BULLETIN DE L'INSTITUT ROYAL DES SCIENCES NATURELLES DE BELGIQUE, BIOLOGIE, 73: 91-105, 2003
BULLETIN VAN HET KONINKLIJK BELGISCH INSTITUUT VOOR NATUURWETENSCHAPPEN, BIOLOGIE, 73: 91-105, 2003

New stygobiontic isopods (Isopoda: Cirolanidae, Anthuridae) from caves in Sulawesi, Indonesia

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Abstract

During field work (2001) in caves in Sulawesi (Maros karst; Muna island) a team of Indonesian and French biospeologists has sampled a rich material, including two new stygobiontic Isopods whose description makes the object. of the present paper. *Cirolana (Anopsilana) marosina* n.sp., sampled from two caves in rather distant parts of the Maros karst, is only the 3d stygobiontic cirolanid known from the Pacific area, and the 1st described from Indonesia; it is interesting that, all specimens sampled in the two localities being morphologically practically identical (and, of course, completely depigmented), the holotype – from one of the caves – is anophtalmic, whereas the remaining specimens – from the 2nd cave – have imperfectly developed eyes. *Cyathura (Stygocyathura) munae* n.sp., sampled from two caves on Muna Island, is now added to the several representatives of this entirely stygobiontic subgenus already described from subterranean habitats in various parts of the Indo-Pacific area; *Stygocyathura* is doubtless the sister taxon of *Cyathura* s.str., not deserving more than the status of subgenus.

Key words: Isopoda, Cirolanidae, Anthuridae, stygobitic/ troglomorphic fauna, Sulawesi, Indo-Pacific area, taxonomy.

Résumé

En échantillonnant dans le cadre d'une mission en 2001 dans des grottes de Sulawesi (karst de Maros, île de Muna) une équipe de biospéologistes Indonésiens et Français a récolté un riche matériel incluant deux nouveaux Isopodes stygobies dont la description fait l'objet du présent travail. *Cirolana (Anopsilana) marosina* n.sp., découverte dans deux grottes de points assez éloignés du karst de Maros, est le 3ème cirolanide stygobie connu du Pacifique, et le 1er décrit d'Indonésie; fait intéressant, tous les exemplaires récoltés dans les deux localités sont morphologiquement pratiquement identiques (et complètement dépigmentés), mais tandis que le holotype – en provenance de l'une des grottes – est anophtalme, les autres exemplaires, récoltés dans la seconde grotte, possèdent des yeux assez rudimentaires. *Cyathura (Stygocyathura) munae* n.sp., capturée dans deux grottes de l'île de Muna, s'ajoute maintenant aux représentants de ce sous-genre entièrement stygobie, déjà décrits d'habitats souterrains de diverses parties de l'Indo-Pacifique; *Stygocyathura* est sans doute le taxon-frère de *Cyathura* s.str., et le statut de sous-genre est justifié dans ce cas.

Mots-clés: Isopoda, Cirolanidae, Anthuridae, faune stygobie/ troglomorphe, Sulawesi, Indo-Pacifique, taxonomie.

Introduction

As part of the project "The effect of human impact on cave and karst biodiversity. An Indonesian example" supported by ARCBC (ASEAN Regional Center for Biodiversity Conservation) and LIPI (Indonesian Institute of Sciences), a team of Indonesian and French biospeologists has sampled a rich zoological material in various zones of Sulawesi, and especially in the Maros karst – considered as being a hot spot of subterranean biodiversity. Material of two new stygobiontic isopods, a cirolanid and an anthurid, has been offered for study to the author of the present paper; their description marks a step forward in the knowlegde of the aquatic subterranean fauna of Indonesia

Cirolanidae
Cirolana (Anopsilana) marosina n.sp.
(Figs 1-22)

MATERIAL AND LOCALITIES

Male holotype (length: ca: 1 cm) sampled on 17.08.2001 by Franck BREHIER in the subterranean river of Gua (cave) Assuloang (Indonesia, province Sulawesi Selatan, Kabupaten Pangkajene, Balocci). The cave is at about 17-18 km (as the crow flies) from the sea shore; the river water is fresh. In the Museum Zoologicum Bogoriense in Cibinong, Indonesia.

Female allotype (length: ca 9.2 mm) sampled on 1.08.2001 by Cahyo RAHMADI, Anne BEDOS and IWING in a remanent pool along a temporary stream flowing through a cave and whose outlet is known as the temporary exsurgence of Saripa (Indonesia, province Sulawesi Selatan, Kabupaten Maros, Samanggi). The locality is at about 26-27 km (as the crow flies) from the sea shore; the water of the stream and exsurgence is fresh; the specimen has been sampled in complete darkness, during a period of drought, at ca. 50 m. from the spring inside the cave. In the MZB.

Male paratype (length: slightly more than 1cm) sampled together with the ♀ allotype; in the Zoological Museum of the University of Amsterdam.

Male paratype (length only 5.1 mm; although remarkably small, this specimen has 7 completely developed pereiopods and normally developed appendix masculina); sampled

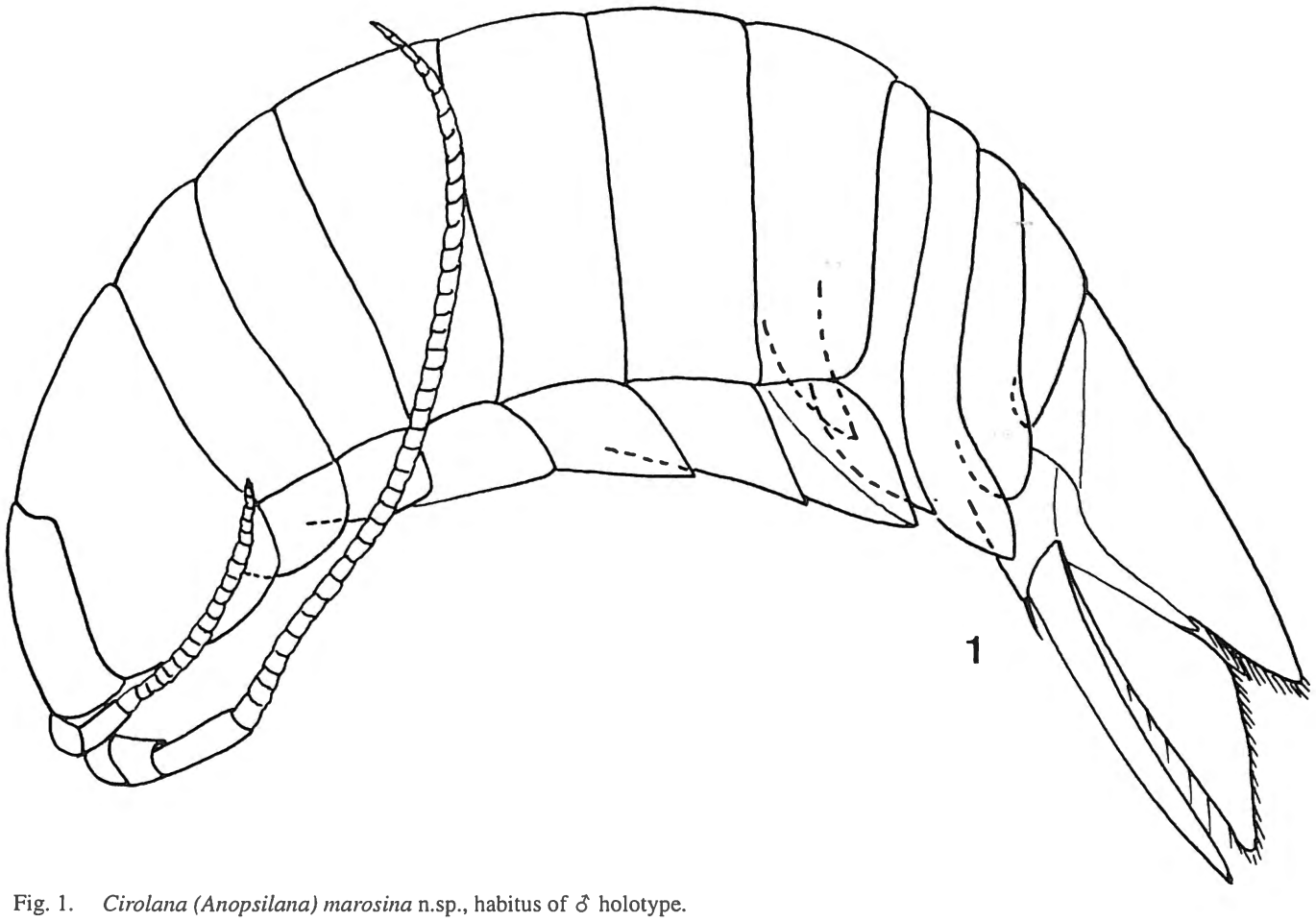


Fig. 1. *Cirolana (Anopsilana) marosina* n.sp., habitus of ♂ holotype.

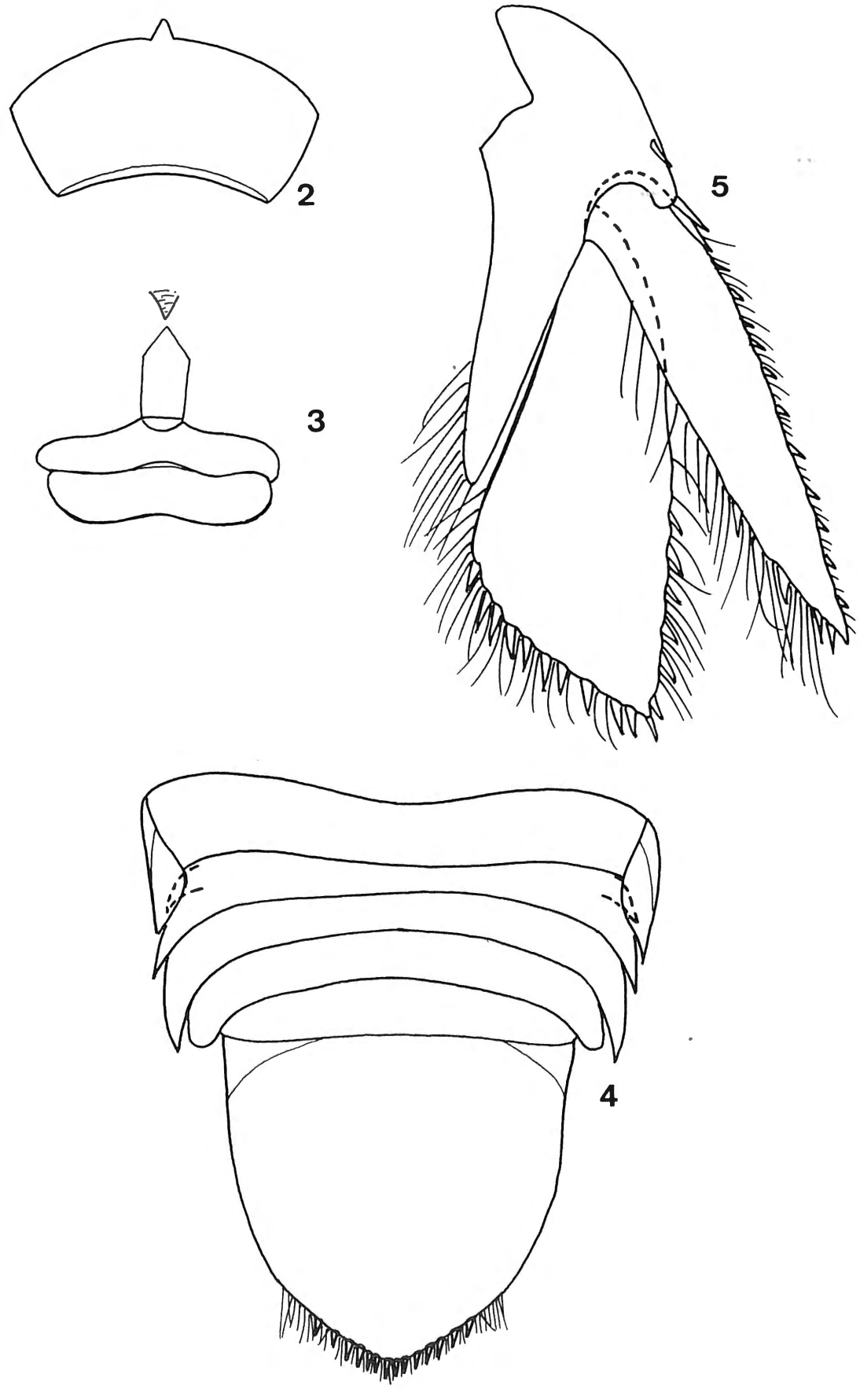
together with the other ♂ paratype, and with the ♀ allotype; in the ZMAN.
One additional specimen, sampled at a later date from the exsurgence of Saripa, in the Muséum National d'Histoire Naturelle, Paris.
Gua Assuloang is situated NE from Maros, whereas the exsurgence of Saripa is situated SE from that town. The two subterranean systems, distant of 13 km., are completely independent.

DESCRIPTION

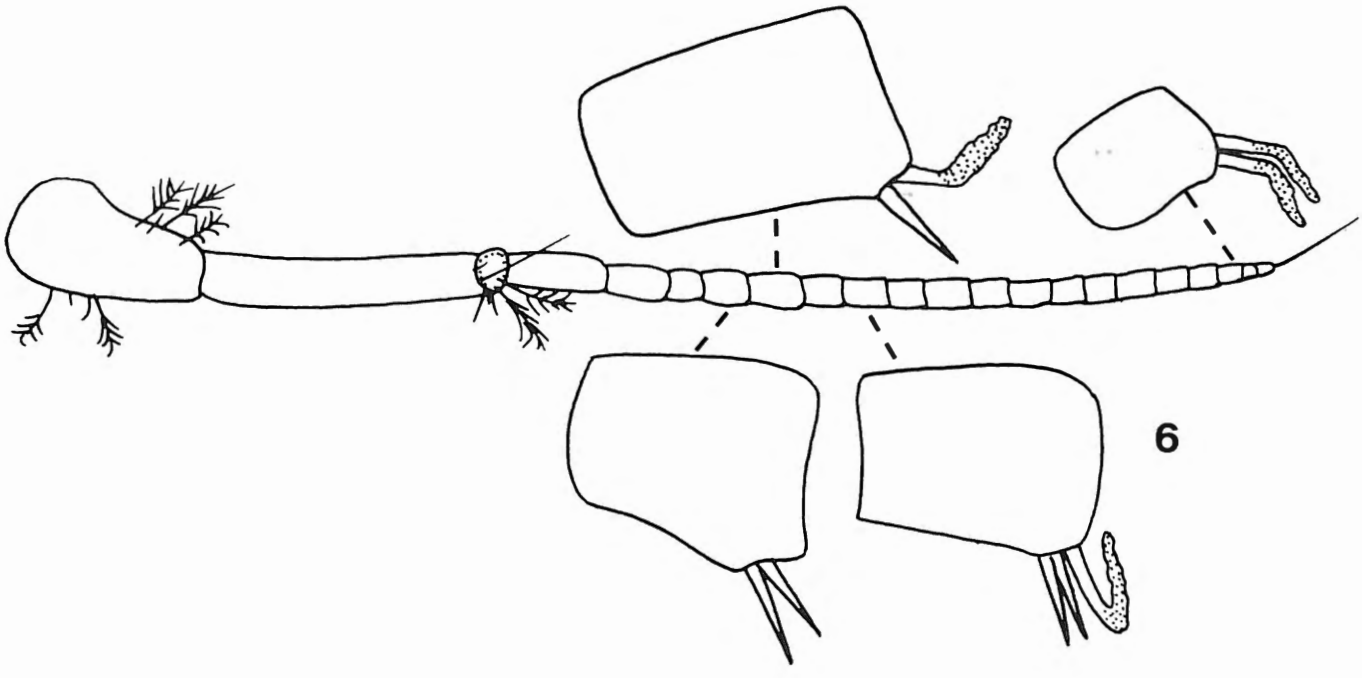
This description is mainly based on the ♂ holotype, the illustration being prepared from this specimen.
All specimens are completely depigmented and with perfectly smooth tegument. Whereas the holotype is anophtalmic, the 3 remaining specimens have imperfectly developed eyes, with about 23 ommatidia in the two large specimens. The three large specimens show – at least in preserved state – a slight tendency towards "rolling into a ball".

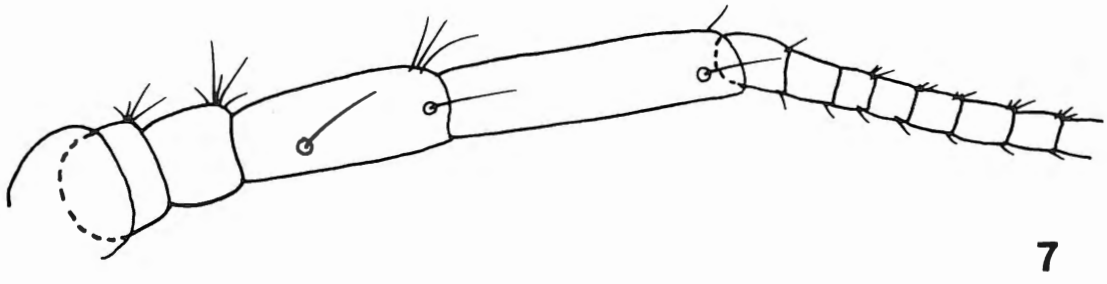
Body relatively stodgy. Cephalon very wide, anterior margins rounded, lateral margins oblique towards median line, posterior margin emarginate; rostrum rather well developed, turning ventrad towards the point of lamina dorsalis. Lamina dorsalis well resembling a writing pen, its root covered by clypeus; clypeus sinuous, its obtuse ends slightly protruding beyond ends of the labrum.

For details about pereion and pleon see figs 1 and 4. As usual in the genus and subgenus, the small pleonite I is completely – almost completely in the allotype – hidden under pereionite VII; also pleonite II is partly concealed, as well as the tips of pleonite V.
There is no trace of penes in the 3 ♂ specimens.
Pleotelson roughly triangular, its apex not really acuminate but certainly not blunt. Distally with 14 short spines between which several short, finely plumose setae are inserted (such setae, but slightly longer, on both sides of spine row). In one ♂ paratype the pleotelson is mutilated (sharply cut, possibly by a predator).
Antennula very short, only reaching posterior limit of pereionite I; peduncle from 2 articles (1st one resulting from coalescence of two articles); 2nd article with well individualized apical zone. Flagellum from 19 articles (holotype) or from 18 articles (allotype and ♂ paratype); 1st article longest; equipement of setae and/or aesthetascs on the flagellum articles seemingly quite irregularly distributed (in the holotype art. 1 and possibly also art. 3, devoid of such equipement; on remaining articles situation quite variable: fig. 6 presents four different cases; the aesthetasks are short but with strong petiole).
Antenna reaching posterior limit of pereionite V. Peduncle from 5 articles, art. 1-3 short and of about the same length, art. 4 as long as art. 2 + 3, art. 5 as long as art. 3 + 4. Flagellum from 34 articles in the holotype (33 in the allotype;



Figs 2-5. *C. (A.) marosina* n.sp. 2: cephalon; 3: lamina dorsalis, clypeo-labrum, and tip of rostrum; 4: pereionite VII, pleon, and pleotelson (from pleonite I only tips illustrated); 5: right uropod, dorsal (all setae are plumose). Figs. 2 and 4: same scale.





Figs 6-7. *C. (A). marosina* n.sp. 6: Left AI, with more strongly magnified articles 4, 5, 7, and 17 of flagellum; 7: Left AII peduncle and basal part of flagellum. Figs 6 and 7: same scale.

27 and, resp., 30 in the two antennae of the larger ♂ paratype).

Molar process of the mandibles distally with long row of *submarginal* denticles, reaching the tip of the process; and proximally with a row of fine setulae as long as the denticle row.

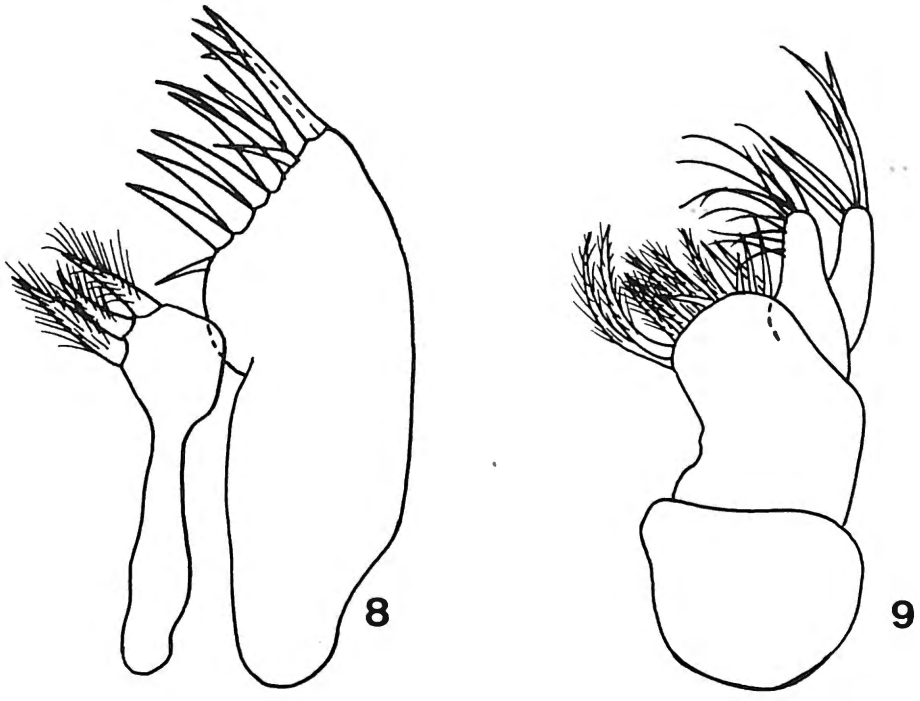
Maxillula: internal lobe ending strongly capitate, with 3 stout circumplumose setae; external lobe armed with ca. 12 glabrous setae of various lengths.

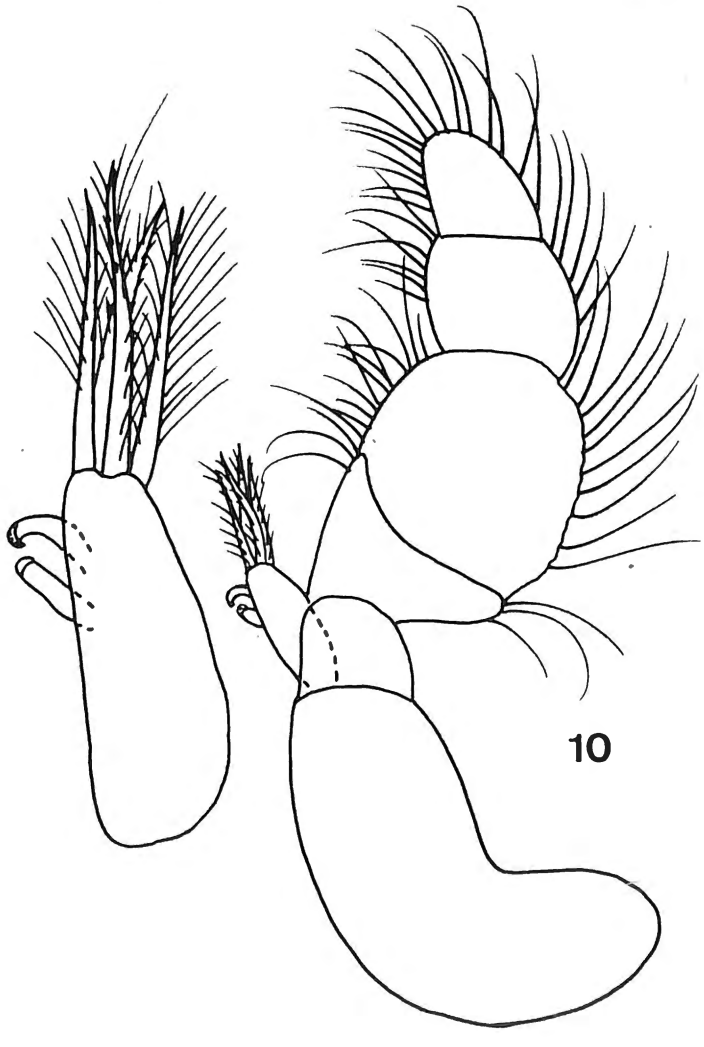
Maxilla with internal lobe squarish, armed with 14 setae (the two inserted in the internal angle much longer than remaining ones, and curved, circumplumose; circumplumose are, too, the 5 setae following, whereas the smaller remaining ones are glabrous). The two smaller lobes are elongate and narrow, median one with 13, lateral one with 5 glabrous setae.

Maxilliped endite with 2 coupling hooks forming like a forceps, and with 4 long circumplumose apical setae.

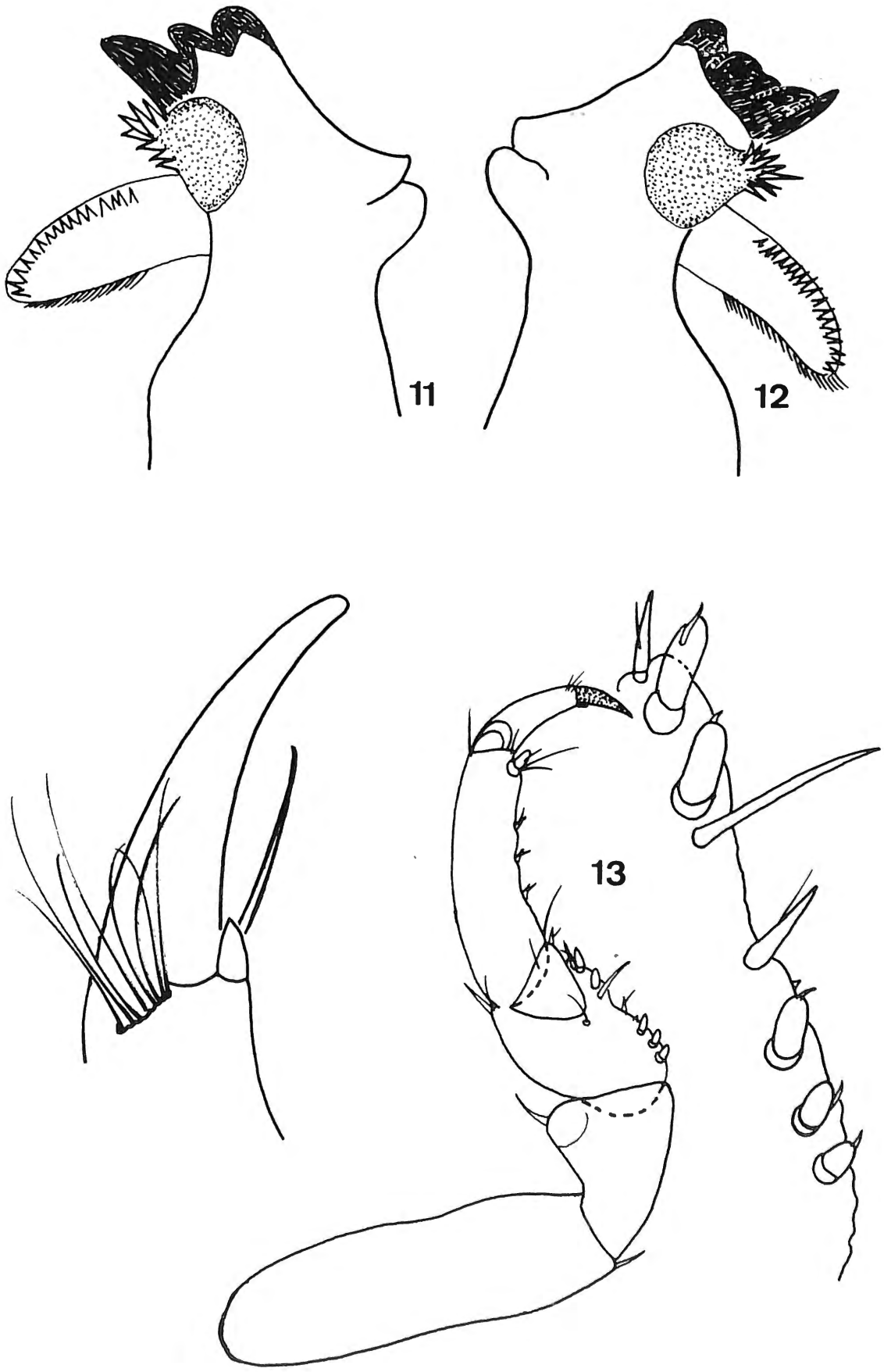
Morphology and chaetotaxy of the pereiopods do not need detailed description, the illustration providing the necessary information. The carpus is small, triangular, and encompassed by merus in PI and PIII, but quadrangular and "free" in PII. A specific characteristic is the number and distribution of short thick-set spines along the internal margin of merus in the first 3 pereiopods. There is a minute secondary unguis accompanied by a seta in all pereiopods.

The pleopodal morphology is that known from all *Cirolana (Anopsilana)* but with some details deserving mention. Pl I: coxopodite with numerous *short* "coupling spines", exopodite oval and with rigid seta from external margin. Coxopodites of Pl II and Pl III with row of long "coupling spines." Endopodites Pl I-II setose and of about the same length as the exopodites, those of Pl III-V glabrous, fleshly, notably shorter than the exopodites and of irregular shape (in the ♀ allotype and ♂ paratypes aspects differing from those in the ♂ holotype have been observed). Exopodites Pl III-V very large, incompletely bipartite in the ♂ holotype (but completely bipartite in the ♀ allotype and in the large ♂ paratype!). Appendix masculina slender, straight, basally

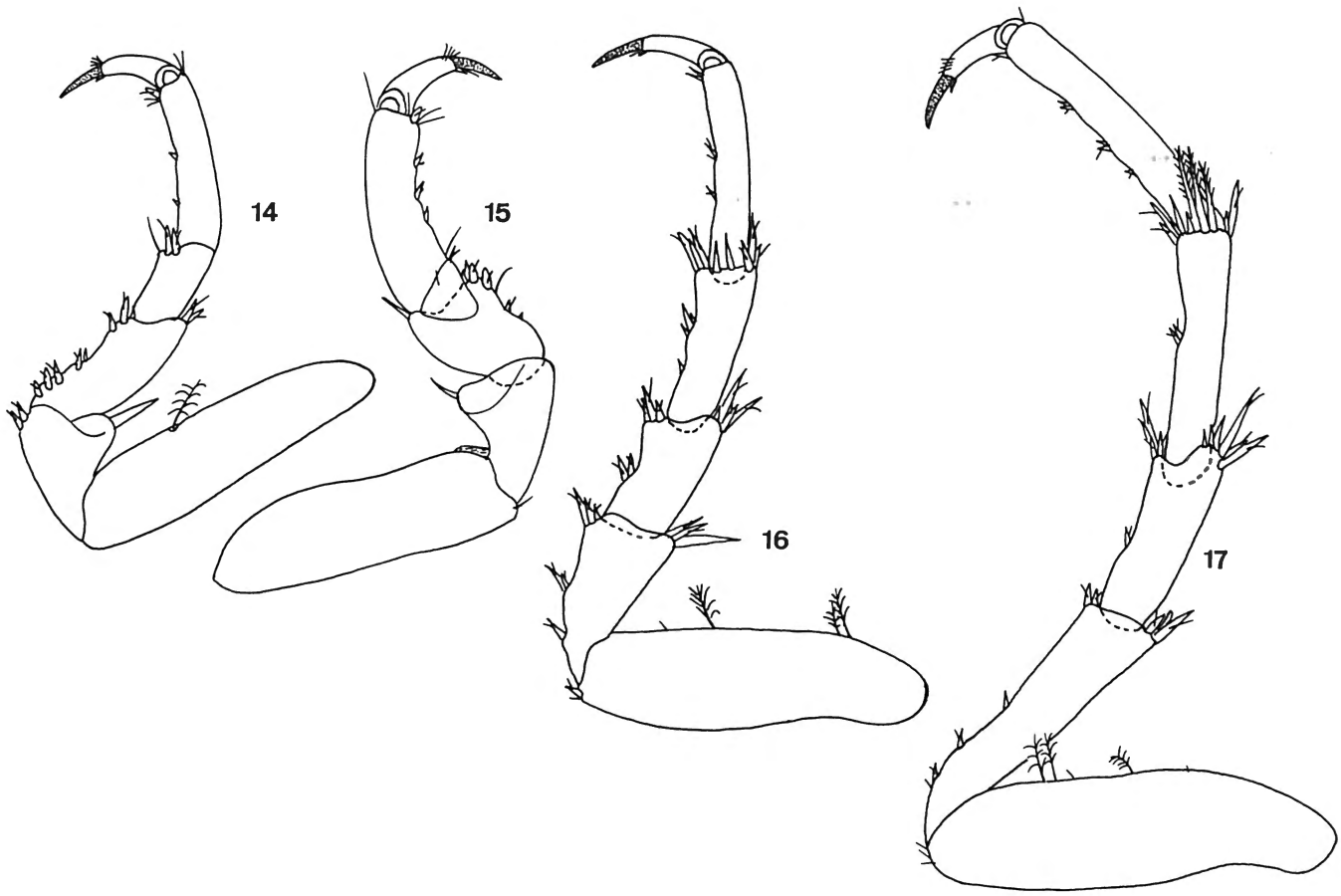




Figs 8-10. *C. (A.) marosina* n.sp. 8: Left MxI; 9: Left MxII; 10: Left Mxp. (all same scale, excepting detail of Mxp endite, more strongly magnified).



Figs 11-13. *C.(A.) marosina* n.sp. 11-12: distal parts of right and left Mdb., without palp; 13: right pereiopod I with more strongly magnified internal margin of merus, and unguis with secondary unguis and dactylian organ.



Figs 14-17. *C. (A.) marosina* n.sp., pereiopods II (left), III (right), IV (left) and VII (left). All same scale.

inserted, as long as endopodite Pl II; if strongly magnified, its tip appears not acuminate but either with a small bulge or with a sinus.

Uropod exo – and endopodite reaching beyond pleotelson; with very long but not very broad internal projection of coxopodite (anteapically with a few setae). Endo- and exopodite of about the same length; exopodite narrow (maximal width only 1/2 of maximal width of endopodite), ending in sharp point, 4 spines along the distal part of its internal margin, some 10-12 (smaller) regularly distributed along its external margin; endopodite asymmetrically foliaceous, with some 10 spines regularly distributed along its internal margin, and 7 along slightly more than the distal 1/3 of its external margin; both endo- and exopodite rather setose.

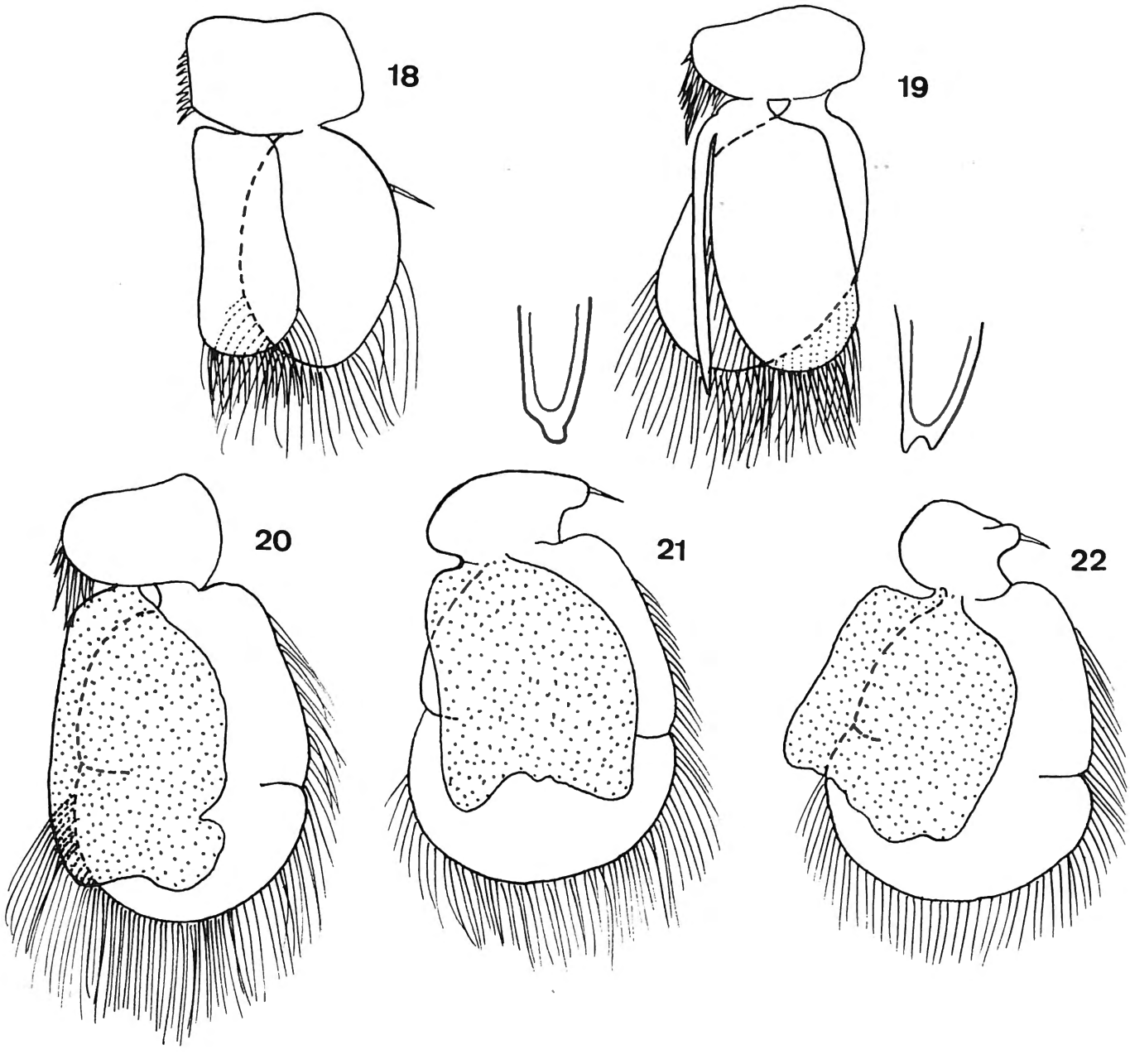
Discussion

Since its description (PAULIAN & DELAMARE – DEBOUTTEVILLE, 1956) *Anopsilana* has been the object of a number of discussions, being considered either as good genus, as a synonym of the large genus *Cirolana* LEACH, or as a polyphyletic assemblage of species. BOTOSANEANU & ILIFFE (1997) have proposed as solution for *Anopsilana* the status of subgenus of *Cirolana*; this solution has two advantages: first, it stresses the undoubtely strong evolutionary ties between the two taxa, and, second, it maintains *Anopsilana* which – monophyletic or not – is characterized by a number of morphological features shared by all its species (the significance of pleopod morphology has been underlined in several publications, but I think that several other shared characters could be added).

The new species here described undoubtely belongs to *Cirolana (Anopsilana)*, as shown by comparison with diagnoses published for *Anopsilana* (i.a.: BRUCE, 1981; BRUSCA, WETZER & FRANCE, 1995). At present sg. *Anopsilana* includes, besides a number of non-hypogean species, 9 stygobitic and troglomorphic species (list in BOTOSANEANU & ILIFFE, 2000), most of them described from the Caribbean, with one species from Madagascar and two from North Pacific islands.

It would be practically impossible – and also not really useful – to compare the new species with all those described. Instead, we shall compare it with the two troglomorphic species described from the Pacific area: *C. (A.) conditoria* (BRUCE & ILIFFE, 1992) from an anchialine cave pool on an islet N. of Koron Island, Philippines, and *C. (A.) lingua* (BOWMAN & ILIFFE, 1987) from a natural well on Peleliu island, Palau. Most striking differences will be underlined.

In several respects the new species resembles *C. (A.) lingua*:



Figs 18-22. *C. (A.) marosina* n.sp., right pleopods I-V, dorsal. All same scale. All setae are plumose. Fig. 19 accompanied by strongly magnified tip of appendix masculina of holotype (left side) and of paratype (right side).

root of lamina dorsalis overlapped by clypeus; general shape of clypeo-labrum; AII peduncle with about the same relative length of the articles; similar molar process of mandibulae; identical Mx I; identical armament of Mxp endite; pleopods III-V of exactly the same type (exopodite bipartition in *lingua* incomplete, like in the holotype of the new species). But there are numerous differences enabling distinction of *C. (A.) lingua* from the new species: *pleotelson distally broadly rounded* and with only 10 spines; *cephalon roughly triangular* and with rostrum not reflexed ventrad; *quite differently shaped lamina dorsalis (widening distally); A I peduncle from 3 articles*, and flagellum with distinctly less articles, like that of AII; MxII with less phanerae on median and internal lobe; among the differences in pereiopod morphology: *PIII carpus not triangular but normally developed; uropod exopodite shorter*, less acuminate, *and with less spines on both sides, like the endopodite*.

Turning now to *C. (A.) conditoria* (described from a single very small and possibly immature specimen), we find similarity between it and the new species in: shape of cephalon, AI and AII peduncle, morphology and armament of MxI, bipartition of Pl III-V exopodites (which is complete, like in the ♀ allotype and the large ♂ paratype of the new species). The differences enabling distinction of *conditoria* from the new species are numerous: *pleotelson distally more rounded* (but less broadly than in *lingua*) and with only 10 spines;

lamina dorsalis of different shape, bluntly ending; AI flagellum with only 7 articles, AII flagellum with only 10 articles; MxII with strongly reduced number of phanerae on the three lobes; Mxp endite with single coupling hook; pereiopods I and II with distinctly reduced number of short, blunt spines on merus; *appendix masculina longer*, much thicker and slightly curved; *endopodites of Pl III-V of more regular shape and not fleshly; uropods with exopodite broader, much shorter*, with less spinose margins – like the endopodite.

One interesting fact about *C. (A.) marosina* n.sp. is the existence of two known populations distinguished mainly by anophtalmy in one case, and by imperfectly developed eyes in the second one. Slight differences between specimens of the two populations with respect to number of flagellar articles of AI and AII, degree of bipartition of pleopod endopodites III-V, or shape of the appendix masculina tip, have been mentioned in the description; but, in the author's opinion, they do not allow distinction of two taxa. That we have here only one species is shown, for instance, by the identical cephalon, AI, AII, clypeo-labrum + lamina dorsalis, pleotelson, and uropods. Nevertheless, a process of incipient speciation cannot be excluded in this case.

Anthuridae

Cyathura (Stygocyathura) munae n.sp.

(Figs 23-28)

MATERIAL AND LOCALITIES

Female holotype (length: 9 mm) and 10 female paratypes (measuring between 7 and 9 mm) sampled on 25.08.2001 by Cahyo RAHMADI, Louis DEHARVENG, Franck BREHIER and Anne BEDOS from brackish water table in Gua (cave) Lamansi (Indonesia, Southeast Sulawesi, Muna Island, Metere). The holotype is in the Museum Zoologicum Bogoriense in Cibinong, Indonesia. The paratypes have been divided between the MZB and rhe MNHN, Paris.

Seven female paratypes (7.5 – 9.3 mm), same locality and date (but five of them sampled by Franck BREHIER near bait). In the Zoological Museum of the University of Amsterdam.

Two female paratypes (5.5 and 3.7 mm) – smaller one with incompletely developed P VII: postmanca stage ? – sampled on 26.08.2001 by Louis DEHARVENG from brackish water table in Gua Kalengmbungo (Indonesia, Southeast Sulawesi, Muna Island, Walengkabola). In the ZMAN.

Gua Lamansi is several km. distant from the sea shore, whereas only ca. 500 m. separate Gua Kalengmbungo from the littoral.

DESCRIPTION

This description is mainly based on a ♀ paratype (8.7 mm) from Gua Lamansi, the illustration being prepared from this specimen. Attention has been mainly directed to body parts and appendages known as furnising specific distinctive characters in sg. *Stygocyathura* (BOTOSANEANU & STOCK, 1982); nevertheless, some other appendages have been, too, illustrated. Unfortunately, in the absence of the ♂ the highly informative appendix masculina could not be studied.

All specimens are completely depigmented and anophtalmic. Five specimens have well developed oostegites.

The almost generally accepted opinion that the pleonal segments in *Cyathura* are completely fused with the pleotelson, is-once more – partly infirmed by observation of our specimens, where dorsal and lateral limits can be well seen – even without use of some colorant; nevertheless, these probably do not correspond to genuine articulations.

The pleotelson is slender and elongate (linguiform); its apex has neither a sinus nor a small protuberance, being simply blunt; from the 3 pairs of apical setae one is 5-7 times longer than the remaining two; anteapically a pair of long setae attaining about 1/2 of the length of the longest apical ones is inserted at some distance from the pleotelson margins.

AI: 2nd and 3d articles of peduncle of about the same length, but 3d one considerably more slender. Also 1st article of flagellum remarkably slender and elongate, attaining 1/2 of the length of the 3d article of peduncle; 2nd – and last- article very small.

All with 2nd article of peduncle showing a strong disto-lateral prong; articles 3-5 all relatively slender, art 5 distinctly longer than art. 3 or 4. The distal zones of peduncular articles 4 and 5 seem to be only very feebly differentiated. Like in many ♀ *Stygocyathura* there are 4 flagellar articles.

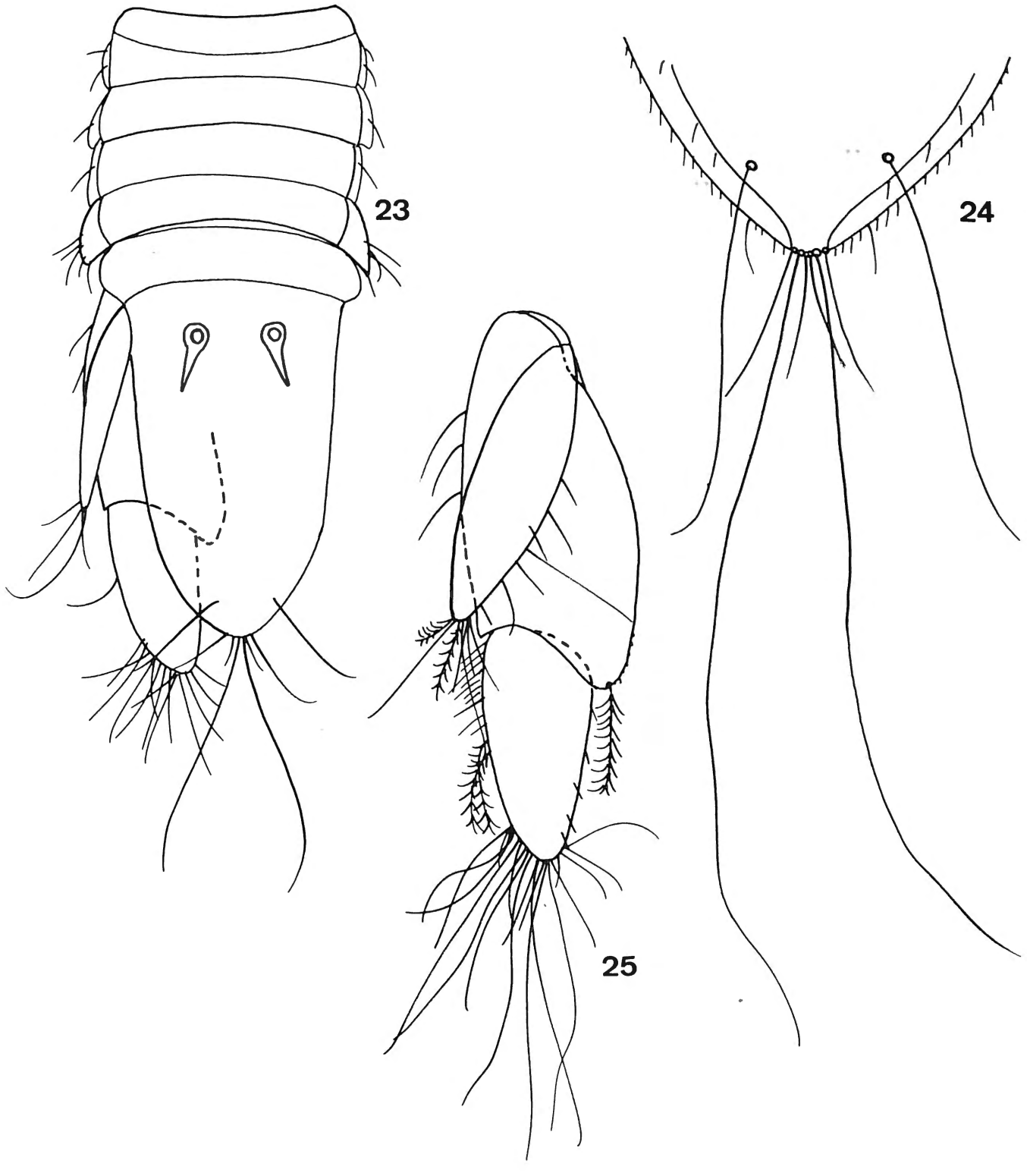
Mandibular palp with articles 2 and 3 subequal in length and two times as long as art. 1; no less than 19-20 pectinate setae are inserted on the last article.

A remarkable characteristic of the maxilliped of the new species is the presence, between coxa and the 1st of the "three free articles" (basis) of a pair of small articles: one oval and somewhat larger placed medially, and one round and minute with central position between the first one and the epipodite; the morphological significance of these two articles is unknown to me. There is nothing looking like an "endite" or like a "small setose protuberance" on the 1st of the "3 free articles" (basipodite) of the maxilliped, as described or illustrated for *C. (S.) curassavica* STORK, 1940 (BOWMAN, 1965: fig. 82), *C. (S.) papuae* WÄGELE, 1987 (WÄGELE, 1987: fig. 6), *C. (C.) numeae* WÄGELE, 1982 (WÄGELE, 1982: fig. 1), or *C. (C.) rapanuia* BOTOSANEANU, 1987 (BOTOSANEANU, 1987: fig. 6). For chaetotaxy, see fig. 28 (5 setae are inserted along the distal half of the penultimate article internal margin).

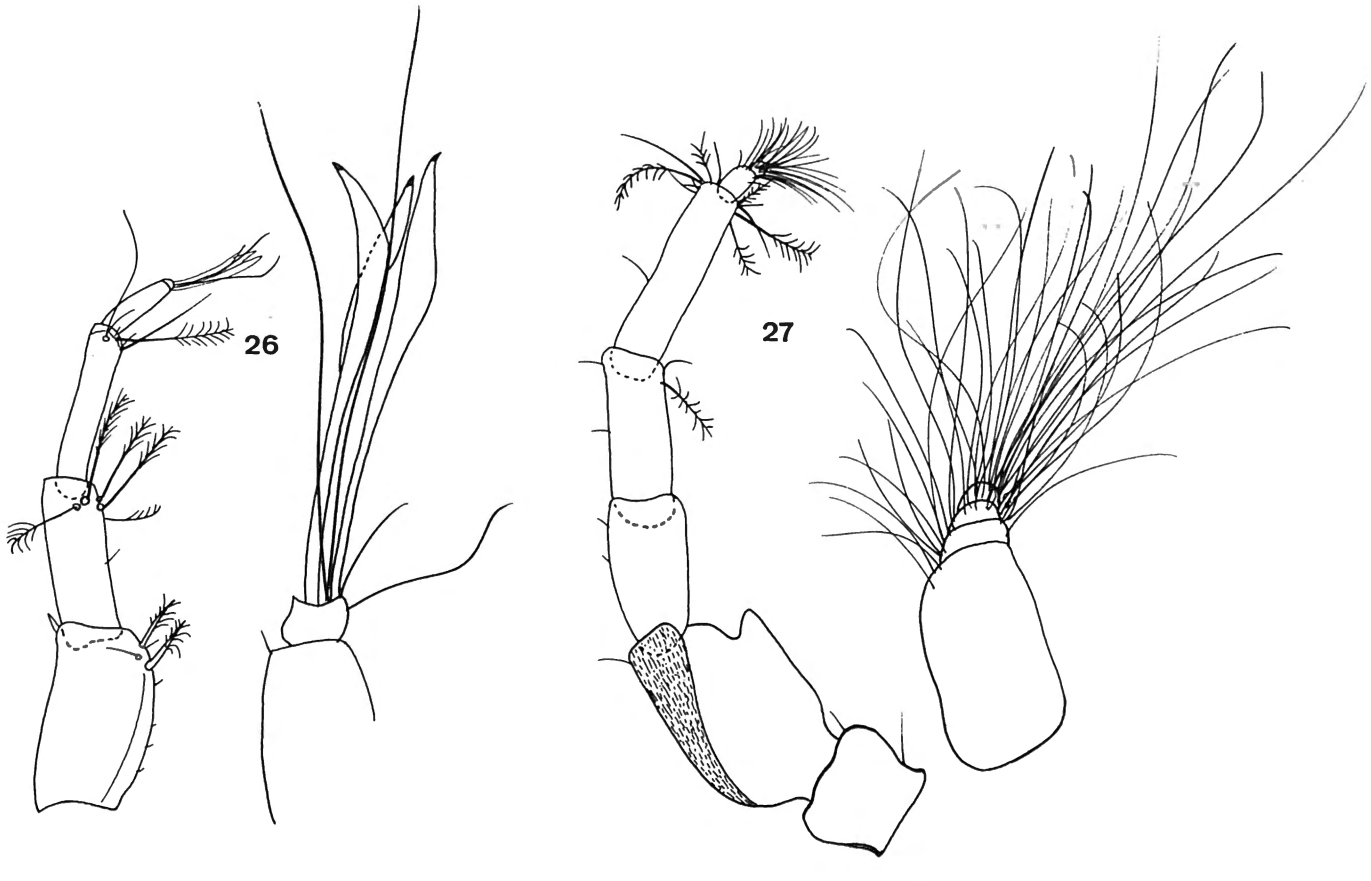
Gnathopod with palm of propodus only very slightly convex and sinuous, without any prong or "tooth", and armed with some 19-20 short spines which are only exceedingly shortly pectinate. Anteapically on the median face a remarkably high number of flexible pectinate setae.

Pleopods of the 1st pair with endopodite reduced to an ovoidal tubercle, and protopodite devoid of retinacula. Remaining pleopods all similar, with glabrous endopodites practically as long as the setose exopodites which are completely bipartite (they can be easily folded along the bipartition lines).

Uropod structure typical for *Stygocyathura*. Exopodite relatively broad (of the type described in BOTOSANEANU & STOCK (1982: 19) as "more or less broadly foliaceous."



Figs 23-25. *Cyathura (Stygocyathura) munae* n.sp., ♀ paratype. 23: pleon, pleotelson, and uropod; 24: apex of pleotelson (setae more correctly represented than in fig. 23); 25: right uropod, dorsal.



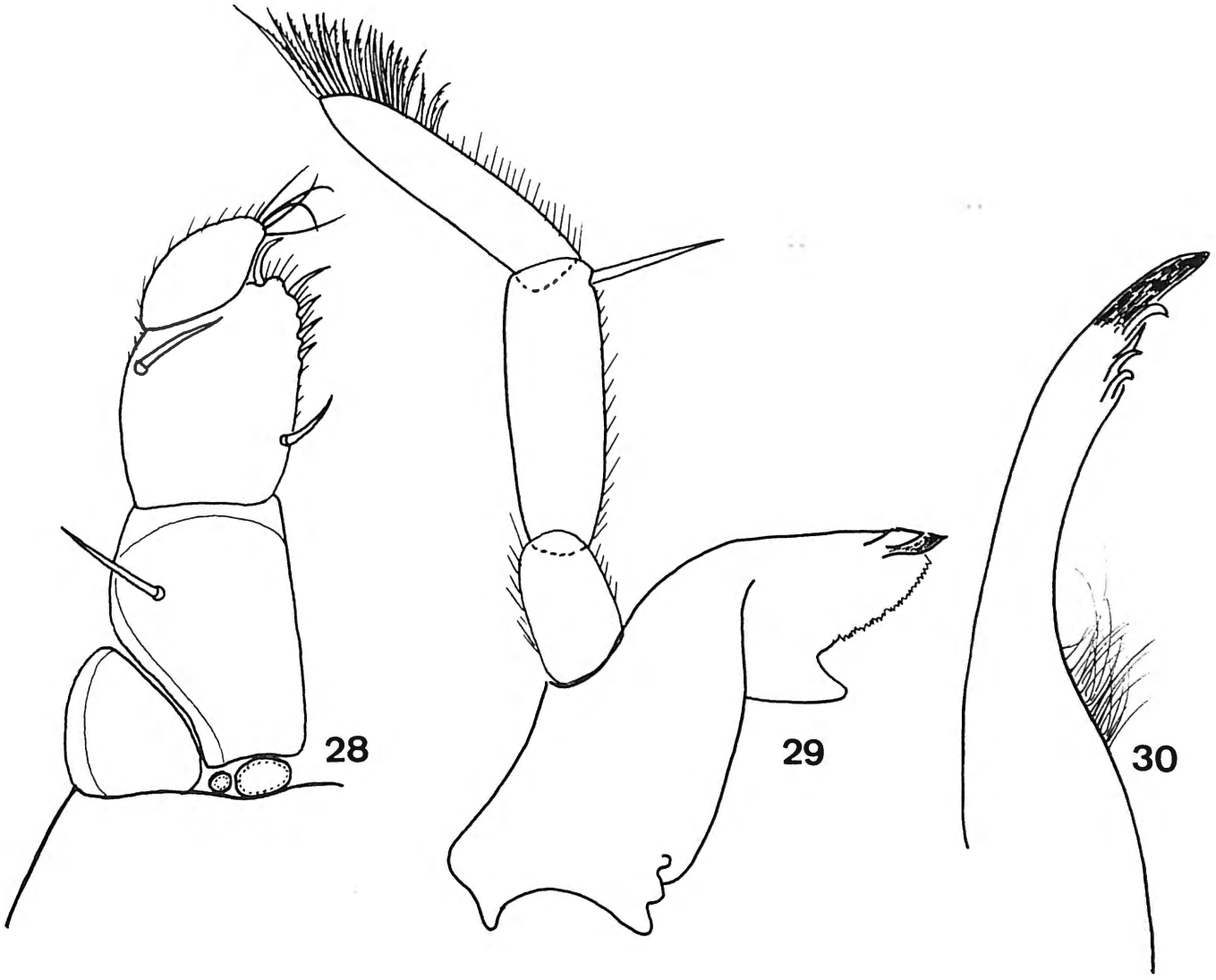
Figs 26-27. *C. (S.) munae* n.sp. 26: right AI, dorsal, with strongly magnified distal parts of flagellum; 27: right AII, dorsal, with strongly magnified flagellum. Figs 26 and 27, and, respectively, their details: same scale.

Discussion

From the Indo-Pacific area several *Cyathura (Stygocyathura)* have been described from different habitats of the Stygal: *C.(S.)miloti* CHAPPUIS, DELAMARE & PAULIAN, 1956, from Réunion Island; *C.(S.) wadincola* BOTOSANEANU & STOCK, 1997, from Oman; *C.(S.) filipinica* BOTOSANEANU & SKET, 1999, from Bohol Island, the Philippines; *C.(S.) chapmani* ANDREEV, 1982, from Sarawak, N. Borneo; *C.(S.) beroni* ANDREEV, 1982, from Papua – New Guinea (subsequently rediscovered from New Britain Island: BOTOSANEANU & HENRY, 1986); *C. (S.) papuae* WÄGELE, COLEMAN & HOSSE, 1987, from Papua–New Guinea; and *C. (S.) fijiensis* WÄGELE, COLEMAN & HOSSE, 1987, from Fiji. To make this list more complete, should be added that two completely depigmented and anophtalmic marine-interstitial species belong – in my opinion – to *Cyathura* (sg. *Cyathura*), as shown especially by the significant uropod morphology; these are *C. (C.) numeae* WÄGELE, 1982, from New Caledonia; and *C. (C.) rapanuia* BOTOSANEANU, 1987, from Easter Island and Pitcairn Island.

Comparing *C. (S.) munae* n.sp. with all those already described from the Indo-Pacific area is quite difficult a task, because: 1) several were incompletely described from insufficient or poorly preserved material; 2) the style of the various published descriptions is far from being uniform, and there is lack of uniformity, too, in the morphological terminology used. It seems thus more reasonable to summarize the characters of the new species whose combination allows – even in the absence of the ♂ – clear distinction from each of the above mentioned species. These are as follows. Large size. Distinctly linguiform pleotelson ending simply blunt, with pair of long setae inserted anteapically on its surface. AI and AII with relatively slender articles of peduncle; AI flagellum with 2 articles, 1st one very slender. Mandibular palp with high number of pectinate setae on last article. Mxp remarkable especially by presence of 2 "microarticles" between coxa and 1st of the 3 "free articles" – this being possibly an unique character in the genus/subgenus; no "endite" or "setose protuberance" from the coxa; 5 setae inserted along distal half of median margin of penultimate article. Gnathopod: propodial palm almost straight, without prong/tooth, marginal spines short and only minutely pectinate, large number of flexible pectinate setae anteapically on median face. Pl I exopodite reduced to tubercle. Pl II-V with endo- and exopodites of same size, and completely bipartite exopodites. Ur with "broadly foliaceous" exopodite.

One final point has to be tackled here. It has been generally accepted that *Stygocyathura* BOTOSANEANU & STOCK, 1982, does not deserve more than the status of a subgenus of *Cyathura* NORMAN & STEBBING, 1886, including most of the troglomorphic (depigmented and anophtalmic) species in



Figs 28-30. *C. (S.) munae* n.sp. 28: right Mxp., ventral; 29: right Mdb, ventral; 30: distal parts of MxI.

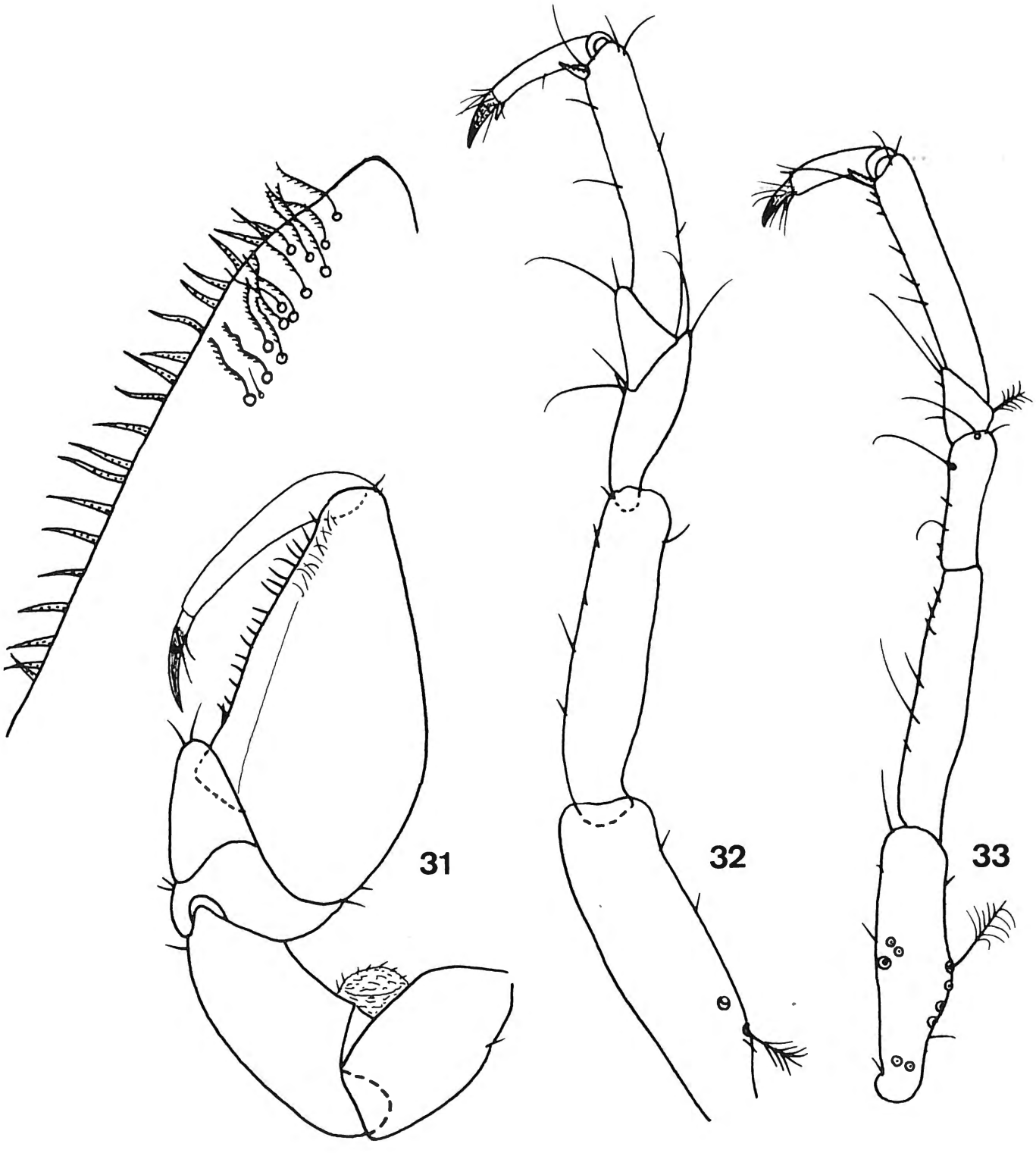
this genus. In fact, only uropodal morphology allows in all cases distinction between the two taxa, whereas additional characters (BOTOSANEANU & STOCK, 1982: 38-39), although useful, do not always allow firm distinction. We have here one of the few happy cases in which the origin of species of a stygobiontic taxon from those of a marine (epigean) one can be postulated with some degree of certainty.

In a recent revision of Isopoda Anthuridae POORE (2001: 111, etc), based on the results of a cladistic analysis with computerized programmes, gives *Stygocyathura* the status of genus, concluding that it is not a sister taxon of *Cyathura* which is found more nearly related to two small marine genera: *Pendanthura* MENZIES & GLYNN, 1968, and *Sauranthura* POORE & KENSLEY, 1981, both characterized (op. cit.: 104, 115-116, 117-118) by some conspicuously distinct morphological features. To comment about this, I shall quote, in English translation, a paragraph from a recent publication (SCHMALFUSS, *in* BECHLY *et al.*, 2001) exactly wording my own opinion: "Computerized programmes considering as many characters as possible, of different strength, as having identical value, are, for theoretical- cognitive reasons, unable to lead to discovery of relationships, because of their uniquely statistical significance. Relationships cannot be statistically discovered, they have to be reconstructed, namely through careful examination of all characters considered."

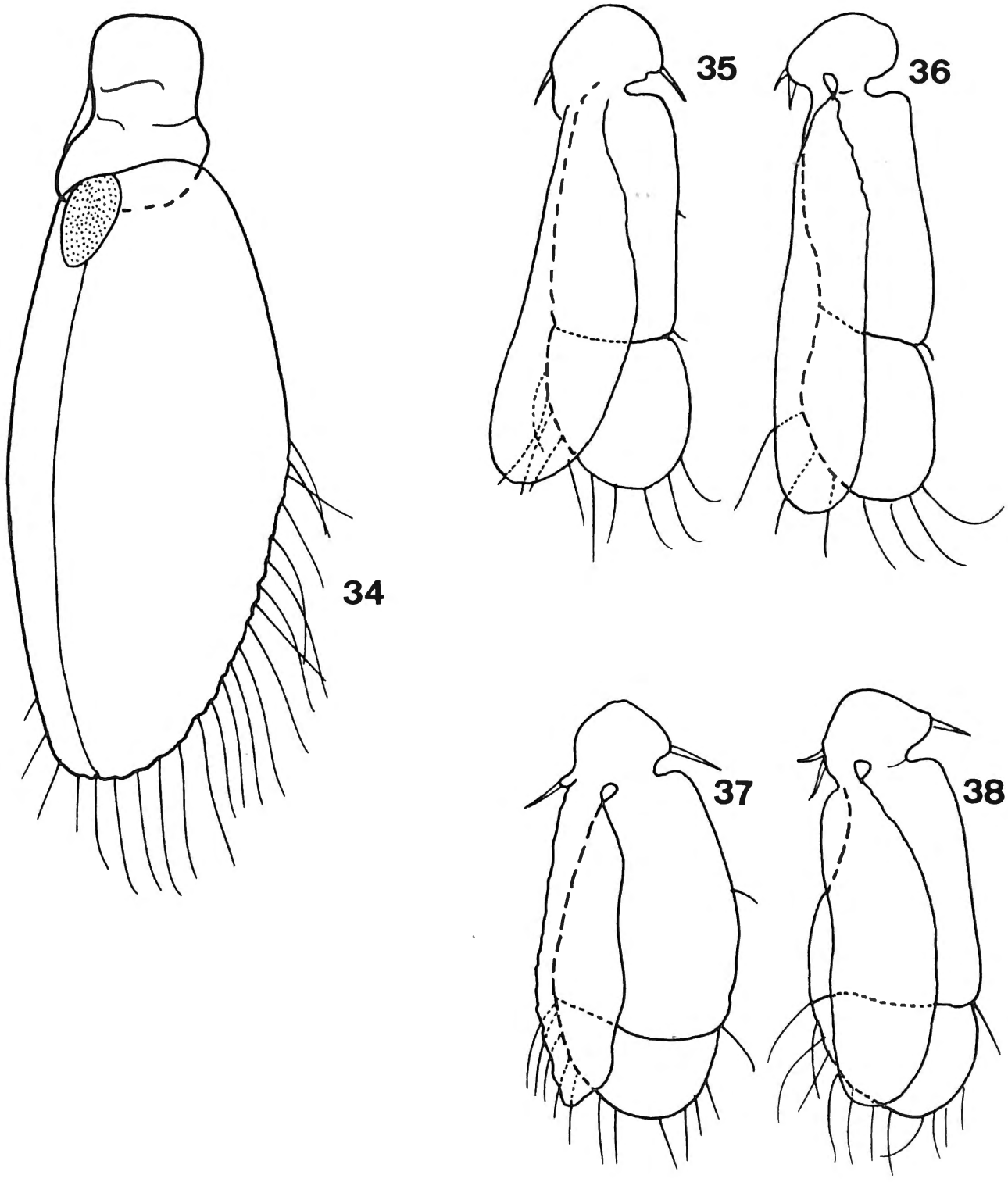
Acknowledgements

This material has been collected during the project RE-IDN-008 "The effect of human impact on cave and karst biodiversity. An Indonesian example" supported by ARCBC (ASEAN Regional Center for Biodiversity Conservation) and LIPI (Indonesian Institute of Sciences), thanks to a grant of the European Union.

The author expresses this thanks to Dr. L. DEHARVENG and to Mrs Anne BEDOS for having enthrusted him the specimens for study, and to Mrs Liesbeth VERMEULEN for having typed the MS.



Figs 31-33. *C. (S.) munae* n.sp. 31: right gnathopod, median face, with more strongly magnified propodial palm; 32-33: right PII and PVI (both same scale; without attention for details like exact number of plumose setae on coxa, structure of disto- internal spine of propodus, or dactylian organ).



Figs 34-38. *C. (S.) munae* n.sp., left pleopod I, and right Pl. II-V. All dorsal, all same scale; all setae are plumose.

References

ANDREEV, S., 1982 a. Une *Cyathura* nouvelle de Sarawak-Kalimantan du Nord (Isopoda, Anthuridae). *Bulletin Zoologisch Museum Universiteit van Amsterdam*, 8(18): 149-155.

ANDREEV, S., 1982 b. Sur une nouvelle espèce cavernicole du genre *Cyathura* (Isopoda, Anthuridae). *International Journal of Speleology*, 12: 55-62.

BOTOSANEANU, L., 1987. A new thalassostygobiont species of *Cyathura* (Isopoda: Anthuridea) from the South-East Pacific. *Stygologia*, 3(4): 296-304.

BOTOSANEANU, L. & HENRY, J.P., 1986. Une *Cyathura* stygobie (Isopoda: Anthuridae) de l'île New Britain, en Papouasie – Nouvelle Guinée. *Bulletin Zoologisch Museum Universiteit van Amsterdam*, 10(23): 197-199.

BOTOSANEANU, L. & ILIFFE, T.M., 1997. Four new stygobitic cirolanids (Crustacea: Isopoda) from the Caribbean – with remarks on intergeneric limits in some Cirolanidae. *Bulletin de l'Institut Royal des Sciences Naturelles de Belgique, Biologie*, 67: 77-94.

BOTOSANEANU, L. & ILIFFE, T.M., 2000. Two new stygobitic species of Cirolanidae (Isopoda) from deep cenotes in Yucatan. *Bulletin de l'Institut Royal des Sciences Naturelles de Belgique, Biologie*, 70: 149-161.

BOTOSANEANU, L. & SKET, B., 1999. A new freshwater stygobiotic species of *Cyathura* (Isopoda: Anthuridae) from Bohol Island, the Philippines. *Acta Biologica Slovenica*, 42(2): 27-33.

BOTOSANEANU, L. & STOCK, J.H., 1982. Les *Cyathura* stygobies (Isopoda, Anthuridae) et surtout celles des Grandes et des Petites Antilles. *Bijdragen tot de Dierkunde*, 52(1): 13-42.

BOTOSANEANU, L. & STOCK, J.H., 1997. Stygofauna of Oman, 1. A new freshwater stygobiont *Cyathura* (Isopoda, Anthuridae), from interstitia of coarse wadi sediments in Oman. *Annales de Limnologie*, 33(2): 79-84.

BOWMAN, T.E., 1965. *Cyathura specus*, a new cave isopod from Cuba (Anthuroidea: Anthuridae). *Studies Fauna of Curaçao*, 22(85): 87-97.

BOWMAN, T.E. & ILIFFE, T.M., 1987. *Anopsilana lingua*, a new freshwater troglobitic isopod from the Palau Islands (Flabellifera: Cirolanidae). *Proceedings of the Biological Society of Washington*, 100(2): 347-352.

BRUCE, N.L., 1981. Cirolanidae (Crustacea: Isopoda) of Australia: Diagnoses of *Cirolana* LEACH, *Metacirolana* NIERSTRASZ, *Neocirolana* HALE, *Anopsilana* PAULIAN & DELAMARE – DEBOUTTEVILLE, and three new genera – *Natatolana*, *Politolana* and *Cartetolana*. *Australian Journal of Estuarine and Freshwater Research*, 32: 945-966.

BRUCE, N.L. & ILIFFE, T.M., 1992. *Anopsilana conditoria*, a new species of anchialine troglobitic cirolanid isopod (Crustacea) from the Philippines. *Stygologia*, 7(4): 225-230.

BRUSCA, R.C., WETZER, R. & FRANCE, S.E., 1995. Cirolanidae (Crustacea: Isopoda: Flabellifera) of the tropical Eastern Pacific. *Proceedings of the San Diego Society of Natural History*, 30: 1-96.

CHAPPUIS, P.-A., DELAMARE-DEBOUTTEVILLE, C. & PAULIAN, R., 1956. Crustacés des eaux souterraines littorales d'une résurgence d'eau douce à la Réunion. *Mémoires de l'Institut Scientifique de Madagascar*, (A) 11: 51-78.

PAULIAN, R. & DELAMARE-DEBOUTTEVILLE, C., 1956. Un cirolanide cavernicole à Madagascar (Isopode). *Mémoires de l'Institut Scientifique de Madagascar*, (A) 11: 85-88.

POORE, G.C.B., 2001. Families and genera of Isopoda Anthuridea. Pp. 63-173. in: KENSLEY, B. & BRUSCA, R.C. (eds), Isopod systematics and Evolution. *Crustacean Issues*, 13. A.A. Balkema, Rotterdam, Brookfield.

SCHMALFUSS, H., 2001. Willi Hennig: Moderne stammesgeschichtliche Forschung. In: BECHLY, G. *et al.*, Ur-Geziefer, Die faszinierende Evolution der Insekten. *Stuttgarter Beiträge zur Naturkunde*, (C) 49: 82-86.

WÄGELE, J.W., 1982. A new hypogean *Cyathura* from New Caledonia (Crustacea, Isopoda, Anthuridea). *Bulletin Zoölogisch Museum Universiteit van Amsterdam*, 8(23): 189-197.

WÄGELE, J.W., COLEMAN, O. & HOSSE, U., 1987. Two new hypogean species of *Cyathura* from Melanesia (Crustacea, Isopoda, Anthuridea): further Tethyan relicts ? *Stygologia*, 3(1): 89-106.

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