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COPEPODA ENDOPARASITIC OF TROPICAL HOLOTHURIANS

JAN H. STOCK

ABSTRACT

A number of Copepoda of the family Lichomolgidae, all endoparasitic in tropical holothurians, has been described. All belong to the group of genera related to Paranthessius, as borne out by the structure of their appendages, although the body-shape often has undergone modifications due to the endoparasitic mode of life.

A key to the genera of the Paranthessius group is provided. Descriptions and illustrations are given of Scambicornus carinatus n.sp. (host Stichopus monotuberculatus from the Ethiopian Red Sea coast), Lichothuria mandibularis n.gen., n.sp. (host Halodeima atra from the Gulf of Aqaba), Diogenella spinicauda n. gen., n. sp. (host Holothuria mexicana from Curaçao), D. seticauda n.sp. (hosts Halodeima surinamensis and Holothuria impatiens from the Antilles), Diogenidium nasutum Edwards, 1891 (host Holothuria mexicana from the Antilles), D. spinulosum n.sp. (host Isostichopus badinotus from Puerto Rico), and D. deforme (host Holothuria glaberrina from Puerto Rico).

INTRODUCTION

The classification of the so-called "semi-parasitic" copepods is a matter of considerable difficulty, chiefly because of the rather refined nature of the characters used in their taxonomy.

This is especially true on the generic and family levels, where it is easy to recognize trends in the reduction or specialization of certain structures, but where it is exceeding difficult to formulate clear-cut, natural units. One of the greatest draw-backs is no doubt the fact that the number of undescribed species in associated copepods is far greater than the number now known to science. Apart from the work of Humes and his scholars (on the Madagascar copepods) and from a few works from places as India, the Red Sea and the West Indies, our knowledge of this group of animals from the tropical belt is practically zero. It is hard then, with so many new forms to be described or discovered, to develop a watertight classification system.

It is tried in this paper to overcome some of the difficulties, in studying a group of associates not on a local basis, but by involving materials from different tropical zoogeographic areas in one study. So, the present paper will deal with the endoparasitic cyclopoid copepods from holothurians. Although three very transformed genera of cyclopoids (Allantogynus Changeux, 1958; Nanaspis Humes & Cressey, 1959; and Cucumaricola Paterson, 1958) are known to inhabit holothurians, the greater part of their ecto- and endoparasites is much less transformed. With the exception of Synaptiphilus (= Colaceutes) (family Clausiidae), all little modified forms belong to the Lichomolgidae. The result of the present study is chiefly that, although several endoparasitic forms have undergone considerable transformations in body-shape as a result of their mode of life, none of them has acquired much specialization in the structure of the appendages. The species used in this study would, less than 20 years ago (cf. Illg, 1949), have been classified all in a single genus, Paranthessius Claus, 1889. Illg included in this concept species of Paranthessius s.str. (type: P. anemoniae Claus, 1889), Diogenidium (type: D. nasutum Edwards, 1891), Herrmannella (type: H. rostrata Canu, 1891), and Scambicornus (syn.: Preherrmannella; type: S. hamatus Heegaard, 1944). Moreover, he rightly considered the genera Modiolicola (type: M. insignis Aurivillius, 1883) and Sabelliphilus (type: S. elongatus M. Sars, 1862) as closely related.

These forms seem to differ in a number of characters, in every possible combination. These characters are: (1) the structure of the A2 (segments 3 and 4 elongated; segment 4 set off laterally; prehensile function reduced or well-developed, in the latter case located on segment 3 or on segment 4); (2) the structure of the mandible (blade narrow or wide, toothed or ciliated); (3) the structure of the mx2 (with or without accessory lash; lashes short or long); (4) the more or less prehensile nature of the ♀ maxilliped; (5) the armature of the 4th endopod; (6) the structure of the rostrum.

It seems to me that each of the generic units mentioned above has its own special combination of these features. So, Paranthessius s.str. has an unspecialized rostrum; it possesses three distal elements on mx2, all of a size, all toothed; moreover, the 4th endopod has the remarkable chaetotaxis formula of 0-1; 0-2; I-II (cf. Bocquet & Stock, 1959). Diogenidium and Herrmannella have specialized rostra, and present the formula 0-1; 0-1; 0-II in the 4th endopod; in Diogenidium, however, the accessory lash of the mx2 is short and broad, in Herrmannella it is long and narrow. A new genus created in the present publication, Diogenella, resembles Herrmannella and Diogenidium, but has transformed armature on the caudal rami, in addition to smaller details in the P5, A1, A2, mx2, etc. Scambicornus has a number of peculiarities, the most obvious being the chaetotaxis formula 0-1; 0-1; 0-V for the 4th endopod. Modiolicola has the same P4 as Herrmannella, but possesses an unspecialized rostrum, elongate 3rd and 4th segments in the A2, while the mx2 is devoid of an accessory lash. Sabelliphilus is characterized by a very short A2, with elaborate prehensile armature, by a bifid rostrum, and by a rich ornamentation of the basal segment of mx2. A new genus described in this paper, Lichothuria, is close to Scambicornus, but has a secondary lash on the mandible, as well as a formula for the 4th endopod intermediate between Scambicornus and Herrmannella. To complete the picture, Ischnurella Pelseneer, 1929, Pseudolichomolgus Pesta, 1909, and Pestalichomolgus Wilson, 1932, are synonymous with Herrmannella.

Moreover, two more genera, both endoparasitic in holothurians, and both rather imperfectly known, seem to be closely related to Scambicornus. These are Lecanurius Kossmann, 1877, and Synapticola Voigt, 1892. They have never been found again after their description, and the latter leaves too many queries to make a sound discussion of their affinities possible.

The host preferences of these generic units are rather diversified. So, Paranthessius s. str. lives on sea-anemones; Modiolicola and Herrmannella in the mantle cavity of bivalve molluscs; Scambicornus is usually ectoparasitic on holothurians, Lichothuria, Diogenella and Diogenidium are endoparasitic in this group of animals; Sabelliphilus lives on polychaet worms. Other reported hosts are moreover tunicates.

Although the above sketch is merely an outline (since every described species has to be checked in order to identify its place in this system), it is in my opinion opportune for the moment to retain all these generic units. Not much is won if we - as was done in the past for Lichomolgus - lump together all species in one genus, notwithstanding differences in both host preference and morphology. Moreover, Lichomolgus contains far too many species to be a convenient generic unit.

Key to the genera of the Paranthessius group

1a) Posterior maxilla distally with one lash only 2
b) Posterior maxilla distally with a main lash and an auxiliary lash 3
2a) Third endopod segment of third leg with 5 elements (2 setae + 3 spines). Mandible without well-defined "blade", just tapering into a long lash, the "blade" portion being unornamented, the lash finely toothed.
Lichomolgidium Kossmann, 1877
(in tunicates of the families Pyuridae and Styelidae)
b) Third endopod segment of third leg with 6 elements (usually 4 spines + 2 setae, sometimes 3 spines + 3 setae). Mandible with well-defined (widened) proximal portion ("blade"); blade and lash uniformly ciliated.
Modiolicola Aurivillius, 1882
(in bivalve molluscs)
3a) Fourth endopod with 2 elements on the distal segment 6
b) Fourth endopod with more than 2 elements on the distal segment 4
4a) Five elements on the distal endopod segment of fourth leg.
Scambicornus Heegaard, 1944
(on holothurians)
b) Three or four elements on the distal endopod segment of fourth leg 5
5a) Second segment of fourth endopod with 2 setae. Mandible with one terminal lash. Posterior maxilla with 3 terminal elements of a size, all toothed.
Paranthessius Claus, 1889
(on sea-anemones)
b) Second segment of fourth endopod (♀) with 1 seta. Mandible with main lash and auxiliary lash. Posterior maxilla with 2 distal elements.
Lichothuria n.gen.
(endoparasitic in holothurians)
6a) Posterior antenna with 2 or 3 very heavy claws distally.
Sabelliphilus M. Sars, 1862
(on tubicolous Polychaeta)
b) Posterior antenna with 1, rather slender, distal claw 7
7a) Lateralmost and medialmost setae of the caudal ramus strongly developed, central setae vestigial.
Diogenella n.gen.
(endoparasitic in holothurians)
b) Medialmost furcal setae not vestigial 8
8a) Main lash of posterior maxilla the longest.
Herrmannella Canu, 1891
(in bivalve molluscs)
b) Auxiliary lash of posterior maxilla the longest.
Diogenidium Edwards, 1891
(in holothurians)

THE TRANSFORMATION OF BODY SHAPE IN ASSOCIATED CYCLOPOIDS

One of the results of the present study is that, however queer or aberrant the general habit of the associate may be, the morphology of its appendages tends to show very few discrepancies from a more normal pattern. The taxonomic position of all species treated in this paper is at once clear from their appendages. This corresponds with several observations on other genera in the literature. Thus, we have in one genus species of "normal" (= cyclopoid) body-shape, by the side of others with more or less distinct transformations. Examples are e.g.: Anthessius (most species "normal", but some transformed, viz., A. fitchi Illg, 1960; A. solidus Humes & Stock, 1965; A. amicalis Humes & Stock, 1965; A. alatus Humes & Stock, 1965); Herrmannella (most species "normal"; transformed e.g. H. barneae (Pelseneer, 1929), H. columbiae (Thompson, 1897)); Lichomolgus (with many "normal" species, and some transformed, such as L. trochi Canu, 1899; L. protulae Stock, 1959); Scambicornus (with, in addition to the great number of "normal" species, the transformed S. carinatus n.sp.); Leptinogaster (with half the species "normal", the others transformed); Diogenidium with 2 "normal" species (spinulosum and nasutum) and one transformed species, deforme.

Apparently, body-shape is a plastic character in this group, whereas the structure of the appendages is much more conservative.

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Genus Scambicornus Heegaard, 1944

As was shown recently (Stock, 1964), the widely used name Preherrmannella Sewell, 1949, is a junior synonym of Scambicornus.

The discovery of a new, endoparasitic species in this genus (predominantly consisting of ectoparasites of holothurians), makes actual again the question of the status of the genus Synapticola Voigt, 1892, an endoparasite of the holothurian, Synapta kefersteini Selenka from Amboina, Indonesia. This genus is chiefly characterized by 2-segmented endopods of all legs in both sexes, thus agreeing in this respect with the new species to be described below, S. carinatus.

As far as one can judge from the rather inadequate figures in Voigt's paper, Synapticola is not identical with Scambicornis. Voigt describes the posterior antenna as 3-segmented, with a very simple terminal armature (1 claw + 1 seta); the posterior maxilla is devoid of an auxiliary lash. It is hard to say whether these differences are real or due to incorrect observation.

Scambicornus carinatus n.sp.

Material examined.- 2 ♀ ovig. (one of which is made the holotype), 1 ♂. Ejected by a single specimen examined of the holothurian, Stichopus monotuberculatus (Quoy & Gaimard). Ethiopia: Dahlak Archipelago, southwestern end of the island of Umm Aabak. Depth 0.5 m. March 23, 1963 (Z.M.A. Co. 101.063).

Description.- Female: The holotype is 1.88 mm long (excluding the furcal setae), the paratype is 1.61 mm long. The body is elongate, slender, and does not recall the usual "Scambicornus" habit (fig. 1a). The first pedigerous segment is indistinctly separated from the cephalic segment. Pedigerous segments 2, 3 and 4 diminish only slightly in width. The genital segment is more or less rounded in dorsal view; the genital openings are strengthened by several complex sclerotizations; two setae are probably the vestiges of the 6th legs. The anterior half of the genital segment bears, mid-ventrally, a low keel; on the posterior half, the keel is much more important; it projects caudalward and is visible in dorsal view (by transparency) and in ventral view as a triangular projection at the level of the 3rd urosome segment (figs. 1a, 1d). There are 3 unornamented post-genital segments. The caudal rami are slightly divergent; each ramus (fig. 1c) is 130 μ long and 58 μ wide and bears 4 long terminal setae, a short subterminal, dorsal setule, and - at about 2/3 of its length - a long lateral seta. Of these setae, the three medialmost terminal ones are finely barbelate, the others being completely smooth.

Although the ovisacs are lacking, some few eggs stick to the genital segment; they measure 161 x 129 μ.

The anterior antenna is 7-segmented; only the terminal segment bears one aesthete. Fig. 1f shows the relative lengths of the segments and their armature. A broad, rounded rostrum (fig. 2a), is present between the bases of the anterior antennae.

The posterior antenna (fig. 2b) has a strong articulated claw on the 3rd segment, accompanied by 3 setae. The 4th segment is set off laterally, is less than twice as long as wide and distinctly shorter than the basal part of the claw; it is distally and sub-distally armed with 7 setae.

The mandible has a wide blade and a short lash. Medially, the blade has 4 widely spaced short teeth and, towards the end, very fine spinules; the other margin is partly smooth, partly provided with small denticles (fig. 2c).

The anterior maxilla (fig. 2d) is terminally projected into a triangular process; it bears furthermore 2 barbelated setae.

The posterior maxilla has two apical lashes, one with short teeth on the medial margin, one with long, needle-like teeth on the medial margin (fig. 2e).

The maxilliped (fig. 2f) has two unarmed basal segments, and two distal segments forming a claw.

The legs 1 to 4 are biramous; all exopods are 3-segmented, all endopods 2-segmented. All legs have intercoxal plates, have a smooth lateral basipod seta, and a medial coxopod seta; the latter is plumose in legs 1 to 3, naked in leg 4. The 2-segmented endopods have been realized through fusion of the 2nd and 3rd endopod segments; a notch at the lateral margin of the fusion complex indicates the place of the fusion. The figures 3a, c, e, f and the following chaetotaxis formula will supply the necessary details about legs 1 to 4:

P1	exp.	I - 0; I - 1; III - I - 4	P3	exp.	I - 0; I - 1; II - I - 5
	enp.	0 - 1; I - 5 - 1		enp.	0 - 1; IV - 2 - 2
P2	exp.	I - 0; I - 1; III - I - 5	P4	exp.	I - 0; I - 1; II - I - 5
	enp.	0 - 1; III - 3 - 2		enp.	0 - 1; V - 1

The 5th leg (fig. 3g) has a tapering free segment, 38 μ long, basal diameter 21 μ. Distally, it bears two long spines, 82 and 45 μ long.

The legs and most of the other appendages are covered with patches of very fine rugosities. These are illustrated (punctilated) in the figures of the mandible and the posterior maxilla, but omitted in the other figures.

Male: Length of the body, without furcal setae, 1449 μ; greatest width 483 μ. The prosome and metasome are as in female. The genital segment (fig. 1b) has two rounded, projecting antero-lateral corners. The spermathecae are nearly circular. Two setae represent the rudiments of P6. There are 4 post-genital segments, the first of which bears the triangular keel on its ventral surface (fig. 1e). The urosome segments are not ornamented.

Sexual dimorphism has been observed in the mxp, P1, P2, and P5. The maxilliped is strongly prehensile (fig. 2g); the 2nd segment is armed with 2 to 3 rows of conical spinules and with 2 slightly longer spines. The first leg (fig. 3b) has longer exopod spines than in female, but differs chiefly in having the lateral spine of the distal endopod segment transformed; this spine has become shorter, more robust and unornamented. In the 2nd leg, we observe the same differences: longer exopod spines and two of the medial endopod spines transformed (fig. 3d). The 5th leg (fig. 3h) is smaller (32 x 16 μ), but for the rest very similar to that of the female.

One of the 3rd endopods in the single male available showed an aberrant armature, viz. III-2-2 (instead of IV-2-2).

Remarks.- The only Scambicornus in which the female shows fusion of endopod segments is S. changeuxi (Stock & Kleeton, 1963). (Males of most species show fusion of endopod segments, particularly in the anterior legs). The female of the present species has the endopods of legs 1 to 4 all 2-segmented; this is a step farther than the stage reached by S. changeuxi, where legs 1 to 3 have 2-segmented, but leg 4 still 3-segmented endopods. It is significant perhaps, that both S. changeuxi and the present species are endoparasitic in holothurians, whereas the species with 3-segmented endopods are ectoparasitic. The nature of the female endopod alone is sufficient to distinguish the present species. Also the presence of the curious keel on the 2nd (♀) or 3rd (♂) urosome segment is absolutely distinctive; the specific name proposed (carinatus = keeled) alludes to this feature.

Lichothuria n.gen.

Diagnosis.- Lichomolgidae. Body slender, though not just vermiform. Urosome with 3 (♀) or 4 (♂) postgenital segments. Caudal rami with complete armature (6 elements). Eggs reduced in number; in uniserial arrangement. Anterior antenna 7-segmented, normal. Rostrum small, rounded. Posterior antenna 4-segmented; prehensile element on 3rd segment; 4th segment set off laterally.
Mandible with secondary lash. Anterior maxilla simplified, consisting of a simple lobe and 3 smooth elements. Posterior maxilla of the general lichomolgid type. Paragnaths present as ciliated lobes. Maxilliped rather simple (♀) or strongly prehensile (♂). Legs 1 to 4 biramous; exopods 3-segmented (♀, ♂), endopods 3-segmented (♀) or 2-segmented (♂). Distal segment of 4th endopod with 3 (♀) or 4 (♂) elements. Fifth leg having a single free segment, armed with 2 distal elements. The type-species is endoparasitic in holothurians.

Remarks.- This genus is obviously (by the nature of the A2, by the fusion of endopod segments in male, in the presence of more than 2 elements on the distal segment of the 4th endopod, and by the preference for holothurians as host) related to Scambicornus Heegaard, 1944. It differs from that genus in numerous characters, viz. in the presence of a well-developed auxiliary lash on the mandible, the absence of spiniform processes on the anterior maxilla, the fusion of segments in all male endopods (and not in legs 1 and 2 only), the presence of only 2 spines + 1 seta (plus one extra setiform element in male) on the distal segment of the 4th endopod (instead of 5 spines), and in having uniserial egg-strings. Most of these characters are simplifications in comparison with Scambicornus, with the exception of the structure of the mandible, which is distinctly more specialized in the new genus.

Lichothuria differs from the poorly known genus Lecanurius Kossmann, 1877, in the armature of the 4th endopod (distal segment with 5 elements in Lecanurius). From the genus Synapticola Voigt, 1892, the new genus differs by its more complex A2, the different mandible, and the uniserial eggs. The armature of the 4th endopod of Diogenidium Edwards, 1891, is said to agree with that of Lichothuria, but topotypes in my collection do not bear out that feature and show on the contrary that Diogenidium is close to Herrmannella. Moreover, Diogenidium has the prehensile armature of A2 in terminal position (and not in subterminal position as in Lichothuria), it has no auxiliary lash on the mandible, and it has multiserial eggs.

Type-species.- Lichothuria mandibularis n.sp. (from Greek leicho = to lick, and part of the group-name Holothuria; mandibularis, referring to the specialized nature of the mandibles). The gender of Lichothuria is feminine.

Lichothuria mandibularis n.sp.

Material examined.- 2 ♀, 2 ♂. Ejected by the holothurian, Halodeima atra (Jaeger, 1833). Eilat (Israel), in a lagoon near the Coral Beach Hotel, depth about 1 m . Apr.29, 1962 (Z.M.A. Co. 101.053). Frequency: Of 12 hosts inspected, two ejected a male and a female each of the parasite.

Description.- Female: The total length of the two females was 1530 and 1465 μ; the greatest width (at the level of the cephalosome) 403 and 467 μ, respectively. The body is very slender, though without attaining a worm-like appearance (fig. 4a, 4b). The first pedigerous segment is fused with the cephalosome. The three metasome segments are more or less rectangular and hardly narrower than the cephalosome. The fifth pedigerous segment (= first urosome segment) is narrower than the metasome segments; the fifth leg is implanted latero-ventrally, and is only in part visible in dorsal view. The genital segment consists of a gradually widening anterior half, and a narrow posterior one. Like the three following urosome segments, it carries a row of distinct denticles at its postero-ventral margin (fig. 4d). Both females carried two ovisacs, each ovisac containing but one or two eggs (fig. 4a), of about 160 x 160 μ, in uniserial arrangement. The caudal ramus (fig. 4d) is 54 μ long, 43 - 44 μ wide. It bears a short, smooth lateral seta; a short, smooth latero-terminal seta; a smooth dorso-terminal seta; and 3 stronger, plumose distal setae.

The anterior antenna is 7-segmented, not very slender (fig. 4e). The number of elements on these segments is as follows: segment I - 4 setae; II - 12 setae; III - 5 setae; IV - 4 setae; V - 4 setae + 1 aesthete; VI - 2 setae + 1 aesthete; VII - 7 setae + 1 aesthete. A small, rounded, more or less tongue-shaped rostrum is present.

The posterior antenna (fig. 4f) has a robust basal segment with 1 seta. The elongate 2nd segment is also armed with 1 seta and with several minute spinules. The 3rd segment is wider than long; it carries, on an expanded corner, 3 setae and an articulated claw. The 4th segment is palp-like, set off laterally, and complexely armed with 2 transverse rows of denticles, 1 shorter and 6 longer setae (3 of which are articulated in the middle).

The mandible (figs. 5a,b) consists of a blade, finely toothed at both margins, and produced into a short lash. A second, auxiliary, lash inserts at the median part, near the basis of the blade. It has smooth margins and shows up rather narrow or rather wide, according to the angle under which it is observed. The auxiliary lash is about half the length of the main blade plus its lash.

The anterior maxilla (figs. 5a,b) is a simple lobe, with two longer apical, and one shorter lateral seta. The posterior maxilla (fig. 5c) has a slender, unarmed basal segment. The distal segment forms a kind of socle on which the terminal lash, the auxiliary lash, and a smooth seta are implanted. The main lash bears two rows of fine denticles, the auxiliary lash one row.

A ciliated lobe (fig. 4d) represents a paragnath.

The maxilliped (fig. 4e) is a tapering appendage having 3 unarmed proximal segments and an apparently 2-segmented claw, armed with 1 spine.

The legs 1 to 4 (figs. 6a-d) have 3-segmented rami. All legs have intercoxal plates, all have a heavy, internal coxopod seta (plumose), and a smooth, lateral basipod seta.

The chaetotaxis formula is as follows:

P1	exp.	I-0; I-1; III-I-4	P3	exp.	I-0; I-1; II-I-5
	enp.	0-1; 0-1; I-5		enp.	0-1; 0-2; II-2
P2	exp.	I-0; I-1; II-I-5	P4	exp.	I-0; I-1; II-I-5
	enp.	0-1; 0-2; III-3		enp.	0-1; 0-1; II-I

The 5th leg is scarcely visible in dorsal view. The first urosome segment bears a smooth seta near the place where the free segment of P5 arises (fig. 4d). This free segment (fig. 4g) has a greatest length of 46 μ, a greatest width of 38 μ; it has a straight medial margin, and a sinuous lateral margin. The distal armature consists of one long spine and one shorter, smooth seta; near the implantation of the seta, a row of fine denticles is found.

The 6th leg is reduced to a minute, spiniform lateral projection of the genital segment.

Male: The two available specimens are 966 and 918 μ long; their greatest width is 290 and 258 μ, respectively. The body shape is as in female (fig. 4c), but there is one extra post-genital segment, whereas the genital segment is more or less quadrate. The anterior antenna is slightly more clumsy than in female, but the number of elements (including aesthetes) on the various segments appears to be identical.

The maxilliped (fig. 5f) has a swollen 2nd segment, armed with 2 rows of strong teeth. The 3rd segment is unarmed; the strong terminal claw bears one spine near its base.

All legs, except P5, exhibit secondary sexual dimorphism. The endopods became, through fusion of segments 2 and 3, 2-segmented. The total number of elements on these endopods remains, however, the same as in female (the elements of the female segments 2 and 3, are simply added up into the male segment 2). The exopods of legs 2 to 4 are identical to those in female. The first exopod has one spine less on segment 3 than in female. The coxo- and basipods are similar in both sexes. The figures 5g-j, and the following chaetotaxis formula show better than words the features of legs 1 to 4:

P1	exp.	I-0; I-1; II-I-4	P3	exp.	I-0; I-1; II-I-5
	enp.	0-1; I-5-1		enp.	0-1; II-2-2
P2	exp.	I-0; I-1; II-I-5	P4	exp.	I-0; I-1; II-I-5
	enp.	0-1; III-3-2		enp.	0-1; II-1-1

The 5th leg resembles in shape that of the female. The 6th leg consists of 2 spinules.

Colour.- Live specimens are opaque white; the eggs are pink.

Diogenella n.gen.

Lichomolgidae with more or less transformed body shape. Closely related to Herrmannella and Diogenidium, but differing in the following characters: (1) Caudal ramus with modified armature (the latero-terminal and medio-terminal elements are strongly developed, the two centralmost terminal setae are vestigial; the lateral setae displaced in proximal direction). (2) Fifth leg distally with two very unequal elements plus one or more rows of spinules. (3) Second and fourth segments of posterior antenna ornamented with several rows of spinules. (4) Distal lashes of posterior maxilla slender, of equal lengths. (5) Ciliation of the setae on legs 1 to 4 irregular, instead of plumiform. (6) Segment 2 of the anterior antenna bears an enlarged, ciliated element.

Of the two species, both new, referable to this genus, the male is known in one of them. This male shows the following peculiarities: (1) Maxilliped segment 2 provided with an enlarged, slightly trifid, spine. (2) Hardly any sexual dimorphism in the fifth leg. (3) Well-developed sexual dimorphism in the first leg.

Diogenella, gender feminine, has D. spinicauda n.sp. for type-species. Other species: D. seticauda n.sp. Both endoparasitic in holothurians.

Diogenella spinicauda n.sp.

Material examined.- 1 ♂ (holotype), 1 ♀ (allotype). Ejected by Holothuria mexicana Ludwig. Curaçao, Fuikbay, depth about 2 m. Oct.23, 1958 (Z.M.A. Co. 101.060).

Description.- Male. Total length, without furcal elements, 1497 μ. The body is slender, hardly "cyclopoid" any longer. The animal tends to lie on its side, in which position (fig. 7a) the post-genital segments are curved upward. The first pedigerous segment is separated by a faint line from the cephalosome. The genital segment has regularly curved lateral margins; it is 26 μ long and 37 μ wide. The sixth leg is represented by one spinule only. The 4 post-genital segments are 116, 102, 75 and 75 μ long and 163, 116, 109 and 129 μ wide. This implies, that the anal segment is slightly wider than the others. All post-genital segments are unornamented, except for a row of conical spinules at the ventro-posterior margin of the anal segment.

The caudal ramus (fig. 7b) is very characteristic. It is not very elongate (length 75 μ, width 44 μ); its lateral margin bears, not far from the proximal end of the ramus, a lateral setule, a small spinule, and a large, flat, plumose spine. At the distal margin of the ramus two more large, flat, plumose spines are borne (lengths 61 and 58 μ); between these, two setules are found which represent no doubt the rudiments of the two central furcal setae. A dorso-subterminal seta is found in the usual position and is of the usual length.

The anterior antenna is short and clumsy (fig. 7c). The 2nd segment is provided with a large, straight seta, which bears irregularly placed ciliations all over its length. The remaining setae on this appendage are smooth. The distal segment carries an aesthete. A distinct rostrum, shaped like the human tongue, is present (fig. 7e).

The posterior antenna (fig. 7d) is 4-segmented. Segments 1, 2, and 4 are provided with numerous small spines, arranged in rather untidy rows. The distal armature consists chiefly of a slender, feebly curved claw, and of 3 short setae.

The mandible (fig. 8a) has a very slender sickle-shaped blade and tapers very evenly to a sharp point; both margins are regularly armed with very small teeth of homogeneous length.

The anterior maxilla (fig. 8b) is a tapering lobe with 2 distal elements. The posterior maxilla (fig. 8c) has two equally slender and elongate apical lashes, both armed at their medial margin with a row of teeth; the latter are long and slender in the proximal part of the row, but grow rapidly smaller and shorter towards the end of the lash.

The maxilliped (fig. 7g) consists of an unarmed basal segment, a swollen 2nd segment, a trapezoidal 3rd segment, and a strong claw. The 2nd segment is armed with a large number of spinules arranged into irregular, longitudinal rows; more distalward a setule is implanted, and still more distalward a vaguely trilobed spine is implanted on a socle-like swelling. The claw bears a plumose seta at its base.

The legs 1 to 4 (fig. 8d, f, g, h) are biramous, each ramus being 3-segmented. These legs have several peculiarities: the median coxopod seta has a strongly swollen basal portion; the lateral basipod seta, present in all legs, is plumose; all setae on the rami, as well as the coxopod seta, are not just ordinarily feathered, but bear ciliations irregularly scattered all over their surface (this feature is illustrated only in fig.8h for P4, but it is present in all legs 1 to 4); rows of needle-like spinules ornament the endopods.

The chaetotaxis formula is identical to that of Diogenidium deforme n.sp., described in the sequel.

The free segment of the 5th leg (fig. 8j) is short, dilated towards the end, and distally armed with one very short, conical spine and a longer, robust, ciliated spine. At the basis of the longer spine, a row of about 6 spinules is found. The 5th pedigerous segment bears a seta near the implantation of the P5.

Female.- The single female available is only 1143 μ long, thus smaller than the male. All the appendages have the adult morphology, but judging from the somewhat flabby condition in which this specimen is, it has recently moulted from the last copepodid instar to the adult stage. No secondary sexual dimorphism is observed in the A1, A2, mouthparts, P2, P3, P4 and P5.

The urosome is 5-segmented; the genital segment has evenly rounded margins and is 143 μ long and 211 μ wide, the three post-genital segments are 102 x 177 μ, 88 x 129 μ, and 82 x 102 μ. The caudal rami (68 x 37 μ) are similar to those in male.

The maxilliped (fig. 7f) has a squarish basal segment, a more elongate 2nd segment, armed with a patch of spinules and 2 short median spines, and a pointed 3rd segment. The latter is suggestively made up of two segments, but no intersegmental line is found.

The first leg (fig. 8e) has a shorter spiniform process distally on the 3rd endopod segment than in male. As said before, the 5th leg (fig. 8i) is very similar to that of the male.

Diogenella seticauda n.sp.

Material examined.- 1 ♀ ovig. (holotype). From Halodeima surinamensis (Ludwig). Puerto Rico, Cayo Caracoles (near La Parguera). Under flat stones at the waterline. Feb.14, 1963 (Z.M.A. Co. 101.061). Frequency: 21 specimens of the host examined.
1 ♀ (paratype). From Holothuria impatiens (Forskål). Same locality and data as previous record (Z.M.A. Co. 101.062). Frequency: 2 specimens of the host examined.

Description.- Female: The holotype was 1160 μ long (without furcal setae), and at the level of the cephalosome 386 μ wide. These measurements are for the paratype 1224 x 386 μ. The body (fig. 9a) is slender, not unlike that of certain Clausidiidae, such as Hersiliodes. The first pedigerous segment is separated by a faint line from the cephalic segment. The metasome segments diminish but very slightly in width. The genital segment is cylindrical, with a faint notch near the genital openings.

The ovisacs are shorter than the urosome and contain relatively few (about 12) eggs, in multiserial arrangement. A short spine demarcates the position of the genital openings. Rows of spinules occur at the posterior margin of the ventral side of urosome segments 2, 3, 4 and 5 (fig. 9b). The caudal ramus (fig. 9c) is 62 μ long, and has a greatest width of 35 μ; near its implantation, the lateral margin of the ramus bears a long, plumose seta; distally, the armature consists of two long, plumose setae (127 and 105 μ long), with 2 rudimentary setules between them, and of a subterminal, dorsal seta.

The anterior antenna (fig. 9d) is remarkably short and clumsy. The segments bear the following armature: segment I - 3 setae + 1 plumose seta; II - 12 setae + 1 plumose seta; III - 5 setae; IV - 3 setae; V - 3 setae + 1 plumose seta; VI - 2 setae + 1 plumose seta; VII - 7 setae + 1 aesthete. A beak-shaped rostrum, distally rounded, and with two anchor-like points, is present (fig. 9e).

The posterior antenna (fig. 9f) is rather more slender, but apart from trifling differences in the fine ornamentation very similar to that of D. spinicauda.

The mandible (fig. 9g) has a long lash, the median margin of which bears rather long teeth, the other margin shorter teeth.

The anterior maxilla (fig. 9h) is terminally armed with 2 long, plumose setae.

The posterior maxilla (fig. 9i) is rather similar to that of D. spinicauda; its subterminal spine is plumose.

The maxilliped consists of an elongate basal segment, a rounded 2nd segment, and a short, spine-like claw (fig. 9j).

The legs have the same chaetotaxis formula as D. spinicauda. Like in that species, the lateral basipod seta is plumose, the medial coxopod seta has a swollen base (especially so in the anterior 3 pairs of legs) and an irregularly implanted plumosity. The setae on the rami are also irregularly plumose, but less so than in D. spinicauda. The legs 1 to 4 (fig. 10a-d) differ chiefly from D. spinicauda in the greater elongation of their lateral spines on exopod segment 2 and 3 and of the terminal spines of endopod segment 3. One of the 4th legs of the holotype presents a most interesting anomaly: instead of a slight notch on the lateral margin of the 3rd endopod segment, as is present in the contra-lateral P4 of the holotype and in both 4th legs of the paratype, the anomalous leg carries an extra spine (fig. 10e).

The 5th leg has a short and wide, rounded free segment, distally armed with a very long plumose seta and a short spine. Moreover, several rows of needle-like spinules occur along the distal margin of the segment (fig. 10f).

Colour of the live female: opaque white; eggs cream-coloured.

Remarks.- Though apparently closely related to the previous species, D. spinicauda, as is shown by the remarkable furca, by the P5, etc., the present animal is no doubt a different species. It differs from D. spinicauda in a smaller size; a less transformed, dorso-ventrally flattened, habit; a shorter A1; a more beak-shaped rostrum; longer spines on exo- and endopods of P1 to P4; longer distal elements on P5; and much longer, setiform elements on the caudal ramus. The specific name proposed, seticauda, refers to the latter character.

Diogenidium Edwards, 1891

At first, and merely on the basis of Edwards' description, I was inclined to consider this as a very clearly demarcated genus, chiefly because of the very curious armature of the 3rd endopod segment in P4 illustrated in Edwards' figure 16. As discussed in the sequel after the re-description of D. nasutum Edwards, 1891, this feature is not borne out by freshly collected material, and thus presumably must be considered a lapsus. Nevertheless, I have - after much hesitation - decided to maintain Diogenidium Edwards, 1891 and Herrmannella Canu, 1891 [1] as separate genera. The difficulty is not so much finding differences between a characteristic Diogenidium and a characteristic Herrmannella, but more the presence of a number of species tending to bridge the gap. Of the following four differences, I consider the first (also in the light of the importance of this character in the taxonomy of related genera) as the most valuable:

(1) The main lash of the posterior maxilla is much shorter than the auxiliary lash in Diogenidium (moreover it is widened), whereas in Herrmannella it is very slender, narrow and distinctly longer than the auxiliary lash (exceptions: in H. spinicauda n.sp. and H. seticauda n.sp., which are also otherwise aberrant, the two lashes are equally long).
(2) The first endopod shows a strong sexual dimorphism in Diogenidium (exception: in D. nasutum slight dimorphism only), whereas there is little or no sexual dimorphism in Herrmannella.
(3) The mandible of Diogenidium has a toothed blade, of Herrmannella a ciliated blade (exception: H. seticauda n.sp.).
(4) The maxilliped ♂ has, at the distal end of the medial margin of segment 2, a simple spine in Herrmannella (exceptions: H. saxidomi Illg, 1949, H. columbiae (Thompson, 1897), H. spinicauda n.sp.), a curiously transformed spine in Diogenidium. The way in which the spine is transformed is rather characteristic for Diogenidium: it is distally bifid, a setule being implanted in the cleft. H. saxidomi, H. columbiae and H. spinicauda have this spine modified in a different way.

Thus defined, the genus Diogenidium contains in addition to the type-species (by monotypy), D. nasutum Edwards, 1891, two new species to be described below: D. deforme and D. spinulosum.

1) Since Canu, 1891a, b, in his description of Herrmannella refers to Edwards' paper, Diogenidium clearly has priority over Herrmannella.

Diogenidium nasutum Edwards, 1891

Diogenidium nasutum Edwards, 1891: 87-91, pl. IV figs. 12-18
Paranthessius nasutum Illg, 1949: 401

Material examined.- From the body cavity of *Holothuria mexicana* (Ludwig). Off La Parguera (south coast of Puerto Rico), on a coral island called locally "Mata Cagada", depth 0.30 m. 3 ♀, 3 ♂ from a single example of the host. Jan.31, 1963 (Z.M.A. Co. 101.057).

Same host. Cayo Caracoles, off La Parguera (Puerto Rico). Depth 0.30 m. 2 ♂ from 7 specimens of the host. Feb.3, 1963 (Z.M.A. Co. 101.064).

Same host. Curaçao, Fuikbay, depth about 2 m. 1 ♀. Oct.23, 1958 (Z.M.A. Co. 101.058).

Description.- Female. The length of two Puerto Rican females is 1497 and 1530 μ (excluding furcal setae); their greatest width, at the level of the cephalosome, is 547 and 531 μ, respectively. The female from Curaçao is 1352 μ long and 564 μ wide. The body is rather slender (fig. 11a). The first pedigerous segment is fused with the cephalic segment. Metasome segments 1, 2 and 3 have rather well-developed epimeral areas. The first urosome segment is distinctly narrower than the last metasome segment. The genital segment has a narrower anterior and posterior part; the genital openings are dorsal, and strongly reinforced with chitinous bars; they are each armed with 1 spine. The post-genital segments are all weakly sclerotized; they articulate by means of, sometimes large, membranous articulation zones (fig. 11b). The caudal rami (fig. 11c) are still more "flabby" and their chitin is wrinkled. Slightly before the middle, a lateral seta arises; dorsally, slightly before the distal end, a short dorsal seta is implanted; there are 3 short terminal setae; the 4th, so-called terminal, seta is displaced and is implanted on the lateral margin of the ramus, at some distance of the tip. All furcal setae are smooth.

The anterior antenna (fig. 12a) is 7-segmented. Segment I bears 4 setae; II bears 12 setae; III bears 6 setae; IV bears 3 setae; V bears 4 setae; VI bears 3 setae; VII bears 7 setae and 1 aesthete. A long, beak-shaped, sharply pointed rostrum (fig. 12a) is present between the bases of the antennae.

The posterior antenna (fig. 11e) is 4-segmented. Segment II is elongate, the other segments are much shorter. Segment I carries 1 seta, segment II carries 1 seta, segment III carries 4 setae, segment IV carries 3 normal setae, 2 curved setae, and 1 curved, long claw.

The mandible (fig. 11f) has a narrow blade, and a fairly long lash. The medial margin bears a row of well-developed teeth and an elongate rugose area; the other margin bears proximally a finely toothed membrane, distally just cilii. There is no auxiliary lash.

The anterior maxilla (fig. 11f) is elongate and carries one lateral and 2 terminal spines.

The posterior maxilla (fig. 11g) is distally armed with one smooth spine; one long, slender, finely toothed lash; and one short, broad accessory lash, armed medially with longer, laterally with smaller and finer teeth.

The maxilliped (fig. 11h) consists of an unarmed, rectangular basal segment, of a very slender, elongate 2nd segment (with 1 spine near its middle), and of a terminal complex made up of a pointed segment and a flat spine.

The legs 1 to 4 are biramous and have 3-segmented rami. A lateral basipod setule is present in all legs. All legs have intercoxal plates and a medial coxopod seta (plumose). The 3rd segment of the 4th endopod bears 2 terminal spines. In the Puerto Rican specimens, the lateral margin of this segment is ornamented by 2 distinct spiniform processes; in the Curaçao specimen, the distal one of these processes is reduced in size. The figures 12b, d, e, f and the following table show structure and armature of the legs:

P1	exp.	I-0; I-1; III-I-4	P3	exp.	I-0; I-1; III-I-5
	enp.	0-1; 0-1; I-5		enp.	0-1; 0-2; III-2
P2	exp.	I-0; I-1; III-I-5	P4	exp.	I-0; I-1; II-I-5
	enp.	0-1; 0-2; III-3		enp.	0-1; 0-1; II-0

The 5th leg (fig. 12g) has a single free segment, slightly curved, 2.5 times as long as wide, distally provided with a very short and a rather long spine.

Male: The length (without furcal setae) of 3 males is 1385, 1401, and 1578 μ; the corresponding greatest body width is 515, 515, and 547 μ, respectively. The genital segment has regularly curved lateral margins (fig. 11d); two spines at the postero-lateral corners represent no doubt the 6th leg. There are 4 post-genital segments. Like in female, the post-genital segments and the caudal rami are weakly sclerotized. Sexual dimorphism is observed only in the maxilliped, and in the first and fifth legs. The maxilliped (fig. 11i) has an unarmed basal segment. The 2nd segment is swollen; it bears a group of spinules, irregularly arranged in 4 longitudinal rows, and 2 spines, the proximal of which is smooth; the distal spine is implanted on a triangular projection of the 2nd segment; distally, this spine is bifid and provided with a hair.

The 3rd maxilliped segment bears a long curved spine and a long, curved, unornamented terminal claw.

A very slight dimorphism is present in the 3rd endopod segment of P1: the spiniform processes are slightly longer than in female (fig.12c).

The 5th leg (fig.12h) is elongately ovate, thus less slender than in female, but has the same terminal armature as the other sex.

Colour.- Live specimens were opaque white.

Remarks.- Edwards' (1891) description of *Diogenidium nasutum* is, for that epoch at least, remarkably detailed. He was one of the first, if not the first, author to give a tabular synopsis of the chaetotaxis of all biramous legs. On the other hand, the description and illustrations of the mouth parts have been made evidently only from a toto mount and consequently many small errors crept in. Nevertheless all characteristic features of the species are clearly borne out by Edwards' work. So, the characteristic rostrum, the short and wide accessory lash of mx2 and the ♂ maxilliped are very clearly represented.

It must be remarked, that all Edwards' figures, except 13 and 19, have been made after a male. Fig.16 thus represents P4 ♂ (and not, as could be gathered from Illg's key, 1949, which is "based on characters of females", a P4 ♀). The alleged dimorphism in the P2 and P3 exopods and in the 3rd endopod segment of P4 is not supported by the freshly collected material. Edwards' chaetotaxis formula for P4 ♀ is correct, but in his counts for P4 ♂ (and in his drawing of that leg), he wrongly attributed an additional seta to the *medial* margin of the 3rd endopod segment. [1]

If one takes these shortcomings into account, there can be little doubt that the present material, which was like Edwards' specimens collected in the body cavity of a West Indian holothurian [2], is identical with *Diogenidium nasutum*.

Diogenidium spinulosum n.sp.

Material examined.- 1 ♂ (holotype). Ejected by *Isostichopus badinotus* (Selenka). Puerto Rico: San Christobal Reef, La Parguera. Depth about 1 m. Feb. 15,1963 (Z.M.A. Co. 101.065).

1) It should be noted, that in those members of the *Paranthessius* group that do have 3 elements on the 3rd endopod segment of P4, the extra element is always implanted on the *lateral* margin of the segment.

2) According to Edwards, the host of his specimens was *Muelleria* (= *Actinopyga*) *agassizi* Selenka.

Description.- Male : Length (without furcal setae) 1.58 mm; greatest width (at the level of the cephalosome) 0.48 mm. The body is very slender (fig.13a); the first pedigerous segment is only vaguely demarcated. Metasome segments 1, 2, and 3 have distinct, but not unduly enlarged, epimeral areas; these segments diminish only slightly in width in backward direction. The genital segment has evenly rounded lateral margins; two setae represent no doubt the sixth leg; ventrally, near the posterior margin of the so-called genital lobes, run two parallel rows of spinules (fig.13b). All post-genital segments are covered with minute, irregularly placed, cuticular setules; moreover, urosome segments 3 and 4 bear, on their ventral surface, a curved sclerotization armed with 5 spinules. The urosome and caudal rami are well sclerotized, and not flabby as in D. nasutum. The caudal rami (fig.13b) are 92 x 32 μ. A lateral seta arises slightly before the middle of the ramus. There are 4 short terminal setae and a dorsal setule.

The anterior antenna (fig.13c) is very slender; in addition to the normal setal armature, it bears an aesthete on segments 6 and 7. The rostrum (fig.13d) is very characteristic: it consists of a rounded anterior lobe, followed by a cow-bell shaped, strongly chitinized structure. On a "deeper level" (i.e., more dorsalward), the latter structure is connected with the upper lip.

The posterior antenna (fig.13e) is slightly less slender than that of D. nasutum.

The mandible (fig.13f) has a very long lash; the proximal part of the medial margin bears a crest of longer teeth.

The anterior maxilla (fig.13g) is a tapering lobe, armed with 2 distal spines only. The posterior maxilla (fig.14a) has the characteristic Diogenidium shape, i.e., with one short and wide and one elongate apical lash. The two lashes are toothed at their medial margin only.

The maxilliped (fig.14b) has a heavy, tapering second segment, at the medial margin of which a bifid spine, placed on a socle, is found. This spine is much wider and shorter than the corresponding one in D. nasutum. Long spines, placed in 3 irregular rows, extend distally beyond the bifid spine (in nasutum they occur only proximally of the bifid spine).

The biramous legs are rather similar to those of D. nasutum, but differ in distinct details. The 2nd and 3rd segments of both exo- and endopod bear, near their lateral margin small spinules with a strongly sclerotized base. The exopod spines are slightly longer than in D. nasutum.

The endopod of leg 1 (fig.14c) has very strong spiniform processes on the lateral margin of segments 2 and 3. The disto-lateral spine of segment 3 is very heavy and unornamented (not over-heavy and ornamented in nasutum).

The 2nd leg is similar to that of nasutum, except for the slightly greater lengths of the exopod spines and the presence of small extra spinules (fig.14d).

Longer spines and presence of small additional spinules characterize also the 3rd leg (fig.14e), and the 4th leg (fig.14f). The two distal spines on the 3rd endopod segment of P4 are more unequal in length than in nasutum. The 5th leg is similar to that of nasutum.

Live colour.- Opaque white.

Remarks.- The secondary sexual differences are so small in Diogenidium and Herrmannella, that it is not considered inconvenient that only the male sex of the present species is known. In fact, the ♂ maxilliped offers one of the best distinctions between D. nasutum and D. spinulosum. For the rest, D. spinulosum, though certainly closely related to D. nasutum, is very easily recognizable by the very curious structure of the rostrum, by the presence of spinules on the 2nd, 3rd, and 4th urosome segments and on the biramous legs, and by the structure of the first endopod.

Diogenidium deforme n.sp.

Material examined.- 1 ♀ (holotype), 1 ♂ (allotype), ejected by Holothuria glaberrima Selenka. Puerto Rico, south coast, between Isla Matei and La Parguera, under stones at low tide. Feb.4, 1963 (Z.M.A. Co. 101.059).

Description.- The female is (without furacal setae) 2273 μ long, and its cephalosome is 739 μ wide; the same dimensions for the male are 1751 x 6 2 μ. The body is elongate (figs.15a,b), especially in the urosomal region. The cephalosome has a rather curious shape, since the postero-lateral areas tend to extend in a wing-like way. The first pedigerous segment is completely fused with the cephalosome. The metasome is 3-segmented, each segment has fairly well-developed epimeral areas. The 5th pedigerous segment is in ♀ much wider than the metasome; dorsally, in the midline of the body, the segment bears a distinct swelling; the fifth leg is implanted dorsally, at the postero-lateral end of the segment. In male (fig.15b), the 5th pedigerous segment is of about the same width as the last metasome segment; the P5 is implanted dorsally as well. The genital segment ♀ has a widened anterior part, with the genital openings and 1 seta (= rudimentary P6), and an elongated, cylindrical posterior part. The 3rd and 4th urosome segments are likewise elongate; the anal segment is unornamented and about as long as wide. In male, the genital segment is rounded; the genital openings are surrounded by heavily sclerotized thickenings in ovate arrangement; the P6 is represented by 2 setae. The post-genital segments are less elongate than in female; the anal segment is unornamented. The caudal ramus (fig.15c) is 355 x 113 μ (♀), or 274 x 81 μ(♂). It bears a robust, smooth lateral seta, slightly beyond the middle and 4 short, robust, smooth terminal setae. The dorsal seta is very small.

The anterior antenna (fig.15e) is similar in both sexes. Its segments are armed as follows: I - 4 setae; II - 13 setae; III - 6 setae; IV - 3 setae; V - 5 setae: VI - 4 setae; VII - 7 setae + 1 aesthete. A strongly sclerotized, beak-shaped rostrum (fig.15f) is present.

The posterior antenna (♀, ♂) is rather robust (fig.15g). Segments 1,2,and 3 bear 1, 1,and 4 setae, respectively. The terminal segment bears 2 latero-subdistal setae, 3 terminal setae, and 1 strongly curved terminal claw.

The mandible (♀, ♂) has a narrow blade (fig.15h), produced into a very long lash; both margins are provided with slender, gradually decreasing, teeth.

The anterior maxilla (♀, ♂) is very narrow at its base (fig.15i) but distally wider and bifid; the more proximal lobe bears 1 heavy seta, the other 2 heavy setae.

The posterior maxilla (♀, ♂) has a bulgy basal segment (fig.16a), and a distal segment produced into two lashes, one being very narrow and elongate, the other wider and shorter. The medial margin of both lashes is armed with long, slender, gradually decreasing teeth. Moreover the distal segment bears an ornamented spine.

The maxilliped is sexually dimorph. In ♀, it is 3-segmented (fig.15j); the longest segment (=segment 2) bears 2 setae; the distal segment bears 2 spines and is terminally produced into a short, triangular "claw". In ♂ (fig.16b), the 2nd segment is swollen, and armed with irregular rows of short, conical spinules. There are about 7 such rows on the one side of the segment, about 5 on the other. Distalward of the spinose area, a seta and a compound spine are implanted, the latter being bifid. The heavy claw is accompanied by an annulated seta.

Of the biramous legs, only leg 1 is sexually dimorph. In ♂ (fig.16d) the single spine on the 3rd endopod segment is relatively longer, less ornamented and providing a kind of grasping organ. In ♀ (fig.16c) this spine is shorter than the 3rd endopod segment.

Spiniform processes are well-developed in both sexes, especially on the endopods. All legs have a large, plumose, internal coxopod seta, and a smooth external basipod setule. The figures (figs. 16c-g) and the following table provide the necessary information concerning the shape and armature:

P1	exp.	I-0 ; I-1 ; III-I-4	P3	exp.	I-0 ; I-1 ; III-I-5	
	enp.	0-1 ; 0-1 ; I-5		enp.	0-1 ; 0-2 ; III-2	1)
P2	exp.	I-0 ; I-1 ; III-I-5	P4	exp.	I-0 ; I-1 ; II-I-5	
	enp.	0-1 ; 0-2 ; III-3		enp.	0-1; 0-1 ; II-0	

The fifth leg is much larger in female (116.8 x 59.4 μ) than in male (43.2 x 21.6 μ), although in both cases, the free segment is about twice as long as wide. Distally, the P5 is armed with a longer and a shorter spine; these are in ♀ about 30 and 51 μ long, in ♂ 22 and 43 μ (figs.16h,i).
Colour in live.- Semitransparent, slightly yellowish, intestine lilac-brown.

Remarks.- The transformed body shape (expanded cephalosome ♀ ♂, enlarged 5th pedigerous segment ♀, dorsal implantation of P5 ♀ ♂, elongation of the post-genital segments ♀, reduced length of the furcal setae) is almost certainly the result of the endoparasitic mode of life. By these characters, the present species is easily distinguished from all others in the genera Diogenidium and Herrmannella.

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Dr. J.H. STOCK
Professor in Systematic Zoology
Zoological Museum of the University of Amsterdam
Plantage Middenlaan 53
Amsterdam - The Netherlands

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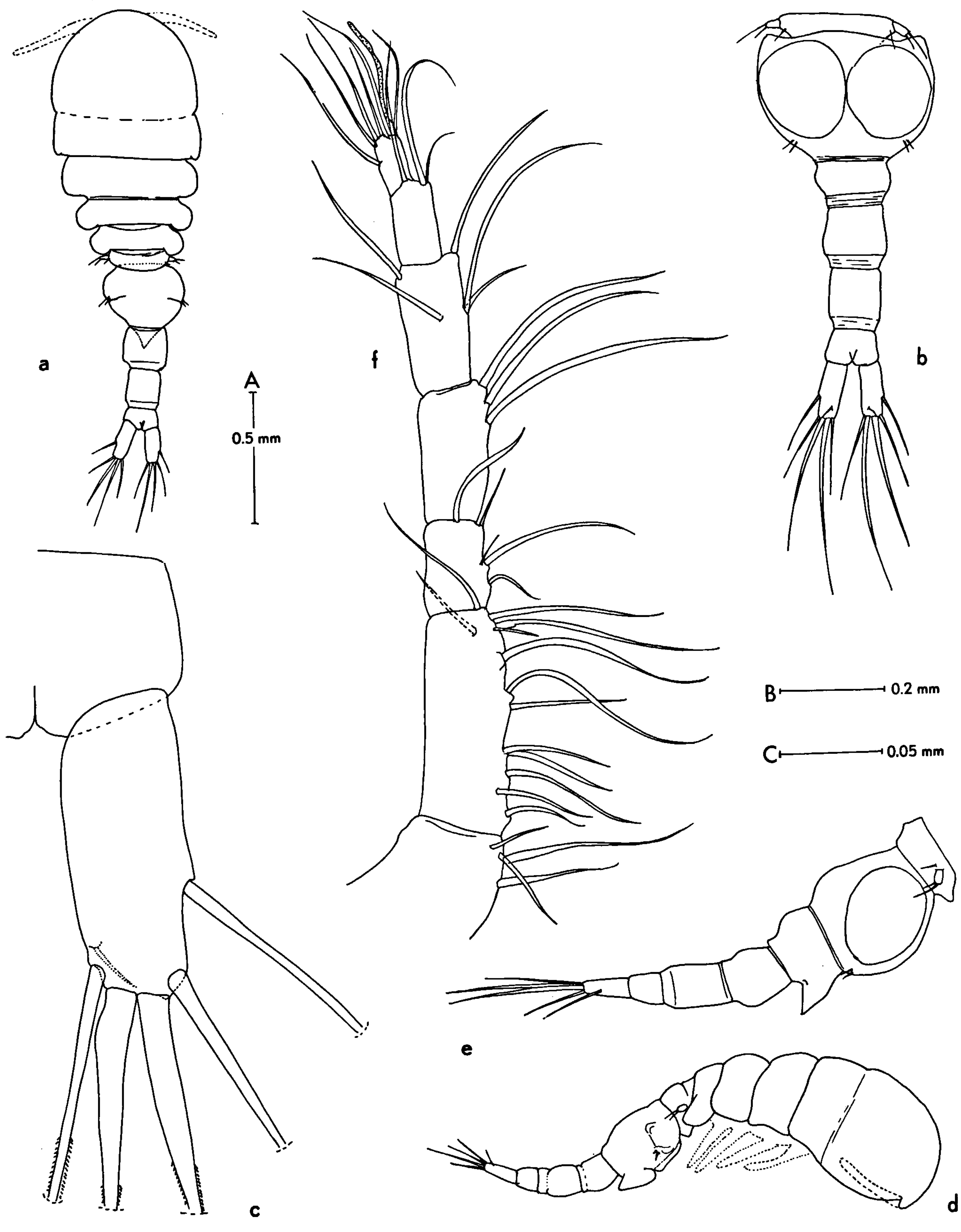

Fig. 1. Scambicornus carinatus n.sp. a, female, holotype, dorsal (scale A); b, urosome ♂, dorsal (B); c, caudal ramus ♀, ventral (C); d, female, paratype, lateral (A); e, urosome ♂, lateral (B); f, anterior antenna ♀ (C).

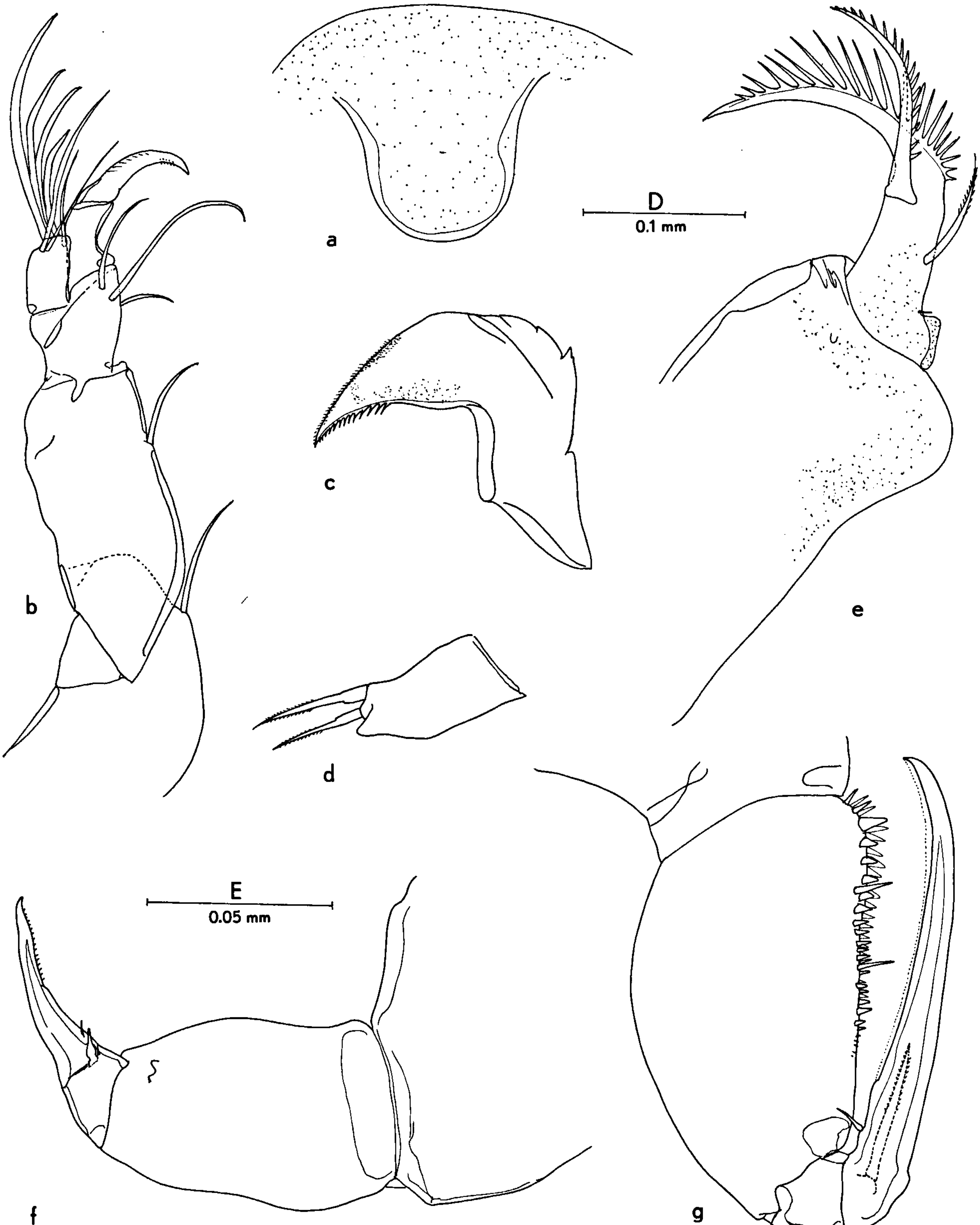

Fig. 2. Scambicornus carinatus n.sp. a, rostrum ♀, ventral (scale D); b, posterior antenna ♀ (B); c, mandible ♀ (E); d, anterior maxilla ♀ (E); e, posterior maxilla ♀ (E); f, maxilliped ♀ (C) (rugosities on segments 1 and 2 omitted); g, maxilliped ♂ (C).

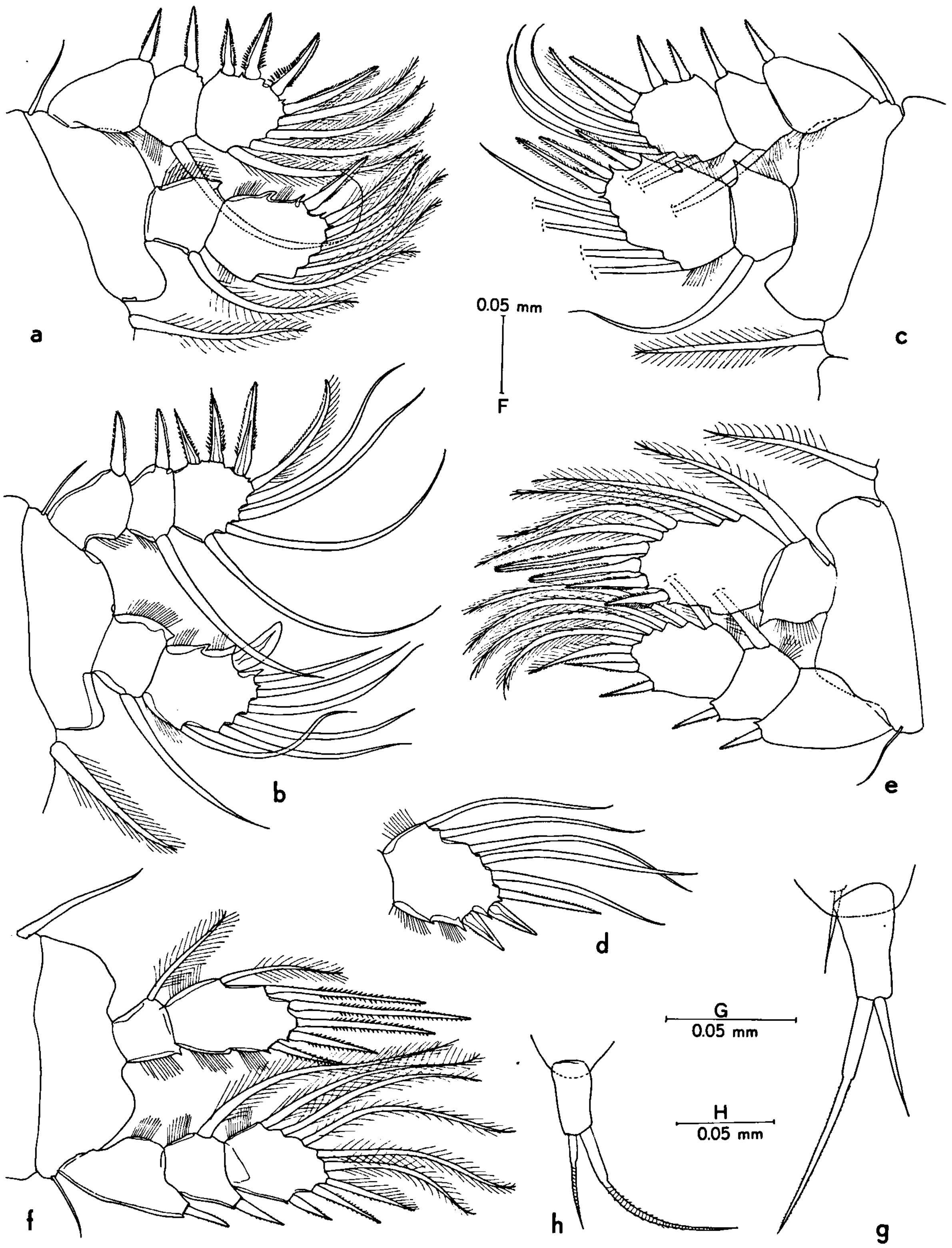

Fig. 3. **Scambicornus carinatus** n.sp. a, first leg ♀ (F); b, first leg ♂ (F); c, second leg ♀ (F); d, third endopod segment of second leg ♂ (F); e, third leg ♀ (F); f, fourth leg ♀ (F); g, fifth leg ♀ (G); h, fifth leg ♂ (H). (In b, c, and d the plumosities on the setae of the rami are omitted).

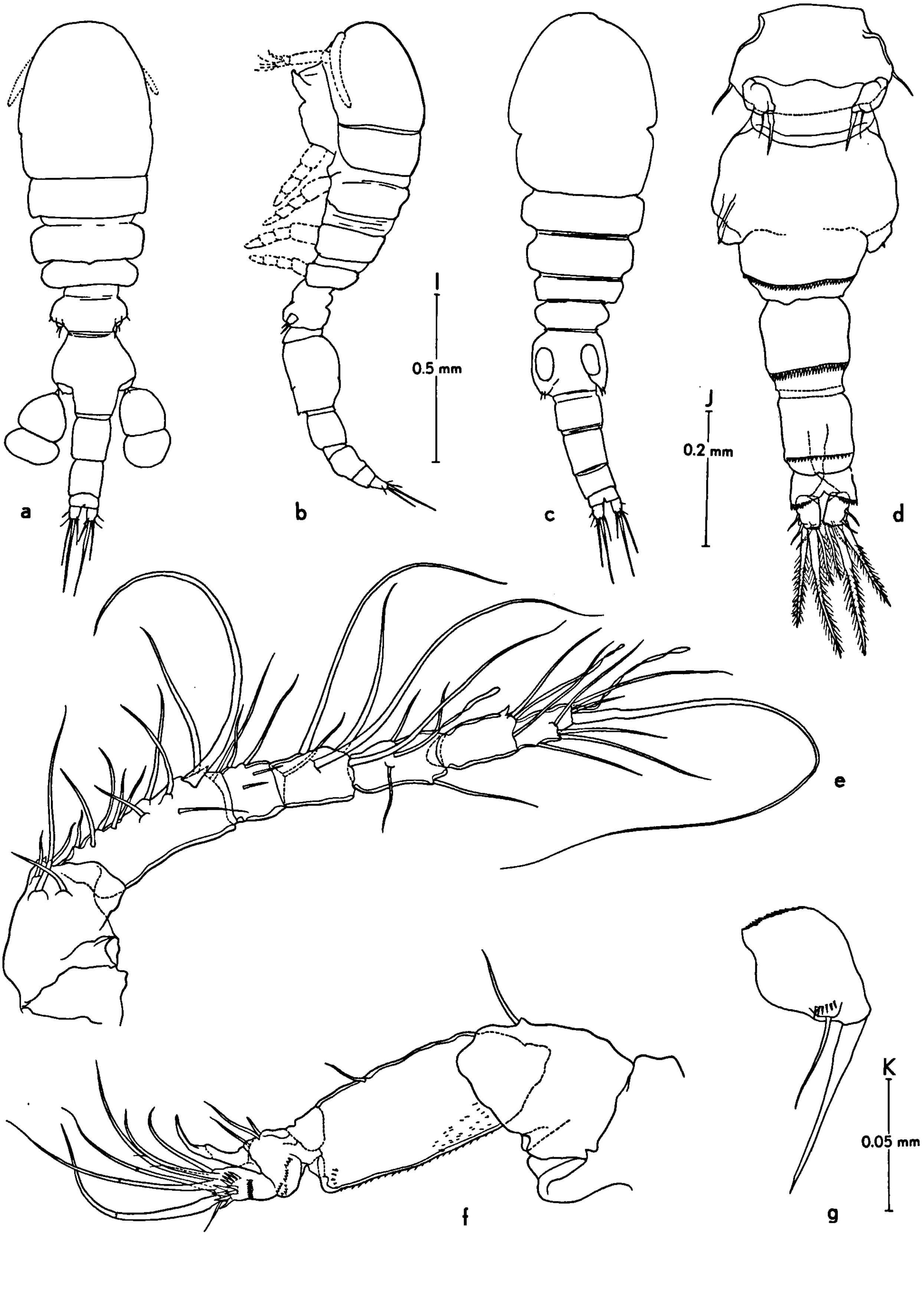

Fig. 4. Lichothuria mandibularis n.gen., n.sp. a, female, dorsal (scale I); b, female, lateral (I); c, male, dorsal (B); d, urosome ♀, ventral (J); e, anterior antenna ♀ (C); f, posterior antenna ♀ (C); g, fifth leg ♀ (K).

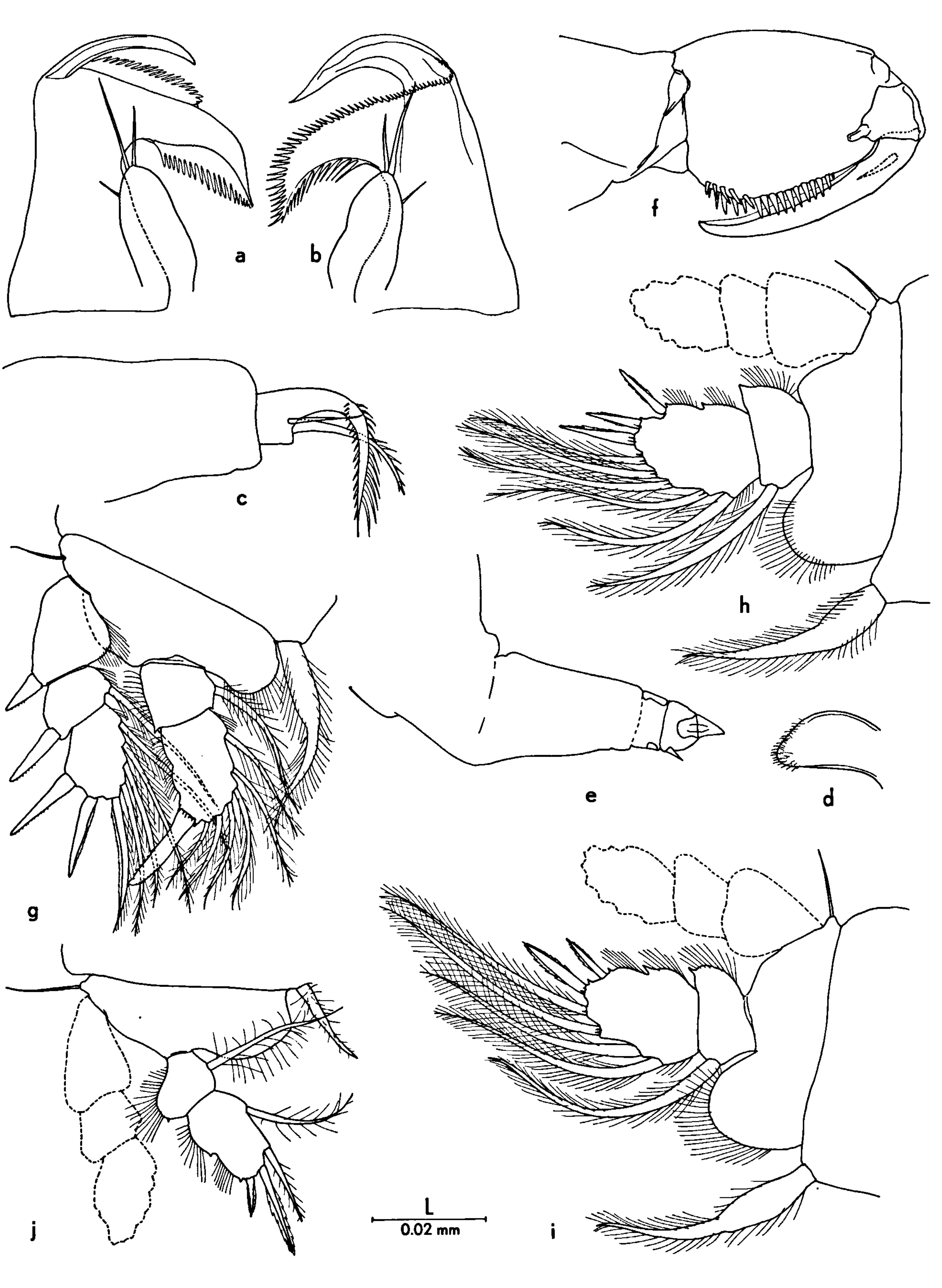

Fig. 5. L i c h o t h u r i a m a n d i b u l a r i s n.gen., n.sp. a, mandible and anterior maxilla ♂ (scale L); b, mandible and anterior maxilla ♀ (L); c, posterior maxilla ♀ (E); d, paragnath ♀ (L); e, maxilliped ♀ (E); f, maxilliped ♂ (K); g, first leg ♂ (K); h, second leg ♂ (K); i, third leg ♂ (K); j, fourth leg ♂ (K).

Fig. 6. L i c h o t h u r i a m a n d i b u l a r i s n.gen., n.sp. a, first leg ♀ (scale H); b, second leg ♀ (H); c, third leg ♀ (H); d, fourth leg ♀ (H).

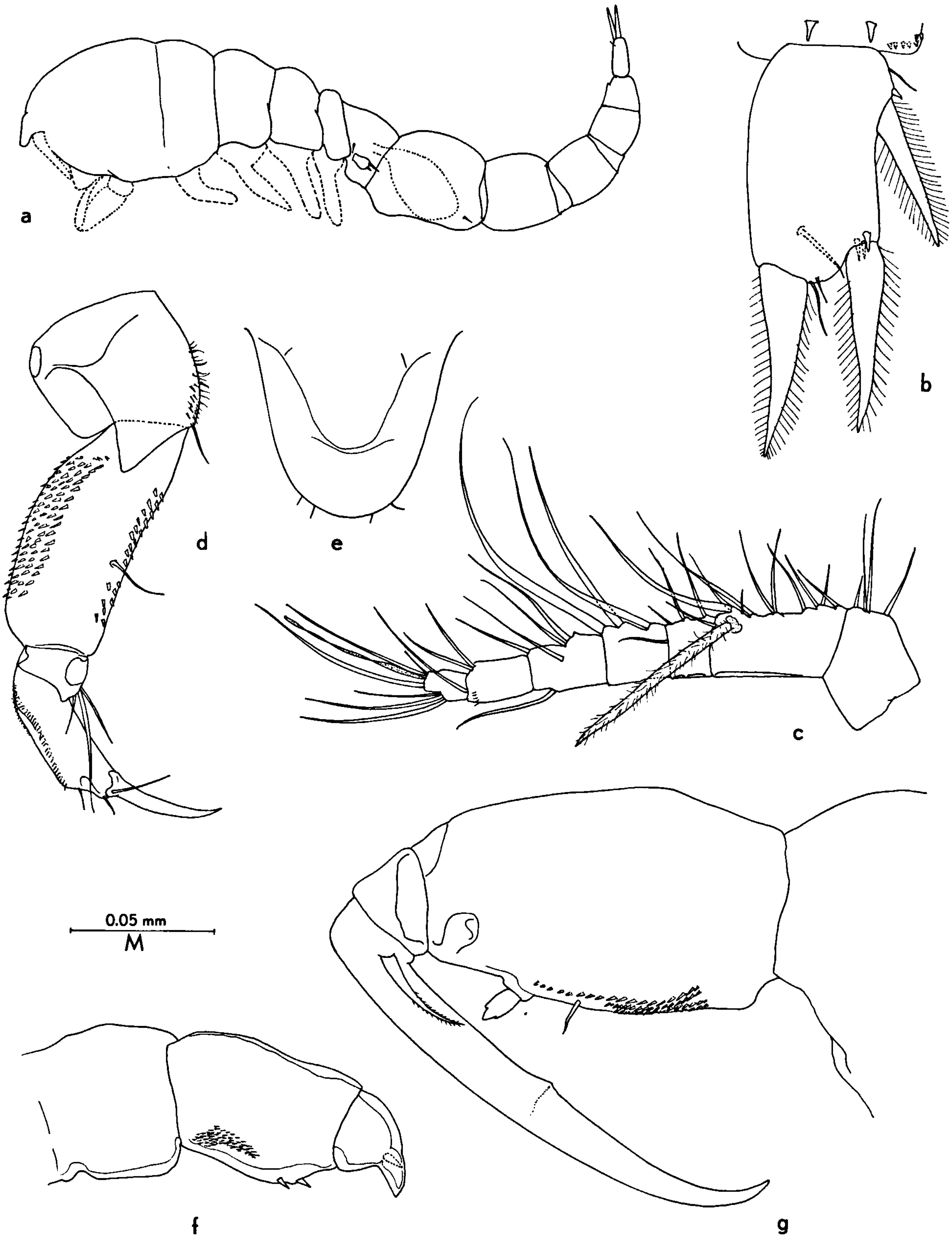

Fig. 7. Diagonella spinicauda n.gen., n.sp. a, male, lateral (scale B); b, caudal ramus ♂, ventral (K); c, anterior antenna ♂ (M); d, posterior antenna ♂ (M); e, rostrum ♂ (E); f, maxilliped ♀ (E); g, maxilliped ♂ (E).

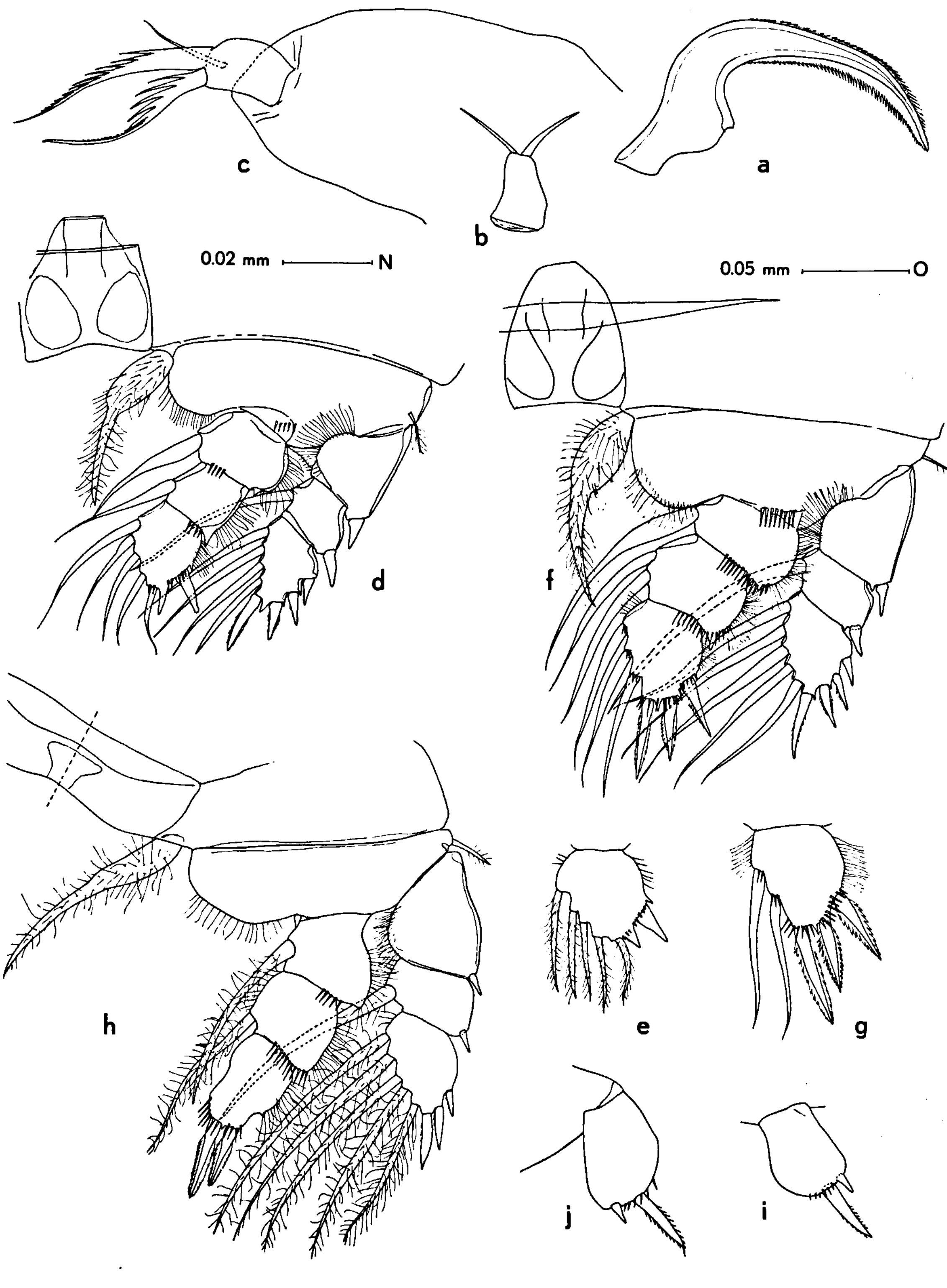

Fig. 8. Diogenella spinicauda n.gen., n.sp. a, mandible ♂ (scale N); b, anterior maxilla ♂ (N); c, posterior maxilla ♂ (N); d, first leg ♂ (O); e, third endopod segment of first leg ♀ (G); f, second leg ♂ (O); g, third endopod segment of third leg ♂ (G); h, fourth leg ♂ (O); i, fifth leg ♀ (G); j, fifth leg ♂ (G). (In figures d, f, and g the plumosity on the setae of the rami has been omitted).

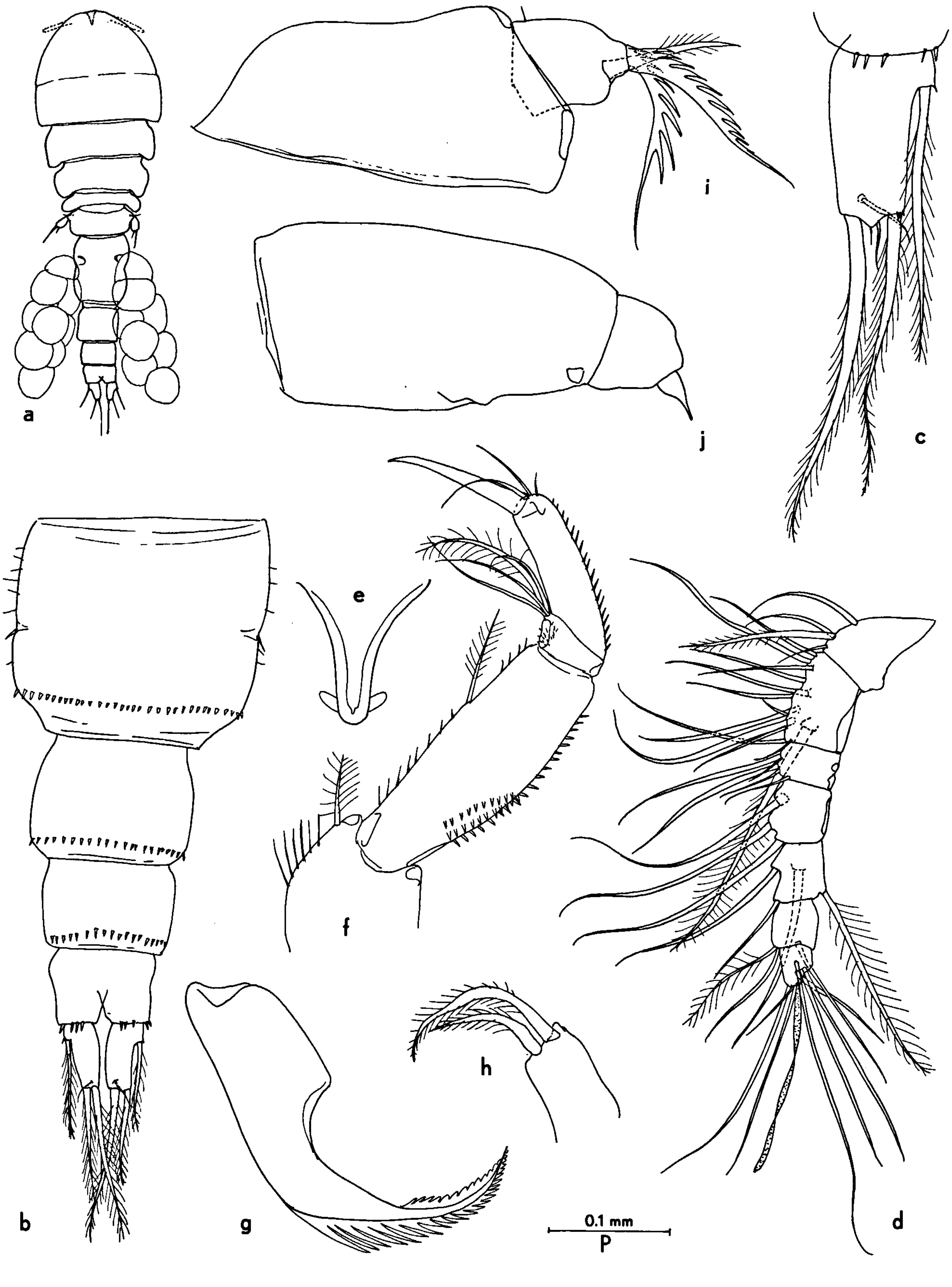

Fig. 9. Diogenella seticauda n.sp., ♀. a, entire animal, dorsal (scale I), b, urosome, ventral (slightly pressed under a cover glass) (P); c, caudal ramus, ventral (K); d, anterior antenna (K); e, rostrum, ventral (K); f, posterior antenna (E); g, mandible (L); h, anterior maxilla (L); i, posterior maxilla (L); j, maxilliped (L).

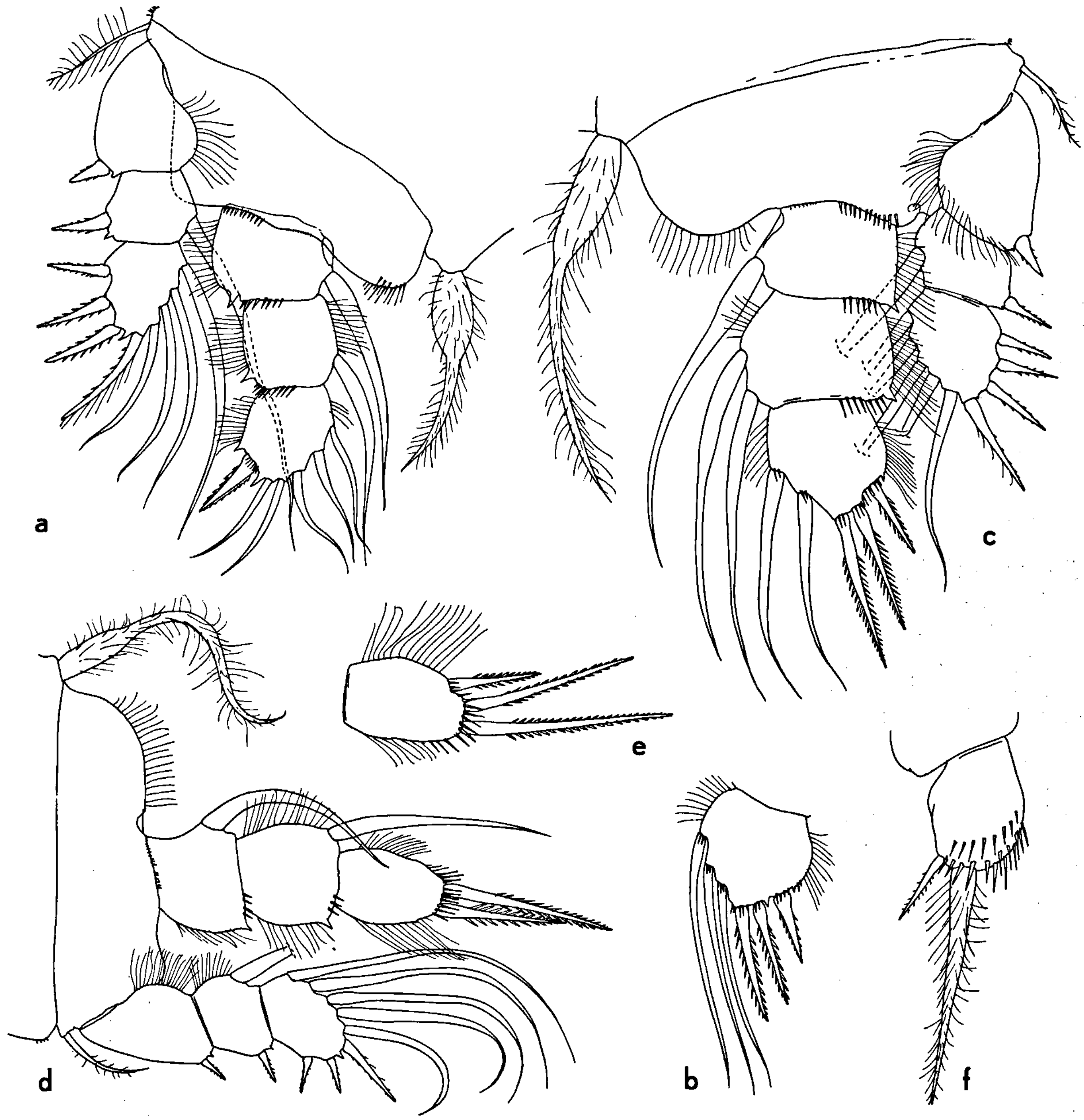

Fig. 10. **Diogenella seticauda** n.sp., ♀. a, first leg (scale G); b, third endopod segment of second leg (G); c, third leg (G); d, fourth leg (G); e, contralateral third endopod segment of fourth leg from the same specimen illustrated in fig. 10d (G); f, fifth leg (G). (In figures a, b, c and d the plumosity on the setae of the rami is omitted).

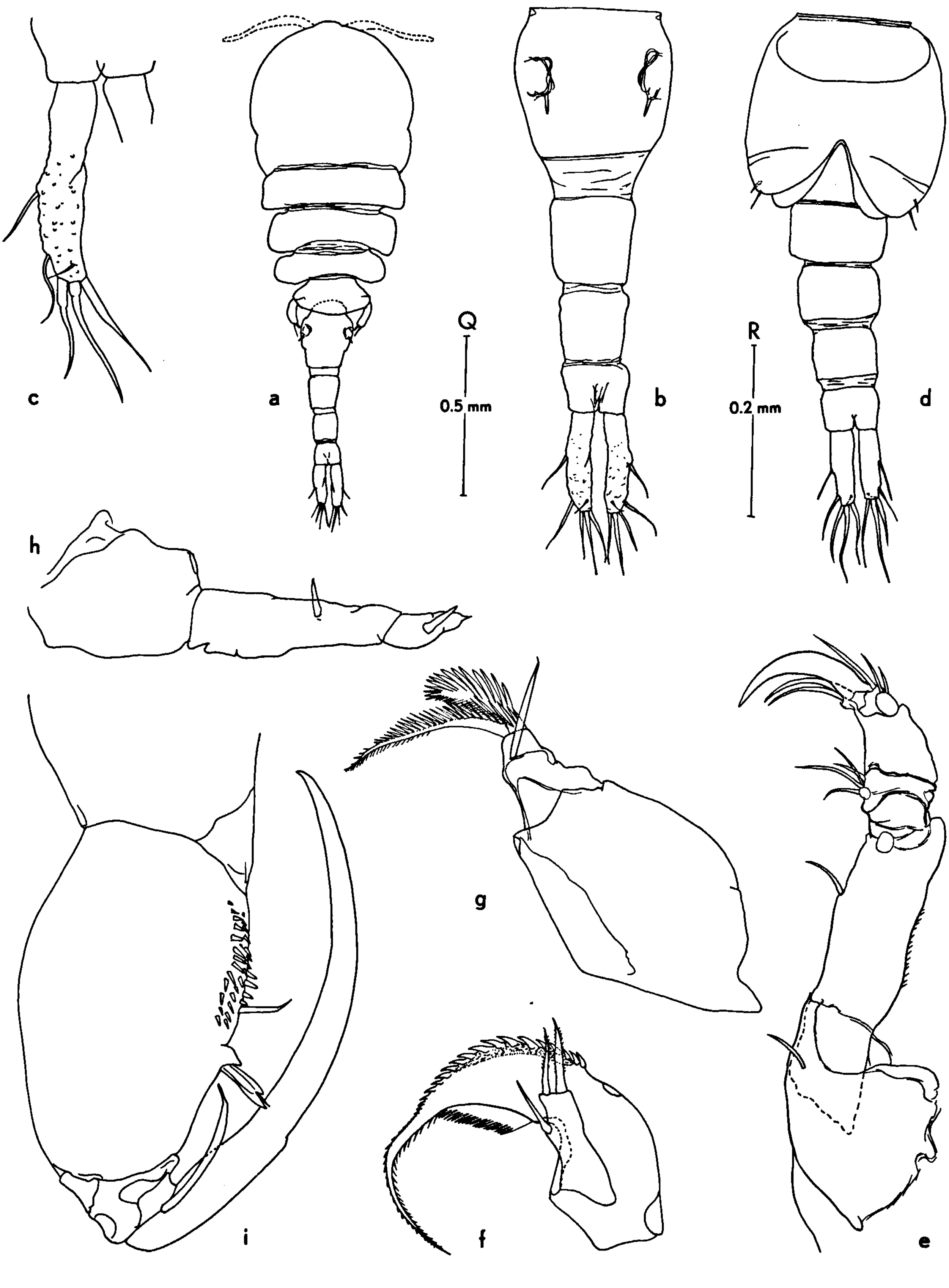

Fig. 11. Diogenidium nasutum Edwards, 1891. a, female, dorsal (scale Q); b, urosome ♀, dorsal (R); c, caudal ramus ♀, dorsal (D); d, urosome ♂, ventral (R); e, posterior antenna ♀ (U); f, mandible and anterior maxilla ♀ (E); g, posterior maxilla ♀ (U); h, maxilliped ♀ (U); i, maxilliped ♂ (C).

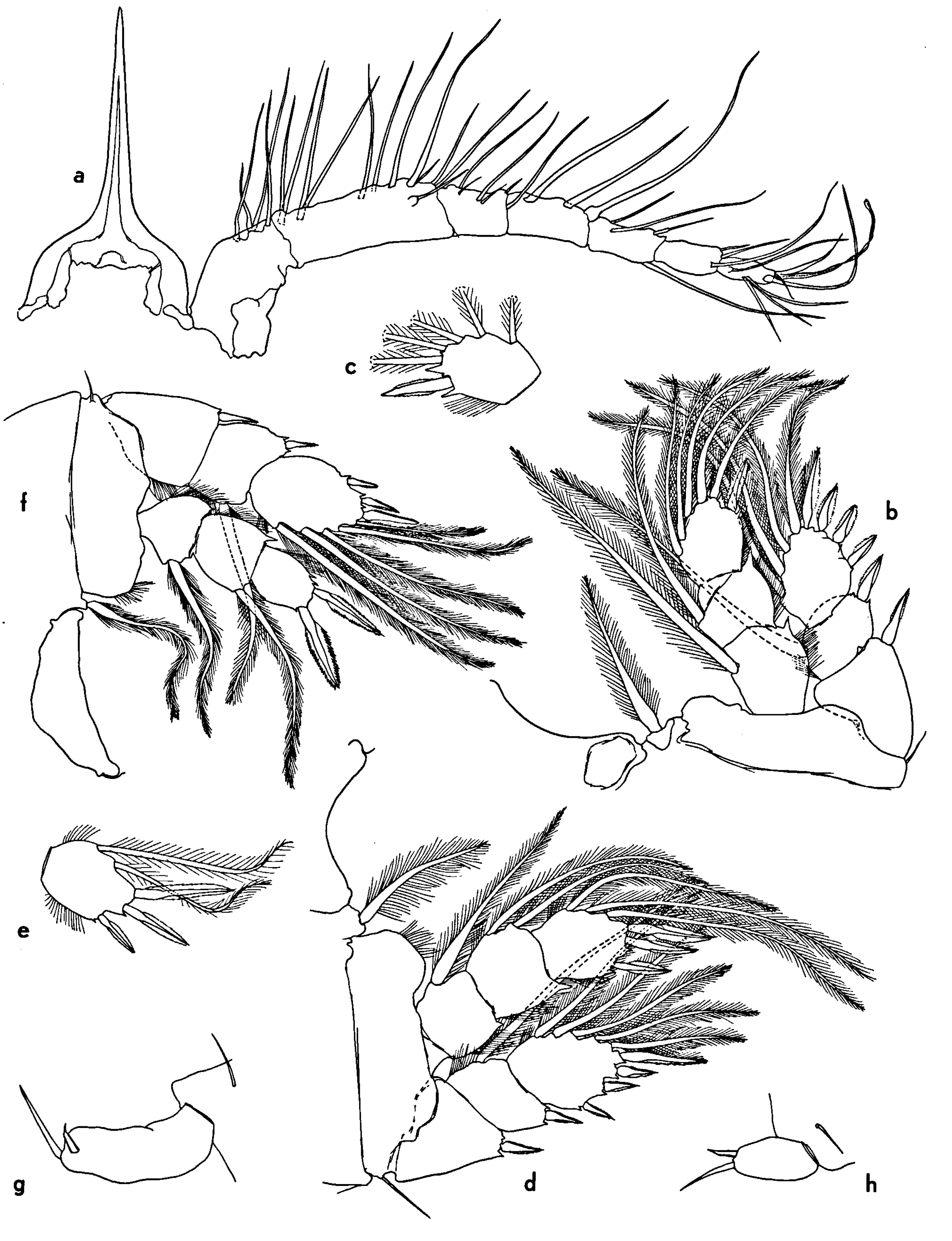

Fig. 12. Diogenidium nasutum Edwards, 1891. a, anterior antenna and rostrum ♀ (scale H); b, first leg ♀ (H); c, third endopod segment of first leg ♂ (G); d, second leg ♀ (H); e, third endopod segment of third leg ♀ (H); f, fourth leg ♀ (H); g, fifth leg ♀ (H); h, fifth leg ♂ (H).

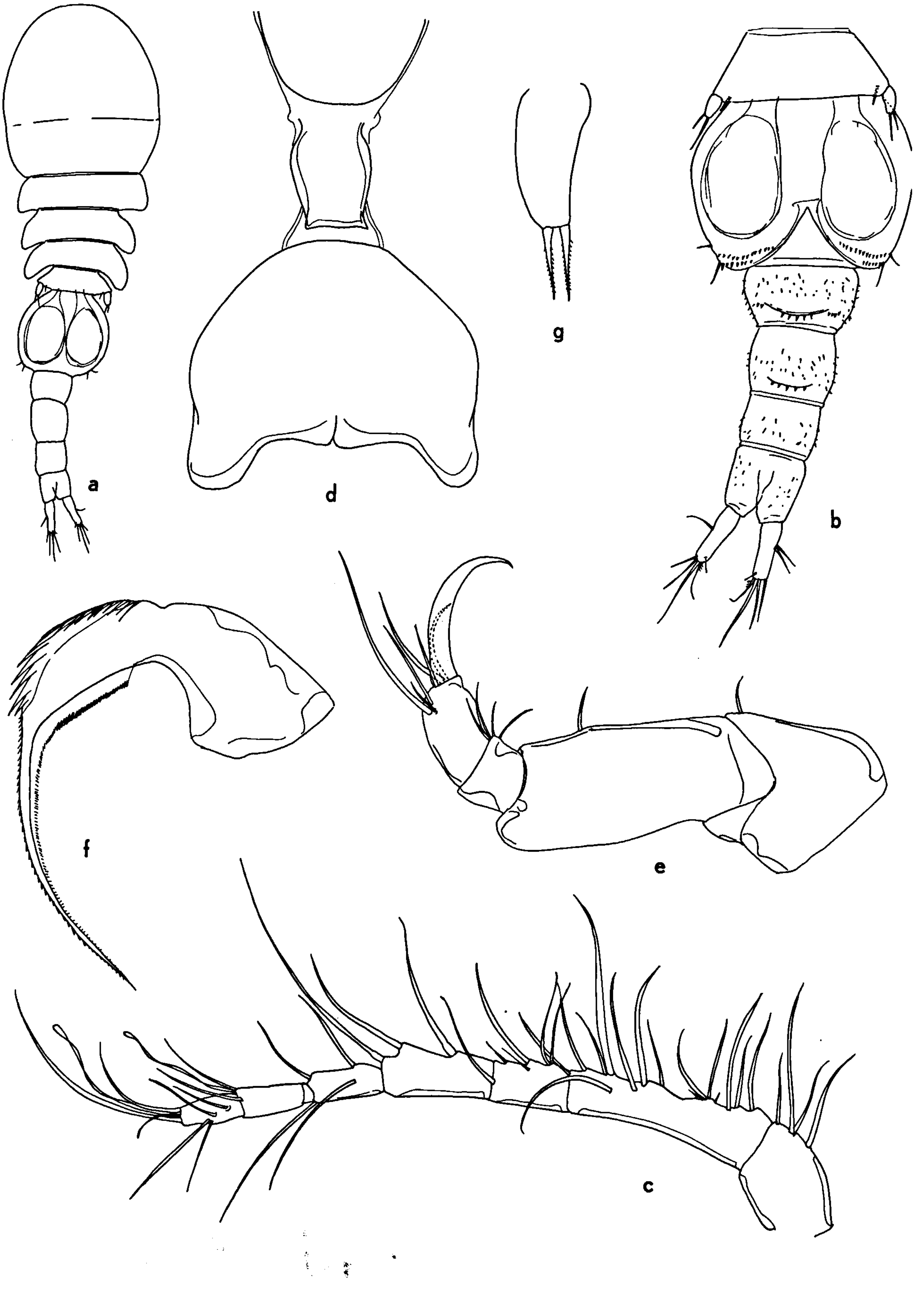

Fig. 13. Diogenidium spinulosum n.sp., ♂. a, entire animal, dorsal (scale Q); b, urosome, ventral (J); c, anterior antenna (C); d, rostrum and labrum (C); e, posterior antenna (C); f, mandible (E); g, anterior maxilla (E).

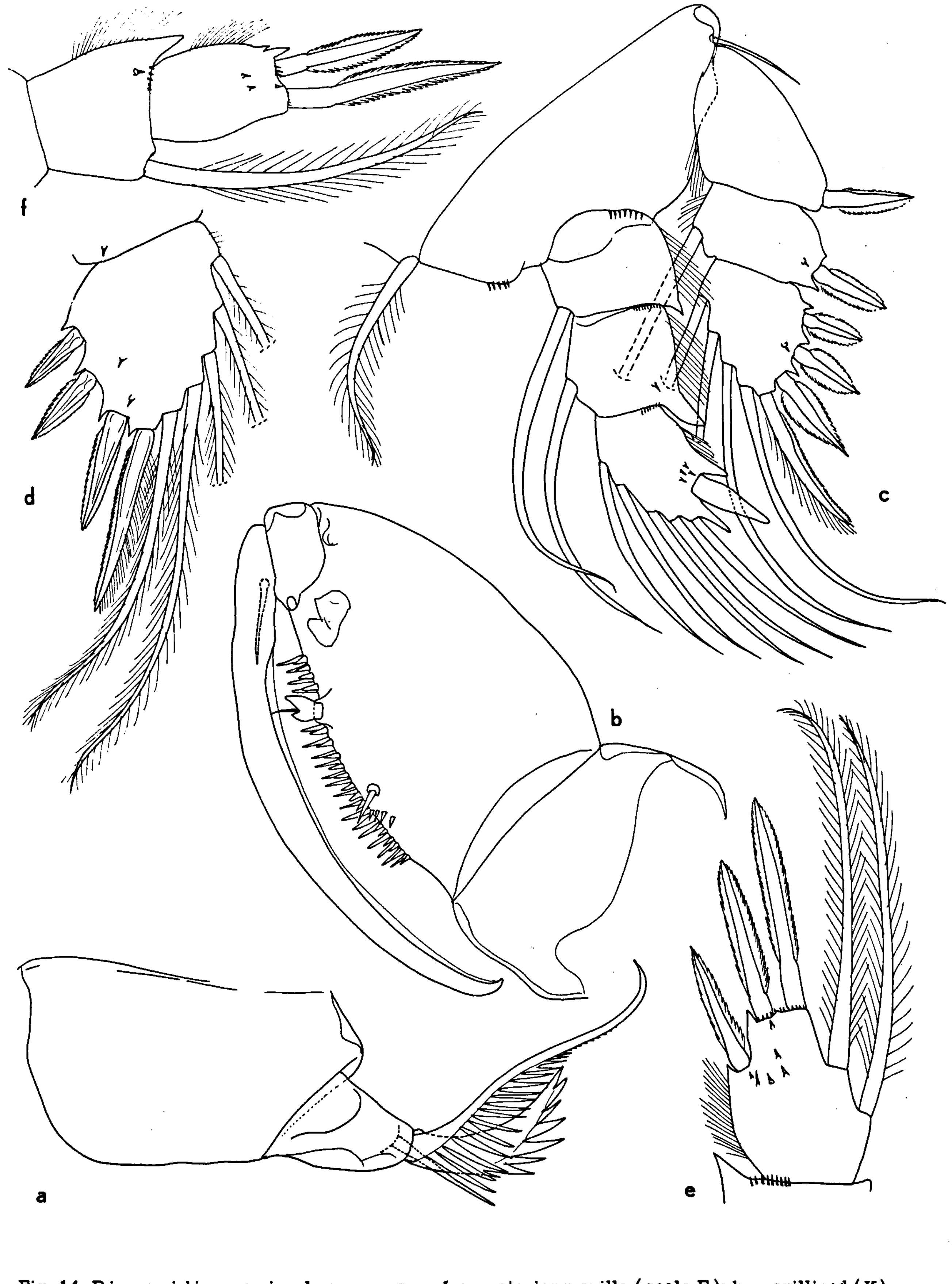

Fig. 14. **Diogenidium spinulosum** n.sp., ♂. a, posterior maxilla (scale E); b, maxilliped (K); c, first leg (K); d, third exopod segment of second leg (E); e, third endopod segment of third leg (E); f, fourth endopod (E). (In figure c, the plumosity on the setae of the rami is omitted).

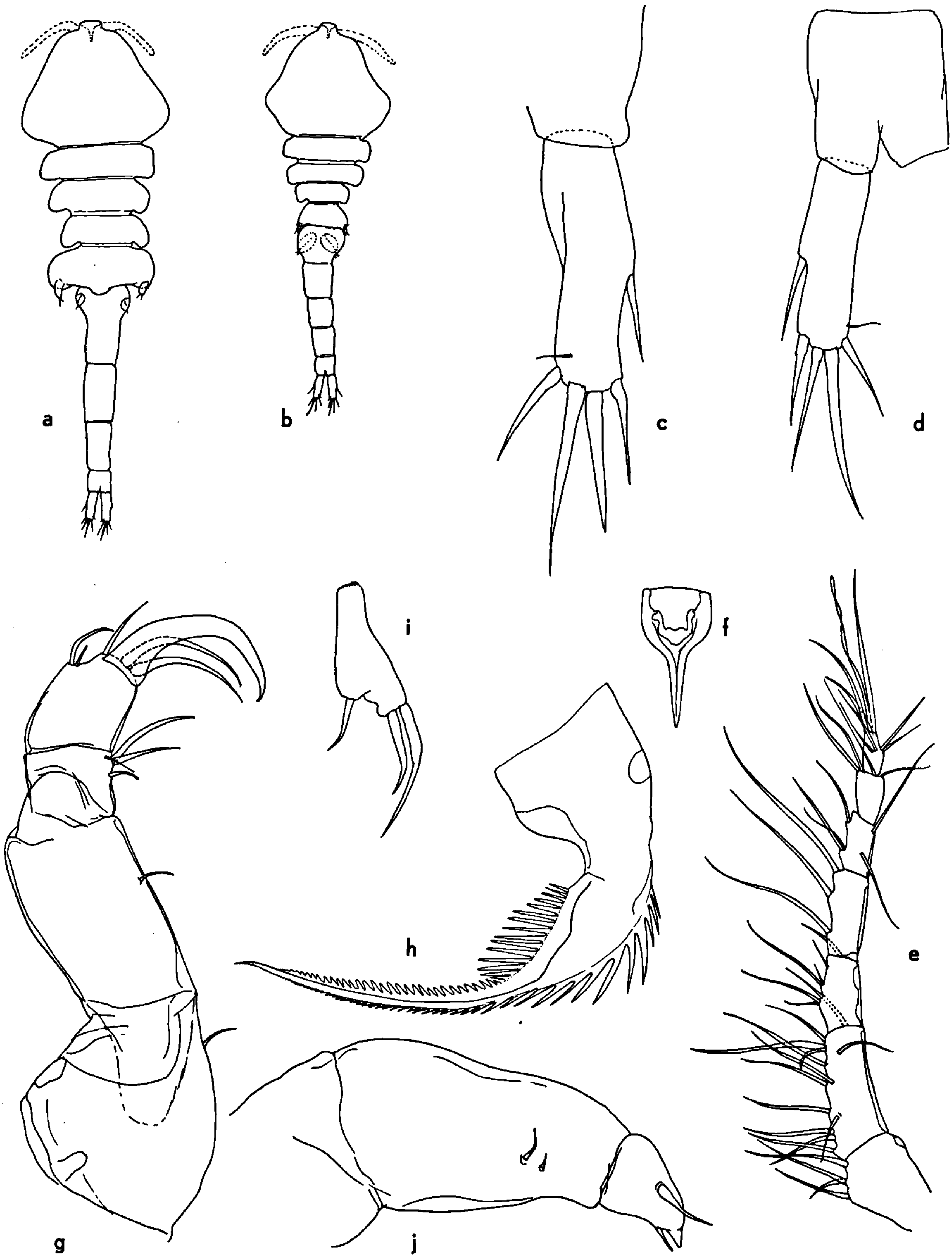

Fig. 15. Diogenidium deforme n.sp. a, female, dorsal (scale S); b, male, dorsal (S); c, caudal ramus ♀, dorsal (D); d, anal segment and caudal ramus ♂, dorsal (D); e, anterior antenna ♀ (D); f, rostrum ♀ (J); g, posterior antenna ♀ (C); h, mandible ♂ (E); i, anterior maxilla ♂ (E); j, maxilliped ♀ (K).

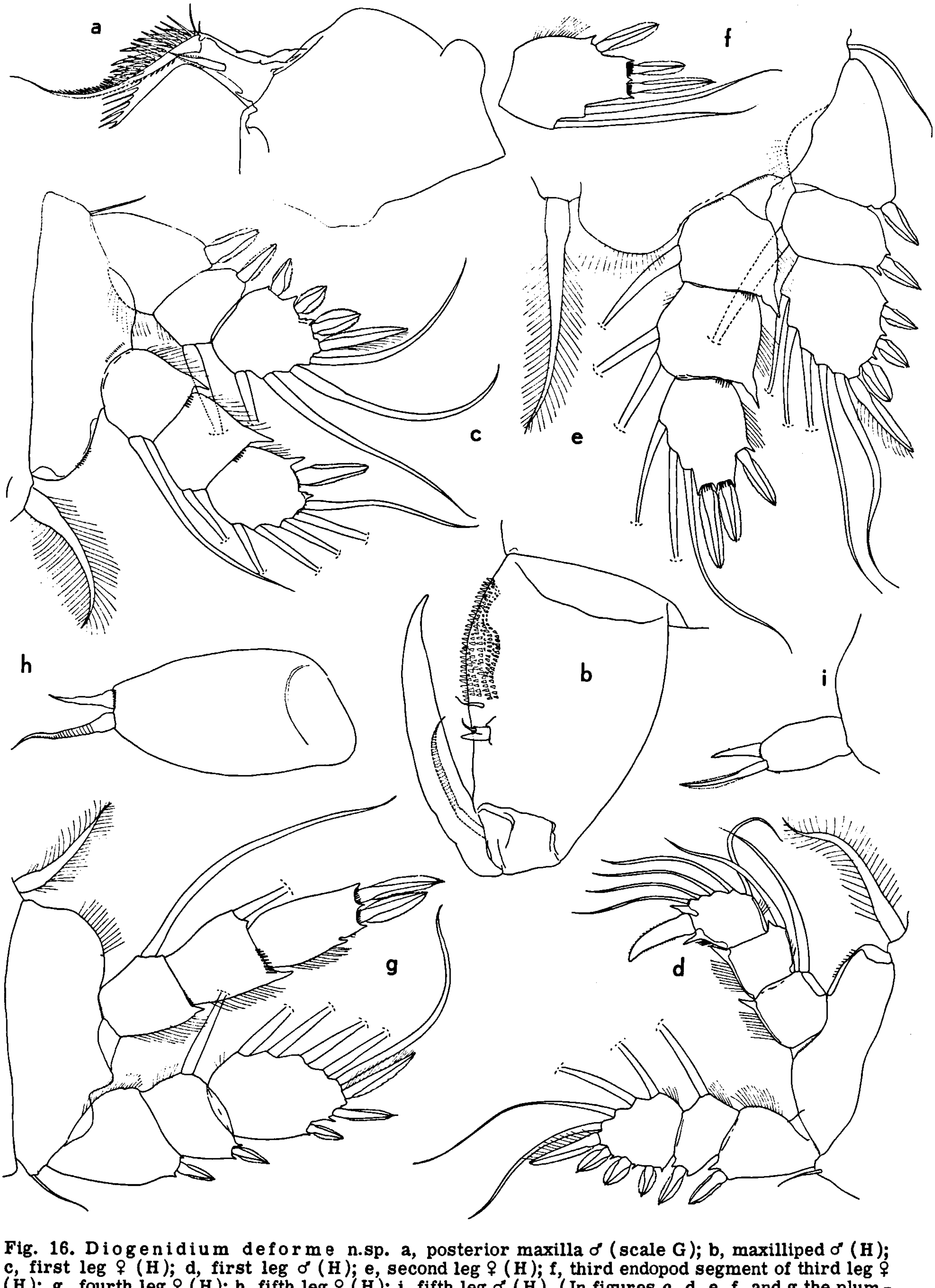

Fig. 16. Diogenidium deforme n.sp. a, posterior maxilla ♂ (scale G); b, maxilliped ♂ (H); c, first leg ♀ (H); d, first leg ♂ (H); e, second leg ♀ (H); f, third endopod segment of third leg ♀ (H); g, fourth leg ♀ (H); h, fifth leg ♀ (H); i, fifth leg ♂ (H). (In figures c, d, e, f, and g the plumosity on the setae of the rami is omitted).