

*The Leptophlebiidae : Atalophlebiinae  
of New Caledonia (Ephemeroptera)*  
Part V. — Systematics

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ABSTRACT

*The fifth in a series on the Leptophlebiidae (Ephemeroptera) of New Caledonia, this paper treats three new genera, Fasciamirus, Simulacala, and Kouma, and eight new species, Fasciamirus rae, Simulacala notialis, S. miletti, S. massula, Kouma adusta, K. annulata, K. becki, and K. aurata. The genera are described from nymphs and adults.*

KEY WORDS: Ephemeroptera — Systematics — New Caledonia.

RÉSUMÉ

LES LEPTOPHLEBIIDAE : ATALOPHLEBIINAE DE NOUVELLE-CALÉDONIE (ÉPHÉMÉROPTÈRES).  
CINQUIÈME PARTIE : SYSTÉMATIQUE.

*Cinquième d'une série sur des Leptophlebiidae (Ephemeroptera) de Nouvelle-Calédonie, ce travail traite trois genres nouveaux, Fasciamirus, Simulacala, et Kouma, et huit espèces nouvelles, Fasciamirus rae, Simulacala notialis, S. miletti, S. massula, Kouma adusta, K. annulata, K. becki, et K. aurata. Ces genres ont été décrits à partir des stades larvaires et adultes.*

MOTS-CLÉS : Éphéméroptères — Systématique — Nouvelle-Calédonie.

INTRODUCTION

This paper is the fifth in a series on the systematics, phylogeny, biogeography, and ecology of the Leptophlebiidae of New Caledonia. Part I of this series (PETERS, PETERS and EDMUNDS 1978) lists all localities, methods, and acknowledgments. Part

II (PETERS and PETERS 1980), Part III (PETERS and PETERS 1981a) and Part IV (PETERS and PETERS 1981b) give additional systematics.

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**Fasciamirus**, new genus (Fig. 1-6, 32-42, 83-87, 99-104, 117-123).

IMAGO. Length of ♂: body, 5.2-6.7 mm; fore wings, 5.5-6.5 mm. Length of ♀: body, 5.0-6.7 mm; fore wings, 6.4-7.8 mm. Eyes of ♂ separated on meson of head by a distance 1-1/2 times maximum width of a lateral ocellus, dorsally upper portion circular-shaped, on short stalk, lower portion of eyes 3/4 length of upper portion (Fig. 4-6); eyes of ♀ separated on meson of head by a length 4 times as great as maximum width of an eye. Wings (Fig. 1-3): maximum width of fore wings a little more than 1/3 maximum length; vein Rs of fore wings forked a little less than 1/4 of distance from base to margin; vein MA forked a little more than 1/2 of distance from base to margin, fork symmetrical, distal portion of vein MA sagged posteriorly; vein MP<sub>2</sub> attached at base to veins MP<sub>1</sub> and CuA with a cross vein (Fig. 1), attachment of vein MP<sub>2</sub> to MP<sub>1</sub> less than 1/3 of distance from base to margin, base of vein MP<sub>2</sub> equidistant between veins MP<sub>1</sub> and CuA; vein ICu<sub>1</sub> attached to veins CuA and CuP with a cross vein, remainder of Cu-A area as in Fig. 1; cross veins numerous. Costal projection of hind wings weakly developed with indentation distal to apex (Fig. 2-3), apex located 1/2 distance from base, apex curved over; apex of wings acute, rounded; cross veins few. Legs: ratios of segments of ♂ fore legs, 0.60-0.68: 1.00 (2.0-2.2 mm): 0.02-0.03: 0.40-0.45: 0.32-0.35: 0.23-0.28: 0.09-0.10. Claws of a pair on prothoracic legs dissimilar, one apically hooked (Fig. 34), other obtuse, pad-like with subapical hook; claws of a pair on meso- and metathoracic legs nearly similar, both apically hooked, one with a small opposing hook (Fig. 35). Male genitalia (Fig. 32-33): segment 2 of forceps equal in length to segment 3, segment 2 1/8 length of segment 1, apex of segment 3 rounded, base of forceps broad, its inner margin forming an angular bend near middle of forceps; length of styliger plate along median line a little more than 1/2 maximum width, apex shallowly cleft as in Fig. 32; penes fused, broad, flattened, base broader, apex shallowly cleft (Fig. 32). Ninth sternum of ♀ entire apically (Fig. 83); margin of sternum 7 convex (Fig. 84-86). Terminal filament a little longer than cerci.

MATURE nymph. Head prognathous. Antennae more than 2 times maximum length of head. Mouthparts (Fig. 99-104, 117-118): dorsal hair on labrum as in Fig. 99; submedian to anterior areas of hair ventrally; anteromedian emargination with 5 (rarely 6)

denticles, shape of denticles as in Fig. 100. Clypeus as in Fig. 99. Left mandible as in Fig. 101. Lingua of hypopharynx with well developed lateral processes, paired submedian row of long hair on internal dorsal surface, anterior margin deeply cleft (Fig. 103); superlingua as in Fig. 103, with a row of hair along anterior margin, lateral margins rounded. Segment 2 of maxillary palpi equal to a little longer than length of segment 1; segment 3 3/5 to 4/5 length of segment 2, triangular; a V-shaped ridge near the ventral, inner anterolateral margin of maxillae; hair on maxillae as in Fig. 104. Labium as in Fig. 117; segment 2 of palpi 4/5 to a little shorter than length of segment 1; segment 3 of palpi 3/5 to a little shorter than length of segment 2, triangular, base broad; paraglossae ventral to glossae. Sparse, long, fine hair on entire head and body. Legs (Fig. 119-120, 123): maximum width of tibiae 2 times maximum width of tarsi, tibiae in cross section oval, inner margin of femora indented in apical half so tibiae can draw partially into femora; apex of claws hooked and narrow, denticles on claws progressively larger apically, except apical denticle a little larger (Fig. 123). Gills (Fig. 121-122): gills on segment 1 long, slender, lanceolate, rarely with short ventral portion (Fig. 121); upper and lower portions of lamellae of gills 2-7 forked about 1/4 distance from base to apex; each portion long, smoothly tapered to apex (Fig. 122); main trunk of tracheae forked near base of gills and each branch along median line of each portion of lamellae, main trunk darkly pigmented, both portions of lamellae translucent gray. Posterolateral spines on abdominal segments 5 to 6-9, spines progressively larger posteriorly, apex of posterolateral spines on segment 9 indented and sometimes giving appearance of double spines. Terminal filament a little longer than cerci.

ETYMOLOGY. fascia, L., meaning band; mirus, L., meaning wonderful. Masculine.

TYPE SPECIES. *Fasciamirus rae*, new species.

DISCUSSION. *Fasciamirus* can be distinguished from all genera of the Leptophlebiidae by the following combination of characters. In the imagos: (1) the Cu-A area of the fore wings possesses 2 long intercalaries (Fig. 1); (2) length of vein Sc of the hind wings is 7/10 maximum length of hind wings (Fig. 2-3); (3) costal projection of hind wings is weakly developed with an indentation distal to apex (Fig. 2-3); (4) the penes of ♂ genitalia are fused, broad, and flattened (Fig. 32); and (5) claws of ♂ prothoracic legs are dissimilar, one apically hooked (Fig. 34), other obtuse, pad-like with a subapical hook. In the nymphs: (1) inner margin of segment 3 of labial palpi has thick heavy spines (Fig. 118); (2) glossae of labium are straight

(Fig. 117); (3) maximum width of tibiae is 2 times maximum width of tarsi (Fig. 119); (4) abdominal gills 1 differ from gills 2-7; gill 1 is long, slender, usually without fork (Fig. 121) while gills 2-7 are forked and each portion is long and smoothly tapered to apex (Fig. 122); distance from base to fork of gills 2-5 exceeds length of ensuing segment; and (5) denticles on claws are progressively larger apically, except the apical denticle is a little larger (Fig. 123).

*Fasciamirus* appears to be most closely related to *Simulacala* and can be distinguished from it by the following combination of characters. In the imagos: (1) the penes of ♂ genitalia are fused, broad, and flattened (Fig. 32); and (2) claws of ♂ prothoracic legs are dissimilar, one apically hooked (Fig. 34), other obtuse, pad-like with a subapical hook. In the nymphs: (1) denticles on the anteromedian emargination of the labrum are approximately equal-sized (Fig. 100); and (2) abdominal gills 1 differ from gills 2-7; gill 1 is long, slender, usually without fork (Fig. 121) while gills 2-7 are forked and each portion is long and smoothly tapered to apex (Fig. 122); distance from base to fork of gills 2-5 exceeds length of ensuing segment. Within New Caledonia, *Fasciamirus* can be easily recognized by the conspicuous dark bands on the femora of all legs in imagos, subimagos and mature nymphs (Fig. 36, 87).

The usual condition of abdominal gills 1 is a single, slender filament. In 26 nymphs examined, only 3 showed any evidence of a furcation in this gill, usually a short ventral portion less than half the length of the dorsal portion; these 3 were all mature females. An unforked gill 1 and a forked gill 1 occurred together on the same specimen. The margin of the seventh sternum in females imagos is smooth and slightly convex (Fig. 85-86); however, in females which have apparently oviposited, this margin is distended as a small, medial, membranous egg guide or ovipositor. The distention may be caused by the passage of eggs.

***Fasciamirus rae***, new species (Fig. 1-6, 32-42, 83-87, 99-104, 117-123).

**MALE IMAGO** (in alcohol). Length: body, 5.2-6.7 mm; fore wings, 5.5-6.5 mm. Upper portion of eyes reddish-brown, lower portion black (Fig. 4). Head brown to dark brown, carinae darker. Antennae brown, flagellum paler. Thorax dark brown, mesonotum darker, carinae darker, carinae of pleura and pronotum blackish-brown. Coxae and trochanters dark brown, remainder of legs pale, except a wide, transverse, dark brown band at apex and near base of femora (Fig. 36) and a narrow, transverse, dark brown band at apex of tibiae. Wings (Fig. 1-3): longitudinal veins of fore and hind wings pale brown

to brown, veins faded in Cu-A area and posterior half of hind wings, cross veins of fore and hind wings hyaline to light brown; wing membrane hyaline to pale brown, except brown at base and costal brace, apical 1/3 of cells C and Sc of fore wings translucent, whitish-brown. Abdomen: segments 1-7 washed lightly to heavily with dark brown, segments 8-10 opaque dark brown; terga 1-9 with a narrow darker transverse posterior band, terga 2-7 with a pale median longitudinal line extended entire length of each tergum, terga 2 and 7 with pale anteromedian marks as in Fig. 37-38, terga 3-6 with more extensive pale anteromedian marks as in Fig. 37-38; spiracles darker brown, tracheae washed lightly with brown (Fig. 39-40); sterna 1-8 with a narrow darker transverse posterior band, sternum 1 with large paired posteromedian dark brown maculae, sterna 8-9 uniformly dark brown, sterna 2-7 with very small to extensive submedian dark brown marks as in Fig. 41-42. Genitalia (Fig. 32-33): brown, apical 1/3 of forceps and penes paler. Caudal filaments brown.

**FEMALE IMAGO** (in alcohol). Length: body, 5.0-6.7 mm; fore wings, 6.4-7.8 mm. Eyes black. Head dark brown, carinae darker. Antennae brown, flagellum paler. Thorax: color and marks as in ♂ imago. Wings: color and marks as in ♂ imago, except darker. Color and marks of legs as in ♂ imago. Abdomen: dark brown; terga 1-9 with a narrow darker transverse posterior band on each tergum, terga 2-8 with a pale median longitudinal line, terga 2-8 with paired pale oblique sublateral bars extended to anterior 1/3 of each tergum, terga 1-9 with darker brown lateral oval-shaped marks; spiracles darker brown, tracheae washed lightly with brown; color and marks of sterna as in ♂ imagos. Caudal filaments brown.

**MATURE NYMPH** (in alcohol). Head: light brown, washed with darker brown between eyes, ocelli and antennae as in Fig. 87. Thorax: brown, marks as in ♂ and ♀ imagos. Legs: pale, except tibiae and tarsi reddish-brown, marks as in ♂ and ♀ imagos. Abdomen: brown, darker brown and paler marks as in ♂ and ♀ imagos. Gills (Fig. 121-122): membrane translucent, grayish, tracheae black. Caudal filaments brown.

**SPECIMENS.** Holotype ♂ imago, No. N42; allotype ♀ imago, No. N42; paratypes: 4 ♂, 6 ♀, 2 nymphs, No. N15; 1 ♂ subimago, No. N19; 2 nymphs, No. N21; 4 ♂, 1 ♀, 2 nymphs, No. N25; 1 ♂, 2 ♀, 6 nymphs, No. N27; 19 ♂, 10 ♂ subimagos, 1 ♀, 5 ♀ subimagos, 4 nymphs, No. N35; 1 ♂, 1 ♀, 2 nymphs, No. N37; 1 ♀, 1 nymph, No. N41; 26 ♂, 28 ♂ subimagos, 7 ♀, 7 ♀ subimagos, 19 nymphs, No. N42; 1 ♂, 1 ♂ subimago, 1 ♀, 2 ♀ subimagos, No. N50; 1 nymph, No. N53; 1

♂, 2 ♂ subimagos, 1 ♀, 2 nymphs, No. N54; 1 ♂, 1 ♂ subimago, 1 ♀, 2 ♀ subimagos, No. N55; 3 nymphs, No. FNK9; 4 nymphs, No. FNK29; 1 nymph, No. FNK39; 9 nymphs, No. FNK62; 1 nymph, No. FNK67; 2 nymphs, No. FNK79; 2 nymphs, No. FNK111; 1 nymph, No. FNK121. All types are in alcohol. Association of the nymphs and adults is by rearing. All types are deposited in the following collections: holotype, allotype, 24 nymphal paratypes, 20 ♂ paratypes, 14 ♂ subimaginal paratypes, 7 ♀ paratypes, and 4 ♀ subimaginal paratypes at FAMU; 20 nymphal paratypes, 18 ♂ paratypes, 13 ♂ subimaginal paratypes, 6 ♀ paratypes, and 4 ♀ subimaginal paratypes at UU; 5 nymphal paratypes, 5 ♂ paratypes, 4 ♂ subimaginal paratypes, 2 ♀ paratypes, and 2 ♀ subimaginal paratypes each at BPBM, ORSTOM, CTFT, and NMNH.

**ETYMOLOGY.** Species is named for Rae Ellen Adams who collected many of the specimens described in this paper.

**DISCUSSION.** The range of variability in the color pattern of this species is illustrated in Fig. 61-66, but there is a graduated change from the lighter to darker forms. The darkest varieties were from localities No. N21 and N42; all variations were equally represented at No. N42. The holotype and allotype were both chosen from the lightest color form.

**BIOLOGY.** *Fasciamirus rae* occurs at various localities throughout New Caledonia and is found in small streams to medium-sized rivers. Nymphs were collected in streams with water temperatures of 18 °C-24.5 °C, at 46-458 m altitude. The species was most abundant in streams with water temperatures of 18 °C-20 °C.

Nymphs occur on small stones in quiet water near the banks. When at rest the gills are held out laterally and seldom move. Nymphs swim with a serpentine movement.

Nymphs emerged to subimagos in early evening and subimagos were collected in abundance at light traps. The subimagos molted to imagos in early morning in full light. At locality No. N42 imagos swarmed between 0730 and 0930 near bushes on the banks. The bushes were 1/2-1 m above the stream surface. At locality No. N25 on a cloudy day, imagos swarmed between 1230 and 1600, whenever the sun appeared between the clouds. Swarms consisted of 3 to 5 ♂ near or under tall bushes.

**Simulacala**, new genus (Fig. 7-19, 43-56, 88-93, 105-110, 124-127, 131-135)

**IMAGO.** Length of ♂: body, 5.0-6.0 mm; fore wings,

4.5-6.8 mm. Length of ♀: body, 4.2-5.0 mm; fore wings, 4.5-5.5 mm. Eyes of ♂ separated on meson of head by a length 1 to 1-1/2 times maximum width of upper portion of an eye (Fig. 11, 13, 18-19); dorsally upper portion oblong (Fig. 10, 17), set on lateral sides of head by short stalk, lower portion bulbous and fused to upper portion, lower portion a little less than 1/4 length of upper portion; eyes of ♀ separated on meson of head by a length 5 times as great as maximum width of an eye. Wings (Fig. 7-9, 12, 14-16); maximum width of fore wings 1/3 maximum length; vein Rs of fore wings forked less than 1/4 of distance from base to margin; vein MA forked less than 1/2 of distance from base to margin, fork symmetrical, distal portion of vein MA sagged posteriorly; vein MP<sub>2</sub> attached at base to veins MP<sub>1</sub> and CuA with a cross vein (Fig. 7, 14), attachment of vein MP<sub>2</sub> to MP<sub>1</sub> 1/3 of distance from base to margin, base of vein MP<sub>2</sub> nearer to vein MP<sub>1</sub> than vein CuA; base of vein ICu<sub>1</sub> attached to vein CuP or to a cross vein between CuA and CuP, remainder of Cu-A area as in Fig. 7, 14; cross veins numerous. Costal projection of hind wings rounded (Fig. 8-9, 12, 15-16), apex located 2/3 to 3/4 distance from base; apex of wings acute, rounded; cross veins few to numerous. Legs: ratios of segments in ♂ fore legs, 0.33-0.40: 1.00 (2.6-3.8 mm): 0.03-0.07: 0.36-0.47: 0.30-0.44: 0.29-0.34: 0.09-0.13. Claws of a pair dissimilar, one apically hooked (Fig. 45), other obtuse, pad-like. Male genitalia (Fig. 43-44, 47-53): segment 3 of forceps shorter than to 3/4 length of segment 2, segment 2 1/3 to 1/4 length of segment 1, apex of segment 3 rounded, base of forceps broad, its inner margin curved near middle of forceps; length of styliiger plate along median line 1/3 to 1/2 maximum width; penes fused except at apex, penes thin and broad except basal 1/2 broader, apex of each penis lobe rounded, submedian areas of penes heavily sclerotized, apical 1/2 of penes slightly to strongly curved dorsally (Fig. 43-44, 47-52). Ninth sternum of ♀ entire, apically acute with a median longitudinal ridge along entire length of sternum (Fig. 88); margin of sternum 7 convex with median membranous portion (Fig. 89-91). Terminal filament a little longer than cerci.

**MATURE NYMPH.** Head prognathous. Antennae 1-1/2 times maximum length of head. Mouthparts (Fig. 105-110, 124-125): dorsal hair on labrum as in Fig. 105; submedian and anterolateral areas of long hair ventrally; anteromedian margin deeply cleft, 5 denticles on anteromedian cleft, submedian denticles larger (Fig. 106). Clypeus as in Fig. 105. Left mandible as in Fig. 107. Lingua of hypopharynx with well developed lateral processes, paired submedian row of hair on internal dorsal surface, anterior margin deeply cleft; superlingua as in Fig. 109, with

a row of hair along anterior margin, lateral margins acute. Segment 2 of maxillary palpi a little shorter to a little longer than length of segment 1; segment 3 of palpi  $3/4$  to  $4/5$  length of segment 2, triangular; hair on maxillae as in Fig. 110. Labium as in Fig. 124; segment 2 of palpi a little shorter than to equal length of segment 1; segment 3 of palpi  $2/3$  to a little shorter than length of segment 2, triangular, base broad (Fig. 125); palpi broad; paraglossae ventral to glossae. Sparse long hair over entire body. Legs (Fig. 126-127, 133-134): maximum width of tibiae 2 times maximum width of tarsi, tibiae oval in cross section; outer margin of femora indented near apex so tibiae can draw partially into femora (Fig. 133); apex of claws hooked and narrow, denticles on claws progressively larger apically, apical denticle larger to much larger (Fig. 126-127). Gills (Fig. 131-132, 135): gills on segments 1-7 alike; gills deeply forked and 2 portions of lamellae overlap, each portion long, smoothly to abruptly tapered to apex (Fig. 131-132, 135); main trunk of tracheae forked near base of gills and each branch along median line of each portion of lamellae; lamellae heavily pigmented. Posterolateral spines on abdominal segments 6-9, spines progressively larger posteriorly, apex of posterolateral spines on segment 9 weakly to strongly indented giving appearance of double spines. Terminal filament a little longer than cerci.

ETYMOLOGY. *simulacrum*, L., meaning phantom; *ala*, L., f., meaning wing. Feminine.

TYPE SPECIES. *Simulacala notialis*, new species.

DISCUSSION. *Simulacala* can be distinguished from all genera of the Leptophlebiidae by the following combination of characters. In the imagos: (1) the Cu-A area of the fore wings possesses 2 long intercalaries (Fig. 7, 14); (2) length of vein Sc of the hind wings is  $3/4$  to  $7/8$  maximum length of hind wings (Fig. 8-9, 12, 15-16); (3) costal projection of hind wings is rounded (Fig. 8-9, 12, 15-16); (4) dorsally, upper portion of eyes of ♂ is oblong and set laterally on head by a short stalk; lower portion of eyes is bulbous and fused to upper portion (Fig. 10-11, 13, 17-19); and (5) penes of ♂ genitalia are fused except at apex; apical  $1/2$  of penes is curved dorsally (Fig. 43-44, 47-48, 50-51). In the nymphs: (1) inner margin of segment 3 of labial palpi has thick heavy spines (Fig. 125); (2) glossae of labium are straight (Fig. 124); (3) denticles on claws are progressively larger apically, except apical denticle larger to much larger (Fig. 126-127); (4) segment 3 of the maxillary palpi is  $3/4$  to  $4/5$  length of segment 2 (Fig. 110); and (5) abdominal gills 1-7 are deeply forked and 2 portions of lamellae overlap; each portion is long

and smoothly to abruptly tapered to apex (Fig. 131-132, 135).

*Simulacala* appears to be mostly closely related to *Fasciamirus* but can be distinguished from it by the following combination of characters. In the imagos: (1) dorsally, upper portion of eyes of ♂ is oblong and set laterally on head by a short stalk (Fig. 10-11, 13, 17-19); and (2) the penes of ♂ genitalia are fused except at apex; apical  $1/2$  of penes are curved dorsally (Fig. 43-44, 47-53). In the nymphs: (1) 5 denticles occur on the anteromedian cleft of the labrum; submedian denticles are larger (Fig. 106); and (2) abdominal gills 1-7 are deeply forked and 2 portions of lamellae overlap; each portion is long and smoothly to abruptly tapered to apex (Fig. 131-132, 135).

We describe herein 3 species of *Simulacala*, *S. notialis*, *S. milleti*, and *S. massula*. The nymphs are reared and both the ♂ and ♀ imagos are known for *S. notialis* and *S. massula*. The nymphs and ♂ imago of *S. milleti* are associated from the same locality.

#### KEY TO THE SPECIES OF *SIMULACALA*, NEW GENUS

##### IMAGOS

1. Membrane of fore and hind wings with light tan to golden brown tint (Fig. 14); apex of femora with brown maculae (Fig. 56); dorsal portion of eye of ♂ laterally directed as in Fig. 17-19 ..... *S. massula*  
—Membrane of fore and hind wings hyaline to hyaline with apical tint (Fig. 7); apex of femora without maculae, although sometimes darker; eyes of ♂ as in Fig. 10-11, 13 ..... 2
2. Anterior margin of mesobasisternum dark brown; a dark brown, oblique bar extended from anterior margin of fore wing bases to anterior margin of mesopleura (Fig. 46) ..... *S. notialis*  
—Mesobasisternum entirely pale; mesopleura around wing bases pale ..... *S. milleti*

##### MATURE NYMPHS

1. Abdominal gill margins subparallel and tapered abruptly at apex as in Fig. 131 ..... *S. notialis*  
—Abdominal gills margins taper gradually to apex (Fig. 132, 135) ..... 2
2. Anterior margin of mesobasisternum washed with blackish-brown; femora with apical marks (Fig. 133) .. *S. massula*  
—Anterior margin of mesobasisternum pale; femora pale ..... *S. milleti*

Although female imagos of *S. milleti* are unknown, they probably resemble *S. notialis* and *S. massula*. Female imagos of these species and mature female nymphs of all 3 species have similar abdominal marks, but the absence of marks on the mesobasis-

ternum, femora, and mesopleura anterior to the fore wings should distinguish *S. milleli* from *S. massula* and *S. notialis*.

***Simulacala notialis***, new species (Fig. 7-11, 43-46, 131)

**MALE IMAGO** (in alcohol). Length: body, 5.0-5.6 mm; fore wings, 4.5-5.5 mm. Upper portion of eyes red-brown, stalk darker, lower portion black (Fig. 10-11). Head light brown, area between lateral ocelli and around base of eyes dark brown. Antennae pale. Thorax pale, carinae of mesothorax darker, sutures of mesothorax paler; a dark brown, oblique bar extended from anterior margin of fore wing bases to anterior margin of mesopleura; anterior margin of mesobasisternum blackish-brown (Fig. 46). Legs pale, except apex of prothoracic femora and tibiae darker, anterior margin of mesothoracic coxae dark brown. Wings (Fig. 7-9): longitudinal veins and cross veins of fore wings light brown, faded in posterior half of wings, longitudinal and cross veins of hind wings pale; membrane of fore wings a little translucent, light brown, color faded in posterior half of wings, apical 1/3 of cells C and Sc of fore wings more translucent, membrane of hind wings faded, hyaline. Abdomen: segments 1-6 translucent pale, segments 7-10 opaque, pale; posterior half of terga 8-10 with paired, submedian, dark brown maculae, those on tergum 8 faded; spiracles and tracheae hyaline. Genitalia (Fig. 43-46): pale, median line of penes darker. Caudal filaments pale.

**FEMALE IMAGO** (in alcohol). Length: body, 4.2-4.8 mm; fore wings, 4.5-5.2 mm. Eyes black. Head pale, areas between eyes and ocelli washed with darker brown. Antennae pale. Color and marks of thorax as in ♂ imago, except prothorax and metathorax darker, pronotum with dark brown marks. Color and marks of legs as in ♂ imagos, except basal half of prothoracic femora a little darker, apex of mesothoracic and metathoracic legs darker. Wings: color and marks as in ♂ imago, except longitudinal veins of fore wings darker brown, faded in Cu-A area. Abdomen: opaque, pale, terga 1-10 with an extensive dark pattern on each tergum similar to that of *S. massula* (Fig. 91-92), darker longitudinal paired submedian lines on each tergum, median line paler, pattern faded on terga 1 and 8-10; spiracles and tracheae hyaline. Caudal filaments pale.

**MATURE NYMPH** (in alcohol). Head: light yellowish-brown, marks as in ♂ and ♀ imagos. Thorax: color and marks as in ♂ and ♀ imagos. Legs: light yellowish-brown, tarsi and claws darker, marks as in ♂ and ♀ imagos, except faded. Abdomen: light

yellowish-brown, marks as in ♂ and ♀ imagos. Gills (Fig. 131): lateral margins parallel and abruptly tapered to apex; membrane gray; tracheae black, lateral edges of main trunk darker. Caudal filaments light yellowish-brown.

**SPECIMENS.** Holotype ♂ imago, No. N51; allotype ♀ imago, No. N51; paratypes: 1 nymph, No. N13; 2 nymphs, No. N22; 26 nymphs, No. N27; 2 nymphs, No. N28; 1 nymph, No. N35; 3 nymphs, 3 ♂ subimagos, 3 ♀ imagos, 4 ♀ subimagos, No. N50; 17 nymphs, 3 imagos, 17 ♂ subimagos, 4 ♀ subimagos, No. N51; 7 nymphs, No. FNK9; 3 nymphs, No. FNK55; 4 nymphs, No. FNK63. Association of the nymph and adults is by rearing. All types are deposited in the following collections: holotype, allotype, 10 nymphal paratypes, 1 ♂ paratype, 4 ♂ subimaginal paratypes, 1 ♀, and 2 ♀ subimaginal paratypes at FAMU; 10 nymphal paratypes, 2 ♂ paratypes, 4 ♂ subimaginal paratypes, 2 ♀ paratypes, and 2 ♀ subimaginal paratypes at UU; 7 nymphal paratypes, 3 ♂ subimaginal paratypes, 1 ♀ subimaginal paratype each at BPBM, ORSTOM, CTFT, and NMNH.

**ETYMOLOGY.** *notialis*, L., meaning southern.

**DISCUSSION.** *Simulacala notialis* can be distinguished from *S. milleli* and *S. massula* by the characters given in the key. The tergal color pattern of the ♀ nymphs from localities No. N27 and N55 is much lighter, except for the sublateral bars. Also, the general color of the abdominal gills is a little darker.

**BIOLOGY.** *Simulacala notialis* may be confined to the extreme Southern Region of New Caledonia at higher elevations. Nymphs were found in streams with water temperatures of 19°C-20°C and at 153-183 m elevation.

Nymphs were collected on the underside of median sized rocks partially buried in coarse sand along the edges of the streams. The water was only a few cm deep with little to no water movement. Nymphs emerged in the evening after dark and subimagos were readily attracted to light. No imagos were found swarming.

***Simulacala milleli***, new species (Fig. 12-13, 47-49, 127, 132)

**MALE IMAGO** (in alcohol). Length: body, 5.5-6.0 mm; fore wings, 6.5-6.8 mm. Upper portion of eyes brown, stalk blackish-brown, lower portion black. Head light brown, area between ocelli and vertex of head washed with blackish-brown. Antennae pale. Thorax pale, carinae a little darker, sutures paler. Legs pale, prothoracic legs a little darker, apex of

prothoracic femora and tibiae darker brown. Wings: longitudinal veins and cross veins of hind wings pale; membrane of fore wings translucent, light tan, color faded in posterior half of wings, apical 1/3 of cells C and Sc of fore wings more translucent, membrane of hind wings faded, hyaline. Abdomen: segments 1-6 translucent pale, segments 7-10 opaque, pale; spiracles and tracheae hyaline. Genitalia (Fig. 47-49): pale. Caudal filaments pale, apical half a little darker.

**FEMALE IMAGO.** Unknown.

**MATURE NYMPH** (in alcohol). Head: light yellowish-brown, marks as in ♂ imago. Thorax: light yellowish-brown, margins and median area of pronotum of ♀ washed with darker brown, area around base of mesothoracic wing pads and anterolateral corners of mesothorax of ♀ washed with darker brown. Legs: light yellowish-brown, tarsi and claws darker, apex of prothoracic tibiae of ♂ with darker band. Abdomen: light yellowish-brown, a darker brown color pattern on terga of ♀ nymphs (similar to Fig. 93). Gills (Fig. 132): smoothly tapered to apex; membrane gray; tracheae black. Caudal filaments light yellowish-brown.

**SPECIMENS.** Holotype ♂ imago, No N42; paratypes: 6 ♂ imagos, No. N17; 2 nymphs, No. N21; 30 nymphs, No. N37; 3 nymphs, 1 ♂ imago, No. N42; 1 nymph, No. N46; 1 nymph, No. FNK53. Association of the ♂ nymph and ♂ imago is by the color marks on the legs and shape of the eyes on specimens from the same locality. All types are deposited in the following collections: holotype, 11 nymphal paratypes, and 2 ♂ paratypes at FAMU; 10 nymphal paratypes and 2 ♂ paratypes at UU; 5 nymphal paratypes and 1 ♂ paratype each at BPBM, ORSTOM, and CTFT; 5 nymphal paratypes are at NMNH.

**ETYMOLOGY.** Species is named for Mr. Y. MILLET, Eaux et Forêts, Poindimié, Nouvelle Calédonie.

**DISCUSSION.** *Simulacala milleli* can be distinguished from *S. notialis* and *S. massula* by the characters gives in the key.

**BIOLOGY.** *Simulacala milleli* appears to range from the East Coast westward to the central, higher mountain areas on the West Coast. Nymphs were found commonly in streams with water temperatures of 16.5°C-19°C and at 76-458 m elevation.

Nymphs were found buried into coarse sand along the sides of streams in areas with little water movement. At locality No. N37, nymphs were collected buried into coarse sand under large rocks in the fastest portion of the river. Males swarmed about 5 m over the rivers just at dark. Swarms consisted of

5 or less ♂, and no ♀ were collected from these swarms. No subimagos or imagos were collected at light traps.

**Simulacala massula**, new species (Fig. 14-19, 50-56, 88-93, 105-110, 124-126, 133-135)

**MALE IMAGO** (in alcohol). Length: body, 5.0-5.5 mm; fore wings, 5.2-5.6 mm. Upper portion of eyes reddish-brown, laterally directed (Fig. 17-19); lower portion black. Head pale brown, area around ocelli washed with dark brown. Antennae pale brown, flagellum paler. Thorax pale brown, carinae darker, sutures pale; mesonotum and metanotum darker; dark brown, oblique bar extending from anterior margin of fore wing bases to anterior margin of mesopleura; a small, dark brown macula anterior to mesothoracic coxae; a narrow, longitudinal, dark brown line on median of prosternum; anterior half of mesobasisternum dark brown. Legs pale brown, prothoracic legs a little darker, mesothoracic coxae with a large dark brown macula, apex of femora with a wide, transverse, dark brown band (Fig. 56), apex of tibiae with a wide, transverse, dark brown band, band paler on metathoracic tibiae. Wings (Fig. 14-16): longitudinal veins and cross veins of fore and hind wings brown; membrane of fore and hind wings hyaline, light brown, membrane darker in cells C, Sc and R<sub>1</sub> of fore wings, apical 1/3 of cells C and Sc of fore wings translucent brownish-white. Abdomen: segments 1-7 hyaline white; segments 8-10 opaque brownish-white; terga 2-10 with a dark blackish-brown wash (Fig. 54); spiracles and tracheae hyaline (Fig. 55). Genitalia (Fig. 50-53): light brownish-white, apical half of forceps segment 1 lightly washed with darker brown. Caudal filaments light brown.

**FEMALE IMAGO** (in alcohol). Length: body, 4.7-5.0 mm; fore wings, 5.0-5.5 mm. Eyes black. Head pale brown, area around ocelli and vertex darker brown. Antennae pale brown. Color and marks of thorax as in ♂ imago, except carinae of pronotum washed with darker brown. Color and marks of legs as in ♂ imago. Wings: color and marks as in ♂ imago, except membrane of fore and hind wings much lighter brown. Abdomen: opaque, pale brown, terga 1-10 with blackish-brown pattern as in Fig. 89, 91-92, pattern faded on tergum 1; spiracles and tracheae hyaline. Caudal filaments pale brown.

**MATURE NYMPH** (in alcohol). Head: light yellowish-brown, marks as in ♂ and ♀ imagos, except carinae on mesonotum between wing pads darker. Abdomen: color and marks as in ♂ and ♀ imagos (Fig. 93). Legs (Fig. 126, 133-134): color and marks as in ♂ and ♀ imagos. Gills (Fig. 135): smoothly tapered to apex;

membrane gray; tracheae black. Caudal filaments light yellowish-brown.

**SPECIMENS.** Holotype ♂ imago, No. N35; allotype ♀ imago, No. N35; paratypes: 28 nymphs, 5 ♂ imagos, 1 ♀ imago, 1 ♀ subimago, No. N15; 2 nymphs, 190 ♂ imagos, 19 ♀ imagos, No. N35; 1 nymph, No. N54. All types are in alcohol. Association of the nymph and adults is by rearing. All types are deposited in the following collections: holotype, allotype, 10 nymphal paratypes, 57 ♂ paratypes, 5 ♀ paratypes, and 1 ♀ subimaginal paratype at FAMU; 9 nymphal paratypes, 57 ♂ paratypes, and 6 ♀ paratypes at UU; 3 nymphal paratypes, 20 ♂ paratypes, and 2 ♀ paratypes each at BPBM, ORSTOM, CTFT, and NMNH.

**ETYMOLOGY.** *massula*, L., meaning mass.

**DISCUSSION.** *Simulacala massula* can be distinguished from *S. notialis* and *S. milleli* by the characters given in the key.

**BIOLOGY.** *Simulacala massula* was found only at localities No. N15, N35, and N54, a tributary of the Rivière Karionan. Most nymphs were collected from September 10 to October 11-12 when water temperatures were 18°-19°C.

Nymphs were found burrowed into coarse sand in the fastest portions of the tributary. Coarse sand could be found between large rocks to boulders on the stream bottom. Nymphs emerged at dark and subimagos molted in late afternoon.

Imagos were found swarming on 2 occasions. On September 10 (N15), small companies of about 10 ♂ were swarming about 4.5 m above the road. Males were collected from 1745 to 1800, and as males were collected, new males entered the swarm. Swarms were difficult to see; no imagos or subimagos were collected at light. On October 11-12 (No. N35), a mass swarm of thousands occurred over the stream from 1730-1800 and ceased at dark. The swarm formed quickly at about 1 m above the tributary and covered the entire stream as far as we could observe. Males, with heads pointed downstream, flew in a slow up-and-down motion and there were only a few cm distance between males. Females entered the swarm to mate. Following the swarm, all cobwebs over the stream were filled with dead individuals. No imagos or subimagos were collected at light trap.

**Kouma**, new genus (Fig. 20-31, 57-81, 94-98, 111-116, 128-130, 136-139)

**IMAGO.** Length of ♂: body 5.0-7.1 mm; fore wings 5.5-7.3 mm. Length of ♀: body 5.0-8.3 mm; fore wings 6.5-10.4 mm. Eyes of ♂ separated on meson of head by a length a little less than to equal maximum

width of a lateral ocellus, upper portion of eye circular-shaped dorsally, lower portion 3/4 length of upper portion (Fig. 23-24, 26, 31); eyes of ♀ separated on meson of head by a length 4 times maximum width of an eye. Wings (Fig. 20-22, 25, 27-30): maximum width of fore wings a little less to a little more than 1/3 maximum length; vein Rs of fore wings forked more than 1/5 to a little less than 1/4 of distance from base to margin; vein MA forked 1/2 of distance from base to margin, fork symmetrical, distal portion of vein MA sagged posteriorly; vein MP<sub>2</sub> attached at base to vein MP<sub>1</sub> by a cross vein, base of vein MP<sub>2</sub> nearer to vein MP<sub>1</sub> than vein CuA to almost touching vein MP<sub>1</sub>; vein ICu<sub>1</sub> attached to veins CuA and CuP with a cross vein to attached to vein CuA with a cross vein, remainder of Cu-A area as in Fig. 20, 27, 29; cross veins numerous. Costal projection of hind wings rounded (Fig. 21-22, 25, 28, 30), apex located more than 1/2 distance from base, apex curved over; apex of wings acute, rounded; cross veins few. Legs: ratios of segments in ♂ fore legs, 0.44-0.60: 1.00 (2.5 mm): 0.03-0.05: 0.28-0.36: 0.28-0.32: 0.20-0.23: 0.09-0.14. Claws of a pair on prothoracic legs dissimilar, one apically hooked (Fig. 60), other obtuse, pad-like, with small apical hook; claws of a pair on mesothoracic and metathoracic legs similar, both apically hooked. Male genitalia (Fig. 57-59, 67-79, 72-74, 77-79): segment 2 of forceps equal to a little longer in length than segment 3, segment 2 of forceps 1/9 to 1/7 length of segment 1, apex of segment 3 rounded, apex may or may not be indented, base of forceps broad, its inner margin forming an angular bend near middle of forceps; length of styliger plate along median line 1/2 maximum width, apex of styliger plate cleft; penes fused, broad, apical 1/3 to 1/2 curved over ventrally, apex with a pad-like structure (Fig. 57-59, 67-69, 72-74, 77-79). Ninth sternum of ♀ entire apically, a median, longitudinal ridge extended entire length of sternum (Fig. 94); margin of sternum 7 with median membranous portion (Fig. 96-97). Terminal filament a little longer than cerci.

**MATURE NYMPH.** Head prognathous. Antennae 1-1/2 to 2 times maximum length of head. Mouthparts (Fig. 111-116, 128-129): dorsal hair on labrum as in Fig. 111; submedian, anterosubmedian and anterolateral areas of hair ventrally; anteromedian emargination with 5 large denticles, median denticle and sometimes lateral denticles smaller (Fig. 112). Clypeus as in Fig. 111. Left mandible as in Fig. 113. Lingua of hypopharynx with well developed lateral processes; paired, submedian, longitudinal row of long hair on dorsum, anterior margin of lingua deeply cleft; superlingua as in Fig. 115, with a row of hair along anterior margin, lateral margins blunt. Segment 2 of maxillary palpi a little longer than



length of segment 1; segment 3 of palpi  $2/3$  to shorter in length than segment 2, triangular; a V-shaped ridge near the ventral, inner anterolateral margin of maxillae; hair on maxillae as in Fig. 116. Labium as in Fig. 128; segment 2 of palpi equal in length to segment 1; segment 3 of palpi  $3/5$  to  $4/5$  length of segment 2, triangular (Fig. 129); palpi broad; paraglossae ventral to glossae. Legs (Fig. 130, 136-137): maximum width of tibiae 4 times maximum width of tarsi, tibiae in cross section flattened, ventral surface of femora indented so tibiae can draw under femora; apex of claws hooked and narrow, denticles on claws progressively larger apically (Fig. 130). Gills (Fig. 138): gills on segments 1-7 alike; gills deeply forked and 2 portions of lamellae overlap, each portion long, smoothly tapered to apex; main trunk of tracheae forked near base of gills and each branch along median line of each portion of lamellae, main trunk darkly pigmented, both portions of lamellae mottled with black and give appearance of fine lateral branches of tracheae. Posterolateral spines on abdominal segments 5-9, spines progressively larger posteriorly, apex of posterolateral spines on segment 9 indented and gives appearance of double spines (Fig. 139). Terminal filament a little longer than cerci.

**ETYMOLOGY.** *Kouma*, based on the name Tribu de Kouma, Feminine.

**TYPE SPECIES.** *Kouma adusta*, new species.

**DISCUSSION.** *Kouma* can be distinguished from all genera of the Leptophlebiidae by the following combination of characters. In the imagos: (1) the Cu-A area of the fore wings possesses 2 long intercalaries (Fig. 20, 27, 29); (2) length of vein Sc of the hind wings is  $3/4$  maximum length of hind wings (Fig. 21-22, 25, 28, 30); (3) costal projection of hind wings is rounded (Fig. 21-22, 25, 28, 30); (4) apical  $1/3$  to  $1/2$  of penes of ♂ genitalia is curved over ventrally (Fig. 57-59, 67-69, 72-74, 77-79); apex of penes is pad-like; and (5) ninth sternum of ♀ is entire apically; a median, longitudinal ridge extends entire length of sternum (Fig. 94). In the nymphs: (1) inner margin of segment 3 of labial palpi has a row of thick heavy spines (Fig. 128-129); (2) glossae of labium are flat (Fig. 128); (3) maximum width of tibiae is 4 times maximum width of tarsi (Fig. 136-137); (4) abdominal gills 1-7 are deeply forked and 2 portions of lamellae overlap; each portion is long and smoothly tapered to apex (Fig. 138); and (5) posterolateral spines occur on abdominal segments 5-9.

*Kouma* appears to be most closely related to *Fasciamirus* and can be distinguished from *Fasciamirus* by the following characters. In the imagos: (1) apical  $1/3$  to  $1/2$  of penes of ♂ genitalia is curved over ventrally; apex of penes is pad-like (Fig. 57-59, 67-

69, 72-74, 77-79); and (2) apex of costal projection of hind wing is located more than  $1/2$  distance from base (Fig. 21-22, 25, 28, 30). In the nymphs: (1) maximum width of tibiae is 4 times maximum width of tarsi (Fig. 136-137); (2) abdominal gills 1 are similar to gills 2-7 (Fig. 98, 138); and (3) segment 3 of the labial palpi is as in Fig. 128-129. We have a few nymphs from the northern area of the West Coast collected by Prof. STARMÜHLNER and a few nymphs from the Southern region collected by us which cannot be assigned to any of the species of *Kouma* described herein. All these specimens are deposited at FAMU.

The following keys are based on ♂ imagos and ♂ nymphs only, as the ♀ imagos of *K. annulata* and *K. becki* are unknown. The ♀ nymphs of *K. adusta* and *K. annulata* are indistinguishable based on existing collections, while the nymphs of *K. becki* and *K. aurata* are unknown.

#### KEY TO THE SPECIES OF *KOUMA*, NEW GENUS

##### ♂ IMAGOS

1. Abdominal terga 1-7 washed with blackish-brown (Fig. 61-66); general color of thorax brown ..... *K. adusta*  
— Abdominal terga 1-7 hyaline, light tan, with or without transverse band on posterior margin of each tergum (Fig. 70, 75, 80); general color of thorax golden yellow to brown..... 2
2. General color of thorax golden yellow; femora entirely golden yellow; posterior margin of terga 1-6 and spiracular area without distinct marks (Fig. 80-81) ..... *K. aurata*  
— General color of thorax tan to light brown; apex of femora brown; posterior margin of terga 1-6 with transverse, blackish-brown band and spiracular area marked with blackish-brown..... 3
3. Thorax brown; terga 1-6 with a black band on posterior margin as in Fig. 70-71; genitalia as in Fig. 67-69 ..... *K. annulata*  
— Thorax tan; terga 1-6 with a narrow black band on posterior margin (Fig. 75-76); genitalia as in Fig. 72-74 ..... *K. becki*

##### MATURE ♂ NYMPHS

1. General color of abdominal terga 1-10 dark brown (Fig. 98) ..... *K. adusta*  
— Abdominal terga 1-7 pale, tan, with dark band on posterior margin of each tergum..... *K. annulata*

***Kouma adusta*, new species** (Fig. 20-24, 57-66, 94-98, 111-116, 128-130, 136-139)

**MALE IMAGO** (in alcohol). Length: body, 5.0-5.8 mm; fore wings, 5.5-5.9 mm. Upper portion of eyes brown, lower portion black (Fig. 23). Head dark brown, carinae darker. Antennae brown, flagellum paler. Thorax dark brown, mesothorax darker,

carinae darker, sutures paler. Coxae dark brown, remainder of legs pale, except apex of femora and tibiae irregularly washed with dark brown, basal 1/2 of femora irregularly washed with dark brown, except faded on metathoracic femora. Wings (Fig. 20-22): longitudinal veins and cross veins of fore and hind wings brown, cross veins a little lighter; membrane of fore and hind wings hyaline, except base of fore and hind wings dark brown, apical 1/3 of cells C and Sc of fore wings translucent, whitish. Abdomen: washed heavily with blackish-brown, anterior margin of terga 2-7 irregularly hyaline as in Fig. 61-63, terga 2-7 with a pale, median, longitudinal line extended entire length of each tergum, terga 2-7 with paired, pale, submedian, longitudinal lines extended to middle of each tergum, terga 1-7 with darker brown lateral, oval shaped marks as in Fig. 61-63; spiracles darker brown, tracheae hyaline; sterna 1-7 washed with brown as in Fig. 64-66, sterna 8-10 darker. Genitalia (Fig. 57-59): brown, apical 1/2 of forceps and penes lighter. Caudal filaments pale, dark brown, annulations at articulations, alternate annulations darker in basal 1/2 of caudal filaments.

**FEMALE IMAGO** (in alcohol). Length: body, 5.0-5.7 mm; fore wings, 6.5-6.8 mm. Eyes black. Head dark brown, carinae darker. Antennae brown, flagellum paler. Thorax: dark brown, carinae darker, sutures paler. Color and marks of legs as in ♂ imago, except general color darker, basal color pattern on femora obscure. Wings: color and marks as in ♂ imago, except cross veins of fore and hind wings darker, membrane of fore and hind wings light brown. Abdomen: color and marks as in ♂ imago, except general color darker, anterior hyaline areas on each tergum smaller. Caudal filaments brown, marks as in ♂ imago.

**MATURE NYMPH** (in alcohol). Head: light brown, washed with darker brown as in Fig. 98. Thorax: brown, venter lighter, pronotum and mesonotum washed with darker brown as in Fig. 98, ganglia washed with darker brown. Legs (Fig. 136): light brown marks as in ♂ and ♀ imago, except basal marks on femora and apical marks on tibiae obscured. Abdomen: dark brown, venter lighter, marks as in ♂ and ♀ imagos, except median and submedian lines on terga obscured. Gills (Fig. 138): membrane black, granular, tracheae black. Caudal filaments brown.

**SPECIMENS.** Holotype ♂ imago, No. N31; allotype ♀ imago, No. N31; paratypes: 33 nymphs, 1 ♂, 1 ♀, No. N13; 2 nymphs, No. N14; 21 nymphs, No. N15; 1 nymph, No. N16; 4 nymphs, No. N22; 1 nymph, No. N26; 98 nymphs, 13 ♂, 3 ♀, 6 ♂ subimagos, 4 ♀ subimagos, No. N27; 29 nymphs, No. N28;

149 nymphs, 15 ♂, 15 ♀, 7 ♂ subimagos, 11 ♀ subimagos, No. N31; 39 nymphs, No. N33; 55 nymphs, 2 ♂, 1 ♀, 3 ♂ subimagos, No. N35; 10 nymphs, 1 ♂, 7 ♂ subimagos, No. N37; 1 ♂, No. N40; 7 nymphs, 41 ♂, 41 ♂ subimagos, No. N42; 6 nymphs, 8 ♂, 2 ♂ subimagos, No. N50; 1 ♂ subimago, No. N51; 5 nymphs, No. N52; 9 nymphs, 1 ♂, 2 ♂ subimagos, No. N53; 18 nymphs, 3 ♂, 3 ♀, 3 ♂ subimagos, No. N54; 24 nymphs, 5 ♂, 7 ♂ subimagos, 4 ♀ subimagos, No. N55; 1 nymph, No. FNK4; 6 nymphs, No. FNK9; 4 nymphs, No. FNK18-20; 1 nymph, No. FNK25-26; 1 nymph, No. FNK37; 9 nymphs, No. FNK64; 1 nymph, No. FNK67; 2 nymphs, No. FNK79; 2 nymphs, No. FNK95; 1 nymph, No. FNK102; 1 nymph, No. FNK107; 2 nymphs, No. FNK111; 13 nymphs, No. FNK113; 1 nymph, No. FNK115; 4 nymphs, No. FNK116; 3 nymphs, No. FNK117; 7 nymphs, No. FNK121. All types are in alcohol. Association of the nymphs and adults is by rearing. All types are deposited in the following collections: holotype, allotype, 240 nymphal paratypes, 31 ♂ paratypes, 20 ♂ subimaginal paratypes, 10 ♀ paratypes, and 10 ♀ subimaginal paratypes at FAMU; 150 nymphal paratypes, 20 ♂ paratypes, 12 ♂ subimaginal paratypes, 5 ♀ paratypes, and 5 ♀ subimaginal paratypes at UU; 45 nymphal paratypes, 10 ♂ paratypes, 5 ♂ subimaginal paratypes, 2 ♀ paratypes, and 1 ♀ subimaginal paratypes at BPBM, ORSTOM, CTFT, and NMNH.

For all localities along the East Coast and Southeastern Region only the ♂ imagos, subimagos, and nymphs are included in the type series of *K. adusta* as *K. adusta* and *K. annulata* are sympatric in these two areas. The ♀ imago of *K. adusta* is apparently similar to that of *K. annulata* and the ♀ imagos of *K. annulata* cannot be distinguished based on existing collections. Occasional adult specimens of *K. adusta* are generally lighter in color, especially the abdomen. Lighter specimens were collected from most localities.

**ETYMOLOGY.** *adustus*, L., meaning brown.

**DISCUSSION.** Male imagos and ♂ nymphs of *Kouma adusta* can be distinguished from the remaining species of *Kouma* by characters given in the keys. Immature nymphs of *K. adusta* are difficult to determine; the median, pale color pattern on the abdominal terga is indistinct.

**BIOLOGY.** *Kouma adusta* is common throughout New Caledonia and Ile des Pins and is found in small streams to medium-sized rivers. Nymphs were found in streams with water temperatures of 18 °C-27 °C and at 8-458 m. The species was most abundant in streams with water temperatures of 18 °C-20.5 °C.

Nymphs are found on small rocks to pebbles throughout the streams. Nymphs emerge to subima-

gos from 1200 to 1600, and subimagos were collected in abundance at light traps. The subimagos molted to imagos in very early morning in complete darkness. Swarming occurred just at morning twilight between 0600 and 0700 over low bushes along the streams in small companies of 10 to 15 males. Occasional females were seen ovipositing until 1200.

***Kouma annulata***, new species (Fig. 25-26, 67-71)

**MALE IMAGO** (in alcohol). Length: body, 5.2-5.8 mm; fore wings, 5.6-6.0 mm. Upper portion of eyes brown, lower portion black. Head dark brown, carinae darker. Antennae brown, flagellum paler. Thorax dark brown, carinae of pleura and pronotum blackish-brown, anterior 1/3 of mesobasisternum blackish-brown. Coxae brown, remainder of legs pale, except apex of femora and apex of prothoracic tibiae darker. Wings (Fig. 25): longitudinal veins and cross veins of fore and hind wings brown, cross veins a little lighter; membrane of fore and hind wings hyaline, except base of fore and hind wings brown, apical 1/3 of cells C and Sc of fore wings translucent, whitish. Abdomen: segments 1-7 hyaline, washed with light brown, segments 8-10 opaque, brown; terga 1-9 with a black, transverse band on posterior margin of each tergum, tergum 1 more heavily washed with light brown especially near lateral margins, tergum 5 and 6 lightly washed with black anterior to black posterior band, posterior half of tergum 7 washed with brown as in Fig. 70, terga 8 and 9 with a lighter brown median pattern as in Fig. 70; spiracles black, tracheae washed with black; sternum 1 washed heavily with light brown, sterna 8 and 9 lighter brown than terga 8 and 9. Genitalia (Fig. 67-69): brown. Caudal filaments pale, dark brown annulations at articulations, alternate annulations darker in basal 1/2 of caudal filaments.

**FEMALE IMAGO.** Unknown.

**MATURE NYMPH** (in alcohol). Head: light brown, washed with darker brown. Thorax: brown, venter lighter, pronotum and mesonotum washed with darker brown, ganglia washed with darker brown along edges. Legs: light brown, tarsi darker, marks as in ♂ imago, except apical marks on femora lighter. Abdomen: brown, venter lighter, darker brown marks as in ♂ imago. Gills: membrane black, granular, tracheae black. Caudal filaments brown.

**SPECIMENS.** Holotype ♂ imago, No. N42; paratypes: 3 nymphs, 4 ♂, 7 ♂ subimagos, No. N37; 45 ♂, 23 ♂ subimagos, No. N42; 6 ♂ subimagos, No. N50; 2 ♂, No. N53; 1 nymph, No. FNK80; 1 nymph, No. FNK85; 1 nymph, No. FNK98; 5 nymphs, No. FNK104. All types are in alcohol. Association of the

nymphs and male imagos is by rearing. All types are deposited in the following collections: holotype, 6 nymphal paratypes, 18 ♂ paratypes, and 12 ♂ subimaginal paratypes at FAMU; 5 nymphal paratypes, 17 ♂ paratypes, and 12 ♂ subimaginal paratypes at UU; 4 ♂ paratypes, and 3 ♂ subimaginal paratypes at BPBM, ORSTOM, CTFT, and NMNH. The known distribution of *K. annulata* is entirely sympatric with *K. adusta*. The type series of *K. annulata* includes only ♂ imagos, subimagos and nymphs as the ♀ imago is apparently similar to that of *K. adusta* and cannot be distinguished based on existing collections.

**ETYMOLOGY.** annulus, L., meaning ring.

**DISCUSSION.** Male imagos and ♂ nymphs of *Kouma annulata* can be distinguished from the remaining species of *Kouma* by characters given in the keys. In the paratype nymphs from FNK98, the length of the third segment of the labial palp is 4/5 that of the second segment. This ratio is closer to 2/3 in *K. adusta* and material of *K. annulata* from N37. This character might prove useful when a longer series of material becomes available.

**BIOLOGY.** *Kouma annulata* has been collected along the East Coast and Southern Region in small streams to medium-sized rivers. Nymphs were found in streams with water temperatures of 18 °C-19 °C, at 76-458 m.

Nymphs apparently emerge to subimagos during the day as subimagos were abundant at light traps. Swarming occurred at morning twilight between 0600 and 0700 over the streams.

***Kouma becki***, new species (Fig. 27-28, 72-76)

**MALE IMAGO** (in alcohol). Length: body, 6.5 mm; fore wings, 6.9 mm. Upper portion of eyes tan, lower portion black. Head tan, washed lightly with darker brown between eyes. Antennae tan, flagellum paler. Thorax: tan, areas around base of fore and hind wings and base of legs washed with dark brown, mesofurcasternum and ventral portion of mesoepisternum washed lightly with dark brown. Coxae of legs tan with a large, darker brown macula, remainder of legs tan, except apex of femora and apex of prothoracic tibiae darker. Wings (Fig. 27-28): longitudinal veins and cross veins of fore and hind wings tan; membrane of fore and hind wings hyaline, except base of fore and hind wings tan, apical 1/3 of cells C and Sc of fore wings translucent, whitish-light tan. Abdomen: segments 1-7 hyaline, washed lightly with tan, segments 8-10 opaque, tan; terga 1-8 with a black, narrow, transverse band on posterior margin of each tergum, band faded on terga 1, 7-8; terga 8

and 9 with large, darker brown, paired submedian maculae as in Fig 75; spiracles on terga 1-7 black (Fig. 76), remaining spiracles and tracheae hyaline. Genitalia (Fig. 72-74): tan. Caudal filaments tan, darker brown annulations at articulations, alternate annulations darker in basal 1/2 of caudal filaments.

FEMALE IMAGO. Unknown.

MATURE NYMPH. Unknown.

SPECIMENS. Holotype ♂ imago, No. N19; paratype; 1 ♂ subimago, No. N21. All types are in alcohol. All types are deposited in the following collection: holotype and 1 ♂ subimaginal paratype at FAMU.

ETYMOLOGY. Species is named for Professor WILLIAM M. BECK, Jr., a member of the FAMU collecting team in New Caledonia.

DISCUSSION. *Kouma becki* can be distinguished from the remaining species of *Kouma* by characters given in the keys.

BIOLOGY. *Kouma becki* has been collected only in the Col d'Amieu area and is found in small streams and small rivers. Subimagos were collected near streams with a water temperature of 18 °C at 259-412 m altitude. Both specimens were collected at light traps as subimagos.

***Kouma aurata*, new species (Fig. 29-31, 77-82)**

MALE IMAGO (in alcohol). Length: body, 6.5-7.1 mm; fore wings, 6.5-7.3 mm. Upper portion of eyes yellowish-brown, lower portion black. Head golden yellow, washed lightly with brown between eyes. Antennae yellowish-brown, flagellum paler. Thorax: golden yellow, carinae darker, sutures lighter, area anterior to base of fore and hind wings darker. Legs golden yellow, prothoracic tarsi lighter, apex of each tarsal segment of meso- and metathoracic legs darker. Wings (Fig. 29-30): longitudinal veins and cross veins of fore and hind wings golden yellow; membrane of fore and hind wings transparent, golden yellow, base and cells C and Sc of fore and hind wings darker, apical 1/3 of cells C and Sc of fore wings translucent, whitish-golden yellow. Abdomen: segments 1-7 hyaline, washed heavily with golden yellow, segments 8-10 opaque, golden yellow; terga 8

and 9 with paired, submedian, large, light brown maculae, maculae faded on tergum 9; spiracles and tracheae hyaline. Genitalia (Fig. 77-79): golden yellow. Caudal filaments golden yellow, darker annulations at alternate articulations in basal 1/3 of caudal filaments.

FEMALE IMAGO (in alcohol). Length: body, 8.3 mm; fore wings, 10.4 mm. Eyes black. Head golden yellow, area between lateral ocelli washed with brown. Antennae golden yellow, flagellum paler. Thorax: color and marks as in ♂ imago, except paired, submedian, brown, L-shaped marks on pronotum, base of L-marks directed anteriorly. Legs dark golden yellow, tarsi paler. Wings: longitudinal veins and cross veins of fore and hind wings dark golden yellow; membrane of fore and hind wings golden yellow, except base of fore and hind wings, cells C, Sc, and R<sub>1</sub> of fore wings, and cells C and Sc of hind wings darker, apical 1/3 of cells C and Sc of fore wings translucent whitish-golden yellow. Abdomen: opaque, golden yellow, terga 1-9 with paired, submedian, brown maculae as in Fig. 82, maculae faded on tergum 9; spiracles and tracheae hyaline. Caudal filaments golden yellow, darker annulations at alternate articulations, annulations faded in basal 1/2 of caudal filaments.

MATURE NYMPH. Unknown.

SPECIMENS. Holotype ♂ imago, No. N37; allotype ♀ imago, No. N37; paratypes: 2 ♂, 1 ♂ subimago, 1 ♀ subimago, No. N37. All types are in alcohol. All types are in the following collections: holotype, allotype, 1 ♂ paratype and 1 ♂ subimaginal paratype at FAMU; 2 ♂ paratypes and 1 ♀ subimaginal paratype at UU.

ETYMOLOGY. *auratus*, L., meaning golden.

DISCUSSION. *Kouma aurata* can be distinguished from the remaining species of *Kouma* by characters given in the keys.

BIOLOGY. *Kouma aurata* was collected only at locality No. N37, a small river with water temperature of 18 °C-19 °C at an altitude of 458 m. All specimens were collected at light.

*Manuscrit accepté par le Comité de Rédaction le 15 décembre 1989*

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## APPENDIX

## Source of Material

Species	Figures numbers	Locality
<i>Fasciamirus rae</i>	1-3, 87	15
	4-6, 36	27
	32-33, 35, 37-42, 86, 100b, 121-122	42
	100c	53
	others	35
<i>Simulacala notialis</i>	131	15
	others	51
<i>S. milleti</i>	132	37
	12, 127	42
	others	17
<i>S. massula</i>	17-19, 50-53, 88-91, 125	35
	others	15
Kouma adusta	129	15
	96-97	31
	62-63, 65-66	42
	23-24	50
	others	27
<i>K. annulata</i>	all	42
<i>K. becki</i>	all	19
<i>K. aurata</i>	all	37

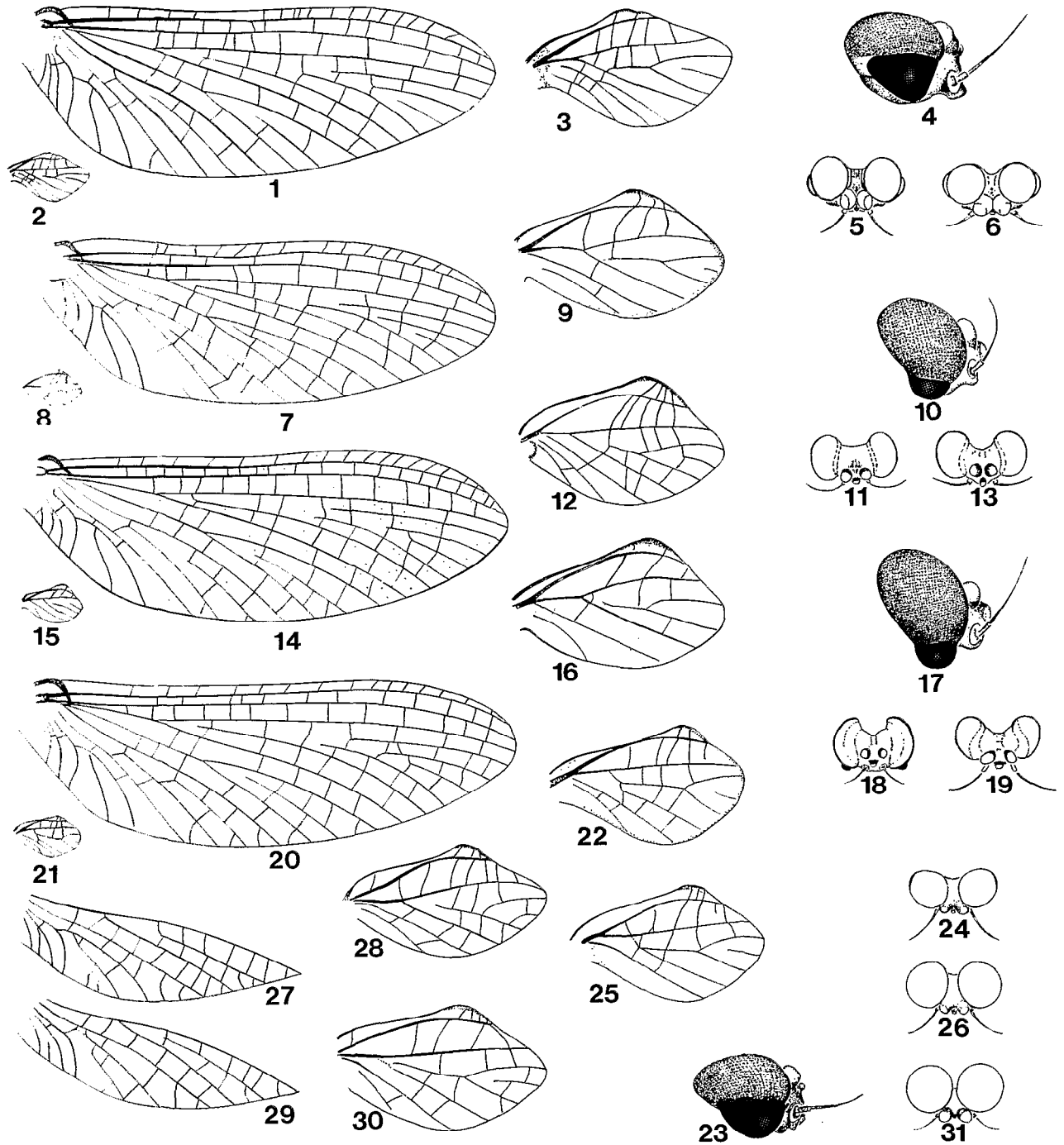


FIG. 1-31. — Male imagos: 1-6, *Fasciamirus rae*; 7-11, *Simulacala notialis*; 12-13, *S. milleti*; 14-19, *S. massula*; 20-24, *Kouma adusta*; 25-26, *K. annulata*; 27-28, *K. becki*; 29-31, *K. aurata*. Fore wing (1, 7, 14, 20) with detail of Cu-A area (27, 29), hind wing and hind wing enlarged (2-3, 8-9, 12, 15-16, 21-22, 25, 28, 30). Lateral (4, 10, 17, 23), dorsal (5-6, 11, 13, 19, 24, 26, 31) and frontal (18) views of head.

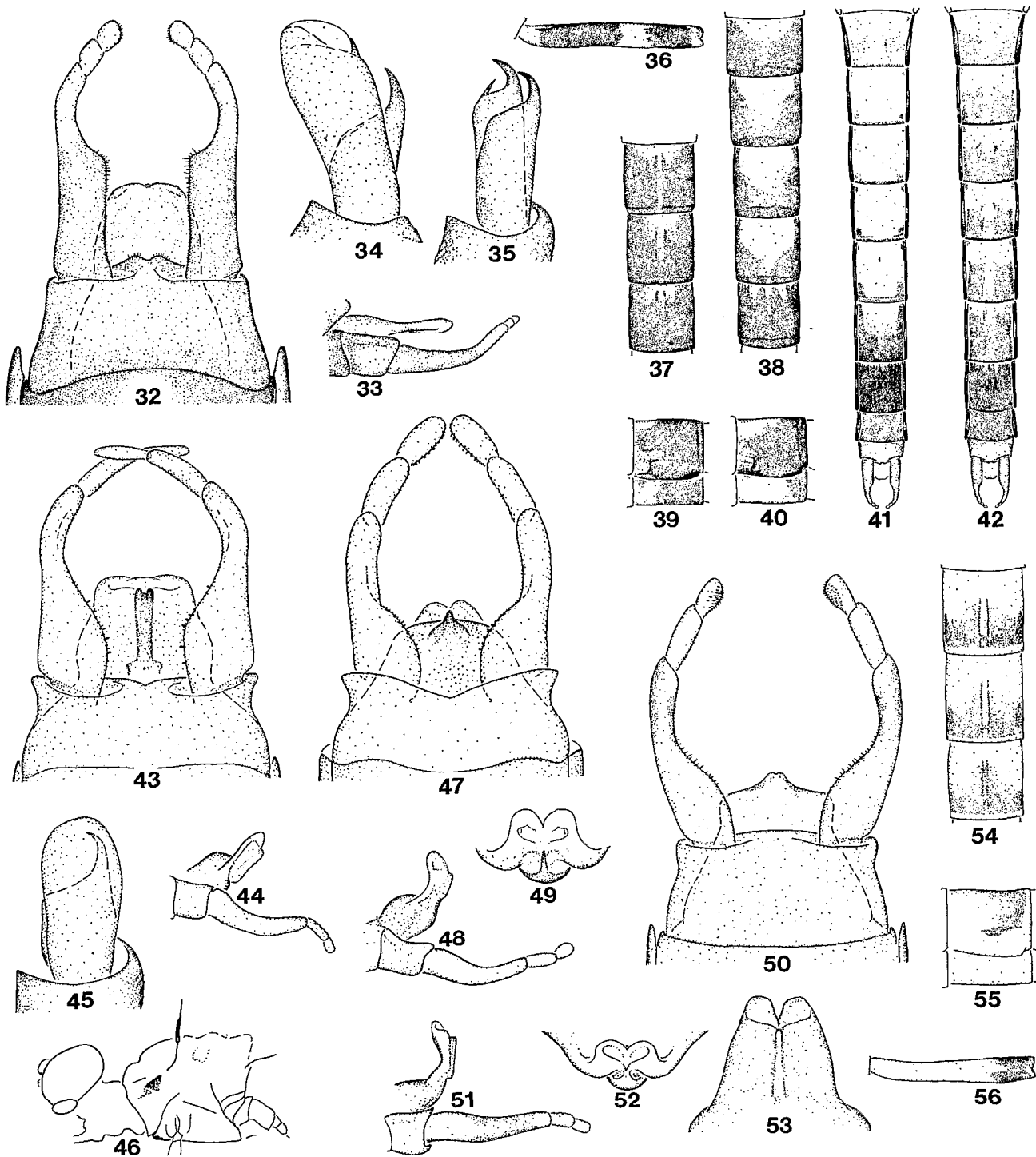


FIG. 32-56. — Males imagos: 32-42, *Fasciamirus rae*; 43-46, *Simulacala notialis*; 47-49, *S. milleti*; 50-56, *S. massula*. Genitalia: ventral (32, 43, 47, 50), lateral (33, 44, 48, 51), with ventral (53) and distal (49, 52) detail of penes. Fore claw (34, 45); mesothoracic claw (35). Fore femur (36, 56). Abdominal segments: terga 5-7 (37, 54), terga 3-7 (38), sterna 2-9 (41-42), lateral segment 6 (39-40, 55). Lateral view of thorax (46).

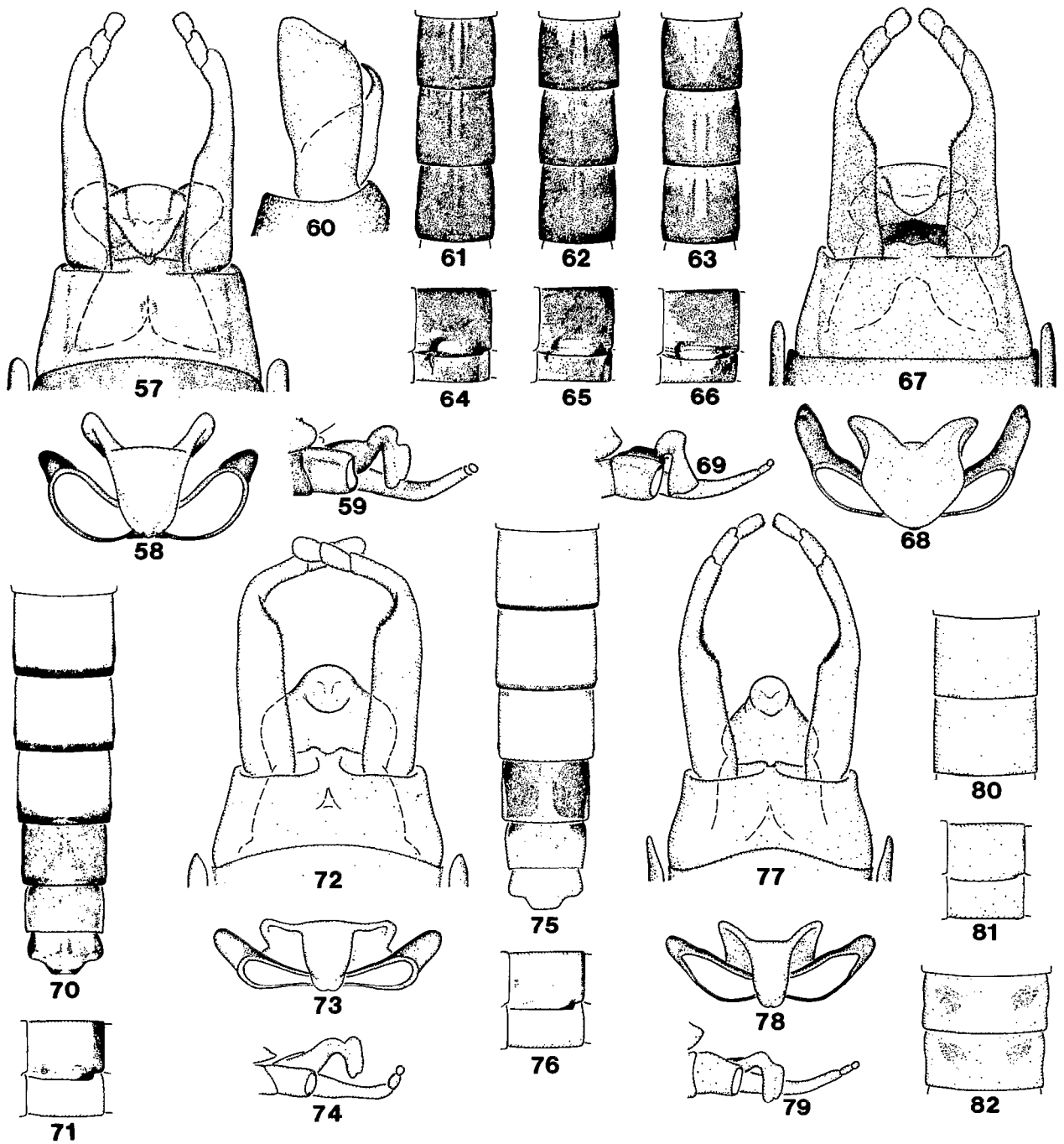


FIG. 57-81. — Male imagos: 57-66, *Kouma adusta*; 67-71, *K. annulata*; 72-76, *K. becki*; 77-81, *K. aurata*. Genitalia: ventral (57, 67, 72, 77), lateral (59, 69, 74, 79), and distal (58, 68, 73, 78), forceps removed in some figures. Fore claw (60). Abdominal segments: terga 5-6 (80), terga 5-7 (61-63), terga 5-10 (70, 75); lateral of segment 6 (64-66, 71, 76, 81). Fig. 82. — Abdominal terga 5-6 of female imago of *K. aurata*.



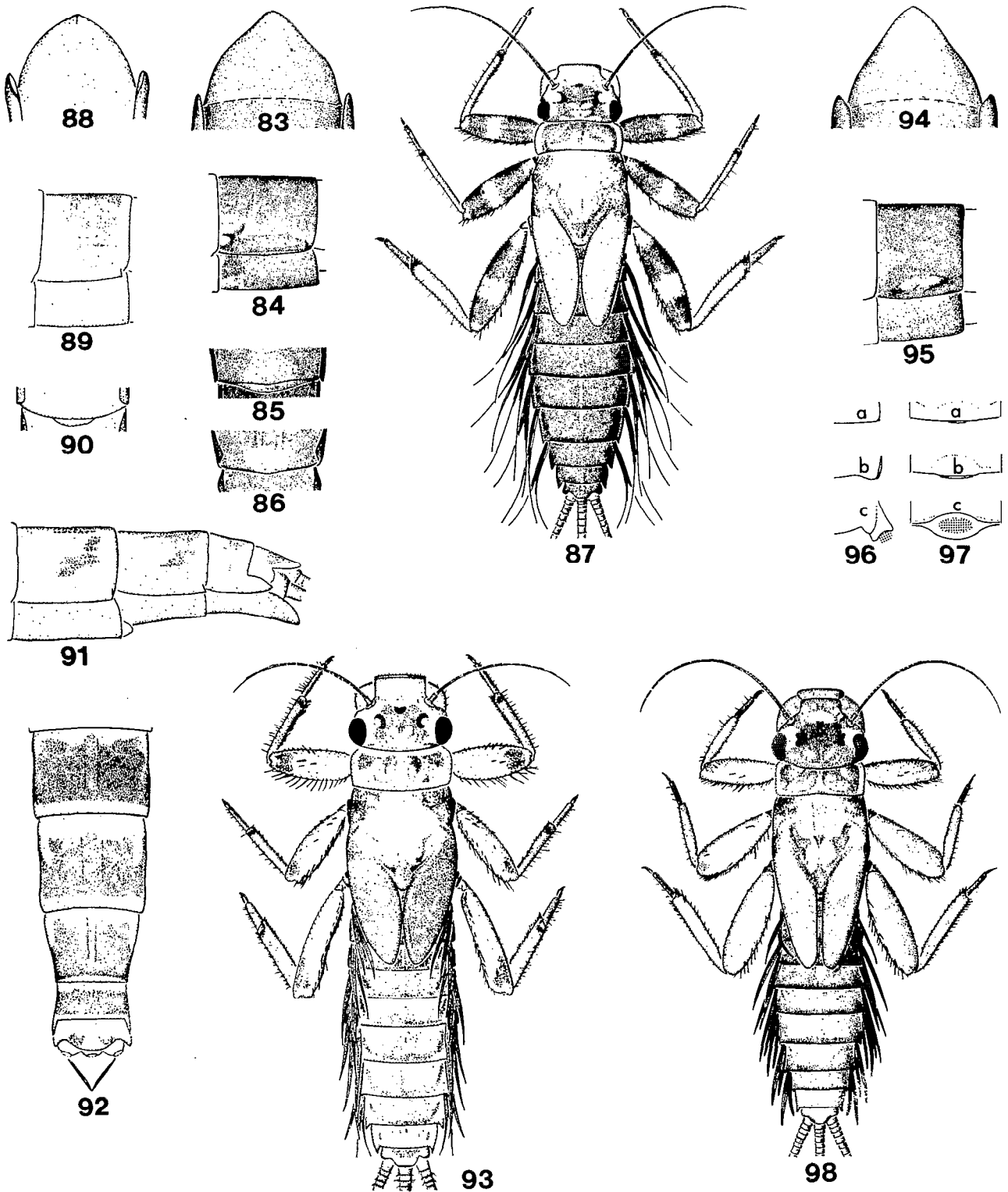


FIG. 83-98. — Female imago and mature female nymph: 83-87, *Fasciamirus rae*, 88-93, *Simulacala massula*; 94-98, *Kouma adusta*. Ninth sternum (83, 88, 94). Abdominal segment 7: lateral (84, 89, 95), lateral margin of sternum (96), ventral margin of sternum (85-86, 90, 97). Lateral view of abdominal segments 7-10 (91) of teneral imago and dorsum of terga 5-10 (92) of spent imago. Fig. 96-97 show stages of eversion of membranous egg guide (egg position shaded).

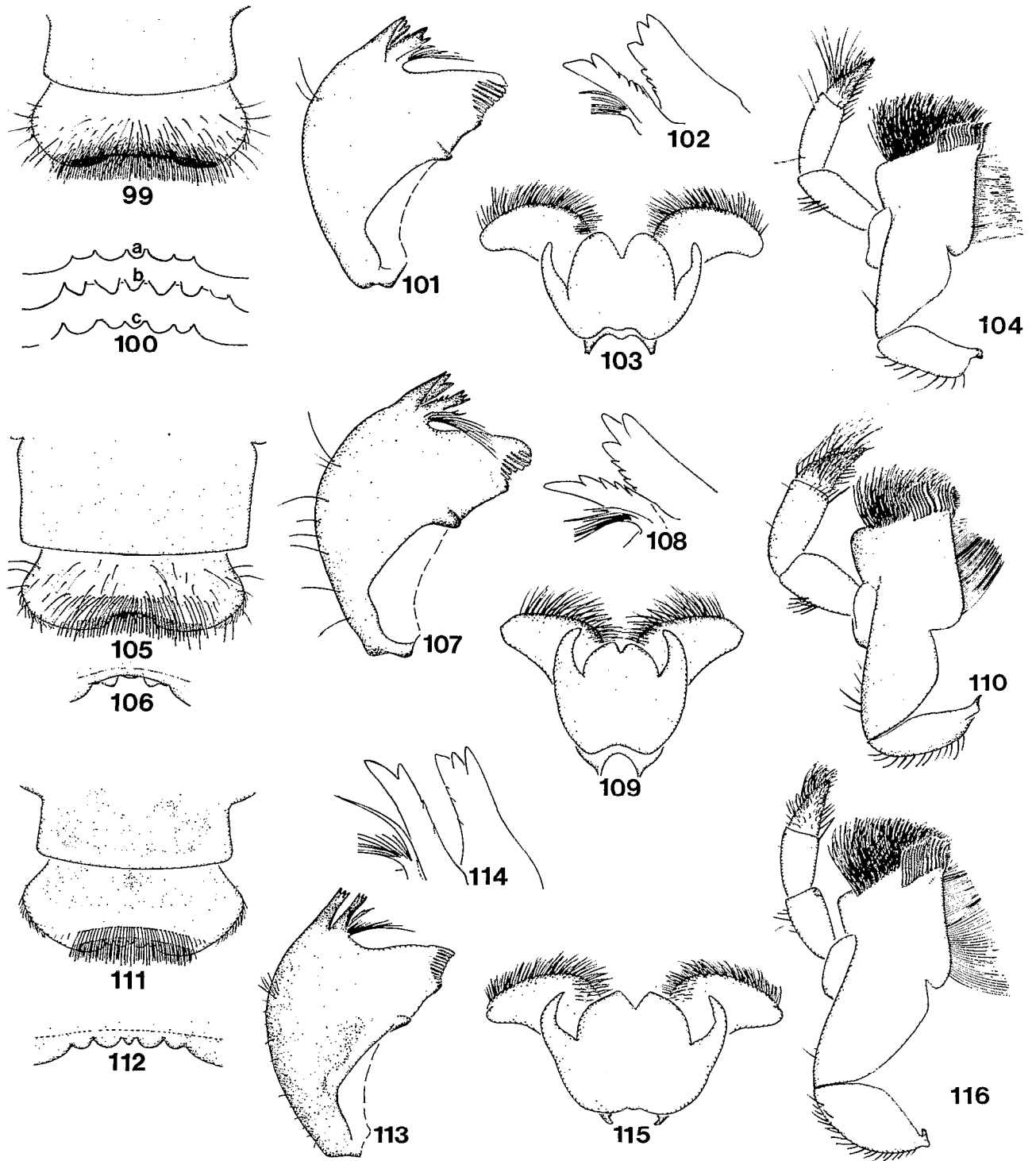


FIG. 99-116. — Mouthparts of mature nymph: 99-104, *Fasciamirus rae*; 105-110, *Simulacala massula*; 111-116, *Kouma adusta*. Clypeus and labrum with detail of anteromedian emargination (99-100a-c, 105-106, 111-112). Left mandible and detail of incisors of right mandible (101-102, 107-108, 113-114). Hypopharynx, ventral (103, 109, 115). Maxilla, ventral (104, 110, 116).

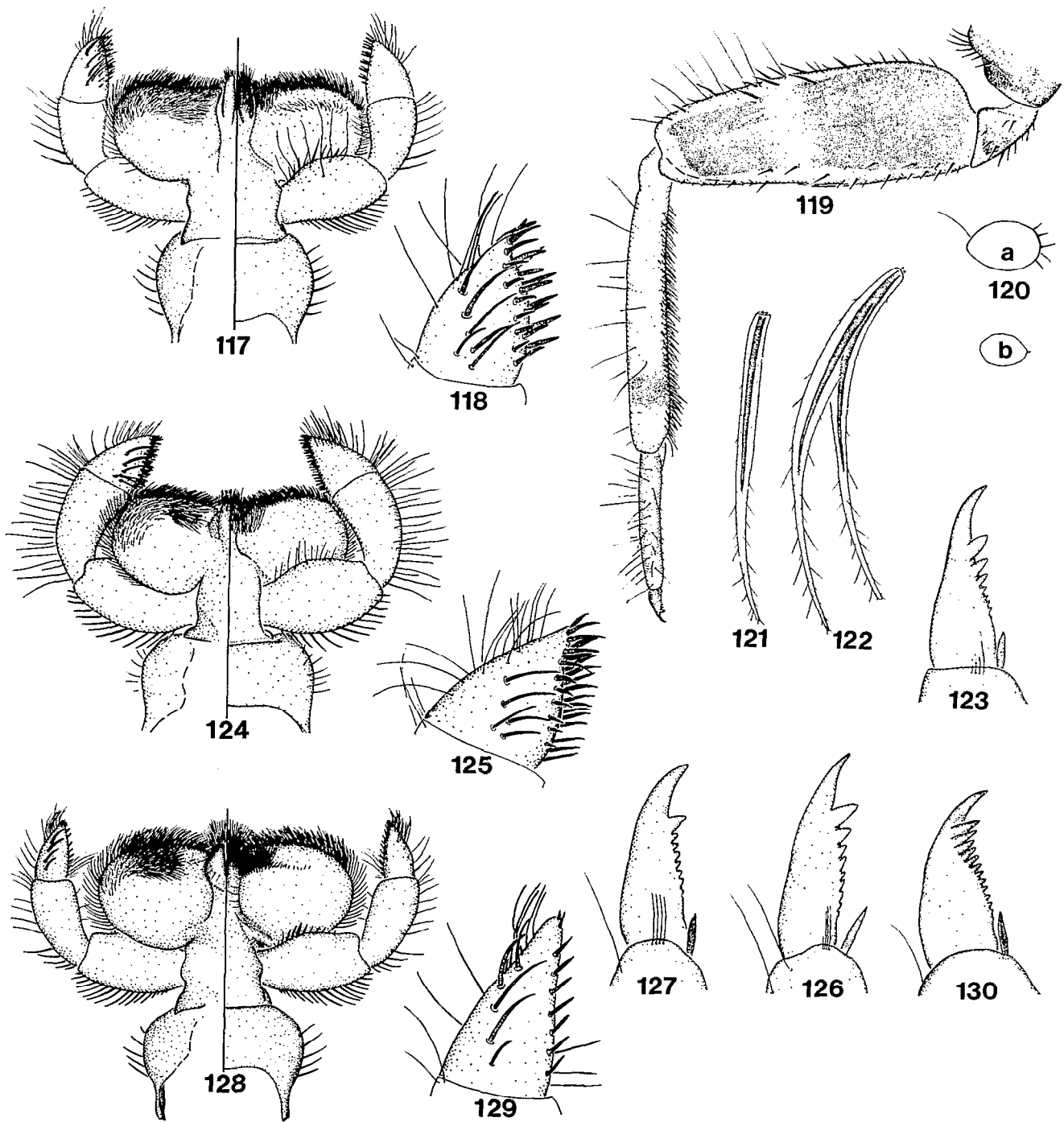


FIG. 117-130. — Mature nymph: 117-123, *Fasciamirus rae*; 124-126, *Simulacala massula*; 127, *S. millei*; 128-130, *Kouma adusta*. Labium (venter on right, dorsum on left) with detail of palpal segment 3 (117-118, 124-125, 128-129). Fore leg (119-120) with cross section of tibia (a) and tarsus (b). Fore claw (123, 126-127, 130). Gill 2 (121) and gill 4 (122).

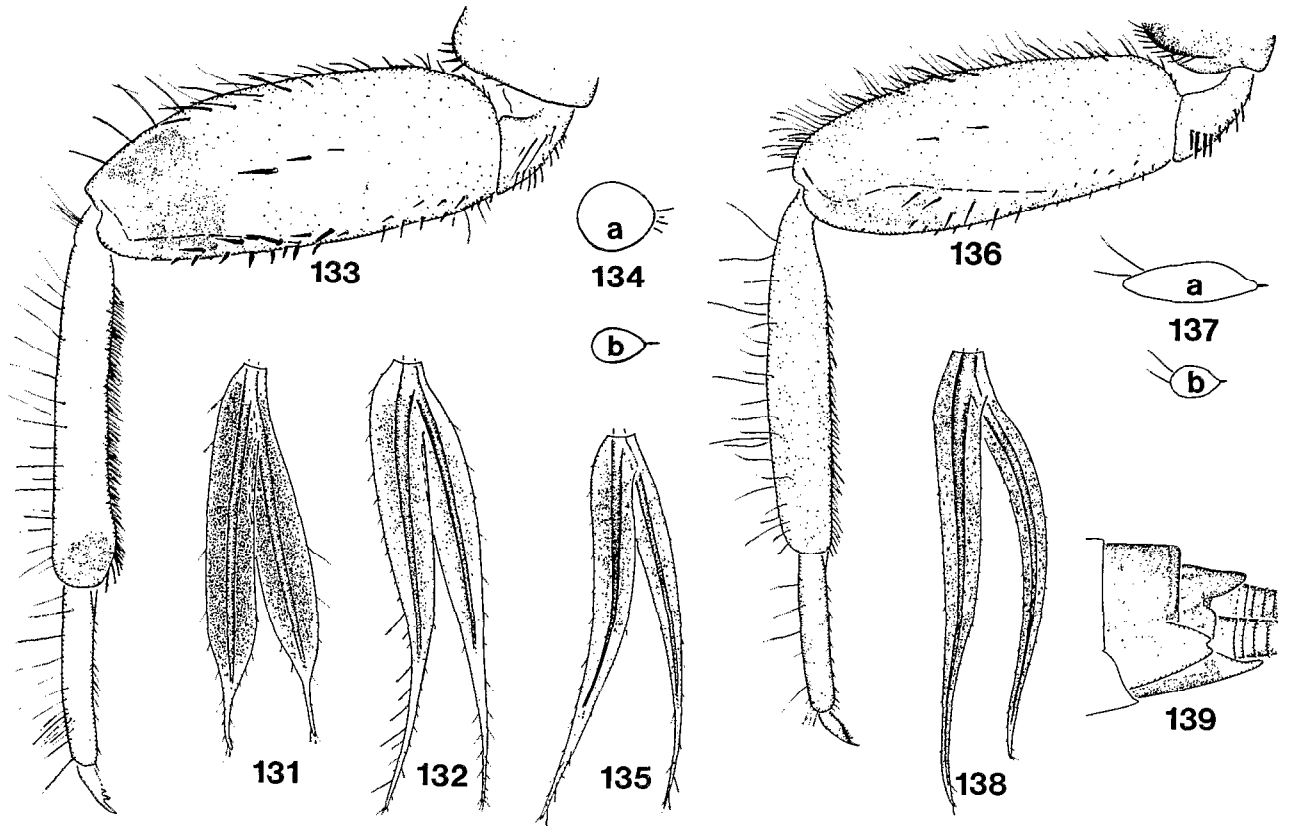


FIG. 131-139. — Mature nymph: 131, *Simulacala notialis*; 132, *S. milleti*; 133-135, *S. massula*; 136-139, *Kouma adusta*. Gill 4 (131-132, 135, 138). Fore leg (133-134, 136-137) with cross section of tibia (a) and tarsus (b). Lateral view of abdominal segments 9-10 (139).