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A new species of *Scambicornus* (Copepoda, Cyclopoida, Lichomolgidae) associated with a holothurian in Madagascar, with notes on several previously described species

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ABSTRACT

A new lichomolgid copepod, *Scambicornus lobulatus,* associated with a holothurian, *Bohadschia graeffei,* is described from the region of Nosy Bé, Madagascar. Certain previously described species of *Scambicornus* in that area are redescribed in part. New host records are: *S. campanulipes* from *Actinopyga lecanora* and *A. miliaris, S. idoneus* from *Argiodia nobilis* and *Holothuria scabra, S. modestus* from *Brandtothuria impatiens* and either *Microthele difficilis* or *Urodemas ehrenbergi,* and *S. tuberatus* from *Bohadschia marmorata.*

INTRODUCTION

Field investigations in 1955 resulted in the description of seven species of *Scambicornus* (= *Preherrmannella*) associated with nineteen holothurians (distributed in eight genera) and one echinoid at Nosy Bé, in northwestern Madagascar (Humes & Cressey, 1961). Later collections in 1960 and 1963-64 at Nosy Bé have produced the new species described below.

The copepods formerly placed in the genus *Preherrmannella* Sewell, 1949, must now be removed to *Scambicornus* Heegaard, 1944, since Stock (1964) has shown, after an examination of type specimens of *Scambicornus hamatus* Heegaard, 1944, that *Scambicornus* and *Preherrmannella* represent the same genus, with Heegaard's name having clear priority.

The holothurians examined in this study were isolated in sea water in plastic bags immediately after collection. Later a small amount of ethyl alcohol (about five per cent) was added, the holothurians thoroughly rinsed for several minutes, and the copepods then recovered by pouring the water through a fine net. With this technique there was little possibility of accidental contamination of the samples.

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All figures were 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, MX_2 = second maxilla, MXPD = maxilliped, and P_1 = leg 1.

ACKNOWLEDGEMENTS

The collections were made by the author, during four months in 1960 while a member of an expedition sent to Madagascar by the Academy of Natural Sciences of Philadelphia, and during eighteen months in 1963-64 while participating in the U.S. Program in Biology of the International Indian Ocean Expedition.

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I thank Dr. H. Barraclough Fell and Mr. James F. Clark, of the Museum of Comparative Zoology, Harvard University, for the identifications of the holothurians collected in 1963-64 and Dr. Elisabeth Deichmann, also of the Museum of Comparative Zoology, for the determination of those collected in 1960. The field work was aided in many ways by the staff of the Centre d'Océanographie et des Pêches at Nosy Bé.

Scambicornus lobulatus n. sp. Figs. 1—35.

Type material. — 29 ♀♀, 49 ♂♂, and 27 copepodids washed from the body surface of 10 holothurians, *Bohadschia graeffei* (Semper), in a depth of 2 m, Antsiabe, on the southern end of Nosy Komba, near Nosy Bé, Madagascar. (Seventeen of these males were in amplexus with adult females and five were in amplexus with apparently last copepodids.) Collected November 30, 1963. Holotype female, allotype, and 45 paratypes (18 ♀♀, 27 ♂♂) deposited in the Zoölogisch Museum, Amsterdam; 15 paratypes (6 ♀♀, 9 ♂♂) in the United States National Museum, Washington; and the remaining paratypes in the collection of the author.

Other specimens (all from *Bohadschia graeffei*). — 7 ♀♀, 13 ♂♂, and 1 copepodid from 1 host in 12 m, Ambatoloaka, Nosy Bé, August 17, 1960; 1 ♀ from 1 host in 1 m, Pte. Ambarionaomby, Nosy Komba, near Nosy Bé, August 18, 1960; 6 ♀♀ and 1 copepodid from 1 host in 2 m, Tany Kely, a small island to the south of Nosy Bé, August 26, 1960; 37 ♀♀, 25 ♂♂, and 6 copepodids from 4 hosts in 2 m, Pte. Ambarionaomby, October 2, 1960; 40 ♀♀, 20 ♂♂, and 2 copepodids from 21 hosts in 3 m, northern end of Nosy Sakatia, near Nosy Bé, October 8, 1960; 11 ♀♀ and 4 ♂♂ from 6 hosts in 2 m, southern end of Nosy Sakatia, October 23, 1960; 24 ♀♀, 11 ♂♂, and 1 copepodid from 2 hosts in 1 m, Tany Kely, July 9, 1963; and 12 ♀♀, 3 ♂♂, and 1 copepodid from 5 hosts in 2 m, Nosy N'Tangam, near Nosy Bé, August 8, 1963. (These collections include 60 pairs in amplexus.)

Female. — Body (fig. 1) with a moderately broadened prosome. Length (not including the setae on the caudal rami) 1.39 mm (1.34—1.44 mm) and greatest width 0.73 mm (0.68—0.79 mm), based on 10 specimens. Ratio of length to width of the prosome 1.27 : 1. Segment of leg 1 separated from the head by a dorsal furrow. Epimeral areas of the segments of legs 1 and 2 pointed posteriorly, those of the segment of leg 3 rounded, and those of the segment of leg 4 small and outlined as shown in the figure.

Segment of leg 5 (fig. 2) 117 × 203 μ. Between this segment and the genital segment a weakly developed ventral intersegmental sclerite. Genital segment wider than long, 161 × 237 μ, with posteriorly directed lateral wings. Areas of attachment of the egg sacs situated laterally at the tips of the wings, each area (fig. 3) bearing two naked setae 47 and 80 μ in length and a ventral row of

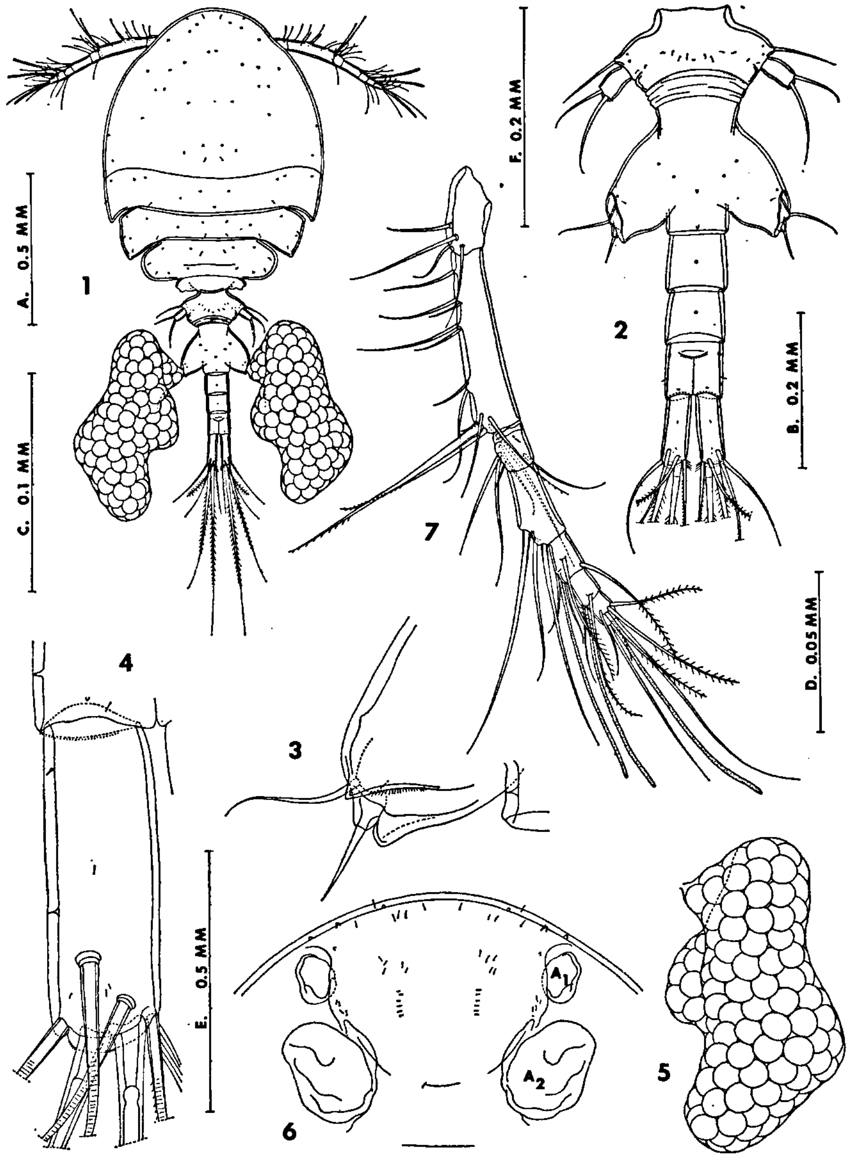

FIG. 1—7. *Scambicornus lobulatus* n. sp., female: 1, body, dorsal (A); 2, urosome, dorsal (B); 3, area of attachment of egg sac and leg 6, ventral (C); 4, caudal ramus, dorsal (D); 5, egg sac, ventral (E); 6, rostral area, ventral (B); 7, first antenna, ventral (F).

minute spinules. Three postgenital segments 70 × 81, 68 × 78, and 76 × 73 μ from anterior to posterior. Anal segment with a row of minute spinules along its posteroventral margin on each side.

Caudal ramus (fig. 4) moderately elongated, 99 × 34 μ in greatest dimensions, about 2.9 times longer than wide. Outer lateral seta (placed dorsally on the ramus) 185 μ and naked; outermost terminal seta 174 μ and naked; innermost terminal seta 156 μ with a short row of hairs proximally on the inner side and barbed along the outer side. Two long median terminal setae 715 μ (inner) and 451 μ (outer), both with lateral spinules in their midregions; these two setae inserted between dorsal (smooth) and ventral (with a row of minute spinules) flaps. Dorsal seta 143 μ with lateral hairs distally. A minute spinule basally near the outer margin of the ramus. A few hairs on the dorsal surface of the ramus.

Dorsal surface of the prosome and urosome with hairs and refractile points as in figs. 1 and 2; ventral surface of the urosome with a few hairs and refractile points. Ratio of the length of the prosome to that of the urosome 1.59 : 1.

Egg sac (figs. 1 and 5) of a peculiar lobulate form and rather flattened dorsoventrally, its greatest dimensions in dorsal aspect 605 × 352 μ. Large number of relatively small eggs (about 100), each about 55 μ in diameter. Actual attachment of the egg sac dorsal to the two setae.

Rostral area (fig. 6) not well defined posteroventrally.

First antenna (fig. 7) 7-segmented, 418 μ in length, with a sclerite on the ventral side of the third segment suggesting an intercalary segment. Lengths of the segments (measured along their posterior non-setiferous margins) 42 (70 μ along the anterior edge), 153, 34, 69, 36, 27, and 29 μ respectively. Formula for the armature: 4, 13 (5 + 8), 6, 3, 4 + 1 aesthete, 2 + 1 aesthete, and 7 + 1 aesthete. Several setae with lateral hairs as indicated in the figure.

Second antenna (fig. 8) 4-segmented, 290 μ long, including the claw. Armature: 1, 1, 3 + claw, and 7. All setae naked. Second segment 200 μ along its outer margin and 109 μ along its inner margin. Claw 90 μ along its axis. Last segment with five of the seven setae arising from a lobe which appears to be somewhat separated from the proximal part of the segment (fig. 9).

Labrum (fig. 10) with two posteroventral lobes, their distal margins hyaline.

Mandible (fig. 11) with the convex margin of the blade serrated, the concave margin with a proximal spiniform recurved process followed by a row of hairs. Paragnath (fig. 12) a small lobe with hairs distally. First maxilla (fig. 13) with three terminal setae and a prominent subterminal digitiform process hyaline in its distal two-thirds. Second maxilla (fig. 14) 2-segmented. First segment unarmed. Second segment having on its outer (ventral) margin a proximal setule, on its posterior surface a naked seta and a spinulose spine, and terminating in a lash with a few small spines on its posterior proximal area, a row of teeth along one edge, and a few short spinules on the opposite edge. Maxilliped (fig. 15) 3-segmented. First segment unarmed. Second segment with two naked setae, an inner oblique row of spinules, and two patches

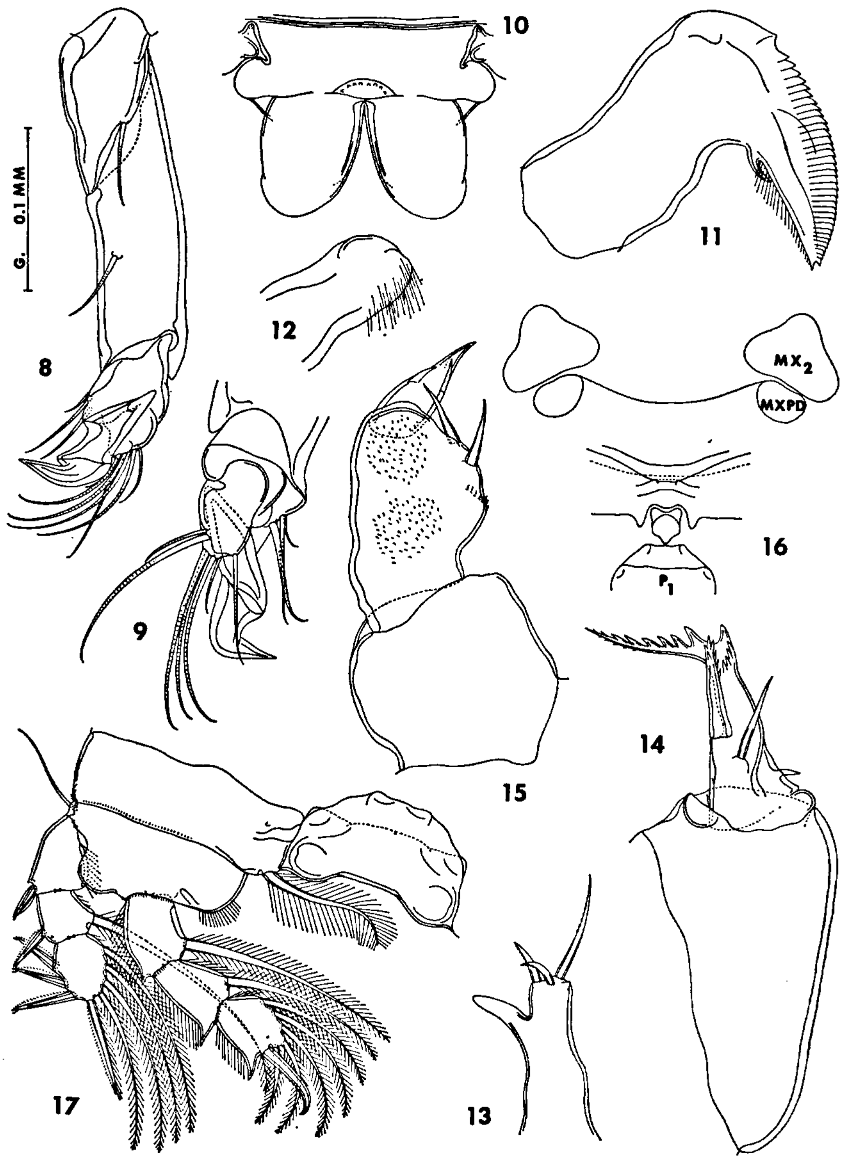

FIG. 8—17. *Scambicornus lobulatus* n. sp., female (continued): 8, second antenna, anterior (G); 9, segments 3 and 4 of second antenna, posterior (C); 10, labrum, ventral (C); 11, mandible, posterior (D); 12, paragnath, ventral (D); 13, first maxilla, posterior (D); 14, second maxilla, posterior (D); 15, maxilliped, antero-inner (D); 16, area between maxillipeds and first pair of legs, ventral (F); 17, leg 1, anterior (G).

of minute spinulus on its antero-inner surface. Third segment with two hyaline spinules and terminating in a spiniform process.

Area between the maxillipeds and the first pair of legs (fig. 16) not protuberant; a sclerotized line between the bases of the maxillipeds.

Legs 1—4 (figs. 17, 18, 19, and 20) with 3-segmented rami. Armature as follows (Roman numerals indicating spines, Arabic numerals setae):

P_1	protopod	0—1	1—0	exp	I—0	I—1	III, I, 4
				end	0—1	0—1	I, 5
P_2	protopod	0—1	1—0	exp	I—0	I—1	III, I, 5
				end	0—1	0—2	I, II, 3
P_3	protopod	0—1	1—0	exp	I—0	I—1	III, I, 5
				end	0—1	0—2	I, III, 2
P_4	protopod	0—1	1—0	exp	I—0	I—1	II, I, 5
				end	0—1	0—1	I, II, II

Inner seta on the coxa of legs 1—3 long and plumose, but in leg 4 short (15 μ) and naked. Outer seta on the basis moderately long in legs 1 and 2, but much longer (about 150 μ, or a little longer than the entire exopod) in legs 3 and 4. Outer spines on the exopod of leg 1 flagellated. Five spines on the last segment of the endopod of leg 4 measuring in length from outer to inner 27.5, 43, 70, 62, and 42 μ.

Leg 5 (fig. 21) with a relatively short free segment, 43 $\times$ 23 μ in greatest dimensions (in leg shown in figure) including the distal fringe, or 1.9 : 1. (Opposite leg in this individual 46 $\times$ 23 μ or 2 : 1, and both legs in another female 41 $\times$ 26 μ or 1.58 : 1). Outer terminal seta 75 μ long and naked; inner terminal seta, inserted dorsally to the serrated fringe, 104 μ with a few inner barbules. Seta on the body near the insertion of the free segment 78 μ and haired distally.

Leg 6 probably represented by the two setae near the attachment of each egg sac (see fig. 3).

Color in life in transmitted light translucent, eye red, egg sac grayish.

Male. — Body (fig. 22) resembling that of the female but the cephalosome a little more rounded anteriorly. Length (without the setae on the caudal rami) 0.71 mm (0.66—0.75 mm) and greatest width 0.33 mm (0.31—0.34 mm), based on 10 specimens. Ratio of length to width of the prosome 1.36 : 1.

Segment of leg 5 (fig. 23) 36 $\times$ 73 μ. Between this segment and the genital segment no ventral intersegmental sclerite. Genital segment 99 $\times$ 109 μ, slightly wider than long. Four postgenital segments 22 $\times$ 46, 23 $\times$ 45, 21 $\times$ 44, and 24 $\times$ 46 μ from anterior to posterior.

Caudal ramus (fig. 24) much shorter than in the female, 29 $\times$ 19 μ in greatest dimensions or 1.47 times longer than wide.

Dorsal surface of the body ornamented with hairs and refractile points as in figs. 22 and 23; ventral surface of the urosome with almost no ornamentation. Ratio of the length of the prosome to that of the urosome 1.83 : 1.

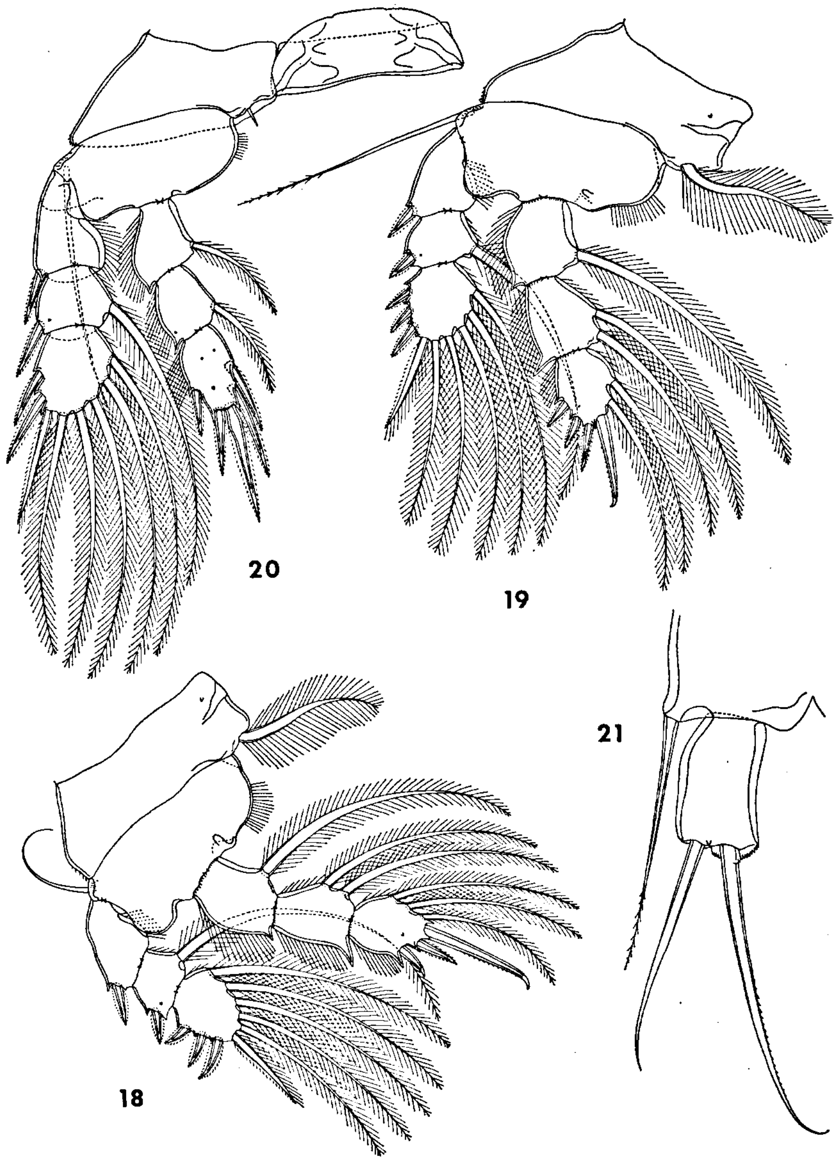

FIG. 18—21. *Scambicornus lobulatus* n. sp., female (continued): 18, leg 2, anterior (G); 19, leg 3, anterior (G); 20, leg 4, anterior (G); 21, leg 5, dorsal (D).

Rostral area as in the female.

First antenna resembling that of the female, but with a short aesthete added on segment 3 (fig. 25) and with lateral hairs on certain of the setae much less prominent. Second antenna (fig. 26) similar to that of the female, but with a patch of spinules on the inner surface of the second segment proximal to the seta and with all setae less obviously annulated.

Labrum resembling that of the female but the distal edges of the two lobes a little less hyaline.

Mandible, paragnath, and first maxilla like those in the female. Second maxilla (fig. 27) resembling that of the female but the lash has two large teeth followed by 5—6 slender teeth, and spinules are absent on the opposite side. Maxilliped (figs. 28 and 29) 4-segmented, assuming that the proximal part of the claw represents a fourth segment. First segment short and unarmed. Second segment elongated, its inner surface with two naked setae and an elongated patch of small spines, its posterior surface covered with minute spinules. Third segment short and unarmed. Claw 135 μ along its axis, recurved, bearing two unequal setae proximally, showing a slight indication of division about midway, and having terminally a few denticles and a conspicuous lamella (fig. 30) which fits like a hood over the end of the claw. (In amplexus the claws of the maxillipeds are held around the anterior part of the genital segment of the female, with their tips crossed below that segment.)

Exopods of legs 1—3 and both rami of leg 4 segmented and armed as in the female (except that the outer seta on the basis of legs 3 and 4 is shorter than in the female, being not much longer than on legs 1 and 2). Endopods of legs 1—3 with the same arrangement of spines and setae as in the female, but showing sexual dimorphism. (Spine and setal formula of the male is thus similar to that of the female, allowing for the fusion of the second and third segments of the endopods in legs 1 and 2.) Endopod of leg 1 (fig. 31) 2-segmented, with the last two segments completely fused. Outer spine 17 μ long and rather hyaline in its distal three-fourths. Outermost seta 39 μ, with hairs proximally but with barbules distally. Endopod of leg 2 (fig. 32) 2-segmented, with the last two segments fused, there being only an extremely indistinct suggestion of division, without a definite line. Outer spine 22 μ, two terminal spines 31 μ (outer) and 55 μ (inner), all three spines hyaline distally. Endopod of leg 3 (fig. 33) 3-segmented. Four spines, all hyaline distally with obtuse tips, from outer to inner 44, 20, 37, and 65 μ long. Outer spine and outermost of the three terminal spines recurved so that they oppose each other. Five spines on the last segment of the endopod of leg 4, from outer to inner, 18, 32, 52, 30, and 24 μ long, similar to those in the female.

Leg 5 (fig. 34) small, the free segment being only 16 $\times$ 10 μ and slightly tapered distally, with only a trace of a distal fringe. Outer terminal seta 44 μ and naked, inner terminal seta 55 μ with lateral barbules. Seta on the body near the insertion of the free segment 30 μ and haired.

Leg 6 (fig. 35) a posteroventral flap on the genital segment bearing two setae (both 33 μ long), one naked, the other with lateral hairs; ventrad to the

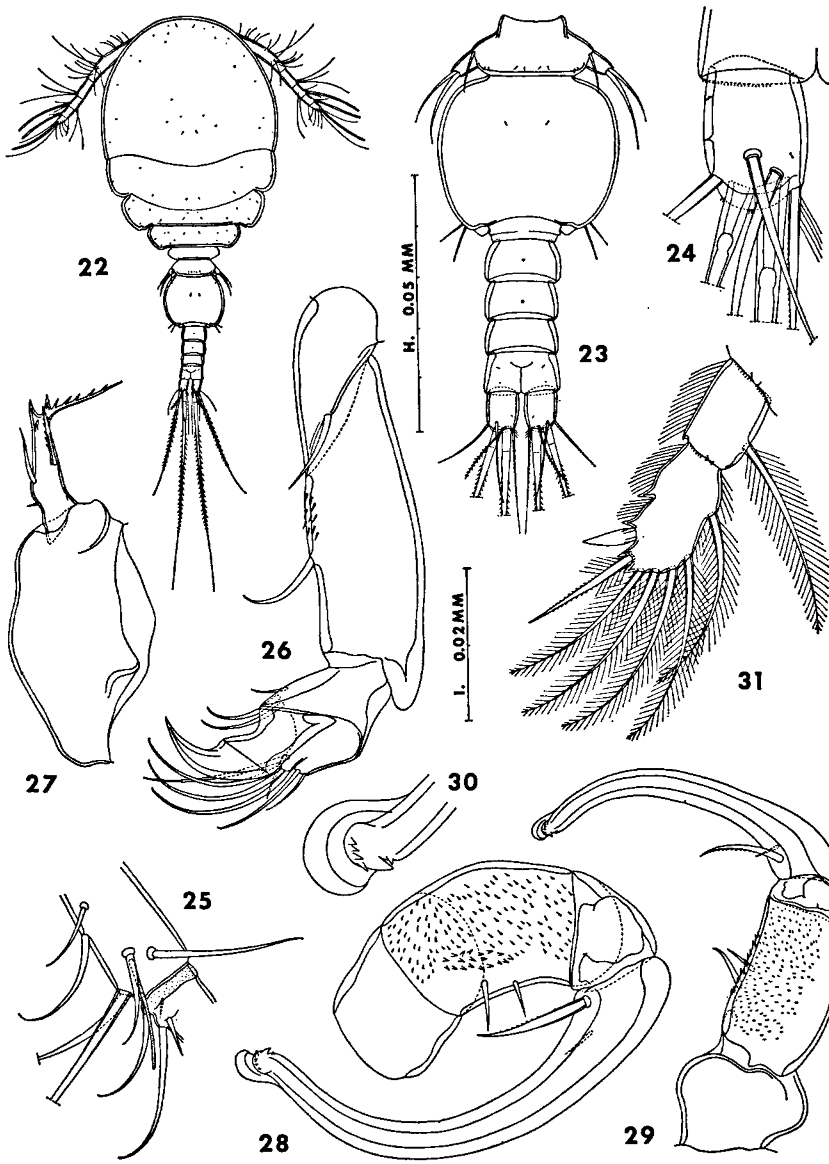

FIG. 22—31. *Scambicornus lobulatus* n. sp., male: 22, body, dorsal (E); 23, urosome, dorsal (G); 24, caudal ramus, dorsal (H); 25, distal part of segment 2 of first antenna, ventral (D); 26, second antenna, anterior (D); 27, second maxilla, posterior (D); 28, maxilliped, posteroventral (D); 29, maxilliped, posterior (C); 30, tip of claw of maxilliped, posterior (I); 31, endopod of leg 1, anterior (D).

insertions of these setae a pointed projection with an outer row of spinules.

Spermatophore not observed.

Color in life in transmitted light similar to that of the female.

(The specific name *lobulatus*, derived from Neo-Latin *lobulus* = provided with lobes, refers to the unusual form of the egg sacs.)

Comparison with related species. — Stock (1964) recognized twenty species in the genus *Scambicornus* which he devided into three groups according to the armature of segments 3 and 4 of the second antenna. (A similar division had been previously suggested by Bocquet, Stock & Kleeton, 1963). *Scambicornus lobulatus* differs from *S. propinquus* (Nicholls, 1944) and *S. armoricanus* (Bocquet, Stock & Kleeton, 1963), both members of Stock's group b, where there is a moderately prehensile element on segment 3 and where segment 4 is normally developed (i.e., elongated). The new species differs also from *S. finmarchicus* (T. Scott, 1903), *S. tenuicaudis* (Sars, 1918), and *S. brevicauda* (Sewell, 1949), all belonging to Stock's group c, where prehensile elements on segment 3 are absent or setiform and where segment 4 is normally developed.

The remaining fifteen species, representing Stock's group a, have a strongly prehensile and usually 2-segmented claw on segment 3 of the second antenna. Three of these, *S. poculiferus* (Humes & Cressey, 1961), *S. nicobaricus* (Sewell, 1949), and *S. changeuxi* (Stock & Kleeton, 1963) have the last segment of the second antenna elongated (longer than the third segment) and thus may be separated from *S. lobulatus*. Four of the remaining twelve species, *S. idoneus* (Humes & Cressey, 1961), *S. petiti* (Stock & Kleeton, 1963), *S. prehensilis* (Sars, 1918), and *S. serendibicus* (Thompson & A. Scott, 1903), have a ratio of length to width of the caudal ramus in the female of more than 4 : 1; and three species, *S. campanulipes* (Humes & Cressey, 1961), *S. subtilis* (Humes & Cressey, 1961), and *S. robustus* (Thompson & A. Scott, 1903), have this ratio only 2 : 1 or less, thus distinguishing them all from *S. lobulatus*.

The five remaining species show certain features by which each may be separated from *S. lobulatus*. In *S. tuberatus* (Humes & Cressey, 1961) the genital segment in the female has rounded lateral borders, lacking wings entirely, and the inner surface of the claw in the maxilliped of the male has a digitiform protuberance. In *S. hamatus* Heegaard, 1944, the genital segment of the female has the central part enlarged to form lateral lobes, the rostrum has a clearly defined point, and the second antenna is rather short and robust. In *S. modestus* (Humes & Cressey, 1961) the body is shorter, the female 1.18 mm (1.06—1.25 mm), the male 0.58 mm (0.54—0.61 mm), not overlapping the size range of *S. lobulatus*, and the inner surface of the second segment of the maxilliped of the male has rows of slender spines. In *S. subgrandis* (Humes & Cressey, 1961) the ratio of the length to width of the caudal ramus of the female is 2.5 : 1, and the spines on the second segment of the endopod of leg 2 in the male are acute and have proportional lengths (26, 46, and 28 μ) different from those in *S. lobulatus*.

The last of the twenty species, *S. adduensis* (Sewell, 1949), seems to be closest to *S. lobulatus*, resembling it in having a comparable size in both sexes,

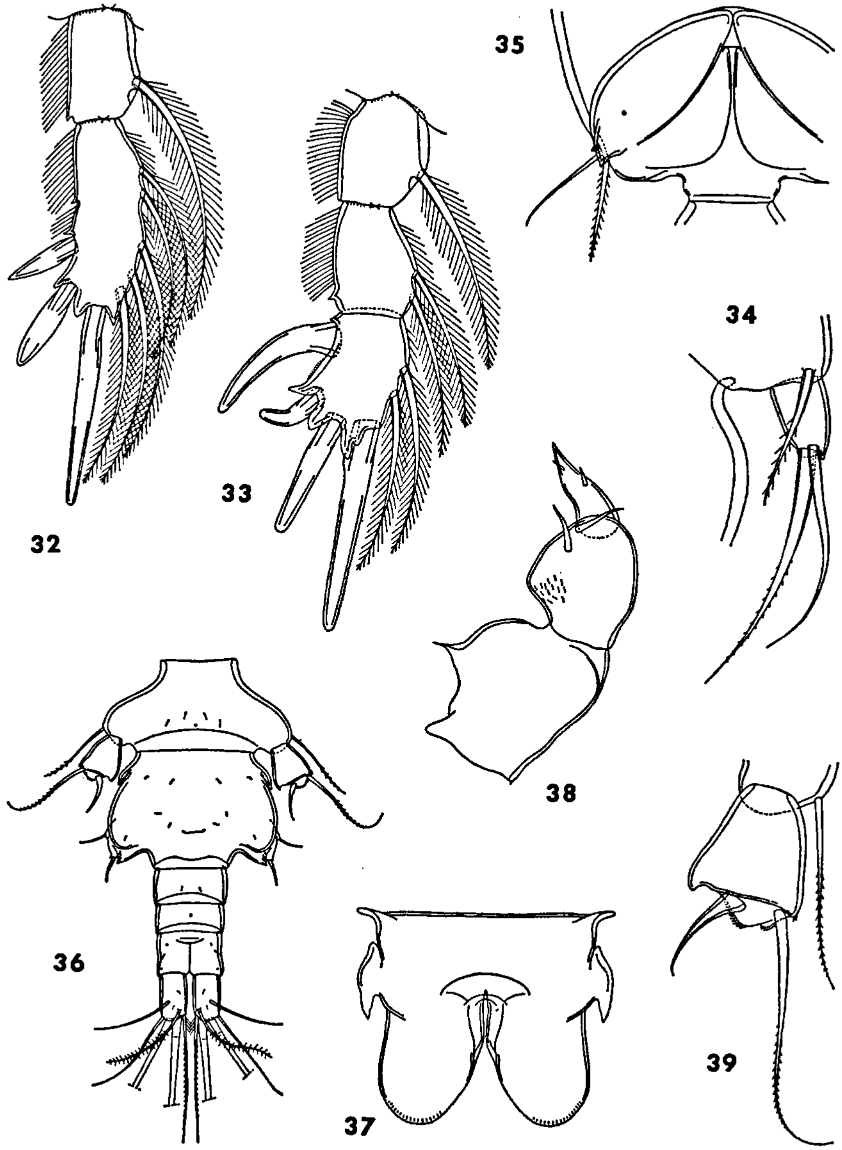

FIG. 32—35. *Scambicornus lobulatus* n. sp., male (continued): 32, endopod of leg 2, anterior (D); 33, endopod of leg 3, anterior (D); 34, leg 5, dorsal (H); 35, leg 6, ventral (D).

FIG. 36—39. *Scambicornus campanulipes* (Humes & Cressey, 1961), female: 36, urosome, dorsal (B); 37, labrum, ventral (C); 38, maxilliped, anterior (C); 39, leg 5, dorsal (C).

in the similar body proportions, and in the pronounced lateral wings on the genital segment in the female. In *S. adduensis*, however, the egg sac (not figured by Sewell) contains only about twelve eggs. (Sewell did not describe its shape, but presumably it is not strongly lobulated as in the new species; otherwise Sewell would surely have made mention of such an unusual form.) The shape of the genital segment of the female is somewhat different (compare fig. 2 with Sewell's text-fig. 20A). The mandible, as shown by Sewell in text fig. 20E, has a short terminal lash, quite unlike the new species.

In the male of *S. adduensis* the cephalosome is more pointed anteriorly than in *S. lobulatus*, the caudal ramus is about as long as broad (instead of 1.47 : 1 as in the new species), the terminal spine on the endopod of leg 2 is relatively shorter, and the outer spine on the last segment of the endopod of leg 3 is straight rather than recurved in opposition to the outermost terminal spine as in *S. lobulatus*.

Remarks on the nature of the egg sacs. — Most cyclopoid copepods have symmetrical egg sacs. In the eleven species of *Scambicornus* whose egg sacs are known, the sacs are elongated, have a regular form without lobes, and usually contain numerous eggs (in several species 75—100, but in *S. adduensis* only about 12). The lobulate form of the egg sacs in *S. lobulatus* is unusual, if not unique, in the suborder Poecilostoma.

The mechanism of the formation of such a lobulate egg sac is difficult to explain. Perhaps the eggs are extruded in spurts so that the cement substance, when hardening, fixes the eggs in lobes. In any case, the mechnism must be inherent and similar in all females of *S. lobulatus*, since all egg sacs produced have the same lobulate form.

Heegaard (1959) suggested that in *Caligus*, parasitic on fishes, the shape of the egg strings may be determined by the movements of the female and by the pressure (currents) of the water related to the movements of the fish host. In the case of *S. lobulatus*, however, the holothurian host is so sluggish that it does not seem possible that its body movements could create water currents rapid enough to influence the form of the egg sacs. Furthermore, other species of *Scambicornus* living on holothurians have regular egg sacs.

Gotto (1962), in an interesting discussion of egg number and ecology in parasitic copepods, made certain assumptions by way of explanation of large numbers of eggs in the egg sacs. He suggested that a high egg number might be related to: the host being sparsely distributed, somewhat inaccessible, or not obviously attractive from a distance; the host being highly mobile; or the environment of the host being inimical to successful infestation (e.g., swift currents, wavebeaten shores, or exposure during low tides). Little correlation has been observed at present, however, between the ecology of the holothurian host and the relatively large numbers of eggs in *S. lobulatus*. The holothurians collected, conspicuous by their size (30 cm or more in length), were found in depths of 1—12 meters, exposed on the surfaces of masses of coral. Sometimes several holothurians occurred within an area of 2 to 3 square meters. They lived in situations where there was considerable water current resulting

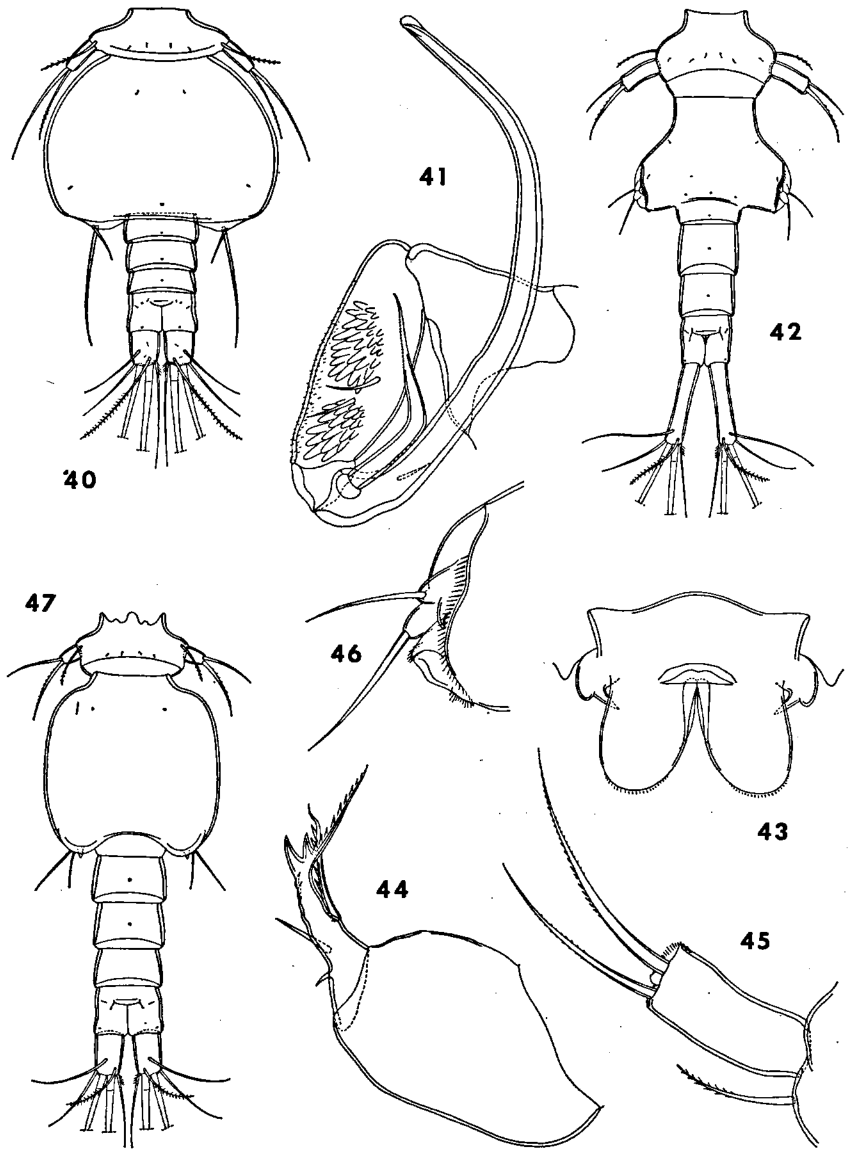

FIG. 40—41. *Scambicornus campanulipes* (Humes & Cressey, 1961), male: 40, urosome, dorsal (C); 41, maxilliped, postero-inner (C).
FIG. 42—46. *Scambicornus idoneus* (Humes & Cressey, 1961), female: 42, urosome, dorsal (B); 43, labrum, ventral (C); 44, second maxilla, anterior (D); 45, leg 5, dorsal (D); 46, area of attachment of egg sac and leg 6, dorsal (D).
FIG. 47. *Scambicornus idoneus* (Humes & Cressey, 1961), male: 47, urosome, dorsal (G).

from tidal change. Possibly this water movement may be related to the large numbers of eggs produced.

REDESCRIPTION OF CERTAIN *Scambicornus* SPECIES

The following five species are redescribed in part. The dissections upon which the original descriptions by Humes & Cressey (1961) were based were done in glycerine and studied in glycerine jelly mounts. I have restudied specimens of each of these species in lactic acid, using the method described by Humes & Gooding (1964). This technique better retains the original shape of the parts and allows greater visual discrimination of details. I find that certain features in the original descriptions need additions or corrections.

Scambicornus campanulipes (Humes & Cressey, 1961). Figs. 36—41.

Material examined. — From *Actinopyga lecanora* (Jaeger): 60 ♀♀, 84 ♂♂, and 38 copepodids from 5 hosts, intertidal, Ambariobe, a small island almost between Nosy Komba and Nosy Bé, October 6, 1963; 21 ♀♀, 27 ♂♂, and 4 copepodids from 3 hosts, intertidal, Ambariobe, August 7, 1963; 14 ♀♀, 13 ♂♂, and 4 copepodids from 5 hosts in 1 m, Pte. Ambarionaomby, Nosy Komba, June 8, 1964; and 48 ♀♀, 61 ♂♂, and 57 copepodids from 5 hosts, intertidal, Ambariotelo, near Ambariobe, September 9, 1960. From *Actinopyga mauritiana* (Quoy & Gaimard): 17 ♀♀, 14 ♂♂, and 2 copepodids from 1 host in 0.5 m, Nosy Sakatia, near Nosy Bé, October 8, 1960; 62 ♀♀, 44 ♂♂, and 19 copepodids from 7 hosts in 2 m, Nosy Taolankena, near Nosy Bé, November 15, 1963; 2 ♀♀, 3 ♂♂, and 6 copepodids from 1 host in 2 m, Antsamantsara, north of Madirokely, Nosy Bé, December 15, 1963; 92 ♀♀, 29 ♂♂, and 7 copepodids from 10 hosts in 10 cm, Tany Kely, a small island to the south of Nosy Bé, May 27, 1964; and 84 ♀♀, 61 ♂♂, and 9 copepodids from 10 hosts, intertidal, Antsakoabe, Nosy Bé, September 7, 1964. From *Actinopyga miliaris* (Quoy & Gaimard): 20 ♀♀, 10 ♂♂, and 1 copepodid from 1 host in 20 cm, Ambariobe, August 6, 1960; 52 ♀♀, 151 ♂♂, and 114 copepodids from 16 hosts in 2 m, Pte. Lokobe, Nosy Bé, August 16, 1960; 93 ♀♀, 30 ♂♂, and 16 copepodids from 21 hosts in 0.5 m, Ambatoloaka, Nosy Bé, September 25, 1960; 5 ♀♀ from 60 hosts in 10 cm, Pte. Mahatsinjo, Nosy Bé, September 29, 1960; 19 ♀♀, 2 ♂♂, and 1 copepodid from 35 hosts in 1 m, Ambatoloaka, October 15, 1960; 11 ♀♀, 6 ♂♂ from 50 hosts in 1 m, Antsamantsara, October 31, 1960; and 13 ♀♀, 2 ♂♂ from 200 hosts in 10 cm, Ambatoloaka, May 26, 1964. From *Actinopyga echinites* (Jaeger): 3 ♀♀ from 10 hosts in 1 m, Tany Kely, May 27, 1964; and 65 ♀♀, 28 ♂♂, and 1 copepodid from 100 hosts in 1 m, Tany Kely, May 28, 1964.

New host records for this species are *Actinopyga lecanora* and *A. miliaris.*

Female. — Genital segment (fig. 36) with rounded lateral edges in dorsal view and with the two toothlike protuberances dorsolateral in position. Caudal ramus 60 × 35 μ. Rostral area lacking a well defined posteroventral border. Formula for the armature of the first antenna the same as in *S. lobulatus.* Labrum (fig. 37) with an auricular sclerotization at the outer base of each lobe. Maxilliped ornamented as in fig. 38. Formula for the armature of legs 1—4 the same as in *S. lobulatus.* Free segment of leg 5 (fig. 39) 62 × 49 μ, form than the longer barbed element (130 μ).

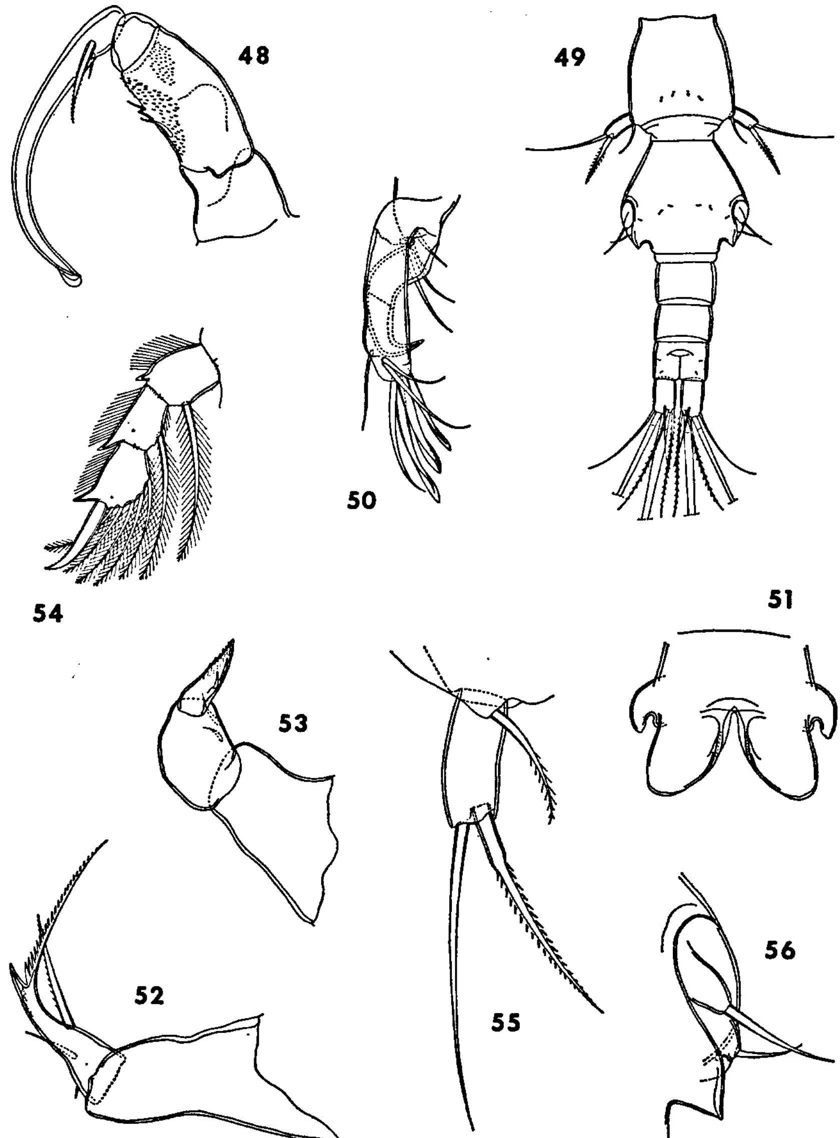

FIG. 48. *Scambicornus idoneus* (Humes & Cressey, 1961), male (continued): 48, maxilliped, posterior (C).

FIG. 49—56. *Scambicornus poculiferus* (Humes & Cressey, 1961), female: 49, urosome, dorsal (B); 50, distal part of second antenna, outer (C); 51, labrum, ventral (C); 52, second maxilla, anterior (D); 53, maxilliped, antero-outer (C); 54, endopod of leg 1, anterior (G); 55, leg 5, dorsal (D); 56, area of attachment of egg sac and leg 6, dorsal (D).

Male. — Genital segment (fig. 40) 156 × 203 μ, rounded laterally in dorsal view. Rostral area as in the female. First antenna with the formula for the armature as in *S. lobulatus*. Maxilliped as in fig. 41, with the two elements on the proximal region of the claw very unequal, the larger one strongly geniculate and delicately serrate distally.

Scambicornus idoneus (Humes & Cressey, 1961). Figs. 42—48.

Material examined. — From *Ludwigothuria atra* (Jaeger): 38 ♀♀ from 30 hosts in 10 cm, Nosy Faly, near Nosy Bé, October 21, 1960; and 22 ♀♀, 11 ♂♂, and 5 copepodids from 110 hosts in 1 m, Pte. Lokobe, Nosy Bé, October 27, 1960. From *Argiodia nobilis* (Selenka): 15 ♀♀, 25 ♂♂, and 2 copepodids from 2 hosts in 2 m, Nosy N'Tangam, near Nosy Bé, August 25, 1960; 3 ♀♀, 1 ♂ from 1 host in 2 m, Nosy N'Tangam, October 5, 1960; 1 ♀ from 1 host in 3 m, northern end of Nosy Sakatia, near Nosy Bé, October 8, 1960; 2 ♀♀ from 1 host in 2 m, Tany Kely, near Nosy Bé, October 9, 1960; 2 ♀♀, 7 ♂♂, and 1 copepodid from 4 hosts in 3 m, Nosy N'Tangam, August 8, 1963; 2 ♀♀ from 2 hosts in 2 m, Nosy Taolankena, near Nosy Bé, November 15, 1963; 2 ♂♂ from 3 hosts in 15 cm, Tany Kely, May 27, 1964; and 12 ♀♀, 14 ♂♂, and 7 copepodids from 10 hosts in 3 m, Sanitry, Nosy Bé, October 6, 1964. From *Holothuria scabra* Jaeger: 5 ♀♀, 3 ♂♂, and 1 copepodid from 8 hosts, intertidal, Antafianambitry, Nosy Bé, November 5, 1963; and 1 ♀ from 79 hosts, intertidal, Antafianambitry, December 4, 1963.

New host records for this species are *Argiodia nobilis* and *Holothuria scabra*.

Female. — Genital segment with lateral wings as in fig. 42. Rostral area without a well developed posteroventral border. First antenna segmented and armed as in *S. lobulatus*. Labrum (fig. 43) with a sclerotized expansion bearing a spiniform process at the outer base of each lobe. Second maxilla as in fig. 44. Formula for the armature of legs 1—4 as in *S. lobulatus*. Leg 5 as in fig. 45. Leg 6 as in fig. 46.

Male. — Genital segment (fig. 47) 110 × 105 μ, with subparallel lateral margins in dorsal view. Caudal ramus 28 × 17 μ, a little longer than wide. Rostral area as in the female. First antenna with the same formula for the armature as in *S. lobulatus*. Maxilliped (fig. 48) with an inner prominence near the base of the distal seta on the second segment.

Scambicornus poculiferus (Humes & Cressey, 1961). Figs. 49—60.

Material examined. — From *Synapta maculata* (Chamisso & Eysenhardt): 134 ♀♀, 117 ♂♂, and 22 copepodids from 1 host in 10 cm, Ambariobe, a small island almost between Nosy Komba and Nosy Bé, October 6, 1963; 157 ♀♀, 310 ♂♂, and 122 copepodids from 1 host in 0.5 m, Ampombilava, Nosy Bé, October 31, 1963; 17 ♀♀, 15 ♂♂, and 4 copepodids from 1 host, intertidal, Antsakoabe, Nosy Bé, December 1, 1963; 14 ♀♀, 8 ♂♂ from 1 host in 1 m, crater at Ambatoloaka, Nosy Bé, January 7, 1964; and 36 ♀♀, 37 ♂♂, and 35 copepodids from 1 host in 1.5 m, Ambatoloaka, January 11, 1964.

Female. — Genital segment (fig. 49) with moderately developed wings. Caudal ramus 44 × 28 μ. Rostral area without a defined posteroventral

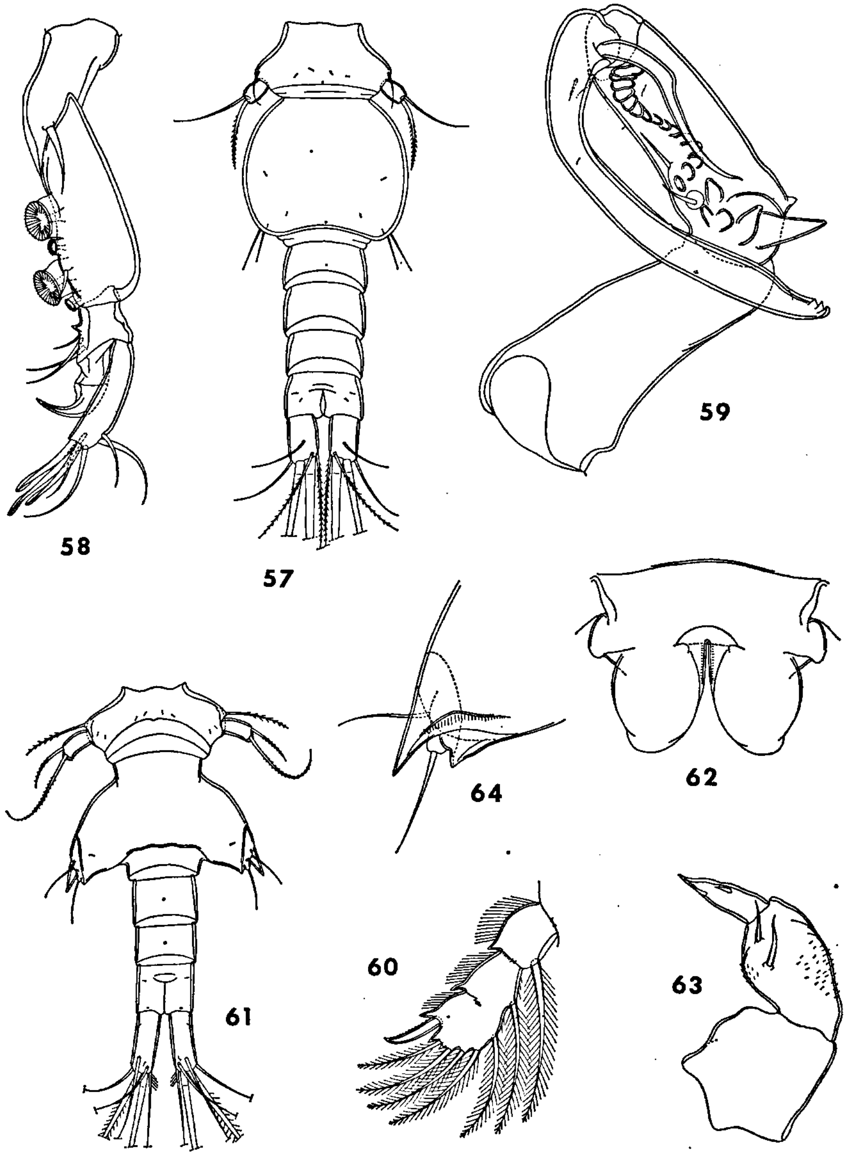

FIG. 57—60. *Scambicornus poculiferus* (Humes & Cressey, 1961), male: 57, urosome, dorsal (G); 58, second antenna, anterior (C); 59, maxilliped, postero-inner (C); 60, endopod of leg 1, anterior (C).

FIG. 61—64. *Scambicornus modestus* (Humes & Cressey, 1961), female: 61, urosome, dorsal (B); 62, labrum, ventral (C); 63, maxilliped, anterior (C); 64, area of attachment of egg sac and leg 6, ventral (C).

margin. First antenna segmented and armed as in *S. lobulatus*. Second antenna with the elongated last segment 64 × 18 μ (fig. 50). Labrum (fig. 51) with a recurved sclerotized expansion at the outer base of each lobe. Second maxilla as in fig. 52. Maxilliped as in fig. 53. Formula for the armature of legs 1—4 as in *S. lobulatus*. Endopod of leg 1 (fig. 54) with the formula for the last segment I, 5, not I, 4 as shown in fig. 136 of Humes & Cressey (1961). Free segment of leg 5 (fig. 55) 40 × 18 μ. Leg 6 as in fig. 56.

Male. — Genital segment (fig. 57) with rounded lateral margins in dorsal view. Caudal ramus 31 × 18 μ, longer than wide. Rostral area as in the female. First antenna apparently lacking an aesthete on the second segment, so that the formula is the same as for the female. Second antenna as in fig. 58. Maxilliped as in fig. 59, with two proximal elements on the claw. Endopod of leg 1 as in fig. 60.

Scambicornus modestus (Humes & Cressey, 1961). Figs. 61—66.

Material examined. — From *Stichopus chloronotus* (Brandt): 16 ♀♀, 18 ♂♂, and 2 copepodids from 2 hosts in 2 m, Pte. Lokobe, Nosy Bé, August 16, 1960; 28 ♀♀, 21 ♂♂, and 5 copepodids from 8 hosts in 15 cm, Tany Kely, near Nosy Bé, July 9, 1963; 3 ♀♀, 5 ♂♂, and 8 copepodids from 1 host in 1 m, Pte. Ambarionaomby, Nosy Komba, July 18, 1963; 3 ♀♀, 3 ♂♂ from 1 host in 10 cm, Ankify, on the mainland of Madagascar opposite Nosy Komba, July 22, 1963; 8 ♀♀, 6 ♂♂ from 4 hosts in 0.5 m, Ambariobe, a small island almost between Nosy Komba and Nosy Bé, August 7, 1963; 5 ♀♀, 5 ♂♂ from 1 host in 1 m, Nosy N'Tangam, Nosy Bé, August 8, 1963; 9 ♀♀, 14 ♂♂, and 9 copepodids from 1 host in 10 cm, Nosy N'Tangam, September 5, 1963; 8 ♀♀, 7 ♂♂, and 2 copepodids from 1 host in 1 m, Pte. de Tafondro, Nosy Bé, October 2, 1963; 17 ♀♀, 24 ♂♂ from 8 hosts in 1 m, Nosy Mamoko, south of Nosy Bé in the Bay of Ampasindava, November 16, 1963; 29 ♀♀, 49 ♂♂, and 14 copepodids from 4 hosts in 1 m, Pte. Ambarionaomby, December 14, 1963; and 31 ♀♀, 29 ♂♂, and 4 copepodids from 2 hosts in 1 m, Pte. Ambarionaomby, June 8, 1964. From *Stichopus variegatus* Semper: 1 ♀, 1 ♂, and 2 copepodids from 1 host in 1 m, west of Pte. de Tafondro, October 19, 1960; and 48 ♀♀, 22 ♂♂, and 1 copepodid from 9 hosts in 10 cm, Ankify, June 11, 1964. From either *Microthele difficilis* (Semper) or *Urodemas ehrenbergi* Selenka (hosts mixed at time of collection): 1 ♀ from 5 hosts in 2 m, Pte. Ambarionaomby, August 18, 1960. From *Brandtothuria impatiens* (Forskål): 1 ♀ from 1 host in 2 m, Pte. Ambarionaomby, August 19, 1960.

New host records for this species are *Brandtothuria impatiens* and either *Microthele difficilis* or *Urodemas ehrenbergi*.

Female. — Genital segment (fig. 61) with expanded wings. Caudal ramus 72 × 33 μ. Rostral area lacking a definite posteroventral border. Segmentation and formula for the armature of the first antenna as in *S. lobulatus*. Labrum (fig. 62) with an expanded sclerotized expansion at the outer base of each lobe. Maxilliped as in fig. 63. Formula for the armature of legs 1—4 as in *S. lobulatus*, with the outer seta on the basis of legs 3 and 4 very long as in that species. Leg 6 as in fig. 64.

Male. — Genital segment (fig. 65) with rounded lateral margins in dorsal view. Caudal ramus 28 × 18 μ. Rostral area as in the female. First antenna

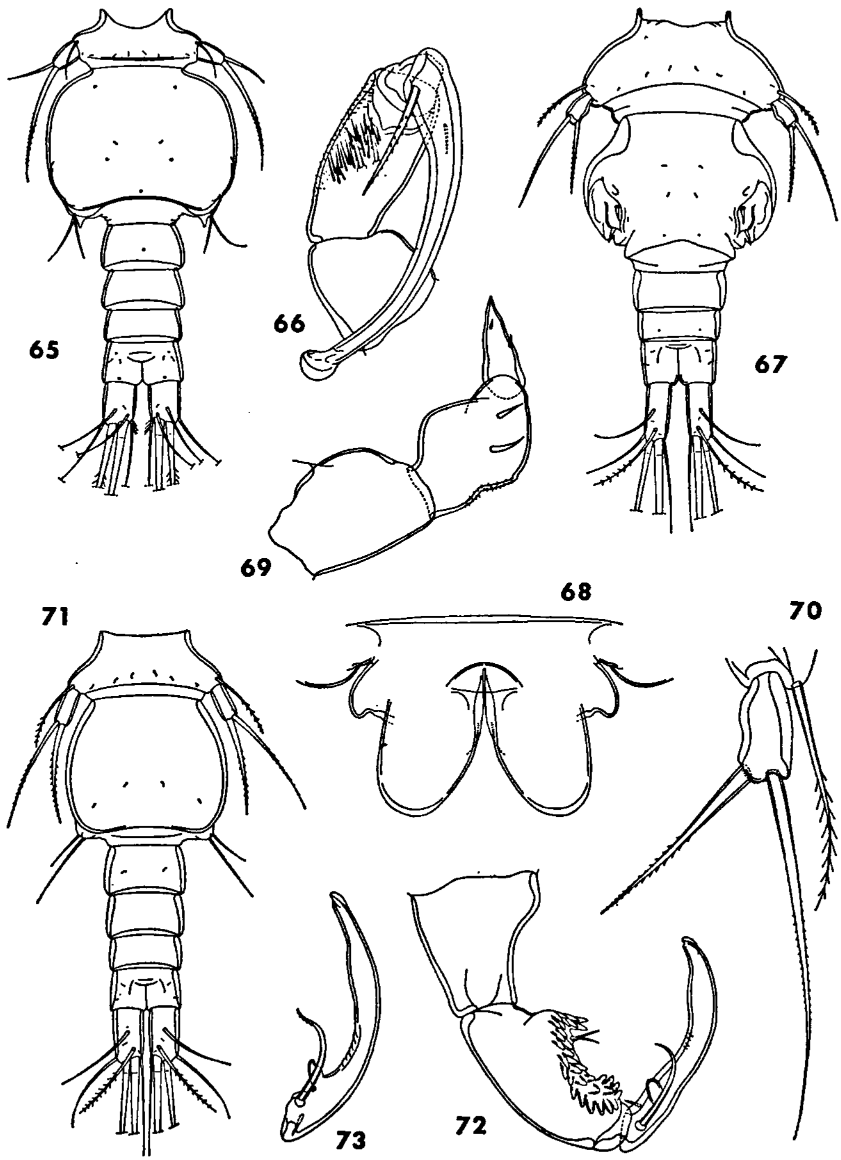

FIG. 65—66. *Scambicornus modestus* (Humes & Cressey, 1961), male: 65, urosome, dorsal (G); 66, maxilliped, postero-inner (C).

FIG. 67—70. *Scambicornus tuberatus* (Humes & Cressey, 1961), female: 67, urosome, dorsal (F); 68, labrum, ventral (C); 69, maxilliped, antero-inner (C); 70, leg 5, ventral (D).

FIG. 71—73. *Scambicornus tuberatus* (Humes & Cressey, 1961), male: 71, urosome, dorsal (G); 72, maxilliped, posterior (C); 73, claw of maxilliped, posterior (C).

with the formula for the armature as in *S. lobulatus*. Maxilliped as in fig. 66, the claw 153 μ in length, with two unequal proximal elements.

Scambicornus tuberatus (Humes & Cressey, 1961). Figs. 67—73.

Material examined. — From *Bohadschia marmorata* Jaeger: 8 ♀♀, 8 ♂♂, and 1 copepodid from 1 host in 2 m, Pte. Mahatsinjo, Nosy Bé, November 2, 1960; 53 ♀♀, 45 ♂♂, and 22 copepodids from 2 hosts in 1 m, Pte. Lokobe, Nosy Bé, November 5, 1960; 4 ♀♀, 1 ♂ from 4 hosts in 1 m, Antsamantsara, north of Madirokely, Nosy Bé, November 6, 1960; and 12 ♀♀, 5 ♂♂ from 5 hosts in 2 m, Nosy N'Tangam, near Nosy Bé, August 8, 1963.

Bohadschia marmorata is a new host record for this species.

Female. — Genital segment (fig. 67) in dorsal view with somewhat expanded and rounded lateral margins. Caudal ramus 50 × 21 μ. Rostral area lacking a definite posteroventral border. First antenna segmented and armed as in *S. lobulatus*. Labrum (fig. 68) with a sclerotized expansion at the outer base of each lobe. Maxilliped as in fig. 69. Formula for the armature of the legs as in *S. lobulatus*. Leg 5 (fig. 70) with the free segment 32 × 15 μ in greatest dimensions and with a sinuous inner margin; the two terminal elements 66 μ (inner) and 100 μ (outer) in length.

Male. — Genital segment (fig. 71) 88 × 97 μ, with rounded margins in dorsal view. Caudal ramus 39 × 18 μ. Rostral area as in the famele. First antenna with the same formula for the armature as in *S. lobulatus*, the aesthete on the second segment being very short. Maxilliped as in fig. 72, with two unequal proximal elements on the claw (fig. 73).

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