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A new species of *Cletocamptus* Schmankewitsch 1875 (Copepoda; Harpacticoida) from a mangrove forest in Malaysia

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Abstract

Cletocamptus merbokensis sp. nov. is described from material collected out of muddy sediments in the Merbok mangrove forest, northwest peninsula Malaysia. It is distinguished from all other known species of *Cletocamptus* by the presence of only two setae on P2 and P3 endopod-2 and no inner seta on P4 exopod-2; and by the form of the male P5 in which the baseoendopod and most of the endopodal and exopodal lobes are absorbed into the somatic cuticle. The higher taxonomic position of the genus is briefly discussed.

Introduction

Cletocamptus Schmankewitsch, 1875 is an enigmatic genus, in that its higher taxonomic position is unclear, and some of its species appear to exhibit an unusual amount of morphological variation. Lang (1936) in his revision of the Cletodidae pointed out that although Monard (1927) included the genus *Cletocamptus* in the Cletodidae, he listed the genera *Wolterstorffia* Schmeil, *Marshia* Herrick and *Godetella* Delachaux as Canthocamptidae. Lang (1936) concurred with a view expressed by Chappuis (1933) that these genera were synonyms of *Cletocamptus* and also added the genus *Regis* Labbé to the list of synonyms. *Cletocamptus* remained in the Cletodidae until the revision of this family by Por (1986) who removed it from the Cletodidae and placed it *incertae sedis* in the Canthocamptidae. In his monograph, Lang (1948) lists eight species in the genus and three species as *incertae sedis*. Fleeger (1980), in a partial revision of *Cletocamptus*, lists a further six species (including two species assigned to *Sinocamptus* Shen & Sung, 1963) but proposes that *C. gabrieli* Löffler, 1961 is a synonym of *C. deitersi* (Richard, 1897). More recently, *C. xenuus* Por, 1968 has been transferred to the genus *Dahlakia* Por by Por (1986).

Cletocamptus, as presently constituted, is a cosmopolitan genus, its species being found primarily in fresh and brackish water habitats. Por (1984) has reported one species, *C. deitersi*, as common in the metahaline mangroves of Bonaire and at least some species (e.g. *C. confluens* (Schmeil, 1894)) are tolerant of low oxygen and high sulphide conditions (Vopel et al., 1998). The new species described in this paper was relatively common in the high detritus sediments of an estuarine mangrove forest in Malaysia.

Materials and methods

Habitat

The sample sites, in which the new species was found, are described in detail in Gee & Somerfield (1997). Briefly, the material was obtained from the Merbok mangrove forest, surrounding the Sungai Merbok estuary in Kedah Province, north-west Peninsular Malaysia (5° 40′ N, 100° 60′ E). The average salinity was around 20–25‰. Samples of sediment which were over 80% silt/clay (taken by scraping the surface few mm) and decaying leaves (picked individually) were taken primarily under *Rhizophora apiculata* Bl. trees between high water neap and high water spring tides.

Systematic procedures

Animals were fixed in 10% and preserved in 4%,

formalin. Before dissection, the habitus was drawn and body length measurements made from whole specimens temporarily mounted in lactophenol. Specimens were dissected in lactophenol, the parts individually mounted in lactophenol under coverslips subsequently sealed with Bioseal. All drawings were prepared using a camera lucida on a Nikon Optiphot 20 differential interference contrast microscope. The terminology of the body and appendage morphology follows that of Huys & Boxshall (1991). Abbreviations used in the text and figures are P1–P6 for thoracopods 1–6; exp(enp)-1(-2–3) to denote the proximal (middle, distal) segment of a ramus; a for aesthetasc. Body length was measured from the base of the rostrum to the median posterior border of the anal somite. All type material has been deposited in the Natural History Museum, London.

Systematics

Family CANTHOCAMPTIDAE

Genus *Cletocamptus* Schmankewitsch, 1875, *incertae sedis, sensu* Por (1986) *Cletocamptus merbokensis* n.sp. (Figures 1–6)

Holotype: A female dissected onto three slides NHM Reg. No.1999.680.

Paratypes: Twenty females (two dissected, each onto three slides), 12 males (two dissected, each onto three slides) and 24 copepodites NHM Reg No. 1999.681–736. Collected in 1995 by J. M. Gee

Locality: All specimens from intertidal mudflats in the Merbok mangrove forest, Kedah, NW Malaysia.

Description of female

Body (Figure 1) length 0.417–0.633 mm (mean 0.548 mm, *n*=18) semi-cylindrical, tapering posteriorly, without clear distinction between prosome and urosome; body surface covered in minute papillae and/or hairs but with some rows of larger papillae as shown in Figure 1. Cephalothorax almost square, rounded anteriorly, with few sensilla and posterior dorsal sub-cuticular rib. Posterior border of all somites, except anal and pre-anal somites, with dentate posterior margin and a number of sensillum-bearing socles (16 on cephalothorax, 12 on free prosomites, 10 on urosomite-1, six on genital double somite and urosomite-4). Genital double-somite with dorsal and lateral sub-cuticular rib marking line of fusion. Dorsal surface of anal somite (Figure 2B) with a sensillum-bearing socle either side of minutely crenulate operculum.

Rostrum (Figure 5A): defined at base, tapering anteriorly and recurved ventrally, with a pair of lateral sensilla; anterior margin bifid and setulose.

Caudal rami (Figure 2B–C): cylindrical, about twice as long as broad, inwardly directed; accessory seta I absent; setae II and III well-developed, latter pinnate, both inserted at 25% of ramus length; seta IV naked; well-developed seta V (Figure 1C) smooth, longer than urosome; seta VI small, naked; triarticulate seta VII pinnate, arising centrally on dorsal surface.

Antennule (Figure 2A): short, robust, 6-segmented, surface covered with minute papillae (not shown in Figure 2A). Proximal three segments about equal in length, each with row of spinules on anterior margin and segments 2 and 3 with additional group of setules on posterior margin. Segments 4 and 5 small, former bearing large aesthetasc; segment 6 with distal trithek of aesthetasc and two setae. All setae on anterior margin short, stout and minutely pinnate; setal formula as follows 1-[1], 2-[7], 3-[6], 4-[2+a], 5-[1], 6-[9+a].

Antenna (Figure 3A): Coxa well-developed, with row of setules. Allobasis with two groups of setules and one pinnate seta on distal half of abexopodal margin. Exopod 1-segmented with three setae (a small naked seta on lateral margin and, on distal margin, one well-developed, pinnate seta and a minute naked seta). Free endopod segment with two rows of strong spinules on anterior margin and a row of long setules on posterior margin; subdistal armature of two spines and one seta; distal margin with dentate hyaline frill and armed with two pinnate spines, one naked spine and two geniculate setae.

Labrum (Figure 3B): A single plate; posterior margin with two lateral rows of spinules and a median row of setules.

Mandible (Figure 3C): Coxa with a proximal row of spinules; gnathobase armed with five short, pointed, bicuspid teeth and two setae. Palp 1-segmented with two rows of setules and five pinnate setae (one exopodal, two endopodal and two basal in origin).

Maxillule (Figure 3D–E): Praecoxal arthrite with two rows of spinules, one anterior surface tube seta, seven unicuspid and bicuspid teeth on distal margin and one lateral pinnate seta. Coxal endite partially fused to basis and bearing one naked seta; rami incorporated into basis which bears five lateral setae and one terminal seta plus one spine apically.

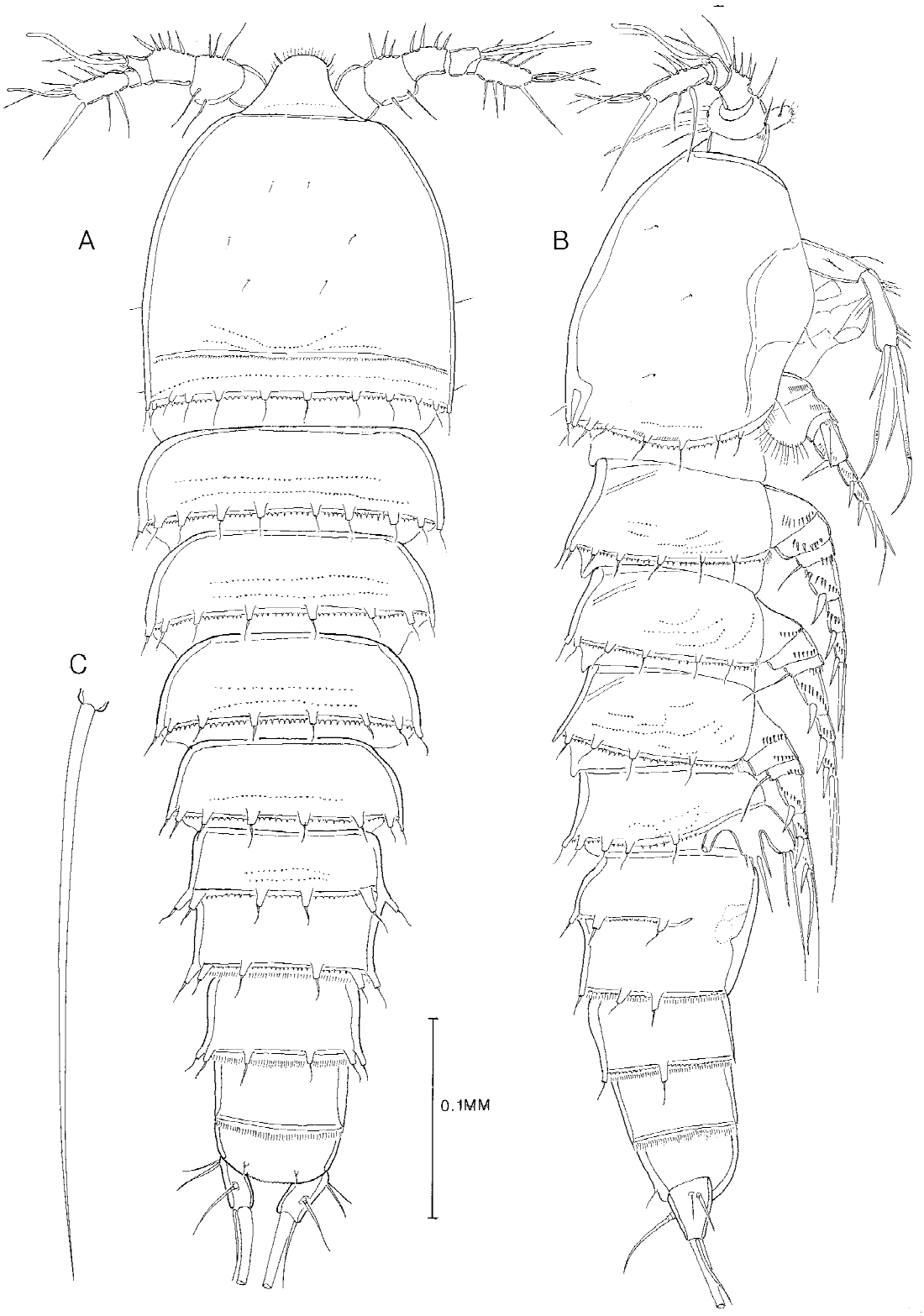

Figure 1. Cletocamptus merbokensis n. sp. Female holotype habitus (A) dorsal view; (B) ventral view; (C) caudal seta V.

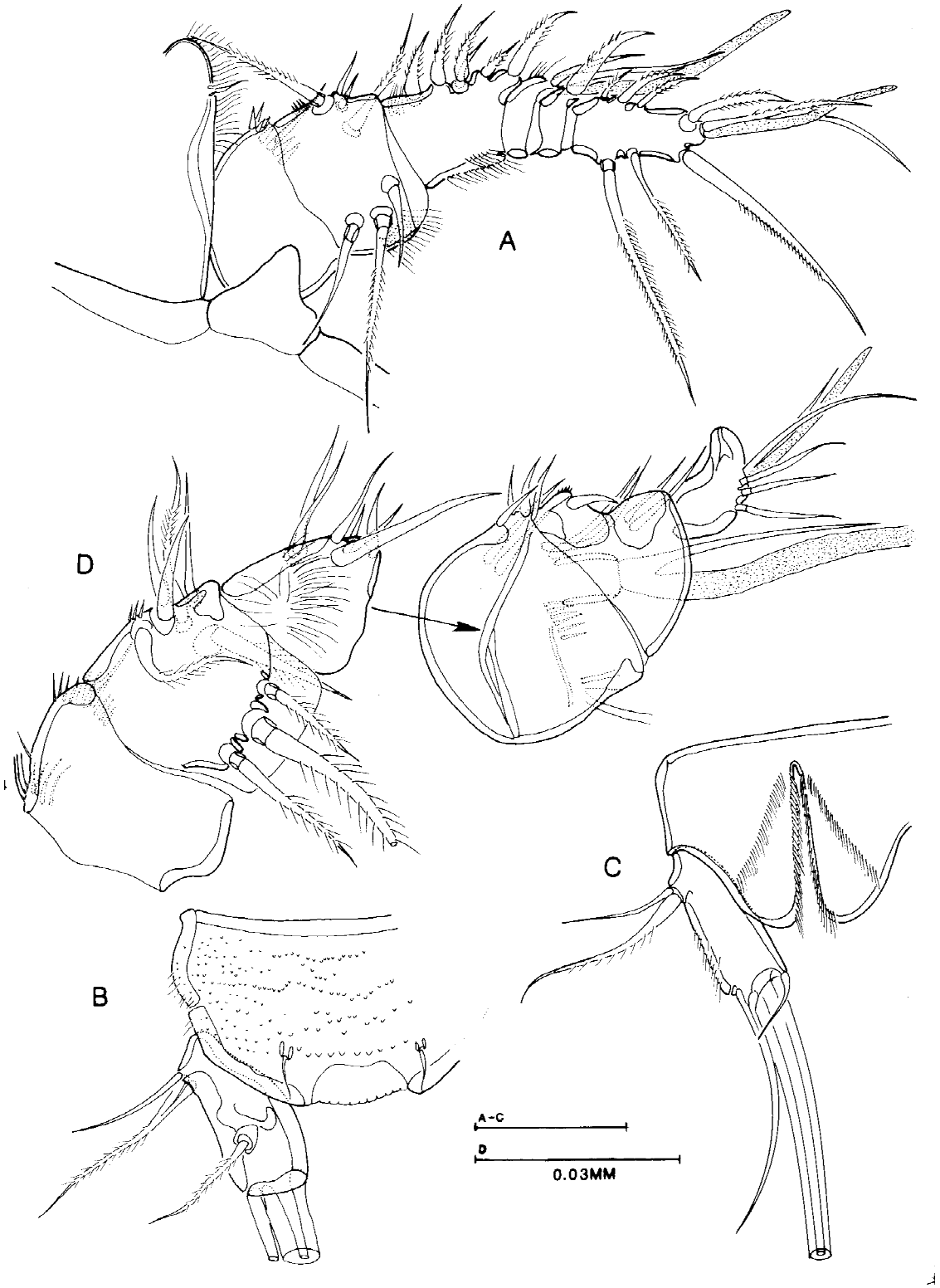

Figure 2. Cletocamptus merbokensis n. sp. Female holotype (A) antennule dorsal view; anal somite and caudal ramus (B) dorsal view; (C) ventral view. Male paratype (D) antennule dorsal view.

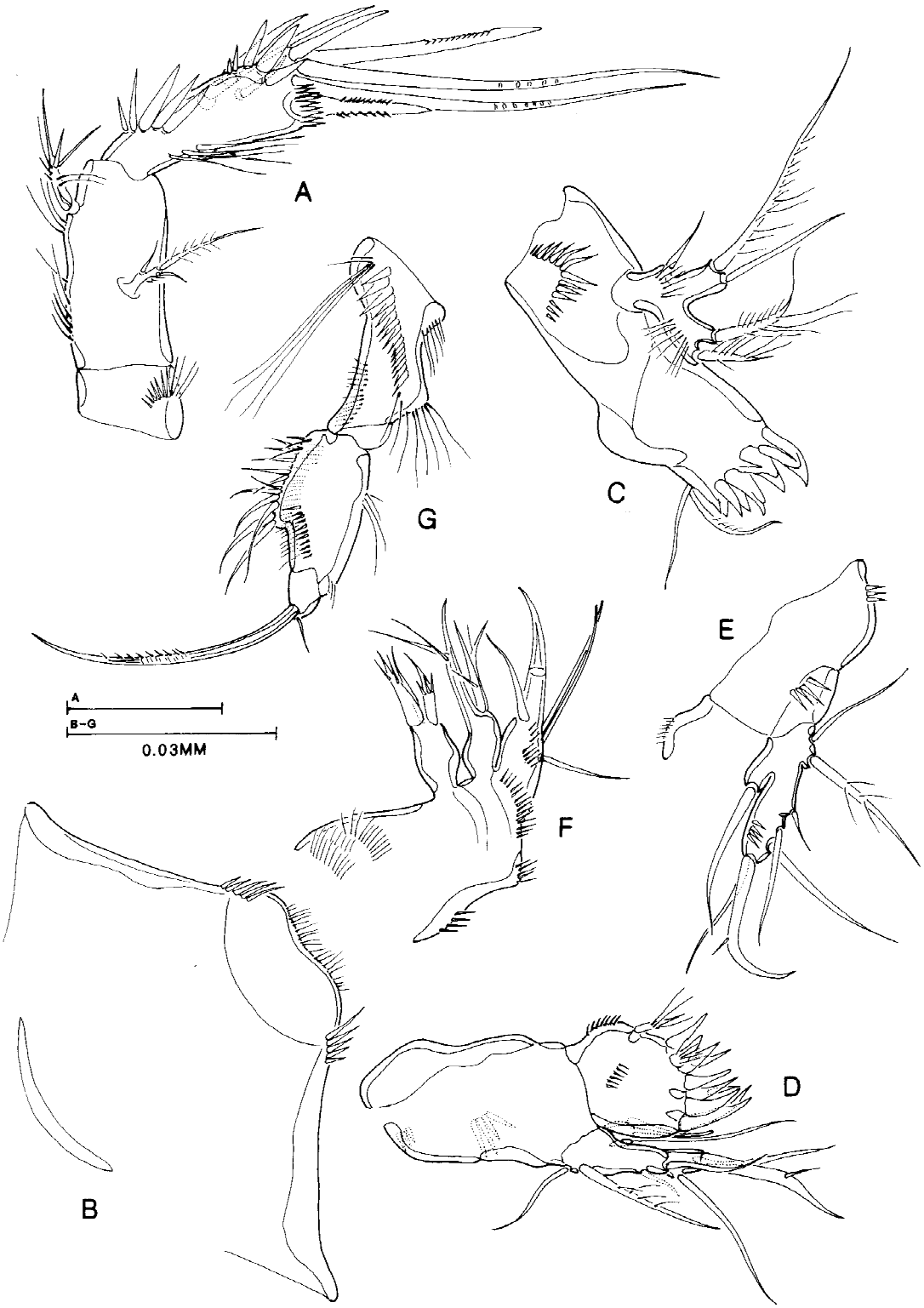

Figure 3. Cletocamptus merbokensis n. sp. Female holotype (A) antennule, dorsal view; (B) labrum, ventral view; (C) mandible ventral view; (D) maxillule anterior view, (E) maxillule coxal and basal endite posterior view; (F) maxilla anterior view; (G) maxilliped, anterior view.

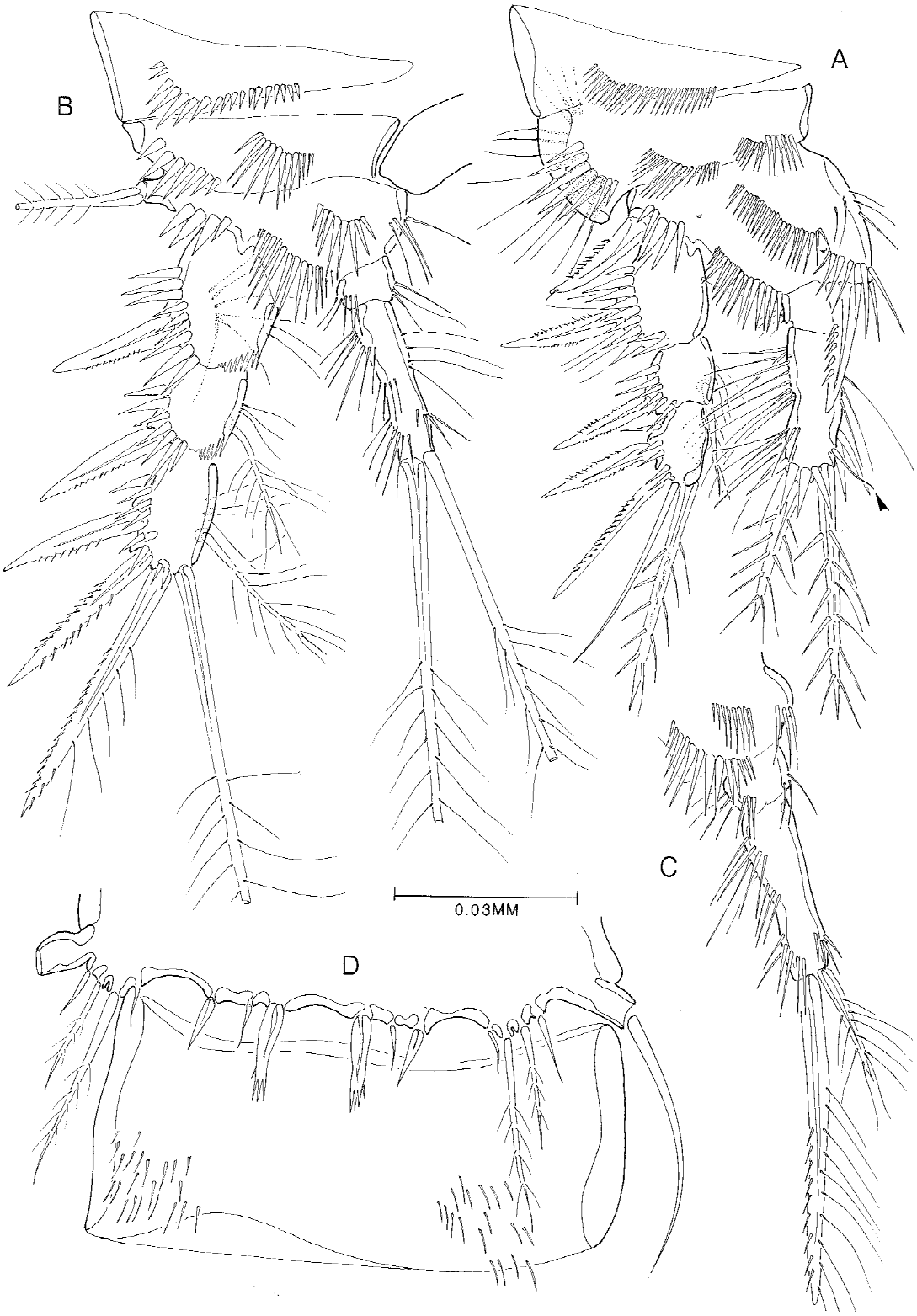

Figure 4. Cletocamptus merbokensis n. sp. Female holotype anterior view of (A) P1, (B) P2. Male paratype (C) P2 endopod, anterior view, (D) P5 and P6, ventral view.

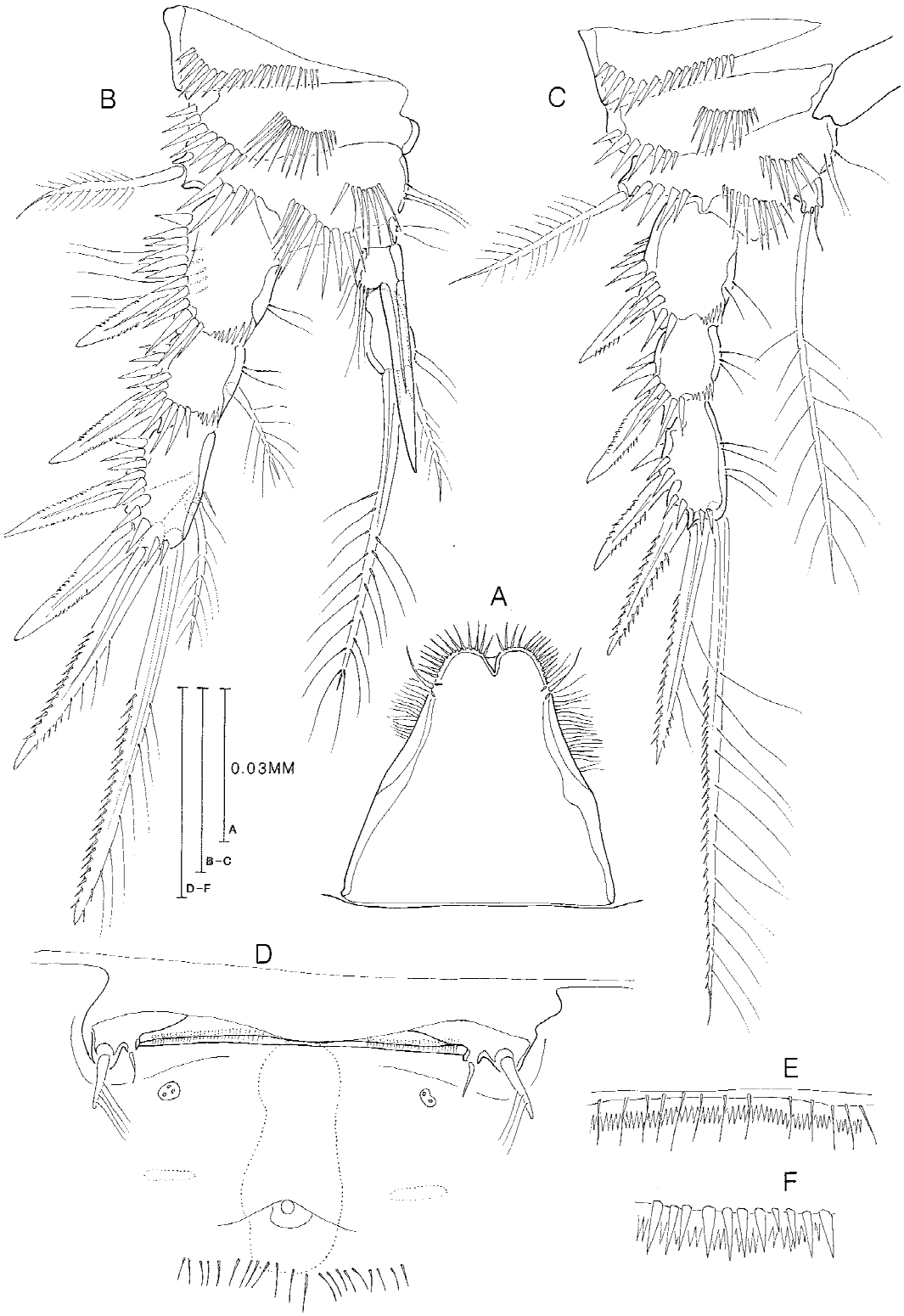

Figure 5. Cletocamptus merbokensis n. sp. (A) female rostrum, dorsal view; (B) male P3, anterior view; (C) female P4, anterior view; (D) female genital field, ventral view. Ventral posterior border of urosomites-3 and -4 in (E) female, (F) male.

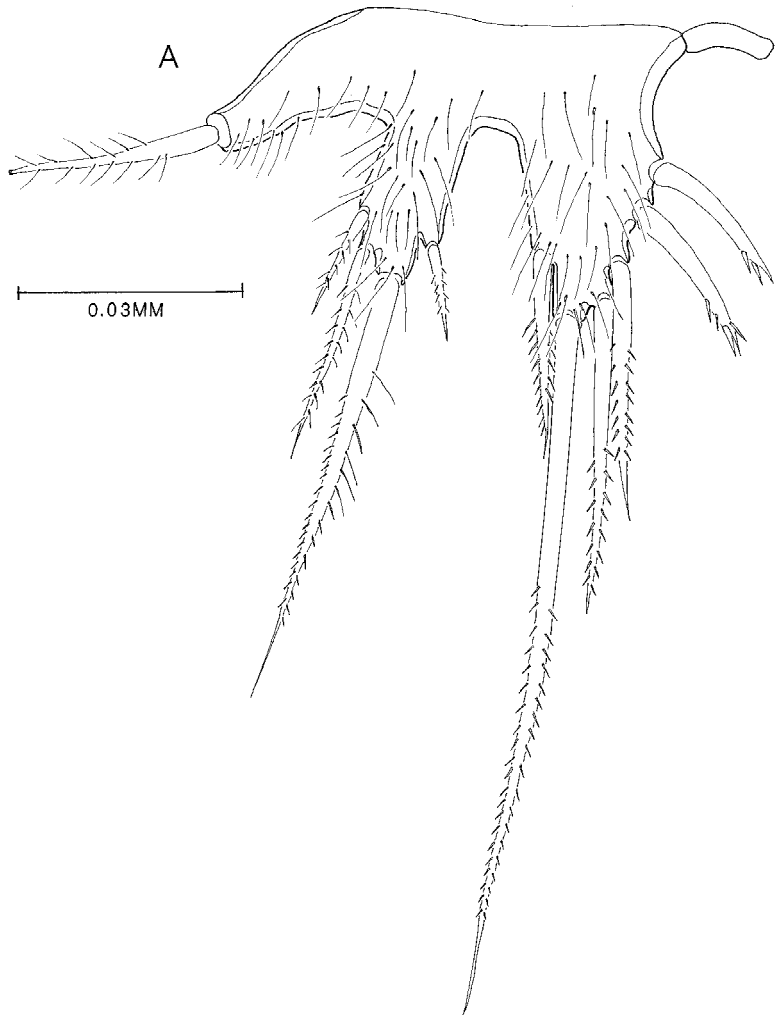

Figure 6. Cletocamptus merbokensis n. sp. (A) female holotype P5, anterior view.

Maxilla (Figure 3F): Syncoxa with five rows of spinules and two endites, each with two pinnate and one naked setae. Allobasal endite with two rows of spinules, a fused terminal spine and two setae; endopod represented by two setae not fused at base.

Maxilliped (Figure 3G): Syncoxa without setae but with proximal group of very long setules, three marginal groups of short setules and a surface row of spinules. Basis, short, oval; palmar margin with a distinct step and a proximal row of large setules, anterior and posterior surfaces each with row of spinules and outer margin with two rows of setules. Endopod represented by a pinnate claw with one accessory seta.

P1 (Figure 4A): Praecoxa well developed, triangular, with row of spinules on distal margin. Coxa with row of setules on posterior and row of spinules on anterior outer margin, and two rows of spinules on distal margin. Basis with row of setules on inner margin, row of spinules at base of inner and outer dentate spines, medially on anterior face and on distal margin. Exopod 3-segmented, each segment with row of setules on inner margin and spinules on outer margin; exp-2 with inner pinnate seta; exp-3 with short pinnate seta and a naked seta on distal margin and two spines on outer margin. Endopod 2-segmented, only reaching to end of exopod, enp-2 three times longer than enp-1, both segments with row of setules on inner and outer margin, enp-2 with row of spinules on distal margin; enp-1 without inner seta, enp-2 armed with minute naked seta and two short pinnate setae.

P2–P4 (Figures 4B, 5C): Protopods ornamented as in P1 except that coxa has no row of setules on

outer margin and only one row of setuled medially on anterior face; basis has only an outer pinnate seta. Exopods 3-segmented, exp-1 without inner seta. Endopods 2-segmented in P2 and P3, enp-2 with two well developed setae; ramus of one very small segment in P4 bearing one well developed pinnate seta and a minute naked seta. Setal formula as follows:

	Exopod	Endopod
P1	0.1.022	0.120
P2	0.1.122	0.020
P3	0.1.122	0.020
P4	0.0.022	020

P5 (Figure 6A): Limbs of each side not fused medially but connected by small sclerite. Limbs with covering of fine setules but no tube pores. Outer basal seta borne on peduncle fused to baseoendopod. Endopodal lobe well developed with six setae, three on inner margin, two on distal margin (of which outer twice as long as inner), and one on outer margin. Exopod fused to baseoendopod, rectangular, reaching almost to end of endopodal lobe, well separated from endopodal lobe, the whole having a distinct U-shape; with four setae.

Genital field (Figure 5D): Vestigial P6s bearing a small pinnate spine and a naked seta. Gonopores opening into common genital slit, setulose on anterior margin; copulatory pore small opening in region of fusion of genital double-somite, two multi-opening pores (tube pores?) just posterior to genital slit.

Description of male

As in female except in urosome, antennule, P2 and P3 endopods, P5, and P6.

Body length 0.361–0.595mm (mean 0.487 mm, n = 10), slightly smaller than female and with urosomites-2–3 not fused.

Antennule (Figure 2D): Short, stout, chirocer, 6-segmented with segments 4 and 5 markedly swollen, major articulation between segments 5 and 6. Segment 1 with two rows of spinules; segment 3 triangular with patch of fine setules, segment 4 with row of setules and a groove on anterior face and bearing aesthetasc fused at base to one seta. Setal formula as follows: 1-[1], 2-[9], 3-[7], 4-[8 + (1 + a)], 5-[2 + 2 spines], 6-[3 + (2 + a)].

P2 (Figure 4C): Endopod as in female except that armature elements on enp-2 much shorter and stouter than in female.

P3 (Figure 5B): Exopod as in female. Endopod 3-segmented, enp-2 with apophysis on anterior distal margin extending well beyond distal margin of enp-3; two terminal setae on enp-3 unequal in length and much shorter than in female.

P5 (Figure 4D): Almost completely absorbed into somite; vestigial endopodal lobe with three armature elements (an inner serrate spine, a naked seta and an outer naked spine), vestigial exopodal lobe with four setae (medial two pinnate and longer than inner and outer naked setae).

P6 (Figure 4D): Almost indistinguishable from somatic cuticle, without armature elements but with two patches of spinules. Only one functional genital aperture present.

Etymology

The specific name refers to the type locality.

Discussion

The species described here agrees with the generic diagnosis of *Cletocamptus* given in Lang (1948). Body elongate without clear distinction between prosome and urosome, dorsal posterior margin of somites smooth or ornamented, female genital-double somite with dorsal fusion line; operculum semicircular; caudal rami longer than broad, terminal setae free or fused at base; rostrum relatively large; antennule 6–8-segmented with aesthetasc on segment 4; exopod of antenna 1- or 2-segmented or represented by a seta; mandible and maxillule without exopod and endopod; maxilla with 3 endites (2 syncoxal and 1 allobasal); P1–P4 exopod 3-segmented, endopod 2-segmented (except P4 which may be 1-segmented), exp-1 without, exp-2 with, inner seta; P2–P4 exp-3 with only 2 outer spines; male P3 endopod transformed. 2- or 3-segmented with apophysis on middle (3-segmented) or distal (2-segmented) segment; P5 rami fused in both sexes; mate guarding males grasping the female by the posterior border of the cephalothorax.

A distinctive feature of this genus not mentioned above is the presense of a relatively short smooth outer seta on the distal margin of P1 exp-3 (Figure 4A), although this seta is shown as plumose in *C. trichotus*

Kiefer, 1929 (see Lang, 1948, Figure 511), *C. feei* (see Shen, 1956, Figure 36) and *C. gravihiatus* (see Shen & Sung, 1963, Figure 51). This feature also appears to be present in *Dahlakia xenuus* (see Por, 1968, Figure 42).

C. merbokensis can be distinguished from all other species in the genus by its setal formula and the form of the male P5. It is the only species with only two armature elements on P2 and P3 endopod-2 (all other species bear three to six setae on enp-2) and no inner seta on P4 exopod-2. The absence of an inner seta on P1 enp-1 is found only in *C. feei*, *C. gravihiatus* and *C. helobius* Fleeger, 1980. The 1-segmented P4 endopod is probably unique except that in *C. helobius* (see Fleeger, 1980, Figure 10) the P4 endopod is represented only by a seta. Herrick (1894) describes *C. albuquerquensis* with a 1-segmented P4 endopod but this is probably wrong as Chappuis (1933) (reproduced in Lang, 1948, Figure 508) illustrates a 2-segmented male P4 endopod in this species, the proximal segment being extremely small. In *C. merbokensis*, the female P5 has fused rami but is distinctly U-shaped with the endopodal and exopodal lobes well-separated. A similarly shaped P5 is also illustrated for *C. feei*, *C. gravihiatus* and *C. deitersi* whereas in all other species the lobes of the P5 are hardly distinguishable or completely indistiguishable. The male P5 of *C. merbokensis* appears to be unique within the genus in that the baseoendopod and most of the endopodal and exopodal lobes are absorbed into the somitic cuticle. The structure of the P5 of both sexes in *C. merbokensis* is almost identical to that exhibited by the cletodid genera *Strongylacron* Gee & Huys and *Schizacron* Gee & Huys (Gee & Huys, 1996).

Cletocamptus, as presently constituted, is probably an amalgam of a number of genera but a more thorough study of the detailed structure of the mouthparts and sexually dimorphic characters of all the species is needed before a meaningful revision can be attempted. For instance there appears to be three forms of sexual dimorphism on the male P3 endopod, irrespective of the number of setae on the 2-segmented female ramus. In most species, the male P3 endopod is as shown in Figure 5B, a 3-segmented ramus with an apophysis on enp-2 and two setae on enp-3. In *C. albuquerquensis* and *C. helobius*, the male P3 endopod is 2-segmented with an apophysis and two setae on the distal margin of the distal segment (which can be derived from the normal condition by the failure to separate of a segment bearing the two setae). In *C. confluens*, the male P3 endopod is also 2-segmented but the proximal segment is larger than in other species and the distal segment appears to bear (see Lang 1948, Figure 509) an inner and outer apophysis and only one seta (which could be derived from the *C. helobius* condition by the fusion to the segment of one seta). Figures in the literature also suggest that in addition to the P3 endopod there may be sexual dimorphism on the P2 and P3 exopod and P2 endopod in some species (as demonstrated here in Figure 4B–C).

The sexual dimorphism in most species of *Cletocamptus* (3-segmented endopod with apophysis on enp-2, irrespective of the number of setae in female P3 endopod) is identical to that found in the Cletodidae. In general body facies, basic structure of the mouthparts and pereiopods the genus appears very cletodid-like. However, Por (1986), in his revision of the Langian family Cletodidae removed it, without giving reasons, from that family and placed it *incertae sedis* in the Canthocamptidae. Gee (1998), in giving a preliminary diagnosis of the Cletodidae (sensu Por) also excluded it from that family on the basis of: a rostrum defined at its base (the rostrum is always fused to the cephalothorax in Cletodidae); the 6-segmented female antennule with an aesthetasc on the fourth segment (all Cletodidae have at most a 5-segmented female antennule with the aesthetasc on the third segment); the presence of an inner seta on P1 exp-2 (never present in the Cletodidae); the presence of an inner seta on P1 enp-1 (present in the Cletodidae only in *Limnocletodes*); the presence of an inner seta on P2 exp-3 (never present in Cletodidae). After further research to delineate the boundaries of the Canthocamptidae, it may be that this genus must be removed to a new family which will probably prove to be a sister family to the Cletodidae.

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