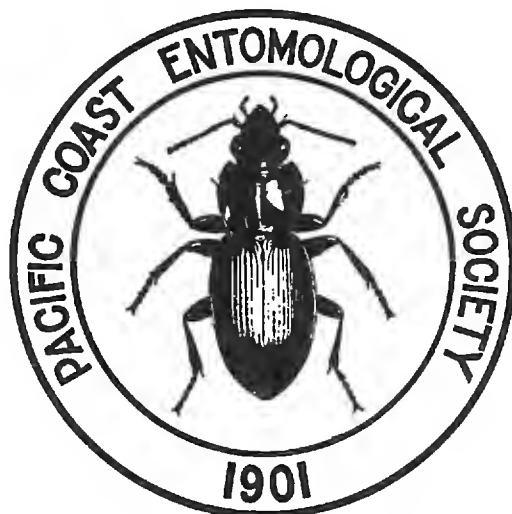


THE PAN-PACIFIC ENTOMOLOGIST



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**NOMENCLATURAL CHANGES IN THE FAMILY BUPRESTIDAE
WITH DESCRIPTIONS OF PREVIOUSLY UNKNOWN SEXES
(COLEOPTERA)¹**

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Investigation of the status of published scientific names in the family Buprestidae has indicated the need to cite new synonyms and/or indicate changes in the status of others. Some are included here with descriptions of previously unknown sexes. The genera and species are listed in alphabetical order for easier reference. Unless otherwise indicated, specimens are in the collector's collection. Abbreviations of collections [brackets] are as published in Arnett and Samuelson (1969). Collections not in that work include: British Museum (Natural History) = BMNH; Museum National d'Historie Naturelle, Paris = MNHP; Narodni Museum, Prague = NMPC; Hungarian Natural History Museum, Budapest = HNHM; Zoological Museum, Academy of Sciences, Leningrad = ZMAS; and Zoological Museum, University of Moscow = ZMUM. My name is abbreviated GHN. For some type specimens label data is given. The hash mark (/) separates data on individual labels and the abbreviations (h) = handwritten and (p) = printed.

Since several of the late Josef N. Knull's species are involved in this paper, it seems worthwhile to mention that his collection, including types of the many species of Buprestidae he described, was willed to the Field Museum of Natural History, Chicago, IL [FMNH]. Much of the overflow material is included in the insect collection of the Ohio State Univ. [OSUC], where Professor Knull taught.

Thanks are extended to the following individuals and institutions, either for helpful suggestions, for the loan of material, or for comparing specimens with types in their care: Anatoly Alexeev, S. Keleinikova, ZMUM, and Mark Volkovitsch, ZMAS, U.S.S.R.; W. F. Barr, UIMC; Svatopluk Bílý and J. Jelinek, NMPC; A. Descarpentries, MNHP; C. M. F. von Hayek, BMNH; H. A. Hespenheide, Los Angeles, Calif; Z. Kaszab, HNHM; D. H. Kavanaugh, CASC; J. M. Kingsolver, USNM; Eric H. Smith, FMNH; Margaret K. Thayer, MCZC; G. C. Walters, Jr., Los Angeles, Calif.; R. L. Westcott, ODAC; and the publications committee of the Division of Plant Industry, Florida Department of Agriculture and Consumer Services. Special thanks are due Ms. Jodelle Alexander for typing the manuscript.

Agrilus cliftoni Knull

Agrilus cliftoni Knull, 1941:382.

This species was described from a unique male. Others have since been collected, usually on *Juglans nigra* L.

Description, female.—Differs from male in being slightly more robust; front of head aeneous instead of bluish green; first 2 abdominal sternites convex; tibiae not toothed on inner margin at apex.

Length 6.1 mm; width 1.7 mm.

Indiana, Tippecanoe Co., 14 July 1963, N. M. Downie, on *Juglans nigra* L. [GHNC] (New State Record).

The 16 males are from 4.3 to 5.8 mm long; the 40 females are from 4.3 to 6.3 mm.

Agrilus duncani Knull

Agrilus duncani Knull, 1929:270.

This species was described from a unique male lacking metatarsi. Many specimens have been taken during the intervening years (Nelson, 1965; Knull, 1970). The claws are similarly toothed on all tarsi.

Description, female.—Differs from male in being slightly more robust; prosternal pubescence shorter and less dense; first 2 abdominal sternites convex, without midline groove.

Length 7.3 mm; width 2.0 mm.

Arizona, Cochise Co., E of Coronado Nat. Monument, 24 August 1964, GHN and family, on *Chrysothamnus nauseosus* (Pall.) Britton [GHNC].

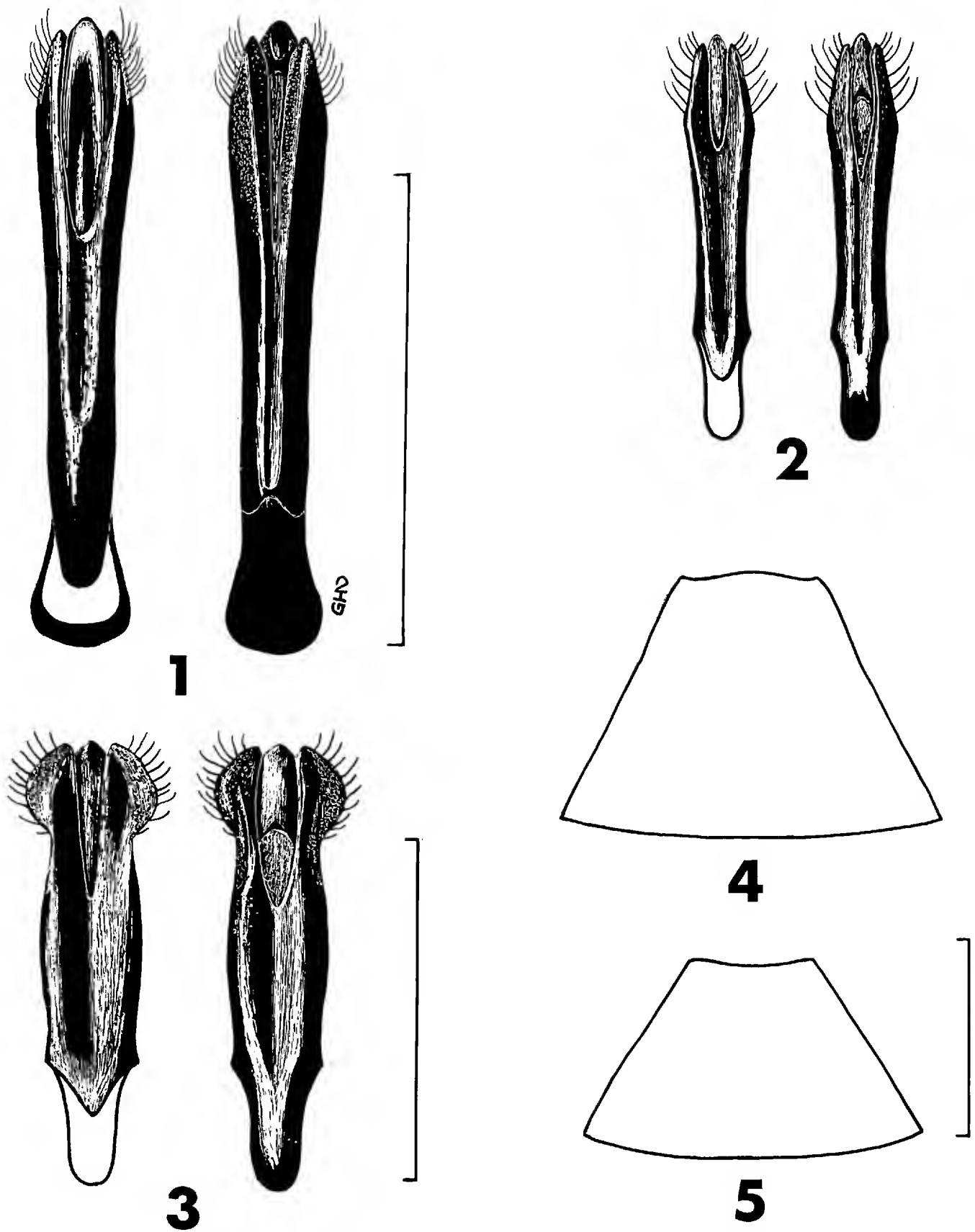
The 53 males are from 5.4 to 6.9 mm long; the 51 females are from 5.4 to 7.5 mm.

Agrilus fisherellus Obenberger

Agrilus fisherellus Obenberger, 1936a:92 (replacement name for *costipennis* Fisher, 1928:182).

Agrilus tarahumarae Cazier, 1951:32 (NEW SYNONYMY).

When *Agrilus tarahumarae* Cazier was described from a single male from Mexico, Chihuahua, 80 km N of Chihuahua City, only a few specimens of *Agrilus fisherellus* Obenberger were available for study. More have since been collected in California, Arizona, and Texas, and the holotypes of both *A. costipennis* and *A. tarahumarae* have been studied and compared. The characteristics indicated by Cazier (1951) to distinguish *A. tarahumarae* from *A. fisherellus* are the concave head, deep median pronotal impression, and larger size. These are variable in a series, with specimens from California having the general pubescence more pronounced and the concavity



Figs. 1-5. Fig. 1. *Agrilus nevadensis* Horn, male genitalia, dorsal view (left) and ventral view (right). (line = 2 mm). Fig. 2. *Brachys apachei* Knull, male genitalia, dorsal view (left) and ventral view (right). Fig. 3. *Brachys cephalicus* Schaeffer, male genitalia, dorsal view (left) and ventral view (right). (line = 1 mm for Figs. 2, 3). Fig. 4. *Buprestis (Buprestis) parmaculativentris* Knull, last visible abdominal sternite, female. Fig. 5. *B. (B.) parmaculativentris* Knull, last visible abdominal sternite, male. (line = 2 mm for Figs. 4, 5).

of the head less pronounced than those from Texas and Mexico, and specimens from Arizona being somewhat intermediate. The 21 specimens studied are from 6.5 to 10.5 mm long, and since the male genitalia are similar, as pointed out by Cazier, I consider the 2 names to represent variants of a single widespread species.

Agrilus fisherellus Obenb. was based on 2 males from Pasadena and Los Angeles in southern California without biological data (Fisher, 1928). This species was recorded by Knull (1944) as on *Celtis reticulata* Sargent in the Davis and Chisos Mts., Texas and the Chiricahua Mts., Arizona. Wellso (1973) recorded it as *A. tarahumarae* and described the female from Texas, Barksdale, on flowers of *Stillingia* sp. Adults of this species are found on diverse hosts as indicated by the foregoing and the following records. California: San Bernardino Co., 12 mi NW of Essex, 16 June 1962, GHN, on *Acacia greggii* Gray; Riverside Co., above Palm Desert, elev. 610 m, Highway 74, 10 June 1965, GHN, on *Baccharis sergiloides* Gray; same locality and plant, 15 June 1968, G. C. Walters; same locality, 8 June 1974, D. S. Verity, flying about young growing tips *Prosopis glandulosa* var. *torreyana* L. Benson. Arizona: Chiricahua Mts. 9.7 km above SW Res. Sta., 23 July 1969, GHN, on *Quercus hypoleucoides* A. Camus. Texas: 3.2 km NW of Fort Davis, Highway 118, 17 June 1965, GHN, on *Celtis laevigata* Willdenow; N of Fort Davis, Highway 118, 16 June 1963, GHN, on *Celtis pallida* Torrey; Comal Co., Canyon Lake, 13 July 1975, GHN, on *Celtis mississippiensis* var. *reticulata* Torrey.

Agrilus nevadensis Horn

Agrilus nevadensis Horn, 1891:303.

The unique female type was the only specimen available to Fisher (1928) when he revised the genus. Carlson & Knight (1969) regarded the type of *A. nevadensis* Horn as deformed and a synonym of *Agrilus quadriguttatus niveiventris* Horn. More specimens are now available and indicate that it should be considered a valid species.

Description, male.—Differs from female as follows: more slender; head with front blue-green, vertex cupreous, pronotum aeneocupreous, elytra darkly cupreous, and beneath cupreous with blue-green tints anteriorly toward midline and on legs; abdominal sternites 1 and 2 with pronounced median groove, broad and punctured toward base, narrowed and smooth apically. Genitalia, Fig. 1.

Length 9.0 mm; width 2.0 mm.

California, Trinity Co., Trinity Nat. Forest, 23 June 1919, R. Hopping [CASC]. Others from California: Trinity Co., Carrville, 19 June 1931; 22 May 1934 [CASC, GHNC]; Plumas Co., Meadow Val., elev. 1220–1524 m,

10 June 1924, E. C. VanDyke [CASC, GHNC] (New State Record). The type from western Nevada is in the Horn collection [MCZC].

While *A. nevadensis* resembles *A. q. quadriguttatus* Gory and *A. q. niveiventris* superficially, it is readily distinguished from both by the following features: pronotum and elytra more coarsely sculptured; pronotum with median depressions more pronounced; apices of elytra acutely produced; male with abdominal sternites 1 and 2 with broad median groove. The general color of *nevadensis* resembles *q. niveiventris*, but the male genitalia resemble *q. quadriguttatus*. Fisher (1928) stated that the scutellum is not carinate, but as Carlson & Knight (1969) stated, the scutellum on the type does appear to be transversely carinate as it is on the other 6 examined. No significant variation was noted in this small series.

Agrilus nigricans Gory

Agrilus nigricans Gory, 1841:257.

Agrilus auricomus Frost, 1912:250 (NEW SYNONYMY).

In lists or revisions of North American *Agrilus* (Leng, 1920; Fisher, 1928; Obenberger, 1936b) *Agrilus nigricans* Gory has been considered a synonym of *Agrilus obsoletoguttatus* Gory. That they are not the same was first indicated by A. Descarpentries (in litt.). However, comparison of the male lectotype of *A. nigricans* Gory [MNHP] with the male holotype of *Agrilus auricomus* Frost [MCZC] reveals that they represent the same species. The type of *A. nigricans* is a small example of the species (6.0 mm) with a bluish tint on some parts of the body, possibly due to discoloration. The color of the hair is whitish and not golden as in the holotype of *A. auricomus*, but is similar in that respect to 1 paratype in the latter. In other salient features, including male genitalia, they compare favorably, and I consider *A. auricomus* Frost a junior synonym of *A. nigricans* Gory.

There are 2 *A. nigricans*, 1 male and 1 female, in the MNHP. The male, here designated as lectotype, has the following labels: Red label with "TYPE" (p)/white label with "*nigricans* Gory" (h).

The type locality for *A. nigricans* Gory is "Amerique Boreale"; for *A. auricomus* Frost, "Framingham, Mass."

Agrilus palmerleei Knull

Agrilus palmerleei Knull, 1944:76.

Description, female.—Differs from male in being more robust; head and pronotum more deeply reddish cupreous; pro- and mesotibiae not toothed on inner margin at apex.

Length 10.3 mm; width 2.8 mm.

Arizona, Chiricahua Mts., 9.6 km above S. W. Res. Sta., 24 July 1969, GHN and D. E. Nelson, on *Quercus hypoleucoides* A. Camus [GHNC].

The 8 males are from 8.7 to 10.0 mm long; the 9 females are from 9.3 to 11.3 mm.

Anthaxia (Anthaxia) prasina Horn

Anthaxia (Anthaxia) prasina Horn, 1882:108.

This species was characterized by Horn, under his broad concept of *Anthaxia aeneogaster* Laporte and Gory, as the brilliantly green form from "Yosemite Valley of California," which "for convenience" was called *prasina*. He indicated having seen 8 specimens. There are 5 specimens now in the Horn collection [MCZC], 4 males and 1 female. Each has the same 2 labels, "Cal" (p) and "Horn Coll, H." (p). Apparently no type was ever designated, so I designate 1 male as lectotype and the other 4 specimens as paralectotypes. The lectotype is 4.5 mm long and 2.0 mm wide. Two males in the LeConte collection, which were also part of the series before Horn, are designated as paralectotypes. One is labelled—"Cal" (p)/"A. *prasina* Horn" (h)/"aeneogaster 25" (h); the other—"Cal" (p)/"aeneogaster 26" (h).

Anthaxia (Haplanthaxia) cyanella Gory

Anthaxia (Haplanthaxia) cyanella Gory, 1841:285.

Anthaxia kaszabiana Pochon, 1967:282 (NEW SYNONYMY).

An examination of the type of *Anthaxia kaszabiana* Pochon [HNHM], collected in Fundort, Ohio, reveals it is a male of *Anthaxia cyanella* Gory. The latter was described from a female, which is deep blue throughout while the male is green and bronzy-brown.

Brachys apachei Knull

Brachys apachei Knull, 1952:359.

This species was described from 2 females collected in Arizona, Chiricahua Mts., 17 June 1939, by D. J. & J. N. Knull, on oak foliage.

Description, male.—The male is much like the female holotype in general appearance, but is less robust; and apical margin of last visible abdominal sternite is roundly truncate, without row of deflexed teeth and submarginal ridge without row of longer hairs. Genitalia, Fig. 2.

Length 3.8 mm; width 1.8 mm.

Arizona, Chiricahua Mts., 6.4 km above Portal, 12 July 1977, GHN, on foliage *Quercus hypoleucoides* A. Camus.

In the Knull collection [FMNH] 17 females are from 3.1 to 4.3 mm long and 1.4 to 2.2 mm wide, 13 males from 3.2 to 4.0 mm long and 1.4 to 1.8 mm wide.

In the original description this species was compared with *Brachys cephalicus* Shaeffer and *Brachys aeruginosus* Gory. The latter is an eastern species with the front of the head less obliquely retracted than in *B. apachei*. *B. cephalicus*, sympatric with *B. apachei*, differs in being more robust, in having more strongly convex tubercles above the eyes, and in the shape of the male genitalia, Fig. 3.

Buprestis (Buprestis) parmaculativentris Knull

Buprestis (Buprestis) parmaculativentris Knull, 1958:154.

This species was described from a unique male.

Description, female.—Differs from male as follows: more robust; yellow-red on front of head confined to spots near medial margin of eyes; antennae shorter, not reaching hind angles of pronotum when laid along side; protibia without internal recurved spine at apex; disk of last visible abdominal sternite more convex toward apex, apical margin convexly truncate in female, Fig. 4, concavely truncate in male, Fig. 5.

Length 20.0 mm; width 8.0 mm.

Texas, Chisos Mts. Basin, 21 June 1965, GHN, on *Pinus cembroides* Zuccarini.

The 5 males available for study are from 16.0 to 17.5 mm long and from 6.5 to 7.0 mm wide; the 15 females from 16.5 to 21.5 mm long and from 7.0 to 8.5 mm wide.

Buprestis (Stereosa) salisburyensis Herbst

Buprestis (Stereosa) salisburyensis Herbst, 1801:174.

Buprestis salisburyensis cazieri Helfer, 1946:100 (NEW SYNONYMY).

Buprestis salisburyensis cazieri Helfer, a dark form, was described as a subspecies of *B. salisburyensis* Herbst. The more common color is green with cupreous elytral margins while “*cazieri*” is dark green to purplish. Since color is the only distinguishing feature and since the 2 forms occur sympatrically it seems advisable to regard *B. cazieri* as a dark color variant of *B. salisburyensis*. The occurrence of dark or cupreous color phases of green forms is not rare among Buprestidae. Others of this genus in which this color variation occurs include: *Buprestis striata* Fabricius, in which the dark color seems more common; and *Buprestis decora* Fabricius in which dark forms are uncommon.

Chalcophorella langeri (Chevrolat)

Chalcophorella langeri (Chevrolat), 1853:308 (*Chalcophora*).

Chalcophorella strandi (Obenberger), 1936c:109 (*Texania*) (NEW SYNONYMY).

When *Chalcophorella strandi* (Obenberger) was described, *Chalcophorella langeri* (Chevrolat) was not considered valid, and *C. strandi* was compared to *Texania fulleri* (Horn), *Texania campestris* (Say) and *Texania serriger* (Casey). The last is a synonym of *C. campestris*. Knull (1956) recognized *C. langeri* as a valid species and presented a key for separating the 3 North American species: *C. fulleri*, *C. campestris*, *C. langeri*. Examination of the female type of *C. strandi* and comparison of it with homotypes of *C. langeri* reveal it is a junior synonym of the latter.

The type locality for *Chalcophora langeri* Chevrolat is "Greenville, pres de la Nouvelle—Orleans" [Louisiana], female type [BMNH]; for *Texania strandi* Obenberger, "Fort Madison" [Iowa], type [NMPC].

Chrysobothris chlorocephala Gory

Chrysobothris chlorocephala Gory, 1841:161.

Chrysobothris concinnula LeConte, 1860:238 (NEW SYNONYMY).

A color slide of the type of *C. chlorocephala* Gory [MNHP] and sketches of its clypeus and last visible abdominal sternite made by H. A. Hespenheide reveal it is the same species as *C. concinnula* LeConte. The male type of *C. chlorocephala* is 5.5 mm long. Fisher (1942) had not seen the type of *C. chlorocephala* and, following Horn (1886), erroneously placed it as a synonym of *Chrysobothris harrisi* (Hentz).

This species is closely related to *Chrysobothris scitula* Gory, and further study may show the two to be conspecific, as suggested by Fisher (1942). In *C. chlorocephala* the violaceous brown color predominates above with iridescent blue or blue-green spots, but in *C. scitula* the latter color predominates with the violaceous brown reduced. A color slide of the type of *C. scitula* [MNHP] indicates Fisher assessed its characteristics accurately.

Chrysobothris cribraria Mannerheim

Chrysobothris cribraria Mannerheim, 1837:77.

Chrysobothris floricola Gory, 1841:179 (NEW SYNONYMY).

Chrysobothris calcarata Melsheimer, 1845:146 (NEW SYNONYMY).

The name *Chrysobothris cribraria* Mannerheim has been considered incorrectly a synonym of *Chrysobothris femorata* (Olivier) by American workers for many years (see Fisher, 1942). An examination of the lectotype

(Nelson, 1976) revealed it to be the same species that Gory later described as *floricola* and Melsheimer as *calcarata*. This species is widely distributed in the pine-growing regions of eastern North America.

Chrysobothris georgei Nelson

Chrysobothris georgei Nelson, **REPLACEMENT NAME** for *Chrysobothris vogti* Nelson, 1975:18, preoccupied by *Chrysobothris ephedrae vogti* Knull, 1964:376.

I overlooked the subspecies described by Knull, so the new name *C. georgei* is proposed for the junior homonym, named in honor of Mr. George B. Vogt.

Chrysobothris purpurifrons Motschulsky

Chrysobothris purpurifrons Motschulsky, 1859:183.

Chrysobothris pubescens Fall, 1907:238 (**NEW SYNONYMY**).

Chrysobothris subpubescens VanDyke, 1937:112 (error for *pubescens*).

Four species of Buprestidae were described from California in the above paper by Motschulsky. The author of *Polycesta californica*, and *Chrysobothris subcylindrica* was Ménétrés, while *Chrysobothris purpurifrons* and *Belionota californica* were described by Motschulsky. In Horn (1886), Fisher (1942), and Barr & Westcott (1976), Motschulsky was listed as the author of *C. subcylindrica*.

The holotype of *C. purpurifrons* Motschulsky [ZMUM] compares well with the type of *C. pubescens* Fall in most features including shape and sculpture of pronotum and elytra, length of body hairs, shape of clypeus, and emargination of last visible abdominal sternite of females. The lateral margins of the elytra are more weakly serrate than in most *C. pubescens* Fall seen, but I feel the two represent the same species. Thus *C. purpurifrons* Motsch. is not synonymous with *Chrysobothris semisculpta* LeConte, as indicated by Horn (1886) and Fisher (1942).

The female holotype of *C. purpurifrons* Motschulsky is in poor condition. Ventral surface is coated with mold. Left front and hind legs missing; right protarsus and all but basal segment of metatarsus missing. Antennae missing except for 2 basal segments on right. Abdomen is glued upside down on card under specimen and 2 antennal segments are glued to same card. Labels on the type are as follows: gray-green disk with *C. (h)/green with Chrysobothris purpurifrons* Motsch California (h)/blank red label/red holotype label det. G. H. Nelson '79. Dr. S. Keleinikova [ZMUM] kindly loaned the holotypes of *C. purpurifrons* Motsch. and *C. subcylindrica* Ménétr., for which I am deeply thankful.

Chrysobothris subcylindrica Ménériés

Chrysobothris subcylindrica Ménériés, in Motschulsky, 1859:182.

Chrysobothris deleta LeConte, 1860:255 (NEW SYNONYMY).

Chrysobothris delecta Obenberger, 1934:619 (typographical error for *deleta*).

The female holotype of *Chrysobothris subcylindrica* Ménériés compares well with the female holotype of *Chrysobothris deleta* LeConte but is larger (9.0 mm compared to 8.0 mm for *C. deleta*) and is slightly more cupreous. Since LeConte's paper appeared in 1860, *C. subcylindrica* Ménériés has priority.

The holotype of *C. subcylindrica* is in poor condition. Antennae missing except for right basal segment which is attached near its normal position. Left front leg, and meso- and metatarsi missing; right front leg, part of mesotarsus, and metatibia and metatarsus missing. Labels on the type are as follows: white with 60 (h)/white with Californ. Sept (p)/green with *Chrysobothris subcylindrica* Ménétr California (h)/blank red label/red holotype label, det. G. H. Nelson, '79.

Chrysobothris ulkei LeConte

Chrysobothris ulkei LeConte, 1860:240.

This species was described from a single female. It has since been collected in large numbers, and notes on its biology have been recorded (Nelson, 1962; Barr & Westcott, 1976).

Description, male.—Iridescent green above and below, disk of elytra with 3 pairs of violaceous spots, faint pair at basal one fourth, distinct pairs at middle and apical one fourth. Externally similar to female, but differs in having apex of last visible abdominal sternite arcuately emarginate, Fig. 6, instead of sinuate. Genitalia, Fig. 7.

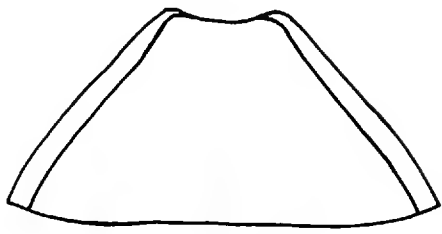
Length 12.5 mm; width 5.5 mm.

Arizona, Cochise Co., 2 mi E of Portal, 28 August 1959, GHN, on *Ephedra trifurca* Torrey.

The iridescent bronzy-green general color is more common in males with the tendency toward bluish hues more common in females. The discal vi-

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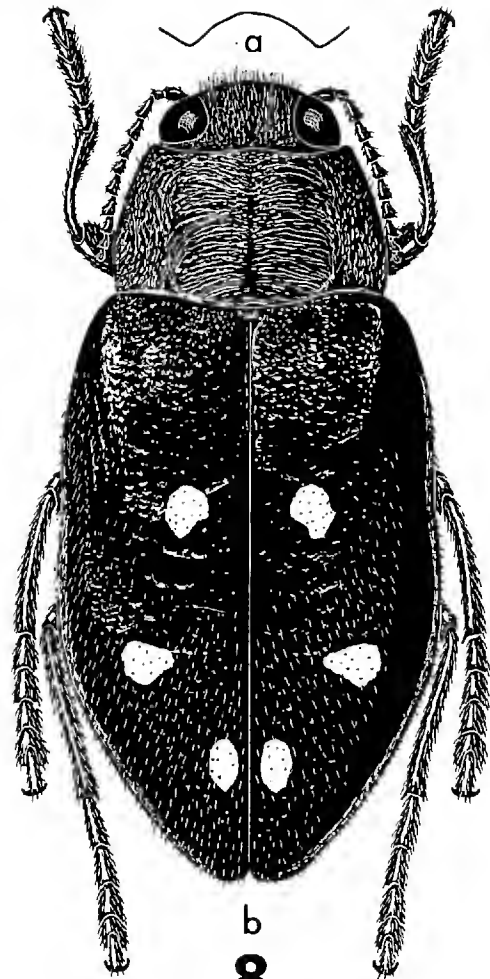
Figs. 6–10. Fig. 6. *Chrysobothris ulkei* Horn, last visible abdominal sternite, male. Fig. 7. *C. ulkei* Horn, male genitalia, dorsal view (left) and ventral view (right). (line = 1 mm for Figs. 6,7). Fig. 8. *Melanophila (Phaenops) abietis* Nelson, a) clypeus; b) dorsal view, female. Fig. 9. *M. (P.) lecontei* Obenberger, a) clypeus; b) dorsal view, female. Fig. 10. *M. (P.) drummondi* (Kirby), a) clypeus; b) dorsal view, female (line = 5 mm for Figs. 8, 9, 10).



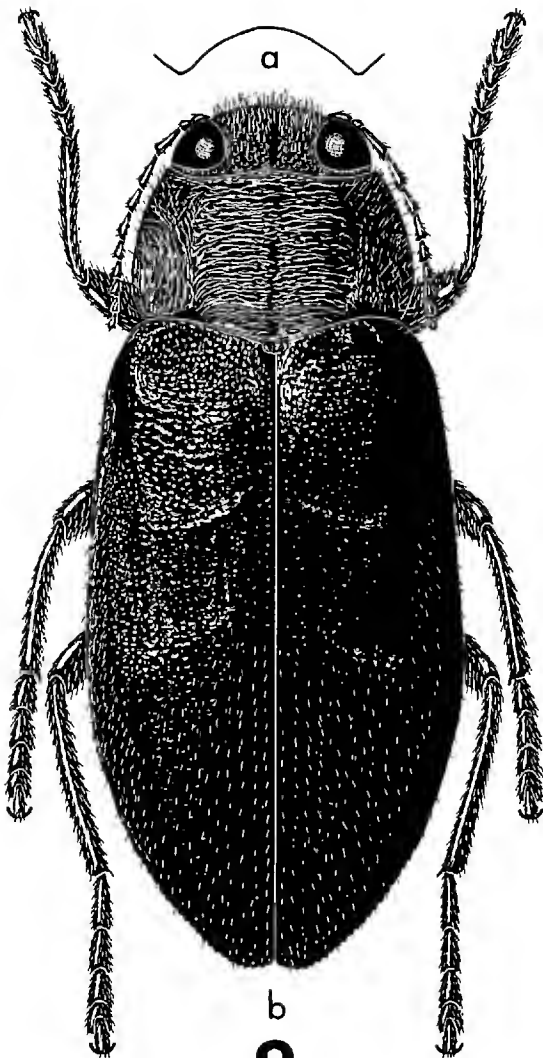
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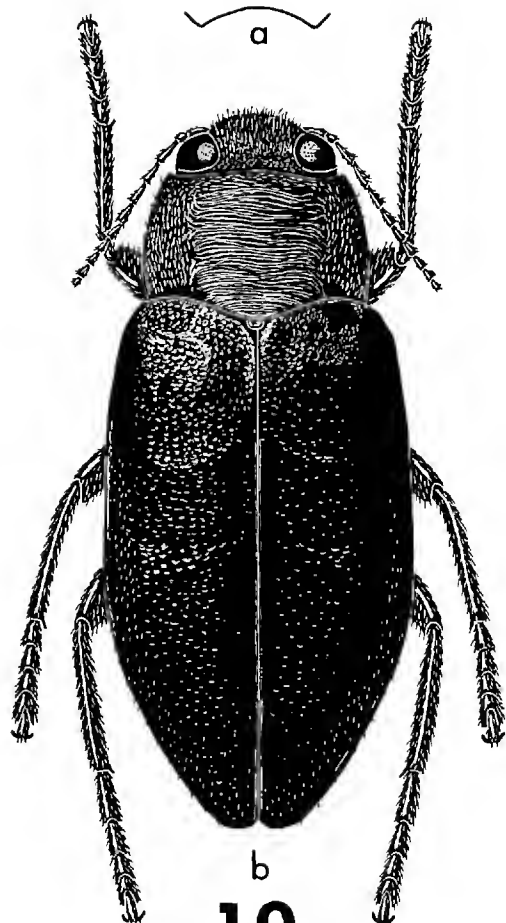
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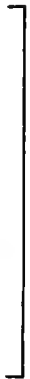
b
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b
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b
10



olaceous elytral spots vary from 3 distinct pairs to no indication of spots. Partial reduction in the number of spots usually proceeds from anterior to posterior. The 24 males studied are from 11.0 to 13.5 mm long and the 31 females from 11.0 to 15.0 mm.

Dystaxia murrayi LeConte

Dystaxia murrayi LeConte, 1866:385.

Dystaxia murrayi cuprea Knull, 1947:72 (NEW SYNONYMY).

Dystaxia murrayi cuprea Knull is a coppery color phase of *D. murrayi* LeConte, as suggested by Nelson (1960). An examination of the type of *D. murrayi cuprea* and a series of 18 green and 26 cupreous color forms supports this conclusion. The 2 forms occur sympatrically.

Melanophila (Melanophila) cuspidata Klug

Melanophila (Melanophila) cuspidata Klug, 1829:34.

Melanophila pecchiolii (Laporte & Gory), 1839:33, (*Anthaxia*) (NEW SYNONYMY).

In the literature, *Melanophila pecchiolii* (Laporte & Gory) has consistently been listed as a synonym of *Melanophila acuminata* (DeGeer). A. Descarpentries indicated (in litt.) that the type of *M. pecchiolii* [MNHP] represents the same species as *Melanophila cuspidata* Klug rather than *M. acuminata*. Since *M. cuspidata* is a European species the synonym *M. pecchiolii* should not appear on North American lists.

Melanophila (Melanophila) notata notata (Laporte & Gory)

Melanophila (Melanophila) notata notata (Laporte & Gory), 1837:4, (*Apatura*).

Melanophila opaca LeConte, 1860:213. *Melanophila hungarica* Csiki,³ 1905:579 (NEW SYNONYMY).

Fisher (1925) established *Melanophila opaca* LeConte as a synonym of *Melanophila notata* (Laporte & Gory) but Sloop (1937), in his revision of the genus, distinguished *M. notata* from *M. opaca* primarily on the basis of color, the former yellow-maculate, the latter immaculate. In a series of *M. notata*, variations from distinctly maculate to immaculate occur and no constant morphological character has been found to separate them, so Fisher's concept is valid. *Melanophila hungarica* Csiki was described from a single specimen from Hungary [HNHM]. An examination of the type reveals it is an immaculate example of *M. notata*, evidently introduced into Hungary, and should not be considered indigeous to Europe. Dr. S. Bílý

[NMPC] first recognized that *M. hungarica* = *M. opaca* and had so labelled the type.

Melanophila (Phaenops) abietis Nelson, (NEW STATUS)

Melanophila (Phaenops) drummondi var. *abietis* Champlain & Knull, 1923:105.

This form was described as a bright green color variety of *Melanophila drummondi* (Kirby). As indicated in the following tabular comparison of *Melanophila abietis* Nelson, *Melanophila lecontei* Obenberger, and *M. drummondi*, the differences in body form, color, and elytral margins show that *M. abietis* should be regarded as a valid species. It is most similar to *M. lecontei* including the male genitalia.

	<i>abietis</i> (Fig. 8)	<i>lecontei</i> (Fig. 9)	<i>drummondi</i> (Fig. 10)
Body form	broadly oval	moderately oval	moderately oval
Color	blue-green	bronzy-black to black, rarely with bluish tint	bronzy-black to black, rarely with bluish tint
Elytral margins	broadly explanate, apically not or finely serrate	moderately explanate, apically coarsely serrate	moderately explanate, apically not or finely serrate
Pronotal disk	coarsely rugose, punctures large	coarsely rugose, punctures large	finely rugose, punctures not evident
Clypeus	deeply emarginate	deeply emarginate	shallowly emarginate
Distribution	eastern Canada & New Hampshire	western North America	western North America

Nanularia (Nanularia) pygmaea (Knull) (NEW COMBINATION)

Hippomelas pygmaea Knull, 1941:386.

An examination of the type reveals it has the characteristics of the genus *Nanularia* (s. str.), as defined by Barr (1970).

Pachyschelus laevigatus (Say)

Pachyschelus laevigatus (Say), 1839:164, (*Trachys*).

Pachyschelus oblongus (Motschulsky), 1860:54, (*Metonius*) (NEW SYNONYMY).

Specimens of *Pachyschelus laevigatus* (Say) were compared with the type of *Pachyschelus oblongus* (Motschulsky) [ZMUM] by Dr. Alexeev (pers. comm.) and were found to be conspecific. *P. oblongus*, listed erroneously from Venezuela by Obenberger (1937), was described from "Etats Unis. Tennessee" [sic], while *P. laevigatus* was described from "New York."

Pachyschelus purpureus purpureus (Say)

Pachyschelus purpureus purpureus (Say), 1839:164, (*Metonius*).

Pachyschelus biimpressus (Motschulsky), 1860:54, (*Metonius*), (NEW SYNONYMY).

Comparison of specimens of *Pachyschelus p. purpureus* (Say) with the type of *Pachyschelus biimpressus* (Motschulsky) [ZMUM] by Dr. Alexeev (pers. comm.) indicates they both represent the same species. The latter was listed by Obenberger (1937) from "America bor.," but no locality was given with the original description. *P. p. purpureus* (Say) was described from "Indiana."

Polycesta deserticola Barr

Polycesta deserticola Barr, 1974:6.

Polycesta californica Ménétriés (not LeConte), in Motschulsky, 1859:180 (NEW SYNONYMY).

This species from southwestern U.S. and northern Mexico was known as *Polycesta velasco* Laporte & Gory until Barr (1974) recognized it was different. An examination of the specimen of *Polycesta californica* Ménétriés [ZMAS], kindly loaned by Mark Volkovitsh and here designated as lectotype, reveals it is the same species as *Polycesta deserticola* Barr. Since LeConte (1857) described another species as *Polycesta californica*, the name *P. californica* Ménétriés is not available and thus must be treated as a synonym of *P. deserticola* Barr.

The lectotype of *Polycesta californica* Ménétriés is labelled as follows: white label with "California sept. Leconte" (p)/white label with "*Polycesta californica* ex Calif." (h). This female, 17.0 mm long and 6.0 mm wide, lacks antennae except for 2 basal segments on left and 3 on right, lacks front legs, right middle leg and metatarsi except for 2 segments on left. The type locality listed in the original description is "Col Ross," a Russian settlement near San Francisco. It was undoubtedly collected from much farther south.

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Footnotes

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² Research Associate, Florida State Collection of Arthropods, Division of Plant Industry, Florida Department of Agriculture and Consumer Services.

³ Bílý, 1979. *Acta Zool. Bulgarica*, 13:48, records *Melanophila lecontei* Obenberger as a synonym of *M. hungarica* Csiki. Dr. Bílý (*in litt.*) indicated that he erred in relating *hungarica* with *lecontei* and agrees that it = *opaca*.

ZOOLOGICAL NOMENCLATURE

AN(S) 111

1st November 1979

The Commission hereby gives six months notice of the possible use of its plenary powers in the following cases, published in *Bull. zool. Nom.* Volume 36, part 3, on 1st November 1979, and would welcome comments and advice on them from interested zoologists. Correspondence should be addressed to the Secretary.

2240 *Anaspis* Müller, 1764; *Luperus* Müller, 1764; *Lampyrus* Müller, 1764; and *Clerus* Müller, 1764 (Insecta: Coleoptera): proposed designation of a type species.

2244 *Ptilium* Gyllenhal, 1827 and *Ptenidium* Erichson, 1845 (Insecta: Coleoptera): proposed conservation.

2246 *Chrysomela flavicornis* Suffrian, 1851 and *C. tibialis* Suffrian, 1851 (Insecta: Coleoptera): proposed conservation.

2146 *Rhodesiella plumigera* (Loew, 1860) (Insecta: Diptera): proposed suppression.

Secretary, International Commission on Zoological Nomenclature,
% British Museum (Natural History), Cromwell Road,
London, SW7 5BD, United Kingdom.

**NOTES ON THE BIOLOGY OF SOME PANAMANIAN POMPILIDAE,
WITH A DESCRIPTION OF A COMMUNAL NEST
(HYMENOPTERA)**

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The large amount of work done by Evans (1966, 1973) on the taxonomy of the Central American spider wasps has made most pompilids in this region identifiable, at least to genus, although there are probably many species yet to be described. Very little is known about the biology of the neotropical pompilids. This is not a problem unique to these wasps, since knowledge of most groups of insects in the tropics is inadequate. In many cases a biologist making a study of a group must become a taxonomist as well.

The nest of *Auplopus esmeralda* (Banks) described below represents the second record of a communal pompilid nest. The first record was the nest of *Auplopus argentifrons* (F. Smith) (as *Paragenia*), described by F. X. Williams (1919) in the Philippines. The *argentifrons* nest consisted of about 24 cells tended by approximately eight females and was built in a bamboo stump.

The remainder of this paper contains behavioral notes on four species of spider wasps. Voucher specimens of wasps and prey have been deposited in the museum of the Department of Entomology, University of California at Davis.

Auplopus esmeralda (Banks). A nest was found on Barro Colorado Island in the Canal Zone on W. M. Wheeler 8 trail. It was first observed in August 1976 when four females were seen flying in and out of the base of a fallen *Scheelea* palm frond, 2 m south of the trail. The palm frond was examined at the island field station on September 22, 1976. At this time many of the adults had already emerged, and most cells were empty.

The nest consisted of 95 mud cells arranged in an elongate mass along the curved inner wall of the palm frond base (Fig. 1a, b). Each cell was ovoid with one flattened end, which usually contained the exit hole of the emerging wasp. The external dimensions of the cells were 13-16 mm by 10-11 mm (Fig. 1d). The cell walls were smooth and unlined inside and rough externally, 0.5-1.0 mm thick. The bottom of the cell was not completely covered with mud medially (Fig. 1c).

The cocoons were papery and ranged from pale yellow to dark brown

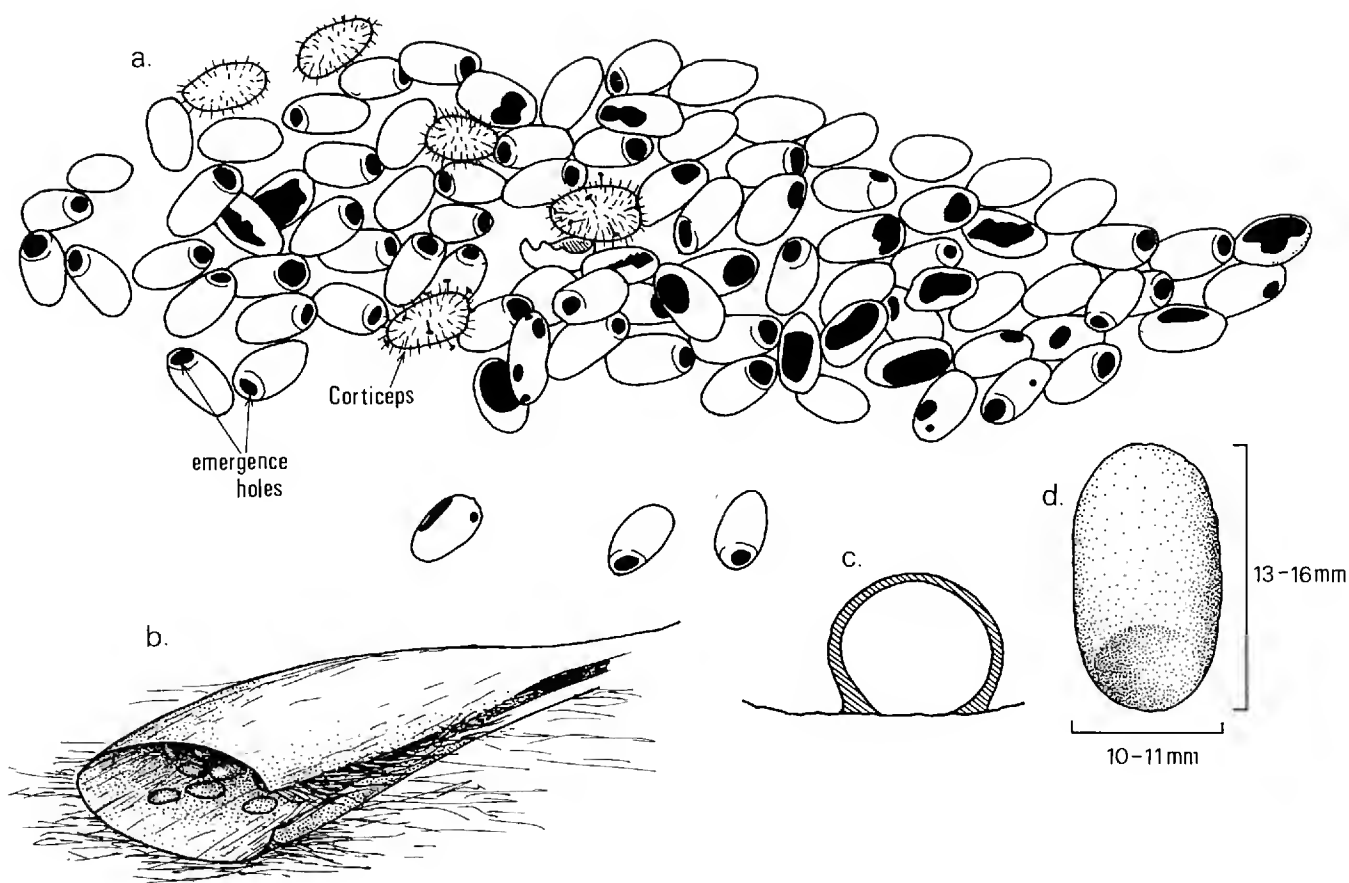


Fig. 1. Communal nest of *Auplopus esmeralda*: a, nest diagram; b, nest in situ; c, cross section of cell; d, dorsal view of cell.

depending on their age. Each cocoon was attached to the wall of the cell opposite the flattened end.

At least 18% of the cells in this nest were parasitized. Fungus accounted for at least five cells and two cells had well developed *Corticeps* fruiting bodies. Other parasites included one unidentified muscoid fly, and a female *Ephuta* sp. (Mutillidae) reared from one cell.

Two other nests of this species were collected from traps which were made from sections of 10 cm diameter bamboo cut with the joint walls forming end walls and a 1 cm diameter hole bored in the middle. One nest had three cells and three adult *Auplopus* were reared from these, one male and two females. The other nest consisted of two cells and two females were reared from these. The construction of these cells was the same as the cells in the palm frond.

Two females of this species were observed collecting mud from a *Nasutotermes* sp. termite nest on the side of a dead tree, one in July 1977 and the other in August 1978. Each female apparently secreted saliva on a small area on the mud wall of the termite nest. After wetting the material the female worked it with her mandibles into a ball almost the size of her head.

She flew away from the tree with the ball held beneath the mandibles, apparently supported with the palpi.

The following observations were also made on Barro Colorado Island:

Mystacagenia elegantula Evans. The type female was observed collecting mud from the same *Nasutotermes* nest as the *Auplopus* females.

Priochilus splendidulum splendidulum (Fabricius). A female was collected carrying a spider, *Ctenus* sp. (Ctenidae), along the top of a log. The spider's legs were not amputated.

Priocnemella rufothorax (Banks). One female was collected carrying the spider, *Acanthoctenus* sp. (Acanthoctenidae), in the leaf litter. The wasp had not amputated the spider's legs.

Ageniella anconis Banks. This female was collected while she was 'resting' on a blade of grass. She was carrying the spider, *Sarinda* sp. (Clubionidae) by the spinnerette and had not amputated the spider's legs.

Acknowledgments

I would like to thank the Smithsonian Tropical Research Institute for allowing me to stay and work at their field station on Barro Colorado Island, Panamá. Also I would like to thank Drs. Marius S. Wasbauer and Howard E. Evans for identifying the pompilid wasps, Willis Gertsch for identifying the spiders and Richard M. Bohart and Marius Wasbauer for comments and criticisms.

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A NEW *OXYETHIRA* (HYDROPTILIDAE, TRICHOPTERA) OF THE
AEOLA ROSS GROUP; WITH A KEY TO SEPARATE THE
FIVE MALES OF THE GROUP¹

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***Oxyethira allosi*, new species**

Holotype, male.—3.3 mm long, specimens from the type series vary from 3.0 to 3.5 in length. Genitalia, Fig. 1A, B. Seventh sternal process short, thin, pointed. Eighth tergite deeply and widely incised, sides of the incision regular. Ninth tergite, the projecting rods apparent in the other species of the group are lacking; subgenital plate arcuate, deeply pigmented, emarginate apically, the apico-lateral corners rounded. Claspers below subgenital plate round, pigmented; a short cylindrical process arises near the clasper base, process tipped with a seta. Aedeagus, Fig. 1ae, long tubular the tip membranous, expanded; a curved structure extends into the membranous part; aedeagal length 0.5 mm.

Holotype, male.—Oroville, Butte Co., California, I-24-1975 T. D. Eichlin and T. Kono collectors. The holotype was taken on concrete fish ladders at fish hatchery. Paratypes, 18 males, same data as above. One male, Sunol Regional Park, Alameda Co., California, X-15-1974, D. G. Denning collector. 14 males, Mendocino Co., California, VI-24-1978, D. G. Denning collector, creek at Brook Trail near Willits. Four males, Nimrod Warm Springs, Route I-90, Granite Co., Montana, V-10-1970, D. S. Potter collector. One male, Goshen, Utah Co., Utah, I-27-1973, R. N. Winget collector.

The paratype from Utah was taken at springs and ponds 1.5 km east of Goshen from a slow running stream (about 10 m in length) connecting two small ponds each less than half a hectare in extent. These ponds are fed by warm water springs and are characterized by heavy growths of submerged and floating vegetation. The connecting stream has a sand-gravel-silt substrate with significant amounts of water cress and *Chara* and other algae.

Allotype, female.—Fig. 1F, same size and color as male. Two sclerotized plates exterior to the cerci, two small setae between cerci. Ninth sternite rounded, covered with setae on anterior part. Bursa copulatrix with three "chambers." Fig. 1bc. There appears to be an inverted Y structure at the base.

Allotype, female.—Mendocino Co., California, creek at Brook Trail near Willits, VI-24-1978, D. G. Denning collector.

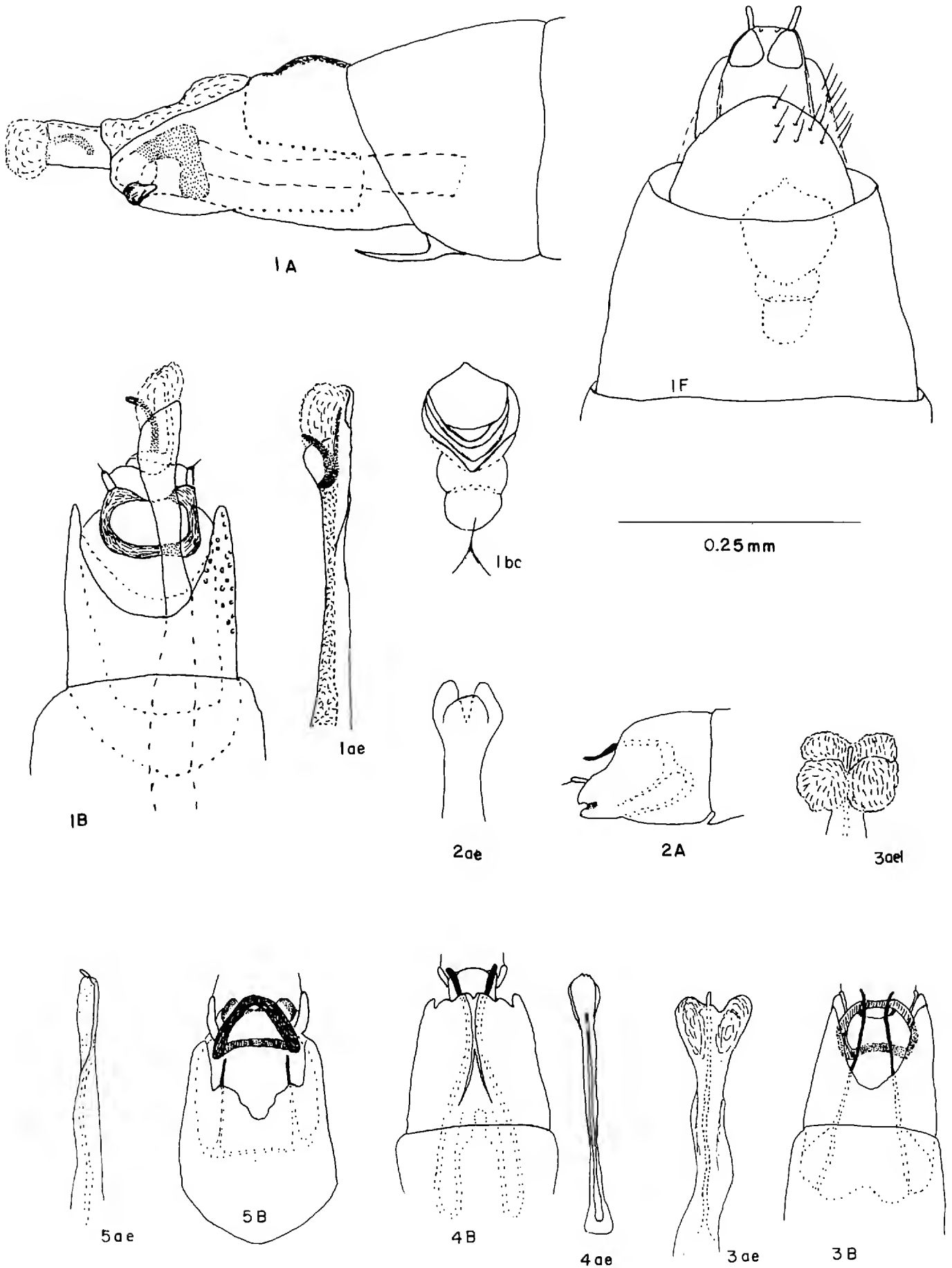


Fig. 1. *Oxyethira allosi* n.sp. Genitalia; A, male, lateral; B, male dorsal; ae, aedeagus, dorsal; F, female, ventral; bc, bursa copulatrix. Line = 0.25 mm. Fig. 2. *Oxyethira abacatia* Denning; A, male, lateral; ae, aedeagus. Fig. 3. *Oxyethira anabola* Blickle; B, male, dorsal; ae, aedeagus; ael, apex of aedeagus lobes expanded. Fig. 4. *Oxyethira barnstoni* Harper; B,

The two plates and the two small setae near the cerci plus the three chambered bursa sets this apart from related species.

Deposition of type material.—Holotype male, allotype female and 13 male paratypes to the California Academy of Science, San Francisco, California. Two male paratypes to California State Department of Agriculture, Insect Taxonomy Laboratory, Sacramento, California. Remaining paratype males to Dr. D. G. Denning, Moraga, California.

This species belongs to a group of hydroptilids characterized by the males having an arcuate subgenital plate, a large tubular aedeagus having no spiral process, and (usually) rods projecting posteriorly from the 9th tergite.

This species differs from *abacatia* Denning (1947) and *anabola* Blickle (1966) by a lack of aedeagal lobes, from *barnstoni* Harper (1976) by having the incision of the 8th tergite deep and from *aeola* Ross (1938) by having the sides of the 8th tergal incision regular, in addition *allosi* n. sp. lacks rods projecting posteriorly from the 9th tergite as possessed by the others of the group. The subgenital plate posteriorly is also more irregular than those of the other species.

The known geographic distribution of the five described species of the *aeola* group is: *Oxyethira abacatia* Denning, Florida, Georgia; *O. aeola* Ross, British Columbia to Minnesota; *O. anabola* Blickle, New Jersey to Quebec to Minnesota; *O. barnstoni* Harper, Quebec; *O. allosi* n. sp., California, Montana, Utah.

Key to Males of *aeola* Ross Group

- | | |
|---|-------------------------|
| 1. Apex of aedeagus 3 or more lobes (Figs. 2, 3) | 2 |
| Apex of aedeagus simple or expanded membranous mass | 3 |
| 2. Apex of aedeagus 3 lobed; rods of 9th segment do not extend beyond subgenital plate (Fig. 2) | <i>abacatia</i> Denning |
| Apex of aedeagus 4 lobed; rods of 9th segment extend beyond subgenital plate (Fig. 3) | <i>anabola</i> Blickle |
| 3. Incision of 8th tergite narrow (Fig. 4) | <i>barnstoni</i> Harper |
| Incision of 8th tergite broad, deep | 4 |
| 4. Sides of 8th tergite incision irregular (Fig. 5) | <i>aeola</i> Ross |
| Sides of 8th tergite incision regular (Fig. 1) | <i>allosi</i> n.sp. |

The key above replaces the couplets 18 to 19, pages 39–40 of the Oxy-

←

male, dorsal; ae, aedeagus. Fig. 5. *Oxyethira aeola* Ross; B, male, dorsal; ae, aedeagus. Fig. 2, redrawn from Denning (1947); Fig. 3, redrawn from Blickle (1966); Fig. 4, redrawn from Harper (1976); Fig. 5, redrawn from Ross (1938).

ethira key in the Hydroptilidae (Trichoptera) of America North of Mexico, Blickle (1979).

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Footnote

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**FLEAS FROM SOME ALASKAN BIRDS
(SIPHONAPTERA)**

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Records of fleas collected from birds are much fewer than records from mammals. Not as many birds are examined for fleas, birds are seldom infested, and in Alaska species of mammal fleas outnumber species of bird fleas 2 to 1. By thoroughly examining dead birds found by chance since 1973, we obtained four fleas. Three of these were true bird fleas, one being a new record for the United States. The fourth was a mammal flea not previously recorded from birds. The specimens are deposited in the collection of the senior author. We thank F. G. A. M. Smit, London, for his comments on *Ceratophyllus adustus* and Dr. G. P. Holland, Ottawa, for his comments on *C. diffinis*.

Ceratophyllus adustus Jordan

Record.—Palmer, 8.8 km SE: 1 female, *Picoides tridactylus*, 27.X.75, G. E. Haas.

No records of this species have been published since Jordan (1932) described it from a single female collected from a porcupine in the Atlin region of British Columbia. He noted the reduced chaetotaxy and concluded that it presumably resulted from a bird flea changing hosts, the porcupine probably becoming the true host. Our studies in Alaska indicate, however, that *C. adustus* is a woodpecker nest flea. The infested porcupine probably climbed a tree in which a woodpecker had nested and approached the nest close enough for the flea to make contact.

Ceratophyllus diffinis Jordan

Record.—Palmer, 4 km E: 1 female, *Ixoreus naevius*, 2.V.76, I. Sims.

This Nearctic flea is transcontinental on a wide variety of birds, especially Galliformes and Passeriformes (Holland, 1963; Benton & Shatrau, 1965). Holland (in litt. 1975) has specimens from *I. naevius* in Alaska.

Ceratophyllus gallinae (Schrank)

Record.—Talkeetna, 19.2 km S: 1 male, *Dendroica coronata*, 1.VI.76, G. E. Haas.

This widespread Old World flea is a natural passerine parasite that became a domestic fowl pest in Europe and supposedly was introduced into North America (Holland, 1963). Holland (1949) recorded it ranging from New Brunswick to Saskatchewan and later (Holland, 1963) from western Alaska, one of several localities in which Smit (1969) considered it an introduction.

Tarsopsylla octodecimdentata coloradensis (Baker)

Record.—Matanuska Glacier, 1 km N: 1 female, *Perisoreus canadensis*, 27.IX.78, T. Rumfelt.

This is a tree squirrel nest flea (Holland, 1963). The jay might have become infested while feeding on a roadkill red squirrel (*Tamiasciurus hudsonicus*) or while visiting a tree hole frequented by this mammal. This is the first record of *T. o. coloradensis* parasitizing a bird.

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OCCURRENCE OF *METAPHYCUS BARTLETTI* ANNECKE AND
MYNHARDT, A SOUTH AFRICAN PARASITE OF
BLACK SCALE, *SAISSETIA OLEAE* (OLIVIER)
IN CENTRAL AND NORTHERN CALIFORNIA
(HYMENOPTERA: ENCYRTIDAE;
HOMOPTERA: COCCIDAE)

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From 1976 through 1978 I conducted periodic field surveys to assess the natural enemy complex of the black scale, *Saissetia oleae* (Olivier), in central and northern California where the scale is a sporadic economic pest in commercial olive groves and on several ornamental trees and shrubs. The surveys were made in conjunction with a continuing program of periodic colonization of parasites newly introduced from the western Cape Province, South Africa, where *S. oleae* is thought to have originated (De Lotto, 1976).

Of special interest among the several parasite species recovered during the surveys was the presence of *Metaphycus bartletti* Annecke and Mynhardt, an African encyrtid not recorded previously from central and northern California.

Although the reports on colonization of beneficial organisms in California by the Division of Biological Control, University of California, Riverside, for the years 1958-1960, show that an encyrtid then identified as *Metaphycus inviscus* Compere was colonized on *S. oleae* infestations in six southern California counties (Fig. 1), it was not reported to have been released in central or northern California. The stock colonized as *M. inviscus* was originally obtained from *S. oleae* infesting olive near Stellenbosch, South Africa by B. R. Bartlett in 1958. Regarding colonization of the parasite, Bartlett (see Annecke and Mynhardt, 1972) stated, "recoveries were abundant the first year of release but it was not taken thereafter" Annecke and Mynhardt (1972) studied specimens of the stock colonized in southern California and concluded that they differed from *M. inviscus* as described by Compere (1940). The California material was then described as *M. bartletti* by Annecke and Mynhardt (1972) who illustrated the cryptic characters which separate the two species.

During the 1976-1978 surveys various host plants of *S. oleae* (principally olive) were examined at 225 sites in 18 central and northern California counties. Light to heavy infestations of *S. oleae* were sampled at 73 sites. At all other sites the scale was either absent or too scarce to permit sampling.

Table 1. Recoveries of *Metaphycus bartletti* from black scale samples according to counties during 1976–1978.

County	No. sample sites	Parasite recoveries—no. sites	No. parasites
Alameda ^a	5	3	107
Butte	4	2	69
Contra Costa ^a	5	4	167
Fresno	3	2	204
Glenn	5	1	2
Madera	2	0	0
Marin ^a	4	2	42
Merced	8	1	1
Placer	1	1	4
Sacramento	1	0	0
San Joaquin	9	0	0
San Luis Obispo ^a	1	0	0
Solano	1	1	1
Stanislaus	8	6	937
Sutter	3	1	8
Tehama	2	0	0
Tulare	8	2	20
Yolo	3	1	15
	<u>73</u>	<u>27</u>	<u>1577</u>

^a Coastal counties.

Results

As shown in Table 1, *M. bartletti* was recovered at 27 (37%) of the 73 sample sites. The parasite was recovered from 18 sites in 10 Central Valley counties and from 9 sites in 3 coastal counties. Thirty-one percent of the samples from the Central Valley counties and 53% of the samples from coastal counties yielded *M. bartletti*. Chronologically, *M. bartletti* was recovered at 7 of 15 sites in 1976, at 4 of 12 sites in 1977, and at 16 of 46 sites in 1978.

The frequency of recovery for *M. bartletti* (27 sites—13 counties) was second only to that for *M. helvolus* (Compere), another African species which was recovered at 42 sites in 17 counties. Total recoveries of *M. bartletti* (1577) were also second to those for *M. helvolus* (2477). Together they represented 71.2% of all parasite recoveries. Coincidental recoveries of *M. bartletti* and *M. helvolus* occurred at 20 sites. At these sites recoveries of *M. helvolus* were numerically superior to *M. bartletti* at 14 sites whereas *M. bartletti* was dominant in numbers at 6 sites.

Laboratory emergence records for *M. bartletti* showed that this species develops gregariously in nearly mature (rubber stage) scales. A lot of 50

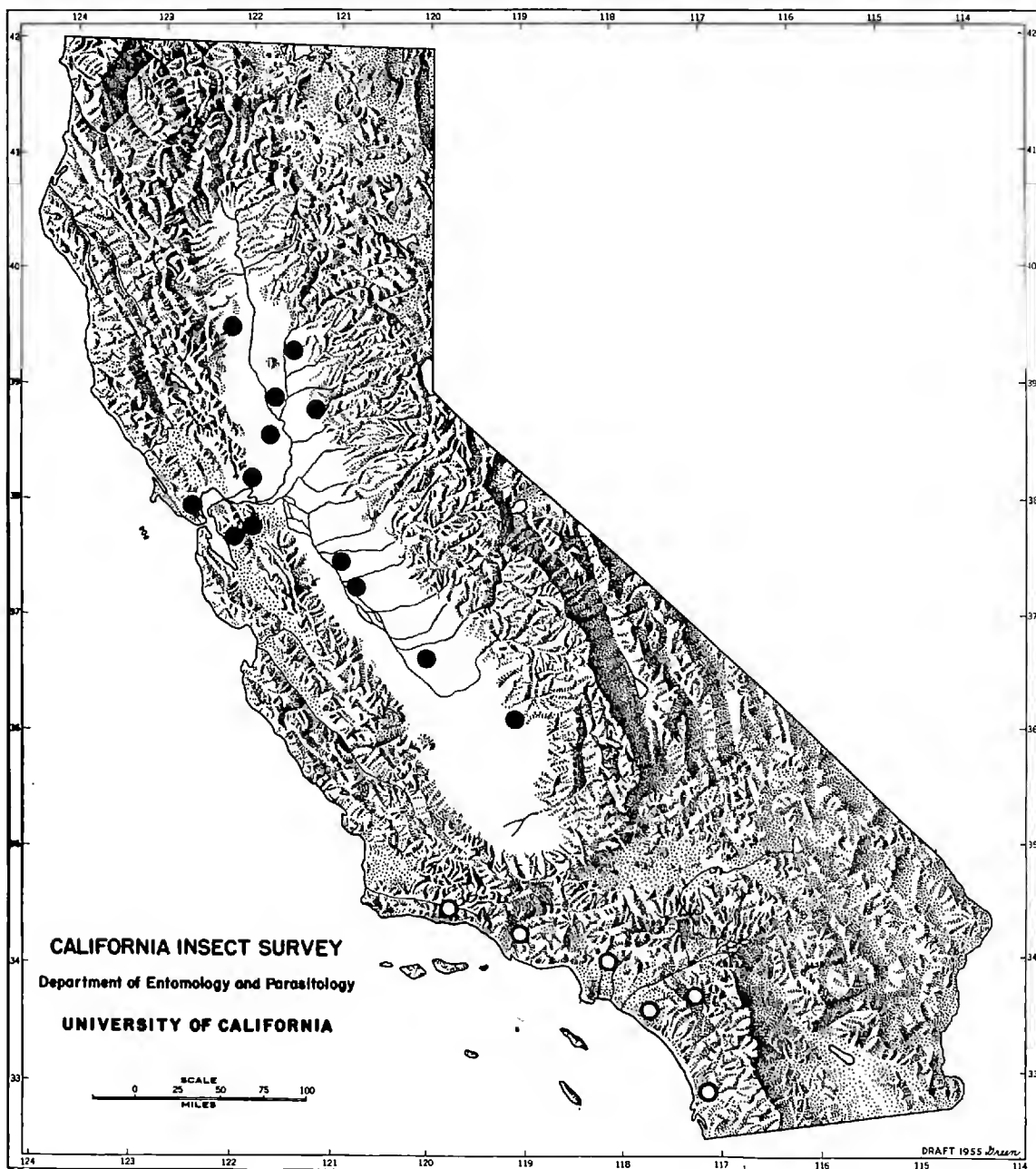


Fig. 1. Distribution of *Metaphycus bartletti* in central and northern California. Solid circles indicate areas where *M. bartletti* was recovered during 1976–1978 surveys. Open circles indicate areas where *M. bartletti* was colonized during 1958–1960.

mummified *S. oleae* (collected at Oakdale, Stanislaus County) yielded an average of 4 parasites/host (range, 2–8).

The wide distribution of *M. bartletti* in central and northern California (Fig. 1) suggests that the parasite has probably been expanding its range over a number of years, very likely throughout the period since it was first colonized in southern California in 1958–1960. The fact that Bartlett's releases some twenty years ago were confined to southern California localities suggests that *M. bartletti* is a recent arrival in central and northern California. Also, earlier sporadic samples of *S. oleae* taken from various localities in central and northern California by the author during the 1950's did not reveal the presence of *Metaphycus* species similar to *bartletti* or *invis-*

cus. Thus the possibility that *M. bartletti* became established in central and northern California prior to 1958 by some unexplained means is not indicated.

The source of colonizing stocks of *M. bartletti* responsible for its establishment in central and northern California is uncertain. Of several possible sources, transport by man of live plant material infested with parasitized scale hosts appears to afford the most logical explanation. Although relatively rapid natural dispersal of parasitic Hymenoptera is known to exist (DeBach, 1974), the relatively barren mountain ranges between southern and central California (Fig. 1) provide a formidable barrier to natural migration. While there remains a possibility that *M. bartletti* was released in central California during 1958–1960, this seems unlikely since it is a policy of the Biological Control divisions of the University of California to report all colonizations of beneficial organisms.

Acknowledgments

I thank Dr. D. P. Annecke, Plant Protection Research Institute, Pretoria, South Africa, who made the initial identification of *Metaphycus bartletti* from material recovered during the early stages of the surveys. I also thank Dr. K. S. Hagen, who reviewed the manuscript and Mr. J. Hamai, who made the figure.

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**ANTI-PREDATOR BEHAVIOR IN SWARMS OF *RHAGOVELIA OBESA*
(HEMIPTERA: VELIIDAE)**

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The broad-shouldered water strider or riffle bug, *Rhagovelia obesa* (Uhler, 1871), is an aquatic hemipteran commonly found along edges of lotic habitat. Its prey principally consists of small insects and crustaceans, trapped within the water's surface film. The median legs, equipped with fan-shaped, setal plumes at apical segments of the tarsi, provide locomotion, beating alternately beneath the water surface (Bueno, 1907; Coker et al., 1936; Cheng and Fernando, 1971). *Rhagovelia obesa* is active in low temperatures and undergoes four larval stages (Cheng and Fernando, 1971). First instar nymphs have been observed in late May in South Carolina. Adults have been observed in November.

Behavioral experiments were conducted on *Rhagovelia obesa* populations on 18-mile Creek in Pendleton, South Carolina. Both nymphs and adults were observed to aggregate into swarms, disperse when disturbed and eventually reassociate. Insects were observed in groups ranging from 4 to 80 individuals. Mating pairs were occasionally included in swarms and were observed as early as July.

Ten large swarms were investigated at midday along various points of 18-mile Creek. Experiments were conducted during sunny days over a two week period using sub-surface and overhead "approach models" to stimulate dispersal. Sub-surface models, resembling salmonid dorsal silhouettes, consisted of metal ovals, approximately 25 cm × 6 cm and painted flat black and dark green. Sub-surface models were pulled by monofilament line along the sandy creek bottoms and were slowly drawn upstream towards riffle bug swarms.

Overhead models were constructed from crow and blue jay skins, stretched across 15 cm × 8 cm × 5 cm wooden frames. These models were suspended from fishing line and lowered by bamboo pole directly above *Rhagovelia obesa* swarms. Twenty trials at five minute intervals were performed for each experiment and for each insect group. Riffle bug responses to shadow movements and water surface disturbances were also noted.

Both moderate and rapid introductions of overhead models resulted in immediate dispersals of tested swarms. The same reactions occurred when gentle, irregular wave action was generated by randomly splashing a wooden ladle within a few feet of the insects. Both experiments revealed that, fol-

lowing 8 to 10 trials, repeated disseminations led to reduced swarm cohesion and partial extinction of dispersal behavior. Aggregates also exhibited small increases in time elapsed prior to regrouping.

However, insect swarms, approached by slowly moving shadows cast on the streambed, maintained tight formations and avoided the projections with coordinated group movements. Riffle bug swarms also behaved as organized units while moving in advance of and at the same speed as approaching sub-surface models.

The described results suggest that swarms of *Rhagovelia obesa*, which may facilitate mate availability, could also function as an indirect deimatic anti-predator defense. Coordinated avoidance of sub-surface images appears to function as a primary defense mechanism. Supplementing this behavior, riffle bug swarms, dispersing at the instant of attack, may further create a secondary "flash" stimulus. Such rapidly scattering assemblies of insects could effectively distort or obliterate search images of approaching fish or fowl.

Acknowledgment

I wish to thank the Deshefy-Sekora clan.

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REVISION OF THE GENUS *STENOBATYLE* CASEY
(COLEOPTERA: CERAMBYCIDAE)

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The purpuricenine genus *Stenobatyle* was proposed by Casey (1912) to include *Entomosterna prolixa* Bates and a new species, *cribrata*, from Mexico. Linsley (1935) described the species *inflaticollis* in a new genus, *Leptobatyle*, observing its close resemblance to *cribrata* Casey. The remaining species herein placed into *Stenobatyle* were in the genus *Entomosterna* Chevrolat until Chemsak and Linsley (1974) transferred them into *Parabatyle* Casey. Subsequent studies indicate that the type species of *Parabatyle* is not congeneric with the other species. Therefore, *sanguiniventris* Chevrolat is retained as *Parabatyle* and the others, including *inflaticollis*, placed into *Stenobatyle*.

The species of *Stenobatyle* are all presently known from Mexico, with one species, *eburata* (Chevrolat), ranging to Costa Rica. Adults are diurnal and are found on the flowers of various trees and shrubs. No host plant data have been seen for any of the species.

Genus *Stenobatyle* Casey

Stenobatyle Casey, 1912:326; Linsley, 1935:101; Chemsak and Linsley, 1974:182 (synonymy).

Leptobatyle Linsley, 1935:101; Chemsak and Linsley, 1974:182 (synonymy).
(Type: *Leptobatyle inflaticollis* Linsley, monobasic).

Form moderate sized, slender. Head small, front oblique; palpi short, apical segments short, truncate at apices; mandibles short, slightly curved at apices, apices acute; eyes finely faceted, deeply emarginate, upper lobes small; antennal tubercles divergent, moderately elevated; antennae slender, eleven-segmented, slightly longer than body in males, third segment usually longer than scape, fourth shorter than third. Pronotum convex, sides rounded; apex narrower than base; apex and base narrowly margined, hind margins usually flaring laterally; prosternum not or very feebly impressed, intercoxal process abruptly declivous, not expanded at apex, coxal cavities broadly open behind; mesosternum with intercoxal process arcuate to declivous, coxal cavities open to epimeron; metasternum with episternum subparallel to slightly tapering posteriorly. Elytra slender, tapering, lateral mar-

gins feebly to strongly impressed at basal $\frac{1}{3}$; eburneous ridges or elevated costae usually present; apices crenulate, outer angles dentate. Legs slender; hind femora linear, arcuate, usually extending to apices of elytra; posterior tarsi slender, usually elongate, third segment cleft to middle. Abdomen normally segmented.

Type species: *Entomosterna prolixa* Bates (by original designation).

This genus may be recognized by the slender form, small head, relatively short antennae, convex, usually tapering pronotum with distinct margins at the base and apex, and usually strongly costate or eburneous ridged elytra.

Key to the Species of *Stenobatyle*

1. Elytra with very distinct longitudinal, often eburneous costae .. 2
Elytra lacking elevated costae, opaque, very coarsely, confluent punctate; pronotum dull, closely alveolate-punctate; integument black, pronotum reddish to orange except for middle.
Length, 13 mm. Mexico and Guerrero *inflaticollis*
- 2(1). Elytra with costae eburneous 3
Elytra with costae not eburneous 4
- 3(2). Each elytron with a single broad costa, punctures rather fine, subequal to those of pronotum. Length, 9–17 mm. Sonora, Mexico to Costa Rica *eburata*
Each elytron with 2 costae, one dorsal and one extending back from humerus, punctures coarse, contiguous, much larger than those of pronotum. Length, 10–11 mm. Guerrero *gracilis*
- 4(3). Pronotum finely, rather sparsely punctate, punctures finer and sparser at sides; elytra finely, very sparsely punctate at basal margin. Length, 15–18 mm. Guerrero to Oaxaca *prolixa*
Pronotum coarsely, confluent punctate, punctures transverse; elytra coarsely, contiguously punctate throughout. Length, 7–12 mm. Sinaloa to Veracruz and Oaxaca *miniaticollis*

Stenobatyle inflaticollis (Linsley), **NEW COMBINATION**

Leptobatyle inflaticollis Linsley, 1935:101.

Parabatyle inflaticollis, Chemsak and Linsley, 1974:182.

Male.—Form moderate sized, slender; integument black, pronotum except apical and basal margins and a median vitta or spot reddish. Head confluent punctate, sparsely pubescent; antennae extending beyond elytra by four segments, scape finely, confluent punctate, segments from sixth longitudinally carinate beneath, outer segments minutely, densely pubescent, third segment much longer than scape, fourth a little shorter than third, fifth equal to fourth. Pronotum a little broader than long, sides broadly

rounded; disk strongly convex, alveolate-punctate with a vague median linear callus behind middle; pubescence obsolete; prosternum opaque, sparsely pubescent; meso- and metasternum finely, densely punctate, densely clothed with silvery recumbent pubescence, mesosternal process subdeclivous. Elytra about $2\frac{1}{2}$ times as long as broad, epipleura shallowly emarginate at basal one-third; punctures very coarse, deep, contiguous to confluent; pubescence obsolete; apices sinuate truncate. Legs slender; hind femora extending a little beyond apices of elytra; hind tibiae arcuate; hind tarsi elongate. Abdomen very densely clothed with silvery recumbent pubescence except narrowly at apices of first four segments; last sternite truncate at apex. Length, 13 mm.

Female.—Form similar. Antennae a little longer than body. Abdomen with last sternite broadly truncate at apex. Length, 13 mm.

Type locality.—Bejucos, Temascaltepec, Mexico, Mexico.

Range.—Mexico and Guerrero.

Flight period.—July.

The punctation of the pronotum and elytra will distinguish this species. The black median line of the pronotum varies from a spot over the basal one-half to extending the entire length. The female specimen at hand has an indication of narrow, pale sub-marginal vittae on the elytra.

New records.—1♂, 1♀, Canyon del Zopilote, 34 mi N Chilpancingo, Guerrero, Mexico, 11 July 1970 (Fisher and Sullivan).

Stenobatyle eburata (Chevrolat), **NEW COMBINATION**

Entomosterna eburata Chevrolat, 1862:755; Bates, 1880:85.

Parabatyle eburata, Chemsak and Linsley, 1974:182.

Entomosterna trucidata Chevrolat, 1862:755; Bates, 1880:86; 1885:330.

NEW SYNONYMY.

Parabatyle trucidata, Chemsak and Linsley, 1974:182.

Entomosterna unicastata Casey, 1912:332. **NEW SYNONYMY.**

Male.—Form moderate sized, tapering; integument black, pronotum often reddish at sides, each elytron with a broad, glabrous, elevated eburneous costa. Head densely, irregularly punctate, sparsely pubescent; antennae slightly longer than body, scape densely, moderately coarsely punctate, outer segments opaque, densely clothed with very short, recumbent pubescence, scape shorter than third segment, fourth equal to scape, fifth equal to third. Pronotum about as long as broad, sides rounded; disk strongly convex, broadly impressed behind middle at base, usually with a shallow, irregular callus before depression; punctures moderately coarse, contiguous, becoming confluent at sides; pubescence rather sparse, depressed, sides with a few, long, erect hairs; prosternum rugulose, densely pale pu-

bescent; meso- and metasternum finely, densely punctate, densely clothed with recumbent silvery pubescence, mesosternal process moderately declivous. Elytra more than $2\frac{1}{2}$ times as long as broad, sides shallowly impressed at middle; eburneous costae sutural, extending from basal margin almost to apex; basal punctures separated, becoming coarser and contiguous almost to apex; pubescence short, depressed, rather sparse, with a few erect hairs near base; apices bi-emarginate or bitruncate, angles usually dentate. Legs slender; hind femora extending to apices of elytra or a little beyond; hind tarsi elongate. Abdomen minutely, densely punctate at sides, densely pubescent at sides; last sternite truncate at apex. Length, 9–16 mm.

Female.—Form more robust. Antennae about as long as body. Abdomen with last sternite broadly truncate. Length, 10–17 mm.

Type locality.—of *eburata*, Soleda, Yucatan, Mexico; *trucidata*, Merida, Yucatan; *unicostata*, Guerrero, Mexico.

Range.—Sonora, Mexico to Costa Rica (Fig. 1).

Flight period.—May to August.

Flower records.—*Croton*, *Buddleia*, *Jatropha*, *Donneilsmithia*.

This species is easily recognized by the broad, eburneous costa on each elytron.

From Sinaloa, Mexico to Veracruz and Yucatan, all specimens have the pronotum uniformly black. From Oaxaca and Yucatan to Costa Rica all specimens at hand have the pronotum reddish at the sides. There appear to be no other differences but the southern population may eventually prove to represent a distinct subspecies, *trucidata*.

Adults are common in western Mexico on flowers of *Croton*, *Buddleia* and *Jatropha* during July and August. In Costa Rica, adults emerge earlier, in May. This species is usually found on flowering plants together with *miniatricollis*.

Most records are from Mexico (Fig. 1). Others include: Chontales, Nicaragua (BCA); 8 mi NW Bagaces, Guanacaste, Costa Rica.

***Stenobatyle gracilis*, new species**

Male.—Form moderate sized, slender; integument black, pronotum except apical and basal margins reddish, each elytra with a yellowish subsutural and submarginal costa. Head finely, confluent punctate, sparsely pubescent; antennae extending beyond elytra by about two segments, scape confluent punctate, outer segments densely clothed with fine, dark, appressed pubescence, third segment much longer than scape, fourth segment about one-third longer than scape, fifth equal to fourth. Pronotum as long as broad, sides broadly rounded; disk with a shallow, elongate, longitudinal, glabrous callus at middle; punctures coarse, shallow, almost alveolate; pubescence obsolete; prosternum rugulose, sparsely pubescent; meso- and

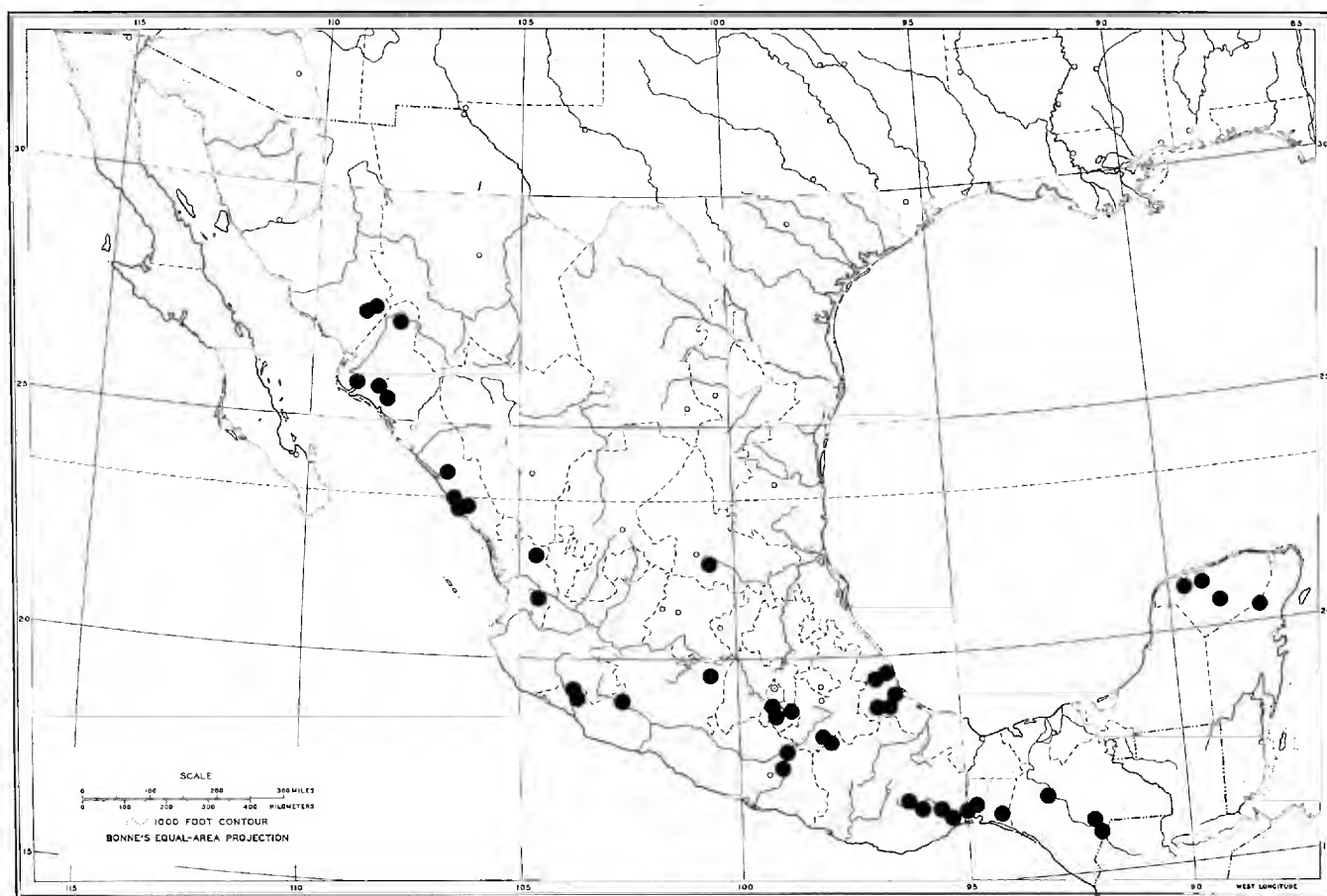


Fig. 1. Known distribution of *Stenobatyle eburata* (Chevrolat) in Mexico.

metasternum minutely, densely punctate at sides, coarsely and more sparsely to glabrous midline of mesosternum, pubescence silvery, dense at sides. Elytra more than three times as long as broad, epipleura moderately emarginate at basal one-third; subsutural costae moderately broad, sub-marginal pair narrow; punctures coarse, contiguous, larger at middle; pubescence obsolete; apices unevenly truncate. Legs slender; hind femora extending to apices of elytra, rather sparsely punctate; hind tarsi moderately elongate. Abdomen minutely, densely punctate, densely clothed with short appressed, silvery pubescence; last sternite truncate at apex. Length, 10 mm.

Female.—Form similar. Antennae slightly longer than body. Abdomen with last sternite broadly truncate. Length, 10 mm.

Holotype male (California Academy of Sciences) from Mexcala, Guerrero, Mexico, 29 June, 1951 (P. D. Hurd). One female paratype from Canyon del Zopilote, 24 mi N Chilpancingo, Guerrero, 11 July, 1970 (Fisher, Sullivan).

This species is easily recognized by the color and small, slender form. Although the type series possesses double yellowish vittae on each elytron, it is probable that other individuals would lack one or both of these. However, the costae should remain evident.

Stenobatyle prolixa (Bates)

Entomosterna prolixa Bates, 1892:180; Chemsak, 1967:76 (lectotype).

Stenobatyle prolixa, Linsley, 1935:102.

Male.—Form moderate sized, elongate; integument shining, black, pronotum bright red except narrowly at apical and basal margins, femora often reddish. Head finely, irregularly punctate, pubescence very short; antennae extending about three segments beyond elytra, scape finely, densely punctate; segments densely clothed with very fine, dark, appressed pubescence, third segment longer than scape, fourth equal to scape, fifth equal to third. Pronotum about as long as broad, sides broadly rounded; disk with a median, glabrous callus behind middle; punctures fine, somewhat transverse, densest at middle, becoming very shallow toward sides; fine setae rising out of punctures depressed, transversely directed toward center of disk; prosternum transversely rugulose, densely clothed with short, erect, pale pubescence; meso- and metasternum very finely, densely punctate at sides, densely clothed with appressed, silvery pubescence, mesosternal process moderately declivous. Elytra almost three times longer than basal width, sides feebly impressed at middle; each elytron with an elevated, glabrous costa near suture and vague one extending from humerus to near apex where it joins with the other; basal punctures fine, sparse, becoming denser and coarser toward apex; pubescence short, sparse; apices sinuate-truncate. Legs slender; hind femora extending to apices of elytra; pubescence fine; hind tarsi elongate. Abdomen finely, densely punctate and pubescent at sides; last sternite truncate at apex. Length, 15–16 mm.

Female.—Form more robust. Antennae about as long as body. Abdomen with last sternite broadly subtruncate at apex. Length, 15–18 mm.

Type locality.—Guerrero, Mexico.

Range.—Guerrero to Oaxaca.

Flight period.—July and August.

The finely punctate, reddish pronotum and sparse punctures at the base of the elytra will separate this species from *miniaticollis*.

New records.—Mexico: 3♂♂, 2♀♀, Acapulco, Guerrero, 9–14 July, 10 August, 1936 (C. Seevers); 1♀, Puerto Angel, Oaxaca, 15 July, 1964 (A. B. Lau); 1♂, 23 mi S Matias Romero, Oaxaca, 14 August, 1963 (Parker, Stange); 1♀, 56 mi NW Tehuantepec, Oaxaca, 27 July, 1963 (W. A. Foster).

Stenobatyle miniaticollis (Chevrolat), **NEW COMBINATION**

Entomosterna miniaticollis Chevrolat, 1862:756; Bates, 1880:86; 1885:330.

Parabatyle miniaticollis, Chemsak and Linsley, 1974:182.

Stenobatyle cribrata Casey, 1912:331; Linsley, 1935:102; Chemsak and Linsley, 1974:182 (synonymy).

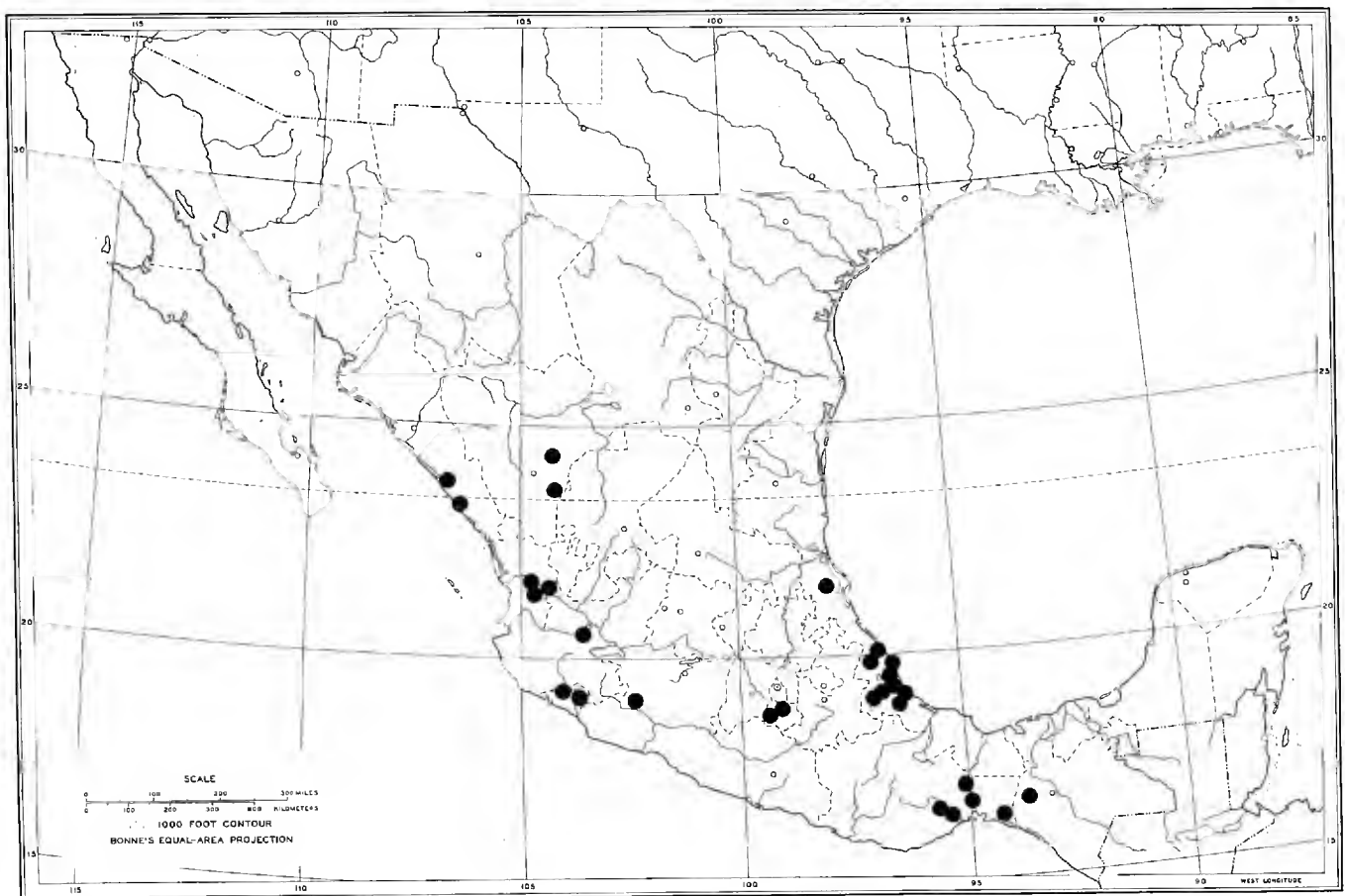


Fig. 2. Known distribution of *S. miniaticollis* (Chevrolat).

Male.—Form moderate sized, slender; integument black, pronotum reddish, usually with a longitudinal, median black spot. Head densely, irregularly punctate, very finely pubescent; antennae slightly longer than body, scape moderately coarsely, densely punctate, outer segments opaque, densely clothed with very short, appressed pubescence, third segment much longer than scape, fourth segment shorter than scape, fifth slightly longer than scape. Pronotum about as long as broad, sides broadly rounded, as broad as elytra at base; disk convex, moderately coarsely, closely punctate at middle, punctures at sides coarse, confluent; pubescence sparse, depressed, transverse; prosternum rugulose, rather sparsely pubescent; meso- and metasternum minutely punctate at sides, rather coarsely at middle, pubescence depressed, silvery, denser at sides, mesosternal process arcuate. Elytra about three times as long as broad, epipleura deeply emarginate at basal one-third; each elytron with a glabrous, elevated, subsutural costa extending from basal margin almost to apex; pubescence very short; apices sinuate-truncate. Legs slender; hind femora extending to apices of elytra; hind tarsi elongate. Abdomen minutely, densely punctate at sides, pubescence denser at sides; last sternite truncate at apex. Length, 7–12 mm.

Female.—Form similar. Antennae about as long as body. Abdomen with last sternite broadly truncate. Length, 8–12 mm.

Type locality.—of *miniaticollis*, Oaxaca, Mexico; *cribrata*, Guerrero, Mexico.

Range.—Sinaloa, Mexico to Veracruz and Oaxaca (Fig. 2).

Flight period.—June to September.

Flower records.—*Buddleia*, *Acacia*.

The reddish, coarsely punctate pronotum and coarse punctures of the elytra will distinguish this species.

Adults are numerous on the flowers of *Buddleia wrightii* in Sinaloa, Mexico, where they commonly occur with *eburata*.

Acknowledgments

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REVIEW OF THE NORTH AMERICAN SPECIES OF *APOCRYPHA*
ESCHSCHOLTZ, WITH A DESCRIPTION OF THE IMMATURE
STAGES OF *APOCRYPHA ANTHICOIDES*
(COLEOPTERA: TENEBRIONIDAE)

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The genus *Apocrypha* was established by Eschscholtz (1831) for *A. anthicoides* Eschscholtz. Subsequently *A. dyschirioides* was described from southern California by LeConte (1851) and *A. clivinoides* from the Owens Valley, California by Horn (1870). Recently 5 additional species have been described from Argentina (Kulzer, 1962; Kaszab, 1969). Lacordaire (1859) placed *Compsomorphus* Solier (1851) in synonymy under *Apocrypha*, and recognized the distinction of the genus by establishing the tribe Apocryphini, which has been recognized ever since. Gebien (1942) listed 6 genera under Apocryphini, including *Melytra* Pascoe from Tasmania and *Diplocyrtus* Quedenfeldt from Morocco. However, knowledge of these uncommonly collected beetles has grown by haphazard accretion, and the tribe will probably require redefinition when adequate material can be compared. The purpose of this paper is to review the species of *Apocrypha* occurring in North America and to describe the immature stages of *A. anthicoides* so that the information will be available for an analysis of the higher classification of Tenebrionidae (Doyen and Lawrence, 1979).

Materials and Methods

For morphological comparison adults and larvae were partially dissected, cleared in hot KOH and then completely dissected under binocular microscopes. Mouthparts and other sclerotized structures were mounted in glycerine jelly so that they could be viewed from various perspectives. Defensive glands and internal parts of the female reproductive tract were cleared, stained with chlorazol black and mounted in Canada balsam. Larvae were obtained by confining adults in containers half-filled with slightly moist sand and providing a variety of grains, dry dog foods and dead insects as food. Prepupal larvae were removed to petri dishes with a shallow layer of sand for pupation.

Apocrypha Eschscholtz

Apocrypha Eschscholtz, 1831:13; LeConte, 1851:137; LeConte, 1862:219;

Lacordaire, 1859:433; Horn, 1871:390; LeConte and Horn, 1883:384; Kulzer, 1962:98; Kaszab, 1969:328.

Compsomorphus Solier, 1851:206; Lacordaire, 1859:433 (synonymy). Type species: *Compsomorphus elegans* Solier (monobasic).

Very small beetles with globular prothorax, constricted, petiolate mesothorax and long slender legs with clavate femora. Eyes moderate, nearly round or with slight anterior emargination; antennae slender, filiform basally, becoming slightly clavate and serrate apically; labrum transversely subrectilinear with medial processes of tormae transverse; mandibles elongate, with prominent retinaculum and smooth (nonstriate) mola; maxillae with galea densely setose, lacinia with 2 large apical teeth and subapical brush of stout setae; labrum small, exposing ligula and maxillae; tentorium with sides short, straight, reaching occipital foramen; tentorial bridge straight (not arched), situated posteriorly. Prothorax globular, rounded, without defined angles or lateral carinae; procoxal cavities closed externally and internally. Mesocoxal cavities closed laterally by apposed sterna, trochantin concealed; mesendosternite with short, slender dorsal arms and stout, horizontal, apically enlarged anterior arms; elytra oval, inflated, abruptly constricted basally; epipleuron narrow, extending from humerus to elytral apex. Metanotum membranous; metendosternite with short, broad stalk, long stout arms without laminae extending to vicinity of elytral articulations and terminating in large apical flanges; tendons inserted medially; wings absent. Abdomen with external membranes between segments 3–5; abdominal glands small, saccate, without annulations; ovipositor with gonostyles small, subapical; aedeagus with tegmen dorsal.

Type species: *Apocrypha anthicoides* Eschscholtz (monobasic).

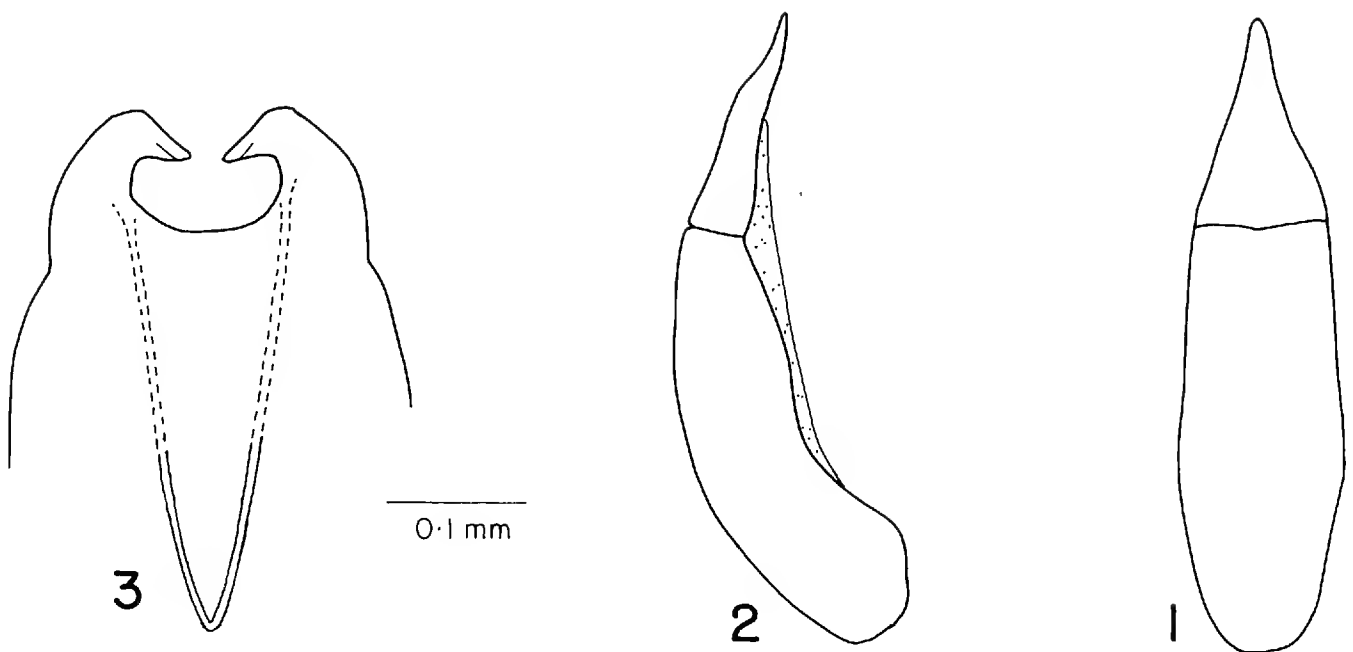
The North American species of *Apocrypha* can be separated by the following key.

1. Pronotum with 2–8 long, projecting setae near each lateral margin of disk; antennae with 3rd segment about 1.3 times longer than 4th . . . 2
 Pronotum without long, projecting setae; antennae with 3rd segment subequal to 4th *anthicoides*
2. Pronotum with 2 long projecting setae near each lateral border of disk; elytra without long, projecting setae *clivinoides*
 Pronotum with 4–8 long projecting setae near each lateral margin of disk; elytra with scattered long setae projecting from disk, denser on humeri and declivity *setosa* n.sp.

Apocrypha anthicoides Eschscholtz
(Figs. 1–3)

Apocrypha anthicoides Eschscholtz, 1831:13.

Apocrypha dyschirioides LeConte, 1851:137. **NEW SYNONYMY.**



Figs. 1–3. *Apocrypha anthicoides*, male genitalic structures. Figs. 1–2, aedeagus, dorsal and lateral, respectively. Fig. 3, eighth sternite and spiculum.

This common species is easily recognized by the 3 rows of about 6 long, erect setae on each elytron; by the absence of long, erect setae on the pronotum; by the barely emarginate eyes; and by the polished lustrous cuticle. The head, pronotum, elytra and abdominal sternites are relatively sparsely punctate, with the punctures separated by about 1.5–2 puncture diameters. The first 3 abdominal sternites are clearly connate, without incised intersegmental sutures. The 8th sternite of the male is deeply emarginate (Fig. 3), and the aedeagus abruptly attenuate to an acutely rounded, upturned apex (Figs. 1–2).

The characters cited by LeConte (1851) and Horn (1870) as distinguishing *A. anthicoides* from *dyschirioides* involved differences in punctation, body size and color. Color ranges from pale tan (in obviously teneral individuals) through brown to black or dark brown with paler elytral humeri. Body length (measured as elytral length plus pronotal length) varies from 1.9–3.1 mm. The smallest individuals are dark brown to black and are predominantly from localities near the seacoast. Larger, brownish individuals and those with pale humeri are predominantly from interior localities. There is continuous variation in both color and size, and large collections from many localities include a range of phenotypes. This pattern of variation appears to conform to Gloger's ecogeographic rule, which has been applied to various other insects (Mayr, 1963:324).

Horn (1870) stated that the pronotum was longer than broad in *A. dyschirioides*, broader than long in *anthicoides*. Measurement of numerous individuals showed that the pronotum is always broader than long, with continuous variation in both dimensions. Furthermore, the distinctive male

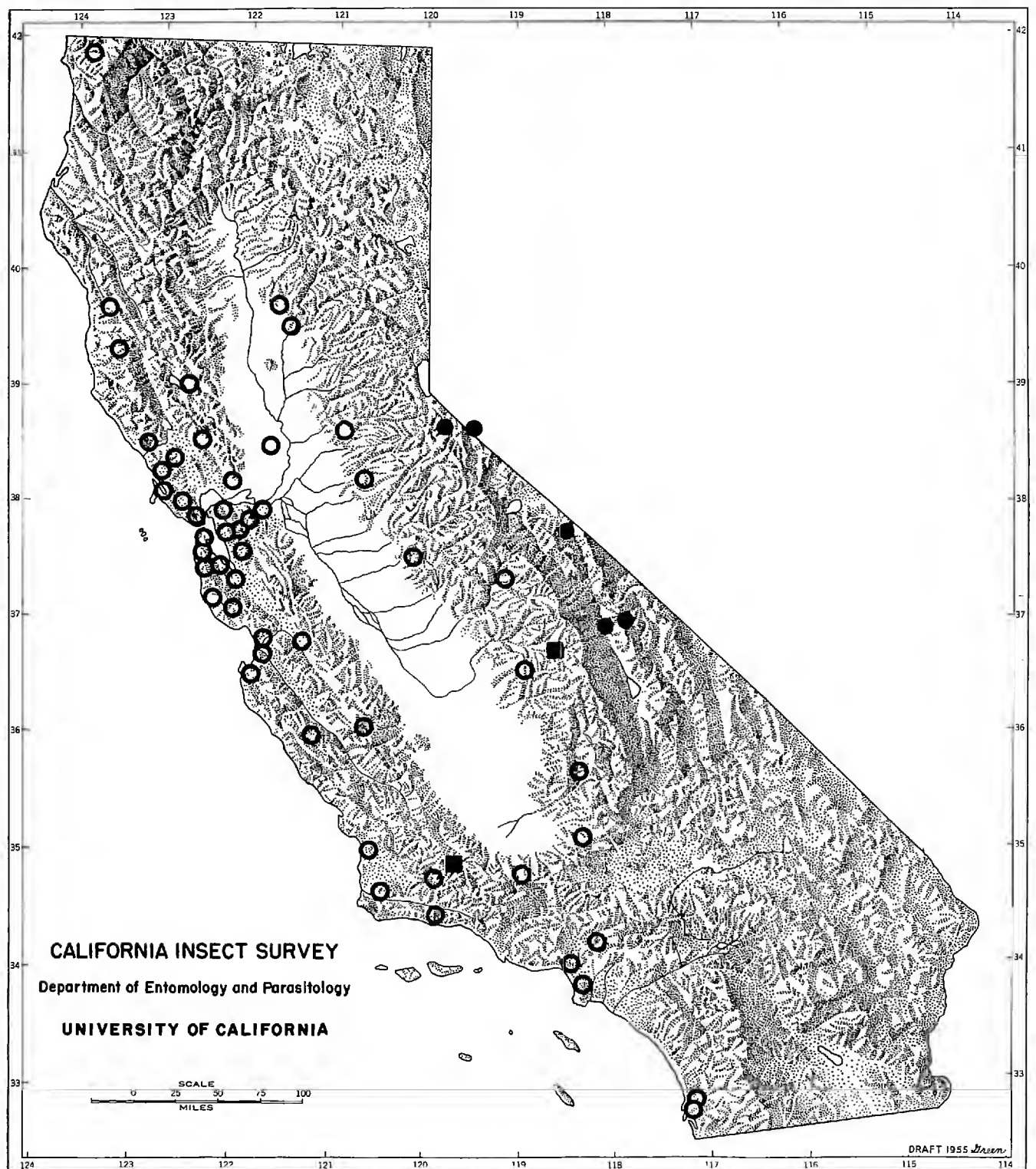
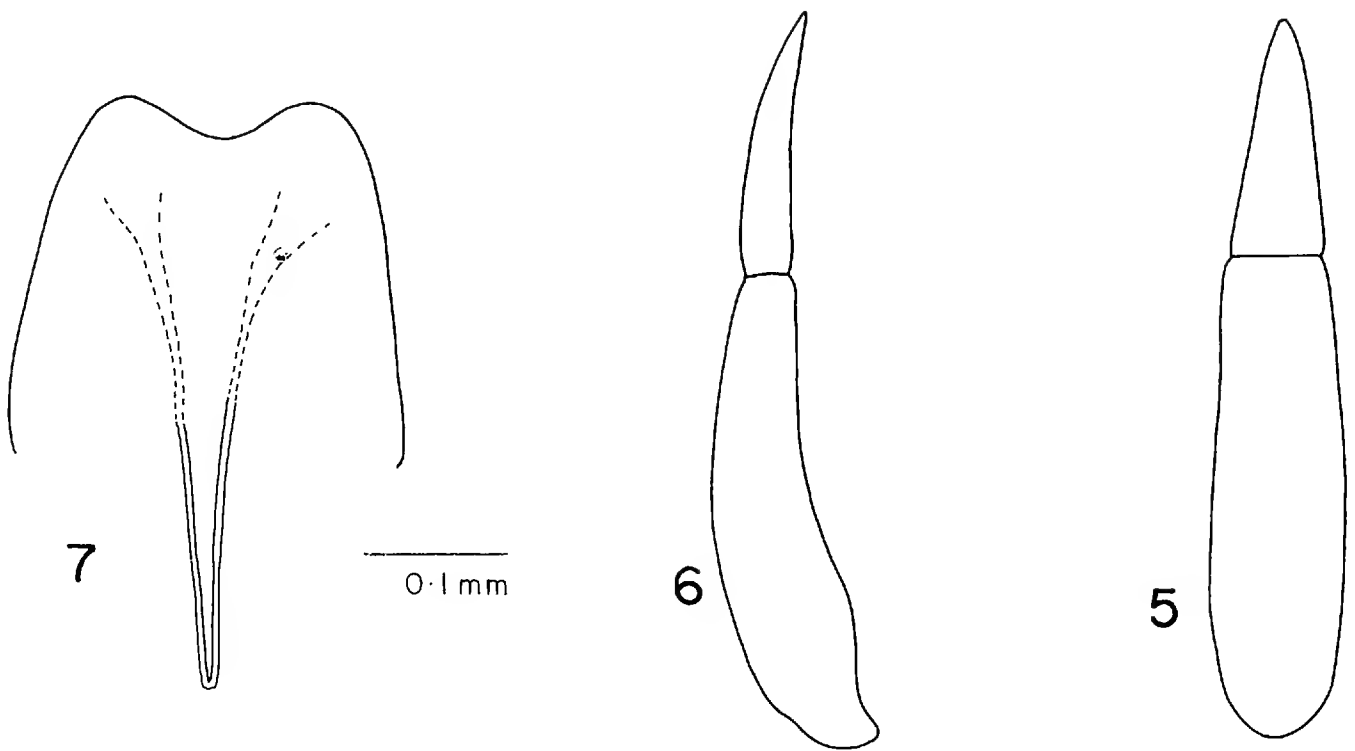


Fig. 4. Distribution of *Apocrypha anthicoides* (open circles), *A. clivinoides* (closed circles) and *A. setosa* (squares).

genitalic characters (Figs. 1–3) were exhibited by all individuals, indicating that a single species is represented.

Apocrypha anthicoides is common below 1200 m from northern Mendocino County and Butte County, south through the Sierra Nevada and the coast ranges to San Diego County (Fig. 4). *A. anthicoides* occurs in coastal sage scrub, chaparral, and about the margins of salt marshes in the coastal part of its range. Interior populations inhabit deciduous or mixed deciduous-



Figs. 5–7. *Apocrypha clivinoides*, male genitalic structures. Figs. 5–6, aedeagus, dorsal and lateral views, respectively. Fig. 7, eighth sternite and spiculum.

coniferous woodland or chaparral habitats, especially in relatively well-drained situations. Nearly all individuals are collected by Berlese extraction of leaf or needle litter.

Apocrypha clivinoides Horn

Apocrypha clivinoides Horn, 1870:391.

The more depressed, elongate form and slightly larger size clearly distinguish this species from *anthicoides*. It is similar to *setosa*, but slightly smaller and has only 2 pairs of long projecting setae on the pronotum (4–8 pairs in *setosa*).

The elytra are densely covered by pale, appressed setae, but lack long, erect setae. The eyes are slightly emarginate, and the cuticle is very finely granulate and dull. The head, pronotum and elytra are densely, almost confluent punctate. The anterior 3 abdominal sternites are separated by incised intersegmental sutures, and the 8th sternite of the male is longer than broad and shallowly emarginate (Fig. 7). The aedeagus gradually attenuates to a sharply rounded apex which is not upturned (Figs. 5–6).

Material examined (Fig. 4).—Calif., Alpine Co., 1 mi. E Woodfords, X-30-1965, N. Ueshima, ex litter *Artemisia* (9); Fresno Co., Summit Meadow, VI-4-1911, R. Hopping (1); Inyo Co., Goodale Creek, N. Lone Pine, IV-3-1953, R. E. Leech (1); 7 mi. SE Benton Crossing, VI-15-1970, M. S. Was-

bauer and F. G. Andrews (1); Waucoba Spr., IV-30-1975, ex litter *Pinus monophylla*, F. G. Andrews (1); Nev., Douglas Co., Topaz Jct., VII-19-1975, ex litter *Pinus monophylla*, A. R. Hardy, F. G. Andrews (3). The single specimen from Summit Meadow, Fresno County, is the only record from west of the Sierran crest. Since the place name Summit Meadow occurs 3 times in Fresno County, an exact collection locality cannot be specified.

Apocrypha setosa, new species
(Fig. 8)

Body slender, elongate, slightly depressed dorsoventrally, medium brown to nearly black; cuticle finely granulate, weakly shining or dull. Head subhexagonal in dorsal aspect, anterior epistomal margin straight; eyes with anterior margin straight or slightly emarginate; ommatidia coarse, numbering about 30 per eye, and set with fine setae at intersections; vertex, frons, genae and subgenae closely, almost confluent set with punctures about as large as ommatidia, and densely clothed with long, pale, appressed setae directed anterad; longer, erect setae located as follows: 1–3 dorsad of each eye, 1–4 in irregular submedian row on each side of vertex and frons, 1–3 near anterolateral corners of epistoma.

Pronotum with broadly rounded anterior corners, sides nearly parallel in anterior half, strongly, evenly converging in posterior half; disk slightly flattened, closely, nearly confluent set with punctures about as large as ommatidia, and densely clothed with pale, appressed setae directed posterad; each lateral margin set with 4–8 long setae projecting dorsolaterally; hypomera and sternum coarsely punctate to punctatorugose, with setal clothing less dense than on disk; sternum bearing about 10–15 long, erect setae. Elytra irregularly set with punctures slightly larger than those on prothorax, separated by about 1–2 puncture diameters, and bearing pale, posteriorly declined setae producing a sparser clothing than on thorax; long, erect setae located as follows: 3–10 in each humeral region; 2–8 arranged in 2 irregular rows on each side of disk; about 25 in irregular patch on declivity. Thoracic and abdominal sternites closely, almost confluent punctate to punctatorugose, and densely set with long, pale, appressed setae interspersed with occasional erect setae; intersegmental sutures incised. Femora, tibiae and tarsi densely covered with pale, appressed setae. Aedeagus gradually attenuate to sharply rounded apex (as in Figs. 5–6); eighth sternite shallowly emarginate (as in Fig. 7).

Length (pronotum plus elytra), 3.0–3.3 mm.

Holotype female and 12 paratypes from New Cuyama, Santa Barbara Co., Calif., VI-28-1975, ex litter *Quercus wizlizenii*, Hobza and Muldowney, colls.; 1 paratype from S. Fork Kings River Canyon, 5000', Fresno Co., Calif., VII-4-1910. The holotype and one paratype are deposited in the Cal-

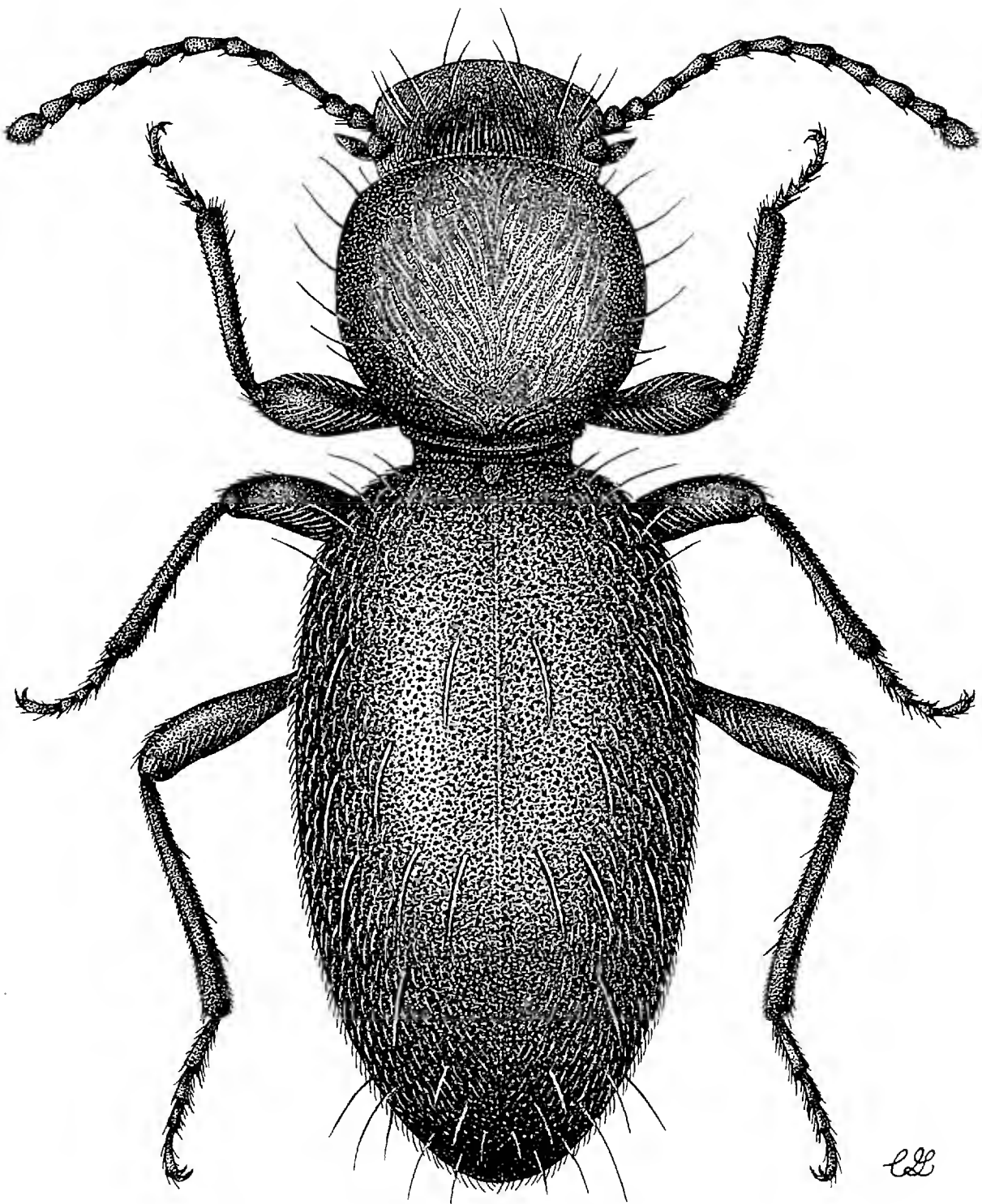


Fig. 8. *Apocrypha setosa*, dorsal aspect.

ifornia Academy of Sciences, San Francisco and paratypes in the collection of the California Department of Food and Agriculture, Sacramento and the Essig Museum of Entomology, Berkeley, California.

The long setae projecting from the lateral margins of the pronotum distinguish *A. setosa* from *anthicoides*, which lacks long setae on the thorax. The larger number of long pronotal setae and the long, erect setae on the elytra of *setosa* distinguish it from *clivinoides*, which averages about 20 percent smaller. Counts of setae vary, even between sides of a single spec-

imen. This variation is partly traumatic, and stubs of setae may be found on some specimens.

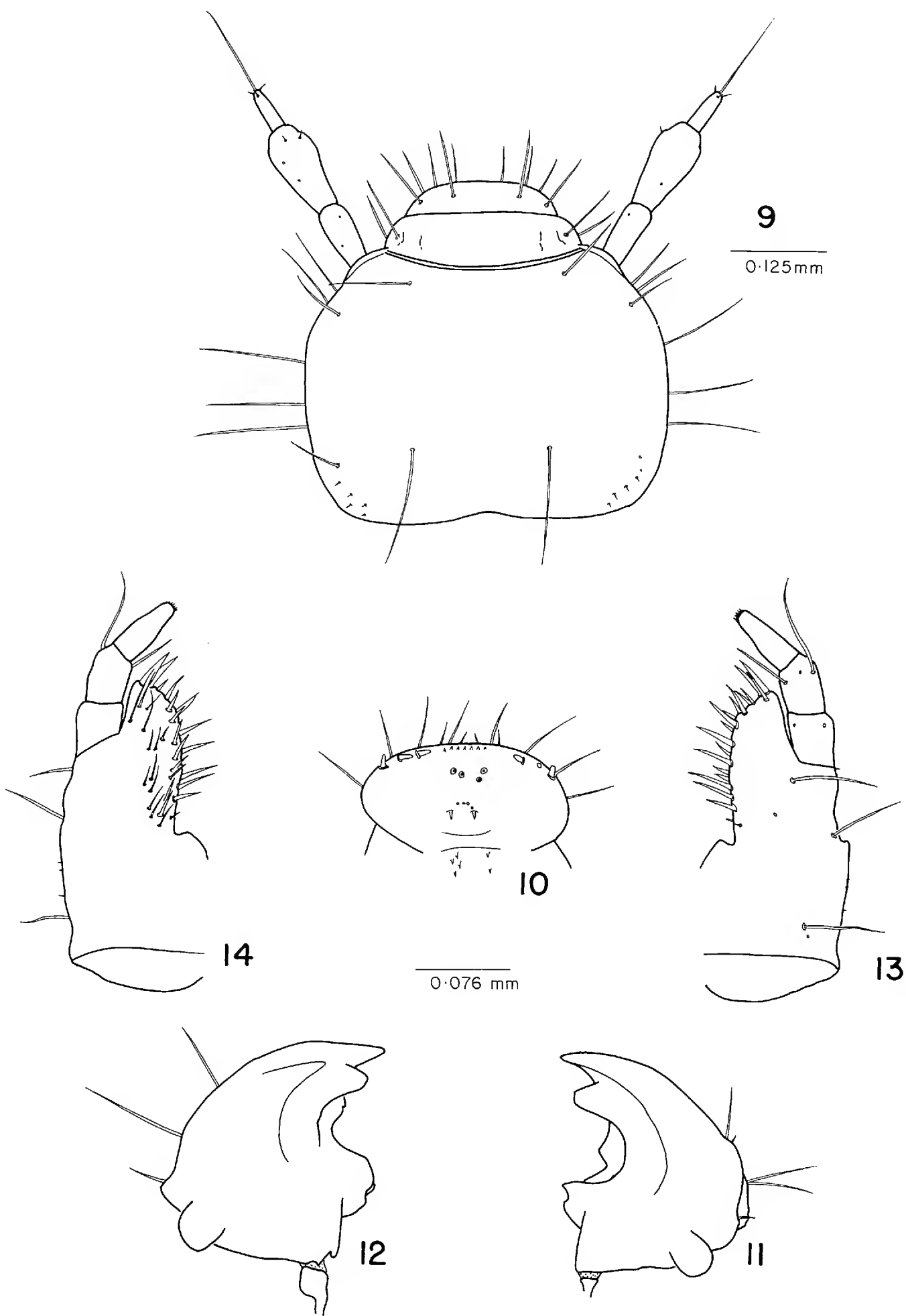
A. setosa and *clivinoides* appear to be largely allopatric, but each is known from a single individual from Fresno County. Unfortunately, as mentioned above, the exact collection locality for *clivinoides* cannot be determined.

Description of the Immature Stages of *A. anthicoides*

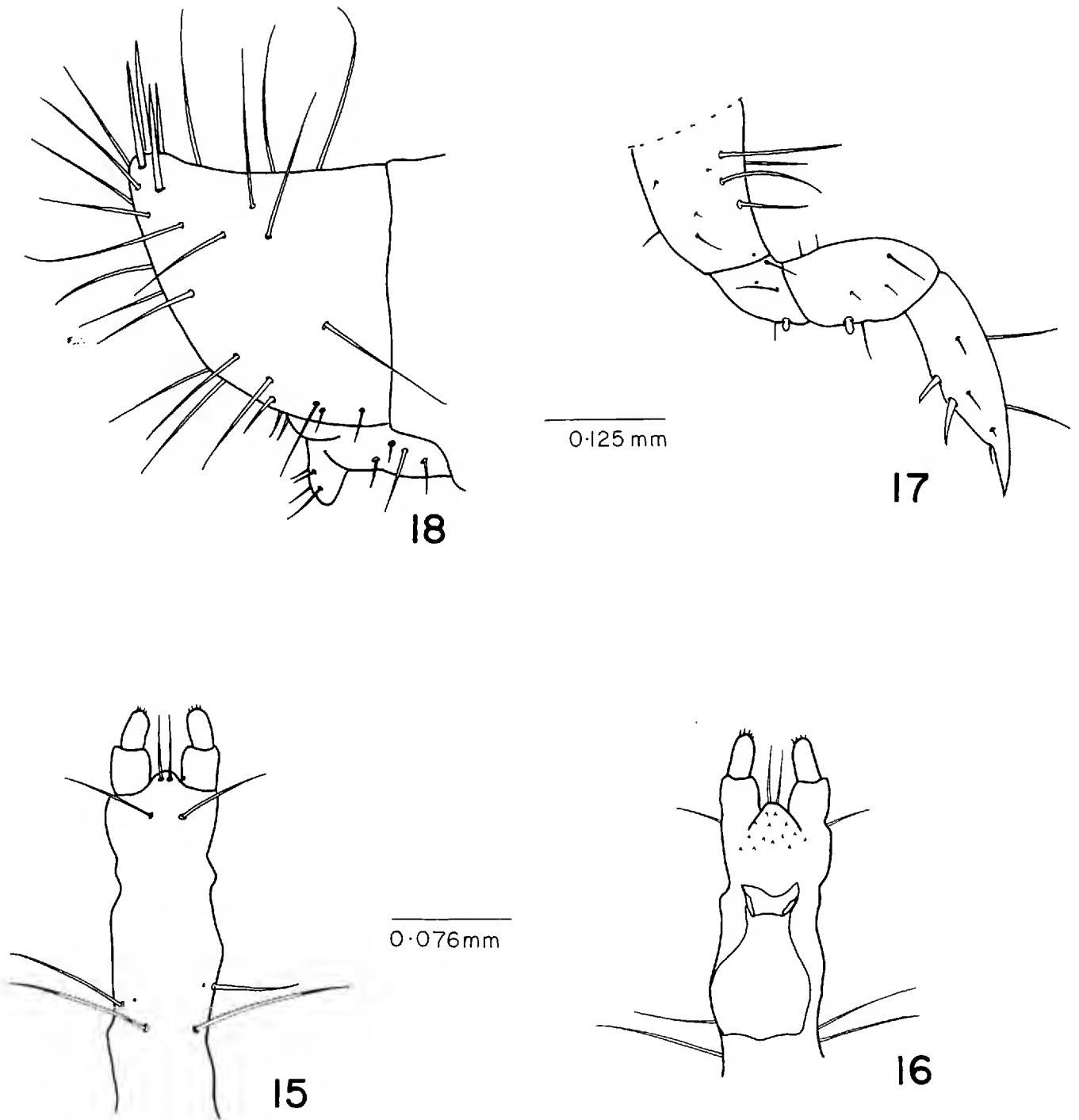
Mature larva (Figs. 9–18).—Body elongate, cylindrical, pale tan in alcohol preserved specimens, creamy in life; cranium, thorax, legs and abdomen lightly sclerotized, fragile; maxillae, clypeus, labrum and labium moderately sclerotized, tan; mandibles and claws heavily sclerotized, dark brown to black.

Cranium (Fig. 9) subquadrate with rounded corners; prognathous, without ocellar lenses; cuticle finely rugose with few setae scattered dorsally and laterally and few short spines posterolaterally; labrum evenly arcuate, with 10 long setae dorsally and marginally; epipharynx (Fig. 10) with 6 short, blunt setae marginally, scattered circular sensillae centrally, and 2 short spines basally; antennae articulated on prominences just laterad of clypeus (Fig. 9); basal segment cylindrical, slender; 2nd segment clavate; 3rd segment shorter, slender, with 1 long and several shorter setae at apex; mandibles (Figs. 11–12) stout with strongly bidentate incisor lobe and massive mola with multituberculate anterior prominence; retinaculum prominent, midway between mola and incisor teeth; basolateral corner of mandible bearing several long, coarse setae; maxillae (Figs. 13–14) with cardo triangularly arcuate, poorly differentiated from stipes; mala with row of stout, sharp setae on medial margin and irregularly scattered finer setae medially on dorsal surface; maxillary palp with basal 2 segments subequal, bearing 2 long setae or setal sockets; apical segment about 1.3 times length of 2nd, gradually narrowing to rounded apex bearing minute, spine-shaped sensillae; labium (Fig. 15) elongate, with submentum, mentum and prementum not delimited by sutures; bearing 4 long setae basally, 2 apically and 2 anteriorly directed shorter setae on ligula; palp with segments subequal in length; apical segment finer, bearing minute, spine-shaped sensillae apically; hypopharynx (Fig. 16) with low, symmetrical, anteriorly concave sclerome; dorsal surface of ligula bearing about 15 sharp teeth.

Prothorax nearly as long as 1st abdominal segment, flattened, partly enveloping head in contracted specimens, glabrous at 100× magnification except for few scattered long projecting setae dorsolaterally and laterally; mesothorax and metathorax similar, about $\frac{2}{3}$ length of 1st abdominal segment; sterna transverse, postcoxales separate on all segments. Legs similar, but prothoracic pair (Fig. 17) about 1.3 times larger than posterior pairs; lightly sclerotized except for articulations, with sparse, scattered setae; cox-



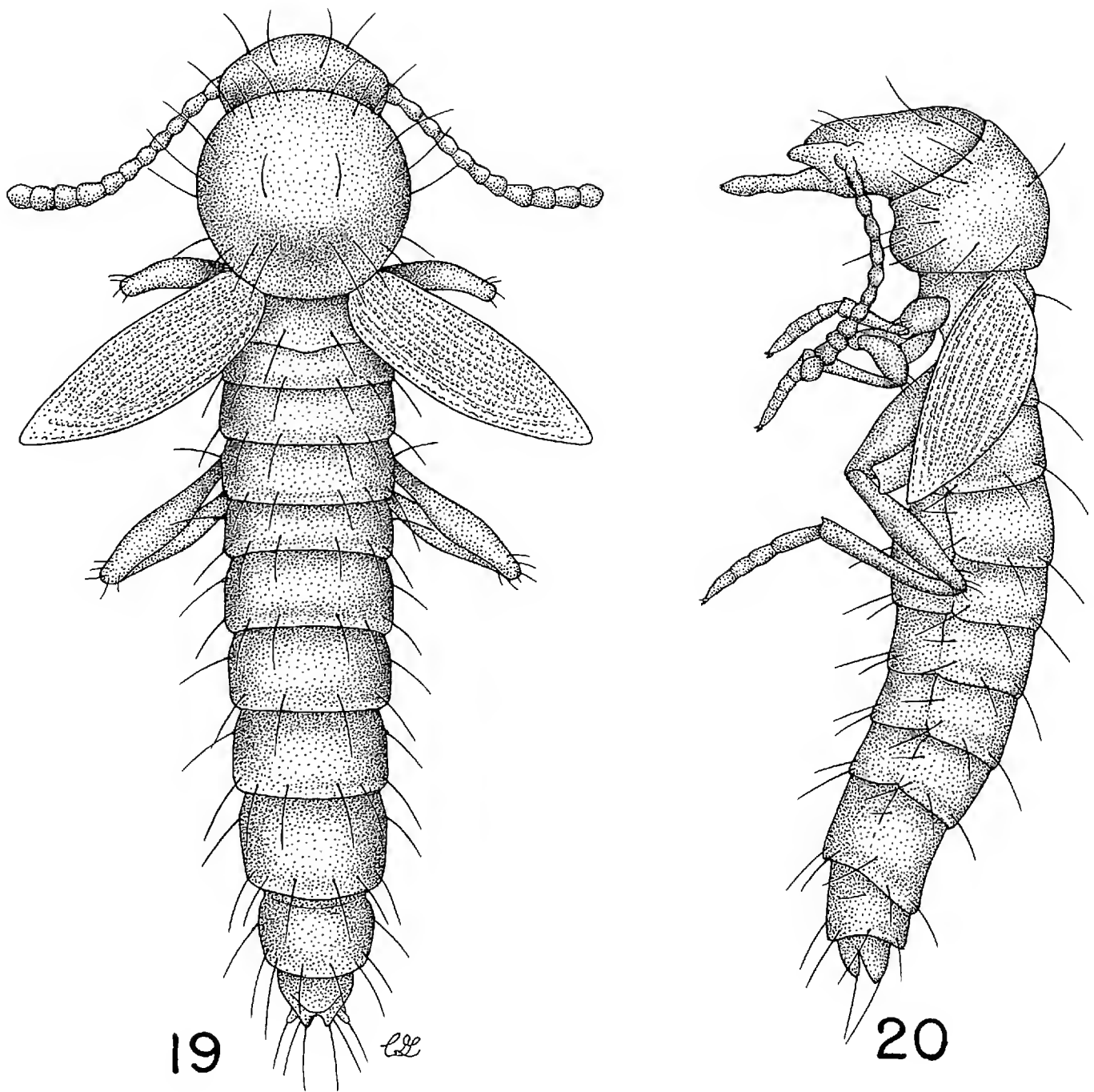
Figs. 9-14. *Apocrypha anthicoides*, larval structures. Fig. 9, dorsal aspect of head. Fig. 10, epipharynx. Figs. 11-12, dorsal aspect of right and left mandibles. Figs. 13-14, ventral and dorsal aspects of left maxilla.



Figs. 15–18. *Apocrypha anthicoides*, larval structures. Fig. 15, labium. Fig. 16, hypopharynx. Fig. 17, anterior aspect of left foreleg. Fig. 18, lateral aspect of abdominal apex.

ae directed anteroventrally, forecoxae contiguous, middle and hind coxae separated by about 1.5 coxal diameters; trochanters short, triangular, with single tuberculate seta on each foremember, slender setae on posterior pairs; femora about as long as coxae, stout, bearing single tuberculate seta on each foremember; tibiae subequal in length to femora, broadest in middle and bearing 2 large, stout setae on mesal surface of each foremember, slender setae on posterior pairs; claw stout, sharp, without differentiated base and apex.

Abdominal segments cylindrical; segments 1–8 subequal, subquadrate in



Figs. 19–20. *Apocrypha anthicoides*, pupa, dorsal and lateral aspects respectively.

dorsal aspect, glabrous at 100 \times magnification except for sparsely scattered long setae dorsolaterally and laterally; 9th segment (Fig. 18) about half length of preceding segments, tapering to rounded apex bearing 4 stout, stiff, erect spines and bearing numerous long slender setae on dorsal, lateral and ventrolateral surfaces; 10th segment small, subtending 9th, with short, blunt pygopods posteriorly. Spiracles simple, annular.

Length, 5.5–6.5 mm; head capsule width, 0.49–0.52 mm.

Pupa (Figs. 19–20).—Elongate, subcylindrical with enlarged globular prothorax, diagonally projecting elytra, and deflexed head; cream colored with long fine setae.

Head elongate, slightly depressed, exerted and deflexed beneath pro-

thorax (Fig. 19); vertex and epistoma with sparsely scattered, long, erect setae; antennae free, extending posterolaterally above or below forelegs and elytra.

Prothorax globular, excavated anteroventrally for reception of head; lateral margins rounded, without trace of carina; pronotum nearly round in dorsal aspect, with scattered, long, erect setae peripherally; mesonotum about $\frac{1}{3}$ as long as pronotum, narrower anteriorly, subequal in width to metanotum posteriorly, and bearing 2 long setae between elytra; elytra directed diagonally backward and slightly downward or nearly horizontal, faintly 9-striate, glabrous; metanotum short, transverse, bearing 2 long erect setae; wing sheaths about $\frac{3}{4}$ as long as elytra, without apparent venation; metacoxae projecting ventrally well below level of abdomen. Femora clavate, with short setae on knees.

Abdominal segments 1–6 subcylindrical, about twice as broad as long, bearing sparsely scattered, long, posteriorly declined setae; lateral margins without gin traps, but with 2 small tubercles each bearing long, projecting seta; segment 7 tapering, rounded posteriorly; abdominal apex with apparently 2-segmented projecting papillae in female, shorter unsegmented papillae in male.

Length, 3.0–3.5 mm.

Material examined.—5 larvae, laboratory reared from adults collected in Calif., S. L. Obispo Co., San Simeon, IV-1976, C. Y. Kitayama; harvested XII-1976. 20 larvae, 6 pupae, laboratory reared from adults collected in California, S. L. Obispo Co., 3 mi. S Oceano, II-23-1975, J. Doyen; harvested IV-18 to VII-24-1975.

The larvae of *Apocrypha* are superficially very similar to larvae of *Tribolium* and other small Ulomini. As elaborated below, this similarity extends to several anatomical details. Berlese extraction yielded only adult beetles, suggesting that the larvae inhabit deeper layers of the soil. The absence of gin traps on pupae is unusual in Tenebrionidae. Presumably the tiny lateral abdominal tubercles represent reduced gin traps. Presence of pupal wing sheaths in brachypterous or flightless Coleoptera is common (Smith, 1964; Spilman, 1979). In species in which the adult is entirely wingless, the pupal wing sheath is usually much shorter than the elytral sheath, and the adult wing is absent or only partly fills the sheath, and degenerates before the adult emerges. *Apocrypha* is unusual in that the adult is completely apterous with the metanotum reduced to a membrane, yet the pupal wing sheaths are about two-thirds as long as the elytral sheaths and about half as broad. No imaginal wings are visible within the pupal sheaths, although wings could have been present and degenerated, since the ages of the pupae are unknown.

Spilman (1979) examined pupae of various wingless and brachypterous Coleoptera, and concluded that in general pupal wing sheaths are short or

absent in taxa in which brachyptery or winglessness is widespread. In contrast, in taxa with occasional wingless or brachypterous members, pupal wing sheaths are long. This might suggest that *Apocrypha* represents a specialized, wingless member of some larger taxon containing mostly winged species. However, the apparent total absence of imaginal wings suggests derivation from a higher taxon in which wing reduction is widespread. The only other species of Apocryphini which we have dissected, *A. clivinoidea*, is apterous.

Apocrypha shows some other interesting differences between the pupa and adult. In the adults long, erect setae are present on the elytra and head, absent from the thorax. In the pupa, setae are present on the head and pronotum but absent on the elytra. The elytra of adult *Apocrypha anthicoides* are without defined striae, although striae are present in some South American species (Kaszab, 1969). In pupae of *A. anthicoides* striae are visible, though very faint in some specimens. These pupal striae are difficult to count, but apparently are nine in number.

Phylogenetic Relationships

Apocryphini has been placed as a tribe in the subfamily Tenebrioninae since the work of Lacordaire (1859), who suggested a position close to Helopini. Watt (1974) treated Apocryphini as a tribe of Lagriinae, but indicated only a few characters of adults which support this relationship—notably, the absence of lateral pronotal carinae (shared with Lagriini) and the presence of 10-striate elytra in some (unspecified) species (universal in Lagriinae). Similarities resulting from loss of structures (such as carinae) can easily arise through convergence. The retention of 10 elytral striae is a primitive feature in Coleoptera, and not very useful in indicating cladistic relationship. Moreover, the pupal elytra of *A. anthicoides* bear only 9 striae, suggesting that this may be the primitive number for the genus.

Watt's Lagriinae is defined primarily by characters of the larvae, especially the structure and position of the antennae. In most Tenebrionidae the larval antennae have three subequal segments or have the third segment variably reduced. In Lagriinae the larval antennae have two densely pubescent segments, with the second much longer than the first. The second segment bears a distinctive sensorium or group of sensillae at the apex, and the antennae are clearly separated from the bases of the mandibles by a strip of cuticle (contiguous in all other Tenebrionidae except Nilionini). In addition the epipharynx and hypopharyngeal sclerome are highly asymmetrical in Lagriinae (symmetrical in most Tenebrionidae). In all of these features *Apocrypha* exhibits the generalized character state common to Tenebrioninae and most other subfamilies. In addition, the larva of *Apocrypha* is elongate, cylindrical, and weakly sclerotized. Larvae of Lagriinae are

usually much stouter, flattened and moderately sclerotized, especially dorsally.

Several features of adult *Apocrypha* indicate derivation from Tenebrioninae. The labrum is short and transverse (elongate in Lagriinae) and the epipharynx membranous and symmetrical (asymmetrical with sclerotized plates in Lagriinae). The ovipositor has the gonostyles short and situated subapically. In Lagriinae, Diaperinae and most other primitive subfamilies the gonostyles are elongate and apical. The defensive glands are small and saccate, and the bursa copulatrix bears a single accessory tube which branches to form the spermatheca and the accessory gland. Diverse glandular structures occur in Lagriinae, but simple saccate glands without extrinsic musculature are not represented (Tschinkel and Doyen, in press). In many Lagriinae multiple spermathecal tubules originate independently from the bursa. In other Lagriinae the bursa (which may be constricted to produce 2 subequal chambers) bears a single, unbranched tube which apparently represents the spermathecal accessory gland.

Precise affinities of Apocryphini within Tenebrioninae cannot be specified with certainty. Lacordaire's *Helopides* contained Adeliini, Misolampini and Helopini, as well as *Apocrypha*. These taxa share only a general similarity in superficial external characters, and are now classified in remote parts of the Tenebrionidae. Misolampini appear synonymous with Coelometopini based on structures of defensive glands and the female reproductive tract (Tschinkel and Doyen, in press), which are very different than those in *Apocrypha*. Described larvae of Helopini have long, recurved urogomphi, frequently opposing sclerotized processes on abdominal tergite eight, and have the hypopharyngeal sclerome tridentate apically. The larva of *Apocrypha* lacks urogomphi, has the sclerome concave anteriorly and the head and mouthparts differ in many structural details from those of Helopini (see Byzova and Gilyarov, 1956).

Several of the larval features of *Apocrypha* are shared with Opatrini and/or the *Tribolium* group of Ulomini. For example, the third antennal segment is relatively large in *Tribolium*, *Palorus* and *Alphitophagus* (Ulomini), as in *Apocrypha*. The mandibles of *Apocrypha*, with large, subequal incisor teeth and the large anterior molar prominence, are similar to those of many Ulomini and Opatrini (see Hayashi, 1966). Likewise, the anteriorly concave hypopharyngeal sclerome is shared with many representatives of those tribes. The enlarged forelegs of *Apocrypha*, with modified, peg-shaped setae on the trochanter and femur, are similar to those of many Opatrini and Pedinini (see Hayashi, 1966; Keleinikova, 1966; Skopin, 1960). Finally, the stiff marginal spines on the apex of the ninth abdominal tergite are shared with many Opatrini and Ulomini.

Some of the features discussed above are probably plesiomorphic and not indicative of cladistic relationships. For example, the relatively elongate

antennae, with approximately equal segments, are probably primitive to the subfamily Tenebrioninae, if not the entire family. Other features, such as the enlarged forelegs with specialized spination, and the elongate, cylindrical body without urogomphi are shared by soil inhabiting species from several tribes (e.g., the *Pedobionta* of Skopin, 1964 or the combined tenebrioid and opatroid lineages of Keleinikova, 1963). Such features may have arisen convergently in *Apocrypha*. However, the balance of characters indicates a position near Opatrini or Ulomini, where Apocryphini should be retained as a separate tribe until its relationships can be further elucidated.

Acknowledgments

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**TWO NEW SPECIES OF *MACRUROHELEA* FROM CHILE
WITH A KEY TO THE NEOTROPICAL SPECIES
(DIPTERA: CERATOPOGONIDAE)**

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Ingram and Macfie (1931) described *Macrurohelea* for two species from southern South America, *M. caudata* I. & M., the type species, and *M. thoracica* I. & M. Wirth (1965) presented a revised diagnosis of the genus, described two new species from Chile, and offered a key to separate the known species. He also discussed the relationship of the genus with *Stilobezzia* Kieffer and other genera considered to be related to that genus. Wirth (1974) assigned *Macrurohelea* to the tribe Stilobezziini and Wirth et al. (1974) included the genus in their key to the genera of Ceratopogonidae. Grogan and Wirth (1977), in their revision of the Nearctic *Parabezzia* Malloch stated that the male genitalia of *Macrurohelea* are similar to those of *Parabezzia*, and to the closely related *Fittkauhelea* Wirth and Blanton.

Subsequently, Grogan and Wirth (1979), in describing the new genus *Notiohelea* from Chile, remarked on the similarity of that genus and *Macrurohelea* to *Ceratopogon* Meigen. They stressed that all three of these genera possess sensilla coeloconica on the first flagellomere of the antenna, a character absent in *Stilobezzia* and its relatives. At least one species of *Macrurohelea*, *M. thoracica* Ingram and Macfie, has sensilla coeloconica present on flagellomeres 5-8 as well as on one. We have seen only one other species of Ceratopogonini possessing these sensilla beyond the first flagellomere, *Brachypogon fuscivenosus* (Lutz), which also has them on flagellomeres 2-4. We have not found any other ceratopogonids except for the Culicoidini with these sensilla on the distal flagellomeres.

On the basis of its sensillar characters, we assign *Macrurohelea* to the tribe Ceratopogonini. This placement of *Macrurohelea* is supported by its possession of pubescence between the eye facets. The genus is perhaps most closely related to *Ceratopogon* and is probably a sister group of that

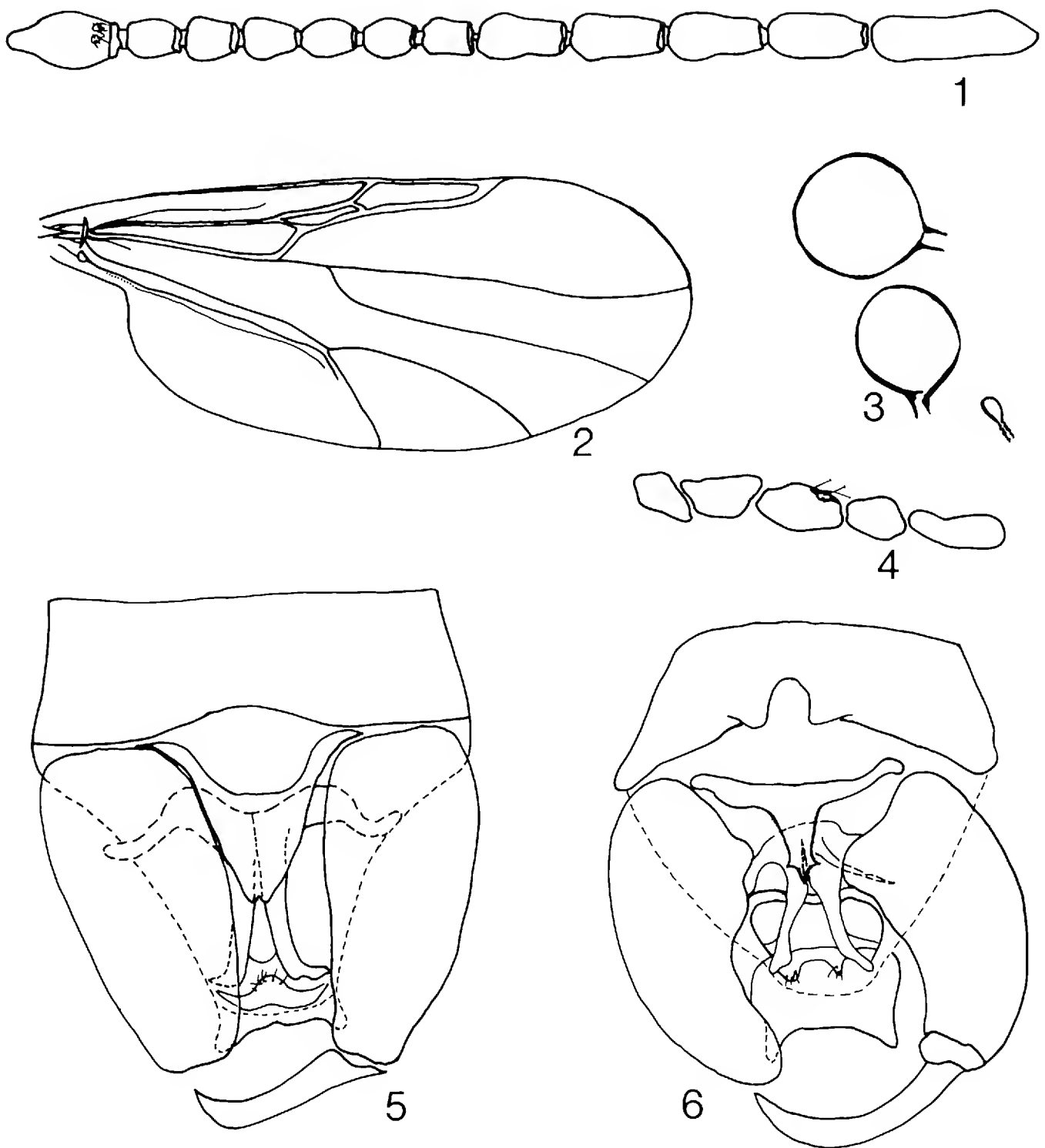
genus that is restricted to the southern hemisphere. *Ceratopogon* is a Holarctic genus, ranging north to at least 82°N latitude and probably as far south as 35°N. *Macrurohelea* exhibits a similar latitudinal distribution in South America.

In the present paper we describe two new species of *Macrurohelea* recently taken by M. E. Irwin in Chile. These descriptions increase the number of known species of the genus to seven, and there are probably many more yet to be discovered. An Australian species, *M. commoni* Lee (1962), is not included in the present key but is distinguished from all of the Neotropical species by having the second radial cell over four times the length of the first.

For an explanation of general ceratopogonid terminology see Wirth (1952); terms dealing with male genitalia are those of Snodgrass (1957); terminology of antennal sensilla follows Wirth and Navai (1978). We gratefully acknowledge the aid of Susan Powell, who prepared the illustrations.

Key to the Neotropical Species of *Macrurohelea*

- | | |
|---|---|
| 1. Females | 2 |
| Males | 6 |
| 2. Second radial cell of wing twice as long as the first | 3 |
| Second radial cell at least 3 times as long as the first | 4 |
| 3. Flagellum very short, flagellomeres 9–12 each broader than long, antennal ratio 0.59; very small species, wing length 0.94 mm ... | |
| <i>kuscheli</i> Wirth | |
| Flagellum longer, flagellomeres 9–12 each twice as long as broad, antennal ratio 1.06–1.16; small species, wing length 1.27–1.42 mm | |
| <i>irwini</i> new species | |
| 4. Small species, wing length 1.3–1.5 mm; intercalary fork of wing present | |
| <i>caudata</i> Ingram and Macfie | |
| Larger species, wing length 2.1 mm or greater; intercalary fork of wing absent | 5 |
| 5. Flagellomeres 5–8 with apical sensilla coeloconica; legs with inconspicuous setae; wing including the veins pale | |
| <i>thoracica</i> Ingram and Macfie | |
| Flagellomeres 5–8 lacking sensilla coeloconica; legs with numerous long bristly setae; wing including veins infuscated dark brown .. | |
| <i>setosa</i> Wirth | |
| 6. Large species, wing length 2.1 mm or greater | 7 |
| Smaller species, wing length less than 1.5 mm | 8 |
| 7. Legs with numerous long bristly setae; wing including veins infuscated dark brown | |
| <i>setosa</i> Wirth | |



Figs. 1-5. *Macrurohelea irwini*; 6, *M. paracaudata*. 1, female antenna; 2, female wing; 3, spermathecae; 4, female palpus; 5, 6, male genitalia.

- Legs with inconspicuous setae; wing including veins pale
 *thoracica* Ingram and Macfie
8. Very small species, wing length 0.90 mm ... *paracaudata* new species
 Small species, wing length 1.3 mm or greater 9
9. Intercalary fork of wing present; second radial cell subequal to first
 *caudata* Ingram and Macfie
- Intercalary fork of wing absent; second radial cell twice as long as
 first *irwini* new species

Macrurohelea irwini, new species
(Figs. 1–5)

Diagnosis.—A small species of *Macrurohelea* distinguished by the following combination of characters: Wing length 1.27–1.43 mm, the second radial cell twice as long as the first; females with long antennal flagellum, flagellomeres 9–12 twice as long as broad, antennal ratio 1.06–1.16; males with tip of aedeagus bifid.

Holotype female.—Wing length 1.27 mm; breadth 0.50 mm.

Head.—Brown. Eyes pubescent; barely contiguous; facets broadly separated. Antenna with dark brown pedicel; flagellum (Fig. 1) with proximal eight flagellomeres globose, distal five flagellomeres more elongated, about twice as long as broad; first flagellomere with 2–3 apical sensilla coeloconica; proximal flagellomeres each with subbasal whorl of six sensilla chaetica and a central whorl of three long sensilla trichodea; distal five flagellomeres with scattered sensilla chaetica and sensilla basiconica; flagellomeres with lengths in proportion of 12-7-7-7-7-7-7-7-11-12-12-12-20; antennal ratio 1.10. Palpus (Fig. 4) light brown; lengths of segments in proportion of 6-12-11-7-12; third segment twice as long as broad with a small shallow apical pit bearing slender capitate sensilla. Mandible with 9–10 teeth, distal teeth longest.

Thorax: Dark brown with sparse scattered setae and fine pubescence. Legs uniform brown; femora with sparse setae, setae on tibiae moderately dense; first tarsomere of fore and hind legs with well developed palisade setae; fourth tarsomeres cordate; fifth tarsomeres about three times longer than broad with small equal simple claws. Wing (Fig. 2) hyaline, moderately broad, about 2.5 times longer than broad, veins grayish; second radial cell twice as long as first; costa extending to 0.70 of wing length; venation as figured. Halter stem light brown; knob pale.

Abdomen: Dark golden brown; covered with uniform, fine pubescence and a few scattered setae on sterna and terga. Tenth segment elongated and bent forward ventrally as is typical for members of the genus. Spermathecae (Fig. 3) heavily sclerotized, spheroid, subequal, with stout, moderately long necks.

Allotype male.—Similar to holotype female with the usual sexual differences. Wing length 1.43 mm; breadth 0.49 mm; costa extending to 0.62 of wing length; flagellum and fifth tarsomeres and claws of fore and mid legs lost. Genitalia as in Fig. 5. Ninth sternum about three times broader, than long, with a shallow caudomedian excavation; ninth tergum tapering rather abruptly distally to a narrow truncate apex bearing two short apicolateral processes, cerci very short and subapical to apicolateral processes. Basimere nearly straight, about twice as long as broad; telomere about half the length of basimere, curved gradually distally to pointed tip. Aedeagus triangular, slightly broader than long, moderately heavily sclerotized with deep

basal arch about $\frac{1}{3}$ of total length; membrane spiculate but ventral surface of aedeagus bare; basal arms heavily sclerotized and recurved 90° ; distal portion tapering rather abruptly to slightly bifid tip. Claspettes nearly separated; basal arm very heavily sclerotized and doubly recurved; distal portion lightly sclerotized with tips bent at 90° .

Variation.—*Females.*—Wing length 1.37 (1.27–1.41, $n = 4$); breadth 0.57 (0.50–0.61, $n = 4$). Antennal ratio 1.11 (1.06–1.16, $n = 3$).

Distribution.—Chile; known only from the type locality.

Types.—Holotype female, allotype male, 3 paratype females, Chile, Santiago Prov., Quebrada de la Plata Maipú, $33^\circ30'S$, $70^\circ55'W$, 10 Aug. 1966, M. E. Irwin (Deposited in Calif. Acad. Sci., San Francisco; paratypes in U.S. National Museum and University of California, Riverside).

Discussion.—We take great pleasure in naming this species for its collector, Michael E. Irwin of the University of Illinois, in recognition of his contributions to our knowledge of Chilean Diptera.

M. irwini was taken at the same time and place as the holotype male of *M. paracaudata* n.sp. We are associating the single male of *M. irwini* with the females of this species because they are nearly identical in size, as is the case with other species in this genus.

This species appears to be most similar to *M. kuscheli* Wirth in having a small, short, broad wing with the second radial cell twice as long as the first. However, *M. kuscheli* differs from *M. irwini* in having a smaller wing (wing length 0.94 mm), shorter antenna (antennal ratio 0.59) with flagellomeres 9–12 broader than long. The male genitalia of *M. irwini* are distinctive and easily distinguished from those of other species by the broad triangular aedeagus with bifid tip.

***Macrurohelea paracaudata*, new species**

(Fig. 6)

Diagnosis.—A small species of *Macrurohelea*: males distinguished by the following combination of characters: Small size (wing length 0.90 mm); ninth sternum with distinct caudomedian notch bearing setose tubercles on each side; aedeagus with hastate tip.

Holotype male.—Wing length 0.90 mm; breadth 0.34 mm.

Head.—Brown. Eyes pubescent, moderately broadly separated. Pedicel of antenna dark brown; flagellum lost. Palpus light brown; segments shrunken and not measured; fifth segment more than twice as long as fourth.

Thorax.—Dark reddish brown with sparse scattered setae and fine pubescence. Legs uniform lighter brown; femora with sparse setae, tibiae with more dense setae; first tarsomere of fore and hind legs with well developed palisade setae; tarsi of mid legs and all but first tarsomere of hind leg lost;

fourth tarsomere of fore leg cordate; fifth tarsomere of fore legs slender with small, equal, simple claws. Wing similar to that of *M. irwini* n. sp. (Fig. 2); second radial cell about 1.4 times the length of first; costa extending to 0.64 of wing length. Halter lost.

Abdomen.—Dark golden brown. Genitalia as in Fig. 6. Ninth sternum with caudomedian notch bearing setose tubercles on each side; ninth tergum gradually tapering distally to a broad truncate tip bearing two rather long apicolateral processes; cerci short, subapical to apicolateral processes. Basimere greatly curved, nearly twice as long as broad with basal mesal lobe; telomere nearly the length of basimere, greatly curved to pointed tip. Aedeagus rather short, 1.3 times broader than long, heavily sclerotized with very shallow basal arch only about $\frac{1}{4}$ of total length, membrane and ventral surface not spiculate; basal arm rather long and slender with recurved tip; distal portion very short and not as heavily sclerotized, the tip hastate or shaped like the point of a crowquill pen. Claspettes nearly fused at base; basal arm heavily sclerotized with slender, ventrally projecting portion; distal portion more lightly sclerotized with broad flat tip that bends at apex.

Female.—Unknown.

Distribution.—Chile; known from a single specimen from the type locality.

Type.—Holotype male, Chile, Santiago Prov., Quebrada de la Plata Maipo, 33°30'S, 70°55'W, 10 August 1966, M. E. Irwin (Calif. Acad. Sci.).

Discussion.—The affinities of *M. paracaudata* with other species of the genus are uncertain, but this species has a low aedeagus similar to that of *M. caudata* Ingram and Macfie, hence the specific name. *M. caudata* differs by having a straight stout basimere, a narrower ninth sternum, apex of ninth tergum lacking apicolateral processes, and wing with an intercalary fork.

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NOTICE

BELTSVILLE AGRICULTURAL RESEARCH CENTER SYMPOSIUM V

The Beltsville Agricultural Research Center sponsors an annual research symposium with a specific theme. The subject of the fifth "BARC Symposium" will be "Biological Control in Crop Production." It is scheduled for May 19 to May 21, 1980. Subject matter will be presented as invited lectures and contributed posters with the lectures published in the BARC symposium series (5th volume). Previous symposia in this series were: (1) Virology in Agriculture, (2) Biosystematics in Agriculture, (3) Animal Reproduction, and (4) Human Nutrition Research: Questions and Answers.

Registration and a reception will be held Sunday evening followed by five technical sessions held Monday morning through Wednesday noon. The sessions are as follows:

Session 1—Relevance of ecological theories to practical biological control.

Session 2—Concepts, principles and mechanisms of biological control of pests.

Session 3—Recent advances in mass production of biological control agents.

Session 4—Strategies of biological control.

Session 5—General considerations: Environmental, regulatory, safety, economic and biocontrol in integrated pest management systems.

Voluntary poster presentations will be held Monday from 5:30 to 7:30 pm. Registration fee \$60.00.

Anyone wishing to receive a registration packet for this symposium should contact:

Publicity Chairman, Symposium V, Room 214, Bioscience Bldg 011A, BARC-West, Beltsville, Md. 20705.

**PARASITISM OF SWEAT BEES IN THE GENUS *AGAPOSTEMON*
BY CUCKOO BEES IN THE GENUS *NOMADA*
(HYMENOPTERA: HALICTIDAE, ANTHOPHORIDAE)**

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Nomada is a large Holarctic genus of cleptoparasitic ("cuckoo") bees whose species superficially resemble wasps. Most species parasitize soil-nesting bees in the genus *Andrena* (Andrenidae), but a few have been recorded from other soil-nesting Andrenidae (*Panurgus*, *Nomadopsis*), Halictidae (*Halictus*, *Lasioglossum*, *Evyllaesus*, *Nomia*), Melittidae (*Melitta*, *Dasygoda*), and Anthophoridae (*Eucera*) (Stoeckhert, 1933, 1954; Stephen, Bohart, and Torchio, 1969; Bohart, 1970). Despite the abundance of many species of *Nomada*, only Linsley and MacSwain (1955) have conducted detailed studies of their biology. Rozen (1966) described the larvae of five species and he (Rozen, 1977) also described the pupa of one species and summarized nomadine behavior.

In this paper we record the first definite association between species of *Nomada* and host species in the sweat bee genus *Agapostemon* (Halictinae). Species of *Nomada* previously had been suspected of parasitizing species of *Agapostemon* (Linsley, MacSwain, and Smith, 1954; Roberts, 1969) but were never recovered from nest cells. We also present observations on nest-entering behavior, development of immature stages, and incidence of parasitism to supplement the meager biological data on *Nomada*.

Materials and Methods

Nomada (Nomadula) articulata Smith was studied in Ithaca, Tompkins Co., New York, principally on the Cornell University campus. J. A. made a detailed study of the above-ground behavior of one of its hosts, the univoltine, communally nesting *Agapostemon virescens* (Fabricius), at an aggregation of 13 nests in a 2 sq. m area in a weedy, sporadically mowed campus location in 1975 (Abrams, 1977¹). Three female *N. articulata* were captured as they emerged from host nests, on 1 and 3 June and 5 July. She observed 15 female parasites at the nest site in June and July. Eleven of these were marked for individual recognition; seven reappeared at the nest site. She also recovered three adult *N. articulata* in host nests excavated in October. At the same site, G.C.E. excavated a nest containing immature *N. articulata* on 18 July 1972. G.C.E. also recovered *N. articulata* from nests of univoltine *Agapostemon radiatus* (Say) in a level, moist,

grassy lawn on the Cornell campus about 270 m from the nest site of *A. virescens*. Five nests, excavated on 19 July 1974, 23 June 1978, and 25 July 1978, contained immature *Nomada*. Adult *Nomada* were collected at the site but we did not conduct detailed behavioral observations.

Nomada (Micronomada) formula Viereck was studied near Richmond, Contra Costa Co., California, at the entrance to San Pablo Reservoir. G.C.E. observed *Nomada* flying about an aggregation of active nests of *Agapostemon texanus* Cresson located in level, bare, dry sandy soil, on 22 and 29 August 1975. He excavated five nests that contained immature *N. formula* on 24 and 25 September.

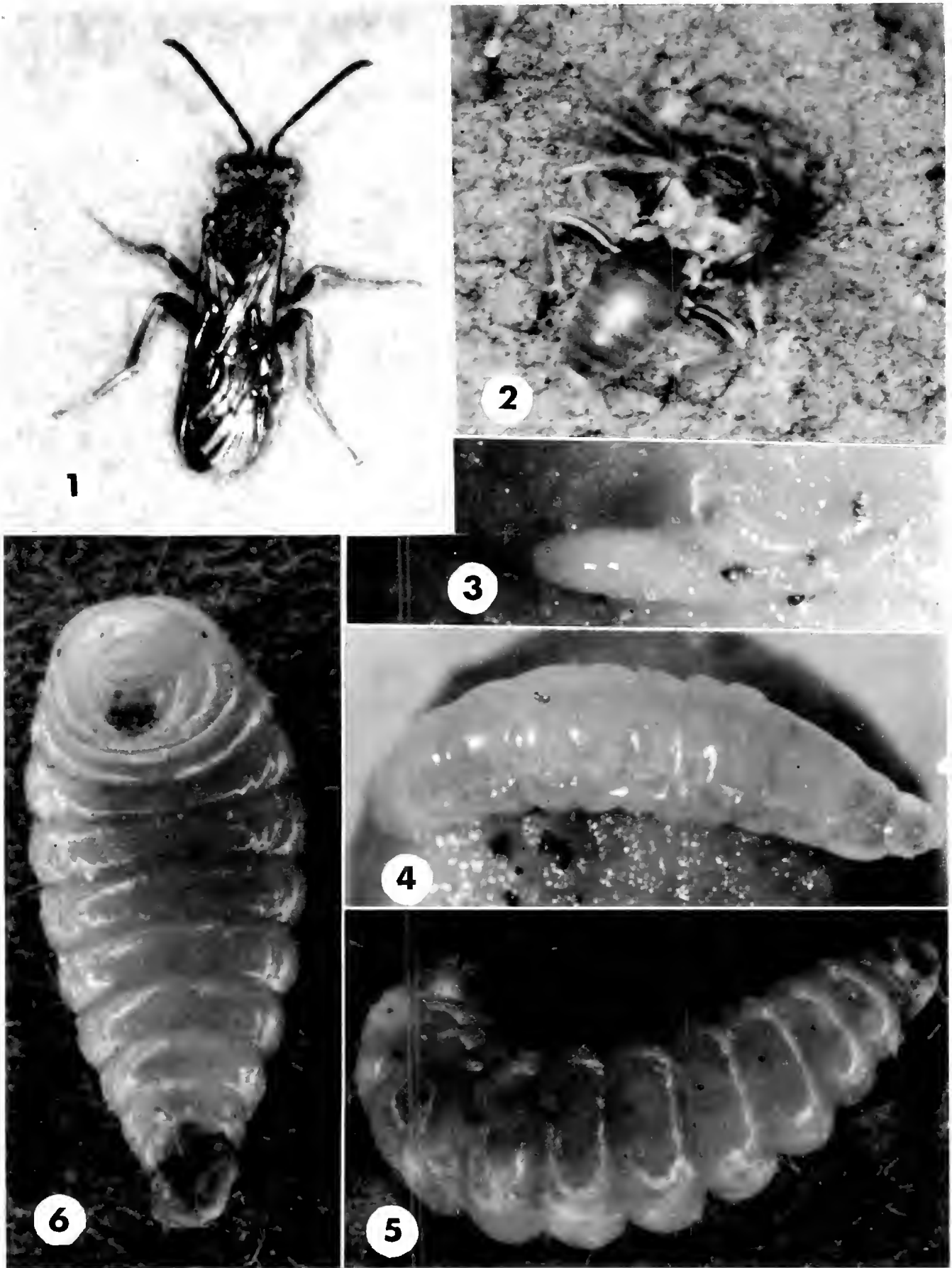
Techniques of observation, nest excavation, and rearing and preservation of immature bees are given by Abrams and Eickwort (1980a). In addition, some prepupae were kept in a refrigerator for several months to break diapause. Twenty-nine *N. articulata* immatures and 12 *N. formula* immatures were recovered from nest cells, of which six of the former and two of the latter species were reared to adults.

Voucher specimens of cleptoparasites and hosts and their immature stages are deposited in the Cornell University insect collection, lot number 995. Larvae and pupae of *Nomada* are also deposited in the American Museum of Natural History.

Nomada (Nomadula) articulata Smith

Marked adult females returned repeatedly to the *Agapostemon virescens* nest site. One female, marked on 2 July, visited the site on 15 of the next 18 observation days. Females were active from 0800 to 1230 hr. They flew in both sun and shade, but not when air temperatures were below 22°C. Typically a female visited the aggregation once or twice per morning and remained each time from 15 to 45 minutes, repeatedly attempting to enter nests. Her behavior was similar to that of *Nomada opacella* Timberlake and *Nomada* sp. at *Andrena* nest sites in California (Linsley and MacSwain, 1955; Thorp, 1969). *Nomada articulata* flew slowly through the aggregation a few centimeters above the ground and alighted on raised perches of earth, twigs, leaves, or stones, 3 to 12 cm from nest entrances. A female waited on the perch with her antennae directed towards the nest opening from 5 sec to 10 min before approaching the entrance (Fig. 1). About half of the attempts to enter nests were made immediately after an *Agapostemon* had left on a foraging trip. The other attempts were made just after an *Agapostemon* had entered her nest or when no activity could be seen at the nest entrance. *Nomada* did not approach a nest if a guard was visible at the entrance.

Each *N. articulata* female followed the same behavioral sequence when attempting to enter an *A. virescens* nest. She walked slowly towards the



Figs. 1-6. *Nomada articulata*. Fig. 1, adult female perched near host nest. Fig. 2, adult female attempting entry into nest of *Agapostemon virescens*. Fig. 3, first instar larva on egg of *A. virescens*. Fig. 4, larva feeding on provision mass of *A. virescens*. Fig. 5, prepupa, lateral view. Fig. 6, prepupa, ventral view.

nest entrance with her wings vibrating. She stopped at the entrance, still fanning her wings, and inserted her antennae into the burrow for 1 or 2 sec (Fig. 2). She then stopped vibrating her wings and walked into the burrow.

If the *Nomada* encountered an *Agapostemon* guard when she inserted her antennae into the nest entrance, she immediately backed away from the burrow and returned to a watching position or investigated another nest. The guard either snapped at the intruder with her mandibles or advanced towards the *Nomada* until her thorax was outside the entrance. If the guard was further down the burrow, the *Nomada* entered the nest but always reappeared within 10 sec. The guard followed the *Nomada* to the surface and blocked the nest entrance with her head or the dorsal surface of her abdomen. Of 50 attempts to enter nests, 48 were unsuccessful.

Agapostemon virescens did not interact with *Nomada* outside the nests. Guards did not chase parasites perched nearby, and on several occasions a returning forager flew right over a *Nomada* in order to enter her nest. In these instances, the *Nomada* immediately retreated.

Only one nest was entered successfully in 1975, by two *N. articulata* females on 1 July. This was the only nest in the aggregation that was occupied by a solitary *Agapostemon* female during the pollen-foraging season. July 1 was the only day that the host was seen foraging. She brought a load of pollen into her nest at 0936, emerged at 0941, and flew away. At 0957 an unmarked *N. articulata* entered the nest and remained in the burrow 3 min before emerging. The *Agapostemon* brought in two more pollen loads by 1050. At 1055, a second, marked *Nomada*, which had just been driven away from a communal nest, entered this nest and also remained 3 min before departing. Observations on 1 July were ended at 1100 hr. Although the nest entrance was open for the next three days, the *Agapostemon* had apparently abandoned her nest because she was never seen again. Two *Nomada* approached the nest entrance during these three days but neither descended into the burrow. Like other nomadines (Rozen, 1977), *N. articulata* probably oviposits only in host cells that are in the stage of being provisioned.

In two more instances in 1975, *Nomada* may have successfully entered nests of *A. virescens*. Both cleptoparasites were found trapped under plastic cups that were used to check exiting *Agapostemon*. Since *Nomada* walk to hosts' nest entrances, they may have approached the burrows through the gap between the ground and the edge of the cup. In one of these cases, a guard was blocking the nest entrance with the dorsal surface of her abdomen. The *Nomada* had apparently been stung, because she was partially paralyzed and died within 10 min.

Nomada opacella makes orientation flights after examining host burrows (Linsley and MacSwain, 1955). Most *N. articulata* had probably learned nest locations before we began constant observations at the Cornell nest

site, but one female was observed making an orientation flight. On 5 July, the female *Nomada* emerged from an *Agapostemon* nest at 0855 hr. She remained at the nest site, walking and taking short flights, until 1028 and then flew off. At 1121 she returned and attempted to enter a second nest, but was stopped by a guard. She then made a short orientation flight of three or four loops and left the nest site. On 6 July, she returned and attempted to enter both the nest from which she had first emerged and the second nest that she had located on 5 July.

In the nest of *A. virescens* excavated in 1972 that contained *Nomada* immatures, at least four of 13 cells (31%) were infested by the cleptoparasite. This nest also contained only one adult host. In contrast to *A. virescens*, *Agapostemon radiatus* made solitary nests that were scattered and well hidden in the grassy lawn. Five of the six excavated nests of *A. radiatus* yielded *Nomada* immatures, with percentages of infested cells for each nest of 100% of 8 cells, 93% of 14 cells, 50% of 2 cells, 33% of 6 cells, and 25% of 4 cells. The percentage of infested cells from all nests in this site was 63% of 40 cells; for infested nests only, 74% of 34 cells. Another nest of *A. radiatus*, well separated from nests of other *Agapostemon* in another lawn, yielded no *Nomada*.

We did not recover eggs of *N. articulata*, but they probably were placed in the cell walls, as occurs in all other Nomadinae (Rozen, 1977). *Nomada edwardsii* Cresson and *N. opacella* usually lay two eggs in each cell and the larva that first hatches kills the other egg (Linsley and MacSwain, 1955). The presumed oviposition period of *N. articulata* was half as long as the 4 to 6 min recorded for *N. opacella*, so double oviposition may not occur in *N. articulata*. We recovered first-instar *N. articulata* larvae on two provision masses. One larva apparently was in the act of consuming the host egg when we broke into its cell. The larva was situated parallel to and partially on top of the egg (Fig. 3). We brought the provision mass into the laboratory and provided another host egg. The mobile first-instar *Nomada* also killed this egg. All other *N. articulata* larvae were on provision masses without host eggs or larvae, so killing host eggs is typical of the first instar of this species, as it is of most Nomadinae (Rozen, 1977). Later instars (Fig. 4) perched on top of and consumed provision masses in the manner illustrated for other *Nomada* by Linsley and MacSwain (1955).

Mature *N. articulata* larvae from three nests defecated and then became quite turgid, resting on their dorsa in the cells with their elevated heads towards the cell mouths (Figs. 5–6), as illustrated for *N. suavis* Cresson by Bohart (1970). They presumably would have spent the winter as postdefecating larvae (prepupae), pupated in the spring, and emerged as adults along with their hosts in late May or early June. This developmental pattern is typical for Nomadinae (Rozen, 1977). In the laboratory, these prepupae

entered diapause and did not further develop unless they were refrigerated for several months. This cold treatment broke diapause, and development resumed when the bees were brought to room temperature.

However, *N. articulata* immatures from an *A. radiatus* nest excavated on 25 July 1978 did not follow this pattern. Ten were already pupae when the nest was excavated, and development of those that survived proceeded immediately to the adult stage without refrigeration. Three adult *N. articulata* were found in nests of *A. virescens* in October. Overwintering of adults was hypothesized for *Nomada* parasitizing vernal *Andrena* by Linsley and MacSwain (1955) and by Thorp (1969). Our data show that *N. articulata* from the same population and indeed the same nest site may overwinter both as prepupae and as adults.

Nomada (Micronomada) formula Viereck

Agapostemon texanus nests were aggregated, although each was believed to be occupied by a single female. The population was probably multivoltine, with provisioning for the last generation occurring in late August when adult *N. formula* were also present at the nest site. Flight activity of parent hosts and of cleptoparasites had ceased by late September, when nest burrows were partially filled with soil and no live parent females were in the nests. Most of the host cells were deserted at this time; a few contained older host pupae. Some newly emerged adult female hosts were in burrows or in hibernacula similar to those of *A. virescens* (Abrams and Eickwort, 1980a).

All *Nomada* recovered during these excavations were turgid postdefecating larvae. As with *N. articulata*, they were on their dorsa with their elevated heads towards the cell mouths. The feces appeared to be plastered on all the cell walls, although denser posteriorly. These feces often were separated from the cell walls and appeared to form a loose, amorphous, cocoon-like structure around the larva, the cylindrical fecal pellets being held together by silk-like strands (these may have been fungal mycelia). This loose configuration may have been due to the low soil moisture. Stephen, Bohart, and Torchio (1969) noted that *Nomada* larvae speckle cell walls with fecal pellets oriented in various directions.

No pupal or adult *N. formula* were recovered during the excavations, so that population was overwintering as diapausing prepupae. Several prepupae were refrigerated in the spring of 1976 and these moulted into pupae and then adults when removed to room temperature.

It was impossible to estimate parasitism rates in the largely deserted nests of *A. texanus*, although all five burrows traced to cell level appeared to lead to some cells that contained *Nomada* prepupae. Twelve *Nomada* prepupae

were recovered in total. In contrast, a large isolated nest of *A. texanus* located several hundred meters from the aggregation contained no *Nomada*.

Discussion

The *Nomada* that attack *Agapostemon* behave very much like those that attack *Andrena*, despite the differences in host biology and phylogenetic relationship, and despite the fact that *Agapostemon* is a basically Neotropical genus whose species have been in contact with species of the Holarctic genus *Nomada* for presumably a relatively short period of evolutionary time. Indeed, *Andrena* nests were abundant in the nesting areas of *A. radiatus* and *A. virescens*, and quite possibly *N. articulata* is primarily an *Andrena* parasite that enters *Agapostemon* nests when it encounters them. Several European species of *Nomada* (i.e., *N. fucata* Panzer, *rufipes* Fabricius, and *zonata* Panzer, see Stoeckert, 1933) have been recorded as parasites of both halictines and *Andrena*.

Tengö and Bergström (1977) have analyzed the cephalic secretions of several species of *Nomada* and found an interesting pairwise correlation between the secretions of the male (but not the female) cleptoparasites and the Dufour's gland secretions of the females of their host species of *Andrena*. The male *Nomada* coats his mate with this secretion during copulation so she has the same odor as the host nest. Presumably the female is then able to enter a nest without being attacked by the host female. However, if some *Nomada* do indeed attack hosts belonging to more than one family, then either chemical mimicry does not occur in these species of *Nomada* or host species belonging to different genera produce similar chemicals in their Dufour's glands.

The behavior of *N. articulata* at nests of *A. virescens* and the heavy parasitism of some nests of *A. radiatus* and *A. texanus* by *Nomada* while others were untouched indicates that the *Nomada* learned the locations of nests and repeatedly returned to them. Such learning is apparently widespread in cleptoparasitic bees, as reviewed by Rozen, Eickwort, and Eickwort (1978). We hypothesize that *N. articulata* were "traplining," visiting each remembered nest in turn and, when a host female was not present, pausing long enough to check for cells being provisioned.

Solitary *Agapostemon radiatus* and *A. texanus* appear to be defenseless against such a strategy once their nests are discovered. Their only effective counter-strategies are to conceal their nest entrances more effectively and, especially, to build nests distant from those of other potential hosts. In contrast, communal *Agapostemon virescens* escape parasitism by *Nomada* through effective nest guarding, and only the occasional solitary nest of this species falls prey to the cleptoparasite (Abrams and Eickwort, 1980b).

A final point is the overwintering of *N. articulata* from the same population in two different stages, as prepupa and as adult. Similar developmental flexibility has been observed in several species of *Osmia* (Megachilidae) (Levin, 1966; Rust, 1974).

Acknowledgments

We thank F. Robert Wesley and Patricia Lockwood of Cornell University for assistance in excavating *Agapostemon radiatus* nests and for lovingly rearing immature stages of *Nomada articulata*. Mr. Roy Snelling of the Los Angeles County Museum graciously identified the *Nomada*. Dr. Jerome Rozen, Jr., of the American Museum of Natural History, Dr. Robbin Thorp of the University of California at Davis, and Ms. Barbara Taraday of Cornell critically read the manuscript. We thank the East Bay Municipal Utility District for permitting excavations of nests of *A. texanus* at San Pablo Reservoir. G.C.E. acknowledges the hospitality of the Division of Entomology and Parasitology of the University of California at Berkeley, where he was a research associate while conducting field studies on *A. texanus*, and the Department of Entomology of the University of California at Davis, where he was a visiting professor during the preparation of the manuscript. Observations on adult behavior of *N. articulata* were adapted from the M.S. thesis of J.A. This research was supported by National Science Foundation grant nos. BMS-72-02386 and DEB-78-03151.

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Footnotes

¹ *Nomada articulata* was erroneously identified as *Nomada australis* Mitchell in Abrams (1977).

NOTICE

AWARDS FOR STUDY AT The Academy of Natural Sciences, Philadelphia, Pa.

The Academy of Natural Sciences of Philadelphia, through its Jessup and McHenry funds, makes available each year a limited number of awards to support students pursuing natural history studies at the Academy. Awards usually include a stipend to defray living expenses, and support for travel to and from the Academy. Current application deadlines are 1 April and 1 October 1980. Further information may be obtained by writing to: Chairman, Jessup-McHenry Award Committee, Academy of Natural Sciences of Philadelphia, 19th and the Parkway, Philadelphia, Pennsylvania 19103.

**DASYMUTILLA PHOENIX (FOX), A NEW
SYNONYM OF *D. FOXI* (COCKERELL)
(HYMENOPTERA: MUTILLIDAE)**

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The species *Dasymutilla foxi* was first described by Cockerell (1894) in the genus *Sphaerophthalma* (sic) later transferred to the genus *Dasymutilla* by Mickel (1928). This was followed by a first description of the species *Dasymutilla phoenix* by Fox (1899). In reviewing the genus, Mickel (1928) stated that the two species are not different structurally from one another but that *D. phoenix* is larger in size than *D. foxi* and that the pubescence of the dorsum of *D. phoenix* is whitish as opposed to scarlet pubescence of the latter. Inclusion of the following biological evidence and a good series of specimens from the same location has led to the conclusion that *D. phoenix* should no longer be considered as a valid species but is, instead, a synonym of *D. foxi*.

Materials and Methods

A series of 129 specimens, including 85 females and 44 males (of which 8 pairs were taken *in copula*), were collected from a mating aggregation on Willow Springs Ranch, north of Tucson, Arizona (described separately by Manley and Taber, 1978). All were collected between September 18, 1976 and September 29, 1976. Of these, 31 specimens (16 females, 7 males, and four pairs taken *in copula*) have been deposited in the Entomology Museum of the University of Arizona and 98 (61 females, 28 females, plus 4 females and 5 males taken *in copula*) have been retained in the personal collection of the author.

All of the specimens collected were determined as belonging to the *D. foxi-phoenix* complex. All were active in the same area, at the same times. It seemed impossible to distinguish two species on the basis of behavior.

Results and Discussion

Since the major criteria for distinguishing these two as valid species have been coloration and size, these criteria were examined more closely in the laboratory. The following were found:

Males: Of 44 males that were collected, pubescence of the dorsum of the head and thorax of 43 was a smokey yellow ("dirty white"), with the abdomen being scarlet. On the remaining male, head, thorax and abdomen were all scarlet. The latter male was one of those taken *in copula*, and was coupled with a female having the smokey yellow pubescence on head and thorax, and scarlet abdomen. Males ranged in length from 8 mm to 13 mm.

Females: There was considerably more variation in color among the females. The continuum ranged from smokey yellow to scarlet. The color variation has, however, been categorized for descriptive purposes. The pubescence above for the majority (61) of the 85 females was smokey yellow (head, thorax, and abdomen). Of the remaining 24, 23 had head and thorax colored smokey yellow. Of those, the abdomens of 7 were of an orange-yellow color, 6 were orange, 4 were a red-orange, and 6 were scarlet. Pubescence of the dorsum of the remaining female was entirely scarlet (head, thorax, and abdomen). Length in the females ranged from 7 mm to 12 mm and seemed to be entirely independent of color.

If these were separate species, one would expect to find more individuals with the colors of the two extremes, with only a few intermediates. The actual situation was one of many more individuals with the smokey yellow pubescence of *D. phoenix*, with a few variants ranging all the way to the scarlet extreme. It is thus concluded that the two should be considered as one species, *D. foxi*, with the updated synonymy being as follows:

Dasymutilla foxi (Cockerell)

Sphaerophthalma (sic) *foxi* Cockerell 1894:199. ♂

Sphaerophthalma (sic) *heterochroa* Cockerell and Casad 1894:298. ♀

Mutilla phoenix Fox 1899:247. NEW SYNONYM. ♀

Sphaerophthalma (sic) *foxi* var. *arizonica* Cockerell 1900:65. ♀

Dasymutilla foxi Mickel 1928:84. Sex not stated.

Dasymutilla phoenix Mickel 1928:85. Sex not stated.

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SCIENTIFIC NOTE

ENTOMOBRYA KANABA (WRAY) (COLLEMBOLA:
ENTOMOBRYIDAE) AN INDOOR HOUSEHOLD
PEST IN CENTRAL CALIFORNIA

Entomobrya kanaba (Wray) is here reported as an indoor household pest in central California. Maynard (1951, A monograph of the Collembola or springtail insects of New York State, p. 14) states "It is only rarely that Collembola are reported as household pests, and then usually the damage is in the aesthetic sense." Curran (1947, Nat. Hist., 56(10):476, 1 fig.) has pointed out that the presence of springtails can be a sign that there is excess moisture in the building that should be eliminated.

During the fall months of 1977 Mr. Earl Enos, a Custodian at the Wilson Elementary School, in San Leandro, Alameda County, California, repeatedly observed small insects in the classroom sink of the kindergarten room. Often several dozen specimens would be seen in the early morning around the inside of the white enamel sink (with only a few on the drainboard). They were not noticed in other classrooms. Finally, as the identity of these unknown jumping insects was wanted, Mr. Enos collected a sample of 17 specimens and they were submitted to Mrs. Mary A. Davies to have them identified. The writers forwarded the specimens to Dr. David L. Wray, Collembolist and Entomologist Emeritus of the North Carolina Department of Agriculture, who identified them as *Entomobrya kanaba* (Wray) (deposited in the CAS and Wray collections).

Interestingly, in addition to being observed at the Wilson Elementary School, in San Leandro, Mrs. Leslie Sweeny, the kindergarten teacher, stated that she had noted Collembola in her home in Fremont, California over a period of three or four years. Also, Mrs. Cyndi Rose, a next door neighbor to Mrs. Sweeny, had a very troublesome infestation of Collembola throughout her home. Samples of the Collembola in Mrs. Rose's home were made (2 specimens on 29-IX-1977 and 60 specimens on 5-X-1977) and these were submitted to Dr. Wray, and he also identified them as *Entomobrya kanaba* (Wray). Samples were not collected in Mrs. Sweeny's home, but it is possible that they were also this species.

The infestation in Mrs. Rose's home was throughout the entire building. The collection made on September 29th was from the back of a bathroom shower curtain and this curtain was described as being "black" with Collembola. These Collembola were also stated to be in every sink, basin, tub, in the pots and pans in the kitchen, and in the clothes closets. An attempt to control the infestation with an insecticide was made (in this instance RAID was used) but it was not successful. A pest control operator

was hired to control the infestations in both the homes of Mrs. Rose and Mrs. Sweeny at a cost of \$40.00 per home. The infestation of Collembola at the home of Mrs. Sweeny was minor, however, but there was a problem with silverfish that she wished controlled.

Entomobrya kanaba was described by D. L. Wray (1953, Nature Notes, Occ. Pap. No. 1:4, fig. 2, A-F, in the genus *Drepanura*) on the basis of a large series taken by Dr. G. F. Knowlton at Kanab, Utah on June 15–16, 1952. They were collected “on a tile floor of auto camp bath room, on the sidewalk, and under plank.” Knowlton states that “in the early morning of June 16 they were graying the ground by the thousands.” About one thousand specimens were obtained. It would appear that their large numbers about dwellings may lend to their dispersal by artificial means. Wray and Knowlton (1956, Great Basin Nat., 16(1–4):4) also record *Entomobrya kanaba* from the state of Idaho from two collections—from shade tree litter and boxelder litter. Salmon, in his world catalog of Collembola (1964, Roy. Soc. New Zealand, Bull. 7 (vol. 2):440), does not list further references or distribution for this species. Christiansen (1956, Ent. News, 67(5):129–130; 1958, Bull. Mus. Comp. Zool., 118(7):469) considers *kanaba* to a synonym of *Entomobrya unostriata* Stach (1930, Abhand. Senckenberg. Naturf. Ges., 42(1):63), and provides records under the latter name from San Diego, California and Fort Collins, Colorado. Stach (1963, Polska Akad. Nauk Inst. Zool., Cracow, p. 70) discusses *unostriata* and *kanaba* and indicates some differences.

Collembola are probably present in small numbers in homes or offices, particularly if indoor plants are kept, and they may often go unnoticed. For example, *Lepidocyrtus cinereus* Folsom was recently collected on 29-IX-1977 in a pot planter in an office (PHA) at the California Academy of Sciences, San Francisco, where it is an inconspicuous species. In contrast, *Entomobrya kanaba* with other habits, probably associated with drains, has been shown to be a household pest.

Our thanks are extended to Dr. D. L. Wray for his identification of the Collembolan collections and to Mrs. Mary A. Davies, Mr. Earl Enos, Mrs. Cyndi Rose, and Mrs. Leslie Sweeny for specimens and information concerning the infestations, and to the reviewers of this note.

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SCIENTIFIC NOTE

NOTES ON THE LIFE HISTORY OF THREE *CONODERUS* SPECIES OF WIREWORMS IN CALIFORNIA: (COLEOPTERA: ELATERIDAE)

Information on the duration of the larval period of three introduced *Conoderus* species was obtained by confining newly hatched larvae individually in two ounce salve tins containing screened moist soil and a surplus of wheat, both of which were replenished at two week intervals. The larvae were confined indoors where temperatures ranged from 15° to 25°C (60° to 78° F).

Conoderus exsul (Sharp)

Two separate rearings of *Conoderus exsul* were started in 1978. The first, or early group, included 31 larvae which hatched March 19. Of these, 20, or 65%, pupated between July 6 and November 11 of the same year, for an average larval period of 149 days. The remaining 11 larvae pupated the following year between January 18 and March 19, for an average larval period of 331 days. Stone (1976, Pan-Pac. Entomol., 52:304) showed that 16% of June hatched larvae had matured the same year and 84% the second year. The pupal period in this early matured group ranged from 10 to 19 days, averaging 11.7 days. Lower temperatures the second year prolonged the pupal period from 18 to 22 days (Tables 1 and 2).

Larvae which hatched on July 25, 1978, or approximately 4 months later than the above, were used in the second rearing experiment. Of the 53 larvae involved, 13 pupated the same year between October 3 and 25 for an average larval period of 80 days. All remaining larvae pupated the following year between February 28 and May 29, the larval period averaging 242 days. The pupal period for the early and late maturing groups averaged 13 and 17.3 days, respectively.

Conoderus amplicollis (Gyll.) (Gulf Wireworm)

This species was reared in the manner described previously. Of 16 larvae that had hatched on July 20, 1978, none matured the first year. All pupated the following year over a period of 3.5 months from March 23 to July 1. Their larval period averaged 305 days and their pupal period, 14.3 days.

In a 1979 paper, (Stone & Wilcox, Pan-Pac. Entomol., 55:235-238) "The Gulf Wireworm in California," ten of 19 larvae pupated the same year, which was due, perhaps, to their May 5 hatching date.

Table 1. Duration of the larval stage of three introduced *Conoderus* species, Riverside, CA. 1978-79.

Date hatched 1978	Records (no.)	Larvae completing development in					
		1978 Larval period			1979 Larval period		
		Pupations (%)	Range (days)	Average (days)	Pupations (%)	Range (days)	Average (days)
<i>Conoderus exsul</i>							
Mar. 19	31	65	109-237	149	35	305-365	331
July 25	53	25	70-92	80	75	199-295	242
<i>Conoderus amplicollis</i>							
July 20	16	0			100	247-347	305
<i>Conoderus falli</i>							
Aug. 16	11	64	80-106	90	36	229-270	259
Oct. 9	20	10	62-70	66	90	183-291	258

Table 2. Duration of pupal stage of *Conoderus* species, Riverside, CA. 1978-79.

Date hatched 1978	Larvae completing development in					
	1978 Pupal period			1979 Pupal period		
	Records (no.)	Range (days)	Average (days)	Records (no.)	Range (days)	Average (days)
<i>Conoderus exsul</i>						
Mar. 19	10	10-19	11.7	11	18-22	19.5
July 25	12	11-17	13	38	14-20	17.3
<i>Conoderus amplicollis</i>						
July 20	—	—	—	14	11-19	14.3
<i>Conoderus falli</i>						
Aug. 16	7	12-19	16.3	4	16-17	16.3
Oct. 9	2	21-22	21.5	12	10-17	11.4

Conoderus falli Lane (Southern Potato Wireworm)

Of 19 *C. falli* larvae that hatched August 16, 1978 reared on wheat, 8 larvae died in the larval stage. Seven of the remaining 11 larvae pupated between November 4 and 30 the same year, for an average larval period of 90 days. The 4 remaining larvae pupated in 1979 between April 1 and May 12. Their larval period averaged 259 days. The duration of the pupal period for both groups was 16.3 days.

Additional data on the life span of *C. falli* was obtained in 1978 by rearing a group of 20 larvae that had hatched later than usual, on October 9. It is interesting to note that even at this delayed hatching date two larvae pupated on December 10 and 18, for an average larval period of 66 days. The remaining 18 larvae pupated the following year over a period of 4 months from April 9 to July 26. Their larval period ranged from 183 to 291 days, averaging 258 days.

The duration of the pupal period varied with the temperature, from an average of 21.5 days in December to 11.4 days for those maturing the second year during warmer months.

Discussion

Rearing these species of *Conoderus* wireworms indoors, possibly under the most favorable of conditions, one might expect the larvae to develop more rapidly and mature earlier than would be the case for larvae inhabiting dry, weedy fields or soils lacking in suitable food. Conditions closer to the indoor rearing conditions would prevail in irrigated vegetable growing areas planted to green or dry beans or to other crops more palatable for their survival.

As judged by the thousands of beetles attracted to a black light at Riverside, both *C. exsul* and *C. falli* have found climatic conditions and food very favorable. Rearings of larvae of these species showed that, depending upon the time of beetle emergence and egg deposition, from 10 to 65 percent of the larvae may complete development the same year, the remainder the second year. *C. exsul* larvae also appear to have found conditions favorable for survival at Olive, in an avocado grove, where the annual collection of beetles exceeded that obtained at Riverside. However, of interest, was the fact that no *C. falli* adults were collected at this location in the 5 year period 1975-79.

Adults of *C. amplicollis* are not highly attracted to light, nevertheless their presence in 15 counties is an indication that they too have become well established in California soils.

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