(1)

Bull. Soc. Hist. Nat., Toulouse, 137, 2001, 7-15

Callistina panda, a striking new genus and species of Caeninae (Insecta : Ephemeroptera : Caenidae) from Madagascar

by Lu Sun and W. P. McCafferty[1]

Department of Entomology, Purdue University, West Lafayette, IN 47907 USA
1 : Correspondent author

ABSTRACT

Callistina Sun & McCafferty, n. gen. and *C. panda* Sun & McCafferty, n. sp. are described from larvae from Madagascar. *Callistina* is only the third genus of the pannote mayfly family Caenidae, and only the second of the subfamily Caeninae, known from Madagascar. The new genus is distinguished by : its robust body ; cephalic ridges ; absence of long setae marginally on mandibles, abdomen, and operculate gills ; and the dorsomedial development of abdominal terga 7-9. The new species demonstrates a unique and distinctively contrasting color pattern. *Callistina* is most similar to the Southern African genus *Barnardara* McCafferty & Provonsha and the Afrotropical and Oriental genus *Clypeocaenis* Soldán. Specimens were collected from stones in riffles of a small stream, and gut contents were found to be mainly fine detritus.

Key-words : mayflies, Pannota, Caenidae, new genus, Madagascar.

RÉSUMÉ

Callistina Sun & McCafferty, n. gen. and *C. panda* Sun & McCafferty, n. sp. sont décrits à partir de larves provenant de Madagascar. *Callistina* est seulement le troisième genre d'éphémères Pannota de la famille des Caenidae, et seulement le second de la sous-famille des Caeninae, connus de Madagascar. Ce genre nouveau se distingue par : son corps robuste ; des crêtes céphaliques ; l'absence de longues soies marginales sur les mandibules, l'abdomen, et les branchies operculaires ; et le développement médiodorsal des tergites abdominaux 7-9. L'espèce nouvelle possède un pattern coloré contrasté, distinctif et unique. *Callistina* est très similaire au genre Sud Africain *Barnardara* McCafferty & Provonsha et au genre Afrotropical et Oriental *Clypeocaenis* Soldán. Les spécimens ont été récoltés sur substrat pierreux, dans les radiers d'un petit cours d'eau, et les contenus stomacaux étaient principalement constitués de fins débris.

Mots-clés : éphémères, Pannota, Caenidae, nouveau genre, Madagascar.

1. INTRODUCTION

The mayfly (Insecta : Ephemeroptera) family Caenidae, also known as the Small Squaregills (McCAFFERTY 1981) or Cainflies (e.g., AGNEW 1985) are poorly known from Madagascar. The fauna is known to include only five species of *Caenis* Stephens and one species of *Madecocercus* Malzacher (MALZACHER 1995). These genera are representative of the cosmopolitan subfamily Caeninae and the Afrotropical subfamily Madecocercinae, respectively. The larvae of Madagascar Caenidae are especially poorly known, with none of the Caeninae known in this aquatic stage and only the endemic genus *Madecocercus* (and presumably *M. tauroides* Malzacher) having been detailed as larvae by McCAFFERTY & WANG (1995) (as *Provonshaka* McCafferty & Wang and *P. thomasorum* McCafferty & Wang).

The subfamily Caeninae currently consists of 11 genera worldwide (SUTER 1999, McCAFFERTY & WANG 2000), with its greatest diversity in the Southern Hemisphere. McCAFFERTY & WANG (2000) differentiated this subfamily and hypothesized its cladistic relationships among three sub-

families of Caenidae and the pannote mayflies in general. Based on materials taken from Madagascar streams in 1971 by George Edmunds (Salt Lake City, Utah) and in 1998 by Jonathan Benstead (Athens, Georgia), we here describe a remarkable new genus and species of Caeninae. Besides adding biodiversity data for a relatively poorly known and possibly imperiled Madagascar fauna, the new genus is expected to contribute important new information for deciphering the evolution and historical biogeography within the Caeninae.

2. *Callistina* Sun & McCafferty, n. gen.

2.1. Description

Larva

Body (Figs. 1, 2) robust, relatively deep dorsoventrally, relatively heavily sclerotized, lacking long setae.

HEAD

Vertex and frons (Fig. 9) bordered with cephalic ridges as follows : epicranial ridge (Fig. 9, E) along epicranial suture and its lateral branches (coronal suture and frontal suture) ; frontoclypeal ridge (Fig. 9, FC) transversely between frons and clypeus ; subantennal ridges (Fig. 9, SA) transversely between lateral portion of frons and basis of mandible ; laterofrontal ridges (Fig. 9, LF) vertically between median and lateral portion of frons ; and midfrontal ridge (Fig. 9, MF) transversely between laterofrontal ridges and crossing median ocellus. Median portion of frons protruding, rectangulate, encompassed by lateral branches of epicranial ridge, frontoclypeal ridge, and laterofrontal ridges. Head capsule with major cephalic depressions as follow : antennal pits encompassing antennal bases, each bordered by laterofrontal ridge, anterior margin of compound eye, and subantennal ridge ; pair of elongate-transverse concavities, each concavity posterior to epicranial ridge branch ; and pair of depressions medioposterior to compound eye. Under light microscopy, frons and vertex appearing glabrous, but with SEM cuticle with dense, microscopic pits, each with one complex, banching seta enclosed (Figs. 9, 10).

Ocelli (Figs. 1, 9) not raised or tuberculate.

Compound eyes (Figs. 1, 2, 9) not reduced in size.

Labrum (Fig. 3) broadly emarginate medially.

Mandibles (Figs. 4, 5) without clusters of long setae on outer margins.

Maxillary palps (Fig. 7) three segmented.

Labium (Fig. 8) with palps three segmented ; apical segment subequal in length to segment 2 ; basal segment broader than segment 2 and 3 ; submentum rectangulate.

THORAX

Nota (Figs. 1, 2) robust, gradually elevating dorsally from lateral margin to medial line, with microscopic pits with complex setae as described for head capsule (see Figs. 9, 10). Pronotum (Figs. 1) trapezoidal ; lateral margins divergent posteriorly ; and with narrow translucent shelves laterally ; transversely arranged concavities distinct.

Femora (Figs. 17, 18) only moderately expanded. Tarsal claws (Fig. 19) with one row of denticles. Forelegs (Fig. 17) lacking long setae ; forecoxae approximate ventrally ; forefemora dorsally with transverse setal row in apical third consisting of several bifurcate setae.

ABDOMEN

Width (Fig. 1) less than that of thorax.

Segments lacking long lateral setae. Posterolateral projections on segment 2-9 not curving upwards, those of segment 2 (Fig. 2) broad and round, those of segments 7-9 (Fig. 11) pointed, longest on segment 9. Terga 7-9 (Fig. 11) with mediolongitudinal ridge, sloping laterally, thus segments appearing triangulate in cross-section. Terga 7 and 8 (Figs. 11, 12) lacking long setae, but with triangulate denticles and some interspersed complex, branching setae covering surface and posterior margin. Filamentous gills 1 (Figs. 1, 2) short, oriented dorsally.

Operculate gills (Figs. 1, 2, 20) medially elevated, providing medially peaked covering for gills 3-6, with Y-shaped ridges dorsally, lacking long setae marginally, ventrally with clusters of simple microtrichiae in submarginal row and sparsely between submarginal row and gill margin (Figs. 22-23) (detectable only with SEM). Gills 3-6 fringed marginally.

Adult

Unknown.

2.2. Type species

Callistina panda Sun & McCafferty, n. sp., by monotypy.

2.3. Etymology

The generic name, *Callistina* (f.), from the Greek *Kallisto*, is an allusion to a "most beautiful sea nymph".

2.4. Diagnosis

Callistina larvae share character states with all other genera in the subfamily Caeninae as follows : the absence of ocellar tubercles, the presence of maxillary palps and three segmented labial palps, a narrow prosternum, legs of subequal length, an abdomen that is poorly developed laterally, and operculate gills that have a ventral submarginal row of microtrichiae (McCafferty & Wang, 2000). *Callistina* larvae can be distinguished from *Caenis* Stephens and other genera essentially similar to *Caenis* in the larval stage by the following combination of characters : the presence of extensive cephalic ridges and microscopic pits with enclosed setae on the cuticular surface of the head ; mandibles that lack clusters of long setae marginally ; a labial palp segment 3 that is subequal in length to segment 2 ; abdominal segments and operculate gills that lack long setae ; ventral oper-

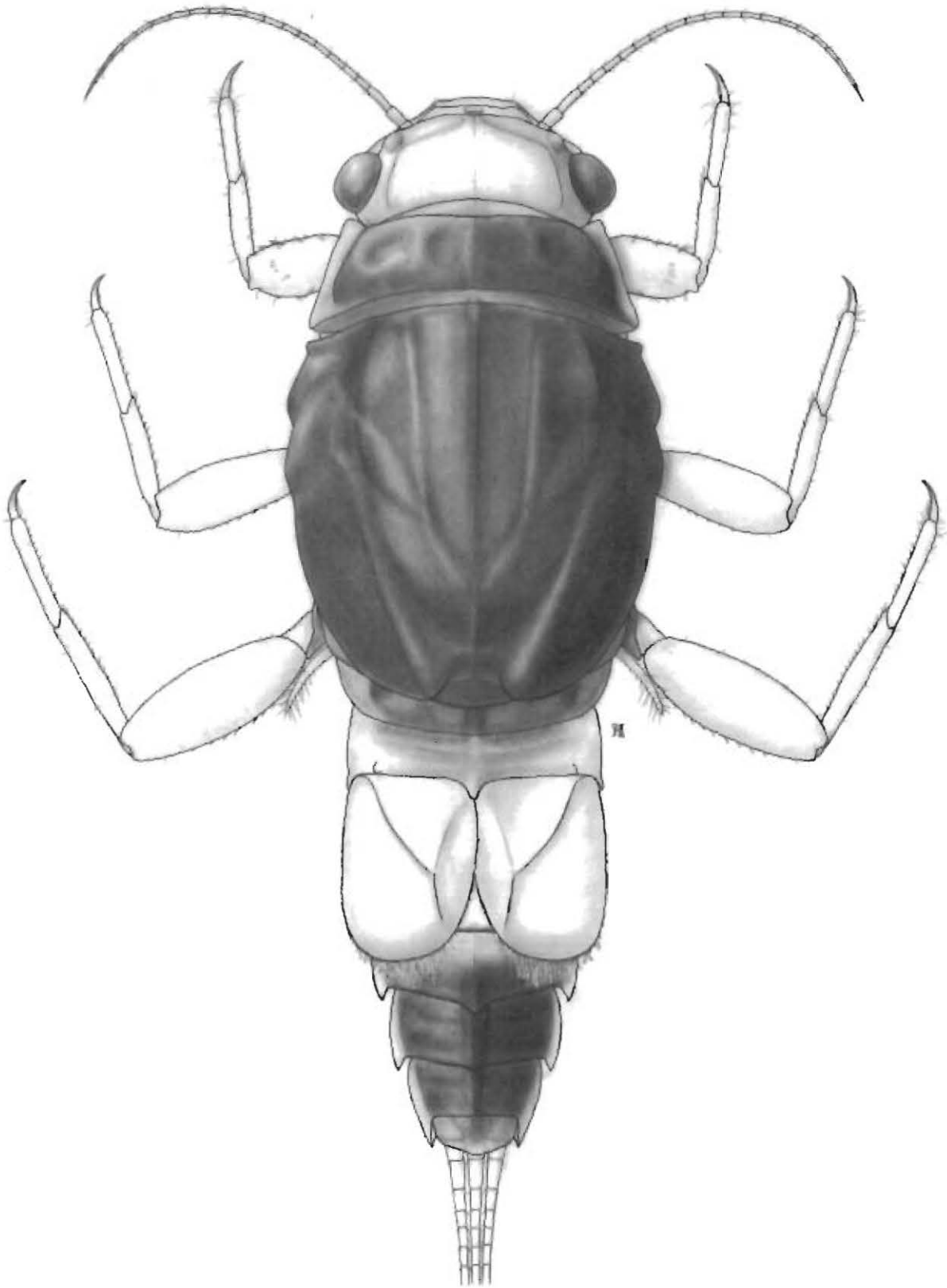


Fig. 1. *Callistina panda*, dorsal habitus of larva.
Fig. 1. *Callistina panda*, habitus dorsal de la larve.

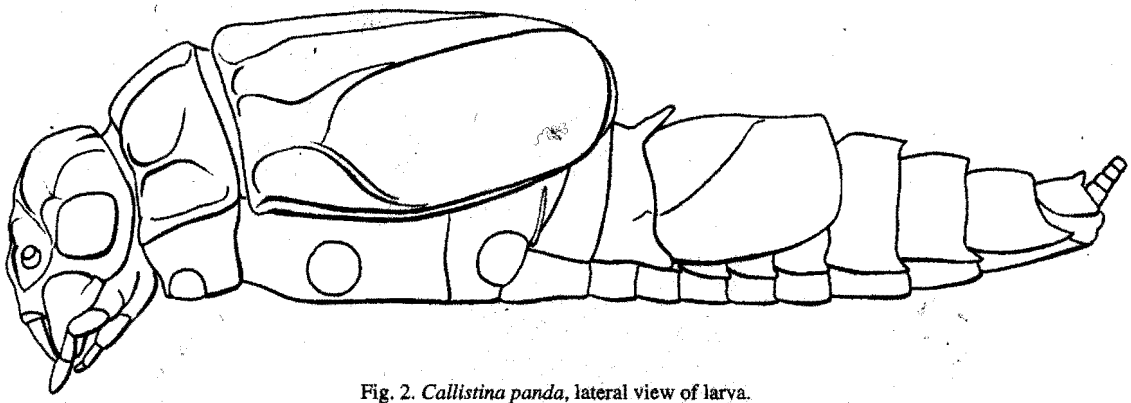


Fig. 2. *Callistina panda*, lateral view of larva.
Fig. 2. *Callistina panda*, larve en vue latérale.

culate gill microtrichiae that are extremely minute ; and abdominal terga 7-9 that have a mediolongitudinal ridge.

Within Caeninae, four described genera, *Clypeocaenis* Soldán, *Barnardara* McCafferty & Provonsha, *Amercaenis* Provonsha & McCafferty, and *Irpacaenis* Suter, share character state of absence of long setae on the operculate gills and abdomen with *Callistina*. Common characters shared by *Clypeocaenis, Barnardara*, and *Amercaenis*, including relatively long labial palp segment 3 and short gill 1 (see SOLDÁN 1978, PROVONSHA & MCCAFFERTY 1985, 1995), are also found in *Callistina panda*. In *Clypeocaenis* and *Barnardara*, the epicranial, frontoclypeal, and subantennal cephalic ridges are present. Although *Clypeocaenis umgeni* McCafferty & Provonsha (and presumably other *Clypeocaenis* that have not been studied by SEM) has operculate gill setation, abdominal tergal surface armature, and a mediolongitudinal ridge on abdominal terga 7-9 reminiscent of those of *Callistina* (see PROVONSHA & MCCAFFERTY 1995, SOLDÁN 1978, 1983), *Clypeocaenis* is easily distinguished from *Callistina* by the presence of brushed forelegs, as are known *Barnardara* and *Amercaenis* species. SUTER (1999) described Australian caenid genus *Irpacaenis*. Larvae of *Irpacaenis* share certain character states with *Callistina*, including the absence of long setae on operculate gills and abominal segments 7-8 and the presence of relatively long labial palp segment 3. However, *Irpacaenis* can be distinguished from *Callistina* by its lack of a medial ridge on abdominal terga 7-9, and the absence of postolateral projections on abdominal segment 9, which are highly developed in *Callistina*.

3. *CALLISTINA PANDA* SUN & MCCAFFERTY, N. SP.

3.1. Description

Larva

Mature larva 2.7-3.9 mm in length, caudal filaments 1.9-2.2 mm in length. Coloration pale yellowish white contrasted with dark blackish brown as shown in Figure 1.

HEAD

Color pale yellow to cream. Compound eyes black. Ocelli dark grey ; lateral ocelli posterior to epicranial suture branches ; mid-ocellus smaller than lateral ones.

Antennae (Figs. 1, 9) pale ; pedicel approximately 2.5 times length of scape ; first segment of flagella more than 1.5 times length of segment 2.

Labrum (Fig. 3) with six small notches along anterior emargination ; dorsally only with sparse setae.

Mandibles (Figs. 4, 5) anteriorly with dense, small, round granules in basal half. Angulate mandible (Fig. 4) with outer and inner incisors with three denticles ; very few setae below mola on inner margin. Planate mandible (Fig. 5) with outer incisor with three denticles and inner incisor with two denticles ; several setae below mola on inner margin.

Hypopharynx as in Figure 6.

Maxillae (Fig. 7) with palp segment 1 width approximately twice that of segments 2 and 3 ; segment 3 slightly longer than segment 2, tapering to bluntly pointed apex.

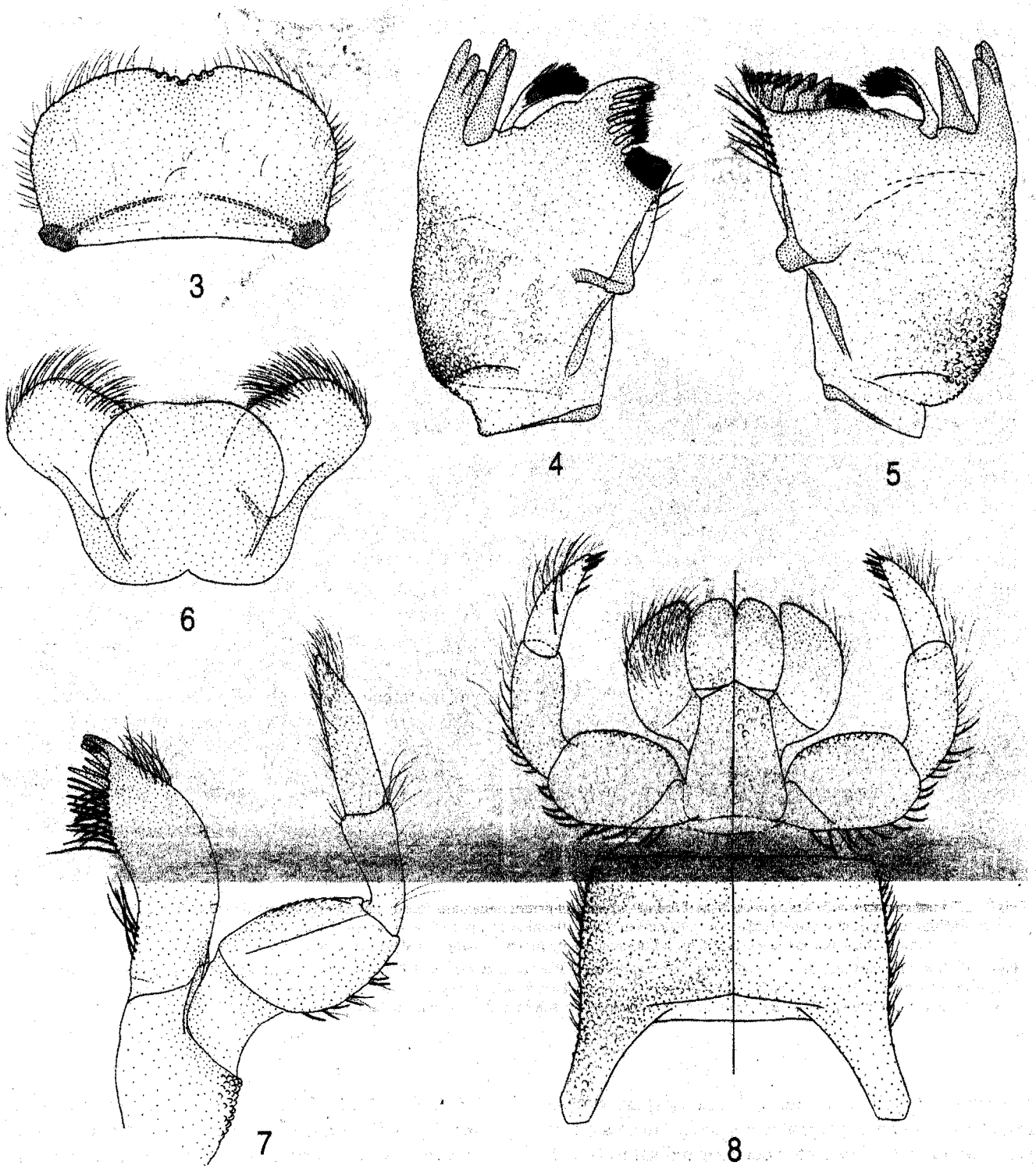
Labium (Fig. 8) with palp segment 1 width approximately twice that of segments 2 and 3, with row of pectinate setae laterally ; segment 2 with several pectinate setae laterally in basal portion, and long simple setae laterally in distal portion ; segment 3 with moderately long, simple setae and shorter, more robust setae, tapering to bluntly pointed apex. Submentum (Fig. 8) with dense, small, round granules ventrally.

THORAX

Nota and pleura dark blackish brown ; sterna light purple-brown ; pronotum and mesonotum sometimes with areas of lighter stain.

Notal ridges present as shown in Figure 1. Prosternum with short, fleshy, tuberculate, truncate process between forecoxae anterior to medioanterior margin of furcasternum (Fig. 13).

Legs pale. Forelegs (Fig. 17) with coxal processes as shown in Figure 14 ; femur with 10 or fewer bifurcate setae forming sparse, transverse row ; tibia with several pectinate

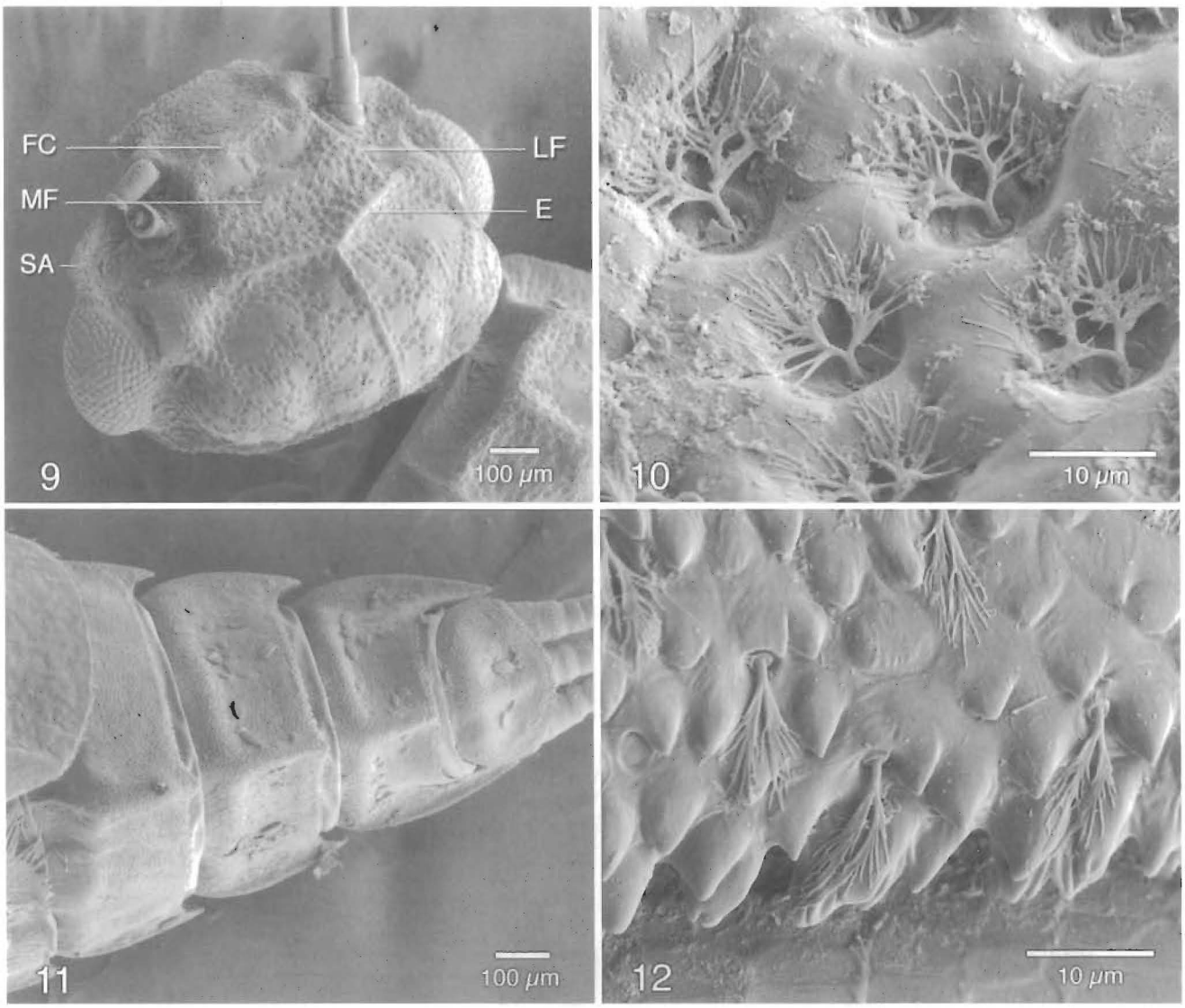


Figs 3-8. Larval structures of *Callistina panda*. 3 : labrum. 4 : angulate mandible. 5 : planate mandible. 6 : hypopharynx. 7 : maxilla. 8 : labium.
Figs 3 à 8. Structures larvaires de *Callistina panda*. 3 : labre. 4 : mandibule angulée. 5 : mandibule plane. 6 : hypopharynx. 7 : maxille. 8 : labium.

setae distally on inner margin ; tarsus with row of pectinate setae along inner margin and moderately dense, long, simple setae distally on outer margin. Midlegs with coxal processes as shown in Figure 15. Hindlegs (Fig. 18) with coxal processes as shown in Figure 16 ; tibia and tarsus with one row of pectinate setae along inner-ventral surface. Hindclaw (Fig. 19) with 7 well-developed denticles.

ABDOMEN

Terga (Figs. 1, 2, 11) with tergum 1 dark brown ; tergum 2 brown anteriorly but becoming lighter in posterior and la-



Figs 9-12. Larval structures of *Callistina panda*. 9 : head capsule and partial pronotum, dorsal view. E, epicranial ridge ; FC, frontoclypeal ridge ; LF, laterofrontal ridge ; MF, midfrontal ridge ; SA, subantennal ridge. 10 : microscopic pits and branching setae on head capsule. 11 : abdominal segments 7-10, dorsal view. 12 : triangulate denticles and branching setae along posterior margin of abdominal segment 8.

Figs 9-12. Structures larvaires de *Callistina panda*. 9 : capsule céphalique et pronotum partiel, vue dorsale. E, arête épicraniale ; FC, arête frontoclypéale ; LF, arête latérofrontale ; MF, arête médiofrontale ; SA, arête subantennaire. 10 : puits microscopiques et soies ramifiées sur la capsule céphalique. 11 : segments abdominaux 7-10, en vue dorsale. 12 : denticules et soies ramifiées le long du bord postérieur du segment abdominal 8.

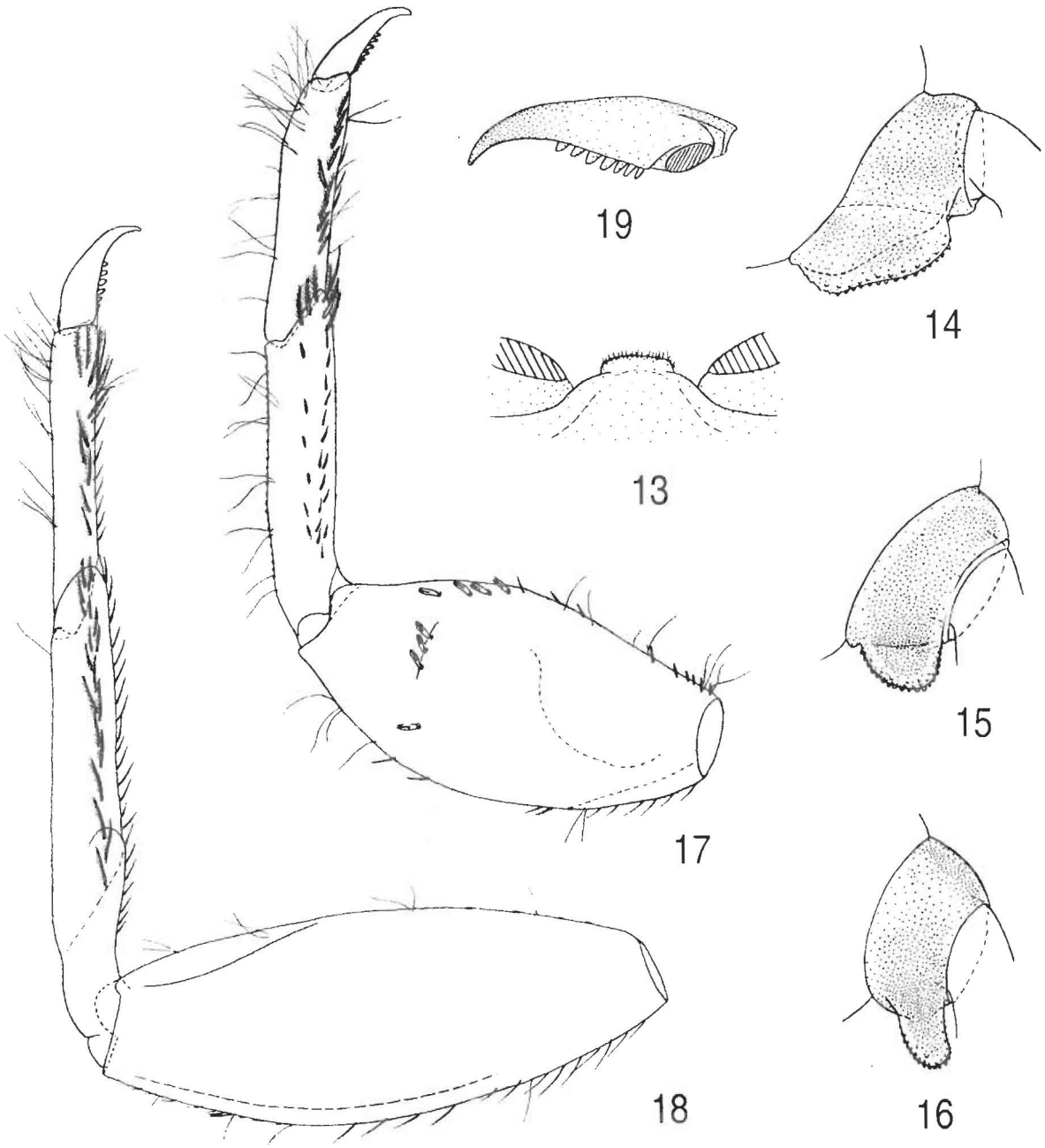
teral areas, pale yellowish white at lateral margins, with somewhat flat posteromedial protrusion pointed to obtuse ; terga 3-6 white ; terga 7-9 with mediolongitudinal ridge dark brown-black, and lateral shelves somewhat pale-translucent ; tergum 7 yellowish white with brownish smear in anterior one-third and dark brown in posterior two-thirds, with very short and blunt posteromedial protrusions ; terga 8-9 dark brown ; tergum 8 with indistinct posteromedial protrusion ; tergum 10 brown, somewhat lighter than terga 8 and 9. Sterna with sternum 1 light purple-brown ; sterna 2-6 white ; sterna 7-8 light brown, and lighter medially ; sternum 9 light brown in anterior half and pale-translucent in posterior half, with small medial notch on posterior margin.

Operculate gills (Figs. 1, 20, 21) pale yellowish white, shading to light brown in far posterior, without conspicuous setation dorsally, with row of short, flat, pectinate setae along posterior margin, with some short, bifurcate, flat ribbon-like setae interspersed among pectinate setae, and with short row of small spines on inner branch of Y-ridge. Gills 3-6 white.

Caudal filaments pale, with short, fine setae sparsely whorled at each margination; setae on segments in middle portion longer than those on basal and distal portions.

Adult

Unknown.



Figs 13-19. Larval structures of *Callistina panda*. 13 : prosternal process, postero-ventral view. 14 : forecoxal process. 15 : midcoxal process. 16 : hindcoxal process. 17 : foreleg, dorsal view. 18 : hind leg, ventral view. 19 : hind claw.

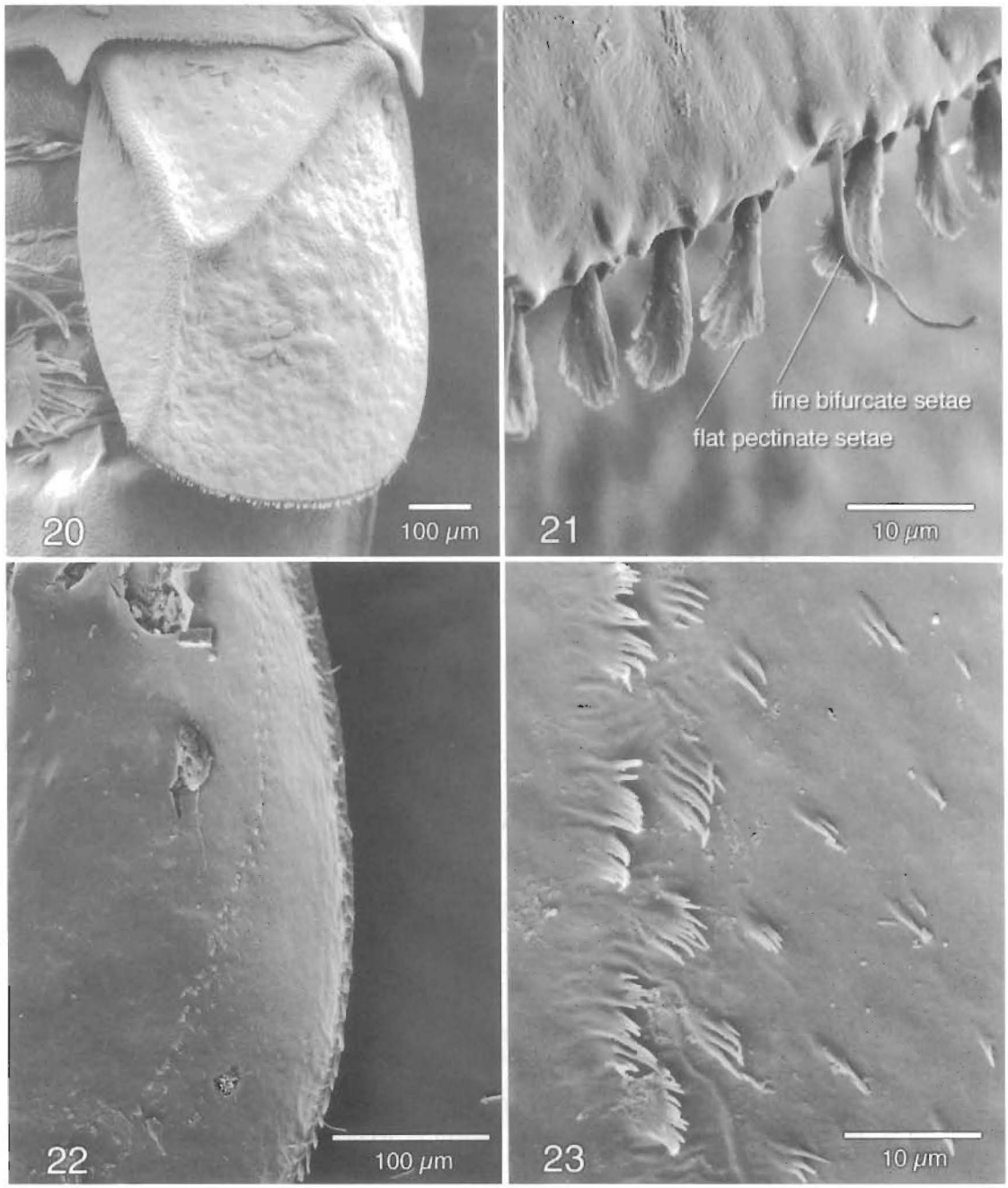
Figs 13-19. Structures larvaires de *Callistina panda*. 13 : processus prosternal en vue postéro-ventrale. 14 : processus de la coxa antérieure. 15 : processus de la coxa moyenne. 16 : processus de la coxa postérieure. 17 : patte antérieure en vue dorsale. 18 : patte postérieure en vue ventrale. 19 : griffe de la patte postérieure.

3.2. Material examined

Holotype : larva, Madagascar, north Ranomafana National Park, Tolongonia Stream, S 21° 15.417', E 47° 27.440', VII-2-1998, J. P. Benstead, deposited in the Purdue Entomological Research Collection, West Lafayette, Indiana, USA. Paratypes : 9 larvae, same data and deposition as holotype. Additional material : 1 larva, Malagasy, Pr. Tam., Anevoka Riv. 15 km E Perinet, X-11-1971, G. F. Edmunds, C. H. Edmunds, & F. Emmanuel, same deposition as holotype.

3.3. Etymology

The species name *panda* is simply an allusion to the giant panda of China, because of the unique contrasting coloration and robustness of the species.



Figs 20-23. Larval structures of *Callistina panda*. 20 : operculate gill, dorsal view. 21 : setae along posterior margin of operculate gill. 22 : outer portion of operculate gill, ventral view. 23 : submarginal microtrichia on ventral side of operculate gill.

Figs 20-23. Structures larvaires de *Callistina panda*. 20 : branchie operculaire, vue dorsale. 21 : soies du bord postérieur de la branchie operculaire. 22 : partie externe de la branchie operculaire, vue ventrale. 23 : microtriches sous-marginales de la face ventrale de la branchie operculaire.

4. Ecology

The following ecological data associated with *C. panda* were provided to us by J. Benstead (pers. comm.). Specimens were collected in the Tolongoina Stream (Fig. 24), a tributary of the Namorona River. At the collection site, the channel is 7 m wide, 0.55 m deep, with a temperature of 17.3 °C, and canopy coverage 14 % at the time of collection. Stream substrate consisted of boulders, cobble, gravel, and sand. Riffles were present at the sampling site as shown in Figure 24. Gut content from five measured larvae of *C. panda* included amorphous (non-cellular) detritus (99.5 %), diatoms (0.4 %), and filamentous algae (0.1 %). It may be deduced from the makeup of this diet that *C. panda* larvae

Fig. 24. Natural habitat of *Callistina panda*, Tolongoina stream, tributary of Namorona River, near town of Ranomafana, Madagascar.

Fig. 24. Habitat naturel de *Callistina panda*, cours d'eau Tolongoina, affluent de la rivière Namorona, près de la ville de Ranomafana, Madagascar.

are fine detritus deposit feeders probably confined to the undersides of cobbles or surfaces not exposed to direct light.

5. Remarks

It is within the realm of possibility that the larvae described as *C. panda* could eventually prove to be the currently unknown larvae of any of the five species of *Caenis* that have been described as adults only from Madagascar by Malzacher (1995). There is no direct or indirect evidence of this, however, at this time. All of the *Caenis* species referred to appear to be typical *Caenis* with no indication of generic level variation. Nevertheless, it is known that certain genera of Caeninae are expressed strongly in only one life stage. For example, *Tasmanocoenis* Lestage is distinguishable as adults primarily, whereas *Amercaenis* Provonsha & McCafferty is distinguishable primarily as larvae. Additionally, however, there is no suggestion whatsoever of the striking larval color pattern of *C. panda* in any of the known adults of Madagascar *Caenis*.

Acknowledgments

We thank J. P. Benstead (Athens, Georgia) for allowing us to study his Madagascar specimens, and for the detailed information about habitat and diet of the new species. We also thank A. Provonsha (West Lafayette, Indiana) for his valued advice on the study, and critique of artworks. Our SEM works were done in Life Science Microscopy Facility, Purdue University, and D. Sherman (West Lafayette, Indiana) is kindly acknowledged for her technical assistance. This paper has been assigned Purdue ARP Journal No. 16528.

References

Agnew (J.D.). 1985. — Chapter 3. Order Ephemeroptera (mayflies). Pp. 33-40. *In* : C.H. Scholtz & E. Holm (eds), *Insects of southern Africa*. Butterworths, Durban.

Malzacher (P.). 1995. — Caenidae from Madagascar (Insecta : Ephemeroptera). *Stuttg. Beitr. Natkd. Ser. A (Biol.)*, 530, 1-12.

McCafferty (W.P.). 1981. — *Aquatic Entomology*. Jones & Bartlett, Boston.

McCafferty (W.P.) & Wang (T.-Q.). 1995. — A new genus and species of Tricorythidae (Ephemeroptera : Pannota) from Madagascar. *Ann. Limnol.*, 31, 179-183.

McCafferty (W.P.) & Wang (T.-Q.). 2000. — Phylogenetic systematics of the major lineages of pannote mayflies (Ephemeroptera : Pannota). *Trans. Am. entomol. Soc.*, 126, 9-101.

Provonsha (A.V.) & McCafferty (W.P.). 1985. — *Amercaenis* : new Nearctic genus of Caenidae (Ephemeroptera). *Int. Quart. Entomol.*, 1, 1-7.

Provonsha (A.V). & McCafferty (W.P.). 1995. — New brushlegged Caenid mayflies from South Africa (Ephemeroptera : Caenidae). *Aquat. Insects*, 17, 241-251.

Soldán (T.). 1978. — New genera and species of Caenidae (Ephemeroptera) from Iran, India and Australia. *Acta Entomol. Bohemoslov.*, 75, 119-129.

Soldán (T.). 1983. — Two new species of *Clypeocaenis* (Ephemeroptera : Caenidae) with a description of adult stage and biology of the genus. *Acta Entomol. Bohemoslov.*, 80, 196-205.

Suter (P.J.). 1999. — *Irpacaenis*, a new genus of Caenidae (Insecta : Ephemeroptera) from Australia. *Aust. J. Entomol.*, 38, 159-167.