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Sea ice inhabiting Harpacticoida (Crustacea, Copepoda) of the Weddell Sea (Antarctica)

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Abstract

Five species of harpacticoid copepods belonging to three families and four genera were collected from various samples of sea ice taken during five cruises of RV Polarstern to the Weddell Sea from 1985-89. One species is new and described, namely *Hastigerella antarctica* sp. n. *Drescheriella racovitzai* comb. n. (GIESBRECHT, 1902), *Harpacticus furcifer* GIESBRECHT, 1902 and *Idomene antarctica* (GIESBRECHT, 1902) are redescribed. The fourth nauplius of an unknown representative of Ectinosomatidae is described as well as three naupliar stages of *Harpacticus furcifer*.
Keywords : Icefauna, Southern Ocean, Ectinosomatidae, Tisbidae, Thalestridae, Harpacticidae, nauplii.

Zusammenfassung

Fünf Arten der Harpacticoida, die zu drei verschiedenen Familien und vier Gattungen gehören, wurden in verschiedenen Meereisproben aus der Antarktis festgestellt. Die Proben wurden auf fünf Expeditionen des Forschungsschiffes R.V. Polarstern von 1985-89 in die Weddell See genommen. Eine Art is neu und wird hier beschrieben : *Hastigerella antarctica* sp. n. Die Arten *Drescheriella racovitzai* (GIESBRECHT, 1902), *Harpacticus furcifer* GIESBRECHT, 1902 und *Idomene antarctica* (GIESBRECHT, 1902) werden nachbeschrieben. Der fünfte Nauplius eines unbekannten Vertreters der Ectinosomatidae sowie drei Naupliusstadien von *Harpacticus furcifer* werden ebenfalls dargestellt.
Schlagwörter : Eismeiofauna, Antarktis, Ectinosomatidae, Tisbidae, Thalestridae, Harpacticidae, Nauplien.

Introduction

Sea ice has been known as a habitat for organisms for about a century and a half. However, the majority of data on ice biota refers to ice algae (HORNER, 1985) or to the macrofauna (e.g. RICHARDSON & WHITAKER, 1979). Little is known about the communities of the smaller sympagic fauna especially for the Antarctic (BRADFORD, 1978). Studies such as those by SPINDLER & DIECKMANN (1986) on a planktonic foraminifer and by HOSHIAI & TANIMURA (1986) on benthic meiofauna inhabiting the ice are rare exceptions. Our studies on the ice-meiofauna of the Weddell Sea have shown that two harpacticoid species, viz. *Drescheriella glacialis* DAHMS & DIECKMANN, 1987 and *Harpacticus furcifer* (GIESBRECHT, 1902) are a constant element of the fauna in the lower strata of sea ice throughout this part of the Southern Ocean. Two species, namely *Drescheriella racovitzai* comb. n. (GIESBRECHT, 1902) and *Idomene antarctica* (GIESBRECHT, 1902) are rare, and three more are stray inhabitants of the ice (cf. DAHMS *et al.*, 1990b). Compared with the species richness of the Antarctic benthos (DAHMS *et al.*, 1987) this is no more than a small assemblage of presumably well adapted species.

Material and methods

Sea ice inhabiting Harpacticoida were collected during five cruises of RV Polarstern to the Weddell Sea from 1985-89 : leg Ant III/3 from 3.1.-5.3.1985; leg Ant V/2 from 27.6.-10.9.1986; leg Ant V/3 from 28.9.-14.12.1986 (DAHMS *et al.*, 1987); leg Ant VI/2 from 20.10.-19.12.1987 and EPOS (European Polarstern Studies) leg Ant VII/4 from 12.1.-10.3.1989 (DAHMS *et al.*, 1990a).
The most extensive collection was made during Ant V/2 of the Winter Weddell Sea Project (WWSP). During Ant III/3, Ant V/2 and Ant V/3 sea ice cores were collected using a modified SIPRE ice corer with a diameter of 7.5 cm. The cores were cut into 10 cm sections, put into PVC cans, returned to the ship's laboratory and thawed in the dark at 3°C. During the other legs large pieces of ice were torn off ice floes and thawed at 4°C in large buckets filled with seawater. The format for sample origin used here is : (date - location - water depth below the ice). The specimens are at the deposit of the Koninklijk Belgisch Instituut voor Natuurwetenschappen, Brussels.
Specimens collected from the field or dying in the laboratory were immediately preserved in 4 % formaldehyde and transferred into W15 embedding medium (C. Zeiss) for dissection and identification. The terminology is adopted from LANG (1948, 1965). Abbreviations used : P1-4 = swimming legs; P5, 6 = fifth, sixth leg; Enp I, II ... = first, second segment of endopodite; Exp = exopodite.

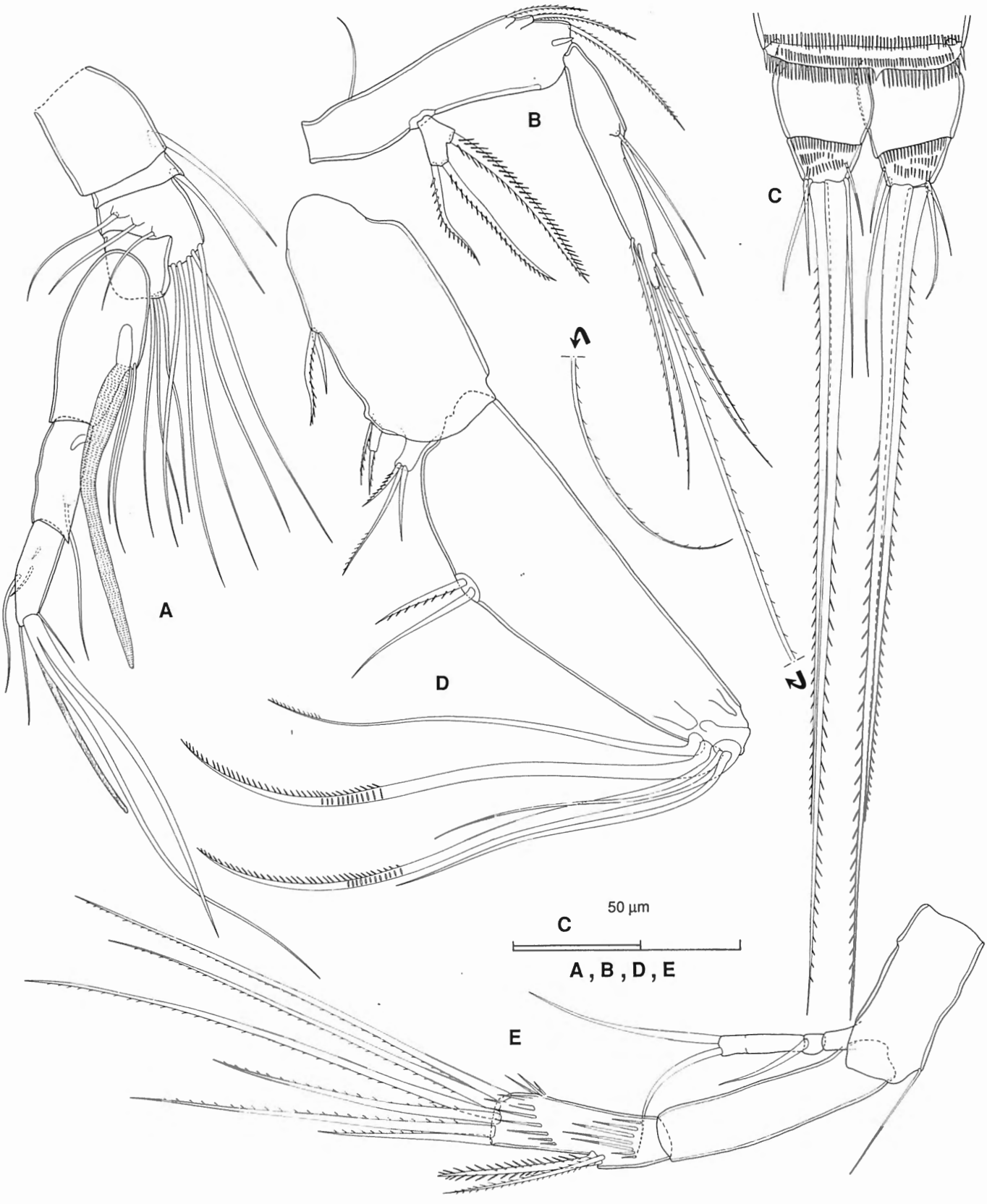

Fig. 1 – Hastigerella antarctica *n. sp. Male. Cephalic appendages and caudal rami. A. antennule, B. mandibular basis, endopodite and exopodite, C. caudal ramus, D. maxilla, E. antenna.*

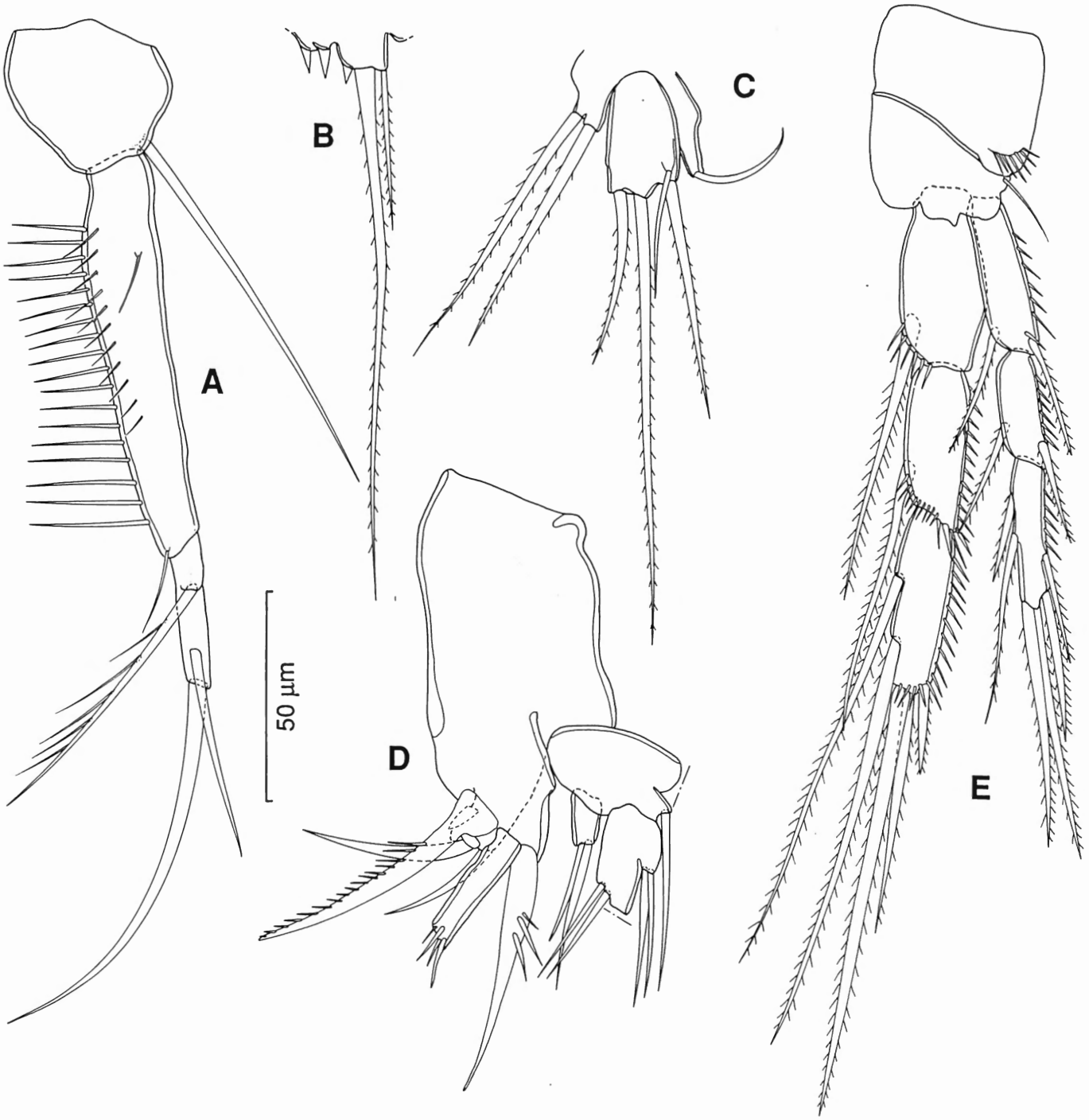

Fig. 2 – Hastigerella antarctica *n. sp. Male. Cephalic appendages and legs 4-6. A. maxilliped, B. leg 6, C. leg 5, D. maxillule (some portions are broken off), E. leg 4.*

Body lengths were measured from anterior to the posterior end of the naupliar body, and from the base of the rostrum to the posterior edge of the caudal rami in copepodids. Body width is given as the widest part of the nauplius or the copepodid cephalothorax, respectively.

As for the depth distribution of the Harpacticoida see Dahms *et al.* (1990).

Nauplii of *Idomene antarctica* and *Harpacticus furcifer* were collected from the field and cultivated in the laboratory ever since. For cultivation methods see Dahms (1987).

Systematic Account

FAMILY ECTINOSOMATIDAE

Hastigerella antarctica n. sp.

One adult male holotype with a mature spermatophore in the *vas deferens* was found in Drescher-Inlet (31.1.85 - 72°52'S/19°23'W - approx. 240 m) in the lowermost section of an ice-core together with *D. glacialis*.

Body length is 780 µm; body width 170 µm.

Caudal rami (Fig. 1) shorter than wide with two dorsal

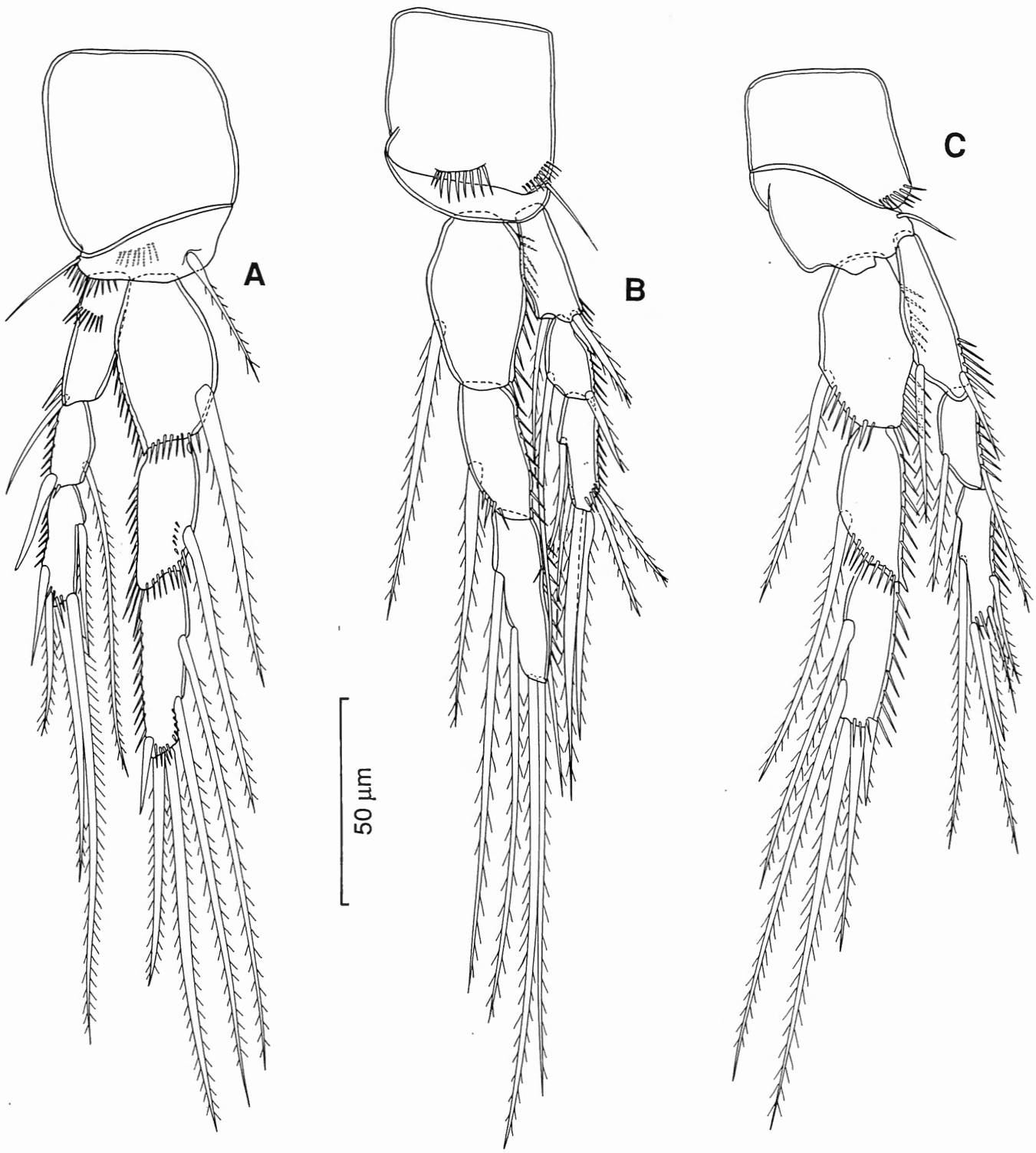

Fig. 3 – Hastigerella antarctica *n. sp. Male. Swimming legs 1-3. A. leg 1, B. leg 2, C. leg 3.*

rows of spinules. All six caudal setae bare except for the two terminal ones. Next to the two major setae there are two outer lateral setae, one inner lateral and one dorsal articulated seta.

Antennule (Fig. 1) seven-segmented, haplocer; segment V longest, bearing the proximal aesthetasc. All setae plain. Segment I and II with one inner seta, segment III with eight and IV with three setae. Segment V bearing one aesthetasc and two accompanying setae, VI with one seta and seventh segment with two short proximal setae, one seta midway on outer margin and two setae terminally fused at base, accompanying an aesthetasc with another seta at their base.

Armature : 1.-1.-8.-3.-2+Ae.-1.-7+Ae

Antenna (Fig. 1). Allobasis twice as long as wide with a slender seta in the distalmost fifth of the inner margin.

Exopodite three-segmented; first segment bare, second with one distal seta and third segment with two terminal setae equal in length; an inner lateral suture in the distal third of the distal segment may indicate a formerly four-segmented exopodite. First segment of endopodite longer than second, without armature. Second segment with two rows of strong spinules, two inner spinulose setae in proximal half and six terminal setae.
Mandible (Fig. 1). Syncoxa lost during preparation. Basis with one slender seta in proximal half and three spinulose setae in distal fourth. Rami 1-segmented. Exopodite with three spinulose setae. Endopodite with two setae midlength, one distal spinulose seta and two pairs of subdistally implanted spinulose setae.
Maxillule (Fig. 2) The preparation of this appendage was not successfull. Arthrite of praecoxa with two slender setae and three strong spines. Exopodite with two apical setae.
Maxilla (Fig. 1). Syncoxa with three endites; proximal endite almost reduced with two setae, proximalmost spinulose; middle endite at its base with a spinulose seta and with another spinulose one terminally; distal endite twice as long as broad with three setae. Basis fully twice as long as syncoxa, with two setae in proximal third along inner edge. Endopodite with two strong, curved and three additional slender setae.
Maxilliped (Fig. 2). Praecoxa short, with one long plain seta at outer distal corner. Coxa almost 2.5 times as long as second segment, bearing a row of heavy spinules and another row of smaller spinules in the proximal two thirds along the inner edge; basis with one seta in proximal third, one shorter seta subdistally. Endopodite represented by a long sickle-shaped seta.
P 1-4 (Figs 2, 3) with three-segmented rami.

Table I :
Chaetotaxy of the legs of *Hastigerella antarctica* n. sp.

	Coxa	Basis	Endopodite	Exopodite
P 1	0	2	1.1.221	0.1.122
P 2	0	1	1.1.221	1.1.222
P 3	0	1	1.1.221	1.1.222
P 4	0	1	1.1.221	1.1.222

P 5 (Fig. 2). Inner expansion of baseoendopodite with two spinulose setae. Exopodite distinct, with three marginal setae and one surface seta arising in distal outer portion of exopodite.
P 6 (Fig. 2) with two spinulose setae, outermost 2.5 times as long as innermost, and three inner spines.

ETYMOLOGY

The specific name refers to the continent 'Antarctica', where the species was collected.

DISCUSSION

The new species fits well into *Hastigerella* NICHOLLS, 1935 with the exception of a character normally present in *Hastigerella* and *Arenosetella* C.B. WILSON, 1932. This is a modified inner seta on the middle segment of the exopodites of the first four pairs of legs. This seta is usually in an oblique or upright position and bears a brush of spinules at its tip. *Hastigerella antarctica* is without this seta. According to LANG (1965 : 11) this character is of no generic value and is not included into his generic diagnosis.
The new species is most similar to *Hastigerella psammae* (NOODT, 1955) in sharing only one seta on the middle segment of P 2-4; five setae on the distal segment of P 1-4; a thin anal operculum; the same shape and armature of the maxilliped. Differences are the upright position of the seta on the second segment of at least P 1 in *H. psammae* (for this is the only swimming leg figured) and details of the armature of the other appendages described.

Nauplius IV of an unknown representative of Ectinosomatidae

(Figs. 4, 5)

Body length 140 µm; body width 95 µm.
Nauplius oval in outline, bearing antennules, antennae, mandibles and maxillules. (Fig. 4).
Caudal margin armed with two spinulose setae on either side, the dorsalmost of them articulated, a spinule row lateral to the setae.

Antennule (Fig. 5) three-segmented. Segment I unarmed; segment II with three spinulose setae and one inner proximal and two distal spinule rows; segment III with two anterior setae and two spinule rows midlength, two posterior setae subdistally, one aesthetasc accompanied by a seta on a terminal extension of the distal segment with another seta at its base.
Antenna (Fig. 5) with a strong coxal masticatory spiniform process furnished with hairy spinules in distal half. Basis with three plain setae on an inner proximal process, a seta near the articulation with the endopodite and one spinule row along the outer margin. Endopodite with three inner setae in distal third and four terminal setae with peculiar ornamentation; the major inner one twice as long as the endopodite with spinules on its proximal half. Exopodite four-segmented. One small seta proximally and one strong inner spinulose seta distally on first segment. Second and third segments each with one long spinulose seta and one long spinulose and one shorter plain seta together with an outer spinule row on distal segment.
Mandible (Fig. 5) with a spinulose coxal seta. Three setae along inner margin of basis, two of which are

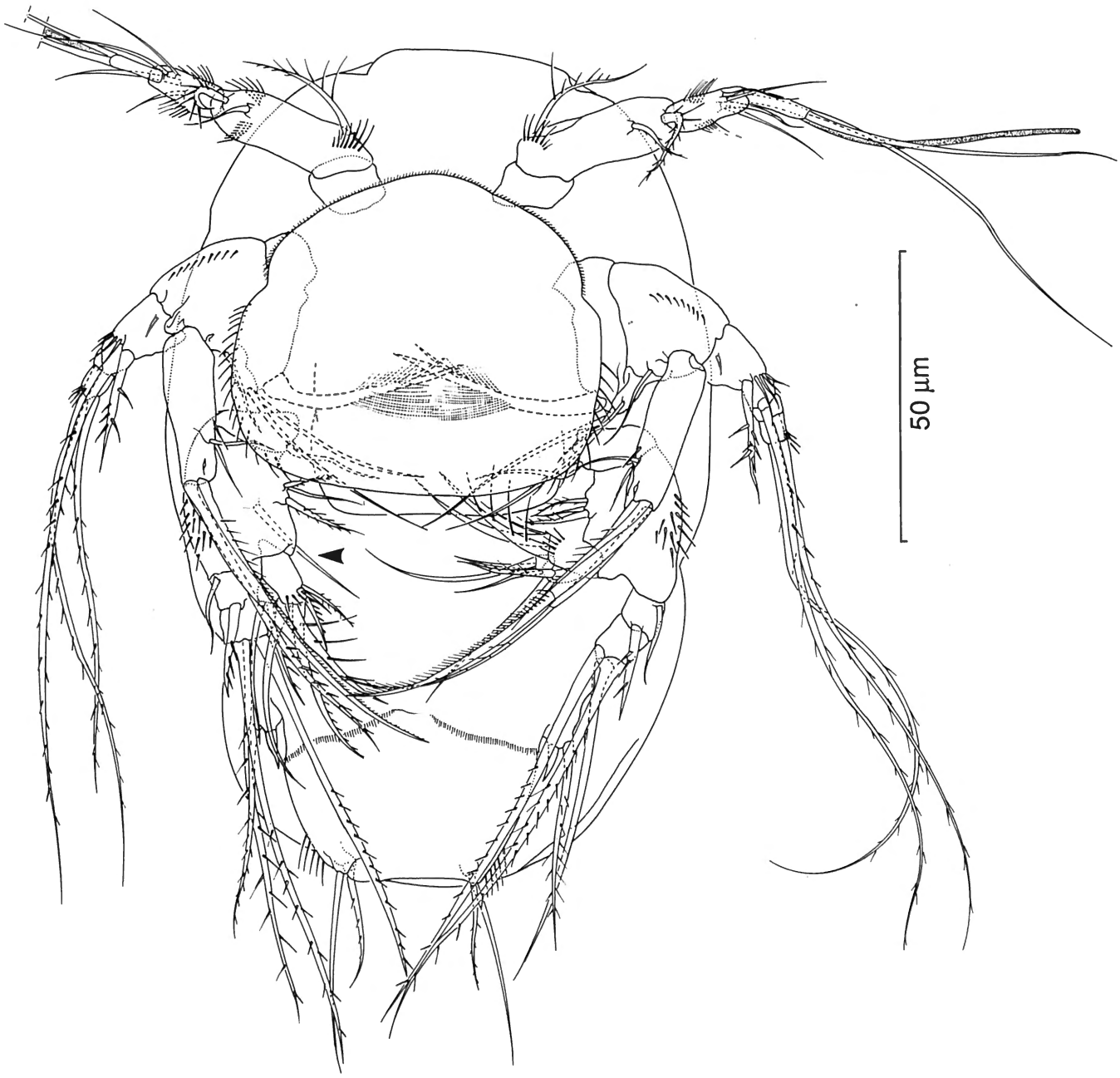

Fig. 4 – *Ectinosomatid nauplius IV. Body in ventral view.*

spinulose. Spinule field on outer margin. Endopodite with two strong setae on a terminal process; the innermost plain, the outermost with a sparse row of spinules along the inner margin. Outer lateral field of endopodite with six setae, three spinulose. Exopodite three-segmented; first segment with two setae, the distal stout and spinulose; second segment bearing one long seta. Third segment having two long spinulose setae.

Maxillule (arrowhead in Fig. 4) represented by a single seta.

Postmaxillulary appendage (Fig. 4) represented by a lateral lobe with 1 short inner and 1 longer spinulose outer seta.

DISCUSSION

The nauplius described most probably belongs to the Ectinosomatidae, a group characterized by nauplii with good swimming abilities, lacking a nauplius eye (cf. DAHMS, 1991). Swimming capability is enhanced by the oval body shape as well as by the 4-segmented exopodite of the antenna and the strong 3-segmented exopodite of the mandible, both furnished with long setae. Preliminary observations of other ectinosomatids suggest that the distal two segments of the antennules move in a slightly rotating manner. These segments are cylindrical and show a peculiar articulation with the first segment.

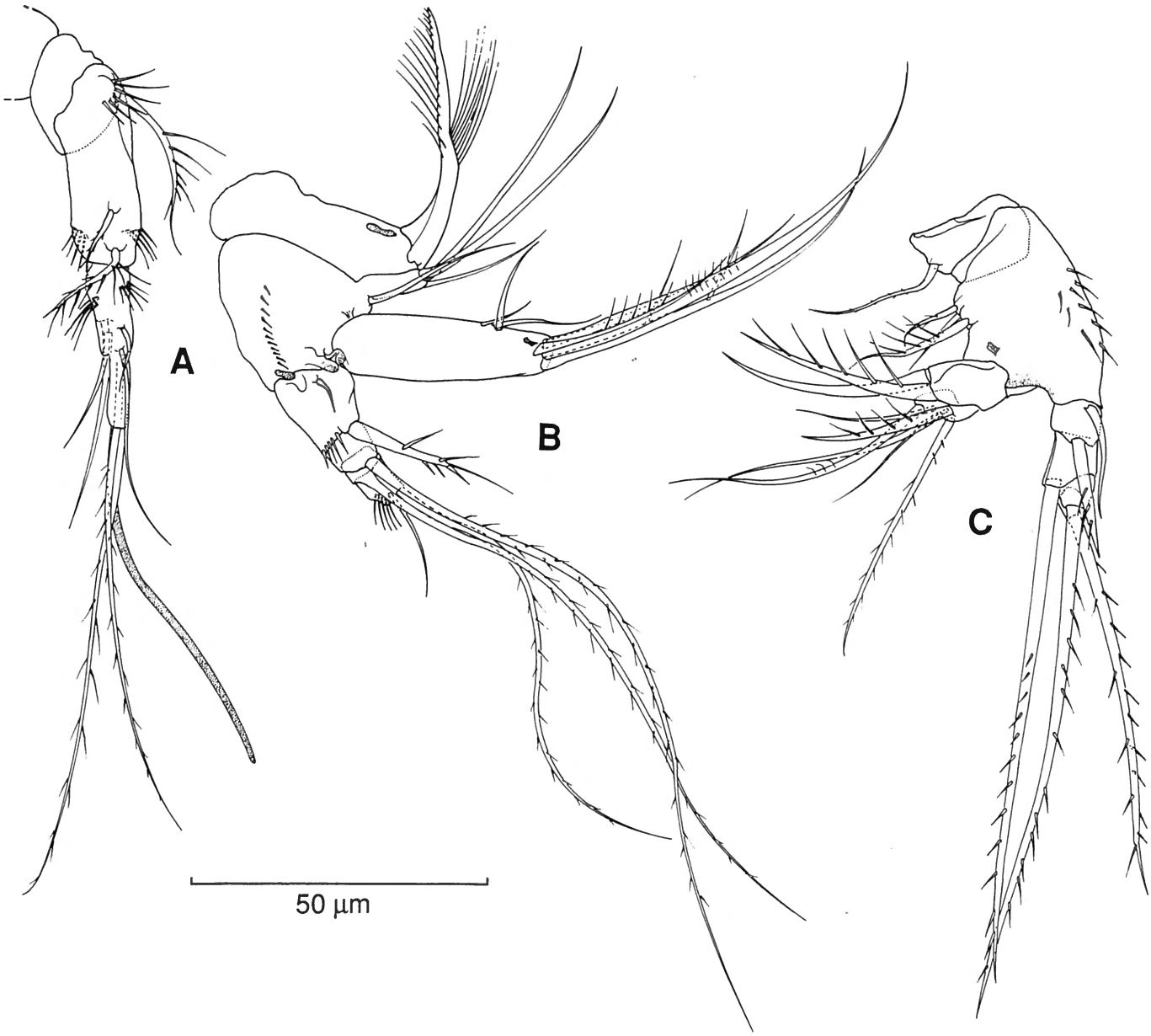

Fig. 5 – *Ectinosomatid nauplius IV. A.left antennule, B. right antenna, C. left mandible in anterior view.*

This is very similar in all ectinosomatid nauplii. The same applies by convergence to the nauplii of the planktonic tachidiid. *Euterpina acutifrons.*

Further characteristic features of an ectinosomatid nauplius are : the terminal process of the distal segment of the antennule, the slender cylindrical masticatory process of the antennal coxa and the fact that there are at least two long terminal setae on the antennal endopodite. In the nauplius described here there are even four long terminal setae. This number is shared by most harpacticoids, but normally three of these setae are much reduced in size and accompany the single claw at tip. It seems exceptional that all four setae are fully developed.

Although very similar, the present nauplius does not belong to *Microsetella* as evidenced by the descriptions of earlier workers (e.g. Björnberg 1972, Hirakawa 1974, Diaz & Evans 1983). *Microsetella* is present in the waters of the Weddell Sea underlying the ice, but only in low numbers. The new nauplius differs most from that of *Microsetella* by its oval shape (*Microsetella* nauplii are drop-shaped), the four setae apically on its antennal endopodite, the mandibular endopodite with pincer-like apical setae on its process (a uniform bundle of setae in *Microsetella*) and by its slender caudal setae of which at least one on either side is robust in *Microsetella*. It seems possible that the present nauplius belongs

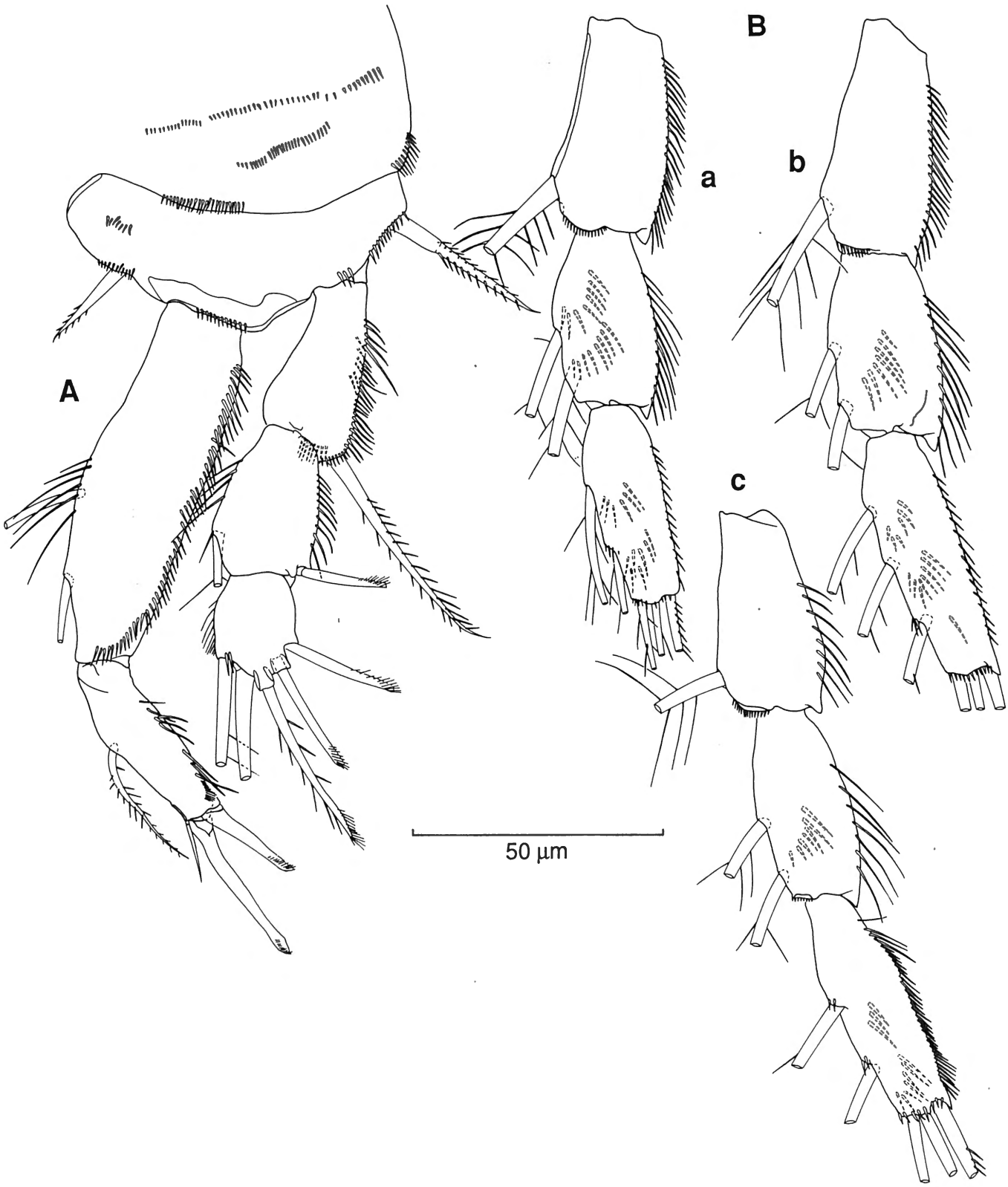

Fig. 6 – Drescheriella racovitzai. *Male. A. swimming leg 1, B endopodites of leg 2 (a), leg 3 (b), leg 4 (c).*

to the ectinosomatid genus *Hastigerella* found in the ice, for no other representative of the family is known from the area, neither from the ice nor from the plankton. The nauplius described must be of N IV stage because it cannot be of N III stage bearing a maxillule precursor will not consisting of two setae. It can hardly be of N V stage either because this stage is usually characterized by the presence of more than the two caudal setae.

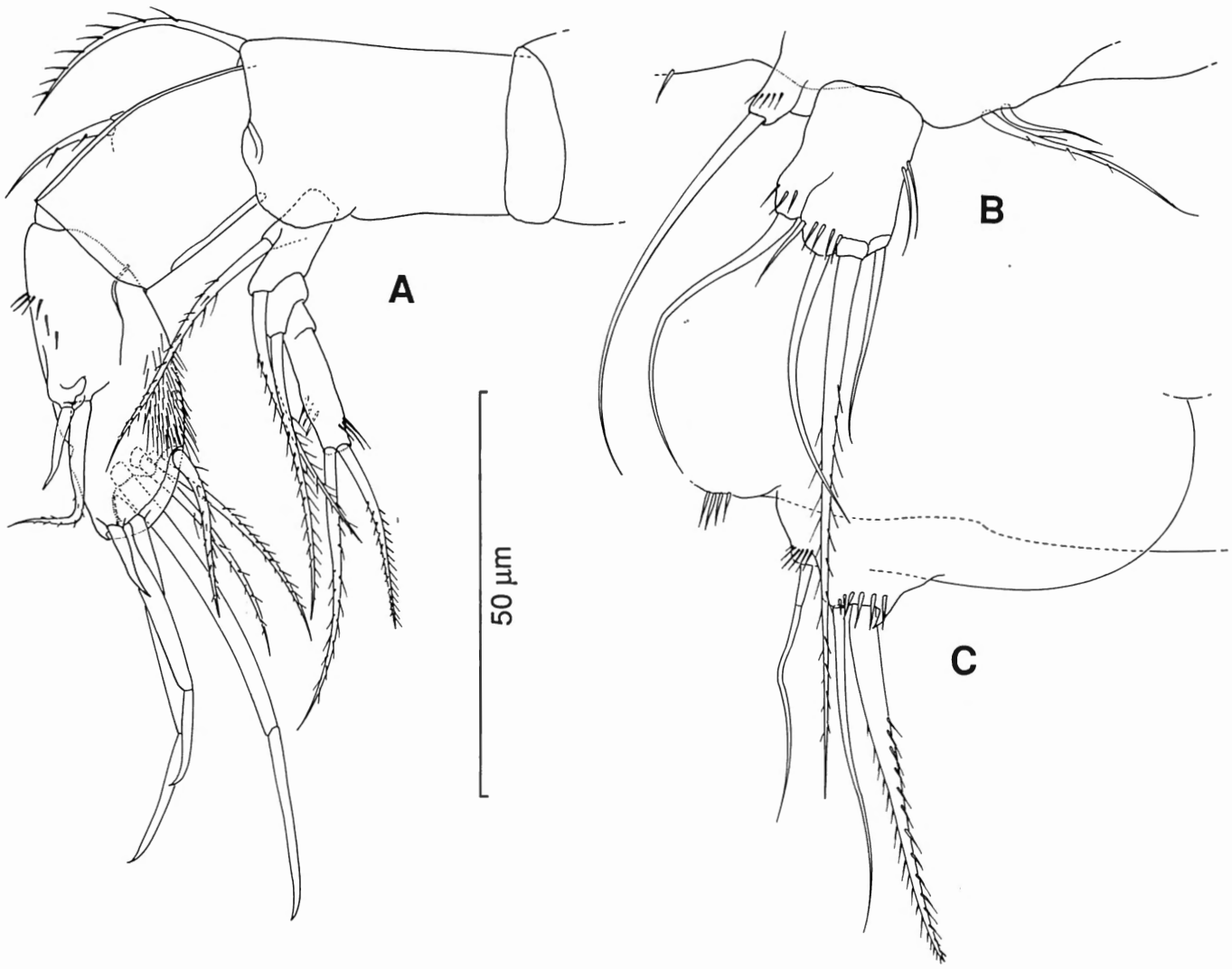

Fig. 7 – Drescheriella racovitzai. *Male. A. antenna, B. leg 5, C. leg 6.*

FAMILY TISBIDAE

Drescheriella racovitzai (GIESBRECHT, 1902) comb. n.

This species was found in 2 different years at locations about 800 km apart : a single C V male (22.7.86 - 62°55,20'S/2°45,70'W - 5276 m) and a live sample of 103 copepodids (11.2.89 - 73°27,70'S/22°33,90'W - melting pool on ice floe above 1479 m) (cf. DAHMS *et al.*, 1990b).

The stage distribution of the copepodids collected from the melting pool on an ice floe above 1480 m depth on 19.2.89 was : 2 C I, 24 C II, 35 C III, 29 C IV, 5 male and 12 female C V but no adults. From this group the first adult male appeared on 4.7.89 (observation interval was 8 d).

So far only adult males are available for description. They are similar to *Drescheriella glacialis* DAHMS & DIECKMANN, 1987 except for the following morphological characters.

Body length 650 µm; body width 170 µm.

Antenna (Fig. 7). Basis without spinule near the implantation of inner spinulose distal seta. Endopodite-II with only two inner setae midlength. Exopodite three-segmented, with two spinulose setae on first, one seta on second and two apical spinulose setae on third segment. This segment also with subapical outer crest of spinules and proximal fold probably an indication of a formerly additional segment.

P 1 (Fig. 6). Endopodite two-segmented with first segment bearing two setae in distal half of the inner margin; second segment with one spinulose seta midlength and two apical setae armed with tuftlike combs of setules, the inner one nearly twice as long as the outer one. An additional tiny seta at inner distal corner. Exopodite three-segmented; distal segment bearing five setae, middle seta with tip consisting of tuftlike comb of setules, stem spinulose as the innermost two setae.

P 2-4 (Fig. 6). Endopodites with two setae on the inner margin of segment II.

P 5 (Fig. 7). Inner expansion of baseoendopodite with two setae, outermost twice as long as innermost. Exopodite with five setae, second innermost longest and spinulose; two setules on the inner margin and two rows of spinules near the base of setae.

Table II :
Chaetotaxy of the legs of *Drescheriella racovitzai*

	Coxa	Basis	Endopodite	Exopodite
P 1	0	2	2.220	0.1.023
P 2	0	1	1.2.221	1.1.223
P 3	0	1	1.2.321	1.1.323
P 4	0	1	1.2.221	1.1.323

DISCUSSION

The specimens at hand agree all in aspects with the fragmentary description of *Idya racovitzai* GIESBRECHT, 1902 for it shares all characteristics obvious from the fragmentary description of the female specimen by GIESBRECHT (1902), especially the 2-segmented endopodite of the first swimming leg. It belongs to *Drescheriella* DAHMS & DIECKMANN, 1987 for it shows most of the constitutive characters of this genus, viz. the antennal exopodite with 2 setae terminally, the mandibular exopodite bearing 2 setae and, most importantly, the P 1 exopodite-III with 5 setae. In contrast to its congener *D. glacialis, D. racovitzai* shares with all species of *Tisbe* 2 inner setae on P 2-4 endopodite-II and 3 setae on the inner margin of P 3 endopodite-III.
Drescheriella racovitzai differs from *D. glacialis* in being more slender, in having larger oil droplets, in a more pronounced floating behaviour (stages never rest on the bottom) and in the morphology of antenna, legs 1-4 and male leg 5. For the comparison of adults, only males are so far available : the antenna bears an indistinctly 3-segmented exopodite with two setae on the first segment (distinctly 4-segmented with only one seta on first segment in adults of *D. glacialis* — there is a second seta, however, in the younger copepodids which is subsequently reduced in later stages (DAHMS 1991); P 1 Enp is 2-segmented (3-segmented in *D. glacialis*); P 2-4 Enp II has 2 inner setae (as in *Tisbe*, in contrast to 1 seta in *D. glacialis*), P 3 Enp III : 0.321 setae (as in *Tisbe*, in contrast to 0.221 in *D. glacialis*). In contrast to all known representatives of *Tisbe*, *D. racovitzai* has a P 1 Exp III bearing only 5 setae. The new species can be distinguished from *D. glacialis* from C III onwards : P 3 Enp II of C III bearing 6 setae (5 in *D. glacialis*); P 2-3 Enp II of C IV bearing 7 setae (6 in *D. glacialis*); P 2-4 Enp II of C V having 2 setae (1 seta in *D. glacialis*); the second to innermost seta of P 5 exopodite is spinulose, remarkably strong and three times as long as the exopodite itself (of equal size as the surrounding setae in *D. glacialis*).

The species was collected by GIESBRECHT (1902) from the plankton : at the surface, May 1898, 71°24'S, 89°30'W, at 200 m depth, November 1898, 70°06'S, 82°30'W; from the pack ice, December 1898, 70°18'-20'S, 84°51'-85°52'W. FARRAN (1929) reported *D. racovitzai* from plankton hauls at the surface and at 80 m depth from 60°-66°30'S.

FAMILY HARPACTICIDAE

Harpacticus furcifer GIESBRECHT, 1902

During the present study specimens were found in sea ice above the shelf of Signy Island (South Orkneys) (19.1.89 - 61°30'S/47°W - 540 m). All 29 females and 4 males were dead and decayed; none of the females carried an egg-sac. A single C I belonging to Harpacticidae and probably to this species was found in sea ice of the eastern Weddell Sea (20.8.86 - 67°36,91'S/3,07'W - 4454 m). At other location and times of the year only nauplii were found. Near Drescher Inlet four nauplii were isolated from the lowermost portion of an ice core (170-176 cm section) (18.11.86 - 72°52,60'S/19°20,8'W - 200-400 m). These developed into two adult females and one adult male of *H. furcifer* in the laboratory. Although precopulae have repeatedly been observed (the male clasping the female's posterior margin of the cephalosome, as is usual in Harpacticidae), no egg-sac has been produced and specimens died fairly early. During leg Ant V/2 nauplii of *H. furcifer* morphologically identical with the exuviae of the above-mentioned nauplii were found at several locations in the ice of the eastern Weddell Sea : two N I, three N II (31.7.86 - 65°36,66'S/3°01,40'W - 2954 m); one N IV (4.8.86 - 65°20,25'S/7°59,91'W - 4785 m); one N VI (10.8.86 - 68°40,00'S/0°52,00'E - 4227 m); one N VI (12.8.86 - 68°47,77'S/0°43,02'E - 3261 m); one N I, one N II, one N III, four N IV and one N V (16.8.86 - 69°18,69'S/01°18,06'W - 2250 m); three N III, five N IV, six N V and one N VI (19.8.86 - 63°38,12'S/3°42,36'W - 3766 m).

Female (Figs. 8-11)

Body length 1430 µm; body width 420 µm.
Antennule (Fig. 8) nine-segmented. First segment as long as second one. All segments furnished with bare setae, fourth and terminal segments with an aesthetasc. Armature : 1.-9.-8.-4+Ae.-2.-3.-2.-2.-7+Ae.
Antenna (as in male, see Fig. 9). Coxa small, bare. Allobasis large with one spinulose seta on inner edge in median third. Exopodite two-segmented with two spinulose setae on first and four spinulose setae on second segment. Endopodite with two spines and two accessory setae subdistally on anterior margin; distal margin bears a denticulate spine, four geniculate setae

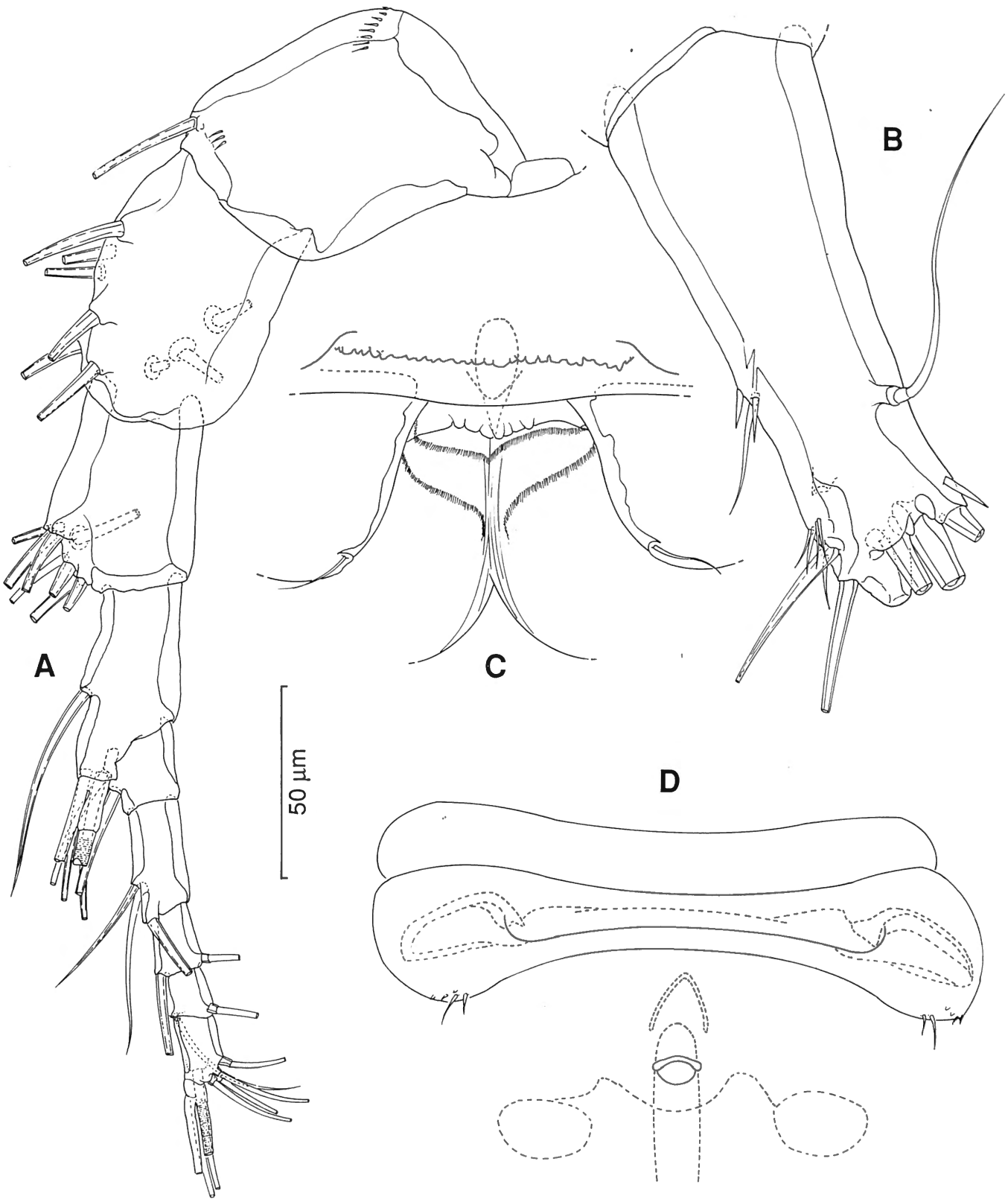

Fig. 8 – Harpacticus furcifer. *Female. A. antennule, B. caudal ramus, C. anal aperture in dorsal view, D. genital field.*

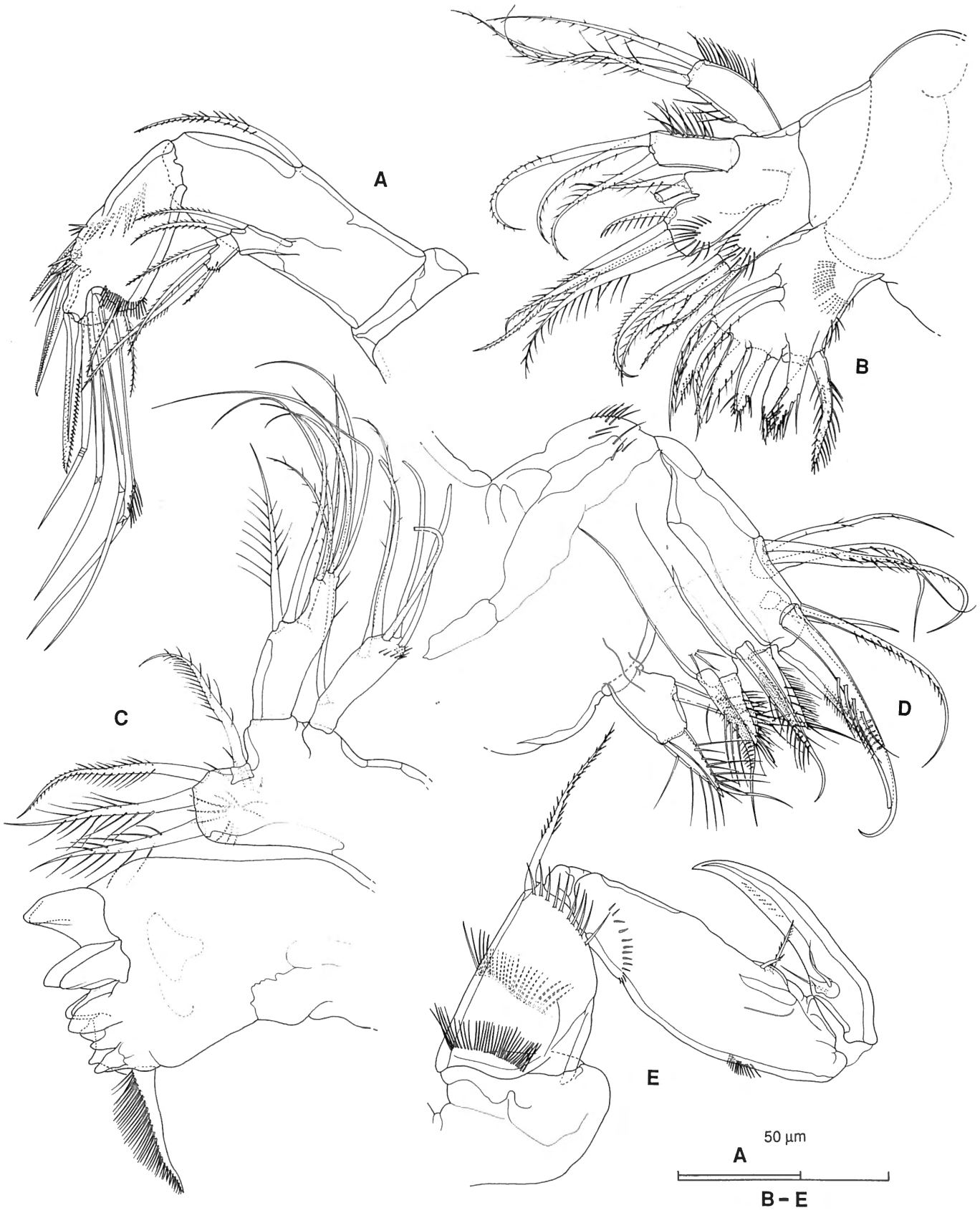

Fig. 9 – Harpacticus furcifer. *Female and Male. Cephalic appendages. A. male antenna, B. male maxillule, C. female mandible, D. female maxilla, E. female maxilliped.*

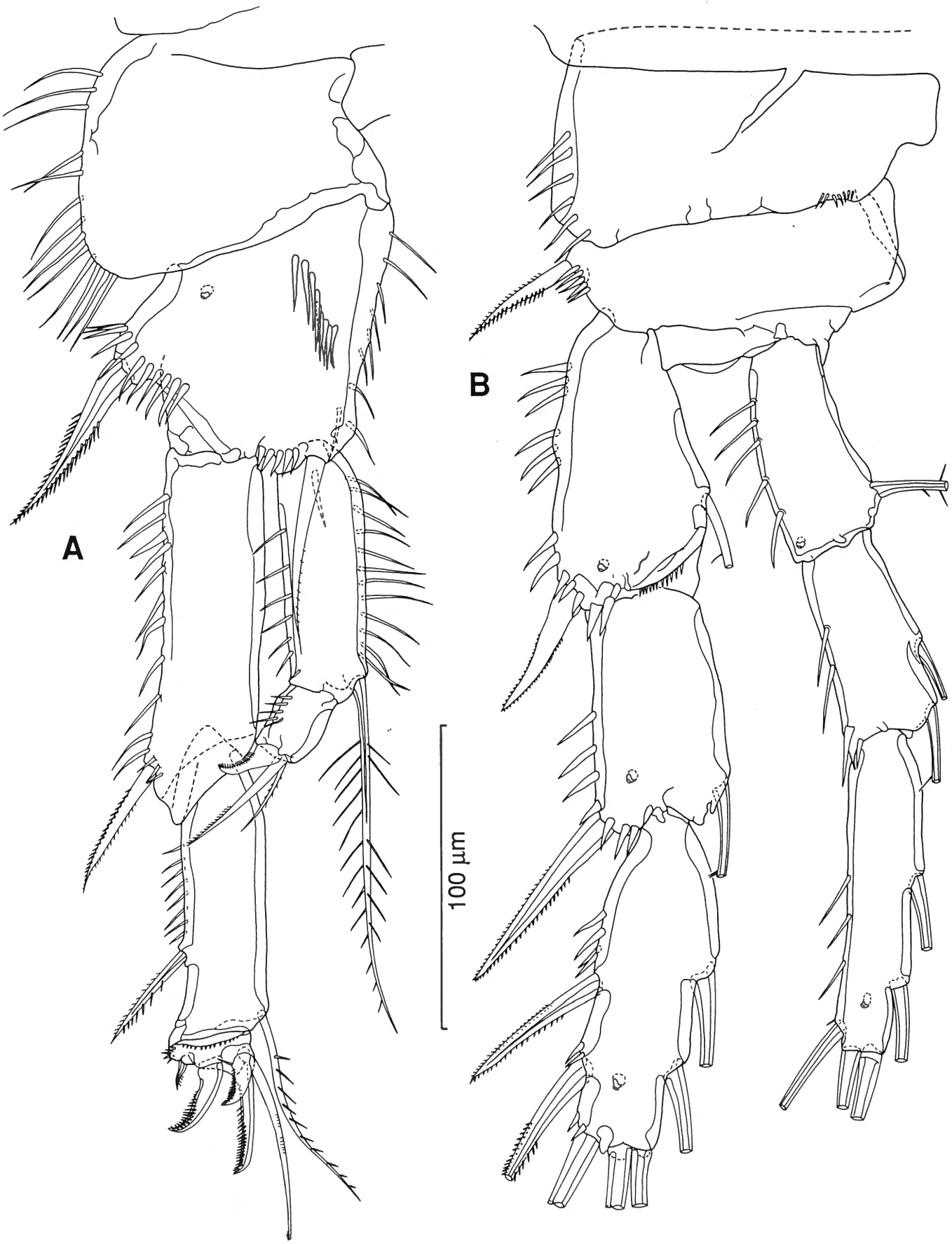

Fig. 10 – Harpacticus furcifer. *Female. A. swimming leg 1, B. leg 2.*

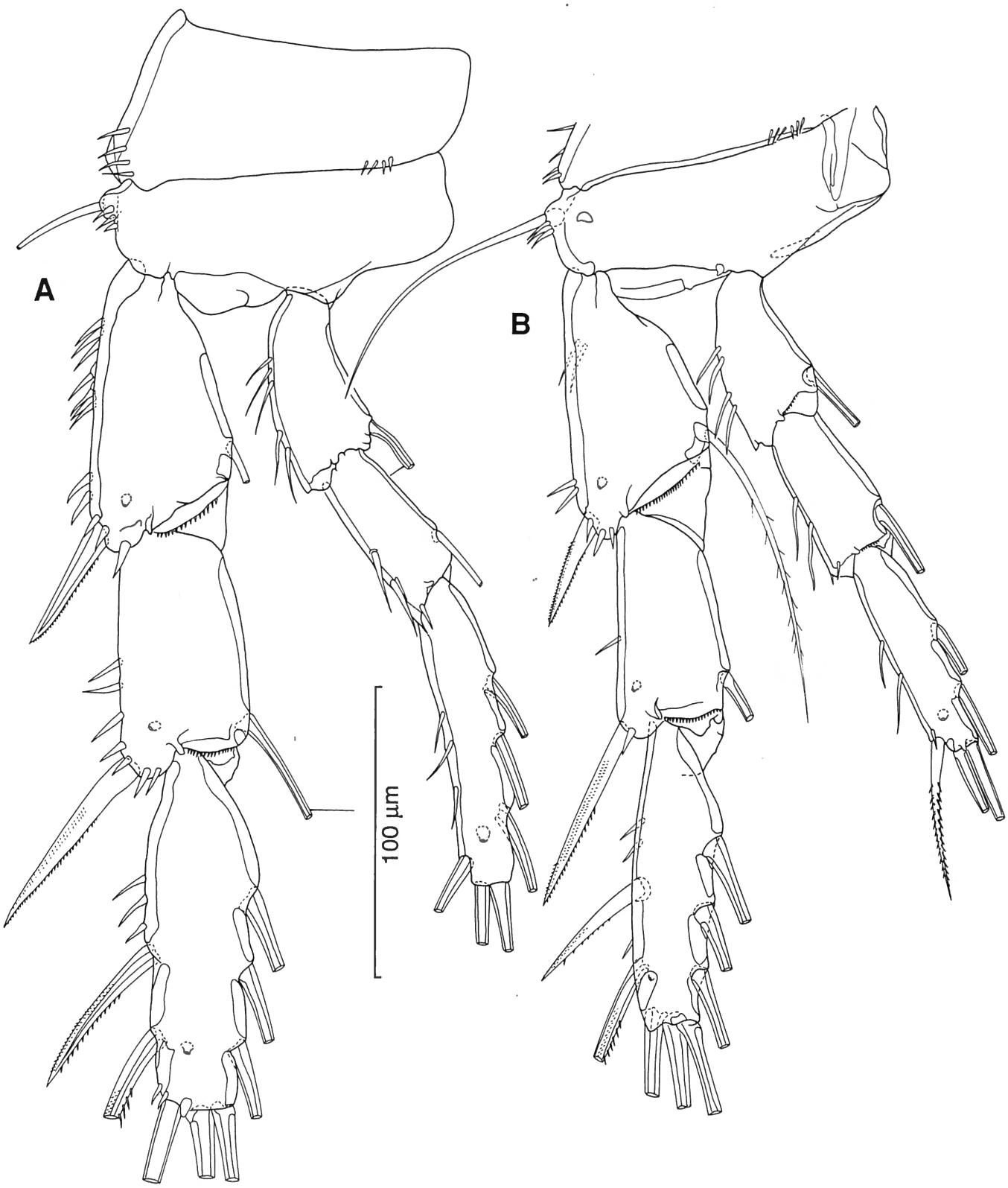

Fig. 11 – Harpacticus furcifer. *Female. A. swimming leg 3, B. leg 4.*

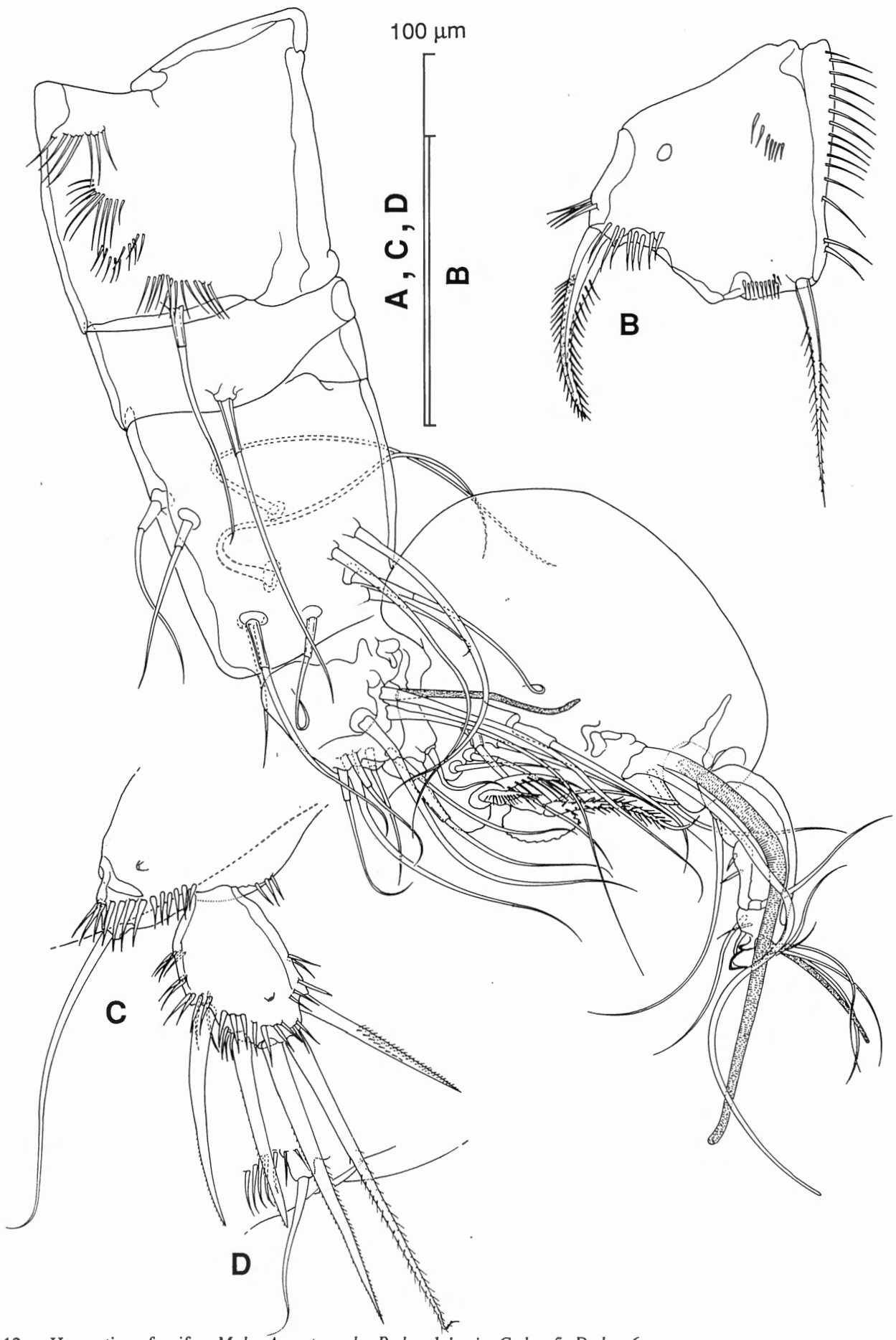

Fig. 12 – Harpacticus furcifer. *Male. A. antennule, B. leg 1 basis, C. leg 5, D. leg 6.*

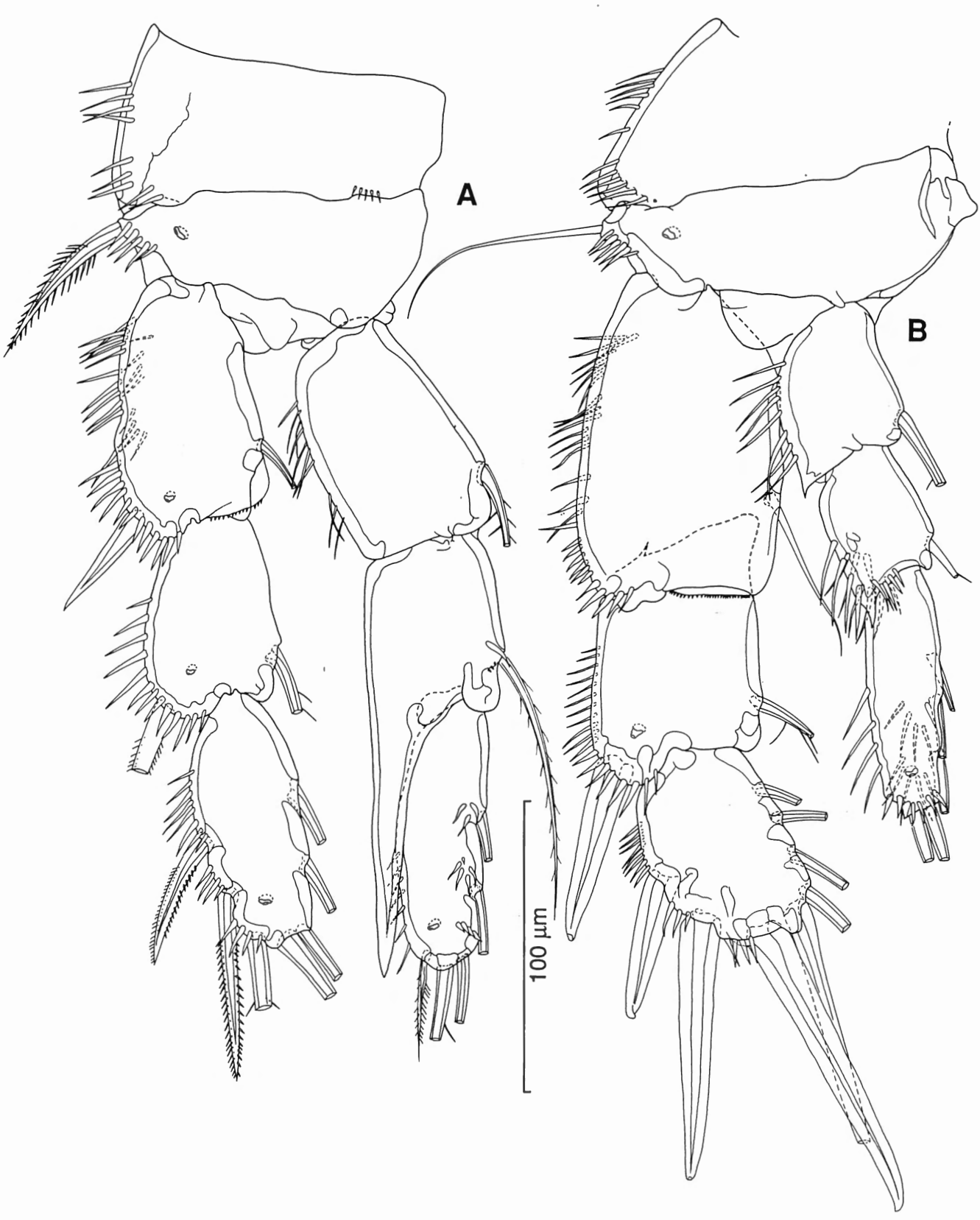

Fig. 13 – Harpacticus furcifer. *Male. A. swimming leg 2, B. leg 3.*

two pinnate setae. There is a median longitudinally transverse row of large spinules and one transverse row of small spinules wrapped around the lateral margin near the distal border.
Mandible (Fig. 9) with a long cutting edge, bearing strong blunt-shaped teeth and a strong seta with a double row of spinules on the inner distalmost edge. Basis with four spinulose distal setae. Endopodite with three spinulose setae medially on lateral margin and six setae apically. Exopodite with one proximal, one subapical spinulose seta and four distal plain setae, the apical ones aesthetasc-like and rounded at tip.
Maxillule (as in male, see Fig. 9). Arthrite of praecoxa terminally with one spinulose seta at inner edge and nine strong claws, ornamented in a complex manner; two spinulose setae are present on the surface. Coxa proximally confluent with basis and armed with four spinulose setae apically and with spinules in distal third. Basis with three terminal setae and one shorter spinulose seta at outer edge and two spinulose setae midlength at outermost edge. Endopodite and exopodite with three spinulose setae apically and each ramus with a spinule row along outer margin.
Maxilla (Fig. 9). Syncoxa with three endites. Proximal endite terminally with two strong plumose setae and one spinulose seta medially on outer margin. Two inner endites each with three very strong and spiniform setae. Basis terminally with one strong spine accompanied by one subapical unguiform seta and two slender setae. Four spinulose setae in the distal half on outer edge, most probably representing the endopodite.
Maxilliped (Fig. 9). Praecoxa very short, with a smooth surface. Coxa shorter than basis, with two transverse rows of spinules near the distal margin. One spinulose seta near the edge. Basis almost straight along inner edge having two tiny setae subdistally and two transverse rows of spinules along the outer margin : one proximally and one in distal third. Endopodite represented by a strong claw and two setules, arising from a distinct sock.
P 1 (Fig. 10). Coxa with slender spinules along the outer edge. Anterior surface of basis with three rows of spinules; one short-plumose seta at inner distal corner and slender setules along the inner margin. Outer seta strong, finely spinulated on both sides. Exopodite three-segmented; first two segments subequal in length; first segment slightly longer than the endopodite and furnished with one seta near the outer distal corner; second segment with one spine in distal third of outer edge and with a row of spinules above the spine; distal edge with an inner seta; third segment with three armed claws, one outer tiny seta and one inner long plain seta which is obviously pectinate. Endopodite two-segmented; first segment about four times as long as second one, with one spinulose seta at the inner distal corner. Second segment slightly longer than broad, distal edge with an outer strong claw, and two spinulose setae.
P 2-4 (Figs. 10, 11). Anterior surface of coxa with two rows of spinules. Basis of second leg with an outer, strong, plumose seta; basis of two succeeding legs with one bare slender seta. Rami three-segmented. Last exopodite segment longest; each segment spinulose along the outer edge. Setal formula in table III.
P 5 (Fig. 14). Baseoendopodite rather broad bearing four spinulose setae. Endopodal lobe reaching the distal margin of the exopodite, set with spinules along the distal part of the outer margin. There is one tube-pore each on the anterior face of each the baseoendopodite and exopodite. Members are not fused medially.

Table III :
Chaetotaxy of the legs of *Harpacticus furcifer*

	Coxa	Basis	Endopodite	Exopodite
P 1	0	2	1.120	0.1.140
P 2	0	1	1.2.221	1.1.223
P 3	0	1	1.1.321	1.1.323
P 4	0	1	1.1.221	1.1.323

Male

Body length 1320 µm; body width 380 µm.
Sexual dimorphism manifested in antennule, P 1-6, genital double somite and urosome.
Antennule (Fig. 12) subchirocerate, bearing three aesthetascs. Antepenultimate segment globularily expanded, anterior surface of complicated structure.
P 1 basis (Fig. 12) with the outer spine much stronger than the corresponding one of female. Spinule rows with much smaller spinules than in female.
P 2-4 (Figs 13, 14). Exopodite-III outer spines more strongly developed on P 3; P 2-4 endopodites reduced in size; P 2 endopodite-II with outer distal corner extended into an apophysis reaching distal margin of endopodite-III; P 2 endopodite-III outer distal seta considerably reduced.
P 5 (Fig. 12) with confluent baseoendopodites. Exopodite with a few spinules all around its edge, and one row of stronger spinules subapically on anterior surface just above the three outer marginal setae; five marginal setae, all delicately plumose, and all, except the second innermost seta, spiniform.
P 6 (Fig. 12) as a small emargination with one long apical and two tiny setae at base.

DISCUSSION

The specimens agree quite well with GIESBRECHT's original descriptions and with the type specimens borrowed from the GIESBRECHT collection of the Koninklijk Belgisch Instituut voor Natuurwetenschappen, Brussels (coll. no. COP 007A and B, I.G. 10131).
Agreement is to be found especially in the following

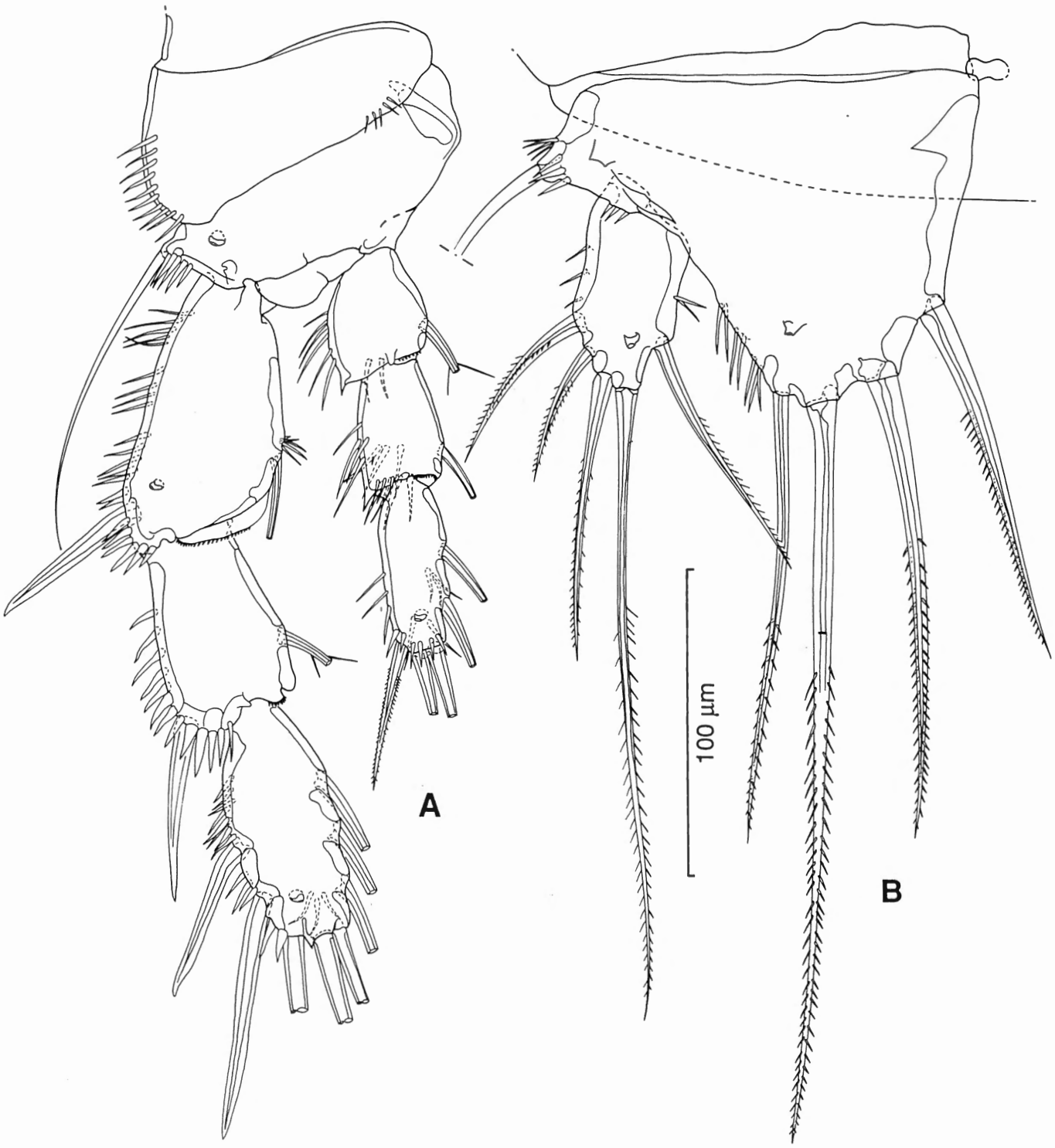

Fig. 14 – Harpacticus furcifer. *A. male leg 4, B. female leg 5.*

details : the cutting edge of the mandible, setules and spinules of the complex maxillule and maxilla and three prominent spinules at the baseoendopodite border and base of P 5 exopodite. There are also a few differences which to the authors impression do not warrant taxonomic consequences. The second endopodite segment of the female P 4 according to GIESBRECHT has two setae, but there is only 1 seta in the females described here. It cannot be ruled out that GIESBRECHT has interchanged the labels of leg 4 and leg 2 of the female for the latter leg is said to bear two setae on the middle endopodite segment which agrees well with our observations for leg 4. Other differences are as follows : the third segment of the female antennule has 9 setae in the holotype (only 8 setae in our material); mandibular basis without spinules in holotype but spinules present in our specimens; spinules of the maxilliped coxa are reduced in length in holotype (longer spinules in our material); setae of caudal rami shorter and taller in holotype than in the specimens investigated here. However, some of these size-specific differences may well be due to shrinking processes of the original holotype.
According to F. FIERS (pers. comm.) we have not redescribed *H. furcifer* herein but probably tackled a new species. According to him GIESBRECHT did not interchange the P 2 and P 4. The type-specimen has the following setal formula :

	endopodite	exopodite
P 1	1.120	0.1.140
P 2	1.2.221	1.1.223
P 3	1.1.321	1.1.323
P 4	1.2.221	1.1.323

Also, our drawings should differ in several other aspects with the type-specimen : e.g. the claws on the P 1 exopodite are distinctly different and the armature on the P 5 spines is not the same as illustrated in our MS. Differences were also encountered in the mandible (without aesthetasc-like setae), maxillule and maxilliped.
GIESBRECHT (1902) collected this species from a brackish ditch in the pack ice (together with *Drescheriella racovitzai*) in December 1898 at 70°18'-20'S,84°51'-85°52'W. FARRAN (1929) collected it from under sea ice at 66°30'-76°S and 76°-78°S.

Nauplii of *Harpacticus furcifer*
(Figs. 15-18).

Nauplii oval-shaped with a complex pattern of spinules on the ventral body wall.
Labrum tongue-shaped with spinules along its lateral and caudal margin and with another field of longer spinules anteriorly at subcaudal margin.

NAUPLIUS II

Body length 140 µm; body width 80 µm.
Ventral body wall ornamented with lateral row of spinules on both sides and medial field of spinules just under the labral margin. Hind-body with one seta on either side and one row of spinules on anal operculum (Figs. 15, 16).
Antennule (Fig. 17). Second segment with three setae and one outer spinule row on outer margin. One subdistal seta as well as two setae and one aesthetasc on terminal extension of distal segment, also one outer spinule row.
Antenna (Fig. 18) with strong coxal masticatory process, shuffle-shaped at tip with two inner setules and a row of spinules in between outer spiniform extensions. Basis with three long inwardly curved setae, one shorter seta and one spinule row on outer margin. Endopodite with two setae on the inner margin in proximal third, a terminal claw-like seta with two spinules at outer margin of distal third; there are two setae at inner base of claw and one seta at the outer distal corner. Exopodite four-segmented with two setae on first segment, one spinulose seta on second and third segments each and one outer short and two spinulose setae terminally on fourth segment, the innermost twice as long as the outermost.
Mandible (Fig. 17) with a coxal seta ornamented with a ring of spinules in the proximal third, coxa with outer crest of spinules. Basis with two spinulose setae and outer crest of spinules. Endopodite with inner process bearing one claw distally, one small seta at its inner base and one proximal seta anteriorly. Exopodite indistinctly three-segmented, the first segment bearing two setae, the second one seta and the third segment also one outer seta.
Maxillule precursor present as a spinulose seta (Figs. 15, 16).

NAUPLIUS IV

Body length 190 µm; body width 100 µm.
Ventral body wall ornamented with half-circled rows of spinules laterally to medial field of spinules and a spinule row at caudal edge. Hind-body with three setae on both sides, middle one of which articulated and with two rows of spinules at base; row of spinules on either side midlength of hind-body (Fig. 16). Differences to N II :
Antennule (Fig. 17) with two setae medially on third segment.
Antenna (Fig. 18) with a newly developed strong seta proximally on outer margin of masticatory process. First segment of exopodite with a third tiny seta and an outer spinule crest proximally.
Mandible (Fig. 17) with three setae on basis. Outer lateral field of endopodite with a sixth seta.
Maxillule (Fig. 16) precursor arising from a protuberance.

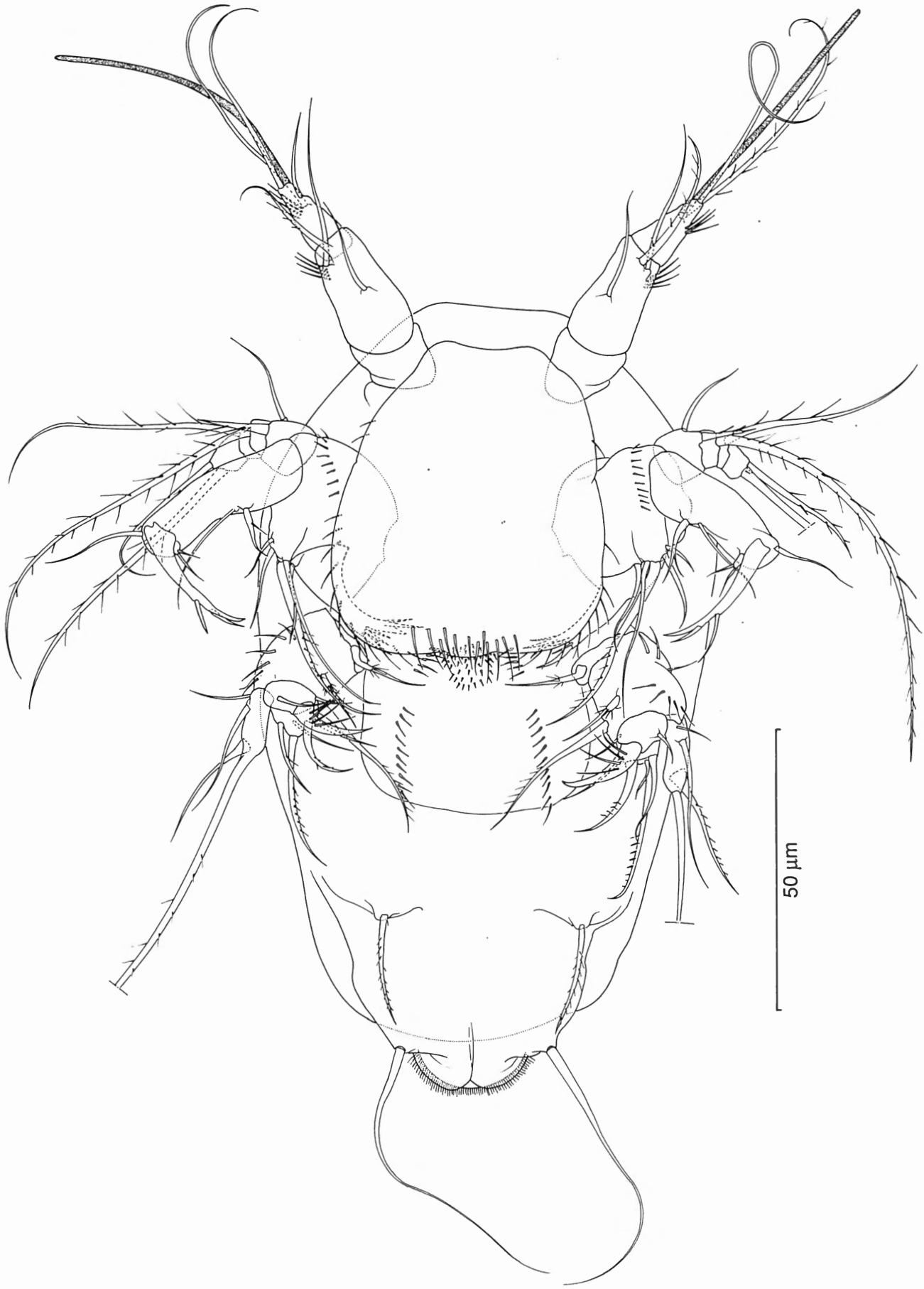

Fig. 15 – Harpacticus furcifer. *Nauplius II. Body in ventral view.*

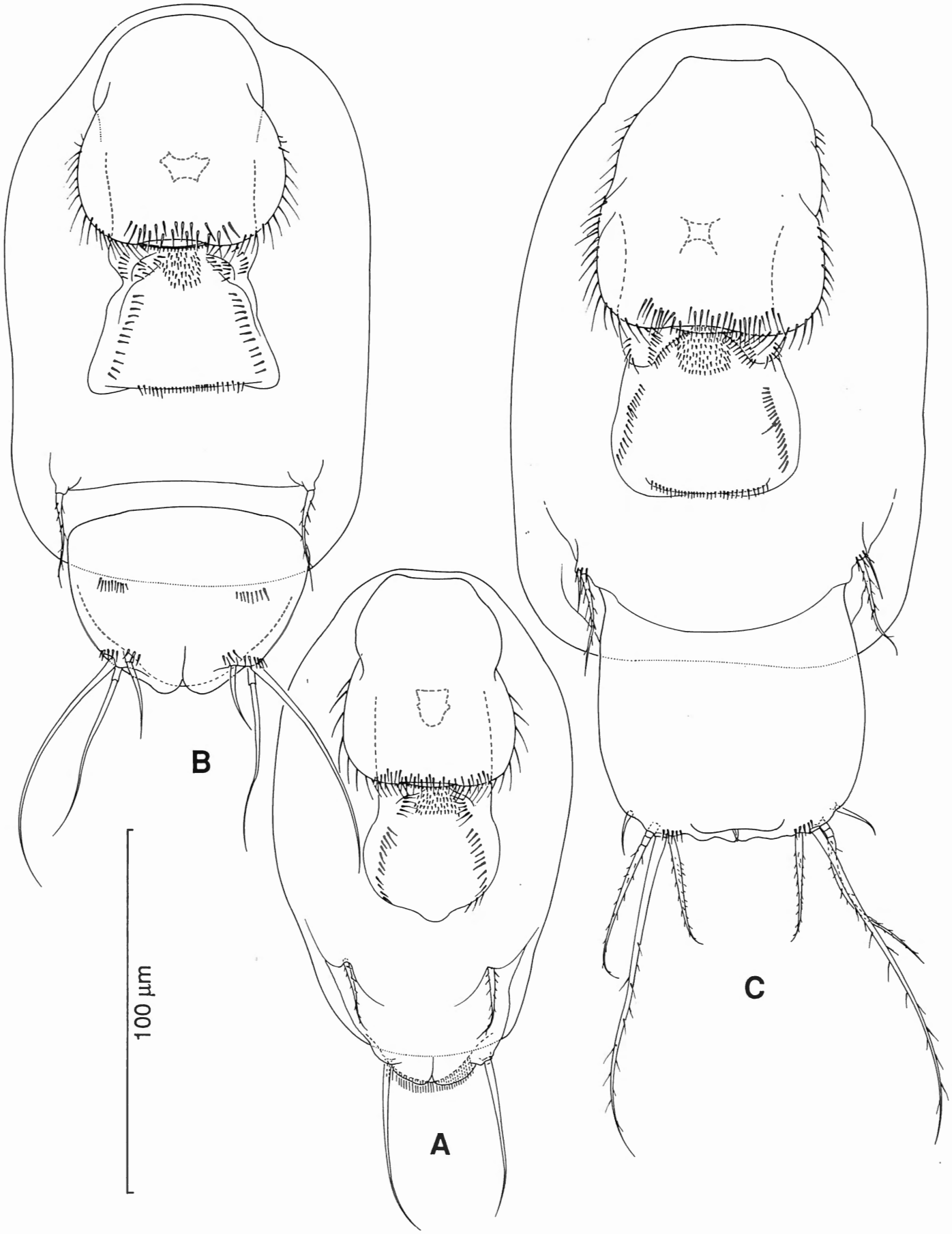

Fig. 16 – Harpacticus furcifer. *A. nauplius II, B. nauplius IV, C. nauplius V. Body shapes in ventral view, premaxillular appendages omitted.*

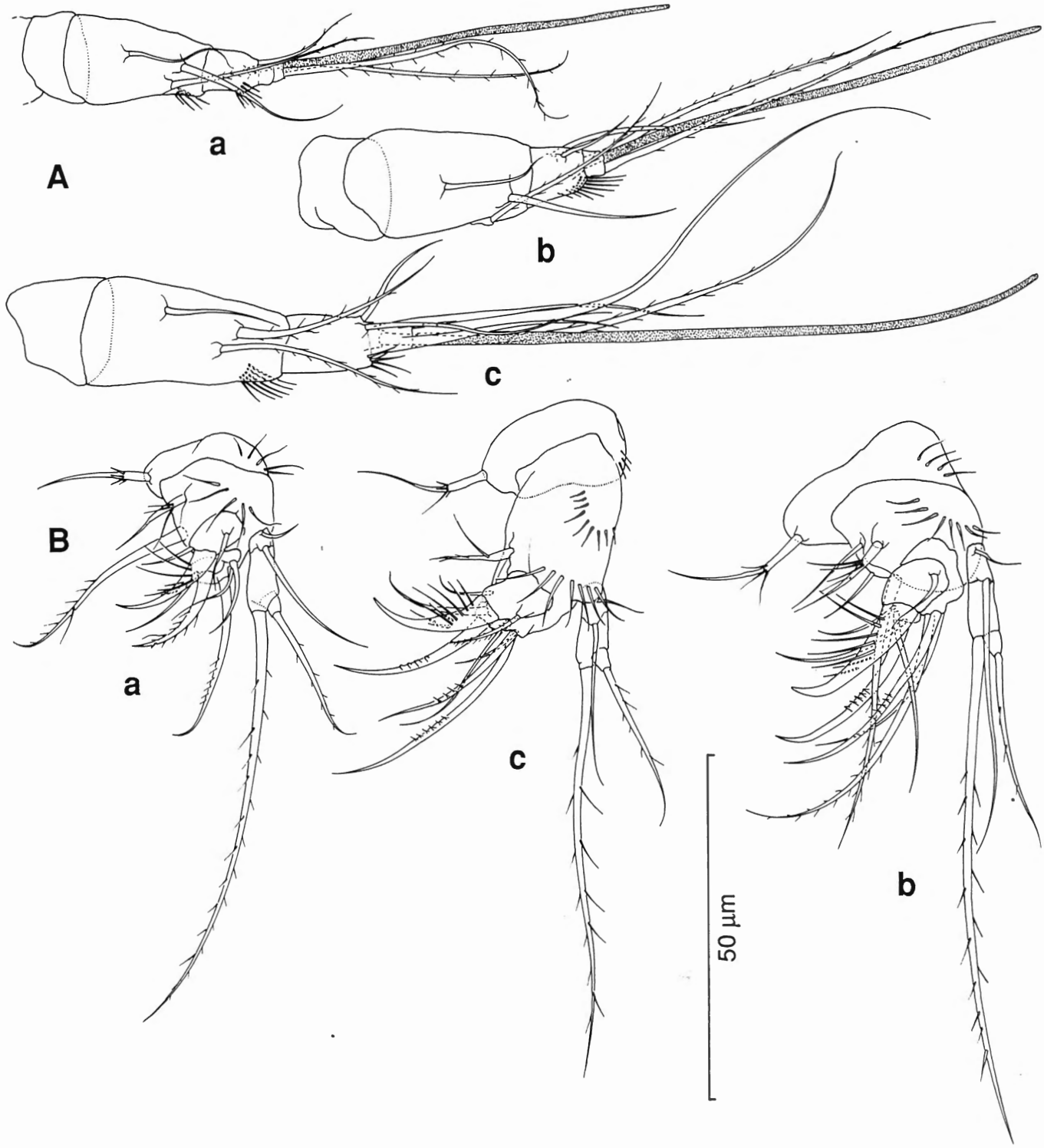

Fig. 17 – Harpacticus furcifer. *A. antennules, B. mandibles of nauplius II (a), nauplius IV (b), nauplius V (c) in anterior view.*

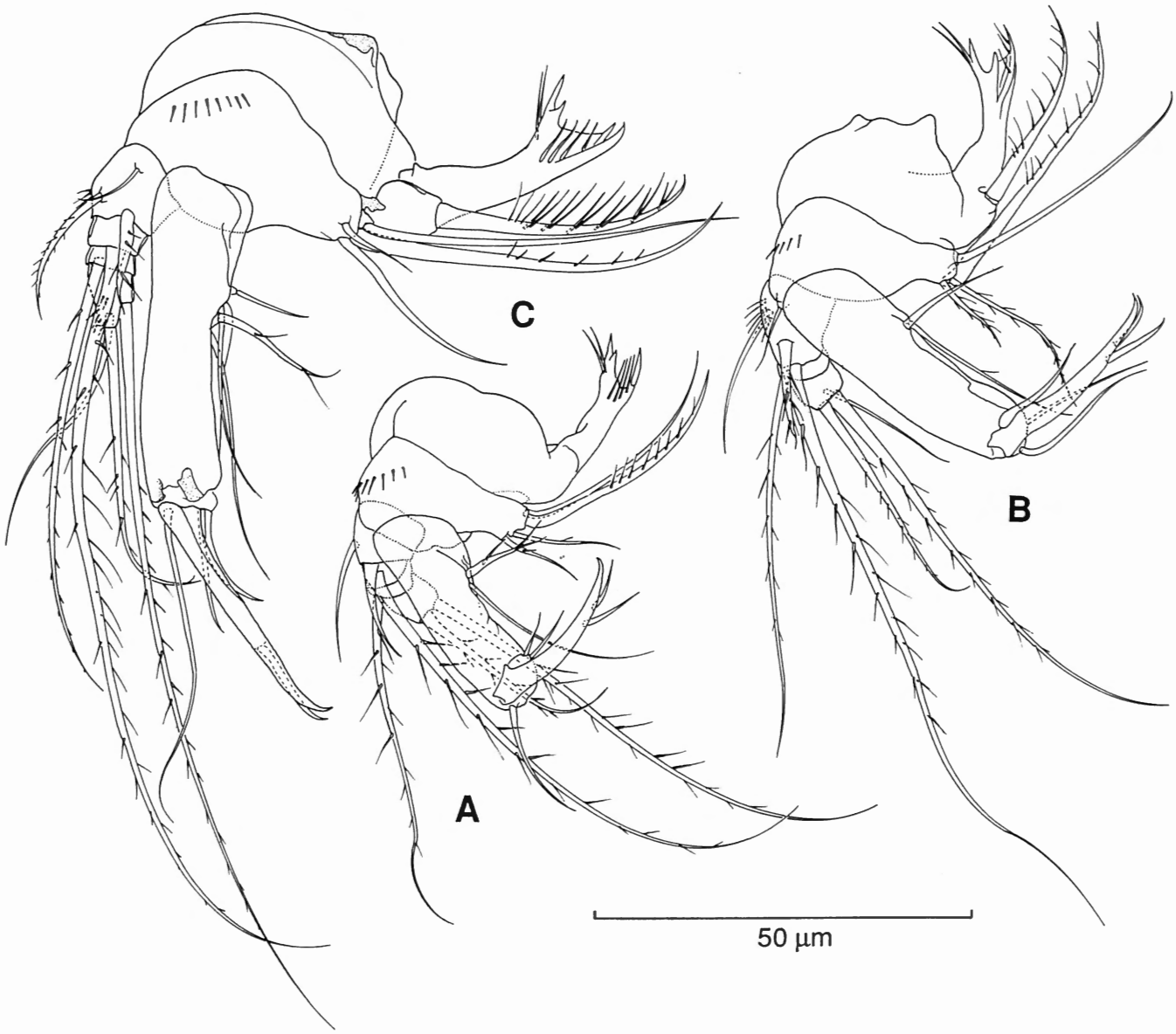

Fig. 18 – Harpacticus furcifer. *Antennae of nauplius II (A), nauplius IV (B), nauplius V (C) in anterior view.*

NAUPLIUS V

Body length 225 µm; body width 110 µm.
Hind-body with four setae on both sides, outer one new and shortest; dorsalmost seta now biarticulated; outer spinule row reduced (Fig. 16). Differences to N IV :
Antennule (Fig. 17) with third segment bearing six setae and one aesthetasc.
Antenna (Fig.18). Proximal seta of coxal process with a double-row of spinules along inner margin. Endopodite with four setae in the proximal third of inner margin.
Mandible (Fig. 17) with four setae along the inner margin of basis.
Maxillule (Fig. 16) precursor with an additional outer short seta and a row of spinules at base.

FAMILY THALESTRIDAE
Sub-family Pseudotachidiinae

Idomene antarctica (GIESBRECHT, 1902)

This species was found in pack ice of Gerlache Street as well as in the southern Weddel Sea : one non-ovigerous female (31.1.85 - 72°52'S/19°23'W - approx. 240 m); one nauplius of uncertain stage raised into adult male (3.12.87 - between 64° and 65°S/ and between 66°58,50' and 68°W - depth unknown); one precopulatory pair consisting of one adult male and one C III female, and one early copepodid moulting to a male later on (11.2.89 - 73°27,70'S/22°33,90'W - depth unknown).

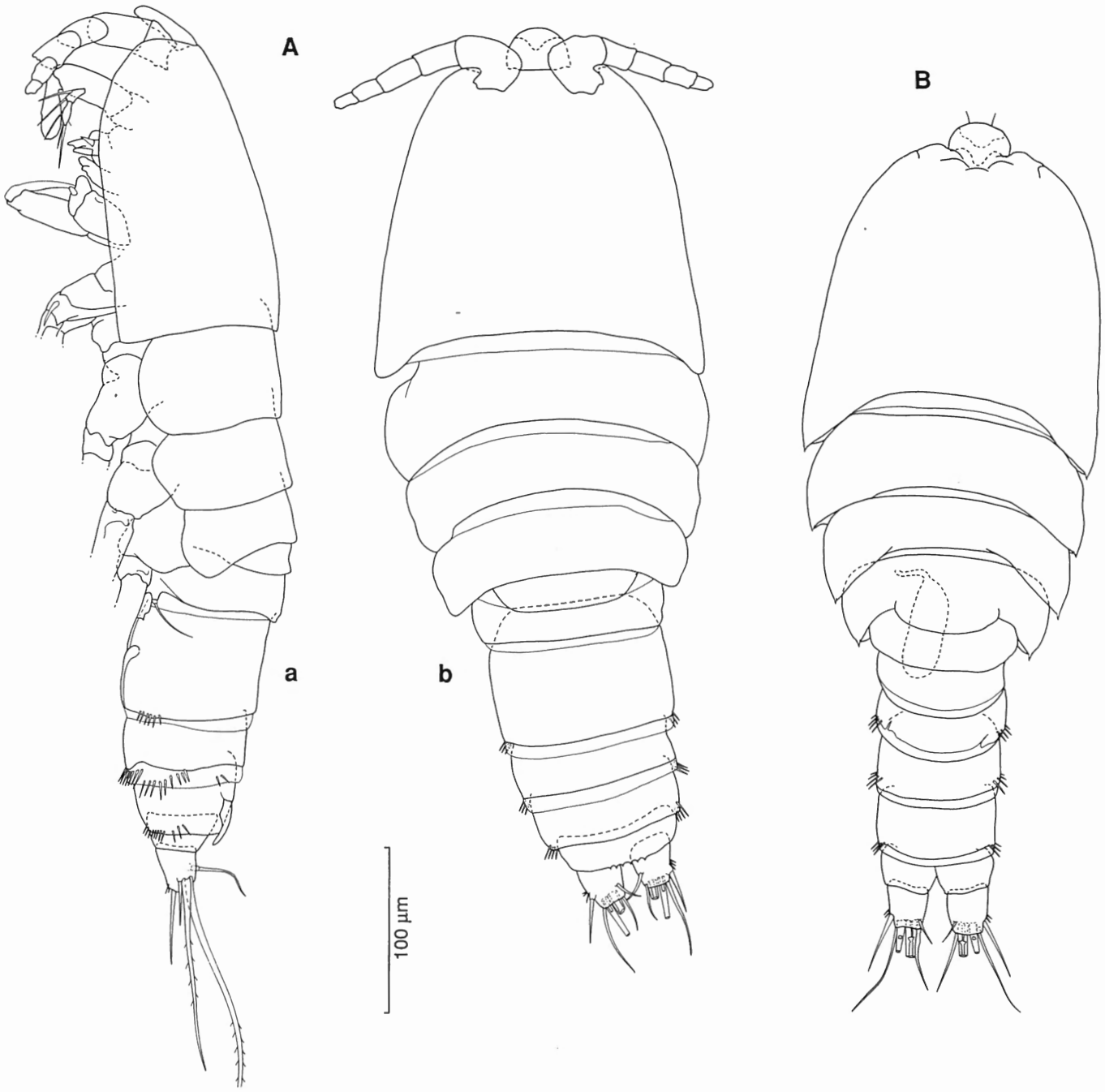

Fig. 19 – Idomene antarctica. *A. female in lateral (a) and dorsal view (b). B. male in dorsal view.*

Female (Figs 19 A, B; 20-23).

Body length 530 µm; body width 200 µm.
Abdomen as long as cephalothorax with chitinous stripe of genital double somite conspicuous ventrally. No dorsal ornamentation. Spinule rows on postero-lateral margin of 2nd-4th abdominal somites (Fig. 19) and posterior ventral margin of 3rd and 4th abdominal somites (Fig. 23). Anal somite deeply divided and operculum striated with serrate posterior edge. Caudal ramus seta I a pinnate spine, seta III-IV pinnate setae, seta VI a naked spine, seta VII triarticulate.

Antennule (Fig. 23) six-segmented with an aesthetasc on the fourth and distal segments.
Armature : 1.-9.-8.-7+Ae.-8.-7+Ae.
Antenna (Fig. 20). Allobasis curved rectangular, with one spinulose seta medially on inner edge. Endopodite with two spines and two setae subdistally and, on distal margin, one spine, four geniculate setae (outermost with spinules at elbow) and two pinnate setae. Exopodite three-segmented; first segment with two setae, second with one seta and third with three setae; a row of spinules near the base of distalmost setae.
Mandible (Fig. 20) with strong coxa. Basis with spinules

Fig. 20 – Idomene antarctica. *Female. A. antenna, B. mandible, C. maxillule.*

and four spinulose setae. Rami one-segmented. Endopodite with three setae medially and six setae terminally. Exopodite with one proximal seta, one seta midlength and two apical spinulose setae and one setule at the outer distal corner.

Maxillule (Fig. 20). Arthrite of praecoxa with nine apical spines, and two medial surface setae. Coxa with five spinulose terminal setae; basis with two lateral and four apical setae. Endopodite apically with three setae. Exopodite stout, slightly longer than broad with four well developed spinulose setae, the innermost three ones spinulose.

Maxilla (as for male, see Fig. 24). Syncoxa large with three endites, proximalmost deeply cleft. The latter with one spinulose seta on proximal part and two spinulose setae on distal part; second and distalmost endites with three spinulose setae each.

Maxilliped (as for male, see Fig. 24). Coxa with one

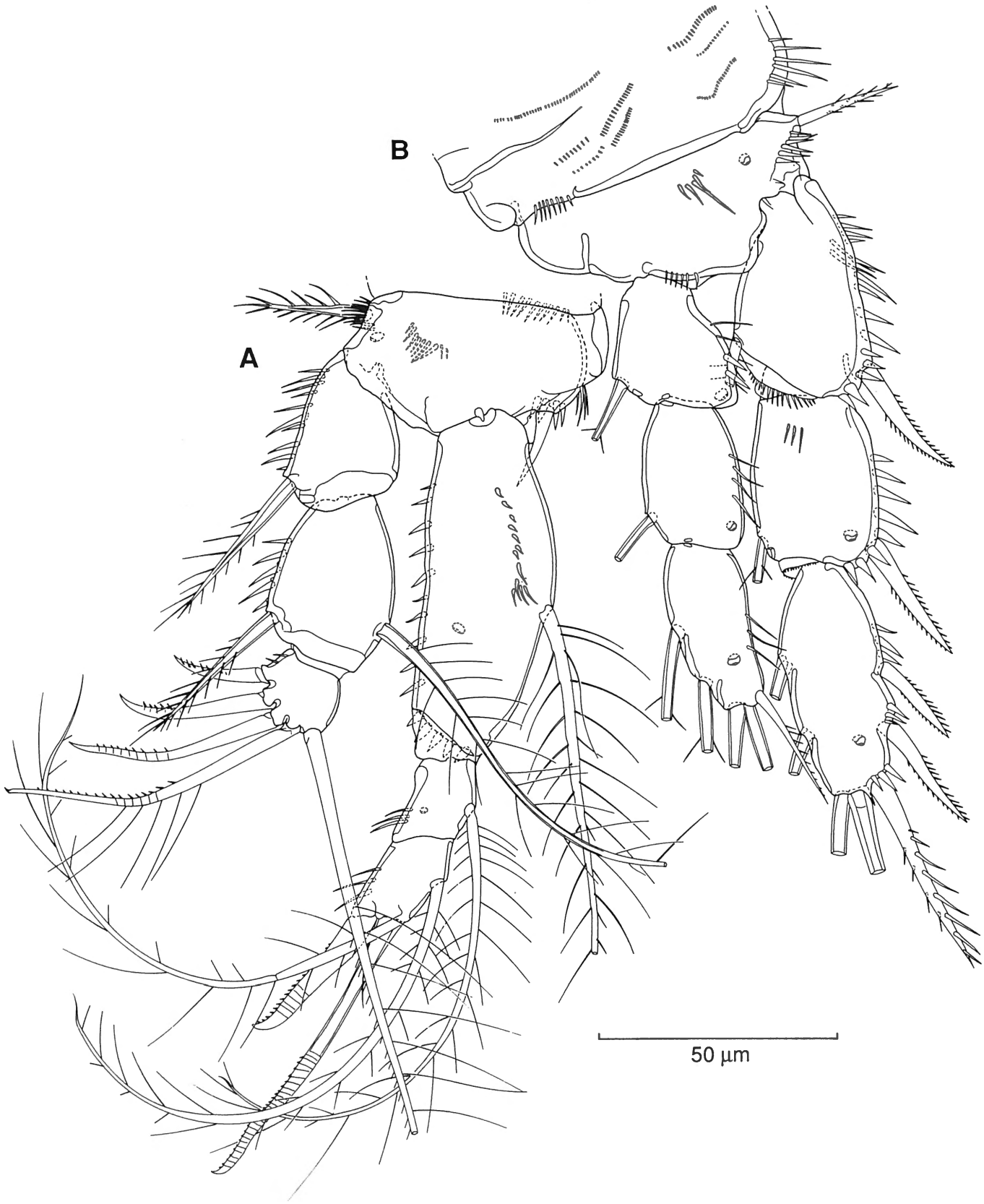

Fig. 21 – Idomene antarctica. *Female. A. swimming leg 1, B. leg 2.*

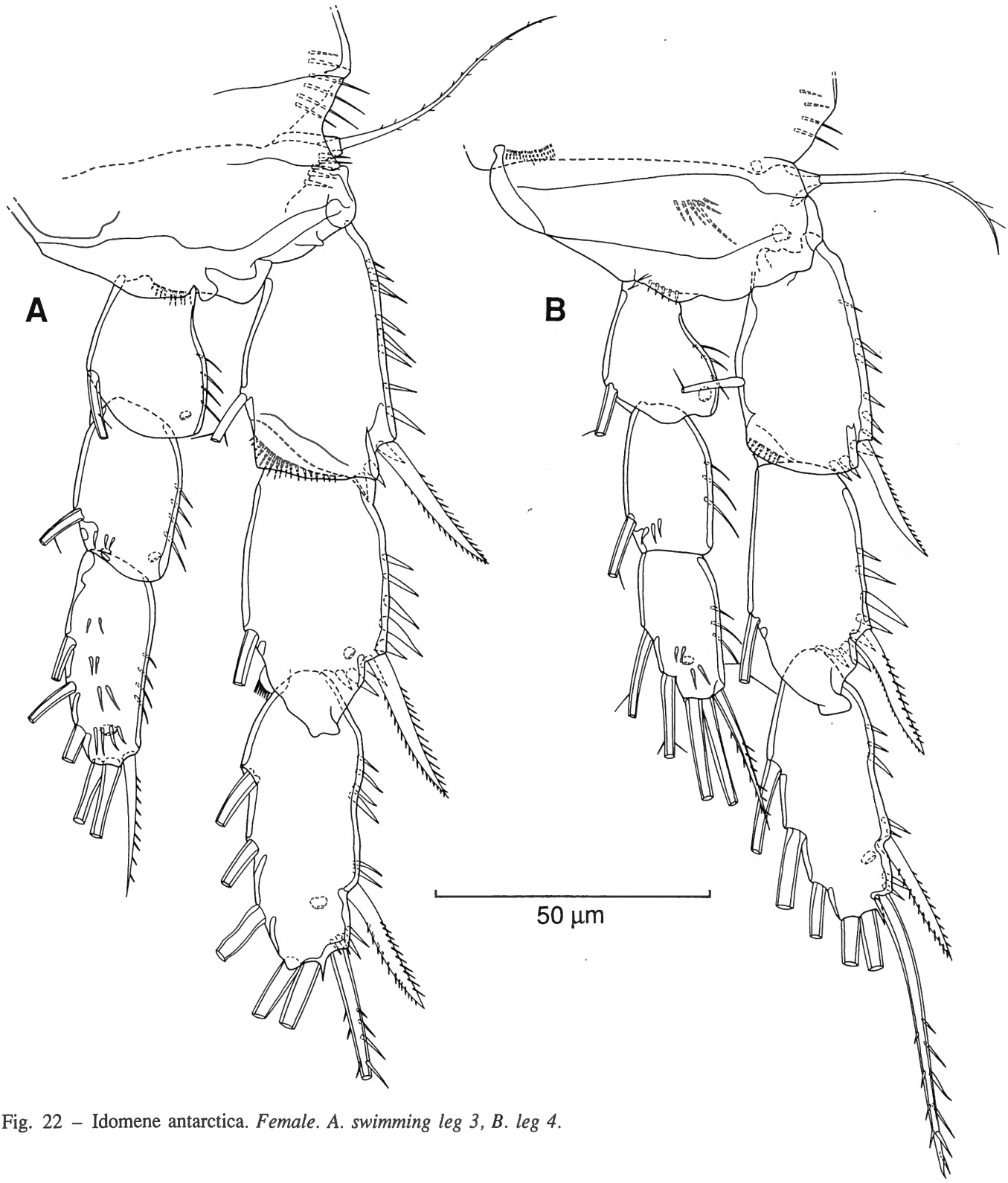

Fig. 22 – Idomene antarctica. *Female. A. swimming leg 3, B. leg 4.*

strong spinulose seta at inner distal corner. Basis with spinules and one spinulose seta midlength on inner margin. Endopodite represented as a movable claw with a seta on knob-like protrusion near the base.

P 1 (Fig. 21). Basis with strong spinulose seta on outer margin and a naked spine on inner edge. Segment III of endopodite with two spinulose setae on inner margin and two dentated, striated claws apically. Basis and first two endopodite segments with prominent pores. First endopodite segment as long as entire exopodite.

P 2 (Fig. 21), P 3, P 4 (Fig. 22) with three-segmented rami; prominent pores occur subdistally on surface of all segments except exopodite-I.

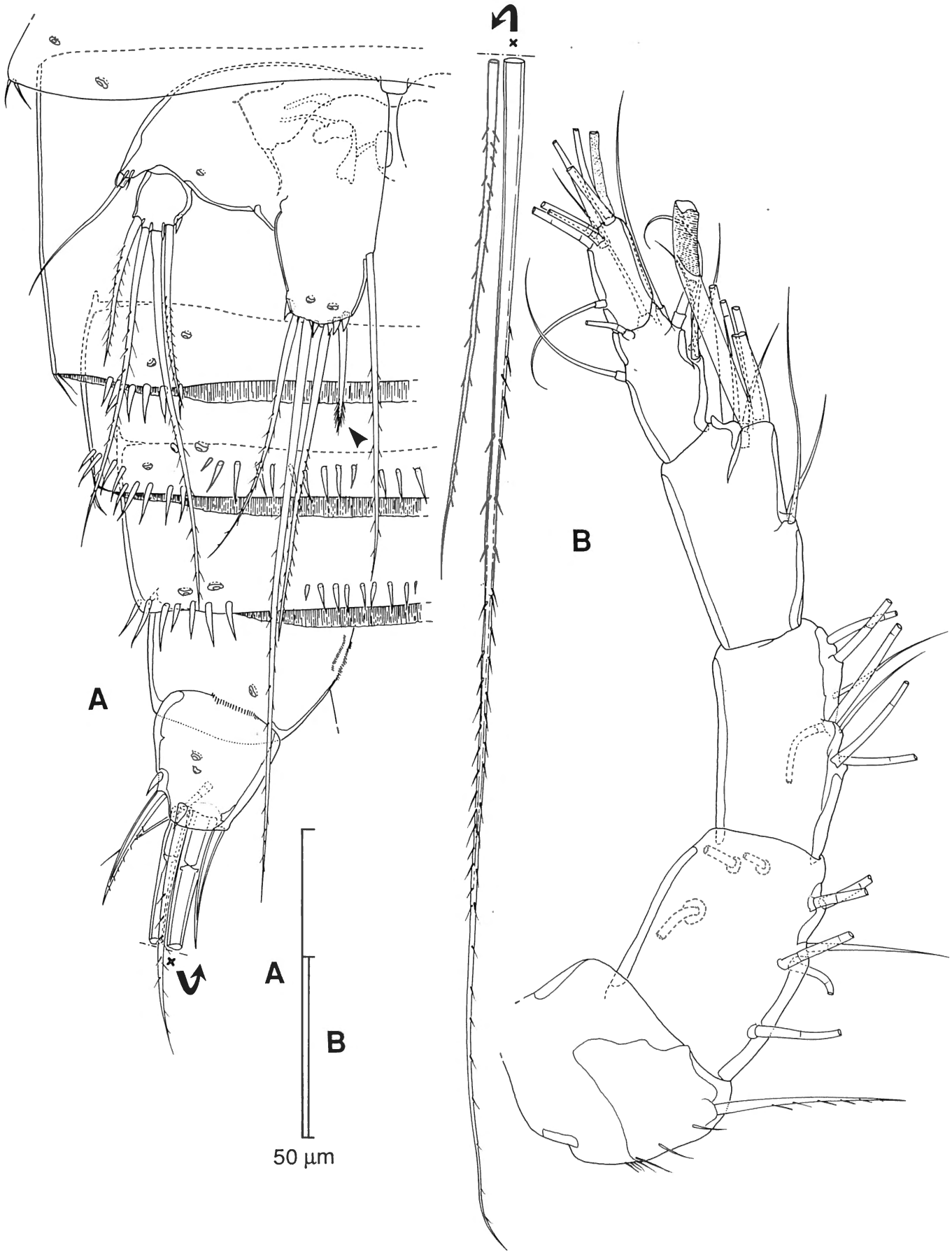

Fig. 23 – Idomene antarctica. *Female. A. right half of abdomen in ventral view, B. antennule.*

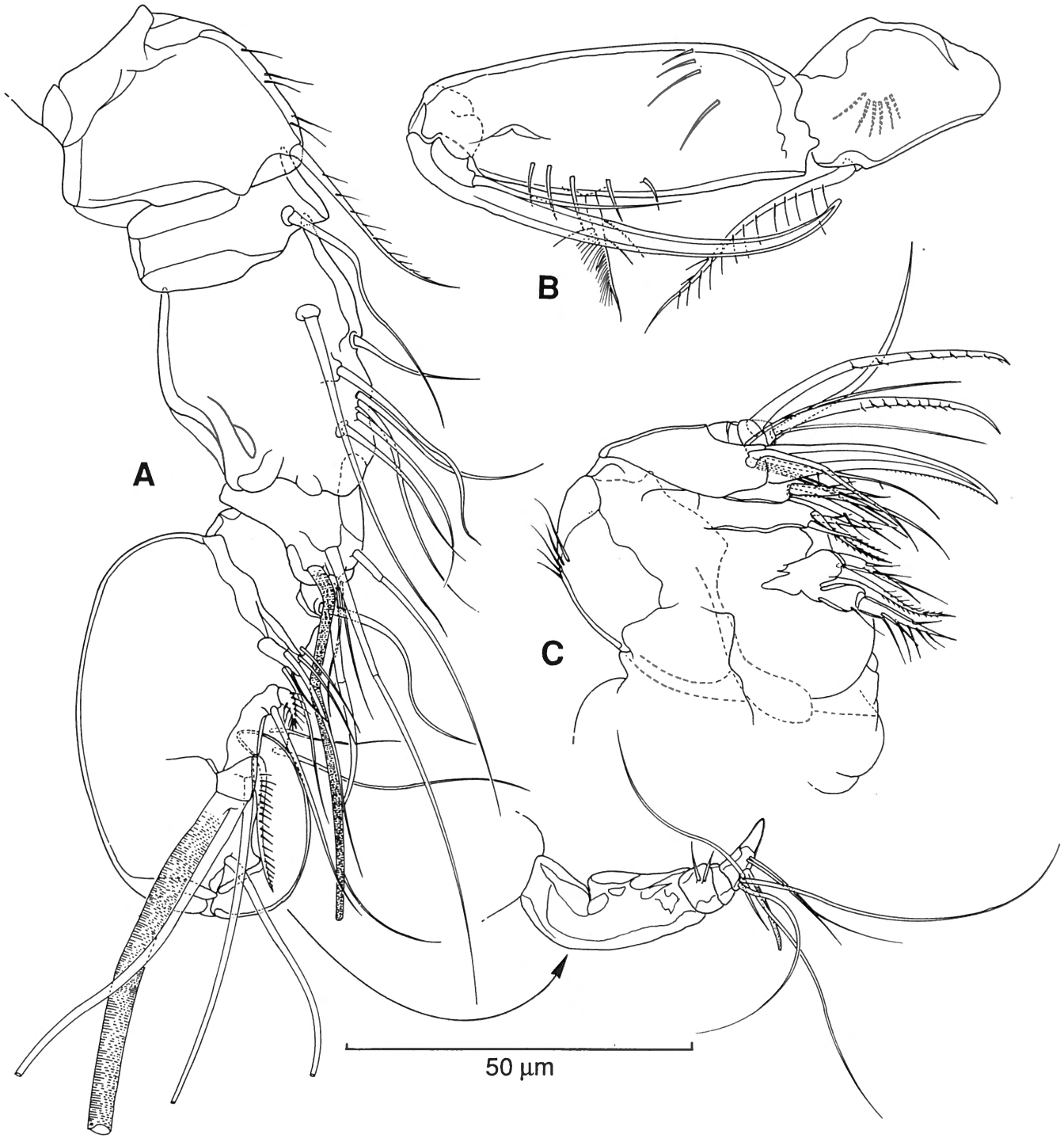

Fig. 24 – Idomene antarctica. *Male. A. antennule, B. maxilliped, C. maxilla.*

P 5 (Fig. 23). Inner expansion of baseoendopodite and exopodite well separated, the former bearing five well developed setae, second innermost shortest and densely spinulose on apical fourth (arrowhead in Fig. 23). Exopodite as long as wide, with four spinulose setae of unequal length. Members not fused medially.

Table IV :
Chaetotaxy of legs of *Idomene antarctica*

	Coxa	Basis	Endopodite	Exopodite
P 1	0	2	1.1.220	0.1.023
P 2	0	1	1.1.221	1.1.223
P 3	0	1	1.1.321	1.1.322
P 4	0	1	1.1.221	1.1.322

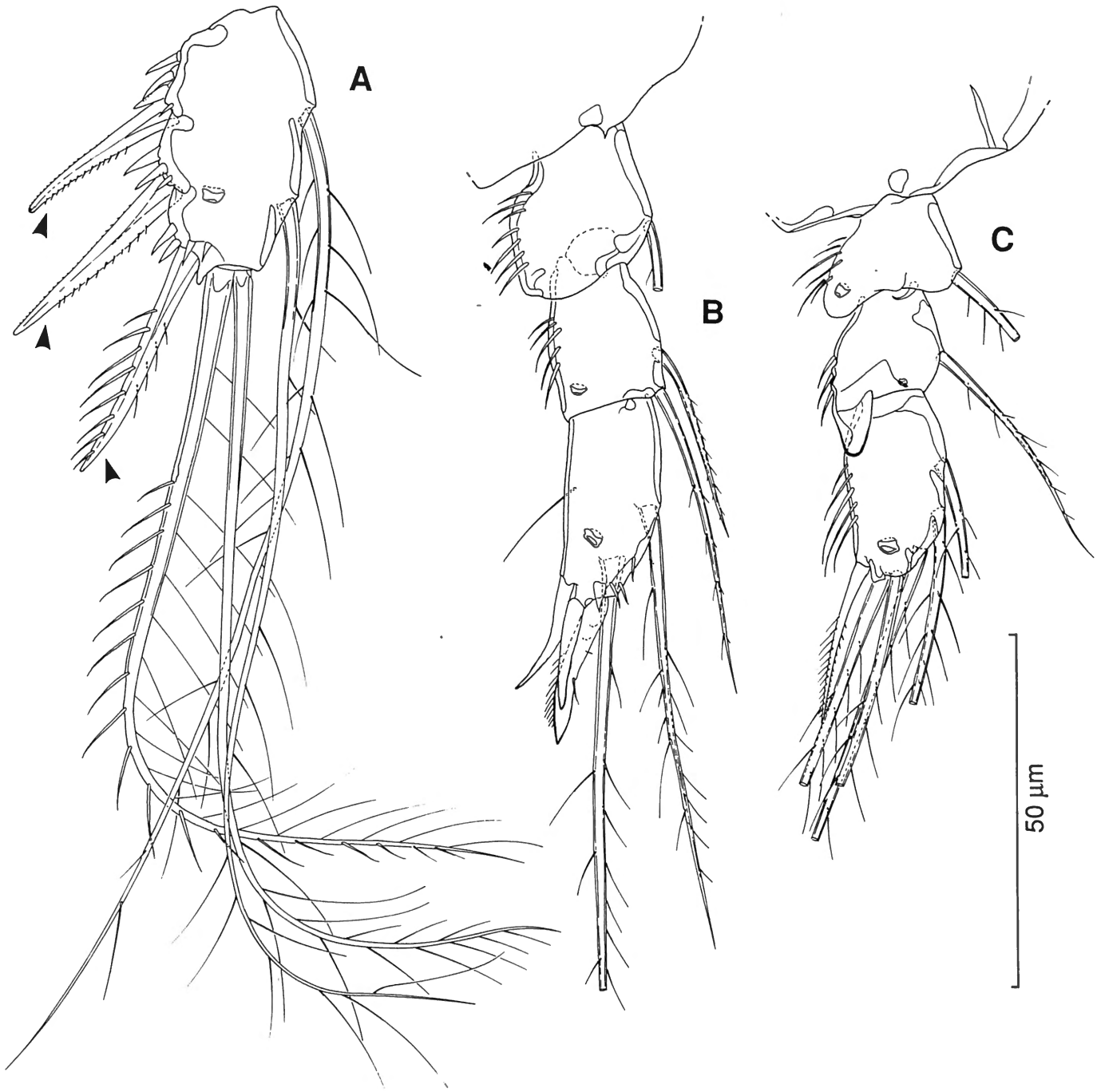

Fig. 25 – Idomene antarctica. *Male. Parts of swimming legs 2 and 3 exhibiting sexual dimorphism. A. Exopodite III of leg 2, B. endopodite of leg 2, C. endopodite of leg 3.*

Male (Figs 19C, 24, 25).

Body length 480 µm; body width 180 µm.
Sexual dimorphism manifested in antennule, P 2, P 3, P 5, P 6, and abdomen.
Abdominal somites less broad than in female.
Antennule (Fig. 24) ten-segmented, haplocer, bearing three aesthetascs. Sixth segment globularily expanded, anterior surface of complicated structure.
P 2 and P 3 endopodites (Fig. 25) transformed. P 2 exopodite III with much stronger outer setae than in female (arrowheads in Fig. 25). P 2 endopodite-II has an additional inner seta; P 2 endopodite-III terminal and outer seta transformed into short spines of equal length. P 3 endopodite-II has the inner margin extended into a small apophysis.
P 5 (Fig. 26). Inner expansion of baseoendopodite with two spinulose setae. Exopodite with five setae of unequal length, inner subapical setae shortest. Members fused medially at base.
P 6 (Fig. 26) with three setae, both innermost spinulose.

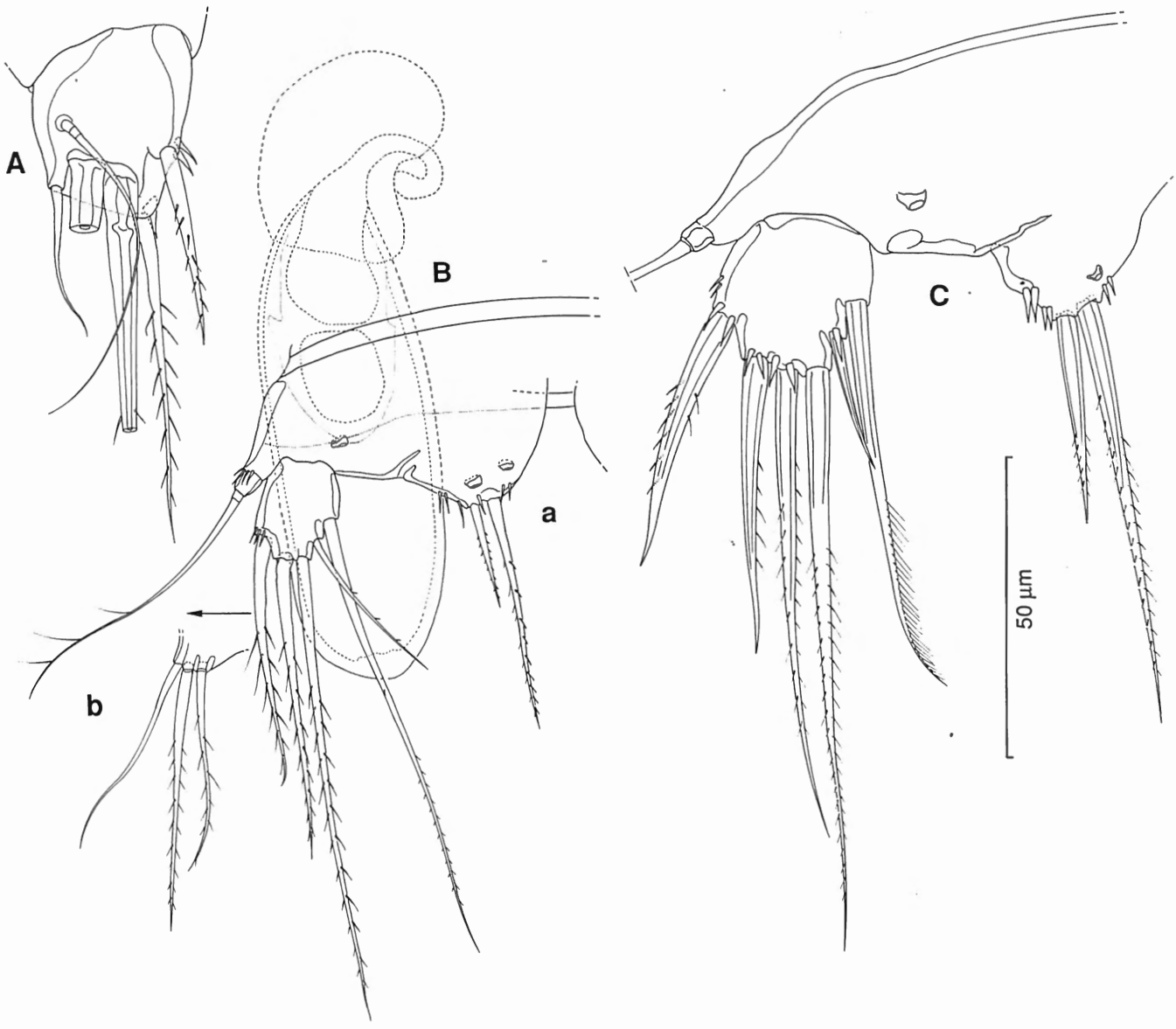

Fig. 26 – Idomene antarctica. *Male. A. caudal ramus in dorsal view, B. leg 5 (a) and leg 6 (b) (the latter shifted to the left, spermatophore in its original position as compared to leg 5 in stippled line. C. variation of* I. antarctica *in leg 5.*

DISCUSSION

The specimens redescribed herein agree well with the original description of *Dactylopus antarctica* by GIESBRECHT (1902). Differences exist in the shape of the stiletto-shaped seta of male P 2 Enp-III : the middle one is reduced in size in GIESBRECHT's specimen whereas all three setae are long in our specimens. GIESBRECHT did not mention the sexual dimorphism in P 3 Enp male where there is a knoblike protuberance on the middle segment in our specimens.

There is a striking variability in male P 5 Exp in that it may have 5 or 6 setae in different specimens. The drawing given in Fig. 26 A is similar to GIESBRECHT's original type whereas an exopodite with 5 setae was not yet known for this species. Both specimens are very similar in other characters.

GIESBRECHT (1902) encountered this species in plankton hauls from the following locations : April 1898 - 71°02'-S,92°03'W - 10 m; April 1898 - 70°44'S,90°58'W - 350 m; May 1898 - 70°41'S,90°14'W - 350 m; May 1898 - 70°33'S,89°22'W - 350 m; May 1898 - 70°49'-S,89°19'W - 450 m; May 1898 - 71°24'S,89°12'W - surface; September 1898 - 69°59'S,82°39'W - 500 m.

General discussion

GEOGRAPHICAL DISTRIBUTION

From a total of 84 ice samples investigated in the present study, 71 contained Copepoda (Harpacticoida and Calanoida) and 13 were without any Metazoa. In 26 samples Harpacticoida and Calanoida were present; 17 samples contained only Harpacticoida and 28 only Calanoida. Thus, harpacticoids were present in 43 samples (cf. DAHMS *et al.*, 1990b).

Drescheriella glacialis and *Harpacticus furcifer*, have a wide distribution in the Weddell Sea, occurring as far north as the South Orkneys, offshore in the far east and near the shelf ice at Drescher Inlet (DAHMS *et al.*, 1990b). *D. glacialis* is by far the most abundant species : during Ant V/2, a total of 458 specimens were collected. DAHMS & DIECKMANN (1987) reported a maximum of 295 specimens from a single sea ice core yielding 8 l melted seawater. *Idomene antarctica* was found near shore at Drescher Inlet and above relatively shallow water (approx. 240 m depth) west of the Antarctic Peninsula in Gerlache Street. Its occurrence offshore remains to be documented. Although *Drescheriella racovitzai* was found only at two different locations, this species is believed to belong to the sympagic fauna. A single female of *Tisbe* sp. (not described herein) is believed to be of benthic origin but became entrapped in the ice accidentally.

Compared with the remarkable diversity of benthic Harpacticoida of the Weddell Sea shelf (DAHMS *et al.*, 1987), the ice-inhabiting species are only a small though highly specialized fraction of the total harpacticoid fauna of the Antarctic.

GRAINGER & MOHAMMED (1986) mentioned nineteen copepod species found in sea ice in the Arctic, nine of which belong to the Harpacticoida. For the Antarctic, ANDRIASHEV (1968) reported three genera of Harpacticoida, viz *Tisbe*, *Harpacticus* and *Dactylopusia* (syn. *Dactylopodia*). As these same genera are also known from the Arctic, they seem to be preadapted for becoming a member of the sympagic fauna. *Idya racovitzai* GIESBRECHT, 1902 is reallocated herein to *Drescheriella*. ANDRIASHEV's species of *Harpacticus* most likely is identical with *Harpacticus furcifer* (found in the Antarctic by GIESBRECHT (1902), FARRAN (1929) and WOLFENDEN (1908) : cit. LANG (1948)). *Harpacticus furcifer* had been discovered between algae of a brackish water trough amidst the pack ice by GIESBRECHT (1902) as well as by FARRAN (1929) but had not been recorded again since ever. The only genus known from the Antarctic and not found during the present study is *Dactylopusia* which could be a misidentification and in reality be the related taxon *Idomene*.

ICE HABITAT

In the area of the pack ice zone where sea ice is reformed every year after melting away in summer the ice habitat and its epontic communities are ephemeral (BUNT & WOOD, 1963). Therefore, the sympagic fauna has to recolonize the newly formed annual ice either from the sea bottom, the water column or a marginal fast ice belt of the coast. *Hastigerella antarctica* sp. n., unfortunately represented by one adult specimen only, probably is a planktonic species with strong affinities to sea ice. A nauplius probably belonging to this species is found in the ice. *Idomene antarctica*, although found in low numbers, is present in sea ice not only of the inner Weddell Sea but also of Gerlache Street. Therefore, this species seems to belong to the genuine ice fauna. The most abundant species in the present study, *Drescheriella* spp. and *Harpacticus furcifer*, occur both in the fast ice belt near to the ice shelf, and in annual pack ice far offshore above deep water. After the summer melting of this offshore ice recolonization in winter from a coastal fast ice belt is as unlikely as from the benthos. Therefore, these species must spend some time in the open water, and, if they are not completely neustonic must be able to invade the newly formed sea ice from the plankton by vertical migration.

PLANKTONIC HARPACTICOIDA

Several quite unrelated harpacticoid species are known to be pelagic throughout their life cycle. LANG (1948) listed twelve holoplanktonic species belonging to six families. Whereas in Aegisthidae, Miracidae and Clytemnestridae all known species are planktonic, Ectinosomatidae have only two, Tachidiidae and Thalestridae only one planktonic species each, all of their other species being epibenthic or phytal. LANG omitted *Bathyidya* FARRAN, 1926, *Paraidya* SEWELL, 1940 and *Tisbintra* SEWELL, 1940 known at that time to be holoplanktonic Tisbidae. Later BOXSHALL (1979) described two new genera (*Volksmannia* and *Neotisbella*) from open waters of the northeastern Atlantic and grouped all the abovementioned holoplanktonic genera together with *Tisbe* LILLJEBORG, 1853 and *Tisbella* GURNEY, 1927 into the *Tisbe* group within the subfamily Tisbinae. The swimming ability of the latter two genera is good. Adult *Tisbella* are reported by VOLKMANN (1979) to have a more gliding movement than *Tisbe*. DAHMS & DIECKMANN (1987) considered the new genus *Drescheriella* to be a sistergroup of *Tisbe*. They did not mention the good swimming ability of the copepodids of this genus, a behavioural trait held in common with all members of the *Tisbe* group (sensu BOXSHALL, 1979). The diapausing copepodids and adults of *Drescheriella racovitzai* display an even more pronounced swimming/floating behaviour for they have never been observed touching the bottom of the culture bowl.

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