LICHOMOLGID COPEPODS (CYCLOPOIDA) ASSOCIATED WITH CORALS IN MADAGASCAR

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INTRODUCTION

Seven species of lichomolgid copepods are known to be associated with madreporarian corals in the region of Nosy Bé, Madagascar. These are *Lichomolgus actinophorus*, *Lichomolgus compositus*, and *Monomolgus unihastatus*, all described by Humes and Frost (1964); *Kombia angulata* Humes, 1962 (see below for a discussion of its familial position); and *Monomolgus psammocorae*, *Rhynchomolgus corallophilus*, and *Lichomolgus rhadinus*, all described by Humes and Ho (1967a). This paper deals with seven new species of *Lichomolgus* and three new lichomolgid genera, each with a single new species, collected from corals at Nosy Bé in 1960 and 1963–64.

All collections were made by A. G. Humes, those in 1960 during an expedition sponsored by the Academy of Natural Sciences of Philadelphia, and those in 1963–64 as part of the U.S. Program in Biology of the International Indian Ocean Expedition. Type material has been deposited in the United States National Museum. Other specimens of certain species have been placed in the Museum of Comparative Zoology.

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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 measurement of the length of the body has been made in all cases from specimens in lactic acid and does not include the setae on the caudal rami. In the spine and setal formulas of legs 1–4 the Roman numerals indicate spines and the Arabic numerals represent setae. The lengths of the segments of the first antenna have been measured along their posterior non-setiferous margins.

The abbreviations used are: A_1 = first antenna, A_2 = second antenna, MD = mandible, P = paragnath, MX_1 = first maxilla, MX_2 = second maxilla, MXPD = maxilliped, and P_1 = leg 1.

We are greatly indebted to Dr. Donald F. Squires of the United States National Museum for the identification of the corals collected in 1960, and to Dr. Michel Pichon, then at the Centre d'Océanographie et des Pèches at Nosy Bé, for the determinations of those collected in 1963–64.

The new copepods described in this paper comprise the following:

1) *Lichomolgus campulus* n. sp. from *Alveopora* sp.
2) *Lichomolgus digitatus* n. sp. from *Goniopora* sp.

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3) *Lichomolgus prolixipes* n. sp. from *Porites* sp. cf. *P. andrewsi* Vaughan, *Porites* sp. cf. *P. nigrescens* Dana, and *Porites* (s. g. *Synaraea*) sp.

4) *Lichomolgus arcuatipes* n. sp. from *Acropora palifera* (Lamarck)

5) *Lichomolgus lobophorus* n. sp. from *Acropora scherzeriana* Brueggemann, *Acropora* sp., and *Acropora cytherea* Dana

6) *Lichomolgus geminus* n. sp. from *Stylophora pistillata* (Esper), *Stylophora mordax* (Dana), and *Acropora* sp.

7) *Lichomolgus crassus* n. sp. from *Stylophora pistillata* (Esper), *Stylophora mordax* (Dana), and *Acropora* sp.

8) *Prionomolgus lanceolatus* n. gen., n. sp. from *Pachyseris speciosa* (Dana)

9) *Haplomolgus montiporae* n. gen., n. sp. from *Montipora sinensis* Bernard, *Montipora* sp., and *Montipora* sp. cf. *M. stellata* Bernard

10) *Ravahina tumida* n. gen., n. sp. from *Porites* sp. cf. *P. andrewsi* Vaughan

The following represent new host records:

1) *Lichomolgus actinophorus* Humes and Frost, 1964, from *Pavona danai* (M. Edwards and Haime), *Pavona* ? *venusta* (Dana), and *Pavona danai* or *P. angularis* (Klunzinger)

2) *Lichomolgus compositus* Humes and Frost, 1964, from *Seriatopora octoptera* Ehrenberg and *Seriatopora* sp.

3) *Monomolgus unihastatus* Humes and Frost, 1964, from *Porites* sp. cf. *P. nigrescens* Dana

4) *Kombia angulata* Humes, 1962, from *Porites* (s. g. *Synaraea*) sp., *Porites* (young colony), and *Porites* sp. cf. *P. nigrescens* Dana

SYSTEMATIC DESCRIPTION

LICHOMOLGIDAE Kossmann, 1877

LICHOMOLGUS Thorell, 1860

Lichomolgus campulus n. sp.

Figs. 1–24

Type material.—31 females, 32 males, and 2 copepodids from *Alveopora* sp. in a depth of 3.5 m, Nosy N'Tangam, on the western side of Nosy Bé, Madagascar. Collected October 23, 1964. Holotype female, allotype, and 50 paratypes (25 females and 25 males) deposited in the United States National Museum, Washington; the remaining paratypes in the collection of A. G. Humes.

Female.—Body (Fig. 1) moderately slender. Length 1.21 mm (1.15–1.26 mm) and greatest width 0.45 mm (0.43–0.47 mm), based on 10 specimens. Ratio of length to width of prosome 1.63:1. Epimeral areas of metasomal segments formed as in figure.

Segment of leg 5 (Fig. 2) 65 × 200 μ. Between this segment and genital segment a short weak ventral intersegmental sclerite. Genital segment broadened anteriorly and narrowed posteriorly, with slight lateral indentations, wider than long, its greatest dimensions being 180 × 224 μ. Areas of attachment of egg sacs located dorsally, each area (Fig. 3) with two small setae 6 and 10 μ long with a spinelike process between them. Three postgenital segments 86 × 107, 70 × 92, and 78 × 83 μ from anterior to posterior. Anal segment with a row of minute spinules along its posteroventral margin on each side.

Caudal ramus (Fig. 4) elongated, 105 × 33 μ, about 3.2 times longer than wide. Outer lateral seta 64 μ, outermost terminal seta 45 μ, innermost terminal seta 62 μ. Two long median terminal setae 260 μ (inner) and 150 μ (outer). Dorsal pedicellate seta 58 μ. All setae naked. Dorsal surface of ramus with a few minute hairs.

Dorsal surface of prosome and urosome with a few minute hairs as in Figure 1;

ventral surface of urosome almost entirely lacking ornamentation. Ratio of length of prosome to that of urosome 1.59:1.

Egg sac unknown.

Rostral area (Fig. 5) poorly developed, without a definite posteroventral margin.

First antenna (Fig. 6) slender, 370 μ long, and 7-segmented, with a sclerite on third segment suggesting an intercalary segment. Lengths of segments: 33 (78 μ along anterior margin), 133, 32, 43, 39, 28, and 19 μ, respectively. Formula for armature: 4, 13 (5 + 2 + 6), 6, 3, 4 + 1 aesthete, 2 + 1 aesthete, and 7 + 1 aesthete, as in many other species of *Lichomolgus*. All setae naked.

Second antenna (Fig. 7) slender and 4-segmented. Penultimate segment 60 μ along outer edge, last segment 39 μ along outer edge and 20 μ along inner edge. Armature: 1, 1, 3, I. All setae small and naked; terminal claw 41 μ along its axis and rather sinuous.

Labrum (Fig. 8) with two posteroventral lobes.

Mandible (Fig. 9) with proximal region separated into two parts by a constriction. Region beyond constriction having on its convex side a row of small spinules and a prominent elongated posteriorly directed process; on its concave side two lobes each with a row of larger spinules. Flagellum elongated with lateral spinules. Paragnath (Fig. 10) a small lobe with a few hairs. First maxilla (Fig. 11) with three terminal elements, two of them broad and hyaline. Second maxilla (Fig. 12) 2-segmented. First segment large and unornamented. Second segment small, having proximally on its outer (ventral) margin a minute setule only 1.5 μ long followed by a naked seta and on its inner (dorsal) margin a barbed seta; terminal lash with a row of prominent spinules. Maxilliped (Fig. 13) moderately slender and 3-segmented; first segment unarmed, second with two very unequal inner naked setae, and third with a naked seta and a barbed seta, and terminating in a spiniform process with lateral spinules which bears a small setiform element on its outer surface.

Area between maxillipeds and first pair of legs (Fig. 5) not protuberant; a sclerotized line between bases of maxillipeds.

Legs 1–4 (Figs. 14, 15, 16, and 17) with trimerous rami, except for endopod of leg 4 which is 2-segmented. Armature as follows:

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, II, 2
P_4	protopod 0–1; 1–0	exp I–0; I–1; II, I, 5 end 0–1; II

Inner seta on coxa of leg 4 somewhat smaller than in legs 1–3, with shorter lateral hairs. Hairs on inner margin of basis present in legs 1–3 but absent in leg 4. Endopod of leg 4 (Fig. 17) with hairs along outer margins of both segments. First segment 22 × 23 μ, its plumose inner seta 39 μ long. Second segment somewhat bottle-shaped, 35 × 20 μ in greatest dimensions, with two terminal unequal barbed spines 13 μ (outer) and 36 μ (inner) in length.

Leg 5 (Fig. 18) with an elongated free segment, 34 × 13 μ, without a basal expansion. Two terminal naked setae, outer 33 μ, inner 36 μ long. Seta on body near free segment 44 μ and naked.

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

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

Male.—Body (Fig. 19) moderately slender as in female. Length 1.11 mm (1.04–1.17 mm) and greatest width 0.39 mm (0.38–0.40 mm), based on 10 specimens. Ratio of length to width of prosome 1.40:1.

Segment of leg 5 (Fig. 20) 36 × 169 μ ventrally, 52 × 169 μ dorsally. Between this segment and genital segment no ventral intersegmental sclerite. Genital segment rather quadrate in dorsal view, 208 × 242 μ, wider than long. Four postgenital seg-

ments 43 × 84, 46 × 80, 39 × 70, and 66 × 73 μ from anterior to posterior.

Caudal ramus resembling that of female, though smaller, 90 × 28 μ.

Dorsal and ventral surfaces of body ornamented with a few minute hairs as in female. Ratio of length of prosome to that of urosome 1.20:1.

Rostral area like that of female.

First antenna segmented and armed as in female, but two aesthetes added on segment 2 and one on segment 4 (their positions indicated by small arrows in Figure 6), so that formula is 4, 13 + 2 aesthetes, 6, 3 + 1 aesthete, 4 + 1 aesthete, 2 + 1 aesthete, and 7 + 1 aesthete. All aesthetes a little longer than in female. Second antenna (Fig. 21) resembling that of female, but inner surface of second segment with short spinelike bosses; third segment with a few similar bosses and with three elements, two hyaline and obtuse, the other setiform.

Labrum, mandible, paragnath, first maxilla, and second maxilla resembling those in female. Maxilliped (Fig. 22) slender and 4-segmented, assuming that the proximal part of the claw represents a fourth segment. First segment unarmed, second with two setae and two rows of spinules on inner surface, third small and unarmed. Claw only slightly recurved, 151 μ along its axis (including terminal lamella), with faint indication of division midway; proximally with two unequal naked setae, distal half of longer one hyaline and blunt.

Area between maxillipeds and first pair of legs as in female.

Legs 1–4 as in female.

Leg 5 (Fig. 23) with a short free segment, 15 × 9 μ, its terminal setae being 24 and 33 μ in length.

Leg 6 (Fig. 24) consisting of a posteroventral flap on genital segment, bearing two small naked setae about 20 μ long.

Spermatophore not observed.

Color in life in transmitted light similar to female.

Etymology.—The specific name *campulus*, from καμπύλος = bent, refers to the sinuous nature of the claw on the second antenna.

Comparison with related species.—The presence of a prominent elongated process on the basal part of the mandible distinguishes this species from most other species of *Lichomolgus*. Only six other species (among the seventy or more described in the genus) have a process which is at all comparable. *L. actinophorus* Humes and Frost, 1964, has an elongated posteriorly directed process on the mandible, but this process is more pointed and dentiform than in the new species. Furthermore, *L. actinophorus* has a setiferous spherical process on the second maxilla, distinguishing it from *L. campulus*. *L. decorus* Humes and Frost, 1964, has an anteriorly directed toothlike process on the mandible and the formula for the last segment of the exopod of leg 4 is III, I, 5. In *L. organicus* Humes and Ho, 1967b, and *L. conjunctus* Humes and Ho, 1967b, there is a posteriorly directed toothlike process on the mandible, the caudal ramus is not more than 1.5 times longer than wide, and there are two claws on the second antenna. *L. protulae* Stock, 1959, has an anteriorly directed tooth on the mandible, greatly elongated caudal rami, and several claws on the second antenna. *L. rhadinus* Humes and Ho, 1967a, has a process on the mandible rather similar to that in *L. campulus*, but the two species may readily be distinguished. The female of *L. rhadinus* has an inner basal expansion on the elongated (about 5:1) free segment of leg 5 and the genital segment is rather abruptly indented posteriorly on both sides in dorsal view. The male of *L. rhadinus* has a much shorter caudal ramus (28 × 18 μ), its leg 1 shows sexual dimorphism (the last segment being I, I, 4 instead of I, 5 as in the female), and the genital segment is longer than wide. In spite of these clear differences, *L. campulus* seems to be more closely related to *L. rhadinus* than to any other species.

There are eight species of *Lichomolgus*

in which the form of the mandible, being unknown, can not be compared with that of the new species. (Thompson and A. Scott, 1903, did not describe the mandible of their *Lichomolgus gigas*, but stated, p. 280, that the "mouth organs . . . nearly resemble *L. simplex*.") All eight, however, possess characters which distinguish them from *L. campulus*. Thus, *L. dentipes* Thompson and A. Scott, 1903, and *L. rigidus* (Ummerkutty, 1962) have the formula for the last segment of the exopod of leg 4 as III, I, 5; *L. gigas* Thompson and A. Scott, 1903, is much larger (female 2 mm, male 1.4 mm); *L. longipes* (Sewell, 1949), *L. rotundus* Sewell, 1949, *L. tenuicornis* Brady, 1910, and *L. vagans* Gurney, 1927, have two claws on the last segment of the second antenna; and *L. elegans* Thompson and A. Scott, 1903, has the caudal ramus about as broad as long.

Lichomologus digitatus n. sp.

Figs. 25–52

Type material.—9 females, 4 males, and 2 immature specimens from *Goniopora* sp. in a depth of 2 m, west of Pte. Mahatsinjo, Nosy Bé, Madagascar. Collected April 10, 1964. Holotype female, allotype, and 9 paratypes (7 females and 2 males) deposited in the United States National Museum; the remaining paratypes (dissected) in the collection of A. G. Humes.

Female.—Body (Fig. 25) with prosome moderately broadened. Length 1.89 mm (1.73–2.00 mm) and greatest width 0.70 mm (0.66–0.73 mm), based on 9 specimens. Ratio of length to width of prosome 1.49:1. Epimeral areas of metasomal segments as in figure.

Segment of leg 5 (Fig. 26) 83 × 255 μ. Between this segment and genital segment a weak ventral intersegmental sclerite. Genital segment broadened anteriorly and tapered posteriorly, wider than long, 253 × 290 μ in greatest dimensions. Areas of attachment of egg sacs located dorsally, each area (Fig. 27) with two small setae (7 and 10 μ long) and a small spinelike process. Three postgenital segments 82 × 122, 55 × 107, and 101 × 104 μ from anterior to posterior. Spinules on posteroventral margin of anal segment very few in number and minute.

Caudal ramus (Fig. 28) elongated, 220 × 36 μ, about 6.1 times longer than wide. Setae relatively short and naked. Outer lateral seta 33 μ, outermost terminal seta 28 μ, innermost terminal seta 33 μ. Two long median terminal setae 172 μ (inner) and 133 μ (outer). Dorsal pedicellate seta very short, 14 μ. Dorsal surface of ramus with refractile points. A minute spinule 5 μ long on proximal outer margin of ramus.

Dorsal surface of prosome and dorsal and ventral surfaces of urosome with scattered refractile points and small hairs as in Figure 25. Ratio of length of prosome to that of urosome 1.37:1.

Egg sac unknown.

Rostral area (Fig. 29) weakly developed.

First antenna (Fig. 30) slender, 390 μ long, segmented and armed as in the previous species. Lengths of segments: 40 (68 μ along anterior margin), 120, 28, 55, 57, 39, and 24 μ respectively. All setae naked.

Second antenna (Fig. 31) 4-segmented, with two proximal segments stouter than in *L. campulus*. Penultimate segment 66 μ along outer edge, last segment 44 μ along outer edge and 31 μ along inner edge. A sclerotized bar running diagonally across outer surface of last segment. Armature: 1, 1, 3, I + 3 minute setules. All setae small and naked; terminal claw 29 μ along its axis and not recurved.

Labrum (Fig. 32) with two posteroventral lobes.

Mandible (Fig. 33) more massive than in *L. campulus*, with a less prominent constriction in proximal region. On convex side a short row of spinules (apparently not always present) and two unequal digitiform hyaline processes, followed by a long row of spinules. Concave margin beyond constriction with two prominent lobes armed with spinules. Flagellum

elongated with lateral spinules. Paragnath (Fig. 34) a small lobe with hairs. First maxilla (Fig. 35) with four lamellate elements and a patch of minute spinules. Second maxilla (Fig. 36) 2-segmented, first segment large and unornamented. Second segment with a small setuliform process on its proximal outer (ventral) margin, a lamellate seta on its anterior surface, and a seta with a striated membranous lamella on its inner (dorsal) margin; terminal lash with a row of spinules. Maxilliped (Fig. 37) stout and 3-segmented; first segment unarmed; second with two naked inner setae and an outer patch of spinules; and third with a slender seta, a spine, and a terminal spiniform process, all naked.

Area between maxillipeds and first pair of legs (Fig. 38) not protuberant; sclerotized line between bases of maxillipeds.

Legs 1–4 (Figs. 39, 40, 41, and 42) segmented as in the previous species, with same spine and setal formula. Leg 4 with inner seta on coxa naked and 31 μ long; hairs present on inner margin of basis. Endopod of leg 4 with hairs along inner margins of both segments. First segment 34 $\times$ 30 μ, its plumose inner seta 73 μ long. Second segment 70 $\times$ 28 μ in greatest dimensions, with its two terminal unequal fringed spines 37 μ (outer) and 74 μ (inner) in length.

Leg 5 (Fig. 43) with a moderately elongated free segment, 36 $\times$ 17 μ in greatest dimensions, without a basal expansion. Two unequal naked terminal setae 20 and 39 μ. Seta on body near free segment 36 μ. All setae naked.

Leg 6 probably represented by the two setae near attachment of egg sac (see Figure 27).

Color in life in transmitted light translucid, eye dark red.

Male.—Body (Fig. 44) with prosome moderately broadened as in female. Length 1.55 mm (1.48–1.62 mm) and greatest width 0.54 mm (0.52–0.59 mm), based on 4 specimens. Ratio of length to width of prosome 1.38:1.

Segment of leg 5 (Fig. 45) 52 $\times$ 177 μ ventrally, 60 $\times$ 177 μ dorsally. Between this segment and genital segment no ventral intersegmental sclerite. Genital segment subquadrate in dorsal view, 275 $\times$ 290 μ, a little wider than long. Four postgenital segments 52 $\times$ 91, 55 $\times$ 90, 39 $\times$ 83, and 79 $\times$ 83 μ from anterior to posterior.

Caudal ramus resembling that of female, but shorter, 166 $\times$ 39 μ, about 4.3 times longer than wide.

Dorsal and ventral surfaces of body ornamented with scattered refractile points and small hairs (Fig. 44) as in female. Ratio of length of prosome to that of urosome 1.06:1.

Rostral area as in female.

First antenna segmented and armed as in female, but two aesthetes added on segment 2 and one on segment 4, so that formula is same as for male of *L. campulus*. Second antenna (Fig. 46) resembling that of female, but inner surface of second segment with sclerotized spinelike knobs.

Labrum, mandible, paragnath, first maxilla, and second maxilla like those in female. (Mandibles in single male dissected lacking short row of spinules near digitiform processes.) Maxilliped (Fig. 47) slender and 4-segmented, assuming that the proximal part of the claw represents a fourth segment. First segment unarmed, second with two barbed setae and a row of spinules on inner surface, third small and unarmed. Claw recurved, 270 μ along its axis (including terminal lamella), with slight evidence of division midway; proximally with two very unequal setae, the longer one bent and having fine lateral spinules in its distal half.

Area between maxillipeds and first pair of legs as in female.

Legs 1–4 as in female, except for sexual dimorphism on last segment of endopod of leg 1 (Fig. 48), where formula is I, I, 4, instead of I, 5 as in female.

Leg 5 (Fig. 49) with free segment more slender than in female, 31 $\times$ 9 μ, its two terminal naked setae 27 and 40 μ in length.

Leg 6 (Fig. 50) a posteroventral flap on

genital segment, bearing two small naked setae about 23 μ long.

Spermatophore not observed.

Color in life as in female.

Etymology.—The specific name *digitatus*, from Latin = having fingers, alludes to the small fingerlike processes on the mandible.

Notes on copepods from Porites, closely resembling L. digitatus.—Six females and five males which differ slightly from *L. digitatus* in the proportions of certain parts were recovered from a piece of a massive colony of *Porites* sp. in 1 m, at Ampora, Nosy Bé, October 22, 1964.

One female measures 1.94 × 0.72 mm. The genital segment is slightly larger, 275 × 352 μ. The caudal ramus (Fig. 51) is relatively a little longer, 286 × 42 μ, or 6.8 times longer than wide. The endopod of leg 4 (Fig. 52) is longer, the first segment 50 × 34 μ with its inner seta 110 μ, the second segment 92 × 25 μ with its two terminal spines 44 and 94 μ. The free segment of leg 5 is a little longer, 46 × 19 μ.

One male measures 1.76 × 0.60 mm. The genital segment is larger and slightly wider, 341 × 400 μ. The caudal ramus is relatively longer, 247 × 39 μ, or 6.33 times longer than wide. The claw on the maxilliped is relatively longer, 335 μ. The second segment of the endopod of leg 4 is 88 × 28 μ. The free segment of leg 5 is 44 × 14 μ.

In other respects, such as details of the armature and ornamentation, these copepods from *Porites* are identical with *L. digitatus*. The differences mentioned above, concerning chiefly proportions and based on very few specimens, probably should not be considered at present to be of specific or even subspecific rank. Perhaps the future study of a large series of these copepods from both *Porites* and *Goniopora* would clarify the significance of such proportional differences.

Comparison with related species.—There are fifteen species already described in the genus *Lichomolgus* which have the combination of one claw (often with other small elements) on the second antenna and the formula II, I, 5 on the last segment of the exopod of leg 4, thus resembling the new species. These are: *L. actinophorus* Humes and Frost, 1964, *L. anomalus* A. Scott, 1909, *L. arcanus* Humes and Cressey, 1958, *L. asaphidis* Humes, 1959, *L. campulus*, *L. chamarum* Humes, in press, *L. compositus* Humes and Frost, 1964, *L. elongatus* Buchholz, 1869, *L. gigas* Thompson and A. Scott, 1903, *L. inflatus* Tanaka, 1961, *L. politus* Humes and Ho, 1967*d*, *L. rhadinus* Humes and Ho, 1967a, *L. simulans* Humes and Ho, 1967*d*, *L. spondyli* Yamaguti, 1936, and *L. trochi* Canu, 1899. In only one of these, *L. gigas*, does the mandible resemble that of *L. digitatus* in apparently having two small digitiform processes on the convex side. (Although Thompson and A. Scott did not describe the mouthparts of *L. gigas* in detail, they stated, p. 280, that they nearly resemble those of *L. simplex*, in which the mandible has two "small corner filaments," illustrated on their pl. XV, fig. 30). However, the shape of the genital segment in the female, the relative size of leg 5 in the female, and the relative sizes of segments 3 and 4 of the second antenna (the fourth much longer than the third) distinguish this Ceylonese species from *L. digitatus*.

L. elegans Thompson and A. Scott, 1903, of which only the female is known, has only one claw on the second antenna, but the formula for the last segment of the exopod of leg 4 is unknown. However, this species may be easily distinguished from the new species by its very short caudal ramus, which is about as broad as long, and by the notched genital segment.

Lichomologus prolixipes n. sp.

Figs. 53–78

Type material.—4 females and 3 males from *Porites* sp. cf. *P. andrewsi* Vaughan in a depth of 3 m, Pte. de Tafondro, Nosy Bé, Madagascar. Collected September 28, 1960. (This is the same colony of coral from which the types of *Monomolgus unihastatus* Humes and Frost, 1964, were col-

lected.) Holotype female, allotype, and 2 paratypes (one female and one male) deposited in the United States National Museum; the remaining paratypes (dissected) in the collection of A. G. Humes.

Other specimens.—From *Porites* sp. cf. *P. andrewsi*: 4 females in 0.5 m, at the point north of the village of Madirokely, Nosy Bé, October 24, 1960. From *Porites* sp. cf. *P. nigrescens* Dana: 2 females in 1 m, Pte. de Tafondro, Nosy Bé, September 19, 1963. From *Porites* (s. g. *Synaraea*) sp.: 3 females in 1 m, Pte. Lokobe, Nosy Bé, November 20, 1963; 4 females and 2 males in 1–2 m, Ankify, on the mainland of Madagascar, near Nosy Bé, December 30, 1963.

Female.—Body (Fig. 53) with rather slender prosome, cephalosome somewhat pointed anteriorly. Length 1.11 mm (1.05–1.15 mm) and greatest width 0.47 mm (0.46–0.47 mm), based on 4 specimens. Ratio of length to width of prosome 1.41:1. Epimeral areas of metasomal segments as in figure.

Segment of leg 5 (Fig. 54) 58 × 156 μ. Between this segment and genital segment a very weakly developed ventral intersegmental sclerite. Genital segment 177 μ in length, broadened in its anterior two-thirds (156 μ wide) but constricted in its posterior third (88 μ wide). Areas of attachment of egg sacs situated dorsally, each area (Fig. 55) with two small setae (anterior seta held erect and not measured, posterior seta 17 μ in length) and a small spinous process. Three postgenital segments 49 × 75, 43 × 72, and 69 × 72 μ from anterior to posterior. A row of minute spinules on posteroventral margin of anal segment.

Caudal ramus (Fig. 57) moderately elongated, 77 × 29 μ, 2.65 times longer than wide. Setae longer than in preceding species and naked except for the two long setae. Outer lateral seta 85 μ, outermost terminal seta 117 μ, innermost terminal seta 112 μ. Two long median terminal setae 390 μ (inner) and 275 μ (outer), with their edges in midregion roughened to suggest presence of extremely short lateral barbules, but these not clearly visible under oil immersion. Dorsal pedicellate seta relatively short, 50 μ. Dorsal surface of ramus with a few small hairs. No spinule seen on proximal outer margin of ramus.

Dorsal surface of prosome and dorsal and ventral surfaces of urosome with few scattered hairs and refractile points as in Figures 53 and 54. Ratio of length of prosome to that of urosome 1.57:1.

Egg sac (Fig. 57) relatively small, 385 × 220 μ in lateral view, containing about nine eggs, each approximately 112 μ in diameter.

Rostral area (Fig. 58) weakly developed.

First antenna (Fig. 59) slender, 341 μ long, segmented and armed as in previous two species. Lengths of segments: 28 (50 μ along anterior margin), 113, 28, 62, 40, 30, and 18 μ, respectively. All setae naked.

Second antenna (Fig. 60) 4-segmented, more slender than in *L. digitatus*. Penultimate segment 40 μ along outer edge, last segment 37 μ along outer edge and 21 μ along inner edge. Armature: 1, 1, 3, I. Setae small and naked. Apparently no setules near base of terminal claw, which is recurved and 42 μ along its axis.

Labrum (Fig. 61) with two posteroventral lobes of somewhat irregular outline and with hyaline medial margins.

Mandible (Fig. 62) resembling that of *L. digitatus*, with two similar digitiform processes on convex edge, but without spinules near the processes and with flagellum a little shorter. Paragnath (Fig. 63) a small lobe with hairs. First maxilla (Fig. 64) with three terminal elements and a lateral fringe. Second maxilla (Fig. 65) resembling that of *L. digitatus*, but second segment with process on proximal outer (ventral) margin broad and hyaline and seta on inner (dorsal) margin with hyaline lamellae. Maxilliped (Fig. 66) 3-segmented; first segment unarmed; second with two very unequal naked setae and lacking outer patch of spinules seen in previous species; third with two unequal naked setae and

a short terminal finely barbed spiniform process.

Area between maxillipeds and first pair of legs (Fig. 58) not protuberant; sclerotized line between bases of maxillipeds.

Legs 1–4 (Figs. 67, 68, 69, and 70) segmented as in previous two species, with same spine and setal formula. Leg 4 with inner seta on coxa minute and naked, 5 μ long; hairs present on inner margin of basis. Endopod of leg 4 with hairs along outer margins of both segments. First segment 26 × 20 μ in greatest dimensions, its plumose inner seta relatively short, 30 μ. Second segment 44 × 18 μ, with its two terminal fringed spines 31 μ (outer) and 41 μ (inner) in length.

Leg 5 (Fig. 71) with slightly recurved free segment greatly elongated, 203 × 30 μ, or 6.76 times longer than wide, reaching a little beyond posterior end of genital segment. Very small spinules along outer surface. Two naked terminal setae 80 μ (outer) and 100 μ (inner) in length; seta on body near free segment 65 μ long (a row of minute spinules near insertion of this seta).

Leg 6 probably represented by the two setae near attachment of egg sac (see Figure 55).

Color in life in transmitted light translucid to opaque, eye red.

Male.—Body (Fig. 72) with prosome more slender than in female, cephalosome more rounded anteriorly. Length 0.82 mm (0.80–0.85 mm) and greatest width 0.30 mm (0.28–0.31 mm), based on 3 specimens. Ratio of length to width of prosome 1.65:1.

Segment of leg 5 (Fig. 73) 39 × 90 μ. Between this segment and genital segment no ventral intersegmental sclerite. Genital segment longer than wide, 165 × 138 μ. Four postgenital segments 24 × 56, 26 × 53, 19 × 51, and 33 × 53 μ from anterior to posterior.

Caudal ramus resembling that of female, but shorter, 46 × 23 μ, or 2 times longer than wide.

Dorsal and ventral surfaces of body ornamented as in female with a few hairs and refractile points (Figs. 72 and 73). Ratio of length of prosome to that of urosome 1.43:1.

Rostral area as in female.

First antenna segmented and armed as in female, but two long aesthetes added on segment 2 and one on segment 4 (see Figure 72), so that formula is same as for males of previous two species. Second antenna (Fig. 74) resembling that of female, but having small spinelike knobs along inner surface of second segment.

Labrum, mandible, paragnath, first maxilla, and second maxilla similar to those in female. Maxilliped (Fig. 75) slender, segmented and armed as in *L. digitatus*; spinules on inner surface of second segment longer than in that species, and claw 172 μ along its axis.

Area between maxillipeds and first pair of legs as in female.

Legs 1–4 as in female, except for leg 1 which shows sexual dimorphism in last segment of endopod, formula here being I, I, 4 (Fig. 76), instead of I, 5 as in female.

Leg 5 (Fig. 77) with free segment much shorter than in female, 35 × 10 μ, its two terminal setae 60 μ (outer) and 68 μ (inner), and seta on body adjacent to free segment 58 μ. All setae naked as in female.

Leg 6 (Fig. 78) a posteroventral flap on genital segment, bearing two small naked setae 41 μ and 28 μ in length.

Spermatophore not seen.

Color in life as in female.

Etymology.—The specific name *prolixipes*, from Latin *prolixus* = long, and *pes* = foot, refers to the unusually long fifth legs in the female.

Comparison with related species.—*L. prolixipes* and *L. digitatus* show several features in common which indicate their close relationship. In both, the mandible has similar digitiform processes, the second antenna has a single claw, the formula for the last segment of the exopod of leg 4 is II, I, 5, and there is similar sexual dimor-

phism in the last segment of the endopod of leg 1 (female I, 5, male I, I, 4).

The new species may be readily distinguished from *L. digitatus*, however, by its smaller size, its shorter caudal rami, the shape of the genital segment, and the form of leg 5.

The distinctions made above in comparing *L. digitatus* with other species of *Lichomolgus* (which have the combination of one claw on the second antenna and the formula II, I, 5 on the last segment of the exopod of leg 4) apply also to *L. prolixipes*.

Lichomologus arcuatipes n. sp.

Figs. 79–104

Type material.—137 females, 111 males, and 13 immature specimens from *Acropora palifera* (Lamarck) in a depth of 2 m, Tany Kely, a small island to the south of Nosy Bé, Madagascar. Collected August 22, 1963. Holotype female, allotype, and 90 paratypes (50 females and 40 males) deposited in the United States National Museum, the same number of paratypes in the Museum of Comparative Zoology, and the remaining paratypes in the collection of A. G. Humes.

Other specimens (all from *Acropora palifera*).—84 females, 32 males, and 9 immature specimens in 2 m, Tany Kely, October 3, 1963; 61 females, 39 males, and 1 immature specimen in 0.5 m, Ambariobe, a small island almost between Nosy Komba and Nosy Bé, June 21, 1963.

Female.—Body (Fig. 79) with rather broadened prosome. Length 1.06 mm (1.01–1.11 mm) and greatest width 0.40 mm (0.38–0.41 mm), based on 10 specimens. Ratio of length to width of prosome 1.34:1. Epimeral areas of metasomal segments as in figure.

Segment of leg 5 (Fig. 80) 57 × 208 μ. Between this segment and genital segment no clearly defined ventral intersegmental sclerite. Genital segment subquadrate, 133 × 159 μ, a little wider than long, in dorsal view broadest in its anterior fourth and tapering slightly posteriorly. Areas of attachment of egg sacs located dorsally, each area (Fig. 81) with two small setae about 6 μ long. Three postgenital segments 75 × 89, 66 × 58, and 62 × 48 μ from anterior to posterior. A row of minute spinules along posteroventral border of anal segment.

Caudal ramus (Fig. 82) elongated, 130 × 18 μ, 7.2 times longer than wide. Certain setae with lateral spinules as in figure. Outer lateral seta 60 μ, outermost terminal seta 64 μ, innermost terminal seta 86 μ. Two long median terminal setae 180 μ (inner) and 117 μ (outer). Dorsal pedicellate seta 75 μ. Dorsal surface of ramus with a few small hairs, ventral surface with sclerotized knobs. No spinule seen on proximal outer margin of ramus.

Dorsal surfaces of prosome and urosome with scattered hairs and refractile points, ventral surface of urosome with refractile knobs (as on this surface of caudal ramus). Ratio of length of prosome to that of urosome 1.30:1.

Egg sac (Fig. 79) small, globular, 198 × 187 μ in dorsal view, containing usually 3 eggs (sometimes only 2) flattened against each other.

Rostral area (Fig. 83) not well developed, with refractile knobs.

First antenna (Fig. 84) slender, 278 μ long, segmented and armed as in previous three species. Lengths of segments: 21 (44 μ along anterior edge), 83, 23, 50, 39, 22, and 17 μ, respectively. All setae naked. A group of surficial sclerotizations on proximal dorsal surface of second segment.

Second antenna (Fig. 85) 3-segmented, last two segments being fused, with only a slight break in sclerotization of outer wall indicating bipartite nature. Armature: 1, 1, 2 + I. Last segment (fusion of original segments 3 and 4) with two minute spiniform projections, perhaps representing remnants of two of the three setae often present here in *Lichomolgus*. Terminal claw straight, about 20 μ long, apparently lacking an actual articulation with segment, no small elements near base of claw. With

scalelike knobs on antero-outer surface of second segment.

Labrum (Fig. 86) similar in general form to that of the previous species.

Mandible (Fig. 87) resembling that of *L. digitatus*, but distal convex margin produced, forming two lobes, proximal one with four slender digitiform processes, distal one broadly triangular. Paragnath (Fig. 88) a small lobe with hairs. First maxilla (Fig. 89) with three terminal elements. Second maxilla (Fig. 90) resembling that of the previous species, but element on proximal outer (ventral) margin a slender setule. Maxilliped (Fig. 91) slender, 3-segmented; first segment unarmed; second with two very unequal naked setae; third with two small naked elements and a short barbed terminal spiniform process.

Area between maxillipeds and first pair of legs (Fig. 92) not protuberant; sclerotized line between bases of maxillipeds.

Legs 1–4 (Figs. 93, 94, 95, and 96) segmented as in previous three species, with same spine and setal formula. Outer spines of exopods with either smooth or serrate lamellae, those of leg 1 as in Figure 93, those of legs 2 and 3 as in Figure 94, and those of leg 4 as in Figure 95. Leg 4 with inner coxal seta short, 16 μ, with a few lateral hairs proximally; hairs present on inner margin of basis. Endopod of leg 4 with hairs along outer margins of both segments and along inner distal margin of second segment. First segment 29×22 μ, with plumose inner seta 40 μ. Second segment 58×20 μ (greatest dimensions) with its two terminal fringed spines 39 μ (outer) and 47 μ (inner) in length.

Leg 5 (Fig. 97) with free segment elongated and strongly arched, with its tip extending dorsally over genital segment (as in Figure 80); dimensions about 117×24 μ, with inner surface slightly concave and outer surface convex and ornamented with short broad spinules. Two terminal naked setae 28 μ (outer) and 87 μ (inner). Naked seta on body near free segment 83 μ. A row of spinules on body near insertion of free segment.

Leg 6 probably represented by the two setae near attachment of egg sac (see Figure 81).

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

Male.—Body (Fig. 98) with rather broadened prosome as in female. Length 1.23 mm (1.15–1.28 mm) and greatest width 0.40 mm (0.39–0.43 mm), based on 10 specimens. Ratio of length to width of prosome 1.42:1.

Segment of leg 5 (Fig. 99) 55×153 μ. Between this segment and genital segment no ventral intersegmental sclerite. Genital segment quadrate, 208×200 μ. Four postgenital segments 65×81, 68×70, 62×60, and 78×60 μ, from anterior to posterior.

Caudal ramus resembling that of female, but larger in absolute dimensions, 161×24 μ, ratio of length to width a little less, 6.7:1.

Dorsal and ventral surfaces of body ornamented as in female. Ratio of length of prosome to that of urosome 0.88:1, urosome being a little longer than prosome.

Rostral area as in female.

First antenna segmented and armed as in female, but two long aesthetes added on segment 2 and one on segment 4 (see Figure 98), so that formula is same as for males of previous three species. Second segment with surficial sclerotizations as in female. Second antenna (Fig. 100) resembling that of female, but with inner margin of second segment somewhat irregular with two protuberances bearing scalelike knobs. Claw a little shorter and stouter than in female.

Labrum, mandible, paragnath, first maxilla, and second maxilla as in female. Maxilliped (Fig. 101) slender, segmented and armed as in the previous species; prominent spinules in two rows on inner surface of second segment. Claw 234 μ along its axis.

Area between maxillipeds and first pair of legs as in female.

Legs 1–4 resembling those in female, with similar segmentation and with same spine and setal formula, except for last segment of endopod of leg 1 (Fig. 102) where armature is I, I, 4, instead of I, 5 as in female. Outer spines (except first and last) on exopod of leg 2 showing finely serrated proximal lamellae (instead of smooth as in female); outer terminal spine on endopod of this leg with its outer lamella serrated instead of smooth.

Leg 5 (Fig. 103) with elongated straight free segment, 48 × 12 μ, without surficial ornamentation and much smaller than in female. Two terminal setae 34 μ (outer) and 13 μ (inner), and seta on body near free segment 60 μ. All setae naked.

Leg 6 (Fig. 104) a posteroventral flap on genital segment, bearing two small naked setae 17 and 23 μ in length.

Spermatophore not seen.

Color in life as in female.

Etymology.—The specific name *arcuatipes*, from Latin *arcuatus* = bent in the form of a bow, arched, and *pes* = foot, refers to the form of the fifth legs in the female.

Comparison with related species.—From those species of *Lichomolgus* having one claw on the second antenna and the formula II, I, 5 on the last segment of the exopod of leg 4 (see list above under *L. digitatus*), *L. arcuatipes* may be distinguished by the two lobes on the convex margin of the mandible, one with four slender digitiform processes, the other broadly triangular. These features are not present in any of the fifteen species listed above or in either *L. digitatus* or *L. prolixipes.*

Only one other species of *Lichomolgus*, *L. compositus* Humes and Frost, 1964, has a 3-segmented second antenna, but this species is unlike *L. arcuatipes* in such features as the number of eggs in the egg sac, the nature of the setae on the caudal rami, the surficial ornamentation of the second segment of the first antenna, the armature of the second maxilla, the nature of the outer spines on the exopods of legs 1–4, and the form and ornamentation of leg 5.

L. elegans Thompson and A. Scott, 1903, has one claw on the second antenna, but the formula for the last segment of the exopod of leg 4 is unknown. This species, however, has a very short caudal ramus, about as broad as long, and an elongated notched genital segment, thus distinguishing it from *L. arcuatipes.*

Lichomolgus lobophorus n. sp.

Figs. 105–133

Type material.—21 females, 15 males, and 2 immature specimens from *Acropora scherzeriana* Brueggemann in a depth of 1 m, Pte. Lokobe, Nosy Bé, Madagascar. Collected October 25, 1960. Holotype female, allotype, and 30 paratypes (18 females and 12 males) deposited in the United States National Museum, and the remaining paratypes in the collection of A. G. Humes.

Other specimens.—From *Acropora* sp.: 12 females and 20 males in 1 m, Ambariobe, a small island almost between Nosy Komba and Nosy Bé, September 17, 1963; 27 females, 19 males, and 1 immature specimen in 0.5 m, Ambariobe, October 20, 1963. From *Acropora cytherea* Dana: 14 females and 6 males in 1 m, Andilana (sometimes spelled Andilah), Nosy Bé, September 4, 1960.

Female.—Body (Fig. 105) with moderately broadened prosome. Length 1.27 mm (1.21–1.36 mm) and greatest width 0.50 mm (0.47–0.52 mm), based on 10 specimens. Ratio of length to width of prosome 1.44:1. Epimeral areas of metasomal segments expanded as in figure.

Segment of leg 5 (Fig. 106) 104 × 280 μ. Between this segment and genital segment a faint indication of an intersegmental sclerite ventrally. Genital segment rectangular, a little longer than wide, its lateral margins slightly indented in dorsal view. Length 247 μ, width in anterior half 234 μ and in posterior half 228 μ. Areas of attachment of egg sacs situated dorsally, each area

(Fig. 107) with two small naked setae about 7 μ long separated by a minute spinous process; adjacent area with hyaline setules. Three postgenital segments (Fig. 108) 120 × 164, 70 × 107, and 114 × 91 μ, measured dorsally, from anterior to posterior. First postgenital segment asymmetrical in lateral view (Fig. 109), extended ventrally and posteriorly as a prominent broad lobe underlying part of next segment (cf. Figure 108); ventral length of segment including lobe 169 μ. A row of minute spinules along outer posterior border of anal segment.

Caudal ramus (Fig. 110) elongated, 180 × 29 μ, 6.2 times longer than wide. Certain setae with lateral spinules as in figure. Outer lateral seta 73 μ, outermost terminal seta 65 μ, innermost terminal seta 73 μ. Two long median terminal setae 95 μ (inner) and 83 μ (outer). Dorsal pedicellate seta 55 μ. Dorsal and ventral surfaces of ramus with hairs and refractile areas (which appear to be minute depressions in the cuticula rather than knobs). No spinule seen on proximal outer margin of ramus.

Dorsal surface of prosome and dorsal and ventral surfaces of urosome with a few hairs and numerous refractile areas (apparently slight depressions in the cuticula). Ratio of length of prosome to that of urosome 1.42:1.

Egg sac (Figs. 105 and 111) small, globular, 237 × 195 μ in dorsal view, containing 6–7 eggs of somewhat irregular shape.

Rostral area (Fig. 112) not well developed, but covered anteriorly with refractile points.

First antenna (Fig. 113) slender, 376 μ long, segmented and armed as in previous four species. Lengths of segments: 31 (55μ along anterior edge), 136, 28, 62, 46, 28, and 21 μ, respectively. All setae naked.

Second antenna (Fig. 114) 3-segmented, last two segments having been fused, as in *L. arcuatipes*, but fusion even more complete, without an interruption in sclerotization of outer wall and without a trace of three setae usually seen on penultimate segment in *Lichomolgus*. Armature: 1, 1 (very small), I. Terminal claw straight, about 20 μ long, without definite articulation with segment; no minute elements near base of claw. Antero-outer surface of second segment with refractile areas (which, like those on body surface, seem to be slight depressions in the cuticula rather than knobs).

Labrum (Fig. 115) with two lobes more pointed than in previous species.

Mandible (Fig. 116) closely resembling that of *L. arcuatipes*. Paragnath (Fig. 117) a small hairy lobe. First maxilla (Fig. 118) with three terminal elements. Second maxilla (Fig. 119) and maxilliped (Fig. 120) much like those of *L. arcuatipes*.

Area between maxillipeds and first pair of legs (Fig. 121) not protuberant; sclerotized line between bases of maxillipeds.

Legs 1–4 (Figs. 122, 123, 124, and 125) segmented as in previous four species, with same spine and setal formula. Inner coxal seta of leg 4 moderately long, 41 μ, and haired; basis of this leg with hairs on inner margin. Endopod of leg 4 resembling that of *L. arcuatipes*. First segment 36 × 30 μ, with its plumose inner seta 69 μ. Second segment attenuated distally, 81 × 28 μ (greatest dimensions), with its two terminal fringed spines 50 μ (outer) and 57 μ (inner) in length.

Leg 5 (Fig. 126) with free segment elongated and arched (but less strongly so than in the previous species), dimensions about 200 × 35 μ, with outer convex surface ornamented with short stout spinules. Two terminal naked setae 38 μ (outer) and 75 μ (inner). Naked seta on body near free segment 90 μ. A row of spinules on body near insertion of free segment.

Leg 6 probably represented by the two setae near attachment of egg sac (see Figure 107).

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

Male.—Body (Fig. 127) with moderately broadened prosome. Length 1.15 mm

(1.11–1.19 mm) and greatest width 0.39 mm (0.37–0.39 mm), based on 10 specimens. Ratio of length to width of prosome 1.40:1.

Segment of leg 5 (Fig. 128) 65 × 166 μ. Between this segment and genital segment no ventral intersegmental sclerite. Genital segment quadrate, 260 × 270 μ, only a little wider than long. Four postgenital segments 78 × 112, 65 × 81, 50 × 72, and 90 × 71 μ, measured dorsally, from anterior to posterior. Second postgenital segment with a prominent broad posteroventral lobe as in female.

Caudal ramus resembling that of female, but shorter, 164 × 29 μ, 5.7 times longer than wide.

Dorsal and ventral surfaces of body ornamented as in female. Ratio of length of prosome to that of urosome 1.0:1.

Rostral area as in female.

First antenna segmented and armed as in female, but two long aesthetes added on segment 2 and one on segment 4 (see Figure 127), so that formula is same as for males of previous four species. Second antenna (Fig. 129) resembling that of female, but small knobs along inner margin of second segment proximal to minute setule.

Labrum, mandible, paragnath, first maxilla, and second maxilla as in female. Maxilliped (Fig. 130) rather closely resembling that of *L. arcuatipes*. Claw 330 μ along its axis.

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

Legs 1–4 resembling those of female, except formula for last segment of endopod of leg 1 (Fig. 131) which is I, I, 4, instead of I, 5 as in female.

Leg 5 (Fig. 132) with elongated straight free segment, 68 × 19 μ (greatest dimensions), with small spinules on outer surface. Two terminal setae 40 μ (outer) and 17 μ (inner), and seta on body near free segment 63 μ. All setae naked.

Leg 6 (Fig. 133) with two small naked setae 18 and 20 μ long.

Spermatophore not seen.

Color in life in transmitted light somewhat more amber than in female, eye red.

Etymology.—The specific name *lobophorus*, from λοβός = a lobe and φορέω = to bear or carry, alludes to the prominent posteroventral lobe on the first postgenital segment in the female (second in male).

Comparison with related species.—The prominent posteroventral lobe on the first postgenital segment of the female (and on the second postgenital segment of the male) distinguishes this species from all other known species of *Lichomolgus*.

By its 3-segmented second antenna (rather than 4-segmented), *L. lobophorus* differs from all species in the genus except *L. compositus* Humes and Frost, 1964, and *L. arcuatipes*. *L. compositus*, though showing a generally similar body form, is unlike the new species in the nature of the setae on the caudal rami, the details of the armature of segment 3 of the second antenna, the form of the mandible (lacking inner digitiform processes), the armature of the second maxilla, and the form of leg 5.

L. lobophorus, being similar to *L. arcuatipes* in many ways (particularly in the form of the mandible), is apparently closely related to it. However, *L. lobophorus* may be distinguished from *L. arcuatipes* by the posteroventral lobe on the postgenital region and by other details such as the number of eggs in the egg sac, the surficial ornamentation of the second segment of the first antenna, the form of the labral lobes, the nature of the outer spines on the exopods of legs 1–4, and the form and ornamentation of leg 5.

Lichomolgus geminus n. sp.

Figs. 134–150

Type material.—141 females and 102 males from *Stylophora pistillata* (Esper) in a depth of 0.5 m, Navetsy, Nosy Bé, Madagascar. Collected September 24, 1964. Holotype female, allotype, and 145 paratypes (90 females and 55 males) deposited in the United States National Museum, 45 paratypes (25 females and 20 males) in the

Museum of Comparative Zoology, and the remaining paratypes in the collection of A. G. Humes.

Other specimens.—From *Stylophora pistillata*: 15 females and 7 males in 0.2 m, Ambariobe, a small island almost between Nosy Komba and Nosy Bé, June 21, 1963; 9 females and 7 males in 0.5 m, Ambariobe, July 21, 1963; 36 females, 16 males, and 1 copepodid in 0.5 m, Ambariobe, August 4, 1963; 27 females and 21 males in 3 m, Ambariobe, August 13, 1963; 18 females and 8 males in 0.5 m, Ambariobe, October 6, 1963; and 2 females and 1 male in 0.5 m, west of Pte. Mahatsinjo, Nosy Bé, January 31, 1964. From *Stylophora mordax* (Dana): 21 females, 7 males, and 1 copepodid in 2 m, Pte. Ambarionaomby, Nosy Komba, near Nosy Bé, October 1, 1963. From *Acropora* sp.: 32 females and 6 males in 2 m, Pte. Lokobe, Nosy Bé, August 16, 1960.

Female.—Body form (Fig. 134) resembling that of *L. compositus* Humes and Frost, 1964. Length 1.59 mm (1.56–1.61 mm) and greatest width 0.58 mm (0.57–0.59 mm), based on 10 specimens. Ratio of length to width of prosome 1.38:1.

Segment of leg 5 (Fig. 135) 83 × 202 μ. Genital segment 146 × 138 μ, very similar in form to that of *L. compositus*. Areas of attachment of egg sacs dorsolaterally placed, each area (Fig. 136) with two very small setae (4 μ long) and a minute process. Three postgenital segments 125 × 138, 107 × 117, and 88 × 100 μ from anterior to posterior.

Caudal ramus (Fig. 137) greatly elongated, 265 × 29 μ (width taken at middle), tapering slightly distally, 9.1 times longer than wide. Setae short and naked, resembling those of *L. compositus*. Outer lateral seta 50 μ, outermost terminal seta 53 μ, innermost terminal seta 55 μ. Two median terminal setae broadened and hyaline, 68 μ (outer) and 75 μ (inner) in length. Dorsal pedicellate seta 34 μ. Both dorsal and ventral surfaces of ramus with minute hairs. No setule seen on proximal outer margin of ramus.

Egg sac (Fig. 138) small, globular, 244 × 212 μ in dorsal view, containing usually 4 eggs (sometimes 5).

Dorsal surface of prosome and dorsal and ventral surfaces of urosome with a few small hairs. Ratio of length of prosome to that of urosome 1.14:1. (In life the urosome may form a Z-shaped flexure, with the genital segment drawn forward under the metasome and the postgenital segments retained in line with the prosome.)

Rostral area with many long setules as in *L. compositus*.

First antenna segmented and armed as in *L. compositus*, first segment having only a single seta. Lengths of segments: 75 (88 μ along anterior edge), 101, 42, 59, 48, 34, and 25 μ, respectively.

Second antenna, labrum, mandible, paragnath, first maxilla, second maxilla, maxilliped, region between maxillipeds and first leg, leg 1, leg 2, and leg 3 like those of *L. compositus*.

Leg 4 (Fig. 139) segmented and armed as in *L. compositus*, last segment of exopod with the formula II, I, 5. Inner coxal seta naked and 22 μ long. Endopod somewhat longer than in that species; first segment 39 × 32 μ, with its plumose inner seta 65 μ; second segment 99 × 23 μ (length including terminal processes of 5 μ and width taken at widest point), narrowest width 12.5 μ, two terminal fringed spines 40 μ (outer) and 74 μ (inner) in length.

Leg 5 (Fig. 140) with free segment slender and arched, 147 × 14 μ (width taken at narrowest point at junction of first and second thirds), without fine ornamentation. Two terminal setae 26 μ (outer) and 88 μ (inner). Seta on body near insertion of free segment 35 μ. All setae naked.

Leg 6 probably represented by the two setae near attachment of egg sac (see Figure 136).

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

Male.—Body form (Fig. 141) like that of *L. compositus*. Length 1.49 mm (1.42–

1.55 mm) and greatest width 0.50 mm (0.48–0.51 mm), based on 10 specimens. Ratio of length to width of prosome 1.32:1.

Segment of leg 5 (Fig. 142) 55 × 161 μ. Genital segment 208 × 280 μ, wider than long. Four postgenital segments 57 × 94, 86 × 86, 73 × 82, and 78 × 86 μ from anterior to posterior. Caudal ramus (Fig. 153) similar to that in *L. compositus*, but longer, 229 × 31 μ, 7.4 times longer than wide.

Rostral area, first antenna (with aesthetes arranged as 0, 2, 0, 1, 1, 1, and 1), second antenna, labrum, mandible, paragnath, first maxilla, second maxilla, maxilliped (claw 305 μ along its axis), region between maxillipeds and first leg, and leg 1 (with last segment of endopod having one serrated spine, one setiform spine, and four setae) resembling those of *L. compositus*.

Exopods of legs 2, 3, and 4 as in *L. compositus*. Endopod of leg 2 with outer terminal spine on last segment (Fig. 144) modified as shown in detail in Figure 145. Endopod of leg 3 with outer terminal spine on last segment (Fig. 146) shorter than that in *L. compositus*, but not as greatly modified as in preceding leg. Endopod of leg 4 (Fig. 147) elongated; first segment 39 × 33 μ, with its plumose seta 77 μ; second segment 111 × 27 μ (length including terminal processes of 5 μ and width taken at widest point), narrowest width 12.5 μ, two terminal fringed spines 43 μ (outer) and 79 μ (inner) in length.

Leg 5 (Fig. 148) with elongated rectangular free segment 50 × 12.5 μ, unornamented, its two naked terminal setae 28 μ (outer) and 34 μ (inner) in length.

Leg 6 (Fig. 149) the usual posteroventral flap on genital segment, bearing two small naked setae 23 and 19 μ in length.

Spermatophore (Fig. 150), attached to female, oval, 174 × 107 μ (not including the short neck).

Color in life as in female.

Etymology.—The specific name *geminus*, from Latin = twin-born or similar, refers to the close similarity of this species to *L. compositus*.

Comparison with related species.—*L. geminus* shows three features which in combination serve to distinguish it from all species of *Lichomolgus* except *L. compositus* Humes and Frost, 1964 (associated with the coral *Seriatopora subseriata* Ehrenberg in Madagascar). These are: the presence of only a single seta on segment 1 of the first antenna, a 3-segmented second antenna, and the two short broad hyaline setae on the caudal ramus. *L. lobophorus* and *L. arcuatipes* both have a 3-segmented second antenna, but differ from the new species in having four setae on segment 1 of the first antenna, and in having relatively unmodified setae on the caudal ramus.

L. geminus appears to be very closely related to *L. compositus*, the two species showing striking similarities. There exist, however, several significant differences which are sufficiently important in our opinion to warrant considering these copepods from *Stylophora* as representing a distinct species. In *L. geminus* the endopod of leg 4 is relatively more slender than in *L. compositus*, the free segment of leg 5 in the female is more slender, the caudal ramus is longer and more slender (9.1:1 in the female, 7.4:1 in the male), the egg sac is globular with 4–5 eggs (7 eggs in *L. compositus*), and there is sexual dimorphism in the outer terminal spine on the last segment of the endopods of legs 2 and 3 in the male.

Lichomolgus crassus n. sp.

Figs. 151–182

Type material.—54 females and 27 males from *Stylophora pistillata* (Esper) in a depth of 0.5 m, Ambariobe, a small island nearly between Nosy Komba and Nosy Bé, Madagascar. Collected August 4, 1963. Holotype female, allotype, and 61 paratypes (41 females and 20 males) deposited in the United States National Museum, 14 paratypes (10 females and 4 males) in the

Museum of Comparative Zoology, and the remaining paratypes in the collection of A. G. Humes.

Other specimens.—From *Stylophora pistillata*: 1 female and 5 males in 0.2 m, Ambariobe, June 21, 1963; 3 males in 0.5 m, Ambariobe, July 21, 1963; 1 female and 16 males in 0.5 m, Ambariobe, August 13, 1963; 1 female and 10 males in 0.5 m, Ambariobe, October 6, 1963; 3 males in 0.5 m, west of Pte. Mahatsinjo, Nosy Bé, January 31, 1964; and 1 female and 33 males in 0.5 m, Navetsy, Nosy Bé, September 24, 1964. From *Stylophora mordax* (Dana): 33 males in 2 m, Pte. Ambarionaomby, Nosy Komba, near Nosy Bé, October 1, 1963. From *Acropora* sp.: 15 males in 2 m, Pte. Lokobe, Nosy Bé, August 16, 1960.

Female.—Body (Figs. 151 and 152) with broadened and thickened prosome; urosome slender and in life folded under metasome with only postgenital segments visible in dorsal view. Length 1.38 mm (1.32–1.44 mm) and greatest width 0.66 mm (0.60–0.72 mm), based on 10 specimens. Greatest dorsoventral thickness 0.48 mm. Segment of leg 1 clearly set off from head; epimeral areas of metasomal segments as in figures. Ratio of length to width of prosome 1.07:1.

Segment of leg 5 (Fig. 153) 96 × 257 μ. Genital segment (Fig. 153) rather narrow, wider in its anterior third (156 μ) than in its posterior two-thirds (127 μ); its dorsal length (95 μ) much shorter than its ventral length (195 μ). Areas of attachment of egg sacs located dorsolaterally, each area (Fig. 154) with two minute setae about 6 μ in length with a spiniform process between them. First postgenital segment (Fig. 155) shorter dorsally (60 μ) than ventrally (112 μ) and 117 μ wide; second 83 × 96 μ, and third 78 × 98 μ (this last segment apparently without a row of spinules along posteroventral margin).

Caudal ramus (Fig. 156) moderately elongated, 112 × 39 μ, 2.87 times longer than wide. Setae relatively short and naked. Outer lateral seta 41 μ, outermost terminal seta 50 μ, innermost terminal seta 46 μ. Two median terminal setae broadened, 68 μ (outer) and 73 μ (inner) in length. Dorsal pedicellate seta 30 μ. Both dorsal and ventral surfaces of ramus with a few minute hairs and refractile points. No setule seen on proximal outer margin of ramus.

Egg sac unkown.

Dorsal surface of prosome with many refractile points. Dorsal and ventral surfaces of urosome with a few hairs and refractile points. Ratio of length of prosome to that of urosome difficult to establish because of flexure of urosome, but estimated to be about 1.5:1.

Rostral area (Fig. 157) with many hyaline setules. On ventral surface of head a sclerotized ridge extending from insertion of first antenna diagonally toward posterolateral corners of head region.

First antenna (Fig. 158) segmented and armed as in *L. compositus* and *L. geminus*, first segment having only a single seta (in one female first segment of one antenna had an extra seta). Lengths of segments: 66 (84 μ along anterior edge), 70, 40, 35, 42, 21, and 19 μ respectively. All setae short and naked.

Second antenna (Fig. 159) 3-segmented as in *L. compositus*, *L. arcuatipes*, *L. lobophorus*, and *L. geminus*, the dual nature of the slender third segment (formed by fusion of original segments 3 and 4) indicated by three small obtuse hyaline elements (representing the usual three setae on penultimate segment in *Lichomolgus*). Armature: 1, 1, 3 + I + 2 small obtuse elements. Terminal claw short (25 μ along its axis) and reflexed.

Labrum (Fig. 160) with a few hyaline setules, its posteroventral margin bilobed.

Mandible (Fig. 161) resembling that of *L. compositus* and *L. geminus*. Paragnath (Fig. 162) a small somewhat pointed lobe with hairs. First maxilla (Fig. 163), with four elements, second maxilla (Fig. 164), and maxilliped (Fig. 165), resembling those of *L. compositus* and *L. geminus*.

Area between maxillipeds and first pair

of legs (Fig. 166) not protuberant; sclerotized line between bases of maxillipeds not complete.

Legs 1–4 (Figs. 167, 168, 169, and 170) segmented as in previous six species, with same spine and setal formula. Inner coxal seta of leg 4 short, 22 μ in length, and naked; basis of this leg with hairs on inner margin. Spines on exopod of leg 1 lamellate, with short proximal spinules and terminal flagella; these spines on legs 2–4 with smooth lamellae. Endopod of leg 4 moderately elongated. First segment 28 × 24 μ, with its plumose inner seta 40 μ. Second segment 57 × 22 μ (greatest dimensions), its terminal spines naked with obtuse tips, outer 33 μ, inner 56 μ in length.

Leg 5 (Fig. 171) with elongated free segment 88 × 14 μ, only slightly arched and without fine ornamentation. Two terminal setae 24 μ (outer) and 60 μ (inner). Seta on body near insertion of free segment 23 μ. All setae naked.

Leg 6 probably represented by the two small elements near attachment of egg sac (see Figure 154).

Color in life in transmitted light translucid to opaque, reddish amber areas at bases of first antennae and external to insertions of legs, eye red.

Male.—Body (Fig. 172) with prosome less broadened and thickened than in female; urosome not folded under metasome, but extended in a more usual position. Length 1.23 mm (1.20–1.25 mm) and greatest width 0.51 mm (0.50–0.51 mm), based on 10 specimens. Ratio of length to width of prosome 1.2:1.

Segment of leg 5 (Fig. 173) 68 × 168 μ. Genital segment 177 × 224 μ, wider than long, with rounded lateral margins. Four postgenital segments 44 × 91, 64 × 85, 70 × 74, and 65 × 75 μ from anterior to posterior.

Caudal ramus (Fig. 174) similar to that of female, but longer, 149 × 29 μ, 5.13 times longer than wide.

Rostral area as in female.

First antenna (Fig. 175) segmented and armed as in female, but two aesthetes added on segment 2 and one on segment 4, so that formula is same as for males of *L. compositus* and *L. geminus*.

Second antenna, labrum, mandible, paragnath, first maxilla, and second maxilla resembling those of female. Maxilliped (Fig. 176) segmented and armed as in previous species. Claw 145 μ along its axis (including lamella), showing a distinct line of division about midway, and having hyaline serrations along concave margin.

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

Legs 1–4 with same spine and setal formula as in female. Leg 1 (Fig. 177) with spines on exopod and single spine on endopod much more strongly barbed than in female. Legs 2 and 3 with spines on exopods moderately barbed, those on endopod of leg 2 as in Figure 178, and on endopod of leg 3 as in Figure 179. Leg 4 with spines on exopod slightly barbed. Endopod (Fig. 180) longer than in female; first segment 30 × 31 μ, with its plumose inner seta 58 μ; second segment 75 × 25 μ, more attenuated than in female, with its two terminal spines 37 μ (outer) and 66 μ (inner) in length.

Leg 5 (Fig. 181) with straight and moderately short free segment, 35 × 10 μ, without fine ornamentation. Two terminal naked setae 23 and 37 μ long.

Leg 6 (Fig. 182) a posteroventral flap on genital segment, bearing two small naked setae 20 and 17 μ in length.

Spermatophore seen only partly developed inside body of male (Fig. 182).

Color in life resembling that of female.

Etymology.—The specific name *crassus*, from Latin = thick or solid, alludes to the broadened and thickened prosome.

Comparison with related species.—*L. crassus* may be distinguished from all but four species of *Lichomolgus* by its 3-segmented second antenna (resulting from a fusion of segments 3 and 4). These four species are: *L. compositus* Humes and Frost, 1964, *L. arcuatipes*, *L. lobophorus*, and *L. geminus*. Two of these, *L. arcuatipes* and *L. lobophorus*, differ from the

new species in having four setae (instead of one) on the first segment of the first antenna and in having four small fingerlike processes on the basal part of the mandible. The other two, *L. compositus* and *L. geminus*, differ in showing sexual dimorphism in the formula for leg 1 (last segment of endopod I, 5 in the female, I, I, 4 in the male) and in having a less broadened prosome (ratio of length to width in female of *L. compositus* 1.27:1, in *L. geminus* 1.38:1).

On the basis of several points of similarity in *L. crassus*, *L. compositus*, and *L. geminus*, such as the setulose rostral area, the single seta on the first segment of the first antenna, the structure of the mandible, and the two broadened and relatively short terminal setae on the caudal ramus, these three species appear to be closely related.

Lichomolgus actinophorus Humes and Frost, 1964

This species has been previously reported (Humes and Frost, 1964) from *Pavona angulata* Klunzinger and *Pavona cactus* (Forskål) in Madagascar. New host records are:

1) From *Pavona danai* (Milne Edwards and Haime): 31 females and 29 males in 10 cm, Ambariobe, near Nosy Bé, October 6, 1963; 189 females and 193 males in 10 cm, Boloboxo, Nosy Faly, east of Nosy Bé, August 10, 1964.

2) From *Pavona danai* or *Pavona angularis* (Klunzinger): 111 females and 87 males in 1 m, Ambariobe, September 6, 1963. Identification of host uncertain.

3) From *Pavona*? *venusta* (Dana): 28 females and 22 males in 1 m, Ambariobe, September 17, 1963.

Lichomolgus compositus Humes and Frost, 1964

This species has been known only from *Seriatopora subseriata* Ehrenberg in Madagascar (Humes and Frost, 1964). It is now reported as follows:

1) From *Seriatopora octoptera* Ehrenberg: 14 females and 2 males in 2 m, Pte. Ambarionaomby, Nosy Komba, August 18, 1960.

2) From *Seriatopora* sp.: 8 females and 2 males in 1 m, Pte. Ambarionaomby, January 12, 1964.

Monomolgus unihastatus Humes and Frost, 1964

This lichomolgid has been reported only from *Porites* sp. cf. *P. andrewsi* Vaughan in Madagascar (Humes and Frost, 1964). It is now recorded from *Porites* sp. cf. *P. nigrescens* Dana (111 females and 93 males in 1 m, Pte. de Tafondro, Nosy Bé, September 19, 1963).

Kombia angulata Humes, 1962

This copepod has been previously known only from *Psammocora* sp. in Madagascar (Humes, 1962). New host records are:

1) From *Porites* (s. g. *Synaraea*) sp.: 19 females and 43 males in 1 m, Pte. Ambarionaomby, Nosy Komba, November 28, 1963; 28 females and 28 males in 1 m, Pte. Lokobe, Nosy Bé, November 29, 1963; 6 females and 32 males in 2 m, northern end of Nosy Sakatia, an island close to the western shore of Nosy Bé, August 19, 1963; 4 females in 1 m, Ambariobe, near Nosy Bé, September 17, 1963; 10 females and 14 males in 2 m, northern end of Nosy Sakatia, September 18, 1963; 8 females and 10 males in 1 m, Pte. de Tafondro, Nosy Bé, October 2, 1963; 102 females and 153 males in 1 m, Pte. Lokobe, November 30, 1963; and 7 females and 8 males in 1–2 m, Ankify, on the mainland of Madagascar, near Nosy Komba, December 30, 1963.

2) From *Porites* sp. cf. *P. nigrescens* Dana: 1 female and 1 male in 1 m, Pte. de Tafondro, September 19, 1963.

3) From *Porites*, young colony: 3 females and 5 males in 1 m, Pte. de Tafondro, September 19, 1963.

Although Humes (1962) indicated that the genus *Kombia* should probably be placed in the Xarifiidae, it would now seem

that *Kombia* belongs instead to the Lichomolgidae. The discovery of certain new genera of the Lichomolgidae since 1962 has widened our concept of the family. The mouthparts of *Kombia* are essentially lichomolgid in form, though the flagellum of the mandible is relatively short compared to most other genera. A somewhat similar short flagellum is present in other lichomolgids, for example, *Monomolgus unihastatus* Humes and Frost, 1964, and *Rhynchomolgus corallophilus* Humes and Ho, 1967a. The tendency in *Kombia* toward reduction of legs 1–5, beginning at the posterior end of the series, is seen also in *Rhynchomolgus* (where it is even more strongly expressed). Since the limits of the Lichomolgidae, as we see them, now include such transformed genera as *Rhynchomolgus*, it does not seem inconsistent to include *Kombia* in this family.

PRIONOMOLGUS n. gen.

Type and only known species: *Prionomolgus lanceolatus* n. sp.

Body cyclopoid. Segment of leg 1 in female separated from head by a dorsal and lateral furrow, in male lacking this separation. Urosome 5-segmented in female, 6-segmented in male. Caudal ramus with six setae. First antenna 7-segmented, with lichomolgid setation. Second antenna 3-segmented. Mouthparts lichomolgid. Mandible with proximal region having two strongly serrated lobes on concave edge; flagellum relatively short. Paragnath a small nearly naked lobe. First maxilla with three setae. Second maxilla 2-segmented. Maxilliped in female 3-segmented, in male 4-segmented (fourth segment probably forming part of terminal claw).

Legs 1–4 with 3-segmented rami, except for endopod of leg 4 which is 2-segmented. Leg 1 in male showing sexual dimorphism, formula for last segment of endopod being I, I, 4, instead of I, 5 as in female. Endopod of leg 4 with formula 0–1; I. Leg 5 with free segment bearing two terminal setae.

Other features as in the species described below.

Associated with madreporarian corals.

Gender masculine.

Etymology.—The generic name is a combination of πρίων = a saw (alluding to the serrated lobes on the mandible) and μολγός = a sack made of leather.

Prionomolgus lanceolatus n. gen., n. sp. Figs. 183–210

Type material.—31 females, 67 males, and 23 copepodids from *Pachyseris speciosa* (Dana) in a depth of 3 m, Pte. Ambarionaomby, Nosy Komba, near Nosy Bé, Madagascar. Collected September 3, 1963. Holotype female, allotype, and 79 paratypes (25 females and 54 males) deposited in the United States National Museum, 13 paratypes (3 females and 10 males) in the Museum of Comparative Zoology, and the remaining paratypes in the collection of A. G. Humes.

Other specimens (all from *Pachyseris speciosa* in 2 m, Ambariotsimaramara, an islet on the southern shore of Nosy Bé, between Pte. Mahatsinjo and Ampombilava).—6 females, 9 males, and 4 copepodids, October 18, 1963; 2 females and 1 male, June 12, 1964.

Female.—Body (Fig. 183) with flattened and broadened prosome. Length 1.36 mm (1.26–1.42 mm) and greatest width 0.85 mm (0.77–0.91 mm), based on 10 specimens. Ratio of length to width of prosome about 1:1. Segment of leg 1 separated from head dorsally and laterally by a furrow. Epimeral areas of segments of legs 1–3 expanded, those of segment of leg 4 short and pointed.

Segment of leg 5 (Fig. 184) 55 × 263 μ. Between this segment and genital segment no ventral intersegmental sclerite discernible. Genital segment broadened in its anterior fourth and tapered posteriorly, its greatest dimensions being 166 × 245 μ, wider than long. Areas of attachment of egg sacs situated dorsolaterally, each area (Fig. 185) with two minute setae 5 μ in

length. Three postgenital segments 83 × 92, 68 × 88, and 78 × 90 μ from anterior to posterior. Anal segment with a row of minute spinules along its posteroventral margin on each side and two short rows of similar spinules posterodorsally near insertion of ramus (see Figure 186).

Caudal ramus (Fig. 186) moderately elongated, 100 × 39 μ, 2.56 times longer than wide. Outer lateral seta 100 μ and naked, outermost terminal seta 105 μ with a few proximal hairs, innermost terminal seta 113 μ with proximal hairs. Two long median terminal setae 340 μ (inner) and 230 μ (outer), both with very short barbules along their midregions. Dorsal pedicellate seta short, 40 μ, and haired. Dorsal and ventral surfaces of ramus with short hairs and refractile points.

Dorsal surface of prosome with many refractile points and a few hairs; dorsal and ventral surfaces of urosome with a few refractile points. Ratio of length of prosome to that of urosome 1.84:1.

Egg sac (Fig. 187) oval, 363 × 242 μ, containing about 15 eggs, each 94–104 μ in diameter.

Rostral area (Fig. 188) weakly developed, without a definite posteroventral margin.

First antenna (Fig. 189) slender, 376 μ long, and 7-segmented, with a sclerite on third segment suggesting an intercalary segment. Lengths of segments: 42 (86 μ along anterior margin), 141, 26, 42, 39, 27, and 15 μ respectively. Formula for armature: 4, 13 (5 + 2 + 6), 6, 3, 4 + 1 aesthete, 2 + 1 aesthete, and 7 + 1 aesthete, as in many species of *Lichomolgus*. Several setae on last three segments distally haired as in figure.

Second antenna (Fig. 190) slender and 3-segmented, the last segment representing the fusion of two original segments (dual nature of this segment indicated by presence of three small setae corresponding to those usually found on segment 3 in other lichomolgids). Armature: 1, 1, 3 + I + 1 small hyaline element. Terminal claw short, about 24 μ along its axis.

Labrum (Fig. 191) with two posteroventral lobes having broad medial hyaline margins.

Mandible (Fig. 192) with proximal region separated into two parts by a constriction. Distal area beyond constriction having on its convex side a short row of spinules followed by a triangular process and then by a row of small spinules; on its concave side two lobes with strongly serrated margins. Flagellum relatively short with lateral serrations. Paragnath (Fig. 193) a small lobe, naked except for a single small setule. First maxilla (Fig. 194) having three elements with serrated flanges. Second maxilla (Fig. 195) 2-segmented. First segment unarmed. Second segment with its outer (ventral) margin bearing a minute proximal spinule and a distal spinulose seta, with its inner (dorsal) margin carrying a blunt seta with hyaline lamellae; terminal lash with long proximal spinules and distal serrations. Maxilliped (Fig. 196) 3-segmented; first segment unarmed, second with two sparsely barbed inner setae, and third with two setae (one small and naked, the other larger and barbed) and terminating in a slender barbed spiniform process.

Area between maxillipeds and first pair of legs (Fig. 188) not protuberant; a sclerotized line between bases of maxillipeds.

Legs 1–4 (Figs. 197, 198, 199, and 200) with trimerous rami, except for endopod of leg 4 which is 2-segmented. Armature as follows:

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, II, 2
P_4	protopod 0–1; 1–0	exp I–0; I–1; II, 1, 5 end 0–1; I

Inner coxal seta long and haired in legs 1–3, but in leg 4 only 6 μ long and naked. Hairs on inner margin of basis in all four legs. Outer spines on exopod of leg 1 with

coarsely spinulose lamellae and having flagella; those of legs 2–4 with finely spinulose lamellae and without flagella. Endopod of leg 4 (Fig. 201) with hairs along outer margins of both segments. First segment 22 × 14 μ (greatest dimensions), its plumose inner seta 56 μ long. Second segment 26 × 9 μ (greatest dimensions), somewhat narrowed distally, its single terminal spine 33 μ long with narrow hyaline lamellae.

Leg 5 (Fig. 202) having a moderately elongated free segment 84 μ long, 25 μ wide at the level of proximal inner expansion and 17 μ wide halfway from the outer marginal notch to the end. Two terminal naked setae 60 and 77 μ in length. Outer surface of segment with small spinules. Seta on body near free segment 77 μ long and naked; a row of spinules near this seta.

Leg 6 probably represented by the two setae near attachment of egg sac (see Figure 185).

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

Male.—Body (Fig. 203) with broad flattened prosome nearly as in female. Length 1.04 mm (0.99–1.08 mm) and greatest width 0.53 mm (0.49–0.55 mm), based on 10 specimens. Ratio of length to width of prosome 1.12:1. Segment of leg 1 not separated from head by a furrow. Epimeral areas of metasomal segments as in female.

Segment of leg 5 (Fig. 204) 26 × 172 μ. Between this segment and genital segment no ventral intersegmental sclerite. Genital segment broader than long, 208 × 270 μ, its lateral borders sclerotized and rounded anteriorly but hyaline and crenated posteriorly. Four postgenital segments 36 × 70, 42 × 67, 40 × 63, and 61 × 67 μ from anterior to posterior.

Caudal ramus resembling that of female, but smaller, 88 × 31 μ, with hairs on setae fewer than in female (see Figure 204).

Dorsal and ventral surfaces of body ornamented as in female. Ratio of length of prosome to that of urosome 1.33:1.

Rostral area like that of female.

First antenna segmented and armed as in female, but two aesthetes added on segment 2 and one on segment 4, so that formula is 4, 13 + 2 aesthetes, 6, 3 + 1 aesthete, 4 + 1 aesthete, 2 + 1 aesthete, and 7 + 1 aesthete. Second antenna, labrum, mandible, paragnath, first maxilla, and second maxilla as in female. Maxilliped (Fig. 205) slender and 4-segmented, assuming that the proximal part of claw represents a fourth segment. First segment unarmed, second with two naked setae and two rows of spinules on its inner surface, third small and unarmed. Claw elongated, slender, and recurved, 196 μ along its axis (including terminal lamella), with weak indication of division about midway; proximally with two unequal setae, the smaller seta naked, the larger with distal spinules.

Area between maxillipeds and first pair of legs as in female.

Legs 1–4 segmented and armed as in female, except for last segment of endopod of leg 1 where formula is I, I, 4 (Fig. 206), instead of I, 5 as in female. Endopod of leg 4 (Fig. 207) with second segment relatively shorter than in female; first segment 15 × 11 μ, with its plumose inner seta 41 μ, and second segment 17.5 × 8 μ, with its terminal spine 28 μ.

Leg 5 (Fig. 208) with free segment 42 × 9 μ, lacking an inner proximal expansion, with outer marginal notch less evident than in female, and with fewer outer spinules than in opposite sex. Two terminal setae 28 and 48 μ; seta on body near insertion of free segment 56 μ.

Leg 6 (Fig. 209) consisting of a posteroventral flap on genital segment, bearing two slender naked setae 33 and 38 μ long.

Spermatophore (Fig. 210), attached to female in a pair, about 200 × 95 μ (not including the neck).

Color in life similar to that of female.

Etymology.—The specific name *lanceolatus*, from the Latin word *lanceola* = a small lance, refers to the single terminal spine on the endopod of leg 4.

Comparison with other lichomolgids.—In the Lichomolgidae eight genera have a 2-segmented endopod in leg 4. These are: *Lichomolgus* Thorell, 1860, *Epimolgus* Bocquet and Stock, 1956, *Gelastomolgus* Humes, in press, *Indomolgus* Humes and Ho, 1967c, *Lichomolgides* Gotto, 1954, *Monomolgus* Humes and Frost, 1964, *Nasomolgus* Sewell, 1949, and *Stellicola* Kossmann, 1877. (*Macrochiron* Brady, 1872, has a 1-segmented endopod which may be partially divided.) Of these only *Gelastomolgus* has the formula for the endopod of leg 4 as 0–1; 1, thus resembling *P. lanceolatus*.

The new genus and species differs, however, from *Gelastomolgus spondyli* Humes, in press, in several important respects. In *G. spondyli* the body form is rather modified from the usual cyclopoid type, the second antenna is 4-segmented, the mandible has a broad elongated blade and lacks serrated lobes, the maxilliped of the female is apparently 2-segmented and much modified, and leg 1 has the same formula in both sexes.

The mandible of *P. lanceolatus*, although basically lichomolgid in form, differs from that in all other genera in the family. In no other genus do the two lobes on the concave side of the basal part of the mandible possess strongly serrated margins; in those genera where such lobes occur they are ornamented with spinules or hairs.

Since there seems to be no known genus in the Lichomolgidae which could receive the new species from *Pachyseris* without radically broadening the generic concept, we have concluded that the species represents a new genus, basing our judgment primarily on the nature of the mandible and the form and armature of the endopod of leg 4.

HAPLOMOLGUS n. gen.

Type and only known species: *Haplomolgus montiporae* n. sp.

Body cyclopoid. Segment of leg 1 fused with head. Urosome 5-segmented in female, 6-segmented in male. Caudal ramus with six setae. First antenna 7-segmented, with lichomolgid setation. Second antenna 4-segmented. Mouthparts lichomolgid.

Legs 1–4 with 3-segmented rami, except for endopod of leg 4 which is composed of a single unarmed segment, often bearing a small rounded terminal lobe. Leg 5 with a large free segment armed with two terminal setae.

Other features as in the species described below.

Associated with madreporarian corals.

Etymology.—The generic name is a combination of ἁπλόος = single (alluding to the 1-segmented unarmed endopod of leg 4) and μολγός = a sack made of leather. Gender masculine.

Haplomolgus montiporae n. gen., n. sp.

Figs. 211–240

Type material.—147 females and 81 males from *Montipora sinensis* Bernard in a depth of 1 m, Nosy Taolankena, a small island on the northwestern side of Nosy Bé, Madagascar. Collected November 15, 1963. Holotype female, allotype, and 140 paratypes (90 females and 50 males) deposited in the United States National Museum, 45 paratypes (30 females and 15 males) in the Museum of Comparative Zoology, and the remaining paratypes in the collection of A. G. Humes.

Other specimens.—From *Montipora* sp.: 58 females and 19 males in 1 m, west of Pte. de Tafondro, Nosy Bé, December 3, 1963; 165 females and 66 males in 3 m, western side of Nosy Komba, near Nosy Bé, October 19, 1964. From *Montipora* sp. cf. *M. stellata* Bernard: 27 females and 12 males in 2 m, Ampombilava, Nosy Bé, September 26, 1964.

Female.—Body (Fig. 211) rather slender, with prosome moderately thickened dorsoventrally. Length 0.86 mm (0.83–0.89 mm) and greatest width 0.27 mm (0.26–0.29 mm), based on 10 specimens. Ratio of length to width of prosome 1.5:1. Segment of leg 1 not separated from head. Epimeral areas

of metasomal segments only moderately expanded.

Segment of leg 5 (Fig. 212) 101 × 146 μ. Genital segment 112 × 96 μ, only a little longer than wide and slightly wider in its anterior half than posteriorly. Areas of attachment of egg sacs located dorsally, each area (Fig. 213) with two small setae 4 μ long. Three postgenital segments (Fig. 214) 65 × 65, 78 × 55, and 37 × 55 μ from anterior to posterior, the middle segment being the longest. Edge of anal operculum with a row of minute spinules.

Caudal ramus (Fig. 215) moderately elongated, 48 × 21 μ, about 2.3 times longer than wide. Outer lateral seta 54 μ, outermost terminal seta 58 μ, innermost terminal seta 77 μ. Two long median terminal setae 218 μ (inner) and 156 μ (outer). Dorsal pedicellate seta 73 μ. All setae naked. A few hairs on dorsal surface of ramus.

Dorsal surface of prosome and urosome with a few hairs. Ratio of length of prosome to that of urosome 1.21:1.

Egg sac (Fig. 211) approximately 215 × 133 μ, containing two large eggs 107–133 μ in diameter.

Rostrum (Fig. 216) well formed, extending as a tongue-shaped raised area between bases of antennae. Between rostrum and labrum a small raised keel-like area.

First antenna (Fig. 217) slender, 203 μ long, and 7-segmented. Lengths of segments: 17 (35 μ along anterior margin), 64, 18, 19, 30, 22, and 15 μ respectively. Formula for armature: 4, 13 (5 + 2 +6), 6, 3, 4 + 1 aesthete, 2 + 1 aesthete, and 7 + 1 aesthete, as in many lichomolgids. All setae naked.

Second antenna (Fig. 218) 4-segmented. Armature: 1, 1, 3, I. Last segment 28 μ along outer side, 15 μ along inner side. Terminal claw 23 μ along its axis.

Labrum (Figs. 216 and 219) with its free edge having two widely divergent narrow lobes. Immediately dorsal to posteromedian area of labrum two pairs of small spiniform processes.

Mandible (Fig. 220) with an unusually slender proximal part and broadened distal part, the two areas separated by a constricted neck. Distal part bearing on its convex side a large pointed posteriorly directed process (partly hyaline) followed by a row of small serrations, and on its concave side two lobes, each with a row of slender and slightly obtuse spinules. Flagellum moderately long, with lateral spinules distally. Paragnath (Fig. 221) a small lobe with a few hairs. First maxilla (Fig. 222) a single segment with four elements, three finely spinulose setae and a smaller naked seta. Second maxilla (Fig. 223) 2-segmented. First segment with a minute spinule. Second segment bearing on its outer (ventral) margin a minute proximal spinule and a distal lamellate seta and on its inner (dorsal) margin a seta with a row of minute spinules; terminal lash with a row of dentiform spinules becoming more slender distally. Maxilliped (Fig. 224) 3-segmented; first segment unarmed, second with two very unequal setae, and third with two setae (one large and barbed, the other small and naked) and terminating in a barbed spiniform process.

Area between maxillipeds and first pair of legs not protuberant and formed as in Figure 216. Immediately anterior to this area and between second maxillae a median minutely setose lobe.

Legs 1–4 (Figs. 225, 226, 227, and 228) with trimerous rami, except for endopod of leg 4 which has only a single segment. Armature as follows:

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; II, I, 5 end 0–1; 0–2; II, 2
P_4	protopod 0–1; 1–0	exp I–0; I–1; II, I, 5 end 0

Inner coxal seta long and haired in legs 1–3, but in leg 4 only 7 μ long and naked. Hairs on inner margin of basis in all four legs. Endopod of leg 3 (Fig. 227) with last segment having formula of II, 2, in-

stead of I, II, 2 as often seen in other lichomolgid genera. Endopod of leg 4 (Fig. 229) a single small unarmed segment 17 × 9 μ, bearing a few outer hairs. Often on this endopod a small distal hyaline lobe is present (Figs. 230 and 231), probably not representing a segment.

Leg 5 (Fig. 232) with a broad free segment 85 × 40 μ, its inner surface slightly concave, and armed with two terminal naked setae 39 and 44 μ long. Between these two setae a patch of minute spinules. Seta on body near free segment 46 μ and naked.

Leg 6 probably represented by the two setae near attachment of egg sac (see Figure 213).

Color in life in transmitted light slightly amber, eye red, egg sacs grayish black.

Male.—Body (Fig. 233) resembling in general form that of female. Length 0.87 mm (0.81–0.90 mm) and greatest width 0.28 mm (0.27–0.29 mm), based on 10 specimens. Ratio of length to width of prosome 1.43:1. Segment of leg 1 fused with head. Epimeral areas of metasomal segments as in female.

Segment of leg 5 (Fig. 234) 49 × 112 μ. Genital segment 169 × 156 μ, only slightly longer than wide, its lateral borders gently rounded in dorsal view. Four postgenital segments 44 × 56, 53 × 51, 63 × 48, and 34 × 51 μ from anterior to posterior, the next to the last segment being the longest, as in the female.

Caudal ramus resembling that of female, 43 × 22 μ.

Dorsal surface of body ornamented much like that of female. Ratio of length of prosome to that of urosome 1:1.

Rostrum similar to that of female.

First antenna segmented and armed as in female, but two aesthetes added on segment 2 and one on segment 4 (their positions indicated by arrows in Figure 217), so that formula is 4, 13 + 2 aesthetes, 6, 3 + 1 aesthete, 4 + 1 aesthete, 2 + 1 aesthete, and 7 + 1 aesthete. Second antenna, labrum, mandible, paragnath, first maxilla, and second maxilla as in female. Maxilliped (Fig. 235) slender and 4-segmented, assuming that the proximal part of claw represents a fourth segment. First segment unarmed, second with two naked setae and two rows of spinules on its inner surface, third small and unarmed. Claw long, slender, and recurved, 156 μ along its axis, with weak indication of division about midway. Proximal part of claw with two unequal setae, the smaller seta naked, the larger with distal spinules; terminal lamella long and narrow.

Area between maxillipeds and first pair of legs as in female. Small median lobe between second maxillae as in that sex.

Legs 1–4 segmented and armed as in female, but slight sexual dimorphism in endopods of legs 1–3. Endopod of leg 1 (Fig. 236) with third segment relatively longer than in female and with outermost seta short (less than length of segment). Endopod of leg 2 (Fig. 237) with third segment broader, two terminal spiniform processes longer, and inner terminal spine relatively shorter than in female. Endopod of leg 3 (Fig. 238) with third segment relatively shorter and broader than in female. Endopod of leg 4 as in female. Outer seta on basis of leg 1 with proximal lateral hairs.

Leg 5 (Fig. 239) with free segment smaller and narrower than in female, 24 × 11 μ, its two terminal setae 11 and 28 μ long. Three small patches of minute spinules as indicated in figure. Seta on body near base of free segment 60 μ long. All setae naked.

Leg 6 (Fig. 240) a posteroventral flap on genital segment, bearing two naked setae 31 and 38 μ long.

Spermatophore not observed.

Color in life as in female.

Etymology.—The specific name *montiporae* is based on the generic name of the host.

Comparison with other lichomolgids.—We interpret the endopod of leg 4 of *Haplomolgus* as being 1-segmented, though the presence in some specimens of a small hya-

line terminal lobe might suggest a reduced second segment. This lobe is not always present, however. In three females and one male it was seen on both endopods, in five females and five males on only one endopod, and in two females and one male it was absent.

There are five lichomolgid genera in which the endopod of leg 4 is 1-segmented, namely, *Kelleria* Gurney, 1927, *Lichomolgella* Sars, 1918, *Octopicola* Humes, 1957, *Paramacrochiron* Sewell, 1949, and *Pseudanthessius* Claus, 1889. In these, however, the endopod is elongated and always provided with setae or spines, while in *Haplomolgus* the endopod is rather oval and unarmed (the few minute hairs along the outer margin being regarded as ornamentation rather than as armature). The mandible in these five genera does not have the large pointed posteriorly directed process seen in *Haplomolgus*.

In *Heteranthessius* T. Scott, 1903, the endopod of leg 4 is reduced to a minute knob, leg 5 is rudimentary with only two setae, and the mandible lacks the large process characteristic of *Haplomolgus*.

On the basis of the nature of the endopod of leg 4 the new genus appears to occupy a position between the group of five genera mentioned above and *Heteranthessius*. The unarmed 1-segmented endopod of leg 4 serves to distinguish *Haplomolgus* from all other lichomolgid genera known to us.

RAVAHINA n. gen.

Type and only known species: *Ravahina tumida* n. sp.

Female.—Body transformed, with swollen prosome. Segment of leg 1 weakly delimited from head. Urosome 5-segmented. Caudal ramus with six elements. First antenna 7-segmented. Second antenna 4-segmented. Mouthparts lichomolgid. Mandible with a small terminal spiniform process apparently representing a much reduced flagellum. First maxilla with three elements. Second maxilla 2-segmented. Maxilliped 3-segmented.

Legs 1 and 2 with 3-segmented rami; legs 3 and 4 with 3-segmented exopods but endopods represented only by a small unsegmented knoblike process. Leg 5 with free segment bearing two terminal setae.

Other features as in the species described below.

Associated with madreporarian corals.

Male.—Unknown.

Etymology.—The generic name is formed from Ravahiny, the name of a queen of the Sakalava, who reigned at Majunga in Madagascar about 1800. Gender feminine.

Ravahina tumida n. gen., n. sp.
Figs. 241–259

Type material.—2 females from *Porites* sp. cf. *P. andrewsi* Vaughan in a depth of 2 m, Pte. Lokobe, Nosy Bé, Madagascar. Collected September 2, 1960. One of these females is the holotype, the other (dissected) a paratype. Also one paratypic female and one immature specimen from *Porites* sp. cf. *P. andrewsi* in 3 m, Pte. de Tafondro, Nosy Bé (about five kilometers east of Pte. Lokobe). Collected September 28, 1960. Holotype and one paratype deposited in the United States National Museum, dissected paratype and immature specimen in the collection of A. G. Humes.

Other specimen.—1 female from *Porites* sp. cf. *P. andrewsi* in 2 m, Pte. de Tafondro, August 29, 1960.

Female.—Body (Figs. 241 and 242) with expanded and swollen prosome. Urosome relatively slender and sometimes contracted. Dimensions of two uncontracted specimens 1.97 × 1.15 mm and 1.67 × 1.10 mm. Ratio of length to width of prosome about 1.1:1. Segment of leg 1 weakly delimited from head.

Segment of leg 5 (Fig. 243) 91 × 363 μ. Genital segment broad, 173 × 363 μ, with rounded lateral borders in dorsal view. Areas of attachment of egg sacs located dorsally, each area (Fig. 244) with two minute setae 3 μ long. Three postgenital

segments 70 × 213, 73 × 180, and 104 × 208 μ from anterior to posterior, the last segment expanded in its posterior two-thirds.

Caudal ramus (Fig. 245) moderately elongated, 159 × 65 μ in greatest dimensions, about 2.45 times longer than wide. All setae naked and all spiniform except dorsal pedicellate seta which is slender and 34 μ long. Outer lateral seta 32 μ, outermost terminal seta 28 μ, innermost terminal seta 18 μ, and two median terminal setae 47 μ (inner) and 33 μ (outer). A few small hyaline setules on dorsal surface of ramus.

Dorsal surface of prosome with minute refractile irregularities (Fig. 246) in the cuticula. Dorsal and ventral surfaces of urosome almost entirely lacking ornamentation. Ratio of length of prosome to that of urosome 1.85:1.

Egg sac unknown.

Rostral area (Fig. 247) weakly developed.

First antenna (Fig. 248) slender, 393 μ long, and 7-segmented. Lengths of segments: 24 (64 μ along anterior edge), 106, 38, 44, 65, 40, and 36 μ respectively. Formula for armature: 3, 14 (6 + 8), 5, 4, 5, 2 + 1 aesthete, and 7 + 1 aesthete. All setae naked.

Second antenna (Fig. 249) 4-segmented. Last segment 77 μ along outer edge, 44 μ along inner edge. Armature: 1, 1, 3, 6 + I. Terminal claw 46 μ along its axis; adjacent long seta (jointed and somewhat spiniform) 56 μ.

Labrum (Fig. 250) with two slightly truncated posteroventral lobes.

Mandible (Fig. 251) with distal part (beyond slight constriction) bladelike, its convex side with two small surficial lobes and a distal marginal serrated fringe, its concave edge with a row of prominent spines. Tip of mandible forming a small spiniform process, perhaps representing the flagellum usually present in lichomolgids. Paragnath not observed. First maxilla (Fig. 252) a small lobe with three terminal elements. Second maxilla (Fig. 253) 2-segmented. First segment unarmed. Second segment with a minute proximal setule on its outer (ventral) margin, a naked seta on its distal anterior surface, and a strongly spinulose distal area on its inner (dorsal) margin, the segment terminating in a lash (apparently only partially articulated with the segment) bearing a row of strong spines. Maxilliped (Fig. 254) 3-segmented; first segment unarmed, second with two very unequal naked setae, and third with two barbed spines (the distal one possibly lacking an articulation and thus being a process rather than a spine) and two small naked setae.

Area between maxillipeds and first pair of legs not protuberant. Without sclerotization between bases of maxillipeds.

Leg 1 (Fig. 255) and leg 2 (Fig. 256) with 3-segmented rami, leg 3 (Fig. 257) and leg 4 (Fig. 258) with 3-segmented exopods but endopods reduced to a small process. Armature as follows:

P_1	protopod 0–0; 1–0	exp I–(1); I–1; II, II, 2 end 0–0; 0–0; I, 2
P_2	protopod 0–0; 1–0	exp I–(2); I–1; II, II, 1 end 0–0; 0–1; II
P_3	protopod 0–0; 1–0	exp I–0; I–1; II, II, 1 end –
P_4	protopod 0–0; 1–0	exp I–0; I–1; II, II end –

All four legs without inner coxal seta and without inner marginal hairs on basis. First segment of exopod of leg 1 with an inner setule (probably to be considered as ornamentation rather than as a part of the armature); two such setules in leg 2, but these setules absent in legs 3 and 4. Both first and second segments of endopod of leg 1 and first segment of endopod of leg 2 lacking the inner seta usually seen in lichomolgids. Endopod of legs 3 and 4 consisting of a small knoblike unornamented and unsegmented process lacking a definite articulation with the basis. Intercoxal plates in all four legs wide and short as in leg 1.

Leg 5 (Fig. 259) with a moderately elongated free segment, 73 × 30 μ, of somewhat irregular outline. Two terminal naked

setae 36 and 19 μ in length. Seta on body near free segment 34 μ and naked.

Leg 6 probably represented by the two setae near attachment of egg sac (see Figure 244).

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

Male.—Unknown.

Etymology.—The specific name *tumida*, from Latin = swollen, refers to the tumid prosome.

Comparison with other lichomolgids.—*Ravahina tumida* apparently belongs to the family Lichomolgidae. Its mandible lacks the long flagellum characteristic of many lichomolgid genera, but shows a small terminal spiniform process which may represent a very reduced flagellum. (Reduction of the flagellum to a lesser extent is seen in lichomolgids such as *Monomolgus unihastatus* Humes and Frost, 1964, *Kombia angulata* Humes, 1962, and *Rhynchomolgus corallophilus* Humes and Ho, 1967a.) The other mouthparts are essentially lichomolgid in their form.

The first antenna and legs 1–4 have an armature somewhat different from that in many lichomolgid genera. However, in certain transformed lichomolgid genera such as *Kombia* Humes, 1962, *Heteranthessius* T. Scott, 1903, *Rhynchomolgus* Humes and Ho, 1967a, and *Temnomolgus* Humes and Ho, 1967c, the armature of these appendages may not conform to the more "typical" arrangement seen in untransformed lichomolgids (for example, *Lichomolgus* Thorell, 1860).

Evidence for placing *Ravahina* in the Lichomolgidae would be more conclusive if the structure of the male were known. On the basis of our knowledge of the female, however, we think that the new genus should be provisionally considered as belonging to the Lichomolgidae.

Key to the Seventeen Genera of Lichomolgidae Known from the Vicinity of Nosy Bé, Madagascar

1. Legs 1 and 2 with both rami 3-segmented 2
   Legs 1 and 2 with one or both rami reduced to two segments 13
2. Leg 3 with both rami 3-segmented 3
   Leg 3 with one or both rami reduced 15
3. Leg 4 with endopod 3-segmented 4
   Leg 4 with endopod of one or two segments 5
4. Second antenna with claw on third segment; on holothurians ..... *Scambicornus* Heegaard, 1944
   Second antenna with terminal claws on fourth segment; in mantle cavity of pelecypods ..... *Modiolicola* Aurivillius, 1882
5. Leg 4 with endopod 2-segmented, with a distinct line of segmentation between the segments 6
   Leg 4 with endopod 1-segmented 16
6. Second antenna 3-segmented 7
   Second antenna 4-segmented 9
7. Second segment of endopod of leg 4 with two elements; third and fourth segments of second antenna fused to form an apparent single segment; on corals ..... *Lichomolgus* Thorell, 1860 (in part)
   Second segment of endopod of leg 4 with one or three elements 8
8. Mandible with proximal region having two outer serrated lobes; second antenna with a single terminal claw; second segment of endopod of leg 4 with a single spine; on corals ..... *Prionomolgus* n. gen.
   Mandible with proximal region having a row of setae or spines; second antenna with 1, 2, or 3 terminal claws; second segment of endopod of leg 4 with three elements; on asteroids ..... *Stellicola* Kossmann, 1877
9. Endopod of leg 4 with a single element on second segment 10
   Endopod of leg 4 with more than one element on second segment 11
10. First segment of endopod of leg 4 with an inner seta; body rather transformed; in mantle cavity of pelecypods ..... *Gelastomolgus* Humes (in press)
    First segment of endopod of leg 4 unarmed; body typically cyclopoid; on corals ..... *Monomolgus* Humes and Frost, 1964
11. Endopod of leg 4 with two elements on second segment 12
    Endopod of leg 4 with four or five elements (spines or setae) on last segment, formula variable; in zoanthids ..... *Indomolgus* Humes and Ho, 1967c
12. With a pair of setae on anterior part of labrum; maxilliped in female with a long slender last segment; on polychaetes ..... *Nasomolgus* Sewell, 1949
    Without a pair of setae on labrum; maxilliped in female with short last segment; in mantle cavity of pelecypods, on sea anemones, corals, alcyonarians, zoan-

thids, nudibranchs ..... *Lichomolgus* Thorell, 1860 (in part)

13. Both rami of legs 1 and 2 two-segmented; in corals ..... *Rhynchomolgus* Humes and Ho, 1967a
    In legs 1 and 2 exopods 3-segmented, endopods 2-segmented 14
14. Endopod of leg 3 and entire leg 4 absent; in corals ..... *Kombia* Humes, 1962
    Endopod of leg 3 present; leg 4 with 3-segmented rami; on holothurians ..... males of *Scambicornus* Heegaard, 1944
15. Leg 3 with 3-segmented exopod, endopod a small process; in corals ..... females of *Ravahina* n. gen.
    Leg 3 represented only by two setae; in zoanthids ..... *Temnomolgus* Humes and Ho, 1967c
16. Leg 5 with a distinct segment 17
    Leg 5 without a distinct segment; on echinoids, polychaetes ..... *Pseudanthessius* Claus, 1889
17. Second antenna 3-segmented, with large terminal denticulated claw and sometimes an unguiform seta; on hydroids ..... *Macrochiron* Brady, 1872
    Second antenna 4-segmented 18
18. Last segment of second antenna with four claws; endopod of leg 4 with three elements; on cephalopods ..... *Octopicola* Humes, 1957
    Last segment of second antenna with one claw; endopod of leg 4 unarmed; on corals ..... *Haplomolgus* n. gen.

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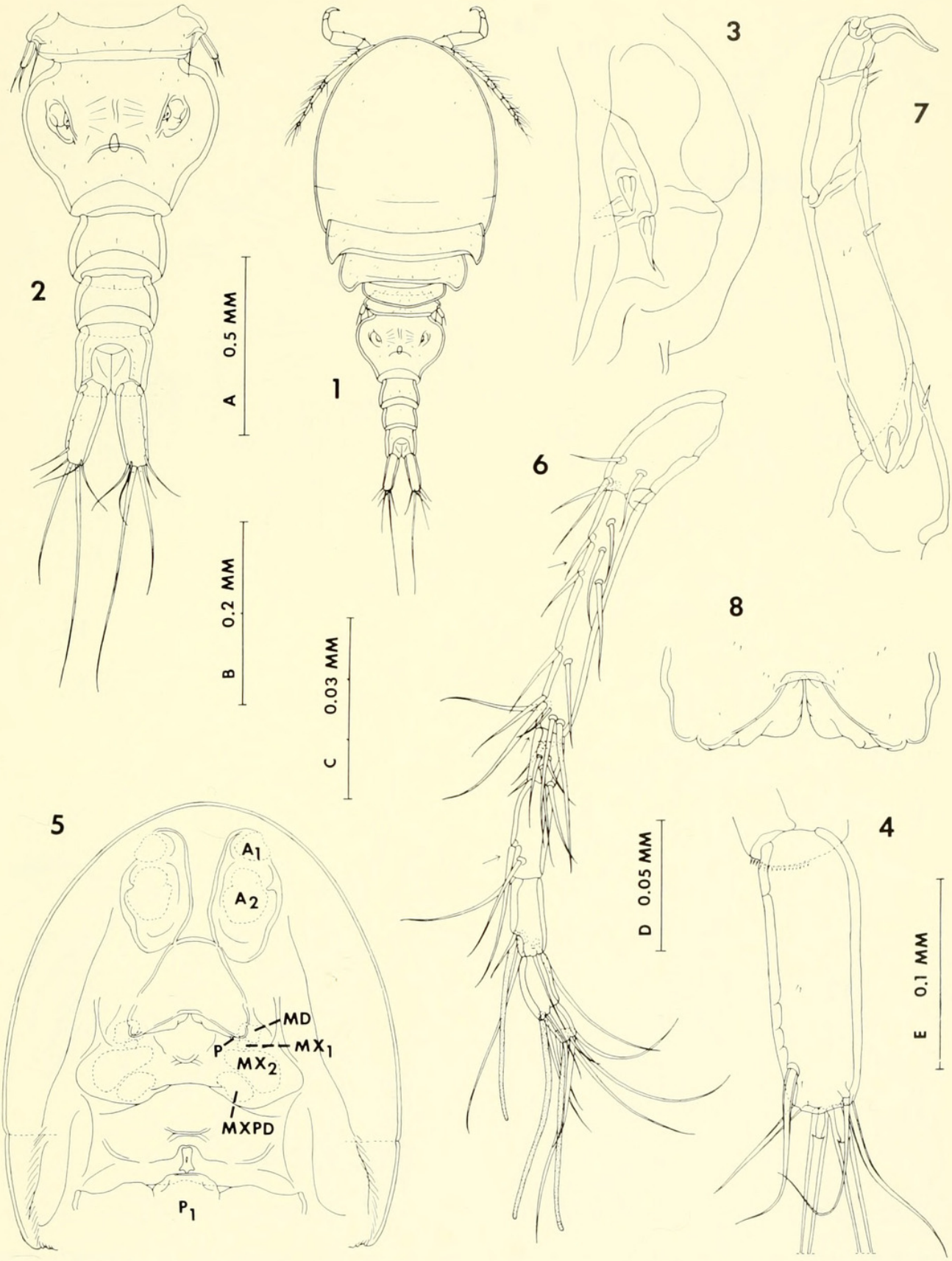
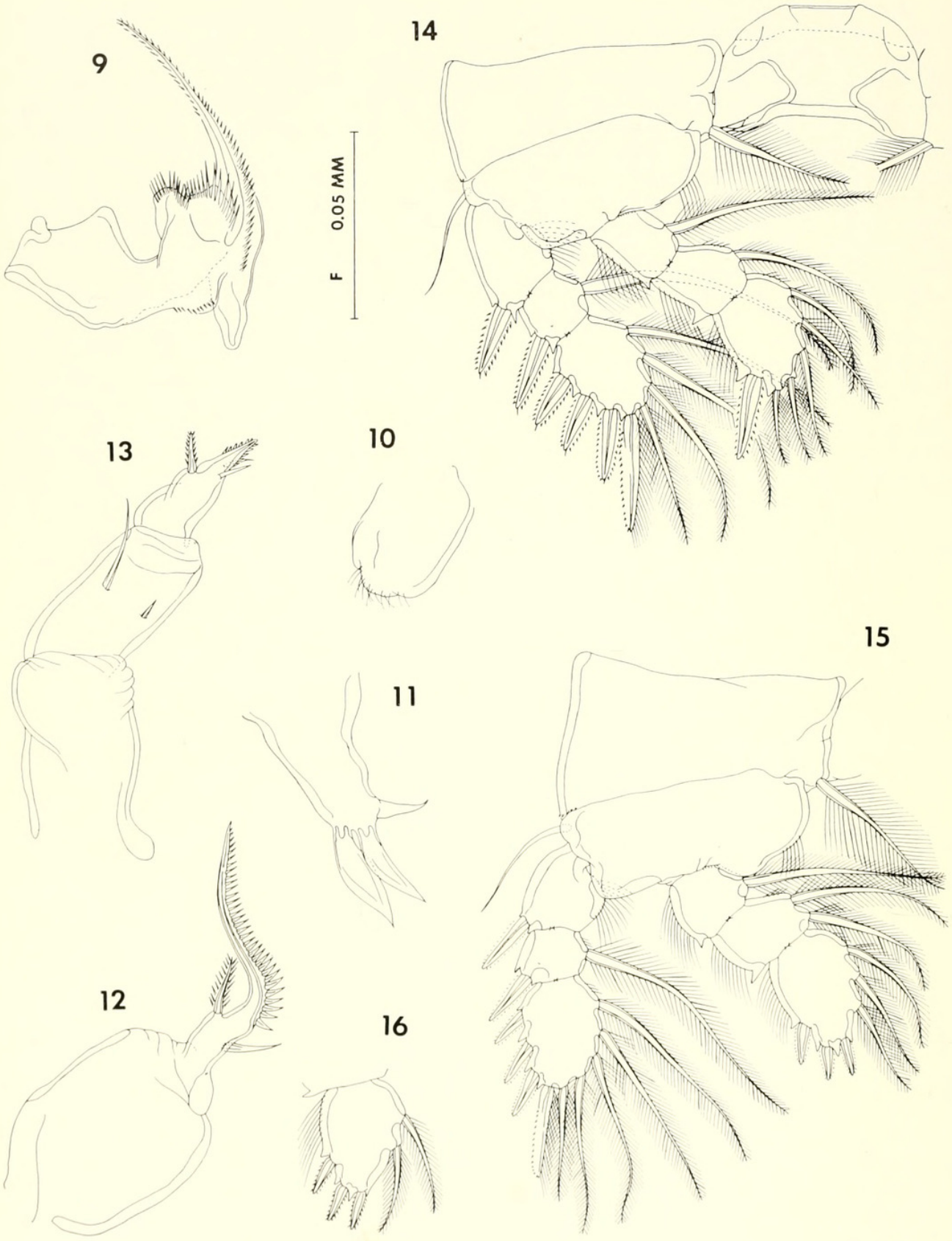
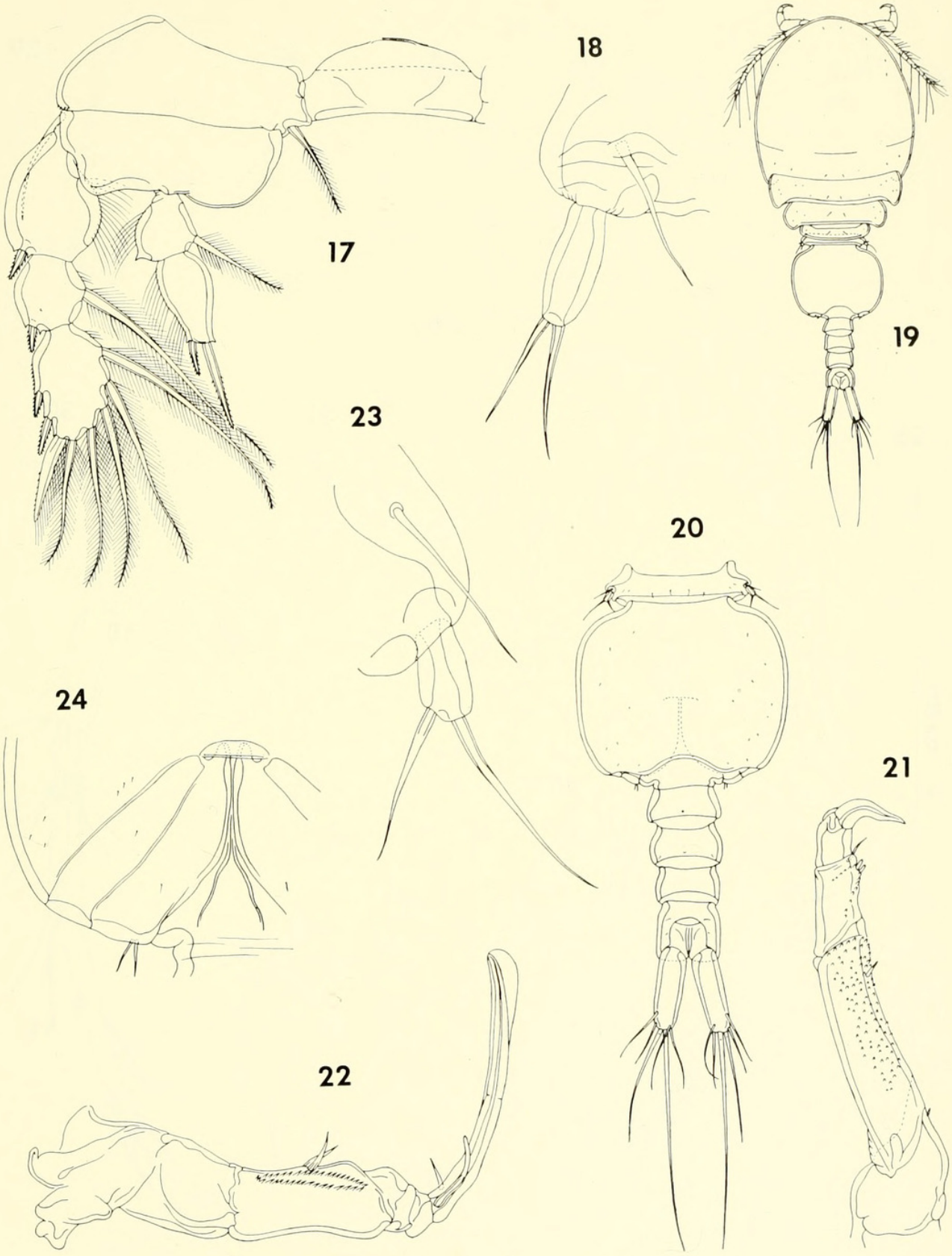


Figures 1–8. *Lichomolgus campulus* n. sp., female. 1, body, dorsal (A); 2, urosome, dorsal (B); 3, area of attachment of egg sac, dorsal (C); 4, caudal ramus, dorsal (D); 5, cephalosome, ventral (B); 6, first antenna, with arrows indicating positions of aesthetes in male, anterodorsal (E); 7, second antenna, outer (E); 8, labrum, ventral (E).

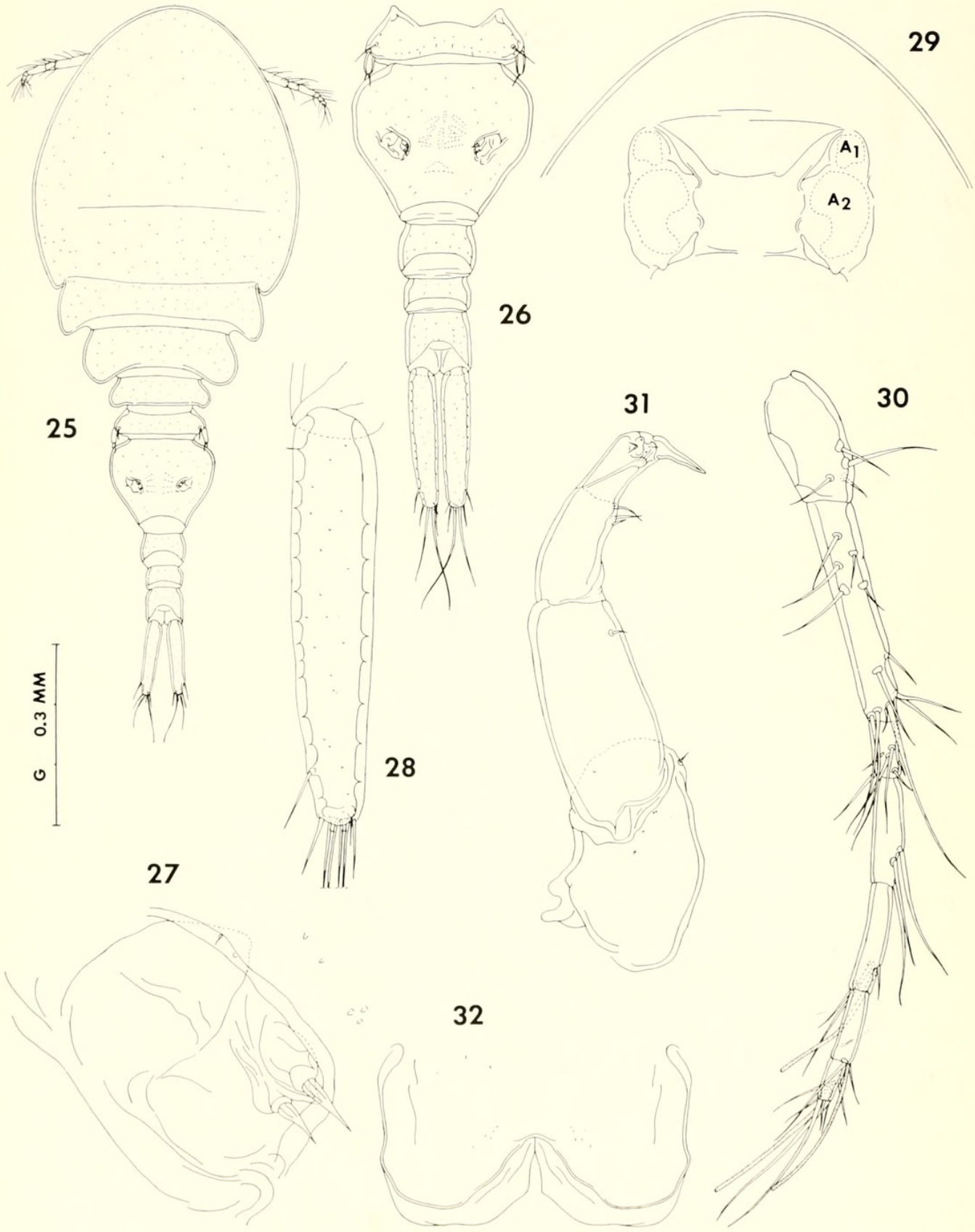


Figures 9–16. *Lichomolgus campulus* n. sp., female (continued). 9, mandible, posterior (F); 10, paragnath, anterior (F); 11, first maxilla, anterior (F); 12, second maxilla, posterior (D); 13, maxilliped, inner (F); 14, leg 1 and intercoxal plate, anterior (D); 15, leg 2, anterior (D); 16, last segment of endopod of leg 3, anterior (D).

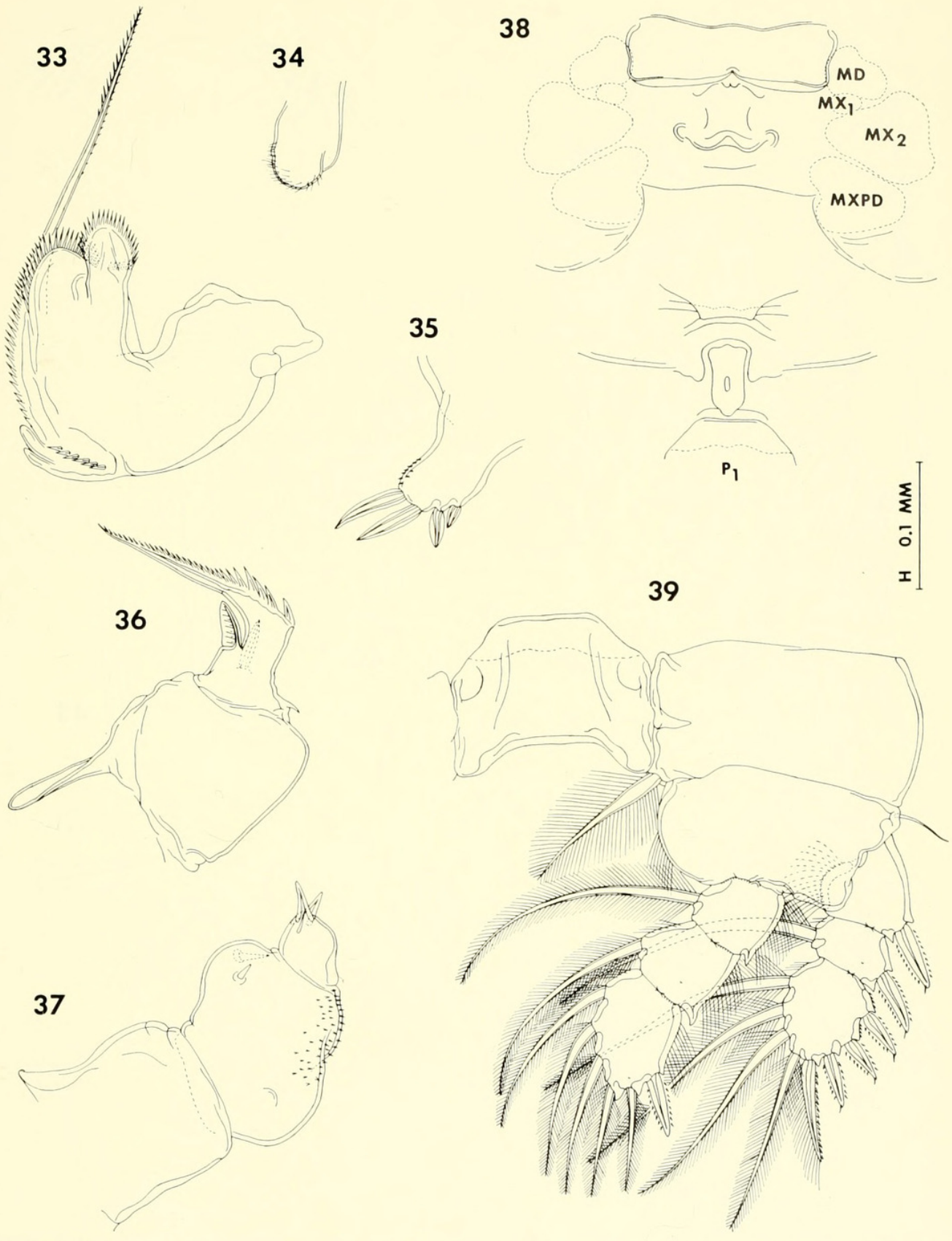


Figures 17–18. *Lichomolgus campulus* n. sp., female (continued). 17, leg 4 and intercoxal plate, anterior (D); 18, leg 5, dorsal (F).

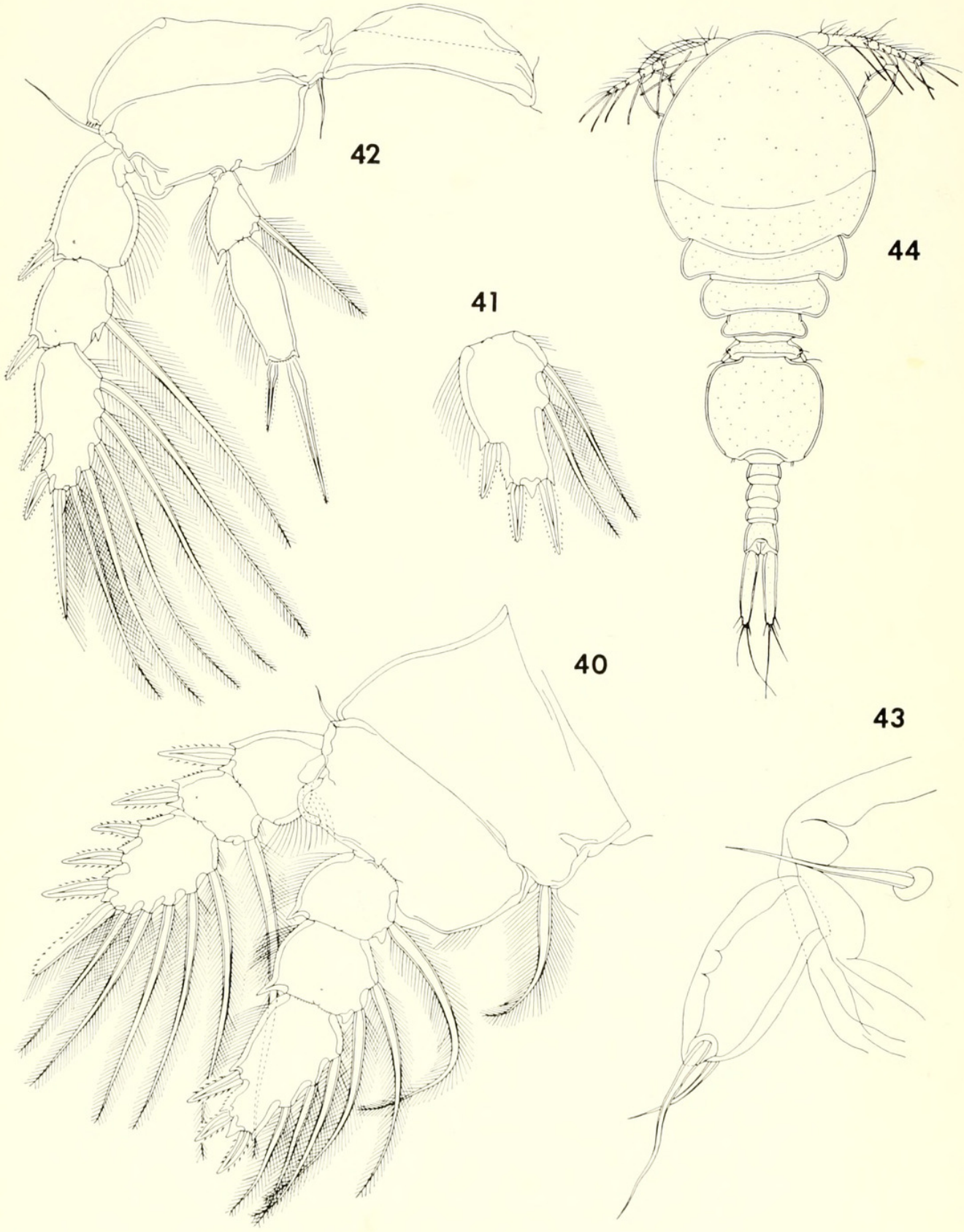
Figures 19–24. *Lichomolgus campulus* n. sp., male. 19, body, dorsal (A); 20, urosome, dorsal (B); 21, second antenna, outer (E); 22, maxilliped, inner (E); 23, leg 5, posterodorsal (G); 24, leg 6, ventral (E).



Figures 25–32. *Lichomolgus digitatus* n. sp., female. 25, body, dorsal (A); 26, urosome, dorsal (G); 27, area of attachment of egg sac, dorsal (C); 28, caudal ramus, dorsal (E); 29, rostral area, ventral (B); 30, first antenna, anterodorsal (E); 31, second antenna, outer (E); 32, labrum, ventral (E).

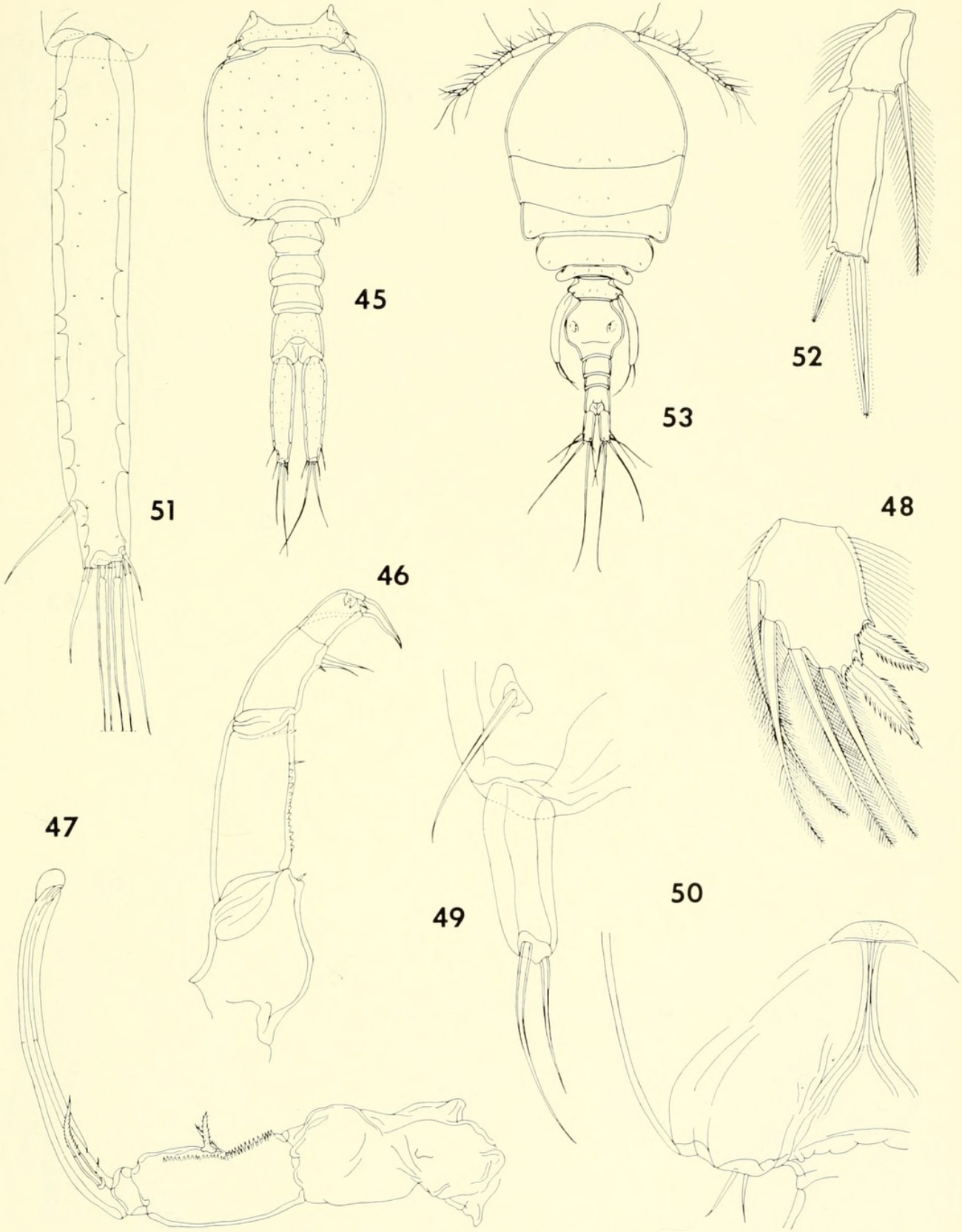


Figures 33–39. *Lichomolgus digitatus* n. sp., female (continued). 33, mandible, posterior (D); 34, paragnath, ventral (D); 35, first maxilla, ventral (D); 36, second maxilla, posterior (E); 37, maxilliped, anterior (D); 38, oral and postoral areas, with edge of labrum turned ventrally, ventral (H); 39, leg 1 and intercoxal plate, anterior (E).



Figures 40–43. *Lichomolgus digitatus* n. sp., female (continued). 40, leg 2, anterior (E); 41, last segment of endopod of leg 3, anterior (E); 42, leg 4 and intercoxal plate, anterior (E); 43, leg 5, dorsal (C).

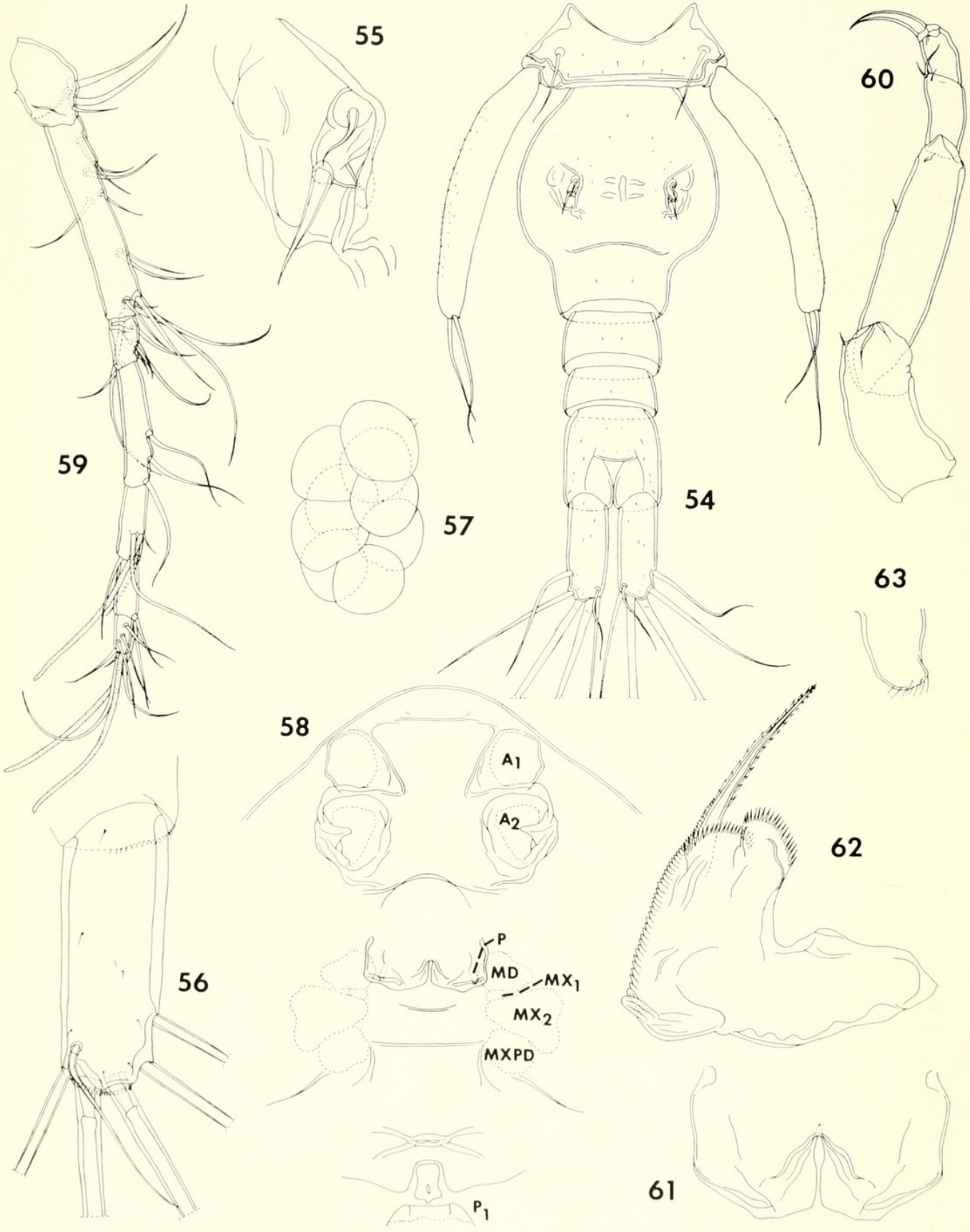
Figure 44. *Lichomolgus digitatus* n. sp., male. 44, body, dorsal (A).



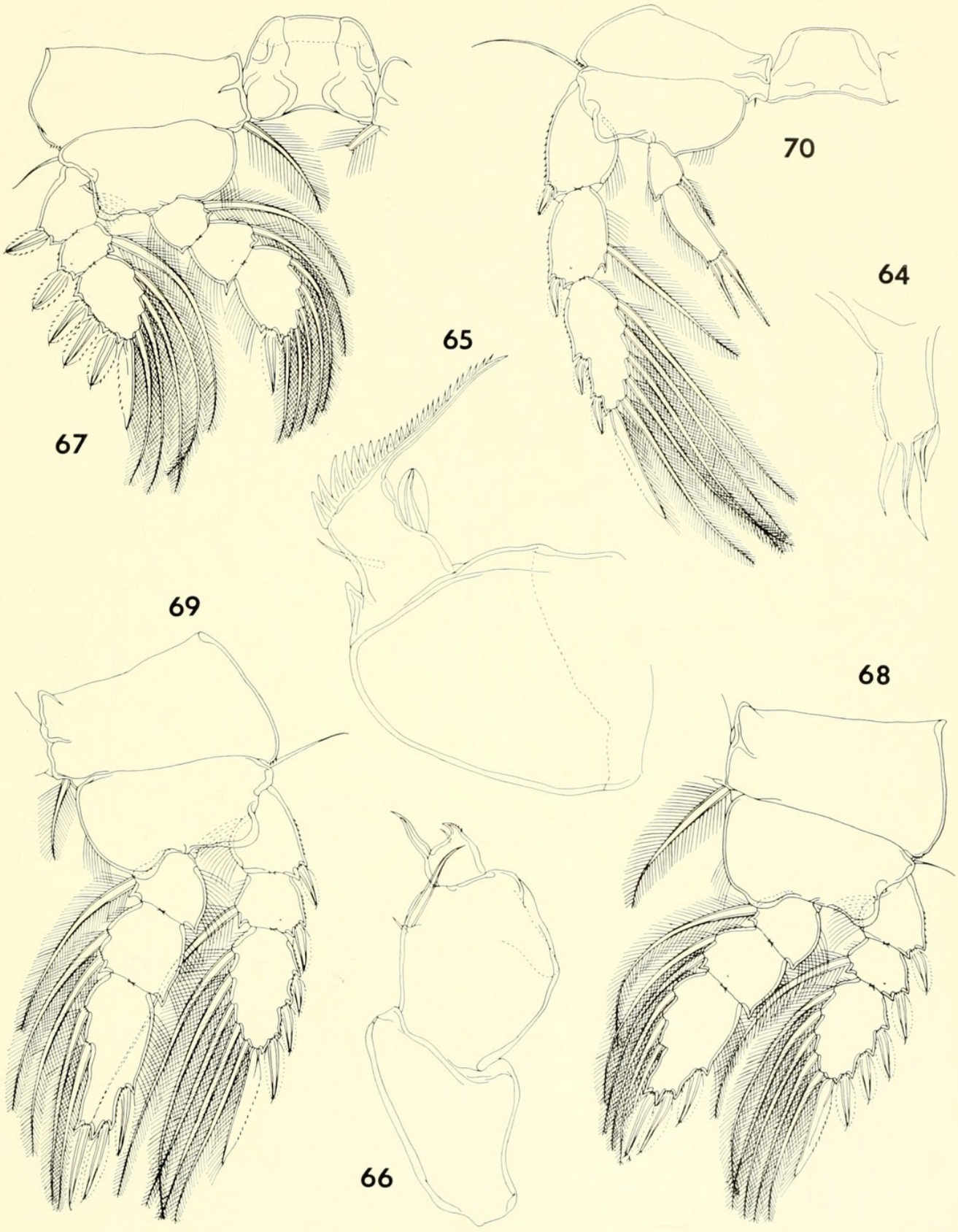
Figures 45–50. *Lichomolgus digitatus* n. sp., male (continued). 45, urosome, dorsal (G); 46, second antenna, inner (E); 47, maxilliped, inner (H); 48, last segment of endopod of leg 1, anterior (D); 49, leg 5, dorsal (C); 50, leg 6, ventral (E).

Figures 51–52. *Lichomolgus digitatus* n. sp., female, from *Porites*. 51, caudal ramus, dorsal (E); 52, endopod of leg 4, anterior (E).

Figure 53. *Lichomolgus prolixipes* n. sp., female. 53, body, dorsal (A).



Figures 54–63. *Lichomolgus prolixipes* n. sp., female (continued). 54, urosome, dorsal (G); 55, area of attachment of egg sac, dorsal (C); 56, caudal ramus, dorsal (F); 57, egg sac, lateral (G); 58, rostral, oral, and postoral areas, ventral (H); 59, first antenna, posteroventral (E); 60, second antenna, inner (E); 61, labrum, ventral (D); 62, mandible, posterior (F); 63, paragnath, ventral (F).



Figures 64–70. *Lichomologus prolixipes* n. sp., female (continued). 64, first maxilla, anterior (F); 65, second maxilla, posterior (F); 66, maxilliped, posterointernal (F); 67, leg 1 and intercoxal plate, anterior (E); 68, leg 2, anterior (E); 69, leg 3, anterior (E); 70, leg 4 and intercoxal plate, anterior (E).

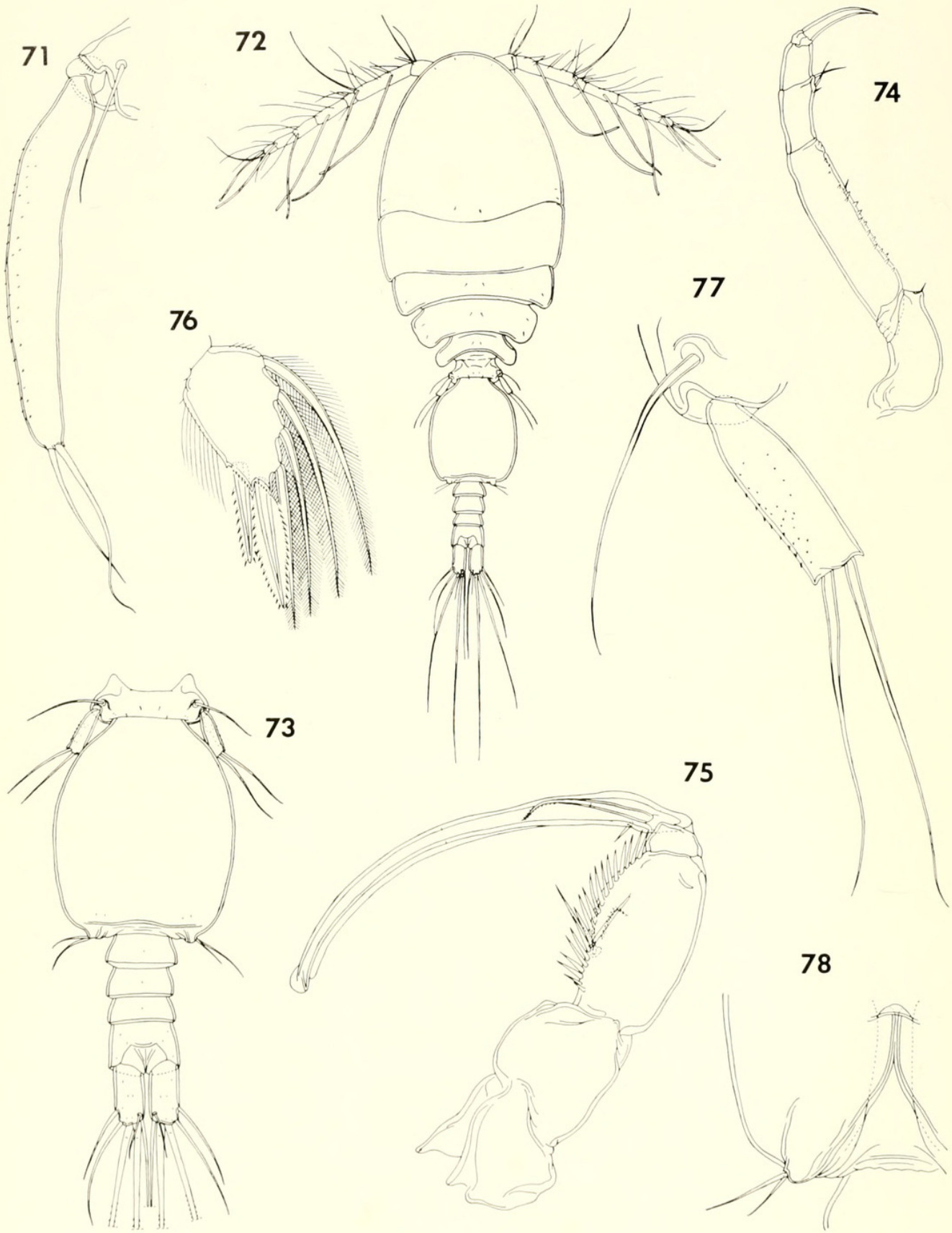
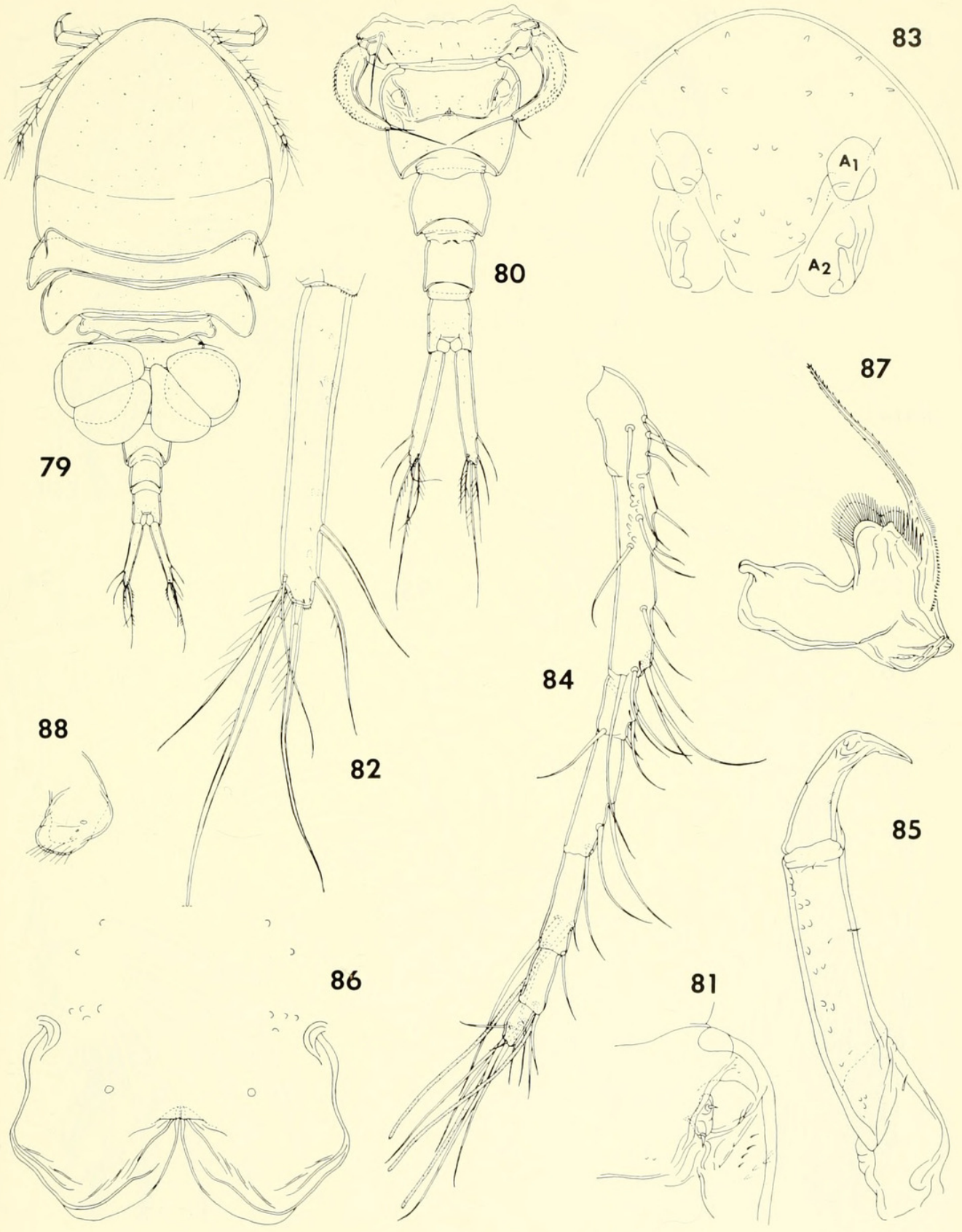
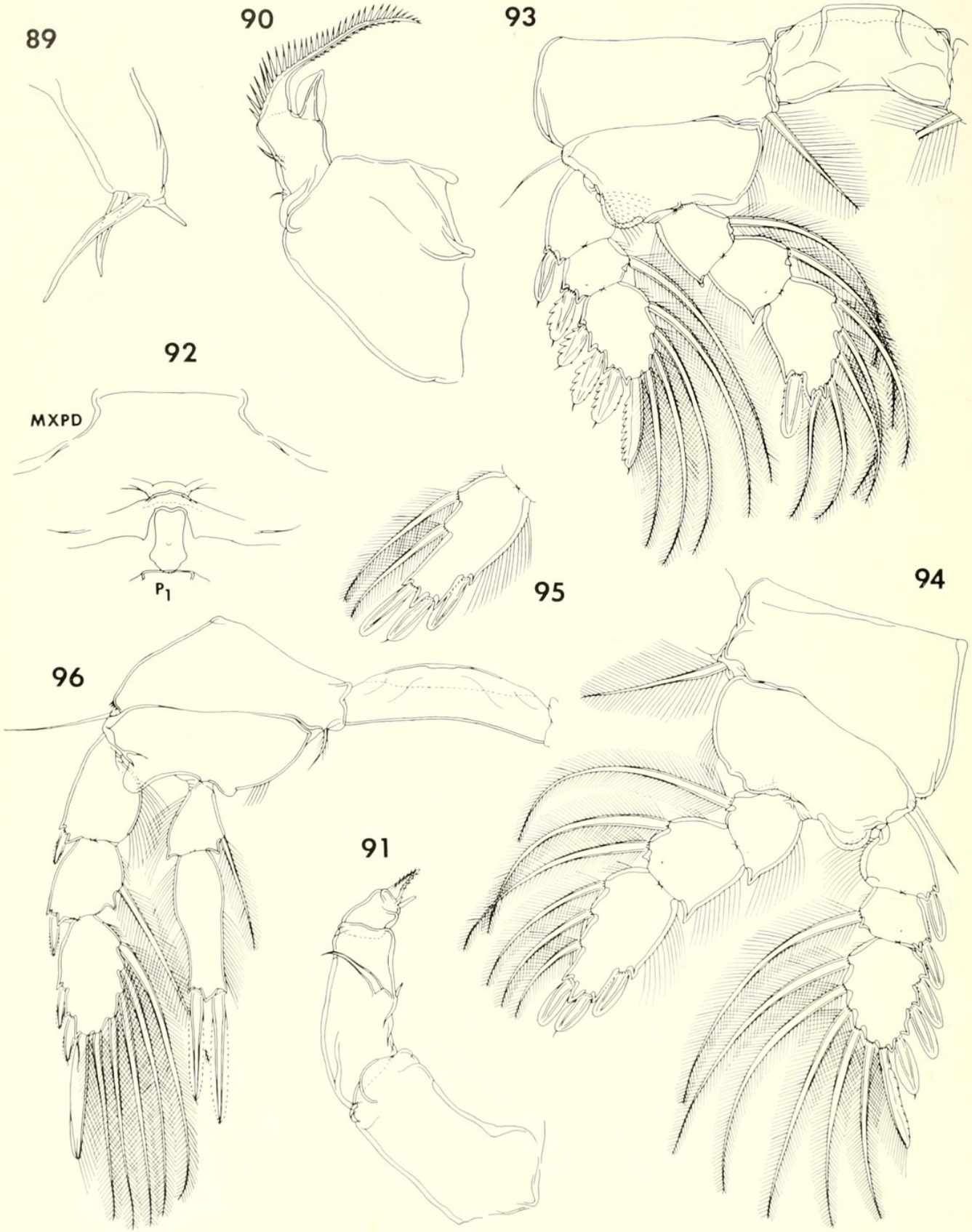


Figure 71. *Lichomolgus prolixipes* n. sp., female (continued). 71, leg 5, dorsal (E).

Figures 72–78. *Lichomolgus prolixipes* n. sp., male. 72, body, dorsal (G); 73, urosome, dorsal (H); 74, second antenna, inner (E); 75, maxilliped, inner (D); 76, last segment of endopod of leg 1, anterior (F); 77, leg 5, dorsal (C); 78, leg 6, ventral (D).



Figures 79–88. *Lichomolgus arcuatipes* n. sp., female. 79, body, dorsal (G); 80, urosome, dorsal (B); 81, area of attachment of egg sac, dorsal (D); 82, caudal ramus, dorsal (D); 83, rostral area, ventral (H); 84, first antenna, dorsal (D); 85, second antenna, outer (D); 86, labrum, ventral (F); 87, mandible, posterior (F); 88, paragnath, ventral (C).



Figures 89–96. *Lichomolgus arcuatipes* n. sp., female (continued). 89, first maxilla, posterior (C); 90, second maxilla, anterior (F); 91, maxilliped, posterior (F); 92, postoral area, ventral (E); 93, leg 1 and intercoxal plate, anterior (D); 94, leg 2, anterior (D); 95, last segment of endopod of leg 3, anterior (D); 96, leg 4 and intercoxal plate, anterior (D).

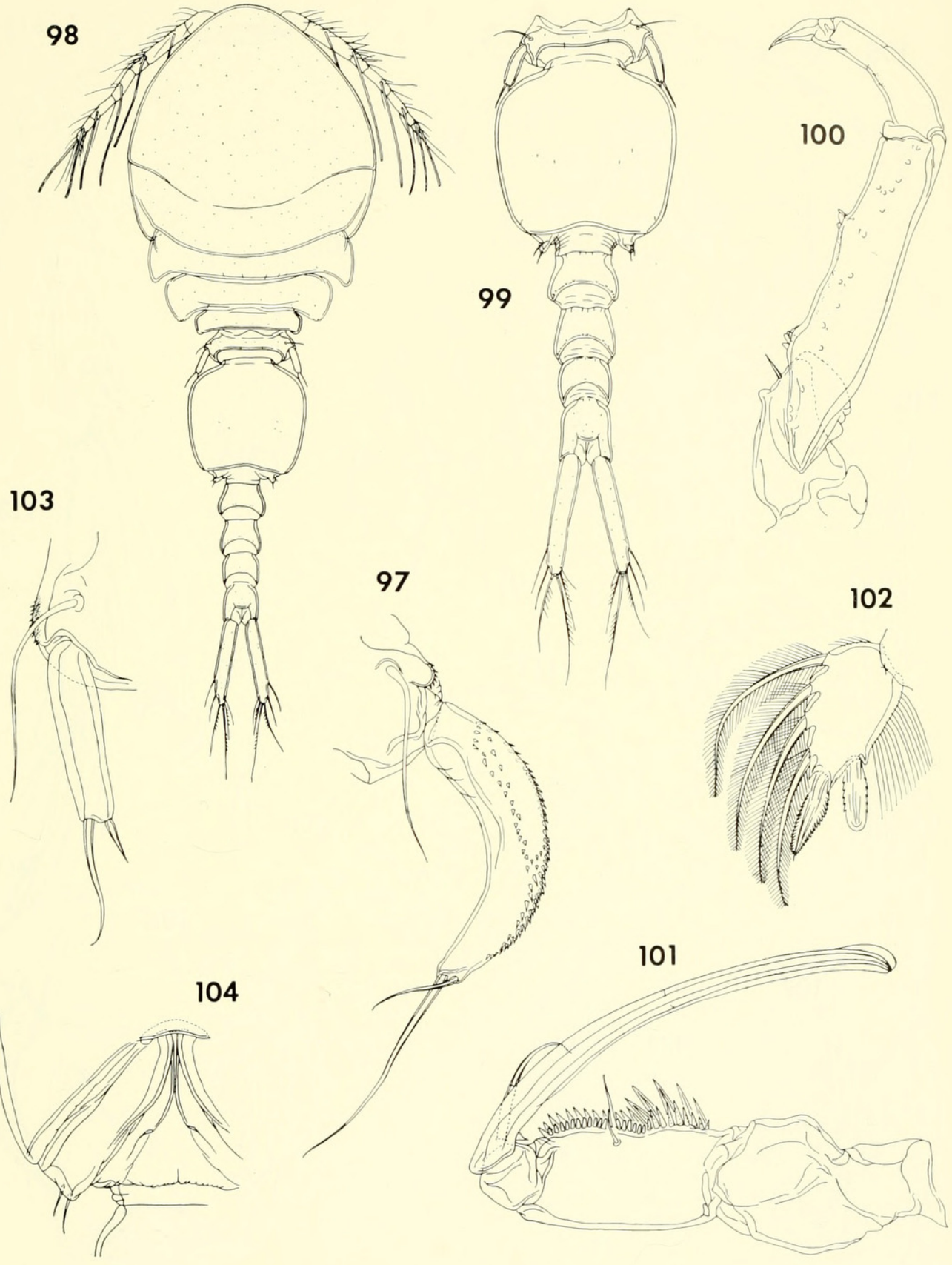
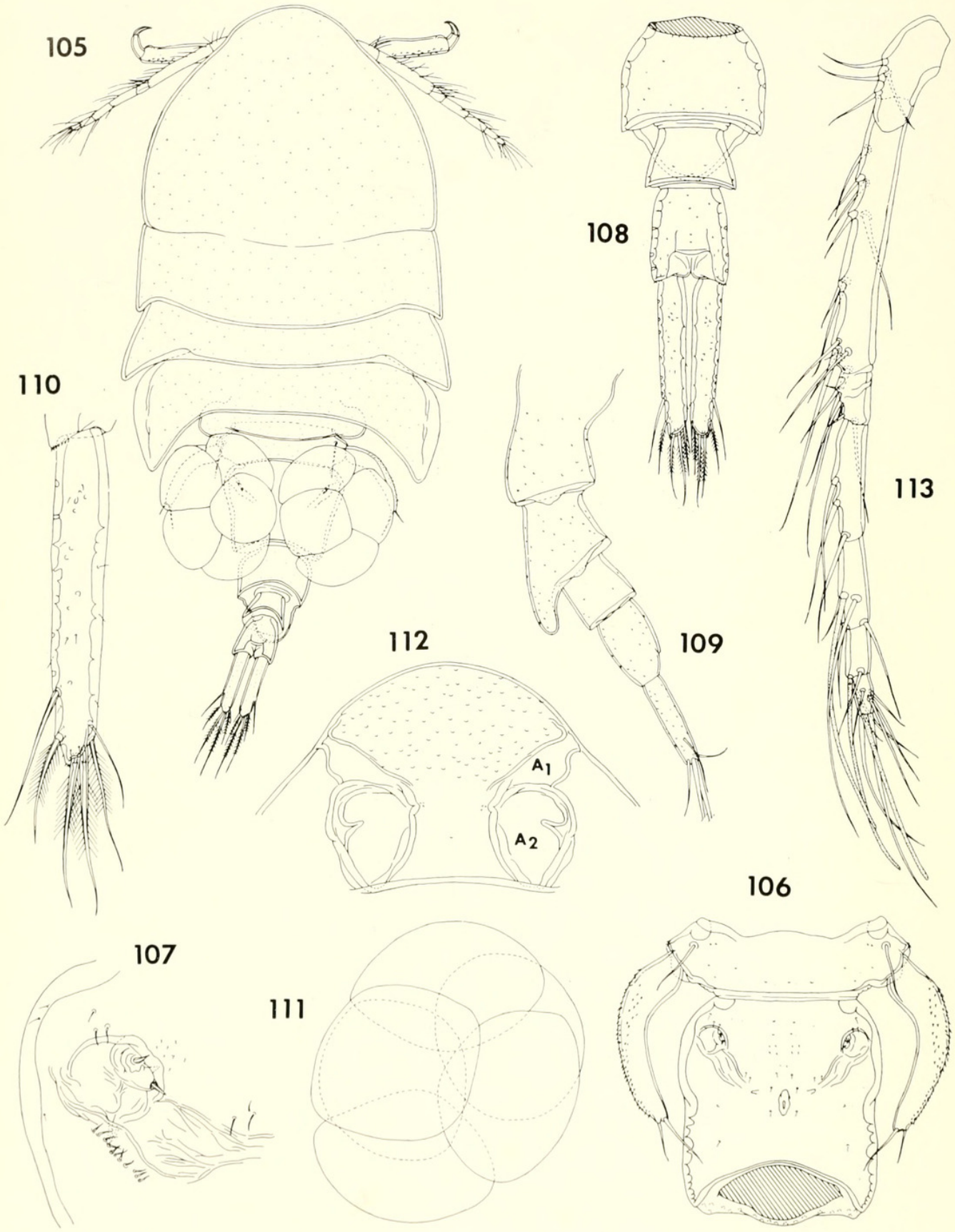
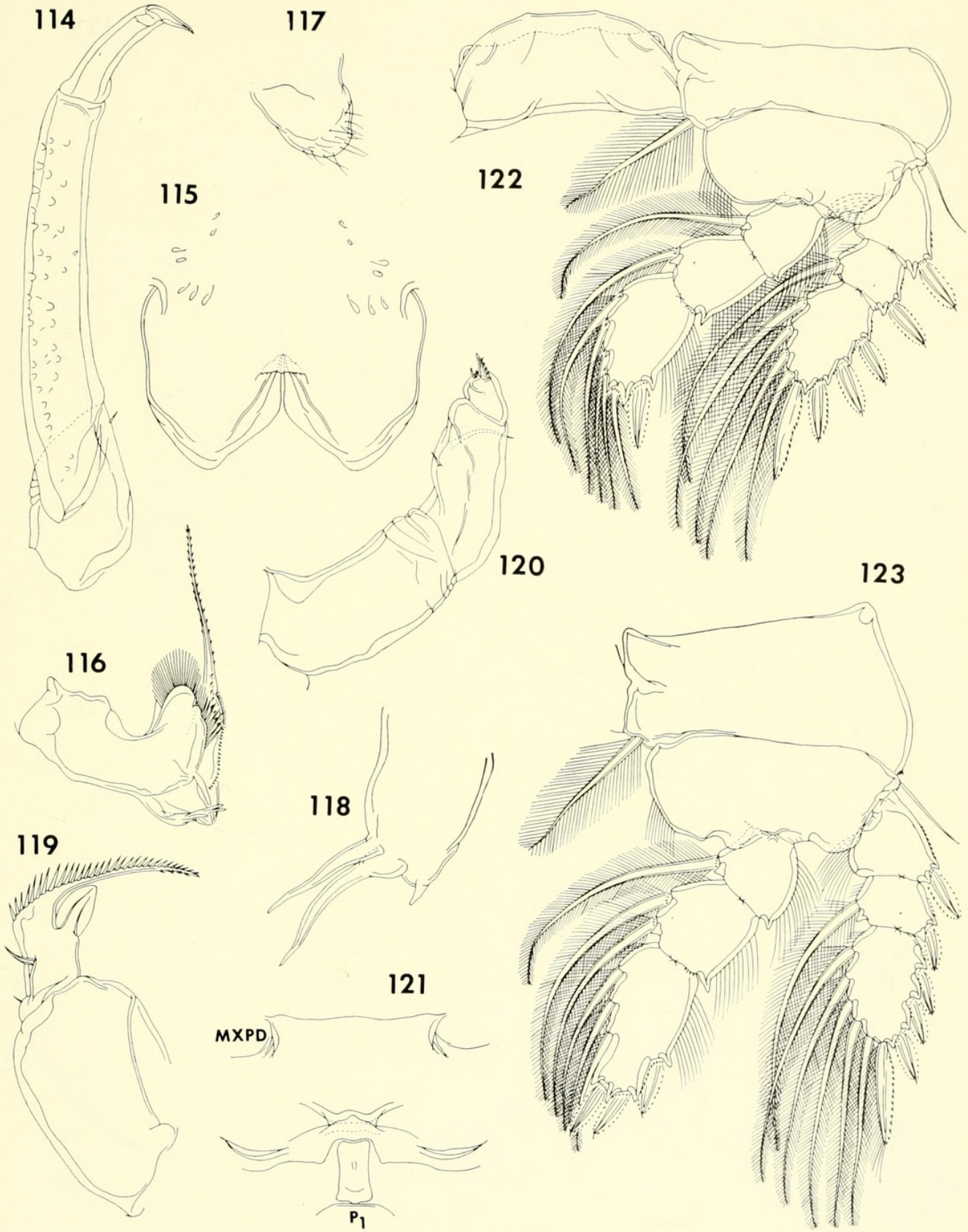


Figure 97. *Lichomolgus arcuatipes* n. sp., female (continued). 97, leg 5, dorsal (D).

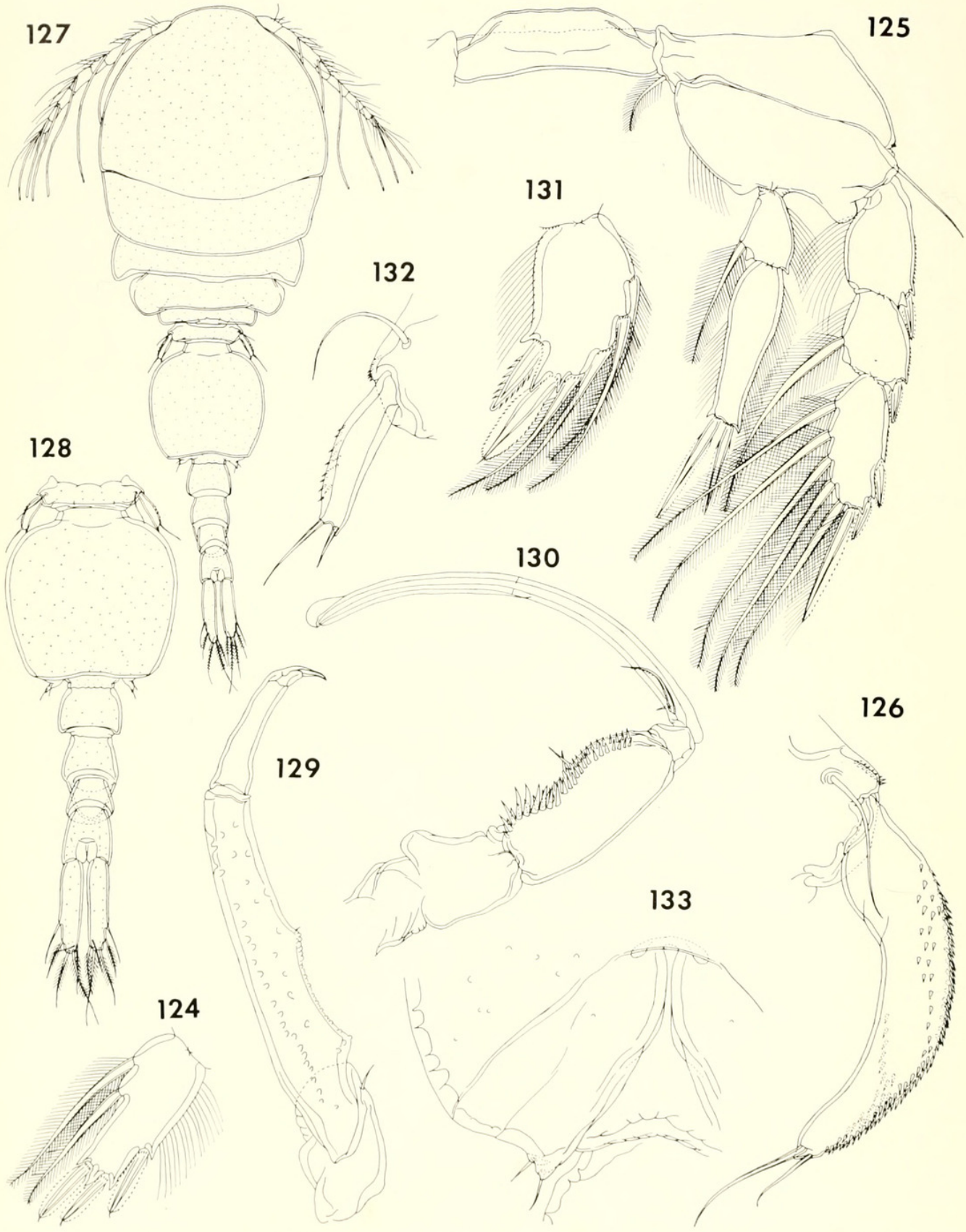
Figures 98–104. *Lichomolgus arcuatipes* n. sp., male. 98, body, dorsal (G); 99, urosome, dorsal (B); 100, second antenna, outer (D); 101, maxilliped, outer (E); 102, last segment of endopod of leg 1, anterior (D); 103, leg 5, dorsal (F); 104, leg 6, ventral (E).



Figures 105–113. *Lichomolgus lobophorus* n. sp., female. 105, body, dorsal (G); 106, segment of leg 5 and genital segment, dorsal (B); 107, area of attachment of egg sac, dorsolateral (D); 108, postgenital segments and caudal rami, dorsal (B); 109, part of urosome, lateral (B); 110, caudal ramus, dorsal (E); 111, egg sac, dorsal (H); 112, rostral area, ventral (H); 113, first antenna, ventral (E).

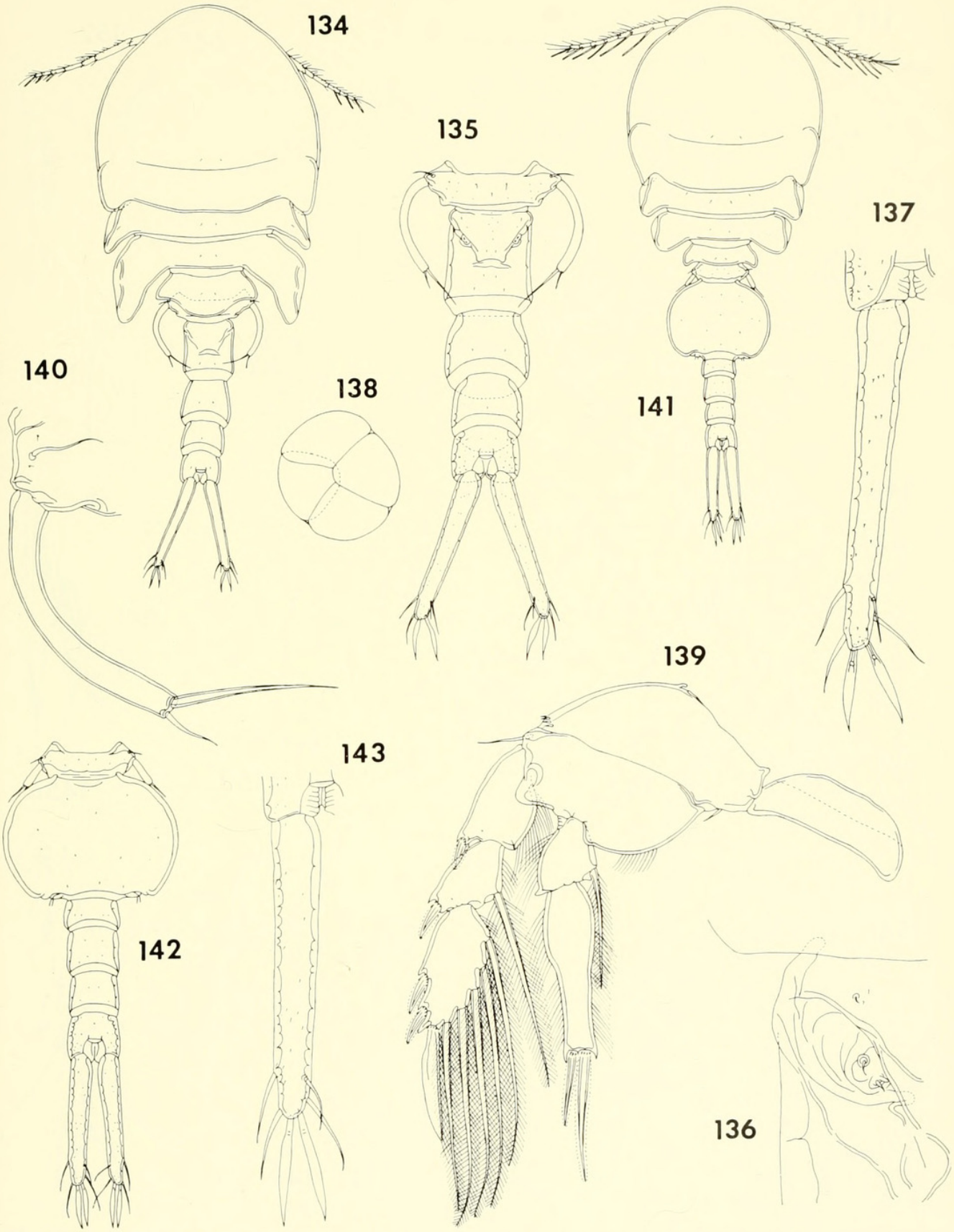


Figures 114–123. *Lichomolgus lobophorus* n. sp., female (continued). 114, second antenna, outer (E); 115, labrum, ventral (D); 116, mandible, posterior (D); 117, paragnath, ventral (C); 118, first maxilla, posterior (C); 119, second maxilla, posterior, (D); 120, maxilliped, anterior (D); 121, postoral area, ventral (H); 122, leg 1 and intercoxal plate, anterior (E); 123, leg 2, anterior (E).



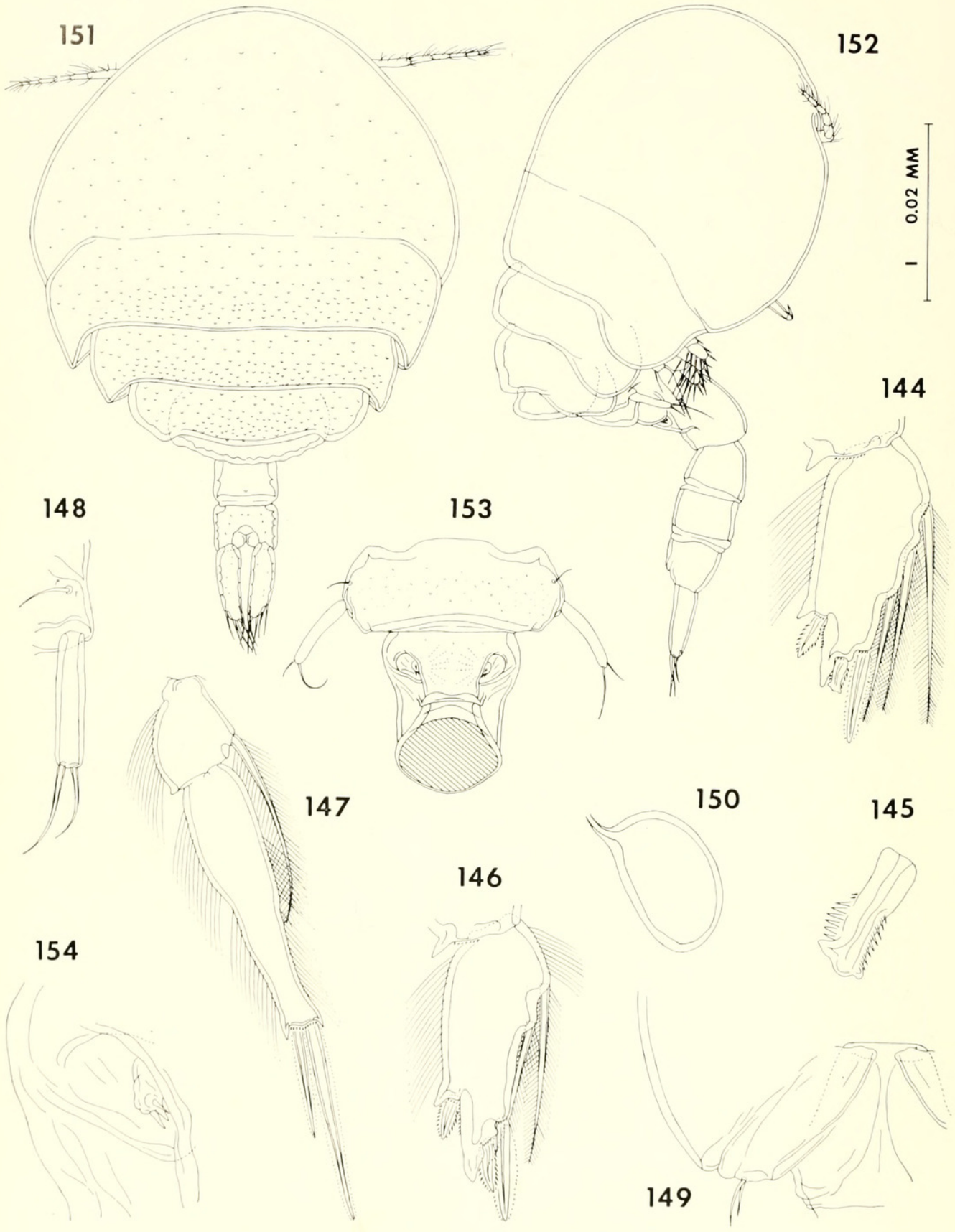
Figures 124–126. *Lichomolgus lobophorus* n. sp., female (continued). 124, last segment of endopod of leg 3, anterior (E); 125, leg 4 and intercoxal plate, anterior (E); 126, leg 5, dorsal (E).

Figures 127–133. *Lichomolgus lobophorus* n. sp., male. 127, body, dorsal (G); 128, urosome, dorsal (B); 129, second antenna, outer (E); 130, maxilliped, inner (H); 131, last segment of endopod of leg 1, anterior (D); 132, leg 5, dorsal (D); 133, leg 6, ventral (E).



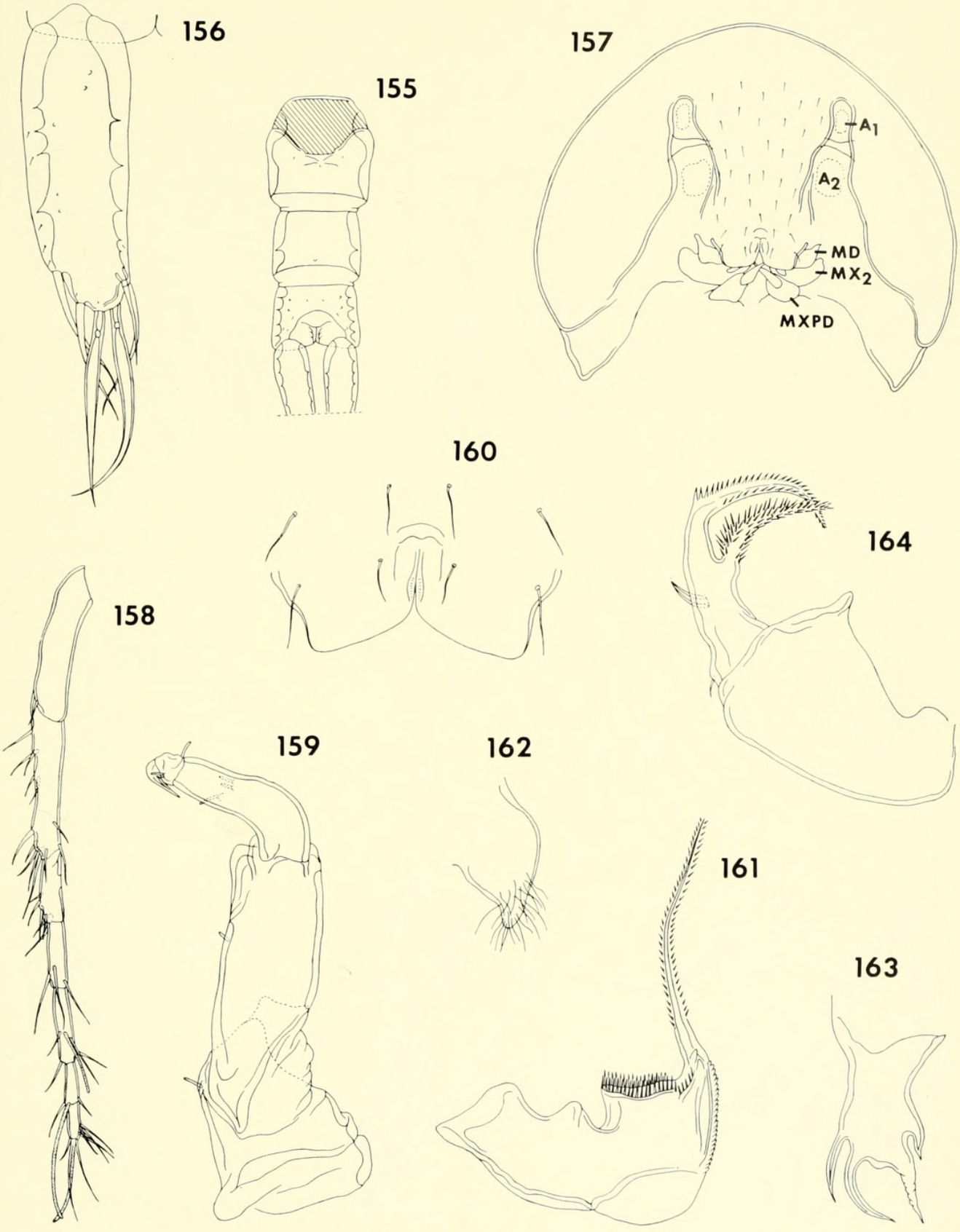
Figures 134–140. *Lichomolgus geminus* n. sp., female. 134, body, dorsal (A); 135, urosome, dorsal (G); 136, area of attachment of egg sac, dorsal (F); 137, caudal ramus, dorsal (H); 138, egg sac, dorsal (G); 139, leg 4 and intercoxal plate, anterior (E); 140, leg 5, dorsal (E).

Figures 141–143. *Lichomolgus geminus* n. sp., male. 141, body, dorsal (A); 142, urosome, dorsal (G); 143, caudal ramus, dorsal (H).

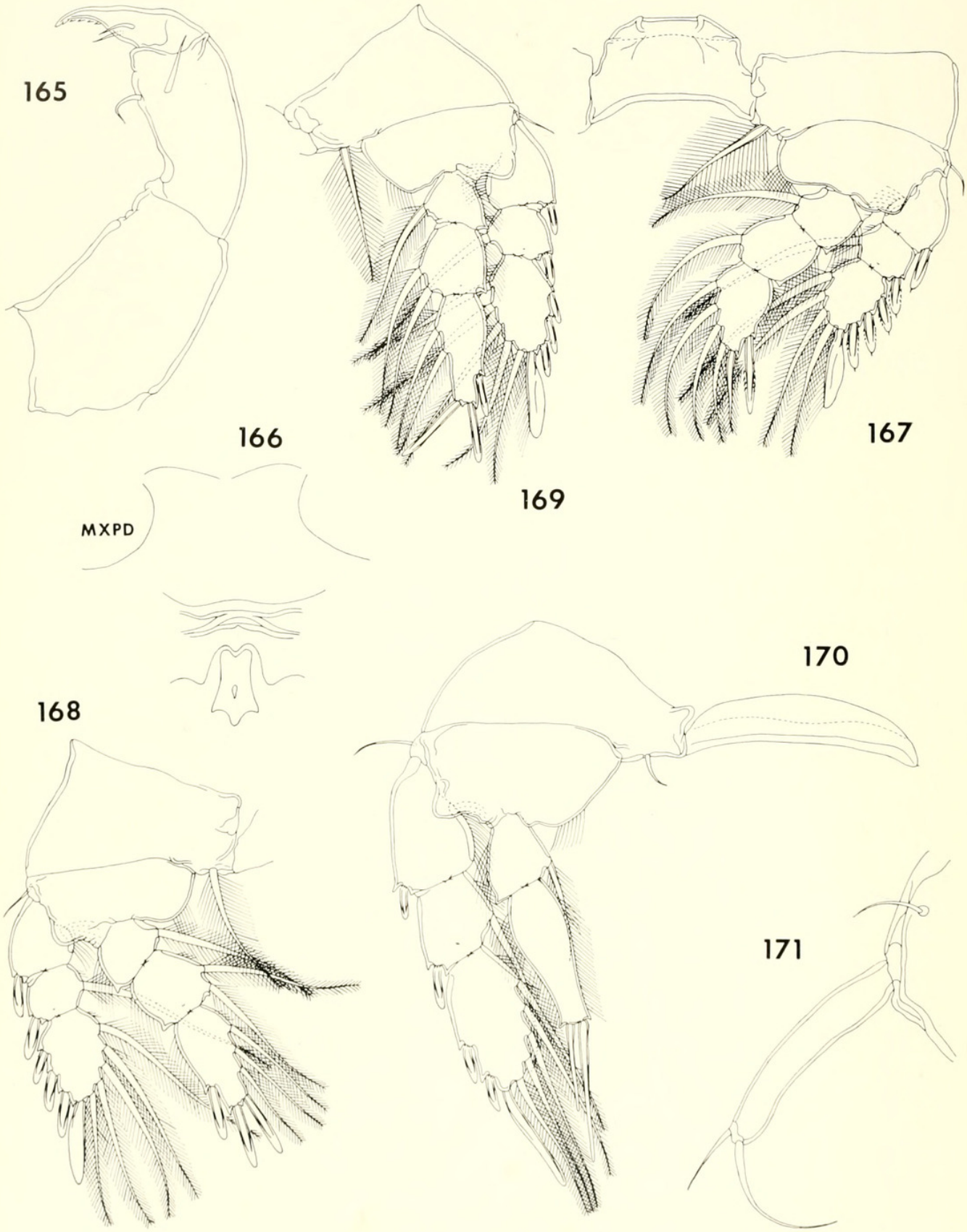


Figures 144–150. *Lichomolgus geminus* n. sp., male (continued). 144, last segment of endopod of leg 2, anterior (D); 145, middle distal spine on last segment of endopod of leg 2, anterior (I); 146, last segment of endopod of leg 3, anterior (D); 147, endopod of leg 4, anterior (D); 148, leg 5, dorsal (D); 149, leg 6, ventral (E); 150, spermatophore, attached to female, dorsal (B).

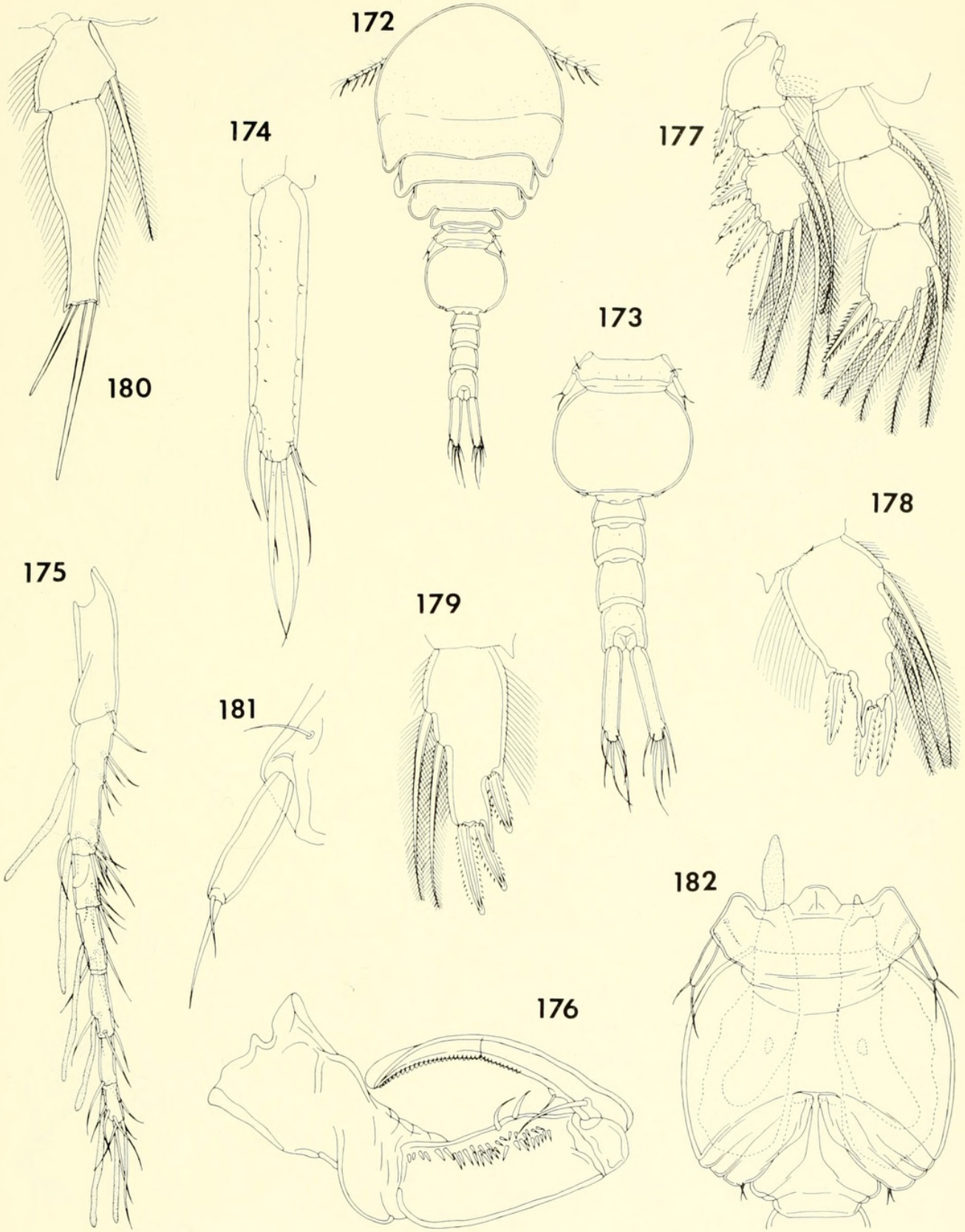
Figures 151–154. *Lichomolgus crassus* n. sp., female. 151, body, dorsal (G); 152, body, lateral (G); 153, segment of leg 5 and genital segment, dorsal (B); 154, area of attachment of egg sac, dorsal (F).



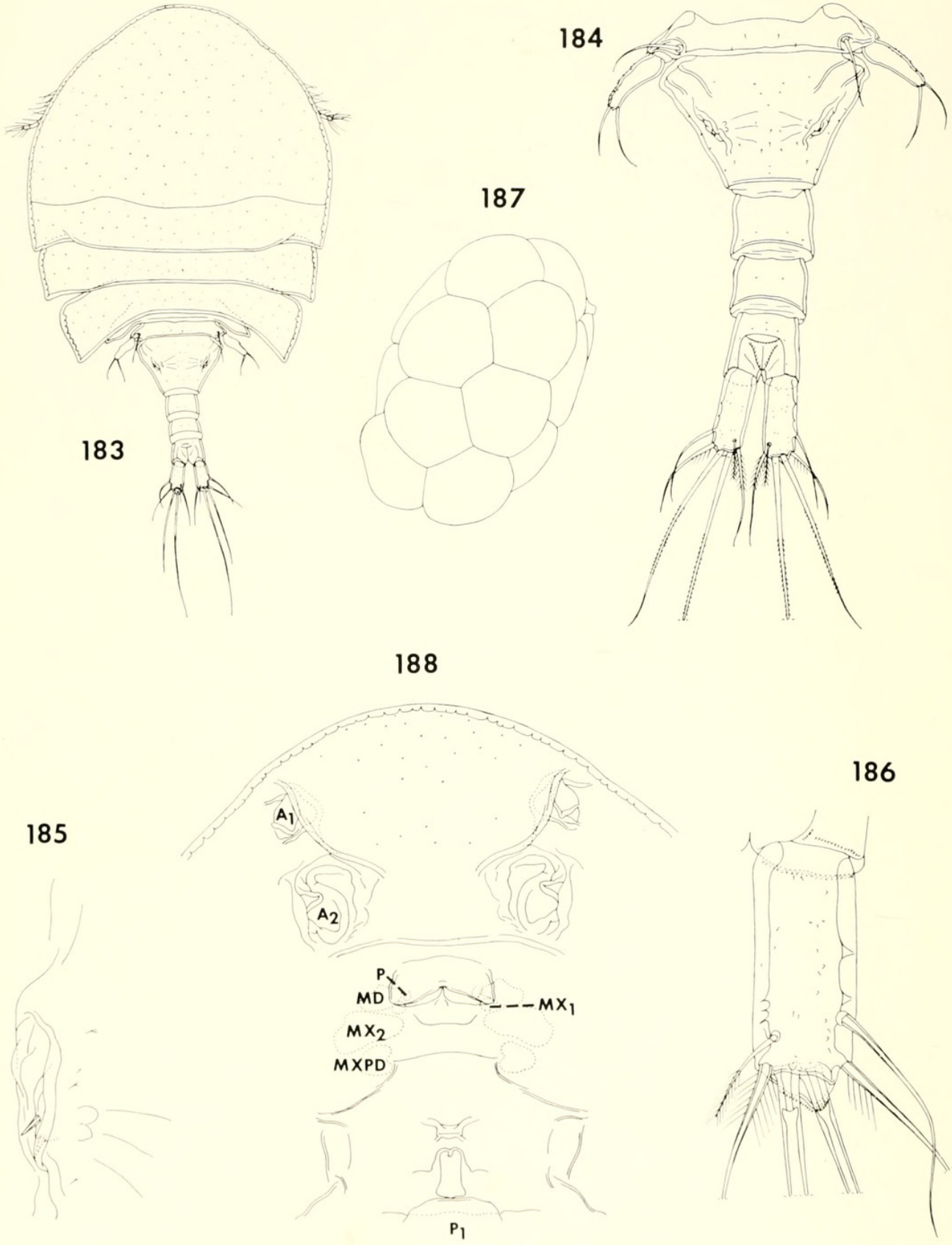
Figures 155–164. *Lichomolgus crassus* n. sp., female (continued). 155, postgenital segments, dorsal (B); 156, caudal ramus, dorsal (D); 157, anterior part of cephalosome, ventral (G); 158, first antenna, dorsal (E); 159, second antenna, outer (E); 160, labrum, ventral (E); 161, mandible, posterior (D); 162, paragnath, posterior (C); 163, first maxilla, anterior (D); 164, second maxilla, anterior (D).



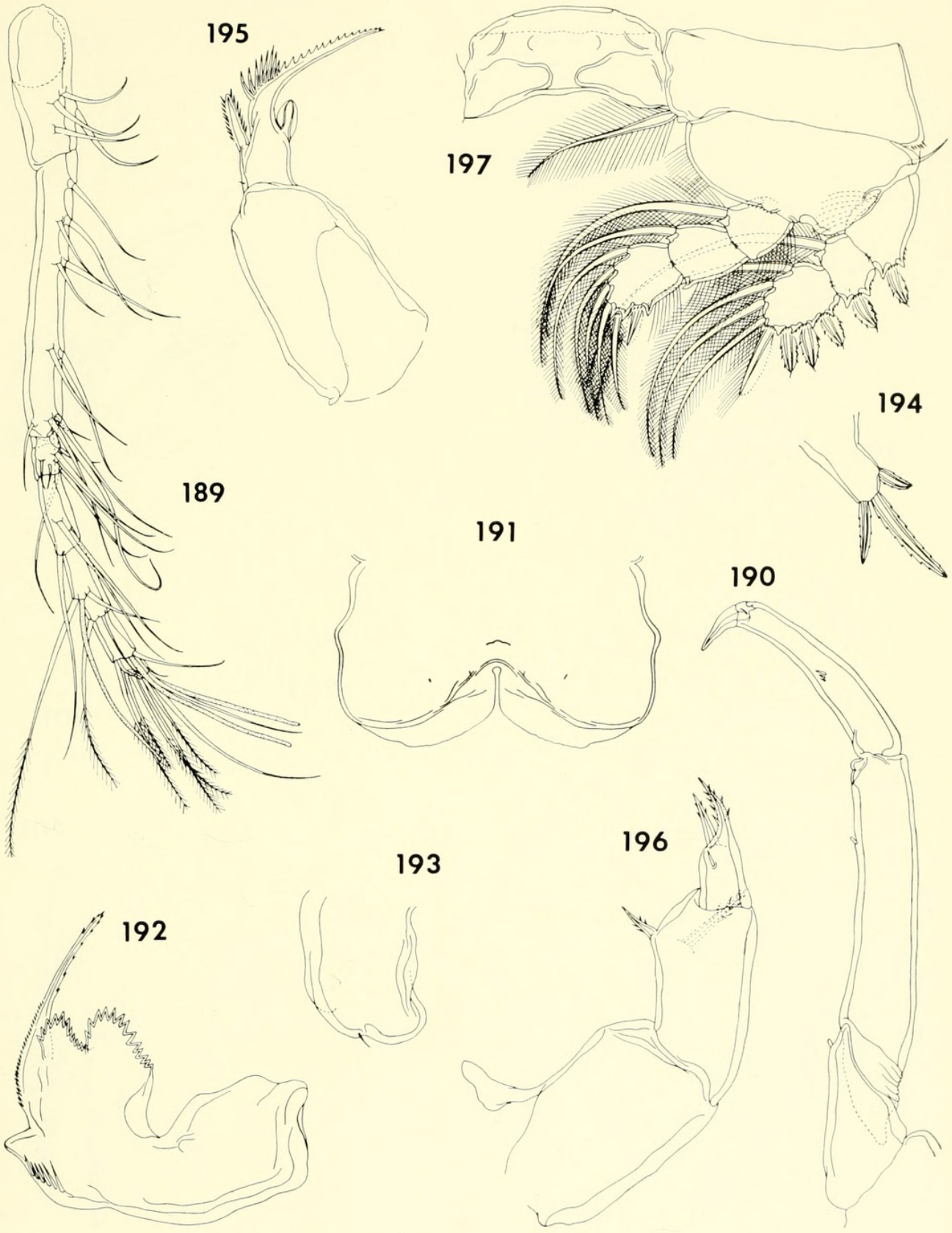
Figures 165–171. *Lichomologus crassus* n. sp., female (continued). 165, maxilliped, inner (D); 166, postoral area, ventral (E); 167, leg 1 and intercoxal plate, anterior (E); 168, leg 2, anterior (E); 169, leg 3, anterior (E); 170, leg 4 and intercoxal plate, anterior (D); 171, leg 5, dorsal (D).



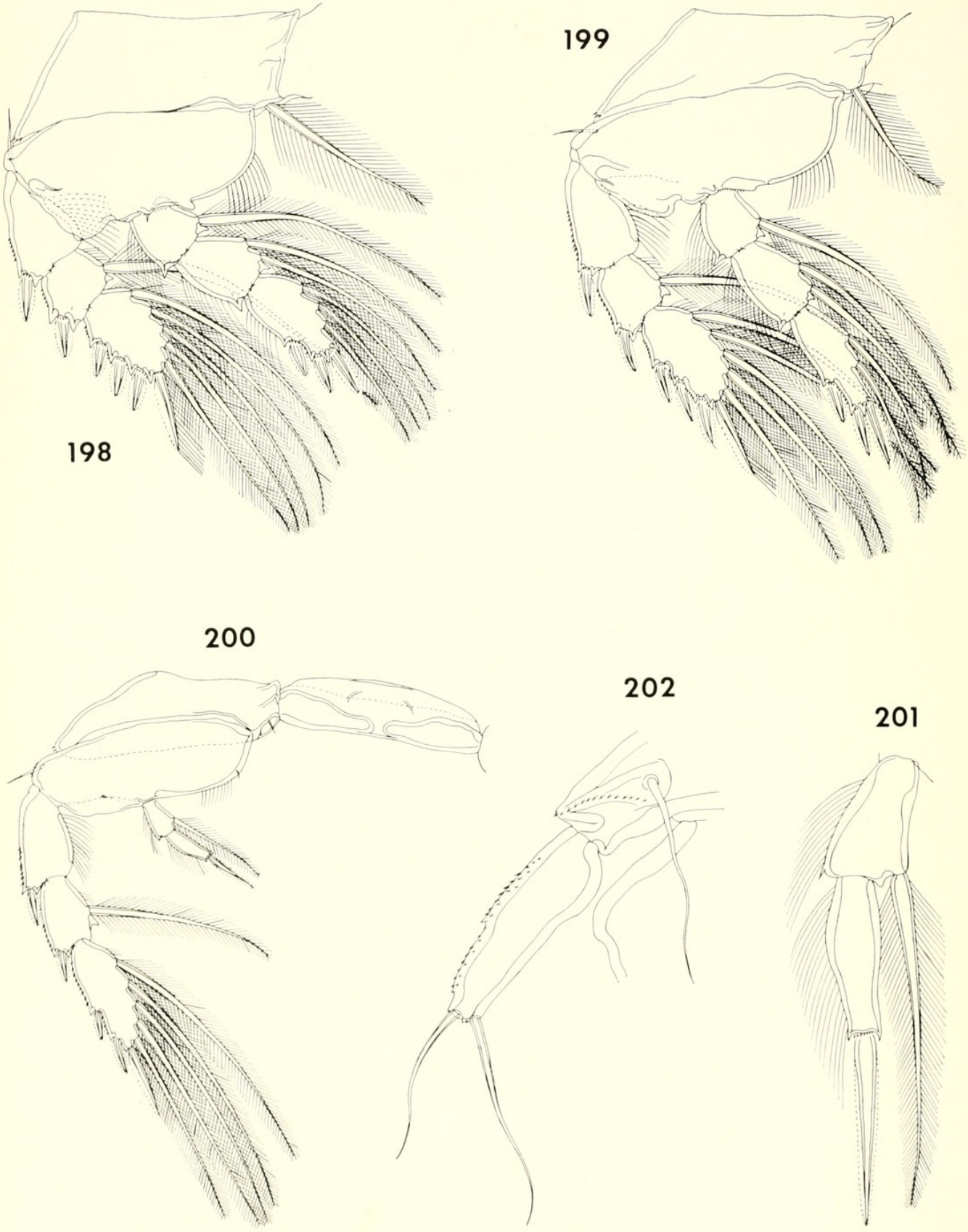
Figures 172–182. *Lichomolgus crassus* n. sp., male. 172, body, dorsal (A); 173, urosome, dorsal (G); 174, caudal ramus, dorsal (E); 175, first antenna, ventral (E); 176, maxilliped, inner (E); 177, leg 1, anterior (E); 178, last segment of endopod of leg 2, anterior (D); 179, last segment of endopod of leg 3, anterior (D); 180, endopod of leg 4, anterior (D); 181, leg 5, dorsal (F); 182, segment of leg 5 and genital segment, ventral (H).



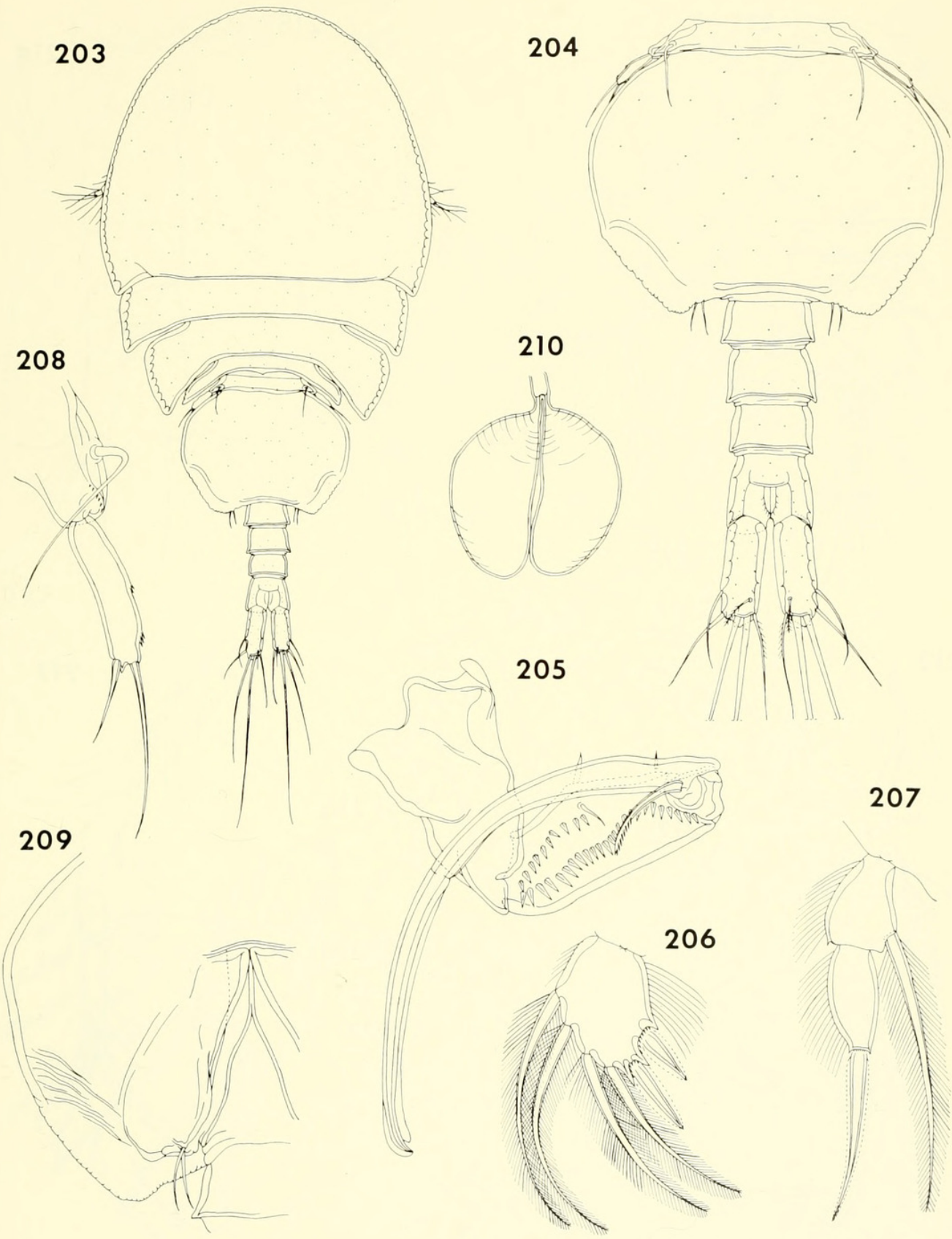
Figures 183–188. *Prionomolgus lanceolatus* n. gen., n. sp., female. 183, body, dorsal (A); 184, urosome, dorsal (B); 185, area of attachment of egg sac, dorsal (F); 186, caudal ramus, dorsal (D); 187, egg sac, ventral (B); 188, cephalosome, ventral (B).



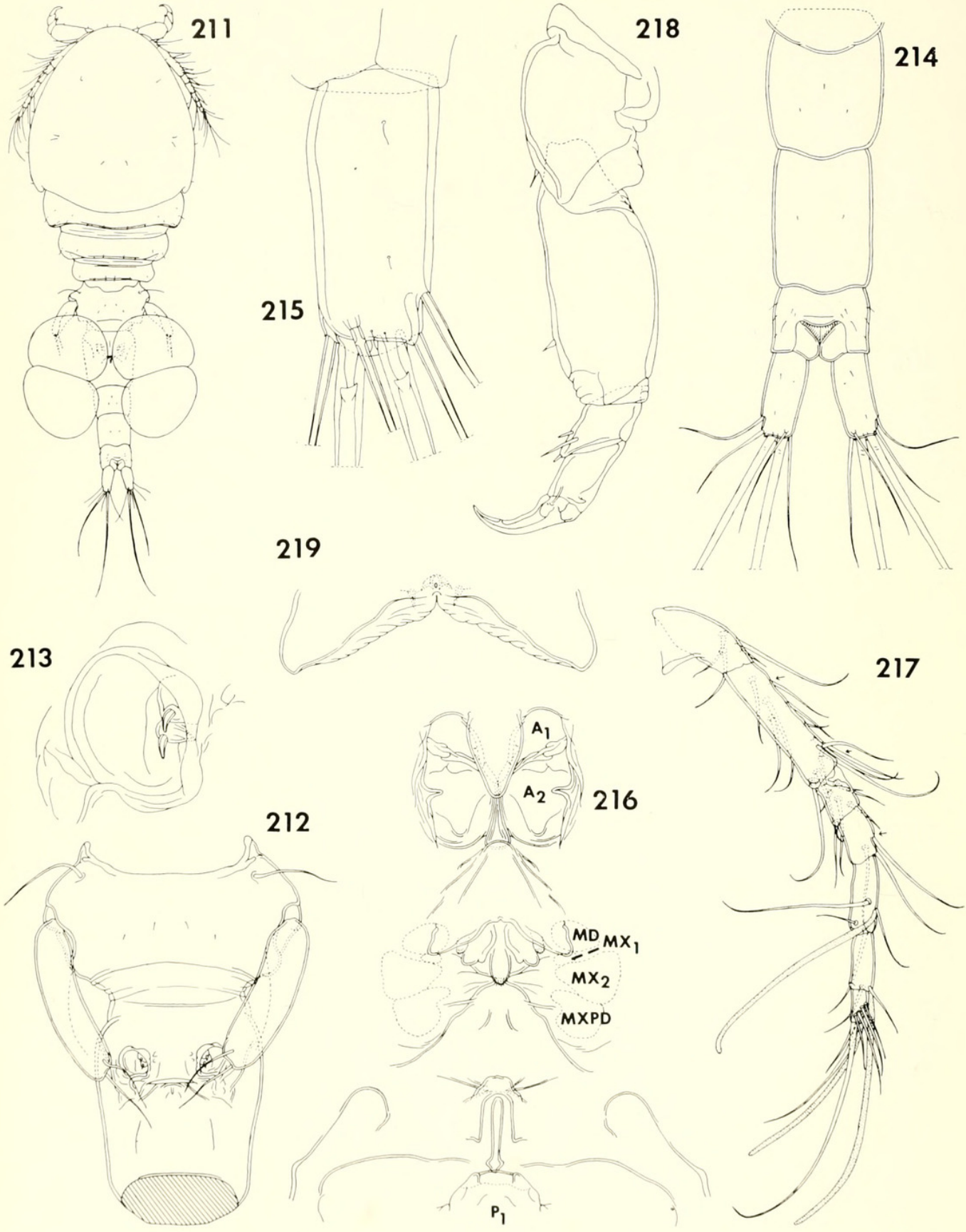
Figures 189–197. *Prionomolgus lanceolatus* n. gen., n. sp., female (continued). 189, first antenna, dorsal (E); 190, second antenna, posterior (E); 191, labrum, ventral (D); 192, mandible, posterior (F); 193, paragnath, posterior (I); 194, first maxilla, posterior (F); 195, second maxilla, anterior (D); 196, maxilliped, outer (F); 197, leg 1 and intercoxal plate, anterior (E).



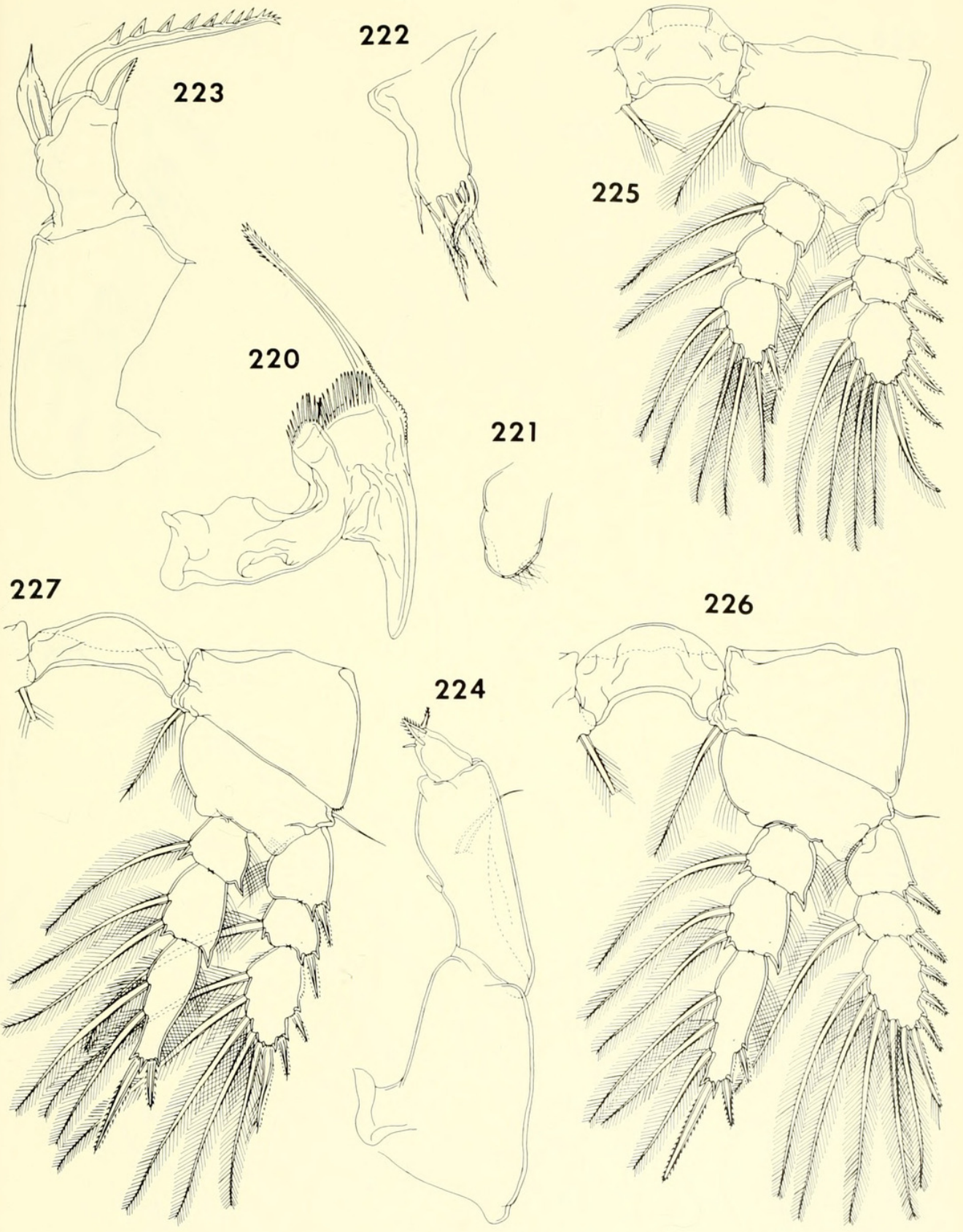
Figures 198–202. *Prionomolgus lanceolatus* n. gen., n. sp., female (continued). 198, leg 2, anterior (E); 199, leg 3, anterior (E); 200, leg 4 and intercoxal plate, anterior (E); 201, endopod of leg 4, anterior (C); 202, leg 5, dorsal (D).



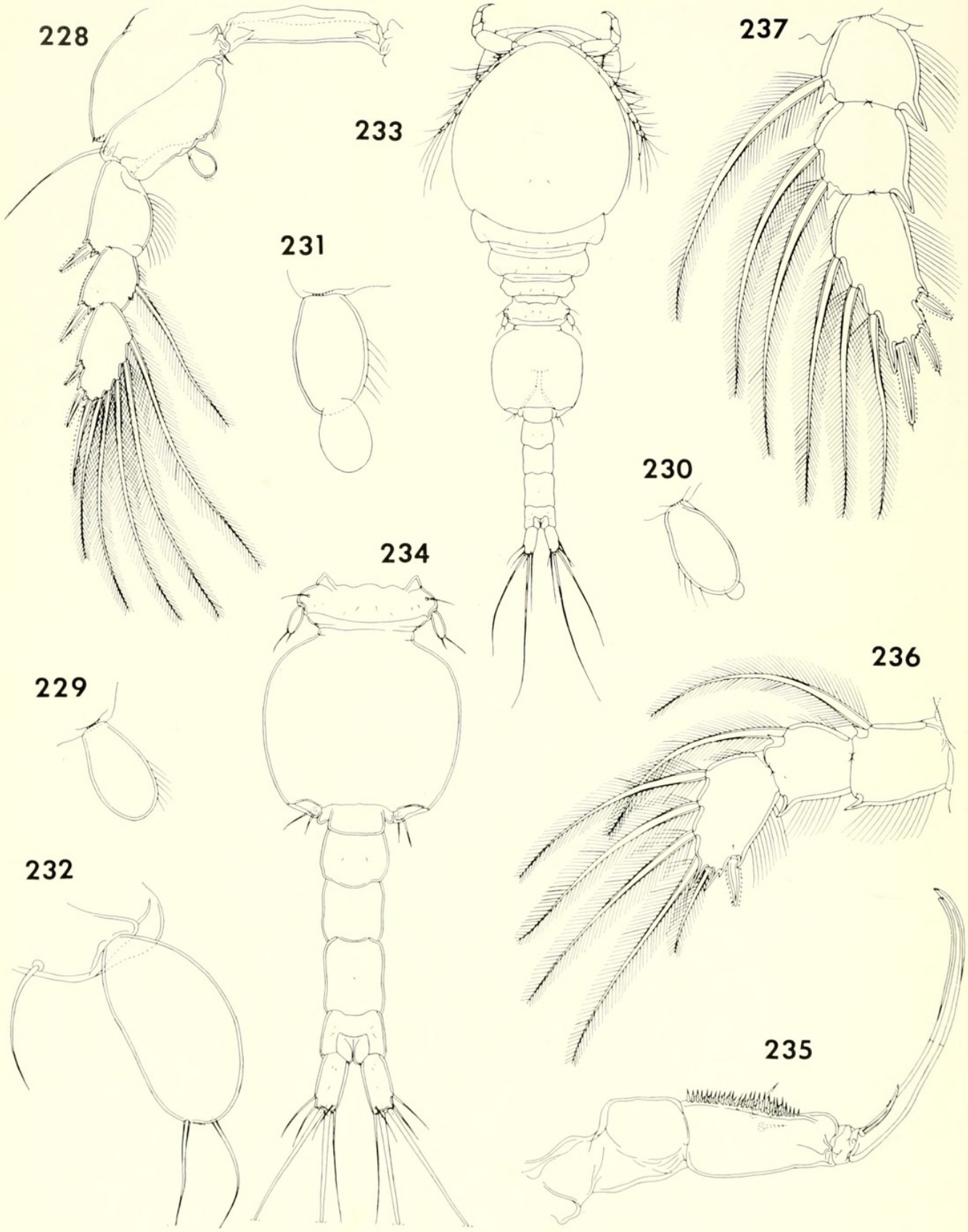
Figures 203–210. *Prionomolgus lanceolatus* n. gen., n. sp., male. 203, body, dorsal (G); 204, urosome, dorsal (H); 205, maxilliped, anterointernal (D); 206, last segment of endopod of leg 1, anterior (F); 207, endopod of leg 4, anterior (C); 208, leg 5, dorsal (F); 209, leg 6, ventral (E); 210, spermatophores, attached to female, lateral (B).



Figures 211–219. *Haplomolgus montiporae* n. gen., n. sp., female. 211, body, dorsal (G); 212, segment of leg 5 and genital segment, dorsal (E); 213, area of attachment of egg sac, dorsal (I); 214, postgenital segments and caudal rami, dorsal (E); 215, caudal ramus, dorsal (C); 216, rostral, oral, and postoral areas, ventral (E); 217, first antenna, with arrows indicating positions of aesthetes in male, posteroventral (D); 218, second antenna, inner (F); 219, edge of labrum, ventral (F).

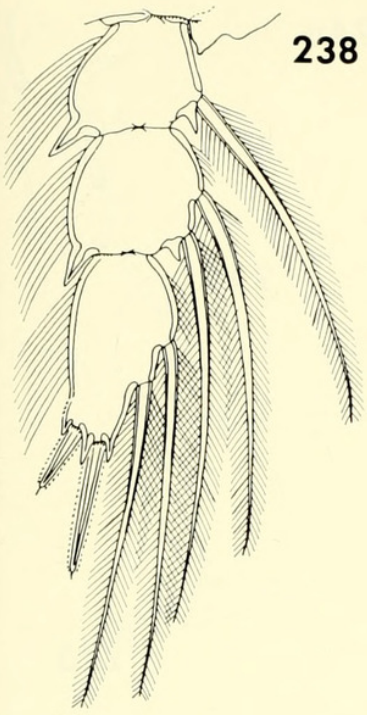


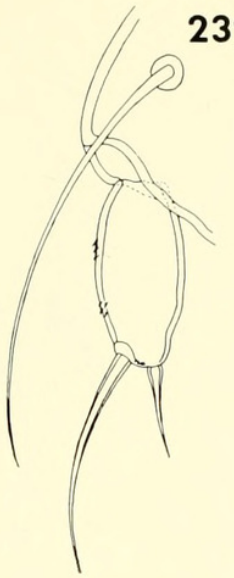
Figures 220–227. *Haplomolgus montiporae* n. gen., n. sp., female (continued). 220, mandible, posterior (C); 221, paragnath, posterior (C); 222, first maxilla, posterior (C); 223, second maxilla, posterior (C); 224, maxilliped, anterior (C); 225, leg 1 and intercoxal plate, anterior (D); 226, leg 2 and intercoxal plate, anterior (D); 227, leg 3 and intercoxal plate, anterior (D).

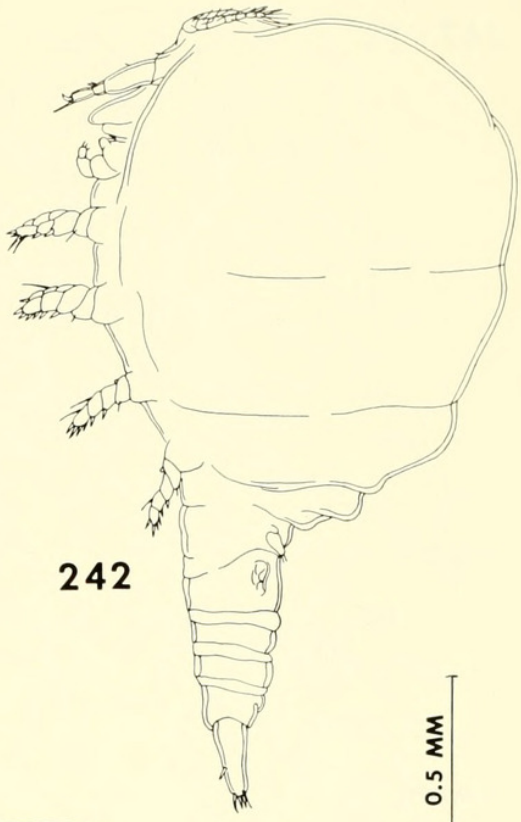


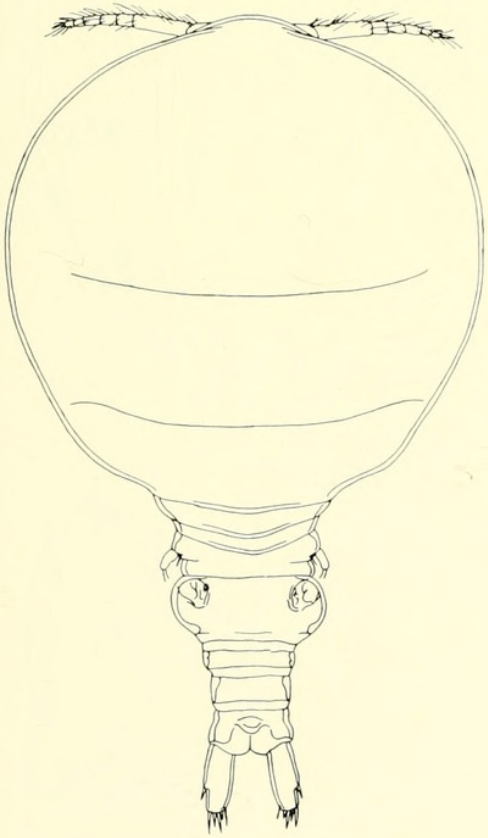
Figures 228–232. *Haplomolgus montiporae* n. gen., n. sp., female (continued). 228, leg 4 and intercoxal plate, anterior (D); 229, endopod of leg 4, anterior (C); 230, endopod of leg 4, anterior (C); 231, endopod of leg 4, anterior (C); 232, leg 5, lateroventral (D).

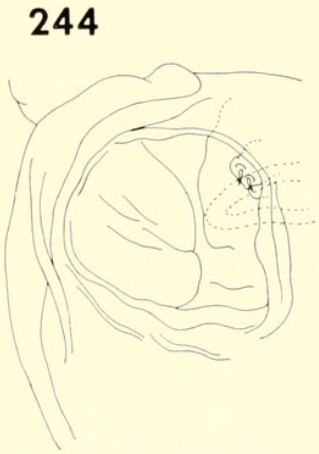
Figures 233–237. *Haplomolgus montiporae* n. gen., n. sp., male. 233, body, dorsal (G); 234, urosome, dorsal (H); 235, maxilliped, inner (E); 236, endopod of leg 1, anterior (F); 237, endopod of leg 2, anterior (F).

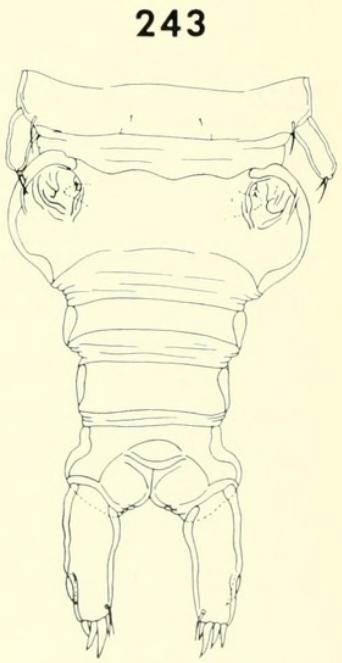


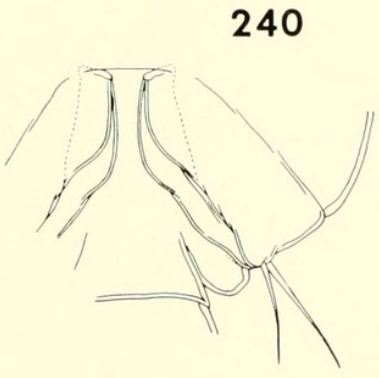






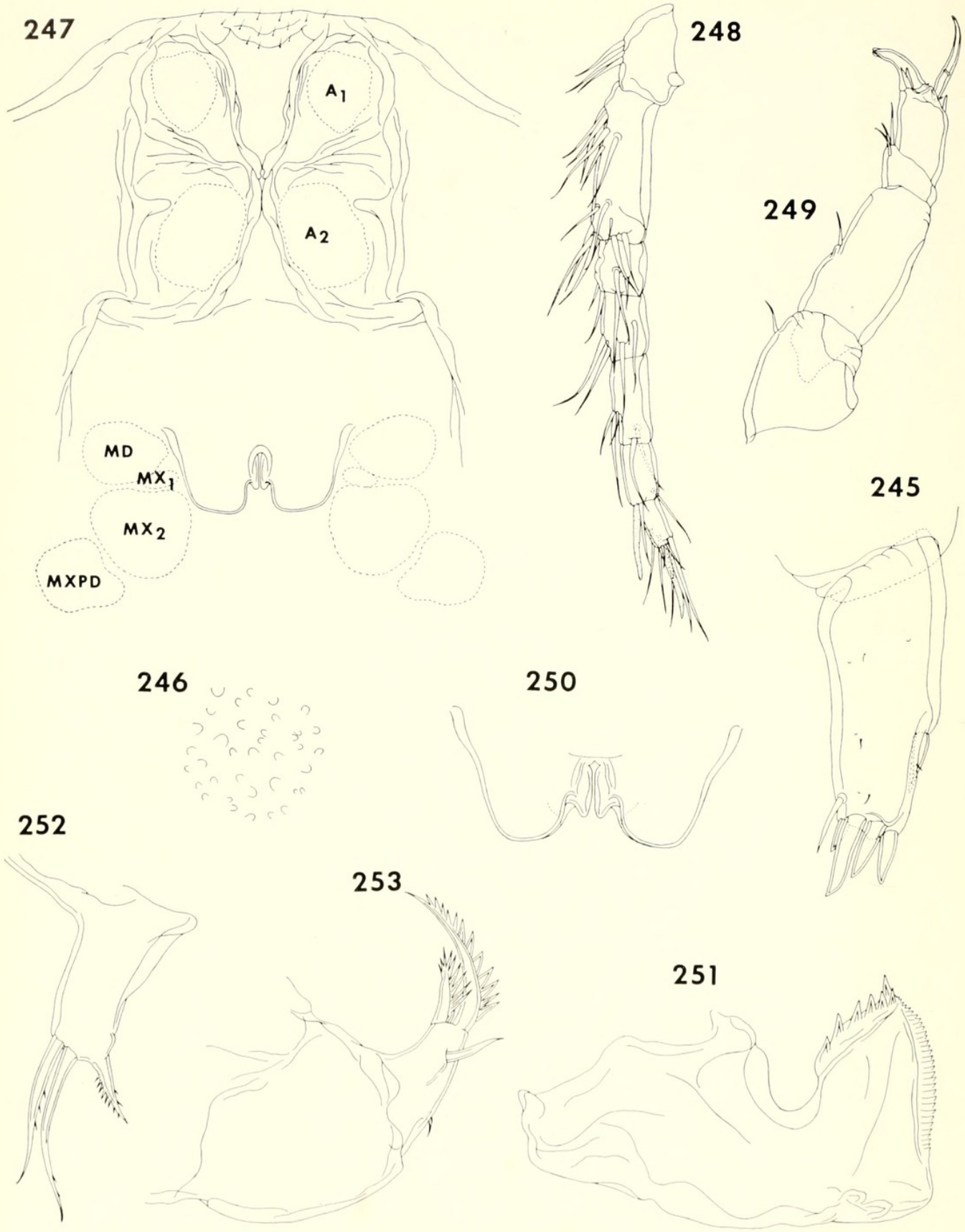




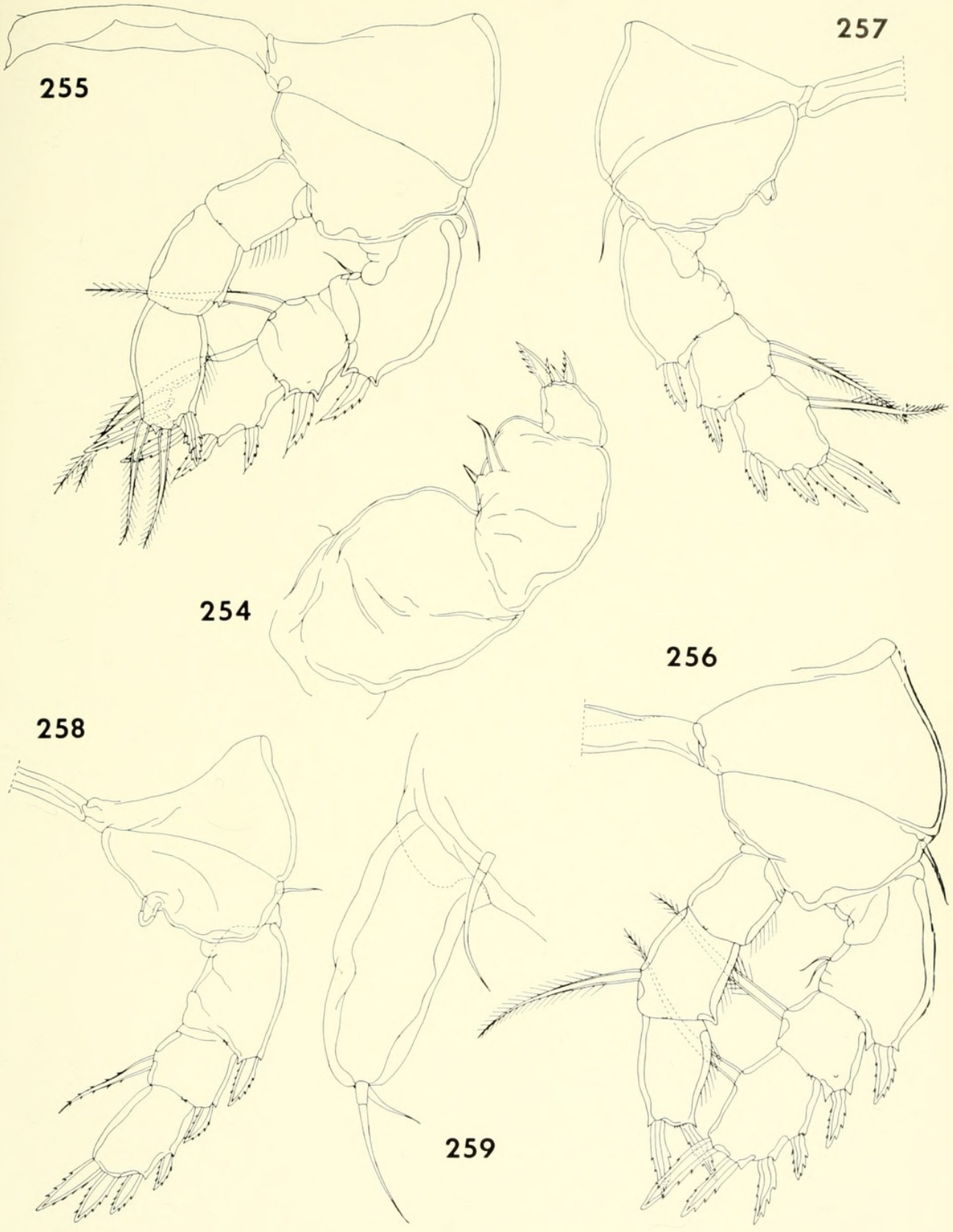


Figures 238–240. *Haplomolgus montiporae* n. gen., n. sp., male (continued). 238, endopod of leg 3, anterior (F); 239, leg 5, dorsal (C); 240, leg 6, ventral (D).

Figures 241–244. *Ravahina tumida* n. gen., n. sp., female. 241, body, dorsal (J); 242, body, lateral (J); 243, urosome, dorsal (G); 244, area of attachment of egg sac, dorsal (D).



Figures 245–253. *Ravahina tumida* n. gen., n. sp., female (continued). 245, caudal ramus, dorsal (E); 246, portion of dorsal surface of segment of leg 1 showing irregular surface of cuticula, dorsal (F); 247, rostral and oral areas, ventral (H); 248, first antenna, anterodorsal (H); 249, second antenna, anterior (H); 250, labrum, ventral (E); 251, mandible, posterior (F); 252, first maxilla, posterior (F); 253, second maxilla, anterior (D).



Figures 254–259. *Ravahina tumida* n. gen., n. sp., female (continued). 254, maxilliped, anterior (D); 255, leg 1 and intercoxal plate, anterior (E); 256, leg 2, anterior (E); 257, leg 3, anterior (E); 258, leg 4, anterior (E); 259, leg 5, dorsal (F).