Odonatologica 36(1): 27-51 *March 1, 2007*

THIRTEEN NEW ZYGOPTERA LARVAE FROM VENEZUELA (CALOPTERYGIDAE, POLYTHORIDAE, PSEUDOSTIGMATIDAE, PLATYSTICTIDAE, PROTONEURIDAE, COENAGRIONIDAE)

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Received March 30, 2006 / Reviewed and Accepted May 24, 2006

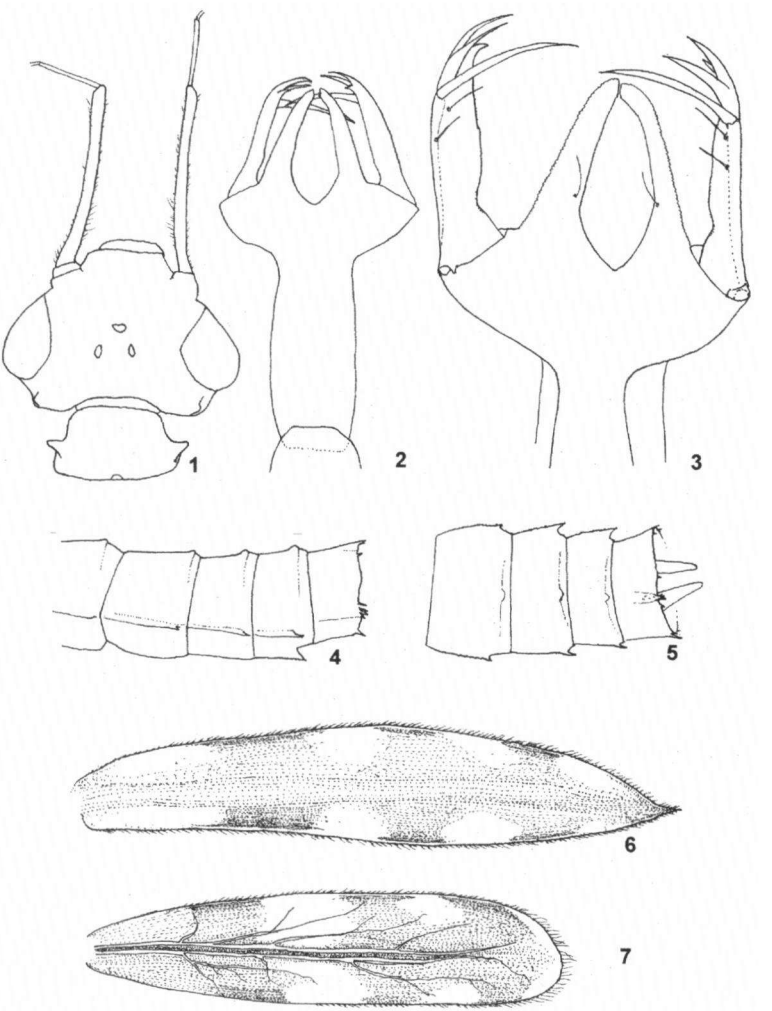
The ultimate instar larvae or exuviae of the following spp. and sspp. are described and illustrated: *Hetaerina medinai* Rácenis, *Euthore f. fasciata* (Hagen), *E. f. plagiata* Selys, *E. f. fastigiata* (Selys), *Microstigma rotundatum* Selys, *Palaemnema clementia* Selys, *Epipleoneura metallica* Rácenis, *Neoneura fulvicollis* Selys, *Acanthagrion imeriense* De Marmels, *A. vidua* Selys, *Argia adamsi* Calvert, *Cyanallagma laterale* (Selys), and *C. tamaense* De Marmels. A key to the known larvae of Polythoridae found in Venezuela is included. The larva of each sp./ssp. is diagnosed against similar larvae of other taxa, and notes on the larval habitat are added.

INTROCUCTION

The larvae of numerous species of Zygoptera, mostly reared or recovered together with the emerging adult, have accumulated in the collection of the Museo del Instituto de Zoología Agrícola "Francisco Fernández Yépez" (MIZA) over the past twenty years. In order to make this information available to other workers, I decided to describe and illustrate these immature stages and to offer diagnostic comments and information about geographic distribution and habitat of the species studied.

MATERIAL AND METHODS

All larvae and some exuviae are kept in alcohol; the rest of the exuviae are kept dry and were soaked with water for study, and later again dried and mounted, or introduced in alcohol and stored in vials. The drawings were made using a stereoscope Wild M8, coupled with a camera lucida. All measurements are given in millimeters. Total length does not include caudal gills; length of femur excludes trochanter.



Figs 1-7. *Hetaerina medinai*, ultimate instar male larva from Waikinima: (1) head and pronotum, dorsal view; – (2) prementum, ventral view; – (3) anterior portion of prementum, dorsal view; – (4) abdominal segments 6-10, left lateral view; – (5) abdominal segments 7-10 with cerci, dorsal view; – (6) left lateral gill, left lateral view; – (7) median gill, left lateral view.

CALOPTERYGIDAE

HETAERINA MEDINAI RÁCENIS, 1968
Figures 1-7

Material (2 ♂, ultimate instar larvae; supposition: only species in range at this elevation above sea level). – 1 ♂, Venezuela, Bolívar State, Waikinima Tepuí (Cerro Guaiquinima National Monument), 1000 m, 05°53'N, 63°30'W, 12-II-1990; 1 ♂, Bolívar State, El Pilón, road Santa Elena de Uairén-Icabarú, 950 m, 28-I-1985, both J. De Marmels leg.

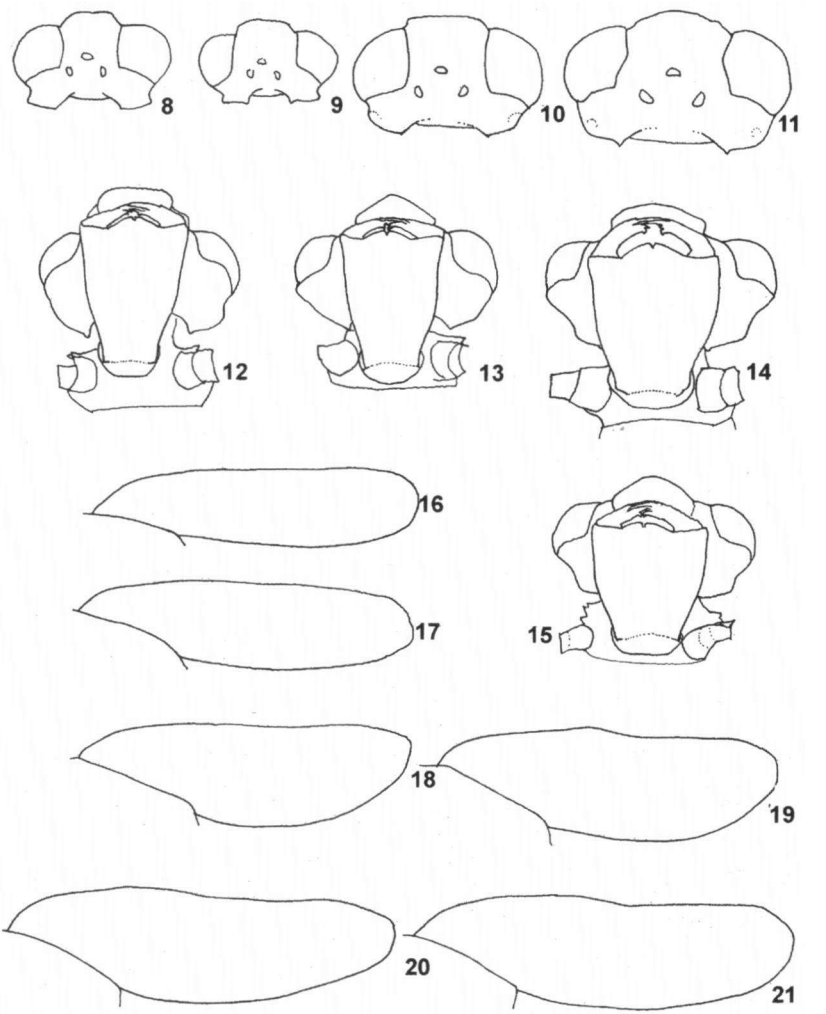
Larvae brown. If there was any body pattern in the living specimens, this has vanished due to the alcohol. Head little broader than thorax; occipital lobes obtusely angled with dorsal tubercle. Antenna with seven segments; length of first segment equaling 80% of maximum width of head (Fig.1), pale brown with basal half darker and extreme tip paler; segments two and three show a similar pattern. Labium reaching to between second pair of coxae, otherwise as illustrated (Figs 2-3). Pronotum bearing a triangular process on each side of middle lobe directed laterodorsad (Fig. 1). Femora and tibiae of all legs with three dark crossbands; there are no strong setae or spines along anterior border of first femur. Wing sheaths reaching to end of abdominal segment 4, or beyond. Abdomen with recognizable, albeit very low, mediodorsal tubercle near posterior border of segments 6-9 in the larva from Waikinima (Fig. 4; absent in the specimen from El Pilón); segment 10 with blunt dorsal longitudinal ridge ending in three closely-set spines, which surpass end of segment; an additional spine each side at some distance from the median spines; four apical spines laterally on each side (Figs 4-5); ventrally one large spine each side at about half the distance between median line and lateral margin, accompanied once by three minute accessory spinules; segments 8 and 9 with lateral apical spine. Caudal gills as illustrated (Figs 6-7); all marginal spinules beset with a single, short, soft, apical seta.

Measurements (in mm). – Total length 21-24; lateral gill 6-7; head width 3.0-3.5; hind femur 5.8; hind tibia 5.7-6.2.

REMARKS. – *H. medinai* is an endemic of the Pantepui region, and was the sole *Hetaerina* species present at the collecting places of the larvae. The only site known to me where *H. medinai* descends to below 500 m above sea level is at the bauxite mines of Los Pijiguaos, in northwestern Bolívar State. There it occurs syntopically with *H. sanguinea* Selys and *H. westfalli* Rácenis, both with unknown larvae. The larva of *H. medinai* differs from that of *H. caia dominula* Hagen described by GEIJSKES (1943) mainly in the shape of the caudal gills. ZLOTY et al. (1993) described the larvae of seven species of *Hetaerina* found in Costa Rica, five of which occur in Venezuela as well, but outside the range of *H. medinai*.

POLYTHORIDAE

Larvae of this family are difficult and sometimes seemingly impossible to identify on external morphology, even at the generic level. The immature stages of



Figs 8-21. Diagnostic characters of Venezuelan Polythoridae larvae: (8-11) head showing angulation of occipital lobes, dorsal view, of (8) *Chalcothore montgomeryi*, – (9) *Chalcopteryx scintillans*, – (10) *Cora cyane*, – (11) *Euthore f. fastigiata*; – (12-15) shape of prementum of (12) *Cora marina*, – (13) *C. cyane*, – (14) *Euthore f. fastigiata*, – (15) *E. f. fasciata*; – (16-21) left hindwing sheath, left lateral view, of (16) *C. marina*, – (17) *C. cyane*, – (18) *E. f. fasciata*, – (19) *E. fasciata plagiata*, – (20) *E. f. fastigiata*, – (21) *E. fastigiata meridana*.

many species are still unknown, and the descriptions of those known are based on one or few specimens, a fact which further complicates the task, because potentially informative characters cannot be evaluated by comparison among a significant number of taxa, or even among specimens of the same species. Of the four species of *Cora* Selys known to occur in Venezuela the larva of just two have been described, viz. *C. cyane* Selys (DE MARMELS, 1982) and *C. marina* Selys (NOVELO-GUTIÉRREZ & GONZÁLEZ-SORIANO, 1985). These two are easily separated from larvae of *Euthore* Selys, and from each other, but the hitherto unknown larvae of *C. inca* Selys and of *C. xanthostoma* Ris may resemble that of Central American *C. chirripa* Calvert described by CALVERT (1911), which is closely similar in shape of the caudal gills to larvae of *Euthore*, not of *C. cyane* and *C. marina*. The key given here must hence be considered provisional.

KEY TO THE DESCRIBED ULTIMATE INSTAR LARVAE OF POLYTHORIDAE FOUND IN VENEZUELA*

1 Total length (excl. caudal gills) less than 9 mm: occipital lobes strongly angled lateroposteriorly (Figs. 8-9) 2
– Total length (excl. caudal gills) more than 9 mm; occipital lobes not obviously angled lateroposteriorly (Figs 10-11) 3
2 Fore and hindwing sheaths of approximately same outline; projections of caudal gills long and pointed ..... ***Chalcothore montgomeryi*** **(Rácenis)**
– Forewing sheath narrow with costal and anal borders parallel; hindwing sheath broader with anal border convex; projections of caudal gills not known, but probably short and blunt, as in *C. rutilans* (Rambur) (SANTOS & COSTA, 1987) ..... ***Chalcopteryx scintillans*** **McLachlan**
3 Prementum longish and narrow (Figs 12-13); hindwing sheath slender with costal and anal margins parallel (Figs 16-17) ..... *Cora* 4
– Prementum appearing shorter and broader (Figs 14-15); hindwing sheath broader, with anal border convex (Figs 18-21) ..... *Euthore* 5
4 Dorsal spines of abdomen (Fig. 22) and projections of caudal gills (Fig. 24) long and slender ..... ***Cora marina***
– Dorsal spines of abdomen (Fig. 23) and projections of caudal gills (Fig. 25) short and blunt ..... ***Cora cyane***
5 Total length (excl. caudal gills) less than 15 mm; hind tibia less than 4 mm ..... ***Euthore fasciata***
– Total length (excl. caudal gills) more than 15 mm; hind tibia more than 4 mm ..... ***Euthore fastigiata***

* Not included in the key, besides of *Cora inca* and *C. xanthostoma*, is *Polythore terminata* Fraser, a single male of which was collected by J.W. Williamson, in Táchira State in 1920. The locality label of this male could be erroneous however (DE MARMELS, 1999), and the larva of this species, and of the genus *Polythore* Calvert in general, is unknown.

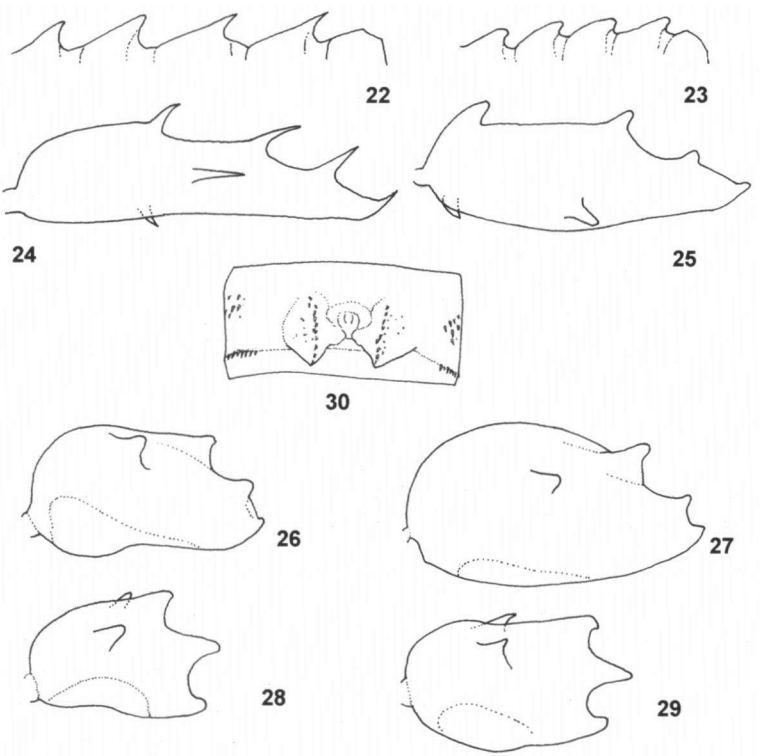
EUTHORE F. FASCIATA (HAGEN *in* SELYS, 1853)
Figures 15, 18, 26, 28

Material (1 ♂, 1 ♀, ultimate instar larvae; supposition: only *Euthore* in range). – 1 ♀, Venezuela, Aragua State, road Maracay-Choroní, Regresiva del Diablo (Henri Pittier National Park), 1350 m, 1-VI-2000; 1 ♂, 30-V-2002, both J. De Marmels leg.

Larva brown, very similar to larvae of *E. fastigiata meridana* Selys described by DE MARMELS (1995). Mandibles as in *E. fasciata plagiata* (see below). Dorsomedian spine of abdominal segment 1 minute. Ovipositor surpassing distal border of abdominal segment 10 by a distance equal to three quarters the length of that segment, as seen in lateral view, but this may vary depending on the degree of abdominal contraction, which is considerable in the specimens examined; outer valves of ovipositor covered with spinules which tend to form an irregular row at ventral border, as well as along dorsolateral margin. Caudal gills (Figs 26-28) as in *E. fastigiata meridana*.

Measurements (in mm). – Total length 11-12 (note abdominal contraction); lateral gill 3.0-3.5; head width 4; forewing sheath 4.8-5.0; hind femur 3; hind tibia 3.4.

REMARKS. – *E. f. fasciata* is common at the collecting spot next to a cascade in cloud forest, where it occurs together with *Cora cyane* and *C. xanthostoma*.



Figs 22-30. Diagnostic larval characters of Venezuelan *Cora* and *Euthore*: (22-23) skyline of abdominal segments 6-10, left lateral view, of (22) *C. marina*, – (23) *C. cyane*; – (24-27) left lateral gill, left lateral view, of (24) *C. marina*, – (25) *C. cyane*, – (26) *E. f. fasciata*, – (27) *E. f. fastigiata*; – (28-29) median gill, left lateral view, of (28) *E. f. fasciata*, – (29) *E. f. fastigiata*; – (30) abdominal segment 9 showing male gonapophyses, ventral view, of *E. fasciata plagiata*.

I attribute the present larvae to *Euthore fasciata*, because of the comparatively broad prementum and the rounded anal border of the hindwing sheaths, as well as their close similarity with larvae of *E. f. plagiata* described here below.

EUTHORE FASCIATA PLAGIATA SELYS, 1873
Figures 19, 30

Material (4 ♂, ultimate instar larvae; supposition: only *Euthore* in range). – 4 ♂, Venezuela, Táchira State, Palmira, Quebrada La Flautera, 1200 m, 9-VII-2000, J. De Marmels leg.

Larvae dark brown with pale area around dorsal spine on abdominal segments 7-9, and middle of segment 10. Mandibles with four large teeth in the outer row, and a fifth, small one, in the most mesal position (ventral view); right mandible additionally with small tooth at base of the first large tooth (ventral view). Male gonapophyses (Fig. 30) slightly more protruding distally than in *E. fastigiata*.

Measurements (in mm). – Total length 12.2-13.3; lateral gill 2.5-3.2; head width 3.9-4.0; forewing sheath 5; hind femur 3.3- 3.5; hind tibia 3.3-3.8.

REMARKS. – No consistent morphological differences (besides of size) could be found between larvae of *E. f. plagiata* and larvae of either *E. f. fasciata* or *E. fastigiata* (see below). The larvae were collected in a mountain stream in forest, between leaf litter caught by stones in the fast flowing water, and between masses of floating rootlets of trees. Adults were common, and a few *Hetaerina cruentata* (Rambur) were observed at the same spot. BICK & BICK (1992) consider *E. f. fasciata* and *E. f. plagiata* forms of one species based on female wing colour pattern. However, females are polymorphic in both subspecies, whereas males show more consistent differences (DE MARMELS, 1988). In Venezuela, *E. f. plagiata* is present only around the Táchira depression, while *E. f. fasciata* has been recorded to the northeast, from Barinas State to the Coastal Cordillera.

EUTHORE F. FASTIGIATA (SELYS, 1859)
Figures 11, 14, 20, 27, 29

Material (3 ♂, 1 ♀, ultimate instar larvae; supposition: only *Euthore* in range). – 1 ♂, Venezuela, Táchira State, San Vicente de La Revancha, Vega Grande, 1800 m, 17-V-1999; 2 ♂, 1 ♀, 8/9-V-2002, all J. De Marmels leg.

Larvae dark brown, indistinguishable from larvae of *E. fastigiata meridana* Selys. Mandibular dentition is identical in these two subspecies, i. e. five teeth in the outer row in both mandibles, the right mandible with a small accessory tooth at the base of the first large tooth (ventral view). The ovipositor in the female larva of *E. f. fastigiata* reaches well to the distal border of abdominal segment 10 (female ultimate instar larvae of *E. f. meridana* have not been described so far).

Measurements (in mm). – Total length 15.3-18.0; lateral gill 4.0-4.2; head width 4.5-5.0; forewing sheath 6; hind femur 4; hind tibia 4.2-4.8.

REMARKS. – The larvae of *E. f. fastigiata* were collected in a stony stream within a gallery forest, between masses of rootlets of trees in the flowing water, and between leaf litter retained by stones at spots with fast current. Adults, including tenerals, were common. Numerous *Hetaerina cruentata*, *Teinopodagrion oscillans* (Selys), a female *Cannaphila vibex* (Hagen), as well as an unknown gomphid, were also recorded. BICK & BICK (1992) treat *E. f. meridana* as different at the specific level from *E. f. fastigiata*, but their strict allopatry, together with their close similarity, seem to support a subspecific status.

PSEUDOSTIGMATIDAE

MICROSTIGMA ROTUNDATUM SELYS, 1860

Figures 31-39

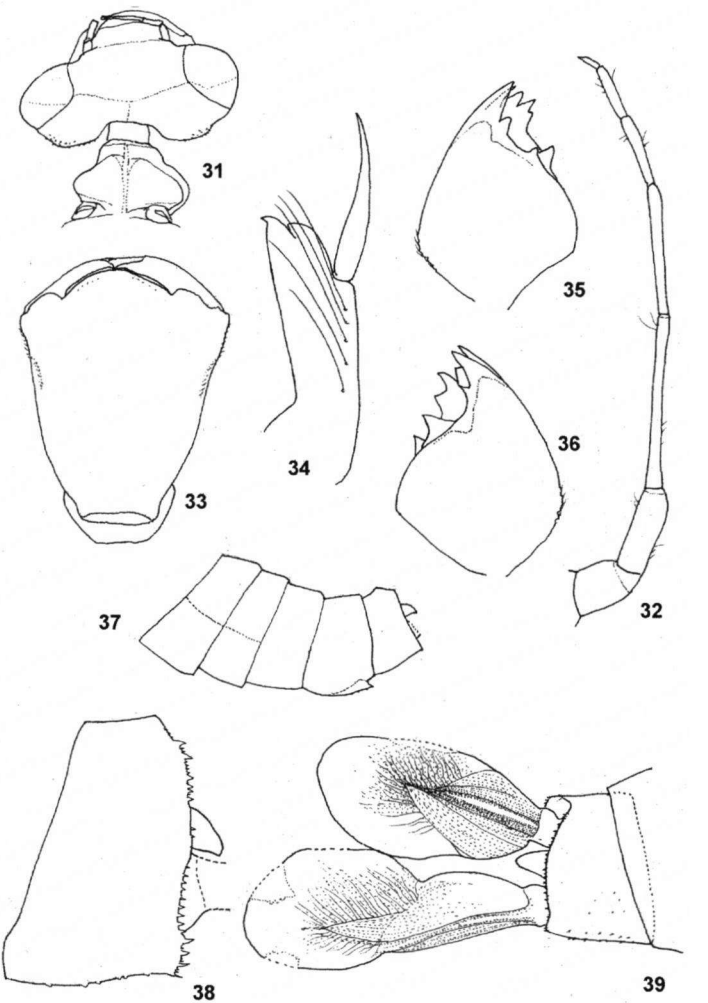
Material (2 ♂, ultimate instar). – 1 ♂, exuviae (reared): Venezuela, Amazonas State, km 2, road San Carlos de Río Negro-Solano, ca. 100 m, 4/13-III-1984; 1 ♂, larva (supposition) same data, both J. De Marmels leg.

Larva and exuviae dark brown, unpatterned. Head broader than thorax; occipital lobes broadly rounded, occiput concave in middle (Fig. 31). Antenna with seven segments (Fig. 32). Labium at rest reaching backwards to hind border of first coxae; prementum (Fig. 33) with about 20 spinules laterally in distal half; median lobe rounded, its free border weakly serrulate; labial palp bearing five or six (once) setae (Fig. 34); mandibles as illustrated (Figs 35-36). Legs unpatterned, femora and tibiae with unconspicuous spinules; larger spinules near tip of tibiae and ventrally on tarsal segments. Wing sheaths reaching to middle of abdominal segment 5. Spinulation of abdominal segment 10 as illustrated (Fig. 38), its dorsal border with broad, semicircular median excision, the margin of which bears no spines; middle third of ventral distal border of same segment without spines, but ventral surface of each lateral third of same segment, and of male gonapophyses with minute, tubercle-like spinules. Caudal gills of exuviae lost, those of larva damaged (Fig. 39).

Measurements (in mm). – Total length 23; lateral gill (larva) 4; head width 5; length of prementum 4; forewing sheath 7.5-9; hind femur 6.

REMARKS. – The larvae were recovered from a crevice in the stem of a fallen tree in the jungle. This crevice was about 70 cm long and 10 cm deep; the width of its opening did not exceed 5 cm. Abundant leaf litter was found on the bottom of the crevice. From the five pseudostigmatid larvae of varying instars found only two ultimate instar larvae were collected. One larva was reared successfully, the other one died. Unfortunately, the alcohol in which the exuviae and the larva were kept later dried up and both specimens suffered damage and partial or total loss (exuviae) of the caudal gills. Whether all larvae found in this crevice, including the one described here, were *Microstigma* Rambur, is not known. Another

pseudostigmatid species observed in the area was *Mecistogaster linearis* Fabricius. The larva of the latter was described by SAHLÉN & HEDSTRÖM (2005). It may be separated from that of *M. rotundatum* by the fewer mandibular teeth, and by the presence of six palpal setae (only five in *Microstigma rotundatum*). No larva of *Microstigma* has been formally described so far, although DE MESQUITA



Figs 31-39. *Microstigma rotundatum*, ultimate instar male exuviae: (31) head and pronotum, dorsal view; – (32) right antenna; – (33) prementum, ventral view; – (34) right labial palp, dorsal view; – (35) right mandible, ventral view; – (36) left mandible, ventral view; – (37) apical portion of abdomen, left lateral view; – (38) abdominal segment 10, left lateral view; – (39) tip of abdomen showing right lateral and median gills, right lateral view – (Note: Fig. 39 is of supposed larva).

(1992) presented a paper with a description of the larva of *M. maculatum* Selys, during the 4th Brazilian Limnological Congress.

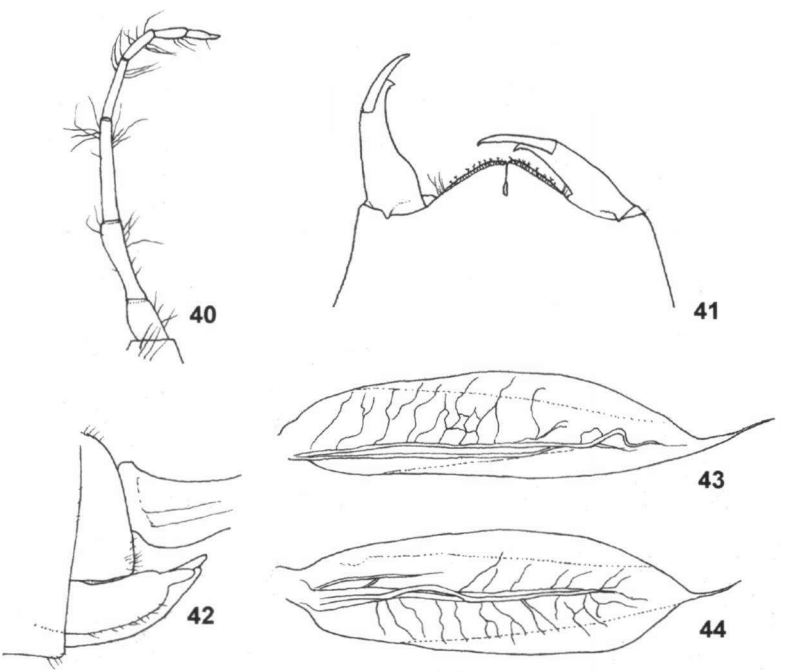
PLATYSTICTIDAE

PALAEMNEMA CLEMENTIA SELYS, 1886

Figures 40-44

Material (3 ♂, 1 ♀, ultimate instar exuviae: males taken together with emerging adults). – 1 ♂, Venezuela, Táchira State, San Félix, Quebrada La Resbalosa, 350 m, 16/23-VI-1998; 1 ♂, 19-V-1999; 1 ♀, 11-VII-2000; 1 ♂, 12-V-2002, all J. De Marmels leg.

Exuviae pale yellowish brown, unpatterned; frons, clypeus, labrum and labial palps ferruginous; free border of labrum fringed with long, hair-like setae; basal socket of antenna bearing a group of five or six such setae; a few setae also along central portion of concave occipital border and along ecdysial line, on vertex,as well as on postocular lobes near lateral angle; a row of shorter setae also laterally and ventrally along hind border of compound eye. Antenna with



Figs 40-44. *Palaemnema clementia*, ultimate instar exuviae: (40) left antenna, male; – (41) anterior portion of labium, male, dorsal view; – (42) tip of abdomen with ovipositor, left lateral view; – (43) right lateral gill, male, left lateral (internal) view; – (44) median gill, male, left lateral view.

seven segments (Fig. 40), these bearing hair-like setae, especially in apical portion. Prementum reaching to between first pair of coxae; median lobe moderately protruding, its free border beset with divided scales and with a group of hairs on each side near base of corresponding labial palp (Fig. 41). Dorsal surface of prementum with narrow band of transverse striae each side of median line; these striae reaching from near base of labial palp to maximum width of prementum. Labial palp with few hairs ventrobasally, and with only one tooth, a second cusp is weakly indicated proximally of main tooth by a notch; Mandible beset with strong setae externally; right mandible with four large cusps and with inner branch armed with two teeth; left mandible also with four cusps, but with serrulate internal branch composed of about eight denticles plus one small denticle at base of inner branch. Scattered hairs at lateroposterior angle of pronotum and on proepimeron, same on mesepimeron. Legs pale, beset with scattered short to fairly long hairs; fore tibiae armed with a row of strong spines apically, with the largest four to five spines located dorso-internally; similar spines on mid and hind tibiae much smaller. Wing sheaths reaching to near distal border of abdominal segment 4 or 5, depending on actual distortion of exuviae. Abdomen with scattered, short hairs dorsally on segments 6-10, densest on segment 10. Caudal gills darker brown, tip and apical filament pale. Ovipositor surpassing end of abdominal segment 10 by almost half its own length; ventral border of outer valves beset with a row of short hairs (Fig. 42). Caudal gills as illustrated (Figs 43-44); no hair cover or fringe was observed.

Measurements (in mm). – Total length 11-12; lateral gill (excl. filament) 3.8-4.0 (+fil. 1.0); hind femur 2.8; hind tibia 2.8-3.0.

REMARKS. – NOVELO-GUTIÉRREZ & GONZÁLEZ-SORIANO (1986) described the larvae of *P. desiderata* Selys and *P. paulitoyaca* Calvert, and NOVELO GUTIERREZ (2003) that of *P. domina* Calvert. These three species are absent from South America. Judging from the figures given by those authors, the median lobe of the prementum is notably less prominent in *P. clementia* than in the three species described by them. *P. clementia* has only one well-developed cusp on the labial palp, whereas the Mexican species have two equally developed cusps.

PROTONEURIDAE

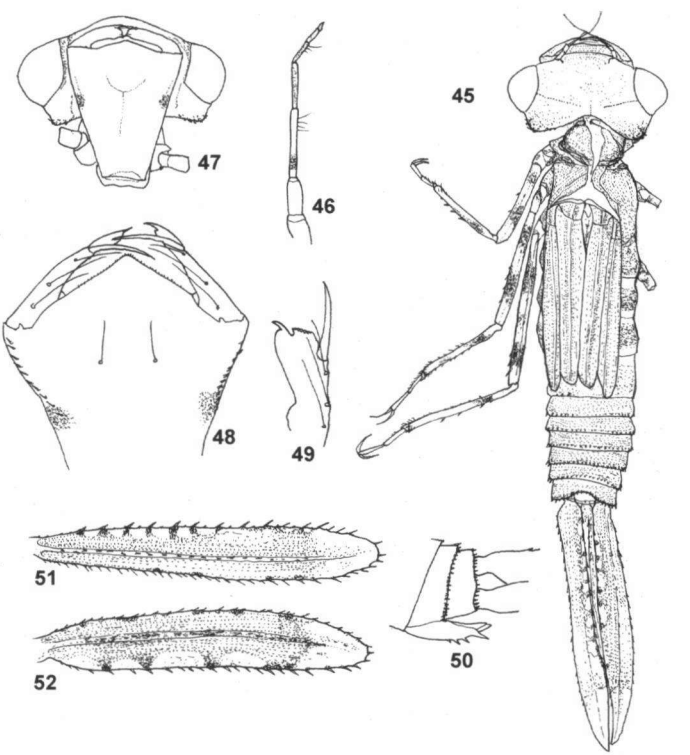
EPIPLEONEURA METALLICA RÁCENIS, 1955

Figures 45-52

Material (1 ♀, ultimate instar exuviae, collected together with emerging adult). – 1 ♀, Venezuela, Bolívar State, Minas de Los Pijiguaos, Quebrada La Solanera, 150 m, 06°34'N, 66°49'W, 3/13-VI-1992, J. De Marmels leg.

Exuviae brown (Fig. 45). Head broader than thorax, flat; occipital lobes obtusely angled, not protruding laterally, and beset with short spines; occipital

margin concave. Antenna with seven segments; third segment with dark cross-band at basal third, this segment little longer than segments 1+2 together (Fig. 46). Prementum narrowly trapezoidal, with almost straight lateral borders, and reaching backwards to between first and second pair of coxae (Fig. 47); a dark postmedian spot on each side at lateral margin; apical half of lateral borders beset with about 10 spinules; one premental seta and three palpal setae, on each side (Fig. 48); labial palp without spines externally on lateral border; apical portion of labial palp between end hook and movable hook obtuse, finely serrulate (Fig. 49). Pronotum with well-marked, almost straight, lateral border forming obtusely rounded angle with equally well-marked and nearly straight posterior border. Legs pale, femora and tibiae with dark cross-bands (Fig. 45), and with few weak spinules dorsally and ventrally; apical end of tibiae, and tarsi, beset with numerous spines; tarsal claws, especially those of hind tarsi, notably long. Wing sheaths reaching to end of abdominal segment 4. Abdomen unpatterned; most



Figs 45-52. *Epipleoneura metallica*, ultimate instar female exuviae: (45) exuviae, dorsal view; – (46) left antenna; – (47) head showing prementum, ventral view; – (48) anterior portion of prementum, dorsal view; – (49) right labial palp, dorsal view; – (50) tip of abdomen showing ovipositor, left lateral view; – (51) left lateral gill, left lateral view; – (52) median gill, left lateral view.

segments have complete row of spinules along distal border. Ovipositor surpassing end of segment 10; outer valves armed with three spines ventrally (Fig. 50). Lateral caudal gills as long as segments 3-10 together, parallel-sided; dorsal and ventral carinae armed with strong spines over their whole extension; there is no division between basal and apical portion of gills other than by slightly weaker pigmentation of the latter (Figs 51-52).

Measurements (in mm). – Total length 11.5; lateral gill 4.0; head width 2.0; hind femur 2.5; hind tibia 2.5.

REMARKS. – The exuviae were collected at a fairly rapidly flowing (70 cm per second), four to five meters broad, and 50-80 cm deep stream in primary forest. Other species observed are *Hetaerina caja dominula*, *H. sanguinea*, *H. westfalli*, *Heteragrion breweri* De Marmels, *Neoneura denticulate* Williamson, *Protoneura amatoria* Calvert, *Palaemnema brevignoni* Machet, *Agriogomphus ericae* (Belle), *Progomphus brachycnemis* Needham, etc.

When comparing the larva of *Epipleoneura metallica* with those known of *Neoneura* Selys, 1860 (NEEDHAM, 1939; GEIJSKES, 1954), and especially with the larva of *N. fulvicollis* described below, some differences become apparent: The shape of the prementum is longish and trapezoidal in *Epipleoneura*, but short, broad and rounded in *Neoneura*. Spinules along the outer border of the labial palp are absent in *Epipleoneura*, but present in *Neoneura*. The caudal gills in *Epipleoneura* are not divided into a thick, opaque proximal half and a membranous, pale distal portion, as is the case in *Neoneura*. But, most notably, in *Epipleoneura* the median and lateral gills have strong and complete row of spines along entire dorsal and ventral borders, while in *Neoneura* spines are present only dorsally in basal half of median gill, and only ventrally in basal half of lateral gills. The larva of *Epipleoneura* superficially resembles the larvae of two species of *Protoneura* Selys described by NOVELO-GUTIÉRREZ (1994). Shape of prementum is similar. However, the caudal gills in *Protoneura* show a clear division into an opaque basal and a hyaline distal portion, as known from *Neoneura*, while the distribution of the marginal spines on the gills differs in these three genera, and hence may be of diagnostic value at the generic level.

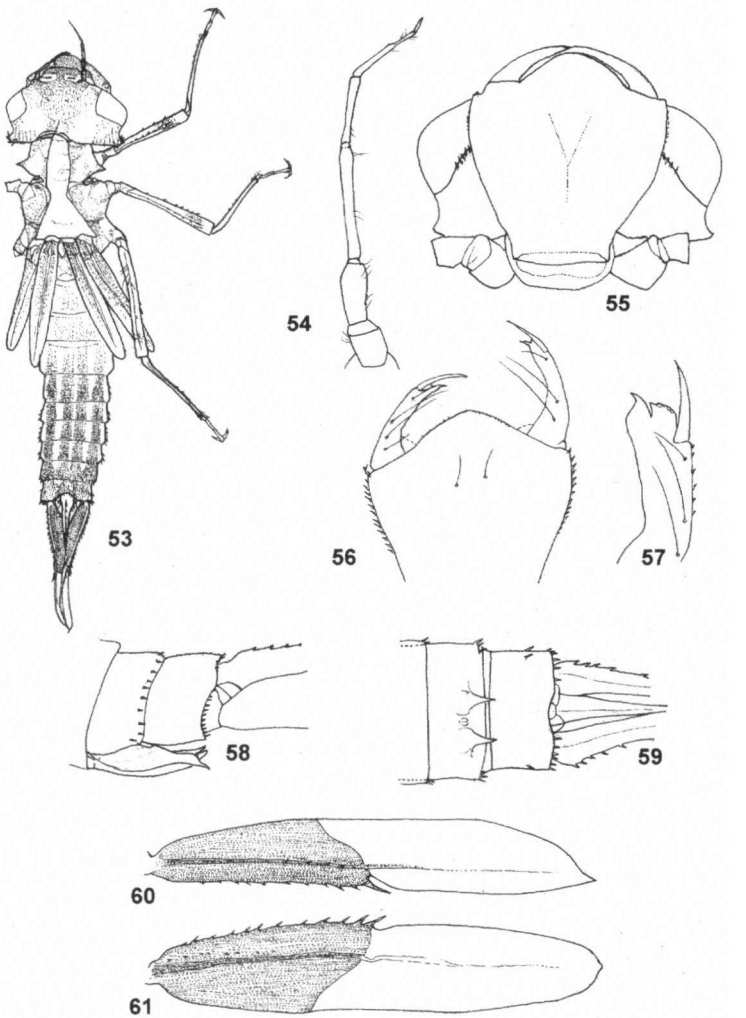
NEONEURA FULVICOLLIS SELYS, 1886

Figures 53-61

Material (5 ♂, 9 ♀, ultimate instar exuviae; supposition). – 5 ♂, 9 ♀, Venezuela, Bolívar State, San Francisco de Las Babas, Río Caroní, 350 m, 7/13-IV-1983, J. De Marmels leg.

Exuviae pale brown (Fig. 53). Head broader than thorax, flat; occipital lobes angled, these angles laterally protruding and beset with spines; occipital margin with semicircular excision in middle. Antenna with seven segments (Fig. 54), third segment longer than segments 1+2 together. Prementum short, broad, rounded, reaching backwards to hind border of first coxae (Fig. 55); lateral borders of pre-

mentum in apical half armed with about 14 broad spines; one premental seta and three to four palpal setae, on each side (Fig. 56); external border of labial palp beset with a row of about 6 spines in apical half; apical portion of labial palp between movable hook and end hook obtuse, finely serrulate (Fig. 57). Pronotum



Figs 53-61. *Neoneura fulvicollis*, ultimate instar exuviae: (53) female exuviae, dorsal view; – (54) left antenna, female; – (55) head showing prementum, male, ventral view; – (56) apical portion of prementum, female, dorsal view; – (57) right labial palp, same specimen, dorsal view; – (58) tip of abdomen showing ovipositor, left lateral view; – (59) tip of abdomen showing male gonapophyses, ventral view; – (60) left lateral gill, female, left lateral view; – (61) median gill, same specimen, left lateral view.

laterally produced into a sharply pointed, triangular projection. Legs pale; first and second femora with ill-defined, dark cross-band at apical third; dorsal and ventral anterior carinae beset with variable number of small spines, and some soft hairs; metafemora with fewer spines; tibiae with few, minute spines along ventral anterior carina; tip of tibiae, and tarsal segments ventrally, armed with numerous, partly scale-like spines. Wing sheaths reaching to end of abdominal segment 4. Abdomen patterned as in Fig. 53; lateral spinules starting at segment 5 or 6. Male gonapophyses surpassing hind border of segment 9 (Fig. 59); female ovipositor reaching to end of segment 10; valves without spines, but beset with few soft hairs (Fig. 58). Lateral caudal gills as long as abdominal segments 4-10 together (Figs. 60-61).

Measurements (in mm). – Total length 15-16.5; lateral gill 3.8-4.3; head width 2.7-3.1; hind femur 2.8-3.2; hind tibia 2.7-3.0.

REMARKS. – Dozens of tandems were found ovipositing into dead sticks and branches laying at the water line on the open shore of a quiet stretch of the Río Caroní, between three and five o'clock in the afternoon. Many emerging adults were observed in the morning, between 9 and 10 o'clock. Some tandems of *N. joana* were seen at the same spot, but no ovipositing was recorded.

The larva of *N. joana* Williamson was described by GEIJSKES (1954). It differs from larvae of *N. fulvicollis* in possessing a few spines on the ventral border of the ovipositor, which is also a bit longer than that of *N. fulvicollis*. Exuviae of *N. fulvicollis* are less patterned. The mandibular dentation is identical in both species.

COENAGRIONIDAE

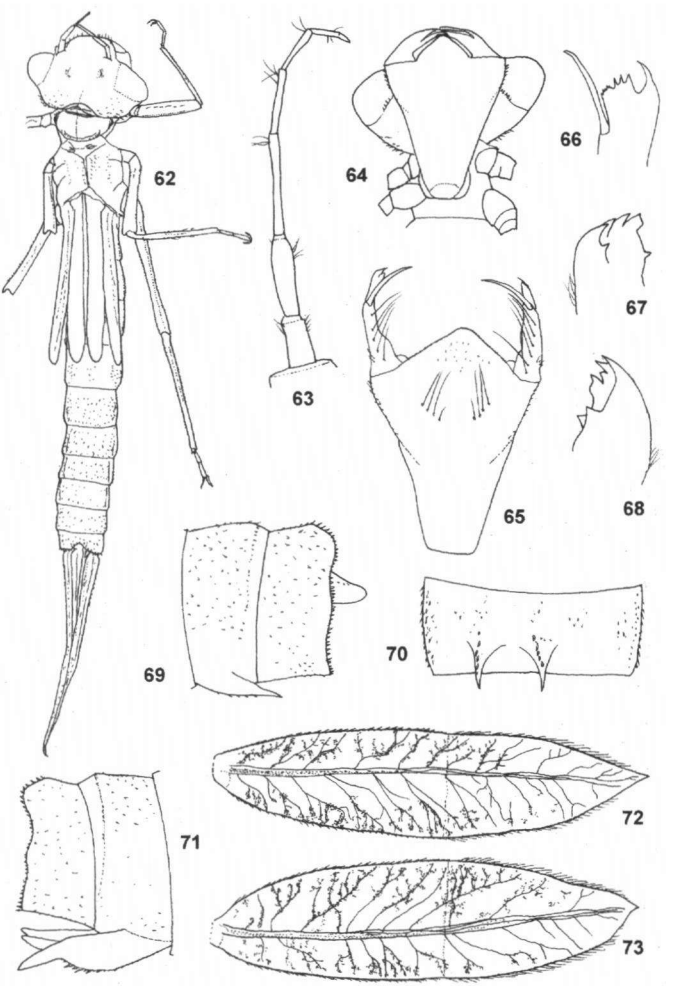
ACANTHAGRION IMERIENSE DE MARMELS, 1989

Figures 62-73

Material (2 ♂, 2 ♀, ultimate instar exuviae; all reared). – 2 ♂, 2 ♀, Venezuela, Amazonas State, Cerro Neblina (Mt. Neblina National Park), 00°50'00"N, 65°58'48"W, 2100 m, 15/18-III-1984, J. De Marmels leg.

Exuviae pale, with no pattern (Fig. 62). Head with smoothly rounded occipital lobes; these beset with spinules; occipital margin concave at middle. Antenna with seven segments (Fig. 63); mandibles as illustrated (Figs 67-68); prementum reaching backward to between second pair of coxae (Fig. 64); median lobe of prementum convex, its free margin serrulate; three premental setae each side, if four, then the innermost shorter (Fig. 65); labial palp as illustrated (Fig. 66), with six palpal setae (one male with only five setae on left palp, see Fig. 65). Hind border of pronotal hind lobe laterally rounded, obtusely ridged, this ridge beset with spinules; prothoracic apophyses heavily sclerotized at tip and armed with three or four spinules anteriorly. Legs pale; longitudinal carinae of femora and tibiae armed with minute spinules. Wing sheaths reaching at least to end of abdomi-

nal segment 3. Segments 4-10 covered with scattered, minute spinules dorsally; segment 10 with triangular emargination at middorsum, and with row of spines along entire distal border. Male gonapophyses bearing an irregular row of short spinules along ventral border (Fig. 69-70). Ovipositor reaching to, or surpassing



Figs 62-73. *Acanthagrion imeriense*, ultimate instar exuviae: (62) male exuviae, dorsal view; – (63) left antenna, male; – (64) head showing prementum, male, ventral view; – (65) prementum, male, dorsal view; – (66) apical portion of right labial palp, external view; – (67) right mandible, ventral view; – (68) left mandible, ventral view; – (69) tip of abdomen showing male gonapophyses, left lateral view; – (70) male gonapophyses, ventral view; – (71) tip of female abdomen showing ovipositor, right lateral view; – (72) left lateral gill, male, left lateral view; – (73) median gill, male, left lateral view.

distal border of segment 10 (Fig. 71). Caudal gills with weakly developed node, which is marked by a shallow emargination at ventral border of lateral gill, and at dorsal border of median gill. All spinules proximally of node are loosely-set and bear a short seta, while those distally of node are small, closely-set, and bear a long, soft hair (Figs 72-73). All gills ending in a short point.

Measurements (in mm). – Total length 12.5-13.0; lateral gill 5.0-5.5; forewing sheath 4.1-4.3; hind femur 3.0-3.3; hind tibia 3.2-3.3.

REMARKS. – *A. imeriense* is endemic in western Pantepui (Amazonas State) and has not so far been found together with the other pantepuyan endemic, *A. tepuiense* De Marmels, from eastern Pantepui (Bolívar State), the larva of which is still unknown. Larvae of *A. imeriense* were found plentiful in a small black-water stream in a partly open palm forest, together with larvae of *Rhionaeschna draco* (Rácenis). On penile morphology, *A. imeriense* fits in the Ablutum group of LEONARD (1977) (DE MARMELS, 1989), a placement which is confirmed by the larval characteristics. PESSACQ et al. (2005) described the larva of *A. ablutum* Calvert, which differs from that of *A. imeriense* mainly in details of the caudal gills.

ACANTHAGRION VIDUA SELYS, 1876

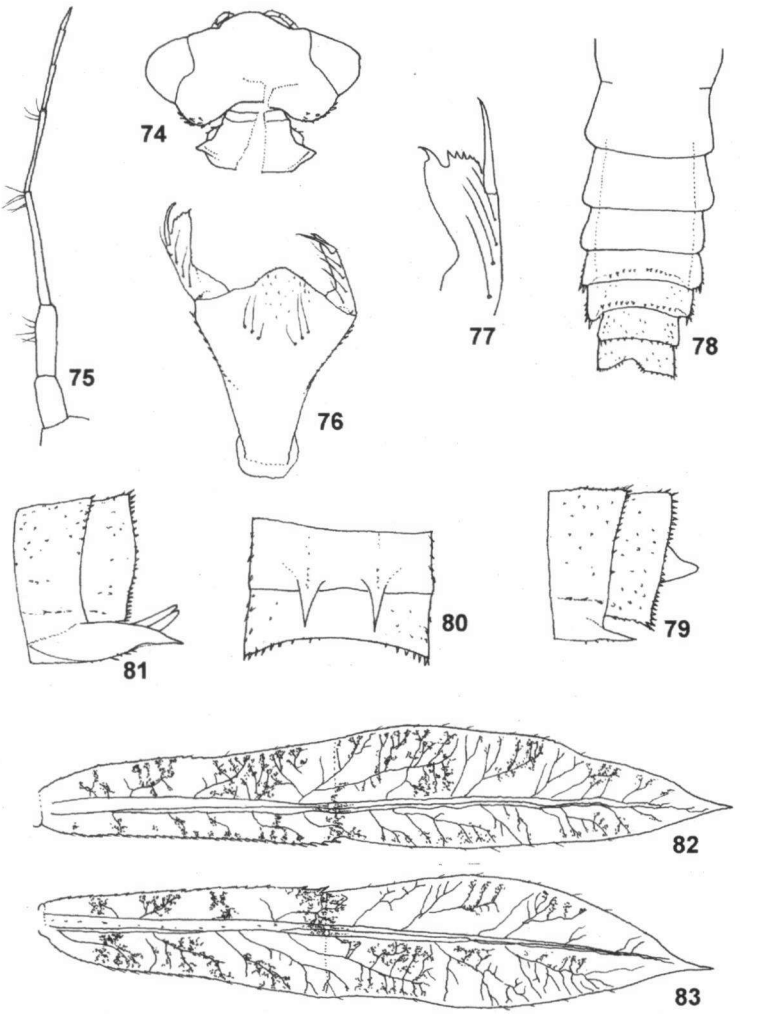
Figures 74-83

Material (7 ♂, 5 ♀,ultimate instar exuviae, in part reared). – 2 ♂, 1 ♀, Venezuela, Aragua State, El Limón, 430 m, 07-XI-1981 (reared); 1 ♂, 1 ♀, 26-XI-1981 (reared); 3 ♂, 3 ♀, -XII-1982; 1 ♂, VI-1990 (reared), all J. De Marmels leg.

Exuviae pale to dark brown, but lacking any definite pattern. Head and antenna as illustrated (Figs 74-75); mandibles similar to *A. imeriense*; prementum reaching posteriorly to second pair of coxae; two premental setae each side, if three, than the inner most considerably shorter (Fig. 76); lateral palp with four setae; apical portion between end hook and movable hook distally armed with three larger teeth followed proximally by two or three minute toothlets (Fig. 77). Hind border of pronotal hind lobe lacking spinules, but produced laterally suggesting (dorsal view) a triangular process (Fig. 74); prothoracic apophyses bearing two or three spinules along anterior border. Legs pale with scattered spinules along carinae of femora and tibiae. Wing sheaths reaching to middle of abdominal segment 4. Segments 7-10 with row of spinules dorsally along distal border; lateral carinae of segments 4-8 well developed, and beset with small spinules along lateral edge; segments 7 and 8 with larger apical spinules (Fig. 78); segment 10 with rounded, dorsomedian excision, this excision armed with 4-5 strong spines each side. Male gonapophyses reaching well beyond middle of segment 10, basally beset with a row of hardly distinguishable minute spinules (Figs79-80). Ovipositor reaching far beyond distal end of segment 10 (Fig. 81). Caudal gills with unconspicuous node at two fifths their length, and with spinules only proximally of node; apical

spinules in close proximity of node larger, dorsally on median gill, ventrally on lateral gills; all gills ending in long, narrow point (Figs 82-83).

Measurements (in mm). – Total length 9.3-10.5; lateral gill 6-7; forewing sheath 3.5-4.0; hind femur 2.0-2.6; hind tibia 2.2-2.7.



Figs 74-83. *Acanthagrion vidua*, ultimate instar exuviae: (74) head and pronotum, male, dorsal view; – (75) left antenna, male; – (76) prementum, male, dorsal view; – (77) right labial palp, male, dorsal view; – (78) male abdomen showing spinulation of apical segments, dorsal view; – (79) tip of male abdomen showing gonapophyses and cercus, left lateral view; – (80) male gonapophyses, ventral view; – (81) tip of female abdomen with ovipositor, left lateral view; – (82) right lateral gill, male, left lateral (internal) view; – (83) median gill, male, left lateral view.

REMARKS. – *A. vidua* is a common pioneer species along the Coastal Cordillera and other hilly areas north of the Orinoco, and in the foothills of the Venezuelan Andes up to elevations above 1000 m, where it breeds in stagnant and slowly flowing water. LEONARD (1977: 66) includes this species (sub *A. risi* Leonard) in the Yungarum group, which has a "probable affinity with the Ablutum group". Larvae of *A. vidua* can easily be separated from larvae of the allopatric *A. imeriense* by the differing number of premental and palpal setae, the laterally projected hind border of the pronotal hind lobe (in *A. vidua*), and shape and spinulation of the caudal gills. Larvae of *A. vidua* are also much smaller and have less produced occipital lobes.

ARGIA ADAMSI CALVERT, 1902
Figures 84-95

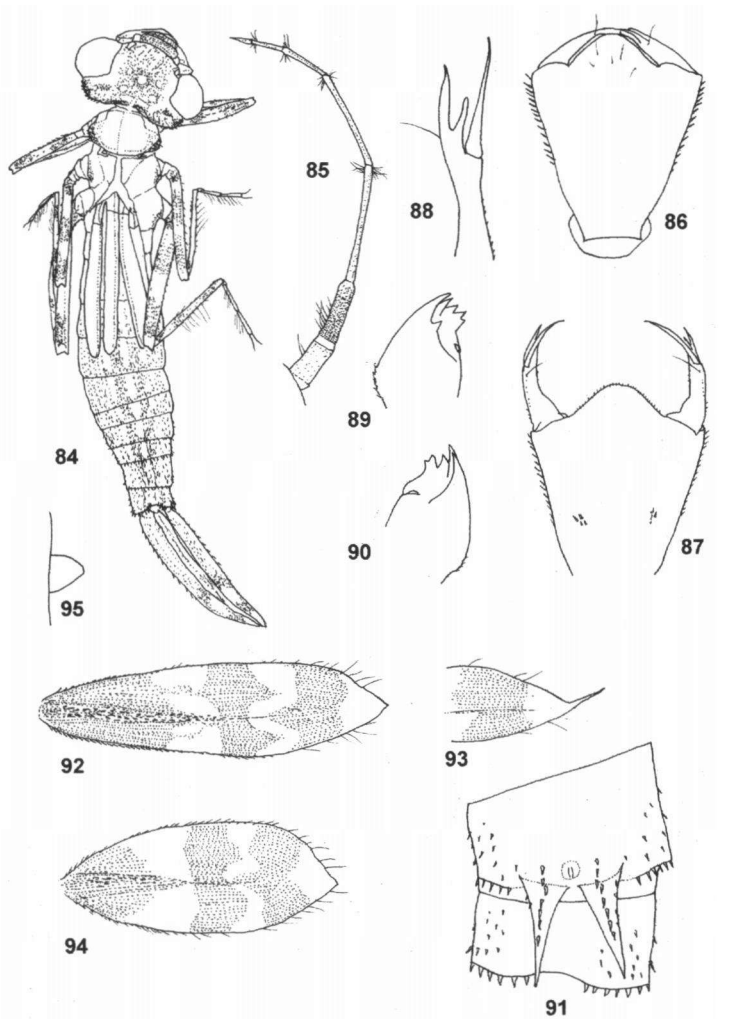
Material (5 ♂, ultimate instar exuviae, collected together with the emerging adults). – 2 ♂, Venezuela, Táchira State, San Félix, Quebrada La Resbalosa, 350 m, 13-IV-1996; 1 ♂, 19-V-1999; 1♂, 3-XI-1999; 1 ♂, 19-V-2002, all J. De Marmels leg.

Exuviae pale with no recognizable pattern to darker brown with pattern better developed (Fig. 84). Head above with pale ocellar and other spots; occiput excavated, occipital lobes rounded and beset with spinules posteriorly. Antenna longer than head, but 0.5 mm shorter than its greatest width; first antennal segment pale, second dark, flagellum paler than second segment, but darker than first (Fig. 85). Prementum reaching posteriorly to beyond first pair of coxae; median lobe strongly prominent, ventrally beset with scattered, soft setae, a longer seta also externally at base of end hook of labial palp (Fig. 86), these setae visible only against the light. Prementum and labial palp in dorsal view as illustrated (Figs 87-88). Mandibles as in Figs 89-90. Hind border of pronotal hind lobe obtusely ridged, laterally beset with short spines. Wing sheaths reaching to middle of abdominal segment 4. Legs armed with spinules along carinae, and with scattered soft hairs, especially dorsally on tarsi. Femora with two, tibiae with three dark cross-bands. Abdomen with variably developed, pale median line, accompanied each side by interrupted pale lateral line. Spinules laterally on segments 5-10, densest on segments 6-8. Distal border of segment 10 with obtusely triangular excision middorsally. Male gonapophyses reaching close to distal border of segment 10 or beyond, and armed ventrally with 7-9 spinules (Fig. 91). Caudal gills variable, either as illustrated (Figs 92, 94), or lateral gills with tip prolonged into a terminal filament of 0.5 mm length (Fig. 93); the scattered, long hairs in distal half visible only against the light.

Measurements (in mm). – Total length 10.5-11.0; lateral gill 3.8-4.5; forewing sheath 3.5-4.0; hind femur 3; hind tibia 3.0-3.2.

REMARKS. – In Venezuela, *A. adamsi* has been recorded from the Lake Maracaibo drainage system only. Other species of the genus at the collecting place

of the exuviae of *A. adamsi* were *A. oculata* Selys and *A. translata* Selys, the larvae of which have much shorter and stouter male gonapophyses. A third species observed at the same spot was *A. cupraurea* Calvert, the larva of which has not been described so far. The ultimate instar exuviae of a single (reared) female in the MIZA collection differs from larvae of *A. adamsi* in having a yet more con-



Figs 84-95. *Argia adamsi*, ultimate instar male exuviae: (84) exuviae, dorsal view; – (85) left antenna; – (86) prementum, ventral view; – (87) same, dorsal view; – (88) left labial palp, left external view; – (89) right mandible, ventral view; – (90) left mandible, ventral view; – (91) abdominal segments 9 and 10 with male gonapophyses, ventral view; – (92) left lateral gill, left lateral view; – (93) tip of left lateral gill of other specimen; left lateral view; – (94) median gill, left lateral view.

vex median lobe of prementum; the basidorsal spiniform setae of prementum are arranged, on each side, in a row (grouped in *A. adamsi*), and the valves of the ovipositor are armed with three parallel rows of knob-like spines. The female larva of *A. adamsi* is still unknown, but may show to have a single row of spines there. NOVELO-GUTIÉRREZ (1992) separates the larvae of Mexican *Argia* Rambur in three groups, based on the condition of the ligula. His "prominent ligula group" (p. 68) also has only one palpal seta. *A. adamsi*, and the other South American species mentioned here above, belong here.

CYANALLAGMA LATERALE (Selys, 1876)
Figures 96-110

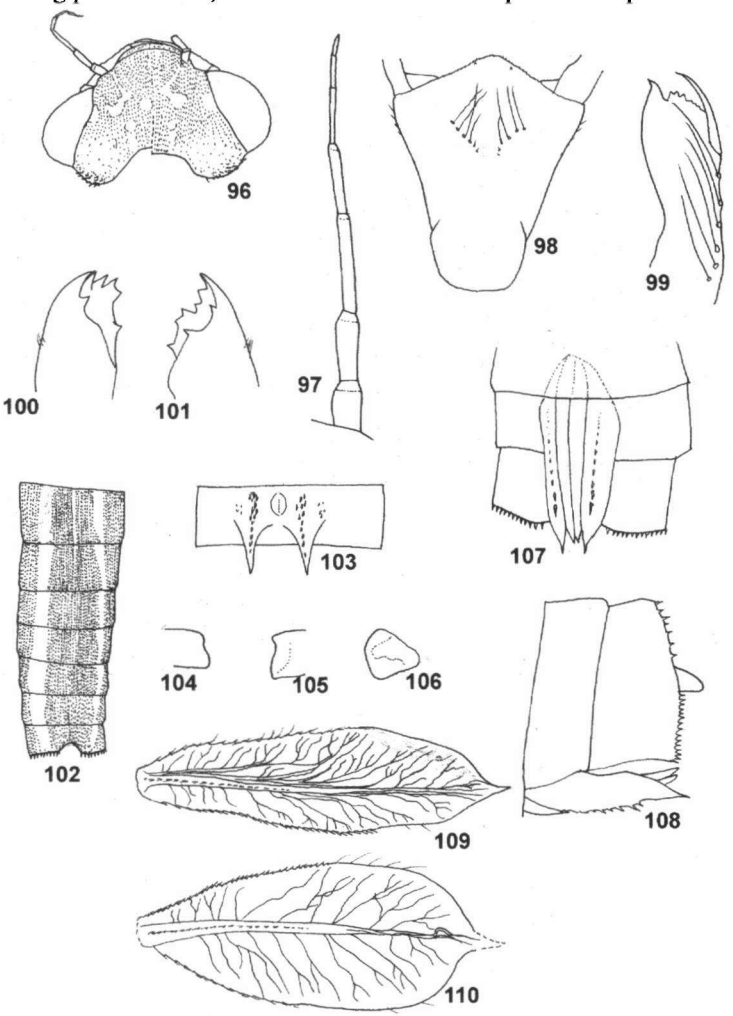
Material (5 ♂, 1 ♀, ultimate instar exuviae).- 3 ♂, 1 ♀, Venezuela, Táchira State, San Vicente de La Revancha, road to Las Copas (Tamá National Park), 2000 m, -VII-2000 (supposition); 2 ♂ (collected with emerging adults), 8-V-2002, all J. De Marmels leg.

Exuviae pale to darker brown, with abdominal pattern as described below. Head with pale ocellar and additional spots (Fig. 96); antenna with seven segments (Fig. 97); occiput deeply excavated, occipital lobes rounded and beset with short spines posteriorly. Prementum reaching backwards to between second pair of coxae, median lobe broadly rounded. There are four premental setae each side, these often accompanied mesally by one to three minute accessory setulae (Fig. 98); six palpal setae (one male has seven on the left palp); teeth of labial palp between movable hook and end hook small (Fig. 99); mandibles as illustrated (Figs 100-101), the small tooth at base of first large tooth of left mandible, as viewed from ventrally (Fig. 101), absent in some specimens. Hind border of pronotal hind lobe rounded, somewhat bulging and sparsely granulose. Wing sheaths reaching to end of abdominal segment 3, or slightly beyond. Legs unpatterned; femora and tibiae armed with short spines along all carinae and laterally. Abdomen granulose dorsally; spines are present only along distal border of segment 10; this latter with narrow median excision dorsally; segment 4-10 with two parallel, dark, longitudinal dorsal bands separated from each other by pale median line, and bordered laterally by broad pale band (Fig. 102). Male gonapophyses slender, pointed and armed with an irregular row of spinules along ventral border (Fig. 103). Ovipositor just surpassing distal border of segment 10; ventral border of valvae beset with one row of spines (Figs 107-108). Caudal gills lacking node, broadly lanceolate and ending in a more or less developed point (Figs 109-110).

Measurements (in mm). – Total length 10.6-11.0; lateral gill 3.7-4.0; forewing sheath 3.6-4.0; hind femur 2.6-2.8; hind tibia 2.7-2.8.

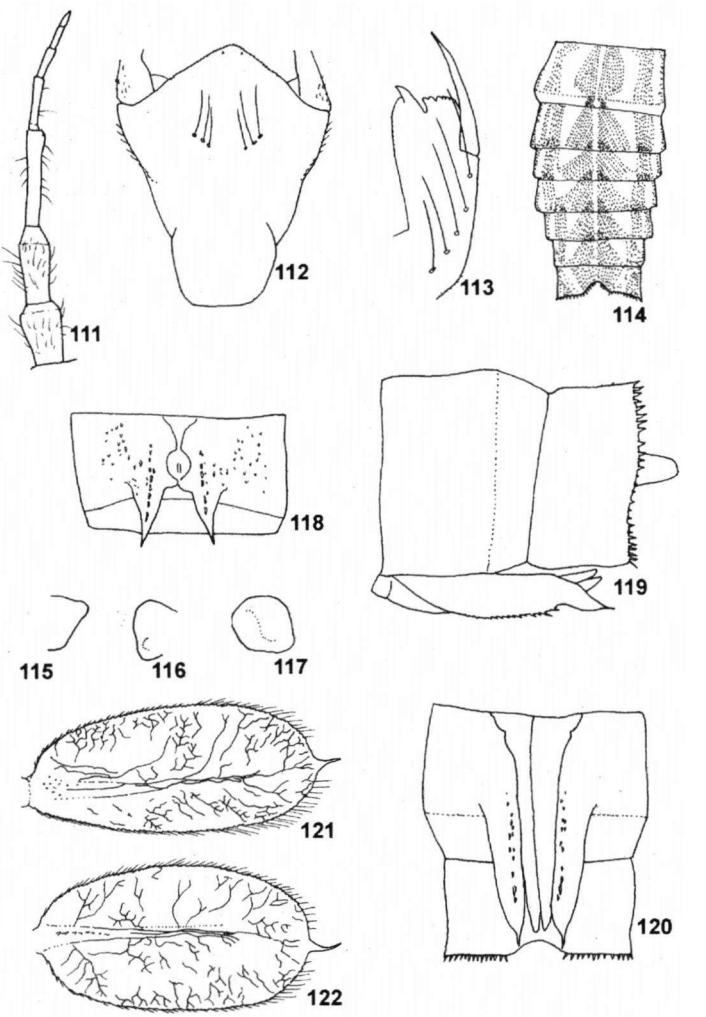
REMARKS. – The larva of *C. laterale* is hardly distinguishable from that of *C. gaianii*, described by DE MARMELS (1997). This is not surprising, as both species are closely similar also in the adult stage, but are allopatric. The larva of

a third Andean species, viz. *C. tamaense*, is described below. Adults of *C. laterale* were common at the pond, where the exuviae were found clinging to emergent plants. *C. tamaense* was also very common, along the small streams in the surrounding pasture land, but does not breed in the pond. The pond is the type



Figs 96-110. *Cyanallagma laterale*, ultimate instar exuviae: (96) head, male, dorsal view; – (97) left antenna, male; – (98) prementum, male, dorsal view; – (99) right labial palp, same specimen, dorsal view; – (100) right mandible, ventral view; – (101) left mandible, ventral view; – (102) abdominal pattern, male, dorsal view; – (103) abdominal segment 9 with male gonapophyses, ventral view; – (104) left cercus, male, left lateral view; – (105) same, right internal view; – (106) same, posterior view; – (107) tip of abdomen with ovipositor, ventral view; – (108) same, left lateral view; – (109) right lateral gill, male, right lateral view (transposed); – (110) median gill, male, right lateral view (transposed).

locality of *Rhionaeschna condor* De Marmels and *R. demarmelsi* von Ellenrieder and was described by DE MARMELS (2001).



Figs 111-122. *Cyanallagma tamaense*, ultimate instar exuviae: (111) left antenna, male; – (112) prementum, male, dorsal view; – (113) right lateral palp, same specimen, dorsal view; – (114) abdominal pattern, male, dorsal view; – (115) left cercus, male, left lateral view; – (116) same, right internal view; – (117) same, posterior view; – (118) abdominal segment 9 with male gonapophyses, ventral view; – (119) tip of female abdomen with ovipositor, left lateral view; – (120) same, ventral view; – (121) left lateral gill, male, left lateral view; – (122) median gill, same specimen, left lateral view.

CYANALLAGMA TAMAENSE DE MARMELS, 1988
Figures 111-120

Material (4 ♂, 2 ♀, ultimate instar exuviae, all reared; 1 ♂,ultimate instar larva). – 1 ♂ (larva), 2 ♂, 1 ♀ (exuviae),Venezuela, Táchira State, San Vicente de La Revancha, Las Copas, Fundo El Remanso (Tamá National Park), 2000 m, 30-XI-1997; 2 ♂, 1 ♀ (exuviae), 1-XII-1997.

Exuviae pale brown with weakly developed pattern on dorsum of abdomen (Fig. 114). Head as in *C. laterale*, but antenna slightly shorter with flagellum more robust (Fig. 111). Prementum reaching backwards to second pair of coxae; there are three premental setae each side (rarely a fourth, short one mesally, on one side), and five palpal setae (rarely six in one palp) (Figs 112-113); teeth of labial palp between movable hook and end hook small and only shallowly separated from each other. Hind border of pronotal hind lobe with lateral angles rounded, but these slightly more bulging than in *C. laterale*. Pattern of dark longitudinal bands on dorsum of abdomen as in Fig. 114. Male gonapophyses and ovipositor as illustrated (Figs 118-120); ovipositor from almost reaching distal border of segment 10 to slightly surpassing it. Caudal gills comparatively short, broadly oval to subcircular, and ending in a short, slender and sharply pointed filament (Figs 121-122). Other characters as in *C. laterale*.

Measurements (uin mm). – Total length 11-15.5; lateral gill 2.6-3.7; forewing sheath 4.2-5.0; hind femur 3.0-3,3; hind tibia 3.0-3.3.

REMARKS. – In Venezuela, *C. tamaense* is restricted to Mt. Tamá where it is common along streamlets in marshy pasture land with *Juncus* sp., between 1900 and at least 2500 m. Its larva differs from those of *C. gaianii* and *C. laterale* in having only three premental and five palpal setae each side, and by the short and broadly oval caudal gills.

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