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Sentiropsis, Peltisenia and *Afrosenia* : Three New Genera of Paranannopidae (Copepoda, Harpacticoida)

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Abstract : Re-examination of *Idomene aberrans* Por, previously referred to the Pseudotachidiinae (Thalestridae), has provided unequivocal morphological evidence for its removal to a new genus *Peltisenia* placed in the Paranannopidae. The revelation of claviform aesthetascs on the mandible, maxillule and maxilla supports close affinity to a specialized lineage including *Paradanielssenia* Soyer, *Micropsammis* Mielke, *Leptotachidia* Becker and *Telopsammis* Gee & Huys. On the basis of the biramous mandibular palp and differences in the male morphology of the P2 endopod it is suggested that *Peltisenia* gen. nov. represents the sistergroup of this lineage. *Danielssenia minuta* Coull from Bermuda and *D. spinipes* Wells from Mozambique are both redescribed from the type material and placed in monotypic genera *Sentiropsis* gen. nov. and *Afrosenia* gen. nov., respectively. The former occupies an intermediate position between *Jonesiella* Brady and the genera equipped with claviform aesthetascs on the mouthparts. The relationships of *Afrosenia* gen. nov. are less clear but new data on the mouthparts and swimming leg sexual dimorphism indicate a position near the base of the lineage leading to the oral aesthetasc bearing genera.

Résumé : Un réexamen de *Idomene aberrans* Por, préalablement rangé dans la famille des Pseudotachidiinae (Thalestridae) révèle sans équivoque que, sur des bases morphologiques, cette espèce doit être rangée dans un nouveau genre *Peltisenia*, dans la famille des Paranannopidae. La mise en évidence d'aesthétasques sur la mandibule, la maxillule et la maxille démontre une affinité étroite avec une lignée specialisée qui inclut *Paradanielssenia* Soyer, *Micropsammis* Mielke, *Leptotachidia* Becker et *Telopsammis* Gee & Huys. En se basant sur la présence d'un palpe mandibulaire biramé et sur des différences dans la morphologie de l'endopodite de P2, il est suggéré que *Peltisenia* gen. nov. représente le groupe frère de cette lignée. *Danielssenia minuta* Coull, originaire des Bermudes et *D. spinipes* Wells du Mozambique sont tous les deux redécrits à partir du matériel type et sont respectivement placés dans les genres monotypiques *Sentiropsis* gen. nov. et *Afrosenia* gen. nov. Le premier occupe une position intermédiaire entre *Jonesiella* Brady et les genres equipés d'aesthétasques claviformes sur les pièces buccales. Les relations d'*Afrosenia* gen. nov. sont moins claires mais les nouvelles données sur les pièces buccales et le dimorphisme sexuel des péréiopodes indique une position proche de la base de la lignée conduisant aux genres portant des aesthétasques buccaux

Keywords : Harpacticoida, Copepoda, *Sentiropsis* gen. nov., *Peltisenia* gen. nov., *Afrosenia* gen. nov., systematics.

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Introduction

This paper is the final in our series of contributions to the taxonomy and phylogeny of the genus *Danielssenia* Boeck

(Gee, 1988; Huys & Gee, 1992, 1993; Gee & Huys, 1990, 1994) and deals with the remaining shallow-water species *D. minuta* Coull from Bermuda and *D. spinipes* Wells from Mozambique (Coull, 1969; Wells, 1967). In their review of the genus Huys & Gee (1993) tentatively referred both species to two monotypic genera, *Sentiropsis* and *Afrosenia*, respectively. These taxa were merely proposed as intentional *nomina nuda* and consequently are not available. In order to avoid further nomenclatural confusion and instability both names are formally made available herein for the same taxonomic concept. Hence, they will take authorship and date from the current act of establishment, not from their earlier publication (Huys & Gee, 1993) as *nomina nuda*.

In the course of a study of the sub-family Pseudotachidiinae (Thalestridae), the presumed sistergroup of the Paranannopidae, it was found that *Idomene aberrans* Por deviated in several major characters from its congeners, justifying its removal from both the genus *Idomene* and Pseudotachidiinae. Huys & Gee (1993) hinted at the close relationship of *I. aberrans* to the Paranannopidae, in particular to those genera that displayed sensory aesthetascs on the mouthparts. In a cursory note they proposed the new genus *Peltisenia* to accommodate this species, however, without any proper diagnosis the name *Peltisenia* Huys & Gee, 1993 is unavailable and should be regarded as a *nomen nudum*. Similar to the genera mentioned above, it is re-introduced here to maintain stability and will include *I. aberrans*, its type and only species.

Material and methods

Specimens were dissected in lactic acid and the dissected parts were placed in lactophenol mounting medium. Preparations were sealed with glyceel (Gurr®, BDH Chemicals Ltd, Poole, England). All drawings have been prepared using a camera lucida on a Zeiss Axioskop microscope equipped with differential interference contrast.

The descriptive terminology applied to segmentation and setation of body appendages is adopted from Huys & Boxshall (1991). Abbreviations used in the text and figures are: ae, aesthetasc; P1 - P6, first to sixth thoracopods; exp, exopod; enp, endopod; exp(enp)-1(-2, -3), to denote the proximal (middle, distal) segment of a ramus.

Systematics

Sentiropsis gen. nov.

Diagnosis. - Paranannopidae. Body relatively small, semi-cylindrical, with prosome slightly wider than urosome. Rostrum large, rounded anteriorly and tapering proximally, hyaline; with 2 pairs of small sensilla. Somatic hyaline frills minutely dentate. Female genital double-somite with dorsolateral and ventral sub-cuticular transverse ridges marking original segmentation. Remaining urosomites also with transverse internal chitinous ribs. Pseudoperculum hyaline with dentate margin. Caudal rami wider than long; with 7 setae: seta I vestigial, setae II-III and VI naked, setae IV and V well developed and pinnate, seta VII sparsely plumose and tri-articulated at base.

Sexual dimorphism in antennule, P2 endopod, P3 endopod, P5, P6 and in genital segmentation.

Antennules short; 6-segmented in ♀, setae without ornamentation, pinnate or spinulose spines absent, with aesthetasc on segment 4 and as part of apical acrothek on segment 6; 7-segmented and chirocer in ♀, with geniculation between segments 6 and 7, with aesthetasc on segment 6 and as part of apical acrothek on segment 7.

Antennary allobasis with abexopodal seta; exopod small, 3-segmented, armature formula [2-1-2]. Setiform sensory aesthetascs present on mandibular endopod, maxillulary basis and maxillary endopod. Mandibular coxa robust, with pointed teeth on gnathobase; basis with 1 small naked and 2 pinnate setae; endopod 1-segmented, with 3 lateral and 5 distal elements; exopod 1-segmented, with 2 lateral and 2 apical elements. Maxillule with 2 setae on exopod; endopod smaller than exopod. Maxillary syncoxa with reduced middle endite bearing 2 small setae. Maxilliped subchelate; syncoxa with 1 naked seta; basis with short naked seta on palmar margin; endopodal claw with 1 short and 1 long accessory seta.

P1 coxa produced transversely forming large outer lobe; exopod 3-segmented, exp-3 with 3 outer spines (distal outer spine longer than middle outer spine), 1 geniculate spine and 1 plumose seta; endopod 2-segmented, slightly longer than exopod with enp-1 longer than enp-2. P2-P4 with squarish, naked intercoxal sclerites; rami 3-segmented; exp-1 without inner seta; distal inner seta of P3-P4 exp-3 reduced. Armature formula of P1-P4 as follows:

	Exopod	Endopod
P1	0.1.023	1.121
P2	0.1.223	1.1.221
P3	0.1.323	1.1.321
P4	0.1.323	1.1.221

P2 endopod ♂ 3-segmented; inner setae of enp-1 and -2 shorter than in ♀; outer distal corner of enp-2 forming minute spinous process; enp-3 with distal inner element replaced by pinnate spine, apical elements represented by short bare setae, outer spine slightly displaced to apical position. P3 endopod ♂ 3-segmented; outer margin of enp-2 bare and with crenulated process; inner seta distinctly shorter than in ♀.

P5 with free exopod bearing 4 setae/spines in both sexes; endopodal lobe with 5 setae in ♀. Male fifth pair of legs fused medially and largely incorporated into somite; baseoendopod represented only by short setophore bearing outer basal seta; endopodal lobe not developed.

Female genital field with moderately sized copulatory pore and genital slit covered by vestigial P6 bearing plumose seta and setule. Male sixth pair of legs symmetrical; each P6 with outer sparsely plumose seta, middle naked seta and short inner spiniform seta.

One spermatophore.

Etymology. - The generic name is derived from the Latin *sentire*, meaning to feel or perceive, and refers to the presence of sensory aesthetascs on the mandible, maxillule and maxilla. Gender: feminine.

Type and only species. - *Danielssenia minuta* Coull, 1969.

Type locality. - Trunk Island, Harrington Sound, Bermuda (32°20.0' N, 64°43.5' W), from sediment 20 m north of northeast tip of Trunk Island, 5 m depth.

Original description.- Coull (1969): 561-564, Figs 1-12.

Material. - National Museum of Natural History, Smithsonian Institution, Washington, D.C.: holotype ♀ (in alcohol; reg. no. USNM 126181); paratypes (13 ♀♀, 7 ♂♂ in alcohol; reg. no. USNM 126182).

Redescription

Sentiropsis minuta (Coull, 1969) comb. nov.

FEMALE

Total body length measured from anterior tip of rostrum to posterior margin of caudal rami: 495 µm. Body semi-cylindrical with prosome slightly wider than urosome (Fig. 1A-B). P4- and P5-bearing somites with row of minute spinules dorsally; dorsal and lateral surface of cephalothorax and other somites without conspicuous ornamentation. Somitic hyaline frills weakly developed, slightly dentate (Fig. 5D). Urosomites with transverse internal chitinous ribs (Figs 1A-B; 5D).

Genital double-somite wider than long; original segmentation marked by internal chitinous ribs dorsolaterally, laterally and ventrally (Figs 1A-B; 5D); anterior half with paired rows of tiny spinules ventrally (Fig. 5D). Genital apertures fused medially forming common transverse genital slit; closed off by paired operculae derived from vestigial P6, each bearing outer pinnate seta and inner vestigial element represented by setule. Midventral copulatory pore located at about mid-point of double-somite length; moderately large; leading via short copulatory duct to median seminal receptacle with paired chambers located anterior to genital slit.

Postgenital somites (Fig. 5D) with paired ventrolateral rows of spinules around posterior margin; penultimate and anal somites also with midventral spinules. Anal somite deeply cleft medially (Figs 5D; 6A); anal operculum absent but replaced by membranous, dentate pseudoperculum derived from dorsal posterior margin of penultimate somite (Fig. 6A-B).

Caudal rami (Figs 5D; 6A-B) slightly divergent, short, wider than long; with ventral extensions bearing 2 tube pores and overlying bases of setae IV and V; with 7 setae. Seta I minute; setae II and III slender and bare; setae IV and V well developed, spinulose in posterior two-thirds, not fused basally, with predesigned fracture planes; seta VI bare; seta VII sparsely plumose.

Rostrum (Fig. 2A) large, ventrally deflected, hyaline, rounded anteriorly, tapering posteriorly to short articulation with cephalothorax; with 2 pairs of minute sensilla and 1 median pore dorsally.

Antennule (Fig. 2B) of moderate length, 6-segmented; without pinnate or plumose setae/spines. Segment 1 with 3 spinular rows; segment 4 with aesthetasc (35 µm) fused basally to seta; segment 6 with apical acrothek consisting of 2 setae and slender aesthetasc (25 µm). Armature formula: 1-[1], 2-[9], 3-[7], 4-[5 + (1+ae)], 5-[6], 6-[5 + acrothek].

Antenna (Fig. 2C-D). Coxa represented by small sclerite without ornamentation. Basis and proximal endopod segment completely fused forming allobasis; abexopodal margin with spinular row and 1 unipinnate seta. Exopod (Fig. 2D) 3-segmented, small; exp-2 minute; armature formula [2-1-2]; proximal seta of exp-1 and outer apical seta of exp-3 small; exp-3 with tuft of spinules at outer distal corner. Endopod with 2 spinular rows laterally; lateral armature consisting of minute seta (arrowed in Fig. 2C), and 1 geniculate spine flanked by 2 pinnate spines; distal armature represented by 1 naked and 4 geniculate setae (largest fused basally to vestigial seta and provided with few spinules around geniculation), and 1 bipinnate spine.

Labrum (Fig. 2E) well developed; anterior face with paired secretory pores and dentate processes; distal margin with fine spinules medially, and longer spinules plus secretory tube pore bi-laterally.

Mandible (Fig. 2F). Coxal gnathobase with numerous pointed teeth as figured and 1 naked seta at dorsal corner. Palp biramous, consisting of basis and 1-segmented rami. Basis with 3 spinule rows and 3 armature elements (proximal unipinnate spine, middle bipinnate seta and distal minute naked seta). Exopod distinctly smaller than endopod; with 2 short lateral and 2 long apical setae. Endopod not elongate; lateral armature consisting of 1 naked and 1 pinnate seta plus 1 vestigial seta; distal armature consisting of 5 basally fused elements: 1 short and 2 long naked setae, 1 pinnate seta and 1 aesthetasc provided with flagellate tip.

Maxillule (Fig. 3A). Praecoxal arthrite represented by rectangular lobe with 8 marginal elements (7 spines,

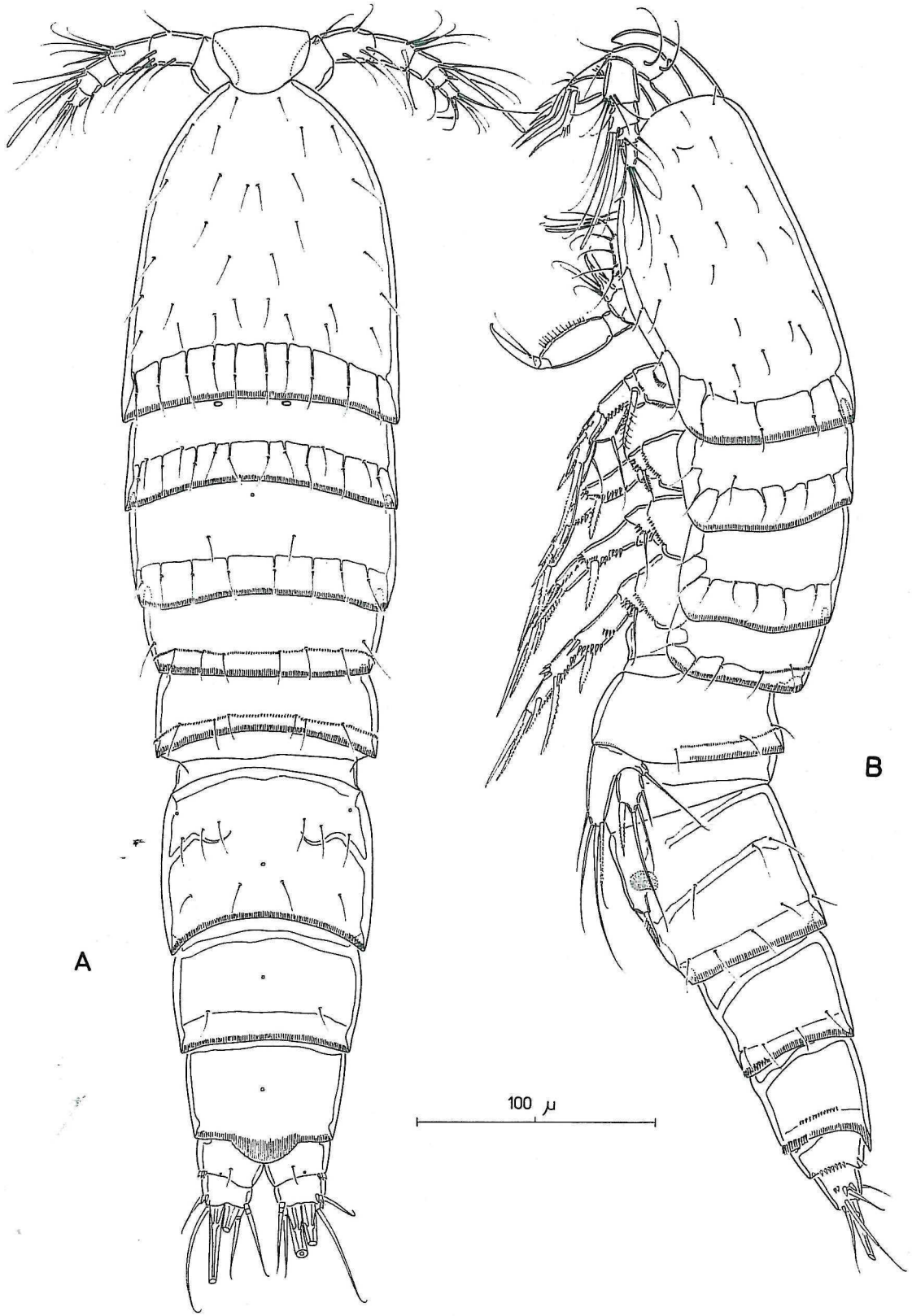

Figure 1. *Sentiropsis minuta* (Coull, 1969) comb. nov. A, habitus ♀, dorsal; B, same, lateral.
Figure 1. *Sentiropsis minuta* (Coull, 1969) comb. nov. A, habitus ♀, vue dorsale ; B, vue latérale.

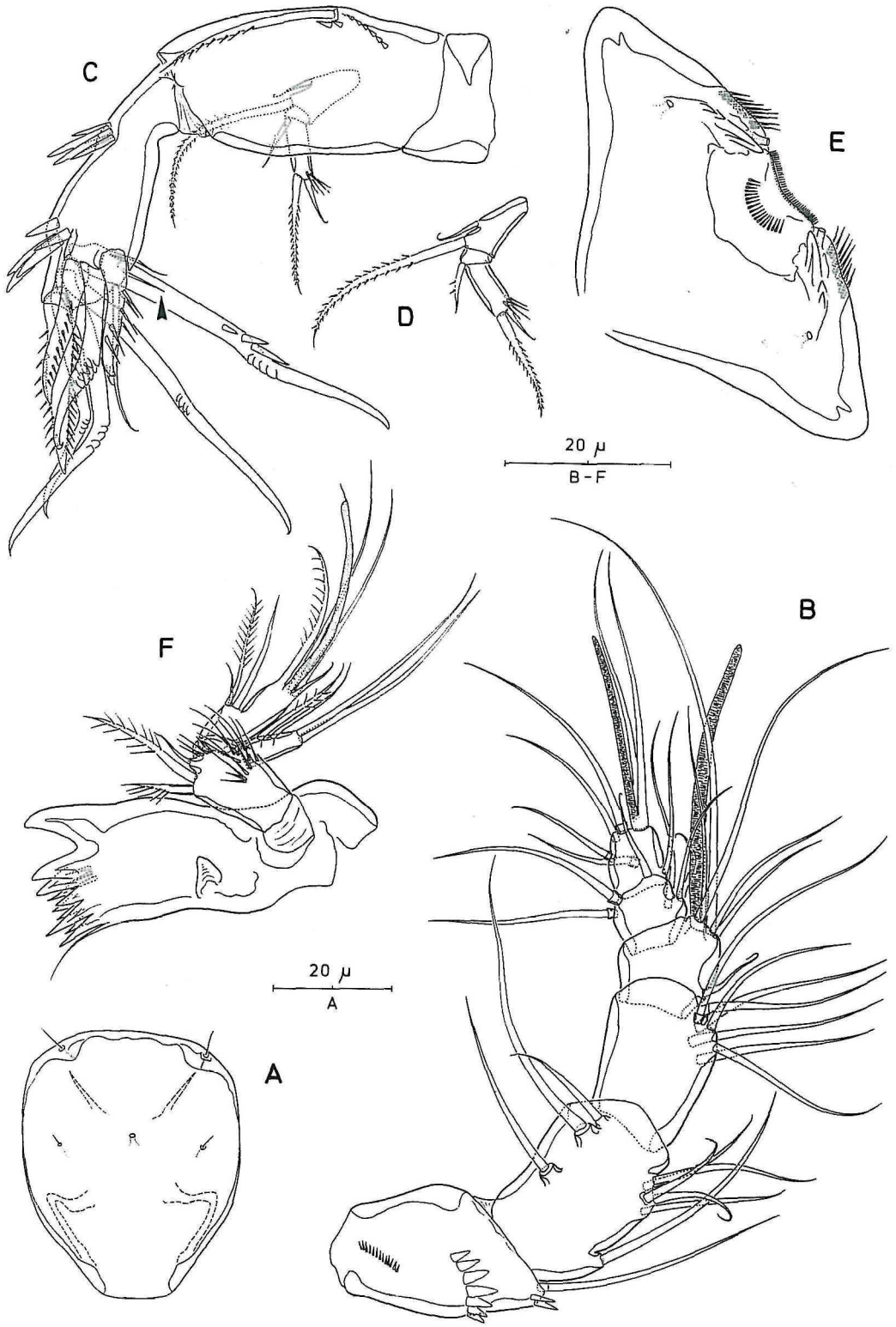

Figure 2. *Sentiropsis minuta* (Coull, 1969) comb. nov. A, rostrum, dorsal; B, antennule ♀, ventral; C, antenna (vestigial lateral seta on endopod arrowed); D, antennary endopod; E, labrum, posterior; F, mandible.

Figure 2. *Sentiropsis minuta* (Coull, 1969) comb. nov. A, rostre, vue dorsale ; B, antennule ♀, vue ventrale ; C, antenne (soie vestigiale latérale sur l'endopodite indiquée par une flèche) ; D, endopodite antennaire ; E, labre, vue postérieure ; F, mandibule.

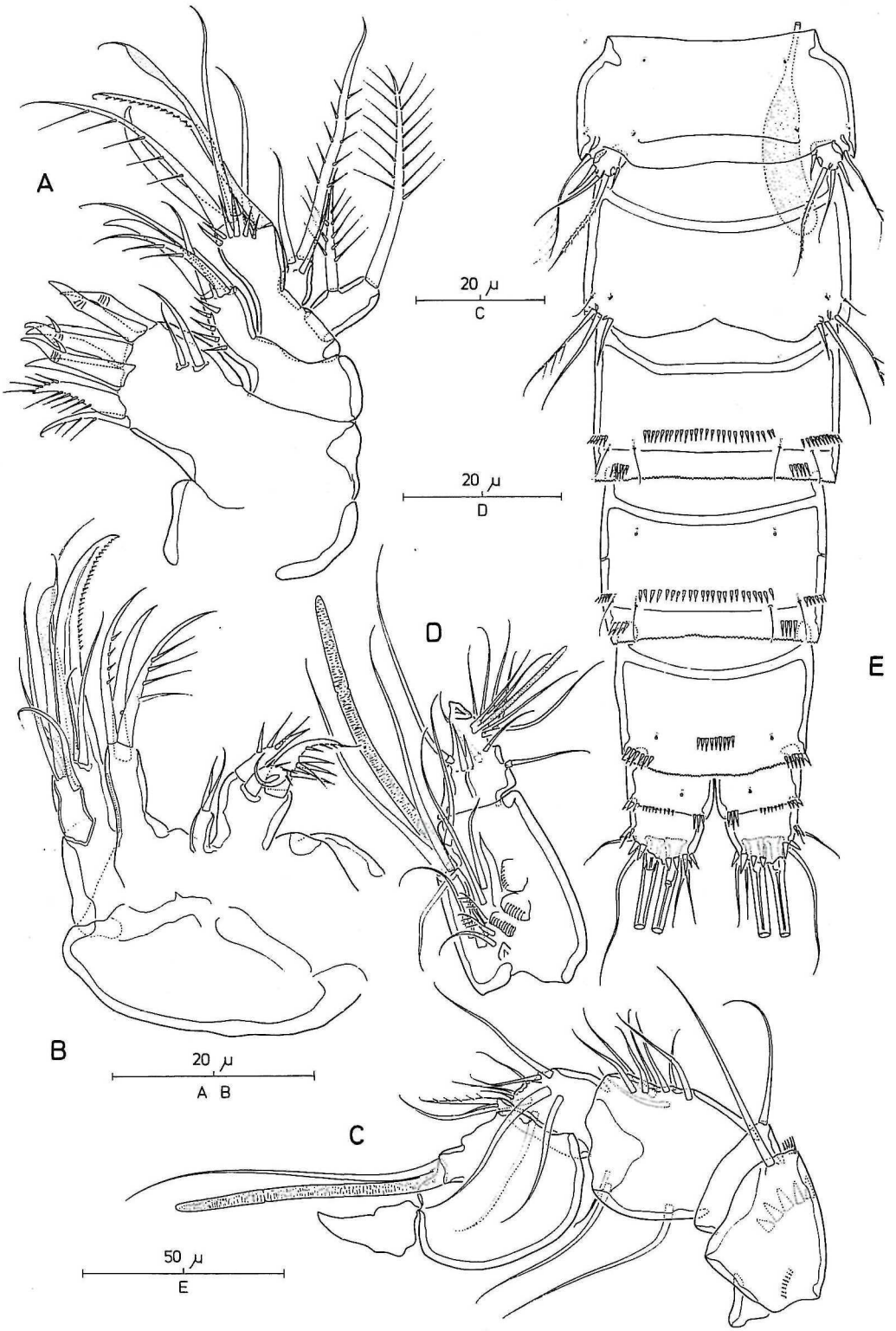

Figure 3. *Sentiropsis minuta* (Coull, 1969) comb. nov. A, maxillule, anterior; B, maxilla; C, antennule ♂, ventral (armature of segment 6 and 7 omitted); D, antennulary segments 6 and 7 ♂, anterior; E, urosome ♂, ventral.

Figure 3. *Sentiropsis minuta* (Coull, 1969) comb. nov. A, maxillule, vue antérieure ; B, maxille ; C, antennule ♂, vue ventrale (armature des articles 6 et 7 omise) ; D, articles 6 et 7 de l'antennule ♂, vue antérieure ; E, urosome ♂, vue ventrale.

1 pinnate seta) and 2 naked setae (1 long, 1 short) arising from anterior surface. Coxa with cylindrical endite bearing spinules along inner margin and 3 setae plus 1 claw distally. Basis with 2 closely set endites and subdistal spinular row; proximal endite with 1 naked and 1 pinnate seta; distal endite with 1 spine, 1 pinnate seta, 1 naked seta and 1 distally swollen aesthetasc provided with flagellate tip. Exopod larger than endopod; with short lateral and long apical pinnate seta. Endopod with large pinnate seta apically and 2 short naked setae subdistally.

Maxilla (Fig. 3B) with syncoxa largely fused to allobasis along anterior surface. Syncoxa with 3 endites; proximal endite with 1 short subdistal and 2 larger distal spines (all elements spinulose); middle endite reduced, with 2 short naked setae apically; distal endite cylindrical, with 1 naked and 2 pinnate elements. Allobasis drawn out into unipinnate claw; accessory armature consisting of 1 posterior and 2 anterior setae. Endopod 1-segmented, well defined at base; with 1 long and 2 short naked setae plus distally swollen aesthetasc provided with flagellate tip.

Maxilliped (Fig. 5A). Syncoxa with 2 spinular rows and 1 naked seta. Basis with spinular row along palmar margin and short naked seta near joint with endopod. Endopod drawn out into strong, slightly curved unipinnate claw; accessory armature consisting of 1 long and 1 short naked seta.

P1 (Fig. 4A). Intercoxal sclerite without ornamentation. Praecoxa well developed. Coxa produced transversely forming large outer lobe. Basis with strong pinnate spines at inner distal corner and outer margin. Exopod 3-segmented; exp-3 with 3 unipinnate spines, 1 weakly geniculate spine and 1 plumose seta. Endopod 2-segmented, distinctly longer than exopod; enp-1 wider and slightly longer than enp-2, with spinulose distal and outer margins and with distally serrate seta along inner margin; enp-2 with short inner plumose seta and distal armature consisting of short pinnate spine, long weakly geniculate spine and sparsely plumose seta.

P2-P4 (Figs 4B; 5B) with rectangular, smooth intercoxal sclerites. Praecoxae with anterior spinular row. Coxae with spinular rows as figured. Basis with outer naked (P2) or sparsely plumose seta (P3-P4). Rami 3-segmented; outer margins of segments with coarse spinules. Inner setae of P2-P4 exp-2 serrate distally. Distal inner seta of P3-P4 exp-3 reduced and bare. Armature formula as for genus.

P5 (Fig. 4D) biramous, comprising small, semi-circular exopod and large baseoendopod. Exopod not extending beyond endopodal lobe; inner margin with apically serrate spine; outer margin with short pinnate and longer naked seta; apex with long bipinnate seta. Baseoendopod with secretory pores near proximal margin and at apex (arrowed in Fig. 4D); outer basal seta slender and sparsely plumose, located on short setophore; endopodal lobe with slightly stepped inner margin bearing short serrate seta flanked by 2 long bipinnate setae, outer distal margin with 2 bipinnate setae.

MALE

Total body length measured from anterior tip of rostrum to posterior margin of caudal rami: 395 µm. Urosomites with transverse internal chitinous ribs (Fig. 3E); postgenital somites with spinules ventrolaterally and with midventral spinular row. Hyaline frills as in ♀.

Antennule (Fig. 3C-D) 7-segmented, short, chirocer; geniculation between segments 6 and 7 with segment 6 distinctly swollen. Segment 1 surrounded by small sclerite at base and with 3 spinular rows and 1 slender naked seta along anterior margin. Segment 2 with 1 naked seta. Segment 3 with 9 short and 2 long naked setae. Segment 4 with 5 long and 4 short setae. Segment 5 minute, represented by incomplete ring with 1 naked and 1 pinnate seta. Segment 6 with 9 naked (1 fused basally to aesthetasc: 40 µm) and 2 pinnate setae, and 5 modified elements fused to segment. Segment 7 with 2 modified elements, 10 naked setae and acrothek consisting of 2 naked setae fused basally to short aesthetasc (15 µm).

P2 endopod (Fig. 4C) 3-segmented. Inner setae of enp-1 and -2 distinctly shorter than in ♀. Outer distal corner of enp-2 forming minute spinous process (arrowed in Fig. 4C). Enp-3 somewhat longer than in ♀; distal inner seta replaced by pinnate spine; apical elements represented by short bare setae; outer spine slightly displaced to apical position.

P3 endopod (Fig. 5C) 3-segmented. Outer margin of enp-2 without spinules but with crenulated process bearing pore; inner seta distinctly shorter than in ♀.

Fifth pair of legs fused medially and largely incorporated into somite (Fig. 3E). Baseoendopod represented only by short setophore bearing outer basal seta and possibly evidenced also by secretory pores (Fig. 6C); endopodal lobe and corresponding armature completely absent. Exopod very small, discrete; with short naked inner seta, and 1 short plus 2 long pinnate setae around distal margin.

Sixth pair of legs symmetrical; each P6 with armature consisting of outer sparsely plumose seta, middle naked seta and short inner spiniform seta (Figs 3E; 6C).

Urosome with 1 small spermatophore (35 µm) (Figs 3E; 6C).

Distribution. - Bermuda: Trunk Island, Harrington Sound, Castle Harbor and Bailey's Bay (Coull, 1969); Barbados: Belairs (Coull, 1970).

Remarks. - The original description of *D. minuta* is incomplete on various points, the primary reason for which might be sought in the small size of the species. Coull (1969) did not illustrate the mouthparts, female genital field or male sixth legs and overlooked the sexual dimorphism on the P3 endopod and the presence of a pseudoperculum covering the anal opening.

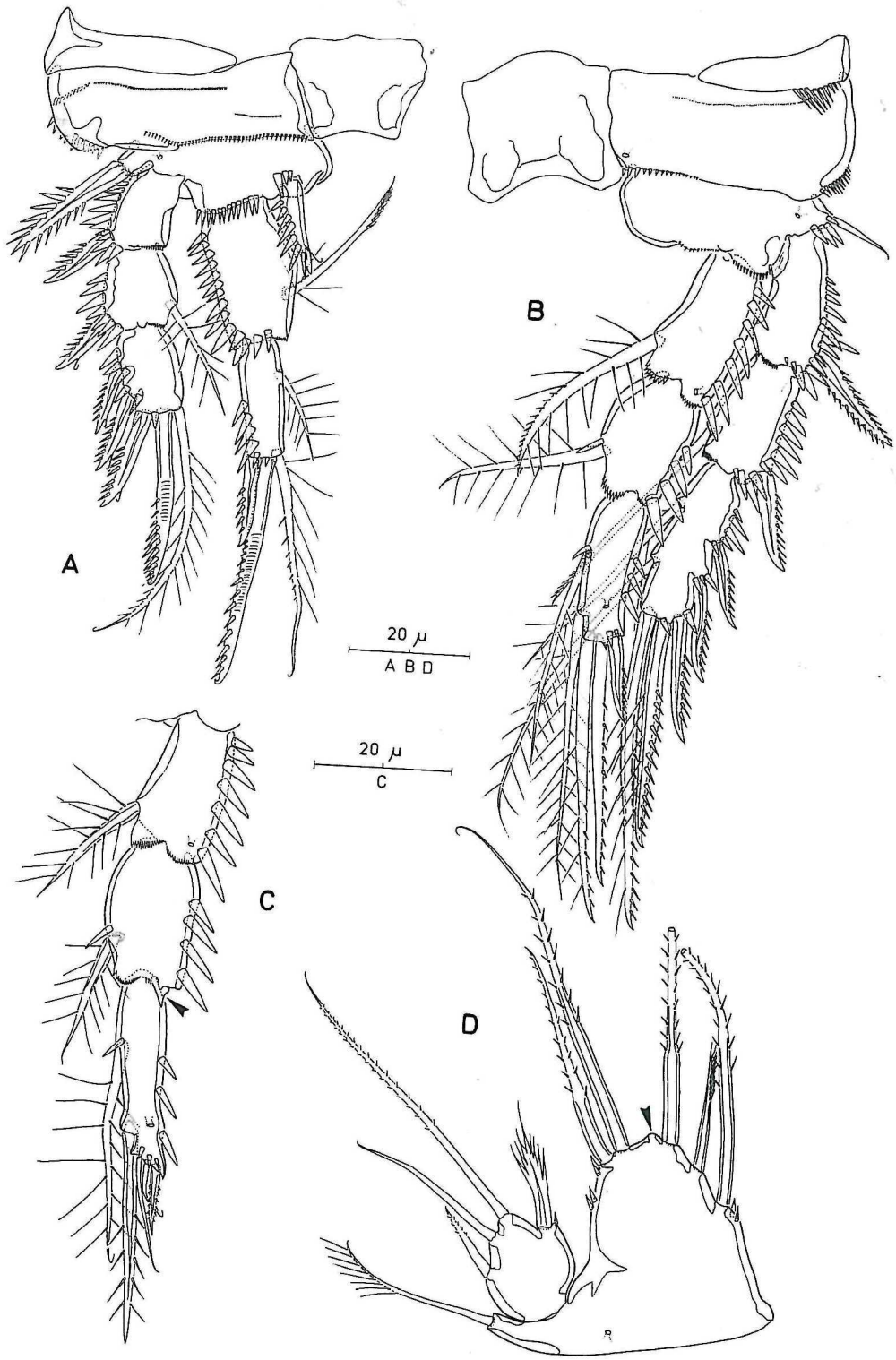

Figure 4. *Sentiropsis minuta* (Coull, 1969) comb. nov. A, P1, anterior; B, P2 ♀, anterior; C, P2 endopod ♂, anterior (vestigial apophysis on enp-2 arrowed); D, P5 ♀, anterior (arrow indicating pore on endopodal lobe).

Figure 4. *Sentiropsis minuta* (Coull, 1969) comb. nov. A, P1, vue antérieure ; B, P2 ♀, vue antérieure ; C, endopodite de P2 ♂, vue antérieure (l'apophyse vestigiale sur enp-2 indique par une flèche) ; D, P5 ♀, vue antérieure (la flèche indique le pore sur le lobe de l'endopodite).

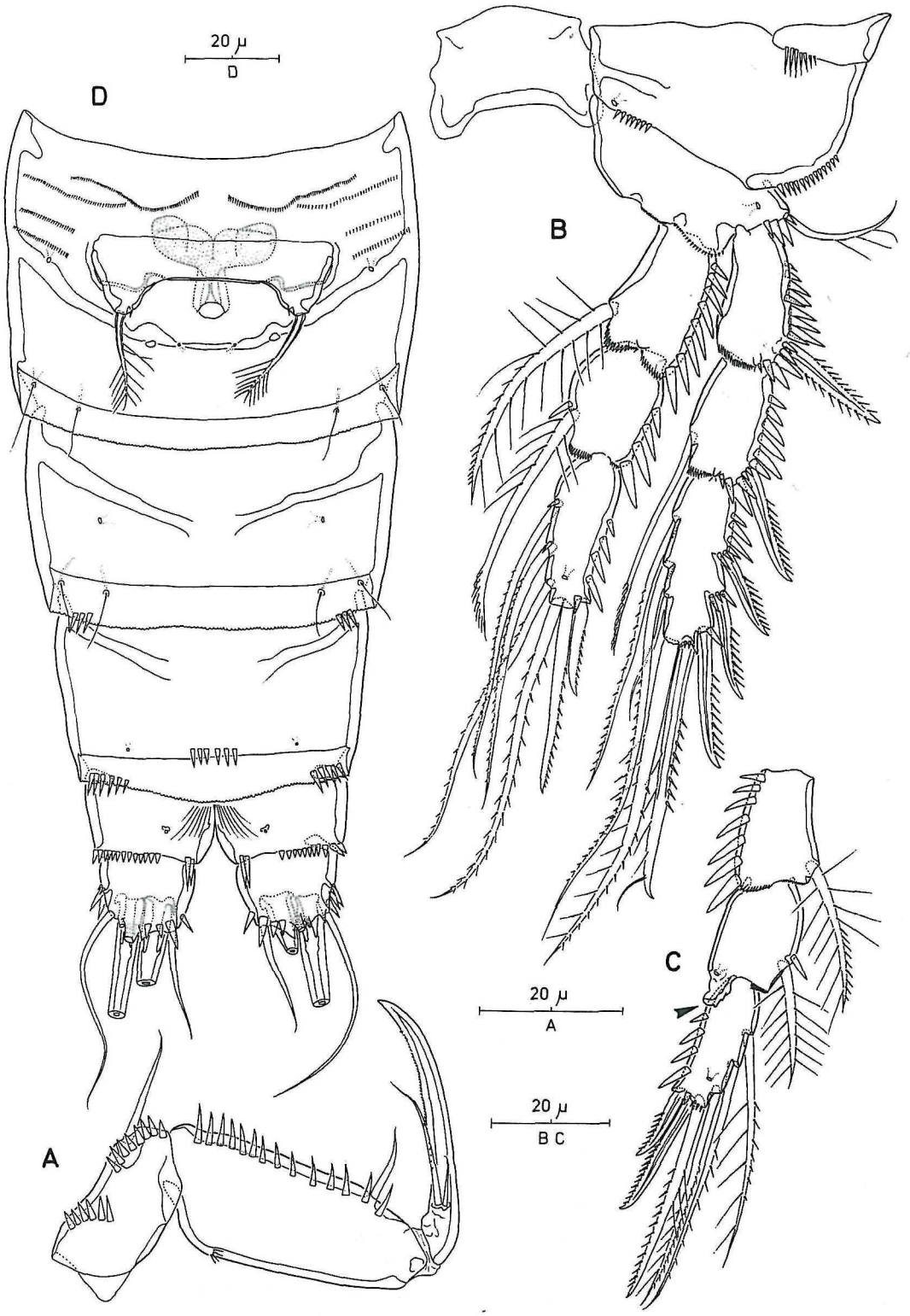

Figure 5. *Sentiropsis minuta* (Coull, 1969) comb. nov. A, maxilliped; B, P3 ♀, anterior; C, P3 endopod ♂, anterior (arrow indicating apophysis on enp-2); D, urosome ♀ (excluding P5-bearing somite), ventral.

Figure 5. *Sentiropsis minuta* (Coull, 1969) comb. nov. A, maxillipède ; B, P3 ♀, vue antérieure ; C, endopodite de P3 ♂, vue antérieure (la flèche indique l'apophyse sur enp-2) ; D, urosome ♀ (sauf le somite portant P5), vue ventrale.

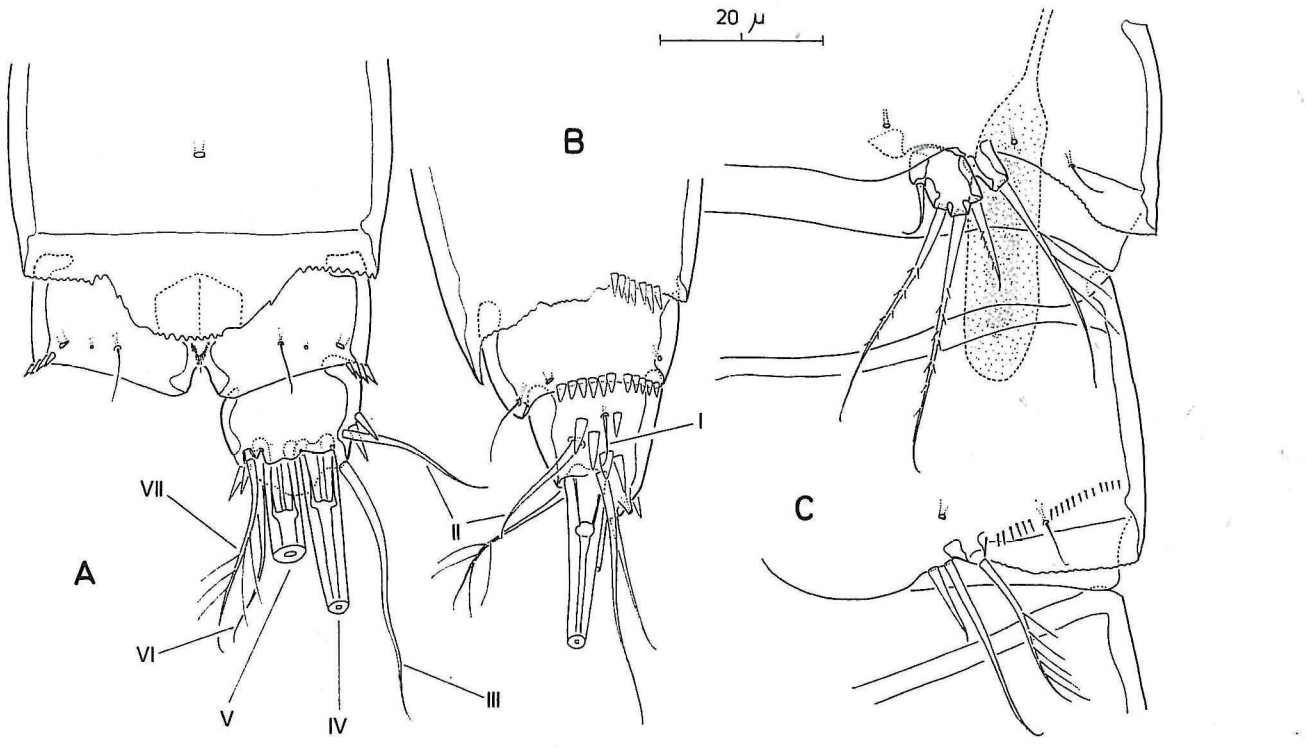

Figure 6. *Sentiropsis minuta* (Coull, 1969) comb. nov. A, pseudoperculum, anal somite and right caudal ramus, dorsal; B, same, lateral; C, left P5 and P6 ♂, ventral.

Figure 6. *Sentiropsis minuta* (Coull, 1969) comb. nov. A, pseudo-operculum, somite anal et rame caudale droite, vue dorsale B, même région en vue latérale ; C, P5 et P6 ♂ gauche, vue ventrale.

The present redescription based on Coull's types has highlighted some important discrepancies and deficiencies in the original text and illustrations.

(1) In the latter the rostrum is shown to have a broad apex and concave lateral margins and seems to be fused to the cephalothorax. It is obvious that the hyaline lateral parts were overlooked and that the structure illustrated by Coull is incomplete, representing only the central part which is slightly reinforced ventrally.

(2) The male antennule is 7-segmented and chirocer rather than 5-segmented and haplocer as stated in the text.

(3) According to Coull (1969) each abdominal somite is dorsally ornamented with a continuous spinular row. No such dorsal ornamentation was present in our material and it is considered unlikely that the weakly denticulate hyaline frill was mistaken for a transverse spinular row since its fine structure could only be revealed using interference contrast microscopy which was unavailable to Coull. A logical explanation could be that the ventral spinules were superimposed onto the dorsal surface by viewing an excessively squashed specimen, yet the ventral spinular rows are not continuous in females (Fig. 5D) which, in conjunction with the completely separated genital somite drawn by Coull, hints at the possibility that his figure was taken from a male specimen.

(4) The discovery of an additional inner seta on P3-P4 exp-3 requires alteration of Coull's setal formula presented in his table on p. 564. Since no statement is made in the text it seems that the author failed to recognize that the inner seta of P1 enp-1 was missing from the specimen illustrated, although his drawing clearly shows the insertion site evidenced by the stepped inner margin.

(5) In the original description the outer distal corner of the male P2 enp-2 is described as "... prolonged into a scimitar-shaped spine", and illustrated as a slightly curved spinous apophysis extending beyond the insertion site of the proximal inner seta of enp-3. Examination of all male paratypes revealed only a minute process as shown in Fig. 4C.

(6) Coull's illustration of the male P5 is an enigma and bears little relationship to what is visible from the alcohol

preserved types. It contains gross discrepancies in the shape, setation and distribution of armature elements which cannot satisfactorily be explained. From the presence of an additional outer seta on the exopod it would appear that Coull has superimposed the outer basal setophore and its accompanying seta. This is substantiated by the general outline and larger size of the exopod, and the arrangement of the other setal elements. Such interpretation, however, would not account for the presence of a distinct baseoendopod in Coull's figure, bearing an outer seta arising from a setophore and 2 medial setae (presumably representing the endopodal lobe). In our material the basoendopod is completely absorbed into the somite wall and no evidence of endopodal armature could be found.

(7) There seems to be some inconsistency in the relative length of armature elements between Coull's and the present description, in particular for the antennary exopod, P1 and endopod female P5 exopod. For example, his illustration of the P1 endopod gives the deceiving impression that the outer distal spine is inserted at the inner distal corner.

Peltisenia gen. nov.

Diagnosis. - Paranannopidae. Body large, distinctly dorsoventrally flattened, with prosome markedly wider than urosome. Rostrum large, squarish, well chitinized; with 2 pairs of equally long sensilla. Somatic hyaline frills minutely dentate. Female genital double-somite with lateral and ventral sub-cuticular transverse ridges marking original segmentation. Pseudoperculum hyaline with dentate margin. Caudal rami wider than long; largely concealed dorsally beneath posterior extensions of anal somite; inner distal corner produced into ventral spinous process bearing fine setules; with 7 setae: seta I about as long as seta II, setae I-III and VI naked, setae IV and V modified and composite (consisting of styliform proximal and flagellate distal parts), seta VII tri-articulated at base and sparsely plumose.

Sexual dimorphism in antennule, P2 endopod, P3 endopod, P5, P6 and in genital segmentation.

Antennules short. Six-segmented in _, distal segments very short; with numerous long and slender setae but without pinnate or spinulose spines; with aesthetasc on segment 4 and as part of acrothek on segment 6. Eight-segmented and haplocer (or slightly subchirocer) in ♂, with geniculation between segments 6 and 7; with aesthetasc on segment 6 and as part of acrothek on segment 8.

Antenna small compared to mouthparts; allobasis without abexopodal seta; exopod 3-segmented, armature formula [2-1-3]. Claviform sensory aesthetascs present on mandibular endopod, maxillulary basis and maxillary endopod. Mandibular coxa elongate, with blunt teeth on gnathobase; basis with 4 plumose/pinnate setae; endopod 1-segmented, with 3 lateral and 5 distal elements; exopod 2-segmented, exp-1 with 2 lateral, exp-2 with 3 apical setae. Maxillule with 3 setae on exopod. Maxillary syncoxa with 3 elements on middle syncoxal endite. Maxilliped subchelate, slender; with 2 relatively short setae on syncoxa; basis with short naked seta on palmar margin; endopodal claw with 2 long accessory setae.

P1 basis forming wide distal pedestal articulating with endopod; exopod 3-segmented, exp-3 with 3 outer spines (distal outer spine longer than middle outer spine) and 2 plumose setae; endopod 2-segmented, slightly longer than exopod with enp-1 longer than enp-2. P2-P4 with wide intercoxal sclerites provided with anterior spinule rows and distal setules; rami 3-segmented; exp-1 with inner seta; enp-1 larger than distal segments (particularly in P2-P3) with inner distal corner produced into spinous process and bearing tripinnate inner spine. Armature formula of P1-P4 as follows:

	Exopod	Endopod
P1	0.1.023	1.121
P2	1.1.223	1.1.221
P3	1.1.323	1.1.221
P4	1.1.323	1.1.221

P2 endopod ♂ 3-segmented; spinous process of enp-1 slightly shorter than in ♀; outer distal corner of enp-2 slightly more attenuated than in ♀; outer spine of enp-3 blunt, with crenulated outer margin; inserting apically and flanked by spinous outgrowths of segment. P3 endopod ♂ 3-segmented; outer margin of enp-2 naked, outer distal corner produced into recurved process covering anterior surface of enp-3.

P5 with free triangular exopod bearing 5 setae/spines in both sexes; endopodal lobe _ wide and rounded, with 5 setae separated by closely adpressed spinule rows (resembling striated, serrate scales). Male fifth pair of legs fused medially forming extremely wide transverse baseoendopodal plate; endopodal lobe not developed, with short naked seta and bipinnate inner spine.

Female genital field with 1 pinnate seta and 1 vestigial element. Male sixth pair of legs symmetrical; each P6 with outer sparsely plumose seta, middle naked seta and inner naked spine.

Paired large spermatophores.

Etymology. - The generic name is derived from the Greek *pelte*, meaning shield, and refers to the unique dorsoventrally flattened body shape. Gender: feminine.

Type and only species. - *Idomene aberrans* Por, 1964

Type locality. - Off Nahariya, Israel, Mediterranean; depth 26 fathoms.

Original description.- Por (1964): 79-80, Plate 10, Figs 82-89.

Material. - From Dr P. Bodin: 2 ♀♀ and 1 ♂ dissected on slides, mounted in glycerinated gelatine with added phenic acid; Marseille, Plateau des Chèvres; coll. P. Bodin, January 1963.

Partial redescription.

Peltisenia aberrans (Por, 1964) comb. nov.

Synonym. - *Idomene (?) peresi* Bodin, 1964

Por's description was published on 17 April 1964. Since the date of publication of *I. (?) peresi* is not completely specified, the earliest day on which Bodin's (1964) paper is demonstrated to be in existence as a published work is, in accordance with ICZN Art. 21(C)(ii), the last day of the year when only the year is specified, i.e. 31 December 1964. *I. (?) peresi* loses therefore in priority and sinks as a junior subjective synonym of *I. aberrans* as already noted by Bodin (1967).

FEMALE

Anal somite (Fig. 11D) medially cleft; ventral hind margin with lateroventral spinular rows and pair of pores.

Caudal ramus (Fig. 11D) wider than long; largely concealed dorsally beneath posterior extensions of anal somite; inner distal corner produced into ventral spinous process bearing fine setules; ventral hind margin with 2 large secretory pores and coarse spinules at insertion sites of setae V-VI; with 7 setae. Setae I-II of about equal length, naked. Seta III long and naked. Setae IV and V modified, composite; consisting of strong, styliform part proximally (with well developed fracture plane) and flagellate part distally (provided with 2 long pinnules and arising from the ventral side of the proximal part); seta V twice as long as IV. Seta VI slender and naked. Seta VII tri-articulated at base, plumose.

Rostrum (Fig. 8A) squarish, with rounded anterior margin, well chitinized; dorsal surface with anterior and posterior pair of equally long sensilla and median pore; with pair of lateral pores located posteriorly to anterior pair of sensilla.

Antennule (Fig. 7A-B) short, 6-segmented, distal segments very short; with numerous long and slender setae but without pinnate or spinulose spines. Segment 1 with 3 spinular rows; segment 4 with aesthetasc (150 µm) fused basally to seta; segment 6 with apical trithek consisting of 2 setae and short aesthetasc (20 µm). Setal formula: 1-[1], 2-[4 plumose + 6 naked], 3-[2 plumose + 7 naked], 4-[3 plumose + 2 naked + (1 + ae)], 5-[1 plumose + 7 naked], 6-[5 + acrothek].

Antenna (Fig. 10A-B) small compared to mouthparts. Coxa represented by small sclerite without ornamentation. Basis and proximal endopod segment completely fused forming allobasis; original segmentation marked by transverse membranous strip; abexopodal margin with spinular row but without seta. Exopod 3-segmented, slender; exp-2 minute, separated from exp-1 by surface suture only; armature formula [2-1-3]; proximal seta of exp-1 small; exp-3 with tuft of spinules at outer distal corner. Endopod with various spinular rows as illustrated in Fig. 10A-B; lateral armature consisting of 1 proximally pinnate spine and 1 geniculate spine flanked by 2 pinnate spines; distal armature represented by 4 geniculate setae (largest fused basally to vestigial seta and provided with few spinules around geniculation and pore near base) and 1 distally pinnate spine.

Mandible (Fig. 8B-C). Coxal gnathobase elongate; with blunt teeth as figured and 1 large bipinnate seta at dorsal corner; spinular row present around articulation with palp. Palp biramous, consisting of basis, 1-segmented endopod and 2-segmented exopod. Basis with 3 spinular rows and 4 plumose setae. Exopod elongate but distinctly smaller than endopod; exp-1 with 1 sparsely plumose and 1 long bare seta; exp-2 with 3 very long setae apically, outermost with long pinnules along one side. Endopod elongate; lateral armature consisting of 1 unipinnate and 2 naked setae; distal armature consisting of claviform aesthetasc with flexure zone and 4 naked setae (2 fused at base, other 2 fused to aesthetasc).

Maxillule (Fig. 7C-D). Protopodal segments fused; original boundaries marked by transverse spinular rows. Praecoxal arthrite represented by rectangular lobe with 10 marginal elements (8 spines, 1 pinnate seta, 1 tube seta) and 2 long naked tube setae arising from anterior surface and provided with flexure zone halfway their length; posterior surface with 2 spinular rows. Coxal endite (Fig. 7D) with anterior spinular row; with 6 elements (2 naked and 2 sparsely plumose setae, 1 spine with long spinules and 1 distally unipinnate seta). Basis with 2 closely set endites and subdistal spinular row; proximal endite with 2 sparsely pinnate setae; distal endite with 1 plumose and 2 naked setae plus 1 claviform aesthetasc provided with bipinnate flexure zone. Exopod with small articulation zone; with setules along inner margin and 3 long plumose setae. Endopod represented by elongate segment; with 1 naked and 2 unipinnate short setae.

Maxilla (Fig. 9A) with syncoxa completely separate from allobasis. Syncoxa with 3 endites, each with transverse spinular row and 3 elements; proximal endite widest, with 3 strong bipinnate spines, all defined at base; middle endite with 3 slender spinulose spines; distal endite with 3 pinnate setae. Allobasis with strong pinnate claw, largely defined at base; accessory armature consisting of 1 anterior (with long pinnules on one side) and 2 lateral setae (1 bare, 1 unipinnate and with long spinules). Endopod 1-segmented, well defined at base; with 1 sparsely plumose and 2 naked

Figure 7. *Peltisenia aberrans* (Por, 1964) comb. nov. A, antennule ♀, ventral; B, antennulary segments 4-6 ♀; C, maxillule, anterior (armature of coxal endite omitted); D, coxal endite of maxillule; E, maxilliped.

Figure 7. *Peltisenia aberrans* (Por, 1964) comb. nov. A, antennule ♀, vue ventrale ; B, articles antennulaires 4-6 ♀ ; C, maxillule, vue antérieure (armature de l'endite coxal omise) ; D, endite coxal de la maxillule ; E, maxillipède.

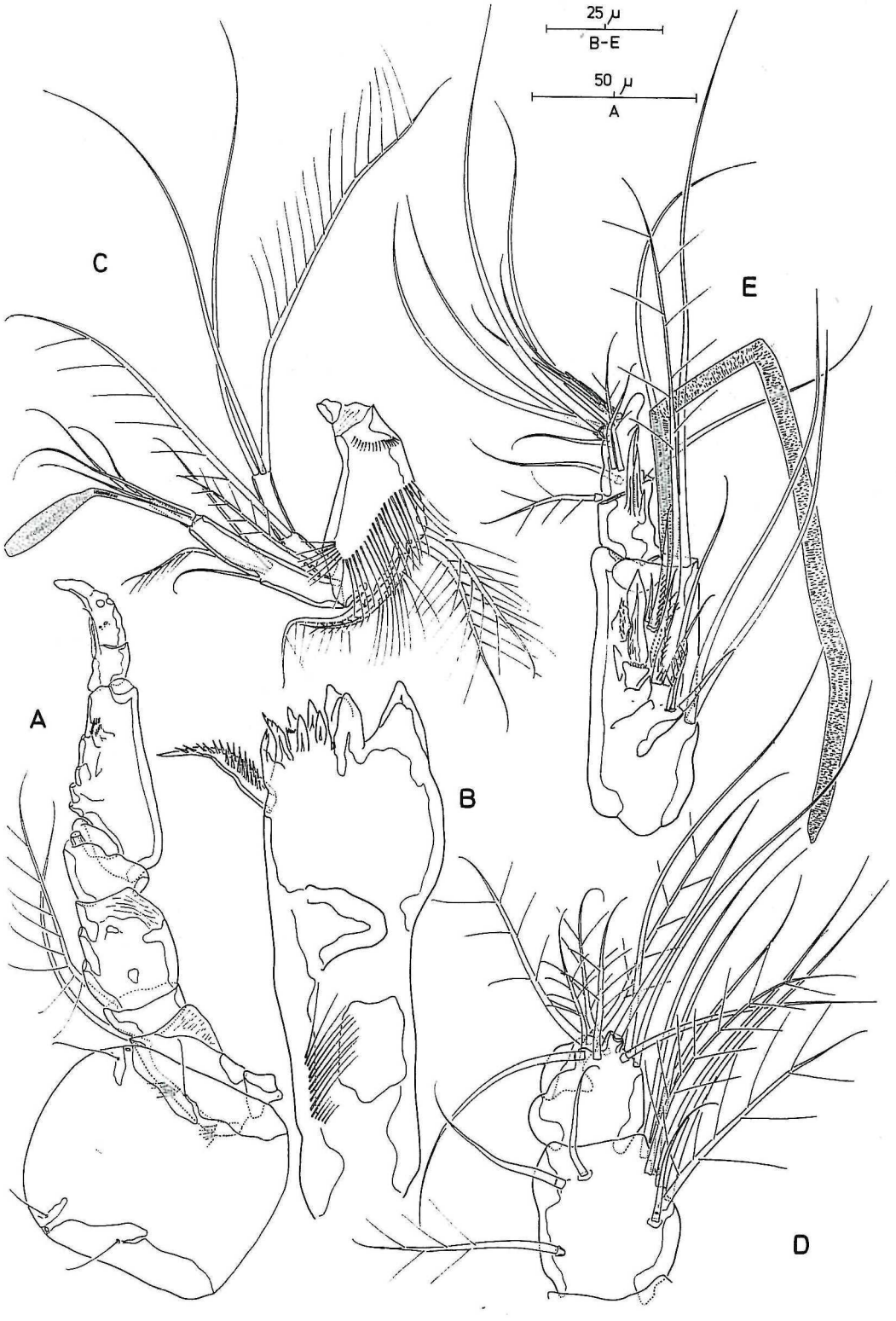

Figure 8. *Peltisenia aberrans* (Por, 1964) comb. nov. A, rostrum and antennule ♂, dorsal (armature of segments 3-8 omitted); B, mandible, gnathobase; C, mandible, palp; D, antennulary segments 3-5 of ♂, anterior; E, antennulary segments 6-8 of ♂, anterior.

Figure 8. *Peltisenia aberrans* (Por, 1964) comb. nov. A, rostre et antennule ♂, vue dorsale (armature des articles 3-8 omise) ; B, mandibule, gnathobase ; C, mandibule, palpe ; D, articles antennulaires 3-5 ♂, vue antérieure ; E, articles antennulaires 6-8 ♂, vue antérieure.

setae plus claviform aesthetasc provided with well defined flexure zone.

Maxilliped (Fig. 7E) slender. Syncoxa with 3 well developed spinular rows on anterior surface and row of diminutive spinules near proximal margin; armature consisting of 2 relatively short unipinnate setae. Basis with spinular row along proximal half of palmar margin and short naked seta at about halfway the palmar margin. Endopod drawn out into slender, straight claw, acutely recurved at tip, provided with denticles in distal third; accessory armature consisting of 2 long setae arising from small cylindrical process.

P1 (Fig. 9B-C). Intercoxal sclerite with 2 rows of denticles on anterior surface. Outer margin of coxa abaxially expanded, with transverse spinular rows on both anterior and posterior surfaces as illustrated. Basis forming wide distal pedestal articulating with endopod; partly fused to coxa along inner margin which bears row of long setules; outer seta strong and plumose; inner spine with spinules along outer margin. Exopod 3-segmented; outer spines of segments with comb of outer spinules; outer distal seta of exp-3 bipinnate and inner distal seta longest, plumose with subapical tuft of spinules; inner seta of exp-2 plumose in proximal half and unipinnate in distal half. Endopod 2-segmented, slightly longer than exopod; enp-1 longer than enp-2, with posterior row of setules and spinules along distal and outer margins; enp-2 with 2 plumose setae, 1 pinnate seta and outer spine with spinular comb; outer distal corner of enp-2 with large curved spinule and posterior distal part weakly chitinized (Fig. 9C).

P2-P4 (Figs 9D; 10C; 12E) with wide intercoxal sclerites provided with anterior spinule rows and distal setules (Fig. 10C). Coxa with numerous spinular rows on anterior surface. Basis with outer bipinnate spine (P2), plumose seta (P3) or pinnate seta (P4). Rami 3-segmented. Outer spines of exp-1 and -2 with long setules subapically. Inner setae of P2-P4 exp-1 and -2 plumose proximally and serrate distally. Middle inner seta of P4 exp-3 slightly enlarged, not plumose but serrate along most of its inner margin. Outer margins of endopod segments with coarse spinules; enp-1 larger than distal segments (particularly in P2-P3; compare Figs 9E and 10C) with inner distal corner produced into spinous process and bearing tripinnate inner spine. Inner setae of P2-P4 enp-2 and -3 tripinnate. Armature formula as for genus.

P5 (Fig. 11A) biramous, comprising triangular exopod and transversally expanded baseoendopod. Exopod extending beyond endopodal lobe; inner margin stepped, with long spinules along proximal half and large spine located halfway; distal margin produced into cylindrical apex surrounded by 3 coarse spinules and bearing slender, naked seta; outer margin with 3 slender setae, proximal one plumose and arising from posterior face, middle one naked and distal one with 1 pinnule; both posterior and anterior surface with 1 secretory pore. Baseoendopod with oblique posterior surface suture; anterior surface with 3 secretory pores; outer basal seta very long and slender, sparsely plumose, located on dorsally recurved spinular setophore; endopodal lobe rounded, distal margin with long spinules along outer half and 5 setae located along inner half: short bi-articulate seta, long sparsely plumose seta, 2 short pinnate setae and 1 short naked seta; latter 4 setae separated by closely adpressed spinule rows (resembling striated, serrate scales); outer distal corner with 1 anterior and 2 posterior spinular rows.

MALE

Antennule (Fig. 8A, D-E) 8-segmented, slender; geniculation between segments 6 and 7 with segment 6 not swollen as in other Paranannopidae. Segment 1 surrounded by small sclerite at base and with 2 spinular rows and 1 slender naked seta along anterior margin. Segment 2 with 1 long plumose seta. Segment 3 with 3 plumose and 8 naked setae. Segment 4 with 3 plumose and 5 naked setae. Segment 5 minute, represented by incomplete ring with 1 naked and 1 plumose seta. Segment 6 with 1 long plumose, 7 naked (1 fused basally to aesthetasc: 165 _m) and 4 pinnate setae; 1 large and 1 small spine; and number of spinulose and bare outgrowths. Segment 7 with 1 seta and 3 modified elements fused to segment. Segment 8 with 2 plumose and 2 naked setae plus acrothek consisting of 2 naked setae fused basally to short aesthetasc (15 µm).

P2 endopod (Fig. 10D) 3-segmented. Spinous process of enp-1 slightly shorter than in ♀. Outer distal corner of enp-2 slightly more attenuated than in ♀. Outer spine of enp-3 blunt, with crenulated outer margin; inserting apically and flanked by spinous outgrowths of segment.

P3 endopod (Fig. 12F) 3-segmented. Outer margin of enp-2 without spinules but with membranous flange; outer distal corner produced into recurved process covering anterior surface of enp-3 and bordered with membrane along outer margin.

Fifth pair of legs fused medially forming extremely wide transverse baseondopodal plate across ventral surface of somite (Fig. 11B). Baseoendopod and exopod separate. Baseoendopod with small basal setophore bearing outer sparsely plumose seta; endopodal lobe not developed; endopodal armature consisting of short, naked, outer seta and somewhat longer, bipinnate, inner spine; anterior surface with 3 secretory pores, distal margin with setules between outer seta and exopod and with spinules medial of inner spine. Exopod with shape, ornamentation and armature as in ♀ except for distal margin not produced into cylindrical apex and inner distal element represented by spine with flagellate tip rather than slender naked seta.

Sixth pair of legs symmetrical; each P6 with armature consisting of outer sparsely plumose seta, middle naked seta and inner naked spine with flagellate tip (Fig. 11C).

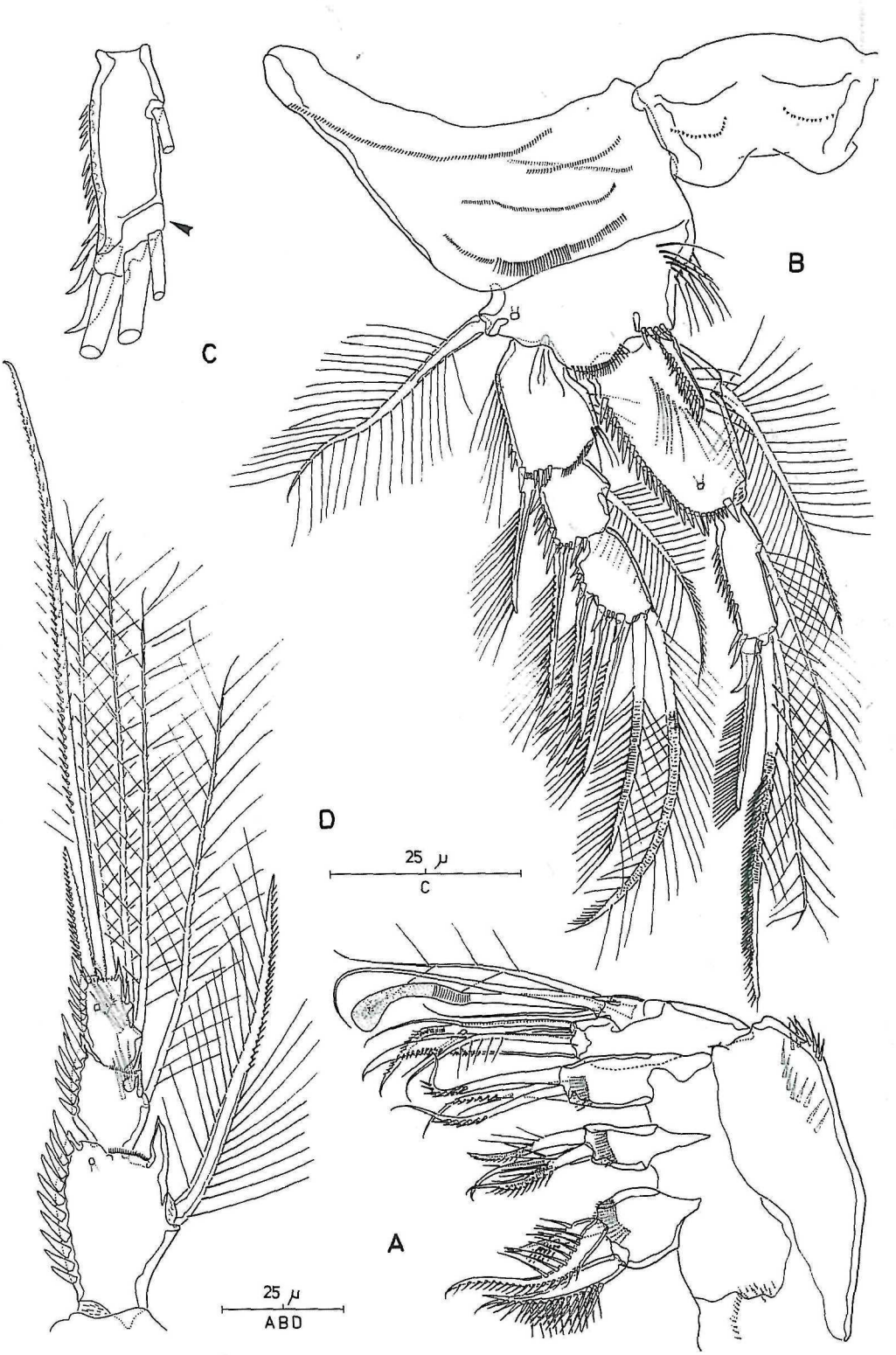

Figure 9. *Peltisenia aberrans* (Por, 1964) comb. nov. A, maxilla; B, P1, anterior; C, P1 enp-2, posterior (arrow indicating mei area); D, P4 endopod ♀.

Figure 9. *Peltisenia aberrans* (Por, 1964) comb. nov. A, maxille B, P1, vue antérieure ; C, P1 enp-2, vue postérieure (la flèch l'aire membraneuse) ; D, endopodite dc P4 ♀.

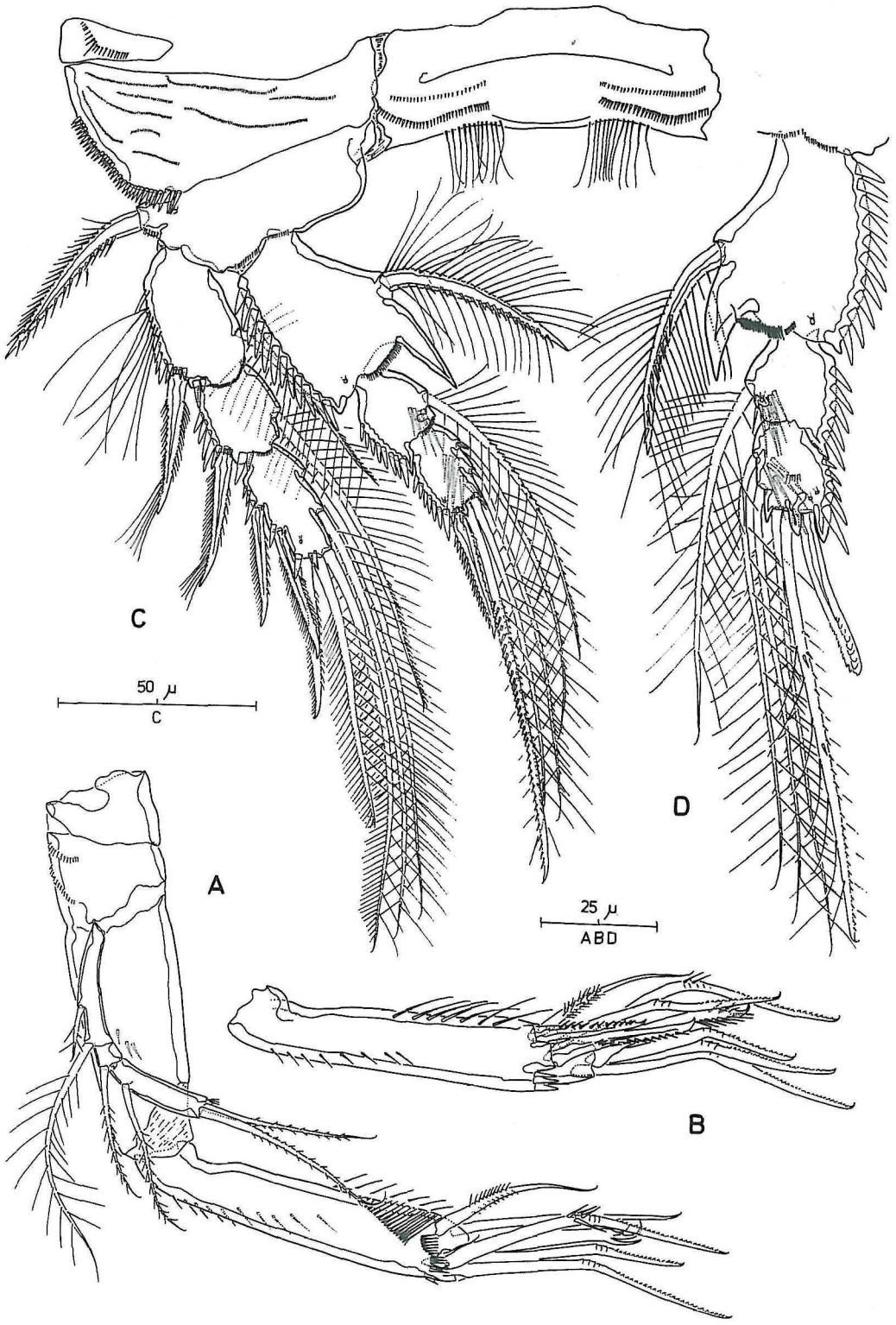

Figure 10. *Peltisenia aberrans* (Por, 1964) comb. nov. A, antenna, outer; B, antennary free endopod, inner; C, P2 ♀, anterior; D, P2 endopod ♂, anterior.

Figure 10. *Peltisenia aberrans* (Por, 1964) comb. nov. A, antenne, vue externe ; B, endopodite de l'antenne, vue interne ; C, P2 ♀, vue antérieure ; D, endopodite de P2 ♂, vue antérieure.

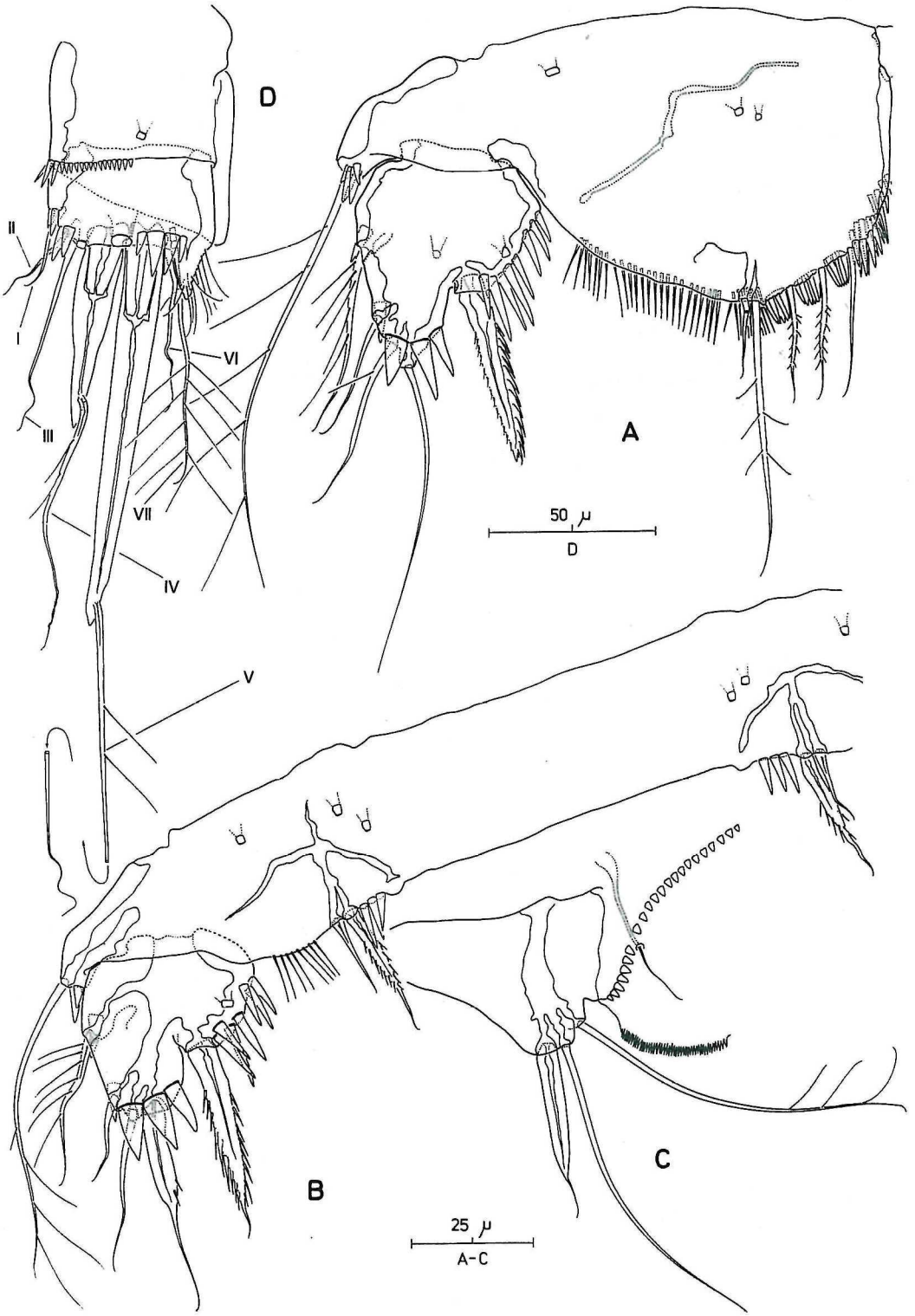

Figure 11. *Peltisenia aberrans* (Por, 1964) comb. nov. A, P5 ♀, anterior; B, P5 ♂, anterior; C, left P6 ♂, anterior; D, caudal ramus and left half of anal somite, ventral.

Figure 11. *Peltisenia aberrans* (Por, 1964) comb. nov. A, P5 ♀, vue antérieure ; B, P5 ♂, vue antérieure ; C, P6 gauche ♂, vue antérieure ; D, rame caudale et moitié gauche du somite anal, vue ventrale.

Urosome with large paired spermatophores.

Distribution. - Israel: off Nahariya (Por, 1964); France: Marseille (Bodin, 1964), Banyuls (Soyer, 1971, 1975); England: Isles of Scilly (Wells, 1970).

Remarks. - The present specimens from Marseille agree with those essential details of *I. aberrans* as outlined by Por (1964) and leave no doubt that *I. (?) peresi* is conspecific with the latter. The only significant difference between both original descriptions is found in the segmentation of the antennary exopod which is described as 2-segmented by Por (1964), however, it is clear that the author failed to recognize the tiny middle segment. Por (1964) also noted the peculiar form of the P1, underlining the highly reduced condition of the last endopod segment and consequently interpreting the endopod as 3-segmented. Lang (1965) pointed out that accepting Por's illustration as correct would imply that *I. aberrans* displays a setal formula hitherto unknown in harpacticoids since the middle endopod segment possesses an outer spine. Both Bodin's (1964) description and our observations have revealed the 2-segmented condition of the P1 endopod. The distal segment typically has a membranous area around the bases of the apical armature elements (Fig. 9C). This flexure zone is only present at the posterior surface and appears to be marked proximally by an oblique line which is merely a reflection of the difference in cuticle thickness and corresponds to the additional suture line identified by Por (1964).

Afrosenia gen. nov.

Diagnosis. - Paranannopidae. Body relatively small, broad and dorsoventrally depressed, with prosome wider than urosome. Rostrum large, rounded anteriorly and tapering proximally, hyaline; with 2 pairs of small sensilla. Somatic hyaline frills deeply incised on thoracic somites forming large lappets; minutely dentate on urosomites. Female genital double-somite with dorsolateral and ventral sub-cuticular transverse ridges marking original segmentation. All urosomites with transverse spinular rows. Pseudoperculum of very distinctive shape, multilappeted, hyaline. Caudal rami wider than long; with 7 setae: seta I vestigial, setae II-III and VI naked, setae IV and V well developed and multipinnate, seta VII naked and tri-articulated at base.

Sexual dimorphism in antennule, P2 endopod, P3 endopod, P5, P6 and in genital segmentation.

Antennules short; 5-segmented in ♀, with pinnate or spinulose spines on segments 2 and 5, with aesthetasc on segment 4 and as part of apical acrothek on segment 5; 9-segmented and subchirocer in ♂, with geniculation between segments 6 and 7, with aesthetasc on segment 6 and as part of apical acrothek on segment 9.

Antennary allobasis with abexopodal seta; exopod 3-segmented, armature formula [1-1-3]. Mandibular endopod, maxillulary basis and maxillary endopod without sensory aesthetascs. Mandibular coxa robust, with blunt teeth on gnathobase; basis with 2 pinnate setae; endopod 1-segmented, with 3 lateral and 5 distal elements; exopod 2-segmented, exp-1 with 2 lateral, exp-2 with 3 apical elements. Maxillule with 3 setae on exopod; endopod larger than exopod. Maxillary syncoxa with 3 elements on middle endite. Maxilliped subchelate; syncoxa with 2 pinnate spines; basis with short naked seta on palmar margin; endopodal claw with 1 short and 1 long accessory seta.

P1 exopod 3-segmented, exp-3 with 3 outer spines (distal outer spine longer than middle outer spine), 1 long bipinnate spine and 1 plumose seta; endopod 2-segmented, longer than exopod with enp-1 shorter than enp-2. P2-P4 with squarish, naked or ornate (P2) intercoxal sclerites; rami 3-segmented; exp-1 with inner seta. Armature formula of P1-P4 as follows:

	Exopod	Endopod
P1	0.1.023	1.121
P2	1.1.223	1.1.221
P3	1.1.223	1.1.321
P4	1.1.323	1.1.221

P2 endopod ♂ 3-segmented; inner seta of enp-1 slightly shorter than in ♀, of enp-2 absent; outer distal corner of enp-2 forming very large spinous process extending beyond distal margin of enp-3; enp-3 with distal inner element replaced by extremely large spinulose spine, apical elements represented by short bipinnate setae, outer spine slightly displaced to apical position. P3 endopod ♂ 3-segmented; outer margin of enp-2 bare and with small process.

P5 with free exopod bearing 5 setae/spines in both sexes (with 1 element displaced to inner margin); endopodal lobe large, with 5 spines in ♀. Male fifth pair of legs fused medially and largely incorporated into somite; endopodal lobe minute, with 2 elements.

Female genital field with small copulatory pore and genital slit covered by vestigial P6 bearing plumose seta and setule. Male sixth pair of legs symmetrical; each P6 with outer sparsely plumose seta and long, inner naked seta.

One spermatophore.

Etymology. - The generic name alludes to the African continent where the type species was found.

Type and only species. - *Danielssenia spinipes* Wells, 1967

Type locality. - Inhaca Island, Mozambique; detritus sand, marine station beach.

Original description.- Wells (1967): 248-252, Text-Figs 32-33.

Material. - The Natural History Museum, London: holotype ♀ dissected on slide (reg. no. 1967.8.4.125), paratype ♂ dissected on slide (reg. no. 1967.8.4.126) and 1 paratype ♀ in alcohol (reg. no. 1967.8.4.127); coll. J.B.J. Wells, 17 September 1963. Since the slide material proved to be in a very bad condition and the undissected paratype ♀ turned out to be a copepodid V, only a brief redescription is presented here covering the major points that needed re-examination or refiguring.

Redescription.

Afrosenia spinipes (Wells, 1967) comb. nov.

FEMALE

Rostrum (Fig. 12A) large, ventrally deflected, hyaline, rounded anteriorly, tapering posteriorly to short articulation with cephalothorax; with 2 pairs of minute sensilla dorsally.

Body somites typically with transverse spinular rows along posterior margin (Fig. 14D). Somatic hyaline frills well developed, deeply incised on thoracic somites forming large lappets (Fig. 14D); those of urosomites minutely dentate and forming irregular lappets separated by small incisions (Fig. 13D). Dorsal rear margin of penultimate somite posteriorly produced forming large hyaline pseudoperculum covering large part of anal somite (Fig. 13D); pseudoperculum very distinctive as illustrated in Fig. 13D. Anal opening bordered by frill consisting of setulose extensions (Fig. 13D).

Caudal rami (Fig. 13D-E) slightly divergent; distinctly wider than long; with 7 setae. Seta I minute. Setae II and III naked, latter located on small pedestal. Setae IV and V strongly developed, with predesigned fracture planes, richly spinulose except for short proximal parts. Seta VI long and naked. Seta VII positioned at inner subdistal corner, tri-articulate at base.

Genital apertures fused medially forming common transverse genital slit (Fig. 12D); closed off by paired operculae derived from vestigial P6, each bearing outer pinnate seta and inner vestigial element represented by setule. Midventral copulatory pore small (arrowed in Fig. 12D), located closely to genital slit; leading via short copulatory duct to median seminal receptacle with paired chambers.

Antennule (Fig. 14A) very short, 5-segmented. Segment 1 with 3 spinular rows; segment 4 with long aesthetasc fused basally to seta; segment 5 with apical trithek consisting of 2 setae and slender aesthetasc (30 µm). Armature formula: 1-[1 plumose], 2-[7 + 1 pinnate + 1 pinnate spine], 3-[7], 4-[5 + (1+ae)], 5-[6], 6-[8 + 4 pinnate spines + acrothek].

Antennary exopod (Fig. 14B) 3-segmented. Armature formula [1-1-3].

Mandibular palp (Fig. 13B) biramous; comprising basis, 1-segmented endopod and 2-segmented exopod. Basis with long setules in proximal half; armature consisting of 2 pinnate setae. Rami of about equal length but endopod wider. Endopod with 1 pinnate and 2 naked setae laterally, and with 5 basally fused naked setae apically. Exopod with 1 proximal pinnate and 1 distal naked seta on exp-1; exp-2 with 3 naked setae apically.

Maxillary allobasis (Fig. 14C) drawn out into strong bifid claw with distal spinules; accessory armature consisting of 1 geniculate and 2 naked setae. Endopod represented by small segment with 4 setae.

Maxilliped (Fig. 13C). Syncoxa with various spinules, and 2 strong pinnate spines (1 long, 1 short). Basis with spinular row along palmar margin, and short seta (bearing 1 spinule) near articulation with endopodal claw. Endopod represented by strong claw bearing coarse spinules in distal third, and 2 accessory naked setae (1 long, 1 short).

P1 (Fig. 13A). Praecoxa well developed, with row of minute spinules. Coxa with spinular rows on anterior surface as illustrated in Fig. 13A. Basis with strong pinnate spines at inner distal corner and outer margin. Exopod 3-segmented; exp-3 with 4 pinnate spines and 1 plumose seta. Endopod 2-segmented, distinctly longer than exopod; enp-1 wider and much shorter than enp-2, with spinulose distal and outer margins and with distally serrate seta along inner margin; enp-2 with short inner plumose seta and distal armature consisting of 1 short and 1 long pinnate spine, and 1 sparsely plumose seta (missing in slide material; inserted in dotted lines by reference to undissected paratype; Fig. 13A).

P5 (Fig. 14E) biramous, comprising triangular exopod and large, rectangular baseoendopod. Exopod not extending beyond endopodal lobe; inner margin with apically serrate spine; outer margin with 3 pinnate spines; apex with short (naked?) seta; anterior surface with 2 secretory pores. Baseoendopod with 2 secretory pores on endopodal lobe and 2 others near basal setophore; outer basal seta slender and sparsely plumose, located on short setophore; endopodal lobe with stepped distal margin bearing short serrate seta flanked by 2 long bipinnate spines at inner corner, and 2 closely set bipinnate spines near outer corner.

MALE

Antennule (Fig. 14F) 9-segmented, subchirocer; geniculation between segments 6 and 7. Segment 1 with 2 spinule rows. Segment 5 represented by small discoid sclerite bearing 2 setae. Segment 6 distinctly swollen, with cylindrical pedestal bearing long aesthetasc fused basally to long naked seta. Apical segment hook-shaped, bearing acrothek consisting of short aesthetasc and 2 naked setae.

P2 endopod (Fig. 12B) strongly modified, 3-segmented. Enp-1 small, with strong spinules along outer margin and

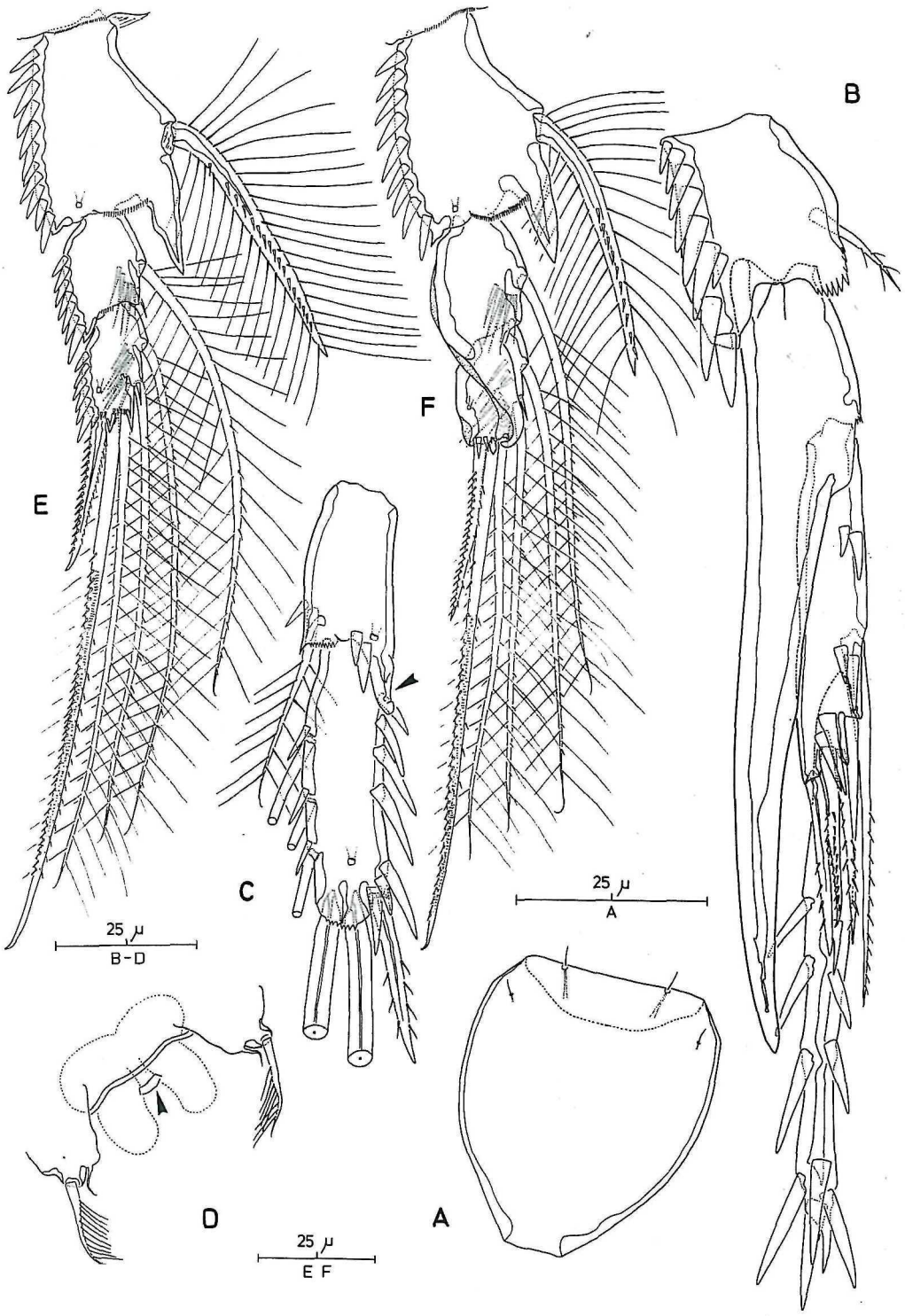

Figure 12. *Afrosenia spinipes* (Wells, 1967) comb. nov. A, rostrum, dorsal; B, P2 endopod ♂, anterior; C, P3 enp-2 and -3 ♂, anterior (apophysis on enp-2 arrowed); D, genital field ♀, ventral (copulatory pore arrowed). *Peltisenia aberrans* (Por, 1964) comb. nov. E, P3 endopod ♀, anterior; F, P3 endopod ♀, anterior.

Figure 12. *Afrosenia spinipes* (Wells, 1967) comb. nov. A, rostre, vue dorsale ; B, endopodite de P2 ♂, vue antérieure; C, enp-2 et -3 de P3 ♂, vue antérieure (la flèche indique l'apophyse sur enp-2) ; D, région génitale ♀, vue ventrale (la flèche indique l'orifice copulateur). *Peltisenia aberrans* (Por, 1964) comb. nov. E, endopodite de P3 ♀, vue antérieure ; F, endopodite de P3 ♂, vue antérieure.

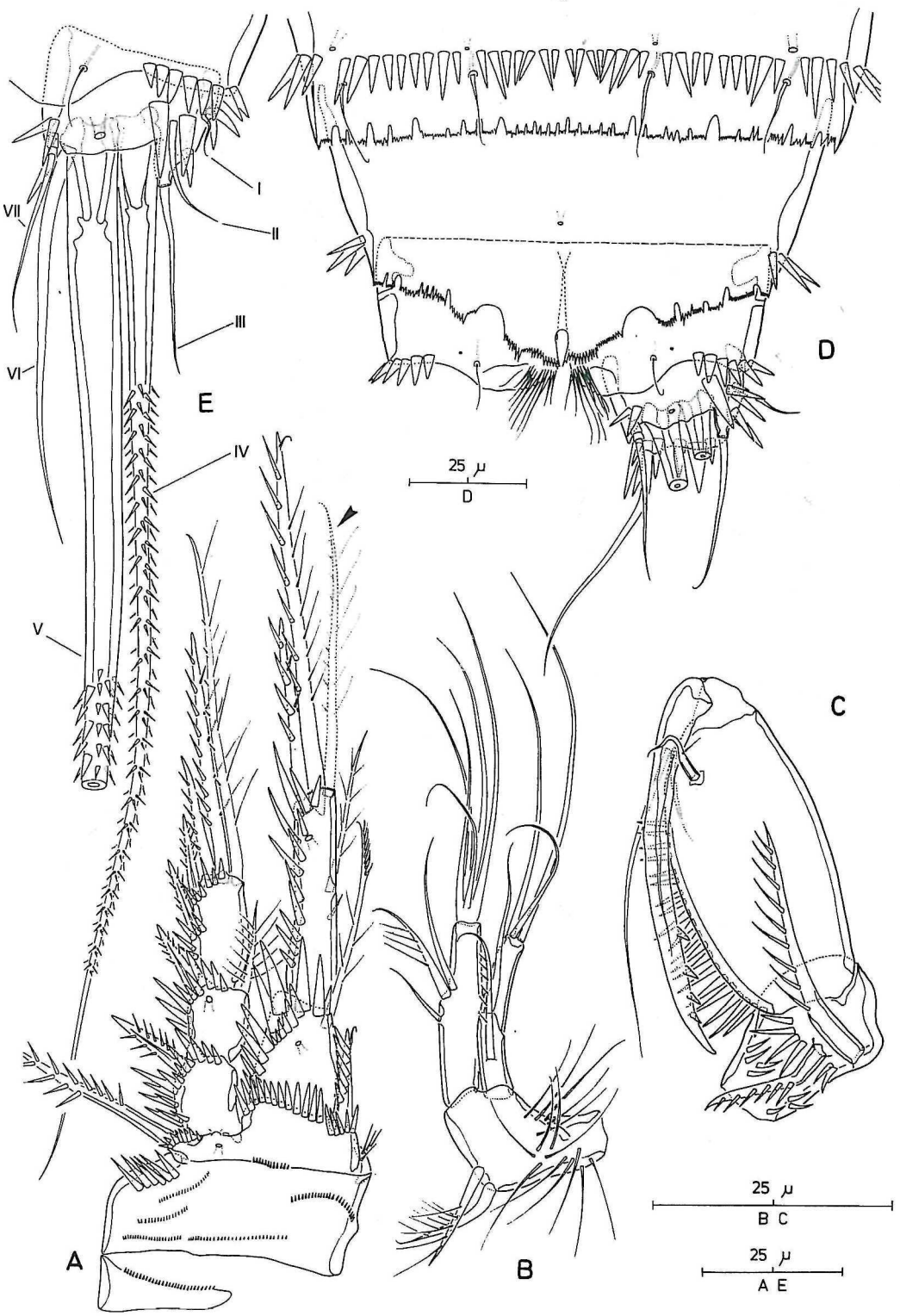

Figure 13. *Afrosenia spinipes* (Wells, 1967) comb. nov. A, P1, anterior (missing seta on enp-2 arrowed); B, mandibular palp; C, maxilliped; D, posterior abdominal somites and right caudal ramus, dorsal; E, right caudal ramus, dorsal.

Figure 13. *Afrosenia spinipes* (Wells, 1967) comb. nov. A, P1, vue antérieure (la flèche indique la soie manquante sur enp-2) ; B, palpe mandibulaire ; C, maxillipède ; D, somites postérieurs abdominaux et rame caudale droite, vue dorsale ; E, rame caudale droite, vue dorsale.

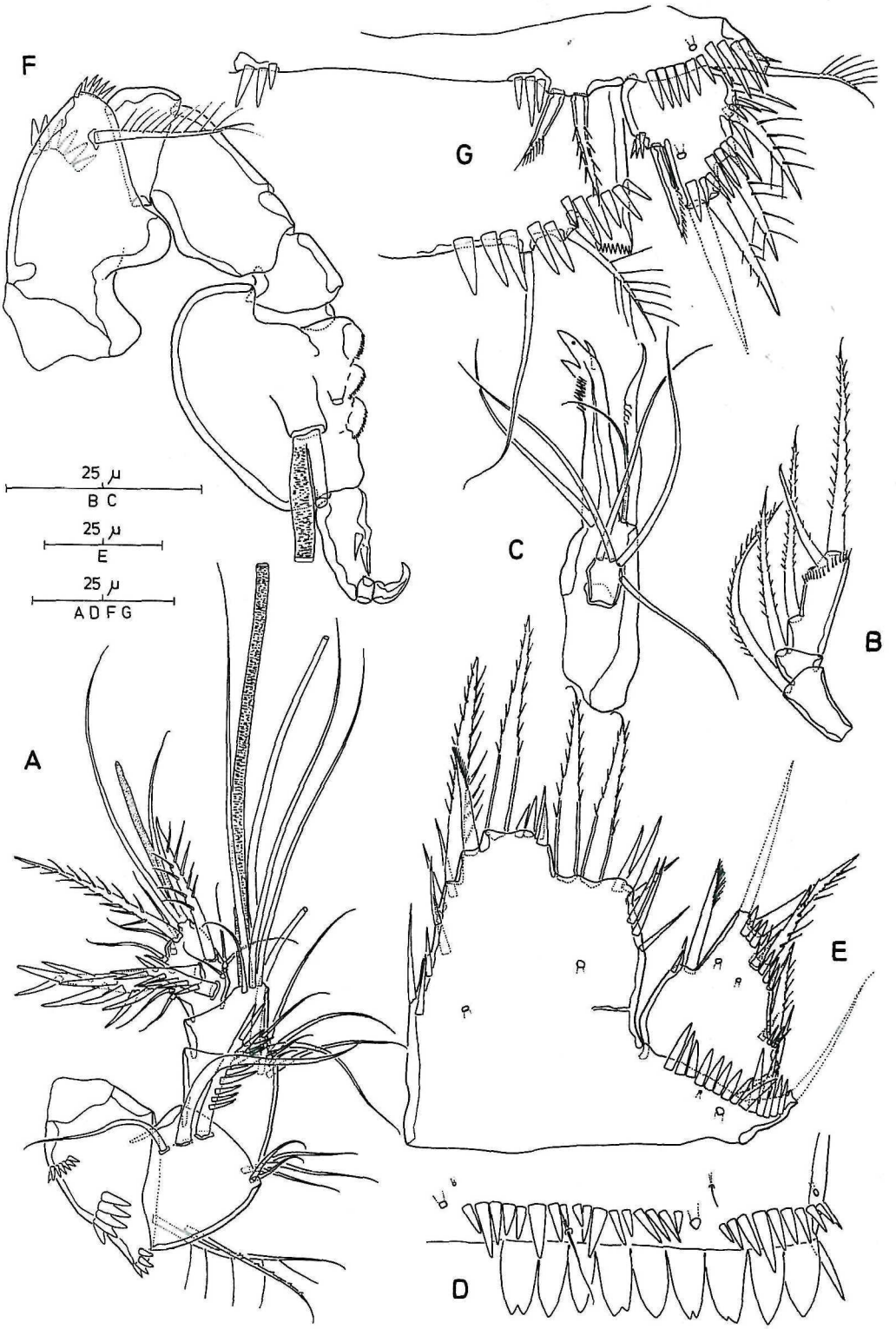

Figure 14. *Afrosenia spinipes* (Wells, 1967) comb. nov. A, antennule ♀; B, antennary exopod; C, maxillary allobasis and endopod; D, hyaline frill and somitic ornamentation of P4-bearing somite; E, P5 ♀, anterior; F, antennule ♂, ventral (armature omitted); G, left P5 and P6 ♂, ventral.

Figure 14. *Afrosenia spinipes* (Wells, 1967) comb. nov. A, antennule ♀ ; B, exopodite antennaire ; C, allobase et endopodite maxillaire; D, bord hyalin et ornementation du somite portant P4; E, P5 ♀, vue antérieure ; F, antennule ♂, vue ventrale (armature omise) ; G, P5 et P6 gauches ♂, vue ventrale.

short pinnate seta along inner margin. Enp-2 with outer distal corner produced into large spinous apophysis extending well beyond distal margin of enp-3; inner margin without seta. Enp-3 with distal inner seta transformed into very large spine bearing coarse spinules; proximal inner seta unipinnate; apical setae reduced in size compared to ♀, pinnate; outer spine displaced to apical position, defined at base.

P3 endopod (Fig. 12C) 3-segmented. Enp-2 with outer distal corner modified into short, acutely recurved process (arrowed in Fig. 12C).

Fifth pair of legs fused medially and partly incorporated into somite (Fig. 14G). Baseoendopod with coarse spinules largely obscuring basal setophore and articulation with exopod; endopodal lobe obsolete, represented by 3 coarse spinules and 2 pinnate spines of different lengths; outer basal seta sparsely plumose and borne on short setophore. Exopod with clearly stepped inner and outer margins, tapering towards apex; inner margin with apically serrate spine; apex and outer margin both with 2 pinnate spines; anterior surface with 1 secretory pore; insertion sites of most elements concealed beneath coarse spinules.

Sixth pair of legs symmetrical; each P6 with armature consisting of outer plumose seta and long inner naked seta, and bearing transverse row of coarse spinules (Fig. 14G).

Distribution. - Known only from the type locality.

Remarks. - Wells' (1967) could not confidently place *D. spinipes* in the genus *Danielssenia*. This is partly due to the fact that he failed to clarify critical features of the P1 and female P5. Wells illustrates the distal exopod segment of the P1 with a total of 6 elements, the maximum in the Paranannopidae being 5. We could find no evidence for the additional weak, inner seta; in our opinion the setation of this ramus is as in other genera of the danielsseniid grouping. The author also erroneously figured only 2 distal elements on the distal endopod segment, but this can be explained by the fact that the inner distal seta on enp-2 was missing in both dissected paratypes. Its presence could be identified by reference to the undissected copepodid V paratype and close examination of enp-2 in the adult paratypes revealing a socket corresponding to the insertion site of the missing seta.

The female P5 is as illustrated by Wells (1967), but is described in the text as having 4 plumose setae on the endopodal lobe. Our observations revealed that these elements are bipinnate and that the inner serrate spine, although being figured, had been mistaken for a spinule inserting between the inner lateral and inner apical spines.

The existence of dorsal spinular rows on the pedigerous somites is confirmed contrary to the unornamented condition suggested by Wells (1967). Moreover, scrutinous resolution of somatic ornamentation has proved that the spinule groups shown along the posterior margin of the thoracic and abdominal somites are genuine spinules forming part of a transverse subdistal row and should not be attributed to the hyaline frill proper as claimed by Wells (1967). The fine details of the hyaline frills could only be revealed under high power and were shown to differ significantly between the prosome and urosome.

Contrary to Wells' claim, the rostrum is defined at the base, not fused to the cephalothorax. The presence of only 2 postgenital somites in his Text-Fig. 32A-C suggests that the author failed to recognize the somite boundaries at the rear end of the abdomen. It is conceivable that the last somite (illustrated with an operculum) in actual fact represents the penultimate one forming a posteriorly directed pseudoperculum of peculiar shape and form and largely obscuring the outlines of the anal somite in dorsal aspect.

Other features elaborated by scrutinous examination of the type slides include the 2-segmented condition of the mandibular exopod, the presence of an exopod on the maxillule, the true setation pattern of the maxillary endopod and syncoxal endites, and the presence of 2 pinnate spines on the coxa of the maxilliped and of 2 accessory setae on its endopodal claw.

The male P2 endopod is a fair representation, but the distal segment has a total of 5 elements; the 2 setae which escaped Wells' attention are the ones that overlie the large subdistal spine and are difficult to discern without fine focussing. Finally, as in many other early descriptions of Paranannopidae, the sexual dimorphism on the P3 endopod was overlooked.

Discussion

The present redescriptions have clarified some critical features of the mouthparts and swimming leg sexual dimorphism. Of great phylogenetic significance, however, is the revelation of sensory aesthetascs on the oral appendages of both *D. minuta* and *I. aberrans*. These modified armature elements can be identified as the positional homologues of similar aesthetascs in the genera *Jonesiella* Brady (= *Sentiropsis* Huys & Gee), *Paradanielssenia* Soyer, *Micropsammis* Mielke, *Leptotachidia* Becker and *Telopsammis* Gee & Huys as they are found on identical sites, i.e. the mandibular endopod, maxillulary basis and maxillary endopod (Gee & Huys, 1991; Huys & Gee, 1992).

Por (1964) states that *I. aberrans* is undoubtedly related to *I. australis* Brady and perhaps also to the Indo-Pacific species like *I. laticaudata* (Thompson & A. Scott) and *I. aemula* (Thompson & A. Scott), but gives no grounds for these presumed affinities. Lang (1965) questioned these vague morphological parallels but did not present any evidence to the contrary nor any pointers as to the possible relationships of *I. aberrans*. Bodin (1964) expressed some

doubts about the generic affinity of *I. (?) peresi* as is apparent from the orthography of the name, however, refrained from a proper analysis of its relationships.

The present investigation has established beyond doubt that *I. aberrans* clearly belongs to the Paranannopidae. The setation pattern of the cephalic appendages and swimming legs, in particular the P1, indicate that the species should be removed from the Pseudotachidiinae. Representatives of the latter display a tetrasetose maxillulary exopod whereas in *I. aberrans* and all other Paranannopidae this ramus typically bears 3 setae (exceptionally 2; see *Sentiropsis*). Males of all three pseudotachidiinid genera, *Pseudotachidius* T. Scott, *Dactylopodella* Sars and *Idomene* Philippi typically possess 2 large aesthetascs on the antennule (in addition to the small apical one). In *I. aberrans* and all other paranannopids only a single large aesthetasc is found, usually present on the swollen segment 6. The conclusive piece of evidence for accommodating *I. aberrans* in the Paranannopidae, however, is provided by the presence of sensory aesthetascs on the mouthparts. Furthermore, the claviform shape of these structures serves to link the species to a specialized group of genera encompassing *Paradanielssenia*, *Micropsammis*, *Telopsammis* and *Leptotachidia*. Gee & Huys (1991) discussed the relationships of these taxa and concluded that they constitute a monophyletic group on the basis of (1) the uniramous mandibular palp comprising palp and 1-segmented endopod, and (2) the form of the sexual dimorphism on the male P2 endopod in which the outer distal spine of enp-3 is fused to the segment forming a rigid apophysis. *I. aberrans* cannot be referred to any of these four genera nor can it be placed in this monophyletic group since (1) the mandibular palp is clearly biramous, comprising a 1-segmented endopod and an elongate 2-segmented exopod, and (2) the outer distal spine of P2 enp-3 is not integrated into the segment and forming an apohysis-like extension; instead this element is modified into a blunt spine with crenulated outer margin, inserting apically and flanked by spinous outgrowths of segment. The claviform nature of the mouthpart aesthetascs suggests that *I. aberrans* occupies an intermediate position between this group and the two genera that have setiform aesthetascs, i.e. *Jonesiella* and *Sentiropsis*. A sistergroup relationship with the *Paradanielssenia* lineage might be supported by the similar shape and form of the inner spine on P2-P3 enp-1 (but not P4!) in both *I. aberrans* and *Paradanielssenia* (cfr. Gee & Huys, 1991, 1994). The usefulness of this character in defining a 5-taxon-clade is weakened however, by the absence of the inner spine in the more advanced genera *Micropsammis, Telopsammis* and *Leptotachidia*.

I. aberrans is unique in several respects, justifying its removal to a distinct genus *Peltisenia*. *P. aberrans* comb. nov. can easily be recognized without dissection by the markedly dorsoventrally depressed body and the very distinctive caudal rami, including the unique modification of setae IV and V which are composed of a strong, styliform part proximally and a flagellate part distally. The modified fifth legs in both sexes of *P. aberrans* bear little resemblance to those of other Paranannopidae. The transverse extension of the P5 across the entire width of the urosome, expressed in the development of a very large endopodal lobe in the female and a massive transverse plate in the male, is obviously the indirect result of the extreme dorsoventral flattening of the body. This is also reflected in the very wide intercoxal sclerites of the P2 to P4. *P. aberrans* is the only species in the Paranannopidae (including the deep-sea genera *Paranannopus* Lang and *Cylindronannopus* Coull) to have haplocer male antennules possessing an unmodified sixth aesthetasc-bearing segment. In all other members of the family the male antennules are clearly chirocer or at least subchirocer, and in all cases segment 6 is extremely swollen. The female antennules are characterized by the absence of pinnate or spinulose spines, the only ornamented elements being the sparsely plumose setae on segments 2-5. In the great majority of the Paranannopidae elaborated spines or setae are typically present on both segment 2 and the apical segments. The only marked exception to this pattern is *Sentiropsis* where all antennulary setae lack ornamentation. The antenna of *Peltisenia* differs from all other paranannopids in the absence of the abexopodal seta on the allobasis. Additional main characteristics separating *Peltisenia* from other paranannopid genera are found in the facies of the P2-P4 endopods, the form and size of the hook-like apophysis on the male P3 enp-2 and the presence of paired spermatophores in the male.

The discovery of aesthetacs on the mouthparts of *D. minuta* has similar consequences to the generic affiliations of the species. Coull (1969) experienced some difficulties in his attempt to place *D. minuta* in either of the two species groups in *Danielssenia* as defined by Lang (1944, 1948). We have amply demonstrated (Gee & Huys, 1990; Huys & Gee, 1992, 1993) that this division is not tenable since the genus artificially groups species drawn from several lineages. *D. minuta* is reminiscent of the two species currently accommodated in *Jonesiella* in the presence of setiform aesthetascs on the oral appendages. Gee & Huys (1991) suggested that the setiform aesthetasc represented the most primitive type and could be regarded as the precursor from which the more specialized claviform type had been derived. This implies that *D. minuta* should be placed near the basal node of the *Paradanielssenia* group, either as a member of *Jonesiella*, or as the sistergroup of the latter, or as a distinct genus intermediate between *Jonesiella* and the genera equipped with club-shaped aesthetascs. The first option can be ruled out on the basis of profound differences in the male P2 endopod which

in *Jonesiella* has a robust spinous apophysis on enp-2 reaching to the distal margin of enp-3, whereas in *D. minuta* the apophysis is reduced to a minute spinous outgrowth. Both *J. fusiformis* Brady and *J. eastwardae* (Coull) have two synapomorphies not found in *D. minuta*: (1) maxillulary exopod folded under basis [fully exposed in *D. minuta*]; (2) maxillary syncoxa with modified bifid spine on distal endite [spine not modified]. In addition, *D. minuta* displays a suite of unique autapomorphic character states preventing its allocation to *Jonesiella* and adequately justifying its removal to a separate genus *Sentiropsis*: (1) antennule with all setae slender and naked [with numerous pinnate setae and spines, and large spinulose spines on segment 5 in *Jonesiella*]; (2) antennary exopod with 2 apical setae on exp-3 [with 1 lateral and 2 apical]; (3) maxillule with 2 setae on exopod [trisetose]; (4) maxillary syncoxa with reduced middle endite bearing 2 setae [normally developed with 3 elements]; (5) maxillipedal syncoxa with 1 naked seta [with 2 pinnate spines]; (6) P1 enp-1 longer than enp-2 [shorter]; (7) male P5 baseoendopod completely absorbed into somite, endopodal setae lost [baseoendopod defined at base with 2 spines on endopodal lobe].

There are few similarities that could hint at a sistergroup relationship between *Jonesiella* and *Sentiropsis*. Both genera share the same type of hyaline rostrum with rounded anterior margin and typically tapering towards the base, however, this condition is not unique since it is also found in *D. spinipes* (Fig. 12A). The only other resemblance is found in the armature of the mandibular basis, comprising 2 pinnate setae proximally and 1 naked seta distally. Conversely, there is stronger evidence for placing *Sentiropsis* as the sistergroup of the *Paradanielssenia* lineage. This is provided by the loss of the proximal inner seta on P2 enp-2 and, more importantly, the reduction of the spinous apophysis on the same segment in the male.

Wells (1967) linked *D. spinipes* to *D. intermedia* Wells (= *Fladenia robusta* (Sars)) on account of the presence of an inner seta on P2-P4 exp-1 and regarded the transitionary status of the species as supporting evidence for maintaining the generic distinctiveness of *Danielssenia* and *Psammis* Sars. Coull (1969) regarded the species as most closely related to *D. minuta* in size and general body shape. Neither of these relationships is acceptable since *F. robusta* displays unique sexual dimorphism on the endopods of P2-P4, and *S. minuta* possesses sensory aesthetascs on the mouthparts which are not present in *D. spinipes*. Perhaps the most distinctive feature of *D. spinipes* is the extreme sexual dimorphism on the male P2 endopod. The proportions of the spinous apophysis arising from enp-2 are reminiscent of those found in *Archisenia* Huys & Gee and the species belonging to *Danielssenia* (except *D. spitsbergensis* Gee & Huys). Furthermore, the loss of the inner seta on this segment in male *D. spinipes* is also found in *Archisenia sibirica* (Sars). Neither *Danielssenia* nor *Archisenia* can be considered a likely candidate to accommodate *D. spinipes*. The former genus differs primarily in the presence of an incised hyaline frill on the P5-bearing somite, the 4-segmented female antennule, the mandible with short rami and 3 setae on the basis, the maxillipedal syncoxa with only 1 spine, the absence of an inner seta on P2-P4 exp-1 and the male P6 with only 2 elements. *Archisenia* shows fundamental differences with *D. spinipes* in the shape of the rostrum, the 6-segmented female antennule, the presence of 2 setae on exp-1 of the antenna, the mandibular palp with short rami and 4 setae on the basis, the sexual dimorphism of P2 endopod (particularly the modification of enp-1), and the detailed morphology of the female genital field and P5. In general, a combination of rather primitive features characterizes *D. spinipes*, however the 5-segmented female antennule, the elongate mandibular palp and the distinctive pseudoperculum assist in setting it apart as the type species of a new genus *Afrosenia*. The strong modification of the distal inner element of P2 enp-3 forming a massive spine in *Afrosenia* has morphological parallels in *Jonesiella*, *Sentiropsis* and *Paradanielssenia*, and it is conceivable that its absence in the advanced genera *Micropsammis*, *Telopsammis* and *Leptotachidia* is caused by the secondary loss of this element. This would suggest that *Afrosenia* diverged from the basal node of the lineage leading to the genera with oral aesthetascs, i.e. in close proximity to *Jonesiella*.

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