

NEW DRAGONFLIES (ODONATA) FROM COSTA RICA

by

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ABSTRACT

Brooks, S. J., 1989. New dragonflies (Odonata) from Costa Rica. — *Tijdschrift voor Entomologie* 132: 163-176, figs. 1-24. [ISSN 0040-7496]. Published 1 December 1989.

Palaemnema baltodanoi (Platystictidae), *Philogenia peacocki* (Megapodagrionidae), *Phyllogomphoides burgosi* and *Epigomphus echeverrii* (Gomphidae) are described from a collection of Odonata made in Guanacaste National Park, north-west Costa Rica. A fifth new species, *Epigomphus boughtoni* from eastern Costa Rica, is also recorded. The possible affinities of the new species are discussed.

Key words. — Odonata, Costa Rica, Guanacaste, new species.

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INTRODUCTION

This paper forms the first part of a larger project to make an inventory of the Odonata of Guanacaste National Park, in north-west Costa Rica, and ultimately to produce a field-guide to the dragonflies of Costa Rica. Four of the five species described below were part of a collection that I made in Guanacaste National Park during July 1988. The fifth species was collected by Mr. John Paul in eastern Costa Rica and for convenience it is also recorded here.

Most of the 700 km² of Guanacaste National Park comprises tropical dry forest (Janzen 1986), although all of the new species were collected in the rain-forest covering the western slopes of two volcanoes at the northern end of the Cordillera de Guanacaste. Here there are many permanent rivers and streams which support large assemblages of Odonata. Some of these species are wide-ranging throughout much of Mesoamerica but some genera, and particularly those in which the new species are described, include species which have more restricted distributions. The odonate fauna of Costa Rica is probably the best known in all of Central America and comprises about 250 species (Paulson 1982). However, until I visited Guanacaste National Park there had been no major collection of Odonata on Volcan Orosi or Volcan Cacao. Several of the species that I collected on the volcanoes, such as *Erpetogomphus tristani* Calvert, *Perigomphus pallidistylus* (Belle), *Neocor-*

dulia batesi longipolex Calvert and *Argia rogersi* Calvert, had rarely been collected before. Of a total of 15 species collected on Volcan Cacao, three were undescribed. Therefore, it is possible that the new species are endemic to the river systems on the volcanoes or are at least restricted to the surviving remnants of upland rain-forest in the northern part of the country.

TAXONOMY

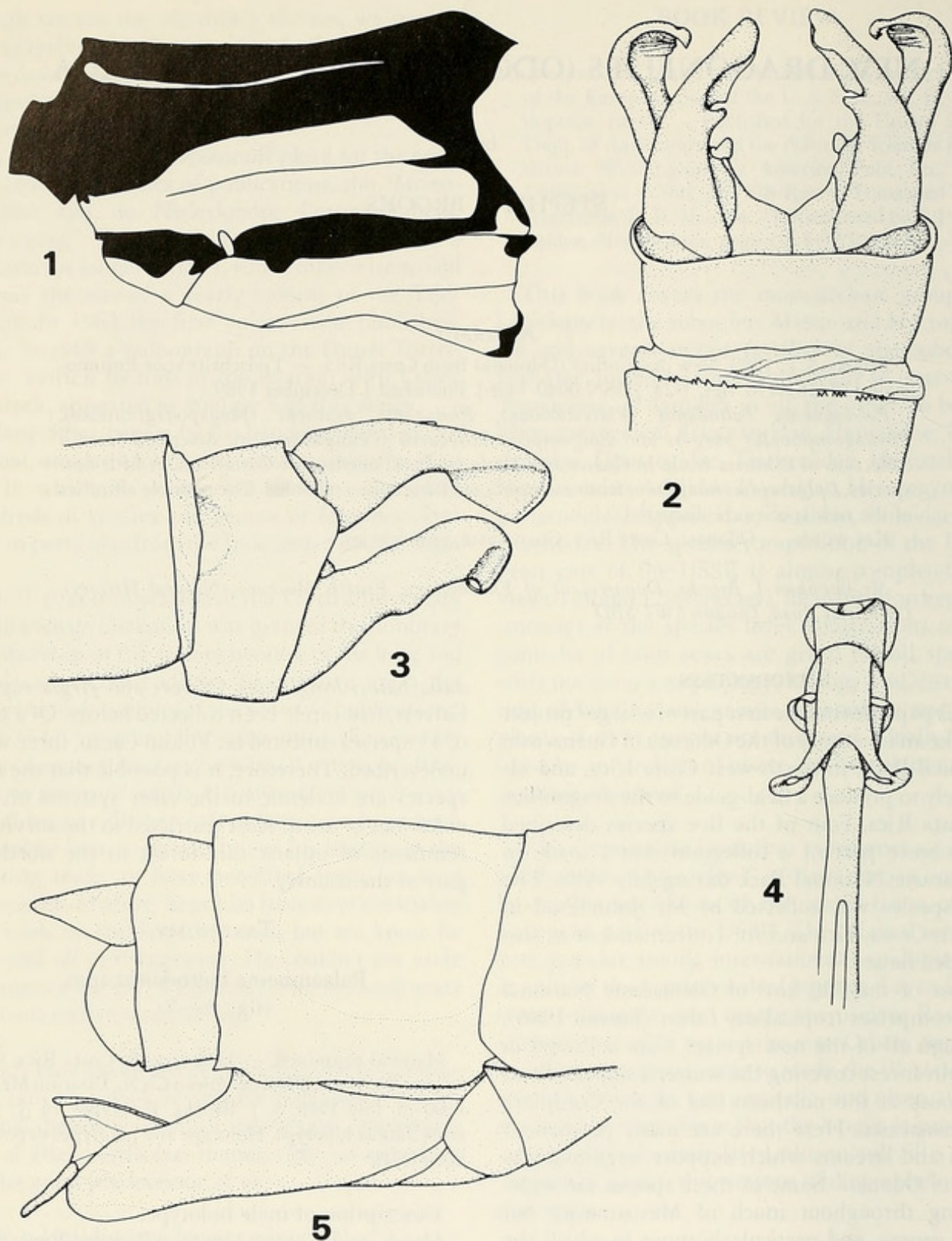
Palaemnema baltodanoi sp.n. (figs. 1—5)

Material examined. — Holotype ♂: Costa Rica, Guanacaste Province, SW side Volcan Cacao, Estacion Mengo, 1100 m, July 1988, S. J. Brooks. Paratypes 14 ♂, 3 ♀: same data as holotype. Holotype and paratypes deposited in BMNH.

Description of male holotype.

Head: width across eyes 4.7 mm. Eyes dark brown in life. Labrum pale blue with black stripe across anterior margin; base of mandible pale blue; gena pale blue; anteclypeus pale blue; postclypeus black; frons and area between eye and antenna from lateral ocellus to gena metallic dark blue; vertex black with small pale brown spot adjacent to lateral ocellus; occiput black; labium pale brown.

Prothorax: anterior lobe apple green, black medially; propleuron black; median lobe with large apple green lateral spot; posterior lobe black.



Figs. 1—5. *Palaemnema baltodanoi* sp.n. — 1, Pterothorax, left lateral view. 2, Male anal appendages and apex of abdomen, dorsal view. 3, Male anal appendages and apex of abdomen, lateral view. 4, Penis, ventral view. 5, Female apex of abdomen, lateral view.

Pterothorax (fig. 1): bronze-black on dorsum with narrow (width 10% of episternum 2) apple green antehumeral stripe extending from collar carina to within 10% of antealar carina; mesepimeron black in dorsal half, apple green below, this pale area tapering anteriorly with broad black stripe adjacent to antealar carina; metepisternum apple green in dorsal half, black ventrally; metepimeron apple green, becoming pale yellow ventrally, with narrow black stripe adjacent to second lateral suture.

Legs: white with black stripe on dorsum of femur and fore tibia; coxa white; tarsus black.

Wings: hyaline with yellow-brown suffusion along costal margin, darkest at apex. Venation black. Pterostigma red-brown with narrow pale border; 1.4 mm in fore wing, 1.7 mm in hind wing; 2–2.5 cells below pterostigma in fore wing, 1.75 in hind wing. 25 postnodals in fore wing, 20–22 in hind wing. R^3 arises at 8th postnodal in fore wing, 7th in hind wing.

Measurements: hind wing 28.0 mm; 5.0 mm at greatest width.

Abdomen: black with the following pale yellow ventro-lateral markings: S1 with large square spot; S2 with longitudinal stripe, tapering apically, in basal three-quarters; S3–S7 with tapering longitudinal stripe in basal quarter; S8 with rounded spot in basal quarter; S9–S10 unmarked. Penis filament tips (fig. 4) form A of Calvert (1931).

Superior appendages (figs. 2–3): black; about same length as inferiors, three times as long as S10; parallel in basal half, converging apically with short, blunt submedian (53% of length) tooth on inner dorsal margin; appendage abruptly widened ventrally at 70% of length with ventral margin of this portion straight; apex straight.

Inferior appendages (figs. 2–3): black with white ventro-lateral subapical spot; diverging basally but strongly incurved in apical 20%, this latter section with transverse ridges on inner surface; abruptly constricted at apex to give short, curled apical tooth; ventral margin with slight swelling present just proximal to apical tooth; short, blunt, apically projecting tooth present on inner margin at 25% of length; dorsum of basal 25% concave; in lateral view appendage angled dorsally at about 45°.

Measurements: total length 47.5 mm; abdomen 39.5 mm (including appendages 1.3 mm).

Description of female.

As male except the following:

Prothorax: pale markings dull yellow-green.

Pterothorax: pale markings dull yellow-green, mesepimeron entirely black.

Wings: hind wing 26.0–27.5 mm. Pterostigma 1.4 mm in fore wing, 1.5 mm in hind wing; 25–27 postnodals in fore wing, 21–23 in hind wing.

Abdomen: pale markings yellow-brown, triangular, broader and shorter than in male; S9 with large lateral blue-grey spot in basal two-thirds extending dorsally in basal half. Ovipositor extending 0.4 mm beyond apex of abdomen; straight ventrally, untoothed (fig. 5).

Anal appendages: short, conical, 0.4 mm in length.

Measurements: total length 40.5–44.0 mm; abdominal length 32.5–36.0 mm.

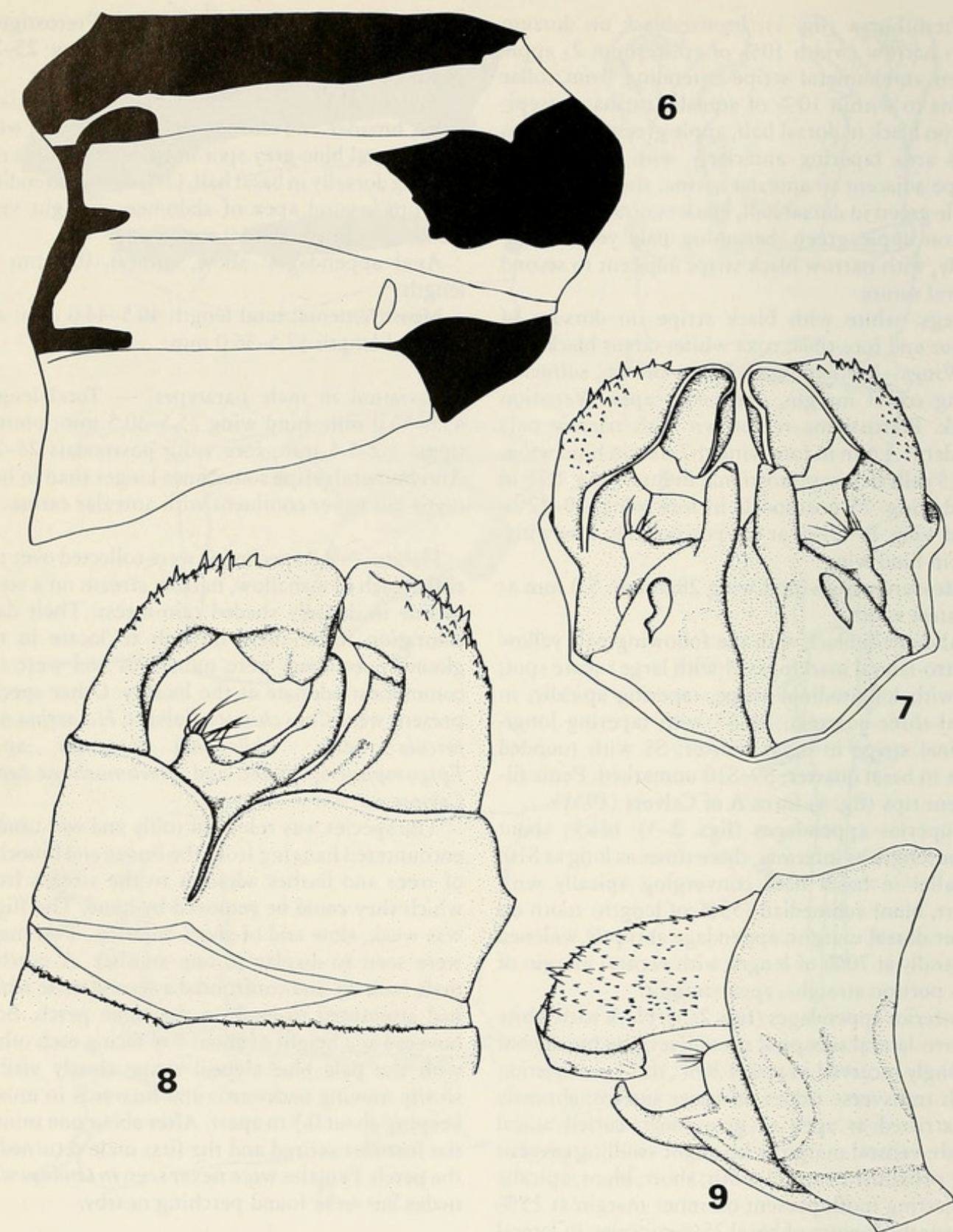
Variation in male paratypes. — Total length 43.0–55.0 mm; hind wing 25.5–30.5 mm; pterostigma 1.2–1.4 mm; fore wing postnodals 24–27. Antehumeral stripe sometimes longer than in holotype but never confluent with antealar carina.

Habits. — All specimens were collected over the riffle reach of a shallow, narrow stream on a steep incline in densely shaded rain-forest. Their dark coloration made them difficult to locate in the gloom. Specimens were numerous and were the commonest odonate at the locality. Other species present were *Cora chirripa* Calvert, *Hetaerina majuscula* Selys, *Philogenia peacocki* sp.n., *Epigomphus* sp. indet. and *Brechmorhoga rapax* Calvert.

The species was reluctant to fly and was usually encountered hanging from the leaves and branches of trees and bushes adjacent to the stream from which they could be removed by hand. The flight was weak, slow and of short duration. Two males were seen to display to one another. A perched male took off and confronted a second male which had attempted to land on the same perch. Both hovered at a height of about 1 m facing each other, with the pale blue clypeal stripe clearly visible, slowly moving backwards and forwards in unison keeping about 0.3 m apart. After about one minute the intruder retired and the first male returned to the perch. Females were never seen *in tandem* with males but were found perching nearby.

Remarks. — Paulson (1982) lists 17 species of *Palaemnema* from Central America of which seven are known from Costa Rica. There is a high degree of endemism with six of the seven Costa Rican species being endemics. Typically these species inhabit shady streams in dense forest although the more widely distributed species occur in more open, lowland localities.

Males of *Palaemnema baltodanoi* sp.n. can be



Figs. 6—9 *Philogenia peacocki* sp.n., male holotype. — 6, Pterothorax right lateral view. 7, Anal appendages, ventral view. 8, Apex of abdomen and anal appendages, interno-dorsal view. 9, Apex of abdomen and anal appendages, lateral view.

distinguished from most of the other species in the genus by the lack of blue markings at the apex of the abdomen. Also, the abrupt median swelling of the ventral margin of the superior appendages is distinctive since in most species this gradually widens. In the keys to the genus provided by Calvert (1931) the new species comes out to *apicalis* Calvert. However, unlike *baltodanoi*, there is no antehumeral stripe in *apicalis* and the medio-dorsal tooth of the superior appendage is not as prominent in lateral view. The apical tooth of the inferior appendage in *apicalis* is long and abruptly curved dorsally (like a hairpin) to form a narrow dorsal notch but in *baltodanoi* it is shorter, more rounded and curves inwards with no notch on the dorsal margin. The inferior margin of the superior appendage, where it expands in the apical half, is not angulate in *apicalis* and is narrower than in *baltodanoi*. At the apex of the penis filament there is a basal lobe in *apicalis* which is absent in *baltodanoi*.

The anal appendages of *baltodanoi* are similar morphologically to *P. paulirica* Calvert and *distadens* Calvert and in particular there is a swelling on the ventral margin of the inferior appendage just proximal to the apical hook in both *distadens* and *baltodanoi*. However, *paulirica* differs from *baltodanoi* in possessing a slight invagination at the apex of the superior appendages and in *distadens* the apical tooth on the inferiors is not curled. The thoracic markings of *baltodanoi* are also similar to *distadens* but in *distadens* and *paulirica* the abdominal segments 8 and 9 are marked blue dorsally.

This species is named in honour of Sr Jorge Baltodano who very kindly allowed his ranch to be purchased by Guanacaste National Park.

Philogenia peacocki sp. n.

(figs. 6–9)

Material examined. — Holotype ♂: Costa Rica, Guanacaste Province, SW side Volcan Cacao, Estacion Mengo, 1100 m, July 1988, S. J. Brooks. Paratype ♂: Costa Rica, Puntarenas Province, Monteverde, Rio Guacimal and small streams in biological reserve, 1600 m, 7 June 1986, T. W. Donnelly. Holotype deposited in BMNH, paratype in Donnelly collection.

Description of male holotype.

Head: width across eyes 6.7 mm. Eyes black in life. Labrum pale blue; base of mandible pale blue; gena pale blue; anteclypeus and postclypeus black; frons black with small pale blue spot below scape; vertex black with pale blue spot between lateral ocellus and eye; labium and occiput black.

Prothorax: anterior lobe with blue medio-lateral spot; median lobe with large blue lateral spot; posterior lobe with small blue lateral spot.

Pterothorax (fig. 6): azure blue with the following black markings: broad antehumeral stripe extending over dorsal carina; small spot at posterior end of humeral suture; narrow black stripe adjacent to antealar carina with short stripe extending onto first and second lateral suture; katepisternum 2 black; broad black stripe at anterior end of mesepimeron; katepisternite 3 black. Minute blue spots on antealar sinus. Notum of thorax with pale blue/grey pruinescence.

Legs: femur blue with black stripe on posterior side; tibia and tarsus black with pale brown stripe on posterior side of mid and hind leg.

Wings: hayline with yellow-brown suffusion especially around margins. Venation black. Pterostigma dark reddish brown, 2.2 mm in fore wing, 2.5 mm in hind wing. 24–25 postnodals in fore wing, 22–23 in hind wing. 4–5 cells below pterostigma; R³ arises between 10th and 11th postnodal in fore wing, between 8th and 9th in hind wing.

Measurements: hind wing 34 mm, greatest width 6 mm.

Abdomen: black with the following markings: S1 with broad lateral blue spot, S2–S7 with small blue oval baso-lateral spot and yellowish tapering stripe in basal quarter; blue-grey pruinosity on dorsum and laterally on S1–S2 and S9–S10.

Superior appendages (figs. 7–9): black with dorsal blue-grey pruinosity; strongly convergent in dorsal view; apical half downcurved in lateral view; meso-ventral process absent; apex swollen with shallow median indentation.

Inferior appendages (figs. 7–9): 0.7 times length of superiors; parallel not diverging; strongly curving dorsally in lateral view, tapering to blunt apex with a small subapical notch; setose, dorsally projecting, basal tubercle present.

Measurements: total length 51 mm; abdomen 40.5 mm (including anal appendages 1.4 mm).

Female unknown.

Variation in paratype. — 25–26 postnodals in fore wing; 23–24 postnodals in hind wing. Hind wing 36 mm, 6.5 mm at widest. Total length 53 mm; abdomen 42 mm. When viewed laterally the internal apical lobe of the superior appendages extends further ventrad. The superiors, on the interno-dorso-lateral margin, have a more prominent lobe just proximal of the ventral expansion. The subapical tooth on the inferiors is smaller. In dorsal view, the median dog-leg curve of the inferior appendage is more angulated.

Habits. — The holotype was perched on the branch of a bush at about 2 m, overhanging a riffle reach on a narrow (1 m), shallow (0.2 m) stream in densely shaded rain-forest. It was the only specimen seen.

Remarks. — Six species of *Philogenia* are known from Central America of which three occur in Costa Rica (Bick & Bick 1988, May 1989). Only one of these is endemic to the country but the other two species occur only in Costa Rica and Panama. In fact, as Bick & Bick (1988) point out, only one of the 28 known species of *Philogenia* has anything like a widespread distribution. The distribution of the genus is centred on northern South American with Costa Rica being its northern limit.

The new species belongs to the *helenae* (Hagen)-group of species (Bick & Bick 1988). It seems closest to *P. berenice* Higgins, described from Peru, but the superior appendages are relatively longer and more abruptly downcurved in *berenice* and the meso-ventral process is broader in the latter species. The inferior appendages of *berenice* lack the ventral cavity and dorso-basal tubercle, although the dorso-basal ridge is more developed. In addition, at the apex of the inferior appendages of *berenice* are a pair of small, subequal tubercles, rather than a subapical notch which is present in *peacocki*.

This species is named in honour of Mr. Harold Peacock who very kindly allowed his ranch to be purchased by Guanacaste National Park.

***Phyllogomphoides burgosi* sp.n.**
(figs. 10–13)

Material examined. — Holotype ♀: Costa Rica, Alajuela Province, 8 km S Santa Cecilia, Estacion Pitilla, 680 m, July 1988, S. J. Brooks. Holotype deposited in BMNH.

Male: Unknown.

Description of female holotype.

Head (fig. 10): width across eyes 10.2 mm. Eyes blue-grey in life. Labrum black with medio-lateral yellow-green spot; mandible black, yellow-green at base; gena brown with small yellow-green ventral spot; anteclypeus yellow-green; postclypeus brown with yellow-green lateral spot; frons brown with prominent lateral, dorsally projecting horn 2.8 mm in height, 1.5 mm wide at base, 0.4 mm at apex; horn brown with pale yellow-green stripe on inner and front surface and tuft of short, posteriorly projecting setae at apex; vertex red-brown with steep M-shaped ridge behind lateral ocelli; dorsum of occiput dark brown with shallow median depres-

sion and fringe of long setae on upturned posterior margin; occiput red-brown with shallow groove extending from occipital tubercle to sinus of pre-mandibular suture, crossed at right angles by numerous short striae.

Prothorax: red-brown with yellow lateral spot on anterior lobe, yellow median and lateral spot on middle lobe.

Pterothorax (fig. 11): red-brown with the following yellow markings: narrow stripe on dorsal carina; collar carina with broad stripe; antehumeral stripe short and narrow; humeral stripe broadening posteriorly; broad mesepimeral stripe; metepisternal stripe broad, interrupted at spiracle with isolated spot anterior of spiracle; katepisternite with large spot; metepimeral stripe narrowly margined with brown; sternites with median stripe.

Legs: tibia and tarsus black; femur yellow-brown but fore femur black on outer surface.

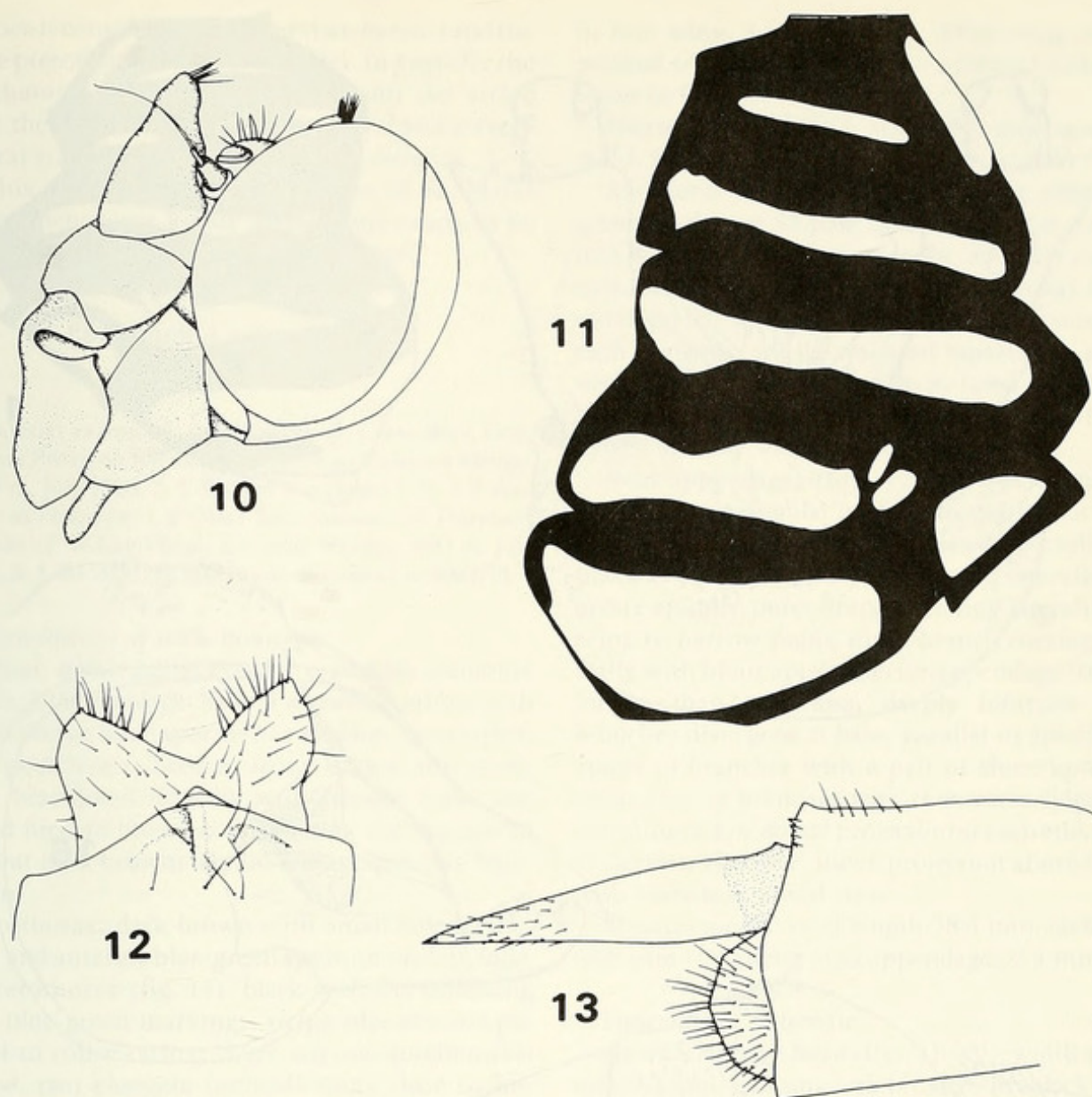
Wings: hyaline with amber suffusion around veins, becoming darker at wing base. Venation black. Pterostigma dark red-brown, 5.4 mm in fore wing, 5.9 mm in hind wing. Basal subcostal crossvein present. Nodal index 17 : 25 : 23 : 16/15 : 18 : 18 : 17. Secondary primary antenodal 8th or 9th crossvein in fore wing, 8th in hind wing. Inter-median crossveins 14 : 13/11 : 10. Supratriangle 2-celled in fore wing, 2-3 celled in hind wing. Discoidal triangle 3-celled; subtriangle 3-celled. One cubitoanal crossvein in all wings. Anal loop 3-celled.

Measurements: hind wing 47 mm, greatest width 12 mm.

Abdomen: black with the following yellow markings: S1 dorsum with small medio-apical spot and lateral spot in ventral half; S2 dorsum with basal T-shaped marking extending to second carina, laterally with spot in ventral half; S3 with lateral semicircular spot almost extending to transverse carina, dorsum marked with fine mid-dorsal stripe broadening slightly at base; S4 marked dorsally with small basal spot and laterally with small dome-shaped spot terminating before transverse carina; S5–S6 marked similarly to S4 but spots progressively smaller; S7 with basal band extending to transverse carina; S8 with wedge-shaped medio-ventral lateral spot and minute isolated spot beyond apex of wedge; S9–S10 unmarked. Foliations absent. Vulvar scale (fig. 12) broadly U-shaped, arms broad with small apical tubercle, 0.56 mm in length.

Anal appendages (fig. 13): black in basal 0.15% then yellow, lanceolate with black tip.

Measurements: total length 70 mm; abdomen 51 mm (including anal appendages 3.1 mm).



Figs. 10—13, *Phyllogomphoides burgosi* sp.n., female holotype. — 10, Head, lateral view. 11, Pterothorax, right lateral view. 12, Vulvar scale, ventral view. 13, Apex of abdomen, lateral view.

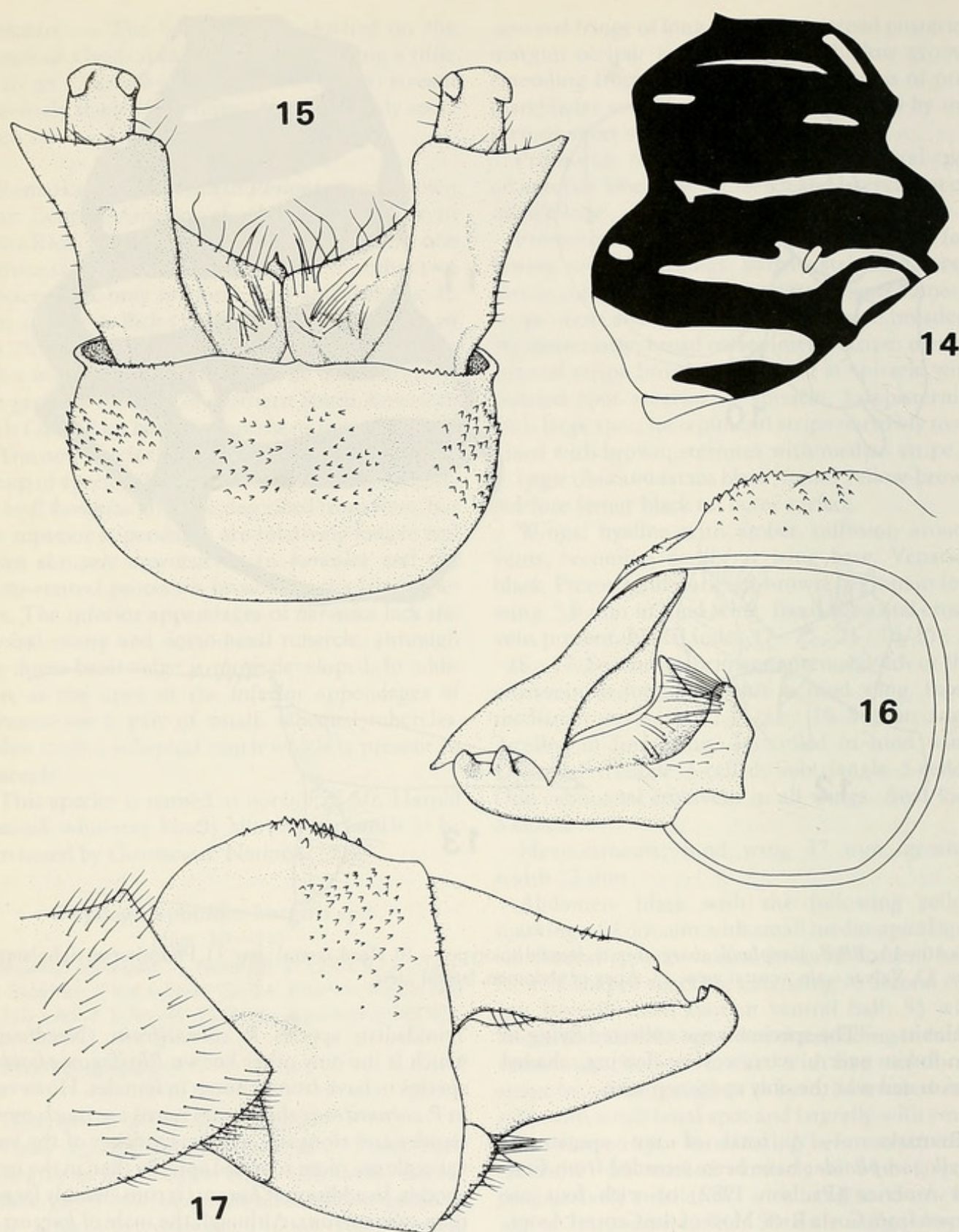
Habits. — The specimen was collected flying in rain-forest over a narrow slow-flowing, shaded stream and was the only specimen seen.

Remarks. — A total of ten species of *Phyllogomphoides* have been recorded from Central America (Paulson 1982) of which four are known from Costa Rica. Most of the Central American species are quite widespread and only three are restricted to just one country. None of the previously described species is restricted to Costa Rica but *P. appendiculatus* Kirby occurs only in Costa Rica and Panama.

The new species appears to belong to the *bifasciatus* (Hagen)-group (Donnelly 1979) in which the vulvar scale is simple without lateral spines or protrusions. It is apparently related to the

Trinidadian species *P. cornutifrons* (Needham) which is the only other known *Phyllogomphoides* species to have frontal horns in females. However, in *P. cornutifrons* the frontal horns are much more slender and elongate, and the branches of the vulvar scale are more rounded apically than in the new species. In addition *P. burgosi* is considerably larger than *cornutifrons*. Although the male of *burgosi* is still unknown there can be little doubt concerning the identity of the species because of the possession of the extraordinary frontal horns. I feel that it is justifiable to describe the species based on a single female specimen in order to draw attention to the existence of second *Phyllogomphoides* species with frontal horns.

Of the Central American species only the female of *P. pugnifer* Donnelly is unknown. However, this



Figs. 14—17. *Epigomphus echeverrii* sp.n., male holotype. — 14, Pterothorax, right lateral view. 15, Apex of abdomen and anal appendages, dorsal view. 16, Left anal appendages, interno-caudal view (right appendages not shown). 17, Apex of abdomen and anal appendages, lateral view.

species is considerably smaller than *burgosi* and the male pterothoracic markings differ. In *pugnifer* the antehumeral stripe is confluent with the stripe near the collar carina and the humeral and mesepimeral stripes are narrower than in *burgosi*.

This species is named in honour of Sr. Mario Burgos who very kindly allowed his ranch to be purchased by Guanacaste National Park.

***Epigomphus echeverrii* sp. n.**
(figs. 14–21)

Material examined. — Holotype ♂: Costa Rica, Guanacaste Province, SW side Volcan Cacao, Estacion Mengo, 1100 m, July 1988, S. J. Brooks. Paratypes 1 ♂, 2 ♀ data same as holotype; 1 ♀ Costa Rica, Guanacaste Province, W side of Volcan Orosi, Estacion Maritza, 600 m, July 1988, S. J. Brooks. All specimens deposited in BMNH.

Description of male holotype.

Head: width across eyes 8.1 mm. Eyes turquoise in life. Labrum black; base of mandible yellow with small brown basal spot; gena pale blue; anteclypeus and postclypeus brown; frons brown anteriorly, pale blue-green dorsally with narrow basal and broad median brown stripe; vertex and dorsum of occiput dark brown; labium and occiput pale blue-green.

Prothorax: dark brown with small lateral, median and anterior blue-green spots on median lobe.

Pterothorax (fig. 14): black with the following pale blue-green markings: stripe adjacent and parallel to collar carina; short, narrow antehumeral stripe; two elongate humeral spots close to humeral suture, one near anterior suture, the second near the antealar carina; narrow mesepimeral stripe; metepisternal stripe interrupted posteriorly leaving small isolated spot near antealar carina; metepimeron with broad stripe concurrent posteriorly with narrow ventral stripe.

Legs: tibia and tarsus black, femur dark brown, paler on posterior edge and internal face of fore femur yellow-green. Hind leg with spines on outer row of tibia and first two tarsal segments short, thick, rounded apically; apical spines on outer edge of fore tibia elongate.

Wings: hyaline with yellowish tinge. Venation black. Pterostigma dark red-brown, 3.5 mm in fore wing, 4.0 mm in hind wing. Basal subcostal crossvein present. Nodal index 16 : 20 : 20 : 16/16 : 15 : 15 : 16. Second primary antenodal 8th crossvein in fore wing, 7th in hind wing. Intermedian crossveins 7 : 8/4 : 5. Supratriangle one-celled. Discoidal triangle free in left fore wing, crossed in other wings; subtriangle free. 3–4 cubitoanal crossveins

in fore wing, 3 in hind wing. Hind wing with 5 paranal cells, 4 postanal cells, 4 rows of cells posterior to Cu₂.

Measurements: hind wing 36 mm, greatest width 9.5 mm.

Abdomen: black with the following pale blue-green markings: S1 pale laterally; S2 with narrow mid-dorsal stripe, pale laterally; S3 with narrow mid-dorsal stripe and lateral spot in basal three-quarters; S4–S6 with narrow dorsal band at base of each segment, and lateral spot tapering to transverse carina; S7 entirely pale in basal two-thirds; S8–S9 unmarked; S10 pale brown in basal half, darker apically with tapering ventral spot.

Anal appendages (figs. 15–17): black; superior appendages triangular in cross-section, about three times as long as broad when viewed dorsally, 1.8 times as long as broad when viewed laterally, bifurcate apically, outer branch bending laterally tapering to narrow point, inner branch curving ventrally with blunt apex; inferior appendage 0.6 mm longer than superiors, deeply bifurcate with branches divergent at base, parallel in apical half, apices of branches with a pair of short upturned teeth, base of branches with transverse ridge, terminating in low dorsal projection at each end, outer projection elongate, inner projection short, broad with numerous apical setae.

Measurements: total length 58.4 mm; abdomen 43.8 mm (including anal appendages 2.4 mm).

Description of female.

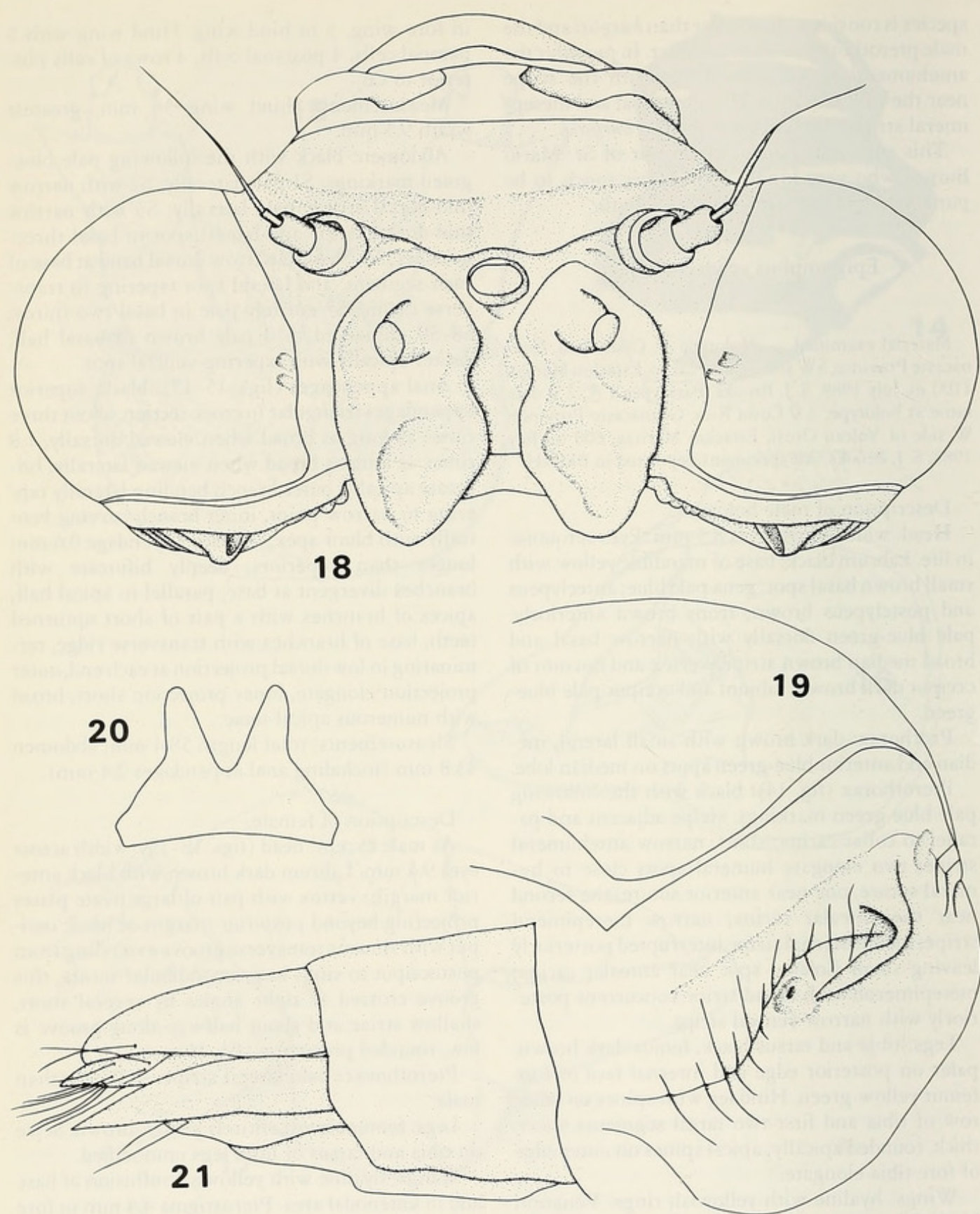
As male except: head (figs. 18–19), width across eyes 9.4 mm. Labrum dark brown with black anterior margin; vertex with pair of large ovate plates projecting beyond posterior margin of head; occiput with sinuous transverse groove extending from postocciput to sinus in premandibular suture, this groove crossed at right angles by several short, shallow striae and about halfway along groove is low, rounded projection (fig. 19).

Pterothorax: pale lateral stripes yellower than male.

Legs: femur almost entirely yellow-brown. Setae on tibia and tarsus of hind legs unmodified.

Wings: hyaline with yellowish suffusion at base and in antenodal area. Pterostigma 4.4 mm in fore wing, 4.7 mm in hind wing. Nodal index 13 : 20 : 19 : 15/14 : 15 : 15 : 13. Second primary antenodal crossvein seventh crossvein in all wings. Intermedian crossveins 6 : 6/4 : 4. Discoidal triangle free. All wings with 3 cubitoanal crossveins. Hind wing with 3 postanal cells.

Measurements: hind wing 40.5 mm, 10.5 mm at greatest width.



Figs. 18—21. *Epigomphus echeverrii* sp.n., female. — 18, Head, dorsal view. Note puncture marks near inner margin of eyes. 19, Right eye, rear view. 20, Vulvar scale, ventral view. 21, Apex of abdomen, lateral view.

Abdomen: black with yellow-green markings; S3 with lateral pale marking narrowing beyond transverse carina; S7 pale only in basal third; S10 entirely black; abdomen with greyish pruinescence ventrally. Vulvar scale (fig. 20) narrowly V-shaped with narrow arms, 0.78 mm in length. Dried ova ovate, 0.52×0.3 mm.

Anal appendages (fig. 21) lanceolate.

Measurements: total length 62 mm; abdomen 41 mm (including anal appendages 1.4 mm).

Variation in paratypes. — Labrum with postero-lateral blue-green spot and antero-lateral lobes of postclypeus black in male. Wings with distinct amber suffusion in male and females, possibly older specimens.

Habits. — I collected two males and one female near Estacion Mengo by the riffle reach of a shallow stream in semi-shaded rain-forest with a broken canopy. They were flying in the company of *Epigomphus subobtus* Selys and were quite common at the locality while the sun was shining but disappeared when it became overcast. In flight the males characteristically curved the apical segments of the abdomen ventrally. Like other *Epigomphus* species, the males frequently perched on low horizontal sticks at the edge of the stream and flew close to the surface of the water. The female was seen flying low over the stream in a pool of sunlight. The other Mengo female was collected at the side of a track in a field cleared of trees about 2 km from the edge of the forest. The insect was perched in long grass, probably sheltering from the wind which was blowing very strongly at the time, and may have been blown there from the forest. The Maritza female was discovered dead in the web of an orb-web spider next to a riffle reach on a large river in forest with broken canopy.

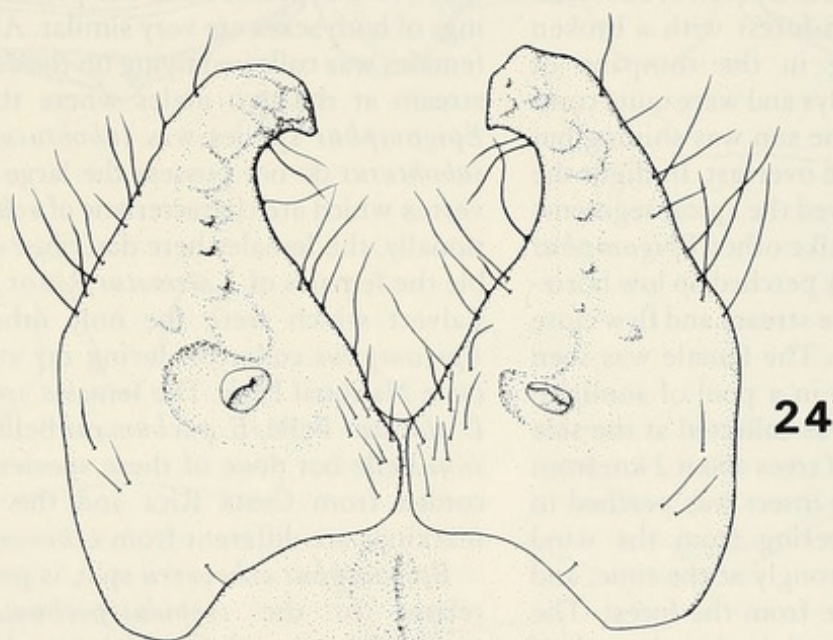
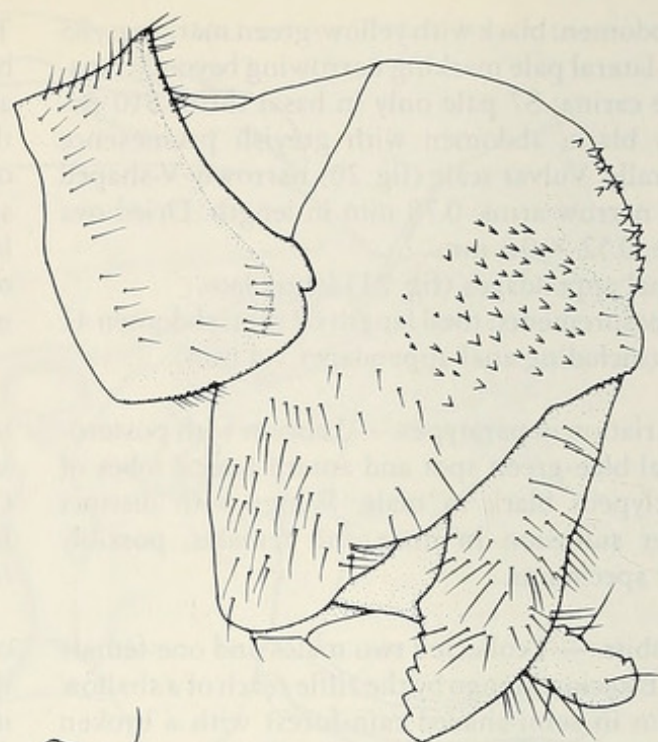
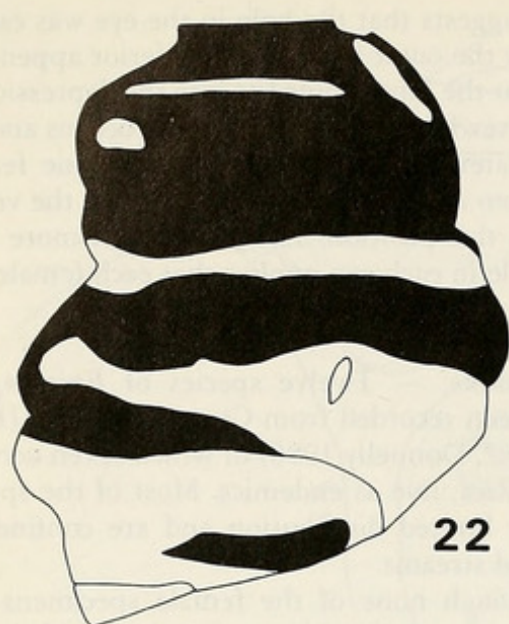
In all three females there was damage to the inner dorsal margin of the eyes (fig. 18) which was probably inflicted by the apical spines on the inferior appendages of males during mating. These mating marks or ocular cicatrices are usually superficial in Odonata (Dunkle 1979) but more extensive damage has been described in species of *Ophiogomphus* (Dunkle 1984) and in three species of *Epigomphus* (Calvert 1920). In the three females of *E. echeverrii* the ocular cicatrices took the form of at least two rounded holes which had sometimes coalesced to form a longitudinal groove. The spines at the apex of the inferior appendage in males of *echeverrii* are positioned transversely about 0.5 mm apart but the holes in the eyes are situated one above the other about 0.2 mm apart.

This suggests that the hole in the eye was caused by only the outer spine of the inferior appendage and that the inner spine fits into the depression in the vertex lobe between the lateral ocellus and the outer lateral margin of the lobe. In one female specimen a hole had been punctured in the vertex lobe in this position. The presence of more than one hole in each eye implies that each female had mated at least twice.

Remarks. — Twelve species of *Epigomphus* have been recorded from Central America (Paulson 1982, Donnelly 1986) of which seven occur in Costa Rica, five as endemics. Most of the species have a limited distribution and are confined to forested streams.

Although none of the female specimens was collected *in copula* with a male, it is very likely that they are conspecific since the pterothoracic markings of both sexes are very similar. Also, one of the females was collected flying on the same stretch of stream at the two males where the only other *Epigomphus* species was *subobtus*. Females of *subobtus* do not possess the large plates on the vertex which are characteristic of *echeverrii*. Additionally, the females here described do not resemble the females of *E. armatus* Ris or *E. tumefactus* Calvert which were the only other species of *Epigomphus* collected during my stay in Guanacaste National Park. The females are unknown in *E. clavatus* Belle, *E. pechumani* Belle and *E. paulsoni* Belle but none of these species has been recorded from Costa Rica and the pterothoracic markings are different from *echeverrii*.

Epigomphus echeverrii sp.n. is probably closely related to the *crepidus-pechumani-subsimilis* group of species, all of which have broad superior appendages which bifurcate apically and long, narrow, deeply bifurcate inferiors which project beyond the apex of the superiors and bear a pair of short teeth at the apex of each branch. However, in all the latter species, unlike *echeverrii*, one of the teeth at the apex of the branches of the inferior appendage is positioned slightly subapically. *E. echeverrii* differs from *subsimilis* Calvert in which the branches of the inferior appendages are relatively short and the outer apical projection of the superior appendage curls ventrally. *E. pechumani* Belle has a basal internal spine on the superiors, which is absent in *echeverrii*, and the inner apical fork is toothed. In addition, the inferiors are shorter than those of *echeverrii*. In *crepidus* Kennedy the outer apical branch of the superior appendage is very short and blunt and, although the inferiors are morphologically similar to *echeverrii*, the inner



Figs. 22-24. *Epigomphus houghtoni* sp.n., male holotype. — 22, Pterothorax, right lateral view. 23, Apex of abdomen and anal appendages, lateral view. 24, Inferior appendage, dorsal view.

tooth at the apex of the branch of the inferiors is about twice the length of the outer and the apex is more acutely pointed. Although some specimens of *crepidus* have two antehumeral stripes, in other individuals the lower stripe is interrupted medially as it is in *echeverrii*.

The females of *E. echeverrii* are easily distinguished from other species in the genus by the large flattened lobes on the vertex which project considerably from the rear of the head. There are no similar structures in any of the species of the genus in which the females are known. In females of *crepidus* and *subsimilis* (the female of *pechumani* is unknown) there is a longitudinal

groove adjacent to the lateral ocellus and a pair of small tubercles on the vertex.

This species is named in honour of Sr Gustavo Echeverri who very kindly donated his ranches to the Guanacaste National Park.

***Epigomphus houghtoni* sp.n.**
(figs. 22—24)

Material examined. — Holotype: ♂, Costa Rica, Limon, Siquirres, 5.iv.1988. J. Paul. Holotype deposited in BMNH.

Description of male holotype.

Head: width across eyes 7.8 mm. Colour of eyes

in life unknown (probably blue). Labrum black with postero-lateral yellow-green spot and small pale brown median spot; base of mandibles yellow-green; genae yellow-green; postclypeus dark brown, marked black medially and on antero-lateral lobes; frons dark brown anteriorly, pale yellow-green dorsally with basal and median black stripe; vertex and occiput black; labium and back of eyes yellow-green.

Prothorax: black with median and lateral pale green spot on middle lobe.

Pterothorax (fig. 22): black dorsally, dark brown laterally; marked dorsally with pale green transverse stripe adjacent to collar carina, short pale green antehumeral stripe and pale green posterior spot positioned between antehumeral stripe and humeral suture; marked laterally with narrow yellow mesepimeral stripe, yellow metepisternal stripe broad anteriorly narrowing posteriorly, metepimeron almost entirely yellow with narrow brown stripe adjacent to posterior half of second lateral suture and ventral brown stripe in anterior half.

Legs: almost entirely dark brown-black with pale brown stripe on posterior side of femur. Hind leg with spines on outer row of tibia and first two tarsal segments short, thick, rounded apically.

Wings: membrane hyaline with slight yellow-brown suffusion at base of wings and along posterior margin of hind wing. Venation black. Pterostigma dark reddish brown, 3.7 mm in fore wing, 4.2 mm in hind wing. Basal subcostal crossvein present. Nodal index 15 : 19 : 18 : 14/14 : 13 : 14 : 14. Second primary antenodal crossvein seventh in fore wing and hind wing. Intermedian crossveins 5-6/3-3. Supratriangle one celled. Discoidal and sub-triangle uncrossed. 3-4 cubitoanal crossveins in fore wing, 2 in hind wing. Hind wing with 5 paranal cells, 3 postanal cells, 3 rows of cells posterior of Cu₂.

Measurements: hind wing 34.5 mm, greatest width 9.5 mm.

Abdomen: dark brown with the following yellow markings: S1 and S2 with narrow medio-dorsal stripe and entirely yellow laterally; S3 with narrow median dorsal stripe restricted to basal half, large lateral spot in lower half occupying basal three-quarters of segment; S4-S6 with lateral spot in lower half of segment extending to lateral carina and small mid-dorsal basal spot; S7 entirely yellow in basal two-thirds; S8-S9 with small spot on baso-lateral membrane; S10 marked with tapering ventral spot.

Anal appendages (fig. 23-24): black; superior appendages rectangular, about 2½ times as long as

broad, dorsal edge curving ventrally in apical half with seven short teeth on ventro-apical margin; inferior appendage with dorso-basal depression; deeply bifurcate; each branch with low medio-dorsal ridge and small median spine in shallow depression; apices hooked and curving inwards.

Measurements: total length 53.6 mm; abdomen 39.5 mm (including anal appendages 2.7 mm)

Remarks. — *E. houghtoni* belongs to the largest species group in *Epigomphus* all of which have the superior appendages rounded apically, bearing a row of short subapical teeth or crenellations. Most of these species, such as *armatus* Ris and *subobtusus* Selys, have two antehumeral stripes but a few, like *occipitalis* Belle and *tumefactus* Calvert, have only one. Of this latter group *houghtoni* seems to be closest to *occipitalis* since this is the only other species in the genus which has a horse-shoe-shaped inferior appendage. However, *occipitalis* (which was described from Peru) can be readily distinguished from *houghtoni* by the presence of a strong median tooth on each branch of the inferior appendage which is absent in *houghtoni*.

This species is named after Mr Greg Houghton who accompanied John Paul in Costa Rica but who was tragically killed shortly afterwards.

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