

Cyclopoid Copepods
(Nanaspidae and Sabelliphilidae)
Associated with Holothurians
in New Caledonia

ARTHUR G. HUMES

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ABSTRACT

Humes, Arthur G. Cyclopoid Copepods (Nanaspidae and Sabelliphilidae) Associated with Holothurians in New Caledonia. *Smithsonian Contributions to Zoology*, number 202, 41 pages, 24 figures, 1975.—*Nanaspis mixta*, new species, from *Microthele nobilis*; *Chauliolobion bulbosum*, new genus, new species, from *Actinopyga echinites* and *Actinopyga obesa palauensis*; *Chauliolobion halodeimatis*, new genus, new species, from *Halodeima atra*; *Scambicornus tylotus*, new species, from *Bohadschia argus*; *Scambicornus sewelli*, new species, from *Halodeima edulis*, *Halodeima coluber*, *Halodeima atra*, *Holothuria curiosa*, *Actinopyga echinites*, and *Microthele nobilis*; *Scambicornus calcaratus*, new species, from *Actinopyga miliaris*, *Actinopyga obesa palauensis*, *Actinopyga plebeja*, *Actinopyga serratidens*, *Actinopyga echinites*, and *Actinopyga lecanora*. Six species of *Scambicornus* are reported from New Caledonia for the first time, their ranges being extended from the western Indian Ocean (Madagascar and Mauritius): *Scambicornus tuberatus* from *Bohadschia vitiensis* and from a new host *Bohadschia argus*; *Scambicornus subtilis* from *Halodeima edulis* and *Holothuria curiosa*, and from the new hosts *Halodeima coluber*, *Halodeima atra*, *Actinopyga echinites*, and *Microthele nobilis*; *Scambicornus campanulipes* from *Actinopyga lecanora* and a new host *Actinopyga plebeja*; *Scambicornus modestus* from *Stichopus chloronotus* and *Stichopus variegatus*; *Scambicornus poculiferus* from *Synapta maculata*; *Scambicornus idoneus* from *Holothuria leucospilota*, *Halodeima atra*, *Actinopyga echinites*, and *Microthele nobilis*. The Indian species *Scambicornus brachysetosus* Reddiah, 1968, is briefly redescribed and figured from paratypes.

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Cyclopoid Copepods (Nanaspidae and Sabelliphilidae) Associated with Holothurians in New Caledonia

Arthur G. Humes

Introduction

Cyclopoid copepods are frequently associated with Holothuroidea, especially in tropical waters. The genus *Nanaspis* Humes and Cressey, 1959, containing ten species, is known from holothurians from the West Indies, the western coast of Sweden, the Mediterranean coast of France, Madagascar, and Eniwetok Atoll. Several sabelliphilid genera are known from holothurians, chiefly in the West Indies, Madagascar, and the Red Sea. These records have been summarized by Humes and Stock (1973). Associations of copepods and holothurians have not previously been reported in New Caledonia.

Twelve copepods are here recorded from various shallow-water holothurians in New Caledonia. These comprise six new species, and six already known species for which there are six new hosts (preceded by an asterisk in the list below). The twelve species are:

- Nanaspis mixta*, new species
from *Microthele nobilis* (Selenka)
- Chauliolobion bulbosum*, new genus, new species
from *Actinopyga echinites* (Jaeger) and *Actinopyga obesa palauensis* Panning
- Chauliolobion halodeimatis*, new species
from *Halodeima atra* (Jaeger)
- Scambicornus tylotus*, new species
from *Bohadschia argus* (Jaeger)

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Scambicornus sewelli, new species

from *Halodeima edulis* (Lesson), *Halodeima coluber* (Semper), *Halodeima atra* (Jaeger), *Holothuria curiosa* Ludwig, *Actinopyga echinites* (Jaeger), and *Microthele nobilis* (Selenka)

Scambicornus calcaratus, new species

from *Actinopyga miliaris* (Quoy and Gaimard), *Actinopyga obesa palauensis* Panning, *Actinopyga plebeja* (Selenka), *Actinopyga serratidens* Pearson, *Actinopyga echinites* (Jaeger), and *Actinopyga lecanora* (Jaeger)

Scambicornus tuberatus (Humes and Cressey, 1961)

from *Bohadschia vitiensis* (Semper) and **Bohadschia argus* (Jaeger)

Scambicornus subtilis (Humes and Cressey, 1961)

from *Halodeima edulis* (Lesson), **Halodeima coluber* (Semper), **Halodeima atra* (Jaeger), *Holothuria curiosa* Ludwig, **Actinopyga echinites* (Jaeger), and **Microthele nobilis* (Selenka)

Scambicornus campanulipes (Humes and Cressey, 1961)

from **Actinopyga plebeja* (Selenka) and *Actinopyga lecanora* (Jaeger)

Scambicornus modestus (Humes and Cressey, 1961)

from *Stichopus chloronotus* (Brandt) and *Stichopus variegatus* Semper

Scambicornus poculiferus (Humes and Cressey, 1961)

from *Synapta maculata* (Chamisso and Eysenhardt)

Scambicornus idoneus (Humes and Cressey, 1961)

from *Holothuria leucospilota* (Brandt), *Halodeima atra* (Jaeger), *Actinopyga echinites* (Jaeger), and *Microthele nobilis* (Selenka)

The field work in New Caledonia during June-August, 1971, and the ensuing study of the copepods were made possible by a grant (GB-8381X) from the National Science Foundation. Mr. Roger C. Halverson from the University of California at

Santa Barbara assisted in the field work. I wish to acknowledge with thanks and appreciation the aid provided by the staff of the Centre ORSTOM de Noumea.

For the identification of the holothurian hosts I am greatly indebted to Monsieur G. Cherbonnier, Muséum National d'Histoire Naturelle, Paris. I wish also to thank Shri G. Ramakrishna, Superintending Zoologist, Zoological Survey of India, for sending me paratypes of *Scambicornus brachysetosus* Reddiah, 1968.

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, MXP = maxilliped, and P_1 = leg 1.

The measurements were made on specimens in lactic acid and are expressed in microns unless otherwise stated. The body length does not include the setae on the caudal rami. The lengths of the first antennal segments were measured along their posterior nonsetiferous margins.

Specimens that are deposited in the National Museum of Natural History, Smithsonian Institution, Washington, D.C., are listed under the catalog numbers of the former United States National Museum (USNM).

NANASPIDIDAE Humes and Cressey, 1959

Nanaspis Humes and Cressey, 1959

Nanaspis mixta, new species

FIGURES 1-3

TYPE MATERIAL.—327 ♀♀, 223 ♂♂, and 41 copepodids from two holothurians, *Microthele nobilis* (Selenka), in 2 m, west of Isle Mando, near Noumea, New Caledonia, 22°18'59"S, 166°09'30"E, 3 July 1971. Holotype ♀, allotype, and 380 paratypes (250 ♀♀, 130 ♂♂) deposited in the National Museum of Natural History, Smithsonian Institution, Washington, D.C.; 80 paratypes (40 ♀♀, 40 ♂♂) in the Zoölogisch Museum, Amsterdam; the remaining paratypes in the collection of the author.

OTHER SPECIMENS.—17 ♀♀ from two *Microthele nobilis*, in 0.5 m, off Goro, southeastern New Caledonia, 22°18'00"S, 167°02'00"E, 6 August 1971.

FEMALE.—Body (Figure 1a-c) ovoid and moderately flattened dorsoventrally. Length of the shield-like prosome (not including the urosome, which is folded ventrally in specimens preserved in ethyl alcohol) 450 (440-462) and the greatest width 327 (319-330), based on 10 specimens. Prosome with a dorsal transverse suture separating the anterior cephalosome (including the segment of leg 1) from the posterior metasome (the segments of legs 2-4). Posterior margin of the metasome truncated.

Urosome (Figure 1d,e) with three distinct segments (that of leg 5, the genital segment, and the anal segment). Segment of leg 5 (Figure 1e) with four transverse ventral rows of spinules. Genital area (Figure 1f) with a small naked seta 5.5 long. Anal segment rather deeply incised.

Egg sac (Figure 1a) 200 × 120 not including the neck, and containing two eggs.

Caudal ramus (Figure 1g) minute, 14 × 11, bearing six naked setae, the two longest 65 and 140. Ramus with a few distal inner spinules.

Arrangement of the appendages as in Figure 1c.

Rostral area not well developed (Figure 1c). First antenna (Figure 1h) 82 long and probably 5-segmented, though the second and third segments are incompletely separated. Lengths of the segments: 12 (19 along the anterior margin), 14, 5, 4.5, 4.5, 6.5, 6.5, and 20 respectively. Armature: 1, 1, 1, 2, 2, 3, and 7 + 2 aesthetes. All setae naked. Second antenna (Figure 2a) about 130 long, 4-segmented, the first segment unornamented, the second segment with a few distal outer spinules, the elongated third segment with spinules as illustrated, the small fourth segment with a minute seta and a minutely setose pad with a recurved tip.

Oral cone (Figure 2b) projecting ventrally (Figure 1b). Mandible (Figure 2c) a simple blade 23 long. First maxilla (Figure 2d) with the inner branch having one spinulose seta and the outer branch having three naked setae. Seta external to the base of the first maxilla and near the base of the second antenna large and spinulose. Second maxilla (Figure 2e) with the large first segment bearing a few slender outer spinules; claw 73 along its axis and reflexed distally. Maxilliped (Figure 2f) 164 long. Ventral area between and immediately behind the maxillipeds as in Figure 2g.

Legs 1 and 2 biramous. Both rami of leg 1 a single segment (Figure 2h). Leg 2 (Figure 2i) with both rami 3-segmented. Legs 3 and 4 uniramous

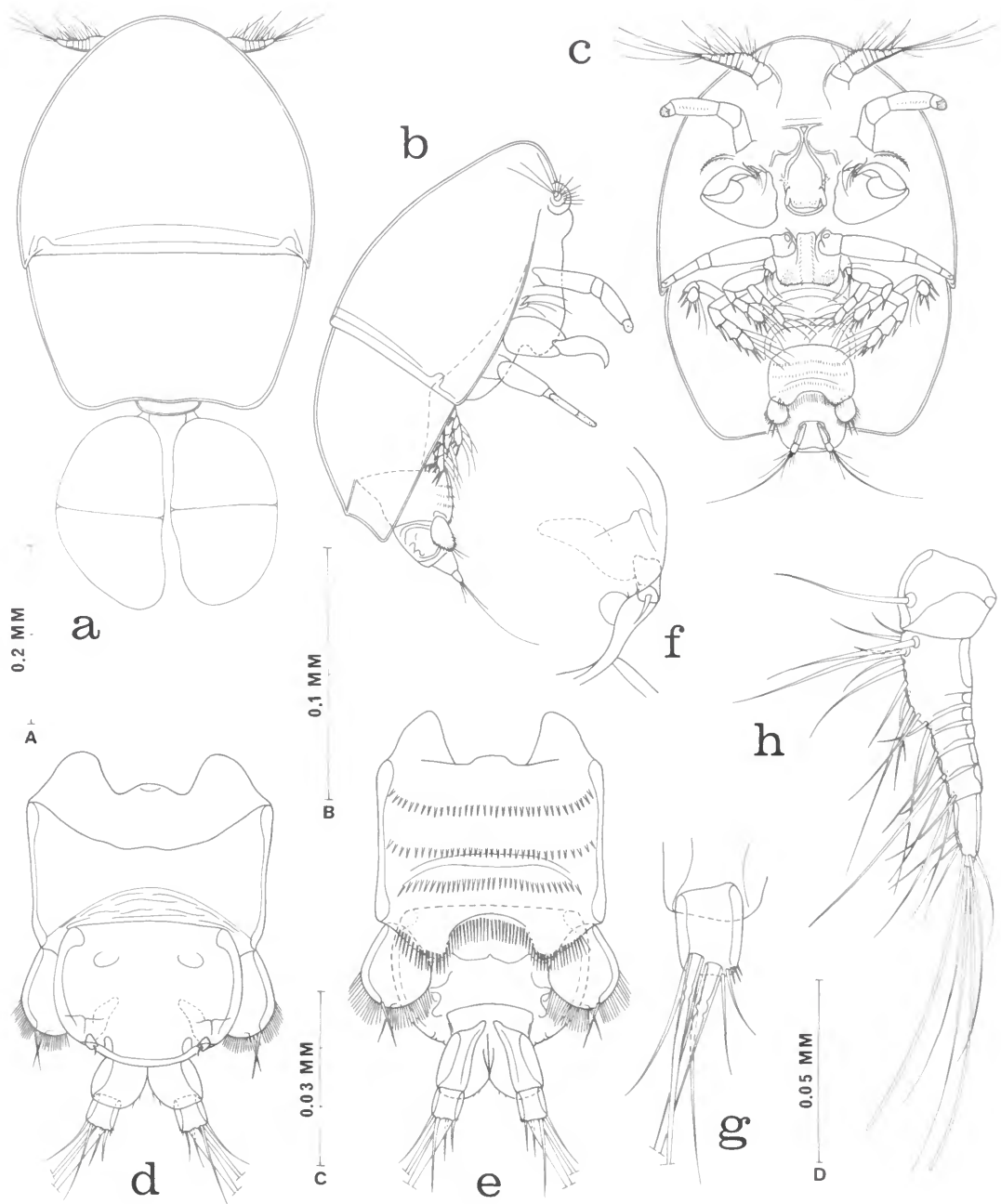


FIGURE 1.—*Nanaspis mixta*, new species, female: *a*, dorsal (A); *b*, lateral (A); *c*, ventral (A); *d*, urosome, dorsal (B); *e*, urosome, ventral (B); *f*, genital area, dorsal (C); *g*, caudal ramus, ventral (C); *h*, first antenna, ventral (D).

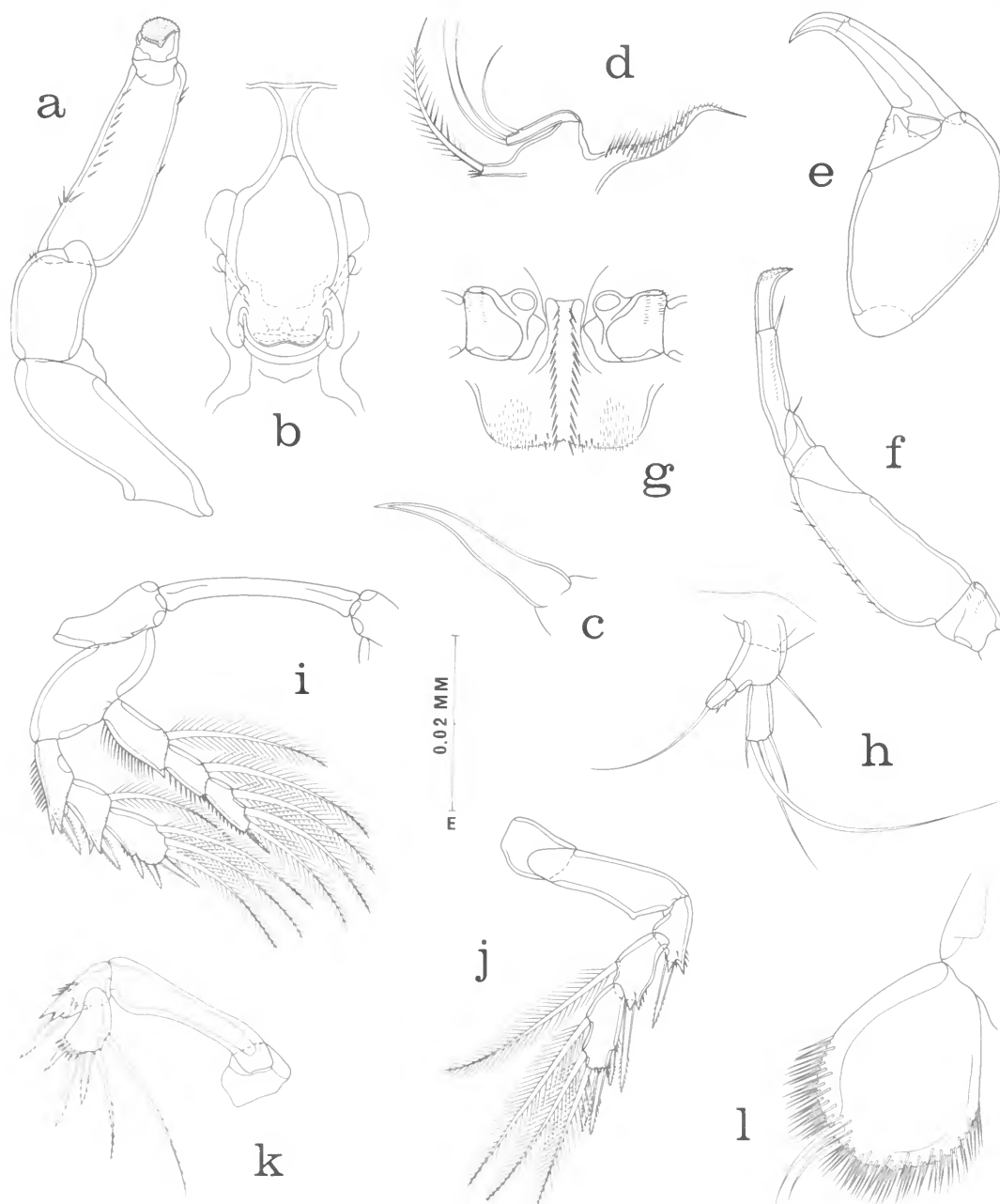


FIGURE 2.—*Nanaspis mixta*, new species, female: *a*, second antenna, posteroventral (D); *b*, oral cone, ventral (B); *c*, mandible, ventral (E); *d*, first maxilla and adjacent seta, posterior (B); *e*, second maxilla, posterior (B); *f*, maxilliped, anterior (B); *g*, area between and behind bases of maxillipeds, ventral (B); *h*, leg 1, anterior (D); *i*, leg 2 and intercoxal plate, posterior (B); *j*, leg 3, anterior (B); *k*, leg 4, anterior (B); *l*, leg 5, ventral (C).

(the endopods absent), the ramus of leg 3 3-segmented (Figure 2j), that of leg 4 2-segmented (Figure 2k).

Spine and setal formula for legs 1-4 as follows (the Roman numerals indicating spines, the Arabic numerals 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; 0-1		I,3
P ₃	coxa	0-0	basis	0-0	exp	I-0; I-1	III,3
P ₄	coxa	0-0	basis	0-0	exp	I-0; I,II,2	

In leg 1 (Figure 2h) the protopod bearing an outer seta 20 long. Exopod with four terminal setae from outer to inner 17, 38, 70, and 8. Endopod bearing only one seta 39 long and ornamented with a few small spinules. All setae on leg 1 smooth. Leg 2 (Figure 2i) with delicately fringed spines and plumose setae. Leg 3 (Figure 2j) with the two

terminal spines on the third segment inserted very close together and partly overlapping. Leg 4 (Figure 2k) with the spines having only a few small distal barbules and the setae weakly plumose. Both segments of the ramus ornamented with spinules.

Leg 5 (Figure 2l) oval and flattened, 34 × 26 in ventral view, and held in preserved specimens ventral to the edge of the genital segment (Figure 1d,e); bearing two naked setae 19 and 12 and ornamented marginally with many long slender spinules.

Leg 6 probably represented by the single small seta on the genital area (Figure 1f).

Living specimens in transmitted light slightly opaque, the eye red, the egg sacs gray.

MALE.—Body (Figure 3a) ovoid and flattened dorsoventrally, with the posterior margin of the metasome rounded. Length of the prosome (not including the urosome, which is folded ventrally)

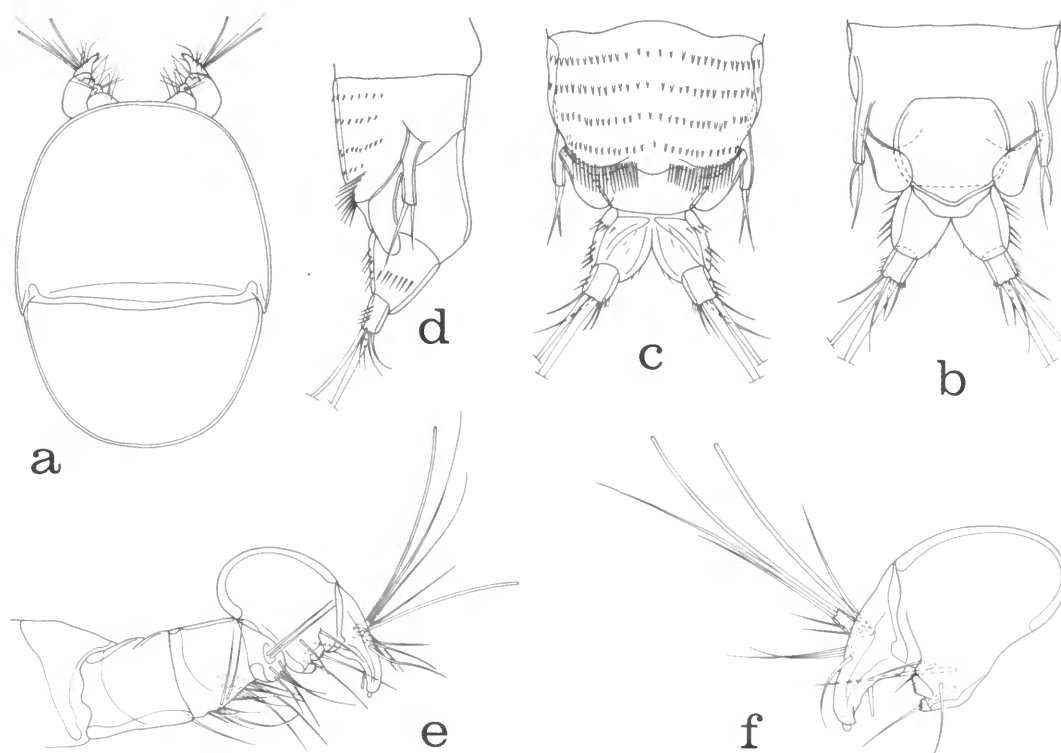


FIGURE 3.—*Nanaspis mixta*, new species, male: a, dorsal (A); b, urosome, dorsal (B); c, urosome, ventral (B); d, urosome and leg 5, lateral (B); e, first antenna, antero-outer (B); f, last two segments of first antenna, antero-outer (B).

367 (360–385) and the greatest width 270 (264–275), based on 10 specimens.

Urosome (Figure 3*b–d*) 3-segmented. Segment of leg 5 smooth dorsally but with five transverse rows of spinules ventrally. Genital segment longer dorsally than ventrally and unornamented. Anal segment deeply incised and ornamented with slender spinules.

Caudal ramus similar to that of the female, but having a few small spinules along the outer margin.

Rostral area undeveloped as in the female. First antenna (Figure 3*e,f*) 5-segmented, the first two segments nearly equal in size, the third segment small, the fourth segment swollen and bearing two small inner dentate ridges, and the fifth segment clawlike. Formula for the armature: 1, 14, 6, 5, and 10 + 2 aesthetes. Two of the elements on the claw short and obtuse.

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

Leg 5 (Figure 3*d*) consisting of a slender segment about 26 long. Two naked terminal setae and a large hyaline lamellate element arising from the middle of the ventral edge of the segment.

Leg 6 not identifiable. Genital openings probably between the fifth pedigerous and genital segments (as suggested by Stock, Humes, and Gooding, 1962, in their original description of *Nanaspis pollens*).

Spermatophore not seen.

Living specimens colored as in the female.

ETYMOLOGY.—The specific name *mixta* from Latin (= mixed or combined) alludes to the combination in the new species of certain characters found in West Indian and European species of *Nanaspis*.

COMPARISON WITH OTHER SPECIES IN THE GENUS.—In the four West Indian species of *Nanaspis* described by Stock, Humes, and Gooding (1962), namely *N. pollens*, *N. exigua*, *N. media*, and *N. truncata*, the endopod of leg 2 is 3-segmented as in the new species. In all other species (*N. tonsa* Humes and Cressey, 1959, *N. mediterranea* Stock and Kleeton, 1963, *N. ninae* Bresciani and Lützen, 1962, *N. manca* Humes, 1973, *N. spinifera* Humes, 1973, and *N. pusilla* Humes, 1973) this endopod is 2-segmented. A similar distinction is seen in the number of setae on the exopod of leg 1, where there are four in the new species and in the West

Indian species, but three in all others. In respect to the formula for leg 4, *N. mixta* differs from the West Indian species, where this formula is 1–0; IV,1.

The well-formed leg 5 in both sexes of the new species serves as a useful recognition character. In no other species is the fifth leg of the female as large and as clearly set off from the body segment; in no other species does the fifth leg of the male bear a large hyaline lamellate element.

SABELLIPHILIDAE Gurney, 1927

Chauliobion, new genus

DIAGNOSIS.—Sabelliphilidae. Body modified, elongated. Urosome 5-segmented in the female, 6-segmented in the male. Caudal ramus with the two median terminal setae relatively short. Rostrum not well defined. First antenna 7-segmented, with the formula in both sexes 4, 13, 6, 3, 4 + 1 aesthete, 2 + 1 aesthete, and 7 + 1 aesthete and with a few small spines on all but the last segment. Second antenna 4-segmented, with the formula 1, 1, 3 + one claw, and 7.

Labrum with two posteroventral lobes. Mandible with two long setiform processes arising near the base of the lash. Paragnath a small hairy lobe. First maxilla with two elements. Second maxilla similar to that in other sabelliphilid genera. Maxilliped in the female 3-segmented with a pointed tip; in the male 4-segmented (if the proximal part of the claw is considered as a fourth segment).

Legs 1–4 in the female with both rami 3-segmented, in the male with the exopods 3-segmented but the endopods 2-segmented. In both sexes a long digitiform process on the distal outer corner of the coxa of legs 2 and 3. In the female the endopod of leg 3 with the formula 0–1; 0–1; I, I, 2; that of leg 4 with 0–1; 0–1; II, I (or I, 2). In the male these endopods 0–1; I, I, 2, 2 and 0–1; I, 2, 1 respectively. Exopod of leg 4 in both sexes 1–0; 1–1; II, I, 5. Leg 5 with a free segment bearing two terminal elements. Leg 6 in the female represented by the two setae near the genital openings, in the male by a posteroventral flap on the genital segment bearing two setae.

Other features as in the species described below. Endoparasitic in holothurians.

TYPE-SPECIES.—*Chauliolobion bulbosum*, new species.

ETYMOLOGY.—The generic name is a combination of the Greek *χαυλιος* (projecting) and *λοβιον* (a small lobe), alluding to the digitiform processes on the coxa of legs 2 and 3.

COMPARISON WITH THE MOST CLOSELY RELATED SABELLIPHILID GENUS.—*Chauliolobion* is close to *Lichothuria* Stock, 1968, a genus which contains the single species *L. mandibularis* Stock, 1968 (partially redescribed by Humes and Ho, 1969), endoparasitic in holothurians in the Gulf of Aqaba and in Madagascar. As in *Lichothuria* the body of *Chauliolobion* is elongated and slender, the terminal setae on the caudal ramus are relatively short, and leg 5 is placed ventrally rather than dorsally. In the female the two genera have the formula I,1,2 on the third endopod segment of leg 3 and three elements on the third endopod segment of leg 4. In the male the endopods of legs 1–4 of both genera are 2-segmented and the second segment of the endopod of leg 4 has the formula II,1,1.

In spite of these similarities, however, there are several major features that occur in the two species of *Chauliolobion* but are not found in *Lichothuria*. Chief among these are the long digitiform process on the distal outer corner of the coxa in legs 2 and 3, the two long setiform processes arising near the base of the attenuated lash of the mandible, the presence of small spines on most of the first antennal segments, and the claw of the male maxilliped being much longer than the second segment.

Chauliolobion bulbosum, new species

FIGURES 4–8

TYPE MATERIAL [all from *Actinopyga echinites* (Jaeger)].—Holotype ♀, allotype ♂, from 22 hosts, in 2 m, eastern end of Ricaudy Reef, near Noumea, New Caledonia, 22°19'00"S, 166°27'18"E, 18 June 1971. Paratypes: 1 ♀, 2 ♂♂ from 1 host, in 1–2 m, Rocher à la Voile, Noumea, 22°18'24"S, 166°25'50"E, 2 June 1971; 2 ♀♀, 1 ♂ from 12 hosts, in 2 m, Rocher à la Voile, 10 June 1971; 1 ♂ from 35 hosts, intertidal, Ricaudy Reef, 22°19'00"S, 166°26'44"E, 21 July 1971; 2 ♂♂ from 2 hosts, in 2 m, north of Isle Maître, near Noumea, 22°19'00"S, 166°24'35"E, 13 July 1971. All types deposited in the National Museum of Natural History, Smith-

sonian Institution, Washington, D.C., except 1 ♀ and 1 ♂ (dissected) in the collection of the author.

OTHER SPECIMENS.—4 ♀♀, 17 ♂♂ from one *Actinopyga obesa palauensis* Panning in 3 m, north of Isle Maître, 22°19'30"S, 166°24'35"E, 13 July 1971.

FEMALE.—Body (Figure 4a,b) elongated and slender, with the urosome not much thickened dorsoventrally. Length 1.27 mm (1.09–1.40 mm) and the greatest width 0.39 mm (0.39–0.41 mm), based on 4 specimens. Epimeral areas of the segments of legs 1–4 broadly rounded. Ratio of the length to the width of the prosome 2.14:1. Ratio of the length of the prosome to that of the urosome 1.46:1.

Segment of leg 5 (Figure 4c,d) 99 × 221. Between this segment and the genital segment no ventral sclerite. Genital segment 234 × 244, slightly wider than long, tapered posteriorly in dorsal view, and ornamented ventrally with a posterior transverse row of spines. Genital areas located dorso-laterally near the midregion of the segment. Each area (Figure 4e) bearing two naked setae 31 and 17. Three postgenital segments from anterior to posterior 83 × 120, 73 × 94, and 49 × 78. First and second postgenital segments with a ventral transverse row of spines, that on the second segment continued dorsally. Anal segment with posterolateral spines and posteroventrally with two short transverse rows of spines.

Caudal ramus (Figure 5a) 55 × 30, nearly two times longer than wide. Outer lateral seta 50, dorsal seta 22, outermost terminal seta 44, and innermost terminal seta 44. Two median terminal setae relatively short and stout, the outer 138, the inner 216. All setae spinulose as illustrated except the dorsal seta which is smooth. Ramus ornamented with small spines near the insertions of the outer lateral seta and the outermost terminal seta, and with small spines along the edge of the small dorsal flange covering the insertions of the two median setae.

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

Egg sac unknown.

Rostral area (Figure 5b) not protuberant.

First antenna (Figure 5c) 264 long. Lengths of its seven segments: 24 (53 along the anterior edge), 46, 28, 39, 42, 32, and 24 respectively. Formula for the armature: 4, 13, 6, 3, 4 + 1 aesthete, 2 + 1

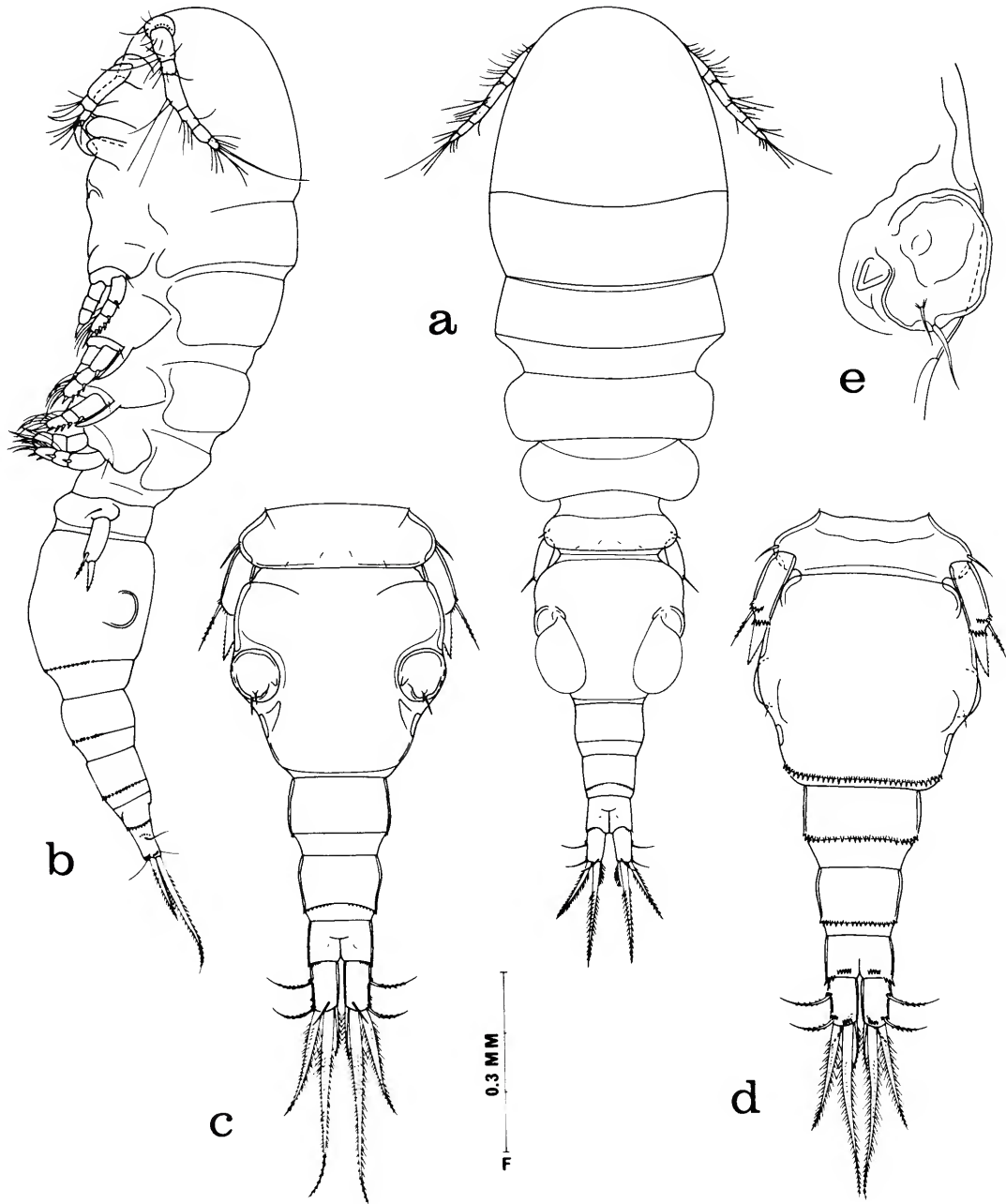


FIGURE 4.—*Chauliolobion bulbosum*, new genus, new species, female: a, dorsal (F); b, lateral (F); c, urosome, dorsal (A); d, urosome, ventral (A); e, genital area, dorsal (B).

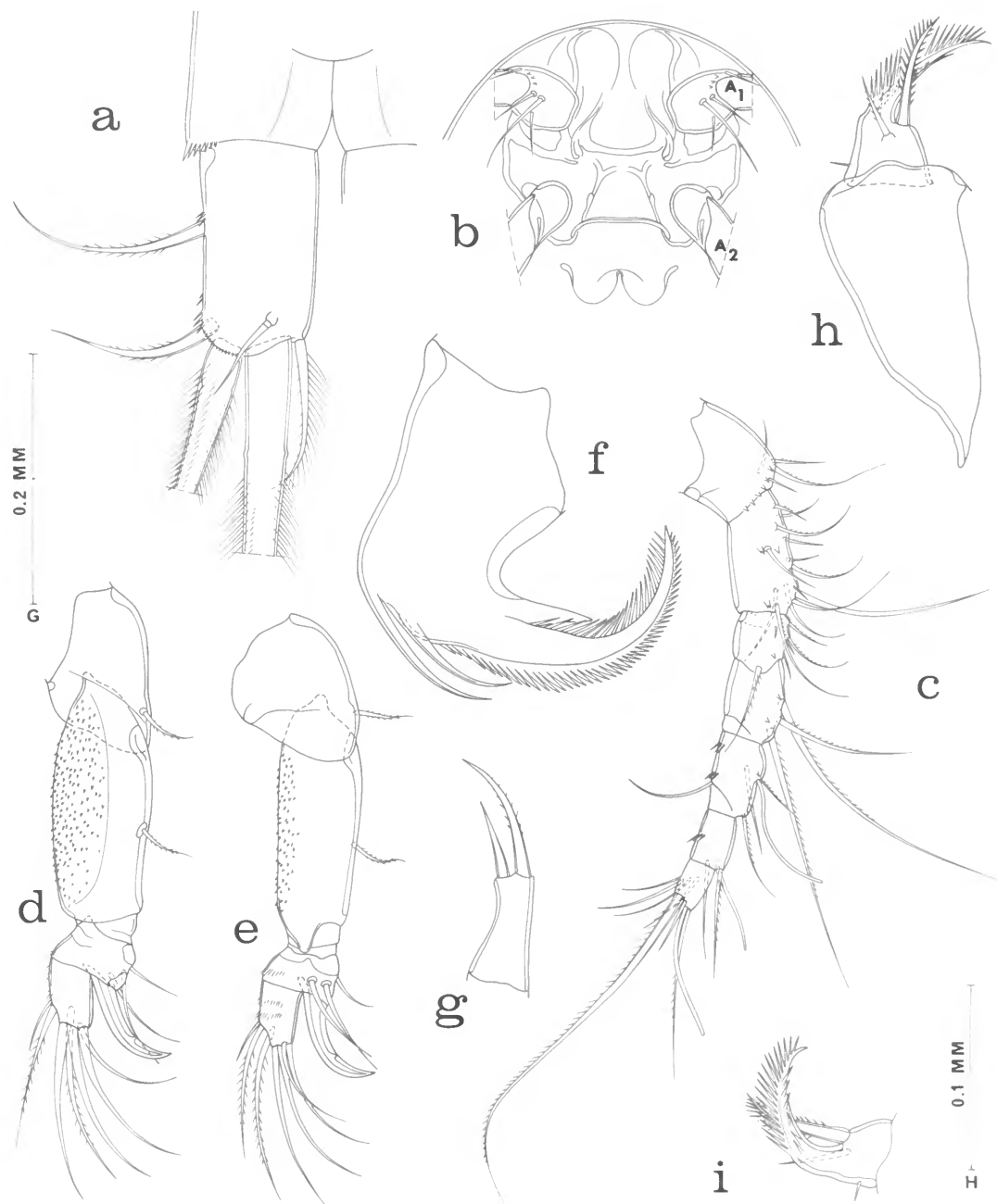


FIGURE 5.—*Chauliobion bulbosum*, new genus, new species, female: a, caudal ramus, dorsal (D); b, rostral area, ventral (V); c, first antenna, dorsal (H); d, second antenna, anterior (A); e, second antenna, posterior (P); f, mandible, posterior (C); g, first maxilla, posterior (C); h, second maxilla, posterior (P); i, tip of second maxilla, anterior (A).

aesthete, and 7 + 1 aesthete. Many of the setae unilaterally with spinules. First segment with a distal dorsal row of small spines. A few spines on segments 2-5 and groups of spinules on the posterior surface of segments 5 and 6.

Second antenna (Figure 5*d,e*) 4-segmented, 180 long including the claw. Armature: 1, 1, 3 + claw, and 7. Setae on the first two segments and two setae on the fourth segment spinulose. Fourth segment much shorter than the claw which is about 45 along its axis. Outer surface of the second segment cov-

ered with small spines. Transverse rows of slender spinules on the postero-outer surface of the third and fourth segments.

Labrum with two small rounded posteroventral lobes as in Figure 5*b*.

Mandible (Figure 5*f*) having on the concave margin near the base of the bispinulose lash a pointed process and on the convex margin two long setiform processes. Paragnath a small hairy lobe. First maxilla (Figure 5*g*) with two unequal terminal elements, the longer element sparsely

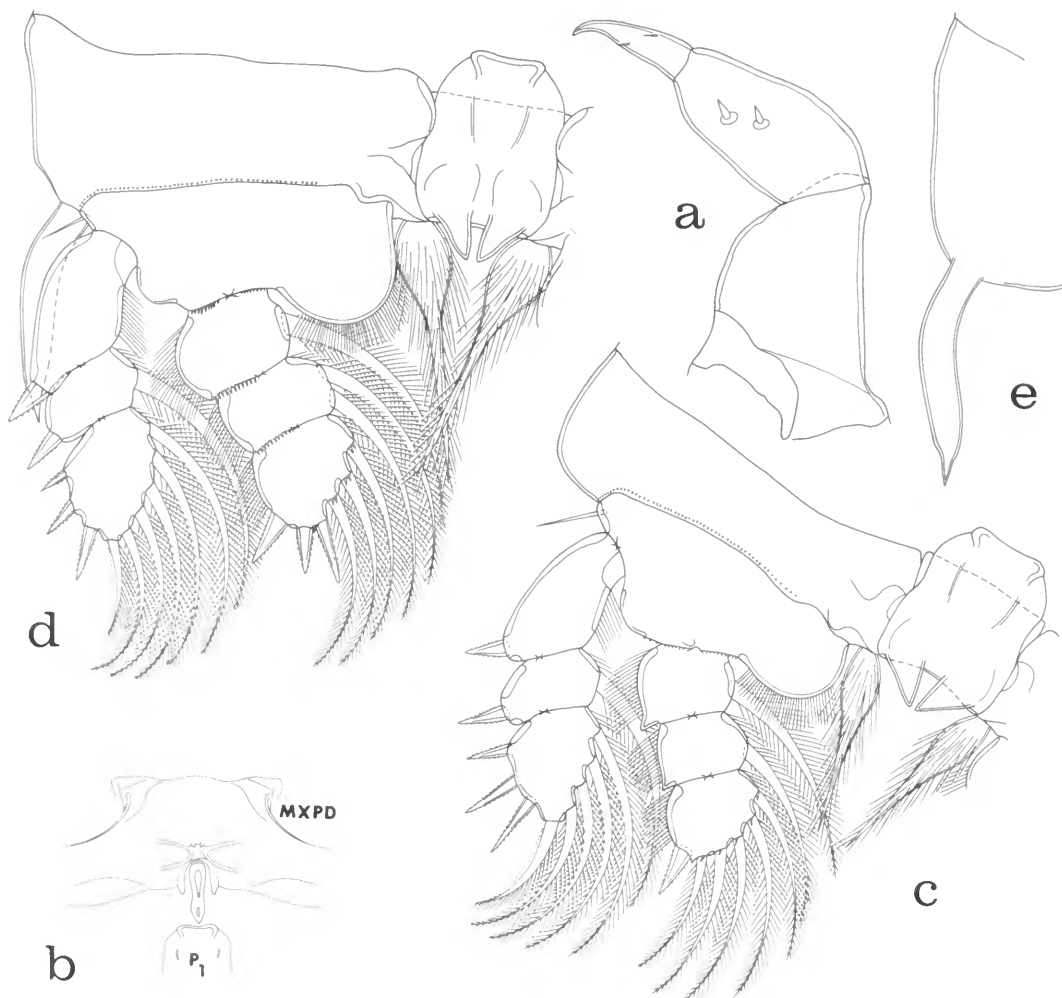


FIGURE 6.—*Chauliobion bulbosum*, new genus, new species, female: a, maxilliped, antero-inner (b); b, area between maxillipeds and leg 1, ventral (c); c, leg 1 and intercoxal plate, anterior (b); d, leg 2 and intercoxal plate, anterior (b); e, outer process on coxa of leg 2, posterior (b).

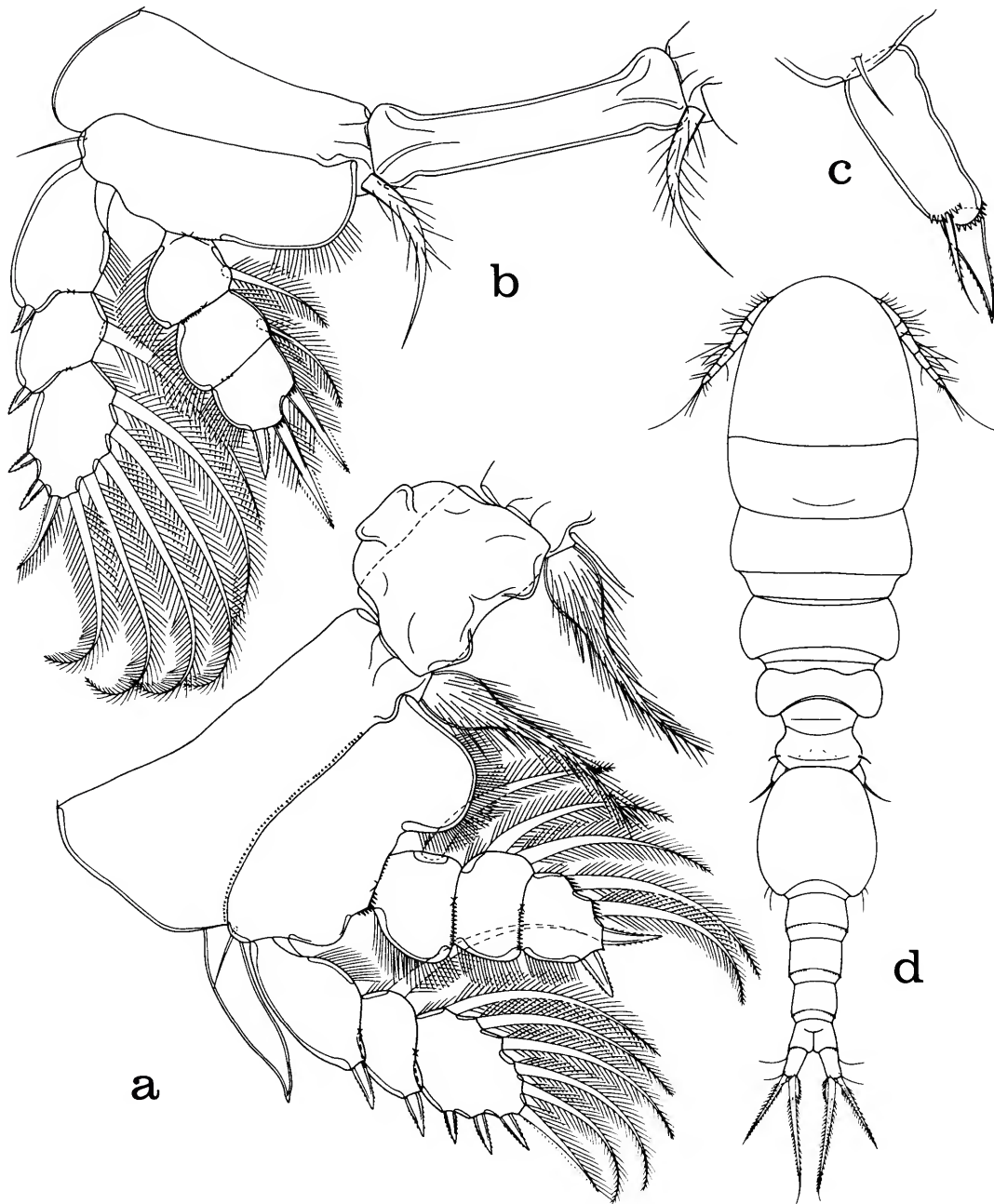


FIGURE 7.—*Chauliobion bulbosum*, new genus, new species. Female: *a*, leg 3 and intercoxal plate, anterior (♂); *b*, leg 4 and intercoxal plate, anterior (♂); *c*, leg 5, ventrolateral (♂). Male: *d*, dorsal (♂).

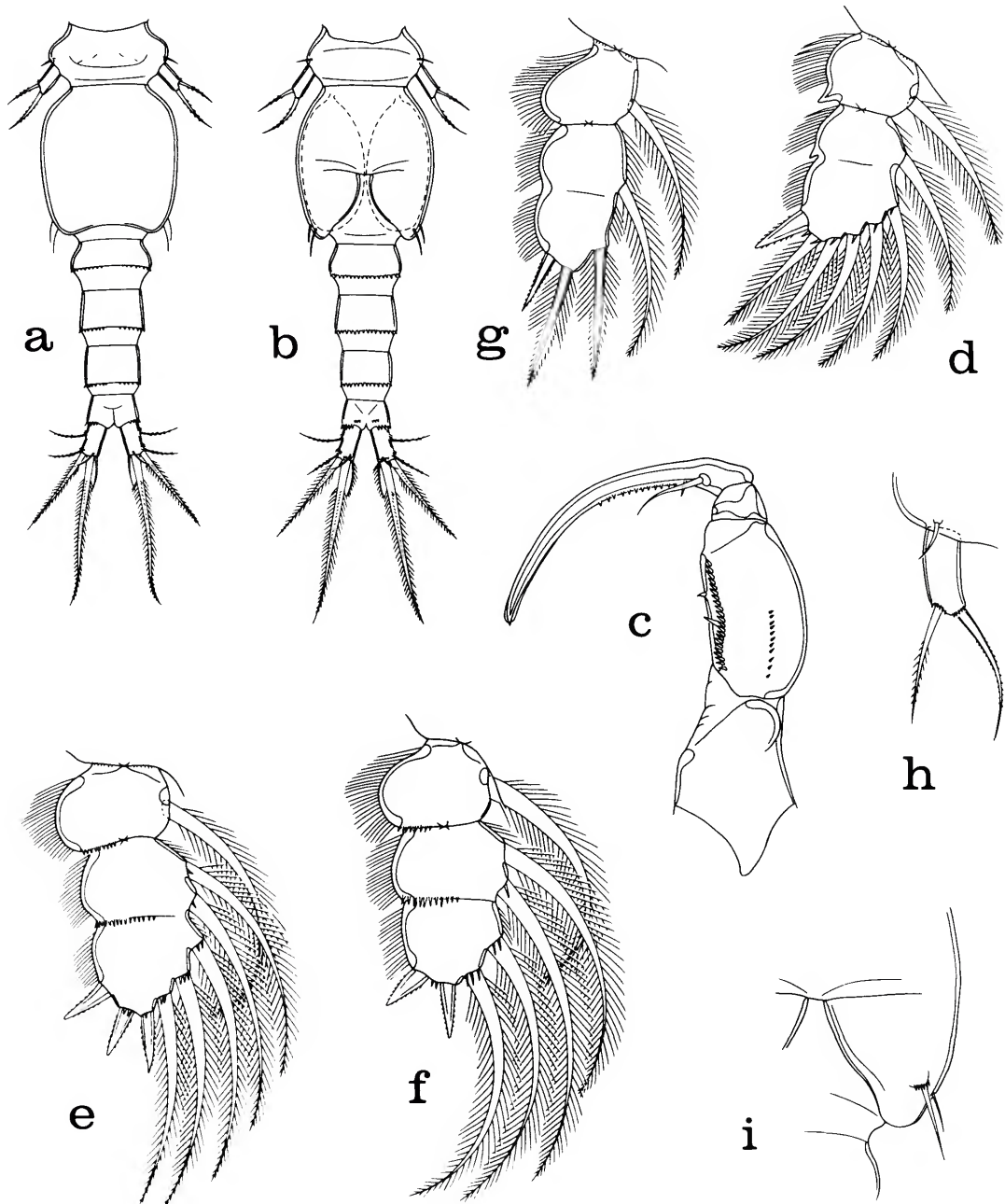


FIGURE 8.—*Chauliobion bulbosum*, new genus, new species, male: a, urosome, dorsal (A); b, urosome, ventral (A); c, maxilliped, postero-inner (B); d, endopod of leg 1, anterior (D); e, endopod of leg 2, anterior (D); f, endopod of leg 3, anterior (D); g, endopod of leg 4, anterior (D); h, leg 5, ventral (B); i, leg 6, ventral (H).

barbed. Second maxilla (Figure 5*h*) 2-segmented, the large first segment unarmed. Second segment having a small proximal setule on its outer (ventral) margin, a finely barbed seta on its posterior surface, and inner (dorsal) spiniform element with prominent lateral spinules; segment terminating in a moderately short lash with a row of long spines along the distal edge and a row of spines on the anterior surface (Figure 5*i*). Maxilliped (Figure 6*a*) 3-segmented, the first segment unarmed, the second with two short naked spines, and the third with two small setules and having a clawlike tip.

Area between the maxillipeds and the first pair of legs (Figure 6*b*) not protuberant (see Figure 4*b*).

Legs 1-4 (Figures 6*c,d*; 7*a,b*) with 3-segmented rami throughout. Armature as follows (the Roman numerals indicating spines, the Arabic numerals setae):

P ₁	coxa	0-1	basis	1-0	exp	1-0; 1-1;	III,1,4
					enp	0-1; 0-1;	I,5
P ₂	coxa	0-1	basis	1-0	exp	1-0; 1-1;	III,1,5
					enp	0-1; 0-2;	I,II,3
P ₃	coxa	0-1	basis	1-0	exp	1-0; 1-1;	III,1,5
					enp	0-1; 0-2;	I,1,2
P ₄	coxa	0-1	basis	1-0	exp	1-0; 1-1;	II,1,5
					enp	0-1; 0-1;	II,1

Intercoxal plate of legs 1 and 2 with a pair of prominent pointed ventral processes. These processes on leg 3 small and rounded; absent on leg 4. Inner coxal seta in legs 1-3 proximally swollen and setulose; in leg 4 this seta not swollen. Distal outer corner of the coxa of legs 2 and 3 bearing a digitiform process (Figure 6*e*) about 80 long. Endopod of leg 2 with the inner seta on the first segment setulose on its posterior surface; endopod of leg 3 with the inner setae on the setae on the first and second segment similarly setulose. Leg 4 with the exopod 125 long; the endopod 75, with the three spines from outer to inner 11, 47, and 39. Two inner spines of this trio plumose proximally but barbed distally.

Leg 5 (Figure 7*c*) placed somewhat ventrally. Free segment 68 × 28, about 2.43 times longer than wide. Two terminal elements unequal, one a slender barbed seta 46 and the other a stout spiniform finely barbed element 50 long. Rows of small spines on the segment near the insertions of these elements. Seta on the body near the insertion of

the free segment situated ventrally and only 15 long.

Leg 6 probably represented by the two setae on the genital area (Figure 4*e*).

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

MALE.—Body (Figure 7*d*) slender. Length 1.13 mm (1.02-1.27 mm) and the greatest width 0.28 mm (0.23-0.31 mm), based on 6 specimens. Ratio of the length to the width of the prosome 2.38:1. Ratio of the length of the prosome to that of the urosome 1.29:1.

Segment of leg 5 (Figure 8*a,b*) 68 × 120. Between this segment and the genital segment no ventral intersegmental sclerite. Genital segment subquadrate, 174 × 156. Four postgenital segments from anterior to posterior 57 × 86, 62 × 70, 57 × 60, and 29 × 60, ornamented with rows of spinules as in the female.

Caudal ramus similar to that of the female but shorter, 40 × 21.

Body surface ornamented with very few hairs (sensilla).

Rostral area, first antenna, second antenna, labrum, mandible, paragnath, first maxilla, and second maxilla like those in the female. Maxilliped (Figure 8*c*) 4-segmented, assuming that the proximal part of the claw represents a fourth segment. First segment unarmed. Second segment with two short setae and two rows of spines. Small third segment unarmed. Claw 110 along its axis, bearing proximally two unequal naked setae and a row of small hyaline teeth on the concave margin; terminal lamella small.

Area between the maxillipeds and the first pair of legs like that of the female.

Legs 1-4 resembling those of the female except for the segmentation of the endopods, which are 2-segmented rather than 3-segmented (Figure 8*d-g*), the two distal segments fused, in legs 1 and 4 the original separation very indistinct, in legs 2 and 3 the point of separation indicated by a transverse row of spinules. Endopod of leg 4 (Figure 8*g*) 57 long, its three spines from outer to inner 17.5, 36, and 35.

Leg 5 (Figure 8*h*) with the free segment 34 × 15.5, its two subequal terminal elements 52 and 57.

Leg 6 (Figure 8*i*) a posteroventral flap on the genital segment bearing two unequal naked setae 39 and 22.

Spermatophore (Figure 4a) oval, 135×70 .

Color as in the female.

ETYMOLOGY.—The specific name *bulbosum*, Latin (= containing bulbs), alludes to the bulblike swelling of the inner coxal setae on legs 1–3.

Chauliolobion halodeimatis, new species

FIGURES 9–12

TYPE MATERIAL.—5 ♀♀, 3 ♂♂ from 8 *Halodeima atra* (Jaeger), in 1.5 m, Rocher à la Voile, Noumea, New Caledonia, $22^{\circ}18'24''S$, $166^{\circ}25'50''E$, 2 June 1971. Holotype ♀, allotype, and 6 paratypes (4 ♀♀, 2 ♂♂) deposited in the National Museum of Natural History, Smithsonian Institution, Washington, D.C.

OTHER SPECIMENS.—4 ♀♀, 3 ♂♂ from 31 *Halodeima atra*, in 4–5 m, on the reef between Isle Ndié and Mt. Kumuru, northwest of Noumea, $22^{\circ}13'24''S$, $166^{\circ}24'11''E$, 29 July 1971.

FEMALE.—Body (Figure 9a) elongated and slender. Length 1.01 mm (0.91–1.13 mm) and the greatest width 0.24 mm (0.23–0.26 mm), based on 8 specimens. Epimeral areas of the segments of legs 1–4 variously formed as in the figure. Ratio of the length to the width of the prosome 2.30:1. Ratio of the length of the prosome to that of the urosome 1.33:1.

Segment of leg 5 (Figure 9b,c) 57×140 . Between this segment and the genital segment no ventral sclerite. Genital segment 150×160 , slightly wider than long, in dorsal view widest in its anterior third and tapered posteriorly, and bearing ventrally a posterior transverse row of spines. Genital areas situated laterally near the midregion of the segment. Each area (Figure 9d) having two naked setae 22 and 33. Three postgenital segments from anterior to posterior 52×88 , 60×73 , and 35×65 . First and second postgenital segments with a ventral transverse row of spines. Anal segment with a short posteroventral row of spines on each side.

Caudal ramus (Figure 9e) 53×25 , 2.12 times longer than wide. Outer lateral seta 62, dorsal seta 20, outermost terminal seta 77, innermost terminal seta 60. Two median terminal setae relatively short, the outer 122, the inner 156. All setae spinulose except the smooth dorsal seta. Ramus with small spines near the outer lateral seta and the outermost

terminal seta; small terminal dorsal flange smooth.

Body surface with very few hairs (sensilla) as in Figure 9a.

Egg sac unknown.

Rostral area similar to that in *C. bulbosum*.

First antenna (Figure 9f) 174 long. Lengths of its seven segments: 12 (29 along the anterior edge), 37, 15, 30, 29, 17.5, and 16.5 respectively. Armature as in *C. bulbosum*; only one group of small spines on the fifth segment.

Second antenna (Figure 9g) 4-segmented, 138 long including the claw. Armature as in *C. bulbosum*. Fourth segment much shorter than the claw which is 34 along its axis. Spinules on the inner surface of the first segment, on both inner and outer surfaces of the second segment, and on the outer surface of the fourth segment.

Labrum (Figure 10a) with the two lobes widely divergent.

Mandible (Figure 10b) resembling that in *C. bulbosum*; the outer setiform process hyaline. Paragnath a small hairy lobe (Figure 10a). First maxilla (Figure 10a) with two very unequal naked elements. Patch of small spines on the ventral surface of the head at either side of the labrum. Second maxilla (Figure 10c) similar in basic form to that of *C. bulbosum*, but the seta on the posterior surface of the second segment smooth and the inner (dorsal) spiniform element on that segment stout and spinulose with a blunt tip. Maxilliped (Figure 10d) resembling that in *C. bulbosum*, but the third segment more attenuated than in that species.

Area between the maxillipeds and the first pair of legs (Figure 10e) not protuberant.

Legs 1–4 (Figures 10f,g; 11a,b) segmented as in *C. bulbosum* and possessing the same spine and setal formula as in that species with the exception of the third endopod of leg 4, which is 1,2. Distal outer corner of the coxa of legs 2 and 3 bearing a prominent digitiform process or lobe, which in leg 2 is about as long as the exopod (Figure 10g). Leg 4 with the exopod 96 long. Endopod of this leg 62, with the last two segments not completely separated; terminal armature consisting of an outer spine 18 and two setae 36 (outer) and 52 (inner).

Leg 5 (Figure 11c) placed ventrally as in *C. bulbosum*. Free segment 42×17 , about 2.47 times longer than wide. Two unequal terminal elements 39 and 68. A few small spines near the insertion of

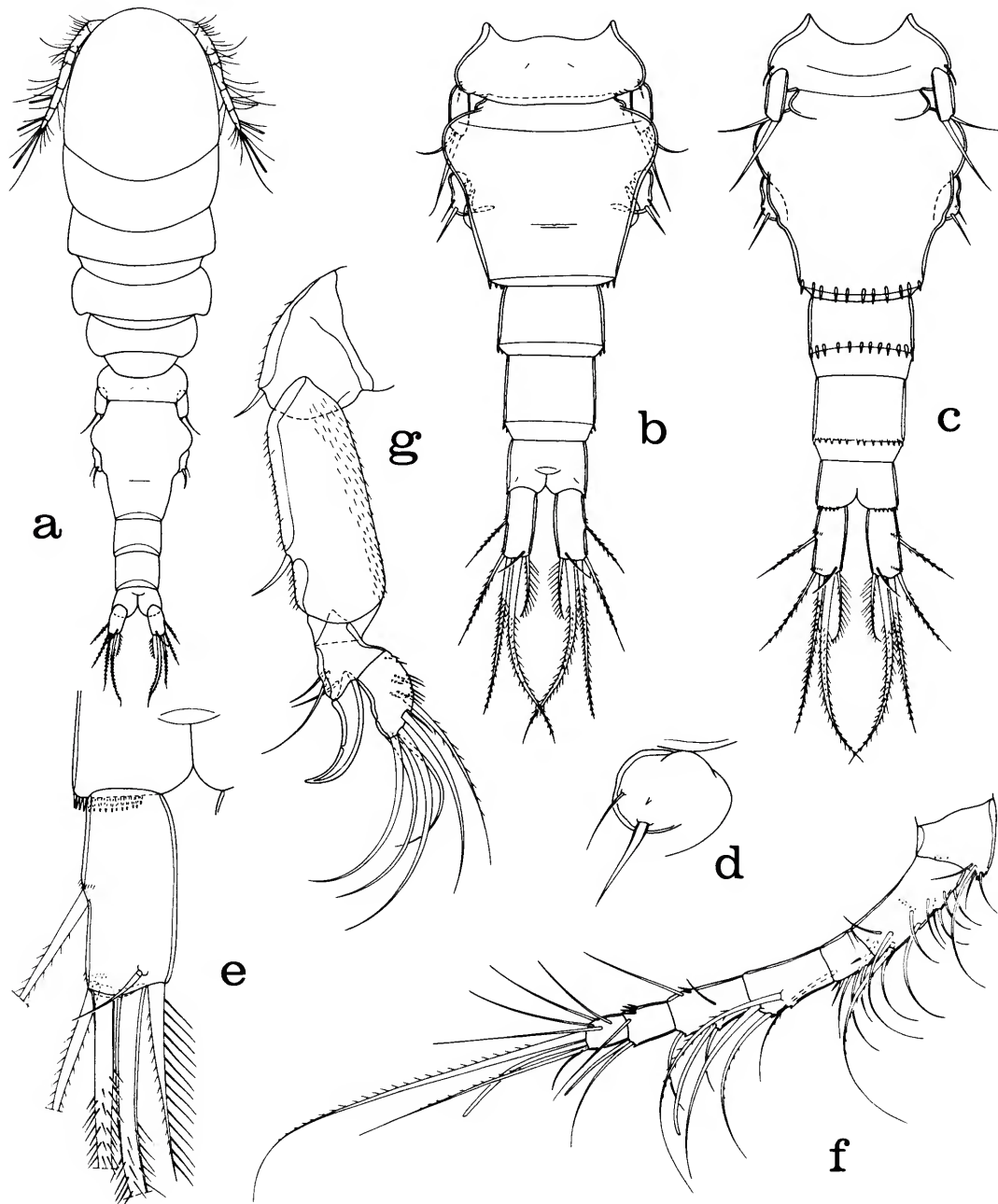


FIGURE 9.—*Chauliobion halodeimatis*, new genus, new species, female: a, dorsal (F); b, urosome, dorsal (C); c, urosome, ventral (C); d, genital area, lateral (B); e, caudal ramus, dorsal (D); f, first antenna, ventral (B); g, second antenna, anterior (D).

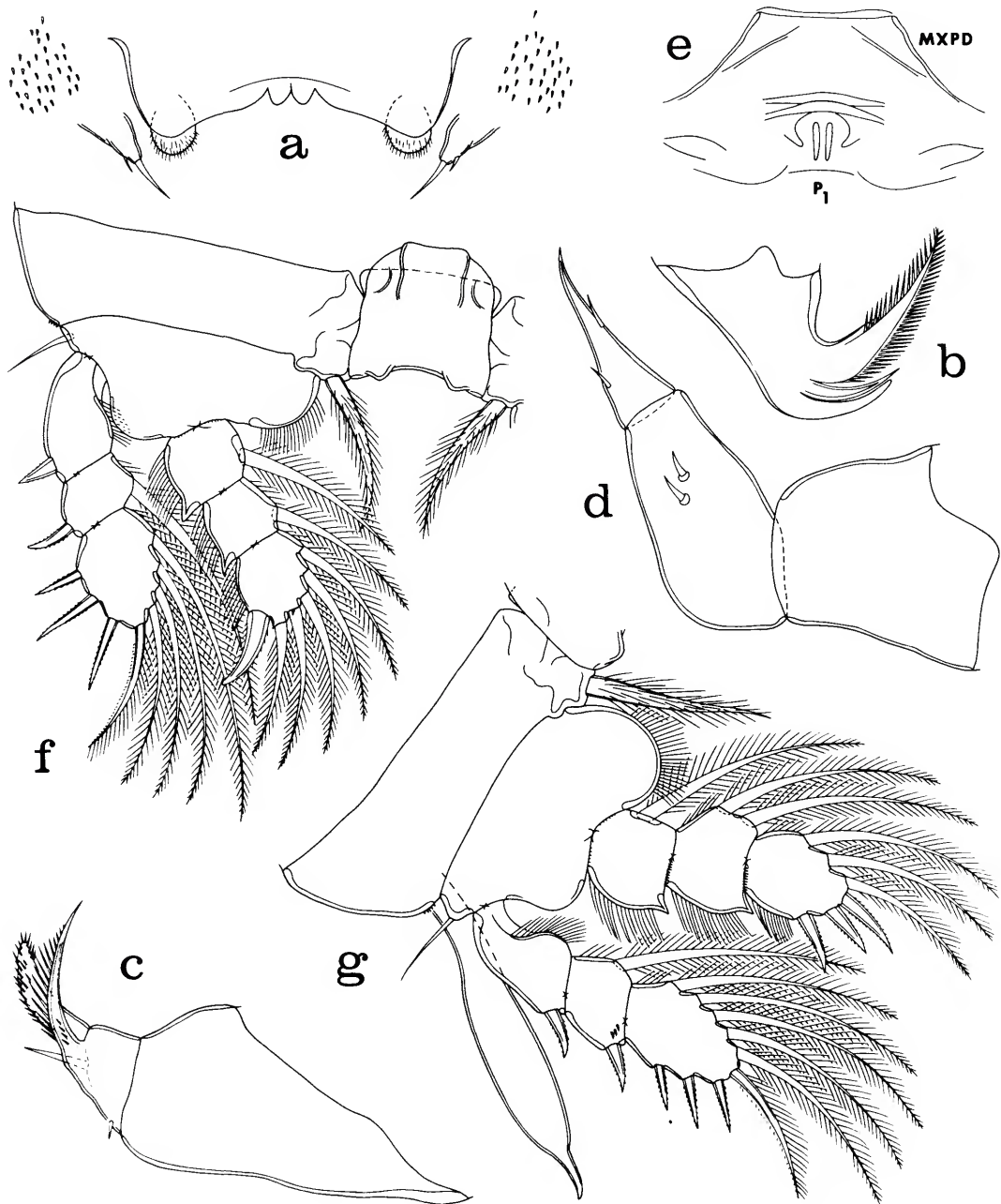


FIGURE 10.—*Chauiolobion halodeimatis*, new genus, new species, female: *a*, labrum, paragnaths, and first maxillae, ventral (*b*); *b*, mandible, posterior (*c*); *c*, second maxilla, anterior (*c*); *d*, maxilliped, antero-inner (*c*); *e*, area between maxillipeds and leg 1, ventral (*b*); *f*, leg 1 and intercoxal plate, anterior (*b*); *g*, leg 2, anterior (*b*).

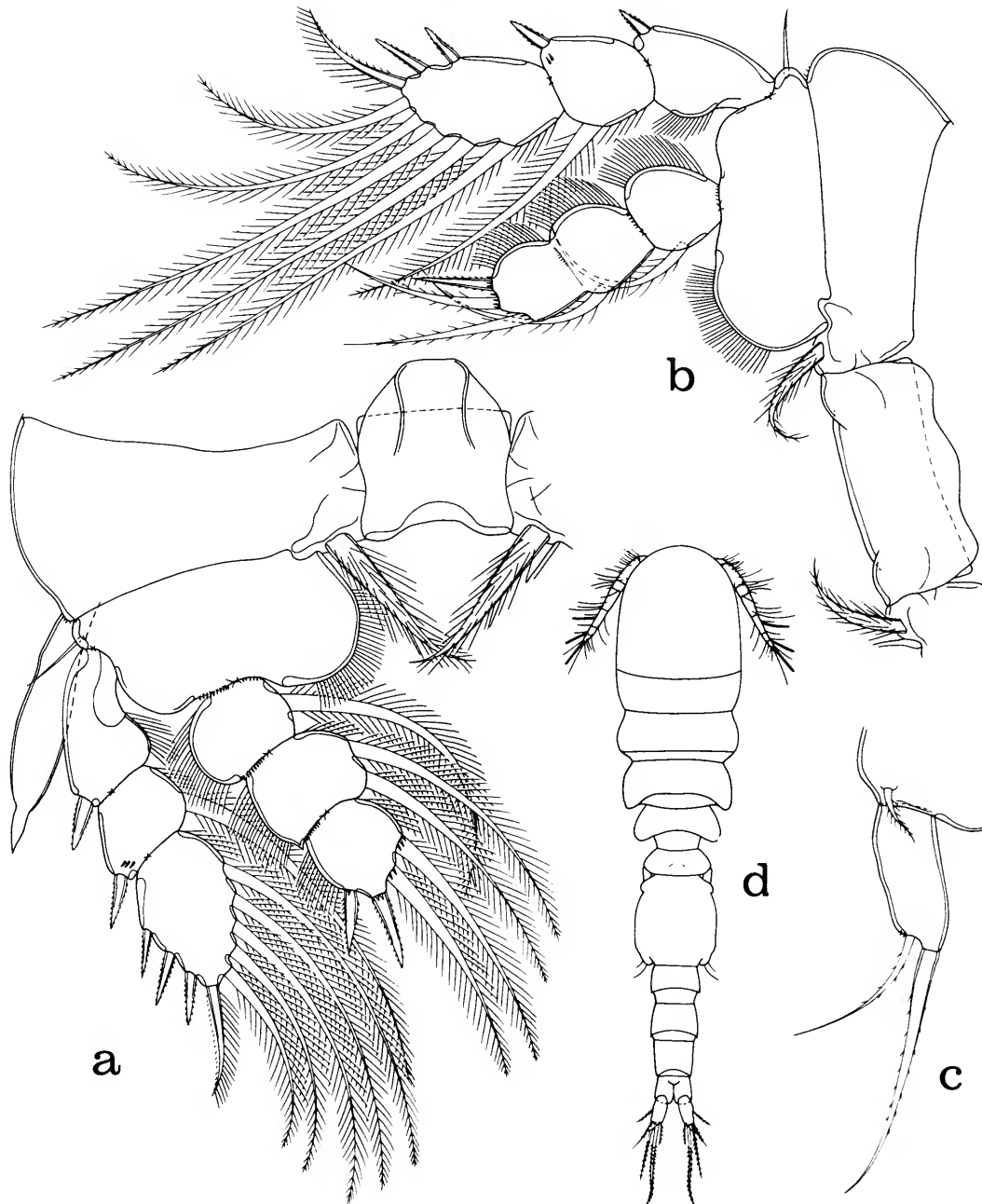


FIGURE 11.—*Chauliobion halodeimatis*, new genus, new species. Female: *a*, leg 3 and intercoxal plate, anterior (v); *b*, leg 4 and intercoxal plate, anterior (v); *c*, leg 5, ventral (v). Male: *d*, dorsal (F).

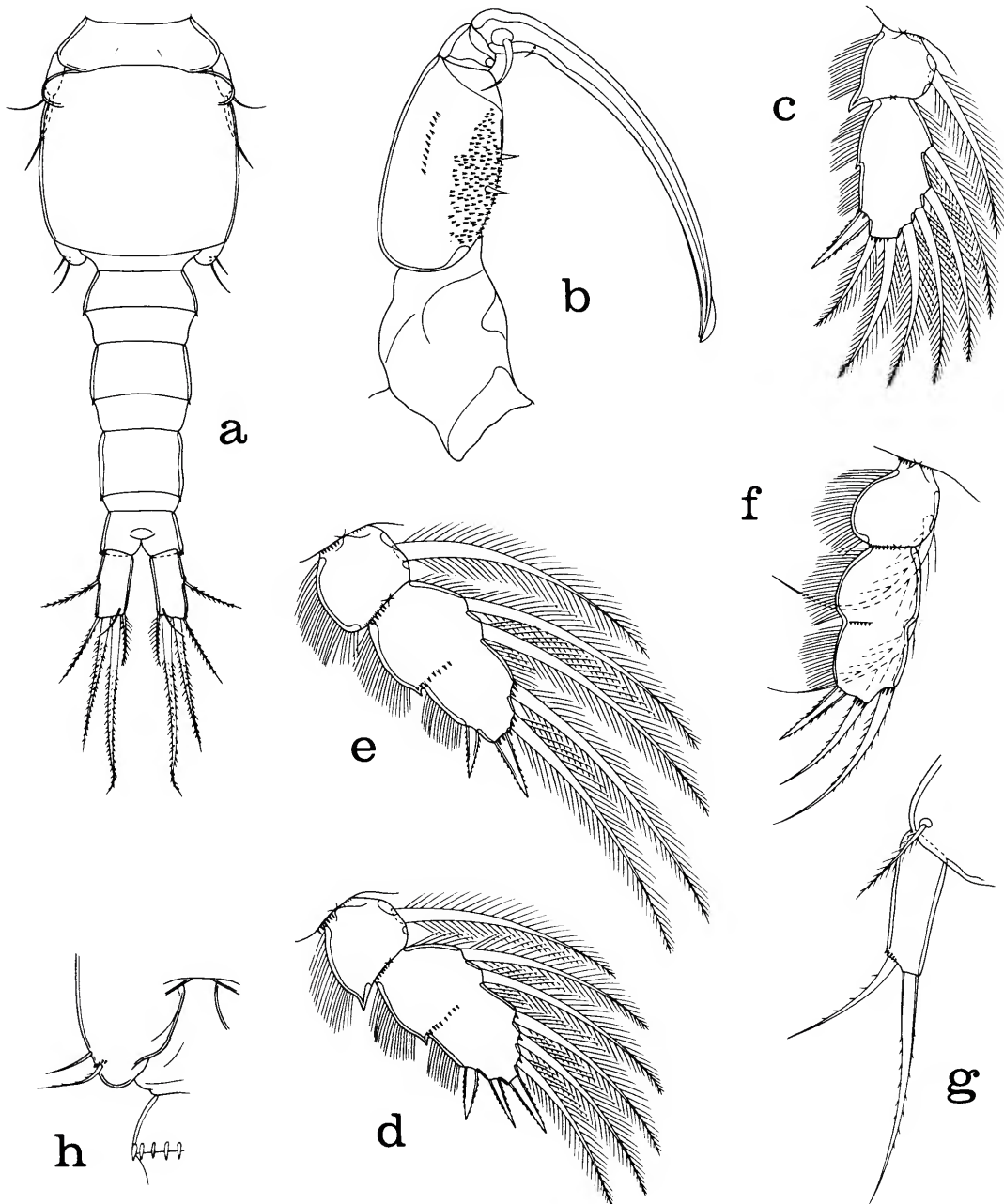


FIGURE 12.—*Chauliobion halodeimatis*, new genus, new species, male: *a*, urosome, dorsal (\times); *b*, maxilliped, postero-inner (\times); *c*, endopod of leg 1, anterior (\times); *d*, endopod of leg 2, anterior (\times); *e*, endopod of leg 3, anterior (\times); *f*, endopod of leg 4, anterior (\times); *g*, leg 5, ventral (\times); *h*, leg 6, ventral (\times).

the smaller seta. Seta on the body near the insertion of the free segment situated ventrally and 16 long.

Leg 6 probably represented by the two setae on the genital area (Figure 9d).

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

MALE.—Body (Figure 11d) slender. Length 0.92 mm (0.86–0.98 mm) and the greatest width 0.20 mm (0.19–0.21 mm), based on 7 specimens. Ratio of the length to the width of the prosome 2.41:1. Ratio of the length of the prosome to that of the urosome 1.09:1.

Segment of leg 5 (Figure 12a) 52×117 . Between this segment and the genital segment no ventral sclerite. Genital segment quadrate, 148×146 . Four postgenital segments from anterior to posterior 55×82 , 65×73 , 62×65 , and 34×63 , ornamented ventrally with rows of spinules as in the female.

Caudal ramus resembling that of the female and of about the same size.

Body surface, rostral area, first antenna, second antenna, labrum, mandible, paragnath, first maxilla, and second maxilla like those in the female. Maxilliped (Figure 12b) 4-segmented, considering the proximal part of the claw to represent a fourth segment. First segment unarmed. Second segment with two short naked setae, a large inner patch of spines, and a short row of spines. Small third segment unarmed. Claw 105 along its axis including the terminal lamella, bearing proximally two very unequal naked setae.

Area between the maxillipeds and the first pair of legs like that of the female.

Legs 1–4 similar to those of the female except for the segmentation of the endopods, which are 2-segmented rather than 3-segmented (Figure 12c–f). In these endopods the two distal segments fused, in legs 2–4 the original line of separation indicated by a row of small spines. Endopod of leg 4 (Figure 12f) 62 long, the three terminal elements from outer to inner 20, 31, and 44.

Leg 5 (Figure 12g) with the free segment 39×13 , its two unequal terminal elements 39 and 62.

Leg 6 (Figure 12h) a posteroventral flap on the genital segment bearing two setae 33 and 44.

Spermatophore unknown.

Color as in the female.

ETYMOLOGY.—The specific name *halodeimatis* is

the genitive form of the generic name of the host.

COMPARISON WITH *C. bulbosum*.—In *Chauliobion halodeimatis* the inner coxal setae of legs 1–3 are not swollen proximally as they are in *C. bulbosum*, and the terminal armature of the endopod of leg 4 is I,2 rather than II,I. In the female the inner element on the free segment of leg 5 is long and setiform, while in *C. bulbosum* it is stout and spiniform. In the male the concave margin of the claw of the maxilliped is smooth rather than provided with hyaline teeth as in the species from *Actinopyga*.

Scambicornus Heegaard, 1944

Scambicornus tylotus, new species

FIGURES 13–16

TYPE MATERIAL.—62 ♀♀, 72 ♂♂ from one holothurian, *Bohadschia argus* (Jaeger), in 2 m, western side of Isle Maitre, near Noumea, New Caledonia, $22^{\circ}20'05''$ S, $166^{\circ}24'05''$ E, 11 June 1971. Holotype ♀, allotype, and 110 paratypes (50 ♀♀, 60 ♂♂) deposited in the National Museum of Natural History, Smithsonian Institution, Washington, D.C.; the remaining paratypes in the collection of the author.

OTHER SPECIMENS.—7 ♀♀, 5 ♂♂ from two *Bohadschia argus*, in 4 m, west of Isle Ngou, near Noumea, $22^{\circ}13'44''$ S, $166^{\circ}23'01''$ E, 3 August 1971.

Both lots of specimens occurred in company with *Scambicornus tuberosus* (Humes and Cressey, 1961).

FEMALE.—Body (Figure 13a) with the prosome moderately broad. Length 1.19 mm (1.12–1.24 mm) and the greatest width 0.69 mm (0.65–0.73 mm), based on 10 specimens. Segment of leg 1 separated from the head by a dorsal furrow. Epimeral areas of the segment of leg 1 angular, those of the segments of legs 2–4 rounded. Tergum of the segment of leg 4 hidden in dorsal view under that of leg 3. Ratio of the length to the width of the prosome 1.18:1. Ratio of the length of the prosome to that of the urosome 2.18:1.

Segment of leg 5 (Figure 13b) 78×211 . Between this segment and the genital segment no ventral sclerite. Genital segment 122×172 , wider than long, with its anterior three-fourths laterally expanded and the posterior fourth abruptly narrowed (91 wide). Genital areas located dorsolaterally just

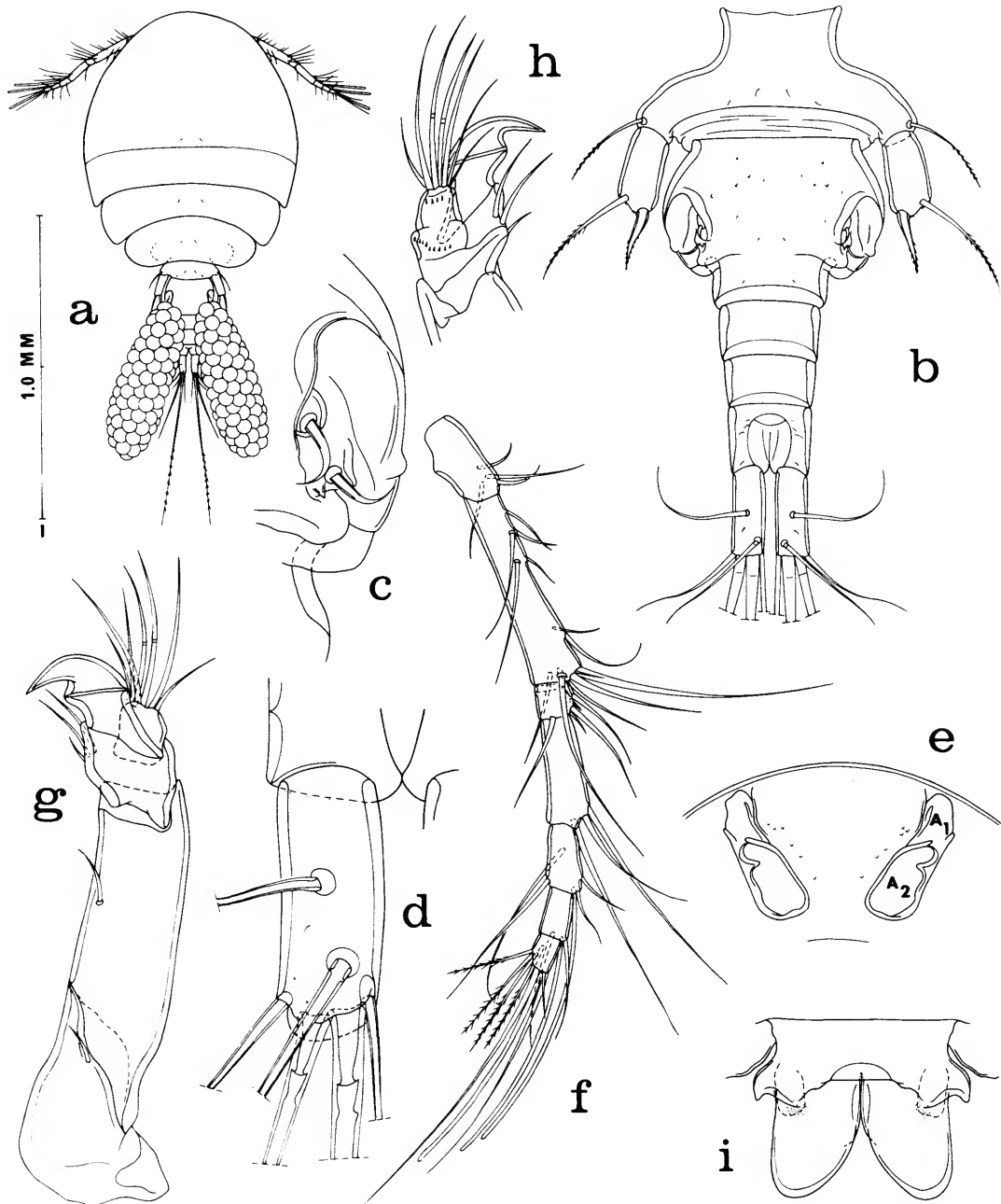


FIGURE 13.—*Scambicornus tylotus*, new species, female: *a*, dorsal (1); *b*, urosome, dorsal (2); *c*, genital area, dorsal (3); *d*, caudal ramus, dorsal (4); *e*, rostral area, ventral (5); *f*, first antenna, dorsal (6); *g*, second antenna, anterior (7); *h*, third and fourth segments of second antenna, posterior (8); *i*, labrum with paragnaths indicated by broken lines, ventral (9).

behind the middle of the segment. Each area (Figure 13c) bearing two naked setae approximately 19 long and a small spiniform process. Three post-genital segments from anterior to posterior 42×76 , 34×65 , and 52×62 . Anal segment with a row of minute spinules on its posteroventral margin on each side.

Caudal ramus (Figure 13d) elongated, 73×29 in greatest dimensions, about 2.5 times longer than wide. Outer lateral seta (situated dorsally on the ramus) 83 and naked. Dorsal seta 90 and weakly haired distally. Outermost terminal seta 96 and innermost terminal seta 112, both naked. Two long median terminal setae 308 (outer) and 610 (inner), both with lateral spinules in their mid-regions and both inserted between dorsal (smooth) and ventral (with a marginal row of minute spinules) flanges.

Body surface with a few small hairs (sensilla) as in Figure 13a.

Egg sac (Figure 13a) elongated oval, 594×198 , with many eggs, each about 52 in diameter.

Rostral area (Figure 13e) not well defined posteroventrally, but bearing numerous refractile points.

First antenna (Figure 13f) 443 long. Lengths of its seven segments: 34 (70 along the anterior edge), 159, 27, 78, 47, 36, and 26 respectively. Small sclerite on the ventral surface of the third segment suggesting an intercalary segment. Formula for the armature: 4, 13 (5 + 8), 6, 3, 4 + 1 aesthete, 2 + 1 aesthete, and 7 + 1 aesthete. Setae naked except for four with lateral spinules on the last segment.

Second antenna (Figure 13g) 4-segmented, 270 long including the claw. Armature: 1, 1, 3 + claw, and 7. All setae naked. Small fourth segment much shorter than the claw, which is 78 along its axis. Posterior surface of the third and fourth segments ornamented with a row of small spines (Figure 13h).

Labrum (Figure 13i) with two rather slender posteroventral lobes.

Mandible (Figure 14a) similar to that in other species, for example, *Scambicornus lobulatus* Humes, 1967. Paragnath (Figure 13i) a small lobe with a few inconspicuous spinules. First maxilla (Figure 14b) with three terminal elements and a subterminal hyaline process, also similar to that in *S. lobulatus* and other species in the genus. Second maxilla (Figure 14c) 2-segmented, with the large first segment unarmed. Second segment having a

proximal setule on its outer (ventral) margin, a naked seta on its posterior surface and an inner (dorsal) seta unilaterally barbed; segment terminating in a short lash with two large proximal teeth followed by smaller spines, the third and fourth spines in the series being larger than the rest (Figure 14d). Maxilliped (Figure 14e) 3-segmented, the first segment unarmed, the second segment with two short naked setae and a patch of small spines, and the third segment with two small naked setae and having a pointed tip.

Area between the maxillipeds and the first pair of legs (Figure 14f) not protuberant.

Legs 1-4 (Figures 14g,h; 15a,b) with 3-segmented rami. Armature as follows (the Roman numerals indicating spines, the Arabic numerals 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,III,2
P ₄	coxa	0-1	basis	1-0	exp	I-0; I-1; II,I,5
	enp	0-1; 0-1;				I,II,II

Inner seta on the coxa of legs 1 and 2 long and plumose, but in leg 3 shorter, and in leg 4 reduced to a small naked seta 16 long. Outer seta on the basis of legs 1 and 2 shorter than the first exopod segment. This seta in legs 3 and 4 much longer (130), exceeding slightly the length of the entire exopod. Inner margin of the basis with a row of long slender spinules in legs 1-3, but smooth in leg 4. In the exopod of leg 1 the most proximal outer spine on the third segment distinctly more slender than the other exopod spines (Figure 14g). Endopod of leg 4 (Figure 15b) 143 long, with both first and second segments having a short spinelike inner element instead of a true seta. Five spines on the third segment from outer to inner 26, 30, 95, 49, and 29.

Leg 5 (Figure 15c) with a relatively large free segment 65×31 , ratio 2.1:1. Outer terminal seta 96 with short lateral spinules. Inner terminal seta 47, swollen proximally, and with short lateral barbules. Distal rim of the segment ornamented with a few small spinules. Seta on the body near the insertion of the free segment 68 with short lateral spinules.

Leg 6 probably represented by the two setae on the genital area (Figure 13c).

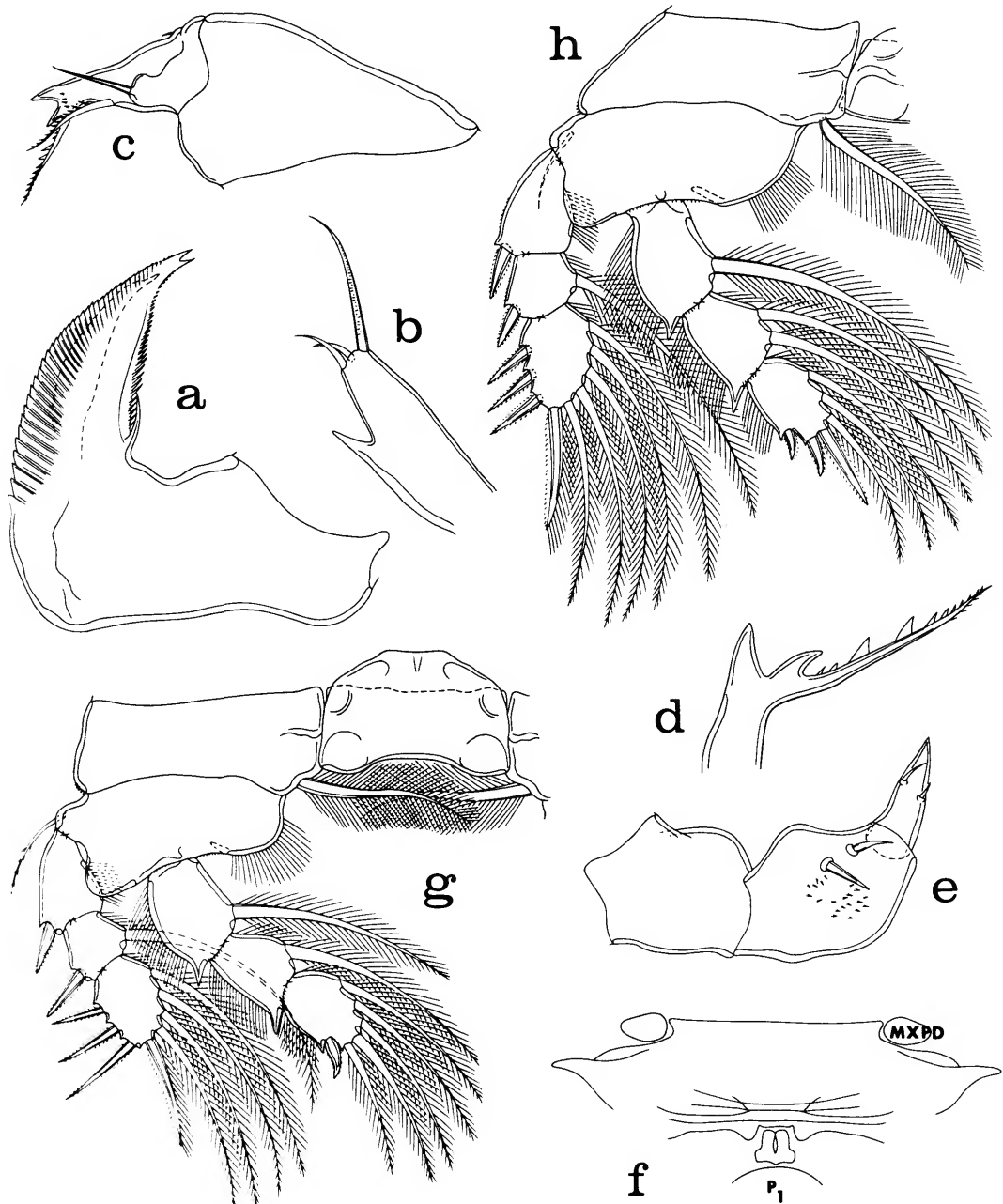


FIGURE 14.—*Scambicornus tylotus*, new species, female: *a*, mandible, anterior (D); *b*, first maxilla, anterior (D); *c*, second maxilla, posterior (B); *d*, tip of second maxilla, anterior (C); *e*, maxilliped, antero-inner (B); *f*, area between maxillipeds and leg 1, ventral (C); *g*, leg 1 and intercoxal plate, anterior (H); *h*, leg 2, anterior (H).

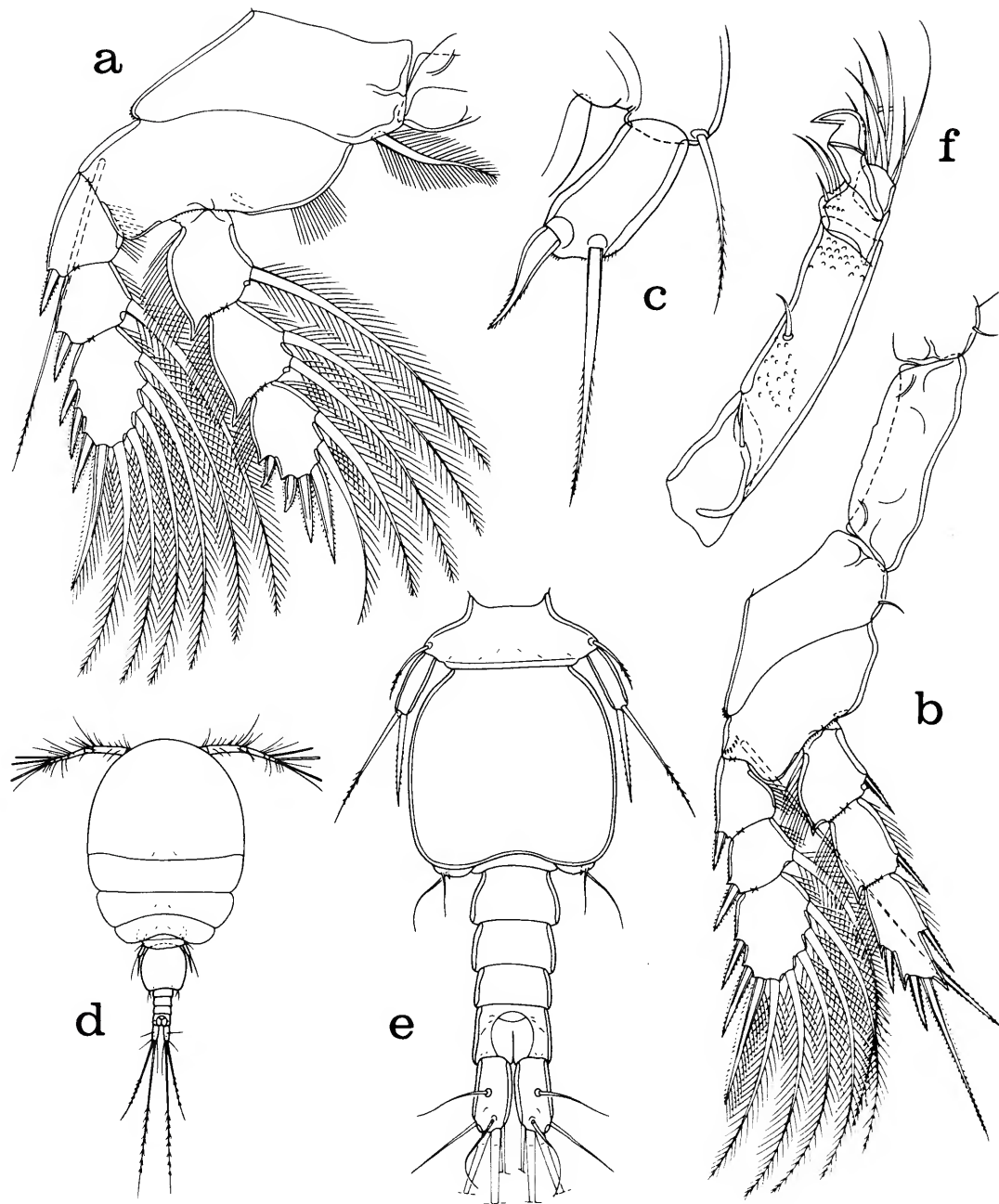


FIGURE 15.—*Scambicornus tylotus*, new species. Female: a, leg 3, anterior (H); b, leg 4 and intercoxal plate, anterior (H); c, leg 5, dorsal (B). Male: d, dorsal (I); e, urosome, dorsal (C); f, second antenna, anterior (H).

Color in life in transmitted light translucent to yellowish, the eye red, the egg sacs light gray.

MALE.—Body (Figure 15*d*) resembling in general form that of the female, though the prosome is narrower. Length 1.03 mm (0.96–1.11 mm) and the greatest width 0.51 mm (0.50–0.55 mm), based on 10 specimens. Ratio of the length to the width of the prosome 1.30:1. Ratio of the length of the prosome to that of the urosome 1.98:1.

Segment of leg 5 (Figure 15*e*) 55×133 . Between this segment and the genital segment no ventral sclerite. Genital segment quadrate, 160×160 . Four postgenital segments from anterior to posterior 36×70 , 36×65 , 31×62 , and 43×64 .

Caudal ramus (Figure 15*e*) resembling that of the female, but shorter, 53×25 , or 2.12 times longer than wide.

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

Rostral area and first antenna like those in the female.

Second antenna (Figure 15*f*) with two groups of small bosses on the second segment and a row of several similar bosses on the third segment; otherwise the second antenna resembling that of the female.

Labrum, mandible, paragnath, first maxilla, and second maxilla like those in the female. Maxilliped (Figure 16*a*) 4-segmented, assuming that the proximal part of the claw represents a fourth segment. First segment unarmed. Second segment with two short naked inner setae surrounded by a patch of large stout blunt spines. Small third segment unarmed. Claw 222 along its axis, bearing two unequal naked setae proximally and a small terminal lamella. Concave margin of the claw undulating, with three knoblike processes, the claw distinctly narrowed between the distal two of these processes (Figure 16*b*).

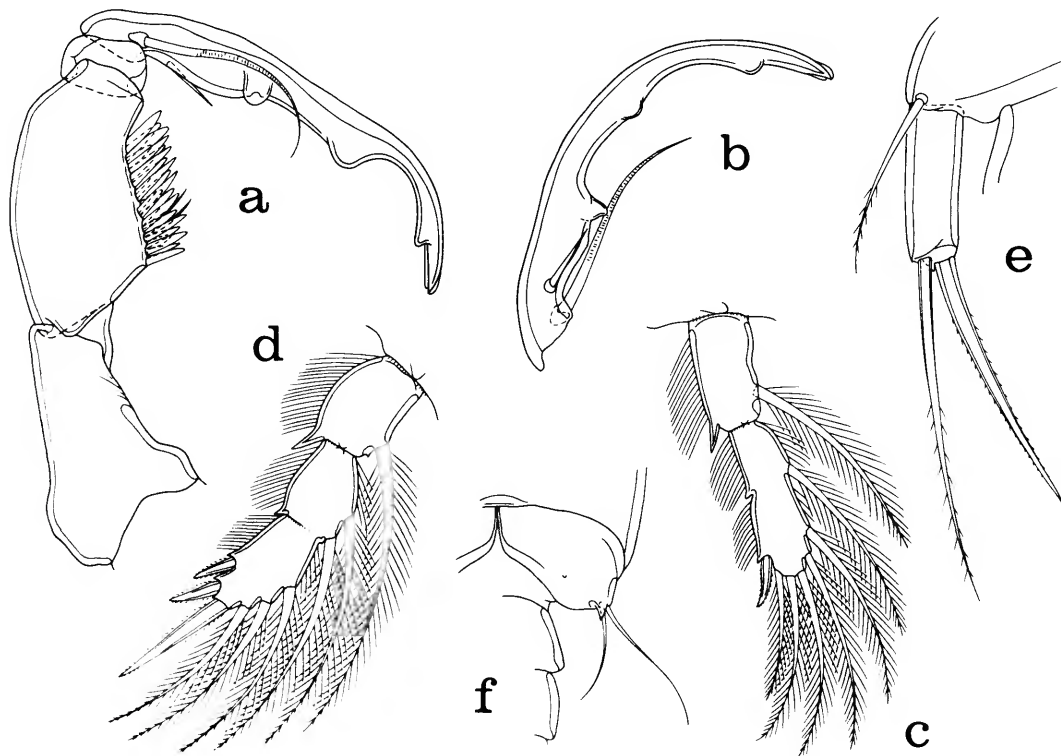


FIGURE 16.—*Scambicornus tylotus*, new species, male: *a*, maxilliped, posterior (H); *b*, claw of maxilliped, anterior (H); *c*, endopod of leg 1, anterior (H); *d*, endopod of leg 2, anterior (H); *e*, leg 5, dorsal (H); *f*, leg 6, ventral (H).

Area between the maxillipeds and the first pair of legs resembling that of the female.

Legs 1–4 like those of the female except for the endopods of legs 1 and 2. Endopod of leg 1 (Figure 16c) 2-segmented and relatively longer (130) than the exopod (99). (In the female these two rami are: endopod 135, exopod 117.) Endopod of leg 2 (Figure 16d) also 2-segmented and relatively longer (146) than the exopod (122). (In the female these two rami are: endopod 151, exopod 133.) Second segment of the endopod showing a slight indication of subdivision.

Leg 5 (Figure 16e) with the unornamented free segment 39×13 , three times longer than wide. Outer terminal seta 81, inner terminal spiniform seta 70. Seta on the body near the free segment 44.

Leg 6 (Figure 16f) a posteroventral flap on the genital segment bearing two naked setae 50 and 75.

Spermatophore not observed.

Color as in the female.

ETYMOLOGY.—The specific name *tylotus*, from the Greek τυλωτος (= knobbed), refers to the knob-like processes on the claw of the male maxilliped.

COMPARISON WITH RELATED SPECIES.—Humes and Stock (1973) listed 21 species in the genus *Scambicornus*. These fall in three groups based on the armature of segments 3 and 4 of the second antenna (Stock, 1964). *Scambicornus tylotus* may be distinguished from Stock's group b, containing *S. propinquus* (Nicholls, 1944) and *S. armoricanus* (Bocquet, Stock, and Kleeton, 1963), where segment 3 has a moderately prehensile element and where segment 4 is normally developed. The new species differs from Stock's group c, comprising *S. finmarchicus* (T. Scott, 1903), *S. tenuicaudis* (Sars, 1918), and *S. brevicauda* (Sewell, 1949), where prehensile elements on segment 3 are absent or setiform and where segment 4 is normally developed.

The remaining 16 species, representing Stock's group a, have as in the new species a strongly prehensile and usually 2-segmented claw on segment 3 of the second antenna. Two of these, *S. poculiferus* (Humes and Cressey, 1961) and *S. nicobaricus* (Sewell, 1949), have an elongated fourth second antennal segment (longer than the third segment). In 4 of the remaining 14 species, *S. idoneus* (Humes and Cressey, 1961), *S. petiti* (Stock and Kleeton, 1963), *S. prehensilis* (Sars, 1918), and *S. serendibicus* (Thompson and A. Scott, 1903), the female caudal ramus is more than four times longer than wide;

and in 3 species, *S. campanulipes* (Humes and Cressey, 1961), *S. subtilis* (Humes and Cressey, 1961), and *S. robustus* (Thompson and A. Scott, 1903), the ratio is only 2:1 or less.

The 7 species that remain show certain important differences from *S. tylotus*. In *S. modestus* (Humes and Cressey, 1961), *S. subgrandis* (Humes and Cressey, 1961), *S. adduensis* (Sewell, 1949), and *S. lobulatus* Humes, 1967, the female genital segment has laterally expanded wings. In *S. hamatus* (Heegaard, 1944) the second antenna is stouter and more robust than in the new species, and the female caudal ramus is about 3:1. In *S. tuberatus* (Humes and Cressey, 1961) the female leg 5 is much smaller both in absolute size and in relation to the genital segment than in *S. tylotus*. The final species, *S. brachysetosus* Reddiah, 1968, may be distinguished from the new species on the basis of its small size alone (\varnothing 0.6 mm, δ 0.4 mm).

The 3-knobbed claw of the male maxilliped in *S. tylotus* serves as a useful distinguishing feature. Among those 15 species where males are known, 13 have maxillipedal claws with a smooth concave surface. *S. tuberatus* has a single knoblike protuberance on the proximal part of the claw. *S. brachysetosus* has a spiniform projection near the middle of the concave side of the claw (Figure 24k).

Undissected specimens of *S. tylotus* and *S. tuberatus* in lactic acid may be quickly separated, the females by the relative size of leg 5 and the males by the condition of the claw of the maxilliped.

Scambicornus sewelli, new species

FIGURES 17–20

TYPE MATERIAL.—161 \varnothing \varnothing , 204 δ δ from 50 holothurians, *Halodeima edulis* (Lesson), in 3 m, near reef between Isle Ndié and Mt. Kumuru, northwest of Noumea, New Caledonia, $22^{\circ}13'40''S$, $166^{\circ}24'18''E$, 9 July 1971. Holotype \varnothing , allotype, and 240 paratypes (100 \varnothing \varnothing , 140 δ δ) deposited in the National Museum of Natural History, Smithsonian Institution, Washington, D.C.; 117 paratypes (57 \varnothing \varnothing , 60 δ δ) in the Zoölogisch Museum, Amsterdam; the remaining paratypes (dissected) in the collection of the author.

OTHER SPECIMENS.—From *Halodeima edulis*: 4 \varnothing \varnothing , 1 δ from 1 host, in intertidal pool, Ricaudy Reef, Noumea, $22^{\circ}19'00''S$, $166^{\circ}26'44''E$, 9 June

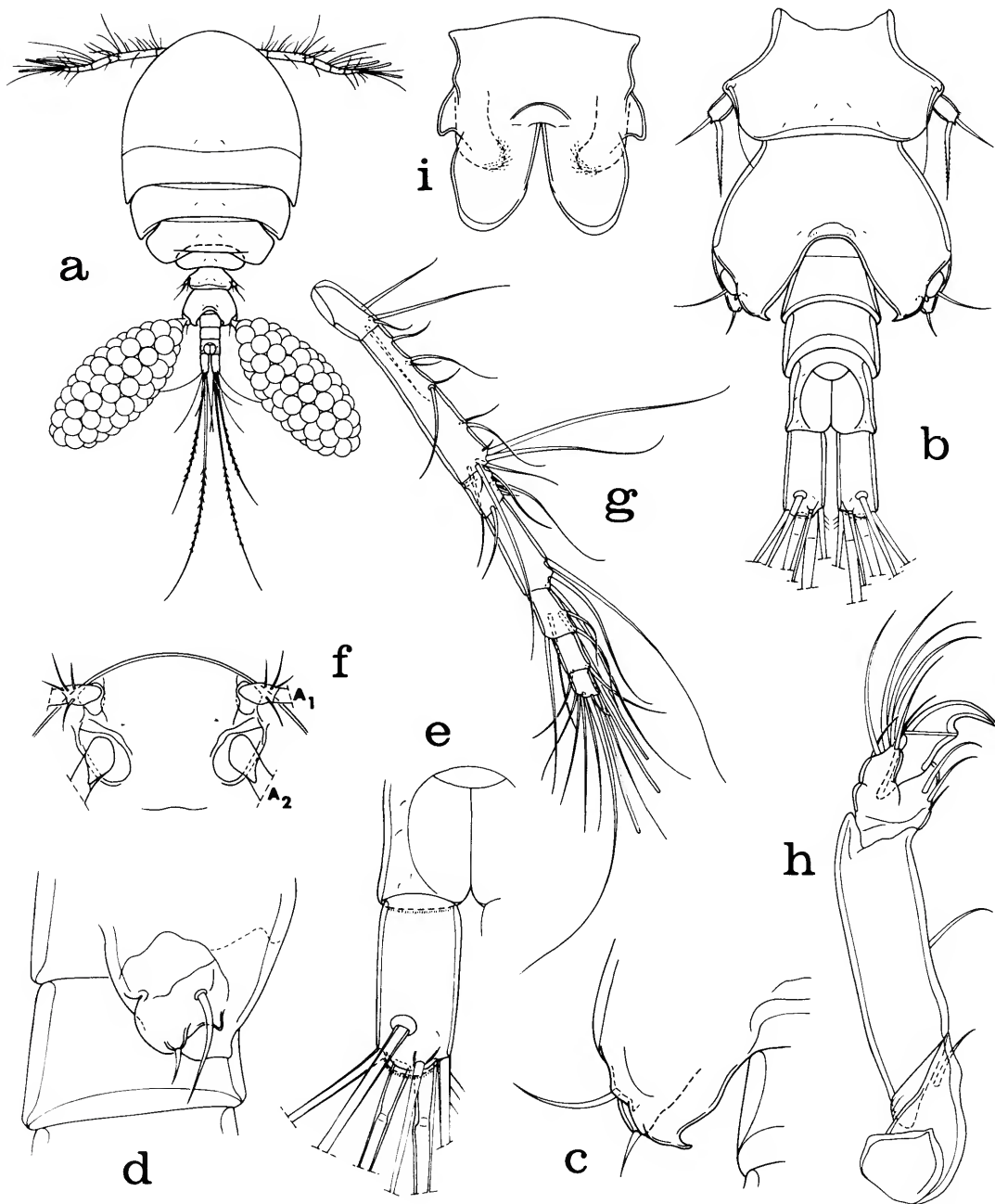


FIGURE 17.—*Scambicornus sewelli*, new species, female: a, dorsal (i); b, urosome, dorsal (c); c, genital area, dorsal (b); d, genital area, lateral (b); e, caudal ramus, dorsal (b); f, rostral area, ventral (f); g, first antenna, dorsal (c); h, second antenna, posterior (h); i, labrum with paragnaths indicated by broken lines, ventral (h).

1971; 3 ♀♀, 5 ♂♂ from 1 host, in 2 m, western side of Isle Maître, near Noumea, 22°20'05"S, 166°24'05"E, 11 June; 7 ♀♀, 1 ♂ from 6 hosts, in 1 m, western side of Isle Maître, 20 June; 3 ♂♂ from 1 host, in intertidal pool, southwestern side of Port Ngea, 2 kms north of Ricaudy Reef, 22°18'18"S, 166°26'47"E, 8 July.

From *Halodeima coluber* (Semper): 3 ♀♀, 4 ♂♂ from 1 host, intertidal, southwestern side of Port Ngea, 2 kms north of Ricaudy Reef, 8 July 1971; 22 ♀♀, 57 ♂♂ from 6 hosts, intertidal, eastern side of Isle Maître, near Noumea, 22°20'35"S, 166°25'10"E, 16 July; 14 ♀♀ from 6 hosts, intertidal, eastern side of Isle Maître, 31 July.

From *Halodeima atra* (Jaeger): 11 ♀♀, 5 ♂♂ from 8 hosts, in 1.5 m, Rocher à la Voile, 22°18'24"S, 166°25'50"E, 2 June 1971; 56 ♀♀, 18 ♂♂ from 10 hosts, intertidal, Ricaudy Reef, 9 June; 137 ♀♀, 65 ♂♂ from 31 hosts, in 4–5 m, reef between Isle Ndié and Mt. Kumuru, northwest of Noumea, 22°13'40"S, 166°24'18"E, 29 July.

From *Holothuria curiosa* Ludwig: 16 ♀♀, 10 ♂♂ from 1 host, in 1 m, Ricaudy Reef, 9 June 1971; 19 ♀♀, 20 ♂♂ from 1 host, intertidal, eastern side of Isle Maître, 16 July; 14 ♀♀, 9 ♂♂ from 1 host, intertidal pool, eastern side of Isle Maître, 16 July.

From *Actinopyga echinites* (Jaeger): 4 ♀♀ from 2 hosts, intertidal, Ricaudy Reef, near Noumea, 9 June 1971.

From *Microthele nobilis* (Selenka): 1 ♀ from 2 hosts, in 2 m, west of Isle Mando, 22°18'59"S, 166°09'30"E, 3 July 1971.

In all but one of these collections the new species was accompanied by *S. subtilis* (Humes and Cressey, 1961).

FEMALE.—Body (Figure 17a) with the prosome a little less widened than in *S. tylotus*. Length 1.14 mm (1.07–1.20 mm) and the greatest width 0.60 mm (0.57–0.63 mm), based on 10 specimens. Epimera of the segments of legs 1 and 2 angular, those of the segments of legs 3 and 4 rounded. Ratio of the length to the width of the prosome 1.33:1. Ratio of the length of the prosome to that of the urosome 2.21:1.

Segment of leg 5 (Figure 17b) 91 × 156. Between this segment and the genital segment no ventral sclerite. Genital segment 94 in midlength, 140 in greatest length, and 180 wide, posterolaterally ex-

panded to the level of the second postgenital segment. Genital areas situated laterally in the posterior half of the segment. Each area (Figure 17c,d) with two unequal naked setae 50 and 21, and a small spiniform process. Margin of the segment medial to the genital area with a small inwardly turned flange. Three postgenital segments from anterior to posterior 39 × 75, 34 × 70, and 55 × 69. Anal segment with a row of small spinules on its posteroventral margin on each side.

Caudal ramus (Figure 17e) elongated, 68 × 31 in greatest dimensions, about 2.19 times longer than wide. Outer lateral seta (situated dorsally on the ramus) 300 and naked. Dorsal seta 210 and naked. Outermost terminal seta 220 and naked, innermost terminal seta 150 with a few proximal inner spinules. Two long median terminal setae 540 (outer) and 870 (inner), both with a few delicate lateral spinules (easily broken off) in their midregions and both inserted between small dorsal (smooth) and ventral (with a marginal row of small spinules) flanges.

Body surface with a few small hairs (sensilla) as in Figure 17a.

Egg sac (Figure 17a) elongated oval, 570 × 250, with numerous eggs, each about 60 in diameter.

Rostral area (Figure 17f) not well defined.

First antenna (Figure 17g) 380 long. Lengths of its seven segments: 24 (57 along the anterior edge), 130, 34, 66, 41, 29, and 23 respectively. Formula for the armature as in *S. tylotus*. All setae naked.

Second antenna (Figure 17h) 286 long. Segmentation and armature as in *S. tylotus*. All setae naked. Claw 80 along its axis. Third and fourth segments without fine ornamentation.

Labrum (Figure 17i) similar to that in *S. tylotus*.

Mandible (Figure 18a) with a small conical process preceding the serrations on the convex margin and with unusually long proximal spinules on the concave margin; bifurcation at the tip unequal. Paragnath (Figure 17i) a small hairy lobe. First maxilla (Figure 18b) resembling that of *S. tylotus* but with a spiniform process adjacent to the longest terminal seta. Second maxilla (Figure 18c) armed as in *S. tylotus*. Second segment with the posterior surficial seta naked, the inner (dorsal) seta with prominent unilateral barbs (Figure 18d), and the second and third teeth on the lash longer than the rest. Maxilliped (Figure 18e) similar to

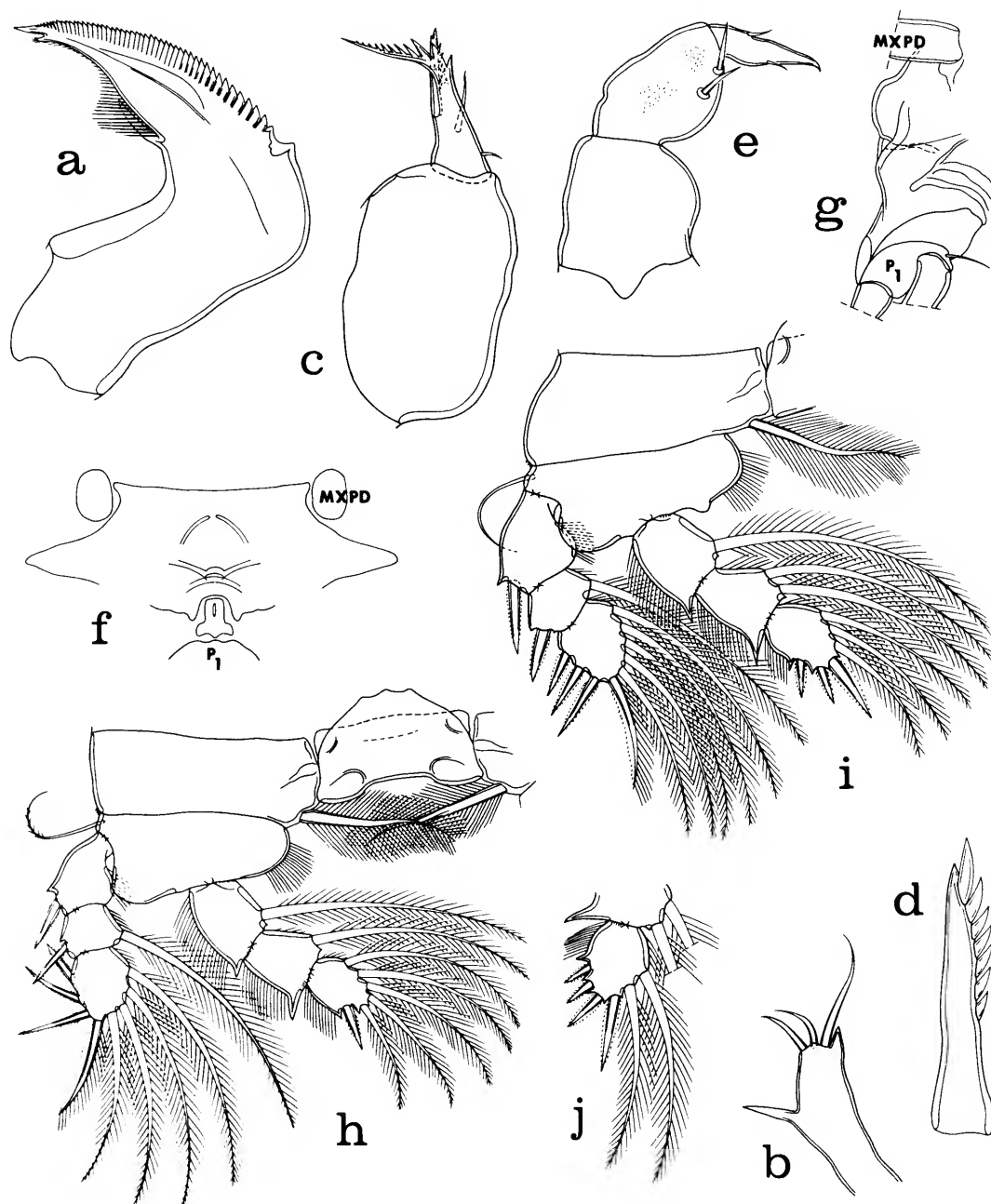


FIGURE 18.—*Scambicornus sewelli*, new species, female: a, mandible, posterior (D); b, first maxilla, anterior (A); c, second maxilla, anterior (A); d, spine on second segment of second maxilla, posterior (P); e, maxilliped, antero-inner (A); f, area between maxillipeds and leg 1, ventral (V); g, area between maxillipeds and leg 1, lateral (L); h, leg 1 and intercoxal plate, anterior (A); i, leg 2, anterior (A); j, third segment of endopod of leg 3, anterior (A).

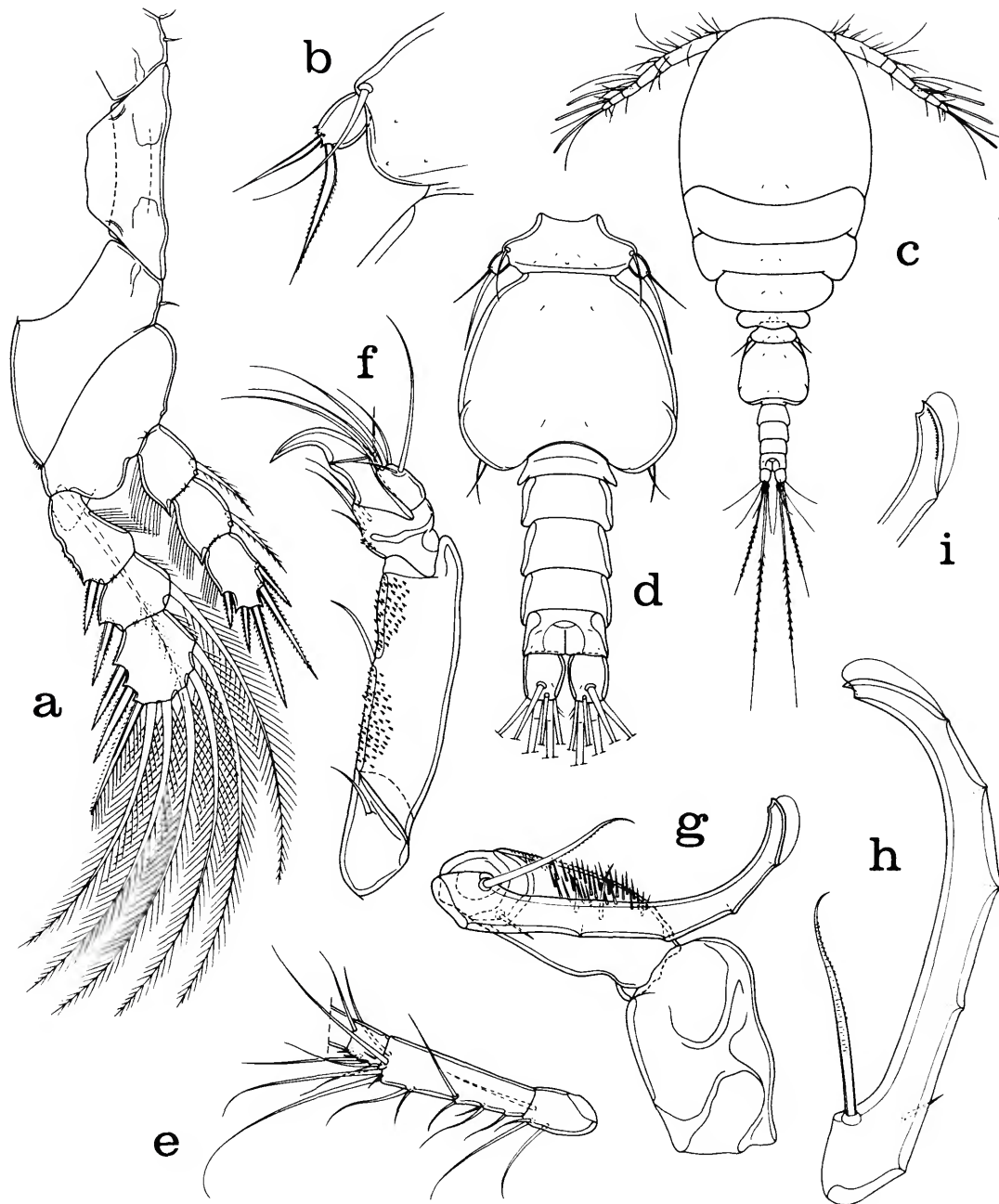


FIGURE 19.—*Scambicornus sewelli*, new species. Female: a, leg 4 and intercoxal plate, anterior (H); b, leg 5, dorsal (B). Male: c, dorsal (F); d, urosome, dorsal (H); e, segments 1-3 of first antenna, dorsal (H); f, second antenna, anterior (B); g, maxilliped, posterior (B); h, claw of maxilliped, posterior (B); i, tip of claw of maxilliped, anterior (B).

that in *S. tylotus*. Tip of the third segment recurved.

Area between the maxillipeds and the first pair of legs (Figure 18f) slightly protuberant in lateral view (Figure 18g).

Legs 1-4 (Figures 18h-j; 19a) segmented and armed as in *S. tylotus*. Leg 4 with the inner coxal seta 11 and naked. Outer seta on the basis 130. Exopod 118. Endopod 109, with the inner element on segments 1 and 2 a plumose seta about 40. Five spines on the third segment from outer to inner 21, 28, 59, 61, and 31.

Leg 5 (Figure 19b) with a small free segment 22×16 , ratio 1.37:1. Outer terminal seta 42 and smooth. Inner terminal seta 61, slightly swollen proximally and angular. Segment ornamented distally with a few small spinules. Seta on the body near the insertion of the free segment 65 and naked.

Leg 6 probably represented by the two setae on the genital area (Figure 17d).

Color in life in transmitted light as in *S. tylotus*.

MALE.—Body (Figure 19c) with the prosome more slender than in the female. Length 0.71 mm (0.66-0.75 mm) and the greatest width 0.31 mm (0.30-0.32 mm), based on 10 specimens. Ratio of the length to the width of the prosome 1.59:1. Ratio of the length of the prosome to that of the urosome 1.89:1.

Segment of leg 5 (Figure 19d) 31×76 . No ventral intersegmental sclerite. Genital segment 109×117 , slightly wider than long. In dorsal view the greatest width of the segment occurring in its posterior third. Four postgenital segments from anterior to posterior 26×49 , 29×48 , 26×47 , and 23×45 .

Caudal ramus (Figure 19d) similar to that of the female, but shorter, 29×21 , or 1.38 times longer than wide.

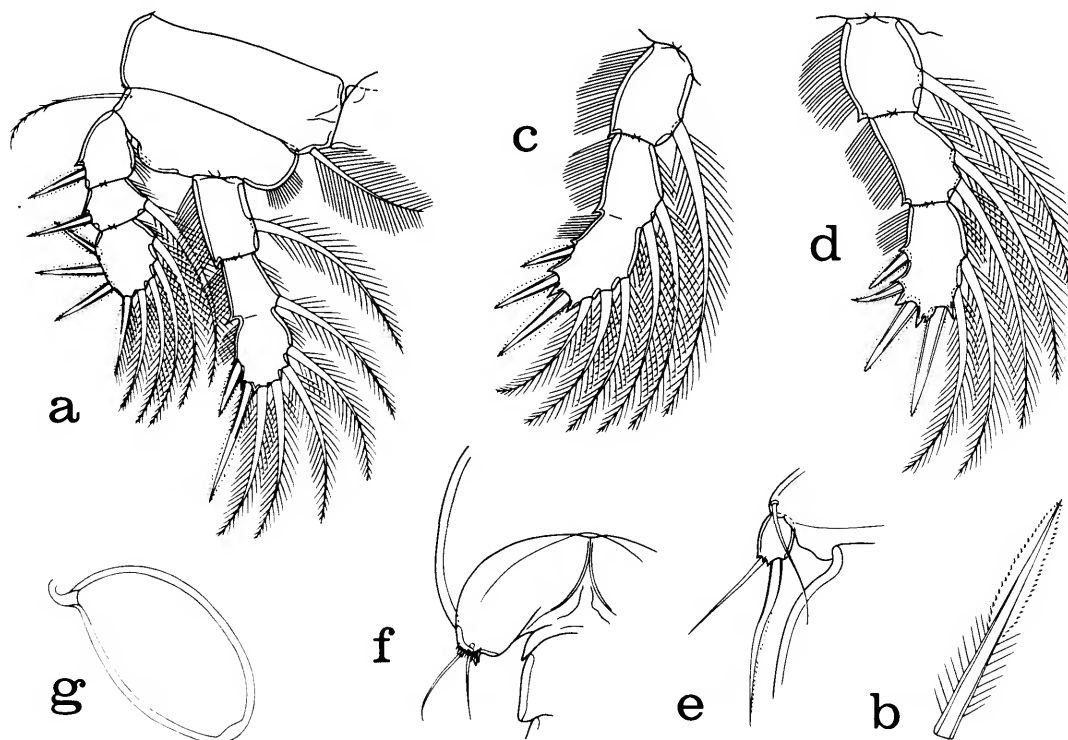


FIGURE 20.—*Scambicornus sewelli*, new species, male: a, leg 1, anterior (♂); b, terminal spine on endopod of leg 1, anterior (♂); c, endopod of leg 2, anterior (♂); d, endopod of leg 3, anterior (♂); e, leg 5, dorsal (♂); f, leg 6, ventral (♂); g, spermatophore, ventral (♂).

Body surface ornamented with hairs as in the female.

Rostral area like that of the female.

First antenna 250 long, resembling that of the female but the second segment relatively a little shorter (Figure 19e). Lengths of the segments: 20 (39 along the anterior edge), 81, 21, 46, 26, 19, and 18 respectively.

Second antenna (Figure 19f) with two groups of small spinules on the second segment and a few spinules on the third segment; otherwise as in the female.

Labrum, mandible, paragnath, first maxilla, and second maxilla like those in the female. Maxilliped (Figure 19g) with a somewhat enlarged first segment. Second segment more slender with two inner naked setae and ornamented with a patch of slender spines and a distal group of minute spinules. Small third segment unarmed. Claw (Figure 19h) 145 along its axis (including the hyaline terminal lamella), bearing proximally two unequal setae, the longer with minute barbules along one side, the other naked. Convex margin of the claw with the sclerotization interrupted at five points where, in a favorable view, the margin is seen to protrude on a slight knob. Near the tip of the claw on the anterior surface a row of minute spinules (Figure 19i).

Legs 1-4 segmented as in *S. tylotus*, with the spine and setal formula as in that species. Leg 1 (Figure 20a) with the exopod 65 and the 2-segmented endopod 82 long. Terminal spiniform element on the endopod with lateral hairs proximally but with a barbed fringe distally (Figure 20b). Endopod of leg 2 (Figure 20c) also 2-segmented and relatively longer (99) than the exopod (73). Legs 3 and 4 with the outer seta on the basis much shorter than in the female, only about half as long as the exopod. Endopod of leg 3 (Figure 20d) longer (104) than the exopod (87). Outer terminal spine on the third segment with an attenuated rather than a blunt tip and deflected slightly toward the more proximal spine on the outer side of the segment. Leg 4 as in the female.

Leg 5 (Figure 20e) with a minute free segment 10×7.5 armed as in the female.

Leg 6 (Figure 20f) a posteroventral flap on the genital segment bearing two naked setae about 25, a small spiniform process, and a ventral row of slender spinules.

Spermatophore (Figure 20g) oval, 78×44 , not including the neck.

Color as in *S. tylotus*.

ETYMOLOGY.—This species is named for the late Colonel R. B. Seymour Sewell, who described several species of *Scambicornus* (under the name *Preherrmannella*) from the Indian Ocean.

COMPARISON WITH RELATED SPECIES.—On the grounds mentioned above in connection with *S. tylotus*, the new species from *Halodeima* may be separated from *S. propinquus*, *S. armoricanus*, *S. finmarchicus*, *S. tenuicauda*, *S. brevicauda*, *S. poculiferus*, *S. nicobaricus*, *S. idoneus*, *S. petiti*, *S. prehensilis*, and *S. serendibicus*.

Eight of the eleven other species in the genus may be distinguished from *S. sewelli* by selected characters as follows: In *S. campanulipes* the female has a bell-shaped fifth leg. In *S. subtilis*, *S. modestus*, *S. subgrandis*, and *S. lobulatus* the female genital segment has laterally expanded wings. In *S. hamatus* the second antenna is stouter and more robust and the female caudal ramus is about 3:1. In *S. tuberatus* leg 5 in the female is much smaller (28×18) and the claw of the male maxilliped has a proximal inner digitiform process. In *S. tylotus* the female leg 5 is much larger, both absolutely and in relation to the genital segment, and the claw of the male maxilliped has three inner knoblike processes.

The three species that remain are less well known and therefore more difficult to compare with the new species. In *S. robustus*, of which only the female is known, the genital segment has evenly rounded sides instead of being posterolaterally expanded. In *S. brachysetosus* both sexes are much smaller than in *S. sewelli*, the female genital segment has evenly rounded sides, and the concave side of the claw of the male maxilliped has a spiniform projection.

The two females and two males described as *Preherrmannella adduensis* by Sewell (1949) may comprise two species. His females represent a species close to *S. subtilis*, but distinguished from that species by the longer fourth segment on the second antenna and by the longer caudal ramus (nearly 3:1, instead of 1.67:1 as in *S. subtilis*). Sewell's males show an irregular convex margin on the claw of the maxilliped (his fig. 21n) suggesting the unusual nature of the maxillipedal claw of *S. sewelli*. Although it is impossible to be certain

from Sewell's meager description and figures, the possibility exists that Sewell's males of *Preherrmannella adduensis* may actually represent *Scambicornus sewelli*.

Examination of type material of *Preherrmannella adduensis* has not been possible. The specimens on which the original description was based, collected by Sewell while on board the *Investigator* in the Indian Ocean, no longer exist. Colonel Sewell informed me by letter of 26 April 1963 that the specimens from the *Investigator* were deposited in the collections of the Zoological Survey of India. During World War II the collections of the Indian Museum (containing the specimens from the *Investigator*) were transferred to Benares. There they were exposed to a severe flood, with the result that the labels were washed off.

Scambicornus calcaratus, new species

FIGURES 21-23

TYPE MATERIAL.—179 ♀♀, 120 ♂♂, and 43 copepodids from five holothurians, *Actinopyga miliaris* (Quoy and Gaimard), in 3 m, reef between Isle Ndié and Mt. Kumuru, northwest of Noumea, New Caledonia, 22°13'40"S, 166°24'18"E, 9 July 1971. Holotype ♀, allotype, and 291 paratypes (175 ♀♀, 116 ♂♂) deposited in the National Museum of Natural History, Smithsonian Institution, Washington, D.C.; the remaining paratypes (dissected) and the copepodids in the collection of the author.

OTHER SPECIMENS.—From *Actinopyga miliaris*: 72 ♀♀, 23 ♂♂, and 3 copepodids from one host, in 2 m, west of Isle Mando, near Noumea, 22°18'59"S, 166°09'30"E, 17 July 1971.

From *Actinopyga obesa palauensis* Panning: 11 ♀♀, 7 ♂♂ from one host, in 3 m, north of Isle Maître, near Noumea, 22°19'30"S, 166°24'35"E, 13 July 1971.

From *Actinopyga plebeja* (Selenka): 6 ♀♀, 4 ♂♂ from one host, in 2 m, northwestern side of Isle Maître, 22°20'05"S, 166°24'05"E, 11 June 1971; 9 ♀♀, 1 ♂ from one host, in 2 m, north of Isle Maître, 13 July; 4 ♀♀, 3 ♂♂ from one host, in 2 m, west of Isle Mando, near Noumea, 15 July.

From *Actinopyga serratidens* Pearson: 10 ♀♀, 5 ♂♂ from 3 hosts, in intertidal pool, Ricaudy Reef, 22°19'00"S, 166°26'44"E, 10 July 1971.

From *Actinopyga echinites* (Jaeger): 23 ♀♀, 14 ♂♂, and 43 copepodids from one host, in 2 m, Rocher à la Voile, Noumea, 2 June 1971; 2 ♀♀ from two hosts, intertidal, Ricaudy Reef, near Noumea, 9 June; 28 ♀♀, 7 ♂♂, and 1 copepodid from 12 hosts, in 2 m, Rocher à la Voile, Noumea, 10 June; 2 ♀♀, 5 ♂♂ from 22 hosts, in 2 m, eastern end of Ricaudy Reef, near Noumea, 22°19'00"S, 166°27'18"E, 18 June; 22 ♀♀, 15 ♂♂ from two hosts, in 2 m, north of Isle Maître, near Noumea, 22°19'30"S, 166°24'35"E, 13 July.

From *Actinopyga lecanora* (Jaeger): 66 ♀♀, 36 ♂♂ from one host, in 0.5 m, eastern side of Isle Maître, 22°20'05"S, 166°24'05"E, 8 June 1971; 52 ♀♀, 24 ♂♂ from one host, in 2 m, north of Isle Maître, near Noumea, 13 July; 2 ♀♀ from one host, in tide pool, beach west of Paita, northwest of Noumea, 22°07'10"S, 166°12'00"E, 22 July; 41 ♀♀, 18 ♂♂ from one host, in tide pool, eastern side of Isle Maître, 31 July.

FEMALE.—Body (Figure 21a) with a moderately broad prosome. Length 1.30 mm (1.21–1.39 mm) and the greatest width 0.62 mm (0.58–0.64 mm), based on 10 specimens. Tergum of leg 3 longer than that of leg 2. Epimeral areas varied as illustrated in the figure. Ratio of the length to the width of the prosome 1.37:1. Ratio of the length of the prosome to that of the urosome 1.84:1.

Segment of leg 5 (Figure 21b) 130 × 185. Between this segment and the genital segment no ventral sclerite. Genital segment 122 × 143, slightly wider than long and in dorsal view only slightly expanded laterally. Genital areas situated dorso-laterally in the posterior half of the segment. Each area (Figure 21c) bearing two naked setae about 12 long and a small spiniform process. Three post-genital segments from anterior to posterior 57 × 76, 52 × 74, and 62 × 70. Anal segment with a row of extremely small spinules on the posteroventral margin on each side.

Caudal ramus (Figure 21d) elongated, 81 × 29 in greatest dimensions, 2.79 times longer than wide. Outer lateral seta (situated dorsolaterally on the ramus) 104 and smooth. Dorsal seta 140 and lightly feathered distally. Outermost terminal seta 73 and the innermost terminal seta 83, both smooth. Two long median terminal setae 275 (outer) and 638 (inner), both with sparse lateral spinules and both inserted between small smooth dorsal and ventral flanges.

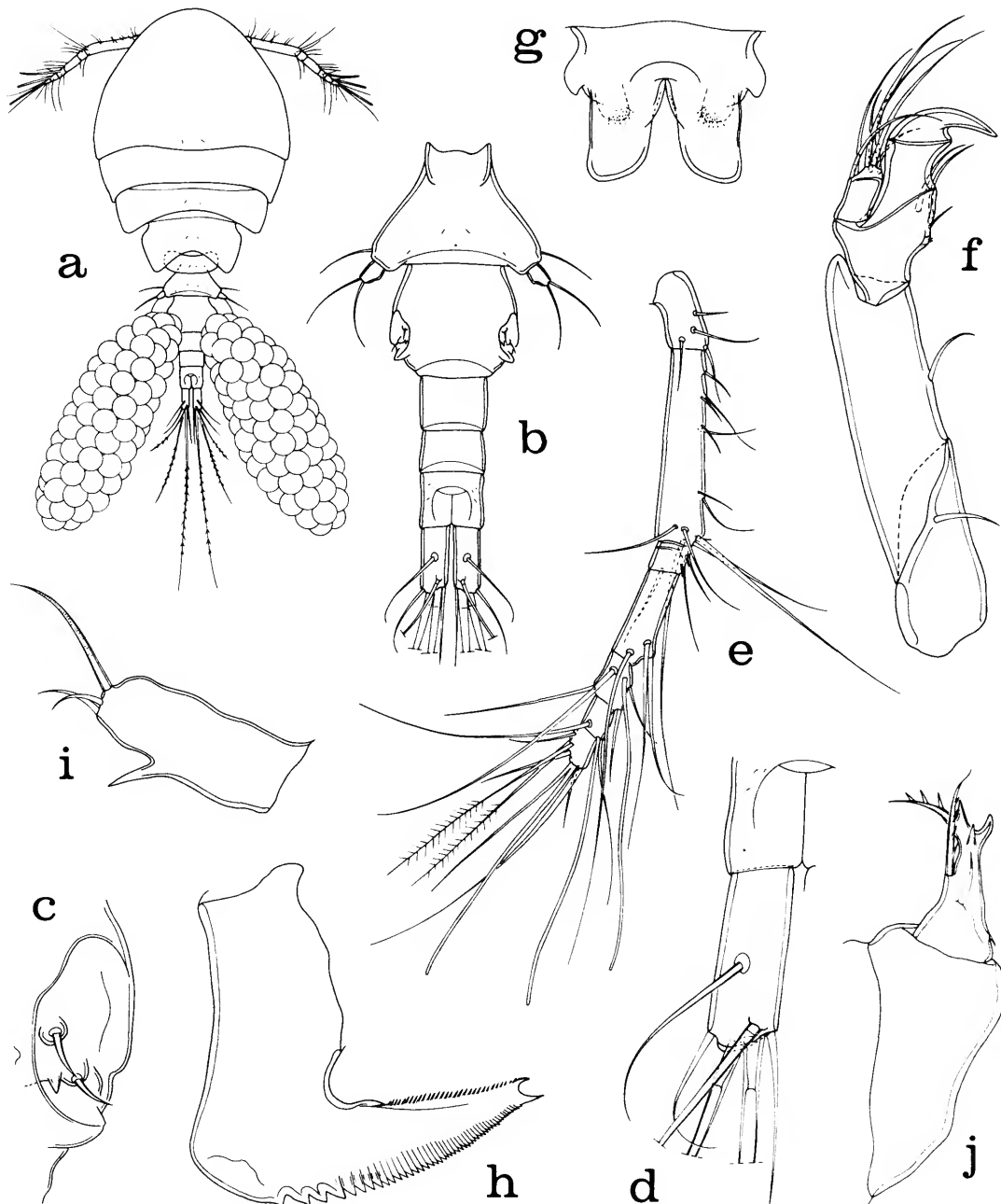


FIGURE 21.—*Scambicornus calcaratus*, new species, female: a, dorsal (♂); b, urosome, dorsal (♂); c, genital area, dorsal (♂); d, caudal ramus, dorsal (♂); e, first antenna, ventral (♂); f, second antenna, anterior (♂); g, labrum with paragnaths indicated by broken lines, ventral (♂); h, mandible, anterior (♂); i, first maxilla, posterior (♂); j, second maxilla, posterior (♂).

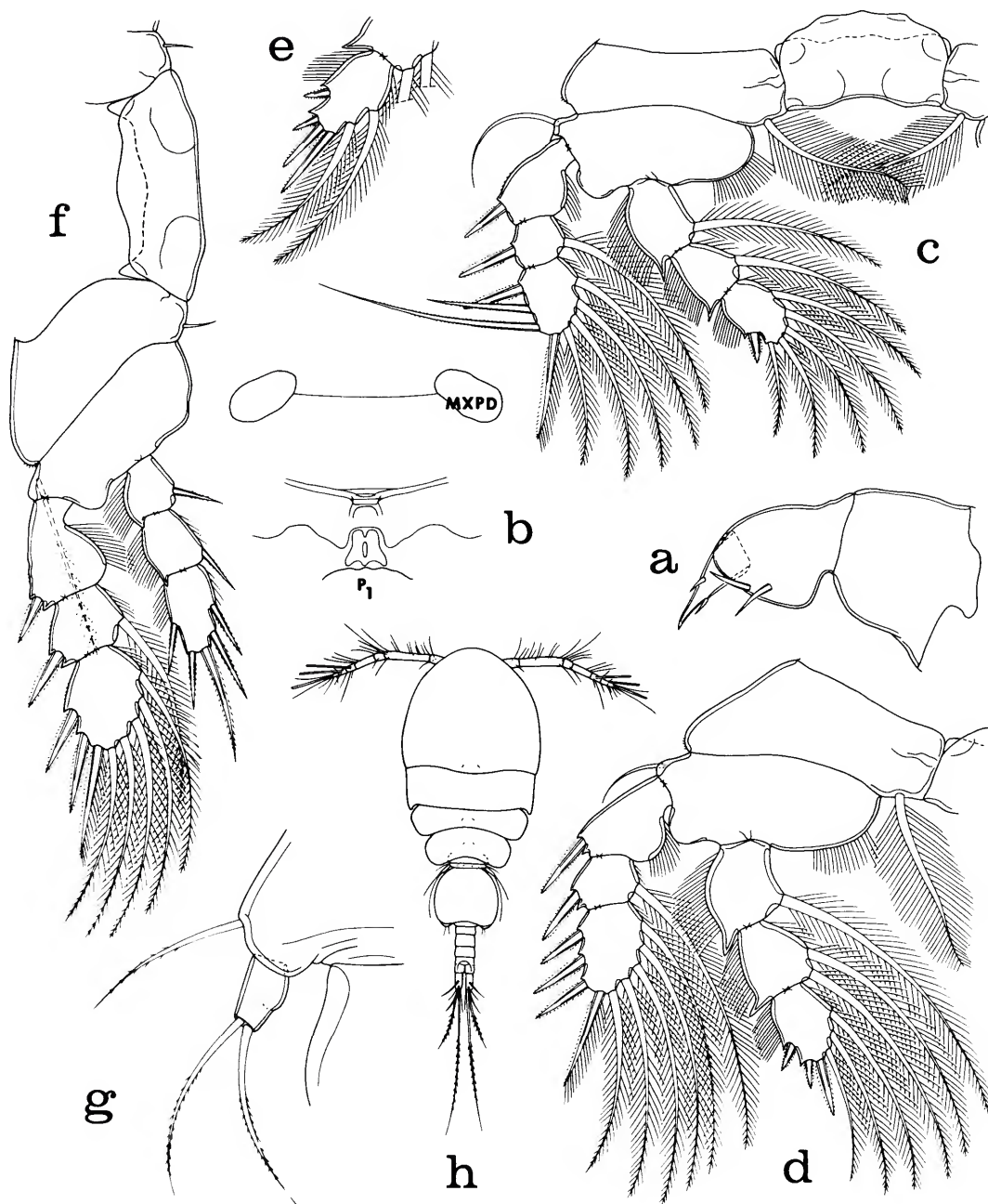


FIGURE 22.—*Scambicornus calcaratus*, new species, Female: *a*, maxilliped, antero-inner ($\times 2$); *b*, area between maxillipeds and leg 1, ventral ($\times 2$); *c*, leg 1 and intercoxal plate, anterior ($\times 10$); *d*, leg 2, anterior ($\times 10$); *e*, third segment of endopod of leg 3, anterior ($\times 10$); *f*, leg 4 and intercoxal plate, anterior ($\times 10$); *g*, leg 5, dorsal ($\times 10$). Male: *h*, dorsal ($\times 1$).

Body surface with a few minute hairs (sensilla) as in Figure 21a.

Egg sac (Figure 21a) elongated, 800×280 , with numerous eggs, each about 83 in diameter.

Rostral area as in *S. sewelli*.

First antenna (Figure 21e) 385 long. Lengths of its seven segments: 39 (60 along the anterior edge), 143, 23, 68, 39, 26, and 26 respectively. Formula for the armature as in *S. tylotus* and *S. sewelli*. Setae naked except for two on the last segment which are feathered.

Second antenna (Figure 21f) 4-segmented, 300 long including the claw. Armature as in the two preceding species. Claw 83 along its axis. Third segment with a few small inner spinules, but the fourth segment without fine ornamentation.

Labrum (Figure 21g) with two rather elongated posteroventral lobes.

Mandible (Figure 21h) differing from other species only in minor details. Paragnath (Figure 21g) a small lobe with a few hairlike spinules. First maxilla (Figure 21i) in general form resembling the two preceding species. Second maxilla (Figure 21j) armed basically as in *S. tylotus* and *S. sewelli*. Lash with two large proximal teeth and only 3 or 4 smaller distal spines. Maxilliped (Figure 22a) similar to that of *S. tylotus*, but the second segment without fine ornamentation.

Area between the maxillipeds and the first pair of legs (Figure 22b) very slightly protuberant.

Legs 1-4 (Figure 22c-f) segmented and armed as in the two previous species. Leg 1 with the second and third outer spines on the third exopod segment setiform and unusually elongated, the second spine 50 long and the third 105; exopod 105. Outer seta on the basis of legs 3 and 4 not greatly elongated, in the third leg 96 long and the exopod 148, in the fourth leg 99 and the exopod 138. Leg 4 with the inner coxal seta 16 and naked. Endopod 112, with the inner element on segments 1 and 2 a slender spine 27 long. Five spines on the third segment from outer to inner 31, 38, 68, 47, and 30.

Leg 5 (Figure 22g) with a small unornamented free segment 29×18 , ratio 1.61:1. Two terminal setae 83 and 78, both finely barbed. Seta on the body near the insertion of the free segment 73 and lightly feathered.

Leg 6 probably represented by the two setae on the genital area (Figure 21c).

Color in life in transmitted light similar to that of the two preceding species.

MALE.—Body (Figure 22h) with a slender prosome. Length 1.13 mm (1.21–1.39 mm) and the greatest width 0.62 mm (0.58–0.64 mm), based on 10 specimens. Ratio of the length to the width of the prosome 1.57:1. Ratio of the length of the prosome to that of the urosome 1.60:1.

Segment of leg 5 (Figure 23a) 39×117 . No ventral intersegmental sclerite. Genital segment 174×178 . Four postgenital segments from anterior to posterior 36×70 , 44×70 , 39×69 , and 55×65 .

Caudal ramus (Figure 23a) resembling that of the female, but shorter, 62×29 , or 2.14 times longer than wide.

Body surface ornamented with small hairs as in the female.

Rostral area and first antenna like those of the female.

Second antenna (Figure 23b) similar to that of the female, but two groups of small bosses added on the inner surface of the second segment.

Labrum, mandible, paragnath, first maxilla, and second maxilla like those of the female. Maxilliped (Figure 23c) long and slender. First segment unarmed. Second segment with two short naked inner setae, a large postero-inner patch of spines, and many small bosses along its outer surface. Small third segment obscure and unarmed. Claw 213 along its axis (including the minute terminal lamella) with a weak line of subdivision about midway and bearing proximally two very unequal setae.

Legs 1-3 segmented as in *S. tylotus* and *S. sewelli*, with the spine and setal formula as in those species. Leg 1 (Figure 23d) with the second and third outer spines on the third exopod segment elongated, 47 and 73 respectively; exopod 112. Endopod 156 long. Third segment of the exopod of leg 2 (Figure 23e) with the third outer spine and the terminal spine 45 and 90 respectively (in the female these spines 34 and 52). Endopod of leg 2 (Figure 23f) 143 long. Seta on the basis of legs 3 and 4 relatively short, 65 long in leg 4 where the endopod is 130. Leg 4 exopod as in the female. Leg 4 endopod (Figure 23g) unusual in being 2-segmented, the second and third segments fused, with their original junction indicated only by breaks in the sclerotization.

Leg 5 (Figure 23h) with a small slender unorna-

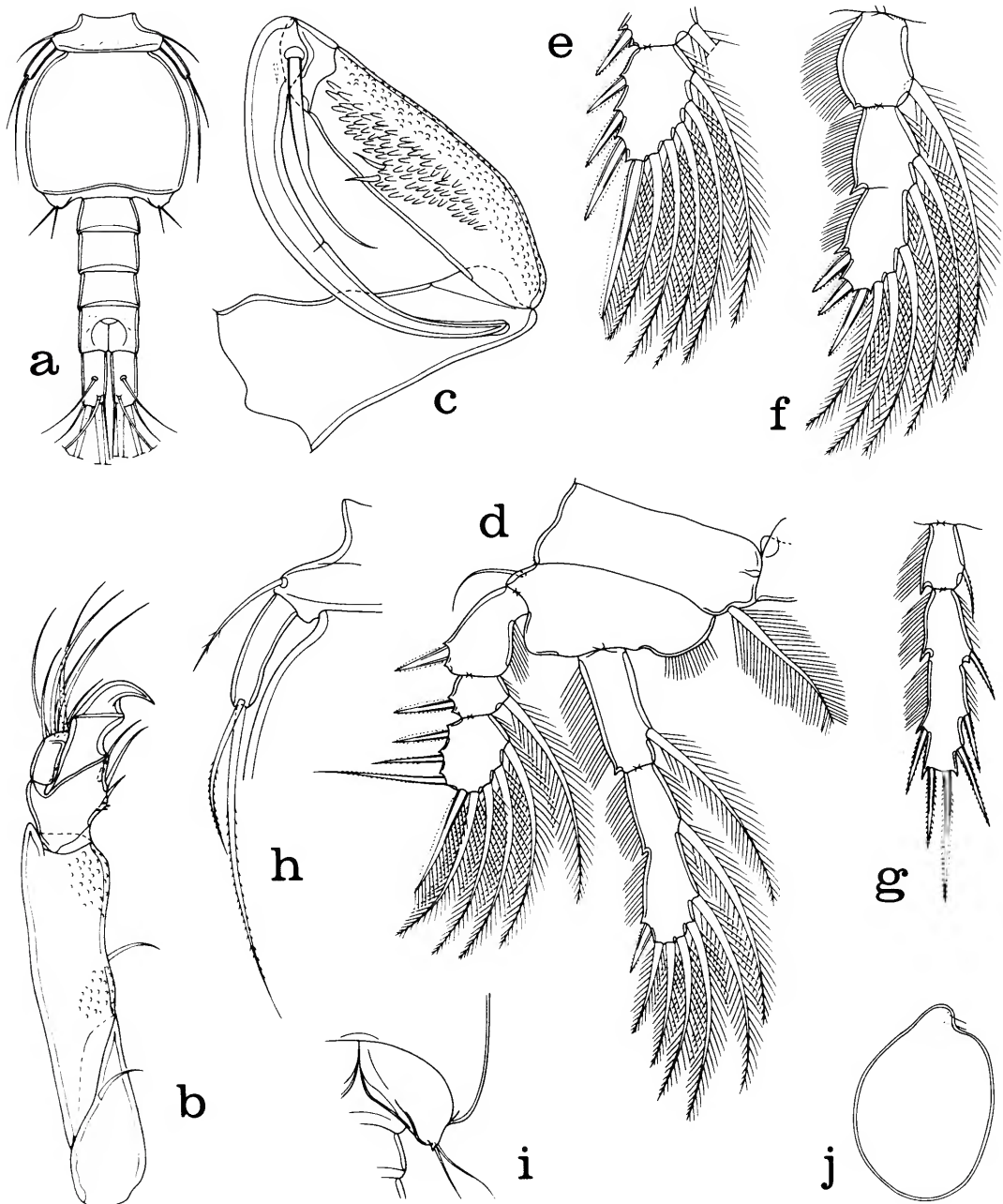


FIGURE 23.—*Scambicornus calcaratus*, new species. Male: *a*, urosome, dorsal (A); *b*, second antenna, anterior (H); *c*, maxilliped, posterior (H); *d*, leg 1, anterior (H); *e*, third segment of endopod of leg 2, anterior (H); *f*, endopod of leg 2, anterior (H); *g*, endopod of leg 4, anterior (H); *h*, leg 5, dorsal (B); *i*, leg 6, ventral (C); *j*, spermatophore, ventral (C).

mented free segment 44×13 . Two terminal setae unequal, 68 and 127. Seta on the body near the insertion of the free segment 47 long.

Leg 6 (Figure 23i) a posteroventral flap on the genital segment bearing two naked setae 50 and 65, and a small spiniform process.

Spermatophore (Figure 23j) oval, 155×107 , not including the short neck.

Color as in the previous species.

ETYMOLOGY.—The specific name *calcaratus*, derived from the Latin *calcar* (a spur), alludes to the two long spurlike elements on the third segment of the exopod of leg 1.

New Records and Hosts

(New hosts are preceded by an asterisk)

Scambicornus campanulipes
(Humes and Cressey, 1961)

SPECIMENS COLLECTED.—From **Actinopyga plebeja* (Selenka): 1 ♀ from one host, in 2 m, northwestern side of Isle Maitre, near Noumea, $22^{\circ}20'05''S$, $166^{\circ}24'05''E$, 11 June 1971.

From *Actinopyga lecanora* (Jaeger): 1 ♀ from one host, in 2 m, north of Isle Maitre, $22^{\circ}19'30''S$, $166^{\circ}24'35''E$, 13 July 1971.

This species has been recorded from Madagascar (Humes and Stock, 1973) and Mauritius (Humes, 1975).

Scambicornus idoneus
(Humes and Cressey, 1961)

SPECIMENS COLLECTED.—From *Holothuria leucospilota* (Brandt). 115 ♀♀, 107 ♂♂, and 32 copepodids from 5 hosts, in 1.5–2 m, Rocher à la Voile, Noumea, $22^{\circ}18'24''S$, $166^{\circ}25'50''E$, 2 June 1971.

From *Halodeima atra* (Jaeger): 18 ♀♀, 13 ♂♂ plus 9 pairs in amplexus from 8 hosts, in 1.5 m, Rocher à la Voile, 2 June 1971; 16 ♀♀, 16 ♂♂ plus 1 pair in amplexus from 10 hosts, intertidal, Ricaudy Reef, 9 June; 3 ♀♀, 4 ♂♂ from 31 hosts, in 4–5 m, reef between Isle Ndié and Mt. Kumuru, northwest of Noumea, 29 July.

From *Actinopyga echinites* (Jaeger): 1 ♀, 1 ♂ from 12 hosts, in 2 m, Rocher à la Voile, Noumea, 10 June 1971.

From *Microthele nobilis* (Selenka): 23 ♀♀, 13 ♂♂ from two hosts, in 0.5 m, Goro, southeastern

New Caledonia, $22^{\circ}18'00''S$, $167^{\circ}02'00''E$, 6 August 1971; 4 ♂♂ from two hosts, in 2 m, west of Isle Mando, near Noumea, $22^{\circ}18'59''S$, $166^{\circ}09'30''E$, 3 July.

This species is known from Madagascar (Humes and Stock, 1973) and Mauritius (Humes, 1975).

Scambicornus modestus
(Humes and Cressey, 1961)

SPECIMENS COLLECTED.—From *Stichopus chloronotus* (Brandt): 8 ♀♀, 11 ♂♂, and 9 copepodids plus 3 pairs in amplexus from 8 hosts, in 2 m, Rocher à la Voile, Noumea, $22^{\circ}18'24''S$, $166^{\circ}25'50''E$, 2 June 1971; 7 ♀♀, 9 ♂♂, and 4 copepodids plus 6 pairs in amplexus from 8 hosts, in 1–2 m, Rocher à la Voile, 3 June; 54 ♀♀, 28 ♂♂, and 11 copepodids plus 18 pairs in amplexus from 15 hosts, in 2 m, Rocher à la Voile, 10 June.

From *Stichopus variegatus* Semper: 3 ♂♂ from 1 host, in 4 m, reef between Isle Ndié and Mt. Kumuru, northwest of Noumea, $22^{\circ}13'24''S$, $166^{\circ}24'11''E$, 29 July 1971; 1 ♀, 1 ♂, and 3 copepodids from 1 host, in 1 m, eastern side of Isle Maitre, near Noumea, $22^{\circ}20'35''S$, $166^{\circ}25'45''E$, 31 July; 1 ♀ plus 1 pair in amplexus from 2 hosts, in 2 m, west of Isle Ngou, near Noumea, $22^{\circ}13'44''S$, $166^{\circ}23'01''E$, 3 August.

Scambicornus modestus has thus far been known only from Madagascar (Humes and Stock, 1973).

Scambicornus poculiferus
(Humes and Cressey, 1961)

SPECIMENS COLLECTED.—From *Synapta maculata* (Chamisso and Eysenhardt): 3 ♀♀, 2 ♂♂ from 1 host, in 10 cm, reef 5 kms south of Yaté, southeastern New Caledonia, $22^{\circ}11'00''S$, $166^{\circ}59'00''E$, 23 June 1971; 29 ♀♀, 25 ♂♂, and 23 copepodids from 2 hosts, in 0.5 m, 1 km offshore from Goro village, southeastern New Caledonia, $22^{\circ}18'00''S$, $167^{\circ}02'00''E$, 6 August.

This species is known only from Madagascar (Humes and Stock, 1973).

Scambicornus subtilis
(Humes and Cressey, 1961)

SPECIMENS COLLECTED.—From *Halodeima edulis* (Lesson): 4 ♀♀, 9 ♂♂ from 50 hosts, in 3 m, near

reef between Isle Ndié and Mt. Kumuru, northwest of Noumea, 22°13'40"S, 166°24'18"E, 9 July 1971; 3 ♀♀, 6 ♂♂ from 1 host, intertidal, Ricaudy Reef, Noumea, 22°19'00"S, 166°26'44"E, 9 June; 6 ♂♂ from 2 hosts, in 2 m, Rocher à la Voile, Noumea, 22°18'24"S, 166°25'50"E, 10 June; 2 ♀♀, 13 ♂♂ from 1 host, in 2 m, western side of Isle Maître, near Noumea, 22°20'05"S, 166°24'05"E, 11 June; 5 ♀♀ from 6 hosts, in 1 m, western side of Isle Maître, near Noumea, 20 June; 1 ♀, 2 ♂♂ from 1 host, intertidal, southwestern side of Port Ngea, 2 kms north of Ricaudy Reef, near Noumea, 22°18'18"S, 166°26'47"E, 8 July.

From **Halodeima coluber* (Semper): 1 ♀, 2 ♂♂ from 6 hosts, intertidal, eastern side of Isle Maître, 22°20'35"S, 166°25'45"E, 16 July 1971; 2 ♀♀ from 6 hosts, intertidal, eastern side of Isle Maître, 31 July.

From **Halodeima atra* (Jaeger): 12 ♀♀, 3 ♂♂ from 8 hosts, in 1.5 m, Rocher à la Voile, Noumea, 2 July 1971; 8 ♀♀, 6 ♂♂ from 10 hosts, intertidal, Ricaudy Reef, 9 June; 1 ♀, 2 ♂♂ from 31 hosts, in 4–5 m, reef between Isle Ndié and Mt. Kumuru, northwest of Noumea, 29 July.

From *Holothuria curiosa* Ludwig: 2 ♀♀ from 1 host, in 0.5 m, Ricaudy Reef, 5 June 1971; 5 ♀♀, 14 ♂♂ plus 1 pair in amplexus from one host, in 1 m, Ricaudy Reef, 9 June; 4 ♀♀, 3 ♂♂ from 1 host, intertidal, eastern end of Isle Maître, near Noumea, 16 July; 4 ♀♀ from 1 host, intertidal pool, eastern side of Isle Maître, 16 July.

From **Actinopyga echinites* (Jaeger): 2 ♀♀ from 2 hosts, intertidal, Ricaudy Reef, 9 June 1971.

From **Microthele nobilis* (Selenka): 2 ♀♀, 5 ♂♂ from two hosts, in 0.5 m, Goro, southeastern New Caledonia, 22°18'00"S, 167°02'00"E, 6 August 1971; 2 ♀♀ from 2 hosts, in 2 m, west of Isle Mando, near Noumea, 22°18'59"S, 166°09'30"E, 3 July.

Until now *S. subtilis* has been known only from Madagascar (Humes and Stock, 1973).

Scambicornus tuberatus
(Humes and Cressey, 1961)

SPECIMENS COLLECTED.—From *Bohadschia vitiensis* (Semper): 12 ♀♀, 4 ♂♂ from 1 host, in 2–3 m, Anse Vata, Noumea, 22°18'27"S, 166°26'30"E, 4 June 1971; 44 ♀♀, 35 ♂♂, and 2 copepodids from 1 host, Anse Vata, 7 June.

From **Bohadschia argus* (Jaeger): 23 ♀♀, 85 ♂♂ from 1 host, in 2 m, western side of Isle Maître, near Noumea, 22°20'05"S, 166°24'05"E, 11 June 1971; 52 ♀♀, 76 ♂♂ from 2 hosts, in 4 m, west of Isle Ngou, near Noumea, 22°13'44"S, 166°23'01"E, 3 August.

This species has previously been known only from Madagascar (Humes and Stock, 1973).

**Notes on *Scambicornus brachysetosus*
Reddiah, 1968**

FIGURE 24

The description and figures of this small copepod found on *Holothuria* (= *Halodeima*) *atra* Jaeger at Kilakarai (Ramnad District, Madras State, India) lack certain details essential for the correct recognition of the species. The following notes are based on two paratypes, one female and one male, in the collection of the Zoological Survey of India, Calcutta, generously sent to me by Shri G. Ramakrishna.

FEMALE.—Length 0.63 mm, greatest width 0.30 mm. Caudal ramus (Figure 24a) 38 × 18, 2.1 times longer than wide. First antenna 159 long. Second antenna (Figure 24b) 101 long, the claw about 22 along its axis. Labrum, paragnath, and first maxilla as in Figure 24c. Mandible, second maxilla, and maxilliped as in Figure 24d,e,f respectively.

Endopod of leg 4 (Figure 24g) 64 long, with both first and second segments having a spiniform element instead of a true seta. Five spines on the third segment from outer to inner 16.5, 28.5, 59, 36, and 17.5.

Leg 5 (Figure 24a) with the free segment 27.5 × 14, ornamented distally with a few minute spinules. Outer terminal seta slender and 42 long, inner terminal element stout and spiniform, 45 long; both elements smooth. Dorsal seta 30 long.

MALE.—Length 0.43 mm, greatest width 0.20 mm. Caudal ramus (Figure 24h) smaller than in the female, 19 × 13, 1.46 times longer than wide. Second antenna (Figure 24i) showing sexual dimorphism in the presence of rows of small spines on the second and third segments. Maxilliped (Figure 24j) with the concave surface of the claw finely denticulated and having a distinct proximally directed spiniform process near the midregion (Figure 24k). Claw 70 along its axis.

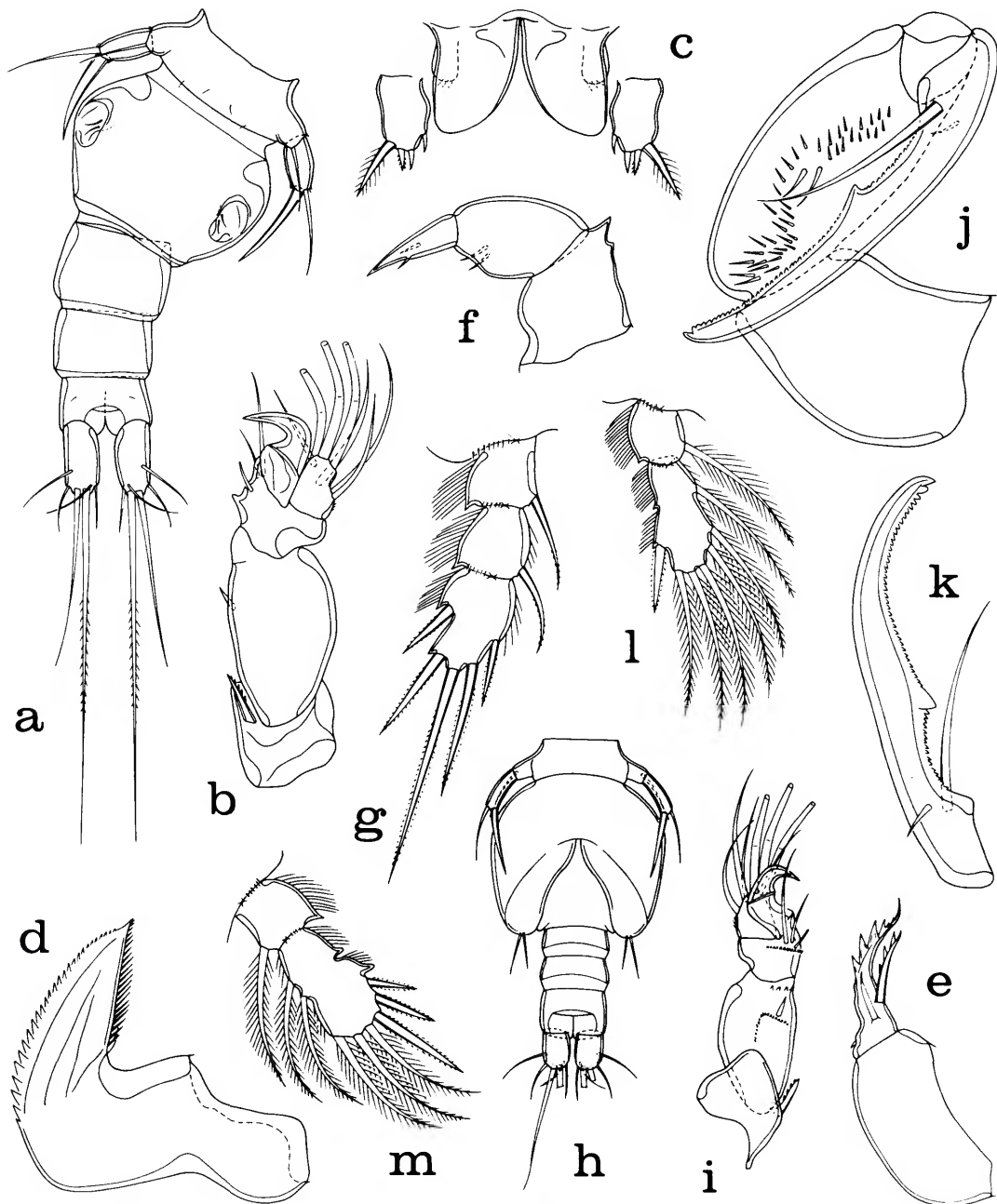


FIGURE 24.—*Scambicornus brachysetosus* Reddiah, 1968, paratypes. Female: *a*, urosome, dorsal (H); *b*, second antenna, posterior (D); *c*, labrum, paragnaths, and first maxillae, ventral (C); *d*, mandible, posterior (C); *e*, second maxilla, posterior (D); *f*, maxilliped, postero-outer (D); *g*, endopod of leg 4, anterior (D). Male: *h*, urosome, ventral (H); *i*, second antenna, anterior (D); *j*, maxilliped, posterior (C); *k*, claw of maxilliped, anterior (C); *l*, endopod of leg 1, anterior (D); *m*, endopod of leg 2, anterior (D).

Endopod of leg 1 (Figure 24l) 2-segmented and only a little shorter (45) than the exopod (50). Endopod of leg 2 (Figure 24m) also 2-segmented and similarly a little shorter (46) than the exopod (50).

Leg 5 (Figure 24h) with the free segment 22×7.5 .

List of New Caledonian Holothurians and Their Associated Copepods

- Actinopyga echinites* (Jaeger)
Chauliobion bulbosum, new genus, new species
Scambicornus sewelli, new species
Scambicornus calcaratus, new species
Scambicornus subtilis (Humes and Cressey, 1961)
Scambicornus idoneus (Humes and Cressey, 1961)
- Actinopyga lecanora* (Jaeger)
Scambicornus calcaratus, new species
Scambicornus campanulipes (Humes and Cressey, 1961)
- Actinopyga miliaris* (Quoy and Gaimard)
Scambicornus calcaratus, new species
- Actinopyga obesa palauensis* Panning
Chauliobion bulbosum, new genus, new species
Scambicornus calcaratus, new species
- Actinopyga plebeja* (Selenka)
Scambicornus calcaratus, new species
Scambicornus campanulipes (Humes and Cressey, 1961)
- Actinopyga serratidens* Pearson
Scambicornus calcaratus, new species
- Bohadschia argus* (Jaeger)
Scambicornus tylotus, new species
Scambicornus tuberatus (Humes and Cressey, 1961)
- Bohadschia vitiensis* (Semper)
Scambicornus tuberatus (Humes and Cressey, 1961)
- Halodeima atra* (Jaeger)
Chauliobion halodeimatis, new genus, new species
Scambicornus sewelli, new species
Scambicornus subtilis (Humes and Cressey, 1961)
Scambicornus idoneus (Humes and Cressey, 1961)
- Halodeima coluber* (Semper)
Scambicornus sewelli, new species
Scambicornus subtilis (Humes and Cressey, 1961)
- Halodeima edulis* (Lesson)
Scambicornus sewelli, new species
Scambicornus subtilis (Humes and Cressey, 1961)
- Holothuria curiosa* Ludwig
Scambicornus sewelli, new species
Scambicornus subtilis (Humes and Cressey, 1961)
- Holothuria leucospilota* (Brandt)
Scambicornus idoneus (Humes and Cressey, 1961)
- Microthele nobilis* (Selenka)
Nanaspis mixta, new species
Scambicornus sewelli, new species
Scambicornus subtilis (Humes and Cressey, 1961)
Scambicornus idoneus (Humes and Cressey, 1961)
- Stichopus chloronotus* (Brandt)
Scambicornus modestus (Humes and Cressey, 1961)
- Stichopus variegatus* Semper
Scambicornus modestus (Humes and Cressey, 1961)
- Synapta maculata* (Chamisso and Eysenhardt)
Scambicornus poculiferus (Humes and Cressey, 1961)

Literature Cited

- Bocquet, C., J. H. Stock, and G. Kleeton
 1963. Copépodes parasites d'invertébrés des côtes de France, X: Cyclopoïdes poecilostomes associés aux annélides polychètes, dans la région de Roscoff. *Archives de Zoologie Expérimentale et Générale*, 102 (notes et revue, number 1):20-40.
- Bresciani, J., and J. Lützen
 1962. Parasitic Copepods from the West Coast of Sweden Including Some New or Little Known Species. *Videnskabelige Meddelelser fra Dansk Naturhistorisk Forening i København*, 124:367-408.
- Gurney, R.
 1927. Zoological Results of the Cambridge Expedition to the Suez Canal, 1924, XXXIII: Report on the Crustacea: Copepoda (Littoral and Semi-Parasitic). *Transactions of the Zoological Society of London*, 22 (4):451-477.
- Heegaard, P.
 1944. A New Copepod (*Scambicornus hamatus*) Parasitic on a Japanese Holothurian. *Videnskabelige Meddelelser fra Dansk Naturhistorisk Forening i København*, 107:359-366.
- Humes, A. G.
 1967. A New Species of *Scambicornus* (Copepoda, Cyclopoïda, Lichomolgidae) Associated with a Holothurian in Madagascar, with Notes on Several Previously Described Species. *Beaufortia*, 14 (173): 135-155.
 1973. *Nanaspis* (Copepoda: Cyclopoïda) Parasitic on the Holothurian *Theleota ananas* (Jaeger) at Eniwetok Atoll. *Journal of Parasitology*, 59 (2):384-395.
 1975. Cyclopoïd Copepods Associated with Marine Invertebrates in Mauritius. *Zoological Journal of the Linnean Society of London*, 56(3).
- Humes, A. G., and R. F. Cressey
 1959. A New Family and Genus of Cyclopoïd Copepods Parasitic on a Holothurian. *Journal of Parasitology*, 45:209-216.
 1961. Copépodes cyclopoïdes du Genre *Preherrmannella* Parasites d'Holothuries et d'un Oursin à Madagascar. *Mémoires de l'Institut Scientifique de Madagascar*, 1959, series F, 3:25-65.
- Humes, A. G., and J.-S. Ho
 1969. Cyclopoïd Copepods Parasitic in Holothurians in Madagascar. *Journal of Parasitology*, 55:877-894.

Humes, A. G., and J. H. Stock

1973. A Revision of the Family Lichomolgidae Kossmann, 1877, Cyclopoid Copepods Mainly Associated with Marine Invertebrates. *Smithsonian Contributions to Zoology*, 127: v+368.

Nicholls, A. G.

1944. Littoral Copepods from South Australia (II): Calanoida, Cyclopoida, Notodelphyoida, Monstrilloida and Caligoida. *Records of the South Australian Museum*, 8 (1):1-62.

Reddiah, K.

1968. *Scambicornus brachysetosus* n. sp. (Copepoda: Lichomolgidae) from a Holothurian in the Gulf of Mannar. *Journal of the Marine Biological Association of India*, 1967, 9 (1):126-131.

Sars, G. O.

1918. *An Account of the Crustacea of Norway with Short Descriptions and Figures of All the Species*, volume VI: Copepoda, Cyclopoida, parts XIII, XIV, Lichomolgidae (concluded), Oncaeidae, Corycaeidae, Ergasilidae, Clausiidae, Eunicicolidae, Supplement, pages 173-225. Bergen.

Scott, T.

1903. Notes on Some Copepoda from the Arctic Seas Collected in 1890 by the Rev. Canon A. M. Norman, F.R.S. In A. M. Norman, Notes on the Natural History of East Finmark. *Annals and Magazine of Natural History*, series 7, 11 (61):4-32.

Sewell, R. B. S.

1949. The Littoral and Semi-Parasitic Cyclopoida, the Monstrilloida, and Notodelphyoida. In *John Murray Expedition, 1933-34, Scientific Reports*, 9 (2): 17-199.

Stock, J. H.

1964. On *Scambicornus* Heegaard, 1944, a Senior Synonym of *Preherrmannella* Seymour Sewell, 1949 (Copepoda, Cyclopoida). *Beaufortia*, 10 (123): 183-192.

1968. Copepoda Endoparasitic of Tropical Holothurians. *Bulletin Zoologisch Museum, Universiteit van Amsterdam*, 1:89-105.

Stock, J. H., and G. Kleeton

1963. Copépodes ectoassociés aux invertébrés des côtes du Roussillon. *Vie et Milieu*, 13 (4):681-702.

Stock, J. H., A. G. Humes, and R. U. Gooding

1962. Copepoda Associated with West Indian Invertebrates, I: The Genus *Nanaspis* (Siphonostoma, Nanaspidae). In *Studies on the Fauna of Curaçao and Other Caribbean Islands*, 13:1-20.

Thompson, I. C., and A. Scott

1903. Report on the Copepoda Collected by Professor Herdman, at Ceylon, in 1902. In *Report to the Government of Ceylon on the Pearl Oyster Fisheries of the Gulf of Manaar*, supplementary reports, 7:227-307.

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