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New neotropical species of the genus *Phlugis* (Orthoptera: Tettigoniidae: Meconematinae)

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Abstract

Seventeen new species of the predaceous katydid genus *Phlugis* Karny (Meconematinae) are described and figured. All of these species were collected from rainforests in northern Peru. Three of them — along with the already described species, *P. teres* (DeGeer) — regularly were captured along trails at ground level; the remaining 14 were collected from treetop canopies 10 to 30 m above ground level, using pesticide fogging methods. Based on the numbers of new forms collected from tree canopies, it is probable that many species of this already large genus are yet to be discovered as this niche is explored more thoroughly.

Resumen

Diecisiete nuevas especies de grillos depredadores del género *Phlugis* Karny (Meconematinae) se describen e ilustran. Todas estas especies fueron recolectadas de las selvas tropicales en la región norte del Perú. Tres de ellas — junto con la especie ya descrita, *Phlugis teres* (DeGeer) — fueron capturados regularmente a lo largo de los trillos a nivel del suelo; las catorce restantes fueron recogidos de los pabellones de las copas de árboles a 10-30 m sobre el nivel del suelo, usando el método de pesticidas que empañaba. De acuerdo con los números de las nuevas formas recogidas de las copas de los árboles, es probable que muchas especies de este género, ya numeroso, van a ser descubiertas conforme este nicho sea explorado más a fondo.

Key words

Phlugidini, katydid, Peru, rainforest, arboreal

Introduction

Phlugis Stål 1891 (Meconematinae) is a large genus of small, slender, predaceous katydids. Its world distribution is disjunct, with 10 Australasian (Kevan & Jin 1993) and 24 neotropical species (Otte 1997). Kevan and Jin (1993) resurfaced an obscure, long-overlooked paper describing the tribe Phlugidini (Eichler 1938) — contrasting it with characters defined for the tribe Phisidini (Jin & Kevan 1991) — and included in it the genera *Phlugis*, *Phlugiola* Karny 1907, and two additional genera described therein (*Phlugidia* Kevan 1993, with one species from Africa, and *Tenuiphlugis* Kevan 1993, with 4 species from Australasia).

Unfortunately, Kevan and Jin (1993), as well as Otte (1997), overlooked the genus *Lucienola* Gurney 1975, which was erected to separate the Australasian species *Phlugiola gressitti* Chopard 1969, from neotropical species of *Phlugiola*. Nickle (2003) corrected this oversight by synonymizing *Tenuiphlugis* with *Lucienola*. All of these genera share numerous characters, the most distinctive of which is the presence of open, exposed tympana on the foretibia. Although the Australasian species currently assigned to *Phlugis* eventually may

be removed to another taxon when revisionary studies review all the characters used to define this genus, nevertheless, this genus would still remain as the most speciose genus of meconematine katydids.

In a long-term study (funded to D. A. Nickle and J. L. Castner by Earthwatch Foundation, Cambridge, MA) on the biodiversity of orthopteroid and dictyopteroid insects of northern Peru (Nickle & Castner 1995), I discovered a complex of many additional species of *Phlugis*, only one of which — *P. teres* (DeGeer 1773) — has been described. Seventeen of these species are presented in this paper. An identification key of the new species is provided. Specimens are deposited in the National Museum of Natural History, Smithsonian Institution, Washington, DC [USNM].

The present study is based on a series of 73 males, 65 females, and 11 nymphs collected at 5 sites in northern Peru in Loreto Province. Three of the sites are part of an ecotourist facility, Exploraciones Amazonicas, also known as Explorama, owned and operated by Peter Jenson in Iquitos, Peru. These sites [abbreviated in the text] are as follows: Explorama Inn [INN], 40 km NE Iquitos on Rio Amazon (nr Indiana) lat 3°26' S, long 73°02' W; Explorama Lodge [LODGE], 80 km NE Iquitos on Rio Yanamono (1 km upriver from Rio Amazon, lat 3°30' S, long 73°05' W); and Explornapo Camp [CAMP], 90 km NE Iquitos on Rio Sucusari (1 km upriver from Rio Amazon, lat 3°11' S, long 72°53' W). A fourth site, the Amazon Center for Environmental Education and Research [ACEER] nr Explornapo Camp [CAMP], 90 km NE Iquitos on Rio Sucusari (1 km upriver from Rio Napo, lat 3°11' S, long 72°53' W), is closely linked to Explornapo Camp. A fifth site, Yacumama Lodge—an ecotourist facility owned by Lawrence Bishop and Norman Walters, Iquitos, Peru—is located above the confluence of the Rio Ucuyali, with the following actual location: Yacumama Lodge [YACU], on the Rio Yurapa (ca 30 km upstream from Rio Ucuyali, lat 4°48' S, long 73°30' W).

Specimens were collected over an 11-y period by 20 teams of Earthwatch volunteers (each team comprising the collecting efforts of 11 to 17 persons, supervised by D. A. Nickle and J. L. Castner). Collecting dates for each team are as follows: Team 1 (XI.1-18.1986); Team 2 (II.1-14.1987); Team 3 (II.14-28.1987); Team 4 (VII.1-14.1987); Team 5 (VII.15-28.1987); Team 7 (VIII.5-19.1989); Team 8 (VIII.19-IX.1.1989); Team 9 (VI.23-VII.14.1990); Team 11 (X.3-17.1990); Team 13 (VI.22-VII.6.1991); Team 14 (VIII.8-22.1992); Team 15 (VIII.22-IX.3.1992); Team 16 (VIII.5-20.1994); Team 17 (VIII.20-IX.3.1994); Team 19 (VII.29-VIII.12.1995); Team 20 (VIII.17-31.1996); Team 21 (VIII.31-IX.14.1996); Team 22 (VII.26-VIII.9.1997); Team 23 (VIII.9-23.1997); Team 24 (VII.25-VIII.8.1998).

Specimens were collected both at ground level during nightly collecting forays along forest trails and from rainforest canopy samples obtained by fogging treetops with a mild pesticide (Resmethrin®, 0.5%). Three of the species described herein, along with *P. teres*, were collected only at ground level along trails (n = 53 specimens), and are probably understory species. The other 14 species were collected in fogging samples from tree canopies 10 to 30 m above ground level, and they are considered arboreal species. Of these species, only 3 arboreal taxa were collected sporadically at ground level over the 10-y period of study — *maculata* Nickle, n. sp. (n = 1 specimen of a total of 13 collected in the study), *bimaculata* Nickle, n. sp. (n = 1 out of 23), and *orioni* Nickle, n. sp. (1 of 2) — suggesting that it is unlikely that arboreal species will be found on a regular basis at ground level.

Specimens were measured (in mm) with a device described by Grant (1965), and characters used to evaluate species were essentially those detailed by Emsley *et al.* (1967). Measurements were defined as follows: **total length**, the distance between the frons and apex of the abdomen; **length of pronotal disc**, the median length of the disc from anterior to posterior margin; **width of pronotal disc**, the width across the posterior margin of the pronotum as the shortest distance between the two points at the base of the curvature of the posterior margin; **length and width of both fore- and hindfemur**, the greatest dimensions of those structures as seen in lateral view; **length of tegmen**, the length of the tegmen from its point of insertion at the mesothorax to its apex; **width of tegmen**, the greatest width across the tegmen; **length of eye**, the greatest length of the eye when viewed in lateral aspect; **depth of eye**, the dimension of the eye, also as seen in lateral aspect, as the greatest distance between ventral and dorsal margins; **width of eye**, as seen from above, the greatest distance between lateral margin and medial margin of eye; **length of ovipositor**, the distance from the apex of the ovipositor to the apex of the subgenital plate. The stridulatory file of males was examined only in species where more than 4 specimens were available in the collection. All teeth on the stridulatory file on the left tegmen were counted, and the straight-line distance between first and last tooth on the file recorded as the **length of the file**. Internal genitalia of males of several species could be seen without the aid of dissections and appeared to be quite complex in structure. However, no dissections were made at this juncture, because all species were easily recognizable without the need to examine internal structures. Internal genitalia should prove to be a useful set of characters when revisionary studies are eventually undertaken; because of the small representation of males in most of the species, it was considered best to wait to examine these structures.

List of neotropical species of *Phlugis*

Described species:

abnormis (Redtenbacher 1891)
caribbeum (Rehn 1903)
caudata (Redtenbacher 1891)
cephalotes Bolivar 1888
chelifera Rehn 1918
chelyera Rehn 1918
chrysopa Bolivar 1888
crassifemorata Kastner 1932
irregularis Bruner 1915
macilenta (Redtenbacher 1891)
marginata (Redtenbacher 1891)
nemoptera Bolivar 1888

ocraceovittata Toledo Piza 1960
pehlkei Kastner 1932
permutata Kastner 1932
poecila Hebard 1927
proseni Mello Leitao 1947
proxima Bruner 1915
rhodophthalmus Mello Leitao 1940
similis Bruner 1915
simplex Hebard 1927
spinipes (Fabricius 1775)
teres (DeGeer 1773)
virens (Thunberg 1815)

New species:

Group I

bullatinota Nickle, new species

Group II

lewisi Nickle, new species
orioni Nickle, new species

Group III

celerincta Nickle, new species
chrysopoides Nickle, new species
gracila Nickle, new species

Group IV

bimaculatum Nickle, new species
bimaculoides Nickle, new species
stigmata Nickle, new species

Group V

arborea Nickle, new species
convexitermina Nickle, new species
gigantea Nickle, new species
glabra Nickle, new species
herculi Nickle, new species
maculata Nickle, new species
scalpra Nickle, new species
wittmani Nickle, new species

Key to species of *Phlugis* from Peruvian research sites

- 1 Forefemur with 3 spines on inner ventral margin 2
- 1' Forefemur with 4 or 5 spines on inner ventral margin 5
- 2 Ventral margins of foretibia each with 4 moveable spines; ovipositor <3.8 mm (Fig. 70) *teres*
- 2' Ventral margins of foretibia each with 5 moveable spines; ovipositor >4.0 mm 3
- 3 Outer and inner ventral margins of hindfemur with about 4 and 1 spines, respectively; dorsal margins of hindtibia usually with <25 spines; in ventral view incision of emargination of male subgenital plate >1/2 length of plate (Fig. 44); distal half of ovipositor broad, not significantly more narrow than basal half (Fig. 71); female subgenital plate as in Fig. 80 *celerincta*
- 3' Outer and inner ventral margins of hindfemur with about 10 and 4 spines, respectively; dorsal margins of hindtibia usually with >25 spines; in ventral view incision of emargination of male subgenital plate <1/2 length of plate; combination of female characters not as above 4
- 4 Male tenth tergite bilobed, with each lobe in turn being bilobed (Fig. 7); head about as long as wide; L/W of pronotum ≤1.9; ovipositor very long, >50 mm, apical half narrow and weakly up-curved (Fig. 72) *chrysopoides*

- 4' Male tenth tergite truncate, apically unmodified; head longer than wide; L/W of pronotum ≥ 2.2 ; female unknown *gracila*
- 5 Innerventral margin of forefemur with 5 spines; large, slender species with elongated forelegs (> 6 mm) and pronotum (> 4 mm); male with metazona greatly inflated (Fig. 1); apical half of ovipositor broad, not significantly more narrow than basal half (Fig. 68); female subgenital plate as in Fig. 78 *bullatinotum*
- 5' Inner ventral margin of forefemur with 4 spines; smaller species with shorter forelegs (< 4 mm) and pronotum (< 4 mm); male with metazona at most weakly inflated (Fig. 2); combination of female characters not as above 6
- 6 Outer ventral margin of forefemur with 2 spines 7
- 6' Outer ventral margin of forefemur with 3 to 4 spines 9
- 7 Male tegmen lacking black bands on anal margin behind stridulatory field; female tegmen with a single black band arising at base of anal margin; male cercus greatly elongated, cylindrical, tapering apically (Fig. 27); female cercus long and narrow and ovipositor as in Fig. 73; female subgenital plate as in Fig. 82 *stigmata*
- 7' Male tegmen with one black band on anal margin behind stridulatory field; female tegmen with two black bands along basal half of anal margin; male cercus short, with apex bilobed, lateral apical lobe apically pointed, median preapical lobe broad apically rounded; combination of female characters not as above 8
- 8' Apex of male cercus with median lobe extending away from lateral lobe, resembling an opened crab claw (Fig. 25); female subgenital plate as in Fig. 81 *bimaculata*
- 8' Apex of male cercus with median lobe closely adherent to lateral lobe, resembling a closed crab claw (Fig. 26); female similar to *P. bimaculata* *bimaculoides*
- 9 Outer ventral margin of forefemur with 4 spines 10
- 9' Outer ventral margin of forefemur with 3 spines 11
- 10 Ventral margins of hindfemur with 6 to 11 preapical spines in both sexes; male cercus short, stout, with 2 sharp apical teeth and one rounded preapical lobe (Fig. 28) *orioni*
- 10' Ventral margins of hindfemur with 0-2 preapical spines in both sexes; male cercus elongated, gradually upcurved, apically armed with a cluster of setiform spines (Fig. 29) *lewisei*
- 11 Male subgenital plate with 2 true articulating styles 12
- 11' Male subgenital plate with 2 non-articulating lobes divided by a deep medial apical emargination 14
- 12 Short-winged species, with tegmina and hind wings extending only to apex of abdomen (δ) or shorter (♀); ventral margins of hindfemur lacking preapical spines *maculata*
- 12' Long-winged species, with tegmina and hind wings extending 3 to 6 mm beyond apex of abdomen; ventral margins of hindfemur with 3 to 11 apical spines 13
- 13 Tenth tergite of male distally constricted, then expanded into two apically rounded and diverging lobes (Fig. 10); male cercus elongated, with apical fifth expanded into a dorsally combed inflation with a preapical ventral hooked process (Figs 30, 31); outer ventral margin of midtibia with 3 spines in both sexes; female subgenital plate as in Fig. 84. *arborea*
- 13' Tenth tergite of male distally produced, apically rounded (Fig. 12); male cercus short, gradually incurved, with apex inflated into two rounded lobes (Figs 35, 36); outer ventral margin of midtibia with 2 spines; female unknown *wittmani*
- 14 Tenth tergite of male with rounded or pointed apex; females of all species unknown. 15
- 14' Tenth tergite of male with bilobed or modified bifid apex; female of 1 of 2 species with ovipositor > 5 mm (Fig. 76), female of other species unknown 16
- 15 Tenth tergite of male greatly produced distally into a chisel-shaped elongation with parallel sides and rounded apex (Figs 13, 14) *scalpra*
- 15' Tenth tergite of male moderately produced, sides gradually converging apically to a blunt point with minute teeth (Fig. 19) *convexitertina*
- 16 Apex of tenth tergite of male modified into 2 elongated bilobed processes (Figs 15, 16); cercus simple cylindrical, tapering gradually into a point *glabra*
- 16' Apex of tenth tergite of male with a broad V-shaped emargination, producing 2 triangulate lobes (Figs 17, 18) 17
- 17 Male cercus short, stout, cylindrical, apically dorsoventrally flattened and terminating as a small median tooth (Figs 37, 38); subgenital plate of male as in Figs 52, 65; ovipositor > 5 mm in length (Fig. 76); female subgenital plate as in Fig. 85 *gigantea*
- 17' Male cercus elongated, sinuate, basally cylindrical, becoming laterally flattened, recurving sharply both anteriorly and dorsally, as in Fig. 39; subgenital plate of male as in Figs 53, 66; female unknown *herculi*

Group I— Species with 5 spines on each ventral margin of forefemur: *P. bullatinotum*.

***Phlugis bullatinotum* Nickle, new species**
(Figures 1, 4, 20-21, 41, 55, 68, 78, 86)

Diagnosis.— This is the longest species of the genus, but it is also the most slender species, with greatly elongated fore- and midlegs. It differs from all other species by the presence of 5 spines on each ventral margin of the forefemur and in males by the greatly expanded metazona (somewhat less expanded in females) and arched tegmina.

Holotype.— δ . Peru: INN, Team 8.

Allotype.— ♀ . Same data as holotype.

Paratypes.— 7 δ , 7 ♀ , 3 nymphs: INN, Team 4, 1 δ ; Team 5, 1 δ ; LODGE: Team 7, 1 ♀ ; Team 8, 2 δ , 3 ♀ , 1 nymph; Team 11, 1 ♀ ; Team 24, 1 δ ; CAMP: Team 8, 1 δ ; Team 11, 1 nymph; ACEER: Team 18, 1 δ , 1 ♀ , 1 nymph; YACU: Team 16, 1 ♀ .

Description.—

Head: Narrow for genus, from above longer than wide; eyes prominent, globose to ellipsoidal, greatest length along anteroposterior axis; in side view front of face concave; ratio of width of head at compound eyes as seen in dorsal view to width of head behind eyes ranging from 1.32:1 to 1.34:1.

Thorax: Pronotum sexually dimorphic; 3.47 to 3.59 \times longer than wide in male and 2.29 to 2.36 \times longer than wide in female; metazona greatly inflated in male (Fig. 1), considerably more weakly so in female; metazonal suture dividing pronotal disc behind midpoint but anterior of posterior 1/3 of length in male and at posterior 1/5 of length in female; anterior margin weakly concave, hindmargin weakly convex; L/W pronotal disc 1.92 to 1.98 (δ), 2.30 to 2.34 (♀).

Legs: Forelegs: Femur slender, elongated, basally weakly inflated, tapering distally; L/basal W 7.3 to 8.3; both inner and outer ventral margins with 5 spines; tibia with ventral spines very long (inner spines somewhat longer than corresponding outer spines), somewhat evenly spaced, with 5 elongated spines on each margin, most basal spines arising behind tympanum. Midlegs: Femur elongated, basally weakly inflated, tapering distally, unarmed ventrally; tibia with two outer ventral spines and 0 inner ventral spines. Hindlegs: Femur L/W ca 7.8 to 8.7.

Numbers of spines on legs: Ventral margins, forefemur: inner (anterior) 5; outer (posterior) 5; midfemur inner (posterior) 0; outer (anterior) 0; hindfemur inner (posterior) 0; outer (anterior) 1. Ventral margins, foretibia: inner (anterior) 5; outer (posterior) 5; midtibia inner (posterior) 0; outer (anterior) 0 to 1; hindtibia inner (posterior) 0; outer (anterior) 0. Dorsal margins, foretibia: inner (anterior) 0; outer (posterior) 0; midtibia inner (posterior) 0; outer (anterior) 0; hindtibia inner (posterior) 23 to 33; outer (anterior) 19 to 26.

Wings: Tegmina and wings well developed, sexually dimorphic; in male, tegmina greatly arched in repose, tapering gradually posteriorly; left tegmen with thickened elevated edge behind stridulatory field; in female tegmina not arched. Tegmen in both sexes extending 3 to 5 mm beyond tip of abdomen; hind wing extending 6 to 8 mm beyond apex of tegmen. Stridulatory file of single specimen examined with 71 teeth, 1.19 mm in length (Fig. 86).

Abdomen: ♂. Tenth tergite weakly produced, apex broadly and shallowly emarginate, resulting in a shallow triangulate projection over the base of each cercus (Fig. 4). Cercus basally simple, cylindrical, apically expanded into a primary lateral lobe and a secondary, broad, flanged medial lobe (Figs 20-21). Subgenital plate basally spatulate, apex with a broad, shallow, U-shaped emargination and 2 widely spaced, elongated, ventroposteriorly-directed articulating styles (Figs 41, 55). ♀. Terminal tergite truncate. Cercus simple, cylindrical, elongated, fully 1/2 as long as ovipositor. Ovipositor robust for genus, as in Fig. 68. Subgenital plate spatulate, apically somewhat truncate (Fig. 78).

Color: Uniform light chartreuse green *in vivo*, light green to tan in preserved specimens, with well defined post-ocular greenish bands present on all specimens (including faded preserved specimens); a creamy whitish green band extending full length of median line of pronotal disc; apices of antennal annuli distinctively dark banded; tips of spines on fore- and hindlegs light brown.

Measurements.— (means, range) in mm. Total length: ♂ (n=8) 24.6, 22.8 to 26.3; ♀ (n=8) 27.9, 25.3 to 29.1; length pronotum: ♂ 4.5, 4.2 to 4.9; ♀ 4.0, 3.9 to 4.3; width pronotum: ♂ 2.3, 2.1 to 2.4; ♀ 1.7, 1.5 to 1.8; length forefemur: ♂ 6.2, 6.0 to 6.4; ♀ 6.5, 6.4 to 6.6; length midfemur: ♂ 5.8, 5.6 to 5.9; ♀ 6.3, 6.1 to 6.6; length hindfemur: ♂ 13.0, 12.5 to 13.2; ♀ 13.6, 13.3 to 13.8; width hindfemur: ♂ 1.5, 1.4 to 1.7; ♀ 1.7, 1.5 to 1.8; length tegmen: ♂ 12.9, 12.5 to 13.2; ♀ 15.3, 14.9 to 15.6; width tegmen: ♂ 2.2, 2.0 to 2.4; ♀ 2.1, 1.8 to 2.2; eye length: ♂ 1.2, 1.1 to 1.4; ♀ 1.3, 1.1 to 1.4; eye width: ♂ 0.8, 0.7 to 0.9; ♀ 0.9, 0.8 to 1.0; eye depth: ♂ 1.0, 0.9 to 1.1; ♀ 1.0, 0.9 to 1.2; length ovipositor: 4.7, 4.2 to 4.8.

Etymology.— noun (Latin) *bullatus* — inflated, and *notum* — shield, referring to the inflated metanotum found only on this species.

Group II— Species with 4 spines on each ventral margin of forefemur: *P. lewisi* and *P. orioni*.

***Phlugis lewisi* Nickle, new species**
(Figures 29, 74)

Diagnosis.— This species is most similar to *P. orioni*, both having 4 spines on each ventral margin of the forefemur. Differing from *P. orioni* in the shape of the male cercus and shape of female subgenital plate.

Holotype.— ♂. Peru: LODGE. Team 22. Fogging site 7.

Allotype.— ♀. Same data as holotype.

Paratypes.— 1 ♂, 1 ♀. Same data as holotype.

Description.—

Head: Moderately broad for genus, from above wider than long. Eyes prominent, globose, only slightly longer than deep. Ratio of width of head at compound eyes as seen in dorsal view to width of head behind eyes *ca* 1.24:1 (♂) to 1.28:1 (♀).

Thorax: Pronotum 2.2 to 2.9× longer than wide; metazona of male weakly inflated, that of female not inflated; metazonal suture dividing pronotal disc at just posterior to midpoint in male and at posterior 1/3 of pronotal length in female; anterior margin truncate, hindmargin weakly convex; L/W pronotal disc 1.7 to 1.9.

Legs: Genicular lobes of all legs unarmed. Forelegs: Femur basally weakly inflated, tapering distally; L/basal W 5.4 to 5.9; inner ventral margin with 4 spines, outer ventral margin with 4 spines; tibia with ventral spines long (inner spines somewhat longer than corresponding outer spines), somewhat evenly spaced, with 5 spines on each margin, most basal spines arising behind tympanum. Midlegs: Femur basally inflated, tapering distally, unarmed ventrally; tibia with 2 outer ventral spines and 0 inner ventral spines. Hindlegs: Femur L/W *ca* 6.7 to 7.0, ventral margins usually unarmed. Tibia unarmed ventrally.

Numbers of spines on legs: Ventral margins, forefemur: inner (anterior) 4; outer (posterior) 4; midfemur inner (posterior) 0; outer (anterior) 0; hindfemur inner (posterior) 0 to 1; outer (anterior) 0. Ventral margins, foretibia: inner (anterior) 5; outer (posterior) 5; midtibia inner (posterior) 0; outer (anterior) 2; hindtibia inner (posterior) 0; outer (anterior) 0. Dorsal margins, foretibia: inner (anterior) 0; outer (posterior) 0; midtibia inner (posterior) 0; outer (anterior) 0; hindtibia inner (posterior) 25 to 30; outer (anterior) 22 to 26.

Wings: Tegmina and wings well developed; tegmen extending 2 to 4 mm beyond tip of abdomen; hind wing extending 4 to 6 mm beyond apex of tegmen. Stridulatory file not examined.

Abdomen: ♂. Tenth tergite distally produced, apically bilobed. Cercus elongated, recurved dorso-medially along its length, with lateral margin gradually expanded just beyond midpoint into an expanded tooth; cercus becoming flattened from tooth area to preapex, then becoming rounded in cross-section to apex; apex with a cluster of small, pigmented setiform teeth (Fig. 29). Subgenital plate damaged and distorted in both holotype and paratype, but appearing to be spatulate basally, narrowing distally with 2 elongated articulating true styles. ♀. Terminal tergite truncate. Cercus short, cylindrical less than 1/2 as long as ovipositor. Distal half of ovipositor slender, elongated for genus, as in Fig. 74. Subgenital plate spatulate, apically rounded with a shallow U-shaped emargination.

Color: Uniform light chartreuse green *in vivo*, light green to tan in preserved specimens.

Measurements.— in mm. Total length: ♂ (n=2) 21.6, 21.4 to 21.9; ♀ (n=2) 23.7, 23.6 to 23.8; length pronotum: ♂ 3.61, 3.6 to 3.7; ♀ 3.3, 3.3 to 3.4; width pronotum: ♂ 2.0, 1.9 to 2.1; ♀ 1.8, 1.7 to 1.8; length forefemur: ♂ 4.0, 3.9 to 4.1; ♀ 4.0, 4.0 to 4.1; length midfemur: ♂ 4.3, 4.2 to 4.4; ♀ 4.6, 4.5 to 4.7; length hindfemur: ♂ 11.1, 10.8 to 11.4; ♀ NA; width hindfemur: ♂ 1.6, 1.6; ♀ NA; length tegmen: ♂ 12.2, 12.0 to 12.3; ♀ 13.7, 13.4 to 13.9; width tegmen: ♂ 1.7, 1.6 to 1.8; ♀ 1.8, 1.7 to 1.8; eye length: ♂ 1.4, 1.3 to 1.4; ♀ 1.4, 1.3 to 1.4; eye width: ♂ 0.8, 0.8; ♀ 0.8, 0.8 to 0.9; eye depth: ♂ 0.9, 0.9 to 1.0; ♀ 0.9, 0.9 to 1.0; length ovipositor: 5.3, 5.2 to 5.5.

Etymology.— A patronym, for Dr. Jon A. (Buck) Lewis, one of my trusted staff members, in appreciation of his dedication to the project and of his friendship under harsher conditions when we were on the northern border of Peru in an earlier expedition with the Smithsonian Institution.

Phlugis orioni Nickle, new species

(Figures 28, 47, 62)

Diagnosis.— Based on numbers of spines on the ventral margins of the forefemur (4 inner, 4 outer), this species is most similar to *P. lewisi*. Male cerci of both species, however, are distinctive (cf Figs. 28, 29). Females are indistinguishable and are associated with conspecific males on the basis of collection proximity.

Holotype.— ♂. Peru: INN. Team 15.

Allotype.— ♀. LODGE. Team 15.

Paratypes.— 1 ♀. LODGE: Team 22. Fogging site 7, secondary. 1 ♀.

Description.—

Head: Narrow for genus, from above longer than wide. Eyes prominent, ellipsoidal. In side view front of face concave. Ratio of width of head at compound eyes as seen in dorsal view to width of head behind eyes *ca* 1.34:1.

Thorax: Pronotum 2.7 to 3.0× longer than wide; metazona not inflated in either sex; metazonal suture dividing pronotal disc at posterior 1/3 of length; anterior margin truncate, hindmargin weakly convex; L/W pronotal disc 2.04 to 2.17.

Legs: Forelegs: Femur relatively long, slender, basally weakly inflated, tapering distally; L/basal W 5.4 to 5.5; both inner and outer ventral margins with 4 spines; tibia with ventral spines long (inner spines somewhat longer than corresponding outer spines), somewhat evenly spaced, with 5 spines on each margin, most basal spines arising behind tympanum. Midlegs: Femur basally weakly inflated, tapering distally, unarmed ventrally; tibia with 2 outer ventral spines and 0 inner ventral spines. Hindlegs: Femur L/W *ca* 5.7 to 6.1; armed ventrally with 6 to 8 inner and 9 to 11 outer ventral spines; tibia unarmed ventrally but with 19 to 22 spines on inner dorsal margin and 21 to 23 on outer dorsal margin.

Numbers of spines on legs: Ventral margins, forefemur: inner (anterior) 4; outer (posterior) 4; midfemur inner (posterior) 0; outer (anterior) 0; hindfemur inner (posterior) 6-8; outer (anterior) 9-11. Ventral margins, foretibia: inner (anterior) 5; outer (posterior) 5; midtibia inner (posterior) 0; outer (anterior) 2; hindtibia inner (posterior) 0; outer (anterior) 0. Dorsal margins, foretibia: inner (anterior) 0; outer (posterior) 0; midtibia inner (posterior) 0; outer (anterior) 0; hindtibia inner (posterior) 19 to 22; outer (anterior) 21 to 23.

Wings: Tegmina and wings well developed; tegmen extending 3 to 5 mm beyond tip of abdomen; hind wing extending 3 to 4 mm beyond apex of tegmen. Stridulatory file not examined.

Abdomen: ♂. Tenth tergite weakly produced, with a shallow medioapical U-shaped emargination. Cercus simple, stout, cylindrical, apically terminating as 3 closely adherent lobes: 2 lobes dark pigmented, flattened, apically sharp and 1 lobe unpigmented, rounded, apically blunt (Fig. 28). Subgenital plate spatulate, narrowing gradually distally, apical margin with a shallow U-shaped emargination bordered on each side with 2 elongated articulating styles (Figs 47, 62). ♀. Terminal tergite weakly produced, apically truncate. Cercus simple, cylindrical, less than 1/2 as long as ovipositor. Distal half of ovipositor slender, elongated for genus. Subgenital plate spatulate, elongated, tapering gradually distally, apex with a minute U-shaped emargination.

Color: Uniform light chartreuse green *in vivo*, light green to tan in preserved specimens, with no well defined darkly pigmented structures.

Measurements.— in mm. Total length: ♂ (n=1) 21.6, 21.4 to 21.9; ♀ (n=2) 23.7, 23.6 to 23.8; length pronotum: ♂ 3.61, 3.6 to 3.7; ♀ 3.3, 3.3 to 3.4; width pronotum: ♂ 2.0, 1.9 to 2.1; ♀ 1.8, 1.7 to 1.8; length forefemur: ♂ 4.0, 3.9 to 4.1; ♀ 4.0, 4.0 to 4.1; length midfemur: ♂ 4.3, 4.2 to 4.4; ♀ 4.6, 4.5 to 4.7; length hindfemur: ♂ 11.1, 10.8 to 11.4; ♀ NA; width hindfemur: ♂ 1.6, 1.6; ♀ NA; length tegmen: ♂ 12.2, 12.0 to 12.3; ♀ 13.7, 13.4 to 13.9; width tegmen: ♂ 1.7, 1.6 to 1.8; ♀ 1.8, 1.7 to 1.8; eye length: ♂ 1.4, 1.3 to 1.4; ♀ 1.4, 1.3 to 1.4; eye width: ♂ 0.8, 0.8; ♀ 0.8, 0.8 to 0.9; eye depth: ♂ 0.9, 0.9 to 1.0; ♀ 0.9, 0.9 to 1.0; length ovipositor: 5.3, 5.2 to 5.5.

Etymology.— A patronym for Orion, the mythological hunter placed into the night sky by the goddess Artemis.

Group III— Species with 3 inner and 4 outer ventral spines on forefemur: *P. chrysopoides*, *P. celerinicta*, *P. gracila*, *P. teres*.

Phlugis celerinicta Nickle, new species

(Figures 2, 3, 5, 24, 44, 58, 71, 80, 87)

Diagnosis.— Most similar to *P. teres*, differing from it in following characters: 5 (instead of 4) spines on each ventral margin of foretibia, longer male cercus, forelegs more elongated, and greater depth of apical incision of male subgenital plate.

Holotype.— ♂. Peru: LODGE. Team 13.

Allotype.— ♀. LODGE. Team 19.

Paratypes.— 12 ♂♂, 20 ♀♀: LODGE: Team 1, 1 ♂, 1 ♀; Team 3, 1 ♀; Team 5, 1 ♂; Team 7, 1 ♀; Team 8, 2 ♂♂, 3 ♀♀; Team 9, 1 ♀; Team 13, 2 ♂♂, 1 ♀; Team 14, 1 ♀; Team 17, 1 ♂, 1 ♀; Team 19, 2 ♀♀; Team 20, 1 ♂, 3 ♀♀; Team 21, 3 ♂♂, 2 ♀♀. INN: Team 2, 2 ♀♀; Team 3, 1 ♂; Team 5, 1 ♀.

Description.—

Head: Narrow for genus, from above longer than wide; eyes prominent, ellipsoidal; ratio of width of head at compound eyes as seen in dorsal view to width of head behind eyes *ca* 1.31:1.00.

Thorax: Pronotum 2.5 to 2.9× longer than wide; metazona very weakly inflated; metazonal suture dividing pronotal disc at posterior 1/3 of length in male and at posterior quadrant in female (Figs 2-3); anterior margin weakly concave, hindmargin weakly convex; L/W pronotal disc 1.97 to 2.22.

Legs: Forelegs: Femur relatively long, slender, basally weakly inflated, tapering distally; L/basal W 6.84 to 7.29; tibia with ventral spines long (inner spines somewhat longer than corresponding outer spines), somewhat evenly spaced, with 5 spines on each margin, most basal spines arising behind tympanum. Midlegs: Femur basally weakly inflated, tapering distally, unarmed ventrally; tibia with 2 outer ventral spines and 0 inner ventral spines. Hindlegs: Femur L/W *ca* 7.7 to 8.1.

Numbers of spines on legs: Ventral margins, forefemur: inner (anterior) 3; outer (posterior) 4; midfemur inner (posterior) 0; outer (anterior) 0; hindfemur inner (posterior) 0 to 1; outer (anterior) 2 to 5. Ventral margins, foretibia: inner (anterior) 5; outer (posterior) 5; midtibia inner (posterior) 0; outer (anterior) 2; hindtibia inner (posterior) 0; outer (anterior) 0. Dorsal margins, foretibia: inner (anterior) 0; outer (posterior) 0; midtibia inner (posterior) 0; outer (anterior) 0.

(anterior) 0; hindtibia inner (posterior) 20 to 25; outer (anterior) 16 to 20.

Wings: Tegmina and wings well developed; tegmen extending 4 to 7 mm beyond tip of abdomen; hind wing extending 5 to 6 mm beyond apex of tegmen. Stridulatory file of single specimen examined with 62 teeth, 1.23 mm in length (Fig. 87).

Abdomen: ♂. Tenth tergite weakly produced distally, medially cleft with inner margins recoiling beneath ventral surface (Fig. 4). Cercus simple, cylindrical, without additional lobes, less than 1/2 length of subgenital plate (Fig. 24). Subgenital plate basally spatulate, tapering posteriorly and very elongated, medially deeply incised from basal third of its overall length to apex, forming two non-articulating, closely appressed pseudostyles (Fig. 44); in lateral view ventral margin of distal half and dorsal margin of distal 1/3 gradually inflated (Fig. 58). ♀. Terminal tergite truncate. Cercus short, cylindrical less than 1/2 as long as ovipositor. Ovipositor robust, as in Fig. 71. Subgenital plate spatulate, apically rounded (Fig. 80).

Color: Uniform light chartreuse green *in vivo*, light green to tan in preserved specimens. Apices of antennal annuli distinctively dark banded. Hind tarsi dark brown. Tips of spines on fore- and hindlegs light brown.

Measurements.— in mm. Total length: ♂ (n=10) 22.1, 20.9 to 23.3; ♀ (n=10) 24.8, 22.2 to 25.9; length pronotum: ♂ 3.7, 3.5 to 3.9; ♀ 3.6, 3.3 to 3.9; width pronotum: ♂ 1.9, 1.7 to 2.1; ♀ 1.6, 1.5 to 1.8; length forefemur: ♂ 5.0, 4.7 to 5.2; ♀ 5.4, 5.0 to 5.7; length midfemur: ♂ 5.1, 5.0 to 5.3; ♀ 5.3, 5.1 to 5.6; length hindfemur: ♂ 12.0, 11.8 to 12.4; ♀ 12.2, 12.0 to 12.4; width hindfemur: ♂ 1.6, 1.5 to 1.9; ♀ 1.5, 1.3 to 2.0; length tegmen: ♂ 12.5, 12.4 to 12.6; ♀ 14.7, 13.1 to 14.9; width tegmen: ♂ 1.7, 1.6 to 1.8; ♀ 2.4, 1.8 to 2.6; eye length: ♂ 1.2, 1.1 to 1.3; ♀ 1.3, 1.1 to 1.5; eye width: ♂ 0.7, 0.6 to 0.9; ♀ 0.9, 0.7 to 1.1; eye depth: ♂ 0.9, 0.7 to 1.1; ♀ 1.0, 0.9 to 1.3; length ovipositor: 4.6, 4.1 to 4.7.

Etymology.— (Latin) adjective, *celer* – swift, and *nictus* – a winking, “quick as a wink”, referring to this species’ quick movements in avoiding capture when spotted during the day.

***Phlugis chrysopoides* Nickle, new species**
(Figures 7, 60, 72; [*P. chrysopa*: 88])

Diagnosis.— Slender species with narrow elongated head. Most similar to *P. teres*, *P. chrysopa* (a Central American species), *P. celerinicta*, and *P. gracila* by having 3 inner and 4 outer ventral spines on forefemur. Differing from these primarily in shape of male subgenital plate (Fig. 60, *cf* Figs 57-59). Morphologically most similar to *P. chrysopa*, the two species differing in degree of development of apical lobes of male tenth tergite (Figs 6, 7), male subgenital plate (*cf* Figs 59, 60), and ovipositor (*cf* Figs 72, 77).

Holotype.— ♂. PERU: CAMP. Team 20.

Allotype.— ♀. PERU: LODGE. Team 24. Fogging site 2.

Description.—

Head: Narrow for genus, from above, longer than wide; eyes prominent, ellipsoidal, greatest length along anteroposterior axis; ratio of width of head at compound eyes as seen in dorsal view to width of head behind compound eyes 1.26:1 to 1.40:1.

Thorax: Pronotum 2.33 to 2.51× longer than wide; metazona of pronotum very weakly inflated; metazonal suture located at about posterior third of pronotal disc; anterior margin of pronotal disc weakly concave, hindmargin convex; L/W pronotal disc 1.82 to 1.85.

Legs: Forelegs: Femur short, basally weakly inflated, tapering distally; L/W 4.80; tibia with 5 spines on each margin. Midlegs: Femur basally weakly inflated, tapering distally, unarmed ventrally. Hindlegs: Femur L/W *ca* 6.23.

Numbers of spines on legs: Ventral margins, forefemur: inner (anterior) 3; outer (posterior) 4; midfemur inner (posterior) 0; outer (anterior) 0; hindfemur inner (posterior) 3 to 5; outer (anterior) 9 to 11. Ventral margins, foretibia: inner (anterior) 5; outer (posterior) 5; midtibia inner (posterior) 0; outer (anterior) 2; hindtibia inner (posterior) 0; outer (anterior) 0. Dorsal margins, hindtibia: inner (posterior) 28 to 29; outer (anterior) 27 to 29.

Wings: Tegmina and wings elongated, tegmen extending *ca* 3 to 6 mm beyond apex of abdomen, hind wing extending 3 to 6 mm beyond apex of tegmen. Stridulatory file not examined in unique male specimen, but in related species *P. chrysopa* a single specimen was examined with 37 teeth, 0.49 mm in length (Fig. 88).

Abdomen: ♂. Tenth tergite weakly produced, strongly declivent, apically medially cleft, with 2 well developed bilobe projections encircling cerci (Fig. 7, *cf* Fig. 6). Cercus simple, cylindrical, lacking modifications, tapering gradually, its total length *ca* half of that of subgenital plate. Subgenital plate elongated, spatulate, apically medially narrowly emarginate 1/3 of length, producing 2 laterally flattened triangulate lobes, and with a ventral median keel expanding just anterior of emargination; in lateral view, dorsal margin of expanded lobe with a broadened tooth (Fig. 60, *cf* Fig. 59). ♀. Terminal tergite truncate. Ovipositor elongated, apical half narrow, weakly upurved along its length (Fig. 72). Cerci nearly half as long as ovipositor.

Color: Uniformly light chartreuse green *in vivo*, light green to tan in preserved specimens. Apices of spines on legs light brown.

Measurements.— (in mm). Total length: ♂ (n=1) 21.64; ♀ (n=1) 19.39; length pronotum: ♂ 3.19; ♀ 3.16; width pronotum: ♂ 1.72; ♀ 1.74; length forefemur: ♂ 3.24; ♀ 3.36; length midfemur: ♂ 3.85; ♀ 3.87; length hindfemur: ♂ 9.65; ♀ NA; width hindfemur: ♂ 1.55; ♀ NA; length tegmen: ♂ 12.31; ♀ 12.38; width tegmen: ♂ 1.60; ♀ 1.78; eye length: ♂ 1.14; ♀ 1.38; eye width: ♂ 0.76; ♀ 0.85; eye depth: ♂ 0.86; ♀ 1.11; length ovipositor: 5.12

Etymology.— (Latin), noun, — *oides* — similar to, like, referring to resemblance of this species to the Central American species *P. chrysopa*.

***Phlugis gracila* Nickle, new species**
(Figures 22, 42, 56)

Diagnosis.— Slender, elongated species with narrow elongated head. Most similar to *P. teres*, *P. celerinicta*, and *P. chrysopoides* by having 3 inner and 4 outer ventral spines on forefemur. Differing from these primarily in shape of male subgenital plate (Figs 42, 56).

Holotype.— ♂. PERU: INN. Team 4. Known only from holotype.

Description.—

Head: Narrow for genus, from above, longer than wide; eyes prominent, ellipsoidal, greatest length along anteroposterior axis; ratio of width of head at compound eyes as seen in dorsal view to width of head behind compound eyes 1.58:1.

Thorax: Pronotum 2.76× longer than wide; metazona of pronotum very weakly inflated; metazonal suture located at about posterior third of pronotal disc; anterior margin of pronotal disc weakly concave, hindmargin convex; L/W pronotal disc 2.25.

Legs: Forelegs: Femur basally weakly inflated, tapering distally;

L/W 5.61; tibia with 5 spines on each margin. Midlegs: Femur basally weakly inflated, tapering distally, unarmed ventrally. Hindlegs: Femur L/W *ca* 7.2.

Numbers of spines on legs: Ventral margins, forefemur: inner (anterior) 3; outer (posterior) 4; midfemur inner (posterior) 0; outer (anterior) 0; hindfemur inner (posterior) 3 to 5; outer (anterior) 10 to 11. Ventral margins, foretibia: inner (anterior) 5; outer (posterior) 5; midtibia inner (posterior) 0; outer (anterior) 2; hindtibia inner (posterior) 0; outer (anterior) 0. Dorsal margins, hindtibia: inner (posterior) 28 to 29; outer (anterior) 27 to 29.

Wings: Tegmina and wings greatly elongated, tegmen extending *ca* 3 mm beyond apex of abdomen, hind wing extending 6 mm beyond apex of tegmen. Stridulatory file not examined in unique male specimen.

Abdomen: ♂. Tenth tergite weakly produced, apically medially cleft, with medial edges deflected ventrally. Cercus simple, cylindrical, lacking modifications, tapering gradually, its total length *ca* half of that of subgenital plate (Fig. 22). Subgenital plate elongated, spatulate, apically medially narrowly emarginate 1/3 of length, and with a ventral median keel expanding just anterior of emargination (Fig. 42); in lateral view, basal third of each dorsolateral margin expanded as a small broadened tooth, posterior third expanded into a complex, apically bilobed inflation, its dorsal margin convex terminating anteriorly in a well developed blunt tooth (Fig. 56). ♀. Unknown.

Color: Uniformly light chartreuse green *in vivo*, light green to tan in preserved specimens. Apices of spines on legs light brown.

Measurements.—(in mm). Total length: 27.10; length pronotum: 3.67; width pronotum: 1.33; length forefemur: 3.90; length midfemur: 4.52; length hindfemur: 11.72; width hindfemur: 1.62; length tegmen: 15.31; width tegmen: 1.68; eye length: 1.28; eye width: 0.76; eye depth: 0.99; head width: 1.81.

Etymology.—(Latin), adjective, *gracila* – thin, slender, referring to the elongated, narrow habitus of this species.

Phlugis teres (DeGeer 1773)
(Figures 23, 43, 57, 70, 79)

Diagnosis.—Slender, elongated species with narrow elongated head. Most similar to *P. gracila*, *P. celerinicta*, and *P. chrysopoides* by having 3 inner and 4 outer ventral spines on forefemur. Differing from other species herein described by having 4 spines on inner and 4 spines on outer ventral margins of foretibia, compared with 5 on each. Differing from *P. gracila*, *P. celerinicta*, and *P. chrysopoides* primarily in shape of male subgenital plate (Figs 43, 57).

Specimens examined.—2 ♂♂, 3 ♀♀, 1 nymph: Peru: INN, Team 1. 1 ♂, 1 ♀; LODGE, Team 16, 1 ♂, 2 ♀♀; ACEER, Team 18, 1 nymph.

Redescription.—

Head: Similar to *P. gracila*, except in size and eyes being less antero-posteriorly elongated; ratio of width of head at compound eyes as seen in dorsal view to width of head behind compound eyes 2.88:1 to 2.93:1.

Thorax: Pronotum 2.10-2.15× longer than wide; metazona slightly inflated in male, not inflated in female; metazonal suture dividing pronotum just posterior to midpoint; anterior margin weakly truncate, hindmargin convex; L/W pronotal disc 1.71 to 1.75.

Legs: Forelegs: Femur elongated, basally weakly inflated, tapering distally; L/W 4.78 to 4.89; tympana fully exposed; tibia with only 4 spines on each margin, most basal spines arising behind tympanum. Midlegs: Femur basally weakly inflated, tapering distally, unarmed ventrally. Hindlegs: Femur L/W *ca* 5.75 to 5.82.

Numbers of spines on legs: [both sexes] Ventral margins, forefemur: inner (anterior) 3; outer (posterior) 4; midfemur inner (posterior) 0; outer (anterior) 0; hindfemur inner (posterior) 4 to 8; outer (anterior) 5 to 11. Ventral margins, foretibia: inner (anterior) 4; outer (posterior) 4; midtibia inner (posterior) 1 to 2; outer (anterior) 2; hindtibia inner (posterior) 0; outer (anterior) 0. Dorsal margins, foretibia: inner (anterior) 0; outer (posterior) 0; midtibia inner (posterior) 0; outer (anterior) 0; hindtibia inner (posterior) 21 to 25; outer (anterior) 24 to 26.

Wings: Tegmina and wings well developed; tegmen extending 4 to 5 mm beyond apex of abdomen; hind wings extending *ca* 5 mm beyond apex of tegmen. Stridulatory file not examined.

Abdomen: ♂. Tenth tergite produced distally, apically bilobed. Cercus simple, cylindrical, without additional lobes, less than 1/4 total length of subgenital plate (Fig. 23). Subgenital plate spatulate, elongated, apically deeply incised nearly to 1/2 of total length of subgenital plate (Fig. 43); in lateral view, greatly elongated, sinuate, keel on ventral margin expanded basally and at midpoint (Fig. 57). ♀. Tenth tergite produced, apically bilobed. Cercus short, cylindrical, about 1/3 as long as ovipositor. Ovipositor short, robust for genus, as in Fig. 70. Subgenital plate apically rounded (Fig. 79).

Color: Uniform light chartreuse green *in vivo*, light green to tan in preserved specimens. Compound eyes uniformly green *in vivo*. Light brown apices of spines on hindlegs only.

Measurements.—(means, range) in mm. Total length: ♂ (n=2) 21.8, 20.2 to 22.2; ♀ (n=2) 22.3, 22.1 to 23.1; length pronotum: ♂ 2.9, 2.7 to 3.0; ♀ 3.0, 2.9 to 3.1; width pronotum: ♂ 1.8, 1.7 to 2.0; ♀ 1.7, 1.4 to 1.9; length forefemur: ♂ 3.4, 3.0 to 3.6; length midfemur: ♂ 3.8, 3.5 to 3.9; ♀ 4.1, 3.9 to 4.3; length hindfemur: ♂ 10.3, 10.0 to 10.4; ♀ 10.7, 10.3 to 11.1; width hindfemur: ♂ 1.7, 1.6 to 1.9; ♀ 1.7, 1.6 to 2.1; length tegmen: ♂ 12.2, 12.1 to 12.4; ♀ 14.3, 13.8 to 14.2; width tegmen: ♂ 1.6, 1.4 to 1.9; ♀ 1.7, 1.6 to 1.8; eye length: ♂ 1.3, 1.3 to 1.5; ♀ 1.2, 1.1 to 1.4; eye width: ♂ 0.8, 0.7 to 0.9; ♀ 0.8, 0.7 to 0.9; eye depth: ♂ 0.8, 0.8 to 0.9; ♀ 0.8, 0.7 to 1.0; length ovipositor: 3.4, 3.2 to 3.7.

Group IV— Species with 4 inner and 2 outer spines on ventral margins of forefemur: *P. bimaculata*, *P. bimaculoides*, *P. stigmata*.

Phlugis bimaculata Nickle, new species
(Figures 8, 25, 45, 61, 73, 81)

Diagnosis.—Macropterous but shorter-winged species, with distinctive color patterns. Most similar to *P. bimaculoides* and *P. stigmata* by having 4 inner and 2 outer ventral spines on forefemur. Differing from these primarily in shapes of male cerci (*cf* Figs 25-27) and color patterns on the tegminal margins.

Holotype.—♂. Peru: LODGE. Team 22. Fogging site 2.

Allotype.—♀. LODGE. Team 22. Fogging site 5.

Paratypes.—11 ♂♂, 10 ♀♀: LODGE: Team 21, 2 ♂♂, 1 ♀; Team 22, Fogging sites 2, 3, 4, 5, 6, 7, 7 (secondary), 8 ♂♂, 7 ♀♀; Team 23, Fogging site 13, 1 ♀; Team 24, Fogging site 3 (secondary), 1 ♂.

Description. — **Head:** Moderately broad for genus, from above wider than long. Eyes prominent, globose, only slightly longer than deep. Ratio of width of head at compound eyes as seen in dorsal view to width of head behind eyes *ca* 1.38:1 (♂) to 1.40:1 (♀).

Thorax: Pronotum 2.2 to 2.4× longer than wide; metazona of male moderately inflated, that of female not inflated; metazonal suture dividing pronotal disc at posterior 3/5 of pronotal length in male and at posterior 1/3 in female; anterior margin weakly concave, hindmargin convex; L/W pronotal disc *ca* 1.7.

Legs: Forelegs: Femur relatively short, robust, basally weakly inflated, tapering distally; L/basal W *ca* 4.5 to 4.8; inner ventral margin with 4 spines, outer ventral margin with 2 spines; tibia with 5 spines on each margin, most basal spines arising behind tympanum. Midlegs: Femur short, robust, basal half inflated, tapering distally, unarmed ventrally; tibia with 2 large outer ventral spines and 0 inner ventral spines. Hindlegs: Femur L/W *ca* 5.7.

Numbers of spines on legs: Ventral margins, forefemur: inner (anterior) 4; outer (posterior) 2; midfemur inner (posterior) 0; outer (anterior) 0; hindfemur inner (posterior) 0; outer (anterior) 0. Ventral margins, foretibia: inner (anterior) 5; outer (posterior) 5; midtibia inner (posterior) 0; outer (anterior) 2; hindtibia inner (posterior) 0; outer (anterior) 0. Dorsal margins, foretibia: inner (anterior) 0; outer (posterior) 0; midtibia inner (posterior) 0; outer (anterior) 0; hindtibia inner (posterior) 26 to 33; outer (anterior) 26 to 32.

Wings: Macropterous, but tegmina and hind wings extending only to about apex of terminal abdominal tergites; hind wing extending only about 1 to 2 mm apex of tegmen. Stridulatory file not examined.

Abdomen: ♂. Posterior margin of tenth tergite with a broad, apical U-shaped emargination, producing two triangulate lobes (Fig. 8). Cercus complex in structure, consisting of 3 lobes: apex claw-like, with an apical brown or black pigmented pointed lateral lobe and a smaller unpigmented apically rounded median lobe, and on median ventral margin near base of cercus, a broad, dorso-ventrally flattened, apically convex lobe (Fig. 25). Subgenital plate basally broad, spatulate, with a shallow apical V-shaped emargination, and two elongated, apically expanded true styles (Figs 45, 61).

♀. Terminal tergite weakly produced, apically truncate. Cercus elongated, slender, cylindrical, about 1/2 as long as ovipositor. Ovipositor elongated, distal half slender, in lateral view as in Fig. 73. Subgenital plate spatulate, apically bilobed and rounded, with a smaller rounded lobe on each lateral margin (Fig. 81).

Color: Light chartreuse green *in vivo*, light green to tan in preserved specimens with numerous brown markings, as follows: scape and first antennal annulus green but distal half of subsequent annuli light brown; lateral face of foretibia, fore- and midtibial spines, and all tarsi dark brown; apical half of midtibia and most of hindtibia light castaneous brown; spines on hindtibia dark brown; anal margin of tegmen on female with 2 blackened edges, one about 2 mm in length at midregion of anal margin, the other about 1 mm in length arising at base of tegmen just behind posterior margin of pronotum; anal margin of male tegmen with only one blackened edge about 2 mm in length arising at stridulatory field and extending distally; in female apical half of ovipositor brown and tip of cercus black.

Measurements. — in mm. Total length: ♂ (n=10) 13.0, 12.3 to 13.3; ♀ (n=10) 13.9, 13.3 to 14.3; length pronotum: ♂ 3.0, 2.8 to 3.1; ♀ 3.2, 2.9 to 3.4; width pronotum: ♂ 1.6, 1.4 to 1.8; ♀ 1.9, 1.7 to 2.2; length forefemur: ♂ 3.2, 2.9 to 3.4; ♀ 3.5, 3.4 to 3.9; length midfemur: ♂ 3.8, 3.6 to 4.2; ♀ 4.0, 3.8 to 4.2; length hindfemur: ♂ 10.8, 10.4 to 10.9; ♀ 11.6, 11.2 to 11.9; width hindfemur: ♂ 1.9,

1.7 to 2.1; ♀ 2.0, 1.8 to 2.2; length tegmen: ♂ 8.9, 8.6 to 9.1; ♀ 9.7, 9.5 to 10.1; width tegmen: ♂ 1.2, 0.9 to 1.3; ♀ 1.5, 1.3 to 1.7; eye length: ♂ 1.4, 1.3 to 1.5; ♀ 1.5, 1.4 to 1.7; eye width: ♂ 0.9, 0.8 to 1.0; ♀ 1.0, 0.8 to 1.1; eye depth: ♂ 1.0, 0.9 to 1.1; ♀ 1.2, 1.1 to 1.3; length ovipositor: 5.2, 5.1 to 5.4.

Etymology. — (Latin), adjective, *bi* – two, *macula* – spot, marking, referring to the two spots that are present on the margins of the tegmina of females that first made this recognizable from other arboreal species during the course of canopy fogging.

***Phlugis bimaculoides* Nickle, new species**
(Figures 8, 26, 61, 73, 81)

Diagnosis. — This is a sibling species closely resembling *P. bimaculata*, differing from *P. bimaculata* in having 3-lobed cercus, with apical two lobes appressed not open and divergent. The female of this species is indistinguishable from that of *P. bimaculata*.

Holotype. — ♂. Peru. ACEER. Team 24.

Allotype. — ♀. CAMP. Team 22. Fogging site 10.

Description. — Similar to *P. bimaculata* in all respects, except the following:

Abdomen: ♂. Cercus complex in structure, consisting of 3 lobes: apex claw-like, with an apical brown or black pigmented pointed lateral lobe closely appressed to a smaller unpigmented apically rounded median lobe, and a broad, dorso-ventrally flattened, apically convex lobe located on median ventral margin near base of cercus (Fig. 26). Subgenital plate basally broad, spatulate, with a shallow apical V-shaped emargination, and two elongated, apically expanded true styles; base of styles more similar to that of *P. stigmata*, more widely separated than in *P. bimaculata* (*cf* Figs 45, 46). ♀. Ovipositor similar to that of *P. bimaculata* (Fig. 73). Subgenital plate as in Fig. 81.

Measurements. — (in mm). Total length: ♂ (n=1) 21.64; ♀ (n=1) 19.39; length pronotum: ♂ 3.19; ♀ 3.16; width pronotum: ♂ 1.72; ♀ 1.74; length forefemur: ♂ 3.24; ♀ 3.36; length midfemur: ♂ 3.85; ♀ 3.87; length hindfemur: ♂ 9.65; ♀ NA; width hindfemur: ♂ 1.55; ♀ NA; length tegmen: ♂ 12.31; ♀ 12.38; width tegmen: ♂ 1.60; ♀ 1.78; eye length: ♂ 1.14; ♀ 1.38; eye width: ♂ 0.76; female 0.85; eye depth: ♂ 0.86; ♀ 1.11; length ovipositor: 5.12.

Etymology. — (Latin), noun, *bi* – two, *macula* – spot, marking, *-oides*, like, similar to, referring to similarities this species shares with *P. bimaculata*.

***Phlugis stigmata* Nickle, new species**
(Figures 9, 27, 46, 73, 82)

Diagnosis. — Medium, robust katydids with tegmina concealing hind wings and extending only to tip of abdomen. A distinctive species resembling *P. bimaculata* and *P. bimaculoides*, all of which differ from other species in having 4 inner and 2 outer spines on ventral margins of forefemur. ♂. Differing from both *P. bimaculoides* and *P. bimaculatus* in having an enlarged, lanceolate, left mandible and an elongated, simple, cylindrical cercus (Fig. 27). ♀. Differing from both *P. bimaculoides* and *P. bimaculatus* by having a single black marking on anal margin of tegmen at base just behind posterior margin of pronotum.

Holotype.— ♂. PERU: LODGE. Fogging site 3. Team 22.

Allotype.— ♀. Same data as holotype.

Paratypes.— 1 ♂, 1 ♀. Same data as holotype.

Description.—

Head: Robust for species of genus, head width beneath eyes 2.4 to 3.1 mm; eyes large, tumescent; ratio of width of head at compound eyes as seen in dorsal view to width of head behind compound eyes 1.1:1 to 1.2:1; mandibles sexually dimorphic: male left mandible elongated, lanceolate, extending well beyond right margin of face from beneath labrum, causing dextral torsion of clypeus and labrum; female mandibles similar in shape, not excessively developed, concealed beneath clypeus and labrum.

Thorax: Pronotum 2.6 (♂) and 2.3 (♀) × longer than wide; L/W of disc 1.7 to 1.9; anterior margin truncate, posterior margin well rounded; in lateral view metazona weakly inflated in male, not inflated in female. Metazonal suture bisecting pronotum behind midpoint; ventral margin with a notch-like groove above prothoracic spiracle.

Legs: Forelegs: Basal 2/3 of femur inflated gradually tapering distally to apex; L/W 4.5 to 5.1; inner ventral margin with 4 spines, outer ventral margin with 2 spines. Tibia with 5 elongated ventral spines on each margin (medial spines somewhat longer than corresponding lateral spines), somewhat evenly spaced, most basal pair of spines arising behind tympanum. Midlegs: Femur basally weakly inflated, tapering distally, unarmed ventrally. Tibia with 2 spines on outer ventral margin and 0 on inner ventral margin. Hindlegs: Femur L/W 5.5 to 5.7, with 0 to 1 small preapical spine of lateral margin only. Tibia unarmed ventrally, but with 23 to 25 minute spines on each dorsal margin.

Numbers of spines on legs: Ventral margins, forefemur: inner (anterior) 4; outer (posterior) 2; midfemur inner (posterior) 0; outer (anterior) 0; hindfemur inner (posterior) 0; outer (anterior) 1. Ventral margins, foretibia: inner (anterior) 5; outer (posterior) 5; midtibia inner (posterior) 0; outer (anterior) 2; hindtibia inner (posterior) 0; outer (anterior) 0. Dorsal margins, foretibia: inner (anterior) 0; outer (posterior) 0; midtibia inner (posterior) 0; outer (anterior) 0; hindtibia inner (posterior) 23 to 25; outer (anterior) 23 to 25.

Wings: Tegmina short, in repose extending only to apex of tenth tergite (or slightly beyond) (0.2 to 2.4 mm, ♂; 0.0 to 0.5 mm, female); hind wings short, extending only 0.8 to 1.3 mm beyond apex of tegmen. Stridulatory file not examined.

Abdomen: ♂. Tenth tergite developed into two nodular, weakly declivent lobes; supra-anal plate also bilobed, nestled between two lobes of tenth tergite (Fig. 9). Cercus nearly 4X length of tenth tergite, elongated, sinuate, basally cylindrical, but becoming dorsoventrally flattened along its length, terminating apically as a narrow, laterally-directed tooth and with a short, medially-directed, dorsoventrally flattened papilliform lobe at its base near supra-anal plate (Fig. 27). Subgenital plate basally spatulate, with two well developed, dorsoventrally flattened, elongated styles with concave dorsal surfaces (Fig. 46).

♀. Tenth tergite truncate. Cercus nearly equal in length to flattened ovipositor blades, elongated, cylindrical, tapering apically to a point. Ovipositor basally inflated, blades narrow; as in Fig. 73. Subgenital plate spatulate, with a well defined medial carina, apically bilobed (Fig. 82).

Color: Light green *in vivo* (but deeper green than typical charreute green for most *Phlugis* species), light green to tan in preserved specimens. Dorsum of tegmen (in repose), distal 1/3 of hindfemur, and all of hindtibia tan. In female only, base of anal margin of left tegmen marked with a black patch.

Measurements.— in mm. Total length: ♂ (n=2) 14.5, 14.2 to 14.8; ♀ (n=2) 14.0, 13.9 to 14.1; length pronotum: ♂ 4.0, 3.7 to 4.2; ♀ 3.4, 3.3 to 3.4; width pronotum: ♂ 2.3, 2.2 to 2.3; ♀ 1.9, 1.8 to 2.0; length forefemur: ♂ 3.9, 3.7 to 4.0; ♀ 3.7, 3.6 to 3.9; length midfemur: ♂ 3.9, 3.4 to 4.5; ♀ 4.1, 4.1 to 4.2; length hindfemur: ♂ 12.0, 11.7 to 12.2; ♀ 11.5, 11.3 to 11.6; width hindfemur: ♂ 2.1, 2.1 to 2.2; ♀ 2.1, 2.0 to 2.1; length tegmen: ♂ 8.6, 8.5 to 8.7; ♀ 8.6, 8.5 to 8.7; eye length: ♂ 1.7, 1.6 to 1.8; ♀ 1.7, 1.6 to 1.7; eye width: ♂ 1.1, 1.0 to 1.1; ♀ 1.0, 1.0 to 1.1; eye depth: ♂ 1.2, 1.1 to 1.2; ♀ 1.3, 1.2 to 1.3; length ovipositor: 4.9, 4.7 to 5.0.

Etymology.— (Latin), adjective, *stigma* – mark, referring to the large single black mark on the dorsum of the tegmen in repose.

Group V— Species with 4 inner and 3 outer spines on ventral margins of forefemur: *P. arborea*, *convexiterrina*, *glabra*, *gigantea*, *hercules*, *maculata*, *scalpra*, *wittmani*.

Phlugis arborea Nickle, new species

(Figures 10, 31-32, 49, 69, 84, 89)

Diagnosis.— Based on numbers of spines on the ventral margins of the forefemur (4 inner, 3 outer), this species is most similar to *P. maculata*, *P. wittmani*, *P. scalpra*, *P. glabra*, *P. gigantea*, *P. herculi*, and *P. convexiterrina*, differing from them in having 3, instead of 2, spines on the outer ventral margin of the midtibia. Males of all of these species have different and easily recognizable cerci. Most similar in habitus to *P. gigantea*, *P. herculi*, and *P. convexiterrina*, all of which are distinctive robust in form with broad heads and short, robust forelegs.

Holotype.— ♂. Peru: INN. Team 23. Fogging site 11 (secondary), 8-12-97.

Allotype.— ♀. LODGE. Team 22. Fogging site 6.

Paratypes.— 10 ♂♂, 4 ♀♀, 1 nymph. INN, on trail at ground level, Team 22, 1 ♂; CAMP, Fogging site 2, Team 21, 1 ♂, 1 nymph; ACEER, Fogging site 19, Team 23, 1 ♂; LODGE, Fogging sites 3 and 7, Team 22, 5 ♂♂, 2 ♀♀; Fogging site 13, Team 23, 1 ♀; Fogging site 11, Team 24, 2 ♂♂, 1 ♀.

Description.—

Head: Large tumescent eyes rising above dorsum of head and extending forward of facial plane; with a well defined broad reddish band circum-orbiting above anteroposterior axis; in dorsal view ratio of width of head at compound eyes to width of head behind compound eyes 1.15 to 1.25.

Thorax: Pronotum 2.3 to 2.5 × longer than wide; metazonal suture bisecting pronotum at midpoint; anterior margin weakly concave, hindmargin convex; L/W pronotal disc 1.6 to 1.7.

Legs: Forelegs: Femur basally weakly inflated, tapering distally; median L/W 4.3 to 4.5; tibia with 5 spines on each margin, most basal spines arising behind tympanum. Midlegs: Femur basally weakly inflated, tapering distally, unarmed ventrally; tibia with 3 ventral spines on outer margin only. Hindlegs: Femur L/W ca 5.5.

Numbers of spines on legs: Ventral margins, forefemur: inner (anterior) 4; outer (posterior) 3; midfemur inner (posterior) 0; outer (anterior) 0; hindfemur inner (posterior) 3 to 5; outer (anterior) 4 to 9. Ventral margins, foretibia: inner (anterior) 5; outer (posterior) 5; midtibia inner (posterior) 0; outer (anterior) 3; hindtibia inner (posterior) 0; outer (anterior) 0. Dorsal margins, foretibia: inner (anterior) 0; outer (posterior) 0; midtibia inner (posterior) 0; outer (anterior)

0; hindtibia inner (posterior) 22 to 26; outer (anterior) 18 to 21. **Wings:** Tegmina well developed, extending 3 to 5 mm beyond apex of cerci; hind wings extending 3 to 5 mm beyond apex of tegmina. Stridulatory file of single specimen examined unusually convoluted, with 3 arched areas; 64 teeth, 0.77 mm in length (Fig. 89).

Abdomen: ♂. Tenth tergite produced distally, abruptly narrowing preapically, and expanded apically into 2 digitiform lobes (Fig. 10). Cercus long, cylindrical for most of its length, gradually narrowing distally to preapex, then recurving laterad, equally narrow along its preapical length, with a minute, serrate medial margin, and with a small, dark, hook-like tooth arising on ventral margin just anterior of preapical serrate portion of cercus (Figs 31 to 32). Subgenital plate spatulate, with 2 widely separated, elongated dorsoventrally flattened articulating styles (Fig. 49). ♀. Tenth tergite produced, narrowing into a blunted, thickened apical ridge. Cercus elongated, cylindrical, fully 1/2 length of ovipositor. Ovipositor as in Fig. 69. Subgenital plate spatulate, apically broad, truncate (Fig. 84).

Color: Light chartreuse green *in vivo*, light green to tan in preserved specimens. Dark reddish to reddish-brown band circum-orbiting dorsal half of anteroposterior axis of eye.

Measurements. — in mm. Total length: ♂ (n=4) 21.2, 20.4 to 22.0; ♀ (n=4) 22.3, 20.9 to 23.8; length pronotum: ♂ 3.9, 3.8 to 4.0; ♀ 3.5, 3.4 to 3.6; width pronotum: ♂ 2.2, 2.0 to 2.4; ♀ 2.0, 1.9 to 2.2; length forefemur: ♂ 3.8, 3.6 to 3.9; ♀ 3.8, 3.6 to 4.1; length hindfemur: ♂ 10.8, 10.6 to 11.0; ♀ 10.8, 10.3 to 11.3; width hindfemur: ♂ 2.0, 1.8 to 2.1; ♀ 1.9, 1.8 to 2.1; length tegmen: ♂ 10.8, 10.6 to 11.1; ♀ 10.8, 10.3 to 11.3; eye length: ♂ 1.5, 1.5 to 1.6; ♀ 1.5, 1.5 to 1.6; eye width: ♂ 0.9, 0.8 to 0.9; ♀ 0.9, 0.9 to 1.0; eye depth: ♂ 1.1, 1.0 to 1.2; ♀ 1.1, 1.0 to 1.1; length ovipositor: 5.1, 4.6 to 5.7.

Etymology. — (Latin), adjective, *arborea* – of trees; this was the first new species to be recognized having an arboreal niche.

***Phlugis convexitermina* Nickle, new species**
(Figures 19, 40, 54, 67)

Diagnosis. — On the basis of 3 outer and 4 inner ventral spines on the forefemur, this species is most closely related to *P. gigantea* and *P. herculi*, differing from them by the shapes of the male tenth tergite (Fig. 19) and cercus (Fig. 40). The female of this species is unknown.

Holotype. — ♂. Peru: LODGE. Team 24. Fogging site 5. Known only from holotype.

Description. —

Head: Robust, broad for genus, from above wider than long. Eyes prominent, ellipsoidal. Ratio of width of head at compound eyes as seen in dorsal view to width of head behind eyes *ca* 1.1:1.

Thorax: Pronotum 2.17× longer than wide; metazona very weakly inflated; metazonal suture dividing pronotal disc just posterior to midpoint; anterior margin truncate, hindmargin convex; L/W pronotal disc 2.17.

Legs: Forelegs: Femur short, robust, basally weakly inflated, tapering distally; L/basal W 4.41; inner ventral margin with 4 spines, outer ventral margin with 3 spines; tibia with ventral spines long (inner spines somewhat longer than corresponding outer spines), somewhat evenly spaced, with 5 spines on each margin, most basal spines arising behind tympanum. Midlegs: Femur basally weakly inflated, tapering distally, unarmed ventrally; tibia with 2 outer

ventral spines and 0 inner ventral spines. Hindlegs: Femur L/W *ca* 5.30.

Numbers of spines on legs: Ventral margins, forefemur: inner (anterior) 4; outer (posterior) 3; midfemur inner (posterior) 0; outer (anterior) 0; hindfemur inner (posterior) 0; outer (anterior) 1. Ventral margins, foretibia: inner (anterior) 5; outer (posterior) 5; midtibia inner (posterior) 0; outer (anterior) 2; hindtibia inner (posterior) 0; outer (anterior) 0. Dorsal margins, foretibia: inner (anterior) 0; outer (posterior) 0; midtibia inner (posterior) 0; outer (anterior) 0; hindtibia inner (posterior) 21 to 23; outer (anterior) 28 to 29.

Wings: Tegmina and wings well developed; tegmen extending *ca* 3 mm beyond tip of abdomen; hind wing extending *ca* 5 mm beyond apex of tegmen. Stridulatory file not examined.

Abdomen: ♂. Tenth tergite elongated, produced distally, tapering apically to a point with minute spines at tip (Fig. 19). Cercus short, stout, basally cylindrical, apex expanded laterally into a very broad, medially-directed tooth; distal margin of cercus convoluted and thickened, with an additional thickened ridge arising at dorso-lateral preapical region and recurving into apical ridge at a right angle (Fig. 40). Subgenital plate greatly elongated, extending beyond tip of tenth tergite by length of cercus; apex deeply cleft, producing 2 nonarticulating apically toothed lobes (Figs 54, 67).

Color: Uniform light chartreuse green *in vivo*, light green to tan in preserved specimens. Anal margin of tegmina brownish behind stridulatory field. Spines on dorsal margins of hindtibia dark brown.

Measurements. — in mm. Total length: 24.46; length pronotum: 4.18; width pronotum: 2.60; length forefemur: 4.06; length midfemur: 4.49; length hindfemur: 11.77; width hindfemur: 2.22; length tegmen: 14.42; width tegmen: 2.15; eye length: 1.75; eye width: 1.02; eye depth: 1.30.

Etymology. — (Latin), adjective, *convexus* – arched outward, protuberant, *terminus* – end, referring to the unusual rounded, protuberant apex of the tenth tergite of the male of this species.

***Phlugis gigantea* Nickle, new species**
(Figures 17, 37-38, 52, 65, 76, 85, 90)

Diagnosis. — A very large, robust species closest in form to *P. herculi* and *P. convexitermina*. Males of all of these species have easily recognizable cerci. The female is identifiable by the shapes of the ovipositor and subgenital plate. Females of *P. herculi* and *P. convexitermina* are unknown.

Holotype. — ♂. Peru: ACEER. Team 22. Fogging site 9.

Allotype. — ♀. ACEER. Team 24. Fogging site 11.

Paratypes. — 5 ♂♂, 1 ♀. ACEER. Team 22. Fogging site 10. 3 ♂♂, 1 ♀. Team 24. 2 ♂♂.

Description. —

Head: Large, broad, with prominent, nearly globose eyes; face in side view only weakly concave; ratio of width of head at compound eyes to width of head behind compound eyes 1.15 to 1.25:1.

Thorax: Pronotum 2.3 to 2.5× longer than wide; metazonal suture bisecting pronotum at midpoint; anterior margin weakly concave, hindmargin convex; L/W pronotal disc 1.6 to 1.7.

Legs: Forelegs: Femur basally weakly inflated, tapering distally; median L/W 4.3 to 4.5; tibia with 5 spines on each margin, most basal spines arising behind tympanum. Midlegs: Femur basally weakly inflated, tapering distally, unarmed ventrally; tibia with 3 ventral spines on outer margin only. Hindlegs: Femur L/W *ca* 5.5.

Numbers of spines on legs: Ventral margins, forefemur: inner (anterior) 4; outer (posterior) 3; midfemur inner (posterior) 0; outer (anterior) 0; hindfemur inner (posterior) 3 to 5; outer (anterior) 5 to 12. Ventral margins, foretibia: inner (anterior) 5; outer (posterior) 5; midtibia inner (posterior) 0; outer (anterior) 2; hindtibia inner (posterior) 0; outer (anterior) 0. Dorsal margins, foretibia: inner (anterior) 0; outer (posterior) 0; midtibia inner (posterior) 0; outer (anterior) 0; hindtibia inner (posterior) 22 to 28; outer (anterior) 16 to 22.

Wings: Tegmina and hind wings well developed, tegmina extending 4 to 5 mm beyond apex of tenth tergite; hind wings extending 6 to 7 mm beyond apex of tegmina. Stridulatory file with 82 teeth, 0.91 mm in length (Fig. 90).

Abdomen: ♂. Tenth tergite produced distally, with a broad V-shaped emargination, producing two triangulate, apically finely tapered, gracile lobes (Fig. 17). Cercus short, stout, basally cylindrical, widening and becoming dorso-ventrally flattened distally, with a medially-directed preapical tooth on its disto-medial margin (Figs 37-38). Subgenital plate basally spatulate, apically greatly produced well beyond apex of tenth tergite, with a deep medial emargination extending nearly the length of subgenital plate, producing 2 nonarticulating, apically toothed lobes, each with a broad, weakly developed tooth arising on lateral face at nearly the same level as deepest extension of emargination (Figs 52, 65). ♀. Terminal tergite weakly produced, apically weakly bilobed. Cercus elongated, cylindrical, slightly greater than basal inflation of ovipositor. Ovipositor as in Fig. 76. Subgenital plate spatulate, apically narrowing gradually, truncate (Fig. 85).

Color: Light chartreuse green *in vivo*, light green to tan in preserved specimens. Eyes dark reddish to reddish-brown on all specimens. Apical half of each antennal annulus banded dark brown. Tarsi and hindtibial spines dark brown.

Measurements.— in mm. Total length: ♂ (n=6) 21.2, 20.4 to 22.0; ♀ (n=2) 22.3, 20.9 to 23.8; length pronotum: ♂ 3.9, 3.8 to 4.0; ♀ 3.5, 3.4 to 3.6; width pronotum: ♂ 2.2, 2.0 to 2.4; ♀ 2.0, 1.9 to 2.2; length forefemur: ♂ 3.8, 3.6 to 3.9; ♀ 3.8, 3.6 to 4.1; length hindfemur: ♂ 10.8, 10.6 to 11.0; ♀ 10.8, 10.3 to 11.3; width hindfemur: ♂ 2.0, 1.8 to 2.1; ♀ 1.9, 1.8 to 2.1; length tegmen: ♂ 10.8, 10.6 to 11.1; ♀ 10.8, 10.3 to 11.3; eye length: ♂ 1.3, 1.3 to 1.5; ♀ 1.2, 1.1 to 1.4; eye width: ♂ 0.8, 0.7 to 0.9; ♀ 0.8, 0.7 to 0.9; eye depth: ♂ 0.8, 0.8 to 0.9; ♀ 0.8, 0.7 to 1.0; length ovipositor: 5.1, 4.6 to 5.7.

Etymology.— (Latin), adjective, *giga* – large, grand, referring to the exceptionally large size of this robust species.

***Phlugis glabra* Nickle, new species**
(Figures 15-16, 51, 64, 91)

Diagnosis.— Based on numbers of spines on the ventral margins of the forefemur (4 inner, 3 outer), this species is most similar to *P. maculata*, *P. wittmani*, *P. scalpra*, *P. arborea*, *P. gigantea*, *P.*, and *P. convexitermina*. Based on the male subgenital plate, it appears to be transitional between *P. wittmani* and *P. arborea*, on the one hand, with articulating styles, and *P. gigantea*, *P. herculi*, and *P. convexitermina*, on the other hand, all with greatly elongated subgenital plates having nonarticulating apically toothed lobes. The male tenth tergite, which is bilobed with each lobe in turn being apically bilobed, is unique for this species. The female is most similar to *P. arborea*, the two being separated mainly by the number of spines on the outer ventral margin of the midtibia (3 in *P. arborea*, 2 in *P. glabra*).

Holotype.— ♂. Peru: LODGE. Team 22. Fogging site 5.

Allotype.— ♀. Same data as holotype.

Paratype.— 1 ♂. LODGE. Team 22. Fogging site 2.

Description.—

Head: Large tumescent eyes rising above dorsum of head and extending forward of facial plane; with a well defined broad reddish band circum-orbiting above anteroposterior axis; in dorsal view ratio of width of head at compound eyes to width of head behind compound eyes 1.15 to 1.25.

Thorax: Pronotum 2.4 to 2.5× longer than wide; metazonal suture bisecting pronotum at midpoint; anterior margin weakly concave, hindmargin convex; L/W pronotal disc 1.7 to 1.8.

Legs: Forelegs: Femur basally weakly inflated, tapering distally; median L/W 4.3 to 4.7; tibia with 5 spines on each margin, most basal spines arising behind tympanum. Midlegs: Femur basally weakly inflated, tapering distally, unarmed ventrally; tibia with 3 ventral spines on outer margin only. Hindlegs: Femur L/W 5.7 to 6.3.

Numbers of spines on legs: Ventral margins, forefemur: inner (anterior) 4; outer (posterior) 3; midfemur inner (posterior) 0; outer (anterior) 0; hindfemur inner (posterior) 1 to 4; outer (anterior) 1 to 7. Ventral margins, foretibia: inner (anterior) 5; outer (posterior) 5; midtibia inner (posterior) 0; outer (anterior) 2; hindtibia inner (posterior) 0; outer (anterior) 0. Dorsal margins, foretibia: inner (anterior) 0; outer (posterior) 0; midtibia inner (posterior) 0; outer (anterior) 0; hindtibia inner (posterior) 21 to 27; outer (anterior) 19 to 25.

Wings: Tegmina and hind wings well developed, tegmina extending 4.1 to 4.7 mm beyond apex of abdomen; hind wings extending 3.4 to 4.3 mm beyond apex of tegmina. Stridulatory file of single specimen examined with 76 teeth, 1.02 mm in length (Fig. 91).

Abdomen: ♂. Tenth tergite produced distally, apically split into two widely divergent, apically bilobed, weakly declivent lobes (Figs 15-16). Cercus small, well concealed beneath tenth tergite, recurved medially near apex and terminating as a sharp tooth. Subgenital plate basally spatulate, with 2 widely separated, elongated seemingly articulating styles; apex of styles flattened, folding in on itself, terminating as a dorso-medial tooth-like process (Figs 51, 64). ♀. All features similar to those of *P. arborea*.

Color: Light chartreuse green *in vivo*, light green to tan in preserved specimens. Body appearing unusually glabrous and glossy, compared with other species of *Phlugis*. Apical 1/4 of antennal annuli dark brown. Tarsi and hindtibial spines light brown.

Measurements.— in mm. Total length: ♂ (n=2) 19.4, 19.3 to 19.5; ♀ (n=1) 19.7; length pronotum: ♂ 3.6, 3.5 to 3.7; ♀ 3.2; width pronotum: ♂ 2.0, 1.9 to 2.1; ♀ 1.9; length forefemur: ♂ 3.4, 3.2 to 3.7; ♀ 3.4; length hindfemur: ♂ 11.5, 11.2 to 11.8; ♀ 10.6; width hindfemur: ♂ 1.8, 1.7 to 1.9; ♀ 1.9; length tegmen: ♂ 12.0, 11.6 to 12.4; ♀ 11.9; length ovipositor: 4.4.

Etymology.— (Latin), adjective, *glaber* – bald, smooth, referring to the apparent shiny appearance of this species.

***Phlugis herculi* Nickle, new species**
(Figures 18, 39, 53, 66)

Diagnosis.— A robust species similar in form to *P. convexitermina*, *P. arborea*, and *P. gigantea*, sharing with them the presence of 4 inner and 3 outer spines on the ventral margins of the forefemur. Differing from them in having an extended bilobed tenth tergite of the male. The female is unknown for this species.

Phlugis maculata Nickle, new species
(Figures 11, 30, 48, 75, 83)

Holotype.— ♂. Peru: Loreto Prov. ACEER. Team 24.

Paratype.— 1 ♀: ACEER, Team 24, Fogging site 10 secondary.

Description.—

Head: Robust, broad for genus, from above wider than long. Eyes prominent, ellipsoidal. Ratio of width of head at compound eyes as seen in dorsal view to width of head behind eyes *ca* 1.11:1.

Thorax: Pronotum 2.2× longer than wide; metazona very weakly inflated; metazonal suture dividing pronotal disc just posterior to midpoint; anterior margin truncate, hindmargin convex; L/W pronotal disc 1.7 to 1.8.

Legs: Genicular lobes of all legs unarmed. Forelegs: Femur short, robust, basally weakly inflated, tapering distally; L/basal W 4.3 to 4.7; inner ventral margin with 4 spines, outer ventral margin with 3 spines; tibia with ventral spines long (inner spines somewhat longer than corresponding outer spines), somewhat evenly spaced, with 5 spines on each margin, most basal spines arising behind tympanum. Midlegs: Femur basally weakly inflated, tapering distally, unarmed ventrally; tibia with 2 outer ventral spines and 0 inner ventral spines. Hindlegs: Femur L/W *ca* 5.1 to 5.8; armed ventrally with 1 spine near apex on outer margin only.

Numbers of spines on legs: Ventral margins, forefemur: inner (anterior) 4; outer (posterior) 3; midfemur inner (posterior) 0; outer (anterior) 0; hindfemur inner (posterior) 0; outer (anterior) 1. Ventral margins, foretibia: inner (anterior) 5; outer (posterior) 5; midtibia inner (posterior) 0; outer (anterior) 2; hindtibia inner (posterior) 0; outer (anterior) 0. Dorsal margins, foretibia: inner (anterior) 0; outer (posterior) 0; midtibia inner (posterior) 0; outer (anterior) 0; hindtibia inner (posterior) 26; outer (anterior) 23.

Wings: Tegmina and wings well developed; tegmen extending 3 to 4 mm beyond tip of abdomen; hind wing extending 5 to 6 mm beyond apex of tegmen. Stridulatory file not examined.

Abdomen: ♂. Tenth tergite elongated, produced distally, apex with a broad V-shaped emargination, resulting in 2 broad, apically rounded lobes (Fig. 18). Cercus basally cylindrical, distal half becoming laterally flattened, sinuate, recurving anteriorly, then dorsally, and terminating in a pointed apex (Fig. 39). Subgenital plate similar to that of *P. convexitermina*, greatly elongated, extending beyond tip of tenth tergite by length of cercus; apex deeply cleft, producing 2 nonarticulating apically toothed lobes (Figs 53, 66). ♀. Unknown.

Color: Uniform light chartreuse green *in vivo*, light green to tan in preserved specimens. Spines on hindtibia and dorsal margins of foretibial spines dark brown. Anal margin of tegmina behind stridulatory field brownish.

Measurements.— in mm. Total length: ♂ (n=2) 24.8, 24.0 to 25.5; length pronotum: (n=1) 4.0, 4.0; width pronotum: (n=1) 2.3, 2.3; length forefemur: 4.3, 3.8 to 4.8; length midfemur: 4.3, 4.2 to 4.4; length hindfemur: 11.5, 11.3 to 11.66; width hindfemur: 2.2, 2.1 to 2.3; length tegmen: 15.0, 14.9 to 15.0; width tegmen: 2.2, 2.1 to 2.2; eye length: 1.7, 1.6 to 1.8; eye width: 1.0, 1.0 to 1.1; eye depth: 1.2, 1.2 to 1.3.

Etymology.— A powerful species named after Hercules, the [Greek and Roman] mythological son of Zeus and Alcmene, who was known for his great strength and unusual size; a patronym.

Diagnosis.— Based on numbers of spines on the ventral margins of the forefemur (4 inner, 3 outer), this species is most similar to *P. arborea*, *P. wittmani*, *P. scalpra*, *P. glabra*, *P. gigantea*, *P. herculi*, and *P. convexitermina*. It differs from them in having short tegmina and wings, barely reaching the tip of the abdomen in the male and only to tergite IV in the female.

Holotype.— ♂. Peru: LODGE. Team 22. Fogging site 3.

Allotype.— ♀. Same data as holotype.

Paratypes.— 2 ♂♂, 7 ♀♀, 1 nymph: INN: Team 8, 1 ♀; Team 22, Fogging site 1, 2 ♂♂; Lodge: Team 20, Fogging site 1, 2 ♀♀; Team 22, Fogging sites 4, 5, 2 ♀♀; Team 23, Fogging sites 14, 15, 16, 1 ♀, 1 nymph; Team 24, Fogging site 1, 1 ♀.

Description.—

Head: From above about as long as wide; eyes prominent, globose, only slightly longer than deep; in side view front of face concave; ratio of width of head at compound eyes as seen in dorsal view to width of head behind eyes *ca* 1.44:1 (♂) and 1.36:1 (♀).

Thorax: Pronotum *ca* 2.28 (♂) to 2.56× (♀) longer than wide; metazona inflated in male, not inflated in female; metazonal suture dividing pronotal disc at posterior 1/3 of length in male and at posterior quadrant in female; anterior margin truncate, hindmargin convex; L/W pronotal disc 1.60 to 1.68 [♂], 1.83 to 1.89 [♀].

Legs: Forelegs: Femur relatively short, somewhat robust, basally weakly inflated, tapering distally; L/basal W 4.8 to 5.2; tibia with ventral spines shorter and less curved than those of other species (inner spines about twice as long as corresponding outer spines), somewhat evenly spaced, with 5 spines on each margin, most basal spines arising behind tympanum. Midlegs: Femur basally weakly inflated, tapering distally, unarmed ventrally; tibia with two large outer ventral spines and 0 inner ventral spines. Hindlegs: Femur L/W *ca* 5.7 to 6.1.

Numbers of spines on legs: Ventral margins, forefemur: inner (anterior) 4; outer (posterior) 3; midfemur inner (posterior) 0; outer (anterior) 0; hindfemur inner (posterior) 0; outer (anterior) 0. Ventral margins, foretibia: inner (anterior) 5; outer (posterior) 5; midtibia inner (posterior) 0; outer (anterior) 2; hindtibia inner (posterior) 0; outer (anterior) 0. Dorsal margins, foretibia: inner (anterior) 0; outer (posterior) 0; midtibia inner (posterior) 0; outer (anterior) 0; hindtibia inner (posterior) 27 to 37; outer (anterior) 24 to 36.

Wings: Macropterous in male, but tegmina and hindwings extending only to about apex of terminal abdominal tergites, somewhat shorter in female, extending at most only about half length of abdomen; hind wing extending only about 1 mm apex of tegmen. Stridulatory file not examined.

Abdomen: ♂. Tenth tergite with a broad, apical U-shaped emargination, producing two medially recurved hook-shaped lobes (Fig. 11). Cercus complex, consisting of 3 lobes: a well developed apically-pointed, medially-directed apical lobe, a central medially-directed lobe located at midpoint of length of cercus, rounded from above but with a flanged extension beneath, and a basal, dorsally recurved, medially-directed, apically pointed lobe located at base of cercus (not easily seen in holotype) (Fig. 30). Subgenital plate basally spatulate, with 2 elongated articulating styles; styles 2X longer than basal portion of subgenital plate (Fig. 48). ♀. Terminal tergite weakly produced, apically truncate. Cercus elongated, cylindrical, about 1/2 as long as ovipositor. Ovipositor elongated, distal half

slender, in lateral view as in Fig. 75. Subgenital plate spatulate, longer than wide, apically shallowly emarginate, developed into two thin lobes (Fig. 83).

Color: Uniform light chartreuse green *in vivo*, light green to tan in preserved specimens. Apices of antennal annuli light brown banded; edges of tarsal lobes dark brown; bases and leading edges of foretarsal spines light brown; apical half of each tibial spine on hindlegs glossy brown; on females only, a blackened spot or maculation on anal margin of tegmen in repose, immediately behind posterior margin of pronotum.

Measurements. — in mm. Total length: ♂ (n=2) 9.2, 9.0 to 9.3; ♀ (n=7) 9.7, 9.3 to 9.9; length pronotum: ♂ 2.7, 2.5 to 2.9; ♀ 3.0, 2.8 to 3.2; width pronotum: ♂ 1.4, 1.3 to 1.5; ♀ 1.6, 1.5 to 1.8; length forefemur: ♂ 3.0, 2.7 to 3.2; ♀ 3.6, 3.4 to 4.1; length midfemur: ♂ 3.4, 3.2 to 3.6; ♀ 3.8, 3.4 to 3.9; length hindfemur: ♂ 10.1, 9.8 to 10.4; ♀ 10.6, 10.2 to 10.9; width hindfemur: ♂ 1.6, 1.5 to 1.9; ♀ 1.9, 1.6 to 2.0; length tegmen: ♂ 4.9, 4.6 to 5.1; ♀ 5.2, 5.0 to 5.4; width tegmen: ♂ 1.0, 0.9 to 1.2; ♀ 1.1, 1.0 to 1.2; eye length: ♂ 1.4, 1.3 to 1.5; ♀ 1.4, 1.3 to 1.5; eye width: ♂ 0.9, 0.8 to 1.0; ♀ 0.9, 0.8 to 1.0; eye depth: ♂ 0.9, 0.7 to 1.1; ♀ 1.0, 0.9 to 1.2; length ovipositor: 4.2, 4.1 to 4.4.

Etymology. — (Latin), adjective, *macula* – spot, mark, referring to the single black spot on tegmina in repose.

***Phlugis scalpra* Nickle, new species**
(Figures 13-14, 33-34, 92)

Diagnosis. — A robust species with a broad head and short thickened forelegs, most similar to *P. gigantea*, *P. herculi*, and *P. convexitermina*, sharing with these species the number of spines on the ventral margins of the forefemur (4 inner, 3 outer). The male is distinguished from them by its elongate, chisel-shaped tenth tergite (Fig. 13) and by the shape of the cercus (Figs 33-34). The female of this species is unknown.

Holotype. — ♂. LODGE. Team 22. Fogging site 3.

Paratypes. — 2 ♂♂. Same data as holotype.

Description. —

Head: Large tumescent eyes rising above dorsum of head and extending forward of facial plane; in dorsal view ratio of width of head at compound eyes to width of head behind compound eyes 1.17:1 to 1.25:1.

Thorax: Pronotum 2.1 to 2.7× longer than wide; metazonal suture dividing pronotum at posterior third of its length; anterior margin weakly concave, hindmargin convex; L/W pronotal disc 1.81 to 1.99.

Legs: Forelegs: Femur relatively short, stout, basally weakly inflated, tapering distally; median L/W 2.11 to 2.75; inner ventral margin with 4 spines, outer ventral margin with 3 spines; tibia with 5 spines on each margin, most basal spines arising behind tympanum. Midlegs: Femur basally weakly inflated, tapering distally, unarmed ventrally; tibia with 2 ventral spines on outer margin only. Hindlegs: Femur L/W ca 5.7 to 6.1; outer ventral margin with 2 to 4 spines, inner ventral margin with only one spine. Tibia unarmed ventrally but with 21 to 26 minute spines on outer dorsal margin and 25 to 27 spines on inner dorsal margin.

Numbers of spines on legs: Ventral margins, forefemur: inner (anterior) 4; outer (posterior) 3; midfemur inner (posterior) 0; outer (anterior) 0; hindfemur inner (posterior) 1; outer (anterior) 2 to 4. Ventral margins, foretibia: inner (anterior) 5; outer (posterior) 5;

midtibia inner (posterior) 0; outer (anterior) 2; hindtibia inner (posterior) 0; outer (anterior) 0. Dorsal margins, foretibia: inner (anterior) 0; outer (posterior) 0; midtibia inner (posterior) 0; outer (anterior) 2; hindtibia inner (posterior) 25 to 27; outer (anterior) 21 to 26.

Wings: Tegmina and hind wings well developed, extending 1.9 to 4.0 mm beyond apex of tenth tergite; hind wings extending ca 3.5 mm beyond apex of tegmen. Hind wing extending 4 to 5 mm beyond tegmen. Stridulatory file of single specimen examined with 66 teeth, 0.67 mm in length (Fig. 92).

Abdomen: ♂. Tenth tergite greatly produced distally into a flattened chisel-shaped, medially troughed elongation, with lateral margins parallel-sided, elevated, thickened; in lateral view with a keeled ventral margin (Figs 13, 14). Cercus short, thickened, recurved medially, apically armed with one dorsal apically pointed claw and two smaller ventral lobes (Figs 33, 34). Subgenital plate basally spatulate, tapering posteriorly and very elongated, apically deeply emarginated, forming two nonarticulating, closely appressed pseudostyles. ♀. Unknown.

Color. Light chartreuse green *in vivo*, light green to tan in preserved specimens. Compound eyes uniformly green *in vivo*, or with diffuse reddish patch on dorsum.

Measurements. — Total length: ♂ (n=3) 21.88, 21.61 to 22.20; length pronotum: 4.16, 4.15 to 4.18; width pronotum: 2.22, 2.09 to 2.31; length forefemur: 4.08, 3.99 to 4.18; length midfemur: 4.56, 4.51 to 4.61; length hindfemur: 12.15, 12.04 to 12.24; width hindfemur: 2.04, 1.99 to 2.13; length tegmen: 13.34, 12.99 to 13.58; width tegmen: 1.88, 1.87 to 1.91; eye length: 1.66, 1.62 to 1.72; eye width: 1.01, 0.98 to 1.03; eye depth: 1.18, 1.14 to 1.21.

Etymology. — (Latin), adjective, *scalprum* – chisel, blade, referring to the unusual shape of the male tenth abdominal tergite.

***Phlugis wittmani* Nickle, new species**
(Figures 12, 35-36, 50, 63, 93)

Diagnosis. — A large, robust, broad-headed species similar in form to *P. convexiterminis*, *P. gigantea*, and *P. herculi*, though with shorter wings. It shares with these species the numbers of spines on the ventral margins of the forefemur (4 inner, 3 outer). Males are readily identifiable by the combination of the convex, apically produced tenth tergite (Fig. 12) and short, stout, apically bilobed cerci (Figs 35, 36).

Holotype. — ♂. Peru: Loreto Prov. LODGE. Team 22. Fogging site 3.

Paratypes. — 7 ♂♂. LODGE. Team 22, Fogging sites 2, 3, 5.

Description. — Similar to *P. convexitermina* except as follows:

Numbers of spines on legs: Ventral margins, forefemur: inner (anterior) 4; outer (posterior) 3; midfemur inner (posterior) 0; outer (anterior) 0; hindfemur inner (posterior) 0 to 8; outer (anterior) 1 to 13. Ventral margins, foretibia: inner (anterior) 5; outer (posterior) 5; midtibia inner (posterior) 0; outer (anterior) 2; hindtibia inner (posterior) 0; outer (anterior) 0. Dorsal margins, foretibia: inner (anterior) 0; outer (posterior) 0; midtibia inner (posterior) 0; outer (anterior) 0; hindtibia inner (posterior) 20 to 26; outer (anterior) 21 to 25.

Wings: Tegmina and wings well developed; tegmen extending 2.5 to 5 mm beyond tip of abdomen; hind wing extending 4 to 5 mm beyond apex of tegmen. Stridulatory file of single specimen examined with 54 teeth, 0.57 mm in length (Fig. 93).

Abdomen: ♂. Tenth tergite elongated, produced distally (not

as long as that of convexitermina), tapering apically to a blunted point with minute spines at tip (Fig. 12). Cercus short, stout, basally cylindrical, apex expanded laterally into a very broad, medially-directed rounded lobe; distal margin of cercus convoluted and slightly thickened (Figs 35, 36). Subgenital plate greatly elongated, extending beyond tip of tenth tergite by length of cercus; apex deeply cleft, producing 2 non-articulating, apically toothed lobes (Figs 50, 63).

Color: Uniform light chartreuse green *in vivo*, light green to tan in preserved specimens. Light brown bases of foretibial spines, apical fifth of midtibia, and anal margin of tegmen behind stridulatory field; spines on dorsal margins of hindtibia and all tarsi dark brown.

Measurements.— in mm. Total length: ♂ (n=7) 20.9, 20.7 to 21.1; length pronotum: 3.5, 3.4 to 3.5; width pronotum: 2.0, 1.9 to 2.1; length forefemur: 3.5, 3.4 to 3.6; length midfemur: 4.0, 3.9 to 4.1; length hindfemur: 11.2, 11.0 to 11.7; width hindfemur: 2.0, 2.0 to 2.1; length tegmen: 12.5, 12.3 to 12.6; width tegmen: 1.8, 1.8 to 1.9; eye length: 1.6, 1.5 to 1.6; eye width: 1.0, 0.9 to 1.0; eye depth: 1.2, 1.1 to 1.2.

Etymology.— A patronym, for Dr. Philip K. Wittman, in appreciation of his assistance in enhancing our arboreal collection techniques.

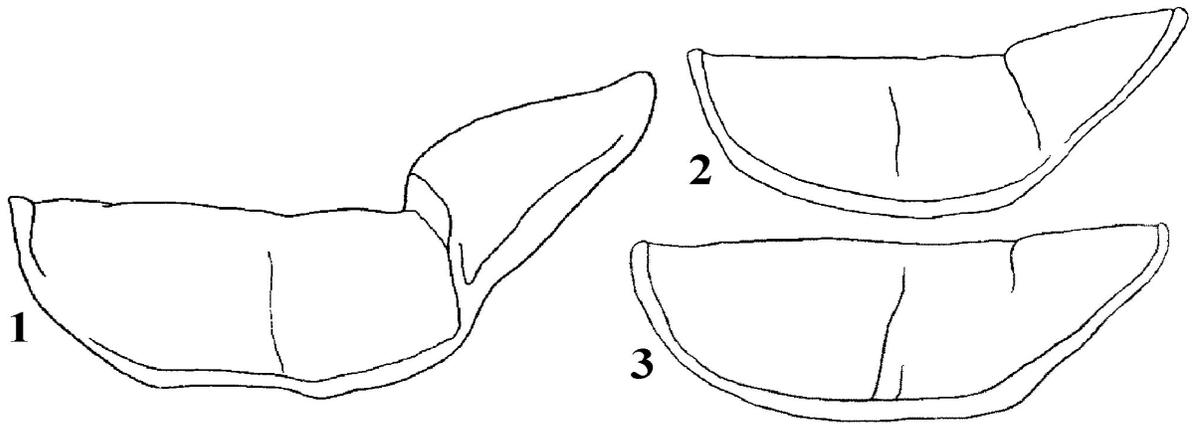
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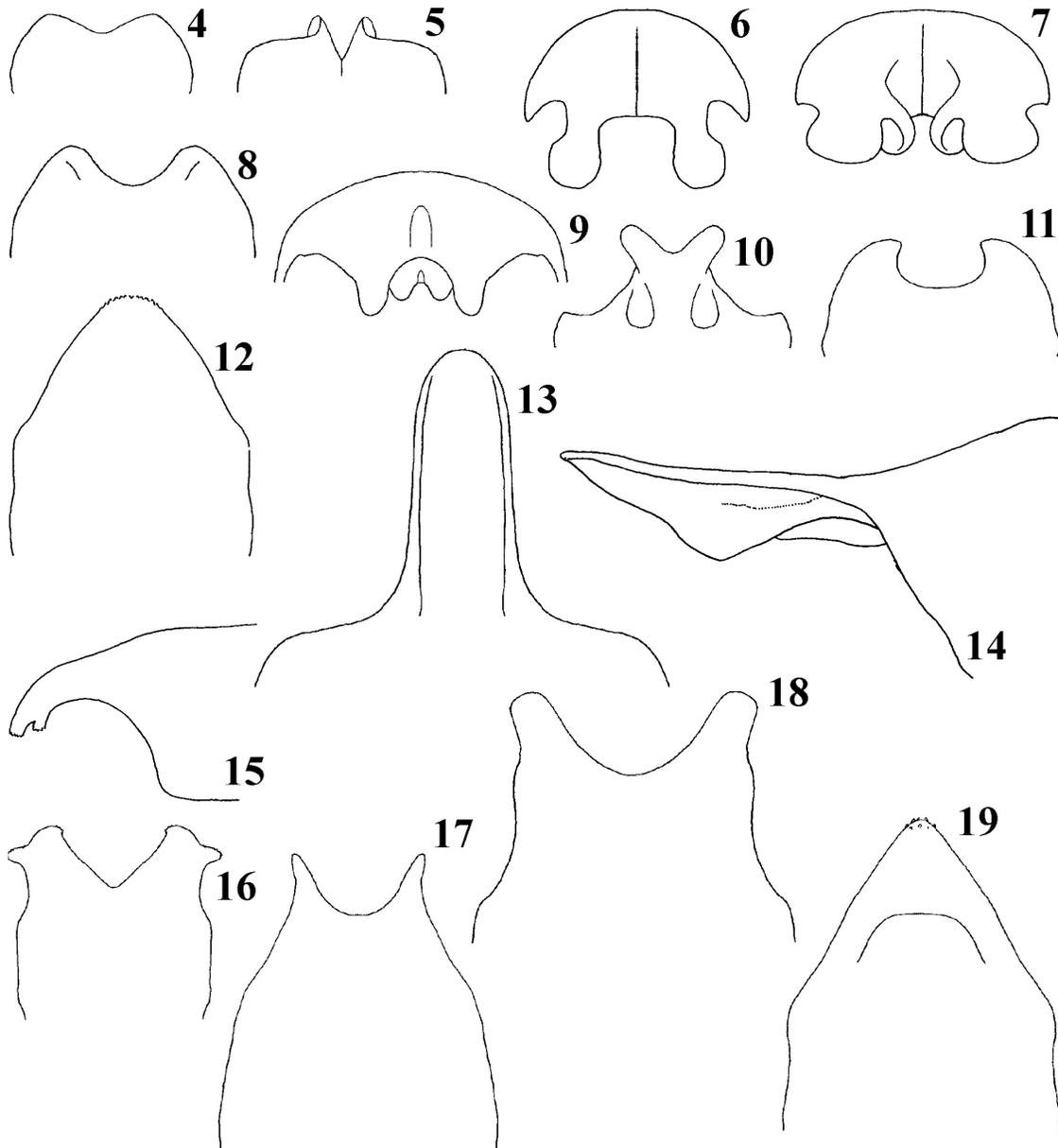
Literature Cited

Bolivar I. 1888. Enumeration des Orthoptères de l'île de Cuba. *Memoires Societe Zoologique France* 1: 116-164.
 Bruner L. 1915. Notes on tropical American Tettigonoidea (Locustidae). *Annals of the Carnegie Museum* 9: 284-404.
 Chopard L. 1969. Un extraordinaire tettigoniide des Iles Salomon (Orthoptera). *Memorie della Societa Entomologica Italiana* 48: 47-51.
 DeGeer K. 1773. *Mémoires pour servir à l'histoire des insectes* 3: 399-554.
 Eichler W. 1938. Lebensraum und Lebensgeschichte der Dahmler Palmenhausheuschrecke *Phlugiola dahlemica* nov. spec. (Orthopt. Tettigoniid.). Inaug. Dissertation der mathematisch-naturwissenschaftlichen Fakultät der Universität Berlin, Neu Brandenburg, 201 pp.

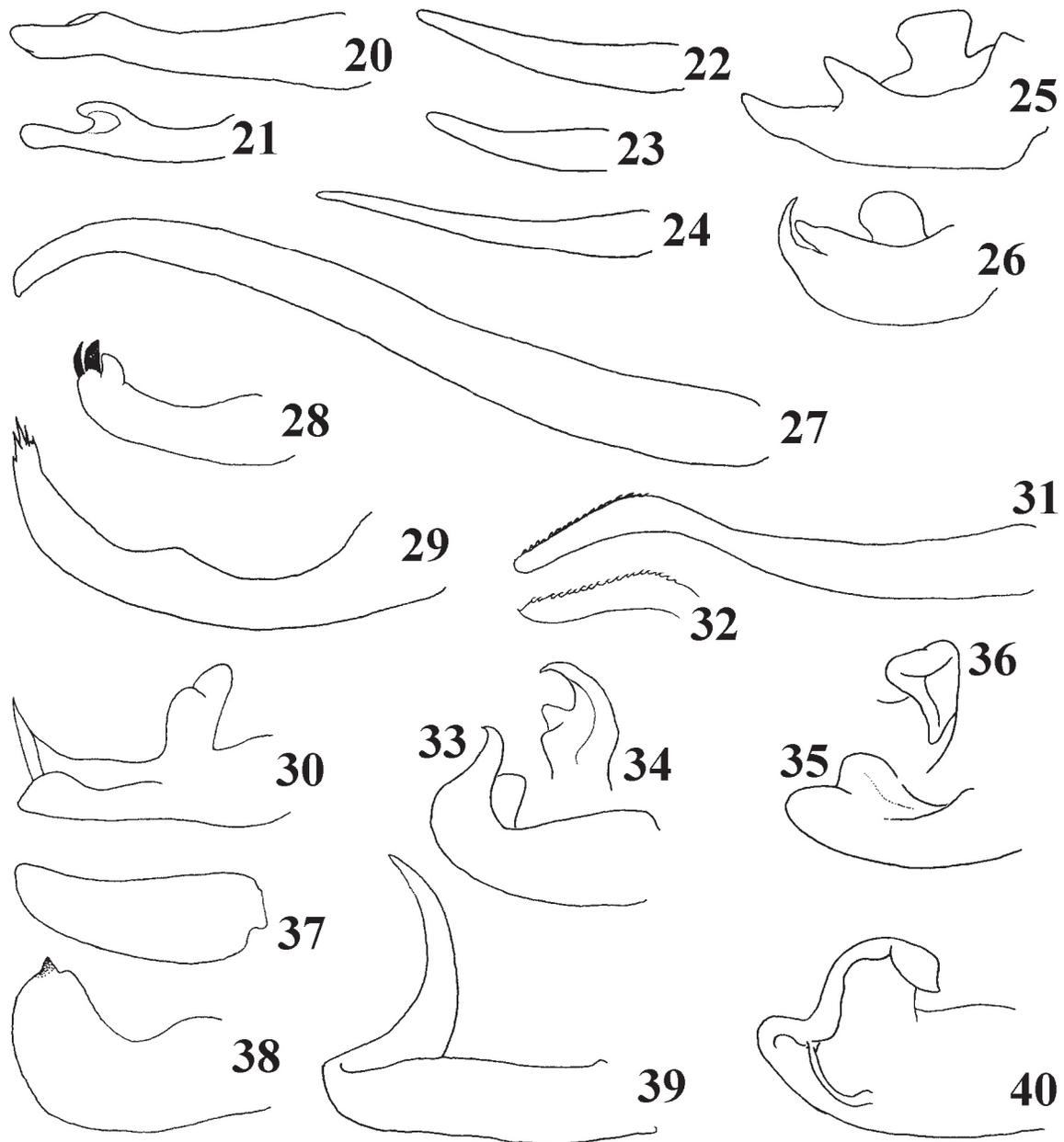
Emsley M. G., Nickle D. A., Moss W. W.. 1967. The value of the stridulatory file and other characters in tettigoniid taxonomy (Orthoptera). *Notulae Naturae Academy of Natural Sciences of Philadelphia* No. 404: 1-9.
 Fabricius I. C. 1775. *Systema entomologiae, sistens insectorvm classes, ordines, genera, species, adiectis synonymis, locis descriptionibus, observationibus.* Flensburgi et Lipsiae. 832 pp.
 Grant H. J., Jr. 1965. A measuring device for use in insect systematics. *Entomological News* 76: 249-251.
 Gurney A. B. 1975. The male of the South American katydid genus *Phlugiola*, and a new related genus from the Solomon Islands (Orthoptera: Tettigoniidae, Meconematinae). *Proceedings of the Entomological Society of Washington* 77: 426-433.
 Hebard M. 1922. Studies in Malayan, Melanesian and Australian Tettigoniidae (Orthoptera). *Proceedings of Academy of Natural Sciences of Philadelphia* 74: 121-299.
 Hebard M. 1927. Studies in the Tettigoniidae of Panama (Orthoptera). *Transactions of the Entomological Society of America* 53: 79-156.
 Jin X.-B., D. K. McE. Kevan. 1991. Taxonomic revision and phylogeny of the tribe Phisidini (Insecta: Grylloptera: Meconematidae). *Koenigstein Koeltz Scientific Books*. 360 pp.
 Kary H. 1907. *Revisio Conocephaliderum.* *Abhandlungen der K. K. Zoologische-Botanische Gesellschaft Wien* IV: 1-114.
 Kary H. 1924. Beitrage zur Malayischen Orthopterenfauna. *Treubia* 5:1-234.
 Kastner. 1932. Die Meconeminae des Stettiner Museums. *Stettiner Entomologische Zeitung* 93: 163-182.
 Kevan D. K. McE. and X.-B. Jin. 1993. Remarks on the Tribe Phlugidini Eichler and recognition of new taxa from the Indo-Malayan region and East Africa (Grylloptera: Tettigoniidae: Meconematidae). *Invertebrate Taxonomy* 7: 1589-1610.
 Mello Leitao C. 1940. Quatro novos Tettigonioides do Brasil (Orthoptera). *Rev. Entomol. Rio de Janeiro* 11: 150-162.
 Mello Leitao C. 1947. Nuevo Listrocelido Argentino (Orthopt. Tettigon.). *Rev. Soc. Entomol. Argentina* 13: 147-149.
 Nickle D.A. 1992. Katydids of Panama (Orthoptera: Tettigoniidae). pp. 142-184. In: Quintero, D., Aiello, A. (Eds) *Insects of Panama and Mesoamerica.* Oxford University Press.
 Nickle D.A. 2002. New species of katydids (Orthoptera: Tettigoniidae) of the neotropical genera *Arachnoscelis* (Listrocelidinae) and *Phlugiola* (Meconematinae), with taxonomic notes. *Journal of Orthoptera Research* 11: 125-133.
 Nickle D. A., J. L. Castner. 1995. Strategies utilized by katydids (Orthoptera: Tettigoniidae) against diurnal predators in rainforests of northeastern Peru. *Proceedings 6th International Meeting of the Orthopterists' Society, Hilo, HI, 2-7 Aug. 1993.* *Journal of Orthoptera Research* 5: 59-78.
 Otte D. 1997. Orthoptera Species File 7: Tettigoniidae. *Publications on Orthopteran Diversity. The Orthopterists' Society at Academy of Natural Sciences of Philadelphia.* 373 pp.
 Redtenbacher J. 1891. Monographie der Conocephaliden. *Verhandlungen Zoologische-Botanische Gesellschaft Wien* 41: 315-562.
 Rehn J. A. G. 1903. A new genus of the orthopterous subfamily Phaneropterinae. *Entomological News* 14: 141-142.
 Rehn J. A. G. 1918. On a collection of Orthoptera from the State of Pará, Brazil. *Proceedings of the Academy of Natural Sciences of Philadelphia*, 1918: 144-236.
 Thunberg C. P. 1815. *Hemipterorum maxillosorum genera illustrata.* *Mem. Acad. St. Petersburg.* 5: 211-301.
 Toledo Piza 1960. *Rev. bras. Entomol.* 9: 34.



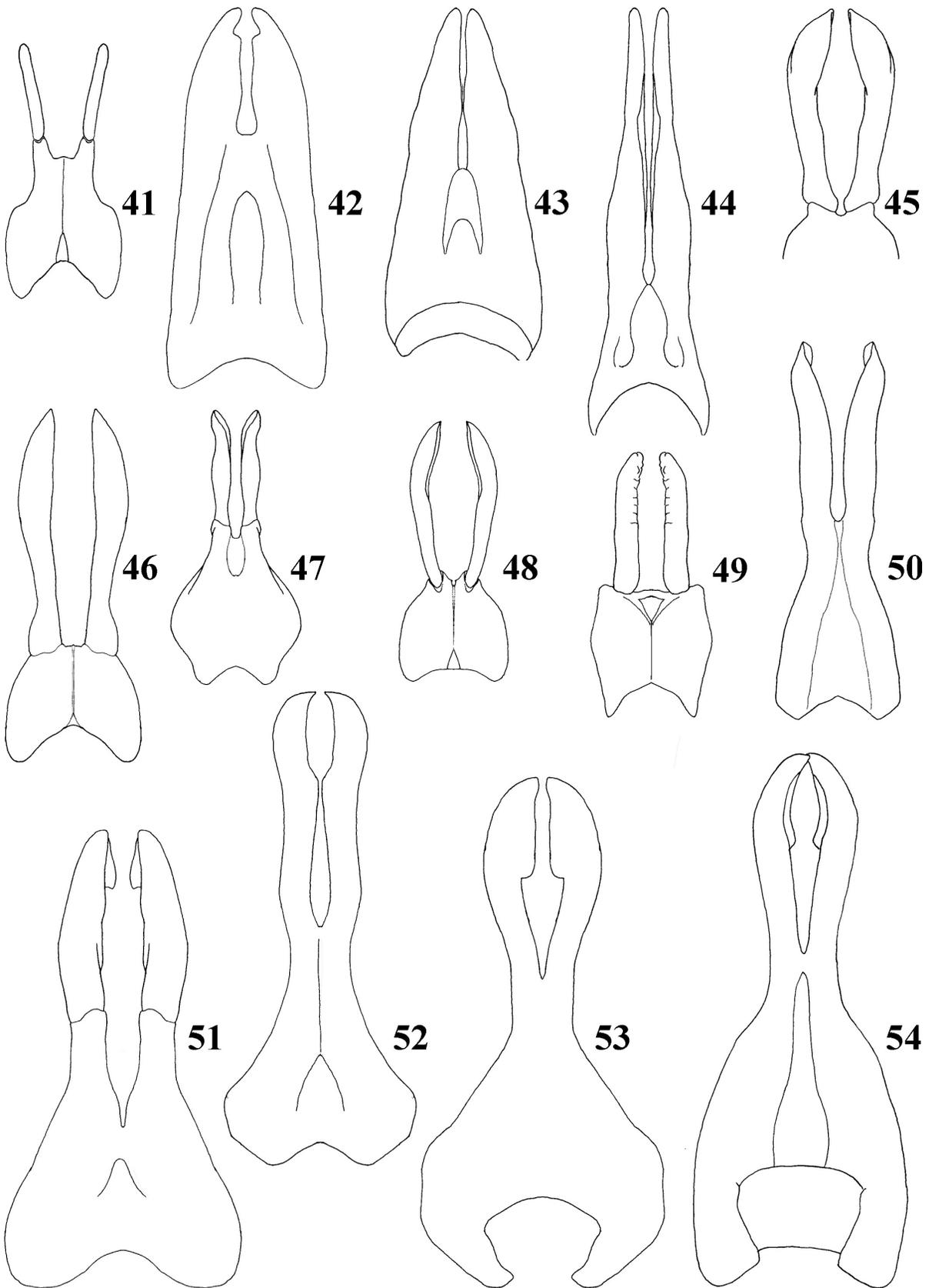
Figs 1-3. Pronotum of *Phlugis* species, left lateral view: 1, *bullatinotum*, ♂; 2, *celerinicta*, ♂; 3, *celerinicta*, ♀.



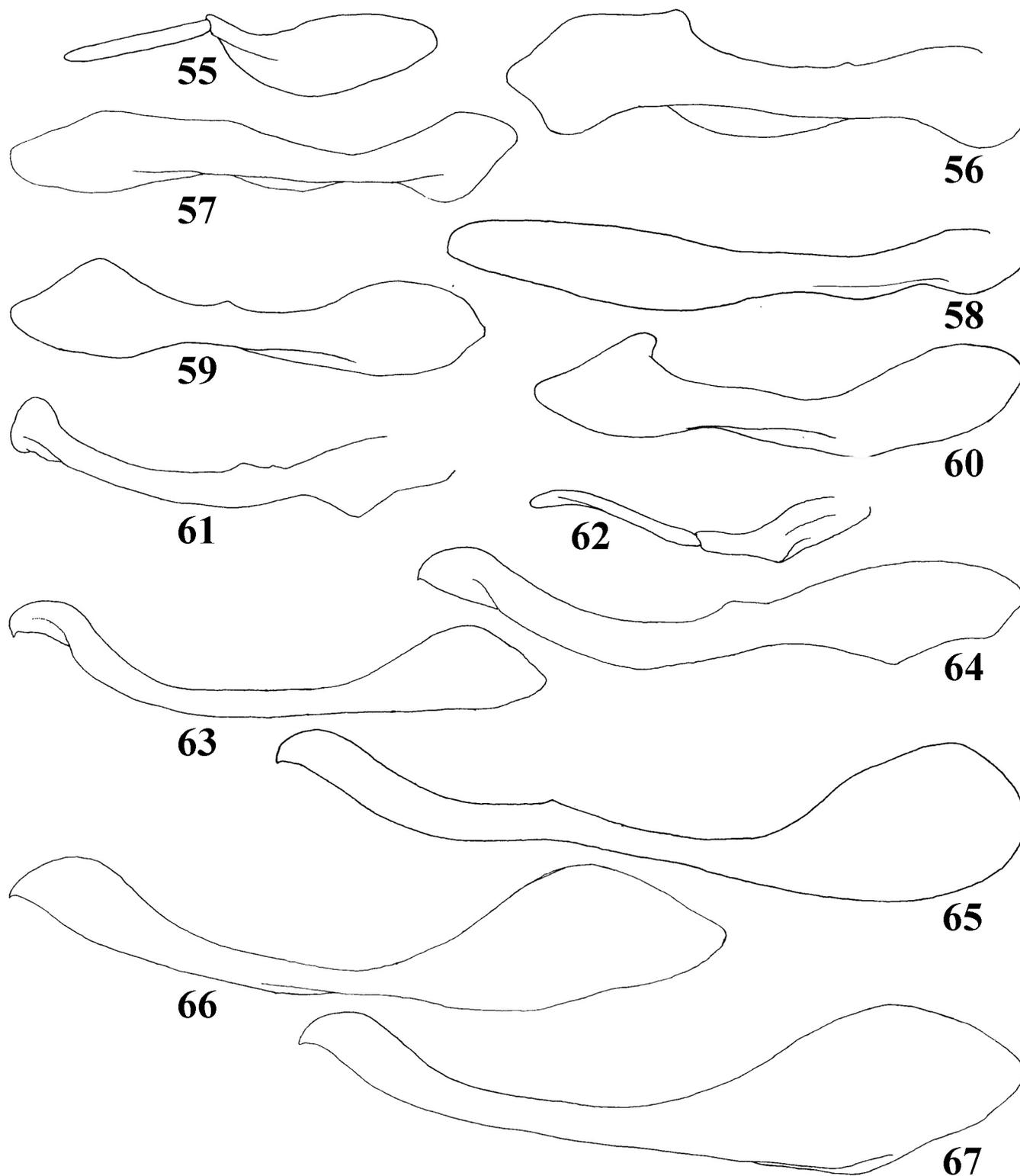
Figs 4-19. Male tenth tergite of *Phlugis* species, dorsal view (except as noted): 4, *bullatinotum*; 5, *celerinicta*; 6, *chrysopa* (specimen from Costa Rica), posterior; 7, *chrysopoides*, posterior; 8, *bimaculata* and *bimaculoides*; 9, *stigmata*, posterior; 10, *arborea*; 11, *maculata*; 12, *witmani*; 13-14, *scalpra*, 13, dorsal, 14, right lateral; 15-16, *glabra*, 15, right lateral, 16, dorsal; 17, *gigantea*; 18, *herculi*; 19, *convexitermina*.



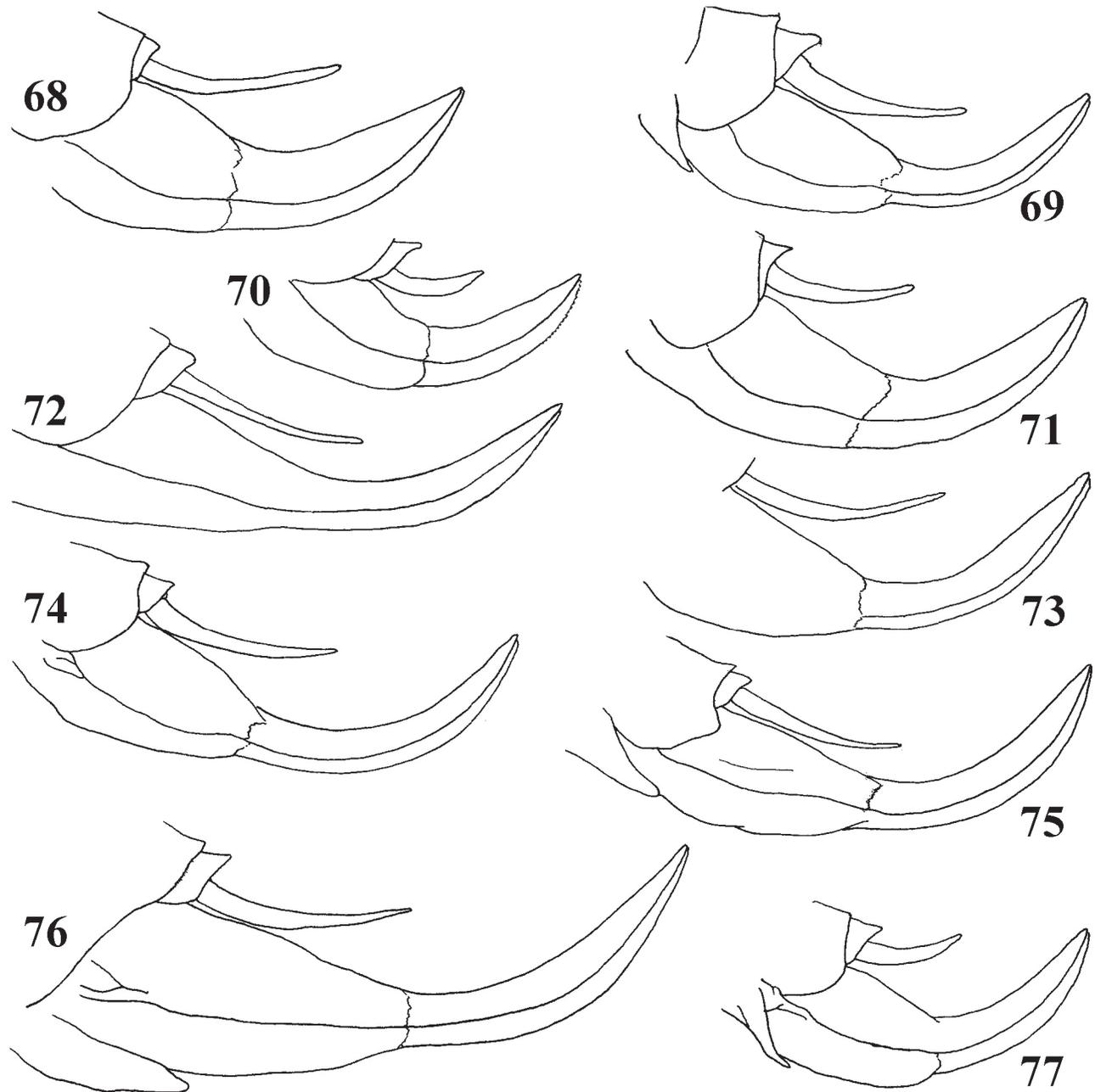
Figs 20-40. Male right cercus of *Phlugis* species, right lateral view (except as noted): 20-21, *bullatinotum*, 20, lateral, 21, dorsal; 22, *gracila*; 23, *teres*; 24, *celerinicta*; 25, *bimaclulata*, dorsal; 26, *bimacluloides*, dorsal; 27, *stigmata*; 28, *orioni*, dorsal; 29, *lewisi*; 30, *maculata*, dorsal; 31-32, *arborea*, 31, lateral, 32, apex dorsal; 33-34, *scalpra*, 33, dorsolateral, 34, posterior; 35-36, *wittmani*, 35, dorsolateral, 36, posterior; 37-38, *gigantea*, 37, lateral, 38, dorsal; 39, *herculi*; 40, *convexitermina*, dorsal.



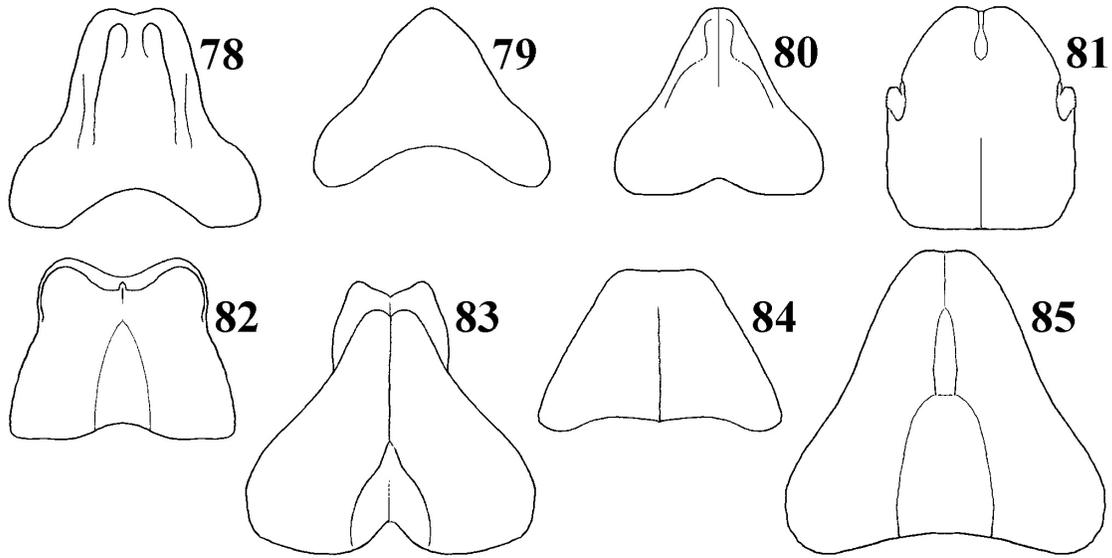
Figs 41-54. Male subgenital plate of *Phlugis* species, ventral view: 41, *bullatinotum*; 42, *gracila*; 43, *teres*; 44, *celerincta*; 45, *bimaculata* and *bimaculoides*; 46, *stigmata*; 47, *orioni*; 48, *maculata*; 49, *arborea*; 50, *wittmani*; 51, *glabra*; 52, *gigantea*; 53, *herculi*; 54, *convexitermina*.



Figs 55-67. Male subgenital plate of *Phlugis* species, right lateral view: 55, *bullatinotum*; 56, *gracila*; 57, *teres*; 58, *celerincta*; 59, *chrysopa* (from Panama); 60, *chrysopoides*; 61, *bimaculata* and *bimaculoides*; 62, *orioni*; 63, *wittmani*; 64, *glabra*; 65, *gigantea*; 66, *herculi*; 67, *convexiterna*.

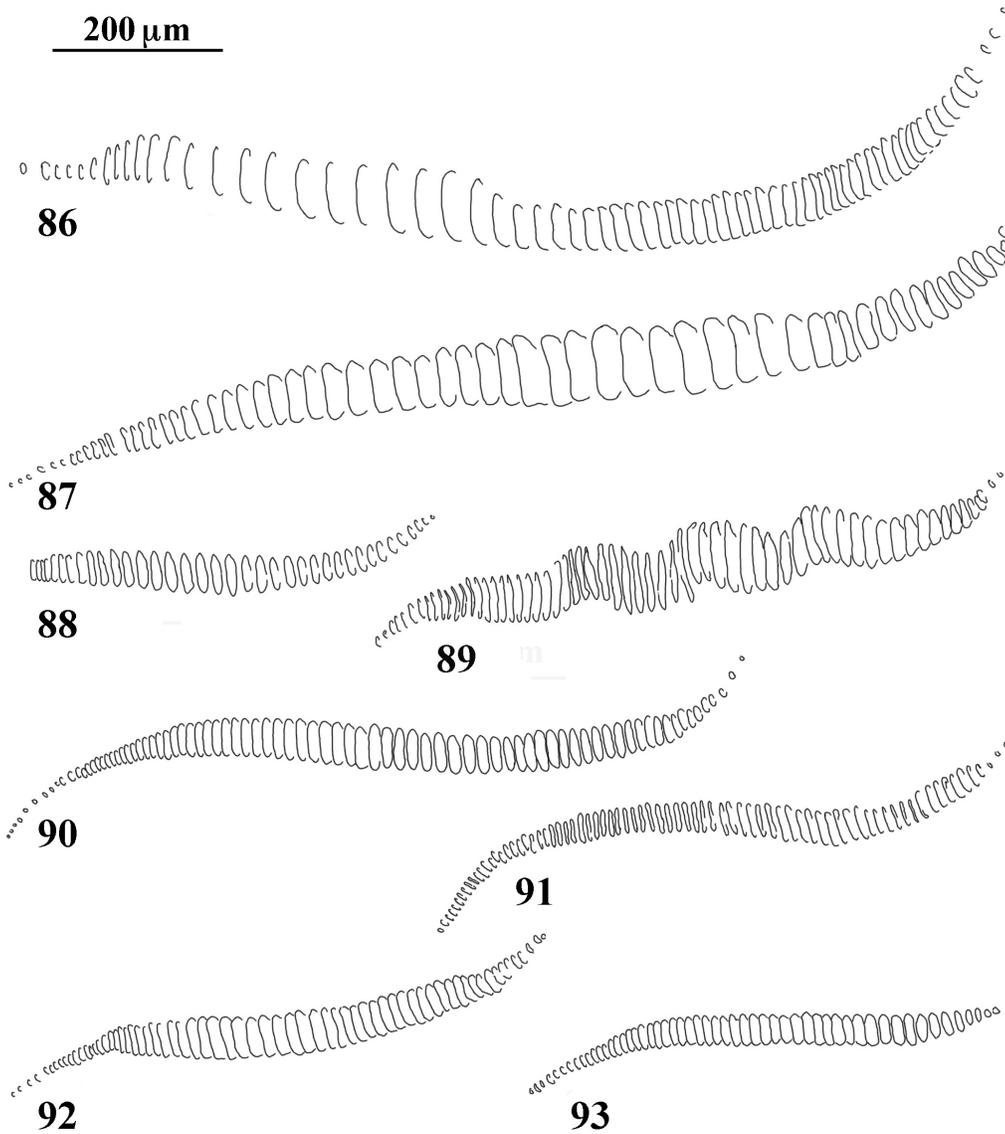


Figs 68-77. Ovipositor of *Phlugis* species, left lateral view: 68, *bullatinotum*; 69, *arborea*; 70, *teres*; 71, *celerincta*; 72, *chrysopoides*; 73, *stigmata* (*bimaculata* and *bimaculoides* are essentially the same); 74, *lewisi*; 75, *maculata*; 76, *gigantea*; 77, *chrysopa* (from Panama).



Figs 78-85. Female subgenital plate of *Phlugis* species, ventral view: 78, *bullatinotum*; 79, *teres*; 80, *celerinicta*; 81, *bimaculata* and *bimaculoides*; 82, *stigmata*; 83, *maculata*; 84, *arborea*; 85, *gigantea*.

200 μm



Figs 86-93. Male stridulatory file of *Phlugis* species, ventral view: 86, *bullatinotum*; 87, *celerinicta*; 88, *chrysopa* (Panama); 89, *arborea*; 90, *gigantea*; 91, *glabra*; 92, *scalpra*; 93, *wittmani*.