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Paravireia holdichi n. sp., an enigmatic isopod crustacean from the Canary Islands with affinities to species from New Zealand

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Abstract

Paravireia holdichi n. sp. is reported from the Canary Islands, western Atlantic Ocean. The new species was discovered within empty barnacle shells in areas of intense tourism. It differs from other species of the genus in having a distinctive shield-like shape of the head and prominent lateral keels on anterior pereonites of males. The genus is unique within the Isopoda in lacking any trace of the uropoda. It is remarkable that the two other known species of the genus occur only in New Zealand. Three species are known, the type species *Paravireia typica* Chilton, 1925, from the supralittoral, and *P. pistus* Jansen, 1973, from the sublittoral, each from single localities in New Zealand, while *Paravireia holdichi* n. sp. is known from several supralittoral locations in the Canary Islands. Comparison with known isopod taxa leads to the conclusion that *Paravireia* does not fit clearly into any known isopod family, although on the basis of overall similarity of the antennule, antenna, mouthparts and pereopods the genus is regarded as incertae sedis with the strongest affinities to the Sphaeromatidae.

Key words: Crustacea, Isopoda, Sphaeromatidae, Paravireia holdichi, taxonomy, Canary Islands, barnacles, phylogeny

Introduction

A peculiar isopod was discovered in 1996 by Dr. D. Holdich (University of Nottingham, England) while examining barnacle shells on high rocky inter-tidal shores of the Canary Islands (Gran Canaria and Lanzarote). At first sight, it seemed to belong to no existing isopod genus or family, and was sent to the authors for closer examination. It proved to be a new species belonging to the largely overlooked genus *Paravireia* Chilton, 1925, until now only known from a supralittoral stream in New Zealand and from shallow marine mud bottoms of Stewart Island, New Zealand (Chilton 1925, Jansen 1973).

The taxonomic relationships of *Paravireia* are discussed, and while the genus seems closest to the Sphaeromatidae, the lack of uropods, the segmentation of the pleon and a bilobed maxilla 2 prevent its inclusion in that family. At present we regard the genus as incertae sedis.

Paravireia Chilton, 1925, incertae sedis

Paravireia Chilton, 1925: 323.

Type species. – *Paravireia typicus* Chilton, 1925, by monotypy.

Composition. – In addition to the type species, *Paravireia pistus* Jansen, 1973, and *Paravireia holdichi* n. sp., described here.

Diagnosis

Eyes lateral, on lobes in male. Cephalon deeply immersed in pereonite 1. Pereon strongly vaulted, 7 pereonites present; pereonite 1 longest segment, pereonite 7 shortest. Coxal plates free or fused to tergites; ventral margins of coxae 2–7 with fans of fused setae. Pleon with 4 free pleonites dorsally; pleonite 1 markedly narrower than pleonite 2. Fans of setae on ventrolateral margins of pleonites 2–4. Pleotelson cupolate, wider than long, distal margin with continuous dense row of setae.

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Antennule peduncle 3-articled, antenna peduncle 5-articled; both pairs of antennae with multi-articulated flagellum. Mandible with incisor, crushing (or grinding) molar and setal row present; lacinia distinct on left mandible; maxilliped palp 3-articled. Maxilla 1 with 2 endites, maxilla 2 with only 2 endites; endites medially fused, without long setae or long stout setae distally. Maxilliped palp 5-articled, palp articles articulated or variously fused. Endite long, surpassing palp article 3, narrower than palp article 4.

Pereopods ambulatory; pereopod 1 similar to pereopods 2 and 3 in both sexes; pereopods 4–7 sub-similar, similar to pereopods 1–3 but becoming progressively longer posteriorly. Pleopods all lamellar; pleopods 1–3 with endopod distinctly smaller than exopod, exopods with plumose marginal setae; pleopods 4 and 5 markedly smaller that pleopods 1–3, without marginal setae. Male with appendix masculina articulating in proximo-medial position on pleopod 2. Uropods wholly absent.

Remarks

The genus *Paravireia* has been placed within the Flabellifera (Jansen 1973) and within the Sphaeromatidae (see Chilton 1925, Nierstrasz 1931, Jackson 1941, Hurley 1961; Kensley and Schotte — World-list of isopods). Hurley and Jansen (1977) in their monograph on New Zealand sphaeromatids commented that species of *Paravireia* lacked "the characteristic pleon with only two free separate segments" that is regarded as typical of the Sphaeromatidae. Four free pleonites is indeed a plesiomorphy absent in all known sphaeromatids. Harrison and Ellis (1991) simply made no mention of *Paravireia* in their key to the genera of the Sphaeromatidae.

Comparing the morphology of *Paravireia holdichi* n.sp. and the other species of *Paravireia* with all other known isopods it is clear that the apomorphies characteristic for any of the families are absent. The genus can be immediately excluded from the Phreatoicidea, Asellota, Calabozoidea, Oniscidea, Valvifera, Anthuridea, and the families of parasitic and specialised flabelliferan carnivorous and parasitic isopods (Cymothoida sensu Wägele 1989). All these groups have unique characters that are not present in *Paravireia*. The remaining taxa that may be considered as appropriate to place *Paravireia* are all related to the Sphaeromatidae (taxon Sphaeromatidea, sensu Wägele 1989). Of these, the Plakarthriidae, Serolidae, Bathynataliidae, and Keuphyliidae have a dorsoventrally flattened, more or less disc-shaped body (although this character is variable in the Sphaeromatidae and Bathynataliidae, and also occurs to a lesser degree in the Cirolanidae).

In the Sphaeromatidae pleonites 2–5 are partly or wholly fused at least dorsally, and the uropodal endopod is fused to the peduncle. As the uropods are entirely absent in *Paravireia,* this critical character state cannot be compared with those of other species, otherwise the fusion of sympod and endopod is another apomorphy of the sphaeromatids and a useful diagnostic character.

The exopod of pleopod 5 has one or more cuticular-scale patches (see Bruce 1993, Fig 1F; 1994a, Figs 8H, 44E, 54G; 1997, 44G) in all sphaeromatid genera, although this is variably expressed from being very weak to being on prominent lobes. This character is a potential synapomorphy for the family, and indeed may be so. However, given that the character is variably expressed, being weak in some genera, we feel that it would be premature to definitively exclude *Paravireia* from the Sphaeromatidae on the basis of this character.

On the other hand, in *Paravireia* the morphology of most of the appendages falls well within the range shown by the Sphaeromatidae. The antennule, antenna, mandible, maxilla 1, maxilliped, pereopods and pleopods differ little at family level (see SEMs in Bruce 1994a, 1994b, 1995, 1997).

The maxilliped palp of *Paravireia* lacks medial lobes on article 2–4. The maxilliped in most sphaeromatid genera has palp articles 2–4 with the medial margin extended to form a lobe to greater or lesser degree. However, as with many characters, while generally considered 'typical' for the family, it does not hold true for all genera, with *Heterodina* (Kensley and Schotte, in press), *Syncassidina* Baker, 1929 (see Harrison and Holdich, 1981; Bruce 1994a) and *Platysphaera* Harrison and Holdich 1981 (see also Bruce 1994a) all lacking lobate maxilliped palp articles.

Maxilla 2 differs from all variations known in the Sphaeromatidae. In all sphaeromatid genera, including the highly modified commensal genus *Xynosphaera* Bruce, 1994b, maxilla 2 has three lobes, whereas there are only two lobes in *Paravireia*. The morphology of maxilla 2 is not unique to *Paravireia*, and is much the same as that shown by the fish-parasitic families Aegidae and Cymothoidae, a difference being the lack of recurved spines in *Paravireia.* Reduced lobes also occur in the Oniscidea.

Another feature seen in some sphaeromatids is the lateral cuticular membrane seemingly being composed of fused setae (see Fig. 12B, C). Such membranes are present e.g. in *Paraleptosphaeroma* (Buss & Iverson 1981, Müller 1990) but also in the Plakarthriidae (J.W. Wägele, unpublished observations) and therefore may be a plesiomorphic character within the Sphaeromatidae.

Paravireia lacks characters generally regarded as 'typical' of the Sphaeromatidae such as fused pleonites and scale lobes on pleopod five. As the uropods are entirely absent, the critical and diagnostic character of the fused uropodal endopod cannot be used, and as there is a lack of unique character states we cannot unambigu-

ously establish a new family, and indeed even to assess the need for a new family at this point. The only unique character at present is the total absence of uropods, and until further research is undertaken on both the type species of *Paravireia* and the phylogeny of the Sphaeromatidae and related families, we feel that it is prudent to conserve the genus as incertae sedis.

Paravireia holdichi n. sp.

Material

All material from the Canary Islands, coll. David M. Holdich (University of Nottingham, England).

Holotype: 1 male, 3.4 mm, Queensland Museum (QM W25438), Playa Taurito, Gran Canaria, collection date 12/04/1999, 27°48′ N, 15°45′ W, solitary in empty barnacle tests at high-tide level on cliff face exposed to strong wave action.

Paratypes: 3 males, 2.3–2.9 mm, 2 females, 2.4 and 2.6 mm, 1 immature specimen, 1.9 mm, same locality as holotype; 2 males, 2.5 and 2.6 mm, 2 females, 2.2 and 2.8 mm (QM W25439 and W25440). 2 enrolled specimens (probably females), 2.5 and 2.6 mm, Hotel Salinas, Costa Teguise, Lanzarote, upper shore, rock crevices and barnacles; 26 micro-slides, 13 with appendages from male and 13 with appendages from a female (2.2 mm) (QM W24901). Further material (in possession of J.W.W., to be deposited in the Zoological Museum Berlin) from Tenerife, Playa de las Americas (28°3′ N, 16°43′ W) inside shells of *Chthamalus* sp. This material is being used for molecular studies.

Type locality: Playa Taurito, Gran Canaria, Canary Islands.

Distribution: Known only from the Canary Islands

Etymology: The species is dedicated to for Dr. David Holdich, University of Nottingham, in recognition of his contribution to knowledge of the Isopoda, particularly of the rocky inter-tidal shores of the eastern Atlantic.

Note: pictures of this species will be available in the electronic supplement of this journal (see http://senckenberg.uni-frankfurt.de/ODES/01-02.htm).

Description of male holotype (Figs. 1–7)

Body about twice as long as wide, oval, dorsally vaulted (Fig.2). Cephalon with 2 shield-like lobes on anterior dorsal margin, eyes on lateral lobes, deep incisions between these lobes. Pereonite 1 longest segment, with 2 deep concavities on anterior margin, dorsolaterally with a pronounced longitudinal keel, a row of small acute setae on this keel. Similar keel on pereonite 2 and on pereonite 3, on the latter beginning anteriorly and curved dorsomedially, ending in a transverse row of small setae. Similar transverse rows also present on other pereonites, but without continuation on a keel.

Relative length of pereonites: 1 > 2 = 3 = 4 < 5 > 6 > 7, pereonite 7 smallest. Coxal plates not discernible. All lateral margins of body segments and pleotelson bearing a transparent membrane seemingly composed of fine fused setae (Figs. 1, 2, 12).

Antenna 1 (Fig. 4) peduncular article 1 largest, article 2 smaller, with 3 plumose setae, article 3 smallest; flagellum of 6 articles, article 1 bearing distally 2 plumose setae and 2 simple setae, 2 aesthetascs on article 3, one on article 4, last article distally 5 simple setae.

Antenna 2 (Fig. 4) longer than antenna 1; peduncular article 3 with one seta, article 4 with 3 setae, peduncular

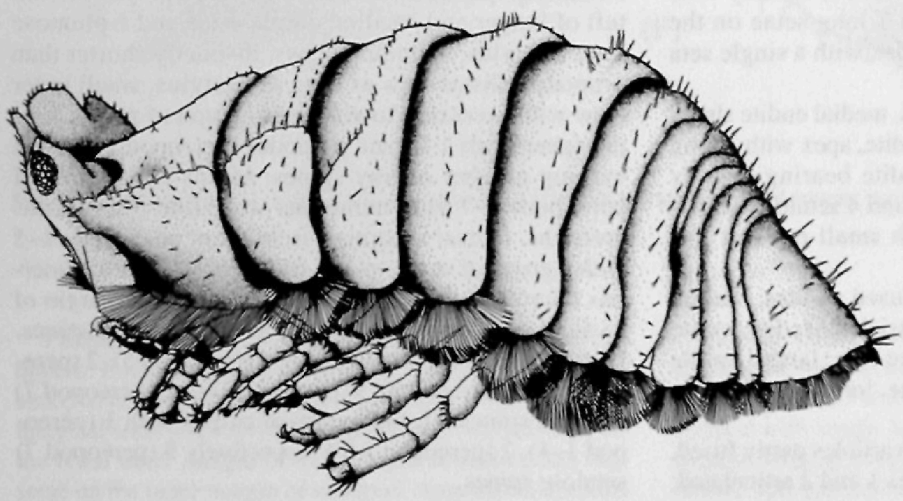

Fig. 1. *Paravireia holdichi* . n.sp., lateral view of male holotype (total length: 3.4 mm).

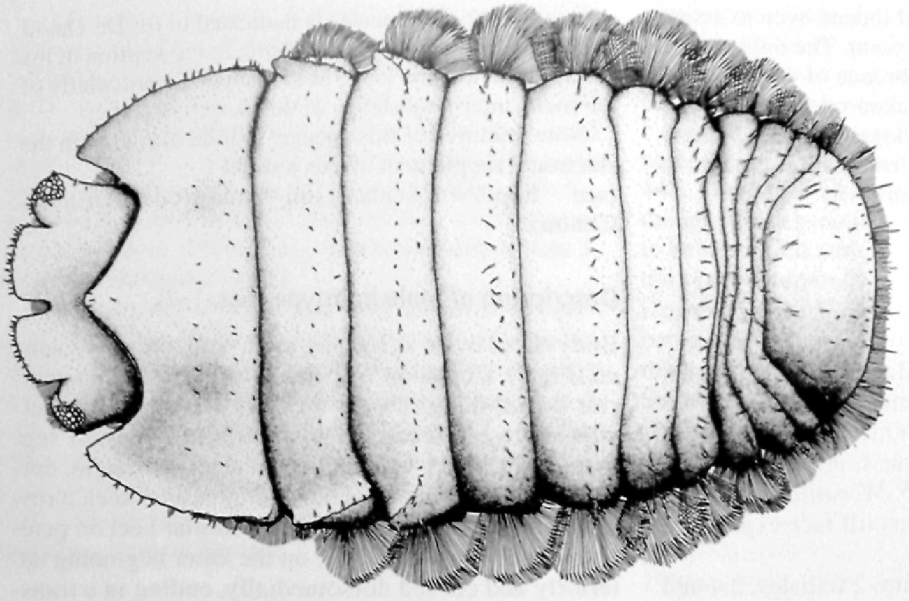

Fig. 2. *Paravireia holdichi* n.sp., dorsal view of male holotype (total length: 3.4 mm).

article 5 distally with 4 plumose and 3 simple setae; flagellum of 7 articles of decreasing size, all articles with setal tufts at the distal margin, articles 1, 2, 4, 5 each with additional single seta and terminal article with two long simple setae.

Mandibles proximally slender in comparison to other isopods, corpus mandibularis proximal to molar process with prominent lobe on the inner margin. Left (Fig. 4) lacinia mobilis with 3 teeth and setal lobe of 4 setulose spines, pars incisiva formed of 7 teeth. Right mandible without lacinia mobilis, but with setal lobe of five setulose spines, the distal ones possibly on a lobe homologous to the lacinia. Pars molaris of both mandibles with small grinding surface of small blunt teeth and with tufts of small setae on proximal margin of grinding surface. Palp article 3 smallest, with 6 setulose spines on the left and 8 on the right palp; article 2 distally with 3 setulose spines, moreover with 2 long setae on the right palp; article 1 long and slender, with a single seta on the left palp.

Maxilla 1 (Fig. 4) with 2 endites, medial endite shorter and more slender than lateral endite, apex with 3 long and some small setae; lateral endite bearing distally 5 large and 1 small smooth spines and 4 setulose spines, lateral margin of this endite with small rows of microtrichs.

Maxilla 2 (Fig. 4) flat, with 2 fused endites. Medial margin with small rows of microtrichs. Medial endite with 9 robust setae, setae not spine-like; lateral endite with numerous long hair-like setae, long apical spines absent.

Maxilliped (Fig. 4) slender, palp articles partly fused. Palp article 1 fused to basis, articles 1 and 2 articulated; medial margins of articles 2–5 with distomedial groups of simple setae, fusion line between articles visible medially. Endite long, narrower than palp article 4, surpassing palp article 3, distally with 3 smooth and blunt spines and numerous hair-like setae.

Pereopods (Figs. 5, 6) all sub-similar, becoming progressively longer posteriorly. Basis and ischium long, merus and carpus shortest articles, carpus supporting propodus with a medial protrusion, propodus elongate oval, dactlyus short. Inner margin of merus of P 1–3 with 1 longer and one short simple seta in addition to tiny setae, lateral surface with many small rows of microtrichs, distal dorsal edge with 2 setulated spines; carpus medially some simple setae and many microtrichs as on merus, distal dorsal edge with one setulose spine; propodus palm with simple setae and microtrichs, without strong spines; distal outer margin of propodus with tuft of longer and smaller simple setae and 1 plumose seta. Dactylus, including claws, distinctly shorter than propodus, distal claw as long as dactylus, small inner claw with accessory tooth. Inner margin of merus, carpus (pereopods 1–7) and propodus (pereopod 1–4) with varying number of tiny spines. Merus and carpus of pereopods 5–7 with numerous scale-like rows of microtrichs. Dorsal margin of ischium of pereopods 1–5 with a group of small spines, of pereopod 7 with numerous microtrichs and 1 setulose spine. Dorsal margin of basis of pereopod 5 also with a group of small spines. Distal margin of merus carrying 1 (pereopod 5), 2 (pereopod 2–4, pereopod 6), 3 (pereopod 1) or 5 (pereopod 7) setulose spines. Distal margin of carpus with 1 (pereopod 1–4), 2 (pereopod 5–6) respectively 9 (pereopod 7) setulose spines.

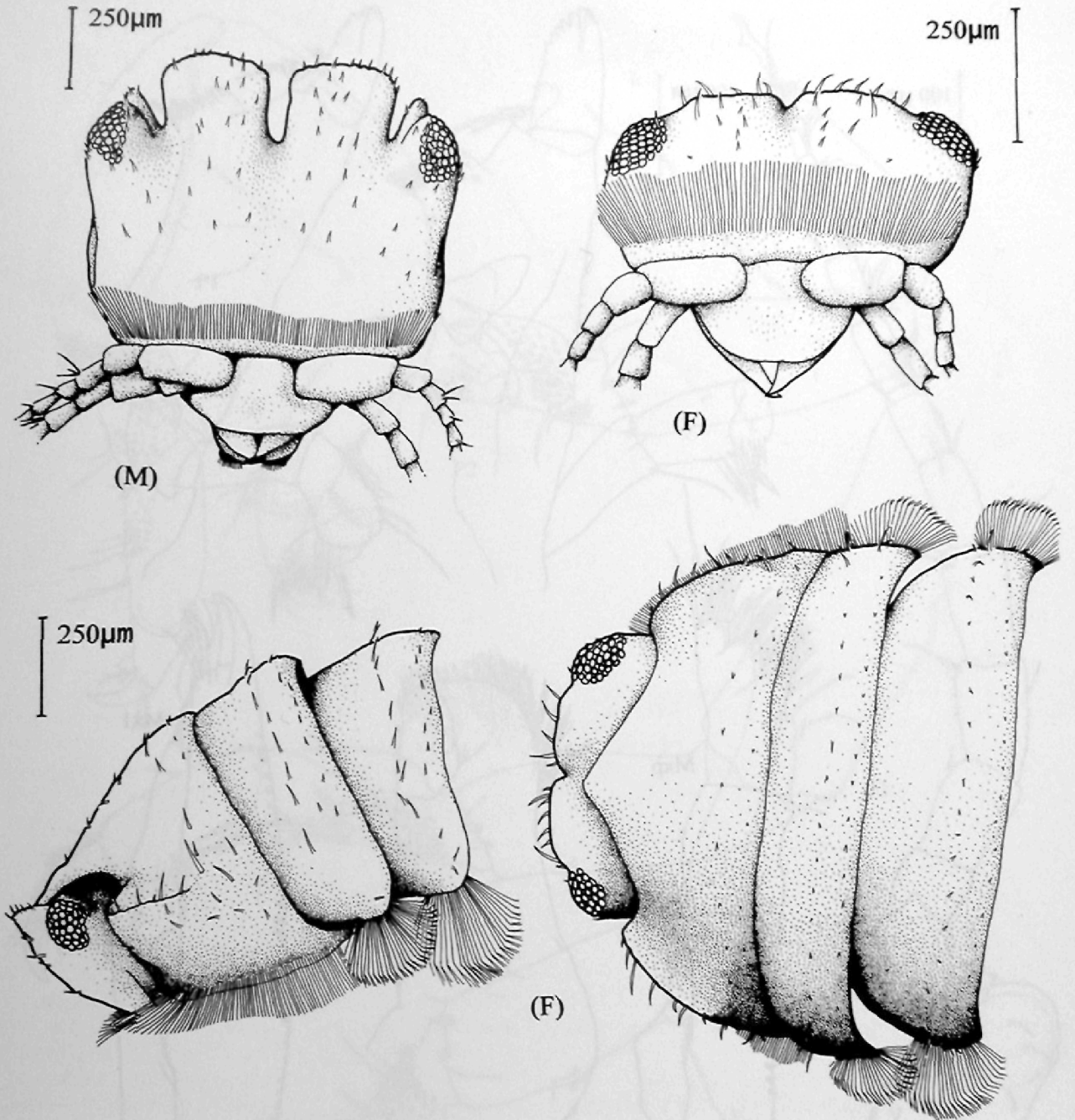

Fig. 3. *Paravireia holdichi* n.sp., head in frontal view of male (M) and female (F) and anterior body of female.

Pleopods 1–3 (Fig. 7) with large exopods and small endopods. Exopods bearing numerous plumose marginal setae, endopod of pleopods 1 and 2 bearing 4 and 2 short plumose marginal setae respectively. Pleopod 1 with 3 simple setae on the basal inner margin of exopod and numerous hair-like setae on the inner margin of endopod. Appendix masculina cylindrical, slender, with blunt apex, about twice the length of endopod. Medial margin of sympod of pleopods 1–3 with 3, of pleopods 4–5 with 2 coupling spines. Pleopod 2, 3 and 5 sympod with single seta on lateral margin. Pleopods 4–5 smaller, without plumose marginal setae, endopods oval, smaller than trapezoidal exopods.

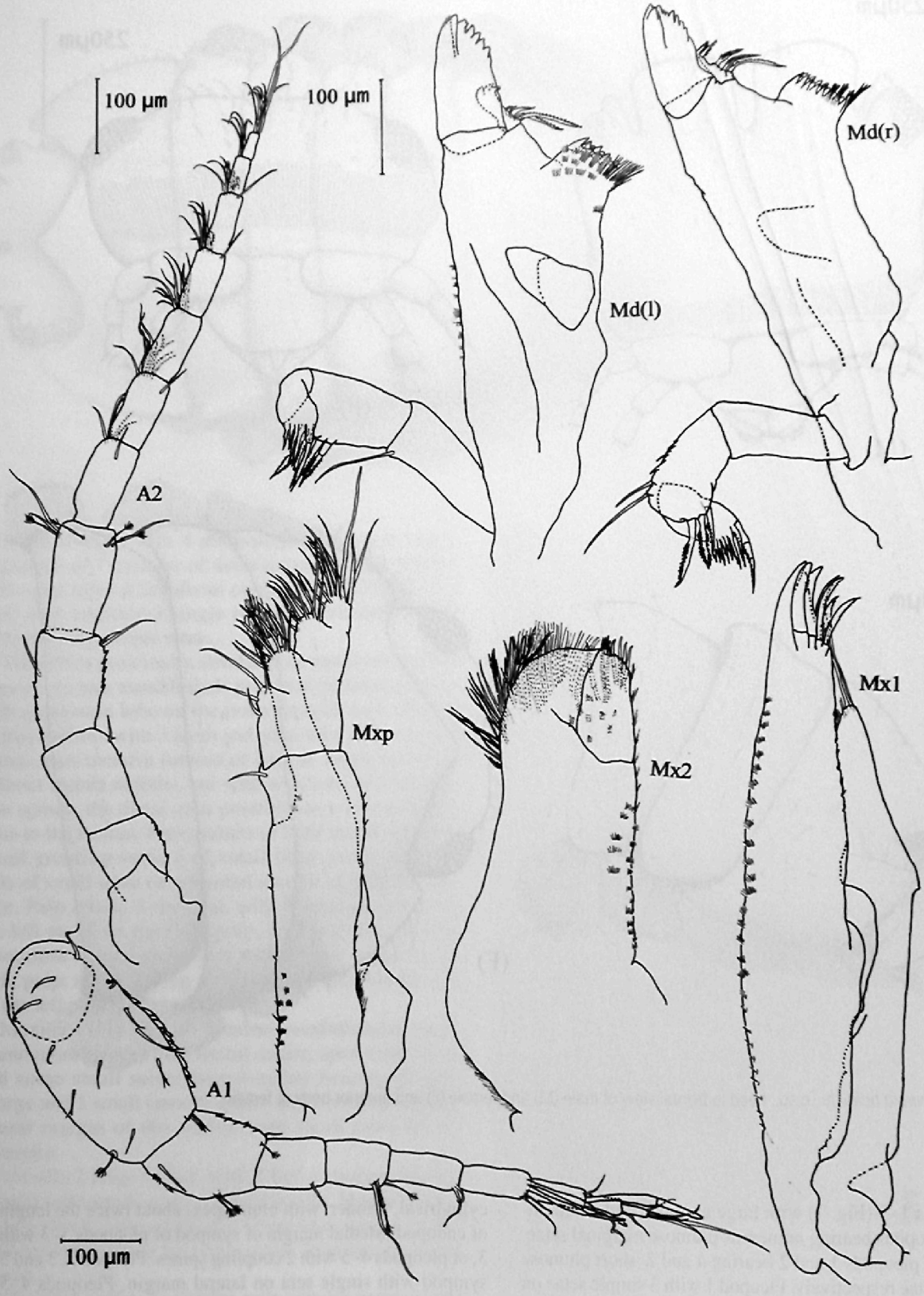

Fig. 4. *Paravireia holdichi* . n.sp., male holotype, antennae and mouparts.

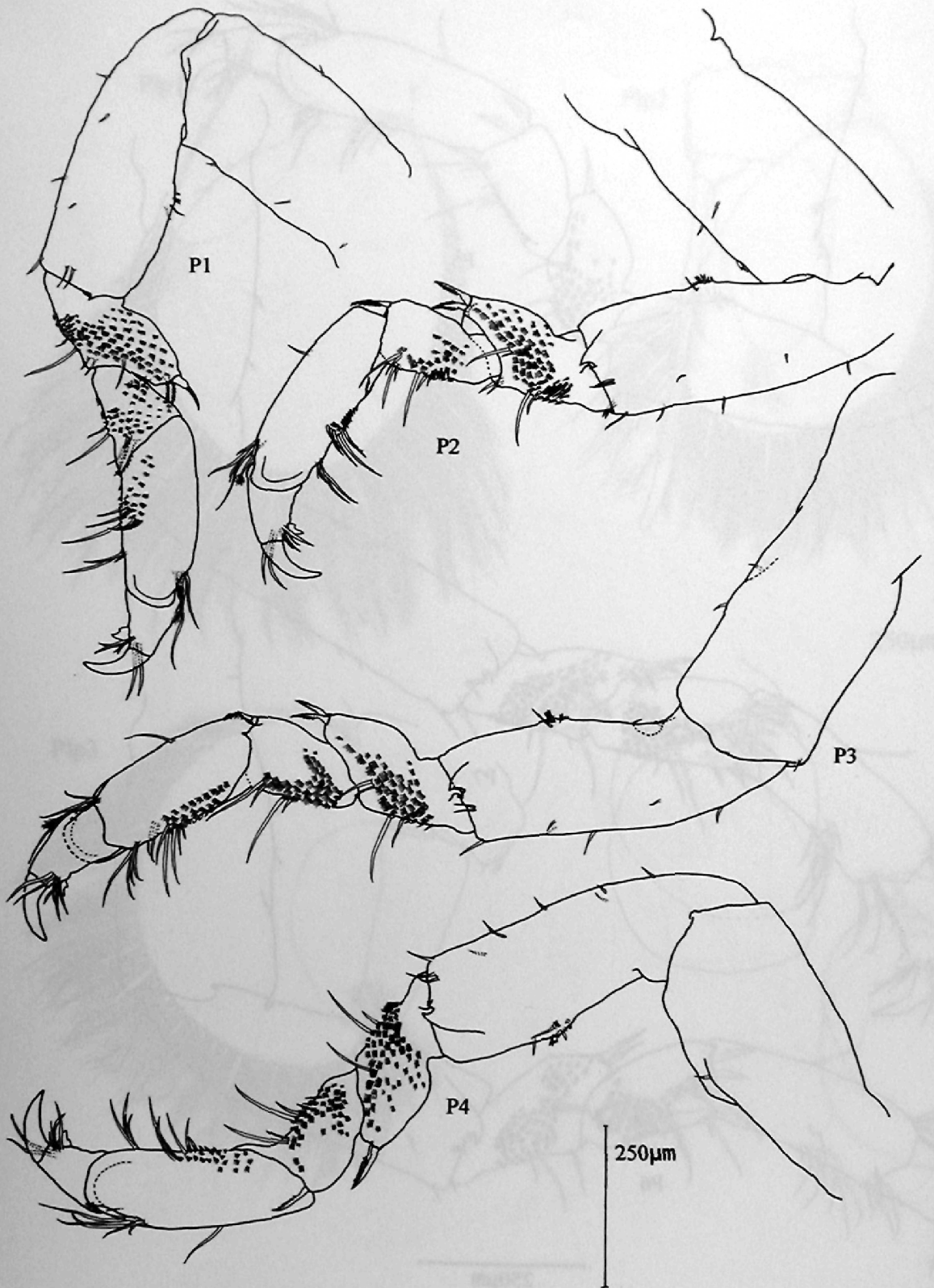

Fig. 5. *Paravireia holdichi* . n.sp., male holotype, pereopods 1–4.

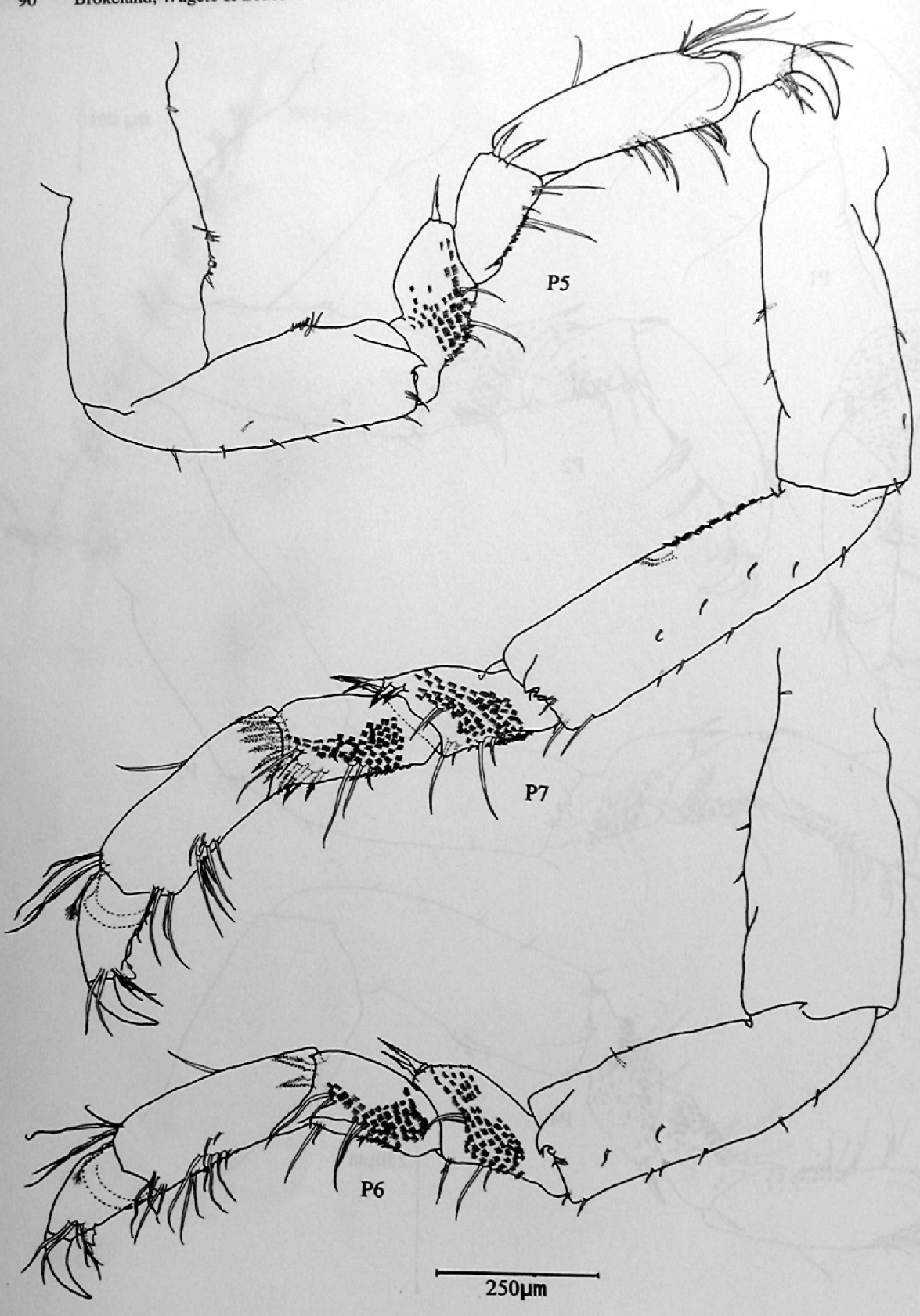

Fig. 6. *Paravireia holdichi* . n.sp., male holotype, pereopods 5 to 7.

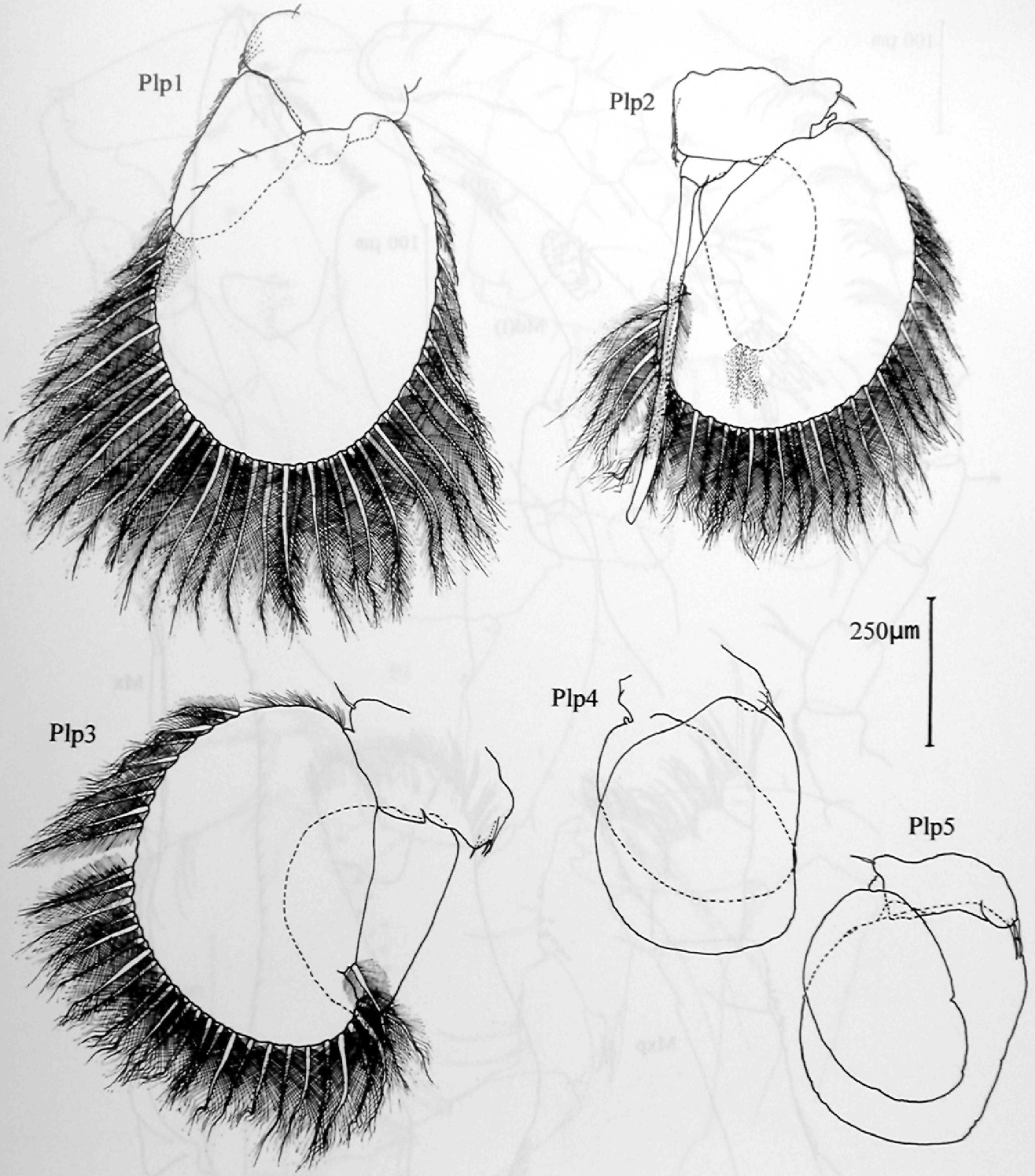

Fig. 7. *Paravireia holdichi* n.sp., male holotype, pleopods.

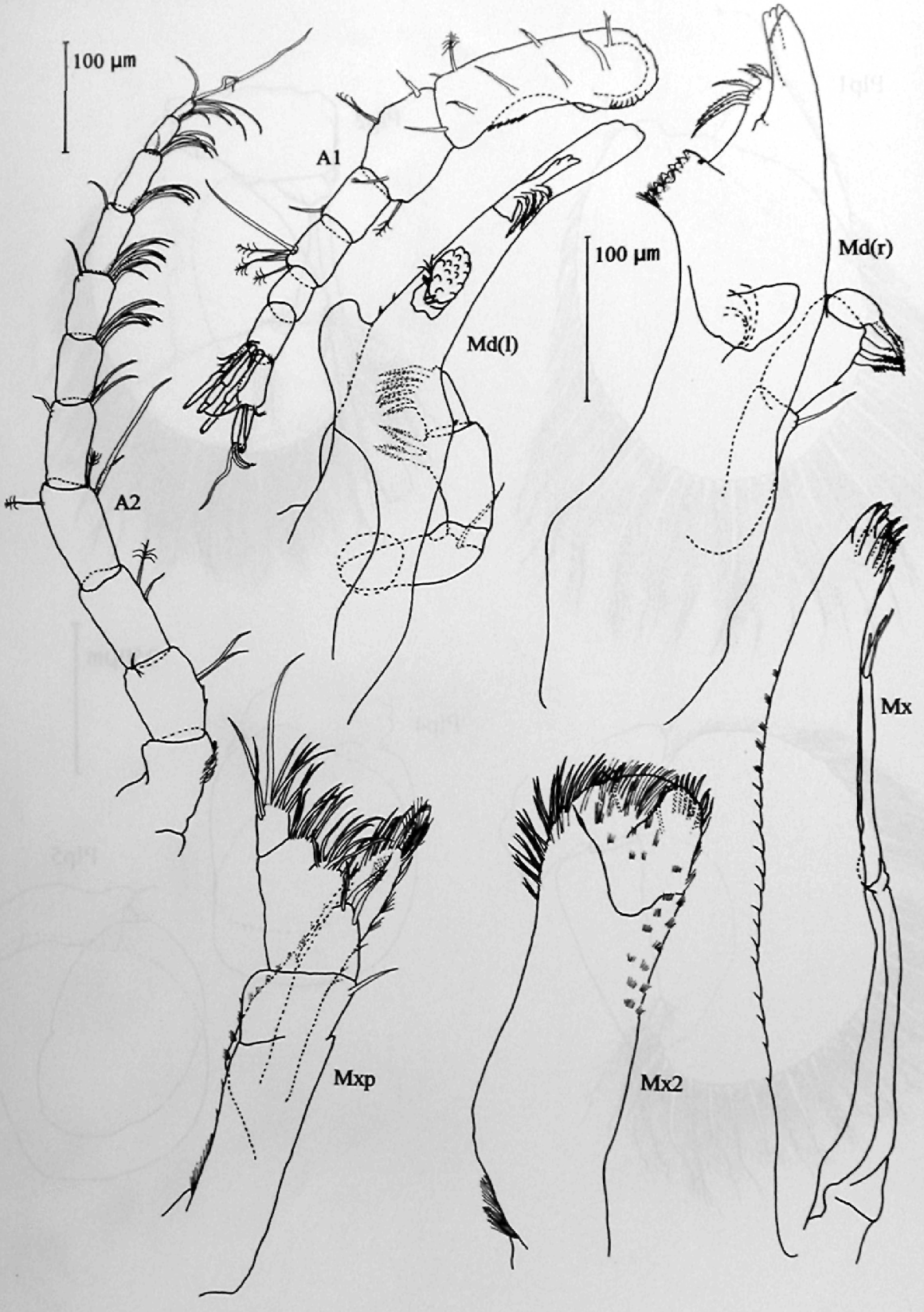

Fig. 8. *Paravireia holdichi* n.sp., ovigerous female, antennae and mouthparts.

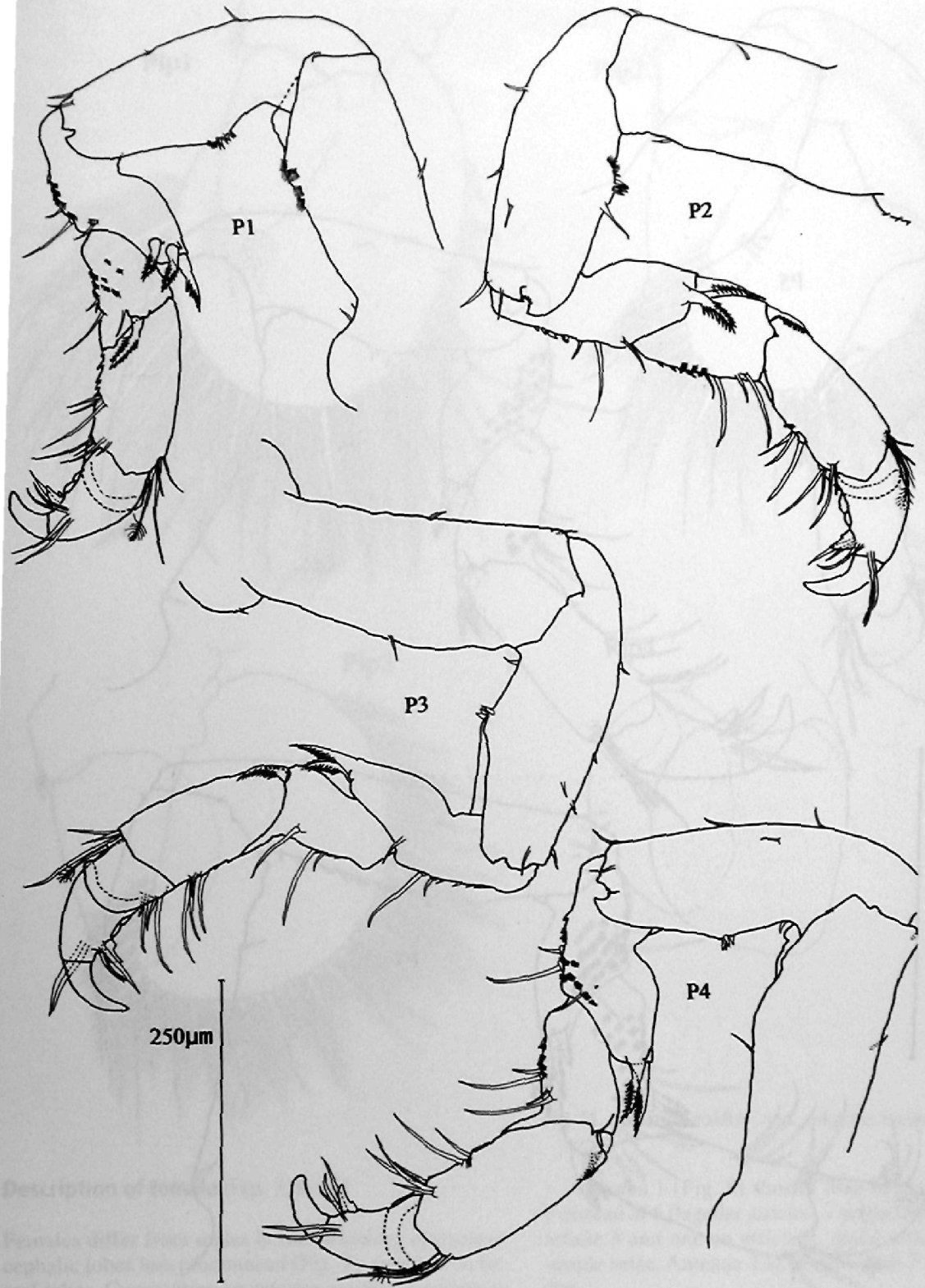

Fig. 9. *Paravireia holdichi* n.sp., ovigerous female, pereopods.

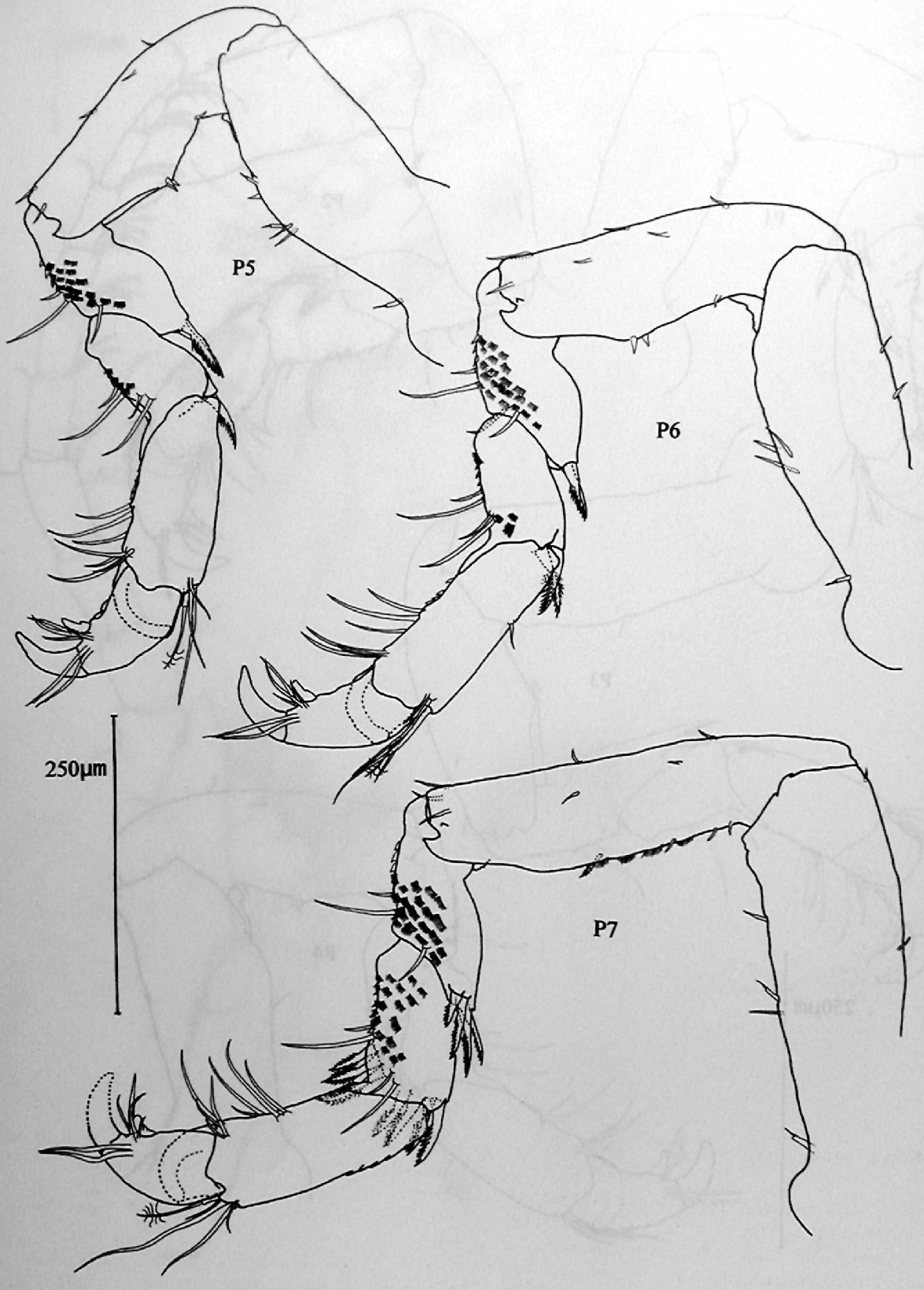

Fig. 10. *Paravireia holdichi* . n.sp., ovigerous female, pereopods.

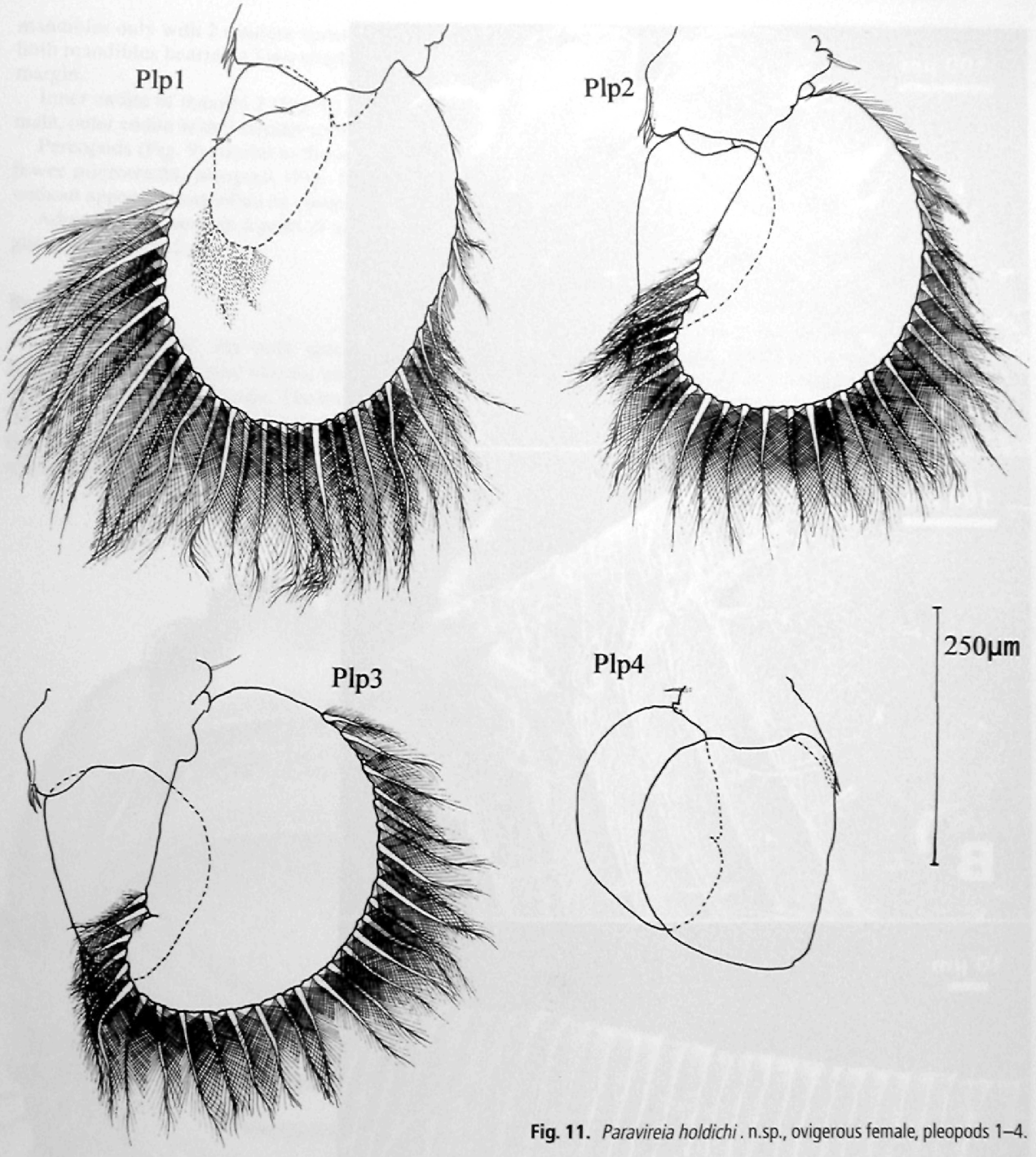

Fig. 11. *Paravireia holdichi* . n.sp., ovigerous female, pleopods 1–4.

Description of female (Figs. 3; 8–11)

Females differ from males in the following characters: cephalic lobes less pronounced (Fig. 3), eyes not on lateral lobes. Concavities on anterior margin of pereonite 1 less deep, lateral longitudinal keel of pereonite 1 not reaching the posterior margin of this pereonite (Fig. 3). Pereonites 2–3 without lateral keel.

Antenna 1 (Fig. 8) shorter than in male, with only 5 instead of 6 flagellar articles, 3 aesthetascs on flagellar article 3 and one on article 4, distal article only with simple setae. Antenna 2 as in male with 7 flagellar articles.

Left mandible (Fig. 8) pars incisiva with 4 indistinct blunt teeth. Right mandible pars incisiva with 3 large teeth and several small teeth. Palp article 2 of both

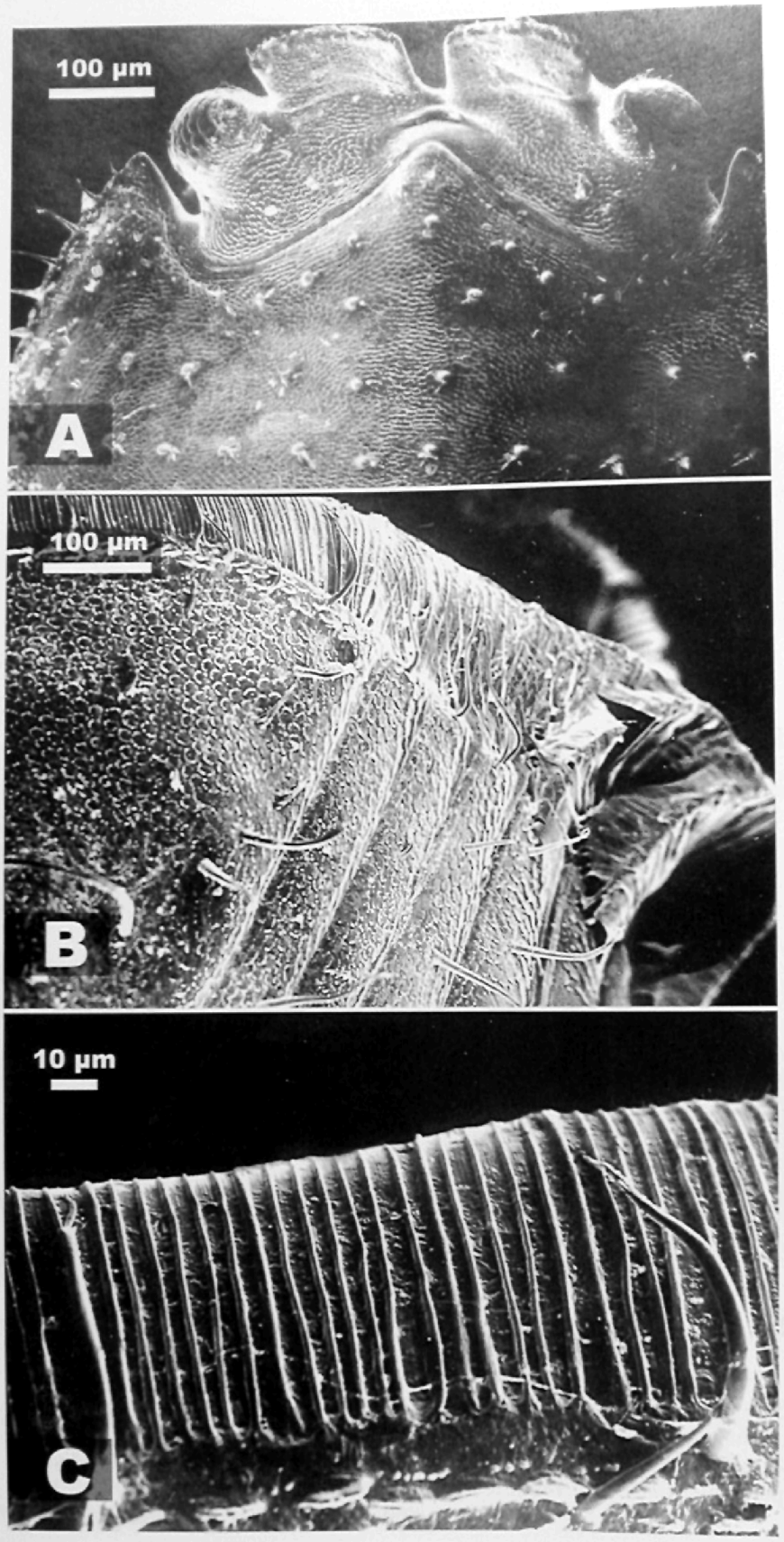

Fig. 12. *Paravireia holdichi*. n.sp. A: head in dorsal view; note shape of head and cuticular tubercles. B: dorsolateral view of left parts of pleonites and pleotelson. C: lateral seam of fused setae (?) on margins of pleotelson. Similar structures are also seen laterally on pleonites, pereonites and on the head (photographs by Dr. D. Holdich).

mandibles only with 2 setulose spines, palp article 1 of both mandibles bearing a long single seta on its distal margin.

Inner endite of maxilla 2 (Fig. 8) more slender than male, outer endite with 9 slender spines.

Pereopods (Fig. 9) similar to those of male, but with fewer microtrichs, pleopods (Fig. 11) as in male but without appendix masculina on pleopod 2.

Adult females bearing 4 pairs of membranous oostegites on pereopod 2–5.

Remarks

Paravireia holdichi, the only species of the genus known from the Atlantic Ocean, cannot be confused with any other isopod species. The total lack of uropods, the cupolate telson and the dramatic ornamentation of the head and pereonite 1 all enable immediate and easy identification. *Paravireia holdichi* has the ability to enrol into a ball (Fig. 13), with the posterior margin of the pleotelson covering the labrum just below the insertions of the antennae. Frons and pleotelson together form a common plane which gives the enrolled animal a hemispherical shape, all appendages and antennae being sheltered inside.

The differences between *Paravireia holdichi* and the two other species of *Paravireia* are striking, but are solely based on ornamentation. Critical similarities exist in the appendage morphology. The ornamentation of the lateral margins of the body with a thin cuticular membrane composed of fused setae (?) and the presence of apomorphies such as the absence of uropods, the reduced endites of maxilla 2 and the narrow, elongated endite of the maxilliped indicate that these three species should be retained in the one genus. *Paravireia pistus*, as yet effectively undescribed, does appear to have a similar morphology to the anterior margin of pereonite 1. We recognise that *Paravireia* is probably most close-

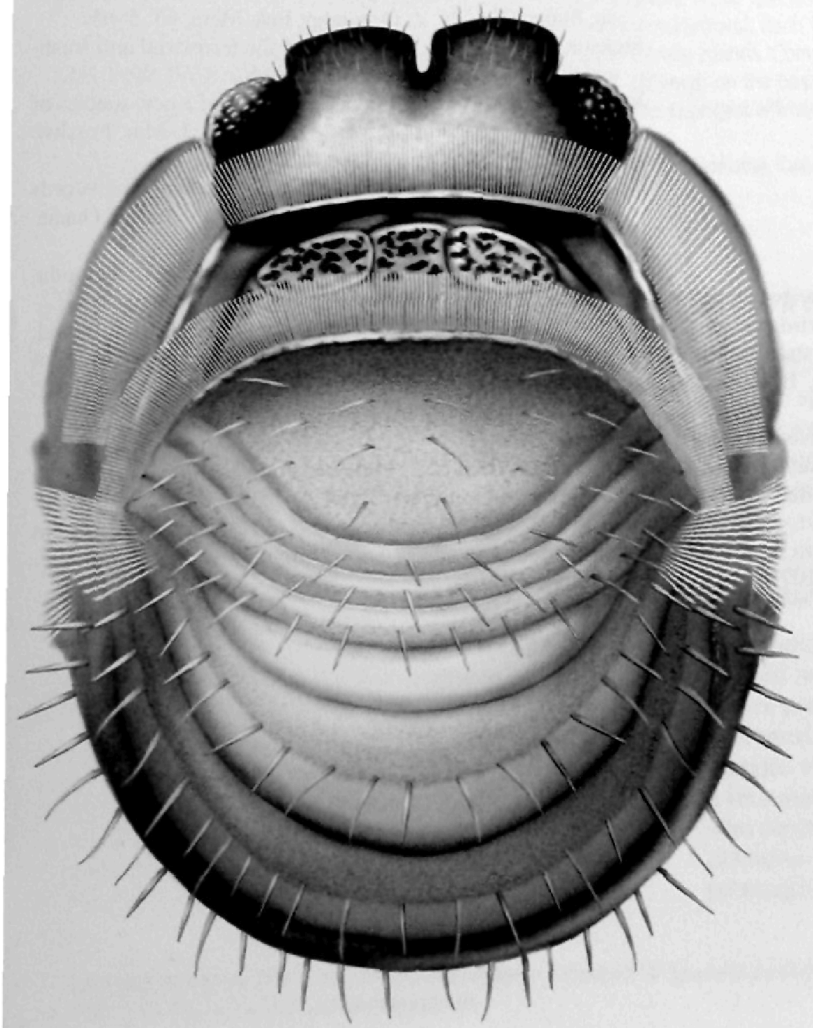

Fig. 13. *Paravireia holdichi*. n.sp., enrolled animal.

ly related to the Sphaeromatidae. Such ornamentation as seen in the new species within that family is not axiomatically of generic merit, and there are numerous genera with dorsal ornamentation ranging from absent to complex (e.g. *Paracassidina*, see Bruce 1994a; *Oxinasphaera*, see Bruce 1997). On that basis we judge this ornamentation to be diagnostic at the species level only.

Acknowledgements

The authors are grateful to Dr. D. Holdich for making his collections available and for the SEM photographs (Fig. 12), and to Ms Birgitte Rubaek for the fine illustration of the enrolled animal (Fig. 13).

List of abbreviations used in figures

(M)	Male
(F)	Female
A1, 2	Antenna1, 2
Md(r)	Right mandible
Md(l)	Left mandible
Mx1, 2	Maxilla 1, 2
Mxp	Maxilliped
P1–7	Pereopods 1–7
Plp1–5	Pleopods 1–5

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