A new genus of notodelphyid copepod (Crustacea, Copepoda, Cyclopoida) from a compound ascidian host collected in the Suez Canal

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Boxshall G. A. & Marchenkov A. 2005. — A new genus of notodelphyid copepod (Crustacea, Copepoda, Cyclopoida) from a compound ascidian host collected in the Suez Canal. *Zoosystema* 27 (3) : 483-497.

ABSTRACT
A new genus and species, *Janstockia phallusiella* n. gen., n. sp., of the family Notodelphyidae is described from *Phallusia nigra* Savigny, 1816 collected in the Suez Canal. The new genus is most closely related to *Ophioseides* Hesse, 1864. Supplementary morphological observations are presented on the type species of the latter genus, *Ophioseides cardiocephalus* Hesse, 1864, and the two genera are compared. The genera differ especially in the form of the maxillules, which have a complex trilobate structure in *Janstockia* n. gen., and the maxillipeds, which are two-segmented in *Janstockia* n. gen. The structure of the swimming legs in these two genera is re-interpreted.

KEY WORDS
Crustacea,
Copepoda,
Cyclopoida,
Janstockia n. gen.,
parasitic in ascidian,
Suez Canal,
new genus,
new species.

RÉSUMÉ
Un nouveau genre de copépode Notodelphyidae (Crustacea, Copepoda, Cyclopoida) parasite d'une ascidie coloniale du Canal de Suez.
Un nouveau genre et une nouvelle espèce de la famille des Notodelphyidae, *Janstockia phallusiella* n. gen., n. sp., sont décrits ici, provenant de *Phallusia nigra* Savigny, 1816, collecté dans le Canal de Suez. Le nouveau genre est proche du genre *Ophioseides* Hesse, 1864. Des observations morphologiques supplémentaires sur l'espèce type du genre, *Ophioseides cardiocephalus* Hesse, 1864, sont présentées et la comparaison entre les deux genres est discutée. Les genres se distinguent en particulier par la forme des maxillules dont la structure est complexe et trilobée chez *Janstockia* n. gen. et par les maxillipèdes, bi-segmentés chez *Janstockia* n. gen. Une nouvelle interprétation de la structure des pattes natatoires dans les deux genres est proposée ici.

MOTS CLÉS
Crustacea,
Copepoda,
Cyclopoida,
Janstockia n. gen.,
parasite d'ascidies,
Canal de Suez,
nouveau genre,
nouvelle espèce.

INTRODUCTION

The modern concept of the family Notodelphyidae was established by Illg (1958), who undertook a comprehensive revision of the family, recognising 28 genera as valid. The number of genera has increased dramatically since 1958 and currently there are 46 genera which we recognise as valid. The systematics of the Notodelphyidae is based mainly on the morphology of the adult female but there are two genera, *Agnathaner* Canu, 1891 and *Kystodelphys* Monniot, 1963, based only on males. Hipeau-Jacquotte (1980) elegantly demonstrated that *Agnathaner minutus* Canu, 1891 was the atypical male of *Pachypygus gibber* (Thorell, 1859). The true identity of the type species, *Agnathaner typicus* Canu, 1891, has not been established, although this form almost certainly represents the atypical male of another, known species and genus. In addition to the 46 valid genera, there are currently four *genera inquirenda* attributable to the family: *Campopera* Schellenberg, 1922, *Dysgenopsyllus* Nicholls, 1944, *Salpicola* Richiardi, 1880 and *Sphaerothylacus* Sluiter, 1884.

The material described below is from the extensive collection of ascidicolous copepods made by Drs Claude and Françoise Monniot of the MNHN during their studies on ascidians. There are nine large female copepods taken from the ascidian *Phallusia nigra* Savigny, 1816 collected in the Suez Canal. These copepods have a vermiform body shape and, after comparison with existing notodelphyid genera with similarly vermiform bodies, we describe this material below as a new genus and species. It exhibits several similarities to the genus *Ophioseides* Hesse, 1864; so detailed comparisons are presented, based on examination of new material of *Ophioseides cardiocephalus* Hesse, 1864 from the coast of France.

MATERIAL AND METHODS

Copepods were dissected and examined as temporary slide preparations in lactophenol. All drawings were made using a camera lucida on an Olympus BH-2 microscope equipped with differential interference contrast. Material for SEM was washed in distilled water, dehydrated through graded acetone series, critical point dried using liquid carbon dioxide as the exchange medium, mounted on aluminium stubs and sputter coated with palladium. Coated material was examined on a Phillips X50 Scanning Electron microscope. Morphological terminology follows Huys & Boxshall (1991).

ABBREVIATIONS

BMNH The Natural History Museum, London;
MNHN Muséum national d'Histoire naturelle, Paris.

SYSTEMATICS

Order CYCLOPOIDA Burmeister, 1834
Family NOTODELPHYIDAE Dana, 1853

Genus *Janstockia* n. gen.

TYPE AND ONLY SPECIES. — *Janstockia phallusiella* n. sp. by original designation.

ETYMOLOGY. — The genus is named in honour of Professor Jan Stock, who contributed significantly to our knowledge of parasitic copepods from marine invertebrates.

DIAGNOSIS. — Adult female vermiform, comprising distinct head and elongate, unsegmented, postcephalic trunk terminating in small abdomen. Head with flared swollen posterolateral margins to dorsal cephalic shield. Antennule conical, tapering strongly from broad base. Antenna robust, with strong apical claw. Labrum an elongate lobe. Mandible represented by tapering, conical palp; gnathobase lacking. Maxillule complex, trilobate. Maxilla vestigial. Maxilliped elongate, indistinctly two-segmented with dense covering of hair-like setules over distal segment. First to fourth swimming legs distributed along trunk; leg pairs robust, biramous, rami typically with one or two sclerotized points derived from outer distal angles of proximal and middle segments, plus an array of reduced setae on vestigial distal segment. Fifth legs represented by paired setae on body surface. Genital field with midventral copulatory pore. Abdomen terminating in paired caudal lobes, each bearing cluster of setae derived from incorporated caudal rami. Male unknown.

Janstockia phallusiella n. sp.
(Figs 1-6; 7A, B; 9)

TYPE MATERIAL. — Holotype ♀ and 8 paratype ♀ (1 incomplete). Three females dissected on slides, two prepared for SEM on stubs. Registration numbers: holotype MNHN-Cp2177, two paratypes (one in alcohol and one dissected on 3 slides) MNHN-Cp2178, MNHN-Cp2179; five paratypes (one in alcohol, two on SEM stubs and two dissected on 2 and 3 slides respectively) BMNH 2004.247-251; one paratype in alcohol, Zoological Museum, St Petersburg, Reg. No. 18096.

TYPE LOCALITY. — Suez Canal.

TYPE HOST. — *Phallusia nigra* Savigny, 1816 (site in host unknown).

ETYMOLOGY. — The specific name is derived from the generic name of the host ascidian.

DESCRIPTION

Based on adult female, male unknown.

Adult female vermiform (Fig. 1), comprising distinct head and elongate, postcephalic trunk terminating in small abdomen (Fig. 5A, D). Mean body length 6.2 mm, with range from 5.1 to 8.4 mm. Head somewhat dorsoventrally flattened, with flared swollen posterolateral margins partly concealing lateral expansions of first pedigerous somite (arrowed in Figure 1C). Swollen lateral margins extending medially to partly conceal mouthparts (Figs 1B; 3A). Rostrum well developed, fused to dorsal cephalic shield; connected to anterior margin of labrum by mid-ventral ridge (Fig. 3B). Entire surface of dorsal cephalic shield and anterior part of rostrum densely ornamented with hair-like setules (Fig. 3A, B). Postcephalic trunk comprising first to fifth pedigerous somites but without clearly defined segmental boundaries. First pedigerous somite shortest, with paired lateral expansions (Fig. 1C); second to fourth pedigerous somites elongate, with linear lateral margins. Surface of trunk highly ornamented with complex system of epicuticular ridges, mostly orientated transversely around the body; numerous hair-like setules distributed among these ridges (Fig. 3C). Swimming legs 1 to 4 located at approximately 1%, 5%, 24% and 60% of length of trunk, respectively (Fig. 1A). Each leg pair carried on slightly raised, common, ovoid pedestal, which is not ornamented with surface ridges and appears to be retractable into body (Figs 3A; 6D). Fifth leg located laterally just anterior to boundary zone where trunk tapers down to abdomen. Genital field with midventral copulatory pore (Figs 3D; 5A, B) and paired internal ducts; genital field lacking ornamentation of surface setules (Fig. 3D). Abdomen indistinctly two-segmented, terminating in paired rounded lobes representing caudal rami incorporated into urosome, each armed with five or six caudal setae (Fig. 5C) (setae difficult to distinguish from numerous surface setules).

Antennule conical (Fig. 2A, B), tapering strongly from broad base; posterior margin showing traces of original segmentation pattern. Setal formula indeterminable: setae largely concealed within dense covering of setules over anterior surface; three aesthetascs present distally (Fig. 2B).

Antenna (Fig. 2C) comprising robust proximal segment (coxobasis), lacking setal armature, and compound distal segment terminating in strong claw (Fig. 2D) and cluster of five setal elements (three terminal setae and two subterminal setae). Patch of tiny denticles present medially, near base of claw.

Labrum (Fig. 3B) consisting of an elongate, midventral lobe; naked anteriorly but densely ornamented with hair-like setules posteriorly.

Mandible (Figs 4A; 5E) lacking gnathobase, consisting of palp only, represented by tapering, conical lobe armed with four setae terminally and three setae along anterior margin; all setae are hirsute; surface ornamented with numerous, slender setules.

Maxillule (Figs 4B, C; 5F) complex in structure; consisting of three lobes of uncertain homology, arising from common base and arranged anteriorly to posteriorly. Anterior lobe simple, armed with one subterminal and two terminal setae; surface of lobe ornamented with setules. Middle lobe subdivided into two rounded processes covered with long hair-like setules (Fig. 3C). Posterior lobe simple, armed with one terminal seta. All setae hirsute.

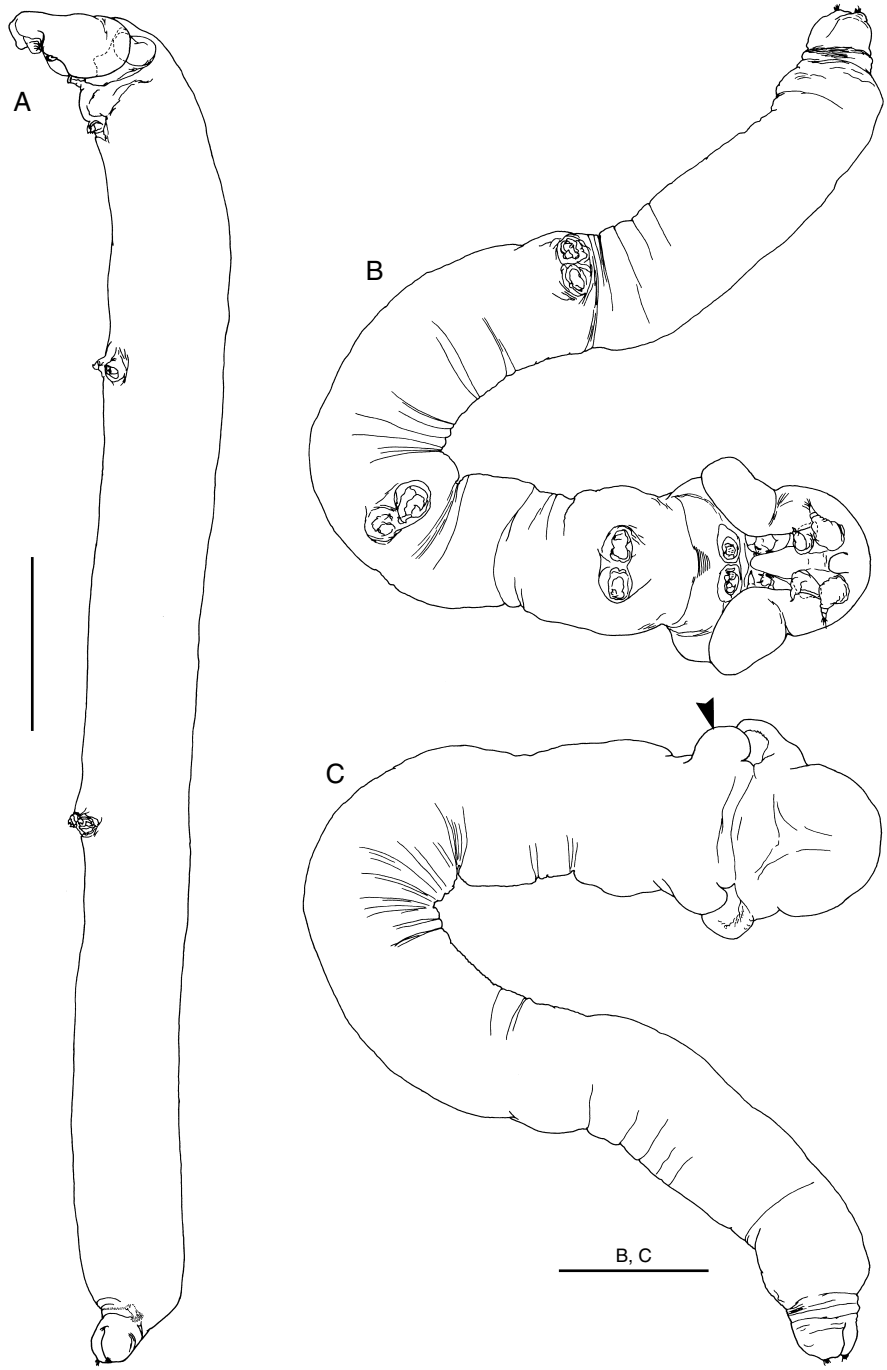

FIG. 1. — *Janstockia phallusiella* n. gen., n. sp. ♀; **A**, habitus of paratype (MNHN-Cp2178), lateral view; **B**, habitus of holotype (MNHN-Cp2177), ventral view; **C**, habitus of holotype, dorsal view showing lateral expansions of first pedigerous somite (arrow). Scale bars: A, 1.0 mm; B, C, 0.5 mm.

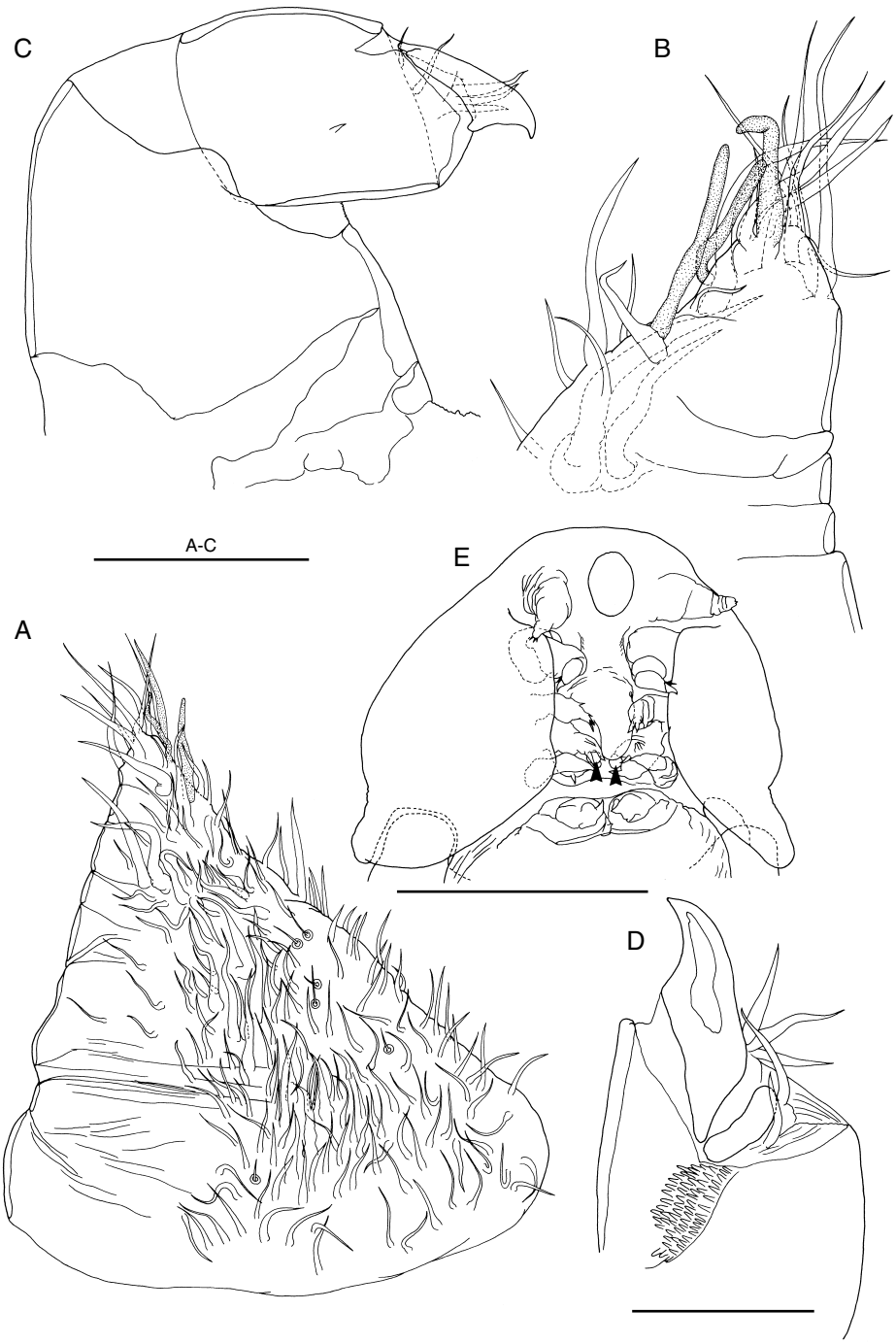

FIG. 2. — *Janstockia phallusiella* n. gen., n. sp. ♀; **A**, antennule; **B**, tip of antennule showing aesthetascs (stippled) and setae; **C**, antenna; **D**, apical claw of antenna and accessory setae; **E**, cephalosome with surface ornamentation of long setules omitted, ventral view showing positions of vestigial maxillae (arrowed). Scale bars: A, C, 50 µm; B, D, 25 µm; E, 300 µm.

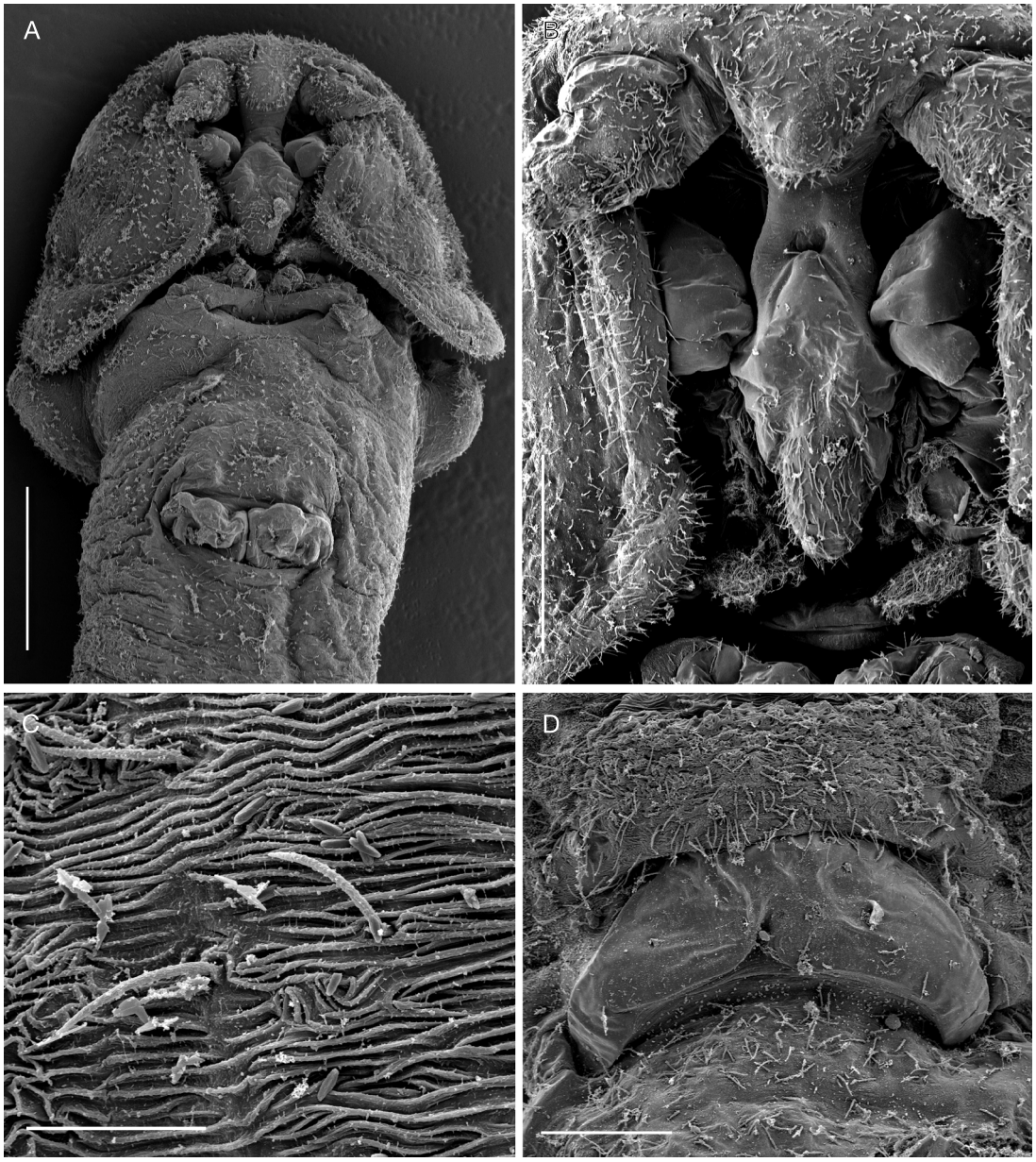

FIG. 3. — *Janstockia phallusiella* n. gen., n. sp. ♀, scanning electron micrographs; **A**, cephalosome and anterior part of trunk, ventral view; **B**, rostrum, labrum and oral area, ventral view; **C**, detail of trunk surface showing integumental ornamentation; **D**, genital openings, ventral view. Scale bars: A, 200 µm; B, 100 µm; C, 10 mm; D, 50 µm.

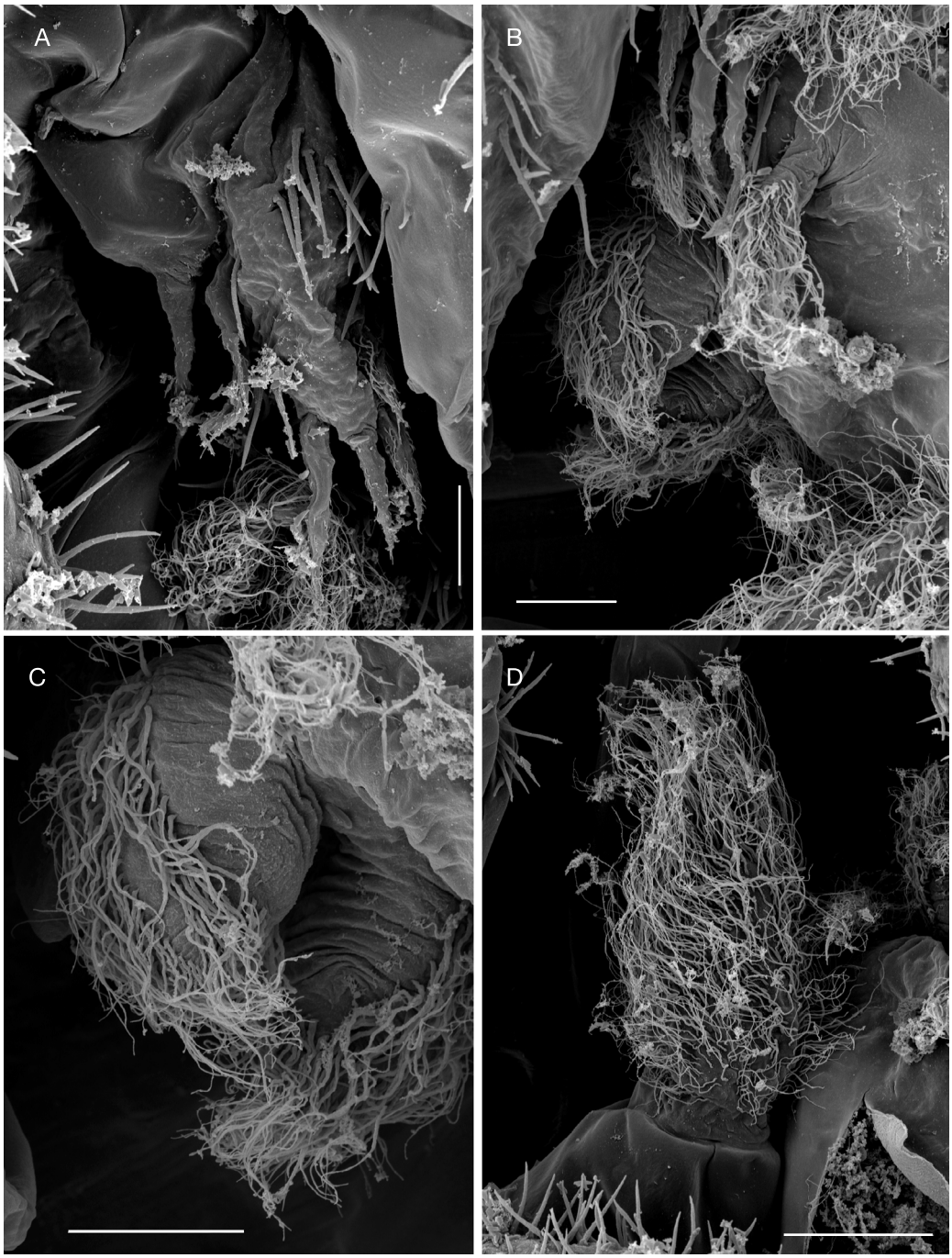

FIG. 4. — *Janstockia phallusiella* n. gen., n. sp. ♀, scanning electron micrographs; **A**, mandibular palp, ventral view *in situ*; **B**, maxillule, ventral view *in situ*; **C**, hirsute lobes of maxillule; **D**, maxilliped. Scale bars: A-C, 10 µm; D, 20 µm.

Maxilla very reduced, represented by small, unarmed, digitiform lobe located posteromedially to base of maxillules (arrowed in Figure 2E).
Maxilliped (Figs 4D; 5G) elongate, two-segmented; proximal segment cylindrical, without setation or ornamentation: distal segment densely covered with long hair-like setules and armed with three weak setae terminally and two subterminally (Fig. 5H).
First to fourth pairs of legs (Figs 6; 7A, B) with broad, ovoid protopodal part common to both members of leg pair; typically ornamented with patches of fine spinules and scattered, hair-like setules. Members of each leg pair connected by small but strongly sclerotized intercoxal sclerite. Legs 1 to 4 biramous, with modified, indistinctly segmented rami; outer protopodal (basal) seta present on all legs. Legs apparently retractable into body.
Leg 1 (Figs 6A, B; 7A) with large spinulate inner basal seta and slender outer basal seta. Exopod indistinctly two-segmented: outer distal angle of first segment produced into pointed sclerotized process, armed with single outer spine (Fig. 6B); distal segment not sclerotized, cuticle wrinkled and ornamented with long setules; armed with five short setae distally; setae finely spinulate over surface and with rounded tips. Endopod indistinctly two-segmented; proximal segment ornamented with patches of fine spinules (Fig. 6B), distal segment broad, armed with similar short, blunt setae as on exopod, partly concealed by irregular ornamentation of large setules; array of integumental pores present near apex of endopod.
Legs 2 to 4 (Figs 6D, F; 7B) all similar in structure: biramous with exopod two-segmented, outer distal angle of first segment produced into pointed sclerotized process, lacking outer spine; distal segment cylindrical, cuticle not sclerotized, but wrinkled and ornamented with scattered long setules; armed with four, five or six short setae distally; setae finely spinulate over surface and with rounded tips. Endopod indistinctly segmented; proximal part produced into two pointed sclerotized processes, probably derived from outer distal angles of first two endopodal segments, and a small raised lobe, representing third endopodal segment, carrying about five short setae with blunt tips. Third endopodal segment forming a weak incorporated lobe in leg 2 (Fig. 6C), leg 3 (Fig. 6E) and leg 4 (Fig. 6F).
Fifth leg represented by two setae inserted directly on body surface near posterior margin of trunk.

REMARKS

The new genus shares the vermiform body entirely covered with setular ornamentation with five other notodelphyid genera (Ooishi 1998): *Haplostatus* Illg & Dudley, 1961, *Ophioseides*, *Pholeterides* Illg, 1958, *Prophioseides* Chatton & Brément, 1915 (excluding *P. ampullacea* Ooishi, 1972, the generic affiliation of which is, according to Ooishi [1998], in need of reconsideration) and *Pythodelphys* Dudley & Solomon, 1966. In addition, the body of *Anoplodelphys* Lafargue & Laubier, 1978 is covered with setular ornamentation and tends towards a vermiform morphology. *Prophioseides*, *Pholeterides* and *Pythodelphys* are all characterized by extreme reduction or loss of swimming legs 1 to 4, while at the same time typically retaining a well developed, setose maxilla and a well developed mandible (with biramous palp and gnathobase). *Anoplodelphys* species exhibit reduced or transformed oral appendages and legs 1 to 4, when present, are typically biramous with the rami forming elongate lobes. *Haplostatus* has extreme reduction of the mouthparts and has no swimming legs. In contrast, the new genus and *Ophioseides* are characterized by reductions of the mouthparts (i.e. loss of the mandibular gnathobase and extreme reduction of the maxilla to a minute lobe) in combination with retaining well developed, although modified, swimming legs 1 to 4. These genera also share produced tergal margins of the first pedigerous somite, which form the lateral lobes lying just posterior to the cephalosome. The new genus can be distinguished from *Ophioseides* by the complex, trilobate form of the maxillule of the new genus (either absent or represented by a minute lobe in *Ophioseides*) and by the two-segmented state of the maxilliped (absent in *Ophioseides*).

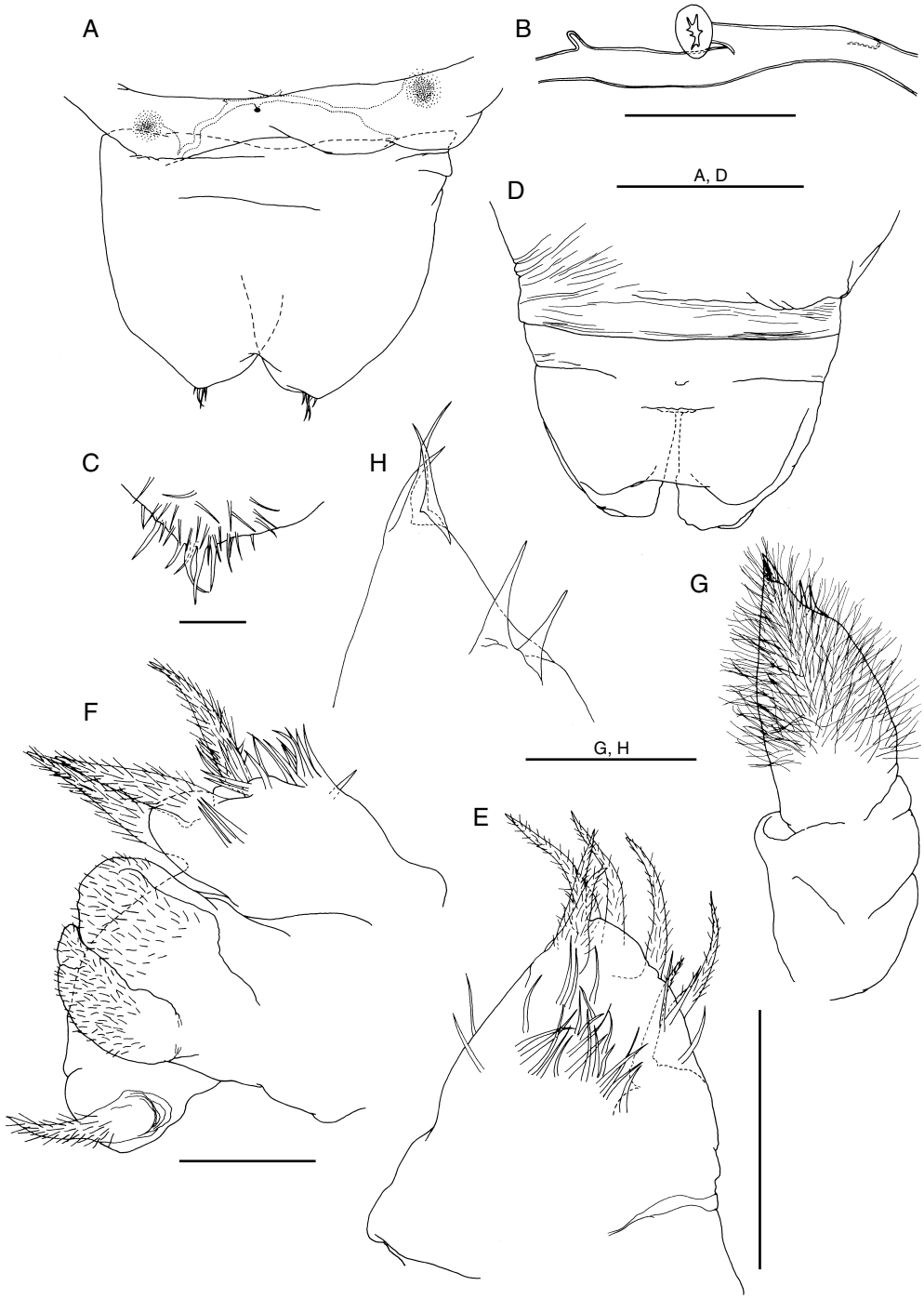

FIG. 5. — *Janstockia phallusiella* n. gen., n. sp. ♀; **A**, urosome, ventral view; **B**, copulatory pore and paired sperm ducts, with blind projections; **C**, cluster of setae representing incorporated caudal rami, showing setular ornamentation, dorsal view; **D**, urosome, dorsal view; **E**, mandibular palp; **F**, maxillule; **G**, maxilliped; **H**, tip of maxilliped. Scale bars: A, D, 200 µm; B, C, F, H, 25 µm; E, G, 50 µm.

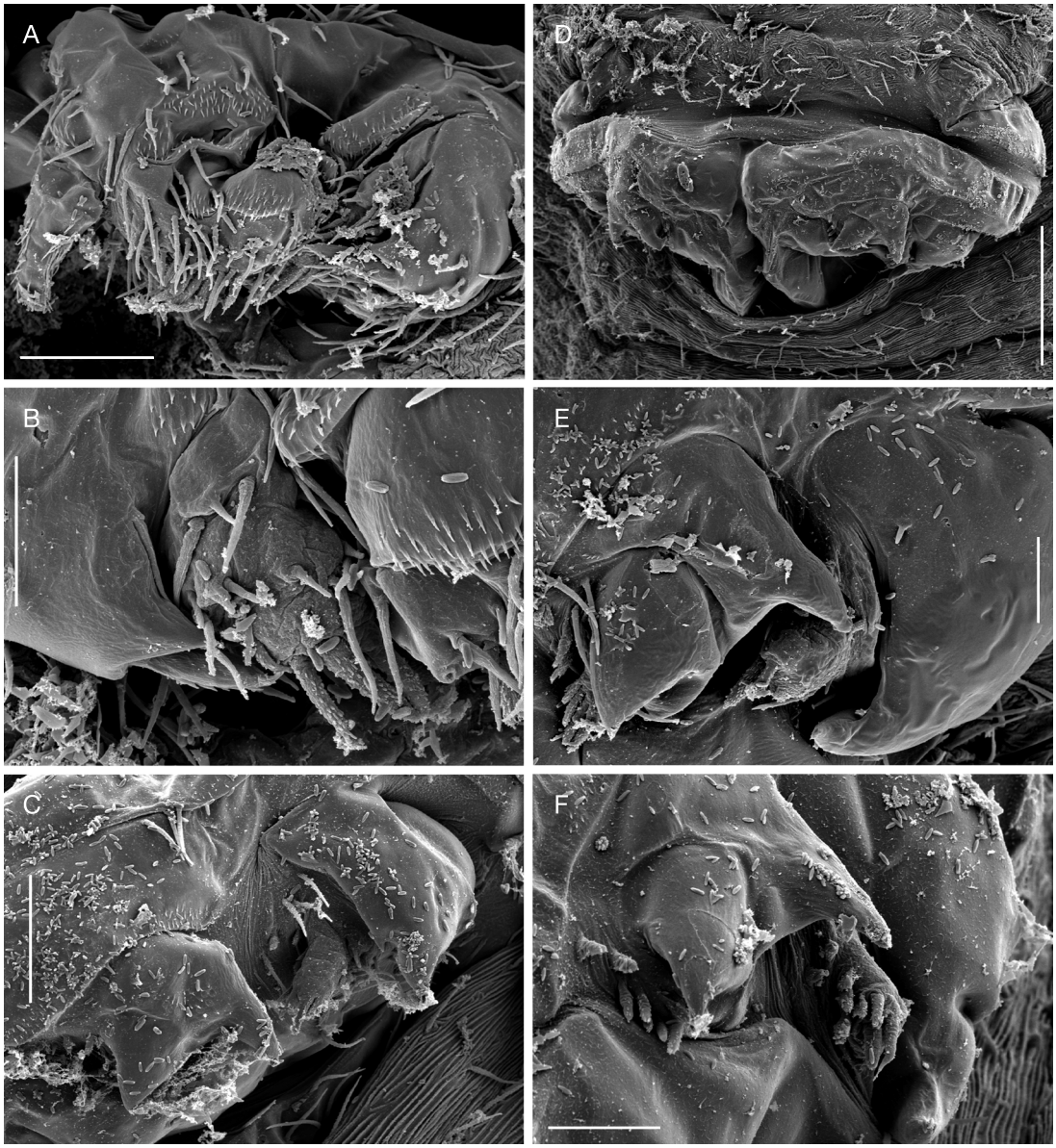

Fig. 6. — *Janstockia phallusiella* n. gen., n. sp. ♀, scanning electron micrographs; **A**, leg 1, anteroventral; **B**, detail of leg 1 exopod; **C**, rami of leg 2; **D**, leg 4; **E**, detail of leg 3 rami; **F**, detail of leg 4 rami. Scale bars: A, 20 µm; B, C, E, F, 10 µm; D, 50 µm.

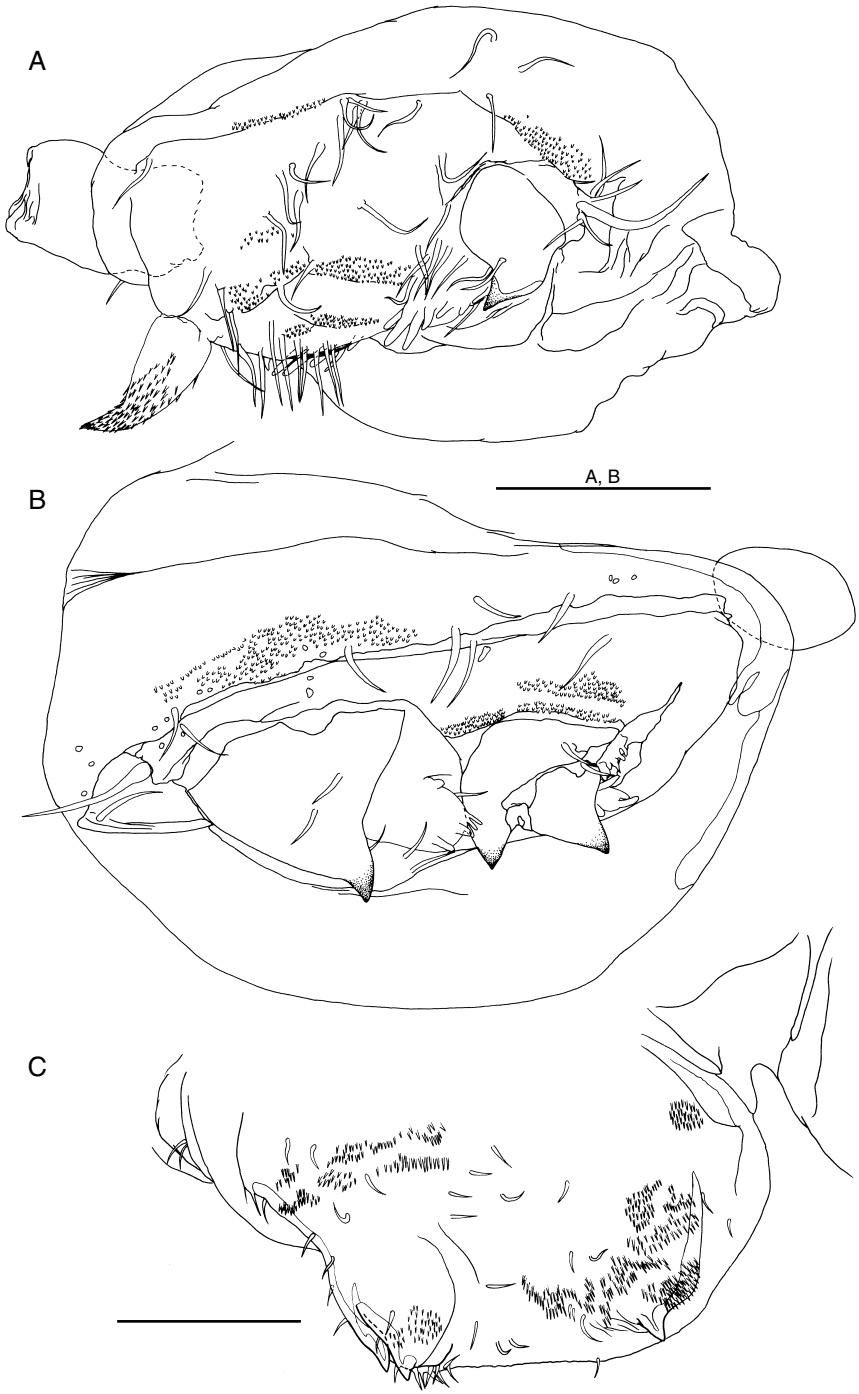

FIG. 7. — **A**, **B**, *Janstockia phallusiella* n. gen., n. sp. ♀; **A**, leg 1; **B**, leg 2; **C**, *Ophioseides cardiocephalus* Hesse, 1864 ♀, leg 1. Scale bars: 50 µm.

Ophioseides cardiocephalus Hesse, 1864

MATERIAL EXAMINED. — **France.** Dinard, in *Dendrodoa grossularia* (Van Beneden, 1846), 2 ♀♀, 1 in alcohol (MNHN-Cp2180), 1 dissected. — Banyuls-sur-Mer, in *Distomus variolosus* Gaertner, 1774, 3 ♀♀, 1 in alcohol, 1 dissected on 2 slides (BMNH 2004.245-246); 1 in alcohol (Zoological Museum, St Petersburg 275).

SUPPLEMENTARY DESCRIPTION OF ADULT FEMALE

Body vermiform (as figured by Bocquet & Stock 1961: figs 1-4). Caudal rami incorporated into urosome and represented by vestigial lobes bearing five caudal setae terminally and ornamented with hair-like setules.

Antennule (Fig. 8A, B) an unsegmented tapering lobe, showing traces of segmentation in form of sclerotizations along posterior margin. Surface densely ornamented with hair-like setules concealing setal elements except around apex (Fig. 8B).

Antenna (Fig. 8C, D) comprising robust proximal segment (coxobasis) and compound distal segment representing endopod: distal segment with seta at mid-length, at plane of fusion between first and second endopodal segments; apical armature comprising claw, plus four stout setae.

Three pairs of oral appendages present (Fig. 8E). Anterior pair (mn, Fig. 8) represented by elongated slightly narrowing lobe armed with two long and one short terminal setae and one long subterminal seta. Posterior pair (mx, Fig. 8) represented by large unsegmented lobe armed with four long terminal setae and one long lateral seta. Vestige of third appendage (mxl, Fig. 8) located between bases of anterior and posterior pairs, forming tiny digitiform lobe with weak apical lobules. Maxillipeds absent.

First to fourth pairs of legs all similar (Fig. 7C), each comprising large ovoid protopod bearing rami distally. Exopod armed with two sclerotized hooks; endopod with single sclerotized hook: surfaces of all legs ornamented with fine setules and small spinules.

REMARKS

Establishing the homology of the three pairs of oral appendages is problematic. The anterior pair probably represents the mandibular palps (the gnathobase is lacking). The posterior pair probably represents the maxillae and their structure and setation is basically the same in all *Ophioseides* species. Illg & Dudley (1961, as *Scolecodes*) labelled these two appendages "Md" and "Mx" respectively. The third paired structure has not been reported previously for any species of *Ophioseides*, although it may have been overlooked because of its small size and thin cuticle. We interpret it as probably representing the maxillule, on the basis of its position between the mandible and maxilla.

This species has a complex nomenclatural and taxonomic history. *Ophioseides cardiocephalus* was first described by Hesse (1864) under the vernacular binomen "Ophioséide cardiocéphale" but was attributed to Bate, 1864 (Bate was the compiler of the *Zoological Record* for 1864) by Illg (1958) under the name *Ophioseidus cardiocephalus*. Even though it could be argued that Illg (1958) was acting as first reviser, Bocquet & Stock (1961) revisited this nomenclatural issue and concluded that the genus and species should be attributed to Gerstaecker (1870-1871), as *Ophioseides cardiacephalus*. Their argument was that Hesse (1864) did not attribute a latinised name to his vernacular "Ophioséide cardiocéphale" and that Gerstaecker (1870-1871) was the first to give a diagnosis of the genus and mention the name *Ophioseides cardiacephalus*. The genus names *Ophioseides* and *Ophioseidus* were both proposed as latinised versions of Ophioséide, proposed by Hesse in 1864. *Ophioseides* was attributed to Hesse by Gerstaecker (1870-1871). We therefore consider that there is no justification in attributing this genus to any author other than Hesse, 1864. Although Boxshall & Halsey (2004) used the original spelling *Ophioseide*, we consider that nomenclatural stability would be best served by adopting the spelling of *Ophioseides* as used by Gerstaecker (1870-1871), since this has been widely used for over 100 years. We consider that there is no justification for changing the spelling of the specific epithet from *cardiocephalus* to *cardiacephalus* and we follow Illg (1958) in using the former. We therefore adopt the name *Ophioseides*

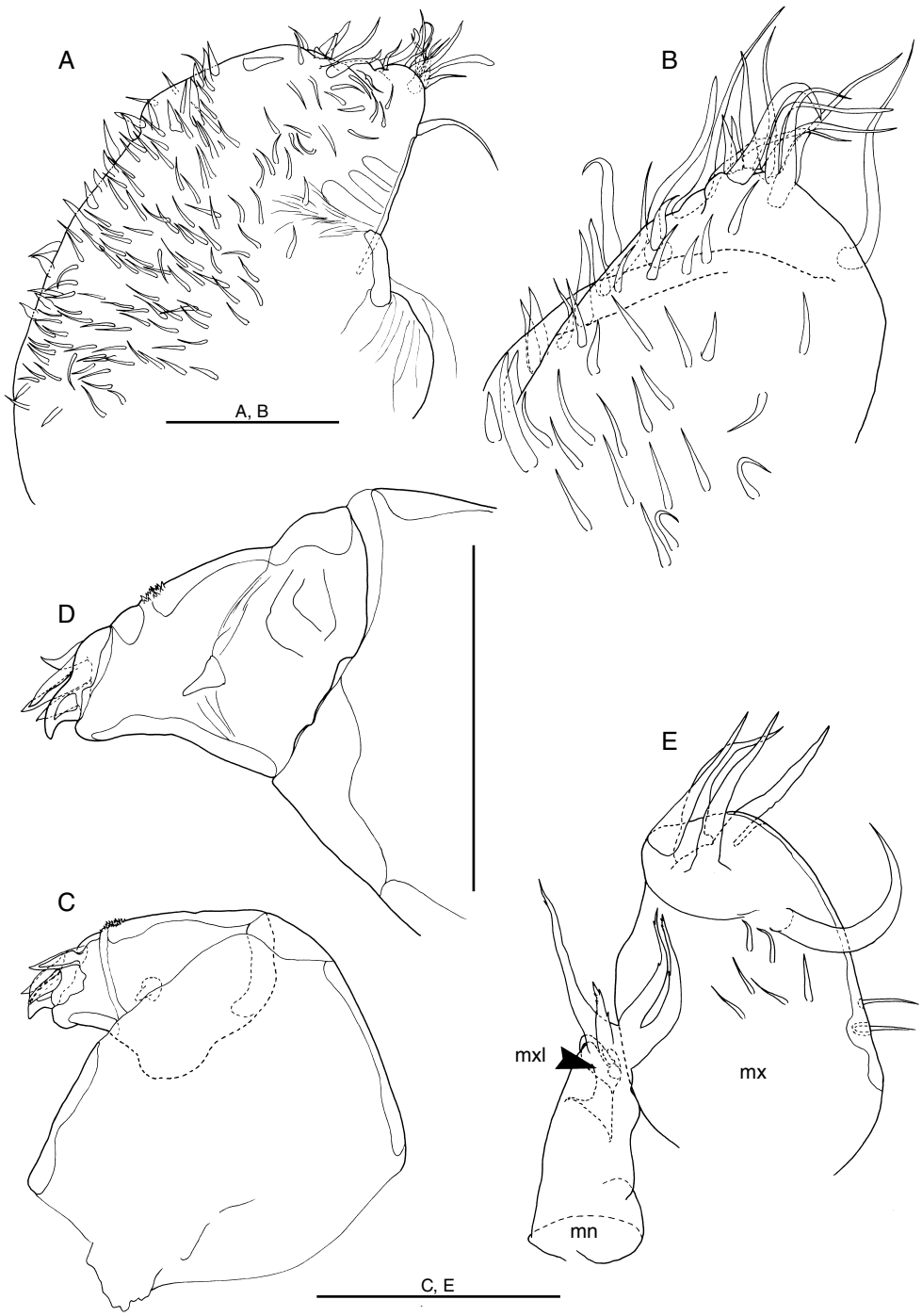

FIG. 8. — *Ophioseides cardiocephalus* Hesse, 1864 ♀; **A**, antennule; **B**, tip of antennule showing setal elements; **C**, antenna; **D**, detail of antennal endopod, showing claw and accessory setae; **E**, oral appendages *in situ*. Abbreviations: **mn**, mandible; **mx**, maxilla; **mxl**, maxillule. Scale bars: A, C-E, 50 µm; B, 25 µm.

cardiocephalus Hesse, 1864 for this taxon. Boxshall & Halsey (2004) mistakenly stated that Bocquet & Stock (1961) concluded that the genus should be attributed to Hesse, 1864 whereas they concluded it should be Gerstaecker (1870-1871).

A second species *Ophioseides joubini* was established by Chatton (1909) based on material from the ascidian host "*Microcosmus sabatieri* Roule, 1885" (possibly = *Microcosmus sulcatus* Coquebert, 1797) collected at Banyuls-sur-Mer. Subsequently Schellenberg (1922) described material from New Zealand (from the ascidians *Pyura trita* Sluiter, 1900 and *Cnemidocarpa cerea* Sluiter, 1900), which he attributed to *Ophioseides joubini*. In his monograph on the family, Illg (1958) recognised this taxon in a new combination, as *Scolecimorpha joubini* (Chatton, 1909). It is unclear why Illg choose to adopt the genus *Scolecimorpha* Sars, 1926 over *Ophioseides*. Later, Illg & Dudley (1961) published a detailed redescription of *Scolecimorpha joubini* using Chatton's (1909) type material and other material from the type locality. They drew attention to the close relationship between the type species of the two genera, stating: "The type of the genus is *Scolecimorpha insignis* Sars, 1926, which appears to us quite possibly conspecific with *S. joubini*, the older species" (Illg & Dudley 1961: 87). They continued: "This question will probably have to be settled by study of topotypic material of Sars' species from Norway".

In the same year a detailed redescription of *Ophioseides joubini* from the host *Distomus variolosus* Gaertner, 1774 collected in Baie de Morlaix and Baie de St-Malo was published by Bocquet & Stock (1961). They reviewed the genus *Ophioseides* and demonstrated that *Ophioseides joubini* should not be placed in *Scolecimorpha*. They reverted to the original name *Ophioseides joubini* for this species. Comparison between Illg & Dudley's (1961) redescription of *Scolecimorpha joubini* and Bocquet & Stock's (1961) redescription of *Ophioseides cardiocephalus* leaves no doubt that they are conspecific. Subsequently, Stock (1967) included *O. joubini* as a junior synonym of *O. cardiocephalus*. Finally, Jones (1979) redescribed the material from New Zealand identified as *O. joubini* (Chatton) by Schellenberg (1922), on the basis of type and newly collected material from the host *Pyura cancelata* Brewin, 1946 from the type locality. He established a new species for this material, *Ophioseides schellenbergi* Jones, 1979. There are currently three valid species of *Ophioseides*: *O. cardiocephalus* from European waters, *O. elongatus* Stock, 1967 from the Red Sea and *O. schellenbergi* from New Zealand. *O. joubini* Chatton, 1909 is a junior subjective synonym of *O. cardiocephalus*.

DISCUSSION

There are significant synapomorphies in leg structure between *Janstockia* n. gen. and *Ophioseides*. The legs comprise massive, ovoid protopods, which carry vestiges of both rami distally. These legs are best understood with the aid of a schematic (Fig. 9). In the new genus, the rami of legs 2 to 4 are each fused to the protopod proximally but both retain traces of the original segmentation. The outer distal angles of the first and second endopodal segments are highly sclerotized and provide reference points for interpreting the limb. The third endopodal segment is vestigial, unsclerotized and carries vestiges of the setae. The exopod appears to show only one sclerotized point, derived from the outer distal angle of the first exopodal segment, and has a vestigial distal segment bearing reduced setae (Fig. 9). Leg 1 in the new genus is similar to legs 2 to 4 in the form of the exopod, but the endopod is further reduced, appearing only two-segmented. The form of leg 1 is partly concealed by the dense ornamentation of unusually long setules covering the anterior surface of the leg.

In specimens of *J. phallusiella* n. gen., n. sp. observed under SEM, the legs are often partially or fully retracted into the body, so that their tips do not project above the general level of the body surface. Presumably this retraction is effected by contraction of the extrinsic muscles of the swimming legs. Relaxation of these muscles would

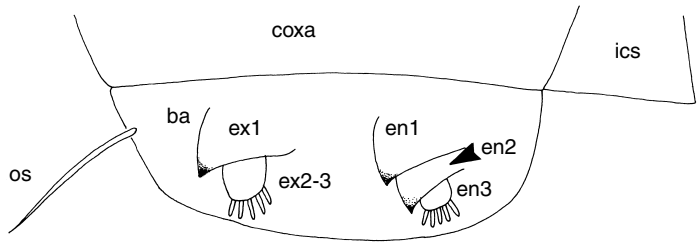

FIG. 9. — Schematic of leg 2 of *Janstockia phallusiella* n. gen., n. sp. Abbreviations: **ba**, basis; **en1**-**3**, endopodal segments 1 to 3; **ex1**-**3**, exopodal segments 1 to 3; **ics**, intercoxal sclerite; **os**, outer basal seta.

then allow the legs, with their hooked extremities, to project above the surface and make contact with the host tissues. It is speculated here that this mechanism may improve the grip of these vermiform parasites against the adjacent host tissues, and facilitate their movement within the hosts.

Acknowledgements

We would like to thank Drs Claude and Françoise Monniot (MNHN) for kindly allowing us to study this material from their collection of ascidian associated copepods. This work was carried out during the tenure of a NATO Postdoctoral Fellowship administered by the Royal Society, London.

REFERENCES

BOCQUET C. & STOCK J. H. 1961. — Copépodes parasites d'invertébrés des côtes de France. XIII. Les genres ophioseidimorphes de la famille des Notodelphyidae. *Proceedings Koninklijke Nederlandse Akademie van Wetenschappen-Amsterdam* Series C, 64: 212-226.

BOXSHALL G. A. & HALSEY S. H. 2004. — *An Introduction to the Copepod Diversity*. The Ray Society, London, 966 p.

CHATTON E. 1909. — Sur le genre *Ophioseides* Hesse et sur l'*Ophioseides joubini* n. sp., copépode parasite de *Microcosmus sabatieri* Roule. *Bulletin de la Société zoologique de France* 34: 11-19.

GERSTAECKER A. 1870-1871. — Die Klassen und Ordnungen der Arthropoden in Wort und Bild, Fünfter Band, erste Abtheilung. Crustacea (erste Hälfte). Zweite Ordnung. Spaltfüssler: Copepoda, *in* BRONN H. G. (ed.), *Die Klassen und Ordnungen des Thier-reichs wissenschaftlich dargestellt in Wort und Bild*. C. F. Wintersche Verlagshandlung, Leipzig: 590-806.

HIPEAU-JACQUOTTE R. 1980. — La forme mâle atypique du Copépode ascidicole Notodelphyidae *Pachypygus gibber* (Thorell, 1859) : description et synonymie avec *Agnathaner minutus* Canu, 1891. *Bulletin du Muséum national d'Histoire naturelle* 4e sér., sect. A (Zoologie) 2 (2): 455-470.

HUYS R. & BOXSHALL G. A. 1991. — *Copepod Evolution*. The Ray Society, London, 468 p.

ILLG P. L. 1958. — North American copepods of the family Notodelphyidae. *Proceedings of the United States National Museum* 107: 463-649.

ILLG P. L. & DUDLEY P. L. 1961. — Notodelphyid copepods from Banyuls-sur-Mer. *Vie et Milieu*, *Supplement* 12: i-iv + 1-126.

JONES J. B. 1979. — New Notodelphyidae (Copepoda: Cyclopoida) from New Zealand solitary ascidians. *New Zealand Journal of Marine and Freshwater Research* 13: 533-544.

OOISHI S. 1998. — Two species of notodelphyid copepods, *Doroixys bispinosa* and *Pythodelphys illgi*, from the Gulf of California. *Journal of Crustacean Biology* 18: 369-382.

SCHELLENBERG A. 1922. — Neue Notodelphyiden des Berliner und Hamburger Museums mit einer Übersicht der ascidienbewohnenden Gattungen und Arten. *Mitteilungen aus dem Zoologischen Museum in Berlin* 10: 219-274, 277-298.

STOCK J. H. 1967. — Report on the Notodelphyidae (Copepoda, Cyclopoida) of the Israel South Red Sea Expedition. *Israel South Red Sea Expedition, 1962. Reports* 27: 1-126.

Submitted on 18 March 2004;
accepted on 5 October 2004.