I conclude that, at least for the Central American species of the genus with which I am familiar, *P. strigilis* is an aberrant member of the *carrillica* group, and I would caution that the superior appendage may be a deceptively plastic appendage which should be used for phylogenetic groupings only with great care.

I have taken a single female of *Philogenia* near Puerto Barrios, Guatemala, which is about 75 km WNW of San Pedro Sula. This female resembles *strigilis* but has a darker face and a simply rounded lateral margin of the hind lobe. Unless *strigilis* is strongly polymorphic (Calvert, 1924, was puzzled by apparent polymorphism in females of *carrillica* Calvert.), then this female belongs to yet another species.

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THREE NEW SPECIES OF EPIGOMPHUS FROM BELIZE AND MEXICO (ODONATA: GOMPHIDAE)

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ABSTRACT

The genus *Epigomphus* Selys 1854 in Mexico and northern Central America contains six described and three new species. *E. maya* n. sp. from the Maya Mountains of Belize is closest to *E. quadracies* from western Guatemala, Costa Rica, and Panama. *E. flinti* n. sp. from Oaxaca and *E. sulcatistyla* n. sp. (originally placed with *E. paulsoni* from Veracruz) are closest to *E. paulsoni*, which is limited to Chiapas. Males of *Epigomphus* are separated most reliability by the form of their abdominal appendages.

RESUMEN

El género *Epigomphus* Selys 1854 en México y la parte norte de Centro América

contiene seis espécies descritas y tres nuevas. *E. maya* n. sp. de las "Maya Mountains" de Belize está relacionada con *E. quadracies* de la parte occidental de Guatemala, Costa Rica, y Panamá. *E. flinti* n. sp. de Oaxaca y *E. sulcatistyla* n. sp. (originalmente puesta con *E. paulsoni*) de Veracruz están relacionadas con *E. paulsoni*, que está limitada a Chiapas. Machos de *Epigomphus* se diferencian con más seguridad por la forma de los apéndices abdominales.

Although there are 9 species of *Epigomphus* in northern Central America and México, only one of these (*subobtusus* Selys, 1878) is widespread (Costa Rica to México) and represented in collections by numerous specimens. The remainder are rarely taken and apparently very restricted in their occurrences. The holotype of *E. quadracies* (Calvert, 1903) was taken in western Guatemala, but no subsequent specimens have been taken north of Costa Rica. *E. paulsoni* (Belle, 1981) was described from 4 males, 2 from Veracruz and 2 from Chiapas. The Veracruz specimens are here placed in a separate species: *E. sulcatistyla*. *E. crepidus* (Kennedy, 1936) is known from a few males from Nayarit and Chiapas. *E. clavatus* (Belle, 1980) is known from a single male from Alta Verapaz, Guatemala. *E. donnellyi* (Gonzalez-Soriano & Cook, 1988) is known from about a dozen specimens from southeastern Veracruz. Three new species are described herein: *E. flinti* from a single locality in Oaxaca, *E. sulcatistyla* from a single locality in Veracruz, and *E. maya* from the Maya Mountains of Belize.

The present study shows that certain characters used in the gomphidae are of questionable value in separating these species of *Epigomphus*. The size, color pattern, wing venation, and hamules of the 2nd segment are all very similar. All of these species have tiny spines on the dorsum of the 10th abdominal segment (denticles of Belle, 1980, 1981); however, these seem to have limited diagnostic significance.

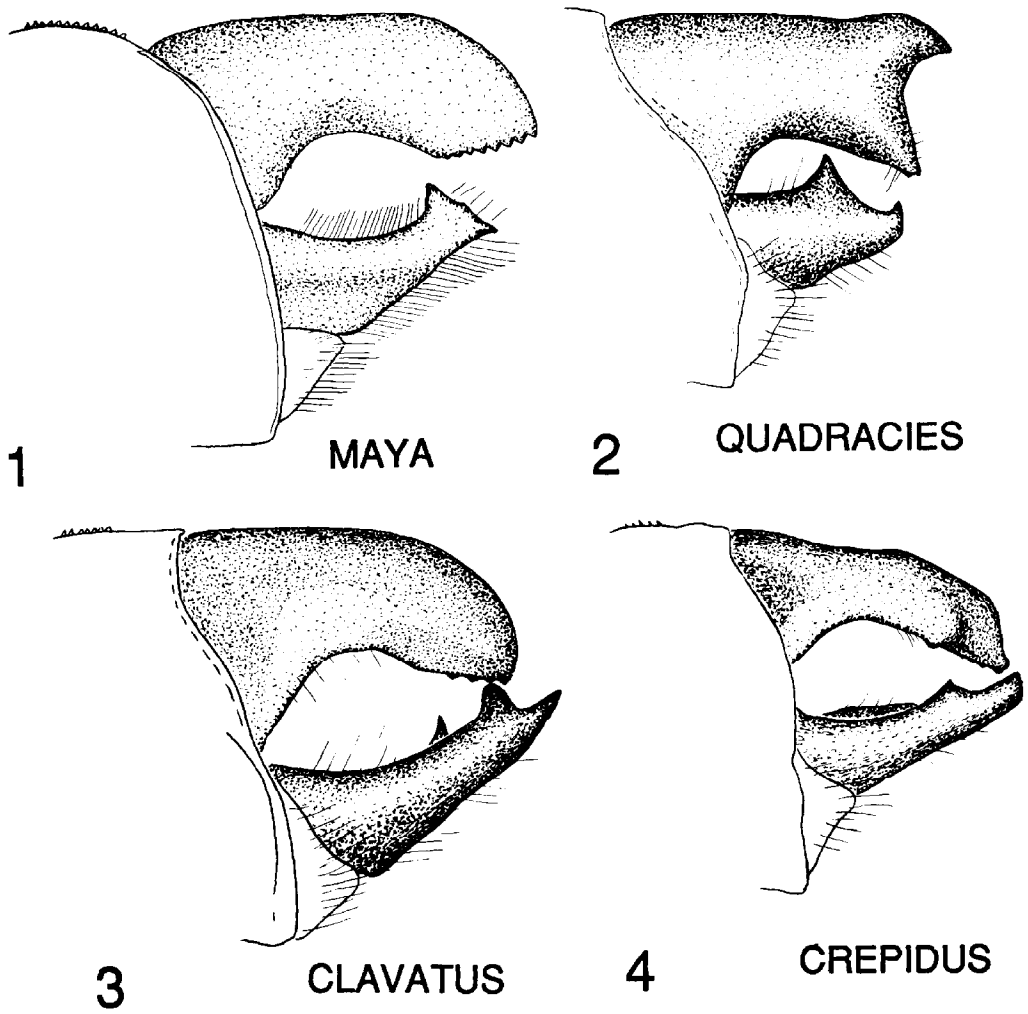
For the males the terminal abdominal appendages are highly differentiated and appear to allow groupings of species. I introduce here a brief terminology to label the protuberances of the dorsal surface of the inferior appendage. The apex (A) of each ramus is generally a distinct point; in some species it is either indistinctly separated from the 1st spine (S1) (*sulcatistyla; maya*) or fused with this spine (*paulsoni*). The 1st, or sublateral, spine (S1) is generally subapical and is especially distinct in lateral view. The 2nd, or submesal, spine (S2) is less visible than S1 in lateral view in four species (*clavatus, sulcatistyla, paulsoni, flinti*) and absent in the remaining 3. The tubercle (T) is the apical end of a rounded submesal ridge on the ramus. In four species it protrudes beyond the margin of the ramus (*maya, quadracies, paulsoni, flinti*). In *sulcatistyla* it has a prominent subapical swelling.

The females of only 3 species are known, not including any of the new species, and I am unable to provide any means for the potential differentiation of the unknown females.

Epigomphus maya Donnelly, new species (Figs. 1, 5, 9)

HOLOTYPE MALE. Head: red brown, pale olive green as follows: rounded lateral spots on labrum, ventro-lateral dashes on postclypeus, transverse band on frons, sides of mandibles, and genae; yellow half circles around outer border of lateral ocelli. Crest of occiput with a very shallow concave angulation; shallow indentations at sides of occiput.

Thorax: prothorax pale brown, obscurely mottled, with paired yellow spots on hind margin of middle lobe. Pterothorax red brown above, obscurely pale yellow below, yellow stripes as follows: 1st and 2nd on mesepisternum, the 2nd (antehumeral) narrow and expanded posteriorly to a rounded spot; 3rd on mesepimeron and 1/4 its width, with



Figs. 1-4. Lateral view of male terminal appendages. Fig. 1, *E. maya*. Fig. 2, *E. quadracies*. Fig. 3, *E. clavatus*. Fig. 4, *E. crepidus*.

expanded, quadrate posterior end; 4th on metepisternum and 1/2 its width, with round, dorsal excavation on posterior 1/2; 5th on metepimeron and 1/2 its width, with expanded, rounded posterior end; transverse isolated bars on anterior edge of mesepisternum; metasternum pale. Wings: venation and pterostigma black; thickened antenodals 6/7 on fore wings, 6/7 on hind wings; 3 cells between A1 and A2, and between A2 and A3 and the hind wing margin; 3 cells between base of wing and A3. Legs: femora pale with darker exterior apical streaks on fore ad mid femora; tibiae and tarsi dark.

Abdomen: dark brown dorsally, sides greenish on 1 to 3, pale on anterior 1/4 (to transverse carina) of 4 to 6; 7 and 8 largely yellow, obscurely brown on posterior 1/4 of 7 and posterior 1/2 of 8; 9 dark; 10 reddish brown; thin yellow dorsal line on 1 to 4; small dorso-apical spot on 5 and 6. Terminal appendages: red brown, tips black; superior thick, decurved (Fig. 1), with truncate tip and thickened apical edge with 7 inferior denticles, angle of tip 35° from midline viewed ventrally (Fig. 9); inferior appendage shorter than superior, shallowly forked with deep, rounded mesal sulcus and sharp dorso-apical projection directed cephalad (S1 of Fig. 5), short apex (A), and submesal dorsally directed tubercle (T) on inner edge of fork. Genitalia of 2nd segment: anterior

hamule thin, flat, with round, tapering tip; posterior subcylindrical, tapering apically to rounded tip, with short black denticles on anterior surface.

Dimensions: abdomen 41 mm; hind wing 35 mm.

VARIATIONS AMONG PARATYPE SERIES. Two paratype males have the abdomen 39 and 41 mm, and the hind wing 34 mm. One paratype male has segment 8 totally dark on the dorsum and the other dark in the apical 1/2 of the dorsum.

MATERIAL EXAMINED. Holotype, BELIZE: Cayo Dist.; Mountain Pine Ridge, Little Vaqueros Cr., Chiquibul Rd. (17° 03 ′ N, 88° 57′ W; 500 m), 22-25 July 1983, Coll. T. Donnelly. One paratype has the same data; the other is from a nearby stream on Wolfson Drive (16° 55′ N, 88° 53′ W; 600 m), 23 July 1983, Coll. T. Donnelly. The holotype is deposited in the Florida State Collection of Arthropods, Gainesville.

The streams in which these insects live are small, clean, probably permanent streams in the dominantly pine forest of the Maya Mountains. The first flows on coarse-grained granite and has a coarse sand to gravel bottom with minor mud; the second flows on sedimentary rocks and has a mud to sand bottom.

ETYMOLOGY: The name is that of the isolated mountain range where the species occurs.

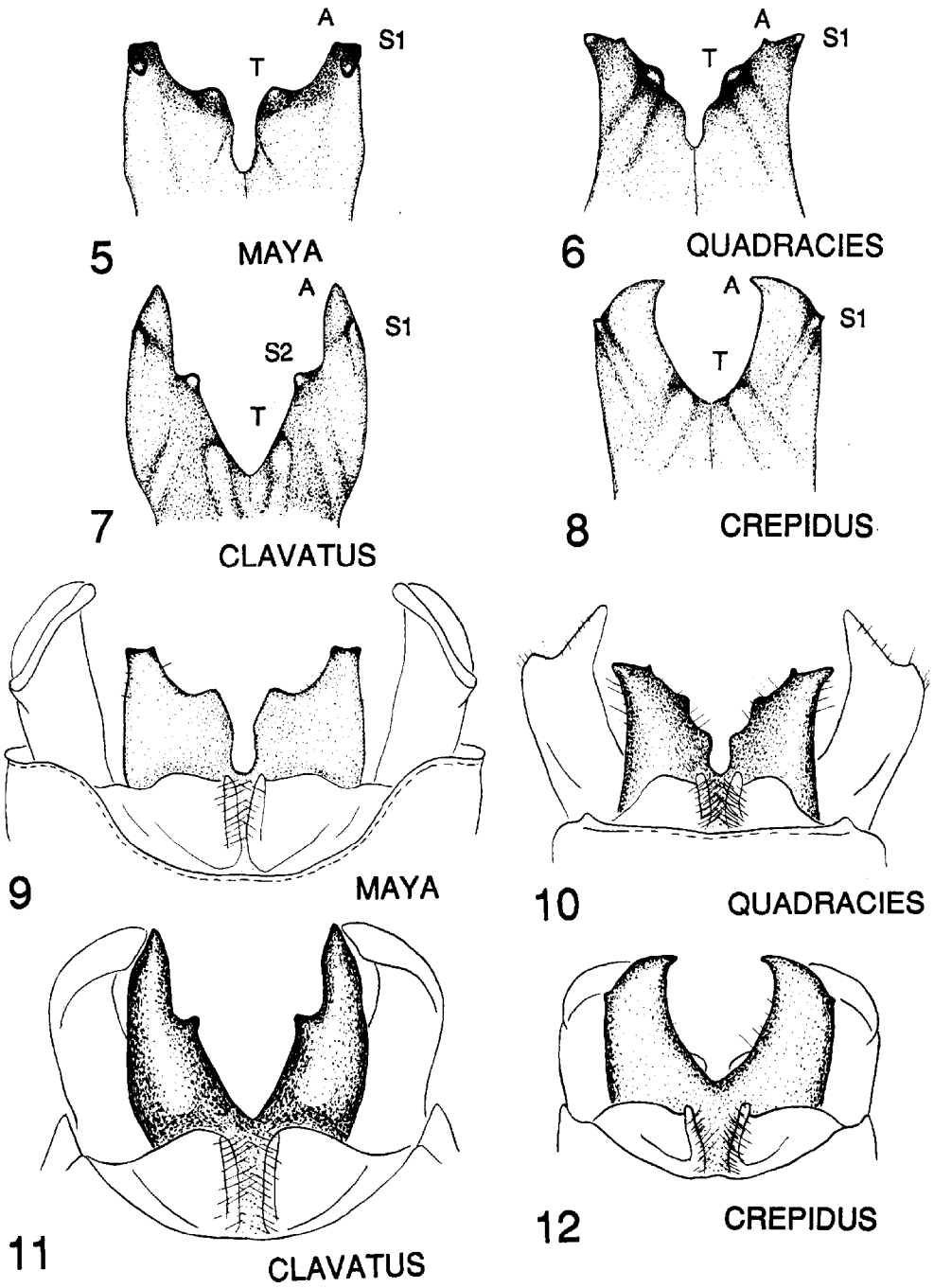
This species is the only *Epigomphus* that has been taken in Belize. The form of its inferior appendage is similar to that of *quadracies*, especially in the appearance of the median sulcus and ornamentation (A, S1, and T; in both species S2 is apparently missing). The superior appendage is of generalized form and resembles several diverse species: *crepidus* (Fig. 4), *clavatus* (Fig. 3), *paulsoni* (Fig. 14), *sulcatistyla* (Fig. 13), and even the very different *subobtusus* (not shown).

Epigomphus flinti Donnelly, new species (Figs. 15, 18, 21, 24)

HOLOTYPE MALE. Head: red brown, pale olive green as follows: large rounded lateral spots on labrum (which also has a vividly black rim), ventro-lateral dashes on postclypeus, transvers centrally interrupted band on frons, sides of mandibles and genae; vertex completely dark; crest of occiput with shallow lateral concave excavations.

Thorax: prothorax obscure red brown, with paired yellow lateral and paired mesal spots on the hind margin of middle lobe; hind lobe dark brown. Pterothorax: red brown above, obscurely pale below, yellow stripes as follows: pale anterior margin of mesepisternum not connected with thin 1st stripe, the 2nd (antehumeral) reduced to a thread and expanded posteriorly to a rounded spot; 3rd on mesepimeron and 1/6 its width, with flared posterior end; 4th on metepisternum and 1/2 its width, with round dorsal excavation on posterior 1/2; 5th on metepimeron and 2/5 its width, with expanded, rounded posterior end; transverse isolated bars on anterior edge of mesepisternum; metasternum pale. Wings: venation black, pterostigma red brown. Thickened antenodals in position 7/7 on fore wings, 6/7 on hind wings; 3 cells between anal vein and hind wing margin, in space between A1 and A2, and between A2 and A3; 3 cells between base of wing and A3. Legs: femora pale, darkened apically; tibiae and tarsi dark.

Abdomen: dark brown dorsally, sides greenish on 1, 2, and anterior 5/6 of 3; pale on anterior 1/4 (to transverse carina) of 4 to 6; basal half of 7 yellow, extended posteriorly on sides; 8 and 9 dark brown; 10 red brown; thin yellow dorsal line on 1 to 4; small dorso-apical spot on 5. Terminal appendages: dark brown; superior thick, decurved, very slightly apically excavated in lateral view (Fig. 15), with truncate tip and thickened apical edge bearing 2 large teeth and a few denticles; angle of tip 30° from mid line viewed ventrally (Fig. 24); inferior appendage shorter than superior, shallowly forked, with small apical point (A of Figs. 18, 21), largest dorsal spine (S1) flattened, subapical on outer edge, small submesal spine (S2) and low mesal paired tubercles (T), with T, S2, and S1 lying on straight line on each ramus. Genitalia of 2nd segment: anterior hamule thin, flat, with rounded, tapering tip; posterior hamule flat, tapering apically to rounded tip, with short, black denticles on anterior surface.



Figs. 5-12. Dorsal view (Figs. 5-8) and ventral view (Figs. 9-12) of male inferior appendages. A = apex; S1 = subapical spine; S2 = submesal spine; T = mesal tubercle. Fig. 5, *E. maya* (S2 not present). Fig. 6, *E. quadracies* (S2 not present). Fig. 7, *E. clavatus*. Fig. 8, *E. crepidus* (S2 not present). Fig. 9, *E. maya*. Fig. 10, *E. quadracies*. Fig. 11, *E. clavatus*. Fig. 12, *E. crepidus*.

Dimensions: abdomen 42.5 mm; hind wing 35 mm.

VARIATIONS AMONG PARATYPE SERIES. Of the 6 paratype males, 2 have the 2nd

thoracic stripe discontinuous. The abdomens of the series range from 39 to 42.5 mm and the hind wings from 32 to 35 mm.

MATERIAL EXAMINED. Holotype and 6 paratype males, MEXICO: Oaxaca, 8 km S. of Valle Nacional, 25 May, 1981, Coll. C. M. and O. S. Flint, Jr. The holotype and most of the paratypes are deposited in the U.S. National Museum, Washington. One paratype is deposited in the Florida State Collection of Arthropods, Gainesville.

ETYMOLOGY: The species is named for its collector, Ollie Flint. The dedication to him also reflects the many extensive and valuable Odonata collections he has made while pursuing trichoptera throughout the New World, as well as his generous and unfailing assistance to odonatologists.

This species is close to *E. paulsoni* and *E. sulcatistyla*, whose ranges straddle the occurrence of *flinti*. The 3 species are distinguished by (1) the tips of the superior appendage in dorsal or ventral view (Figs. 13-18), which are truncated at a far more acute angle in *flinti* than in *paulsoni* or *sulcatistyla*; and (2) the form of the inferior appendage. In *flinti* the subapical spines S1 and S2 of each ramus are rounded in section, pointed, and subequal in length (Fig. 18). They give the appearance of a pair of horns on each ramus, in contrast to the flattened S1 and blunt S2 of the other 2 species (Figs. 16, 17).

Epigomphus sulcatistyla Donnelly, new species (Figs. 13, 16, 19, 22)

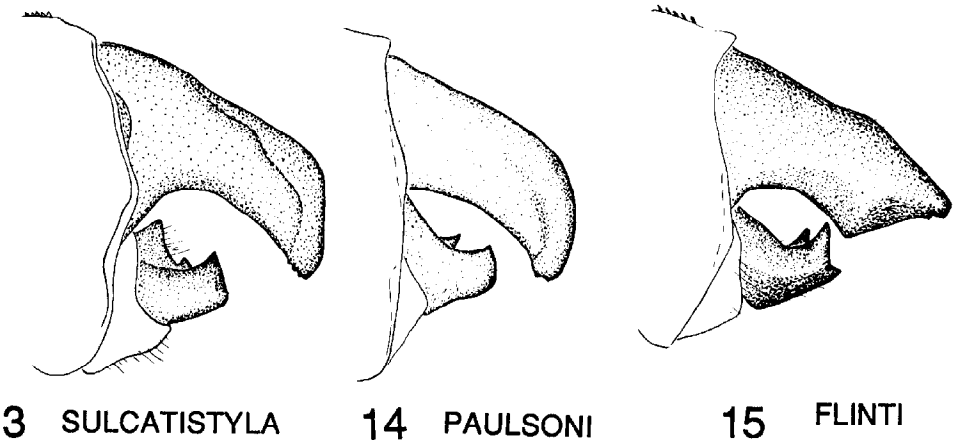
Epigomphus paulsoni: Belle 1981:61 (in part)

HOLOTYPE MALE. Head: red brown, pale olive green as follows: large rounded lateral spots on labrum (which also has a narrowly black rim), ventro-lateral dashes on postclypeus, transverse band on frons, sides of mandibles and genae; vertex completely dark; crest of occiput with shallow lateral concave excavations.

Thorax: prothorax obscure pale brown, with middle lobe pale laterally and with paired yellow mesal spots on the hind margin; hind lobe dark brown. Pterothorax: red brown above, obscurely pale below, yellow stripes as follows: pale anterior margin of mesepisternum not connected with thin 1st stripe, the 2nd (antehumeral) thin and subequal in width throughout; 3rd on mesepimeron and 1/5 its width, with expanded posterior end; 4th on metepisternum and 1/2 its width, narrowed and then expanded posteriorly into a circular spot; 5th on metepimeron and 1/2 its width; transverse isolated bars on anterior edge of mesepisternum; metasternum pale. Wings: venation black, pterostigma dark red brown. Thickened antenodals in position 6/7 on fore wings, 5/6 on hind wings; 3 cells between anal vein and hind wing margin, in space between A1 and A2, and between A2 and A3; 3 cells between base of wing and A3. Legs: femora pale, darkened apically; tibiae and tarsi dark.

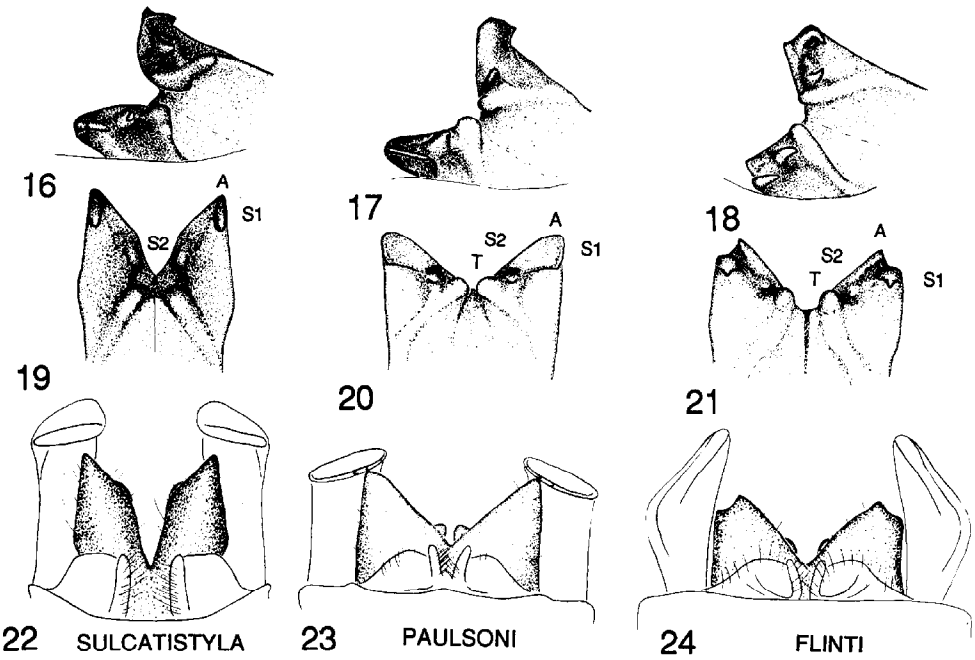
Abdomen: dark brown dorsally, sides heavily marked with greenish on 1 and 2, obscure lateral pale dashes on 3 (5/6 length) to 6 (1/2 length); small pale dorsolateral basal lines on 3 to 6, shortened posteriorly to spots; 7 largely pale, obscurely darker brown on dorsoposterior margin; 8 and 9 obscurely brown; 10 dark red brown. Terminal appendages: dark red brown; superior thick, decurved, tips infolded inwards (Fig. 13), apical-ventral margin bearing dark teeth; angle of tip 85° from mid line viewed ventrally (Fig. 16); inferior appendage shorter than superior, forked, with deep mesal sulcus; apex (A) fused with flattened sublateral spine (S1); submesal spine (S2) midway between S1 and T; tubercle (T) produced subapically into high and prominent submarginal swelling (Figs. 16, 19). Genitalia of 2nd segment: anterior hamule thin, flat, with rounded, tapering tip; posterior hamule subcylindrical-triangular, tapering apically to rounded tip, with short, black denticles on anterior surface.

Dimensions: abdomen 41 mm; hind wing 34 mm.



Figs. 13-15. Lateral views of male terminal appendages. Figs. 13, *E. sulcatistyla.* Figs. 14, *E. paulsoni.* Figs. 15, *E. flinti.*

VARIATIONS AMONG PARATYPE SERIES. The paratype male (figured in part as the paratype of *E. paulsoni* Belle, 1981) has the abdomen broken and the hind wing 34.5 mm. There are no important differences between the two specimens.
MATERIAL EXAMINED. Holotype and paratype males, MEXICO: Veracruz; stream at Coyame (1300'), 1 July 1965, coll. D. R. Paulson. The holotype is deposited in the Florida State Collection of Arthropods, Gainesville, and the paratype in the Paulson collection.



Figs. 19-24. Inclined dorsal-lateral (Figs. 16-18), dorsal (Figs. 19-21), and ventral (Figs. 22-24) views of male terminal appendage. S1, S2, T, and A as for Figs. 5-8. Figs. 16, 19, 22, *E. sulcatistyla* (T not labeled). Figs. 17, 20, 23, *E. paulsoni.* Figs. 18, 21, 24 *E. flinti.*

Belle (1981) discussed the differences between the Veracruz and Chiapas specimens at some length in the original description of *E. paulsoni*. However, he did not dicsuss the very different inferior appendages, which are the crux of the present description. The discovery of *E. flinti* intermediate in range between the other 2 forms forces us to focus on the morphological differences among the members of this group of sibling species.

The Northern Species of *Epigomphus*

The 9 species of *Epigomphus* of Guatemala, Belize, and México are the most northerly in the genus and form a relatively homogeneous group within a total of 22 species extending south to Brazil and Argentina. These 9 species fall into 3 groups of 2 species each and a group of 3 species. The first pair of species are *subobtusus* and *donnellyi*, which are further closely related to *E. westfalli* (Donnelly, 1985) from Nicaragua. These species are not figured here, but have been figured recently in Donnelly (1985) and González-Soriano and Cook (1988). They are easily distinguished from the remaining 7 by their long and deeply divaricate inferior appendage. Of the remaining species, *maya* and *quadracies* have similar inferior appendages, both of which have diminished apices (A of Figs. 5, 6) and a prominent median sulcus. The species *crepidus* and *clavatus* have elongate apices (A of Figs. 7, 8) and diminished mesal tubercles (T), with different arrangements of spines (S1 and S2, the latter absent in *crepidus*). The species *flinti*, *sulcatistyla*, and *paulsoni* have short apices (A of Figs. 19-21) set very close to spines S1, and spines S2 similarly developed. The differences among these 3 species have been noted above.

Acknowledgments

I am very grateful to D. Paulson for the loan of a paratype of *E. paulsoni* and a specimen of *e. crepidus*, and the provision of the holotype of *E. sulcatistyla*; to J. Belle for the loan of a paratype of *E. paulsoni* which has become the paratype of *E. sulcatistyla*; to G. Jurzitza for the loan of the holotype of *E. clavatus*; and to R. Garrison for the loan of additional specimens. G. Bick, M. Westfall, and S. Dunkle made valuable criticisms of an earlier draft of this manuscript.

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