

Notes on the Proratinae (Diptera : Scenopinidae)

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Abstract

The members of Proratinae are treated, which are composed of 6 genera and 23 species. Two new genera and 4 new species are described. A discussion is given on the phylogeny of Proratinae.

Key words: Taxonomy, Phylogeny, Proratinae, 2 new genera, 4 new species.

Introduction

This paper deals with the genera *Acaenotus* (gen. n.), *Alloxytropus*, *Caenotus*, *Caenotoides*, *Jackhallia* (gen. n.) and *Prorates* and supplements YEATES (1992), though we quite agree with Yeates (1992) who placed the genera quoted above into the Scenopinidae and our paper remains still incomplete because of the paucity of material.

BOWDEN (1980) placed *Alloxytropus* (as a synonym of *Prorates*) in “? Bombyliidae or Scenopinidae.”

THEODOR (1983: 72), in briefly discussing the classification of the Bombyliidae, wrote, “The subfamily [Heterotropinae] is considered here to contain only the genus *Heterotropus* and a new genus or subgenus for the Nearctic species *senex*. MELANDER (1950) placed *Prorates* and related species in this subfamily, but this is certainly incorrect. *Prorates* and related genera probably do not belong to the Bombyliidae but to the Scenopinidae, as discussed under *Prorates* (pp. 8, 18).”

EVENHUIS (1991) placed the 5 genera (= *Alloxytropus*, *Apystomyia*, *Caenotoides*, *Caenotus* and *Prorates*) into the Proratinae.

YEATES and IRWIN (1992) concluded as to *Heterotropus*, “Evidence is presented that the genus does not belong in the Bombyliidae. Adult morphology suggests that they are primitive members of the Asiloidea, and may be the sister group to the remaining asiloids.”

YEATES (1992) concluded that the genera placed in the Proratinae by EVENHUIS (1991) should be removed to the Scenopinidae (except *Apystomyia*).

This paper describes 6 genera and 16 species, in which 2 genera (*Acaenotus* and

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Jackhallia) and 4 species (*Caenotus mexicanus*, *Jackhallia argentinae*, *Prorates ballmeri* and *P. painteri*) are new. Table 1 shows the current species in the respective genera of Proratinae.

Table 1. Number of species in respective genera of Proratinae

Genus	No. of species		
	now known from the world	examined in this paper	described as new to science in this paper
<i>Acaenotus</i> (gen. n.)	2	2	0
<i>Alloxytropus</i>	4	1	0
<i>Caenotoides</i>	3	1	0
<i>Caenotus</i>	4	4	1
<i>Jackhallia</i> (gen. n.)	1	1	1
<i>Prorates</i>	9	7	2
Total	23	16	4

Several characters are mentioned separately in order to emphasize them or because some of them must be macerated in KOH solution for examination.

A discussion is given on the phylogeny of Proratinae.

Abbreviations used in the figures

AA, aedeagal apodeme; C, cercus; CP, cord-like phallus; DB, dorsal bridge; DH, distiphallus; DPB, dorsal anterolateral process in basiphallus; DPLP, dorsal posterolateral process in gonocoxite; FC, fore coxa; GA, gonocoxal apodeme; GC, gonocoxite; GDP, gonocoxal dorsal process; GF, genital fork; GMVP, gonocoxal mid-posterior ventral process; GS, gonostylus; GVP, gonocoxal ventral process; HP, hanging-bell phallus; SP, spermatheca; S4–S11, sterna 4–11; T4–T9, terga 4–9; VPLP, ventral posterolateral process in gonocoxite; VPP, ventral anterolateral process in phallus.

Diagnosis

For a diagnosis of the Scenopinidae s. lat., Scenopininae, Caenotinae (which con-

tains only one genus) and Proratinae, see YEATES (1992). *Caenotus* is relegated to the Proratinae in the present article.

For synapomorphic characters for the Scenopinidae (Scenopininae + Proratinae), Scenopininae, Proratinae (which includes *Caenotus*) and several taxa of Proratinae, see forthcoming chapter.

Key (1) to Proratinae and its related taxa by external characters

1. Three veins arising from apical portion of 2nd basal cell 2
- Four veins arising from apical portion of 2nd basal cell..... Therevidae
- 2 (1). Vein M_1 ending at wing margin below wing apex, but if not, then vein M_2 always present 3
- Vein M_1 ending at wing margin above or at wing apex or ending at vein R_5 , and vein M_2 absent (exceptionally vein M_1 incomplete or ending at wing margin below wing apex, but in the latter case vein M_4 absent as well as vein M_2)..... Scenopininae (Scenopinidae s. lat.)
- 3 (2). Eye with posterior margin not indented; occiput flattened ; eye with lower facets much smaller than the upper facets (in *Acaenotus* uppermost facets nearly equal in size to lower facets and distinctly smaller than median facets) ; tibiae without seriate spines ; vein R_{4+5} branched ; 1st posterior cell open; discal cell present; vein M_2 present; anal cell petiolate; anal lobe of wing well developed (after MELANDER, 1950 ; HALL, 1972 ; HULL, 1973 ; YEATES and IRWIN, 1992 ; YEATES, 1992) 4
- Some of the characters above absent..... 6
- 4 (3). Vein R_5 ending at wing margin below wing apex; thickening of costa continuous around wing margin 5
- Vein R_5 ending at wing margin at or above wing apex ; thickening of costa ending at apex of vein R_4 , R_5 or M_1 Proratinae (excluding *Caenotus*) (Scenopinidae s. lat.)
- 5 (4). Proboscis shorter than face; antennal flagellum abruptly widened near base or around middle and with style stout *Caenotus* (Proratinae) (Scenopinidae s. lat.)
- Proboscis longer than face; antennal flagellum rather gradually tapering apically and with style thin..... *Heterotropus* (neither Scenopininae + Proratinae nor Bombyliidae + Hilarimorphidae)
- 6 (3). Discal cell absent; "vein R_{4+5} and M_{1+2} rather similarly forked, each fork not longer than its stem (fig. 40)" (after McALPINE, 1981) Hilarimorphidae
- "[Discal cell] usually present (figs. 36, 37), but if not (figs. 38, 39), then R_{4+5} and M_{1+2} not similarly forked" (after McALPINE, 1981) Bombyliidae

Geographical distribution

The geographical distribution is summarized in Table 2. *Alloxytropus* (4 species), Egypt, Sudan, Mongolia and Kazakhstan; *Jackhallia* (1 species), Argentina; *Acaenotus* (2 species), California and Arizona; *Caenotoides* (3 species), Idaho, California and Mexico; *Caenotus* (4 species), Arizona, New Mexico and Mexico; *Prorates* (9 species), Wyoming, Utah, Nevada, California, Arizona and New Mexico.

Table 2. Geographical distribution in respective species of Proratinae (* species not examined in this paper)

Genus	Species	Geographical distribution	Specimens examined
<i>Acaenotus</i> NAGATOMI et YANAGIDA gen. n.	<i>canus</i> (MELANDER, 1950)	California	1 ♂
	sp.	Arizona	1 ♀
<i>Alloxytropus</i> BEZZI, 1925	<i>anomalus</i> BEZZI, 1925	Egypt and Sudan	1 ♂, 1 ♀
	* <i>bezzii</i> PARAMONOV, 1929	Egypt	0
	* <i>kerzhneri</i> ZAITZEV, 1972	Mongolia	0
	* <i>lehri</i> ZAITZEV, 1972	Kazakhstan	0
<i>Caenotoides</i> HALL, 1972	<i>californicus</i> HALL, 1972	California	1 ♂
	* <i>idahoensis</i> HALL, 1972	Idaho	0
	* <i>mexicanus</i> HALL, 1972	Mexico	0
<i>Caenotus</i> COLE, 1923	<i>hospes</i> MELANDER, 1950	Arizona	4 ♂♂, 1 ♀
	<i>inornatus</i> COLE, 1923	New Mexico	1 ♀
	<i>mexicanus</i> NAGATOMI et YANAGIDA sp. n.	Mexico	12 ♂♂, 1 ♀
	<i>minutus</i> COLE, 1923	New Mexico	1 ♂
<i>Jackhallia</i> NAGATOMI et LIU gen. n.	<i>argentinae</i> NAGATOMI et LIU sp. n.	Argentina	1 ♀
<i>Prorates</i> MELANDER, 1906	* <i>arctos</i> HALL, 1972	Wyoming	0
	<i>ballmeri</i> NAGATOMI et LIU sp. n.	California and Nevada	5 ♂♂
	<i>boydi</i> HALL, 1972	California and Utah	1 ♂
	* <i>claripennis</i> MELANDER, 1906	New Mexico	0
	<i>frommeri</i> HALL, 1972	California	2 ♂♂, 2 ♀♀
	<i>melanderi</i> HALL, 1972	California	2 ♂♂, 2 ♀♀
	<i>nigrescens</i> HALL, 1972	California	3 ♂♂, 3 ♀♀
	<i>painteri</i> NAGATOMI et LIU sp. n.	Arizona	1 ♂, 2 ♀♀
	sp.	Nevada	1 ♂

Of 6 genera and 23 species, 4 genera and 18 species are confined to western USA and Mexico in distribution.

Some generic characters in eye, prosternum and hind coxa

Inner margin of eye (in both sexes) (1) indented opposite antennae or (2) straight: (1), *Alloxytropus*, *Jackhallia* and *Prorates*; (2), *Caenotus* [and *Apystomyia*]. It is slightly indented in *Acaenotus*, *Caenotoides* and some species of *Prorates*.

Prosternum (1) separate from or (2) in contact with propleuron: (1), *Caenotus*; (2), genera of Proratinae other than *Caenotus*. [*Apystomyia* probably belongs to (2)].

Hind coxa (1) with or (2) without knob-like process on anterior surface: (1), *Alloxytropus*, *Caenotus* and *Prorates*; (2), *Acaenotus*, [*Apystomyia*] and *Caenotoides*. In *Caenotus hospes*, the knob is present in the female but probably absent (the presence is not confirmed) in the male. The presence or absence of knob is not confirmed in *Jackhallia*.

Key (2) to genera of Proratinae

(*Apystomyia* is included for comparative purpose)

1. Vein R₄ rather horizontal and longer; vein M₁ (or M₁₊₂) ending at wing margin below wing apex; anal lobe of wing not strongly arched posteroproximally; male mid tibia and basitarsus normal as in female..... 2
- Vein R₄ rather vertical and short; vein M₁ ending at wing apex; anal lobe of wing strongly arched posteroproximally; male mid tibia with a spine-like ventral process before apex and basitarsus dilated ventrally at apical portion (they are not in female)..... *Apystomyia* MELANDER (probably not Scenopinidae)
- 2 (1). Vein R₅ ending at wing apex; thickening of costa ending at apex of vein R₅ (or sometimes R₄); vein M₃ entirely absent; female abdomen shorter (roughly twice as long as mesonotum + scutellum) 3
- Vein R₅ ending at wing margin below wing apex; costa continuous around wing margin; complete or incomplete vein M₃ often present; female abdomen longer (roughly 3 times as long as mesonotum + scutellum); lower occiput, gena and palpus usually with longer and denser tomentum (in both sexes); male mesonotum and scutellum with longer and denser pile; mesonotum and scutellum without bristles..... *Caenotus* COLE
- 3 (2). Antennal flagellum not as below; proboscis fleshy and shorter than face; mesonotum without bristles; scutellum with or without bristles..... 4
- Antennal flagellum in lateral view gradually tapering apically, rather triangular or lancet-shaped; apical style, if present, small and inconspicuous; proboscis largely sclerotized, and longer than face (except in *Prorates boydi*);

- mesonotum and scutellum with bristles; thickening of costa ending at or just beyond apex of vein R₅ 5
- 4 (3). Antennal flagellum abruptly narrower at apical portion, with a tuft of hairs at apex and without apical style; thickening of costa ending at or just beyond apex of vein R₄; scutellum without bristles; abdomen largely white or pale yellow *Caenotoides* HALL
- Antennal flagellum gradually narrowed apically and with thick apical style, which is wider than apex of preceding segment; thickening of costa ending at or just beyond apex of vein R₅; scutellum with a pair of marginal bristles; abdomen dark brown or black *Acaenotus* gen. n.
- 5 (3). Vein M₂ arising from vein M₁; female occiput not forming postocular rim ... 6
- Vein M₂ arising from discal cell; female head with postocular rim; proboscis conspicuously long (this is so in *Prorates arctos*) *Jackhallia* gen. n. (♂ not examined)
- 6 (5). Antennal flagellum with small and inconspicuous apical style *Prorates* MELANDER
- Antennal flagellum without apical style (if not overlooked) *Alloxytropus* BEZZI

Acaenotus NAGATOMI et YANAGIDA gen. n.

Type species: *Caenotus canus* MELANDER, 1950 from California

Acaenotus gen. n. is easily distinguished from *Caenotus* as shown in key (2) (couplet 2). *Acaenotus* is similar to *Caenotoides* but separated from it as shown in key (2) (couplet 4).

Male. Head: Elliptical and wider than long in anterior view, and rounded in lateral view; antenna shorter than distance between antenna and median ocellus; antennal segments 1–2 each not longer than wide; antennal flagellum longer than segments 1+2, gradually tapering apically, and with a thick apical style which is wider than apex of preceding segment; palpus shorter than proboscis, probably one-segmented, and with pile which is longer on base; proboscis fleshy and shorter than face; uppermost facets nearly equal in size to lower facets and distinctly smaller than median facets.

Thorax: Mesonotum rather strongly arched; mesonotum, scutellum, pro-, meso-, and mid-upper part of sternopleuron with pile which is shorter and sparser than in *Caenotus*; scutellum with a pair of marginal bristles which are weak and may be overlooked.

Wing: Vein R₅ ending at wing apex; thickening of costa ending at tip of vein R₅; vein M₂ arising from discal cell; vein M₃ absent; petiole of anal cell longer than cross-vein between discal- and anal cell; veins M₁, M₂ and M₄ evanescent before wing margin; halter knob creamy yellow or creamy white.

Legs: Hind coxa without a knob-like process at anterior face.

Abdomen: Tapering apically and widened somewhat at male genitalia; tergum 2 with mid-posterior modified setose patch.

Female. Head: Frons much narrower than an eye, much longer than wide, slightly wider toward ocellar triangle, and somewhat widened opposite antennae; no striking difference is seen in size of facets; antenna longer than (or about as long as) distance from antenna to median ocellus.

Acaenotus canus (MELANDER) comb. n.

(Figs. 1–4, 64–68)

Caenotus canus MELANDER, 1950, Pan-Pacific Ent. 26: 149. Type locality: California.

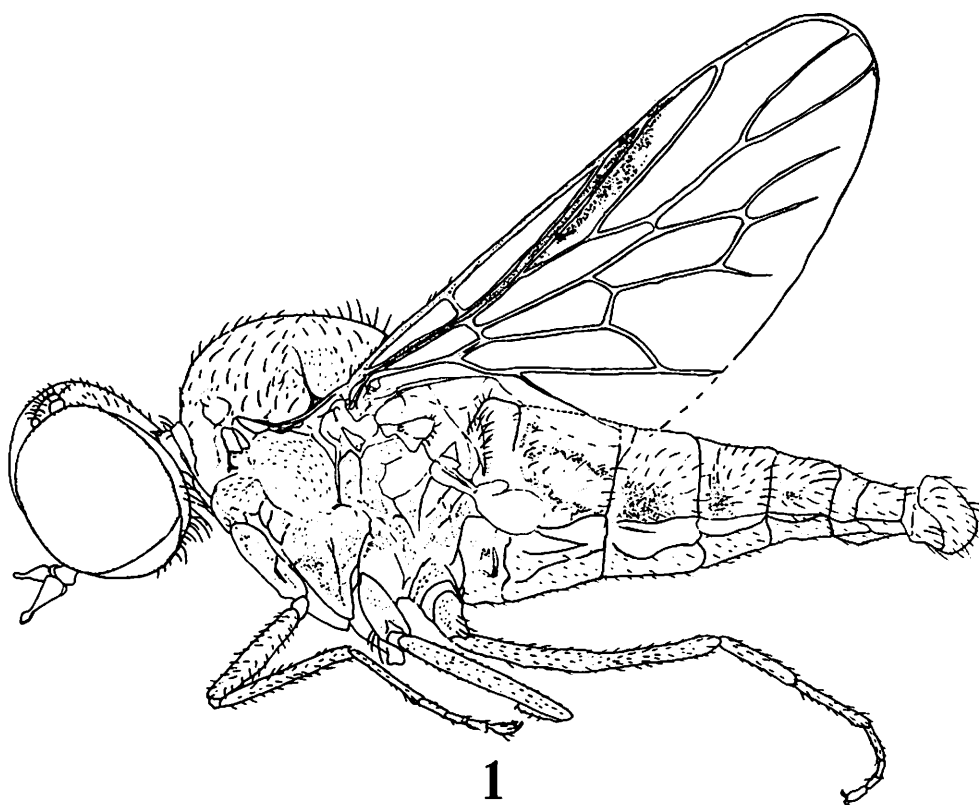
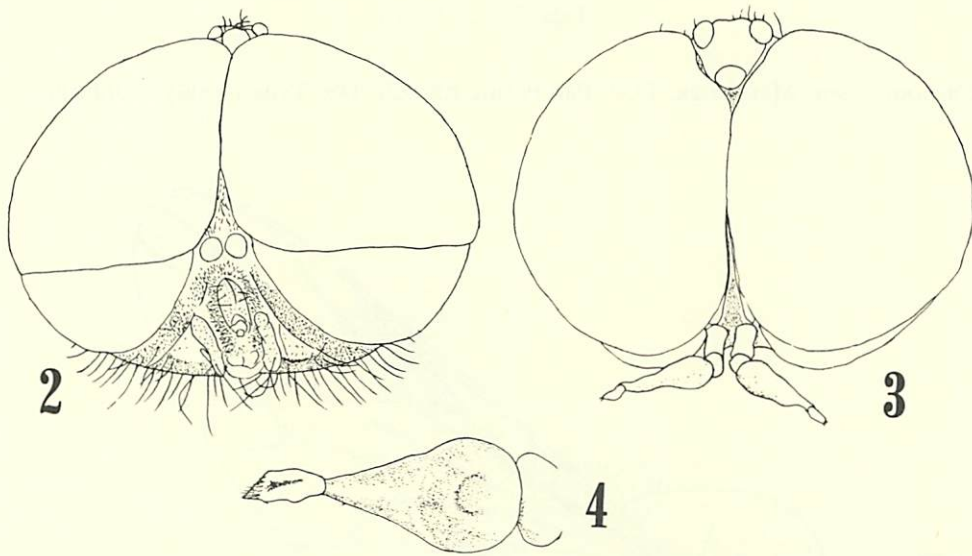


Fig. 1. *Acaenotus canus* (MELANDER), male. Lateral view.

The following description is based on 1 ♂.

Male. Head (Figs. 2–4): Head and its appendages dark brown to black, and pale gray pollinose; ocellar triangle, vertex, occiput, gena, palpus and proboscis with pale

pile; antennal segment 2 may have a few short hairs; area above occipital foramen bare; width of one eye on a mid line from a direct frontal view equal to distance from antenna to median ocellus, and 4.0 times width of frons just above antenna; ocellar triangle as long as wide; distance from lower ridge below proboscis to antenna 0.8 times that from antenna to median ocellus; palpus 0.4 times as long as distance from lower ridge below proboscis to antenna; proboscis 0.7 times as long as distance from lower ridge below proboscis to antenna; antenna 0.7 times distance from antenna to median ocellus; relative lengths of antennal segments 1, 2, 3 and style from inner view 100 : 100 : 350 : 150 and their relative widths viewed from the side 100 : 150 : 175 : 50.



Figs. 2-4. *Acaenotus canus* (MELANDER), male. 2-3, Head, anterior and direct frontal views; 4, antennal segment 2 and flagellum, inner view.

Thorax: Dark brown to black, and pale gray pollinose; mesonotum, scutellum, pro-, meso- and mid-dorsal part of sternopleura with pale pile.

Wing: Membrane pale gray or nearly hyaline; narrow stigma and apical portion of subcostal cell yellowish brown or pale brown; veins yellowish brown or pale brown; halter with knob milky yellowish brown and stem brown; veins M_1 , M_2 and M_4 not reaching to wing margin; vein between discal and 2nd posterior cells 0.5 times as long as r-m crossvein and petiole of anal cell 1.4 times as long as crossvein between discal and anal cells.

Legs: Dark brown to black; knees yellowish brown; coxa and femur pale gray pollinose and pale pilose; relative lengths of segments (excluding coxa and trochanter) of fore leg 233 : 250 : 100 : 50 : 33 : 25 : 33, of mid leg 233 : 267 : 125 : 50 : 38 : 25 : 38, of hind leg 325 : 333 : 158 : 142 : 42 : 33 : 33 and in hind leg viewed from the side relative widths of femur, tibia and tarsomeres 1-3, 33 : 25 : 17 : 13 : 13.

Abdomen: Dark brown to black, and pale gray pollinose; venter polished; abdomen

above and below pale pilose.

Length: Body 3.8 mm; wing 2.7 mm; fore basitarsus 0.30 mm.

Female. Unknown.

Distribution. N. America (California).

Specimen examined: CALIFORNIA: 1 ♂, near Adelanto, 25. v. 1945, A. L. MELANDER.

***Acaenotus* sp.**

(Figs. 5–9, 60, 152–157)

This species (♀) may possibly be identical with *canus*, whose ♀ is unknown.

Female. Similar to *canus* (♂) except as follows: Head (Figs. 5–7): Face and gena reddish brown to brown and palpus pale brown; width of one eye on a mid line from a direct frontal view 1.4 times width of frons just above antenna and 1.2 times width of face at lowest point from a direct frontal view; width of frons just above antenna 1.4 times that at median ocellus and 1.7 times that at narrowest point; distance from lower ridge below proboscis to antenna 1.1 times that from antenna to median ocellus; antenna 1.1 times as long as distance from antenna to median ocellus; relative lengths of antennal segments 1, 2, 3 and style from inner view 100 : 100 : 360 : 80 and their relative widths viewed from the side 120 : 160 : 180 : 60.

Thorax: Sub- and postscutellum polished.

Wing (Fig. 9): Stigma and apical portion of subcostal cell brown to dark brown; halter knob whitish; vein between discal and 2nd posterior cells absent (in one wing) or 0.3 times (in the other wing) as long as r-m crossvein and petiole of anal cell 1.3 times as long as crossvein between discal and anal cells.

Legs: Yellowish brown, but base of coxa, fore tibia (except base), and tarsus (except bases of mid and hind tarsomere 1) brown to dark brown; relative lengths of segments (excluding coxa and trochanter) of fore leg 220 : 233 : 100 : 50 : 37 : 27 : 33, of mid leg 227 : 267 : 127 : 60 : 47 : 27 : 33, of hind leg 333 : 333 : 167 : 73 : 73 : 27 : 40 and in hind leg viewed from the side relative widths of femur, tibia and tarsomeres 1–3, 33 : 23 : 13 : 13 : 13.

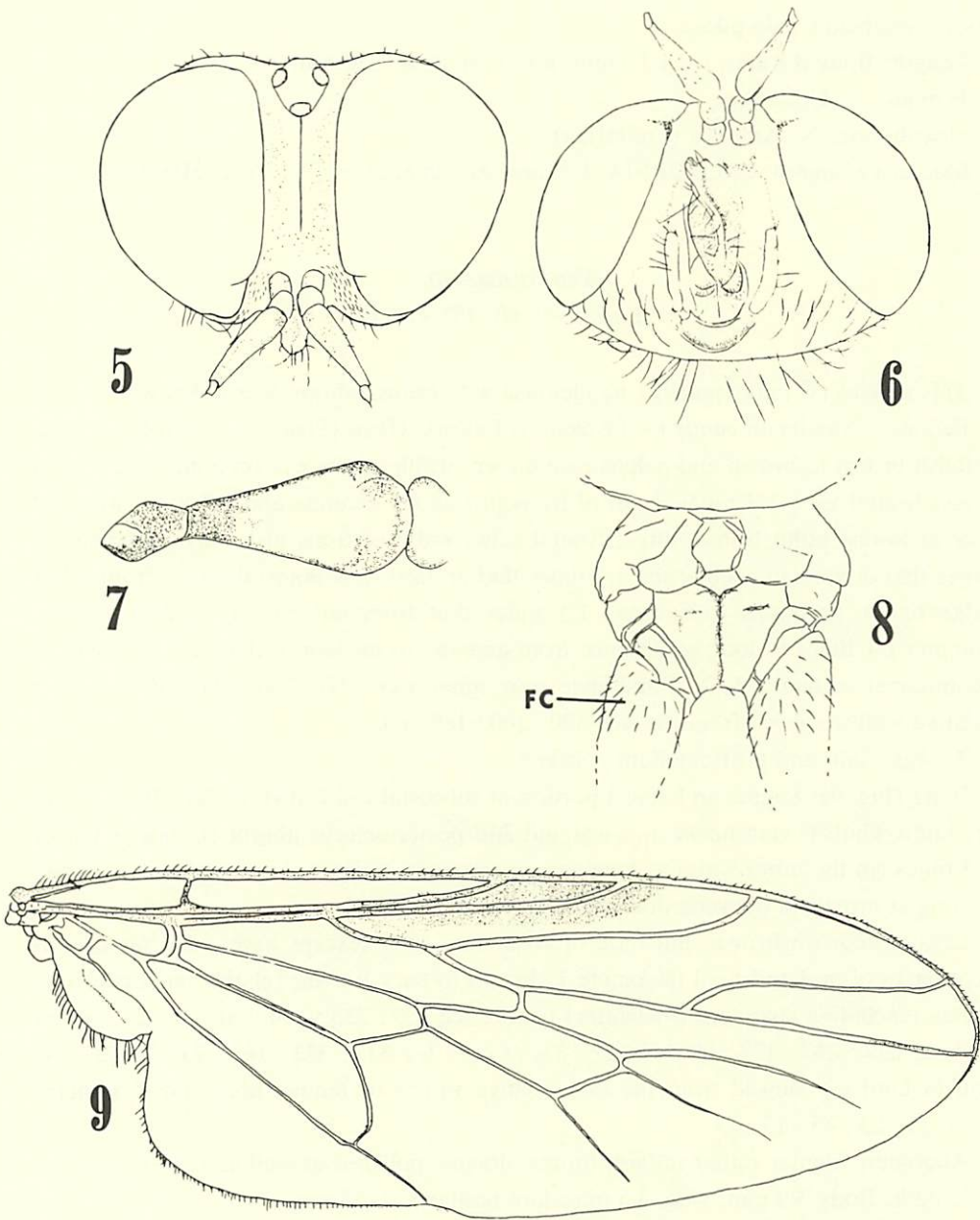
Abdomen: Venter rather reddish brown; dorsum polished as well as venter.

Length: Body 3.9 mm; wing 3.5 mm; fore basitarsus 0.38 mm.

Male. Unknown.

Distribution. North America (Arizona).

Specimen examined: ARIZONA: 1 ♀, Organ-Pipe-Cactus, N. M., Pina Co., R. H. PAINTER.



Figs. 5–9. *Acaenotus* sp., female. 5–6, Head, direct frontal and facial views; 7, antennal segment 2 and flagellum, inner view; 8, thorax and base of fore coxa, anteroventral view; 9, wing.

Genus *Alloxytropus* BEZZI

Alloxytropus BEZZI, 1925, Bull. Soc. Ent. Égypte, 8 (1924): 186. Type species: *Alloxytropus anomalus* BEZZI (by original designation).

This genus was treated as a synonym of *Prorates* by MELANDER (1950), HALL (1972), HULL (1973) and BOWDEN (1980) but was considered as a distinct taxon by ZAITZEV (1989) and EVENHUIS (1991).

YEATES (1992 : 26) wrote, "The relationship between the two genera will only be determined when all described and underscribed species of both are revised."

Alloxytropus contains 4 species and is distributed as shown in Table 2 (after ZAITZEV, 1989).

We have seen only 1 ♂, 1 ♀ of *anomalous*. No specimen of *bezzii*, *kerzhneri* and *lehri* have been examined here.

Alloxytropus may be distinguished from *Prorates* by having the following characters: antennal flagellum without apical style (if not overlooked); cord-like phallus (just behind hanging-bell phallus) not forked anteriorly; a transverse thin sclerite absent at mid-base of fused gonocoxites; paired median longitudinal short ventral sclerites absent between genital fork and sternum 10; genital fork not trapezoid but elliptical.

Alloxytropus anomalous BEZZI

(Figs. 56–57, 69–75, 158–163)

Alloxytropus anomalous BEZZI, 1925, Bull. Soc. ent. Égypte 8 (1924): 187. Type locality: Egypt.

Male. Head: Head and its appendages yellowish brown; proboscis especially at apical portion with pale pile; ocellar triangle, vertex, occiput (except area above occipital foramen), gena and palpus probably pale pilose; [head is crushed, and each part was not measured except for proboscis].

Thorax: Yellowish brown; mesonotum, scutellum, pro- and mesopleura probably with short sparse or indistinct pale pile; notopleural bristle is yellowish brown or pale brown but postalar and scutellar bristles may be black.

Wing: Membrane nearly hyaline; veins yellowish brown to brown; stigma not well marked; halter yellowish brown; basal petiole of 2nd posterior cell 1.3 times as long as r-m crossvein; [length of petiole of anal cell was not measured].

Legs: Yellowish brown; coxa and femur with short sparse or indistinct pale pile; relative lengths of segments (excluding coxa and trochanter) of fore leg 236 : 236 : 100 : 45 : 36 : 27 : 36, of mid leg 227 : 255 : 109 : 45 : 36 : 27 : 36, of hind leg 318 : 318 : 155 : 64 : 45 : 27 : 36 and in hind leg viewed from the side relative widths of femur, tibia and tarsomeres 1–3, 41 : 27 : 18 : 9 : 9.

Abdomen: Yellowish brown; terga 2–7 with brown to dark brown tinge especially at each posterior border; above and below with pale pile.

Length: Body 2.8 mm; wing ?; fore basitarsus 0.28 mm; proboscis (along ventral surface) 0.40 mm.

Female. Fits the description of male; [head is crushed and each part was not

measured, except for proboscis].

Wing: Petiole of anal cell 2.0 times as long as crossvein between discal- and anal cell [length of basal petiole of 2nd posterior cell was not measured].

Legs: Relative lengths of segments of fore leg 218 : 218 : 100 : 36 : 32 : 23 : 32, of mid leg 209 : 236 : 109 : 45 : 36 : 23 : 32, of hind leg 309 : 309 : 155 : 64 : 45 : 27 : 36 and in hind leg viewed from the side relative widths of femur, tibia and tarsomeres 1–3, 41 : 23 : 18 : 14 : 14.

Length: Body 2.5 mm; wing 2.2 mm; fore basitarsus 0.28 mm; proboscis (along ventral surface) 0.53 mm.

Distribution. Egypt and Sudan.

Specimens examined: SUDAN: 1 ♂, 1 ♀, Quweiz, N. W. Gezira, 26–27. x. 1970, [Suction Trap], [BMNH].

Genus *Caenotoides* HALL

Caenotoides HALL, 1972, Pan-Pacific Ent. 48: 46. Type species: *Caenotoides californica* HALL, 1972 (by original designation).

Caenotoides is easily distinguished from *Caenotus* and *Acaenotus* as shown in key (2) (couplets 2 and 4).

Caenotoides contains 3 species, namely, *californicus* HALL, 1972 (Fig. 12), *idahoensis* HALL, 1972 (Fig. 16) and *mexicanus* HALL, 1972. Only one male specimen of *californicus* is examined in this paper. For distinguishing characters of the members of *Caenotoides* see key to species in HALL (1972: 48).

Male. Head: Elliptic and wider than long in direct frontal view; semicircular in lateral view; face wider below; eyes contiguous; antenna shorter than distance from antenna to median ocellus; antennal segments 1–2 each wider than long; antennal segment 3 (=flagellum) longer than segments 1+2, wider than or as wide as segment 2, and its apical portion abruptly narrower than the basal portion, with a tuft of hairs at apex and without apical style (see Figs. 12 & 16); palpus well developed but much shorter than face; proboscis fleshy, short, and shorter than palpus; hairs on gena shorter and sparser than in *Caenotus* [it is not determined (based on 1 ♂ before us) whether the palpus is 1 or 2-segmented and bare or pilose].

Thorax: Mesonotum strongly humped; mesonotum and scutellum with pile which is shorter and sparser than in *Caenotus* and without bristles; pro-, meso-, and mid-dorsal part of sternopleuron pilose; rest of pleuron bare.

Wing: Thickening of costa ending at or beyond end of vein R₄; vein R₅ ending at wing apex; vein M₃ entirely absent; veins M₁, M₂ and M₄ reaching to wing margin [at least in 1 specimen of *californicus* before us]; petiole of anal cell longer than crossvein between discal and anal cells.

Legs: More slender than in *Caenotus*.

Abdomen: Tapering posteriorly; tergum 2 without mid-posterior modified setose patch; abdomen largely pale yellow or whitish in the known species.

Female. No available specimen is on hand. HALL (1972) wrote, "Eyes widely separated on female."

Caenotoides californicus HALL

(Figs. 10–15, 76–81)

Caenotoides californica HALL, 1972, Pan-Pacific Ent. 48: 48. Type locality: California.

This species is distinguished from *idahoensis* and *mexicanus* by having the legs largely dark brown to black and basal portion of antennal segment 3 more abruptly wider than apical portion and so than in other 2 species (after HALL, 1972) (see Figs. 12 & 16).

Male. Head (antennal segment 3 missing) (Figs. 10–12): Dark brown to black, and pale gray pollinose; ocellar triangle, vertex, occiput (except area above occipital foramen), and gena with pale pile; [pile on palpus and proboscis possibly rubbed off in the specimen before us]; antennal segment 2 with a few short hairs; width of one eye on a mid line from a direct frontal view 1.0 times distance from antenna to median ocellus, 2.7 times width of frons just above antenna, and 1.5 times width of face at lowest point from a direct frontal view; ocellar triangle 0.8 times as long as wide; distance from lower ridge below proboscis to antenna 0.8 times that from antenna to median ocellus; palpus 0.5 times as long as distance from lower ridge below proboscis to antenna; proboscis shorter than palpus; relative lengths of antennal segments 1 and 2 from inner view 100 : 100 and their relative widths viewed from the side 200 : 267 [antennal segment 3 is missing].

Thorax: Dark brown to black, and pale gray pollinose; mesonotum, scutellum, pro-, meso-, and mid-dorsal part of sternopleura with pale pile.

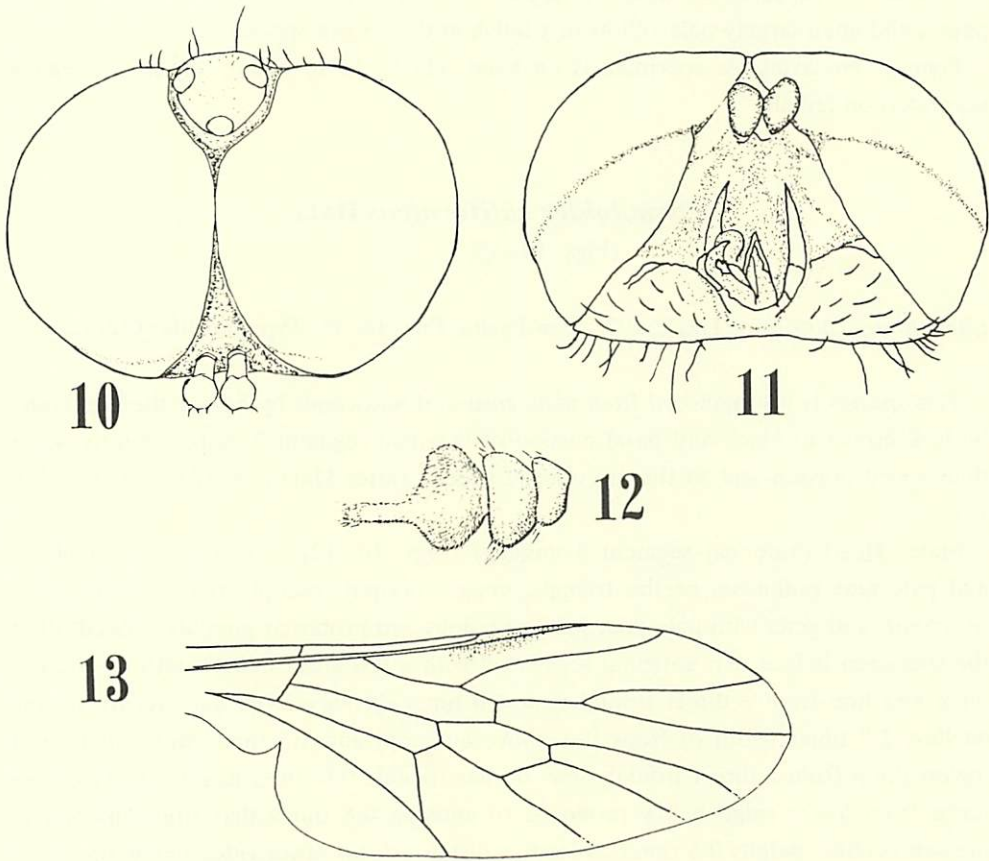
Wing (Fig. 13): Membrane tinged with white gray; stigma narrow and slightly darker (or more grayish); veins pale brown; halter with knob milky white and stem pale brown; vein between discal- and 2nd posterior cell 0.7 times as long as r-m crossvein [petiole of anal cell was not measured].

Legs: Dark brown to black; knees and tibia (except apex) yellowish brown to brown; coxa and femur pale pilose; relative lengths of segments (excluding coxa and trochanter) of fore leg 200 : 200 : 100 : 40 : 30 : 20 : 35, of mid leg 220 : 230 : 120 : 40 : 30 : 20 : 35, of hind leg 300 : 300 : 130 : 50 : 35 : 30 : 40 and in hind leg viewed from the side relative widths of femur, tibia and tarsomeres 1–3, 30 : 20 : 15 : 10 : 10.

Abdomen (Figs. 14–15): Milky white; base of segments 1–5 darkened; paired tergum 9 dark brown to black, and polished.

Length: Body 2.7 mm; wing 2.2 mm; fore basitarsus 0.25 mm.

Female. No specimen is available for study. HALL (1972) wrote, "Front whitish yellow

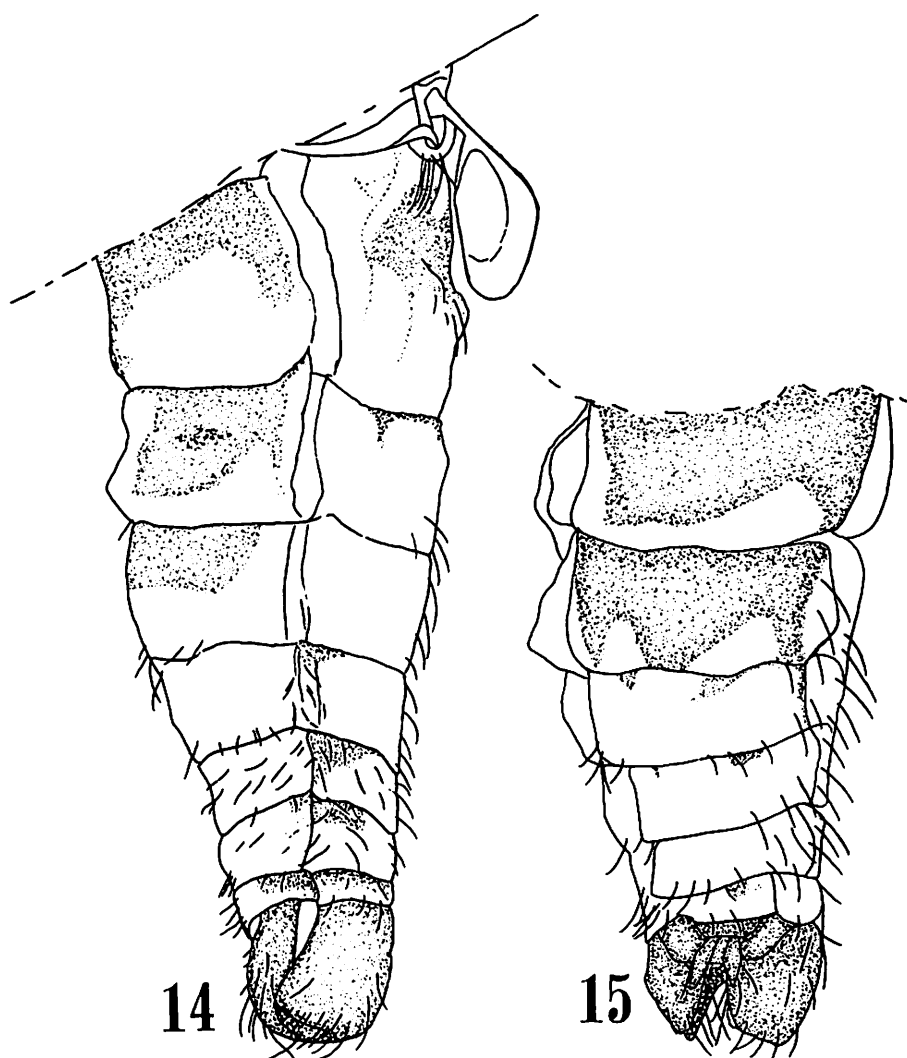


Figs. 10–13. *Caenotoides californicus* HALL, male. 10–11, Head, direct frontal and facial views; 12, antenna, lateral view (from HALL, 1981); 13, wing (from HALL, 1972).

pollinose, small, narrow, median black stripe just below median ocellus. Mesonotum brownish yellow pollinose without apparent vittae; humeral and postalar calli a little lighter in color than notum; hairs on mesonotum pale yellow. Pleura black, upper part of sternopleuron and small spot on posterior portion of mesopleuron yellowish. Abdominal dorsum with small blackish spots on sides of second to fifth segments, sixth and following segments entirely black as in middle of venter. Each side of ovipositor with five stout, blunt spines. Female otherwise as described for male.”

Distribution. North America (California).

Specimen examined: CALIFORNIA: 1 ♂, Palm Springs, 23. ii. 1955, A. L. MELANDER.



Figs. 14–15. *Caenotoides californicus* HALL, male. 14, Abdomen, lateral view (segment 1 is not seen); 15, abdomen, ventral view (segments 1–2 are not seen).



Fig. 16. *Caenotoides idahoensis* HALL, male. Antenna, lateral view (from HALL, 1972).

Genus *Caenotus* COLE

Caenotus COLE, 1923, Proc. U. S. Nat. Mus. 62 (4): 14. Type species: *Caenotus inornatus* COLE, 1923 by original designation.

Caenotus is easily distinguished from other genera of Proratinae as shown in key (2) (couplet 2).

Caenotus contains 4 species, namely, *hospes* MELANDER, 1950 (from Arizona), *inornatus* COLE, 1923 (from New Mexico), *mexicanus* sp. n. (from Mexico) and *minutus* COLE, 1923 (from New Mexico). *Acaenotus* gen. n. is erected in this paper for *Caenotus canus* MELANDER, 1950 (from California and Arizona).

The female of *minutus* is unknown and the male of *inornatus* was not available for this study.

Male. Head: Wider than long; head in lateral view roughly triangular rather than circular; face wider markedly below; eyes contiguous; antenna stout and shorter than distance from antenna to median ocellus; antennal segment 1 longer than wide and than segment 2, which is wider than long; flagellum wider or not narrower than preceding segment, widest at middle or near base, and with thick short apical style having a minute terminal seta; flagellum (including style) roughly as long as (or less than twice as long as) preceding two segments combined; proboscis fleshy and not longer than palpus; palpus shorter than face, cylindrical and thicker; gena and palpus longer, denser pilose.

Thorax: Mesonotum, scutellum, pro-, meso-, and sternopleura (except anterior and posterior parts) longer erect pilose, and without any bristle.

Wing: Costa continuing around wing margin but weakened above end of vein R_5 ; vein R_5 ending below wing apex; veins M_1 , M_2 and M_4 reaching to wing margin; petiole of anal cell usually shorter than crossvein between discal and anal cells; complete or incomplete vein M_3 often present.

Legs: Posterior surfaces of fore and mid femora and ventral surface of hind femur longer erect pilose; anterior surface of hind coxa with a knob-like process which appears to be absent in ♂ *hospes* (distinctly present in ♀ *hospes*).

Abdomen: Tapering apically; tergum 2 with mid-posterior modified setose patch; sides of dorsum longer erect pilose.

Female. Head: Eyes widely separated; frons wider toward antennae; head in lateral view roughly triangular or trapezoid rather than circular; antenna longer than (or about as long as) distance from antenna to median ocellus; pile on gena and palpus shorter than in male.

Thorax: Pile on thorax shorter than in male.

Legs: Hind femur and tibia longer than in male; hairs on posterior surfaces of fore and mid femora shorter than in male; hind femur without longer hairs.

Abdomen: Longer than in male and roughly 3 times as long as mesonotum + scutellum; pile on sides of dorsum shorter than in male.

Key (3) to species of *Caenotus* based on male
(*inornatus* is excluded)

1. Tibia and tarsomere 1 dark brown to black or concolorous with femur; halter yellowish brown or pale brown; vein M_3 entirely absent (based on 4 ♂♂ of *hospes* and 1 ♂ of *minutus*) 2
- Tibia and tarsomere 1 (except apical portions) yellowish brown or paler than femur; halter dark brown rather than yellowish brown or pale brown; complete or incomplete vein M_3 very often present; antennal segment 3 more gradually narrower apically than in *minutus* (Fig. 30); pile on head and thorax pale but that on antennal segments 1–2 black *mexicanus* sp. n.
2. Pile on head black and that on mesonotum and scutellum chiefly so; antennal segment 3 more gradually narrower apically (Fig. 17); pile on occiput at uppermost corner of eye strong and long..... *hospes* MELANDER
- Pile on head and thorax pale; apical part of antennal segment 3 abruptly narrower and short (Fig. 43); pile on occiput at uppermost corner of eye weak and short *minutus* COLE

Key (4) to species of *Caenotus* based on female
(*minutus* is excluded)

1. Width of frons just above antenna 1.7 times (or so) that at median ocellus; pile on gena denser and longer; vein M_3 present or absent according to individual..... 2
- Width of frons just above antenna 1.3 times (or so) that at median ocellus; pile on gena sparser and shorter; coxa and femur wholly yellowish brown to brown (as in *inornatus*); vein M_3 absent; based on 1 ♀ *hospes* MELANDER
2. Coxa and apical portion of femur dark brown to black rather than brown; frons before median ocellus with short recumbent black hairs (as in *hospes*); vein M_3 absent (but probably very often present); based on 1 ♀
..... *mexicanus* sp. n.
- Coxa and femur wholly yellowish brown to brown rather than dark brown; frons wholly covered with pale yellow recumbent hairs; vein M_3 present; based on 1 ♀ *inornatus* COLE

***Caenotus hospes* MELANDER**
(Figs. 17–23, 62, 82–89, 164–170)

Caenotus hospes MELANDER, 1950, Pan-Pacific Ent. 26: 149. Type locality: Arizona.

This species (σ^7) is similar to *minutus* (σ^7) but is easily separated from the latter as shown in key (3) (couplet 2), and it (♀) is easily distinguished from *mexicanus* (♀) and *inornatus* (♀) as shown in key (4) (couplet 1). It is necessary to compare female between *hospes* and *minutus* but this has not yet been done.

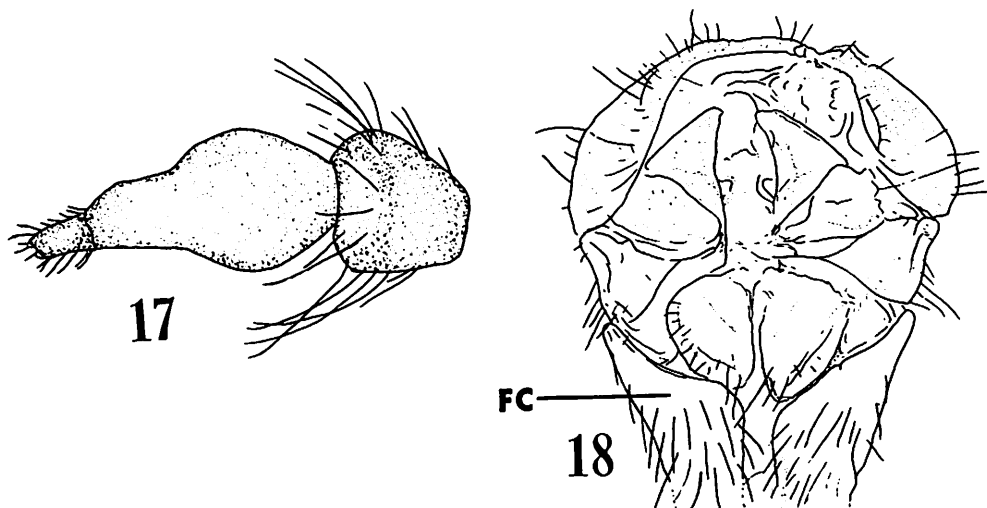
Male. Head (Fig. 17): Head and its appendages dark brown to black, and pale gray pollinose; ocellar triangle, vertex, occiput, gena, antennal segments 1–2, palpus and proboscis with black hairs; some hairs on occiput near uppermost corner of eye strong and longer; large area (except sides and upper margin) above occipital foramen bare; width of one eye on a mid line from a direct frontal view 1.0–1.1 times distance from antenna to median ocellus, 2.8–3.4 times width of frons just above antenna, and 1.0–1.5 times width of face at lowest point from a direct frontal view; ocellar triangle 1.0–1.2 times as long as wide; distance from lower ridge below proboscis to antenna 0.7–0.9 times that from antenna to median ocellus; palpus 0.6–0.7 times as long as distance from lower ridge below proboscis to antenna; antenna 0.7–0.8 times distance from antenna to median ocellus; relative lengths of antennal segments 1, 2, 3 and style from inner view 217 (200–250) : 100 : 310 (280–350) : 93 (80–100) and their relative widths viewed from the side 153 (150–160) : 170 (150–200) : 208 (200–225) : 77 (75–80); data based on 3 specimens.

Thorax (Fig. 18): Dark brown to black, pale gray pollinose; mesonotum and scutellum with erect black hairs which are longer on scutellum and posterior part of mesonotum; pile on humeral and postalar calli, and posterior part of scutellum changes into pale and shorter recumbent pale pile may be present on mesonotum; pro-, meso-, and anterior part of sternopleura with pale pile.

Wing: Membrane pale gray or nearly hyaline; narrow stigma and apical portion of subcostal cell slightly darker; veins largely yellowish brown or pale brown rather than brown to dark brown; vein M_3 entirely absent in 4 specimens before us; halter yellowish brown or pale brown; vein between discal and 2nd posterior cells 0.5–0.8 times as long as r–m crossvein and petiole of anal cell 0.6–1.1 times as long as crossvein between discal and anal cells.

Legs: Dark brown to black; knees yellowish brown; coxa and femur pale gray pollinose and pale pilose, but pile on fore coxa chiefly black and that on posterior surfaces of fore and mid femora longer and erect; relative lengths of segments (excluding coxa and trochanter) of fore leg 214 (206–219) : 249 (228–263) : 100 : 52 (50–56) : 38 (33–41) : 26 (22–28) : 38 (33–41), of mid leg 220 (211–231) : 260 (250–275) : 108 (106–113) : 46 (39–50) : 36 (33–38) : 23 (22–25) : 35 (33–38), of hind leg 320 (311–331) : 357 (327–381) : 126 (122–131) : 54 (50–56) : 38 (34–40) : 24 (22–27) : 36 (33–40) and in hind leg viewed from the side relative widths of femur, tibia and tarsomeres 1–3, 39 (34–41) : 27 (25–28) : 18 (17–19) : 14 (13–16) : 13 (11–16); (N=4).

Abdomen: Dark brown to black, pale gray pollinose, and more or less polished; paired tergum 9 and cerci yellowish brown; abdomen with pale pile which is longer on sides of dorsum and short in middle of dorsum.



Figs. 17–18. *Caenotus hospes* MELANDER, male. 17, Antennal segment 2 and flagellum, inner view; 18, thorax and base of fore coxa, anterior view.

Length: Body 4.4–5.3 mm; wing 3.5–4.1 mm; fore basitarsus 0.38–0.45 mm.

Female. Similar to male except as follows: Head (Figs. 20–23): Hairs on head shorter than in male and those on occiput, gena, palpus and proboscis pale in color; width of one eye on a mid line from a direct frontal view 1.1 times width of frons just above antenna and 0.8 times width of face at lowest point from a direct frontal view; ocellar triangle 0.8 times as long as wide; width of frons just above antenna 1.3 times that at median ocellus; distance from lower ridge below proboscis to antenna 1.1 times that from antenna to median ocellus; palpus 0.8 times distance from lower ridge below proboscis to antenna; antenna 1.1 times as long as distance from antenna to median ocellus; relative lengths of antennal segments 1, 2, 3 and style from inner view 250 : 100 : 350 : 100 and their relative widths viewed from the side 150 : 175 : 200 : 75.

Thorax: Pleura may be brown (or reddish brown) rather than dark brown; pile on thorax shorter than in male; pile on mesonotum chiefly pale and recumbent.

Wing: Vein M_3 entirely absent in the specimen on hand; vein between discal and 2nd posterior cells 0.8 times as long as r–m crossvein and petiole of anal cell 0.8 times as long as crossvein between discal and anal cells.

Legs: Brown (or reddish brown) rather than dark brown; relative lengths of segments of fore leg 207 : 233 : 100 : 47 : 33 : 23 : 33, of mid leg 227 : 260 : 107 : 47 : 33 : 23 : 33, of hind leg 347 : 360 : 127 : 47 : 33 : 23 : 33, and in hind leg viewed from the side relative widths of femur, tibia and tarsomeres 1–3, 40 : 23 : 17 : 13 : 13.

Abdomen: Brown (or reddish brown) rather than dark brown; pile on venter and sides of dorsum shorter than in ♂; terga 2–5 and sterna 2–5 with pale posterior margin (this may be so in ♂).

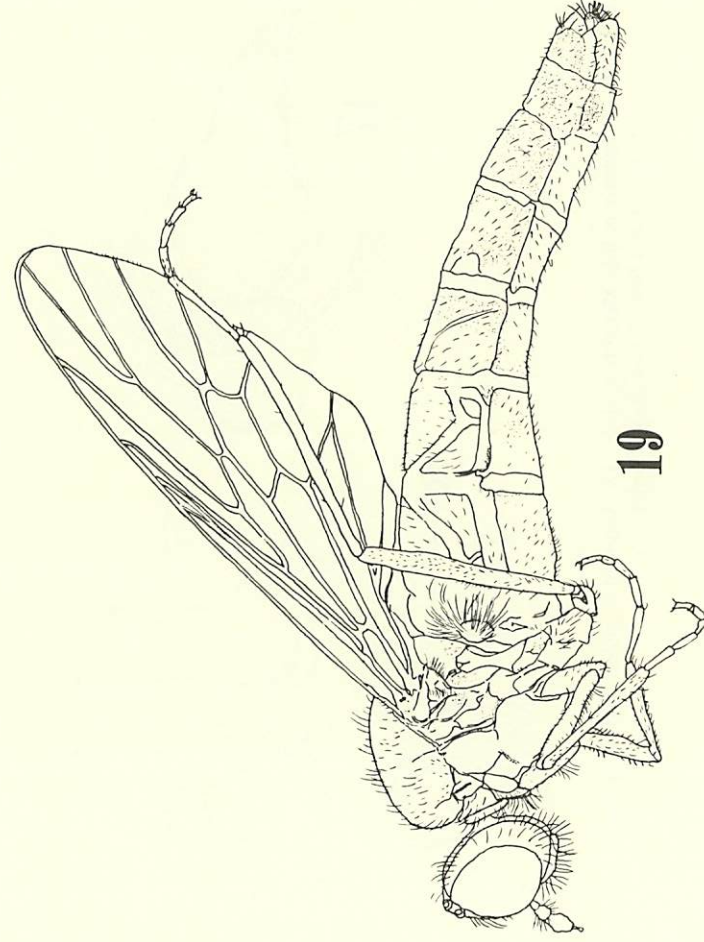
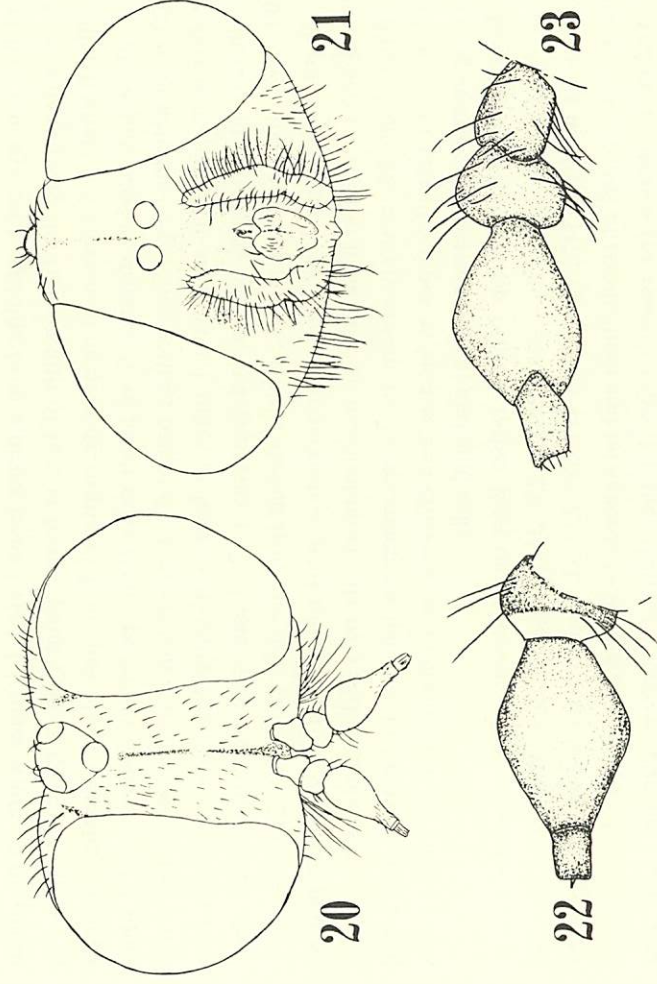


Fig. 19. *Caenottus hospes* MELANDER, female. Lateral view.



Figs. 20-23. *Caenottus hospes* MELANDER, female. 20-21, Head, direct frontal and facial views; 22, antennal segment 2 and flagellum, inner view; 23, antenna, outer view.

Length: Body 5.1 mm; wing 3.5 mm; fore basitarsus 0.38 mm.

Distribution. North America (Arizona).

Specimens examined: ARIZONA: 4 ♂♂, 1 ♀ (paratypes), Organpipe Cactus National Monument, 15–19. iv. 1947, A. L. MELANDER.

MELANDER (1950 : 150) wrote, "Types: Organpipe Cactus National Monument, southern Arizona, at Headquarters camp, 62 males and 6 females, taken during the latter part of April, 1947 and 1948. Nearly all the specimens were found on the outside of the windows of our house trailer during the day. A very few were attracted to light. One specimen has the second posterior cell separated from the pointed discal cell by a short petiole."

Caenotus inornatus COLE

(Figs. 24–27, 171–176)

Caenotus inornatus COLE, 1923, Proc. U. S. Nat. Mus. 62 (4): 16. Type locality: New Mexico.

This species (♀) is similar to *mexicanus* (♀) but may be separated from the latter as shown in key (4) (couplet 2), and it is necessary to compare male between two species in the future.

Female. Head (Figs. 25–27): Dark brown to black, and pale gray pollinose; palpus and base of antennal segment 3 may be brown rather than dark brown; frons wholly covered with dense pale yellow recumbent pile; ocellar triangle and vertex with pale yellow pile; gena, occiput, palpus and proboscis with pale pile, but area behind upper margin of eyes with some bristle-like pale brown hairs; antennal segments 1–2 with brown hairs; large area (except sides and upper part) above occipital foramen bare; width of one eye on a mid line from a direct frontal view 1.2 times distance from antenna to median ocellus, 1.2 times width of frons just above antenna, and 0.8 times width of face at lowest point from a direct frontal view; ocellar triangle 0.9 times as long as wide; width of frons just above antenna 1.8 times that at median ocellus; distance from lower ridge below proboscis to antenna 1.1 times that from antenna to median ocellus; palpus 0.8 times as long as distance from lower ridge below proboscis to antenna; antenna 1.2 times as long as distance from antenna to median ocellus; relative lengths of antennal segments 1, 2, 3 and style from inner view 200 : 100 : 275 : 75 and their relative widths viewed from the side 150 : 150 : 175 : 50.

Thorax: Dark brown to black, and pale gray pollinose; mesonotum with pale recumbent pile which becomes erect on humeral and postalar calli and posterior part of mesonotum; scutellum with pale erect pile; pro-, meso-, and middle of sternopleura pale erect pilose.

Wing: Membrane faintly tinged with brown; narrow stigma and apical portion of subcostal cell slightly darker; veins largely brown; discal cell with 4 veins reaching

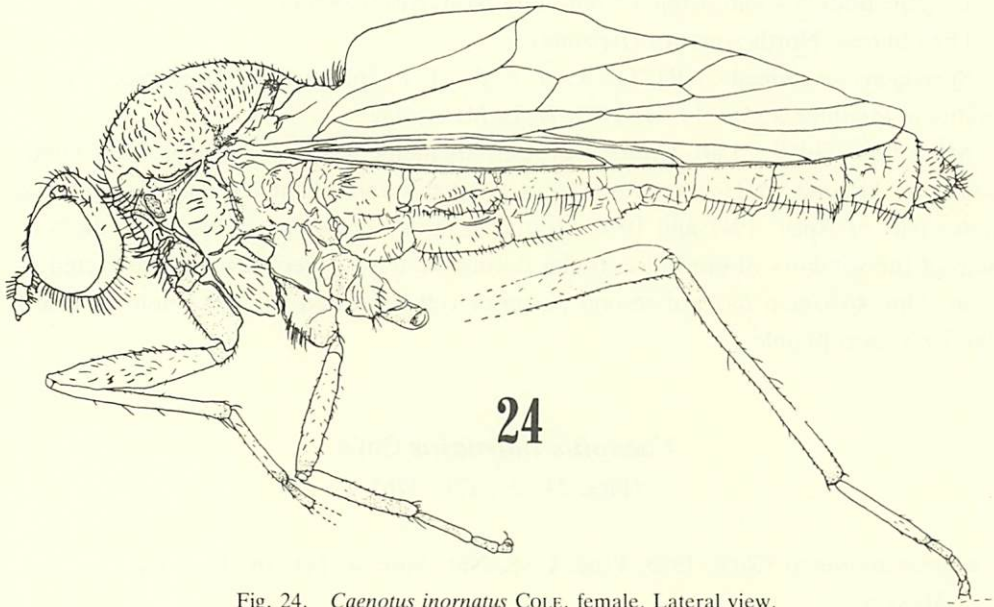
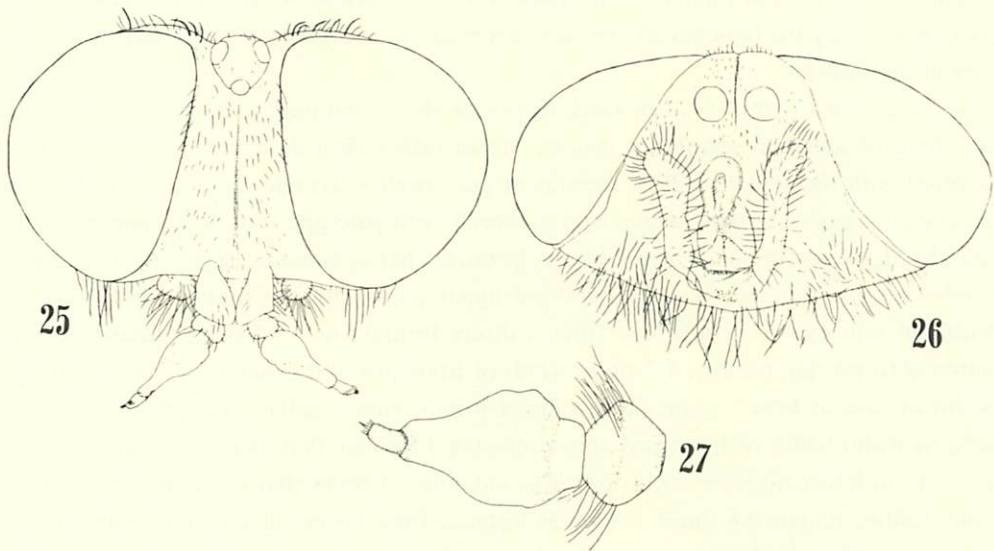


Fig. 24. *Caenotus inornatus* COLE, female. Lateral view.



Figs. 25-27. *Caenotus inornatus* COLE, female. 25-26, Head, direct frontal and facial views; 27, antennal segment 2 and flagellum, inner view.

to wing margin [in the specimen on hand, vein M_3 ending on vein M_4 before wing margin in one wing but reaching to wing margin in the other wing]; halter white, but stem and base of knob brown to dark brown; vein between discal and 2nd posterior cells 0.6 times as long as r-m crossvein and petiole of anal cell 0.5 times as long as crossvein between discal and anal cells.

Legs: Coxa brown, pale gray pollinose, and pale pilose; rest of legs yellowish brown, but tarsomeres 2–5 and apical portion of tarsomere 1 darkened; femur with pale, chiefly recumbent pile; relative lengths of segments (excluding coxa and trochanter) of fore leg 211 : 248 : 100 : 44 : 37 : 22 : 33, of mid leg 233 : 278 : 104 : 48 : 37 : 22 : 30, of hind leg 348 : 385 : 130 : 56 : 37 : 26 : ? and in hind leg viewed from the side relative widths of femur, tibia and tarsomeres 1–3, 48 : 30 : 19 : 17 : 17.

Abdomen: Dark brown to black, and more or less polished; sterna 4–8, posterior border of segment 3 (or 2–3), terga 4–7 (except anterior and lateral parts), tergum 8, and cerci yellowish brown; abdomen above and below pale pilose.

Length: Body 8.4 mm; wing 6.1 mm; fore basitarsus 0.68 mm.

Male. Not available for this study. COLE (1923 : 16) wrote, "Male. — Length 5.5 to 6.5 mm. Very nearly like *C. minutus* in general structure, color, and habitus. The pile of the thorax is a little thicker and more yellowish. The yellowish lobes of the genitalia are very much the same. Knees, hind tibiae, except apices, basal portion of two front pairs of tibiae and base of hind metatarsi, yellowish; spines on tibiae stronger than in *C. minutus*. Halteres as in above species. Wing venation nearly the same as in *C. minutus*, but Cu-1 [=M₄] and M-3 are united for a short distance near the base and end separately and wide apart in the wing margin. There is no m-cu crossvein or cell M-3."

Distribution. North America (New Mexico).

Specimen examined: NEW MEXICO: 1 ♀ (paratype), Alamogordo, 12. v. 1902.

Caenotus mexicanus NAGATOMI et YANAGIDA sp. n.

(Figs. 28–42, 90–97, 177–182)

This species (♀) may be separated from *inornatus* (♀) as shown in key (4) (couplet 2). It is very necessary to compare male between *mexicanus* and *inornatus*, but this has not yet been done. It (♂) may easily be distinguished from *hospes* (♂) and *minutus* (♂) as shown in key (3) (couplet 1).

Male. Head (Figs. 29–30): Head and its appendages dark brown to black, and pale gray pollinose; ocellar triangle, vertex and occiput near vertex with black hairs (which may sometimes change into pale); antennal segments 1–2 with dense black hairs; gena, occiput, palpus and proboscis with white tomentum, but large area (except sides and upper margin) above occipital foramen bare; width of one eye on a mid line from a direct frontal view 1.0–1.1 times distance from antenna to median ocellus, and 2.1–2.9 times width of frons just above antenna; ocellar triangle as long as wide; distance from lower ridge below proboscis to antenna 0.7–0.8 times that from antenna to median ocellus; palpus 0.6–0.8 times as long as distance from lower ridge below proboscis to antenna; antenna 0.7–0.8 times as long as distance from antenna to median ocellus; relative lengths of antennal segments 1, 2, 3 and style from inner view 270 (233–350) : 100 : 319 (267–400) : 84 (67–100) and their relative widths viewed from

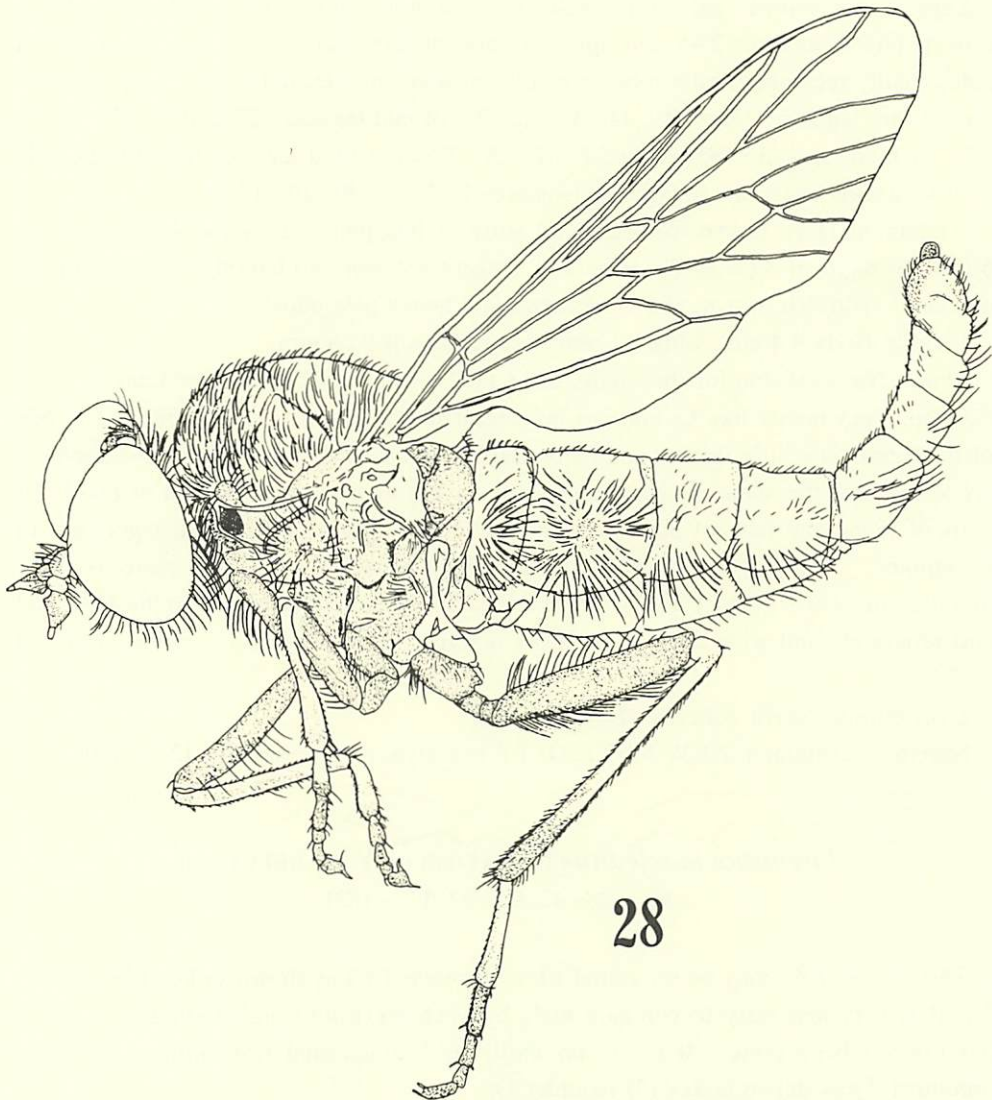
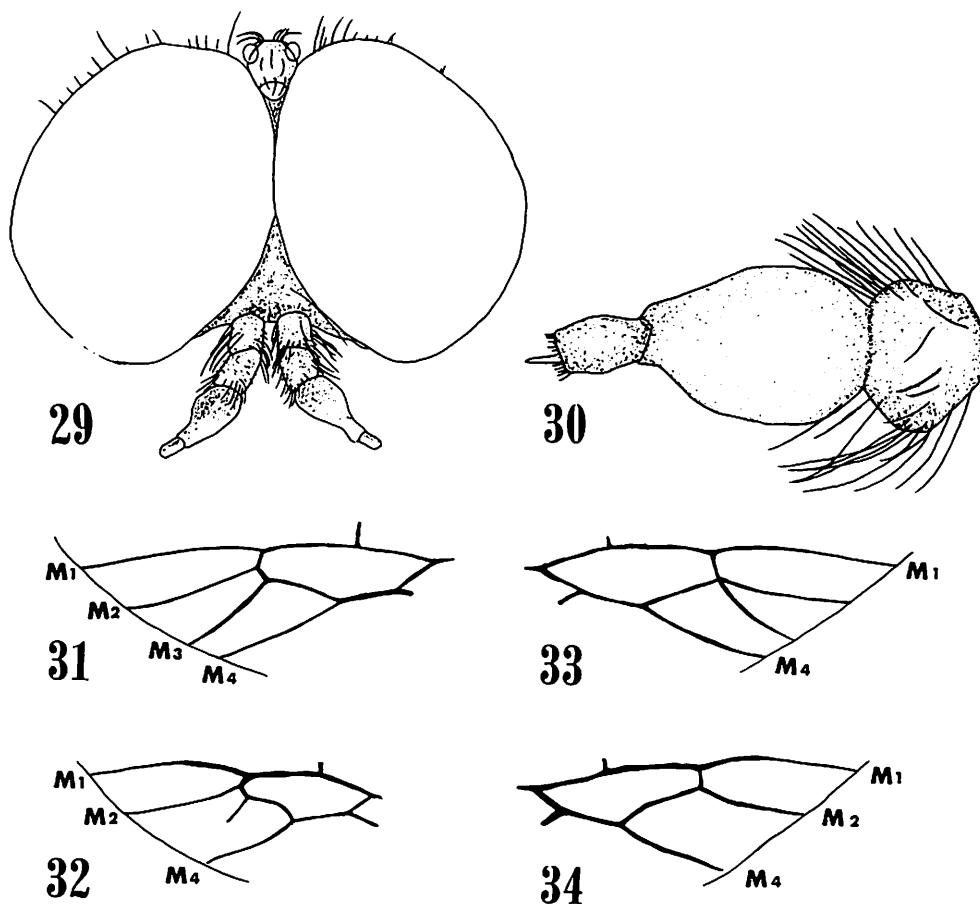


Fig. 28. *Caenotus mexicanus* NAGATOMI et YANAGIDA, male. Lateral view.

the side 187 (133–250) : 186 (133–250) : 208 (167–250) : 79 (67–100) ; data based on 10 specimens.

Thorax: Dark brown to black, and pale gray pollinose; scutellum (except base) and postscutellum (except sides) and subscutellum more or less polished; thorax with white tomentum; sclerite between anterior spiracle and fore coxa, ptero-, meta-, and hypopleura, posterior part of sternopleuron, sub- and postscutellum bare.

Wing (Figs. 31–34): Membrane pale gray or nearly hyaline, but narrow stigma and apical portion of subcostal cell brown to dark brown; veins brown to dark brown; vein M_3 complete, incomplete or entirely absent according to individual or within one



Figs. 29–34. *Caenotus mexicanus* NAGATOMI et YANAGIDA, male. 29, Head, direct frontal view; 30, antennal segment 2 and flagellum, inner view. 31–34, discal cell and veins M_1 – M_4 .

individual; halter brown to dark brown; vein between discal and 2nd posterior cells 0.5–1.3 times as long as r–m crossvein and petiole of anal cell 0.7–1.2 times as long as crossvein between discal and anal cells; (N=11).

Legs: Dark brown to black; knees, femur and tibia (except apical portions) yellowish brown to brown, but often in fore and mid femora and tibiae, yellowish brown to brown parts confined at bases; coxa and tibia pale gray pollinose and pale pilose; relative lengths of segments (excluding coxa and trochanter) of fore leg 219 (209–228) : 242 (233–247) : 100 : 48 (44–53) : 38 (33–42) : 27 (23–31) : 41 (37–47), of mid leg 230 (218–240) : 263 (250–273) : 103 (95–111) : 47 (39–56) : 38 (36–41) : 25 (21–28) : 40 (36–47), of hind leg 337 (318–353) : 372 (355–389) : 130 (121–137) : 57 (50–61) : 40 (37–45) : 27 (25–28) : 41 (37–44) and in hind leg viewed from the side relative widths of femur, tibia and tarsomeres 1–3, 49 (45–56) : 31 (28–33) : 22 (20–25) : 18 (16–22) : 17 (16–19); (N=10).

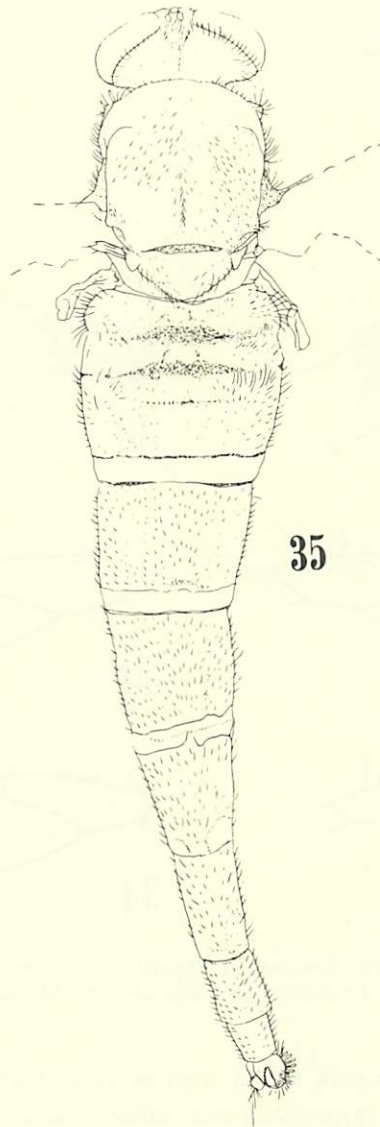
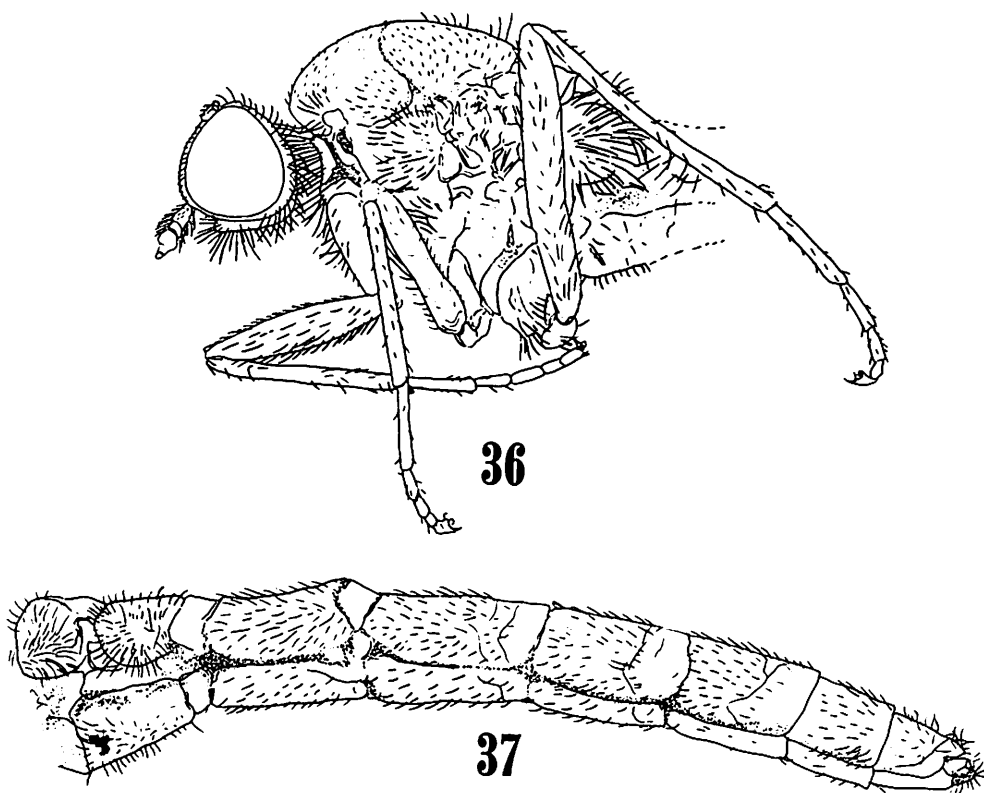


Fig. 35. *Caenotus mexicanus* NAGATOMI et YANAGIDA, female. Dorsal view.

Abdomen: Dark brown to black, and pale gray pollinose; paired tergum 9 yellowish brown; abdomen above and below with white tomentum which is short and recumbent in the middle of dorsum.

Length: Body 5.1–7.0 mm; wing 3.5–4.9 mm; fore basitarsus 0.38–0.50 mm.

Female. Similar to male except as follows: Head (Figs. 38–42): Palpus yellowish brown to brown; frons before median ocellus with short recumbent black hairs; width of one eye on a mid line from a direct frontal view 1.1 times width of frons just above antenna and 0.9 times width of face at lowest point from a direct frontal view; width



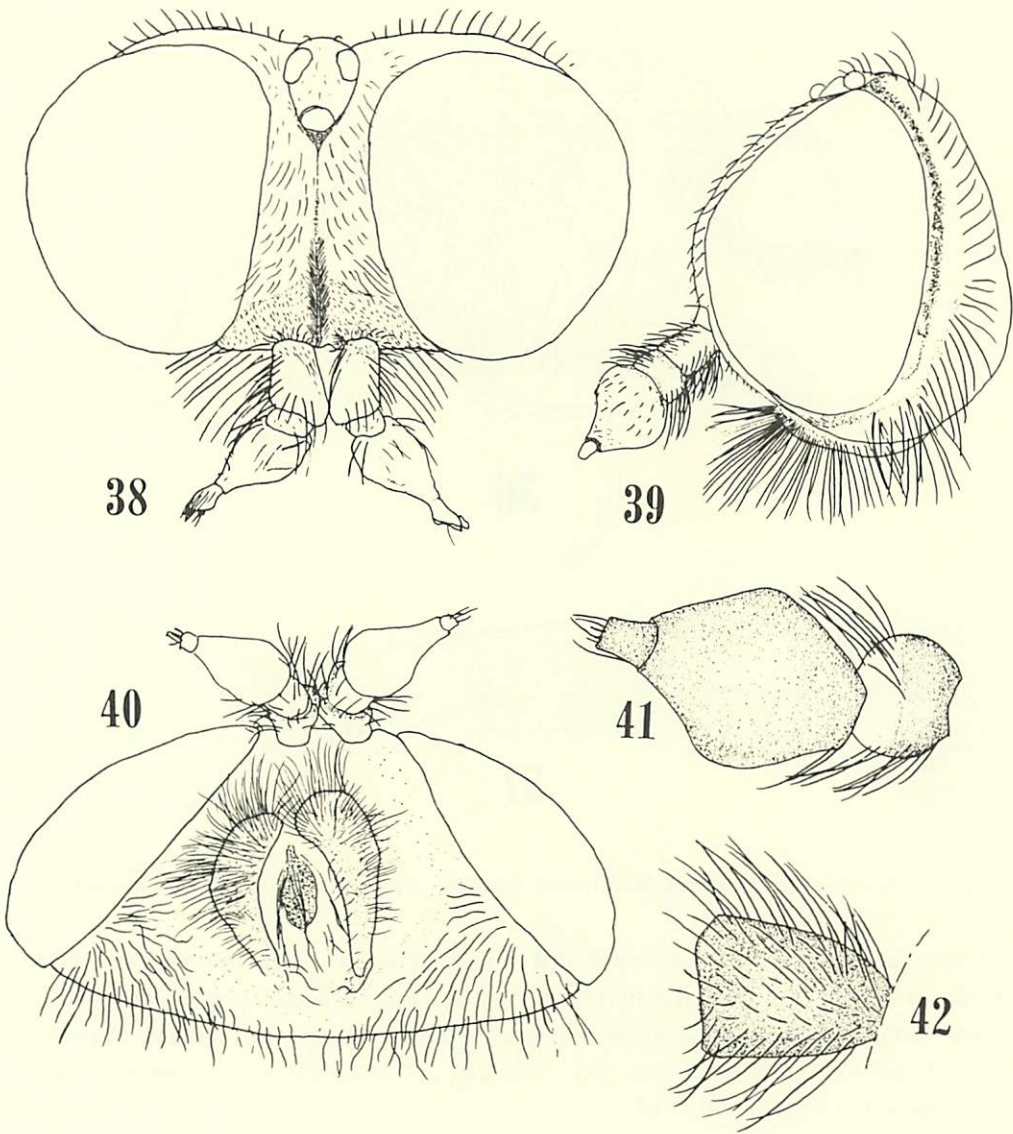
Figs. 36–37. *Caenotus mexicanus* NAGATOMI et YANAGIDA, female. Lateral view. (Wing is omitted).

of frons just above antenna 1.7 times that at median ocellus; distance from lower ridge below proboscis to antenna 1.1 times that from antenna to median ocellus; antenna 1.2 times distance from antenna to median ocellus; relative lengths of antennal segments 1, 2, 3 and style from inner view 233 : 100 : 267 : 67 and their relative widths viewed from the side 150 : 167 : 217 : 67.

Thorax: Pile on mesonotum shorter and mostly recumbent.

Wing: Vein M_3 entirely absent in the specimen before us; halter largely yellowish brown rather than brown to dark brown; vein between discal and 2nd posterior cells 0.4 times as long as r-m crossvein and petiole of anal cell 0.8 times as long as crossvein between discal and anal cells.

Legs: Yellowish brown, but coxa, trochanter, tarsomeres 2–5, apical portion of femur, apices of tibia and tarsomere 1 brown to dark brown; pile on femur shorter than in male; relative lengths of segments of fore leg 210 : 235 : 100 : 45 : 35 : 25 : 35, of mid leg 235 : 265 : 100 : 45 : 35 : 25 : 35, of hind leg 370 : 375 : 120 : 50 : 40 : 25 : 40 and in hind leg viewed from the side relative widths of femur, tibia and tarsomeres 1–3, 50 : 30 : 20 : 15 : 15.



Figs. 38–42. *Caenotus mexicanus* NAGATOMI et YANAGIDA, female. 38–40, Head, direct frontal, lateral and facial views; 41, antennal segment 2 and flagellum, inner view; 42, antennal segment 1, outer view.

Abdomen (Fig. 37): Terga 2–4 with posterior pale band; venter yellowish (or reddish) brown; pile on abdomen shorter than in male.

Length: Body 7.9 mm; wing 4.7 mm; fore basitarsus 0.50 mm.

Distribution. Mexico.

Holotype: MEXICO: ♂, 18 miles S. W. Santa Catarina, San Luis Potosi., 3,500 feet, 7. iv. 1966, R. E. & E. M. PAINTER.

Paratypes: 11 ♂♂, 1 ♀, same data as holotype.

Holotype and paratypes are deposited in U. S. National Museum, Washington, D. C.

Caenotus minutus COLE

(Figs. 43, 98–105)

Caenotus minutus COLE, 1923, Proc. U. S. Nat. Mus. 62 (4): 15. Type locality: New Mexico.

This species (♂) is similar to *hospes* (♂) but may be separated from the latter as shown in key (3) (couplet 2), and it is necessary to compare female between these two species. The female of *minutus* is unknown.

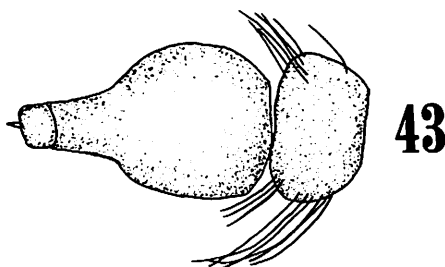


Fig. 43. *Caenotus minutus* COLE, male. Antennal segment 2 and flagellum, inner view.

Male. Head (Fig. 43): Dark brown to black, and pale gray pollinose; ocellar triangle, vertex, occiput, gena, antennal segments 1–2, palpus and proboscis pale pilose; pile on occiput near uppermost corner of eye weak and shorter; pile on gena and palpus longer; large area (except sides and upper margin) above occipital foramen bare; width of one eye on a mid line from a direct frontal view 1.0 times distance from antenna to median ocellus, and 3.0 times width of frons just above antenna; ocellar triangle 1.1 times as long as wide; distance from lower ridge below proboscis to antenna 0.8 times that from antenna to median ocellus; palpus 0.6 times as long as distance from lower ridge below proboscis to antenna; antenna 0.7 times as long as distance from antenna to median ocellus; relative lengths of antennal segments 1, 2, 3 and style from inner view 300 : 100 : 350 : 100 and their relative widths viewed from the side 200 : 250 : 250 : 100.

Thorax: Dark brown to black, and pale gray pollinose; mesonotum, scutellum, pro-meso-, and middle of sternopleura pale erect pilose.

Wing: Membrane pale gray and narrow stigma and apical portion of subcostal cell brown to dark brown; veins brown to dark brown; vein M_3 entirely absent in the specimen before us; halter with knob yellowish brown and stem brown to dark brown; vein between discal and 2nd posterior cells as long as r-m crossvein and petiole of anal cell 0.9 times as long as crossvein between discal and anal cells.

Legs: Dark brown to black, but knees yellowish brown; coxa and femur pale gray pollinose and pale pilose; pile on posterior surfaces of fore and mid femora and on ventral surface of hind femur longer and erect; relative lengths of segments (excluding coxa and trochanter) of fore leg 200 : 229 : 100 : 47 : 41 : 24 : 41, of mid leg 212 : 253 : 94 : 47 : 29 : 24 : 41, of hind leg 318 : 359 : 118 : 47 : 35 : 29 : 41 and in hind leg viewed from the side relative widths of femur, tibia and tarsomeres 1-3, 47 : 32 : 24 : 18 : 18.

Abdomen: Dark brown to black, and pale gray pollinose; posterior part of paired tergum 9 yellowish brown; segments 2-6 (especially sterna 2-6) with pale posterior border; abdomen above and below with pale pile which is longer and erect on sides of dorsum and short in middle of dorsum.

Length: Body 5.5 mm; wing 3.7 mm; fore basitarsus 0.43 mm.

Female. Unknown.

Distribution. North America (New Mexico).

Specimen examined: NEW MEXICO: 1 ♂ (paratype), Alamogordo, 22. iv. 1902.

Jackhallia NAGATOMI et LIU gen. n.

Type species: *Jackhallia argentinae* NAGATOMI et LIU sp. n.

Jackhallia (♀) is most closely related to *Prorates* and *Alloxytropus* but is easily distinguished from them by having vein M_2 arising from discal cell, female head with postocular rim (as in *Scenopinus*), and female abdominal tergum 9 with denser, longer hairs at posterior membranous part.

Female. Head: Eyes widely separated; head rather trapezoid, with lateral margins rounded, wider than long in direct frontal view, and rather triangular in lateral view; frons narrower than an eye, longer than wide, more or less narrower anteriorly but widened opposite antennae; face wider below; postocular rim present; side of face with longitudinal ridge; antenna as long as distance from antenna to median ocellus; antennal segments 1-2 each not longer than wide; antennal segment 3 is rather triangular or lancet-shaped, longer than wide, longer than segments 1+2, and appears to have no apical style; palpus rather thin and shorter than face; proboscis sclerotized and distinctly longer than head.

Thorax: Mesonotum and scutellum with bristles as follows: 1 notopleural, 1 postalar, 1 dorsocentral, and 2 (1 pair) marginal scutellar.

Wing: Vein R_5 ending at wing apex; thickening of costa ending at or just beyond tip of vein R_5 ; vein M_2 arising from discal cell; vein M_3 absent; veins M_1 , M_2 and M_4 evanescent before wing margin; petiole of anal cell about as long as crossvein between discal and anal cells; halter knob creamy white.

Legs: [The presence or absence of knob-like process on anterior surface of hind coxa is not confirmed].

Abdomen: Tapering apically; less than twice as long as mesonotum + scutellum;

tergum 2 with mid-posterior modified setose patch. Posterior membranous part of tergum 9 with denser, longer hairs.

Male. Not examined.

Jackhallia argentinae NAGATOMI et LIU sp. n.

(Figs. 44–47, 61, 183–189)

Female. Head (Figs. 45–46): Dark brown to black, and pale gray pollinose; ocellar triangle and vertex with shorter pale pile; gena and palpus with pale sparser pile; frons (except area above antennae) and upper occiput (except area above occipital foramen) short recumbent pale pilose; antennal segments 1–2 with short sparse black hairs; width of one eye on a mid line from a direct frontal view 1.0 times distance from antenna to median ocellus, 1.3 times width of frons just above antenna, and 1.0 times width of face at lowest point from a direct frontal view; ocellar triangle 0.9 times as long as wide; width of frons just above antenna 1.0 times that at median ocellus and 1.3 times that at narrowest point; distance from lower ridge below proboscis to antenna 1.3 times that from antenna to median ocellus; palpus 0.5 times as long as distance from lower ridge below proboscis to antenna; proboscis measured along ventral surface 2.2 times as long as distance from lower ridge below proboscis to antenna and 2.9 times as long as distance from antenna to median ocellus; antenna as long as distance from antenna to median ocellus; relative lengths of antennal segments 1, 2 and 3 from inner view 100 : 100 : 400 and their relative widths viewed from the side 100 : 125 : 150.

Thorax: Dark brown to black, and largely pale gray pollinose; mesonotum (except anterior part) and posterior part of scutellum with pale pile; pro-, meso- and mid-dorsal part of sternopleura with pale pile.

Wing (Fig. 47): Membrane nearly hyaline; narrow stigma may be slightly darker; veins largely brown; halter with knob creamy white, with stem brown; vein between discal and 2nd posterior cells 0.3 times as long as r-m crossvein and petiole of anal cell 1.1 times as long as crossvein between discal and anal cells.

Legs: Dark brown to black; knees and tarsomere 1 (except apical portion) yellowish brown; coxa and femur pale pilose and more or less pale gray pollinose; relative lengths of segments (excluding coxa and trochanter) of fore leg 192 : 200 : 100 : 38 : 31 : 23 : 31, of mid leg 192 : 215 : 100 : 38 : 31 : 23 : 31, of hind leg 262 : 285 : 108 : 46 : 38 : 23 : 38.

Abdomen: Dark brown to black; more or less shining, but tergum 2 (except side) pale gray pollinose; above and below with pale pile which is shorter on venter; tergum 9 yellowish brown and with anterior border having a transverse row of long pale hairs directed posteriorly.

Length: Body 2.7 mm; wing 2.7 mm; fore basitarsus 0.33 mm.

Distribution. Argentina (Santa Cruz).

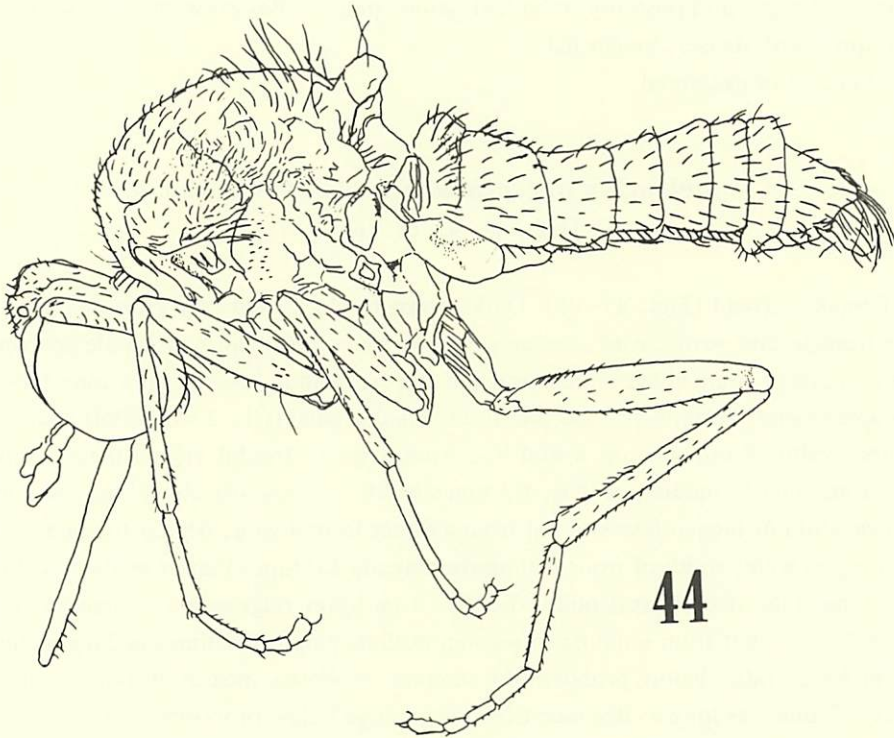


Fig. 44. *Jackhallia argentinae* NAGATOMI et LIU, female. Lateral view. (Wing is omitted).

Male. Unknown.

Holotype: ARGENTINA: ♀, 2 km. S. Caleta Olivia, Santa Cruz, (10 m, coastal dunes), 12. xii. 1967, E. I. SCHLINGER & M. E. IRWIN.

Type is deposited in the California Academy of Sciences, San Francisco.

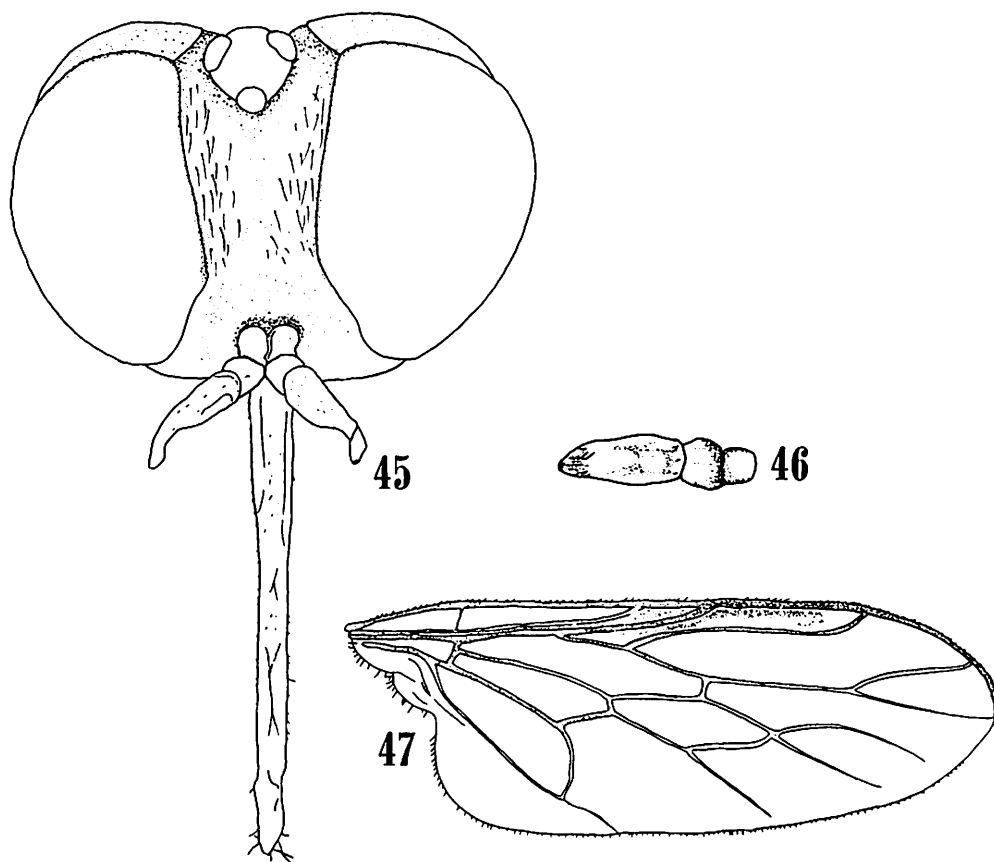
Genus *Prorates* MELANDER

Prorates MELANDER, 1906, Ent. News 17: 372. Type species: *Prorates claripennis* MELANDER, 1906 (monotypic).

Prorates and *Alloxytropus* are easily separated from *Jackhallia* (whose male is unknown) by having the vein M_2 arising from vein M_1 , the female head without postocular rim, and the female tergum 9 without denser, longer hairs at posterior membranous part.

Prorates may be distinguished from *Alloxytropus* by having the cord-like phallus (just behind hanging-bell phallus) forked anteriorly.

Male. Head: Elliptical or rather trapezoidal and wider than long in anterior view,



Figs. 45–47. *Jackhallia argentinae* NAGATOMI et LIU, female. 45, Head, direct frontal view; 46, antenna, outer view; 47, wing.

and circular or semicircular in lateral view; eyes contiguous; antenna not longer than distance between antennae and median ocellus; antennal segments 1–2 each not longer than wide; antennal flagellum longer than preceding segments 1 + 2, longer than wide, tapering apically, triangular in shape and with short apical style which is narrower than preceding segment and pointed at apex; palpus one-segmented, slender, and usually not longer than face; proboscis largely sclerotized and usually longer than face (it is nearly twice as long as eye height in *arctos*).

Thorax: Mesonotum strongly arched; mesonotum, scutellum, pro- and mesopleura with pile which is short and sparse; mesonotum and scutellum with bristles (1 notopleural, 1 postalar, and 2 [1 pair] marginal scutellar).

Wing: Vein R_5 ending at wing apex; thickening of costa ending at or just beyond tip of vein R_5 ; vein M_2 arising from vein M_1 ; petiole of anal cell longer than crossvein between discal and anal cells; veins M_1 , M_2 and M_4 not reaching to wing margin; vein M_3 entirely absent.

Legs: More slender than in *Caenotus*.

Abdomen: Narrower in relation to thorax; tapering apically; tergum 2 with mid-posterior modified setose patch.

Female. Head: Frons narrower than an eye, much longer than wide, wider toward ocellar triangle, and somewhat widened opposite antennae; occiput well seen in direct frontal view but not forming postocular rim.

Key (5) to species of *Prorates*

1. Proboscis (along ventral surface) longer than distance from lower ridge below proboscis to antenna 2
- Proboscis (along ventral surface) not longer than distance from lower ridge below proboscis to antenna *boydi* HALL
(based on 1 ♂ from Utah)
- 2 (1). Proboscis (along ventral surface) distinctly less than twice as long as eye height; palpus not longer than distance from lower ridge below proboscis to antenna 3
- Proboscis (along ventral surface) nearly twice as long as eye height; palpus “extending as far as first antennal segment” (after HALL, 1972; based on 1 ♀ from Wyoming) *arctos* HALL
- 3 (2). Legs (except knees) (at least in ♂) brown to dark brown rather than yellowish brown [some individuals of *ballmeri* (2 ♂♂ from Nevada) may have paler legs, fall into couplet 6 and are hardly separated externally from *melanderi* and *Prorates* sp.) 4
- Legs largely yellowish brown rather than brown to dark brown 5
- 4 (3). Wing stigma yellowish brown, pale brown, or not well marked; wing veins largely yellowish brown or pale brown; halter with knob yellowish brown
..... *ballmeri* sp. n.
(based on 3 ♂♂ from California)
- Wing stigma and veins dark brown; halter black; in ♀, “legs lighter colored; knob of halter brownish yellow”; (after Hall, 1972; based on 1 ♂, 1 ♀ from New Mexico) *claripennis* MELANDER
- 5 (3). Mesonotum and scutellum with pale pile; scutellar bristles pale or pale yellow; halter yellowish brown or pale brown and often with knob paler than stem 6
- Mesonotum and scutellum with chiefly black pile, and scutellar bristles black; in halter knob darker than stem *nigrescens* HALL
(3 ♂♂, 2 ♀♀ from California) and *painteri* (1 ♂, 2 ♀♀ from Arizona)
- 6 (5). Antennal segments 1–2 brown to dark brown; in ♀ (at least in *melanderi*) thorax and abdomen dark brown to black *melanderi* HALL
(based on 2 ♂♂, 2 ♀♀ from California), *ballmeri* (based on 2 ♂♂ from Nevada) and *Prorates* sp. (based on 1 ♂ from Nevada)
- Antennal segments 1–2 yellowish brown; in ♀ thorax and abdomen largely

yellowish brown *frommeri* HALL
 (based on 2 ♂♂, 2 ♀♀ from California)

Prorates arctos HALL

Prorates arctos HALL, 1972, Pan-Pacific Ent. 48: 42. Type locality: Wyoming (Fremont County).

We have seen no specimen of *arctos*. The following is an abridged version of the original description.

"The long proboscis, dark color, well pronounced wing venation and the northern distribution will serve to distinguish this species.

"Female. Black, tip of tibiae, knees and knob of halter pale; Proboscis projecting nearly twice eye height beyond oral margin Palpi long, extending as far as first antennal segment.

"Mesonotum ; hair short, yellowish; bristles brown. Scutellum with yellow hair (bristles apparently broken off).

"Wing veins dark; stigma well pronounced. Wing hyaline; petiole at base of second posterior cell extremely short; Legs fuscous.

"Abdomen rather evenly blackish brown; hair golden yellow; venter with lateral margins of segments one to four pale; hair pale yellow.

"Male. Unknown.

"Holotype female from 10 mi. S. Shoshoni, Fremont County, Wyoming, 3 July 1965 (F. R. HOLLAND) as prey of the robberfly *Heteropogon wilcoxi* JAMES. Deposited in the U. S. National Museum."

Prorates ballmeri NAGATOMI et LIU sp. n.

(Figs. 48–52, 106–113)

This species (♂) differs from *arctos* and *boydi* in the length of proboscis as shown in key (5) (couplets 1–2). It may be separated from *claripennis* in the following respects: wing stigma yellowish brown, pale brown, or not well marked; wing veins largely yellowish brown or pale brown; halter with knob yellowish brown. In *claripennis* (♂) (after Hall, 1972), stigma and veins are dark brown, and halter is black.

It is difficult to distinguish *ballmeri* (♂) from *melanderi* (♂) and *Prorates* sp. (♂) externally, when the legs of *ballmeri* become paler in color. However, the male genitalia of *ballmeri* differ distinctly from those of *melanderi* and *Prorates* sp. as shown in key (8) (couplet 5).

Male. Head (Figs. 49–51): Head and its appendages dark brown to black, and pale gray pollinose; ocellar triangle, vertex, occiput (except area above occipital foramen),

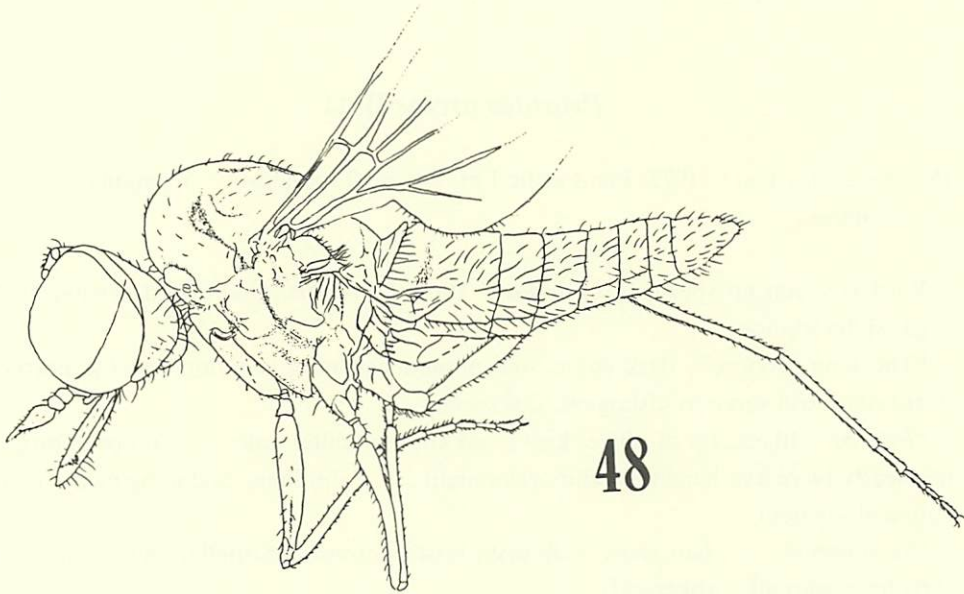
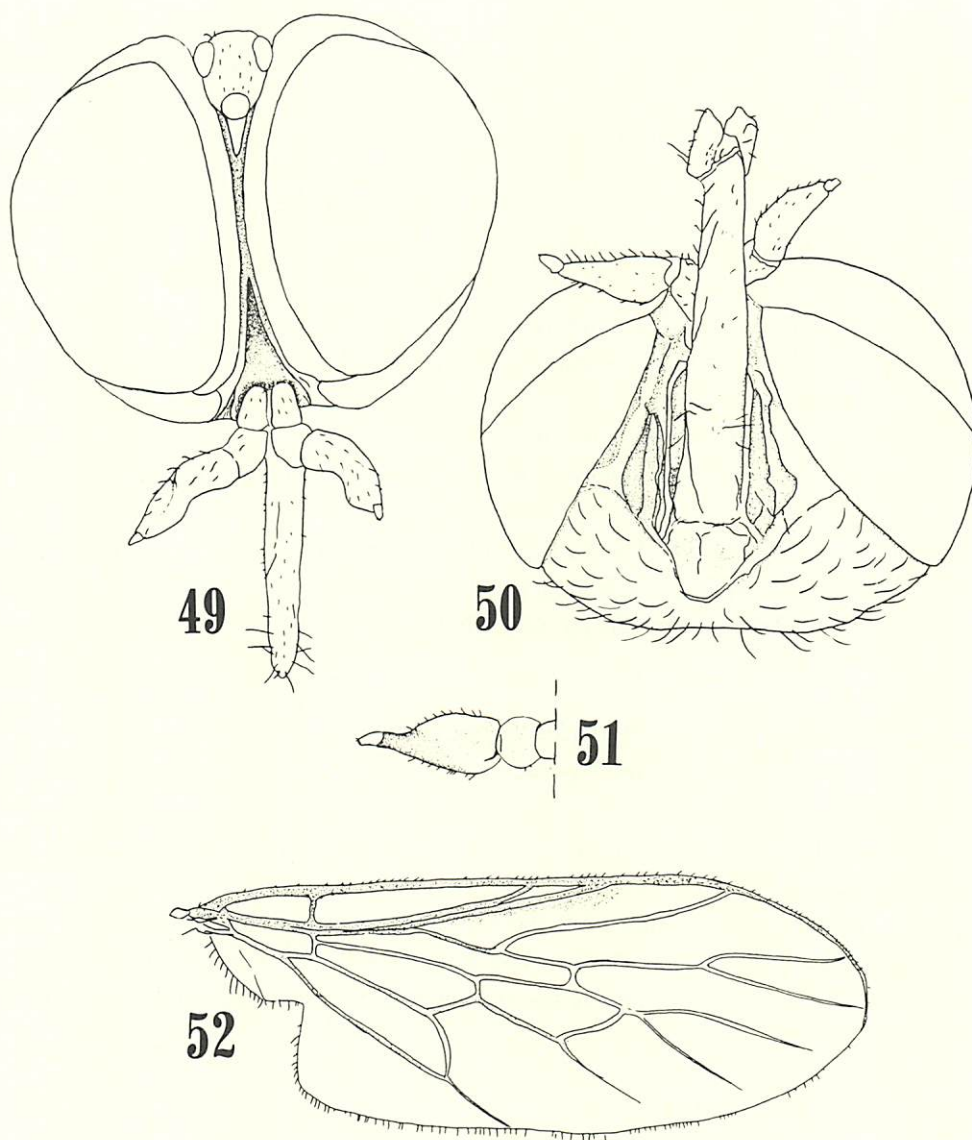


Fig. 48. *Prorates ballmeri* NAGATOMI et LIU, male (from California). Lateral view.

gena, palpus, and apical portion of proboscis with shorter pale pile which is especially inconspicuous on ocellar triangle, vertex and upper occiput; width of one eye on a mid line from a direct frontal view 0.9–1.0 times distance from antenna to median ocellus, 3.4 times width of frons just above antenna, and 1.7–1.9 times width of face at lowest point from a direct frontal view; ocellar triangle 1.3 times as long as wide; distance from lower ridge below proboscis to antenna 1.0 times that from antenna to median ocellus; palpus 0.7 times as long as distance from lower ridge below proboscis to antenna; proboscis measured along ventral surface 1.5 times as long as distance from lower ridge below proboscis to antenna and 1.5 times as long as distance from antenna to median ocellus; antenna 0.8–0.9 times as long as distance from antenna to median ocellus; relative lengths of antennal segments 1, 2 and 3 (including style) from inner view 100 : 100 : 400 and their relative widths viewed from the side 113 (100–125) : 138 (125–150) : 150 (150); data based on 2 specimens from California.

Thorax: Dark brown to black, and pale gray pollinose; mesonotum with three broad darker stripes, of which middle one is divided by a mid vitta and lateral ones are interrupted at the suture; mesonotum, scutellum, pro- and mesopleura shorter pale pilose; bristles on mesonotum and scutellum pale in color.

Wing (Fig. 52): Membrane nearly hyaline or tinged with pale brown; stigma and area above it yellowish brown, pale brown or not well marked; veins largely yellowish brown or pale brown; halter with knob yellowish brown and stem brown; petiole of 2nd posterior cell 0.3–1.3 times as long as r-m crossvein and petiole of anal cell



Figs. 49–52. *Prorates ballmeri* NAGATOMI et LIU, male. 49, Head, direct frontal view (from California); 50, head, facial view (from Nevada); 51, antenna (base of segment 1 is not seen), inner view (from California); 52, wing (from California).

1.6–1.7 times as long as crossvein between discal and anal cells (N=3 from California).

Legs: Brown to dark brown, but knees yellowish brown; coxa and femur pale gray pollinose and pale pilose; relative lengths of segments (excluding coxa and trochanter) of fore leg 209 (192–227) : 218 (299–227) : 100 : 47 (45–50) : 32 (25–36) : 26 (25–27) : 31 (29–32), of mid leg 197 (183–209) : 227 (208–236) : 112 (108–118) : 47 (42–55) : 35 (33–36) : 23 (18–27) : 29 (25–32), of hind leg 274 (250–291) : 289

(267–300) : 147 (142–155) : 55 (54–55) : 41 (36–45) : 26 (25–27) : 31 (25–36) and in hind leg viewed from the side relative widths of femur, tibia and tarsomeres 1–3, 34 (32–36) : 18 (17–18) : 12 (8–14) : 10 (8–14) : 9 (8–9); (N=3 from California).

Abdomen: Dark brown to black; above and below with pale pile which is longer on sides of dorsum.

Length: Body 2.6–2.7 mm; wing 2.3–2.5 mm; fore basitarsus 0.28–0.30 mm; proboscis (along ventral surface) 0.53–0.55 mm; (N=2 from California).

Female. Unknown.

Distribution. North America (California and Nevada).

Holotype: CALIFORNIA: ♂, Summit 6,500, Scherwin, Mono Co., 24. v. 1985, G. R. BALLMER.

Paratypes: 2 ♂♂, same data as holotype.

Holotype and paratypes are deposited in the California Academy of Sciences, San Francisco.

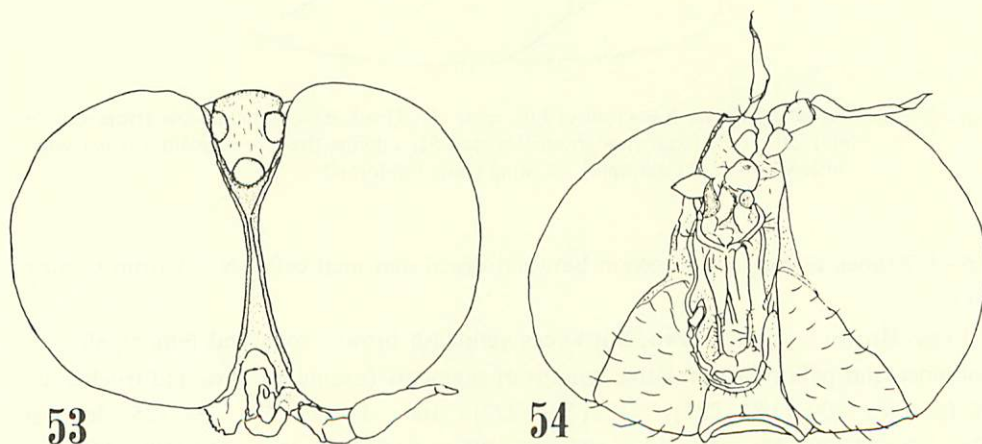
There are 2 ♂♂ (27 mi. W. Denio, Humboldt Co., Nevada, 23. vi. 1971, G. STEYSKAL) on hand, which apparently belong to *ballmeri* but are not designated as paratypes. The legs of these specimens are somewhat paler than in 3 ♂♂ from California.

Prorates boydi HALL

(Figs. 53–54, 58, 114–119)

Prorates boydi HALL, 1972, Pan-Pacific Ent. 48 : 40. Type locality: California.

This species is easily separated from the congeners by having the proboscis (along ventral surface) shorter than distance from antenna to median ocellus. The male genitalia of *boydi* are peculiar among the members of *Prorates* (see couplet 2 of the key [8]).



Figs. 53–54. *Prorates boydi* HALL, male. Head, direct frontal and facial views.

Male. Head (Figs. 53–54): Head coal-black; antenna, palpus, and proboscis dark brown; area below proboscis may be yellowish brown; head and its appendages probably pale gray pollinose; ocellar triangle, vertex, occiput, gena, palpus and proboscis pale pilose; relative lengths of antennal segments 1, 2 and 3 (including style) from inner view 150 : 100 : 500 and their relative widths viewed from the side 100 : 150 : 150 ; [several parts of head are not measured].

Thorax: Coal-black, and pale gray pollinose; mesonotum and scutellum, pro-, meso- and mid-dorsal part of sternopleura pale pilose; at least notopleural bristle pale in color.

Wing: Membrane wholly nearly hyaline; stigma and area above it yellowish brown, but not well marked; veins largely yellowish brown; halter creamy white, with stem brown to dark brown; basal petiole of 2nd posterior cell 0.3 times as long as r-m crossvein and petiole of anal cell 1.5 times as long as crossvein between discal and anal cells.

Legs: Dark brown to black, but tibia, apical portion of femur, hind tarsomere 1 (except apical portion) yellowish brown; coxa and femur pale pilose; relative lengths of segments (excluding coxa and trochanter) of fore leg 192 : 231 : 100 : 38 : 31 : 23 : 38, of mid leg 200 : 238 : 108 : 46 : 31 : 23 : 35, of hind leg 269 : 285 : 131 : 46 : 38 : 23 : 35 and in hind leg viewed from the side relative widths of femur, tibia and tarsomeres 1–3, 31 : 23 : 15 : 12 : 12.

Abdomen: Coal-black, polished, more or less pale gray pollinose; sterna 1–2 with a yellowish brown tinge.

Length: Body 3.6 mm; wing 2.4 mm; fore basitarsus 0.33 mm .

Distribution. North America (California and Utah).

Specimen examined: UTAH: 1 ♂, Wild Horse Creek 4,900', 1.5 mi. NW. Wild Horse Butte, Emery Co., 26–27. vii. 1982, A. S. & Kurt MENKE.

Prorates claripennis MELANDER

Prorates claripennis MELANDER, 1906, Ent. News 17: 373. Type locality: New Mexico.

We have seen no specimen of *claripennis*. HALL (1972) redescribed *claripennis* based on holotype and allotype. His redescription is abridged below.

“Differs from the congeners by the black legs and black halteres. The basal antennal segments are also black. *Prorates claripennis* is very similar to *P. melanderi* HALL. From this latter species *claripennis* may be separated by the shorter proboscis, which does not extend beyond the tip of the antennae and by the pale yellow to white, not golden, abdominal hair.

“Male. — Black, knees and fore coxae a little lighter. Halter stem and knob black, Proboscis projecting, short, not reaching beyond apex of antennae; Palpi testaceous, approximately one-third length of proboscis, Mesonotum ; hair short, yellow; bristles yellowish. Scutellum ; two apical bristles dark brown.

Wing hyaline, stigma dark brown, veins dark, Hair on abdomen pale yellow to white; Venter with white hair.

“Female. Very much like male except legs lighter colored. Knob of halter brownish yellow

“Other than the holotype and allotype, both from New Mexico, I have seen no other specimens. Both are in the U. S. National Museum.”

Prorates frommeri HALL

(Figs. 120–125)

Prorates frommeri HALL, 1972, Pan-Pacific Ent. 48 : 45. Type locality: California.

This species may be separated from the related species as shown in key (5) (couplet 6).

The male genitalia of *frommeri* are peculiar among the members of *Prorates* as shown in key (8) (couplet 3).

Male. Head: Head and its appendages are dark brown to black, and pale gray pollinose, but antennal segments 1–2, and palpus are yellowish brown and proboscis may be partly so (antennal flagellum dark brown); ocellar triangle, vertex, occiput, gena, palpus and proboscis pale pilose; width of one eye on a mid line from a direct frontal view 1.0 times distance from antenna to median ocellus, 4.8 times width of frons just above antenna, and 3.6 times width of face at lowest point from a direct frontal view; ocellar triangle 1.3 times as long as wide; [palpus, proboscis and distance from lower ridge below proboscis to antenna were not measured]; antenna 0.9 times as long as distance from antenna to median ocellus; relative lengths of antennal segments 1, 2 and 3 (including style) from inner view 100 : 100 : 500 and their relative widths from the side 100 : 125 : 150 ; data based on 1 specimen.

Thorax: Brown to dark brown, and pale gray pollinose; mesonotum, scutellum, pro- and mesopleura pale pilose.

Wing : Membrane pale gray or hyaline; stigma not well marked; veins yellowish brown; halter yellowish brown; basal petiole of 2nd posterior cell 1.1 times (N=1) as long as r-m crossvein and petiole of anal cell 1.9–2.2 times (N=2) as long as crossvein between discal and anal cells.

Legs: Yellowish brown; coxa and femur pale pilose; relative lengths of segments (excluding coxa and trochanter) of fore leg 188 (175–200) : 196 (183–208) : 100 : 40 (38–42) : 32 (31–33) : 24 (23–25) : 24 (23–25), of mid leg 172 (167–177) : 200 (192–208) : 100 : 38 : 30 (29–31) : 22 (21–23) : 28 (27–29), of hind leg 244 (233–254) : 260 (250–269) : 128 (125–131) : 56 (54–58) : 40 (38–42) : 24 (23–25) : 32 (31–33) and in hind leg viewed from the side relative widths of femur, tibia and tarsomeres 1–3, 36 (33–38) : 20 (17–23) : 13 (12–13) : 13 (12–13) : 10 (8–12) ; (N=2).

Abdomen: Dark brown to black, and pale gray pollinose, but venter and genitalia

(except epandrium) yellowish brown; abdomen above and below with pale pile which is longer on sides of dorsum.

Length: Body 2.5 mm; wing 2.2–2.4 mm; fore basitarsus 0.30–0.33 mm.

Female. Similar to male except as follows: Head: Lower occiput and gena yellowish brown; [head is crushed and each part is not measured].

Thorax: Yellowish brown.

Wing: Basal petiole of 2nd posterior cell 2.6–3.3 times (N=2) as long as r-m crossvein and petiole of anal cell 2.3 times (N=1) as long as crossvein between discal and anal cells.

Legs: Relative lengths of segments of fore leg 196 (191–200) : 200 : 100 : 44 (42–45) : 33 (32–33) : 24 (21–27) : 30 (27–33), of mid leg 192 (191–192) : 209 (200–217) : 109 (108–109) : 44 (42–45) : 33 (32–33) : 22 (21–23) : 24 (21–27), of hind leg 261 (258–264) : 274 (264–283) : 139 (136–142) : 57 (55–58) : 46 (41–50) : 26 (25–27) : 30 (27–33) and in hind leg viewed from the side relative widths of femur, tibia and tarsomeres 1–3, 39 (36–42) : 20 (18–21) : 14 (13–14) : 9 (8–9) : 9 (8–9) ; (N=2).

Abdomen: Dorsum largely or partly yellowish brown (this may be sometimes so in ♂).

Length: Body 2.2–2.4 mm; wing 2.0–2.3 mm; fore basitarsus 0.28–0.30 mm.

Distribution. North America (California).

Specimens examined (paratypes: 2 ♂♂, 2 ♀♀): CALIFORNIA: 1 ♂, Deep Canyon, Riverside County, 4. x. 1963, E. I. SCHLINGER; 1 ♂, 2 ♀♀, Deep Canyon, Riverside County, 1. x. 1969, S. FROMMER.

Remarks. HALL (1972) wrote, "There is a rather wide range of color expressed from nearly entirely brown (except the legs) to entirely straw colored. The majority of the specimens are of this latter color, although the males generally tend to be darker. I can find no structural differences between the color variants of this species."

Prorates melanderi HALL

(Figs. 55, 126–131)

Prorates melanderi HALL, 1972, Pan-Pacific Ent. 48 : 43. Type locality: California.

This species is very similar to *ballmeri* and it is difficult to distinguish them externally (the female is unknown in *ballmeri*).

The male genitalia of *melanderi* are different from those of *ballmeri* as shown in key (8) (couplet 5) but are hardly distinguished from those of *nigrescens* and *Prorates* sp.

Male. Head: Head and its appendages dark brown to black, and pale gray pollinose, but palpus yellowish brown; ocellar triangle, vertex, occiput, gena, palpus and apical portion of proboscis pale pilose; [head is crushed and each part is not measured].

Thorax: Dark brown to black, and pale gray pollinose; mesonotum, scutellum, pro- and mesopleura short pale pilose; bristles on mesonotum and scutellum pale yellow.

Wing: Membrane pale gray or almost hyaline; stigma and area above it pale brown; veins largely yellowish brown or pale brown; halter yellowish brown; basal petiole of 2nd posterior cell 2.5–2.7 times (N=2) as long as r-m crossvein and petiole of anal cell 1.6–1.8 times (N=2) as long as crossvein between discal and anal cells.

Legs: Yellowish brown; fore coxa (except apical portion), tarsomeres 2–5 and apex of tarsomere 1 may be somewhat darker; coxa and femur pale pilose; relative lengths of segments (excluding coxa and trochanter) of fore leg 184 (175–192) : 192 : 100 : 40 (38–42) : 33 : 25 : 29 (25–33), of mid leg 175 (167–183) : 196 (192–200) : 104 (100–108) : 40 (38–42) : 29 : 21 : 25, of hind leg 242 (233–250) : 250 (242–258) : 138 (133–142) : 50 : 36 (33–38) : 23 (21–25) : 25 and in hind leg viewed from the side relative widths of femur, tibia and tarsomeres 1–3, 33 : 17 : 11 (8–13) : 8 : 8 ; (N=2).

Abdomen: Dark brown to black, and pale gray pollinose; above and below pale pilose.

Length: Body 2.3–2.5 mm; wing 2.0–2.1 mm; fore basitarsus 0.30 mm.

Female. Similar to male except as follows: Head (Fig. 55): Width of one eye on a mid line from a direct frontal view 1.0 times distance from antenna to median ocellus, and 1.5 times (N=1) width of frons just above antenna which is 1.5 times (N=1) that at narrowest point; ocellar triangle 0.9 times as long as wide; distance from lower ridge below proboscis to antenna 1.4–1.5 times that from antenna to median ocellus; palpus 0.5 times as long as distance from lower ridge below proboscis to antenna; proboscis along ventral surface 1.3 times as long as distance from lower ridge below proboscis to antenna and 1.9 times as long as distance from antenna to median ocellus; antenna 1.2 times as long as distance from antenna to median ocellus; relative lengths of antennal segments 1, 2 and 3 (including style) from inner view 90 (80–100) : 100 : 315 (280–350) and their relative widths from the side 90 (80–100) : 123 (120–125) : 123 (120–125); data based on 2 specimens; some of the parts are not measured and some of the values may be as in male.

Wing: Basal petiole of 2nd posterior cell 1.5 times (N=2) as long as r-m crossvein and petiole of anal cell 1.5 times (N=1) as long as crossvein between discal and anal cells.

Legs: Fore coxa yellowish brown (this may be sometimes so in ♂); relative lengths of segments of fore leg 192 : 184 (175–192) : 100 : 40 (38–42) : 28 (27–29) : 22 (21–23) : 26 (25–27), of mid leg 180 (175–185) : 212 (208–215) : 108 : 40 (38–42) : 32 (31–33) : 22 (21–23) : 26 (25–27), of hind leg 260 (250–269) : 268 (258–277) : 132 (131–133) : 52 (50–54) : 40 (38–42) : 24 (23–25) : 30 (29–31) and in hind leg viewed from the side relative widths of femur, tibia and tarsomeres 1–3, 36 (33–38) : 18 (17–19) : 14 (13–15) : 10 (8–12) : 10 (8–12); (N=2).

Abdomen: Venter largely yellowish brown to brown rather than dark brown (this may be sometimes so in ♂); posterior borders of some segments pale or white (this may be so in ♂).

Length: Body 2.4 mm (N=1); wing 2.2–2.5 mm; fore basitarsus 0.30–0.33 mm.

Distribution. North America (California).

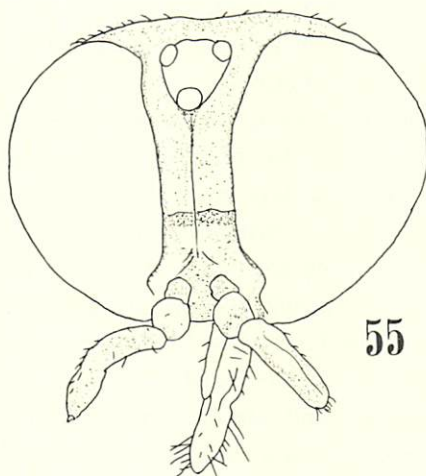


Fig. 55. *Prorates melanderi* HALL, female. Direct frontal view.

Specimens examined (paratypes: 2 ♂♂, 2 ♀♀): CALIFORNIA: 2 ♂♂, 1 ♀, Palm Canyon, Borrego, Imperial County, 3–4. v. 1945, A. L. MELANDER; 1 ♀, Borrego, Imperial County, 3. v. 1956, P. H. TIMBERLAKE.

Prorates nigrescens HALL

(Figs. 59, 133–138, 190–195)

Prorates nigrescens HALL, 1972, Pan-Pacific Ent. 48: 44. Type locality: California (Riverside).

It is difficult to distinguish *nigrescens* from *painteri* externally. These two species are characterized by having the pile on mesonotum and scutellum chiefly black.

In *nigrescens*, proboscis (along ventral surface) is (A) 1.2 times (based on 1 ♂) and 1.6 times (based on 1 ♀) as long as distance from lower ridge below proboscis to antenna and (B) 1.1 times (1 ♂) and 2.0–2.3 times (2 ♀♀) as long as distance from antenna to median ocellus. In *painteri*, (A) is 1.5 times (1 ♂) and 1.9 times (2 ♀♀) and (B) is 1.3 times (1 ♂) and 2.5–2.8 times (2 ♀♀). Thus, proboscis of *nigrescens* may be shorter than in *painteri*.

The male genitalia of *nigrescens* are easily distinguished from those of *painteri* and *ballmeri* as shown in key (8) (couplets 4 and 5) but are hardly distinguished from those of *melanderi* and *Prorates* sp. No significant differences are found among *melanderi*, *nigrescens* and *painteri* in the female genitalia. However, it is premature to treat *nigrescens* as a synonym of *melanderi* at present.

Male. Head: Head and its appendages dark brown to black, and pale gray polli-

nose, but palpus yellowish brown; ocellar triangle, vertex, occiput, gena, palpus and apical portion of proboscis pale pilose; width of one eye on a mid line from a direct frontal view 0.9 times distance from antenna to median ocellus, 3.9 times width of frons just above antenna, and 3.1 times width of face at lowest point from a direct frontal view; ocellar triangle 1.1 times as long as wide; distance from lower ridge below proboscis to antenna 0.9 times that from antenna to median ocellus; palpus 0.6 times as long as distance from lower ridge below proboscis to antenna; proboscis along ventral surface 1.2 times as long as distance from lower ridge below proboscis to antenna and 1.1 times distance from antenna to median ocellus; antenna 0.7 times as long as distance from antenna to median ocellus; relative lengths of antennal segments 1, 2 and 3 (including style) from inner view 100 : 100 : 400 and their relative widths viewed from the side 100 : 125 : 125; data based on 1 specimen.

Thorax: Dark brown to black, and pale gray pollinose; in better preserved specimen, mesonotum with three broad darker stripes, of which middle one is divided by a median vitta; mesonotum and scutellum with short chiefly black pile and longer bristles which sometimes change into pale before suture and on postalar callus; pile on pro- and mesopleurae pale.

Wing: Membrane pale gray or hyaline; stigma and area above it brown; veins largely yellowish brown to brown; halter yellowish brown to brown, but knob darker than stem; basal petiole of 2nd posterior cell 1.0–2.0 times ($N=3$) as long as r-m crossvein and petiole of anal cell 1.6–1.7 times ($N=3$) as long as crossvein between discal and anal cells.

Legs: Yellowish brown; tarsus and fore coxa sometimes more or less darker; coxa and femur pale pilose; relative lengths of segments (excluding coxa and trochanter) of fore leg 200 : 204 (200–208) : 100 : 38 : 31 : 23 : 27, of mid leg 189 (185–192) : 212 (208–215) : 108 : 42 (38–46) : 31 : 21 (19–23) : 23, of hind leg 258 (254–262) : 273 (269–277) : 131 : 54 : 38 : 23 : 27 and in hind leg viewed from the side relative widths of femur, tibia and tarsomeres 1–3, 37 (35–38) : 19 : 15 : 12 : 8; ($N=2$; in hind tarsomeres 1–3, $N=1$).

Abdomen: Dark brown to black, and pale gray pollinose; posterior margins of segments 2–6 usually pale or white; above and below pale pilose.

Length: Body 2.7–3.1 mm ($N=3$); wing 2.3–2.5 mm ($N=3$); fore basitarsus 0.33 mm ($N=2$).

Female. Similar to male except as follows: Head: Area just below proboscis often yellowish brown, width of one eye on a mid line from a direct frontal view 1.0–1.1 times distance from antenna to median ocellus, 1.6–1.8 times width of frons just above antenna, and 1.6 times width of face at lowest point from a direct frontal view; width of frons just above antenna 0.9 times that at median ocellus and 1.5 times that at narrowest point; ocellar triangle 0.9–1.0 times as long as wide; distance from lower ridge below proboscis to antenna 1.3 times ($N=1$) that from antenna to median ocellus; palpus 0.7 times ($N=1$) as long as distance from lower ridge below proboscis to antenna; proboscis along ventral surface 1.6 times ($N=1$) as long as distance from

lower ridge below proboscis to antenna and 2.0–2.3 times that from antenna to median ocellus; antenna 1.1 times distance from antenna to median ocellus; relative lengths of antennal segments 1, 2 and 3 (including style) from inner view 100 : 100 : 375 (350–400) and their relative widths viewed from the side 113 (100–125) : 138 (125–150) : 150; data based on 2 specimens.

Thorax: Sterno-, hypo- and lower part of pteropleura often yellowish brown.

Wing: Veins largely brown to dark brown (this may be sometimes so in ♂); basal petiole of 2nd posterior cell 2.0–2.3 times (N=2) as long as r-m crossvein and petiole of anal cell 1.4–1.6 times (N=3) as long as crossvein between discal and anal cells.

Legs: Relative lengths of segments of fore leg 188 (185–192) : 190 (185–193) : 100 : 36 (33–38) : 30 (29–31) : 22 (21–23) : 24 (23–25), of mid leg 185 (183–186) : 208 (200–217) : 108 (107–108) : 38 (38–39) : 28 (25–31) : 17 (15–18) : 24 (23–25), of hind leg 254 (250–258) : 267 (264–269) : 136 (133–138) : 51 (50–54) : 35 (33–36) : 20 (19–21) : 25 and in hind leg viewed from the side relative widths of femur, tibia and tarsomeres 1–3, 32 (31–33) : 19 (15–21) : 12 (11–13) : 11 (8–13) : 9 (8–11); (N = 3; in length of hind tarsomere 5, N=1).

Abdomen: Venter often largely or partly yellowish brown.

Length: Body 2.5–3.2 mm; wing 2.3–2.5 mm; fore basitarsus 0.30–0.35 mm.

Distribution. North America (California).

Specimens examined: CALIFORNIA: 1 ♂, Riverside, 1. xi. 1969, J. C. HALL; 2 ♂ ♂, 3 ♀ ♀, Riverside, 3. vii. – 20. ix. 1978, J. C. HALL.

Prorates painteri NAGATOMI et LIU sp. n.

(Figs. 139–145)

This species is very similar to *nigrescens* and it is difficult to distinguish them externally, although the proboscis of *painteri* may be longer than in *nigrescens* (see note under *Prorates nigrescens*). However, the male genitalia of *painteri* differ markedly from those of other species as shown in key (8) (couplet 4).

Fits the description of *nigrescens*. All of the structural characters measured are given below.

Male. Head: Pile on ocellar triangle, vertex and upper occiput black; width of one eye on a mid line from a direct frontal view 0.9 times distance from antenna to median ocellus and 3.3 times width of frons just above antenna; [ocellar triangle and width of face at lowest point from a direct frontal view were not measured]; distance from lower ridge below proboscis to antenna 0.9 times that from antenna to median ocellus; palpus 0.5 times as long as distance from lower ridge below proboscis to antenna; proboscis along ventral surface 1.5 times as long as distance from lower ridge below proboscis to antenna and 1.3 times as long as distance from antenna to median ocellus; antenna 0.6 times as long as distance from antenna to median ocellus; relative lengths of antennal segments 1, 2 and 3 (including style) from inner view 100 : 100 : 350 and

their relative widths viewed from the side 100 : 150 : 125; data based on 1 specimen.

Wing: Stigma and area above it brown to dark brown; veins largely brown to dark brown; basal petiole of 2nd posterior cell 1.2 times ($N=1$) as long as r-m crossvein and petiole of anal cell 1.4 times ($N=1$) as long as crossvein between discal and anal cells.

Legs: Relative lengths of segments (excluding coxa and trochanter) of fore leg 200 : 200 : 100 : 38 : 31 : 19 : 27, of mid leg 185 : 215 : 100 : 38 : 31 : 19 : 27, of hind leg 254 : 254 : 123 : 50 : 35 : 19 : 27 and in hind leg viewed from the side relative widths of femur, tibia and tarsomeres 1-3, 31 : 15 : 12 : 8 : 8; ($N=1$).

Length: Body 3.4 mm ; wing 2.3 mm ; fore basitarsus 0.33 mm.

Female. Head: Pile on ocellar triangle, vertex and upper occiput may be pale or practically absent in specimens on hand; width of one eye on a mid line from a direct frontal view 0.9 times distance from antenna to median ocellus, 1.3 times width of frons just above antenna, and 1.1-1.2 times width of face at lowest point from a direct frontal view; width of frons just above antenna 0.8-0.9 times that at median ocellus and 1.2-1.4 times that at narrowest point; ocellar triangle 0.8-0.9 times as long as wide; distance from lower ridge below proboscis to antenna 1.3-1.6 times that from antenna to median ocellus; palpus 0.5 times as long as distance from lower ridge below proboscis to antenna; proboscis along ventral surface 1.9 times as long as distance from lower ridge below proboscis to antenna and 2.5-2.8 times as long as distance from antenna to median ocellus; antenna 1.1 times distance from antenna to median ocellus; relative lengths of antennal segments 1, 2 and 3 (including style) from inner view 100 : 100 : 325 (300-350) and their relative widths viewed from the side 100 : 125 : 150; data based on 2 specimens.

Wing: Basal petiole of 2nd posterior cell ($N=1$) 0.4 times (in left wing) and 1.0 times (in right wing) as long as r-m crossvein and petiole of anal cell ($N=1$) 1.7 times as long as crossvein between discal and anal cells.

Legs: Relative lengths of segments of fore leg 188 (175-200) : 200 (192-208) : 100 : 40 (38-42) : 29 (25-33) : 21 (17-25) : 25, of mid leg 180 (167-192) : 209 (192-225) : 108 : 42 : 27 (25-29) : 19 (17-21) : 25, of hind leg 255 (242-267) : 263 (250-275) : 138 (133-142) : 50 : 38 (33-42) : 25 : 25 and in hind leg viewed from the side relative widths of femur, tibia and tarsomeres 1-3, 33 : 19 (17-21) : 13 : 8 : 8 ; ($N=2$).

Length: Body 2.6-2.8 mm; wing 2.8 mm ($N=1$); fore basitarsus 0.30 mm.

Distribution. North America (Arizona).

Holotype: ARIZONA: ♂, Santa Catalina, Mts. Arizona (2,900 ft.), 12. v. 1961, R. M. & E. M. PAINTER.

Paratypes: ARIZONA: 1 ♀, same data as holotype; 1 ♀, Tucson, 13. v. 1961, R. M. & E. M. PAINTER.

Holotype and paratypes are deposited in U. S. National Museum, Washington, D. C.

Prorates sp.

(Figs. 146–151)

It is difficult to distinguish *Prorates* sp. (♂) from *melanderi* (♂) externally. The proboscis (along ventral surface) of *Prorates* sp. (♂: 0.73 mm, N=1) is longer than that of *melanderi* (♂: 0.43 mm, N=1; ♀: 0.43–0.48 mm, N=2). However, it is uncertain whether or not difference is significant in separating species.

The male genitalia of *Prorates* sp. appear to not be significantly different from those of *melanderi* and *nigrescens*. *Prorates* sp. may possibly be identical with *melanderi*.

Fits the description of *melanderi*. All of the structural characters measured are given below.

Male. Head: Width of one eye on a mid line from a direct frontal view 0.9 times distance from antenna to median ocellus, 5.0 times width of frons just above antenna, and 3.3 times width of face at lowest point from a direct frontal view; ocellar triangle 1.1 times as long as wide; distance from lower ridge below proboscis to antenna 1.0 times that from antenna to median ocellus; palpus 0.5 times as long as distance from lower ridge below proboscis to antenna; proboscis along ventral surface 1.7 times as long as distance from lower ridge below proboscis to antenna and 1.7 times as long as distance from antenna to median ocellus; antenna 0.8 times as long as distance from antenna to median ocellus; relative lengths of antennal segments 1, 2 and 3 (including style) from inner view 100 : 100 : 450 and their relative widths viewed from the side 125 : 150 : 150.

Wing: Basal petiole of 2nd posterior cell as long as r–m crossvein [petiole of anal cell was not measured].

Legs: Relative lengths of segments (excluding coxa and trochanter) of fore leg 200 : 208 : 100 : 38 : 31 : 23 : 27, of mid leg 169 : 223 : 108 : 46 : 35 : 23 : 27, of hind leg 262 : 277 : 146 : 54 : 38 : 23 : 31 and in hind leg viewed from the side relative widths of femur, tibia and tarsomeres 1–3, 31 : 23 : 15 : 12 : 12.

Length: body 2.8 mm; wing 2.6 mm; fore basitarsus 0.33 mm.

Female. Unknown.

Distribution. North America (Nevada).

Specimen examined: NEVADA: 1 ♂, BYU–AEC–NTS, Mercury, 8. viii. 1985.

Modified setose patch on abdominal tergum 2

As already mentioned, there is a modified setose sensory patch on abdominal tergum 2 in the Scenopinidae s. lat. This patch is beautifully illustrated in YEATES (1992), treating 4 genera and 4 species: *Scenopinus fenestralis*, *Caenotus "hospes"*, *Prorates "claripennis"* and *Alloxytropus anomalus* [it is necessary to confirm whether or not the specific identification is correct as to "*hospes*" and "*claripennis*"].

In the present article, some photographs and descriptions are given. The patch in

question varies with genus and species, but the species examined are limited in number. It is unknown whether or not modified setose patch varies with sex. For comparative purpose, *Scenopinus glabrifrons* is included.

Acaenotus sp. (♀) (Fig. 60): Patch forms one cluster of granule-like setae which is oblongish. Integument with anterior setae is pale in color. Anterior setae are somewhat smaller in size and much larger in number than the posterior setae.

Alloxytropus anomalus BEZZI, 1925 (♀) (Figs. 56–57): See also figs. 18–20, 21B in YEATES (1992). Patch forms one cluster of granule-like setae which is triangular. Integument with anterior setae and its large surroundings are pale in color. Anterior setae have rounded or bluntly pointed apex, are much smaller in size and denser than the posterior setae which have truncate apex.

In *Prorates "claripennis"* (see figs. 15–16, 21C in YEATES, 1992) anterior setae have truncate apex. However in anterior setae of *Prorates nigrescens* (♀), the apex is rounded or bluntly pointed.

In any case, the setose patch of *Alloxytropus anomalus* is very similar to that in some species of *Prorates* and no significant difference exists between *Alloxytropus* and *Prorates* in the setose patch structure.

Caenotus hospes MELANDER, 1950 (♀) (Fig. 61): Patch is divided mid-longitudinally into a pair of clusters of bristle-like setae each of which is crescent-shaped. Areas around and between two clusters of setae are bare.

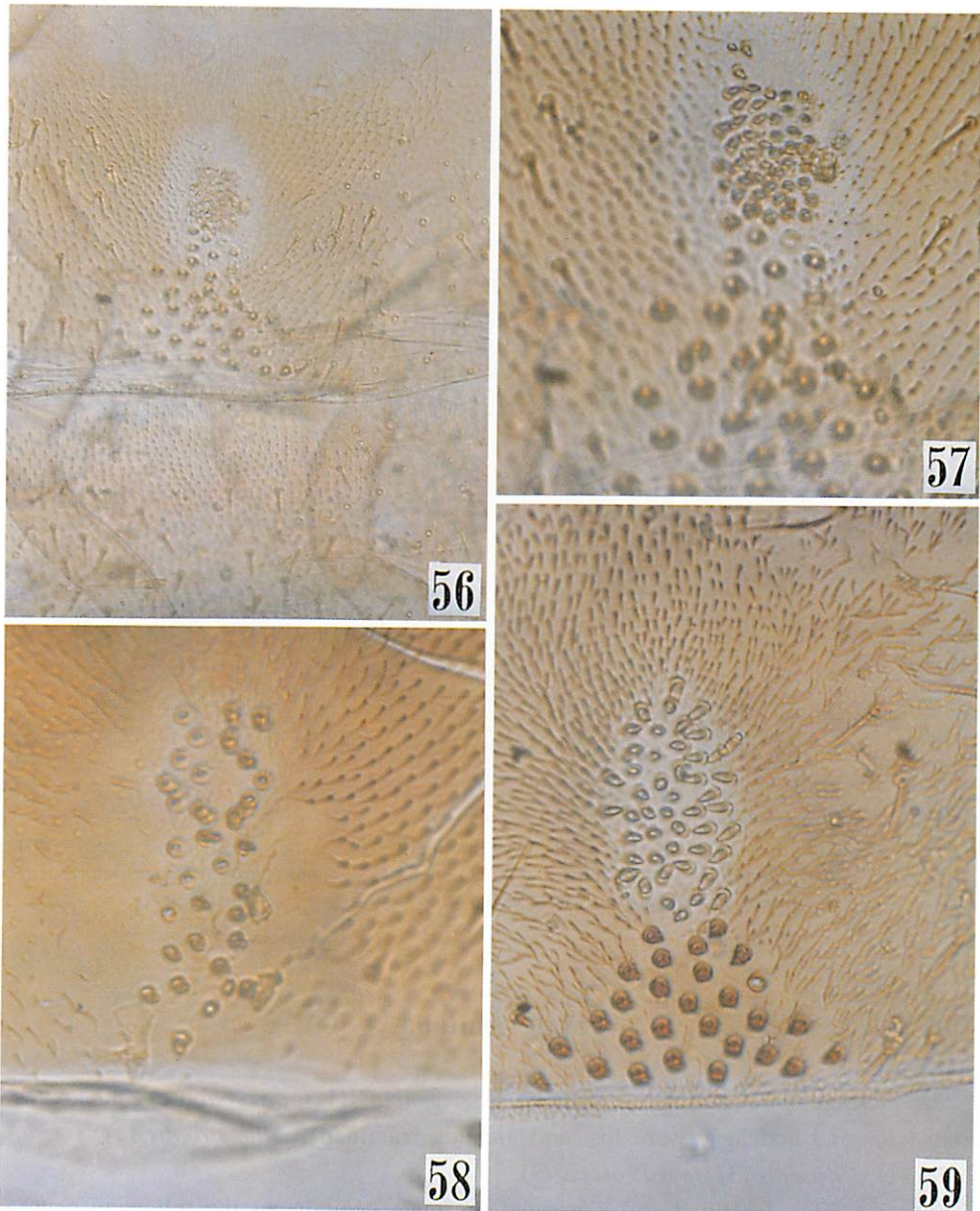
Jackhallia argentinae NAGATOMI et LIU sp. n. (♀) (Fig. 61): Patch forms one cluster of granule-like setae which is circular. A small area in center of this patch is devoid of setae. No striking difference is seen among setae. The integument grown with setae is not paler in color.

Prorates boydi HALL, 1972 (♂) (Fig. 58): Patch forms one cluster of granule-like setae which is rather rectangular. There is no striking difference in size between anterior and posterior setae. Integument grown with anterior setae is pale in color. Large area is bare alongside middle part of setose cluster.

Prorates nigrescens HALL, 1972 (♀) (Fig. 59): Patch forms one cluster of granule-like setae which is triangular. Integument grown with anterior setae is pale in color. Anterior setae have rounded or bluntly pointed apex and are much smaller in size than the posterior setae which have truncate apex.

Scenopinus glabrifrons MEIGEN, 1824 (♀) (Fig. 63): Patch is divided mid-longitudinally into a pair of clusters of bristle-like setae, each of which is triangular or semi-circular. Narrow area around each cluster is bare but a longitudinal stripe of hairs is present between two clusters. Integument grown with modified setae is darker in color.

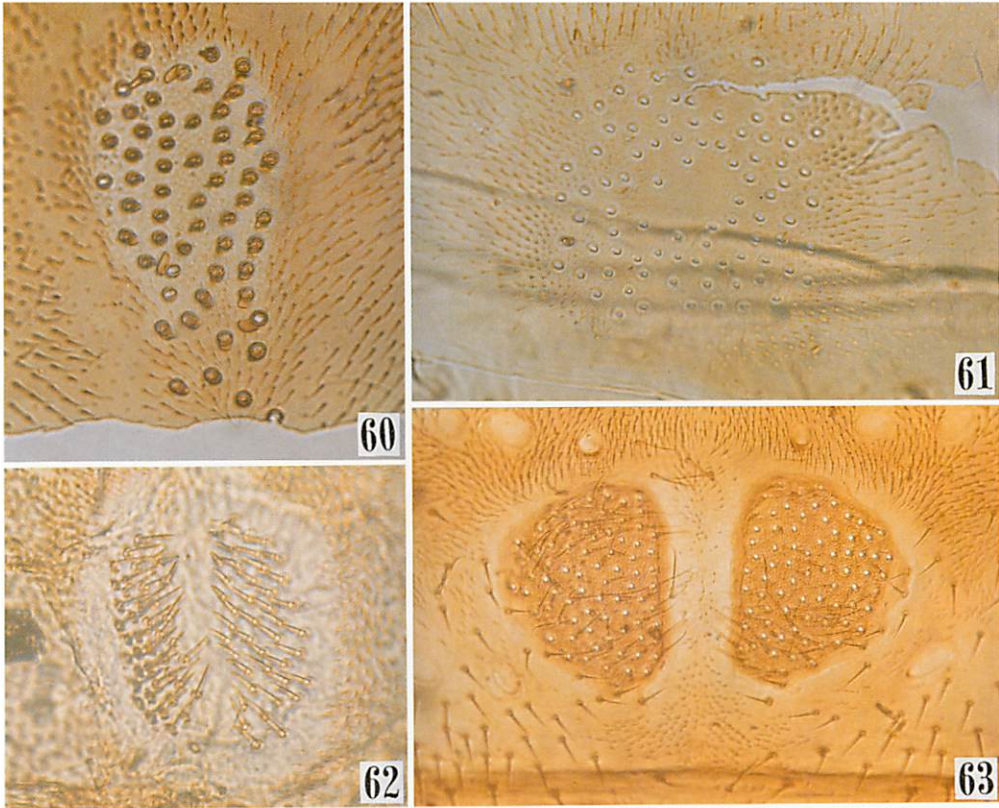
Thus, the Scenopinidae s. lat. is divided into 3 groups according to the structure of the modified setose sensory patch whose types are as follows: (1) divided mid-longitudinally into two clusters of bristle-like setae (*Scenopinus* [Scenopininae] and *Caenotus*), (2) forming one cluster of granule-like setae which is triangular, oblongish or rectangular (*Acaenotus*, *Alloxytropus*, *Prorates* and *Jackhallia*), (3) entirely absent



Figs. 56–59. Modified setose sensory patch on abdominal tergum 2. 56–57, *Alloxytropus anomalus* BEZZI, female; 58, *Prorates boydi* HALL, male; 59, *Prorates nigrescens* HALL, female. [Fig. 56 is different in magnification from Figs. 57–59]

(*Caenotoides* as well as *Apystomyia*).

The presence of patch in question is apparently one of the synapomorphic character states for the Scenopinidae including the Proratinae. If so, its absence took place secondarily. Which is the ground-plan among the Scenopinidae s. lat., (1)-type or (2)-type? It is probably (1)-type, because of the presence of bristle-like setae which is apparently plesiomorphic in relation to granule-like setae.



Figs. 60–63. Modified setose sensory patch on abdominal tergum 2. 60, *Acaenotus* sp., female; 61, *Jackhallia argentinae* NAGATOMI et LIU, female; 62, *Caenotus hospes* MELANDER, female; 63, *Scenopinus glabrifrons* MEIGEN, female.

Male genitalia

The male genitalia are here examined in *Acaenotus* (1 species whose gonocoxites, gonostylus and aedeagus were lost and are not examined), *Alloxytropus* (1), *Caenotooides* (1), *Caenotus* (3), and *Prorates* (7).

YEATES (1992) described and illustrated the male genitalia of the following genera and species: *Alloxytropus anomalus*; *Caenotus* “*hospes*”; *Prorates* “*claripennis*.” [It is necessary to confirm whether or not the determination is correct as to *hospes* and *claripennis* just mentioned].

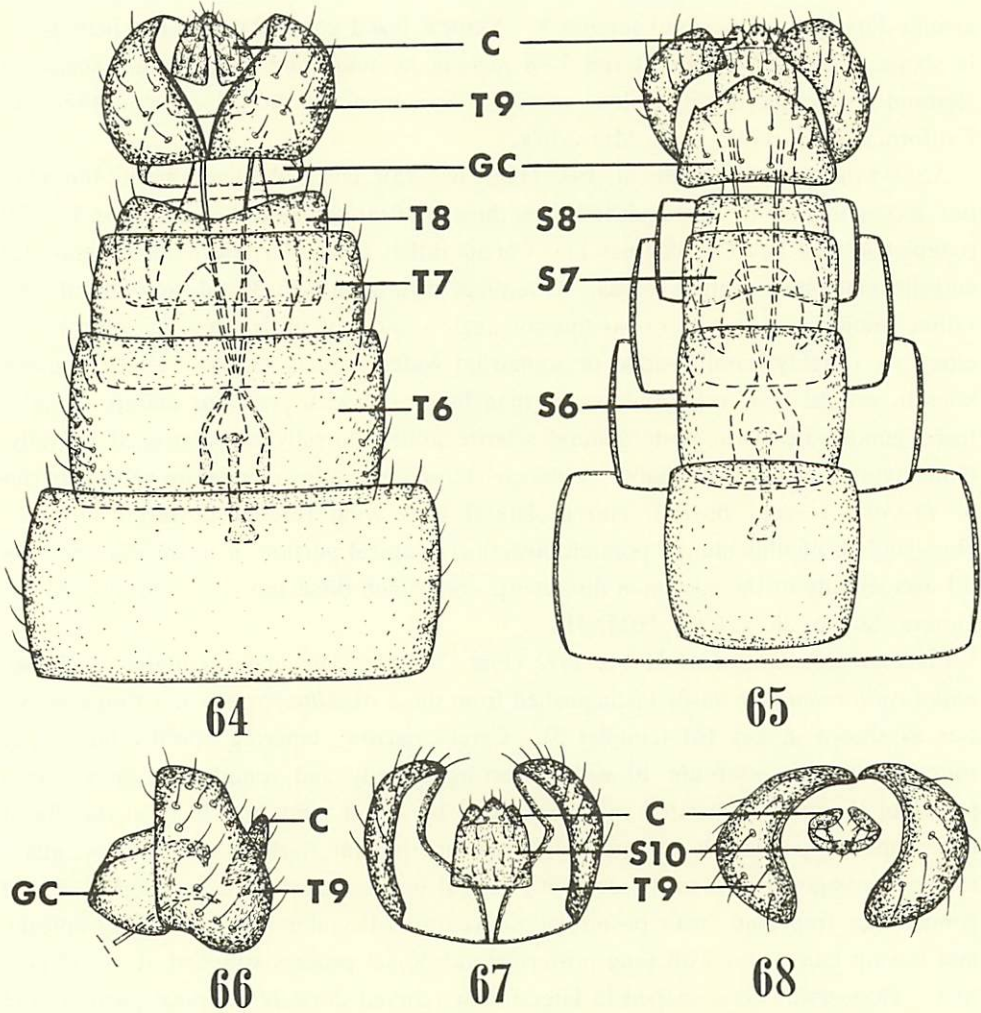
Acaenotus canus (MELANDER, 1950) (Figs. 64–68): [Gonocoxites, gonostylus and aedeagus were lost at the time of dissection and their structures remain unknown to us, but it is certain that aedeagus is similar in form to that of *Caenotooides*]. Cercus rather wide, tapering apically, but rather rounded at apex; sternum 10 quadrate; there is an apical pilose membrane between cerci and sternum 10 and this may be proctiger. Two pieces of tergum 9 contiguous at base, each narrowed apically in dorsal and

lateral views, and wider apically in some ventral view; a thin transverse sclerite absent at mid-dorsal base of paired tergum 9. Ventral fused gonocoxites rather pentagonal in shape. Terga 7–8 and sterna 7–8 rectangular and wider than long, except for sternum 7 which is roughly as long as wide. Specimen dissected: 1 ♂, near Adelanto, California, 25. v. 1945, A. L. MELANDER.

Alloxytropus anomalus BEZZI, 1925 (Figs. 69–75): The male genitalia of *Alloxytropus anomalus* may be distinguished from those of *Prorates* species as shown in key (6) (couplet 4) and key (8) (couplet 1). Cercus rather triangular; sternum 10 semi-oval and distinctly shorter than cercus. One piece of tergum 9 in dorsal- and lateral view rather triangular and with dorso-anterior angle somewhat protruding, in ventral view elongate, roughly parallel-sided or somewhat wider around middle. Fused gonocoxites in ventral view trapezoid, wider than long, and with posterior margin straight; fused gonocoxites with posterolateral sclerite folded dorsally and flattened laterally. Gonostylus a tusk-like in shape. Gonocoxal apodeme short in relation to the species of *Prorates* (except *boydi*), and in lateral view wide (except posterior portion). Hanging-bell phallus bluntly pointed posteriorly; [apical portion of distiphallus was cut off accidentally in the specimen dissected]. Specimen dissected: 1 ♂, Quweiz, N. W. Gezira, Sudan, 26. x. 1970, [BMNH].

Caenotoides californicus HALL, 1972 (Figs. 76–81): The male genitalia of *Caenotoides californicus* are easily distinguished from those of *Alloxytropus* and *Prorates* species as shown in key (6) (couplet 3). Cercus narrow, tapering apically but rather rounded at apex; sternum 10 wide, tapering apically and rounded at apex. Two pieces of tergum 9 connected with each other by a thin transverse band at the dorsal base, tapering posteriorly in dorsal view and tapering anteriorly in ventral view, quadrate or pentagonal in lateral view, with ventral inner apex dilated anteriorly. Fused gonocoxites trapezoid, with posterolateral ventral triangular part protruding apically and having hairs, and with long posterolateral dorsal process widened at apical portion. Gonostylus hook-shaped in lateral view, curved dorsally at apical portion, and pointed at apex. Dorsal bridge forked at posterior end. Hanging-bell phallus rather narrow, and bluntly pointed at posterior end. Basiphallus rather triangular or trapezoid. Terga 7–8 and sterna 7–8 rectangular, and wider than long. Specimen dissected: 1 ♂, Palm Springs, California, 23. ii. 1955, A. L. MELANDER.

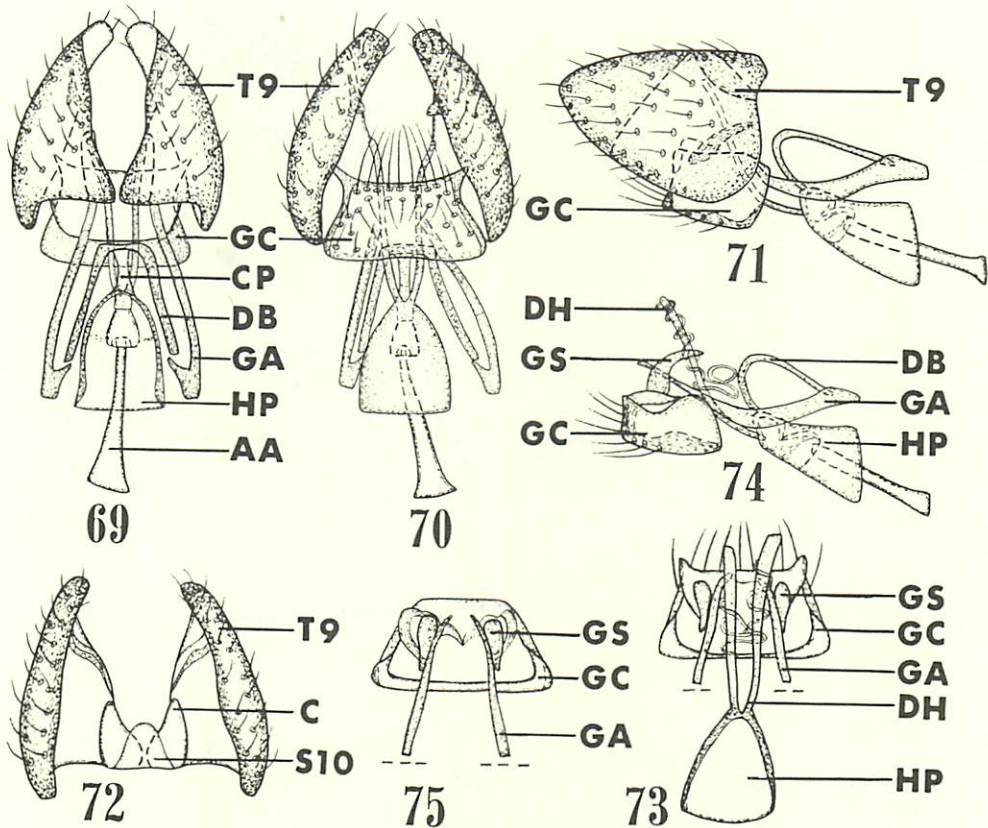
Genus *Caenotus* COLE, 1923: The male genitalia of *Caenotus* are easily distinguished from those of other genera as shown in key (6) (couplet 1). The following description is based on 3 species: *hospes*, *mexicanus* and *minutus*. Cercus elongate, tapering basally and rounded apically. Sternum 10 large, rather trapezoid, and much longer than wide. Two pieces of tergum 9 contiguous or so except anterior and posterior parts; ventrally folded part of tergum 9 confined to very narrow lateral or anterolateral border. Fused gonocoxites with a mid-posterior wide and deep concavity or with posterolateral part protruding apically, and with mid-posterior dorsal border forming a triangle. Sternum 9 distinct or separated from fused gonocoxites by suture, semicircular or triangular, and with apex situated at mid-posterior part of fused



Figs. 64–68. *Acaenotus canus* (MELANDER), male. 64–65, Posterior part of abdomen, dorsal and ventral views; 66, cercus, tergum 9 and gonocoxite, lateral view; 67–68, cerci, sternum 10 and tergum 9, ventral and posterior views.

gonocoxites. Gonocoxal apodeme arising from anterolateral corner of gonocoxite, stick-like and long, but shorter than gonocoxite. Gonostylus stick-like, long, not longer than gonocoxite, and strongly concave dorsally. Phallus with paired anterolateral ventral processes pointed at apex. Distiphallus bifid at apical portion. Aedeagal apodeme spatula-like in dorsal, ventral or lateral view, widest near apex, longer than mid-length of fused gonocoxites, and with a mid-longitudinal darkened line. Basi-phallus (= basal widened part of endophallus) with paired anterolateral dorsal processes pointed at apex, which are probably not homologous with paired endophallic sclerites.

Caenotus hospes MELANDER, 1950 (Figs. 82–89): Sternum 7 rectangular; sternum 8

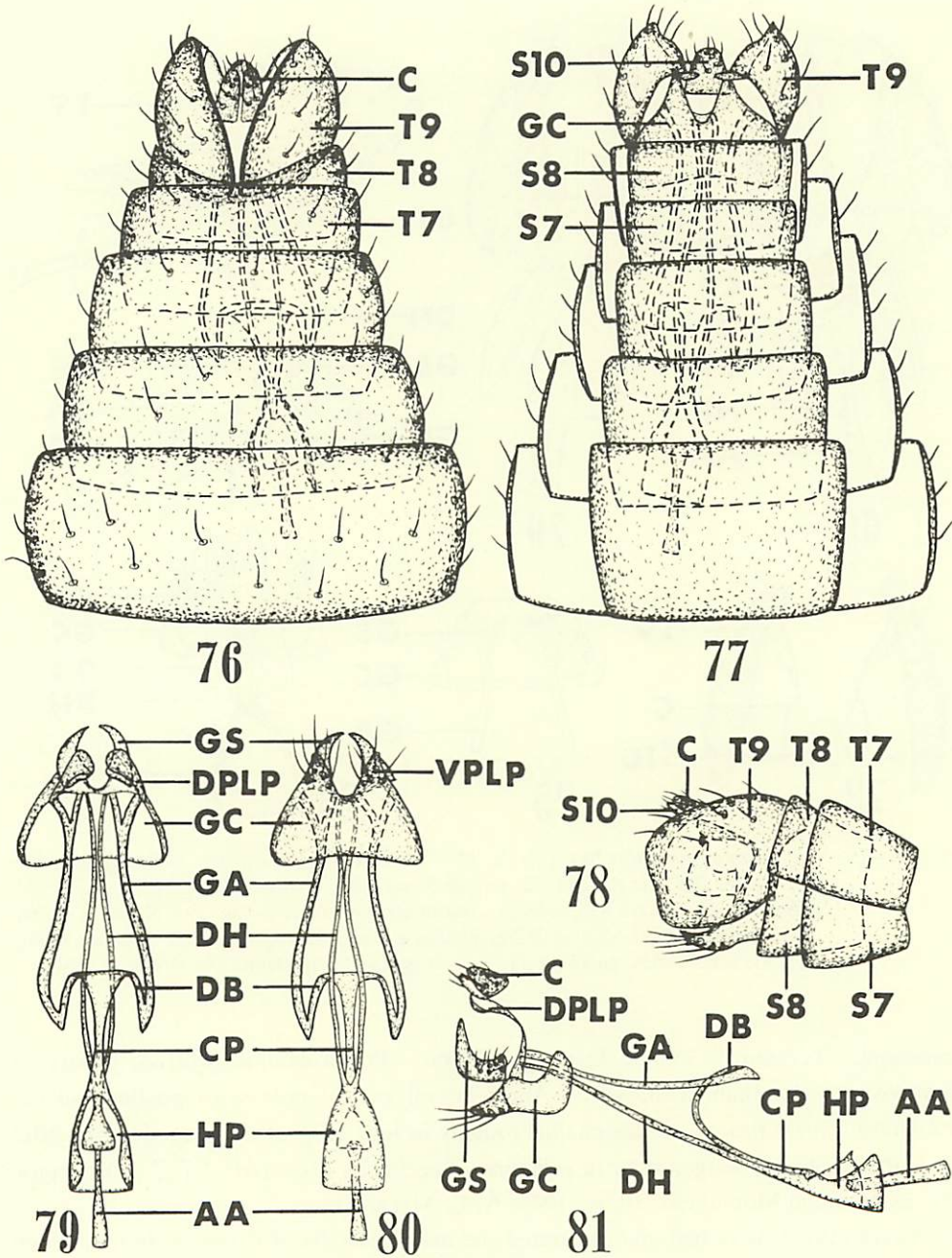


Figs. 69–75. *Alloxytropus anomalus* BEZZI, male. 69–71, Tergum 9, gonocoxites and aedeagus, dorsal, ventral and lateral views; 72, tergum 9, cerci and sternum 10, ventral view; 73–74, gonocoxites, gonostyli and aedeagus, dorsal and lateral views (anterior part of gonocoxal apodeme, dorsal bridge, code-like phallus and aedeagal apodeme are excluded in Fig. 73); 75, gonocoxites, gonostyli and base of gonocoxal apodeme, posterodorsal view.

trapezoid. Tergum 9 longer than in *minutus*. Posterolateral protruded part of gonocoxite wider than in *minutus*. Anterolateral ventral process of phallus and anterolateral dorsal process of basiphallus roughly as long as gonocoxal apodeme. Bifid part of distiphallus longer than in *minutus*. Specimens dissected: 2 ♂♂, Organpipe Cactus National Monument, 19. iv. 1947, A. L. MELANDER.

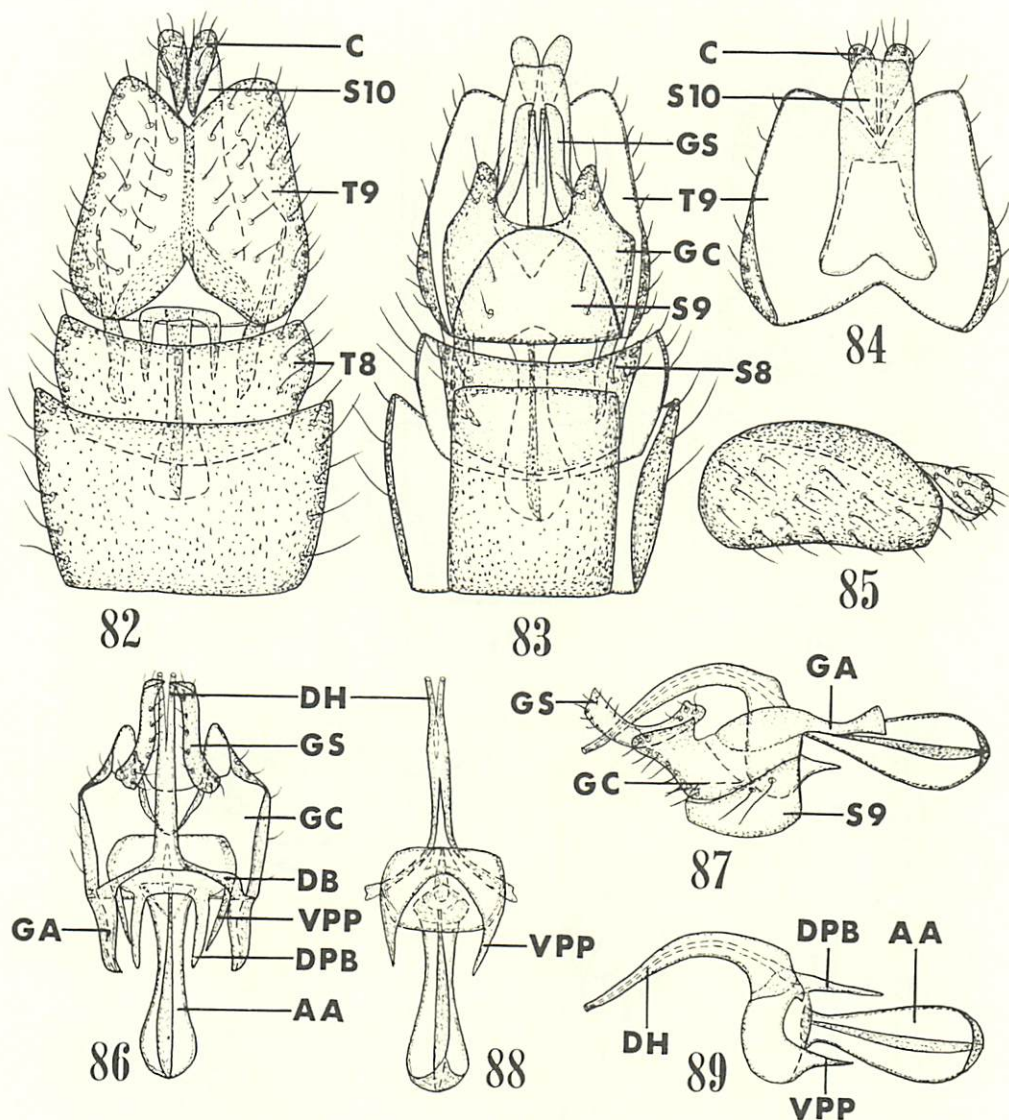
YEATES (1992) described and illustrated the male genitalia of *Caenotus hospes* which differ considerably from those of *hospes* so determined (based on paratypes) in the present article by having following character: anterolateral ventral process of phallus and anterolateral dorsal process of basiphallus are much longer than gonocoxal apodeme (see figs. 39 & 40 in YEATES, 1992). Yeates' *hospes* may be different specifically from true *hospes*.

Caenotus mexicanus NAGATOMI et YANAGIDA sp. n. (Figs. 90–97): Sterna 7–8 trapezoid, tergum 9 longer than in *hospes* and *minutus*. Posterolateral protruded



Figs. 76-81. *Caenotoides californicus* HALL, male. 76-78, Posterior part of abdomen, dorsal, ventral and lateral views; 79-81, gonocoxites, gonostyli and aedeagus, dorsal, ventral and lateral views.

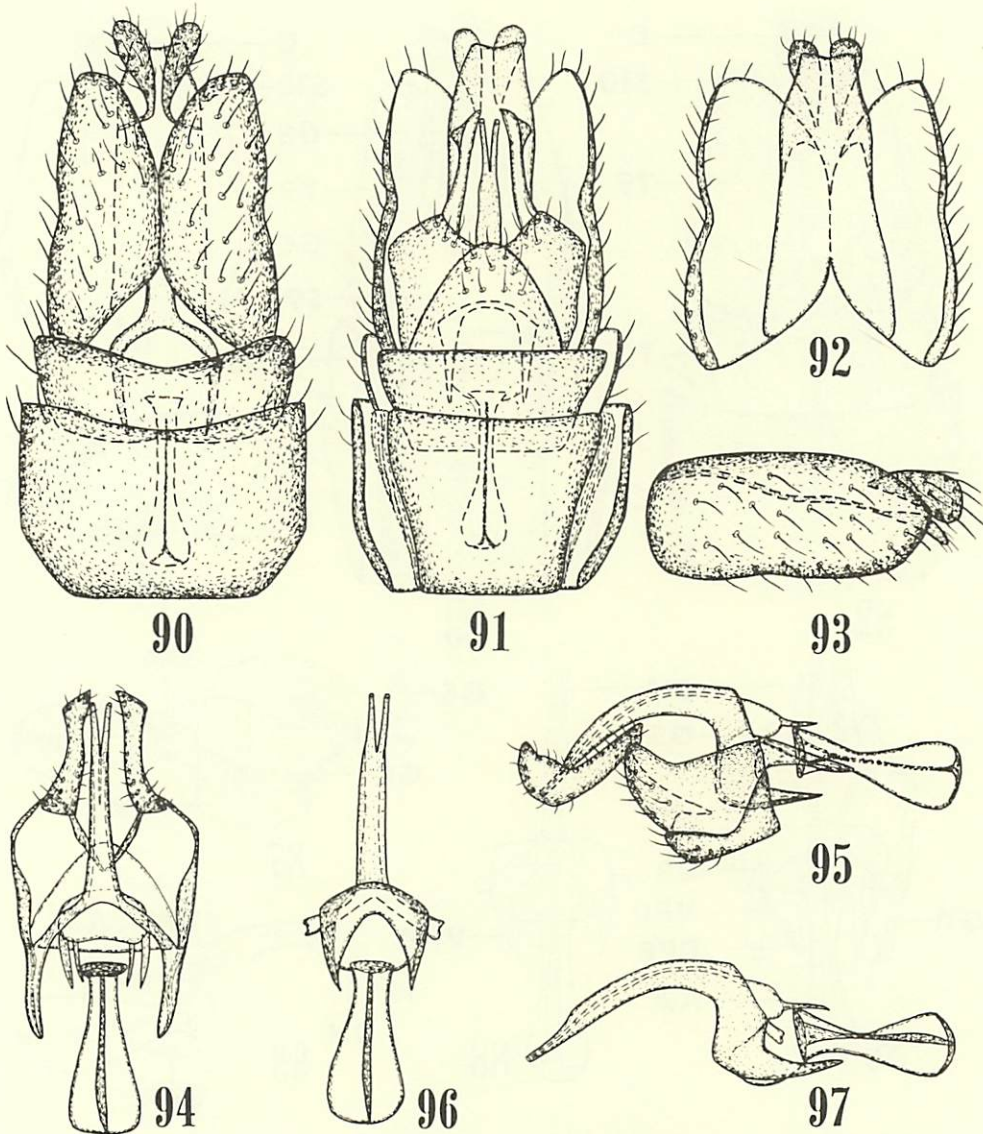
part of gonocoxite wide. Gonostylus widest behind middle in lateral view. Antero-lateral ventral process of phallus and anterolateral dorsal process of basiphallus shorter than gonocoxal apodeme; the process of basiphallus thin. Specimen dissected:



Figs. 82–89. *Caenotus hospes* MELANDER, male. 82–83, Posterior part of abdomen, dorsal and ventral views; 84–85, cerci, sternum 10 and tergum 9, ventral and lateral views; 86–87, gonocoxites, gonostyli and aedeagus, dorsal and lateral views; 88–89, aedeagus, ventral and lateral views.

1 ♂, 18 miles S. W. Santa Catarina, San Luis Potosi 3,500 feet, Mexico, 7. iv. 1966, R. E. & E. P. PAINTER.

Caenotus minutus COLE, 1923 (Figs. 98–105): Sternum 7 rather rectangular and sternum 8 triangular or semicircular. Tergum 9 shorter and wider than in *hospes* and *mexicanus*. Posterolateral protruded part of gonocoxite rather thin at apical portion. Gonocoxal apodeme widened at apical portion in lateral view. Bifid part of distiphallus very short. Anterolateral ventral process of phallus and anterolateral dorsal

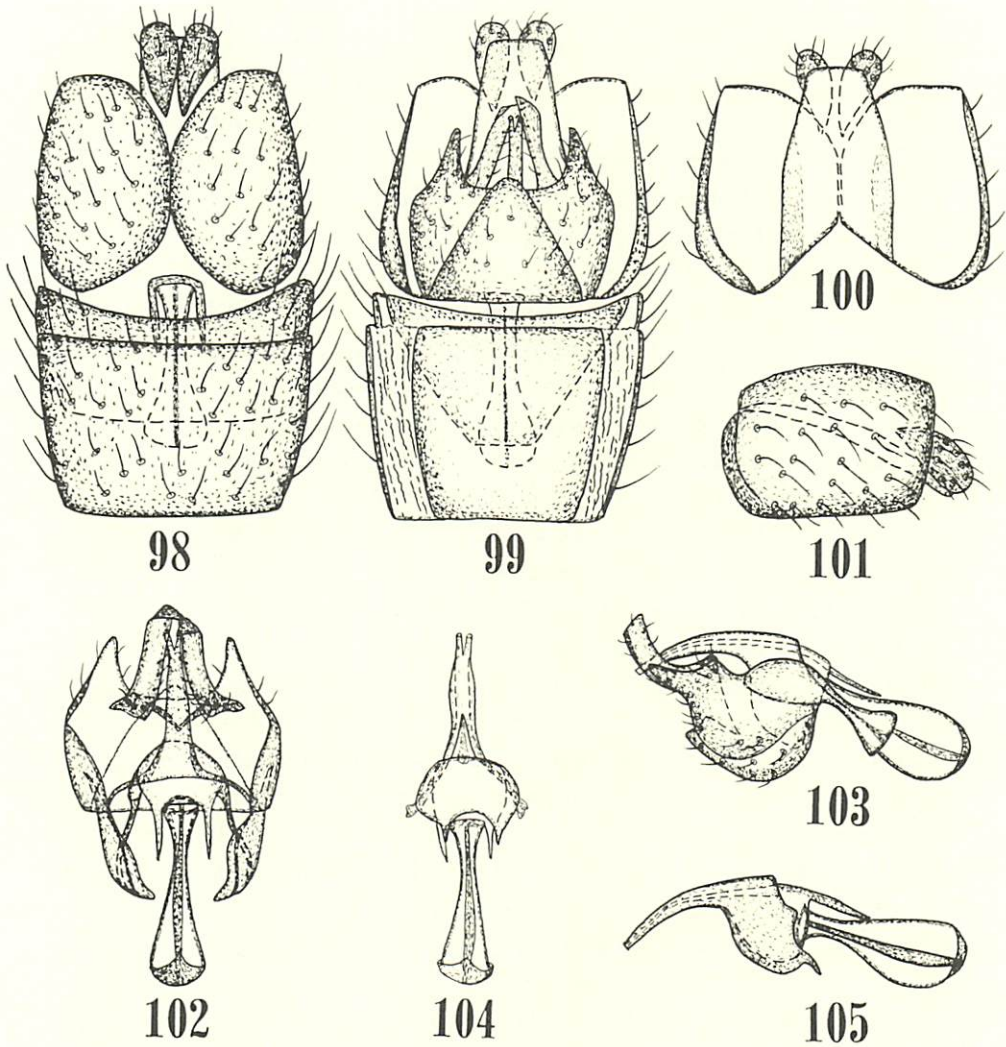


Figs. 90–97. *Caenotus mexicanus* NAGATOMI et YANAGIDA, male. 90–91, Posterior part of abdomen, dorsal and ventral views; 92–93, cerci, sternum 10 and tergum 9, ventral and lateral views; 94–95, gonocoxites, gonostyli and aedeagus, dorsal and lateral views; 96–97, aedeagus, ventral and lateral views.

process of basiphallus shorter than gonocoxal apodeme; the process of basiphallus thin. Specimen dissected: 1 ♂ (paratype), Alamogordo, New Mexico, 22. iv. 1902.

Genus *Prorates* MELANDER, 1906: Seven species of *Prorates* are examined as to male genitalia. For diagnosis of *Prorates*, see Key (6) (couplets 3 & 4).

Prorates ballmeri NAGATOMI et LIU sp. n. (Figs. 106–113): Cercus rounded posteriorly. Sternum 10 rather trapezoid. One piece of tergum 9 in lateral view rather



Figs. 98–105. *Caenotus minutus* COLE, male. 98–99, Posterior part of abdomen, dorsal and ventral views; 100–101, cerci, sternum 10 and tergum 9, ventral and lateral views; 102–103, gonocoxites, gonostyli and aedeagus, dorsal and lateral views; 104–105, aedeagus, ventral and lateral views.

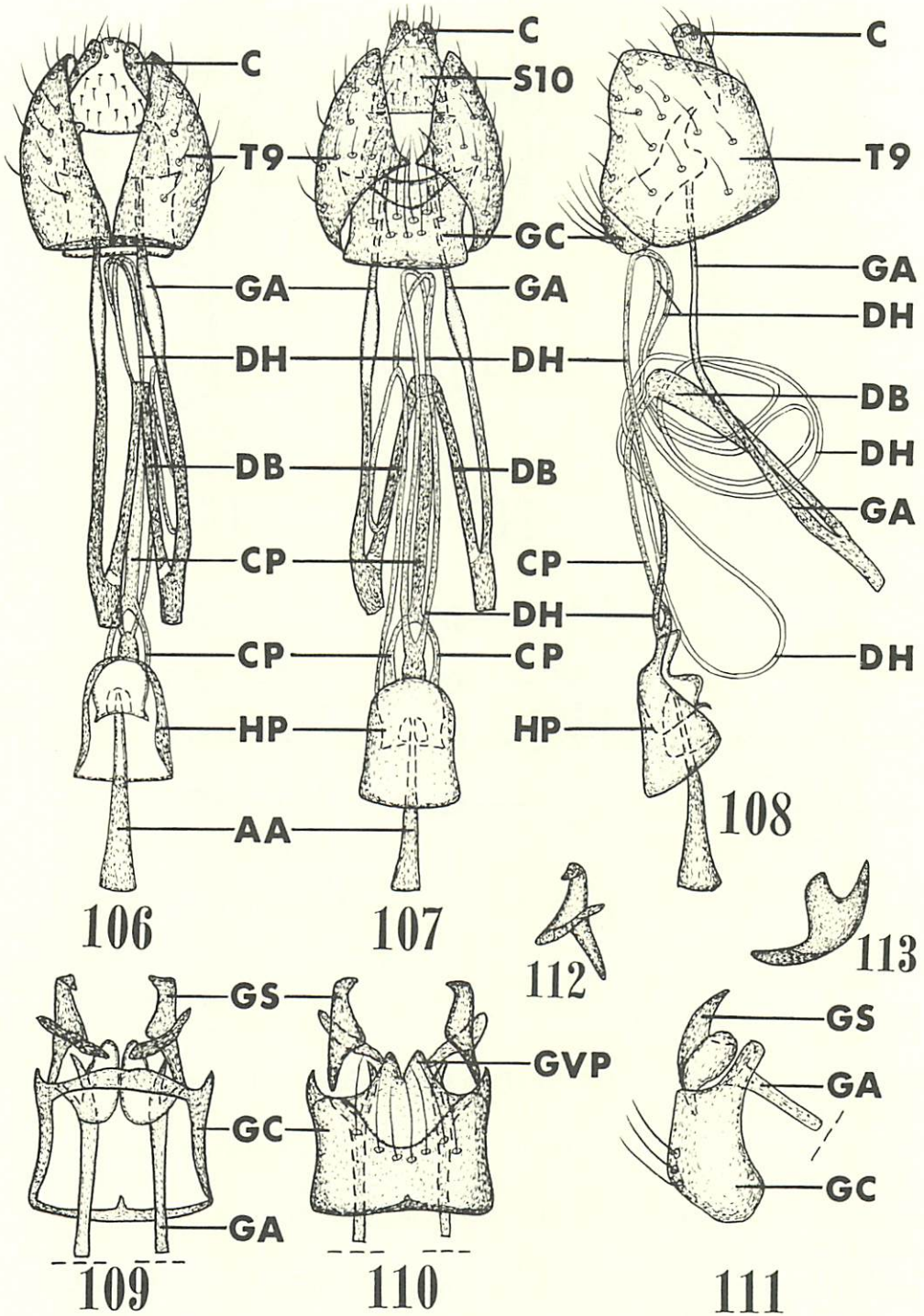
pentagonal, in dorsal view gradually tapering apically, in ventral view widest around middle and pointed at both ends; a thin transversely long sclerite present at mid-dorsal base of paired tergum 9. Fused gonocoxites in ventral view quadrate, with a short posterolateral ventral process and with paired mid-posterior processes (=GVP in Fig. 110). Gonostylus cross-shaped in dorsal or ventral view, and widened around middle in lateral view. Gonocoxal apodeme widened beyond middle in dorsal or ventral view. Posterior (=middle in dorsal or ventral view) part of dorsal bridge widened in lateral view. Hanging-bell phallus rounded posteriorly.

Specimens dissected: 2 ♂♂, Summit 6,500, Scherwin, Mono Co., California, 24. v. 1985, G. R. BALLMER; 1 ♂, 27 mi. W. Denio, Humboldt Co., Nevada, 27. vi. 1971, G. STEYSKAL.

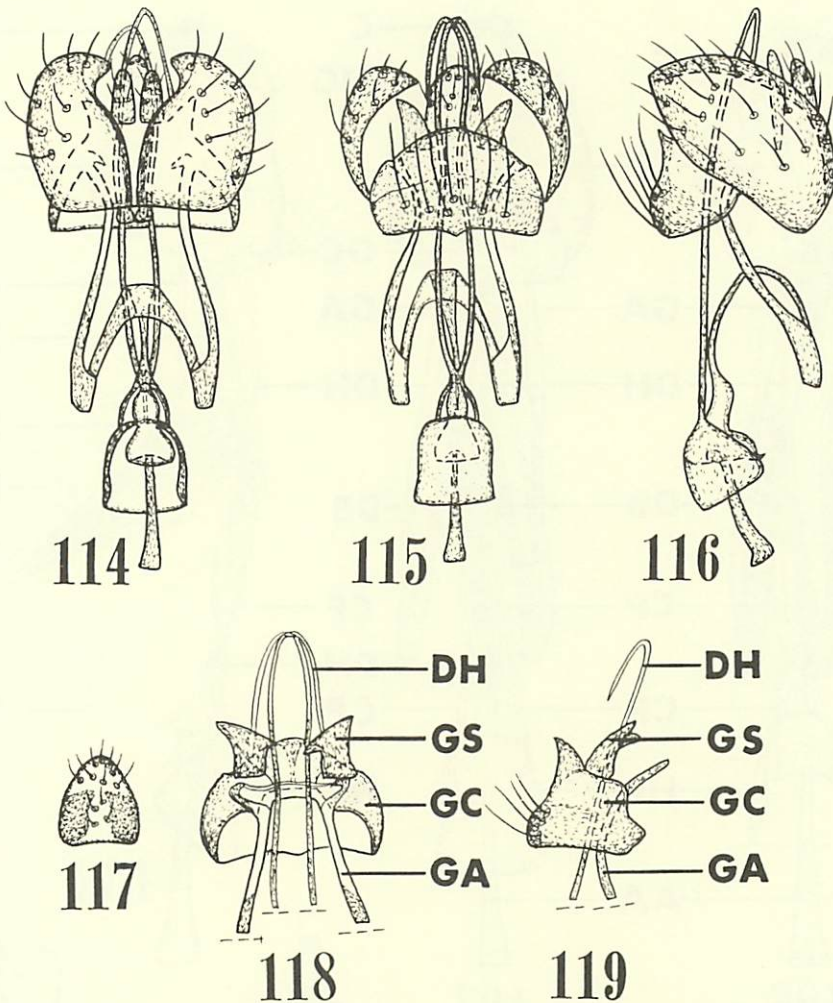
Prorates boydi HALL, 1972 (Figs. 114–119): Cercus elongate, rounded or bluntly pointed posteriorly; sternum 10 oval, with anterior margin straight. One piece of tergum 9 in lateral view elliptical, in dorsal view comparatively wide and with shorter apical portion curved inward, tapering apically and pointed, in ventral view narrow and tapering anteriorly or at both ends; a rectangular sclerite attached to dorsal median base of paired tergum 9. Fused gonocoxites in ventral view rather semicircular, and wider than long, with apex curved ventrally, with thin process at posterodorsal corner (or at base of gonocoxal apodeme), with dorsally folded part wider apically. Gonostylus triangular in dorsal or ventral view and pointed at apex. Gonocoxal apodeme short in relation to other species of *Prorates*. Hanging-bell phallus comparatively short, rounded posteriorly or more or less angulated at posterolateral corner. Specimen dissected: 1 ♂, Wild Horse Creek 4,900', 1.5 mi. NW Wild Horse Butte, Emery Co., Utah, 26–27. vii. 1982, A. S. & Kurt MENKE.

Prorates frommeri HALL, 1972 (Figs. 120–125): Cercus rounded or bluntly pointed at apex; sternum 10 large and semi-oval. One piece of tergum 9 in lateral view pentagonal, with posteroventral process, and with posterodorsal corner acutely pointed, in dorsal view tapering posteriorly, in ventral view narrow and with median inner triangular projection. A transversely long sclerite very thin and indistinct (if present). Fused gonocoxites in ventral view with anterior more sclerotized part having a wide and deep median concavity at posterior margin and with a large mid-posterior ventral process (= GMVP in Figs. 123–125); fused gonocoxites with mid dorsal border protruded vertically (or posteroventrally). Gonostylus comparatively long, straight in dorsal or ventral view, and protruding dorsally at apex and at middle in lateral view. Gonocoxal apodeme widened around middle in dorsal or ventral view; dorsal bridge comparatively short. Hanging-bell phallus longer and narrower, and rounded or bluntly pointed posteriorly. Specimens dissected: Deep Canyon, Riverside County, California: 1 ♂, 4. x. 1963, E. I. SCHLINGER; 1 ♂, 1. x. 1969, S. FROMMER.

Prorates melanderi HALL, 1972 (Figs. 126–132): Cercus rounded or bluntly pointed posteriorly; sternum 10 rather trapezoidal. Tergum 9 in lateral view pentagonal, in dorsal view tapering apically, in ventral view with trapezoidal or triangular (according to visual angle) projection around middle, a thin transversely long sclerite present at mid-dorsal base of paired tergum 9. Fused gonocoxites in ventral view quadrate, with paired median processes at posterior margin (= GVP in Figs. 129–130), with short process at posterolateral corner, and with anterior more sclerotized part concave at posterior margin, in dorsal view with paired processes directed posterolaterally which are united with each other at middle (= GDP in Figs. 129–131). Gonostylus rather cross-shaped in dorsal or ventral view, and widened around middle in lateral view. Gonocoxal apodeme widened beyond middle (in dorsal or ventral view); posterior part of dorsal bridge widened (in lateral view). Hanging-bell phallus narrower and rounded



Figs. 106-113. *Prorates ballmeri* NAGATOMI et LIU, male. 106-108, Cerci, tergum 9, gonocoxites and aedeagus, dorsal, ventral and lateral views; 109-111, gonocoxites, gonostyli and base of gonocoxal apodeme, dorsal, ventral and lateral views; 112-113, gonostyli, dorsal and lateral views. [Figs. 106-108 are different in magnification from Figs. 109-113].

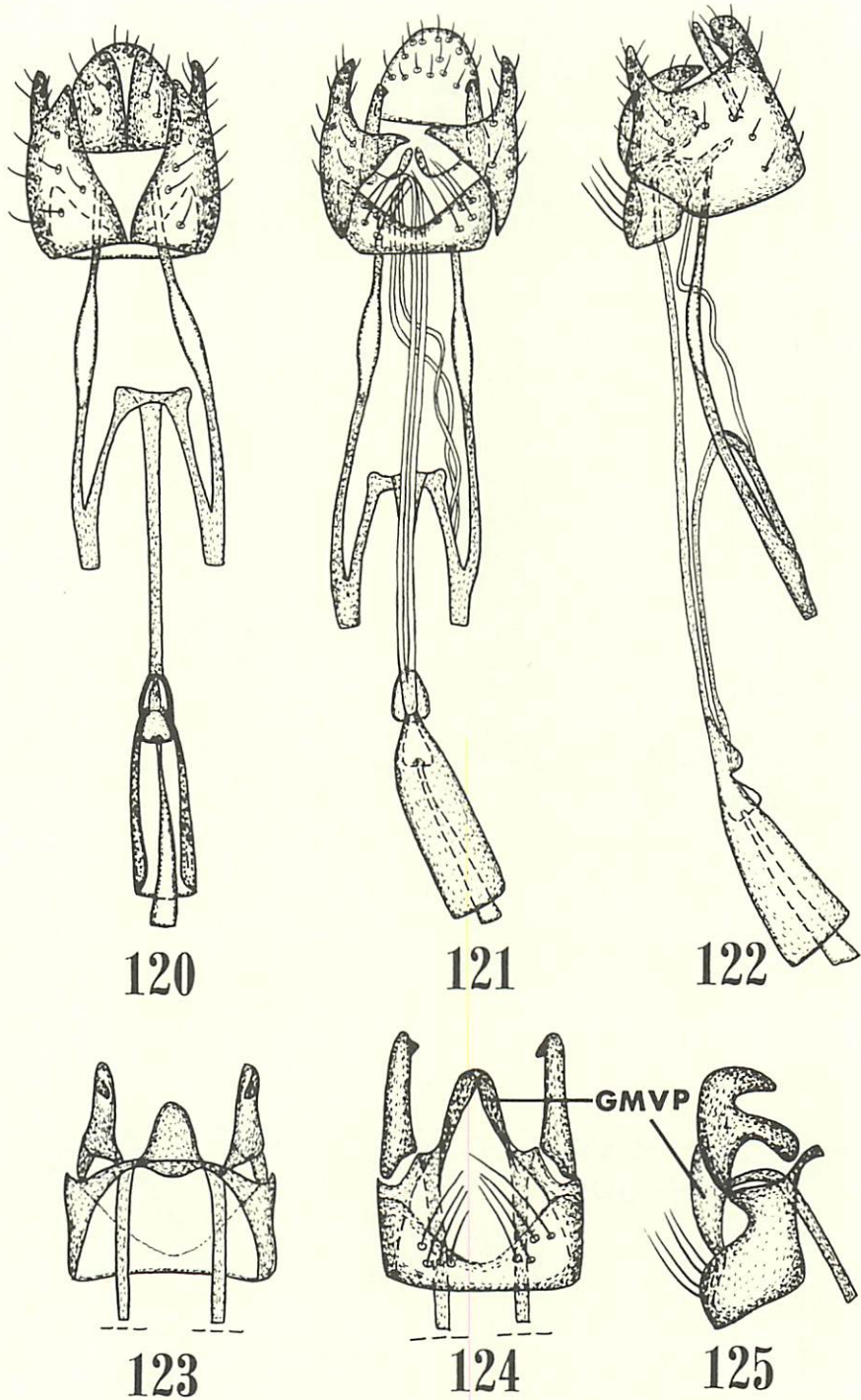


Figs. 114–119. *Prorates boydi* HALL, male. 114–116, Cerci, tergum 9, gonocoxites, gonostyli and aedeagus, dorsal, ventral and lateral views; 117, sternum 10, ventral view; 118–119, gonocoxites, gonostyli, base of gonocoxal apodeme and posterior part of distiphallus, dorsal and lateral views.

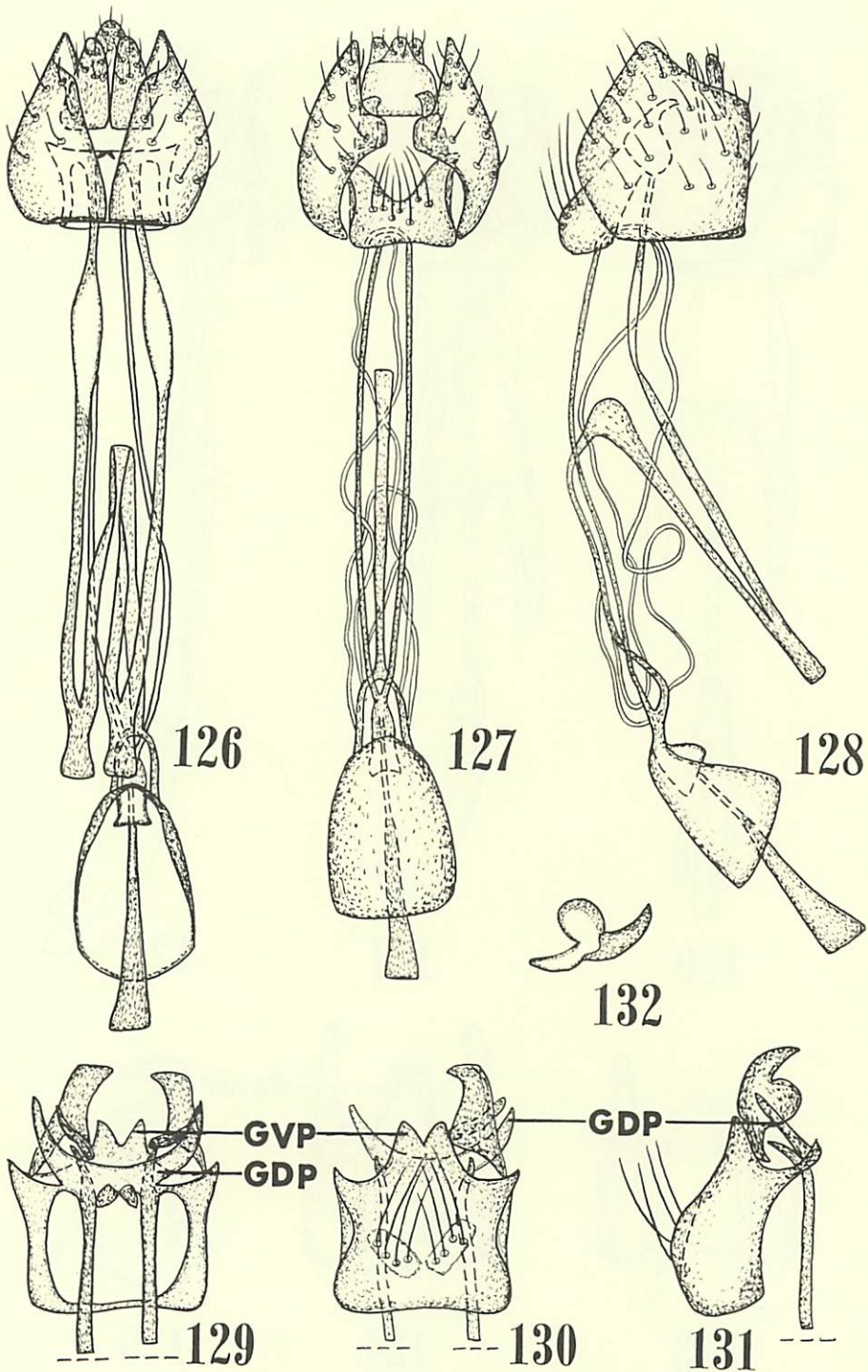
posteriorly. Specimen dissected: 1 ♂, Palm Canyon, Borrego, Imperial County, 4. v. 1945, A. L. MELANDER.

Prorates nigrescens HALL, 1972 (Figs. 133–138): The male genitalia of *nigrescens* are very similar to those of *melanderi*. Further study is necessary to find the difference between them. Specimen dissected: 1 ♂, Riverside, California, i. viii. 1978, J. C. HALL.

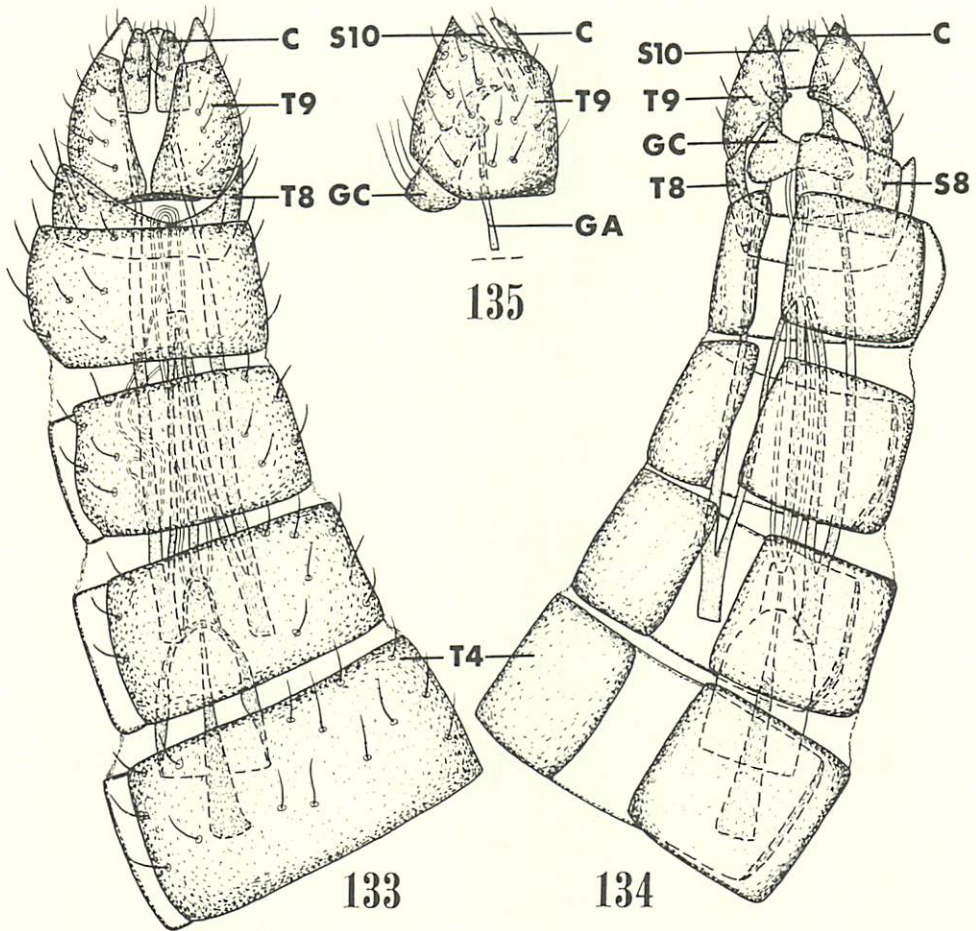
Prorates painteri NAGATOMI et LIU sp. n. (Figs. 139–145): Cercus rounded or bluntly pointed posteriorly; sternum 10 semi-oval. One piece of tergum 9 in lateral view rather pentagonal, in dorsal view tapering apically, in ventral view abruptly widened around middle and pointed at both ends; a thin transversely long sclerite present at mid-dorsal base of fused tergum 9. Fused gonocoxites in ventral view rectangular,



Figs. 120–125. *Prorates frommeri* HALL, male. 120–122, Cerci, tergum 9, gonocoxites, gonostyli and aedeagus, dorsal, ventral and lateral views (distiphallus is excluded in Fig. 120); 123–124, gonocoxites, gonostyli, gonocoxal mid-posterior ventral process (= GMVP) and base of gonocoxal apodeme, dorsal, ventral and lateral views. [Figs. 120–122 are different in magnification from Figs. 123–125]



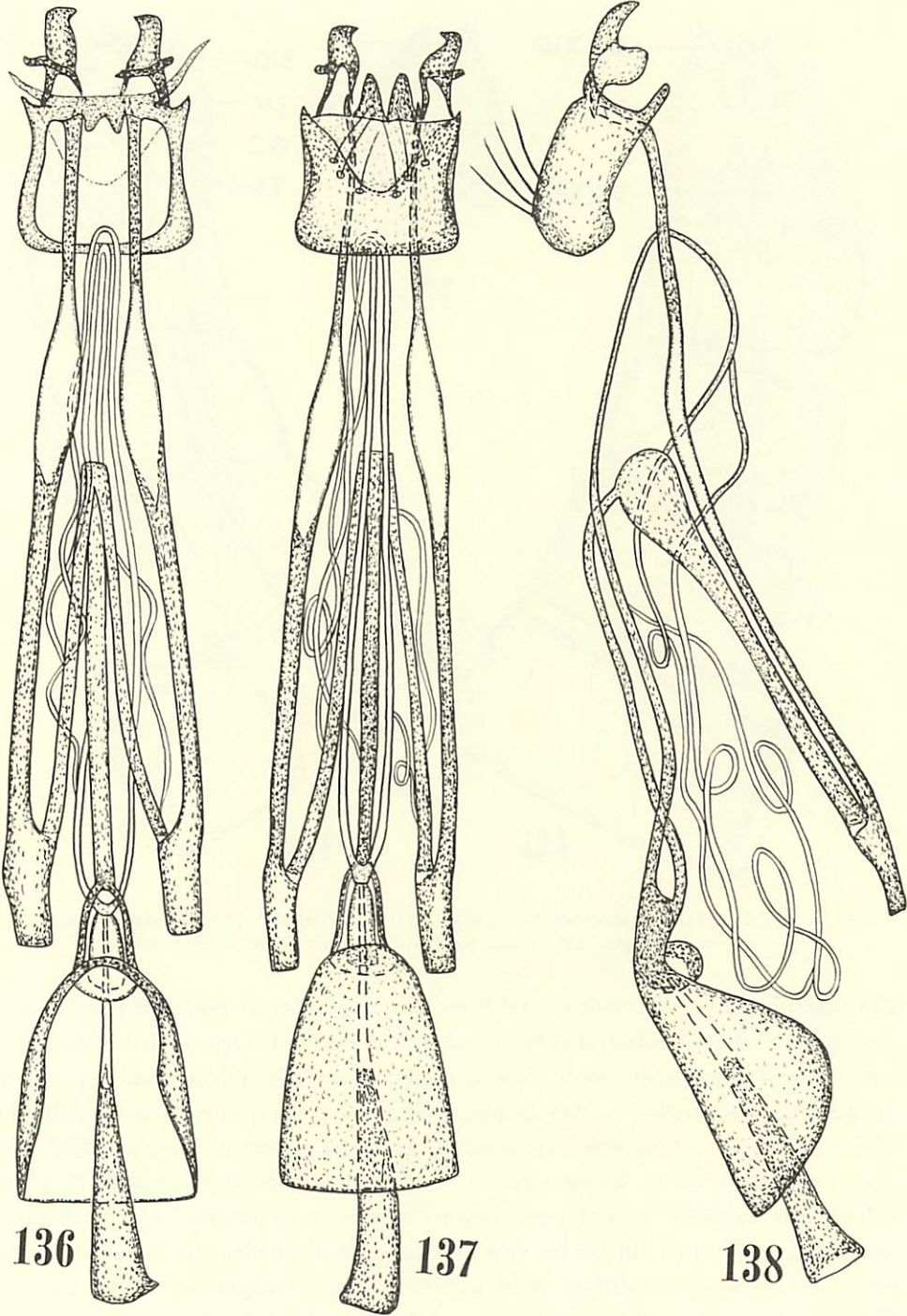
Figs. 126–132. *Prorates melanderi* HALL, male. 126–128, Cerci, sternum 10, tergum 9, gonocoxites, gonostyli and aedeagus, dorsal, ventral and lateral views; 129–131, gonocoxites, gonostyli, gonocoxal dorsal processes, gonocoxal ventral processes and base of gonocoxal apodeme, dorsal, ventral and lateral views; 132, gonostylus, inner lateral view. [Figs. 126–128 are different in magnification from Figs. 129–132]



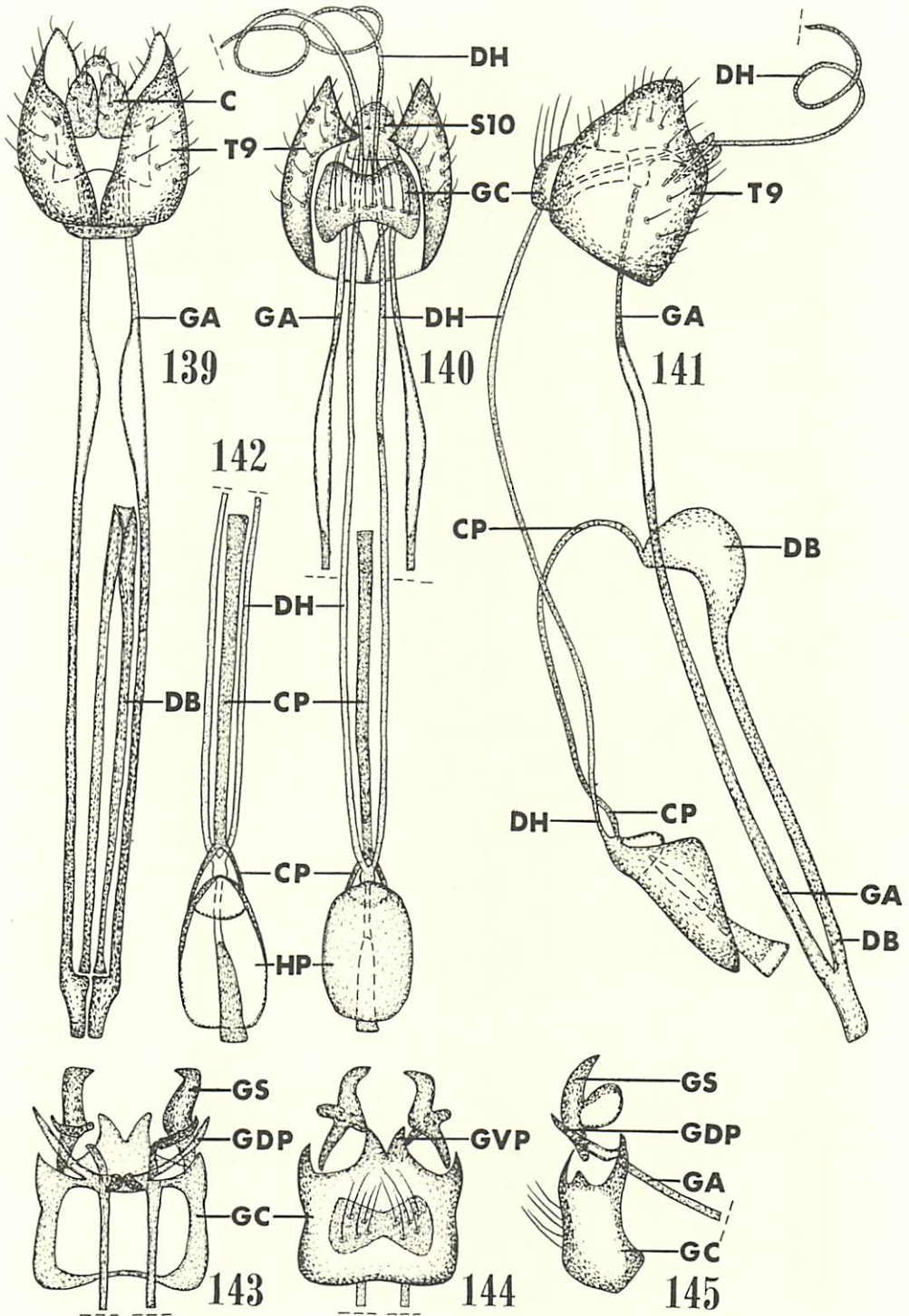
Figs. 133–135. *Prorates nigrescens* HALL, male. 133–134, Abdomen (except base), dorsal and ventral views; 135, cercus, sternum 10, tergum 9, etc., lateral view.

with paired median processes (= GVP in Figs. 143–144) at posterior margin, with short process at posterolateral corner, and with darker part concave both at anterior and posterior margins, in dorsal view with paired cord-like dorsal median processes directed posterolaterally (= GDV in Figs. 143 & 145) and with rectangular mid-posterior ventral plate. Gonostylus cross-shaped in dorsal or ventral view, and with large knob around middle in lateral view. Gonocoxal apodeme conspicuously long and widened (in dorsal or ventral view) beyond middle, posterior part of dorsal bridge conspicuously widened (in lateral view). Hanging-bell phallus (in dorsal or ventral view) not narrower posteriorly, with posterior margin straight or slightly concave. Specimen dissected: 1 ♂, Santa Catalina, Mts. Arizona (2,900 ft.), Arizona, 12. v. 1961, R. M. & E. M. PAINTER.

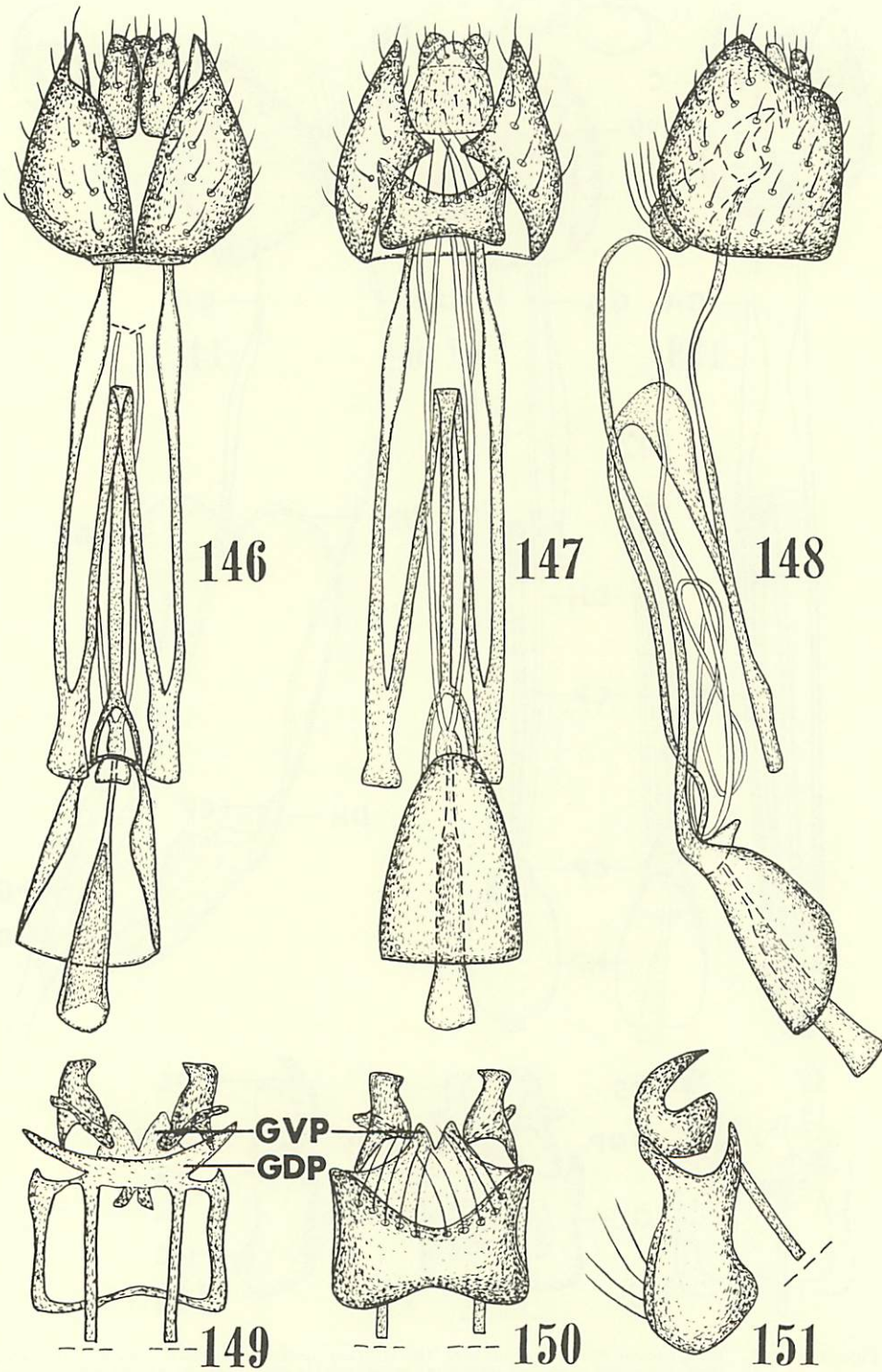
Prorates sp. (Figs. 146–151): Very similar to *melanderi*, but may possibly be distinguished from it by having posterior part of dorsal bridge more widened and hanging



Figs. 136–138. *Prorates nigrescens* HALL, male. Gonocoxites, gonostyli and aedeagus, dorsal, ventral and lateral views.



Figs. 139-145. *Prorates painteri* NAGATOMI et LIU, male. 139-141, Cerci, sternum 10, tergum 9, gonocoxites and aedeagus, dorsal, ventral and lateral views (hanging-bell phallus, cord-like phallus, aedeagal apodeme and distiphallus are excluded in Fig. 139; dorsal bridge and anterior part of gonocoxal apodeme are excluded in Fig. 140); 142, hanging-bell phallus, cord-like phallus, aedeagal apodeme and anterior part of distiphallus, dorsal view; 143-145, gonocoxites, gonostyli, gonocoxal dorsal processes (=GDP), gonocoxal ventral processes (=GVP) and base of gonocoxal apodemes, dorsal, ventral and lateral views. [Figs. 139-142 are different in magnification from Figs. 143-145]



Figs. 146-151. *Prorates* sp., male. 146-148, Cerci, Sternum 10, tergum 9, gonocoxites and aedeagus, dorsal, ventral and lateral views; 149-151, gonocoxites, gonostyli, gonocoxal dorsal processes, gonocoxal ventral processes and base of gonocoxal apodemes, dorsal, ventral and lateral views. [Figs. 146-148 are different in magnification from Figs. 149-151]

bell phallus larger. It is necessary to study more material in order to determine whether or not the differences above are significant. Specimen dissected: 1 ♂, BYU-AEC-NTS, Mercury, Nevada, 8. viii. 1985.

Key (6) to genera of Proratinae based on male genitalia

(*Acaenotus* and *Jackhallia* are excluded, but *Apystomyia* is included)

1. Sternum 9 entirely absent; fused gonocoxites usually not bifurcate; paired tergum 9 contiguous or so at mid-dorsal base; gonocoxal apodeme (when present) arising from posterior border of gonocoxite; basiphallus without anterolateral process..... 2
 - Large sternum 9 present; fused gonocoxites bifurcate or markedly protruded posterolaterally; paired tergum 9 contiguous or so, except for anterior and posterior parts; gonocoxal apodeme arising from anterolateral corner of gonocoxite; basiphallus with a pair of anterolateral processes.....
..... *Caenotus* COLE
- 2 (1). Distiphallus bifid, conspicuously long and usually in a tangle; gonocoxal apodeme conspicuously long; anterior hanging-bell phallus and posterior cord-like phallus present..... 3
 - Distiphallus single-lobed, short and wide; gonocoxal apodeme, hanging-bell phallus, and cord-like phallus entirely absent.....
..... *Apystomyia* MELANDER
- 3 (2). Fused gonocoxites without larger posterolateral ventral triangular part and without long posterolateral dorsal process..... 4
 - Fused gonocoxites with larger posterolateral ventral triangular part protruding apically and having hairs, and with long posterolateral dorsal process widened at apical portion (only one species [= *californicus*] is examined)
..... *Caenotoides* HALL
- 4 (3). Cord-like phallus forked anteriorly (just behind hanging-bell phallus); gonocoxal apodeme and dorsal bridge usually longer than in *Alloxytropus anomalus*; thin transverse sclerite usually present at mid dorsal base of paired tergum 9
..... *Prorates* MELANDER
 - Cord-like phallus not forked anteriorly; gonocoxal apodeme and dorsal bridge shorter than in *Prorates* (except for *boydi*), no transverse sclerite present at mid-dorsal base of paired tergum 9; (only one species [= *anomalus*] is examined)..... *Alloxytropus* BEZZI

Key (7) to 3 species of *Caenotus* based on male genitalia

1. Posterolateral protruded part of fused gonocoxites narrower and pointed or

- bluntly pointed; tergum 9 shorter than in *mexicanus* 2
- Posterolateral protruded part of fused gonocoxites wide; tergum 9 longer than in *hospes* and *minutus* *mexicanus* sp. n.
- 2. Posterolateral protruded part of fused gonocoxites narrower than in *hospes*; bifid part of distiphallus short *minutus* COLE
- Posterolateral protruded part of fused gonocoxites wider than in *minutus*; bifid part of distiphallus longer than in *minutus* *hospes* COLE

Key (8) to 8 species of *Alloxytropus* and *Prorates* based on male genitalia

- 1. Cord-like phallus forked anteriorly (just behind hanging-bell phallus); gonocoxal apodeme long (except for *boydi*); fused gonocoxites without a posterolateral sclerite folded dorsally and flattened laterally (*Prorates*) 2
- Cord-like phallus not forked anteriorly (just behind hanging-bell phallus); gonocoxal apodeme short; fused gonocoxites with a posterolateral sclerite folded dorsally and flattened laterally *Alloxytropus anomalus* BEZZI
- 2 (1). Gonocoxal apodeme long; fused gonocoxites rectangular in ventral view; gonostylus not triangular 3
- Gonocoxal apodeme short in relation to other species; fused gonocoxites semicircular in dorsal or ventral view; gonostylus triangular in dorsal or ventral view *boydi* HALL
- 3 (2). Dorsal bridge longer than in *frommeri*; gonostylus cross-shaped in dorsal or ventral view and widened at middle or near base in lateral view; fused gonocoxites with paired mid-posterior ventral processes; each piece of tergum 9 with posterolateral ventral process absent or short; hanging-bell phallus more robust 4
- Dorsal bridge comparatively short; gonostylus straight in dorsal or ventral view and protruding dorsally at apex and at middle in lateral view; fused gonocoxites with one large mid-posterior ventral process; each piece of tergum 9 with posterolateral corner having a large ventral process; hanging-bell phallus longer and narrower *frommeri* HALL
- 4 (3). Gonocoxal apodeme shorter than in *painteri*, and posterior widened part of dorsal bridge (in lateral view) narrower than in *painteri* 5
- Gonocoxal apodeme conspicuously long, and posterior (middle in dorsal view) part of dorsal bridge (in lateral view) markedly widened; hanging-bell phallus (in dorsal view) not narrower posteriorly; fused gonocoxites with mid-posterior dorsal paired processes directed posterolaterally (= GDB in Fig. 143) as in *melanderi* and *nigrescens* *painteri* sp. n.
- 5 (4). Fused gonocoxites without mid-posterior dorsal processes mentioned below; hanging-bell phallus smaller *ballmeri* sp. n.

- Fused gonocoxites with mid-posterior dorsal paired processes directed posterolaterally which are united with each other at mid-base (= GDB in Fig. 129); hanging-bell phallus larger.....
*melanderi* HALL, *nigrescens* HALL and *Prorates* sp.

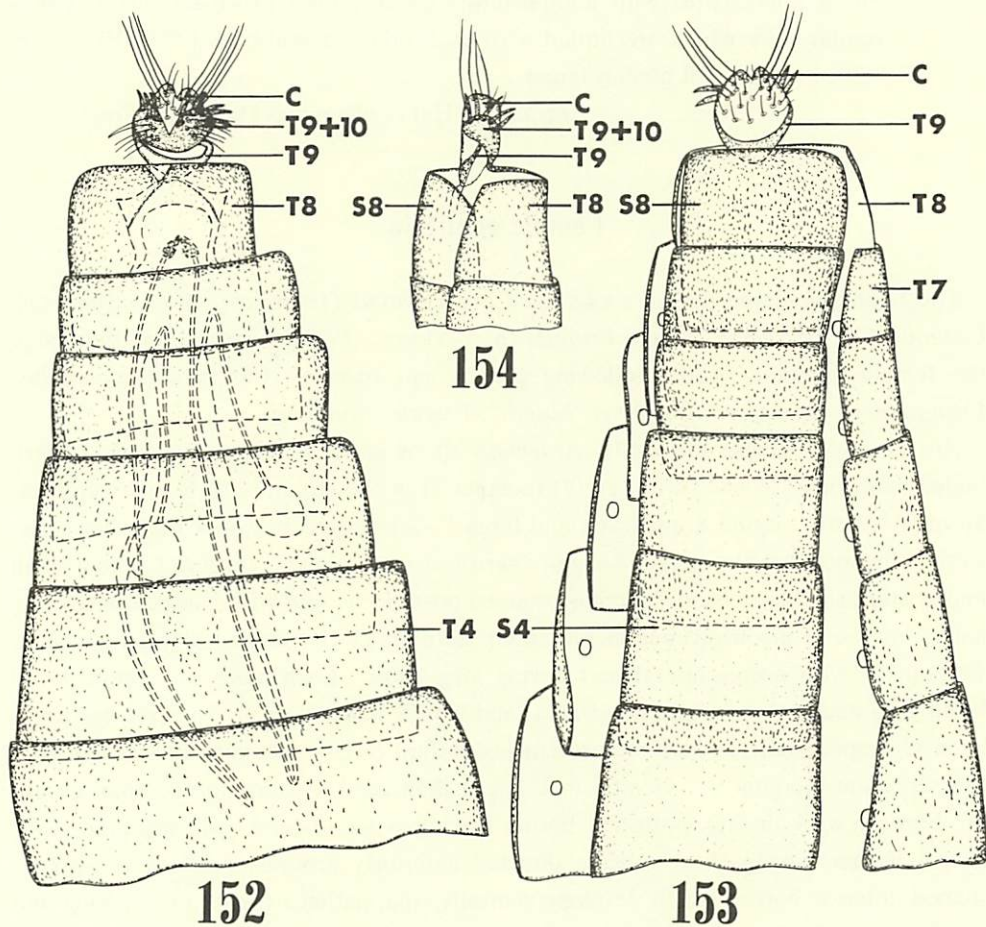
Female genitalia

The female genitalia are here examined in *Acaenotus* (1 species), *Alloxytropus* (1), *Caenotus* (3), *Jackhallia* (1) and *Prorates* (3). YEATES (1992) described and illustrated the female genitalia of the following genera and species: *Alloxytropus anomalus*; *Caenotoides californicus*; *Caenotus* “*hospes*”; *Prorates frommeri*.

Acaenotus sp. (Figs. 152–157): *Acaenotus* sp. is easily distinguished from *Caenotoides californicus* as shown in key (9) (couplet 3) in the structure of female genitalia. Sterna 5–8 and tergum 8 quadrate, and terga 5–7 rectangular (wider than long), terga 5–8 distinctly and sterna 5–8 slightly narrower posteriorly. Tergum 8 with a small mid-posterior paler incision. Cercus rounded posteriorly, and with conspicuously long hairs; small and inconspicuous membranous sternum 11 (= subanal plate) is present; sternum 10 with posterolateral part having long hairs. Each piece of tergum 9 + 10 fused with each other at mid basal area, and with 5 stout setae at posterior border; a large U-shaped ventral sclerite is present just before cerci + sternum 10 and this sclerite represents tergum 9. Genital fork larger than cerci + sternum 10, open except for border, with thicker posterior border having posterolateral part angulate, with lateral border having short process directed anteriorly around middle and with V-shaped anterior border which develops ventrally; spermatheca conspicuously long and consisting of (1) short basal section, (2) long duct, (3) wider duct, (4) apical thinner duct, and (5) circular head. Specimen dissected: 1 ♀, Organ-Pipe-Cactus N. M., Pina Co., Arizona, R. H. PAINTER.

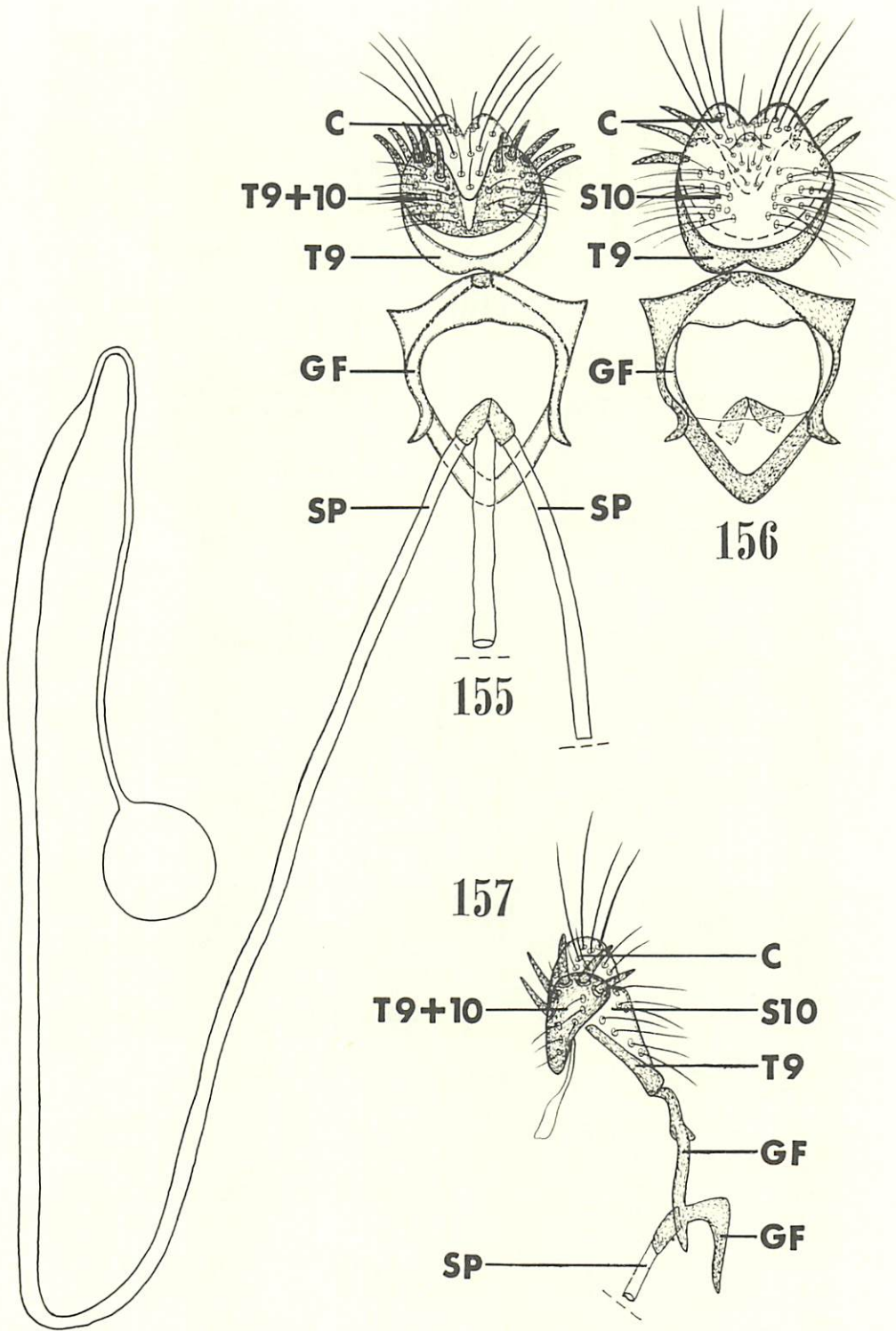
Alloxytropus anomalus BEZZI, 1925 (Figs. 158–163): *Alloxytropus anomalus* is similar to *Prorates* species except as follows: Genital fork not trapezoid but elliptic and with lateral border having two processes directed dorsally, of which posterior one is larger and rounded apically (in lateral view); genital fork with one median hole [whose shape is not accurately grasped] and with paired darkened dots at anterior end. [Spermathecae were lost and are not examined by us, but are illustrated by YEATES (1992)]. Judging from fig. 56 in YEATES (1992), the spermatheca consists of (1) basal thin duct, (2) median longer and wider duct, (3) apical thin duct, and (4) cup-shaped head, and has no thinner tangled part which is present in *Prorates* and *Jackhallia*. Specimen dissected: 1 ♀, Quweiz, N. W. Gezra, 27. x. 1970, [BMNH].

Genus *Caenotus* COLE, 1923: The female genitalia of *Caenotus* are peculiar as shown in key (9) (couplet 1). The common characters of *Caenotus* based on *hospes*, *inornatus* and *mexicanus* are as follows: Terga 6–8 each comparatively long in relation to width; terga 6–7 rectangular; tergum 8 membranous at posterior part and rounded at

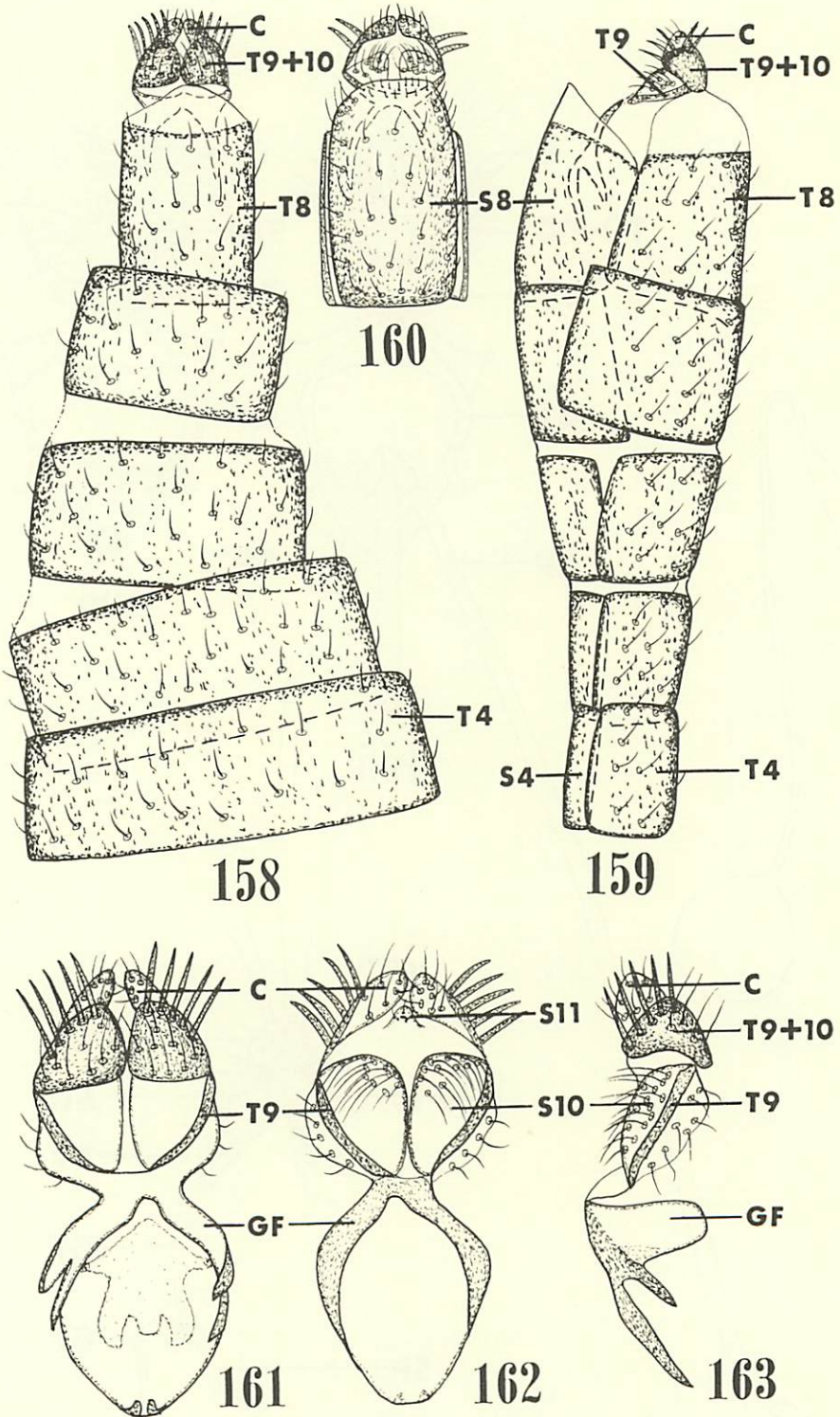


Figs. 152–154. *Acaenotus* sp., female. 152–153, Abdomen (except base), dorsal and ventral views; 154, apex of abdomen, lateral view.

posterior margin; sclerotized part of tergum 8 with a mid-posterior triangular patch and with a mid-posterior thin vitta extending to tergum 9. Sterna 6–8 narrower than terga 6–8 and longer than wide; sterna 6–7 rectangular; sternum 8 narrower posteriorly and rounded at posterior margin. Paired tergum 9+10 widely separated, but connected with each other by a transverse sclerite, that is, part of tergum 9; each piece of tergum 9+10 with 9–10 stout setae, of which 2 or 3 outer anterior ones are longer. Paired elongate lateral ventral sclerites present just before tergum 9+10, that is, probably part of tergum 9. If so, tergum 9 consisting of (1) median dorsal one and (2) paired lateral ventral ones. Cercus rounded posterodorsally. A small mid-ventral sclerite is present between cerci and it is subanal plate or sternum 11. Sternum 10 separated from cerci, semicircular, with mid-posterior pale incision, and with short stout ventral hairs. Genital fork U-shaped, longer than wide, and in lateral view with lateral part wide. Spermatheca consisting of long duct (which is narrower at apical



Figs. 155–157. *Acaenotus* sp., female. Cerci, tergum 9 + 10, sternum 10, tergum 9, genital fork and spermatheca, dorsal, ventral and lateral views.



Figs. 158-163. *Alloxytropus anomalus* BEZZI, female. 158-159, Abdomen (except base), dorsal and lateral views; 160, cerci, sternum 10 and sternum 8, ventral view; 161-163, cerci, sternum 10, tergum 9 and genital fork, dorsal, ventral and lateral views. [Figs. 158-159 are different in magnification from Figs. 161-163]

portion) and widened head which is elliptical and much longer than wide.

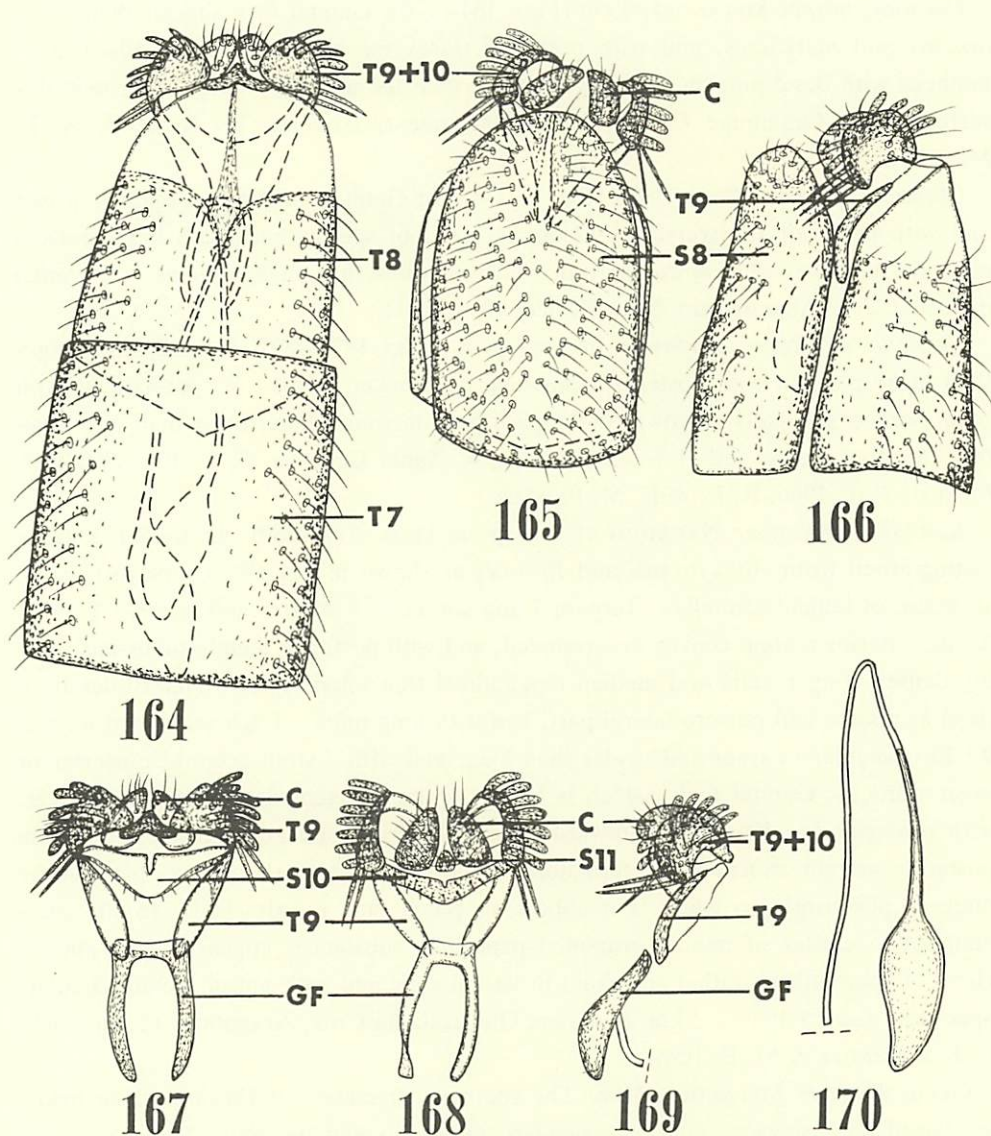
Caenotus hospes MELANDER, 1950 (Figs. 164–170): Genital fork shorter than in *inornatus* and *mexicanus*, and with posterior transverse bar thinner. Head of spermatheca with basal portion abruptly narrower than the apical portion. Specimen dissected: 1 ♀, Organpipe Cactus National Monument, Arizona, 15. iv. 1947, A. L. MELANDER.

Caenotus inornatus COLE, 1923 (Figs. 171–176): Genital fork longer than in *hospes* and with posterior transverse bar thicker. Head of spermatheca with basal portion abruptly narrower than apical portion which is wider than in *mexicanus*. Specimen dissected: 1 ♀, Alamogordo, New Mexico, 12. v. 1902.

Caenotus mexicanus NAGATOMI et LIU sp. n. (Figs 177–182): Genital fork longer than in *hospes* and with posterior transverse bar thicker. Head of spermatheca with basal portion gradually narrower than apical portion which is narrower than in *inornatus*. Specimen dissected: 1 ♀, 18 miles S. W. Santa Catarina, S. L. P., 3,500 feet, Mexico, 7. iv. 1966, R. E. & E. M. PAINTER.

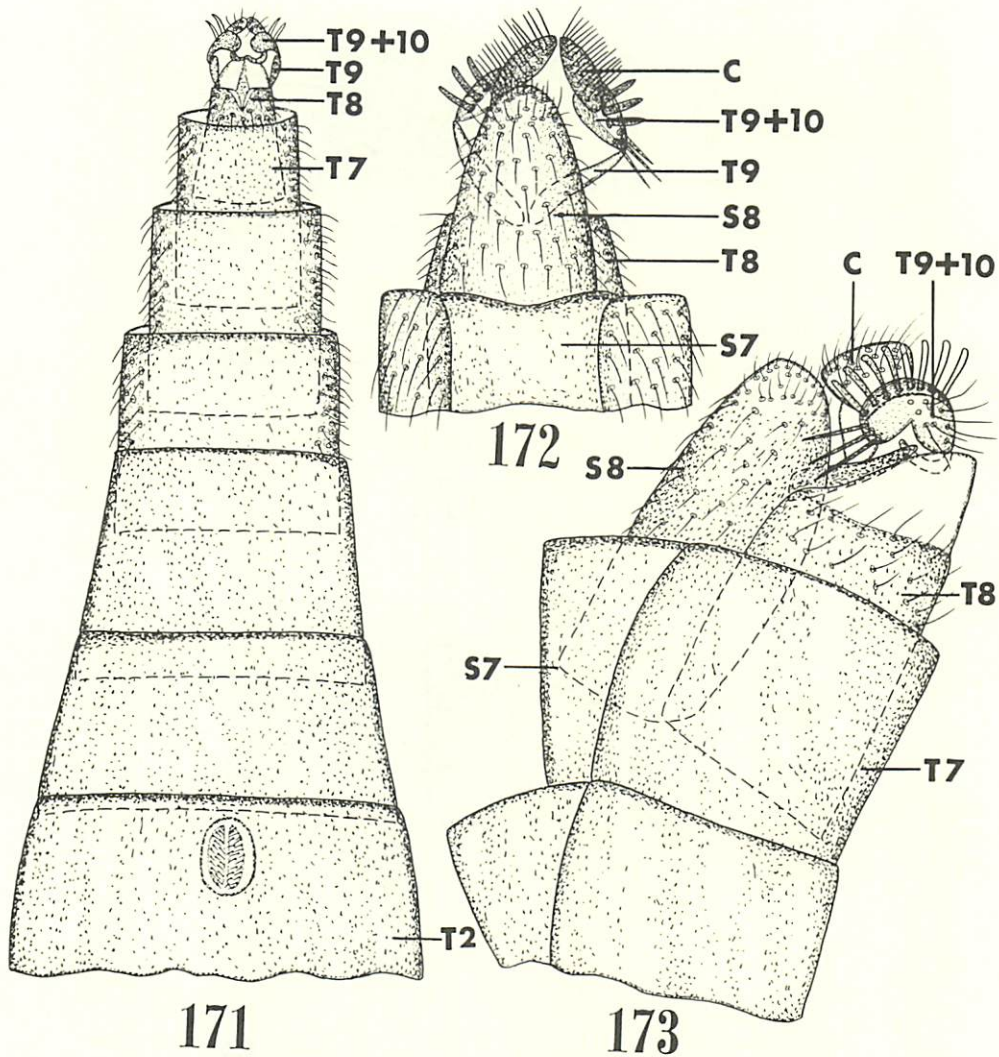
Jackhallia argentinae NAGATOMI et LIU sp. n. (Figs. 183–189): *Jackhallia* is easily distinguished from *Alloxytropus* and *Prorates* as shown in key (9) (couplet 4) in the structure of female genitalia. Tergum 7 and sterna 7–8 shorter and wider. Tergum 8 with anterior margin convex and rounded, and with posterior membranous part having denser, longer hairs and median longitudinal thin sclerite. Sternum 10 desclerotized at middle and postero-lateral part, and with long hairs. Each sclerite of tergum 9+10 triangular or trapezoid, wider than long, and with 7 stout setae at posterior or inner border. Genital fork (which is hollow) rather rectangular, longer than wide, with posterior bar having no outward sclerite, and with thicker anterior bar whose posterior margin concave. Anterolateral angle of genital fork with a thin sclerite directed posteriorly to which a membranous patch may be attached. In the spermatheca, a cluster of minute crumpled paper-like substances appears to be absent. Head of spermatheca rather trapezoid in lateral view and with apical section circular. Specimen dissected: 1 ♀. 2 km. S. Caleta Olivia, Santa Cruz, Argentina, 12. xii. 1967, E. I. SCHLINGER & M. E. IRWIN.

Genus *Prorates* MELANDER, 1906: The common characters of *Prorates* given below are based on 3 species, namely, *melanderi*, *nigrescens* and *painteri*. Terga 5–7 rectangular (wider than long). Tergum 8 (except posterior membranous part) rectangular or trapezoid, about as long as wide or longer than wide, and with a small and inconspicuous mid-posterior concavity or paler incision. Paired tergum 9+10 never fused, but contiguous or so with each other, and each sclerite rather triangular in dorsal view and with 5 setae at posterior border. Tergum 9+10 with paired cord-like anterolateral sclerites running ventrally, and this sclerite may represent tergum 9. Paired median thin short sclerites present near apex of tergum 9 (running ventrally) and this sclerite probably belongs to tergum 9. Mid-posterior haired ventral membrane or subanal plate (= sternum 11) is present just before cerci. Cercus rounded posteriorly. Sternum 10 with posterolateral parts having a cluster of conspicuously



Figs. 164–170. *Caenotus hospes* MELANDER, female. 164–166, Apex of abdomen, dorsal, ventral and lateral views; 167–169, cerci, sternum 10, tergum 9 and genital fork, etc., dorsal, ventral and lateral views; 170, spermatheca (except base).

long dense hairs and with mid-anterior part having shorter sparser hairs. Genital fork with a large hole at middle, consisting of anterior, lateral and posterior thin sclerites, tapering anteriorly, and with posterolateral corners having outward process. Spermatheca consisting of (1) long basal duct, (2) thin duct which is tangled and which is contiguous to a cluster of minute crumpled paper-like substances, (3) long thin apical duct, and (4) head which is oval in some visual angle or daughnut-like.



Figs. 171–173 *Caenotus inornatus* COLE, female. 171, Abdomen, dorsal view; 172–173, apical portion of abdomen, ventral and lateral views.

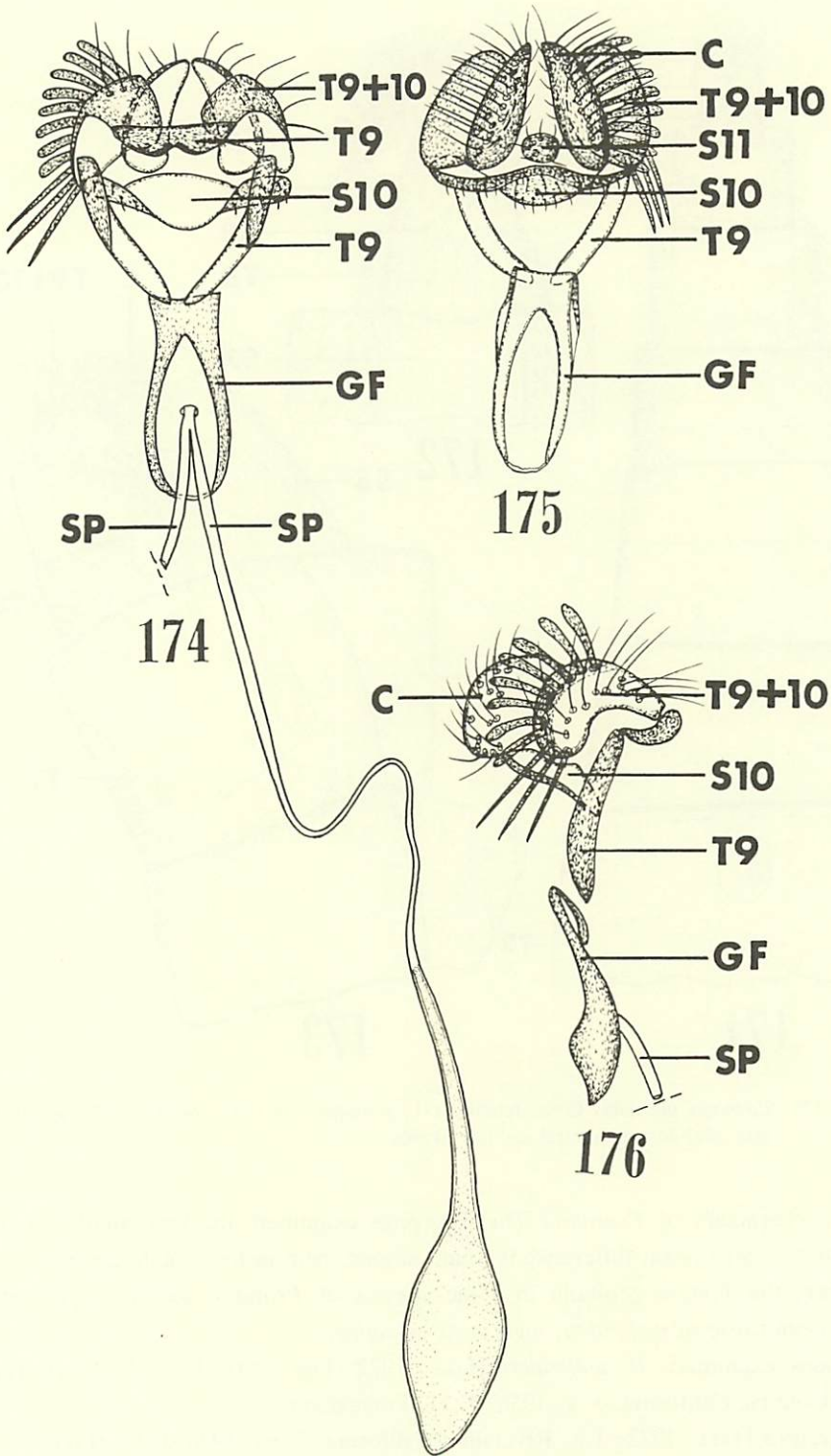
Specific characters of *Prorates*: The 3 species examined are very similar to one another and no significant difference is found among them in the female genitalia.

However, the female genitalia in some species of *Prorates* may be significantly different from those of *melanderi*, *nigrescens* or *painteri*.

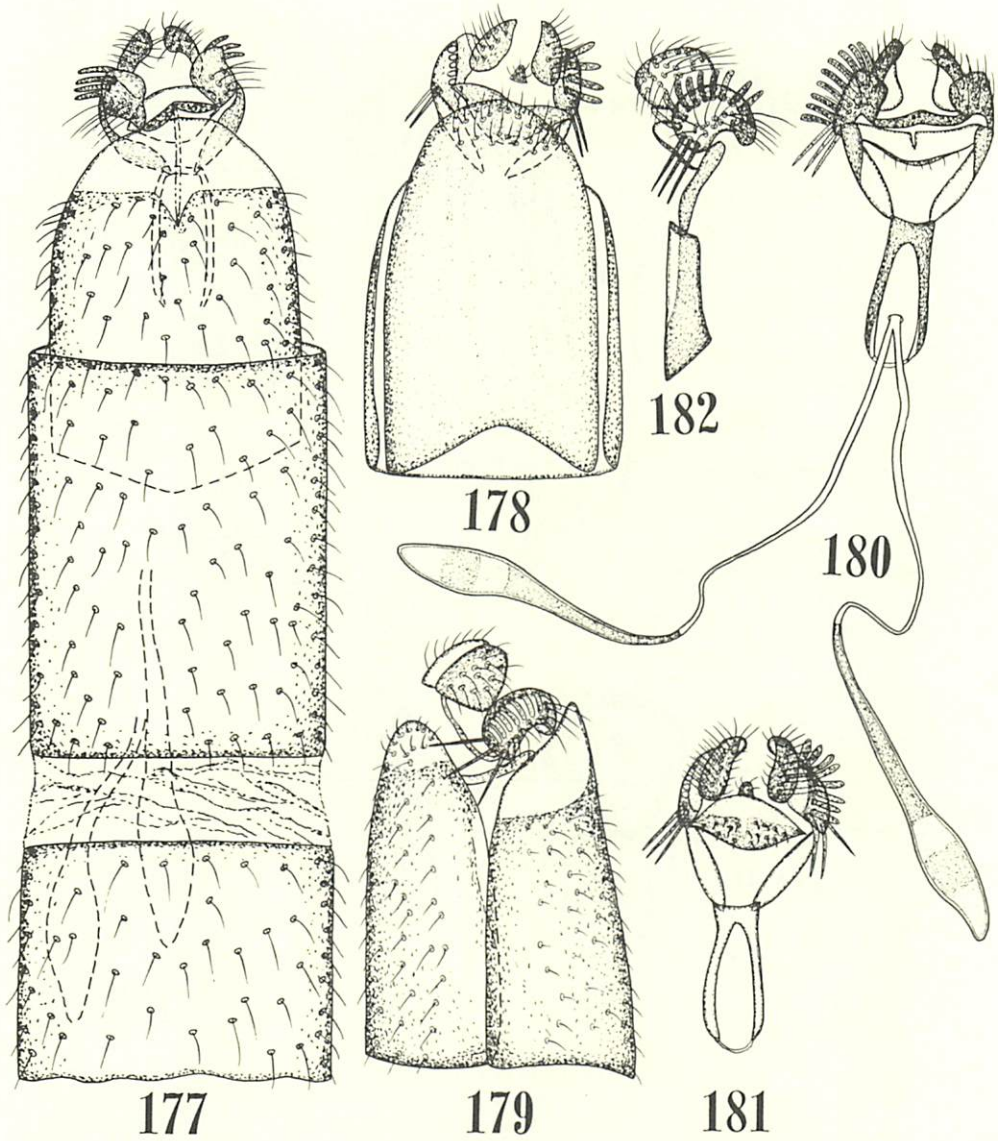
Specimens examined: *P. melanderi* HALL, 1972 (Figs. 190–195): 1 ♀, Borrego, Imperial County, California, 3. v. 1956, P. H. TIMBERLAKE.

P. nigrescens HALL, 1972: 1 ♀, Riverside, California, 3. vii. 1978, J. C. HALL.

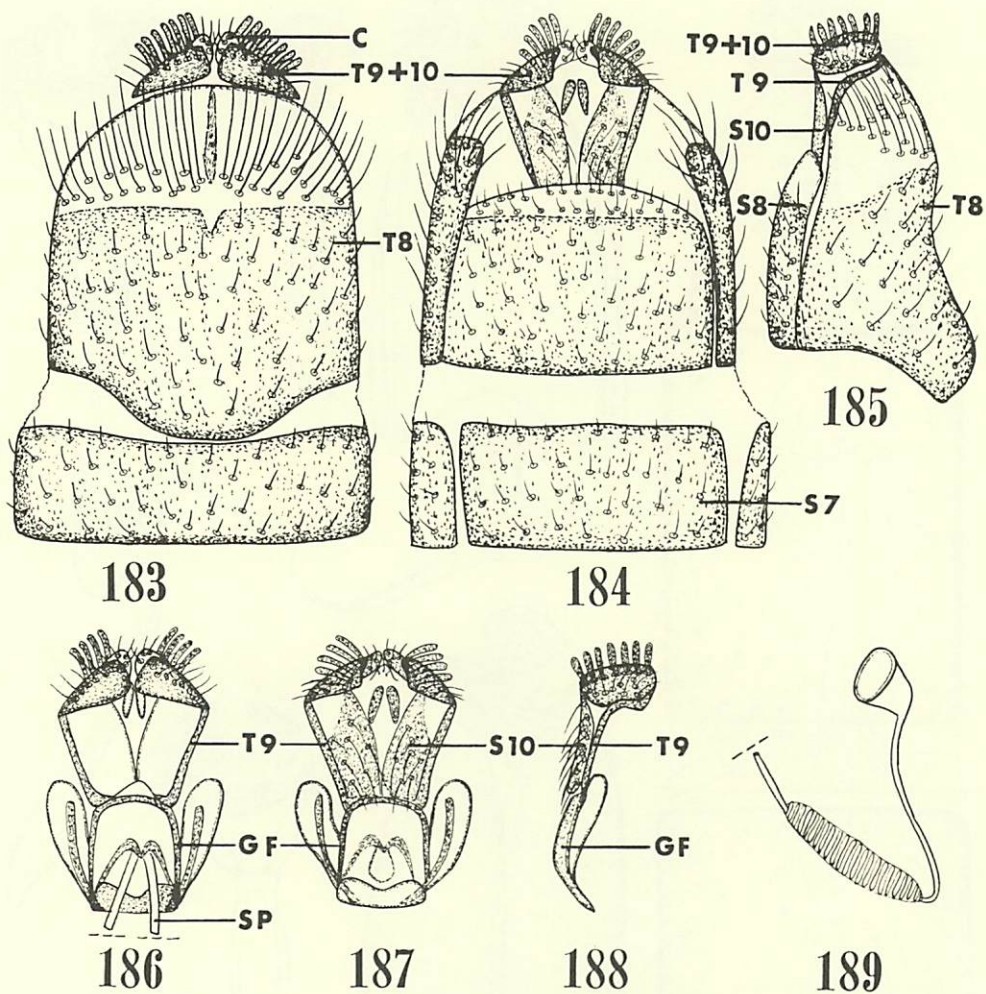
P. painteri NAGATOMI et LIU sp. n.: 1 ♀, Tucson, Arizona, 13. v. 1961, R. M. & E. M. PAINTER.



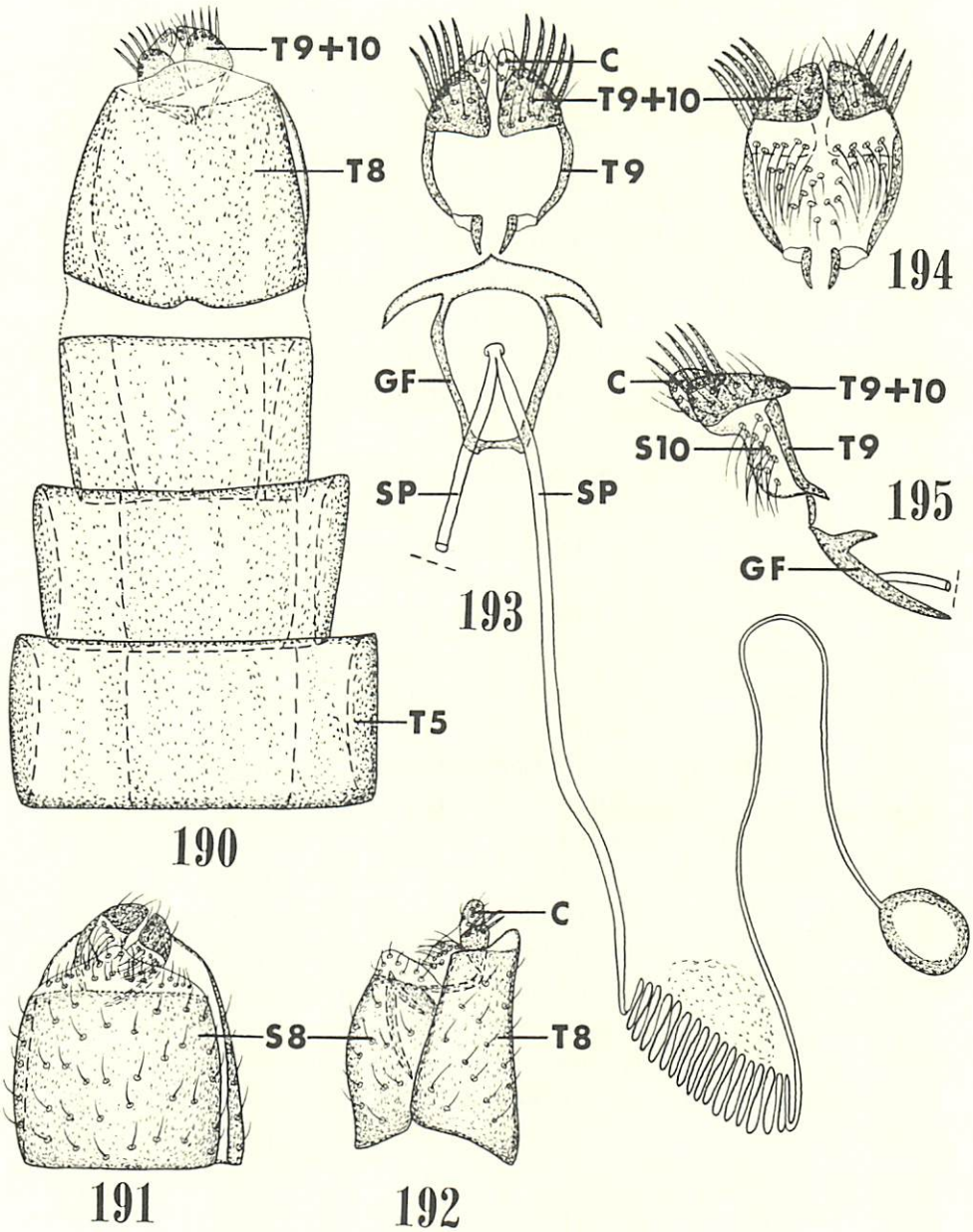
Figs. 174-176. *Caenotus inornatus* COLE, female. Cerci, tergum 9, tergum 9 + 10, sternum 10, sternum 11, genital fork and spermatheca, dorsal, ventral and lateral views.



Figs. 177-182. *Caenotus mexicanus* NAGATOMI et YANAGIDA, female. 177-179, Apical portion of abdomen, dorsal, ventral and lateral views; 180-182, cerci, tergum 9+10, sternum 10, genital fork, spermatheca, etc., dorsal, ventral and lateral views.



Figs. 183–189. *Jackhallia argentiniae* NAGATOMI et LIU, female. 183–185, Apical portion of abdomen, dorsal, ventral and lateral views; 186–188, cerci, tergum 9+10, tergum 9, sternum 10, genital fork, etc., dorsal, ventral and lateral views; 189, spermatheca (except base).



Figs. 190–195. *Prorates melanderi* HALL, female. 190, Abdomen (except base), dorsal view; 191–192, apex of abdomen, ventral and lateral views; 193–195, cerci, tergum 9+10, tergum 9, sternum 10, genital fork and spermatheca, dorsal, ventral and lateral views.

Key (9) to genera of Proratinae based on female genitalia

(*Apystomyia* is excluded)

1. An isolated bridge (= part of tergum 9) absent between paired tergum 9+10; genital fork wider, head of spermatheca oval, doughnut-like, or cup-shaped 2
 - An isolated bridge (= part of tergum 9) present between paired tergum 9+10; genital fork narrower; head of spermatheca elongae, much longer than wide, and with basal portion abruptly or gradually narrower than apical portion *Caenotus* COLE (*hospes*, *inornatus* and *mexicanus*)
- 2 (1). Tergum 9 (running ventrally) not paired but fused with each other at middle and transverse or U-shaped; genital fork (which is hollow) rather triangular 3
 - Tergum 9 (running ventrally) paired; genital fork (which is hollow) rectangular, trapezoid, or elliptical 4
- 3 (2). Genital fork pointed at anterior end *Acaenotus* (sp.)
Genital fork pointed at posterior end *Caenotoides* (*californicus*)
- 4 (2). Tergum 8 without denser, longer hairs and median longitudinal thin sclerite at posterior membranous part; sternum 8 nearly as long as tergum 8; genital fork trapezoid or elliptical, and without a thin sclerite directed posteriorly arising near anterolateral corner 5
 - Tergum 8 with denser, longer hairs and median longitudinal thin sclerite at posterior membranous part; sternum 8 much shorter than tergum 8; genital fork rather rectangular and with a thin sclerite directed posteriorly arising near anterolateral corner *Jackhallia* gen. n. (*argentinae*)
- 5 (4). Genital fork trapezoid and with outward lateral process at posterolateral corner; paired median longitudinal short sclerites (which probably belong to tergum 9) present between tergum 9 (running ventrally) and genital fork (this sclerite may be absent in some species of *Prorates*)
..... *Prorates* MELANDER (*melanderi*, *nigrescens* and *painteri*)
 - Genital fork elliptical and with two lateral processes directed dorsally; paired median longitudinal short sclerites absent between tergum 9 (running ventrally) and genital fork (this is so in *Jackhallia*)
..... *Alloxytropus* BEZZI (*anomalus*)

Key (10) to 3 species of *Caenotus* based on female genitalia

1. Genital fork longer and with posterior transverse bar thicker; head of spermatheca with basal portion gradually or abruptly narrower than apical portion but wider than in *hospes* 2
 - Genital fork shorter and with posterior transverse bar thinner; head of spermatheca with basal portion thin and abruptly narrower than apical portion

- *hospes* COLE
2. Head of spermatheca with basal portion more abruptly narrower than apical portion which is wider.....*inornatus* COLE
- Head of spermatheca with basal portion more gradually narrower than apical portion which is narrower.....*mexicanus* sp. n.

Monophyly of several taxa

Synapomorphic character is pursued and given below in order to assume the monophyly of several taxa.

Apystomyia may be not a member of Scenopinidae, because distiphallus is single-lobed and spermathecae are three in number (after YEATES in personal communication). The family position of *Apystomyia* is uncertain to us at present.

1. Scenopinidae (= Scenopininae + Proratinae)

(*Apystomyia* is excluded)

As discussed by YEATES (1992), the following four character states seem to be synapomorphic for the Scenopinidae (including Proratinae): (1) male tergum 9 (= epanadium) divided into two sclerites along midline; (2) distiphallus bifid; (3) spermathecae two (not three) in number; (4) abdominal tergum 2 with a modified setose patch at mid-posterior part.

However, there are several exceptions as follows: (1) at least in some species of *Scenopinus*, distiphallus is trifid (or single-lobed, apart from paired distal tubes); (2) in *Caenotoides*, modified setose patch on abdominal tergum 2 is absent.

It seems that the exceptional characters above occurred secondarily.

2. Scenopininae (= Scenopinidae s. str.)

As discussed by YEATES (1992), there are two synapomorphic characters which distinguish the Scenopininae from the Proratinae. (1) vein M_2 absent, and usually vein M_1 ending above or at wing apex or ending on vein R_5 (in the latter case, 1st posterior cell [= cell R_5] is closed); (2) antennal flagellum one-segmented and with a short spine on pit at or near apex, instead of apical style (which is absent in *Caenotoides*, *Jackhalla*, and possibly *Alloxytropus*, however).

Judging from figs. 29, 190–192, 196–197, 198b and 199 in KELSEY (1969), (1) vein M_1 is incomplete in *Scenopinus pallidipennis* and some species of *Scenopinus* and *Rikiella* and (2) vein M_2 ends far below wing apex in *Seguyella* where vein M_4 is absent. It is certain that two character states took place secondarily.

The genitalia of the Scenopininae were studied in detail in a few genera and species

below. Male: *Belosta albipilosa* (by YEATES, 1992); *Propebrevitrichia* sp. (by YEATES, 1992); *Scenopinus glabrifrons* (by NAGATOMI, LIU and EVENHUIS, in press). Female: *Propebrevitrichia* sp. (by YEATES, 1992); *Scenopinus fenestralis* (by YEATES, 1992); *Scenopinus glabrifrons* (by NAGATOMI, LIU and EVENHUIS, in press).

The Scenopininae contains many genera. It is premature to say synapomorphic character for the genitalia of the Scenopininae.

3. Proratinae excluding *Caenotus*

(= *Acaenotus* + *Alloxytropus* + *Caenotoides* + [*Jackhallia*] + *Prorates*)

Dorsal bridge (in aedeagus) consisting of a median junction or transverse bar and paired lateral longitudinal bars, and U or V shaped.

Gonocoxal apodeme long, cord-like and originated from posterior part of gonocoxite.

Phallus is pendent and has the following parts: (1) U or V shaped cord-like dorsal bridge connected with the apex of gonocoxal apodeme; (2) posterior cord-like phallus before dorsal bridge; (3) anterior hanging-bell phallus without dorsal surface or anterior dorsal surface (or with dorsal surface open).

Base of aedeagal apodeme situated dorsal to anterior hanging-bell phallus.

Paired distiphalli conspicuously long and very often in a tangle.

4. *Caenotus*

Antennal segment 1 longer than segment 2; mesonotum and scutellum without bristles; vein R₅ ending below wing apex; female abdomen longer and roughly 3 times as long as mesonotum + scutellum, basiphallus (base of endophallus) with a pair of anterolateral dorsal processes.

Caenotus has the following characters which are plesiomorphic in relation to other genera of Proratinae: costa continuous around wing margin; vein M₃ sometimes present; veins M₁, M₂ and M₄ reaching to wing margin; fused gonocoxites rather bifid by having posterolateral corners protruded, and with large semicircular sternum 9 separated by suture.

5. *Caenotoides* + *Acaenotus*

Female tergum 9 (running ventrally) not paired but fused with each other at middle, and U shaped or transverse; genital fork with lateral process around or beyond middle; spermathecal duct with widened part far beyond middle.

6. *Caenotoides*

Antennal flagellum abruptly narrower at apical portion, with a tuft of hairs at apex and without apical style; thickening of costa ending at or just beyond apex of R₄, mesonotum and scutellum without bristles; abdomen largely white or pale yellow; fused gonocoxites with paired dorsal posterolateral processes.

7. *Acaenotus*

Antennal flagellum with thick apical style which is wider than apex of preceding segment.

8. *Prorates* + *Alloxytropus* + *Jackhallia*

(1) Proboscis largely sclerotized and longer than face (it is shorter than face in *Prorates boydi*). (2) Antennal flagellum in lateral view gradually tapering apically, rather triangular or lancet-shaped and with or without apical style which is usually small and inconspicuous.

More detailed study of character (1) is needed in the degree of difference between "sclerotized" and "fleshy." It is not definite that the character (2) is truly synapomorphic for this taxon. However, the characters (1) and (2) convey the impression that *Prorates* (+*Alloxytropus*) and *Jackhallia* are most closely related phylogenetically.

9. *Prorates* + *Alloxytropus*

Vein M₂ arising from vein M₁.

It is probable that the absence of antennal style takes place independently in each of *Alloxytropus* and *Jackhallia*.

10. *Prorates*

Cord-like phallus forked anteriorly (just behind hanging-bell phallus); spermatheca with a cluster of minute crumpled paper-like substance alongside thinner tangled duct (this character may possibly be sometimes absent).

11. *Alloxytropus* [whose spermatheca is not examined]

We have examined only one species, i. e., *anomalus*. Antennal flagellum without style (if not overlooked) (this is so in *Jackhallia argentinae*).

12. *Jackhallia* [whose male is not examined]

Female head with postocular rim; female abdominal tergum 8 with denser, longer hairs on posterior membranous part; genital fork with largely membranous elongate wing arising from anterolateral corner; female sternum 8 much shorter than tergum 8; antennal flagellum without style (this is so in *Alloxytropus anomalus*, if not overlooked); proboscis distinctly longer than head (this is so in *Prorates arctos*).

13. ? [Proratinae (including *Caenotus*)]

Gonocoxites completely fused with each other ventrally, *with dorsally folded part narrow and confined to border*.

Apart from *Caenotus*, sternum 9 is absent and fused gonocoxites are single and neither paired nor bifid.

In *Caenotus*, a large semicircular sternum 9 is separated from the fused gonocoxites by suture and fused gonocoxites are rather bifid but no cylindrical gonocoxites are present.

However, the character state above may be seen in various taxa of the Asiloidea including the Scenopininae. More study is needed in this respect, that is, the structure of male genitalia must be clarified in more genera and species of Scenopininae.

14. ? [Scenopininae + Proratinae (excluding *Caenotus*)]

YEATES (1992) considered the following four character states as synapomorphic for this taxon: "costal vein ending in the R field, "; "wing with veins of M and CuA fields not reaching margin (figs. 6, 8–10)"; "vein M₃ absent"; "hypandrium fused to the gonocoxites or absent."

However, these character states might occur independently in each of the Scenopininae and Proratinae (excluding *Caenotus*).

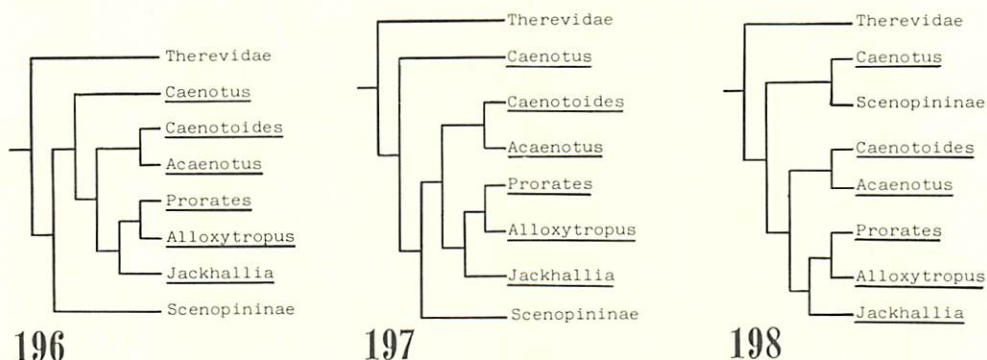
15. ? [Scenopininae + *Caenotus*]

Modified setose patch on abdominal tergum 2 divided mid-longitudinally into a pair of clusters of bristle-like setae.

However, the character state above is probably not synapomorphic but sympleiomorphic.

Phylogeny of Proratinae

Figures 196–198 show supposed phylogeny of the Proratinae. *Apystomyia* remains undetermined in family position and is excluded from these figures.



Figs. 196–198. Possible phylogenetic relationships of the Therevidae and Scenopininae (Scenopininae + genera of Proratinae)

Which relationship is correct, Proratinae (including *Caenotus*), Scenopininae + Proratinae (excluding *Caenotus*), or Scenopininae + *Caenotus*? It is uncertain to us at present.

In any case, the Scenopininae has deviated so much at least externally from the Proratinae (plus *Caenotus*).

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