New lichomolgid copepods (Cyclopoida) associated with alcyonarians and madreporarians in Madagascar

by

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The copepods belonging to the genus *Lichomolgus* are associated with a great variety of marine invertebrates. In spite of the apparent abundance of these copepods in the Indian Ocean (about 29 species of this genus are known from this region, the Red Sea and the Suez Canal included), only two species of *Lichomolgus* have to our knowledge been reported from alcyonarians and none from madreporarians. *Lichomolgus serratipes* Ummerkutty, 1962, has been found in washings of *Pteroides esperi* Herklots (order Pennatulacea) in the Gulf of Manaar and Palk Bay, on the southeastern coast of India. *Lichomolgus anomalus* A. Scott, 1909, was collected by Sewell (1949) from debris in a jar of Alcyonacea from the southern coast of Arabia. No species of *Lichomolgus* have been reported up to now from alcyonarians and madreporarians in Madagascar.

The copepods described below were collected while the first author was the leader of an expedition sent to Madagascar by the Academy of Natural Sciences of Philadelphia in 1960.

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Lichomolgidae Kossmann, 1877

Monomolgus gen. n.

Mandible with a short terminal spiniform process instead of a long flagellum. Endopod of the fourth leg 2-segmented, the first segment unarmed, the second with a single terminal spine.

Other characters as in the species described below.

Living in association with the coral *Porites*.

Genotype and only species : *Monomolgus unihastatus* sp. n. (μόνος = unique, single and μολγος = a sack made of leather; *unus* = one and *hastatus* = armed with a lance, alluding to the single spine on the endopod of the fourth leg).

Gender masculine.

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Monomolgus unihastatus sp. n.

Figs. 1-36

—Types - 134 females, 110 males, and 6 copepodids from the coral, *Porites cf. P. andrewsi* Vaughan, at a depth of 3 meters at Pointe de Tafondro, Nossi Bé, Madagascar, September 28, 1960. Holotype female, allotype male, and 48 paratypes (26 females, 22 males) deposited in the United States National Museum at Washington, the same number of paratypes in the Muséum National d'Histoire Naturelle at Paris, in the Zoölogisch Museum at Amsterdam, and in the collection of the Centre d'Océanographie et des Pêches at Nossi Bé; the remaining paratypes in the collection of the first author.

—Other specimens (all from *Porites cf. P. andrewsi* Vaughan) - 45 females, 52 males, and 3 copepodids in 3 meters at Pointe de Tafondro, Nossi Bé, August 29, 1960. 91 females, 60 males, and 3 copepodids in 2 meters at Pointe Lokobe, Nossi Bé, September 2, 1960. 10 females, 7 males, and 2 copepodids in 2 meters at Ambariotelo, a small island to the southeast of Nossi Bé, August 27, 1960. 29 females, 14 males in 2 meters at Tany Kely, a small island about 8 kms to the south of Nossi Bé, October 9, 1960. 58 females, 38 males, and 1 copepodid in 0.5 meter at low tide at the point to the north of the village of Madirokely, Nossi Bé, October 24, 1960. 35 females, 28 males, and 4 copepodids in 1 meter at Pointe Lokobe, Nossi Bé, October 25, 1960.

—Female - Cephalosome widened (fig. 1). Length of the body (the setae of the caudal rami not included) 1.30 mm (1.25-1.34 mm), greatest width 0.52 mm (0.52-0.55 mm), the measurements based on 10 specimens. Segment of the first leg separated from the head by a furrow. Epimeral areas of the segments of the second, third, and fourth legs somewhat extended as indicated in the figure. Genital segment (fig. 2) a little widened in its anterior part and slightly wider than long, 160 x 174 μ. Areas of the attachments of the egg sacs situated dorsolaterally and armed with two small spines (fig. 3). Three postgenital segments 103, 99, et 84 μ long respectively, the last segment with a ventral row of small spines near the base of the caudal ramus. Ratio of the prosome to the urosome about 1.13:1. Egg sacs 382 x 249 μ, each containing 6 eggs about 170 μ in diameter, and reaching almost to the last postgenital segment.

Caudal ramus (fig. 4) elongated, 153 x 39 μ, 3.9 times longer than wide. All the setae relatively short, less than the length of the ramus, and apparently naked. External lateral seta situated distally at a point about three quarters of the length of the ramus. Dorsal pedicellate seta very close to the end of the ramus. The four terminal setae inserted between dorsal and ventral expansions of the ramus (figs. 5 and 6). The dorsal and ventral surfaces of the ramus with scattered hairs and refractile points.

Region of the rostrum not developed (as indicated in fig. 7). First antenna (fig. 8) 7-segmented, the segments 53, 74, 25, 40, 42, 25, and 17 μ long respectively (measured along their posterior borders). Near the base of the third segment (on its ventral surface), a small sclerified region (fig. 9), perhaps representing the vestige of a segment. The seven segments with an ornamentation of 39 setae and 3 aesthetes, arranged as follows : 4, 13, 6, 3, 4 and 1 aesthete, 2 and 1 aesthete, and 7 and 1 aesthete. All the setae naked.

Second antenna (fig. 10) 4-segmented, the first segment 72 μ long with a small distal inner seta, the second 120 μ with a similar seta a little beyond the middle of the inner border, the third 25 μ with three inner distal setae, and the fourth 35 x 21 μ (the length taken on the outer side) and bearing a single distinctly angular claw 42 μ long (measured in a straight line along its axis). All the setae naked. (The lengths of the segments represent the actual length, taking into consideration the overlapping of the segments).

Posterior border of the labrum (fig. 11) indented in the middle and without ornamentation. Mandible (fig. 12) with its basal region showing distally an outer lobe bordered with a row of spinules and an inner row of minute spines. Flagellum unusually short and stout, armed with lateral spinules,

and rather abruptly delimited from the basal region. Paragnath (fig. 13) a small lobe with some small setae arranged in a straight line. First maxilla (fig. 14) a rather elongated lobe, terminally with two unequal naked setae (their articulations indistinct) and a linguiform process (perhaps representing a third seta). Second maxilla (fig. 15) 2-segmented, but the junction between these two segments very indistinct. First segment large, expanded, with setae as indicated in the figure. Second segment armed with an outer hyaline digitiform process (probably homologous to the seta on the posterior surface in species of *Lichomolgus*) and with a smaller inner hyaline process (homologous to the subterminal barbed spine in *Lichomolgus*); a very small process (spinule ?) on the outer basal area of this segment; the extremity of the segment attenuated in the form of a spine with a row of sharp teeth along its outer edge.

Maxilliped (fig. 16) 3-segmented, the first segment unarmed, the second with two unequal obtuse hyaline setae, and the third with an obtuse seta, a small hyaline process, and a terminal triangular process.

Orientation of the mouthparts as in *Lichomolgus*. Ventral region between the maxillipeds and the first legs (fig. 17) with a transverse furrow; with a thickening in the form of a V in front of the furrow. In lateral view (fig. 18) this thickening appears as a protuberance.

Rami of legs 1-4 (figs. 19, 20, 21, and 22) 3-segmented, except the endopod of the fourth leg which is 2-segmented. Formula of the spines and setae of these legs as follows (the Arabic numerals representing the setae, the Roman numerals the spines) :

P 1	exp.	I-0;	I-1;	III-I-4
	end.	0-1;	0-1;	I-5
P 2	exp.	I-0;	I-1;	III-I-5
	end.	0-1;	0-2;	I-II-3
P 3	exp.	I-0;	I-1;	III-I-5
	end.	0-1;	0-2;	I-II-2
P 4	exp.	I-0;	I-1;	III-I-5
	end.	0-0;	I	

Coxopods of legs 1-3 with a long inner seta, but the coxopod of the fourth leg without a seta. Each of the four basipods with a naked outer seta and a row of hairs on the inner border. Endopod of the fourth leg (fig. 22) reaching to the end of the second segment of the exopod; its first segment 30 x 22 μ and without a long inner seta but furnished on each side with a row of hairs; the second segment 39 x 20 μ, rather tapered, also bordered with hairs on each side, and bearing at its extremity a single barbed spine 40 μ long.

Fifth leg (fig. 23 and 24) with its free segment flattened, widened, 179 x 105 μ measured in flat view, concave on its inner surface to fit the curvature of the end of the egg sac (see fig. 1); somewhat attenuated distally with two unequal naked terminal setae. Borders of this segment bearing small hairs and its outer lateral surface covered with minute spinules.

Sixth leg probably represented by the two small spines near the attachment of the egg sacs (see fig. 3).

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

—Male - Form of the body (fig. 25) resembling that of the female. Total length (the setae of the caudal rami excluded) 1.24 mm (1.17-1.28 mm), greatest width 0.47 mm (0.45-0.49 mm), the measurements based on 10 specimens. Genital segment (figs. 25 and 26) subquadrangular, 220 μ long and 241 μ wide. Four postgenital segments 78, 90, 65, and 82 μ long respectively. Ratio of the prosome to the urosome about 1:1.22. Spermatophore (fig. 27) somewhat pear-shaped, 187 x 103 μ, the neck excluded.

Caudal ramus as in the female, but relatively longer, 178 x 31 μ, almost 6 times longer than wide (5.7:1).

Rostral region resembling that of the female. First antenna (fig. 28) with the seven segments having the same relative lengths as in the female; the setae arranged as in the female, but the formula of the aesthetes 0, 2, 0, 1, 1, 1, and 1. Near the base of the third segment a small sclerified region as in the female.

Second antenna (fig. 29) resembling that of the female, but the setae slightly stouter, the distal seta on the third segment longer; the inner border of the second segment (proximal to the seta) with some small spines as indicated in the figure.

Posterior border of the labrum, mandible, paragnath, first maxilla, and second maxilla as in the female. Maxilliped (fig. 30) elongated, 4-segmented (a part of the claw probably representing the fourth segment). The first segment unarmed, 130 μ long. The second, 109 μ long, having on its inner surface two projecting spines (11 and 23 μ long) and a row of spinules. The third very short, 13 μ long, and unarmed. The fourth segment incorporated with the long recurved claw, 195 μ long (measured in a straight line from the base to the extremity), bearing near its base a very small inner seta (only 4 μ long) and a larger seta (46 μ long) unilaterally pectinate with its basal part slightly swollen.

Legs 1-4 as in the female, with the same armature except the last segment of the endopod of the first leg (fig. 31) which has two spines and four setae (I-I-4). Last segment of the endopod of the second leg (fig. 32) and of the third leg (fig. 33) slightly longer than those of the female. Endopod of the fourth leg (fig. 34) with the first segment 34 x 21 μ, the second segment 48 x 19 μ, and the terminal spine 36 μ long (the relative proportions thus slightly different from those in the female).

Fifth leg (fig. 35) with the free segment very small in comparison with that of the female subrectangular, 23 x 13 μ, without fine ornamentation, bearing two unequal naked terminal setae (33 and 20 μ long respectively). Naked seta near the base of this segment relatively long, 40 μ.

Sixth leg (fig. 36) represented by a ventrolateral ridge on the posterior part of the genital segment (fig. 26); bearing two naked setae 90-100 μ long.

Color in life resembling that of the female.

These copepods were found in the sediment obtained after a gentle rinsing of the coral in sea water with 5 per cent ethyl alcohol for a half-hour. After the coral had been broken in small pieces with a hammer and subjected to a second washing, no copepods were found. These copepods probably live on the outer surface of the coral, or, if they live inside the polyps, they emerge under the stimulation of the alcohol.

The new genus *Monomolgus* seems to be close to *Lichomolgus*, as characterized by Stock (1957). However the armature of the endopod of the fourth leg (with the formula 0-0; I) distinguishes it from the numerous species of *Lichomolgus* (where this formula is 0-1; II). The mandible, with its short spiniform terminal process, does not resemble that of species of *Lichomolgus*, which have generally a rather long mandibular flagellum. Only *Lichomolgus congoensis* T. Scott, 1894, from the Gulf of Guinea, has a mandible suggesting the condition of *Monomolgus* (see figure 42, plate XIII, of T. Scott). In this African species, however, the endopod of the fourth leg has an armature characteristic of *Lichomolgus*.

As in all cases of new monotypic genera, it is difficult to estimate the systematic significance of characters, especially to distinguish those which are generic from those which are specific. Furthermore, if one considers a single character (such as the armature of the endopod of the fourth leg) of a monotypic genus, it is difficult to know whether this character forms the basis for a generic distinction or whether it represents a point in a progressive series (in the case of *Monomolgus* the reduced armature of the endopod of the fourth leg being the result of an evolutionary reduction). We are inclined to the point of view that *Monomolgus* represents a new genus.

Other characters of special interest in *M. unihastatus* are the spinules (instead of hairs) on the paragnath, the two setae (instead of 3 or 4) on the first maxilla, the obtuse hyaline setae

on the second maxilla and the maxilliped, the protuberance on the ventral surface behind the maxillipeds, the hairs on both sides of the first segment of the endopod of the fourth leg, and the flattened wide concave fifth leg of the female.

Lichomolgus Thorell, 1860

Lichomolgus actinophorus sp. n.

Figs. 37-65

—Types - 312 females, 339 males, and 22 copepodids from the coral, *Pavona angulata* Klunzinger, at a depth of 0.5 meter at low tide at Befotaka, Nossi Bé, Madagascar, September 24, 1960. Holotype female, allotype male, and 128 paratypes (61 females, 67 males) deposited in the United States National Museum at Washington, the same number of paratypes in the Muséum National d'Histoire Naturelle at Paris, in the Zoölogisch Museum at Amsterdam, and in the collection of the Centre d'Océanographie et des Pêches at Nossi Bé; the remaining paratypes in the collection of the first author.

—Other specimens - 19 females and 31 males from *Pavona angulata* Klunzinger in 0.5 meter at Ambariobe, a small island to the southeast of Nossi Bé, October 10, 1960. 7 females, 4 males, and 2 copepodids from *Pavona cactus* (Forskål) in 1 meter at Pointe de Tafondro, Nossi Bé, October 19, 1960.

—Female - Cephalosome slightly widened (fig. 37). Total length (the setae of the caudal rami excluded) 1.42 mm (1.37-1.49 mm), greatest width 0.50 mm (0.48-0.55 mm), the measurements based on 10 specimens. Segment of the first leg separated from the head by a rather indistinct furrow. Epimeral areas of the segments of the second and third legs rounded, but those of the segment of the fourth leg angular. Genital segment (fig. 38) 216 μ long, 241 μ wide in its anterior half, 170 μ wide in its posterior half, the two halves separated by a lateral constriction. Areas of the attachments of the egg sacs situated dorsolaterally and bearing two small spines (fig. 39). Three postgenital segments 82, 53, and 78 μ long respectively. Ratio of the prosome to the urosome about 1.26:1. Egg sacs 299 x 174 μ, with 8-10 eggs, reaching almost to the middle of the first postgenital segment.

Caudal ramus (fig. 40) elongated, 139 x 40 μ, almost 3.5 times longer than wide; with a small naked pedicellate dorsal seta, a naked lateral seta on its outer edge, a naked subterminal outer seta, and three barbed terminal setae (the outer two with an internal thickening near the base). The dorsal and ventral surfaces of the ramus without ornamentation.

Rostral region not developed (as shown on fig. 41). First antenna (fig. 42) 7-segmented, the segments 40, 69, 29, 36, 34, 25, and 23 μ long respectively (measured along their posterior borders). Near the base of the third segment, on its ventral surface, a small sclerified region (fig. 43), perhaps representing the vestige of a segment. The seven segments with an ornamentation consisting of 39 naked setae and 3 aesthetes, arranged as follows : 4, 13, 6, 3, 4 and 1 aesthete, 2 and 1 aesthete, and 7 and 1 aesthete.

Second antenna (fig. 44) 4-segmented, the first segment 81 μ long with a small inner distal seta, the second 120 μ with an even smaller seta slightly beyond the middle of the inner border, the third 40 μ with three small inner distal setae, and the fourth segment 38 μ long on its outer margin, 22 μ long on its inner margin, and 19 μ wide, bearing a slightly recurved claw 55 μ long (measured along its axis). All the setae naked.

Posterior border of the labrum (fig. 45) indented in the middle and smooth. Mandible (fig. 46) consisting of a basal region (its inner edge armed with a strong tooth directed toward the base and a distal row of very small teeth; its outer edge with two striated fringes, the striations continuing beyond the margin of the fringes as free hairs) and a barbed flagellum attenuated and rather distinctly delimited from the basal region. Paragnath (fig. 45) a small rounded lobe with its distal border slightly crenulated. First maxilla (fig. 47) composed of a single segment, bearing three setae rather strongly barbed with spinules. Second maxilla (fig. 48) 2-segmented, the large proximal segment bearing some slender setae, the distal segment much smaller, armed with a naked outer seta and an inner process

in the form of a setiferous sphere, and bearing a strong terminal spine with a row of large teeth on one side and a row of spinules on the other. A very small spinule on the outer basal area of this segment.

Maxilliped (fig. 49) 3-segmented, the first segment unarmed, the second with two unequal setae, the larger one barbed, the other naked, the third with a short seta, a stout barbed spine, and a terminal process (spine ?) as indicated in the figure.

Orientation of the mouthparts as shown in fig. 50. Ventral region between the maxillipeds and the first legs (fig. 51) with a transverse furrow; in lateral view (fig. 52) a slight protuberance behind this furrow.

Rami of legs 1-4 (figs. 53, 54, 55, and 56) 3-segmented, except the endopod of the fourth leg which has only two segments. Formula of the spines and setae of these legs as follows (the Arabic numerals representing the setae, the Roman numerals the spines) :

P 1	exp.	I-0;	I-1;	III-I-4
	end.	0-1;	0-1;	I-5
P 2	exp.	I-0;	I-1;	III-I-5
	end.	0-1;	0-2;	I-II-3
P 3	exp.	I-0;	I-1;	III-I-5
	end.	0-1;	0-2;	I-II-2
P 4	exp.	I-0;	I-1;	II-I-5
	end.	0-1;	II	

Coxopods with a large inner plumose seta (but this seta on the fourth leg much smaller than the others). Basipods provided on the inner border with a row of hairs and bearing a slender outer seta rather weakly barbed.

Fourth leg (fig. 56) with the endopod reaching to the end of the second segment of the exopod; its first segment 29 x 17 μ, with a single inner seta, the second segment 53 x 23 μ with a slight interruption in its outer margin and armed distally with two spines, the outer 29 μ, the inner 46 μ long. Outer margin of both segments with a row of hairs.

Fifth leg (fig. 57) with the free segment flattened, 141 x 67 μ, its borders slightly irregular; with some very small spinules on its dorsal surface and bearing two naked unequal terminal setae (46 and 32 μ long respectively).

Sixth leg perhaps represented by the two small spines near the attachment of the egg sacs (see fig. 39).

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

—Male - Form of the body (fig. 58) nearly as in the female. Total length (the setae of the caudal rami not included) 1.28 mm (1.20-1.32 mm), greatest width 0.39 mm (0.37-0.41 mm), the measurements based on 10 specimens. Epimeral areas of the segment of the fourth leg less angular than in the female. Genital segment (fig. 59) almost square in dorsal contour, 213 x 208 μ. Four postgenital segments 67, 61, 50, and 69 μ long respectively. Ratio of the prosome to the urosome 1:1. Spermatophore not observed.

Caudal ramus like that of the female, 135 x 36 μ.

Rostral region not developed. First antenna (fig. 60) 7-segmented, the segments of the same relative lengths as in the female; arrangement of the setae as in the female, but the aesthetes 0, 2, 0, 1, 1, 1, and 1. Near the base of the third segment a small sclerified region as in the female.

Second antenna (fig. 61) resembling that of the female, but with two pairs of conical protuberances on the inner border of the second segment (in one specimen only one protuberance at each point instead of a pair).

Posterior border of the labrum, mandible, paragnath, first maxilla, and second maxilla as in the female. Maxilliped (fig. 62) elongated, 4-segmented (assuming that a part of the claw represents a fourth segment). The first two segments long, the first unarmed, the second with two inner spines and with other small spines on its inner surface as indicated in the figure. Third segment very short and unarmed. Fourth segment in the form of a long recurved claw, 177 μ long (measured in a straight line from the base to the extremity), bearing near its base a very small inner seta and a larger seta unilaterally barbed. Postoral region like that of the female.

Legs 1-4 as in the female, with the same armature of setae and spines, except the last segment of the endopod of the first leg where the formula is I-I-4.

Fifth leg (fig. 64) with the free segment much smaller than in the female, 46 x 19 μ, without ornamentation on its surface, and with the two naked terminal setae relatively longer, 32 and 35 μ respectively.

Sixth leg (fig. 65) represented by a ventrolateral ridge on the posterior part of the genital segment, provided with two naked setae.

Color in life as in the female.

(The specific name is derived from ακτις = a ray, and φορειυ = to carry, alluding to the setiferous sphere on the second maxilla).

This species may be distinguished from other species in the genus by the setiferous sphere on the second maxilla and by a combination of other characteristics : the relatively short setae on the caudal ramus, the single terminal claw on the second antenna, the form of the mandible, the formula of the last segment of the exopod of the fourth leg (II-I-5), the shape of the fifth leg, the armature of the maxilliped in the male, and the form of the genital segment in the female.

L. actinophorus seems to be close to certain other species of *Lichomolgus* from the Indian Ocean, but at the same time it shows some evident differences from them. *L. elegans* Thompson and A. Scott, 1903 (the male is unknown), from "general washings of dredged Invertebrates" in Ceylon, has approximately the same size as the species from Madagascar, but the genital segment, although indented laterally, is more slender, the caudal ramus is shorter, the second segment of the first antenna is relatively longer, and the second maxilla lacks a setiferous sphere (see fig. 11, plate XVI, of T. and S.). *L. gigas* Thompson and A. Scott, 1903, from "general washings of dredged Invertebrates" in Ceylon, is larger than the species from Madagascar (the female 2 mm long) and the second maxilla does not show a setiferous sphere (see fig. 24, plate XVI, of T. and S.). *L. simplex* Thompson and A. Scott, 1903, from sponge washings in the Gulf of Manaar, is smaller than *L. actinophorus* (the female 0.88 mm), the segments of the slender second antenna have different proportions, and the second maxilla lacks the setiferous sphere (see fig. 31, plate XV, of T. and S.).

L. actionophorus was found associated with the same specimens of coral, *Pavona angulata*, from which another copepod, *Xarifia longipes* Humes, 1962, was collected.

Lichomolgus compositus sp. n.

Figs. 66-98

—Types - 17 females, 10 males, and 1 copepodid from the coral, *Seriatopora subseriata* Ehrenberg, at a depth of 1 meter at Pointe Mahatsinjo, Nossi Bé, Madagascar, September 5, 1960. Holotype female, allotype male, and 8 paratypes (5 females, 3 males) deposited in the United States National Museum at Washington, the same number of paratypes in the Muséum National d'Histoire Naturelle at Paris, and the other paratypes in the collection of the first author.

—Female - Prosome moderately widened (fig. 66). Total length (the setae of the caudal rami excluded) 1.58 mm (1.41-1.66 mm), greatest width 0.60 mm (0.58-0.63 mm), the measurements based on 5 specimens. Segment of the first leg incompletely separated from the head by an indistinct furrow. Segments of the second and third legs wide, their epimeral areas angular. Segment of the fourth leg much narrower, its epimeral areas much less expanded. Genital segment (fig. 67) slightly longer than wide, 166 μ long, 153 μ wide anteriorly, and 143 μ wide posteriorly, the two sides nearly parallel. In lateral view (fig. 68) this segment weakly convex ventrally and concave dorsally with a transverse dorsal furrow in the middle of the segment. Some small setules on the lateral surface of the segment, and the posterior part of the segment finely striated as indicated in the figure. Areas of attachment of the egg sacs situated laterally and showing three small spiniform projections, two of them articulated (fig. 68). Three postgenital segments 122, 112, and 90 μ long respectively. Ratio of the prosome to the urosome about 1:1. Egg sac (fig. 69), seen on a single female, 330 x 202 μ, and containing 7 eggs.

Caudal ramus (fig. 70) elongated, 226 x 37-44 μ, 5 times longer than wide, slightly constricted near the middle. Its two surfaces with some very small refractile hairs. The six setae naked, much shorter than the ramus, only one third or less than its length, and situated around the rounded extremity of the ramus. The dorsal seta pedicellate and slender (50 μ long), the lateral seta (60 μ) and the inner and outer terminal setae (65 μ and 60 μ long respectively) of the usual form (the inner one placed rather far from the nearest terminal seta). The two median terminal setae only one third as long as the ramus (70 μ and 78 μ long), widened and hyaline with attenuated tips (fig. 71), inserted a little ventrally on the ramus, near a group of minute refractile knobs.

Rostral region not developed, but the region between the bases of the first and second antennae covered with hyaline setules (fig. 72). First antenna (fig. 73) 7-segmented, the segments 97, 103, 34, 52, 49, 34, and 24 μ long respectively (measured along their posterior borders). The third segment with a small sclerified region (fig. 74) on its ventral surface. The disposition of the 36 setae and 3 aesthetes as follows : 1, 13, 6, 3, 4 and 1 aesthete, 2 and 1 aesthete, and 7 and 1 aesthete, the first segment having only a single seta instead of four as in other species. All the setae naked and relatively short.

Second antenna (fig. 75) 4-segmented, the first segment 78 μ long with a small obtuse hyaline seta, the second 130 μ long with a similar seta, the third and fourth united, without an articulation between them. This double segment more slender than the second segment, 114 μ long on its outer border, 101 μ long on its inner border, 20 μ wide in its proximal part, and 12 μ wide in its distal part; with three small obtuse hyaline setae (belonging to the third segment) on the inner surface (the distalmost of the three situated 62 μ from the base of the segment); with a small short recurved terminal claw, 19 μ long (measured along its axis); some small hyaline processes (setae ?) near the insertion of the claw.

Labrum (fig. 76) with its posterior border indented in the middle. Ventral surface of the labrum ornamented with slender hyaline setules and refractile points as indicated in the figure. Mandible (fig. 77) with its basal region bearing on the inner margin a rounded hyaline expansion followed by a distal row of very small teeth and on the outer margin a fringe of hairs; terminal flagellum rather long and attenuated, with lateral hairs, and rather abruptly delimited from the basal region. Paragnath (fig. 78) a small lobe with hairs distally. First maxilla (fig. 79) a single segment showing four hyaline prolongations (setae ?) without evident articulations. Second maxilla (fig. 80) 2-segmented, the proximal segment with some refractile points (spinules ?), the distal segment bearing a very small hyaline outer seta near its base, a larger hyaline widened outer seta more distally, an inner barbed setiform process (without distinct articulation but probably homologous to the setiferous sphere in *L. actinophorus* and to the small hyaline process in *M. unihastatus*), and a terminal flagelliform process barbed along one side.

Maxilliped (fig. 81) 3-segmented, the first segment long and unarmed, the second shorter with two short naked equal inner setae, the third elongated and attenuated, armed with two small setae and prolonged almost in the form of a claw (with three very small subterminal spinules).

Orientation of the mouthparts as in *L. actinophorus*. Ventral region between the maxillipeds and the first legs (fig. 82) with a transverse furrow, better seen in lateral view (fig. 83).

Rami of legs 1-4 (figs. 84, 85, 86, and 87) segmented as in *L. actinophorus*, with the same spine and setal formula. The inner seta of the first three coxopods long and plumose, but that of the fourth coxopod short and naked. The outer seta of the four basipods short and naked.

Fourth leg (fig. 87) with the endopod reaching beyond the middle of the third segment of the exopod; its first segment 44 x 40 μ with an inner seta, the second 100 μ long, 33 μ wide in its proximal half and 22 μ wide in its distal half, the two halves delimited by a weak constriction. The two terminal spines unequal, the outer 57 μ long, the inner 81 μ long, with their edges very hyaline and weakly serrated (fig. 88).

Fifth leg (fig. 89) with the free segment long, slender, and recurved, 135 μ long (measured in a straight line along its axis) and 17 μ wide, 7.9 times longer than wide; bearing two very unequal terminal setae, the inner more than twice the length of the outer. This segment without ornamentation.

Sixth leg represented by the two very small articulated projections near the attachment of the egg sacs (see fig. 68).

Color in life opaque, eye red.

—Male - Form of the body (fig. 90) resembling that of the female. Total length (the setae of the caudal rami excluded) 1.21 mm (1.17-1.29 mm), greatest width 0.45 mm (0.45-0.46 mm), the measurements based on 5 specimens. Segment of the first leg almost completely fused with the head. Segment of the third leg dorsally with two oblique lateral lines. Genital segment (fig. 91) subspherical, wider than long, 179 x 231 μ. Four postgenital segments 62, 78, 81, and 64 μ long respectively. Ratio of the prosome to the urosome 1:1. Spermatophore not seen.

Caudal ramus (fig. 92) in general like that of the female, but smaller, 67 x 15 μ, and the two widened terminal setae relatively longer.

Rostral region not developed. First antenna (fig. 93) with the seven segments of the same relative lengths as in the female. Third segment with a small sclerified region as in the female. Arrangement of the setae as in the female, but with six rather long aesthetes situated as in the male of *L. actinophorus*.

Second antenna, labrum, mandible, paragnath, first maxilla, and second maxilla as in the female. Maxilliped (fig. 94) elongated, 4-segmented (a part of the claw probably representing the fourth segment). The first segment unarmed, the second elongated, its inner surface with two rather slender setae, a row of obtuse spines, and a row of sharp spines. The third segment short and unarmed. The fourth segment in the form of a long recurved claw, 300 μ long (measured along its axis, not along the curvature), as long as the first three segments of the maxilliped together; near its base a very small inner seta and a larger naked seta. Postoral region like that of the female.

Legs 1-4 segmented and armed as in the female, except the endopod of the first leg where the formula of the last segment is I-I-4 (the terminal spine being almost setiform). The last segment of the endopods of the second and third legs (figs. 95 and 96) with a spiniform process (more pronounced than in the female) externally to the two terminal spines. Inner seta of the coxopod of the fourth leg of the same size as in the female, but with distinct lateral hairs.

Fifth leg (fig. 97) with the free segment shorter than that of the female, 45 x 11 μ (the width taken in its basal half), 4 times longer than wide, weakly constricted in the middle. The two terminal setae relatively short and more nearly equal than in the other sex.

Sixth leg (fig. 98) represented by a ventrolateral ridge on the posterior part of the genital segment, bearing two small naked setae (each about 17 μ long) often hidden in dorsal view (see fig. 90).

Color in life as in the female.

(The specific name comes from *compositus* = compound, combined, referring to the apparent fusion of the third and fourth segments of the second antenna).

This species seems to be unique among the species of *Lichomolgus* in showing two characteristics : the fusion of the last two segments of the second antenna and the form of the two terminal setae on the caudal ramus (short, only one third as long as the ramus, hyaline, and widened).

L. compositus was found on the coral, *Seriatopora subseriata*, in company with another copepod, *Xarifia serrata* Humes, 1962.

Lichomolgus decorus sp. n.

Figs. 99-133

—Types - 109 females, 41 males, and 12 copepodids from the alcyonarian, *Cladiella laciniosa* (Tixier-Durivault), at a depth of 2 meters at Pointe de Tafondro, Nossi Bé, Madagascar, August 29, 1960. Holotype female, allotype male, and 35 paratypes (26 females, 9 males) deposited in the United States National Museum at Washington, the same number of paratypes in the Muséum National d'Histoire Naturelle at Paris and in the collection of the Centre d'Océanographie et des Pêches at Nossi Bé; the remaining paratypes in the collection of the first author.

—Female - Prosome very widened (fig. 99), the greatest width at the level of the posterior region of the cephalosome. Total length (the setae of the caudal rami excluded) 0.93 mm (0.87-1.00 mm), greatest width 0.43 mm (0.37-0.47 mm), the measurements based on 10 specimens. Segment of the first leg separated from the head by a rather weak furrow. Segments of legs 2-4 progressively narrow, with their lateral borders rounded. Genital segment (fig. 100) 143 μ long, broadly rounded in its first three quarters (130 μ wide), but narrow in its fourth quarter (62 μ wide) where its lateral borders are nearly parallel. Areas of attachment of the egg sacs placed dorsolaterally and armed with two small spines (fig. 101). Three postgenital segments 55, 53, and 36 μ long respectively, the first segment with two ventrolateral furrows which do not join medially. Ratio of the prosome to the urosome about 1.14:1. Egg sacs 328 x 183 μ, with 40-50 eggs, reaching slightly beyond the beginning of the caudal ramus (fig. 99).

Caudal ramus (fig. 102) 50 x 23 μ, twice as long as wide, its two surfaces without ornamentation. A small dorsal pedicellate seta, a lateral seta, and four terminal setae (the two longer setae in the center of the group distinctly barbed, the other setae naked). Ventral extremity of the ramus slightly produced and bearing a row of very small spinules.

Rostral region not developed (this region as indicated in fig. 103). First antenna (fig. 104) 7-segmented, the segments 54, 78, 21, 35, 33, 28, and 29 μ long respectively (measured on their posterior borders). Near the base of the third segment, on the ventral surface, a small sclerified region (fig. 105), as in the preceding species. First antenna bearing 39 setae and 3 aesthetes, arranged as in *L. actinophorus*.

Second antenna (fig. 106) 4-segmented, the first segment 55 μ long with a rather long slender seta (28 μ) at the inner distal corner, the second segment 82 μ long with a similar seta, the third segment short, 16 μ long on its outer border, and subtriangular, with three inner distal setae. The fourth segment 54 μ long on its outer border, 33 μ long on its inner border, and 25 μ wide; armed with two small hyaline mucronate setae, more distally a long mucronate seta weakly striated, a long spine slightly recurved (almost in the form of a claw but not showing a break in the sclerotization of its inner concave wall), a small straight spine, and finally a terminal recurved claw 40 μ long. (The lengths given are approximate because of the irregular shape of the segments, but in each case are taken along the outer borders of the segments. The lengths represent the actual length, taking into account the overlapping of the segments). All the setae and spines naked.

Posterior border of the labrum (fig. 107) indented in the middle and smooth. Mandible (fig. 108) composed of a basal region (its inner margin bearing a large tooth directed distally and beyond that a striated fringe; its outer border with a row of slender spinules) and a terminal flagellum with lateral spinules. Paragnath (fig. 109) a small irregular lobe bearing hairs. First maxilla (fig. 110) a single segment bearing three naked setae. Second maxilla (fig. 111) 2-segmented, the proximal segment unarmed; the distal segment bearing a unilaterally barbed seta on its posterior surface, an inner spine with spinules along one side, and attenuated distally in the form of a flagellum provided with a row of teeth on one side. (A very small spinule on the outer side near the base of this segment, like that in the preceding species, not evident in this species).

Maxilliped (fig. 112) 3-segmented, the first segment unarmed, the second with a naked seta and a barbed spine, and the third with a spine and a terminal attenuated process (both unilaterally with spinules).

Orientation of the mouthparts as in the preceding species. Ventral region between the maxillipeds and the first legs (fig. 113) with a transverse furrow which is seen better in lateral view (fig. 114).

Rami of legs 1-4 (figs. 115, 116, 117, and 118) segmented as in *L. actinophorus* and *L. compositus*, with the same spine and setal formula, except the last segment of the exopod of the fourth leg where the formula is III-I-5, instead of II-I-5.

Coxopods of legs 1-3 with a large plumose inner seta, but the coxopod of the fourth leg with a very small naked seta at this point. Basipods with a naked outer seta and a row of hairs on the inner border (except the basipod of the fourth leg where this border is naked).

Fourth leg (fig. 118) with the endopod reaching nearly to the middle of the last segment of the exopod; its first segment 32 x 18 μ with a naked inner distal seta, its second segment 43 x 17 μ with a slight interruption in its outer border, and bearing two distal spines, the outer 30 μ long and naked, the inner 44 μ long and slightly barbed.

Fifth leg (fig. 119) with its free segment 33 μ long and 15 μ wide (greatest width), showing a distinct inner swelling in its basal half, the entire segment rather triangular and without ornamentation. Two unequal terminal setae about 30 and 55 μ long respectively.

Sixth leg probably represented by the two small spines near the attachment of the egg sacs (see fig. 101).

Color in life in transmitted light : dorsally on the posterior edges of the segments of legs 1-4, a narrow transverse orange-red band; eye red.

—Male - Form of the body (fig. 120) in some respects like that of the female, but the prosome slightly less widened and of a somewhat more rounded shape. (One whole mount of a male in lactic acid showing a prosome shaped as in the female). Total length (without the setae of the caudal rami) 0.94 mm (0.85-1.00 mm), greatest width 0.36 mm (0.32-0.43 mm), the measurements based on 10 specimens. Genital segment broadly rounded, wider than long, 200 x 224 μ. Four postgenital segments 48, 53, 42, and 38 μ long respectively, the first two showing ventrolateral furrows as on the first postgenital segment of the female. Ratio of the prosome to the urosome 1:1. Spermatophore not seen.

Caudal ramus (fig. 122) like that of the female, but shorter, 42 x 23 μ, twice as long as wide. The row of spinules at the ventral extremity not evident.

Rostral region as in the female. First antenna (fig. 123) 7-segmented, the segments having nearly the same relative lengths as in the female. Armature composed of 39 setae and 6 aesthetes, arranged as in *L. actinophorus*. The aesthetes of segments 2, 4, and 5 unusually long. All the setae naked. Near the base of the third segment, on its ventral surface, a small sclerified region as in the female.

Second antenna (fig. 124) closely resembling that of the female, but the seta of the first segment unilaterally barbed.

Labrum, mandible, paragnath, first maxilla, and second maxilla as in the female. Maxilliped (fig. 125) elongated, 4-segmented (the basal part of the claw probably representing a fourth segment). The first segment unarmed, the second with two inner spines and a row of smaller spines along its inner surface. Third segment very short and unarmed. Fourth segment in the form of a long recurved claw, 172 μ long (measured in a straight line from the base to the extremity), bearing near its base a small inner naked seta and on the surface of the claw a seta unilaterally with spinules. Postoral region as in the female.

Legs 1-4 (figs. 126, 128, 130, and 131) as in the female, with the same spine and setal formula, except the last segment of the endopod of the first leg where the formula is I-I-4. This segment terminating in two prolongations in the form of a scoop with serrated edges (fig. 127). Last segment of the endopod of the second leg also with two serrated prolongations, as in fig. 129. Fourth leg (fig. 131) with the inner seta of the coxopod small (15 μ long) as in the female, but with sparse lateral hairs. Endopod with the first segment 42 μ long, 17 μ wide in its proximal part, 10 μ wide in its distal part, the two parts separated by a small indentation on the outer border. The two terminal setae naked, the longer seta 46 μ long.

Fifth leg (fig. 132) with the free segment 20 x 12 μ, without the swelling seen in the female. The two terminal setae 55 and 31 μ long respectively, the inner one with a slight thickening near its base.

Sixth leg (fig. 133) represented by a ventrolateral ridge on the posterior part of the genital segment, provided with two naked setae about 45 μ long.

Color in life in transmitted light as in the female, but the dorsal surface of the genital segment marked with irregular orange-red spots.

(The specific name comes from *decorus* = graceful, pleasing, alluding to the long aesthetes on the first antenna of the male).

This species of *Lichomolgus* was collected from six successive washings of the coral in sea water with about 5 per cent ethyl alcohol. After the first rinsing, without agitation, 10 copepods appeared in the sediment; after the second rinsing, also without agitation, 15; after the third, with agitation, 71; after the fourth, 26; after the fifth, 20; and after the sixth, only 8. Since these copepods made their appearance in large numbers in the sediment only after a thorough washing with agitation, one may infer that they live in the polyps of the alcyonarian.

L. decorus may be separated from other species of the genus by a combination of the following characters : its small size, the first antenna terminally with one true claw and a somewhat recurved spine, the last segment of the exopod of the fourth leg with the formula III-I-5, the form of the fifth leg of the female (with a basal swelling), and the proportions of the caudal ramus.

L. decorus suggests an affinity with *Lichomolgus robustus* Thompson and A. Scott, 1903 (the male is unknown), from "general washings of dredged Invertebrata" in Ceylon. This Ceylonese species, however, has a ratio of prosome to urosome of 2.3:1 (measurements taken from fig. 14, plate XVI, of T. and S.), the prosome is less widened, the two terminal structures on the maxilliped are shorter (see fig. 19, plate XVI, of T. and S.), and the shape of the second segment of the endopod of the fourth leg is somewhat different.

Lichomolgus spinulifer sp. n.

Figs. 134-166

—Types - 50 females, 39 males, and 5 copepodids from the alcyonarian, *Lemnalia* sp., at a depth of 1 meter at Pointe Lokobe, Nossi Bé, Madagascar, November 1, 1960. Holotype female, allotype male, and 20 paratypes (11 females, 9 males) deposited in the United States National Museum at Washington, the same number of paratypes in the Muséum National d'Histoire Naturelle at Paris and in the collection of the Centre d'Océanographie et des Pêches at Nossi Bé; the remaining paratypes in the collection of the first author.

—Female - Prosome not much widened (fig. 134). Total length (without the setae of the caudal rami) 1.37 mm (1.32-1.41 mm), greatest width 0.58 mm (0.55-0.61 mm), the measurements based on 10 specimens. Segment of the first leg separated from the head by a dorsal furrow. Epimeral areas of the segments of legs 2-4 somewhat angular. Genital segment (fig. 135) elongated, 202 x 162 μ,

weakly swollen; between the two posterior thirds a transverse dorsal furrow, with groups of very small hairs (?) near its two ends. Areas of attachment of the egg sacs dorsolateral and provided with two spines (fig. 136). Three postgenital segments 69, 53, and 61 μ long respectively. Last segment with a row of spinules near the insertion of each caudal ramus. Ratio of the prosome to the urosome about 1.6:1. Egg sacs relatively large, 606 x 269 μ, reaching beyond the extremity of the caudal ramus.

Caudal ramus (fig. 137) elongated, 126 x 38 μ, 3.3 times longer than wide, with hairs on its ventral surface, and having a row of spinules along the ventral extremity near the insertion of the long terminal setae (fig. 138). Dorsal seta small, pedicellate, and naked. Lateral seta barbed. The four terminal setae barbed, the outer of the two long setae distinctly swollen near its base; the other long seta less swollen.

Rostral region as indicated in fig. 139. First antenna (fig. 140) 7-segmented, the segments 69, 149, 32, 82, 65, 57, and 34 μ long respectively (measured along their posterior borders). Near the base of the third segment, on the ventral surface, a small sclerified region (fig. 141) as in all the preceding species. The seven segments with the same arrangement of the 39 setae and 3 aesthetes as in *L. actinophorus*. All the setae naked except for one seta at the anterior distal corner of the penultimate segment which has lateral hairs.

Second antenna (fig. 142) 4-segmented, the first segment 95 μ long with a short naked seta at the inner distal angle, the second 118 μ long with a comparable seta two-thirds of the way along its inner border, the third 15 μ long on its outer border but much longer on its inner border, with three inner distal setae; the fourth segment 77 μ long on its outer border, 44 μ long on its inner border, and 24 μ wide, with three slender subterminal outer setae, two terminal recurved claws 27 and 29 μ long, and a very small spine near the base of one claw. All the setae naked. (The lengths of the segments represent the actual length, taking into consideration the overlapping of the segments).

Posterior border of the labrum (fig. 143) indented in the middle and smooth. Mandible (fig. 144) composed of a basal region (its inner margin bearing a proximal thickening (scale or spine ?) with a row of spinules, this thickening joined by a membrane to a distal striated lamella with a serrated border; its outer margin with a fringe of long hairs) and a terminal flagellum with lateral spinules. Paragnath (fig. 145) a small lobe with hairs. First maxilla (fig. 146) a single segment with unilaterally barbed terminal setae and another small naked subterminal seta. Second maxilla (fig. 147) 2-segmented, the proximal segment naked, the distal segment bearing two spines (one on the posterior surface, the other subterminal and inner), each with a unilateral row of spinules; this segment attenuated distally like a flagellum with a row of dentiform spines along its postero-inner border (these spines graduated in size as indicated in the figure). Probably a very small spinule on the outer side near the base of the last segment, but it is difficult to be certain of this.

Maxilliped (fig. 148) 3-segmented, the first segment with small slender setae on its inner surface; the second segment with a large barbed spine and a row of spinules on its inner margin, and with a much longer barbed spine on its posteroventral surface; the third segment with two rather short barbed spines.

Orientation of the mouthparts as in the preceding species. Ventral region between the maxillipeds and the first legs (fig. 149) slightly protuberant and showing a transverse furrow, better seen in lateral view (fig. 150).

Rami of legs 1-4 (figs. 151, 152, 153, and 154) segmented as in *L. actinophorus*, and possessing the same spine and setal formula. Coxopods of legs 1-3 with a large inner plumose seta, but this seta on the fourth leg somewhat smaller and weakly barbed. Basipods with a rather slightly barbed outer seta and with the inner margin having a row of hairs (except the last basipod which lacks such hairs).

Fourth leg (fig. 154) with the endopod about as long as the exopod. The first segment of the endopod 50 x 32 μ, with an inner plumose seta and with a row of spinules along its outer margin. Second segment 106 μ long, slightly constricted in the middle, its greatest width 26 μ, its smallest width 20 μ; with an outer row of spinules (interrupted in the middle of the segment and thus forming two groups), with a short row of hairs on the inner basal margin, and bearing two terminal barbed spines, the inner one 67 μ long, the outer 39 μ. (The spinules on the outer margin of the second segment often do not seem to have a distinct articulation).

Fifth leg (fig. 155) with the free segment inwardly swollen in its proximal third, but rather slender distally, 147 μ long, 50 μ wide at the swelling, and 18 μ wide near the distal end. Spinules along its outer surface. The two terminal setae naked, the outer one 52 μ, the inner 98 μ long.

Sixth leg perhaps represented by the two spines near the attachment of the egg sacs (see fig. 136).

Color in life in transmitted light transparent, without distinct color, eye red, egg sac grayish.

—Male - Form of the body (fig. 156) comparable to that of the female. Total length (without the setae of the caudal rami) 1.08 mm (1.03-1.12 mm), greatest width 0.39 mm (0.36-0.40 mm), the measurements based on 10 specimens. Genital segment (fig. 157) more widened than that of the female, 216 x 208 μ. Four postgenital segments 40, 32, 20, and 42 μ long respectively. Ratio of the prosome to the urosome 1.38:1. Spermatophore (fig. 158) elongated 241 x 91 μ, the neck not included.

Caudal ramus as in the female, but shorter, 88 x 36 μ, 2.44 times longer than wide.

Rostral region as in the female. First antenna (fig. 159) 7-segmented, the segments with almost the same relative lengths as in the female. Disposition of the 39 setae and 6 aesthetes as in *L. actinophorus*. The distal seta on the penultimate segment (which in the female has lateral hairs) with fewer hairs than in the female. Near the base of the third segment, on the ventral surface, a small sclerified region as in the other sex.

Second antenna (fig. 160) in general like that of the female, with the same arrangement of the spines and setae, but the last segment slightly more elongated and relatively more slender (80 μ long on its outer border, 53 μ long on its inner border, and 18 μ wide). The seta of the first segment, that of the second segment, and two setae on the third segment finely barbed along one side. Inner surface of segments 1 and 2 with groups of strong spinules as indicated in the figure. Inner margin of the fourth segment with a row of small spinules. The two claws each about 24 μ long.

Region of the labrum, mandible, paragnath, first maxilla, and second maxilla as in the female. Maxilliped (fig. 161) elongated, 4-segmented (the basal part of the claw probably representing a fourth segment). The first segment relatively short, 84 μ long (measured along its outer border), and unarmed; the second elongated, 116 μ long, with two rather long spines and two rows of smaller spines on its inner surface; the third short, 21 μ long, and unarmed; and the fourth in the form of a long recurved claw, 241 μ long (measured in a straight line from the base to the extremity), and armed near its base with two setae, one very small naked and inner, the other much larger and unilaterally barbed (a small knob near the base of this larger seta). Postoral region as in the female.

Legs 1-4 like those of the female, with the same spine and setal formula, except the last segment of the endopod of the first leg (fig. 162) where the formula is I-I-4, as in all the preceding species; the triangular prolongation between these two spines with serrated margins (fig. 163). Last segment of the endopod of the second leg (fig. 164) almost like that of the female, but with the triangular prolongation slightly larger.

Fifth leg (fig. 165) with the free segment elongated, slender, 53 x 13 μ, 4 times longer than wide, without the swelling seen in the female; bearing a row of spinules along the outer border and two naked terminal setae 60 and 45 μ long respectively.

Sixth leg (fig. 166) represented by a ventrolateral ridge on the posterior part of the genital segment, armed with two setae 40-50 μ long.

Color as in the female.

(The specific name is derived from *spinula* = a small spine, and *ferre* = to carry, referring to the outer rows of spinules (instead of hairs) on the two segments of the endopod of the fourth leg).

L. spinulifer may be recognized by a combination of the following characters : its size, the second antenna with two claws, the fourth leg with the last segment of the exopod having the formula II-I-5 and with the two segments of the endopod showing outer rows of spinules instead of hairs, the shape of the fifth leg in the female (with a basal swelling), and the proportions of the caudal ramus.

L. spinulifer is near *Lichomolgus hirsutipes* T. Scott, 1893, from Scotland, but it differs from it in several characters. The length of this species of T. Scott is 1.14 mm (the sex not indicated). The larger spine on the second segment of the maxilliped of the female is not as long as in *L. spinulifer* (see fig. 6, plate IV, of T. Scott) and the last segment of this appendage bears two setae in addition to the two spines. The free segment of the fifth leg of the female does not show a basal swelling and its outer surface is covered with short aculeiform setae (see fig. 10, plate IV, of T. Scott). Sars (1917) reported *L. hirsutipes* from Norway, in which the female (1.30 mm long) has the last segment of the second antenna relatively longer and the free segment of the fifth leg (without a basal expansion) covered with hairs instead of spinules. Sewell (1949) found this species in "weed-washings" at Addu Atoll, in the Maldive Islands. His two females measured 1.50 and 1.58 mm in length; the last segment of the second antenna is relatively much longer than in *L. spinulifer* and it bears only one claw; the endopod of the fourth leg is shorter than in the species from Madagascar; the outer surface of the free segment of the fifth leg is covered with parallel rows of hairs instead of spinules as in *L. spinulifer* (see fig. 24G of Sewell). In the male of Sewell's species the claw of the maxilliped is at least twice as long as the second and third segments together (see fig. 25F of Sewell). In the specimens from Scotland, Norway, and the Maldives the outer borders of the two segments of the endopod of the fourth leg bear hairs instead of spinules as in the specimens from Madagascar. Considering these differences between *L. hirsutipes* (as described by T. Scott, Sars, and Sewell) and *L. spinulifer*, we are inclined to regard the species from Madagascar as distinct.

Lichomolgus squamiger sp. n.

Figs. 167-202

—**Types** - 16 females, 59 males, and 73 copepodids from the alcyonarian, *Sinularia polydactyla* (Ehrenberg), at a depth of 0.5 meter at Ambariobe, a small island to the southeast of Nossi Bé, Madagascar, October 10, 1960. Holotype female, allotype male, and 22 paratypes (8 females, 14 males) deposited in the United States National Museum at Washington, 15 paratypes (1 female, 14 males) in the Muséum National d'Histoire Naturelle at Paris and in the collection of the Centre d'Océanographie et des Pêches at Nossi Bé, and the remaining paratypes in the collection of the first author.

—**Female** - Body not much widened (fig. 167), the cephalosome slightly pointed. Total length (the setae of the caudal rami excluded) 1.30 mm (1.24-1.37 mm), greatest width 0.53 mm (0.51-0.54 mm), the measurements based on 10 specimens. Segment of the first leg separated from the head by a dorsal furrow. Epimeral areas of the segments of legs 1-3 projecting and rounded; those of the segment of leg 4 in the form of a tongue with a subtriangular extremity. Genital segment (fig. 168) 132 μ long, 158 μ wide in its anterior two thirds, but only 99 μ wide in its last third where the walls are more strongly sclerified; the anterior part somewhat swollen, the posterior part with parallel sides. Areas of attachment of the egg sacs situated dorsolaterally and bearing two spines, the more posterior much longer than the other (fig. 169). Three postgenital segments 61, 55, and 53 μ long respectively, the last segment ornamented with hairs. Ratio of the prosome to the urosome 2:1. Egg sacs (fig. 170) 257 x 166 μ, containing about 30 eggs, reaching to the beginning of the caudal ramus.

Caudal ramus (fig. 171) small, almost square, 30 x 32 μ. Some setules on its dorsal surface. All six setae naked; the dorsal seta pedicellate, the two long terminal setae with the usual internal sclerotization near the base.

Rostral region not well developed (fig. 172), but this region with short hairs. First antenna (fig. 173) 7-segmented, the segments 42, 122, 38, 90, 42, 29, and 32 μ long respectively (measured along their posterior borders). Near the base of the third segment, on its ventral surface, a small sclerified zone, as in all the preceding species. Arrangement of the 39 setae and 3 aesthetes the same as in *L. actinophorus*. The sclerotization of the walls of segments 1-4 slightly thicker than in segments 5-7. All the setae naked.

Second antenna (fig. 174) 4-segmented, the first segment 110 μ long (measured along the outer border) with a small inner distal seta; the second 104 μ long with a very small inner distal seta; the third 20 μ long with three inner setae; and the fourth segment elongated, 70 μ long on its outer border, 50 μ long on its inner border, and 20 μ wide, with a small rather hyaline process (seta ?) and two small spinules at the outer distal angle and bearing a single terminal recurved claw 55 μ long (measured along its axis). All the setae naked.

Posterior border of the labrum (fig. 175) indented in the middle and smooth. Mandible (fig. 176) in general form comparable to that of the preceding species; inner margin of its basal region with a sclerified piece bearing a row of spinules, this piece joined by a hyaline zone to a striated distal fringe with a serrated edge; outer margin with a fringe of long spinules; terminal flagellum distinctly delimited from the basal region and bearing lateral spinules. Paragnath (fig. 177) a small lobe with a small hairy process. First maxilla (fig. 178) consisting of a single segment bearing three distal setae, one short and barbed, the other two long and naked, one of them transversely striated in its basal half and well sclerified in its distal half. Second maxilla (fig. 179) 2-segmented, the first segment unarmed, the second segment resembling in some respects the preceding species, but the inner subterminal spine and the terminal flagellum of nearly the same length. (It was impossible to establish the presence of a very small spinule on the outer side of the base of this segment as in other species).

Maxilliped (fig. 180) 3-segmented, in general form comparable to the preceding species. The first segment ornamented with spinules as indicated in the figure. The second segment with two very unequal spines; the smaller one naked, the larger one barbed with spinules in its proximal two thirds and with hairs distally; with two groups of spinules, one group on the inner border of the segment, the other on the distal posterior surface. The third segment with a naked spine and a process (spine ?) with spinules as shown in the figure.

Orientation of the mouthparts as in the preceding species. Ventral region between the maxillipeds, and the first legs (fig. 181) with a transverse furrow, better seen in lateral view (fig. 182).

Rami of legs 1-4 (figs. 183, 184, 185, and 186) segmented as in *L. actinophorus*, with the same spine and setal formula, except the last segment of the exopod of the fourth leg where the formula is III-I-5. Inner seta of the coxopod of the fourth leg not reduced as in the other species of *Lichomolgus* described above, but long and plumose. Outer seta of the basipods rather weakly barbed.

Fourth leg (fig. 186) with the endopod slightly longer than the exopod. The first segment 47 μ (without the spiniform distal processes) x 27 μ (greatest width) with a long plumose inner seta. Second segment 110 μ (without the inner distal process, 127 μ with this process) x 17 μ (width taken at the middle of the segment). With a slight interruption in the middle of its outer margin, and bearing two terminal barbed spines, the outer one 36 μ long, the inner one 56 μ long. Inner hairs of the basipod of the fourth leg lacking.

Fifth leg (fig. 187) with the free segment elongated, about 82 x 34 μ, slightly recurved, its dorsal outer surface covered with obtuse broad spines (in the form of erect scales); with two unequal terminal setae, 31 and 70 μ long respectively.

Sixth leg represented by the two spines near the regions of attachment of the egg sacs (see fig. 169).

Color in life in transmitted light transparent, eye red.

—Male - Form of the body (fig. 188) nearly like that of the female, but the epimeral areas of the segment of the fourth leg more rounded. Total length (without the setae of the caudal rami) 0.97 mm (0.96-1.01 mm), greatest width 0.32 mm (0.31-0.32 mm), the measurements based on 10 specimens. Genital segment (figs. 189 and 190) not constricted posteriorly as in the female, but distinctly rounded, about as long as wide, 179 x 170 μ. Four postgenital segments 38, 38, 23, and 37 μ long respectively. Ratio of the prosome to the urosome about 1.46:1. Spermatophore (fig. 191) elongated, 170 x 86 μ, the neck not included.

Caudal ramus as in the female, but smaller, 24 x 23 μ.

Rostral region similar to that of the female, but having two small lateroventral processes which project in ventral view slightly beyond the margin of the head (fig. 192). First antenna (fig. 193) 7-segmented, the relative lengths of the segments comparable to those of the female. Arrangement of the 39 setae and 6 aesthetes as in *L. actinophorus*. The third segment with a small sclerified zone as in the female. All the setae naked.

Second antenna (fig. 194) in general similar to that of the female, with the same arrangement of setae. On the first segment proximally to the seta, a group of short obtuse spines. Some similar spines (their number rather variable) along the inner border of the second segment; a row of rather slender spines on the inner surface of this segment. On the inner border of the fourth segment, a row of spinules. Terminal claw 50 μ long (measured along its axis).

Posterior border of the labrum, mandible, paragnath, first maxilla, and second maxilla as in the female. Maxilliped (fig. 195) unusually elongated (about 530 μ long when extended) and slender, 4-segmented (the basal part of the claw probably representing a fourth segment). The first segment 137 μ long (measured along the inner side) and unarmed. The second 139 μ long, with two long inner setae, one of them placed in the middle of the segment and naked, the other situated near the base of the segment and recurved, of a distinctive form (fig. 196); with a row of spines along the inner border and near this row a shorter row of similar spines along the distal half of the segment. The third segment short, 25 μ long, and unarmed. The fourth segment in the form of a long recurved claw, 232 μ long (measured along its axis); with two setae near its base, one very small naked and inner, the other long (as long as half the length of the claw) and naked.

Postoral region (fig. 197) slightly different from that of the female, the transverse furrow apparently weaker.

Rami of legs 1-4 segmented as in the female, with the same spine and setal formula, except the last segment of the endopod of the first leg (fig. 198) where the formula is I-I-4, as in the four preceding species of *Lichomolgus*. The last segment of the endopod of the first leg with the triangular process between the two spines as indicated in fig. 199. Last segment of the endopod of the second leg showing sexual dimorphism, with the spines modified and with the process in the form of a bent thumb (fig. 200).

Fifth leg (fig. 201) with the free segment very elongated, 40 x 8 μ, 5 times longer than wide, bearing two naked terminal setae about 30 μ long.

Sixth leg (figs. 190 and 202) represented by a ventrolateral ridge on the posterior part of the genital segment, bearing two naked setae.

Color in life as in the female.

(The specific name comes from *squama* = scale, and *gerere* = to carry, alluding to the obtuse spines in the form of scales on the fifth leg of the female).

L. squamiger seems to be very close to *Lichomolgus spinipes* (Sewell, 1949), from "weed-washings" in the harbor of Nankauri, in the Nicobar Islands. (The male of *L. spinipes* is unknown). In the new species from Madagascar, however, there are some characters by which one may distinguish it from Sewell's species. The relative lengths of the segments of the first antenna of the female are slightly different :

1	2	3	4	5	6	7	
10.6	30.9	9.6	22.8	10.6	7.3	8.1	= 100

The maxilliped of *L. spinipes* (see fig. 27F of Sewell) shows the two spines on the second segment almost equal in length, and at the extremity of the appendage the spine and the process are recurved and unguiform. The endopod of the fourth leg (see fig. 27I of Sewell) bears at the extremity a large serrated spine and a much smaller setiform spine; the inner border of the basipod of the fourth leg has a row of hairs. The free segment of the fifth leg (see fig. 27A of Sewell) is armed with two rows of small spinules; the inner terminal spine is serrated.

(Colonel Sewell has informed us (by letter of April 26, 1963) that the female on which the description of *L. spinipes* (Sewell) was based no longer exists. He collected this female in 1921-22 during the voyage of the Investigator. It was dissected, mounted on a slide, and deposited in the collection of the Zoological Survey of India. During the second world war the collections of the Indian Museum (with the specimens from the Investigator) were transferred to Benares. There they were exposed to a severe flooding, with the result that the labels were washed off).

Lichomolgus protentus sp. n.

Figs. 203-236

—Types - 66 females, 28 males, and 10 copepodids from the alcyonarian, *Sarcophyton* sp. at 3 meters depth at Ankify, to the south of Nossi Komba, on the mainland of Madagascar, November 4, 1960. Holotype female, allotype male, and 21 paratypes (15 females, 6 males) deposited in the United States National Museum at Washington, the same number of paratypes in the Museum National d'Histoire Naturelle at Paris and in the collection of the Centre d'Océanographie et des Pêches at Nossi Bé, and the remaining paratypes in the collection of the first author.

—**Female** - Prosome rather widened (fig. 203), slightly pointed anteriorly, the greatest width at the level of the segment of the first leg. This segment separated from the head by a dorsal furrow. Total length (the setae of the caudal rami excluded) 1.67 mm (1.62-1.73 mm), greatest width 0.76 mm (0.72-0.79 mm), the measurements based on 10 specimens. Epimeral areas of the segment of the first leg extending posteriorly and rounded; those of the second leg expanded and slightly truncated; those of the segment of the third leg less expanded; and those of the segment of the fourth leg having the form indicated in the figure. Genital segment (fig. 204) expanded in the middle, 189 x 237 μ, distinctly wider than long. Areas of attachment of the egg sacs situated dorsolaterally and bearing two small spines (fig. 205). Three postgenital segments 86, 53, and 147 μ long respectively, the last unusually long. Anal region as indicated in fig. 206, with two recurved rows of spinules. Ratio of the prosome to the urosome about 1.5:1. Egg sacs (fig. 203) about 425 μ long, reaching nearly to the beginning of the caudal rami, but of a peculiar form (perhaps by reason of the hatching of a portion of the eggs).

Caudal ramus (fig. 207) 74 x 34 μ, about twice as long as wide, with the dorsal seta naked and pedicellate and the outer lateral seta naked; of the terminal group of four setae, the inner and outer barbed in the usual manner, but the two long setae in the center of the group barbed only in the proximal half. Ventral margin of the extremity of the ramus furnished with a row of spinules; dorsal margin less extended, angular, with some spinules near the base of the outer seta (fig. 208). Small hairs on the dorsal and ventral surfaces of the ramus.

—Rostral region slightly better developed (fig. 209) than in the preceding species, ornamented with small hairs on the anterior surface. First antenna (fig. 210) 7-segmented, the segments 116, 187, 38, 74, 40, 42, and 25 μ long respectively (measured along their posterior borders). Near the base of the third segment, on its ventral surface, a small sclerified region (fig. 211). Armature composed of 39 setae, many of them finely annulated, and 3 aesthetes, their disposition as in *L. actinophorus*. Four setae on the second segment plumose, all the others naked.

Second antenna (fig. 212) 4-segmented, the first segment 99 μ long (measured along the outer border) with a small inner distal seta; the second 165 μ long with a similar seta on the inner border; the third 20 μ long with three inner distal setae; and the fourth segment 110 μ long on its outer border, 83 μ long on its inner border, and 21 μ wide, bearing distally three outer obtuse hyaline prolongations, one of them much longer (12 μ) than the others, and a very small spinule; armed terminally with a recurved claw 46 μ long (measured along its axis). All the setae naked.

Posterior border of the labrum (fig. 213) indented in the middle, the two margins slightly crenulated. Mandible (fig. 214) of a general form like that of the two preceding species; inner border of the basal region with a rather sclerified triangular zone bearing a row of minute spinules, this zone joined to a distal serrated fringe; outer border with a fringe of spinules; terminal flagellum barbed with spinules and having a narrow lamella along one side. Paragnath (fig. 215) a small lobe with hairs. First maxilla (fig. 216) a single segment with three naked distal setae. Second maxilla (fig. 217) comparable to that of the preceding species, but the first segment with some small spines near its base, and the second segment provided with a very small spinule on the outer side near its base, a more distal short naked hyaline seta, and a long inner barbed spine; this segment attenuated as a flagellum with two rows of spinules.

Maxilliped (fig. 218) 3-segmented, in general form comparable to that of the two preceding species. The first segment unarmed, the second with two very unequal spines (the larger pectinate distally, the smaller naked), and the third segment armed with two unequal naked spines and a sharp process between them.

Orientation of the mouthparts as in the preceding species. Ventral region between the maxillipeds and the first legs (figs. 219 and 220) with a transverse furrow, in front of which there is a slight protuberance.

Rami of legs 1-4 (figs. 221, 222, 223, and 224) segmented as in *L. actinophorus* and with the same formula of spines and setae except the last segment of the exopod of the fourth leg where the formula is III-I-5 (as in *L. decorus* and *L. squamiger*). Outer margin of the coxopod of the first leg with a prominent and rather irregular projection. Inner seta of the coxopods of legs 1-3 long and plumose, but this seta on the fourth leg small (12 μ long), spiniform and slightly barbed. Outer seta of the basipod of the second leg shorter than on the other legs. Row of hairs on the inner margin of the coxopod of legs 1-3 replaced on the fourth leg by a single very small naked spinule.

Fourth leg (fig. 224) with the endopod about as long as the exopod. The first segment 44 μ (the spiniform distal process excluded) x 22 μ (greatest width) with an inner plumose seta. The second segment 93 μ (measured along the inner border to the extremity of the inner spiniform process) x 20 μ (the width taken at the middle). This segment with a slight interruption in the middle of its outer margin, bearing a row of hairs on both sides, and armed terminally with an outer slender naked seta (22 μ long) and an inner strongly barbed spine (44 μ long), a row of spinules near their insertions.

Fifth leg (fig. 225) with the free segment not very elongated, 53 x 27 μ, about twice as long as wide, its dorsal outer surface bearing spines; with two terminal naked setae, the inner one 65 μ long, the outer one 48 μ long.

Sixth leg probably represented by the two spines near the areas of attachment of the egg sacs (see fig. 205).

Color in life in transmitted light, rose ventrally near the bases of the maxillipeds and legs 1-4, some reddish globules in the prosome, eye bright red.

—Male - Form of the body (fig. 226) in general like that of the female, but the cephalosome more rounded anteriorly and the epimeral areas of the segments of legs 1-4 of a somewhat different shape. Total length (the setae of the caudal rami excluded) 1.14 mm (1.07-1.20 mm), greatest width 0.45 mm (0.42-0.47 mm), the measurements based on 10 specimens. Genital segment (fig. 227)

199 x 208 μ, about as long as wide, with the regions of the sixth legs projecting slightly posteriorly. Four postgenital segments 48, 46, 29, and 82 μ long respectively. Anal region as in the female. Ratio of the prosome to the urosome about 1.33:1. Spermatophore (fig. 228) 166 x 97 μ, the neck excluded.

Caudal ramus as in the female, but smaller, 55 x 27 μ.

Rostral region as in the female. First antenna (fig. 229) 7-segmented, the segments with relative lengths comparable to those of the female. Disposition of the 39 setae and 6 aesthetes as in *L. actinophorus*. Four plumose setae on the second segment as in the female. Third segment with a very small sclerified region on the ventral surface as in the female.

Second antenna (fig. 230) similar to that of the female, but with rows of small spinules along the inner surface of the second segment (fig. 231). Terminal claw 40 μ long (measured along its axis).

Posterior border of the labrum, mandible, paragnath, and first maxilla as in the female. Second maxilla (fig. 232) resembling that of the female, but bearing long spinules on the first segment. Maxilliped (fig. 233) elongated and slender, 4-segmented (the basal part of the claw considered as a fourth segment). The first segment 105 μ long (measured along the outer side) and naked. The second 170 μ long, bearing on its inner surface the two usual setae (one of them unilaterally barbed distally, the other naked) and two rows of small spines. The third short, 23 μ long, and unarmed. The fourth segment in the form of a claw 185 μ long (measured in a straight line along its axis) and bearing near its base a small inner naked seta and a much larger seta finely barbed and 63 μ long.

Postoral region as in the female.

Legs 1-4 like those of the female, except the last segment of the endopod of the first leg (fig. 234) which has the formula I-I-4 as in the five species of *Lichomolgus* described above. The extremity of this segment extended as a lamelliform process, concave on its anterior surface and bearing spinules on both edges.

Fifth leg (fig. 235) with the free segment elongated, more slender than in the female, 21 x 8 μ, 2.6 times longer than wide, without ornamentation, and provided terminally with two naked setae somewhat longer than the segment.

Sixth leg (fig. 236, see also fig. 227) represented by a ventrolateral ridge on the posterior part of the genital segment, bearing two naked setae.

Color in life as in the female.

(The specific name comes from *protendere* = to extend, elongate, referring to the last postgenital segment, which is unusually long).

One may distinguish *L. protentus* from other species in the genus by a combination of the following characters : the form of the body, the relative length of the last postgenital segment, the single terminal claw on the second antenna, the formula of the last segment of the exopod of the fourth leg (III-I-5), the size and form of the fifth leg, and the proportions of the caudal ramus. This species from Madagascar has also other finer rather distinctive characters, such as the four plumose setae on the second segment of the first antenna and the inner hairs on the second segment of the endopod of the fourth leg.

L. protentus may be compared with *Lichomolgus robustus* Thompson and A. Scott, 1903 (the male is unknown) from "general washings of dredged Invertebrates" in Ceylon. In this Ceylonese species, however, the form of the prosome is different, the anal segment is only slightly longer than the preceding segment (see fig. 14, plate XVI, of T. and S.), the ratio of the caudal ramus is only about 1.5:1, and the last segment of the second antenna is relatively shorter and the claw relatively larger (see fig. 16, plate XVI, of T. and S.).

The collection of these lichomolgid copepods is very easy. It is necessary simply to wash the alcyonarians or the madreporarians in sea water with about 5 per cent ethyl alcohol. Very often

copepods will be found in the sediment after a single rinsing, but sometimes several successive rinsings are necessary (see above the case of *Lichomolgus decorus*). Most of the copepods appear after washing the exterior of these coelenterates; they are rarely found in a second washing after the hosts have been broken up (see above the case of *Monomolgus unihastatus*).

In the region of Nossi Bé the new genus *Monomolgus* has been found associated only with the coral *Porites*. *M. unihastatus* occurred on each of seven collections of *Porites cf. P. andrewsi*.

The six new species of *Lichomolgus* live on madreporarians *(Pavona angulata, Pavona cactus,* or *Seriatopora subseriata)* or on alcyonarians (*Cladiella laciniosa, Lemnalia* sp., *Sinularia polydactyla,* or *Sarcophyton* sp.

List of madreporarians and their associated lichomolgid copepods in the region of Nossi Bé :

Porites cf. P. andrewsi Vaughan	*Monomolgus unihastatus* gen. et sp. n.
Pavona angulata Klunzinger	*Lichomolgus actinophorus* sp. n.
Pavona cactus (Forskål)	*Lichomolgus actinophorus* sp. n.
Seriatopora subseriata Ehrenberg	*Lichomolgus compositus* sp. n.

List of alcyonarians and their associated lichomolgid copepods in the region of Nossi Bé :

Cladiella laciniosa (Tixier-Durivault)	*Lichomolgus decorus* sp. n.
Lemnalia sp.	*Lichomolgus spinulifer* sp. n.
Sinularia polydactyla (Ehrenberg)	*Lichomolgus squamiger* sp. n.
Sarcophyton sp.	*Lichomolgus protentus* sp. n.

The six new species of *Lichomolgus* show certain characteristics in common. The arrangement of the aesthetes on the first antenna is always 0, 0, 0, 0, 1, 1, 1 in the female and 0, 2, 0, 1, 1, 1, 1 in the male; the disposition of the setae is in each case 4, 13, 6, 3, 4, 2, 7 in the two sexes (with the exception of *L. compositus* where the first segment has only one seta). The mandible has a flagellum which is rather long and quite distinctly delimited from the basal region. The last segment of the endopod of the first leg always has the formula I-5 in the female and I-I-4 in the male.

There are other variable characters, whose significance is not evident. For example, the armature of the last segment of the exopod of the fourth leg is II-I-5 *(actinophorus, compositus,* and *spinulifer*) or III-I-5 (*decorus, squamiger*, and *protentus*); the setae of the caudal ramus are short in *actinophorus* and *compositus* but long in the others; and the number of eggs is small in *actinophorus* and *compositus* but rather large in the others. Sexual dimorphism exists not only in the first antenna, second antenna, maxilliped, first leg, fifth leg, and caudal ramus, but also in *spinulifer* and *squamiger* in the endopod of the second leg, in *compositus* and *decorus* in the second and third legs, and in *protentus* even in the second maxilla.

In a large genus like *Lichomolgus* one would like to find characters which might indicate phylogenetic lines. In this genus, however, the necessary information for a careful morphological study is often lacking in the published descriptions and figures. Furthermore, our knowledge of the functional morphology remains at present very fragmentary. The known species of *Lichomolgus* from Madagascar, including also the ten other species of *Lichomolgus* from sea anemones, nudibranchs, and a pelecypod, described by Humes (1959, 1961) and Humes (1964), show usual arrangements of the aesthetes on the first antenna of the male of 0, 0, 0, 0, 1, 1, 1 or 0, 2, 0, 1, 1, 1, 1 (with *L. securiger* being exceptional in having the arrangement of 0, 2, 0, 0, 1, 1, 1). The armature of the last segment of the exopod of the fourth leg is of two types, either II-I-5 or III-I-5. These patterns are not paired consistently, however, and in different species either aesthete pattern may occur with either formula of the exopod. The significance of such variation is not clear, and groups derived by combinations of these characters seem to be rather artificial.

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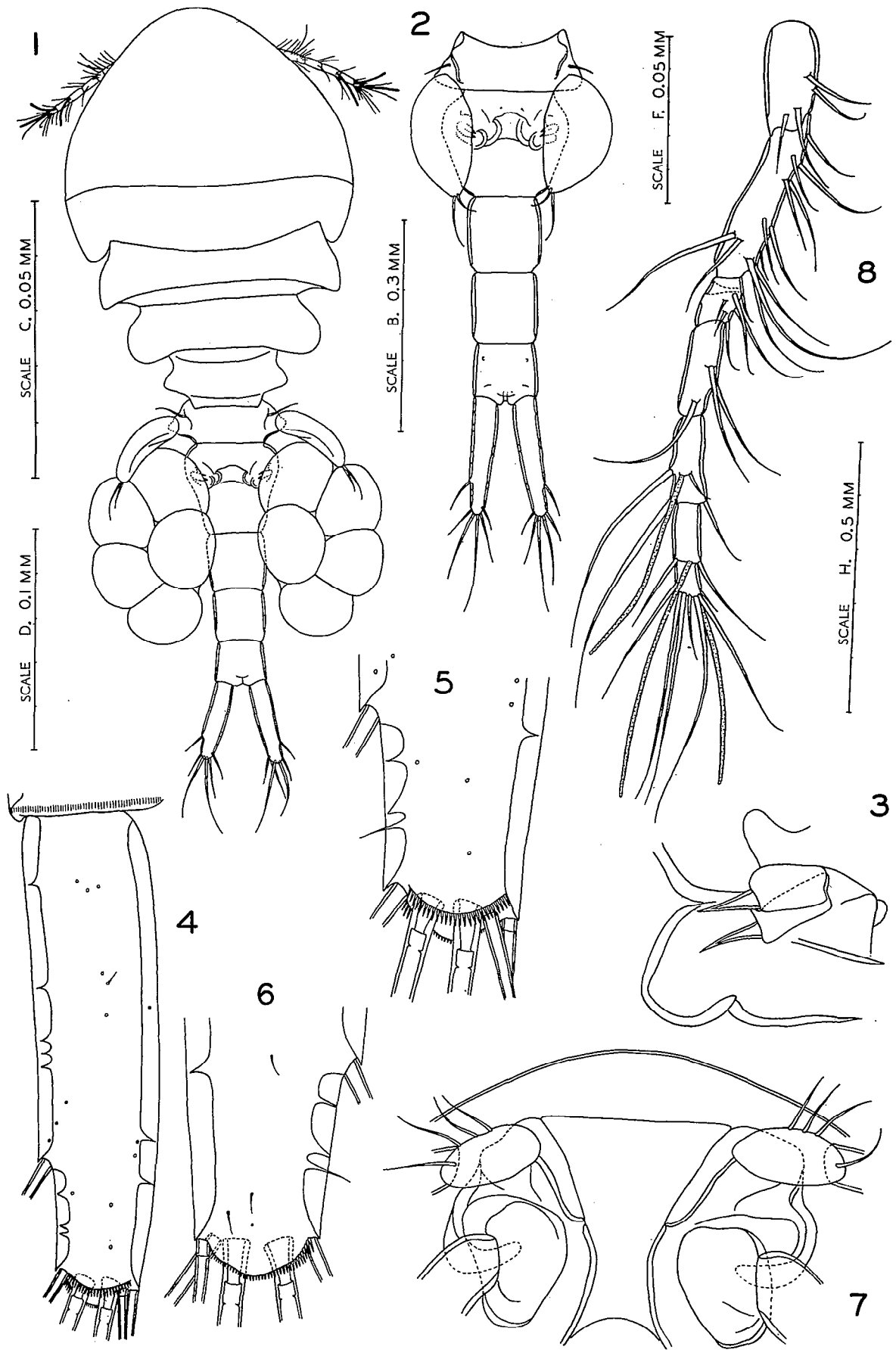
Explanation of the figures

All the 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 the figure was drawn.

Figs. 1-8 - *Monomolgus unihastatus* gen. et. sp. n. , female

1 - Body, dorsal view (H)
2 - Urosome, dorsal (B)
3 - Area of attachment of an egg sac, dorsal (C)
4 - Caudal ramus, ventral (F)
5 - Extremity of the caudal ramus, ventral (C)
6 - Same, dorsal (C)
7 - Rostral region, ventral (D)
8 - First antenna, dorsal (D)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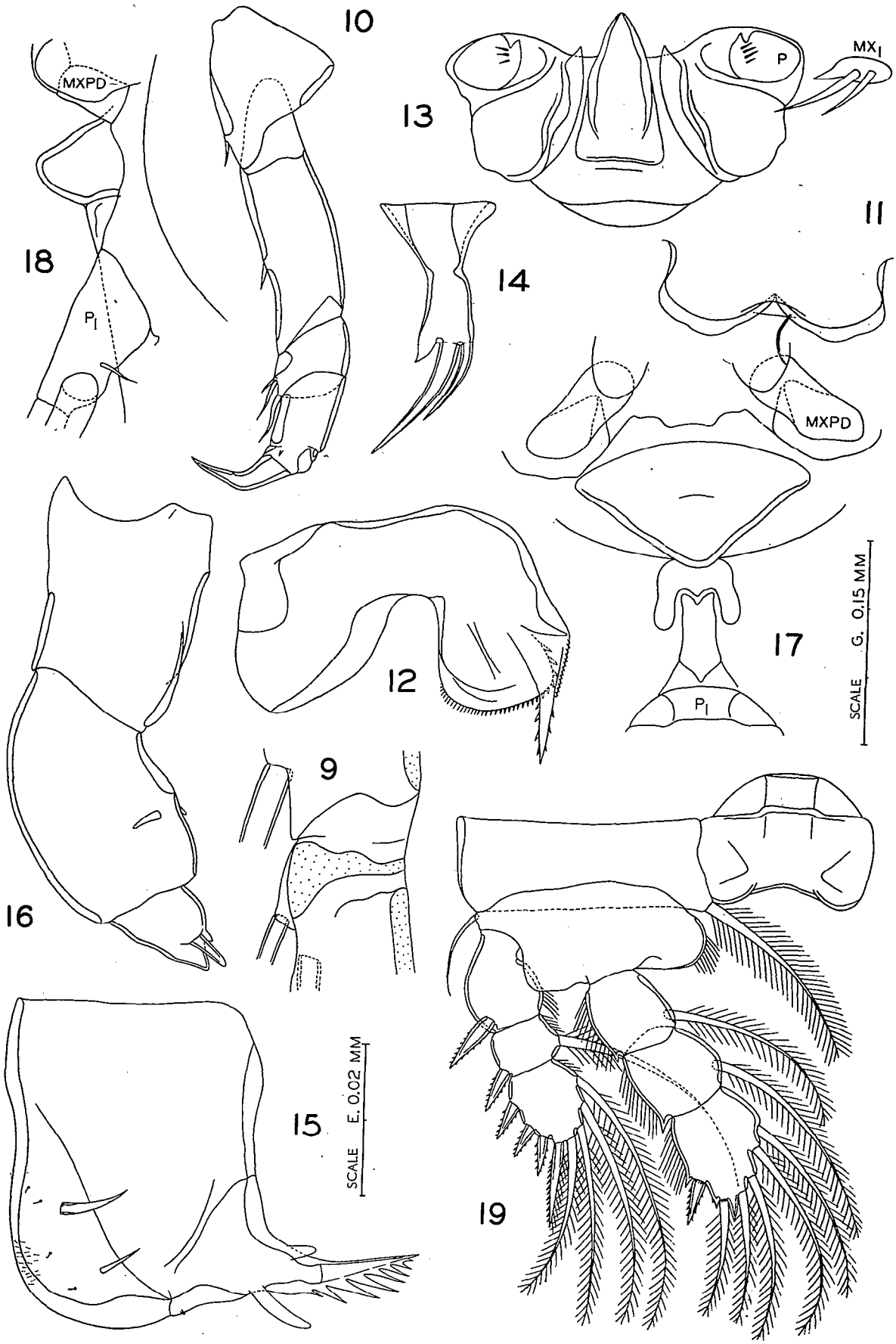
Figs. 9-19 - *Monomolgus unihastatus* gen. et sp. n., female (continued)

9 - Basal region of the third segment of the first antenna, ventral (E)
10 - Second antenna, inner view (D)
11 - Posterior border of the labrum, ventral (D)
12 - Mandible (C)
13 - Paragnaths and the region behind the labrum, ventral (C)
14 - First maxilla (C)
15 - Second maxilla (C)
16 - Maxilliped (C)
17 - Region between the maxillipeds and the first legs, ventral (D)
18 - Same, lateral (G)
19 - First leg, anterior (D)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Figs. 20-24 - *Monomolgus unihastatus* gen. et sp. n. , female (continued)

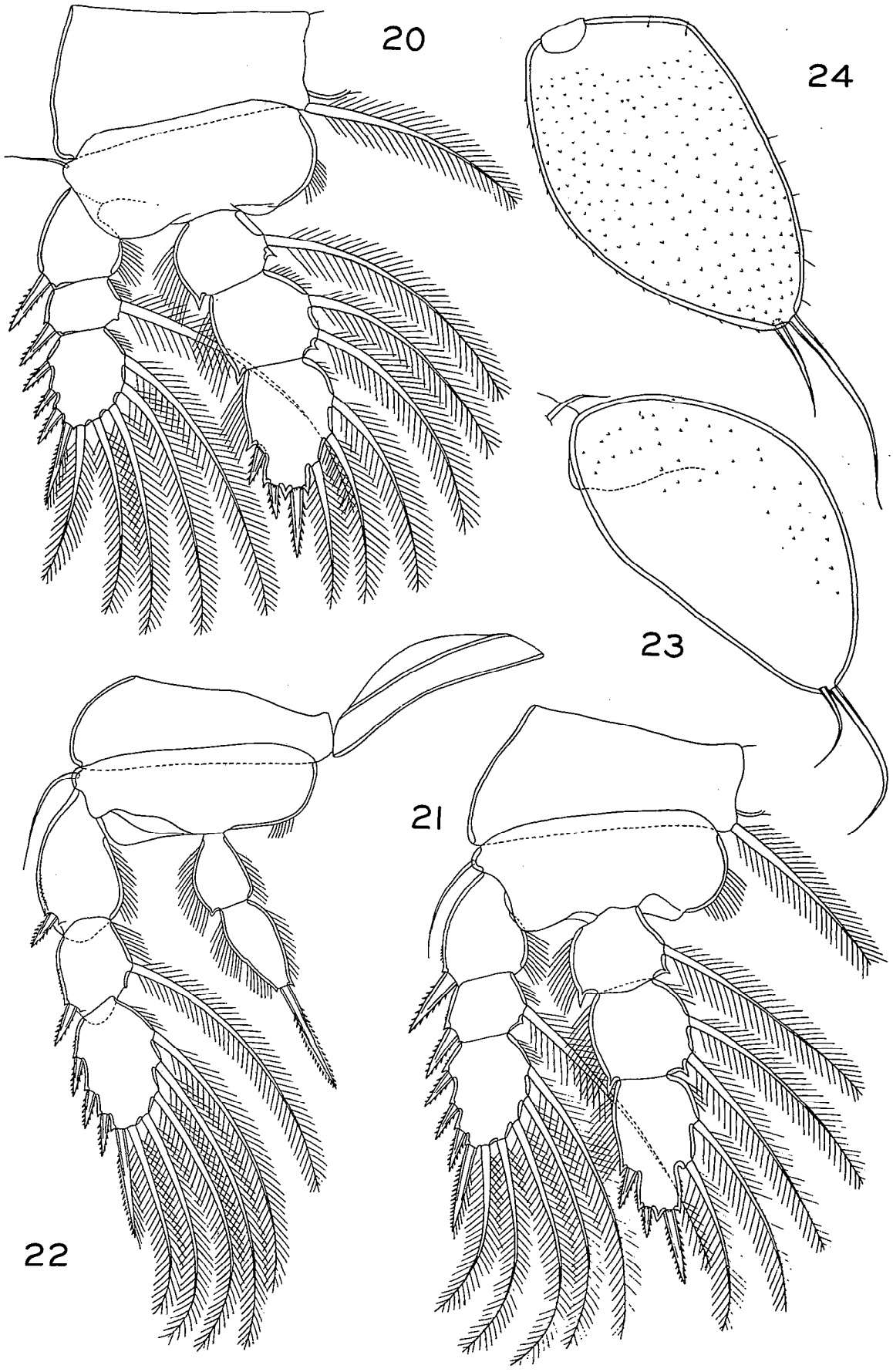
20 - Second leg, anterior (D)

21 - Third leg, anterior (D)

22 - Fourth leg, anterior (D)

23 - Fifth leg, dorsal (D)

24 - Same, lateral and outer (D)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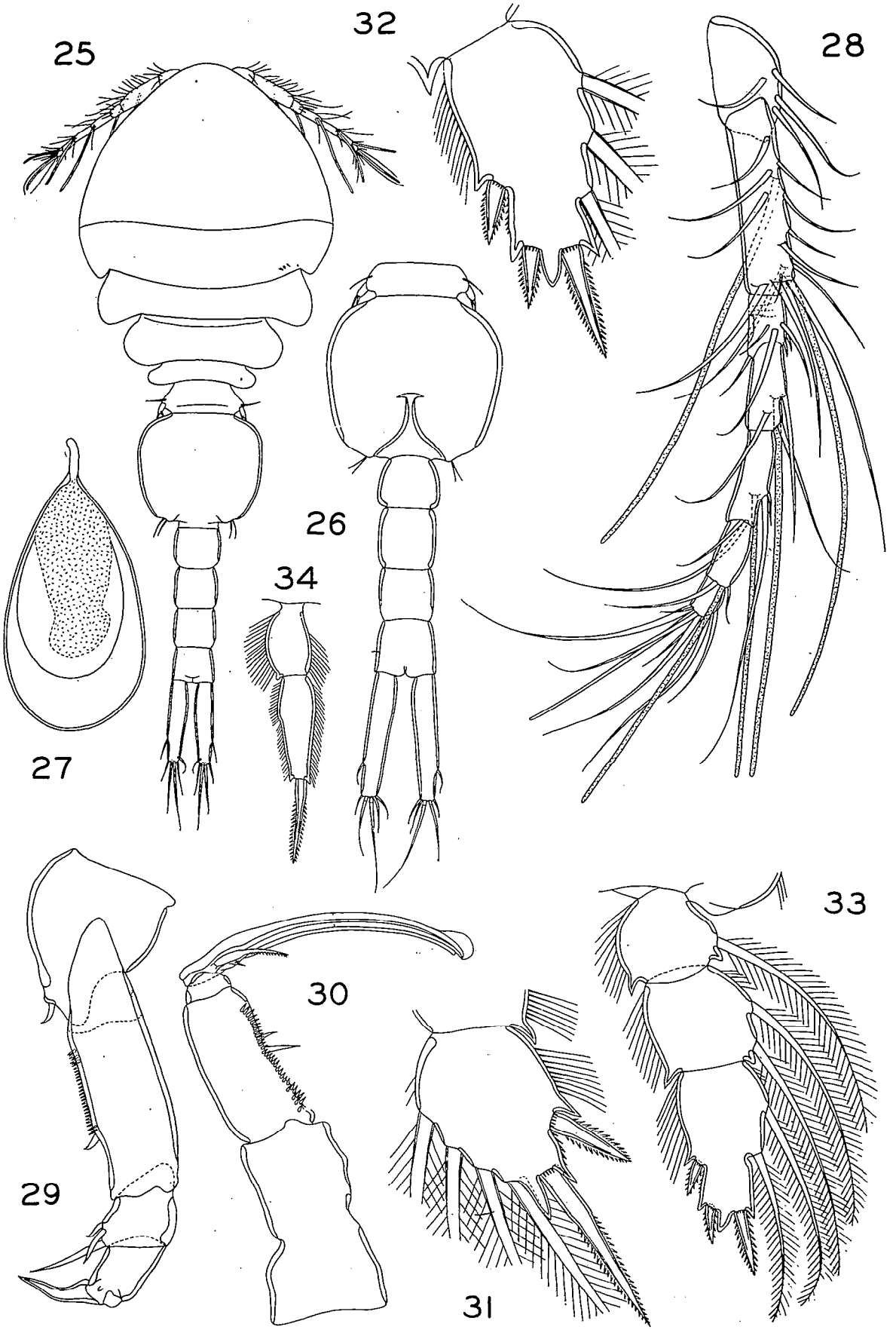
Figs. 25-34 - *Monomolgus unihastatus* gen. et sp. n., male

25 - Body, dorsal (H)
26 - Urosome, ventral (B)
27 - Spermatophore (G)
28 - First antenna, dorsal (D)
29 - Second antenna, outer surface (D)
30 - Maxilliped, inner (G)
31 - Third segment of the endopod of the first leg (F)
32 - Third segment of the endopod of the second leg (F)
33 - Endopod of the third leg, anterior (D)
34 - Endopod of the fourth leg, anterior (D)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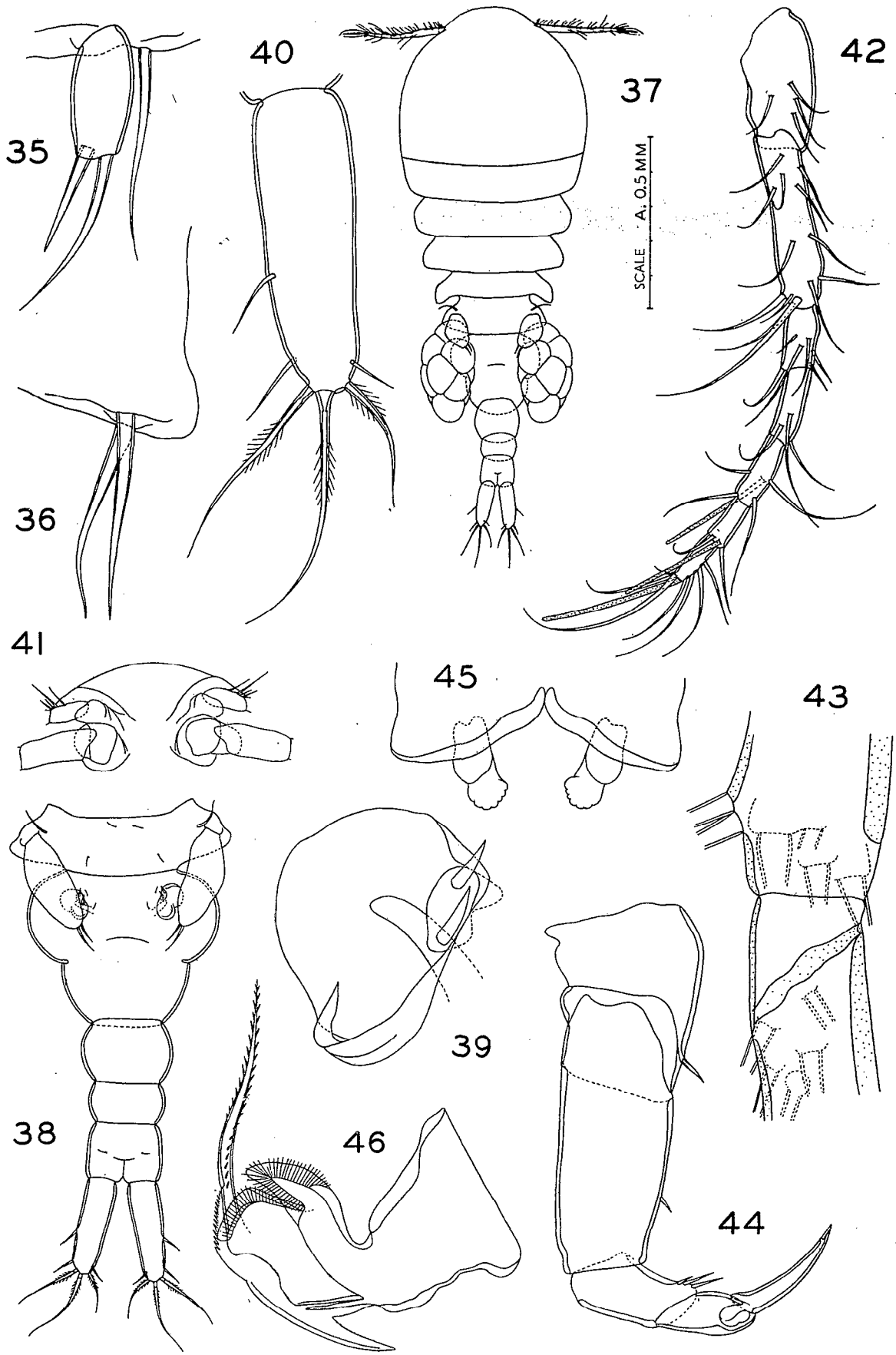
Figs. 35-36 - *Monomolgus unihastatus* gen. et sp. n., male (continued)

35 - Fifth leg, dorsal (C)
36 - Setae of the sixth leg, ventral (C)

Figs. 37-46 - *Lichomolgus actinophorus* sp. n. female

37 - Body, dorsal (A)
38 - Urosome, dorsal (B)
39 - Area of attachment of an egg sac, dorsal (C)
40 - Caudal ramus, dorsal (D)
41 - Rostral region, ventral (B)
42 - First antenna, dorsal (D)
43 - Basal region of the third segment of the first antenna, ventral (E)
44 - Second antenna, outer (D)
45 - Posterior border of the labrum and paragnaths, ventral (D)
46 - Mandible (F)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SCALE A, 0.5 MM
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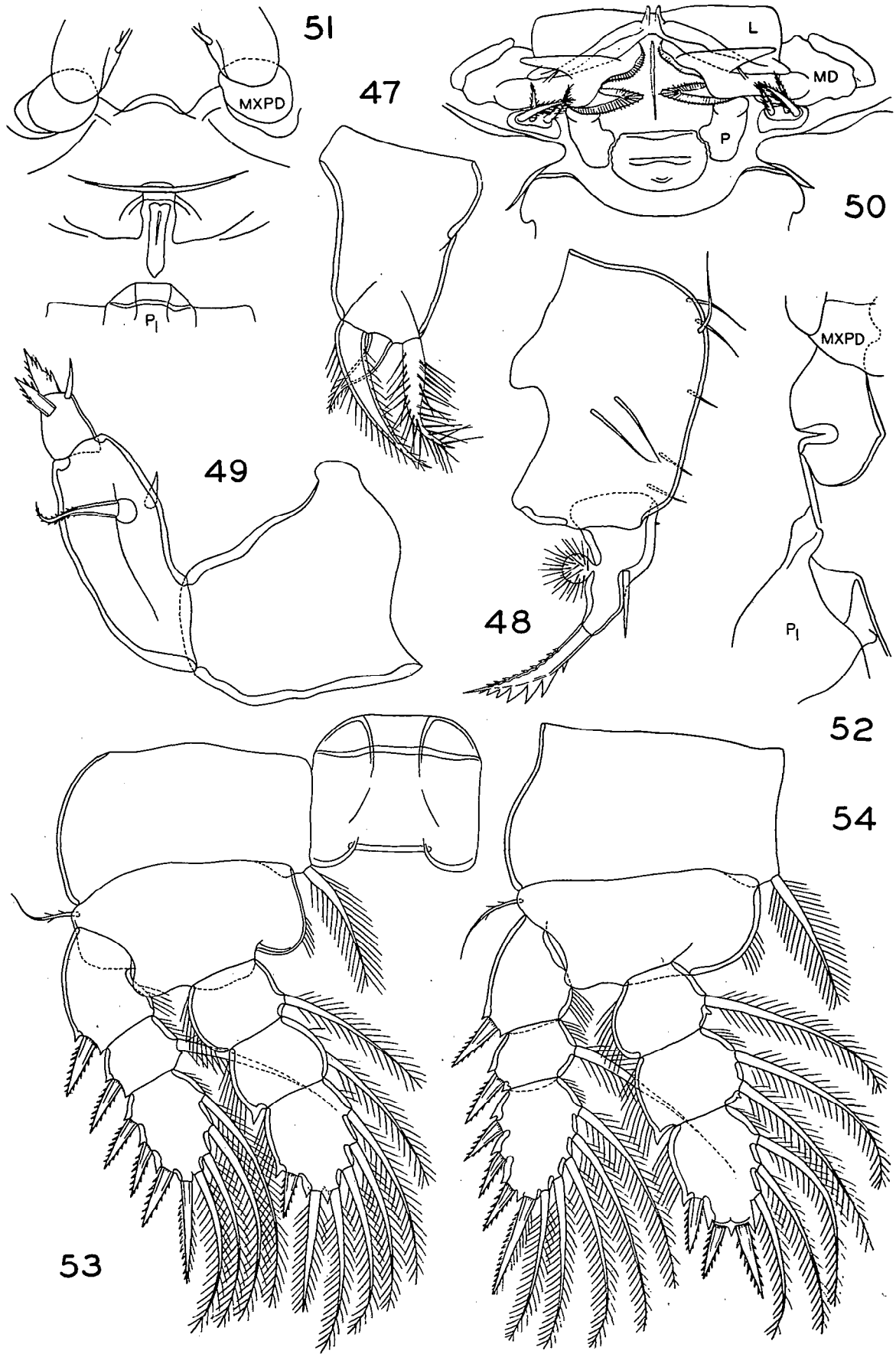
Figs. 47-54 - *Lichomolgus actinophorus* sp. n., female (continued)

47 - First maxilla (C)
48 - Second maxilla, posterior (F)
49 - Maxilliped, somewhat posterior (F)
50 - Oral region, ventral (D)
51 - Region between the maxillipeds and the first legs, ventral (G)
52 - Same, lateral (G)
53 - First leg, anterior (D)
54 - Second leg, anterior (D)


51
MXPD
P1
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L
MD
P
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MXPD
P1
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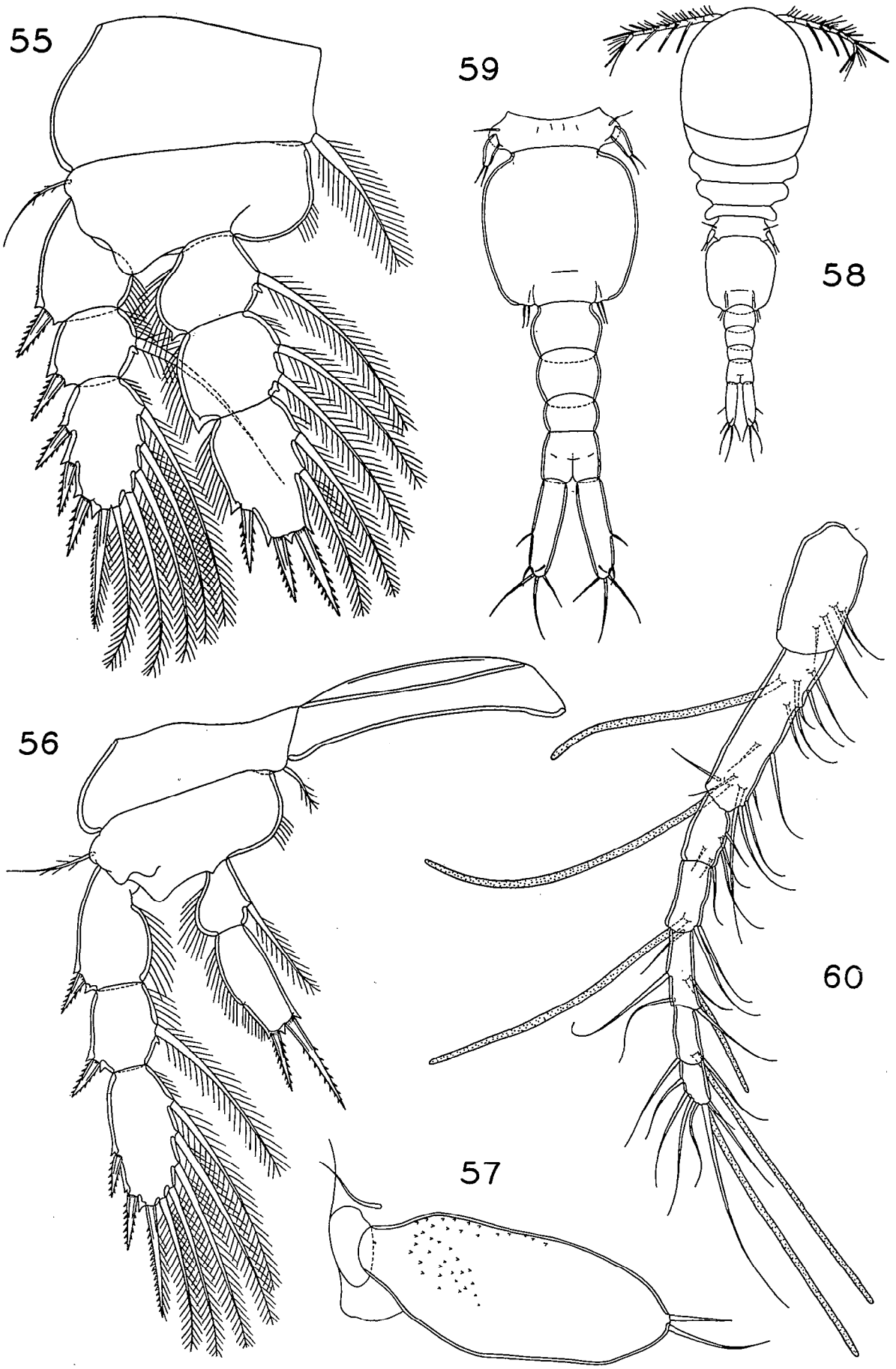
53

Figs. 55-57 - *Lichomolgus actinophorus* sp. n. , female (continued)

55 - Third leg, anterior (D)
56 - Fourth leg, anterior (D)
57 - Fifth leg, dorsal (D)

Figs. 58-60 - *Lichomolgus actinophorus* sp. n. , male

58 - Body, dorsal (A)
59 - Urosome, dorsal (B)
60 - First antenna, dorsal (D)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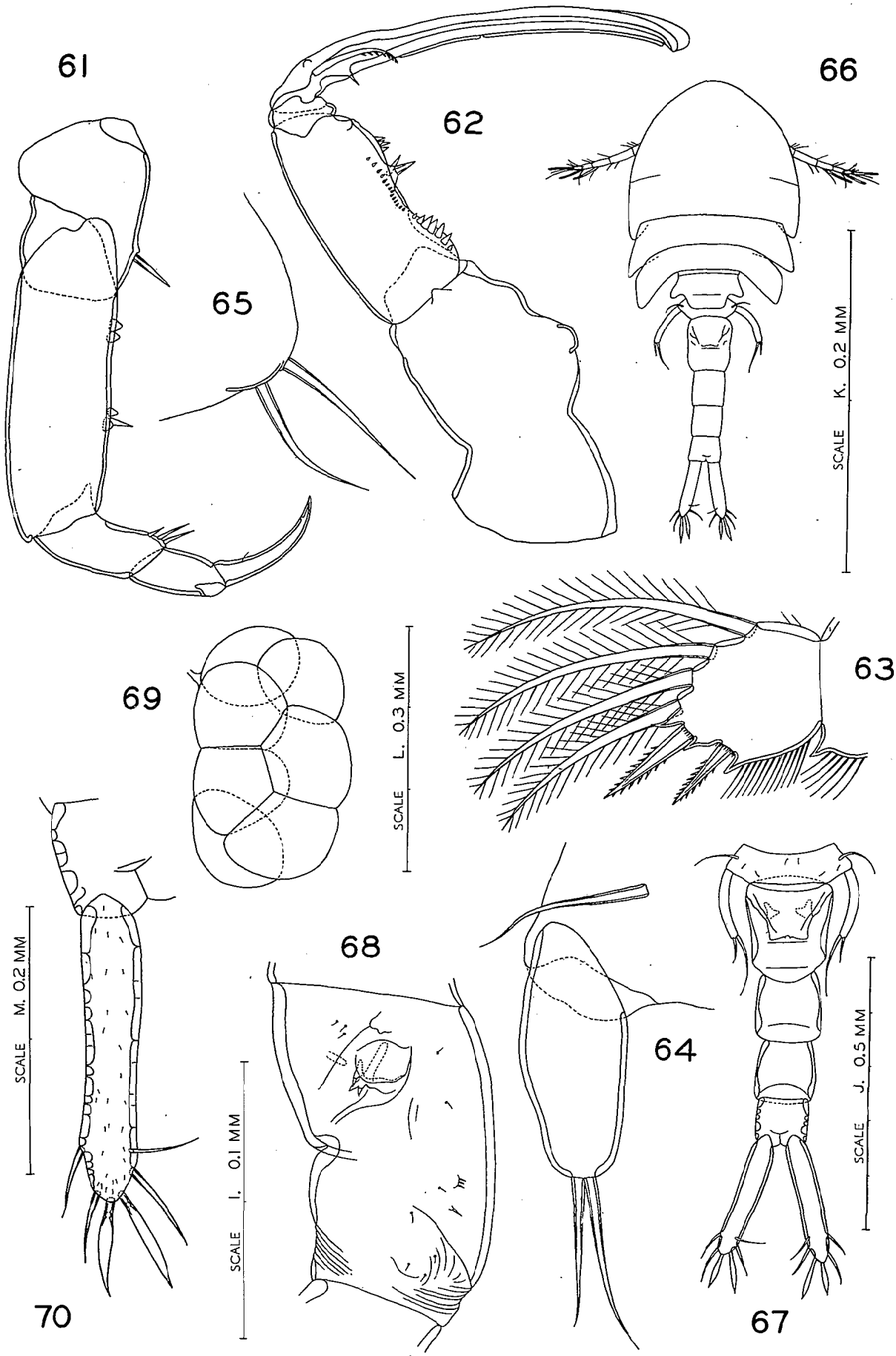
Figs. 61-65 - *Lichomolgus actinophorus* sp. n. , male (continued)

61 - Second antenna, outer (D)
62 - Maxilliped, inner (D)
63 - Third segment of the endopod of the first leg (F)
64 - Fifth leg, dorsal (C)
65 - Setae of the sixth leg (C)

Figs. 66-70 - *Lichomolgus compositus* sp. n. , female

66 - Body, dorsal (I)
67 - Urosome, dorsal (J)
68 - Genital segment, lateral (K)
69 - Egg sac (L)
70 - Caudal ramus, dorsal (M)


61
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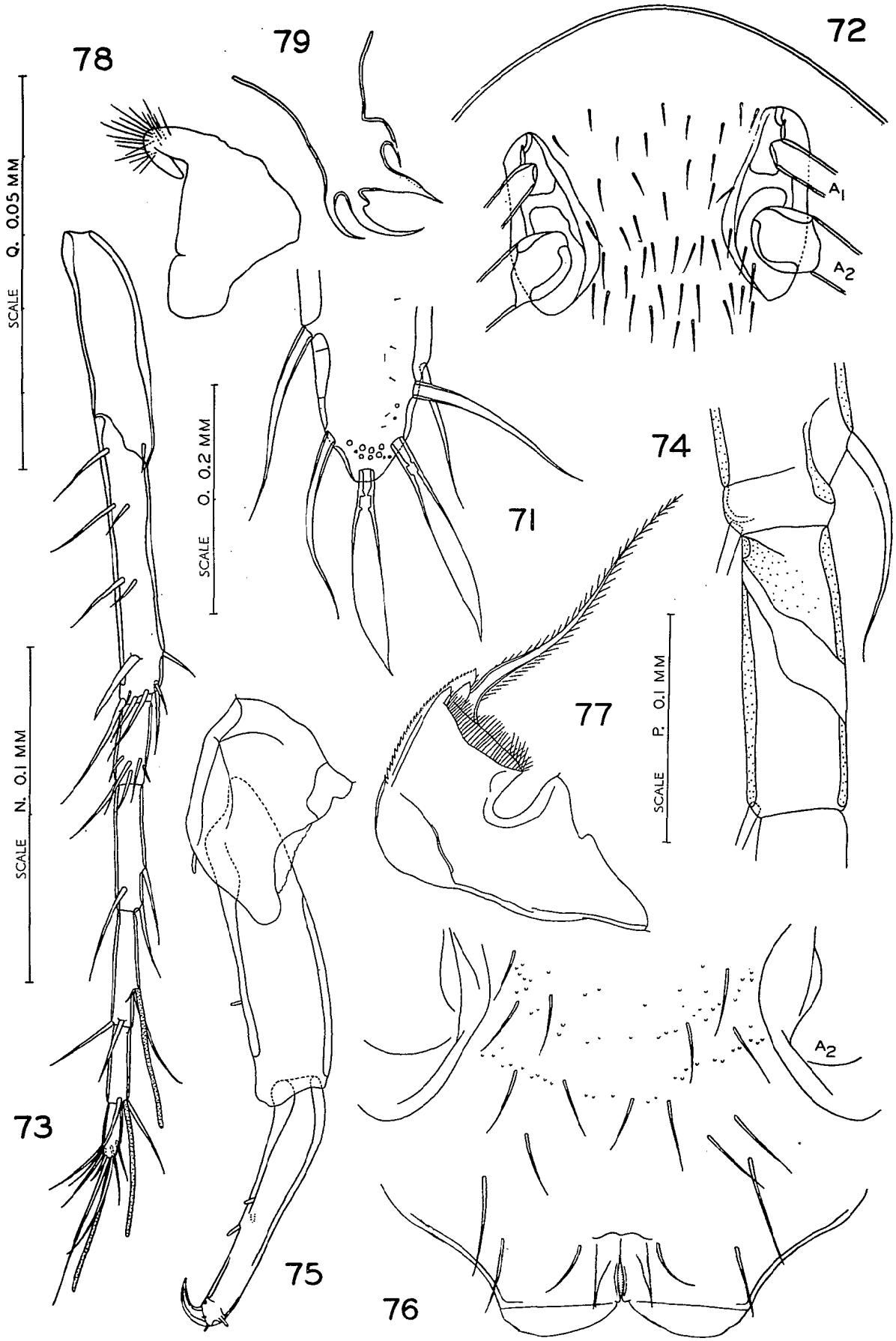
SCALE K. 0.2 MM
63
69
SCALE L. 0.3 MM
68
64
67
SCALE J. 0.5 MM
SCALE M. 0.2 MM
SCALE I. 0.1 MM
70

Figs. 71-79 - *Lichomolgus compositus* sp. n. , female (continued)

71 - Extremity of the caudal ramus, ventral (N)
72 - Rostral region, ventral (O)
73 - First antenna, dorsal (P)
74 - Basal region of the third segment of the first antenna, ventral (N)
75 - Second antenna, inner (P)
76 - Labrum, ventral (P)
77 - Mandible (N)
78 - Paragnath (Q)
79 - First maxilla (N)


78
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72
A1
A2
SCALE Q. 0.05 MM
SCALE O. 0.2 MM
71
74
SCALE P. 0.1 MM
77
SCALE N. 0.1 MM
73
75
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A2

Figs. 80-86 - *Lichomolgus compositus* sp. n. , female (continued)

80 - Second maxilla, posterior (N)

81 - Maxilliped, somewhat inner (N)

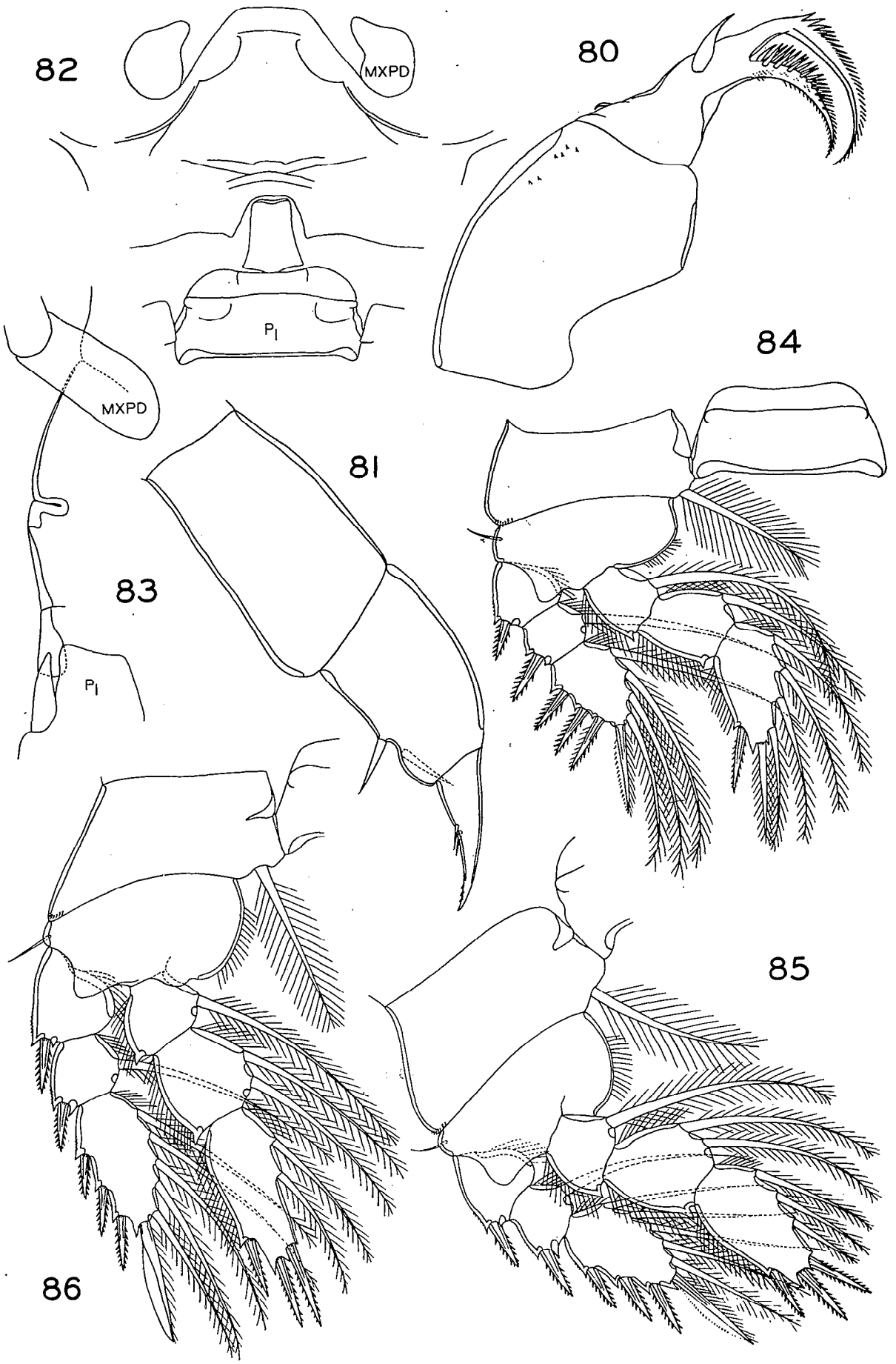
82 - Region between the maxillipeds and the first legs, ventral (K)

83 - Same, lateral (K)

84 - First leg, anterior (K)

85 - Second leg, anterior (K)

86 - Third leg, anterior (K)


82
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MXPD
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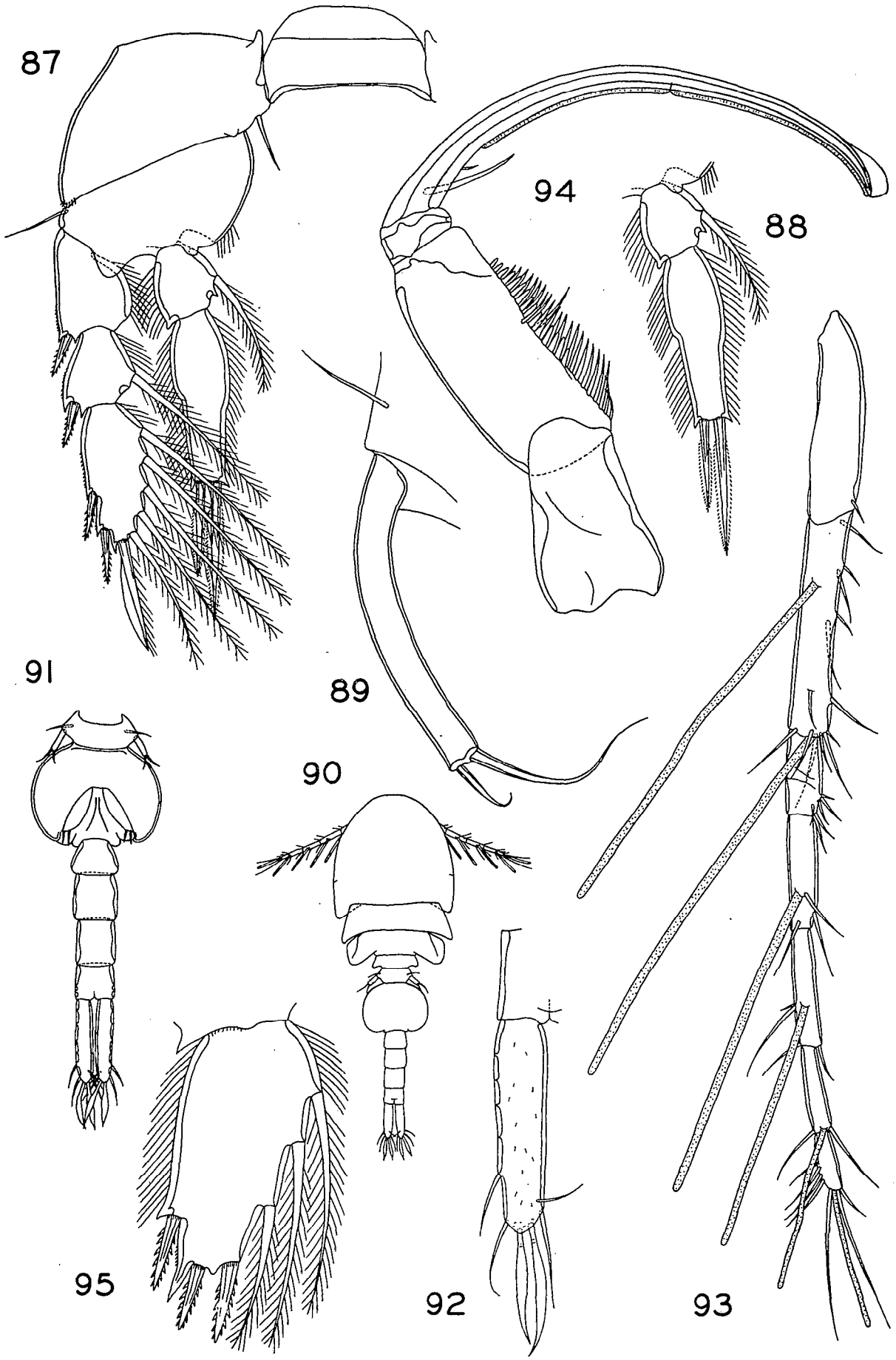
Figs. 87-89 - *Lichomolgus compositus* sp. n., female (continued)

87 - Fourth leg, anterior (K)
88 - Endopod of the fourth leg, anterior (K)
89 - Fifth leg, dorsal (P)

Figs. 90-95 - *Lichomolgus compositus* sp. n., male

90 - Body, dorsal (I)
91 - Urosome, ventral (J)
92 - Caudal ramus, dorsal (M)
93 - First antenna, ventral (P)
94 - Maxilliped, outer (K)
95 - Third segment of the endopod of the second leg (N)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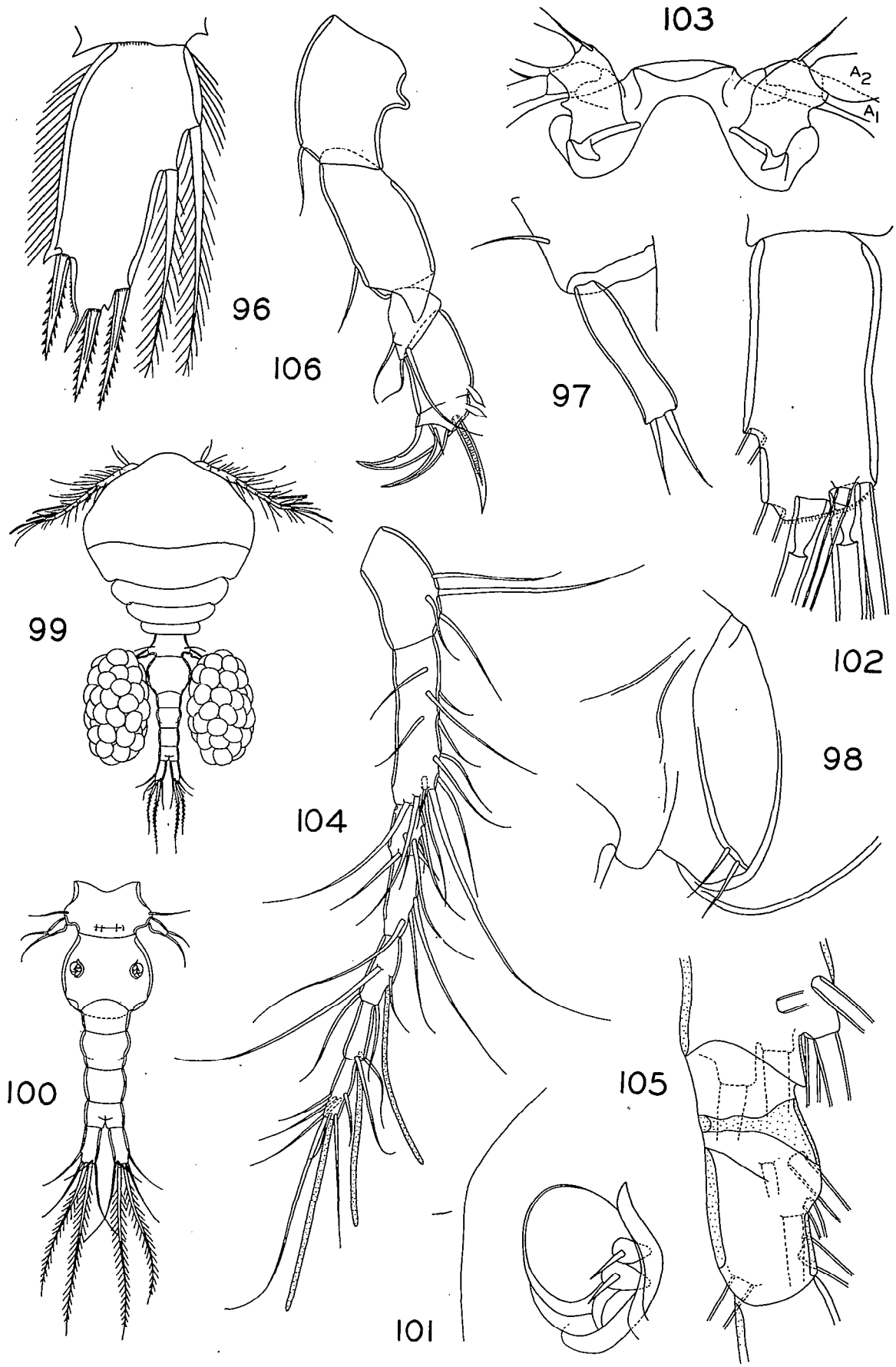
Figs. 96-98 - *Lichomolgus compositus* sp. n. , male (continued)

96 - Third segment of the endopod of the third leg (N)
97 - Fifth leg, dorsal (N)
98 - Sixth leg, ventral (P)

Figs. 99-106 - *Lichomolgus decorus* sp. n. , female

99 - Body, dorsal (A)
100 - Urosome, dorsal (B)
101 - Area of attachment of an egg sac, dorsal (C)
102 - Caudal ramus, dorsal (C)
103 - Rostral region, ventral (G)
104 - First antenna, dorsal (D)
105 - Basal region of the third segment of the first antenna, ventral (E)
106 - Second antenna, inner (D)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Figs. 107-116 - *Lichomolgus decorus* sp. n. , female (continued)

107 - Posterior border of the labrum (mandibles and paragnaths in dashed lines), ventral (D)

108 - Mandible (F)

109 - Paragnath (C)

110 - First maxilla (C)

111 - Second maxilla, posterior (F)

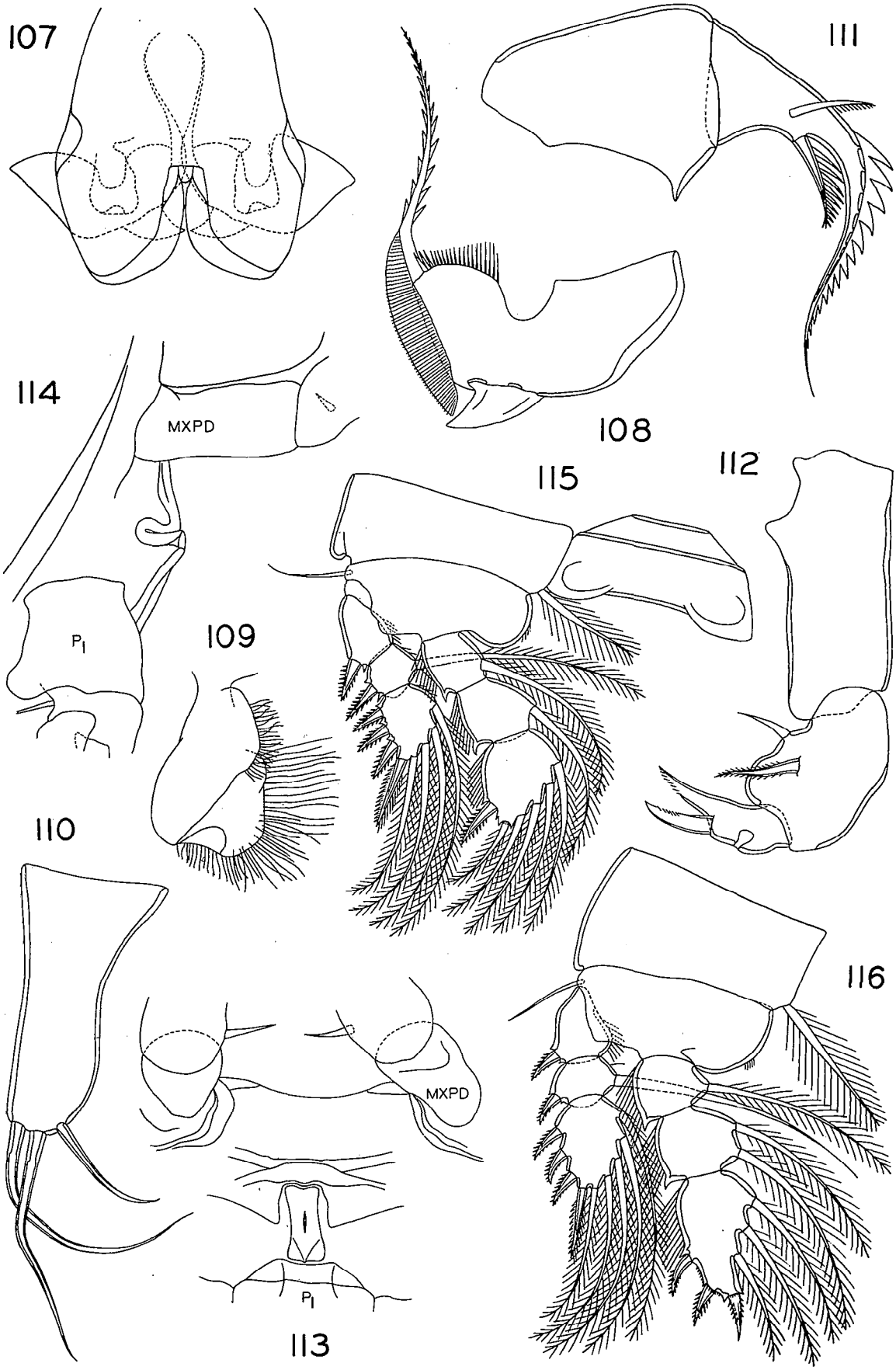
112 - Maxilliped, posterior (F)

113 - Region between the maxillipeds and the first legs, ventral (D)

114 - Same, lateral (D)

115 - First leg, anterior (D)

116 - Second leg, anterior (D)


107
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P1
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MXPD
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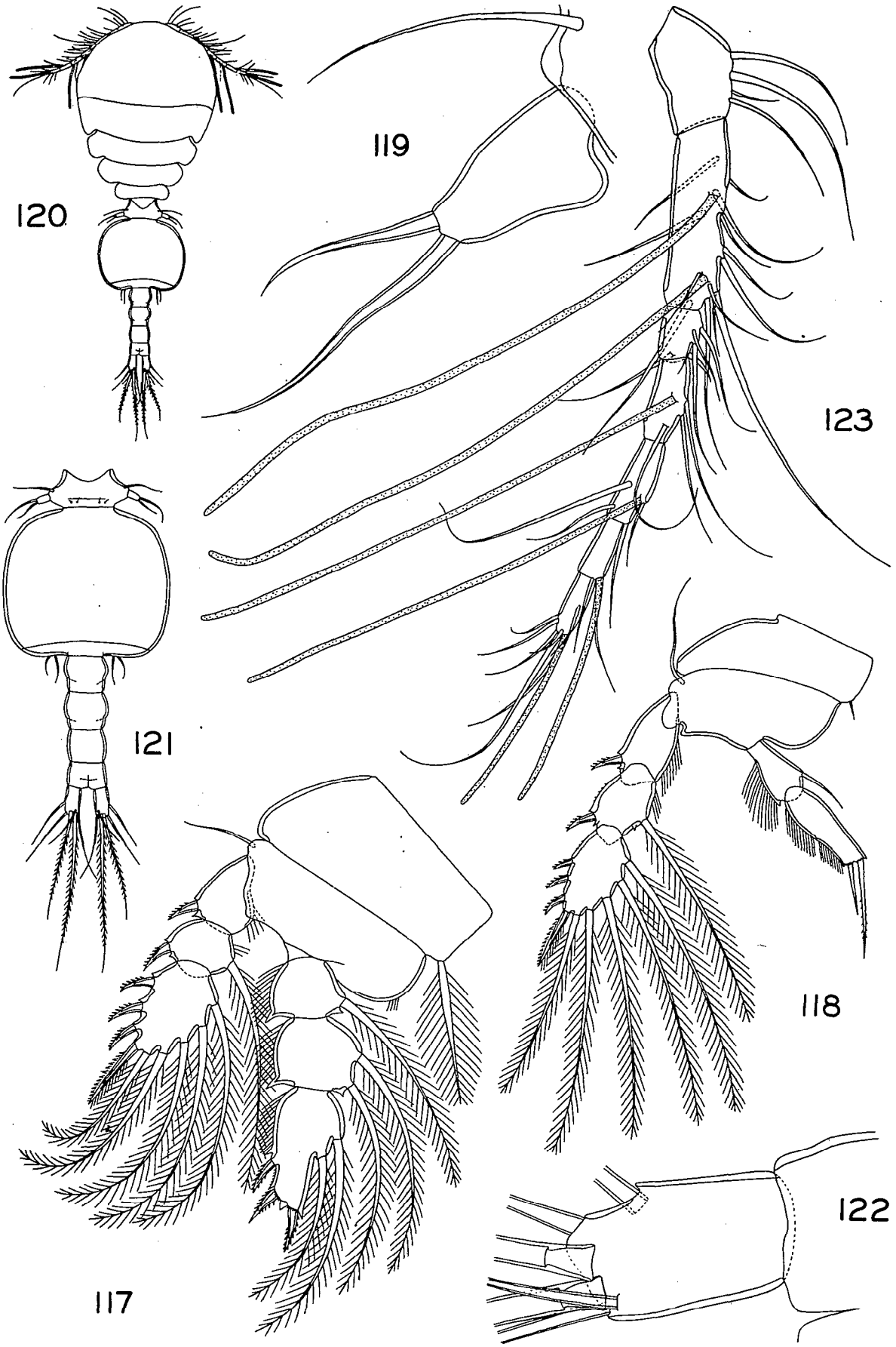
P1
113

Figs. 117-119 - *Lichomolgus decorus* sp. n. , female (continued)

117 - Third leg, anterior (D)
118 - Fourth leg, anterior (D)
119 - Fifth leg, dorsal (C)

Figs. 120-123 - *Lichomolgus decorus* sp. n. , male

120 - Body, dorsal (A)
121 - Urosome, dorsal (B)
122 - Caudal ramus, dorsal (C)
123 - First antenna, ventral (D)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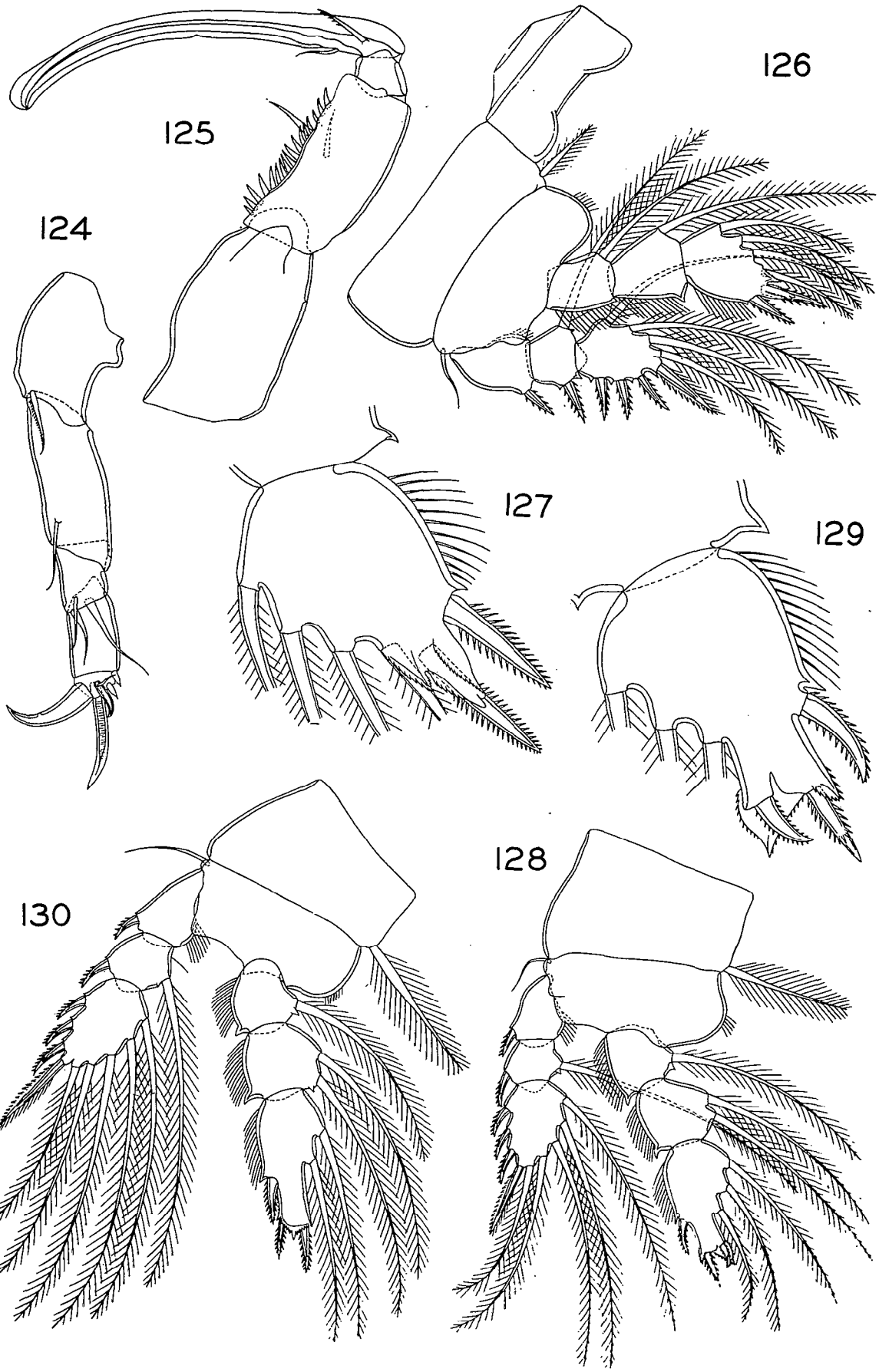
Figs. 124-130 - *Lichomolgus decorus* sp. n. , male (continued)

124 - Second antenna, somewhat inner (D)
125 - Maxilliped, inner (D)
126 - First leg, anterior (D)
127 - Third segment of the endopod of the first leg (C)
128 - Second leg, anterior (D)
129 - Third segment of the endopod of the second leg (C)
130 - Third leg, anterior (D)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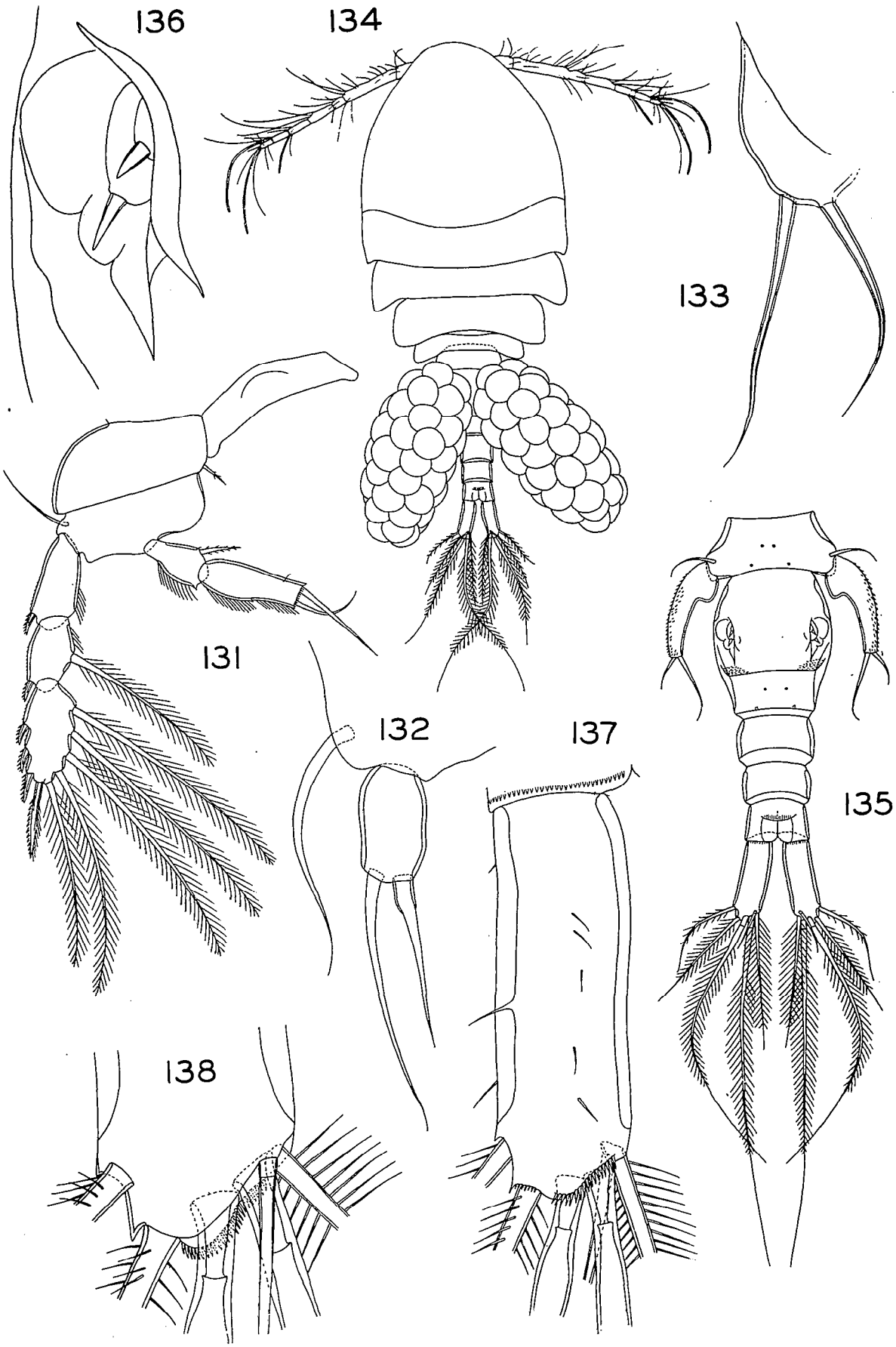
Figs. 131-133 - *Lichomolgus decorus* sp. n. , male (continued)

131 - Fourth leg, anterior (D)
132 - Fifth leg, dorsal (C)
133 - Setae of the sixth leg, ventral (C)

Figs. 134-138 - *Lichomolgus spinulifer* sp. n. , female

134 - Body, dorsal (A)
135 - Urosome, dorsal (B)
136 - Area of attachment of an egg sac, dorsal (C)
137 - Caudal ramus, ventral (F)
138 - Extremity of the caudal ramus, dorsal (C)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Figs. 139-146 - *Lichomolgus spinulifer* sp. n. , female (continued)

139 - Rostral region, ventral (G)

140 - First antenna, dorsal (G)

141 - Basal region of the third segment of the first antenna, ventral (E)

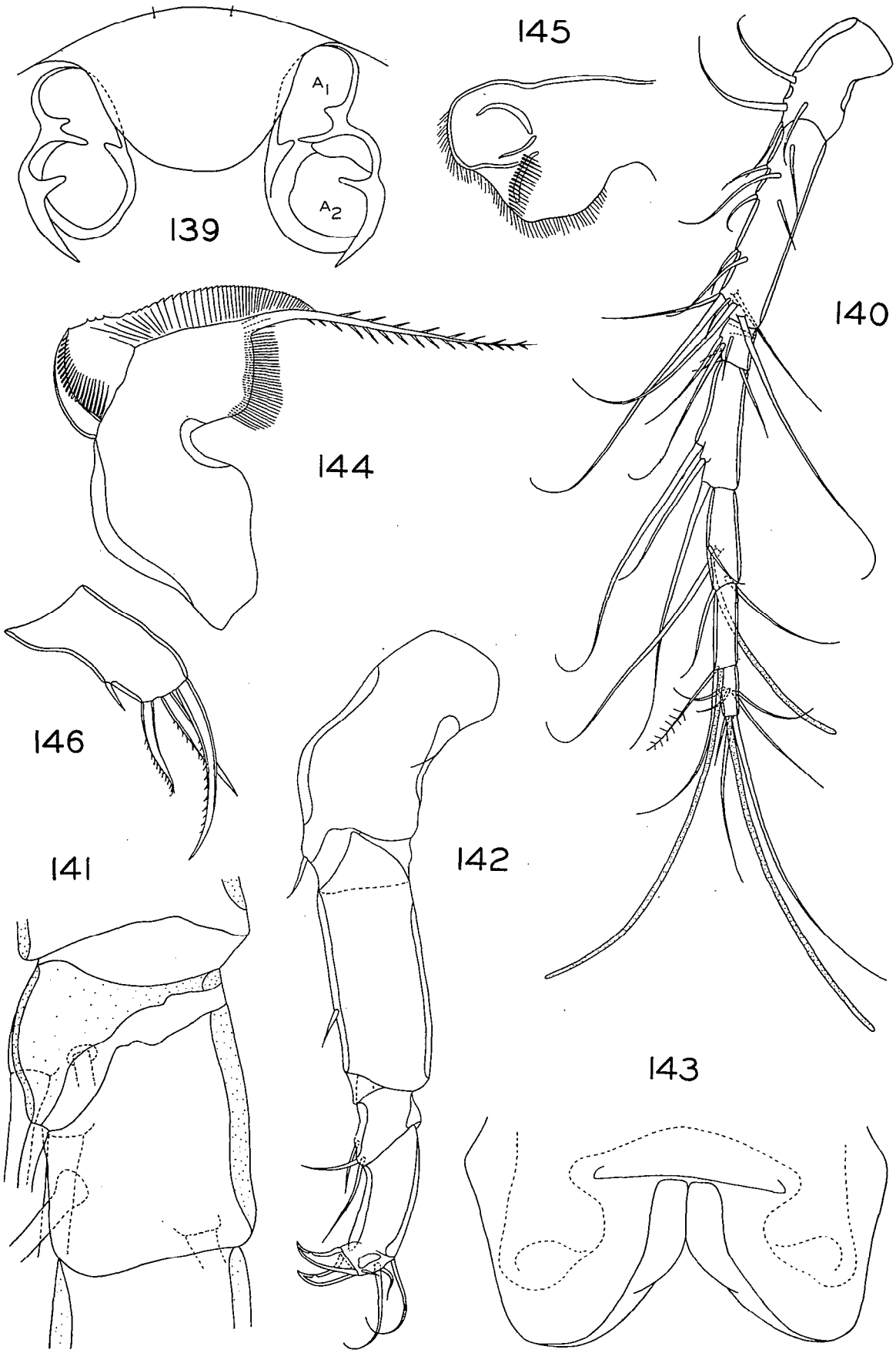
142 - Second antenna, outer (D)

143 - Posterior border of the labrum (paragnaths in dashed lines), ventral (F)

144 - Mandible (F)

145 - Paragnath (C)

146 - First maxilla (F)


A1
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Figs. 147-151 - *Lichomolgus spinulifer* sp. n. , female (continued)

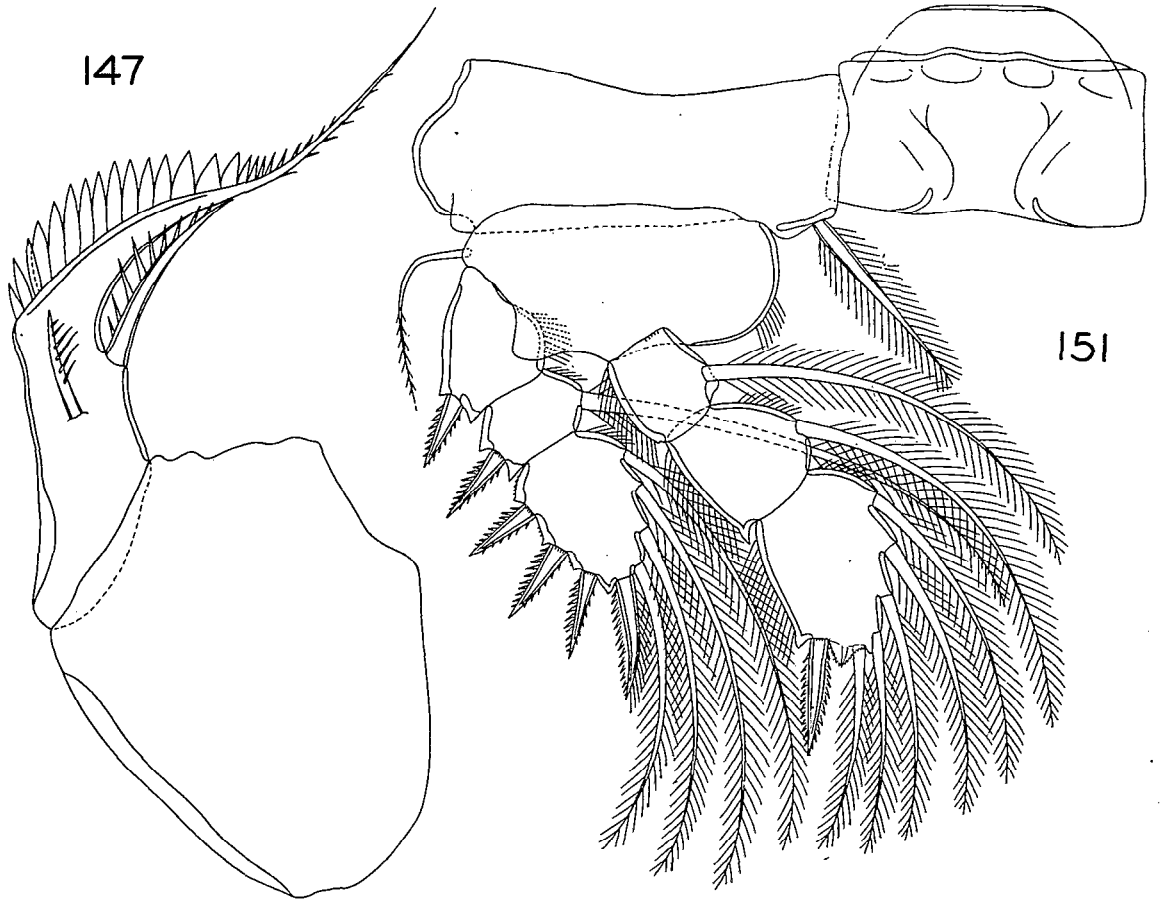
147 - Second maxilla, posterior (F)

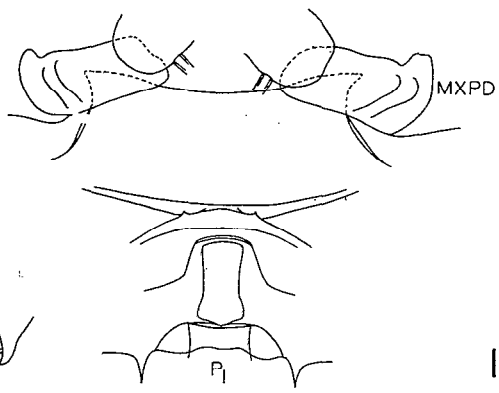
148 - Maxilliped, posterior (F)

149 - Region between the maxillipeds and the first legs, ventral (G)

150 - Same, lateral (G)

151 - First leg, anterior (D)





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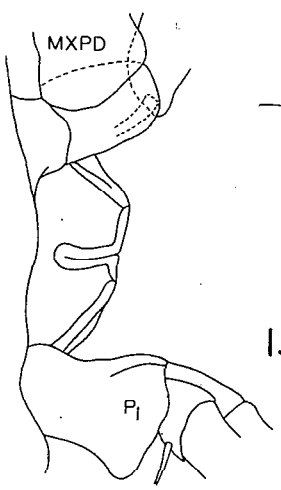

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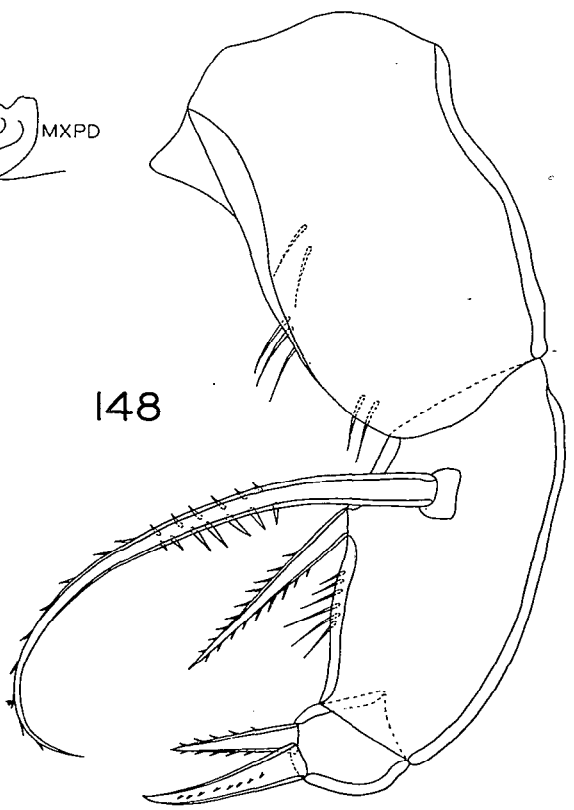


148

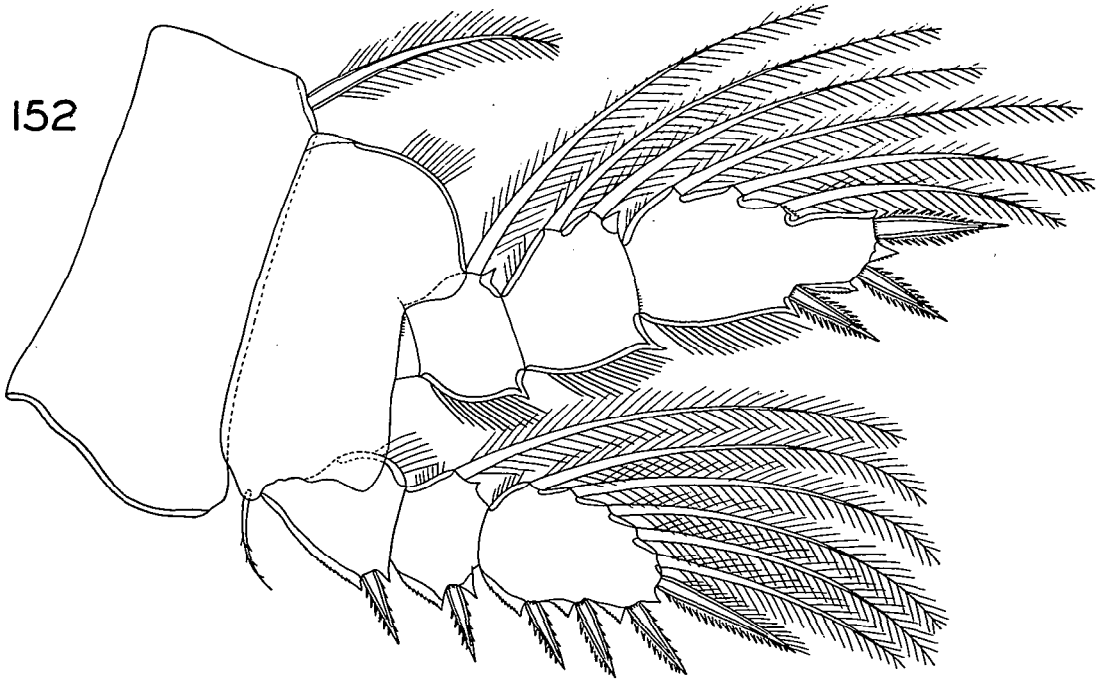
Figs. 152-154 - *Lichomolgus spinulifer* sp. n. , female (continued)

152 - Second leg, anterior (D)

153 - Third leg, anterior (D)

154 - Fourth leg, anterior (D)

152



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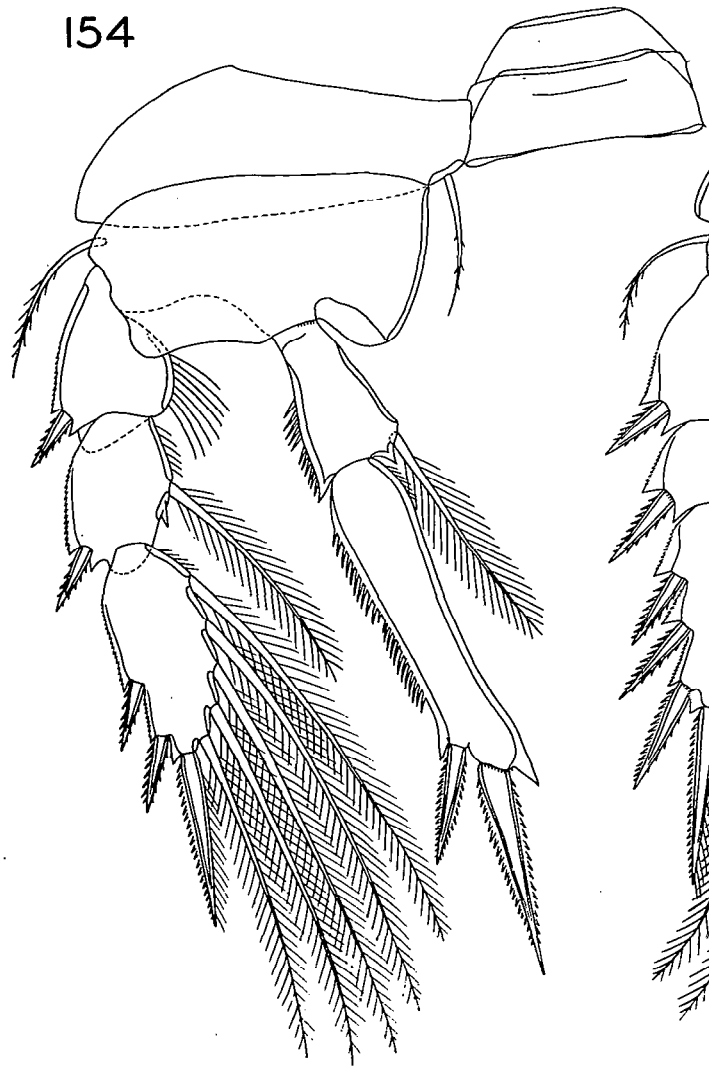

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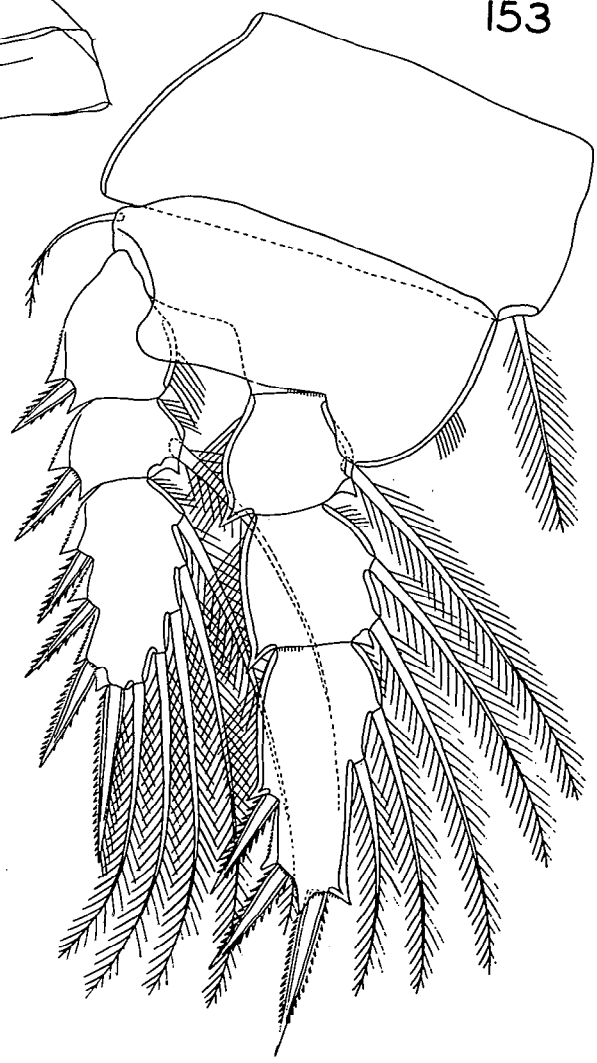
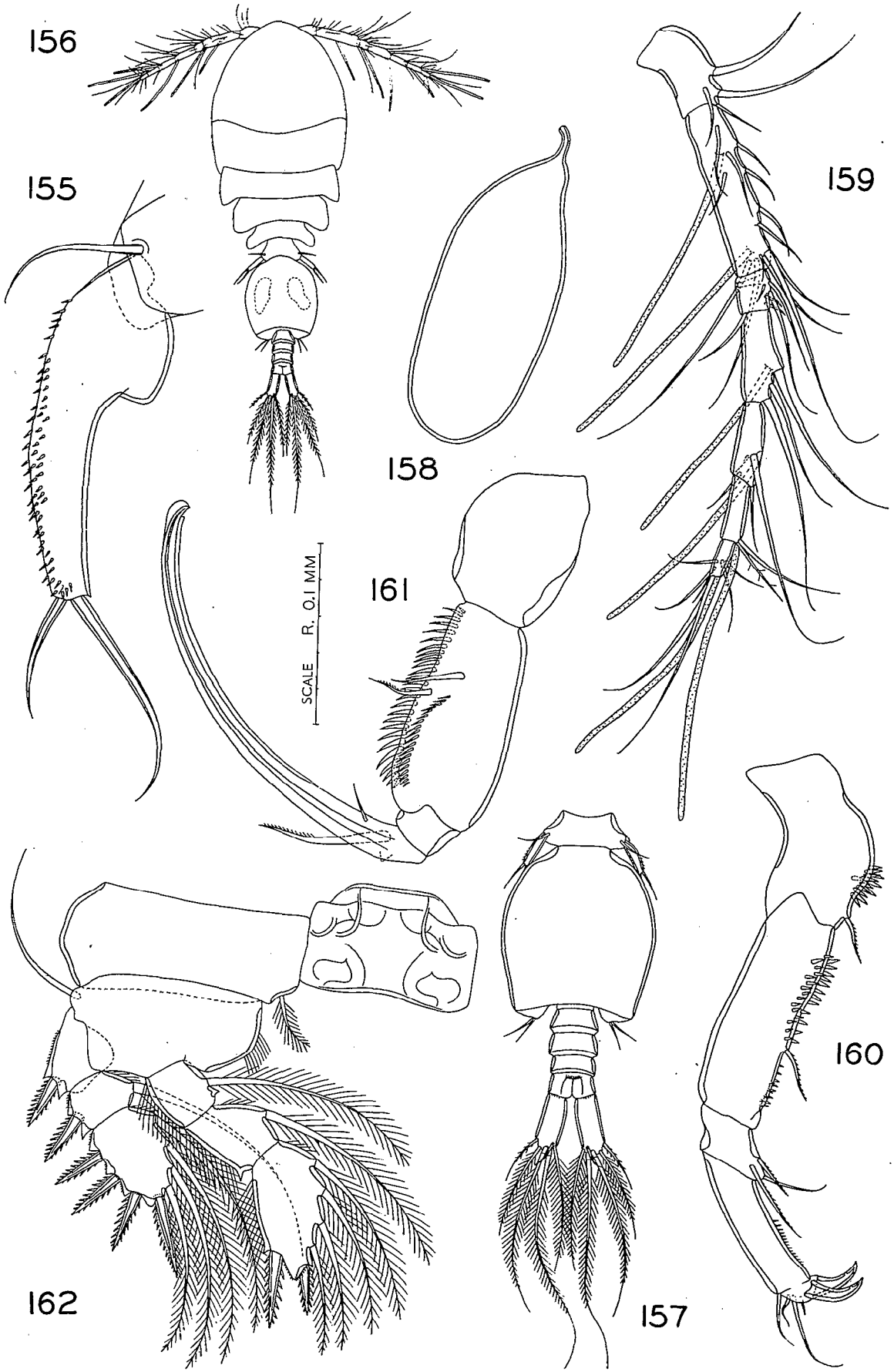


Figs. 155 - *Lichomolgus spinulifer* sp. n. , female (continued)

155 - Fifth leg, dorsal (D)

Figs. 156-162 - *Lichomolgus spinulifer* sp. n. , male

156 - Body, dorsal (A)
157 - Urosome, dorsal (B)
158 - Spermatophore (G)
159 - First antenna, dorsal (G)
160 - Second antenna, outer (D)
161 - Maxilliped, outer (R)
162 - First leg, anterior (D)


156
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SCALE R. 0.1 MM
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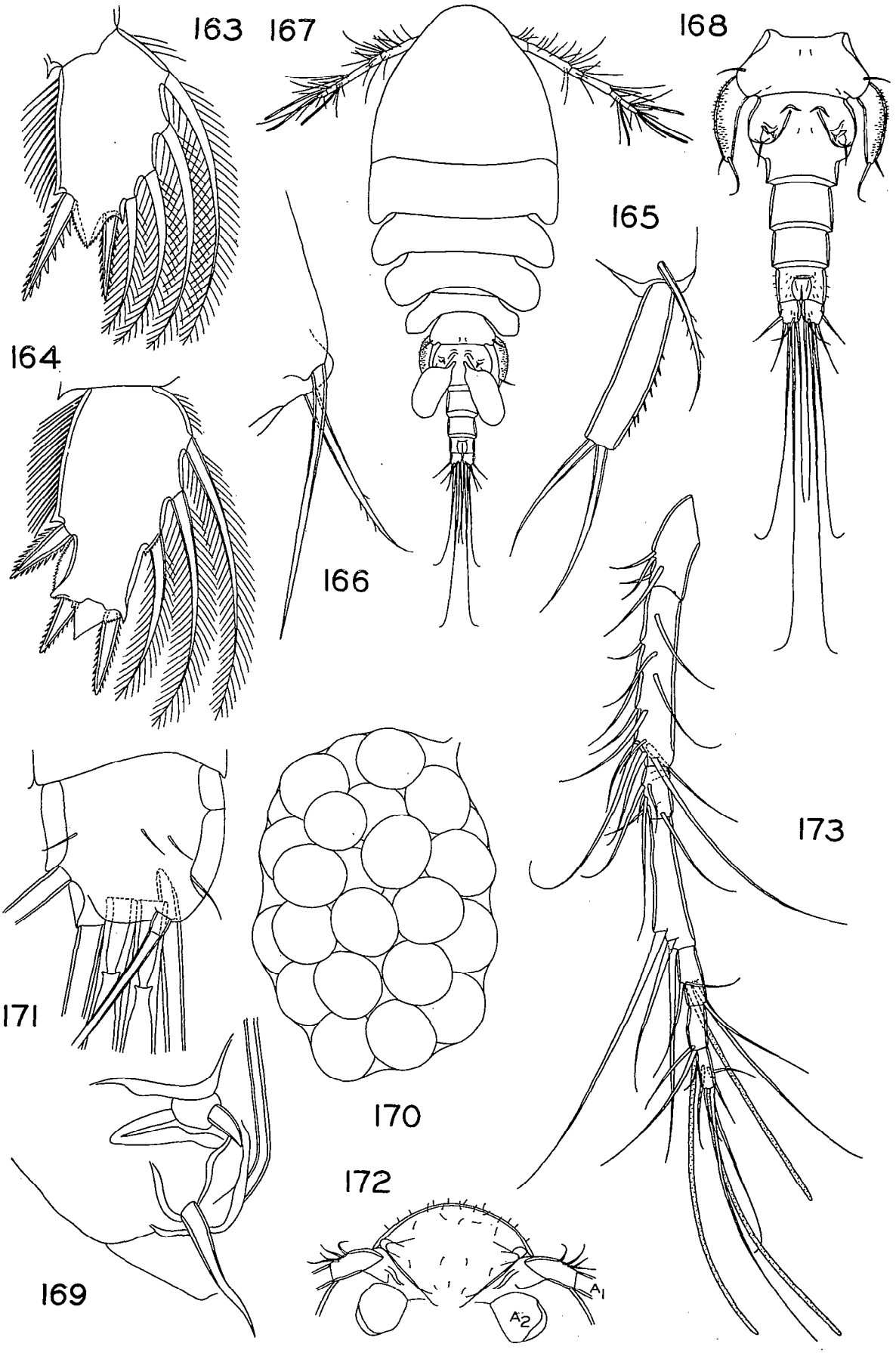
Figs. 163-166 - *Lichomolgus spinulifer* sp. n. , male (continued)

163 - Third segment of the endopod of the first leg (F)
164 - Third segment of the endopod of the second leg (F)
165 - Fifth leg, dorsal (F)
166 - Setae of the sixth leg, ventral (C)

Figs. 167-173 - *Lichomolgus squamiger* sp. n. , female

167 - Body, with two spermatophores attached, dorsal (A)
168 - Urosome, dorsal (B)
169 - Area of attachment of an egg sac, dorsal (C)
170 - Egg sac (G)
171 - Caudal ramus, dorsal (C)
172 - Rostral region, ventral (B)
173 - First antenna, dorsal (G)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A1
A2

Figs. 174-183 - *Lichomolgus squamiger* sp. n., female (continued)

174 - Second antenna, outer (D)

175 - Posterior border of the labrum, ventral (D)

176 - Mandible (F)

177 - Paragnath in relation to the first maxilla and the base of the labrum, ventral (C)

178 - First maxilla (C)

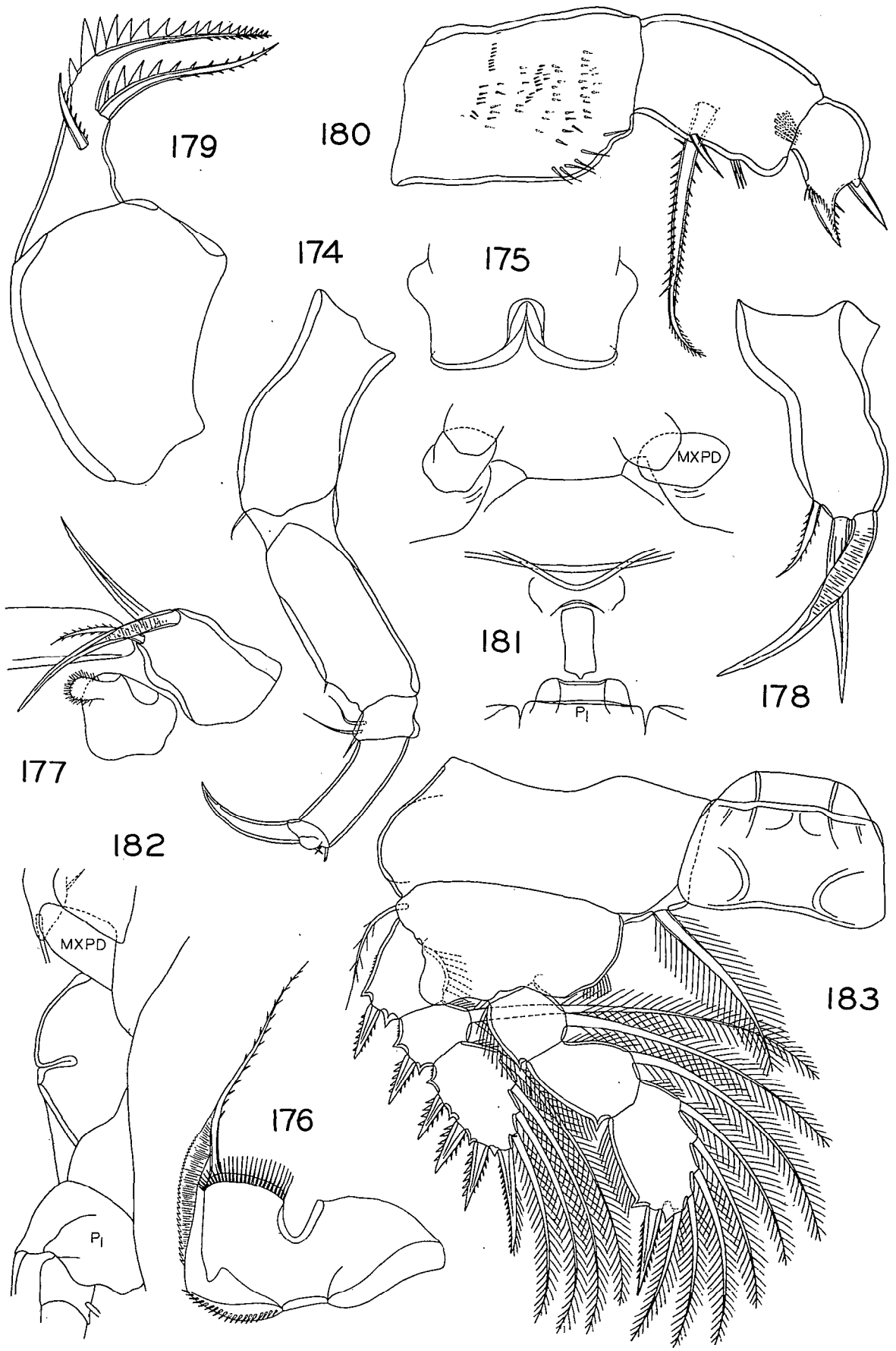
179 - Second maxilla, posterior (F)

180 - Maxilliped, anterior (F)

181 - Region between the maxillipeds and the first legs, ventral (G)

182 - Same, lateral (G)

183 - First leg, anterior (D)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MXPD
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182
MXPD
183
176
P1
P1

Figs. 184-186 - *Lichomolgus squamiger* sp. n. , female (continued)

184 - Second leg, anterior (D)

185 - Third leg, anterior (D)

186 - Fourth leg, anterior (D)

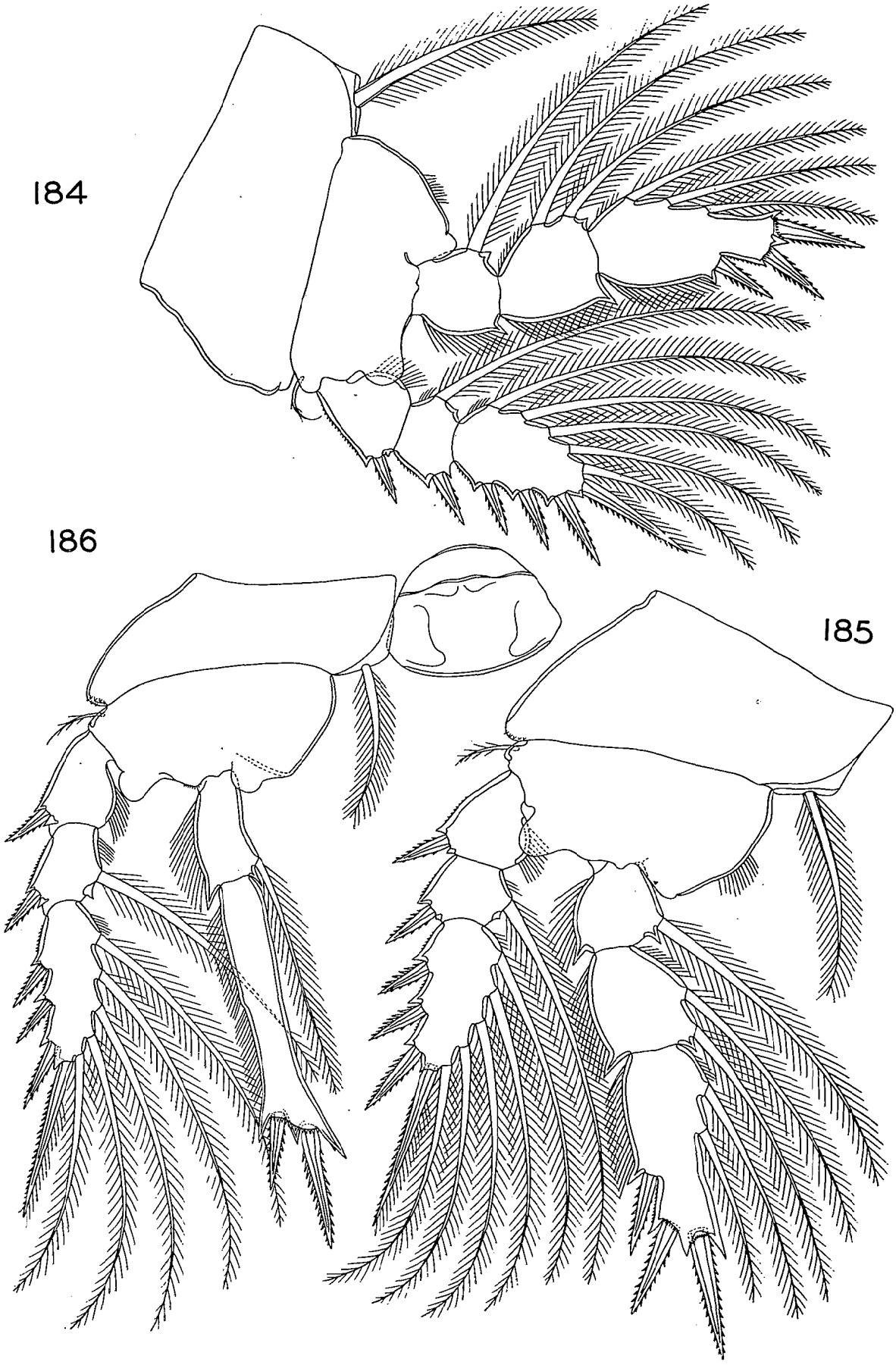
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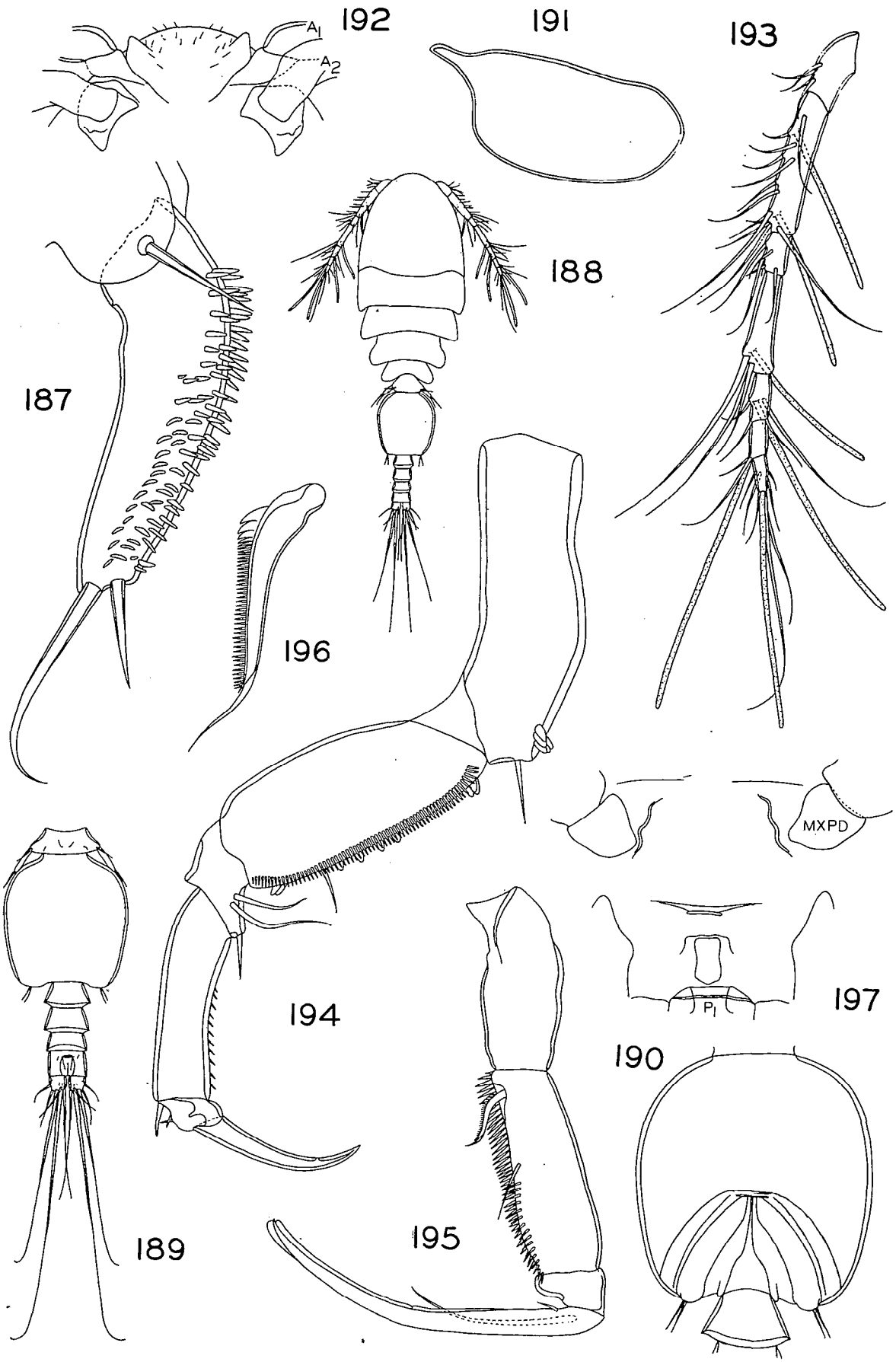
Fig. 187 - *Lichomolgus squamiger* sp. n. , female (continued)

187 - Fifth leg, dorsal (F)

Figs. 188-197 - *Lichomolgus squamiger* sp. n. , male

188 - Body, dorsal (A)
189 - Urosome, dorsal (B)
190 - Genital segment, ventral (G)
191 - Spermatophore (G)
192 - Rostral region, ventral (G)
193 - First antenna, dorsal (G)
194 - Second antenna, inner (F)
195 - Maxilliped, outer (G)
196 - Proximal seta of the second segment of the maxilliped (C)
197 - Region between the maxillipeds and the first legs, ventral (G)


192
A1
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MXPD
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P1
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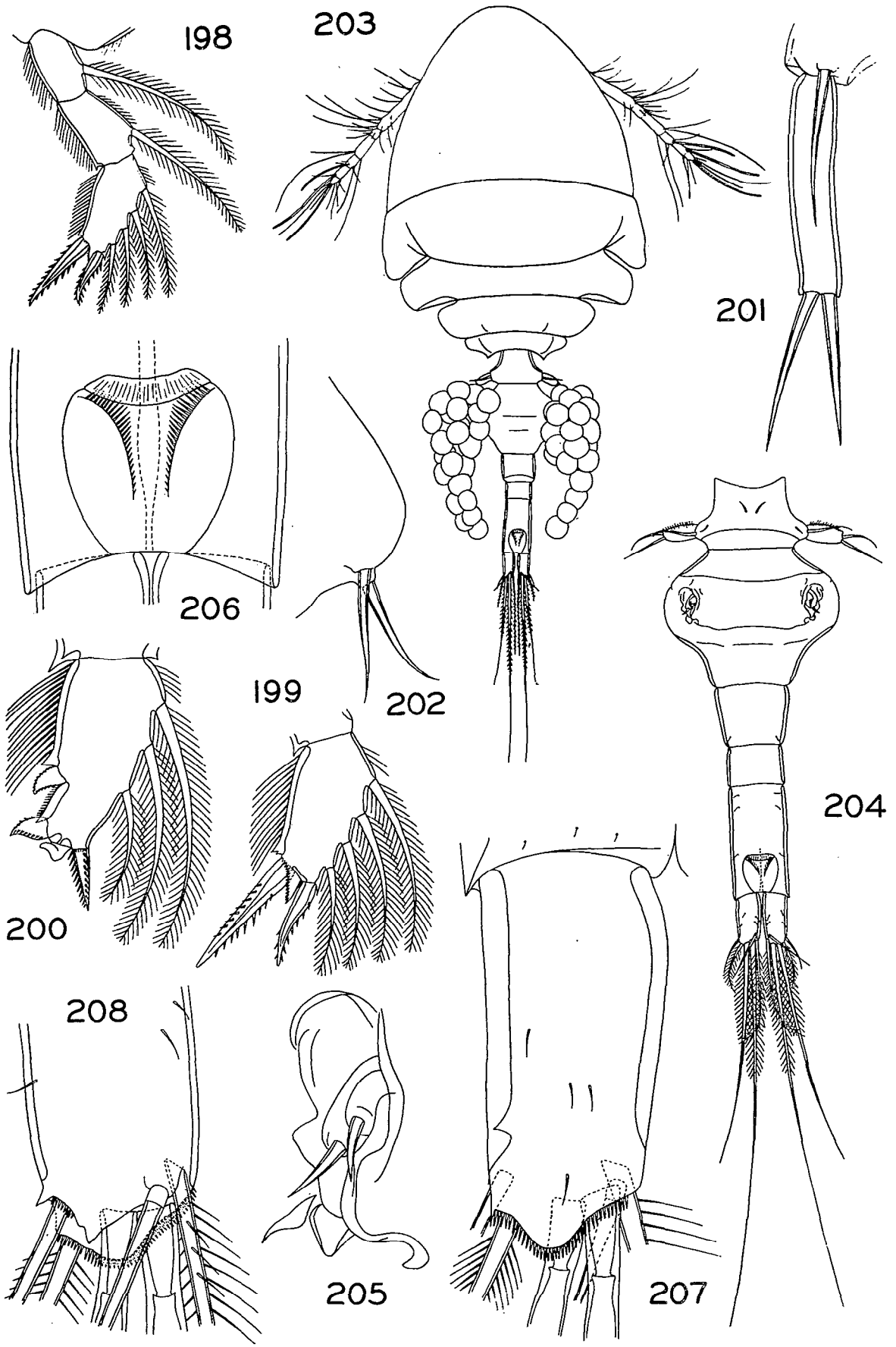
Figs. 198-202 - *Lichomolgus squamiger* sp. n. , male (continued)

198 - Endopod of the first leg (D)
199 - Third segment of the endopod of the first leg (F)
200 - Third segment of the endopod of the second leg (F)
201 - Fifth leg, dorsal (C)
202 - Setae of the sixth leg, ventral (C)

Figs. 203-208 - *Lichomolgus protentus* sp. n. , female

203 - Body, dorsal (A)
204 - Urosome, dorsal (B)
205 - Area of attachment of an egg sac, dorsal (C)
206 - Posterior region of the anal segment, dorsal (F)
207 - Caudal ramus, ventral (C)
208 - Extremity of the caudal ramus, dorsal (C)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Figs. 209-217 - *Lichomolgus protentus* sp. n. , female (continued)

209 - Rostral region, ventral (B)

210 - First antenna, dorsal (G)

211 - Basal region of the third segment of the first antenna, ventral (E)

212 - Second antenna, inner (G)

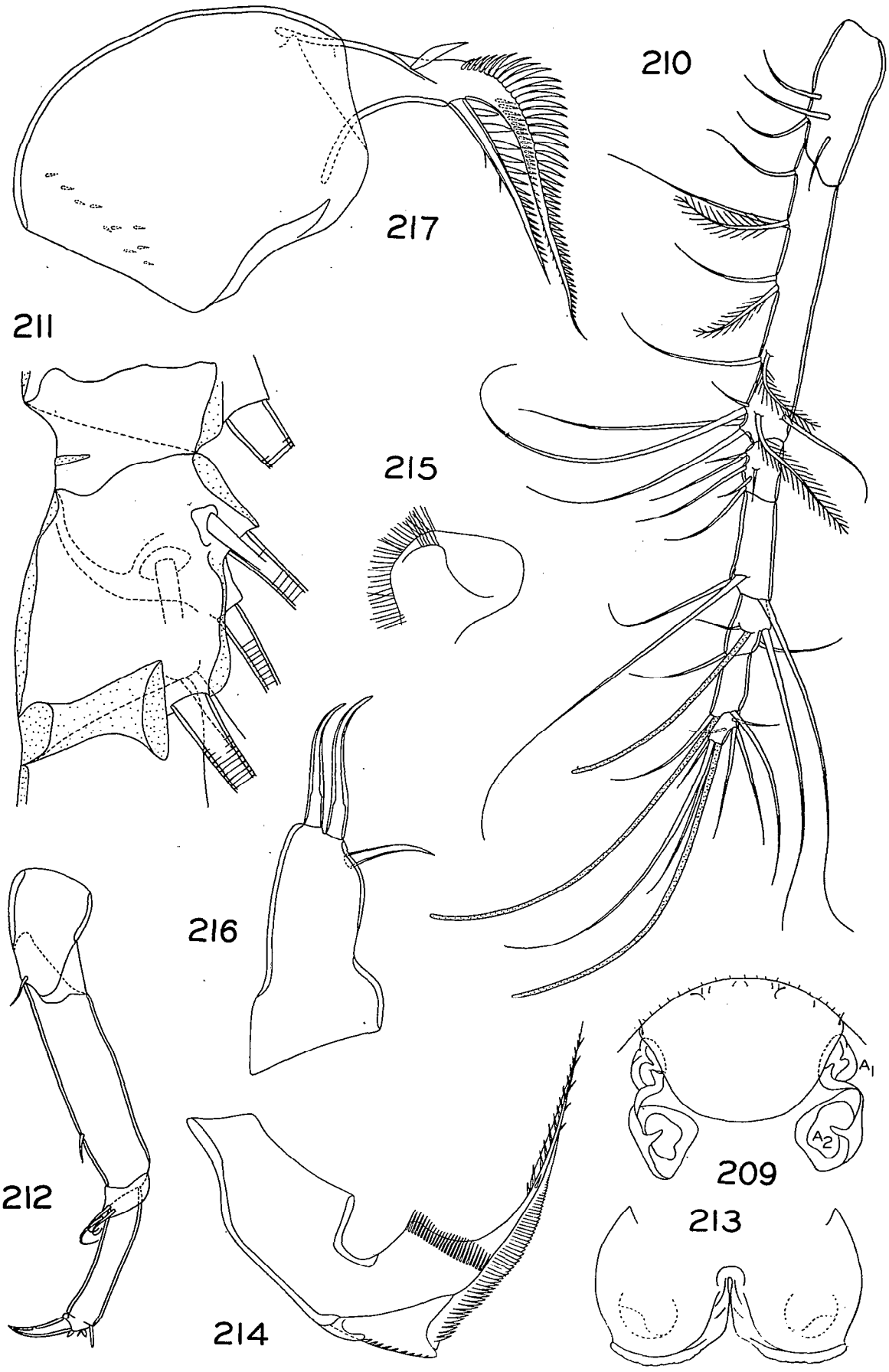
213 - Posterior border of the labrum (positions of the paragnaths in dashed lines), ventral (D)

214 - Mandible (F)

215 - Paragnath (C)

216 - First maxilla (C)

217 - Second maxilla, posterior (F)


210
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A1
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Figs. 218-222 - *Lichomolgus protentus* sp. n., female (continued)

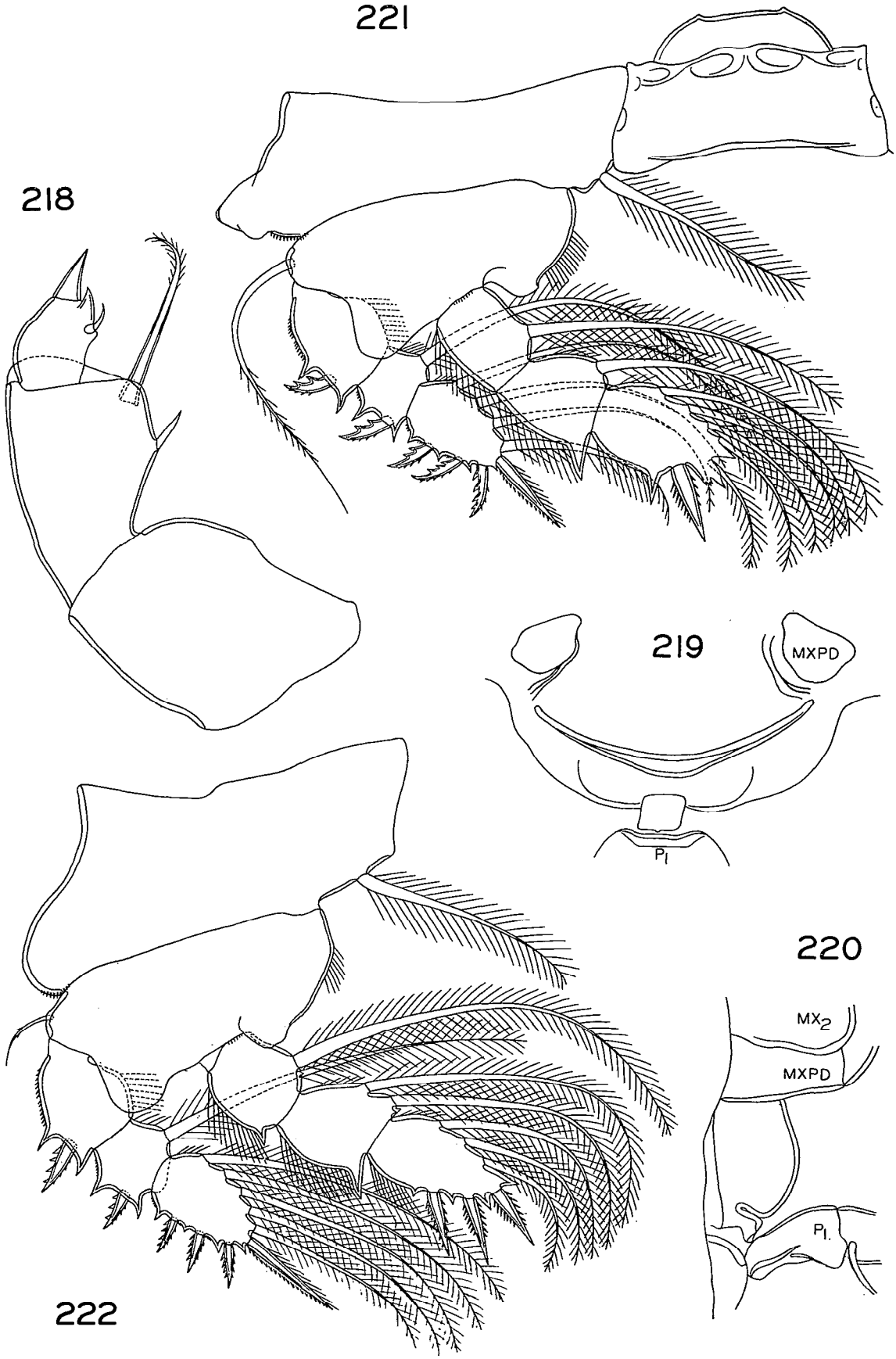
218 - Maxilliped, somewhat anterior (F)

219 - Region between the maxillipeds and the first legs, ventral (G)

220 - Same, lateral (G)

221 - First leg, anterior (D)

222 - Second leg, anterior (D)

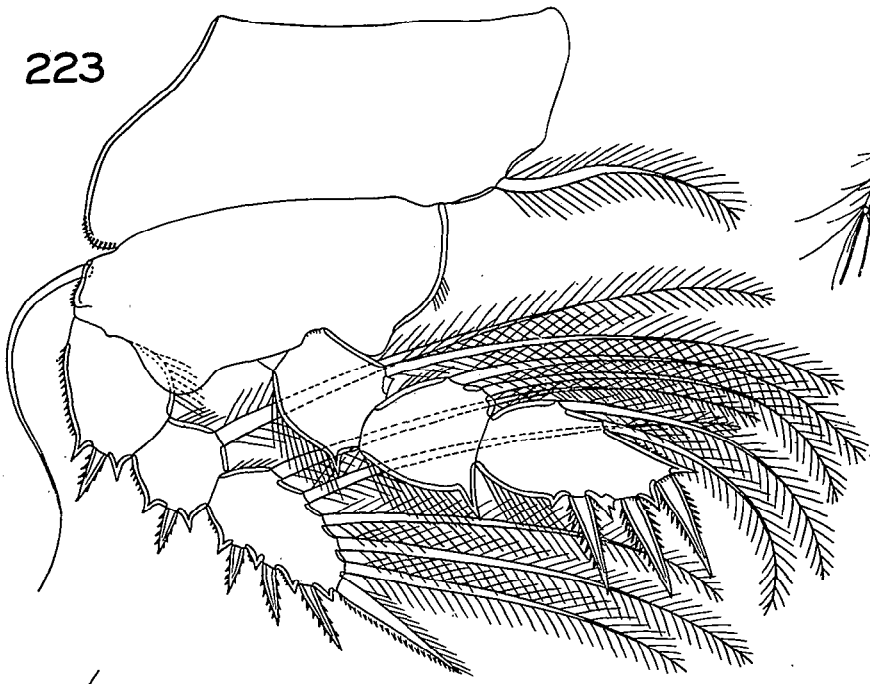

221
218
219
MXPD
P1
220
MX2
MXPD
P1.
222

Figs. 223-225 - *Lichomolgus protentus* sp. n., female (continued)

223 - Third leg, anterior (D)
224 - Fourth leg, anterior (D)
225 - Fifth leg, dorsal (F)

Figs. 226-228 - *Lichomolgus protentus* sp. n., male

226 - Body, dorsal (A)
227 - Urosome, dorsal (B)
228 - Spermatophore (G)



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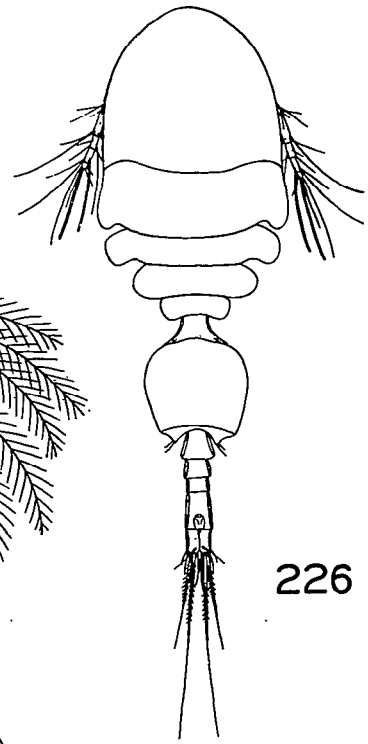
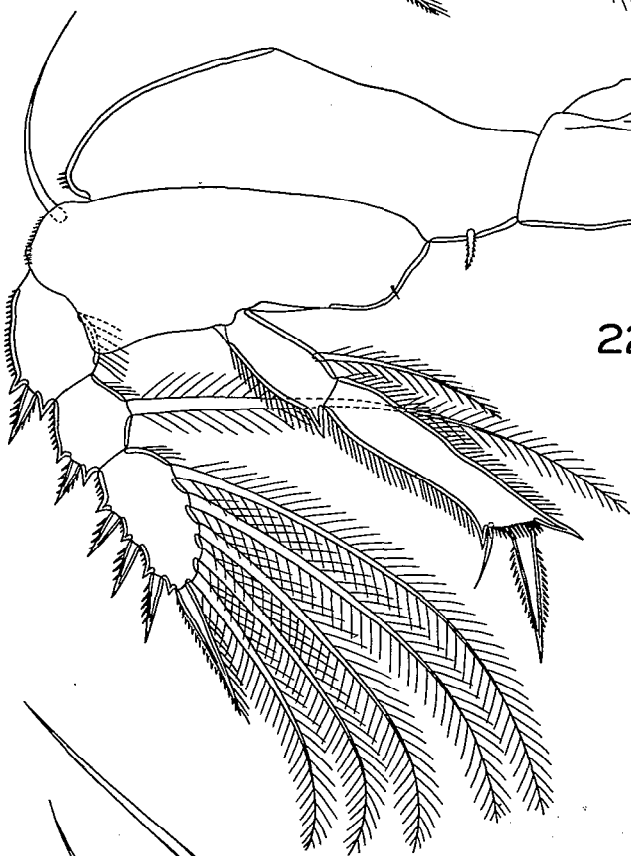
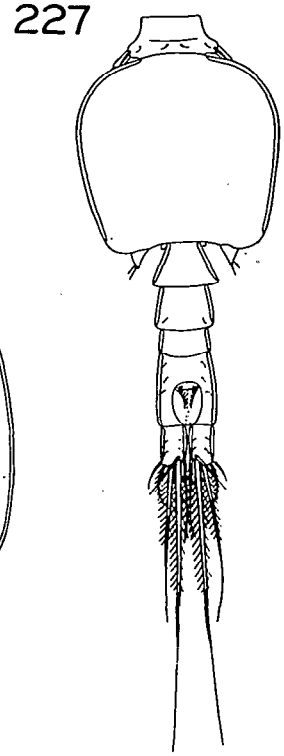


226



224



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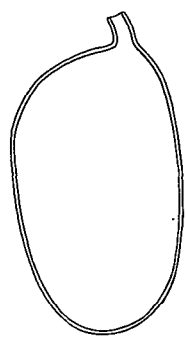
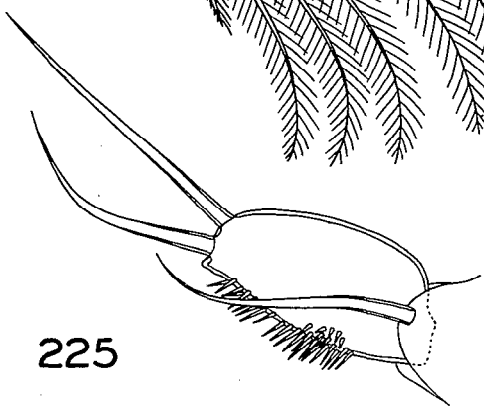


228



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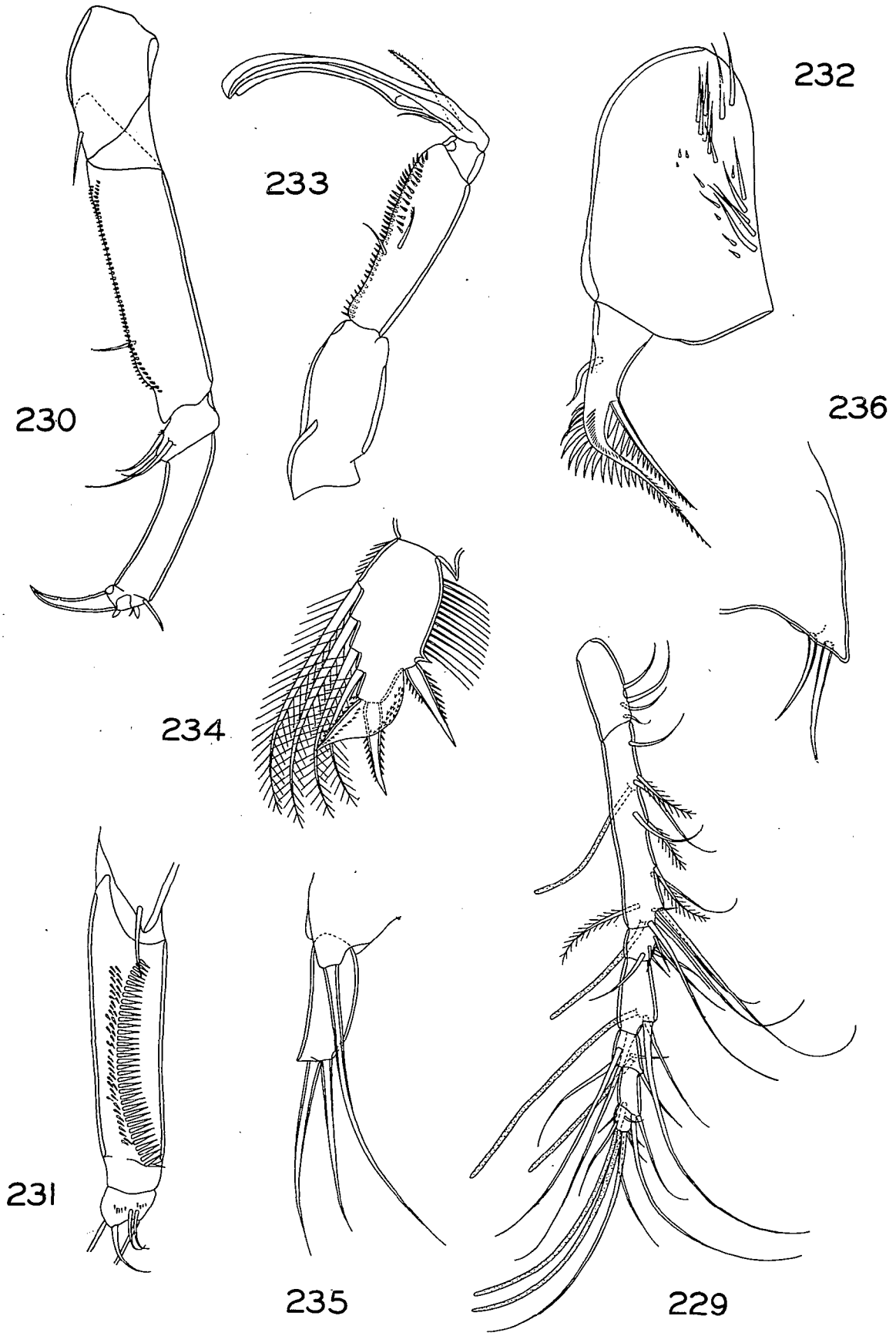
Figs. 229-236 - *Lichomolgus protentus* sp. n., male (continued)

229 - First antenna, dorsal (G)
230 - Second antenna, inner (D)
231 - Second and third segments of the second antenna, anteromedian (D)
232 - Second maxilla, anterior (F)
233 - Maxilliped, outer (G)
234 - Third segment of the endopod of the first leg (F)
235 - Fifth leg, dorsal (C)
236 - Setae of the sixth leg, ventral (C)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229

RESUME

Les auteurs décrivent sept espèces nouvelles des Copépodes cyclopoïdes lichomolgides (une d'eux appartenant à un genre nouveau *Monomolgus*, les autres au genre *Lichomolgus*) du nord-ouest de Madagascar. Trois de ces espèces s'associent aux coraux : *Monomolgus unihastatus* gen. et sp. n. à *Porites cf. P. andrewsi*, *Lichomolgus actinophorus* sp. n. à *Pavona angulata* et *P. cactus*, et *L. compositus* sp. n. à *Seriatopora subseriata*. Les quatre autres espèces s'associent aux alcyonaires : *L. decorus* sp. n. à *Cladiella laciniosa*, *L. spinulifer* sp. n. à *Lemnalia* sp., *L. squamiger* sp. n. à *Sinularia polydactyla*, et *L. protentus* sp. n. à *Sarcophyton* sp. Certains caractères de ces copépodes sont brièvement discutés et comparés.