina* Burkart, *P. chilensis*[1], *P. flexuosa*[1]
S. vinalicola, new species	*P. abbreviata, P. affinis* Sprengel (also as *P. algarobilla* Griseb. of authors and insect labels), *P. alba, P. alpataco, P. caldenia, P. chilensis, P. elata* (Burk.) Burk.[1], *P. flexuosa, P. hassleri* Harms, *P. nigra, P. ruscifolia, P. strombulifera, P. torquata, P. vinalillo* Stuckert

[1] Records courtesy Sra. Susana M. L'Argentier, Jujuy, Argentina.

Lillo, Tucumán, Argentina. Allotype and paratypes deposited in the National Museum of Natural History, Washington, D.C.; the Bernardino Rivadavia Museum of Natural Sciences, Buenos Aires; Museo de Ciencias Naturales, La Plata, Argentina; C. D. Johnson Collection, Flagstaff, Arizona; and Museo Nacional de Historia Natural, Santiago, Chile.

Remarks.—I have not found external morphological characteristics to distinguish this species from *S. ceratioborus.* In coloration, size, shape, and size of the basal abdominal pit in the male, the two species appear identical. Only by the consistently distinctive characters in the male genitalia can they be separated (cf. Figs. 4 and 6, 9 and 11).

The slight horizontal expansions of the lateral processes suggest a more intermediate trend toward the alae in *S. gastoi* and *ferocis.*

I am pleased to name this species for my good friend Arturo Terán of the Lillo Institute, Tucumán.

Scutobruchus vinalicola **Kingsolver, New Species**

Figs. 10, 12, 13, 29

Scutobruchus sp. F: Kingsolver et al., 1977: 115.

Description.—Length, 2.6–4.0 mm; width, 1.5–2.2 mm.

Color: Integument mostly reddish brown except the following piceous: anterior ½ of each segment of antennal club; diffuse spot on frontoclypeal suture; T-shaped mark on vertex; disk of pronotum with central area darker than margins; indistinct spots and bars on elytra; sometimes with ventral ⅓ of metafemur darker; sometimes with diffuse areas on thoracic pleura and sterna; entire pygidium except for median reddish stripe and narrow lateral stripes paler. Vestiture of bronze, gray, and dark-brown slender hairs.

Structure: As in *ceratioborus* except: Basisternal pit small, less than ⅓ length of basisternum (Fig. 13).

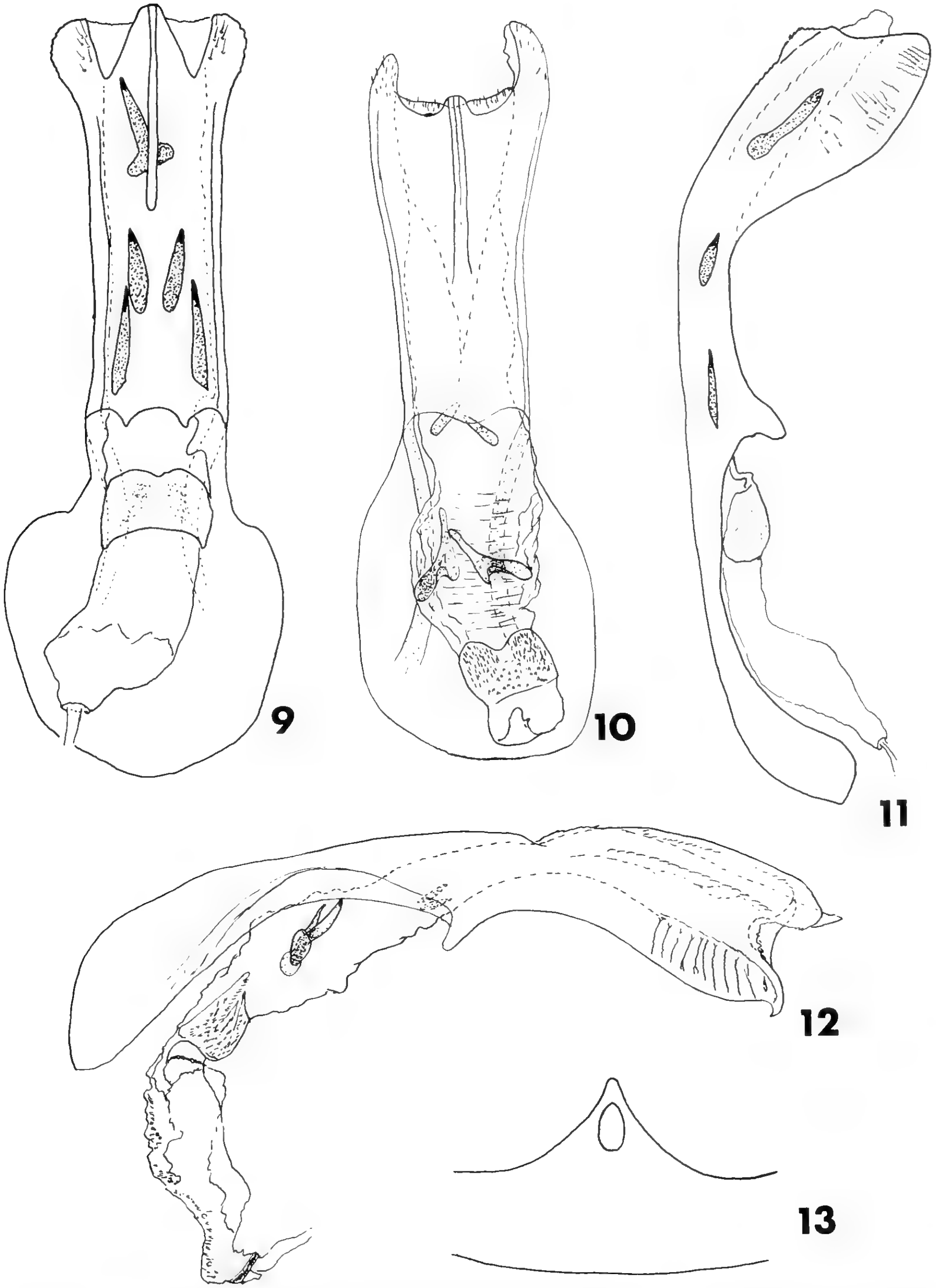
Table 2. *Prosopis* species and their *Scutobruchus* predators. Scientific names of hosts and bruchids are listed in Table 1.

Prosopis Species	*Scutobruchus* Species
P. abbreviata	*S. ceratioborus*[1], *S. terani*, *S. vinalicola*
P. affinis	*S. vinalicola*
P. alba	*S. ceratioborus*, *S. curtitropis*, *S. vinalicola*
P. alpataco	*S. terani*, *S. vinalicola*, *S. ceratioborus*
P. argentina	*S. terani*
P. caldenia	*S. ceratioborus*, *S. vinalicola*
P. chilensis	*S. ceratioborus*, *S. curtitropis*, *S. terani*[1], *S. vinalicola*
P. elata	*S. vinalicola*[1]
P. ferox	*S. ferocis*
P. flexuosa	*S. ceratioborus*, *S. terani*[1], *S. vinalicola*
P. hassleri	*S. vinalicola*
P. juliflora	*S. ceratioborus*
P. nigra	*S. ceratioborus*, *S. curtitropis*, *S. vinalicola*
P. reptans	*S. ceratioborus*
P. ruscifolia	*S. ceratioborus*, *S. vinalicola*
P. sericantha	*S. ceratioborus*
P. strombulifera	*S. ceratioborus*, *S. gastoi*, *S. vinalicola*
P. tamarugo	*S. gastoi*
P. torquata	*S. ceratioborus*, *S. vinalicola*
P. vinalillo	*S. vinalicola*

[1] Records courtesy of Sra. Susana M. L'Argentier, Jujuy, Argentina.

Male genitalia: Median lobe with apex of keel recurved (Fig. 12); lateral processes flanking apical orifice not of equal length (Fig. 10); armature on internal sac consisting of 2 slender spines at middle of sac, 2 larger spines and shield-shaped sclerite in apical ½.

Types.—Holotype ♂, ARGENTINA: La Rioja between San Martin and Casa Piedra, 1 km W of El Mandano, 29 December 1970, in *Prosopis* sp., Solbrig coll. no. 4221. Allotype ♀, 3 ♂ and 3 ♀ paratypes same data. Other paratypes: ARGENTINA: Formosa Prov.: Dto. Patino, Estancia La Primavera, 8–9 January 1972, in *Prosopis alba, hassleri, nigra, ruscifolia, vinalillo,* 27 ♂, 24 ♀; Rt. 81, 44 mi NW Formosa, 10 December 1976, in pods *Prosopis alba,* 4 ♂, 3 ♀; Rt. 81, 15 mi NW Formosa, 10 December 1976, in pods *Prosopis algarobilla* (× *nigra* (?)), 2 ♂, 1 ♀ in pods from ground, *Prosopis nigra,* 7 ♂, 3 ♀ in pods *Prosopis algarobilla,* 1 ♂; Rt. 11, 12 mi N Chaco-Formosa border, 8 December 1976, in pods *Prosopis nigra,* 2 ♂; Rt. 90, 4 mi SW Pirane, 11 December, in pods *Acacia* sp. (!), 1 ♂. Catamarca Prov.: Mollecito, 10 January 1969, in *Prosopis vinalillo,* 2 ♂; Recreo, 1 June 1899, 1 ♂; Rt. 62, 26 mi S Andalgalá, 1 March 1977, in pods *Prosopis abbreviata,* 4 ♂, 2 ♀; Andalgalá IBP Desert Site, 6 December 1973, flowers *Atamisquea emarginata,* 1 ♂; Rt. 62, 34 mi S Andalgalá, 27 February 1978, beating *Prosopis chilensis,* 1 ♂; Rt. 40, 13 mi NE Tinogasta, 26 February 1978, sweeping *Larrea,* 1 ♂; 61 mi S Andalgalá, 25 December 1970, *Prosopis* sp., 1 ♂; 50 km W Andalgalá, 31 October 1972, on *Cassia,* 1 ♂, 3 ♀; Andalgalá, 30 October 1972, 1 ♂, 4 November 1972, 1 ♂; 15 mi S Colpes, 27 October 1972, 1 ♂. Tucumán Prov.: Horca Molle, nr. Tucumán, 18 October 1968, 8 ♂, 4 ♀. Santiago del Estero Prov.: Rio Salado, Wagner coll., 1 ♂. La Rioja Prov.: Rt. 9, S of Aimogasta, 15 February



Figs. 9–13. 9, *Scutobruchus terani,* ♂ genitalia, median lobe, ventral. 10, *S. vinalicola,* same. 11, *S. terani,* ♂ genitalia, median lobe, lateral. 12, *S. vinalicola,* same. 13, *S. vinalicola,* ♂ basisternum, median portion with outline of basal pit.

1971, in *Prosopis chilensis,* Vuill. #1020, 6 ♂; Rt. 9, 46 mi N Bazan, 15 February 1971, in *Prosopis torquata,* Vuill. # 1021, 1 ♂; Rt. 20, 23 mi E Chepes, 20 February 1978, in *Prosopis torquata,* 2 ♂; Rt. 9, 9 km N Bazan, 15 February 1971, in *Prosopis chilensis,* 2 ♂. San Juan Prov.: Rt. 20, 32 mi SE Caucete, 19 February 1978, in *Prosopis chilensis,* 2 ♂, 1 ♀; Rt. 20, 3 mi E Caucete, 19 February 1978, in *Prosopis torquata,* 3 ♂, 2 ♀; Rt. 20, 1 mi SE Caucete, 19 February 1978, in *Prosopis strombulifera,* 2 ♂, in *Prosopis alpataco,* 2 ♂; 82 km E San Juan, 21 April 1967, 1 ♂, 1 ♀. Córdoba Prov.: Rt. 38, Capilla del Monte, 22 February 1978, in *Prosopis alba,* 2 ♂, 3 ♀; Alta Gracia, March 1959, 3 ♂, 3 ♀; Rt. 38, Camino a los Mogotes, 25 February 1977, in pods *Prosopis chilensis,* 2 ♀; Rt. 38, 8 mi NW Cruz del Eje, 24 February 1977, in pods *Prosopis chilensis,* 1 ♂, 4 ♀; Rt. 7, 1 mi E Córdoba-San Luis border, 19 November 1976, in pods *Prosopis caldenia,* 4 ♂, 1 ♀; Tuclame, Rt. 38, 26 December 1970, in *Prosopis alba,* Solbrig 4211(1), 1 ♂. Entre Ríos Prov.: Rt. 126, 9 mi E La Paz, 15 March 1977, in pods *Prosopis nigra,* 4 ♂, 4 ♀. Mendoza Prov.: Rt. 40, 4 mi N Mendoza, 19 February 1978, in pods *Prosopis strombulifera,* 1 ♂; Rt. 40, 35 mi S Tunuyán, 19 February 1977, in pods *Prosopis flexuosa,* 2 ♂; Rt. 143, 11 mi N Alvear, 18 February 1977, in pods *Prosopis flexuosa,* 1 ♂, 1 ♀. San Luis Prov.: Rt. 188, 20 mi W La Pampa-San Luis border, 17 February 1977, in pods *Prosopis flexuosa,* 2 ♂, 2 ♀; Rt. 7, 12 mi SE Mercedes, 19 November 1976, in pods *Prosopis caldenia,* 1 ♀. La Pampa Prov.: Rt. 35, 9 mi N Santa Rosa, 18 November 1976, in pods *Prosopis caldenia,* 5 ♂, 3 ♀; Rt. 35, 26 mi W Buenos Aires-La Pampa border, 17 November 1976, in pods *Prosopis caldenia,* 1 ♂, 2 ♀; Rt. 35, 85 mi N Santa Rosa, 15 February 1978, in *Prosopis caldenia,* 1 ♂, 4 ♀; Rt. 188, 38 mi W Realico, 15 February 1978, in *Prosopis caldenia,* 2 ♂, 1 ♀. Buenos Aires Prov.: San Fernando, June 1957, 1 ♂. (Province not known): San Pedro Orchard, 12 April 1927, M. Kisliuk, 1 ♂; intercepted 12 April 1969, Miami, Florida, Plant Quarantine 51482, in *Prosopis* sp. (vinal), 4 ♂, 2 ♀. PARAGUAY: Pres. Hayes Prov., Trans-Chaco Hwy. 9, 369 km NW Asunción, 18 January 1976, in pods *Prosopis ruscifolia,* 48 ♂, 55 ♀.

Holotype ♂, allotype ♀, and paratypes deposited in the National Museum of Natural History, Washington, D.C. (Type # 100460). Paratypes also deposited in the following collections: Bernardino Rivadavia Museum of Natural Sciences, B.A.; Colección Fundación-Instituto Miguel Lillo, Tucumán, Argentina; Museo de Ciencias Naturales, La Plata, Argentina; Canadian National Collections, Ottawa, C. D. Johnson Collection, Flagstaff, Arizona; Texas A&M University, College Station; and Museo Nacional de Historia Natural, Santiago, Chile.

Remarks.—Except for the generally darker appearance and the smaller basal pit on the metasternum, this species is indistinguishable from *ceratioborus* on external characters. The recurved apex of the ventral keel and the asymmetrical lateral processes of the median lobe distinguish *vinalicola* from any other species in this genus. The lateral metatibial carina places it in the group with *ceratioborus.*

The name *vinalicola* is derived from "vinal," the common name of *Prosopis ruscifolia,* a host for this species and "*cola*" (Latin = dweller in).

Scutobruchus curtitropis **Kingsolver, New Species**

Figs. 14, 15, 17, 28

Scutobruchus sp. H: Kingsolver et al., 1977: 115.

Description.—Length, 2.9–4.2 mm; width, 1.9–2.1 mm.

Color: Similar to *S. vinalicola* except body generally more reddish with dark spots and bars more prominent; pygidium reddish with broad piceous stripe either side of median reddish stripe; metafemur all red.

Structure: Resembling *vinalicola* except basisternum with very small basal pit (Fig. 15); median lobe of ♂ genitalia with short ventral keel (Fig. 17), lateral processes curved mesad, concave on mesal faces; armature of internal sac as shown (Fig. 14).

Types.—Holotype ♂, ARGENTINA: La Rioja, Aimogasta, 25 February 1978, in pods *Prosopis chilensis*; 2 ♂ paratypes, same data. Other paratypes: ARGENTINA: Córdoba Prov.: Rt. 38, Capilla del Monte, 22 February 1978, in pods *Prosopia alba,* 3 ♂. Catamarca Prov.: Andalgalá, 4 November 1972, 1 ♂. "Argentina", intercepted Washington, D.C. at quarantine, 8 March 1917, in seeds *Prosopis juliflora nigra,* 1 ♂; same data except in *Prosopis juliflora "blanco*", 1 ♂. "Catamarca a Salta", January 1907, 13 ♂, 8 ♀.

Holotype deposited in Colección Fundación-Instituto Miguel Lillo, Tucumán, Argentina. Paratypes deposited in the same institution and in the National Museum of Natural History, Washington, D.C.; the Museo Nacional de Historia Natural, Santiago, Chile; the Bernardino Rivadavia Museum of Natural Sciences, Buenos Aires; and the C. D. Johnson Collection, Flagstaff, Arizona.

Remarks.—This species seems to be most closely related to *S. vinalicola* in the small abdominal pit, and in the shape of the lateral processes of the median lobe in the male genitalia.

The name is derived from "*curtus*" (Latin = short), and "*tropis*" (Latin = keel), and refers to the short ventral keel of the median lobe.

***Scutobruchus gastoi* Kingsolver**

Figs. 19–26, 29

Scutobruchus gastoi Kingsolver, 1968: 285; Reyes and Hermosilla, 1974 (biology); Kingsolver et al., 1977: 115; Koch and Campos, 1978 (biology).

Description.—Length, 2.5–3.0 mm; width, 1.25–1.50 mm.

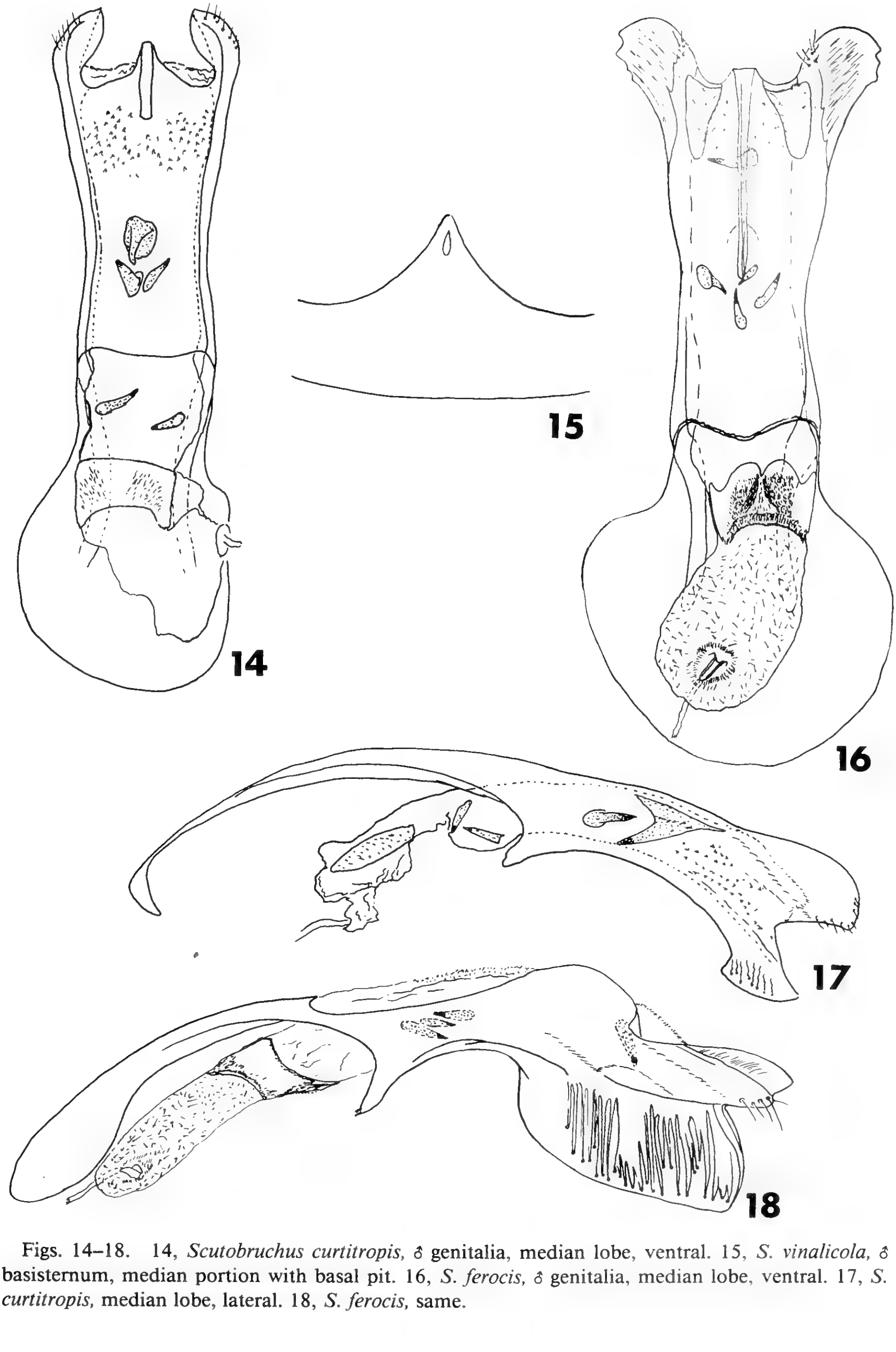
Color: Integument reddish brown to piceous; pronotum varying from reddish brown with median stripe piceous to nearly all piceous; elytra varying from nearly unicolorous reddish brown to the pattern in Fig. 20 with lateral borders and apices piceous; pygidium reddish, often with darker stripes laterally. Vestiture of gray, yellowish, and brown slender setae.

Structure: Abdominal pit less than ½ length of basisternum (Fig. 23); metatibia lacking lateral carina (Fig. 26); median lobe of male genitalia as in Figs. 22 and 25.

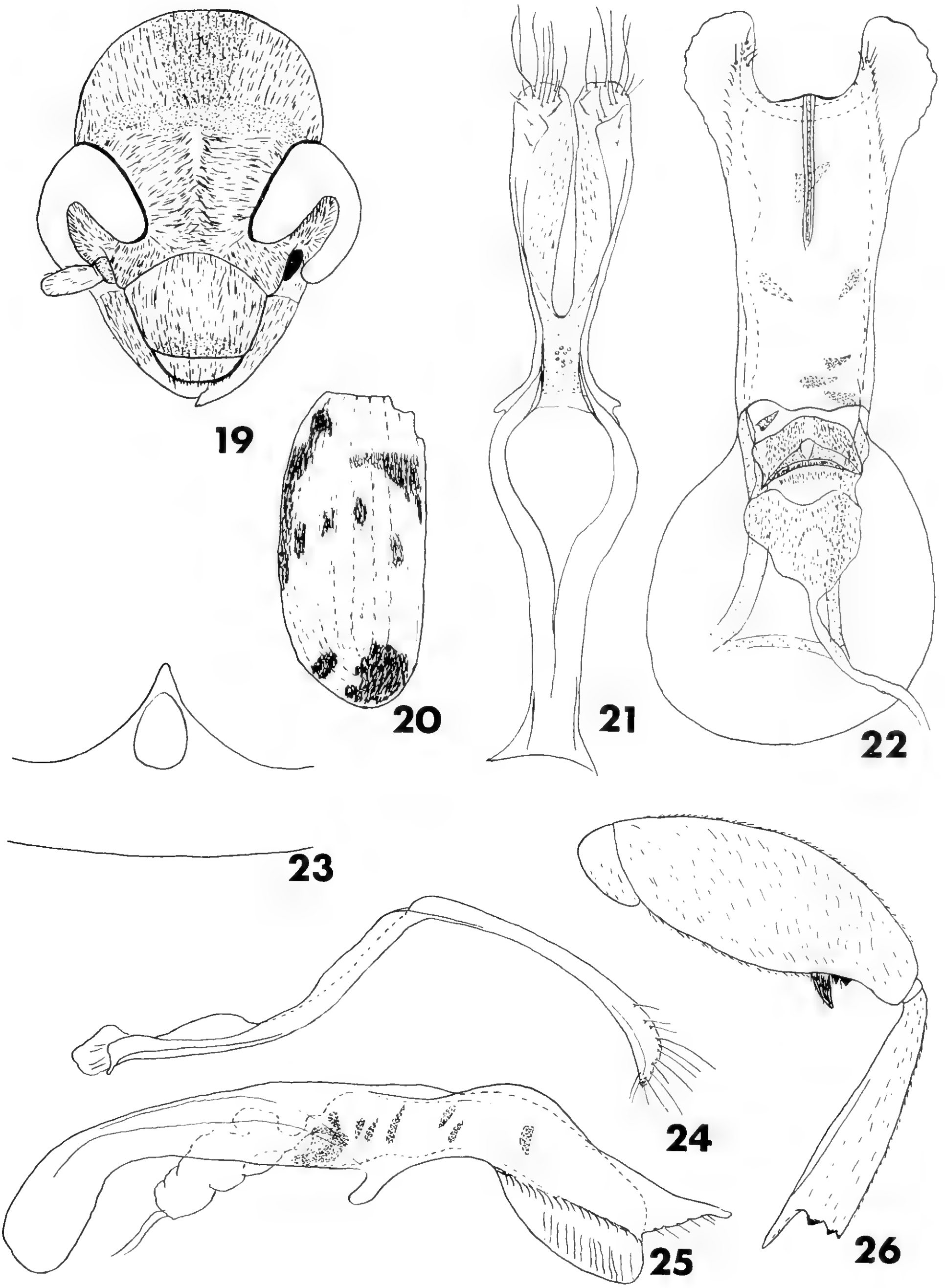
The first two characters are shared with *S. ferocis*; Figs. 16 and 17 should be compared for the third character. Geographical distribution of the two species appears to be discrete with *gastoi* known only from northern Chile and *ferocis* known only from northern Argentina. The type-locality of *gastoi* is Canchones, Tarapaca Prov., Chile, near La Guiaca. The holotype is deposited in the National Museum of Natural History, Washington, D.C.

Hosts.—Known host plants are *Prosopis tamarugo* and *P. strombulifera.*

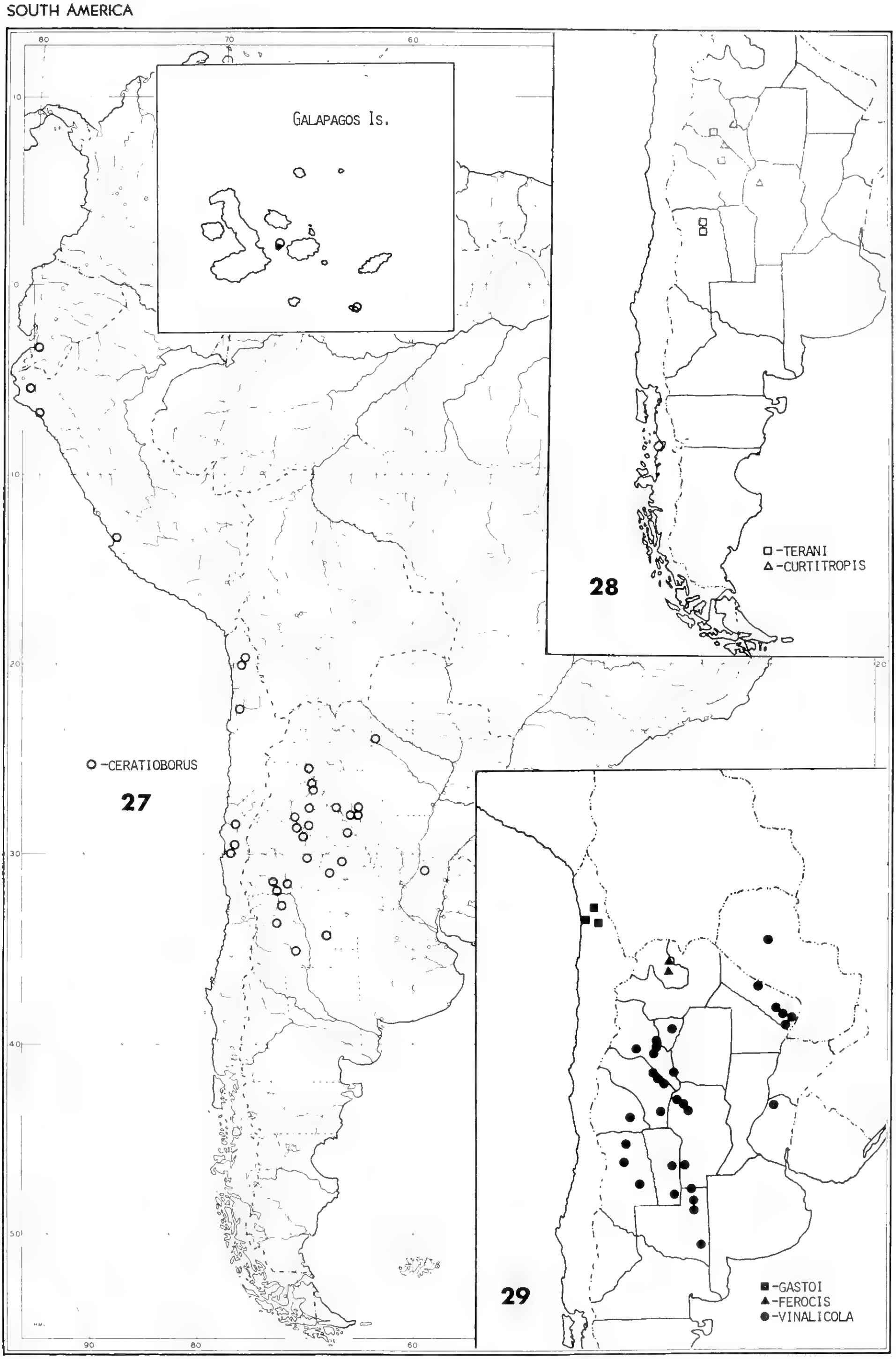
Distribution.—New records since 1968. CHILE: Tarapaca Prov.: Junoy, 24 October 1968, *Prosopis* sp.; Pampas del Tamarugal, 5 July 1956, November 1968,



Figs. 14–18. 14, *Scutobruchus curtitropis,* ♂ genitalia, median lobe, ventral. 15, *S. vinalicola,* ♂ basisternum, median portion with basal pit. 16, *S. ferocis,* ♂ genitalia, median lobe, ventral. 17, *S. curtitropis,* median lobe, lateral. 18, *S. ferocis,* same.



Figs. 19–26. *Scutobruchus gastoi.* 19, Head, cephalic. 20, Left elytron, darkest pattern. 21, ♂ genitalia, lateral lobes and tegmen, ventral. 22, Same, median lobe, ventral. 23, ♂ basisternum, median portion with outline of basal pit. 24, ♂ genitalia, lateral lobes and tegmen, lateral. 25, Same, median lobe, lateral. 26, Left metafemur and metatibia.



Figs. 27–29. Known distribution of *Scutobruchus* spp. 27, Open circles, *S. ceratioborus* (Galapagos Is., inset). 28, Open squares, *S. terani*; open triangles, *S. curtitropis*. 29, Solid squares, *S. gastoi*; solid triangles, *S. ferocis*; solid circles, *S. vinalicola*.

Prosopis strombulifera; Llamara, 28 July 1968; Tiliviche, 4 December 1966; Arica, in *Prosopis tamarugo*; between Iquique and Pica, 9 February 1969, *Prosopis* sp. Antofagasta Prov.: San Pedro de Atacama, 12 September 1967.

Scutobruchus ferocis **Kingsolver, New Species**

Figs. 16, 18, 29

Scutobruchus sp. I: Kingsolver et al., 1977: 115.

Description.—Body length, 3.3–3.7 mm; width, 1.9–2.0 mm. Similar to *S. gastoi* Kingsolver.

Color: Integument mostly reddish brown with indistinct or no pattern on elytra and pronotum, if pattern present, as piceous lateral margins, sometimes with two small, dark spots on each third interval; pronotum usually uniformly reddish brown, pygidium of both sexes reddish brown occasionally with piceous sublateral streaks or entirely piceous with median yellowish stripe; legs reddish brown with metafemur sometimes darker ventrally. Vestiture of grayish-yellow slender hairs in irregular mottled pattern on dorsum, more densely distributed on venter.

Structure: Metatibia lacking lateral carina; abdominal pit less than ½ length of basisternum (Fig. 23). Male genitalia (Figs. 16, 18) similar to those of *S. gastoi* but with lateral alae and ventral keel distinctly shaped.

Types.—Holotype ♂, ARGENTINA: Jujuy Prov.: Uquia, 6 January 1972, A. Terán, seeds of *Prosopis ferox.* Allotype ♀ and 34 ♂, 19 ♀ paratypes, same data. Other paratypes: ARGENTINA: Jujuy Prov.: Rt. 9, 4 mi N Tilcara, 8 March 1977, in pods *Prosopis ferox,* 2 ♂, 4 ♀. Holotype and paratypes in the Colección Fundación-Instituto Miguel Lillo, Tucumán, Argentina. Allotype and paratypes in the National Museum of Natural History, Washington, D.C.

Remarks.—This species is smaller than *ceratioborus* and approaches *S. gastoi* in size and color, and shows a close relationship with *gastoi* in the form of the male genitalia and lack of a lateral metatibial carina.

The specific name is taken from the host plant, *Prosopis ferox.*

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EUPTERYX ATROPUNCTATA: NORTH AMERICAN DISTRIBUTION, SEASONAL HISTORY, HOST PLANTS, AND DESCRIPTION OF THE FIFTH-INSTAR NYMPH (HOMOPTERA: CICADELLIDAE)

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Abstract.—*Eupteryx atropunctata* (Goeze), a Palearctic leafhopper known previously in North America from Connecticut, Ontario, and Quebec, is recorded from Michigan, New York, and Pennsylvania. Seasonal history was studied at Ithaca, N.Y., during 1980–82. Overwintering occurs in the egg stage; eggs begin to hatch in early May, and at least four generations develop by November. This mesophyll feeder produces chlorotic or stippled areas on upper leaf surfaces of host plants. A list of 34 hosts, mostly medicinal and herb garden plants of the Lamiaceae (= Labiatae), is given. A diagnosis of the adult is provided, and the fifth-instar nymph is described and illustrated.

Eupteryx atropunctata (Goeze), a typhlocybine leafhopper occurring throughout most of Europe (Metcalf, 1968; Nast, 1972), feeds on a variety of herb garden and crop plants. In England it is part of an herb-feeding complex of closely allied species; LeQuesne (1973) presented a key to separate *E. atropunctata* from *E. aurata* (L.) and *E. origani* Zakhvatkin. *Eupteryx atropunctata* is often common on medicinal plants, especially labiates such as *Mellisa officinalis* L., *Mentha piperita* L., and *Salvia officinalis* L. (Nowacka and Adamska-Wilczek, 1974), and *Ballota, Lamium, Marrubium, Nepeta,* and *Origanum* (Ossiannilsson, 1943). The broad host range also is known to include the composites sunflower (Nowacka and Bielejewski, 1978); burdock, *Arctium lappa* L. (Fokker, 1891); and *Petasites officinalis* Moench (Blattny, 1924). Linnavuori (1952) reported it from *Filipendula ulmaria* (L.) Maxim (Rosaceae); Günthart (1971) found it on *Apium* sp. (Apiaceae = Umbelliferae); and Blattny (1924) recorded it from *Althaea officinalis* L. (Malvaceae).

Eupteryx atropunctata has long been known from potato (Curtis, 1860), on which characteristic chlorotic spots appear at feeding sites (Horne and Lefroy, 1915). Feeding also may cause leaf edges to curl, producing symptoms that resemble those of potato leaf curl (Heinze, 1937); this leafhopper, however, appears not to transmit leaf curl virus. From a study of populations on potato, Gromadzka (1970) reported two annual generations for *E. atropunctata* with overwintering possibly occurring in the adult stage.

Because of its association with crop plants in the Old World, including sugar beet, Quaintance (1913) listed *E. atropunctata* as an exotic pest that eventually might be introduced to the United States. *Eupteryx mellisae* Curtis, a leafhopper occurring in England on some of the same hosts used by *E. atropunctata* (Douglas, 1879), already had been detected in the U.S. (McAtee, 1919; Leonard and Barber, 1923). Osborn (1929), in calling attention to the ease with which leafhoppers can be imported as eggs concealed in plant material, regarded *E. mellisae* as artificially introduced.

Moore (1950), the first to record *E. atropunctata* from North America, reported it from Isle Jesus, near Montreal, Quebec. Beirne (1956) noted that *E. atropunctata* is "widely distributed in southern Ontario and Quebec," and gave hollyhock (*Althaea rosea* Cav.) as the host plant. Until recently, no further attention was given this introduced species.

During the "High Hazard Pest Survey" conducted by USDA-APHIS, Hoebeke (1980) identified this Palearctic leafhopper from the United States, based on a collection from beans, *Phaseolus vulgaris* L., at Willimantic (Windham Co.), Connecticut, in July 1979. New records have since become available from additional USDA survey work and from our own collecting in New York and Pennsylvania. In this paper we record the known North American distribution and host plants of *E. atropunctata,* summarize our observations on biology and seasonal history at Ithaca, N.Y., and describe and illustrate the adult and fifth-instar nymph.

North American distribution.—In addition to the published records from Ontario and Quebec in Canada and the U.S. record from Connecticut, the following new records of *E. atropunctata* can be given. The Michigan collections are the result of the USDA-APHIS survey; the New York and Pennsylvania records are based on our collecting. The host plants for this leafhopper in New York and Pennsylvania are recorded in Table 1.

MICHIGAN: *Calhoun Co.,* Homer, 12 June 1980, W. A. Martin, on potato. *Eaton Co.,* Eaton Rapids, 10 July 1980, W. A. Martin, on potato; Grand Ledge, 19 June 1980, W. A. Martin, on potato.

NEW YORK: *Cayuga Co.,* Auburn, 26 June 1982, ERH and AGW; near Locke, 11 July 1981, ERH and AGW. *Chemung Co.,* Elmira, 18 July 1981, ERH and AGW; Wellsburg, 27 June 1982, AGW. *Cortland Co.,* Cortland, 11 July 1981, ERH and AGW. *Erie Co.,* Sardinia, 19 May 1981, ERH; Tonawanda, 13–14 June 1981 and 1982, ERH. *Genesee Co.,* Bergen and Le Roy, 31 July 1982, ERH and AGW. *Onondaga Co.,* Elbridge-Camillus Townline and Solvay, 26 June 1982, ERH and AGW. *Seneca Co.,* Hayts Corners, 10 June–8 July 1981, ERH. *Tioga Co.,* near Spencer, 19 July 1981, ERH and AGW. *Tompkins Co.,* Ithaca area and Cornell Univ. campus, 8 June–14 September 1980, and 3 May–24 December 1981, ERH and AGW; Ludlowville, 23 May 1981, ERH; Town of Ulysses, near Jacksonville, 18 October 1981, and May–June 1982, ERH. *Wayne Co.,* Lyons, 31 July 1982, ERH and AGW.

PENNSYLVANIA: *Bedford Co.,* Bedford, 2 July 1981, AGW. *Blair Co.,* Altoona, 14 May 1981, AGW. *Centre Co.,* State College, 19 June 1980, and 17 June–29 October 1981, AGW. *Columbia Co.,* Numidia, 7 July 1982, AGW. *Cumberland Co.,* Carlisle, 14 July 1982, AGW. *Franklin Co.,* near Fannettsburg, 14 July 1982, AGW. *Fulton Co.,* McConnellsburg, 14 July 1982, AGW. *Montour Co.,* near Danville, 10 June 1980, AGW. *Susquehanna Co.,* Great Bend, 30 July 1981, AGW.

Table 1. Host plants of *Eupteryx atropunctata* in New York and Pennsylvania, 1980–82.

Species	Common Name
Malvaceae	
Althaea ficifolia L.	hollyhock
A. rosea L.	hollyhock
Primulaceae	
Primula japonica A. Gray	primrose
Lamiaceae (= Labiatae)	
Agastache foeniculum Pursh (O. Kuntze)	anise hyssop
Ajuga pyramidalis L.	bugleweed
Glechoma hederacea L.	gill-over-the-ground
Lamium maculatum L.	spotted dead nettle
Mentha aquatica L. var. *crispus* (L.) Benth.	water mint
M. spicata L.	spearmint
Monarda didyma L.	bee balm
Nepeta cataria L.	catnip
N. × faasseni Bergmans ex Stearn	catnip
N. grandiflora Bieb.	showy catnip
N. mussinii K. Spreng. ex Henckel	catnip
Ocimum sanctum L.	holy basil
Origanum marjorana L.	sweet marjoram
O. pulchellum (Boiss.) O. Kuntze	marjoram
O. vulgare L.	marjoram
Salvia argentea L.	silver salvia
S. officinalis L.	common sage
S. pratensis L.	meadow clary
S. verticillata L.	lilac sage
S. viridis L. 'Blue Bird'	annual clary sage
S. 'Red Hussar'	
Stachys grandiflora (Willd.) Benth.	betony
Scrophulariaceae	
Verbascum lychnitis L.	white mullein
V. olympicum Boiss.	
Veronica latifolia L. (=*teucrium*)	speedwell
V. longifolia L.	speedwell
V. officinalis L.	common speedwell
Asteraceae (= Compositae)	
Ageratum 'Blue Tango'	
Arctium minus (Hill) Bernh.	common burdock
Inula orientalis Lam.	caucasian inula
Verbenaceae	
Verbena 'Ideal Florist's Mix'	

Seasonal history and host plants.—In June 1980 we discovered a large population of *E. atropunctata* in several herb and flower gardens on the Cornell University campus at Ithaca, N.Y. We made notes on phenology at irregular intervals through September and recorded host plants. In 1981 we made weekly or biweekly collections from early May through December (with the exception of mid-September) to determine a generalized pattern of seasonality. Foliage of *Salvia pra-*

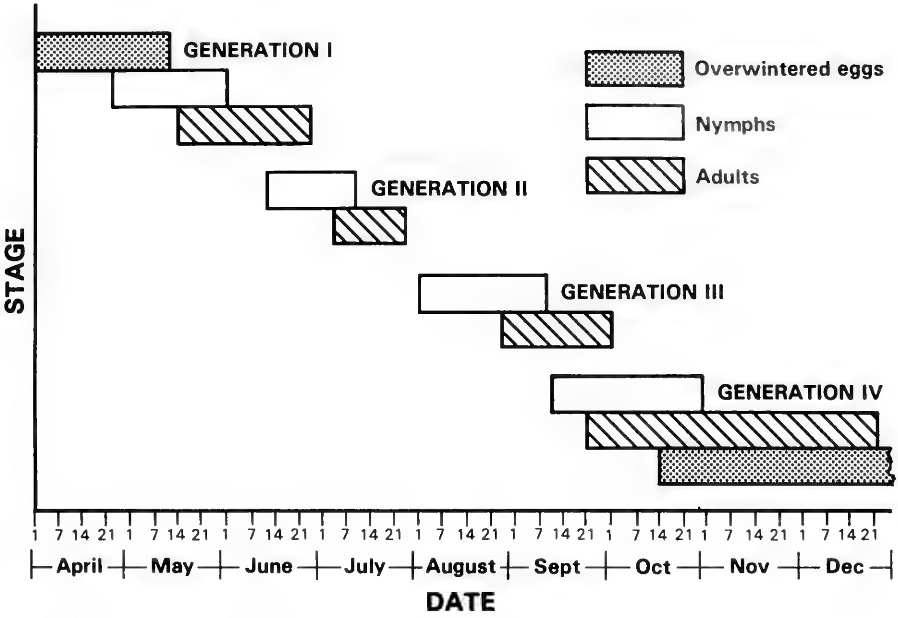
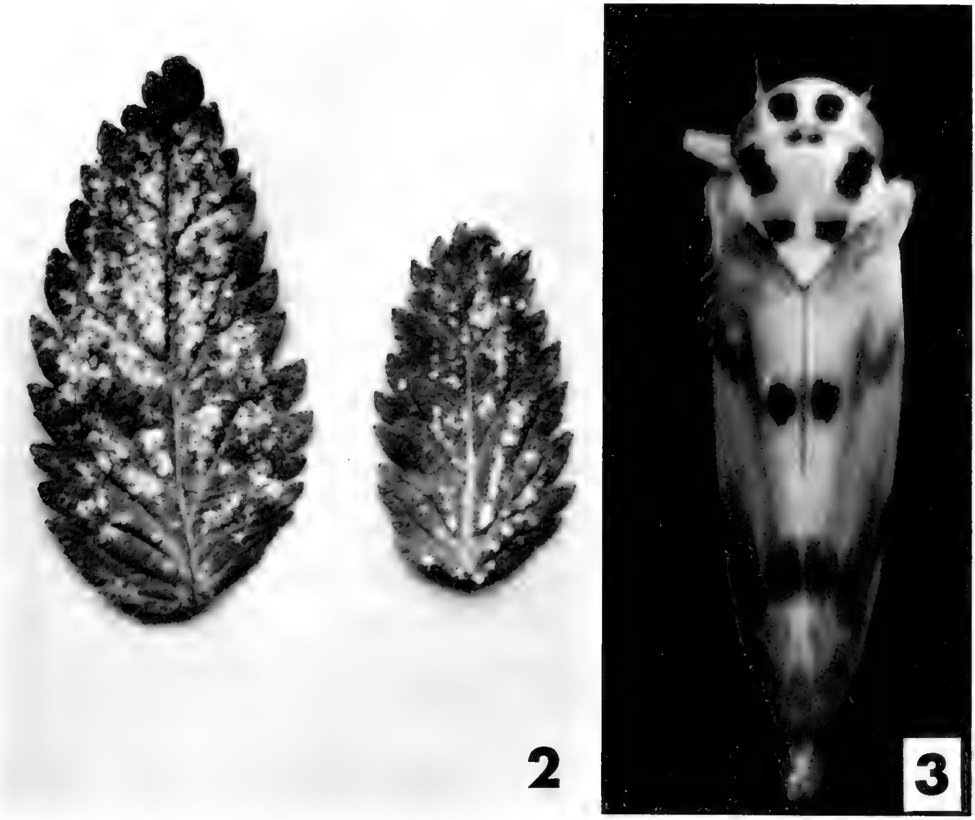


Fig. 1. *Eupteryx atropunctata.* Generalized seasonal history at Ithaca, N.Y., 1980–82.

tensis L. and *Stachys grandiflora* was examined for leafhoppers and the predominant stages present (except eggs) were recorded. Supplemental seasonal history observations were made throughout the season at other New York localities and in Pennsylvania. Early-season collections were made in 1982 to establish the overwintering stage.

On 3 May 1981 we found early instars in the absence of adults and therefore assumed that *E. atropunctata* overwintered in the egg stage as noted by Müller (1957) and Schiemenz (1969) in Europe. Because adults were collected on the undersides of *Salvia* leaves as late as 24 December in 1981, it seemed possible that adults might overwinter in certain years. Gromadzka (1970) suggested that overwintering occurred in the adult stage in Poland. In 1982 we were able to confirm that the eggs overwinter. Egg hatch in the Ithaca area began during late April to early May, and teneral adults of the first generation were found by 18 May in 1981 (see Fig. 1). Adults appeared at this time at nearby sites and at State College, Pa. Early instars of a second brood were first collected in mid-June; adults began to appear by the first week of July. Early instars again were found in early August, indicating the beginning of a third generation. Our collections show that most third brood nymphs develop during mid-August to early September and suggest that the presence of first-instar nymphs in mid-October marked the beginning of a fourth generation. It is also possible that the overlapping of generations, which makes brood delineation more difficult later in the season, obscured a fifth generation. Only four generations, however, are shown in Fig. 1.

In Switzerland, Günthardt and Wanner (1981) noted that *E. atropunctata* is a bivoltine species, and Gromadzka (1970) stated that two generations develop on potato in Poland, although the crop apparently was sampled only from early July



Figs. 2–3. *Eupteryx atropunctata.* 2, Leaf of *Veronica* sp. showing chlorosis produced by mesophyll feeding. 3, Adult habitus, dorsal aspect.

to mid-September. Nowacka and Adamska-Wilczek (1974) found that two generations developed in the field on medicinal plants but that three generations were produced in an insectary. At Ithaca, N.Y., *E. atropunctata* is multivoltine, with at least four generations having been produced in 1981. The duration of the nymphal period as determined in the laboratory by Gromadzka tends to support our seasonal history observations. An incubation period of 9–13 days and a nymphal period of 18 days at 20°C and 21 days at 12.5°C suggest that during mid-summer only a month, or slightly longer, is required for the completion of a generation.

Host plants and damage.—In the herb and flower gardens at Ithaca, various mints appeared to be the preferred hosts (see Table 1), but nymphs also developed on *Althaea* spp., hollyhock (Malvaceae); *Primula japonica,* primrose (Primulaceae); and *Veronica* spp., speedwell (Scrophulariaceae). Along roadsides and in disturbed areas, we found that catnip, *Nepeta cataria,* and burdock, *Arctium minus,* were common hosts. *E. mellisae* often was present with *E. atropunctata* on catnip.

Injury became apparent by early May and was most visible on mints and

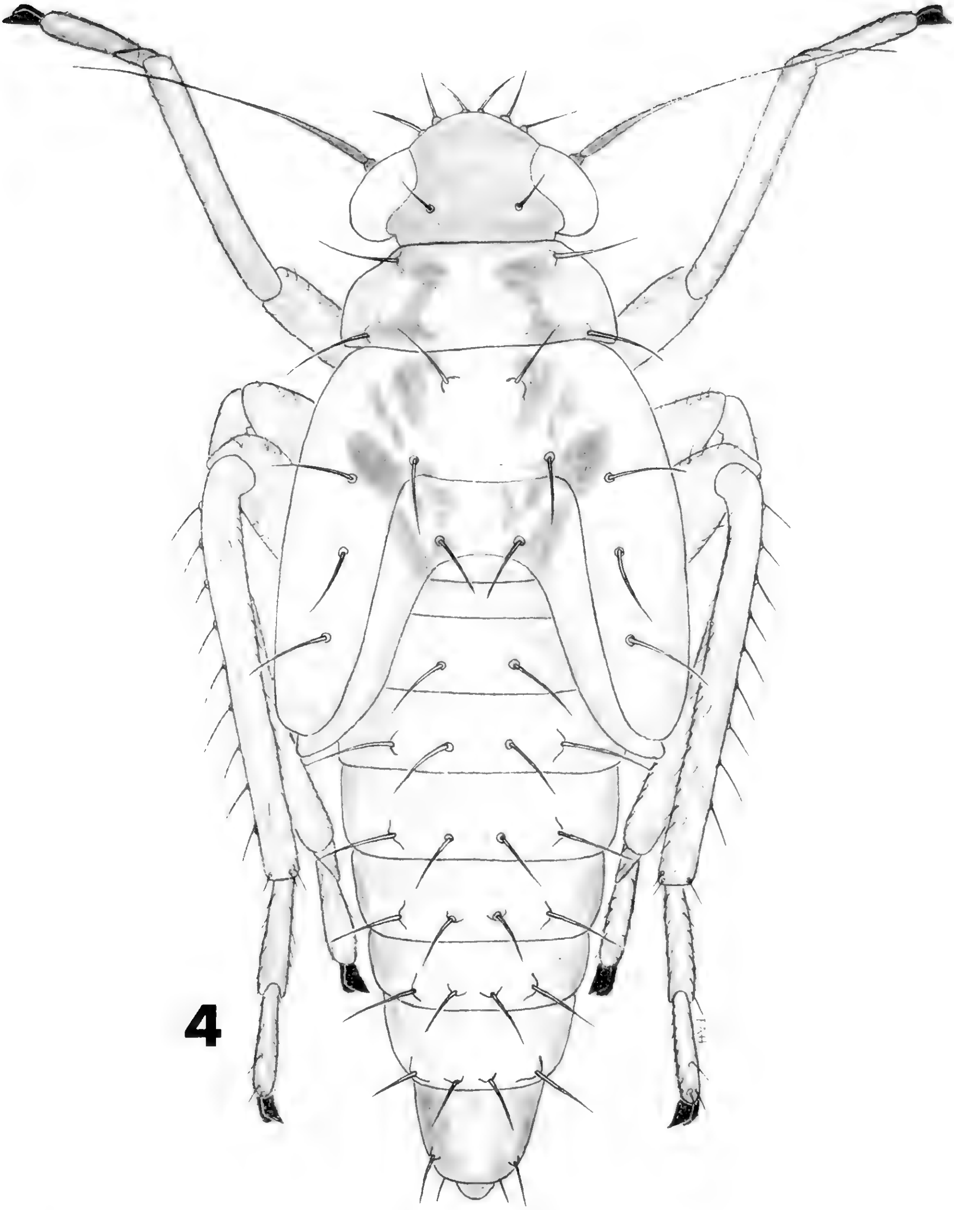


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Fig. 4. *Eupteryx atropunctata.* Fifth-instar nymph, dorsal aspect.

burdock, least so on hollyhock. Nymphs and adults, which usually are observed on the undersides of host foliage, are said to probe the leaf surface and insert their stylets into palisade parenchyma of mesophyll tissue. According to Günthardt and Wanner (1981), they are able to survive only a few hours when confined to stems. These authors also found that *E. atropunctata* avoids strongly pubescent plants, but from our observations they are often found on plants with pubescent foliage. Their sucking, typical of mesophyll-feeding leafhoppers (Smith and Poos, 1931), produces yellowish-white, chlorotic or stippled areas visible only on upper leaf surfaces (Fig. 2). In their comparative study of two typhlocybine leafhoppers developing on broad bean, *Vicia faba* L., Günthardt and Wanner considered the mesophyll-feeding *E. atropunctata* a more specialized feeder than *Empoasca decipiens* Paoli, a stem-parenchyma feeder.

Adult.—The adult of *E. atropunctata* (Fig. 3) is quite distinctive and readily distinguishable among other North American typhlocybine leafhoppers. The following description is drawn predominantly from Ossiannilsson (1981):

Overall length 3.4–3.8 mm. Dorsal coloration whitish yellow, usually with a green tinge. Vertex with 2 large rounded or quadrangular black spots, usually not extending to anterior margin of head. Pronotum usually with 2 pairs of black spots, the anterior-median pair smaller and often confluent, the lateral pair larger, rectangular and widely separated. Scutellum with 2 large black spots, one at each anterior corner. Forewing with 2 prominent black spots, one on middle of clavus and another at costal border. In addition, a more or less distinct oblique black or fuscous streak usually present in subcostal and radial cells. Apex of clavus fuscous; diffuse fuscous longitudinal band in cubital and median cells present or absent. Male genitalia figured in Ossiannilsson (1981).

Description of fifth-instar nymph (in alcohol), Fig. 4.—Length 2.7–3.1 mm ($\bar{x}$ = 2.92, $n = 5$). Color pale greenish or yellowish, with long, erect setae dorsally. Infuscated areas on pronotum, meso- and metanotum producing a variable, yet characteristic pattern (see Fig. 4). *Head:* Length 0.26–0.30 mm, width across eyes 0.70 mm. Two pairs of setae on anterior margin; 1 pair of setae on vertex. *Rostrum:* Length 0.26–0.30 mm, extending to metacoxae. *Antenna* (including basal segments): Length 1.0–1.06 mm; 2 basal segments short, cylindrical; flagellum long and threadlike, thickened at base. *Pronotum:* Length 0.20–0.26 mm, median width 0.60–0.70 mm, lateral-anterior and lateral-posterior angles each with an erect, long seta. *Meso- and metanotum:* Length along median line 0.60–0.70 mm, median width across wing pads 1.0–1.1 mm; forewing pads extending to apex of abdominal segment IV. Mesonotum with 2 pairs of setae: 1 pair near anterior margin, one seta on each side of midline, approximate; 1 pair near posterior margin, one seta on each side of midline, widely separated. Metanotum with 1 pair of setae along posterior margin, one seta on each side of midline. Forewing pads each with 3 long, erect setae, widely separated, arranged nearly linearly as in Fig. 4. *Abdomen:* 10-segmented, broadly tapered to apex. Segments I and II small, devoid of setae. Segment III with 1 pair of setae, one seta on each side of midline. Segments IV–VIII each with 2 pairs of setae, one pair on each side of midline. Segment IX with 1 pair of setae, one seta on each side of midline along lateral margin.

Specimens examined: five fifth-instar nymphs, collected from foliage of catnip, *Nepeta cataria,* at State College (Centre Co.), Pennsylvania, 18 May 1981, by A. G. Wheeler, Jr. Determined by rearing and association with adults. Specimens have been deposited in the collections of Cornell University and the Pennsylvania Department of Agriculture.

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PROC. ENTOMOL. SOC. WASH.
85(3), 1983, pp. 537–542

TWO NEW SPECIES OF *PHERBELLIA* FROM NORTH AMERICA (DIPTERA: SCIOMYZIDAE)

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Abstract.—Two new species, *Pherbellia* ***aloea*** and *P.* ***inflexa***, are described from western North America. Illustrations, photos, and a map of the geographic distribution for the new species are given.

Pherbellia includes more species than any other genus of Sciomyzidae. In North America north of Mexico, *Pherbellia* now includes 39 species, including the two new species described in this paper. Six of these species are known to be holarctic. The genus is known from all zoogeographic regions of the world.

Pherbellia, by comparison to other members of the family Sciomyzidae, are rather small, drab, plain-looking flies. They are not nearly as striking as species of *Limnia, Sepedon,* and *Tetanocera.* As a result they are not as avidly collected nor as well represented in collections, especially those species that closely resemble each other. Although there may be considerable variation among some groups within the genus, many can only be identified by careful dissection of the male (rarely female) terminalia. The extensive biological work of Bratt et al. (1969) has greatly increased the understanding of *Pherbellia.*

Several years prior to my discovery of the following new species, George C. Steyskal recognized them as new and proposed the species names used herein. I here express my thanks to him for allowing me to describe these species.

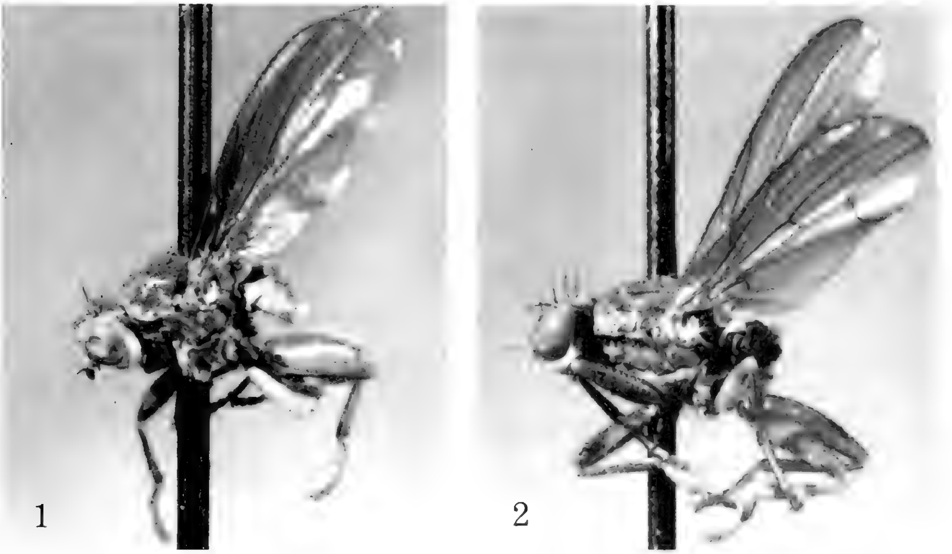
Pherbellia aloea Orth, New Species

Figs. 1, 3, 4, 7

Holotype ♂.—Height of head ⅔ width. Medifacies yellowish, pruinose; facial grooves subshiny; parafacies and cheeks pruinose, yellowish to whitish respectively. Frons testaceous. Midfrontal stripe extending less than ½ distance from anterior ocellus to anterior margin of frons. Ocellar triangle and orbital plates tannish grey, tomentose. Orbital plates tapered anteriorly, extending beyond midfrontal stripe. Orbito-antennal spot lacking; narrow tomentose strip along upper orbital margin. Two pairs of fronto-orbital bristles, anterior pair ⅔ as long as posterior pair; ocellars, postocellars, and inner and outer verticals well developed. Occiput tannish grey tomentose. Short black setae on lower ⅔ of cheeks and parafacies, on anterior ½ of frons, between ocellar and postocellar bristles, along outer parts of orbital plates, and in midcervical patch. Lateral occipital margins with somewhat stronger setae and bristles. Antenna testaceous.

Thorax dorsally grey tomentose with brownish longitudinal stripes.

Pleura tannish grey tomentose. Mesopleuron bare, with upper surface more



Figs. 1, 2. 1, *Pherbellia aloea,* holotype male. 2, *P. inflexa,* holotype male. Abdominal segments excised and retained in genitalia vial on pins beneath specimens. Photos by M. E. Badgley, University of California, Riverside.

brownish. Pteropleuron with cluster of 10 sinistral and 11 dextral bristles of nearly equal size situated mid-anteriorly. Sternopleuron with very fine short setae over central surface, slightly stronger setae along dorsal margin, and well-developed setae or bristles ventrally. Prosternum bare.

Coxae yellowish white tomentose. Forefemur and tibia brownish, infumated; tarsal segments tawny. Mid- and hindlegs tawny, lightly infumated.

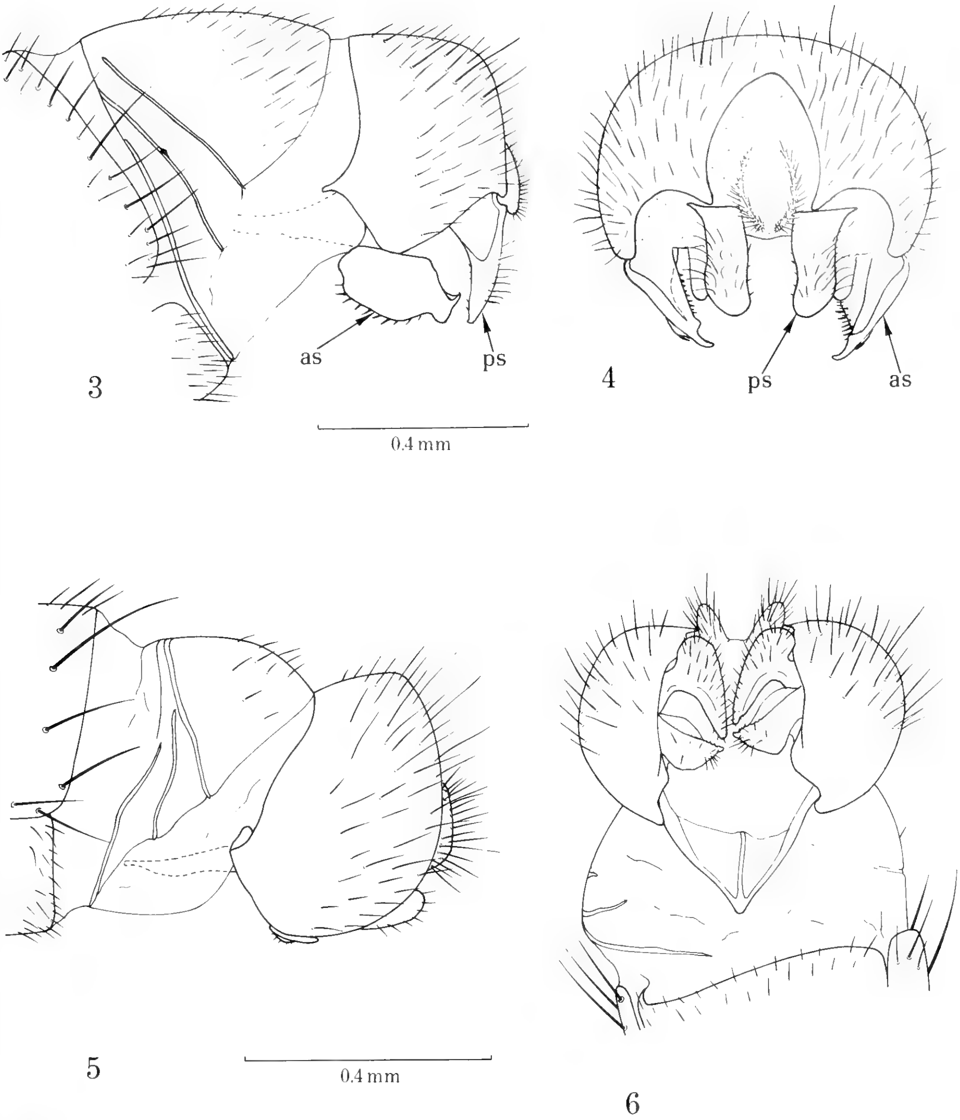
Wing length 4.1 mm. Membrane greyish yellow, hyaline; costal margin and wing veins brownish yellow, area around crossveins not clouded. No stump veins; anterior crossvein slightly oblique, first vein distinctly surpassing level of anterior crossvein; anal vein reaching wing margin. Halter, squama, and squamal ciliae yellowish.

Abdominal segments tawny, slightly infuscated dorsally; andrium testaceous; terminalia as in Figs. 3 and 4.

Female.—Not known.

Holotype.—♂, USA, Washington, Mt. Rainier, Berkeley Park, 23 August 1934, A. L. Melander. Deposited in the National Museum of Natural History, Washington, D.C.

Paratypes.—CANADA. *Alberta:* Banff National Park, 9 July 1955, G. E. Shewell (3 ♂); Banff National Park, Mt. Norquay, elevation 6600 feet, 25 May 1960, J. G. Chillcott (1 ♂). *British Columbia:* Mt. Thornhill nr. Terrace, 21 June 1960, J. G. Chillcott (1 ♂, 3 ♂); same locality, 14 July 1960, 26 July 1960, 8 August 1960, C. H. Mann (1 ♂, 2 ♂, 1 ♂); same locality, 21 June 1960, G. E. Shewell (1 ♂); same locality, 14 July 1960, B. Heming (1 ♂). *Northwest Territories*: Bathurst Inlet, Ekalulia Island, 12 August 1966, G. E. Shewell (1 ♂); Bathurst Inlet, Baychimo Harbor, 2 August 1966, G. E. Shewell (1 ♂). *Yukon:* Otter Lake, 130° 25′ 62° 30′, elevation 4000 feet, 22 July 1960, 29 July 1960, E. W. Rockburne (1 ♂, 1 ♂); same



Figs. 3–6. 3, 4, *Pherbellia aloea,* paratype male, 14 mi E of Glacier R. S., Whatcom Co., Washington, 8–11 August 1974, W. J. Turner. 3, Terminalia, sinistral view. 4, Terminalia, posterior view; as = anterior surstylus; ps = posterior surstylus. 5, 6, *P. inflexa,* paratype male, 4 mi S of Anatone, Asotin Co., Washington, 12–13 June 1974, W. J. Turner. 5, Terminalia, sinistral view. 6, Terminalia, ventral view.

locality, 16 July 1960, J. E. H. Martin (1 ♂). USA. *Alaska:* Anchorage, July 1960, M. R. Wheeler (1 ♂). *Idaho:* Moscow Mt., 4 June 1919, A. L. Melander (1 ♂). *Washington:* Chehalis, 15 March 1911, A. L. Melander (1 ♂); Everett, 19 June 1920, A. L. Melander (1 ♂); Whatcom Co., Silver Fir Campground, 14 mi E of Glacier R. S., North Fork of Nooksack River, elevation 2000 feet, 8–11 August 1974, W. J. Turner (1 ♂). Deposited in Agriculture Canada, Cornell University,

University of California at Riverside, and the National Museum of Natural History.

Variation.—Bristles in the cluster on the pteropleuron vary in number from 6 to 13. Wing length varies from 3.2 to 4.1 mm.

Etymology.—The species name *aloea* was supplied by G. C. Steyskal *in litt.* He stated, "... *aloea* is Latin in form but will not be found in any dictionary. I conceived it as an adjective formed from *aloe,* with reference to denticles on the surstyli resembling those on the leaves of *Aloe* species."

Diagnosis.—See diagnosis under *Pherbellia inflexa.*

Pherbellia inflexa **Orth, New Species**

Figs. 2, 5–7

Holotype ♂.—Height of head ⅔ width. Medifacies whitish, pruinose; facial grooves subshiny; parafacies and cheeks tomentose, yellowish to whitish respectively. Frons testaceous, lighter anteriorly. Midfrontal stripe extending approximately ½ distance from anterior ocellus to anterior margin of frons. Ocellar triangle and orbital plates tannish grey tomentose. Orbital plates tapered anteriorly, extending beyond midfrontal stripe. Orbito-antennal spot lacking; narrow strip of whitish tomentum along upper orbital margin. Two pairs of fronto-orbital bristles, anterior pair ⅔ as long as posterior pair; ocellars, postocellars, and inner and outer verticals well developed. Occiput tannish grey tomentose. Short black setae on lower ⅔ of cheeks and parafacies, on anterior ½ of frons, between ocellar and postocellar bristles, along outer parts of orbital plates, and in midcervical patch. Lateral occipital margins with stronger setae and bristles. Antenna testaceous, segment 3 elongate oval. Arista blackish, without hairs. Palpi yellowish, labium and labella testaceous.

Thorax dorsally grey tomentose, with brownish longitudinal stripes.

Pleura tannish grey tomentose. Mesopleuron bare, with upper surface brownish. Pteropleuron with cluster of 6 sinistral and 7 dextral bristles of nearly equal size, situated mid-anteriorly. Sternopleuron with fine short setae or bristles over central surface, stronger bristles along dorsal margin and well-developed bristles ventrally. Prosternum bare.

Coxae yellowish white tomentose. Forefemur and tibia brownish, infumated; tarsal segments tawny, first segment lightest. Mid- and hindlegs tawny, lightly infumated.

Wing length 3.9 mm. Membrane greyish yellow, hyaline; costal margin and wing veins brownish yellow, area around crossveins lightly clouded. No stump veins; anterior crossvein slightly oblique, first vein distinctly surpassing level of anterior crossvein; anal vein reaching wing margin. Halter, squama, and squamal ciliae yellowish.

Abdominal segments brownish, infuscated dorsally; andrium testaceous; terminalia as in Figs. 5 and 6.

Female.—Not known.

Holotype.—♂, Canada, British Columbia, Robson, 6 April 1947, H. R. Foxlee. Deposited in the National Museum of Natural History.

Paratypes.—All USA. *California:* Yosemite, elevation 3880–4000 feet, 19 May 1938, K. D. Snyder (1 ♂). *Colorado:* Nederland, Science Lodge, elevation 9500 feet, 3 July 1961, C. H. Mann (1 ♂). *Idaho:* Moscow Mt., 28 August 1916, 26

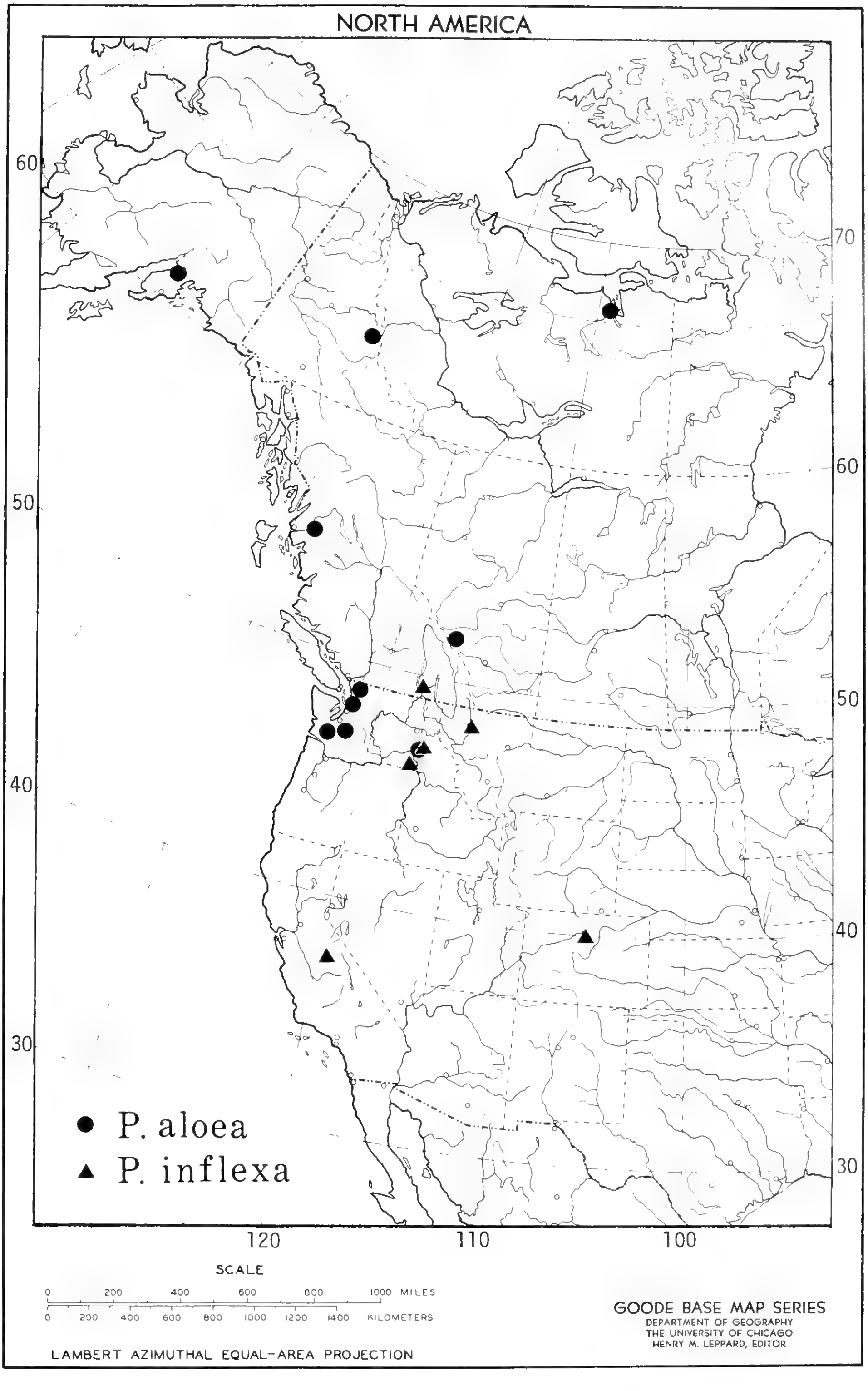


Fig. 7. Collection sites for *Pherbellia aloea* and *P. inflexa.*

June 1920, A. L. Melander (1 ♂, 1 ♂). *Montana:* 15 mi S of Big Fork, 17 August 1965, B. A. Foote (1 ♂). *Washington:* Asotin Co., 4 mi S of Anatone, elevation 3500–4000 feet, 12–13 June 1974, W. J. Turner (1 ♂); same locality, 30 April 1977, R. S. Zack (1 ♂). Deposited in Agriculture Canada, Cornell University, University of California at Riverside, and the National Museum of Natural History.

Variation.—Bristles in the cluster on the pteropleuron vary in number from 5 to 7. Wing length varies from 3.3 to 4.4 mm.

Etymology.—The species name *inflexa* was supplied by G. C. Steyskal *in litt.* He stated, "... *inflexa* is the feminine form of the Latin past participle *inflexus* and means 'bent inward,' with reference to the position of the surstyli."

Diagnosis.—The external morphology of *Pherbellia aloea* and *P. inflexa* is very similar. Only the following two external characters appear to separate the two species: 1) The wing membrane bordering the anterior and posterior crossveins of *P. inflexa* appears clouded while in *P. aloea* it is clear, and 2) the setae and bristles on the mesopleura and pteropleura of *P. inflexa* are heavier than those of *P. aloea.* Coloration of the two species is very similar. Color variation within and between these two species prevents valid separation by such characters. However, dissection of the male terminalia reveals that *P. aloea* and *P. inflexa* (Figs. 3–6) are distinct. Further, the terminalia of the two species do not resemble those of any other species of *Pherbellia.* For comparison of terminalia with other species of *Pherbellia* see: Steyskal (1961), Rozkošný (1966), Orth et al. (1980).

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A NEW GENUS OF MYMARIDAE (HYMENOPTERA: CHALCIDOIDEA) FROM THE NEW WORLD[1]

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Abstract.—***Omyomymar*** Schauff, new genus, is described and illustrated from material collected in North and South America. *Omyomymar silvanum* (Ogloblin), n. comb., type of the genus, is redescribed and a lectotype designated. Three additional species, (*O.* ***grisselli***, n. sp., *O.* ***alar***, n.sp., and *O. clavatum* (Ogloblin), n. comb.) are treated, and a key is presented.

Although the purpose of this paper is to describe a new genus, some of the included species have been the subject of previous taxonomic work. Girault (1913) described the genus *Paranaphoidea* for two species collected in Queensland, Australia. During the next 24 years he added several additional species, all from Australia (Girault, 1914, 1915, 1920, 1923, 1925a, 1925b, 1938), bringing the total to ten species plus one subspecies. In 1935 Ogloblin described two species from South America (*silvana* and *clavata*) and placed them in *Paranaphoidea.* He gave no reasons as to why he thought they were members of *Paranaphoidea.* Annecke and Doutt (1961), who had seen no specimens of *Paranaphoidea,* commented that Ogloblin was the only worker other than Girault to recognize the genus and noted that it might prove to be no more than a subgenus of *Patasson* Walker (now considered a synonym of *Anaphes* Haliday). Finally, Doutt (1973) examined the types of *Paranaphoidea* and concluded that the genus was quite distinct from *Patasson.* He also stated that Ogloblin's species were not congeneric with Girault's species of *Paranaphoidea* but did not go further. I have recently examined the types of several of Girault's species of *Paranaphoidea* (*P. egregia* (type of genus), *P. caudata, P. nigriclava, P. ponderosa,* and *P. intermedia*) and concur with Doutt's statements.

During 1979 and 1980 I collected a number of specimens from North America which I believed to be congeneric with the species described by Ogloblin as *Paranaphoidea.* After examining the types of these species, I have concluded that Ogloblin's species and the specimens I have taken represent an undescribed genus. I take this opportunity to describe the genus and differentiate it from *Paranaphoidea* and related genera.

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Measurements and ratios were made on cleared and slide mounted specimens at 100× and 160× with a compound microscope and eyepiece reticle. All measurements are in microns unless specified otherwise. In general, terminology for morphological features is that of Debauche (1948) and Eady (1968). Funicle segments, wings, etc. were measured flat and in their longest dimension. The length of the thorax and abdomen were measured dorsally along the midline. Measurements of ovipositor length refer only to that part past the tip of the abdomen. The abbreviation LMC stands for the longest marginal cilia of the forewing and F for funicle segment (e.g., F4 is the fourth segment on the funicle). Means and standard deviations were calculated from a sample of ten individuals unless specified otherwise.

***Omyomymar* Schauff, NEW GENUS**

Type-species.—*Paranaphoidea silvana* Ogloblin, 1935.

Female.—Head slightly wider than thorax; antenna 10-segmented, scape longitudinally striate, slightly swollen medially; club 2-segmented, basal segment with 1 sensory ridge, apical segment with 5 sensory ridges, apically and ventrally produced into a digit (Fig. 3); toruli placed in middle of face, separated by ca. 3× their diameter; median, frontal, and supraorbital carinae unbroken; postfrontal suture present; vertex wider than long; ocelli in an equilateral triangle, width equal to ⅓ POL; compound eyes well developed, with many ommatidia; facial grooves originating at ventromedial edge of toruli, converging to edges of oral cavity (Fig. 11); mandibles reduced, generally not overlapping, bidentate or weakly tridentate; scutum, anterior scutellum, lateral propodeum reticulate, postscutellum alutaceous (Fig. 12); pronotum reduced to a small band, barely visible when viewed dorsally, spiracle at posterolateral margin, sessile; prosternum as long as wide, divided medially, mesosternum with a group of small teeth between forecoxae, median lobe with single pair setae, side lobes each with single seta; notauli a thin groove, similar throughout; scutellum divided transversely into anterior and posterior sections, anterior section with paired placoid sensilla removed ca. 2 diameters from anterior edge, separated ca. 3 diameters, pair of setae posterolaterally near margin of axillae, axillae not advanced into side lobes of scutum; posterior section divided medially by a sulcus (Fig. 12); metanotum expanded medially, not projecting over propodeum; propodeum divided by a longitudinal suture, single seta placed posterior to each spiracle; phragma reaching to hindcoxae or slightly beyond; forewing (Fig. 5) with LMC greater than wing width, hypochaeta near proximal macrochaeta, submarginal vein ca. 6–8× as long as wide; marginal vein (Fig. 10) about as long as wide, radial vein about 2× as long as wide, proximal and distal sensillae separated, membrane with 2 longitudinal lines of setae on basal ½ past venation, setae scattered over apical ½; hindwing about as long as forewing, membrane parallel sided, with few discal setae; tarsi 4-segmented, subequal, hindcoxae with a group of small teeth on inner surface, foretibia with few scattered sensilla basiconica; foretibial spur bifurcate; abdomen broadly attached to thorax, anterior ⅓ to ½ lightly sclerotized, becoming darker posteriorly, posterodorsal surface imbricate with some imbrications produced as small denticles; spiracle absent; cerci semicircular, each with 4 setae; ovipositor originating in anterior ⅓ of gaster, exserted posteriorly beyond apex.

Male.—Generally similar to the female except the following: antenna 13-segmented, scape with few to many conical sensilla basiconica (Fig. 7), all funicles with sensory ridges, terminal segment arising directly from segment 12, intersegmental membrane absent (Fig. 8); mandibles well developed, tridentate, overlapping; pronotum visible dorsally, about ⅓ as long as wide, spiracular opening enlarged, elliptic; genitalia as in Fig. 9.

Diagnosis.—Tarsi 4-segmented, female antenna 10-segmented, funicle 6-segmented, club 2-segmented, the apical segment produced into a digit (as Fig. 3); male scape with several conical sensilla basiconica (Fig. 7); posterior scutellum divided medially by a longitudinal sulcus (Fig. 12); propodeum divided medially, phragma projecting to hindcoxae or beyond; gaster broadly attached to thorax, lightly sclerotized anteriorly, darkening posteriorly; ovipositor exserted past tip of abdomen.

Species of *Omyomymar* are most easily confused with, and most closely related to, members of *Anagrus* and *Stethynium*. These genera also have the gaster broadly attached to the thorax and the posterior scutellum divided by a longitudinal sulcus as in *Omyomymar*. However, in *Anagrus* and *Stethynium* the female mandibles are well developed and overlapping (small and not overlapping in *Omyomymar*) and the ovipositor is rarely exserted past the tip of the abdomen (always exserted in *Omyomymar*). *Anagrus* also differs in having a single-segmented antennal club with no apical digit, the axillae are thrust forward into the side lobes of the scutum (axillae end on line with posterior edge of scutum in *Omyomymar*), and the hypochaeta arises at the base of the submarginal vein, anterior of the macrochaetae (hypochaeta between proximal and distal macrochaetae in *Omyomymar*). In addition, males of *Anagrus* lack the conical sensillae on the scape found in *Omyomymar*.

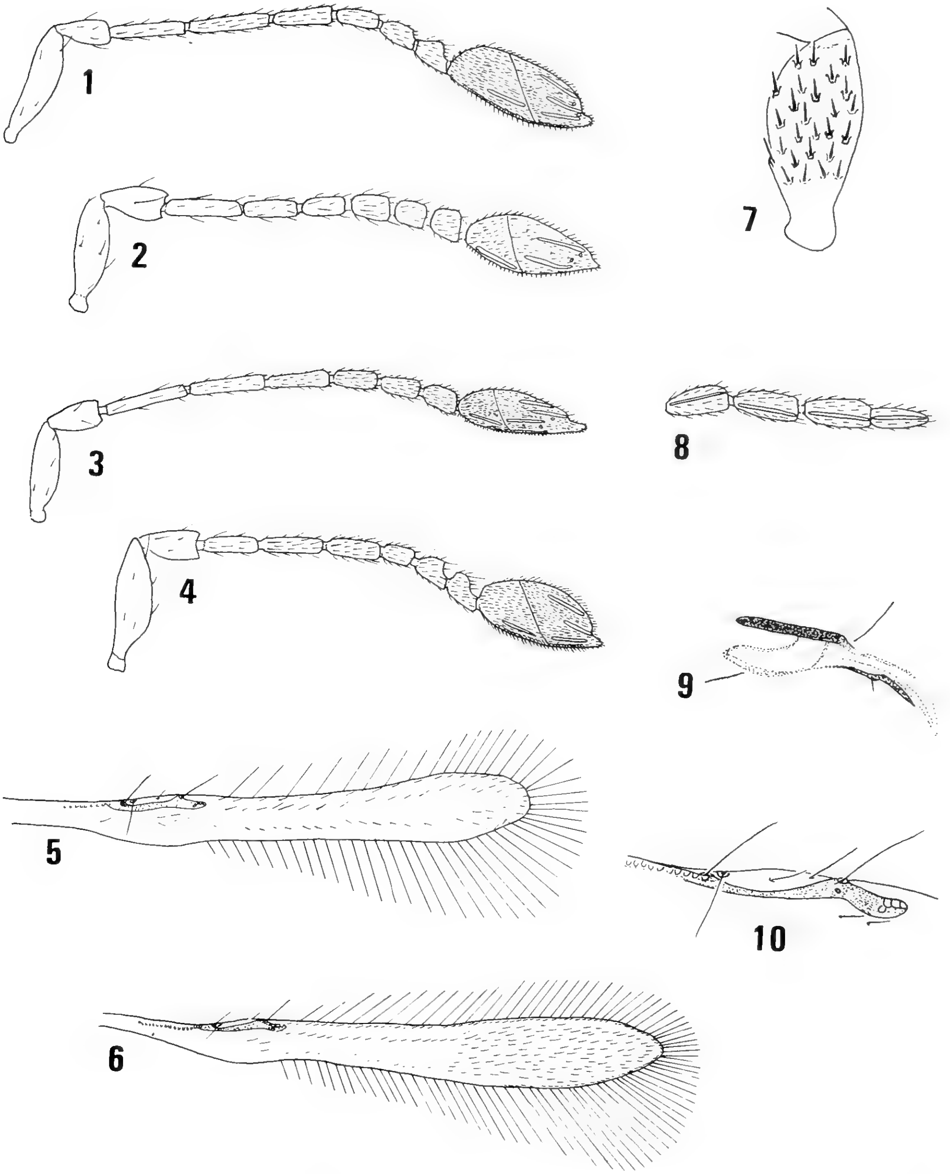
Females of *Stethynium* have a 3-segmented club with no apical digit and the forewings are only 2–3× as long as wide (forewings at least 5× as long as wide in *Omyomymar*). As in *Anagrus,* males of *Stethynium* lack the conical sensillae on the scape. Both sexes of *Anagrus* and *Stethynium* have the dorsal thorax covered by light alutaceous or occasionally coriaceous sculpturing (dorsal thorax reticulate, except for postscutellum, in *Omyomymar* (Fig. 12)).

Most of the available specimens of *Paranaphoidea* are very poorly preserved. Nevertheless, several differences are apparent between species of this genus and *Omyomymar. Paranaphoidea* differs in having the tip of the forewing truncate (wing tip rounded in *Omyomymar*), LMC less than wing width (greater than wing width in *Omyomymar*), the hindwing broadening past the venation (hindwing parallel-sided in *Omyomymar*), and the tip of the female antennal club rounded (produced into a digit in *Omyomymar*).

Etymology.—*Omyomymar* from Greek mymar to blame or ridicule, gender neuter. The prefix omyo is an euphonious arbitrary combination of letters.

KEY TO FEMALES OF *OMYOMYMAR*

1. F6 wider than long (Fig. 2), F5 quadrate; ovipositor exserted just beyond tip of abdomen; apical club digit wider than long; apical ½ of forewing with few scattered setae (Fig. 5) . . . . *alar,* new species
– F6 longer than wide (Fig. 3), F5 longer than wide; ovipositor exserted at least ½ length of abdomen; apical club digit equal to, or longer than, wide; apical ½ of forewing with many evenly scattered setae (Fig. 6) 2
2. Dorsal margin of F6 excised (Fig. 4); club only about 2× as long as wide, apical digit as long as wide 3



Figs. 1–10. 1–4, Female antennae. 1, *O. grisselli.* 2, *O. alar.* 3, *O. silvanum.* 4, *O. clavatum.* 5, 6, Forewings. 5, *O. alar.* 6, *O. grisselli.* 7–10, *Omyomymar* spp. 7, Male scape (lateral view). 8, Male antenna (lateral view). 9, Male genitalia (lateral view). 10, Forewing venation.

– Dorsal margin of F6 straight (Fig. 3); club 3× as long as wide, apical digit 2× as long as wide .... *silvanum* (Ogloblin)

3. F1 4× as long as wide (Fig. 4); ovipositor exserted less than length of abdomen; body length about 0.7 mm .... *clavatum* (Ogloblin)

– F1 6× as long as wide (Fig. 1); ovipositor exserted length of abdomen or more; body length 1.0–1.1 mm .... *grisselli,* new species

Omyomymar silvanum **(Ogloblin), NEW COMBINATION**

Fig. 3

Paranaphoidea silvana Ogloblin, 1935: 149.

Lectotype female.—Length excluding ovipositor 0.76 mm (0.71 ± 0.07). Head, funicle segments, club, thorax, distal ⅔ of abdomen except tip light brown; scape, pedicle, legs, basal ⅓ and tip of abdomen light yellow; compound eyes and area adjacent to ocelli red; frons alutaceous, vertex imbricate, genae and area laterad of foramen strigulate, imbricate near postfrontal suture; POL 46, OOL 15; antennal ratio beginning with scape 83:43:65:55:49:37:34:31:108 (club width 31), dorsal margin of funicle segments straight, basal segment of club slightly smaller than apical segment, apical digit about 2× as long as wide (Fig. 3); thorax length 264 (240 ± 9), alutaceous ventrally, phragma rounded posteriorly, indented medially, reaching just past hindcoxal foramen; propodeal spiracle set in a shallow depression, seta removed ca. 1× own length; forewing length 681 (615 ± 27), width 82 (82 ± 4), LMC 139 (143 ± 6), setae evenly scattered over apical ½ of membrane; hindwing length 624 (581 ± 23); forecoxa alutaceous, mid- and hindcoxae smooth or faintly striate; ratio femur:tibia:tarsus as follows: foreleg 107:138:178; midleg 122:221:178; hindleg 138:291:190; abdomen ovate elliptic, length 384 (384 ± 39); ovipositor exserted 264 (180 ± 34).

Types.—**Lectotype** ♀, by present designation, on slide with data: Loreto Mision, 10-iii-1933, A. Ogloblin. Paralectotypes: 2 ♀, Loreto Misiones 18-ix-1933 and 8-x-1933, A. Ogloblin; 1 ♀ Puerto Aquirre Misiones, 19-iv-1933, A. Ogloblin. Deposited in Facultad de Ciencias Naturales y Museo, Universidad Nacional de La Plata, La Plata, Argentina.

Other specimens examined.—1 ♀, Venezuela, Lara, Parque Nac Yacumba, 7-iv-1981, E. E. Grissell. 14 ♀, 3 ♂, Maryland, Prince Georges Co., Laurel, Patuxent Wildlife Research Center, June 1979 and June–Sept. 1980, M. E. Schauff, Malaise Trap. 3 ♀ and 1 ♂, Maryland, Prince Georges Co., Beltsville, Beltsville Agric. Res. Center, June 1980, K. Thorpe, Malaise Trap (all in USNM). 1 ♀, Ontario, Canada, 16-7-1975. E. Sigler (CNC).

Variation.—Quantitative estimates of variation are given in the species description. The phragma may end just beyond the hindcoxal insertion or extend slightly farther back so that it pushes against the dorsal abdominal surface giving the impression that it projects slightly into the abdominal cavity. Scrobal depressions are quite evident in some specimens but not in others. It is unclear at this time if the apparent lack of scrobes in some specimens is due to changes that occur during mounting or if they are truly lacking. A single male collected at Beltsville has only 4 conical sensilla on the surface of the scape (other males have ca. 30 sensilla on each scape).

Discussion.—This species may be distinguished from other species by the following: Dorsal margin of F5 and 6 straight (margin excised in *clavatum* and *grisselli*); club 3× as long as wide (2× as long as wide in *clavatum* and *grisselli*); F6 longer than wide (wider than long in *alar*); and ovipositor exserted at least half the length of the abdomen (ovipositor exserted just past tip in *alar*).

Ogloblin described *silvanum* from four specimens and failed to designate a holotype. Therefore I have designated the most complete and best preserved specimen of the series as the lectotype.

Omyomymar grisselli **Schauff, New Species**

Figs. 1, 6

Holotype female.—Length excluding ovipositor 1.10 mm. Head, funicle segments, club, thorax, distal ⅔ abdomen except tip dark brown; scape, pedicle light brown; legs, basal ⅓ abdomen light brown to yellow; tip of abdomen white; frons alutaceous above toruli, sculpturing becoming lighter below toruli and lateral of facial grooves, fading to smooth between facial grooves, vertex imbricate, genae and area laterad of foramen strigulate; POL 55, OOL 15; scrobes indicated only by a slight groove; antennal ratio beginning with scape 113:55:80:83:61:43:43:43:140 (club width 63); F5 and 6 excised dorsally (Fig. 1), club segments subequal, digit longer than wide; thorax length 310, sculpture fading from reticulate to smooth over median propodeum, lightly alutaceous ventrally; phragma indented medially, reaching beyond hindcoxae; propodeal spiracle set in shallow depression, seta removed ca. 3× own length; forewing (Fig. 6) length:width:LMC 912:110:168, setae evenly scattered over apical ½ of membrane; hindwing length 840; fore- and midcoxae alutaceous, hindcoxa reticulate basally; ratio femur:tibia:tarsus as follows: foreleg 153:187:216; midleg 168:288:240; hindleg 182:408:264; abdomen elongate elliptic, length 576, ovipositor exserted 576.

Allotype.—Similar to female except for following: length 0.90 mm; antennal ratio beginning with scape 77:46:55:61:58:49:46:46:46:43:46:46:43.

Types.—Holotype ♀; on slide with data: Maryland, Prince Georges Co., Laurel, Patuxent Wildlife Research Center, 29 Aug.–8 Sept. 1980. M. Schauff, Malaise trap in old field. Deposited in the National Museum of Natural History, type no. 100573. Allotype ♂, same data as above except collected 10–18 July. Paratype ♀ on slide with data: Michigan, E. Lansing, 20-ix-1965. B. D. Burks. Allotype and paratype deposited in USNM.

Variation.—Very little variation was observed in the specimens available for study. The female paratype is slightly smaller (1.0 mm) and more uniformly brown colored with the base of the abdomen remaining light brown and becoming almost black posteriorly. The median indentation of the phragma is less pronounced in the male than in the females.

Discussion.—Specimens of *grisselli* are most easily confused with *clavatum* which shares the excised dorsal margin of F6 (Fig. 4) (*silvanum* and *alar* have the dorsal margin of F6 straight (Figs. 2, 3)). Specimens of *clavatum* differ in having F1 4× as long as wide (6× as long as wide in *grisselli*), and the ovipositor exserted less than the length of the abdomen (exserted the length of the abdomen or more in *grisselli*).

Etymology.—This species is named in honor of Dr. E. E. Grissell.

Omyomymar alar **Schauff, New Species**

Figs. 2, 5

Holotype female.—Length excluding ovipositor 0.59 mm (0.55 ± 0.047). Head, funicle segments, club, thorax, distal ½ of abdomen except tip light brown; scape, pedicel, legs, basal ½ of abdomen light yellow; frons lightly alutaceous, vertex imbricate, genae and area around foramen imbricate; POL 38, OOL 13; antennal ratio beginning with scape 77:46:52:38:31:28:25:25:92 (club width 37), dorsal margin of all funicles straight, basal segment of club ca. ½ size of apical segment, apical digit wider than long (Fig. 2); thorax length 230 (221 ± 21.9); phragma rounded posteriorly, not indented medially, reaching just beyond hindcoxae; propodeal spiracle flush with surface, seta removed ca. 1.5× own length; forewing (Fig. 5) length 470 (477 ± 15): width 62 (60 ± 2): LMC 99 (102 ± 3), apical ½ of wing with bare spots medially; hindwing length 450 (449 ± 17); coxa alutaceous, ratio femur:tibia:tarsus as follows: foreleg 96:114:129, midleg 95:163:123, hindleg 98:187:138; abdomen ovate elliptic, length 291 (274 ± 33); ovipositor exserted 71 (71 ± 12).

Allotype.—Similar to female except the following: length 0.61mm; antennal ratio beginning with scape 50:34:35:28:30:26:28:27:27:27:26:30:27.

Types.—Holotype ♀ on slide with data: Maryland, Prince Georges Co., Laurel, Patuxent Wildlife Research Center, 25 July–6 Aug. 1980. M. Schauff, Malaise trap in old field. Deposited in the National Museum of Natural History, type no. 100574. Allotype and paratypes as follows: 2 ♂ and 6 ♀ same data as holotype; 3 ♂ and 3 ♀ same data except collected 6–15 Aug.; 1 ♂ and 1 ♀ collected 29 Aug.–8 Sept. Allotype in USNM, paratypes deposited in the USNM and British Museum (Natural History).

Variation.—Quantitative estimates of variation are given in the species description. The posterior scutellar sulcus occasionally fades anteriorly and was very faint in one specimen. There is minor variation in the setal pattern of the forewing with a few setae occasionally found in the region between the two lines. In some specimens, the phragma appears to penetrate the abdominal cavity, while in others, the phragma-propodeum complex seems to push back the anterior margin of the abdomen. Scrobal depressions are evident in some specimens, but are apparently lacking in others. One male specimen had the first and second funicle of one antenna partially fused, and the coxal teeth were absent. Another male had a reduced number of conical sensillae on the scape (12 instead of the average of about 30).

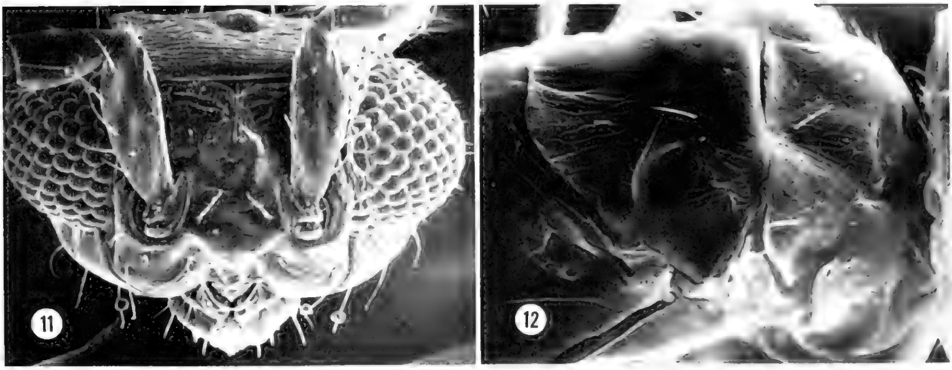
Discussion.—This species may be distinguished by the following: F5 quadrate, 6 wider than long (5 and 6 longer than wide in other species); ovipositor exserted just past tip of abdomen (ovipositor exserted at least half length of abdomen in other species); and club digit reduced and wider than long (digit longer than wide in other species).

Etymology.—The species epithet is an euphonious arbitrary combination of letters.

***Omyomymar clavatum* (Ogloblin), NEW COMBINATION**
Fig. 4

Paranaphoidea clavata Ogloblin, 1935: 152.

Holotype female.—Length excluding ovipositor 0.67 mm. Head, funicle segments, club, thorax, distal ½ of abdomen except tip light brown; scape, pedicel, legs, basal ½ of abdomen yellow; compound eyes and area adjacent to each ocellus red; vertex imbricate; antennal ratio beginning with scape 61:49:58:58:49:34:31:31:135 (club width 59); dorsal margin of funicles 5 and 6 excised (Fig. 4), club segments subequal, apical digit longer than wide; thorax length 276, phragma rounded posteriorly, indented medially, reaching past hindcoxae, propodeal spiracle flush with surface, seta removed ca. 3× own length; forewing length 734,



Figs. 11, 12. Scanning electron micrographs of *Omyomymar* spp. 11, Head (facial view). 12, Thorax (dorsal view).

width 86, setae evenly scattered over distal ⅓ of membrane; hindwing length 638; ratio femur:tibia:tarsus as follows: foreleg—:129:168; midleg—:236:184; hindleg—:288:199; abdomen elongate elliptic, length 360; ovipositor exserted 322.

Types.—Holotype ♀ on slide with data: Loreto, Misiones, 4-x-1933. A. Ogloblin. Deposited in Facultad de Ciencias Naturales y Museo, Universidad Nacional de La Plata, La Plata, Argentina.

Other specimens examined.—2 ♀, 1 ♂, Porto Lavaca, Texas, iv-7-1938, H. J. Crawford, on Compositae (USNM). 7 ♀, Trinidad, Curepe, St. Mary Rd., 10–24-iii-1974, F. D. Bennett, yellow pan trap (CNC).

Discussion.—This species can be distinguished by the following: F5 and 6 with dorsal margin excised (dorsal margin straight in *alar* and *silvanum*); F1 4× as long as wide (F1 6× as long as wide in *grisselli*); ovipositor exserted less than length of abdomen (exserted length of abdomen or more in *grisselli*).

This species was described from a single female which is mounted on a slide in balsam. This specimen is poorly cleared and one forewing and parts of some of the legs are missing. None of the femora were positioned so that they could be measured. Most of the remaining marginal cilia are broken or missing and the head is partially collapsed. As a result, the description given above is incomplete.

ACKNOWLEDGMENTS

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A NEW GENUS AND SPECIES OF GEOMETRIDAE (LEPIDOPTERA) FROM BIG BEND NATIONAL PARK, TEXAS

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Abstract.—A new genus, ***Astalotesia***, is described by D. C. Ferguson, and a new species, *A.* ***bucurvata***, is described by A. Blanchard and E. Knudson. It belongs in the tribe Melanolophiini Forbes. The male and female imagines, genitalia, and male wing venation are figured.

While collecting with UV light trap at Big Bend National Park, Texas, in March 1982, E. C. Knudson took a small series of an unfamiliar geometrid, which was later matched to a single specimen in A. Blanchard's collection, taken 11 years previously at the same locality. Upon dissection, the moth proved to belong to the tribe Melanolophiini Forbes. However, it possessed an unusual combination of characters that did not allow placement in any existing genus. Assignment of the new genus to the Melanolophiini was based on a comprehensive assessment of adult characters. The paired, comblike structure on the anterior margin of the eighth sternite of the male and the wide, flat, modified scales associated with it (but arising from the posterior margin of the seventh sternite) (Fig. 5), together with the unscaled branches of the bipectinate male antenna, almost always serve to distinguish moths of this tribe.

Of nine genera examined, the posterior abdominal comb is lacking only in *Vinemina* McDunnough, and is vestigial in *Carphoides* McDunnough. These two genera have also lost the modified scales, of which usually two to four pairs are present in other genera. Most melanolophiine genera also have two other secondary sexual characters on the male abdomen. These consist of a ventral, transverse row of spines or bristles, also comblike, near the middle of the third segment, and a ventrolateral pair of tufts of long hairlike scales that appear to arise from the intersegmental membrane between segments three and four. These hairy tufts resemble coremata, but do not seem to be extensile to any great degree. These anterior ventral structures of the male abdomen may be present or absent in Melanolophiini, even sometimes between species of the same genus, and both happen to be absent in *Astalotesia.* The ventral comb of the third segment also occurs in some Boarmiini, which the Melanolophiini most closely resemble, but the tufts that resemble coremata, when present, are unique to the Melanolophiini, as far as we know.

Although placement of the new genus *Astalotesia* in the tribe Melanolophiini was not difficult, determining its relationship to other genera within the tribe did present some problems. Every effort to assign the species to a previously recognized genus failed because its particular combination of characters would fit none of them. It appears related to the group consisting of *Melanolophia* Hulst, *Pherotesia* Schaus, and *Melanotesia* Rindge. In general appearance it could be a species of *Melanolophia,* but has different, symmetrical male genitalia and more simplified female genitalia, lacks the anterior ventral comb and hairy tufts of the male abdomen, has veins R_1 and R_2 arising separately, not stalked, and vein Sc of the hindwing unbranched. Structurally, it comes closest to *Melanotesia* of western South America, having a similar juxta (Fig. 4a) (otherwise unique), and similar venation, but again differs in the lack of the anterior ventral structures of the male abdomen. Also, in wing color and pattern, it is not at all like the contrastingly marked *Melanotesia.* Thus the present genus differs as much or more from these and all other known genera as they do from one another. Recognition of other melanolophiine genera for purposes of comparison was greatly simplified by F. H. Rindge's revisionary studies, especially that of 1964.

Astalotesia **Ferguson, New Genus**

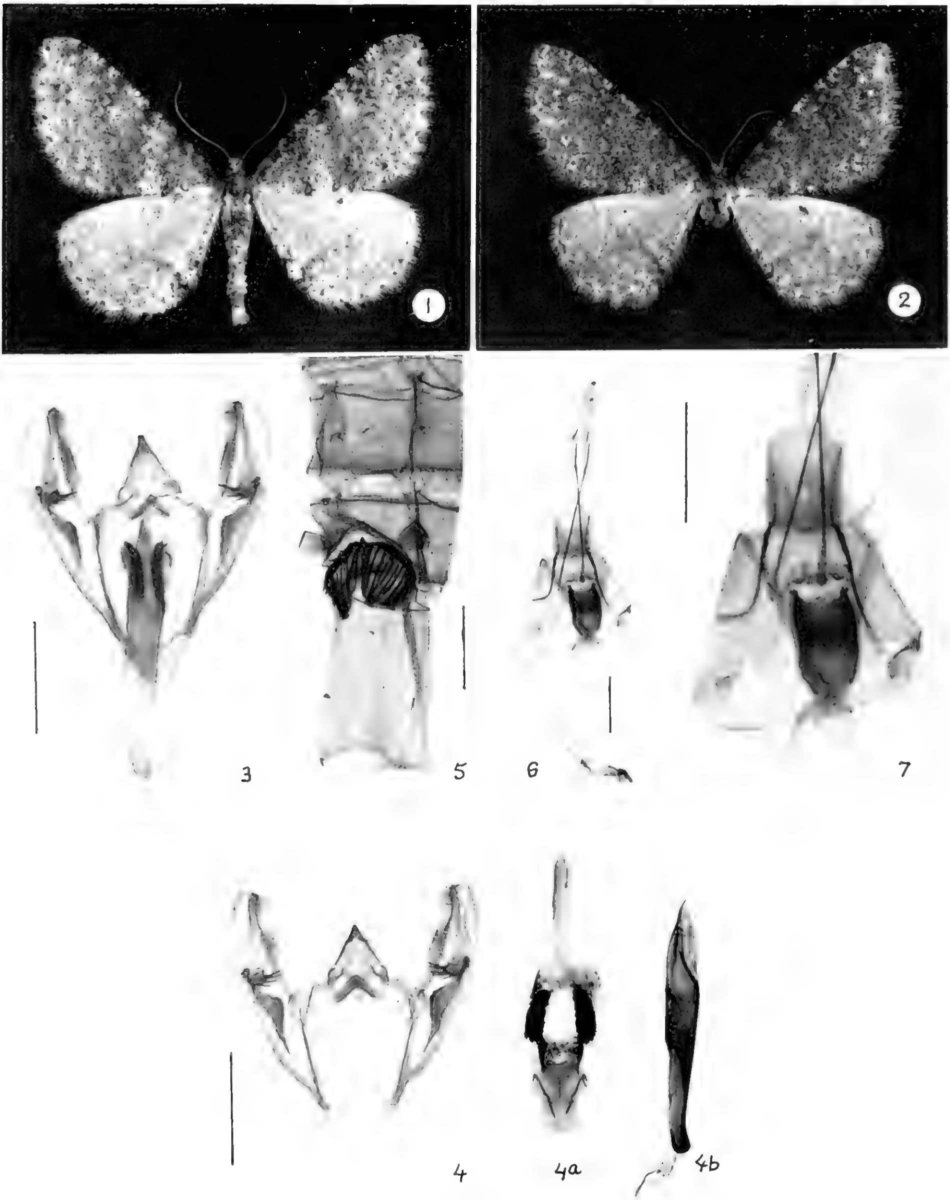
Type species.—*Astalotesia bucurvata* Blanchard and Knudson. Monotypic.

Description.—Moth similar in size to species of *Melanolophia,* cryptically colored, light gray brown with weak pattern of darker markings; hindwing not with full repetition of forewing pattern as in *Melanolophia,* but paler, with pattern reduced and essentially limited to anal ½ of wing. Forewing venation with R_1 and R_2 not stalked, but arising separately from anterior side of cell (although closely crowded together with Sc and stem of R_{3-5}); hindwing with Sc unbranched. Male antenna bipectinate with long branches, probably longer than those of any other genus in tribe; female antenna simple. Male hindtibia long, almost twice as long as femur, cylindrical, only moderately thickened, without a hair pencil. Male abdomen without anterior ventral structures; i.e., transverse, medial row of spines or bristles on 3rd sternite and ventrolateral scale tufts associated with this segment both wanting. Paired, comblike structure between 7th and 8th sternites well developed and immediately preceded by 1 pair of greatly enlarged, flaplike, modified scales (Fig. 5) (usually 3 or 4 pairs in most closely related genera). Male genitalia with juxta highly modified, bearing 2 dense, elongated clusters of appressed spines as in *Melanotesia*; valve with medial, transverse, protuberant sclerite bearing 6 stout, sharp spines in a fanlike configuration, and basad of this, a medial, longitudinal, abruptly raised ridge bearing a dense cluster of very short spines; aedeagus simple, slender, without cornuti. Female genitalia with posterior apophyses 3× length of anterior apophyses; ostial cavity deep, not funnel-shaped, but essentially cylindrical, sclerotized, separated from bursa copulatrix only by a constriction that may represent ductus bursae; corpus bursae membranous, without signum. Early stages unknown.

Astalotesia bucurvata **Blanchard and Knudson, New Species**

Figs. 1–7

Description.—*Head:* Front flat, smooth scaled, fuscous. Vertex rough scaled, ochreous, apices of scales fuscous. Labial palpi ascending to just beyond eye,



Figs. 1–7. *Astalotesia bucurvata.* 1, Holotype male, Brewster Co., Texas, Big Bend National Park, Chisos Basin, 29-III-82. 2, Paratype female, same locality, Green Gulch, 28-III-82. 3, Male genitalia of paratype, from slide AB 5071, same locality, Green Gulch, 25-III-71. 4, Male genitalia of paratype, from slide ECK 315B, same locality, Green Gulch, 28-III-82. 4a, Anellus and juxta from slide ECK 315B. 4b, Aedeagus from slide ECK 315B. 5, Male abdomen from slide ECK 315B. 6, Female genitalia of paratype, slide ECK 299, same locality, Green Gulch, 28-III-82. 7, Detail of ostium bursae, slide ECK 299. The segments in Figs. 3–7 represent 1 mm.

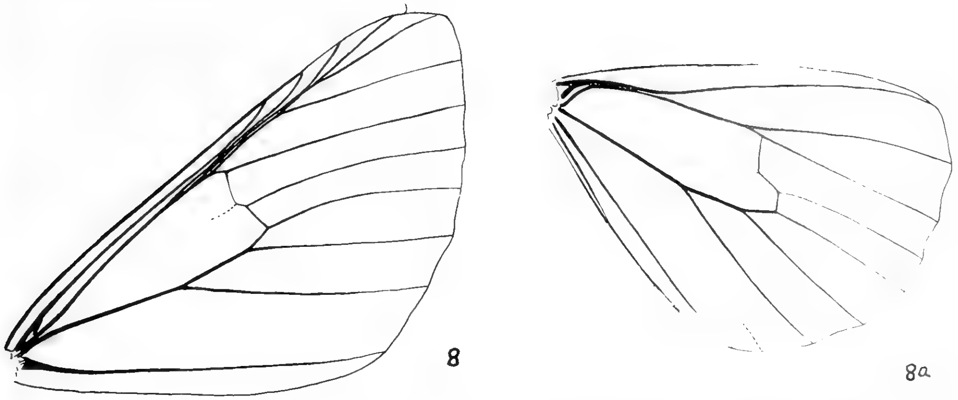


Fig. 8. *Astalotesia bucurvata,* wing venation of paratype male, slide ECK 315A, same locality as Fig. 1, Green Gulch, 28-III-82. 8, Forewing. 8a, Hindwing (frenulum omitted).

brownish ochreous, scale apices dark fuscous. Antenna, in male, bipectinate, with pectinations decreasing in length to extreme apex, which is simple, in female entirely simple.

Thorax: Vestiture consists of scales having a light gray base, blackish central band, and whitish gray apex. No posterior tuft.

Abdomen: Grayish ochreous.

Maculation: Male: Forewing ground color light ochreous gray, irrorated with black scales. Usual line obscure. Antemedial line from basal ⅕ of costa, convex outwardly, dark gray. Postmedial line double, angles slightly outward at margin of cell, moderately serrate, dark gray. A vaguely defined median shade between antemedial and postmedial lines. Subterminal line indicated only by 2 pairs of black spots near vein 2, and 2 or 3 pairs of black spots near vein 6. Costal margin strigulate with dark gray and light ochreous gray, interrupted by 5 quadrate grayish black patches, which originate at the am, median, pm (double), and st lines. Terminal line indicated by black intravenular spots. Fringe concolorous with ground. Hindwing lighter, with outer ½ more irrorated with gray black. Extradiscal line dark gray, serrate, obscure toward costa. Blackish intravenular spots or dashes along termen. Ventral surface of wings light ochreous gray, nearly immaculate, except for costal strigulations and patches, as above. Female: Both wings much more heavily irrorated with blackish scales, otherwise like male.

Venation: As in Fig. 8.

Length of forewing: Male: $N = 5$, 18.5–19.7 mm, average 19.2 mm; Female: $N = 1$, 18.0 mm.

Male genitalia (Figs 3–5): As in description of genus.

Female genitalia (Figs. 6,7): As in description of genus.

Holotype (Fig. 1).—♂, Brewster Co., Texas, Big Bend National Park, Chisos Basin, 29–III-82, collected by E. Knudson and deposited in the National Museum of Natural History, Washington, D.C.

Paratypes.—Same data as holotype, 2 ♂; Big Bend National Park, Green Gulch, 28-III-82, 1 ♂, 1 ♀ (Fig. 2), all collected by E. Knudson. Same locality, 25-III-71, 1 ♂, collected by A. and M. E. Blanchard.

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The authors thank the authorities of the U.S. National Park Service and Big Bend National Park, Texas, for their assistance, past and present.

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A NEW SPECIES OF *ERNOBIUS* (COLEOPTERA: ANOBIIDAE) INJURIOUS TO SPRUCE

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Abstract.—A new species, *Ernobius* **bicolor**, is described that is injurious to black spruce, *Picea mariana* (Mill.) B.S.P., in Newfoundland. The beetle feeds within old cones that remain attached to trees and thereby interferes with natural reestablishment of black spruce stands after harvest or destruction by fire. Characters are given that distinguish the beetle from other, similar species. A full figure drawing of the male is provided along with illustrations of the antennae of both sexes, the male genitalia, and for comparison, the male genitalia of *Ernobius mollis* (L.).

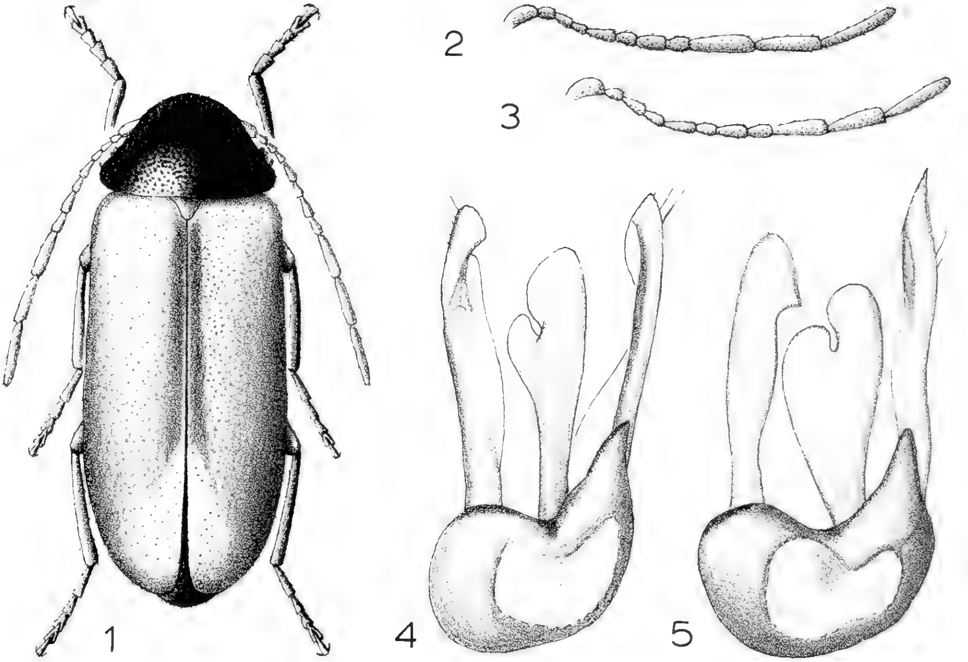
The Canadian Forestry Service, through Donald E. Bright of the Biosystematics Research Institute in Ottawa, requested the identification of a species of *Ernobius* that damages cones of black spruce (*Picea mariana* (Mill.) B.S.P.) in Newfoundland. Examination of this beetle showed it to be a new species distinct from all other Nearctic and Palearctic species of *Ernobius.* The new species is herein named and described in order to provide a name for those who are working on its biology and control, and to allow its recognition.

The beetle causes significant damage by feeding within old cones that remain attached to spruce trees. By destroying seeds retained in the cones it interferes with natural reestablishment of black spruce stands following harvest or destruction by fire. Up to 50% of field-collected cones have been found to be damaged by the beetle, which also destroys many seeds in cones stored for seed extraction. The beetle evidently occurs throughout the island of Newfoundland, for evidence of damage was found in cones from all 31 locations where collections were made; it is not yet known from other areas.

Ernobius bicolor White, NEW SPECIES

Figs. 1–4

Description.—*General:* Body elongate, 2.4–2.6 × as long as wide; pronotum nearly as wide as elytra at base. Color of male as follows: head and pronotum exclusively to primarily black, ventral surface primarily black, often with posterior margin of abdominal segments orangish to reddish brown; antenna, legs, and elytra primarily orangish to reddish brown, tibiae noticeably darker than remainder of legs, elytra often darkened along lateral margin, sometimes darkened along median suture; elytral apex often lighter than remainder of elytra, infrequently with elytra irregularly dark brown. Color of female as follows: orangish



Figs. 1–5. 1–4, *Ernobius bicolor.* 5, *E. mollis.* 1, Male, dorsal view. 2, Male antenna. 3, Female antenna. 4, 5, Male genitalia.

to reddish brown nearly throughout, but often elytral apex lighter than remainder of elytra, various parts of body (especially pronotum and elytra) sometimes clouded with brown. Pubescence yellowish, with a weakly orange hue, moderate in length and density, not at all obscuring surface, appressed. Dorsum punctate, punctures moderate in density, margins of punctures on pronotum distinctly raised, margins of punctures on elytra feebly raised. Pronotum and elytra with surfaces moderately shiny.

Head: Eyes of male separated by 1.7–2.0× vertical diameter of an eye, eyes of female smaller, separated by 2.0–2.4× vertical diameter of an eye. Antenna 11-segmented, that of male about ⅔ as long as body, that of female about ½ as long as body; basal 8 segments of both sexes with first segment longest, 5th and 7th segments long and similar in length, 2nd, 3rd, 6th, and 8th segments shorter and subequal in length, 4th segment shortest, or among the shortest; male with last 3 segments longer than all preceding united, 9th segment about 4× as long as wide; female with last 3 segments shorter than all preceding united, 9th segment about 3× as long as wide. Last segment of labial palpus triangular, longer than wide; last segment of maxillary palpus subfusiform, about 2× as long as wide.

Dorsal surface: Pronotum with a complete, sharp, explanate lateral margin, in dorsal view margin arcuate and widest near base; pronotal surface weakly undulate. Elytral surface feebly depressed basally near suture.

Ventral surface: Finely granulate punctate. Sixth abdominal sternite of male deeply notched; 6th abdominal sternite of female shallowly to deeply notched.

Length: 3.7–5.4 mm.

Types.—Described from 45 individuals (25 ♂, 20 ♀) from Gambo, Newfoundland, reared from *Picea mariana* cones during July of 1980 by H. O. Schooley. The specimens bear handwritten numbers 1 through 45. Male holotype (with number 10), allotype, and 28 paratypes (14 ♂, 14 ♀) in Canadian National Collection, Ottawa (CNC); 15 paratypes (10 ♂, 5 ♀) in National Museum of Natural History, Washington, D.C. (USNM).

Remarks.—The specific name, *bicolor,* refers to the body color of the male.

The sexes of *bicolor* are readily distinguished by color characters. Most of the males have the head, pronotum, and ventral surface black with just the apices of the abdominal segments orangish to reddish brown. Some males have the head and pronotum partly, and also the ventral surface, orangish to reddish brown. The elytra are orangish to reddish brown and sometimes also the suture and sides are dark brown. The female is nearly always orangish to reddish brown throughout, but sometimes the pronotum and elytra are clouded with dark brown.

In the key to species of *Ernobius* (Fall, 1905: 140), *bicolor* keys to *mollis* (L.). It clearly is not that species, for both sexes of *mollis* are unicolorous, and the male genitalia of the two species differ (Figs. 4, 5).

Brown (1932: 9) described *Ernobius schedli* from Bascotasing, Ontario, and mentioned that females of the species key to *E. mollis* in Fall's key. I have examined the male holotype (in CNC) and five paratypes (4 ♂, 1 ♀; 3 in CNC, 2 in USNM) of *E. schedli* Brown and it is clearly different from *E. bicolor.* The male of *schedli* has the last 3 antennal segments about one-third longer than all preceding segments united, and the female has the last 3 antennal segments a little longer than all preceding segments united. The male of *bicolor* has the last 3 antennal segments a little longer than all preceding segments united. Also, *schedli* (both sexes) has antennal segments 5–8 subequal in length, while *bicolor* has antennal segments 5 and 7 subequal and clearly longer than 6 and 8. There are similarities in the color differences between sexes of the two species, but this color dimorphism, with the male being darker than the female, is not as strongly developed in *schedli* as in *bicolor.*

Comparison of the male genitalia of *bicolor* with the genitalic illustrations by Johnson (1975) in a study of the Palearctic species of *Ernobius* shows that the greatest similarities are to be found with those of *explanatus* (Mannerheim), a species that occurs in Finland, Norway, Sweden, and northwestern Russia. The external morphology of *explanatus* suggests that it is closely related to *bicolor*; in fact, the similarities in many characters are greater than are those of *mollis.* Unlike *bicolor,* both sexes of *explanatus* are nearly uniformly dark reddish brown throughout, and, of antennal segments 5–8, 5 is the longest, 7 is clearly shorter than 5 and a little longer than 6 and 8. In *bicolor,* of segments 5–8, 5 and 7 are the longest and subequal in length, while 6 and 8 are clearly shorter and subequal in length.

My thanks are offered to Donald E. Bright, Biosystematics Research Institute, Agriculture Canada, Ottawa, for loan of type specimens.

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THE SYSTEMATIC STATUS OF THE FAMILY THAUMASTOCORIDAE WITH THE DESCRIPTION OF A NEW SPECIES OF *DISCOCORIS* FROM VENEZUELA (HEMIPTERA: HETEROPTERA)[1]

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Abstract.—The systematic relationships of the Thaumastocoridae are discussed. The Xylastodoridinae, which has recently been elevated to family status, is returned to its former position as a subfamily of Thaumastocoridae. *Discocoris* ***fernandezi*** is described as a new species from Venezuela. A key to the four species of *Discocoris* is included.

Drake and Slater (1957) in their revision of the family Thaumastocoridae recognized that two very distinct subfamilies were represented, the Thaumastocorinae restricted largely to Australia (a single species in south India) and the Xylastodoridinae (as Xylastodorinae)[2] represented by one species of *Xylastodoris* in Cuba and Florida and one species of *Discocoris* in South America. Subsequently several additional species have been described including two in the Xylastodoridinae (*Discocoris drakei* Slater and Ashlock (1959), and *D. kormilevi* Viana and Carpintero). Viana and Carpintero (1981) proposed that the Xylastodoridinae be elevated to family status as the Xylastodorididae. The stated reasons for this action were the differences in the genitalia, the differences in host plants and the different distributions.

We believe that elevation of the Xylastodoridinae to family rank is unwarranted and will only serve to obscure relationships, both morphological and zoogeographic, rather than to clarify them.

Most importantly, despite important morphological differences between the two subfamilies, the Thaumastocoridae seem to unquestionably form a monophyletic group held together by several important synapomorphies such as the asymmetrical pygophore in which the phallus rides with accompanying modification of the adjacent abdominal segments, loss of the ovipositor, shortening and broadening of the first labial segment, etc.

The geographic separation emphasized by Viana and Carpintero (1981) seems to favor rather than oppose retention of the two groups as subfamilies. A distri-

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[1] This work was supported in part by a grant from the National Science Foundation.

[2] According to G. C. Steyskal, Systematic Entomology Laboratory, USDA, the word *doris* could be from either of two different Greek words, both of which are feminine and have the stem *dorid*–; therefore, the family-group name based on *Xylastodoris* should be Xylastodoridinae.

bution that is essentially Australian-Neotropical occurs in many plant and animal groups (i.e., Marsupalia, *Nothofagus,* Peloridiidae, Idiostolidae, and Udeocorini). Such distributions suggest relationships that go back at least to 45 million years before present when a distributional pathway lay open between Australia and South America through Antarctica.

The differences between the two subfamilies are chiefly the loss of parameres in the Xylastodoridinae. This merely expresses a condition further derived than that found in the Thaumastocorinae where only one paramere is lost. Viana and Carpintero may have been influenced by Drake and Slater's (1957) statement that neither arolia (= parempodia) nor pseudarolia (= pulvilli) are present in the Thaumastocorinae but that both are present in the Xylastodoridinae. However, Schuh (1976) notes that while the Thaumastocorinae lack pulvilli they do have small setiform parempodia similar to those found in the Xylastodoridinae.

The elevation of the Xylastodoridinae to family status thus appears to be only splitting of a monophyletic taxon and not a modification of the relationships of the two groups to one another or to any other hemipterous taxon. Such actions have the disadvantage of disrupting stability without enhancing an understanding of relationships. In this case it has the disadvantage of obscuring zoogeographic as well as morphological relationships. Therefore we return the Xylastodoridinae to subfamily status as one of the two subfamilies of Thaumastocoridae.

All of the Western Hemisphere species of Thaumastocoridae apparently breed only on palms (Palmaceae): *Xylastodoris luteolus* Barber on the Royal Palm *Roystonea regia* (Baranowski, 1958), *D. drakei* on "yarina palm" *Phytelephas* sp. (Schuh, 1975), *Discocoris kormilevi* on "Yatay, Enana" (*Butia yatay poni*) (Viana and Carpintero, 1981) and *D. vianai* Kormilev on *Euterpe edulis* (Kormilev, 1955). The new species of *Discocoris* described below probably also will prove to breed on palms although the host plant is as yet unknown.

All measurements in the description below are in millimeters.

Discocoris fernandezi **Slater and Brailovsky, NEW SPECIES**

Description.—Broadly ovate. Nearly uniformly light testaceous. Humeral angles of pronotum, a diffuse ray on posterior lobe of pronotum on either side of midline and antero-lateral angles of scutellum brown. Eyes bright red. Dorsal surface of pronotum and scutellum strongly and conspicuously punctate. Hemelytra with corium bearing relatively small, shallow, inconspicuous punctures; those on clavus large, forming 3 rows. Dorsal surface nearly glabrous. Ventral surface clothed with short, decumbent, silvery hairs.

Head broad, nondeclivent. Juga strongly arcuate; juga and tylus extending forward an equal distance, the latter not tapering anteriorly. An acute, inwardly curving spine present at anterior angle of each eye, extending only ½ way to distal end of 1st antennal segments. Ocelli located exactly at level of posterior margins of compound eyes. Length head 0.52 (4); width 0.76; interocular space 0.48. Pronotum with anterior margin moderately concave; antero-lateral angles produced forward to posterior margins of eyes; lateral margins broadly explanate, slightly arcuate with a few small teeth present. Posterior margin of pronotum sinuate adjacent to scutellum, laterally curving slightly antero-laterad to humeri; humeral angles conspicuously tumid and elevated. Length pronotum at midline 0.58; maximum length 0.70; maximum width 1.32. Scutellum somewhat laevigate with a faint median elevation. Distance between scutellar punctures much less than diameter of a puncture. Scutellum length 0.74, width 0.66.

Hemelytra symmetrical. Corium moderately convex; lateral margins strongly explanate and broadly arcuate. Membrane considerably exceeding apex of abdomen. Length claval commissure 0.20. Midline distance apex clavus–apex hemelytron 1.08. Labium extending well onto abdominal sternum three. Length labial segments I 0.26, II 0.26, III 0.50, IV 0.62. Length antennal segments I 0.08, II 0.14, III–IV missing. Total body length 2.84.

Holotype.—♂. VENEZUELA: Aragua, Rancho Grande, 1100 m, 1.IV.1966 (J. & B. Bechyne leg.). In Universidad Central de Venezuela collection.

Paratype.—♂. VENEZUELA: Roraima, Bolivar Gran Sabana. 1800 m, 22.X.1966 (J. & B. Bechyne and E. Osuna). In J. A. Slater collection.

Remarks.—*Discocoris fernandezi* may readily be separated from the previously described species of *Discocoris* by the characters given in the following key. It appears to be most closely related in most structural characteristics to *D. vianai* but the large coarse punctures readily distinguish it. Both *vianai* and *drakei* are relatively finely punctate. *Discocoris kormilevi* has a rather coarsely punctate dorsal surface. It is unique, however, in having extremely large flaring lateral pronotal expansions that project far forward of the eyes to reach the level of the middle of the tylus. The ocelli in *kormilevi* are placed considerably behind the posterior margins of the compound eyes in contrast to the other species where the ocelli are located on a level with the posterior eye margins.

This species is named for Dr. Francisco Fernandez-Yepez of the Universidad Central de Venezuela in recognition of his many contributions to the entomology of Venezuela.

KEY TO SPECIES OF *DISCOCORIS*

1. Pronotum with antero-lateral projections extending much forward of anterior margins of eyes (Viana and Carpintero, 1981: figs. 3, 11, 12, 21) .... *kormilevi* Viana and Carpintero
– Antero-lateral pronotal projections not extending anterior to eyes 2
2. Tylus strongly tapered anteriorly to a subacute apex; hemelytra strikingly asymmetrical (Slater and Ashlock, 1959: fig. 1; Viana and Carpintero, 1981: fig. 2) .... *drakei* Slater and Ashlock
– Tylus not strongly tapering anteriorly, of nearly uniform width throughout; hemelytra symmetrical 3
3. Pronotal and scutellar punctures fine and shallow, distance between those (centrally) on scutellum and posterior pronotal lobe as great as or greater than diameter of puncture; lateral flanges of pronotum impunctate or nearly so adjacent to margins; spine on head anterior to each eye reaching distal end of 1st antennal segment (Slater and Ashlock, 1959: fig. 2; Viana and Carpintero, 1981: figs. 1, 20) .... *vianai* Kormilev
– Pronotal and scutellar punctures coarse, large and deep, those mesally on scutellum and posterior portion of pronotum much greater in diameter than distance between them; lateral flanges of pronotum with conspicuous punctures almost to margins; head spine anterior to each eye extending only to middle of 1st antennal segment .... *fernandezi*, new species

ACKNOWLEDGMENTS

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DISCRIMINATION OF *LIRIOMYZA* SPECIES (DIPTERA: AGROMYZIDAE) USING ELECTROPHORESIS AND SCANNING ELECTRON MICROSCOPY

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Abstract.—Starch gel electrophoresis was used to distinguish three species of *Liriomyza* Mik, based on mobilities of four enzymes. Comparison of *L. brassicae* (Riley), *L. trifolii* (Burgess), and *L. sativae* Blanchard revealed different enzyme mobilities at three loci. *Liriomyza trifolii* and *L. sativae* were separated based on enzyme mobility differences at all four loci tested. Enzyme mobilities of conspecific strains of *L. trifolii* and *L. sativae* were not influenced by host feeding or geographic site of collection. Scanning electron micrographs revealed interspecific differences in length and spacing of mesonotal microsetae.

Leafmining flies in the genus *Liriomyza* Mik (Diptera: Agromyzidae) are serious pests of vegetable and ornamental crops in California. Specimens collected from celery in Ventura County, California, in 1980 were identified as a newly introduced species, *L. trifolii* (Burgess) (Trumble, 1981). This was the first record of an economically important infestation of *L. trifolii* on a vegetable crop in California. The introduction of this species has also affected the California ornamentals industry where *L. trifolii* has become the primary leafminer species damaging chrysanthemums (Parrella et al., 1981).

Prior to the introduction of *L. trifolii* to California, several leafminers had been documented as economic pests. *Liriomyza sativae* Blanchard was reported as a secondary pest of tomato capable of reaching injurious population levels when exposed to methomyl spray regimes (Oatman and Kennedy, 1976). *Liriomyza brassicae* (Riley) only sporadically causes serious damage to cruciferous crops and is considered of minor economic importance in California (Oatman and Platner, 1969). A fourth species, *L. huidobrensis* (Blanchard), is considered a pest of some ornamental plants and can attack legumes and other vegetable crops (Parrella, *in press*). Another economically important leafminer species, *L. trifoliearum* Spencer (as *L. pictella* (Thompson)), has been reported as a pest of alfalfa in California (Jensen and Koehler, 1970).

Fifteen *Liriomyza* species of economic importance in California have been reported, although only five species are currently recognized. The taxonomic confusion in the genus *Liriomyza* results from general morphological similarity and overlapping host ranges (Parrella, *in press*). Agromyzid nomenclature has recently been coordinated (Spencer, 1981) but misidentification may occur when morphological characters vary among individuals or when genitalia comparisons are incorrectly interpreted. *Liriomyza trifolii, L. sativae,* and *L. brassicae* were included in this study because of morphological similarity, economic importance, and overlapping host ranges. *Liriomyza huidobrensis* and *L. trifoliearum* were not included because of gross morphological differences and restricted host range, respectively.

Within the last decade, gel electrophoresis of enzymes has become a suitable technique for discrimination of closely related taxa (Berlocher, 1979). Species in many insect genera have been identified using electrophoresis, including *Culex* Linnaeus (Mahon et al., 1976), *Speyeria* Scudder (Brittnacher et al., 1977), and *Drosophila* Fallén (Ayala and Powell, 1972). Berlocher (1980) developed a useful electrophoretic key to larvae, pupae, and adults of *Rhagoletis* Loew species.

Scanning electron microscopy has recently been used to delinate morphological structures for the description of new insect species (Boppré and Scherer, 1981; Bright, 1981). The purpose of our study was to determine whether gel electrophoresis or scanning electron microscopy could be utilized for separation of *Liriomyza* species.

MATERIALS AND METHODS

Gel electrophoresis experiments.—*Liriomyza* spp. were obtained from the following sources:

Liriomyza trifolii: (1) A laboratory colony established on celery in December 1980 from an infestation occurring on celery in Ventura County, California. (2) Fresh market tomatoes in Ventura County, California. (3) Celery in South Bay, Florida.

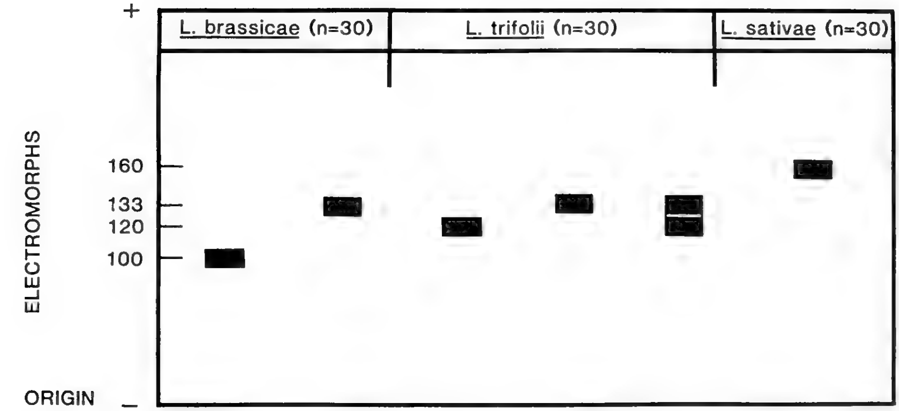
Liriomyza sativae: (1) A laboratory colony established on squash in December 1980 from an infestation occurring on fresh market tomatoes in Irvine, California.

Liriomyza brassicae: (1) Broccoli in Irvine, California.

Liriomyza brassicae were difficult to collect and rear in the laboratory, and sample sizes were limited. All available *L. brassicae* were electrophoretically compared with *L. trifolii* and *L. sativae* on the same gels. Repeated comparisons of *L. trifolii* and *L. sativae* were performed since samples of these species were plentiful. Specimens were collected as larvae in infested plant material and held in an environmental chamber (27° ± 0.5°C, 65 ± 3% RH: LD = 14–10) for completion of development. After emergence, 48 hours were allowed for cuticular hardening and coloration before flies were transferred to glass vials and stored in liquid nitrogen. Numbers of individuals examined in each test have been reported in Tables 1 and 2 and Figs. 1–6.

Prior to homogenization for electrophoresis, individual adult flies were identified to species using mesonotal and vertical bristle characters described by Spencer (1965). Equal numbers of males and females were analyzed on each gel.

The starch gel electrophoresis technique described by Bush and Huettel (1972) was followed or slightly modified as described. Gels were formulated using 49.2 g Sigma hydrolyzed starch in 420 ml of gel buffer. Gel and electrode buffers were prepared as continuous tris citrate II (Selander et al., 1971), except pH was adjusted to 7.7 with additional citric acid. All four enzymes included in this study were separated on this buffer system. Gels were run at 4°C for five hours at 100 volts and ca. 70 milliamps. The enzyme systems examined were isocitrate dehydro-



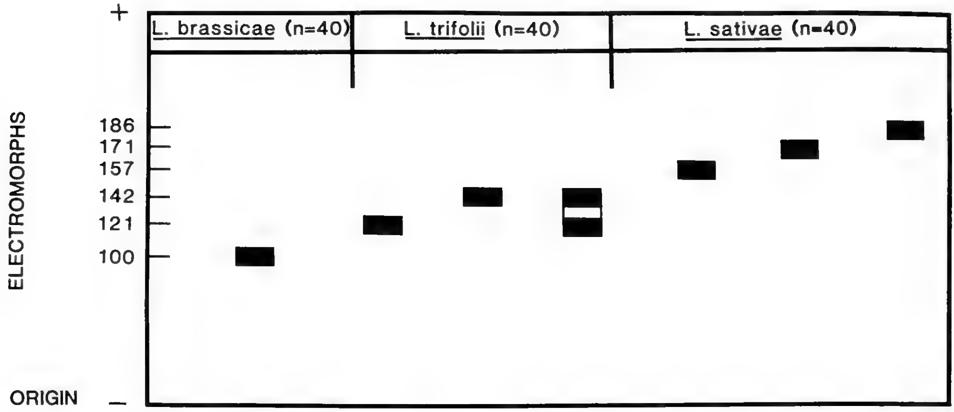
PHENOTYPE	100/100	133/133	120/120	133/133	120/133	160/160
FREQUENCY	.967	.033	.033	.933	.033	1.00
MIGRATION-DISTANCE(mm)	15	20	18	20	18–20	24

Fig. 1. Isocitrate dehydrogenase banding patterns in *Liriomyza brassicae, L. trifolii,* and *L. sativae.*

genase (IDH), aldehyde oxidase (AO), aconitase (ACON), and glucose-6-phosphate dehydrogenase (G-6-PDH). Stain and substrate buffer ingredients are as follows:

IDH–100 mg isocitric acid, 10 mg NADP, 100 mg $MgCl_2$, 15 mg MTT, and 5 mg PMS in 75 ml 0.1M tris HCl buffer (pH 7.5).

AO–10 mg NAD, 15 mg MTT, 5 mg PMS, and 2 ml benzaldehyde in 75 ml 0.1M tris HCl buffer (pH 8.4). Note: the glass stain dish must be tightly sealed or the benzaldehyde will diffuse and cause the AO reaction on nearby gels.



PHENOTYPE	100/100	121/121	142/142	121/142	157/157	171/171	186/186
FREQUENCY	1.00	.925	.025	.050	.100	.875	.025
MIGRATION-DISTANCE(mm)	7	8.5	10	8.5–10	11	12	13

Fig. 2. Aldehyde oxidase banding patterns in *Liriomyza brassicae, L. trifolii,* and *L. sativae.*

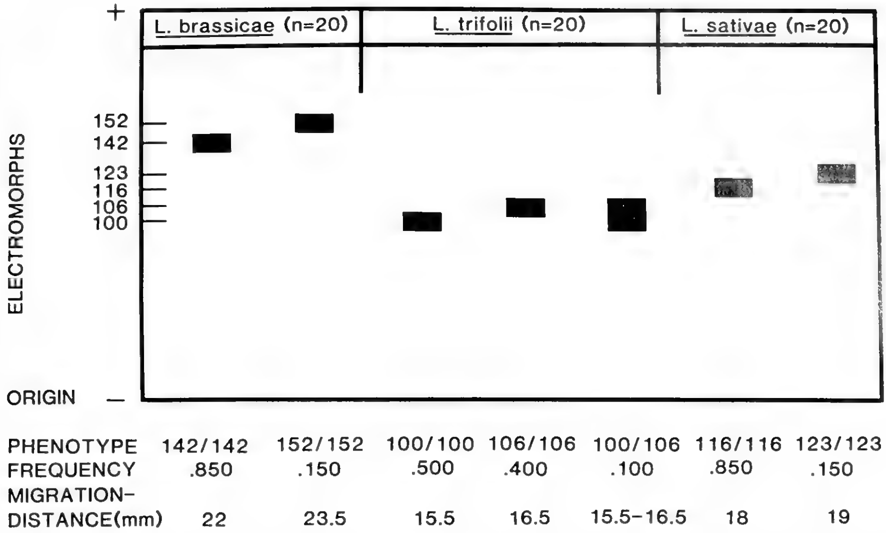


Fig. 3. Glucose-6-phosphate dehydrogenase banding patterns in *Liriomyza brassicae, L. trifolii,* and *L. sativae.*

ACON–100 mg cis-aconitic acid, 30 mg NADP, 100 mg $MgCl_2$, 15 mg MTT, 5 mg PMS, and 12 units isocitrate dehydrogenase in 75 ml 0.2M Na phosphate buffer (pH 8.0).

G-6-PDH–250 mg glucose-6-phosphate, 10 mg NADP, 100 mg $MgCl_2$, 20 mg MTT, and 5 mg PMS in 75 ml 0.1 M tris HCl buffer (pH 8.0).

Gel slices were incubated at 37°C until individual bands became distinct. One hour was sufficient for a complete stain reaction to occur for all enzymes. Band mobilities were measured from the sample origin. Electromorphs (terminology after King and Ohta, 1975) were assigned relative mobility values with 100 representing the most common electromorph. Electromorphs with faster or slower relative migration were assigned values greater or less than 100. In the interspecific comparisons with anodal migration (Figs. 1–5), 100 is assigned to the most common electromorph in the species with the slowest band migration. At the ACON locus (Fig. 6), the bands migrated cathodally and the 100 value is given to the most common electromorph in the fastest migrating species. Analysis of enzyme activity is presented as set forth by Berlocher (1980), where phenotypes are presented as combinations of electromorphs.

Scanning electron microscopy.—Specimens were sequentially immersed in increasing concentrations of alcohol up to 100%, then subjected to critical point drying, and examined with a JEOL model JSM-35C scanning electron microscope. The mesonotal regions of nine adult females of each species were photographed at 1200 magnification with a microscope voltage of 15 kV.

RESULTS AND DISCUSSION

Intraspecific electrophoresis.—Differential host feeding in the larval stage did not prevent positive species identification since *Liriomyza trifolii* collected from different host plants produced similar electrophoretic banding patterns. When *L.*

Table 1. Biochemical similarity of *Liriomyza trifolii* from different hosts and geographic locations.

Locus	Migration[1] Distance (mm)	Phenotype Designation	Phenotype Frequency Calif. Tomato	Calif. Celery	Florida Celery
Isocitrate dehydrogenase	18	95/95	.071	.045	.043
	19	100/100	.858	.910	.957
	18–19	95/100	.071	.045	—
(*N*)			(42)	(89)	(47)
Aldehyde oxidase	9	100/100	.750	.942	1.00
	11	122/122	.179	.029	—
	9–11	100/122	.071	.029	—
(*N*)			(28)	(70)	(44)
Aconitase[2]	−3	−100/−100	.952	.974	1.00
	−4	−133/−133	.024	.026	—
	−3–−4	−100/−133	.024	—	—
(*N*)			(42)	(77)	(35)
Glucose-6-phosphate dehydrogenase	15.5	94/94	.238	.250	.267
	16.5	100/100	.738	.694	.700
	15.5–16.5	94/100	.024	.056	.033
(*N*)			(42)	(72)	(30)

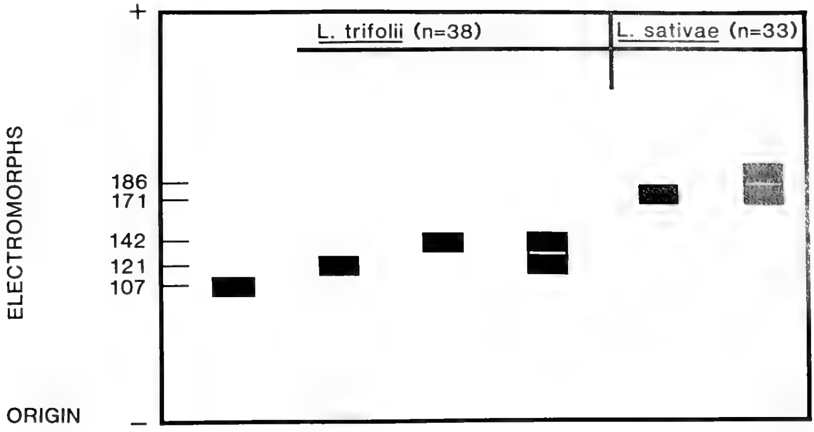
[1] Measured from sample origin to center of band.

[2] Migrates cathodally. A weak anodal band was not scored.

trifolii from the celery laboratory culture were compared with *L. trifolii* collected from fresh market tomatoes (Table 1), flies from both host plants were genetically similar and all but one phenotype were present in both strains at all loci. The only phenotype not shared by both the celery and tomato strains is the −100/−133 phenotype at the ACON locus found in one individual reared from tomato.

Similar results were found when *L. sativae,* reared for six months on squash in the laboratory, were compared with *L. sativae* collected from fresh market tomatoes (Table 2). At the IDH locus, all specimens were monomorphic and shared the 100/100 phenotype. The majority of individuals of both strains possessed the 100/100 phenotype at the other three loci. Rare phenotypes were also shared by both strains except for three individuals reared from tomato that demonstrated a 100/114 phenotype at the AO locus and three other individuals from tomato that exhibited a 79/129 phenotype at the same locus. Also, a −100/−250 phenotype was present in two individuals from tomato at the ACON locus that was not shared by those reared from squash.

Populations of *L. trifolii* collected from widely separated geographic locations demonstrated similar electrophoretic banding patterns (Table 1). Flies from celery in Florida were compared with a laboratory culture established from celery in Ventura County, California. Both strains shared the 100/100 phenotype in at least 91% of the specimens at the IDH, AO, and ACON loci. The Florida strain was less polymorphic than the California strain, producing fixed bands at the AO and ACON loci. Fewer individuals of both strains shared the 100/100 phenotype at the G-6-PDH locus when compared to other loci. This may have been caused by difficulty in scoring phenotypes due to lack of distinct borders for individual bands.



PHENOTYPE	107/107	121/121	142/142	121/142	171/171	171/186
FREQUENCY	.053	.737	.157	.053	.909	.091
MIGRATION-DISTANCE(mm)	7.5	8.5	10	8.5–10	12	12–13

Fig. 4. Aldehyde oxidase banding patterns in *Liriomyza trifolii* and *L. sativae.*

However, relative mobility ranges of the Florida and California strains were the same (15.5–16.5 mm) at the G-6-PDH locus.

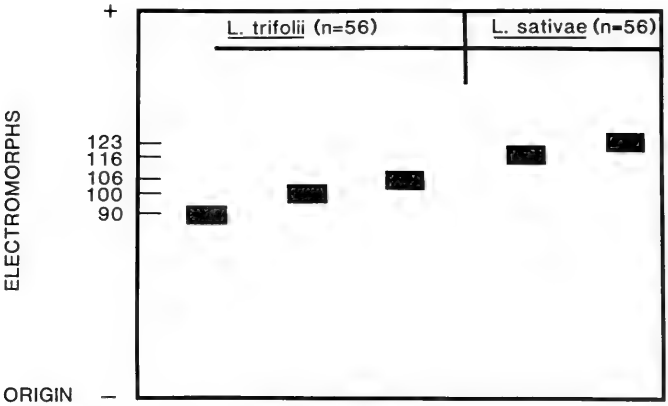
Interspecific electrophoresis.—*Liriomyza brassicae, L. trifolii,* and *L. sativae* demonstrated different enzyme mobilities at the IDH locus (Fig. 1), except for a

Table 2. Biochemical similarity of *Liriomyza sativae* reared from squash and tomato.

Locus	Migration[1] Distance (mm)	Phenotype Designation	Phenotype Frequency	
			Squash	Tomato
Isocitrate dehydrogenase	27	100/100	1.00	1.00
(*N*)			(45)	(45)
Aldehyde oxidase	14	100/100	.733	.533
	16	114/114	.267	.333
	14–16	100/114	—	.067
	11–18	79/129	—	.067
(*N*)			(45)	(45)
Aconitase[2]	−1	−100/−100	.822	.889
	−2.5	−250/−250	.178	.067
	−1–−2.5	−100/−250	—	.044
(*N*)			(45)	(45)
Glucose-6-phosphate dehydrogenase	21	95/95	.111	.267
	22	100/100	.800	.689
	23	105/105	.089	.044
(*N*)			(45)	(45)

[1] Measured from sample origin to center of band.

[2] Migrates cathodally. A weak anodal band was not scored.



PHENOTYPE	90/90	100/100	106/106	116/116	123/123
FREQUENCY	.107	.839	.054	.893	.107
MIGRATION-DISTANCE(mm)	14	15.5	16.5	18	19

Fig. 5. Glucose-6-phosphate dehydrogenase banding patterns in *Liriomyza trifolii* and *L. sativae.*

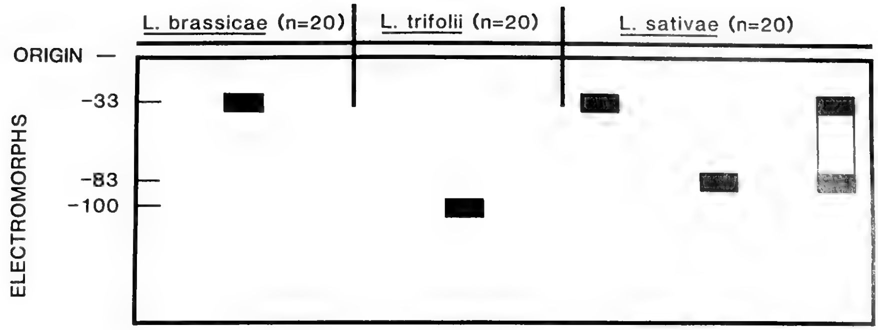
single *L. brassicae* which shared the most common 133/133 phenotype of *L. trifolii.* This individual may have been mislabeled or a flaw in the gel could have accounted for the faster band mobility. An additional 105 *L. trifolii* and 95 *L. sativae* demonstrated identical phenotypes to those shown for these species in Fig. 1. Except for the overlap resulting from the single specimen, the IDH locus proved suitable for separation of the three species.

Enzyme mobility differences between the three species were also demonstrated at the AO and G-6-PDH loci (Figs. 2, 3). The relative mobilities were the same for AO and IDH, where *L. brassicae, L. trifolii,* and *L. sativae* had increasing mobility rates, respectively. Banding patterns for enzymes at the G-6-PDH locus were recognizably different: *L. brassicae* migrated fastest and *L. trifolii* slowest.

An additional 38 *L. trifolii* were compared to 33 *L. sativae* at the AO locus (Fig. 4). Three *L. sativae* demonstrated a new 171/186 phenotype not present in Fig. 2. Five of 40 *L. sativae* in Fig. 2 possessed 157/157 or 186/186 phenotypes not seen in the 33 *L. sativae* in Fig. 4. Two of 38 *L. trifolii* in Fig. 4 possessed a rare 107/107 phenotype not present in the 40 *L. trifolii* in Fig. 2.

Fig. 5 represents the G-6-PDH locus for an additional 56 individuals each of *L. trifolii* and *L. sativae.* A new 90/90 phenotype not seen in Fig. 3 is present in 6 *L. trifolii* in Fig. 5. The 100/106 phenotype seen in 2 *L. trifolii* in Fig. 3 is not present in any of the 56 *L. trifolii* in Fig. 5. The 56 *L. sativae* in Fig. 5 and the 20 *L. sativae* in Fig. 3 had identical phenotypes.

It is possible that unique individuals do not represent rare phenotypes but that they were scored incorrectly or their bands altered by gel defects. Since one or only a few specimens often yield adequate data for the description of an entire species (Avise, 1975), these rare phenotypes can be ignored. In any case, rare phenotypes accounted for no band overlap between species and thus did not prevent accurate discrimination.



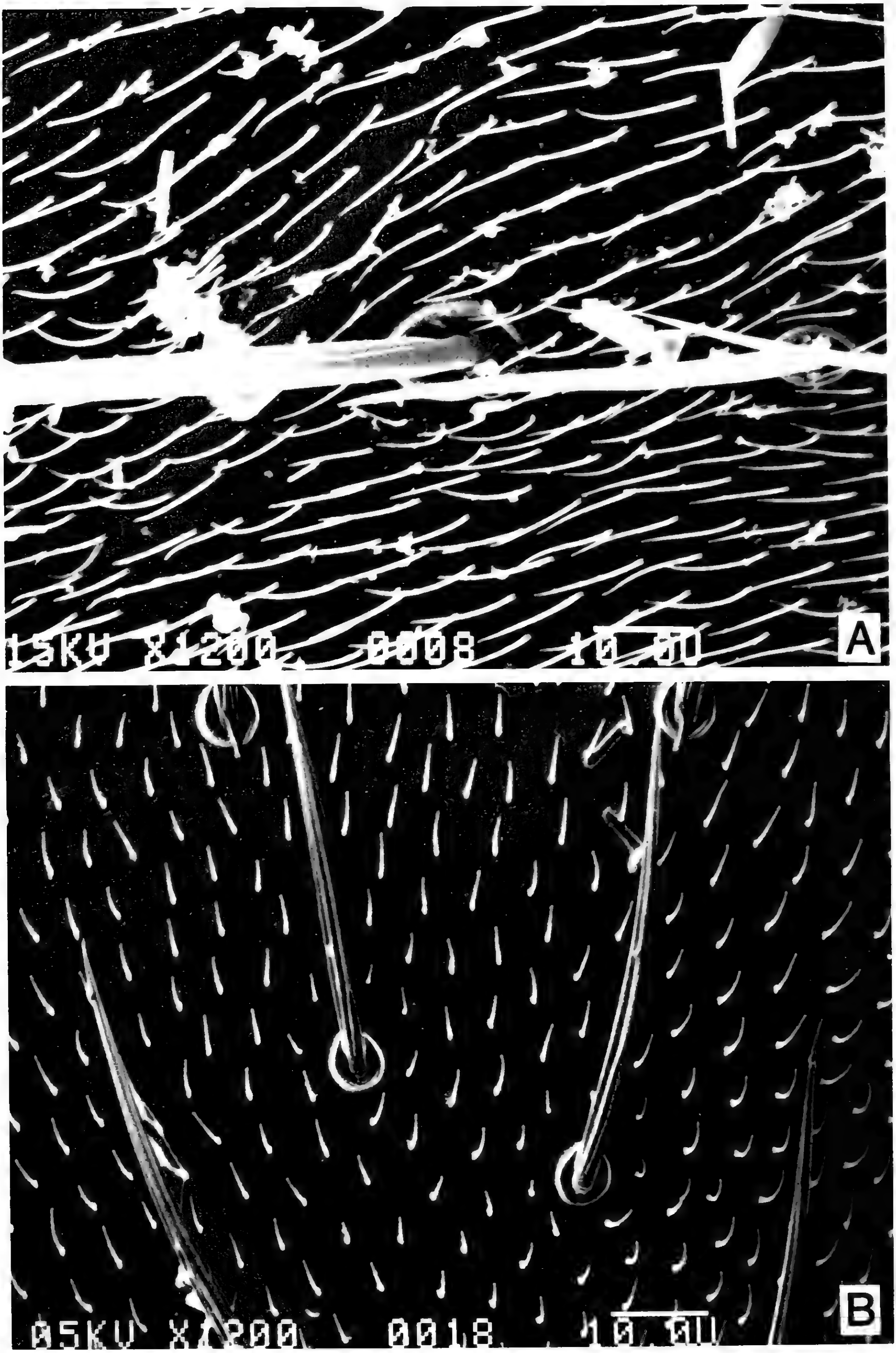
PHENOTYPE	-33/-33	-100/-100	-33/-33	-83/-83	-33/-83
FREQUENCY	1.00	1.00	.750	.100	.150
MIGRATION-DISTANCE(mm)	-1	-3	-1	-2.5	-1-2.5

Fig. 6. Aconitase banding patterns in *Liriomyza brassicae, L. trifolii,* and *L. sativae.*

ACON was not diagnostic for all three species since *L. brassicae* and *L. sativae* shared a common −33/−33 phenotype (Fig. 6). This locus was suitable for discrimination of *L. brassicae* and *L. sativae* from *L. trifolii.* An additional 53 *L. trifolii* and 48 *L. sativae* had identical phenotypes to those presented for these species in Fig. 6.

At most loci, the frequency of heterozygotes was lower than predicted by Hardy-Weinberg equilibrium. For example, *L. sativae* reared from squash possessed homozygous phenotypes at the AO locus with frequencies of 0.73 and 0.27, with no heterozygotes (Table 2). The presence of homozygotes with absence of heterozygotes can be explained by the Wahlund effect (Ferguson, 1980). This occurs when a sample is actually a mixture of two fully or partially isolated populations possessing different allelic frequencies. The frequencies of 0.73 and 0.27 suggest that the *L. sativae* culture consists of two such populations present in a 3:1 ratio. Sex-linkage of the enzyme systems, or active selection in a population, may also result in a deficiency of heterozygotes (Ferguson, 1980). Nonetheless, electrophoretic discrimination of the three species of *Liriomyza* is valid since the range of enzyme mobility for each species is separable at several loci.

Scanning electron microscopy.—A morphological character used in separation of *L. sativae* and *L. trifolii* is the shiny black vs. mat-grey mesonotum (Spencer, 1965). Scanning electron micrographs of the mesonota of *L. brassicae, L. sativae,* and *L. trifolii* were taken to determine the ultrastructure responsible for these differences. A dense covering of microsetae in *L. trifolii* (Fig. 7A) is responsible for the mat-grey appearance of its mesonotum. Large areas of exposed cuticle give *L. sativae* (Fig. 7B) and *L. brassicae* (Fig. 7C) the shiny black appearance noted by Spencer. *Liriomyza brassicae* appears to have microsetae that are curved more than those of *L. sativae.* This curvature may be due to slightly different orientation of the flies to the electron beam, since curved microsetae were not evident on all *L. brassicae* photographed. Although *L. trifolii* can be separated



Figs. 7A, 7B. Scanning electron micrographs of mesonotum. A, *Liriomyza trifolii.* B, *L. sativae.*

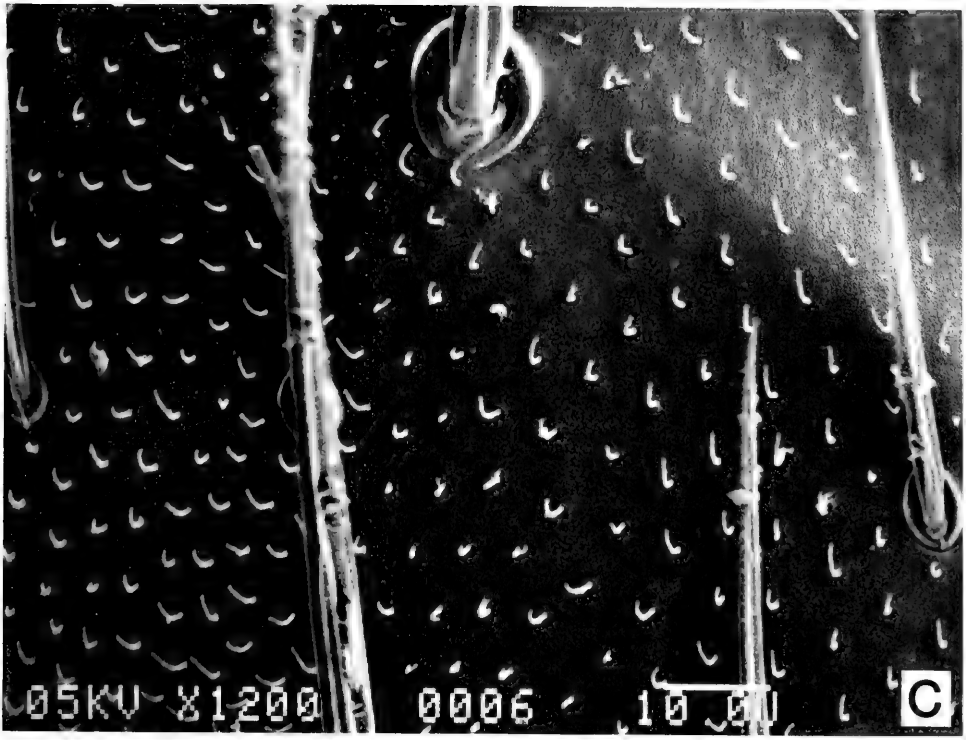


Fig. 7C. Scanning electron micrographs of mesonotum, *Liriomyza brassicae.*

from *L. sativae* and *L. brassicae* by electron microscopy, this technique is not suitable for discrimination between *L. sativae* and *L. brassicae.*

ACKNOWLEDGMENTS

We thank Clay Sassaman, Michael Parrella, and Tom Unruh who provided valuable advice in review of this manuscript. Scanning electron micrographs were taken by Arnold Bell and Thomas Powers. Florida leafminer samples were provided by South Bay Growers, Inc., South Bay, Florida. Identification of representative *L. brassicae* and *L. sativae* was confirmed by K. A. Spencer (Exwell Farm, Bray Shop, Callington PL17 8QJ, Cornwall, Great Britain) and R. H. Foote (Systematic Entomology Laboratory, IIBIII, USDA, Washington, D.C.).

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COLLEMBOLA IN AMBER FROM THE DOMINICAN REPUBLIC

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Abstract.—The following taxa are reported from a collection of Collembola preserved in early Miocene amber from the Dominican Republic: Family Isotomidae—*Cryptopygus, Isotoma* (*Desoria*); Family Entomobryidae—*Lepidocyrtus, Pseudosinella, Seira, Salina, Paronella, Cyphoderus* (first fossil record for the genus); Family Sminthuridae—*Sphyrotheca.* One group of blind isotomids tentatively identified as *Isotoma* (*Desoria*) probably represent a new genus. Forty-three percent of the specimens belong to *Lepidocyrtus* and *Seira.* Overall morphology indicates that this springtail fauna is remarkably modern and very similar to that of Miocene amber from Chiapas, Mexico. Six photographs and 37 drawings complement the descriptive notes.

Tropical fossil Collembola are known only from a contribution by Christiansen (1971), who studied 70 specimens preserved in Miocene amber from the State of Chiapas, Mexico. This author was able to place 34 of the specimens into seven genera and, with some degree of doubt, identify seven species which are still extant.

Herein I report the study of 90 springtails preserved in amber from the Dominican Republic. The insects belong to nine living genera, although a group of isotomids probably represent a new genus. Although several specimens are very well preserved, many relevant morphological details remain obscured and it has not been possible to reliably distinguish these insects from extant forms or assign them to living species. Overall morphology strongly suggests, however, that an essentially modern collembolan fauna was established in the Dominican Republic by Tertiary times.

Baroni-Urbani and Saunders (*in press*) have estimated the age of substrate taken at the Palo Alto amber mines, north of Santiago. From the study of their foraminiferan faunas, the three samples were assigned an age of 20–23 million years (lower early Miocene). This age must be considered as minimum because, as Brouwer and Brouwer (1980) pointed out, the amber has undergone extensive redeposition since its formation. The present association with sediments that bear marine organisms must have occurred at a later date.

Amber studied for the present investigation was purchased from Mr. Jacob Brodzinsky, Amberica Inc., Santo Domingo, Dominican Republic. According to Mr. Brodzinsky, most of the fossil-bearing amber he obtains is extracted from mines in the northern mountain range between Santiago and Puerto Plata. However, since amber may change hands repeatedly on its way to Santo Domingo, it is not possible to determine from which particular mine it was removed.

Figs. 1, 2. 1, *Cyphoderus* sp. (37). 2, *Salina* sp. (22).

The complete collection of springtails is temporarily deposited at the Entomological Research Laboratory, University of Puerto Rico, Mayagüez. A number has been assigned to each piece and is given in parentheses throughout the taxonomic section and in the legends for the figures.

Methods

It is very difficult to study small structural details of springtails preserved in amber unless a substantial amount of resin surrounding the specimen is removed.

3

4

Figs. 3, 4. 3, *Pseudosinella* sp. (16). 4, *Seira* sp. (5).

The small working distance of high magnification objectives demands that the specimen be brought as close to the surface of the amber as possible. The amber piece should also be thin so that enough light passes through without undue reflections or distortions from bubbles or debris.

Amber was sectioned with a 10 cm diameter, 0.2 mm thick Elgin copper diamond blade mounted on the shaft of an electric motor rated at 1725 rpm. Resulting pieces were sanded along desired planes on a small wooden wheel covered with 400 grit sandpaper. Polishing was accomplished by a dry rotating cloth wheel impregnated with Menzema Werk beige-colored polishing compound (distributed to amber shops in Santo Domingo by Brouwer Dental Supply Company). The sanding and polishing wheels were mounted on a belt-driven axle connected to a similar electric motor. Almost all the drawings in this paper were made while using a Leitz oil immersion objective on amber sections less than 1 mm thick.

Surface details of the head and body (especially eyes, postantennal organ, and tenaculum) are more readily observed by complementing the substage light of the compound microscope with surface illumination from one or more high-intensity illuminators. Coating the amber with immersion oil renders invisible many surface imperfections and is recommended for photography and for the study of amber that has not been adequately polished.

Descriptive Notes and Comments

Family Isotomidae

Genus *Cryptopygus* Willem

Two specimens (30, 32) isolated from the same piece of amber belong to this genus. Length approximately 0.38 mm. Body covered by smooth setae markedly longer on last abdominal segment (Fig. 7). Mucro and claws (Figs. 8, 10) typical of genus. Eyes g and h reduced (Fig. 9), postantennal organ (PAO) large and oval-shaped.

Genus *Isotoma* Bourlet

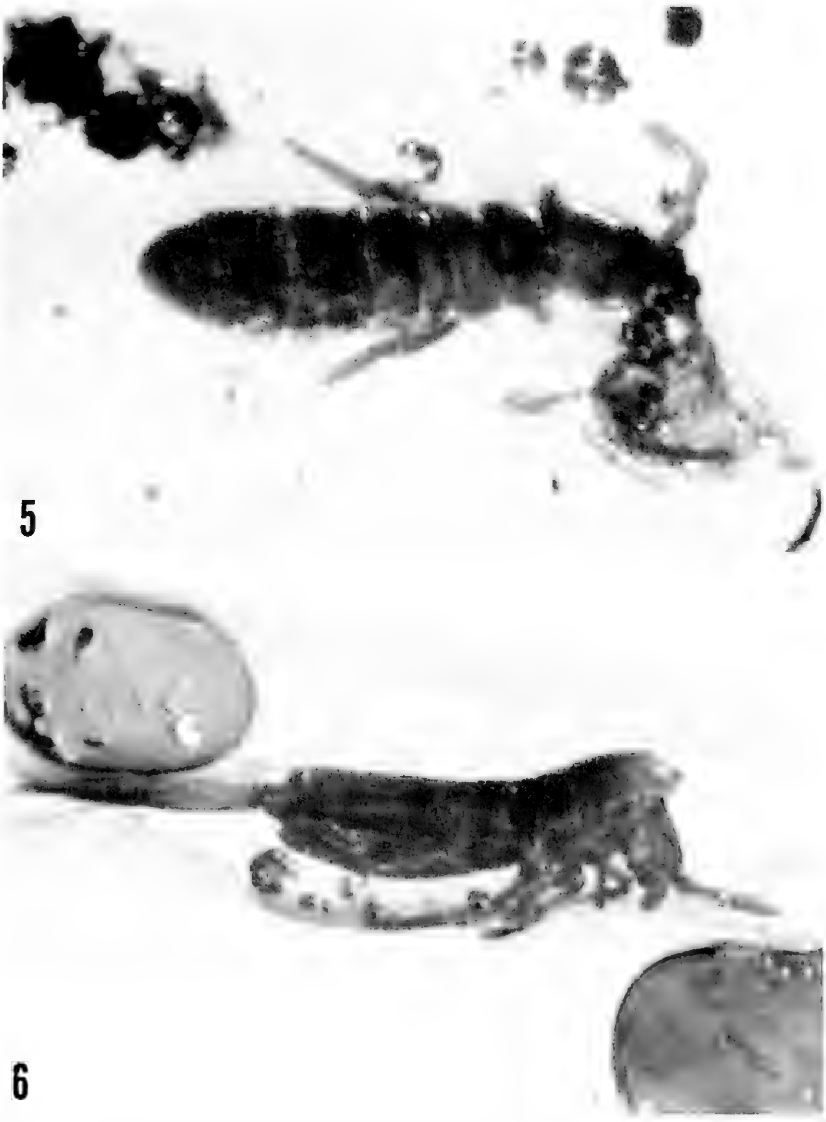
Isotoma (*Desoria*) sp. 1.—This species is represented by two specimens, one of which (33) is in very poor condition and the only observation possible is its length (0.68 mm). The second individual (Fig. 5, no. 31) measures 0.62 mm and has the fifth and sixth abdominal segments clearly separated. Body covered by smooth setae, bothriotricha absent. Several eyes visible, mucro with 2 teeth in line and a lateral tooth. Directed forwards, furcula almost reaches collophore; dorsal portion of dentes crenulated. Claw structure as in Fig. 11.

Isotoma (*Desoria*) sp. 2.—Eighteen specimens in one amber piece (37) belong to a species with the following unusual combination of characters: Eyes absent, PAO present (Fig. 12), fifth and sixth abdominal segments fused (Fig. 16), and body clothed only by short smooth setae. Furcula reaches forwards to collophore, manubrium and dentes with many short smooth setae but no spines or spinelike setae, dentes dorsally crenulate, mucro with 3 teeth (Fig. 13), corpus of tenaculum with at least 8 setae and rami with at least 3 teeth (Fig. 15), claws devoid of teeth (Fig. 17). Largest specimen measures 1.6 mm.

The aforementioned characters place this species in *Isotoma,* subgenus *Desoria,* as defined by Christiansen and Bellinger (1980), although it is clearly not a typical member of the taxon. Only two of the 41 Nearctic species in this subgenus lack eyes and both have the fifth and sixth abdominal segments separated. Types of body setae, claw structure, and mucronal morphology also separate the Dominican specimens from both Nearctic forms.

Judging from Stach (1947: 365) the Holarctic *Isotoma sphagneticola* Linnaniemi has a combination of characters similar to those of the amber fossils. However, Gisin (1960) and Grindbergs (1960) placed this species in the genus *Cryptopygus* (as *Isotomina*) and the former called it a *species inquirenda.* Christiansen and Bellinger (1980) regarded the species as "unplaceable without types."

The Dominican specimens could be referred to *Pseudosorensia* Izarra 1972, a genus erected for a species from Tierra del Fuego, Argentina. However, individuals



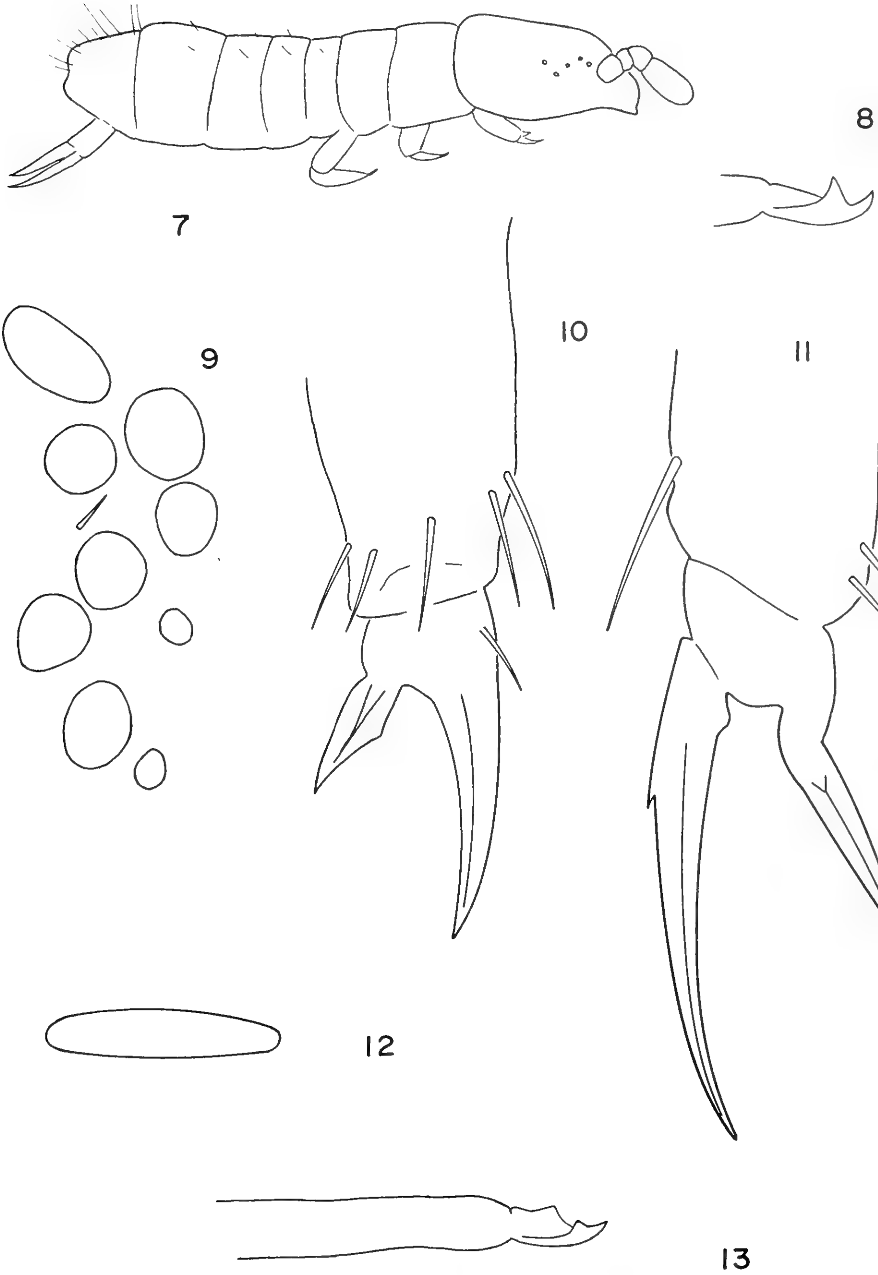
Figs. 5, 6. 5, *Isotoma* (*Desoria*) sp. 1 (31). 6, *Lepidocyrtus* sp. (21).

of *P. fueguensis* possess one eye, a much wider PAO, spinelike setae on the head and body, and some of the body setae are ciliated. The amber fossils very likely represent a new genus but I hesitate to define such a taxon until a general consensus on the limits of *Isotoma* and several other genera of Isotominae is reached.

Family Entomobryidae

Genus *Lepidocyrtus* Bourlet

Twenty specimens distributed among 11 pieces (17–21, 37–42) belong in this taxon. Individuals range in length from 0.46 to 1.0 mm and lack macrochaetae.



Figs. 7–13. 7–10, *Cryptopygus* sp. 7, Habitus (30). 8, Mucro (32). 9, Eyes and postantennal organ (32). 10, Claws (32). 11, *Isotoma* (*Desoria*) sp. 1, claws (33). 12, 13, *Isotoma* (*Desoria*) sp. 2. 12, Postantennal organ (37). 13, Mucro (37).

Most specimens have a well developed mesothoracic hood (Fig. 6). The five individuals in piece 39 range in size from 0.50 to 0.68 mm and demonstrate a direct relation between increase in overall length and the size of the hood. Some specimens possess a short mucronal spine (Figs. 20, 21) while others have the spine more strongly developed (Fig. 19).

Genus *Pseudosinella* Schaeffer

One specimen (Fig. 3) in piece 16 belongs to this genus. Length 0.74 mm. Scales hyaline, some macrochaetae along anterior margin of mesonotum, no thoracic hood. Mucro (Fig. 18) with long basal spine.

Genus *Seira* Lubbock

Nineteen specimens in as many pieces (1–15, 27–29, 36) represent this taxon. They range in length from 0.64 to 1.67 mm and most can be readily distinguished from the preceding entomobryids by the many macrochaetae along the anterior margin of the mesonotum and on the rest of the thorax. Mucronal structure (Fig. 25) is also characteristic. Scales usually conspicuous (Fig. 4) and strongly striated. Long tenent hairs (Figs. 22, 24) on all legs. Arrangement of eyes (Fig. 23) observed in one individual.

Genus *Salina* MacGillivray

The seven specimens preserved in six pieces (22–24, 41–43) measure 0.90 to 1.60 mm and belong to a species with tridentate mucrones and apically pointed dental scalelike lobe (Figs. 26, 27). A truncate unguiculus (Fig. 28) is visible in one leg of one specimen. Habitus (Fig. 2) typical of genus.

Christiansen (1971) identified as *Salina tristani* two specimens in amber from Chiapas with mucrones very similar to those of individuals in Dominican amber. I have studied 26 Puerto Rican specimens of *S. tristani* and in these the mucro bears a minute but distinct fourth tooth on one of the lamellae (see Denis 1931: 150 or Mari Mutt 1976: 117). Since other species of *Salina* have tridentate mucrones and the extant springtail fauna of the Dominican Republic is essentially unknown, it is undesirable to assign specific status to the fossils under study.

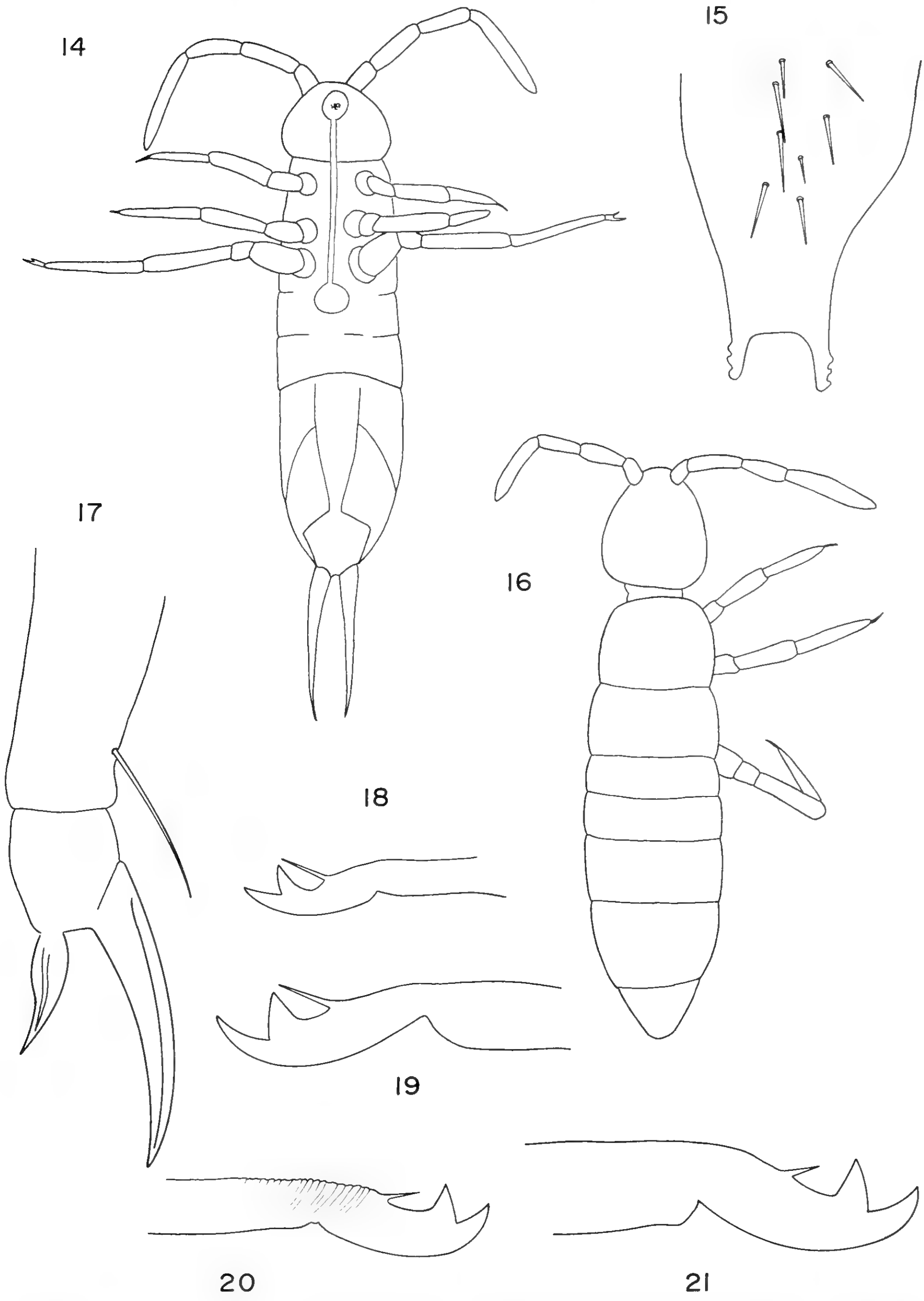
Genus *Paronella* Schött

Three specimens (25, 26, 44) belong to this genus. In habitus (Fig. 29) they resemble individuals of the preceding genus but the antennae are shorter and the mucro (Figs. 30–32) is very different. A metathoracic unguiculus is visible and is long and acuminate, not dilated as in *Salina*. Specimens measure 0.81–0.85 mm.

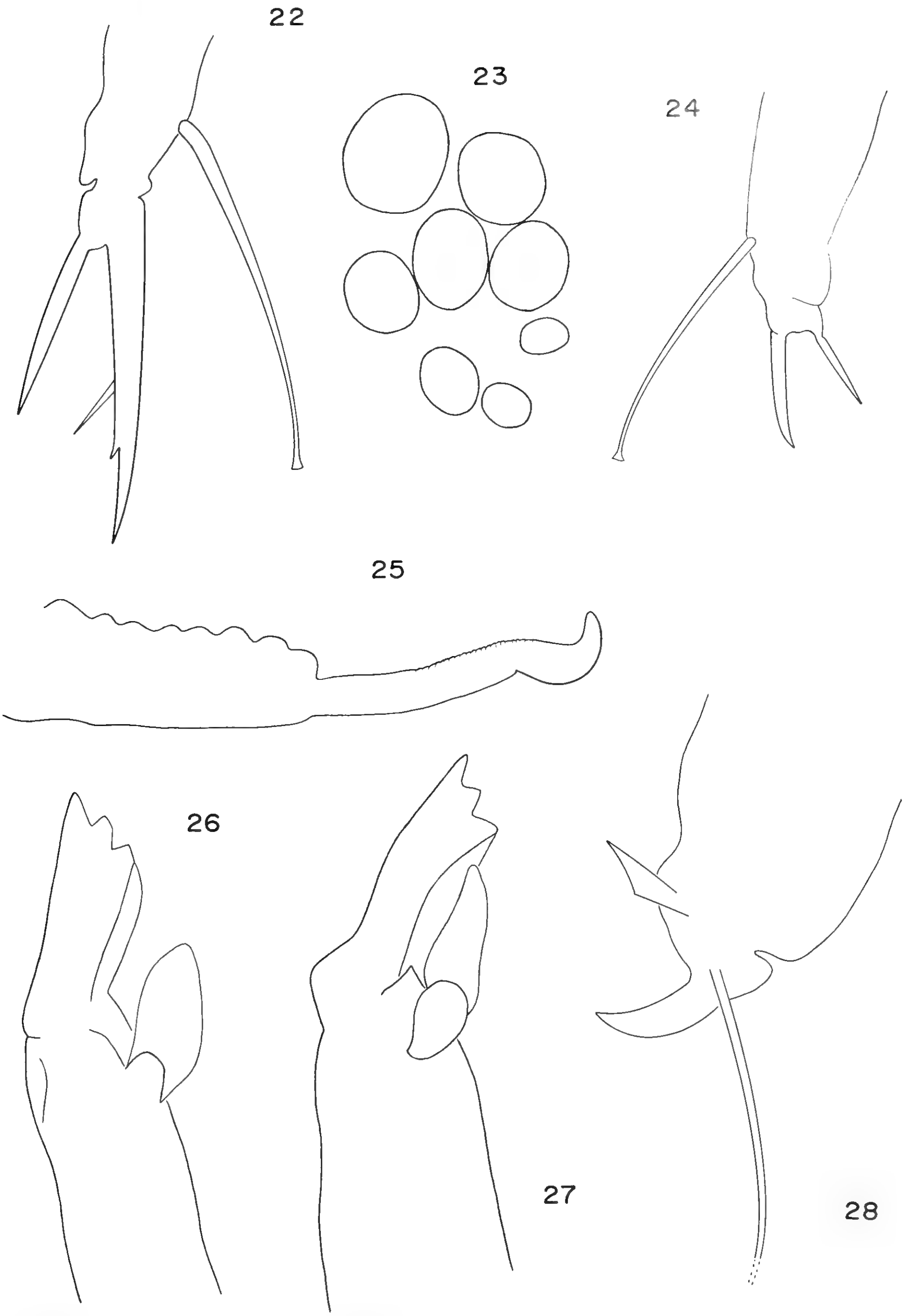
Genus *Cyphoderus* Nicolet

Cyphoderus sp. 1.—Fourteen specimens in the same amber piece (37) belong to a species recognized by short antennae (Figs. 1, 39) and mucrones with up to 8 teeth (Figs. 35, 36). The largest specimen measures 1.06 mm. Claw structure (Fig. 40) visible in a metathoracic leg of one specimen. A direct relation exists between overall length of the specimens and number of mucronal teeth (Figs. 33–36).

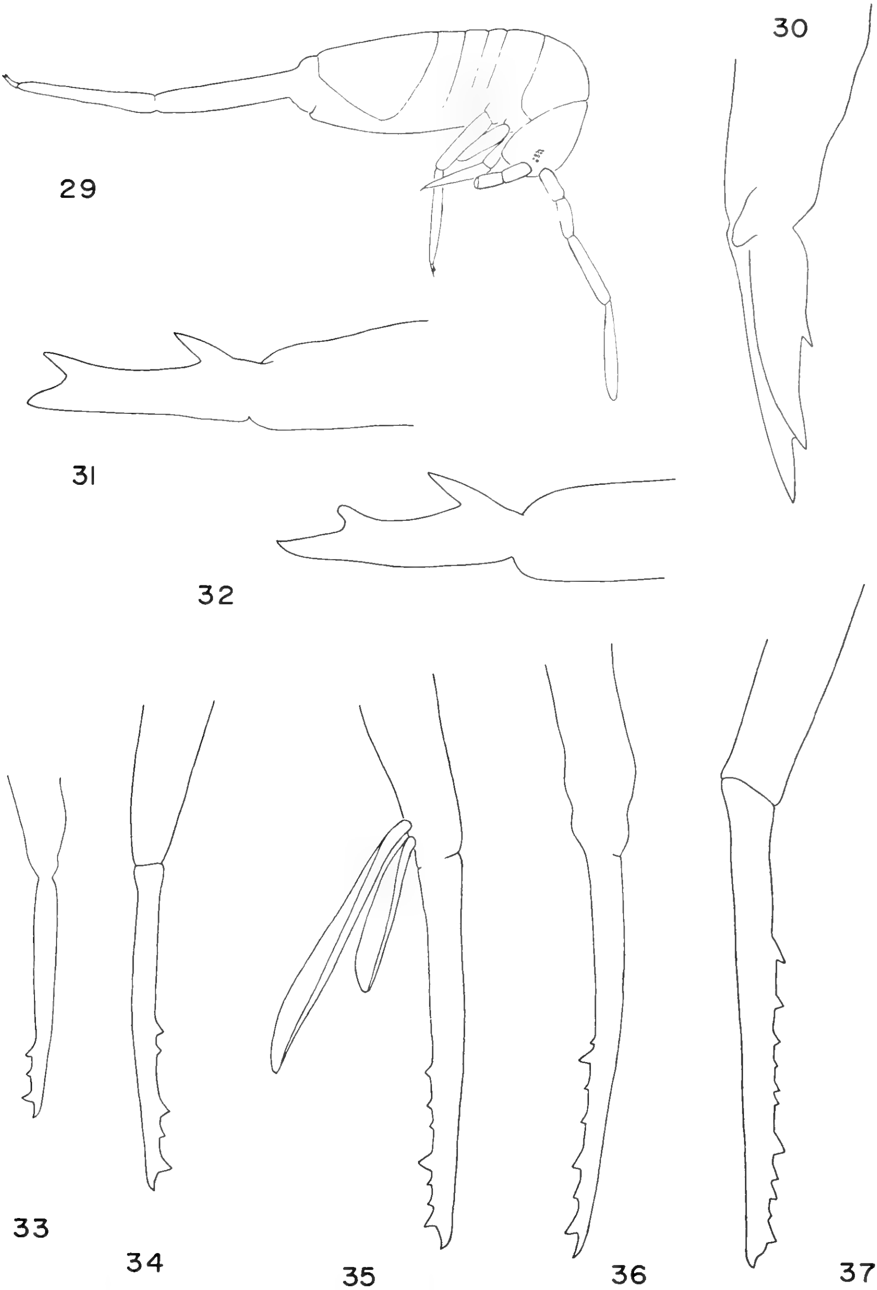
Cyphoderus sp. 2.—Amber piece 37 also houses two specimens of a different



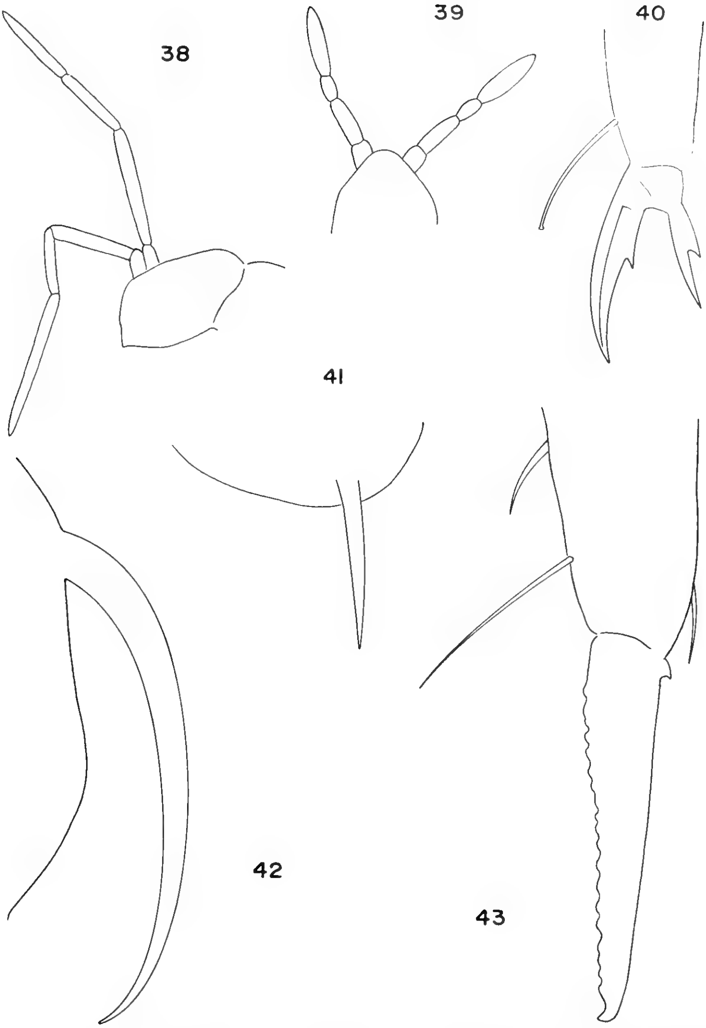
Figs. 14–21. 14–17, *Isotoma* (*Desoria*) sp. 2; all drawings from amber piece 37. 14, Habitus, ventral view. 15, Tenaculum. 16, Habitus, dorsal view. 17, Claws. 18, *Pseudosinella* sp., mucro (16). 19–21, *Lepidocyrtus* sp., mucrones (18, 21, 38).



Figs. 22–28. 22–25, *Seira* sp. 22, Claws (10). 23, Eyes (3). 24, Claws (3). 25, Mucro (11). 26–28, *Salina* sp. 26, 27, Mucrones (22, 43). 28, Claws (24).



Figs. 29–37. 29–32, *Paronella* sp. 29, Habitus (44). 30–32, Mucrones (26, 44). 33–36, *Cyphoderus* sp. 1; all drawings from specimens in amber piece 37; from left to right, individuals with these structures measure 0.55, 0.96, 1.06, and 1.04 mm. 37, *Cyphoderus* sp. 2, mucro of specimen measuring 1.26 mm (37).



Figs. 38–43. 38–40, *Cyphoderus* sp. 2. 38, Relative lengths of antennae and head (37). 39, As preceding (37). 40, Claws (37). 41–43, *Sphyrotheca* sp. 41, Trochanteral spine (35). 42, Subanal appendage (34). 43, Mucro (35).

species. These individuals possess much longer antennae (Fig. 38), measure up to 1.26 mm, legs are somewhat longer, and mucrones have 10–12 teeth (Fig. 37). Like all extant *Cyphoderus,* these fossils lack eyes.

FAMILY SMINTHURIDAE

Genus *Sphyrotheca* Börner

Two individuals (34, 35) belong to this genus, which is readily recognized by strong spinelike setae on head and body and large trochanteral spine (Fig. 41). A specimen in piece 34 measures 1.04 mm and is a female with a conspicuous subanal appendage (Fig. 42). Thick ungues suggest presence of tunica, mucro with minute serrations on both lamellae. Fourth antennal segment with 11 subsegments.

The specimen in piece 35 measures 0.46 mm and apparently is a male. Mucro with conspicuous serrations in at least one lamella (Fig. 45).

Discussion

Amber piece 37 is outstanding in harboring all the specimens of *Cyphoderus* and of the unusual *Isotoma* (*Desoria*) sp. 2. The former taxon is herein reported from fossils for the first time. The vast majority of cyphoderines are commensals in ant and termite nests and the presence of these fossils in Dominican amber indicates that this partnership has existed for a long time. The occurrence of the eyeless *Isotoma* in this same piece suggests that the latter may have also been a commensal and that these insects were perhaps trapped by resin flow from the roots of a tree located near a nest.

A comparison of the springtails in Dominican amber with those in amber from Chiapas studied by Christiansen (1971) suggests that both contemporary faunas were very similar and probably closely related. Christiansen reported seven genera, and, of these, *Seira* (as *Lepidocyrtinus*), *Lepidocyrtus, Salina, Paronella* and *Cryptopygus* (as *Isotomina*) occur in Dominican amber. The only significant difference between both groups is that in the Mexican resin the dominant genus in terms of number of specimens is *Entomobrya* while in Dominican amber this distinction is shared by *Lepidocyrtus* and *Seira* (43% of the specimens). Neither *Entomobrya* nor *Isotomurus,* also reported by Christiansen, have been discovered in Dominican amber, but both surely live today in the Dominican Republic and may be discovered during study of additional amber.

With respect to ants preserved in Dominican amber, Baroni-Urbani and Saunders (*in press*) state: "A quick overview of this fauna shows a typical Neotropical fascies not very far from what one would expect from a random sample taken in a Dominican forest today." This observation also applies to the Collembola reported herein. With the possible exception of *Isotoma* (*Desoria*) sp. 2, all other species are very likely either alive today or have their closest descendants in the extant fauna of the Dominican Republic.

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85(3), 1983, p. 587

BOOK REVIEW

An Introduction to Biological Control. By R. van den Bosch, P. S. Messenger, and A. P. Gutierrez. Plenum Press, New York and London. 247 pp., illus., 1982. Cost: $18.95, hardback.

This volume, a revision of *Biological Control* by R. van den Bosch and P. S. Messenger, is intended as an undergraduate textbook. It serves this function well, being written in straightforward, simple language, with ample and usually good definitions of the many terms and concepts needed for understanding this complex subject. Chapters include: the nature and scope of biological control, with emphasis on control of insects and weeds by insects, the ecological basis for biological control, history and international development, examples of insect predators and parasites, use of pathogens and nematodes in biological control, procedures for introducing and culturing natural enemies, application of life tables, factors limiting success, some examples of classical biological control, natural control and integrated pest management, biological control of vertebrates and their dung, some examples of competitive and cultural pest control, economics of biological control, and future prospects.

In general, except for a few "typos," the text is excellent, and the tables and diagrams are very good and useful. Many photographs should have been omitted because they detract from the text, in particular, several pictures of nonspecific predators, duplications, and those which were too dark or indistinct to show the subject. The apparently inadvertent use of boldface type on several scattered pages is distracting; this obvious mistake should have been corrected in proof.

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THE IDENTITY OF TWO CLOSELY RELATED AND FREQUENTLY ENCOUNTERED SPECIES OF NEW WORLD *TRICHOGRAMMA* (HYMENOPTERA: TRICHOGRAMMATIDAE)

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Abstract.—Most literature references to *Trichogramma perkinsi* (Girault) prior to 1978 are referable to *T. exiguum* Pinto and Platner. All treatments of *T. fasciatum* Perkins as a New World species are incorrect. Material erroneously identified as such represents *T. fuentesi* Torre, a species previously known only from Cuba. *Trichogramma exiguum* and *T. fuentesi* are similar in structure and easily confused. They are best separated by differences in hindwing setation and male genitalic structure.

Recent keys to North American *Trichogramma* (Nagarkatti and Nagaraja, 1971; Nagaraja and Nagarkatti, 1973) differentiate between two closely related species referred to as *T. fasicatum* (Perkins) and *T. perkinsi* Girault. Pinto et al. (1978) determined *T. fasciatum* to be a senior synonym of *T. beckeri* Nagarkatti that had been used inappropriately by recent authors. Similarly, Oatman et al. (1982) noted that *T. perkinsi* was a replacement name for *Pentarthron flavum* Perkins, a distinctive Hawaiian species quite unlike the North American material commonly identified as *T. perkinsi.*

Continuing studies now allow us to clarify the identity of these two species. Populations identified as *T. perkinsi* (e.g., Nagarkatti and Nagaraja, 1971) are assignable to *T. exiguum* Pinto and Platner. Material referred to as *T. fasciatum* appears to be conspecific to *T. fuentesi* Torre, previously known only from Cuba. Pinto et al. (1978) questionably cited several of the literature references of *T. fasciatum* under *T. exiguum.* The correct citations of these misidentifications are given below in the species synonymy of *T. exiguum* and *T. fuentesi.*

The two species considered here are relatively common east of the Rocky Mountains in North America and are very easily confused. For these reasons we are including a redescription of *T. fuentesi* to complement our earlier description of *T. exiguum* (Pinto et al., 1978). The descriptive data for *T. fuentesi* are based on material from Del Rio, Texas. Intraspecific variation is discussed separately.

The terminology used in our description of male genitalia follows Pinto et al. (1978). Terms used are gonobase (GB), dorsal expansion of gonobase (DEG), median ventral projection (MVP), chelate structures (CS), and chitinized ridge (CR). This terminology was utilized by Nagarkatti and Nagaraja (1968, 1971). Labelled drawings of male genitalia of *Trichogramma* spp. have appeared several times in the literature (e.g., Nagarkatti and Nagaraja, 1968; Nagarkatti, 1973).

Quantitative data in the description include the mean, ± the standard error, followed by the range and sample size.

Trichogramma fuentesi **Torre**
Figs. 1a, 1c

Trichogramma fasciatum: Quednau 1960: 32; Flanders 1968: 1122; Nagarkatti and Nagaraja 1971: 20, 1977: 159–168 *passim*; Nagaraja and Nagarkatti 1973: 289; Nagarkatti and Fazaluddin 1973: 103.
Trichogramma fuentesi Torre 1980: 12.

Color in male light yellow to yellow with yellow-brown to black markings. Pronotum, mesoscutum, and coxae yellow brown; abdomen yellow brown to black, darker anteriorly. Females lighter, mesoscutellum yellow, black markings on abdomen not as extensive as in male, confined to lateral and basal areas of sclerites.

Male.—Antennal flagellum relatively long, only slightly arcuate basally, usually slightly longer (subequal to less than 10% longer) than hindtibia; flagellar setae stout, tapering noticeably at apex only, ca. 45 in number; length of longest seta 1.80 ± 0.03 (1.6–1.9) ($n = 10$) as long as maximum flagellar width.

Forewing with vein tracts distinct, setae between tracts relatively sparse, area between 4th and 5th vein tract with 5–27 setae; longest seta on postapical margin of wing ca. 70% longer than maximum width of hindtibia.

Hindwing (Fig. 1a) with posterior and anterior tracts not as prominent as middle tract; posterior tract moderately well developed with setae increasing in length apically and extending $^3/_5$ to $^4/_5$ the distance of middle tract; anterior tract consisting of only 1–4 widely spaced setae, extending less than half the distance of middle tract.

Mesoscutellum with anterior pair of setae fine, moderately long, about ⅓ the length of posterior pair.

Genitalia (Fig. 1c): Genital capsule 0.34 ± .004 (.32–.36) ($n = 10$) as wide as long; DEG distinctly narrowed, subacute apically, apex slightly anterior to level of MVP and CS; MVP long, robust, blunt at apex, reaching or almost reaching apex of CS (ratio of the distance from base of genital capsule to apex of MVP to the distance from base of genital capsule to apex of CS = 0.98 ± .004 [.96–1.00] [$n = 10$]); CS attaining 0.87 ± .002 (.86–.89) ($n = 10$) length of genital capsule. CR distinct at posterior end only, not extending to basal half of genital capsule. Aedeagus slightly longer than apodemes, together 0.87 ± .01 (.81–.91) ($n = 10$) as long as hindtibia.

Female.—Ovipositor 1.06 ± .001 (1.056–1.060) ($n = 3$) as long as hindtibia. Flagellum short, 0.83 ± .01 (.81–.85) ($n = 3$) the length of scape, 0.48 ± .02 (.43–.50) ($n = 3$) as wide as long.

Material examined and hosts.—F_3 material originating from Del Rio, Texas, ex. unidentified Noctuidae eggs on *Sonchus* sp. Generations subsequent to the F_1 reared on eggs of *Trichoplusia ni* Hübner at 23–27°C. Additional material includes a collection from Crowley, Louisiana, taken from *Chilo plejadellus* Zincken (Pyralidae) on rice, and two specimens, including a male paratype, from the original series of *T. fuentesi* collected in Cuba from *Diatraea saccharalis* (F.) on sugar cane at the type locality (see below), and at Quivican, respectively.

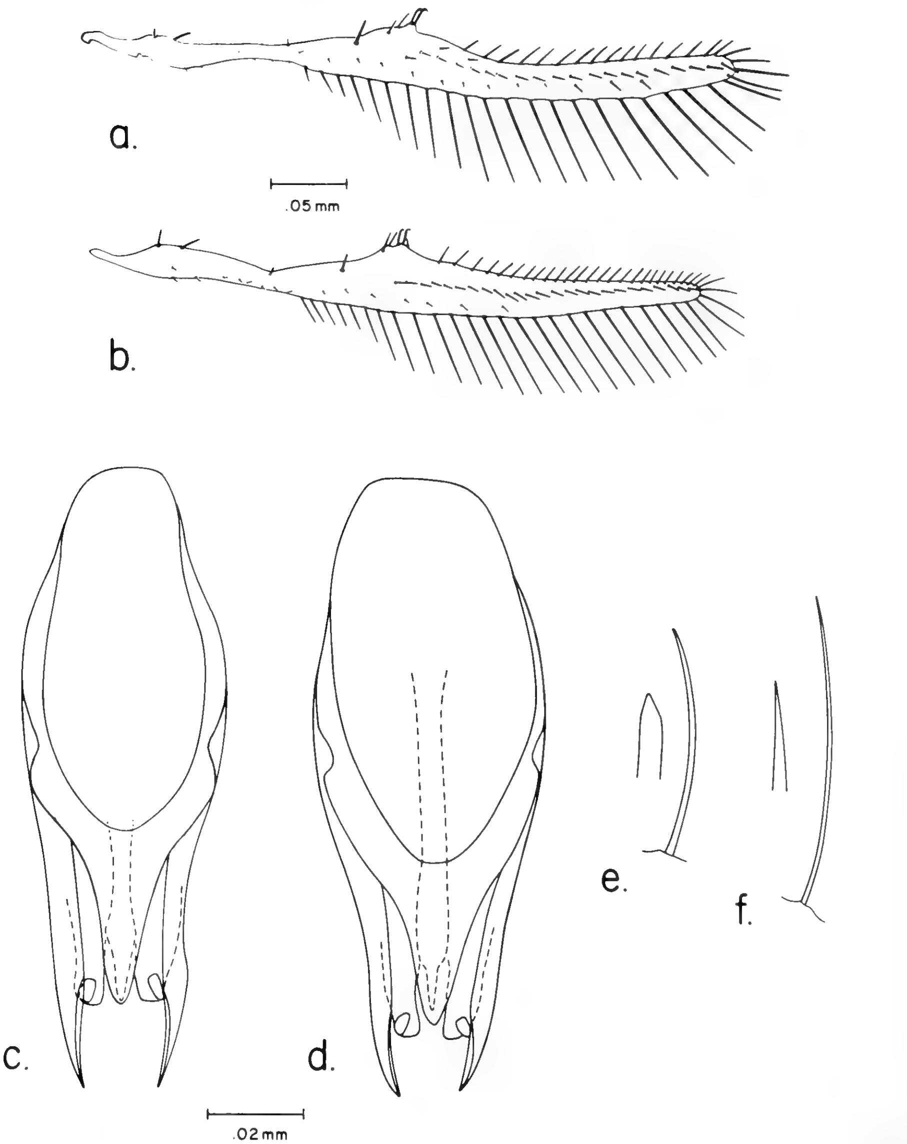

Fig. 1. a, c, *Trichogramma fuentesi*. b, d, e, *T. exiguum*. f, *T. minutum*. a, b, Hindwings. c, d, Genital capsules, dorsal view. e, f, Flagellar setae.

Type information.—Holotype, male?, from material originating at San José de las Lajas, La Habana Province, Cuba; deposited in the Zoology Department collection of the University of Havana, Cuba.

Geographic distribution.—Known from Texas and Louisiana in the United States, and from Cuba. Nagarkatti and Nagaraja (1971) also record this species (as *T. fasciatum*) from Argentina, Barbados, Mexico, and Peru.

Variation.—Torre (1980) recognized two forms of *T. fuentesi* in Cuba. These differ primarily in the color of the host egg (*D. saccharalis*) after parasitization.

The population from the type locality, San José de las Lajas, causes no discoloration of the host egg. Those parasitized by the form from Quivican turn grey with black spots. The two variants also differ slightly morphometrically. The major difference noted is in the length of the hindtibia relative to the combined length of the aedeagus and apodeme. In the type material the latter is ca. 5% longer than the hindtibia; in material from Quivican it is ca. 5% shorter. Individuals intermediate in this and other traits convinced Torre that the two populations are conspecific.

Based on the original description and examination of specimens from the original series, it appears that the U.S. populations studied represent *T. fuentesi*. The hindwing setation was obscured in the two examined specimens from Cuba, but all other distinguishing traits including those of the male genitalia and male antennae match. As with Cuban material, the U.S. specimens are variable in the combined length of the aedeagus and apodemes relative to that of the hindtibia. In specimens from Del Rio the hindtibia is between 10–20% longer; in those from Crowley, Louisiana, it varies from 10% longer to subequal (see below). In none of the U.S. material is the hindtibia shorter, as occurs in the type series.

We have not reared *T. fuentesi* from *D. saccharalis* eggs and cannot comment on their coloration in response to parasitization by U.S. populations. However, those of an unknown species of Noctuidae (Del Rio host) and *Trichoplusia ni* (laboratory host) turn blackish as do most eggs parasitized by *Trichogramma*.

The only character that appears to differ significantly between U.S. and Cuban *T. fuentesi* is ovipositor length. Torre reports the ovipositor to be 1.24 the length of the hindtibia. In our material it averages only 1.06 the hindtibial length. We have not seen females of *T. fuentesi* from Cuba and cannot be sure that Torre is measuring these structures as we are. Nevertheless, ovipositor length is one of the most intraspecifically variable characters in *Trichogramma* and we are reluctant to delimit species on this basis alone.

Specimens from Crowley, Louisiana, are similar to those from Del Rio, Texas, in all respects. Minor differences are the slightly longer setae on the male flagellum (1.91 ± .05 [1.7–2.0] [$n = 9$] as long as maximum flagellar width), the greater combined aedeagus-apodeme length (0.94 ± .02 [.9–1.0] [$n = 9$] the length of the hindtibia), and the slightly longer MVP which reaches the apex of the CS in almost all of the males examined.

Trichogramma exiguum Pinto and Platner

Figs. 1b, 1d, 1e

Trichogramma perkinsi: Nagarkatti and Nagaraja 1971: 23, 1977: 160–169 *passim*; Nagaraja and Nagarkatti 1973: 289.
Trichogramma exiguum Pinto and Platner 1978: 177.

The original description of *T. exiguum* was based on material from Alabama (Selma) and Missouri (Columbia and Springfield). We have since examined material from St. John, Kansas; Krotz Springs, Louisiana; and Palmira, Colombia. All other literature records questionably listed under *T. exiguum* by Pinto et al. (1978) are almost certainly assignable to *T. fuentesi*. Known hosts for *T. exiguum* include five species of Noctuidae: *Diatraea grandiosella* (Dyar), *Heliothis zea* (Boddie), *H. virescens* (F.), *Pseudoplusia includens* (Walker), and *Trichoplusia ni*.

IDENTIFICATION OF *T. EXIGUUM* AND *T. FUENTESI*

Trichogramma exiguum and *T. fuentesi* are superficially similar to *T. minutum*, but are easily distinguished by the shape of the flagellar setae in the male. In *T. minutum*, the setae gradually taper to a fine point (Fig. 1f). In *T. exiguum* and *T. fuentesi*, they are essentially the same diameter most of their length, tapering noticeably at the apex only (Fig. 1e).

Trichogramma exiguum and *T. fuentesi* (as *T. perkinsi* and *T. fasciatum*, respectively) are separated in couplet 9 of Nagaraja and Nagarkatti (1973). The following modification of this couplet adequately separates the two species:

- Male genitalia with median ventral projection attaining or nearly attaining apex of chelate structures, chitinized ridge indistinct except at posterior end, not extending to basal half of genital capsule (Fig. 1c); hindwing with setae of posterior tract increasing in length apically, tract extending $^3/_5$–$^4/_5$ the distance of middle tract (Fig. 1a) .... *T. fuentesi*
- Male genitalia with median ventral projection distinctly short of apex of chelate structures, chitinized ridge distinct throughout length and attaining basal half of genital capsule (Fig. 1d); hindwing with setae of posterior tract uniformly short, tract not extending more than ½ the distance of middle tract (Fig. 1b) .... *T. exiguum*

Although less reliable than the above traits, color of adults and the extension of the chelate structures also provide separation. *Trichogramma fuentesi* is a darker species, with dark areas of the body almost black rather than yellow brown as in *T. exiguum*. In *T. exiguum*, the chelate structures approximate the apex of the gonoforceps more closely than in *T. fuentesi* (Figs. 1c, 1d). In four geographically distinct populations of *T. exiguum*, the chelate structures attain 0.91 ± .002 (.90–.93; $n = 36$) the length of the genital capsule; in populations of *T. fuentesi*, they only attain 0.87 ± .002 (.85–.89; $n = 18$) its length.

Cross-breeding studies support the recognition of *T. exiguum* and *T. fuentesi* as distinct. Attempted crosses between *T. exiguum* from Selma, Alabama, and *T. fuentesi* from Del Rio, Texas, were completely unsuccessful. Procedures used in these cross-breeding studies were as detailed by Oatman et al. (1970).

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PROC. ENTOMOL. SOC. WASH.
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NEW RECORDS OF A PALEARCTIC FLEA BEETLE, *PSYLLIODES AFFINIS,* IN EASTERN NORTH AMERICA (COLEOPTERA: CHRYSOMELIDAE)

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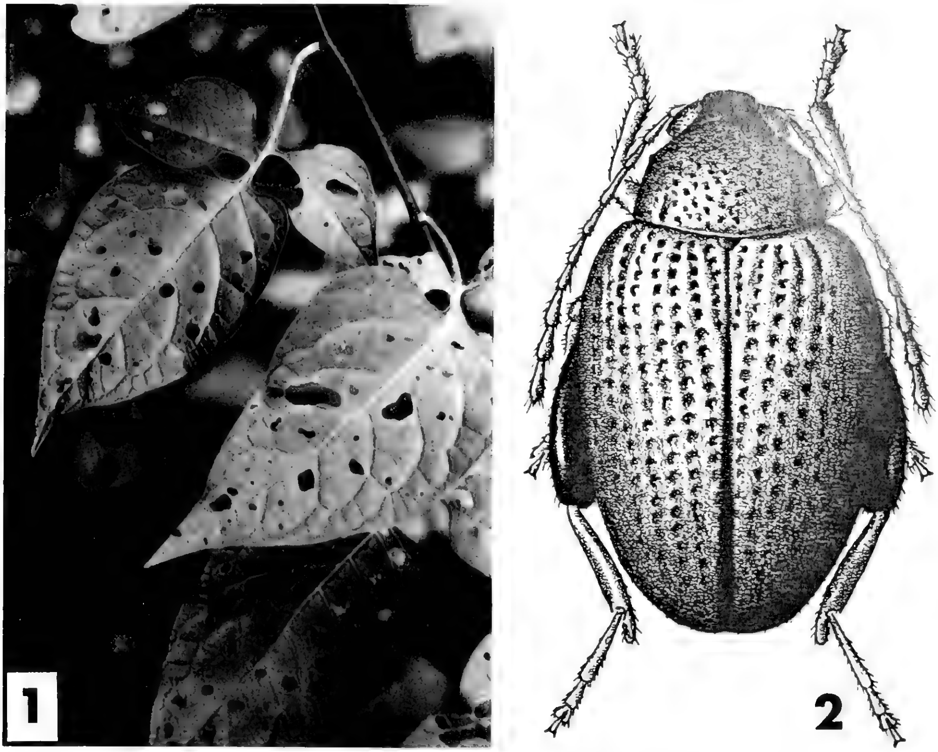
Abstract.—Psylliodes affinis (Paykull), a Palearctic flea beetle known in North America only from two counties of eastern New York, is reported from additional New York counties and from Pennsylvania and Ontario. The known distribution is listed and mapped, and a brief review of its distribution and biology in Europe is given. An adult diagnosis and habitus and a photograph of adult feeding damage on bitter nightshade (*Solanum dulcamara*), its principal host plant in eastern North America, are also provided.

In America north of Mexico, the alticine genus *Psylliodes* Latreille is represented by 12 species, five of which are introduced: *cucullata* (Illiger), *chrysocephala* (L.), *napi* (F.), *picina* (Marsham), and *affinis* (Paykull). All species of *Psylliodes* are distinctive by having a 10-segmented antenna.

The first report of establishment of the Palearctic *P. affinis* in North America was based on collections from bitter nightshade, *Solanum dulcamara* L., in Albany and Greene counties, New York, in July 1968 (Anon., 1968). *Psylliodes affinis* also has been intercepted at ports of entry in the United States on dahlia roots that originated in Poland, and in a package of rose stock shipped from Germany (Anon., 1968).

Psylliodes affinis, common throughout most of Europe, also occurs in Siberia. This specialized feeder on solanaceous plants prefers bitter nightshade but often feeds on potato, *S. tuberosum* L. Usually only a minor pest of potato, it sometimes causes severe, local injury. Adults of *P. affinis* may attack other solanaceous plants, including tobacco (*Nicotiana* spp.), tomato (*Lycopersicon esculentum* Mill.), black henbane (*Hyoscyamus niger* L.), *Lycium* sp., and occasionally hops (*Humulus* sp., Cannabinaceae).

In Europe, overwintered adults become active during late April or early May and produce characteristic, small, round holes in the leaves of their hosts (Fig. 1). Oviposition begins about one month later, with the eggs laid singly or in small groups near the host plant; the eggs are elongate-oval, yellow, and 0.6–0.7 mm long. The whitish larvae feed on rootlets and make superficial (and occasionally deep) galleries or tunnels in roots, with feeding lasting approximately one month. Pupation takes place in the soil, and adults of this univoltine species emerge in about 3–4 weeks. Although larval injury is considered non-economic, adult feeding



Figs. 1, 2. *Psylliodes affinis* and host plant. 1, Adult feeding damage on bitter nightshade, *Solanum dulcamara.* 2, Dorsal habitus (taken from Anonymous, 1968; drawing by R. E. White).

may severely damage potato foliage during September. Several workers have implicated the adults as minor vectors of the virus that causes potato leaf curl.

Information on distribution, phenology, and economic importance of *P. affinis* in Europe was taken from Heikertinger (1915), Tölg (1915), Murphy (1923), Walton (1925), Newton (1929), Blunck (1931), and Elze (1931). Additional references may be consulted in Balachowsky (1963).

In May 1980, we collected *P. affinis* in the vicinity of Ithaca, New York (Hoebeke, 1980), and subsequently at other New York localities and in Pennsylvania and Ontario. The Ontario collection represents the first record of this Palearctic species in Canada. Herein, we summarize and map the known North American distribution of this introduced species (Fig. 3). Additional records from the Ithaca area, obtained from May–August, 1980–82, are not given. All collections listed below were made from bitter nightshade, *Solanum dulcamara.*

United States: NEW YORK: *Cortland Co.,* 11 July 1981, AGW & ERH. *Erie Co.,* Buffalo (Allentown), 12 June 1982, ERH; Tonawanda, 31 August 1980, ERH. *Livingston Co.,* Letchworth State Park, 5 mi. E. of Perry, 18–21 June 1980–82, ERH. *Monroe Co.,* along Rt. 31, Egypt, 31 July 1982, AGW & ERH. *Nassau Co.,* Planting Fields Arboretum, Oyster Bay, Long Island, 29 May 1981 and 28 May 1982, AGW & ERH. *Niagara Co.,* Niagara Falls, 12 June 1981, ERH. *Onondaga Co.,* Solvay, 26 June 1982, AGW & ERH. *Seneca Co.,* Hayts Corners,

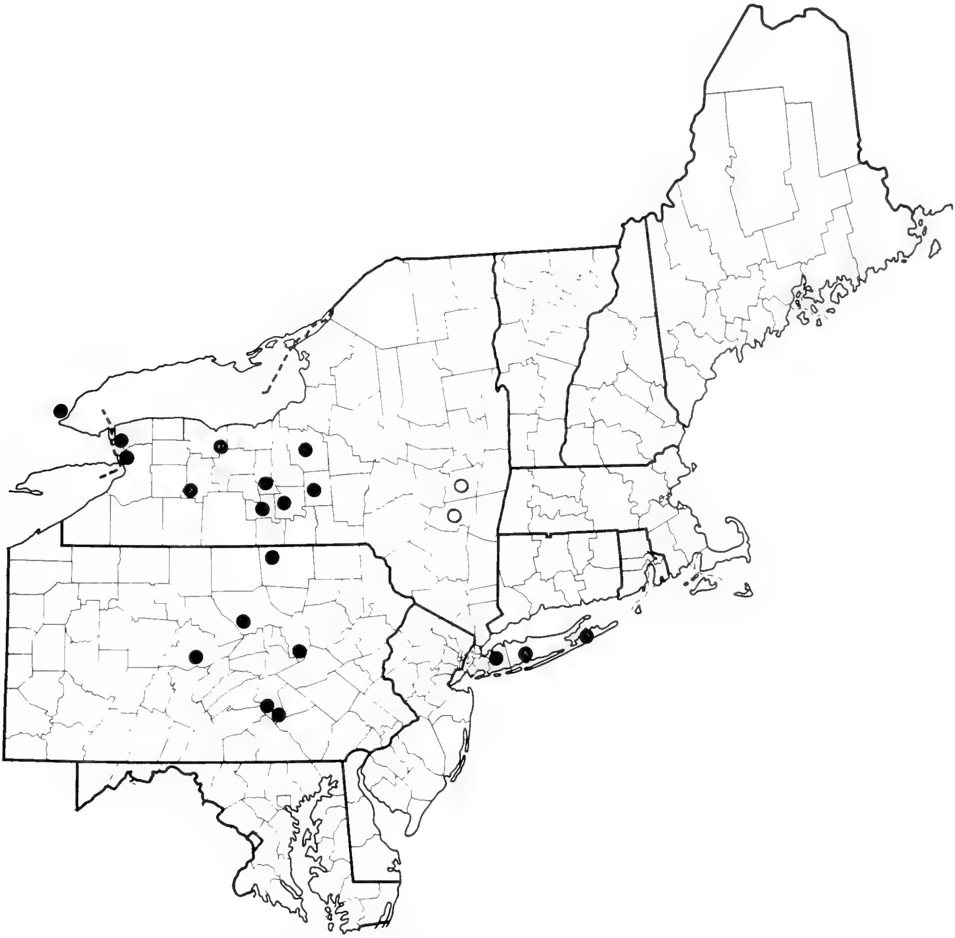


Fig. 3. Known distribution of *Psylliodes affinis* in eastern North America. Open circles represent original detection sites; closed circles represent new records and Tompkins Co., N.Y., records (Hoebeke, 1980).

24 June 1981, ERH. *Suffolk Co.,* Bayard Cutting Arboretum, Oakdale, Long Island, 30 May 1982, AGW & ERH; Flying Point, near Southampton, L.I., 30 May 1982, AGW & ERH. PENNSYLVANIA: *Bradford Co.,* Centerville, 25 June 1982, AGW. *Centre Co.,* State College, 18 May 1981, AGW. *Columbia Co.,* Numidia, 7 July 1982, AGW. *Dauphin Co.,* Harrisburg, 13 and 19 May 1981, AGW; Hershey, 16 June 1981, 17 May 1982, and 23 June 1982, AGW. *Lycoming Co.,* Jersey Shore, 5 August 1982, ERH.

Canada: ONTARIO: *Halton Co.,* between Hamilton and Burlington, Guelph line, 13 June 1981, ERH.

Even though *P. affinis* has not been collected on plants of economic importance in North America, it remains a potential pest of potato. This introduced chrysomelid (Fig. 2) may be distinguished by the following combination of characters: Adult length 2.0–2.8 mm, body ovoid, dorsal color light tan or brown, head and ventral surface black, elytral suture narrowly bordered with dark brown or black, and hindfemur very large and black to reddish black.

Psylliodes affinis is at once recognized by its light tan or brown dorsal coloration; in general, all other North American species of *Psylliodes* are shiny pitch black to dark bluish green dorsally, with or without a metallic luster.

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A TECHNIQUE FOR REARING AND SOME NOTES ON THE BIOLOGY OF A DESERT SAND COCKROACH, *ARENIVAGA INVESTIGATA* (DICTYOPTERA: POLYPHAGIDAE)

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Abstract.—A simple technique for rearing a desert sand cockroach, *Arenivaga investigata* Friauf and Edney, is presented, and observations on its age-dependent egg production are included.

A desert sand cockroach, *Arenivaga investigata* Friauf and Edney, is an important species in laboratory studies of physiological ecology. Some of its unique features, such as absorption of water from unsaturated air (Edney, 1966; O'Donnell, 1977) and low rate of water loss (Edney, 1968), have contributed to our knowledge of adaptations to xeric environments. Cochran (1979) reported a culturing method for *A. tonkowa* Hebard; however, to date, there have been no reports of successful rearing of *A. investigata.* We report herein a technique for rearing *A. investigata* that has proved successful in our laboratory and measurements of female age-dependent egg production.

Materials and Methods

Adult females and nymphs of *A. investigata* were collected at the type locality of "Windy Point," 9.7 km west of Palm Springs in Riverside County, California, in March, 1981. The specimens were found in sand dunes at a depth of 0.25–0.5 m. The small collection consisted of two adult females and five nymphs.

Our culture technique is similar to the method developed by Cochran (1979) but slightly modified from observations of the collection site. Most of the cockroaches were found in fairly fine, moist sand (20–30% moisture), but they could easily burrow upward into essentially dry areas. A 1-gallon glass jar filled with fine chromatographic grade sand (200-mesh) to a depth of 7 cm served as the culture container. Water was provided by burying a tightly covered 70-ml glass jar with a 5-mm-diam central hole in the cover which secured a piece of dental wick ca. 1 cm above the cover. Five or six pieces of dry dog chow, crushed or in pellet form, were placed on the surface of the sand. Each month 15 ml of water were added to the sand. The culture container, covered with paper toweling and secured with a rubber band, was kept on a laboratory bench subject to ambient temperature (23–27°C), RH (30–40%) and light fluctuations.

Results

After their placement on the surface of the sand, the cockroaches rapidly burrowed until they were completely covered. The cockroaches remained submerged

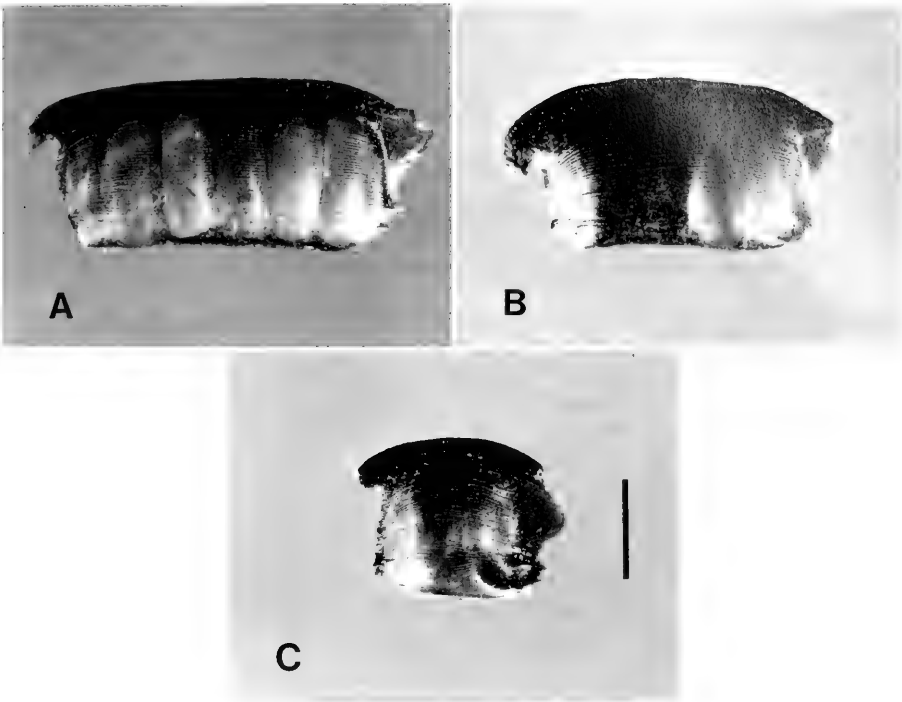

Fig. 1. *Arenivaga investigata* oothecae. A, From young (1–3 month) adult females. B, From middle-aged (3–6 month) adult females. C, From old (>6 month) adult females. Scale represents 2 mm.

in the sand throughout the photophase; however, adult males and females and, on rare occasions, nymphs were observed on the surface during the scotophase. Unlike *A. tonkowa* (Cochran, 1979), *A. investigata* were never observed atop the sand during the photophase, despite some disturbances.

Two months following the initiation of the colony, an adult male was observed, and about one week later the first ootheca was found. During the next year over 20 oothecae, averaging 7.7 eggs/ootheca, were deposited of which only two hatched, yielding 16 nymphs (8♂ and 8♀) that successfully developed and reproduced. Interestingly, adult males survive less than two months following adult ecdysis. As the age of adult females increases the number of eggs deposited/ootheca decreases. A young female deposits 8–11 eggs/ootheca (8.0–9.5 × 3.5 mm) whereas females near death deposit 1–4 eggs/ootheca (3.5–6.5 × 3.5 mm). Fig. 1 shows typical oothecae from young, middle-aged, and old females.

DISCUSSION

The technique described has provided a successful albeit small laboratory culture of *A. investigata*. Although no quantitative life cycle studies have yet been undertaken, development from egg to adult takes about seven months.

Decreasing numbers of eggs per successive ootheca have been observed in *Blattella germanica* (L.) and *B. vaga* Hebard (Willis et al., 1958); however, to our knowledge, this is the first report of this phenomenon in a polyphagid species.

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NEW SPECIES OF *CURTARA* (HOMOPTERA: CICADELLIDAE) FROM CENTRAL AND SOUTH AMERICA

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Abstract.—Seven species of Central and South American *Curtara* are described. Six species, *C.* ***insueta***, n. sp. (Mexico), *C.* ***scutella***, n. sp. (Peru), *C.* ***retusa***, n. sp. (Mexico), *C.* ***alicuja***, n. sp. (Bolivia), *C.* ***canora***, n. sp. (Nicaragua) and *C.* ***longula***, n. sp. (Ecuador) are placed in the subgenus *Curtara*. One species, *C.* ***declivara***, n. sp. (Mexico), is placed in the subgenus *Curtarana*.

The genus *Curtara* was described by DeLong and Freytag (1972) and *C. samera* DeLong and Freytag was designated as the type-species. A synopsis of the genus by the same authors (1976) treated 76 species, 59 of which were described as new. Four South American species were described by DeLong (1977); one species was described by DeLong and Triplehorn (1978) from Paraguay and three species from Peru were described by the same authors (1979); two species from Panama were described by DeLong and Wolda (1978); and 30 species from Central and South America were described by DeLong (1980). Seven species are described in this manuscript. Types, unless otherwise designated, are in the DeLong Collection, The Ohio State University.

Curtara insueta DeLong, New Species

Figs. 1–5

Description.—Length of male 9 mm, female 11 mm. Crown almost ¾ as long at middle as wide at base between eyes. Color: crown yellow tinted with brown, ocelli red. Pronotum brownish yellow, a longitudinal white line extending from anterior margin of pronotum to apex of scutellum. Lateral margins pale yellow. Forewings brownish yellow, costal margin, basal margin along scutellum, claval suture, and commissure pale yellow.

Female with posterior margin of 7th sternum with a U-shaped notch, ⅓ distance to base of segment on each side of a broadly rounded median lobe extending to distance of lateral angles.

Male genital plates, 3× as long as wide at middle, apices bluntly rounded. Style slender, elongate, apex bent dorsally and truncate. Aedeagal shaft slender, apex broadly rounded, bearing 2 subapical processes, ⅓ length of shaft, which extend laterobasally. Paraphyses blade-like, ⁴⁄₅ length of shaft. Pygofer rounded apically, apex bearing a slightly embrowned, sclerotized tip.

Types.—Holotype ♂, Mexico, Oaxaca, 5 mi. N.E. Juchitan, 2-VIII-1974, C. W., L. B. O'Brien, and Marshall colls. Paratype, 1 ♀, same data as holotype.

Remarks.—*Curtara insueta* is placed in the subgenus *Curtara* and is related to

C. bicolorata (Metcalf and Bruner) (1949: 93) from which it can be separated by the apically broadened tip of the aedeagal shaft, the broader laterobasal directed subapical processes and the shorter paraphyses.

Curtara scutella **DeLong, New Species**

Figs. 6–10

Description.—Length of male 9 mm, female unknown. Crown broadly rounded, more than twice as wide between eyes at base as long at middle. Ocelli equidistant between eyes and median line. Color: crown yellow. Pronotum yellow with a small round brown spot behind each eye, disc with small brown punctate spots. Scutellum yellow with black basal angles. Forewings yellow with a few irregular brown spots and markings.

Male genital plates twice as long as wide at middle, apices rounded. Style rather short, broadly and irregularly triangular at apex. Aedeagal shaft rather long, curved, and bearing 2 long terminal processes, each of which is bifid near shaft and bears a short process extending basad. Pygofer narrowed caudally, blunt at apex.

Holotype.—♂, Peru, Guayabamba, 70 km E. of Cuachapaya, Aug. 16, 1936, F. Woythowski coll. In the Snow Collection, University of Kansas.

Remarks.—*Curtara scutella* is placed in the subgenus *Curtara* and is related to *C. trista* DeLong and Freytag (1976: 32) from which it can be separated by the pointed "heel" of the foot-shaped apex of the style.

Curtara retusa **DeLong, New Species**

Figs. 11–15

Description.—Length of male 9.2 mm, female unknown. Crown twice as wide between eyes at base as long at middle. Ocelli closer to median line than to eyes. Color: crown brownish yellow. Pronotum brownish yellow with numerous brown punctate spots. Scutellum brownish yellow, basal angles slightly darker brown. Forewings pale brownish subhyaline with a few darker brown spots and markings.

Male genital plates slender, elongate, almost 5× as long as wide at middle, apices bluntly pointed. Style with an elongate, sloping apex, pointed near blade at basal end and curved with a pointed tip basally at extended, more apical end. Aedeagal shaft slender, bearing 2 anteapical processes which are about ⅓ length of shaft, extending caudally and broadening before pointed apex. Paraphyses broadly, concavely rounded dorsally near pointed apex. Pygofer rounded apically.

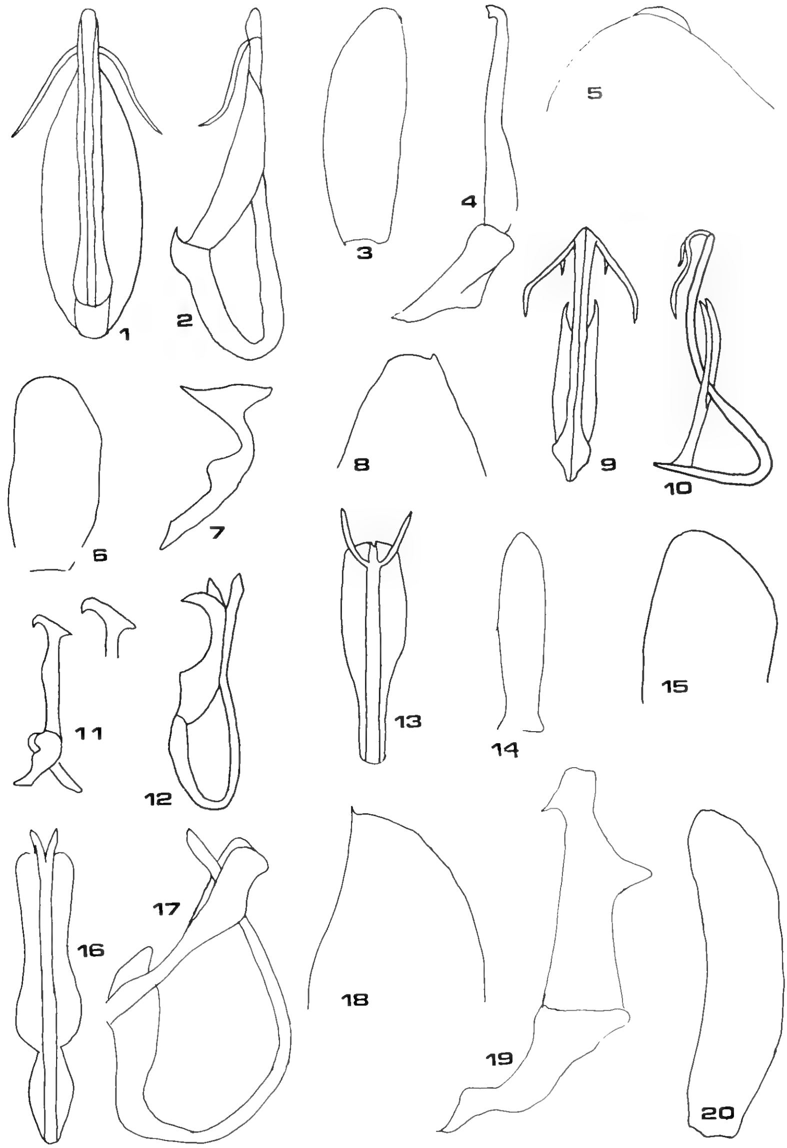
Holotype.—♂, Mexico, 10 mi. W. of Tuxtla, Guterrez, July 8, 1955, R. E. Beer and party colls. In Snow Entomology Collection, University of Kansas.

Remarks.—*Curtara retusa* is placed in the subgenus *Curtara* and is related to *C. rugara* DeLong and Freytag (1976: 35) and can be separated from it by the more elongate, broader, apical portion of the style, the deeper, broadened cavity of the paraphyses and the widened apical processes of the aedeagal shaft.

Curtara alicuja **DeLong, New Species**

Figs. 16–20

Description.—Length of male 8 mm, female unknown. Crown almost half as long at middle as wide at base, between eyes. Ocelli a little closer to median line than to eyes. Color: crown, pronotum and scutellum pale brown with numerous dark brown punctate spots. Veins pale brown.



Figs. 1–20. 1–5, *Curtara insueta.* 6–10, *C. scutella.* 11–15, *C. retusa.* 16–20, *C. alicuja.* 1, 9, 13, 16, Aedeagus ventrally. 2, 10, 12, 17, Aedeagus laterally. 3, 6, 14, 20, Plate ventrally. 4, 7, 11, 19, Style laterally. 5, 8, 15, 18, Pygofer laterally, apical portion.

Male genital plates more than 3× as long as wide at middle, apex bluntly angled. Style with blade broad, bearing a large spinelike process on ventral margin at ⅔ its length. Apex of blade blunt and bearing a pointed subapical spine which curves dorsobasally. Aedeagal shaft slender, apex bifid with pointed tips. Paraphyses slender on basal ½, broadened on apical ½ with apices rounded. Pygofer narrowed apically, bearing a short dorsocaudal apical spine.

Holotype.—♂, Bolivia, Santa Cruz, 10 mi. W. Portachuela, III-27-1978, C. W. and L. B. O'Brien colls.

Remarks.—*Curtara alicuja* is placed in the subgenus *Curtara* and is related to *C. canera* DeLong and Freytag (1976: 10) from which it can be separated by the large central tooth on the the style and by the narrower basal half of the paraphyses.

Curtara canora DeLong, New Species

Figs. 21–24

Description.—Length of male 8 mm, female unknown. Crown roundly produced, more than ½ as long at middle as wide between eyes at base. Ocelli nearer to median line than to eyes. Color: crown yellowish with 3 marginal, small brown spots in front of ocelli. Pronotum yellow with a brownish spot on anterior portion behind each ocellus and apical portion embrowned. Scutellum yellowish. Forewings yellowish subhyaline with numerous irregular brown spots and markings, veins yellowish.

Male genital plates 4× as long as wide at middle, apices narrowed, rounded. Style slender, apical portion enlarged, triangular, apex pointed. Aedeagal shaft slender bearing a pair of subapical processes which are bifid near shaft, with short processes extending caudally. Paraphyses broad, apical ½ deeply concave on dorsal margin. Pygofer narrowed, rounded apically.

Holotype.—♂, Nicaragua, 3 mi. S.W. Managua, February 12, 1956, J. R. Alcorn coll. In Snow Entomological Collection, University of Kansas.

Remarks.—*Curtara canora* is placed in the subgenus *Curtara* and is related to *C. bifidella* DeLong and Freytag (1976: 27) from which it can be separated by the subapical processes of the aedeagal shaft, which are long and bear a short branched process which arises near base.

Curtara longula DeLong, New Species

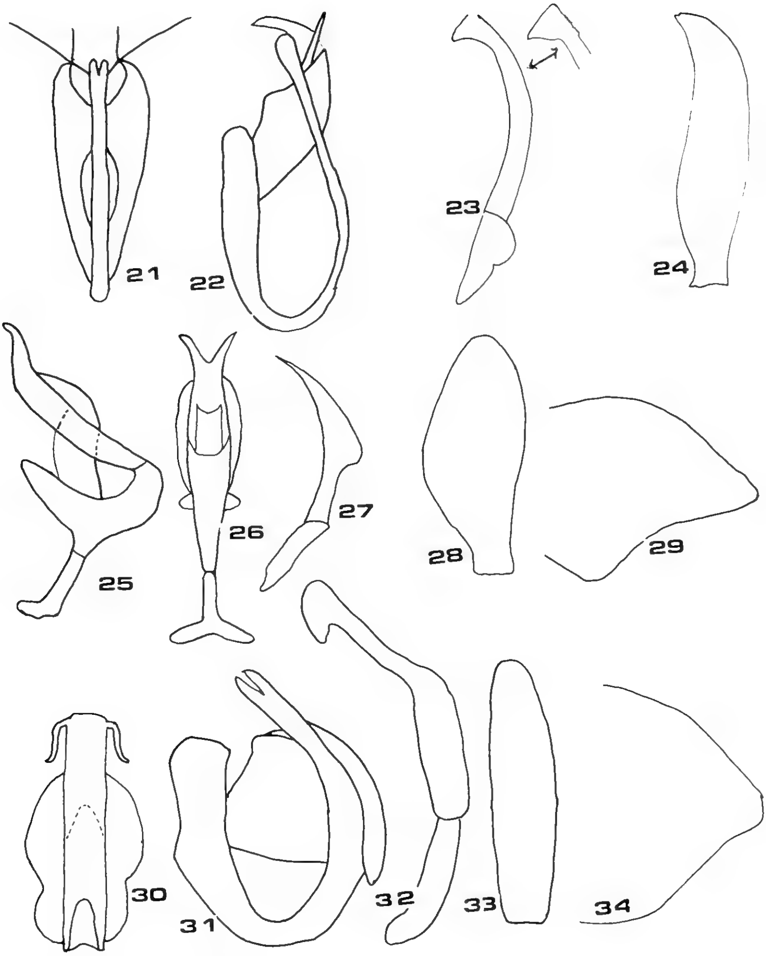
Figs. 25–29

Description.—Length of male 7.0 mm, female unknown. Crown roundly produced, a little more than twice as wide between eyes at base as long at middle. Ocelli nearer to median line than to eyes. Color: crown yellow with 3 faint black spots on margin and one behind each ocellus, at base. Pronotum yellowish with punctate brown spots, dark brown markings behind each eye and a pair of median, small, round, black spots at base. Scutellum yellow with dark brown, basal angles. Forewings yellow with irregular dark brown markings, costal and apical portions yellow with numerous small, dark brown spots.

Male genital plates twice as long as wide at middle, apices rounded. Style with an enlarged, broadened, triangular apex, which is almost flat apically and is pointed anteriorly and posteriorly. Aedeagus with a rather broad, apically bifid shaft. Paraphyses long, rather uniform in width to near apex, exceeding aedeagal shaft in length. Pygofer narrowed, bluntly pointed apically.

Holotype.—♂, Pallatango, Ecuador, G. H. H. Tate coll. In Snow Entomology Collection, University of Kansas.

Remarks.—*Curtara longula* is placed in the subgenus *Curtara* and is related to *C. catena* DeLong and Freytag (1976: 53) and can be separated from it by the more elongate, footlike apex of the style with a rounded "heel" and by an apically bifid aedeagal shaft.



Figs. 21–34. 21–24, *Curtara canora*. 25–29, *C. longula*. 30–34, *C. declivara*. 21, 26, 30, Aedeagus ventrally. 22, 25, 31, Aedeagus laterally. 24, 28, 33, Plate ventrally. 23, 27, 32, Style laterally. 29, 34, Pygofer laterally, apical portion.

Curtara declivara **DeLong, NEW SPECIES**

Figs. 30–34

Description.—Length of male 10 mm, female unknown. Crown and pronotum declivated, crown more than twice as wide between eyes at base as long at middle. Ocelli equidistant between eyes and median line. Color: crown brownish yellow with irregular dark brown markings. Pronotum brownish yellow with 2 proximal small, round, dark brown spots, and 2 larger black circular spots near basal margin. Disc with irregular dark brown spots and ramose pigment. Scutellum yellowish with black basal angles and irregular brown markings. Forewings dull whitish with dark brown spots and markings. Veins dark brown.

Male genital plates 4× as long as wide at middle, apices rounded. Style angled and narrowed at ½ length of blade; apex enlarged, rounded, with pointed basad margin. Aedeagal shaft curved, broad (ventral aspect), bearing 2 short apical processes $1/6$ length of shaft, extending basad. Paraphyses broad, extending beyond curved aedeagal shaft. Pygofer narrowed, bluntly pointed.

Holotype.—♂, Maiz, S. L. P., Mexico, 12 mi. west, 3200 ft., July 23, 1962, taken at light.

Remarks.—*Curtara declivara* is placed in the subgenus *Cartarana* and is related to *C. animosa* DeLong and Freytag (1976: 52) from which it can be separated by the more rounded apex of the style, the apical processes of the aedeagus, and the more circular shaped paraphyses.

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85(3), 1983, pp. 607–611

THE GARDEN FLEAHOPPER GENUS *HALTICUS* (HEMIPTERA: MIRIDAE): RESURRECTION OF AN OLD NAME AND KEY TO SPECIES OF THE WESTERN HEMISPHERE

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Abstract.—The plant bug *Halticus canus* (Distant), known from Guatemala, Mexico, and Nicaragua, is resurrected from the synonymy of the garden fleahopper, *H. bractatus* (Say). Male genitalia for both species are illustrated, and a key is provided to separate the four species of *Halticus* known from the western Hemisphere: *H. apterus* (F.), *H. bractatus, H. canus,* and *H. intermedius* (Uhler). A record of *H. bractatus* from Hawaii is new for the state.

Halticus bractatus (Say), an important crop pest, has been the subject of numerous economic investigations. Ashmead's (1887) observation of *bractatus* (as *Rhinacloa citri* Ashmead) attacking orange trees in Florida is the first record documenting damage by this species. Chittenden (1902) apparently coined the common name "garden fleahopper" because of its preference for many truck or garden crops and for its ability to hop. Beyer (1921) summarized most of the literature relating to this pest (as *Halticus citri*), reviewed distribution and synonymies, described the immature stages, and listed 41 host plants. *Halticus bractatus* prefers plants in the family Fabaceae such as alfalfa, beans, and clovers, but it will readily feed on many others, including barley, corn, oats, wheat, eggplant, potato, tobacco, and cotton. The fleahopper occurs throughout much of North (eastern and midwestern United States), Central, and South America (Carvalho 1958), and the West Indies (Maldonado, 1969; Alayo, 1974).

While identifying a collection of Neotropical Miridae from Mexico, I discovered a species of *Halticus* that appeared similar to but larger than *bractatus,* the only species of the genus known from this region. Perusal of the literature revealed that six names have been placed in synonymy under *bractatus*; one of these names is here considered to represent a distinct species.

Herein, I resurrect the name *canus* Distant for a species occurring in southern Mexico and Central America, compare *canus* to *bractatus,* illustrate male genitalia of both species, and provide a revised key to separate the four species of *Halticus* now recognized from the Western hemisphere.

Halticus canus (Distant)

Figs. 4–6

Calocoris canus Distant, 1893: 430.
Calocoris canus: Van Duzee, 1907: 30.

Halticus canus was synonymized under *bractatus* without any specific comment or comparison (Van Duzee, 1907). Van Duzee apparently based this synonymy solely on the overall similarity of *bractatus* to Distant's figures of *canus.*

I have reviewed the original descriptions of *bractatus* and the six taxa considered as junior synonyms: *Halticus spegazzinii* Berg, 1884[1]; *Rhinacloa citri* Ashmead, 1887; *Halticus minutus* Uhler, 1889; *Halticus uhleri* Giard, 1982; *Calocoris canus* Distant, 1893; and *Halticus nigricornis* Reuter, 1908. Based on the descriptions (size and color), distribution, and my knowledge of the species, I have concluded that *canus* is distinct from *bractatus.*

Although I have not seen the male lectotype of *canus* designated by Carvalho and Dolling (1976), I have examined two brachypterous females in the USNM (det. as *Calocoris canus* Distant) that were part of the "Biologia" material; they agree in all respects with Distant's description and figures.

Description.—Macropterous male ($n = 10$): Length, 2.64–3.12 mm; width, 0.84–0.86 mm. *Head:* Width, 0.62–0.64 mm; vertex, 0.26–0.30 mm. *Rostrum:* Length, 0.80–0.86 mm, reaching mesocoxae. *Antenna:* Segment I, 0.26–0.28 mm; II, 1.12–1.20 mm; III, 0.70–0.78 mm; IV, 0.40–0.48 mm. *Pronotum:* Length, 0.40–0.48 mm; basal width, 0.86–0.92 mm. *Genitalia:* Left paramere (Fig. 4); aedeagus (Fig. 5); right paramere (Fig. 6).

Macropterous female ($n = 2$): Length, 2.76–3.08 mm; width, 1.08 mm. *Head:* Width, 0.58–0.60 mm; vertex, 0.30 mm. *Rostrum:* Length 0.86 mm. *Antenna:* Segment I, 0.24 mm; II, 0.92–0.98 mm; III, 0.70–0.78 mm; IV, 0.42–0.48 mm. *Pronotum:* Length, 0.50 mm; basal width, 0.96–0.98 mm.

Overall coloration shiny black, with narrow inner margin of eyes yellow and apex of cuneus white; membrane translucent black or brown, veins black; venter shiny black; antennal segment I yellowish brown; segment II variably colored, from entirely yellowish brown to black; segments III and IV darker brown with base of III pale yellowish to yellowish brown; pro- and mesofemora yellowish brown with bases black; metafemur entirely black except for narrow yellow apex; tibiae uniformly yellowish brown, base of metatibia usually black; tarsi yellowish brown except for blackish apex of 3rd segment; claws black. Dorsum clothed with long, semierect, brown simple setae, intermixed on hemelytra with patches of silvery, silky or scalelike setae.

Brachypterous female ($n = 10$): Length to apex of abdomen, 1.68–1.96 mm; length to apex of hemelytra, 1.52–1.68 mm; width, 1.12–1.16 mm. *Head:* Width, 0.58–0.60 mm; vertex, 0.30 mm. *Rostrum:* Length, 0.90–0.92 mm. *Antenna:* Segment I, 0.22–0.24 mm; II, 0.86–0.92 mm; III, 0.68–0.70 mm; IV, 0.42–0.44 mm. *Pronotum:* Length, 0.38–0.40 mm; basal width, 0.74–0.80 mm.

Very similar to macropterous forms in the shiny black dorsum and venter, narrow yellow band along inside of eyes, leg markings, and pubescence; differing in the shortened coleopteroid hemelytra lacking a cuneus and membrane, antennal segment I black or yellowish brown with apex black or strongly infuscated (macropterous female also with this color development on segment I), and antennal segment II usually entirely black.

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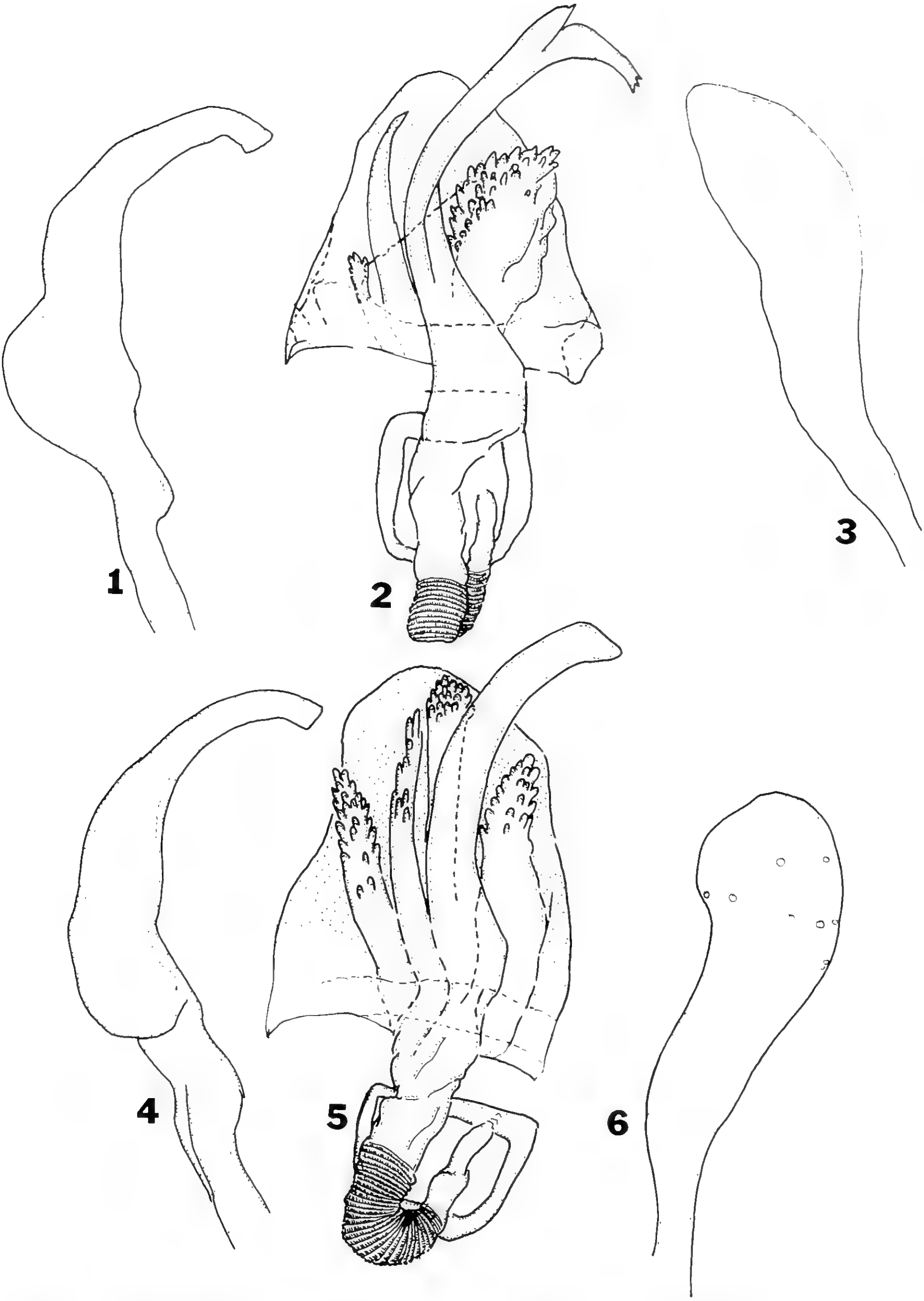
[1] Lack of sufficient material precludes fully re-evaluating the status of *H. spegazzinii* described from South America. A preliminary investigation, however, suggests that it is different from the species included in my key.



Figs. 1–6. Male genitalia of *Halticus* spp. 1–3, *H. bractatus.* 1, Left paramere. 2, Aedeagus. 3, Right paramere. 4–6, *H. canus.* 4, Left paramere. 5, Aedeagus. 6, Right paramere.

Specimens examined. All in the National Museum of Natural History, Washington, D.C. (USNM). 2 brachypterous ♀, syntypes, Cerro-Zunil [Guatemala], 4–5000 ft., Champion coll.; 12 ♂, 18 brachypterous ♀, Yepocapa, Guatemala, 1948–49, no collector data; 1 brachypterous ♀, Huehuet'go, Guatemala, 3 Mar. 1949, H. T. Dalmat coll.; 4 brachypterous ♀, Cordoba, Mexico, Mar.–Apr. 1908, F. K. Knab coll.; 1 ♂, Hidalgo, Mexico, 316 km, 8 Mar. 1946, J. Caldwell coll.; 7 ♂, 12 brachypterous ♀, Veracruz, Mexico, 8 km north of Fortin, 1300 m, 21–22 Apr. 1978, T. J. Henry, J. C. Schaffner, and R. T. Schuh colls.; 8 ♂, 2 macropterous ♀, 5 brachypterous ♀, Veracruz, Mexico, 34 km north of Maolinco, 1280 m, 21–22 Apr. 1978, Henry, Schaffner, and Schuh colls.

Remarks.—*Halticus canus* can be separated from *bractatus* by the larger size and by the differently colored femora as given in the key. In *canus,* males and females have the pro- and mesofemora yellow with only the bases black; in males of *bractatus,* the pro- and mesofemora are entirely yellow, and in females they are black with only the apices yellow.

Male genitalia of *bractatus* (Figs. 1–3) also differ significantly from those of *canus* (Figs. 4–6). The left paramere of *canus* (Fig. 4) is less angulate in lateral aspect; the right paramere (Fig. 6) is more rounded; and the aedeagus (Fig. 5) has the primary spiculum straight and truncate apically, and the four secondary spiculi are slender with numerous shingle-like tubercles apically. In *bractatus,* the primary spiculum of the aedeagus (Fig. 2) is bifurcate apically, one secondary spiculum is acutely produced apically and lacks shingle-like tubercles, and the right secondary spiculum is broad and roughened laterally.

With the resurrection of *canus,* four species of *Halticus* are now recognized to occur in the Western Hemisphere. The genus can be keyed easily in such notable works as Blatchley (1926), Knight (1941), and Carvalho (1955). The following is a revised key to species.

KEY TO SPECIES OF *HALTICUS* FROM THE WESTERN HEMISPHERE

1. Hemelytra without silky or scalelike pubescence; Maine, Nova Scotia, Ontario and Palearctic .... *apterous* (Linnaeus)
– Hemelytra with distinct tufts of golden or silvery silky or scalelike pubescence 2
2. Robust species, length 3.0–3.8 mm, body width more than ½ (.60) body length; only macropterous form known; Ontario south to Mississippi, west to Manitoba, Colorado, and California .... *intermedius* Uhler
– Slender species, length usually less than 3 mm; body width ¼ or less body length in macropterous form; brachypterous female common, length 2.00 mm or less 3
3. Larger species, length 2.60–3.12 mm; narrow pale-yellow band along inside margin of eye complete from base of vertex to antennal bases; pro- and mesofemora yellow with only bases black in both sexes; Guatemala, Mexico, and Nicaragua .... *canus* (Distant)

– Smaller species, length 2.30 mm or less; narrow pale-yellow band along inside margin of eye restricted to vertex; pro- and mesofemora entirely yellow in male, black with only apices yellow in female; North, Central, and South America, West Indies, and Hawaii [Volcano, Hawaii, 2 Nov. 1981, ex: artichoke, C. J. Davis coll. (USNM); NEW STATE RECORD] . . . . *bractatus* (Say)

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COMPARATIVE STUDIES OF THE DEVELOPMENT OF TWO SPECIES OF SPOTTED CUTWORM *XESTIA ADELA* AND *XESTIA DOLOSA* (LEPIDOPTERA: NOCTUIDAE), AND IDENTIFICATION OF LARVAE BY ELECTROPHORESIS

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Abstract.—The immature states of *X. adela* Franclemont and *X. dolosa* Franclemont are structurally indistinguishable except for size. In laboratory rearings the average maximum weight of the last larval instar of *X. dolosa* was about double that of *X. adela*; the average weight of *X. dolosa* pupae was similarly greater than that of *X. adela.* The difference in size, measured as the width of the larval head capsules, increased after the fourth instar; at this time the head capsule of *X. dolosa* became distinctively darker. Eight enzymes were surveyed by electrophoresis; two were found to completely distinguish larvae, pupae, and adults of the two species in sympatric populations.

Xestia adela Franclemont and *Xestia dolosa* Franclemont are recently recognized sibling species (Franclemont, 1980) of what was previously known in North America as the spotted cutworm, *Xestia c-nigrum* (L.). As such they are reported to have caused economic damage in localized outbreaks (Beirne, 1971). *Xestia adela* is the more widely distributed, occurring in the northern and central United States and throughout most of Canada, whereas *X. dolosa* is restricted to the northeastern and central United States and southeastern Canada (Franclemont, 1980). In the east, where the two species occur sympatrically, it is not known if accounts of damage by *X. c-nigrum* can be attributed to one or both species.

Adults of *X. adela* and *X. dolosa* can usually be distinguished on the basis of characters of the genitalia and reproductive system (Franclemont, 1980; Hudson, 1981), and by selected measurements of the head and wings; they can also be distinguished electrophoretically by allozymes of adenylate kinase (Hudson and Lefkovitch, 1980).

The use of allozymes (alleles at a single locus) as species diagnostic characters was described by Ayala and Powell (1972) for distinguishing sibling species of *Drosophila,* and these authors established criteria for selecting loci which could be safely considered to be diagnostic. Since then, electrophoretic keys have been constructed for the identification of adults and larvae of several groups of insects that are difficult to identify by structural characters (e.g., Miles, 1979; Berlocher, 1980).

The immature stages of *X. adela* and *X. dolosa* are structurally indistinguishable, except in terms of maximum size. As *Amathes c-nigrum* the larvae have been

Table 1. Maximum weights reached by larvae and pupae of *X. adela* and *X. dolosa* under two different temperature and photoperiod regimes.

Temp.	Photoperiod L:D	No. in Sample	Species	Mean Max. Weight of Larvae (Range)	Mean Max. Weight of Pupae (Range)
24°C	16:8	29	*X. adela*	0.564 (0.442–0.640)	0.281 (0.245–0.332)
		30	*X. dolosa*	0.996 (0.648–1.118)	0.427 (0.367–0.534)
21°C	12:12	25	*X. adela*	0.531 (0.432–0.701)	0.266 (0.177–0.329)
		24	*X. dolosa*	1.032 (0.726–1.222)	0.475 (0.353–0.552)

described as non-specific feeders on vegetable and cereal crops and tobacco; they also climb to feed on fruit and shade trees (Rings, 1977; Rings and Johnson, 1977), but it is not known if this behaviour is typical of both sibling species.

The present study compares the development of *X. adela* and *X. dolosa*, reared under controlled conditions, and applies the method of electrophoresis to the immature stages, in a survey for diagnostic enzyme loci that could be used to identify them in sympatric populations.

MATERIAL AND METHODS

Gravid females of the spring broods of *X. adela* and *X. dolosa* were collected from light traps set up in North Gower and Harrow, Ontario. They were placed in cages for oviposition and eggs were laid on strands of frayed nylon cord, or squares of nylon screening.

Two methods of rearing were employed to provide samples for comparative studies of development (duration of larval instars, head capsule widths, maximum weights) and for electrophoresis.

Method 1 was carried out under two regimes of temperature and photoperiod; 24°C with 16 h light and 8 h dark, and 21°C with 12 h light and 12 h dark.

Fertile eggs were removed from the cages and placed in 3 cm diameter clear polystyrene vials containing small slices of artificial diet spaced between strips of absorptive paper (Hinks and Byers, 1976). Larvae that emerged during a 12 hour period were placed individually in 4.5 × 2.3 × 2.0 cm clear polystyrene boxes containing diet and reared individually through to pupation. The food was changed daily during the early instars and then on alternate days. The vials were examined daily for head capsules which were removed and measured, and the date of each moult was recorded. After reaching the last instar the larvae were weighed daily and the maximum weight attained by each was recorded; this marked the onset of the prepupal period. Prepupae were placed in moistened peat moss until pupation. When the pupal cuticle had hardened the pupae were weighed and sexed and returned to the peat moss until emergence.

Method 2 was carried out at 24°C 16L:8D. The progeny of ten *X. adela* and 5 *X. dolosa* females were reared as single lines. Fifty eggs from each female were

Table 2. Number of days spent at each developmental stage by *X. adela* and *X. dolosa* under two different regimes of temperature and photoperiod (mean values taken from 25–35 insects ±SE)

	24°C 16L:8D				21°C 12L:12D			
Species	Larvae	Prepupae	Pupae	Egg to Adult	Larvae	Prepupae	Pupae	Egg to Adult
X. adela	16.65 ± 0.19	4.35 ± 0.24	12.15 ± 0.13	32.37 ± 0.21	26.64 ± 0.21	4.24 ± 0.13	14.52 ± 0.59	45.17 ± 0.40
X. dolosa	18.20 ± 0.20	9.40 ± 0.26	15.80 ± 0.24	43.43 ± 0.54	35.02 ± 0.24	8.54 ± 0.26	21.26 ± 0.59	64.61 ± 0.40

frozen at −80°C; the remaining eggs from a single female were placed in a vial and after hatching two groups of 10 first instar larvae were removed and frozen. The remaining larvae from each line were maintained separately in larger containers for further development; from each line samples of five larvae of successive instars, as well as newly emerged adults, were removed and frozen. These samples were used for electrophoresis.

Electrophoresis.—The horizontal starch gel method described by Ayala et al. (1972) was employed using 12% by weight of electrostarch (Electrostarch Co., Wisconsin). Eight enzyme loci were surveyed using three different buffer systems. (1) Bridge buffer 0.135 M tris–0.04 M citric acid–0.001 M EDTA pH 7.2, gel buffer diluted 1:2, for adenylate dinase (Adk), α-glycerophosphate (α-Gpdh) and isocitrate dehydrogenase (Idh). (2) Bridge buffer 0.3 M boric acid–0.06 M NaOH pH 8.1, gel buffer 0.08 M tris–0.006 M citric acid pH 8.85 (Poulik, 1957) for hexokinase (Hk), phosphoglucose isomerase (Pgi) and glutamate-oxaloacetate transaminase (Got). (3) Bridge buffer 0.05 M Tris–0.05 M NaH_2PO_4, gel buffer diluted to 1 in 10 (Harris and Hopkinson, 1976) for mannose phosphate isomerase (Mpi).

Results and Discussion

Salkeld (unpublished) has found that the eggs of *X. adela* and *X. dolosa* resemble each other closely in size and chorionic patterns, but that the number of primary (rosette) cells is usually greater in *X. dolosa.* Under the standard rearing conditions (24°C, 16L:8D) fertile eggs of both species darkened within 6–8 days.

The larvae of the two species appear to be structurally indistinguishable except for a difference in size which becomes increasingly evident from the fourth instar. Under two different rearing conditions the final instar mean maximum weight attained by *X. dolosa* larvae was close to double that of *X. adela* (Table 1); the range of maximum weights of individuals in each species was large, but there was no overlap. There was a gradual reduction in size during the prepupal stage by each species, to about one half the maximum larval weight (Table 1).

The total times taken for development by each species from egg to adult, under the two different temperature and photoperiod regimes, differed by 12.8 days for *X. adela* and 21.2 days for *X. dolosa* (Table 2). At 24°C, 16L:8D *X. dolosa* took 11.1 days longer than *X. adela* to complete development, mainly due to longer duration of the prepupal and pupal stages. At 21°C, 12L:12D *X. dolosa* took 19.4 days longer than *X. adela,* but under these conditions the time spent as larvae increased also.

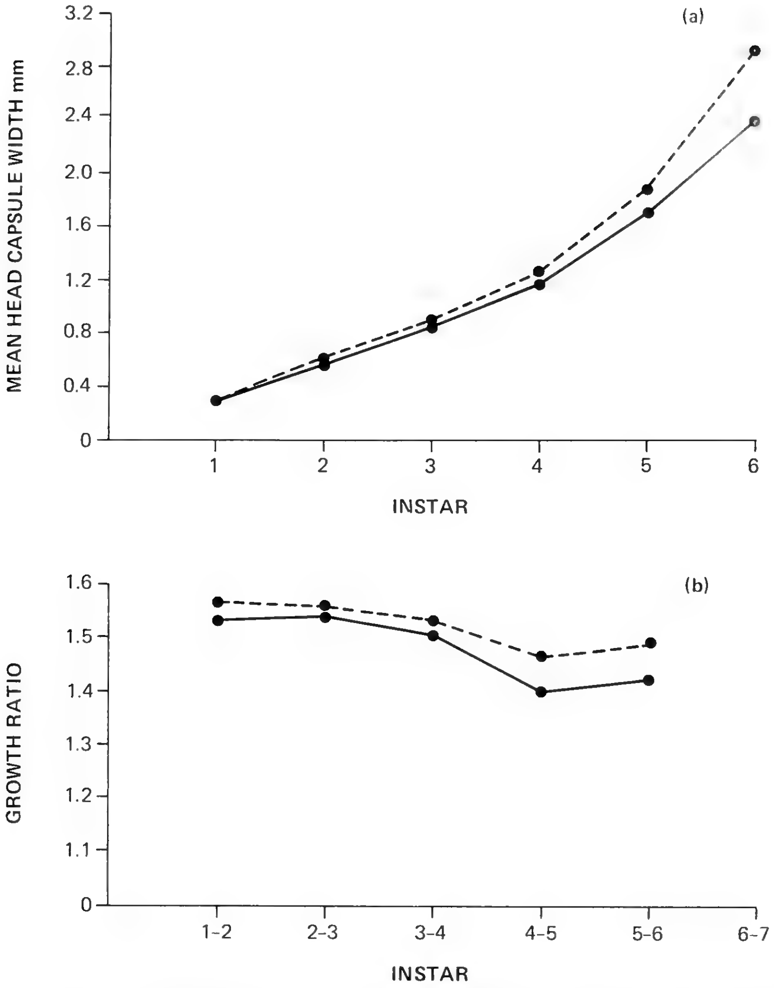

Fig. 1. a, Growth of head width of 1st- to 6th-instar larvae of *Xestia adela* (solid line) and *X. dolosa* (broken line). b, Growth ratios for 1st–6th instars as above.

Comparisons of larval growth in the two species were made in terms of head capsule widths. Little difference was evident between them until the fourth instar (Fig. 1a) when the mean width for *X. adela* was 1.19 mm ± 0.019 (84 individuals), and for *X. dolosa* 1.33 ± 0.023 mm (81). After the fourth instar the difference in size between the species increased at each moult until at the sixth instar (prepupa) the mean head width of *X. adela* larvae was 2.40 ± 0.033 mm (55) and of *X. dolosa* larvae 2.90 ± 0.02 mm (54). Growth ratios (the ratio of the means for two successive instars) are shown in Fig. 1b, and follow a similar pattern in both species. The ratios for instars 1–2, 2–3, and 3–4 were highest, dropping slightly for instar 4–5 and 5–6. The mean growth ratio for *X. adela* was 1.48 and for *X. dolosa* it was 1.52. A small number of the insects reared at 21°C, 12L:12D underwent an additional moult and the resulting adults from these larvae had slightly larger head widths. After the fourth instar the head capsules of *X. dolosa* became

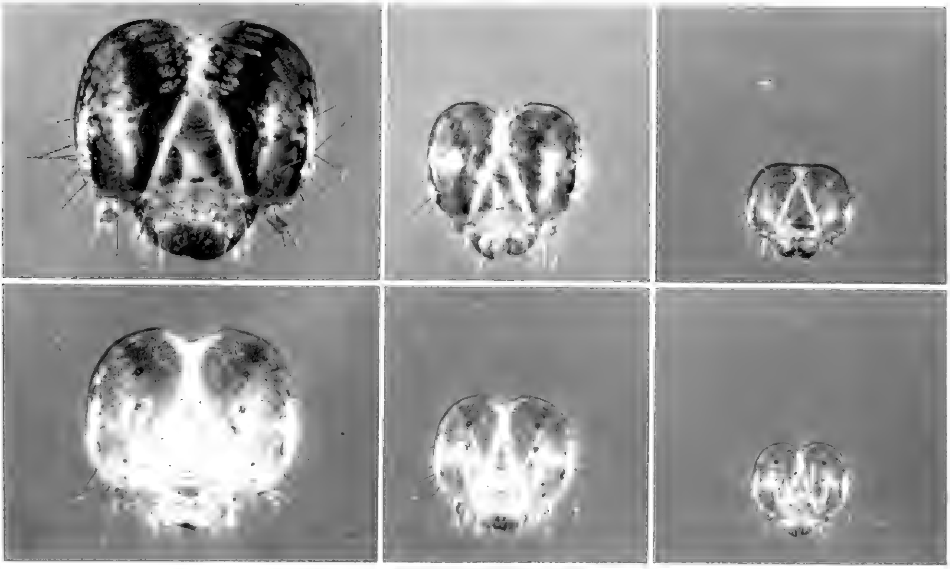

Fig. 2. Head capsules of *Xestia dolosa* (top) and *X. adela* (bottom) larvae. Right to left, 4th–6th instars.

more heavily pigmented than those of *X. adela* (Fig. 2) and individuals could usually be distinguished in this way.

Electrophoresis.—All the enzymes surveyed in the larval stages had been examined previously in field populations of adults, and allele frequencies and segregation data of the polymorphic enzymes in the species have been reported (Hudson and Lefkovitch, 1982). In the present study we have surveyed eight enzymes and selected, for the purpose of identification, those which are diagnostic either because they occur as single banded isoenzymes with different electrophoretic mobilities (i.e., are monomorphic), or because although polymorphic, there are certain alleles that can be used to identify the species with a probability greater than 99.9%.

The enzyme Idh was monomorphic, with a different band characterizing each species. It can be used to identify immatures in Ontario populations by Idh allele 1.0 which typifies *X. adela* and Idh 1.1 which typifies *X. dolosa* (Fig. 3a). The same band distinguished adults in which extracts of the abdomens stained intensely, but the thoraces only faintly. Adk was polymorphic with four alleles (0.94, 0.96, 1.0, 1.03) seen in the larval stages. Adk allele 1.0 was characteristic of *X. adela* and Adk 0.96 of *X. dolosa* (Fig. 3b). This Adk locus was used to identify moths in collections from four locations in Ontario and in a collection of *X. c-nigrum* made in Oxford, England. In the latter collection Adk allele 1.0 was found in 55% of the individuals and 0.96 in none (Hudson and Lefkovitch, 1982). The remaining enzymes were either monomorphic for the same band in both species (α-Gpdh and Got), or polymorphic (Hk, Mpi, Pgi, Pgm) with the same alleles as those found in the previous study of adult moths, and so are not useful for direct identification of individuals. Only larvae of the spring broods were

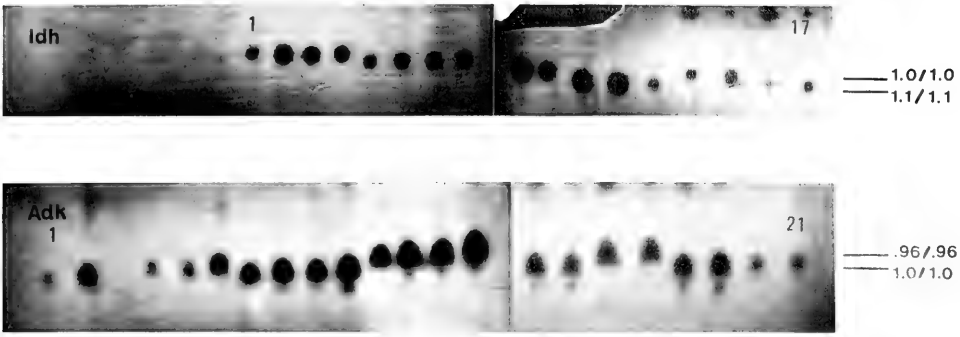

Fig. 3. Diagnostic enzymes isocitrate dehydrogenase (Idh) and adenylate kinase (Adk) in the larvae and adults of *Xestia adela* and *X. dolosa.* Idh: left to right, 1–4, *X. adela* 4th–6th (prepupa) instars; 5–8, *X. dolosa* 4th–6th (prepupa) instars; 9–10, *X. adela* pupae; 11–13, *X. dolosa* pupae (13 = pharate adult); 14–15, *X. adela* newly emerged adults (♂, ♀); 16–17, *X. dolosa* newly emerged adults (♂, ♀). Adk: left to right, 1–2, *X. adela* 2nd and 3rd instars; 3–5, *X. dolosa* 1st–3rd instars; 6–9, *X. adela* 4th–6th (prepupa) instars; 10–13, *X. dolosa* 4th–6th (prepupa) instars; 14–15, *X. adela* pupae; 16–17, *X. dolosa* pupae; 18–19, *X. adela* newly emerged adults (♂, ♀); 20–21, *X. adela* 14 day old adults (♂, ♀).

examined but on the basis of adult studies it is probable that summer brood larvae can be distinguished in the same way.

The existence of diagnostic enzymes provides a direct and definitive method of identifying field collected larvae associated with crop damage by the "spotted cutworm," and to provide information on host preference and feeding behaviour of these sibling species. It is possible also that the difference in the intensity of head capsule pigmentation, seen in our samples, could be used to identify larvae of these species in the field, provided its validity within large sympatric populations is first confirmed by electrophoresis.

The later appearance of *X. dolosa* compared to *X. adela* in both spring and summer broods in Ontario is predictable from the differing lengths of time required to complete development. Hinks and Byers (1976) showed that the length of time taken to reach maturity by different species of *Euxoa* was not related to size and this seems to be true also for these species of *Xestia.* The results of the laboratory rearings also show that the effect on growth of lower temperature and shorter photoperiod, as indicated by the relative extensions of duration of development, is greater in *X. dolosa* than in *X. adela* and may account for the lower number of second field generation *X. dolosa* adults collected at the northern limits of its distribution.

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85(3), 1983, pp. 619–621

A NEW SPECIES OF *PSOROSINA* DYAR (LEPIDOPTERA: PYRALIDAE) FROM TEXAS

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Abstract.—Psorosina ***fergusonella*** is described from eastern Texas. Imagines, male and female genitalia, and venation are figured.

A small series of a new phycitine pyralid was collected by both authors in eastern Texas. Generic assignment proved difficult, but based on the wing venation and genitalia, the heretofore monotypic genus, *Psorosina* Dyar, seemed to be the only possible choice.

Psorosina fergusonella Blanchard and Knudson, New Species

Figs. 1–7

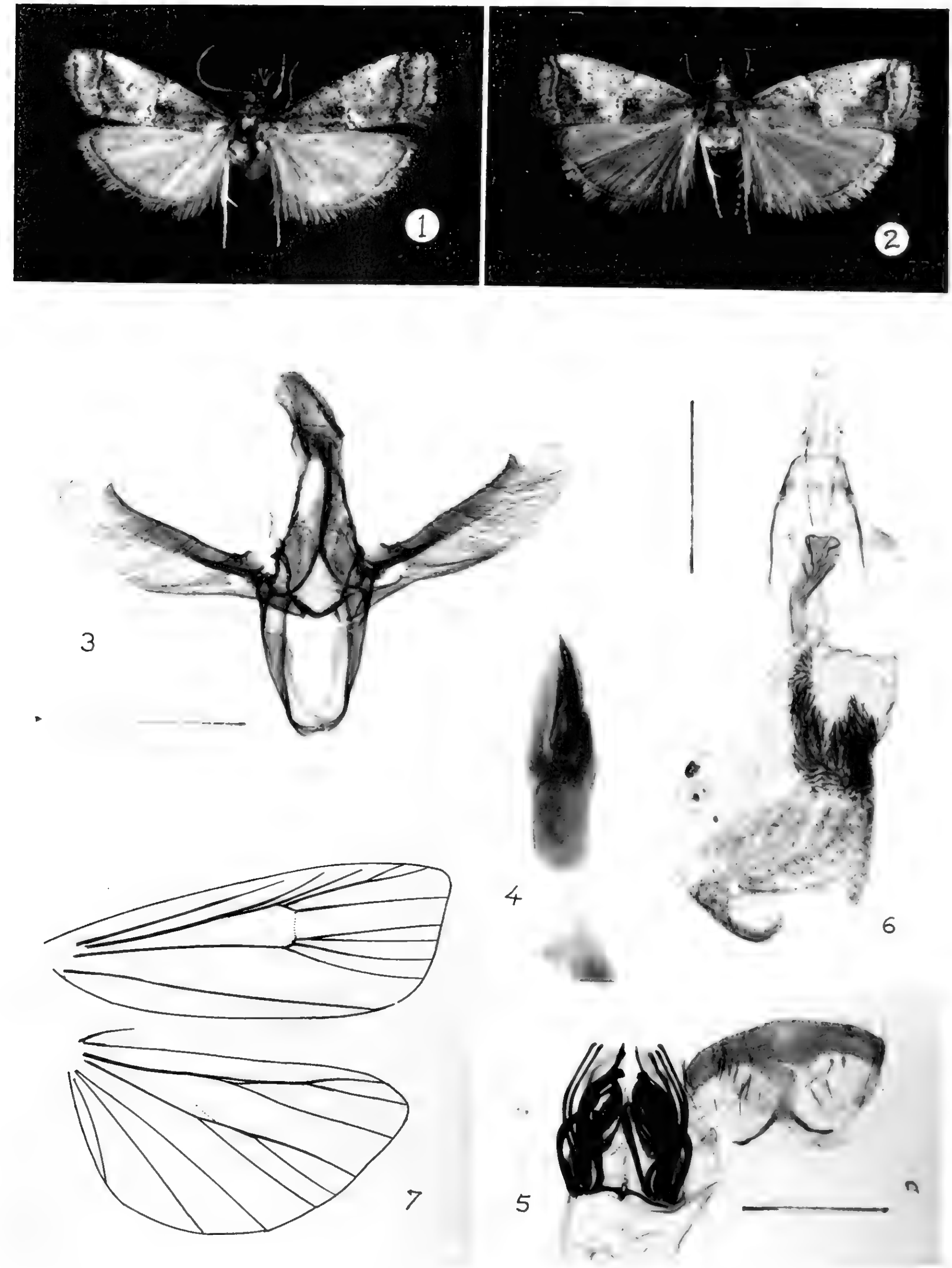
Description.—*Head:* Front and vertex fuscous. Labial palpus upturned, extending above vertex by ½ an eye diameter; smooth scaled, fuscous. Maxillary palpus in male, an aigrette, dull orange; in female, squamous, whitish. Antenna simple, pubescent in male, with basal portion of flagellum expanded to form relatively small sinus with fuscous scale tuft. Each segment of flagellum ochreous and fuscous.

Thorax: Entirely light reddish violet dorsally, ochreous ventrally.

Venation (Fig. 7): Forewing: Smooth, 11 veins, Cu_2 from below lower outer angle of cell, Cu_1 from angle; M_2–M_3 very shortly stalked; R_3–R_5 stalked for ⅔ of their lengths; R_2 from upper outer angle of cell, R_1 from cell. Hindwing: M_3 absent; Cu_1-M_2 stalked for ⅓ of their lengths; Sc-Rs stalked for slightly less than ½ their lengths; discocellular vein incomplete.

Maculation (Figs. 1, 2): Forewing: Ground color dull reddish violet with extensive whitish suffusion over entire costa, extending to dorsal margin near middle. In male, whitish costal area irrorated with black scales, resulting in a bluish gray shade to naked eye. In female, this area feebly irrorated with red scales. Antemedial line faint, white, slightly sinuous and angled slightly outward from costa; margined outwardly by narrow reddish line. Subterminal line conspicuous, white, slightly outwardly angled near middle; margined inwardly with strong reddish line, outwardly with fainter, diffuse, reddish line. Subterminal area suffused with whitish. Discal dots black, separate or confluent. Terminal line black. Fringe fuscous. Hindwing: Fuscous, lighter toward base. Black terminal line. Fringe dark fuscous inwardly, lighter outwardly.

Length of forewing: Male: $n = 2$, 6.4 and 6.8 mm; Female: $n = 3$, 6.5, 6.6, and 6.8 mm.



Figs. 1–7. *Psorosina fergusonella.* 1, Holotype, male, Anderson Co., Texas, Engeling WMA, near Tennessee Colony, 19-VI-82. 2, Paratype female, Harris Co., Texas, Houston, 17-VIII-66. 3, Male genitalia of paratype, from slide ECK 410, same data as holotype. 4, Aedeagus of paratype, from slide ECK 410. 5, Ventral compound tufts of 8th Abdominal segment, from slide ECK 410. 6, Female genitalia of paratype, from slide ECK 418, Harris Co., Texas, Lake Houston, 22-VIII-82. 7, Wing venation of paratype, from slide ECK 418 (female). The segments in Figs. 3, 4, and 6 represent 1 mm.

Male genitalia (Figs. 3–5): Uncus hoodlike, apex rounded; apical process of gnathos a slender hook; transtilla rudimentary; harpe moderately slender, cucullus rounded; heavily sclerotized costa produced into short spine before apex of cucullus; juxta with lateral lobes; vinculum oblong, longer than broad; aedeagus armed with single strong cornutus. Eight abdominal segment of male with compound ventral tufts.

Female genitalia (Fig. 6): Ostium and ductus bursae sclerotized ventrally; ductus seminalis from lobe of bursa adjacent to junction of bursa and ductus bursae; bursa membranous, apical ½ covered with dense mat of fine spines on inner surface; elongate mat of larger, heavily sclerotized spines extending from near junction of bursa and ductus bursae to near middle; 3 plate like signa near middle of bursa, posterior 1 larger than other 2.

Holotype (Fig. 1).—♂, Anderson Co., Texas, Engeling Wildlife Management Area, near Tennessee Colony, 19-VI-82, with genitalia slide ECK 352, collected by E. Knudson and deposited in the National Museum of Natural History, Washington, D.C.

Paratypes.—Same data as holotype, 1 ♂; Harris Co., Texas, Lake Houston, 22-VIII-82, 1 ♀, with slide ECK 418, collected by E. Knudson. Harris Co., Texas, Houston, 17-VIII-66, 1 ♀, with slide A.B. 1810, 26-VIII-66, 1 ♀, with slide A.B. 2038, collected by A. and M. E. Blanchard.

Remarks.—This new species was assigned to the genus *Psorosina* chiefly by virtue of its unique wing venation, which occurs in no other genus of the phycitines. There are also strong similarities in the male genitalia between *Psorosina fergusonella* and *Psorosina hammondi* (Riley), the only other species in this genus. However, there are also several important disparities noted in the new species, some of which depart from Heinrich's (1956) redescription of Dyar's genus. These characters of the new species are as follows: Male with maxillary palpus an aigrette; male antennal sinus reduced; male eighth segment ventral tuft of different form; and female genitalia with ductus bursae sclerotized ventrally, lacking spined plates laterally; bursa with more highly developed signa. In comparison with other phycitine genera, however, these differences can easily be regarded as specific rather than generic. *Psorosina fergusonella* should be easily diagnosed by maculation, wing venation, and maxillary palpi of the male. The new species is named for Dr. Douglas C. Ferguson in appreciation of the great amount of assistance and encouragement he has given to the authors.

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NOTE

The Collection of an Adventive Exotic Thrips—*Cartomothrips* sp. (Thysanoptera: Phlaeothripidae)—in California

The purpose of this note is to record the collection of an exotic thrips, *Cartomothrips* sp., in California on the San Bruno Mountains in San Mateo County, on two occasions, the first in 1976 and the second in 1979. This genus was previously known to occur only in Australia and New Zealand.

The first collection was made during mid-day of September 9, 1976. This had been a hot day for what in the summer is frequently a cool foggy locality. While collecting on a rock outcrop, there had been many small thrips and micro-Hymenoptera that had been annoying to me. These had settled on my perspiring face and neck, with some walking about and some biting. Samples of these pestiferous species were made in addition to the Tachinidae that I visited this rock outcrop to collect. The thrips included one specimen of *Limothrips angulicornis* (Jablonowski) and 17 specimens of *Isoneurothrips australis* Bagnall. The Hymenoptera included two male *Copidosoma* sp. and one male Encyrtinae (? Ooencyrtini) of the family Encyrtidae (identified by Gordon Gordh), several specimens of *Inostemma* sp. of the family Platygastridae (identified by Paul M. Marsh), and four males of *Leptothorax* sp. of the family Formicidae (identified by Roy R. Snelling). When leaving the area by a path in open grassland with some shrubbery, the first *Cartomothrips* here recorded was felt crawling on the writer's face and it was collected. It was noted to be a much larger and darker thrips, in comparison to the smaller thrips collected earlier.

The specimens of thrips were sent to Tokuwo Kono, who identified the *Limothrips* and *Isoneurothrips* reported above, but was unable to identify the phlaeothripid. The female phlaeothripid specimen was then sent to Kellie O'Neill. In a letter dated February 4, 1977, she reported that Steve Nakahara had identified the specimen as a member of the genus *Cartomothrips* Stannard. O'Neill further commented that she had identified "an unknown species of *Cartomothrips* in 1969 from New Zealand, *Eucalyptus melidora* seed, intercepted at San Francisco (no. 43766), December. As far as Nakahara and I know (cataloguing of thrips stopped effectively in 1965 here) there are no other records of this genus, ..."

The second collection of a specimen (male) of a *Cartomothrips* (Fig. 1) was made on February 3, 1979, at the lower part of the Guadalupe Parkway, along Colma Creek, at the edge of a planting of *Eucalyptus globulus* Labillardière. The specimen happened to enter my insect net while I was collecting other insects. The large size and dark coloration of the thrips made me to suspect it as being a *Cartomothrips,* and this was subsequently confirmed by Nakahara.

The genus *Cartomothrips* was described by Stannard (1962, Proc. R. Entomol. Soc. Lond. (B) 31(3/4): 38) with two included species—*C. browni* Stannard (1962: 39–40) with type-data for the holotype female and two female paratypes "AUSTRALIA: McCrae, Arthur's Seat, Victoria" from "dead leafy wattle branches" (family Leguminosae) and *C. manukae* Stannard (1962: 40) with type-data for the holotype female and 19 female paratypes "NEW ZEALAND: Dusky Forest"

Fig. 1. *Cartomothrips* sp., male.

from "seed heads of manuka (*Leptospermum scoparium*)" (family Myrtaceae). Most recently, Mound and Walker (1982, J. Nat. Hist. 16: 305–313) have revised *Cartomothrips* and described two new species, one from Australia and the other from Australia and New Zealand—*C. laughlini* Mound and Walker with type-data for the holotype female and 19 female and male paratypes "AUSTRALIA, South Australia, Berri Forest Reserve, *Morgania glabra*" (family Scrophulariaceae), and *C. neboissi* Mound and Walker with the holotype from "AUSTRALIA, Victoria, nr. Alexandria, *Leptospermum ericoides*" (family Myrtaceae) and 27 paratypes from 3 localities in Australia and 12 paratypes from 9 localities in New Zealand, from beating manuka and kanuka (family Myrtaceae), dead wood, cut *Solanum mauritianum* Blanco (family Solanaceae), on *Daucus carota* L. (family Umbelliferae), and beating *Muehlenbeckia* sp. (family Polygonaceae). Mound has studied the two specimens of *Cartomothrips* collected in the San Bruno Mountains, and, in a letter dated 5 April 1982, commented that they may possibly represent an undescribed species.

Cartomothrips spp. are thought to be fungus-feeders on dead twigs and leaves

(Mound and Walker, 1982: 305). McClintock and Knight (1968, Proc. Calif. Acad. Sci. (4) 32(20): 587–677, 14 figs., 5 pls.) present a flora of the San Bruno Mountains that include several introduced plants of the Australian Realm on which fungal hosts may be associated. These include Green Wattle, *Acacia decurrens* Willdenow and two other acacias—*A. melanoxylon* R. Brown and *A. retinodes* Schlechtendal. *Eucalyptus globulus* (Blue Gum) which is a native of Tasmania and Victoria, Australia, occurs in stands on various parts of the San Bruno Mountains, including the Guadalupe Parkway.

Based on the casual encounters of this thrips that I have made, I suspect that *Cartomothrips* sp. may develop sizeable populations.

I acknowledge aid of Tokuwo Kono, California Department of Food and Agriculture, Sacramento, Laurence A. Mound, British Musuem (Natural History), London, and Steve Nakahara and Kellie O'Neill, Systematic Entomology Laboratory, USDA, Beltsville, Maryland, for their identifications and advice on the thrips here discussed; Gordon Gordh, University of California, Riverside, Paul M. Marsh, Systematic Entomology Laboratory, USDA, and Roy R. Snelling, Los Angeles County Museum of Natural History, for their identifications of Hymenoptera; and Susan M. Middleton, California Academy of Sciences, for photographic assistance. The insect specimens discussed herein are deposited in the collection of the California Academy of Sciences.

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NOTE

The Status of *Aphelinus varipes* (Foerster) and *Aphelinus nigritus* Howard (Hymenoptera: Aphelinidae)

The greenbug, *Schizaphis graminum* (Rondani) (Aphididae), was first recorded in the U.S. in 1882 (Webster and Phillips. 1912. U.S. Dep. Agric. Bur. Entomol. Bull. 110, 153 pp.). Its origin is unknown, but Webster and Phillips (1912) recorded it from Europe, Asia, and Africa by 1910. Howard (1908. Entomol. News 19: 365–367) described *Aphelinus nigritus* from six specimens (USNM type #12032) reared from the greenbug in South Carolina during the 1907 outbreak. *Aphelinus varipes* (Foerster) (1841. Beiträge zur Monographie der Pteromaliden Nees, 1. Heft. Aachen), was first introduced to California against *Aphis gossypii* Glover and later to Oklahoma against the greenbug (Jackson et al. 1970. J. Econ. Entomol. 63: 733–736). Specimens of *A. varipes* from Europe have also been sent to Missouri (R. Kirkland, personal communication) and Texas (F. Gilstrap, personal communication) for greenbug control.

Graham (1976. Syst. Entomol. 1: 123–146) studied the British *Aphelinus* and showed *A. varipes* to be a color-variable species. *Aphelinus nigritus,* however, has

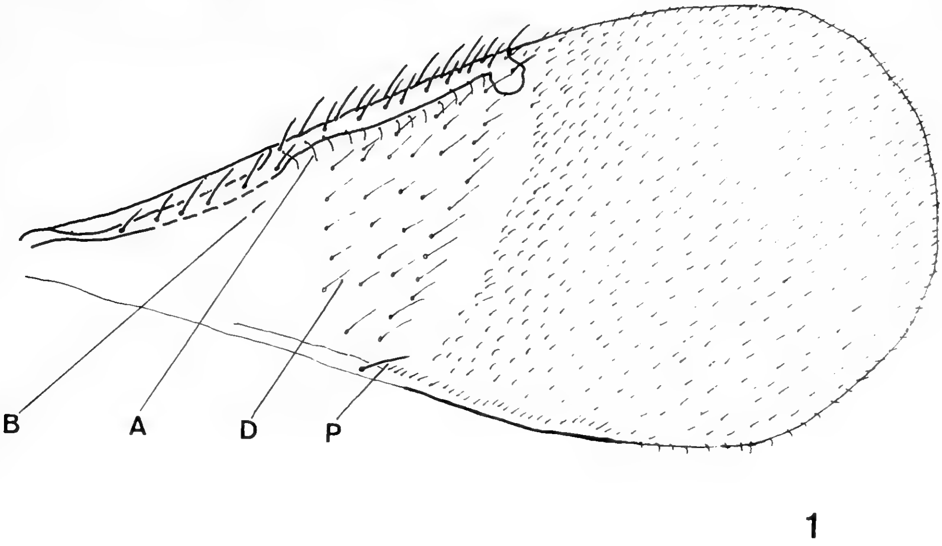

Fig. 1. Forewing of *Aphelinus varipes.* A = admarginal line setae; B = basal seta; D = delta setae; P = post-delta seta. Setae of costal cell not shown.

not been previously critically examined nor adequately compared to *A. varipes.* The present study is a result of difficulties encountered in distinguishing the two species following the release of *A. varipes* in areas where *A. nigritus* had previously been collected.

Eric Grissell kindly located four of the original specimens used by Howard (1908) in the description of *A. nigritus.* Two are point mounted. The other two are mounted on a single slide. From this syntype series, I now designate the lower of the two slide-mounted females (as indicated on a separate label) as **lectotype**.

Comparison of the lectotype of *A. nigritus,* the lectotype of *A. varipes* (Graham, 1976), specimens of *A. varipes* from Europe determined by Graham (USNM collection), specimens of *A. varipes* introduced to Texas from Europe, and specimens of *A. nigritus* from Texas, revealed little difference between the two species, and none that I consider significant. In material introduced to Texas from Europe, the scape, hindtibia, and first metasomal segment were generally more infuscate than in populations already occurring in Texas. There was some overlap in the color patterns, however. A careful comparison of the wing setation characteristics used by Hennessey (1981. Entomophaga 26: 363–364) also revealed no consistent differences. In both *A. varipes* and *A. nigritus* at least some of the admarginal line setae are on the membrane rather than on the marginal vein (Fig. 1). The number and position on and off the vein varied among specimens examined, but the presence of at least some of these setae on the membrane is an important feature (Hennessey, 1981). Other characters shared by *A. varipes* and *A. nigritus* include the presence of 13–30 delta setae, 1 (very rarely 2) post-delta setae, 3 rows of costal cell setae, and 0–2 basal setae.

Because of the failure to find any consistent differences between the two, *Aphelinus nigritus* Howard, 1908, is suppressed as a junior subjective synonym (**New**

SYNONYM) of *Aphelinus varipes* (Foerster, 1841). A logical conclusion would be that *A. varipes* was introduced to the U.S. along with the greenbug but was not detected until a large outbreak occurred.

The synonymy of *A. nigritus* with *A. varipes* does not necessarily preclude the further introduction of *A. varipes* to the U.S. for greenbug control. Frazer and van den Bosch (1973. Environ. Entomol. 2: 561–568), for example, have shown that an aphid parasitoid from one region may be much better adapted to an introduced pest than the same species of parasitoid from a second region. Thus importations of *A. varipes* to control greenbug could continue, but much more care should be given to the discovery and use of source populations better adapted to U.S. conditions.

I am especially thankful to Eric Grissell, Systematic Entomology Laboratory, USDA, and to Ron Hennessey for their thoughts and discussions on this problem. Ray Eikenbary, Oklahoma State University, Reed Kirkland, University of Missouri, and Frank Gilstrap and Tim Kring both of Texas A&M University willingly provided material and information which helped make this study possible.

Robert A. Wharton, *Department of Entomology, Texas A&M University, College Station, Texas 77843.*

PROC. ENTOMOL. SOC. WASH.
85(3), 1983, pp. 626–627

NOTE

Nomenclatural Notes on Apionidae (Coleoptera: Curculionoidea)

One of us (MAAZ) is assembling a world card catalogue of Apionidae, presently with some 2000 entries. Since most species of Apionidae at one time or another have been treated as *Apion,* and since no catalogue for the world has been recently published, it is not surprising to find uncorrected primary homonymies. Five such corrections are provided herein.

Apion balfourbrownei Alonso Zarazaga, **NEW NAME**

This is a replacement name for *Apion rubiginosum* Balfour-Browne, 1944 (Proc. R. Entomol. Soc. Lond. [B] 13: 18; South Africa), a primary homonym of *Apion rubiginosum* Grill, 1893 (Entomol. Tidskr. 14: 253). Grill proposed using the name *Apion rubiginosum* Dejean, 1821 (Catalogue de Coleoptères, p. 80) for the misidentification *Apion sanguineum* of Redtenbacher and other authors, not De Geer. Although Grill attributed the name to Dejean, *Apion rubiginosum* is properly attributed to Grill because the usage in the Dejean catalogue was a *nomen nudum.* Until recently (e.g., H. Silfverberg [ed.], 1979, Enumeratio Coleopterorum Fennoscandiae et Daniae, Helsinki, 79 pp.), the name *Apion rubiginosum* Grill was missed by cataloguers and therefore not in common use. In summary:

Apion sanguineum (De Geer, 1775).
  Curculio sanguineus De Geer, 1775.
  Apion miniatum Germar, 1833.

Apion rubiginosum Grill, 1893.
  Apion sanguineum, of Redtenbacher and others, not De Geer.
  Apion rufum A. & F. Solari, 1905.
Apion balfourbrownei Alonso Zarazaga, new name.
  Apion rubiginosum Balfour-Browne, 1944, homonym.

Apion (*Fallapion*) *distenticolle* Whitehead, New Name.

This is a replacement name for *Apion dilaticolle* Fall, 1925 (Bull. Brooklyn Entomol. Soc. 20: 85; New Jersey), a primary homonym of *Apion dilaticolle* Motschulsky, 1858 (Études Entomologiques 7: 92; India). The epithet *distenticolle* (*distentus* + *collum*) bears the same meaning as *dilaticolle.*

Apion philippianum Alonso Zarazaga, New Name

This is a replacement name for *Apion vestitum* R. A. & F. Philippi, 1864 (Stettin. Entomol. Zeit. 25: 364; Chile), a primary homonym of *Apion vestitum* Gyllenhal, 1833 (*In* Schoenherr, Genera et Species Curculionidum 1: 267; Hispaniola).

Apion (*Aspidapion*) *roudieri richardi* Alonso Zarazaga, New Name

This is a replacement name for *Apion* (*Aspidapion*) *roudieri nigrum* Richard, 1957 (Mem. Inst. Sci. Madagascar [E] 8: 73; Reunion Island), a primary homonym of *Apion nigrum* Herbst, 1797 (Natursyst. Ins. Kaf.: 112; North America).

Onychapion poupillieri tibesticola Alonso Zarazaga, New Name

This is a replacement name for *Apion* (*Onychapion*) *poupillieri grandis* A. Hoffman, 1962 (Bull. Inst. Fr. Afr. Noire 24: 438; Tibesti), a primary homonym of *Apion grande* Burgeon, 1938 (Rev. Zool. Bot. Afr. 31[2]; Zaire), now *Conapion* (*Pseudoconapion*) *grande* (Burgeon).

We thank D. G. Kissinger (Loma Linda University), C. W. O'Brien and G. Wibmer (Florida A&M University), P. G. Spangler (Smithsonian Institution), and W. Murphy and F. C. Thompson (Systematic Entomology Laboratory, USDA) for constructive comments.

M. A. Alonso Zarazaga, *Carretera de Cadiz, 89* (*Edif. S. Joaquin*), *Malaga-4, Spain, and* Donald R. Whitehead, *Systematic Entomology Laboratory, IIBIII, Agricultural Research Service, USDA, % National Museum of Natural History, Washington, D.C. 20560.*

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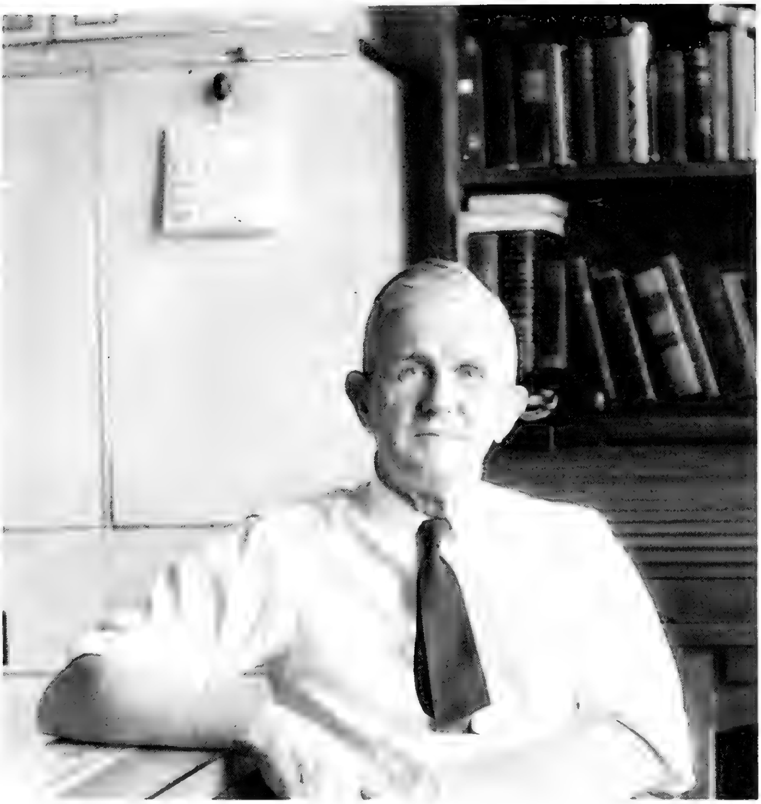
85(3), 1983, pp. 628–630

OBITUARY



DR. MARION RUSSELL SMITH
1894–1981

Dr. Marion Russell Smith, "Pat" to his friends and colleagues, died December 29, 1981, over 17 years after retiring from the U.S. Department of Agriculture. During his long career, he built an enviable reputation as a national and international authority on ants.

Dr. Smith was born June 19, 1894, in Pendleton, South Carolina, and was one of six children of James Dawson and Celema Russell Smith. He attended public schools in Pendleton, then entered Clemson College, just a few miles away, where he obtained his B.S. degree in 1915. In 1917, he received a M.S. degree from Ohio State University. After periods of employment with the Bureau of Entomology, U.S. Department of Agriculture, as a scientific assistant working on biology and control of truck crop insects (1917–1918), at Clemson College as assistant entomologist (1918–1919), with the North Carolina Department of Agriculture as extension entomologist (1919–1920), at Fort Mill High School in

South Carolina as an instructor in vocational agriculture (1920–1921), and with the Mississippi State Plant Board as an assistant entomologist and specialist on ants in charge of mapping infestations and directing control and eradication programs of the Argentine ant (1921–1924), he attended the University of Illinois and was awarded his Ph.D. in 1927. After his graduate work, he returned to Mississippi as an associate professor at Mississippi State College and was involved in work on ants as well as teaching. Intermittently, he was also employed by the U.S. Department of Agriculture in 1931–1933 as entomologist in charge of Argentine ant surveys, in 1935–1936 in Puerto Rico for research on the pineapple mealy bug and coffee insects, and in 1936–1937 with the Southern Forest Experiment Station at Provencal, Louisiana, working on the control of the Texas leafcutting ant. In 1937, Dr. Smith was hired by the Division of Insect Identification, Bureau of Entomology and Plant Quarantine, U.S. Department of Agriculture, Washington, D.C., later known as the Insect Identification and Parasite Introduction Research Branch, Entomology Research Division, where he was employed until his retirement in 1964. His work involved taxonomic research on ants, ant identification, and curation of the ants in the National Collection at the Smithsonian Institution.

Dr. Smith's interest in ants began in 1915, and his first publication in 1916 dealt with some observations on ants in South Carolina. However, early interests resulted in articles on other insects such as a list of Syrphidae of northern Indiana (1919) and the bembicine wasps of North Carolina (1920). During his employment with the Mississippi State Plant Board, he worked under the direction of the late R. W. Harned who encouraged him to work on the ants of Mississippi and other states. Dr. Smith always credited Dr. Harned for the special encouragement that guided him into his productive career. From 1916–1969, Dr. Smith published 150 articles, mostly concerning the taxonomy and biology of ants. He described 86 new taxa, worldwide, but concentrated on the fauna of North America. A list of his publications and taxa described was published in 1973 in the *Proceedings of the Entomological Society of Washington* (vol. 75, no. 1, pp. 88–95). Some major contributions were keys for the identification of genera of North American ants based on males (1943) and workers (1947). The key to males is a classic work and is the only such key available. In 1936, he published on the ants of Puerto Rico which was based largely on his own collecting and observations during his stay there in 1935–1936; this is still the only comprehensive treatment of the ant fauna of that island. Preparation of the ant section for the catalog "Hymenoptera of America North of Mexico" (1951) took much of his time, and he also prepared the ant sections of the 1958 and 1967 supplements to that catalog. A major contribution was his bulletin "House-Infesting Ants of the Eastern United States, Their Recognition, Biology, and Economic Importance" (1965), a work that was so much in demand that it was reprinted in 1972. In this, 50 of the most common and economically important ants are illustrated, keyed, and discussed. It was prepared largely from the meticulous records he kept during his many years experience with the U.S. Department of Agriculture concerning the incidences of ant species in buildings and other accumulated notes on the importance of ants. It is a widely used reference for extension entomologists and others having to answer inquiries about ants. The many other biological and revisionary works are too many to mention, but his major efforts were directed toward improving the knowledge of ants through preparation of identification aids and clarification of nomenclature.

On New Year's Day, 1920, Dr. Smith married Myra W. Fant of Walhalla, South Carolina. Their marriage lasted until her death in 1980. They have two children, Mrs. Marian S. Stossel of McLean, Virginia, and Dr. David H. Smith of Salisbury, North Carolina, and five grandchildren. Dr. Smith was a member of the Entomological Society of Washington, Entomological Society of America, Sigma Xi, and, for several years, the Cosmos Club. He was an elder in the Presbyterian Church, Church of the Pilgrims, Washington, D.C., for 20 years.

After his retirement in 1964, Dr. Smith lived at his home in Arlington, Virginia. He never returned to work at the Museum, partly because of his failing eyesight. He spent much of his retirement gardening and with his family, frequently returning to his boyhood home in South Carolina to be with relatives. Though not directly involved in research, his interest in ants continued. As a prolific correspondent, he kept in touch with his many colleagues and co-workers throughout the world and was always anxious and interested in hearing from them. He would often call me to find out what was going on in the "ant world," what interesting specimens had come in for identification, whom I had heard from, or any other recent news. He was always most cooperative, kind, and did much to stimulate the interest of young taxonomists. Over the phone and during my visits to his home, he helped to arouse my interest and help me get started in the ant responsibilities assigned to me. He truly enjoyed his work, a factor that may have contributed to his long life.

After the death of his wife, he spent his last year with his daughter in McLean. He succumbed to cancer, December 29, 1981. He is survived by both children and five grandchildren. His illustrious career left a most favorable and indelible impression in the field of myrmecology.

David R. Smith, *Systematic Entomology Laboratory, IIBIII, Agricultural Research Service, USDA, % National Museum of Natural History, Washington, D.C. 20560.*

PROC. ENTOMOL. SOC. WASH.
85(3), 1983, pp. 631–632

OBITUARY

RAYMOND ALEXANDER ST. GEORGE
1894–1982

With the passing of Raymond A. St. George in 1982, the Society lost a former President and an Honorary Member. He joined the Society soon after coming to the area in 1918, attended meetings regularly, and served as President in 1956. In 1975, he was elected an Honorary Member.

Saint (as he was known to his friends) was born in Lynn, Massachusetts, September 10, 1894. He attended Massachusetts Agricultural College (now University of Massachusetts), studied entomology under the well-known Dr. Henry T. Fernald, and graduated in 1918. It is probable he developed an early interest in forest insects because of the concern for the gypsy moth and the attention given to it in the teaching program at the College. Classmates included Harlan P. Worthley and Warren D. Whitcomb who went to Pennsylvania State College and Waltham Field Station in Massachusetts, respectively, to engage in the fields of economic entomology.

In 1919, Saint married Julia Florence Gustafson and they had four sons. They lived in Falls Church, Virginia, and later in Arlington. About 1942, they moved to College Park, Maryland.

Saint was first employed in the Division of Forest Insects, Bureau of Entomology, U.S. Department of Agriculture, at Falls Church under the direction of

A. D. Hopkins, whom F. Schwerdtfeger of Göttingen, Germany, called "the first real forest entomologist in North America" (Smith, R. F., T. E. Mittler, and C. N. Smith. 1973. History of Entomology. Annual Reviews, Inc., Palo Alto, Calif. 517 pp.). Early associates of St. George were Frank C. Craighead and Thomas E. Snyder. During this time, Saint took graduate work at George Washington University and was awarded the Masters Degree in 1923.

Saint began work on the destructive southern pine beetle at Asheville, North Carolina, in 1924 in cooperation with the Appalachian Forest Experiment Station of the U.S. Forest Service. For some years the station was equipped only for summer work carried on in tents. Saint also supervised the white grub studies at Georgetown, South Carolina.

In 1934, Saint was transferred to the Washington office of the Bureau to handle correspondence and to prepare publications on various wood-infesting insects. A little later he established soil treatment plots for tests against subterranean termites at Beltsville, Maryland, plots that are still examined periodically by Raymond H. Beal. Saint also tested chemical injections in live trees to protect them against insect attack and decay after they were cut and used in contact with soil.

The in-house publication *BEPQ Activities* for December 1952 carried a picture of "St. George and the Dragons," walkingsticks that he had collected in western Maryland, where it was said "400 acres of hardwood trees were defoliated." Notice of the outbreak by newsmen and photographers resulted in nationwide coverage.

In his early years, Saint became interested in the taxonomy of larvae of Tenebrionidae and related families. During his career, he published important articles on the following subjects: powderpost beetles and their parasites, southern pine beetle, false wireworms, eastern subterranean termite, mimosa webworm, and the protection of log cabins and rustic furniture from insect attack.

On retirement in 1964, a newspaper carried this story, quoted in part, "Saint's almost encyclopedic knowledge of insect pests of forest trees, forest products, shade trees, and ornamentals, has been a source of amazement and admiration for his younger, more specialized colleagues. His retirement removes a source of general information on these subjects that will be sorely missed."

Retirement did not stop his usefulness. Saint often appeared as an expert witness in court litigation on termite and other wood-infesting insect control cases. He contributed to pest control manuals and trade journals.

Saint was a member of the Entomological Society of America and the Biological Society of Washington. He was a long time Rotarian with a record of perfect attendance at the College Park, Maryland Club and served as President in 1962–1963. He was an active member of the University United Methodist Church, College Park, and was also a director of the YMCA. He was a devotee to bowling and golf.

Saint spent his last years with his son, J. Richard and family, in Ft. Wayne, Indiana. His daughter-in-law, Kitty, called him a Man of Quality. Others say Saint had remarkable enthusiasm for helping people with their insect problems and that he was a good friend to everyone he knew. Saint died at Ft. Wayne on September 12, 1982.

Theodore L. Bissell, *3909 Beechwood Road, Hyattsville, Maryland 20782.* (Contributors to this obituary are: James A. Beal, Raymond H. Beal, Ashley B. Gurney, Clarence H. Hoffman, R. Joe Kowal, Theodore J. Spilman, and Mr. and Mrs. Richard St. George.)

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THE
ENTOMOLOGICAL SOCIETY
OF WASHINGTON

ORGANIZED MARCH 12, 1884

All correspondence concerning Society business should be mailed to the appropriate officer at the following address: Entomological Society of Washington, c/o Department of Entomology, NHB 168, Smithsonian Institution, Washington, D.C. 20560.

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Please see p. 183 of the January 1983 issue for information regarding preparation of manuscripts.

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STUDIES ON THE GENUS *APHODIUS* OF THE UNITED STATES AND CANADA (COLEOPTERA: SCARABAEIDAE). VII. FOOD AND HABITAT; DISTRIBUTION; KEY TO EASTERN SPECIES

Robert D. Gordon

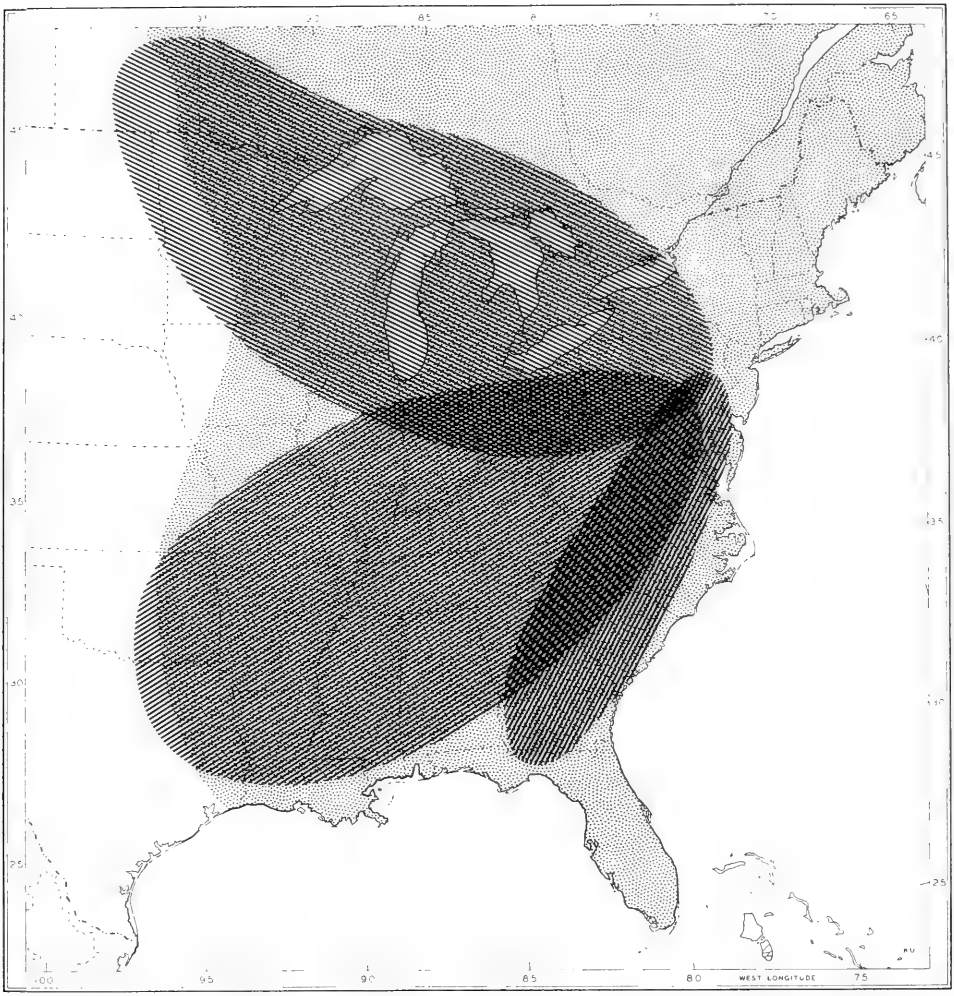
Systematic Entomology Laboratory, IIBIII, Agricultural Research Service, USDA, % National Museum of Natural History, Washington, D.C. 20560.

Abstract.—Currently available information on food and habitat preferences and geographic and temporal distribution is presented, along with a discussion of the factors influencing the distribution of those species associated with deer dung. A key to identify adults of *Aphodius* species that occur in the eastern forest region is constructed.

Although approximately 210 species of *Aphodius* are described from North America (north of Mexico), very little has been published concerning food and habitat preferences. Most published works on the genus deal only with taxonomy, and, in most cases, biological data have not been available. Over the past 12 years, I have collected biological data for species of *Aphodius,* and these, along with data from similarly inclined colleagues, constitute the basis for this report. There is still relatively little known, and one of the reasons for preparing this publication is to stimulate the collection of additional data.

The eastern forest geographic area covered here is not a well defined unit, being based in part on the prevailing distribution patterns of the eastern *Aphodius.* The eastern forest region as considered here is illustrated in map 1. All species of *Aphodius* having primary distributions within these limits are treated even though some extend into the Midwest and West. Those species whose primary distributions lie west of the limits but extend into the eastern forest region are not treated except in the key to species. All of the imported or holarctic species in the region are included even though the distribution patterns often extend across the continent.

Most of the data presented here are previously unpublished and are the result of personal field work and information supplied by fellow workers such as the late O. L. Cartwright (Department of Entomology, Smithsonian Institution, Washington, D.C.), Henry Howden (Carleton University, Ottawa, Canada), and Robert Woodruff (Florida Department of Agriculture, Gainesville, Florida). Published information has been obtained from Cartwright (1957), Robinson (1948), Sim (1930), Brown (1927), Hubbard (1894), and Woodruff (1973). I thank D. R. Whitehead for critical comments and suggestions, and W. Steiner for testing the key to species.



Map 1. Eastern forest region. Ellipses indicate the three major areas of species distribution.

FOOD AND HABITAT

The eastern species of native *Aphodius* can be divided into five categories based on food and habitat preference as indicated in Tables 1–5. Category I is the most important in terms of numbers of species and biological significance.

Category I: Species associated with deer dung (Table 1).—Seventeen species of eastern *Aphodius* are associated with deer dung, either in an obligate fashion or in showing a strong preference for deer dung when it is available. *Aphodius odocoilus* Robinson and *A. robinsoni* Cartwright are examples of the former; *A. ruricola* Melsheimer and *A. rubripennis* Horn are examples of species that show a preference for deer dung, but which will utilize other dung (horse, cow, etc.) if available.

A very thorough study of the ecology of *Aphodius* species occurring on the island of Faro in the Baltic sea was done by Landin (1961). The factors Landin

Table 1. Category I, species associated with deer dung.

Species	Geographic distribution	Temporal distribution
Spring:		
Aphodius odocoilis Robinson	New Jersey	March–May
Aphodius brimleyi Cartwright	North Carolina	April–July
Aphodius abusus Fall	East Texas	March–April
Winter:		
Aphodius crassulus Fall	Virginia to Florida	October–February
Aphodius floridanus Robinson	Florida	January–May
Aphodius silvanus Cartwright	Maryland (Eastern Shore)	October–April
Aphodius windsori Cartwright	South Carolina to Florida	November–March
Aphodius bicolor Say	New York to Florida, west to Kansas and Texas	September–April
Aphodius terminalis Say	Pennsylvania to Florida, west to Kansas and Texas	November–April
Aphodius lodingi Cartwright	South Carolina and Florida, west to Texas	November–April
Aphodius leopardus Horn	North Carolina north to Ontario and west to British Columbia and Alaska	August–June
Fall:		
Aphodius robinsoni Cartwright	New Jersey, West Virginia, North Carolina, South Carolina	September–November
Aphodius stupidus Horn	New Jersey and Pennsylvania to Florida, west to east Texas	October–December
Aphodius lutulentus Haldeman	Maryland and Virginia south to Florida, west to Texas and Oklahoma	October–February
Aphodius manitobensis	Northeastern U.S. and eastern Canada west to Manitoba	September–December
Summer:		
Aphodius rubripennis Horn	Southeastern Canada to North Carolina	June–October
Aphodius ruricola Melsheimer	Ontario to Florida, west to Manitoba and Texas	May–August (most months of year)

found, that influence the selection of dung by *Aphodius* species are, in large part, the factors discussed herein. Landin studied only dung of domestic animals, and perhaps because of that, some of his conclusions differ somewhat from my own observations. For example, Landin states that "it is not the kind of dung, but the climatic conditions of the environment (particularly the microclimatic conditions of the droppings) which restrict dung-beetles to a certain habitat." I find that the obligate deer dung species will not utilize horse or bovine dung even when it occurs in appropriately shaded areas. They will utilize sheep dung, but there

Table 2. Category II, species associated with rodent burrows or nests, or burrows of the gopher tortoise.

Species	Geographic distribution	Temporal distribution
Aphodius aegrotus Horn (pocket gopher)	North Carolina, Florida	March–September
Aphodius laevigatus Haldeman (pocket gopher)	Florida	February–November
Aphodius badiceps Fall (squirrel nests)	Southeastern Canada to South Carolina, west to Minnesota, Kansas and Arkansas	February–November
Aphodius troglodytes Hubbard (gopher tortoise)	South Carolina, Florida	May–December

appears to be very little difference between the dung of deer and sheep. Therefore I conclude that, under natural conditions with dung of native animals, it is often the *kind* of dung that restricts the beetles to a certain habitat.

The moisture content and exposure of deer dung are of paramount importance in regard to selection by beetles. Very few species will use dung that is dry, and, obviously, if eggs are laid in pellets without sufficient moisture content, the larvae will not be able to mature before complete drying occurs. Whether the dung is in shade or exposed to the sun is correlated with moisture. Dung exposed to the sun will dry more quickly than if shaded, and an obvious bias is for shaded dung.

The fact that deer dung normally is in the form of a pile of small pellets makes rapid drying inevitable, especially when precipitation is infrequent, making the moisture factor much more important than when horse or bovine dung is the resource. Very few species are associated with deer dung in the arid regions of western North America, and lack of reliable precipitation is probably the reason. The fact that most deer dung species occur in fall, winter, and spring is another result of moisture supply; the pellets maintain moisture much longer in cool weather. Only two deer dung species of *Aphodius* are classified as summer species (Table 1), and both of these are capable of utilizing a variety of dung resources. In contrast, eight are classified as "winter" species, four as "fall" species, and three as "spring" species. This breakdown is based on available label data for adults. Several species occur in fall, winter, and spring, but the period of peak abundance usually occurs in one season. That is the season used to classify the species treated here. *Aphodius leopardus* Horn is an extreme example, with adults active through all except the hottest months but with peak activity in the winter.

Latitude is, of course, an important factor for those species having a wide north–south distribution. For instance, *A. leopardus* occurs as an adult from August to June; in the southern portions of the range it is most abundant in winter, but in the northern portions of the range the population peaks in the fall. Southern winters have warm periods during which flight activity, etc., can take place, but northern winters normally remain too cold for such activity; therefore, "winter" active species do not occur in the north.

The thermal factor must also be considered. The species that live in deer dung during fall and winter exhibit a "restricted thermal resistance" (Landin, 1961)

Table 3. Category III, native generalists.

Species	Geographic distribution	Temporal distribution
Aphodius cuniculus Chevrolat	South Carolina to Texas (primarily a Caribbean species)	All months of year
Aphodius vittatus Say	Southern Holarctic—North America; southern Canada, U.S. from Maine to South Carolina, west to Washington and Mexico	All months of year
Aphodius femoralis Say	Pennsylvania to South Carolina, west to Nebraska and east Texas	April–June
Aphodius campestris Blatchley	New Jersey to Florida and Mississippi	All months of year
Aphodius stercorosus Melsheimer	Southeastern Canada to Florida, west to Kansas and Texas	May–October
Aphodius rubeolus Beauvois	Southeastern Canada to Florida, west to Nebraska and Texas	April–August
Aphodius lentus Horn	Ontario to Georgia, west to North Dakota and Texas	June–July
Aphodius borealis Gyllenhal	Holarctic, in North America primarily boreal forest	April–July

while the summer species and the majority of the competitor species exhibit "intermediate thermal resistance." This may be very important when attempting to explain partitioning of the resource in terms of winter versus summer. "Thermal resistance" refers to the degree of tolerance for high temperature.

Wind is another factor since dung beetles search for droppings with their olfactory organs. A light wind would aid in the location of droppings, while a strong wind would tend to prevent flight activity. A forested area would tend to favor the search for droppings because strong wind would not be a normal occurrence.

Vagility may be an important factor, but data on this subject are very limited. Location of the food supply is accomplished by a searching flight. Most species are capable fliers and the search mode consists of an erratic, rapid flight close to the ground, a pattern very similar to that observed in many Diptera. Personal observations indicate that flights usually take place on overcast days, or in late afternoon, not when it is sunny and hot.

A conclusion reached by Landin (1961) with which I agree entirely, is that two or more species can occupy the same "niche," in this case the dung heap. In fact this is the rule rather than the exception. Landin summarized this as follows: "Interspecific as well as intraspecific fluctuations occurring in natural populations of dung-beetles in the dung heaps depend on abiotic factors rather than on the competition factor." However, competition possibly is a factor when food resources are limited, as is often the case with deer dung. This competition may come from other species of *Aphodius* or other species of Scarabaeidae that are not *Aphodius*. Table 7 lists the major competition from non-*Aphodius* by season. Note that of the ten species on the list, five are in the summer category and three are found all year, leaving only one species in direct competition with winter

Table 4. Category IV, native detritivores.

Species	Geographic distribution	Temporal distribution
Aphodius paleroides Horn	New York to South Carolina (coastal sand areas)	June–July
Aphodius parcus Horn	Florida	May–September
Aphodius pinguis Haldman	Quebec to New York, west to Alberta and Montana	May–September
Aphodius hyperboreus LeConte	Quebec to New York, west to British Columbia	May–September

Aphodius and one in direct competition with spring *Aphodius.* The temporal distribution of these competitors is almost a complete reversal of the temporal distribution of *Aphodius* species. The first six names on the list are members of the Aphodiinae, the last four are in the Coprinae. Table 8 lists the species of deer dung *Aphodius* on the left and non-*Aphodius* competitors on the right, broken down by season. Where groupings can be indicated by brackets this has been done—where this was not possible lines are drawn directly between the species of *Aphodius* and the competitor. The brackets on the extreme left group those species of *Aphodius* that may compete with each other. For example, the two summer species of *Aphodius* compete with each other whenever they occur together, and all of the competitor species can compete with both *Aphodius* species.

Category II: Species associated with rodent burrows or nests, or burrows of gopher tortoise (Table 2).—In the midwestern and western United States, about 60 species, or approximately 43% of the North American species whose habitats are known, are in this category. However, only four eastern species belong here, presumably because the harsh climatic changes during the Miocene in the western part of North America did not cause the same radical vegetation changes in eastern North America. *Aphodius badiceps* Fall is found in tree squirrel nests, usually those of the flying squirrel; *A. troglodytes* Hubbard only in burrows of the gopher tortoise; and *A. aegrotus* Horn and *A. laevigatus* Haldeman in pocket gopher burrows. The three burrow inhabiting species are restricted to sand areas of the southeastern United States.

Category III: Native generalists (Table 3).—The eight species in this category are general surface dung feeders, some of which are habitat restricted, but are not known to have distinct dung preferences except that they rarely utilize deer dung. Two possible exceptions to this statement are *Aphodius lentus* Horn and *A. borealis* Gyllenhal. I have taken *A. lentus* in sheep dung, and most species that will utilize sheep dung are also capable of living in deer dung. *Aphodius borealis* is a northern holarctic species which may use deer dung, but probably also occurs in dung of moose, elk, caribou, and possibly in ground squirrel pellets.

Category IV: Native detritivores (Table 4).—The eastern forest fauna in this category is analogous to the fauna of the rodent associated category in that the eastern fauna is comparatively depauperate in both. The native detritivores comprise about 23% of the North American fauna, but only four species occur in the eastern forest region. *Aphodius parcus* Horn and *A. phaleroides* Horn occur in sand areas along the Atlantic seaboard, including Florida; *A. pinguis* Haldeman

Table 5. Category V, native species, habits unknown.

Species	Geographic distribution	Temporal distribution
Aphodius serval Say	Pennsylvania to South Carolina, west to Kansas and Texas	September–April
Aphodius guttatus Escholtz	Newfoundland to New England, west to Alaska	May–November
Aphodius fordi Gordon	Georgia	July
Aphodius macdonaldi Robinson	Pennsylvania	April

and *A. hyperboreus* LeConte occur in marshy, grassy situations in southern Canada and northern United States.

Category V: Native species, habits unknown (Table 5).—Obviously little can be said about these species, but probable habits can be predicted from knowledge of the majority of the fauna. *Aphodius mcdonaldi* Robinson may be an early spring deer dung species; *A. guttatus* Escholtz probably utilizes the dung of moose, elk, and possibly deer; *A. serval* Say is probably a detritivore in sandy riverine situations; *A. fordi* Gordon is an enigma, all specimens having been taken at light, but the species is morphologically most similar to the European *A. scrofa* (F.) which is a surface dung feeder. It is possible that this is a recent immigrant because of its apparently restricted distribution (coastal Georgia), but this is pure speculation at present.

Table 6: Imported species of *Aphodius*; mostly generalists.—These species have the same surface dung feeding habits as the native species in Category III, but have been imported from Europe and have become established. Most are widespread in North America; but three species, *A. scrofa* (F.) and *A. subterraneus* (L.) are restricted to eastern seaboard localities, and *A. rufipes* (L.) occurs in the forested mountain regions from New York to Virginia. With the exception of *A. rufipes,* all of the imports prefer open pastures and bovine dung.

SPECIES IDENTIFICATION

The standard reference for determining species of North American *Aphodius* has been Horn (1887), which is still the only publication dealing solely with the

Table 6. Imported species of *Aphodius,* mostly generalists.

Aphodius fimetarius (L.)
Aphodius granarius (L.)
Aphodius haemorrhoidalis (L.)
Aphodius fossor (L.)
Aphodius erraticus (L.)
Aphodius lividus (Olivier)
Aphodius distinctus (Mull.)
Aphodius rufipes (L.)
Aphodius prodromus (Brahm)
Aphodius scrofa (F.)
Aphodius subterraneus (L.)

Table 7. Competitors for deer dung other than species of *Aphodius*: geographic and temporal distribution.

Species	Geographic distribution	Temporal distribution
Dialytellus humeralis (LeConte)	Southeastern Canada to North Carolina	October–May (winter)
Dialytellus dialytoides (Fall)	Eastern Canada to North Carolina	May–October (summer)
Dialytes ulkei Horn	Eastern Canada to South Carolina	June–October (summer)
Dialytes striatulus (Say)	Eastern Canada to Georgia, west to Manitoba and Iowa	June–October (summer)
Dialytes truncatus (Melsheimer)	Southeastern Canada to South Carolina, west to Wisconsin and Illinois	July–October (summer)
Aphotaenius carolinus (Van Dyke)	Maryland to Florida, west to Indiana	June–August (summer)
Onthophagus concinnus	Pennsylvania to Florida, west to Mississippi	April–December (all year)
Onthophagus subaeneus (P. de B.)	Pennsylvania to Florida, west to Kansas and Texas	February–June (spring)
Onthophagus tuberculifrons Harold	Connecticut to Florida, west to Wisconsin and east Texas	February–December (all year)
Copris minutus (Drury)	Vermont to Florida, west to Kansas and Texas	February–December (all year)

North American fauna as a whole. Schmidt (1922) published descriptions and keys to subgenera and species of the *Aphodius* fauna for the world, and included several North American species unknown to Horn in 1887. Since 1922, a few papers dealing with segments of North American *Aphodius* have appeared (Brown, 1927, 1928, 1929; Saylor, 1940; Cartwright, 1972; Gordon, 1976, 1977a, 1977b), as have two significant regional publications dealing with the fauna of the Pacific Northwest (Hatch, 1972) and Florida (Woodruff, 1973). In addition, several new species descriptions also have appeared since 1922.

The following key to eastern North American *Aphodius* includes those species restricted to, or centered in, the eastern forest region. In addition to those species, several species of primarily midwestern occurrence are included because they penetrate the eastern forest to a significant degree; these species are indicated by an asterisk (*). The key is arranged to facilitate identification, regardless of phylogenetic relationships. One species, *A. rotundiceps* Fall (in Fall and Cockerell, 1907) (type locality, Highlands, North Carolina) is not included in the key nor in the foregoing discussion. The species is apparently known only from the holotype which I examined several years ago. I seriously doubt that *A. rotundiceps* is a member of the American fauna; more likely, the type is a mislabeled Old World specimen.

Most species of *Aphodius* have been assigned to various subgenera, most notably by Schmidt (1922). Most of these "subgenera" are of questionable merit. However,

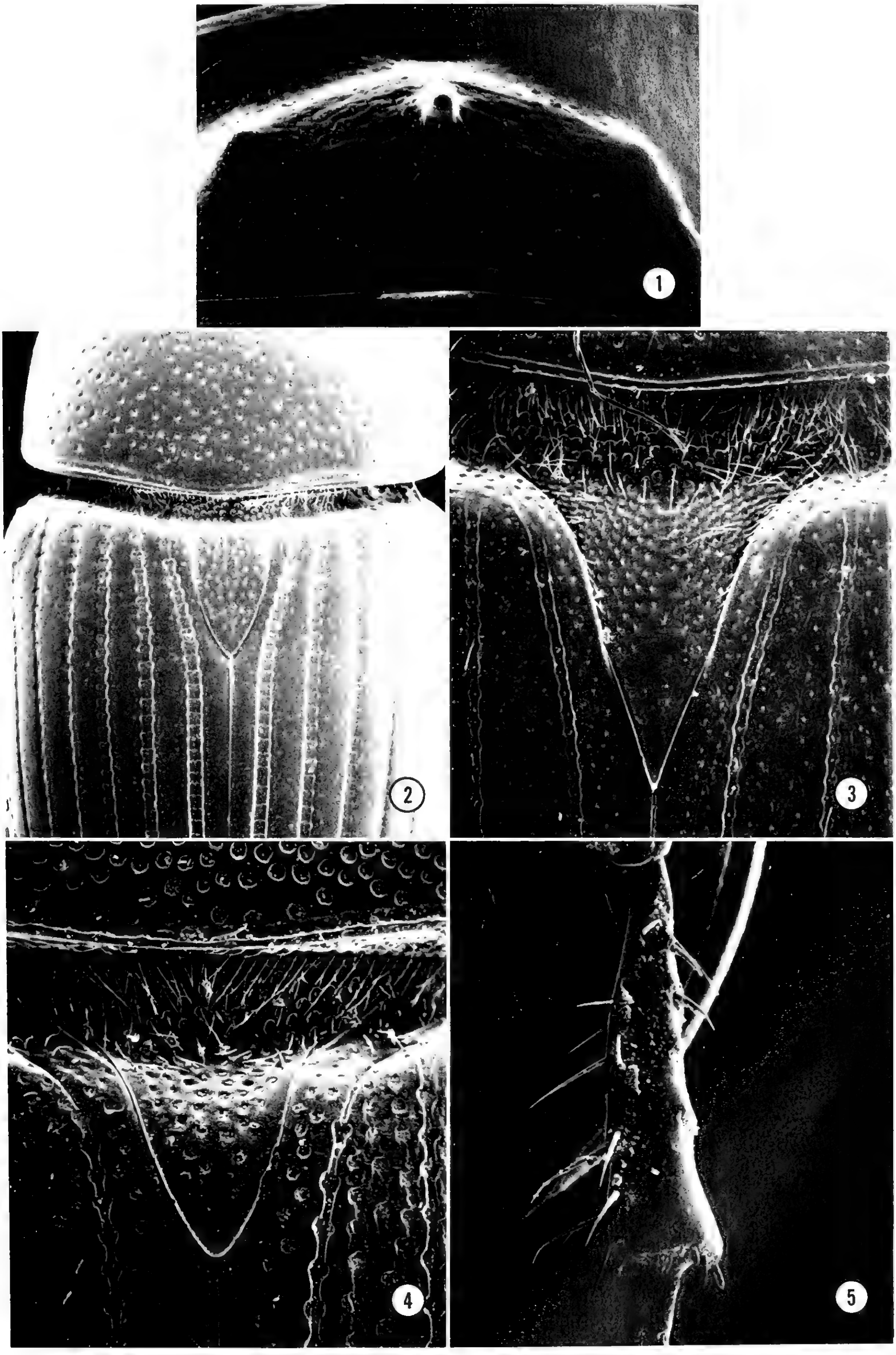
Table 8. Competition among species utilizing deer dung as an energy resource.

Species	Actual and probable competitors
Spring species:	
Aphodius odocoilis Robinson *Aphodius brimleyi* Cartwright	*Onthophagus tuberculifrons* Harold *Onthophagus subaeneus* (P. de B.) *Onthophagus concinnus* LaPorte *Copris minutus* (Drury) *Dialytellus humeralis* (LeConte)
Aphodius abusus Fall	*Onthophagus tuberculifrons* Harold *Onthophagus subaeneus* (P. de B.) *Copris minutus* (Drury)
Summer species:	
Aphodius rubripennis Horn *Aphodius ruricola* Melsheimer	*Dialytellus dialytoides* (Fall) *Dialytes ulkei* (Horn) *Dialytes striatulus* (Say) *Dialytes truncatus* (Melsheimer) *Aphotaenius carolinus* (Van Dyke) *Onthophagus subaeneus* (P. de B.) *Onthophagus concinnus* LaPorte *Onthophagus tuberculifrons* Harold
Fall species:	
Aphodius robinsoni Cartwright *Aphodius stupidus* Horn *Aphodius lutulentus* Haldeman *Aphodius manitobensis* Brown	*Onthophagus tuberculifrons* Harold *Onthophagus concinnus* LaPorte *Onthophagus subaeneus* (P. de B.) *Copris minutus* (Drury)
Winter species:	
Aphodius leopardus Horn *Aphodius terminalis* Say *Aphodius bicolor* Say *Aphodius silvanus* Cartwright *Aphodius crassulus* Fall	*Dialytellus humeralis* (LeConte)
Aphodius leopardus Horn *Aphodius terminalis* Say *Aphodius bicolor* Say *Aphodius silvanus* Cartwright *Aphodius crassulus* Fall *Aphodius windsori* Cartwright *Aphodius lodingi* Cartwright *Aphodius floridanus* Robinson	*Onthophagus tuberculifrons* Harold *Onthophagus concinnus* LaPorte *Copris minutus* (Drury)

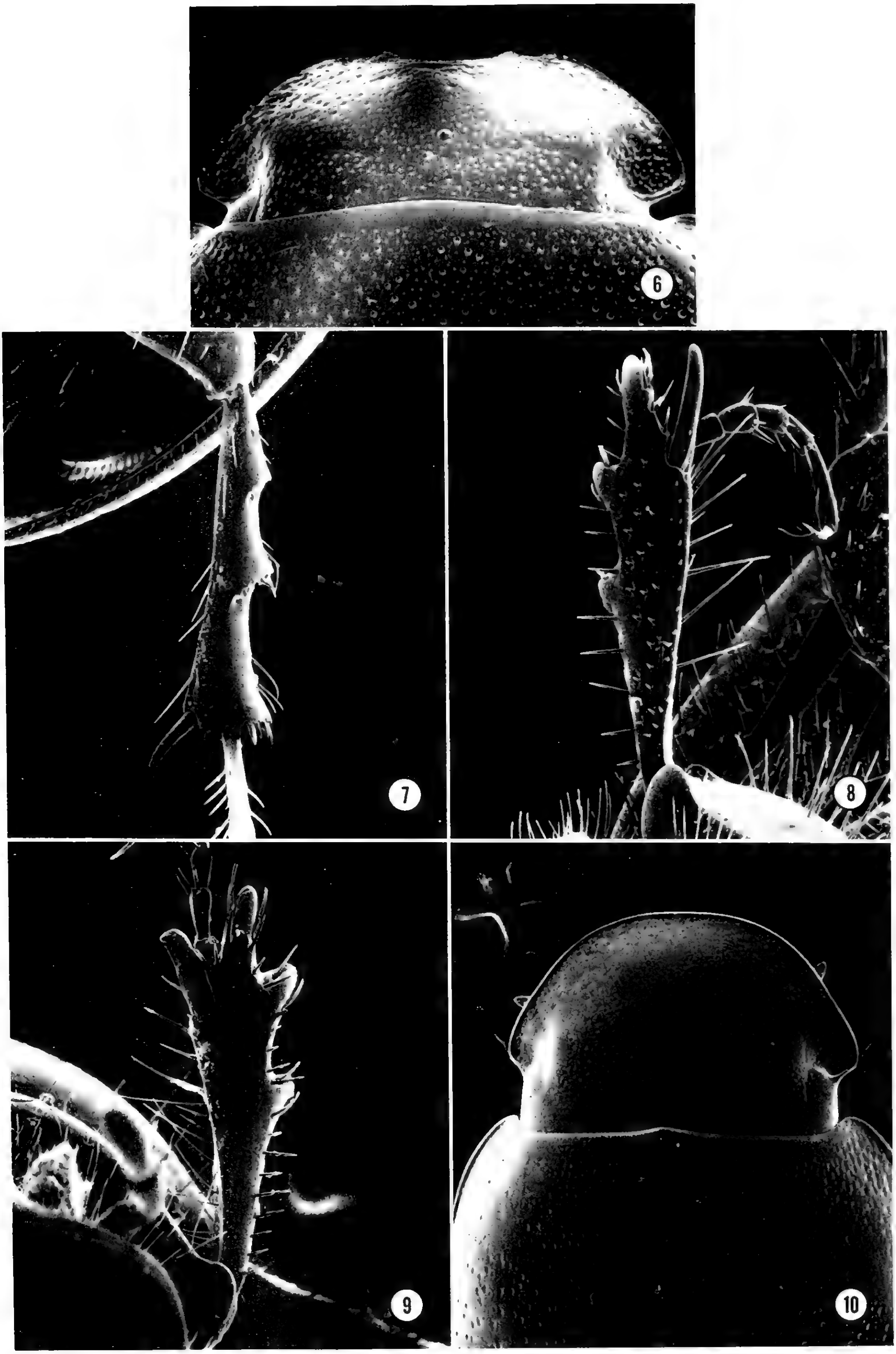
those species occurring in North America that have an elongated scutellum have been placed in two subgenera, or genera, depending on author, and these may need to be separated from *Aphodius* proper. The subgeneric or generic names involved are: *Colobopterus* Mulsant, including the species *fossor* (L.), *erraticus* (L.), *subterraneus* (L.), and *haemorrhoidalis* (L.); and *Diapterna* Horn, including the species *hyperboreus* LeConte, *pinguis* Haldeman, and *hamatus* Say. The first "subgenus" contains species introduced from Europe, and the latter "subgenus" only native North American species. Similarly *Aphodius parcus* Horn has been placed in the subgenus or genus *Didactylia* Orbigny, depending on the author. This species lacks the oblique, transverse ridges on the hindtibia so characteristic of most *Aphodius* species. This species probably deserves at least subgeneric status, but I have followed the same conservative course here in key couplet 9, of treating it as "*Aphodius.*"

KEY TO EASTERN NORTH AMERICAN SPECIES OF *APHODIUS*

1. Scutellum large, $\frac{1}{5}$ to $\frac{1}{3}$ as long as elytron (Figs. 2, 3) 2
– Scutellum small, $\frac{1}{10}$ to $\frac{1}{8}$ as long as elytron (Fig. 4) 8
2. Head with at least one median tubercle, usually with 3 tubercles (Fig. 1); surface of head roughened or densely punctured 3
– Head without trace of tubercles; surface of head smooth 6
3. Small species, less than 6.0 mm long; elytron black except apical $\frac{1}{3}$ always red or yellow, humerus often red or yellow .... *haemorrhoidalis* (L.)
– Species longer than 6.0 mm; elytron not as described above 4
4. Elytron entirely yellow or yellowish brown except sutural margin black; surface of pronotum dull, densely punctured .... *erraticus* (L.)
– Elytron entirely black or dark brown; surface of pronotum shiny, not densely punctured 5
5. Intervals on elytron flat; length 9.0 mm or more .... *fossor* (L.)
– Intervals on elytron convex; length 8.0 mm or less ......*subterraneus* (L.)
6. Elytron yellow or yellowish brown with obscurely defined brown blotch medially ....*hamatus hamatus* Say
– Elytron entirely brown or black 7
7. Mid- and hindfemora and median area of mesosternum coarsely punctured .... *pinguis* Haldeman
– Mid- and hindfemora and median area of mesosternum finely punctured, appearing impunctate ....*hyperboreus* LeConte
8. Hindtibia without oblique, transverse ridges (Fig. 5) .... *parcus* Horn
– Hindtibia with oblique, transverse ridges (Fig. 7) 9
9. Elytron pubescent throughout; dorsal color uniformly dark brown or uniformly light brown, obscurely defined reddish areas may be present.. 10
– Elytron lacking pubescence, or if pubescent, then pubescence not present throughout, or if so, then pronotum and head entirely or partially brown or black, elytron red or yellow, or uniformly dull gray (*lutulentus*) 13
10. Pronotum lacking pubescence on dorsal surface 11
– Pronotum pubescent on dorsal surface 12
11. Mesosternum carinate between coxae; dorsal surface reddish brown .. .. *lentus* Horn
– Mesosternum not carinate between coxae; dorsal surface dark brown to



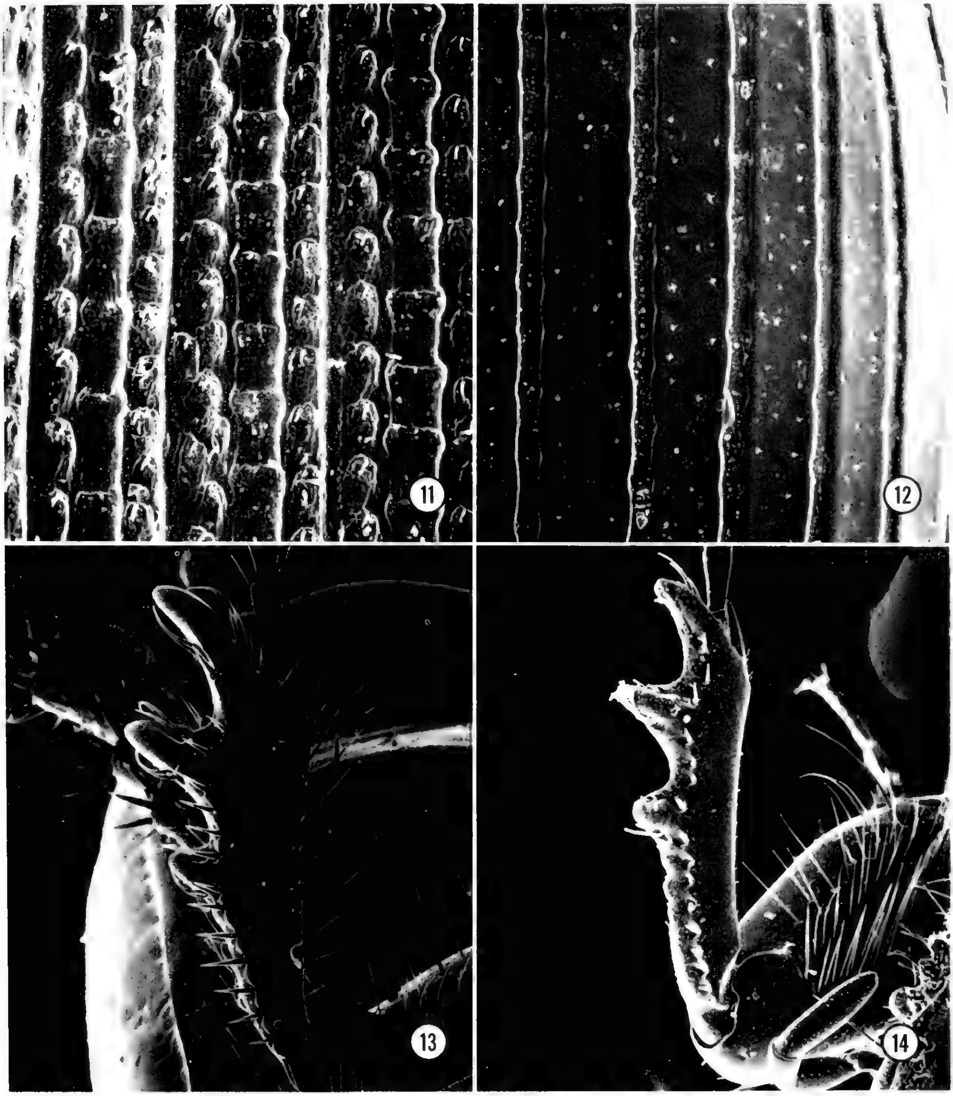
Figs. 1–5. 1, *Aphodius fossor*, head (×44). 2, *A. haemorrhoidalis*, scutellum (×44). 3, *A. erraticus*, scutellum (×60). 4, *A. lutulentus*, scutellum (×100). 5, *A. parcus*, hindtibia (×120).



Figs. 6–10. 6, *Aphodius badiceps*, head with clypeal teeth (×40). 7, *A. distinctus*, hindtibia (×70). 8, *A. campestris*, foretibia (×110). 9, *A. prodromus*, foretibia (×80). 10, *A. rubripennis*, clypeus (×35).

black, elytron with obscure red areas, particularly on apical declivity . . . . *stupidus* Horn

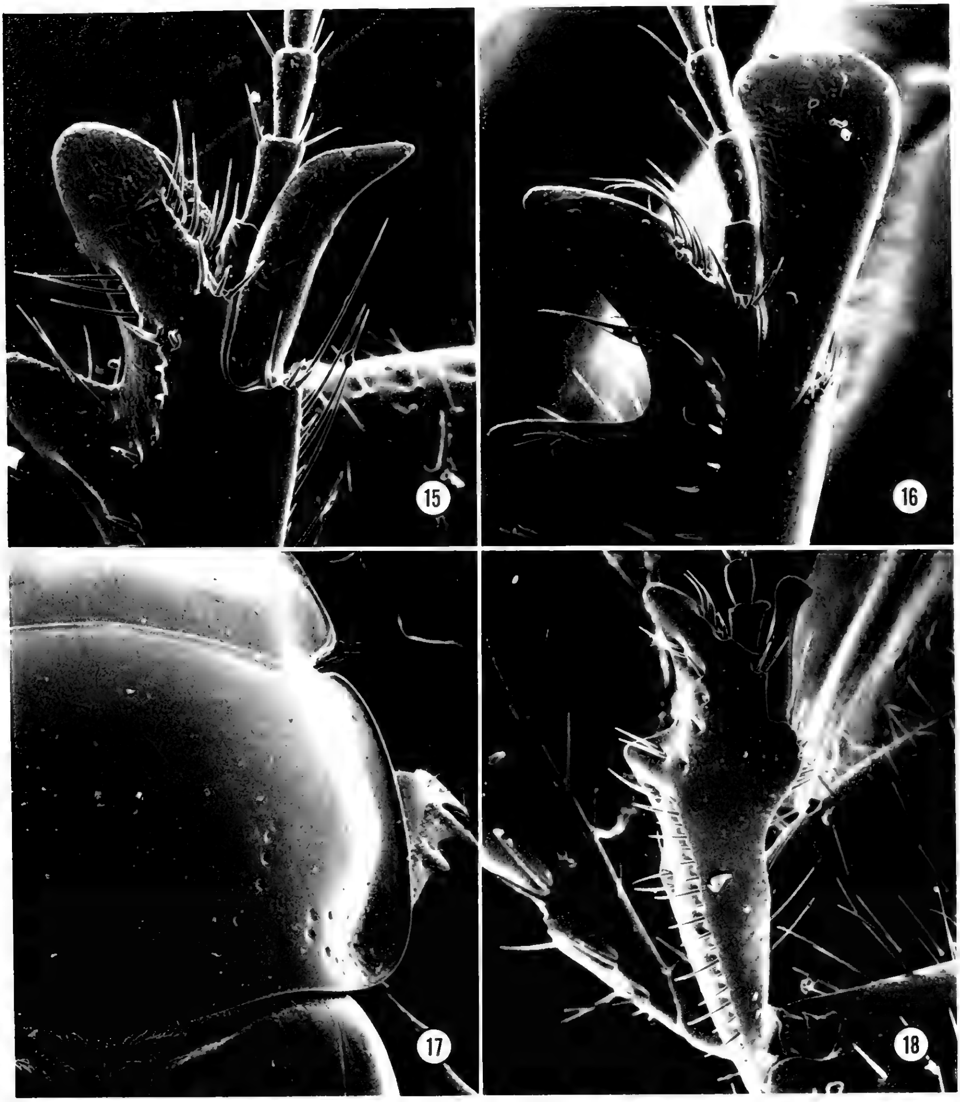
12. Basal marginal line of pronotum strongly impressed; Georgia . . . . *fordi* Gordon
– Basal marginal line of pronotum obsolete; not known from Georgia . . . . *scrofa* (F.)
13. Foretibia punctate on front surface (Fig. 8), punctures may be reduced to a single, irregular row (*sallei*); 1st segment of foretarsus longer than 2nd segment (except *sallei*) 14
– Foretibia impunctate, smooth on front surface (Fig. 9); 1st segment of foretarsus not longer than 2nd segment 19
14. Elytron pubescent in apical ⅓ near lateral margin 15
– Elytron without trace of pubescence except hairs on lateral margin may be present 16
15. First segment of hindtarsus shorter than next 3 segments; color uniformly reddish brown . . . . *rubeolus* Beauvois
– First segment of hindtarsus as long as next 3 segments; pronotum reddish brown, elytron pale brownish yellow . . . . *campestris* Blatchley
16. Head tuberculate; elytron with intervals convex, striae deeply impressed; south Texas; punctures on foretibia arranged in irregular row . . . . *sallei* Harold
– Head smooth; elytron with intervals flat, striae finely impressed; not known from south Texas (except *stercorosus*) 17
17. Pronotal punctures very fine, nearly invisible; lateral margin of elytron with widely spaced, long hairs, burrows of gopher tortoise . . . . *troglodytes* Hubbard
– Pronotum with dense, coarse punctures in lateral ⅓, discal area impunctate or with fine punctures; lateral margin of elytron without hairs 18
18. Basal margin of pronotum slightly projecting medially, pronotal disc with distinct, fine punctures; in surface dung . . . . . . *stercorosus* Melsheimer
– Basal margin of pronotum evenly rounded, pronotal disc appearing impunctate; in pocket gopher burrows . . . . *aegrotus* Horn
19. Each anterior angle of clypeus with short, triangular or spiniform tooth (Fig. 6); dorsal color uniformly black, brown, or dull gray 20
– Each anterior angle of clypeus rounded or obtusely prominent (Figs. 10, 19) dorsal color variable, but if anterior angle of clypeus appears strongly angulate, then elytron pale red, or dark with pale maculation 29
20. Length 8.0 mm or more; clypeal teeth somewhat spiniform (Fig. 6); in squirrel nests . . . . *badiceps* Fall
– Length less than 8.0 mm; clypeal teeth more or less triangular 21
21. Dorsal surface dull, with grayish cast; elytron roughened with carinae or alutaceous sculpture 22
– Dorsal surface shiny, uniformly black or brown 23
22. Length 5.0 mm or more; intervals on elytron roughened, alutaceous, flat . . . . *lutulentus* Haldeman
– Length 4.50 mm or less; intervals on elytron carinate (Fig. 11) . . . . *robinsoni* Cartwright



Figs. 11–14. 11, *Aphodius robinsoni*, elytron (×200). 12, *A. odocoilus*, elytron (×130). 13, *A. windsori*, foretibia (×130). 14, *A. lodingi*, foretibia (×85).

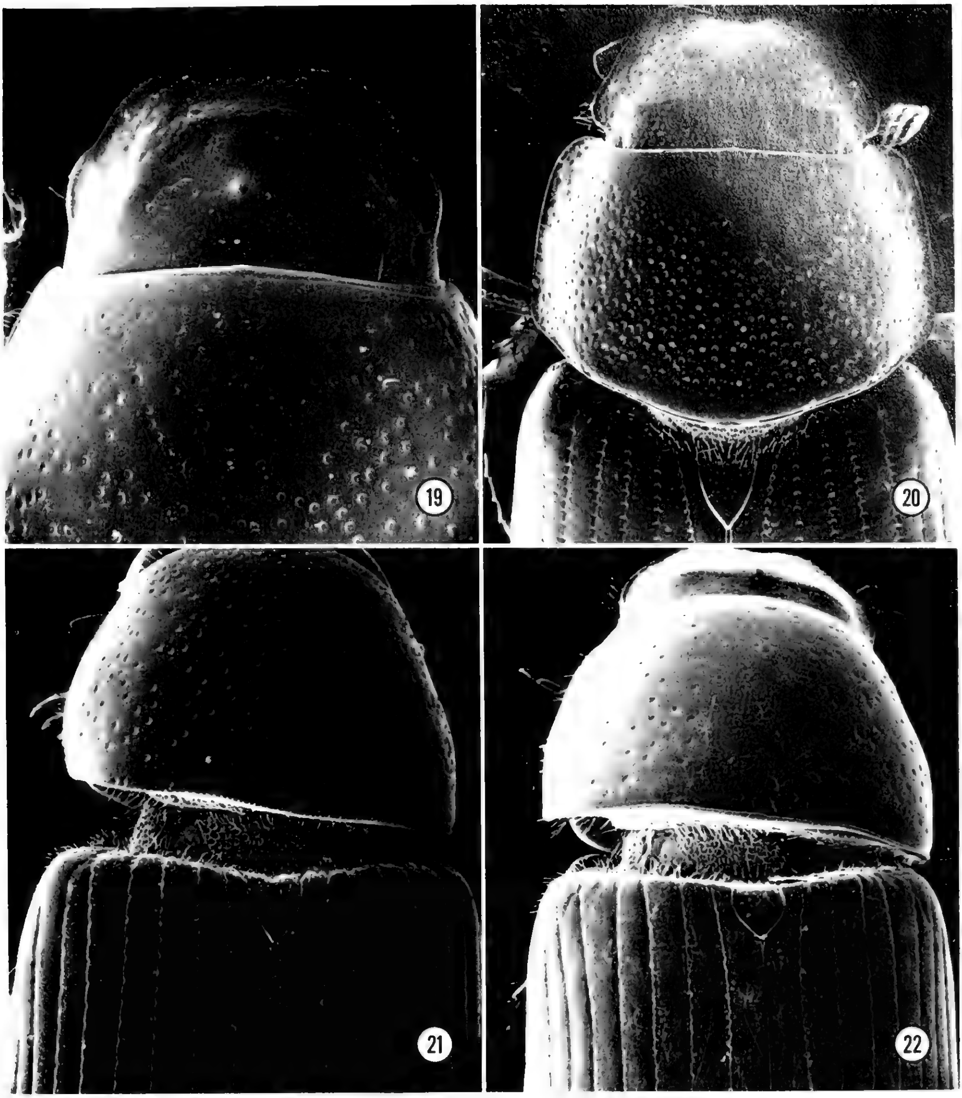
23. Intervals on elytron concave (Fig. 12); middle of metasternum pubescent in male; New Jersey Pine Barrens .... *odocoilis* Robinson
  – Intervals on elytron flat or convex; metasternum not pubescent in male; New Jersey Pine Barrens and elsewhere 24
24. Last abdominal sternum concave medially, apex of sternum acuminate; mountains of North and South Carolina .... *brimleyi* Cartwright
  – Last abdominal sternum not concave medially, apex of sternum rounded 25
25. Striae on elytron wider over apical declivity than on disc 26
  – Striae on elytron not wider over apical declivity than on disc 27

26. Intervals on elytron convex on disc to strongly convex over apical declivity; Virginia to Florida .... *crassulus* Horn
– Intervals on elytron flat on disc, barely convex over apical declivity; Maryland .... *silvanicus* Cartwright
27. Entire clypeus strongly rugose-punctate; east Texas .... *abusus* Fall
– Clypeus with small, rounded, well-separated tubercles, or wrinkled in apical ½ only; not occurring in east Texas 28
28. Basal tooth of foretibia nearer base than apex (Fig. 13); dorsal surface of clypeus strongly wrinkled; surface of pronotum smooth, polished throughout; South Carolina to Florida .... *windsori* Cartwright
– Basal tooth of foretibia nearer apex than base (Fig. 14); dorsal surface of clypeus with distinct, dense tubercles; surface of pronotum smooth, polished except lateral ⅛ weakly alutaceous, somewhat dull .... *lodingi* Cartwright
29. Elytron red, head and pronotum black; elytron pubescent in apical ⅓; head smooth between punctures; pronotum lacking basal marginal line .... *rubripennis* Horn
– Combination of characters not as described above 30
30. Head and pronotum smooth, punctation nearly invisible; length 9.0 mm or more; mountains from New York to North Carolina .... *rufipes* (L.)
– Head usually with at least some visible punctures; pronotum always punctate, at least laterally; length less than 9.0 mm, or if longer, then pronotum distinctly punctate 31
31. Foretibia with apical spur long, abruptly hooked and acuminate (Fig. 15), or broadly expanded, spatulate (Fig. 16) 32
– Foretibia with apical spur variably modified, but never as described above 33
32. Pronotum with lateral margin broadly explanate (Fig. 17); surface of pronotum smooth, shiny, impunctate medially; Florida and Great Plains; in pocket gopher burrows .... *haldemani* Horn
– Pronotum with lateral margin slightly explanate; surface of pronotum densely punctate; Iowa and Great Plains; in pocket gopher burrows .. .. *russeus* Brown
33. Elytron pubescent throughout, or only in apical ⅓ and lateral ⅛; elytron usually yellow or yellowish brown 34
– Elytron without pubescence 36
34. Foretibia with basal tooth reduced, nearly absent (Fig. 18); lateral margin of elytron fringed with hairs as long as scutellum .... *walshi* Horn
– Foretibia with basal tooth prominent; lateral margin of elytron fringed with hairs much shorter than scutellum 35
35. Pronotum impunctate medially, or with some scattered, coarse punctures; elytron yellow with large, yellowish-brown, central cloud not extending to base or apex .... *prodromus* (Brahm)
– Pronotum punctate medially, punctures dense, fine; elytron yellowish brown except basal ⅕ often yellow .... *femoralis* Say
36. Surface of head smooth, without trace of tubercles; clypeus nearly truncate, anterior clypeal angle broadly rounded; color completely yellow or elytron with some small, brown spots, median ⅓ of pronotum usually



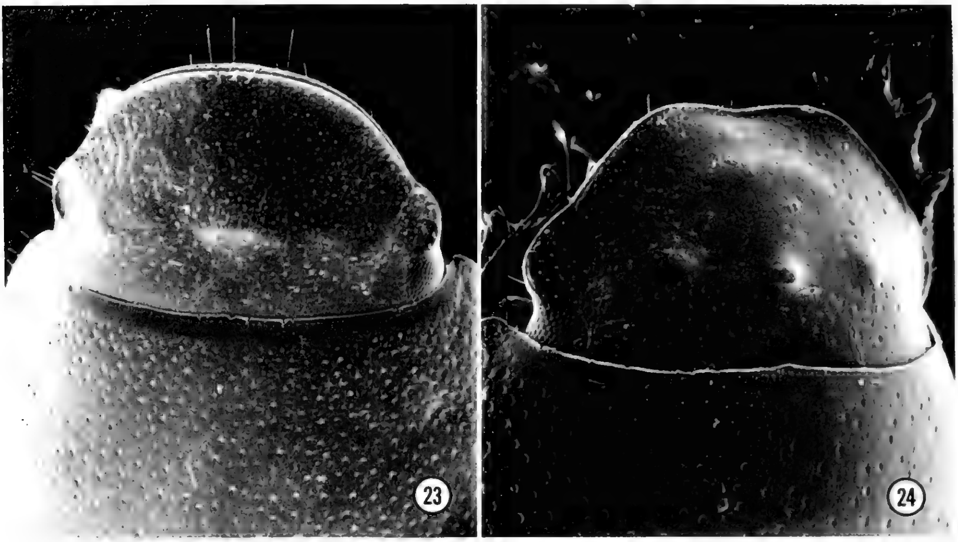
Figs. 15–18. 15, *Aphodius haldemani,* female, foretibial spur (×100). 16, *A. haldemani,* male, foretibial spur (×100). 17, *A. haldemani,* pronotum (×35). 18, *A. walshi,* foretibia (×110).

indistinctly yellowish brown; Atlantic coastal sand areas ....
.... *phaleroides* Horn
– Description not as above; not restricted to Atlantic coastal sand areas 37
37. Dorsal color uniformly red or reddish brown; length 7.0 mm or more 38
– Dorsal color not uniformly red or reddish brown, if elytron red, then pronotum black or brown; length 6.0 mm or less, if longer than 6.0 mm, then pronotum darker than elytron 39
38. Surface of pronotum smooth, punctures extremely fine, appearing impunctate; Florida, Georgia, Alabama; in pocket gopher burrows ......
.... *laevigatus* Haldeman



Figs. 19–22. 19, *Aphodius fimetarius*, head (×35). 20, *A. leptotarsis*, pronotum (×42). 21, *A. cuniculus*, pronotum without basal marginal line (×55). 22, *A. granarius*, pronotum with basal marginal line (×45).

– Surface of pronotum densely, coarsely punctured; Indiana, Illinois, Iowa, Great Plains; in rodent burrows . . . . *_concavus_ Say
39. Elytron entirely red; pronotum black except lateral margin or anterior angle pale 40
– Elytron never entirely red, often partially red or yellow; pronotum entirely black or dark brown, often with lateral margin and/or anterior angle pale 41
40. Length less than 6.0 mm; head without prominent tubercles . . *tenellus* Say



Figs. 23, 24. 23, *Aphodius vittatus,* head (×70). 24, *A. borealis,* head (×80).

- – Length more than 7.0 mm; head with 3 prominent tubercles and strong clypeal ridge (Fig. 19) . . . . *fimetarius* (L.)

41\. Lateral margin of pronotum strongly flared outward, explanate (Fig. 20); hindtarsus as long as tibia; elytron entirely brown; in rodent burrows or nests . . . . *leptotarsis* Brown

- – Lateral margin of pronotum not flared outward, or only feebly so; elytron black or brown, or variably marked; not known to occur in rodent burrows or nests 42

42\. Elytron entirely black; meso- and metasterna, and abdomen reddish yellow . . . . *bicolor* Say

- – Elytron entirely black or brown, or variably marked; meso- and metasterna, and abdomen brown to black, if appearing reddish yellow, then elytron not entirely black 43

43\. Dorsal surface entirely black except apical ⅓ of elytron red . *terminalis* Say

- – Dorsal surface entirely black or brown, or variably marked, but never with only apical ⅓ of elytron red 44

44\. Elytron appearing speckled or mottled, either with pale spots on dark background, or vice versa (see couplet 52, *borealis*) 45

- – Elytron not appearing speckled or mottled 48

45\. Propleuron with few short hairs, hairs not visible in dorsal view; clypeus with anterior angle sharp, nearly dentate . . . . *serval* Say

- – Propleuron with dense, long hairs, usually visible beyond lateral margin of pronotum in dorsal view; anterior clypeal angle rounded 46

46\. Elytron yellow with elongate, black spots varying in pattern; legs dark brown . . . . *distinctus* (Muller)

- – Elytron brownish yellow, mottled with dark brown spots, or dark brown with pale spots, legs red or reddish brown 47

47. Surface of elytron dull, strongly alutaceous; median area of metasternum flat to slightly convex, midline distinct . . . . *leopardus* Horn
– Surface of elytron shiny, feebly alutaceous; median area of metasternum concave, midline nearly obliterated . . . . *guttatus* Escholtz
48. Pronotum without basal marginal line (Fig. 21) 49
– Pronotum with basal marginal line (Fig. 22) 50
49. Elytron yellow with large, yellowish brown, median cloud; pronotum yellow in lateral ⅓, median area brown . . . . *lividus* (Olivier)
– Elytron uniformly brown; pronotum piceous except apical and lateral margin brown . . . . *cuniculus* Chevrolat
50. Scutellum depressed below level of elytron; pronotal punctures coarse, widely, erratically scattered . . . . *granarius* (L.)
– Scutellum not depressed below level of elytron; pronotal punctures coarse or fine, but not widely scattered, more or less evenly spaced 51
51. Clypeus dull, strongly alutaceous; apex of elytron below declivity dull, strongly alutaceous; elytron usually with at least small, red, basal and apical areas 52
– Clypeus mostly shiny, never extremely dull; apex of elytron below declivity as shiny as rest of elytron; elytron uniformly black or brown . . 53
52. Anterior clypeal angle rounded, apex appearing almost semicircular (Fig. 23); elytron usually mostly red except sutural margin, lateral ⅓ obscurely or distinctly darkened, red area often variably reduced . . . . *vittatus* Say
– Anterior clypeal angle obtusely angulate, apex appearing broadly emarginate (Fig. 24); elytron usually with small red area on humerus and apical declivity . . . . *borealis* Gyllenhal
53. Basal segment of hindtarsus longer than long tibial spur . . . . *manitobensis* Brown
– Basal segment of hindtarsus shorter than long tibial spur 54
54. Head essentially impunctate except for fine punctures across vertex and around inner margin of eye; intervals on elytron nearly flat . . . . *mcdonaldi* Robinson
– Head distinctly punctured; intervals on elytron convex 55
55. Elytron with many fine punctures on interval, strial punctures strongly impressed; pronotal punctures separated by 1–2× the diameter of a puncture; Ontario to South Carolina, west to Manitoba and east Texas . . . . *ruricola* Melsheimer
– Elytron with some scattered, fine punctures on interval, strial punctures weakly impressed; pronotal punctures separated by 2–4× the diameter of a puncture; Florida . . . . *floridanus* Robinson

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THE GENUS *COENOMYIA* (DIPTERA: COENOMYIIDAE) IN THE NEARCTIC REGION AND NOTES ON GENERIC PLACEMENT

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Abstract.—The genus *Coenomyia* is revised for the Nearctic Region and its phylogenetic relationships with other genera of lower brachycerous Diptera are discussed. The adults, pupa, and larva of the single species, *C. ferruginea* (Scopoli), are described and illustrated.

This study is based on 542 specimens of *Coenomyia ferruginea* (Scopoli), the only Nearctic species in the genus *Coenomyia.* The adults and immature stages are redescribed with notes on biology and distribution. The relationship between the genus *Coenomyia* and other genera of lower brachycerous Diptera is discussed.

The genus *Coenomyia* was erected by Latreille (1796) although no species name was included. Latreille (1802) repeated the description and included the species *Sicus ferruginea* Fabricius (= *Musca ferruginea* Scopoli, 1763). Three species are currently recognized: *Coenomyia basalis* from Japan (Nagatomi and Saigusa, 1970), *C. bituberculata* from the Himalayas (Enderlein, 1921; Oldroyd 1966); and *C. ferruginea* from the Holarctic Region (James, 1981; Leonard, 1930; Oldroyd, 1966; Séguy, 1955). *Coenomyia pallida* Say (1824) and *C. cinereibarbis* Bigot (1879) were described from the Nearctic Region, but are currently considered synonyms of *C. ferruginea.*

Coenomyia has been placed in three different families of Diptera: (1) Rhagionidae, Coenomyiinae (Lindner, 1925); Rhagionidae, Xylophaginae (Leonard, 1930); (2) Xylophagidae (Williston, 1888); Xylophagidae, Xylophaginae (James, 1965; Williston 1896, 1908); Xylophagidae, Coenomyiinae (James, 1981); Coenomyiidae (Bezzi, 1903; Brues and Melander, 1932; Lundbeck, 1907; Malloch, 1917; Nagatomi 1975a, 1975b, 1977; Nagatomi and Saigusa, 1970; Séguy, 1926; Steyskal, 1953); (3) Coenomyiidae, Coenomyiinae (Brues, Melander, and Carpenter, 1954; Cole, 1969). Nagatomi (1975a) defined the family Coenomyiidae and included the genera *Coenomyia, Anacanthaspis, Arthropeas, Odontosubula,* and *Dialysis.*

For the phylogeny of 21 genera, including *Coenomyia,* of lower brachycerous Diptera in the Nearctic Region, Webb (1981) examined 53 morphological characters of adult males and females. Two phylogenetic (cladistic) and three phenetic methods were utilized in developing and interpreting the relationships of these genera.

Phylogenetic methods.—Cladograms were developed which (1) reflected the least number of convergences for all character states considered and (2) were rooted from a hypothetical ancestor possessing the plesiomorphic state for all 53 characters using the Wagner algorithm.

Phenetic methods.—Phenetic similarities were analyzed, using CLUSTER (written by Dr. R. B. Selander, University of Illinois), and phenograms were produced utilizing UPGMA (unweighted pair-group method using arithmetic averages) for Pearson product-moment correlation coefficients, average taxonomic distances, and mean character differences.

The two phylogenetic analyses associated the genera *Arthropeas, Coenomyia,* and *Dialysis.* The three phenetic analyses closely associated *Coenomyia* and *Dialysis,* but separated *Arthropeas* from these genera and associated it with *Arthroceras.* This phylogenetic analysis reinforces Nagatomi's association and grouping of *Coenomyia, Arthropeas,* and *Dialysis* in Coenomyiidae (Nagatomi, 1975a).

Most recently, James (1981) included the genus *Coenomyia* in the family Xylophagidae, based on the strong similarity in the larvae of *Coenomyia, Rachicerus,* and *Xylophagus.* However, because of the divergence of the adults, he grouped *Coenomyia, Dialysis,* and *Arthropeas* in the subfamily Coenomyiinae. On the basis of the larva, Krivosheina (1967, 1971) associated *Coenomyia* with *Arthropeas.* The immature stages of *Dialysis fasciventris* were reared in 1982 and showed a close association with the larva of *Coenomyia* and *Arthropeas* on the basis of their general shape and appearance, mandibular-maxillary complex (not illustrated for *Arthropeas*), metacephalic rods, and anal plate. Here again, the characteristics of the larvae of *Coenomyia, Dialysis,* and *Arthropeas* reinforce Nagatomi's (1975a) grouping of these genera into the family Coenomyiidae.

The terminology used for the adults is from McAlpine (1981) and Stuckenberg (1973); terminology for the immature stages is from Teskey (1969, 1981).

***Coenomyia* Latreille**

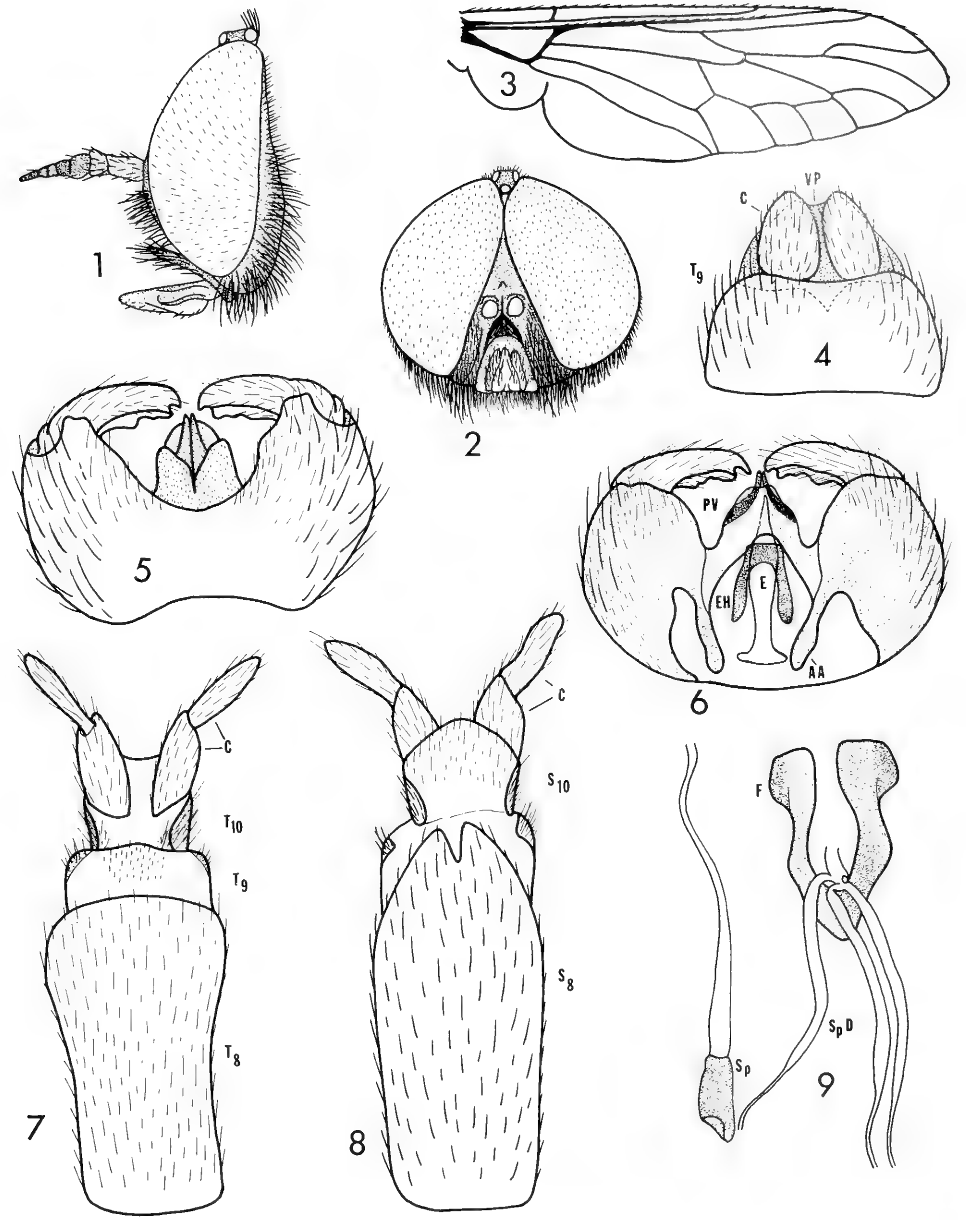
Coenomyia Latreille, 1796: 159; Leonard 1930: 6; Lindner 1925: 4; Oldroyd 1966: 953.

***Coenomyia ferruginea* (Scopoli)**

Musca ferruginea Scopoli, 1763: 349 (No. 913).
Coenomyia ferruginea: Leonard 1930: 7; Lindner 1925: 5; Oldroyd 1966: 957.

Twenty species have been synonymized with *Coenomyia ferruginea* (Leonard, 1930; Lindner, 1925; Oldroyd, 1966).

Male.—Length 13.9–16.2, 15.3 ± 0.41 mm ($N = 10$). Head in lateral view (Fig. 1) hemispherical. Vertex (Fig. 2) broadly rounded, not emarginate lateral to ocellar tubercle. Ocelli fuscous, large; ocellar tubercle fuscous, pruinose, subtriangular, distinctly raised above vertex; setae fuscous, elongate, restricted to caudal margin. Eyes large, holoptic, contiguous for short distance ventral to median ocellus; facets of equal size; setae fuscous, erect, very short, scattered over entire eye; medial margin sinuate, ventral ½ diverging laterally, no emargination dorsolateral to base of scape; in lateral view eyes hemispherical, covering more than ¾ of head. Frons fuscous, pruinose, glabrous, dorsomedial tubercle short. Antenna fuscous, lightly pruinose, elongate, 0.9–1.0, 0.96× width of head in lateral view; scape cylindrical, base almost contiguous, separated by distance 0.2–0.7, 0.4× width of ocellar tubercle, 1.9–2.3, 2.1× longer than wide, 1.7–2.6, 2.0× length of pedicel, setae stramineous, elongate, appressed over entire segment; pedicel globose, 1.0–1.4,



Figs. 1–9. *Coenomyia ferruginea.* 1, Lateral view of male head. 2, Anterior view of male head. 3, Wing. 4, Dorsal view of male terminalia. 5, Ventral view of basistyle. 6, Dorsal view of basistyle. 7, Dorsal view of female terminalia. 8, Ventral view of female terminalia. 9, Internal female reproductive structures. Abbreviations: AA = aedeagal apodeme; C = cercus; E = endophallus; EH = endophallic hilt; F = furca; PV = penis valve; S = sternite; Sp = spermatheca; SpD = spermathecal duct; T = tergite; VP = ventral plate of proctiger.

1.2× longer than wide, setae stramineous, short; flagellum darker than scape and pedicel, elongate, tapered apically, 3.5–4.5, 4.1× longer than wide, 1.1–1.4, 1.2× combined length of scape and pedicel, 5–6 annuli. Gena fuscous, pollinose, broad, narrowed dorsally; parafacial setae white to stramineous, elongate, abundant; facial setae white to stramineous, elongate, abundant. Face broadly rounded in lateral view. Clypeus fuscous, pollinose, anterior surface flat, glabrous, lateral grooves shallow with deep ventrolateral pit. Maxillary palpus with 1 segment, brown to pale fuscous, pruinose, narrow, elongate, 5.2–7.4, 6.5× longer than wide; setae stramineous, elongate, abundant. Labellum pale brown to fuscous, pruinose, membranous; setae fuscous, short, scattered. Postocular setae white to stramineous, elongate, abundant.

Thorax fuscous with anterior ¼ pollinose, broad; dorsum broadly rounded; vittae indistinct; mediolateral pair of tubercles along caudal margin short; setae golden, short, appressed, abundant. Humeral callus concolor with thorax, pruinose; setae white to stramineous, short, covering anterior of callus. Pleura fuscous, pruinose; setae white to stramineous, elongate, abundant on propleuron, mesoanepimeron, dorsal ½ of mesokatepisternum, and scattered along caudal margin of metepleuron; setae on caudal ½ of mesoanepisternum brown, elongate, abundant; setae on meron golden, elongate, restricted to caudolateral corner. Halter stalk dark yellow; capitulum pale yellow, pruinose. Postmetaspiracular scale and suprametacoxal pit absent. Mesoscutellum fuscous, lightly pruinose, caudal margin broadly rounded with 2 medial tubercles; setae golden, elongate, scattered. Mesopostnotum fuscous, pruinose, glabrous; lateral tergites enlarged, setae white to stramineous, elongate, abundant.

Wing (Fig. 3) length 11.7–13.5, 13.0 ± 0.33 mm ($N = 10$), 3.3–3.6, 3.4× longer than wide; membrane dark brown, darker anteriorly; veins dark brown; pterostigma indistinct; thyridium absent; microtrichia over entire wing; macrosetae on R_1. Costa circumambient. Subcosta ends in costa beyond middle of wing. Radial sector originates at middle of first basal cell. Marginal cell narrow, elongate, open. Fork of R_{4+5} originates basal to apex of discal cell, angle broadly rounded, almost right-angled. Cell R_4 large, enclosing apex of wing. R_5 ending posterior to apex of wing. Cell M_3 open. Anal cell narrow, elongate, open. Anal lobe broadly rounded, alula large, broadly rounded. Squama large, dark brown, marginal setae golden, fine.

Legs fuscous, tibiae and tarsi dark brown, coxae pruinose. Forecoxa large, elongate; mid- and hindcoxae short; hindcoxa without anterior tubercle. Tarsomeres 1–4 with ventral band of short, coarse spines; tarsomere 5 longer than either tarsomere 2, 3, or 4. Tibial spurs 1-2-2. Empodium pale fuscous, pulvilliform. Pulvilli pale fuscous, large. Apical claws on tarsomere 5 fuscous, paired, simple. Hindleg not raptorial.

Abdomen dark yellow to brown, glossy, dorsoventrally flattened; 7 visible segments; setae yellow, fine, elongate, with no distinctive pattern. Tergite 1 broad, subrectangular, anterior margin truncate. Tergite 8 reduced, retracted under tergite 7. Tergite 9 (Fig. 4) subrectangular, brown, medial area pale yellow, glabrous, caudal margin truncate, tergite not divided medially. Tergite 10 absent. Cercus with single short, oblong lobe, rounded caudally. Ventral plate of proctiger subtriangular, large, lying ventral to cerci, caudal margin emarginate. Sternite 9 and

10 absent. Basistyle in ventral view (Fig. 5) broad, rounded laterally, fused ventrally, setae absent from broad medial area; in dorsal view (Fig. 6) basistyle with broad, caudal bridge joining inner margins; aedeagal apodemes narrow, short, not extending anteriorly beyond base of basistyle. Dististyle short, thick, reflexed. Aedeagus composed of endophallus, endophallic hilt, and penis valves. Endophallus narrow, elongate, anterior margin truncate, median portion fusiform tapering to acute caudal point. Endophallic hilt broad, heavily sclerotized, with thick lateral extensions projecting anteriorly. Penis valves short, sinuate, lacking apical spines. Endophallic tines absent.

Female.—Length 19.4–24.5, 21.0 ± 0.90 mm ($N = 10$). Ocellar setae golden. Eyes dichoptic, widely separated, distance at vertex 0.7× outer width of scapes. Frons piceous; setae fuscous, short, erect, restricted to area lateral to ocellar tubercle; frontal tubercle larger than in male. Antenna 1.0–1.3, 1.1× width of head in lateral view, separated by distance 1.0–1.3, 1.1× width of median ocellus; scape on broad, short protuberance, pruinose, 1.8–2.1, 1.9× longer than wide, 2.0–3.2, 2.4× length of pedicel, setae pale yellow to golden; pedicel 0.9–1.4, 1.1× wider than long, apex swollen, setae golden to fuscous, short, appressed, scattered; flagellum 3.9–5.7, 5.0× longer than wide, 1.2–1.5, 1.3× combined length of scape and pedicel, 6–8 annuli; minute apical style; setae fuscous, short, appressed, scattered basally. Gena fuscous, pruinose; parafacial setae golden. Maxillary palpus 6.3–7.8, 6.9× longer than wide, setae fuscous. Labellar setae white. Postocular setae golden.

Thorax piceous, concolor. Humeral callar setae over entire callus. Pleura dark yellow, pruinose, setae golden.

Wing length 16.5–20.0, 18.8 ± 0.60 mm ($N = 10$), 2.9–4.2, 3.5× longer than wide. Membrane dark yellow; veins dark yellow. Subcosta ends above r-m and basal ⅓ of discal cell. Fork of R_{4+5} originates above apex of M_3, basal to apex of discal cell.

Legs dark yellow, concolor.

Abdomen with tergite 8 (Fig. 7) elongate, swollen posteriorly, 1.7× longer than wide; caudal margin truncate to broadly rounded. Tergite 9 subrectangular, 2.0× wider than long; caudal margin sinuate; tergite not divided medially. Tergite 10 reduced to 2 small, subtriangular, lateral plates, widely separated medially. Cercus with 2 segments, elongate, basal and apical segment subequal. Sternite 8 (Fig. 8) broad, 2.3× longer than wide; caudal margin broadly pointed with acute medial emargination. Sternite 9 greatly modified, invaginated dorsally to sternite 8 forming internal furca. Sternite 10 reduced to 2 small, subtriangular, lateral plates, widely separated medially. Internal reproductive organs with furca (Fig. 9) broad, heavily sclerotized, not attached laterally to tergite 9, anterior apodeme absent. Common spermathecal duct short, trifurcating to form duct with anterior and caudal ⅓ broader than medial ⅓, ending in spermatheca. Spermatheca oblong, fuscous to black, with apical depression.

Pupa (Figs. 10, 11).—Length 26.6–36.9, 32.0 mm ($N = 3$), width 5.7–7.4, 6.6 mm, 4.4–5.5, 4.9× longer than wide. Adecticous, obtect, dark brown to fuscous.

Head separated from thorax by cephalothoracic suture anterior to thoracic spiracle, extending ventrally from middle of dorsum to beneath sheath of mouthparts. Antennal sheath (AS) broad, tapered apically, about 2.0× longer than basal width. Callus seta (CS) 1, posterior orbital setae (POS) 3, lateral orbital seta (LOS) 1, basalalar seta (BAS) 1. Mesothoracic spiracle (Sp) distinct, lying anterior-lateral. Wing and leg sheaths extend posteriorly over 1st abdominal sternite.

Abdominal segments 1–7 with lateral spiracle and paired lateral spines. Tergites 1–2 with 2 dorsal spines; tergites 3–7 with transverse row of spines on caudal ⅓ of segment, increasing in size on posterior tergites; tergites 4–6 with lateral V-shaped pattern of small, dark brown punctations. Sternites 5–7 with transverse row of spines on caudal ⅓ of segment, increasing in size on posterior sternites; sternites 2–7 with lateral diagonal row of dark brown punctation. Terminal abdominal segment distended caudally to form 2 obtuse projections (Fig. 10, 11); dorsal surface (Fig. 10) with mediolateral tubercle bearing 4 acute spines; lateral margin with broad tubercle bearing 4-6 coarse spines; ventral surface without spines.

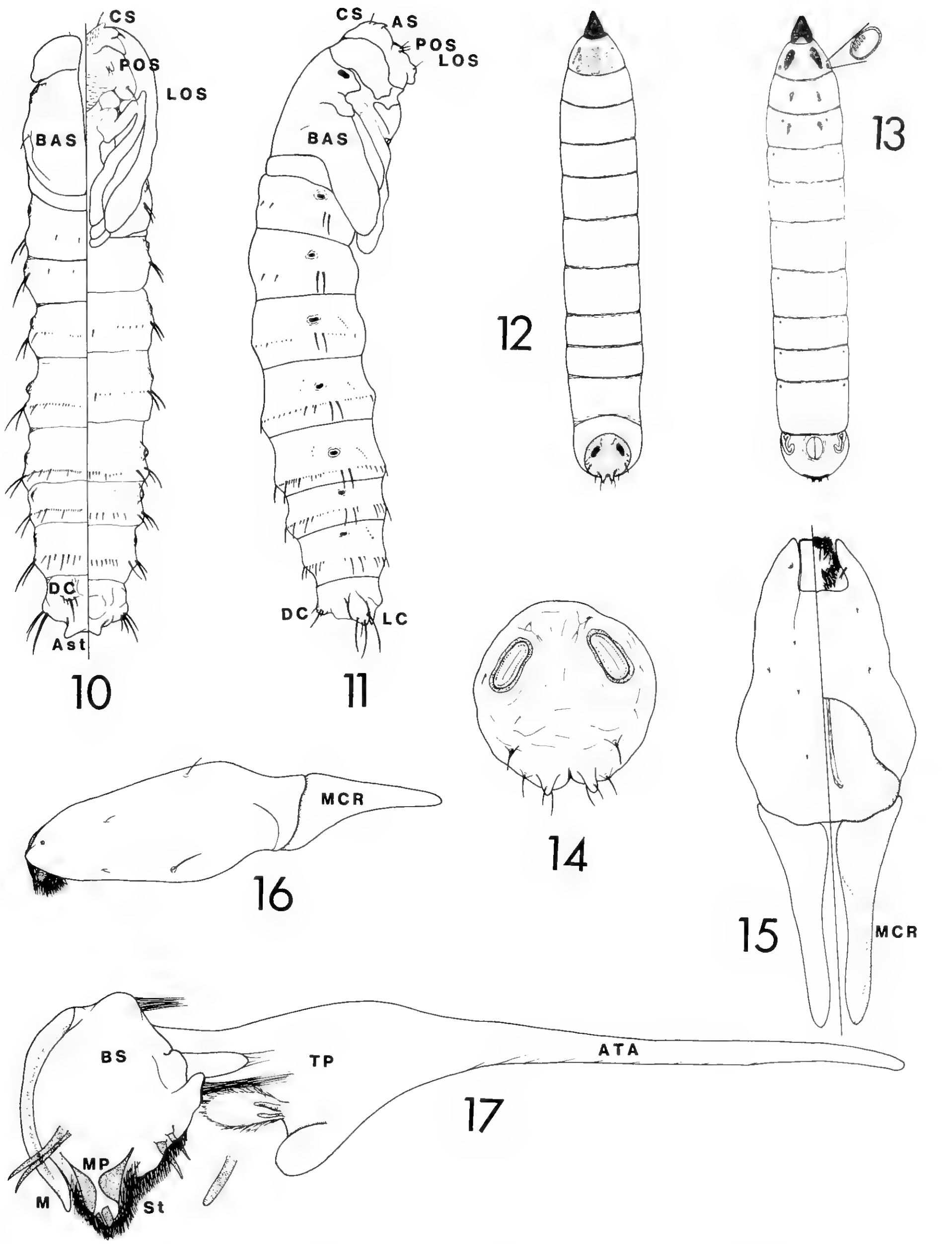
Larva (Fig. 12, 13).—Length of full grown larva 38–48 mm, width 5–8 mm, 6.0–7.6× longer than wide. Body shape fusiform, pale white to ivory, holopneustic.

Cranium (Fig. 15, 16) hemicephalic, partially retracted into 1st thoracic segment, dark brown to black, heavily sclerotized, about 1.5× longer than wide, short, tapering anteriorly, with 4 lateral setae. Ocelli absent. Labrum short, wedge-shaped, curved ventrally; epipharynx with dense setal brush. Mandibles hypognathus. Antenna greatly reduced. Metacephalic rods broad, elongate, flattened laterally, heavily sclerotized, extending posteriorly into 1st thoracic segment.

Mouthparts (Fig. 17) or mandibular-maxillary complex with large basal sclerite (BS) bearing mandible, maxillary palpus, stipes, and 2 pairs of flat elongate blades; 1 pair situated dorsal to base of maxillary palpus and directed anteriorly, the 2nd pair situated posterior to base of maxillary palpus and directed ventrally. Mandible (M) large, dark brown, sickle-shaped, heavily sclerotized, tapered ventrally with 3 small serrations on ventral margin, central canal visible. Maxillary palpus with 2 segments, short, thick, about 1.5× longer than wide; apical segment reduced. Stipes and medial surface of basal sclerite with dense brush of membranous projections. Two tendons, 1 dorsal and 1 ventral are attached to posterior margin of basal sclerite. Tentorial phragma attached posteriorly to basal sclerite, anterior tentorial arm narrow, elongate, tapering posteriorly; attached to anterior surface of tentorial phragma are 2 membranous projections surrounded by a membranous fanlike structure bearing numerous branching filaments along its border. Labial palps with 1 elongate segment.

Thorax with 3 distinct segments. Thoracic tergite 1 (Fig. 12) with broad, oblong median area of fuscous pigmentation and 2 narrow lateral, oblong areas of fuscous pigmentation; thoracic sternite 1 (Fig. 13) with large, lateral, oblong area of fuscous pigmentation; lateral prothoracic spiracle oval, strongly sclerotized, level with surface of segment, with 5 small inner slits. Thoracic tergite 2 (Fig. 12) without pigmented areas; thoracic sternite 2 with reduced area of mediolateral, fuscous pigmentation, and a lateral, diagonal row of brown punctation. Thoracic tergite 3 (Fig. 12) without pigmented areas; thoracic sternite 3 (Fig. 13) with reduced mediolateral patch of fuscous pigmentation, a lateral diagonal row of brown punctation, and a small metathoracic spiracle, similar in shape and size to the lateral spiracles on abdominal segments 1–7. Thoracic setae absent.

Abdominal segments 1–7 (Fig. 12) with small, brown, lateral spiracle, a ring of short, coarse spines along anterior margin, and setae absent. Abdominal tergites



Figs. 10–17. *Coenomyia ferruginea.* 10, 11, Pupa. 12–17, Larva. 10, Dorsal/ventral view. 11, Lateral view. 12, Dorsal view. 13, Ventral view. 14, Anal plate, dorsal view. 15, Head, dorsal/ventral view. 16, Head, lateral view. 17, Mandibular-maxillary complex, lateral view. Abbreviations: AS = alar setae; Ast= aster; ATA = anterior tentorial arm; BAS = basal alar setae; BS = basal sclerite; CS = callus setae; DC = dorsal comb; LC = lateral comb; LOS = lateral orbital setae; M = mandible; MP = maxillary palp; MCR = metacephalic rods; POS = posterior orbital setae; St = stipes; TP = tentorial phragma.

2 and 7 with lateral, diagonal row of brown punctation; tergites 3–6 with lateral V-shaped pattern of brown punctation. Abdominal segment 8 (anal) in dorsal view with large, dark red to fuscous anal plate (AP) (Fig. 14), heavily sclerotized, spherical, surface rugose, with 2 caudal tubercles, each bearing 2 short, fine setae; a single coarse seta lies lateral to caudal projections; posterior spiracle dark brown, oblong, lying diagonally on dorsal ½ of anal plate, with median slit and narrow, outer ring of small, clear punctation; in ventral view abdominal segment 8 with medial anal ring, spherical to broadly oblong.

Remarks.—Adults of *Coenomyia ferruginea* are large, sluggish flies, generally collected on herbaceous vegetation in or along the margin of wooded areas, although they have been collected on white pine and grass and occasionally at black lights and incandescent lights and in Malaise traps. Adults emerged from mid-April until the end of July, with the majority of specimens collected from late May until early July. No evidence of protandry was exhibited and males and females were represented in the collections examined in nearly equal numbers (293 males, 249 females). Generally, adults were collected one or two at a time, although occasionally as many as 18 and 22 individuals were collected at one locality at one time. Adults feed on fluid matter or the nectar of flowers (Malloch, 1917).

Various characters of the immature stages have been described by Beling (1880), Greene (1926), James (1981), Malloch (1917), and Peterson (1951). The larvae of *Coenomyia ferruginea* are similar to the larvae of *Dialysis* and *Arthropeas* (Krivosheina, 1967) in the appearance of the body shape, cranium, and anal plate, and in the possession of two large, metacephalic rods extending posteriorly from the posterior margin of the cranium into the first thoracic segment. The larva of these genera differ from each other in the presence or absence of a lateral spiracle on the third thoracic segment, the presence or absence of pigmentation and/or punctation on the thoracic and abdominal segments, and in the shape and characters of the anal plate. Larvae have been collected in a field some distance from timber or in decaying wood (Malloch, 1917) and from silty clay loam (pH 4.6) in Connecticut in a red oak and sugar maple forest (C.T. Maier, personal communication). The larvae are predaceous and feed upon white grubs and other insect larvae (Malloch, 1917).

Distribution.—In the Nearctic Region, *Coenomyia ferruginea* is an eastern species (Fig. 18), ranging from Georgia to Maine, west to Manitoba and western South Dakota and Nebraska. I have examined a single female specimen from Florida (CAS), although no specific locality data were given.

UNITED STATES. CONNECTICUT: Washington; Farmington; Milford; North Branford; South Meriden; Storrs; Avon; 3 mi NE Southington. DELAWARE: Wilmington; Water Gap. FLORIDA: Locality unknown. GEORGIA: 15 mi NW Dahlonega; Athens. ILLINOIS: Allerton Park, 4 mi W Monticello; Beverly Hills; Elsah; Pine Hills; Edgebrook; Ottawa; Argonne National Laboratory; Chicago; Palos Park; Downers Grove; Charleston; Riverside; Fourth Lake; Sand Lake; Algonquin; Stratford; Galena; Willow Springs; Glen Ellyn; Oakwood. INDIANA: Harrison County; The Bear Wallow (Brown County). IOWA: Ames; Allamakee County; Union County; Lake Okoboji; 4 mi E Gilbert; Ledges S. P.; Leon; Thayer. KANSAS: University of Kansas Natural History Reserve (Douglas County); Manhattan; Tuttle Creek Reserve (Riley County); Onaga; Baldwin; Lone Star Lake;

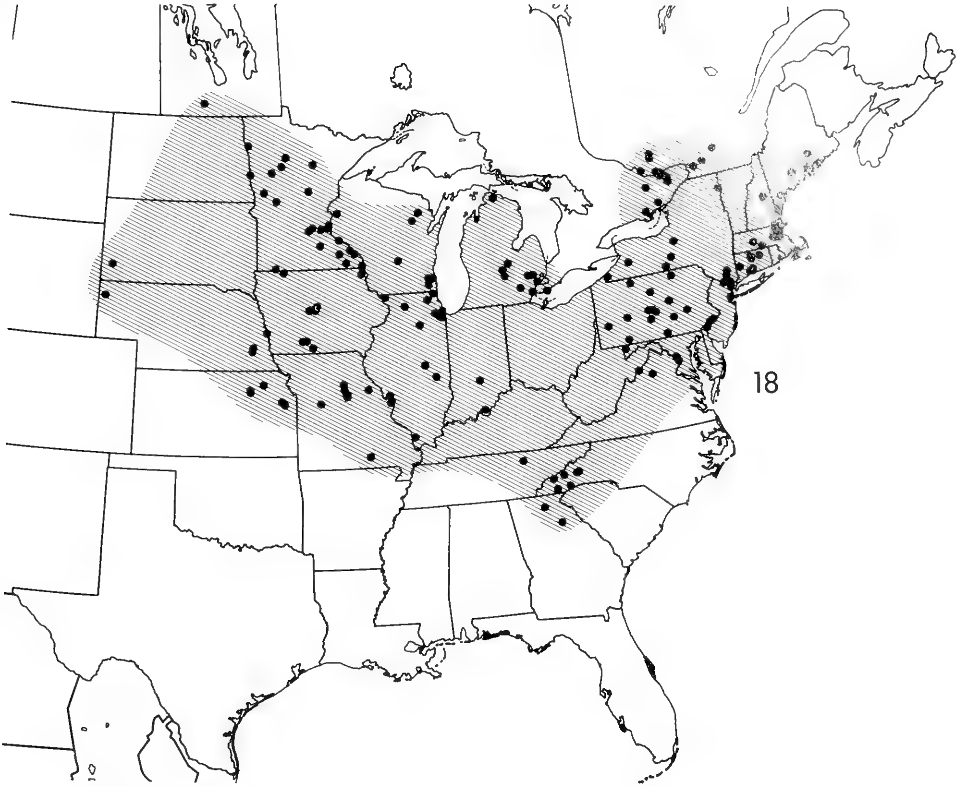


Fig. 18. Distribution of *Coenomyia ferruginea.*

18 mi S Lawrence; Baldwin Woods (Douglas County). MAINE: Orono; Augusta; Hardwick (Quabbin Res.); Hollis. MARYLAND: Plummers Island; Swallow Falls S. P. MASSACHUSETTS: Dover; Amherst; Sturbridge; Falmouth; Concord; Tyngsboro; Melrose Heights; Ashland; Forest Hills. MICHIGAN: Douglas Lake; Rockwood; Ann Arbor; Rochester; East Lansing; Detroit; Brant; Rose Lake. MINNESOTA: St. Paul; Itasca S. P.; 3–4 mi NE Eitzen; Mississippi Bluff (1–2 mi N State Line); John Latch S. P.; Bemidji; Jewitt Lake (near Fergus Falls); 10 mi S Grand Rapids; Lake Pepin (E Frontenac); Mille Lacs Lake (near Garrison); Waconia; Arcola; Lake Minnetonka; Minneapolis; Winona; St. Anthony Park; Round Lake; 9 mi SE East Grand Forks; Camp Carlos (Alexandria). MISSOURI: Columbia; New Hartford; Harrisburg; Ranken; Ashland Wildlife Area; 1 mi E Moberly; 5 mi N Columbia; Knob Noster S. P.; McCormack Lake. NEBRASKA: Sprague; Omaha; Lincoln. NEW HAMPSHIRE: Durham; Moultonboro; Barrington. NEW JERSEY: Alpine; Greenwood Lake; Tenafly. NEW YORK: Monroe; Elmira; Protection; West Point; Syracuse; Colear Bay (Lake Champlain); Fort Montgomery; Chautauqua; Ithaca; Suffern; Pearl River; Richmond; Tuxedo. NORTH CAROLINA: Retreat; Andrews Bald (Great Smoky Mountains N. P.); mi 403.3 Blueridge Parkway; Black Mts.; Wayah Bald (Macon County); 5 mi N Brevard. NORTH DAKOTA: Fargo. PENNSYLVANIA: Lewisburg; Somerset; Mt. Alton; Dauphin; Wilawana; State College; The Rock; Gap Run; Barrens; Oak

Hall; Cashtown; Inglenook; Pine Grove; Charter Oak; Philadelphia; Spring Branch; Pittsburgh; Carlyle Junction; Castle Rock; Spring Creek (State College); Stone Valley Recreation Area; Tamarack; Indiana; Harrisburg. TENNESSEE: Burrville. SOUTH DAKOTA: Black Hills S. P. VIRGINIA: Bergton; Skyland; Glencarlyn; Hawksbill (Shenandoah N. P.). WISCONSIN: Lakewood; Milwaukee; Dells of the Wisconsin; Keshena; Sunny Slope; Balsam Lake; Rochester.

CANADA. MANITOBA: 5 mi SW Shilo. ONTARIO: Ottawa; Belleville; Lanark County (N Burgess Twp.); Metcalfe; Lake Opinicon (Frontenac County); Chaffeys Locks; Kemptville; Leamington; Rothwell; Bathwell. QUEBEC: Montreal; Shawbridge; La Trappe; Berthierville; Oka; Isle of Montreal; Gracefield; Aylmer; Harrington Lake (Gatineau Park); Kazabazua; Hull; Wakefield; Old Chelsea (Summit King Mt.).

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THE MAYFLY *SIPHLONURUS PHYLLIS* MCDUNNOUGH (EPHEMEROPTERA: SIPHLONURIDAE): ITS DISCOVERY IN MINNESOTA

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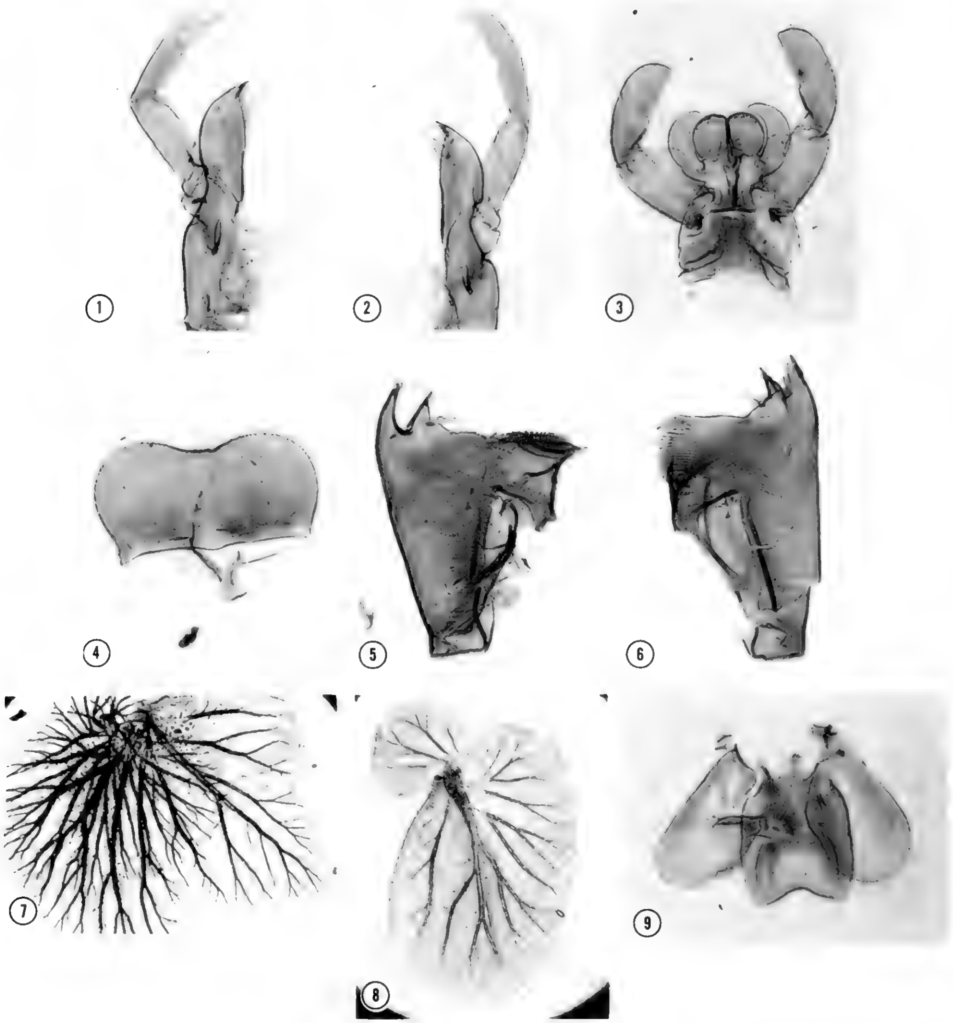
Abstract.—*Siphlonurus phyllis* McDunnough is reported for the first time from the United States. It is known to be widely distributed over Canada, based on sporadic records, ranging from the Gulf of St. Lawrence in the East to Alberta and Northwest Territories in the West. The nymph is described and the habitats from which the immatures were collected are discussed.

During the years 1958–1977, I taught a course in aquatic entomology at the University of Minnesota Biological Station at Lake Itasca. On several occasions while I was with my classes I collected nymphs of the mayfly genus *Siphlonurus,* which I put aside without identifying. In 1969 I found a large population of mature nymphs and reared a few to the adult stage. Again, I reserved the specimens for later identification but it was not until the summer of 1982 that I returned to them.

Much to my surprise, I discovered that the *Siphlonurus* was not *S. quebecensis,* as I had first surmised, but that it is the rarely reported boreal species *S. phyllis* McDunnough. The species was described in 1923 by McDunnough from one adult male and one adult female taken at Banff, Alberta. The next mention of the species was by Criddle (1925) who listed McDunnough's record and added another locality, Douglas, Manitoba. *Siphlonurus phyllis* was again reported by McDunnough (1930) when he mentioned that adults were reared (August 5–10) from nymphs found at Natashquan on the north shore of the Gulf of St. Lawrence. He did not describe the immatures other than to remark (p. 61) that "The nymph is evidently rather closely related to that of *alternatus* Say, possessing double lamellae on all gills, although in the seventh pair one lamella is reduced to a mere flap at the base and is easily overlooked." His paper included a photograph of the nymph, a drawing of the 2nd, 3rd, and 7th gills, and the male genitalia.

Needham et al. (1935) redescribed the species based on McDunnough's account as they had no specimens available to them. In 1981, Harper and Harper reported that adults were taken from late July to early August at Yellowknife, Northwest Territories, and at Churchill, Manitoba. In their 1982 paper, Flannagan and Flannagan listed Criddle's record from Manitoba and Dr. John Flannagan (personal correspondence) informed me of a collection he made of the species from a small, unnamed lake in northwestern Ontario. Because of the scarcity of records

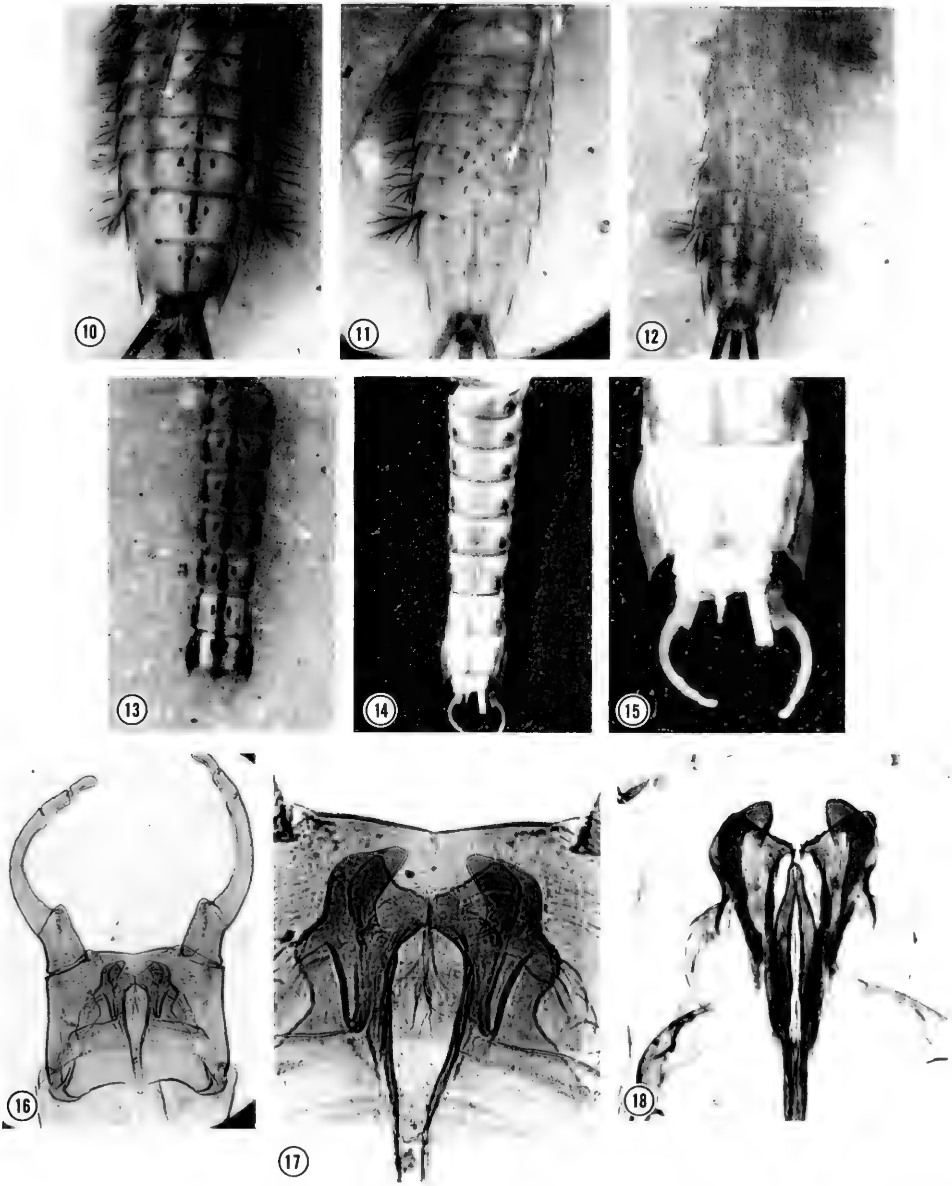


Figs. 1–9. Nymphal parts of *Siphlonurus phyllis.* 1, 2, Maxillae. 3, Labium. 4, Labrum. 5, 6, Mandibles. 7, 4th gill. 8, 7th gill with dorsal lobe turned back. 9, Hypopharynx.

of *S. phyllis,* its apparent disjunct distribution, and the lack of a description of the nymph, I believe that it is valuable to record these collections from Minnesota.

The species appears to be closely related to *S. alternatus,* reported from Minnesota by Daggy (1941), as reflected in the similarity of male genitalia (Figs. 17, 18) and in the similar reflexed lobe on the 7th gill in the nymphs (Fig. 8). Burks' (1953) drawing of *S. alternatus* male genitalia gives an accurate representation of them; however, McDunnough's 1923 drawing of *S. phyllis* genitalia is useful only in that it shows the flanges of the ninth abdominal segment. His 1930 illustration is much more accurate, and Needham et al. (1935) drawing is a reproduction of it.

The truly distinctive feature of the *S. phyllis* male is the strikingly expanded



Figs. 10–18. 10–17, *Siphlonurus phyllis*. 18, *S. alternatus*. 10–12, Ventral views of nymphal abdomen to show variation in color pattern. 13, 14, Ventral and dorsal views of adult abdomen. 15, Dorsal view of 9th segment of adult abdomen to show lateral flanges. 16, 17, Male genitalia. 18, Penes.

lateral margins of the 9th abdominal segment (Fig. 15). When I first observed the characteristic, I immediately related it to that of *Siphlonisca* but the two are very different with the lateral expansions of *phyllis* being confined to segment 9, while those of *Siphlonisca* occur on segments 5–9.

The ventral markings may prove to be useful in distinguishing the various species of *Siphlonurus* and they have been used in keys in the past. When they are employed, it should be done with some discretion as I have noted considerable variation in the samples I have worked with.

As the nymphal stage of *S. phyllis* has not been adequately described, I am, herewith, presenting a description of the last instar.

Siphlonurus phyllis **McDunnough**

Figs. 1–17

Description.—*Body length:* 14.1–16.8 mm; caudal filaments 8.5–9.0 mm. *Head:* Mostly brown. Mottled-brown, submedian stripes extend over vertex between compound eyes to epicranial suture; occiput without deep brown pigmentation. Mouthparts shown in Figs. 1–6 and 9. *Thorax:* Dorsally patterned with brown. Central portion of mesonotum with a prominent V-shaped brown mark opening anteriorly; large brown areas lateral to base of V extend anterolaterally from wing-pad base to margin of segment. Ventrally some specimens with transverse brown bar between bases of legs. *Legs:* Coxae with prominent brown spot on outer side; trochanters generally without special markings. Femora sometimes with 3 brown bands—one basally, a second in outer ⅔, and a distal one at knee. Tibiae with limited brown markings basally and distally. Tarsi with faint brown marks basally and distally; claws long, only slightly curved. Femora from 1½ to 2× length of tibiae; tibiae and tarsi (less the claw) subequal; claws ½ length of tarsi. *Abdomen:* Prominent posterolateral spines on segments 1-9 but particularly conspicuous on 3–9. Lateral margins compressed; segments strongly flanged, especially 7–9. Dorsally, each segment with submedian brown spots, circular on anterior segments but oblong on more posterior ones. Under large gills, each segment with another large brown spot which, on more posterior segments, continues laterally onto abdominal flanges to form a median brown band. Ventrally, in many specimens, a prominent brown median stripe extends length of the abdomen from sternites 2–9. Lateral to median stripe a pair of oblique brown spots usually on each sternite and another pair of dark brown spots sometimes at anterior margin of each sternite. Range of variation in marking shown in Figs. 10–12. In very mature nymphs virtually ready to emerge a reddish-brown lateral stripe extends from sternite 1 through 9 and underlies anterior spot on these segments. Gills 1–6 large and with double lamellae; a small, reflexed lobe present on 7th gill (Fig. 8, lobe turned back). All gills with brownish tinge with 7 colored most prominently in middle. Caudal filaments with brown bands basally, in middle, and distally.

New records.—Minnesota, Clearwater Co., Itasca State Park, U. Minn. Biol. Sta., Ice-house pond, 17.VI.1959, nymphs; Itasca State Park, Beaver Pond, 1.VII.1960, ♀ adult, 28.VI.1969, nymphs, nymphal exuviae, ♂ and ♀ adults reared. Hubbard Co., LaSalle Creek above beaver dam, 29.VII.1977, nymphs, ♂ adults reared. Mahnomen Co., Prairie Pond near Waubun, 7.VII.1959, nymphs and nymphal exuviae, 17.VI.1962, ♀ adults, 17.VII.1962, ♂ adults.

Known distribution.—Eastern Ontario, western Ontario, Manitoba, Alberta, Northwest Territories, Minnesota.

Remarks.—All nymphs were collected from quiet waters. The most extensive collections were taken from a shallow pond, apparently an overflow from Beaver Pond, where the mature nymphs were concentrated in water about one to two feet deep. Here the bottom was silty and covered with a heavy deposit of dead leaves. Other nymphs were collected from vegetation near shore at Beaver Pond. The specimens from LaSalle Creek were found in dense vegetation where collecting was very difficult and the nymphs were widely dispersed. None was found in flowing water. Those nymphs taken at Prairie Pond were also found among vegetation in shallow water. Adults were collected by sweeping among the grass in the vicinity of the pond and were taken in the early afternoon.

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A REVIEW OF THE AMERICAN PREDACEOUS MIDGES OF THE *BEZZIA NOBILIS* GROUP (DIPTERA: CERATOPOGONIDAE)

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Abstract.—The *nobilis* Group of species of the predaceous midge genus *Bezzia,* subgenus *Bezzia,* is diagnosed and a key presented for the three known species, which are briefly redescribed and partially illustrated. The North American species, *B. setulosa* (Loew), *B. barberi* (Coquillett), and *B. atlantica* Wirth and Williams, are considered to be new junior synonyms of *B. nobilis* (Winnertz). *Bezzia nobilis* is one of the commonest and most widespread species of *Bezzia* in the world, formerly recorded only from Eurasia, but new distribution records are presented to extend the range from North America south to the islands of the Greater Antilles, in Central America to El Salvador and Honduras, and two discontinuous new records from southern Brazil and Uruguay. The known range of *Bezzia magnisetula* Dow and Turner is extended by new records from Alaska to Manitoba, south to Oregon and Nebraska, where it has been reared from highly alkaline lake and marshland habitats. The third species, *Bezzia fluminensis* Lane, is known only from the type locality in southern Brazil.

This review is one of a series in which additions and corrections are made to the "Revision of the Nearctic Species of the Genus *Bezzia*" by Dow and Turner (1976). One of the natural and healthy results of the publication of any revisionary or monographic work is to bring the systematics of the group into focus in a way not previously possible. Subsequent workers are thus greatly aided in their studies and further progress is made. Further work is now in progress on the North American *Bezzia* species, and two species groups have already been studied in depth since 1976: Grogan and Wirth (1981) on the genus *Amerohelea* Grogan and Wirth which includes *Bezzia frontispina* Dow and Turner; Wirth and Grogan (1982) on the genus *Phaenobezzia* Haeselbarth which includes the midges Dow and Turner treated as *Bezzia* (*Phaenobezzia*) *opaca* (Loew). Each of these groups involves a different set of taxonomic and nomenclatural problems that Dow and Turner in their conservative approach did not adequately address.

Remm (1974a) divided the genus *Bezzia* Kieffer into five subgenera, one of which, *Phaenobezzia* Haeselbarth, merits generic status (see Wirth and Grogan, 1982). Remm's characters for the recognition of *Homobezzia* Macfie as a subgenus are convincing, but his new subgenera *Pygobezzia* Remm and *Sivabezzia* Remm are not readily separable from *Bezzia* s. str. The species of the *nobilis* Group treated herein are readily separable from other groups of *Bezzia* s. str. by color characters, but structurally they are less distinct (see couplet 1 in Remm's (1974b) key to the USSR species of the subgenus *Bezzia* s. str.) In fact, Remm (p. 113 of the English translation) said of the subgenus *Bezzia* s. str.: "Most divergent from the rest is *B. nobilis*. In color it is more similar to the species of the subgenus *Homobezzia* and would appear to constitute a connecting link between these subgenera, but the structural characters of the male make it necessary to include it in this subgenus."

Four Nearctic species of the *Bezzia nobilis* Group were recognized by Dow and Turner (1976): *atlantica* Wirth and Williams, *barberi* (Coquillett), *magnisetula* Dow and Turner, and *setulosa* (Loew). However, *Bezzia atlantica, barberi*, and *setulosa* appear to be conspecific with *Bezzia nobilis* (Winnertz), the only Palaearctic member of this group. In the Neotropical Region *B. nobilis* ranges south to southern Brazil and Uruguay, and a second species, *B. fluminensis* Lane, occurs in Brazil.

Taxonomic characters employed for identification of the adults were described by Wirth (1952), Dow and Turner (1976), and Wirth et al. (1977). Wing length is measured from the basal arculus to the wing tip and costal length from the basal arculus to the costal apex. Costal ratio is the value obtained by dividing the costal length by the wing length. Antennal ratio of the female is the sum of the lengths of the elongated distal five flagellar segments divided by the sum of the lengths of the preceding eight. Palpal ratio is the length of the third palpal segment divided by its greatest breadth.

SYNOPTIC KEY TO SUBGENERA AND GROUPS OF NEARCTIC *BEZZIA*

1. Male antennal segment 12 no longer than 13, antennal plume weakly developed; (mesonotum dull, occasionally weakly shiny, brownish or grayish with or without vittae; tibiae pale or with a dark medial or basal ring; spines of forefemur stout when present; female with 0–5 pairs of gland rods; males considerably smaller than females; male aedeagus triangular with minute spinules or hairs) (subgenus *Homobezzia* Macfie) 2

– Male antennal segment 12 longest; antennal plume well developed, extending at least to apex of 13th segment; (mesonotum black, shiny or dull or with silvery hairs, if grayish brown with dark vittae, hindtibia yellow in midportion, apex broadly black, and all femora bear spines; tibiae often black; forefemur with spines slender when present; female abdomen with 1–2 pairs of gland rods; males about same size as female; male aedeagus variable but not as above) (subgenus *Bezzia* Kieffer, *s. str.*) 5

Subgenus *Homobezzia* Macfie

2. Larger species, female wing 1.3–3.4 mm long; mesonotum without bristly setae on disc; (forefemur without spines or with 1–4 stout to slender spines of similar lengths, with or without strong basal tubercles; pupal respiratory horn with numerous (25–60) spiracular openings, apex more or less flared, abdominal tubercles well developed) 3

– Small species, female wing 1.2–1.3 mm long; mesonotum with 2 rows of strong bristly setae on disc; (forefemur with 5–7 stout ventral spines of alternating uneven lengths arising from distinct elevations; pupal respiratory horn with only 7–12 spiracular openings, abdominal tubercles small) .... *dorsasetula* Group

3. Forefemur unarmed ventrally .... *bicolor* Group
– Forefemur armed ventrally with one or more short black spines 4
4. Fore- and midfemora entirely dark brown or with dark bands apical .. .. *cockerelli* Group
– Fore- and midfemora with dark bands subapical .... *annulipes* Group

Subgenus *Bezzia s. str.*

5. Forefemur usually unarmed ventrally; legs brown to black; femora and tibiae usually with narrow pale rings, rarely femora pale at base or tibiae pale .... *bivittata* Group
– Forefemur armed ventrally with one or more slender black spines; legs brown to black, or if banded the pale bands broad 6
6. Legs broadly yellow or with broad yellow median bands on forefemur and tibia .... *nobilis* Group
– Legs primarily dark brown to black, at most one pair of legs with broad yellowish bands .... *expolita* Group

Bezzia nobilis Group

Diagnosis.—Medium-size to large species, wing length 1.5–2.6 mm. Mesonotum grayish to whitish pollinose with median brown vitta; scutellum more or less yellowish; large spinelike setae prominent above wing bases. Wing usually whitish with anterior veins yellowish to whitish. Legs more or less yellowish with prominent black bands usually at bases and apices of femora and tibiae; forefemur with 1–6 prominent ventral spines; femora with some prominent spinelike setae at apices, femora and tibiae usually with some scattered spinelike black setae, larger and more numerous in males, especially on dorsal side of hindtibia. Male antennal plume well developed, extending at least to apex of 13th segment; 12th segment longest. Female abdomen with one pair of yellowish gland rods. Male genitalia with moderately broad 9th sternum with shallow caudomedian concavity; basistyle simple, short and moderately stout; dististyle moderately long, tapering to blunt distal point; aedeagus simple, with low basal arch, moderately slender anterolateral arms, distally tapering to slender process with non-spiculate tip; parameres with winglike anterolateral arms, median process in form of a straight rod with rounded tip. Pupa with respiratory horn rather short and only moderately expanded distally, bearing 16–30 spiracular openings around tip and ¼ down dorsal side; abdominal spines short, mostly borne on rounded or bluntly-pointed tubercles; caudal segment about as broad as long, posterolateral processes short, pointed, and divergent, with sclerotized tips. Larva with head brown, moderately long and distinctly tapering, about 2.7× as long as greatest breadth; body white without discernible setae, last segment with 8 moderately long anal setae.

Distribution.—Three known species; Holarctic and Neotropical regions.

KEY TO THE SPECIES OF THE *BEZZIA NOBILIS* GROUP

1. Large robust species, wing length 2.4–2.6 mm in female; antenna black, segments short (Fig. 4a), in male with blackish plume; legs dusky yellow to brown with less contrasting dark bands, especially in male; female abdomen with prominent dorsal segmental brown spots .... *magnisetula* Dow and Turner
– Smaller, more slender species, wing 1.5–2.0 mm long in female; antenna

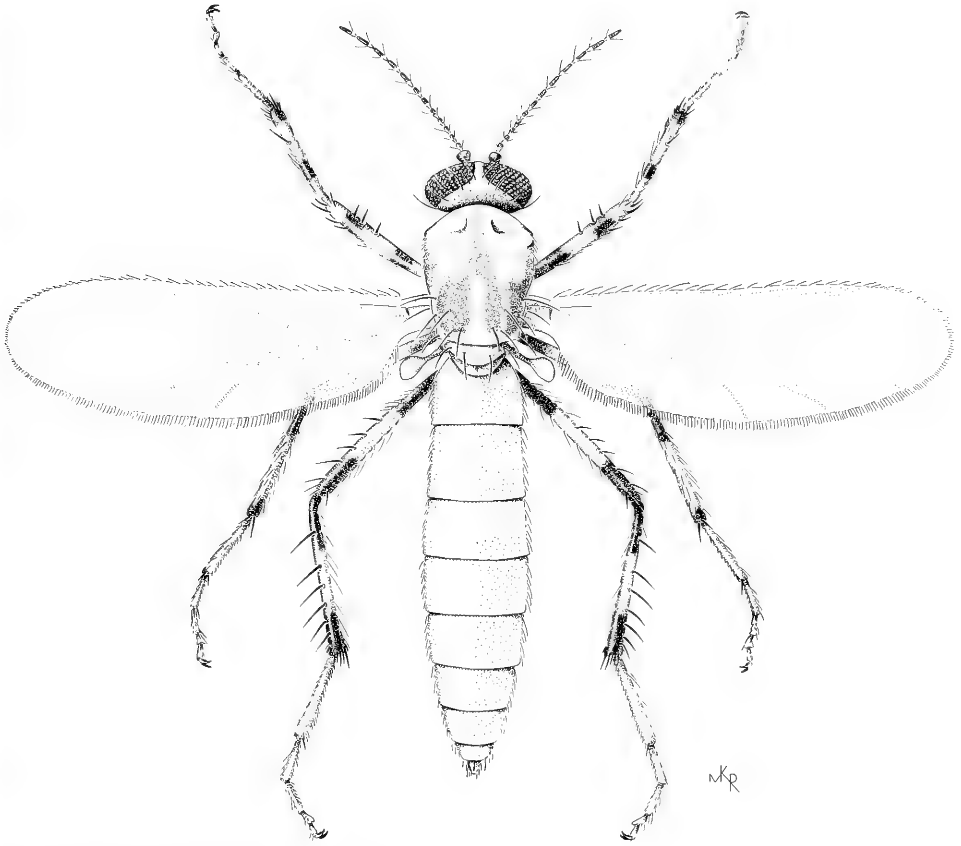

Fig. 1. *Bezzia nobilis,* female habitus.

with segments longer (Fig. 2a, h), bases of segments pale yellowish, in male with yellowish plume; at least mid- and hindlegs bright yellow with contrasting black bands; female abdomen whitish to somewhat dusky, with or without segmental brown spots 2

2. Hindfemur and tibia with prominent black bands at bases and apices, yellow in midportion; female abdomen without segmental brown spots on terga .... *nobilis* (Winnertz)

– Hindfemur and tibia yellow proximally, with prominent black bands on apical ¼; female abdomen with segmental brown spots on terga .... *fluminensis* Lane

Bezzia nobilis (Winnertz)

Figs. 1, 2, 3c, e, g–m

Ceratopogon nobilis Winnertz, 1852: 79 (female; Germany; fig. wing).

Bezzia nobilis (Winnertz): Kieffer, 1901: 153 (combination; in key); Kieffer, 1919: 116 (in key); Goetghebuer, 1920: 109 (Belgium; fig. thorax); Goetghebuer, 1922: 106 (male redescribed); Kieffer, 1925: 121, 129 (in key; France); Edwards, 1926: 425 (male, female diagnoses; Britain); Edwards, 1929: 428 (correction to description); Goetghebuer, *in* Goetghebuer and Lenz, 1934: 80 (diagnosis; Europe); Mayer, 1934: 251 (immature stages; Germany); Zilahi-Sebess, 1940: 105 (redescribed; fig. male genitalia); Krivosheina, 1957: 1099 (biology, habitat notes); Maasik, 1966: 49 (Estonia); Remm, 1973: 183 (Mongolia records); Remm, 1974b: 888 (113 in translation) (in key: diagnosis; figs.; distribution; synonyms: *armaticrus, cinerella, chrysocoma, csikiana, leucosticta, nobiliformis*); Havelka, 1976: 217 (diagnosis; figs.; Germany); Glukhova, 1979: 145 (larva described, figured; USSR); Isaev, 1982: 953 (karyotype; USSR).

Ceratopogon setulosus Loew, 1861: 312 (Cent. 1, no. 8) (male, female; Washington, D.C.). NEW SYNONYMY.

Bezzia setulosa (Loew), Johannsen, 1905: 102 (combination; all stages, figs.; New York); Kieffer, 1906: 58 (in list); Malloch, 1914: 282 (in key); Malloch, 1915: 350 (all stages; Illinois); Kieffer, 1917: 330 (in key); Thomsen, 1937: 76 (larva, pupa; figs.; in key); Johannsen, 1943: 785 (in list; distribution); Johannsen, 1952: 168 (in key); Wirth, 1952: 231 (redescribed, all stages; figs.; Calif.); Cole, 1969: 97 (Western N. Amer. records); Wirth, 1974: 53 (in catalog; Jamaica); Collins, 1975: 1139 (Yellowstone Natl. Park; larval predator on brine flies); Dow and Turner, 1976: 72 (redescribed; figs.; distribution); Downes, 1978: 1–62 (adult prey records); Palchick, 1981: 15 (pupa described; figs.; Wisconsin); Downes and Wirth, 1981: 393–421 (fig. male genitalia, foreleg, wing); Cooper, 1981: 257 (Mississippi; reservoir margins).

Ceratopogon barberi Coquillett, 1901: 601 (female; Maryland). **NEW SYNONYMY.**

Bezzia barberi (Coquillett); Malloch, 1914: 282 (combination; in key); Malloch, 1915: 346 (in key); Kieffer, 1917: 330 (in key); Johannsen, 1943: 785 (in list); Johannsen, 1952: 168 (in key); Dow and Turner, 1976: 26 (type redescribed; figs.).

Bezzia armaticrus Kieffer, 1919: 125 (male; Hungary).

Bezzia cinerella Kieffer, 1919: 124 (female; Hungary).

Bezzia csikiana Kieffer, 1919: 126 (male; Russia).

Bezzia leucosticta Kieffer 1919: 124 (female; Russia).

Bezzia chrysocoma Kieffer, 1922: 355 (male; Silesia); Thienemann, 1928: 603 (larva), 606 (pupa); Tokunaga, 1940: 164 (Manchuria; redescr.).

Bezzia atlantica Wirth and Williams, 1957: 13 (male; female; Bermuda). **NEW SYNONYMY.**

Bezzia nobiliformis Clastrier 1962: 74 (male, female; France; figs.).

Diagnosis.—A medium-sized, pollinose gray species with yellowish legs and broad black bands at or near bases and apices of femora and tibiae; yellowish scutellum with 4 long marginal setae, pale halteres and whitish abdomen; antenna elongate, bases of segments pale, male plume yellowish. Wing length 1.5–2.0 mm.

Head: Eyes (Fig. 2i) broadly separated. Female antenna (Fig. 2a) brown, bases of flagellar segments narrowly pale; lengths of flagellar segments in proportion of 18-10-10-12-12-12-12-12-20-20-20-25-25, antennal ratio 1.12. Male antenna with lengths of flagellar segments in proportion of 25-14-14-14-14-15-15-19-26-63-26-28-31; plume (Fig. 2h) yellowish to golden. Palpus (Fig. 2 b, c) short and slender, 3rd segment with clump of 4–5 sensilla. Female mandible (Fig. 2f) with 9–16 coarse teeth.

Thorax: Brown, pollinose grayish. Mesonotum (Fig. 1) with prominent brownish to blackish median vitta splitting and broadening posteriorly, and ending a

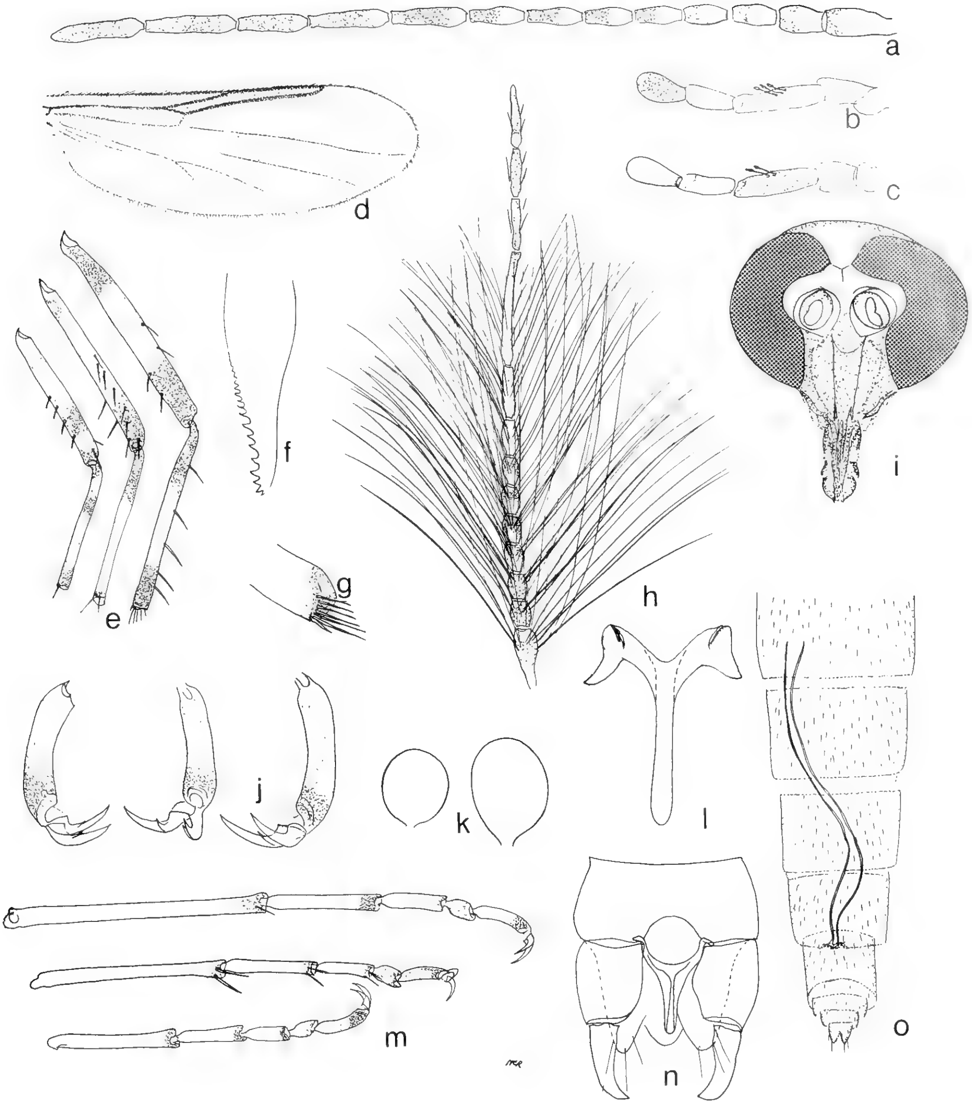

Fig. 2. *Bezzia nobilis.* a–b, d–g, i–k, m, o, Female. c, h, l, n, Male. a, h, Antenna. b, c, Palpus. d, Wing. e, Fore-, mid-, and hind- (left to right) femora and tibiae. f, Mandible. g, Hindtibial comb. i, Anterior view of head. j, Fifth tarsomere and claws of fore-, mid-, and hindlegs (left to right). k, Spermathecae. l, Parameres. m, fore-, mid-, and hindtarsi (bottom to top). n, Male genitalia, parameres removed. o, Female abdomen, dorsal view, showing gland rods (drawn by Niphan Ratanaworabhan).

variable distance before scutellum; humeral corners and sides also with variable brownish to blackish patches. Scutellum yellowish, with 4 strong marginal setae. Wing (Fig. 2d) whitish, anterior veins yellowish, not prominent; costal ratio 0.66–0.75. Halter pale, sometimes slightly infuscated. Legs (Fig. 2e) yellow, both ends of femora and tibiae broadly blackish except the bands subapical on forefemur and subbasal on foretibia; stout, spinelike setae at apices of femora, sometimes absent on mid- and hindlegs; 1–6 stronger black spines in ventral series on forefemur; strong bristly setae dorsally on hindfemur and tibia; spinelike setae stronger and more numerous in male. Hindtibial comb (Fig. 2g) with 6 setae. Tarsi (Fig. 2m) with narrow apices of tarsomeres blackened; a pair of strong, black ventral spines at apices of first 3 tarsomeres on midleg, smaller and paler on fore- and hindlegs. Female claws (Fig. 2j) moderately strong and curved, each with inner basal tooth.

Abdomen: Female abdomen (Fig. 2o) uniformly whitish to pale yellowish, rarely infuscated; with scattered fine blackish setae, more prominent ventrally; one pair of long yellowish gland rods present; 8th sternum moderately pigmented with posterior emargination around gonopore. Spermathecae (Fig. 2k) with very short necks; slightly unequal, measuring 0.059 by 0.046 mm and 0.046 by 0.037 mm. Male abdomen brownish; genitalia (Fig. 2n) small with moderately stout basistyle and moderately short, tapering, bluntly pointed dististyle; 9th sternum with distinct but shallow caudomedian excavation; aedeagus with basal arch extending ¼ to ⅓ total length, basal arms slender, distal median process slender with tip curved ventrally; parameres (Fig. 2L) with broad anterolateral arms, distomedian portion rodlike, slender, with rounded tip.

Pupa.—Length 3.5–4.0 mm; general color dark brown, abdomen slightly paler. Respiratory horn (Fig. 3e) short, 0.22 (male) to 0.27 (female) mm long; rather stout, slightly expanded distally, 5× as long as greatest breadth (female); with 16 (male) to 25 (female) spiracular openings around tip and ¼ way down dorsal side. Operculum wider in female (0.25 by 0.24 mm) than in male (0.28 by 0.20 mm); integument denticulate with prominent longitudinal striations; 3 *am* tubercles, anteriormost with small spine. Cephalothoracic chaetotaxy: 3 *dl* tubercles, 2 with spines 0.068 mm long; 2 short *vm* spines; *vl* tubercle with short spine 0.037 mm long; dorsal spines *d*1–5 as in Fig. 3c. Abdomen with caudal segment (Fig. 3h) about as broad as long, slightly narrower in male; posterolateral processes short (0.09 mm long in female, 0.12 mm in male), divergent with tips sclerotized. Abdominal spines (Fig. 3f) short, mostly borne on rounded tubercles; *dasm* tubercles in straight longitudinal line, *dasm*1 with rounded tubercle and short spine, *dasm*2 with elongate tubercle and medium-length spine; 1 *lasm* tubercle with short spines; *dpm*1 and *dpm*2 tubercles fused together, bearing 2 slender spines, *dpm*3 tubercle rounded and lacking spine; 3 large *lpm* tubercles, each with short spine; *vpm*1 tubercle and *vpm*2 tubercle each rounded with short spine, *vpm*3 truncate, medium length, with slender spine.

Larva (from Thomsen, 1937: 76, figs. 40, 46; Glukhova, 1979: 145, fig. 45).—About 7.0 mm long; white with brown head; each eye with 2 contiguous spots. Head (Figs. 3i–k) long and tapering, 2.7× as long as greatest breadth, rather slender anteriorly, with chaetotaxy as figured. Labrum rounded, about ¼ breadth of head, with 2 pairs of minute apical papillae. Mandibles curved, stout at base and slender distally. Hypopharynx (Fig. 3l) with 1 broad hyaline comb. Body segments entirely devoid of setae except last segment with 8 moderately long setae arranged in dorsal and ventral pairs of 2 setae each; last segment (Fig. 3m) 2.5× as long as basal breadth.

Geographic range.—*Bezzia nobilis* is the commonest and most widespread species of the genus in North America (Malloch, 1915; Wirth, 1952). I have examined

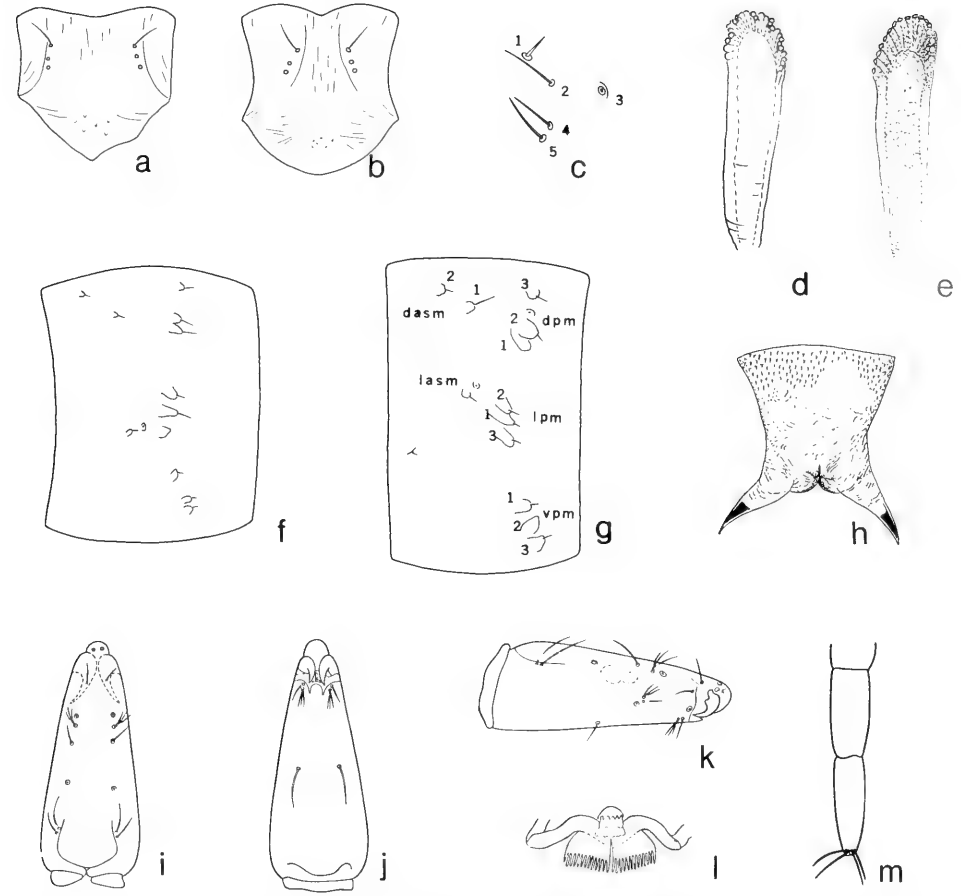

Fig. 3. a, b, d, f, *Bezzia magnisetula* pupa. c, e, g, h, *B. nobilis* pupa. i–m, *B. nobilis* larva. a, Female operculum. b, Male operculum. c, Dorsal tubercles of thorax. d, e, Respiratory horn. f, g, Fourth abdominal segment, lateral view, with tubercles labeled. h, Last abdominal segment, female. i, Dorsal view of head. j, Ventral view of head. k, Lateral view of head. l, Hypopharynx. m, Last two abdominal segments. (i–m from Glukhova, 1979.)

410 slides and 450 pinned North American specimens in the National Museum (USNM) collection from nearly every state in the contiguous United States, from Alaska, southern Canada to Nova Scotia, and south through Mexico to El Salvador and Honduras, and through the Bahamas, Cuba, and Jamaica to Haiti in the West Indies. There is an apparent gap in distribution from Nicaragua and the Lesser Antilles to southern Brazil, but the species shows up again with two USNM records from Santa Catarina, Brazil, and Uruguay. The related species, *Bezzia magnisetula* Dow and Turner, replaces *nobilis* in saline and alkaline habitats in the northwestern United States, western Canada, and Alaska. The other related species, *Bezzia fluminensis* Lane, has been found in only one locality in subtropical southern Brazil. Apparently no closely related species is known from Eurasia, according to Remm (1974b) who gives the Old World distribution of *B. nobilis* as "France

to Japan and from Estonia to the Crimea and Mongolia." There are no *nobilis* in a rather respectable collection of Japanese *Bezzia* in the USNM, but I have determined one female of *nobilis* from Seoul, Korea.

The Neotropical distribution of *Bezzia nobilis* is documented by the following records:

West Indies. CUBA: Guantanamo, ii.1970, J. E. Tisdale, light trap, 2 ♀. HAITI: Chou Chou, Baile, 8.vi.1978, C. Raccurt, and R. Lowrie, swept 1 ♀; Limbe, 14.vi.1978, Raccurt and Lowrie, light trap, 1 ♀. JAMAICA: Clarendon Parish, Milk River Bath, 19.xi.1968, R. E. Woodruff, light trap, 2 ♀. St Catherine Parish, Caymans Estate, 17.xi.1968, S. A. Apeji, light trap, 5 ♀; Twickenham Park, 28.iv.1970, E. G. Farnworth, light trap, 1 ♂, 2 ♀; Worthy Park Estates, 11.xi.1968, Woodruff, light trap, 1 ♀; same, iii-vi.1970, Farnworth, 3 ♀. Westmoreland Parish, Negril, 20.xi.1968, Woodruff, light trap 3 ♀; 22.vi.1970, Farnworth, light trap, 1 ♀. Gordon Town, 1.ii.1937, Chapin and Blackwelder, 1 ♀. Kingston, 1.ii.1937, Chapin and Blackwelder, 1 ♀. Runaway Bay, 16–28.ii.1969, W. W. Wirth, light trap, 1 ♀. Treasure Beach, 15.v.1969, Woodruff, light trap, 1 ♀. VIRGIN ISLANDS: St. Croix, xii.1937, H. A. Beatty, ex larva in puddles, 1 ♀.

Mexico and Central America. EL SALVADOR: San Vicente, Santo Domingo, xi.1966 J. F. Matta, light trap, 1 ♀. HONDURAS: Comayagua, Siguatepeque, viii.1964, F. S. Blanton, light trap, 3 ♂, 7 ♀; 16.vii.1966, Matta, light trap, 1 ♀. MEXICO: Oaxaca, Jaltepec, 21.v.1964, Blanton, light trap, 1 ♀. Tamaulipas, C. Monte, 23.xi.1943, B. Brookman, light trap, 2 ♀. Veracruz, Fortin de Las Flores, vi.1964, Blanton, light trap, 2 ♀.

South America. BRAZIL: Santa Catarina, Nova Teutonia, viii.1970, F. Plaumann, 1 ♀. URUGUAY: Montevideo, 15.i.1965, E. F. Legner, 1 ♀.

Larval habitat.—Reared material from North America is represented in the USNM collections as follows: BERMUDA: Devonshire Marsh, 21–27.vi.1955, recovery cage in marsh (Williams). COLORADO: Rio Grande Co., South Fork, 11,000 ft, 23.vi.1972, reared Beaver Creek Meadows (Wirth). FLORIDA: Alachua Co., Gainesville, 20.iv.1967, pond margin (Wirth). Palm Beach Co., Lake Worth, viii.1951, margin Congress Road Canal (Wirth). ILLINOIS: St. Joseph, margin of Salt Fork (Malloch, 1915). MARYLAND: Montgomery Co., Plummers Island, vi–vii.1976, sand, mud, and stream vegetation (Grogan). Prince George's Co., Lakeland Pond, 23–27.v.1975, pond margin (Grogan); Patuxent Wildlife Res. Center, 8.v.1958, pond margin (Wirth and Scanlon); same, 20.vii.1976, sphagnum and muddy leaves (Grogan); 24.v.1977, vegetation at pond margin (Navai). MICHIGAN: Cheboygan Co., Douglas Lake, 6–31.vii.1954, emergence trap in Bryants Bog (Williams). NEW YORK: Newcomb, Fishing Creek, 28.v.1958, sand, mud at stream edge (Jamnback). North Sea, Cow Neck salt marsh, 19.iv.1956 (Jamnback). Lewis Co., Independence River, Glenfield, 22.vi.1963, river margin (Wirth). Tompkins Co., Ithaca, Renwick Swamps (Johannsen, 1905). OKLAHOMA: Payne Co., Lake C. Blackwell, 12.x.1955, lake margin (Jones). ONTARIO: Algonquin Park, 8.vi.1960, reared from marsh (Wirth). SOUTH DAKOTA: Lawrence Co., Spearfish Creek, 14.vi.1969, creek margin (Wirth). TEXAS: Brewster Co., Big Bend Nat. Park, Hot Springs, 7.v.1956, margin Tornillo Creek (Jones). Gillespie Co., Pedernales River, 7.viii.1956, river margin (Jones). Kerr Co., 20.ii.1956, margin spring creek (Jones). UTAH: Utah Co., Moark Jctn., 31.v.1958, pool margin (Jones). WISCONSIN: Bayfield Co., Fish Creek, 30.vii.1953, algae in pool (Jones). Washburn Co., 16.vii–4.viii.1952, pool (Jones). WYOMING: Yellowstone Nat. Park, Sylvan Springs, summer 1960, algal mat (Collins, 1975).

Notes on synonymy.—Through the courtesy of Karen Jepson I have examined two specimens of *B. setulosa* from the Loew collection at the Museum of Comparative Zoology in Cambridge, Massachusetts: one female labelled "Pa./setosus/setulosus Lw./O. Sacken," and one male from "Texas, Belfr./Loew coll." Since the localities are not mentioned in Loew's original description, these specimens do not have type status.

American material was carefully compared with the following available Palaearctic material of *Bezzia nobilis*: AUSTRIA: Lunz (leg. Strenzke), 2 ♂, 2 ♀ (det. Strenzke). GERMANY: Rohrwiesenbach, 11.vi.1971, P. Havelka, 1 ♀. Rombach, 10.vii.1975, Havelka, 1 ♀ (both determined by Havelka). GREAT BRITAIN: Inverness, Aviemore, vi.1931, F.W. Edwards, 6 ♂, 5 ♀. Yorks., Castle Howard, 2.vii.1926, Edwards, 2 ♂, 2 ♀; Malham Tarn, 30.vi.1930, Edwards, 1 ♀ (all determined by Edwards, from BMNH). KOREA: Seoul, U.S. Army light trap, vi.1955, 1 ♀ (det. Wirth). USSR: Estonia, Myniste, 9.vii.1970, 1 ♂, 4 ♀. Sakhalin, Novo-Aleksandrovsk, 29.vi.1970, 1 ♂, 1 ♀ (all det. as *nobilis* by Remm).

Bezzia nobilis appears to be a rather variable species both in Eurasia and the Americas. This led to a considerable number of synonyms in Europe which were indicated by Remm (1974b), and some new synonymy is herein proposed for North American species. Allowing 10% reduction (because of base point at the wing root rather than basal arculus) Remm's (1974b) value of 1.7–2.7 (mean 2.4) mm for wing length of USSR females is somewhat higher than our value, but this difference may be due to latitudinal variation in size, northern American specimens consistently measuring larger than specimens from warmer climates. Variability was noted in American specimens in size, extent and intensity of mesonotal pattern, leg infuscation, and number and size of leg spines. The number of strong ventral spines on the forefemur was observed to vary from 1 to 6, with 3–4 being the usual number present. Variation in spinosity was independent of variation in intensity and extent of leg or mesonotal markings or of size. No differences were found in the male or female genitalia including spermathecae. No consistent characters could be found to separate American and Eurasian material, and *Bezzia setulosa* (Loew) is therefore considered to be a junior synonym of *B. nobilis*.

Wirth (1952) and Dow and Turner (1976) separated *B. barberi* (Coquillett) from *setulosa* on the basis of its having only one spine on the forefemur, less distinct leg markings, more prominent mesonotal stripe, and darker abdomen. Re-examination of the holotype of *barberi* shows that the color differences are less marked than described and well within the range for *nobilis*. The presence of only one forefemoral spine is not unusual in otherwise typical *nobilis*. For these reasons *B. barberi* (Coquillett) is considered to be a junior synonym of *B. nobilis*.

Wirth and Williams (1957) separated *Bezzia atlantica* from *setulosa* on the basis of its darker legs with more extensive dark markings, brownish halteres, pyriform spermathecae, and gland rods extending through 3.5 rather than 4.5 segments. Re-examination of the types of *atlantica* shows the spermathecae to be more ovoid than pyriform in shape (well within the range of those of *nobilis*), and the gland rods extend through 4–4.5 segments as in *nobilis*. A considerable number of *nobilis* specimens from the mainland USA, especially coastal localities, show the legs and halteres considerably darker than the average, and these specimens are not separable from Bermuda material of *atlantica*. For these reasons *B. atlantica* is considered to be a junior synonym of *B. nobilis*.

Bezzia magnisetula **Dow and Turner**

Fig. 3a–b, d, f, 4

Bezzia magnisetula Dow and Turner, 1976: 48 (male, female; Manitoba, Alberta; figs.).

Diagnosis.—A large, robust brown species with grayish pollinose thorax, brown vittae on mesonotum, yellowish scutellum with 8 marginal setae, yellowish-brown legs with black bands at or near bases and apices of femora and tibiae, whitish abdomen with segmental brown spots forming a narrow median interrupted vitta on female abdomen; male antenna short, plume entirely blackish.

Female.—Wing length 2.23–2.60 mm; breadth 0.76–0.97 mm.

Head: Dark brown including antenna and palpi. Eyes (Fig. 4g) separated by a distance of 0.07 mm. Antenna (Fig. 4a) with lengths of flagellar segments in proportion of 25-16-16-16-16-16-16-17-24-25-25-30-32, antennal ratio 1.00; segments 3–10 with short, stiff verticils. Palpus (Fig. 4b) with lengths of segments in proportion of 8-12-30-14-17; 3rd segment slender (palpal ratio 3.7), with sensilla borne in a clump near middle. Mandible (Fig. 4d) with 11–12 coarse teeth, those in midportion of series largest.

Thorax: Brown; scutellum yellowish brown, with about 8 long black setae. Mesonotum (Fig. 4e) grayish pollinose with a narrow median brown vitta and smaller brown spots on anterior 0.6; 10–15 strong black setae above each wing base. Legs stout, yellowish to yellowish brown with blackish bands as in Fig. 4L; tarsi yellowish, narrow apices of tarsomeres 1–3 and all of 4–5 brown. Forefemur with 1–3 black ventral spines; strong bristly setae at apices of femora and tibiae and in a series dorsally on hindtibia; claws (Fig. 4f) stout and curved, each with inner tooth. Wing (Fig. 4c) pale gray to somewhat milky due to strong macrotrichia, anterior veins yellowish; costal ratio 0.72–0.77. Halter whitish, sometimes slightly infuscated when seen by transmitted light.

Abdomen: Whitish to pale brownish; terga with segmental brown spots as in Fig. 4h. One pair of amber-colored gland rods as long as 4 segments; sterna with dense dark setae, usually each arising from a brown-pigmented integumental spot. Genital sclerotization (Fig. 4i) with 8th sternum brownish, with strong setae. Spermathecae (Fig. 4j) two, ovoid with short stout neck; slightly unequal, measuring 0.070 by 0.052 mm and 0.058 by 0.048 mm.

Male.—Wing length 1.8–2.2 mm; breadth 0.67–0.70 mm. Similar to female with the usual sexual differences. Color darker, mesonotum dark brown with scarcely any indication of vittae, scutellum brownish; abdomen uniformly grayish brown. Antenna blackish; lengths of segments in proportion of 34-16-16-16-16-16-18-22-30-47-34-36-38; proximal segments stout, almost cylindrical; plume dense, blackish, arising from segments 3–12. Vertex, clypeus, and palpi with numerous long bristly black setae. Scutellum with 10 long black bristles; a patch of 20–25 long black bristles arising above each wing base. Leg bands more diffuse than in female, femora especially brownish rather than yellowish in midportion; femora and tibiae with numerous large spinelike black setae dorsally; ventral spines on forefemur longer. Genitalia (Fig. 4m) as figured. Aedeagus slightly longer

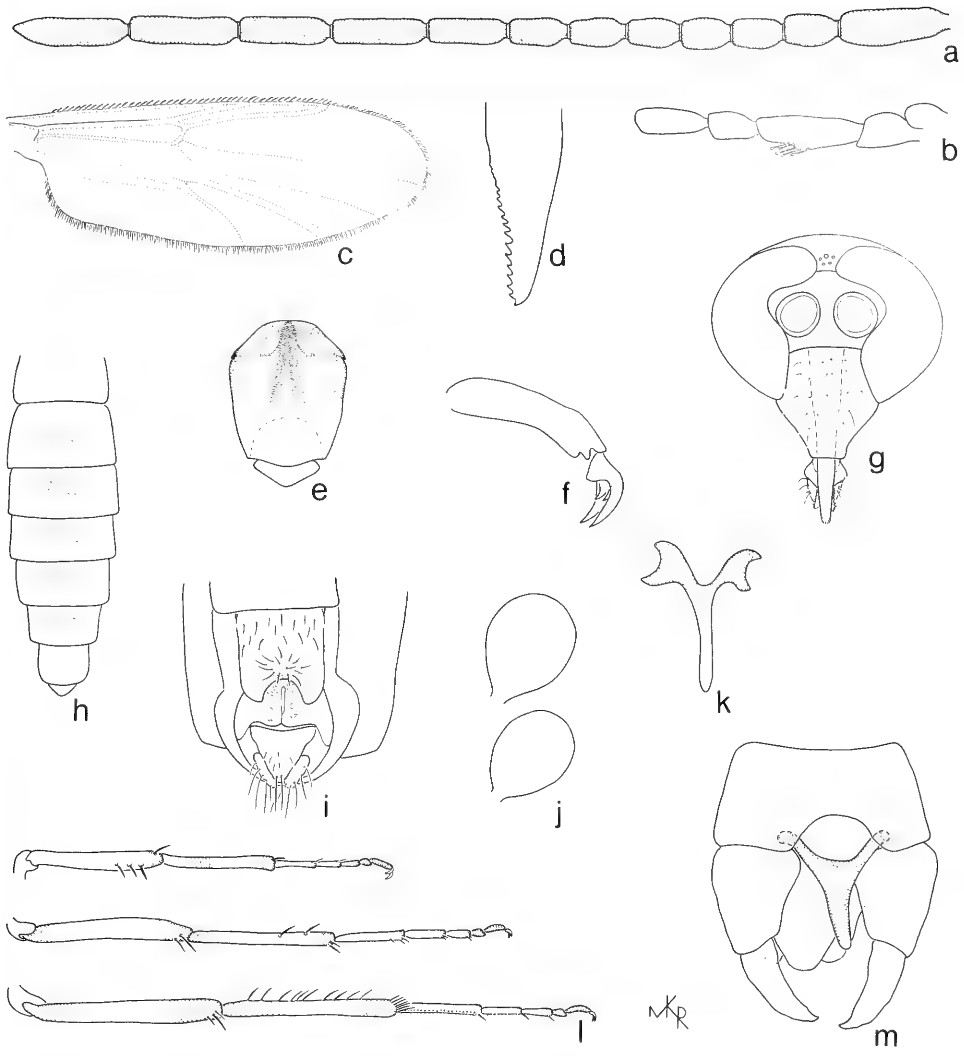

Fig. 4. *Bezzia magnisetula.* a–j, l, Female. k, m, Male. a, Antenna. b, Palpus. c, Wing. d, Mandible. e, Dorsal thoracic pattern. f, Fifth tarsomere and claws. g, Front view of head. h, Color pattern of abdominal terga. i, Genital sclerotization. j, Spermathecae. k, Parameres. l, Femora (left) and tibiae (right) of (top to bottom), fore-, mid-, and hindlegs. m, Genitalia, parameres removed.

than basal breadth (32/30), basal arch to ¼ total length, basal arms and distal process slender. Parameres (Fig. 4k) with anterolateral arms expanded, winglike with 2 short processes on each; distal process straight and slender with rounded tip.

Pupa.—Length 4.8 mm (male) to 5.2 mm (female); general color dark brown. Respiratory horn (Fig. 3d) short, resembling that of *B. nobilis* but apex slightly more expanded, bearing 25–30 spiracles (male and female) in a row much more undulating than in *nobilis*; horn in female 0.35 mm long, 3.8× as long as greatest breadth; in male 0.28 mm long, 4.3× as long as broad. Operculum as in *nobilis* but not as narrow in male, measuring 0.29 mm by 0.29 mm in female (Fig. 3b), 0.29 mm wide by 0.31 mm long in male (Fig. 3a). Cephalothoracic and abdominal chaetotaxy as in *nobilis,* but the posteromarginal tubercles are much shorter (Fig. 3f) and the anterior *dasm*2 is positioned much nearer midline than the posterior *dasm*1, whereas in *nobilis* both tubercles are in line with *dpm*2. Caudal segment as in *B. nobilis.*

Distribution.—Alaska to Manitoba, south to Oregon and Nebraska.

Types.—Holotype ♂, allotype ♀, 7 ♂, 7 ♀ paratypes, MANITOBA, Churchill, 14.vii.1953, J. A. Downes (in CNC).

Specimens examined.—ALASKA: Fairbanks, 12.vi.1968, K. M. Sommerman, jeep trap, 2 ♀. ALBERTA: Brooks, 4.vi, 15.vii.1955, J. A. Downes, 20 ♂, 25 ♀ (CNC). Carmangay, Little Bow River, 27.v.1968, W.W. Wirth, 1 ♂. Cassil, 8.vi.1923, W. Carter, 1 ♀ (CNC). Edmonton, 1932, O. Bryant, 1 ♀ (CAS). Lethbridge, 13.vii.1955, Downes, 1 ♀ (CNC); 27.vi.1968, Wirth, alkali pond, 2 ♂. Onefour, 31.v, 3.vi.1956, O. Peck, 2 ♀ (CNC); 7.vi.1965, J. R. Vockeroth, 1 ♂ (CNC). MANITOBA: Churchill, 25.vi.1930, O. Bryant, 1 ♂, 1 ♀ (CAS). Whitewater Lake, 4 mi N Whitewater, 22.vi.1958, R. D. Bird, 1 ♀ (CNC). MONTANA: Sheridan Co., Medicine Lake, 9.vi.1969, Wirth, reared from alkali lake, 4 ♂, 1 ♀, with pupal exuviae. NEBRASKA: Cherry Co., Big Alkali Lake, 2.vi.1969, Wirth, 1 ♂, 2 ♀, Twin Lake (alkali), 2.vi.1969, Wirth, reared, 19 ♂, 51 ♀, with pupal exuviae; Valentine, 11.vi.1950, Hicks, Slater, and Laffoon, 1 ♂. NORTH DAKOTA: Burleigh Co., Long Lake, 4.vi.1969, Wirth, 20 ♂, 12 ♀. McHenry Co., 4 mi N Upham, 5.vi.1969, Wirth, 1 ♀. Mountrail Co., White Lake, 8.vi.1969, Wirth, 1 ♂. Pierce Co., Pleasant Lake (alkaline), vi.1969, Wirth, 1 ♀. Bismarck, 14.vi.1918, J. M. Aldrich, 1 ♀. Fargo, 13.vi.1918, Aldrich, 1 ♂. OREGON: Harney Co., 10 mi S Burns, 14.vi.1963, K. Goeden, sweeping emergent vegetation in flooded meadow, 10 ♀; Hines, 14.vi.1963, K. Goeden, 1 ♂. Lake Co., Lakeview, 1.viii.1963, 13.viii.1969, Goeden, 2 ♂. Malheur Co., Little Valley, SW Vale, 19.vi.1963, Goeden, 1 ♂, 2 ♀. SASKATCHEWAN: Assiniboia, 23.vi.1955, J. R. Vockeroth, 1 ♀ (CNC). Estevan, 31.viii.1929, P. C. Brown, 1 ♀ (CNC). Great Deer, 21.v.1949, Vockeroth, 1 ♀ (CNC). Saskatoon, 16.vi.1926, L. G. Saunders, ex mud in drying pool, 1 larva, 1 pupa, 1 ♂. Willows, 23.vi.1955, Vockeroth, 1 ♀ (CNC).

Bezzia fluminensis **Lane**

Bezzia fluminensis Lane, 1948: 236 (female; Brazil); Lane, 1958: 31 (male; fig. genitalia).

Diagnosis.—Wing length 1.70 in female and male; costal ratio 0.77 in female, 0.68 in male. Thorax brown; mesonotum with whitish pollinosity, a double median vitta and some lateral spots brownish; scutellum yellow with 4 marginal setae. Legs yellow, coxae and trochanters brown; forefemur brown with faint narrow subapical yellowish band; foretibia with faint, narrow, basal and apical, and broad subbasal, brownish bands, more extensive in male; midfemur faintly brownish at base, distal ¼ dark brown; midtibia with proximal ¼ and narrow apex dark brown; hindfemur and tibia each with distal ¼ dark brown; narrow apices of tarsomeres 1–3 faintly brownish, all of tarsomeres 4–5 pale brown; forefemur with 2–3 stout brown ventral spines; in both sexes apices of femora with 1–2 stout brown setae, dorsal side of hindtibia with several yellowish to brownish, spinelike bristles. Wing whitish including radial veins; halter slightly infuscated. Abdomen shining yellowish, median spots on terga slightly infuscated. Female spermathecae and gland rods not examined. Female antennae missing in available specimens; male antenna with plume and segments 4–12 yellowish, remaining segments brownish, torus dark brown. Male genitalia as in *B. nobilis,* but aedeagus shorter and stouter, in ventral outline nearly an equilateral triangle, the basal arch low and concave, lateral margins nearly straight, median caudal process short and bluntly rounded; parameres as in *B. nobilis.*

Distribution.—Known only from the type locality: BRAZIL, Mun. Itaguay, Km 47, Estrada Rio-São Paulo, 1.ii.1945, P. Wygodzinsky. Specimens examined, 3 ♂, 2 ♀.

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85(4), 1983, pp. 686–690

A KEY TO THE SPECIES OF APHIDS (HOMOPTERA: APHIDIDAE) ON WILD *GERANIUM* SPP. IN THE UNITED STATES, WITH THE DESCRIPTION OF A NEW SPECIES[1]

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Abstract.—A key is given to the species of aphids known to occur on wild geraniums in the United States. The apterous vivipara, alate vivipara, apterous ovipara, and alate male of *Amphorophora* ***coloutensis*** Smith and Knowlton, new species, are described. They were collected on *Geranium fremontii* Torr. ex A. Gray and *G. richardsonii* Fisch. and Trantv. in Colorado and Utah.

Aphids are at times quite common on wild geraniums (*Geranium fremontii* Torr. ex A. Gray and *G. richardsonii* Fisch. and Trantv. in Colorado, Idaho and Utah), and often cause some distortion of plants. The following key should be useful in identifying the species known to occur on wild geraniums in the United States.

Key to Aphids on Wild *Geranium*

Apterous and Alate Viviparae

1. Siphunculi reticulate (4 or more rows of reticulations) 2
– Siphunculi not reticulate 4
2(1). Siphunculi without setae; rostral IV+V with 6–8 accessory setae 3
– Siphunculi usually with setae; rostral IV+V with 12–16 accessory setae (Colo., Idaho, Utah) .... *Macrosiphum aetheocornum* (Smith and Knowlton, 1939)
3(2). Antennal segment III of alate vivipara with 10–18 secondary rhinaria; antennal segment III of apterous vivipara with 2–6 secondary rhinaria .... *Macrosiphum euphorbiae* (Thomas, 1878)
– Antennal segment III of alate vivipara with 5–10 secondary rhinaria, antennal segment III of apterous vivipara with 0–1 secondary rhinaria .... *Macrosiphum geranii* (Oestlund, 1887)
4(1). Siphunculi swollen on distal half 6
– Siphunculi not swollen on distal half (Idaho, Utah, Wyo.) 5

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5(4). Siphunculi without setae .... *Acyrthosiphon malvae* (Mosley, 1841)
– Siphunculi with setae (Syn.: *Capitophorus cefsmithi* Knowlton, 1940 [Heie 1979]) .... *Kakimia crenicorna* (Smith and Knowlton, 1939)
6(4). Rostral IV+V of apterous viviparae with 15–20 accessory setae (Fig. 1A); apterous viviparae with antennal segment III bearing 0–2 secondary rhinaria (Colo., Utah) ... *Amphorophora coloutensis*, new species
– Rostral IV+V of apterous viviparae with 30–40 accessory setae (Fig. 1B); apterous viviparae with antennal segment III bearing 4–8 secondary rhinaria (Colo., Idaho, Utah) .... *Amphorophora geranii* Gillette and Palmer, 1929

Amphorophora coloutensis Smith and Knowlton, New Species

Figs. 1A, C, E

Apterous viviparae.—Color of living material: Pale whitish with longitudinal greenish-brown streak on abdomen. Cleared specimens: Dusky to dark on joints of antenna and antennal segment VI, distal 1/5 of tibiae, and all of tarsi. Remainder of body and appendages pale.

Measurements (11 specimens) (all measurements in mm, first measurement represents the holotype): Body, 3.05 (2.90–3.42); head width, 0.61 (0.58–0.66); antennal segment III, 0.85 (0.71–0.88), IV, 0.67 (0.58–0.76), V, 0.56 (0.49–0.58), VI, 0.15 (0.11–0.16)+0.89 (0.59–0.89); rostral IV+V, 0.18 (0.16–0.18); hindtibia, 2.00 (1.80–2.27), metatarsomere II, 0.10 (0.09–0.12); siphunculi, 0.67 (0.60–0.80); cauda, 0.37 (0.32–0.48).

Morphological characters: Setae on head, antenna and body, blunt to slightly capitate to distinctly capitate. Setae on antenna about ½ width of antennal segment III at base. Antennal tubercles smooth without evident denticulations on ventral surface. Antennal segment III with 0–2 secondary rhinaria. Head with medial area of vertex rectangular. Rostrum attaining metacoxae and bearing 15–18 accessory setae (Fig. 1A). Siphunculi swollen slightly and bearing a few denticulations, especially on basal ½ (Fig. 1E). Tarsal chaetotaxy 2-2-3 or 3-3-3. Cauda nearly parallel-sided, blunt, bearing 10–20 pointed setae (Fig. 1C).

Alate vivipara.—Color of living material: Not observed. Cleared specimens: Dusky on antenna beyond base of antennal segment III, distal ¼ of femora, distal ¼ of tibiae, all of tarsi. Dusky on siphunculi but not as dark as antenna. Pale on remainder of body and appendages.

Measurements (1 specimen): Body, 3.2; head width, 0.61; antennal segment III, 0.86, IV, 0.72, V, 0.61, VI, 0.16+0.89; rostral IV+V, 0.19; hindtibia, 2.10; metatarsomere II, 0.12; siphunculus, 0.60; cauda, 0.36.

Morphological characters: Setae on antenna and body knobbed; antennal segment III with 14–16 secondary rhinaria; rostrum attaining metacoxae; rostral IV+V with 20 accessory setae; siphunculi slightly swollen with inconspicuous denticulations; cauda elongate and bearing 15 setae.

Apterous ovipara.—Color of cleared specimens: Dusky on antenna, distal 1/5 of tibiae and tarsi, siphunculi may be slightly dusky. Pale on remainder of body and appendages.

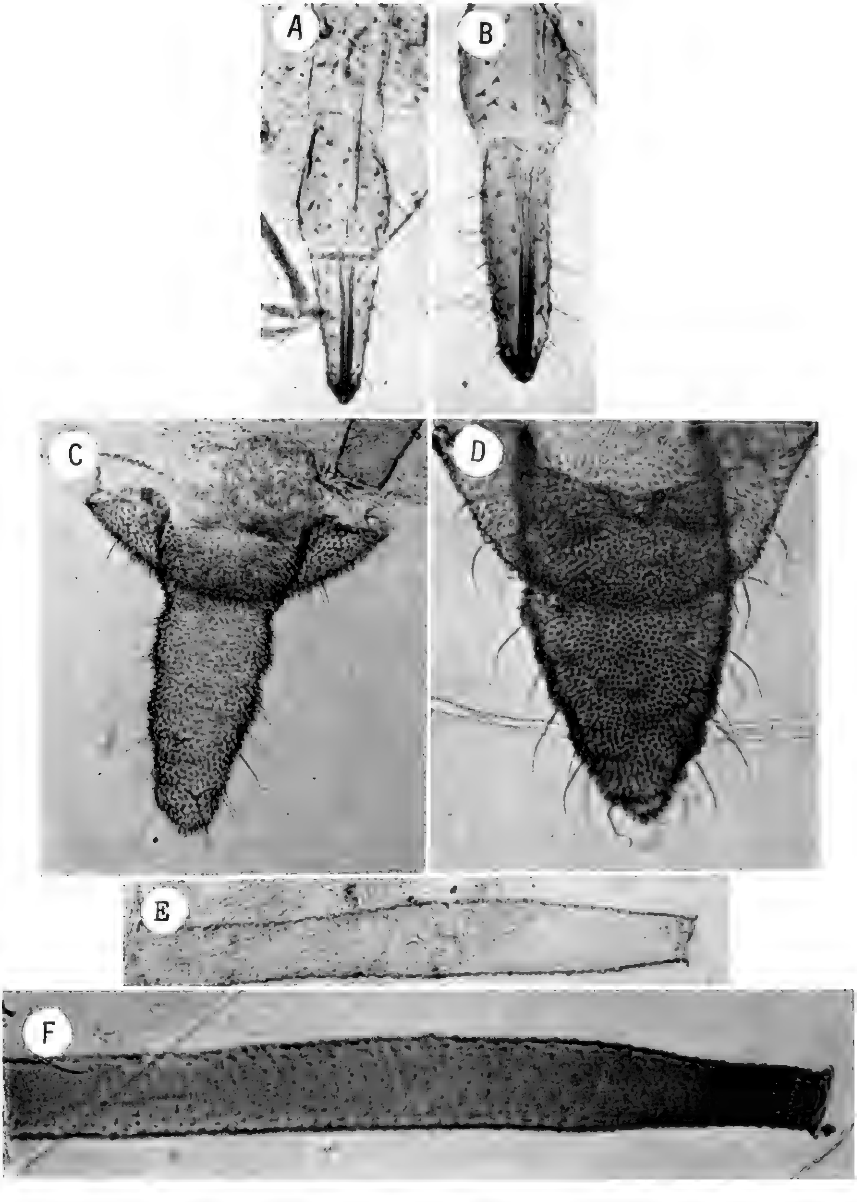

Fig. 1. A, C, E, *Amphorophora coloutensis,* apterous vivipara. B, D, F, *A. geranii,* apterous vivipara. A, B, Rostral IV+V. C, D, Cauda. E, F, Siphunculus. All photographs are the same magnification.

Measurements (4 specimens): Body, 2.8–2.9; head width, 0.63–0.66; antennal segment III, 0.66–0.69, IV, 0.49–0.66, V, 0.43–0.55, VI, 0.11–0.13+0.60–0.65; rostral IV+V, 0.17–0.20; hindtibia, 1.56–1.8, metatarsomere II, 0.11–0.13; siphunculi, 0.61–0.67; cauda, 0.26–0.31.

Morphological characters: Setae on head and body capitate; antennal segment III without secondary rhinaria; rostrum attaining metacoxae; rostral IV+V with apparently 18–22 accessory setae; tarsal chaetotaxy 3-3-3; siphunculi slightly swollen and distinctly denticulated; cauda blunt and bearing apparently 14–22 setae; hindtibia with numerous sensoria on basal ⅔.

Alate male.—Color of cleared specimens: Dusky on antenna, distal ¼ of femorae, distal 1/5 of tibiae, and all of tarsi. Distal portion of siphunculi may be slightly dusky. Pale on remainder of body and appendages.

Measurements (2 specimens): Body, 2.5–2.65; head width, 0.54; antennal segment III, 0.77-0.81, IV, 0.77–0.79, V, 0.61–0.69, VI, 0.13–0.15+1.04–1.13; rostral IV+V, 0.19–0.20; hindtibia, 2.04–2.09, metatarsomere II, 0.11; siphunculi, 0.50–0.55; cauda, 0.23.

Morphological characters: Setae on head and body pointed to slightly capitate. Secondary rhinaria on antennal segment III, 58–69, IV, 28–36, V, 18–22, rostrum attaining metacoxae; rostral IV+V with approximately 18 accessory setae; tarsal chaetotaxy 3-3-3; cauda with 12–14 setae.

Collections.—On wild geranium (probably *Geranium fremontii* Torr. ex. A. Gray or *G. richardsonii* Fisch. and Tranv.). COLORADO: Roosevelt Forest, 6 Aug. 1960, collection 60-751 (7 apt. viv., 1 al. viv., 4 nymphs), C. K. Smith, C. F. Smith and T. O. Thatcher. Estes Park on *Geranium richardsonii,* 23 July 1976 (2 apt. viv.), H. G. Walker; on *Geranium fremontii,* 23 July 1974 (5 apt. viv.), H. G. Walker; 5 Aug. 1978 (1 apt. viv.), H. G. Walker; 11 Aug. 1977 (2 al. ♂), H. G. Walker. UTAH: Monte Cristo, 21 July 1976, collection no. 76-68 (7 apt. viv., 1 nymph), G. F. Knowlton. Parley's Canyon, 21 July 1959 (1 apt. viv., 2 apt. ovip.), collection no. K-199, G. F. Knowlton. Daniel's Canyon, 21 July 1959 (1 apt. viv., 1 apt. ovip.), collection no. K-219, G. F. Knowlton.

Type-locality.—Roosevelt Forest, Colorado.

Types.—Holotype, apterous viviparous ♀ on a slide with an alate and a nymph. The holotype is at 5 o'clock, on slide labeled "60-751, wild geranium, Roosevelt Forest, Colorado, 8-6-60 [6 August 1960], CKS-CFS-T.O. Thatcher." Holotype deposited in the National Museum of Natural History, Washington, D.C., on indefinite loan from N.C. State University; paratypes in collections of the National Museum of Natural History, George F. Knowlton, Clyde F. Smith, and N.C. State University in Raleigh.

Etymology.—Named for Colorado and Utah, the states from which *A. coloutensis* has been collected.

Discussion.—*Amphorophora coloutensis* keys to *Amphorophora urtica* Essig, 1942, in Palmer (1952: 230) but differs in having apterous vivipara with the head and antennal tubercles smooth ventrally instead of denticulate, in lacking presiphuncular sclerites on the abdomen, and in lacking dusky areas around the lateral abdominal tubercles.

Of the 19 species of *Amphorophora* Buckton, 1876, previously known from North America (Smith and Parron, 1978), only *A. geranii* occurs on wild geranium.

Amphorophora coloutensis may be separated from *A. geranii* and other aphids living on wild geranium by the characteristics given in the key.

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NOTE

On the Homonymy of *Hybocoris* Kormilev, 1982 (Hemiptera: Aradidae)

Dr. I. M. Kerzhner, Zoological Institute, Academy of Sciences, USSR, Leningrad, has advised me that the name *Hybocoris* Kormilev, 1982 (Wasmann J. Biol. 40[1–2]: 7), is preoccupied by *Hybocoris* Kiritshenko, 1914 (1913) (Russk. Entomol. Obozr. 13[3–4]: 301) (Hemiptera: Pentatomidae). Therefore, I propose for *Hybocoris* Kormilev the replacement name *Aparilocoris* (**New Name**), which is Greek meaning deceptive. *Hybocoris mexicanus* Kormilev (1982), should therefore be *Aparilocoris mexicanus* (Kormilev) (**New Combination**).

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THE IMMATURE STAGES OF *DIALYSIS FASCIVENTRIS* (LOEW) (DIPTERA: COENOMYIIDAE)

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Abstract.—The immature stages of *Dialysis fasciventris* are described and the phylogenetic relationships of the genus *Dialysis* with other genera of lower brachycerous Diptera are discussed.

Twelve species of the genus *Dialysis* are known worldwide: nine species in North America (Webb, 1978), two species in Japan (Matsumura, 1916; Nagatomi, 1953), and one species in Formosa and South China (Bezzi, 1912). The immature stages of these species are undescribed. It is the intention of this paper to describe the larval and pupal characters of *Dialysis fasciventris* (Loew) and to discuss the phylogenetic relationships of the genus *Dialysis* with other genera of lower brachycerous Diptera.

The terminology used for the immature stages is from Teskey (1969, 1981).

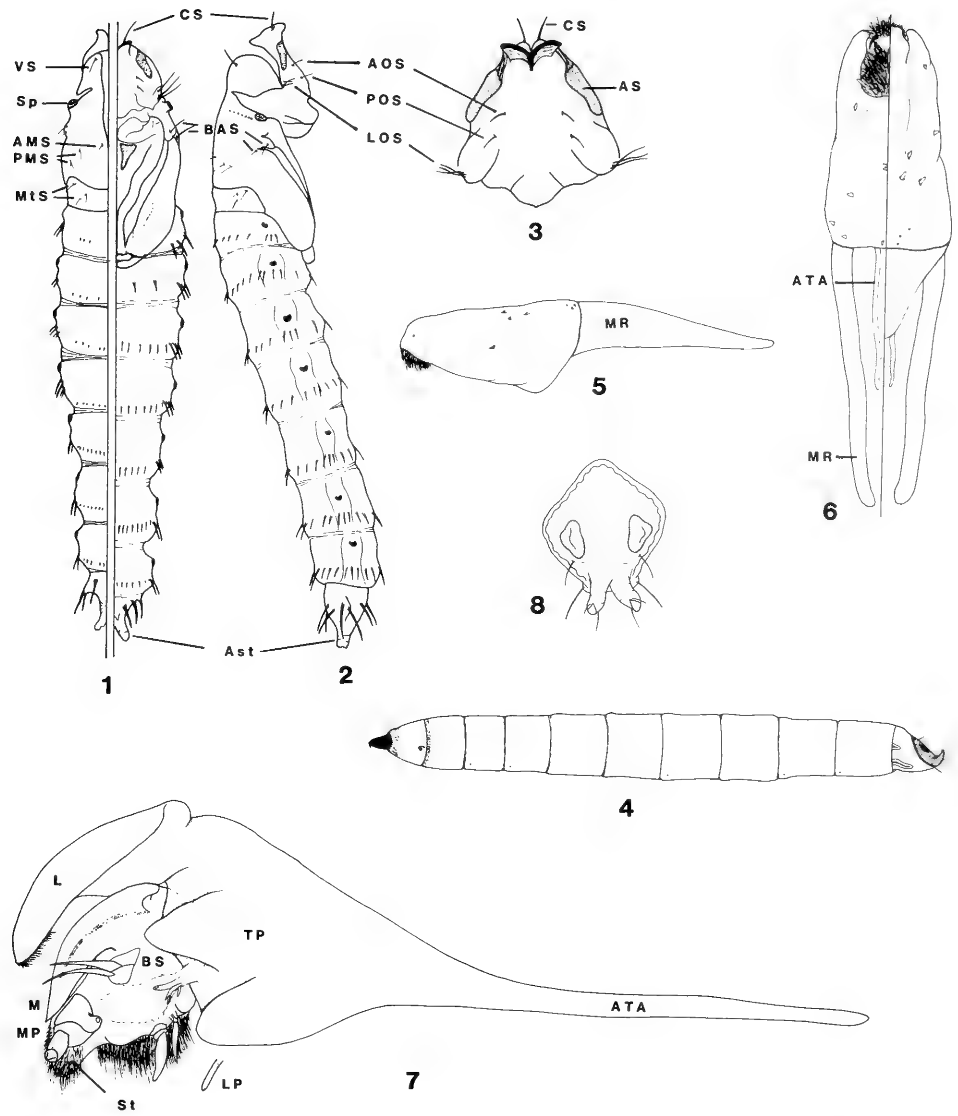
Dialysis fasciventris (Loew)

Triptotrichia fasciventris Loew, 1874: 380.
Dialysis fasciventris (Loew): Leonard, 1930: 65; Webb, 1978: 420.

Pupa (Figs. 1–3).—Length 13.0–22.0, 17.8 mm ($N = 3$), width 3.3–3.8, 3.6 mm, 3.5–5.8, 5.0× longer than wide. Adecticuous, obtect, dark yellow to pale brown.

Head separated from thorax by cephalothoracic suture anterior to mesothoracic spiracle, extending ventrally from middle of dorsum to beneath sheath of mouthparts. Antennal sheath (AS) narrow, fuscous, rounded apically, about 2.0× longer than basal width. Callus seta (CS) 1, lateral orbital setae (LOS) 3, vertical seta (VS) 1, anterior mesonotal seta (AMS) 1, posterior mesonotal setae (PMS) 2, basal alar setae (BAS) 2. Mesothoracic spiracle (Sp) distinct, fuscous, lying anterolateral. Ventrally, wing and leg sheaths extend posteriorly over 1st abdominal sternite. Metanotum broad with 3 pairs of setae (MtS), 1 pair situated at basal angle of wing sheath and 2 pairs close together sublaterally.

Abdominal segments I–VII with lateral spiracle and 3 lateral spines. Tergites I–VII with transverse row of spines on caudal ⅓ of each segment, increasing slightly in size on posterior tergites. Sternite I without spines. Sternite II with 4 ventral spines. Sternites III–VII with transverse row of spines on caudal ⅓ of segment, increasing in size on posterior sternites. Terminal abdominal segment distended caudally to form 2 obtuse projections (Fig. 1, 2); dorsal surface with 2 lateral spines; lateral margin with broad tubercle bearing 3–4 fine spines; ventral surface with 2 lateral spines.



Figs. 1–8. *Dialysis fasciventris.* 1–3, Pupa. 4–8, Larva. 1, Dorsal/ventral view. 2, Lateral view. 3, Frontal plate. 4, Lateral view. 5, Cranium, lateral view. 6, Cranium, ventral/dorsal view. 7, Mandibular-maxillary complex, lateral view. 8, Anal plate. Abbreviations: AS = antennal sheath; AMS = anterior mesonotal seta; AOS = anterior orbital seta; Ast = aster; ATA = anterior tentorial arm; BAS = basal alar setae; BS = basal sclerite; CS = callus seta; L = labrum; LOS = lateral orbital setae; LP = labial palp; M = mandible; MP = maxillary palp; MR = metacephalic rod; MtS = metanotal setae; PMS = posterior mesonotal setae; POS = posterior orbital seta; Sp = spiracle; St = stipes; TP = tentorial phragma; VS = vertical seta.

Larva (Figs. 4–8).—Length of mature larva 25.6 mm, width 3.7 mm, 6.9× longer than wide. Body fusiform, pale white to ivory, holopneustic.

Cranium (Figs. 5–6) hemicephalic, dark brown to black, heavily sclerotized, about 1.5× longer than wide, tapering anteriorly; posterior ¼ of head retracted

Table 1. Comparison of the morphological characters of the pupal stage of *Dialysis* and *Coenomyia*.

Dialysis	*Coenomyia*
Length 13.0–22.0 mm	Length 26.6–36.9 mm
Callus seta 1	Callus seta 1
Anterior orbital seta 1	Anterior orbital seta absent
Posterior orbital seta 1	Posterior orbital setae 3
Lateral orbital setae 3	Lateral orbital seta 1
Vertical seta 1	Vertical seta absent
Anterior metanotal seta 1	Anterior metanotal seta absent
Posterior metanotal setae 2	Posterior metanotal seta absent
Basalar setae 2	Basalar seta 1
Metanotal setae 3	Metanotal seta absent
Abdominal segments I–VII with lateral spines	Abdominal segments I–VII with lateral spines
Posterior row of spines on abdominal tergites I–VII	Posterior row of spines on abdominal tergites III–VII
Posterior row of spines on abdominal sternites III–VII	Posterior row of spines on abdominal sternites III–VII
Abdominal tergites without dark brown punctation	Abdominal tergites IV–VI with dark brown punctation
Abdominal sternites without dark brown punctation	Abdominal sternites II–VII with dark brown punctation
Abdominal sternite II with 2 mediolateral spines	Abdominal sternite II without spines

into 1st thoracic segment, setae absent, although numerous minute sensory pegs (Fig. 6) situated on ventral and lateral surface. Ocelli absent. Labrum short, wedge shaped, curved ventrally; epipharynx with dense spinous brush. Mandible hypognathus. Antenna reduced. Metacephalic rods (MR) broad dorsoventrally, flattened laterally, extending posteriorly into 1st thoracic segment, firmly attached anteriorly to posterior margin of cranium.

Mouthparts (Fig. 7) or mandibular-maxillary complex with large basal sclerite (BS) bearing mandible (M), maxillary palpus (MP), stipes (St), and 2 pairs of flat, elongate blades: 1 pair situated dorsal to base of maxillary palpus and directed anteriorly, a second pair situated posterior to base of maxillary palpus and directed ventrally. Mandible (M) large, dark brown, sickle shaped, heavily sclerotized, tapered ventrally, central canal visible. Maxillary palpus with 2 segments, about 1.7× longer than wide; basal segment short, broad; apical segment reduced, oblong. Stipes and medial surface of basal sclerite with dense brush of elongate spines. Tentorial phragma (TP) attached dorsally to labrum (L) and posteriorly to basal sclerite; attached to anterior surface of tentorial phragma are 3 membranous projections surrounded by membranous fanlike structure bearing numerous branching filaments along its border; anterior tentorial arms (ATA) narrow, elongate, tapering posteriorly. Labial palp (LP) with 1 segment, elongate, situated posterior to ventral surface of basal sclerite.

Thorax with 3 distinct segments, setae absent. Thoracic segments 1 and 2 with broad band of flat scalelike spines (Figs. 3, 4) along anterior margin. Thoracic tergite 1 with subtriangular, mediolateral patch of fuscous pigmentation. Prothoracic spiracle small, with dorsal arc of dark brown pigmentation.

Table 2. Comparison of morphological characters of the larva of *Dialysis, Coenomyia,* and *Arthropeas.*

Dialysis	*Coenomyia*	*Arthropeas*
Length 25.6 mm	Length 38.0–48.0 mm	?
Holopneustic	Holopneustic	?
Body fusiform	Body fusiform	Body fusiform
Cranium dark brown to black, partially withdrawn into first thoracic segment	Cranium dark brown to black, partially withdrawn into first thoracic segment	Cranium dark brown to black
Labrum wedge shaped	Labrum wedge shaped	?
Epipharynx with spinous brush	Epipharynx with spinous brush	?
Stipes with spinous brush	Stipes with spinous brush	?
Maxillary palp with two segments	Maxillary palp with two segments	?
Basal sclerite with pair of anterior and ventral blades	Basal sclerite with pair of anterior and ventral blades	?
Metacephalic rods broad, flattened laterally, extending posteriorly into first thoracic segment	Metacephalic rods broad, flattened laterally, extending posteriorly into first thoracic segment	Metacephalic rods broad, flattened laterally, extending posteriorly into first thoracic segment
Thoracic segment 1 with anterior border of spines	Thoracic segment 1 without anterior border of spines	Thoracic segment 1 without anterior border of spines
Dorsal surface of thoracic segment 1 without pigmentation	Dorsal surface of thoracic segment 1 with 5 areas of pigmentation	Dorsal surface of thoracic segment 1 with one median area of pigmentation
Ventral surface of thoracic segment 1 without pigmentation	Ventral surface of thoracic segment 1 with 2 areas of pigmentation	Ventral surface of thoracic segment 1 with 2 areas of pigmentation
Thoracic tergite 1 without punctation	Thoracic tergite 1 without punctation	Thoracic tergite 1 with median patch of punctation
Thoracic sternite 1 without punctation	Thoracic sternite 1 without punctation	Thoracic sternite 1 with punctation along posterior margin
Thoracic segment 2 with anterior border of spines	Thoracic segment 2 without anterior border of spines	Thoracic segment 2 without anterior border of spines
Ventral surface of thoracic segment 2 without pigmentation	Ventral surface of thoracic segment 2 with two small areas of pigmentation	Ventral surface of thoracic segment 2 without pigmentation
Ventral surface of thoracic segment 2 without punctation	Ventral surface of thoracic segment 2 without punctation	Ventral surface of thoracic segment 2 with lateral diagonal row of punctation
Dorsal surface of thoracic segment 2 without punctation	Dorsal surface of thoracic segment 2 with lateral row of diagonal punctation	Dorsal surface of thoracic segment 2 with lateral punctation in shape of inverted "V"
Thoracic segment 3 without lateral spiracle	Thoracic segment 3 with lateral spiracle	Thoracic segment 3 without lateral spiracle

Table 2. Continued.

Dialysis	*Coenomyia*	*Arthropeas*
Ventral surface of thoracic segment 3 without pigmentation	Ventral surface of thoracic segment 3 with two small areas of pigmentation	Ventral surface of thoracic segment 3 without pigmentation
Ventral surface of thoracic segment 3 without punctations	Ventral surface of thoracic segment 3 without punctations	Ventral surface of thoracic segment 3 with medialateral row of punctation
Dorsal surface of thoracic segment 3 without punctation	Dorsal surface of thoracic segment 3 with diagonal row of punctation	Dorsal surface of thoracic segment 3 with diagonal band of punctation
Abdominal segments I–VII without lateral spiracle	Abdominal segments I–VII with lateral spiracle	Abdominal segments I–VII without lateral spiracle
Abdominal tergites II–VII without punctations	Abdominal tergites II–VII with punctations in diagonal row on tergites II and VII, in "V" shape on tergites III–VI	?
Anal plate diamond shaped	Anal plate spherical	Anal plate diamond shaped
Posterior spiracle subtriangular, on ventral half of anal plate	Posterior spiracle oblong, on dorsal half of anal plate	Posterior spiracle oblong, on dorsal half of anal plate
Anal plate with sculptured border	Anal plate without sculptured border	Anal plate with sculptured border

Abdominal segments I–VII with narrow ring of short, minute spines along anterior margin; setae absent. Abdominal segment VIII (anal) in dorsal view with anal plate (Figs. 4, 8), large, fuscous to dark brown, heavily sclerotized, surface rugose, with 2 caudal tubercles, each bearing 2 elongate coarse setae; a coarse seta situated lateral to caudal projection; on young larvae 3 fine setae are present, situated ventrolateral and dorsomedial to posterior spiracle (the 2 dorsomedial setae apparently lost on mature larvae); posterior spiracle dark brown, situated on ventral ½ of anal plate, with lateral diagonal slit; outer margin of anal plate with serpentine sculpturing; in ventral view abdominal segment VIII (Fig. 4) with median anal ring oblong.

Remarks.—The larvae of *Dialysis fasciventris* were collected from the top 5 cm of soft organic soil in a beech and sugar maple forest in Vermilion County in eastern Illinois. Six larvae were collected from 42 soil samples (each sample 890 sq. cm), giving an average abundance of 1.57 larvae per square meter.

The pupa of *Dialysis fasciventris* resembles that of *Coenomyia ferruginea* (Table 1), each having a single callus seta, lateral spiracles on abdominal segments I–VII, lateral spines on abdominal segments II–VII, and a ring of posterior spines on abdominal segments III–VII. The pupae differ in the position and number of anterior, posterior, and lateral orbital setae; vertical setae; anterior and posterior mesonotal setae; basal alar setae; and metanotal setae, in addition to the presence or absence of spines on abdominal segments I and II.

The larvae of *Dialysis fasciventris, Coenomyia ferruginea,* and *Arthropeas sibirica* (Krivosheina, 1967) are similar in general body shape and appearance (Table 2). The cranium in each is dark brown to black, heavily sclerotized, and partially withdrawn within the first thoracic segment, and each has a pair of broad metacephalic rods extending posteriorly from the posterior margin of the cranium into the first thoracic segment. The larvae differ in a number of other morphological characters.

Dialysis has usually been considered a rhagionid fly (Aldrich, 1905; Cole, 1969; Curran, 1965; Steyskal, 1953; Webb, 1978; Williston, 1888), Rhagionidae: Rhagioninae (James, 1965; Leonard, 1930; Williston, 1896, 1908), or Rhagionidae: Bicalcarinae (Brues et al., 1954). Nagatomi (1975a) defined the family Coenomyiidae and included the genera *Coenomyia, Anacanthaspis, Arthropeas, Odontosubula,* and *Dialysis.* He (1975a, 1975b, 1977) associated *Dialysis* with *Coenomyia* and *Arthropeas.*

In a study of 21 genera of lower brachycerous Diptera in the Nearctic Region, Webb (1981) examined 53 morphological characters of adult males and females. Two phylogenetic (cladistic) and three phenetic methods were used in developing and interpreting the relationships of these genera.

Phylogenetic methods: A cladogram was developed which (1) reflected the least number of convergences for all character states considered and (2) was rooted from a hypothetical ancestor possessing the plesiomorphic state for all 53 characters using the Wagner algorithm.

Phenetic methods: Phenetic similarities were analyzed using CLUSTER (written by Dr. R. B. Selander, University of Illinois) and phenograms were produced using UPGMA (unweighted pair-group method using arithmetic averages) for Pearson-product moment correlation coefficients, average taxonomic distances, and mean character differences.

The two phylogenetic analyses associated the genera: *Dialysis, Coenomyia,* and *Arthropeas.* The three phenetic analyses closely associated *Dialysis* and *Coenomyia,* but separated *Arthropeas* from these genera and associated it with *Arthroceras.* Most recently, James (1981) included *Dialysis* in the Xylophagidae, based on the strong similarity in the larvae of *Coenomyia, Rachicerus,* and *Xylophagus.* However, because of the divergence of the adults, he grouped *Dialysis, Coenomyia,* and *Arthropeas* in the subfamily Coenomyiinae. These five analyses showed no association between *Dialysis, Coenomyia,* or *Arthropeas* and *Xylophagus* or *Rachicerus,* and reinforce Nagatomi's association and grouping of *Dialysis, Coenomyia,* and *Arthropeas* in Coenomyiidae (Nagatomi, 1975a).

The larvae of *Dialysis* show a close association with the larvae of *Coenomyia* and *Arthropeas* in the general body shape and appearance, the mandibular-maxillary complex (not described for *Arthropeas* by Krivosheina, 1967), metacephalic rods, and anal plate. Also, the larvae of *Dialysis* and *Coenomyia* are both holopneustic. Here again, the characteristics of the larvae of *Dialysis, Coenomyia,* and *Arthropeas* reinforce Nagatomi's (1975a) grouping of these genera into the family Coenomyiidae.

ACKNOWLEDGMENTS

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ECHINOCOLEUS SETIGER HORN (COLEOPTERA: LEIODIDAE), AN INQUILINE IN THE NEST OF *POGONOMYRMEX* SPP. (HYMENOPTERA: FORMICIDAE)

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Abstract.—Aspects of the biology of the myrmecophilous beetle *Echinocoleus setiger* Horn which occurs in the nests of the harvester ants *Pogonomyrmex montanus* MacKay and *P. subnitidus* Emery in southern California, USA, are discussed. There was a single generation per year with peak populations occurring in the nest in August.

Considerable variation existed in the numbers of beetles found in each ant nest. The beetles occurred together in groups in the lower regions of the nests and seasonally migrated to areas with the highest humidity. They are either synoeketes or symphiles, licking host secretions and cleaning the body surfaces of the ants.

The genus *Echinocoleus* presently contains three species, all of which are myrmecophiles (Peck, 1976). The genus occurs in the southwestern United States including California, Arizona, New Mexico, and Texas and probably occurs in northern México.

During an investigation of the nest phenologies of *Pogonomyrmex* spp. harvester ants (MacKay, 1981), *E. setiger* Horn was collected in the nests of *P. montanus* MacKay and *P. subnitidus* Emery. This report discusses aspects of the biology of *E. setiger* and its interaction with the ants.

MATERIALS AND METHODS

Study areas.—The ant nests were excavated in southern California: *P. subnitidus* in chaparral near the Vista Grande Ranger Station at 1500 m in the San Jacinto Mountains of Riverside Co., and *P. montanus* in a yellow pine forest at Big Pine Flat at 2100 m in the San Bernardino Mountains of San Bernardino Co.

The beetles.—Peck (1973) placed the genus *Echinocoleus* in the tribe Ptomaphagini and subtribe Ptomaphagina of the subfamily Catopinae. The beetles are small (1.9–2.8 mm total body length) with a turtle-like body form and with the elytra covered with long semierect golden hairs, all of which protect the beetles from the ants.

The ants.—The two ant species are very closely related. Both belong to the subfamily Myrmicinae, the tribe Myrmicini, the nominal subgenus *Pogonomyrmex* and the *occidentalis* species group (MacKay, 1980a). The nests were in soil within clearings in the two plant communities (MacKay, 1981).

Nest excavation.—The nests were excavated in ten-cm levels. The contents of

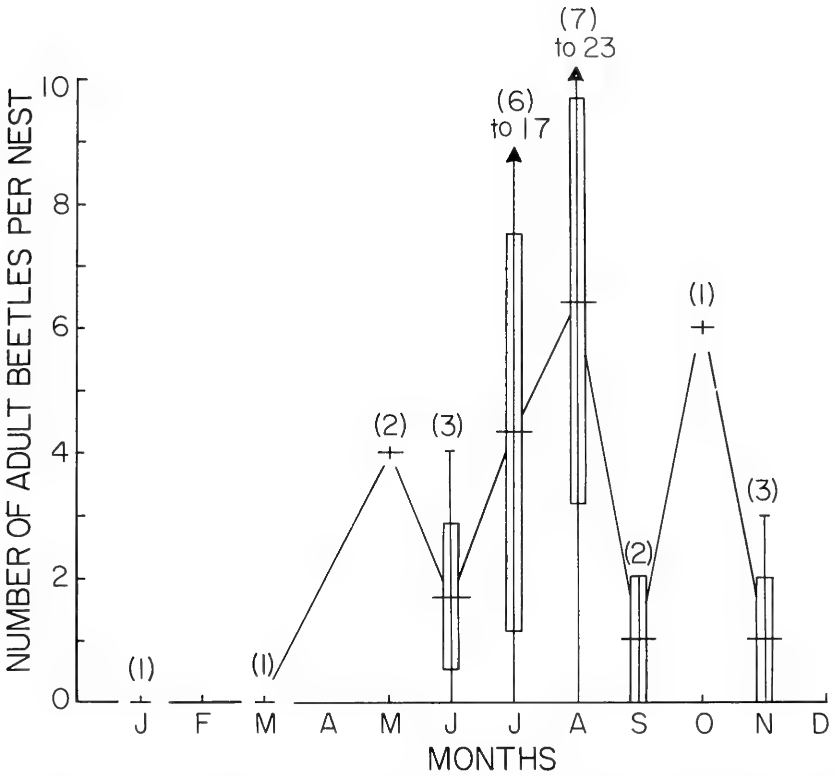

Fig. 1. Seasonal changes in mean numbers of *Echinocoleus setiger* in the nests of *Pogonomyrmex subnitidus*. Rectangles are ± one standard error, vertical lines are the ranges. The numbers of nests excavated are indicated by the numbers in parentheses.

the burrows, including dirt and animals, were placed in plastic containers and later the animals were separated from the dirt by hand. The beetles were preserved in 70% ethanol or were placed in plastic containers for later observations of their behavior. Complete excavation of a *P. montanus* nest required 6–10 hours and of a *P. subnitidus* nest, 20–30 hours.

Observations of living animals.—Ants were placed in observation nests ("Uncle Milton Ant Farms"©) which consisted of about 1 cm width of dirt sandwiched between pieces of clear plastic. The ants were allowed 24 hours to construct a burrow system, and then the beetles were added to the artificial nest.

Results and Discussion

Seasonal changes in the density of the beetle populations.—The adult beetles are most common in the nests of the two species of ants from mid summer to late fall (Fig. 1, Table 1). No beetles were found in the nests of *P. subnitidus* until May when four beetles were observed in each of two nests excavated (Fig. 1). There was a general increase in the beetle population until August. Apparently, at least *E. setiger* is not more common in the cooler months when the ants are less active, as was suggested by Peck (1976). The summer is not a pleasant time to excavate *Pogonomyrmex* spp. nests as the ants are most active and aggressive, but it is the time when the adult beetles are most common.

Table 1. Levels and numbers of *Echinocoleus setiger* collected from five nests of *Pogonomyrmex montanus* at Big Pine Flat, San Bernardino Mountains, San Bernardino County, California.

Nest number	Date of excavation	Level (cm)	Number of beetles
1	17-X-77	not recorded	5
2	12-VII-78	not recorded	3
3	30-IX-78	50	4
4	30-IX-78	not recorded	1
5	19-VIII-80	30	1
	19-VIII-80	50	1
	19-VIII-80	80	2

Considerable variation was observed in the numbers of beetles captured (Fig. 1). For example, during August we found nests without beetles and one nest with 23 beetles. We have no explanation for this variation. All nests were in the same area. There were no significant correlations between the numbers of beetles and numbers of adult ants ($r = 0.02$ ns), of larvae ($r = 0.54$ ns), or of pupae ($r = 0.48$ ns) for the 13 nests excavated in July and August. We excavated a total of 80 *P. montanus* nests, but found beetles in only five (Table 1), all located at Big Pine Flat. The other nests were located about 4 km east of Big Pine Flat. The vegetation and soil appeared similar throughout the area. We cannot explain the absence of *E. setiger* in the nests excavated in other areas. There was a mean of 3.4 beetles per *P. montanus* nest (Table 1).

Echinocoleus chihuahuensis Peck is univoltine (Peck, 1976). Eggs are deposited in the spring, mature larvae are present by early September, and the beetles pass the winter as adults. The seasonal cycle may be similar in *E. sonorensis* Peck (Peck, 1976), as larvae were found in April. Apparently *E. setiger* is also univoltine (Fig. 1). The adults appear in May, reach peak populations in August, with fewer adults occurring in late fall and winter. Although we collected all of the ant brood for determination of annual production, we found no beetle larvae with the ant larvae as was reported with *E. chihuahuensis* (Peck, 1976), or elsewhere in the nest.

Seasonal changes of the depths of the beetles in the nests.—The mean of the maximum nest depths is 67 cm for *P. montanus* and 230 cm for *P. subnitidus* (MacKay, 1981). Most beetles were found in the lowest regions of the nests of *P. montanus* (Table 1) and in the mid to lowest levels in the nests of *P. subnitidus* (Fig. 2).

Small standard errors suggest that the beetles have clumped distributions within the nests. The distributions of the beetles in July and August differ significantly from a Poisson distribution (chi-square = 10297.7, df = 253, $P < 0.001$), verifying a non-random distribution. The ratio of $s^2/\bar{x}$ is 2.0, demonstrating that the beetles have a clumped distribution within the nests.

The beetles tend to move from the 100–150 cm levels in the spring to near the 200 cm level in August and to the upper levels in the fall (Fig. 2). There are few differences among the levels below 20 cm in the seasonal changes in temperature (MacKay, 1981), but there are considerable differences among the levels with respect to the percent free water in the soil (MacKay, 1981). Until mid-May there

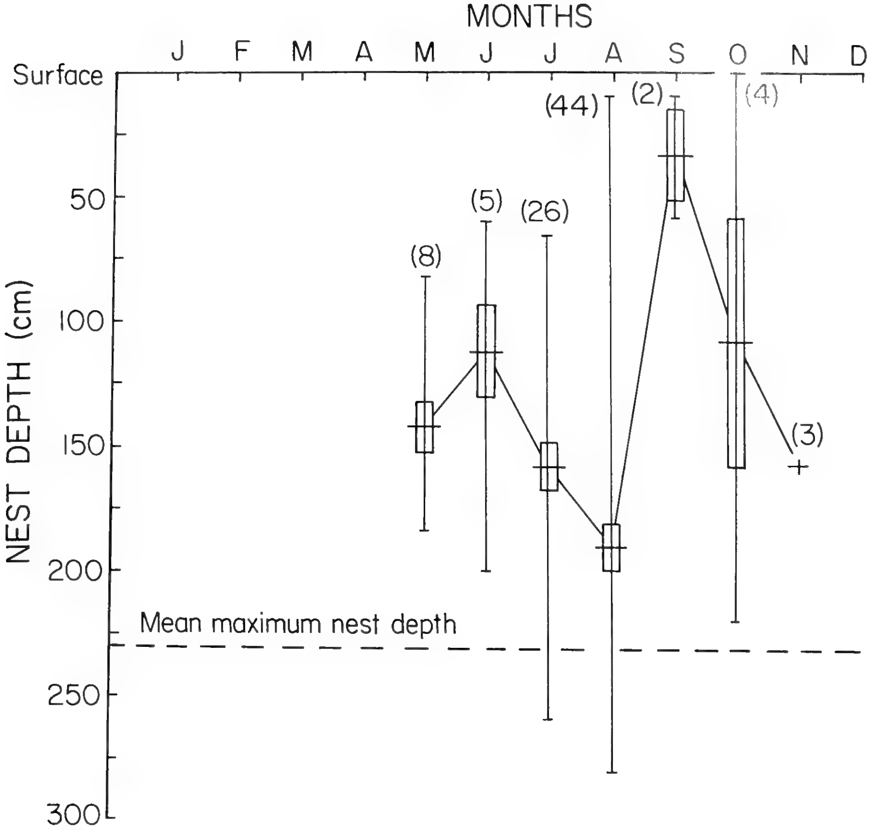

Fig. 2. Seasonal changes in depths of *Echinocoleus setiger* in nests of *Pogonomyrmex subnitidus*. The rectangles are ± one standard error, vertical lines represent the ranges. Numbers captured during each month are indicated in parentheses. The mean of the maximum nest depths is indicated as a dashed line.

was approximately 10% free water in all levels. Later in the summer the superficial levels became very dry (less than 2% free water). In the fall, rains again increased the water content of the soil to 5 or 10% free water. Beetles in the laboratory were kept in a very humid environment. Exposure of only a few hours without free moisture resulted in heavy mortality. The beetles apparently migrated to the nest areas with highest humidity. Similarly Peck (1976) reported that individuals of *E. sonorensis* were found in the upper half meter of a *P. rugosus* nest in April. In October, larvae of *E. chihuahuensis* were found only at depths of over one half meter (2 feet) together with the ant brood (Peck, 1976).

Relationship with the ants.—The beetles appear to be either synoeketes as suggested by Peck (1976) or symphiles. They rapidly scurry away when approached by a worker, winged male, or winged female. Adult ants and winged females often attack the beetles. The ants must be very close to the beetles or actually touch them with their antennae in order to detect their presence. The beetles quickly escape by burrowing into the soil. The ants continue to pursue the beetles, digging

Table 2. The presently known ant hosts and distributions of the three species of *Echinocoleus.*

Species	Host	Distribution
E. chihuahuensis Peck	*Pogonomyrmex maricopa* Wheeler	Texas, New Mexico
E. setiger Horn	*Aphaenogaster albisetosa* Mayr	Arizona
	Pogonomyrmex montanus MacKay	Southern California
	P. subnitidus Emery	Southern California
E. sonorensis Peck	*P. rugosus* Emery	Arizona

after them and attempting to capture them using the mandibles and front legs. The beetles usually manage to escape. The limuloid body shape and the stiff hairs on the dorsum protect them from the ants. When the ants do close their mandibles on a beetle, it snaps away from the ant. We saw numerous aggressive encounters, but never saw an ant kill a beetle.

Most of the time the beetles are either buried in the bottom of a burrow at depths less than a half cm or are scurrying around in the nest. Occasionally a beetle encounters an ant which becomes very docile. The beetle climbs a posterior leg and begins licking the ant's dorsal surface. The ant lowers its antennae and patiently allows the beetle to move over its surface. When the beetle moves onto the ant's head, the ant usually attempts to dislodge it with the anterior legs. The beetle moves to the middle of the head, above and between the eyes, where the ant's anterior legs cannot reach. In these encounters, the ant displays no aggressive behavior toward the beetle. If the ant moves, the beetle moves to the dorsal surface of the ant's gaster. We frequently saw beetles in the observation nest riding on the gasters of ants.

Peck (1976) suggested that the beetles scavenge waste materials in the nests, as catopines are generally scavengers. However, dead ants in the observation nest were never approached by *E. setiger.* Apparently their habits are similar to the common ant crickets, *Myrmecophila* spp. which lick host secretions and clean the body surfaces of the ants.

Evolution and host relations of the genus.—The genus probably evolved from a New World *Ptomaphagus* (*Adelops*) ancestor (Peck, 1976). Several *Ptomaphagus* (*Adelops*) spp. are found in ant nests (MacKay, 1980b). A species in the *consobrinus* group may have invaded *Pogonomyrmex* ants nests in the developing Pliocene Sonoran desert (Peck, 1976), and later differentiated into an *Echinocoleus* sp. which became separated by a woodland-grassland range into eastern and western populations during a Pleistocene glacial period. The western population may have differentiated to become *E. setiger. Pogonomyrmex* spp. are the most common hosts of the three known species of *Echinocoleus* (Table 2), but *E. setiger* also occurs in nests of *Aphaenogaster albisetosa* Mayr (Table 2). We excavated 20 *P. rugosus* Emery nests near Riverside, California, and although we captured numerous myrmecophiles, we captured no *Echinocoleus* sp.

There are undoubtedly undescribed species which occur in the nests of other *Pogonomyrmex* spp. and more host records to be obtained for the presently known species. Unfortunately, collection of these beetles is difficult because of the aggressive nature and painful stings of the ants.

ACKNOWLEDGMENTS

We thank James Zimmerman and Gregory Forbes for critical reviews of the manuscript and Stewart Peck for identification of the beetles. The beetles were deposited in the collection of Stewart Peck. María Concepción García Medina and Alma Rosa Salas Portillo carefully typed the manuscript. The preparation and publication of the manuscript was supported by the Department of Entomology of the Graduate School, Escuela Superior de Agricultura.

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ACERICECIS GAGNÉ, A NEW GENUS FOR *CECIDOMYIA OCELLARIS* OSTEN SACKEN (DIPTERA: CECIDOMYIIDAE), THE MAPLE LEAF OCELLATE GALL MAKER IN NORTH AMERICA

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Abstract.—A new genus, ***Acericecis*** Gagné, is erected for *Cecidomyia ocellaris* Osten Sacken that makes conspicuous red spot galls on leaves of various maples, particularly *Acer rubrum* L. (Aceraceae) in eastern North America. The new genus is described and illustrations are provided for the identification of *A. ocellaris,* new combination. *Mayetiola virginiana* Felt is a new junior synonym of *A. ocellaris.*

One of the most conspicuous and probably best known cecidomyiid galls in eastern North America is the red, circular, leaf spot gall seen in great numbers in late May and early June on red maple, *Acer rubrum* L. Until now the insect itself, *Cecidomyia ocellaris* (Osten Sacken), was known from the one-line original description (Osten Sacken, 1862) of the larva and a longer, subsequent one of a larva accompanied by illustrations (Comstock, 1882). *Cecidomyia ocellaris* was later moved by Giard (1893) from the omnibus category *Cecidomyia* to *Drisina,* a genus described for a species that causes a similar gall on a maple in Europe, but that placement was ignored by American workers and the species was kept in *Cecidomyia* in the broad sense until relegated to "unplaced Cecidomyiidae" by Foote (1965). In the past several years I have succeeded in rearing several adults, including, finally last year, two males. These show that a new genus is needed for *ocellaris.* It also happens that *Mayetiola virginiana* Felt (1908), known from a female caught by sweeping, is a synonym.

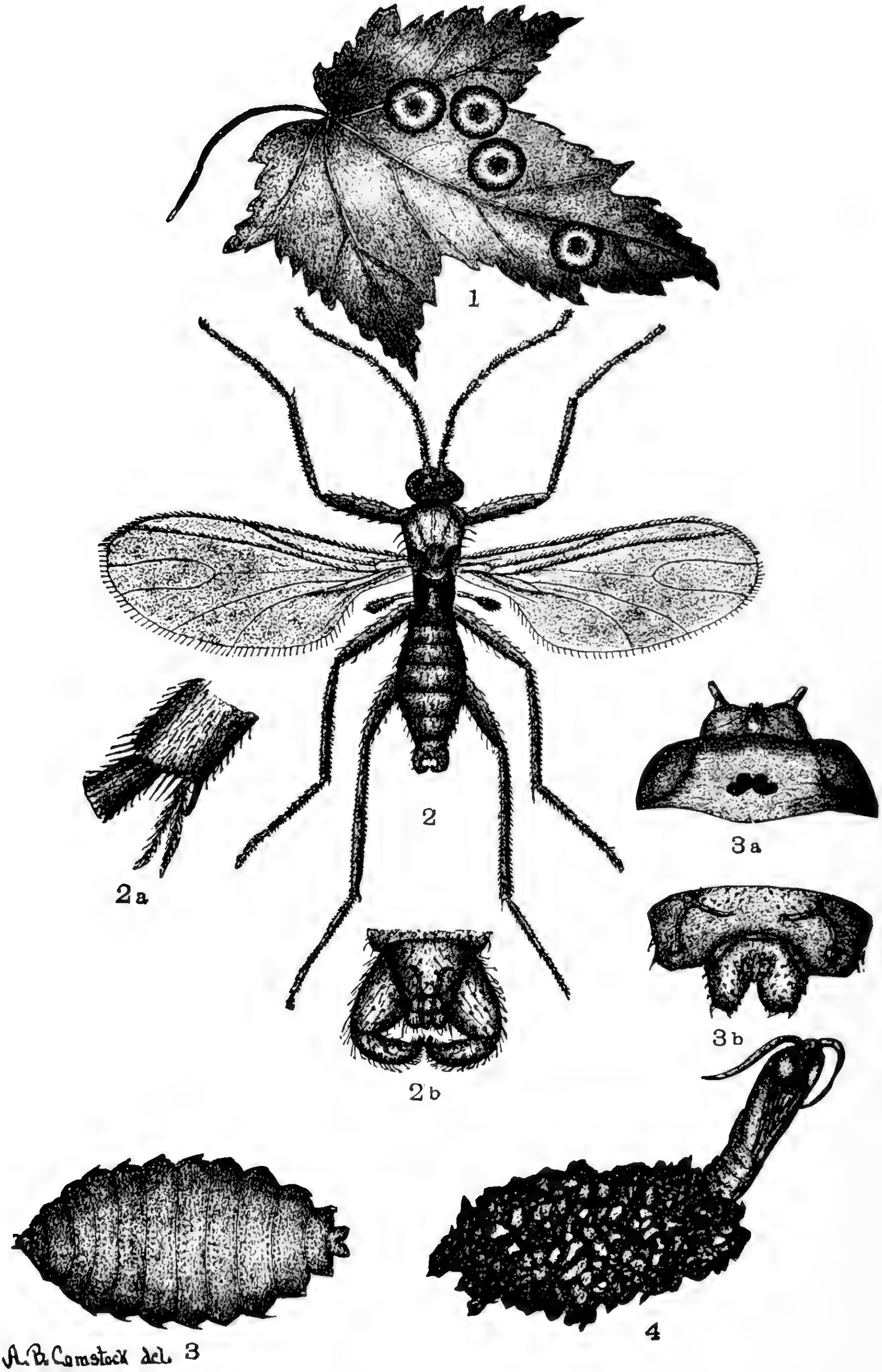
Cecidomyia ocellaris was based on the gall and larva and described by Osten Sacken (1862) in his usual clear way as "Ocelliform, red spots on the leaves of the red maple (*Acer rubrum*). They have about 0.3 in diameter; the margin is bright cherry red, and there is a round patch of the same kind in the centre. The interval between them is pale. They appear brighter on the upper side of the leaf; on the under side in the centre is a small, transparent, colorless larva. I found them in this state at the beginning of June. Later in the season I observed that the spots had lost their fresh color, and that the larva had disappeared; I suppose it drops to the ground to undergo its transformation." In fact the galls are sometimes yellow, sometimes a pale green and inconspicuous except for the tell-tale slightly raised area that is the reverse of the depression on the underside of the leaf. After the full grown larva drops to the ground, the spot turns brown and the leaf is not otherwise affected. Although the galls are quite common in spring, fresh galls are occasionally seen in summer also. The galls are sometimes found in small numbers on other simple-leaved maples. I have seen them on *Acer saccharinum* L. in the Washington, D.C., area and, in August, 1981, I saw them on *Acer saccharum* Marsh, *Acer spicatum* Lam., and *Acer pennsylvanicum* L. in northern Maine. Barnes (1951) summarizes reports of these galls up to the late 1940's that also indicate that the gall is usually on red maple, sometimes on silver maple, and is most commonly seen in spring. Galls have been reported as far west as Missouri and I have seen them in Iowa and Minnesota, so they probably occur throughout the range of red maple.

Comstock (1882) incorrectly associated *C. ocellaris* with the Sciaridae. Adult sciarids, *Bradysia tritici* (Coquillett) (Steffan, 1966), emerged from pots in which Comstock had placed full-grown *C. ocellaris* larvae. That error was shortly afterwards corrected by Mik (1884). But Comstock's report was otherwise noteworthy because of the accompanying plate with good illustrations of a leaf with galls and of larvae of *C. ocellaris.* This plate is reproduced here because it is not generally available and is still adequate for showing these life stages. It has not previously been pointed out that the cocoon and pupal skin shown by Comstock (1882) belong to *B. tritici* also. Sciarids generally incorporate debris and soil particles in their cocoons, but *C. ocellaris* does not.

Development of the larvae is swift. When galls are first noticeable the larvae on the underside of the leaf are first instars and barely visible. Less than one week later the larvae are full grown and ready to drop to the ground. The first and second instar larval skins remain applied to and partially cover the last instar. The larvae bore readily through six inches of potting soil in which I have placed them and within a few days have spun light brown cocoons. Comstock (1882) thought that this species might have several generations yearly, but only because of his misassociation of this species with the sciarid that emerged about a month after the *ocellaris* larvae were collected. I kept *ocellaris* larvae in caged pots for a year and reared adults only the following spring.

Giard (1893) described the European *Drisina glutinosa* that causes a gall on *Acer pseudoplatanus* L. similar to that made by *ocellaris.* He noted the obvious similarities between the galls formed by the two separate species and on that basis transferred *ocellaris* from *Cecidomyia* to *Drisina.* Kieffer (1913) listed *ocellaris* under *Drisina* in his comprehensive catalog, but American authors, most conspicuously Felt (1925), never acted upon that transfer and continued to combine *ocellaris* with *Cecidomyia.* As shown by Möhn (1955), however, the larva of *Drisina glutinosa* is quite different from that of *C. ocellaris.* The two species belong to different supertribes, so the fact that similar galls exist on *Acer* spp. separated by an ocean bears more strongly on the susceptibility of *Acer* to a particular type of gall rather than on any close relationship of the insects causing them.

Cecidomyia ocellaris belongs to the tribe Oligotrophini but is notable in that the female has separate cerci instead of having them fused into a single lamella. That character and the presence of the basic complement of 12 antennal flagellomeres are probably primitive to the tribe and, without evidence to the contrary, can be assumed as primitive rather than separately derived in *ocellaris* also. The loss of the larval spatula and various papillae are presumably adaptive. In the key to nearctic genera of Cecidomyiidae in Gagné (1981), the new genus *Acericecis,* described here for the inclusion of *ocellaris,* will key to couplet 182 where *Ja-*



Figs. 1–4. 1, Leaf galls of *Acericecis ocellaris* on *Acer rubrum.* 2, *Bradysia tritici.* 3, Larva of *A. ocellaris* (dorsal). 3a, Head and prothorax of same. 3b, Posterior segments of same. 4, Cocoon and pupal skin of *B. tritici.* (From Comstock, 1882.)

netiella and *Mayetiola* are separated. A new couplet 181b will separate the new genus from the other two:

181b. Antenna with 12 flagellomeres; male with divided gonocoxal apodeme; female cerci separate .... *Acericecis* Gagné
1 species, *ocellaris* (Osten Sacken)
– Antenna usually with more than 12 flagellomeres; male with undivided gonocoxal apodeme; female cerci fused into single terminal lamella . . . 182

Acericecis Gagné, NEW GENUS

Adult.—Eyes large, broadly joined at vertex, facets closely approximate except laterally. Male flagellomeres 12, necks of most as long as nodes; female flagellomeres 12, nodes cylindrical but narrowed slightly from base to apex where they abruptly narrow to very short neck. Labellae hemispherical, each with 0–3 setae. Palpus 4-segmented, segment 2 widest, 4 longest.

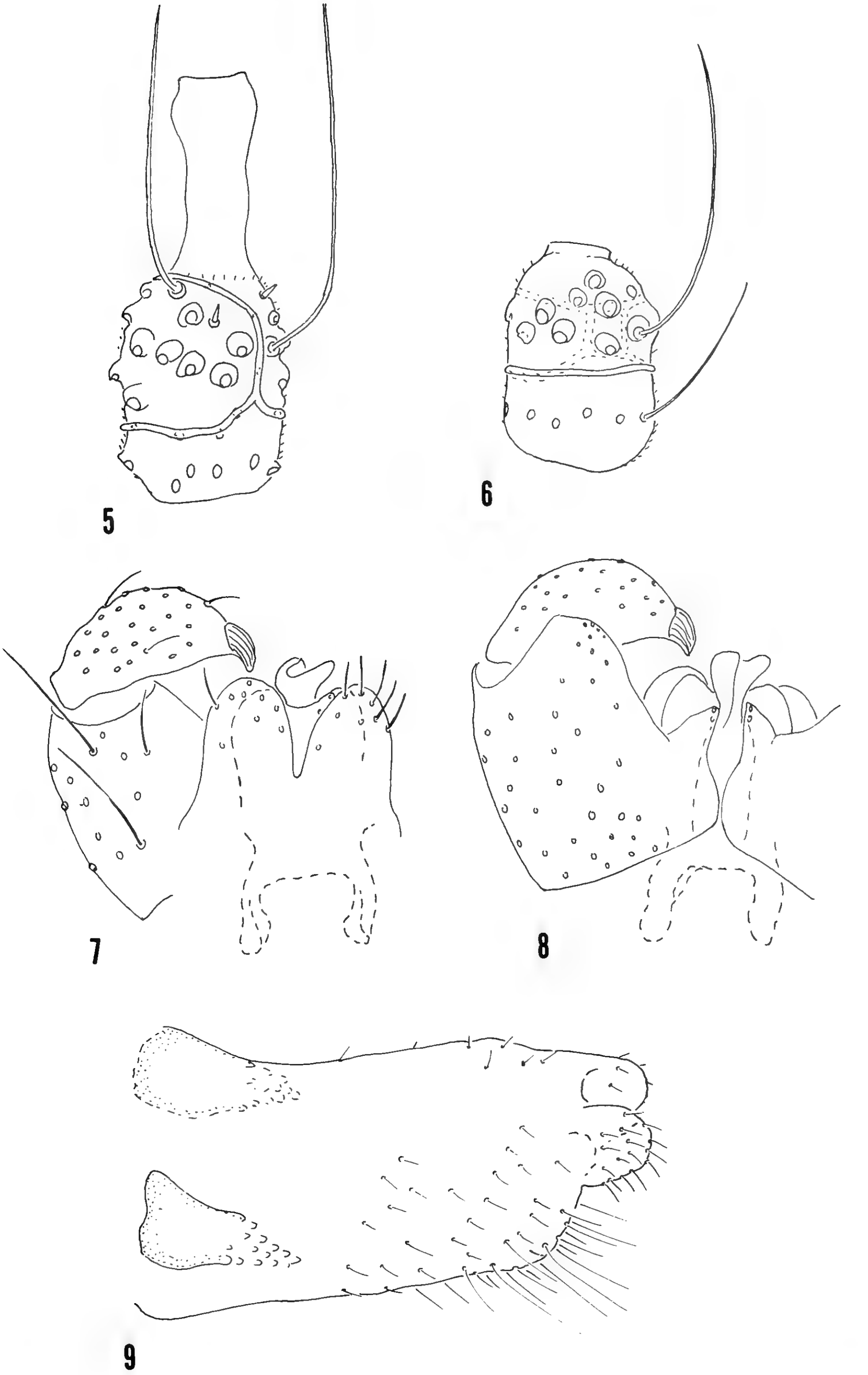
Mesonotum with 4 longitudinal setal rows without scales between. Anepisternum without vestiture, anepimeron with setae, no scales. Wing with R5 curved on distal ½, joining C near wing apex; no break evident in C at juncture with R5. Claws simple, narrow, curved beyond midlength. Empodia about as long as claws. Pulvilli about ½ as long as claws.

Male abdomen: Tergites 1–8 rectangular, with sparse, single, continuous row of long caudal setae, tergites 2–8 with several to many lateral setae occasionally mixed with scales, the 2 groups joining mesally on tergites 6–8, each with 2 basal, widely separated trichoid sensilla, and otherwise bare except for occasional scales. Pleura with scattered scales. Sternites 2–8 rectangular, wider than long, 2–5 with mostly single row of caudal setae, 6–8 with double row, the midlength, horizontal group of setae increasing gradually in number and extent from basal to apical sternites, the sclerites without trichoid sensilla and otherwise bare. Terminalia: cerci and hypoproct of approximately equal length, hypoproct concave distally, each lateral lobe with several distal setae; gonopod short, broad, setose on full length ventrally, on apical ⅔ dorsally, longest and most closely setose on ventromesal corner; gonostylus broadest near midlength, tapering abruptly to apical tooth; claspettes much shorter than aedeagus; aedeagus broadening beyond claspettes; gonocoxal apodeme broad basally, divided cephalad into 2 separate arms.

Female abdomen: Tergites 1–7 as in male; tergite 8 with few, short, scattered, mostly caudal setae, and 2 trichoid sensilla. Pleura and sternites 2–7 as in male; sternite 8 not as strongly demarcated as preceding segments, covered with scattered setae. Ovipositor short, distal ½ with 2 basal, dorsolateral, usually pigmented, pebbled areas, with sparse, short setae distally on dorsal and lateral surfaces, dense setae of mixed length caudoventrally; cerci separate, short-ovoid in lateral view, covered with uniformly short setae laterally; hypoproct short, wider than long, with several short, distal setae.

Pupa.—Antennal sheath simple except for weak ventroapical ridge. Face with papilla with long seta on each side of center and 2 papillae near angle of palpus, one with long seta, the other bare. Pronotal seta very long. Prothoracic spiracle long, slightly curved, pointed, pigmented. Abdomen uniformly covered except intersegmentally with short, pointed setulae.

Larva (third and last instar).—Dorsoventrally flattened, short, broad. Without



Figs. 5–9. *Acericecis ocellaris.* 5, Third male antennal flagellomere. 6, Third female antennal flagellomere. 7, Male terminalia (left half, dorsal). 8, Same (ventral). 9, Distal half ovipositor (dorsolateral).

spatula. Dorsal and pleural papillae with short setae. Papillae on venter not evident. Terminal segment bilobed, each lobe with 4 uniform papillae with setae slightly longer than those of dorsal papillae. Scattered spinules present dorsally and ventrocaudally.

Type-species.—*Acericecis ocellaris* (Osten Sacken).

Acericecis ocellaris **(Osten Sacken), NEW COMBINATION**

Figs. 1, 3, 5–9

Cecidomyia ocellaris Osten Sacken 1862: 199.
Mayetiola virginiana Felt 1908: 369. **NEW SYNONYM.**

Adult.—Male flagellomere 3 as in Fig. 5; female flagellomere 3 as in Fig. 6. Male terminalia as in Figs. 7–8. Distal ½ of ovipositor as in Fig. 9.

Larva.—As for Figs. 3, 3a, 3b.

Types.—*C. ocellaris*: **lectotype** here designated, leaf gall, Washington, D.C. vicinity, in Museum of Comparative Zoology, Cambridge, Mass.; paralectotypes, 18 leaf galls and larvae, same data as lectotype except larvae lost. *M. virginiana*, holotype, ♀, taken on *Prunus virginiana*, V-23-1906, Albany, N.Y., C 80, in Felt Collection at National Museum of Natural History, Washington, D.C.

Other material examined.—2 ♂, 14 ♀, reared one year after larvae were collected in 1969, 1971, 1977, 1979, 1981, Silver Spring, Md., R. J. Gagné; pupal skin associated with a reared male, 1982; pupae from pots, Silver Spring, Md., 1981; larvae from Silver Spring, Md., 1966, 1976, 1980, 1981, 1982, Spring Brook, Pa., 1945, and Va., 1918, 1919, 1920.

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A NEW SPECIES OF *TRICHOGRAMMA* (HYMENOPTERA: TRICHOGRAMMATIDAE), WITH NOTES ON OTHER SPECIES COLLECTED IN GUATEMALA

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Abstract.—*Trichogramma* **atopovirilia**, a new species from Guatemala, is described and compared with other species of *Trichogramma*. Presently, it is known only from *Vanessa* sp. (Lepidoptera: Nymphalidae) eggs collected from *Malva* near Solola, Solola State, Guatemala, and from sweeping vegetation southwest of Ocozocoautla, Chiapas State, Mexico. Notes on *T. pretiosum* and *T. exiguum*, also collected in Guatemala, are given.

While on foreign exploration in Guatemala in 1977 to collect parasites of gelechiid pests on solanaceous crops, lepidopterous eggs also were collected from various host plants by the senior author and held for emergence of *Trichogramma* and other egg parasites. A new species of *Trichogramma* thus obtained is described herein, with notes on other species present in the collections. The description is based on freshly killed specimens mounted in Hoyers solution on glass slides. The cover slips were ringed with Glyptal® to help preserve the specimens.

***Trichogramma atopovirilia* Oatman and Platner, New Species**

Fig. 1

Female dark brown; head and abdomen darker than rest of body; antenna infuscate; coxa and femur of hindleg and coxa of foreleg dark brown; legs yellow except trochanter of hindleg, coxa of midleg, and last tarsal segment of all legs infuscate. Male thorax and abdomen dark brown; head and antenna yellowish brown; legs light yellow except coxa and femur of hindleg dark brown and last tarsal segment of all legs infuscate.

Holotype male.—Antenna with flagellum 0.14 as wide as long (0.032 × 0.230 mm) and 1.14 as long as hindtibia (0.202 mm); flagellar setae 46 in number, longest seta (0.108 mm) 3.36 as long as maximum width of flagellum (0.032 mm). Forewing with 30 setae between 4th and 5th vein tracts; longest seta (0.053 mm) on postapical margin 1.77 as long as maximum width of hindtibia (0.030 mm). Mesoscutellum with anterior pair of setae short and fine, ca. 1/5 length of posterior pair. Genital capsule 0.55 as wide as long (0.076 × 0.138 mm); DEG (0.115 mm long), CS (0.131 mm long), and MVP (0.108 mm long) attaining 0.83, 0.95, and 0.78 the length of genital capsule, respectively. Aedeagus (0.136 mm long) 0.67 length of hindtibia and 0.98 length of genital capsule.

Male.—Antenna (Fig. 1c) with flagellum slightly curved, 0.15 ± 0.004 (0.14–

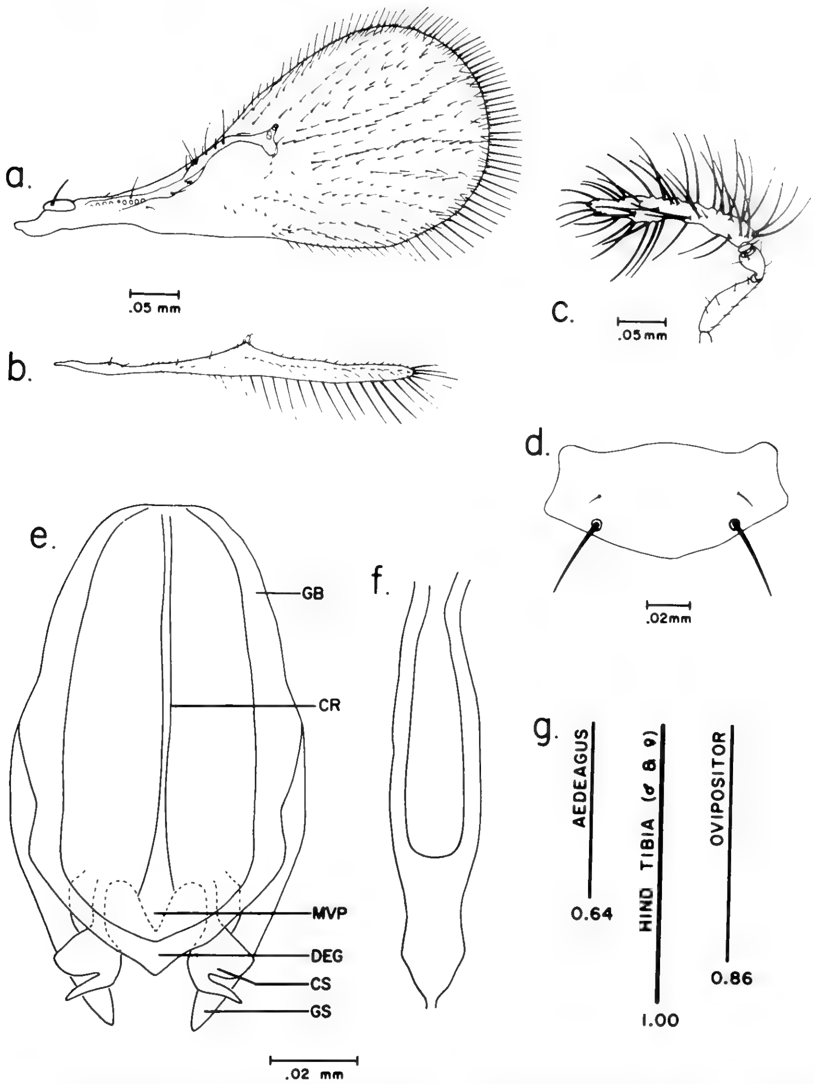

Fig. 1. *Trichogramma atopovirilia.* a, Forewing. b, Hindwing. c, Male antenna. d, Mesoscutellum. e, Genital capsule. f, Aedeagus. g, Ratio of aedeagus and ovipositor to hindtibia of male and female, respectively. See text for explanation of abbreviations.

0.16) ($n = 5$) as wide as long, and 1.15 ± 0.01 (1.14–1.18) ($n = 5$) as long as hindtibia; flagellar setae long, gradually tapering from base to fine point, 46.0 ± 0.71 (44–48) ($n = 5$) in number, length of longest seta 3.09 ± 0.09 (2.85–3.36) ($n = 5$) as long as maximum width of flagellum.

Forewing (Fig. 1a) with vein tracts relatively well defined, area between 4th and 5th tracts (i.e., the 2 tracts posterior to RS_2) with a mean of 21.4 (18–30) ($n = 5$) setae; longest seta on postapical margin 1.72 ± 0.03 (1.67–1.82) ($n = 5$) as long as maximum width of hindtibia.

Hindwing (Fig. 1b) with middle vein tract prominent and complete to apex; anterior tract absent; posterior tract equally as prominent as middle tract, extending almost to apex; setae on middle and posterior tracts equally as long.

Mesoscutellum (Fig. 1d) with anterior pair of setae short, fine, ca. 1/5 length of posterior pair.

Genital capsule (Fig. 1e) 0.57 ± 0.01 (0.55–0.58) ($n = 5$) as wide as long; dorsal expansion of gonobase (DEG) broad, abruptly rounded posteriorly, with blunt subtriangular tip apically, sides slightly concave without basal constriction, moderately to lightly sclerotized; DEG well below chelate structure (CS) and extending 0.88 ± 0.01 (0.83–0.90) ($n = 5$) length of genital capsule; CS extending 0.95 ± 0.004 (0.94–0.96) ($n = 5$) length of genital capsule; median ventral projection (MVP) broad, bluntly pointed, distinctly anterior to CS and DEG, extending 0.80 ± 0.003 (0.78–0.80) ($n = 5$) length of genital capsule. Chitinized ridge (CR) extending almost the length of genital capsule. Aedeagus (Fig. 1f) constricted near apex, 0.93 ± 0.03 (0.82–0.98) ($n = 5$) length of genital capsule and 0.64 ± 0.02 (0.57–0.68) ($n = 5$) length of hindtibia; apodemes comprising ca. ⅔ length of aedeagus.

Female.—Ovipositor (0.173 mm) 0.86 ($n = 1$) length of hindtibia (0.200 mm) (Fig. 1g).

Type information.—Holotype ♂ reared from a *Vanessa* sp. egg (Lepidoptera: Nymphalidae) collected from *Malva* sp. near Solola, Solola State, Guatemala, on Feb. 16, 1977, by Earl R. Oatman. Allotype ♀, same data as holotype. The holotype and allotype are deposited in the collection of the National Museum of Natural History, Washington, D.C.

Material examined.—GUATEMALA: Solola (type-locality, see above), 5 ♂, 1 ♀; MEXICO: Chiapas State, ca. 30 km southwest of Ocozocoautla, 1 ♂, collected by sweeping on June 30, 1981, by Mr. John LaSalle.

Remarks.—This species is readily separated from other known species of *Trichogramma* by the unique "stalked" CS, blackish coloration of both the CS and MVP (margin connecting the two structures), the posteriorly-broad, rounded DEG, and the shape of the aedeagus. *Trichogramma bennetti* Nagaraja and Nagarkatti, a West Indian species, is closest in respect to the CS and DEG (Nagaraja and Nagarkatti, 1973). However, *T. bennetti* differs from *T. atopovirilia* by having the CS less apically expanded and a bulbous DEG which extends well beyond the MVP and reaches level of CS. In *T. atopovirilia* the apical width of DEG is subequal to the width of the genital capsule, whereas the apical width of the DEG is considerably less in *T. bennetti.* The aedeagus of *T. atopovirilia* is most comparable to *T. julianoi* except that the apodemes account for only ca. ⅔ the length of the aedeagus compared to 4/5 its length in *T. julianoi* (Platner and Oatman, 1981).

The specific name refers to the highly distinctive male genitalia of this species.

Other species of *Trichogramma* present in the collections include *T. pretiosum* Riley and *T. exiguum* Pinto and Platner. *Trichogramma pretiosum* was reared from unknown noctuid eggs collected from tomato plants near San Lucas Toliman, Solola State, on Feb. 15; from *Vanessa* sp. eggs from *Malva* sp. and unknown noctuid eggs from potato near Solola, Solola State, on Feb. 16; from unknown noctuid eggs collected from tomato near Sumpango, Sacatepéquez State, on Feb. 18; and from *Heliothis* sp. eggs from field corn near El Progresso, El Progresso

State, on Feb. 19. *Trichogramma exiguum* was reared from unknown noctuid eggs collected from tomato near Sumpango, Sacatepéquez State, on Feb. 18. These represent new locality records for both species which previously have been reported from other Central and South American countries (Pinto et al., 1978; Pinto et al., 1983) as well as from the southern United States and Mexico. As in the Guatemala collections, *T. pretiosum* is by far the most common of these two species.

ACKNOWLEDGMENTS

The authors are grateful to Nancy A. Browning and Patricia L. Mote for preparing the illustrations.

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PROC. ENTOMOL. SOC. WASH.
85(4), 1983, pp. 714–716

A NEW CENTRAL AMERICAN SPECIES OF *DERANCISTRUS* (COLEOPTERA: CERAMBYCIDAE)

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Abstract.—A new prionine cerambycid, *Derancistrus* ***fellerae***, is described from Twin Cays, Belize.

Members of the prionine genus *Derancistrus* Audinet-Serville are widely distributed throughout the West Indies with only four species presently known from Mexico and Central America.

Two specimens of an undescribed species from Twin Cays, Belize, were recently received through T. J. Spilman, Systematic Entomology Laboratory, USDA. According to Spilman (personal communication), Twin Cays (16°50′N, 18°06′W), locally called Water Range, is a swampy mangrove island within the Belize Barrier Reef. It is approximately 1 km in diameter and is 22 km SE of Dangriga (Stan Creek), Belize. Although 20 vascular plant species have been recorded from the island (Stoddert et al., 1982), red mangrove, *Rhizophora mangle* L., and black mangrove, *Avicennia germinans* (L.), were the only woody plants in the area where the beetles were found.

This is a contribution of the Smithsonian Western Atlantic Mangrove Program (SWAMP) in Belize, supported by the Smithsonian Institution and the Exxon Corporation.

Derancistrus fellerae **Chemsak, NEW SPECIES**

Fig. 1

Female.—Form moderate sized, tapering posteriorly: integument black, elytra black basally, dark reddish toward apex, femora reddish, narrowly black at bases and apices, tibiae reddish toward apical ½. Head narrow, front short, deeply impressed longitudinally, impression extending onto vertex; punctures coarse, confluent, becoming finer toward neck; pubescence in median impression whitish, dense, appressed, erect setae sparse; antennae extending to about basal ⅓ of elytra, segments broad, flattened, basal segments sparsely punctate, segments from 7th striolate, 3rd segment shorter than 1st, 4th shorter than 3rd. Pronotum broader than long, sides gradually expanding back from apex to behind middle then narrowing to base, margins crenulate with angles dentate; disk with a v-shaped impression at middle on apical margin, base and sides with rather broad impressions, lateral and basal impressions densely clothed with white, recumbent pubescence; punctures on nonpubescent areas irregular, moderately dense; prosternum densely clothed with whitish appressed pubescence, intercoxal process broad, U-shaped at apex; mesosternum with epimeron densely white pubescent; meta-

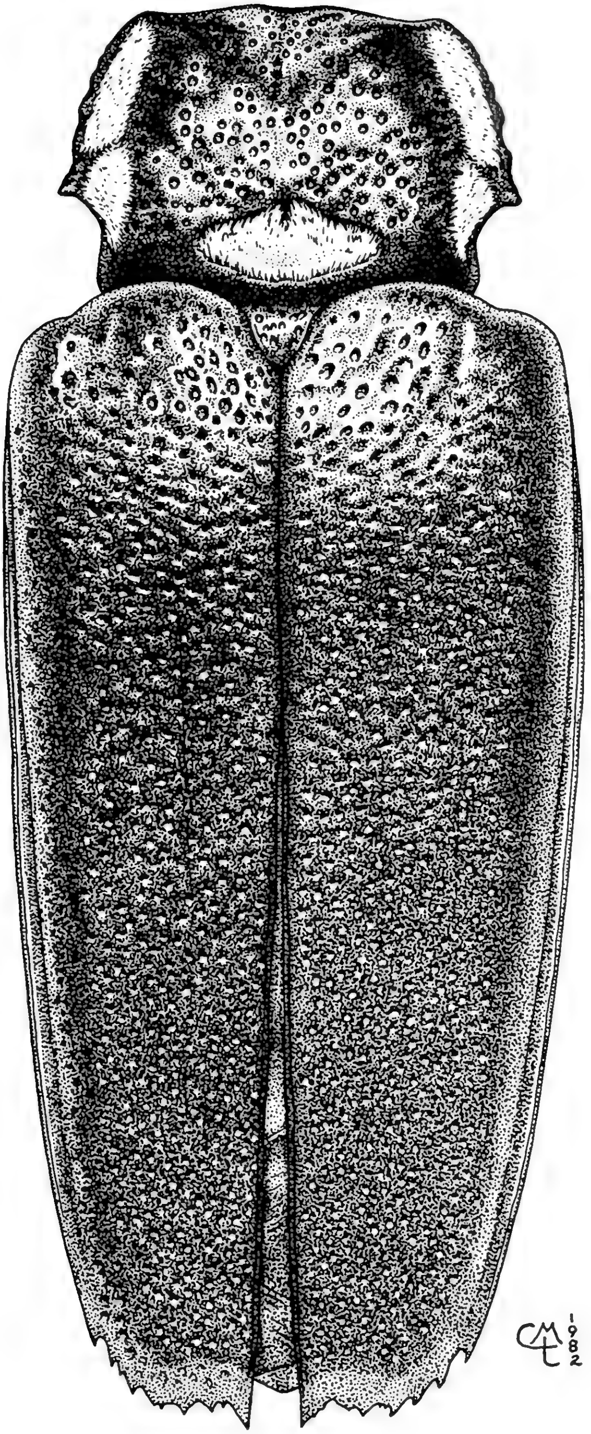

Fig. 1. Dorsal aspect of pronotum and elytra of *Derancistrus fellerae*, female.

sternum finely punctate, punctures very sparse at middle, episternum densely white pubescent. Scutellum cordate, nonpubescent, about as broad as long. Elytra about 2× as long as broad, tapering toward apex; base moderately, broadly lobed on each side; punctures at base coarse, confluent, becoming finer and subconfluent toward apex; pubescence absent; apices serrated, sutural angles dentate. Legs rather slender, femora mostly reddish, tibiae reddish at apices; punctures very sparse, pubescence very sparse, short. Abdomen sparsely punctate, sides of sternites with patches of appressed pubescence; last sternite notched at apex. Length, 23–25 mm.

Holotype.—♀ (National Museum of Natural History, No. 100609) and 1 ♀ paratype from Twin Cays, Belize, 26 May 1982 (Candy Feller).

Remarks.—This species is distinctive by the white pubescent patches of the pronotum. The punctation of the pronotum and elytra and the heart-shaped scutellum will also separate *fellerae* from the other West Indian species in this group. The shape of the pronotum and scutellum will distinguish it from the other species known to occur in Mexico and Central America.

I am pleased to dedicate this species to the collector, Candy Feller, who was illustrator for SWAMP and editorial assistant for the Catalog of the Coleoptera of America north of Mexico.

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PROC. ENTOMOL. SOC. WASH.
85(4), 1983, pp. 717–726

A REVISION OF THE GENUS *DAGUS* CRESSON (DIPTERA: EPHYDRIDAE)

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Abstract.—*Dagus* Cresson, a genus of tropical, New World flies, is revised, to include two new species, *D.* ***wirthi*** (Jamaica) and *D.* ***trichocerus*** (Cuba). Previously, the genus was monotypic, with *D. rostratus* (Cresson) as its only included species.

Since reviewing the tribe Dagini (Mathis, 1982), I have discovered new data concerning the genus *Dagus* Cresson, and this paper presents these data as a revision of that genus. Although *Dagus* was recently reviewed, in the previously cited paper, the finding of two new species warrants revision of that genus. Until the present study, *Dagus* was a monotypic genus, with *D. rostratus* (Cresson) as its only included species. Two additional species, both from the Greater Antilles (Cuba and Jamaica), bring the number of species in the genus to three and alter the concept of *Dagus* slightly, which is recharacterized herein.

The descriptive terminology follows that published in the recent *Manual of Nearctic Diptera, Vol. 1* (McAlpine, 1981) with one exception. I have followed Sabroksy (*in press*) in using "microtomentum" rather than pruinescence or pollinosity for the dustlike vestiture over much of the cuticular surface. The dustlike appearance is the result of cuticular microtrichia at various densities, not a waxy substance, as on a plum (pruinescence), or dust (pollinosity). Two head ratios and two venational ratios are used in the species' descriptions and are defined here. Eye-to-cheek ratio: genal height (immediately below the eye)/eye height; eye width-to-face length ratio: face length (in profile from anterior margin of eye to anterior margin of face)/eye width (greatest length along plane of eye); costal vein ratio: the straight line distance between R_{2+3} and R_{4+5}/distance between R_1 and R_{2+3}; M vein ratio: the straight line distance along M basad of crossvein dm-cu/distance apicad of crossvein dm-cu. For convenience and continuity, the descriptive format essentially follows Mathis (1982), and that paper should be consulted for perspective to this study and as the basis for this report.

Genus *Dagus* Cresson

Dagus Cresson, 1935: 345 [type-species: *Ephydra rostrata* Cresson, by original designation and monotypy]; Wirth, 1968: 24 [catalog]; Mathis, 1982: 20 [review].

Diagnosis.—Specimens of *Dagus* resemble those of *Psilephydra* Hendel, *Physemops* Cresson, and *Diedrops* Mathis and Wirth but may be distinguished by the following characters:

Head: Ocellar bristles present, well developed; lateroclinate fronto-orbital bristles 3, anterior bristle smaller, about ½ to ⅔ length of posterior bristles; arista variable; 1st flagellomere nearly twice length of 2nd antennal segment, and greater than combined length of first 2 segments; face with ventral portion, ½ to ⅔, protrudent, uniformly arched vertically, pointedly arched transversely, dorsum of protrusion bare to very thinly microtomentose, shiny, with metallic reflections, becoming more densely to completely microtomentose ventrally and laterally, subshiny to dull; facial setae sparse but with prominent series along oral margin and from facial carina to posteroventral angle of face, larger bristles of latter series porrect and anaclinate; genal bristle present, although small, generally inconspicuous.

Thorax: Prescutellar acrostichal setae variable; anterior scutellar setae small, less than ½ length of posterior bristles; dorsocentral bristles stronger postsuturally, usually with 1–2 larger seta at suture or presuturally; posterior notopleural bristle inserted at level above that of anterior bristle; propleuron bare of setulae; katepisternal bristle weakly developed, especially as compared to anepisternal bristle; apex of vein R_{2+3} well separated from vein R_{4+5}, distance between these two about equal to that between veins R_{4+5} and M; costal vein ratio about 0.15; M vein ratio about 0.65; pulvilli lacking or greatly reduced; tarsal claws comparatively long, straight, oriented anteriorly, frequently held together throughout length.

Abdomen: Male terminalia: epandrium, in posterior view, abbreviated dorsally, not forming cercal cavity around cerci, ventral portion with a median cleft; cerci placed at dorsal margin of epandrium; aedeagal apodeme about 2× as long as wide, roughly oval; aedeagus long and slender, length subequal to that of epandrium.

Distribution.—New World tropics between 30° north latitude and 10° south latitude.

Discussion.—Within the tribe Dagini, *Dagus* is postulated to be the sister group of *Physemops,* based entirely on the elevated insertion of the posterior notopleural bristle in both genera (Mathis, 1982). Elsewhere in the family, an elevated insertion for the posterior notopleural bristle occurs, and by itself, this character is not the strongest of evidence to indicate the monophyly for the two lineages. Both genera do have this character, however, and within the tribe the character does appear to be unique. Until other characters are discovered and analyzed, this character can serve as a point from which to base our current hypothesis.

The monophyly of *Dagus,* on the other hand, is quite adequately established, as I demonstrated earlier (1982). The essential characters are as follows:

1. Postpronotal callus bearing one or two setulae. In most genera of Ephydrinae, the postpronotal callus is either bare or has conspicuous bristles. The presence of one to two setulae is an autapomorphy for *Dagus.*

2. Pulvilli lacking. *Dagus* is the only genus within the tribe and one of the few among shore flies generally, which lack pulvilli, and I interpret this condition to be autapomorphic.

3. Ventral protrusion of lower one-half of face. In most species of Dagini the face is shieldlike, shallowly protrudent. Only in species of *Dagus* is the face distinctly protrudent, evenly arched horizontally and somewhat pointedly arched transversely.

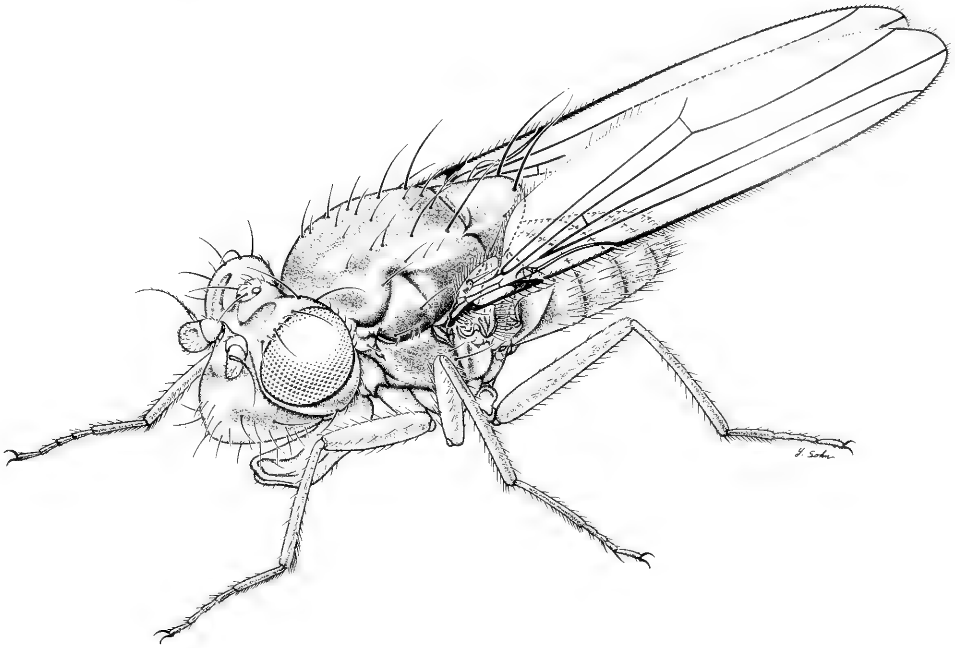
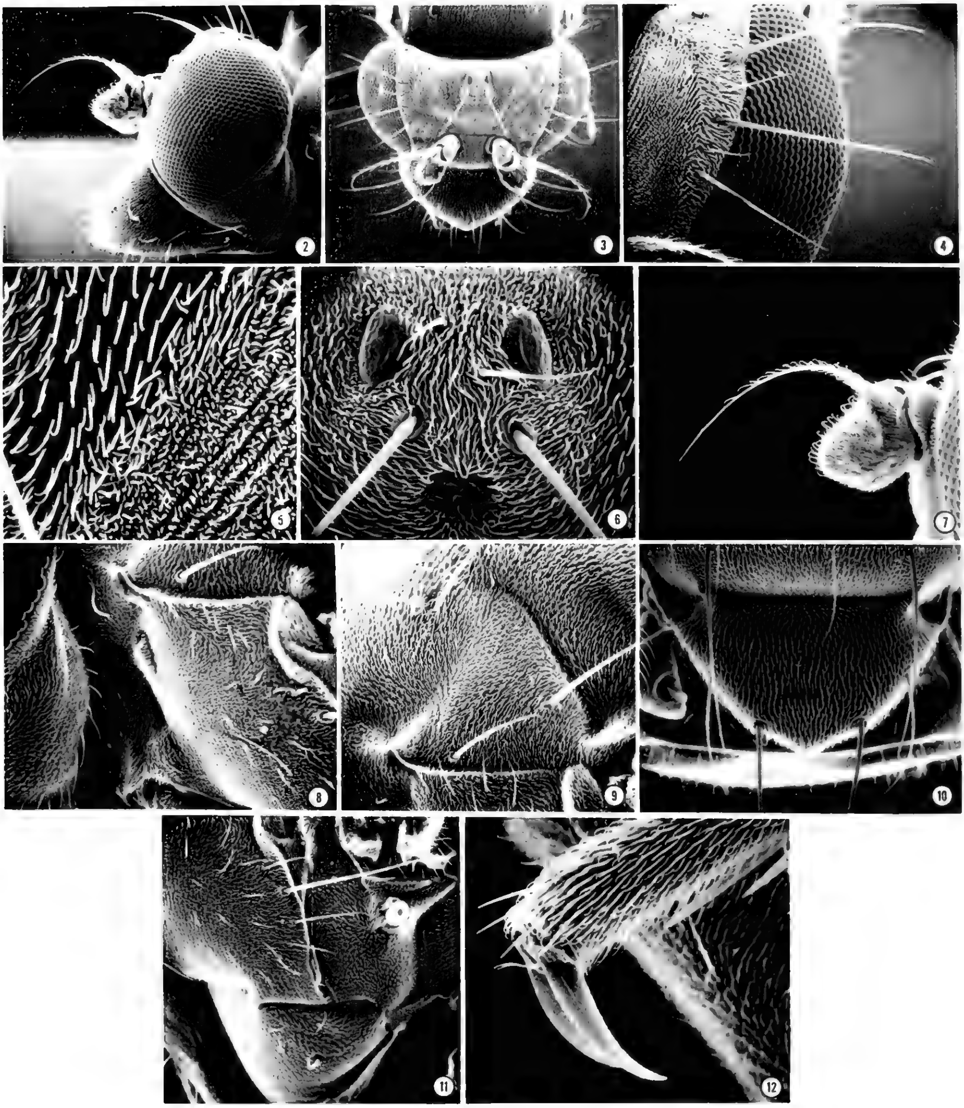


Fig. 1. Habitus of *Dagus rostratus.*

The tribal assignment for *Dagus* has vacillated, although it has always been within the subfamily Ephydrinae. Cresson (1935), followed by Wirth (1968), placed the genus in Ephydrini. In 1979, I listed *Dagus* plus *Diedrops, Physemops,* and *Psilephydra* as a questionable and separate lineage within Ephydrinae, outside of the tribe Ephydrini and within the paraphyletic tribe Scatellini. Subsequently (Mathis, 1982), I formally recognized *Dagus* and the other genera mentioned above as a separate tribe, Dagini. The relationship of Dagini within Ephydrinae, however, is presently unresolved, and indeed, the basis for Dagini, as a distinct, monophyletic lineage, is not founded on character evidence that is totally convincing.

KEY TO SPECIES OF *DAGUS*

1. Larger species, length greater than 2.25 mm; dorsocentral bristles 5 pairs; arista appearing essentially bare, hairs inconspicuous (Jamaica) .... *D. wirthi,* new species
– Smaller species, length generally less than 2.25 mm; dorsocentral bristles 3–4 pairs; arista with hairs evident 2
2. Arista long, 3–4× length of 1st flagellomere, conspicuously haired, with hairs considerably longer than aristal width at base (Cuba) .... *D. trichocerus,* new species
– Arista short, at most slightly more than 2× length of 1st flagellomere, inconspicuously haired, length of hairs no greater than aristal width at base .... *D. rostratus* (Cresson)



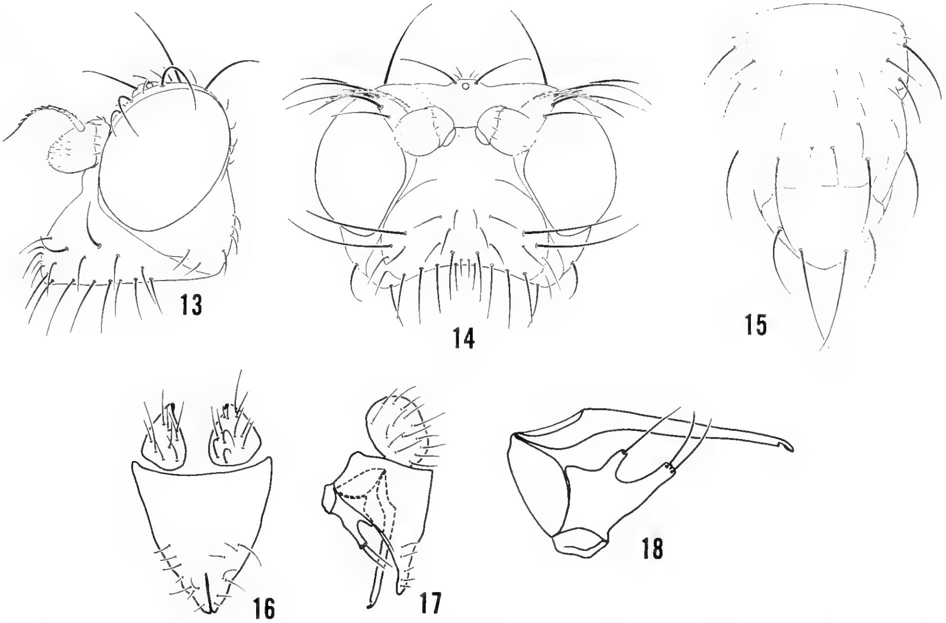
Figs. 2–12. *Dagus rostratus.* 2, Head, lateral view. 3, Head, dorsal view. 4, Frons, dorsal view of left side. 5, Microtomentum of mesofrons (sparse) and parafrons (dense), dorsal view. 6, Ocelli and bristles, dorsal view. 7, Antenna, lateral view. 8, Proepisternum and anepisternum, lateral view. 9, Notopleuron and bristles, lateral view. 10, Scutellum, dorsal view. 11, Anepisternum, katepisternum, and bristles, lateral view. 12, Midleg, apex of fifth tarsomere and claws.

***Dagus rostratus* (Cresson)**
Figs. 1–18

Ephydra pygmaea Williston, 1896: 402 [preoccupied, Haliday, 1833: 174].

Ephydra rostrata Cresson, 1918: 66 [new name for *E. pygmaea* Williston; fig. of head].

Dagus rostrata: Cresson, 1935: 346 [designated as type-species of *Dagus*]; Wirth, 1968: 24 [in part, catalog].



Figs. 13–18. *Dagus rostratus.* 13, Head, lateral view. 14, Head, anterior view. 15, Thorax, dorsal view. 16, Epandrium and cerci, posterior view. 17, Epandrium, cerci, and internal male genitalia, lateral view. 18, Internal male genitalia, lateral view.

Dagus rostratus: Mathis, 1982: 21 [in part, review, figs. of head and male terminalia].

Diagnosis.—Small to moderately small shore flies, length 1.60 to 2.00 mm.

Head (Figs. 2–7, 13–14): Frons with mesofrons thinly microtomentose, subshiny to shiny, remainder of frons densely microtomentose, appearing velvety, brownish black to black. Facial protrusion in lateral (Fig. 2) view with anterodorsal surface more acutely angulate with oral margin; dorsal ½ of facial protrusion mostly bare, shiny, bronzish brown to dark blue, otherwise microtomentose, mostly brown, contrasting with mostly grayish gena. Aristal length (Fig. 7) slightly more than 2× length of 1st flagellomere; arista short, generally inconspicuous, less than width at base. Gena moderately short, eye-to-cheek ratio 0.33; eye width-to-face length ratio 0.56.

Thorax (Figs. 8–12, 15): Thoracic chaetotaxy evident but not strongly developed. Dorsocentral bristles at most 3–4, including laterally displaced posterior bristle; postsutural intra-alar setae generally not well developed, occasional specimen with 1–2 setae; posterior notopleural bristle usually conspicuously displaced anteriorly from notopleural suture as compared with anterior bristle, although with some variation, occasional specimen with posterior bristle insertion only slightly above level of anterior bristle (Fig. 9); basilateral scutellar bristles at most about ½ length of apical bristles (Fig. 10). Hindcoxal strap bare. Costal vein ratio 0.17; M vein ratio 0.63.

Abdomen: Male terminalia (Figs. 16–18): epandrium, in posterior view, triangular, apex narrowly rounded, with short, median cleft; lateral view of epandrium with basal ⅓ wide, thereafter ventrally narrowed rapidly to form rather pointed apex; gonite short with 2 posterior projections, each bearing 1 or more setae; aedeagal apodeme about 2× as long as wide, roughly oval.

Type-locality.—WEST INDIES. Saint Vincent: Perseverance Valley.

Type material.—Lectotype ♂, designated by Mathis (1982), is labeled "Co-type [disk with yellow border]" "Windward side St. Vincent, W[est]. I[ndies]. H. H. Smith." "W. Indies 1907–66." "1000 feet." "Ephydra pygmaea Will [handwritten; two submarginal red borders]" "LECTOTYPE ♂ Ephydra pygmaea Williston by W. N. Mathis [handwritten; red]." The lectotype is double mounted (minute nadel in cardboard base), is in good condition (the apical segment of the right antenna is missing), and is in the British Museum (Natural History).

Other specimens examined.—GUATEMALA. Escuintla, 10 Aug 1965, P. J. Spangler (1 ♀; USNM). MEXICO. Oaxaca: Valle Nacional, 20 Dec 1962 (1 ♀; USNM). Veracruz: Orizaba, 12–22 Aug 1961, R. and K. Dreisbach (1 ♀; USNM). VENEZUELA. Rancho Grande, Aragua, 20 Nov 1973, B. Villegas (1 ♀; USNM). WEST INDIES. Dominica: Antrim, 1000 ft., 10 Mar 1956, J. F. G. Clarke (1 ♀; USNM); Clarke Hall, Cocoa Trail, 16 Jan 1965, W. W. Wirth (14 ♂, 5 ♀; USNM); Clarke Hall, 8 Jan–8 Aug 1964–66, H. Robinson, T. J. Spilman, G. Steyskal, W. W. Wirth (2 ♂, 9 ♀; USNM); Fond Figues River, 20 Jan–16 Mar 1964–65, D. Bray, W. W. Wirth (8 ♀, 1 ♂; USNM); Freshwater Lake, 23 Feb 1964, H. Robinson (1 ♀; USNM); Paqua River, Deux Branches, 3 Feb 1964, H. Robinson (1 ♂; USNM); Rosalie River, 14 Feb 1964, H. Robinson (1 ♀; USNM); South Chitern, 7 Feb 1964, H. Robinson (2 ♀; USNM). Jamaica: Hardwar Gap, stream margin, 10 Mar 1970, W. W. Wirth, T. Farr (2 ♂; USNM); Hermitage Reservoir, Jul 1958, W. B. Heed, M. Wasserman (1 ♂, 1 ♀; USNM); St. Andrew, Newcastle Road, 17 mile post, 3 May–27 Jun 1954, T. H. Farr (3 ♀; USNM).

Distribution.—West Indies (Dominica, Jamaica, Saint Vincent); Mexico south through Guatemala and Costa Rica (Cartago; Cresson, 1918: 66) to Venezuela (Rancho Grande) and Brazil (without specific locality; Cresson, 1935: 346).

Remarks.—This species is most similar to *D. trichocerus* but is distinguished from it by the shorter arista, which is inconspicuously haired, and by the mostly brown, microtomentose vestiture of the face. The male terminalia are also distinct, as described and figured.

Both Williston (1896) and Cresson (1918) initially placed this species in the genus *Ephydra* Fallén, as it has three lateroclinate, fronto-orbital bristles, lacks pulvilli, and the tarsal claws are relatively straight and long. The similarity of these characters with those of *Ephydra,* however, is due to convergence, as was later observed by Cresson (1935), who then proposed the genus *Dagus* to accommodate this species.

The specimens from Mexico and Guatemala are all females, and I have not been able to confirm their identity with certainty. For the present I am considering them to be conspecific with *D. rostratus.*

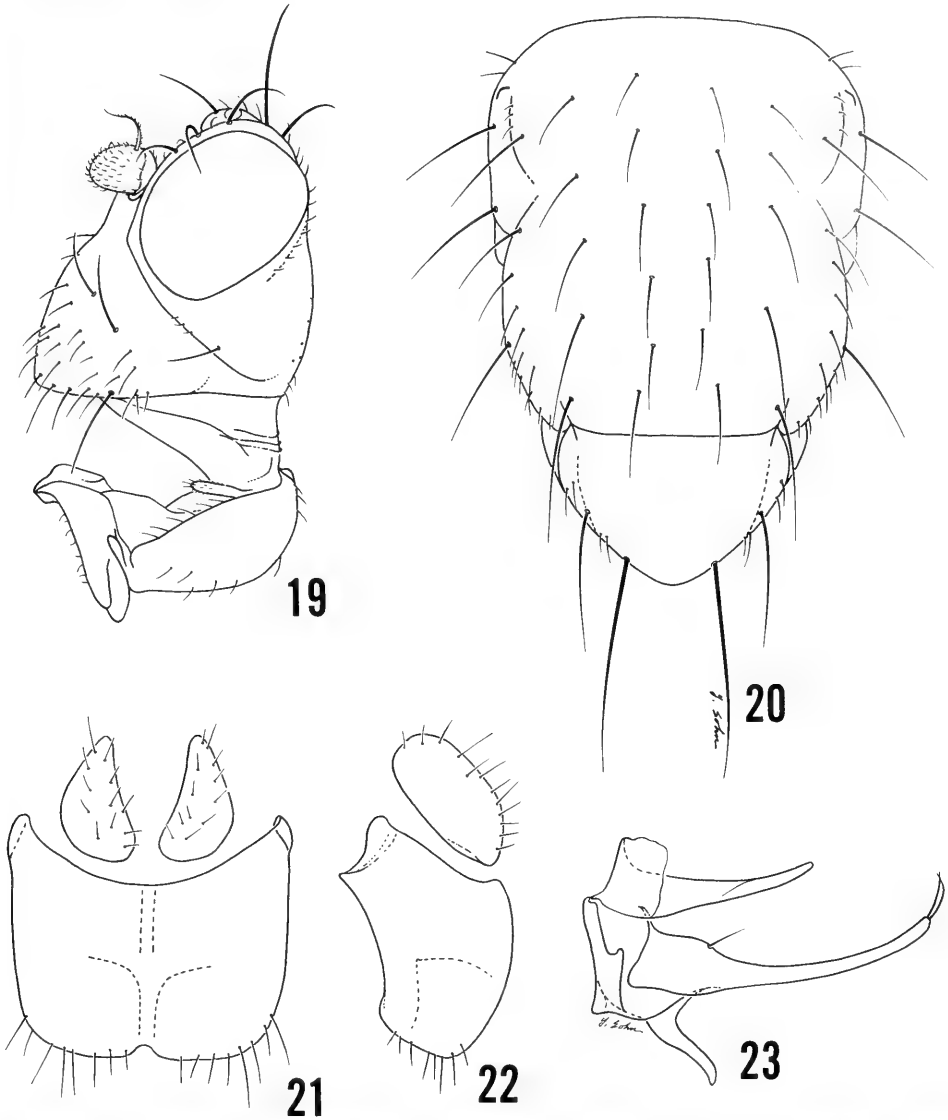
***Dagus wirthi* Mathis, New Species**

Figs. 19–23

Dagus rostratus of authors, not Cresson: Wirth, 1968: 24 [misidentification in part, neotropical catalog]; Mathis, 1982: 21 [misidentification in part, review].

Diagnosis.—Moderately small shore flies, length 2.31 to 2.53 mm.

Head (Fig. 19): Frons entirely densely microtomentose, appearing velvety,



Figs. 19–23. *Dagus wirthi.* 19, Head, lateral view. 20, Thorax, dorsal view. 21, Epandrium and cerci, posterior view. 22, Epandrium and cerci, lateral view. 23, Internal male genitalia, lateral view.

brownish black to black. Facial protrusion in lateral view with anterodorsal surface less acutely angulate with oral margin; dorsal ½ of facial protrusion with bare, shiny area just below antennae, dark blackish blue, otherwise microtomentose, brown, contrasting with mostly grayish gena. Aristal length less than 2× length of 1st flagellomere, aristal hairs short, generally inconspicuous. Gena high, eye-to-cheek ratio 0.60; eye width-to-face length ratio 0.65.

Thorax (Fig. 20): Thoracic chaetotaxy evident and strongly developed. Dorsocentral bristles 5, including laterally displaced posterior bristle; postsutural intra-alar setae generally well developed, usually with 4 setae; posterior notopleural bristle only slightly displaced anteriorly from notopleural suture as compared with anterior bristle; basilateral scutellar bristles large, about ⅔ to ¾ length of apical bristles; hindcoxal strap with 1-2 setulae. Costal vein ratio 0.14; M vein ratio 0.70.

Abdomen: Male terminalia (Figs. 21–23): epandrium, in posterior view, broadly rectangular; lateral view of epandrium with anterior margin shallowly and broadly V-shaped, vertex at basal ⅓, broadly rounded apically; gonite longer than aedeagus, tapered basally thereafter slender, mostly parallel-sided, bearing an apical, stout seta but no posterior projections; aedeagal apodeme about 2× as long as wide, roughly oval.

Type-locality.—JAMAICA. Port Parish.

Type material.—Holotype ♂ is labeled "JAMAICA:Port.Parish (near Hardwar Gap) 6 December 1975 Gary F. Hevel" "HOLOTYPE ♂ Dagus wirthi W. N. Mathis USNM 100715 [name and number handwritten; red]." The ♂ paratype (abdomen removed for dissection, in an attached microvial) is labeled "Jamaica, W[est]. I[ndies]. St. Andrew Newcastle Road 3 May 1954 T. H. Farr (over)" "17 mile post [on reverse side of first label; handwritten]." The ♀ paratype bears the same label data as the ♂ paratype except the date, which is "27 June 1954." The holotype is double mounted (minute nadel in polyporus block), is in excellent condition, and is in the National Museum of Natural History, USNM 100715.

Distribution.—Apparently endemic to Jamaica.

Etymology.—It is a pleasure to name this species after my friend and colleague, Willis W. Wirth, who has contributed so much to our knowledge of shore flies and to my development as a dipterist.

Remarks.—This is the largest species of the genus and is further distinguished from congeners by its well developed setae (5 dorsocentral bristles, 4 postsutural intra-alar setae, larger basilateral scutellar bristles), less protrudent face, higher gena, and shorter arista.

This species occurs sympatrically with *D. rostratus* in Jamaica and has been overlooked as a separate species (see synonymy).

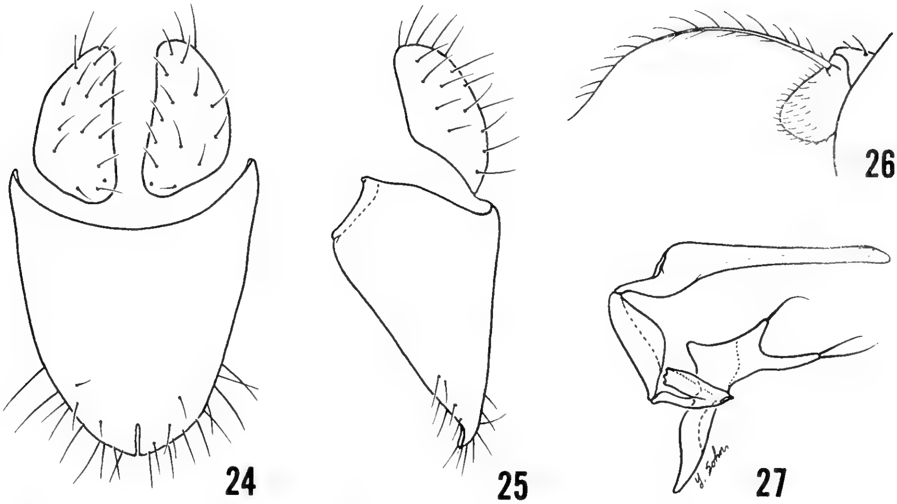
Dagus trichocerus **Mathis, New Species**

Figs. 24–27

Diagnosis.—Small to moderately small shore flies, length 1.70 to 2.35 mm.

Head: Frons with mesofrons thinly microtomentose to bare, subshiny to shiny, remainder of frons densely microtomentose, appearing velvety, brownish black to black. Facial protrusion in lateral view with anterodorsal surface more acutely angulate with oral margin; dorsal ½ of facial protrusion with bare, shiny area just below antennae, dark greenish blue, with metallic reflections, otherwise microtomentose, mostly whitish, concolorous with genal coloration. Aristal length approximately 3.5× length of 1st flagellomere, aristal hairs long and conspicuous (Fig. 26), approximately 2–3× aristal width at base. Gena moderately short, eye-to-cheek ratio 0.27; eye width-to-face length ratio 0.5.

Thorax: Thoracic chaetotaxy evident but not strongly developed. Dorsocentral bristles at most 3–4, including laterally displaced posterior bristle; postsutural intra-alar setae generally not well developed, occasional specimen with 1–2 setae; posterior notopleural bristle conspicuously displaced anteriorly from notopleural suture as compared with anterior bristle; basolateral scutellar bristles at most about ⅓ length of apical bristles; hindcoxal strap bare. Costal vein ratio 0.22; M vein ratio 0.67.



Figs. 24–27. *Dagus trichocerus.* 24, Epandrium and cerci, posterior view. 25, Epandrium and cerci, lateral view. 26, Antenna, lateral view. 27, Internal male genitalia, lateral view.

Abdomen: Male terminalia (Figs. 24–25, 27): epandrium, in posterior view, triangular, apex broadly rounded and with short, median cleft; lateral view of epandrium with basal ⅓ wide, thereafter ventrally narrowed rapidly to form rather pointed apex; gonite long with 2 posterior projections, each bearing 1 or more setae; aedeagal apodeme about 2× as long as wide, roughly oval.

Type-locality.—CUBA. Pinar del Rio Province: Soroa.

Type material.—Holotype ♂ is labeled "CUBA: Pinar del Rio Prov. Soroa 27–28 Apr 1983 Wayne N. Mathis" "HOLOTYPE ♂ Dagus trichocerus W. N. Mathis [name handwritten; red]." The holotype is double mounted (minute nadel), is in excellent condition, and is in the insect collection of the Instituto de Zoologia, Academia de Ciencias de Cuba, Havana, Cuba. Allotype and 27 paratypes (20 ♂, 7 ♀; USNM, Cuba) bear the same label data as the holotype. A paratype ♂ is from: CUBA. San Juan Mountains, Jan 1927, ALMelander Collection 1961 (USNM).

Distribution.—Apparently endemic to Cuba.

Etymology.—The specific epithet is of Greek derivation and is a combination of *trichos,* hair, and *keras,* horn, in allusion to the conspicuously haired and elongate arista.

Remarks.—This species is most similar to *D. rostratus* but is distinguished from it by the elongate arista, which is conspicuously haired, and by the mostly white, microtomentose vestiture on the sides of the face.

I collected the topotypical type-series of this species from exposed rocks situated in and along the margins of a small river. The river had a series of small waterfalls within the area I collected, and the flies were most common on the immediate splash zone of the rocks.

ACKNOWLEDGMENTS

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NEW SYNONYMIES IN NEARCTIC *DICHRORAMPHA* (LEPIDOPTERA: TORTRICIDAE)[1]

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Abstract.—Eight current names in *Dichrorampha* are resolved into three valid species: *D. capitana* (Busck), *D. britana* (Busck), and *D. kana* (Busck) are new synonyms of *D. simulana* (Clemens); *D. immaculata* McDunnough is a new synonym of *D. bittana* (Busck); and *D. dana* (Kearfott) is a new synonym of *D. sedatana* (Busck). In the first two taxa, synonyms arose on the basis of slight differences in wing pattern, length of male costal fold, and size. Such differences intergrade and are viewed as states of population characters rather than species characters. No intraspecific differences were found in genitalia of any of the three taxa.

Dichrorampha is a Holarctic genus of the tribe Grapolitini. Seventeen Nearctic species are currently recognized but few life history details are known. Several temperate species develop in root and stem tunnels of Compositae such as *Aster* (Heinrich, 1926; McDunnough, 1946) while two subtropical species develop in flowers of Sapotaceae, genus *Manilkara* (Heppner, 1981). The Holarctic *D. sedatana* (Busck) feeds on rootstocks of *Chrysanthemum leucanthemum* L. in the British Isles (Bradley and Tremewan 1970).

Nearly half the current Nearctic species of *Dichrorampha* were described by Busck (1906), who differentiated them by forewing color pattern, length of male costal fold, and size. Heinrich (1926) was the first to study their genitalia. He acknowledged difficulty in differentiating some species, questioned the validity of some in the groups to which *D. kana* (Busck) and *D. sedatana* belong, but proposed no changes at the species level. McDunnough (1946) pointed out additional male genital characters useful in differentiating the two main groups with a male costal fold and recorded his doubts about the validity of certain species. Obraztsov (1958) as well as Bradley and coworkers (1970, 1979) considered certain taxa in relation to Palaearctic representatives.

The present paper resolves eight of the current Nearctic names into three taxa. Five synonymies are proposed. Museum abbreviations are: AP—Academy of Natural Sciences of Philadelphia; AM—American Museum of Natural History, New York; BM—British Museum (Natural History), London; CN—Canadian

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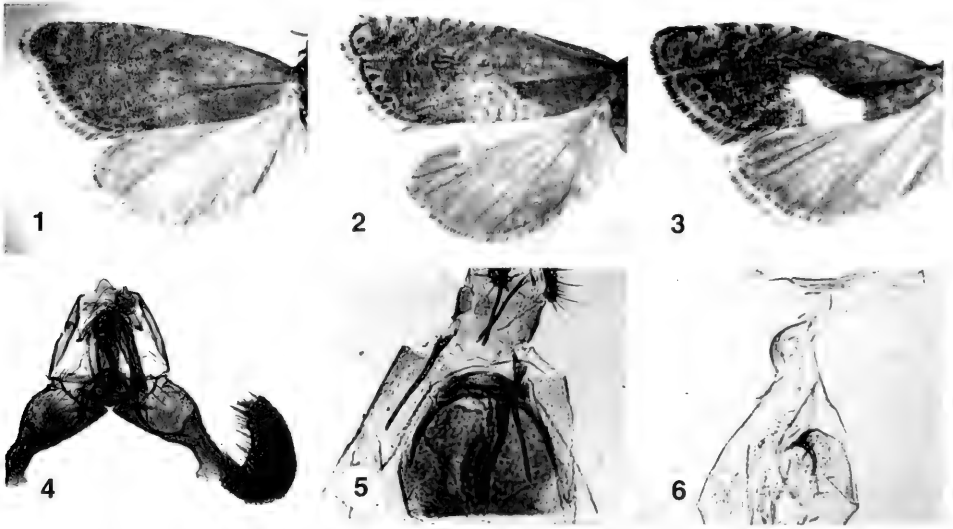


Figs. 1–6. *Dichrorampha simulana.* 1–3, Wings. 4, Male genitalia. 5, Female sterigma. 6, Female corpus bursae and signum. For specimen data see "material examined."

National Collection, Ottawa; FM—Field Museum of Natural History, Chicago; IS—Illinois Natural History Survey, Urbana; MS—Michigan State University, East Lansing; NM—National Museum of Natural History, Washington, D.C.; RH—J. Richard Heitzman Collection, Independence, Mo.; UC—University of California, Berkeley; UM—University of Minnesota, St. Paul; and UW—University of Wisconsin, Madison.

***Dichrorampha simulana* (Clemens)**

Figs. 1–6

Halonota simulana Clemens (1860: 351) (lectotype: Baltimore, Md., or Easton, Pa., designated by Darlington 1947, wing illustrated by Miller 1973, abdomen missing; AP).

Dichrorampha simulana; McDunnough (1946: 65).

Dichrorampha aurisignana Zeller (1876: 319) (holotype ♂: "probably" near Washington, D.C., ♂ genit prep BM 4665; wing and genit photos in AM; BM). Busck (1906: 179), Heinrich (1926: 12).

Hemimene capitana Busck (1906: 178) (holotype ♂: South Park, Colo., genitalia illustrated by Heinrich 1926; NM). **New Synonymy.**

Dichrorampha capitana; Heinrich (1926: 11).

Hemimene britana Busck (1906: 178) (lectotype ♂, here designated: "19699; Kaslo, B.C.; . . . *Hemimene britana* . . . Cotype; ♂ genit on slide Aug 25, 1922, #7, CH; Lectotype . . . by Miller . . ."; NM). **New Synonymy.**

Dichrorampha britana; Heinrich (1926: 12).

Lipoptycha kana Busck (1906: 182) (lectotype ♂, here designated: "23573; Kaslo Cr, B.C.; . . . *Hemimene kana* . . . Type; ♂ genit on slide Feb 24, 1982, 1213, MGP; Lectotype . . . by Miller . . ."; NM). **New Synonymy.**

Dichrorampha kana; Heinrich (1926: 11).

Lipoptycha planiloqua Meyrick (1912: 36). Invalid substitute name.

Male.—Forewing costal fold present, pattern variable: distinct or obscure orange yellow or white dorsal patch sometimes partly or completely divided or crossed by one or more dark lines (Figs. 1–3). Aedeagus distally cylindrical, membranous ventrally, no preapical spur. Basal opening of valva with posterior dorsal margin rounded and not produced into a tongue (Fig. 4).

Female.—Tentatively associated; forewing pattern as in male; sterigma and associated structures as in Figs. 5, 6.

Material examined.—ALBERTA: Mt Piran, August 17, ♂ genit prep OBR 17 (AM); Moraine Lk, August 6, 1923 (Fig. 1), ♂ genit prep Dic 1 (CN). ARIZONA: 16 mi SW Flagstaff, August 13, 1961 (Fig. 3), ♂ genit prep KH 1015812 (NM). BRITISH COLUMBIA: Seton Lake, May 28, 1926, ♂ genit prep Dic 3b (CN). CALIFORNIA: Shasta Retreat, June 17 (Fig. 2), *Dichrorampha britana* Busck, det CH 1924, ♂ genit prep KH 107811 (NM). COLORADO: Silverton, July 16–23, *Hemimene capitana* Busck, det AB 1919, ♂ genit prep CH 1, 24 Aug 1922 (NM); same data except ♀ genit prep NP 8, 27 Feb 1923 (Figs. 5, 6) (NM); Lake City, July 6, 1957, ♂ genit prep KH 1010811 (AM); same data except ♂ genit prep LKM 903764 (AM); Chimney Gulch, July 1, 1904, ♂ genit prep OBR 24 (AM). ILLINOIS: Putnam Co, June 8, 1965, ♂ genit prep KH 1012811 (IS). MANITOBA: Aweme, July 8, 1905, ♂ genit prep OBR 38 (AM). MICHIGAN: Houghton, August 7, 1936, ♂ genit prep PB 219 (MS). NEVADA: White Pine Co, Aug 7, 1980, ♂ genit prep SG 510827 (UC). NEW JERSEY: Anglesea, May 30, 1905, ♂ genit prep OBR 19 (AM). NOVA SCOTIA: White Pt Beach, June 30, 1955, ♂ genit prep 611 (AM). OREGON: Lane Co, June 22, 1975, ♂ genit prep SG 510822 (UC). VIRGINIA: Franconia, May 30, 1981, ♂ genit prep SG 510826 (UC). WASHINGTON: Paradise Valley, ♂ genit prep ES 1, 20 June 1924 (NM). WYOMING: Lower Green River Lk, July 18, 1956, genit prep KH 1021811 (Fig. 4) (AM).

Dichrorampha bittana (Busck)

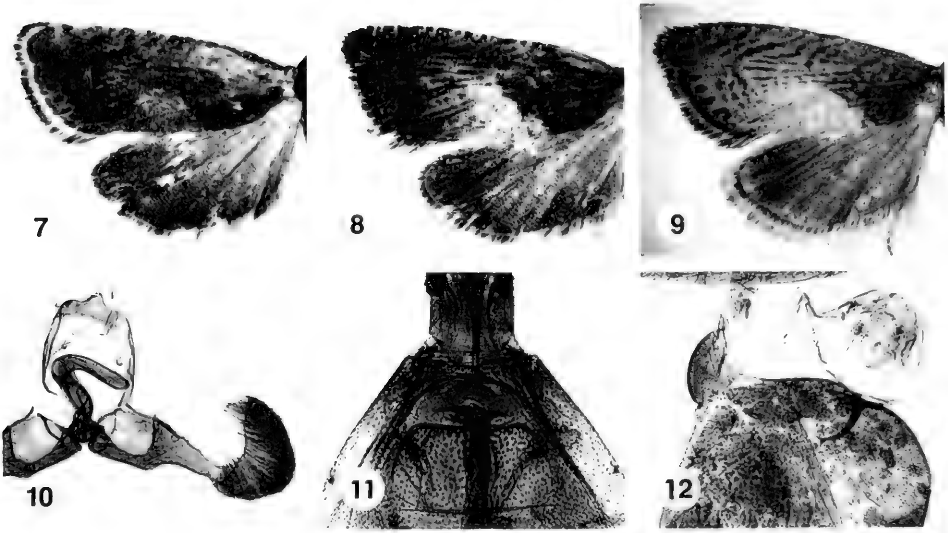
Figs. 7–12

Hemimene bittana Busck (1906: 179) (holotype ♂, Pittsburgh, Pa.; NM).
Dichrorampha bittana; Heinrich (1926: 13), McDunnough (1946: 66).
Dichrorampha simulana (not Clemens); Heinrich (1926: 12).
Dichrorampha immaculata McDunnough (1946: 66) (holotype ♂, Parrsboro, N.S.; CN). NEW SYNONYMY.

Male.—Forewing costal fold present, pattern variable: sometimes with distinct or obscure orange yellow or white dorsal patch that may be partly divided by a dark line; sometimes orange yellow of dorsal patch dominates distal ⅔ of forewing (Figs. 7–9). Aedeagus distally cylindrical, membranous laterally, with a tiny preapical spur. Basal opening of valva with posterior dorsal margin produced into a tongue (Fig. 10).

Female.—Tentatively associated; forewing pattern as in male; sterigma and associated structures as in Figs. 11–12.

Material examined.—ILLINOIS: Arlington Hts, Aug 23, 1934, ♂ genit prep WEM 29673b (FM). MICHIGAN: Midland Co, July 17–27, 1960, ♂ genit prep PJ 254 (MS); same data except ♂ genit prep KH 1021814 (MS); same data except June 25, 1957, ♂ genit prep PJ 253 (MS); Gladwin Co, July 25, 1957, ♂ genit prep LKM 708765 (MS). MISSOURI: Crowder St Pk, Sept 4, 1979 (Fig. 8), ♂ genit



Figs. 7–12. *Dichrorampha bittana.* 7–9, Wings. 10, Male genitalia. 11, Female sterigma. 12, Female corpus bursae and signum. For specimen data see "material examined."

prep DH 120811 (Fig. 10) (RH); same data except June 14, 1980, ♂ genit prep DH 306811 (RH). NEW HAMPSHIRE: Glen House, ♂ genit prep ES 3, 20 June 1924 (NM). NOVA SCOTIA: Parrsboro, Aug 4, 1944, *D. immaculata* McDunnough paratype (Fig. 7), ♂ genit prep LKM 825768 (CN); same data except ♀ genit prep KH 1021813 (Figs. 11, 12) (CN). ONTARIO: Queenston, June 19, 1933, ♂ genit prep Dic 8 (CN). PENNSYLVANIA: Pittsburgh, May 27, *Hemimene bittana* Busck "cotype" (Fig. 9), ♂ genit prep KH 1021812 (NM); same data except ♂ genit prep LKM 908768 (AM). WISCONSIN: Dane Co, Aug 26, 1969, ♂ genit prep VA 351 (UW); same data except ♂ genit prep VA 352 (UW); Lk Katherine, Aug 16, 1961, ♂ genit prep KAK 131 (UC).

Dichrorampha sedatana (Busck)

Figs. 13–15

Hemimene sedatana Busck (1906: 177) (holotype ♂, South Park, Colo.; NM).

Dichrorampha sedatana; Heinrich (1926: 15), Obraztsov (1958: 255), Bradley and Tremewan (1970: 8), Bradley et al. (1979: 302).

Enarmonia dana Kearfott (1907: 65) (lectotype ♂ selected by C. Heinrich, designated by Klots, 1942; AM). **New Synonymy.**

Dichrorampha dana; Heinrich (1926: 16), Bradley and Tremewan (1970: 9).

Enarmonia aequorea Meyrick (1912: 34). Invalid substitute name.

Male.—No forewing costal fold, pattern relatively constant: medium yellowish brown with lighter and darker costal streaks, black dots on termen near base of fringe, dorsal spot obscure or absent (Fig. 13). Genitalia as in Fig. 14.

Female.—As described for male. Sterigma and associated structures as in Fig. 15.

Material examined.—ALASKA: Dawson, June 12, 1916, ♂ genit prep SG 622821 (NM); 17 mi SW Cantwell, June 27, 1979, ♂ genit prep JAP 4502 (UC). BRITISH

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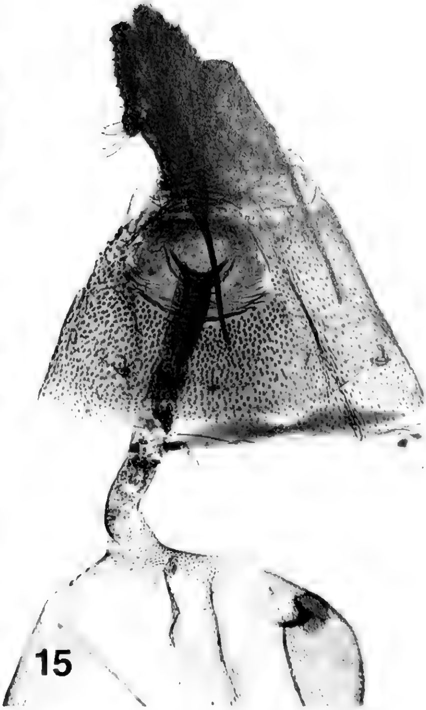

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Figs. 13–15. *Dichrorampha sedatana.* 13, Wings. 14, Male genitalia. 15, Female genitalia. For specimen data see "material examined."

COLUMBIA: Mt Tzouhalem, May 24, 1921, ♂ genit prep SMG 622824 (NM). CALIFORNIA: 3 mi W Lake Tahoe, July 12, 1979, ♀ genit prep SG 510823 (UC). COLORADO: Golden, ♀ genit prep LKM 908766 (Fig. 15) (AM). IDAHO: 6 mi NE Moscow, June 29, 1975, ♀ genit prep SG 510828 (UC). MICHIGAN: Schoolcraft Co, ♂ genit prep PJ 396 (MS); same data except ♂ genit prep PJ 154 (MS); Iron Co, June 13, 1960, ♂ genit prep PJ 158 (MS); same data except ♀ genit prep KAK 43 (MS). ONTARIO: Toronto, July 1930, ♀ genit prep KH 1026811 (AM). OREGON: Ochoco Pass, July 11, 1965, ♀ genit prep SG 622822 (NM). PENNSYLVANIA: Oak Sta, May 25, 1909, ♂ genit prep MAM 312792 (Fig. 14) (AM); New Brighton, May 30, 1907 (Fig. 13), ♂ genit prep LKM 908765 (AM). SOUTH DAKOTA: Hardy W. C., July 3, 1965, ♀ genit prep SG 622825 (NM); Harding, June 1975, ♂ genit prep 575-33 (UM); same data except ♂ genit prep KH 1010814 (UM). WASHINGTON: Blewett Pass, June 10, 1929, ♀ genit prep SG 622823 (NM). WEST VIRGINIA: 5 km NE Sugar Grove, May 24, 1981, ♂ genit prep SG 510824 (UC).

DISCUSSION

McDunnough (1946) revised Heinrich's (1926) identification of *D. simulana* based on genitalia of a male from Pennsylvania that matched the abdomenless lectotype in wing pattern. McDunnough's conclusion is supported by the present study; genitalia of a presumed *D. simulana* male syntype at AP (*Halonota si-*

mulana det B. Clemens . . . 112, ♂ genit prep KL 201) match McDunnough's identification.

The proposed synonymies under *D. simulana* and *D. bittana* are based on lack of evidence for separateness in genitalia. Differences in wing pattern intergrade and are viewed as states of population characters rather than species characters.

According to Busck (1906), costal fold length ranged from 1/5 of forewing length in *D. kana* to ⅓ in *D. simulana.* In the present study, fold length (F) appeared to be a continuous variable linearly related to forewing length (L) ($F = 0.42 + 0.24 L$; $r^2 = .75$, P_t slope coefficient $<.001$; range in L 5.0–8.7 mm, $N = 19$). Specimens from the western half of North America averaged longer forewings than those from the eastern half, as in some other olethreutines.

Identifications of female *D. simulana* and *D. bittana* are based on coincidence in capture of sexes and must be considered tentative; reared pairs were not available. Exterior and genital characters of such females differed negligibly between the species, and some females are placeable just as well in either.

Occasional lack of the tiny preapical spur on the *D. bittana* aedeagus mentioned by McDunnough (1946) proved to be an artifact of mounting. In several such genitalia preparations, including one of McDunnough's, remounting in a different position disclosed the presence of the spur.

The synonymy of *D. sedatana* and *D. dana* is based on lack of evidence for separateness in genitalia and wing pattern. A slight size difference between western and eastern representatives can be expected, but the difference in female corpus bursae size noted by Heinrich (1926) did not persist when the sample was enlarged. The same is true of the difference in shape of the tiny apical spur or spurs on the male aedeagus noted by Bradley and Tremewan (1970). Heinrich's (1926) suspicion that *D. sedatana* is synonymous with the Palaearctic *D. plumbana* (Scopoli) proved groundless; Bradley and coworkers (1970, 1979) point out structural and other differences between them.

More specimens were seen than are listed in "Material Examined" sections, but at least one specimen for each State or Province represented in study material is listed.

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NOTE

Range Extension in *Lytta* (Coleoptera: Meloidae)

Selander (1960. Ill. Biol. Monogr. 28) recorded four species of *Lytta* from the eastern United States: *L. aenea* Say from New Hampshire to Georgia west to Texas; *L. polita* Say from North Carolina to Florida and Louisiana; *L. sayi* LeConte from New Hampshire and New York to Pennsylvania; and *L. unguicularis* (LeConte) from North Carolina, Tennessee, Illinois, and Alabama.

While examining *Lytta* specimens the following range extensions were discovered: *Lytta polita:* MARYLAND: Anne Arundel County, Chesapeake Beach, 9 April 1933. Prince Georges County, Beltsville, 7 May 1969, 20 May 1970; Clinton, 12 April 1977; College Park, 22 April 1967. Worchester County, Shad Landing, 19 April 1978; Snow Hill, 20 April 1978. NEW JERSEY: New Hanover County, McGuire Air Force Base, 21 June 1975.

Lytta sayi: MARYLAND: Montgomery County, Great Falls, 17 April 1978. Prince Georges County, Upper Marlboro, 21 April 1979.

Acknowledgements: I thank the following persons for allowing me to examine the collections under their care: E. J. Ford, APHIS, Baltimore, Md.; R. D. Gordon, Systematic Entomology Laboratory, USDA: and C. Mitter, University of Maryland.

C. L. Staines, Jr., *3302 Decker Place, Edgewater, Maryland 21037.*

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HYDROPORUS ADELARDI, A NEW DYTISCID OF THE *VILIS* GROUP FROM CALIFORNIA (COLEOPTERA: DYTISCIDAE)

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Abstract.—*Hydroporus* **adelardi**, n. sp., is described and the aedeagus illustrated. The types were collected from a winter rain pool and from a pond, both in wooded areas, in Mendocino County, California. This new species raises the number of nominal species in the *vilis* group from 22 to 23.

Fall (1923) first distinguished the *vilis* group in his revision of the Nearctic *Hydroporus* and *Agaporus*. At that time he recognized eight species in this group. Excluding problems of synonomy which still remain to be worked out, the addition of *H. adelardi* raises the number of nominal species in the *vilis* group from 22 (Rochette, *in press*) to 23 in North America, including Mexico.

Hydroporus adelardi Rochette, New Species

Figs. 1, 2

Diagnosis.—This species will key to couplet 5 in Fall's (1923) revision and is most similar to *H. planiusculus* Fall. Both species are elongate oval, parallel sided, and distinctly depressed, but the punctation on the pronotum and elytra is large in *H. adelardi* in comparison to *H. planiusculus* which is finely punctate. Comparable punctation can be seen in *H. bidesoides* Leech and *H. barbarae* Fall, but *H. adelardi* can be separated from the former by its much larger size (measurement of total length, $N = 20$: *H. bidesoides*, $\bar{x} = 2.39 \pm .07$ mm; *H. adelardi*, $\bar{x} = 3.39 \pm .10$ mm) and from the latter by its depressed form. Also, the aedeagus of *H. adelardi* is bifid whereas it is simple in both *H. bidesoides* and *H. barbarae*.

Description.—Holotype male: Length 3.31 mm; width 1.60 mm. Form elongate-oval, parallel sided, distinctly depressed and elytra heavily punctated; head light reddish brown, pronotum and elytra dark reddish brown; prosternal process small; posterior margins of metatrochanter and femur in line with each other. *Head:* Evenly microreticulate; finely punctate, the punctures separated roughly by 1–6× their diameter. *Pronotum:* Microreticulation as on head; punctation larger than that on head, those on disc separated roughly by 1–4× their diameter becoming coarser along apical, basal, and lateral margins; lateral pronotal bead uniformly thick, with very fine scattered punctures. *Elytra:* Microreticulation as on pronotum and head; punctures large, dense and elongate, evenly distributed along length of elytra with very fine punctures scattered in between; no sutural stria of coarse punctures present, pubescence not conspicuous. *Venter:* Prosternal process small, with setae; pro- and mesotarsal segments dilated, more so than in female, adhesion plates (pallettes) prominent, 2-2-2 in configuration; protibia of

Figs. 1, 2. *Hydroporus adelardi,* aedeagus. 1, Lateral view (286×). 2, Dorsal view (280×).

male unmodified; metasternum wrinkled in appearance, irregularly microreticulate, most meshes elongate, more so where metasternum meets coxae, punctation coarse, irregularly spaced; epipleura coarsely punctate; metatrochanter and femur with very fine, sparse punctation; row of setae on face of femur toward anterior edge, beginning ⅔ the distance from anterior tip of femur progressing posteriorly to tip; abdominal segments wrinkled in appearance toward lateral edges, punctation coarse, microreticulation not as strong as on metasternum, setae present. *Genitalia:* Aedeagus bifid, parameres triangular in shape (Figs. 1, 2). *Color:* Antenna and head light reddish brown; pronotal disc and elytra dark reddish brown, with pronotal disc appearing slightly darker, outer margins of pronotum becoming progressively lighter, similar to head in color; venter dark reddish brown, similar to elytra; epipleura, underside of head, palps, and legs light reddish brown.

Allotype female: Length 3.31 mm; width 1.63 mm. Similar to male in all aspects, except pro- and mesotarsal segments not dilated and without adhesion plates (pallettes).

Types.—Holotype ♂ and allotype ♀: CALIFORNIA: Mendocino Co., 3 mi. N. Mendocino behind Helfer ranch, winter rain pool in woods, 9-IV-66, H.B. Leech [CAS]. Paratypes: CALIFORNIA: same data as for holo- and allotype [CAS] (51). Caspar, 15-II-48, pond in woods, H. B. Leech [CAS] (1). Specimens have been deposited in the following institutions: Holo- and allotype and 44 paratypes at the California Academy of Sciences; 2 paratypes (1 ♂, 1 ♀) each at New Mexico State University, National Museum of Natural History, Smithsonian Institution, University of New Hampshire, and author's collection.

Natural history notes.—Specimens were taken from only two places, a winter rain pool and a pond, both in wooded areas.

Distribution.—This species is only known from Mendocino County, California.

Etymology.—This species is named for my father, Adelard Lucien Rochette.

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85(4), 1983, p. 736

BOOK REVIEW

Sunflower Species of the United States. By Charlie E. Rogers, Tommy E. Thompson, and Gerald J. Seiler. National Sunflower Assn., Bismarck, North Dakota. (iv), 95 pp. Cost: Hardcover $12.95, softcover $9.95.

Many entomologists, especially those who study insects that feed upon plants, must use works that deal with the plants used by their insects. In working on a genus of two-winged flies, some species of which feed upon sunflowers (*Helianthus* species), I had occasion to peruse the work here reviewed. It is well illustrated with color photographs, some of which are, however, so small and indistinct as to be of little use. There is no key to species, and the bibliography ("suggested reading") cites only six items. Each species of sunflower is treated with a paragraph giving its characteristics, but inasmuch as *Helianthus* includes 52 species, most of which are quite similar, I must still use the revision by Heiser et al. (1966, Mem. Torrey Bot. Club, vol. 22, no. 3, 218 pp.) in order to be reasonably certain of my determinations.

There are 20 maps (Pls. 1–20) showing distribution of the species of *Helianthus*. Plates 12, 13, 15, and 16 each show the distribution of 2 to 4 species on the same map. Much of the areas overlap and details of the presentation make the maps very confusing. Plate 16, furthermore, does not agree very closely with Map 31 in Heiser et al., for *Helianthus grosseserratus*.

An appendix contains tables on cross compatability of some of the sunflower species; oil content and free fatty acid composition of selected species; relative resistance of selected species to four species of insect pests; growth, habitat data, and survival status; and distribution of sunflower species by States. Each species is given a vernacular name as well as its botanical name.

All in all, I would say that the work is of very limited use to an entomologist or a botanist, but it may be of considerable value by virtue of the appendix to those interested in the use of sunflowers, but of that I cannot judge.

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A REVISION OF THE NEARCTIC SPECIES OF *ARTHROPEAS* (DIPTERA: COENOMYIIDAE)

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Abstract.—The genus *Arthropeas* is revised for the Nearctic Region, and its phylogenetic relationships with other genera of lower brachycerous Diptera are discussed.

This study is based on 83 specimens of two species, *Arthropeas americanum* Loew and *A. magnum* Johnson. A third species *A. jonesi* Cresson (1919) (= *arthracina* Brennan, 1935) was transferred to *Bequaertomyia* (Brennan, 1935) and placed in the Pelecorhynchidae (Philip, 1965; Teskey, 1981), although Nagatomi (1975a, 1975c) treated *Bequaertomyia* as a synonym of *Pseudoerinna* (Shiraki, 1932) and felt that *Pseudoerinna* must be relegated to the Rhagionidae.

The genus *Arthropeas* was erected by Loew (1850) for *Arthropeas sibirica.* Two Palaearctic species, *A. sachalinensis* (Matsumura, 1916) from Sakhalin and *A. sibiricum* (Loew, 1850; Malloch, 1932; Nagatomi, 1975a, 1975b; Ouchi, 1943) from Siberia, Manchuria, Korea, and Tibet are included in this genus. Leonard (1930) reviewed the Nearctic species.

Arthropeas has been placed in three families of Diptera: (1) Coenomyiidae (Bezzi, 1903; Curran, 1965; Malloch, 1917; Nagatomi, 1975a, 1975b, 1977; Steyskal, 1953), Coenomyiidae: Coenomyiinae (Cole, 1969); (2) Rhagionidae (Aldrich, 1905; Williston, 1888), Rhagionidae: Coenomyiinae (Lindner, 1925), Rhagionidae: Xylophaginae (Leonard, 1930; Williston, 1896, 1908); (3) Xylophagidae (Krivosheina, 1967), Xylophagidae: Arthroceratinae (James, 1965). Nagatomi (1975a, 1975b) defined the family Coenomyiidae and included the genera *Coenomyia, Anacanthaspis, Arthropeas, Odontosubula,* and *Dialysis.*

In a study of 21 genera, including *Arthropeas,* of lower brachycerous Diptera in the Nearctic Region, Webb (1981) examined 53 morphological characters of adult males and females. Two phylogenetic (cladistic) and three phenetic methods were used in developing and interpreting the relationships of these genera.

Phylogenetic methods.—Cladograms were developed which (1) reflected the least number of convergences for all character states considered and (2) were rooted from a hypothetical ancestor possessing the plesiomorphic state for all 53 characters, using the Wagner algorithm.

Phenetic methods.—Phenetic similarities were analyzed using CLUSTER (written by Dr. R. B. Selander, University of Illinois), and phenograms were produced using UPGMA (unweighted pair-group method using arithmetic averages) for Pearson product-moment correlation coefficients, average taxonomic distances, and mean character differences.

The two phylogenetic analyses associated the genera *Arthropeas, Coenomyia,* and *Dialysis.* The three phenetic analyses associated *Coenomyia* and *Dialysis* but separated *Arthropeas* from these genera and associated it with *Arthroceras.* These five analyses showed no association between *Arthropeas, Coenomyia,* or *Dialysis* and *Xylophagus* or *Rachicerus,* and reinforce Nagatomi's association and grouping of *Arthropeas, Coenomyia,* and *Dialysis* in the Coenomyiidae (Nagatomi, 1975a, 1975b).

Most recently, James (1981) included *Arthropeas* in the Xylophagidae, based on the strong similarity in the larvae of *Coenomyia, Rachicerus,* and *Xylophagus.* However, because of the divergence of the adults, he grouped *Arthropeas, Coenomyia,* and *Dialysis* in the subfamily Coenomyiinae. On the basis of the larvae Krivosheina (1967) associated *Arthropeas* with *Coenomyia.* A comparison of the larval characters of *Arthropeas* (Krivosheina, 1967), *Dialysis,* and *Coenomyia* has been outlined by Webb and Lisowski (1983). The larvae of *Arthropeas* and *Coenomyia* are similar in their general body shape and appearance, metacephalic rods, and anal plate, and again reinforce Nagatomi's (1975a, 1975b) grouping of this genus into the family Coenomyiidae.

The terminology used here for the adults is from McAlpine (1981) and Stuckenberg (1973).

Arthropeas Loew

Arthropeas Loew, 1850: 304. Type-species: *Arthropeas sibirica* Loew.
Arthropaeas Marschall, 1873: 322.

Description.—Adults large, sluggish. Length of male 8.7–12.9 mm, female 9.2–15.4 mm. Head in lateral view hemispherical. Ocellar tubercle subtriangular, distinctly raised above vertex in male. Vertex rounded, not emarginate lateral to ocellar tubercle. Eyes large, holoptic in male; dichoptic in female, separated by distance equal to outside width of antennal bases; facets equal; glabrous; median margin sinuate, ventral ¾ divergent, no emargination dorsolateral to base of scape; in lateral view eyes hemispherical, covering ¾ of head. Frons in male reduced, in female broad; median tubercle absent. Antenna with scape globular, bases in male separated by distance less than width of median ocellus, in female separated by distance greater than width of median ocellus, setae elongate, generally extending beyond pedicel, around entire segment; pedicel globular, setae elongate, around entire segment; flagellum subulate, with 8 annuli. Gena broad. Clypeus with anterior surface flat to slightly concave. Face in lateral view rounded, not porrect. Maxillary palp 2-segmented, cylindrical. Labellum membranous.

Thorax with dorsum rounded; vittae distinct; setae black, abundant, with no distinctive pattern; caudolateral tubercles absent. Postmetaspiracular scale and suprametacoxal pit absent. Mesoscutellum with caudal margin rounded, without dorsal tubercles.

Wing length of male 8.4–11.4 mm, female 8.9–12.0 mm, 2.8–3.6× longer than wide. Membrane with veins brown to dark brown; pterostigma generally indistinct; microtrichia cover entire wing; macrosetae on entire length of R_1; thyridium absent. Costa circumambient, broader along anterior surface; setae fuscous, short, appressed. Subcosta ends beyond middle of wing. Subcostal cell narrow, elongate, open. R_{2+3} ends distal to fork of R_{4+5}. Marginal cell narrow, elongate, open. Cell R_4 large, enclosing apex of wing. R_4 ends anterior to apex of wing. R_5 ends posterior to apex of wing. M_1, M_2, and M_3 originate separately from apical margin of discal cell. Five posterior cells. Cell M_3 open. Discal cell large, apical margin pointed. Anal cell large, open or closed at wing margin. First basal cell narrow, elongate, apex truncate, extending slightly beyond apex of 2nd basal cell. Anal angle broadly rounded, right-angled. Alula large, broadly rounded.

Tibial spurs 1-2-2. Empodium similar in size and shape to pulvilli. Apical claws on tarsomere 5 fuscous, paired, simple. Hindlegs not raptorial.

Male terminalia with tergite 8 broad, rectangular, about 1.5× longer than wide, posterior margin truncate. Tergite 9 suboval, lateral margins rounded, about 1.5× longer than wide, posterior margin rounded, sinuate. Tergite 10 absent. Cerci 1-segmented, lobate. Ventral plate of proctiger triangular, membranous, lying beneath cerci. Sternites 9 and 10 absent. Basistyle in ventral view broad, lateral margins rounded, fused anteriorly; in dorsal view basistyle with broad arch joining inner margins, aedeagal apodemes narrow, extending slightly beyond base of basistyle. Dististyle broad, thick, apex truncate, reflexed. Aedeagus composed of an aedeagal sheath, endophallus, endophallic hilts, and penis valves. Aedeagal sheath broad, attached basally to inner margins of basistyle, tapered caudally to form endophallic guide. Penis valves thick, sinuate, directed posteriorly. Endophallic tines absent.

Female terminalia with tergite 8 broad, quadrate, 1.2× longer than wide, caudal margin truncate. Tergite 9 reduced, broader posteriorly than at base, as long as wide, posterior margin truncate. Tergite 10 subrectangular, 2.5× wider than long, lightly sclerotized. Cerci large, elongate, 2-segmented; basal segment 2.5× longer than wide, 1.5× longer than apical segment; apical section lobate, without an apical depression. Sternite 8 broad, 1.3–1.4× longer than wide, tapered posteriorly to narrow, median emargination. Sternite 9 greatly modified, invaginated beneath tergite 8 to form internal furca. Sternite 10 broad, subtriangular, tapered posteriorly to rounded, median point. Internal reproductive organs with furca thick, heavily sclerotized, "V" shaped, anterior apodeme absent, posterior enlargement quadrate, not attached laterally to tergite 9. Common spermathecal duct elongate, trifurcating anteriorly to form 3 spermathecal ducts. Each spermathecal duct narrow, membranous, ending anteriorly in oblong spermatheca which lacks internal hairs.

KEY TO NEARCTIC SPECIES OF *ARTHROPEAS*

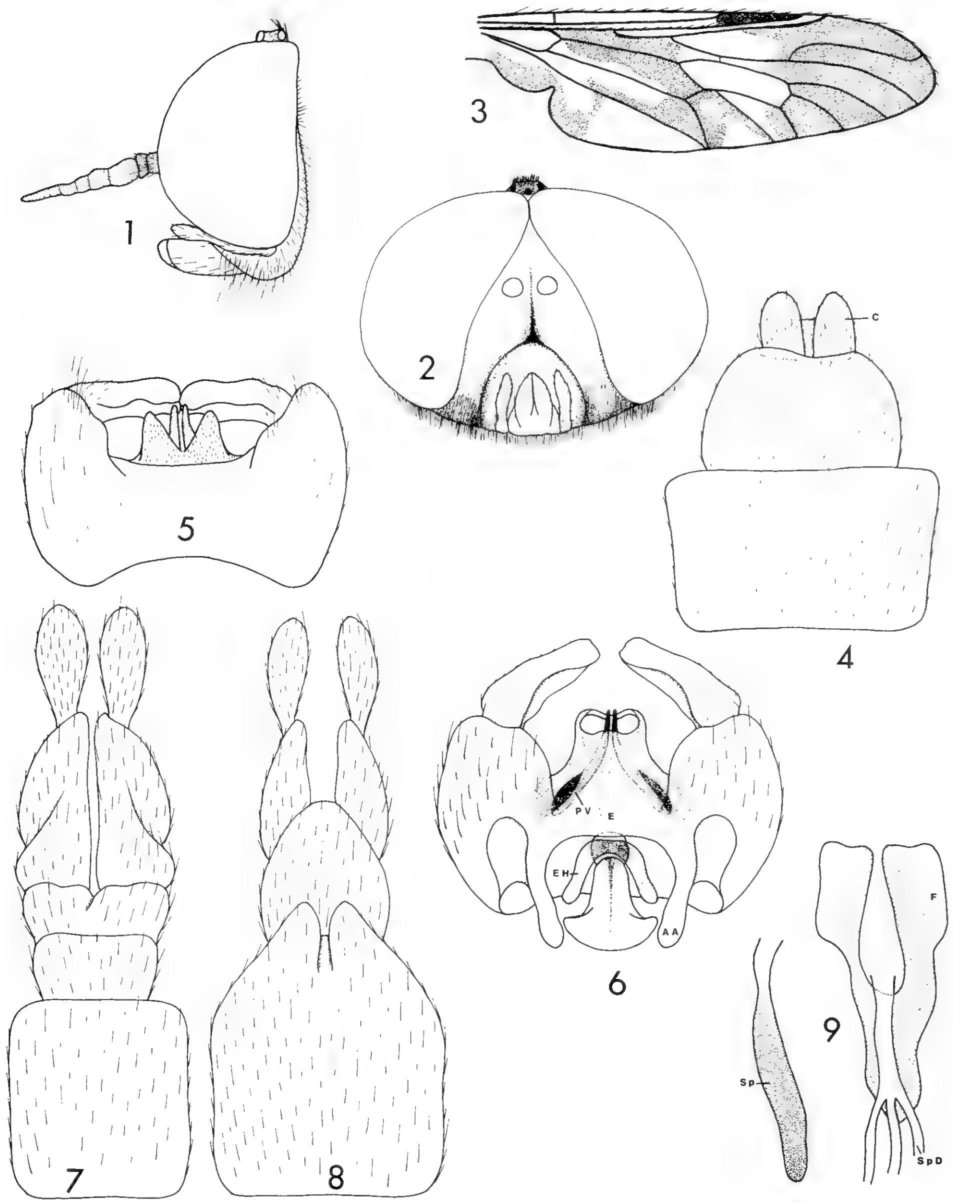
1. Wings with distinct dark brown to black bands (Fig. 3). Abdominal tergites I–IV fuscous with dark yellowish brown fascia along posterior margin .... *americanum* Loew
– Wings pale brown, slightly darker over pterostigma, discal cell, and posterior ¼ of marginal cell (Fig. 11). Abdominal tergites I–IV fuscous, glossy, with 2 pale yellow hemispheres on posterior margin separated medially by fuscous band .... *magnum* Johnson

Arthropeas americanum **Loew**

Figs. 1–9, 14

Arthropeas americana Loew, 1861: 316; Leonard, 1930: 17.

Arthropeas americanum resembles *A. magnum* in having the eyes glabrous; antenna subulate with scapal and pedicellar setae around entire segments, flagellum with 8 annuli; anterior surface of clypeus flat to slightly concave, glabrous;



Figs. 1–9. *Arthropeas americanum.* 1, Male head, lateral view. 2, Male head, frontal view. 3, Wing. 4, Male abdomen, posterior segments. 5, Male terminalia, ventral view. 6, Male terminalia, dorsal view. 7, Female terminalia, dorsal view. 8, Female terminalia, ventral view. 9, Female internal reproductive organs. Abbreviations: AA = aedeagal apodeme; C = cerci; E = endophallus; EH = endophallic hilt; F = furca; PV = penis valve; Sp = spermatheca; SpD = spermathecal duct.

maxillary palps 2-segmented, cylindrical; R_1 with macrosetae over entire length; male terminalia lacks endophallic tines; in female, furca lacks anterior apodeme. *Arthropeas americanum* is readily separated from *A. magnum* by the absence of frontal setae in the male; gena fuscous, pollinose; clypeus pollinose; palpal setae golden; thoracic setae with black spot at base; wing membrane with dark brown to black markings; abdominal tergites I–IV fuscous to black with dark yellow fascia across entire posterior margin; aedeagal apodeme broad, anterior margin expanded laterally; in female, spermathecal duct lacks dark brown enlargement near spermatheca.

Male.—Length 8.7–10.4, 9.9 mm ($N = 5$). Head (Figs. 1, 2) fuscous. Ocelli hyaline to amber; ocellar tubercle fuscous, lightly pruinose; setae fuscous, elongate. Eyes contiguous for short distance ventral to median ocellus. Frons fuscous, pollinose; setae absent. Antenna pale yellow, apical ½ of flagellum fuscous; antenna equal in length to width of head in lateral view; scape 1.1–1.7, 1.4× wider than long, 0.9–1.2, 1.0× length of pedicel, setae pale yellow; pedicel 1.3–1.5, 1.4× wider than long, setae fuscous; flagellum 4.8–5.4, 5.1× longer than wide, 2.9–3.4, 3.1× combined length of scape and pedicel, with ultimate flagellomere about 4.0× length of penultimate flagellomere. Gena fuscous, pollinose; parafacial setae absent; facial setae pale yellow to golden, elongate, abundant. Clypeus pollinose. Maxillary palp pollinose; basal segment 2.5–3.3, 2.9× longer than wide; apical segment 2.6–3.3, 2.9× longer than wide, 1.0–1.1, 1.0× longer than basal segment; setae golden, elongate, abundant. Labellum dark yellow to brown, lightly pollinose; setae dark yellow, elongate, scattered. Postocular setae dark yellow, elongate, abundant, interspersed with short, erect, fuscous setae dorsally.

Thorax fuscous, pruinose; vittae dark brown, broad; setae black, each with small black basal spot. Humeral callus concolor with thorax; setae black, erect, abundant. Pleura fuscous, pruinose; setae stramineous, elongate, abundant over propleuron and on dorsal and posterior ½ of mesoanepisternum, scattered on dorsal ½ of mesokatepisternum and on dorsoposterior corner of meron, absent on mesoanepimeron and metepleuron. Halter dark yellow, setae absent. Mesoscutellum fuscous, lightly pollinose, setae dark brown to fuscous, elongate, abundant. Mesopostnotum fuscous, pruinose, lateral setae dark yellow, elongate. Lateral tergites fuscous, pruinose, setae pale yellow to golden, elongate, abundant.

Wing length 8.4–8.5, 8.5 mm ($N = 5$), 3.1–3.4, 3.3× longer than wide. Membrane (Fig. 3) opaque, with large dark brown to black markings. Fork of R_{4+5} originates above apex of discal cell, angle broadly rounded. R_4 sinuate apically. Anal cell closed at wing margin. Squama opaque, setal margin stramineous, fine, entire.

Legs with coxae fuscous, pruinose, femora and tibiae dark yellow, tarsi fuscous. Forecoxa elongate, mid- and hinecoxae short. Hindcoxa with anterior tubercle. Empodium and pulvilli fuscous.

Abdomen fuscous to black, with dark yellowish brown fascia across entire posterior margin; setae fuscous, short, appressed. Tergite 8 (Fig. 4) rectangular, 1.4–1.5× wider than long. Tergite 9 suboval, 1.6–1.7× wider than long. Cerci lobate. Basistyle in ventral view (Fig. 5), in dorsal view (Fig. 6). Endophallus with endophallic apodeme, expanded laterally, anterior margin broadly rounded, posterior ½ of endophallus narrow, oval, pointed. Endophallic hilt thick, sclerotized, in shape of inverted U, fused medially.

Female.—Length 9.2–14.4, 10.9 mm ($N = 5$). Eyes separated by distance 0.97–1.15, 1.03× outside width of antennal bases. Frons fuscous, pruinose, narrowed apically; setae stramineous, short, erect. Scape with base separated by distance 1.7–2.4, 2.0× width of median ocellus, 1.3–1.4, 1.3× wider than long, 1.0–1.2, 1.1× length of pedicel; pedicel 1.3–1.6, 1.5× wider than long; flagellum 4.5–5.8, 5.3× longer than wide, 2.9–3.3, 3.1× combined length of scape and pedicel. Maxillary palp with basal segment 1.9–3.3, 2.8× longer than wide; apical segment 2.7–3.8, 3.2× longer than wide, 1.1–1.7, 1.2× longer than basal segment.

Humeral callus paler than thorax. Pleura dark yellowish brown, pruinose. Mesoscutellum yellowish brown, glossy. Mesopostnotum yellowish brown to fuscous, lightly pruinose.

Wing length 8.9–12.0, 9.9 mm ($N = 5$), 3.2–3.6, 3.3× longer than wide. Subcosta ends basal to r-m.

Abdomen with tergite 8 (Fig. 7) quadrate, 1.2× longer than wide. Tergite 9 reduced, broader posteriorly than at base, as long as wide. Tergite 10 subrectangular, 2.5× wider than long, lightly sclerotized. Cerci with basal segment 2.5× longer than wide, 1.5× length of apical segment; apical segment lobate. Sternite 8 (Fig. 8) broad, 1.3–1.4× longer than wide, tapered posteriorly to narrow, median emargination. Sternite 10 broad, subtriangular. Internal reproductive organs (Fig. 9) with furca thick, heavily sclerotized, V shaped. Spermathecal ducts lacking dark brown enlargement near spermatheca.

Remarks.—Adults of *Arthropeas americanum* have been collected along dirt roads in wooded areas and on *Aster umbellata.* Adults emerge from the end of June until the beginning of September, with the majority of specimens collected in late July and August. No evidence of protandry was exhibited, and males and females were represented in the collections examined in nearly equal numbers (27 males, 37 females).

Immature stages.—Unknown.

Type-material.—The holotype female of *Arthropeas americanum* (MCZ Type Number 12614) was collected from N. Wis.

Distribution (Fig. 14).—A northeastern species, extending from Virginia to Maine and west to Minnesota.

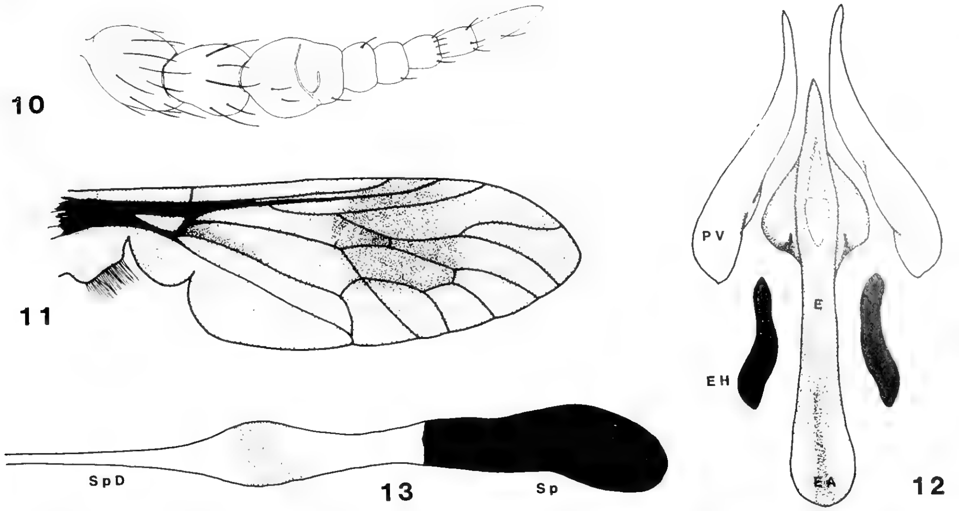
UNITED STATES.—CONNECTICUT: New Haven. MASSACHUSETTS: Cheshire Harbour (near Mt. Greylock). MICHIGAN: Chatham; Oscoda; Sylvania Tract (T49N R38W S8, Gogebic County); Huron Mts (Marquette County); 5 mi E Prudenville; 2 mi E Grayling. MAINE: China. MINNESOTA: St. Anthony Park; Ft. Snelling; Sibeka; Jenkins. PENNSYLVANIA: Black Moshannon S. P.; State College; Tamarack; Scottia Barrens (Centre County); McCraney Run bog, 2 mi SE LeRoy. VIRGINIA: Bald Knob. WISCONSIN: Highway M, 2 mi from Highway 51 (Vilas County); Florence. CANADA.—ONTARIO: Irondale. QUEBEC: Nominigue; Mosham Twp. (Gatineau County); Duncan Lake, near Rupert.

***Arthropeas magnum* Johnson**

Figs. 10–14

Arthropeas magna Johnson, 1913: 11; Leonard, 1930: 19.

Arthropeas magnum is similar to *A. americanum* but can be separated readily from *A. americanum* by the presence of black, lateral frontal setae in males; gena black with dense grey pruinosity; clypeus with dense grey pile; palpal setae black, elongate; thoracic setae stramineous, without basal, black spot; wing membrane pale brown, lacking distinct dark brown markings; abdominal tergites I–IV fuscous, subshiny, with pale yellow hemispheres on posterior margin separated me-



Figs. 10–13. *Arthropeas magnum.* 10, Antenna. 11, Wing. 12, Male aedeagus. 13, Female spermatheca. Abbreviations: E = endophallus; EA = endophallic apodeme; EH = endophallic hilt; PV = penis valve; Sp = spermatheca; SpD = spermathecal duct.

dially by fuscous band; aedeagal apodeme elongate, only slightly expanded anteriorly; female with spermathecal duct bearing dark brown enlargement near spermatheca.

Male.—Length 11.1–12.0, 11.5 mm (N = 5). Head fuscous. Ocelli fuscous; ocellar tubercle fuscous, lightly pruinose; setae black, elongate, on posterior margin. Eyes black. Frons covered with dense greyish black pruinosity; setae black, elongate, scattered laterally. Antenna (Fig. 10) pale brown to pale orangish brown; scape 1.0–1.3, 1.2× wider than long, 1.0–1.1, 1.0× length of pedicel, setae black and gold, elongate, subappressed; pedicel 1.1–1.3, 1.2× wider than long, setae same as scapal setae; flagellum 3.1–5.0, 4.3× longer than wide, 1.6–2.8, 2.4× combined length of scape and pedicel, ultimate flagellomere about 2.0× longer than penultimate flagellomere, setae short, fuscous, scattered. Gena broad, covered with dense greyish black pile; parafacial setae fuscous to black, elongate, abundant; facial setae whitish yellow, elongate, abundant. Clypeus fuscous with short, grey pile. Maxillary palp brown, lightly pruinose; basal segment 2.2–2.9, 2.6× longer than wide; apical segment 2.3–3.3, 2.7× longer than wide, 1.0–1.1, 1.1× length of basal segment; setae black, elongate, abundant. Labellum pale yellow to fuscous; setae stramineous, short, scattered. Postocular setae black, elongate, becoming shorter dorsally.

Thorax yellow to gold, pruinose, with 3 broad, black vittae; setae black, elongate, abundant. Humeral callus pale yellow with grey pruinosity; setae stramineous, elongate, abundant. Pleura fuscous, pruinose; setae stramineous to fuscous, elongate, abundant on propleuron, stramineous, elongate, abundant on posterior ½ of mesoanepisternum and over entire mesoanepimeron, black and stramineous, elongate, abundant on mesokatepisternum and metepleuron and on dorsal ⅓ of meron. Halter stalk dark yellow to brown, capitulum paler, glabrous. Mesoscutellum black, pruinose; setae black, elongate, abundant. Mesopostnotum fuscous, lightly pruinose; setae absent medially, stramineous to fuscous, elongate laterally. Lateral tergite fuscous, pruinose; setae stramineous to fuscous, elongate, abundant.

Wing length 9.2–11.5, 10.6 mm ($N = 5$), 3.0–3.4, 3.2× longer than wide. Membrane (Fig. 11) pale brown with brown band over pterostigma, base of marginal cell, discal cell, and apex of 1st basal cell; veins brown; radial sector originates at middle of 1st basal cell. R-m situated at basal ⅓ of discal cell. Fork of R_{4+5} with angle pointed. Anal cell open slightly at wing margin. Squama stramineous, pruinose, marginal setae stramineous, elongate, entire. M-cu 4–5× length of r-m.

Coxae fuscous to black, pruinose; femora fuscous, glossy; tibiae and tarsi pale brown to fuscous. Empodium and pulvilli orangish brown. Hindcoxa without anterior tubercle.

Abdomen with tergites I–IV fuscous to black, glossy, with 2 pale yellow hemispheres on posterior margin separated medially by fuscous band; setae fuscous on fuscous areas, stramineous to golden on pollinose areas. Tergite V with pollinose posterior fascia entire. Tergites VI–VIII pollinose. Terminalia similar to those of *A. americanum* except for endophallus (Fig. 12) with narrow elongate endophallic apodeme not expanded laterally; endophallic hilts sinuate, separated medially.

Female.—Length 12.5–15.4, 13.5 mm ($N = 5$). Ocellar tubercle black with grey pruinosity; setae absent. Eyes separated by distance 1.0–1.2, 1.1× outside width of antennal bases. Frons black with grey pruinosity; setae absent. Scape with bases separated by distance 1.4–2.6, 2.0× width of median ocellus, 1.0–1.6, 1.3× wider than long, 1.0–1.6, 1.3× length of pedicel; pedicel 1.4–1.6, 1.5× wider than long; flagellum pale brown with apical 2 flagellomeres fuscous, 3.9–5.0, 4.4× longer than wide, 2.3–3.3, 2.7× combined length of scape and pedicel. Parafacial setae generally absent, occasionally with short, scattered, gold setae; facial setae golden, shorter than in male. Maxillary palp dark orangish brown; basal segment 2.8–3.1, 2.9× longer than wide; apical segment 2.2–3.4, 3.0× longer than wide, 0.9–1.2, 1.1× length of basal segment; setae orangish brown. Labellar setae orangish brown.

Thorax grey to black with short golden pile; setae very short, subappressed; vittae black, pruinose, occasionally indistinct. Humeral callus concolor with thorax; setae golden, short, erect. Halter orangish brown. Mesoscutellar setae shorter than in male. Mesopostnotum with lateral setae black, shorter than in male.

Wing length 9.2–11.5, 10.6 mm ($N = 5$), 3.0–3.4, 3.2× longer than wide. Membrane pale brown; veins with brown margins. R_1 ends distal to fork of R_{4+5}, above apex of discal cell. Fork of R_{4+5} originates basal to, above, or distal to apex of discal cell. Squama orangish brown; setae not as abundant as in male.

Coxae orange brown to fuscous. Hindcoxa with anterior tubercle.

Abdomen orange brown, subshiny. Female terminalia and internal reproductive organs similar to those of *A. americanum* except for spermathecal ducts with dark brown enlargement near spermatheca (Fig. 13); spermatheca dark brown, oblong, 3.1× longer than wide.

Remarks.—Little is known of the adult habitat although in Oregon a female was collected at a sphagnum bog. Adults have been collected from the middle of June until the middle of August, with the majority of specimens collected during July. No evidence of protandry was exhibited, and males and females were present in the collections examined in nearly equal numbers (11 males, 8 females).

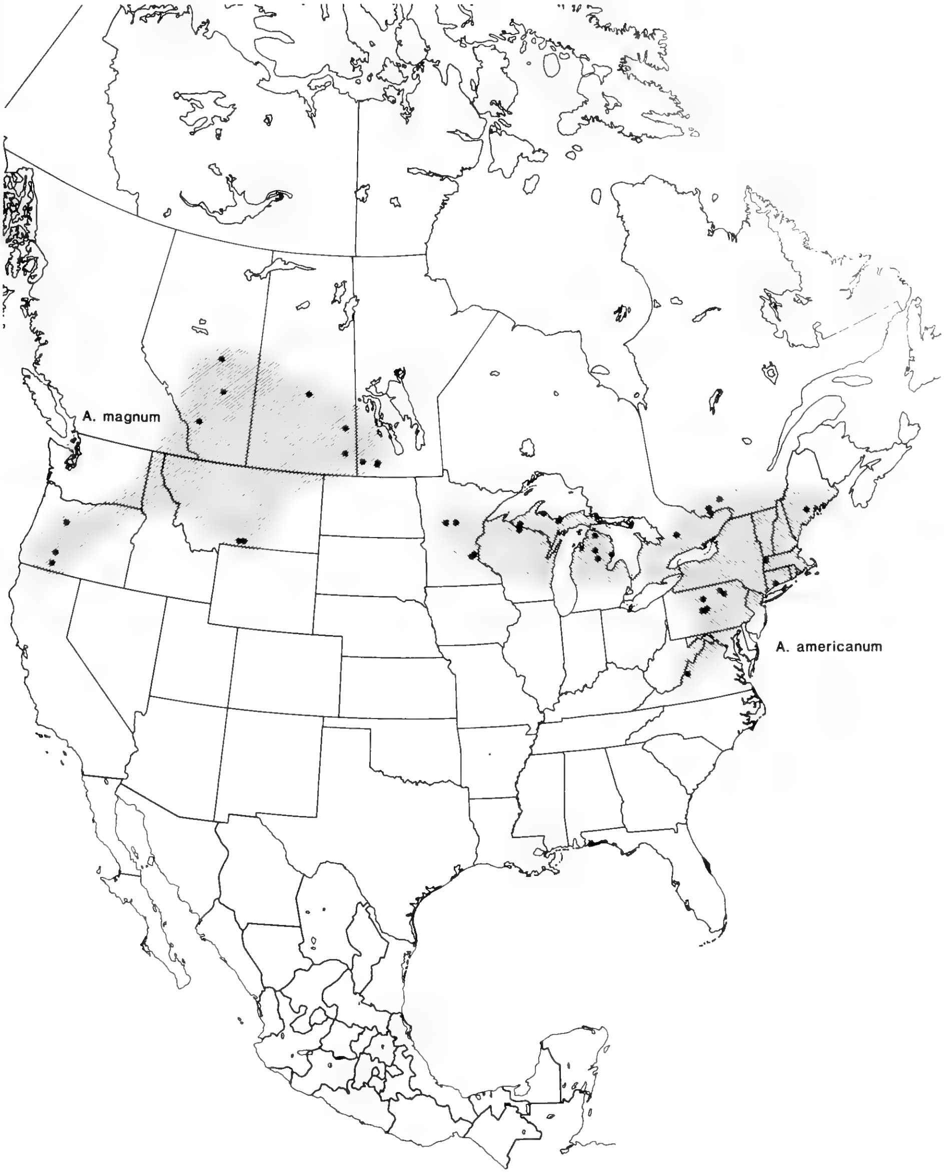


Fig. 14. Distribution of *Arthropeas americanum* and *A. magnum.*

Immature stages.—Unknown.

Type-material.—The holotype male (MCZ) and paratype female (MCZ Type Number 12616) were collected at Beulah, Manitoba.

Distribution (Fig. 14).—*A. magnum* is a northwestern species extending from Manitoba to Oregon. Townsend (1895, *Arthropeas* n. sp.?) reported a female specimen from Hill City, South Dakota, which Johnson (1913) identified as *Arthropea magnum,* but I have been unable to locate this specimen.

UNITED STATES.—MONTANA: Mystic Lake (Stillwater County); Red Lodge Creek, 3 mi SW Luther. OREGON: Lake of Woods (Klamath County); Big Meadow near Santiam Highway (Linn County near Three Finger Jack Mountain); Crater Lake National Park. CANADA.—ALBERTA: Edmonton; Nevis; Jumping Pond Creek, 20 mi W Calgary. MANITOBA: Aweme; Treesbank; Virden. SASKATCHEWAN: Broadview; Prince Albert; Good Spirit Lake (north of Yorkton).

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PROC. ENTOMOL. SOC. WASH.
85(4), 1983, pp. 748–752

SEXING *HYLURGOPINUS RUFIPES* (EICHHOFF) (COLEOPTERA: SCOLYTIDAE) WITH SCANNING ELECTRON MICROSCOPY

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Abstract.—Morphological structures including the size and shape of antennal clubs, the presence of ostioles on female antennal clubs and membranous prothoracic cavities on females are described. When viewed with SEM, these previously undescribed characteristics can provide positive sexual identification of *H. rufipes.*

Few scanning electron microscopy (SEM) studies have been conducted in order to describe antennal morphology of scolytid species (Payne et al., 1973; Borg and Norris, 1971) and bioacoustic mechanisms (Barr, 1969; Michael and Rudinsky, 1972; Rudinsky and Michael, 1973). Except for taxonomic illustrations by Bright (1976) there are no published reports of SEM having been utilized to study *Hylurgopinus rufipes* (Eichhoff), a major vector of Dutch elm disease in northern sections of the United States and southern Canada. To effectively diminish this beetle's role as a vector, knowledge of beetle-beetle and beetle-host relationships is essential. SEM studies can augment this knowledge.

The studies, referred to above, were performed with species for which pheromones or aggregation attractants are known to exist. However, Gardiner (1979) reported that there is no evidence for pheromone production by *H. rufipes.* As research continues on *H. rufipes* in relation to the existence of chemical cues (J. W. Peacock, personal communication), the ability to accurately sex the insect for bioassay purposes is essential. No externally identifiable sex characters have been reported for *H. rufipes* (Kaston, 1936). Our investigation described antennal morphology and a heretofore undescribed secondary sexual characteristic. Both can distinguish the sexes of *H. rufipes* when viewed with an SEM.

Materials and Methods

Sexing involved examining the terminal abdominal segments for movement. Rapid movement of these segments indicated a male, whereas lack of movement or slow movement indicated a female. Utilizing the above behavioral trait, 50 *H. rufipes* of each sex were selected for SEM studies. Dissections have proven this method to be 90% accurate (Lanier, unpublished data).

After sexing, specimens were mounted on aluminum stubs with conductive cement and sputter-coated (Model Hummer V, Technics[1], Springfield, Va.) with

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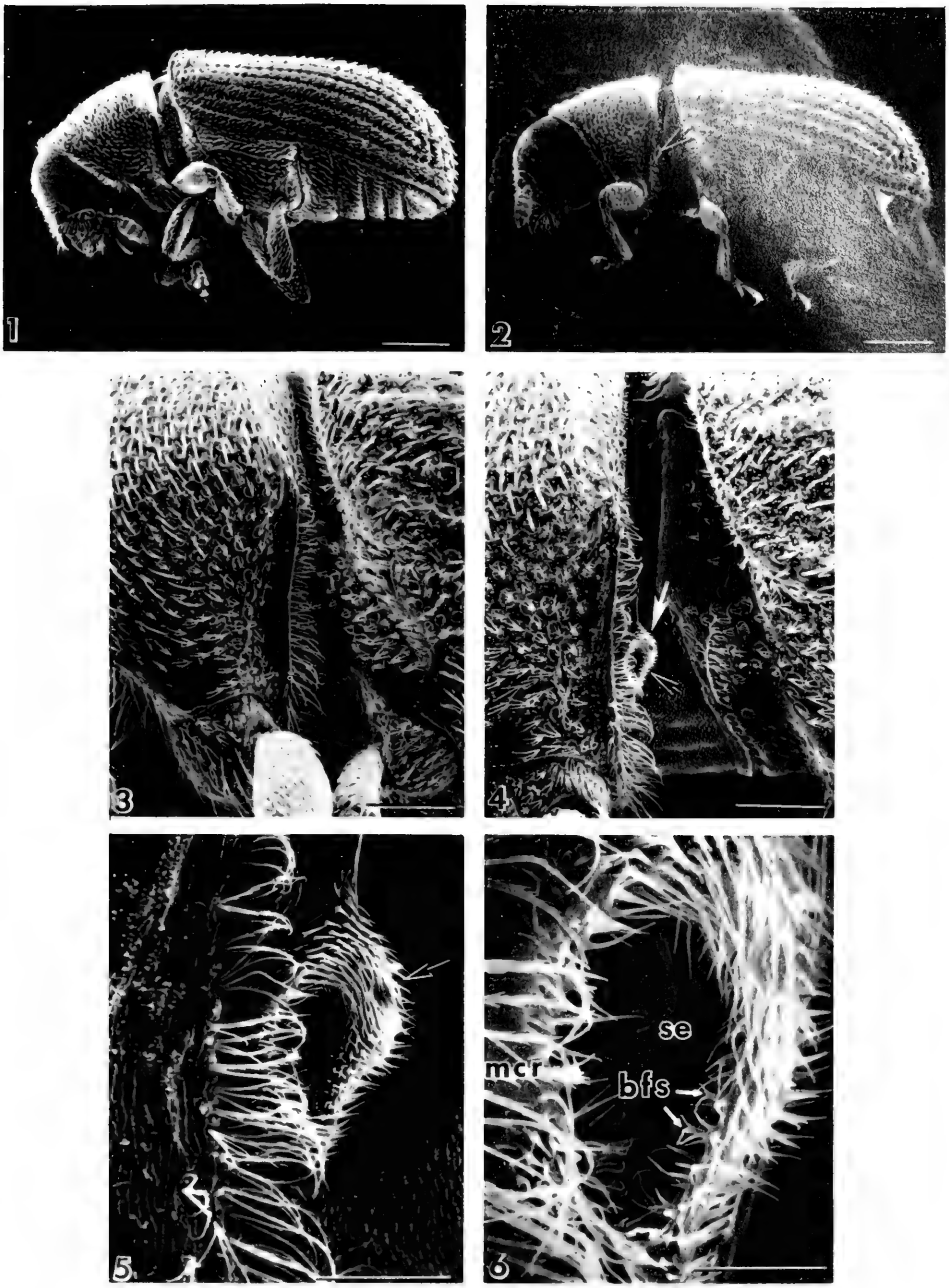
[1] The use of trade, firm, or corporation names in the publication is for the information and convenience of the reader. Such use does not constitute an official endorsement or approval by the U.S. Department of Agriculture of any product or service to the exclusion of others that may be suitable.



Figs. 1–6. *Hylurgopinus rufipes.* 1, Adult male (bar = 500 μm). 2, Adult female (note membraneous cavity) (bar = 500 μm). 3, Posterior margin of prothorax of male, lacking a cavity (bar = 140 μm). 4, Cavity on posterior margin of female prothorax (bar = 140 μm). 5, Globular matrix (arrow) on setal border of cavity in female (bar = 50 μm). 6, Mechanoreceptors, bifurcated setae and simple setae visible in and around cavity of female (bar = 20 μm). Abbreviations: bfs = bifurcate setae; mcr = mechanoreceptor; se = simple setae.

Table 1. *Hylurgopinus rufipes* antennal club parameters (μm) ($n = 50$).

	Length		Width	
	Mean	Range	Mean	Range
Female	250	240–265	160	155–170
Male	300	296–320	120	110–125

500 Å of Au, SEM observations were performed with a Hitachi Model S-500 (Mountainview, Calif.) at 20 kV accelerating voltage. Verifications of secondary electron images were performed with a light microscope (Zeiss IV-B, New York, N.Y.). Ten males and ten females were dissected after SEM observation to confirm sex.

RESULTS AND DISCUSSION

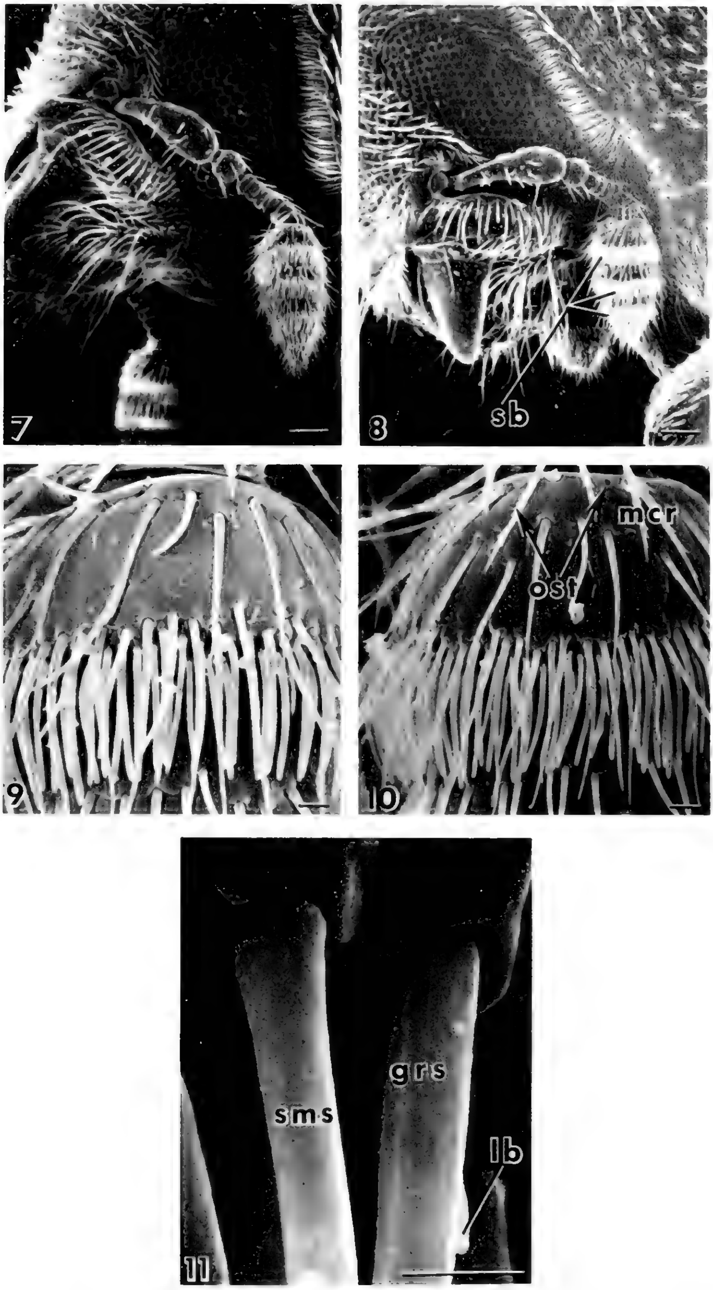
Lateral views are shown of a *H. rufipes* male (Fig. 1) and female (Fig. 2). A membranous cavity surrounded by a dense setal border can be observed on both sides of the lateral posterior region of the prothorax of females (Figs. 2, 4, 5, 6). The cavity was visible with SEM (34X) on gold coated specimens, but was not observed with a light microscope on uncoated beetles. The cavity was positioned under the posterior margin of the prothorax and could not be evaginated. The cavity was not observed on males (Figs. 1, 3). The cavity and associated setae measured ca. 100 μm × 50 μm. Setae were present on the cavity floor (Fig. 6). A globular matrix was seen within the setal border (Figs. 5, 6) on at least ten beetles.

Since serial sections were not made of the female prothoracic area associated with the cavity, we cannot definitively relate the structure to function. Further studies are needed to determine if the cavity is a simple invagination or an opening of a secretory duct. The globular matrix observed within setal borders suggests a glandular function. Faustini (1980) found similar structures (which he referred to as setiferous sex patches) on numerous beetle species. In several instances, Faustini found that setiferous sex patches were responsible for the release of pheromones.

The antenna of *H. rufipes* consists of a seven-segmented funicle and a club that varies in size and shape according to sex. The male antennal club is significantly ($P < .05$) longer and more protracted than the female antennal club (Table 1, Figs. 7, 8). Antennal clubs of both sexes have three distinct sensory bands, with the distal band being the largest. Within the sensory bands were numerous sensilla. The types and sizes were nearly identical in both sexes. A notable sex-related difference was the presence of ostioles on the proximal end of female antennal clubs (Fig. 10).

Table 2. Length of *Hylurgopinus rufipes* antennal sensilla (μm).

	Mean	Range
Smooth	14	13–17
Grooved	22	20–24



Figs. 7–11. *Hylurgopinus rufipes.* 7, Antenna of male, longer and more protracted than female antennal club (bar = 80 μm). 8, Antenna of female (note sensory bands) (bar = 80 μm). 9, Ostioles absent from proximal end of male antennal club (bar = 4 μm). 10, proximal end of female antennal club showing ostioles and mechanoreceptors (bar = 4 μm). 11, Smooth and grooved sensilla found on antennal clubs of both sexes (bar = 3 μm). Abbreviations: grs = grooved sensilla; lb = lateral branch; mcr = mechanoreceptor; ost = ostia; sb = sensory bands; sms = smooth sensilla.

Smooth and grooved sensilla were found within the sensory bands (Fig. 11). Numbers of each sensillum were not determined. Grooved sensilla were considerably longer (Table 2) and had short lateral branches present (Fig. 11). On a given sensillum the number of lateral branches were few but counts were not obtained.

Smooth sensilla were enlarged at the point of contact with their sockets (Fig. 11). These sensilla are similar to sensilla basiconica of other scolytids (Payne et al., 1973). Electrophysiological studies with sensilla basiconica on other insects have demonstrated that sensilla may be responsive to pheromones (Kinzer et al., 1969; Silverstein et al., 1968).

Mechanoreceptors were present on the funicle and none were observed on the club (Fig. 9, 10). Mechanoreceptors are often found "protecting" an underlying band of sensory sensilla, but as is the case with *Dendroctonus* spp., the smooth sensilla on *H. rufipes* lie flat and may not require protection (Payne et al., 1973).

In addition to behavioral traits used previously, we now know of several morphological structures by which *H. rufipes* can be sexed. These include the size and shape of antennal clubs, the presence of ostioles on female antennal clubs and a membranous cavity on females.

Contrary to findings of Gardiner (1979), our findings concerning the types of antennal sensilla and the presence of what may be a secretory duct indicate that some form of chemical communication system may be utilized by *H. rufipes.*

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THE WHITE PEACH SCALE, *PSEUDAULACASPIS PENTAGONA* (TARGIONI-TOZZETTI) (HOMOPTERA: DIASPIDIDAE): EVIDENCE THAT CURRENT CONCEPTS INCLUDE TWO SPECIES[1]

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Abstract.—Evidence is presented that the current species concept of the white peach scale, *Pseudaulacaspis pentagona* (Targioni-Tozzetti) is incorrect and actually includes two species, *P. pentagona* and the white prunicola scale, *P. prunicola* (Maskell). Characteristics used to distinguish between the species include body microstructures, egg colors, host differences, distribution patterns, life history differences, and host transfer data. New data are given on synonymies, morphologies, hosts, distributions, and life histories. First instars and second-instar males of each species were studied but no conspicuous species differences were found.

The white peach scale, *Pseudaulacaspis pentagona,* was described by Targioni-Tozzetti in 1886 from several localities in Italy. Since then, other alleged species have been described and subsequently synonymized with *P. pentagona,* including *Pseudaulacaspis prunicola* (Maskell, 1895).

In the course of research on the economic scale insects of the United States, we noted that Kawai (1980) had treated *P. prunicola* as a species distinct from *P. pentagona.* Since *P. prunicola* has not been reported from the United States, we investigated the distinctiveness of these species further.

The purpose of this paper is to demonstrate that the traditional concept of *P. pentagona* is partially incorrect, and that this taxon actually is composed of two cryptic species. The second species is *P. prunicola.*

MATERIALS AND METHODS

The preliminary search for taxonomic characters involved a detailed examination of 15 specimens of each species from as many localities and hosts as possible. After preliminary morphological differences were discerned, 70 specimens of *P. prunicola* and 74 specimens of *P. pentagona* were used for determi-

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nation of ranges and means. Levels of significance were determined using a standard *t*-test.

Field samples were collected on the College Park Campus, University of Maryland, at irregular intervals from May 27 to October 16, 1981. Branches about 15 cm long were clipped from the host and were examined using a Wild M-5 dissecting microscope at magnifications of 10–60×. At least 15 specimens were examined during each observation; stages present were recorded. *Pseudaulacaspis pentagona* was sampled from a 10 m tall *Morus alba* L., and *P. prunicola* was sampled from a 5 m tall *Prunus serrulata* Lindl. Several additional, life history observations were made in 1982 by Dr. Tova Rivnay in the National Arboretum, the Lyndon B. Johnson Grove, and the East Potomac Park, Washington, D.C.

Laboratory colonies were established from the field populations mentioned above. Transfers were made by placing heavily infested twigs about 7 cm long on top of scrubbed, Idaho russet potatoes. The twigs were removed after 3 weeks. The stock colonies of each species were kept in separate rooms to avoid accidental cross contamination. The rooms were maintained at about 20°C. After two generations on the potatoes, 30 specimens of each species were mounted in Hoyer's mounting medium and examined to see if any morphological differences could be detected between the colony on the potatoes and the source colony. Illustrations were prepared using a Zeiss, phase contrast microscope at magnifications of 256, 640, and 1600. Type material or specimens identified by the author of each junior synonym have been examined.

RESULTS

The following information is not intended to be an exhaustive treatment but includes only data pertinent to distinguishing between *Pseudaulacaspis pentagona* and *P. prunicola.*

***Pseudaulacaspis pentagona* (Targioni-Tozzetti)**

Fig. 1

ESA approved common name.—White peach scale.

Synonyms and combinations.—*Diaspis pentagona* Targioni-Tozzetti 1886: 2; *Diaspis amygdali* Tryon, 1889: 89; *Diaspis lanatus* Morgan, 1892: 137; *Diaspis patelliformis* Sasaki, 1894: 107; *Aspidiotus vitiensis* Maskell, 1895: 40; *Diaspis geranii* Maskell, 1898: 228; *Aulacaspis* (*Diaspis*) *pentagona* (Targioni-Tozzetti): Newstead, 1901: 173; *Sasakiaspis pentagona* (Targioni- Tozzetti): Kuwana, 1926: 9; *Aspidiotus lanatus* ("Cockerell"): Ferris, 1941: 45.

Type material.—We have examined specimens of the following junior synonyms and have confirmed that they are the same as *P. pentagona. Diaspis amygdali* Tryon—6 slides with label "Diaspis/amygdali/Mask./Australia/Mask. Coll. No. 292." *Diaspis lanatus* Morgan—1 slide with label *"Diaspis/lanatus* Ckll./On *Capsicum*/Kingston, Jamaica/T.D.A. Cockerell from Type material." *Diaspis patelliformis* Sasaki—2 slides with label "6025. *Diaspis/patteliformis* (sic)/Saraski. (sic)/Mulberry. Milo, Japan/P. Takabashi. (sic)"; according to notes made by Pergande when the material was received, the specimens were collected November 20, 1893 and were sent by Takahashi as dry material. *Aspidiotus vitiensis* Maskell—8 slides with label "Aspidiotus/vitiensis/Mask./Fiji/Mask. Coll. No. 4.5." *Diaspis/geranii* Maskell—6 slides with label "Diaspis/geranii/Green/Ceylon/Mask.

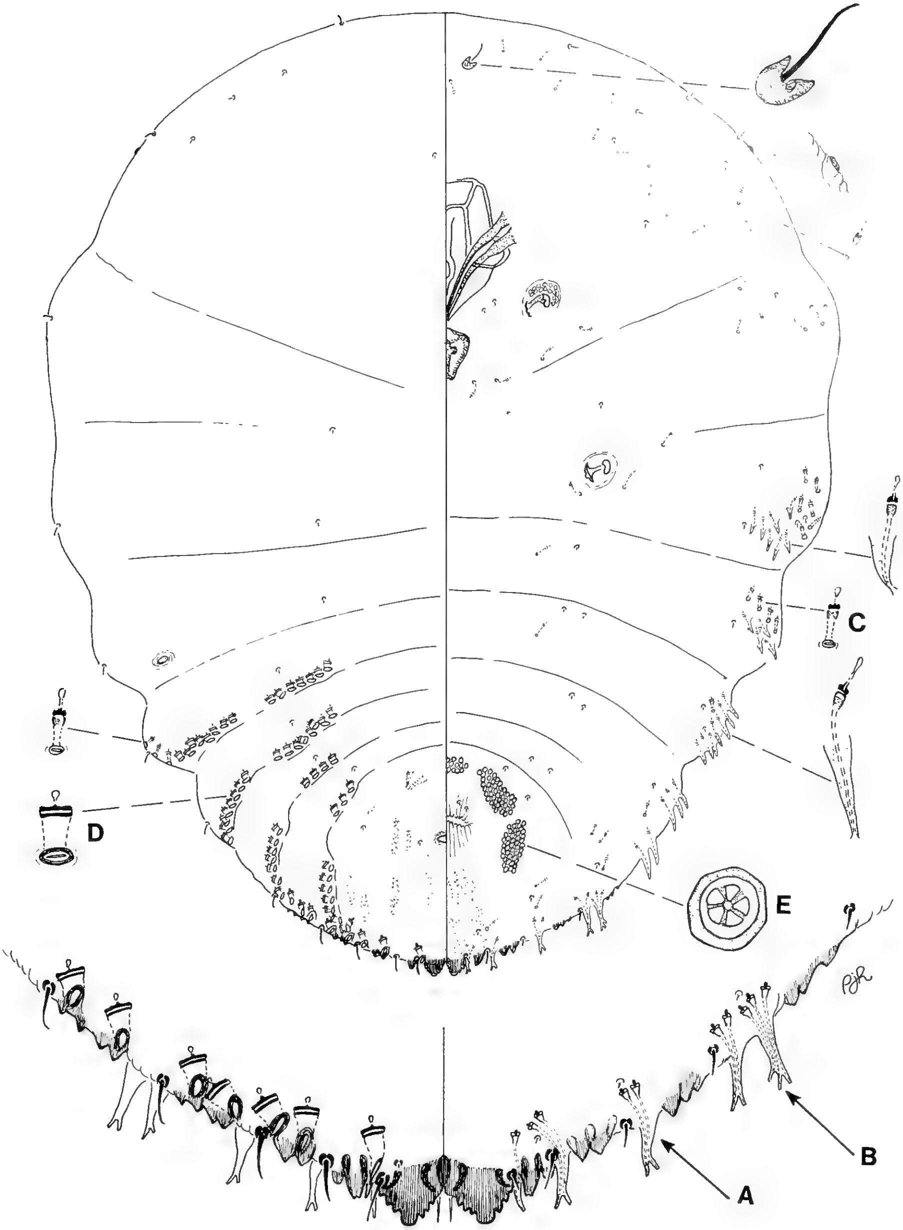

Fig. 1. *Pseudaulacaspis pentagona,* adult female, Hartford Co., North Carolina, IX-29-58, on "umbrella tree." A, Gland spine in third space. B, Bifurcate and trifurcate gland spines. C, Small macroducts. D, Large macroduct. E, Perivulvar pore.

Coll. No. 345"; based on notes taken when the Maskell collection was loaned to Morrison, the above specimens probably were collected on geranium in 1893 and were sent to Maskell by Green.

As is true of most Targioni-Tozzetti species, we have been unable to locate any of the type series. (See Danzig and Kerzhner, 1981, and Miller, 1981, for the designation of a neotype of *Pseudococcus longispinus* (Targioni-Tozzetti)). Therefore, in order to stabilize the identity of *Diaspis pentagona* Targioni-Tozzetti and to avoid further confusion among closely related species, we have selected a neotype that is labelled as follows: Left label "Canzo, Italy/II-11-1982/on Mulberry/coll: A. Tranfaglia"; right label "Neotype/Diaspis/pentagona/Targioni-Tozzetti/desig. Davidson/& Miller 1983." In addition to the neotype there are 24 paraneotypes. The neotype and several paraneotypes are deposited in the collection of the Instituto di Entomologia Agraria, Portici, Naples, Italy. Additional specimens from the same series are deposited in Auburn University, Auburn, Alabama; British Museum (Natural History), London; California Department of Food and Agriculture, Sacramento; Florida State Collection of Arthropods, Gainesville; Museo de Historia Natural de Ciudad de Mexico, Mexico D.F.; Museum National d'Histoire Natural, Paris; University of California, Davis; University of Georgia, Experiment; University of Hawaii at Manoa, Honolulu; National Museum of Natural History, Washington, D.C.; Virginia Polytechnic Institute and State University, Blacksburg; and Zoological Institute, Academy of Sciences of USSR, Leningrad.

Differentiating morphological characters.—On the pygidium the third space usually has 1 gland spine (Fig. 1A); the second, third, or fourth spaces has at least 1, usually more, bifid or trifid gland spines (Fig. 1B); there are 5–22 (12) small macroducts (Fig. 1C) on each side of the metathorax and abdominal segment I; there are 40–106 (68) large macroducts (Fig. 1D) on each side of the body; and there are 51–124 (75) perivulvar pores (Fig. 1E) on each side of the pygidium.

Differentiating field characters.—Eggs are either light salmon or white. A single female may lay all salmon eggs, all white eggs, or a combination of both.

Hosts.—We have examined specimens of this scale collected from 88 genera of host plants. Borchsenius (1966) recorded it from 108 genera of plants and Dekle (1977) reported it from 115 genera. In the United States the white peach scale is commonly collected on *Prunus persica* (L.), *Morus alba, Callicarpa* spp., *Diospyros* spp., and *Melia azedarach* L. It has not been reported on *Syringa* spp.

Distribution.—This species generally is found in tropical and subtropical areas of the world. We have examined specimens from Africa, Asia, Australia, the Caribbean Islands, Central America, the Pacific Islands, South America, and western Europe. In the United States we have seen material from Alabama, California, the District of Columbia, Florida, Georgia, Hawaii, Indiana, Louisiana, Maryland, Mississippi, New Mexico, North Carolina, South Carolina, Tennessee, Texas, and Virginia. The records from California, Hawaii, Indiana, and New Mexico are based on a single collection and may not represent established populations.

Life history observations.—In 1981: May 27—settled crawlers; June 19—mostly newly-molted adult females; June 26—adult females; July 1—egg-laying adult females and a few crawlers; July 6—eggs and crawlers; July 14—primarily crawlers; July 22—prepupal and pupal males, mostly second-instar females, and a few adult females; August 20—egg-laying adult females and eggs; August 29—eggs and a few crawlers; October 16—adult males, adult females, and a few second-instar females. In 1982: May 4—adult female and first eggs of season; July 7—adult females and eggs.

***Pseudaulacaspis prunicola* (Maskell)**

Fig. 2

Suggested common name.—White prunicola scale.

Synonyms and combinations.—*Chionaspis prunicola* Maskell 1895: 49; *Diaspis amygdali* var. *rubra* Maskell (in part) 1898: 228; *Diaspis auranticolor* Cockerell 1899: 106; *Howardia prunicola* (Maskell): Kirkaldy 1902: 112; *Aulacaspis pentagona rubra* (Maskell): Fernald 1903: 235; *Aulacaspis pentagona auranticolor* (Cockerell): Carnes 1907: 160; *Diaspis rubra* Maskell: Scott 1952: 35, *Pseudaulacaspis prunicola* (Maskell): Kawai 1980: 275.

Type material.—The lectotype of *Chionaspis prunicola* Maskell is being designated by Butcher (personal communication) and is deposited in the New Zealand Arthropod Collection, Auckland. We have examined this specimen and have confirmed that it is the same species as other material mentioned in this description. Four additional specimens from the type series are in the National Museum of Natural History, Coccoidea Collection, Beltsville, Maryland. The species originally was described from Hawaii on "Japanese plum." Based on the fact that the scale was killing the trees, Maskell wrote "I presume therefore that the insect originally comes from Japan." It is interesting to note that white prunicola scale has never been recorded from Hawaii since the original description. We have examined specimens of the following junior synonyms and have confirmed that they are the same as *P. prunicola. Diaspis amygdali* var. *rubra*—6 slides from Ceylon with Maskell Collection number 565 and 1 slide with label "*Diaspis/amygdali* var./*rubra* Mask/*Loranthus*?/*Orixa japonica*/Ceylon & Japan/Maskell Coll. 565/PHOTO." The first six slides are the same as *Pseudaulacaspis barberi* (Green) 1908; the single slide is the same as *Pseudaulacaspis prunicola.* We believe that these slides are part of the type series but were mounted from dry material after the species was described. The single slide is probably from Japan. *Diaspis auranticolor*—1 slide with label "*Diaspis*/*auranticolor*/Ckll./Cotype/Japan." This material apparently is from the type series but was mounted from dry specimens after the species was described.

Differentiating morphological characters.—On the pygidium the third space usually has 2 or more gland spines (Fig. 2A); the second, third, and fourth spaces usually have simple gland spines only (Fig. 2B); there are 0–15 (4) small macroducts (Fig. 2C) on each side of the metathorax and abdominal segment I; there are 38–86 (58) large macroducts (Fig. 2D) on each side of the body; and there are 35–99 (65) perivulvar pores (Fig. 2E) on each side of the pygidium.

Differentiating field characters.—Eggs are always light salmon in color.

Hosts.—We have examined specimens of this scale collected on 21 genera of host plants. In the United States the white prunicola scale is commonly collected on *Prunus* spp., particularly *P. serrulata,* and on *Ligustrum* spp. and *Syringa* spp.

Distribution.—This species generally is found in temperate areas of the world. We have examined specimens from the People's Republic of China, Japan, Korea, Okinawa, and Taiwan. In the United States we have seen material from Alabama, California, Connecticut, the District of Columbia, Florida, Hawaii, Louisiana, Maryland, Massachusetts, Mississippi, New Jersey, New York, North Carolina, Ohio, Oregon, Pennsylvania, Rhode Island, Virginia, and West Virginia. The species is known from only a single collection from California, Hawaii, and Oregon; these records may not represent established populations.

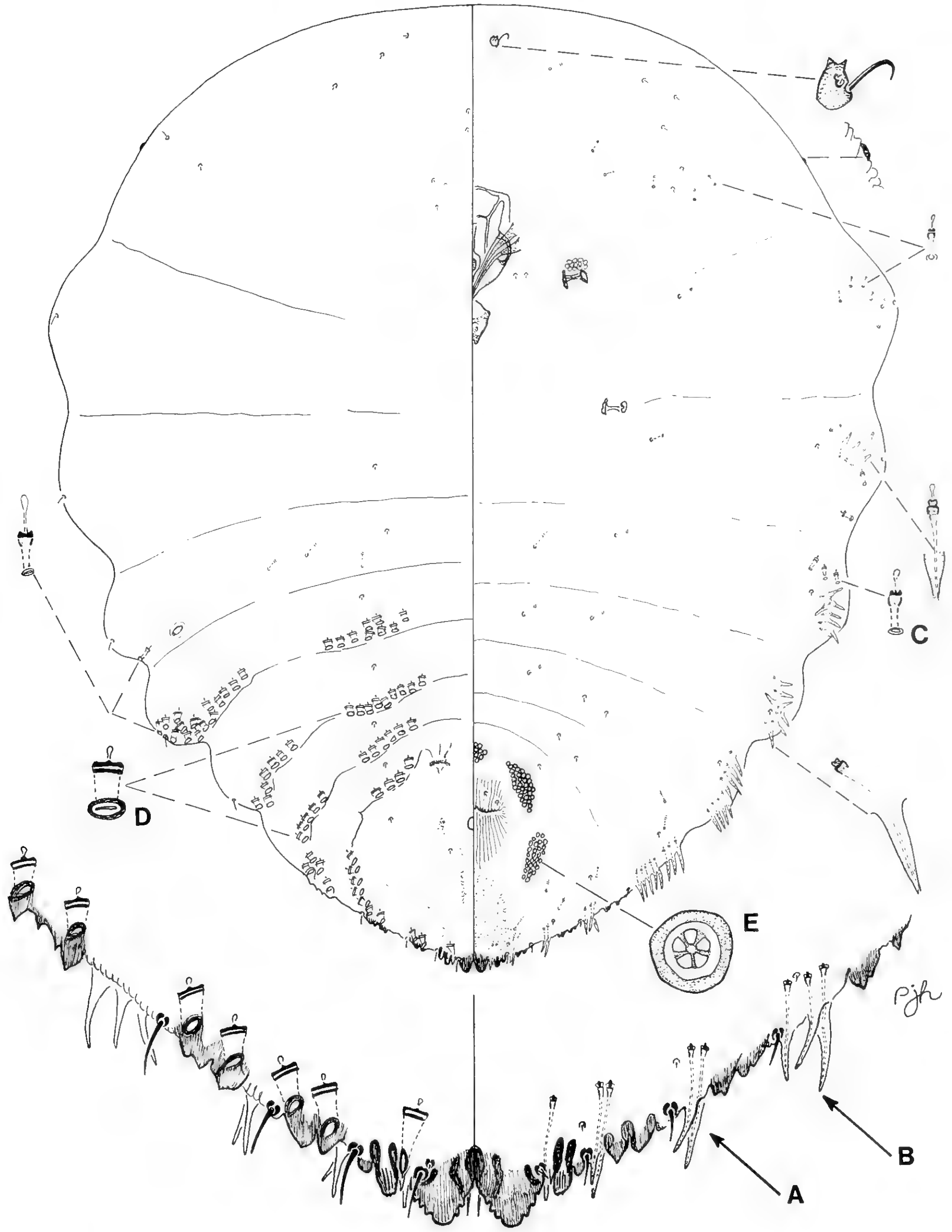

Fig. 2. *Pseudaulacaspis prunicola,* adult female, Hawaii, 1894, on "Japanese Plum." A, Gland spines in third space. B, Simple gland spine. C, Small macroduct. D, Large macroduct. E, Perivulvar pore.

Life history observations.—In 1981: May 5—eggs and a few crawlers; May 26—second-instar males and females; June 9—newly-molted adult females; June 24—adult females and eggs; June 29—adult females and eggs; July 1—crawlers and a few eggs; July 6—crawlers; July 14—mostly second-instar males and females;

Table 1. Comparison of four characters between *Pseudaulacaspis pentagona* and *P. prunicola.* For each character, differences between species were detected with a student's *t*-test. For each species significant differences were found in the numbers of small macroducts, total large macroducts, perivulvar pores, and gland spines.

Characters	Species	Mean	± Standard Error	*n*	*t*-test value	Level of significance
Number of small macroducts on methathorax and seg. 1	*pent.*	11.72	.48	56	12.20	$P < .001$
	prun.	4.81	.32	62		
Number of large macroducts	*pent.*	67.66	2.28	50	3.57	$P < .001$
	prun.	57.64	1.59	47		
Number of perivulvar pores	*pent.*	76.04	2.21	65	3.92	$P < .002$
	prun.	65.39	1.60	67		
Number of gland spines	*pent.*	1.05	.03	65	12.56	$P < .001$
	prun.	2.07	.08	58		

August 17—mostly eggs; August 18—eggs; August 20—eggs and crawlers; September 24—adult males and adult females. In 1982: April 26—many eggs; May 6—first crawlers.

Host transfer information.—Transfer of specimens to potato was more successful with the white peach scale. Each potato had approximately 100 settled crawlers when the dried mulberry twig was removed. In the case of the white prunicola scale, each potato had only 40–50 settled crawlers when the cherry twig was removed. After two generations on the potatoes each species maintained its separate identity with the exception of two specimens of white peach scale that were found on a potato in a prunicola scale colony. We believe that these specimens were accidentally introduced as contaminants on the microscope that was used to examine both populations. Inspection of the remainder of the population on the cross contaminated potato revealed no more material of the white peach scale.

DISCUSSION

The following information suggests that the white peach scale, *Pseudaulacaspis pentagona,* and the white prunicola scale, *P. prunicola,* are separate and distinct species. Morphologically most taxonomic characters show some overlap but are statistically significant at the .001 or .002 levels (Table 1). The white peach scale has more perivulvar pores, more large macroducts, more small macroducts on the metathorax and abdominal segment I, and has fewer gland spines in the third space. Kawai (1980) used characteristics of the gland spines and antennae to separate the species. We were unable to detect significant differences in the morphology of the antennae.

The eggs of the white peach scale may be white or salmon, whereas those of white prunicola scale are always salmon. According to Bennett and Brown (1958) in white peach scale the salmon eggs contain female embryos and the white eggs contain males. We did not test this hypothesis.

Both species are polyphagous, but each is most commonly collected on different hosts. In the Washington, D.C. region, the white peach scale is most frequently collected on mulberry, *Morus alba*; and the white prunicola scale is most often found on Japanese flowering cherry, *Prunus serrulata.*

In terms of geographic distribution, the white peach scale tends to be a more tropical or subtropical species, whereas the white prunicola scale is a more temperate species. Occurrence of the white peach scale in Indiana and the presence of the white prunicola scale in California, Florida, Hawaii, Louisiana, Mississippi, and Okinawa are exceptions to this general pattern. Many of these records are based on one or two collections and may represent infestations that did not become established.

Our life-history observations suggest that the white peach scale begins its activity later in the year than the white prunicola scale, and that this delay remains throughout the season. We found three generations each year in both species. Based on voucher specimens deposited in the National Museum of Natural History, the life-history study of Stimmel (1982) pertains to *P. prunicola.* He found only two generations each year in the cool climate of northeastern Pennsylvania on *Prunus serrulata.*

Both species maintained their unique taxonomic integrity even when they were transferred to potatoes and were maintained under similar environmental conditions. If there were some host-induced-influences on these characteristics, we did not observe them.

Small series of first instars and second-instar males of each species were studied to determine if major differences could be discovered that would support our findings with the morphology of the adult females. Unfortunately, only minor differences were found, and it was beyond the scope of this paper to determine if these differences were interspecific or intraspecific.

Acknowledgments

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THE NORTH AMERICAN SPECIES OF THE *COCKERELLI* AND *DORSASETULA* GROUPS OF THE PREDACEOUS MIDGE GENUS *BEZZIA*, SUBGENUS *HOMOBEZZIA* (DIPTERA: CERATOPOGONIDAE)

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Abstract.—The *cockerelli* and *dorsasetula* Groups of the subgenus *Homobezzia* Macfie, genus *Bezzia* Kieffer, are represented in North America by seven species. A key is presented for the separation of these species and to distinguish them from other subgenera and groups of *Bezzia*; diagnoses are given for the groups; the American species are redescribed and illustrated; and notes are given for the larval habitats and known biology. *Bezzia modocensis* Wirth is a new junior synonym of *B. pruinosa* (Coquillett). Two new species, *Bezzia* ***saileri*** from Alaska and *B.* ***twinni*** from Manitoba, are described in the *cockerelli* Group.

This review is one of a series in which additions and corrections are made to the "Revision of the Nearctic Species of the Genus *Bezzia*" by Dow and Turner (1976). In the present series six groups have already been studied in depth since 1976: Grogan and Wirth (1981) on the genus *Amerohelea* Grogan and Wirth; Wirth and Grogan (1982) on the genus *Phaenobezzia* Haeselbarth; Wirth and Grogan (*in press*) on the *bivittata* Group of *Bezzia* subgenus *Bezzia* Kieffer; Wirth (1983) on the *nobilis* Group of the subgenus *Bezzia* s. str.; Wirth et al. (*in press*) on the *annulipes* Group of *Bezzia* subgenus *Homobezzia* Macfie; and Wirth (*in press*) on the *bicolor* Group of the subgenus *Homobezzia*. The present paper deals with the two remaining groups of the subgenus *Homobezzia*, which are here named the *cockerelli* and *dorsasetula* groups.

The first North American species to be described in these groups was *Bezzia pruinosa* (Coquillett), described from British Columbia in 1905. In 1915 Malloch described *Bezzia cockerelli* from Colorado and *Bezzia obscura* from New York. Wirth (1952) added *B. modocensis* and *B. sordida* from California, but the former is shown herein to be a junior synonym of *B. pruinosa*. Dow and Turner (1976) added descriptions of *Bezzia dorsasetula* and *B. obelisca* from New York, and sank *B. obscura* as a junior synonym of *B. cockerelli*. In this paper I present diagnoses of the *cockerelli* and *dorsasetula* groups, a key to separate the North American species and to distinguish them from other subgenera and groups of the genus *Bezzia*. Two far-northern species are described as new.

A discussion of the taxonomic characters used and a more complete discussion of the subgeneric and group classification in the genus *Bezzia* are given in the three above-mentioned papers on the *bivittata* Group, the *nobilis* Group, and the *annulipes* Group.

Synoptic Key to Subgenera and Groups of Nearctic *Bezzia*

1\. Male antennal segment 12 no longer than 13, antennal plume weakly developed; (mesonotum dull, occasionally weakly shiny, brownish or grayish with or without vittae; tibiae pale or with a dark medial or basal ring; spines of forefemur stout when present; female with 0–5 pairs of gland rods; male considerably smaller than female; male aedeagus triangular with minute spinules or hairs) (Subgenus *Homobezzia* Macfie) 2

– Male antennal segment 12 longest; antennal plume well developed, extending at least to apex of 13th segment; (mesonotum black, shiny or dull or with silvery hairs, if grayish brown with dark vittae, hindtibia yellow in midportion, apex broadly black, and all femora bear spines; tibiae often black; forefemur with spines slender when present; female abdomen with 1–2 pairs of gland rods; male about same size as female; male aedeagus variable but not as above .... Subgenus *Bezzia* Kieffer, s. str.

Subgenus *Homobezzia* Macfie

2\. Larger species, female wing 1.3–3.4 mm long; mesonotum without bristly setae on disc; (forefemur without spines or with 1–4 stout to slender spines of similar lengths, with or without strong basal tubercles; pupal respiratory horn with numerous (25–60) spiracular openings, apex more or less flared, abdominal tubercles well developed) 3

– Small species, female wing 1.2–1.3 mm long; mesonotum with 2 rows of strong bristly setae on disc; (forefemur with 5–7 stout ventral spines of alternating uneven lengths arising from distinct elevations; pupal respiratory horn with only 7–12 spiracular openings, abdominal tubercles small) (*dorsasetula* Group) 9

3\. Forefemur unarmed ventrally .... *bicolor* Group

– Forefemur armed ventrally with one or more short black spines 4

4\. Fore- and midfemora entirely dark brown or with dark bands apical (*cockerelli* Group) 5

– Fore- and midfemora with subapical dark bands .... *annulipes* Group

cockerelli group

5\. Forefemur with 4–5 ventral spines; antenna uniformly black, segments definitely more slender distad; female antennal ratio 1.00; male plume long, dense and blackish; mesonotum without strong discal setae, setae above wing bases long and black; spermathecae small and globular to slightly ovoid with short necks .... *pruinosa* (Coquillett)

– Forefemur with 2 (rarely 3) ventral spines; antenna paler, segments usually with paler bases; male plume shorter and sparse; setae above wing bases shorter and paler; mesonotum and spermathecae various 6

6\. Spermathecae large and oval without distinct necks; mesonotum yellowish with 3 broad brownish vittae; antenna short, female antennal ratio 0.77 .... *cockerelli* Malloch

– Spermathecae small and globular to ovoid with short necks; mesonotum uniformly pale to dark brownish; antennal segments various 7

7\. Mesonotum without strong discal setae; femora and tibiae varying from yellowish with subbasal brown bands on fore- and hindtibiae to entirely dark brown; antennal segments slender and tapering, antennal ratio 1.00 .... *sordida* Wirth

– Mesonotum with scattered enlarged setae on disc; leg pattern various; antennal segments short and not tapering, antennal ratio 0.70–0.82 8

8. Mesonotum with dense vestiture of scattered enlarged setae; legs yellowish with only knee spots and apices of tibiae dark brown; female antennal ratio 0.82; male genitalia in outline forming an incomplete circle, the basistyle short and stout to tip .... *saileri,* new species

– Mesonotum with sparse scattered enlarged setae; legs brownish except narrow bases of segments pale; female antennal ratio 0.70; male genitalia of form typical of group, basistyle with mesal hump at base .... *twinni,* new species

dorsasetula group

9. Larger species, female wing length 1.37 mm; wing slender, 3.3× longer than broad; tibiae with pale rings; forefemur with 6–7 spines; antennal segments longer and more slender; male aedeagus with broad basal arch, concave sides; male antennal segment 12 with 4–5 long black setae, 13 with one long black seta, 14 without such setae .... *dorsasetula* Dow and Turner

– Smaller species, female wing length 1.23 mm; wing broader, 2.8× longer than broad; legs uniformly brown; forefemur with 4–5 ventral spines; antennal segments shorter and stouter; male aedeagus with narrow base, low arch, and straight sides, tapered to tip; male antenna with ring of long black setae on segments 12–14 .... *obelisca* Dow and Turner

Genus *Bezzia* Kieffer

Subgenus *Homobezzia* Macfie

The *cockerelli* Group

Diagnosis.—Large, pollinose grayish to dark brown species, female wing length 2.4–2.8 mm. Legs usually yellowish with knees and narrow apices of tibiae dark brown, distal portions of femora and subbasal bands of tibiae sometimes brownish, but bands never subapical on femora; femora and tibiae often entirely brown in *B. pruinosa* (Coquillett). Legs rather stout, forefemur with 2–4 short, stout, black, ventral spines. Wing grayish, unmarked; costal ratio 0.77. Halter dark. Abdomen uniformly subshining brownish, 2–3 pairs of brownish gland rods. Antenna with segments rather short, tip of last segment bluntly rounded. Male with distinct mandibular teeth. Male genitalia typical of subgenus *Homobezzia,* basistyle without mesal lobe or swelling at base; 9th sternum with broad, moderately deep, caudomedian excavation; aedeagus about as long as basal breadth, with well-developed basal arch and slender tip; parameres slender, rodlike distally. Pupa with flaring respiratory horn with numerous (25–50) spiracular openings in a convoluted row around distal portion; abdominal segments broadened in mid-portion with prominent conical lateral tubercles; last abdominal segment with posterolateral processes long and slender, spiculate. Larva with long, slender, subcylindrical head; last segment with prominent, black, anteriorly directed, caudal hairs.

Remarks.—There are five North American species in the *cockerelli* Group, *Bezzia cockerelli* Malloch, *B. pruinosa* (Coquillett), *B. sordida* Wirth, plus two new northern species. *Bezzia cockerelli* is closely related to the Palaearctic species, *B. xanthocephala* Goetghebuer, and paler adults of *cockerelli* cannot be distinguished from *xanthocephala.* The larvae and pupae of the two species are readily distinguished by the characters given in the discussion that follows under the species *cockerelli.* Species of this group have been reared from marshy and swampy ponds and from algal mats.

Bezzia cockerelli Malloch

Fig. 1

Bezzia cockerelli Malloch, 1915: 346 (female; Colorado); Johannsen, 1943: 785 (in list); Dow and Turner, 1976: 85 (male, female redescribed; figs.; distribution; synonym: *obscura*).

Probezzia obscura Malloch, 1915: 355 (female; New York); Johannsen, 1943: 785 (in list).

Bezzia obscura (Malloch), Wirth, 1951: 325 (combination; notes on type).

Female.—Wing length 2.43 mm; breadth 0.80 mm.

Head: Brown; with dense bristly setae. Eyes separated by a distance of 0.090 mm. Antenna (Fig. 1a) uniformly blackish; lengths of flagellar segments in proportion of 28-15-14-13-12-12-12-13-18-18-18-19-19, antennal ratio 0.77. Palpus (Fig. 1c) with lengths of segments in proportion of 8-15-23-15-20; palpal ratio 2.9. Mandible (Fig. 1e) with 11 teeth.

Thorax: Dark brown with dense brownish pubescence; mesonotum pale brownish pollinose, a broad median anterior vitta and a pair of vittae above wings darker brown. Prealar setae 6–10, postalar seta 1, long stout, and blackish; scutellum yellowish, with 8 similar marginal setae. Legs (Fig. 1k) yellowish to pale brown, knees and ends of tibiae narrowly blackish, tarsomeres 3–5 brown; forefemur (Fig. 1j) with 2 (rarely 3) short, stout, black, ventral spines distally; claws as in Fig. 1f. Some specimens with varying amounts of dark brown infuscation on legs, especially on distal ½ of hindfemur. Wing (Fig. 1d) grayish, anterior veins yellowish brown; costal ratio 0.77. Halter pale brown.

Abdomen: Subshining brown, densely setose on sides and on caudal segments; terga with sparse setae. Two pairs of short, brownish, gland rods. Genital sclerotization (Fig. 1i): 8th sternum with an H-shaped pigmented area anterior to gonopore; 9th sternum without pigmented processes. Spermathecae (Fig. 1h) 2 plus rudimentary 3rd; elongate oval without necks, deeply pigmented; slightly unequal, measuring 0.115 by 0.084 mm and 0.100 by 0.070 mm.

Male.—Wing length 1.54 mm; breadth 0.54 mm. Similar to female with usual sexual differences. Antenna (Fig. 1b) with lengths of flagellar segments in proportion of 20-11-11-11-10-10-10-11-11-14-16-17-17; plume sparse and brown, arising from segments 3–12. Mandible (Fig. 1g) with 4–6 distinct teeth. Thorax uniformly dark brown. Legs darker than in female, femora and tibiae brownish except at bases.

Genitalia (Fig. 1m) elongate, dark brown, with strong black setae. Ninth sternum

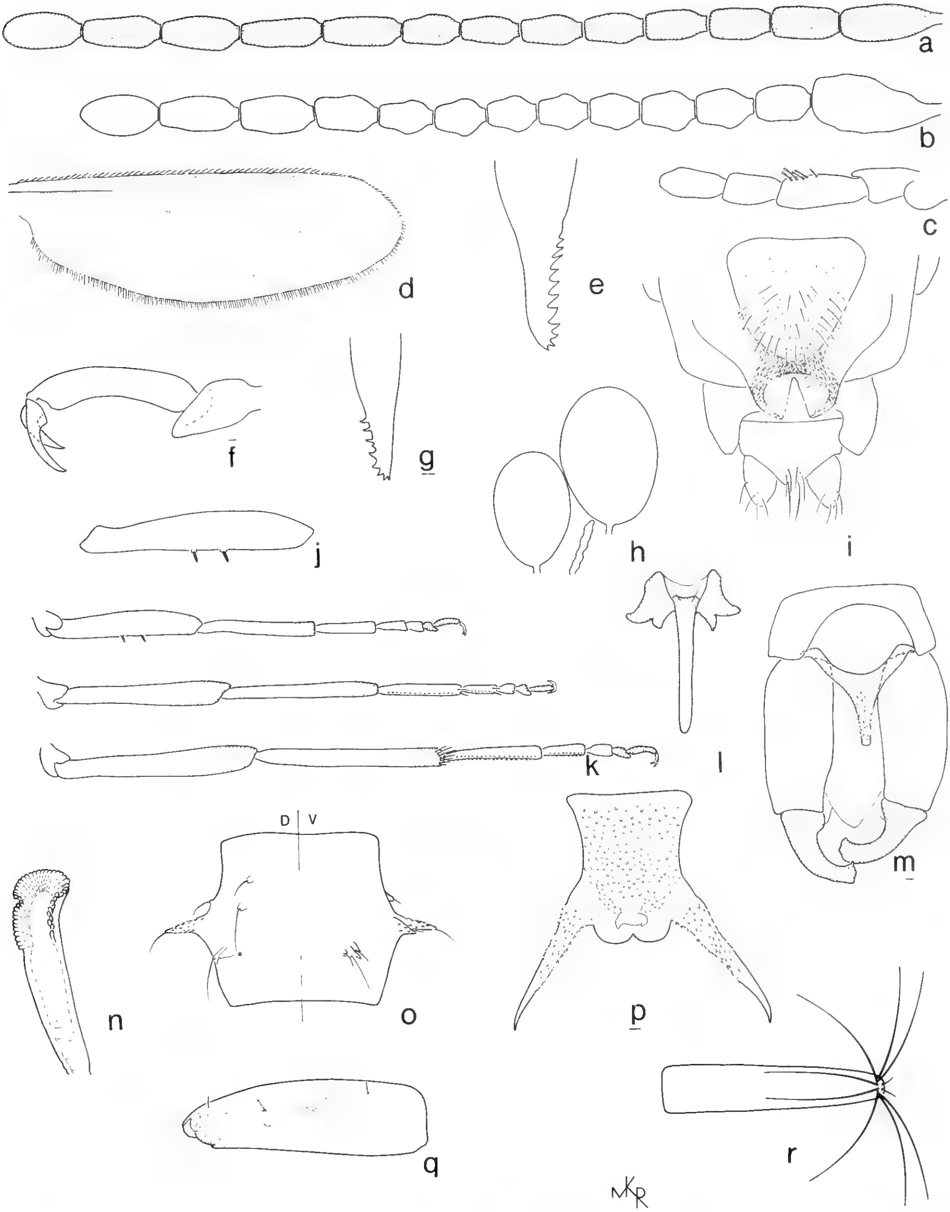

Fig. 1. *Bezzia cockerelli.* a, c–f, h–k, Female. b, g, l–m, Male. n–p, Pupa. q–r, Larva. a, b, Antenna. c, Palpus. d, Wing. e, g, Mandible. f, Tarsomeres 4 and 5 and claws of hindleg. h, Spermathecae. i, Genital sclerotization. j, Forefemoral spines. k, Color pattern of fore-, mid-, and hindlegs (top to bottom). l, Parameres. m, Genitalia, parameres omitted. n, Respiratory horn. o, Dorsal and ventral views of fourth abdominal segment. p, Last abdominal segment. q, Head, side view. r, Last segment, dorsal view.

with broad, deep, caudomedian excavation; basistyle 3× as long as broad, not broadened proximally; dististyle ½ as long as basistyle, heavily sclerotized blackish, with reduced setae, strongly hooked distally with blunt tip; aedeagus with long, slender, basal arms, low basal arch, and short, slender, distal process forming nearly an equilateral triangle with concave sides, distal process strongly spiculate. Parameres (Fig. 1l) with anterolateral plates not deeply lobed, anteromedian cleft a low arch; distal process a very slender, long, straight rod with parallel sides.

Pupa.—Length about 5 mm; color uniform light brown, some dark markings on body segments. Respiratory horn (Fig. 1n) 0.40 mm long, with moderately slender base and flaring tip; 35–40 spiracular openings in a convoluted row around distal ⅓ of horn; tip of horn darker. Integument of cephalothorax micro-rugulose, that of abdomen micro-granulose (pebble-grained). Abdominal segments (Fig. 1o) broad in midportion, the lateral tubercles long and somewhat conical with sharp, thornlike tips, spinulose proximally; 2 pairs of *dasm* tubercles located close together and nearly in line longitudinally, each with a small hyaline seta, a small, pigmented, spineless, 3rd tubercle located just ahead and laterad of *dasm*2. The *dpm* tubercles fused together with bidentate posterior margin, bearing 2 small hyaline setae; *vpm* tubercles also fused together, with 2 sharp points and 2 minute hyaline setae; *lasm* tubercle minute, located just ahead of *lpml,* with a small hyaline seta. Last abdominal segment (Fig. 1p) strongly shagreened, with posterolateral processes about as long as main part of segment, strongly spiculose, strongly diverging, nearly straight, and tapering to sharp spinelike tips.

Larva (Fig. 1q–r).—Length about 10 mm; head 0.48 mm long by 0.16 mm broad. Head pale amber colored, body creamy yellowish. Structure and chaetotaxy nearly identical with that figured by Glukhova (1979) for *Bezzia xanthocephala*; last body segment with 4 pairs of long, black, anteriorly directed, caudal hairs ½ as long as segment, plus 2 pairs of much smaller setae.

Comment.—The larva of *Bezzia xanthocephala* Goetghebuer is nearly identical with that of *B. cockerelli,* but according to the figures of Goetghebuer (1911, 1914) and Glukhova (1979) the long anal hairs are much longer, nearly as long as the last body segment. There are 45–50 spiracular openings in the pupal respiratory horn of *B. xanthocephala,* according to Zilahi-Sebess (1930, as *hungarica*), while there are only 35–40 in *B. cockerelli.*

Types.—Of *cockerelli,* holotype ♀, Modern, Colorado, 28.v, T.D.A. Cockerell (Illinois Natural History Survey, Urbana); of *obscura,* holotype ♀, Ithaca, New York, 15.vii.1901, O. A. Johannsen (in INHS). Both types were examined by Wirth in 1950 through the courtesy of Dr. H. H. Ross.

Recorded distribution.—Alaska, Colorado, Idaho, Iowa, Michigan, Minnesota, Montana, Nebraska, New York, North Dakota, Utah, Washington (Dow and Turner, 1976).

New records.—ALBERTA: Brooks, 3–7.vii.1955, J. A. Downes, 2 ♂, 2 ♀. BRITISH COLUMBIA: Kamloops, 17.vi.1955, Downes, 1 ♀. IDAHO: Latah Co., Trails Pond, 22.vii.1969, Janice Gillespie, reared from algal mats, 4 larvae, 2 pupae, 4 ♂, 3 ♀, with pupal exuviae. MANITOBA: Churchill, 27.vii.1953, Downes, 7 ♂, 4 ♀ (CNC). MONTANA: Roosevelt Co., Bainville, 9.vi.1969, W. W. Wirth, 1 ♂ with pupal exuviae. NEW BRUNSWICK: Kouchibouguac Natl. Park, 2.vii.1977, 9–12.vii.1978, J. R. Vockeroth and L. Forster, 1 ♂, 3 ♀. NORTH DAKOTA: McHenry Co., 4 mi N Upham, 5.vi.1969, Wirth, 2 ♂, 3 ♀, with pupal exuviae. ONTARIO: Constance Bay, 1.viii.1961, Downes, 1 ♂. WISCONSIN: Dodge Co., Horicon Marsh, 7.vii.1978, W. R. Atchley and K. Kann, 1 ♀ with pupal exuviae.

Discussion.—Dow and Turner made a somewhat equivocal indication of the

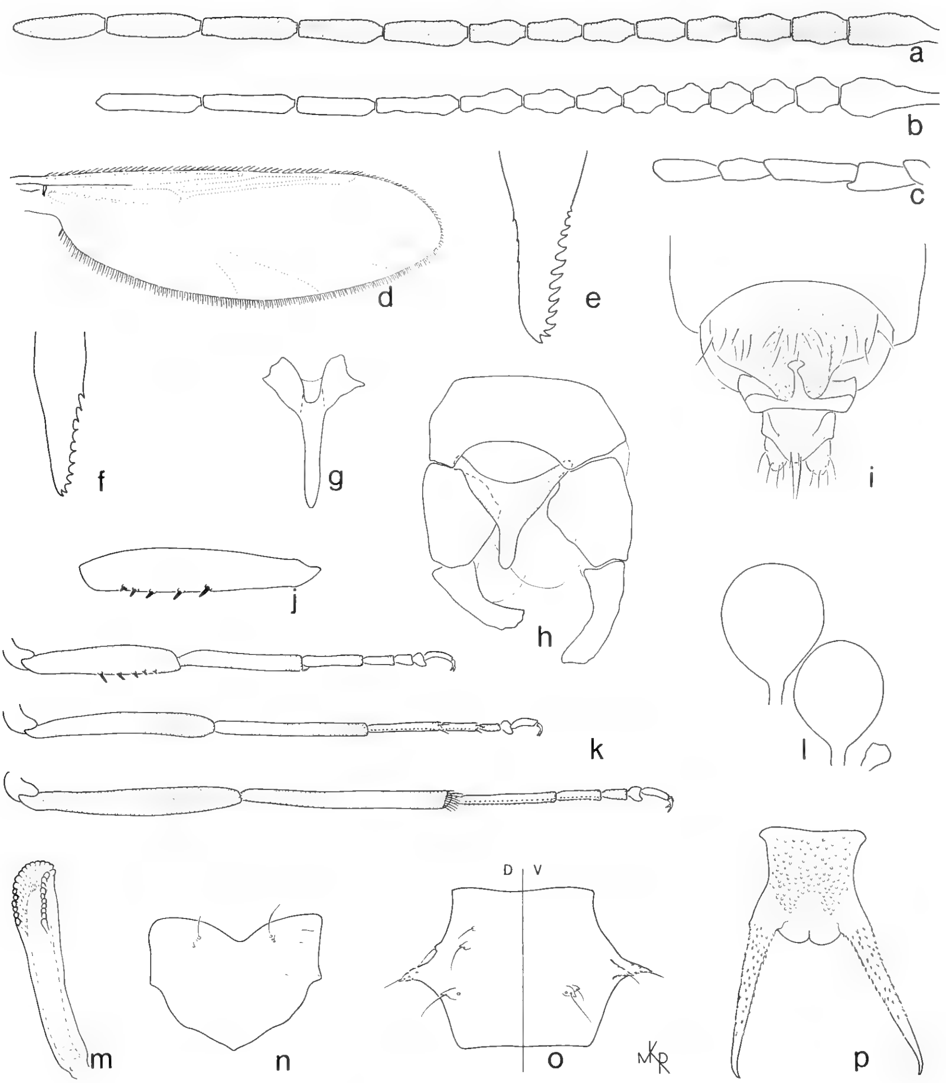

Fig. 2. *Bezzia pruinosa.* a, c–e, i–l, Female. b, f–h, Male. m–p, Pupa. a, b, Antenna. c, Palpus. d, Wing. e, f, Mandible. g, Parameres. h, Genitalia, parameres omitted. i, Genital sclerotization. j, Forefemoral spines. k, Color pattern of fore-, mid-, and hindlegs (top to bottom). l, Spermathecae. m, Respiratory horn. n, Operculum. o, Dorsal and ventral views of fourth abdominal segment. p, Last abdominal segment.

synonymy of *B. obscura*: "Careful comparison of Malloch's (1915) description of *B. obscura* with that of *B. cockerelli* and comparison of the types seem to indicate that these two species are indeed one. While only dissection of the terminalia and microscopic examination can positively affirm this hypothesis, they are treated as such in this paper. Since *B. cockerelli* occurs earliest in the paper, it becomes the senior synonym and takes precedence. Wirth (1951) corroborates the presence of ventral forefemoral spines on Malloch's type of *B. obscura.*" The present study confirms the synonymy.

The Palearctic species *Bezzia xanthocephala* Goetghebuer is nearly identical with *B. cockerelli* except for the following differences. In *B. xanthocephala* the legs are yellow, narrowly brown only on the knees and apices of the tibiae, tarsomeres 4, 5, and the tip of 3 brown; the female genital sclerotization lacks the X-shaped brown eighth sternum, but has two narrow oblique lines; and the pupa has long hyaline setae on the lateral tubercles as in *B. pruinosa* (see figures in Zilahi-Sebess, 1930).

***Bezzia pruinosa* (Coquillett)**

Fig. 2

Ceratopogon pruinosus Coquillett, 1905: 59 (female; British Columbia).

Bezzia pruinosa (Coquillett); Malloch, 1914: 282 (combination; in key); Malloch, 1915: 345 (in key); Johannsen, 1943: 785 (in list); Dow and Turner, 1976: 61 (notes on type; figs.).

Bezzia modocensis Wirth, 1952: 233 (male, female; California; figs.); Wirth and Stone, 1968: 437 (in key); Dow and Turner, 1976: 99 (redescribed; figs.; distribution). **NEW SYNONYMY.**

Female.—Wing length 2.9 mm, breadth 1.0 mm.

Head: Dark brown including antenna and palpus. Eyes broadly separated, a distance of 0.087 mm. Antenna (Fig. 2a) without pale bases of segments, segments definitely more slender distally; lengths of flagellar segments in proportion of 30-20-20-20-20-20-20-20-32-32-35-38-40, antennal ratio 1.04. Palpus (Fig. 2c) with lengths of segments in proportion of 7-20-30-16-23; 3rd segment slender, palpal ratio 4.3. Mandible (Fig. 2e) with 13 teeth, the proximal 3–4 gradually smaller.

Thorax: Uniformly dark brown; mesonotum with dense pubescence, no stronger setae on disc; 8 very long, strong, black, prealar setae above wing base, 1 postalar; scutellum with 8 similar marginal setae. Legs (Fig. 2k) yellowish brown to brown; dark brown on distal 3rd of forefemur, all of mid- and hindfemora, broad subbasal band on hindtibia, and narrow apices of tibiae and tarsomeres 1 and 2, tarsomeres 3-5 brown (in type series of *modocensis,* legs uniformly dark brown, almost blackish, including tarsi); forefemur with 4–5 short, stout black spines (Fig. 2j). Wing (Fig. 2d) brownish hyaline, anterior veins brown; costal ratio 0.77. Halter dark brown.

Abdomen: Brown; sparsely clothed with moderately long setae; 3 pairs of moderately long dark brown gland rods; genital sclerotization as in Fig. 2i, without strong pigmentation. Spermathecae (Fig. 2l) 2 plus rudimentary 3rd strongly pigmented; ovoid with moderately long slender necks; unequal, measuring 0.070 by 0.061 mm plus neck 0.014 mm long, and 0.062 by 0.054 mm with neck 0.012 mm.

Male.—Wing length 2.5 mm, breadth not measured; costal ratio 0.75. Similar to female with usual sexual differences; color darker and setae of legs and abdomen longer and more spinelike; supra-alar setae especially stronger, 12 on each side. Antenna (Fig. 2b) with lengths of flagellar segments in proportion of 45-20-20-20-20-20-22-24-30-40-38-42-45, antennal ratio 1.04; plume dense, with long, black, bristly verticils. Mandible (Fig. 2f) with 4–5 distinct teeth. Genitalia (Fig. 2h) with dististyle as long as basistyle, stout with blunt-pointed tip; 9th sternum with broad caudomedian excavation to ⅓ of total length, distal process slender and scarcely tapering, ventral spicules not distinct; parameres (Fig. 2g) with basal processes broad and not distinctly bilobed, distal process long and slender, slightly attenuated subbasally, with somewhat tapering, rounded tip.

Female pupa.—Length 5.2 mm. Nearly identical with pupa of *B. sordida,* but integument not so strongly shagreened. Respiratory horn (Fig. 2m) 0.32 mm long, shorter than in *sordida* and not so slender proximally or flaring at tip; with 26 spiracular openings in a convoluted row on distal portion. Operculum as in Fig. 2n; abdominal segments as in Fig. 2o; last abdominal segment as in Fig. 2p.

Distribution.—British Columbia to Ontario, south to California, Michigan, and New York.

Types.—Holotype ♀ of *pruinosa,* Bear Lake, British Columbia, 20.vii, R. P. Currie (pinned type no. 8352, USNM). Holotype ♀ of *modocensis,* allotype ♂, and 7 ♀ paratypes, Dismal Swamp, Modoc Co., California, 15.vii,1948, W. W. Wirth, swept from stream margin, 8000 ft (Type no. 59961, USNM).

Other specimens examined.—BRITISH COLUMBIA: Hector, 19.vi.1932, O. Bryant, 1 ♀ (CAS). CALIFORNIA: Humboldt Co., Mad River Beach, 14.viii.1948, W. W. Wirth, 1 ♂ (paratype of *sordida*). MICHIGAN: Bay Co., 17.v.1954, R. R. Dreisbach, 1 ♀. Midland Co., 26.v.1945, Dreisbach, 1 ♂, 1 ♀. Alto, Campau, 15.v.1937, C. W. Sabrosky, 1 ♀. NEW YORK: Erie Co., E. Concord Bog, 1.vi.1963, Wirth, maple swamp, 1 ♀. ONTARIO: Bell's Corners, 21.v.1951, J. F. McAlpine, 1 ♂ (CNC). Marmora, 7.v.1952, J. R. Vockeroth, 5 ♂ (CNC). Mer Bleue, 10.v.1938, G. E. Shewell, 2 ♀ (CNC). WASHINGTON: Pacific Co., Nahcotta, 24.v.1917, A. L. Melander, 4 ♂, 2 ♀. Pierce Co., Fort Lewis, 4.v.1946, P. H. Arnaud, Jr., 2 ♀ (CAS). WISCONSIN: Washburn Co., 8.vi.1952, 4,19.vi.1953, R. H. Jones, 2 ♀.

Discussion.—The synonymy of *Bezzia modocensis* Wirth with *B. pruinosa* is based on comparison of types, as well as detailed study of fresh slide-mounted paratypes of *modocensis* with the northeastern specimens of *pruinosa* listed above. These paratypes appear to be melanistic forms of the rather widespread and somewhat variable species *pruinosa.*

Bezzia saileri **Wirth, New Species**

Fig. 3

Female holotype.—Wing length 2.20 mm, breadth 0.72 mm.

Head: Brown. Eyes broadly separated, a distance of 0.080 mm. Antenna (Fig. 3a) brown, bases of flagellar segments pale; lengths of flagellar segments in proportion of 30-15-14-14-14-14-14-15-20-22-21-21-22, antennal ratio 0.82; segment 11 2.5× as long as broad and 1.35× as long as 10. Palpus (Fig. 3c) with lengths of segments in proportion of 8-12-20-13-17; 3rd segment short and slender, palpal ratio 2.5. Mandible (Fig. 3e) with 8 strong distal teeth plus 4–5 minute proximal denticles.

Thorax: Uniformly dull brown; mesonotum with uniform, moderately dense vestiture of long brown setae about as long as those on scutellum and about 3× as long as underlying pubescence; scutellum with 8–10 brown marginal setae. Legs (Fig. 3i) uniformly dull yellowish brown, knee spots and narrow apices of tibiae dark brown; tarsomeres 4–5 pale brown; forefemur with 2 (3 in some paratypes) stout brown ventral spines borne on distinct tubercles (Fig. 3f); claws as in Fig. 3h. Wing (Fig. 3d) whitish hyaline, anterior veins pale; costal ratio 0.75. Halter brownish.

Abdomen: Uniformly pale brown, clothed with sparse pale brown setae; 1 pair

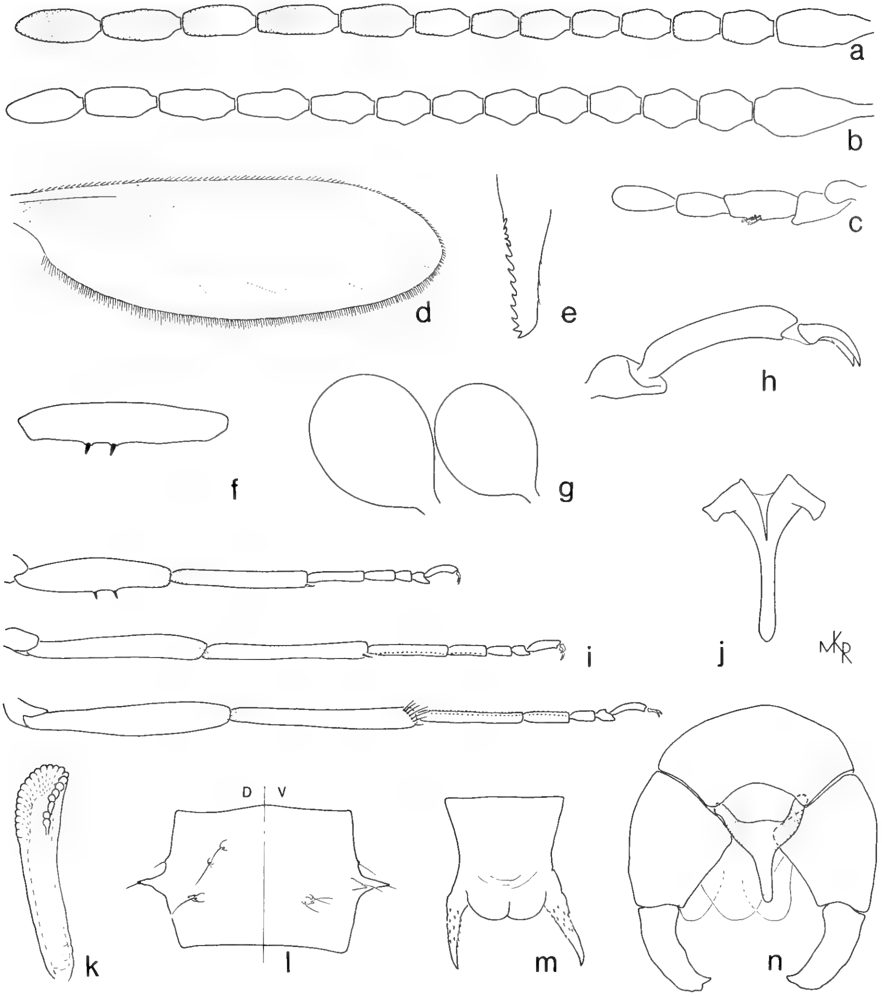

Fig. 3. *Bezzia saileri.* a, c–i, Female. j, n, Male. k–m, Pupa. a, b, Antenna. c, Palpus. d, Wing. e, Mandible. f, Forefemoral spines. g, Spermathecae. h, Fourth and fifth tarsomeres and claws of hindleg. i, Color pattern of (top to bottom) fore-, mid-, and hindlegs. j, Parameres. k, Respiratory horn. l, Dorsal and ventral views of fourth abdominal segment. m, Last abdominal segment. n, Genitalia, parameres omitted.

of hyaline to brownish gland rods about as long as 2 segments. Genital sclerotization not pigmented. Spermathecae (Fig. 3g) 2 plus rudimentary 3rd, ovoid, tapering to short, distinct necks; unequal, measuring 0.087 by 0.067 mm and 0.073 by 0.054 mm including necks.

Male allotype.—Wing length 1.62 mm, breadth 0.51 mm; costal ratio 0.74. Similar to female with usual sexual differences; femora and tibiae slightly darker brown than in female. Antenna (Fig. 3b) with lengths of flagellar segments in proportion of 30-15-15-15-15-14-14-15-16-19-22-20-22, antennal ratio 0.75; plume sparse, pale yellowish. Genitalia (Fig. 3n) with anterior margin of 9th sternum and lateral margins of basistyles and dististyles forming a nearly circular outline; 9th sternum much narrower and longer than usual in the *cockerelli* Group; basistyle short and stout, tapering, less than twice as long as basal breadth; dististyle stout, blunt, ending in a distinct mesal tooth; aedeagus about as broad as long, basal arms strongly sclerotized, basal arch to ⅓ of total length, anterior margin strongly pigmented, distal process only slightly tapering, ending in a rounded hyaline point and a ventral, minutely pubescent portion nearly as long; parameres (Fig. 3j) of usual structure, basal processes well developed and distal process elongate and unusually slender.

Pupa.—Length 3.8 mm. Nearly identical with pupa of *B. cockerelli* but differing as follows: Respiratory horn (Fig. 3k) 0.32 mm long, with 25 spiracular openings in only a slightly convoluted row. Integument of body smooth, lateral tubercles (Fig. 3l) much smaller and bearing stout distal spines and lacking spicules on proximal portion. Last abdominal segment (Fig. 3m, female) 1.1× as long as broad in female, 1.35 in male, with posterolateral processes spinulose at base, not strongly diverging, tapering to sharp, spinelike tips.

Distribution.—Alaska.

Types.—Holotype ♀, allotype ♂, Fire Lake, Anchorage, Alaska, 2.vi.1948, R. I. Sailer (deposited in USNM). Paratypes, 14 ♂, 4 ♀, 6 pupae, same data as types.

Discussion.—This species is named for Reece I. Sailer of the University of Florida in appreciation of his long friendship and in recognition of his important work on the bionomics of Alaskan biting flies while a member of the Alaskan Insect Control Project.

Bezzia saileri keys out to *B. kuhetiensis* Remm in Remm's (1974) key, but that species is a eurytopic summer species, frequently found around springs, in the Soviet Transcaucasus and Central Asia. According to Remm's (1967) figures, *B. kuhetiensis* differs markedly from *B. saileri* in details of the female antenna, spermathecae, genital sclerotization, and male genitalia.

Bezzia sordida **Wirth**

Fig. 4

Bezzia sordida Wirth, 1952: 232 (male, female; California; figs.); Wirth and Stone, 1968: 437 (in key); Dow and Turner, 1976: 108 (redescribed; figs.; distribution).

Female.—Wing length 2.8 mm; breadth 0.80 mm.

Head: Brown. Eyes broadly separated, a distance of 0.100 mm. Antenna (Fig. 4a) brown, narrow bases of flagellar segments pale; lengths of flagellar segments in proportion of 30-20-17-17-17-17-17-17-28-28-28-28-40, antennal ratio 1.00. Palpus (Fig. 4c) with lengths of segments in proportion of 7-16-30-15-16; 3rd segment long and slender, palpal ratio 4.3. Mandible (Fig. 4e) with 10 teeth.

Thorax: Dull brown, humeri grayish black, slightly pruinose; mesonotum and scutellum with fine appressed brown pubescence; 3 long, stout, pre-alar setae, 1 postalar; scutellum with 4 long, black, marginal setae. Legs (Fig. 4j) brownish yellow; coxae and trochanters brown; apices of fore- and midfemora and apices of all tibiae narrowly brown, hindfemur brown on distal ½ to ⅔, all tibiae with faint, broad, subbasal, brown bands; narrow apices of tarsomeres 1–2 and all of 3–5 brown; forefemur (Fig. 4g) with 3–5 stout ventral spines; claws as in Fig. 4f. Wing (Fig. 4d) brownish hyaline, anterior veins brown; costal ratio 0.77. Halter dark brown.

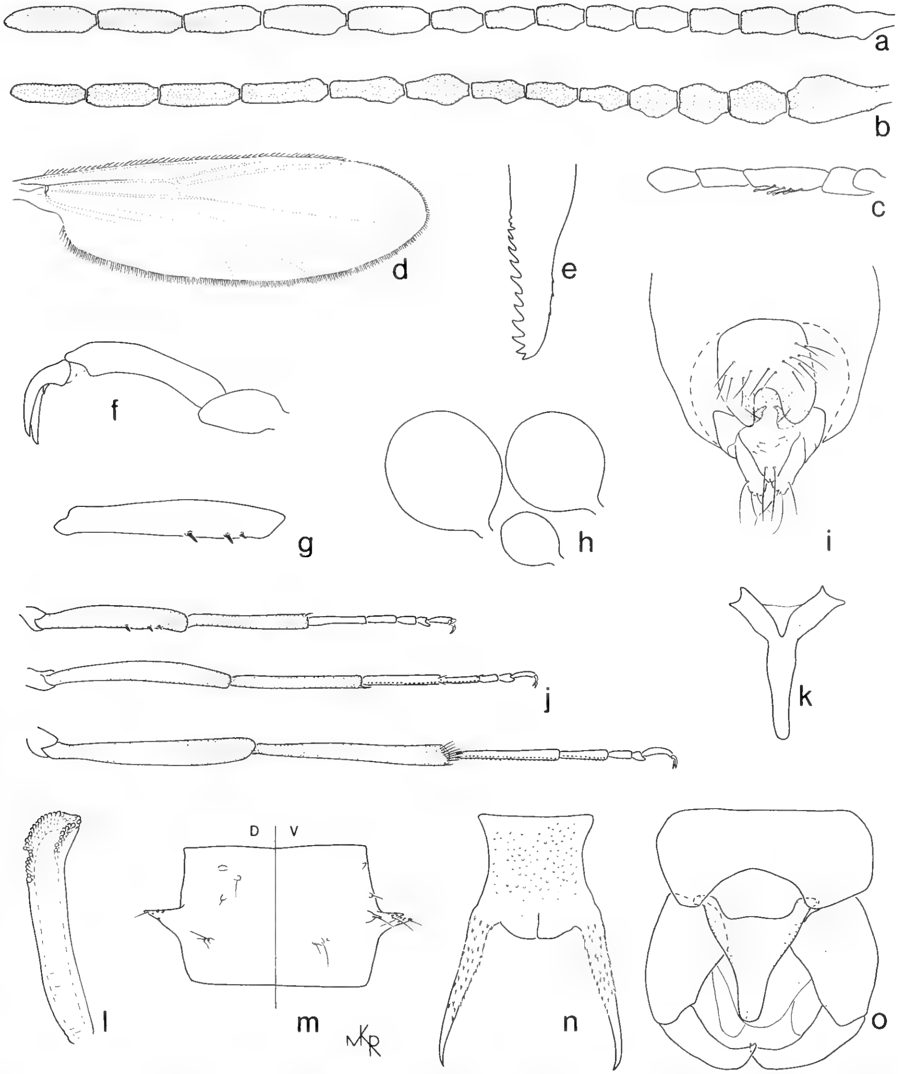

Fig. 4. *Bezzia sordida.* a, c–j, Female. k, o, Male. l–n, Pupa. a, b, Antenna. c, Palpus. d, Wing. e, Mandible. f, Fourth and fifth tarsomeres and claws of hindleg. g, Forefemoral spines. h, Spermathecae. i, Genital sclerotization. j, Color pattern (top to bottom) of fore-, mid-, and hindlegs. k, Parameres. l, Respiratory horn. m, Dorsal and ventral views of fourth abdominal segment. n, Last abdominal segment. o, Genitalia, parameres omitted.

Abdomen: Subshining dark brown dorsally; distal segments with rather long brown setae on sides; 3 pairs of moderately long brownish gland rods. Genital sclerotization (Fig. 4i) with 8th sternum poorly pigmented, bilobate on caudal margin flanking gonopore; processes of 9th sternum moderately sclerotized. Spermathecae (Fig. 4h) 2 plus rudimentary 3rd; globular with very short, slender necks; small and unequal, measuring 0.070 by 0.061 mm and 0.058 by 0.050 mm.

Male.—Wing length 1.70 mm. Similar to female with usual sexual differences;

color darker and setae of legs and abdomen longer and more spinelike. Antenna (Fig. 4b) with lengths of flagellar segments in proportion of 30-17-17-17-17-17-17-20-23-30-30-30-30, antennal ratio 1.00; plume moderately dense, of long, bristly blackish verticils. Mandible with 4–5 distinct teeth. Genitalia (Fig. 4o) dark brown with long bristly setae, nearly as broad as long. Ninth sternum rather long with moderately deep and broad caudomedian excavation; basistyle short, broad at base and tapering evenly to tip, without mesal lobe or swelling; dististyle as long as basistyle, evenly curved and tapering to slightly pointed tip; aedeagus slightly longer than basal breadth, basal arms and distal process stouter than those of *B. cockerelli,* ventral surface not spiculate. Parameres (Fig. 4k) with anterolateral arms flaring, winglike; distal process slender, slightly curved, spindle-shaped.

Pupa.—Length 5.2 mm. Nearly identical with pupa of *B. cockerelli* but differing as follows: Respiratory horn (Fig. 4l) and 0.47 mm long, more evenly slender on proximal ½, flaring abruptly at distal ¼, with 34 spiracular openings in a convoluted row on flared portion. Abdominal segments (Fig. 4m) with lateral tubercles directed slightly more caudad, each with distinct subapical spine bearing a long hyaline seta similar to those of *Bezzia xanthocephala* as figured by Zilahi-Sebess (1930). In *B. cockerelli* this seta shorter and borne subapically on conical tubercle. Last abdominal segment (Fig. 4n) with posterolateral processes longer, 1.4× as long as main part of segment, more abruptly bent at base and directed more caudad like those figured by Zilahi-Sebess (1930) for *B. xanthocephala.*

Distribution.—California.

Types.—Holotype ♀, allotype ♂, 12 ♂, 26 ♀ paratypes, Oceano Beach, San Luis Obispo Co., California, 20.viii.1948, W. W. Wirth, swept from pond margin back of beach (Type no. 59960, USNM).

Other specimens examined.—CALIFORNIA: Marin Co., Olema, 22.ii.1947, H. P. Chandler, 2 ♀ and pupal exuviae. San Luis Obispo Co., Black Lake Canyon, 22.viii.1948, W. W. Wirth, swept from trees at lake margin, 4 ♀ (paratypes).

Discussion.—This species appears to have a limited distribution, which from our records includes only areas near the coast in California.

Bezzia twinni **Wirth, New Species**

Fig. 5

Female holotype.—Wing length 2.50 mm, breadth 0.83 mm.

Head: Uniformly dark brown including antenna and palpi. Eyes broadly separated, a distance of 0.086 mm. Antenna (Fig. 5a) with lengths of flagellar segments in proportion of 30-16-15-14-14-13-13-15-17-17-17-20-20, antennal ratio 0.70; segments not tapering, last segment with bluntly rounded tip. Palpus (Fig. 5c) short and stout, lengths of segments in proportion of 7-13-18-15-12, 3rd segment 2.3× as long as broad. Mandible (Fig. 5e) with 8 strong distal teeth plus 2–3 minute proximal denticles.

Thorax: Uniformly dark brown; mesonotum with usual fine pubescence plus sparse, scattered, long brown setae about 3× as long as the underlying pubescence; scutellum with 8–10 long brown marginal setae. Legs (Fig. 5k) brown, dark brown towards apices of femora and paler at bases of all femora and tibiae; proximal portions of tarsomeres 1–2 paler; forefemur (Fig. 5h) with 2 short stout black spines arising from distinct low tubercles; claws as in Fig. 5f. Wing (Fig. 5d) grayish, anterior veins brown; costal ratio 0.77. Halter brown.

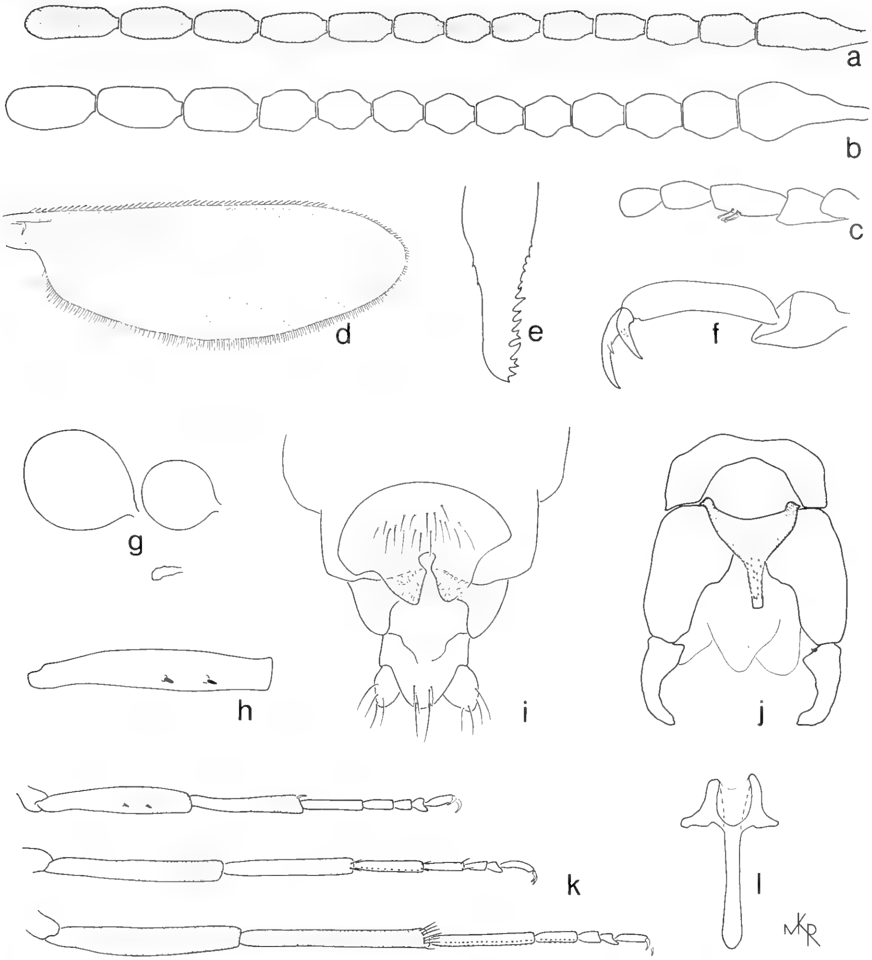

Fig. 5. *Bezzia twinni.* a, c–i, k, Female. j–l, Male. a, b, Antenna. c, Palpus. d, Wing. e, Mandible. f, Fourth and fifth tarsomeres and claws of hindleg. g, Spermathecae. h, Forefemoral spines. i, Genital sclerotization. j, genitalia, parameres omitted. k, Color pattern (top to bottom) of fore-, mid-, and hindlegs. l, Parameres.

Abdomen: Brown, with vestiture of sparse, fine setae; 2 pairs of short brown gland rods, posterior pair as long as the segment, other $1/2$ as long. Genital sclerotization (Fig. 5i) with 8th sternum brownish pigmented and bearing a patch of dense setae in midportion. Spermathecae (Fig. 5g) 2 plus rudimentary 3rd, slightly ovoid, only slightly tapering to very short, slender necks; highly pigmented; unequal, measuring 0.119 by 0.095 mm and 0.075 by 0.065 mm including necks.

Male allotype.—Wing length 1.54 mm, breadth 0.60 mm; costal ratio 0.74. Similar to female with usual sexual differences; pale areas at bases of femora and tibiae scarcely evident. Antenna (Fig. 5b) with lengths of flagellar segments in proportion of 32-14-13-13-12-12-12-12-13-13-18-21-22, antennal ratio 0.72; plume pale brownish, very sparse and the verticils short, longest only about 6×

diameter of a segment. Genitalia (Fig. 5j) longer than broad; 9th sternum with broad caudomedian excavation extending $^2/_3$ way to base of segment; basistyle with marked basal swelling on mesal side forming a pronounced hump, slender distally; dististyle about $^1/_2$ as long as basistyle, markedly curved, and slender on distal $^1/_2$, with pointed tip; aedeagus 1.15 longer than broad, basal arms forming an arch to $^1/_5$ of total length, ventral surface of distal process with numerous coarse spicules except at extreme tip which is nearly hyaline; parameres (Fig. 5l) with the anterolateral arms connected in a broad mesal plate extending nearly to extreme base, distal process slender on proximal $^1/_2$, slightly expanded subapically and clavately rounded at tip.

Distribution.—California, Manitoba.

Types.—Holotype ♀, allotype ♂, Churchill, Manitoba, 14.vii.1953, J. A. Downes (CNC). Paratypes, 3 ♂, 8 ♀, as follows: Churchill, same data as types except dates 14, 23, 24, 27.vii.1953.

Other specimens examined.—CALIFORNIA: Big Bear Lake, 6.vii.1942, A. L. Melander, 1 ♂.

Discussion.—This species is named for the late C. R. Twinn, head of the Veterinary and Medical Entomology Unit, Agriculture Canada, and in charge of the studies on biting flies at Churchill.

Four of the above specimens, recorded in error as *B. modocensis,* were collected as mating pairs at the swarming site, with the females feeding on the males through a puncture on the head (Downes, 1978: 38).

Bezzia twinni is closely related to *B. saileri,* sharing with that species the presence of scattered enlarged setae on the disc of the mesonotum and short antennae and palpi, but *B. saileri* is a much paler species with pale legs, whitish hyaline wings, the mesonotal setae are very numerous, and the male genitalia are stouter and form a somewhat circular outline.

The *dorsasetula* Group

Diagnosis.—Small, shining black species, female wing 1.2–1.3 mm long. Mesonotum with 2 rows of strong bristly setae on disc. Forefemur with 5–7 stout ventral spines of alternating uneven lengths arising from distinct elevations. Pupal respiratory horn only moderately broadened distally, apex with only 7–12 spiracular openings in an even row. Abdominal segments of pupa not broadened at midlength; tubercles small; posterolateral processes of last segment short and bluntly conical. Larva unknown.

Remarks.—There are only two North American species included in this group: *Bezzia dorsasetula* Dow and Turner and *B. obelisca* Dow and Turner. Both species have been reared from sphagnum bogs in the Northeast.

Bezzia dorsasetula Dow and Turner

Fig. 6

Bezzia dorsasetula Dow and Turner, 1976: 89 (male, female; New York; figs.).

Female.—Wing length 1.31 mm; breadth 0.47 mm.

Head: Dark brown. Eyes separated a distance of 0.029 mm. Antenna (Fig. 6a) brown, narrow bases of flagellar segments pale; lengths of flagellar segments in proportion of 15-10-10-10-10-10-10-10-22-22-22-22-22, antennal ratio 1.30.

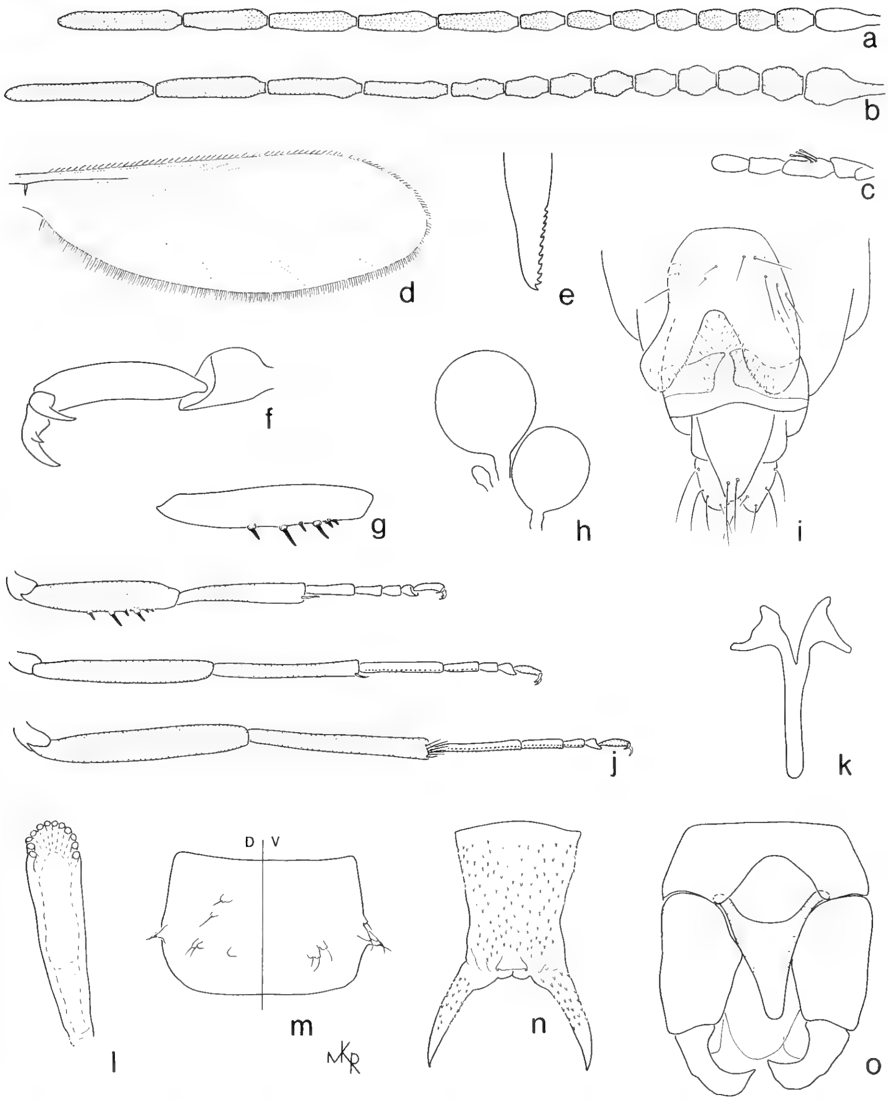

Fig. 6. *Bezzia dorsasetula.* a, c–j, Female. b, k, o, Male. l–n, Pupa. a, b, Antenna. c, Palpus. d, Wing. e, Mandible. f, Fourth and fifth tarsomeres and claws of hindleg. g, Forefemoral spines. h, Spermathecae. i, Genital sclerotization. j, Color pattern of (top to bottom) fore-, mid-, and hindlegs. k, Parameres. l, Respiratory horn. m, Dorsal and ventral views of fourth abdominal segment. n, Last abdominal segment. o, Genitalia, parameres omitted.

Palpus (Fig. 6c) brown; lengths of segments in proportion of 5-7-10-10-10; 3rd segment short and slender, palpal ratio 2.0. Mandible (Fig. 6e) with 8 teeth.

Thorax: Dark brown; mesonotum shining black, without pollinose pattern, with microscopic pubescence, with 4–5 long, relatively stout, blackish setae in posterior portion of each dorsocentral row; 3 similar pre-alar setae and 1 postalar; scutellum with 2 pairs of similar marginal setae. Legs (Fig. 6j) brown; narrow base and apex of forefemur slightly paler; narrow bases of all tibiae and broad apices of fore-and midtibiae yellowish; tarsomeres 1–4 pale; forefemur (Fig. 6g) with 6–7 stout black ventral spines, irregularly alternating long and short spines in series; claws (Fig. 6f) short and slightly curved, stout at base, each with internal basal barb. Wing (Fig. 6d) pale grayish with coarse microtrichia, anterior veins pale brown; costal ratio 0.76. Halter brown.

Abdomen: Dark brown; vestiture of coarse brown setae. Two pairs of long pale brownish gland rods. Genital sclerotization (Fig. 6i) faintly pigmented; 8th sternum with a pair of elongate spiculate processes, bare anteromesad; 9th sternum a pair of pigmented processes flanking gonopore. Spermathecae (Fig. 6h) 2 plus rudimentary 3rd; subspherical with moderately long slender neck; unequal, measuring 0.051 by 0.048 mm plus neck 0.013 mm long, and 0.042 by 0.038 mm with neck 0.009 mm long.

Male.—Wing length 1.11–1.26 mm. Similar to female with usual sexual differences; setose vestiture of legs and abdomen longer and stronger. Antenna (Fig. 6b) with lengths of flagellar segments in proportion of 20-12-12-12-12-13-14-15-16-26-28-28-47; sparse plume of moderately long brownish verticils. Costal ratio 0.72. Genitalia (Fig. 6o): 9th sternum with broad, moderately deep, caudomedian excavation; basistyle moderately long, tapering; dististyle short and stout, strongly curved hooklike; aedeagus triangular, slightly longer than broad, basal arch to $^1/_5$ of total length, basal arms slender, tapering distally to moderately slender, rounded tip. Parameres (Fig. 6k) with deeply bilobed anterolateral plates, deep basomedian cleft; distal process long and slender, rodlike with rounded tip.

Pupa.—Length 3.1 mm; pale brown, dark brown on cephalothorax, tip of respiratory horns, and midportions of abdominal terga; cephalothorax and abdominal terga with coarse dark microtubercles. Respiratory horn (Fig. 6l) 0.22 mm long, relatively stout, evenly widened to tip, 3.7× as long as greatest width; with 12 spiracular openings in a row around apex. Abdominal tubercles (Fig. 6m) short and blunt; three *lpm* tubercles, *lpm*1 very small and located anterior to other 2, which are moderately elevated, triangular, all 3 with a minute seta; 2 pairs of very small *dasm* tubercles, each with a hyaline microseta, anterior pair located closer to midline and the 2 connected to each other by a micro-rugose integumental bar; 3 small *dpm* tubercles, each with a hyaline microseta, 2 laterals contiguous and much stronger than mesal tubercle; 3 low, scalelike *vpm* tubercles, *vpm*2 and *vpm*3 fused in a common tubercle bearing 2 hyaline microsetae, *vpm*1 contiguous to others, more slender, with a hyaline microseta. Last abdominal segment (Fig. 6n) moderately long, 1.8× as long as basal breadth; posterolateral processes moderately long and slightly curved, sparsely spinulose, tapering to pointed, moderately diverging tips; processes ⅔ as long as anterior portion of segment.

Types.—Holotype ♀, Brantingham Lake, Lewis Co., New York, 22.vi.1963, W. W. Wirth (Type no. 76595, USNM). Allotype ♂, 2 ♂, 3 ♀ paratypes, from Tompkins Co., New York.

Recorded distribution.—New York, type series only.

New records.—CONNECTICUT: Norwich, 9.vi.1959, A. A. Hubert, light trap, 6 ♂, 2 ♀. FLORIDA: Wakulla Co., Ochlockonee River St. Park, 29.iv.1970, W. W. Wirth, light trap, 1 ♂. MARYLAND: Garrett Co., Cranesville Swamp, 6.vii.1960, J. Coulson, reared from sphagnum, 2 ♀. Prince George's Co., College Park, reared from Lakeland Pond, 21.v–11.vi.1975, W. L. Grogan, Jr., 4 ♂, 1 ♀ with pupal exuviae; Patuxent Wildlife Res. Center, v–vi.1976, Grogan, Malaise trap, 3 ♂, 4 ♀; 30.v–8.vii.1978, Wirth, Malaise trap, 7 ♂, 1 ♀. Wicomico Co., Salisbury, 20–27.vi.1981, Grogan, Malaise trap, 1 ♀. Worcester Co., Snow Hill, 18.vi.1968, W. H. Anderson, light trap, 1 ♂. NEBRASKA: Cherry Co., Hackberry Lake, 2.vi.1969, Wirth, 1 ♂, 1 ♀. NEW YORK: Chautauqua Co., S. Dayton, 1.vi.1963, Wirth, marsh area, 2 ♂, 1 ♀. Lewis Co., Whetstone Gulf, 20–23.vi.1963, Wirth, 4 ♀. ONTARIO: Kemptville, 5.vi.1960, Wirth, 1 ♂, 2 ♀. Ottawa, Mer Bleue, 25.vi.1954, J. R. Vockeroth, 2 ♀ (CNC). Stanleyville, Black Lake, 3,11.vi.1978, J. A. Downes, 3 ♂, 3 ♀ (CNC).

Discussion.—*Bezzia venustula* (Williston) from the West Indies is very similar to *dorsasetula,* but the dorsocentral setae are not strongly developed, and the strong black sensilla chaetica on the male antenna occur as far as the 15th segment.

***Bezzia obelisca* Dow and Turner**

Fig. 7

Bezzia obelisca Dow and Turner, 1976: 104 (male, female; New York; figs.).

Female.—Wing length 1.20–1.26 mm; breadth 0.40–0.43 mm.

Head: Dark brown. Eyes separated by a distance of 0.036 mm. Antenna (Fig. 7a) brown; lengths of flagellar segments in proportion of 15-10-9-9-9-10-10-10-20-20-20-20-24, antennal ratio 1.27. Palpus (Fig. 7c) brown; lengths of segments in proportion of 4-8-10-9-13; 3rd segment short and slender, tapering, palpal ratio 2.0. Mandible (Fig. 7e) with 9–11 teeth.

Thorax: Shining dark brown; mesonotum with 7–8 long, stout, black setae in each dorsocentral row, extending nearly to anterior margin; 3 similar pre-alar setae and 1 postalar; scutellum with 2 pairs of similar marginal setae. Legs (Fig. 7j) brown, without pale bands; tarsomeres 1–3 pale; forefemur (Fig. 7g) with 4–5 stout black ventral spines, irregularly alternating short and long; claws as in Fig. 7f. Wing (Fig. 7d) grayish, anterior veins pale brown; costal ratio 0.77. Halter dark brown.

Abdomen: Brown. Two pairs of long brownish gland rods. Genital sclerotization (Fig. 7i) with 8th sternum a bare, U-shaped plate arching around gonopore anteriorly; 9th sternum fused posteriorly across midline, anteromedian processes hooklike. Spermathecae (Fig. 7h) 2 plus rudimentary 3rd; subspherical with long slender necks, deeply pigmented; slightly unequal, measuring 0.043 by 0.038 mm plus neck 0.017 mm long, and 0.040 by 0.035 mm with neck 0.011 mm.

Male.—Wing length 0.62 mm. Similar to female with usual sexual differences. Antenna (Fig. 7b) with lengths of flagellar segments in proportion of 18-10-9-9-9-9-9-9-10-15-15-16-20; plume extending to segment 11, segments 12–14 each with proximal ring of black verticils. Genitalia (Fig. 7o): Ninth sternum with broad, shallow, caudomedian excavation; basistyle short, somewhat swollen at base on mesal side; dististyle short, strongly curved hooklike, distal portion slender; aedeagus with base much narrower than in *dorsasetula,* basal arch low, sides straight, evenly tapered to slender rounded tip. Parameres (Fig. 7k) with anterolateral plates not so deeply bilobed as in *dorsasetula,* distal process long and slender, rodlike.

Pupa.—Length 2.3–2.6 mm; brown, abdomen paler. Respiratory horn (Fig. 7l) 0.16 mm long, shaped as in *dorsasetula,* slightly broader distally, 4× as long as broad; with 7–10 spiracular openings in a row around apex. Abdominal tubercles

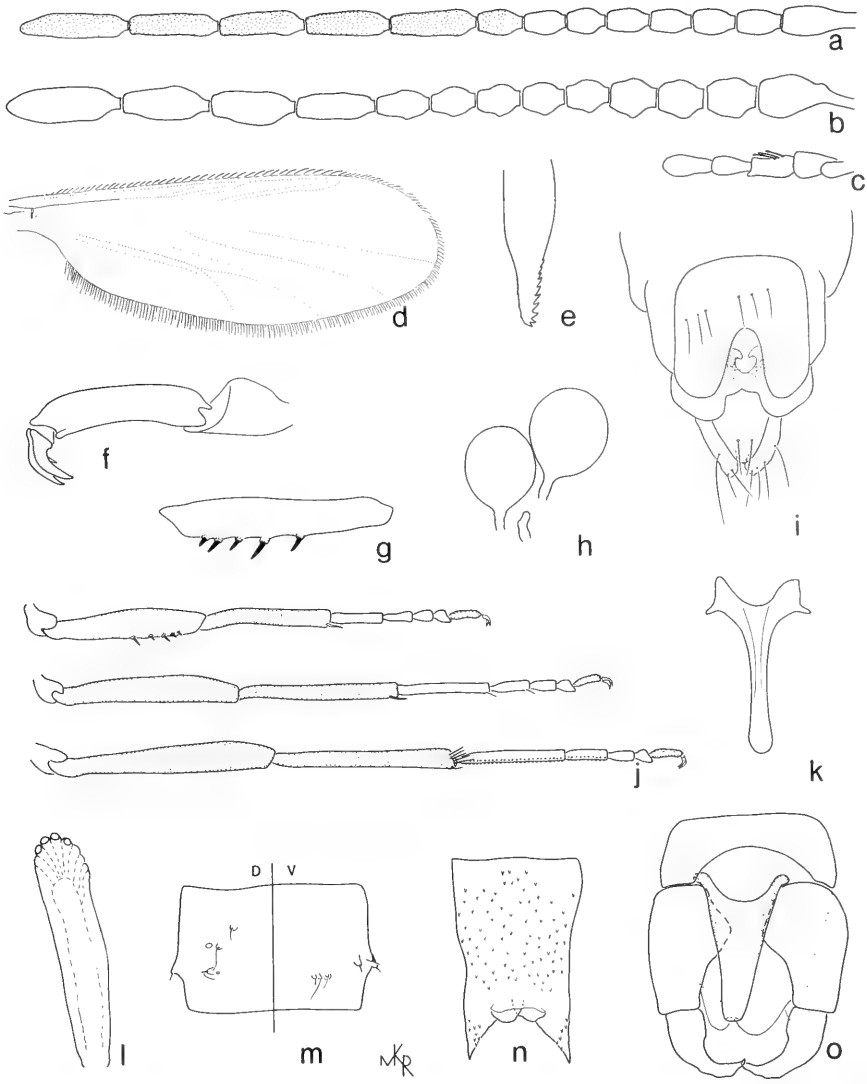

Fig. 7. *Bezzia obelisca*. a, c–j, Female. b, k, o, Male. l–n, Pupa. a, b, Antenna. c, Palpus. d, Wing. e, Mandible. f, Fourth and fifth tarsomeres and claws of hindleg. g, Forefemoral spines. h, Spermathecae. i, Genital sclerotization. j, Color pattern of (top to bottom) fore-, mid-, and hindlegs. k, Parameres. l, Respiratory horn. m, Dorsal and ventral views of fourth abdominal segment. n, Last abdominal segment. o, Genitalia, parameres omitted.

(Fig. 7m) small, short, and rounded to slightly pointed, each with a hyaline microseta. Integument of cephalathorax with sparse brown granules, that of abdomen with minute spinules only. Last abdominal segment (Fig. 7n) only slightly longer than basal breadth, posterolateral processes short, only ¼ as long as rest of segment, tapering abruptly to pointed tips and bearing only sparse thornlike spinules.

Types.—Holotype ♂, allotype ♀, 7 ♂, 3 ♀ paratypes, McLean Reserve, Tompkins Co., New York, 19.vi.1963, W. W. Wirth, reared from sphagnum bog (Type no. 76596, USNM).

Recorded distribution.—New York (type series).

New records.—MICHIGAN: Cheboygan Co., Douglas Lake, vii.1954, R. W. Williams, light trap at boat house, 7 ♂, 5 ♀; emergence trap at Bryants Bog, 2 ♂, 2 ♀. NEW BRUNSWICK: Kouchibouguac, 11.vii.1977, J. R. Vockeroth, 1 ♀; 3–13.vii.1978, J. A. Downes, 3 ♂, 2 ♀ (CNC). NEW YORK: St. Lawrence Co., Cranberry Lake, 26.vi.1963, W. W. Wirth, sphagnum bog, 1 ♂, 1 ♀. ONTARIO: Ottawa, Mer Bleue, 27.v.1960, Wirth, reared from sphagnum, 15 ♂, 15 ♀ (slides), 55 pinned specimens, all with pupal exuviae.

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AN ANNOTATED LIST OF THE CADDISFLIES (TRICHOPTERA) OF OHIO

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Abstract.—A list of 15 families, 55 genera, and 200 species of Trichoptera known to occur in Ohio is presented. Fourteen species are recorded from the state for the first time. Individual species are annotated with known collection localities and adult flight periods.

Prior to 1964, Marshall's (1939) work on the caddisflies of western Lake Erie was the only published study dealing exclusively with the occurrence and distribution of Ohio Trichoptera. However, additional records were included in Ross (1938a, 1938b, 1938c, 1939, 1944, 1947, 1966), Gordon (1974), and Schuster and Etnier (1978). Since 1964, a number of studies dealing either in part or exclusively with the trichopteran fauna of various localities in northern and eastern Ohio have been completed (Horwath, 1964; Tkac, 1973; Wilke, 1976; Hasenstaub, 1977; McElravy et al., 1977; McElravy and Foote, 1978; Masteller and Flint, 1979; Arsuffi, 1980; MacLean and MacLean, 1980; Petersen and Foote, 1980; Hilovsky, 1981; Huryn and Foote, 1981; Huryn, 1982; R. Hunt, unpublished data).

In this paper we report many, previously unpublished, locality data taken from records of the authors, the Cleveland Museum of Natural History, and the Illinois Natural History Survey, as well as summarize published distributional information for Ohio. A consolidated list of 15 families, 55 genera, and 200 species known to occur in Ohio is presented. Fourteen species are recorded from Ohio for the first time. As new records of caddisflies from the state will certainly be found, this paper is obviously a preliminary list that will serve as an aid to workers studying the biology, ecology, and systematics of the order as it occurs in Ohio and throughout North America, as well as a source of baseline data for environmental studies (Resh and Unzicker, 1975).

COLLECTION SITES

The collection sites of Trichoptera in Ohio included in the following list are arranged alphabetically by county. Each site is assigned a number that corresponds to its position on the map (Fig. 1). Sites 8, 34, 62, 68, 75, 114, 116, and 117, are not included in the figure because they refer to county, watershed, or state records and not to specific point localities. Numbers assigned to the collection sites are used in the species list. Collection sites reported in the literature are followed by appropriate citation(s). Where literature records refer to type material, the species, date(s) of collection, number and sex of individuals taken, and type designations are also given.

ADAMS.—1. Cedar Run at Rt 348 and Cedar Mills Rd. 2. Grace Run at Rt 247. 3. Georges Creek at Nichols Ridge Rd. 4. Cedar Fork of Scioto Brush Creek at Portsmouth Rd.

ALLEN.—5. Gomer.

ASHLAND.—6. Hog Hollow, Mohican St. Pk. 7. Clear Fork of the Mohican River (Huryn and Foote, 1981, in part). 8. unspecified locality.

ASHTABULA.—9. Grand River at New Hudson Rd. 10. Grand River at Rt 6 (Hilovsky, 1981, Hydropsychidae). 11. Grand River near Rock Creek. 12. Grand River near Harpersfield (Huryn and Foote, 1981, in part). 13. Grand River at Mechanicsville. 14. Conneaut Creek at Turnpike Rd (Hilovsky, 1981, Hydropsychidae). 15. Conneaut Creek at Rt 7 (Hilovsky, 1981, Hydropsychidae). 16. NW corner of county, 0.2–1.0 km S of Lake Erie (Masteller and Flint, 1979).

ATHENS.—17. Athens (Ross, 1938a, *Triaenodes dipsius,* V/28/1932, m, Holotype; *T. phalacris,* VI/5/1931, m, Holotype; Ross, 1938c, *Pycnopsyche indiana,* IX/23/1933, f, Allotype, IX/30/1931, 1 m, IX/15/1933, 1 m, IX/23/1933, 1 f, IX/25/1933, 1 m, Paratypes).

BUTLER.—18. Seven mile Creek, Middletown.

CHAMPAIGN.—19. Kings Creek at junction of Mad River. 20. Mad River above Urbana.

CLARK.—21. Rock Run, Springfield.

CLERMONT.—22. Kemper Creek, Loveland.

CLINTON.—23. Lytle Creek, Wilmington.

COLUMBIANA.—24. Water Cress Marsh, 9 km S Salem (MacLean and MacLean, 1980). 25. Little Beaver Creek (MacLean and MacLean, 1980). 26. Little Bull Creek E of Rogers at Rt 154 (MacLean and MacLean, 1980). 27. unspecified locality (Huryn and Foote, 1981, in part).

CUYAHOGA.—28. Rocky River. 29. Lakewood. 30. Cleveland. 31. Euclid. 32. Hunting Valley. 33. Chagrin Falls. 34. unspecified locality.

ERIE.—35. Rt 6 and Old Woman Creek. 36. Rt 2 and Old Woman Creek. 37. near I-80, I-90, and Old Woman Creek. 38. Castalia Prairie, Resthaven Wildlife Refuge. 39. unspecified locality.

FRANKLIN.—40. Columbus. 41. Black Lick Creek.

GEAUGA.—42. Stebbins Gulch in Holden Arboretum (Tkac, 1973; McElravy et al., 1977, in part). 43. Kirtland. 44. Cuyahoga River at Stillwell Rd. (Wilke, 1976). 45. West Branch of Cuyahoga River at Rt 322. 46. Punderson Lake (Wilke, 1976). 47. Fern Lake (Wilke, 1976). 48. Cuyahoga River at Geauga Co. Pk. (Wilke, 1976). 49. Grand River near Camp Chickagami (Huryn and Foote, 1981, in part). 50. unnamed tributary of Grand River at Agler Rd., 0.2 km NW of Grove Rd. and Agler. 51. Grand River near Parkman. 52. unspecified locality.

GREENE.—53. Little Miami River, Clifton Gorge, Clifton.

GUERNSY.—54. Byesville. 55. Cambridge (Ross, 1966, *Oecetis nocturna,* IX/13/1936, 1 m, Paratype).

HAMILTON.—56. Cincinnati, Ohio River. 57. Cincinnati, Little Miami River.

HENRY.—58. Holgate.

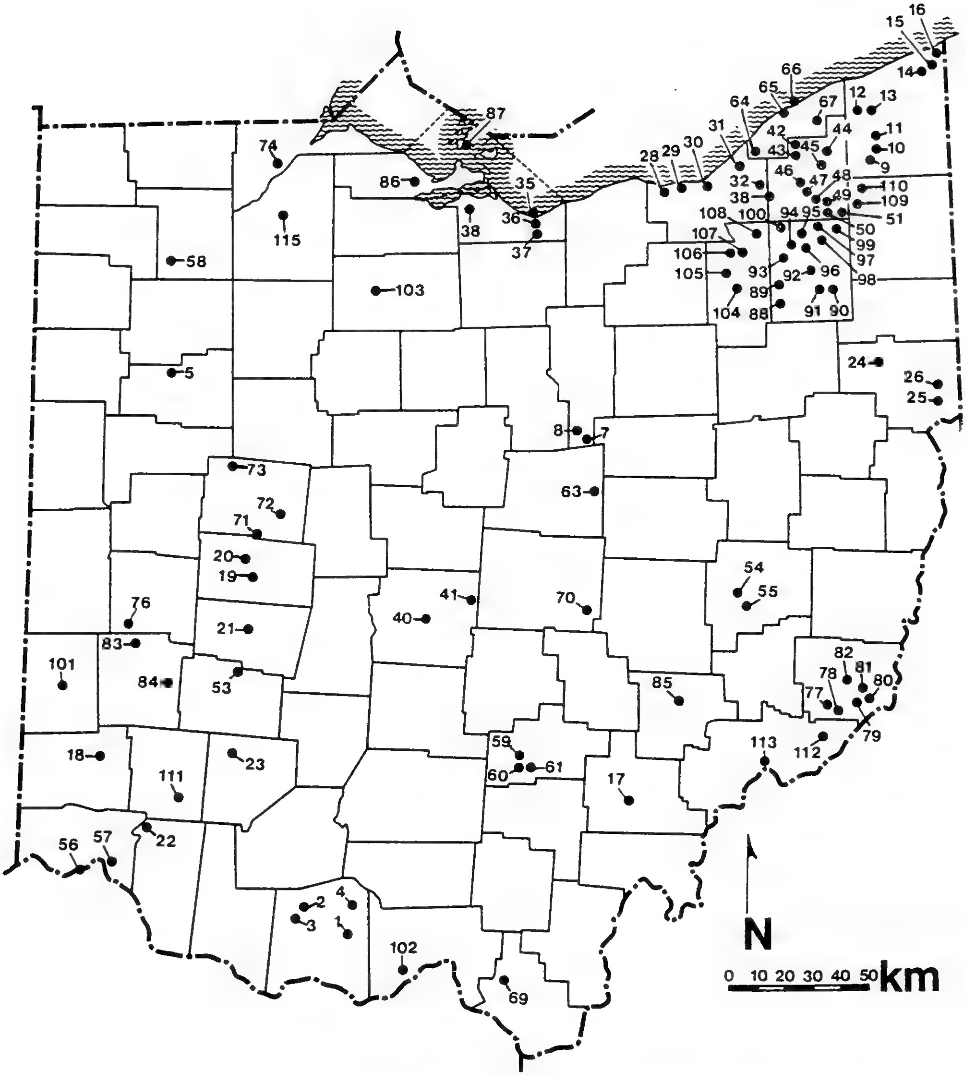

Fig. 1. Ohio map showing collection sites of Trichoptera. Numbers correspond to designated localities given in "Collection Sites."

HOCKING.—59. Hocking Hills St. Pk. 60. Hamilton Hollow. 61. Queer Creek. 62. unspecified locality.

KNOX.—63. 3 km SE of Millwood along Rt 715 (Huryn and Foote, 1981, in part).

LAKE.—64. North Chagrin Reservation. 65. Mentor Marsh. 66. Mentor Headlands St. Pk. 67. Grand River near Blair Rd. (Hilovsky, 1981, Hydropsychidae). 68. Grand River (Huryn and Foote, 1981, in part).

LAWRENCE.—69. Dean State Forest (Ross, 1947, *Polycentropus neiswanderi,* V/1939, 1 m, Paratype).

LICKING.—70. Flint Ridge St. Pk.

LOGAN.—71. Mad River S of West Liberty. 72. Mad River NE of Zanesfield. 73. Indian Lake.

LUCAS.—74. Swan Creek, 4.75 km W of Maumee. 75. no specific locality.

MIAMI.—76. West Milton.

MONROE.—77. Clear Fork of Little Muskingum River at Rt 26 (Huryn, 1982). 78. Little Muskingum River at Knowltons Covered Bridge Park (Huryn, 1982). 79. Witten Fork at Rt 800 (Huryn, 1982; Huryn and Foote, 1981, in part). 80. unnamed tributary of Dogskin Run (Huryn, 1982; Huryn and Foote, 1981, in part). 81. Wildcat Run (Huryn, 1982; Huryn and Foote, 1981, in part). 82. Cranest Fork of Little Muskingum River, 0.8 km above Rt 800 (Huryn, 1982; Huryn and Foote, 1981, in part).

MONTGOMERY.—83. Stillwater River at Englewood (Ross, 1966, *Oecetis ditissa,* VII/31/1939, 1 m, Paratype). 84. Dayton.

MORGAN.—85. Muskingum River near McConnelsville.

OTTAWA.—86. Oak Harbor. 87. Gibralter Island, Put-in-Bay (Ross, 1938a, *Ceraclea erulla,* VI/2/1937, m, Holotype, VI/2–8/1937, 87 m, Paratypes; Ross, 1938b, *Cheumatopsyche campyla,* V/25/1937, 4 m, 4f, Paratypes; Ross, 1939, *Cernotina ohio,* VII/19/1937, m, Holotype, VII/8/1937, 1 m, VII/20/1937, 1 m, VII/29/1937, 1 m, VII/30/1937, 1 m, Paratypes; *Neotrichia okapa,* VIII/13/1937, 2 m, VIII/1937, 1 m, Paratypes; Ross, 1944, *Ceraclea submacula* (Walker), no date, Allotype) (Marshall, 1939; Horwath, 1964).

PORTAGE.—88. Mogadore reservoir (Wilke, 1976). 89. Kent. 90. tributary of Silver Creek, West Branch St. Pk. (Arsuffi, 1980; McElravy et al., 1977, in part). 91. Porter Rd. Spring, West Branch St. Pk. (R. Hunt, unpublished data; Huryn and Foote, 1981, in part). 92. Upper West Branch of Mahoning River (McElravy and Foote, 1978; McElravy et al., 1977, in part). Lake Rockwell at Rt 14 (Wilke, 1976; Hilovsky, 1981, Hydropsychidae). 94. Cuyahoga River at Rt 303 (Wilke, 1976; Hilovsky, 1981, Hydropsychidae). 95. Cuyahoga River at Hiram Rapids (Wilke, 1976; Hilovsky, 1981, Hydropsychidae). 96. Mantua (Huryn and Foote, 1981, in part). 97. Allyn Rd. at Silver Creek. 98. Garrettsville (Huryn and Foote, 1981, in part). 99. Nelson. 100. Aurora Branch of Chagrin River at Rt 306.

PREBLE.—101. Seven Mile Creek, Eaton.

SCIOTO.—102. Shawnee State Forest (Ross, 1947, *Polycentropus neiswanderi,* VI/1942, m, Holotype, 6 m, 14 f, V/1942, 13 m, 5 f, Paratypes).

SENECA.—103. Tiffin.

SUMMIT.—104. Cuyahoga River at the Akron Waste Treatment Plant (Wilke, 1976). 105. Furnace Run (Peterson and Foote, 1980). 106. Cuyahoga River at Rt 303 (Hilovsky, 1981, Hydropsychidae). 107. Haskell Run (above impoundment), Cuyahoga Valley National Recreation Area. 108. Tinkers Creek.

TRUMBULL.—109. tributary of the Grand River near Farmington (Huryn and Foote, 1981, in part). 110. Mill Creek.

WARREN.—111. Todd Fork, Morrow.

WASHINGTON.—112. Little Muskingum River near Rt 26, 6.5 km S of Bloomington (Huryn, 1982; Huryn and Foote, 1981, in part). 113. Marietta.

WAYNE.—114. no specific locality.

WOOD.—115. Bowling Green.

Miscellaneous.—116. "Ohio" (Ross, 1944). 117. "Lake Erie" (Ross, 1944).

LIST OF SPECIES

For each included species, the known Ohio localities and earliest and latest adult collection dates are given. Records represented by specimens located in collections of the senior author, the Royal Ontario Museum, the Cleveland Museum of Natural History, and the Illinois Natural History Survey are designated ADH, ROM, CMNH, and INHS, respectively. Due to the age of some of the records obtained from the latter two institutions, the year of collection follows the initials. Unless otherwise indicated (P = pupa, L = larva), all records are based on adult specimens. Taxa above the species level are arranged as given in Wiggins (1977: 9–14) with the exception of the Hydropsychinae and Macronematinae which follow Ross and Unzicker (1977) and Flint and Bueno (1982), respectively. Species within each genus are listed alphabetically. The 14 species newly recorded for Ohio are designated with an asterisk.

Philopotamidae

Dolophilodes distinctus (Walker). Sites 24, 26, 42, 60 ADH, 82 ADH-L, 110. March–July 31.

Wormaldia moesta (Banks). Sites 42, 59 ADH, 62 INHS-1938, 69 INHS-1939, 80 ADH, 81 ADH, 91, 92. March 12–June 16.

Wormaldia shawnee (Ross). Sites 82 ADH, 90, 92. June 1–30.

Chimarra aterrima Hagen. Sites 21 INHS-1953, 22 INHS-1953, 42, 50 ADH, 72 INHS-1953, 79 ADH-L, 81 ADH-L, 90, 92, 105-L. June 6–30.

Chimarra obscura (Walker). Sites 2 ADH, 3 ADH, 4 ADH, 12, 15, 16, 33 INHS-1941, 41 INHS-1936, 77 ADH, 79 ADH, 81 ADH, 82 ADH, 90, 92, 93, 101 INHS-1953, 102 INHS-1942, 105. June 26–October 13.

Chimarra socia Hagen. Sites 14 ADH, 15, 16, 40 INHS-1933. July 25–October 10.

Psychomyiidae

Lype diversa (Banks). Sites 10, 16, 42, 60, 61 ADH, 79 ADH, 81 ADH, 87 INHS-1937, 90, 92, 105. May 1–September 1.

Psychomyia flavida Hagen. Sites 3 ADH, 7, 11, 44, 77 ADH, 78 ADH, 79 ADH, 81 ADH, 82 ADH, 87 INHS-1937. May 30–September 21.

Polycentropodidae

Cernotina ohio Ross. Site 87 INHS-1937. July 8–30.

Cernotina pallida (Banks). Site 87 INHS-1929-37. July 8–August 27.

Cyrnellus fraternus (Banks). Sites 3 ADH, 12, 38 ADH, 48, 59, 73 INHS-1941, 77 ADH, 78 ADH, 79 ADH, 82 ADH, 87 INHS-1937, 90, 92. June 17–August 23.

Neureclipsis crepuscularis (Walker). Sites 7 ADH, 16, 35 ADH, 79 ADH, 87 INHS-1937, 95 ADH, 112 ADH. June 12–August 23.

Nyctiophylax affinis (Banks). Sites 2 ADH, 3 ADH, 16, 38 ADH, 87 INHS-1937, 107 ADH. June 7–August 23.

Nyctiophylax moestus Banks. Sites 4 ADH, 36, 37 ADH, 60 ADH, 61 ADH, 77 ADH, 78 ADH, 79 ADH, 80 ADH, 81 ADH, 82 ADH, 92, 112 ADH. May 27–September 14.

Polycentropus aureolus (Banks). Site 24. June 11–14.

Polycentropus carolinensis Banks. Site 91. June 2–September 12.

Polycentropus centralis Banks. Sites 2 ADH, 3 ADH, 77 ADH, 79 ADH, 80 ADH, 81 ADH, 82 ADH, 84 INHS-1934, 90, 102 INHS-1942, 105. May 20–September 11.

Polycentropus cinereus Hagen. Sites 2 ADH, 3 ADH, 16, 36, 37, 44, 65 ADH, 73 INHS-1941, 74 INHS-1953, 77 ADH, 78 ADH, 79 ADH, 80 ADH, 81 ADH, 82 ADH, 87 INHS-1937, 88, 89, 90, 92, 107 ADH, 112 ADH. May 22–September 11.

Polycentropus confusus Hagen. Sites 16, 20 INHS-1953, 77 ADH, 79 ADH, 81 ADH, 82 ADH, 87 INHS-1937, 90, 91, 102 INHS-1942, 105, 110, 112 ADH. May 19–August 23.

Polycentropus crassicornis Walker. Sites 16, 58 INHS-1939, 90, 92. May 15–June 5.

Polycentropus elarus Ross. Sites 80 ADH, 81 ADH, 82 ADH, 102 INHS-1942. June 7–September 5.

Polycentropus interruptus (Banks). Sites 10, 105. June 7–19.

Polycentropus neiswanderi Ross. Sites 69 INHS-1939, 102 INHS-1942. May.

Polycentropus pentus Ross. Sites 69 INHS-1939, 80 ADH, 90, 92, 102 INHS-1942, 105. May 20–June 28.

Polycentropus remotus Banks. Sites 38 ADH, 58 INHS-1939, 92, 95. May 30–September 9.

Phylocentropus lucidus (Hagen). Sites 24, 90, 91. May 30–July 30.

Phylocentropus placidus (Banks). Site 87 INHS-1937. May 30–September 9.

Hydropsychidae

Parapsyche apicalis (Banks). Sites 52-L, 96-L, 105-L.

Diplectrona metaqui Ross. Site 63 ADH-L.

Diplectrona modesta Banks. Sites 32 ADH-P, 42, 69 INHS-1939, 80 ADH, 81 ADH, 90, 92, 102 INHS-1942, 105. May–June 21.

Cheumatopsyche aphanta Ross. Sites 15, 23 INHS-1950, 67, 87, 90, 92, 102 INHS-1942, 111 INHS-1951. May 5–August 25.

Cheumatopsyche campyla Ross. Sites 7 ADH, 16, 17 INHS-1931, 23 INHS-1950, 29 ADH, 40 INHS-1940, 57 INHS-1967, 69 INHS-1939, 75 INHS-no date, 77 ADH, 78 ADH, 79 ADH, 81 ADH, 82 ADH, 83 INHS-1939, 84 INHS-1939, 87 INHS-1935–37, 92, 93, 94, 95, 105, 11 INHS-1952, 112 ADH, 114. May 1–September 22.

Cheumatopsyche gracilis (Banks).* Site 53 INHS-1953. May 30.

Cheumatopsyche halima Denning. Site 92. May 14.

Cheumatopsyche minuscula (Banks). Sites 12, 15, 67, 90. July 9–August 25.

Cheumatopsyche oxa Ross. Sites 20 INHS-1953, 76 INHS-1953, 77 ADH, 78 ADH, 79 ADH, 81 ADH, 82 ADH, 84 INHS-1939, 90, 92, 94, 105, 107, 102 INHS-1942. May 13–August 25.

Cheumatopsyche pettiti (Banks), *sensu* Gordon 1974. Sites 3 ADH, 15, 16, 17 INHS-1938, 18 INHS-1953, 23 INHS-1950, 40 INHS-1941, 53 INHS-1953, 56 INHS-1939, 67, 69 INHS-1939, 74 INHS-1953, 77 ADH, 78 ADH, 79 ADH, 82 ADH, 88, 90, 92, 93, 94, 95, 105. May 10–October 1.

Cheumatopsyche pasella Ross. Sites 24, 42. June 14.

Cheumatopsyche speciosa (Banks). Sites 17 INHS-1931–39, 40 INHS-1940, 56 INHS-1939, 69 INHS-1939, 105. June 7–August 15.

Cheumatopsyche wabasha Denning. Site 7 ADH. May 24.

Hydropsyche aerata Ross.* Site 103 ADH. June–July.

Hydropsyche betteni Ross. Sites 7 ADH, 15, 16, 17, 22 INHS-1953, 28 CMNH-1967, 32 ADH, 53 INHS-1938, 77 ADH, 78 ADH, 79 ADH, 80 ADH, 81 ADH, 82 ADH, 84 INHS-1939, 90, 92, 93, 95, 103 ADH, 105, 112 ADH. May 2–September 2.

Hydropsyche bidens Ross. Sites 58 INHS-1939, 83 INHS-1939, 95. May–September 9.

Hydropsyche depravata Hagen.* Sites 29 ADH, 66 ADH. June 23–August 22.

Hydropsyche dicantha Ross. Sites 12, 15, 24, 25, 26, 77 ADH, 78 ADH, 79 ADH, 84 INHS-1939, 92, 105. May 7–August 26.

Hydropsyche orris Ross. Sites 17 INHS-1931, 24, 58 INHS-1939, 77 ADH, 84 INHS-1939, 112 ADH, 113 INHS-1938. May 19–August 20.

Hydropsyche phalerata Hagen. Site 116.

Hydropsyche scalaris Hagen. Sites 10, 16, 24, 67. June 6–July 25.

Hydropsyche separata Banks. Site 16. June–September.

Hydropsyche simulans Ross. Sites 17 INHS-1931, 40 INHS-1941, 69 INHS-1939, 113 INHS-1938. May 10–August 1.

Hydropsyche valanis Ross. Site 58 INHS-1938. July.

Symphitopsyche bifida (Banks). Site 24. July 2.

Symphitopsyche bronta (Ross.). Sites 14, 15, 16, 20 INHS-1953, 23 INHS-1950, 32 ADH, 33 INHS-1941, 42, 67, 71 INHS-1953, 77 ADH, 78 ADH, 79 ADH, 81 ADH, 82 ADH, 84 INHS-1939, 90, 92, 105, 107. May 3–August 20.

Symphitopsyche cheilonis (Ross). Sites 57 INHS-1967, 58 INHS-1939, 84 INHS-1939, 87, 92, 103 ADH. May–August 25.

Symphitopsyche morosa (Hagen). Site 26. June 15.

Symphitopsyche recurvata (Banks). Sites 16, 28 ADH, 66 ADH, 87. June 2–October 5.

Symphitopsyche slossonae (Banks). Sites 12, 15, 42, 44, 79 ADH, 81 ADH, 82 ADH, 90, 92, 105, 107. May 5–October 1.

Symphitopsyche sparna (Ross). Sites 92, 105. May 7–August 30.

Symphitopsyche walkeri (Betten and Mosely). Sites 90, 92. June–August 21.

Potamyia flava (Hagen). Sites 12, 24, 40 INHS-1940, 56 INHS-1939, 69 INHS-1939, 73 INHS-1941, 77 ADH, 78 ADH, 79 ADH, 85 ADH, 93, 94, 113 INHS-1938. June 11–August 25.

Macrostemum zebratum (Hagen). Sites 12, 15, 25, 28 CMNH-1967, 41 INHS-1936, 42-L, 58 INHS-1939–42, 67, 94. July 9–August 25.

Rhyacophilidae

Rhyacophila banksi Ross. Sites 8, 42. May 18–June 18.

Rhyacophila carolina Banks. Sites 6, 27, 42, 80 ADH, 81 ADH, 105. June 22–August 24.

Rhyacophila carpenteri Milne. Site 42. August 12.

*Rhyacophila fenestra.** Sites 53 INHS-1953, 57 INHS-1944-L-P, 84 INHS-1939. May 30.

Rhyacophila glaberrima Ulmer. Sites 42, 80 ADH. July 21.

Rhyacophila ledra Ross. Sites 37, 69 INHS-1939, 102 INHS-1942. June 7–14.

Rhycophila lobifera Betten. Sites 10, 23 INHS-1952, 41 INHS-1936, 82 ADH, 90, 92, 112 ADH-L. April 17–June 6.

Rhyacophila minora Banks. Sites 27, 42. May 25–June 7.

Rhyacophila parantra Ross. Sites 8, 32 ADH, 42. June 5–20.

Rhyacophila torva Hagen. Sites 27, 42. May 19–September 7.

Rhyacophila vibox Milne. Sites 27, 42. May 25–June 13.

Glossosomatidae

Glossosoma nigrius Banks. Sites 42, 51, 92. April 14–September 21.

Protoptila maculata (Hagen). Sites 11, 12, 51. June 23–September 11.

Hydroptilidae

Agraylea multipunctata Curtis. Sites 36, 46, 48, 87, 88, 90, 92, 94, 105. July 6–August 12.

Hydroptila ajax Ross. Sites 23 INHS-1952, 77 ADH, 78 ADH, 79 ADH, 82 ADH, 93, 94, 104, 105, 108, 112 ADH, 115 ADH. June 5–August 20.

Hydroptila albicornis Hagen. Site 87 INHS-1937. June 4–September 8.

Hydroptila amoena Ross. Sites 77 ADH, 79 ADH, 81 ADH, 82 ADH. August 20–October 1.

Hydroptila angusta Ross. Sites 77 ADH, 78 ADH, 82 ADH, 87 INHS-1937, 112 ADH. June 22–September 8.

Hydroptila armata Ross. Sites 4 ADH, 92. May 15–August 31.

Hydroptila callia Denning.* Site 81 ADH. June 7.

Hydroptila consimilis Morton. Sites 1 ADH, 7 ADH, 16, 38 ADH, 60 ADH, 77 ADH, 78 ADH, 79 ADH, 80 ADH, 81 ADH, 82 ADH, 89, 90, 92, 105, 108. May 30–September 9.

Hydroptila grandiosa Ross. Sites 1 ADH, 77 ADH, 78 ADH, 79 ADH, 82 ADH, 90, 92, 112 ADH. May 30–August 26.

Hydroptila hamata Morton. Sites 77 ADH, 78 ADH, 79 ADH, 82 ADH, 87, 92, 105, 107 ADH, 112 ADH. June 25–September 30.

Hydroptila jackmanni Blickle. 79 ADH, 80 ADH, 81 ADH, 82 ADH, 90, 92, 107 ADH. June 7–27.

Hydroptila perdita Morton. Sites 1 ADH, 4 ADH, 7 ADH, 38 ADH, 77 ADH, 78 ADH, 79 ADH, 81 ADH, 82 ADH, 92, 103 ADH, 104, 105, 112 ADH. July 5–September 9.

Hydroptila spatulata Morton. Sites 7 ADH, 16, 87. May 24–September 9.

Hydroptila strepha Ross. Site 92. August 15.

Hydroptila vala Ross. Sites 60 ADH, 92. June 1–15.

Hydroptila virgata Ross. Site 90. May 5–20.

Hydroptila waskesia Ross.* Sites 77 ADH, 78 ADH, 79 ADH, 82 ADH, 112 ADH. June 7–August 21.

Hydroptila waubesiana Betten. Sites 10, 16, 48, 77 ADH, 78 ADH, 79 ADH, 82 ADH, 87 INHS-1937, 89, 90, 92, 93, 94, 95, 105, 112 ADH. May 30–September 12.

Ochrotrichia arva (Ross). Sites 90, 92. May 30–June 7.

Ochrotrichia spinosa (Ross). Sites 23 INHS-1952, 77 ADH, 79 ADH, 81 ADH, 82 ADH, 90, 92, 105. May 30–June 30.

Ochrotrichia tarsalis (Hagen). Sites 2 ADH, 3 ADH, 77 ADH, 78 ADH, 79 ADH, 87, 112 ADH. June 21–September 8.

Ochrotrichia wojcickyi Blickle. Sites 90, 92. June 1–July 21.

Oxyethira forcipata Mosely. Sites 78 ADH, 79 ADH, 82 ADH, 90, 105. June 7–September 14.

Oxyethira michiganensis Mosely.* Site 81 ADH. July 21.

Oxyethira pallida (Banks). Sites 4 ADH, 46, 77 ADH, 78 ADH, 79 ADH, 82 ADH, 87, 88, 89, 93, 105, 112 ADH. June 18–September 10.

Oxyethira zeronia Ross.* Site 38 ADH. July 13.

Stactobiella delira (Ross). Site 12 ADH. May 11–24.

Stactobiella palmata (Ross).* Sites 60 ADH, 61 ADH, 77 ADH, 78 ADH, 79 ADH, 112 ADH. May 30–July 21.

Ithytrichia clavata Morton. Site 87. July 10–August 23.

Orthotrichia aegerfasciella (Chambers). Sites 4 ADH, 46, 77 ADH, 78 ADH, 79 ADH, 82 ADH, 87 INHS-1937, 88, 89, 90, 92, 93, 105. June 22–September 28.

Orthotrichia cristata Morton. Sites 38 ADH, 87, 112 ADH. July 13–September 11.

Mayatrichia ayama Mosely. Site 42. June 18.

Neotrichia falca Ross. Site 79 ADH. September 15.

Neotrichia okapa Ross. Sites 79 ADH, 87, 92. July 1–September 9.

Neotrichia vibrans Ross. Sites 78 ADH, 112 ADH. August 6–September 7.

Phryganeidae

Agrypnia vestita (Walker). Sites 16, 17 INHS-1933, 24, 65 ADH. September 4–October 7.

Banksiola crotchi Banks. Sites 90, 92, 103 ADH. June 7–August 13.

Banksiola dossuaria (Say). Sites 16, 90, 92. June 1–July 31.

Oligostomis pardalis (Walker).* Sites 89 ADH, 97 ADH. June 11–12.

Ptilostomis ocellifera (Walker). Sites 10, 15, 17 INHS-1938, 29 ADH, 34 CMNH-1926, 64 CMNH-1951, 89 ADH, 90, 92. June 6–August 14.

Ptilostomis postica (Walker). Sites 16, 31 CMNH-1951, 65 ADH, 90, 92. June 1–September 14.

Ptilostomis semifasciata (Say). Sites 17 INHS-1938, 38 ADH, 92. May 16–August 21.

Phryganea cinerea Walker.* Site 36 ADH. July 28.

Phryganea sayi Milne. Sites 12, 15, 32 CMNH-1926, 32 CMNH-1975, 85 ADH, 90, 92, 105, 115. July 25–September 14.

Brachycentridae

Micrasema rusticum (Hagen). Site 94. May 1.

Limnephilidae

Ironquia lyrata (Ross). Sites 16, 90, 92. August 21–September 14.

Ironquia parvula (Banks). Site 92. October 5.

Ironquia punctatissima (Walker). Sites 16, 17 INHS-1938, 89, 92, 105, 112 ADH. September 6–19.

Pseudostenophylax uniformis (Betten). Sites 49 ADH, 59 ADH, 80 ADH. May 30–June 15.

Pseudostenophylax sparsus (Banks). Site 25. May 26.

Hydatophylax argus (Harris). Sites 54 ADH, 61 ADH, 90, 92. June 9–August 22.

Pycnopsyche circularis (Provancher). Sites 16, 112 ADH. September 5–15.

Pycnopsyche divergens (Walker). Site 92. May 21–September 21.

Pycnopsyche guttifera (Walker). Site 92. September 7–October 21.

Pycnopsyche indiana (Ross). Site 17 INHS-1931–33. September 15–October 7.

Pycnopsyche lepida Hagen. Sites 16, 78 ADH, 81 ADH, 92, 93, 95, 100. August 31–October 1.

Pycnopsyche luculenta (Betten). Site 92. September 14–October 14.

Pycnopsyche scabripennis Rambur. Sites 16, 43 ADH, 44, 80 ADH, 81 ADH, 90, 92. July 21–October 14.

Limnephilus consocius Walker. Sites 38 ADH, 92, 95, 99 INHS-1961, 103 ADH, 105. May–September 31.

Limnephilus indivisus Walker. Sites 16, 70 INHS-1937, 92, 95. May 14–October 8.

Limnephilus moestus Banks. Sites 16, 24. May–June 18.

Limnephilus ornatus Banks. Site 24. June 11.

Limnephilus rhombicus (Linnaeus).* Site 38 ADH. July 13.

Limnephilus sericeus (Say).* Site 28 CMNH-1967. June.

Limnephilus submonilifer Walker. Sites 17 INHS-1938, 30, 38 ADH, 58 INHS-1939, 65 ADH, 69 INHS-1939, 87, 89, 90, 92. May 25–October 15.

Platycentropus radiatus (Say). Sites 45 ADH, 92, 108. June 2–August 20.

Frenesia missa (Milne). Sites 89, 98, 110. October 28–November 10.

Neophylax ayanus Ross.* Site 7 INHS-1949. September 18.

Neophylax concinnus McLachlan. Sites 81 ROM, 92, 105, 110. September 27–October 16.

Neophylax fuscus Banks. Site 12. October 13.

Neophylax oligius Ross. Site 92. September 24–October 16.

Neophylax wigginsi Sykora and Weaver. Sites 80 ROM, 81 ROM. September 15–October 1.

Goera stylata Ross. Sites 42-L, 80 ADH, 81 ADH, 82 ADH, 90, 92, 107 ADH-L. May 22–June 31.

Lepidostomatidae

Lepidostoma carrolli Flint.* Site 9 ADH. September 11.

Lepidostoma griseum (Banks). Sites 49, 68, 91. August 29–September 19.

Lepidostoma sackeni (Banks). Sites 49 ADH, 68. August 8.

Lepidostoma sommermannae Ross. Sites 63, 91. May 16–September 26.

Lepidostoma togatum (Hagen). Site 16. September 2.

Lepidostoma vernale (Banks). Site 91. May 16–June 22.

Odontoceridae

Psilotreta indecisa (Walker). Site 92. May 21–June 7.

Molannidae

Mollana blenda Sibley. Sites 90, 91, 92. July 7–22.

Molanna tryphena Betten. Site 44. August 1.

Molanna ulmerina Navas. Site 68 ADH. June 24–September 11.

Molanna uniophila Vorhies. Sites 87 INHS-1935–37, 89. June–July 30.

Helicopsychidae

Helicopsyche borealis (Hagen). Sites 4 ADH, 12, 16, 20 INHS-1953, 41 INHS-L-1936, 44, 82 ADH, 87 INHS-1935–37, 90, 92, 93, 105. June 1–September 21.

Leptoceridae

Ceraclea alagma (Ross). Sites 58 INHS-1939, 46, 88, 92, 93. June 21–July 14.

Ceraclea albosticta (Hagen). Site 87 INHS-1937. June 2–27.

Ceraclea ancylus (Vorhies). Sites 13, 77 ADH, 78 ADH, 79 ADH, 82 ADH, 87 INHS-1937, 93, 94, 102 INHS-1941, 112 ADH. June 7–July 8.

Ceraclea cancellata (Betten). Sites 16, 29 ADH, 58 INHS-1939, 69 INHS-1939, 77 ADH, 87 INHS-1937, 102 INHS-1942, 112 ADH, 113 INHS-1938. June 21–August 28.

Ceraclea diluta (Hagen). Sites 87 INHS-1937, 92. May 14–June 30.

Ceraclea erratica (Milne). Site 117.

Ceraclea erulla (Ross). Site 87 INHS-1935–37. June 2–8.

Ceraclea flava (Banks).* Site 109 ADH-L.

Ceraclea maculata (Banks). Site 24, 69 INHS-1939, 78 ADH, 79 ADH, 102 INHS-1942, 112 ADH, 113 INHS-1938. June 11–September 1.

Ceraclea resurgens (Walker). Sites 10, 16, 87 INHS-1937, 92. June 3–15.

Ceraclea submacula (Walker). Site 87 INHS-1935–37. June 4–15.

Ceraclea tarsipunctata (Vorhies). Sites 12, 16, 29 ADH, 35, 36 ADH, 37, 77 ADH, 78 ADH, 79 ADH, 82 ADH, 87, 90, 92, 93, 95, 105, 112 ADH. June 7–September 10.

Ceraclea transversa (Hagen). Sites 16, 23 INHS-1950, 79 ADH, 82 ADH, 87 INHS-1937, 92, 93, 94, 95, 112 ADH. June 7–August 14.

Leptocerus americanus (Banks). Sites 33 INHS-1941, 36, 39 INHS-1961-L, 43 ADH, 46, 47, 48, 58 INHS-1939, 73 INHS-1941, 88, 92, 93, 105. June 7–August 31.

Nectopsyche albida (Walker). Sites 32 ADH, 89, 92, 112 ADH. May 14–July 27.

Nectopsyche candida (Hagen). Sites 17 INHS-1931, 40 INHS-1940, 56 INHS-1939, 77 ADH, 112 ADH, 113 INHS-1939. June 15–August 7.

Nectopsyche diarina (Ross). Sites 94, 95. July 17–21.

Nectopsyche exquisita (Walker). Sites 16, 17 INHS-1941, 87, 105. June 7–August 10.

Nectopsyche pavida (Hagen). Sites 17 INHS-1931, 40 INHS-1941, 87. July 28–29.

Mystacides interjectus (Banks). Site 95. July 24.

Mystacides sepulchralis (Walker). Sites 87 INHS-1935–37, 89 ADH, 93. June 7–September 4.

Triaenodes abus Milne. Sites 58 INHS-1939, 92, 105. June 14–August 8.

Triaenodes dipsius Ross. Sites 17 INHS-1932, 79 ADH, 80 ADH, 82 ADH, 90, 92. May 28–September 7.

Triaenodes flavescens Banks. Sites 87 INHS-1937, 103 ADH, 105. June 7–July 30.

Triaenodes ignitus (Walker). Sites 90, 92, 95. June 7–August 31.

Triaenodes injustus (Hagen). Sites 12, 87, 92. May 21–September 21.

Triaenodes marginatus Sibly. Sites 33 INHS-1941, 90, 92, 95. May 21–September 14.

Triaenodes melacus Ross. Sites 77 ADH, 79 ADH, 82 ADH, 112 ADH. June 7–August 20.

Triaenodes nox Ross. Site 92. June 7–July 31.

Triaenodes pernus Ross. Site 40 INHS-1935. July 2.

Triaenodes phalacris Ross. Site 17 INHS-1931. June 5.

Triaenodes tardus Milne. Sites 5 INHS-1951, 16, 39 INHS-1961-L, 44, 46, 47, 73 INHS-1941, 88, 89, 92, 93, 99 INHS-1961, 103 ADH, 105. May 21–August 31.

Oecetis avara (Banks). Sites 87 INHS-1937, 95. July 4–September 10.

Oecetis cinerascens (Hagen). Sites 7 INHS-1941, 44, 46, 47, 73 INHS-1941, 83 INHS-1939, 87 INHS-1937, 88, 90, 92, 93, 95, 105. June 17–September 11.

Oecetis ditissa Ross. Sites 83 INHS-1939, 90. July 31–September 14.

Oecetis eddlestoni Ross. Sites 12, 87 INHS-1937. June 1–August 26.

Oecetis immobilis (Hagen). Site 87 INHS-1937. June 17–September 10.

Oecetis inconspicua (Walker). Sites 4 ADH, 5 INHS-1951, 12, 16, 33 INHS-1941, 40 INHS-1958, 44, 46, 55 INHS-1936, 65 ADH, 73 INHS-1941, 74 INHS-1953, 77 ADH, 79 ADH, 83 INHS-1939, 86 INHS-1938, 87 INHS-1937, 88, 89, 90, 92, 93, 94, 95, 103 ADH, 112 ADH. May 30–October 4.

Oecetis nocturna Ross. Sites 12, 32 CMNH-1975, 55 INHS-1936, 77 ADH, 78 ADH, 79 ADH, 82 ADH, 112 ADH. May 22–September 14.

Oecetis osteni Milne. Sites 46, 88, 89. July 24–August 15.

Oecetis persimilis (Banks). Sites 77 ADH, 78 ADH, 79 ADH, 82 ADH, 87 INHS-1937, 112 ADH. June 7–September.

QUESTIONABLE RECORDS

The following species have been reported in the literature as occurring in Ohio. For reasons given below, we feel that these records are questionable.

Polycentropus sp. (*nascotius* Ross?), as reported by McElravy and Foote (1978). Tentative identification based on females.

Cheumatopsyche sp. (*harwoodi harwoodi* Denning?), as reported by McElravy and Foote (1978). Tentative identification based on females.

Hydropsyche hageni Banks. Petersen and Foote (1980) reported this species from site 105 on the basis of a single female. Determinations of the females of the *scalaris* group are unreliable without associated males. We feel that this record must remain tentative until confirmed by collections of males.

Protoptila lega Ross. McElravy et al. (1977) reported this species on the basis of 3 females collected at site 46 (Wilke, 1976). Reliable characters for the separation of females of *P. lega* and *P. maculata* have yet to be discovered (Ross, 1944). This record probably represents the latter species which has been recently reported from the Grand River watershed (Huryn and Foote, 1981).

Oxyethira dualis Morton. McElravy et al. (1977) reported this species on the basis of a single female collected at site 6 (Wilke, 1976). At the time of Wilke's study, females had been described for only a few species of *Oxyethira*. Kelly and Morse (1982) have since presented a key to most of the females of the species known to occur in the southern United States. This work includes those taxa presently reported to occur in Ohio. However, we feel that this record should be considered tentative until the collection of male material.

Ochrotrichia sp. (*confusa* [Morton]?), as reported by McElravy and Foote (1978). Tentative identification based on females.

Ceraclea neffi (Resh), as reported by Huryn and Foote (1981). *Ceraclea flava* (Banks) misidentified as *C. neffi.*

Triaenodes frontalis Banks. McElravy et al. (1977) reported this species as occurring at site 90. *T. frontalis* is known only from western North America and is unlikely to occur in Ohio (O. S. Flint, Jr., personal communication). Specimens upon which this record is based are unavailable for further study. Therefore, we feel that this record must remain tentative until confirmed by collections of additional material.

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NEW SPECIES AND NEW RECORDS OF THE LIGNYODINE WEEVIL GENUS *PLOCETES* LECONTE (COLEOPTERA: CURCULIONIDAE) FROM CHIAPAS, MEXICO

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Abstract.—Four new species of *Plocetes* LeConte from the state of Chiapas, Mexico, *P.* ***ancylus***, *P.* ***hebetatus***, *P.* ***incilatus***, and *P.* ***velatus***, are described and illustrated. *Plocetes bahamensis* (Casey), *P. obscurus* (Champion), *P. ornatus* (Champion), and *P. cerberus* Clark are reported for the first time from Chiapas. These Mexican *Plocetes* were collected on plants in the genera *Chiococca, Deppea,* and *Rondeletia* (Rubiaceae).

The lignyodine genus *Plocetes,* as revised by Clark (1982), contained 65 New World species. Only two of these, *P. pilatus* Clark and *P. zonatus* (Champion), were reported to occur in Chiapas. The purpose of this paper is to record the occurrence and host-plant relationships of eight additional species of *Plocetes,* four of them new, collected in Chiapas after the revision was completed. Host plants of the weevils were identified by Robert Kral of Vanderbilt University. The holotype and allotype of each of the new species are deposited in the National Museum of Natural History, Washington, D.C. (USNM). Paratypes and other specimens referred to are in the collections of the Auburn University Entomological Museum, Auburn, Alabama, Texas A&M University, College Station, Texas, and the Instituto de Ecologia, A.C., Mexico, D.F.

Plocetes ancylus **Clark, NEW SPECIES**

Figs. 1, 9, 14

Holotype.—♂, MEXICO, labelled "Mexico: Chiapas/30 km NW La Angostura/14 Sep 1981/Clark & Coe" (USNM type no. 100725).

Allotype.—♀, with same label data as holotype.

Paratypes.—8 ♂, 9 ♀, with same label data as holotype.

Diagnosis.—Integument rufopiceous, legs testaceous; rostrum of male moderately stout, most strongly curved in distal ½, that of female longer, more slender, evenly curved; pronotum and elytra (Fig. 1) with pallid fulvoaeneus scales and with dark ferruginous to fuscous scales, the latter forming diffuse lateromedian maculae on pronotum and variously incomplete subbasal, median, and subapical, zigzag-shaped, transverse bands; median band widest at middle, separated from subapical band by sutural patch of whitish scales; metatibial uncus of male with dorsal prominence; median lobe (Fig. 9) abruptly bent apically, flagellum hook-shaped.

Male holotype.—*Length:* 1.95 mm. *Width:* 1.02 mm. *Eyes:* separated by distance 0.34× eye length; eye height 1.3× length. *Rostrum:* length 0.95× pronotal length; in dorsal view, sides subparallel from base to apex; proximal portion 72% of total rostral length; lateral and dorsolateral sulci deep, bearing slender whitish scales. *Prothorax:* dorsum with intermixed slender, attenuate scales, and broader, longer, less finely attenuate fulvoaeneus scales, these replaced laterally and in posteromedian patch by broader, whitish scales similar to those on pleuron. *Elytra:* each interspace with narrow, slightly attenuate, recumbent scales and with a median row of larger, suberect, attenuate evenly distributed scales; sutural interspaces with a subapical patch of fuscous scales behind a patch of whitish scales. *Abdomen:* sterna 4 and 5 fused, suture between segments evident on extreme sides only; posteromedian portion of fused sterna 4 and 5 broadly concave, clothed with fine, recumbent, seta-like scales; sides of sterna with broader scales.

Female allotype.—*Length:* 2.03 mm. *Width:* 1.07 mm. *Rostrum:* slender, length 1.27× pronotal length; in profile, dorsal margin strongly, evenly curved from base to apex; proximal portion 63% of total rostral length; lateral sulcus deep, dorsolateral sulcus narrower, shallow. *Spermatheca:* (Fig. 14).

Discussion.—*Plocetes ancylus* is known only from specimens collected on small trees (identified only as Rubiaceae) along the highway between Las Limas and La Angostura, southeast of Tuxtla Gutierrez. These trace to *P. hamifer* Clark in the key to species of *Plocetes* (Clark, 1982) if the eyes are regarded as "prominent." The eyes are, in fact, considerably less prominent in *P. ancylus* than in *P. hamifer.* These two species are also distinguished by the darker integument and much more distinct elytral maculation in *P. ancylus.* They are similar in the structure of the median lobe of the male genitalia and hook-shaped endophallic transfer apparatus (cf. Fig. 9, and Clark, 1982: Fig. 195). In *P. hamifer* the "hook" appears to consist of a short tube from which extend a pair of "hooks" (see Clark 1982: Fig. 166). In *P. ancylus* the entire "hook" has a tubular structure, the extreme posterior portion only being divided.

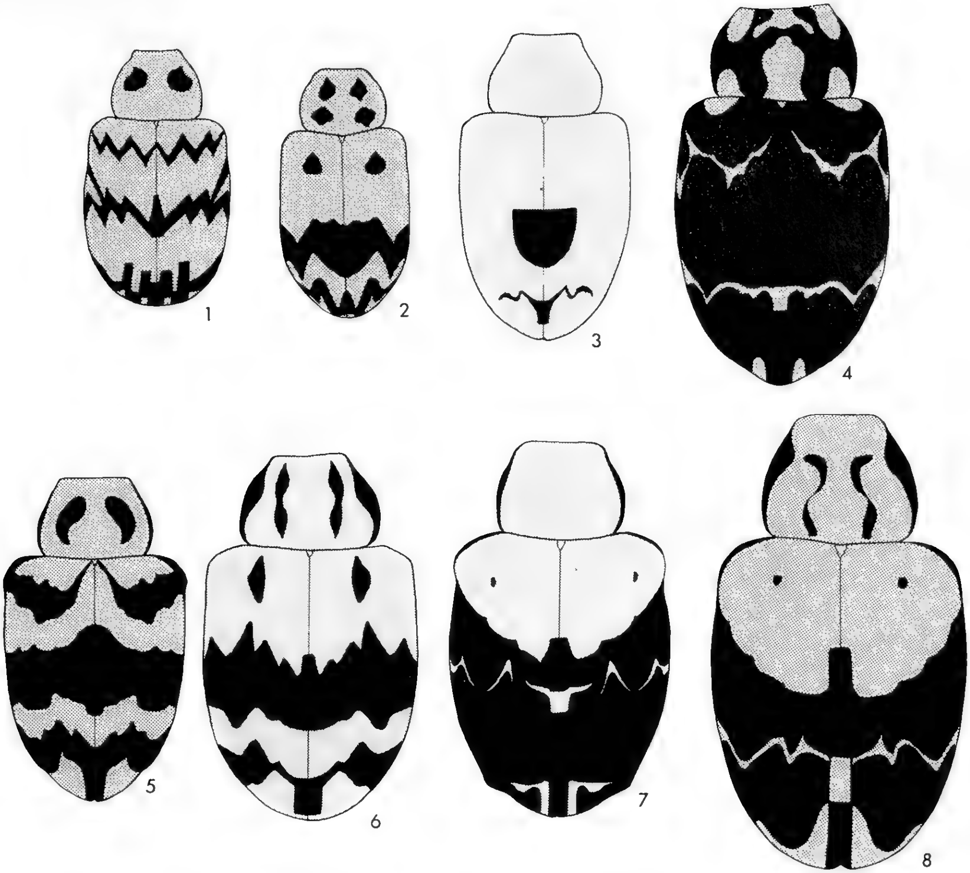
The name *ancylus,* from the Greek "ankylos" (bent, crooked, or hooked), refers to the hook-shaped endophalic flagellum of this species.

***Plocetes bahamensis* (Casey)**

Fig. 2

Hamaba bahamensis Casey 1910: 131.
Plocetes bahamensis (Casey): Clark 1981; 1982: 53.

Two specimens, a male and a female, were collected at Ocozocoautla, Chiapas, on *Chiococca phaenostemon* Schlecht. This is somewhat surprising since *P. bahamensis* was previously known only from the Caribbean region (southern Florida, the Bahamas, and the island of Cozumel, Mexico; see Clark, 1981, 1982). The species is easily distinguished from the other known Chiapan *Plocetes* by its small size and possession of 5 rather than 6 antennal funicular articles. The Chiapas specimens (Fig. 2) are slightly larger and darker than the Cozumel specimen which in turn is slightly larger and darker than the Bahamas and Florida specimens.



Figs. 1–8. Dorsal views of pronotum and elytra. 1, *Plocetes ancylus.* 2, *P. bahamensis.* 3, *P. hebetatus.* 4, *P. obscurus.* 5, *P. incilatus.* 6, *P. velatus.* 7, *P. ornatus.* 8, *P. cerberus.*

Plocetes hebetatus **Clark, New Species**

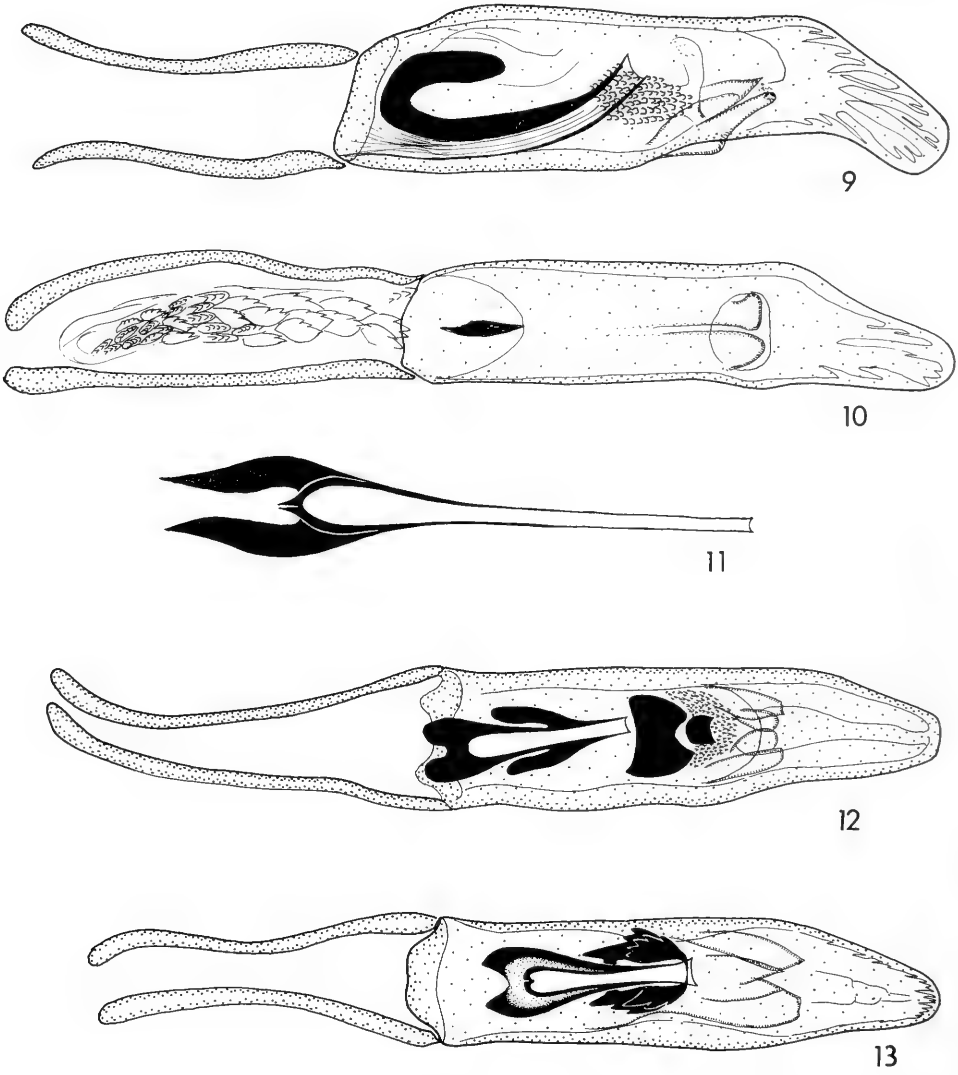
Figs. 3, 10, 15

Holotype.—♂, MEXICO, labelled "Mexico: Chiapas/6.9 km N Jitotol/11 Sep 1981/Clark & Coe" (USNM type no. 100724).

Allotype.—♀, with same label data as holotype.

Paratypes.—4 ♂, 4 ♀, with same label data as holotype; 1 ♀, with same label data, except "10 Sep 1981."

Diagnosis.—Moderate sized, elongate, slender *Plocetes*; eyes relatively large, strongly convex, not prominent; rostrum of male and of female slender, distal portion distinctly tapered to narrow apex; pronotum and elytra (Fig. 3) with lustrous fulvoaeneus scales and dark, fuscous scales, the latter forming small lateromedian patches on pronotum and subbasal patches on elytral interspaces 4–5, a large posteromedian elytral macula extending across interspaces 1–3, and a narrow zigzag-shaped, transverse, subapical elytral band; femora unarmed;



Figs. 9–13. Dorsal views of male external genitalia. 9, *Plocetes ancylus.* 10, *P. hebetatus.* 11, *P. obscurus* (flagellum only). 12, *P. incilatus.* 13, *P. velatus.*

metatibial uncus without dorsal prominence; median lobe of male genitalia (Fig. 10) assymetrical, internal sac with distal profusion of large, bluntly serrate plates.

Male holotype.—*Length:* 2.18 mm. *Width:* 1.13 mm. *Eyes:* separated by distance 0.15× eye length; eye height 1.4× length. *Rostrum:* moderately long, slender, length 1.16× pronotal length; in dorsal view, sides of proximal portion subparallel, distal portion tapered to tip; in profile, dorsal margin most strongly curved over antennal insertions; proximal portion 67% of total rostral length; lateral sulcus deep, dorsolateral sulcus shallower. *Prothorax:* dorsum with admixture of narrow, acuminate fulvoaeneus scales, and longer broader, more pallid, apically rounded scales; pleuron with sparse, shorter, broad scales similar to larger scales on dorsum. *Elytra:* odd-numbered interspaces slightly prominent on declivities; each interspace with uniform vestiture of narrow, acuminate, recumbent scales, and with larger, apically blunt scales which form a median row on each interspace; these scales less dense on even-numbered interspaces, slightly raised on declivities; sutural interspaces with distinct subapical patch of fuscous scales and with a longer patch of slightly raised, broad, whitish scales behind large posteromedian fuscous macula. *Abdomen:* sternum 4 much shorter than sternum 5, length 22% of length of sternum 5; median portions of all sterna with sparse, narrow, seta-like, recumbent scales.

Female allotype.—*Length:* 2.21 mm. *Width:* 1.22 mm. *Rostrum:* slender, length 1.34× pronotal length; in profile, dorsal margin broadly, nearly evenly curved; in dorsal view, distal portion strongly tapered to tip; proximal portion 52% of total rostral length. *Spermatheca:* (Fig. 15).

Discussion.—*Plocetes hebetatus* is known only from specimens in the type-series collected on *Rondeletia* sp. These trace to *P. uniguttatus* (Champion) in the key to species of *Plocetes* (Clark, 1982) and like that species have a prominent posteromedian macula of dark fuscous scales. Unlike *P. uniguttatus,* however, the males of *P. hebetatus* have a simple metatibial uncus lacking a basal prominence, and have the ventral margin of the scrobe entirely ecarinate. In the latter two features, *P. hebetatus* is more like *P. denticulatus* of Honduras and Costa Rica. The armature of the internal sac of the male genitalia of all three species consists of a cluster of relatively large plates (largest in *P. hebetatus*) with a series of blunt serrations (cf. Fig. 10 and Clark, 1982: Figs. 179, 180).

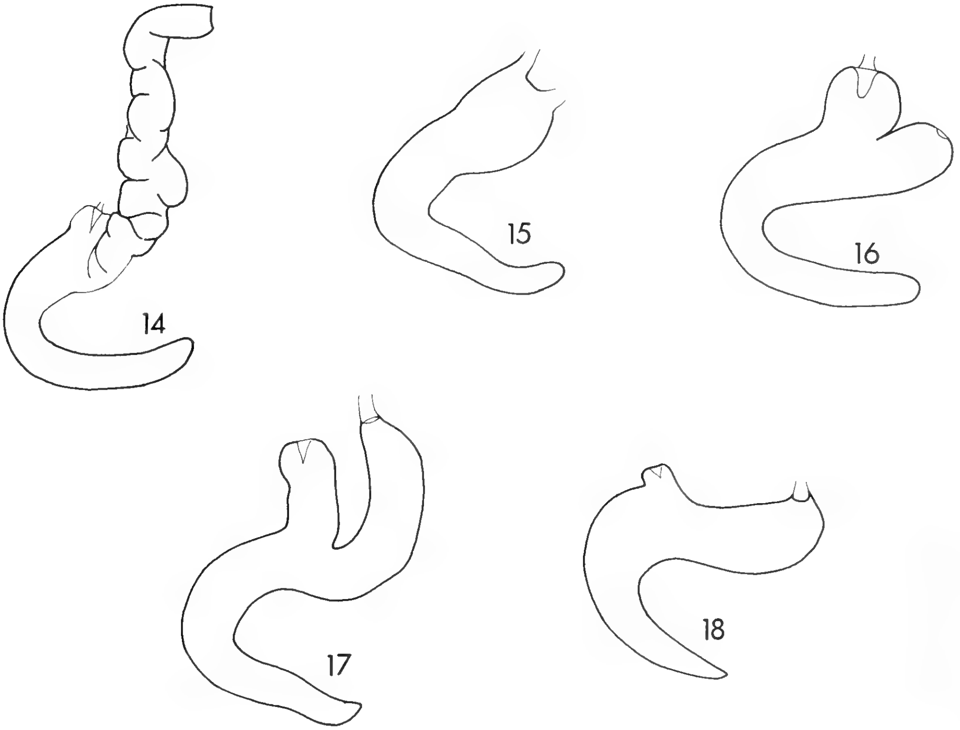
The name *hebetatus,* a Latin adjective meaning "dulled," "blunted," or "weakened," refers to the blunt serrations on the plates which arm the endophallus of this species.

***Plocetes obscurus* (Champion)**

Figs. 4, 11

Thysanocnemis obscurus Champion 1903: 204.
Plocetes obscurus (Champion): Clark 1982: 104.

Among the Chiapas specimens collected in 1981 are 1 male labelled "Mexico: Chiapas/Ocozocoautla/7 Sep 1981/Clark and Coe," and 13 males and 9 females labelled "Mexico: Chiapas/Ocozocoautla/23 Sep 1981/Clark and Coe." The specimens were taken beating *Chiococca phaenostemon* Schlecht. The males key to *P. obscurus* in Clark (1982) (females cannot be keyed in that source). The flagellum of the male genitalia (Fig. 11) is very similar to that of a specimen identified as *P. obscurus* from Monterrey, Mexico (illustrated by Clark 1982: Fig. 199). That specimen differs from the Chiapas specimens in the genitalic characters, as noted, and also has fewer white suberect scales on the elytra and narrower antero- and posteromedian transverse bands of pallid elytral scales. It also differs from the specimens from the lectotype locality, Calderas, Guatemala, and from a paralectotype from Senahu, Guatemala, in the structure of the flagellum of the male genitalia (cf. Clark 1982, Figs. 197–199). A specimen from Mexico without specific locality data cited by Clark (1982) has a flagellum identical in structure to that of the Chiapas specimens.



Figs. 14–18. Spermathecae. 14, *Plocetes ancylus.* 15, *P. hebetatus.* 16, *P. incilatus.* 17, *P. velatus.* 18, *P. cerberus.*

Plocetes incilatus **Clark, New Species**

Figs. 5, 12, 16

Holotype.—♂, MEXICO, labelled "Mexico: Chiapas/10.2 km E Rayon/12 Sep 1981/Clark & Coe" (USNM type no. 100723).

Allotype.—♀, with same label data as holotype (USNM).

Paratypes.—2 ♂, 4 ♀, with same label data as holotype; 7 ♂, 8 ♀, with same label data, except "11 Sep 1981"; 8 ♂, 2 ♀, labelled "Mexico: Chiapas/8.6 km E Rayon/12 Sep 1981/Clark & Coe"; 3 ♂, 2♀, labelled "Mexico: Chiapas/3.7 km S Jitotol/9 Sep 1981/Clark & Coe."

Diagnosis.—Rostrum of male moderately stout, strongly curved distally, straight proximally, that of female distinctly more slender, evenly curved; pronotum and elytra (Fig. 5) with pallid fulvoferruginous scales and with darker fuscous scales which form large lateromedian maculae on pronotum, an incomplete, zigzag-shaped, transverse, anteromedian band on elytra which does not extend across interspaces 1 and 2, and with broader, complete, median and subapical bands, the latter extending to apices on sutural interspaces; elytra also with large, scattered white scales; flagellum (Fig. 12) elongate, stout, enlarged distally with short distal extensions, also with a pair of lateromedian armlike extensions, with a large, deeply emarginate accessory plate and a small proximal plate.

Male holotype.—*Length:* 2.14 mm. *Width:* 1.13 mm. *Eyes:* separated by distance 0.21× eye length; eye height 1.5× length. *Rostrum:* length 0.89× pronotal length; in profile, dorsal margin straight in proximal ⅓, strongly curved distally; in dorsal view, sides subparallel, distal portion abruptly wider; proximal portion 67% of total rostral length; sulci obsolete, represented by rows of shallow punctures. *Prothorax:* dorsum with long, narrow, finely acuminate, recumbent scales, and sparsely admixed, longer, wider, slightly raised scales; pleuron with sparse, fine, aeneus setae below, denser seta-like scales above. *Elytra:* each interspace with uniform vestiture of recumbent, acuminate scales, and with large fuscous and white scales in median rows which are absent from extensive portions, especially on disc. *Abdomen:* sterna uniformly clothed with sparse, aeneus, seta-like recumbent scales which are slightly wider on sides. *Legs:* femora with sparse, long, aeneus setae.

Female allotype.—*Length:* 2.20 mm. *Width:* 1.15 mm. *Rostrum:* length, 1.27× pronotal length, proximal portion 67% of total rostral length, shallowly punctate, not sulcate. *Spermatheca:* (Fig. 16).

Discussion.—*Plocetes incilatus* is known from specimens from the cloud forest habitat along Highway 195 between the communities of Bochil and Rayon, Chiapas. They were taken on *Deppea* sp. at 10.2 km E Rayon and 3.7 km S Jitotol, and on *Deppea excelsa* (HBK) Standley at 8.6 km E Rayon. These trace to *P. obscurus* in the key to species of *Plocetes* (Clark, 1982). The overall general appearance and the structure of the male genitalia (Fig. 12) suggest that *P. incilatus* belongs with *P. obscurus* in the *bicinctus* group. General structure of the median lobe and flagellum is similar in the species in this group (cf. Fig. 11–13 herein and Clark, 1982: Figs. 195–199). *Plocetes incilatus* has greater component similarity with *P. bicinctus* and *P. apparitio.* This is manifest in the possession in all three species of lateromedian extensions on the flagellum itself, as well as a similar complement of accessory armature (cf. Fig. 12 and Clark, 1982: Figs. 195, 196).

Plocetes incilatus is easily distinguished from the Panamanian *P. bicinctus* by the male genitalic characters discussed above and by its smaller size, the prominent, incomplete subbasal transverse band of dark scales on the elytra, the more widely distributed fulvoferruginous scales on the pronotum and the elytra, and the presence of numerous large, scattered white scales on the elytra.

The name *incilatus,* a Latin adjective meaning "to scold," refers to the structure of the flagellum which looks like a woman with hands on hips correcting an errant child.

Plocetes velatus **Clark, New Species**

Figs. 6, 13, 17

Holotype.—♂, MEXICO, labelled "Mexico: Chiapas/4.8 km SE Trinitaria/21 Sep 1981/Clark & Coe" (USNM type no. 100722).

Allotype.—♀, labelled "Mexico: Chiapas/Ocozocoautla/23 Sep 1981/Clark & Coe" (USNM).

Paratypes.—2 ♂, with same label data as holotype; 1 ♀, with same label data as allotype.

Diagnosis.—Integument rufopiceous, legs, rostrum, and antenna lighter; rostrum of male moderately stout, evenly curved, that of female slender; pronotum and elytra (Fig. 6) with intermixed white and pale aeneus scales and with a broad median elytral band of darker fuscous scales and a narrower posteromedian band of such scales which is broad laterally, becomes very narrow on interspaces 2 and 3, and crosses suture as a posteriorly displaced elongate patch of dark scales; elytra with narrow, acuminate, recumbent scales and with a median row of larger, suberect, white and fuscous scales, the former largest and appearing scattered; flagellum (Fig. 13) elongate, surrounded distally by a flared cowl, surrounded proximally by a series of overlapping multidentate plates which are connected above and below flagellum by narrow bridges.

Male holotype.—*Length:* 2.70 mm. *Width:* 1.43 mm. *Eyes:* separated by distance 0.27× eye length; eye height 1.4× length. *Rostrum:* length, 1.05× pronotal length; in profile, dorsal margin broadly, evenly arcuate; in dorsal view, sides subparallel, distal portion slightly wider; proximal portion 67% of total rostral length; lateral sulci deep, dorsolateral sulci shallower, with large punctures. *Prothorax:* dorsum with long, narrow, finely acuminate, recumbent scales, and admixed, slightly longer, wider, slightly raised scales; pleuron with sparse, short, seta-like scales below, wider, recumbent scales above. *Elytra:* each interspace with uniform vestiture of recumbent, acuminate, seta-like scales, and with a median row of broader, longer, suberect scales. *Abdomen:* sterna with sparse, aeneus, seta-like scales medially, with broader, white scales on sides. *Legs:* femora minutely toothed, with long, sparse, whitish setae.

Female allotype.—*Length:* 2.48 mm. *Width:* 1.37 mm. *Rostrum:* length, 1.1× pronotal length, proximal portion 58% of total rostral length; dorsolateral sulci represented by row of shallow punctures. *Spermatheca:* (Fig. 17).

Discussion.—*Plocetes velatus* is known from specimens from two widely separated localities in Chiapas. Two female specimens from Ocozocoautla were among numerous specimens of *Plocetes obscurus.* The specimens from Trinitaria, all males, were with a larger series of *P. cerberus.* Confirmation of the host of *P. velatus* will require further field work.

The specimens of *P. velatus* trace to *P. bicinctus* (Champion) in the key to species of *Plocetes* (Clark, 1982). Genitalic characters and general overall resemblance suggest that the species belongs with that Panamanian species in the *bicinctus* group. The shape of the median lobe is similar in *P. velatus* and in the *bicinctus* group members (cf. Figs. 13 and Clark, 1982: Figs 195–199). The structure of the flagellum in *P. velatus* is also similar to that in these species, being somewhat closer to *P. bicinctus* and *P. apparitio* than to *P. obscurus.* None of these other species has a flared cowl surrounding the distal portion of the flagellum as does *P. velatus* (Fig. 13). It seems likely, however, that this structure is homologous to the long posterolateral extensions present in *P. bicinctus* and *P. apparitio* (cf. Figs. 195, 196); or, perhaps to the various distal extensions seen in the various forms of *P. obscurus* (cf. Fig. 11 herein and Clark, 1982: Figs. 197–199). Likewise, the armature accessory to the flagellum is more similar in *P. velatus, P. bicinctus,* and *P. apparitio. Plocetes velatus* is easily distinguished from *P. bicinctus* by the more extensive elytral vestiture of pallid elytral scales which consists of white and pallid aeneus scales rather than fulvoferruginous scales. *Plocetes velatus* also has a narrower pronotum which lacks the distinct lateromedian c-shaped maculae characteristic of *P. bicinctus.* The absence of dark scales on the basal portion of the elytra, along with the distinctive features of the male genitalia, serve to distinguish *P. velatus* from *P. obscurus* with which it was taken in sympatry at Ocozocoautla (cf. Figs. 11, 13 herein and Clark, 1982: Figs. 197–199).

The name *velatus,* a Latin adjective meaning "to cover" or "to conceal," refers to the flared cowl which covers the distal portion of the flagellum of this species.

Plocetes ornatus **(Champion)**

Fig. 7

Thysanocnemis ornatus Champion 1903: 205; Clark 1982: 105.

Previously known only from the male lectotype and female paralectotype from Guatemala (see Clark, 1982), this distinctive species (Fig. 7) is represented in the Chiapan collections by 57 specimens, collected 11 and 12 Sep 1981 at 10.2 km E Rayon, on *Rondeletia suffrutescens* T. S. Brandeg., by 1 specimen, collected 9 Sep 1981 at 3.7 km S Jitotol, and by 12 specimens, collected 10–11 Sep 1981, at 6.9 km N Jitotol on *Deppea* sp.

Plocetes cerberus **Clark**

Figs. 8, 18

Plocetes cerberus Clark 1982: 106.

This species, known previously from the male holotype from the state of Puebla, Mexico, and from 2 male paratypes from Tampico, Mexico, is represented among the Chiapan material by 1 male and 1 female collected 15 Sep 1981 at 11.2 km S Sumidero on *Chiococca alba* (L.) Hitchc., and by 4 males and 2 females collected 21 Sep 1981 at 4.8 km SE Trinitaria on an unidentified Rubiaceae. The female, previously unknown, has only a slightly longer, more slender rostrum than does the male. The spermatheca of the species is illustrated in Fig. 18.

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OBSERVATIONS ON THE BIOLOGY OF *LIRIOMYZA TRIFOLIEARUM* (DIPTERA: AGROMYZIDAE)

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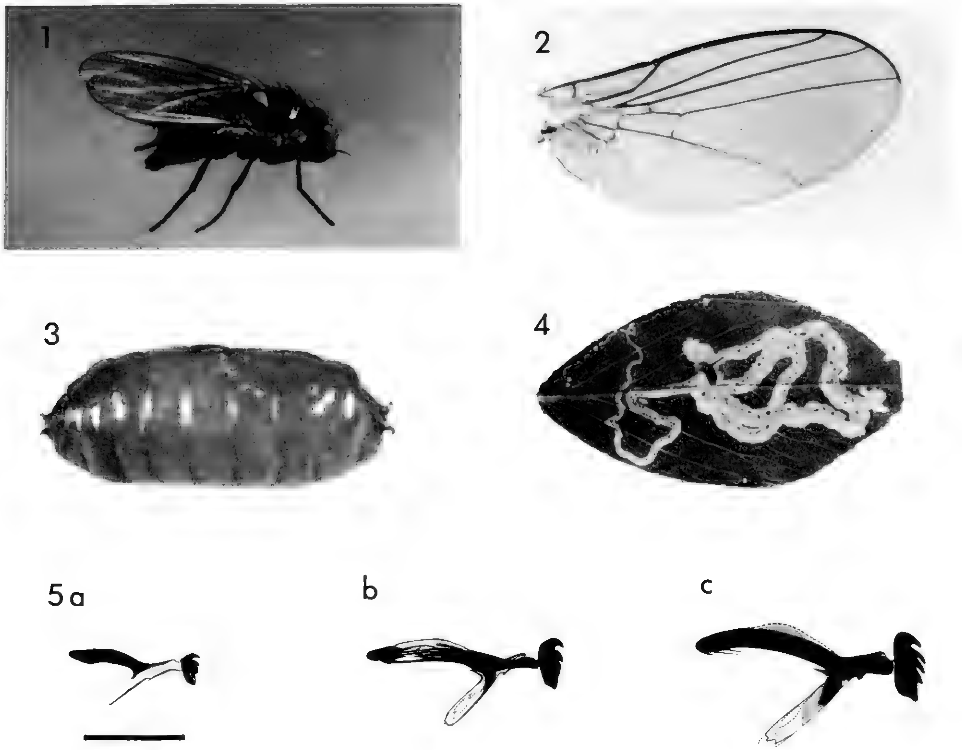
Abstract.—*Liriomyza trifoliearum* Spencer is a native serpentine leafminer attacking alfalfa and other legumes in the USA and Canada. In laboratory tests, fecundity was 213.5 progeny/♀, and number of feeding perforations was 1116/♀. Adult longevity was 2–3 weeks, with a preoviposition period of 4–6 days. The times for development of stages and instars at 21.1°C and 25.6°C were determined. The size of eggs, larvae, adults, and mine widths for each instar was measured. The cephalopharyngeal skeleton of each instar was measured and illustrated. The leafminer was found useful as a host for laboratory rearing of several native and introduced parasite species.

Liriomyza trifoliearum Spencer is a native serpentine leafminer originally described in Spencer and Stegmaier (1973: 107–108). Its range is probably Nearctic on alfalfa, *Medicago sativa* L. (Hendrickson, 1979). Since alfalfa was introduced into North America from Eurasia, it appears this somewhat polyphagous leafminer has accepted alfalfa as an additional host plant. Other reported host plants are *Pisum sativum* L., *Trifolium incarnatum* L., and *T. repens* L. (Spencer, 1973: 99). The leafminer is not an economic pest, with the possible exception of a report by Jensen and Koehler (1970). They observed moderate to heavy infestations of mixed *L. pictella* (Thomson) and *L. munda* Frick (probably *L. sativae* Blanchard and *L. trifoliearum* respectively (Spencer, 1973: 100; Spencer, 1981: 258)) on alfalfa in California. They also reported six parasite species from the two host species. Hendrickson (1979) recovered 19 species of parasites from *L. trifoliearum* in northeastern USA; he also described the low population densities usually encountered in the field. The purpose of this paper is to present notes on the behavior and biology of the leafminer, and on the usefulness of the leafminer as a host for rearing native and introduced parasites in a biological control program against alfalfa blotch leafminer (ABL), *Agromyza frontella* (Rondani). Mass rearing of parasites using ABL as a host is difficult because large numbers of pots of relatively slow growing alfalfa are required, but *Liriomyza trifoliearum* can be abundantly reared on snap beans, *Phaseolus vulgaris* L.

BEHAVIORAL OBSERVATIONS

Oviposition may take place on either the upper or lower epidermis of an alfalfa leaflet, but the lower is preferred. Eggs are positioned between the leaflet epidermis



Figs. 1–5. *Liriomyza trifoliearum*. 1, Adult female. 2, Wing. 3, Puparium. 4, Typical serpentine mine in alfalfa leaflet; a third-instar larva is visible in center. 5, Cepahlopharyngeal larval skeletons: a, first instar; b, second instar; c, third instar. Bar = 0.1 mm.

and the mesophyll. Larvae mine in these same layers until shortly before pupation when they frequently cross over to the opposite epidermis. Newly eclosed larvae usually mine toward the proximate end of the leaflet, then turn, following the central vein for part or all of its length. Some larvae mine in an apparently random manner, even crossing over their own mine and pupate in the distal part of the leaflet. As many as 4 larvae in a single alfalfa leaflet have been observed in the field. Mining larvae sometimes cross over mines of other larvae but remain solitary. Frass is deposited in lumpy trails.

The larva is white at eclosion but soon takes on a yellow cream color. Like other agromyzids, there are three instars. In the late first or early second instar, green gut contents become visible. Large amounts of what appears to be adipose tissue accumulate in the late third (mature) instar and may obscure the cephalopharyngeal skeleton, but otherwise the skeleton is clearly visible throughout larval maturation. During a brief prepupal period, the larva contracts and assumes an ellipsoid shape. Puparia are cream colored initially, darkening to various shades of brown. Pupation occurs within the leaf.

When the adult emerges from the puparium, it passes through either the upper or lower leaflet epidermis, the choice apparently random. The newly emerged

Table 1. Mean values for length, width, and mine width for *Liriomyza trifoliearum.*

	Length (mm)			Width (mm)			Mine width (mm)		
Life stage	Mean	Range	*n*	Mean	Range	*n*	Mean	Range	*n*
Egg	0.24	0.20–0.26	20	0.13	0.10–0.14	20	—	—	—
Larvae									
1st instar	0.51	0.33–0.81	118	0.17	0.10–0.27	119	0.19	0.10–0.39	119
2nd instar	0.91	0.59–1.26	92	0.29	0.20–0.40	92	0.44	0.23–0.79	86
3rd instar	1.66	1.03–2.29	98	0.50	0.33–0.79	99	0.85	0.43–1.61	83
Pupa	1.59	1.31–1.90	40	0.74	0.59–0.87	40	0.94	0.87–1.01	2
Adult									
Female	1.55	1.41–1.61	7	—	—	—	—	—	—
Male	1.41	1.33–1.56	8	—	—	—	—	—	—

adult is almost entirely yellow. Observations of five emerging adults indicated that it takes four hours for the body to become fully sclerotized and colored.

Adult females feed by boring a hole with the ovipositor, usually on the underside of a leaflet, and then imbibing the plant juices. Males sometimes disturbed females in the process of boring the feeding perforations, which caused the females to fly away, then the males fed on the plant juices. Both sexes also fed on honey provided in cultures.

EXPERIMENTS

The laboratory culture of *L. trifoliearum* was maintained on snap beans. Other host plants acceptable in the laboratory but less productive were fava bean, *Vicia faba* L., lima bean, *Phaseolus limensis* Macf., and red clover, *Trifolium pratense* L. (When the latter three species were grown for a summer next to an alfalfa field lightly infested with the leafminer, no mining took place on them, suggesting *L. trifoliearum* has a strong preference for alfalfa as host plant under field conditions.) The leafminer culture was maintained at 25.6°C, 60 ± 5% RH, and 16L:8D.

A single experiment was conducted to determine fecundity, number of sterile eggs, number of feeding perforations, and adult female longevity. Virgin females were isolated by holding bean-leaf pieces containing puparia in individual 5 × 1.2 cm sealed petri dishes with moistened filter paper to maintain humidity. Petri dishes were examined each morning to collect six newly emerged virgin females. A newly emerged female, with two males selected at random from the host culture, were confined on potted alfalfa (25–30 cm height in a plexiglass cylinder [12.7 cm diam × 30 cm]). Ventilation was provided through the top of the cylinder and 16 ventilation holes (2.5 cm diam) which were covered with organdy fabric. Honey was provided as food.

Each female was confined to potted alfalfa for one week, then transferred to a fresh alfalfa plant with two newly collected male flies until the female died. It was determined from other tests that eggs hatched in less than one week, so we allowed the plant to remain unexamined for an additional week before looking at the leaflets. After the female was removed from the pot, and a week for egg hatch was allowed, all leaflets (including dehisced leaflets at the bottom of the pot) were

Table 2. Mean times from oviposition to onset of each stage or larval instar of *Liriomyza trifoliearum* at 21.1°C and 25.6°C.

Stage or instar	Time of onset (h)	
	21.1°C	25.6°C
Larva		
1st instar	88 (2.2)[1]	56 (0.2)
2nd instar	118 (3.8)	89 (1.4)
3rd instar	159 (4.7)	110 (2.0)
Pupa	208 (4.4)	134 (2.7)
Adult	428 (7.7)	386 (0.5)[2]
n	14	26

[1] SE of mean in parentheses.
[2] Mean and SE of 15 observations.

removed and examined under magnification to determine the number of mining larvae, sterile eggs, and feeding punctures.

Results showed that six females produced an average 213.5 progeny, 100.3 sterile eggs, and 1116 feeding perforations each. Sterile eggs accounted for 32% of total oviposition. This unexpectedly high percentage may be due to infrequent mating as Oatman and Michelbacher (1958) observed for *L. pictella* (probably *L. sativae* [Spencer, 1981: 258]). Adult females lived 2–3 weeks. Sex ratio in the laboratory culture on snap beans was 1.1♀:1♂ (*n* = 250).

A similar experiment was set up in which females were transferred from plant to plant daily. Since no eggs were oviposited by any female during the first 4–6 days, we concluded that the species has a pre-oviposition period.

In another experiment, we examined immature development. Potted alfalfa was exposed to the leafminer culture for one-half or one hour. The plants were then removed, covered with a cylindrical cage (described in the first experiment) and placed at either 21.1 ± 1°C or 25.6 ± 1°C. Plants were observed several times daily until hatching occurred. Leaves with larvae were then placed on moistened filter paper to maintain humidity in a plastic petri dish with a tight fitting lid. Observations were made 1–3 times daily until adult emergence occurred. During observation, insects were removed from controlled temperature conditions for about 15 minutes. Measurements taken at each observation were: larval length and width, mine width, cephalopharyngeal skeletal length, and pupal length and width (Table 1). In some instances, measurements could not be taken due to larval curl, crossed mines, etc. Only individuals reaching the adult stage were included in the analyses.

The mean time from oviposition to onset of each stage or larval instar at 21.1°C and 25.6°C was determined by averaging for all insects observed (Table 2). If a molt occurred between observations, as was the usual case, the average of the pre- and post-molt times was taken as the time of molting.

Illustrated in Figs. 1–4 are the female adult, female wing, puparium, and typical serpentine mine. Larvae were cleared overnight in chlorophenol and mounted in Hoyer's medium for illustration of the cephalopharyngeal skeleton of each instar (Fig. 5). Each skeleton has two dorsal processes and a single ventral process. The species has closely appressed left and right mandibles, each with two teeth in the third (mature) instar. The mandibles are asymmetric, so that when viewed laterally, all four teeth appear. The mandibles are fused at their most ventral point.

Use as a Host for Rearing Parasites

We reared seven native and two European parasite species on *L. trifoliearum* on snap beans for biological studies, mass releases, or shipments to cooperators. The native parasite species were Braconidae: *Opius dimidiatus* (Ashmead); Eucoilidae: *Cothonaspis* poss. n. sp.; Eulophidae: *Chrysocharis clarkae* Yoshimoto, *C. giraulti* Yoshimoto, *Diglyphus intermedius* (Girault), *D. pulchripes* Crawford, and *Pnigalio minio* (Walker); and the European species *Chrysocharis melaenis* (Walker) and *Diglyphus isaea* (Walker). A rearing technique for the last species was briefly described by Hendrickson (1975).

We also experimented with *L. sativae* Blanchard and *L. trifolii* (Burgess) as host species. Both these species pupated in the potting mix which had to be kept moist for high percentage emergence of either leafminers or pupal parasites. This moisture requirement allowed contaminant arthropods to reach annoying levels even with sterilized potting mix. The advantage of *L. trifoliearum* as a host is that larvae pupate in the leaves rather than in the potting mix. Thus, pots can be allowed to dry out which greatly reduces the abundance of contaminant species, or leaves can be cut and placed in cages for insect emergence and the potting mix thrown out.

Acknowledgments

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MITES OF THE FAMILY PACHYGNATHIDAE (ACARI: ENDEOSTIGMATA) FROM TEXAS

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Abstract.—Three new taxa of Pachygnathidae were collected during an investigation of the microarthropod fauna of the Southern High Plains and Gulf Coastal Region of Texas, *Petralycus* ***celtisacinus***, n. sp., *P.* ***caryapecaus***, n. sp., and *Bimichaelia dimixsetosa* ***texana***, n. subsp. All three are described here. The two new species represent the first records of *Petralycus* from the Western Hemisphere.

During an investigation of the microarthropod fauna of the Southern High Plains and Gulf Coastal regions of Texas, members of the family Pachygnathidae were collected; these included two new species of the genus *Petralycus* Grandjean (1943) and a new subspecies of *Bimichaelia dimixsetosa* McDaniel (1979).

Petralycus Grandjean

The genus *Petralycus* was, until the work of Theron (1977), known only from the nominal species *P. unicornis* Grandjean from France. Theron (1977) added two new species from South Africa, *P. longicornis* Theron and *P. brevicornis* Theron. In this paper two new species of *Petralycus* are described, extending the known distribution of the genus to include the United States. Setal nomenclature is after Theron (1977).

Petralycus celtisacinus McDaniel and Bolen, New Species

Figs. 1, 2

Description.—Dimensions: Length of body 246 mm; breadth of body 94 mm.

Dorsum (Fig. 1): Palp 5-segmented, palptarsus with 7 plumose setae, 1 thickened solenidion, 2 slender terminal solenidia; palpal segment 4–2 with 2 plumose setae; segment 3 with a single plumose seta. Gnathosoma with both movable and fixed digits provided with denticles. Hypognathum provided with 3 small branched setae, peglike adoral setae not observed. Ectomalae well developed, elongate not thickened at terminal apex. Naso very long, longer than naso of *P. longicornis,* reaching to apex of propodosoma (Fig. 1). Propodosoma with 3 pairs of setae, *ro, xa,* and *in,* these plumose with *in* larger than *xa* and *ro.* Sensilla *le* globose, located above sensilla *bo* and below seta *xa.* Sensilla *bo* filamentous and finely ciliate. Apodomes of propodosoma similar to those found on *P. unicornis* Grandjean. Podosoma (excluding propodosomal region) and opisthosoma with 24 plumose setae. Setae

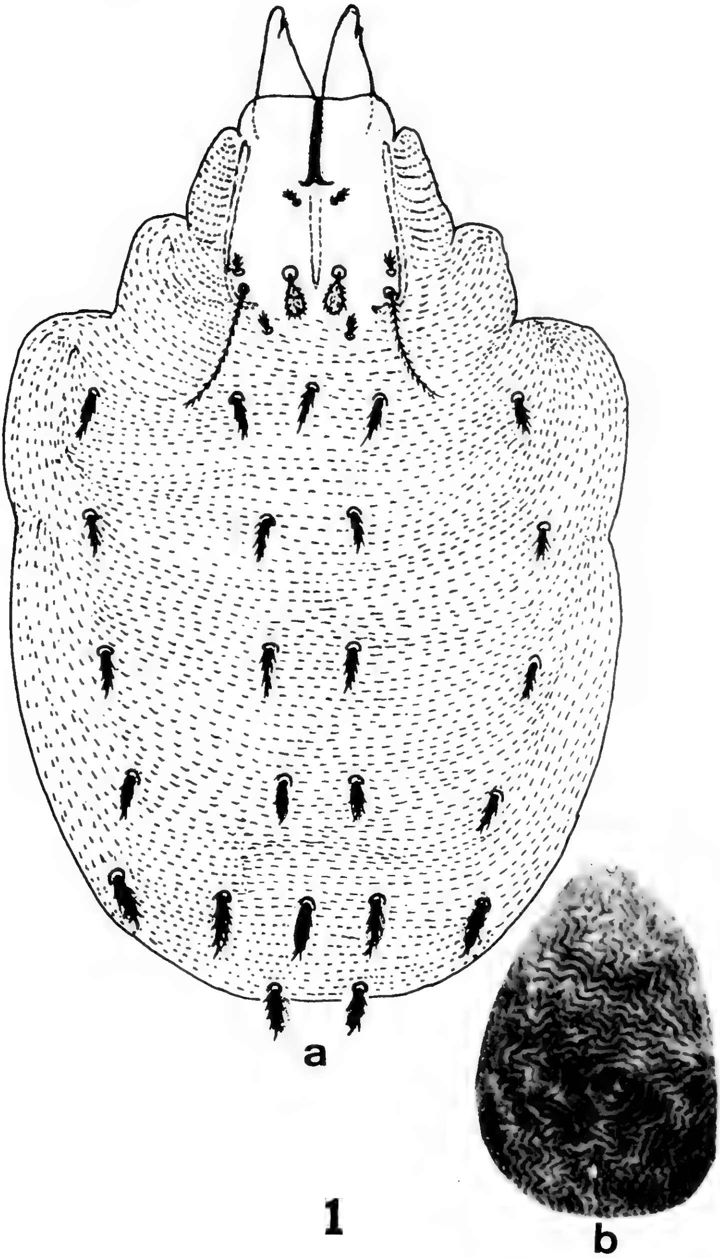

Fig. 1. *Petralycus celtisacinus*. a, Dorsal region of holotype. b, Photograph showing parallel winding ridges.

on posterior portion of hysterosoma larger than other dorsal setae. Integument of dorsum similar to other members of *Petralycus* and with numerous parallel winding ridges. Crests of ridges bear transverse lamellae.

Venter (Fig. 2): Genital plate with variable number of setae, with 16 plumose

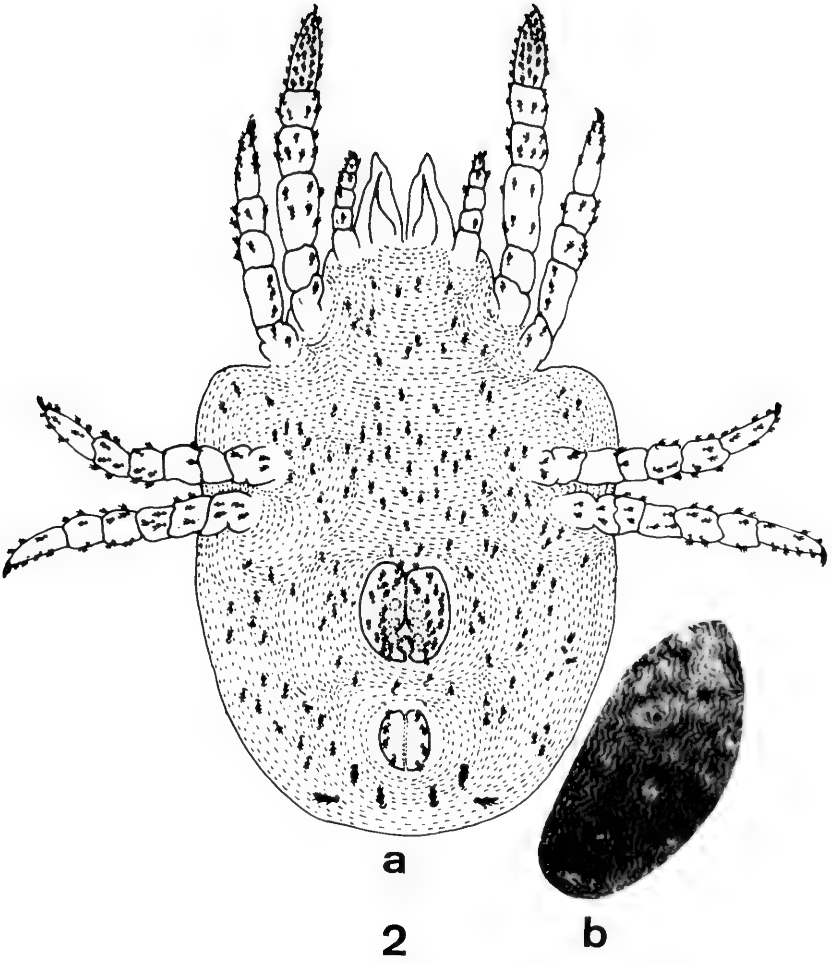

Fig. 2. *Petralycus celtisacinus.* a, Ventral region of holotype. b, Photograph showing parallel winding ridges.

setae on right ½, 8 in outer row and 8 in inner row; left ½ with 6 in outer row, 6 in inner row; 3 pairs of oval papillae. Anal plate bears 4 pairs of plumose setae, posterior pairs largest and anterior pairs smallest. Ventral setae similar to anal plate setae and vary in size and shape. Anal region apex with 2 pairs of large plumose setae similar to posterior dorsal setae.

Legs: First pair of legs longer and thicker than legs II–IV. Ambulacrum with small apotele, 2 well-developed claws, and rayed empodium. Chaetotaxy of legs I–IV: tarsi (54-10-8-9); tibiae (10-6-6-5); genua (9-4-4-4); femora (8-5-3-5); trochanters (1-1-2-2); coxae (3-2-2-2). Solenidotaxy: Tarsi (1-1-0-0); tibiae (2-2-2-2); genua (5-2-2-2); femora (5-1-1-2).

Holotype.—♀ collected in San Patricio County on the Rob and Bessie Welder Wildlife Refuge, 8 mi N Sinton, Texas, May 22, 1978, by Eric G. Bolen and B. McDaniel. The holotype will be deposited with National Museum of Natural History, Washington, D.C.

Habitat.—The site is known locally as Hackberry Motte, a riparian woodland bordering the Aransas River. Soils are loams of the Sinton series, but irregular incursions of fine sands within the motte reflect periodic flooding of the site. The vegetation is a complex of herbaceous growth with a mixed overstory of hackberry (*Celtis laevigata*), anacua (*Ehretia anacua*), elm (*Ulmus crassifolia*), or pecan (*Carya illinoensis*). Mustang grape (*Vitis mustangensis*) conspicuously drapes many of the trees.

Remarks.—*Petralycus celtisacinus* resembles *P. unicornis* but differs in the length of the naso, which reaches the apex of the propodosoma, and in the numbers of solenidia on tibia I and femora I–IV.

Petralycus caryapecaus McDaniel and Bolen New Species

Figs. 3, 4

Description.—Dimensions: Length of body 222 mm; breadth of body 88 mm. *Dorsum* (Fig. 3): Palp 5-segmented, palptarsus with 7 plumose setae; 1 large solenidion and 2 slender terminal solenidia. Gnathosoma with fixed digit provided with denticles at outer apex, movable digit appears bladelike. Hypognathum provided with 3 branched setae. Ectomalae slender with broad base and narrowing apex. Naso shorter than *P. celtisacinus* about same length of *P. longicornis,* not reaching apex of propodosoma (Fig. 3). Propodosoma with 3 pairs of setae, *ro, xa,* and *in,* these plumose all about equal in size. Sensilla *le* globose, appearing smooth and without small ciliated hairs found on other members of *Petralycus.* Sensilla *bo* are filamentous and finely ciliate. Apodomes of propodosoma not as well developed as in *P. unicornis* or *P. celtisacinus* but more developed than *P. longicornis* or *P. brevicornis* (Fig. 3). Podosoma (excluding propodosomal region) and opistherosoma with 32 plumose setae, all similar in shape, opistherosomal setae of last 3 rows slightly larger than other dorsal setae. Integument of dorsum has typical parallel winding ridges with setae surrounded by unstriated areas.

Venter (Fig. 4): Genital plate with 12 plumose setae, 4 in outer row, 8 in inner row. Internal region with 2 small densely plumose setae and 3 pairs of oval papillae. Anal plates with 4 setae each. Ventral region with integument striated similar to dorsum. Ventral setae all similar in size and shape. Gnathosomal base without typical ventral striation, with 3 pairs of large branched setae.

Legs: First pair of legs longer and thicker than legs II–IV. Ambulacrum with small apotele, 2 well-developed claws, and rayed empodium. Chaetotaxy of legs I–IV: Tarsi (38-12-10-12); tibiae (8-6-4-5); genua (8-4-4-3), femora (7-6-2-6); trochanters (1-0-2-2); coxae (2-2-3-4). Solenidotaxy: Tarsi (4-1-0-0); tibiae (3-2-1-1); genua (6-2-1-2); femora (3-3-0-0). Two types of setae present on tarsi of 1st pair of legs. One large solendion accompanied by 10 normal branched setae, 5 in 2 rows with solendion in center. Ventral portion of tarsi with 18 setae much thicker ciliated and bunched near anterior portion of tarsi, accompanied by 10 normal branched setae along lateral margins and in center of posterior portion of tarsi I.

Holotype.—♀ collected in San Patricio County on the Rob and Bessie Welder Wildlife Refuge, 8 mi N Sinton, Texas, May 6, 1978, by Eric G. Bolen and B. McDaniel. The holotype will be deposited in the National Museum of Natural History, Washington, D.C.

Habitat.—The site is known locally as Pecan Motte, a riparian woodland bor-

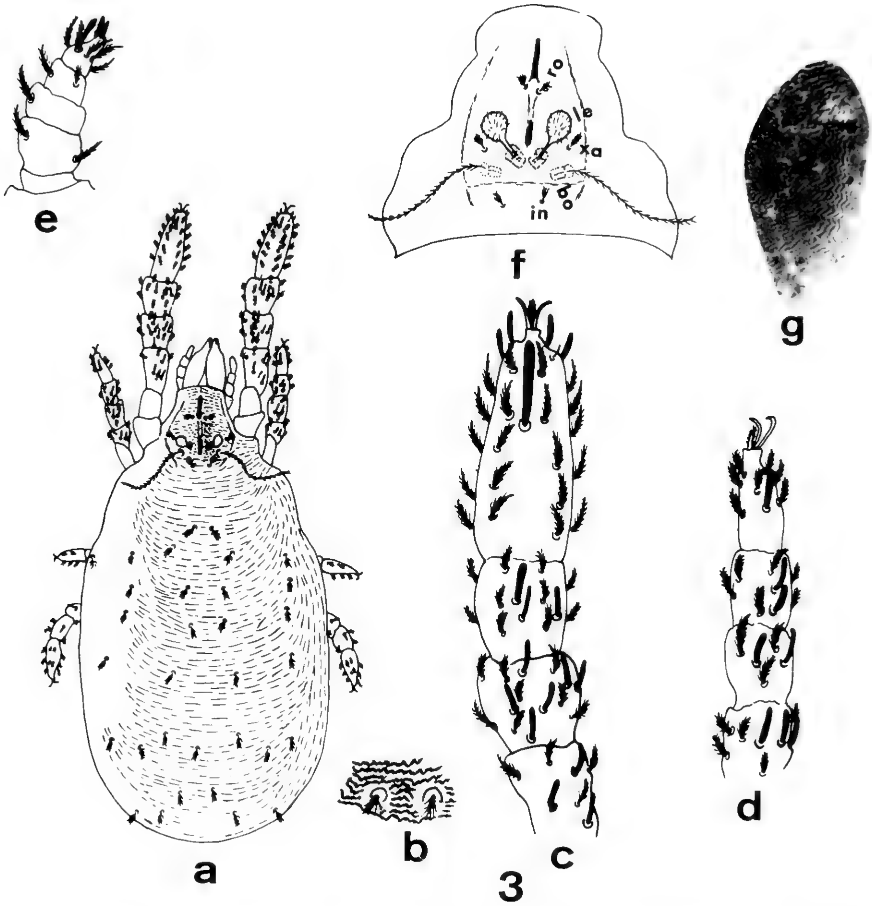

Fig. 3. *Petralycus caryapecaus.* a, Dorsal region of holotype. b, Arrangement of striae. c, Leg I showing solenidia. d, Leg II showing solenidia. e, Enlargement of palpus. f, Enlargement of propodosoma showing naso, sensilla *le* and *bo,* setae *ro, xa,* and *in.* g, Photograph showing parallel winding ridges.

dering the Aransas River. Features of this habitat are virtually identical with those described earlier for Hackberry Motte.

Remarks.—*Petralycus caryapecaus* resembles *P. longicornis* in the length of the naso which is longer than either *P. unicornis* and *P. brevicornis. Petralycus caryapecaus* can be distinguished from *P. celtisacinus* by the naso not reaching the apex of the propodosma and from *P. longicornis* by development of the propodosomal apodemes and the number of solenidia on tarsus I, tibiae I and III, genua I and III, and femora I and II.

Bimichaelia Thor

The genus *Bimichaelia* was first reported from the United States by Banks (1915) for *Michaelia pallida* Ewing (1913), which was placed in the genus *Bimichaelia. Bimichaelia pallida* (Ewing) was collected from moss in Oregon. McDaniel (1979) described two new species, *B. disetosa* McDaniel and *B. di-*

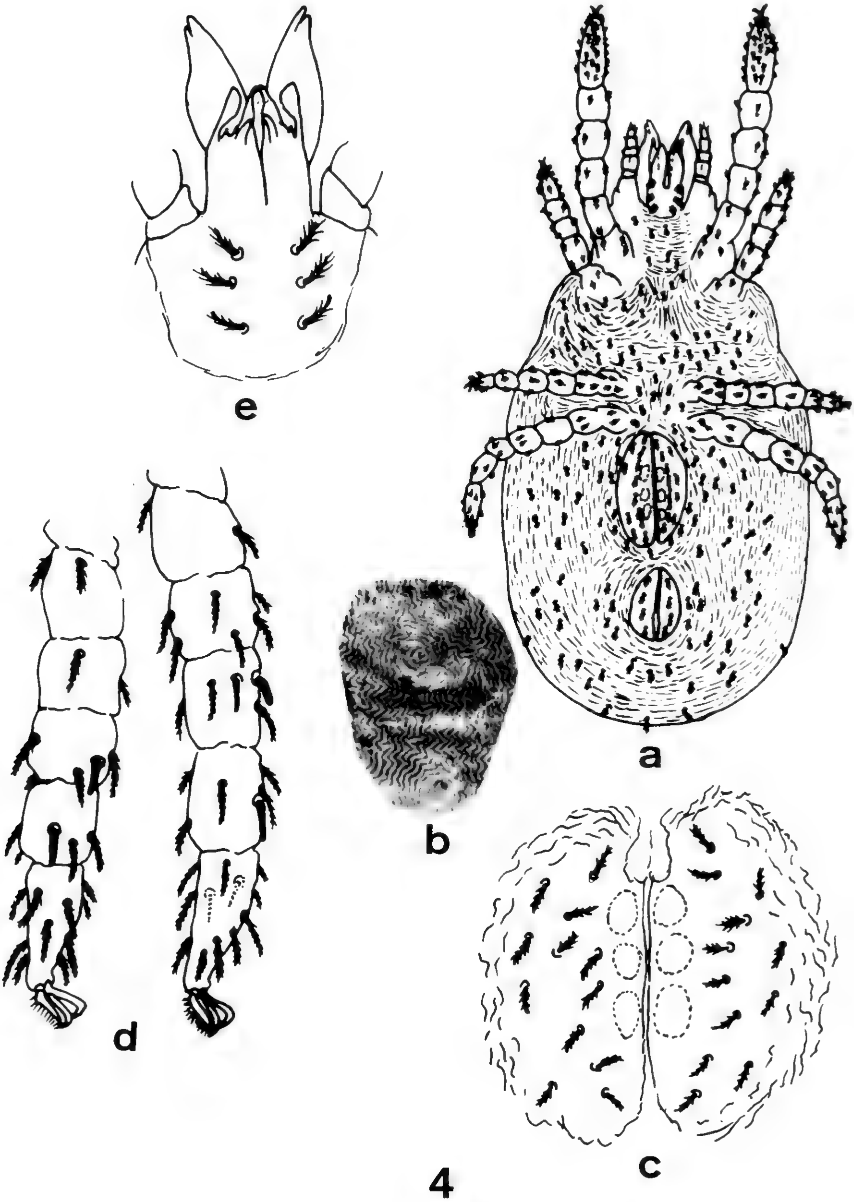

Fig. 4. *Petralycus caryapecaus.* a, Ventral region of holotype. b, Photograph showing parallel winding ridges. c, Enlargement of genital region showing setae and papillae. d, Legs III and IV showing setae. e, Hypognathum showing setae.

mixsetosa McDaniel from South Dakota. Specimens collected from the southern High Plains of Texas constitute a new subspecies of *B. dimixsetosa* McDaniel.

Bimichaelia dimixsetosa texana **McDaniel and Bolen, New Subspecies**

Diagnosis.—Similar to *B. dimixsetosa dimixsetosa* McDaniel but without enlarged setae on dorsum.

Holotype.—Adult ♀ collected 7.5 mi N Paduach, Rt 83, Cottle County, Texas, by Eric G. Bolen and B. McDaniel, May 30, 1980. The holotype will be deposited in the National Museum of Natural History, Washington, D.C.

Paratypes.—Collected from the following locations in Texas: Cottle Co., 7.5 mi N Paducah, Rt. 83, May 30, 1980, 1 deutonymph, 10 adults; Swisher Co., railroad right-of-way, FM 1981 and U.S. 87, July 22, 1979, 7 adults; Wheeler Co., 10 mi N Shamrock, Texas 83 Junction FM 1906, August 17, 1978, 1 adult; Lamb Co., 2 mi N Olton, along FM 168, 10 adults; Motley Co., 8.2 mi E Floyd-Motley Co. line U.S. 62, October 14, 1979, 9 adults, 1 deutonymph, 2 tritonymphs; Refugio Co., 1 mi S Woodsboro, November 14, 1977, 2 deutonymphs; Aransas Co., ¼ mi S. Texas 35 and FM 774, January 4, 1977, 3 adults; San Patricio Co., 7 mi N Sinton, Rob and Bessie Welder Wildlife Refuge, February 13, 1978, 1 adult; March 29, 1978, 5 adults; April 19, 1978, 1 adult; June 15, 1978, 1 adult; July 18, 1977, 2 adults.

Habitat.—The holotype was collected in loamy fine sands of the Miles series. These are brown, neutral soils with high available water capacity. Because Miles loamy fine sands are subjected to severe wind erosion, they are better suited for forage production than for cultivation. Wind-blown accumulations of 3 to 6 feet are common along fence rows bordering cultivated fields. Cover vegetation at the collection site consisted of sand shinnery oak (*Quercus havardii*), a dominant species covering most of the uncultivated sandy soils in Cottle County. A moderate amount of herbaceous vegetation within the oak community is grazed by cattle.

Remarks.—This subspecies is established to denote the more southern form of *B. dimixsetosa* where more than 90% of the individuals collected from Texas are devoid of the dorsal enlarged setae. In the north, the dominant individuals possess enlarged setae on the dorsum and represent about 98% of the individuals studied. All other main diagnostic characters, such as the structure of the genitalia, type of sensilla (*ba*) and dorsal ornamentation, are constant.

Acknowledgments

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TWO NEW SPECIES OF NEOTROPICAL ARADIDAE AND NOTES ON THE GENUS *GLYPTOCORIS* HARRIS AND DRAKE (HEMIPTERA)

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Abstract.—Two new species are described, *Aparilocoris* ***venezuelanus*** from Venezuela and *Mezira* ***auripilosa*** from Mexico. *Glyptocoris sejunctus* Harris and Drake and *G. verus* Drake are found to be congeneric.

The two new species described below were found in a small lot of Neotropical Aradidae kindly loaned to me by Dr. Harry Brailovsky, Departamento de Zoologia, Instituto de Biologia, Universidad Nacional Autonoma de Mexico (UNAM), Mexico, 20; I am grateful to him for the privilege of examining this material. I am also indebted to Dr. Richard C. Froeschner, Curator in the Department of Entomology, National Museum of Natural History, Smithsonian Institution, Washington, D.C., for allowing me to study the type of *Glyptocoris verus* Drake, 1956, and specimens of *G. sejunctus* Harris and Drake, 1944, the type-species of its genus, and decide that they are indeed congeneric.

All measurements in this paper were taken with a micromillimeter eyepiece, 25 units = 1 mm. In simple ratios the first figure represents the length and the second the width of measured portion.

Subfamily CARVENTINAE

Genus *Aparilocoris* Kormilev, 1983

Aparilocoris venezuelanus **Kormilev, NEW SPECIES**

Figs. 1, 2

Male.—Apterous. Ovate, covered with light brown incrustation; under incrustation shiny and without pubescence.

Head slightly shorter than width across eyes (24:25); anterior process tapering, incised anteriorly, genae longer than clypeus and contiguous in front of it; clypeus with a small granule anteriorly. Antenniferous tubercles short, blunt, divaricate. Eye semiglobose, protruding. Postocular borders strongly converging, each with a small tubercle just behind eye. Vertex with U-shaped carina and row of granules. Posterior border transversely raised. Antenna slender, only segment I slightly thicker; relative length of antennal segments I to IV: 9.0:5.5:5.5:7.5. Labium not reaching hind border of a wide and shallow labial groove.

Pro-, meso- and metanotum and connexivum with a thin lateral sulcus making border appear double.

Pronotum short and wide (9:45); collar truncate anteriorly; anterior borders laterad of collar sinuate and receding; anterolateral angles rounded, produced anterolaterally. Disc on each side between median and lateral high tubercles with a transverse, medially angulate thin carina behind which are several deep pits. Hind border deeply incised medially for reception of median ridge of mesonotum.

Mesonotum short, wide (9:52.5); medially forming a stout ridge with median sulcus; laterally fused with metanotum; disc laterad of median ridge uneven, with various pits and tubercles, raised near each lateral border into a high tubercle.

Metanotum short and wide (10:56); raised medially into ridge higher than that of mesonotum, with median sulcus; disc of metanotum laterally completely fused with terga I and II, with various pits and tubercles; medially separated from tergum I by a shallow depression.

Abdomen shorter than width across tergum I (53:60); disc equally strongly raised on terga I and II medially; highest on I, sloping down laterally, there with various pits; terga I and II with a thin median sulcus. Tergum I medially separated from tergum II by a shallow transverse sulcus, laterally fused with it and metanotum. Tergum II similar to tergum I but lower, separated from central dorsal plate by deep sulcus and from connexivum by fine sulcus. Central dorsal plate of terga III to VI subrectangular with rounded posterior angles; on IV and V strongly raised medially forming a hump. Disc with 4 (2 + 2) rows of apodemal callosities separated by thin carinae. Terga IV and V medially with traces of scent glands. Tergum VII raised backward for reception of hypopygium; the latter large and flat; paratergites short and directed upward. Connexiva II and III fused, their exterior border forms 2 projections on II and one on III; other connexiva have 1 projection each; posteroexterior angle of connexivum VII directed obliquely downward; surfaces of connexiva uneven, with granulation and pits. Spiracle of II ventral, placed far from border; of III and IV ventral, but placed nearer to border; of V and VI lateral and visible from above; of VII and VIII terminal.

Prosternum raised medially; meso- and metasternum with double depression medially; pleura roughly granulate; venter uneven.

Legs unspined, with fine setigerous granulation; foretibia with a comb apically. Claws with arolia.

Color pitch black, shiny; eye, antenna, labium and legs brown to dark brown.

Total length 4.12 mm; width of pronotum 1.80 mm; width of abdomen 2.40 mm.

Holotype.—♂, Venezuela, Rancho Grande, El Aragua, Bordon; 20.X.1978; deposited at the Departamento de Zoologia, Instituto de Biologia, UNAM, Mexico 20.

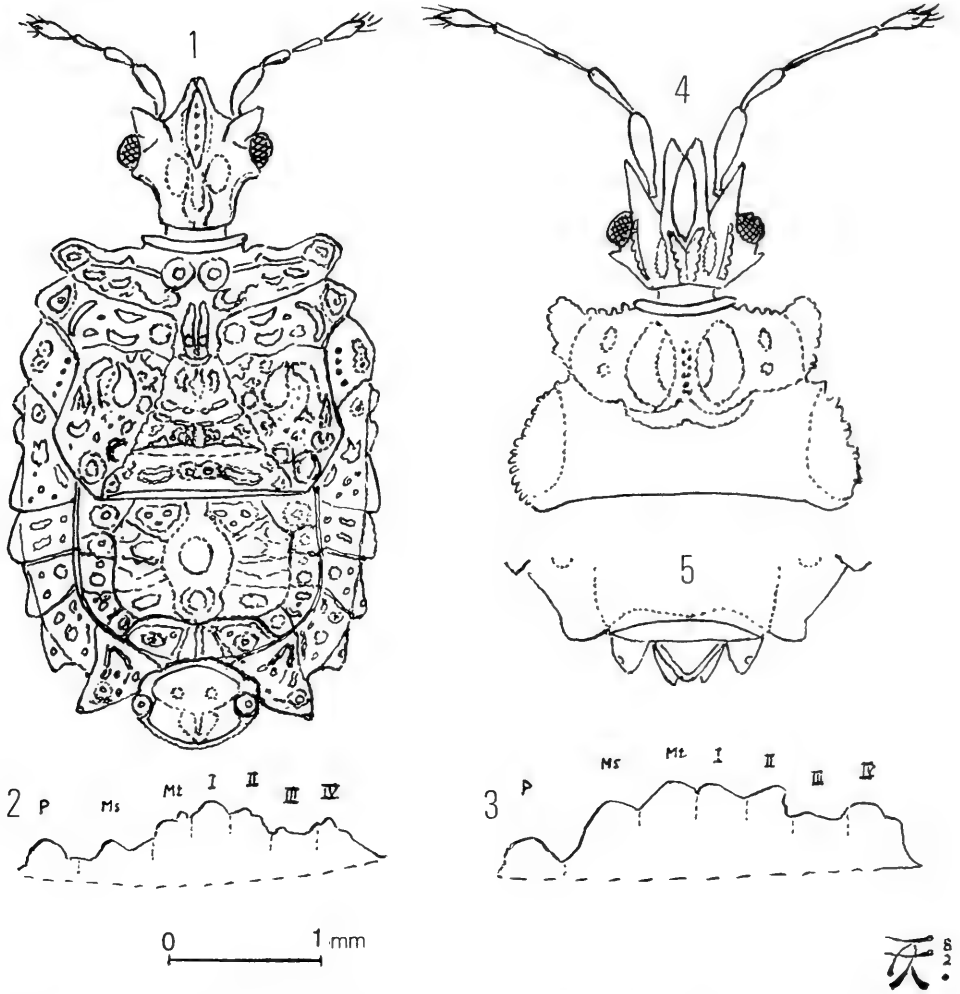
Remarks.—*Aparilocoris venezuelanus* is related to *A. mexicanus* (Kormilev), 1982, from which it may be separated by the shape of the median ridge on the meso- and metanotum and on terga I and II, and the metanotum being lower than tergum I (they are of the same height in *A. mexicanus*).

Genus *Glyptocoris* Harris and Drake, 1944

***Glyptocoris verus* Drake, 1956**

Glyptocoris verus Drake, 1956: 324.

Female.—Ovate; larger, more granulate and flatter than other species of *Glyptocoris,* especially so on abdomen; with distinct postocular tubercles which are absent in the type-species, *G. sejunctus* Harris and Drake, 1944.



Figs. 1–5. 1, 2, *Aparilocoris venezuelanus,* male. 3, *A. mexicanus,* female. 4, 5, *Mezira auripilosa,* female. 1, Dorsal aspect (legs omitted). 2, 3, Dorsum seen from the side. 4, Head and pronotum. 5, Tip of abdomen from above. P = pronotum; Ms = mesonotum; Mt = metanotum; I–IV = terga.

Measurements: Head 28:28; relative length of abdominal segments I and II (III and IV are missing) are: 11:6:—:— (Drake indicated 52:32:42:34); pronotum 15: 52; mesonotum 20:62; metanotum 7:75; abdomen 77:85; width of tergum VIII, 24.

Spiracles II to IV ventral, V sublateral but visible from above, VI to VIII lateral.

Color red brown; median elevation of central dorsal plate and posteroexterior angles of pro-, meso-, metanotum and connexiva II to VII whitish.

Total length 6.32 mm; width of pronotum 2.08 mm; width of abdomen 3.40 mm.

Type.—♀, Guadeloupe; red label: Type *Glyptocoris* ♀ *verus* Drake; and white label: *Glyptocoris* ♀ *verus* Drake Type. The red and white labels both written in Drake's hand.

Remarks.—As Drake has indicated, this species is atypical but fits better in *Glyptocoris* than in any other genus.

Subfamily MEZIRINAE

Genus *Mezira* Amyot and Serville, 1843

***Mezira auripilosa* Kormilev, New Species**

Figs. 4, 5

Female.—Elongate ovate, covered with yellow, curled hairs; connexivum tricolored: testaceous, yellow and black.

Related to *Mezira constricta* (Champion), 1898, from Mexico, but anterior process of head slightly longer, reaching $3/5$ of antennal segment I; antenniferous tubercles acute and relatively longer; postocular tubercles not or slightly produced beyond outer border of eyes; anterolateral angles of pronotum produced forward as far as collar, denticulate on outer border; lateral notch obtuse; apical angle of corium rounded, apical border barely sinuate at base. Posteroexterior angles of connexiva II to VI protruding, those of VII forming small, rounded lobes. Paratergites long, reaching ½ of tricuspidate segment IX. Spiracles II to VI ventral, placed far from border, VII ventral but closer to border, VIII dorsolateral.

Measurements: Head 25.0:25.5; relative length of antennal segments I to IV 15:10:17:10; pronotum 30:59, front lobe narrower than hind lobe 45:59; scutellum 25:32; abdomen 87:70; width of tergum VIII, 27.

Color testaceous, partially darker; connexivum tricolor: testaceous, yellow and black; membrane brown with black veins; pilosity yellow.

Total length 6.92 mm; width of pronotum 2.36 mm; width of abdomen 2.80 mm.

Holotype.—♀, Mexico, Coba, Quintana Roo; 3.XI.1981, E. Barrera leg.; deposited at the Departamento de Zoologia, Instituto de Biologia, UNAM, Mexico 20.

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PROC. ENTOMOL. SOC. WASH.
85(4), 1983, pp. 822–825

A NEW GENUS AND SPECIES OF NEARCTIC COENOMYIID (DIPTERA: COENOMYIIDAE)

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Abstract.—***Napemyia illinoensis,*** a new genus and species of coenomyiid, is described, and its relationship to other genera of Coenomyiidae is discussed.

During a collecting trip in 1976 to Forest Glen Forest Preserve, a beech-maple forest in Vermilion County, Illinois, one male specimen of a unique fly was collected by M. E. Irwin. I have made several trips each year for the last six years and have not collected additional specimens, nor have I found additional specimens in 67 museum, university, and private collections that I have examined. A manuscript, in preparation, on the phylogeny of certain lower brachycerous Diptera in the Nearctic Region necessitates the erection of this new genus and species.

Napemyia Webb, New Genus

Derivation of name.—*Nape* (Greek, feminine) = glen; *myia* (Greek, feminine) = fly.

Type-species.—*Napemyia illinoiensis* Webb, by present designation.

Napemyia is closely associated with *Dialysis* in having the eyes glabrous, the clypeus flat, the anal and 3rd medial cell closed, and the aedeagal apodemes reaching the base of the basistyle. It differs from *Dialysis* (Webb, 1978) in having elongate parafacial setae, the ventral plate of the proctiger narrowly emarginate posteriorly, the basistyle in ventral view with no open areas, penis valves present, and in lacking a thyridium.

This description of the genus is based on one male specimen; the female is unknown.

Male.—Head in lateral view hemispherical (Fig. 1). Vertex (Fig. 2) rounded, not emarginate lateral to ocellar tubercle. Ocellar tubercle subtriangular, slightly raised above vertex. Eyes large, holoptic, contiguous for short distance ventral to median ocellus; facets of equal size; glabrous; medial margin rounded, ventral half diverging; no emargination dorsolateral to base of scape; in lateral view hemispherical, covering almost all of head. Frons small; setae and median tubercle absent. Antenna (without arista) short, 0.3× width of head in lateral view; scape short, subrectangular, shorter than pedicel; pedicel globose; flagellum short, conical, shorter than combined length of scape and pedicel; arista elongate, apical. Gena narrow; parafacial setae elongate. Clypeus with anterior surface flat, glabrous; lateral grooves shallow. Maxillary palpus with 1 segment, cylindrical. Labellum membranous.

Thorax with dorsum rounded; vittae and posterior tubercles absent. Postmetaspiracular scale and suprametacoxal pit absent. Mesoscutellum with posterior margin rounded; posterior tubercles absent.

Wing (Fig. 3) with microtrichia covering entire wing; thyridium absent. Costa circumambient, broader along anterior margin; setae short, subappressed. Subcosta ends beyond middle of wing. Subcostal and marginal cells narrow, elongate, open. Cell R_4 large, enclosing apex of wing. R_4 ends anterior to apex of wing. R_5 ends posterior to apex of wing. M_1, M_2, and M_3 originate separately from apical margin of discal cell. Five posterior cells. Cell M_3 open. Discal cell broad, apical margin pointed. First basal cell narrow, elongate, apex truncate, ends distal to apex of 2nd basal cell. Anal angle broadly rounded, right-angled. Alula large, broadly rounded.

Forecoxa elongate, mid- and hindcoxae short; hindcoxa without anterior tubercle. Tibial spurs 1-2-2. Empodium pulvilliform, similar in size and shape to pulvilli. Apical claws on tarsomere 5 fuscous, paired, simple. Hindlegs not raptorial.

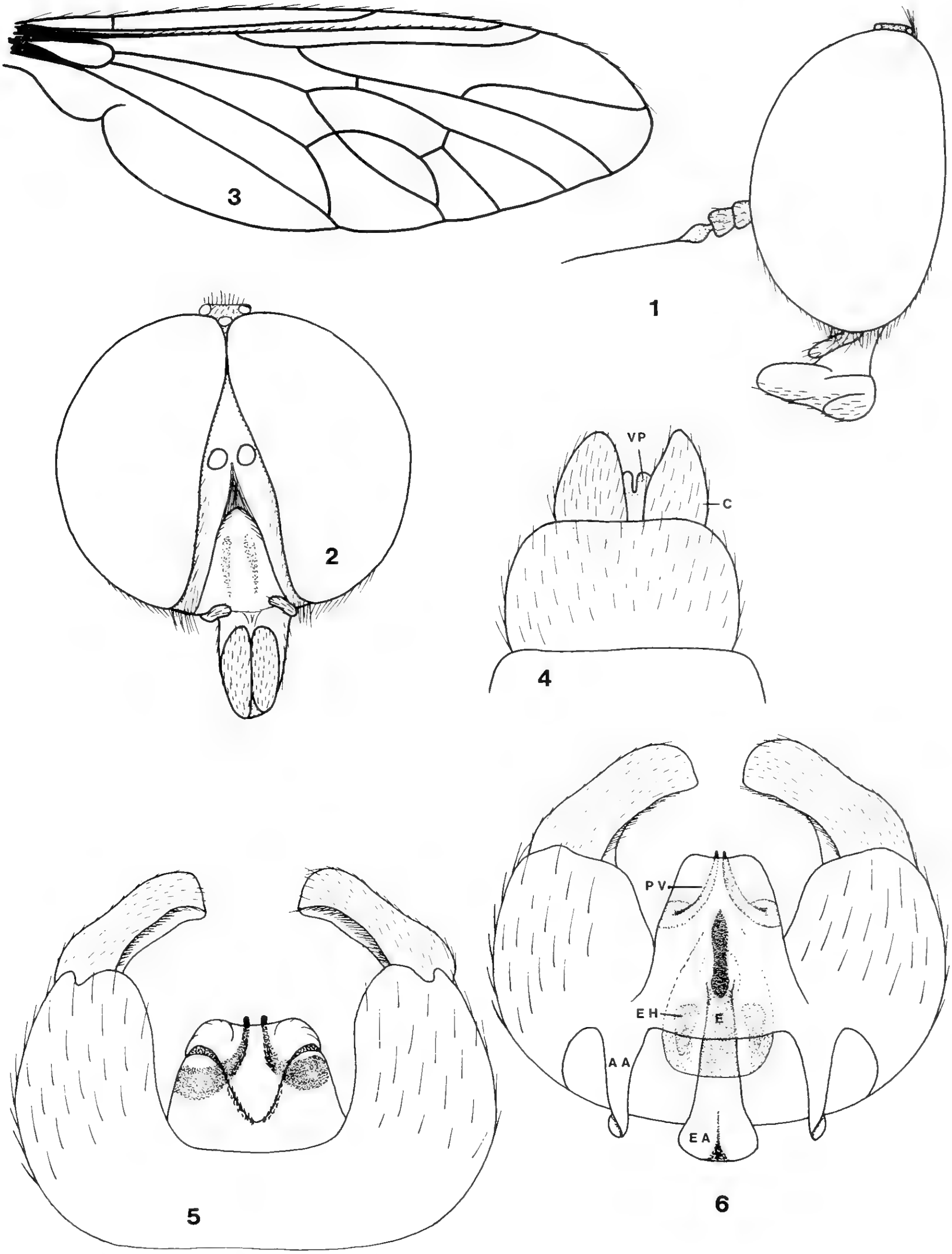
Abdomen with tergite 1 subrectangular, broad, anterior margin truncate. Tergite 9 (Fig. 4) reduced, tapered laterally, posterior margin rounded. Tergite 10 absent. Cerci (C) 1 segmented, lobate. Ventral plate of proctiger (VP) large, membranous, subtriangular, separated medially. Sternites 9 and 10 absent. Basistyle in ventral view (Fig. 5) broad, rounded laterally, fused anteriorly; in dorsal view (Fig. 6) basistyle with narrow sclerotized arch joining inner margins; aedeagal apodemes (AA) elongate, reaching base of basistyle. Dististyle large, thick, truncate apically, with short apical spines. Aedeagus composed of aedeagal sheath, endophallus (E), endophallic hilt (EH), and penis valves (PV). Aedeagal sheath broad basally, tapered posteriorly to form broad endophallic guide, with ventral membranous covering. Endophallic tines absent.

Napemyia illinoensis Webb, New Species

Figs. 1–6

Male.—Length 10.9 mm. Ocelli pale yellow; ocellar tubercle fuscous; setae pale brown, elongate, along posterior margin. Frons pale yellowish brown to fuscous. Scape 0.9× longer than wide, 0.9× length of pedicel, setae fuscous, short, suberect on dorsal and lateral margins, stramineous ventrally; pedicel 1.1× longer than wide, setae similar to those of scape; flagellum conical, 1.0× longer than wide 0.4× combined length of scape and pedicel, setae absent; arista elongate apical, 6.0× length of flagellum. Gena dark brown; parafacial setae stramineous, elongate, sparse; facial setae stramineous, elongate, abundant. Clypeus stramineous with 2 dark brown bands. Maxillary palpus stramineous, 1 segmented, 5.0× longer than wide; setae stramineous, elongate, abundant. Labellum stramineous; setae stramineous, elongate, abundant on ventral surface. Postocular setae stramineous, elongate, abundant, becoming short, fuscous, subappressed dorsally.

Thorax dark yellow; setae stramineous, suberect, abundant, with no distinctive pattern. Humeral callus concolor with thorax; setae stramineous, elongate, abundant. Pleural setae stramineous, elongate, covering all of propleuron, ventral ⅓ of mesokatepisternum, and in sparse median patch on mesoanepimeron; re-



Figs. 1–6. *Napemyia illinoensis.* 1, Head, lateral view. 2, Head, frontal view. 3, Wing. 4, Male terminalia. 5, Basistyle, ventral view. 6, Basistyle, dorsal view. Abbreviations: AA = aedeagal apodeme; C = cercus; E = endophallus; EA = endophallic apodeme; EH = endophallic hilt; PV = penis valve; VP = ventral plate of proctiger.

maining pleurites glabrous. Halter pale yellowish brown; setae absent. Mesoscutellars mesopostnotal, and lateral tergal setae stramineous, elongate, abundant.

Wing (Fig. 3) length 9.2 mm, 2.6× longer than wide. Membrane pale infuscate; veins pale whitish brown; pterostigma absent; macrosetae on entire length of R_1. Radial sector originates from middle of 1st basal cell. R-m occurs at basal ⅓ of discal cell. R_{2+3} ends distal to fork of R_{4+5} and discal cell, basal to apex of M_1. Fork of R_{4+5} originates distal to apex of discal cell, angle rounded. Cell M_3 and anal cell closed, petiolate. M-cu 2.0–2.5× length of r-m. Squama small, stramineous; marginal setae stramineous, short, entire.

Legs dark yellow. Empodium and pulvilli dark yellow. Hindcoxa without anterior tubercle.

Abdomen dark yellow; setae mixed, stramineous and fuscous, elongate, abundant. Basistyle in ventral view (Fig. 5), in dorsal view (Fig. 6). Endophallus (E) broad anteriorly, forming endophallic apodeme (EA) with truncate anterior margin, median area thick, posterior area oval, pointed. Endophallic hilt (EH) narrow, triangular, elongate, tapered anteriorly, separated medially. Penis valves (PV) broad, thick, inner margin with abundant, fine spines.

Holotype.—♂, ILLINOIS, Vermilion County, Forest Glen Forest Preserve, 5 mi SE Westville, 25-VI-1976, M. E. Irwin. Deposited in Illinois Natural History Survey.

ACKNOWLEDGMENTS

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85(4), 1983, pp. 826–839

NEW SPECIES OF WATER BEETLES OF THE GENERA *ELMOPARNUS* AND *PHENEPS* FROM SURINAME (COLEOPTERA: DRYOPIDAE; PSEPHENIDAE)

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Abstract.—A new species of dryopid beetle, *Elmoparnus* ***collinsae***, and a new species of psephenid beetle, *Pheneps* ***antennalis***, from Suriname are described, illustrated with line drawings and scanning electron micrographs, and compared to related taxa. Notes on their habitats are provided.

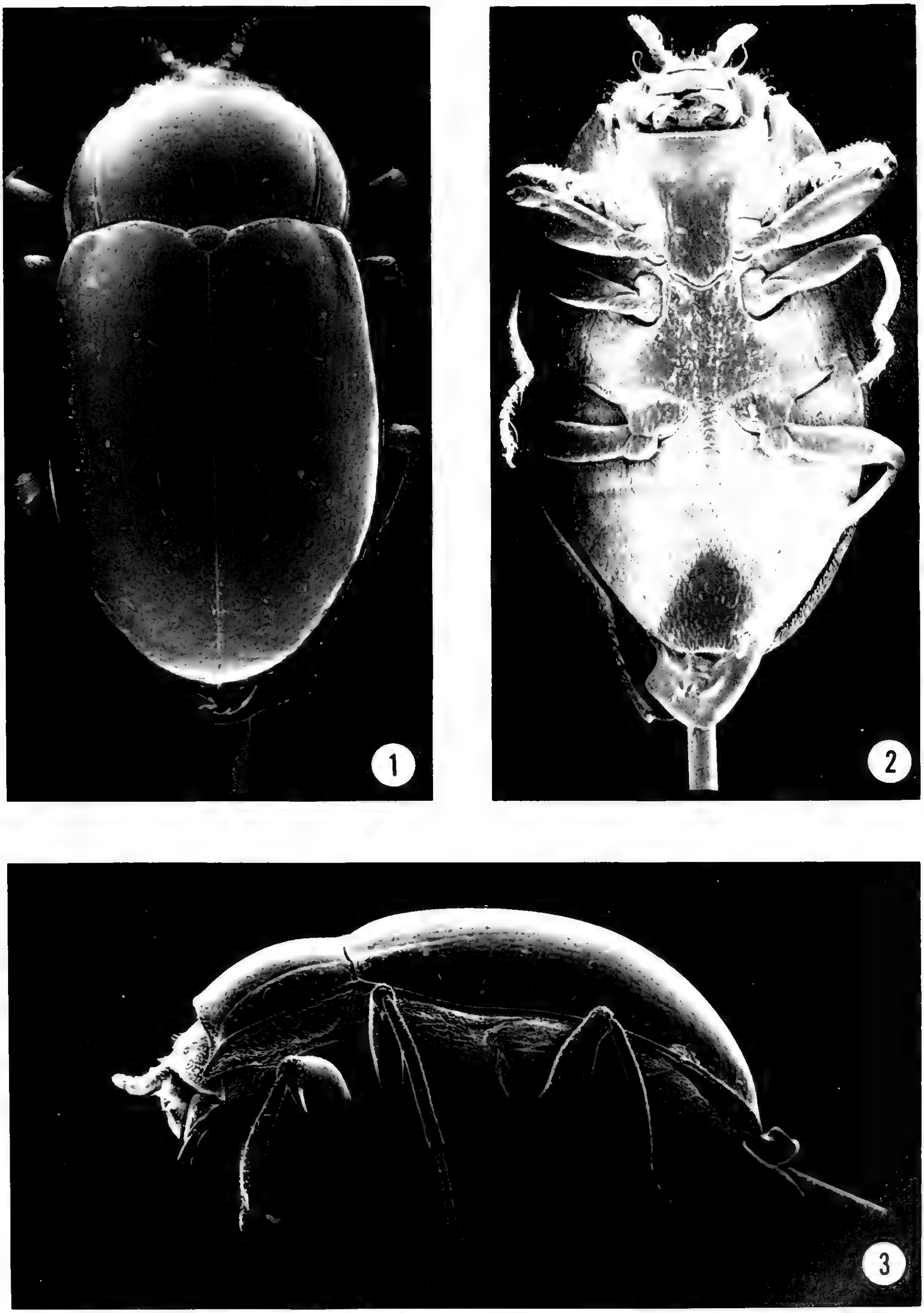
Insect collections made during a research expedition to the Brownsberg Natuurpark in Suriname yielded numerous new taxa, distribution records, and biological data. The two new aquatic beetles described in this paper are examples of the rich and relatively unstudied fauna of the Guiana Highlands. Members of the genus *Elmoparnus* Sharp (Coleoptera: Dryopidae), previously known to occur from Venezuela and Ecuador to southern Mexico (Spangler and Perkins, 1977) are reported for the first time from Suriname. The genus *Pheneps* Darlington (Coleoptera: Psephenidae), previously reported only from Haiti and Cuba (Darlington, 1936), is now represented from Suriname by a distinctive new species described here. The newly discovered water-penny beetle has antennae longer than the body, a character previously not seen in known members of the family.

Elmoparnus collinsae **Spangler and Steiner, NEW SPECIES**

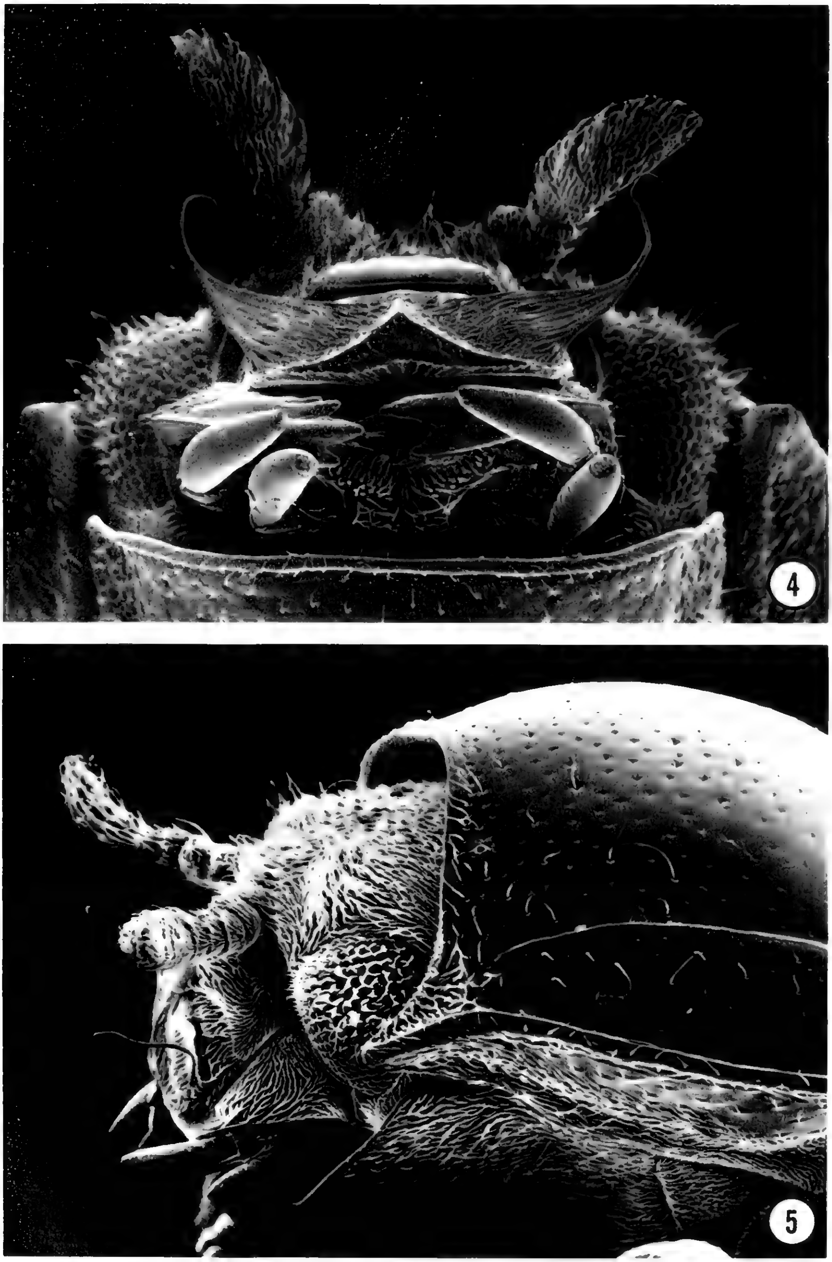
Figs. 1–9

With the description of this new species, the genus *Elmoparnus* is presently represented by six Neotropical species. Members of the genus may be divided into two groups—one group with antennae of nine segments and the other group with antennae of ten segments. The new species described below belongs to the group with antennae of nine segments; that group includes *Elmoparnus brevicornis* Sharp (1882), *E. pandus* Spangler and Perkins (1977), *E. mexicanus* Brown (1970), and *E. miltops* Spangler and Perkins (1977). Of the five species of *Elmoparnus* with antennae of nine segments, *E. brevicornis* may be immediately distinguished by the sublateral carina of the pronotum being confined to the basal two-fifths; the other four species of the group have the sublateral carina extending almost the entire length of the pronotum.

In the key to the species of the genus *Elmoparnus* by Spangler and Perkins (1977), *E. collinsae* keys to *E. pandus. Elmoparnus collinsae* (Figs. 1–9) may be distinguished from *E. pandus* by the following combination of characters: shorter total length (3.0 mm vs. 3.5 mm); distinct rows of closely spaced, moderately

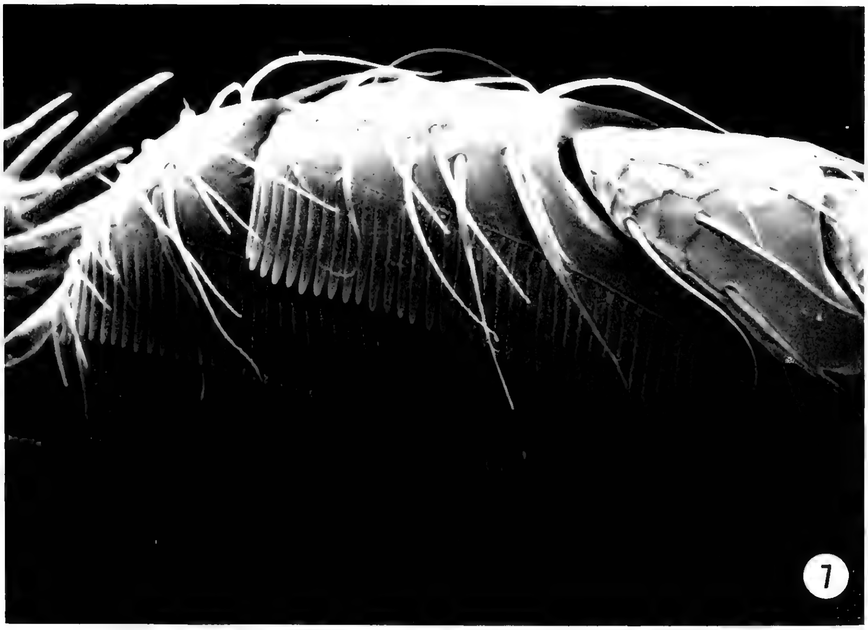


Figs. 1–3. *Elmoparnus collinsae.* 1, Habitus, dorsal view (27×). 2, Habitus, ventral view (27×). 3, Habitus, lateral view (27×).



Figs. 4, 5. *Elmoparnus collinsae.* 4, Head, ventral view (100×). 5, Head and pronotum, lateral view (88×).

small punctures alternating with widely spaced, coarse punctures on intervals (elytral punctures of *E. pandus* not in obvious rows); apicomedial margin of prosternum without a small toothlike projection; females with narrow, indistinct pubescent band bordering anteromedial region of metasternum between meso-



Figs. 6, 7. *Elmoparnus collinsae.* 6, Protarsus, male, dorsolateral view (190×). 7, Combs on protarsal segments 1–3, ventrolateral view (500×).

coxae (*E. pandus* with band twice as wide as that of *E. collinsae*); males of *E. collinsae* lack the notch found at the apical fourth of the foretibia of *E. pandus*; and differences in male genitalia as illustrated (Figs. 8, 9, *E. collinsae*; Figs. 10, 11, *E. pandus*).

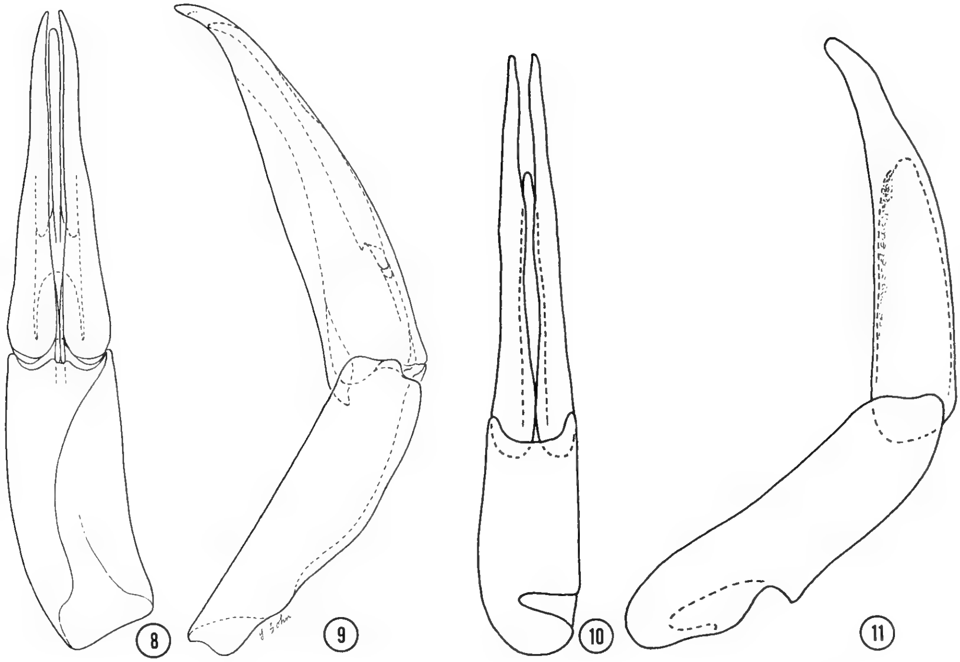
Holotype male.—Body form and size: Obovate; moderately strongly convex dorsally. Length, 3.0 mm; width, 1.5 mm.

Color: Black dorsally except antennae, clypeus, and labrum light reddish brown. Venter black with reddish tinge except all palpi, labium, apical margin of prosternum, tibiae, tarsi, and apex of last abdominal sternum lighter reddish brown.

Head: Finely microreticulate and densely pubescent except anterior edges of clypeus and labrum glabrous. Eyes with large, convex, pubescent facets. Antenna of 9 segments. Labrum (Fig. 4) moderately emarginate anteromedially; emargination bordered by a glabrous liplike area; upper edge of liplike area sharply, angularly demarcated; labral surface above liplike area densely microreticulate, with long, golden, upswept setae that dorsolaterally resemble a mustache (Fig. 4); anterolateral angles broadly rounded.

Thorax: Pronotum 0.8 mm long, 1.3 mm wide; widest across basal ¼; sides arcuate; anterior and lateral sides distinctly margined; posterior side not margined but strongly bisinuate; anterolateral angles strongly produced; apex blunt (concave at apex); sublateral carinae distinct, extending from base almost to apex at each anterolateral angle, diverging so that each carina at apex is only about ½ the distance from lateral margins as at base. Coarse and fine punctures intermixed and sparse between sublateral carina and lateral margin; disc with coarse, moderately dense punctures, punctures separated by a distance equal to about 1½× their diameter; intermixed coarse and fine punctures denser adjacent to lateral carinae. Prosternum with inclined sides densely pubescent; medial surface flat, glabrous and rather finely and sparsely punctate medially; punctures coarser and denser anteromedially and separated by ½–1× their diameter. Prosternal process flat, widening slightly between procoxae; sides moderately margined, arcuate, converging apically and terminating in a slender protuberance (visible when disarticulated); surface glabrous and very sparsely, coarsely punctate on level between mesocoxae. Mesosternum deeply foveate for reception of protuberance of prosternal process. Metasternum with inclined, densely pubescent sides; anteromedial region with narrow indistinct pubescent band adjacent to mesocoxae; medial surface flat, glabrous, punctate, with shallow longitudinal furrow on midline; punctures moderately coarse and denser along furrow on midline; punctures of intercoxal area sparse and fine, only anterolateral punctures coarse. Foreleg with tibia evenly curved from base to apex; without apical notch. Foretibia bearing a sparse, narrow tuft of moderately long, golden setae along posteromedial edge; tuft extends from apex to midlength. Protarsal segments 1 to 3 expanded (Fig. 6) and each bearing a large oblique row of dense, flat, golden setae on medial (ventral) surface (Fig. 7). Scutellum flat, broadly subtriangular; angles rounded; surface finely, sparsely punctate; punctures separated by a distance from 1–5× their diameter. Elytron punctate; punctures coarser and denser than those on pronotum; disc with closely spaced, moderately small punctures in distinct rows, punctures separated by distance equal to their diameter; those punctures alternating with widely spaced, coarse punctures on intervals, punctures separated by 3× their diameter; lateral margin with densely pubescent respiratory fovea at apical ¼. Sides of elytra diverging to basal ⅕ then converging and arcuate to apices; sides strongly margined.

Abdomen: Sterna 1 to 4 microreticulate and densely pubescent. Apical sternum distinctly broadly notched apicomedially; with dense pubescence along anterior



Figs. 8–11. Male genitalia. 8, 9, *Elmoparnus collinsae.* 10, 11, *E. pandus.* 8, Ventral view. 9, Lateral view. 10, Ventral view. 11, Lateral view.

and lateral margins; shiny, triangular, apicomedial triangular area with only a few, fine, golden setae and a few coarse punctures; punctures denser apically.

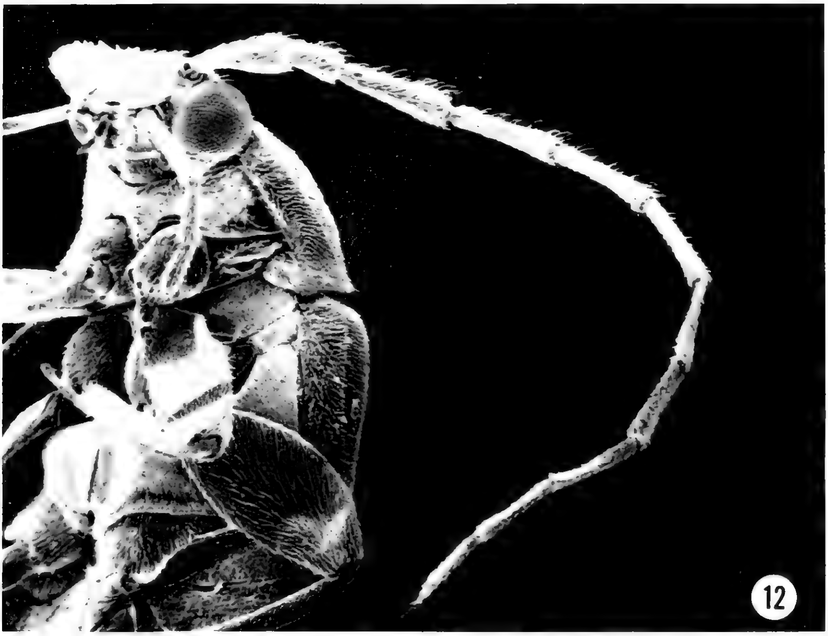
Male genitalia: As illustrated (Figs. 8, 9).

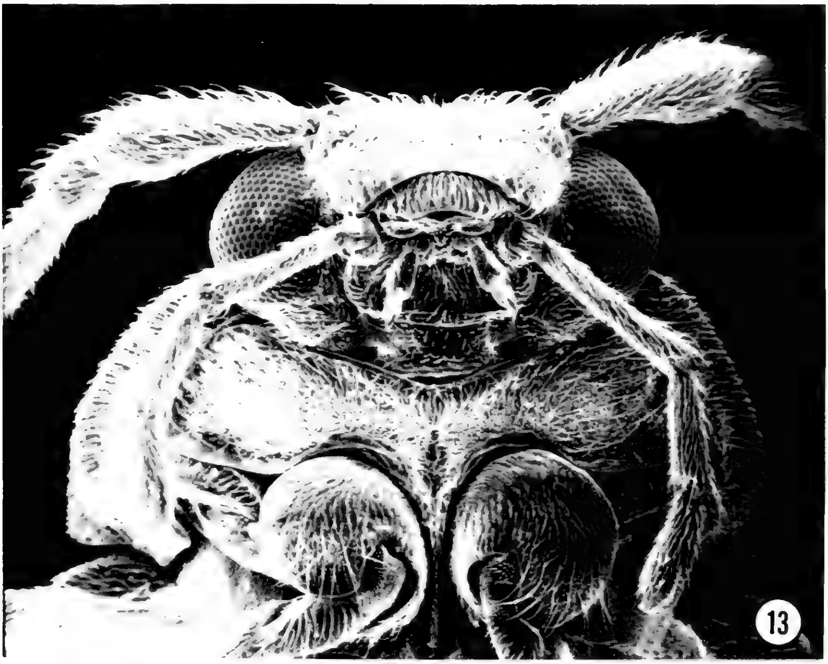
Female.—Similar to male with following exceptions. Upper edge of glabrous liplike area of labrum rounded instead of sharply, angularly extended medially; golden setae above the glabrous liplike area of the labrum sparse and about ½ as long as those on male; 1st to 3rd protarsal segments not expanded and lacking the large oblique row of setae on medial surface; last abdominal sternum rounded, not notched apicomedially.

Type-data.—Holotype ♂: SURINAME: BROKOPONDO DISTRICT: Brownsberg Natuurpark, Witi Kreek, 200 m; 25 August 1982; W. E. Steiner/From leaf packs among rocks in partially shaded stream; rain forest valley/EARTHWATCH Suriname Expedition, August 1982; Collins, Early, Oberman, Pollock, Putnam, Steiner; USNM Type No. 100891, deposited in the National Museum of Natural History, Smithsonian Institution. Allotype and paratypes (3), same data as holotype.

Etymology.—This species is named in honor of our friend Dr. Margaret S. Collins. This new taxon was obtained as a result of her initiating a field expedition to Suriname.

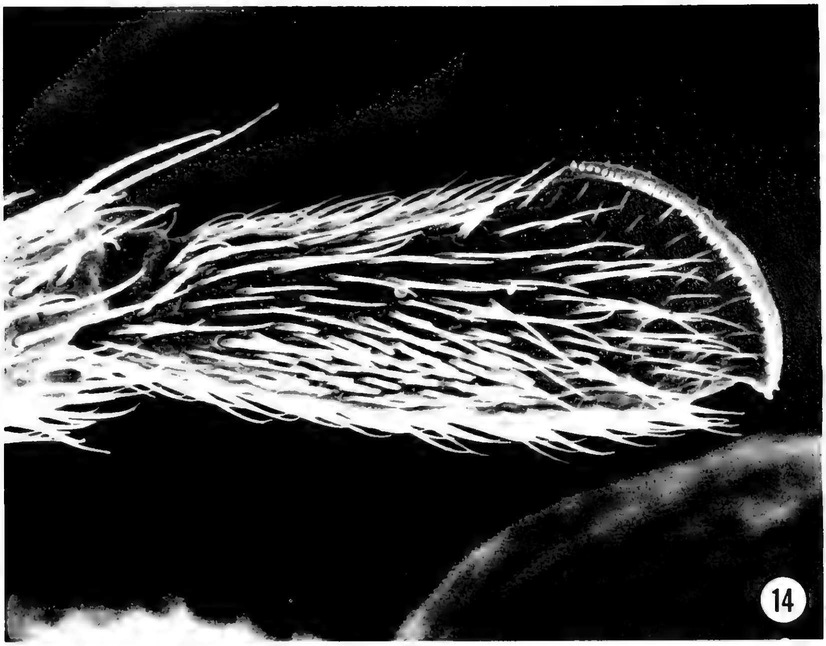
Habitat.—The specimens of *Elmoparnus collinsae* were found in packs of accumulated leaves and sticks between rocks in rapid water of a montane rain forest stream (Witi Creek) approximately 6–10 m wide. Beetles were taken in submerged





Figs. 12, 13. *Pheneps antennalis.* 12, Head and thorax, lateral view (42×). 13, Head and prosternum, ventral view (90×).

leaf packs as well as leaf packs exposed to the air between emergent rocks. The stream was shaded by the forest canopy but the shallow rapid areas where the beetles were found received some direct sunlight during midday.



Figs. 14, 15. *Pheneps antennalis.* 14, Maxillary palpus, lateral view (600×). 15, Maxillary palpus, apex of last palpal segment, ventral view (1310×).

Specimens were taken by holding a small net immediately downstream from the leaf packs as the packs were dislodged and shaken. Debris from the net was spread out on dry rocks in sunlight, and beetles were collected with an aspirator.

Like other known dryopids, these *Elmoparnus* were slow to move and the leaf debris required repeated examination as it dried in order to detect the beetles. The new *Pheneps* species and several species of Elmidae were collected in association with *E. collinsae.*

***Pheneps antennalis* Spangler and Steiner, New Species**

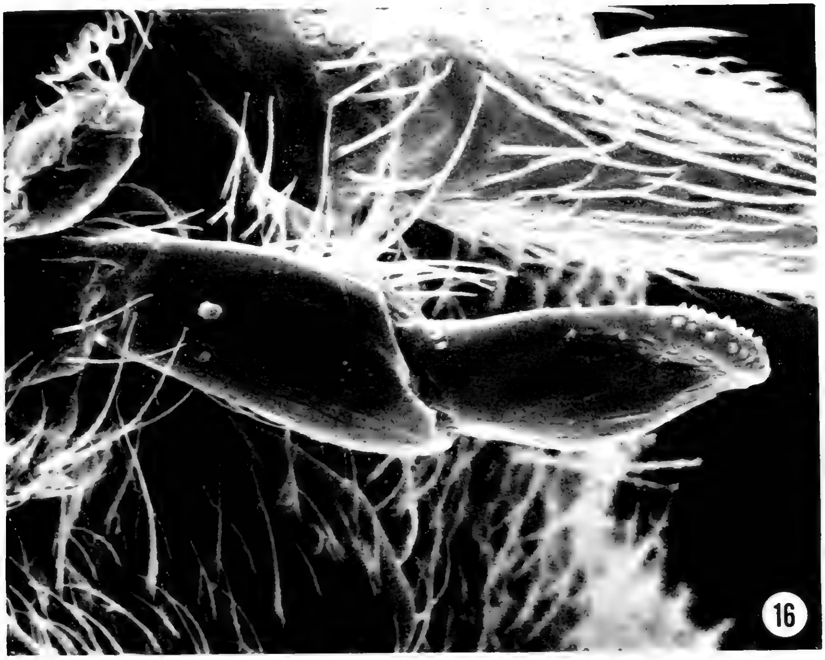
Figs. 12–25

Holotype male.—*Form and size:* Body flattened; thorax narrowed anteriorly; elytra diverging slightly posteriorly, widest at about posterior ¾, apices rounded. Length, 3.2 mm; width, 1.8 mm.

Coloration: Covered with fine, dense, short, recurved golden pubescence. Head, pronotum, and basal 2 antennal segments reddish brown; antennal segments 3–11, scutellum, and elytra dark brown. Pronotum with a dark brown apicomedial macula which is prolonged posteromedially in a narrow extension which converges and terminates at midlength. Ventral surface light yellowish brown except maxillary palpus, prosternum, sides of metasternum, apices of femora, and tibia infuscate. Abdomen darkly infuscate except a vague yellowish lateral macula on each sternum and a distinct reddish-yellow triangular area medially on sterna 1, 3, and 4; sternum 5 reddish brown. Tarsi yellowish brown except basal ½ of last segment infuscate.

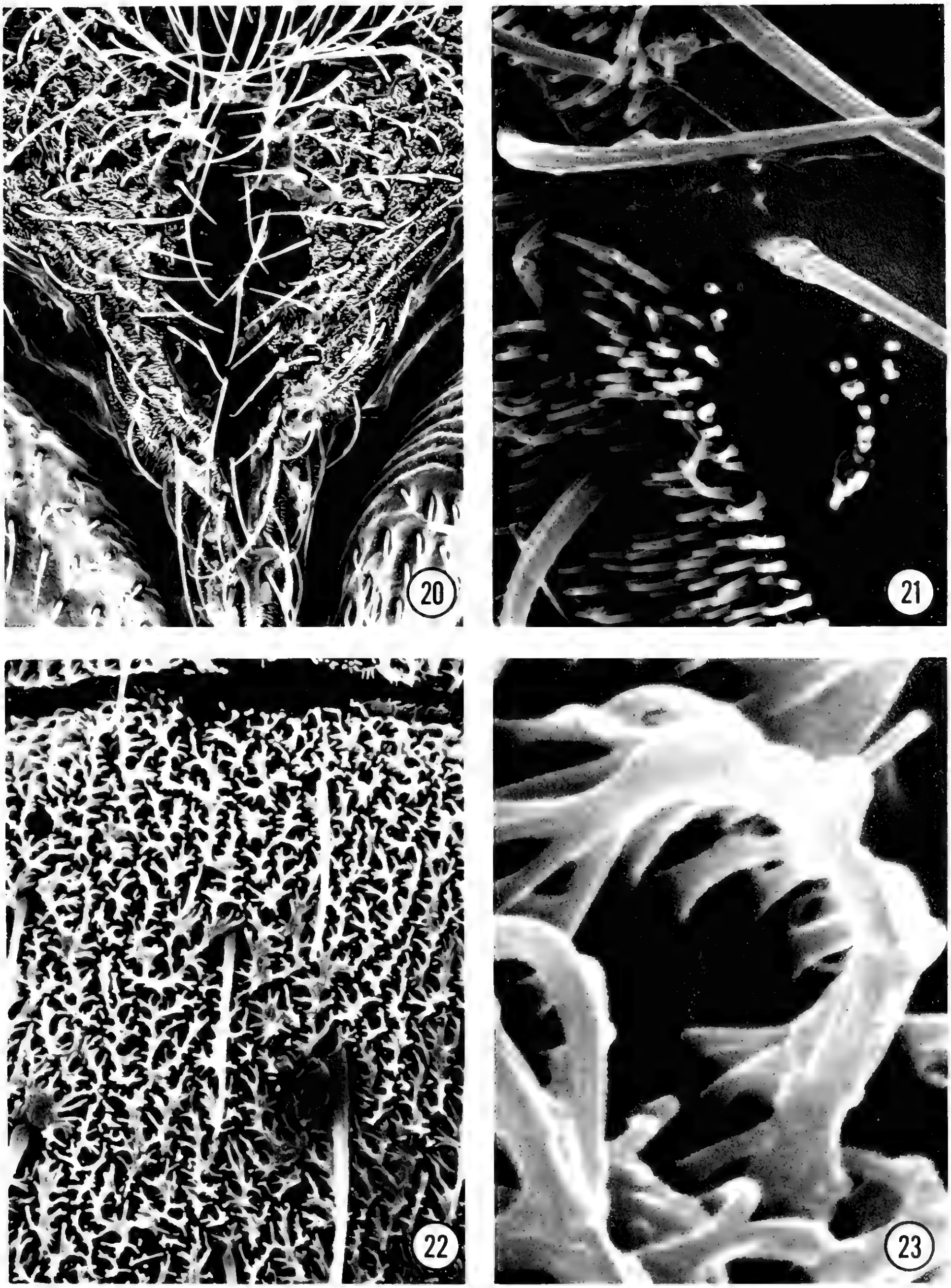
Head: Almost flat behind eyes, decurved between eyes; finely microreticulate and finely punctate, more densely so anteriorly; labroclypeal suture distinctly depressed. Clypeus subtruncate on anterior margin. Labrum broadly rectangular and indistinctly arcuately emarginate on anterior margin. Eyes prominent, hemispherical. Antenna (Fig. 12) densely pubescent; filiform; exceptionally long, longer than length of body. Maxillary palpus (Figs. 13–15) filiform, slightly shorter than antennal segments 1–3 combined; palpal segments, 4; 1st palpal segment shortest, about $\frac{1}{6}$ as long as 2nd palpal segment; 2nd palpal segment longest, about twice as long as 4th palpal segment; 3rd palpal segment about $\frac{1}{4}$ shorter than 2nd palpal segment; 4th palpal segment slightly longer than 3rd palpal segment, compressed laterally (Figs. 14, 15). Labial palpus very small (Figs. 16, 17); palpal segments, 3; 1st palpal segment about $\frac{1}{3}$ as long as 2nd palpal segment; 2nd palpal segment swollen and slightly longer than 3rd palpal segment; 3rd palpal segment partially compressed apically (Figs. 16, 17).

Thorax: Pronotum widest at base; discal area densely, finely punctate; discal punctures separated by $\frac{1}{2}$–1× their diameter; disc moderately convex, depressed adjacent to posterolateral angles; finely and indistinctly margined ventrolaterally; anterolateral angles strongly rounded; posterolateral angles forming distinct right angles; apical and basal margins moderately bisinuate. Prosternum (Fig. 13) moderately short anterior of procoxae; covered by plastron setae (Figs. 20, 21). Prosternal process thin, keel-like; apex of lamina extending into mesosternum. Mesosternum narrow between mesocoxae; with very narrow median longitudinal cleft. Metasternum behind mesocoxae abruptly and strongly raised above plane of mesosternum; with very fine median longitudinal line extending along length of raised portion; surface microreticulate and finely, densely punctate. All legs with femora robust and swollen; all tibiae very slender and each bearing a low but distinct carina posterolaterally. Protibia and mesotibia grooved laterally on apical $\frac{3}{5}$. Protarsal segments (Figs. 18, 19) and mesotarsal segments 1 and 2 much

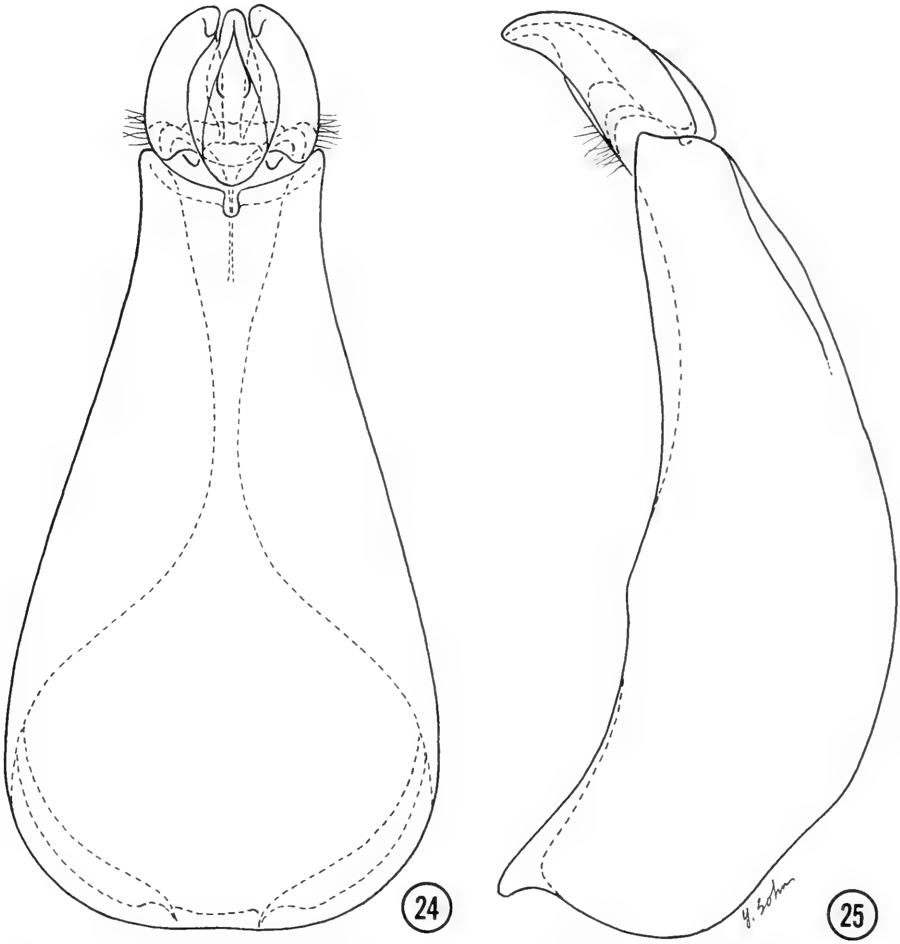


Figs. 16, 17. *Pheneps antennalis.* 16, Labial palpus, lateral view (450×). 17, Labial palpus, apex of last palpal segment, ventral view (2500×).

Figs. 18, 19. *Pheneps antennalis.* 18, Protarsal segments, dorsal view (180×). 19, Adhesive setal pads on protarsal segments 1–3 (800×).



Figs. 20–23. *Pheneps antennalis.* 20, Prosternum, plastron setae (400×). 21, Prosternal plastron setae (3000×). 22, Abdominal sternum 3, plastron setae (1000×). 23, Plastron setae on third abdominal sternum (10,000×).



Figs. 24, 25. *Pheneps antennalis,* male genitalia. 24, Dorsal view. 25, Lateral view.

broader than 3, 4, and 5 and densely pubescent beneath; metatarsi unmodified. Tarsal claws small, slender, and sharp. Scutellum slightly wider than long, flat; finely and densely punctate; rounded posteriorly. Elytra 4× longer than pronotum and about $^1/_3$ wider at widest point than pronotum; humeri slightly gibbous; apices broadly rounded; each elytron with 5 indistinct striae on discal area paralleling elytral suture; punctures fine and very dense.

Abdomen: All sterna with surface sculpture as on metasternum; all sterna covered with plastron setae (Figs. 22, 23). Fifth sternum broadly emarginate along posterior margin; 6th sternum triangularly incised medially, resulting in 2 rounded lateral lobes; 7th sternum rounded at apex.

Male genitalia: Trilobate as illustrated (Figs. 24, 25).

Female.—Unknown.

Variations.—Among the 28 males in the type-series, the dark apicomedial macula varies in intensity, and the posteromedial extension does not extend to midlength on a few specimens. Specimens vary in length from 3.1 to 3.8 mm.

Comparative notes.—The elongate antennae of the male of this species will distinguish it immediately from males of the other two described species in the genus, *Pheneps gracilis* Darlington from Haiti, and *P. cubanus* Darlington from Cuba. Females of *P. antennalis* are unknown.

Type-data.—Holotype ♂: SURINAME: BROKOPONDO DISTRICT: Brownsberg Natuurpark, Witi Kreek, 200 m; 25 August 1982; W. E. Steiner/From leaf packs among rocks in partially shaded stream; rain forest valley/EARTHWATCH Suriname Expedition, August 1982; Collins, Early, Oberman, Pollock, Putnam, Steiner; USNM Type No. 100107, deposited in the National Museum of Natural History, Smithsonian Institution. Paratypes (27 ♂), same data as holotype.

Etymology.—The trivial name, *antennalis,* is derived from the exceptionally long and very obvious antennae on this species; no other described species of *Pheneps* is known with similarly long antennae.

Habitat.—Specimens of *Pheneps antennalis* were found in the same habitat with *Elmoparnus collinsae,* but the specimens of *P. antennalis* were concentrated in those leaf packs which were partially exposed to the air. The beetles were difficult to capture because they ran rapidly and promptly took flight when removed from the water.

ACKNOWLEDGMENTS

We extend our gratitude to Dr. Collins for allowing one of us (Steiner) to assist in the Earthwatch Expedition she led in Suriname during which the new species described were collected. Generous support and field assistance were given by Marianne Early, J. William Oberman, Neal Pollock, and Michael Putnam. We also thank the Center for Field Research, Boston, Massachusetts, under whose aegis the field work in Suriname was made possible. Our appreciation is also extended to Henry Reichardt and Stichting Natuurbehoud Suriname for permission to collect insects at the Brownsberg Park and for numerous other services.

We thank Young Sohn, for the line drawings; Susann Braden, for the micrographs; Robin Faitoute, for technical assistance; and Phyllis Spangler, for typing the manuscript.

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PROC. ENTOMOL. SOC. WASH.
85(4), 1983, pp. 840–844

A REDESCRIPTION OF *HEMIPENTHES BIGRADATA* (LOEW) (DIPTERA: BOMBYLIIDAE) FROM THE BAHAMA ISLANDS

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Abstract.—*Hemipenthes bigradata* (Loew) is redescribed and illustrated. Notes are given on its description.

While collecting asilids and bombyliids on the island of San Salvador in the Bahamas, we found about 100 specimens of a species of a bee fly that we tentatively identified as *Hemipenthes bigradata* (Loew). The San Salvador specimens differ in several significant characters from the original description of *H. bigradata* (Loew, 1869). Recently we examined Loew's holotype (labeled *bigradata,* Loew, m, type 12665 MCZ, 304; it is incorrectly labeled a male). Although the holotype is in poor condition (greased, tomentum badly rubbed, apical two-thirds of left wing absent), we found it to be the same species as that collected on San Salvador. Loew's description is too brief, unclear in some aspects, and fails to mention certain important diagnostic characters. For example, foretibial bristles are present; the tomentum of tergite 4 has a dense layer of yellow scales that is partially covered by white ones, thus the scales are not wholly white as indicated in the description; and the pile on the lateral margin of the thorax is almost wholly white rather than yellow. Coquillett's (1887) description of *H. bigradata* further confuses matters since he apparently described a different species (personal communication, J. C. Hall). A more complete description of *H. bigradata* is presented below. The description is based upon a male and female taken from the series collected on San Salvador. The specimens are labeled homotypes.

***Hemipenthes bigradata* (Loew)**

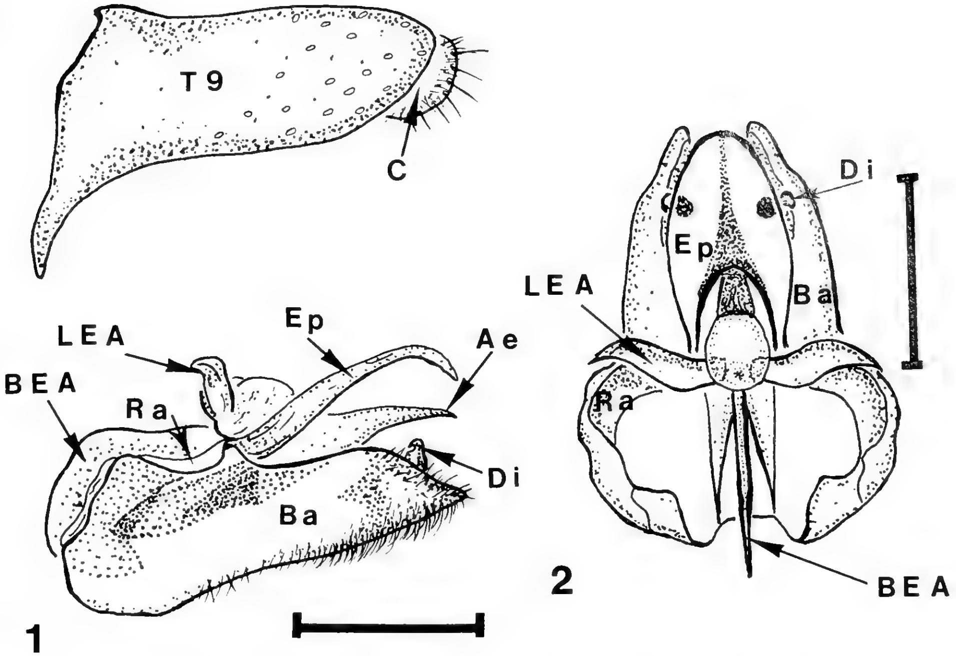
Figs. 1, 2

Anthrax bigradata Loew, 1969: 23; "Cuba." Holotype ♀ in the Museum of Comparative Zoology. Coquillett, 1887: 162, 174 (not in the sense of Loew's *bigradata*); Johnson, 1908: 72.

Villa (*Hemipenthes*) *bigradata*: Painter and Painter, 1962: 84; 1965: 435; Hull, 1973: 385; Painter et al., 1978: 47.

Diagnosis.—*Hemipenthes bigradata* is easily recognized by its dark body, abundant dark scales on the front and usually on the legs, white pile and dark scale pattern on tergite 1, yellow scales partially overlaid by white ones on tergite 4, a few dark bristles on the foretibia, distinct light spots in the dark color of the wing, and by the genitalia.

It is similar to *H. floridana* (Macquart) but is easily distinguished from the



Figs. 1, 2. Genitalia of *Hemipenthes bigradata.* 1. Lateral view. 2. Gonopods and ejaculatory process, dorsal view. Abbreviations: Ae = aedeagus, Ba = basistylus, BEA = basal ejaculatory apodeme, Ce = cercus, Di = dististylus, Ep = epiphallus, LEA = lateral ejaculatory apodeme, Ra = ramus, T = tergite. Horizontal and vertical bars = 0.25 mm.

latter by the absence of reddish pile on the abdomen. In Coquillett's (1894) key, *H. bigradata* may be forced to *H. eumenes* (Osten Sacken) but can be distinguished from it by differences in vestiture, absence of pulvilli and lighter spots in the dark areas of the wing.

Male.—5.5 mm. Ground color brownish black; antenna dark, 3rd segment slightly lighter; sides of tergites 2–3 with somewhat lighter area, more distinct on 3; pleura, coxae and legs brown, tibiae and apices of femora lighter, tarsi darker apically.

Face rounded, slightly projecting below; proboscis not projecting beyond oral margin; hairs of head black, more abundant at midline of face, on oral margin and on 1st antennal segment. Scales primarily black on front and yellowish white to yellowish brown elsewhere, lighter scales most abundant on face and behind indentation of eye; occipital fringe brownish black. Antennal ratio 1.6:1:5.1, 3rd segment somewhat onion shaped at base, style beginning abruptly.

Mesonotum with black hair, longer posteriorly, black scales on dorsum with scattered cupreous scales, most abundant on posetrior 5th, stripes of dense long whitish scales beginning on humeral callus extending onto postular callus, margined above along most of its length by long cupreous scales. Ruff brown, primarily lighter above, darker below, whitish hairs at anterior corner of mesonotum contiguous with stripe of white scales. Pleura with mostly black pile, the latter denser and longer on upper mesopleuron, hypopleuron bare, metapleuron with primarily

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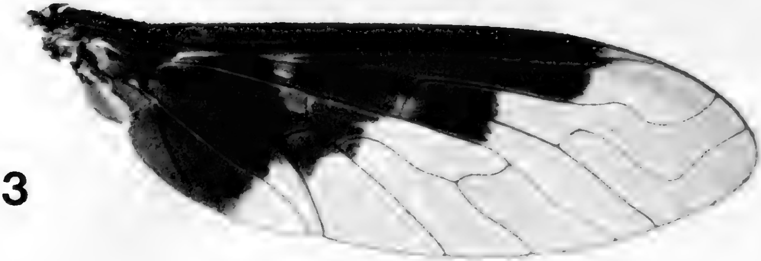

Fig. 3. Wing of *Hemipenthes bigradata,* 5.2 mm.

whitish pile, sparse, short dark pile elsewhere, sparse cupreous scales on lower meso-, ptero- and sternopleurae. Scutellum with black hair, predominantly cupreous scales, a patch of black scales basally in center; scutellar and postalar bristles black; pre-alar bristles orange.

Abdomen with coarse black hair reaching lateral margin, more noticeable on sides of tergites 2–7, denser on 3rd and apical ½ of 2nd tergites. Tergite 1 with long cupreous scales apically, a few shorter brown scales mixed at midline, abundant erect whitish hair laterally tapering into a narrow row toward center, a few dark slender brownish-black hairs medially. Tergites 2–3 with black and a few scattered cupreous or yellowish scales, patches of whitish scales and hairs toward side basally on tergite 2. Tergite 4 with a wide basal band of yellowish scales overlaid with white scales, black scales apically. Tergites 5–7 with decreasing proportion of black scales, light scales yellowish to white, a small patch of white scales basolaterally on 7; lateral margins of tergites 2–7 with brownish scales, a few lighter ones mixed. Venter with black hair, sternite 1 with few scales, more abundant posteriorly, scales predominantly brown, lighter or lighter tipped ones scattered.

Genitalia with tergite 9 longer than high, slightly tapered and rounded apically, base with black hair. Epiphallus about 2× as long as wide, broadly rounded and somewhat recurved apically; aedeagus almost straight, tapered to a point, reaching apical margin of epiphallus, basal ejaculatory apodeme somewhat C-shaped with 2 strong long, lateral aedeagal apodemes, lateral ejaculatory apodemes winglike, equal in length to lateral aedeagal apodemes; base of aedeagus ovate, slightly bulging dorsally; basistylus triangular in lateral view, broad base tapering to a narrow rounded apex, weak, short brown to yellowish hairs below and apically; dististylus small, moderately hooded at apex.

Coxae with black hair and coppery to brown scales; legs with abundant dark brown scales, scattered lighter scales most abundant on mid- and hindlegs, sparse on foretibia; bristles black, present on foretibia; pulvilli absent.

Wing with anterior and basal halves brownish black, the dark pattern extending from near tip of subcosta transversely across marginal cell basally, then transversely to vein M, basally beyond r-m crossvein, then at about a 45° angle to meet wing margin near apical ⅓ of axillary cell. Dark areas include basal ⅓ of discal, extreme base of 3rd posterior, basal ¼ of 4th posterior and basal ⅔ of anal and axillary cells. Prominent pale spots in brownish black area on knee of R_{2+3}, r-m crossvein, basal portion of m crossvein, anterior branch of cubitus, and near base of Rs; black spot before proximal end of discal cell. First posterior cell open more than length of r-m crossvein; anal cell open about ½ or more length of r-m crossvein; discal cell long and narrow, pointed apically, basally at its narrowest point about as wide as length of r-m crossvein; r-m crossvein arising slightly before middle of discal cell; R_{2+3} arising slightly before r-m crossvein; contact of discal and fourth posterior cells less than width of base of 4th posterior cell. Base of costa with black scales and setae; alular and squamal fringes light brownish black. Halter brownish white, basal ½ of knob brownish black.

Female.—Similar to male with the following exceptions: 5.8 mm; antennal ratio 1.8:1.0:5.5. Ground color of antenna uniformly dark, light areas on sides of tergites 2–3 less distinct; 1 or 2 whitish scales on hind coxa. A few light scales at base of costa, contact of discal and fourth posterior cells equal to or more than base of 4th posterior cell, base of M_3 curved upward basally in right wing.

Variation.—Male 4.5–9.4 mm, female 4.4–8.1 mm; antennal ratios: male 1.5:1:5–2:1:5, female 2.5:1:7.5–2.7:1:7.3. Ground color of femora, calli and antenna brownish black to yellowish brown, size and intensity of light areas of tergites highly variable, often indistinct; occasionally light area on tergite 4, usually in male, abdominal tergites of male frequently with light lateral margins, sometimes extending almost or completely across apical margins on posterior tergites. Occiput frequently with dark scales below; scales often dark basally and lighter apically; sometimes scales on mesonotum predominately cupreous. Two females have abundant light brown scales on apical margin of tergite 7. Bristles occasionally brownish orange to orange, prealar bristles rarely black. Pale spot at base of 3rd posterior cell sometimes absent; R_{2+3} often arising slightly beyond r-m crossvein, apex of discal cell rarely truncate, additional veins common, usually in discal cell, and an occasional spur vein present; anal cell sometimes open less than ½ length of r-m crossvein.

Material Examined.—99 specimens; 45 ♂, 54 ♀ San Salvador Island. 2 ♂ Grand Bahama Island. 1 ♂ Cat Island. 2 ♂, ♀ Great Exuma Island. The homotypes (♂, ♀) are deposited in the collection of the National Museum of Natural History. Specimens are also deposited in the following museums: Museum of Comparative Zoology, American Museum of Natural History, National Museum of Natural History, and Museum of Zoology, Towson State University.

Distribution.—Bahama Islands (Abaco, Bimini, Cat, Grand Bahama, Great Exuma, Nassau, San Salvador, Strangers Cay), Cuba. *Hemipenthes bigradata* is also recorded (Painter and Painter, 1962) from Northern California and New Mexico, but specimens from those regions that we have examined are significantly different to warrant re-evaluation of their status. *Hemipenthes bigradata* has been collected in the Bahamas from January through June.

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We gratefully acknowledge the assistance of Norman Woodley, Museum of Comparative Zoology, Harvard University, for permitting us to examine the type and other specimens of *H. bigradata*; Raymond J. Gagné and Lloyd Knutson, Systematic Entomology Laboratory, USDA, Washington, D.C. for access to the

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NEW NORTH AMERICAN SPECIES OF EUCOSMINI (LEPIDOPTERA: TORTRICIDAE)

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Abstract.—Phaneta ***clarkei,*** *Eucosma* ***sierrae,*** and *Eucosma* ***ustulatana*** are described from males only, all from Texas. *Suleima* ***medaciana*** is described from males and females from Texas. *Phaneta* ***musetta*** is described from a male and female from New Mexico and Texas, respectively. *Gretchena* ***nymphana*** is described from males and females from Texas, Mississippi, and Kentucky. Imagines and genitalia are figured.

The species described below, save one, were included in a recent shipment by the authors to the National Museum of Natural History, Washington, D.C., where they were found to represent new taxa. The type series in two cases has been supplemented by NMNH specimens. The last species described has been long known by the authors to be undescribed, but recently the type series has been supplemented by specimens from the collections of Bryant Mather in Mississippi, and the Academy of Natural Sciences in Philadelphia (loaned by Dr. Richard L. Brown). At this writing, the reserve of undescribed Texas Eucosmini is far from exhausted, as many apparently new taxa are known from female examples only.

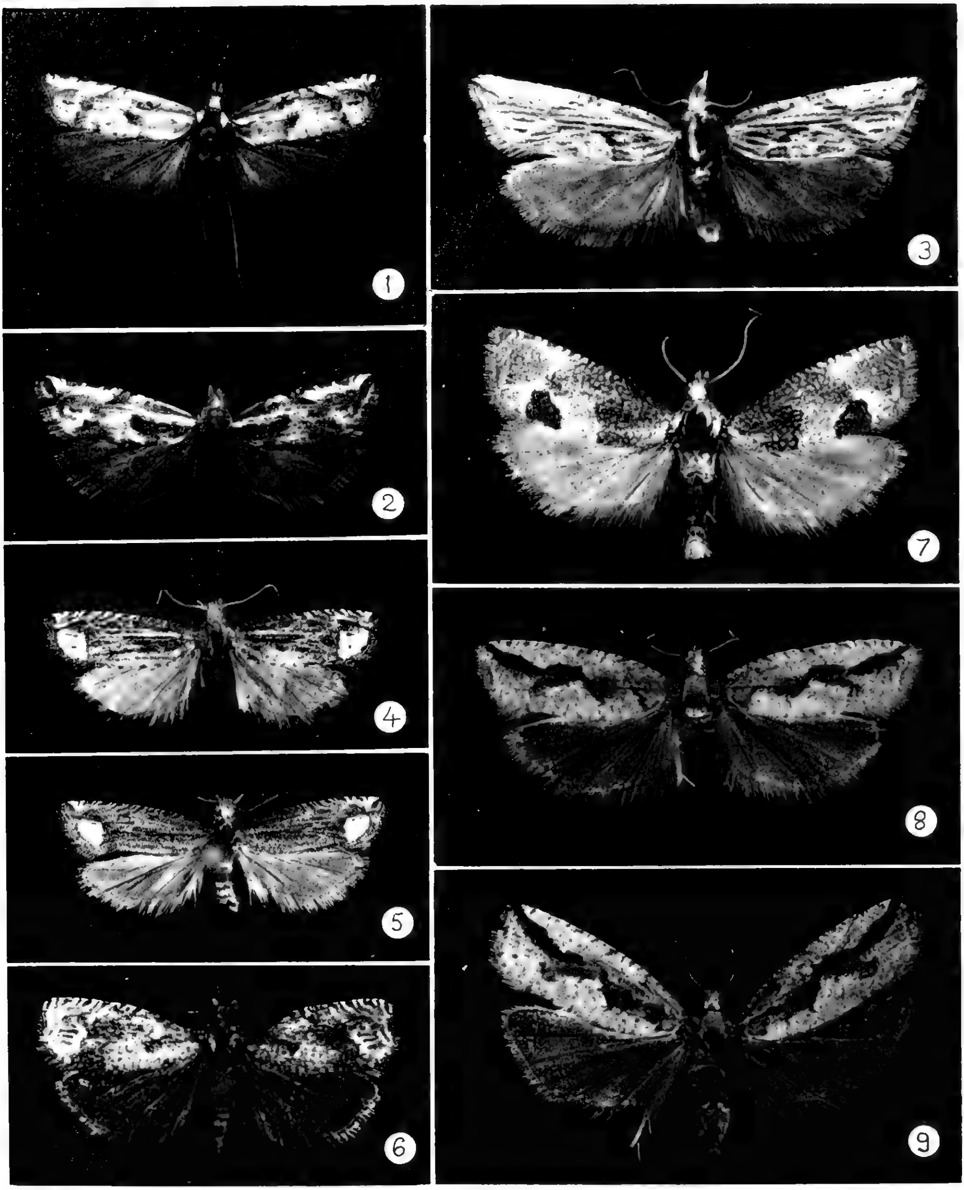
Phaneta musetta Blanchard and Knudson, NEW SPECIES

Description.—*Head:* Front and vertex whitish, rough scaled. Labial palpus whitish, exceeding front by 2 eye diameters. Antenna simple, fuscous, scaled dorsolaterally, undersurface finely pubescent. Collar whitish.

Thorax: Tegula and patagia composed of white tipped pale brown scales, mesonotum light brown.

Forewings: Ground color white with well defined fuscous basal patch extending over basal ⅓, angled outwardly from dorsum to cell, interrupted by a streak of ground color along cell and narrowly edged with white along costa. Outer ⅓ of wing much suffused with fuscous, with outwardly angled postmedian fascia extending from costa near middle to outer ⅓ of dorsum. Outer ⅔ of costa fuscous with 4 strong white strigulations, the basal and apical strigulations geminate. Strigulations connected below costa forming a white subcostal streak. Ocelloid patch white with 1 horizontal black bar in upper portion. Fringe composed of multiple scale rows banded with white and fuscous. Undersurface of wing uniformly fuscous except for costal strigulations, which are repeated as above.

Hindwings: Fuscous, slightly paler toward base. Fringe pale fuscous with darker bands.



Figs. 1–9. Dorsal view of adults. 1, *Phaneta musetta,* holotype ♂, Socorro Co., N. Mex., Gran Quivara Nat. Monument, 6600′, 1–3-VII-64, D. R. Davis, coll. 2, *P. musetta,* paratype ♀, Tarrant Co., Tex., Benbrook Reservoir, 30-IV-78, E. Knudson, coll. 3, *P. clarkei,* holotype ♂, Hemphill Co., Tex., Canadian Nat. Grassland, Lake Marvin, 9-X-82, E. Knudson, coll. 4, *Suleima mendaciana,* holotype ♂, Brewster Co., Tex., Big Bend Nat. Park, Dugout Wells, 28-IX-81, E. Knudson, coll. 5, *S. mendaciana,* paratype ♀, Cameron Co., Tex., South Padre Island, 24-X-82, E. Knudson, Coll. 6, *Eucosma ustulatana,* holotype ♂, Washington Co., Tex., Brenham, 4-VI-79, E. Knudson, coll. 7, *E. sierrae,* holotype ♂, Culberson Co., Tex., Sierra Diablo Wildlife Management Area, 6400′, 30-VIII-70, J. G. Franclemont, coll. 8, *Gretchena nymphana,* holotype ♂, Anderson Co., Tex., Tennessee Colony (Gus Engeling Wildlife Management Area), 15-IV-68, A. and M. E. Blanchard, colls. 9, *G. nymphana,* paratype ♀, Warren Co., Miss., Vicksburg, 25-III-82, B. Mather, coll.

Length of forewing: Male: (1 example) 7.1 mm.; female: (1 example) 6.8 mm.

Male genitalia: As in Fig. 10, from holotype.

Female genitalia (Fig. 16): Ovipositor moderately elongate; lamina postvaginalis arcuate, lightly sclerotized; caudal ½ of ductus bursae partially sclerotized; ductus seminalis from near middle of ductus bursae; bursa membranous, with 2 large thornlike signa.

Holotype (Fig. 1).—♂, Socorro Co., New Mexico, Gran Quivara Nat. Monument, 6600′, 1–3-VII-64, collected by D. R. Davis, and deposited in the National Museum of Natural History.

Paratype (Fig. 2).—♀, Tarrant Co., Texas, Benbrook Reservoir, 30-IV-78, collected by E. Knudson.

Remarks.—Dr. J. F. Gates Clarke, who has examined the types, has made the following comment: "*P. musetta* is very closely related to *P. influana* (Heinrich), but differs from it by having a single black bar in the ocelloid patch; *influana* has two. Moreover, *musetta* has three well defined wedge shaped dark marks in the apical ⅖ of costa, which are lacking or obsolete in *influana.*" The authors, who have examined type specimens of *influana,* note that in comparison with *musetta, influana* is darker, with a more pronounced brown color to the dark markings. There are no specific differences in the male or female genitalia of the two species.

Phaneta clarkei **Blanchard and Knudson, NEW SPECIES**

Figs. 3, 11

Description.—*Head:* Front and vertex rough scaled, yellowish. Labial palpus whitish yellow, exceeding front by 2 eye diameters. Antenna simple, whitish yellow, clothed dorsolaterally with scales, very finely pubescent ventrally. Collar whitish yellow.

Thorax: Tegula and patagia whitish yellow; mesonotum whitish yellow with brownish median stripe.

Forewing: Overall coloration light yellowish tan with darker striations of varying intensity. Under magnification, veins appear whitish, intervenular spaces and striations consist of scale rows of 2 different colors: dark brown centrally and beige on each side. Beige substantially continuous; dark brown more or less discontinuous, occurring along most streaks in well marked specimens, but nearly absent in lighter examples. Obscure lighter patches occur on mid-dorsum, outer ⅖ of costa, and tornus, indicated mainly by a reduction of dark brown scaling of striations. Ocelloid patch absent. Fringe whitish yellow with narrow brown band near base. Undersurface of wing brownish fuscous except for outer ⅖ of costa, which is light ochreous.

Hindwing: Pale fuscous. Fringe lighter with 2 obscure darker bands.

Length of forewing: Male: ($N = 12$) 7.5–9.2 mm., average 8.5 mm.

Male genitalia: As in Fig. 11.

Holotype.—♂, Hemphill Co., Texas, Canadian National Grassland, Lake Marvin, 9-X-82, collected by E. Knudson and deposited in the National Museum of Natural History.

Paratypes.—Cottle Co., Texas, Matador Wildlife Management Area, near Paducah, 8-X-82, collected by E. Knudson, 10 ♂; same locality, 4-VI-70, 1 ♂, collected by A. and M. E. Blanchard.

Remarks.—Dr. J. F. Gates Clarke, who has examined type specimens, made the following comments: "This species is closely related to both *P. grindeliana* (Busck) and *stramineana* (Walsingham). From both it is distinguished by the absence of strong patches of setae at the base of the costa of the harpe. The forewing of *clarkei* exhibits distinct longitudinal striations, absent in *grindeliana* and *stramineana,* although some specimens of *grindeliana* show very weak streaking." The authors take pleasure in naming this new species in honor of Dr. J. F. Gates Clarke in recognition of his many contributions to Lepidopterology, and in gratitude for the great amount of assistance he has given the authors in their ongoing study of the Lepidoptera of Texas.

Suleima mendaciana **Blanchard and Knudson,** NEW SPECIES

Figs. 4, 5, 12, 17

Description.—*Head:* Front and vertex light orange brown, scales tousled. Labial palpus fuscous, tinged with orange brown, exceeding front by 1 eye diameter. Antenna simple, fuscous, very lightly pubescent ventrally. Collar light orange brown.

Thorax: Tegula and patagia light orange brown; mesonotum orange brown shading to fuscous.

Venation: Forewing: R_4 and R_5 united. Hindwing: Rs and M_1 stalked for about ⅓ of their length, M_3 and Cu_1 united.

Forewings: No costal fold in male. Ground color grayish fuscous, each scale tipped with white. Costa strigulated with dark fuscous and white, most conspicuously near apex, becoming obscure basally. Narrow orange brown subcostal patch near apex. Ocelloid patch conspicuous, white, with 2 horizontal blackish dashes. In some examples, lighter and darker scales are arranged in poorly defined longitudinal rows, giving wing a somewhat striated appearance. Fringe consisting of 3 rows of white tipped dark fuscous scales. Underside fuscous with costal strigulations clearly indicated.

Hindwings: Fuscous, barely lighter than forewing. Fringe pale fuscous with 2 darker bands.

Length of forewing: Male: ($N = 3$) 4.9–5.3 mm., average 5.1 mm.; female: ($N = 2$) 4.8, 5.0 mm.

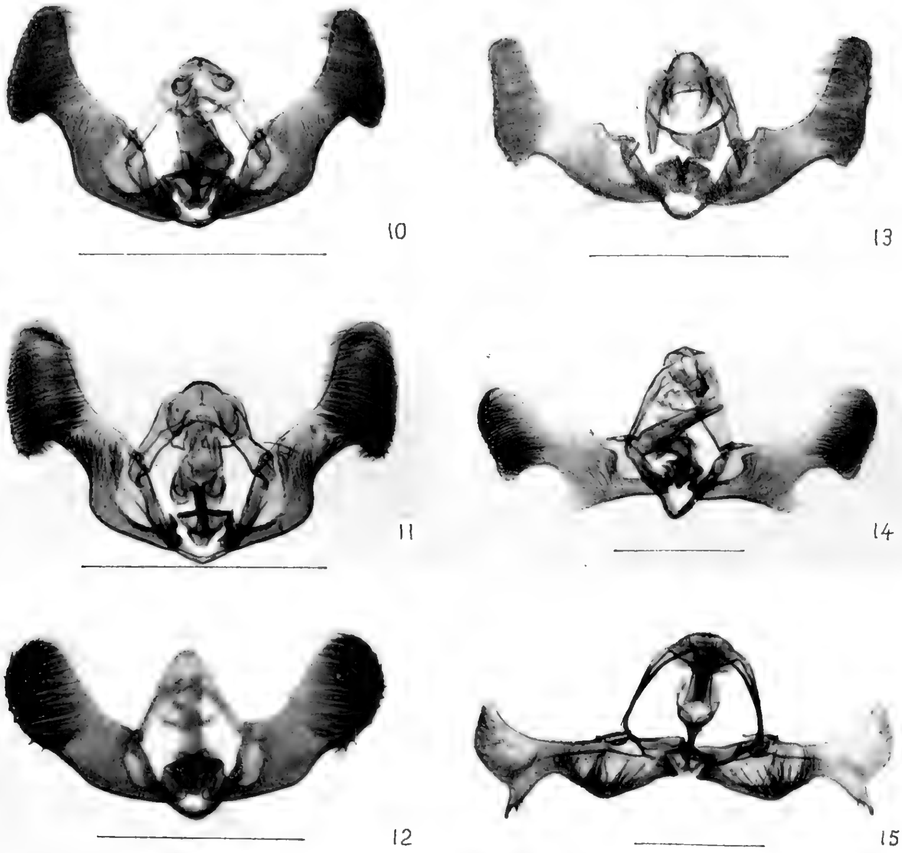
Male genitalia (Fig. 12): Valvae without rudimentary clasper.

Female genitalia (Fig. 17): Ovipositor elongate; ostium bursae funnel shaped, lightly sclerotized; ductus seminalis from middle of ductus bursae; bursa lightly scobinate, with 2 thornlike signa.

Holotype (Fig. 4).—♂, Brewster Co., Texas, Big Bend National Park, Dugout Wells, 28-IX-81, collected by E. Knudson and deposited in the National Museum of Natural History.

Paratypes.—Jeff Davis Co., Texas, Davis Mountains State Park, 25-VIII-79, 1 ♂; Hidalgo Co., Texas, Santa Ana Refuge, 14-XI-81, 1 ♀, 30-XI-81, 1 ♂; Cameron Co., Texas, South Padre Island, 24-X-82, 1 ♀; all collected by E. Knudson.

Remarks.—Although this new species does not closely resemble any other known *Suleima,* it falls into this genus by virtue of the male genitalia, the wing venation, and the absence of a costal fold in the male. The moth closely resembles *Phaneta ochroterminana* (Kearfott), but may be easily distinguished by male genitalia and wing venation.



Figs. 10–15. Male genitalia. 10, *Phaneta musetta,* holotype, slide USNM 25473. 11, *P. clarkei,* paratype, slide AB 2196, Cottle Co., Tex., Paducah (Matador Wildlife Managmenta Area), 4-VI-70, A. and M. E. Blanchard, colls. 12, *Suleima mendaciana,* holotype, slide ECK 186. 13, *Eucosma ustulatana,* paratype, slide ECK 61, Washington Co., Tex., Brenham, 18-VI-79, E. Knudson, coll. 14, *E. sierrae,* paratype, slide AB 2151, Culberson Co., Tex., Sierra Diablo Wildlife Management Area, 1-IX-69, A. and M. E. Blanchard, colls. 15, *Gretchena nymphana,* paratype, slide ECK 510, Warren Co., Miss., Vicksburg, 25-III-82, B. Mather, coll. Lines = 1 mm.

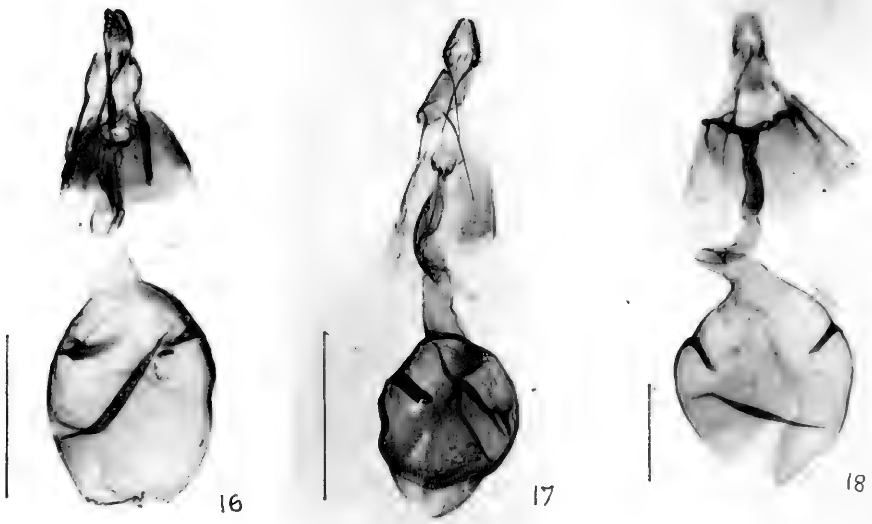
Eucosma ustulatana **Blanchard and Knudson,** NEW SPECIES

Figs. 6, 13

Description.—*Head:* Front and vertex rough scaled, dark orange brown. Labial palpus exceeding front by 1 eye diameter, yellowish brown, 3rd segment blackish. Antenna simple, brown, rings of scales encircling each segment. Collar brown.

Thorax: Tegula, patagia, and mesonotum dark brown.

Forewings: Ground color chocolate brown, composed of a mixture of dark brown, pale orange brown, and light ochreous scales. Costal fold extending over basal ⅓. Costa beyond fold strigulate with light ochreous and dark brown. Several strigulations near apex long and extend over ocelloid patch toward termen, light ochreous scales giving way to metallic silvery scales and dark brown scales be-



Figs. 16–18. Female genitalia. 16, *Phaneta musetta,* paratype (Fig. 2), slide ECK 537. 17, *Suleima mendaciana,* paratype (Fig. 5, dissected after photo), slide ECK 647. 18, *Gretchena nymphana,* paratype, slide 571, Anderson Co., Tex., Gus Engeling Wildlife Management Area, 4-IV-81, E. Knudson, coll. Lines = 1 mm.

coming pale orange brown. Ocelloid patch pale orange brown with 3 horizontal blackish dashes, and bordered by narrow rows of metallic silvery scales. Obscure lighter patch on mid-dorsum, composed mainly of light ochreous scales, peppered with dark brown scales. Fringe composed of 3 rows of scales banded with light ochreous and blackish brown. Underside of forewing dark brown, unmarked, except for costal strigulations.

Hindwings: Uniform dark brown; fringe contrasting light ochreous, with brown inner band.

Length of forewing: Male: ($N = 2$) 6.0, 7.0 mm.

Male genitalia: As in Fig. 13.

Holotype (Fig. 6).—♂, Washington Co., Texas, Brenham, 4-VI-79, collected by E. Knudson and deposited in the National Museum of Natural History.

Paratype.—Same locality as holotype, 18-VI-79, 1 ♂, collected by E. Knudson.

Remarks.—This somberly colored species bears close resemblance to *Eucosma eumaea* Meyrick in male genitalia, differing only in the smoother, more evenly convex anterior margin of the harpe. From this species, it differs also in color and maculation, *eumaea* being mainly dark gray with obscure blackish markings.

Eucosma sierrae Blanchard and Knudson, New Species

Figs. 7, 14

Description.—*Head:* Front and vertex brownish white. Labial palpus white, exceeding front by 1 eye diameter. Antenna light brown, simple, rings of scales completely encircling each segment. Collar light brown.

Thorax: Tegula, patagia, and mesonotum light brown.

Forewings: Costal fold extending over basal ¼. Ground color light brown with many small patches of whitish scales, giving a dappled appearance under magnification. Fairly well defined dark basal patch extending from dorsal margin, vertically to cell, and fading to costa. Conspicuous dark brown subtriangular dorsal patch just before tornus, space between basal and subtornal patches being more or less suffused with whitish. Ocelloid patch obscure, whitish, bordered by vertical bands of slightly irridescent scales, and containing 3 obscure dark brown spots. Fringe consists of multiple scale rows banded with light and dark brown. Underside brownish fuscous, unmarked, except for costal strigulations.

Hindwings: Light fuscous, fringe banded with paler shades.

Length of forewing: Male: ($N = 4$) 9.2–11.0 mm., average 10.1 mm.

Male genitalia: As in Fig. 14.

Holotype (Fig. 7).—♂, Culberson Co., Texas, Sierra Diablo Wildlife Management Area, 6400′ 30-VIII-70, collected by J. G. Franclemont and deposited (by JGF) in the National Museum of Natural History.

Paratypes.—Same location as holotype, 1-IX-69, 1 ♂; 30-VIII-70, 1 ♂; 31-VIII-70, 1 ♂; collected by A. and M. E. Blanchard.

Remarks.—This species has a unique wing pattern and male genitalia in the genus, although there are similarities to *Eucosma mirosignata* Heinrich, with which it keeps company in the Sierra Diablo.

Gretchena nymphana **Blanchard and Knudson,** NEW SPECIES

Figs. 8, 9, 15, 18

Description.—*Head:* Front and vertex buff (pale yellowish brown). Labial palpus buff, exceeding front by 1 eye diameter. Antenna simple, buff, scaled dorsolaterally, finely pubescent beneath. Collar buff.

Thorax: Tegula and patagia light brown; mesonotum buff.

Forewings: Ground color buff, with faint brownish costal strigulations. Wing conspicuously marked with a wavy black line, extending from apex to dorsal margin near base; thick and continuous over apical ⅔, attenuated and interrupted over basal ⅓. Some fuscous scaling in cell adjacent to black line. Ocelloid patch absent. Fringe buff, scales banded with brown. Underside brownish fuscous, unmarked, except for faint costal strigulations.

Hindwings: Fuscous, fring buff.

Length of forewing: Male: ($N = 2$) 8.3, 8.4 mm.; female ($N = 3$) 8.6–9.0 mm., average 8.7 mm.

Male genitalia: As in Fig. 15.

Female genitalia (Fig. 18): Ostium bursae funnel shaped, with elongated slightly curved, sclerotized, transverse plate on ventral rim. Caudal ½ of ductus bursae sclerotized; ductus seminalis from ductus bursae near middle; bursa membranous with 2 blunt, thornlike signa.

Holotype (Fig. 8).—♂, Anderson Co., Texas, Tennessee Colony (Gus Engeling Wildlife Management Area), 15-IV-68, collected by A. and M. E. Blanchard and deposited in the National Museum of Natural History.

Paratypes.—Same location as holotype, 4-IV-81, 1 ♀, collected by E. Knudson; Warren Co., Mississippi, Vicksburg, 25-III-82, 1 ♂, 1 ♀, collected by Bryant Mather;

Laurel Co., Kentucky, Fariston, 2-V-35, 1 ♀, collected by A. F. Braun (in the Academy of Natural Sciences, Philadelphia).

Remarks.—This species is distinguished from other members of the genus by its pale yellowish brown ground color. The male genitalia are similar to *Gretchena biangulana* Walsingham, but in that species, the apex of the cucullus is more bluntly rounded.

ACKNOWLEDGMENTS

The authors are deeply grateful to J. F. Gates Clarke, whose determinations have provided the impetus for this work, and for his help in reviewing the manuscript and providing some of the comments that appear herein. We also thank Don Davis, for his prior examination of the holotype of *Gretchena nymphana.* Additionally we thank Bryant Mather and Richard L. Brown for providing additional type material of this species. Finally, we thank officials of the U.S. National Park Service and the Texas Parks and Wildlife Department for their help in providing access to collecting in the state and federal parks and wildlife refuges that are mentioned above.

Notice of a New Publication

A Systematic Study of the Japanese Chloropidae (Diptera). By Kenkichi Kanmiya, Biological Laboratory, School of Medicine, Kurume University, Fukuoka, Japan. Memoirs of the Entomological Society of Washington, Number 11, 370 pp. Cost, $18.00.

A revised classification of the family Chloropidae of Japan is presented, including a historical review, geographical distribution, genus and species descriptions, discussions of specific relations and generic groupings, food habits, and references. Three subfamilies, 53 genera, and 143 species are recognized including 2 new genera, 1 new subgenus, and 34 new species. Many genera and species are new to Japan. Keys are provided for the subfamilies, genera, and species of Japan. For some genera that contain many species common to the Oriental Region, complete keys to the Oriental species are given. Male genitalia and female terminalia of most species are illustrated in the 430 figures.

This publication may be ordered from the Custodian, Entomological Society of Washington, % Department of Entomology NHB 168, Smithsonian Institution, Washington, D.C. 20560.

PROC. ENTOMOL. SOC. WASH.
85(4), 1983, pp. 853–854

NOTE

Annoyance by the Predaceous Bug, *Reduvius personatus* (L.) (Hemiptera: Reduviidae), in North Central Colorado

Ryckman (1979. Vector Views 26(1, 2): 1–23) and Ryckman and Bently (1979). Vector Views 26(3, 4): 25–49) present comprehensive reviews of the literature concerning the extensive list of true bugs (orders Hemiptera and Homoptera) that attack man. They annotate published reports of bug bites, pointing out that the most serious reactions in humans usually result from hypersensitivity to the bites of hemophagous bugs such as the *Triatoma.* On the other hand, predaceous bug bites usually produce immediate painful reactions when proteolytic enzymes used to stun their arthropod prey are introduced into human tissues. Ulceration and necrosis may develop at the site of the bites. Pain from the bites of several predaceous bugs is frequently attributed to wasp stings.

Reduvius personatus (L.) is the species responsible for a great many of the reported bug bites. This widely distributed predator (North America, Europe, Africa) is called the masked hunter because the nymphs clothe themselves with debris. *Reduvius personatus* nymphs are commonly associated with cliff swallow, *Petrochelidon pyrrhonata,* nests in Colorado, feeding on the plethora of ectoparasites therein (Smith and Eads, 1978. J. Wash. Acad. Sci. 68(1): 23–26). The most abundant swallow ectoparasite in the Rocky Mountain area is the cimicid, *Oeciacus vicarius* Horvath. *Reduvius personatus* shows a marked predilection for feeding on bedbugs (Usinger, 1966. Thomas Say Found. Vol. VII, 585 pp.). Adult *personatus* in captivity will feed on most smaller insects offered them. However, in Colorado we have found nymphs only in swallow nests.

An interesting situation occurred in the vicinity of Fort Collins, Colorado, in the summer of 1981, when both an ectoparasite and its predator became public health problems. Mail (1940. J. Econ. Entomol. 33(6): 949) and Eads et al. (1980. Proc. Entomol. Soc. Wash. 82(1): 81–85) reported the swallow bug, *O. vicarius,* as an annoyance in a school and dwellings, respectively. As these bugs walk only short distances, known human attacks have been restricted to swallow nesting sites. However, adults of *R. personatus,* a predator on the cimicid, are strong fliers and are encountered well removed from swallow nests.

Normally, a few specimens of swallow bugs which have been annoying humans in dwellings in northern Colorado and Wyoming are submitted to us each summer for identification. A smaller number of the masked hunters are received each summer, usually only 1 or 2.

During the summer of 1981, there were no indications of unusually large *O. vicarius* population levels on the basis of complaints received. However, there was a marked increase in the number of *R. personatus* brought to us for specific determination. Most of the reported bites were provoked in that they involved handling of the bugs. A few resulted from bugs in flight alighting on individuals. A systematic survey was not made to evaluate population densities of *R. personatus* in and around dwellings, but specimens were received from throughout the city of Fort Collins and the surrounding area in Larimer County, Colorado, primarily in June and July. One individual, displaying an ulcer on a finger resulting from a painful bite by one of these bugs, reported seeing a dozen or so of them in his yard and home, perhaps attracted by porch lights, within a few days' time in mid-June. There were no cliff swallow nesting colonies in the immediate vicinity of his home. We are unable to explain the high *personatus* population in 1981.

Eads et al. (1980) point out the desirability of reducing human annoyance from swallow bugs by swallow colony management around dwellings. Removing the nests and spraying the immediate area with an approved insecticide after the birds depart in the fall would prevent the buildup of excessive swallow bug populations. Cliff swallows build nests rapidly and are not discouraged or handicapped by being forced to rebuild nests in the spring. Control of the swallow bugs in urban areas would also possibly result in a reduction in the numbers of *R. personatus.* However, since the adults are strong fliers, some dispersal into urban areas from natural rural nesting sites such as cliff faces, bridges, and culverts would likely continue.

R. B. Eads (retired) and E. G. Campos, *Division of Vector-Borne Viral Diseases, Center for Infectious Diseases, Centers for Disease Control, Public Health Service, U.S. Department of Health and Human Services, Fort Collins, Colorado 80522.*

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NOTE

Limnoporus notabilis (Drake and Hottes) from central Arizona (Hemiptera: Heteroptera: Gerridae)

Limnoporus notabilis (Drake and Hottes) has been reported from California, Colorado, Idaho, Iowa, Montana, Oregon, Utah, and Washington (Drake, C. J. and F. C. Hottes, 1925. Ohio J. Sci. 25: 46–50; Drake, C. J. and H. M. Harris, 1928. Ohio J. Sci. 28: 269–276) and Arizona, South Dakota, Wyoming, and British Columbia (Polhemus, J. T. and H. C. Chapman, 1979. Bull. Calif. Insect Surv. 21: 58–69).

Drake and Harris (1934. Ann. Carnegie Mus. 23: 179–240) described *L. notabilis* as a "common western species inhabiting the streams of the Pacific Coast and Rocky Mountain states" and "frequently occurring in large schools on the surface of mountain lakes." Polhemus and Chapman report that in northern and central California the species is found at "low to moderate elevations."

I recently discovered a well-preserved series of 19 specimens of *L. notabilis* in the Arizona State University museum collection. The specimens were collected at Woods Canyon Recreation Area, Cococino Co., Ariz. in a stream on 14 April 1971 by H. R. Rush. Six males and four females are fully macropterous; five males and four females have wings which cover the seventh abdominal tergite. Woods Canyon, although at a low temperate latitude (34°20′), is at an elevation of over 7000 feet (Brown, D. E. et al., 1981. Drainage Map of Arizona).

The series of specimens shows the marked sexual dimorphism which, although characteristic of the species and opposite of that found in most species of Gerridae (Calabrese, unpublished data)—i.e. here the males are larger than the females—

Table 1. Comparative mean sizes, based on selected appendage segments, of representatives from two populations of *Limnoporus notabilis.* Measurements are in units. One unit equals 0.1 mm. Mean values for Woods Canyon series are based on 11 specimens for males and 8 specimens for females unless otherwise noted in parentheses. Mean values for Scott River series are based on 8 specimens for males and 6 specimens for females unless otherwise noted.

	Antennal segments				Midleg				Hindleg			
	I	II	III	IV	Femur	Tibia	Tarsus I	Tarsus II	Femur	Tibia	Tarsus I	Tarsus II
Woods Canyon, Ariz.												
Female	25 ± 2.4	18.4 ± 1.3	14.5 ± 1.8	13.3 ± 3.5	98 ± 5.6	80.8 ± 5.0	48 ± 1.8	10.4 ± .9	110.3 ± 5.8	76.9 ± 1.6	20.1 ± 1.6	9.6 ± 1.0 (7)
Male	26.9 ± 2.0	19.5 ± 2.2	14.1 ± 2.0	15.7 ± 2.1 (9)	102 ± 9.4	88.4 ± 8.7	47.8 ± 4.7	10.2 ± .6	119.5 ± 12.7	83.8 ± 8.4	21.7 ± 1.8	9.7 ± .7
Scott River, Calif.												
Female	23.3 ± 1.8	17.7 ± 1.1	13.9 ± 2.3	13.0 ± 2.2	96 ± 11.9	78.8 ± 5.4 (5)	33.3 ± 11.0 (3)	8 ± 1 (3)	102.7 ± 2.5	76.8 ± 6.8 (5)	24.4 ± 12.4 (5)	8.3 ± 1.1 (5)
Male	32.6 ± 3.9 (7)	24.2 ± 3.1 (7)	18.2 ± 1.0 (7)	15.4 ± 1.1 (7)	115.5 ± 12.2	93.9 ± 12	42.5 ± 13.9 (5)	10.5 ± 1.2 (5)	121.8 ± 19.3	93.9 ± 10.2 (7)	23.6 ± 13.5 (7)	8.9 ± 2.2 (7)

has gone unreported in the literature. Other *L. notabilis* populations exhibit the same dimorphic pattern. Compare, for example, the Woods Canyon, Arizona, series to an equally long series (8 males, 6 females) from Siskiyou County, Scott River (from pools along river), California (44°N) shown in Table 1.

Speculation about the events in ecological time which precipitated the outgrowth of larger males in evolutionary time might go as follows: *L. notabilis* males developed longer rowing (mid-) and stabilizing (hind-) leg segments because they exploit food resources in faster flowing water and join the females in pools for mating, thus expanding the potential resource base for an entire population. Constructed as an hypothesis the foregoing statement should be testable by ascertaining where and how males and females of this species spend their time.

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NOTE

Name Changes in the Membracidae (Homoptera)[1]

This note presents name changes needed in a few taxa of treehoppers. These include new combinations for two species that have previously been placed in an incorrect genus, tribe, and subfamily.

Subfamily Centrotinae Amyot and Serville, 1843

The **new name** *Capeneralus* is here proposed for the genus *Platynotus* Capener, 1954 (J. Entomol. Soc. South Afr. 17: 176; type-species: *P. lobatus* Capener, 1954: 177, by original designation and monotypy), which is preoccupied by *Platynotus* Fabricius, 1801. *Capeneralus* is named for A. L. Capener who contributed so much to our knowledge of African membracids.

Subfamily Stegaspidinae Haupt, 1929

Family-group names based on the genus *Stegaspis* Germar, 1883 (Greek, stegaspis: roof-shield), should be formed from the genitive stem "Stegaspid-" (not "Stegasp-"). Thus, the subfamily Stegaspinae Haupt, 1929 (Zool. Jahrb., Abt. Syst., Ökol., Geol. Tiere 58: 227), becomes Stegaspidinae Haupt, 1929, with the nominate tribe Stegaspidini Haupt, 1929.

Subfamily Heteronotinae Goding, 1926 (1843)

Illustrations accompanying the original descriptions of *Micrutalis viridicollis* Fowler, 1895 (Biol. Centrali-Amer. 2: 118–119; Pl. 8, Fig. 2, 2a), and *Cymbomorpha nitidipennis* Funkhouser, 1922 (J. N.Y. Entomol. Soc. 30: 14–15; Pl. 2,

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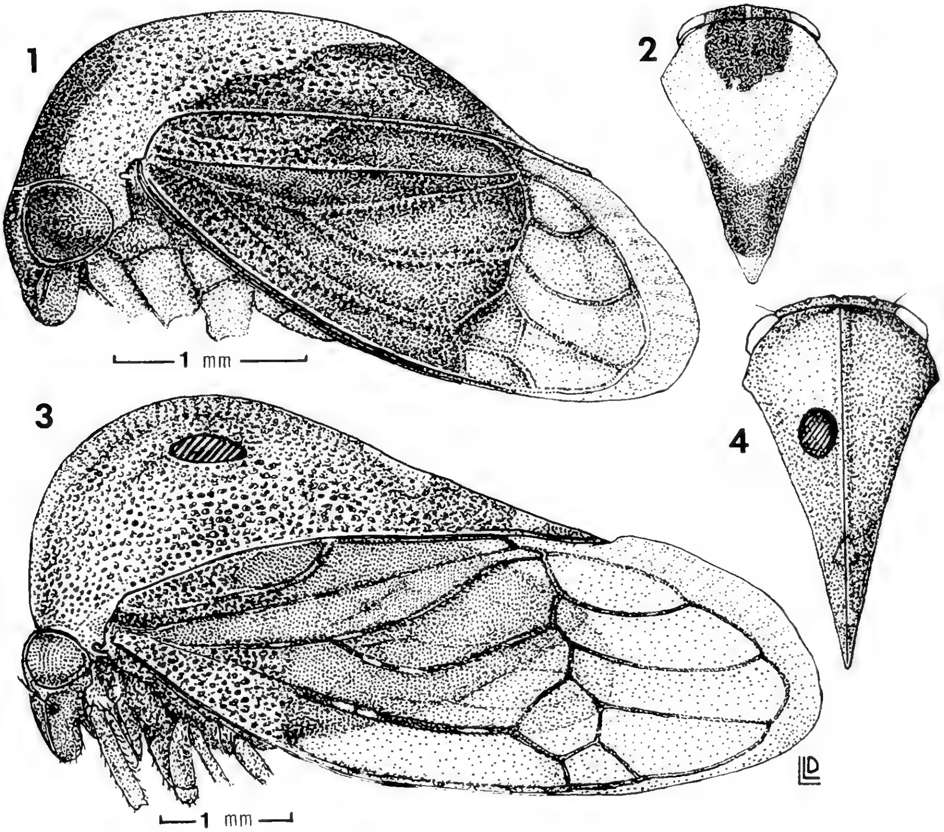
[1] Paper No. 8889 of the Journal Series of the North Carolina Agricultural Research Service, Raleigh, NC 27650.



Figs. 1–4. 1, 2, *Rhexia viridicollis,* holotype, female. 3, 4. *Dysyncritus nitidipennis,* holotype, female (the hatched area is a pin hole). 1, 3, Habitus, lateral aspect (1, right side, reversed). 2, 4, Head and pronotum, dorsal aspect.

Fig. 1), indicate that these species were incorrectly placed. Both have a forewing venation characteristic of the Heteronotini (Heteronotinae) as described by Deitz (1975. N. C. Agric. Exp. Stn. Tech. Bull. 255: 1–177), rather than the Micrutalini (Smiliinae) or Cymbomorphini (Darninae).

Dr. W. J. Knight, British Museum (Natural History), kindly loaned the holotype of *M. viridicollis* Fowler, 1895. I here refer this species (Figs. 1, 2) to the genus *Rhexia* Stål, 1867: *R. viridicollis* (Fowler, 1895) **New Combination.** In many species of *Rhexia* the sexes differ in coloration (Richter. 1955. Caldasia 6: 269–380), and the genus needs revision.

Dr. J. P. Kramer, Systematic Entomology Laboratory, USDA c/o National Museum of Natural History, permitted me to examine the holotype of *C. nitidipennis* Funkhouser, 1922. I here refer this species (Figs. 3, 4) to the genus *Dysyncritus* Fowler, 1895: *D. nitidipennis* (Funkhouser, 1922) **New Combination.**

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NOTE

Pamphilius middlekauffi Shinohara and Smith, New Species, for "*Pamphilius ocreatus*" of Authors (Hymenoptera: Pamphiliidae)

Two species have been found masquerading under the name "*Pamphilius ocreatus* (Say)" in North America. In his revision of *Pamphilius,* Middlekauff (1964. Univ. Calif. Publ. Entomol. 38, 84 pp.) regarded *Pamphilius greenei* Rohwer (1913. Proc. U. S. Natl. Mus. 45: 265–281) as a synonym of "*ocreatus.*" Subsequently, Smith (1979. *In* Krombein et al., Cat. Hym. in America North of Mexico. Smithsonian Institution Press, Vol. 1, pp. 3–137) recognized *ocreatus* and *greenei* as separate species after concluding that two species were present under the name "*ocreatus*" in collections. However, Say's original description of *ocreatus* (1836. Boston J. Nat. Hist. 1: 210–305) fits *greenei*; thus, "*ocreatus*" of authors is without a valid name. *Pamphilius greenei* must again return to the synonymy of *ocreatus,* as treated by Middlekauff (1964), and a new species is described for "*ocreatus*" of authors.

Pamphilius middlekauffi **Shinohara and Smith,** NEW SPECIES

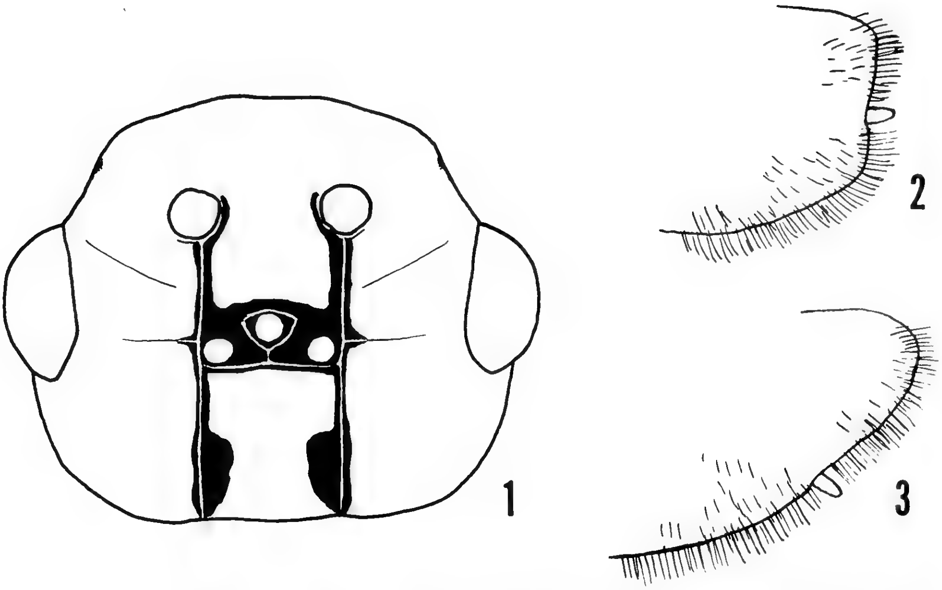
Lyda ocreata: Norton, 1969, Trans. Am. Entomol. Soc. 1: 338–339.

Pamphilius ocreatus: Dyar, 1895, Entomol. News 6: 199–200 (larva and host); Middlekauff, 1964: 35 (in part, female described and illustrated belongs to *ocreatus*); Smith, 1979: 16.

The female will key to "*ocreatus*" in Middlekauff's (1964) key. Females of *middlekauffi* and *ocreatus* are distinguished as follows: *Pamphilius middlekauffi:* Length about 8.5 mm; head color pattern as in Fig. 1; femora darkened dorsoapically; mesobasisternum with dark brown or black marks; sawsheath as in Fig. 2. *Pamphilius ocreatus:* Length about 10.5 mm; head with ocellar area, large spot on vertex, and narrow elongate spot on each postocular area black (Middlekauff, 1964: Fig. 42); femora concolorous; mesobasisternum without dark brown or black marks; sawsheath as in Fig. 3.

Holotype.—♀, from Virginia, labeled "VA, Broad Run, Throughfare Gap, Fauquier Co., V-8-1966, O. S. Flint, Jr." In the National Museum of Natural History, Washington, D.C.

Paratypes.—All ♀, except for 2 ♂ from N.Y. that were associated by rearing. All in the National Museum of Natural History. CONNECTICUT: Lyme, June 4, 1918, Champlain (1). ILLINOIS: Dubois, May 24, 1917 (1). MAINE: Bar Harbor, May 24, 1934 (1); Ashland, XII-10-41 (1). MARYLAND: 3 mi SE Beltsville, May 14, 1966, D. R. Smith (2). MASSACHUSETTS: Springfield, 6-5-31 (1); North Saugus, VI-8-12 (1); Montrose, VI-1917 (1). MICHIGAN: Detroit (1); "Mich." (1). MINNESOTA: "Minn." (1). NEW JERSEY: Ramsey, V-6-16 (1). NEW YORK: Keene Valley (specimens labeled "3U"), reared from *Corylus rostrata* (2 ♀, 2 ♂); McLean Res., Tompkins Co., V-29-1937, H. K. Townes (1); Ithaca, May 29, 1934 (1). PENNSYLVANIA: Inglenook, 6-22-20, J. N. Knull (1); Glendale, VI-16-07, C. T. Greene (1); N. Bloomfield, V-24-21, J. N. Knull (1); York Co., 5 mi NW Davidsburg, May 8–11, 1970, P. and P. Spangler (2). QUEBEC:



Figs. 1–3. 1, Dorsal view of head of *Pamphilius middlekauffi*. 2, Lateral view of sheath of *P. middlekauffi*. 3, Lateral view of sheath of *P. ocreatus*.

Stoneham, June 21, 1938, H. and M. Townes (1). VIRGINIA: Same data as for holotype (2); Fairfax Co., near Annandale, IV-28-81, Malaise trap, D. R. Smith (1). WISCONSIN: Dane Co., VIII, 1899 (1); Polk Co. (1).

Remarks.—Since the male of *ocreatus* is unknown, we cannot distinguish it from *middlekauffi*. The two male paratypes associated with *middlekauffi* by rearing have the dorsum of the head mostly black as opposed to the partially black head of the male figured by Middlekauff (1964: Fig. 43). *Pamphilius middlekauffi* is more commonly collected than *ocreatus*. Other than the holotype of *greenei* from Castle Rock, Pa., we have seen only two other specimens: Ag. Coll. Mich., June 6, 1920, and Lyme, Connecticut, June 16, 1918. Say (1836) described *ocreatus* from Indiana. These four localities were given by Middlekauff for "ocreatus."

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NOTE

Xiphydria prolongata (Geoffroy) (Hymenoptera: Xiphydriidae) Adventive in North America

Xiphydria prolongata (Geoffroy) has been found in two localities in the United States, and its discovery represents a new addition to the North American fauna. It occurs in all of Europe, east to central USSR, and the larvae are wood borers in various deciduous trees. Recorded hosts are *Populus, Salix, Acer, Ulmus, Alnus, Platanus, Quercus,* and *Betula*. For a complete list of recorded hosts, distribution, and literature references, see my world catalog (1978. Hym. Cat., pars 14, 193 pp. [pp. 122–124]). The two United States localities are: Michigan, Eaton Co., 4.5 mi E. Olivet, June 26–July 3, 1980, Malaise trap, Daniel K. Young (1 ♀, in the Michigan State University collection); New Jersey, Wrightstown, McGuire AFB, May 20, 1982, at large in warehouse (1 ♀, in the National Museum of Natural History, Washington, D.C.).

Nine species of *Xiphydria* are known in North America (see my revision, Smith. 1976. Trans. Am. Entomol. Soc. 102: 101–131). The female of *X. prolongata* can be separated from all of them by its long, slender sheath and coloration. The sheath of *X. prolongata* is longer than the hindtibia; in all other species except *X. hicoriae* Rohwer, the sheath is shorter than the hindtibia. The color of *X. prolongata* is mostly black with a red band at the center of the abdomen, at least on the dorsum, and the legs are reddish with the tibiae dark reddish to brown with the basal one-fifth white; none of the North American species have this color combination. The female will not key past couplet 3 in my 1976 key. A new section may be inserted in that couplet stating: "Legs reddish, tibiae dark reddish to brown with basal ⅕ white (abdomen black with segments 3–5, 6, or 7 red, at least on dorsum; sheath longer than basal plate and longer than hindtibia) . . . *prolongata* (Geoffroy)." I have not seen males from North America, but they are mostly black with the abdomen (except the basal plates and apical segment) and legs red. In all other North American species, the males have some yellow markings on the mesopleuron, and those with a mostly black mesopleuron have the abdomen black with lateral white spots.

The following color description of the female of *X. prolongata* will help to differentiate it: Antenna black; head black with short white spot or stripe above each eye lateral to ocelli, a white spot behind each eye on occiput, malar area white, and sometimes supraclypeal area white or partly white; thorax black with posterior corners of pronotum white and sometimes small white spot at center of posterior margin of mesepisternum; abdomen black with segments 3–5, 6, or 7 red, sometimes venter of these segments partly to mostly black, and with lateral white spots on segments 2–5 and 7 and 8, sometimes absent on 2, 3, and 7, spot on segment 8 the largest; legs reddish with coxae and trochanters black, tibiae dark reddish to brown with basal ⅕ white, and apical 3 tarsal segments sometimes blackish.

The occurrence of *X. prolongata* in North American may be rather recent;

however, some xiphydriids are scarce and not commonly collected, and its presence in this country may have gone unnoticed for some time.

I thank R. L. Fischer, Michigan State University, for the opportunity to study specimens in their collection.

David R. Smith, *Systematic Entomology Laboratory, IIBIII, Agricultural Research Service, USDA, % National Museum of Natural History, Washington, D.C. 20560.*

PROC. ENTOMOL. SOC. WASH.
85(4), 1983, p. 861

NOTE

Heteroptera Records from the Grand Cayman Island

Dr. J. F. Gates Clarke, Research Associate of the National Museum of Natural History, collected 40 Heteropterans on the Grand Cayman Island during short stays in February 1980, May 1981, and January 1983. Included were seven species: Scutelleridae: *Diolcus disjunctus* Barber, Eastern District, May. Pentatomidae: *Thyanta perditor* (Fabricius), Western District, Feb. Coreidae: *Leptoglossus gonagra* (Fabricius), Western District, Jan. Lygaeidae: *Craspeduchus pulchellus* (Fabricius), Interior, Western District, Feb.; *Oncopeltus fasciatus* (Dallas), Western District, Feb. Pyrrhocoridae: *Dysdercus mimulus mimulus* Hussey, South Sound, Feb. and May. Reduviidae: *Zelus longipes* (Linnaeus), Western District, Feb.

The finding of published records for but one of these species—*C. pulchellus*—on that island can only be interpreted as stressing our ignorance of its Heteroptera fauna. The information provides no startling extensions of ranges because all the species had been previously reported from the West Indies and all but one—*D. disjunctus* (previously known only from Puerto Rico)—also range onto the continental land masses to the north, west and south of the West Indies.

Richard C. Froeschner, *National Museum of Natural History, Smithsonian Institution, Washington, D.C. 20560.*

PROC. ENTOMOL. SOC. WASH.
85(4), 1983, pp. 862–868

SOCIETY MEETINGS

892nd Regular Meeting—January 6, 1983

The 892nd Regular Meeting of the Entomological Society of Washington was called to order by President Manya B. Stoetzel at 8:00 p.m. on January 6, 1983 in the Naturalist Center, National Museum of Natural History. Twenty-six members and eleven guests attended. Minutes of the previous meeting were read and approved.

The speaker for the evening was Dr. Truman Clark of the USDA Insect Pathology Laboratory, Beltsville, Maryland, whose talk was entitled "Bugs, Bees, and Beetles: The Mystery of the Flower Spiroplasmas." Dr. Clark related the exciting story of how in a very few years our knowledge of spiroplasmas virtually exploded. Dr. Clark is at the forefront of the research in this field, and he described his discovery of the honey bee spiroplasma in May, 1976. At this time only three species of *Spiroplasma* were known. Since then many other species have been found including those in Hymenoptera, Diptera, Hemiptera, and Coleoptera. Dr. Clark also discussed the spiroplasmas infecting plants, the studies on the transmission of the spiroplasmas throughout the life cycle of insects and his work in Peru attempting to find pathogens of beetles of the genera *Diabrotica* and *Epilachna*. He also discussed the degree of pathogenicity of spiroplasmas to insects.

NOTES AND EXHIBITIONS

T. Wallenmaier displayed colored photographs of some Maryland Microlepidoptera.

J. Kingsolver read a poem entitled "The Strange Case of the Entomologist's Heart" by Ogden Nash.

Visitors were introduced and the meeting was adjourned at 9:15 p.m., after which refreshments were served.

Thomas E. Wallenmaier, *Recording Secretary*

893rd Regular Meeting—February 3, 1983

The 893rd Regular Meeting of the Entomological Society of Washington was called to order by President Manya B. Stoetzel at 8:00 p.m. on February 3, 1983 in the Naturalist Center, National Museum of Natural History. Thirty-six members and thirteen guests attended. Minutes of the previous meeting were read and approved.

The President appointed a centennial committee composed of members of the Executive Committee along with T. Bissell, A. Gurney, L. Russell, C. Sabrosky, and T. Spilman. The committee recommended that the annual banquet in 1984 be held on Monday, March 12. The President also asked that any one having photographs of past officers of the Society please forward them to her.

William Deiss of the Smithsonian Archives explained how his department stores and uses historical material and why they would like to receive the historical material and old records from the Society.

Dr. Michael Kosztarab described the need for a project called the Insect Fauna of North America. Dr. Kosztarab read a statement detailing the needs for such a survey and recommended that copies of the statement be sent to various federal agencies, asking for support. A motion by T. Wallenmaier to appoint a committee to study the feasibility of the Society supporting such a project was made, seconded, and tabled. A motion by W. Wirth that the Society support the following resolution was made, seconded, and approved unanimously.

RESOLUTION

WHEREAS the Entomological Society of Washington which includes among its members a very large number of users of taxonomic research and services, is deeply concerned about the state of systematic entomology in the United States today; and

WHEREAS only a small portion of the federal and state funds allocated for basic research in systematics is made available for taxonomic work on insects and related arthropods at present; and

WHEREAS more than half of all living animals are arthropods, many of which species and their life stages are undescribed; and

WHEREAS many of these have major economic impact on mankind, through their medical, veterinary, agricultural, and sylvicultural importance; and

WHEREAS faunal surveys and the production of identification manuals for the many economically important and related arthropod groups are needed in the United States of America in order to provide basic information for research and action programs; and

WHEREAS these needs could be met with the initiation of surveys such as the Biological Survey of Canada, and with the publication of reference works such as the catalogs of the Diptera and Hymenoptera produced in the USA and the first volume of the manual on North American Diptera produced in Canada; therefore be it

RESOLVED that the members of the Entomological Society of Washington at their Meeting on February 3, 1983, recommend to the Government of the United States and its Granting Agencies, that they recognize the importance of the above and provide increased funding for taxonomic research, and services, for faunal surveys on insects and related arthropods, and for the production and publication of identification manuals; and that copies of this resolution be sent to the National Research Council, to the National Science Foundation, the Secretary of the Smithsonian Institution, the Secretary of Agriculture, the Secretary of Interior, and the Secretary of Health and Human Services.

A motion was made and seconded to hold the annual banquet in 1984 on Monday, March 12, 1984. The motion was approved.

The three speakers for the evening discussed the subject: "Insect Collecting in Guyana." Warren Steiner described various facets of his collecting at Kartabo and Takutu. He was able to collect a number of new species of aquatic and

Tenebrionid beetles. Elaine Lowrey described the common flora and bird fauna. The collecting of insects was done mainly in a forest habitat and insects in about 200 families in 23 orders were collected. Dr. Margaret Collins described the collecting of termites. She reported that about 75 species of termites are present within a half mile of Kartabo. Many excellent slides were shown by the speakers.

Visitors were introduced and the meeting was adjourned at 9:30 p.m. after which refreshments were served.

Thomas E. Wallenmaier, *Recording Secretary*

894th Regular Meeting—March 3, 1983

The 894th Regular Meeting of the Entomological Society of Washington was called to order by President Manya B. Stoetzel at 8:00 p.m. on March 3, 1983 in the Naturalist Center, National Museum of Natural History. Nineteen members and nine guests attended. Minutes of the previous meeting were read and approved.

L. Thomas has tendered her resignation as Membership Chairman; the Executive Committee appointed Geoffrey White to fill this vacancy.

Membership Chairman White read the names of the following applicants for membership:

Morton S. Adams, 993 Cornwall Road, Palmyra, New York 14522.
Jeffrey R. Aldrich, Rm. 105, Bldg. 467, USDA, ARS, BARC-East, Beltsville, Maryland 20705.
Arthur G. Appel, Department of Entomology, University of California, Riverside, California 92521.
Truman B. Clark, USDA, ARS, PPI, Bldg. 465, BARC-East, Beltsville, Maryland 20705.
Nancy Y. Cohen, 5024 Baltan Road, Bethesda, Maryland 20816.
Brooke T. Elias, Virology Division, USA MRIID, Ft. Detrick, MD 21701.
Kumar D. Ghorpade, Department of Entomology, Smithsonian Institution, Natural Museum of National History, Washington D.C. 20560.
Jeffrey A. Halstead, 2250 West Fedora, Fresno, California 93705.
Bradford A. Hawkins, Division of Biological Control, Department of Entomology, University of California, Riverside, California 92521.
Charles R. Krause, USDA, ARS, P.O. Box 1003, Delaware, Ohio 43015.
F. J. D. McDonald, Faculty of Agriculture, University of Sydney, Sydney 2006, Australia.
William E. Miller, Department of Entomology, Fisheries, and Wildlife, University of Minnesota, St. Paul, Minnesota 55108.
Allen L. Norrbom, Department of Entomology, 106 Patterson Building, Pennsylvania State University, University Park, Pennsylvania 16802.
Edward S. Ross, California Academy of Sciences, Golden Gate Park, San Francisco, California 94118.
Roy K. Sofield, Mosquito Research and Control, Cook College, New Brunswick, New Jersey 08903.
Stephen A. Teale, Department of Entomology, University of Kansas, Lawrence, Kansas 66045.

Donald B. Thomas, 4119 Baldwin No. 3, Lincoln, Nebraska 68504.

John F. Valentine, Route 16, Box 5, Dutchman Wood's Road, Mobile, Alabama 36609.

Gilbert P. Waldbauer, Department of Entomology, University of Illinois, Urbana, Illinois 61801.

Kenneth L. Manuel, Duke Power Environmental Services, Huntersville, North Carolina 28078.

Allen M. Young, Invertebrate Zoology Section, Milwaukee Public Museum, 800 West Wells Street, Milwaukee, Wisconsin 53233.

Gustavo R. Spinelli, NHB 169, Washington, D.C.

Lee Venables and B. Adrienne B. Venables, 5214 Wood Stove Lane, Columbia, Maryland 21045.

William L. Murphy, 3565 Fort Meade Road, Apt. 318, Laurel, Maryland 20707.

Gordon R. Nielsen, R. R. 1, Box 101, Hinesburg, Vermont 05461.

Ichiji Togashi, Ishikawa Prefecture College of Agriculture, Suematsu, Nonoichimachi, Ishikawa Prefecture, 921 Japan.

Editor David Smith announced that this will be his last year serving as editor. Dr. R. J. Gagné has agreed to assume the position next year and is working with Dr. Smith to effect a smooth transition.

President Stoetzel announced that the annual banquet will be held on June 9, 1983 at the Center for Adult Education on the University of Maryland College Park Campus.

President Stoetzel also announced that Carl F. W. Muesebeck, Honorary President of the Society, has sent a letter to the Society congratulating it on its forthcoming centennial. Dr. Muesebeck also sent a very generous contribution to the Society along with his letter.

The speaker for the evening was Dr. Edward M. Barrows, Department of Biology, Georgetown University, who spoke on the subject "Entomophilic Studies at Georgetown University: Hexapods and Bipedal Gardeners." Dr. Barrows discussed his studies on entomophobia and entomophilia. At the beginning of his talk he distributed a questionnaire which recorded attitudes toward insects and insect control. There are at least 30 organized urban gardens in the District of Columbia and Dr. Barrows and his students studied the larger of these to determine the knowledge and attitudes of urban gardeners toward insect pests. The recognition, common names, and role of common garden insects were presented as questions to a sampling of urban gardeners. Results of the study were surprising in noting for example that the amount of gardening experience was not correlated with knowledge of garden insects. Dr. Barrows also discussed studies on the effectiveness of *Pediobius bifovelatus* (Crawford), a Eulophid wasp, as a biocontrol agent against Mexican Bean Beetles in urban gardens. The results in the District of Columbia showed it to be extremely effective. The talk was accompanied by excellent slides.

NOTES AND EXHIBITIONS

It was noted that Ruth Snodgrass, wife of the late R. E. Snodgrass, passed away recently.

A hemlock twig sent by Ted Spilman was shown which had small areas of "white stuff" at the bases of the needles. Manya Stoetzel identified the pest as *Adelges tsugae* Annand, an adelgid that is commonly found on hemlock. The white wax, produced from glands on the dorsum of the adelgid, completely covers the body of the female and her subsequent eggs. On the underside of the needles were elliptical, often transparent, flat covers of the armored scale insect *Aspidiotus cryptomeriae* Kuwana. The hemlock scale has two generations a year in Maryland and overwinters from October to March as second-instar females and males. The females are just beginning their molt to adults, and the males will soon be prepupae.

Ted Bissell cited a report in "Sports Illustrated" of a new species of spider with an unusual name. *Mastophora dizzydeani* has been named after the famous baseball pitcher Dizzy Dean. The spider throws a ball of spit at its prey to capture it and this practice reminded the author of the alleged practice of Dizzy Dean of doing something similar.

Visitors were introduced and the meeting was adjourned at 9:20 p.m. after which refreshments were served.

Thomas E. Wallenmaier, *Recording Secretary*

895th Regular Meeting—April 7, 1983

The 895th Regular Meeting of the Entomological Society of Washington was called to order by President Manya B. Stoetzel at 8:00 p.m. on April 7, 1983 in the Naturalist Center, National Museum of Natural History. Twenty-five members and thirteen guests attended. Minutes of the previous meeting were read and approved. Richard Robbins read the names of the following applicants for membership:

Dr. Brian J. Armitage, P.O. Box 880, Athens, Alabama 35611.
Dr. Ke Chung Kim, The Frost Entomological Museum, Department of Entomology, Pennsylvania State University, University Park, Pennsylvania 16802.
James B. Stribling, Department of Entomology, 1735 Neil Avenue, Ohio State University, Columbus, Ohio 43210.
Peter K. Lagoy, 2712 N. Pershing Drive #3, Arlington, Virginia 22201.

President Manya Stoetzel announced that Editor David Smith is editing two new Memoirs for the Society.

President-elect Neal Morgan gave the details of the annual banquet which will be held in June.

President Stoetzel also reported that at the meeting of the Centennial Committee on March 30, 1983, the feasibility of a 100 year index of the proceedings was discussed. President Stoetzel then asked the members present for their views of the subject.

The speaker for the evening was Dr. John W. Neal, Jr. of the Beltsville Agricultural Research Center, whose talk was entitled "Diurnal moths: The bagworm (Psychidae) rediscovered; the rhododendron borer (Sesiidae) discovered." Dr. Neal discussed various aspects of the biology and morphology of *Thyridopteryx ephemeraeformis* (Haworth). Host trees and amount of defoliation were discussed. A number of unusual characters of the adult female were illustrated, including the presence of deciduous setae at the anterior of the body and the discovery of the chemical composition of the female pheromone. The unusual protruding abdomen of the adult male was also discussed. The rhododendron borer, *Synanthedon rhododendri* Beutenmuller, a pest in Maryland, was discussed and its life cycle presented in detail. The chemistry of the male pheromone was presented.

Notes and Exhibitions

Two recent deaths were noted. Oscar L. Cartwright passed away on March 21, 1983 and Dorothy Smith, the wife of Floyd Smith, passed away on March 29, 1983.

Ted Spilman displayed a book entitled "Insects, Etc." which consisted of a series of large color prints with accompanying text. The prints are unmatched by anything in the realm of entomology illustrations, according to Mr. Spilman.

Visitors were introduced and the meeting was adjourned at 9:30 p.m., after which refreshments were served.

Thomas E. Wallenmaier, *Recording Secretary*

896th Regular Meeting—May 5, 1983

The 896th Regular Meeting of the Entomological Society of Washington was called to order by President Manya B. Stoetzel at 8:00 p.m. on May 5, 1983 in the Naturalist Center, National Museum of Natural History. Twenty-three members and 13 guests were present. The minutes of the previous meeting were read and approved.

Membership Chairman Geoffrey White read the names of the following applicants for membership:

Elaine Lowry, Gambrels, Maryland.
Cheryl Beckham, Laurel, Maryland.

Richard Robbins exhibited a deutonymph of a uropodid mite phoretic on the posterior abdominal tergites of a male *Atyphloceras multidentatus* (C. Fox), a flea commonly associated with voles in Oregon.

John Fales discussed some of the butterflies he and W. R. Grooms collected in Maryland in 1982. Specimens were exhibited of various intergrades of white admiral and red-spotted purple hybrids from Allegany County. The most unusual specimen taken (WRG) was the rare aberration "cerulea" (Ehrmann) of *Basilarchia arthemis arthemis* form *virithemis,* taken on June 20 in Green Ridge State Forest. Also taken (JHF) at Marshall Hall in Charles County on June 27 was a fresh specimen of the aberration "fulliolus" (Hulst) of the copper butterfly, *Lycaena phlaeas americana* Harris.

Ted Bissell announced that Arnold Mallis, a regular attendee until recently, is not feeling well.

President Stoetzel announced that Richard H. Foote, Past-President and former Editor of the Society, would be retiring from the Systematic Entomology Laboratory, USDA on May 31.

Suzanne Batra of the Beneficial Insects Introduction Laboratory, USDA, was the regular speaker. Her well-illustrated, fascinating talk entitled, "Biology of polyester bees, horn-faced bees, and other unusual Apoidea," reviewed bee biology particularly as it relates to pollination and illustrated some fantastic manifestations of the DuFour's gland.

Following the introduction of visitors, Dr. Stoetzel reminded the members of the June banquet and wished everyone a good summer. Punch and Japanese beetle cookies were enjoyed after the meeting.

Raymond J. Gagné, *Recording Secretary pro tem*

897th Regular Meeting—June 9, 1983

The Entomological Society of Washington and the Plant Pest Society of Washington Joint Annual Banquet was held on June 9, 1983 in the Chesapeake Room on the College Park Campus of the University of Maryland. Neal O. Morgan and Hugh D. Sisler were banquet chairman and John Neal was master of ceremonies. After the social hour and dinner Theodore J. Spilman spoke on the subject "New Harmony: Two Utopias in the Wilderness."

The banquet was attended by 115 persons. Door prizes were awarded after the talk. Door prizes were donated by John W. Kennedy Consultants, Inc., CIBA-GEIGY Corporation, Chevron Chemical Company, William Bickley, Monsanto Agricultural Products Company, National Agricultural Chemicals Association, and Dr. John W. Neal, Jr., of the Beltsville Agricultural Research Center, U.S. Department of Agriculture. Table centerpieces were provided by Dr. John W. Neal, Jr., of the Beltsville Agricultural Research Center.

Thomas E. Wallenmaier, *Recording Secretary*

SPECIAL MEETING NOTICE

THE ENTOMOLOGICAL SOCIETY OF WASHINGTON
1884–1984

On March 12, 1984, the Entomological Society of Washington will celebrate its 100th birthday. From the group of 16 "founders," membership in our Society has increased to more than 600 with nonmember subscriptions to the *Proceedings* standing around 250. In the Americas, there are only three entomological societies that are older than our Society and that have continued uninterrupted publication of their periodicals.

Our centennial year will be marked with a gala celebration on Monday evening, March 12, 1984, at the Center for Adult Education, University of Maryland, College Park. Details on how to purchase tickets will be carried in the January 1984 issue of the *Proceedings.* We hope that many of our members and friends will join us for this very special occasion!

Manya B. Stoetzel, President, 1983.

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 *Dermatophagoides*, 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 *Anastrepha* (Diptera: Tephritidae), by George C. Steyskal	1.50
Taxonomic Studies on Fruit Flies of the Genus *Urophora* (Diptera: Tephritidae), by George C. Steyskal	2.00

MEMOIRS OF THE ENTOMOLOGICAL SOCIETY OF WASHINGTON

No. 1.	The North American Bees of the Genus *Osmia*, by Grace Sandhouse. 1939	$15.00
No. 2.	A Classification of Larvae and Adults of the Genus *Phyllophaga*, by Adam G. Boving. 1942	(out of print)
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 Hirosi Takahasi. 1969	15.00
No. 7.	Ant Larvae: Review and Synthesis, by George C. Wheeler and Jeanette Wheeler. 1976	11.00
No. 8.	The North American Predaceous Midges of the Genus *Palpomyia* Meigen (Diptera: Ceratopogonidae), by W. L. Grogan, Jr. and W. W. Wirth. 1979	12.00
No. 9.	The Flower Flies of the West Indies (Diptera: Syrphidae), by F. Christian Thompson. 1981	10.00
No. 10.	Recent Advances in Dipteran Systematics: Commemorative Volume in Honor of Curtis W. Sabrosky. Edited by Wayne N. Mathis and F. Christian Thompson. 1982	11.00
No. 11.	A Systematic Study of the Japanese Chloropidae (Diptera), by Kenkichi Kanmiya. 1983	18.00

Back issues of the Proceedings of the Entomological Society of Washington are available at $25.00 per volume to non-members and $13.00 per volume to members of the Society.

Prices quoted are U.S. currency. Postage extra except on prepaid orders. 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, NHB 168, Smithsonian Institution, Washington, D.C. 20560.

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