BEAUFORTIA

INSTITUTE OF TAXONOMIC ZOOLOGY (ZOOLOGICAL MUSEUM)
UNIVERSITY OF AMSTERDAM

Vol. 30 no. 4 November 28, 1980

A REVIEW OF THE COPEPODS ASSOCIATED WITH HOLOTHURIANS, INCLUDING NEW SPECIES FROM THE INDO-PACIFIC

ARTHUR G. HUMES

Boston University, Marine Program, Marine Biological Laboratory, Woods Hole, Massachusetts 02543, U.S.A.

ABSTRACT

Copepods associated with Holothuroidea are listed with their hosts and brief characterizations. A key to the genera of these copepods is provided. Twelve new species from the Indo-Pacific are described: *Calypsarion bilobatum* n. sp. from probably *Holothuria atra*, *Chauliolobion imparile* n. sp. from *Bohadschia argus*, *Chauliolobion forcipatum* n. sp. from *Stichopus chloronotus*, *Chauliolobion tectuliferum* n. sp. from *Thelenota ananas*, *Lecanurius planifrontalis* n. sp. from *Actinopyga echinites* and *Actinopyga miliaris*, *Scambicornus batiolatus* n. sp. from *Holothuria atra* and *Thelenota ananas*, *Scambicornus disparilis* n. sp. from *Holothuria atra*, *Scambicornus proluxus* n. sp. from *Holothuria edulis*, *Scambicornus retrospiculus* n. sp. from *Stichopus variegatus*, *Scambicornus sentifer* n. sp. from *Labidodemas semperianum*, *Nanaspis boholensis* n. sp. from *Stichopus variegatus*, and *Nanaspis moluccana* n. sp. from *Stichopus chloronotus*. New host records for *Scambicornus idoneus*, *Scambicornus lobulatus*, *Scambicornus modestus*, *Scambicornus poculiferus*, *Stellicola holothuriae*, and *Nanaspis tonsa*, and new distribution records for 14 other species are included. *Stellicola holothuriae* (Ummerkutty, 1962) is redescribed from specimens found on *Opheodesoma spectabilis*. Keys to the species of *Chauliolobion*, *Scambicornus*, and *Nanaspis* are provided. Aspects of copepod-holothurian associations are discussed.

INTRODUCTION

The earliest record of copepods living with Holothuroidea is that of Hartmann (1856) who in his inaugural dissertation described a copepod from *Labidoplax digitata* (Montagu) at Trieste, naming it *Colaceutes muelleri*. This description, however, remained unknown in zoological literature for more than a century, until Stock (1968) pointed out the synonymy of *Colaceutes* with *Synaptiphilus* Canu & Cuénot, 1892. (The name *Colaceutes* is a *nomen oblitum* under article 23(b) of the International Code of Zoological Nomenclature adopted by the XV International Congress of Zoology, and has been suppressed under the plenary powers of the International Commission on Zoological Nomenclature in Opinion 815.) Since Hartmann's work 77 species of copepods have been reported as associates of holothurians, most of them from hosts living in shallow water.

This review contains descriptions of ten new sabelliphilids, three in the genus *Chauliolobion* Humes, 1975, one in the genus *Lecanurius* Kossmann, 1877, one in the genus *Calypsarion* Humes & Stock, 1972, five in the genus *Scambicornus* Heegaard, 1944, and two new nanaspidids in the genus *Nanaspis* Humes & Cressey, 1959. New hosts are recorded for *Scambicornus idoneus*, *Scambicornus lobulatus*, *Scambicornus poculiferus*, *Scambicornus modestus*, *Stellicola holothuriae*, and *Nanaspis tonsa*, and new distribution records for 14 other species are cited. *Stellicola holothuriae* (Ummerkutty, 1962) is redescribed from specimens living with *Opheodesoma spectabilis*. All copepods known from holothurians are listed, with their hosts and sites of infestation if known. The genera are briefly characterized and the species are accompanied by a few notes facilitating recognition. Such a synopsis has not previously been published, although a few partial lists exist. Barel & Kramers (1977) listed copepods from holothurians in the northeast Atlantic area. Schirl (1973) listed the siphonostomes known at that time from the holothurians of the world.

MATERIALS AND METHODS

At the time of collection the holothurians were isolated, either individually or by species, in sea water in plastic bags in order to prevent accidental transfer of external copepods from one host to another.

Techniques employed for the recovery of copepods associated with holothurians vary according to the site of the copepods and the preference of the investigator. The new species of *Scambicornus* and *Nanaspis* reported here, living externally on the hosts, were removed by washing the hosts in approximately 5 per cent ethyl alcohol in sea water. In order to recover copepods living internally, such as *Chauliolobion, Calypsarion,* and *Lecanurius,* the body wall of the host was slit open before washing. The wash water was passed through a fine net (120 holes per 2.5 cm, each hole approximately 100 μm square) and the copepods were picked from the sediment retained in the net.

All figures have been drawn with the aid of a camera lucida. The letter after the explanation of each figure refers to the scale at which it was drawn. The abbreviations used are: A_1 = first antenna, A_2 = second antenna, L = labrum, MD = mandible, MXPD = maxilliped, and P_1 = leg 1.

ACKNOWLEDGEMENTS

The copepods from the Moluccas were collected by the author during the *Alpha Helix* East Asian Bioluminescence Expedition, which was supported by the National Science Foundation of the United States under grants OFS 74 01830 and OFS 74 02888 to the Scripps Institution of Oceanography and grant BMS 74 23242 to the University of California, Santa Barbara.

I am indebted to Mr. Thomas Forhan, then with the Scripps Institution of Oceanography, for the collections from the Philippines, and to Dr. L. Cannon, Queensland Museum, for specimens from Heron Island, Australia.

I thank Dr. Howard L. Sanders and Dr. J. Frederick Grassle, both of the Woods Hole Oceanographic Institution, for the opportunity to participate in Cruise 106 of R/V *Chain* in 1972.

The Academy of Natural Sciences of Philadelphia supported my field work in Madagascar in 1960.

Collections in Madagascar and the Seychelles in 1963-64 were made during the U.S. Program in Biology of the International Indian Ocean Expedition.

Copepods from Panama were collected in 1965 from R/V *Anton Bruun* while the ship was en route to carry out the Southeastern Pacific Biological Oceanographic Program of the National Science Foundation.

Collections at Eniwetok Atoll in 1969 were made possible by the support and facilities of the Eniwetok Marine Biological Laboratory.

West Indian collections in 1959 were supported by a grant (G-8628) from the National Science Foundation.

The study of the copepods was aided by NSF grant DEB 77 11879.

I thank Dr. David L. Pawson, National Museum of Natural History, Smithsonian Institution, Washington, D.C., for the identification of the holothurians which were hosts for the new species and for advice concerning the correct names for the holothurians mentioned in this work.

SYSTEMATIC DESCRIPTIONS

HARPACTICOIDA

Metidae Sars, 1910

Metis Philippi, 1843

Body pear-shaped, often bright red in color. Prosome gibbous. Mouthparts degenerate. Leg 1 with 3-segmented exopod and 2-segmented endopod; exopod spines strong. Legs 2-4 with 3-segmented rami. Leg 5 small and rudimentary, sexually dimorphic.

Metis holothuriae (Edwards, 1891)

Abacola holothuriae Edwards, 1891.
(Genus synonymized by Gurney, 1927)

Host: *Actinopyga agassizii* (Selenka).

Site: Body cavity.
Locality: Bahamas.
Notes: Length of ♀ 0.35-0.59 mm, ♂ 0.3-0.56 mm (Lang, 1948). Occurs free-living in New England, Bahamas, France, the Mediterranean, Ceylon, Borneo, Lombok, Samoa, etc.

Tisbidae (Stebbing, 1910) Lang, 1948
Sacodiscus C. B. Wilson, 1924
Body flattened. First antenna 9-segmented. Second antenna with prominent exopod. Legs 1-4 with 3-segmented rami. Endopod of leg 1 with first segment massive, following two segments small. Single egg sac.

Sacodiscus humesi Stock, 1960
Host: *Holothuria (Holothuria) tubulosa* Gmelin.
Site: In washings.
Locality: Banyuls, France.
Notes: Length of two ♀♀ 0.73 mm and 0.80 mm. ♂ unknown.

Tisbe Liljeborg, 1853
Body fusiform depressed. First antenna 8-segmented, geniculate in ♂. Second antenna with 4-segmented exopod. Legs 1-4 with 3-segmented rami. Endopod of leg 1 longer than exopod and bearing two terminal elements; exopod with outer seta on second segment. Exopod of leg 5 elongate, linear. Single egg sac.

Tisbe cucumariae Humes, 1957
Host: *Ocnus planci* (Brandt).
Site: Integument.
Localities: Banyuls, France (Humes, 1957). Free-living: Bermuda; Beaufort, North Carolina; Arcachon and Banyuls, France; Venice, Italy (Volkmann-Rocco, 1973); Portugal (Vilela, 1968).
Notes: Length of ♀ 0.84 mm, ♂ 0.84 mm. Inner spine on first segment of endopod of leg 2 in ♂ slightly sinuous with pointed and recurved tip.

Tisbe furcata (Baird, 1837)
Host: *Ocnus planci* (Brandt).
Site: Body cavity.
Locality: Gulf of Naples (Monticelli, 1892).
Notes: Length of ♀ 0.7-1.5 mm (Lang, 1948). The identification by Monticelli as *Tisbe furcata* may be in some doubt. Different species in the genus have been classified as *T. furcata* and the taxonomy of the genus is confused and complex (Volkmann-Rocco, 1971; Coull, 1977). Volkmann-Rocco has not found this species in the Mediterranean Sea. The possibility remains that Monticelli's copepods may actually have been *Tisbe cucumariae*.

Tisbe holothuriae Humes, 1957
Host: *Holothuria (Holothuria) stellati* Delle Chiaje.
Site: Originally reported from anterior part of digestive tube, but corrected by Changeux (1960, p. 18) to surface of integument.
Localities: Banyuls, France (Humes, 1957; Changeux, 1960). Free-living: Venice, Helgoland, Plymouth (Volkmann-Rocco, 1971); Portugal, Adriatic Sea (Petkovsky, 1964); Beaufort, North Carolina (Volkmann-Rocco, 1972); Woods Hole, Massachusetts (Coull, 1977).

Host: *Holothuria (Holothuria) tubulosa* Gmelin.
Site: Body surface, among the podia and dorsal papillae.
Locality: Banyuls, France (Changeux, 1960).
Notes: Length of ♀ 0.93 mm, ♂ 0.64 mm. Inner spine on first segment of endopod of leg 2 in ♂ strongly recurved throughout with slightly truncate tip.

CYCLOPOIDA
GNATHOSTOMA

Namakosiramiidae Ho & Perkins, 1977
Namakosiramia Ho & Perkins, 1977
Body minute, flattened dorsoventrally. First antenna 4-segmented. Exopod of second antenna a compound seta. Mandible with two terminal spines and three basal setae. Leg 1 biramous with prehensile exopod. Leg 2 uniramous and prehensile. Legs 3, 4, and 5 reduced to small bipartite lobes bearing setae.

Namakosiramia californiensis Ho & Perkins, 1977
Host: *Stichopus parvimensis* (Clark).
Site: In washings.
Locality: California.
Notes: Length of ♀ 384 μm, ♂ unknown.

Poecilostoma

Sabelliphilidae Gurney, 1927
Calypsarion Humes & Ho, 1969

Body modified, elongate, slender. Ventral keel on genital segment of ♀ and on first postgenital segment of ♂. First antenna 7-segmented. Second antenna 4-segmented, with claw on third segment. Legs 1-4 with 3-segmented exopods and 2-segmented endopods. Leg 4 endopod with formula 0-1; I, III, I, 1 or 0-1; I, III, I.

Calypsarion bilobatum n. sp.
Figs. 1a-i, 2a-ai, 3a-d

Type material. — 1 ♀ from one black holothurian, probably *Holothuria atra* (Jaeger), North Point, Mahe Island, Seychelles, 14 February 1964. Holotype deposited in the Zoölogisch Museum, Amsterdam.

Female. — Body (figs. 1a, 1b) elongate and slender. Length (not including setae on caudal rami) 2.17 mm and greatest width 0.54 mm. Segment of leg 1 separated from head by a weak dorsal transverse furrow. Epimeral areas of segments of leg 1-4 rounded. Ratio of length to width of prosome 2.07:1. Ratio of length of prosome to that of urosome 1.01:1.

Segment of leg 5 (fig. 1c) 176 × 264 μm. Genital segment in dorsal view 350 × 380 μm, broad in anterior two-thirds and narrow in posterior third. Genital segment in ventral view (fig. 1d) showing large posteriorly directed pointed keel ornamented apically with setules (fig. 1e). In lateral view of genital segment (fig. 1f) length including keel 396 μm and greatest dorsoventral thickness 275 μm. Genital areas located laterally near middle of segment. Each area (fig. 1f) with two smooth setae 33 μm and 30 μm and two prominent but unequal lobes (figs. 1c, 1d). Three postgenital segments from anterior to posterior 153 × 164, 185 × 147, and 92 × 156 μm. Anal segment with row of minute spinules along posteroventral margin on both sides.

Caudal ramus (fig. 1g) moderately elongate, 166 × 62 μm, ratio of length to width 2.68:1. Outer lateral seta 107 μm, outermost terminal seta 156 μm, innermost terminal seta 180 μm, and two long median terminal setae (without usual "joints") 319 μm (outer) and 385 μm (inner). All five setae with extremely small lateral barbules. Dorsal seta 55 μm and smooth. Ramus lacking fine ornamentation.

Body surface with very few hairs (sensilla) as in figure 1a.

Egg sac unknown.

Rostrum weak and broadly rounded as in *Calypsarion leprum* Humes & Ho, 1969.

First antenna (fig. 1h) 418 μm long. Lengths of seven segments (measured along their posterior nonsetiferous margins): 34 (73 μm along anterior margin), 117, 44, 70, 57, 43, and 31 μm respectively. Formula for armature: 4, 13, 6, 3, 4 + 1 aesthete, 2 + 1 aesthete, and 7 + 1 aesthete. All setae naked.

Second antenna (fig. 1i) 300 μm long, including claw, and lacking fine ornamentation. Formula: 1, 1, 3 + claw, and 7. Claw 75 μm along its axis. Fourth segment approximately 34 × 21 μm. All setae smooth.

Labrum (fig. 2a) with two broad posteroventral lobes. Mandible (fig. 2b) with rounded hyaline prominence on convex margin. Broad distally attenuated blade with row of spinules along both margins, those spinules on concave margin fewer in number and stouter than those on convex margin. First maxilla (fig. 2c) with two setae. Second maxilla (fig. 2d) resembling that of *Calypsarion sentosum* Humes & Ho, 1969. Maxilliped (fig. 2e) segmented and armed as in *C. leprum,* but terminal spiniform process longer than in that species.

Ventral area between maxillipeds and first pair of legs (fig. 2f) not protuberant (fig. 1b).

Legs 1-4 (figs. 2g, 2h, 2i, 3a) with 3-segmented exopods and 2-segmented endopods. Armature as follows (Roman numerals representing spines, Arabic numerals indicating setae):

P_1	coxa 0-1	basis 1-0	exp	I-0;	I-1;	III, I, 4
			enp	0-1;	I, 5, 1	
P_2	coxa 0-1	basis 1-0	exp	I-0;	I-1;	III, I, 5
			enp	0-1;	I, II, 3, 2	
P_3	coxa 0-1	basis 1-0	exp	I-0;	I-1;	III, I, 5
			enp	0-1;	I, III, 2, 2	
P_4	coxa 0-1	basis 1-0	exp	I-0;	I-1;	II, I, 5
			enp	0-1;	I, III, I, 1	

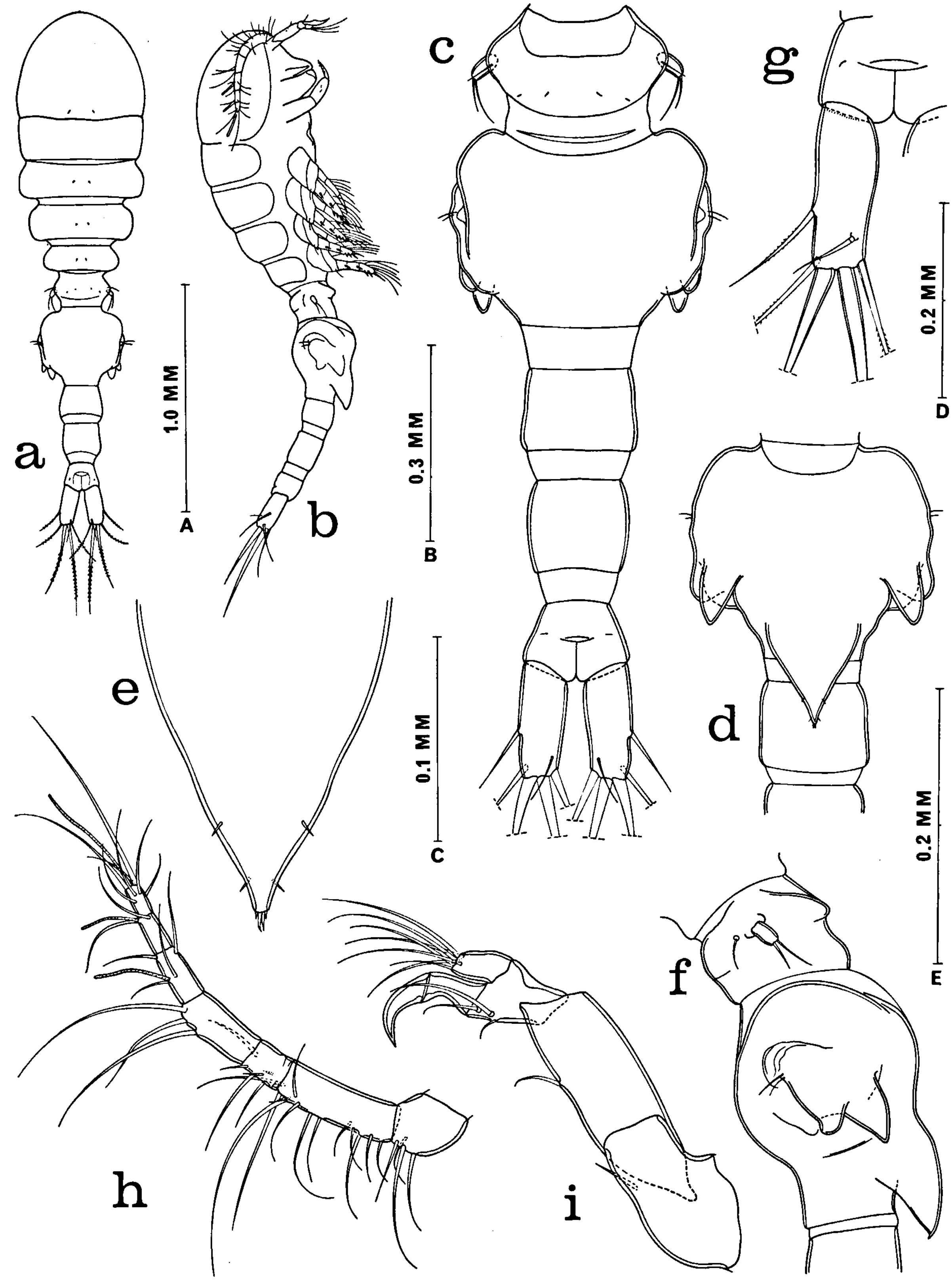

Fig. 1. *Calypsarion bilobatum* n. sp., female. a, dorsal (A); b, lateral (A); c, urosome, dorsal (B); d, genital segment and first postgenital segment, ventral (B); e, keel on genital segment, ventral (C); f, segment of leg 5 and genital segment, lateral (B); g, caudal ramus, dorsal (D); h, first antenna, ventral (D); i, second antenna, posterior (E).

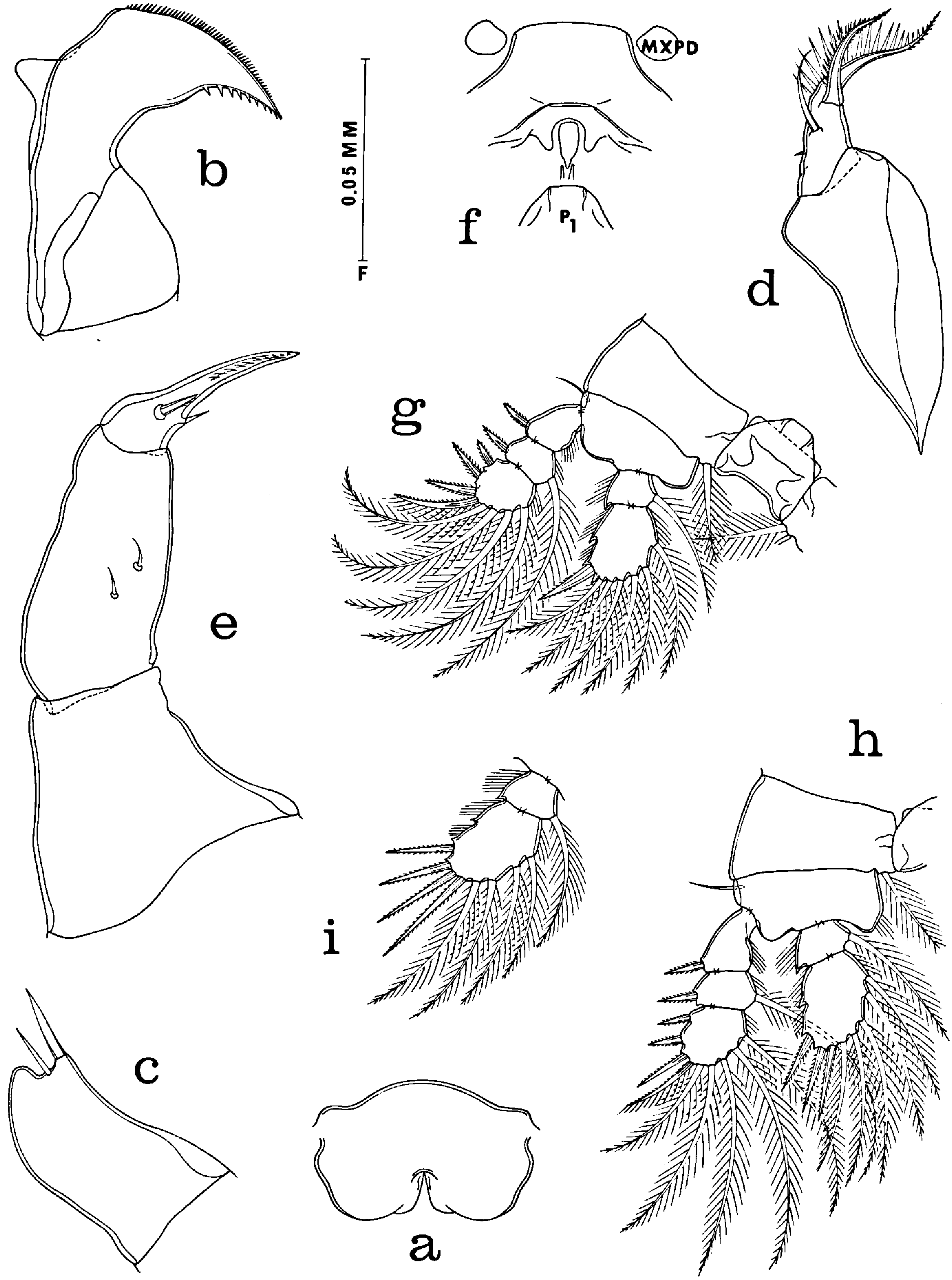

Fig. 2. *Calypsarion bilobatum* n. sp., female. a, labrum, ventral (C); b, mandible, posterior (F); c, first maxilla, anterior (F); d, second maxilla, posterior (C); e, maxilliped, posterior (C); f, area between maxillipeds and first pair of legs, ventral (D); g, leg 1 and intercoxal plate, anterior (D); h, leg 2, anterior (D); i, endopod of leg 3, anterior (D).

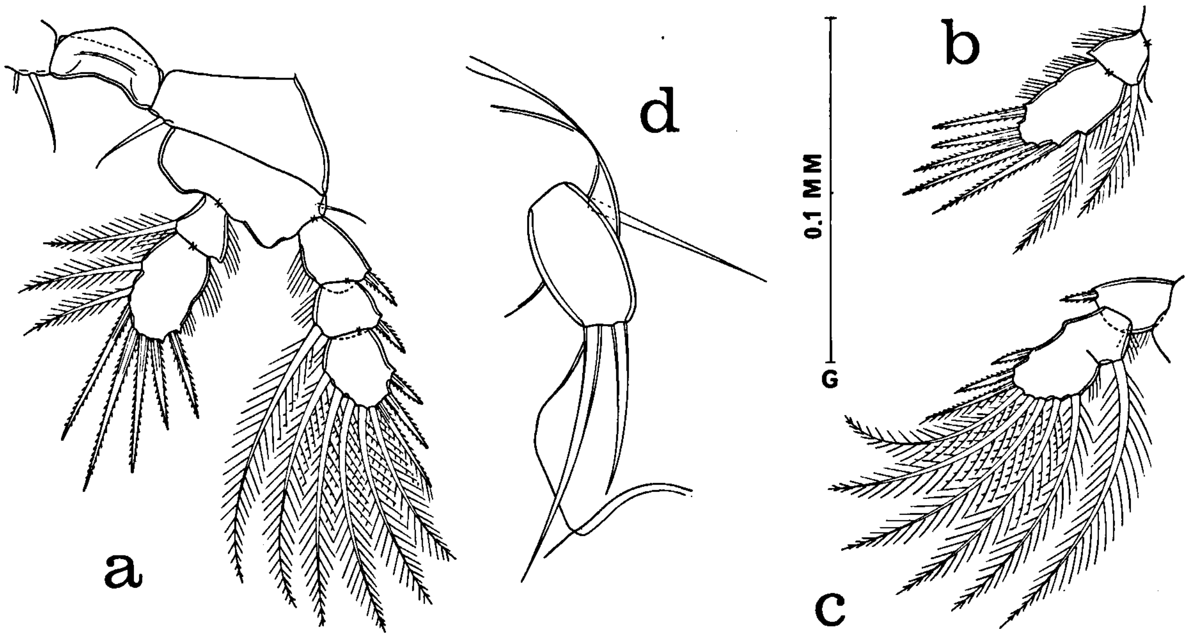

Fig. 3. *Calypsarion bilobatum* n. sp., female. a, leg 4 and intercoxal plate, with second segment of endopod bearing extra seta, anterior (D); b, right endopod of leg 4, normal condition, anterior (D); c, abnormal right exopod of leg 4, anterior (D); d, leg 5, ventral (G).

Leg 4 (fig. 3a) with smooth inner coxal seta 60 µm long. Exopod 159 µm. Endopod 122 µm, five spines on second segment from outer to inner 68, 69, 94, 117, and 107 µm. Endopod of left leg 4 shown in figure 3a with an extra seta on second segment; normal armature of this endopod shown in figure 3b. Exopod of right leg 4 in holotype abnormally 2-segmented (fig. 3c), with second and third segments fused and outer spine of second segment absent.

Leg 5 (figs. 1f, 3d) with unornamented free segment 36 × 24 µm. Two terminal setae 68 µm and 45 µm. Dorsal seta about 33 µm. All three setae smooth.

Leg 6 represented by two small setae on genital area (fig. 1f).

Color in life unknown.

Male. — Unknown.

Etymology. — The specific name *bilobatum*, modern Latin meaning with two lobes, alludes to the two lobes on the genital area.

Remarks. — *Calypsarion bilobatum* may be distinguished from other species in the genus by the form of the female genital segment, with two lobes on the genital area, and by the rounded hyaline prominence on the convex side of the mandible.

Calypsarion carinatum (Stock, 1969)

Scambicornus carinatus Stock, 1969.

Host: *Stichopus monotuberculatus* (Quoy & Gaimard).

Site: Internal, ejected from host.

Locality: Dahlak Archipelago, Ethiopia.

Notes: Length of 2 ♀♀ 1.88 mm and 1.61 mm, ♂ 1.45 mm. First maxilla with two terminal setae. Distal spine on posterior surface of second segment of second maxilla attenuated and laterally barbed. Genital segment of ♀ in dorsal view with more or less rounded lateral margins.

Calypsarion leprum Humes & Ho, 1969

Hosts: *Actinopyga miliaris* (Quoy & Gaimard), *Actinopyga lecanora* (Jaeger), *Actinopyga mauritiana* (Quoy & Gaimard).

Site: Internal.

Locality: Region of Nosy Bé, northwestern Madagascar.

Notes: Length of ♀ 1.22 mm, ♂ 1.39 mm. First maxilla with one terminal seta. Distal spine on posterior surface of second segment of second maxilla club-shaped and spinulose. Genital segment of ♀ in dorsal view expanded in anterior half, posterior half slender. Inner surface of second segment of ♂ maxilliped with one row of obtuse spines and two setae.

Calypsarion sentosum Humes & Ho, 1969

Host: *Bohadschia marmorata* Jaeger.
Site: Internal.
Locality: Region of Nosy Bé, northwestern Madagascar.
Notes: Length of ♀ 1.45 mm, ♂ 1.41 mm. First maxilla with two terminal setae. Distal spine on posterior surface of second segment of second maxilla attenuated and bilaterally barbed. Genital segment of ♀ in dorsal view expanded in anterior third, posterior two-thirds slender. Maxilliped of ♂ with inner margin of second segment greatly produced to form a long scolex-shaped lobe crowned with spines.

Calypsina Humes & Stock, 1972

Body cyclopiform. First antenna 7-segmented. Second antenna 4-segmented, with claw on third segment. Legs 1-3 with 3-segmented exopods and 2-segmented endopods. Leg 4 with both rami 3-segmented. Leg 1 endopod with 0-1; I, 5, 1. Leg 2 endopod with 0-1; I, II, 3, 1. Leg 3 endopod with 0-1; I, III, 2, 1. Leg 4 endopod with 0-0; 0-0; I, III, 1.

Calypsina changeuxi (Stock & Kleeton, 1963)

Preherrmannella changeuxi Stock & Kleeton, 1963; *Scambicornus changeuxi* (Humes, 1967).

Host: *Holothuria (Holothuria) tubulosa* Gmélin
Site: Esophagus.
Locality: Banyuls, France (Stock & Kleeton, 1963).

Host: *Holothuria (Holothuria) stellati* Delle Chiaje.
Site: Esophagus and genital tube.
Locality: Banyuls, France (Changeux, 1960).
Notes: Length: of ♀ 0.765 mm, ♂ 0.60 mm. Rostrum a pointed beak. See Humes & Stock (1973). According to Stock & Kleeton (1963) this is the "poecilostome copepod" mentioned by Changeux (1960) on p. 55 and in footnotes on pp. 109, 110, 111, found by him at Banyuls in both *H. tubulosa* and *H. stellati.*

Caribulus Humes & Stock, 1972

Body cyclopiform. First antenna 7-segmented. Second antenna 4-segmented, with claw on third segment. Legs 1-4 in ♀ with 3-segmented rami, with leg 4 endopod 0-1; 0-1; I, II, II. Legs 1-4 in ♂ with 3-segmented exopods and 2-segmented endopods, with leg 4 endopod 0-1; I, II, II, 1.

Caribulus sculptus (Humes, 1969)

Scambicornus sculptus Humes, 1969.

Host: *Isostichopus badionotus* (Selenka).
Site: Body surface.
Localities: Barbados, Puerto Rico, Jamaica, Bahamas (Humes, 1969).

Host: *Holothuria (Halodeima) mexicana* (Ludwig).
Site: Body surface.
Localities: Bahamas, Jamaica, Curaçao, Bonaire (Humes, 1969).

Host: *Holothuria (Halodeima) grisea* (Selenka)
Site: Body surface.
Localities: Jamaica, Bonaire (Humes, 1969).

Host: *Actinopyga agassizii* (Selenka)
Site: Body surface.
Localities: Bahamas, Jamaica (Humes, 1969).
Notes: Length of ♀ 1.18 mm, ♂ 0.98 mm. Second segment of ♂ maxilliped with inner excavated prominence.

Caribulus sp.

Scambicornus sp. in Humes, 1969.

Host: *Isostichopus badionotus* (Selenka)
Site: Body surface.
Localities: Barbados, Jamaica, Bahamas (Humes, 1969).

Host: *Holothuria (Halodeima) mexicana* (Ludwig).
Site: Body surface.
Localities: Bahamas, Jamaica, Curaçao (Humes, 1969).

New record: 16 ♂♂ from three *Holothuria mexicana,* in 0.5 m, Holandes Cay, near Cape San Blas, Panama, 8°37.6′N, 78°51′W, 18 September 1965.

Host: *Actinopyga agassizii* (Selenka).
Site: Body surface.
Localities: Bahamas, Jamaica (Humes, 1969).
Notes: Length of ♂ 0.63 mm. Second segment of maxilliped lacking inner excavated prominence. ♀ unknown.

Chauliolobion Humes, 1975

Body modified, elongate. First antenna 7-segmented. Second segment 4-segmented, with one claw on third segment. Mandible with one or two long setiform processes arising near base of lash. Legs 1-4 in ♀ with 3-segmented rami; in ♂ with 3-segmented exopods but 2-segmented endopods. In both sexes a long digitiform process on distal outer corner of coxa of legs 2 and 3. Leg 5 placed ventrally.

Chauliolobion bulbosum Humes, 1975

Host: *Actinopyga echinites* (Jaeger).
Site: Internal.
Locality: Region of Nouméa, New Caledonia (Humes, 1975).

Host: *Actinopyga palauensis* Panning.
Site: Internal.
Locality: Region of Nouméa, New Caledonia (Humes, 1975).
Notes: Length of ♀ 1.27 mm, ♂ 1.13 mm. Caudal ramus in ♀ with ratio of length to width 1.66:1, in ♂ 1.91:1. Inner coxal seta on legs 1-3 swollen proximally. Intercoxal plate of legs 1 and 2 with pair of pointed ventral processes. Leg 4 endopod with 0-1; 0-1; II, I. Free segment of leg 5 in ♀ with slender seta and stout spiniform element. Claw of ♂ maxilliped with small teeth along proximal concave margin.

Chauliolobion imparile n. sp.

Figs. 4a-f, 5a-k, 6a-e, 7a-h

Type material. — 19 ♀♀, 14 ♂♂, and 1 copepodid from two holothurians, *Bohadschia argus* (Jaeger), in 4 m, Poelau Marsegoe, western Ceram, 2°59′30″S, 128°03′30″E, 15 May 1978. Holotype ♀, allotype, and 24 paratypes (13 ♀♀, 11 ♂♂) deposited in the Zoölogisch Museum, Amsterdam; the remaining paratypes (dissected) in the collection of the author.

Other specimens (all from *Bohadschia argus*). — 2 ♀♀, 2 ♂♂ from 1 host, in 3 m, Karang Mie, eastern Halmahera, 00°20′07″N 128°25′00″E, 19 May 1975; 2 ♀♀, 3 ♂♂ from 2 hosts, in 3 m, Poelau Parang, eastern Ceram, 3°17′00″S 130°44′48″E, 23 May 1975.

Female. — Body (figs. 4a, 4b) elongate and slender. Length (not including setae on caudal rami) 0.95 mm (0.90-0.97 mm) and greatest width 0.21 mm (0.20-0.23 mm), based on 10 specimens in lactic acid. Ratio of length to width of prosome 2.25:1. Ratio of length of prosome to that of urosome 1.18:1.

Segment of leg 5 (fig. 4c) 85 × 146 μm. Genital segment 151 × 153 μm, as long as wide. Genital areas situated laterally at middle of segment. Each area (fig. 4d) with two unequal naked setae 33 μm and 16 μm and a row of spinules. Three postgenital segments from anterior to posterior 66 × 83, 60 × 69, and 30 × 65 μm. Genital and postgenital segments with transverse row of spines posteroventrally.

Caudal ramus (fig. 4e) short, 37 × 29 μm, ratio 1.27:1. Outer lateral seta 50 μm, dorsal seta 27 μm, outermost terminal seta (inserted somewhat ventrally) 70 μm, and innermost terminal seta 58 μm. All these setae with lateral spinules except naked dorsal seta. Two stout median spinulose terminal setae 146 μm (outer) and 179 μm (inner), both inserted between slight dorsal and ventral flanges. Ramus ornamented ventrally with spinules near insertions of setae (fig. 4c).

Body surface with very few hairs (sensilla) as in figure 4a.

Egg sac (fig. 4f) containing one, two, or three relatively large eggs, their length 169-187 μm and width 114-120 μm.

Rostral area (fig. 5a) weakly developed.

First antenna (fig. 5b) 174 μm long. Lengths of its seven segments (measured along their posterior nonsetiferous margins): 17.5 (30 μm along anterior margin), 31, 16.5, 28.5, 30, 16, and 14 μm respectively. Formula for armature: 4, 13, 6, 3, 4 + 1 aesthete, 2 + 1 aesthete, and 7 + 1 aesthete. Several setae with small spinules along one side.

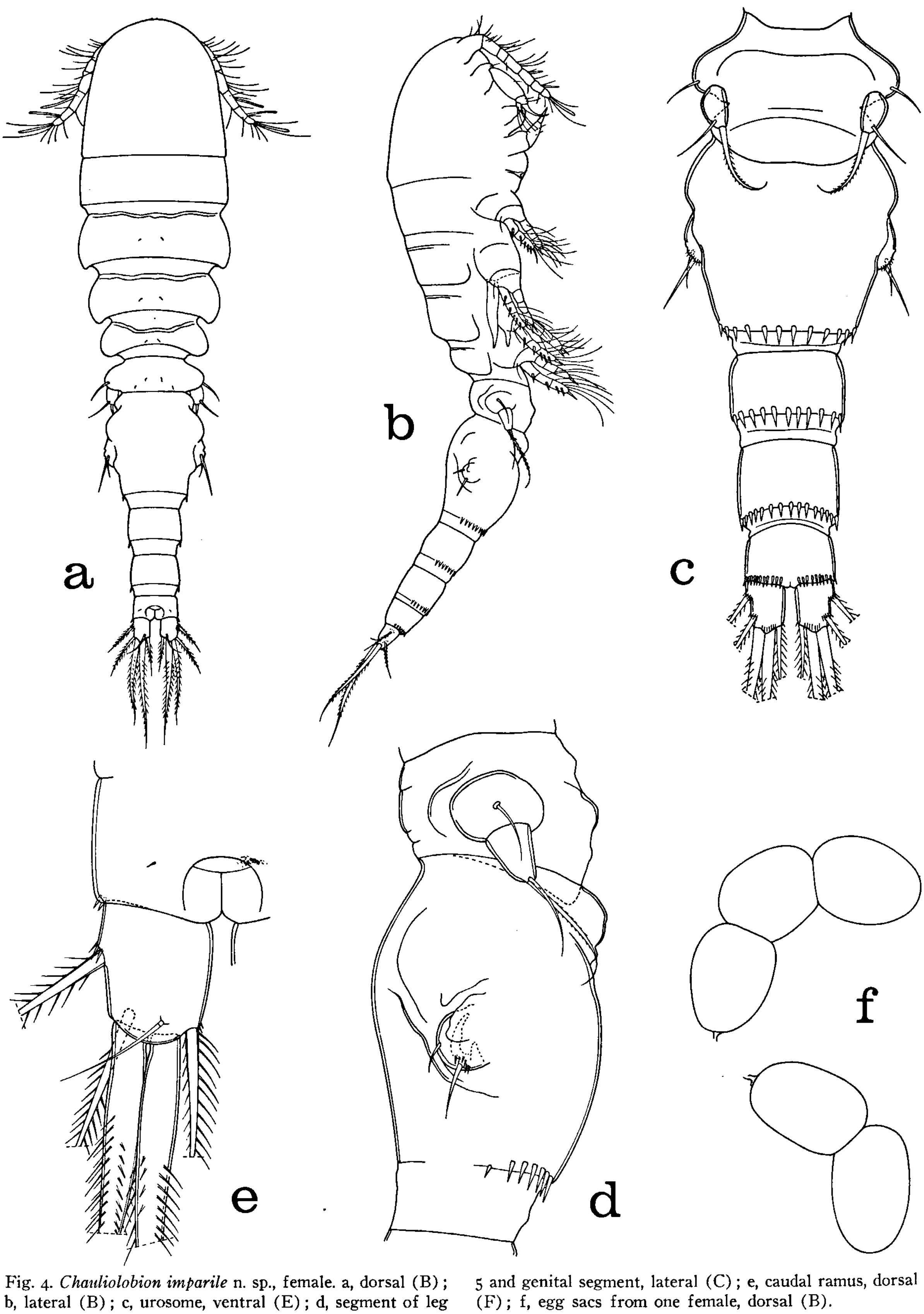

Fig. 4. *Chauliolobion imparile* n. sp., female. a, dorsal (B); b, lateral (B); c, urosome, ventral (E); d, segment of leg 5 and genital segment, lateral (C); e, caudal ramus, dorsal (F); f, egg sacs from one female, dorsal (B).

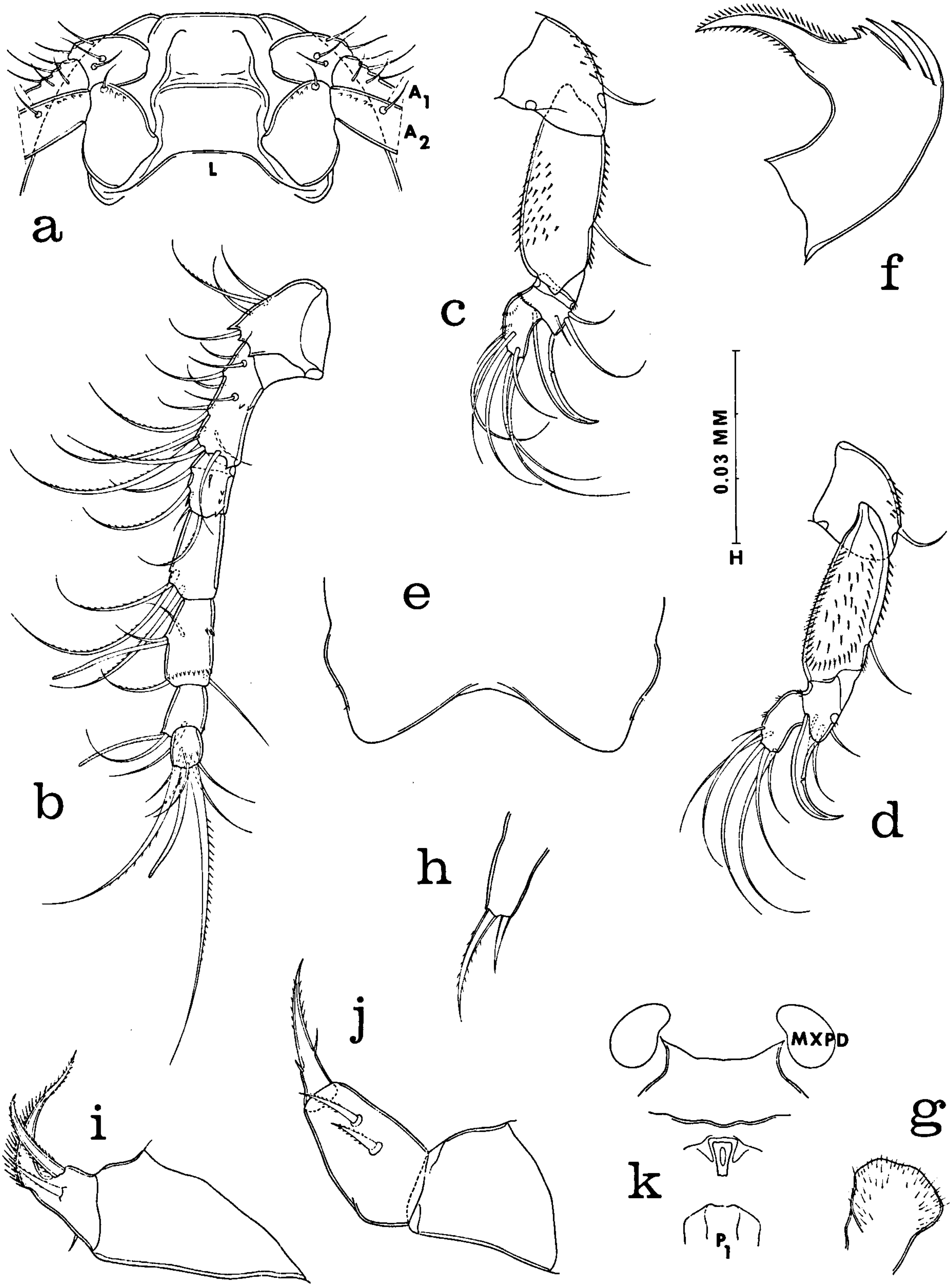

Fig. 5. *Chauliolobion imparile* n. sp., female. a, rostral area, ventral (C); b, first antenna, dorsal (G); c, second antenna, posterior (G); d, second antenna, anterior (G); e, labrum, ventral (F); f, mandible, anterior (H); g, paragnath, ventral (H); h, first maxilla, anterior (H); i, second maxilla, posterior (F); j, maxilliped, antero-inner (F); k, area between maxillipeds and first pair of legs, ventral (C).

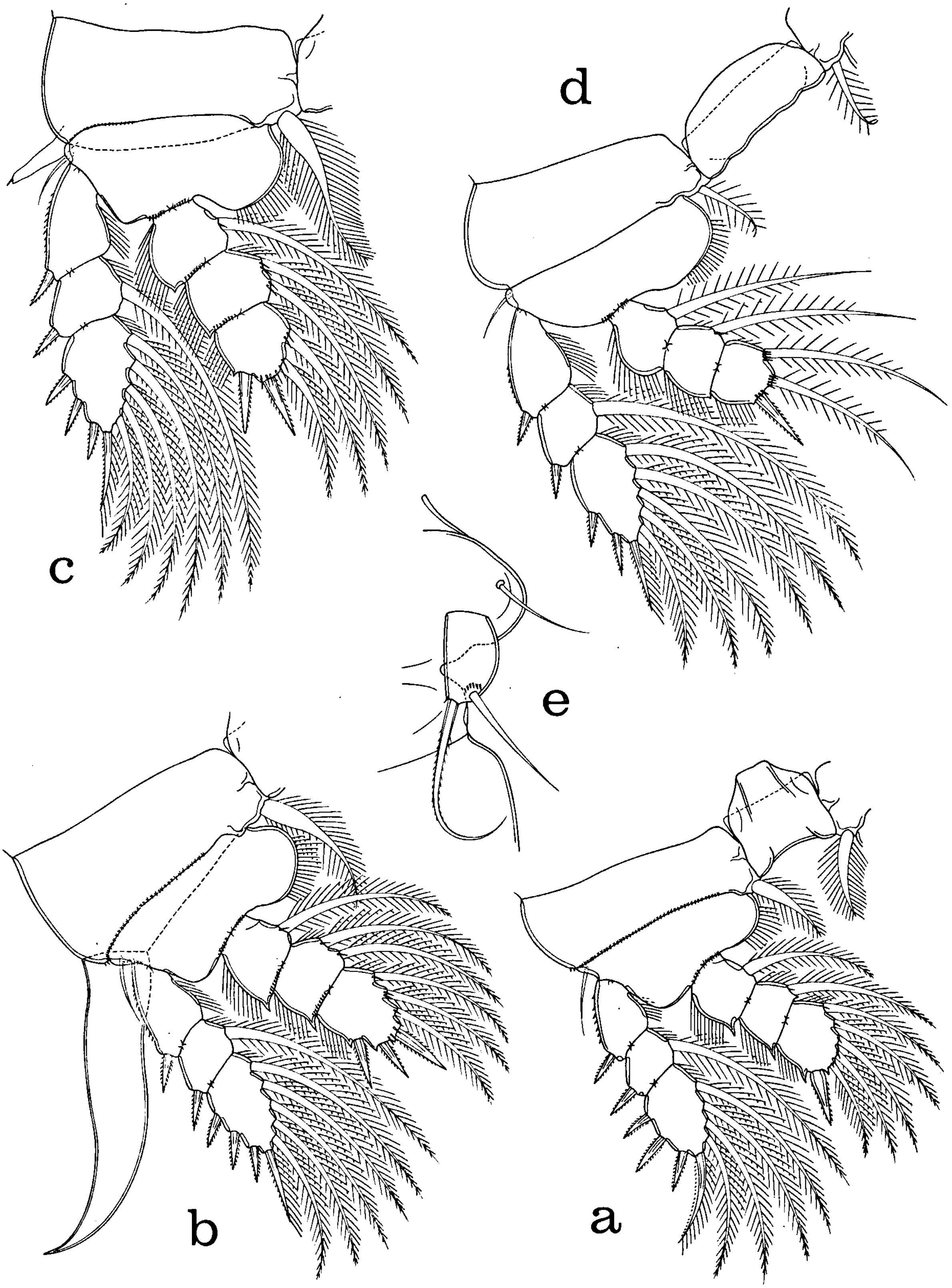

Fig. 6. *Chauliolobion imparile* n. sp., female. a, leg 1 and intercoxal plate, anterior (G); b, leg 2, anterior (G); c, leg 3, anterior (G); d, leg 4 and intercoxal plate, anterior (G); e, leg 5, ventral (G).

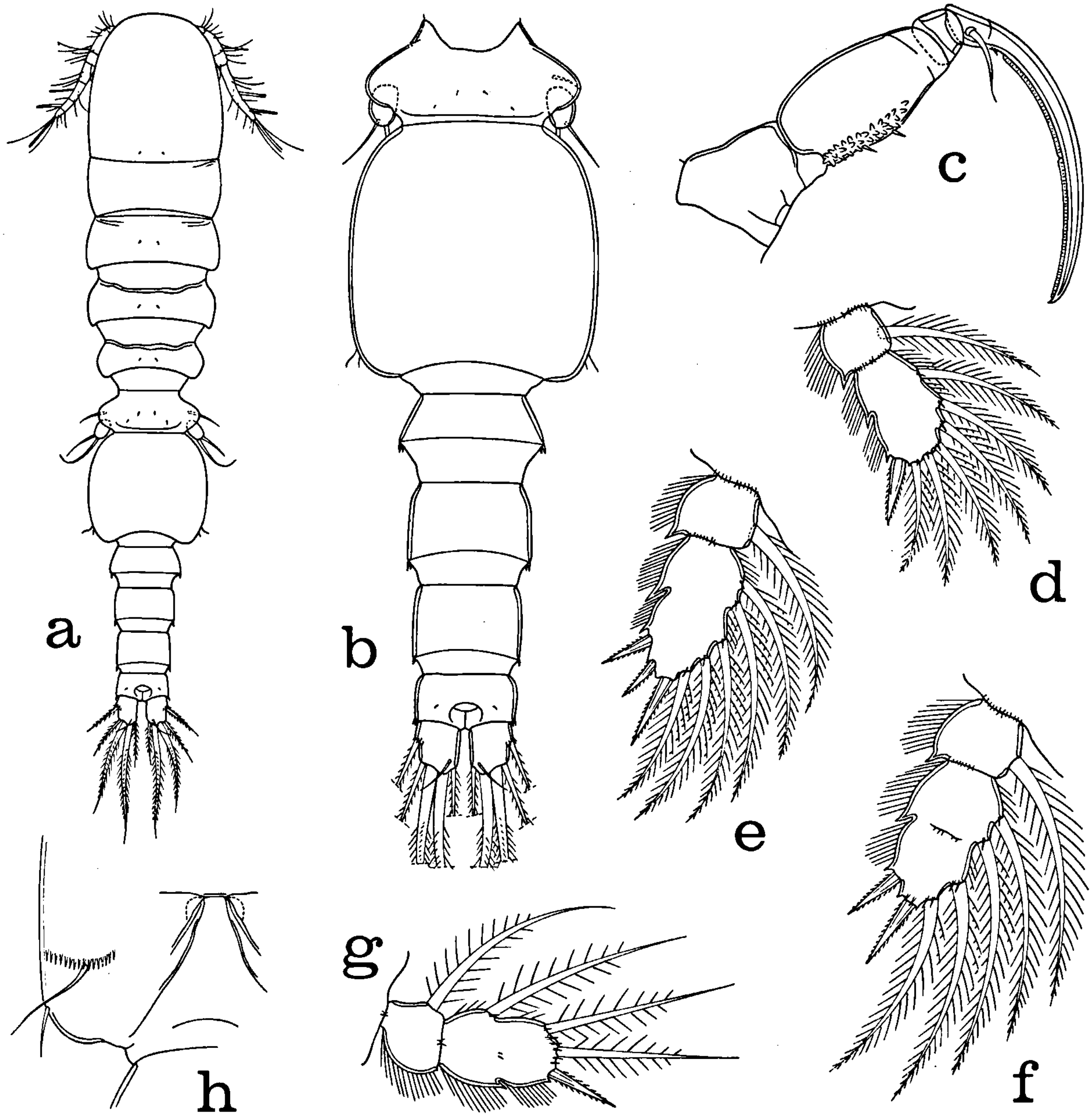

Fig. 7. *Chauliolobion imparile* n. sp., male. a, dorsal (B); b, urosome, dorsal (E); c, maxilliped, postero-inner (G); d, endopod of leg 1, anterior (G); e, endopod of leg 2, anterior (G); f, endopod of leg 3, anterior (G); g, endopod of leg 4, anterior (G); h, leg 6, ventral (C).

All segments with one or more small spines as illustrated.

Second antenna (figs. 5c, 5d) 4-segmented, 138 μm long including claw. Armature: 1, 1, 3 + claw, and 7. All setae smooth. Claw 43 μm long. Ornamentation resembling that in other species of genus.

Labrum (fig. 5e) with two short widely separated posteroventral lobes. Mandible (fig. 5f) similar to that in congeners, but convex side of base bearing a small double spined process distal to two long setiform processes. Paragnath (fig. 5g), first maxilla (fig. 5h), second maxilla (fig. 5i), and maxilliped (fig. 5j) resembling in major respects those of other species of *Chauliolobion.*

Ventral area between maxillipeds and first pair of legs (fig. 5k) slightly protuberant (fig. 4b).

Legs 1-4 (figs. 6a, 6b, 6c, 6d) with 3-segmented rami throughout. Armature as follows (Roman numerals indicating spines, Arabic numerals representing setae):

P_1	coxa	0-1	basis	1-0	exp	I-0;	I-1;	III, I, 4
					enp	0-1;	0-1;	I, 5
P_2	coxa	0-1	basis	1-0	exp	I-0;	I-1;	III, I, 5
					enp	0-1;	0-2;	I, II, 3
P_3	coxa	0-1	basis	1-0	exp	I-0;	I-1;	III, I, 5
					enp	0-1;	0-2;	I, I, 2
P_4	coxa	0-1	basis	1-0	exp	I-0;	I-1;	II, I, 5
					enp	0-1;	0-1;	I, 2

Outer distal corner of coxa of leg 2 (fig. 6b) bearing a long fingerlike lobe, 90 μm, longer than exopod (78 μm). Corresponding lobe in leg 3 (fig. 6c) short, 18 μm. Legs 1 and 4 without such coxal lobes. Leg 4 exopod 88 μm long and endopod 57 μm. Row of small spinules along distal anterior edge of coxa, present in legs 1-3, absent in leg 4. Inner coxal seta and endopodal setae of leg 4 more sparsely haired than in exopod of leg 4 or in preceding legs.

Leg 5 (fig. 6e) placed ventrally. Free segment 30 × 18 μm, ratio 1.67:1. Outer terminal seta 52 μm and smooth, inner terminal seta about 65 μm with short barbules. Row of spinules near insertion of outer terminal seta. Seta on body near insertion of free segment 36 μm and smooth.

Leg 6 represented by two setae on genital area (fig. 4d).

Color in life in transmitted light opaque gray, eye red, egg sacs light gray.

Male. — Body (fig. 7a) elongate. Length (excluding setae on caudal rami) 0.87 mm (0.80-0.92 mm) and greatest width 0.18 mm (0.18-0.19 mm), based on 10 specimens in lactic acid. Ratio of length to width of prosome 2.81:1. Ratio of length of prosome to that of urosome 1.12:1.

Segment of leg 5 (fig. 7b) 57 × 133 μm. Genital segment 156 × 151 μm, about as long as wide, lacking transverse posteroventral row of spines seen in female. Four postgenital segments from anterior to posterior 53 × 86, 61 × 73, 52 × 65, and 29 × 61 μm, each with posteroventral row of spines as in female.

Caudal ramus resembling that of female but smaller, 34 × 26 μm.

Body surface with very few hairs (sensilla) as in figure 7a.

Rostral area, first antenna, second antenna, labrum, mandible, paragnath, first maxilla, and second maxilla as in female. Maxilliped (fig. 7c) 4-segmented (assuming that proximal part of claw represents fourth segment). Second segment with two small inner setae more or less obscured by patch of short spines. Claw 95 μm along its axis, with narrow striated fringe along concave margin, and bearing two very unequal proximal setae. No terminal lamella.

Ventral area between maxillipeds and first pair of legs as in female.

Legs 1-4 resembling those of female except for endopods having two segments instead of three (figs. 7d, 7e, 7f, 7g). Second segment formed by apparent fusion of two distal segments, in legs 3 and 4 original separation indicated by row of few small spinules.

Leg 5 (fig. 7b) similar to that of female, its free segment 23 × 15.5 μm.

Leg 6 (fig. 7h) a posteroventral flap on genital segment bearing two unequal smooth setae 41 μm and 24 μm and a row of spinules.

Spermatophore unknown.

Color as in female.

Etymology. — The specific name *imparile,* Latin meaning unequal or different, alludes to the great difference in size of the outer coxal lobes in legs 2 and 3.

Comparison with other species of *Chauliolobion.* — The genus *Chauliolobion* Humes, 1975, includes two previously described species, *Chauliolobion bulbosum* Humes, 1975, from *Actinopyga echinites* (Jaeger) and *Actinopyga palauensis* Panning in New Caledonia and *Chauliolobion halodeimatis* Humes, 1975, from *Holothuria (Halodeima) atra* Jaeger also in New Caledonia. *Chauliolobion imparile* may be distinguished from these species by the nature of the outer coxal lobes in legs 2 and 3. These lobes are very unequal in size in *C. imparile,* but more nearly equal in *C. bulbosum* and *C. halodeimatis*.

The two New Caledonian species differ in other ways from *C. imparile*. In *C. bulbosum* the third segment of the endopod of leg 4 has the formula II, I, and one of the terminal elements of the free segment of leg 5 is stout and spiniform. In *C. halodeimatis* the caudal ramus is more elongate than in the new species, with a ratio of length to width of 2.12:1.

Chauliolobion forcipatum n. sp.

Figs. 8a-j, 9a-g, 10a-f

Type material. — 6 ♀♀, 4 ♂♂ from one holothurian, *Stichopus chloronotus* Brandt, in 2 m, Karang Mie, east central Halmahera, Moluccas, 00° 20′07″N, 128°25′00″E, 19 May 1975. Holotype ♀, allotype, and 4 paratypes (2 ♀♀, 2 ♂♂) deposited in the Zoölogisch Museum, Amsterdam; the remaining paratypes (dissected) in the collection of the author.

Other specimens. — 1 ♀, 1 ♂ from one *Stichopus chloronotus*, in 2 m, Karang Mie, east central Halmahera, 19 May 1975.

Female. — Body form similar to that of *Chauliolobion imparile*. Length (not including setae on caudal rami) 1.37 mm (1.30-1.40 mm) and greatest width 0.33 mm (0.31-0.33 mm), based on five specimens in lactic acid.

Segment of leg 5 (fig. 8a) 125 × 188 μm. Between this segment and genital segment an incomplete ventral sclerite. Genital segment 213 × 230 μm, in dorsal view broadest in its anterior half. Genital areas situated dorsolaterally near middle of segment (fig. 8b). Each area bearing two small spines about 8 μm long (fig. 8c). Three postgenital segments from anterior to posterior 78 × 113, 65 × 88, and 60 × 84 μm. Genital and postgenital segments with transverse rows of spines posteroventrally, these spines weaker than in *Chauliolobion imparile*.

Caudal ramus (fig. 8d) short, 50 × 35 μm, ratio 1.43:1. Outer lateral seta 44 μm, outermost terminal seta 36 μm, and innermost terminal seta 37 μm, all three setae bilaterally barbed. Dorsal seta 20 μm and naked. Outermost terminal seta 81 μm and innermost terminal seta 138 μm, both setae spinulose. Ramus ornamented subterminally with ventral rows of delicate spinules as indicated in figure.

Body surface with very few hairs (sensilla) as in *C. imparile*.

Egg sac unknown.

Rostral area as in *C. imparile*.

First antenna (fig. 8e) 340 μm long. Lengths of seven segments (measured along their posterior nonsetiferous margins): 33 (65 μm along its anterior margin), 57, 26, 47, 63, 49, and 34 μm respectively. Formula for armature as in *C. imparile*. Setae smooth except for long terminal seta with long unilateral spinules. Fifth and seventh segments with row of small ventral spinules.

Second antenna (fig. 8f) with claw relatively short, 37 μm. Armature as in *C. imparile*. Second segment lacking inner spinules.

Labrum as in *C. imparile*. Mandible (fig. 8g) with only one long outer setiform process on basal area. Paragnath and first maxilla as in *C. imparile*. Second maxilla (fig. 8h) with spines on lash longer than in *C. imparile*. Maxilliped (fig. 8i) with third segment stouter and shorter than in *C. imparile*.

Area between maxillipeds and first pair of legs (fig. 8j) slightly protuberant.

Legs 1-4 (figs. 9a, 9b, 9c, 9d) segmented and armed as in *C. imparile*, except for third segment of endopod of leg 4. Two distal spines on third exopod segment of leg 1 recurved and opposing each other (fig. 9a). Leg 2 and 3 bearing on outer distal corner of coxa a long fingerlike lobe about 84 μm, distinctly shorter than exopod. Leg 4 (fig. 9d) with exopod 130 μm long and endopod 78 μm. Third segment of endopod with three spines 13, 25, and 6.5 μm from outer to inner, two outer spines finely barbed, innermost spine weak and smooth.

Leg 5 (fig. 9e) placed ventrally as in *C. imparile*. Free segment 46 × 25 μm, ratio 1.45:1. Outer terminal seta 31 μm and smooth. Inner terminal element spiniform, 26 μm, very finely barbed. Row of small spinules ventrally near insertion of both terminal elements. Seta on body near insertion of free segment 25 μm and smooth.

Leg 6 represented by two small spines on genital area (fig. 8c).

Color in life in transmitted light opaque gray, eye red.

Male. — Body as in *C. imparile*. Length (not including setae on caudal rami) 1.15 mm (1.13-1.19

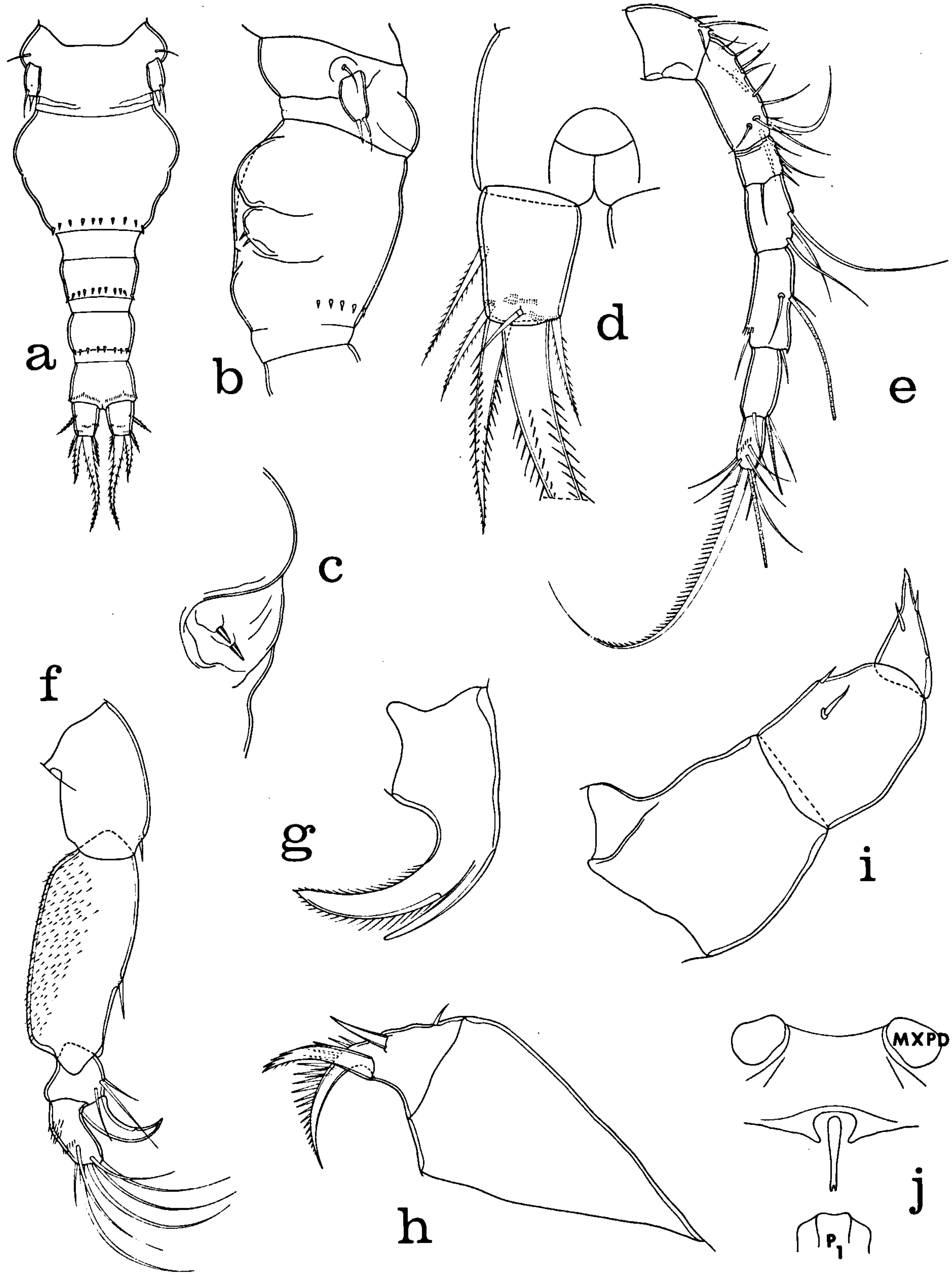

Fig. 8. *Chauliolobion forcipatum* n. sp., female. a, urosome, ventral (B); b, segment of leg 5 and genital segment, lateral (D); c, genital area, dorsal (C); d, caudal ramus, dorsal (G); e, first antenna, ventral (E); f, second antenna, posterior (C); g, mandible, posterior (F); h, second maxilla, anterior (F); i, maxilliped, anterior (F); j, area between maxillipeds and first pair of legs, ventral (E).

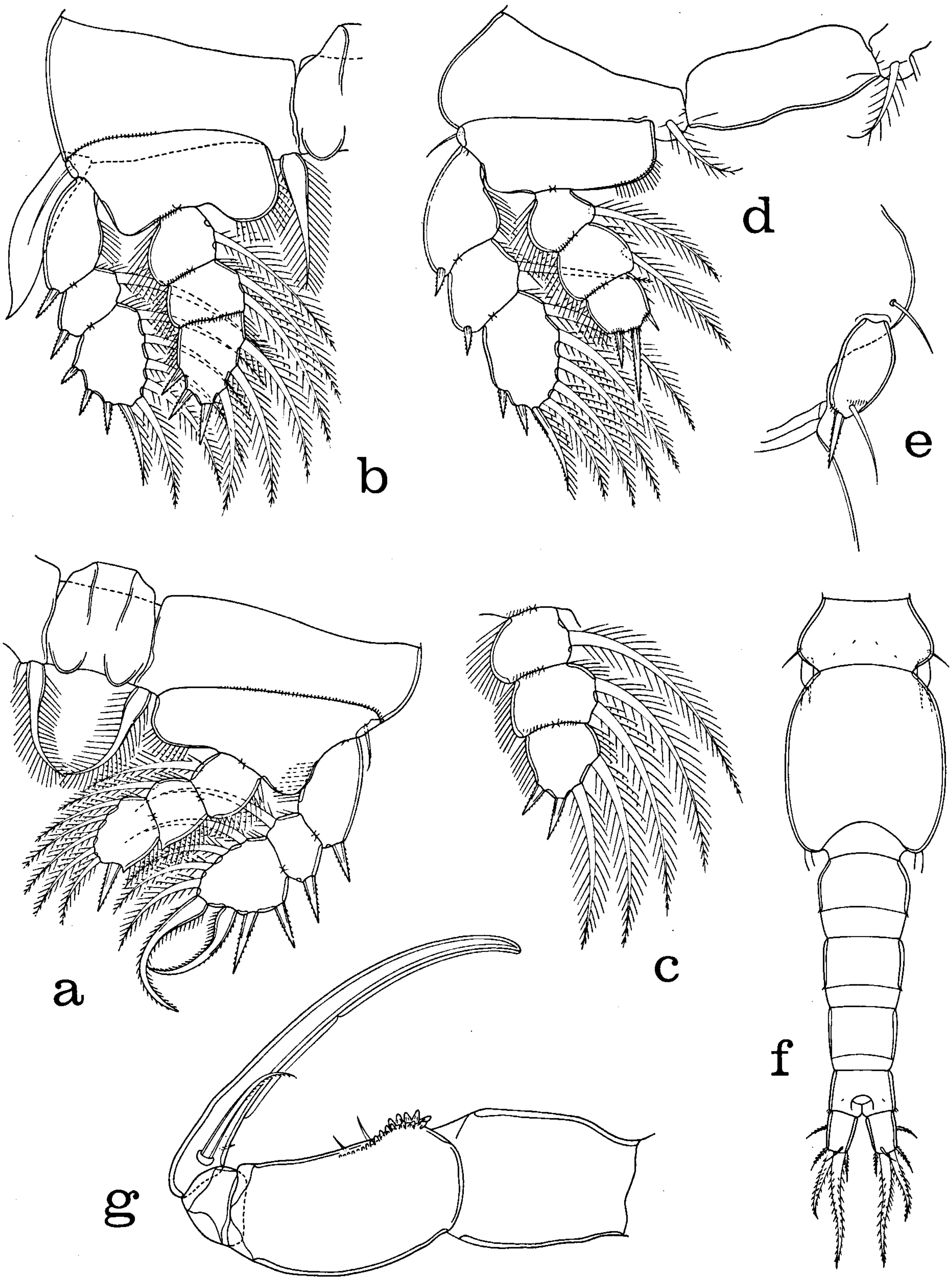

Fig. 9. *Chauliolobion forcipatum* n. sp., female. a, leg 1 and intercoxal plate (C); b, leg 2, anterior (C); c, endopod of leg 3, anterior (C); d, leg 4 and intercoxal plate, anterior (C); e, leg 5, ventral (C). Male: f, urosome, dorsal (D); g, maxilliped, postero-inner (G).

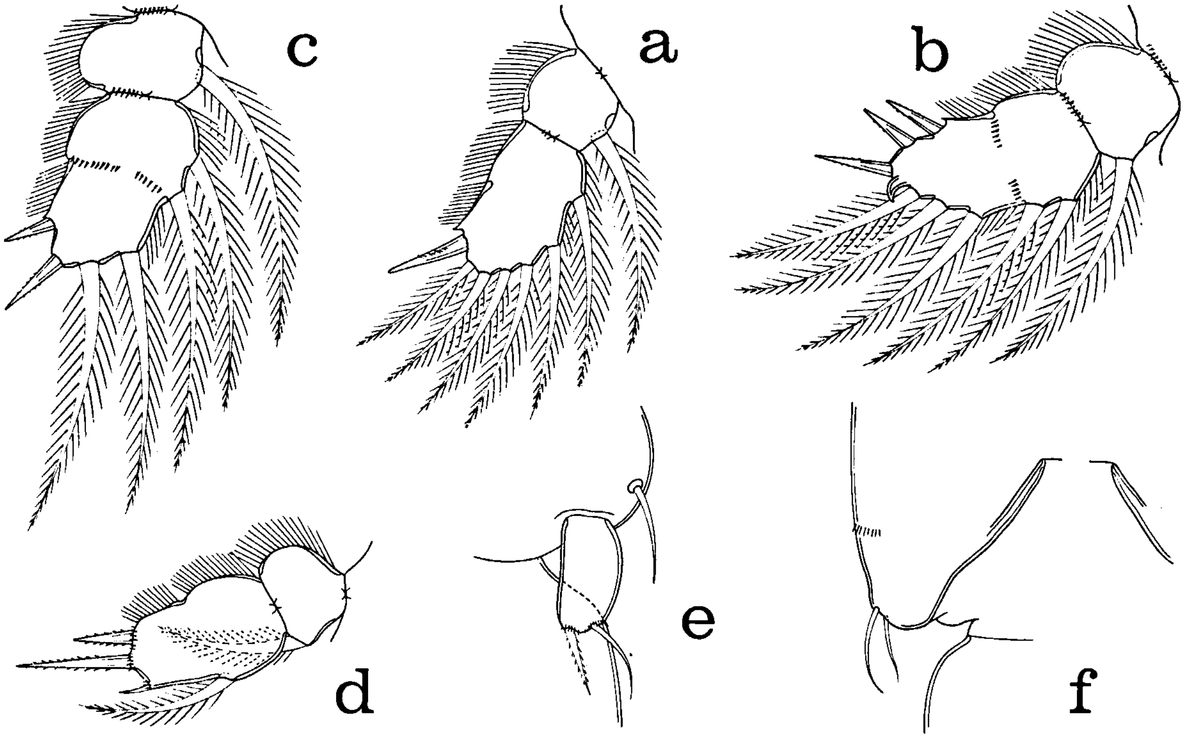

Fig. 10. *Chauliolobion forcipatum* n. sp., male. a, endopod of leg 1, anterior (G); b, endopod of leg 2, anterior (G); c, endopod of leg 3, anterior (G); d, endopod of leg 4, anterior (G); e, leg 5, ventral (G); f, leg 6, ventral (C).

mm) and greatest width 0.26 mm (0.25-0.26 mm), based on three specimens in lactic acid.

Segment of leg 5 (fig. 9f) 78 × 125 μm. Genital segment 187 × 156 μm, longer than wide, lacking transverse posteroventral row of spines. Four postgenital segments from anterior to posterior 78 × 94, 73 × 83, 62 × 70, and 42 × 68 μm. First three segments with sparse posteroventral spines and anal segment with posteroventral spinules.

Caudal ramus resembling that of female, but smaller, 39 × 29 μm.

Body surface with very few hairs (sensilla) as in female.

Rostral area, first antenna, second antenna, labrum, mandible, paragnath, first maxilla, and second maxilla as in female. Maxilliped (fig. 9g) with second segment having on inner surface two small setae and group of conspicuous spines graduating distally to smaller size. Claw 147 μm along its axis.

Ventral area between maxillipeds and first pair of legs as in female.

Legs 1-4 resembling those of female except for endopods having two segments instead of three (figs. 10a, 10b, 10c, 10d). Endopod of leg 2 (fig. 10b) having a distal recurved spiniform process. Distal segment of endopod of leg 4 bearing from outer to inner two unequal barbed spines, a weak slender smooth spine, and a plumose seta.

Leg 5 (fig. 10e) similar to that of female, its free segment 32 × 17.5 μm.

Leg 6 as in figure 10f.

Spermatophore unknown.

Color as in female.

Etymology. — The specific name *forcipatum,* derived from Latin *forceps* meaning forceps or tongs and the suffix *-atus* meaning provided with, refers to the shape of the two terminal spines on the exopod of leg 1.

Comparison with other species of *Chauliolobion.* — *Chauliolobion forcipatum* may be distinguished from its three previously described congeners by the two long forceps-like spines on the third exopod segment of leg 1, and by the three spines on the third endopod segment of leg 4 (the innermost spine much smaller and weaker than the others). The mandible of the new species has only one long setiform process on the convex edge instead of two processes as in other species.

Chauliolobion halodeimatis Humes, 1975

Host: *Holothuria (Halodeima) atra* (Jaeger).
Site: Internal.
Locality: Region of Nouméa, New Caledonia (Humes, 1975).
Notes: Length of ♀ 1.01 mm, ♂ 0.92 mm. Caudal ramus in ♀ with ratio 2.12:1, in ♂ same. Inner coxal seta on legs 1-3 not swollen. Intercoxal plate of legs 1 and 2 lacking pointed processes. Leg 4 endopod with 0-1; 0-1; I, 2. Free segment of leg 5 with two setae. Claw of ♂ maxilliped with smooth concave surface.

Chauliolobion tectuliferum n. sp.

Figs. 11a-k, 12a-h, 13a-f

Type material. — 5 ♀♀, 1 ♂ from one holothurian, *Thelenota ananas* (Jaeger), in 4 m, Poelau Marsegoe, western Ceram, 2°59'30"S, 128°03'30"E, 15 May 1975. Holotype ♀, allotype (dissected), and 2 paratypes deposited in the Zoölogisch Museum, Amsterdam; the remaining two paratypes (dissected) in the collection of the author.

Female. — Body (fig. 11a) slender and elongate. Length (not including setae on caudal rami) 1.32 mm (1.27-1.43 mm) and greatest width 0.29 mm (0.28-0.32 mm), based on five specimens in lactic acid. Ratio of length to width of prosome 2.38:1. Ratio of length of prosome to that of urosome 1.20:1.

Segment of leg 5 (fig. 11b) 91 × 159 μm. Genital segment 216 × 177 μm, longer than wide, with irregular lateral margins. Genital areas situated laterally near middle of segment. Each genital area (fig. 11c) with two nearly equal setae about 16 μm. Three postgenital segments from anterior to posterior 96 × 114, 104 × 99, and 47 × 86 μm. Genital and three postgenital segments with posteroventral spines as indicated.

Caudal ramus (figs. 11d, 11e) 55 × 35 μm, ratio 1.57:1. Outer lateral seta 33 μm, dorsal seta 28 μm, and outermost terminal seta 30 μm, all smooth. Innermost terminal seta 32 μm, with a few proximal inner hairs. Two stout median spinulose terminal setae 65 μm (outer) and 91 μm (inner). Proximal part of dorsal seta covered dorsally by a flange or roof (fig. 11e). Spinules near insertions of lateral seta and outermost terminal seta. Ramus with ventral subterminal patch of spinules.

Body surface with very few hairs (sensilla) as indicated in figure 11a.

Egg sac unknown.

Rostral area as in *Chauliolobion imparile.*

First antenna (fig. 11f) 203 μm long. Lengths of seven segments (measured along their posterior nonsetiferous margins): 19 (39 μm along anterior margin), 40, 25, 29, 33, 20, and 17 μm respectively. Formula for armature as in *C. imparile.* Several setae with spinules as illustrated. First four segments with small spines as shown in figure.

Second antenna (fig. 11g) 4-segmented, 155 μm long including claw. Armature as in *C. imparile.* Claw 31 μm long. All setae smooth.

Labrum (fig. 11h) truncate posteroventrally. Mandible (fig. 11i), paragnath (fig. 11h), first maxilla (fig. 11k), second maxilla (fig. 12a), and maxilliped (fig. 12b) resembling those in congeners. Circlet of spinules near insertion of mandible (fig. 11j).

Ventral area between maxillipeds and first pair of legs as in figure 12c, and only slightly protuberant.

Legs 1-4 (figs. 12d, 12e, 12f, 12g) segmented and armed as in *C. imparile,* but endopod of leg 4 with third segment having I, I, I, these spines barbed and nearly equal in length. Coxae of legs 2 and 3 with long outer digitiform lobes as in *C. forcipatum.*

Leg 5 (fig. 12h) with moderately elongate free segment 36 × 19 μm, ratio 1.89:1. Both terminal setae about 22 μm, inner seta slightly spiniform and unilaterally armed with spinules, outer seta smooth but with row of minute spinules near its insertion. Dorsal seta smooth and 25 μm long.

Leg 6 represented by two small setae on genital area (fig. 11c).

Color in life in transmitted light dark brown, eye reddish but obscure.

Male. — Body elongate as in *C. imparile.* Length 1.17 mm and greatest width 0.25 mm.

Segment of leg 5 (fig. 13a) 68 × 135 μm. Genital segment 195 × 180 μm. Four postgenital

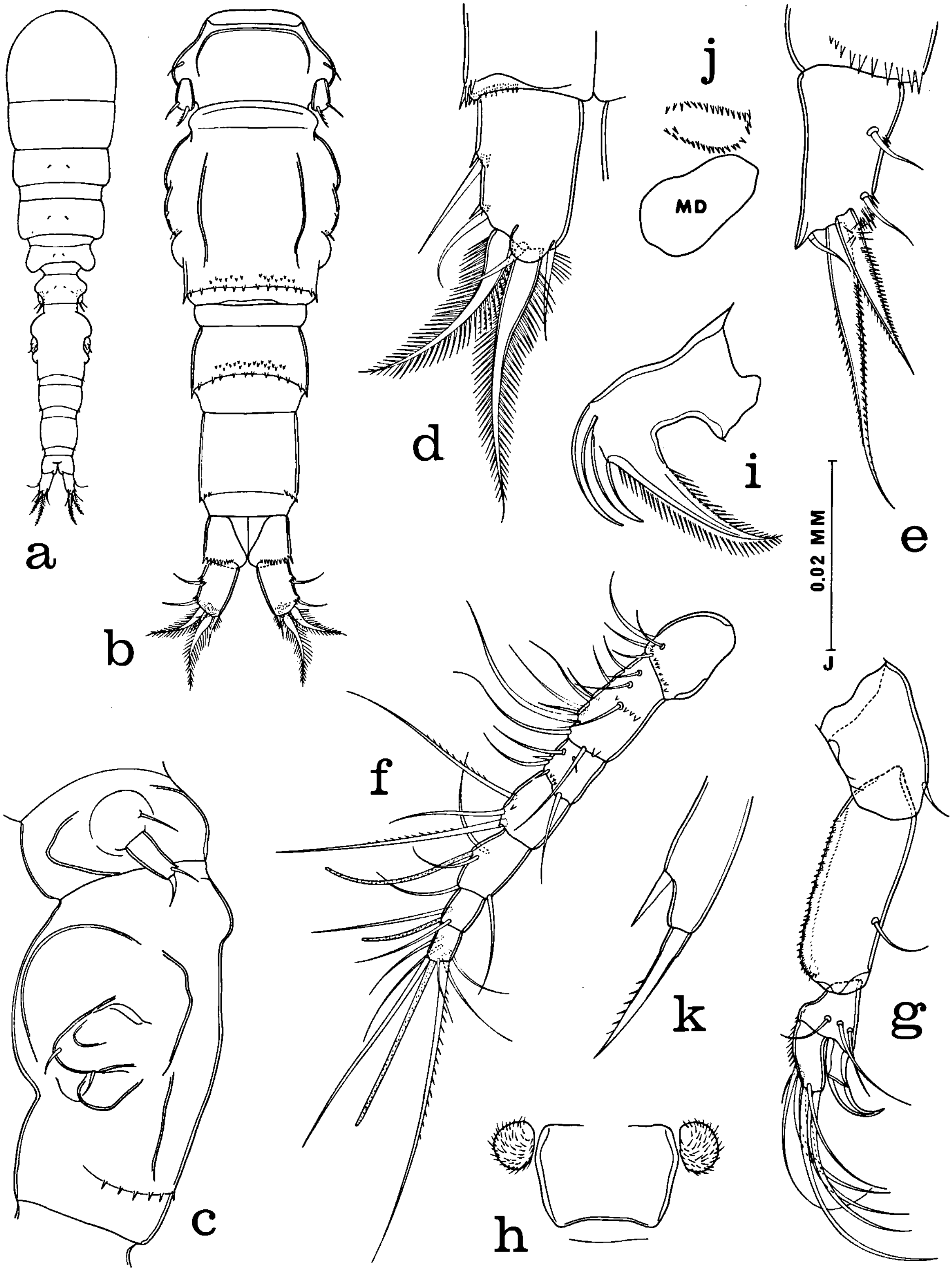

Fig. 11. *Chauliolobion tectuliferum* n. sp., female. a, dorsal (I); b, urosome, ventral (D); c, segment of leg 5 and genital area, lateral (E); d, caudal ramus, dorsal (G); e, caudal ramus, lateral (G); f, first antenna, dorsal (C); g, second antenna, posterior (G); h, labrum and paragnaths, ventral (G); i, mandible, posterior (F); j, circlet of spines lateral to insertion of mandible, ventral (G); k, first maxilla, ventral (J).

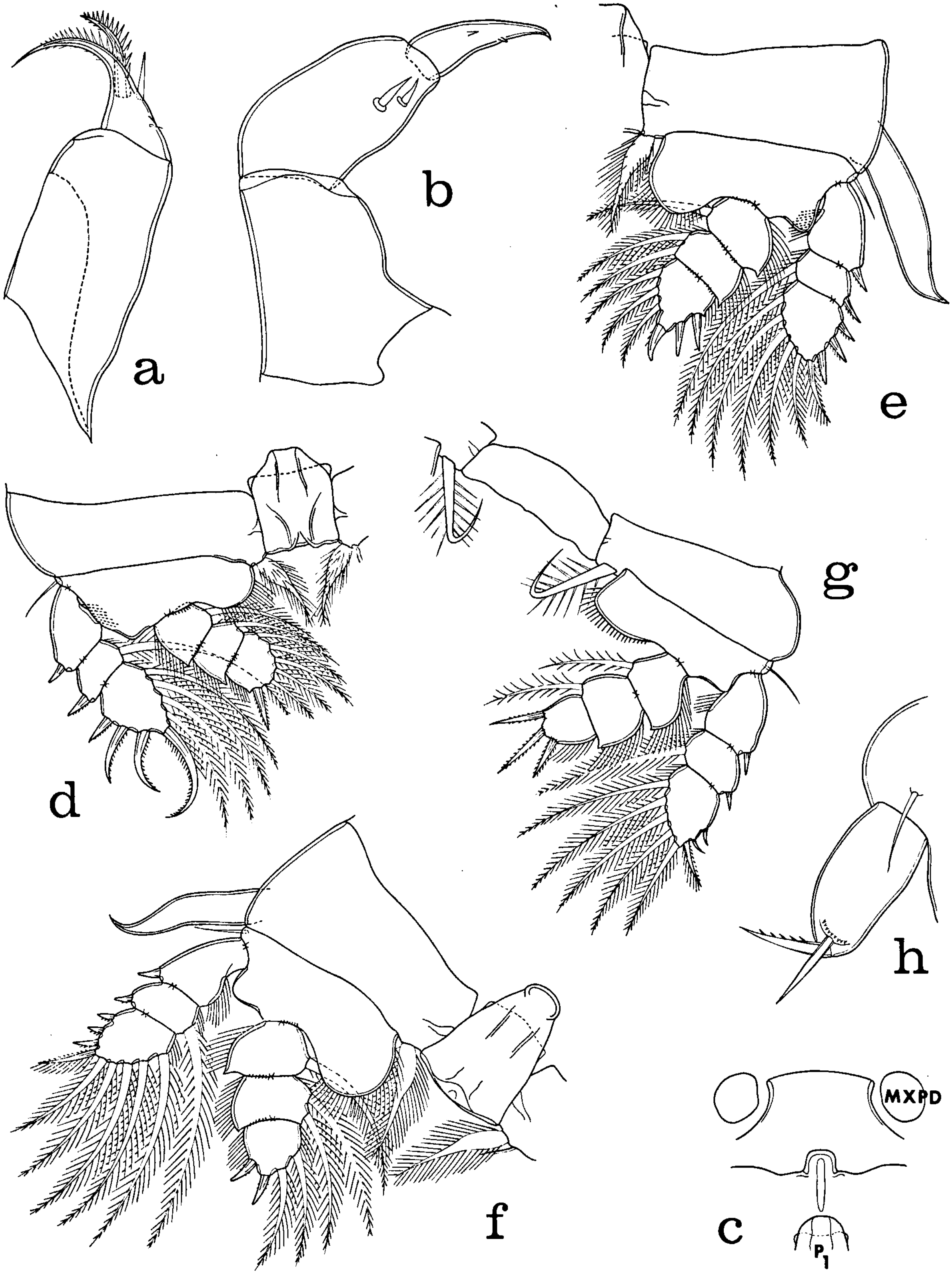

Fig. 12. *Chauliolobion tectuliferum* n. sp., female. a, second maxilla, anterior (F); b, maxilliped, antero-inner (F); c, area between maxillipeds and first pair of legs, ventral (E); d, leg 1 and intercoxal plate, anterior (C); e, leg 2, anterior (C); f, leg 3 and intercoxal plate, anterior (C); g, leg 4 and intercoxal plate, anterior (C); h, leg 5, ventral and slightly lateral (F).

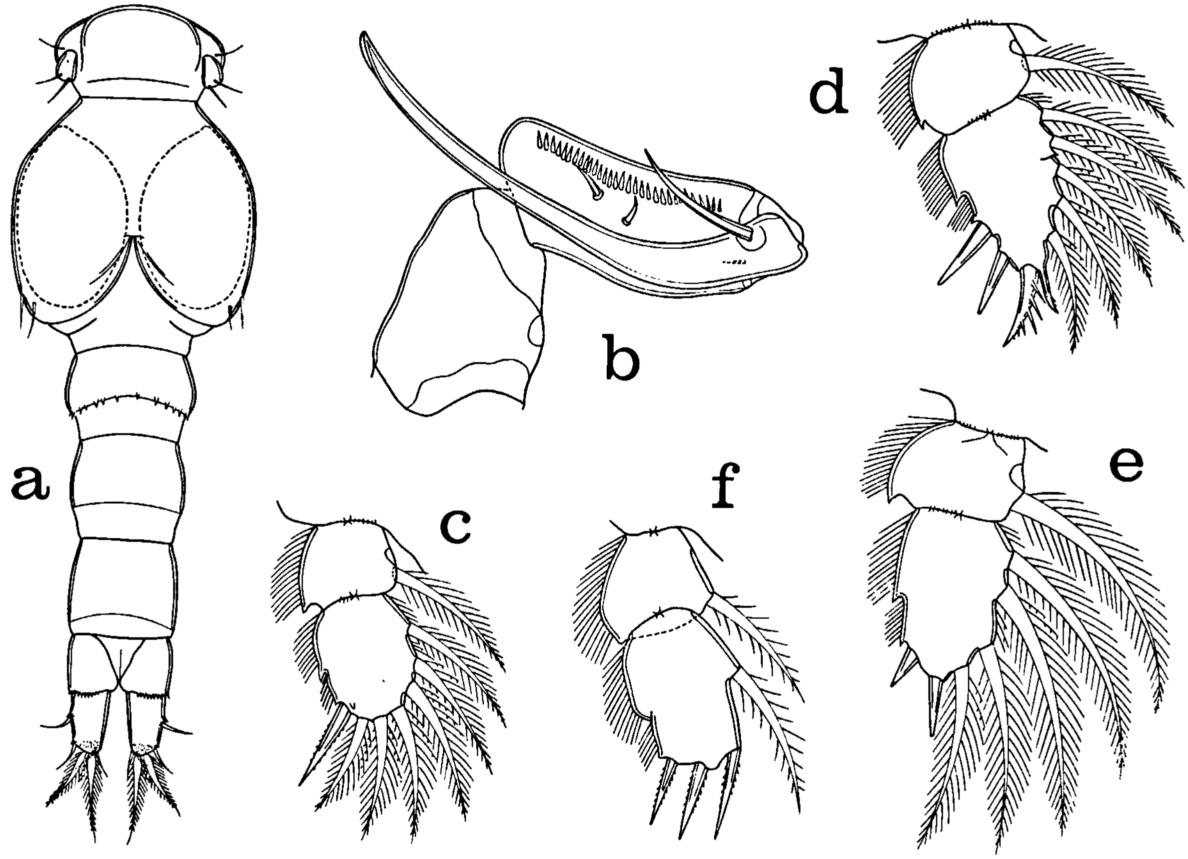

Fig. 13. *Chauliolobion tectuliferum* n. sp., male. a, urosome, ventral (D); b, maxilliped, postero-inner (G); c, endopod of leg 1, anterior (G); d, endopod of leg 2, anterior (G); e, endopod of leg 3, anterior (G); f, endopod of leg 4, anterior (G).

segments from anterior to posterior 70 × 102, 86 × 91, 81 × 86, and 42 × 81 μm. First postgenital segment with posteroventral row of spines.

Caudal ramus like that of female, 52 × 30 μm.

Body surface ornamented with very few hairs (sensilla) as in female.

Rostral area, mandible, paragnath, first maxilla, and second maxilla as in female. Maxilliped (fig. 13b) 4-segmented (assuming that proximal part of claw represents fourth segment). First segment unarmed. Second segment with two setae and row of spinules. Small third segment unarmed. Claw 138 μm long, slightly swollen proximally where it bears two very unequal setae.

Ventral area between maxillipeds and first pair of legs as in female.

Legs 1-4 resembling those of female except for endopods having two segments instead of three (figs. 13c, 13d, 13e, 13f). Endopod of leg 2 (fig. 13d) particularly dimorphic, with long slender spiniform process medial to insertion of terminal spine which has several long spinules.

Leg 5 (fig. 13a) resembling that of female.

Leg 6 (fig. 13a) a posteroventral flap on genital segment bearing two unequal smooth setae 17 μm and 19 μm.

Fully formed spermatophore not seen.

Color as in female.

Etymology. — The specific name *tectuliferum*, from Latin *tectulum* meaning a little roof and *fero* meaning to bear, alludes to the rooflike plate over the dorsal seta on the caudal ramus.

Comparison with other species of Chauliolobion. — *Chauliolobion tectuliferum* may be distinguished from its four previously described congeners by the presence of a rooflike plate over the dorsal seta on the caudal ramus. The two distal spines on the third exopod segment of leg 1 are recurved and oppose each other as in *Chauliolobion forcipatum*. *C. tectuliferum* may be easily distinguished from *C. forcipatum*, however, by the difference in shape of the female genital segment.

Chauliolobion foliaceum (Ummerkutty, 1970)

Host: *Holothuria (Halodeima) atra* (Jaeger).
Site: Body cavity.
Locality: Gulf of Mannar, southeastern India (Ummerkutty, 1970).
Notes: Length of ♀ 0.79 mm, ♂ 0.75 mm. Smaller in size than other species in genus. Second segment of first antenna with a digitiform spine on anterolateral corner. (This species, originally described as *Sabelliphilus foliacea* Ummerkutty, 1970, needs redescription).

Key to the species of *Chauliolobion*

1. Third segment of endopod of leg 4 with II, I or II, 1 2
   Third segment of endopod of leg 4 with I, 2 4
2. Third segment of endopod of leg 4 with II, 1, the seta very small .... *C. forcipatum*
   Third segment of endopod of leg 4 with II, I 3
3. Two distal spines on third segment of exopod of leg 1 strongly recurved and opposing each other; dorsal seta on caudal ramus covered dorsally by a rooflike flange ...... *C. tectuliferum*
   Two distal spines on third segment of exopod of leg 1 not strongly recurved; without rooflike flange over dorsal seta on caudal ramus .... *C. bulbosum*
4. Outer process on coxa of legs 1 and 2 distinctly longer than first segment of exopod 5
   Outer process on coxa of leg 1 longer than entire exopod, that on coxa of leg 2 shorter than first segment of exopod .... *C. imparile*
5. Length of ♀ 1.01 mm (0.91-1.13 mm), ♂ 0.92 mm (0.86-0.98 mm); second segment of first antenna bearing setae only ...... *C. halodeimatis*
   Length of ♀ 0.79 mm, ♂ 0.75 mm; second segment of first antenna bearing a digitiform spine on anterolateral corner ...... *C. foliaceum*

Diogenella Stock, 1968

Body elongate, modified. Caudal ramus with two median terminal setae vestigial and lateral seta displaced proximally. First antenna 7-segmented. Second antenna 4-segmented, with one claw on fourth segment. Legs 1-4 with 3-segmented rami. Leg 4 endopod with 0-1; 0-1; II.

Diogenella deichmannae Humes & Ho, 1970

Host: *Holothuria (Thymioscyia) arenicola* (Semper).
Site: Internal.
Locality: Barbados (Humes & Ho, 1970).
Notes: Length of ♀ 1.24 mm, ♂ 1.05 mm. Caudal ramus with inner terminal seta having only a few minute barbules and outer terminal seta naked. First segment of second antenna lacking spinules. Genital segment of ♀ tapered posteriorly. Genital areas anterior to middle of segment.

Diogenella impar Humes & Ho, 1970

Host: *Holothuria (Thymioscyia) arenicola* (Semper).
Site: Internal.
Locality: Barbados (Humes & Ho, 1970).
Notes: Length of ♂ 1.43 mm. ♀ unknown. Caudal ramus with all terminal setae naked. Rostrum broad and triangular. First segment of second antenna without spinules. Ratio of greatest length to width of caudal ramus about 3.6:1. Outer spines on third segment of exopod of legs 2-4 unequal.

Diogenella seticauda Stock, 1968

Host: *Holothuria (Semperothuria) surinamensis* (Ludwig).
Site: Internal.
Locality: Puerto Rico (Stock, 1968; Humes & Ho, 1970).

Host: *Holothuria (Thymioscyia) impatiens* (Forskål).
Site: Internal.
Locality: Puerto Rico (Stock, 1968).

Hosts: *Holothuria (Thymioscyia) arenicola* (Semper) and *Holothuria (Semperothuria) surinamensis* (Ludwig) (mixed at time of collection).
Site: Internal.
Locality: Puerto Rico (Humes & Ho, 1970).

Notes: Length of ♀ 1.04 mm, ♂ 0.68 mm. Caudal ramus with ciliated inner and outer terminal setae. First segment of second antenna with spinules. Genital segment of ♀ of approximately same width throughout, with genital areas near middle of segment. Genital and first two postgenital segments with transverse posteroventral rows of spines.

Diogenella spinicauda Stock, 1968

Host: *Holothuria (Halodeima) mexicana* Ludwig.
Site: Internal.
Localities: Curaçao (Stock, 1968); Bahamas, Puerto Rico, Jamaica (Humes & Ho, 1970).

Host: *Actinopyga agassizii* (Selenka)
Site: Internal.
Localities: Bahamas, Jamaica (Humes & Ho, 1970).
Notes: Length of ♀ 1.62 mm, ♂ 1.59 mm. Caudal ramus with ciliated inner and outer terminal setae. First segment of second antenna with spinules. Genital segment of ♀ broadest anteriorly and slightly tapered posteriorly, with genital areas in anterior part of segment. Genital and first two postgenital segments lacking transverse posteroventral rows of spines.

Diogenidium Edwards, 1891

Body cyclopiform, but elongate and somewhat modified. Caudal ramus with two median terminal setae normally developed. First antenna 7-segmented. Second antenna 4-segmented, with one claw on fourth segment. Legs 1-4 with 3-segmented rami. Endopod of leg 4 with 0-1; 0-1; II.

Diogenidium deforme Stock, 1968

Host: *Holothuria (Selenkothuria) glaberrima* Selenka.
Site: Internal, ejected from host.
Locality: Puerto Rico (Stock, 1968).

Host: *Holothuria (Thymioscyia) arenicola* (Semper).
Site: Internal.
Locality: Barbados (Humes & Ho, 1971).

Host: *Holothuria (Halodeima) mexicana* (Ludwig).
Site: Internal.
Locality: Puerto Rico, Bahamas (Humes & Ho, 1971).
Notes: Length of ♀ 1.44 mm, ♂ 1.48 mm (Humes & Ho, 1971), ♀ 2.27 mm, ♂ 1.75 mm (Stock, 1968). Rostrum with pointed beak. Second segment of second antenna lacking fine ornamentation. Second segment of maxilliped of ♂ with one of two setae arising from bifid base distal to which spinose area does not extend.

Diogenidium nasutum Edwards, 1891

Host: *Actinopyga agassizii* (Selenka).
Site: Body cavity.
Locality: Bahamas (Edwards, 1891; Humes & Ho, 1971).

Host: *Holothuria (Halodeima) mexicana* (Ludwig).
Site: Body cavity.
Localities: Puerto Rico, Curaçao (Stock, 1968); Puerto Rico, Jamaica (Humes & Ho, 1971).

Host: *Holothuria (Halodeima) grisea* (Selenka).
Site: Body cavity.
Locality: Jamaica (Humes & Ho, 1971).
Notes: Length of ♀ 1.58 mm, ♂ 1.49 mm. Rostrum with a pointed beak. Second segment of second antenna with outer spinules. Longest terminal seta on caudal ramus shorter than ramus.

Diogenidium spinulosum Stock, 1968

Host: *Isostichopus badionotus* (Selenka).
Site: Internal, ejected from host.
Localities: Puerto Rico (Stock, 1968; Humes & Ho, 1971); Jamaica (Humes & Ho, 1971).
Notes: Length of ♀ 1.94 mm, ♂ 1.63 mm. Rostrum with broadly rounded posteroventral margin. Second and third segments of rami of legs 1-4 with small spines on posterior surface.

Diogenidium tectum Humes & Ho, 1971

Host: *Actinopyga agassizii* (Selenka).
Site: Internal.
Localities: Jamaica, Bahamas (Humes & Ho, 1971).
Notes: Length of ♂ 1.41 mm. ♀ unknown. Rostrum with a pointed beak. Second segment of second antenna with small inner spines. Longest ter-

minal seta on caudal ramus about twice length of ramus. Spinose area on second segment of maxilliped extending distally to bifid prominence bearing seta.

Lecanurius Kossmann, 1877

Body modified, elongate, cephalosome broad and triangular. First antenna 7-segmented. Second antenna 4-segmented, with one large claw on third segment. Legs 1-4 with 3-segmented rami. Endopod of leg 4 with armature 0-1; 0-1; I, I, 1, 1, 1 or 0-1; 0-1; I, I, 1, 1.

Lecanurius intestinalis Kossmann, 1877

Host: *Actinopyga lecanora* (Jaeger).
Site: In the intestine.
Locality: Bohol Island, Philippine Islands (Kossmann, 1877).
Notes: Length of ♂ 1.46 mm. ♀ unknown. Cephalosome semicircular in outline, not indented laterally. Claw of maxilliped with two blunt protuberances. Free segment of leg 2 130 μm long.

Lecanurius kossmannianus Humes, 1968

Hosts: *Actinopyga lecanora* (Jaeger) and *Actinopyga miliaris* (Quoy & Gaimard).
Site: Exact location unknown, but presumably internal.
Locality: Region of Nosy Bé, northwestern Madagascar (Humes, 1968).
Notes: Length of ♀ 2.64 mm, ♂ 1.97 mm. Cephalosome somewhat triangular, indented laterally. Claw of ♂ maxilliped with one pointed prominence. Free segment of leg 5 in ♂ 42 μm long.

Lecanurius planifrontalis n. sp.

Figs. 14a-g, 15a-j, 16a-f, 17a-f
Type material. — 1 ♀, 2 ♂♂ from 13 holothurians, *Actinopyga echinites* (Jaeger), in 2 m, Pte. Pontillion (Rocher à la Voile), Nouméa, New Caledonia, 2 June 1971. Holotype ♂, allotype ♀ (dissected), and one paratypic ♂ (dissected) deposited in the Zoölogisch Museum, Amsterdam.
Female. — Body (fig. 14a) elongate, flattened dorsoventrally. Length 2.34 mm and greatest width 0.98 mm. Cephalosome broad with flattened frontal margin and with posterolateral corners turned slightly ventrally (fig. 14b). Segment of leg 1 weakly separated from head. Epimera of segments of legs 2-4 rounded. Ratio of length to width of prosome 0.98:1. Ratio of length of prosome to that of urosome 0.83:1.

Segment of leg 5 (fig. 14c) 187 × 308 μm. Genital segment in dorsal view 352 × 363 μm in greatest dimensions, broad in anterior half but abruptly narrowed in posterior half. Genital areas situated dorsally on posterolateral corners of segment. Each area (fig. 14d) with two naked setae about 39 μm long. Three postgenital segments from anterior to posterior 209 × 164, 176 × 155, and 176 × 180 μm. Each segment with a pair of small lateral setules and anal segment with row of minute spinules near its posteroventral margin on each side.

Caudal ramus (fig. 14e) elongate, 260 × 75 μm (width taken at middle), ratio 3.47:1. Outer lateral seta 44 μm, dorsal seta 40 μm, outermost terminal seta 60 μm, innermost terminal seta 78 μm, and two long median terminal setae 200 μm (outer) and 308 μm (inner). All setae smooth. Subterminally on ventral surface of ramus two rows of minute spinules.

Body surface with few small hairs (sensilla) as in figures 14a and 14c.

Egg sacs (fig. 14a) elongate, 1.38 × 0.19 mm and 1.30 × 0.19 mm, each containing approximately 32 eggs varying in shape from subspherical, 112 × 107 μm, to elongate, 133 × 86 μm.

Rostral area (fig. 14f) weakly defined.

First antenna (fig. 14g) 446 μm long. Lengths of seven segments (measured along their posterior nonsetiferous margins): 52 (91 μm along anterior margin), 146, 36, 70, 42, 35, and 26 μm respectively. Formula for armature: 4, 13, 6, 3, 4 + 1 aesthete, 2 + 1 aesthete, and 7 + 1 aesthete. All setae naked.

Second antenna (fig. 15a) 4-segmented, 470 μm long including claw. Armature: 1, 1, 3 + claw, and 7. Claw 109 μm along its axis. Fourth segment small, 42 × 26 μm. All setae naked.

Labrum (fig. 15b), mandible (fig. 15c), paragnath (fig. 15b), first maxilla (fig. 15d), second maxilla (fig. 15e), and maxilliped (fig. 15f) resembling in general features those of *Lecanurius kossmannianus* Humes, 1968. Setae on second maxilla smooth.

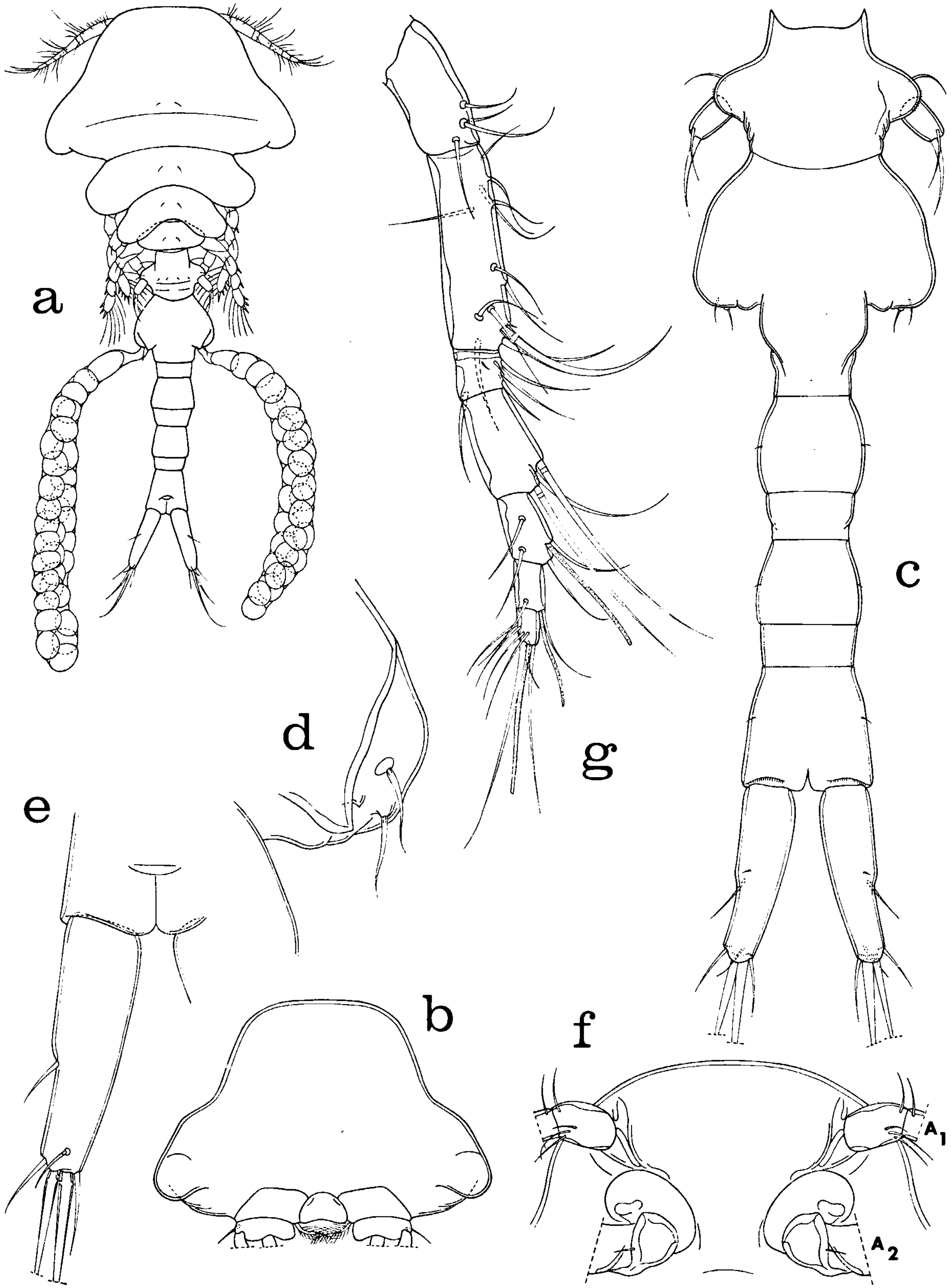

Fig. 14. *Lecanurius planifrontalis* n. sp., female. a, dorsal (A); b, contour of cephalosome, ventral (I); c, urosome, ventral (B); d, leg 6, ventral (C); e, caudal ramus, dorsal (B); f, rostral area, ventral (B); g, first antenna, ventral (E).

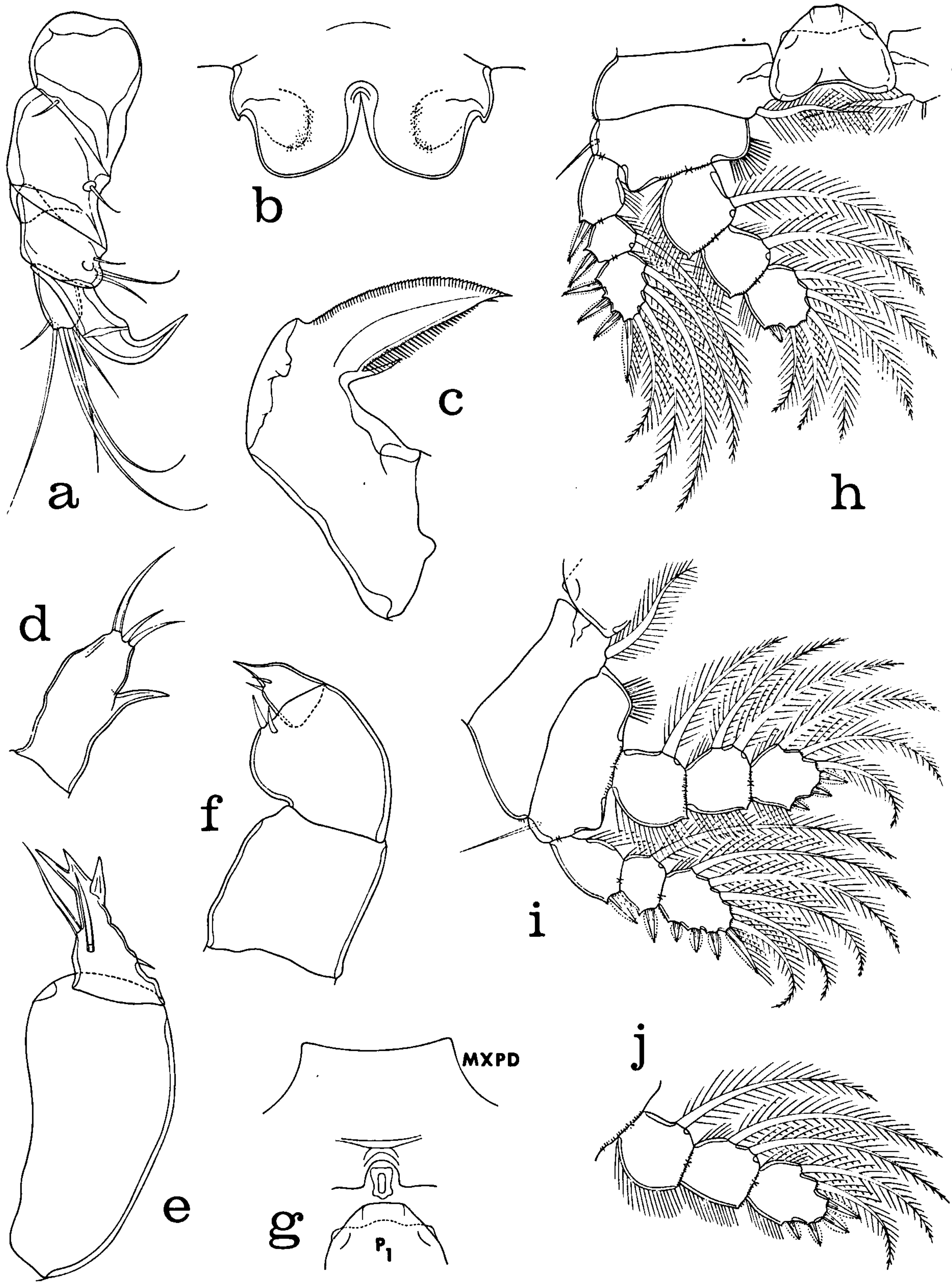

Fig. 15. *Lecanurius planifrontalis* n. sp., female. a, second antenna, anterior (E); b, labrum with position of paragnaths indicated by broken lines, ventral (C); c, mandible, posterior (G); d, first maxilla, posterior (G); e, second maxilla, posterior (C); f, maxilliped, anterior (C); g, area between maxillipeds and first pair of legs, ventral (D); h, leg 1 and intercoxal plate, anterior (D); i, leg 2, anterior (D); j, endopod of leg 3, anterior (D).

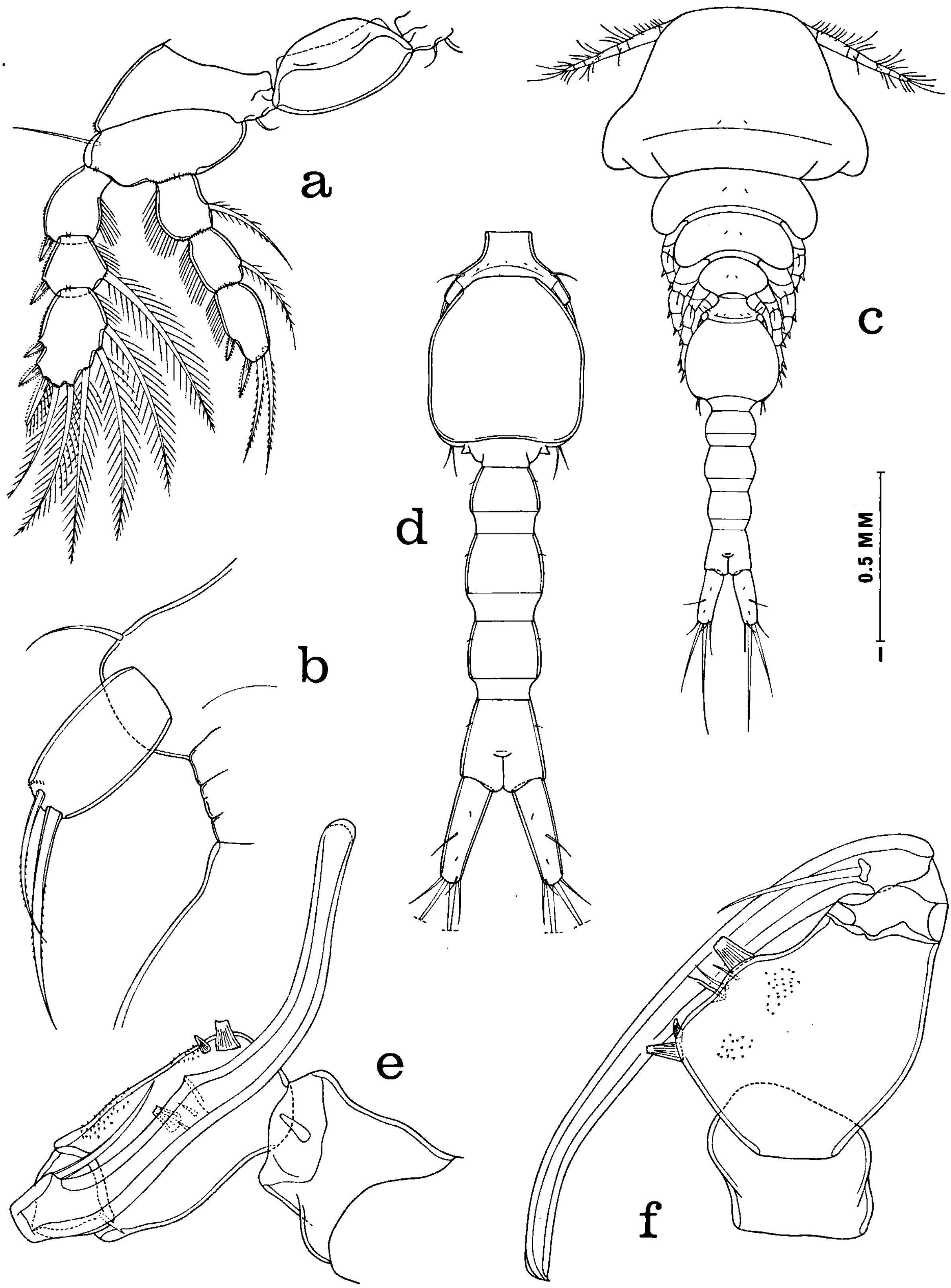

Fig. 16. *Lecanurius planifrontalis* n. s p., female: a, leg 4 and intercoxal plate, anterior (D); b, leg 5, dorsal (C). male: c, dorsal (I); d, urosome, dorsal (B); e, maxilliped, antero-inner (C); f, maxilliped, posterior (C).

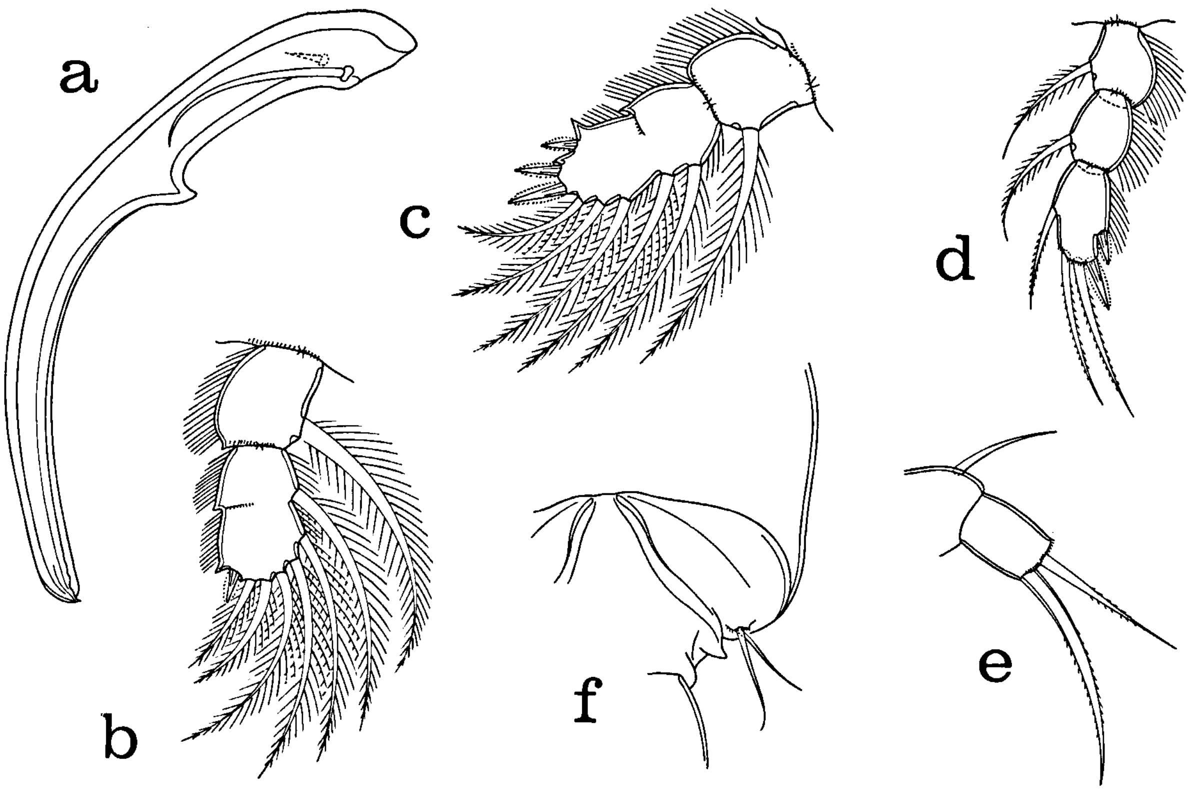

Fig. 17. *Lecanurius planifrontalis* n. sp., male. a, claw of maxilliped, flat view (C); b, endopod of leg 1, anterior (E); c, endopod of leg 2, anterior (E); d, left endopod of leg 4, with extra seta on third segment, anterior (E); e, leg 5, ventral (C); f, leg 6, ventral (E).

Ventral area between maxillipeds and first pair of legs (fig. 15g) not protuberant.

Legs 1-4 (figs. 15h, 15i, 15j, 16a) with 3-segmented rami. Armature as in female of *L. kossmannianus* except for third segment of endopod of leg 4 where formula is I, I, 1, 1, instead of I, I, 1, 1, 1 as in that species. Inner margin of basis of legs 1-3 with slender setules rather than hairs. Inner coxal seta on leg 4 naked and 26 μm long. Leg 4 exopod 234 μm. Endopod 203 μm. First segment 62 × 52 μm, its inner seta 96 μm. Second segment 60 × 49 μm, its inner seta 104 μm. Third segment 81 × 40 μm, its four elements from outer to inner 23, 40, 104, and 122 μm.

Leg 5 (fig. 16b) with subrectangular free segment 78 × 42 μm, ratio 1.86:1. Two terminal setae 68 μm and 104 μm, both delicately barbed. Dorsal seta 47 μm and smooth. Free segment ornamented with row of small spines on distal outer corner.

Leg 6 represented by two setae on genital area (fig. 14d).

Color in life in transmitted light opaque grayish white, eye red, egg sacs pale gray.

Male. — Body (fig. 16c) resembling in general form that of female. Length 1.71 mm (1.67-1.75 mm) and greatest width 0.74 mm (0.67-0.80 mm), based on two specimens in lactic acid. Ratio of length to width of prosome 1.08:1. Ratio of length of prosome to that of urosome 0.90:1.

Segment of leg 5 (fig. 16d) 73 × 174 μm. Genital segment 252 × 234 μm, only slightly longer than wide. Four postgenital segments from anterior to posterior 99 × 104, 123 × 107, 112 × 102, and 120 × 110 μm.

Caudal ramus similar to that of female, but smaller, 150 × 48 μm, ratio 3.13:1.

Body surface ornamented with hairs or setules as in female.

Rostral area, first antenna, second antenna, labrum, mandible, paragnath, first maxilla, and second maxilla as in female. Maxilliped (figs. 16e, 16f) 4-segmented, interpreting proximal part of claw as representing fourth segment. First segment unarmed. Second segment with two small setae, three stout striated spines, two of them with truncate tips, and two groups of minute spines. Third segment small and unarmed. Claw (fig. 17a) 252 μm along its axis, with a proximally directed spiniform process on its concave margin, and bearing proximally two unequal smooth setae.

Legs 1-4 segmented and armed as in female except for endopods of legs 1 and 2 which are 2-segmented. Endopod of leg 1 (fig. 17b) with formula 0-1; I, 5, 1. Endopod of leg 2 (fig. 17c) with 0-1; I, II, 3, 2. Leg 4 endopod with 0-1; 0-1; I, I, 1, 1 in holotype and in endopod of right leg 4 in dissected male, but in endopod of left leg 4 (fig. 17d) of this dissected male formula is 0-1; 0-1; I, I, 1, 1, 1, this being interpreted as an abnormal condition.

Leg 5 (fig. 17e) with free segment shorter than in female, 34 × 23 μm, ratio 1.48:1. Two terminal setae 65 μm and 83 μm. Dorsal seta 39 μm.

Leg 6 (fig. 17f) a posteroventral flap on genital segment bearing two slender smooth setae 39 μm and 55 μm. Near insertion of longer seta a row of minute spinules.

Spermatophore not seen.

Color similar to that of female.

Etymology. — The specific name *planifrontalis*, a combination of Latin *planus* meaning flat, *frons* meaning forehead, and the suffix *-alis* signifying having the quality of, alludes to the flattened anterior margin of the head.

Comparison with other species. — The flattened anterior margin of the head in *Lecanurius planifrontalis* sets the species apart from the other two members of the genus, *Lecanurius intestinalis* Kossmann, 1877, and *Lecanurius kossmannianus* Humes, 1968. The new species differs from *L. intestinalis* (of which only the male is known) in body length of the male (1.97 mm instead of 1.46 mm as in *L. intestinalis*), in the cephalosome being laterally indented instead of rounded, in having one pointed prominence instead of two blunt protuberances on the claw of the maxilliped, and in the length of the free segment of leg 5 (34 μm instead of 130 μm as in *L. intestinalis*).

L. planifrontalis differs from *L. kossmannianus* in having the formula I, I, 1, 1 on the third segment of the endopod of leg 4, instead of I, I, 1, 1, 1. The female of the new species further differs from *L. kossmannianus* in body length (2.34 mm instead of 2.64 mm) and in the dimensions and shape of the genital segment (352 × 363 μm instead of 540 × 396 μm).

Host: *Actinopyga miliaris* (Quoy & Gaimard).
Site: Hind gut.
Locality: Northeastern Australia (present paper).
New host record: 1 ♀, 6 ♂♂ from *Actinopyga miliaris*, Arlington Reef complex, off Queensland, Australia, 11 May 1977, L. Cannon collector.

Lecanurius sp.

Host: *Synapta maculata* (Chamisso & Eysenhardt).
Site: Exact location unknown, but presumably internal.
Locality: Region of Nosy Bé, northwestern Madagascar (Humes, 1968).
Notes: Only a single copepodid known. Some features suggest *Lecanurius*.

Lichothuria Stock, 1968

Body modified, elongate, and slender. First antenna 7-segmented. Second antenna 4-segmented, with one claw on third segment. Mandible with large spinelike element on convex side near origin of bipectinate blade. Legs 1-4 in ♀ with 3-segmented rami, with leg 4 endopod 0-1; 0-1; II, 1; in ♂ with 3-segmented exopods and 2-segmented endopods, with leg 4 endopod 0-1; II, 1, 1.

Lichothuria mandibularis Stock, 1968

Host: *Holothuria (Halodeima) atra* (Jaeger).
Site: Internal, ejected from host.
Localities: Eilat, Gulf of Aqaba, Israel (Stock, 1971); region of Nosy Bé, northwestern Madagascar (Humes & Ho, 1969).

Host: *Holothuria (Metriatyla) scabra* Jaeger.
Site: Internal.

Locality: Region of Nosy Bé, northwestern Madagascar (Humes & Ho, 1969).

Host: *Holothuria (Microthele) nobilis* (Selenka).
Site: Internal.
Locality: Region of Nosy Bé, northwestern Madagascar (Humes & Ho, 1969).

Host: *Holothuria (Cystipus) fuscopunctata* Jaeger.
Site: Internal.
Locality: Region of Nosy Bé, northwestern Madagascar (Humes & Ho, 1969).
Notes: Length of ♀ 1.61 mm, ♂ 1.32 mm.

Scambicornus Heegaard, 1944

Body cyclopiform. First antenna 7-segmented. Second antenna 4-segmented, with claw on third segment. Legs 1-4 in ♀ with 3-segmented rami. Leg 4 endopod with 0-1; 0-1; I, II, II. In ♂ legs 1 and 2 with 3-segmented exopods and 2-segmented endopods; legs 3 and 4 with both rami 3-segmented.

(*Preherrmannella* Sewell, 1949, is a junior synonym of *Scambicornus*).

Scambicornus batiolatus n. sp.

Figs. 18a-k, 19a-k, 20a-j

Type material. — 152 ♀♀, 71 ♂♂ from one holothurian. *Holothuria (Halodeima) atra* (Jaeger), in 10 m, southern shore of Goenoeng Api, Banda Islands, 4°32′05″S, 129°52′30″E, 26 April 1975. Holotype ♀, allotype, and 215 paratypes (148 ♀♀, 67 ♂♂) deposited in the Zoölogisch Museum, Amsterdam; the remaining paratypes (dissected) in the collection of the author.

Other specimens. — From *Holothuria atra*: 6 ♀♀, 1 ♂ from 2 hosts, in 3 m, Poelau Gomumu, south of Obi, 1°50′00″S, 127°30′54″E, 30 May 1975; 20 ♀♀, 18 ♂♂ from 4 hosts, in 5 m, southwestern shore of Goenoeng Api, Banda Islands, 4°31′45″S, 129°51′55″E, 2 May 1975; 1 ♀, 1 ♂ from 1 host, in 4 m, Poelau Marsegoe, western Ceram, 2°59′30″ S, 128°03′30″E, 15 May 1975; 1♀, 1 ♂ from 1 host, in 3 m, Poelau Gomumu, south of Obi, 1°50′ 00″S, 127°30′54″E, 30 May 1975; 7 ♀♀, 5 ♂♂ from 1 host, in 18 m, south of Poelau Naira (Bandanaira), Banda Islands, 4°32′12″S, 129°53′40″E, 2 May 1975; 3 ♀♀, 3 ♂♂ from 1 host, in 1.5 m, southwestern shore of Goenoeng Api, Banda Islands, 4°31′45″S, 129°51′55″E, 2 May 1975; 2 ♂♂ from 4 hosts, in 4 m, Poelau Marsegoe, western Ceram, 2°59′30″S, 128°03′30″E, 15 May 1975. From *Thelenota ananas* (Jaeger): 3 ♀♀, 3 ♂♂ from 1 host, in 4 m, Poelau Marsegoe, western Ceram, 2°59′30″S, 128°03′30″E, 15 May 1975.

Female. — Body (fig. 18a) with moderately broad prosome. Length (not including setae on caudal rami) 0.98 mm (0.85-1.05 mm) and greatest width 0.44 mm (0.41-0.47), based on 10 specimens in lactic acid. Segment of leg 1 separated from head by dorsal transverse furrow. Epimeral areas of segments of legs 1-4 rounded. Ratio of length to width of prosome 1.36:1. Ratio of length of prosome to that of urosome 1.76:1.

Segment bearing leg 5 (fig. 18b) 88 × 104 µm. Genital segment 94 × 109 µm, slightly wider than long, its lateral margins rounded. Posteroventral margin of segment with dentate fringe. Genital areas located dorsolaterally at middle of segment. Each area (fig. 18c) with two small naked setae about 9 µm long and a minute spiniform process. Three postgenital segments from anterior to posterior 36 × 60, 29 × 57, and 55 × 58 µm. First postgenital segment with posteroventral dentate fringe. Anal segment with row of minute posteroventral spinules on each side.

Caudal ramus (fig. 18d) elongate, 83 × 22 µm, ratio 3.77:1. Outer lateral seta (situated dorsally) 82 µm, dorsal seta 94 µm, outermost terminal seta 77 µm, innermost terminal seta 79 µm, and two long median terminal setae 308 µm (outer) and 506 µm (inner). All setae naked. Terminal ventral flange with row of extremely small spinules.

Body surface with few small hairs (sensilla) and refractile points as in figures 18e and 18b.

Egg sac (fig. 18e) elongate, 550 × 187 µm, with many eggs, each with average diameter 50 µm (42-55 µm).

Rostrum (fig. 18f) weakly developed.

First antenna (fig. 18g) 355 µm long. Lengths of seven segments (measured along their posterior nonsetiferous margins): 26 (55 µm along anterior margin), 122, 23, 65, 35, 31, and 24 µm respectively. Formula for armature: 4, 13, 6, 3, 4 + 1 aesthete, 2 + 1 aesthete, and 7 + 1 aesthete. Setae generally smooth but two setae on second segment in some specimens with few small spinules.

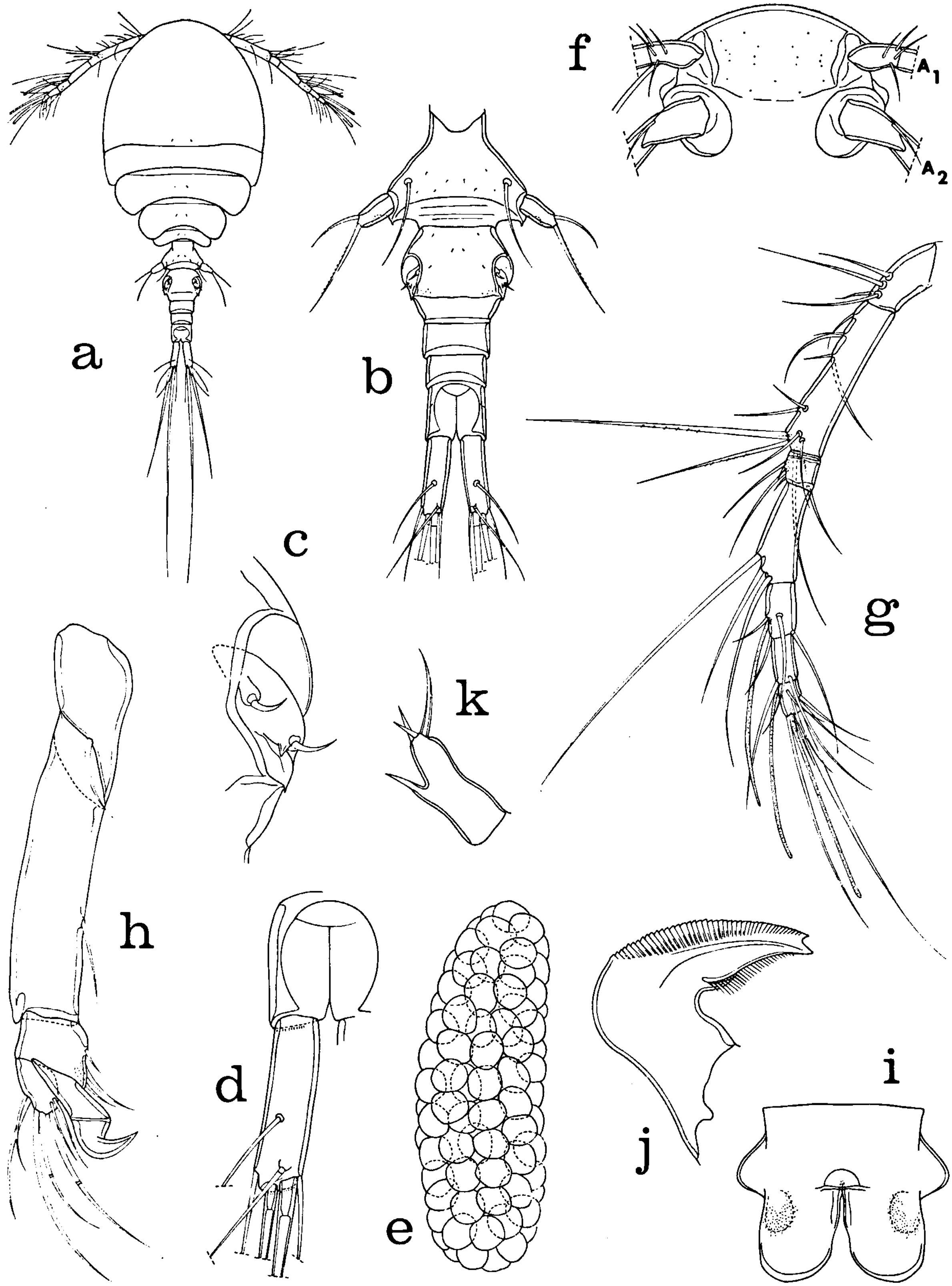

Fig. 18. *Scambicornus batiolatus* n. sp., female. a, dorsal (I); b, urosome, dorsal (D); c, genital area, dorsal (F); d, caudal ramus, dorsal (C); e, egg sac, dorsal (B); f, rostrum, ventral (D); g, first antenna, ventral (E); h, second antenna, anterior (C); i, labrum with position of paragnaths indicated by broken lines, ventral (C); j, mandible, posterior (G); k, first maxilla, posterior (G).

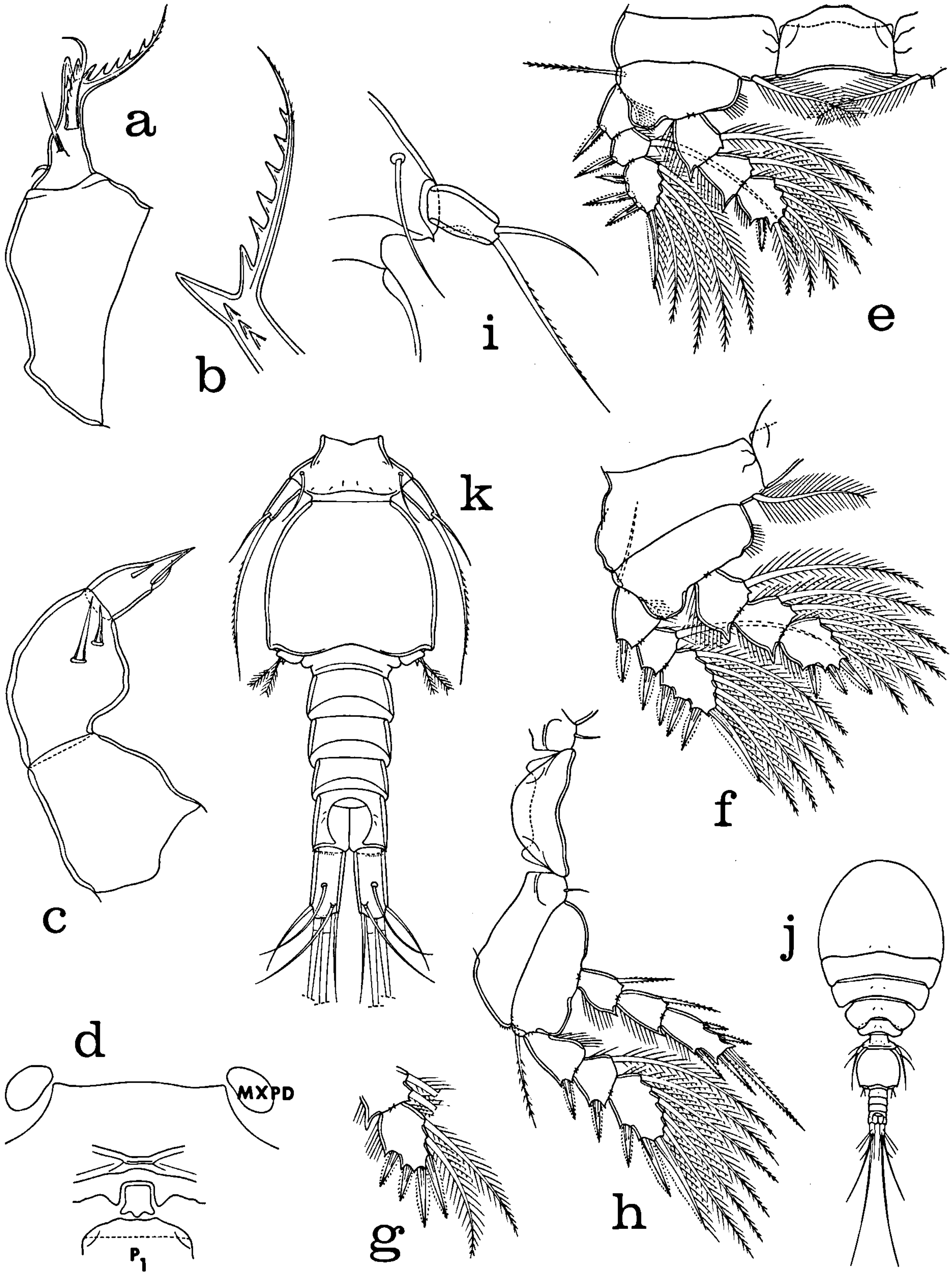

Fig. 19. *Scambicornus batiolatus* n. sp., female: a, second maxilla, posterior (G); b, lash of second maxilla, anterior (H); c, maxilliped, antero-inner (G); d, area between maxillipeds and first pair of legs, ventral (E); e, leg 1 and intercoxal plate, anterior (E); f, leg 2, anterior (E); g, third segment of endopod of leg 3, anterior (E); *h*, leg 4 and intercoxal plate, anterior (E); i, leg 5, dorsal (C). Male: j, dorsal (I); k, urosome, dorsal (E).

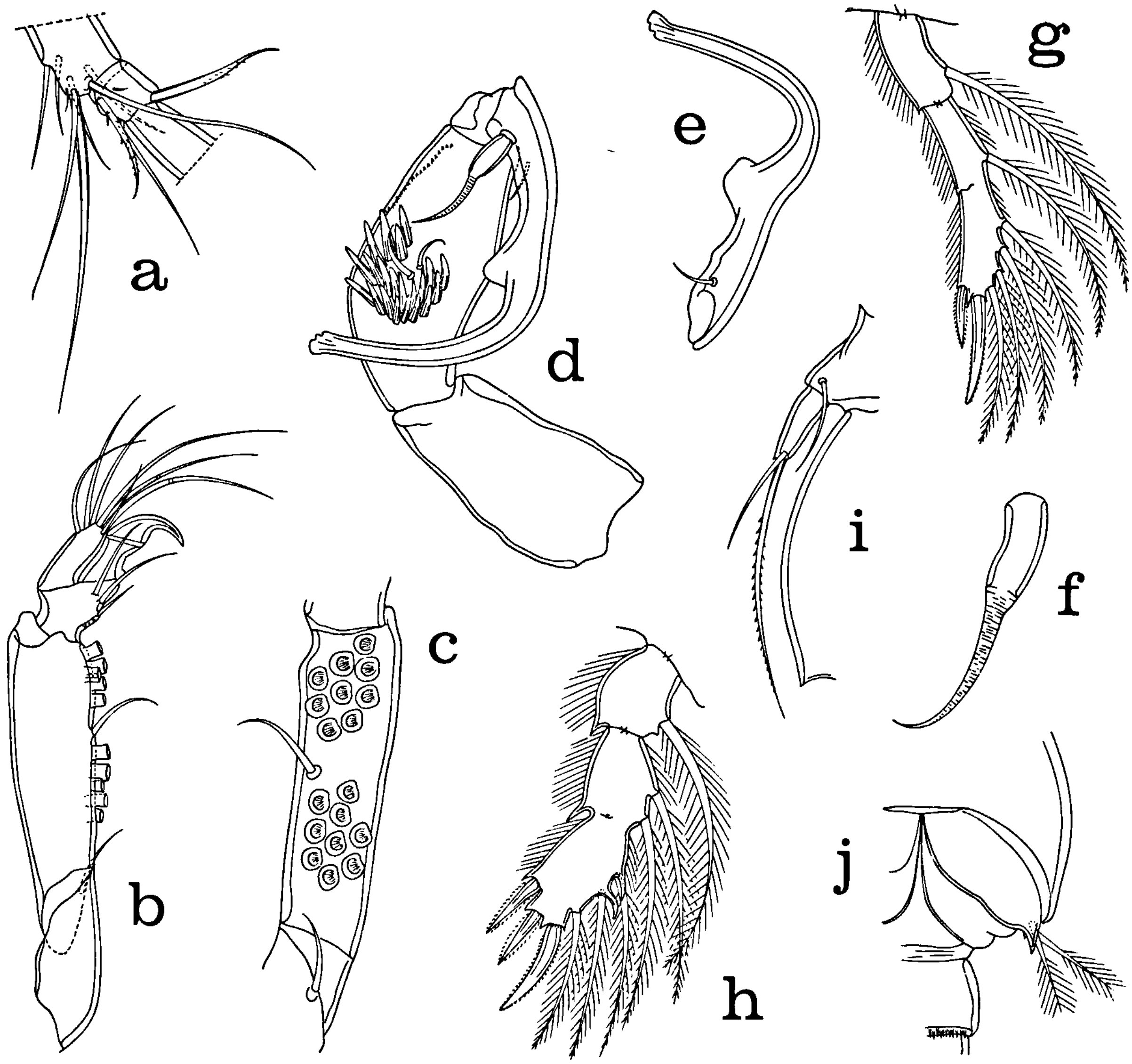

Fig. 20. *Scambicornus batiolatus* n. sp., male. a, third segment of first antenna, dorsal (C); b, second antenna, posterior (C); c, second segment of second antenna, ventral (anterior) (G); d, maxilliped, posterior (C); e, claw of maxilliped, anterior (C); f, proximal seta on claw of maxilliped, posterior (F); g, endopod of leg 1, anterior (C); h, endopod of leg 2, anterior (C); i, leg 5, dorsal (C); j, leg 6, ventral (C).

Second antenna (fig. 18h) 4-segmented, 250 µm long including claw. Armature: 1, 1, 3 + claw, and 7. All setae naked. Small fourth segment much shorter than claw which is 60 µm along its axis.

Labrum (fig. 18i), mandible fig. 18j), paragnath (fig. 18i), and first maxilla (fig. 18k) resembling those of *Scambicornus tylotus* Humes, 1975. Second maxilla (fig. 19a) also similar to that of *S. tylotus* but spinules on inner seta on second segment stronger and teeth on lash more evenly graduated (fig. 19b) than in that species. Maxilliped (fig. 19c) resembling that of *S. tylotus* but lacking patch of small spines on second segment.

Ventral area between maxillipeds and first pair of legs (fig. 19d) slightly protuberant.

Legs 1-4 (figs. 19e, 19f, 19g, 19h) with segmentation and spine and setal formula as in *S. tylotus*. Leg 4 with inner coxal seta 19 µm and naked. Endopod 112 μm long, with first and second segments having spinelike inner element. Five spines on third segment from outer to inner 30, 35, 71, 27, and 22 μm.

Leg 5 (fig. 19i) with small unornamented free segment 39 × 21 μm, ratio 1.86:1, its posterior surface slightly irregular. Outer terminal seta 52 μm and smooth, inner terminal seta 100 μm with outer spinules. Dorsal seta on body near insertion of free segment 40 μm and smooth.

Leg 6 represented by two setae on genital area (fig. 18c).

Color in life in transmitted light pale lavender brown, eye red, egg sacs gray.

Male. — Body (fig. 19j) resembling in general form that of female. Length (excluding setae on caudal rami) 0.80 mm (0.73-0.87 mm) and greatest width 0.37 mm (0.34-0.39 mm), based on 10 specimens in lactic acid. Ratio of length to width of prosome 1.39:1. Ratio of length of prosome to that of urosome 1.72:1.

Segment bearing leg 5 (fig. 19k) 39 × 86 μm. Genital segment 125 × 122 μm, about as long as wide, in dorsal view its outline slightly bell-shaped. Four postgenital segments from anterior to posterior 31 × 57, 34 × 55, 29 × 52, and 39 × 52 μm. First and second postgenital segments with posteroventral dentate fringe.

Caudal ramus (fig. 19k) 49 × 23 μm, ratio 2.13:1, shorter than in female.

Body surface ornamented with hairs and refractile points as in female.

Rostrum as in female. First antenna with segmentation, setal formula, and aesthetes as in female, but seta on posterior distal corner of third segment stouter (fig. 20a) than in female. This seta and many others with minute surficial spinules.

Second antenna (fig. 20b) with two groups of stalked suckers about 6 μm in diameter (nine in each group) on second segment (fig. 20c) and few minute spines on third segment. Otherwise second antenna resembling that of female.

Labrum, mandible, paragnath, first maxilla, and second maxilla like those of female. Maxilliped (fig. 20d) 4-segmented, assuming that proximal part of claw represents fourth segment. First segment unarmed. Second segment with two slender naked setae surrounded by patch of large spines, and in addition a longitudinal row of small spines. Third segment small and unornamented. Claw sharply recurved distally and 135 μm along its axis, with prominent knob on concave margin just proximal to flexure (fig. 20e), and bearing proximally two unequal setae, one seta slender, other seta with stout base and more slender striated distal portion (fig. 20f).

Ventral area between maxillipeds and first pair of legs like that of female.

Legs 1-4 similar to those of female except for endopods of legs 1 and 2. Endopod of leg 1 (fig. 20g) 2-segmented and slender, relatively longer (121 μm) than exopod (91 μm). Formula: 0-1; II, 4, 1. Endopod of leg 2 (fig. 20h) 2-segmented, slightly longer (114 μm) than exopod (102 μm). Formula: 0-1; I, II, 3, 2. Two long recurved spiniform processes on inner margin of distal part of second segment.

Leg 5 (fig. 20i) with small unornamented free segment 31 × 11 μm, ratio 2.82:1. Two terminal setae 44 μm and 105 μm. Dorsal seta 41 μm.

Leg 6 (fig. 20j) a posteroventral flap on genital segment bearing two plumose setae about 34 μm long and a spiniform process.

Color as in female.

Etymology. — The specific name *batiolatus*, derived from Latin *batiola* meaning a cup and the suffix *-atus* signifying provided with, refers to the cuplike suckers on the second antenna of the male.

Comparison with related species. — *Scambicornus batiolatus* differs from all but one species in the genus in having suckers on the second antenna of the male. Only in *Scambicornus poculiferus* (Humes & Cressey, 1961) is this appendage provided with suckers. The number of suckers (four) in that species is much smaller, however, than in the new species (eighteen). *S. batiolatus* may be further distinguished from *S. poculiferus* by the structure of the claw of the male maxilliped, sharply recurved with a prominent knob on the concave margin in the new species, but gently recurved with a smooth concave margin in *S. poculiferus*.

Scambicornus brachysetosus Reddiah, 1968

Host: *Holothuria* (*Halodeima*) *atra* Jaeger.

Site: Unknown, probably body surface.

Locality: Madras State, South India (Reddiah, 1968).
New record: 37 ♀♀ from the esophagus of *Holothuria atra,* Heron Island, eastern Australia, 9 April 1974. Collected by L. Cannon.
Notes: Length of ♀ 0.63 mm, ♂ 0.43 mm (Humes, 1975). Genital segment of ♀ wider than long, with sides evenly rounded. Caudal ramus of ♀ with ratio 2.1:1. Second antenna with fourth segment short, reaching to articulation of claw. Claw of ♂ maxilliped denticulate on convex side and having a proximally directed spiniform process near midregion.

Scambicornus calcaratus Humes, 1975
Host: *Actinopyga miliaris* (Quoy & Gaimard).
Site: Body surface.
Locality: Region of Nouméa, New Caledonia (Humes, 1975a).

Host: *Actinopyga palauensis* Panning.
Site: Body surface.
Locality: Region of Nouméa, New Caledonia (Humes, 1975a).

Host: *Actinopyga plebeja* (Selenka).
Site: Body surface.
Locality: Region of Nouméa, New Caledonia (Humes, 1975a).

Host: *Actinopyga serratidens* Pearson.
Site: Body surface.
Locality: Region of Nouméa, New Caledonia (Humes, 1975a).

Host: *Actinopyga echinites* (Jaeger).
Site: Body surface.
Locality: Region of Nouméa, New Caledonia (Humes, 1975a).

Host: *Actinopyga lecanora* (Jaeger).
Site: Body surface.
Locality: Region of Nouméa, New Caledonia (Humes, 1975a).
Notes: Length of ♀ 1.30 mm, ♂ 1.13 mm. Female genital segment only slightly wider than long, without lateral wings. Caudal ramus of ♀ with ratio 2.97:1, ♂ 2.14:1. Fourth segment of second antenna short, not reaching to articulation of claw. Third segment of exopod of leg 1 with unusually long distalmost lateral spine, as long as entire exopod in ♀. Second segment of ♂ maxilliped with large postero-inner patch of spines and many small bosses along its outer surface.

Scambicornus campanulipes (Humes & Cressey, 1961)
Preherrmannella campanulipes Humes & Cressey, 1961.
Host: *Actinopyga mauritiana* (Quoy & Gaimard).
Site: Body surface.
Locality: Region of Nosy Bé, northwestern Madagascar (Humes & Cressey, 1961; Humes, 1967).

Host: *Actinopyga echinites* (Jaeger).
Site: Body surface.
Locality: Region of Nosy Bé, northwestern Madagascar (Humes & Cressey, 1961; Humes, 1975); Mauritius (Humes, 1975b).

Host: *Actinopyga* sp.
Site: Body surface.
Locality: Region of Nosy Bé, northwestern Madagascar (Humes & Cressey, 1961).

Host: *Holothuria* (*Halodeima*) *atra* (Jaeger).
Site: Body surface.
Locality: Region of Nosy Bé, northwestern Madagascar (Humes & Cressey, 1961).

Host: *Actinopyga lecanora* (Jaeger).
Site: Body surface.
Locality: Region of Nosy Bé, northwestern Madagascar (Humes & Cressey, 1961; Humes, 1967); region of Nouméa, New Caledonia (Humes, 1975a).

Host: *Actinopyga miliaris* (Quoy & Gaimard).
Site: Body surface.
Locality: Region of Nosy Bé, northwestern Madagascar (Humes & Cressey, 1961; Humes, 1967).

Host: *Actinopyga plebeja* (Selenka).
Site: Body surface.
Locality: Region of Nouméa, New Caledonia (Humes, 1975a).
Notes: Length of ♀ 1.21 mm, ♂ 0.81 mm. Genital segment of ♀ wider than long, with two small dor-

sal protuberances on anterior half of segment. Leg 5 of ♀ campanuliform. Maxilliped of ♂ with broad obtuse spines on second segment; larger of two setae at base of claw bent angularly.

Scambicornus disparilis n. sp.

Figs. 21a-j, 22a-k, 23a-g

Type material. — 19 ♀♀, 6 ♂♂ from one holothurian, *Holothuria (Halodeima) atra* (Jaeger), in 10 m, southern shore of Goenoeng Api, Banda Islands, 4°32′05″S, 129°52′30″E, 26 April 1975. Holotype ♀, allotype, and 19 paratypes (15 ♀♀, 4 ♂♂) deposited in the Zoölogisch Museum, Amsterdam; the remaining paratypes (dissected) in the collection of the author.

Other specimens (all from *Holothuria atra*). — 15 ♀♀, 7 ♂♂ from 2 hosts, in 3 m, Poelau Gomumu, south of Obi, 1°50′00″S, 127°30′54″E, 30 May 1975; 8 ♀♀, 3 ♂♂ from 4 hosts, in 5 m, southwestern shore of Goenoeng Api, Banda Islands, 4°31′45″S, 129°51′55″E, 2 May 1975; 6 ♀♀, 7 ♂♂ from 1 host, in 4 m, Poelau Marsegoe, western Ceram, 2°59′30″S, 128°03′30″E, 15 May 1975; 3 ♂♂ from 1 host, in 3 m, Poelau Gomumu, south of Obi, 1°50′00″S, 127°30′54″E, 30 May 1975; 1 ♀, 2 ♂♂ from 1 host, in 18 m south of Poelau Naira (Bandanaira), Banda Islands, 4°32′12″S, 129°53′40″E, 2 May 1975; 2 ♀♀, 3 ♂♂ from 1 host, in 1.5 m, southwestern shore of Goenoeng Api, Banda Islands, 4°31′45″S, 129°51′55″E, 2 May 1975; 7 ♀♀, 5 ♂♂ from 4 hosts, in 4 m, Poelau Marsegoe, western Ceram, 2°59′30″S, 128°03′30″E, 15 May 1975.

Female. — Body (fig. 21a) with fairly broad prosome. Length (not including setae on caudal ramus) 1.11 mm (1.05-1.18 mm) and greatest width 0.60 mm (0.58-0.63 mm), based on 10 specimens in lactic acid. Segment of leg 1 separated from head by dorsal transverse furrow. Epimeral areas of segments of legs 1-4 as in figure. Ratio of length to width of prosome 1.21:1. Ratio of length of prosome to that of urosome 1.70:1.

Segment bearing leg 5 (fig. 21b) 78 × 143 μm. Genital segment 130 × 180 μm, broadest posteriorly. Genital areas situated at posterolateral corners of segment. Each area (fig. 21c) bearing two slender naked setae about 35 μm long and a minute knoblike process. Three postgenital segments from anterior to posterior 49 × 78, 52 × 75, and 73 × 73 μm. Anal segment with row of minute posteroventral spinules on each side.

Caudal ramus (fig. 21d) moderately elongate, 83 × 29 μm, ratio 2.86:1. Outer lateral seta (situated dorsally) 220 μm, dorsal seta 169 μm, outermost terminal seta 210 μm, innermost terminal seta 135 μm, and two long median terminal setae 495 μm (outer) and 650 μm (inner). All setae naked except two long haired terminal setae. Terminal ventral flange with minute marginal spinules.

Body surface with few hairs (sensilla) and numerous refractile points as in figure 21a.

Complete egg sacs not seen, but individual eggs ranging in diameter from 49-60 μm.

Rostrum (fig. 21e) without clearly defined posteroventral border.

First antenna (fig. 21f) 358 μm long. Lengths of seven segments (measured along their posterior nonsetiferous margins): 40 (55 μm along anterior margin), 122, 31, 62, 39, 26, and 23 μm respectively. Formula for armature as in *Scambicornus batiolatus* described above. Setae naked except for certain haired setae on segments 6 and 7.

Second antenna (fig. 21g) 280 μm long including claw. Armature as in *S. batiolatus*. Claw 75 μm along its axis. All setae naked.

Labrum (fig. 21h), mandible (fig. 21i), paragnath (fig. 21h), and first maxilla (fig. 21j) not greatly different from those of *S. batiolatus*. Second maxilla (fig. 22a) resembling that of *S. batiolatus* but first two teeth on lash distinctly larger than more distal teeth. Maxilliped (fig. 22b) with inner marginal spinules on second segment.

Ventral area between maxillipeds and first pair of legs as in *S. batiolatus*.

Legs 1-4 (figs. 22c, 22d, 22e, 22f) with segmentation and spine and setal formula as in *S. batiolatus*. Leg 4 with inner coxal seta 17 μm and naked. Endopod 107 μm long. Five spines on third segment from outer to inner 22, 36, 66, 40, and 39 μm.

Leg 5 (fig. 22g) with discoidal, medioventrally concave free segment 39 × 44 μm, ratio 1:0.89, slightly wider than long. Two terminal setae 86 μm (inner) and 68 μm (outer), both barbed. Free segment ornamented with few minute spinules near insertions of setae. Dorsal seta on body near free segment 65 μm and smooth.

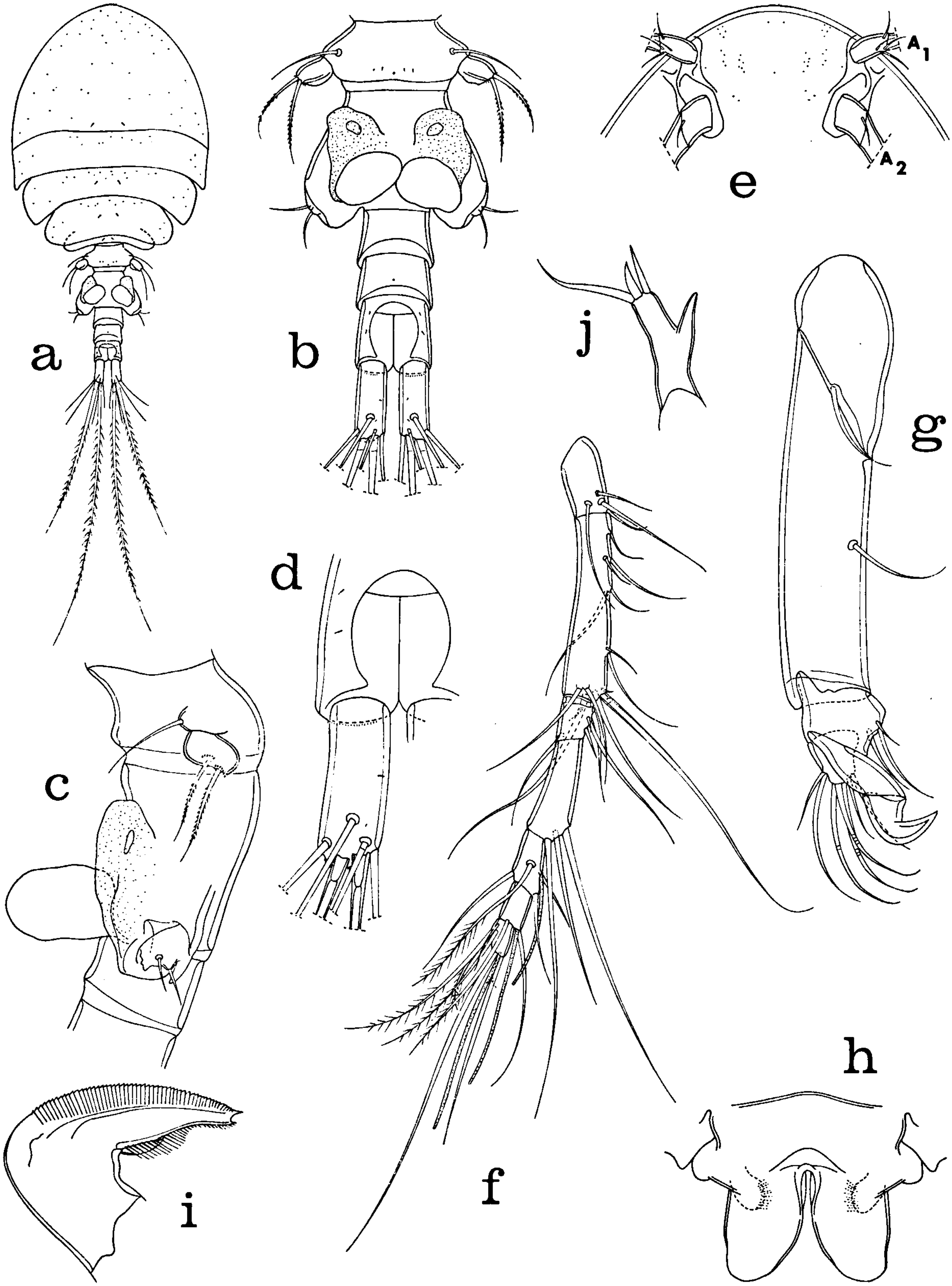

Fig. 21. *Scambicornus disparilis* n. sp., female. a, dorsal (I); b, urosome, dorsal (D); c, segment of leg 5, genital segment, and first postgenital segment, lateral (E); d, caudal ramus, dorsal (C); e, rostral area, ventral (B); f, first antenna, ventral (E); g, second antenna, anterior (C); h, labrum with position of paragnaths indicated by broken lines, ventral (C); i, mandible, posterior (G); j, first maxilla, posterior (G).

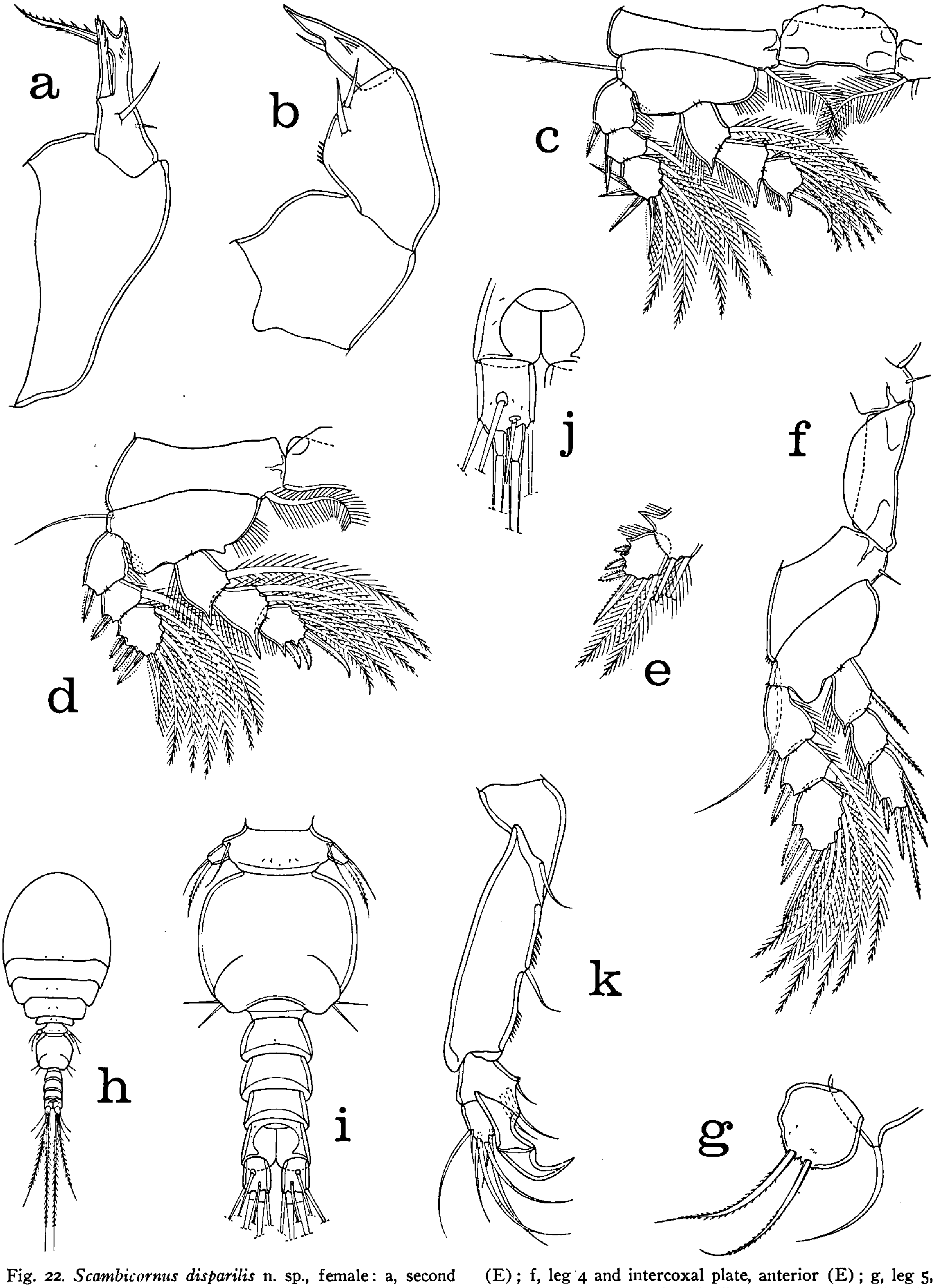

Fig. 22. *Scambicornus disparilis* n. sp., female: a, second maxilla, posterior (G); b, maxilliped, antero-inner (G); c, leg 1 and intercoxal plate, anterior (E); d, leg 2, anterior (E); e, third segment of endopod of leg 3, anterior (E); f, leg 4 and intercoxal plate, anterior (E); g, leg 5, medial (C). Male: h, dorsal (I); i, urosome, dorsal (E); j, caudal ramus, dorsal (G); k, second antenna, anterior (C).

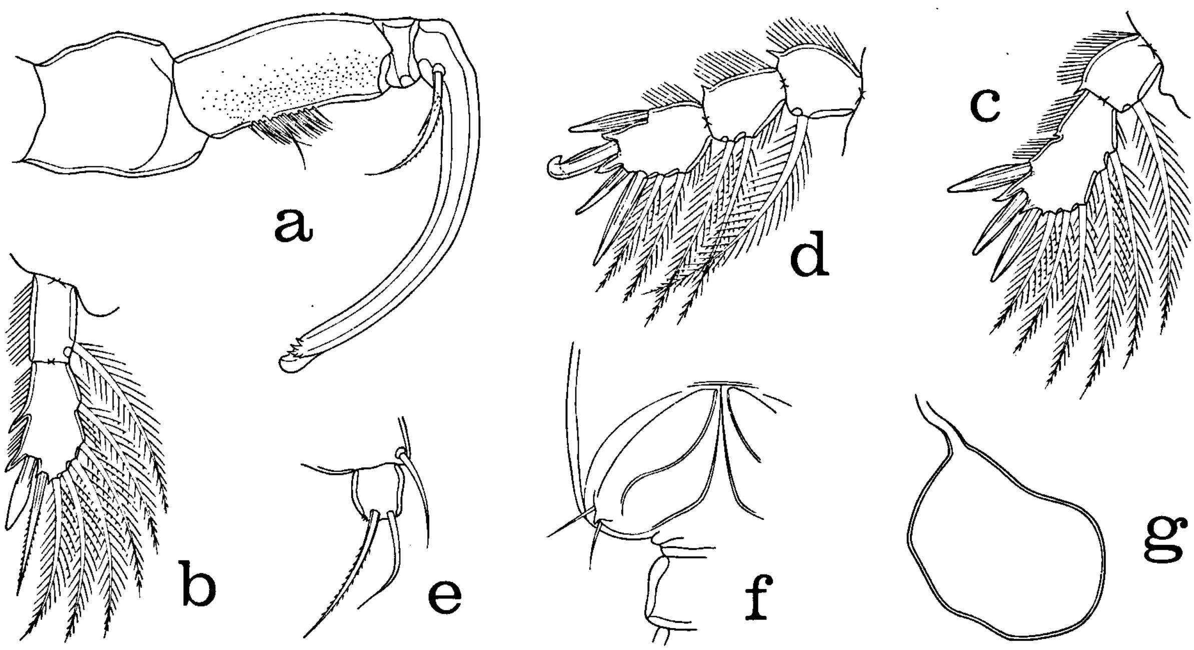

Fig. 23. *Scambicornus disparilis* n. sp., male. a, maxilliped, posterior (C); b, endopod of leg 1, anterior (C); c, endopod of leg 2, anterior (C); d, endopod of leg 3, anterior (C); e, leg 5, dorsal (G); f, leg 6, ventral (C); g, spermatophore, ventral (C).

Leg 6 represented by two setae on genital area (fig. 21c).

Color in life in transmitted light pale lavender brown, eye red, eggs gray.

Male. — Body (fig. 22h) with prosome less broad than in female. Length (excluding setae on caudal rami) 0.72 mm (0.66-0.76 mm) and greatest width 0.32 mm (0.30-0.33 mm), based on six specimens in lactic acid. Ratio of length to width of prosome 1.38:1. Ratio of length of prosome to that of urosome 1.62:1.

Segment bearing leg 5 (fig. 22i) 39 × 78 µm. Genital segment 99 × 112 µm, with gently rounded margins in dorsal view. Four postgenital segments from anterior to posterior 29 × 52, 29 × 49, 25 × 47, and 31 × 50 µm.

Caudal ramus (fig. 22j) much shorter than in female, 28 × 21 µm, ratio 1.33:1.

Body surface ornamented with hairs and fewer refractile points than in female.

Rostrum as in female. First antenna with segmentation and setal formula as in female, but many setae with minute surficial spinules as in *S. batiolatus.*

Second antenna (fig. 22k) resembling that of female but inner spinules on second and third segments.

Labrum, mandible, paragnath, first maxilla, and second maxilla like those of female. Maxilliped (fig. 23a) segmented as in *S. batiolatus.* Second segment inwardly with two slender naked setae, a group of long slender spinules, and a patch of refractile punctations. Claw 150 µm along its axis, bearing two very unequal proximal setae, longer seta barbed, shorter seta smooth.

Ventral area between maxillipeds and first pair of legs as in female.

Legs 1-4 similar to those of female except for endopods of legs 1, 2, and 3. Endopod of leg 1 (fig. 23b) short, 2-segmented, 87 µm long, with formula 0-1; II, 4, 1, outer spine broad and smooth, inner spine slender and minutely barbed. Endopod of leg 2 (fig. 23c) short, 2-segmented, 80 µm long, with formula 0-1; I, II, 3, 2, all three spines narrowly lamellate. Endopod of leg 3 (fig. 23d) 94 µm long, 3-segmented, with formula 0-1; 0-2; I, II, I, 2. Outer terminal spine stout with posteriorly recurved tip, inner terminal spine slender and straight. Leg 4 as in female.

Leg 5 (fig. 23e) with minute free segment 14 × 16 µm.

Leg 6 (fig. 23f) a posteroventral flap on genital segment bearing two slender naked setae about 40 µm long and a small spiniform process.

Spermatophore (fig. 23g) globular, 83 × 57 µm without neck, atached to dorsal surface of genital segment (figs. 21b, 21c) by cement substance (stippled area).

Color as in female.

Etymology. — The specific name *disparilis,* Latin meaning different or unequal, alludes to the dissimilar spines on the third endopod segment in leg 1 in the male.

Comparison with related species. — *Scambicornus disparilis* differs from all its congeners in the discoidal, medioventrally concave nature of the small free segment of leg 5 in the female. In other species this free segment is subrectangular and its medial surface is flat rather than concave.

S. disparilis may be distinguished readily from *Scambicornus batiolatus,* described above, by the shape of the female genital segment and the absence of suckers on the second antenna of the male.

Scambicornus hamatus Heegaard, 1944

Host: *Neothyonidium hawaiiense* (Fisher).

Site: On tentacles.

Locality: Sagami Sea, Japan (Heegaard, 1944).

Notes: Length of ♀ 1.13 mm, ♂ 0.97 mm (Stock, 1964). Genital segment of ♀ in dorsal view with central part much enlarged. Caudal ramus of ♀ with ratio about 3:1. Rostrum with a beaklike point. Second antenna with second segment bearing very short hairs; fourth segment short, reaching only to articulation of claw.

Scambicornus idoneus (Humes & Cressey, 1961)

Preherrmannella idonea Humes & Cressey, 1961.

Host: *Holothuria* (*Halodeima*) *atra* (Jaeger).

Site: Body surface.

Localities: Region of Nosy Bé, northwestern Madagascar (Humes & Cressey, 1961; Humes, 1967); region of Nouméa, New Caledonia (Humes, 1975a); Moluccas and Eniwetok Atoll (present paper).

New records (all from *Holothuria atra* in the Moluccas): 53 ♀♀, 57 ♂♂, and 24 copepodids from 9 hosts, in 2 m, Natsepa, Ambon, 3°27′05″S, 128°17′00″E, 11 May 1975; 64 ♀♀, 28 ♂♂, 14 copepodids from 1 host, in 3 m, Poelau Parang, eastern Ceram, 3°17′00″S, 130°44′48″E, 23 May 1975; 2 ♀♀ from 2 hosts, in 3 m, Poelau Gomumu, south of Obi, 1°50′00″S, 127°30′54″E, 30 May 1975; 1 ♀, 1 ♂ from 4 hosts, in 5 m, southwestern shore of Goenoeng Api, Banda Islands, 4°31′45″S, 129°51′55″E, 2 May 1975; 1 ♂ from 1 host, in 4 m, Poelau Marsegoe, western Ceram, 2°59′30″S, 128°03′40″E, 15 May 1975; 1 ♀ from 1 host, in 3 m, Poelau Gomumu, south of Obi, 1°50′00″S, 127°30′54″E, 30 May 1975; 1 ♂ from 1 host, in 18 m, Poelau Naira, Banda Islands, 4°32′12″S, 129°53′40″E, 2 May 1975; 2 ♀♀ from 1 host, in 1.5 m, southwestern shore of Goenoeng Api, Banda Islands, 4°31′45″S, 129°51′55″E, 2 May 1975; 2 ♂♂ from 1 host, in 2 m, Karang Mie, eastern Halmahera, 00°20′07″N, 128°25′00″E, 19 May 1975; 1 ♀ from 4 hosts, in 4 m, Poelau Marsegoe, western Ceram, 2°59′30″S, 128°03′30″E, 15 May 1975.

New record: 5 ♀♀, 1 ♂ from 2 *Holothuria atra,* in 1 m, in quarry, northern end of Eniwetok Island, Eniwetok Atoll, 14 June 1969. (The caudal ramus in the female is a little shorter than in typical *idoneus,* ranging from 91 × 25 µm to 104 × 23 µm, but otherwise all features are similar).

Host: *Actinopyga echinites* (Jaeger).

Site: Body surface.

Localities: Region of Nosy Bé, northwestern Madagascar (Humes & Cressey, 1961); region of Nouméa, New Caledonia (Humes, 1975a); Mauritius (Humes, 1975b).

Host: *Holothuria (Mertensiothuria) leucospilota* (Brandt).

Site: Body surface.

Localities: Region of Nosy Bé, northwestern Madagascar (Humes & Cressey, 1961); region of Nouméa, New Caledonia (Humes, 1975a).

Host: *Holothuria (Microthele) nobilis* (Selenka).

Site: Body surface.

Localities: Region of Nosy Bé, northwestern Madagascar (Humes, 1967); region of Nouméa and southeastern New Caledonia (Humes, 1975a).

Host: *Holothuria (Metriatyla) scabra* Jaeger.
Site: Body surface.
Locality: Region of Nosy Bé, northwestern Madagascar (Humes, 1967).

Host: *Holothuria (Halodeima) edulis* (Lesson).
Site: Body surface.
Locality: Region of Nosy Bé, northwestern Madagascar (Humes & Stock, 1973).

Host: *Bohadschia argus* Jaeger.
Site: Body surface.
Locality: Ceram, Moluccas (present paper).
New host record from *Bohadschia argus:* 5 ♀♀, 10 ♂♂ from 2 hosts, in 3 m, Poelau Parang, eastern Ceram, 3°17'00"S, 130°44'48"E, 23 May 1975.
Notes: Length of ♀ 1.23 mm, ♂ 0.72 mm. Female genital segment with well developed wings and having rows of hairs on genital areas. Caudal ramus in ♀ with ratio 5.23:1. Fourth segment of second antenna short, scarcely reaching articulation of claw. Second segment of ♂ maxilliped with two groups of small spines and with inner prominence between the two setae.

Scambicornus lobulatus Humes, 1967

Host: *Bohadschia graeffei* (Semper).
Site: Body surface.
Localities: Region of Nosy Bé, northwestern Madagascar (Humes, 1967).

Host: Bohadschia argus Jaeger.
Site: Body surface.
Locality: Moluccas (present paper).
New host records (all from *Bohadschia argus* in the Moluccuas): 40 ♀♀, 18 ♂♂ from 1 host, in 10 m, southern shore of Goenoeng Api, Banda Islands, 4°32'05"S, 129°52'30"E, 26 April 1975; 70 ♀♀, 45 ♂♂, 11 copepodids from 1 host, in 3 m southwestern shore of Goenoeng Api, Banda Islands, 4°31'45"S, 129°51'55"E, 2 May 1975; 9 ♀♀, 6 ♂♂, 6 copepodids from 1 host, in 5 m, Poelau Parang, eastern Ceram 3°17'00"S, 130° 44'48"E, 23 May 1975; 24 ♀♀, 16 ♂♂, 5 copepodids from 2 hosts, in 3 m, Poelau Gomumu, south of Obi, 1°50'00"S, 127°30'54"E, 30 May 1975.

Host: *Actinopyga echinites* (Jaeger).
Site: Body surface.
Locality: Banda Islands, Moluccas (present paper).
New host record from *Actinopyga echinites* in the Moluccas: 2 ♀♀, 1 ♂ from 1 host, in 2 m, Poelau Naira, Banda Islands, 4°31'45"S, 129°53'35"E, 2 May 1975.
Notes: Length of ♀ 1.39 mm, ♂ 0.71 mm. Genital segment of ♀ with posteriorly directed lateral wings. Egg sac lobulate. Caudal ramus of ♀ with ratio 2.9:1. Second antenna with fourth segment short, scarcely reaching to articulation of claw. Outer seta on basis of legs 3 and 4 very long, a little longer than exopod. Second segment of ♂ maxilliped with small inner spines and with posterior surface covered with minute spinules.

Scambicornus modestus (Humes & Cressey, 1961)

Preherrmannella modesta Humes & Cressey, 1961.

Host: *Stichopus monotuberculatus* (Quoy & Gaimard).
Site: Body surface.
Locality: Region of Nosy Bé, northwestern Madagascar (Humes & Cressey, 1961).

Host: *Stichopus chloronotus* Brandt.
Site: Body surface.
Localities: Region of Nosy Bé, northwestern Madagascar (Humes & Cressey, 1961; Humes, 1967); region of Nouméa, New Caledonia (Humes, 1975a); Moluccas (present paper).
New records (all from *Stichopus chloronotus* in the Moluccas): 8 ♀♀, 11 ♂♂ from 1 host, in 2 m, Karang Mie, eastern Halmahera, 00°20'07"N, 128°24'00"E, 19 May 1975; 6 ♀♀, 2 ♂♂ from 1 host, in 2 m, Karang Mie, 19 May 1975; 12 ♀♀, 10 ♂♂ from 1 host, in 2 m, Karang Mie, 19 May 1975; 5 ♀♀, 7 ♂♂ from 1 host, in 2 m, Karang Mie, 19 May 1975.

Host: *Stichopus variegatus* Semper.
Site: Body surface.
Localities: Region of Nosy Bé, northwestern Madagascar (Humes & Cressey, 1961; Humes, 1967); region of Nouméa, New Caledonia (Humes, 1975a).

Host: *Stichopus horrens* Selenka.
Site: Body surface.
Locality: Region of Nouméa, New Caledonia (present paper).
New host record: 1 ♀, 1 ♂ from one *Stichopus horrens* Selenka, intertidal under coral, eastern side of Ile Maître, near Nouméa, New Caledonia, 22°20'45"S, 166°24'45"E, 31 July 1971.

Host: *Holothuria (Lessonothuria) pardalis* Selenka.
Site: Body surface.
Locality: Region of Nosy Bé, northwestern Madagascar (Humes & Cressey, 1961).

Host: *Bohadschia draschi* Cherbonnier.
Site: Body surface.
Locality: Region of Nosy Bé, northwestern Madagascar (Humes & Cressey, 1961).

Host: *Holothuria (Platyperona) difficilis* (Semper) and *Ohshimella ehrenbergi* Selenka (hosts mixed at time of collection).
Site: Body surface.
Locality: Region of Nosy Bé, northwestern Madagascar (Humes, 1967).

Host: *Holothuria (Thymioscyia) impatiens* (Forskål).
Site: Body surface.
Locality: Region of Nosy Bé, northwestern Madagascar (Humes, 1967).

Host: black holothurian, probably *Holothuria atra* Jaeger.
Site: Body surface.
Locality: Seychelles (present paper).
New host record: 5 ♀♀, 1 ♂♂ from one black holothurian, probably *Holothuria atra* Jaeger, North Point, Mahe Island, Seychelles, 14 February 1964.
Notes: Length of ♀ 1.18 mm, ♂ 0.58 mm. Female genital segment with posteriorly directed lateral wings; genital area with large spiniform process. Caudal ramus in ♀ with ratio 2.71:1, ♂ 1.55:1. Fourth segment of second antenna short, scarcely reaching to articulation of claw.

Scambicornus petiti (Stock & Kleeton, 1963)

Preherrmannella petiti Stock & Kleeton, 1963.

Host: *Stichopus regalis* (Cuvier).
Site: Body surface.
Locality: Banyuls, France (Stock & Kleeton, 1963).
Notes: Length of ♀ 1.31-1.32 mm, ♂ 0.79-0.84 mm. Genital segment of ♀ much longer than wide. Caudal ramus in ♀ elongate, ratio approximately 7:1, ♂ about 3.33:1. Fourth segment of second antenna short, reaching only about halfway to articulation of claw.

Scambicornus poculiferus (Humes & Cressey, 1961)

Preherrmannella poculifera Humes & Cressey, 1961.

Host: *Synapta maculata* (Chamisso & Eysenhardt).
Site: Body surface.
Locality: Region of Nosy Bé, northwestern Madagascar (Humes & Cressey, 1961; Humes, 1967); southeastern New Caledonia (Humes, 1975a); Moluccas (present paper).
New record from *Synapta maculata* in the Moluccas: 348 ♀♀, 362 ♂♂, 146 copepodids from 11 hosts, in 3 m, Natsepa, Ambon, 3°37'05"S, 128° 11'00"E, 23 April 1975.

Host: *Opheodesoma grisea* (Semper)
Site: Unknown.
Locality: Bohol Island, Philippines (present paper).
New host record from *Opheodesoma grisea* in the Philippines: 4 ♀♀, 2 ♂♂ from one host, in 3 m, on sand flat with grass, Bohol Island, Philippines, 10°16.8'N, 124°10.8'E, 22 September 1975. Thomas Forhan collector.
Notes: Length of ♀ 1.04 mm, ♂ 0.66 mm. Female genital segment with moderately developed lateral wings. Caudal ramus in ♀ with ratio 1.57:1, ♂ 1.72:1. Fourth segment of second antenna elongate, reaching beyond claw. Second segment of second antenna of ♂ bearing four suckers. Second segment of ♂ maxilliped with large flattened obtuse spines.

Scambicornus prolixus n. sp.
Fig. 24a-i, 25a-j

Type material. — 1 ♀ from washings of three holothurians, *Holothuria edulis* Lesson, in 1 m, Pte. Lokobe, Nosy Bé, Madagascar, 5 November 1960. Holotype (dissected) deposited in the Zoölogisch Museum, Amsterdam.

Female. — Body (fig. 24a) elongate, more so than in any other species of *Scambicornus*. Length 1.21 mm and greatest width 0.38 mm, measured in lactic acid. Segment of leg 1 separated from head by a very weak dorsal transverse furrow. Epimeral areas of segments of legs 1-4 rounded. Ratio of length to width of prosome 1.68:1. Ratio of length of prosome to that of urosome 1.01:1.

Segment bearing leg 5 (fig. 24b) 78 × 146 μm. Genital segment 187 × 166 μm in greatest dimensions, in dorsal view widest in anterior two-thirds and abruptly narrowed in posterior third. Genital areas located laterally near middle of segment. Each genital area (fig. 24c) bearing two unequal setea, one seta 39 μm and smooth, other seta 104 μm, delicately barbed and arising on a distinct pedicel. Three postgenital segments from anterior to posterior 70 × 81, 65 × 84, and 60 × 83 μm. Anal segment with row of very small posteroventral and posterodorsal spinules on each side.

Caudal ramus (fig. 24d) moderately elongate, 86 × 31 μm (width taken at middle), ratio 2.77:1. Outer lateral seta 102 μm and naked, displaced ventrally from lateral position in most other sabelliphilids. Dorsal seta 57 μm, outermost terminal seta 99 μm, and innermost terminal seta 66 μm, all naked. Two long median terminal setae 216 μm (outer) and 260 μm (inner), both finely barbed and lacking proximal "joint" often seen in other *Scambicornus*.

Body surface with a few minute hairs (sensilla) as in figure 24a.

Egg sac not seen.

Rostral area (fig. 24e) poorly defined.

First antenna (fig. 24f) 294 μm long. Lengths of seven segments (measured along their posterior nonsetiferous margins): 18 (44 μm along anterior margin), 88, 26, 52, 37, 29, and 18 μm respectively. Formula for armature as in *Scambicornus batiolatus* above. All setae naked.

Second antenna (fig. 24g) 198 μm long, segmented and armed as in *S. batiolatus*. Second segment with small inner spinules proximal to seta. Claw 50 μm along its axis. All setae naked.

Labrum (fig. 24h), mandible (fig. 24i), and paragnath (fig. 24h) resembling in general form those of *S. batiolatus*. First maxilla (fig. 25a) with three terminal setae and a spiniform process and one subterminal seta. Second maxilla (fig. 25b) also resembling that of *S. batiolatus*, but inner seta on second segment with bilateral slender spinules; lash with one large proximal tooth in row of graduated slender spines (fig. 25c). Maxilliped (fig. 25d) similar to that of *S. batiolatus*, but distal antero-inner surface with many minute spinules.

Ventral area between maxillipeds and first pair of legs (fig. 25e) only slightly protuberant.

Legs 1-4 (figs. 25f, 25g, 25h, 25i) with segmentation and spine and setal formula as in *S. batiolatus*. Leg 4 (fig. 25) with inner coxal seta about 26 μm and naked. Exopod 107 μm. Endopod 97 μm long, with inner element on first segment a plumose seta, that on second segment a barbed spine. Five spines on third segment from outer to inner, 27, 32, 56, 43, and 26 μm.

Leg 5 (fig. 25j) with moderately elongate free segment 73 × 23 μm (width taken at middle), ratio 3.17:1. Outer terminal seta 78 μm, inner terminal seta 133 μm, both finely barbed. Dorsal seta 39 μm and smooth. Free segment with ventral row of spinules near insertion of two terminal setae.

Leg 6 represented by two setae on genital area (fig. 24c).

Color in life in transmitted light opaque gray, eye red.

Male. — Unknown.

Etymology. — The specific name *prolixus*, Latin meaning stretched out or elongate, alludes to the elongate body form and to the unusually long seta on the genital area.

Remarks. — *Scambicornus prolixus* differs from all other species of *Scambicornus* in its elongate body form and relatively slender prosome. The elongate seta on the genital area also is distinctive of the new species. The armature of the lash of the second maxilla, with a single large tooth in a graduated row of slender spines, differs from the armature of all other species in the genus.

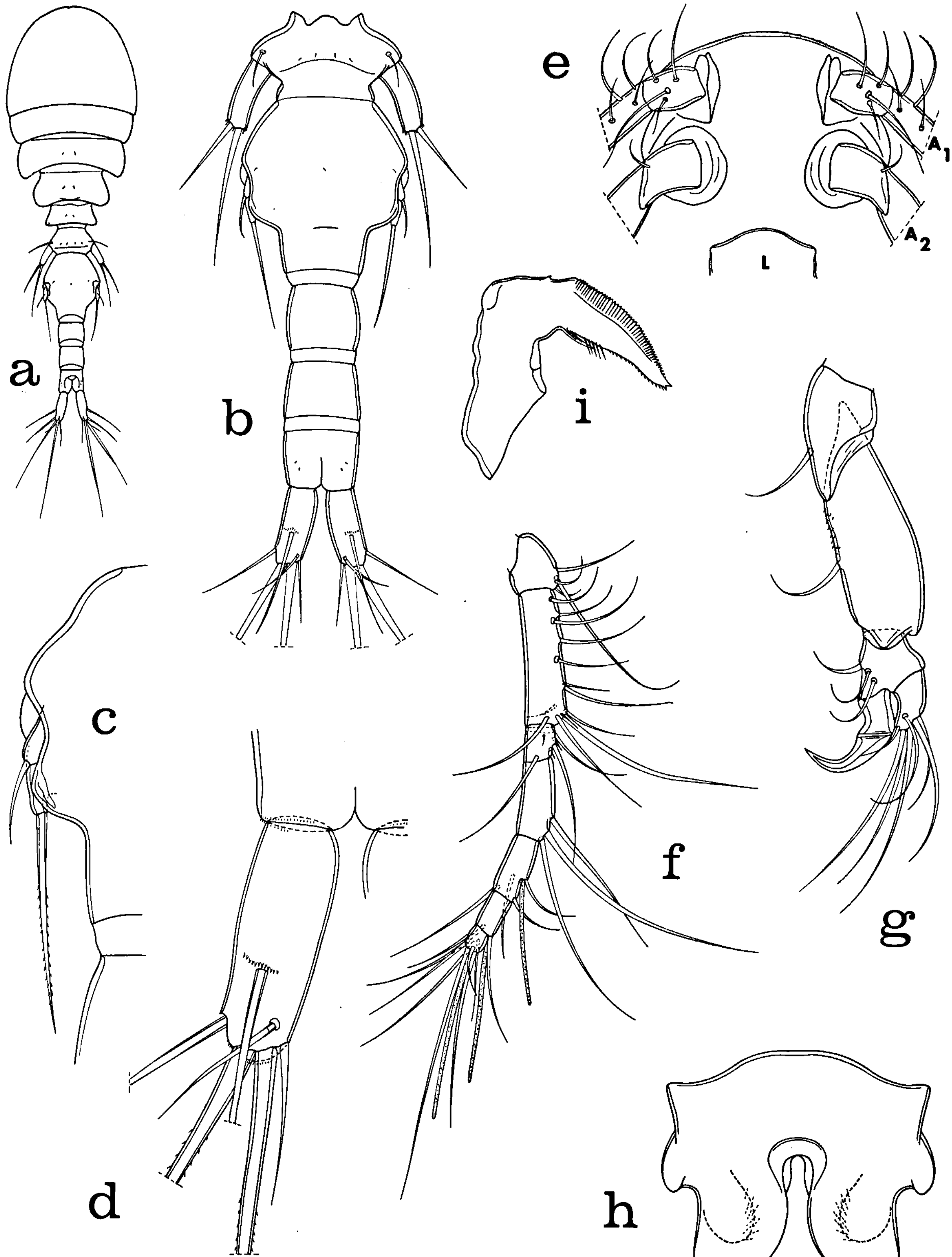

Fig. 24. *Scambicornus prolixus* n. sp., female. a, dorsal (I); b, urosome, dorsal (D); c, genital area, dorsal (C); d, caudal ramus, dorsal (G); e, rostrum, ventral (E); f, first antenna, dorsal (E); g, second antenna, posterior (C); h, labrum with position of paragnaths indicated by broken lines, ventral (G); i, mandible, posterior (G).

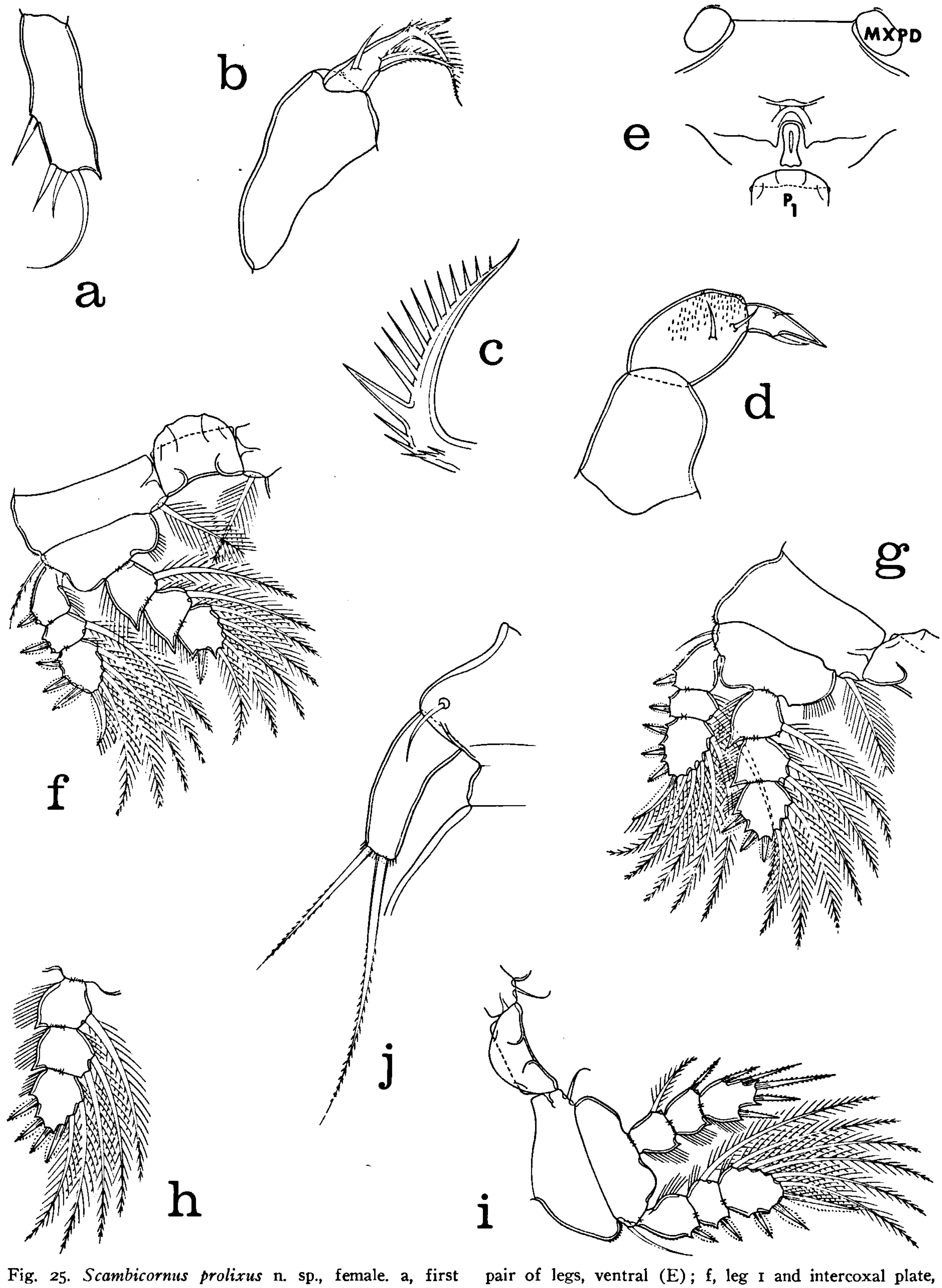

Fig. 25. *Scambicornus prolixus* n. sp., female. a, first maxilla, posterior (F); b, second maxilla, posterior (G); c, lash of second maxilla, posterior (H); d, maxilliped, antero-inner (G); e, area between maxillipeds and first pair of legs, ventral (E); f, leg 1 and intercoxal plate, anterior (E); g, leg 2, anterior (E); h, endopod of leg 3, anterior (E); i, leg 4 and intercoxal plate, anterior (E); j, leg 5, dorsal (C).

Scambicornus retrospiculus n. sp.
Figs. 26a-g, 27a-j, 28a-l

Type material. — 14 ♀♀, 22 ♂♂ from holothurian, *Stichopus variegatus* Semper, in 7 m, on barrier reef, Bohol Island, Philippines, 10°15.88'N, 124°08.61'E, 18 August 1975. Holotype ♀, allotype, and 29 paratypes (10 ♀♀, 19 ♂♂) deposited in the Zoölogisch Museum, Amsterdam; the remaining paratypes (dissected) in the collection of the author.

Female. — Body (fig. 26a) with prosome broad and relatively short. Length (not including setae on caudal rami) 1.37 mm (1.34-1.41 mm) and greatest width 0.68 (0.61-0.70 mm), based on 10 specimens in lactic acid. Segment of leg 1 separated from head by a weak dorsal transverse furrow. Epimeral areas of segment of leg 1 pointed, those of legs 2-4 rounded. Ratio of length to width of prosome 1.26:1. Ratio of length of prosome to that of urosome 1.5:1.

Segment bearing leg 5 (fig. 26b) 125 × 192 µm. Genital segment 177 × 229 µm, with lateral wings, each terminating in a posterolateral spiniform process. Genital areas situated laterally at posterior corners of wings. Each genital area (fig. 26c) bearing two naked setae 39 µm and 83 µm and a row of spinules. Three postgenital segments from anterior to posterior 68 × 82, 55 × 78, and 75 × 70 µm. Anal segment (fig. 26d) with row of very small posteroventral spinules on each side.

Caudal ramus (fig. 26d) moderately elongate, 94 × 31 µm, ratio 3:1. Outer lateral seta 234 µm, sparsely plumose distally, displaced ventrally and distally from lateral position usual in most other sabelliphilids. Dorsal seta 211 µm and weakly plumose distally. Outermost terminal seta 145 µm, innermost terminal seta 164 µm, both naked. Two long median terminal setae 440 µm (outer) and 770 µm (inner), both with lateral spinules (these frequently broken off in type material).

Body surface with a few small hairs (sensilla) and refractile points as in figure 26a.

Entire egg sacs not seen. Individual eggs about 52 µm in diameter.

Rostrum (fig. 26e) weakly developed with minute refractile bosses.

First antenna (fig. 26f) 436 µm long. Lengths of seven segments (measured along their posterior nonsetiferous margins): 34 (65 µm along anterior margin), 161, 34, 75, 44, 31, and 26 µm respectively). Formula for armature as in *Scambicornus batiolatus* above. All setae naked.

Second antenna (fig. 26g) 330 µm long, segmented and armed as in *S. batiolatus*. Claw 94 µm along its axis. All setae naked.

Labrum (fig. 27a), mandible (fig. 27b), paragnath (fig. 27a), and first maxilla (fig. 27c) similar in major features to those of *S. batiolatus*. Second maxilla (fig. 27d) also resembling that of *S. batiolatus,* but spinules on inner seta on second segment small and weak, and two subequal proximal teeth on lash much larger than succeeding spinules. Maxilliped (fig. 27e) similar to that of *S. batiolatus.*

Ventral area between maxillipeds and first pair of legs (fig. 27f) not protuberant.

Legs 1-4 (figs. 27g, 27h, 27i, 27j) with segmentation and spine and setal formula as in *S. batiolatus*. Leg 4 with inner coxal seta 20 µm and naked. Endopod of leg 4 133 µm long, with inner elements on first and second segments setiform. Five spines on third segment from outer to inner 33, 52, 95, 58, and 40 µm.

Leg 5 (fig. 28a) with small subrectangular free segment 34 × 21 µm, ratio 1.62:1 (length not including lamellar process). Outer terminal slender seta 62 µm and smooth. Inner terminal stout seta 86 µm with a row of minute spinules. Free segment near insertion of larger seta with a terminal ventral lamella having a minutely pectinate distal margin. Dorsal seta approximately 90 µm and weakly plumose distally.

Leg 6 represented by two setae on genital area (fig. 26c).

Color in life unknown.

Male. — Body (fig. 28b) with general form similar to female. Length (excluding setae on caudal rami) 0.69 mm (0.66-0.77 mm) and greatest width 0.39 mm (0.35-0.41 mm), based on 10 specimens in lactic acid. Ratio of length to width of prosome 1.27:1. Ratio of length of prosome to that of urosome 2.05:1.

Segment bearing leg 5 (fig. 28c) 23 × 71 µm. Genital segment 104 × 112 µm, only slightly wider than long. Four postgenital segments from an-

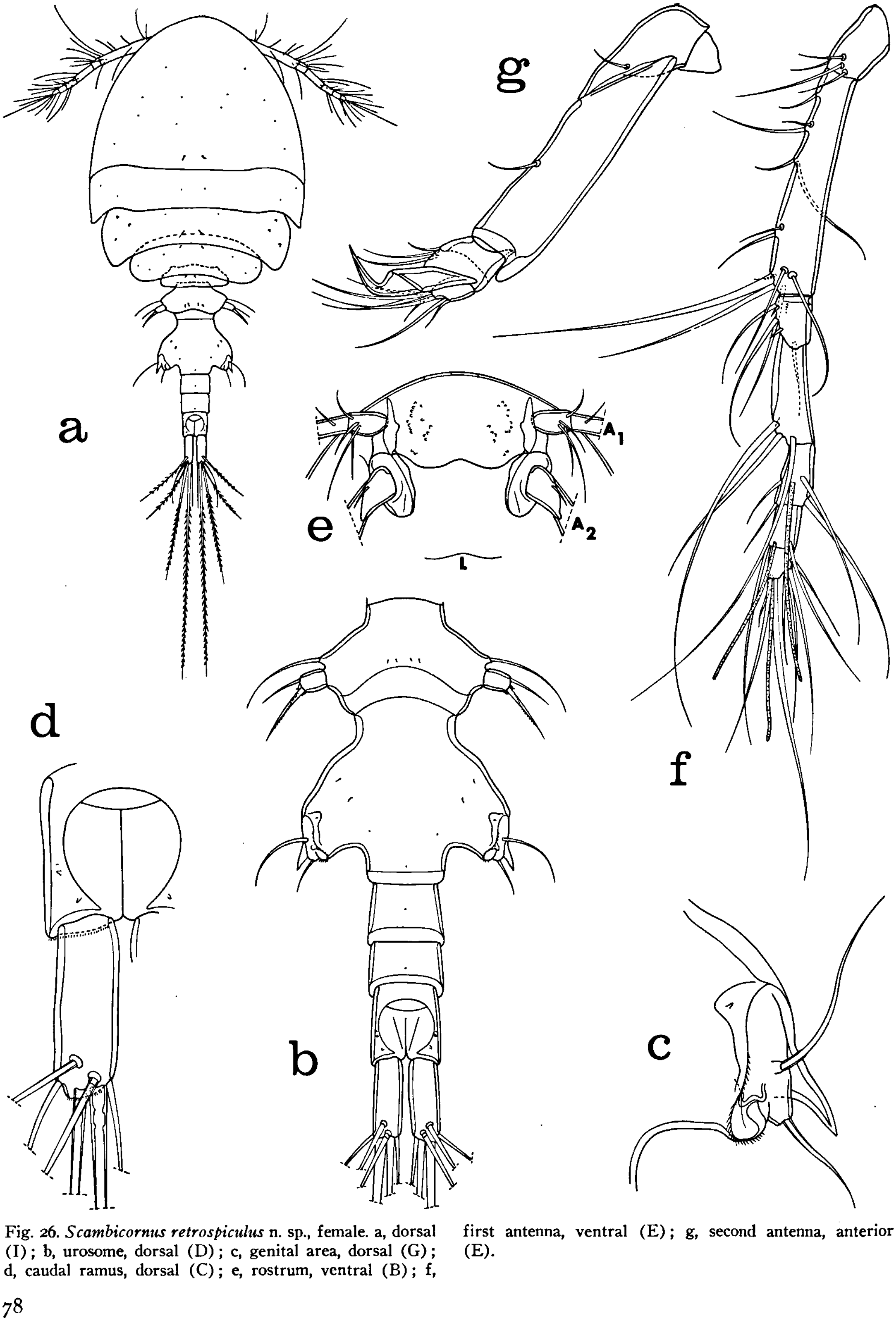

Fig. 26. *Scambicornus retrospiculus* n. sp., female. a, dorsal (I); b, urosome, dorsal (D); c, genital area, dorsal (G); d, caudal ramus, dorsal (C); e, rostrum, ventral (B); f, first antenna, ventral (E); g, second antenna, anterior (E).

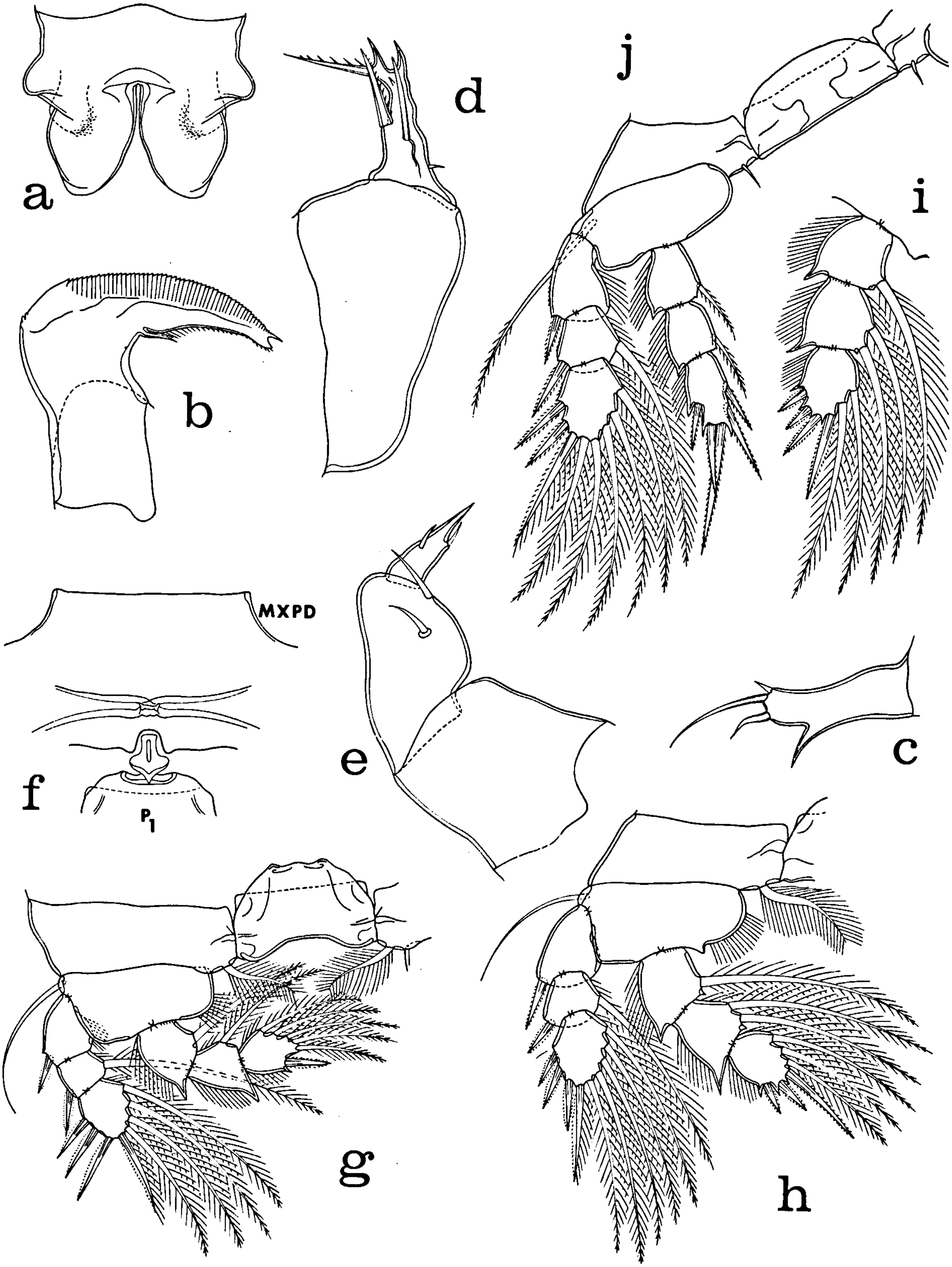

Fig. 27. *Scambicornus retrospiculus* n. sp., female. a, labrum with position of paragnaths indicated by broken lines, ventral (C); b, mandible, posterior (G); c, first maxilla, posterior (G); d, second maxilla, posterior (G); e, maxilliped, antero-inner (G); f, area between maxillipeds and first pair of legs, ventral (E); g, leg 1 and intercoxal plate, anterior (E); j, leg 2, anterior (E); i, endopod of leg 3, anterior (E); j, leg 4 and intercoxal plate, anterior (E).

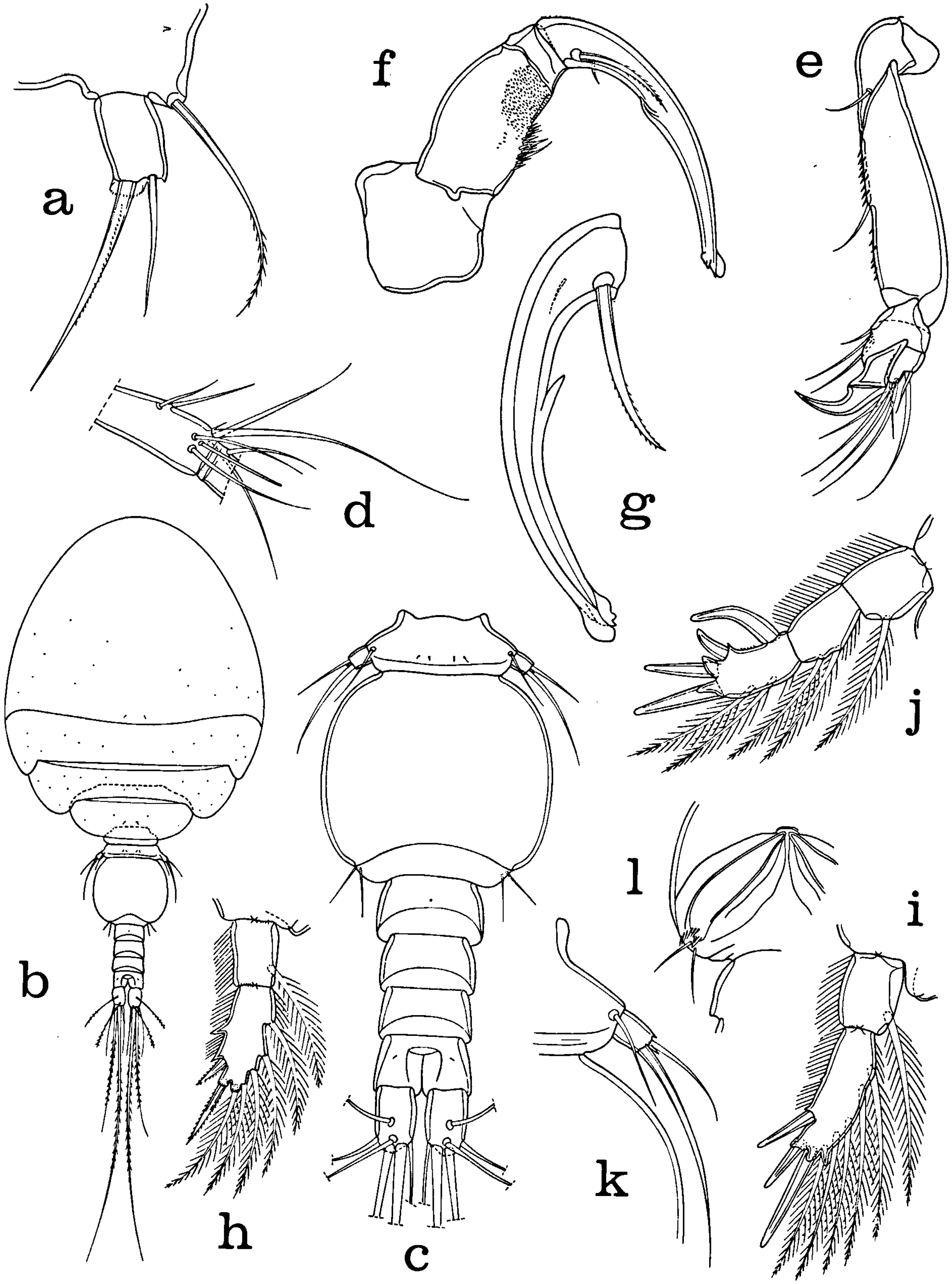

Fig. 28. *Scambicornus retrospiculus* n. sp., female: a, leg 5, dorsal (G). Male: b, dorsal (B); c, urosome, dorsal (C); d, distal part of second segment of first antenna, ventral (C); e, second antenna, anterior (C); f, maxilliped, posterior (C); g, claw of maxilliped, ventral (G); h, endopod of leg 1, anterior (C); i, endopod of leg 2, anterior (C); j, endopod of leg 3, anterior (C); k, leg 5, dorsal (F); l, leg 6, ventral (C).

terior to posterior 26 × 52, 26 × 49, 23 × 47, and 27 × 48 μm.

Caudal ramus (fig. 28c) shorter than in female, 31 × 20 μm, ratio 1.55:1.

Body surface with fine ornamentation similar to that of female.

Rostrum as in female. First antenna segmented and armed as in female, but a small aesthete added distally on second segment (fig. 28d) as in male of *Scambicornus lobulatus* Humes, 1967. Second antenna (fig. 28e) resembling that of female, but with small spines on inner surface of second segment.

Labrum, mandible, paragnath, first maxilla, and second maxilla like those of female. Maxilliped (fig. 28f) 4-segmented, assuming that proximal part of claw represents fourth segment. First segment unarmed. Second segment with two slender naked setae, a group of slender spines, and a patch of very small spinules. Small third segment unornamented. Claw 148 μm along its axis, with a prominent proximally directed barb on concave margin (fig. 28g), and bearing proximally two unequal setae, larger seta with barbules distally, smaller seta naked.

Ventral area between maxillipeds and first pair of legs like that of female.

Legs 1-4 similar to those of female except for endopods of legs 1-3. Endopod of leg 1 (fig. 28h) 2-segmented, a little longer (81 μm) than exopod (70 μm). Formula: 0-1; II, 4, 1. Spines barbed. Endopod of leg 2 (fig. 28i) 2-segmented, longer (96 μm) than exopod (78 μm). Formula: 0-1; I, II, 3, 2. Spines smooth with blunt slightly recurved spatulate tips. Endopod of leg 3 (fig. 28j) 3-segmented, longer (130 μm) than exopod (95 μm). Formula: 0-1; 0-2; I, III, 2. Spines smooth with blunt tips as in leg 2.

Leg 5 (fig. 28k) with very small unornamented free segment 10 × 8 μm, bearing terminally two unequal smooth setae approximately 30 μm and 50 μm, with a smaller slender spiniform process between them. Dorsal seta about 28 μm.

Leg 6 (fig. 28l) a posteroventral flap on genital segment bearing two smooth setae 28 μm and a row of slender spinules.

Spermatophore not observed.

Color in life unknown.

Etymology. — The specific name *retrospiculus,* a combination of Latin *retro* meaning back or backwards and *spiculus* meaning pointed, refers to the proximally directed barb on the claw of the male maxilliped.

Remarks. — *Scambicornus retrospiculus* may be distinguished from all other species of *Scambicornus* by the pointed proximally directed barb on the concave margin of the claw of the male maxilliped. In three species of *Scambicornus* this claw has processes or protuberances. Those in *Scambicornus tuberatus* (Humes & Cressey, 1961) and *Scambicornus tylotus* Humes, 1975, are digitiform or knoblike. Only in *Scambicornus brachysetosus* Reddiah, 1963, does the claw have a spiniform process. In this species, however, the process is shorter and stouter than in *Scambicornus retrospiculus.* The concave surface of the maxilliped claw of *S. brachysetosus* is finely denticulate rather than smooth as in the new species. The genital segment of the female of *S. brachysetosus* lacks the lateral wings seen in *S. retrospiculus.*

Although careful comparison of *S. retrospiculus* with *S. lobulatus* Humes, 1967, will reveal several similarities, the two species may be readily separated. In *S. lobulatus* the wings of the female genital segment lack prominent spiniform processes, the spinules on the second segment of the male second antenna are present only proximally to the seta, and the concave margin of the claw of the male maxilliped is smooth, without protuberances.

Scambicornus sentifer n. sp.

Figs. 29a-i, 30a-i, 31a-k

Type material. — 9 ♀♀, 4 ♂♂ from one holothurian, *Labidodemas semperianum* Selenka, in 3 m, Karang Mie, east central Halmahera 00°20′07″N, 128°25′00″E, 19 May 1975. Holotype ♀, allotype, and 8 paratypes (6 ♀♀, 2 ♂♂) deposited in the National Museum of Natural History, Smithsonian Institution, Washington, D.C.; the remaining paratypes (dissected) in the collection of the author.

Female. — Body (fig. 29a) with moderately broad prosome. Length (not including setae on caudal rami) 1.24 mm (1.20-1.27 mm) and greatest width 0.63 mm (0.61-0.65 mm), based on eight specimens in lactic acid. Segment of leg 1 separated

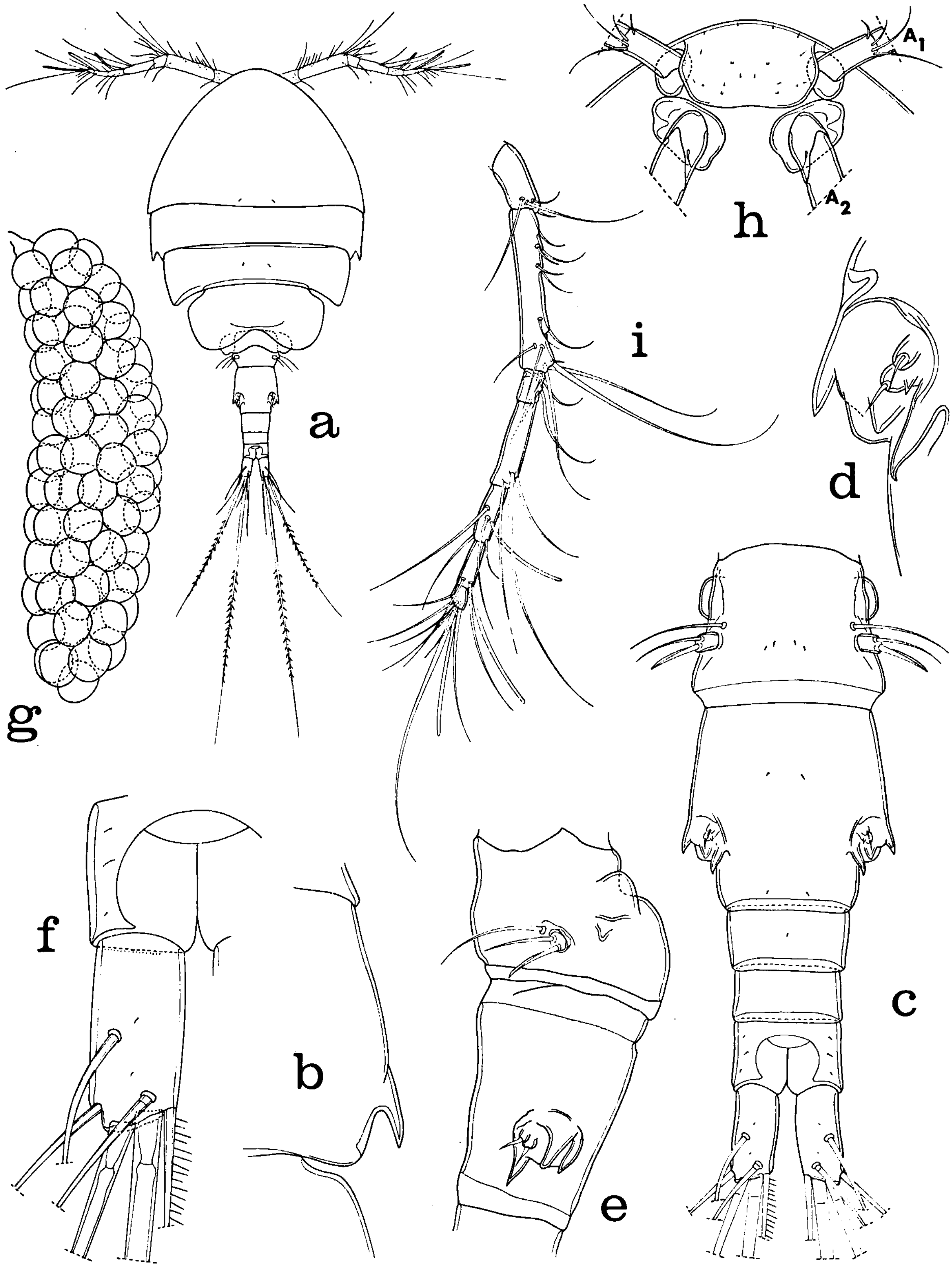

Fig. 29. *Scambicornus sentifer* n. sp., female. a, dorsal (I); b, edge of segment of leg 1, dorsal (C); c, urosome, dorsal (E); d, genital area, dorsal (F); e, segment of leg 5 and genital segment, lateral (E); f, caudal ramus, dorsal (G); g, egg sac, ventral (B); h, rostrum, ventral (D); i, first antenna, ventral (D).

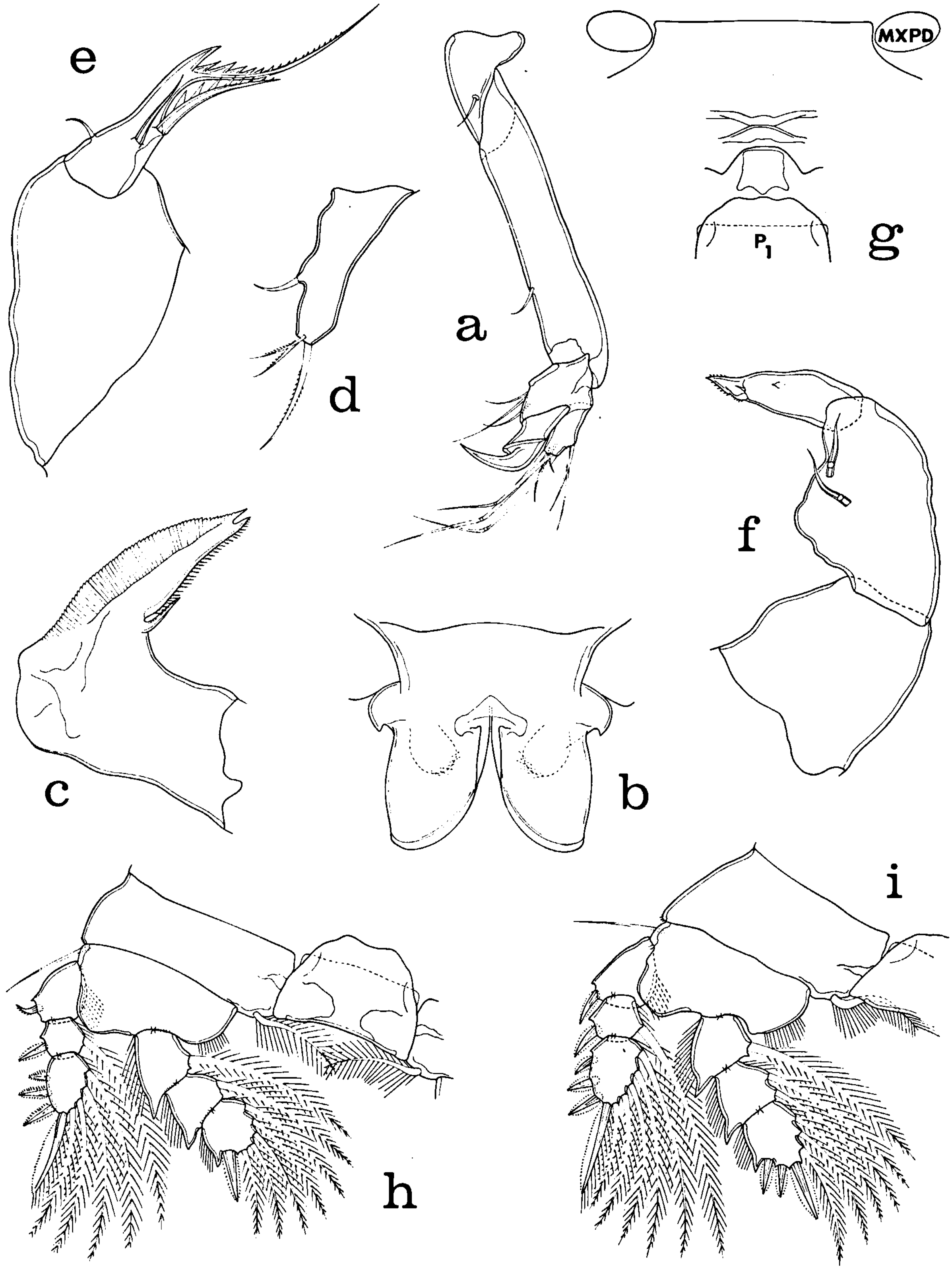

Fig. 30. *Scambicornus sentifer* n. sp., female. a, second antenna, anterior (E); b, labrum, ventral (C); c, mandible, posterior (G); d, first maxilla, posterior (G); e, second maxilla, posterior (G); f, maxilliped, antero-inner (G); g, area between maxillipeds and first pair of legs, ventral (E); h, leg 1 and intercoxal plate, anterior (E); i, leg 2, anterior (E).

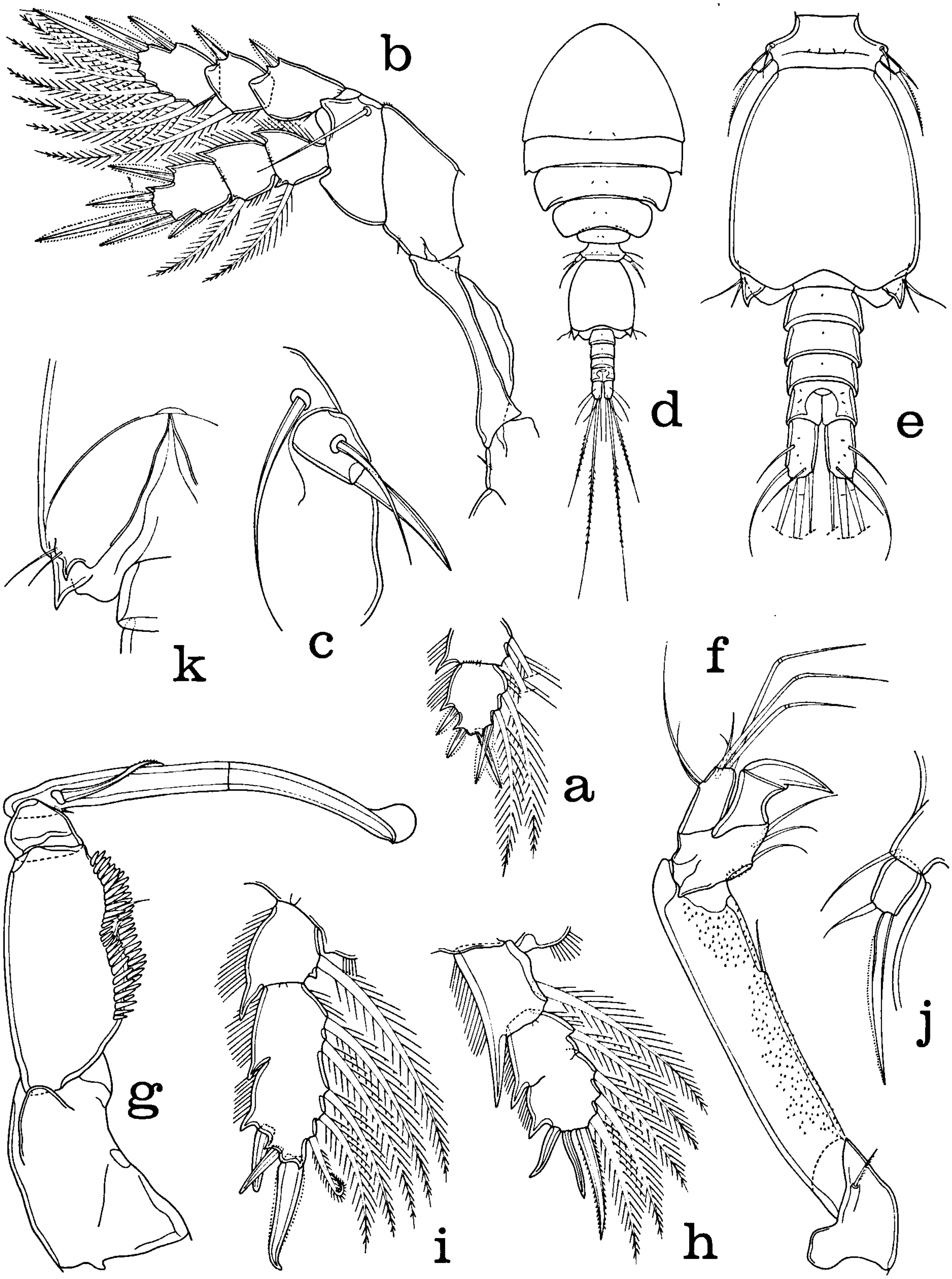

Fig. 31. *Scambicornus sentifer* n. sp., female: a, third segment of endopod of leg 3, anterior (E); b, leg 4 and intercoxal plate, anterior (E); c, leg 5, dorsal (F). Male: d, dorsal (I); e, urosome, dorsal (D); f, second antenna, anterior (C); g, maxilliped, posterior (C); h, endopod of leg 1, anterior (C); i, endopod of leg 2, anterior (C); j, leg 5, lateroventral (C); k, leg 6, ventral (E).

from head by a weakly defined dorsal transverse furrow. Epimeral areas of segment of leg 1 with prominent posteriorly directed thornlike process (fig. 29b), those of segment of leg 2 narrowly rounded, and those of segment of leg 3 broadly rounded. Tergum of segment of leg 3 partly covering in dorsal view small segment of leg 4. Ratio of length to width of prosome 1.29:1. Ratio of length of prosome to that of urosome 1.94:1.

Segment bearing leg 5 (fig. 29c) 104 × 135 μm, bearing laterally in front of fifth legs a pair of broad lobes. Genital segment 135 × 143 μm, slightly wider than long. Genital areas situated at junction of middle and posterior thirds. Each genital area (figs. 29d, e) bearing two small naked setae approximately 12 μm long and a small spiniform process. Near these setae three elongate lobes, two acuminate and one obtuse. Three postgenital segments from anterior to posterior 47 × 83, 39 × 73, and 52 × 75 μm. Anal segment with row of extremely minute posteroventral spinules on each side.

Caudal ramus (fig. 29f) elongate, 70 × 32 μm, ratio 2.19:1. Outer lateral seta (displaced dorsally) 80 μm, dorsal seta 110 μm, and outermost terminal seta 130 μm, all naked. Innermost terminal seta 148 μm with inner hairs. Two median terminal setae 495 μm (outer) and 880 μm (inner), both with short lateral spinules in their midregions and inserted between small dorsal flange (smooth) and ventral flange (with very small marginal spinules).

Body surface with a few hairs (sensilla) as in figures 29a, c.

Egg sac (fig. 29g) elongate, 705 × 210 μm, with numerous eggs ranging from 52-60 μm in diameter.

Rostrum (fig. 29h) broad with nearly transverse posteroventral margin.

First antenna (fig. 29i) 487 μm long. Lengths of seven segments (measured along their posterior nonsetiferous margins): 34 (73 μm along anterior margin), 169, 31, 86, 58, 49, and 21 μm respectively. Formula for armature as in *Scambicornus batiolatus* above. All setae naked.

Second antenna (fig. 30a) 340 μm long including claw, segmented and armed as in *S. batiolatus* above. All setae smooth.

Labrum (fig. 30b) with elongate posteroventral lobes. Mandible (fig. 30c), paragnath (fig. 30b), and first maxilla (fig. 30d) resembling those of *S. batiolatus*. Second maxilla (fig. 30e) with first tooth on lash distinctly larger than more distal teeth; otherwise generally similar to *S. batiolatus*. Maxilliped (fig. 30f) resembling in major respects that of *S. batiolatus* but two setae on second segment jointed near base and third segment with minutely barbed apex and one of two small setae with unilateral barbules.

Ventral area between maxillipeds and first pair of legs (fig. 30g) only slightly protuberant.

Legs 1-4 (figs. 30h, 30i, 31a, 31b) with segmentation and armature as in *S. batiolatus*. Leg 4 with inner coxal seta 13 μm and naked. Endopod of leg 4 122 μm long. Five spines on third segment from outer to inner 45, 48, 86, 55, and 30 μm.

Leg 5 (fig. 31c) small, free segment 19 × 14 μm, ratio 1.36:1. Two terminal elements unequal, one spiniform, 39 μm, with unilateral lamella, other setiform, 49 μm, and smooth. Dorsal adjacent seta 70 μm and naked.

Leg 6 represented by two small setae on genital area (fig. 29d).

Color in life in transmitted light opaque gray, eye red, egg sacs gray.

Male. — Body (fig. 31d) with prosome shaped nearly as in female. Length (excluding setae on caudal rami) 1.09 mm (1.01-1.10 mm) and greatest width 0.49 mm (0.46-0.53 mm), based on three specimens in lactic acid. Epimera of segment of leg 1 with thornlike processes as in female. Ratio of length to width of prosome 1.36:1. Ratio of length of prosome to that of urosome 1.41:1.

Segment of leg 5 (fig. 31e) 47 × 130 μm. Genital segment elongate, 247 × 190 μm, ratio 1.31:1, broadest posteriorly. Four postgenital segments from anterior to posterior 42 × 75, 42 × 70, 39 × 68, and 46 × 70 μm.

Caudal ramus resembling that of female but a little smaller, 61 × 30 μm, ratio 2.03:1.

Body surface ornamented as in female.

Rostrum and first antenna as in female. Second antenna (fig. 31f) resembling that of female but seta on first segment with minute unilateral barbules and inner surfaces of second and third segment with numerous small spines.

Labrum, mandible, paragnath, first maxilla, and second maxilla resembling those of female. Maxilliped (fig. 31g) segmented and armed as in other species of genus. Claw nearly straight, 198 μm along its axis, with large terminal lamella, weakly subdivided about midway, and bearing proximally two very unequal setae, larger seta with barbed tip.

Ventral area between maxillipeds and first pair of legs as in female.

Legs 1-4 similar to those of female except for endopods of legs 1 and 2. Endopod of leg 1 (fig. 31h) 2-segmented, but second segment with indication of subdivision; length of endopod 104 μm, longer than exopod (88 μm). Formula: 0-1; II, I, 3, 1. Two outer spines smooth, but inner spine barbed. Endopod of leg 2 (fig. 31i) 2-segmented, with less evidence of subdivision of second segment than in leg 1; length of endopod 122 μm, longer than exopod (96 μm). Formula: 0-1, I, II, 3, 2. Two outer spines smooth, inner spine fringed. Distalmost inner seta peculiarly reflexed on itself in all males seen. Endopods of legs 3 and 4 as in female.

Leg 5 (fig. 31j) with small free segment 26 × 20 μm, ratio 1.31:1. Two terminal elements, one spinelike, 80 μm, with unilateral fringe, other setiform, 33 μm, and smooth. Adjacent dorsal seta about 50 μm and smooth.

Leg 6 (fig. 31k) a posteroventral flap on genital segment bearing two smooth setae 52 μm and 39 μm, and a pointed process. Larger spiniform process at posterior outer corners of segment.

Spermatophore not observed.

Color in life as in female.

Etymology. — The specific name *sentifer*, from Latin *sentis*, a thorn, and *fero*, to bear, refers to the thornlike process on each side of the segment of leg 1.

Remarks. — *Scambicornus sentifer* differs from all its congeners in having a thornlike process on both epimera of the segment of leg 1 (these processes being much more acutely pointed than in *Scambicornus retrospiculus* (above). The three elongate lobes near the genital area of the female are also distinctive of this species.

Scambicornus sewelli Humes, 1975

Host: *Holothuria (Halodeima) edulis* (Lesson).
Site: Body surface.
Locality: Region of Nouméa, New Caledonia (Humes, 1975a).

Host: *Holothuria (Acanthotrapeza) coluber* (Semper).
Site: Body surface.
Locality: Region of Nouméa, New Caledonia (Humes, 1975a).

Host: *Holothuria (Halodeima) atra* (Jaeger).
Site: Body surface.
Locality: Region of Nouméa, New Caledonia (Humes, 1975a).

Host: *Holothuria (Mertensiothuria) fuscocinerea* (Jaeger).
Site: Body surface.
Locality: Region of Nouméa, New Caledonia (Humes, 1975a).

Host: *Actinopyga echinites* (Jaeger).
Site: Body surface.
Locality: Region of Nouméa, New Caledonia (Humes, 1975a).

Host: *Holothuria (Microthele) nobilis* (Selenka).
Site: Body surface.
Locality: Region of Nouméa, New Caledonia (Humes, 1975a).
Notes: Length of ♀ 1.14 mm, ♂ 0.71 mm. Female genital segment with lateral wings turned inwardly and ending in small flange. Caudal ramus in ♀ with ratio 2.19:1, ♂ 1.38:1. Fourth segment of second antenna short, not reaching to articulation of claw. Outer seta on basis of leg 4 longer than exopod. Leg 5 small, in ♀ 22 × 16 μm, in ♂ 10 × 7.5 μm. Convex margin of claw of ♂ maxilliped with sclerotization interrupted at five points, where margin protrudes on slight knob.

Scambicornus subgrandis (Humes & Cressey, 1961)

Preherrmannella subgrandis Humes & Cressey, 1961.

Host: *Labidodemas rugosum* (Ludwig).
Site: Body surface.
Locality: Region of Nosy Bé, northwestern Madagascar (Humes & Cressey, 1961).
Notes: Length of ♀ 1.40 mm, ♂ 0.68 mm. Female genital segment wider than long, with lateral wings. Genital areas with rows of long hairs. Cau-

dal ramus of ♀ with ratio 2.50:1, ♂ 1.39:1. Fourth segment of second antenna short, scarcely reaching articulation of claw.

Scambicornus subtilis (Humes & Cressey, 1961)

Preherrmannella subtilis Humes & Cressey, 1961.

Host: *Holothuria (Halodeima) edulis* (Lesson).
Site: Body surface.
Locality: Region of Nosy Bé, northwestern Madagascar (Humes & Cressey, 1961); region of Nouméa, New Caledonia (Humes, 1975a).

Host: *Opheodesoma grisea* (Semper).
Site: Body surface.
Locality: Region of Nosy Bé, northwestern Madagascar (Humes & Cressey, 1961).

Host: *Holothuria (Mertensiothuria) fuscocinerea* (Jaeger).
Site: Body surface.
Locality: Region of Nosy Bé, northwestern Madagascar (Humes & Cressey, 1961); region of Nouméa, New Caledonia (Humes, 1975a).

Host: *Holothuria (Acanthotrapeza) coluber* Semper.
Site: Body surface.
Locality: Region of Nouméa, New Caledonia (Humes, 1975a).

Host: *Holothuria (Halodeima) atra* (Jaeger).
Site: Body surface.
Locality: Region of Nouméa, New Caledonia (Humes, 1975a); Moluccas (present paper).
New record from *Holothuria atra* in the Moluccas: 1 ♀ from 4 hosts, in 5 m, southwestern shore of Goenoeng Api, Banda Islands, 4°31′45″S, 129°51′55″E, 2 May 1975.

Host: *Actinopyga echinites* (Jaeger).
Site: Body surface.
Locality: Region of Nouméa, New Caledonia (Humes, 1975a).

Host: *Holothuria (Microthele) nobilis* (Selenka).
Site: Body surface.
Locality: Region of Nouméa and southeastern New Caledonia (Humes, 1975a).
Notes: Length of ♀ 1.16 mm, ♂ 0.61 mm. Female genital segment wider than long, with posteriorly directed lateral wings. Caudal ramus in ♀ with ratio 1.67:1, ♂ of about 1:1. Fourth segment of second antenna short, not reaching to articulation of claw. Second segment of ♂ maxilliped bearing in addition to usual two setae two groups of slender spines and group of small spines.

Scambicornus tuberatus (Humes & Cressey, 1961)

Preherrmannella tuberata Humes & Cressey, 1961

Host: *Bohadschia* sp.
Site: Body surface.
Locality: Region of Nosy Bé, northwestern Madagascar (Humes & Cressey, 1961).

Host: *Bohadschia koellikeri* (Semper).
Site: Body surface.
Locality: Region of Nosy Bé, northwestern Madagascar (Humes & Cressey, 1961).

Host: *Thelenota ananas* (Jaeger).
Site: Body surface.
Locality: Region of Nosy Bé, northwestern Madagascar (Humes & Cressey, 1961).

Host: *Opheodesoma grisea* (Semper).
Site: Body surface.
Locality: Region of Nosy Bé, northwestern Madagascar (Humes & Cressey, 1961).

Host: *Bohadschia cousteaui* Cherbonnier.
Site: Body surface.
Locality: Region of Nosy Bé, northwestern Madagascar (Humes & Cressey, 1961).

Host: *Bohadschia marmorata* Jaeger.
Site: Body surface.
Locality: Region of Nosy Bé, northwestern Madagascar (Humes, 1967).

Host: *Bohadschia vitiensis* (Semper).
Site: Body surface.
Locality: Region of Nosy Bé, northwestern Madagascar (Humes & Stock, 1973); region of Nouméa, New Caledonia (Humes, 1975a).

Host: *Bohadschia argus* (Jaeger).
Site: Body surface.
Locality: Region of Nouméa, New Caledonia (Humes, 1975a); Moluccas (present paper).
New records (all from *Bohadschia argus* in the

Moluccas): 1 ♀, 6 ♂♂ from 1 host, in 3 m, Poelau Marsegoe, western Ceram, 2°59'30"S, 128°03'30"E, 15 May 1975; 2 ♂♂ from 2 hosts in 4 m, Poelau Marsegoe, 15 May 1975; 2 ♂♂ from 1 host, in 3 m, Karang Mie, eastern Halmahera, 00°20'07"N, 128°25'00"E, 19 May 1975.
Notes: Length of ♀ 1.05 mm, ♂ 0.68 mm. Female genital segment a little wider than long with rounded lateral margins but lacking lateral wings. Caudal ramus of ♀ with ratio 2.38:1, ♂ 2.16:1. Fourth segment of second autenna short, not reaching to articulation of claw. Maxilliped of ♂ with second segment having inner proximal expansion and bearing prominent obtuse spines; claw having proximal digitiform protuberance on concave side and slightly swollen distally.

Scambicornus tylotus Humes, 1975

Host: *Bohadschia argus* (Jaeger).
Site: Body surface.
Locality: Region of Nouméa, New Caledonia (Humes, 1975a); Moluccas (present paper).
New records (all from *Bohadschia argus* in the Moluccas): 18 ♀♀, 3 ♂♂ from 1 host, in 3 m, Poelau Marsegoe, western Ceram 2°59'30"S, 128°03'30"E, 15 May 1975; 5 ♀♀ 11 ♂♂ from 2 hosts, in 4 m, Poelau Marsegoe, 15 May 1975; 1 ♀ from 1 host, in 3 m, Karang Mie, eastern Halmahera, 00°20'07"N, 128°25'00"E, 19 May 1975; 1 ♀ from 2 hosts, in 3 m, Poelau Parang, eastern Ceram, 3°17'00"S, 130°44'49"E, 23 May 1975.
Notes: Length of ♀ 1.19 mm, ♂ 1.03 mm. Genital segment of ♀ wider than long, anterior three-fourths laterally expanded and posterior fourth abruptly narrowed. Caudal ramus in ♀ with ratio 2.5:1, ♂ 2.12:1. Fourth segment of second antenna short, hardly reaching to articulation of claw. Concave margin of claw of ♂ maxilliped undulating, with three knoblike processes; claw distinctly narrowed between distal two of these processes.

Key to the species of *Scambicornus* associated with holothurians

1. Body of female elongate, ratio of length to width 3.18:1; one of two setae on genital area unusually long (104 µm) .... *S. prolixus*
   Body of female not elongate, ratio of length to width less than 2.3:1; setae on genital area not unusually long 2
2. Leg 5 in female bell-shaped, much wider proximally than distally; genital segment with pair of dorsolateral toothlike protuberances .... *S. campanulipes*
   Leg 5 in female subrectangular, or if shaped otherwise not wider proximally than distally; genital segment lacking pair of dorsolateral toothlike protuberances 3
3. Third outer spine on third segment of exopod of leg 1 unusually long (as long as exopod) .... *S. calcaratus*
   This spine not unusually long 4
4. Egg sac lobulate .... *S. lobulatus*
   Egg sac symmetrical 5
5. Concave side of claw of male maxilliped with protuberances or processes 6
   Concave side of claw of male maxilliped without protuberances or processes 9
6. Concave side of claw of male maxilliped with spiniform process 7
   Concave side of claw of male maxilliped with digitiform protuberance or knoblike processes 8
7. Concave margin of claw of male maxilliped finely denticulate, spiniform process stout and short .... *S. brachysetosus*
   Concave margin of claw of male maxilliped smooth, spiniform process long and barblike .... *S. retrospiculus*
8. Concave margin of claw of male maxilliped with one rounded digitiform protuberance ... . *S. tuberatus*
   Concave margin of claw of male maxilliped with three knoblike processes ...... *S. tylotus*
9. With suckers on second segment of male second antenna 10
   Without suckers on second segment of male second antenna 11
10. With four suckers on second segment of male second antenna; caudal ramus of female about 1.6:1 .... *S. poculiferus*
    With 18 suckers on second segment of male second antenna; caudal ramus of female 3.77:1 .... *S. batiolatus*
11. Convex margin of claw of male maxilliped with sclerotization interrupted at five slightly protruding knobs .... *S. sewelli*

Convex margin of claw of male maxilliped smooth, sclerotization not interrupted 12
12. Caudal ramus of female at least 5:1 13
Caudal ramus of female less than 4:1 ... 14
13. Caudal ramus of female about 6:1 ... *S. petiti*
Caudal ramus of female about 5.2:1 .... *S. idoneus*
14. Epimera of segment of leg 1 with prominent posteriorly directed process; sides of female genital segment in dorsal view not expanded .... *S. sentifer*
Epimera of segment of leg 1 without thornlike process; sides of female genital segment expanded 15
15. Genital segment of female expanded but without lateral wings; rostrum with beak-shaped point .... *S. hamatus*
Genital segment of female expanded to form prominent lateral wings; rostrum weakly defined, without beak-shaped point 16
16. Length of female 1.40 mm; free segment of leg 561 × 29 μm, ratio 2.1:1 .... *S. subgrandis*
Length of female less than 1.25 mm; free segment of leg 5 approximately 37 × 22 μm, ratio less than 1.8:1 17
17. Caudal ramus of female 2.7:1 ... *S. modestus*
Caudal ramus of female 1.67:1 ... *S. subtilis*

Synapticola Voigt, 1892

Body transformed, elongate. First antenna 7-segmented. Second antenna 4-segmented, with one claw on third segment. Legs 1-4 with 3-segmented exopods and 2-segmented endopods. Endopod of leg 4 with 0-1; III. Leg 5 lacking free segment and consisting of two setae arising from cuticular ring and an adjacent seta. Concave margin of claw of ♂ maxilliped with group of small spines followed by ragged fringe.

Synapticola teres Voigt, 1892

Host: *Polyplectana kefersteini* (Selenka).
Site: Body cavity.
Locality: Amboina (Voigt, 1892).

Host: *Synapta maculata* (Chamisso & Eysenhardt).
Site: Posterior intestine.
Locality: Queensland, Australia (Humes, 1979).

Cucumaricolidae Bouligand & Delamare-Deboutteville, 1959

Cucumaricola Paterson, 1958

Body strongly modified and transformed. Sexually dimorphic. No mandibles or maxillae in adults. Maxilliped in ♂ uncinate, in ♀ a bulbous protuberance. Three pairs of legs, in ♂ small, each with terminal clawlike process and three verrucose areas; in ♀ first pair of legs small, second and third pairs very large, unjointed, bilobed, and somewhat boot-shaped. Life cycle: nauplius (probably several instars) within egg membrane, followed by free active swimming copepodid, quiescent copepodid, juvenile, and adult.

Cucumaricola notabilis Paterson, 1958

Host: *Cucumaria frauenfeldi* Ludwig.
Site: In cysts in coelom.
Locality: Cape Town, South Africa.
Notes: Length of ♀ approximately 35 mm, ♂ 4.0 mm.

Lichomolgidae Kossmann, 1877

Metaxymolgus Humes & Stock, 1972

Body cyclopiform. First antenna 7-segmented. Second antenna 4-segmented, with two claws on fourth segment. Legs 1-4 with 3-segmented rami except endopod of leg 4 which is 2-segmented, with formula 0-1; II, seta being feathered.

Metaxymolgus cuspis (Humes, 1964)

Host: Holothurians.
Site: In washings.
Locality: Gulf of Manaar, southeastern India (Sebastian, 1972).
Notes: Length of ♀ 1.53 mm, ♂ 1.31 mm. According to Sebastian the presence of this copepod on holothurians is probably accidental. *M. cuspis* is associated with the giant actiniarian *Stoichactis* in Madagascar (Humes, 1964) and India (Sebastian, 1972).

Stellicola Kossmann, 1877

Body cyclopiform, in ♀ with broad prosome. Urosome in ♀ 5-segmented, in ♂ fundamentally 6-segmented but segment of leg 5 fused with genital segment. First antenna 7-segmented. Second antenna 3-segmented with one terminal claw. Legs 1-4 with 3-segmented rami except leg 4 endopod which is 2-segmented with formula 0-1; II, I (but 0-1; II in *Stellicola pollex* Humes & Ho, 1967).

Stellicola holothuriae (Ummerkutty, 1962)
Figs. 32a-j, 33a-k.

Lichomolgus holothuriae Ummerkutty, 1962.

Host: Holothurians.
Site: In washings.
Locality: Gulf of Mannar, southeastern India (Ummerkutty, 1962).
Notes: Length of ♀ 1.2 mm, ♂ 0.75 mm.

Host: *Opheodesoma spectabilis* Fisher.
Site: In washings.
Locality: Nosy Bé, northwestern Madagascar (present paper).
New host record: 3 ♂♂, 1 ♀ from two *Opheodesoma spectabilis,* in 3 m, on sand flat with *Cymodocea,* west of Pte. Mahatsinjo, Nosy Bé, Madagascar, 7 August 1960.

Redescription of *Stellicola holothuriae* (Ummerkutty, 1962) based on specimens from *Opheodesoma spectabilis*:

Male. — Body (fig. 32a) flattened. Length (not including setae on caudal rami) 0.73 mm (0.70-0.75 mm) and greatest width 0.43 mm (0.42-0.45 mm), based on three specimens in lactic acid. Ratio of length to width of prosome 1.17:1. Ratio of length of prosome to that of urosome 2.22:1.

Segment of leg 5 (fig. 32b) fused with genital segment. Combined segment 122 μm long, 113 μm wide at level of fifth legs, and 108 μm wide in area of genital segment. Four postgenital segments from anterior to posterior 34 × 58, 34 × 53, 26 × 49, and 29 × 49 μm.

Caudal ramus (fig. 32c) quadrate, 23 × 22 μm. Outer lateral seta 42 μm and dorsal seta 47 μm, both smooth. Outermost terminal seta 109 μm and innermost terminal seta 117 μm, with widely spaced lateral hairs. Two long median terminal setae 240 μm (outer) and 385 (inner), both with lateral hairs. Proximally on outer edge of ramus a slender setule about 16 μm long.

Body surface with a few hairs (sensilla) as in figure 32a.

Rostrum (fig. 32d) with rounded, well sclerotized posteroventral margin.

First antenna (fig. 32e) 226 μm long. Lengths of seven segments (measured along their posterior nonsetiferous margins): 36 (33 μm along anterior margin), 72, 30, 35, 24, 13 and 16 μm respectively. Formula for armature: 4, 13, 6, 3, 4 + 1 aesthete, 2 + 1 aesthete, and 7 + 1 aesthete. All setae naked.

Second antenna (fig. 32f) 218 μm long. Third segment 114 μm long. Formula: 1, 1, 3 plus claw and five setules. Claw 65 μm along its axis.

Labrum (fig. 32g) with two rounded posteroventral lobes. Mandible (fig. 32h) slender. Paragnath a small hairy lobe (fig. 32g). First maxilla (fig. 32i) with three setae. Second maxilla (fig. 32j) with large dentiform process at proximal end of lash. Maxilliped (fig. 33a) 4-segmented, assuming that proximal part of claw represents fourth segment. First segment unornamented. Second segment with two naked setae and circlet of small spines on inner surface. Small third segment unornamented. Claw 70 μm along its axis, bearing two unequal setae proximally, and showing very slight irregularities midway on concave margin.

Ventral area between maxillipeds and first pair of legs (fig. 33b) not protuberant.

Legs 1-4 (figs. 33c, 33d, 33e, 33f) with same segmentation and armature as in other species of genus, for example, *Stellicola illgi* Humes & Stock, 1973. Leg 4 with inner coxal seta very short, 5 μm. Exopod 55 μm long. Endopod with first segment 22 × 14 μm, with inner distal seta 94 μm; second segment 21 × 12 μm, with two spines 22 μm (outer) and 46 μm (inner) and inner seta 66 μm.

Leg 5 (fig. 33g) with very small free segment 10 × 8 μm. Two terminal setae 71 μm and 47 μm, both delicately barbed. Dorsal seta 40 μm and apparently smooth.

Leg 6 (fig. 33g) a posteroventral flap on genital segment bearing two setae 62 μm (very finely barbed) and 39 μm (smooth).

Spermatophore not observed except inside body of male.

Living specimens in transmitted light opaque gray, eye red.

Female. — Body form resembling that of male,

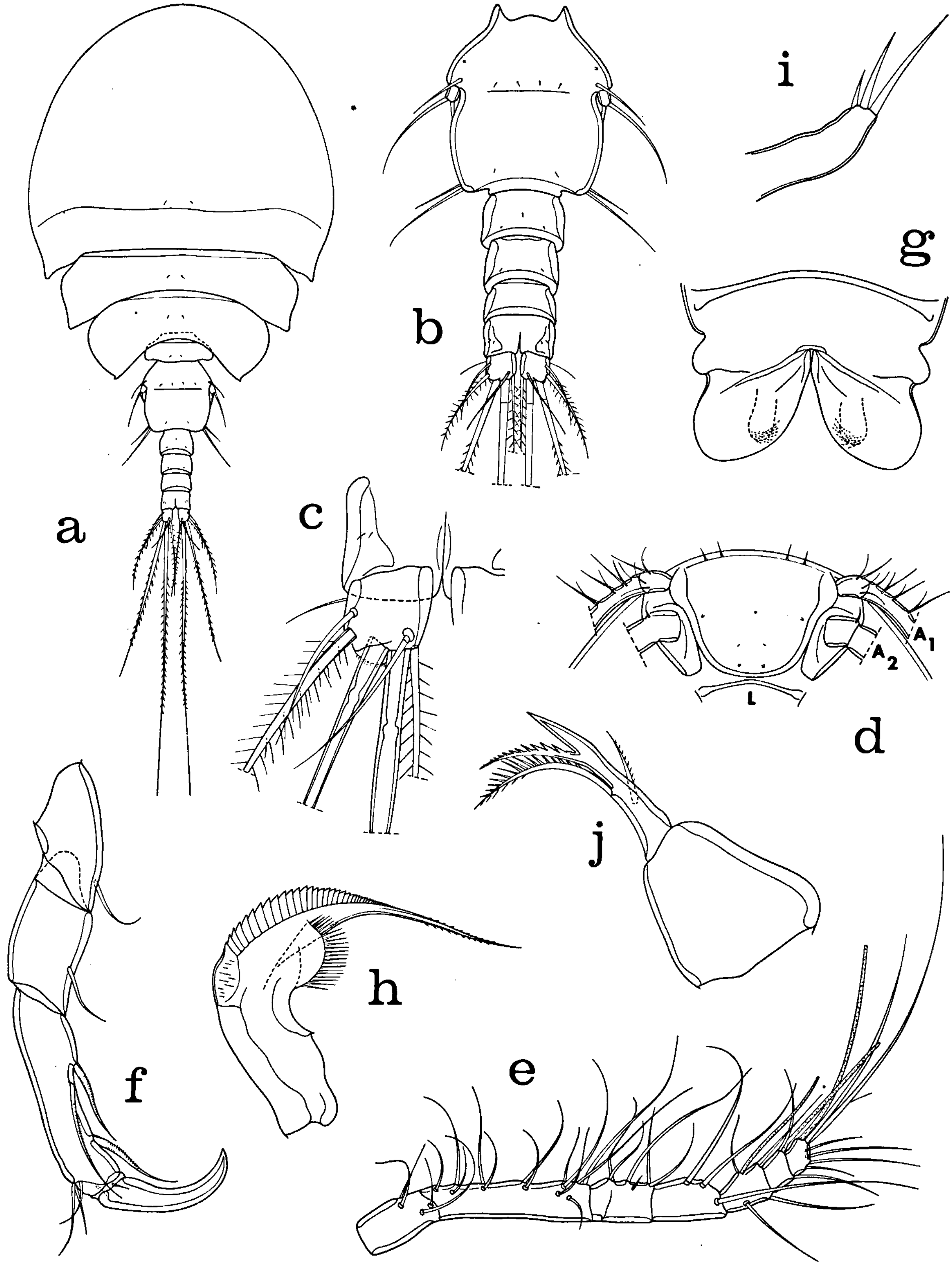

Fig. 32. *Stellicola holothuriae* (Ummerkutty, 1962), male. a, dorsal (B); b, urosome, dorsal (E); c, caudal ramus, dorsal (F); d, rostrum, ventral (D); e, first antenna, ventral (C); f, second antenna, posteroventral (C); g, labrum with position of paragnaths indicated by broken lines, ventral (G); h, mandible, posterior (F); i, first maxilla, ventral (F); j, second maxilla, anterior (F).

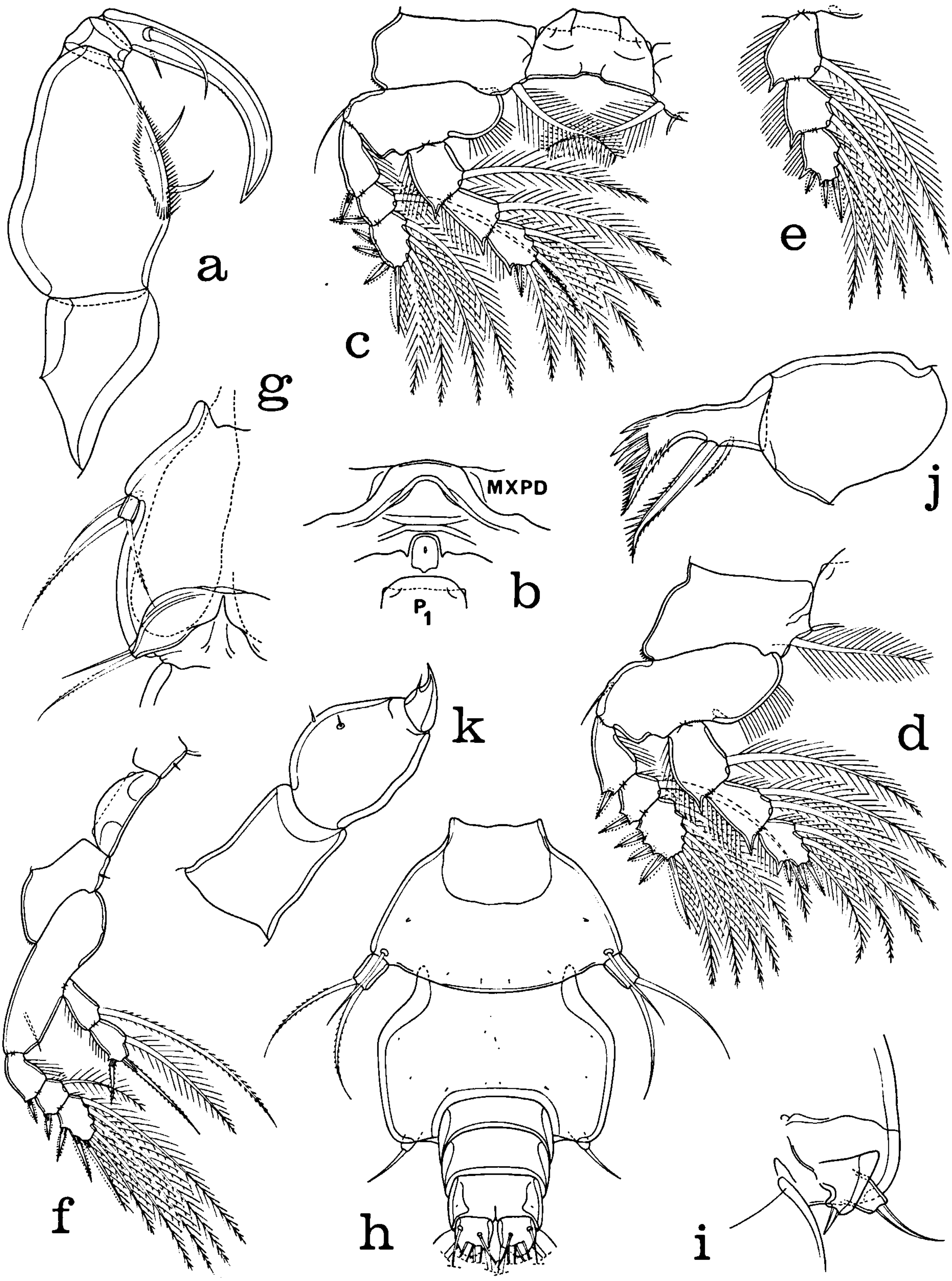

Fig. 33. *Stellicola holothuriae* (Ummerkutty, 1962). Male: a, maxilliped, postero-inner (F); b, area between maxillipeds and first pair of legs, ventral (E); c, leg 1 and intercoxal plate, anterior (C); d, leg 2, anterior (C); e, endopod of leg 3, anterior (C); f, leg 4 and intercoxal plate, anterior (C); g, leg 5 and leg 6, ventral (C). Female: h, urosome, dorsal (E); i, leg 6, ventral (G); j, second maxilla, anterior (G); k, maxilliped, posterior (G).

with prosome slightly wider. Length of single specimen studied 0.99 mm and greatest width 0.67 mm.

Segment of leg 5 (fig. 33h) 117 × 180 µm, not fused with genital segment. Genital segment 120 × 157 µm, wider than long, in dorsal view with truncate lateral margins. Genital areas located posteroventrally. Each area (fig. 33i) bearing two unequal smooth setae 10 µm and 26 µm, longer seta arising on distinct prominence.

Egg sac not observed.

Caudal ramus, body surface ornamentation, rostrum, first antenna, second antenna, labrum, mandible, paragnath, and first maxilla as in male. Second maxilla (fig. 33j) with lash having several strong proximal spines graduating distally to smaller size, instead of a single large proximal dentiform process as in male (compare with figure 32j). Inner spine on second segment stouter than in male. Maxilliped (fig. 33k) with two small setae on second segment and one small setae on third segment near clawlike tip.

Ventral area between maxillipeds and first pair of legs as in male.

Legs 1-4 as in male.

Leg 5 (fig. 33h) with free segment 25 × 13 µm. Two terminal setae 78 µm. Dorsal seta 52 µm.

Leg 6 represented by two setae on genital area (fig. 33i).

Living specimens colored as in male.

Remarks. — The specimens from *Opheodesoma spectabilis* agree fully with the main features of Ummerkutty's (1962) description of *Lichomolgus holothuriae* from holothurian washings in southeastern India. Apparent small differences in details between the copepods from India and those from Madagascar are probably not real, but rather are founded on lack of sufficient information in the description and figures of the Indian material. *Lichomolgus holothuriae* is a true *Stellicola* and was transferred to that genus by Humes & Ho (1967).

Zygomolgus Humes & Stock, 1972.

Body cyclopiform. First antenna 7-segmented. Second antenna 4-segmented, third segment with a clawlike element and fourth segment with four claws. Mandible with a slender base merging into a long lash. Legs 1-4 with 3-segmented rami except leg 4 endopod which is 2-segmented with 0-1; II, seta feathered.

Zygomolgus tenuifurcatus (Sars, 1917)

Lichomolgus tenuifurcatus Sars, 1917.

Host: *Labidoplax digitata* (Montagu).
Site: Attached to host.
Locality: Northern Ireland (Gotto, 1954).
Notes: Length of ♀ 1.40 mm (Sars, 1917), ♂ unknown.

Pseudanthessiidae Humes & Stock, 1972

Pseudanthessius Claus, 1889

Body cyclopiform. Urosome in most species 5-segmented in ♀, 6-segmented in ♂. First antenna 7-segmented. Second antenna 4-segmented with variable terminal armature (1-4 claws or clawlike spines, lamelliform elements, or setae). Legs 1-4 with 3-segmented rami except leg 4 endopod which is 1-segmented with two distal elements. Leg 5 lacking a free segment and represented by three elements.

Pseudanthessius deficiens Stock, Humes & Gooding, 1963a

Host: *Holothuria (Halodeima) mexicana* (Ludwig).
Site: In washings.
Locality: Curaçao (Stock, Humes & Gooding, 1963).
Notes: Length of ♀ 0.975-1.30 mm, ♂ 0.7-0.8 mm. Urosome in this species 4-segmented in ♀, 5-segmented in ♂. (*Pseudanthessius deficiens* usually occurs on Ophiuroidea. The single collection from a holothurian probably represents contamination).

Pseudanthessius pectinifer Stock, Humes & Gooding, 1963a)

Host: *Actinopyga agassizii* (Selenka).
Site: In washings.
Locality: Bahamas (Stock, Humes & Gooding, 1963).
New record: 6 ♀♀, 5 ♂♂ from 21 *Actinopyga agassizii* in 1 m, west of northern end of Pigeon Cay, Bimini Lagoon, Bahamas, 4 June 1959.

Notes: Length of ♀ 0.84-1.10 mm, ♂ 0.79-0.84 mm. Caudal ramus about as long as wide. Spine on third segment of endopod of male leg 1 modified into a long, curved, unilaterally strongly pectinate element. (*Pseudanthessius pectinifer* usually occurs on Echinoidea).

Clausiidae Giesbrecht, 1895b

Synaptiphilus Canu & Cuénot, 1892

Body cyclopiform. First antenna 6-segmented, with first segment armed with two or three strong clawlike processes. Second antenna 4-segmented, with one claw on very short third segment; fourth segment with several bent spatulate setae. Mandible simple, with denticulate spine, shorter spine with fine barbules, and small seta with long barbules. Maxilliped 2-segmented in both sexes, sexually dimorphic, in ♂ subcheliform with large hand opposing claw. Legs 1-4 in both sexes with 3-segmented exopods and 2-segmented endopods. Leg 1 endopod with formula 0-1, I, 1, 1; leg 4 endopod with 0-1; I, 1. Leg 5 with free segment bearing four setae.
(This genus was originally placed in a separate family, the Synaptiphilidae, by Bocquet (1952). Synonyms are: *Colaceutes* Hartmann, 1896 (synonymy by Stock, 1968) and *Remigulus* T. & A. Scott, 1893 (synonymy by T. & A. Scott, 1897).

Synaptiphilus luteus Canu & Cuénot, 1892

(Note: The list of hosts of this and other species of *Synaptiphilus* follows that of Barel & Kramers, 1977).
Host: *Labidoplax digitata* (Montagu).
Site: Anterior body surface and tentacles, anterior part of digestive tube (Bocquet & Stock, 1957).
Localities: Trieste (Hartmann, 1856); Arcachon, France (Cuénot, 1892, 1912); Naples (Cuénot, 1912).

Host: *"Synapta inhaerens"* (Cuénot in 1892 did not distinguish different species of *Leptosynapta).*
Site: Skin, tentacular region.
Locality: Roscoff, Arcachon, France (Cuénot, 1892).

Host: *Leptosynapta bergensis* Oestergren.
Site: Anterior part of body.
Locality: Plymouth, England (Barel & Kramers, 1970).

Host: *Leptosynapta inhaerens* (Müller).
Site: Unknown.
Locality: Roscoff, France (Barel & Kramers, 1970).

Host: *Leptosynapta galliennei* (Herapath).
Site: Anterior body surface, tentacles, esophagus (Bocquet & Stock, 1957).
Localities: Roscoff, Arcachon, France (Cuénot, 1912); Roscoff (Bocquet, 1952; Bocquet & Stock, 1957); Penpoull, France (Stock in Gooding, 1963).
Notes: Length of ♀ 0.8 mm, ♂ 0.45 mm (Bocquet & Stock, 1957, ♀ 1.2 mm and ♂ 0.7 mm according to Canu & Cuénot (1892). Third segment of exopod of leg 1 with III, I, 4. Free segment of leg 5 in ♀ very broad, subcircular.

Synaptiphilus cantacuzenei cantacuzenei Bocquet & Stock, 1957

Host: *Labidoplax digitata* (Montagu).
Site: Anterior part of body, tentacles, esophagus (Bocquet & Stock, 1957).
Localities: Morgat, Concarneau, France (Bocquet & Stock, 1957); Gulf of Naples (Stock, 1959); Banyuls, France (Guille & Laubier, 1965), as a new subspecies.
Notes: Length of ♀ 0.7-0.9 mm, ♂ 0.45-0.5 mm (Bocquet & Stock, 1957). Third segment of endopod of leg 1 with III, I, 3. Free segment of leg 5 in ♀ oval. Outer margin of second segment of endopod of leg 1 with a very fine file; outer margin of first segment with spiniform setae.

Synaptiphilus cantacuzenei mixtus Guille & Laubier, 1965

Host: *Labidoplax digitata* (Montagu).
Site: Not recorded.
Locality: Banyuls, France, in 60 m (Guille & Laubier, 1965).
Notes: This subspecies is distinguished from *S. cantacuzenei cantacuzenei* by longer and more numerous spines on both body and appendages, distal segment of ♀ maxilliped with cluster of long slender setae, and dimensions of various parts, for example, lengths of endopods of leg 1-4.

Synaptiphilus tridens (T. & A. Scott, 1893)

Host: *Leptosynapta inhaerens* (Müller).
Site: Not recorded, but probably similar to other *Synaptiphilus.*
Localities: Roscoff, Finistère, France (Bocquet & Stock, 1957); northern Ireland (Gotto, 1966).

Host: *Leptosynapta cruenta* Cherbonnier.
Site: Not recorded, but probably similar to other *Synaptiphilus.*
Locality: Roscoff, Finistère, France (Bocquet & Stock, 1957).
Notes: Length of ♀ 0.8-0.9 mm, ♂ 0.55 mm. First segment of endopod of leg 1 with an inner row of long setae. Third segment of first antenna elongate, much longer than second segment. Free segment of leg 5 in ♀ oval. (This species was found free-living in western Scotland by T. & A. Scott, 1893).

Family uncertain

Gomphopodarion Humes, 1974

Body elongate and modified, without external segmentation. First antenna 4-segmented. Second antenna 3-segmented. Legs 1-4 biramous, with small 1-segmented exopods and elongate, peglike, unarmed endopods. Leg 5 a large subspherical lobe. ♂ unknown.

Gomphopodarion byssoicum Humes, 1974

Host: *Oneirophanta mutabilis* Theel.
Site: Exact location unknown, but presumably internal.
Locality: 50°04.7′N, 15°44.8′W, west of Ireland, in 4426-4435 m.
Notes: Length of ♀ 1.95 mm.

SIPHONOSTOMA

Asterocheridae Giesbrecht, 1899

Asterocheres Boeck, 1859

Body cyclopoid. First antenna 20-segmented. Second antenna 5-segmented. Siphon present. Mandible with palp. Legs 1-4 biramous throughout, with each ramus 3-segmented.

Asterocheres boecki (Brady, 1880)

Host: *Holothuria (Panningothuria forskali)* Delle Chiaje.
Site: In washings.
Locality: Gulf of Naples (Giesbrecht, 1899, p. 200).
Notes: Length of ♀ about 0.90 mm, ♂ 0.75 mm (Sars, 1915), ♀ 0.6-0.65 mm, ♂ 0.5 mm (Giesbrecht, 1897). Giesbrecht found this copepod only in isolated cases in washings of the holothurian and was not certain that a regular relationship existed between the animals.

Brychiopontiidae Humes, 1974

Brychiopontius Humes, 1974

Body relatively unmodified. First antenna of ♀ 18-segmented, with aesthete located on segment 15. First antenna of ♂ geniculate, 15-segmented, with aesthete on segment 14. In both sexes second antenna and maxilliped bearing terminally a broad lamelliform element. Large recurved outer spine on first segment of leg 1 endopod.

Brychiopontius falcatus Humes, 1974

Host: *Oneirophanta mutabilis* Theel.
Site: Exact location unknown; perhaps external surface.
Locality: 50°04.7′N, 15°44.8′W, west of Ireland, in 4426-4435 m.
Notes: Length of ♀ 1.30 mm, ♂ 1.07 mm.

Myzopontiidae Sars, 1915

Myzopontius Giesbrecht, 1895a

Body cyclopoid. First antenna 12-segmented. Second antenna 4-segmented. Long siphon present. Mandible without palp. Legs 1-4 with 3-segmented rami.

Myzopontius pungens Giesbrecht, 1895a

Host: *Stichopus regalis* (Cuvier).
Site: In washings.
Locality: Gulf of Naples (Giesbrecht, 1899).
Notes: Length of ♀ 0.85-1.1 mm, ♂ 0.8-0.88 mm (Giesbrecht, 1897). The relationship of the copepod to the holothurian is uncertain, according to Giesbrecht.

Nanaspididae Humes & Cressey, 1959

(Originally spelled Nanaspidae, but corrected to Nanaspididae by Humes (1973)).

Allantogynus Changeux, 1958

Body cyclopoid, subcylindrical, with broad prosome and narrow urosome, both bisegmented. First antenna weakly 8-segmented. Second antenna 5-segmented, with fifth segment forming a truncate hook. Second maxilla prehensile with large claw. Leg 1 small, with both rami 1-segmented. Leg 2 with 2-segmented exopod and 1-segmented endopod. Leg 3 uniramous with three segments. Leg 4 uniramous with two segments. Leg 5 apparently absent. ♂ unknown.

Allantogynus was first placed by its author "auprès des Cancerillidae Sars" but later transferred to a new family, the Allantogynidae. The similarity between *Allantogynus* and *Nanaspis,* however, noted *in litt.* by Bresciani, led Stock, Humes and Gooding (1963b) to consider the name Allantogynidae a junior synonym of Nanaspididae.

Allantogynus delamarei Changeux, 1958

Host: *Holothuria (Holothuria) tubulosa* Gmelin
Site: Anterior region of host (pharynx, esophagus, stomach, gonad, coelomic fluid, brown bodies, tentacular ampullae; in coelomic epithelium and wall of pharynx; inner surface of pharynx) (Changeux, 1960).
Localities: Banyuls and Villefranche, France (Changeux, 1960).

Host: *Holothuria (Holothuria) stellati* Delle Chiaje.
Site: Anterior region of host (pharynx, esophagus, stomach, gonad, coelomic fluid, tentacular ampullae, surface of intestine, Polian vesicles, brown bodies) (Changeux, 1960).
Localities: Banyuls and Villefranche, France (Changeux, 1960).

Host: *Holothuria (Lessonothuria) polii* Delle Chiaje.
Site: Not recorded (only 1 ♀ found in this host).
Locality: Banyuls, France (Changeux, 1960).
[Changeux, 1960, p. 107, reported *in litt.* this species having been found by Dr. J. H. Stock in *Holothuria* at Split and Dubrovnik, Jugoslavia].

Notes: Length of ♀ 0.70 mm, greatest width 0.35 mm. ♂ unknown.

Nanaspis Humes & Cressey, 1959

Body minute, oval, flattened dorsoventrally. Articulation between head shield and thoracic shield. Urosome very small. First antenna in ♂ strongly prehensile. Second antenna 4-segmented, lacking an exopod but with terminal setose pad. Short oral cone. Mandible a minute blade. Second maxilla prehensile with strong claw. Leg 1 with 1-segmented rami. Leg 2 with 3-segmented exopod and either 2- or 3-segmented endopod. Legs 3 and 4 uniramous, lacking endopods; exopod of leg 3 either 2- or 3-segmented, exopod of leg 4 always 2-segmented. Leg 5 present or absent. Egg sac with two eggs.

Nanaspis boholensis n. sp.
Figs. 34a-h, 35a-j.

Type material. — 10 ♀♀, 1 ♂, and 1 copepodid from one holothurian, *Stichopus variegatus* Semper, in 7 m, Bohol Island, Philippines, 10°15.88'N, 124°08.61'E, 18 August 1975. Holotype ♀, allotype, and 6 paratypic females deposited in the Zoölogisch Museum, Amsterdam; the remaining paratypes (dissected) and the copepodid in the collection of the author.

Female. — Body (fig. 34a) ovoid and flattened dorsoventrally. Length of shield-like prosome 0.47 mm (0.45-0.47 mm) and greatest width 0.32 mm (0.32-0.33 mm), based on 10 specimens in lactic acid. Posterior border of metasome truncate but slightly extended medially.

Urosome (figs. 34b, 34c) 2-segmented, with segment of leg 5 and genital segment fused and bearing a group of ventral spinules in posterior third. Genital area with two extremely small setae. Anal segment with fringe of lateral and posteroventral spinules and with minute spinules along posterior medial margin.

Egg sac (fig. 34a) approximately 220 × 105 μm, containing two eggs.

Caudal ramus (fig. 34b) 13 × 14 μm, bearing six naked setae, the longest 58 μm, and few distal inner spinules.

Rostral area (fig. 34d) broad. First antenna 47 μm long in ventral view (fig. 34e) and apparently

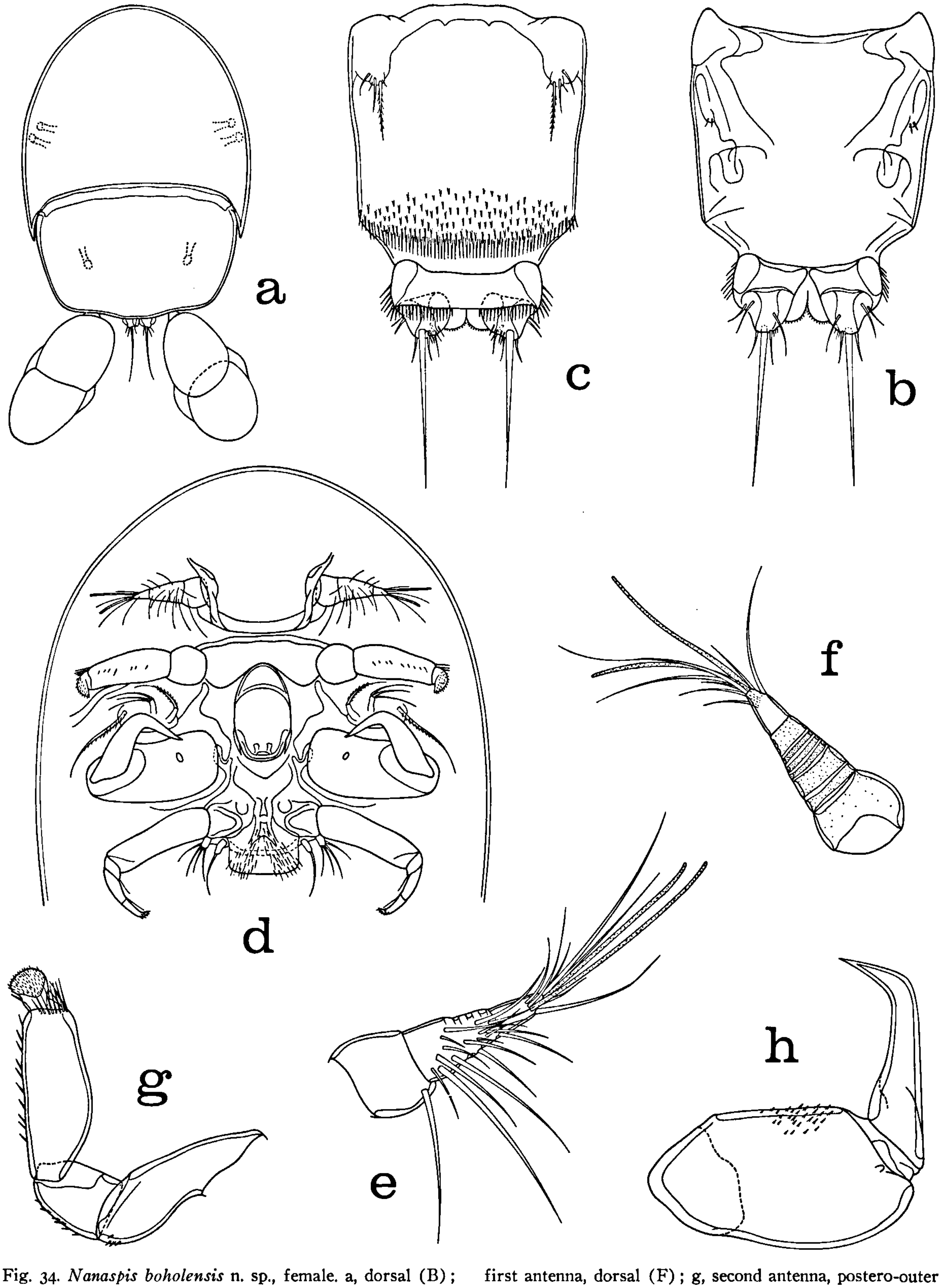

Fig. 34. *Nanaspis boholensis* n. sp., female. a, dorsal (B); b, urosome, dorsal (G); c, urosome, ventral (G); d, cephalosome, ventral (E); e, first antenna, ventral (F); f, first antenna, dorsal (F); g, second antenna, postero-outer (G); h, second maxilla, posterior (G).

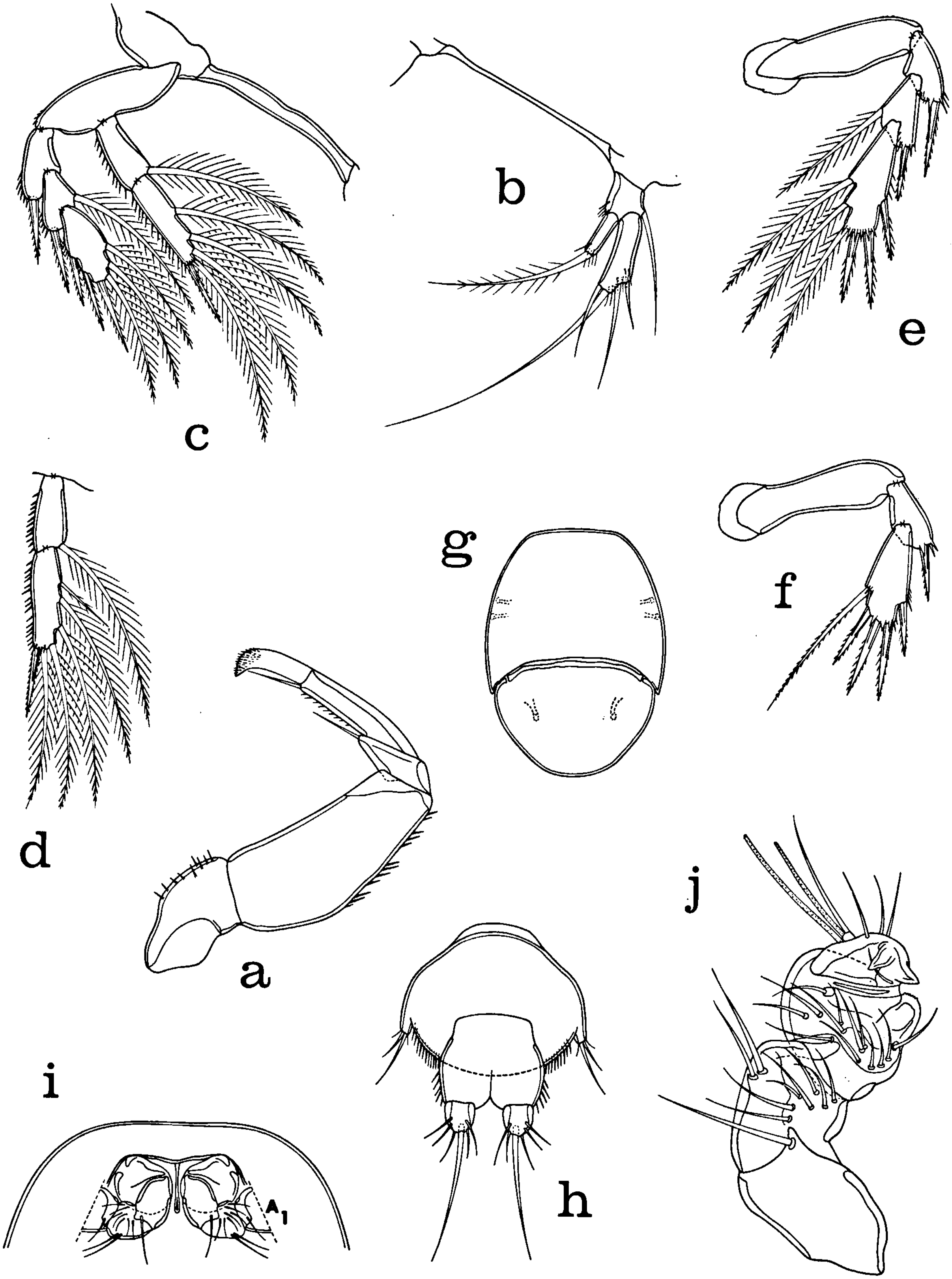

Fig. 35. *Nanaspis boholensis* n. sp., female: a, maxilliped, anterior (G); b, leg 1 and intercoxal plate, anterior (F); c, leg 2 and intercoxal plate, anterior (G); d, abnormal right endopod of leg 2, anterior (G); e, leg 3, anterior (G); f, leg 4, anterior (G). Male: g, dorsal (B); h, urosome, mostly ventral view but urosome recurved ventrally (G); i, rostral area, ventral (E); j, first antenna, ventral (F).

3-segmented, but in dorsal view (fig. 34f) showing sclerotized bands suggesting greater number of segments. Lengths of segments: 16, 20, and 8 μm. Armature: 1, 16, and 7 + 2 aesthetes. All setae smooth. Second antenna (fig. 34g), oral cone (fig. 34d), mandible (fig. 34d), first maxilla (fig. 34d), second maxilla (fig. 34h), maxilliped (fig. 35a), and ventral area between and immediately behind maxillipeds (fig. 34d) similar to those of *Nanaspis moluccana* described below.

Legs 1-4 (figs 35b, 35c, 35e, 35f) segmented as in *N. moluccana* and spine and setal formula as in that species except for second segment of endopod of leg 2 which is I, 4, instead of I, 3. Leg 1 with inner spinules on basis and distal spinules on both exopod and endopod. Seta on endopod delicately feathered. One female with extra seta on second segment of endopod of leg 2 (fig. 35d).

Leg 5 (fig. 34c) with minute segment 3 × 3 μm, bearing two terminal setae 22 μm and 11 μm, longer seta weakly feathered, and two slender spinules.

Leg 6 probably represented by two minute setae on the genital area (fig. 34b).

Color in living specimens unknown.

Male. — Body (fig. 35g) with anterior end of cephalosome truncate and posterior end of metasome rounded. Length 0.35 mm and greatest width 0.26 mm in lactic acid.

Urosome (fig. 35h) 2-segmented, ornamented as in female except lacking minute spinules on anal segment medial to caudal ramus.

Caudal ramus (fig. 35h) 11 × 10 μm, lacking spinules seen in female.

Rostral area (fig. 35i) narrow, with bases of first antenna nearly touching medially.

First antenna (fig. 35j) 78 μm long, apparently 5-segmented and with armature 1, 9, 9, 4, and 5 + 2 aesthetes.

Remaining appendages similar to those in female.

Spermatophore not seen.

Etymology. — The specific name *boholensis* alludes to Bohol Island where the specimens were found.

Remarks. — Only two species of *Nanaspis* have a 2-segmented endopod in leg 2 with the formula 0-1; I, 4. These are *Nanaspis mediterranea* Stock & Kleeton, 1963, and *Nanaspis ninae* Bresciani & Lützen, 1962. *Nanaspis boholensis* differs from these, however, in having four setae on the exopod of leg 1 (instead of three) and in having the formula IV, 1 on the second segment of leg 4 (instead of III, 2).

Nanaspis exigua Stock, Humes & Gooding, 1962

Host: *Isostichopus badionotus* (Selenka).
Site: Body surface.
Locality: Jamaica (Stock, Humes & Gooding, 1962).
Notes: Length of ♀ 0.47 mm, ♂ 0.41 mm. Posterior outline of dorsal shield in ♀ almost straight. Four setae on leg 1 exopod. Leg 2 endopod with 0-1; 0-1; I, 3. Leg 3 with I-0; I-1; III, 3. Leg 4 with I-0; IV, 1. Leg 5 present. Length of ♀ genital segment less than half its width.

Nanaspis manca Humes, 1973

Host: *Thelenota ananas* (Jaeger).
Site: In washings.
Locality: Eniwetok Atoll (Humes, 1973).
Notes: Length of ♀ 0.61 mm, ♂ 0.39 mm (not including urosome folded ventrally). Posterior margin of metasome indented medially and truncate on both sides. First antenna with five segments. Three setae on leg 1 exopod. Leg 2 exopod with I-0; I-0; II, 2; endopod with 0-0; 2. Leg 3 with I-0; III, 2. Leg 4 with I-0; III; 2. Leg 5 absent.

New record: 615 ♀♀, 601 ♂♂ from one *Thelenota ananas*, in 4 m, Poelau Marsegoe, western Ceram, 2°59′30″S, 128°03′30″E, 15 May 1975. (*N. pusilla* and *N. spinifera* also occurred on this holothurian).

Nanaspis media Stock, Humes & Gooding, 1962

Host: *Isostichopus badionotus* (Selenka).
Site: Body surface.
Locality: Near La Parguera, Puerto Rico (Stock, Humes & Gooding, 1962).
Notes: Length of ♀ 0.51 mm, ♂ 0.44 mm. Posterior outline of dorsal shield in ♀ deeply sinuous. Four setae on leg 1 exopod. Leg 2 endopod with 0-1; 0-1; I, 3. Leg 3 with I-0; I-1; III, 3. Leg 4

with I-0; IV, 1. Leg 5 present. Dactyl of ♂ first antenna less than four times as long as wide.

Nanaspis mediterranea Stock & Kleeton, 1963

Host: *Stichopus regalis* (Cuvier).
Site: In washings.
Locality: Banyuls, France (Stock & Kleeton, 1963).
Notes: Length of ♀ 0.60 mm, ♂ 0.49 mm. Posterior outline of dorsal shield in ♀ almost straight. not sinuous; in ♂ this outline concave. Three setae on leg 1 exopod. Leg 2 endopod with 0-1; I, 4. Leg 3 with I-0; I-1; III, 3. Leg 4 with I-0; III, 2. Leg 5 present.

Nanaspis mixta Humes, 1975

Host: *Holoturia (Microthele) nobilis* (Selenka).
Site: In washings.
Locality: Region of Nouméa, New Caledonia (Humes, 1975a).
Notes: Length of ♀ 0.45 mm, ♂ 0.37 mm (not including urosome folded ventrally). Posterior outline of metasome in ♀ truncate, in ♂ rounded. Four setae on leg 1 exopod. Leg 2 exopod with I-0; I-1; III, 3; endopod with 0-1; 0-1; I, 3. Leg 3 with I-0; I-1; III, 3. Leg 4 with I-0; III, 2. Leg 5 present.

Nanaspis moluccana n. sp.
Figs. 36a-k, 37a-m

Type material. — 37 ♀♀, 19 ♂♂ from one holothurian, *Stichopus chloronotus* Brandt, in 2 m, Karang Mie, east central Halmahera, Moluccas, 00°20′07″N, 128°25′00″E, 19 May 1975. Holotype ♀, allotype, and 48 paratypes (32 ♀♀, 16 ♂♂) deposited in the Zoölogisch Museum, Amsterdam; the remaining paratypes (dissected) in the collection of the author.

Female. — Body (figs. 36a, 36b) ovoid and flattened dorsoventrally. Length of shield-like prosome (not including urosome, which is folded ventrally in specimens preserved in ethyl alcohol) 0.43 mm (0.41-0.44 mm) and greatest width 0.31 mm (0.30-0.32 mm), based on 10 specimens in lactic acid. Prosome divided dorsally by a transverse suture into anterior cephalosome and posterior metasome with slightly truncated posterior margin.

Urosome (figs. 36c, 36d, 36e) 2-segmented, original segment of leg 5 and genital segment fused, this composite segment bearing ventrally posterior transverse row of spinules (fig. 36e). Genital area with minute seta 4 µm long (fig. 36d). Anal segment bearing on each side group of slender spinules, and row of small spinules medial to caudal ramus.

Entire egg sac not seen, but one sac from which larvae had emerged showed spaces for two eggs as in many species of *Nanaspis*.

Caudal ramus (fig. 36f) minute, approximately 14 × 14 µm, bearing six naked setae, the longest 62 µm, and few distal inner spinules.

Arrangement of appendages as in figure 36b.

Rostral area weakly developed (fig. 36b). First antenna (fig. 36g) 50 µm long and apparently 4-segmented, though with same number of sclerotized sections of posterior margin as in *Nanaspis mixta* Humes, 1975. Surficial sutures of second segment absent on anterodorsal surface. Lengths of segments (measured along their posterior nonsetiferous margins): 9 (14 µm along anterior margin), 21, 2, and 13 µm respectively. Armature: 1, 14, 2, and 7 + 2 aesthetes. Second antenna (fig. 36h) 4-segmented. First segment unornamented. Second segment with few slender spinules on anterior margin. Third segment with two groups of spinules on anteroventral surface (fig. 36i) and distal posterodorsal row of prominent spinules. Small fourth segment with very small seta and minutely setose pad with recurved tip.

Oral cone (fig. 36b) projecting ventrally. Mandible (fig. 36j) small simple blade 13 µm. First maxilla (fig. 36k) with inner branch having one barbed seta and outer branch bearing three smooth setae. Adjacent seta near base of second antenna large and spinulose. Second maxilla (fig. 37a) with large first segment bearing few inner spinules; claw 73 µm along axis and reflexed distally. Maxilliped (fig. 37b) 5-segmented and resembling that of *Nanaspis mixta*. Ventral area between and immediately behind maxillipeds with spinules as in figure 36b.

Legs 1-4 (figs. 37c, 37d, 37e, 37f) segmented as in *Nanaspis mixta*, except for 2-segmented endopod in leg 2. Spine and setal formula as follows

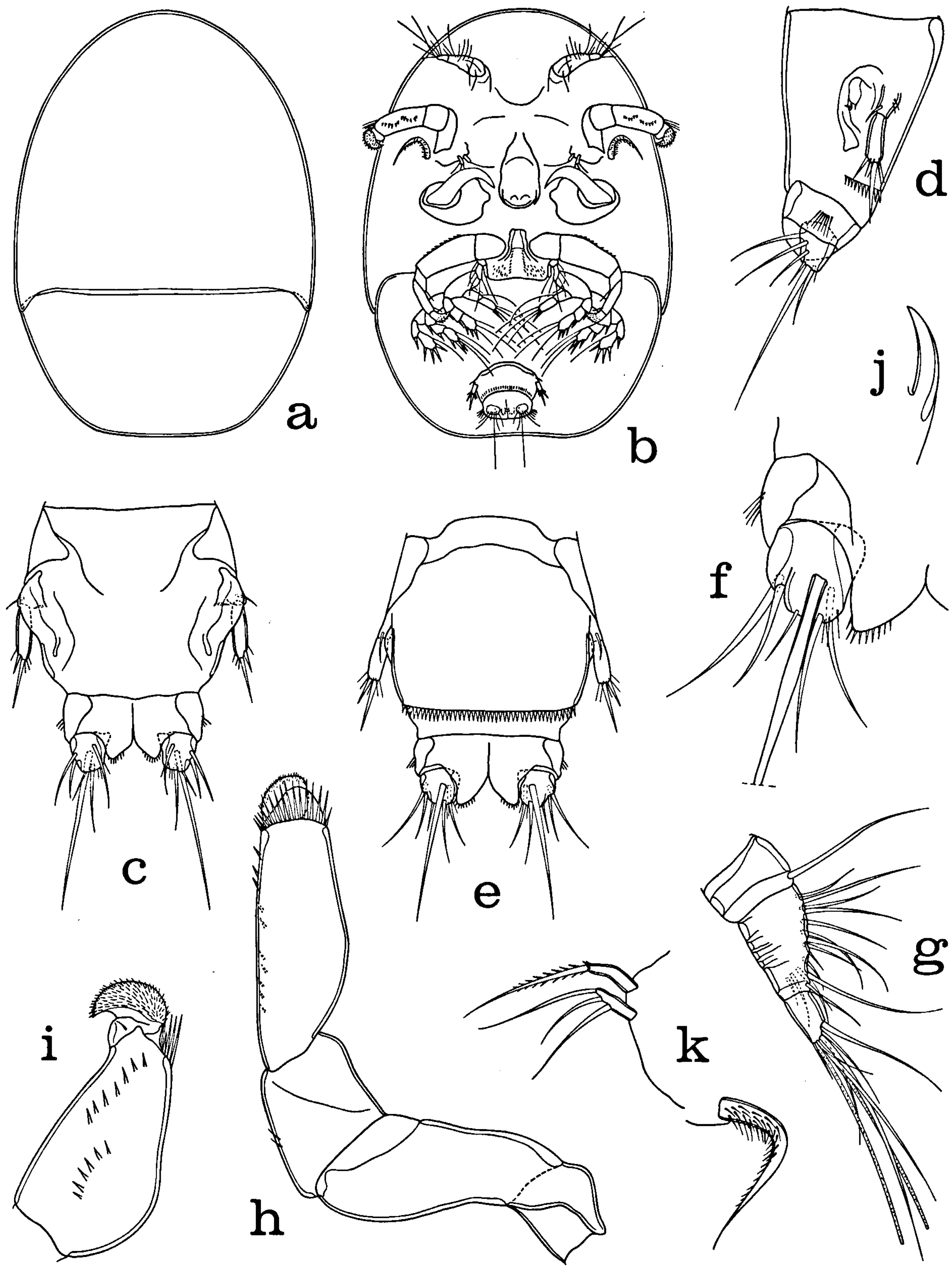

Fig. 36. *Nanaspis moluccana* n. sp., female. a, dorsal (D); b, ventral (D); c, urosome, dorsal (G); d, urosome, lateral (G); e, urosome, ventral (G); f, caudal ramus, ventral (H); g, first antenna, posteroventral (F); h, second antenna, posterodorsal (F); i, two distal segments of second antenna, anteroventral (F); j, mandible, ventral (J); k, first maxilla and adjacent seta, ventral (G).

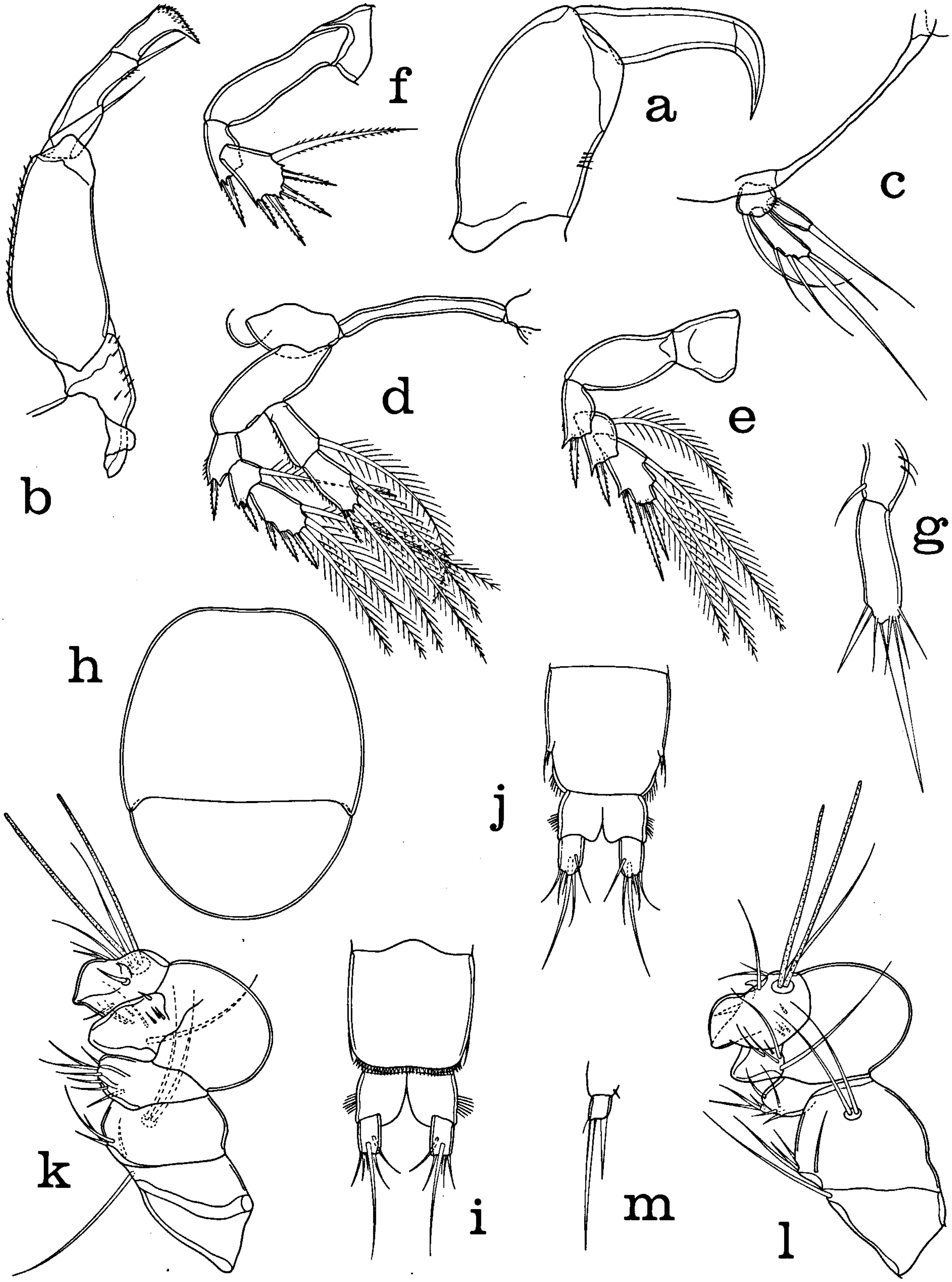

Fig. 37. *Nanaspis moluccana* n. sp., female: a, second maxilla, posterior (G); b, maxilliped, anterior (G); c, leg 1 and intercoxal plate, anterior (F); d, leg 2 and intercoxal plate, anterior (G); e, leg 3, anterior (G); f, leg 4, anterior (G); g, leg 5, lateral (H). Male: h, dorsal (D); i, urosome, ventral (G); j, urosome, dorsal (G); k, first antenna, dorso-outer (F); l, first antenna, ventro-inner (F); m, leg 5, lateral (H).

(Roman numerals indicating spines, Arabic numerals representing setae):

P_1 protopod 1-0		exp 4 enp 1
P_2 coxa 0-0	basis 0-0	exp I-0; I-1; III, 3 enp 0-1; I, 3
P_3 coxa 0-0	basis 0-0	exp I-0; I-1; III, 3 enp absent
P_4 coxa 0-0	basis 0-0	exp I-0; IV, 1 enp absent

Leg 1 (fig. 37c) with few spinules on protopod and all setae on rami smooth. Spines of legs 2-4 minutely barbed. Setae of legs 2 and 3 plumose, but seta of leg 4 less so, with shorter lateral hairs (fig. 37f).

Leg 5 (figs. 37d, 37g) with elongate free segment 18×5.5 μm, bearing distally two smooth unequal setae, longer seta 23 μm, and few long slender spinules. Basis with small dorsal seta and two slender spinules.

Leg 6 probably represented by single small seta on genital area (fig. 36d).

Living specimens in transmitted light transparent to slightly opaque, eye red.

Male. — Body (fig. 37h) ovoid and flattened dorsoventrally, with anterior margin of cephalosome slightly truncate and posterior margin of metasome rounded. Length of prosome (not including urosome, which is folded ventrally) 0.31 mm (0.30-0.32 mm) and greatest width 0.25 mm (0.24-0.25 mm), based on 10 specimens in lactic acid.

Urosome (figs. 37i, 37j) 2-segmented, ornamented as in female except for lack of small spinules on anal segment medial to caudal ramus.

Caudal ramus (fig. 37i) 14×9 μm, a little more slender than in female and lacking slender distal spinules seen in that sex.

Rostral area as in female.

First antenna (figs. 37k, 37l) 5-segmented, fourth segment swollen and fifth segment abbreviated and somewhat clawlike. Formula for armature: 1, 6, 7, 9, and 6 + 2 aesthetes.

Second antenna, oral cone, mandible, first maxilla, second maxilla, maxilliped, and legs 1-4 as in female.

Leg 5 (fig. 37m) minute, free segment 3.5×3.5 μm, bearing two unequal terminal setae, longer seta 21 μm.

Leg 6 not identifiable.

Spermatophore not seen.

Etymology. — The specific name *moluccana* is formed from Moluccas and the Latin suffix *-anus,* signifying belonging or pertaining to.

Remarks. — In the 2-segmented condition of the endopod of leg 2 with the formula 0-1; I, 3 and in the formula of leg 4 (I-0; IV, 1) *Nanaspis moluccana* resembles *Nanaspis tonsa* Humes & Cressey, 1959, a species found on *Stichopus chloronotus* in Madagascar. The new species differs from *N. tonsa,* however, in having four setae on the exopod of leg 1 instead of 3 and in possessing the formula III, 3 on the third segment of leg 3 instead of II, 3.

Nanaspis ninae Bresciani & Lützen, 1962

Host: *Parastichopus tremulus* (Gunnerus).

Site: In washings.

Locality: Gullmar Fjord, Sweden (Bresciani & Lützen, 1962).

Notes: Length of ♀ 0.90 mm, ♂ 0.58-0.60 mm. Posterior outline of dorsal shield in ♀ nearly straight. Three setae on leg 1 exopod. Leg 2 endopod with 0-1; I, 4. Leg 3 with I-0; I-1; III, 3. Leg 4 with I-0; III, 2. Leg 5 absent.

New record: 1 ♀ from washings of 33 *Parastichopus tremulus* taken by epibenthic sled in 479-485 m, west of Ireland, R/V Chain Station 309, 52°21.1′N, 12°07.4′W, 16 August 1972.

Nanaspis pollens Stock, Humes & Gooding, 1962

Host: *Isostichopus badionotus* (Selenka).

Site: Body surface.

Localities: Jamaica, Bahamas (Stock, Humes & Gooding, 1962).

Host: *Holothuria (Thymioscyia) arenicola* and *Holothuria (Semperothuria) surinamensis* (Ludwig) (mixed at the time of collection).

Site: Body surface.

Locality: Near La Parguera, Puerto Rico (Stock, Humes & Gooding, 1962).

Notes: Length of ♀ 0.57 mm, ♂ 0.50 mm. Posterior outline of dorsal shield in ♀ deeply sinuous. Four setae on leg 1 exopod. Leg 2 endopod with

0-1; 0-1; I, 3. Leg 3 with I-0; I-1; III, 3. Leg 4 with I-0; IV, 1. Leg 5 present. Dactyl of ♂ first antenna more than six times as long as wide.

Nanaspis pusilla Humes, 1973

Host: *Thelenota ananas* (Jaeger).
Site: In washings.
Locality: Eniwetok Atoll (Humes, 1973).
Notes: Length of ♀ 0.37 mm, ♂ 0.24 mm. Posterior outline of metasome in ♀ very slightly trilobed. Three setae on leg 1 exopod. Leg 2 exopod with I-0; I-0; II, 2; endopod with 0-0; 2. Leg 3 with I-0; III, 2. Leg 4 with I-0; III, 2. Leg 5 absent.
New record: 408 ♀♀, 211 ♂♂ from one *Thelenota ananas,* in 4 m, Poelau Marsegoe, western Ceram, 2°59′30″S, 128°03′30″E, 15 May 1975. (*N. manca* and *N. spinifera* also occurred on this holothurian.)

Nanaspis spinifera Humes, 1973

Host: *Thelenota ananas* (Jaeger).
Site: In washings.
Locality: Eniwetok Atoll (Humes, 1973).
Notes: Length of ♀ 0.47 mm, ♂ 0.31 mm. Posterior outline of metasome in ♀ slightly sinuous, rounded on both sides; in ♂ slightly indented. First antenna with five segments. Second maxilla with thornlike process on first segment. Three setae on leg 1 exopod. Leg 2 exopod with I-0; I-0; II, 2; endopod with 0-0; 2. Leg 3 with I-0; III, 2. Leg 4 with I-0; III, 2. Leg 5 absent.
New record: 479 ♀♀, 343 ♂♂ from one *Thelenota ananas,* in 4 m, Poelau Marsegoe, western Ceram, 2°59′30″S, 128°03′30″E, 15 May 1975. (*N. manca* and *N. pusilla* also occurred on this holothurian).

Nanaspis tonsa Humes & Cressey, 1959

Host: *Stichopus chloronotus* Brandt.
Site: Body surface.
Locality: Region of Nosy Bé, northwestern Madagascar (Humes & Cressey, 1959).
New records (all from *Stichopus chloronotus*): 47 ♀♀, 18 ♂♂ from 4 hosts, in 0.5 m, Ambariobe, near Nosy Bé, Madagascar, 7 August 1963; 30 ♀♀, 15 ♂♂ from 1 host, in 20 cm, intertidal pool, Ankify, near Nosy Bé, 22 July 1963; 2 ♀♀ from 8 hosts, in 10 cm, intertidal pool, Tany Kely, near Nosy Bé, 9 July 1963; 16 ♀♀, 21 ♂♂ from 2 hosts, in 2 m, Pte. Lokobe, Nosy Bé, 16 August 1960; 52 ♀♀, 39 ♂♂, and 23 copepodids from 1 host, in 1 m, Pte. Ambarionaomby, Nosy Komba, near Nosy Bé, 18 July 1963; 7 ♀♀, 4 ♂♂, and 2 copepodids from 1 host, in 15 cm, intertidal pool, Nosy N'Tangam, near Nosy Bé, 5 September 1963; 1 ♂ from 1 host, in 1 m, Pte. de Tafondro, Nosy Bé, 2 October 1963.

Host: *Stichopus variegatus* Semper
Site: Body surface.
Locality: Region of Nosy Bé, northwestern Madagascar (present paper).
New host records (both from *Stichopus variegatus*): 3 ♀♀, 2 ♂♂ from 1 host, in 1 m, west of Pte. de Tafondro, Nosy Bé, Madagascar, 19 October 1960; 36 ♀♀, 21 ♂♂ from 1 host, in 1 m, Nosy Iranja, southwest of Nosy Bé, 7 October 1960.
Notes: Length of ♀ 0.43 mm, ♂ 0.35 mm. Three setae on leg 1 exopod. Leg 2 endopod with 0-1; I, 3. Leg 3 with I-0; I-1; II, 3. Leg 4 with I-0; IV, 1. Leg 5 present.

Nanaspis truncata Stock, Humes & Gooding, 1962

Host: *Holothuria (Platyperona) parvula* (Selenka).
Site: Body surface.
Locality: Near La Parguera, Puerto Rico (Stock, Humes & Gooding, 1962).

Host: *Holothuria (Thymioscyia) arenicola* (Semper) and *Holothuria (Semperothuria) surinamensis* (Ludwig) (mixed at time of collection).
Site: Body surface.
Locality: Near La Parguera, Puerto Rico (Stock, Humes & Gooding, 1962).
Notes: Length of ♀ 0.48 mm, ♂ 0.40 mm. Posterior outline of dorsal shield in ♀ truncate and almost straight. Four setae on leg 1 exopod. Leg 2 endopod with 0-1; 0-1; I, 3. Leg 3 with I-0; I-1; III, 3. Leg 4 with I-0; IV, 1. Leg 5 present.

Key to species of *Nanaspis*

1. Leg 2 endopod 2-segmented 2
   Leg 2 endopod 3-segmented 9

2. Leg 2 endopod with 0-0; 2 3
Leg 2 endopod with 0-1; I, 3 or 0-1; I, 4 ... 5
3. Leg 3 with saddle-shaped sclerotization (intercoxal plate?) between coxae 4
Leg 3 lacking such sclerotization ... *N. manca*
4. Sclerotized lobes on each side of female genital segment with three small marginal teeth; seta on endopod of leg 1 located terminally .... *N. spinifera*
Sclerotized lobes on each side of female genital segment with smooth margin; seta on endopod of leg 1 located subterminally .... *N. pusilla*
5. Leg 2 endopod with 0-1; I, 3 6
Leg 2 endopod with 0-1; I, 4 7
6. Leg 3 with third segment having formula II, 3 .... *N. tonsa*
Leg 3 with third segment having formula III, 3 .... *N. moluccana*
7. With four setae on exopod of leg 1 and second segment of endopod of leg 4 with IV, 1 .... *N. boholensis*
With three setae on exopod of leg 1 and second segment of endopod of leg 4 with III, 2 8
8. Length of female up to 0.90 mm, male 0.58-0.60 mm; prosomal shield in male rounded anteriorly and posteriorly .... *N. ninae*
Length of female 0.57-0.63 mm, male 0.47-0.52 mm; prosomal shield in male with concave posterior border .... *N. mediterranea*
9. Leg 4 with second segment having formula III, 2 .... *N. mixta*
Leg 4 with second segment having formula IV, 1 10
10. Posterior outline of dorsal shield in female deeply sinuous, fixed finger-like process on chela of male first antenna slender 11
Posterior outline of dorsal shield in female almost straight; fixed finger-like process on chela of male first antenna stout 12
11. Female body more than 0.56 mm in length; dactyl of male first antenna more than six times as long as wide .... *N. pollens*
Female body less than 0.53 mm in length; dactyl of male first antenna less than four times as long as wide .... *N. media*
12. Length of female genital segment more than 3/5 width; both aesthete-seta groups on dactyl of male first antenna in proximal half of segment .... *N. truncata*
Length of female genital segment less than half width; one aesthete-seta group on dactyl of male first antenna in distal half of segment .... *N. exigua*

KEY TO THE GENERA OF COPEPODS ASSOCIATED WITH HOLOTHUROIDEA

(based on ♀♀ of species included in this review)

1. Body distinctly segmented; endopod of leg 1 often prehensile; segment of leg 5 and genital segment firmly joined ... Harpacticoida ... 2
Body segmented, or transformed without external segmentation; endopod of leg 1 not presensile; segment of leg 5 and genital segment not firmly joined ... Cyclopoida ... 4
2. Body pyriform, prosome gibbous; color often bright red .... *Metis*
Body not pyriform, prosome depressed or flattened; color otherwise 3
3. Prosome flattened, much broader than urosome; first antenna 9-segmented; first segment of endopod of leg 1 massive, following two segments small .... *Sacodiscus*
Prosome depressed, only a little wider than urosome; first antenna 8-segmented; first segment of endopod of leg 1 not massive, second segment elongate .... *Tisbe*
4. Genital openings midventral; mandible with three palplike setae .... *Namakosiramia*
Genital openings dorsal or lateral; mandible lacking palplike setae 5
5. Mandible a stylet; second maxilla and maxilliped subchelate; labrum and metastomal area produced to form a cone or siphon ... Siphonostoma 6
Mandible not styliform; second maxilla and maxilliped not subchelate; lacking cone or siphon .... Poecilostoma 10
6. External body segmentation reduced or lacking; first antenna with at most eight segments; second antenna without an exopod... 7
External body segmentation distinct; first antenna with 12 or more segments; second antenna with a small one-segmented exopod ... 8

7. Body minute, oval, flattened dorsoventrally, and shieldlike, with articulation between head shield and thoracic shield; urosome very small .... *Nanaspis*
Body subcylindrical, globular, with both prosome and urosome bisegmented; prosome twice as wide as urosome ...... *Allantogynus*
8. Long siphon present; leg 5 with free segment 9
Short oral cone present, but no siphon; leg 5 without free segment .... *Brychiopontius*
9. First antenna 20-segmented; mandible with palp .... *Asterocheres*
First antenna 12-segmented; mandible without palp .... *Myzopontius*
10. Body large, highly transformed, length 20-40 mm; legs 4 and 5 absent; lacking mandible and first maxilla in adult ...... *Cucumaricola*
Body small, less than 5 mm, cyclopiform or modified; legs 4 and 5 present; mandible and first maxilla present 11
11. Leg 5 without a free segment .... *Pseudanthessius*
Leg 5 with a free segment (except a short papilla in *Synapticola*) 12
12. Free segment of leg 5 with four setae; first segment of first antenna armed with 2 or 3 strong clawlike processes ...... *Synaptiphilus*
Free segment of leg 5 with two setae; first segment of first antenna without such processes 13
13. Body elongate and moderately tumid, modified, without external segmentation; legs 1-4 biramous with 1-segmented rami .... *Gomphopodarion*
Body cyclopiform, sometimes elongate and moderately transformed; externally segmented; legs 1-4 with all rami at least 2-segmented 14
14. Legs 1-4 with 3-segmented rami except for 2-segmented endopod in leg 4 15
Legs 1-4 with rami segmented otherwise ... 17
15. Second antenna 3-segmented with one terminal claw; leg 4 endopod with 0-1; II, 1 .... *Stellicola*
Second antenna 4-segmented; leg 4 endopod with 0-1; II 16
16. Second antenna with two terminal claws .... *Metaxymolgus*
Second antenna with a clawlike element on third segment and four claws on fourth segment .... *Zygomolgus*
17. Legs 1-3 with 3-segmented exopods and 2-segmented endopods; leg 4 with both rami 3-segmented .... *Calypsina*
Legs 1-4 with rami segmented otherwise ... 18
18. Legs 1-4 with 3-segmented exopods and 2-segmented endopods 19
Legs 1-4 with rami segmented otherwise ... 20
19. Ventral keel on genital segment; leg 4 endopod with 0-1; I, III, I, 1 or 0-1; I, III, I .... *Calypsarion*
Without ventral keel on genital segment; leg 4 endopod with 0-1; III .... *Synapticola*
20. Second antenna 4-segmented with one claw on fourth segment 21
Second antenna 4-segmented with one claw on third segment 22
21. Caudal ramus with two median terminal setae vestigial .... *Diogenella*
Caudal ramus with two median terminal setae normally developed .... *Diogenidium*
22. Leg 4 endopod with 0-1; I, II, II, 1 .... *Caribulus*
Leg 4 endopod otherwise 23
23. Long digitiform process on distal outer corner of basis of legs 2 and 3 .... *Chauliolobion*
Basis of legs 2 and 3 lacking such a process 24
24. Leg 4 endopod with 0-1; 0-1; I, II, II .... *Scambicornus*
Leg 4 endopod otherwise 25
25. With unusually broad cephalosome; leg 4 endopod with 0-1; 0-1; I, I, 1, 1, 1 or 0-1; 0-1; I, I, 1, 1 .... *Lecanurius*
Cephalosome not much wider than metasome; leg 4 endopod with 0-1; 0-1; II, 1 .... *Lichothuria*

ASPECTS OF COPEPOD-HOLOTHURIAN ASSOCIATIONS

Body form

In most genera of copepods living with holothurians the body, segmented and with obvious appendages, is easily recognized as copepodan. This is particularly true among external species. A few copepods living internally, however, have modified or transformed bodies. The female of *Gomphopodarion* is elongate and subcylindrical without external segmentation. Legs 1-4 are biramous and small, with 1-segmented rami (Humes, 1974). The female of *Allantogynus* is globular, with reduced segmentation. Legs 1-4 are small, 1 + 2 biramous, 3 + 4 uniramous (Changeux, 1960). Males of both these genera are unknown.

The greatest transformation of the body is seen in *Cucumaricola* where strong sexual dimorphism occurs in the adults, with the female being 6-8 times as long (20-40 mm) as the male (0.51-5.0 mm). Mature males retain trunk segmentation, have three pairs of small trunk appendages, and possess long caudal rami more than half the body length. Mature females have a bizarre appearance, possess three pairs of boot-shaped trunk appendages, and have relatively short caudal rami only one-sixth of the body length (Paterson, 1958).

Location on host

Copepods living on the integument of holothurians can sometimes be seen with the unaided eye, as Humes & Cressey (1961) reported for *Scambicornus idoneus* on the black holothurian *Holothuria atra*. *Tisbe holothuriae* can be seen swarming among the podia and dorsal papillae of *Holothuria tubulosa* and *H. stellati* (Changeux, 1960). *Scambicornus hamatus* was found clinging to the tentacles of *Neothyonidium* (Heegaard, 1944). The exact location of many external species remains unknown. The large size and contractility of the host often make microscopic examination of the integument difficult. Therefore, the general practice in the field has been to recover the copepods by washing intact hosts in a weak solution of ethyl alcohol in sea water.

The exact location in the host is known for only a few internal copepods. *Allantogynus delamarei* lives in the anterior part of the body cavity of *Holothuria tubulosa* and *H. stellati*, particularly in the vicinity of the pharynx. Female *Allantogynus* placed in intestinal juice of the holothurian host died within 10 minutes, but controls in sea water with daily changes lived up to 14 days. This toxic action of the digestive juice prevents the copepods from entering the digestive tract beyond the posterior limit of the stomach. By penetrating the pharynx the copepod escapes any toxic action (Changeux, 1960).

Scambicornus brachysetosus has been found in the esophagus of *Holothuria atra* (see above). *Calypsina changeuxi*, which lives permanently in the esophagus of *H. tubulosa* and *H. stellati*, owes its maintenance at this level to a very particular stereotropism which rivets it solidly to the wall by the head appendages (Changeux, 1960).

Certain copepods can live both externally on the anterior integument and tentacles or in the anterior part of the digestive tract, as in the case of *Synaptiphilus* on *Leptosynapta* (Bocquet & Stock, 1957).

Cucumaricola notabilis occurs in galls or cysts, probably formed by the host, *Cucumaricola frauenfeldi*. Small cysts are attached to the tissues between the circumpharyngeal ossicles or to the inner wall of the cloaca near the respiratory trees. Larger cysts lie detached in the coelom. Normally each cyst contains a pair of copepods (Paterson, 1958).

Egg number

The number of eggs produced in different species varies widely. Generally the egg sacs of external species contain more eggs (from about 75 to more than 100) than those of internal species. *Scambicornus idoneus*, for example, a copepod living on the body surface of *Holothuria atra*, carries about 75 eggs in each sac. Humes & Cressey (1961) recovered 451 ♀♀ of this species from seven hosts. These females could theoretically bear 67,650 eggs if each female carried two egg sacs. On the other hand, females of the genus *Nanaspis*, also an external species, have only two eggs in each sac. *Nanaspis*, however, often occurs in large numbers. For example, 1502 ♀♀ of three species were found on one host *Thelenota* (see above). Their theoretical egg burden would be 6,008. Since not all females are ovigerous at a given time, these theoretical numbers should be reduced. The impression remains, however, that the potential for egg production in these external copepods is large.

Copepods living inside the host tend to have fewer eggs (from 1 to about 32) in each egg sac.

Thus *Chauliolobion imparile* has 1-3 eggs, *Calypsarion leprum* 3, *Diogenidium deforme* 6, *Diogenella seticauda* 12, *Lichothuria mandibularis* 9-23, and *Lecanurius planifrontalis* about 32.

Among the internal forms *Allantogynus delamarei* is exceptional in respect to the nature of the egg sac and egg number. In this species the sac becomes progressively larger and filled with numerous eggs until it drops free into the body cavity of the holothurian (Changeux, 1960).

The reproductive capability of copepods found in large numbers on common holothurians of coral reefs is potentially very high. *Holothuria atra* is often very abundant in shallow water on reefs and in lagoons or tidal flats behind reefs. Its maximum density at Nosy Bé in northwestern Madagascar is estimated at one for every 25 m^2, or 400 holothurians per hectare. At the egg carrying capacity of *Scambicornus idoneus* mentioned above, the theoretical number of eggs at a given time would be 3,800,000 per hectare. Various factors such as variations in the density of the hosts and their degree of infestation, and changes in the number of simultaneously ovigerous females would no doubt intervene to affect the reproductive capability as estimated by egg number.

It has been suggested that large numbers of eggs in the egg sacs might be related to: the host being sparsely distributed, somewhat inaccessible, or not obviously atractive from a distance; the host being highly mobile; or the environment of the host being inimical to successful infestation, e.g., swift currents, wave beaten shores, or exposure during low tides (Gotto, 1962). In *Caligus*, parasitic on fishes, it has been suggested that the shape of the egg strings may be determined by the movements of the female and by pressure (currents) of the water related to the movements of the fish host (Heegaard, 1959). It is difficult to understand how environmental forces may influence egg number or the shape of the egg sacs. Water flow seems not to be important in the case of certain holothurian associates. *Scambicornus idoneus* on *Holothuria scabra*, a holothurian usually partly or almost entirely buried in sand, has numerous eggs (about 75) in each sac, as many as *Scambicornus modestus* on *Stichopus chloronotus*, a host living entirely exposed. The great difference in egg number between *Nanaspis* and *Scambicornus*, both external associates, is also difficult to explain on environmental grounds.

Development

Investigations of the development and life histories of copepods living with sea cucumbers has lagged far behind morphological and taxonomic studies of adult copepods. Reasons for this are several, among them the difficulties of maintenance of the developmental stages in the laboratory (which may require the maintenance of the host also) and the lack of laboratory facilities in many tropical areas such as the Indo-Pacific where copepod associates of holothurians are particularly abundant.

In the case of *Tisbe holothuriae* on *Holothuria tubulosa* and *H. stellati* ovigerous and nonovigerous females, males, nauplii, and copepodids occur on the integument of the hosts, and in all probability the complete life cycle of the copepod is carried out in association with the holothurian (Changeux, 1960). The association is not obligatory for development, however, since *T. holothuriae* may complete its development free among algae or in culture in the laboratory (Volkmann-Rocco, 1971).

Allantogynus delamarei in *Holothuria tubulosa* and *H. stellati* deposits eggs in a sac which envelopes the female. Changeux (1960) followed development *in vitro*, identifying a naplius stage and two metanauplius stages followed by a first copepodid larva. Further copepodids were not obtained.

The development of *Cucumaricola notabilis* from *Cucumaria frauenfeldi* has been studied by Paterson (1958). The number of naupliar ecdyses was not established, since most nauplii molted only once and failed to develop further. Since a copepodid was seen with four telescoped naupliar exuviae still attached, it seems probable that several naupliar stages precede the copepodid. The first copepodid, which probably emerges from the host for a brief free existence, is an actively swimming form that within 24 hours or less settles to the bottom and molts to a second copepodid. This is a quiescent stage during which transformation to a juvenile parasitic form occurs. The minute vermiform stage emerges from the ruptured copepodid skin and begins to crawl on the bottom with leechlike movements. Cultured juveniles and juveniles found in the host are so similar that one may suppose that at this stage they seek out and enter the host.

In the search for copepods associated with the holothurians late copepodid stages are sometimes found along with adults, both in external forms such as *Caribulus, Nanaspis,* and *Scambicornus,* and in internal forms such as *Chauliolobion, Diogenella, Lichothuria,* and others. Nauplii are not evident in the hosts, however. Probably an early copepodid stage, perhaps the second copepodid as Dudley (1966) has shown likely in notodelphyid copepods of ascidians, is the infective form that reaches the host.

Incidence of copepod-holothurian associations

Seventy-seven species of copepods are known as associates of holothurians. They are distributed among six families and 18 genera of the Holothuroidea (Table 1). The majority of the associations occur in the Holothuriidae, with 55 copepods involved: *Actinopyga* with 17 species, *Bohadschia* 7, *Holothuria* 29, and *Labidodemas* 2. In the Stichopodidae 22 associations are known: *Isostichopus* 5, *Parastichopus* 1, *Stichopus* 10, and *Thelenota* 6. The Synaptidae have 12 associations: *Labidoplax* 3, *Leptosynapta* 2, *Opheodesoma* 4, *Polyplectana* 1, and *Synapta* 2. The remaining three families show only a few associations. In the Cucumariidae there are three associations: *Cucumaria* 1 and *Ocnus* 2. In the Phyllophoridae two associations occur: *Neothyonidium* 1 and *Ohshimella* 1. Finally in the Deimatidae two associations are known, both in the genus *Oneirophanta.* If the numbers of associations in each family are added, we arrive at a total of 96, a figure larger than the number of species of copepods involved. This is accounted for by the fact that several species occur with more than one host genus. In fact, in a few cases a copepod may be associated with hosts in more than one family, as *Caribulus sculptus, Scambicornus batiolatus,* and *Nanaspis pollens* on both Holothuriidae and Stichopodidae; *Scambicornus subtilis* on both Holothuriidae and Synaptidae; *Scambicornus tuberatus* with hosts in three families, Holothuriidae, Stichopodidae, and Synaptidae; and *Scambicornus modestus* with hosts in three families, Holothuriidae, Stichopodidae, and Phyllophoridae (Table 2). The six species of copepods which associate with members of more than one family of holothurians are external forms. In such relatively unmodified species a lesser degree of host specificity might be expected than internal more hightly modified species. Internal forms tend to parasitize members of one holothurian family, the Holothuriidae, or even one genus (Table 3).

Certain holothurians harbor several species of copepods (Table 4). The greatest number of copepod associates occurs with *Holothuria atra* (11 species, 8 of them external, 3 internal), followed by *Actinopyga echinites* with 8 species (6 external, 2 internal). These figures represent a compilation of associations over the entire range of the hosts where the holothurians have been examined. Such extensive associations do not occur in any one locality, however. For *H. atra* the numbers of associated copepods are as follows: Seychelles 2 spe-
38).

Table 1. Number of copepod associates and their host families and genera.

	number of species of copepods	total
Holothuriidae		55
Actinopyga	17	
Bohadschia	7	
Holothuria	29	
Labidodemas	2	
Stichopodidae		22
Isostichopus	5	
Parastichopus	1	
Stichopus	10	
Thelenota	6	
Synaptidae		12
Labidoplax	3	
Leptosynapta	2	
Opheodesoma	4	
Polyplectana	1	
Synapta	2	
Cucumariidae		3
Cucumaria	1	
Ocnus	2	
Phyllophoridae		2
Neothyonidium	1	
Ohshimella	1	
Deimatidae		2
Oneirophanta	2	
		96

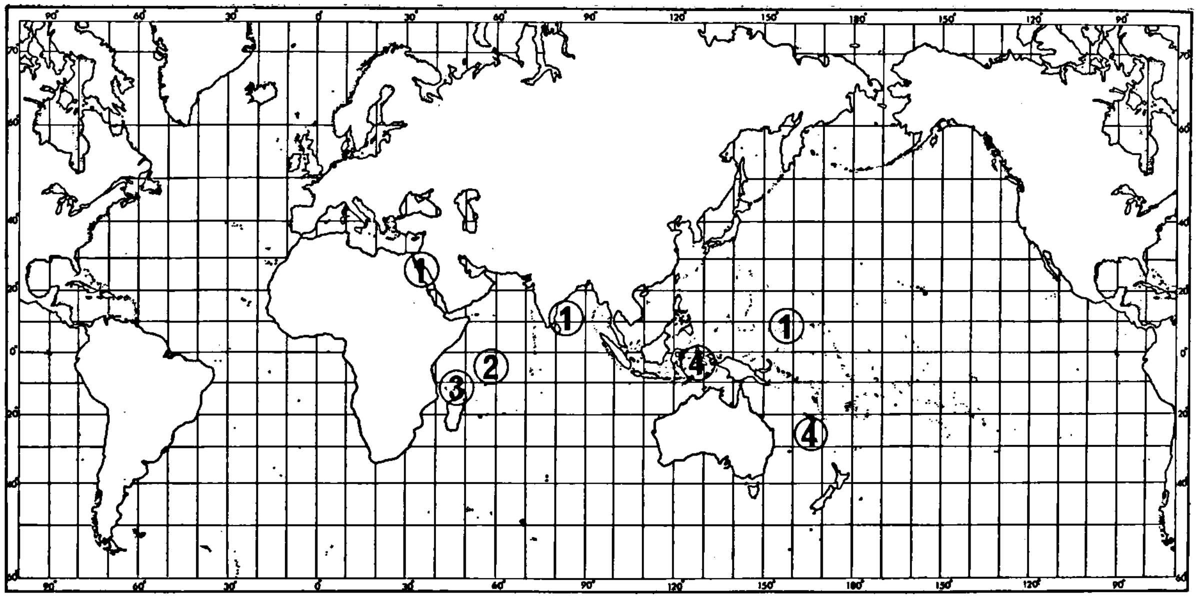

Fig. 38. Number of species of copepods associated with *Holothuria atra* in the Gulf of Aqaba, Seychelles, Madagascar, India, the Moluccas, Eniwetok Atoll, and New Caledonia.

Table 2. Distribution of external species having more than one host among Holothuroidea.

copepod	number of species serving as hosts in various genera			
	Holothuriidae	Stichopodidae	Synaptidae	Phyllophoridae
* *Caribulus sculptus*	2 *Holothuria*	1 *Isostichopus*		
	1 *Actinopyga*			
* *Scambicornus batiolatus*	1 *Holothuria*	1 *Thelenota*		
Scambicornus calcaratus	6 *Actinopyga*			
Scambicornus campanulipes	5 *Actinopyga*			
	1 *Holothuria*			
Scambicornus idoneus	1 *Actinopyga*			
	1 *Bohadschia*			
	5 *Holothuria*			
Scambicornus lobulatus	1 *Actinopyga*			
	1 *Bohadschia*			
* *Scambicornus modestus*	1 *Bohadschia*	4 *Stichopus*		1 *Ohshimella*
	4 *Holothuria*			
Scambinornus poculiferus			1 *Opheodesoma*	
			1 *Synapta*	
Scambicornus sewelli	1 *Actinopyga*			
	5 *Holothuria*			
* *Scambicornus subtilis*	1 *Actinopyga*		1 *Opheodesoma*	
	5 *Holothuria*			
* *Scambicornus tuberatus*	5 *Bohadschia*	1 *Thelenota*	1 *Opheodesoma*	
‡ *Synaptiphilus luteus*			1 *Labidoplax*	
			3 *Leptosynapta*	
‡ *Synaptiphilus tridens*			2 *Leptosynapta*	
* *Nanaspis pollens*	2 *Holothuria*	1 *Isostichopus*		
Nanaspis tonsa		2 *Stichopus*		
Nanaspis truncata	3 *Holothuria*			

* hosts in more than one family
‡ occurs in esophagus as well as on integument

Table 3. Distribution of internal species having more than one host among Holothuroidea.

copepod	number of species serving as host in various genera Holothuriidae	Stichopodidae	Synaptidae
Allantogynus delamarei	3 *Holothuria*		
Calypsarion leprum	3 *Actinopyga*		
Chauliolobion bulbosum	2 *Actinopyga*		
Diogenella seticauda	3 *Holothuria*		
Diogenella spinicauda	1 *Holothuria*		
	1 *Actinopyga*		
Diogenidium deforme	3 *Holothuria*		
Diogenidium nasutum	2 *Holothuria*		
	1 *Actinopyga*		
Lecanurius kossmannianus	2 *Actinopyga*		
Lichothuria mandibularis	4 *Holothuria*		
Synapticola teres			1 *Polyplectana*
			1 *Synapta*

Table 4. Holothurians having three or more copepod associates.

Number of species of copepod associates	Holothuriidae	Stichopodidae	Synaptidae
11	*Holothuria atra*		
8	*Actinopyga echinites*		
6	*Actinopyga agassizii*		
	Holothuria arenicola	*Thelenota ananas*	
5	*Actinopyga lecanora*	*Isostichopus badionotus*	
	Holothuria mexicana		
4	*Actinopyga miliaris*	*Stichopus variegatus*	
	Bohadschia argus		
	Holothuria edulis		
	Holothuria nobilis		
3	*Holothuria surinamensis*	*Stichopus chloronotus*	*Opheodesoma grisea*
	Holothuria tubulosa	*Stichopus regalis*	*Labidoplax digitata*

cies, Madagascar 3, Gulf of Aqaba 1, India 1, Moluccas 4, New Caledonia 4, and Eniwetok 1 (fig.

Approximately half of the copepod associates (47 out of 77) are known from only one species of holothurian. Sixteen of these copepods are internal species. Many more collections from widespread localities are needed to determine whether or not the apparent restriction to one host is real.

Susceptibility of holothurians to copepod associations

The number of species that may occur with a single holothurian (Table 5) is not large. There may be as many as five species of copepods with *Thelenota ananas*, three with *Holothuria atra, Stichopus chloronotus, Bohadschia argus,* and *Actinopyga echinites,* and two with *Holothuria edulis* and *Holothuria fuscocinerea.* On the other hand, certain holothurians, for example, *Bohadschia graeffei,* appear to have only one copepod associate.

Degree of infestation

The number of copepods on individual holothurians varies widely. Determination of the numbers of associates is affected by the degree of refinement of techniques for recovering the copepods, particularly in the case of internal forms where often much mucus and debris interfere with the search. The number of copepods on the body surface may be very large. Washings of one *Thelenota ananas* at Eniwetok yielded 847 adults and 206 copepodids representing three species of *Nanaspis* (Humes, 1973). On a single *Thelenota ananas* at Poelau Marsegoe in western Ceram 2,657 specimens of the same three species of *Nanaspis* were found (see above). From one *Synapta*

Table 5. Number of species associated with individually examined holothurians.

holothurian	locality		copepods
one *Thelenota ananas*	Moluccas		*Scambicornus batiolatus*
			Nanaspis manca
			Nanaspis spinifera
			Nanaspis pusilla
			Chauliolobion tectuliferum
four *Holothuria atra*	Moluccas	each with	*Scambicornus batiolatus*
			Scambicornus disparilis
			Scambicornus idoneus
one *Stichopus chloronotus*	Moluccas		*Scambicornus modestus*
			Chauliolobion forcipatum
			Nanaspis moluccana
one *Bohadschia argus*	Moluccas		*Scambicornus tylotus*
			Scambicornus tuberatus
			Chauliolobion imparile
one *Actinopyga echinites*	New Caledonia		*Scambicornus calcaratus*
			Chauliolobion bulbosum
			Lecanurius planifrontalis
three *Holothuria edulis*	New Caledonia	each with	*Scambicornus subtilis*
			Scambicornus sewelli
three *Holothuria fuscocinerea*	New Caledonia	each with	*Scambicornus subtilis*
			Scambicornus sewelli
nine *Bohadschia graeffei*	5 in Moluccas, 4 in Madagascar	each with	*Scambicornus lobulatus*
one *Labidodemas semperianum*	Moluccas		*Scambicornus sentifer*

Table 6. Comparison of the incidence of external and internal associates of holothurians.

copepod	number of collections from pooled hosts	number of hosts examined	number of copepods collected	number of copepods per host
External species				
Caribulus sculptus	21	93	414	4.45
Scambicornus calcaratus	16	56	899	16.10
Scambicornus campanulipes	24	556	1634	2.94
Scambicornus idoneus	22	330	1246	3.78
Scambicornus lobulatus	13	54	581	10.76
Scambicornus modestus	26	86	1000	11.63
Scambicornus poculiferus	8	10	1111	111.10
Scambicornus sewelli	16	128	874	6.83
Scambicornus subtilis	21	142	158	1.11
Scambicornus tuberatus	14	28	1124	40.14
Nanaspis media	6	36	342	9.50
	187	1519	9383	av. = 19.85
Internal species				
Calypsarion leprum	19	746	91	0.12
Chauliolobion bulbosum	6	73	32	0.44
Diogenella spinicauda	13	201	102	0.51
Diogenidium deforme	5	111	12	0.11
Diogenidium nasutum	6	109	26	0.24
Lecanurius kossmannianus	10	219	21	0.10
Lichothuria mandibularis	19	830	355	0.42
	78	2289	639	av. = 0.28

maculata at Nosy Bé, Madagascar, 467 adults and 122 copepodids of *Scambicornus poculiferus* were recovered (Humes, 1967). In general, however, external species are more abundant than those living internally. In a selected group of 11 external species and 7 internal species where at least 5 collections were made the average number of external copepods was 19.85 and that of internal copepods 0.28 (Table 6).

GEOGRAPHICAL DISTRIBUTION

The information upon which concepts of geographical distribution of copepod associates of holothurians may be founded remains scanty. Since associated copepods are believed to have some degree of specificity for their holothurian hosts, the copepods might be expected to be restricted to the range of the host. This does not preclude, however, the replacement of one copepod by another over that range. Along the same line, two related species of holothurians with slightly overlapping geographical ranges might harbor the same species of copepod, thereby extending the range of the copepod.

Scambicornus is a relatively large genus containing 19 species living with holothurians. Its species occur widely and abundantly on holothurians in the Indo-Pacific (fig. 39). One species, *Scambicornus petiti,* is an inhabitant of the Mediterranean Sea, where it lives on *Stichopus regalis.* The presence of an essentially tropical genus in the Mediterranean is not so surprising considering the history of the Mediterranean and its origin from the Tethys Sea in the Tertiary. *Scambicornus* does not occur in the West Indies. There it is replaced by *Caribulus,* a genus where speciation has been slow, with only one certain species, *Caribulus sculptus,* and possibly a second species known.

Nanaspis is also a fairly large genus with 13 species on holothurians. Its species occur in the Indo-Pacific, Europe, and the West Indies (fig. 40). The four West Indian species, however, may represent a separate genus, as suggested by Stock, Humes & Gooding (1962). The four species have two features that seem to unite them: a 3-segmented endopod in leg 2 and the formula I-0; IV, 1 in leg 4. If this separation is supported, the remaining nine species show a distributional pattern similar to that of *Scambicornus.*

Collections of other genera of copepods from holothurians are too fragmentary to portray a satisfactory distributional picture.

Copepod associates are unknown from holothurians in many areas of the world (South America, Africa except Cape Town, mainland Asia, New Zealand, Greenland and the Arctic, and the Ant-

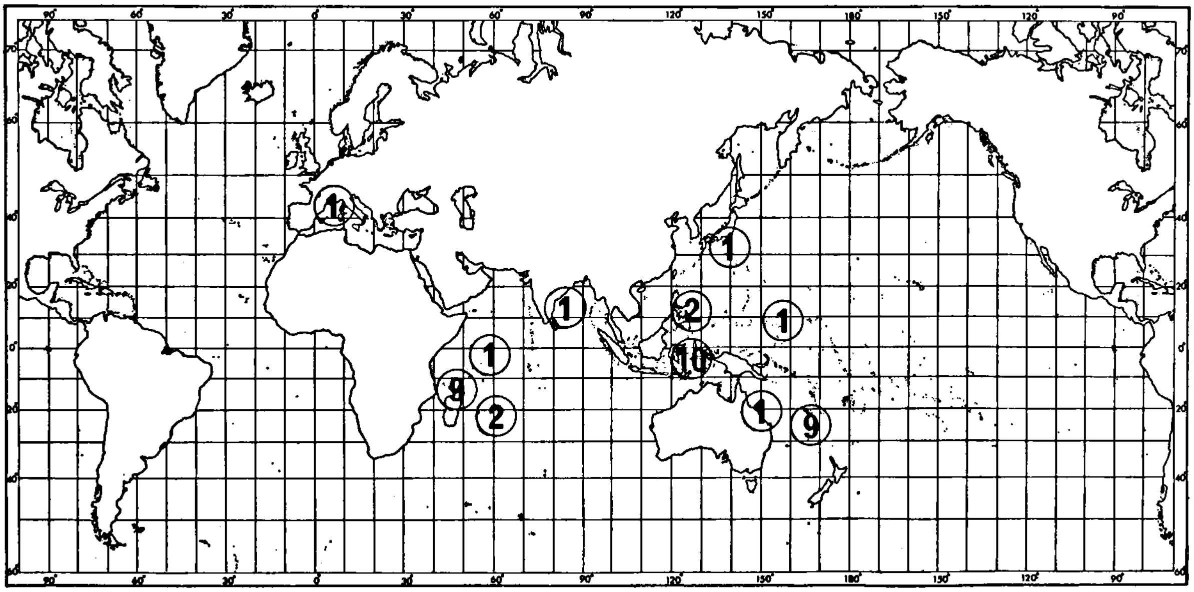

Fig. 39. Distribution of *Scambicornus,* with numbers of species found in the Mediterranean Sea, Madagascar, Seychelles, Mauritius, India, Japan, Philippines, Eniwetok Atoll, Moluccas, Australia, and New Caledonia.

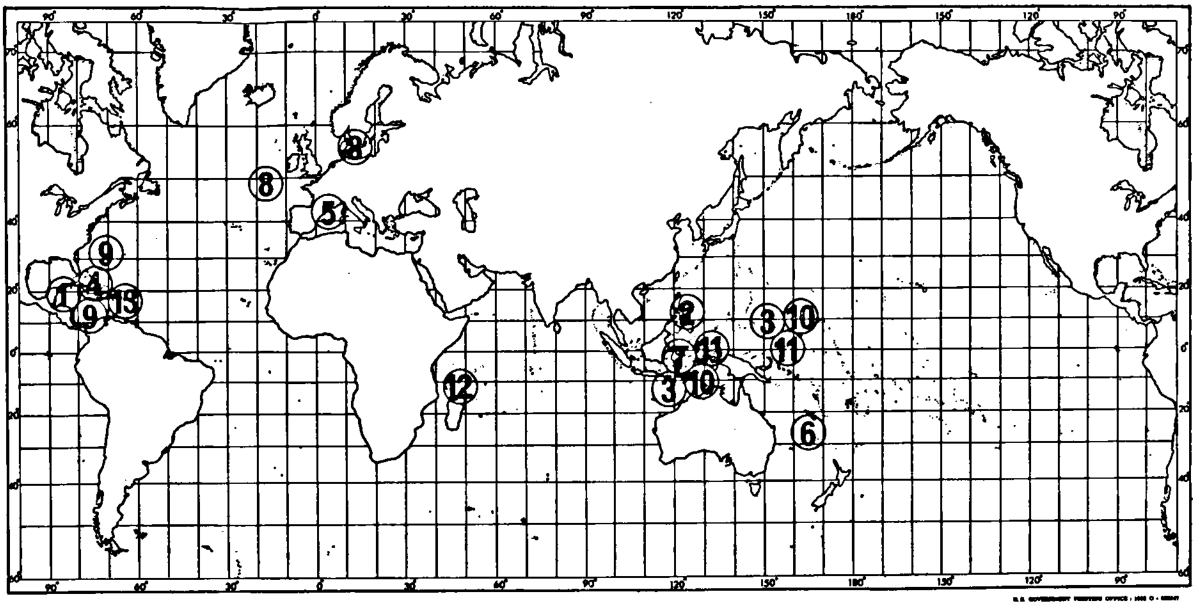

Fig. 40. Distribution of *Nanaspis*. 1 = *exigua*, 2 = *boholensis*, 3 = *manca*, 4 = *media*, 5 = *mediterranea*, 6 = *mixta*, 7 = *moluccana*, 8 = *ninae*, 9 = *pollens*, 10 = *pusilla*, 11 = *spinifera*, 12 = *tonsa*, 13 = *truncata*.

arctic). Most of the collections have been from shallow-water Holothuroidea, with the majority of these hosts coming from the tropical intertidal and subtidal. Very few deep-water holothurians have been examined. *Nanaspis ninae* has been found on *Parastichopus tremulus* in 479-485 m, and *Brychiopontius falcatus* and *Gomphopodarion byssoicum* have been collected from *Oneirophanta mutabilis* in 4426-4435 m, all from a point west of Ireland.

COPEPODS AND THEIR HOLOTHURIAN HOSTS

Abacola holothuriae Edwards - see *Metis*

Allantogynus delamarei Changeux

Holothuria (Lessonothuria) polii
Holothuria (Holothuria) stellati
Holothuria (Holothuria) tubulosa

Asterocheres boecki (Brady)

Holothuria (Panningothuria) forskali

Brychiopontius falcatus Humes

Oneirophanta mutabilis

Calypsarion bilobatum Humes

probably *Holothuria atra*

Calypsarion carinatum (Stock)

Stichopus monotuberculatus

Calypsarion leprum Humes & Ho

Actinopyga lecanora
Actinopyga mauritiana
Actinopyga miliaris

Calypsarion sentosum Humes & Ho

Bohadschia marmorata

Calypsina changeuxi (Stock & Kleeton)

Holothuria (Holothuria) stellati
Holothuria (Holothuria) tubulosa

Caribulus sculptus (Humes)

Actinopyga agassizii
Holothuria (Halodeima) grisea
Holothuria (Halodeima) mexicana
Isostichopus badionotus

Caribulus sp.

Actinopyga agassizii
Holothuria (Halodeima) mexicana
Isostichopus badionotus

Chauliolobion bulbosum Humes

Actinopyga echinites
Actinopyga palauensis

Chauliolobion foliaceum (Ummerkutty)

Holothuria atra

Chauliolobion forcipatum Humes

Stichopus chloronotus

Chauliolobion halodeimatis Humes

Holothuria (Halodeima) atra

Chauliolobion imparile Humes

Bohadschia argus

Chauliolobion tectuliferum Humes

Thelenota ananas

Cucumaricola notabilis Paterson

Cucumaria frauenfeldi

Diogenella deichmannae Humes & Ho

Holothuria (Thymioscyia) arenicola

Diogenella impar Humes & Ho

Holothuria (Thymioscyia) arenicola

Diogenella seticauda Stock

Holothuria (Semperothuria) surinamensis
Holothuria (Thymioscyia) arenicola
Holothuria (Thymioscyia) impatiens

Diogenella spinicauda Stock

Actinopyga agassizii
Holothuria (Halodeima) mexicana

Diogenidium deforme Stock

Holothuria (Halodeima) mexicana
Holothuria (Selenkothuria) glaberrima
Holothuria (Thymioscyia) arenicola

Diogenidium nasutum Edwards

Actinopyga agassizii
Holothuria (Halodeima) grisea
Holothuria (Halodeima) mexicana

Diogenidium spinulosum Stock

Isostichopus badionotus

Diogenidium tectum Humes & Ho

Actinopyga agassizii

Gomphopodarion byssoicum Humes

Oneirophanta mutabilis

Lecanurius intestinalis Kossmann

Actinopyga lecanora

Lecanurius kossmannianus Humes

Actinopyga lecanora
Actinopyga miliaris

Lecanurius planifrontalis Humes

Actinopyga echinites
Actinopyga miliaris

Lecanurius sp.

Synapta maculata

Lichothuria mandibularis Stock

Holothuria (Cystipus) fuscopunctata
Holothuria (Halodeima) atra
Holothuria (Metriatyla) scabra
Holothuria (Microthele) nobilis

Metaxymolgus cuspis (Humes)

holothurians

Metis holothuriae (Edwards)

Actinopyga agassizii

Myzopontius pungens Giesbrecht

Stichopus regalis

Namakosiramia californiensis Ho & Perkins

Stichopus parvimensis

Nanaspis boholensis Humes

Stichopus variegatus

Nanaspis exigua Stock, Humes & Gooding

Isostichopus badionotus

Nanaspis manca Humes

Thelenota ananas

Nanaspis media Stock, Humes & Gooding

Isostichopus badionotus

Nanaspis mediterranea Stock & Kleeton

Stichopus regalis

Nanaspis mixta Humes

Holothuria (Microthele) nobilis

Nanaspis moluccana Humes

Stichopus chloronotus

Nanaspis ninae Bresciani & Lützen

Parastichopus tremulus

Nanaspis pollens Stock, Humes & Gooding

Holothuria (Semperothuria) surinamensis
Holothuria (Thymioscyia) arenicola
Isostichopus badionotus

Nanaspis pusilla Humes

Thelenota ananas

Nanaspis spinifera Humes

Thelenota ananas

Nanaspis tonsa Humes & Cressey

Stichopus chloronotus
Stichopus variegatus

Nanaspis truncata Stock, Humes & Gooding

Holothuria (Platyperona) parvula
Holothuria (Semperothuria) surinamensis
Holothuria (Thymioscyia) arenicola

Preherrmannella - see *Scambicornus*

Preherrmannella changeuxi Stock & Kleeton - see *Calypsina*

Pseudanthessius deficiens Stock, Humes & Gooding

Holothuria (Halodeima) mexicana

Pseudanthessius pectinifer Stock, Humes & Gooding

Actinopyga agassizii

Sacodiscus humesi Stock

Holothuria (Holothuria) tubulosa

Scambicornus batiolatus Humes

Holothuria (Halodeima) atra
Thelenota ananas

Scambicornus brachysetosus Reddiah

Holothuria (Halodeima) atra

Scambicornus calcaratus Humes

Actinopyga echinites
Actinopyga lecanora
Actinopyga miliaris
Actinopyga palauensis
Actinopyga plebeja
Actinopyga serratidens

Scambicornus campanulipes (Humes & Cressey)

Actinopyga echinites
Actinopyga lecanora
Actinopyga mauritiana
Actinopyga miliaris
Actinopyga plebeja
Actinopyga sp.
Holothuria (Halodeima) atra

Scambicornus carinatus Stock - see *Calypsarion*

Scambicornus changeuxi (Stock & Kleeton) - see *Calypsina*

Scambicornus disparilis Humes

Holothuria (Halodeima) atra

Scambicornus hamatus Heegaard

Neothyonidium hawaiiense (Fisher)

Scambicornus idoneus (Humes & Cressey)

Actinopyga echinites
Bohadschia argus
Holothuria (Halodeima) atra
Holothuria (Halodeima) edulis
Holothuria (Mertensiothuria) leucospilota
Holothuria (Metriatyla) scabra
Holothuria (Microthele) nobilis

Scambicornus lobulatus Humes

Actinopyga echinites
Bohadschia graeffei Humes

Scambicornus modestus (Humes & Cressey)

Bohadschia draschi
Holothuria (Halodeima) atra
Holothuria (Lessonothuria) pardalis
Holothuria (Platyperona) difficilis
Holothuria (Thymioscyia) impatiens
Ohshimella ehrenbergi
Stichopus chloronotus
Stichopus horrens
Stichopus monotuberculatus
Stichopus variegatus

Scambicornus petiti (Stock & Kleeton)

Stichopus regalis

Scambicornus poculiferus (Humes & Cressey)

Opheodesoma grisea
Synapta maculata

Scambicornus prolixus Humes

Holothuria (Halodeima) edulis

Scambicornus retrospiculus Humes

Stichopus variegatus

Scambicornus sculptus Humes - see *Caribulus*

Scambicornus sentifer Humes

Labidodemas semperianum

Scambicornus sewelli

Actinopyga echinites
Holothuria (Acanthotrapeza) coluber
Holothuria (Halodeima) atra
Holothuria (Halodeima) edulis
Holothuria (Mertensiothuria) fuscocinerea
Holothuria (Microthele) nobilis

Scambicornus sp. - see *Caribulus*

Scambicornus subgrandis (Humes & Cressey)

Labidodemas rugosum

Scambicornus subtilis (Humes & Cressey)

Actinopyga echinites
Holothuria (Acanthotrapeza) coluber
Holothuria (Halodeima) atra
Holothuria (Halodeima) edulis
Holothuria (Mertensiothuria) fuscocinerea
Holothuria (Microthele) nobilis
Opheodesoma grisea

Scambicornus tuberatus (Humes & Cressey)

Bohadschia argus
Bohadschia cousteaui
Bohadschia koellikeri
Bohadschia marmorata
Bohadschia sp.
Bohadschia vitiensis
Opheodesoma grisea
Thelenota ananas

Scambicornus tylotus Humes

Bohadschia argus

Stellicola holothuriae (Ummerkutty)

holothurians
Opheodesoma spectabilis

Synapticola teres Voigt

Polyplectana kefersteini
Synapta maculata

Synaptiphilus luteus Canu & Cuénot

Labidoplax digitata
Leptosynapta bergensis
Leptosynapta galliennei
Leptosynapta inhaerens

Synaptiphilus cantacuzenei cantacuzenei Bocquet & Stock

Labidoplax digitata

Synaptiphilus cantacuzenei mixtus Guille & Laubier

Labidoplax digitata

Synaptiphilus tridens (T. & A. Scott)

Leptosynapta cruenta
Leptosynapta inhaerens

Tisbe cucumariae Humes

Ocnus planci

Tisbe furcata (Baird)

Ocnus planci

Tisbe holothuriae Humes

Holothuria (Holothuria) stellati
Holothuria (Holothuria) tubulosa

Zygomolgus tenuifurcatus (Sars)

Labidoplax digitata

HOLOTHURIANS AND THEIR COPEPOD ASSOCIATES

Actinopyga agassizii (Selenka) (= *Muelleria agassizii* Selenka)

Caribulus sculptus
Caribulus sp.
Diogenella spinicauda
Diogenidium nasutum
Diogenidium tectum
Metis holothuriae
Pseudanthessius pectinifer

Actinopyga echinites (Jaeger)

Chauliolobion bulbosum
Lecanurius planifrontalis
Scambicornus calcaratus
Scambicornus campanulipes
Scambicornus idoneus
Scambicornus lobulatus
Scambicornus sewelli
Scambicornus subtilis

Actinopyga lecanora (Jaeger) (= *Muelleria lecanora* Jaeger)

Calypsarion leprum
Lecanurius intestinalis
Lecanurius kossmannianus
Scambicornus calcaratus
Scambicornus campanulipes

Actinopyga mauritiana (Quoy & Gaimard)

Calypsarion leprum
Scambicornus campanulipes

Actinopyga miliaris (Quoy & Gaimard)

Calypsarion leprum
Lecanurius kossmannianus
Lecanurius planifrontalis
Scambicornus calcaratus
Scambicornus campanulipes

Actinopyga palauensis Panning (= *Actinopyga obesa palauensis* Panning)

Chauliolobion bulbosum
Scambicornus calcaratus

Actinopyga plebeja (Selenka)

Scambicornus calcaratus
Scambicornus campanulipes

Actinopyga serratidens Pearson

Scambicornus calcaratus

Bohadschia argus Jaeger

Chauliolobion imparile
Scambicornus idoneus
Scambicornus lobulatus
Scambicornus tuberatus
Scambicornus tylotus

Bohadschia cousteaui Cherbonnier

Scambicornus tuberatus

Bohadschia draschi Cherbonnier

Scambicornus modestus

Bohadschia graeffei (Semper)

Scambicornus lobulatus

Bohadschia koellikeri (Semper)

Scambicornus tuberatus

Bohadschia marmorata Jaeger

Calypsarion sentosum
Scambicornus tuberatus

Bohadschia vitiensis (Semper)

Scambicornus tuberatus

Cucumaria frauenfeldi

Cucumaricola notabilis

Holothuria (Thymioscyia) arenicola Semper (= *Brandtothuria arenicola* (Semper))

Diogenella deichmannae
Diogenella impar
Diogenella seticauda
Diogenidium deforme
Nanaspis pollens
Nanaspis truncata

Holothuria (Halodeima) atra Jaeger (= *Halodeima atra* (Jaeger))

Calypsarion bilobatum
Chauliolobion foliaceum
Chauliolobion halodeimatis
Lichothuria mandibularis
Scambicornus batiolatus
Scambicornus brachysetosus
Scambicornus campanulipes
Scambicornus disparilis
Scambicornus idoneus
Scambicornus modestus
Scambicornus sewelli
Scambicornus subtilis

Holothuria (Acanthotrapeza) coluber Semper (= *Halodeima coluber* (Semper))

Scambicornus sewelli
Scambicornus subtilis

Holothuria (Platyperona) difficilis Semper (= *Microthele difficilis* (Semper))

Scambicornus modestus

Holothuria (Halodeima) edulis Lesson (= *Halodeima edulis* Lesson)

Scambicornus idoneus
Scambicornus prolixus
Scambicornus sewelli
Scambicornus subtilis

Holothuria (Panningothuria) forskali Delle Chiaje

Asterocheres boecki

Holothuria (Mertensiothuria) fuscocinerea (Jaeger) = *Holothuria curiosa* Ludwig)

Scambicornus sewelli
Scambicornus subtilis

Holothuria (Cystipus) fuscopunctata Jaeger (= *Holothuria* aff. *fuscopunctata* Semper)

Lichothuria mandibularis

Holothuria (Selenkothuria) glaberrima (Selenka)

Diogenidium deforme

Holothuria (Halodeima) grisea (Selenka) (= *Ludwigothuria grisea* (Selenka))

Caribulus sculptus
Diogenidium nasutum

Holothuria (Thymioscyia) impatiens Forskål

Diogenella seticauda
Scambicornus modestus

Holothuria (Mertensiothuria) leucospilota (Brandt)

Scambicornus idoneus

Holothuria (Halodeima) mexicana (Ludwig) (= *Ludwigothuria mexicana* (Ludwig))

Caribulus sculptus

Caribulus sp.
Diogenella spinicauda
Diogenidium deforme
Diogenidium nasutum
Pseudanthessius deficiens

Holothuria (Microthele) nobilis (Selenka) (= *Microthele nobilis* (Selenka)) (= *Argiodia nobilis* (Selenka))

Lichothuria mandibularis
Nanaspis mixta
Scambicornus idoneus
Scambicornus sewelli
Scambicornus subtilis

Holothuria (Lessonothuria) pardalis Selenka

Scambicornus modestus

Holothuria (Platyperona) parvula (Selenka

Nanaspis truncata

Holothuria (Lessonothuria) polii Della Chiaje

Allantogynus delamarei

Holothuria (Metriatyla) scabra Jaeger

Lichothuria mandibularis
Scambicornus idoneus

Holothuria (Holothuria) stellati Della Chiaje

Allantogynus delamarei
Calypsina changeuxi
Tisbe holothuriae

Holothuria (Semperothuria) surinamensis (Ludwig) (= *Semperothuria surinamensis* (Ludwig))

Diogenella seticauda
Nanaspis pollens
Nanaspis truncata

Holothuria (Holothuria) tubulosa Gmelin

Allantogynus delamarei
Calypsina changeuxi
Sacodiscus humesi

Holothurians

Metaxymolgus cuspis

Isostichopus badionotus (Selenka)

Caribulus sculptus
Caribulus sp.
Diogenidium spinulosum
Nanaspis exigua
Nanaspis media
Nanaspis pollens

Labidodemas rugosum (Ludwig) (= *Holothuria rugosa* Ludwig)

Scambicornus subgrandis

Labidodemas semperianum Selenka

Scambicornus sentifer

Labidoplax digitata (Montagu) (= *Synapta digitata* Montagu) (= *Oestergrenia digitata* (Montagu))

Synaptiphilus cantacuzenei cantacuzenei
Synaptiphilus cantacuzenei mixtus
Synaptiphilus luteus
Zygomolgus tenuifurcatus

Leptosynapta bergensis (Östergren)

Synaptiphilus luteus

Leptosynapta cruenta Cherbonnier

Synaptiphilus tridens

Leptosynapta galliennei (Herapath)

Synaptiphilus luteus

Leptosynapta inhaerens (Müller)

Synaptiphilus luteus
Synaptiphilus tridens

Neothyonidium hawaiiense (Fisher) (= *Thyonidium alexandri* Fisher)

Scambicornus hamatus

Ocnus planci (Brandt) (= *Cucumaria planci* (Brandt))

Tisbe cucumariae
Tisbe furcata

Ohshimella ehrenbergi (Selenka) (= *Urodemas ehrenbergi* Selenka)

Scambicornus modestus

Oneirophanta mutabilis Theel

Brychiopontius falcatus
Gomphopodarion byssoicum

Opheodesoma grisea (Semper)

Scambicornus poculiferus
Scambicornus subtilis
Scambicornus tuberatus

Opheodesoma spectabilis Fisher

Stellicola holothuriae

Parastichopus tremulus (Gunnerus) (= *Stichopus tremulus* (Gunnerus))

Nanaspis ninae

Polyplectana kefersteini (Selenka) (= *Synapta kefersteini* Selenka)

Synapticola teres

Stichopus chloronotus Brandt

Chauliolobion forcipatum
Nanaspis tonsa
Scambicornus modestus

Stichopus horrens Selenka

Scambicornus modestus

Stichopus monotuberculatus (Quoy & Gaimard)

Calypsarion carinatum
Scambicornus modestus

Stichopus parvimensis (Clark)

Namakosiramia californiensis

Stichopus regalis (Cuvier)

Myzopontius pungens
Nanaspis mediterranea
Scambicornus petiti

Stichopus variegatus Semper

Nanaspis boholensis
Nanaspis tonsa
Scambicornus modestus
Scambicornus retrospiculus

Synapta maculata (Chamisso & Eysenhardt)

Lecanurius sp.
Scambicornus poculiferus
Synapticola teres

Thelenota ananas (Jaeger)

Chauliolobion tectuliferum
Nanaspis manca
Nanaspis pusilla
Nanaspis spinifera
Scambicornus batiolatus
Scambicornus tuberatus

REFERENCES

BAIRD, W., 1837. The natural history of the British Entomostraca. Mag. Zool. Bot., **1**: 309-333.

BAREL, C. D. N. & P. G. N. KRAMERS, 1970. Notes on associates of echinoderms from Plymouth and the coast of Brittany. Proc. kon. Ned. Akad. Wetensch. Amsterdam, (C), **73**: 159-170.

——, 1977. A survey of the echinoderm associates of the north-east Atlantic area. Zool. Verhand., **156**: 1-159.

BOCQUET, C., 1952. Copépodes semi-parasites et parasites des échinodermes de la région de Roscoff. Description de *Lichomolgus asterinae* n. sp. Bull. Soc. Zool. France, **77**: 495-504.

BOCQUET, C. & J. H. STOCK, 1957. Copépodes parasites d'invertébrés des côtes de France. Va. Le genre *Synaptiphilus* Canu et Cuénot. Proc. kon. Ned. Akad. Wetensch. Amsterdam, (C), **60**: 679-695.

BOECK, A., 1859. Beskrivelse over tvende nye parasitiske Krebsdyr, *Artotrogus orbicularis* og *Asterocheres liljeborgii*. Forh. Vid. Selsk Christiania, **1859**: 171-182.

BOULIGAND, Y. & C. DELAMARE-DEBOUTTEVILLE, 1959. Le dimorphisme sexuel de *Linaresia mammillifera* Zulueta, 1908, copépode parasite de l'octocoralliaire *Muricea chameleon* von Koch. C. R. Acad. Sci., Paris, **248**: 286-288.

BRADY, G. S., 1880. A monograph of the free and semi-parasitic Copepoda of the British Islands, **3**: 1-83 (Roy. Soc., London).

BRESCIANI, J. & J. LÜTZEN, 1962. Parasitic copepods from the west coast of Sweden including some new or little known species. Vidensk. Medd. fra Dansk Naturh. Foren., **124**: 367-408.

CANU, E. & L. CUÉNOT, 1892. In: L. Cuénot, Commensaux et parasites des échinodermes (deuxième note). Rev. Biol. Nord France, **5**: 1-23.

CHANGEUX, J.-P., 1958. Quelques caractères biologiques d'un copépode parasite d'holothuries: *Allantogynus delamarei* n. g. n. sp. C. R. Acad. Sci., Paris, **247**: 961-964.

——, 1960. Contribution à l'étude des animaux associés aux holothurides. Act. Sci. Industr., **1284**: 1-124.

COULL, B., 1977. Marine flora and fauna of the northeastern United States. Copepoda. Harpacticoida. NOAA Tech. Rept. NMFS Circ., U. S. Dept. Commerce, **399**: 1-48.

CUÉNOT, L., 1892. See Canu & Cuénot, 1892.

——, 1912. Contributions à la faune du bassin d'Arcachon. V. Echinodermes. Bull. Stat. Biol. Arcachon, **14**: 17-116.

DUDLEY, P. L., 1966. Development and systematics of some Pacific marine symbiotic copepods. A study of the biology of the Notodelphyidae, associates of ascidians: 1-282 (Univ. Washington Press, Seattle).

EDWARDS, C. L., 1891. Beschreibung einiger neuen Copepoden und eines neuen copepodenähnlichen Krebses, *Leuckartella paradoxa*. Arch. Naturg., **57**: 75-104.

GIESBRECHT, W., 1895a. The subfamilies, genera, and species of the copepod family Ascomyzontidae Thorell: diagnosis, synonymy, and distribution. Ann. Mag. Nat. Hist. (6), **16**: 173-186.

——, 1895b. Mittheilungen über Copepoden. 10 u. 11. Mitt. Zool. Stat. Neapel, **12**: 217-226.

——, 1899. Die Asterocheriden des Golfes von Neapel und der angrenzenden Meeres-Abschnitte. Fauna Flora Golfes Neapel, **25**: 1-217.

GOODING, R. U., 1963. External morphology and classification of marine poecilostome copepods belonging to the families Clausidiidae, Clausiidae, Nereicolidae, Eunicicolidae, Synaptiphilidae, Catiniidae, Anomopsyllidae, and Echiurophilidae: 1-247. (Ph.D. Thesis, Univ. Washington)

GOTTO, R. V., 1954. A copepod new to the British Isles and others hitherto unrecorded from Irish coastal waters. Irish Nat. J., **11**: 133-135.

——, 1962. Egg-number and ecology in commensal and parasitic copepods. Ann. Mag. Nat. Hist., (13), **5**: 97-107.

——, 1966. Copepods associated with marine invertebrates from the northern coast of Ireland. Irish Nat. J., **15**: 191-196.

Guille, A. & L. Laubier, 1965. *Synaptiphilus cantacazenei mixtus* ssp. nov., copépode ectoparasite sur *Oestergrenia digitata* à Banyuls-sur-mer. Crustaceana, **9**: 125-136.

Gurney, R., 1927. Zoological results of the Cambridge Expedition to the Suez Canal, 1924. XXXIII. Report on the Crustacea: Copepoda (Littoral and Semi-parasitic). Trans. zool. Soc. London, **22**: 451-577.

Hartmann, C. E. R., 1856. *Colaceutes* novum parasitorum genus. Dissertatio inauguralis historiconaturalis, etc., 1-13 (Berolini) (In Latin).

Heegaard, P., 1944. A new copepod (*Scambicornus hamatus*) parasitic on a Japanese holothurian. Vidensk. Medd. fra Dansk Naturh. Foren., **107**: 359-366.

——, 1959. The shaping of the egg strings in the copepods. Smithsonian Misc. Coll., **137**: 231-235.

Ho, J.-S. & P. S. Perkins, 1977. A new family of cyclopoid copepod (Namakosiramiidae) parasitic on holothurians from southern California. J. Parasitol., **63**: 368-371.

Humes, A. G., 1957. Deux copépodes harpacticoïdes nouveaux du genre *Tisbe*, parasites des holothuries de la Méditerranée. Vie et Milieu, **8**: 9-22.

——, 1964. New species of *Lichomolgus* (Copepoda, Cyclopoida) from sea anemones and nudibranchs in Madagascar. Cah. ORSTOM, Oceanogr. **6** (1963, série Nosy Bé 11): 59-130.

——, 1967. A new species of *Scambicornus* (Copepoda, Cyclopoida, Lichomolgidae) associated with a holothurian in Madagascar, with notes on several previously described species. Beaufortia, **14**: 135-155.

——, 1968. *Lecanurius kossmannianus,* a new cyclopoid copepod parasitic in holothurians in Madagascar. Proc. Biol. Soc. Wash., **81**: 179-190.

——, 1969. Copepods of the genus *Scambicornus* (Cyclopoida, Lichomolgidae) associated with holothurians in the West Indies. Stud. Fauna Curaçao Carib. Is., **29**: 79-95.

——, 1973. *Nanaspis* (Copepoda, Cyclopoida) parasitic on the holothurian *Thelenota ananas* (Jaeger) at Eniwetok Atoll. J. Parasitol., **59**: 383-395.

——, 1974. New cyclopoid copepods associated with an abyssal holothurian in the eastern North Atlantic. J. Nat. Hist., **8**: 101-117.

——, 1975a. Cyclopoid copepods (Nanaspididae and Sabelliphilidae) associated with holothurians in New Caledonia. Smithsonian Contr. Zool., **202**: 1-41.

——, 1975b. Cyclopoid copepods associated with marine invertebrates in Mauritius. Zool. J. Linn. Soc., **56**: 171-181.

——, 1979. *Synapticola teres* Voigt, 1892 (Copepoda, Cyclopoida, Sabelliphilidae) from a holothurian in northeastern Australia. Crustaceana, **36**: 249-256.

Humes, A. G. & R. F. Cressey, 1959. A new family and genus of cyclopoid copepods parasitic on a holothurian. J. Parasitol., **45**: 209-216.

——, 1961. Copépodes cyclopoïdes du genre *Preherrmannella* parasites d'holothuries et d'un oursin à Madagascar. Mem. Inst. Sci. Madagascar, 1959, (F), **3**: 25-65.

Humes, A. G. & J.-S. Ho, 1967. New species of *Stellicola* (Copepoda, Cyclopoida) associated with starfishes in Madagascar, with a redescription of *S. caeruleus* (Stebbing, 1900). Bull. Brit. Mus. (Nat. Hist.), Zool., **15**: 201-225.

——, 1969. Cyclopoid copepods parasitic in holothurians in Madagascar. J. Parasitol., **55**: 877-894.

——, 1970. The genus *Diogenella* (Copepoda, Cyclopoida) parasitic in holothurians in the West Indies. Crustaceana, **19**: 15-36.

——, 1971. The genus *Diogenidium* (Copepoda, Cyclopoida) parasitic in holothurians in the West Indies. Crustaceana, **20**: 171-191.

Humes, A. G. & J. S. Stock, 1972. Preliminary notes on a revision of the Lichomolgidae, cyclopoid copepods mainly associated with marine invertebrates. Bull. zool. Mus., Univ. Amsterdam, **2**: 121-133.

——, 1973. A revision of the family Lichomolgidae Kossmann, 1877, cyclopoid copepods mainly associated with marine invertebrates. Smithsonian Contr. Zool., **127**: i-v, 1-368.

Kossmann, R., 1877. Entomostraca (1. Theil: Lichomolgidae). In: Zoologische Ergebnisse einer im Auftrage der Königlichen Academie der Wissenschaften zu Berlin ausgeführten Reise in die Küstengebiete des Rothen Meeres, erste Hälfte, **4**: 1-24.

Lang, K., 1948. Monographie der Harpacticiden. 2 vols. 1-1682 (Lund, Sweden).

Liljeborg, W., 1853. Om de inom skåne förekommande Crustaceer af ordingarne Cladocera, Ostracoda och Copepoda.: i-xv, 1-222 (Lund, Sweden).

Monticelli, F. S., 1892. Notizia preliminare intorno ad alcuni inquilini degli Holothurioidea del Golfo di Napoli. Monit. Zool. Ital., **3**: 248-256.

Paterson, N. F., 1958. External features and life cycle of *Cucumaricola notabilis* nov. gen. et sp., a copepod parasite of the holothurian, *Cucumaria*. Parasitol., **48**: 269-290.

Petkovsky, T., 1964. Zur Kenntnis der Harpacticiden Portugals (Crustacea, Copepoda). Lunds Univ. Årsskr., (n.s. 2), **59**: 1-22.

Philippi, A., 1843. Fernere Beobachtungen über die Copepoden des Mittelmeeres. Arch. Naturg., (9) **1**: 54-71.

Reddiah, K., 1968. *Scambicornus brachysetosus* n. sp. (Copepoda: Lichomolgidae) from a holothurian in the Gulf of Mannar. J. Mar. Biol. Ass. India, 1967, **9**: 126-131.

Sars, G. O., 1910. An account of the Crustacea of Norway with short descriptions and figures of all the species, vol. 5, Copepoda Harpacticoida, pts. XXIX & XXX, Tachidiidae (concluded), Metidae, Balaenophilidae, Supplement (part): 337-368 (Bergen).

——, 1915. An account of the Crustacea of Norway with short descriptions and figures of all the species, vol. 6, Copepoda Cyclopoida, pts. IX & X. Ascomyzontidae (concluded), Acontiophoridae, Myzopontiidae, Dyspontiidae, Artotrogidae, Cancerillidae: 105-140 (Bergen).

——, 1917. An account of the Crustacea of Norway with short descriptions and figures of all the species, vol. 6, Copepoda, Cyclopoida, pts. XI, XII. Clausidiidae, Lichomolgidae (part): 141-172 (Bergen).

Schirl, K., 1973. Cyclopoida Siphonostoma (Crustacea) von Banyuls (Frankreich, Pyrénées-Orientales) mit

besonderer Berücksichtigung des Gast-Wirtverhältnisses. Bijdr. Dierk., **43**: 64-92.
SCOTT, T. & A. SCOTT, 1893. On some new or rare Crustacea from Scotland. Ann. Mag. Nat. Hist., (6), **12**: 237-246.
——, 1897. Notes on *Sunaristes paguri* Hesse and some other rare Crustacea. Ann. Mag. Nat. Hist., (6), **20**: 489-494.
SEBASTIAN, M. J., 1972. Copepod associates of South Indian invertebrates: 1-344. (Ph.D. Thesis, Univ. Kerala, Trivandrum, India)
SEWELL, R. B. S., 1949. The littoral and semi-parasitic Cyclopoida, the Monstrilloida and Notodelphyoida. John Murray Exped., 1933-34, sci. Repts., **9**: 17-199.
STEBBING, T. R. R., 1910. General catalogue of South African Crustacea (Part V of S. A. Crustacea, for the marine investigations in South Africa). Ann. S. Afr. Mus., **6**: 518-563 (Copepoda only).
STOCK, J. H., 1959. Copepoda associated with Neapolitan invertebrates. Pubbl. Staz. Zool. Napoli, **31**: 59-75.
——, 1960. Sur quelques copépodes associés aux invertébrés des côtes du Roussillon. Crustaceana, **1**: 218-257.
——, 1964. On *Scambicornus* Heegaard, 1944, a senior synonym of *Preherrmannella* Seymour Sewell, 1949 (Copepoda, Cyclopoida). Beaufortia, **10**: 183-192.
——, 1968. Copepoda endoparasitic of tropical holothurians. Bull. Zool. Mus., Univ. Amsterdam, **1**: 89-105.
STOCK, J. H. & G. KLEETON, 1963. Copépodes associés aux invertébrés des côtes du Roussillon. Vie et Milieu, **13**: 681-702.
STOCK, J. H., A. G. HUMES & R. U. GOODING, 1962. Copepoda associated with West Indian invertebrates I. The genus *Nanaspis* (Siphonostoma, Nanaspidae). Stud. Fauna Curaçao Carib. Is., **13**: 1-20.
——, 1963a. Copepoda associated with West Indian invertebrates IV. The genera *Octopicola, Pseudanthessius* and *Meomicola* (Cyclopoida, Lichomolgidae). Stud. Fauna Curaçao Carib. Is., **18**: 1-74.
——, 1963b. Copepoda associated with West Indian invertebrates II. Cancerillidae, Micropontiidae (Siphonostoma). Stud. Fauna Curaçao Carib. Is., **15**: 1-23.
UMMERKUTTY, A. N. P., 1962. Studies on Indian copepods 5. On eleven new species of marine cyclopoid copepods from the south-east coast of India. J. Mar. Biol. Ass. India, 1961, **3**: 19-69.
——, 1970. Description of *Sabelliphilus foliacea* sp. n. (Copepoda, Cyclopoida) with notes on the affinities of the species. Rec. zool. Surv. India, **64**: 101-105.
VILELA, M. H., 1968. Copépodes da campanha do N. R. P. "Faial", 1958-59. Notas Estud. Inst. Biol. Mar., Lisbon, **35**: 1-55.
VOIGT, W., 1892. *Synapticola teres* n. g., n. sp., ein parasitischer Copepode aus *Synapta kefersteinii* Sel. Z. Wiss. Zool., **53** (supplement): 31-42.
VOLKMANN-ROCCO, B., 1971. Some critical remarks on the taxonomy of *Tisbe* (Copepoda, Harpacticoida). Crustaceana, **21**: 127-132.
——, 1972. Species of *Tisbe* (Copepoda, Harpacticoida) from Beaufort, North Carolina. Archo. Oceanogr. Limnol., **17**: 223-258.
——, 1973. *Tisbe biminiensis* (Copepoda, Harpacticoida), a new species of the *gracilis* group. Archo. Oceanogr. Limnol., **18**: 71-90.
WILSON, C. B., 1924. New North American parasitic copepods, new hosts, and notes on copepod nomenclature. Proc. U. S. Nat. Mus., **64**: 1-22.

INDEX TO COPEPODS

Received: May 4, 1979.

Institute of Taxonomic Zoology (Zoological Museum), University of Amsterdam,
P.O. Box 20125, 1000 HC Amsterdam - The Netherlands