

Five New Bomolochid Copepods
Parasitic on
Indo-Pacific Clupeid Fishes

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and
HILLARY BOYLE

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ABSTRACT

Cressey, Roger F., and Hillary Boyle. Five New Bomolochid Copepods Parasitic on Indo-Pacific Clupeid Fishes. *Smithsonian Contributions to Zoology*, number 161, 25 pages, 73 figures, 1973.—Five new species of bomolochid copepods were discovered as parasitic on the eyes of Indo-Pacific clupeid fishes preserved in the collections of the Smithsonian Institution. The new species described, *Pumiliopes capitulatus*, *Pumiliopes squamosus*, *Pumiliopsis plautus*, *Pumiliopsis emarginatus*, and *Orbitacolax nudus* were recovered from *Clupanodon punctatus*, *Sardinella zunasi*, *Sardinella sirm*, *Sardinella leiogaster*, *Sardinella perforata*, and *Herklotsiehthys punctatus* respectively. *Orbitacolax*, considered by Pillai to be synonymous with *Bomolochus*, is retained as a separate genus.

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Introduction

Examination of several species of Indo-Pacific clupeid fishes in the collections of the Smithsonian Institution for parasitic copepods yielded 3 genera containing 5 new species of Bomolochidae. Two of the genera, *Pumiliopes* and *Pumiliopsis*, are so far only known from the Indo-Pacific and recovered only from the eyes of the hosts. The third genus, *Orbitacolax*, is apparently circumtropical and found both in the gill chamber and the eyes of the hosts.

Pillai, 1962, considered the genus *Orbitacolax* to be synonymous with *Bomolochus* because Shen's generic diagnosis of *Orbitacolax* did not differ significantly from the definition of *Bomolochus*. We feel that the diagnosis of *Orbitacolax* by Shen was inadequate and that valid differences do exist; hence, we prefer to retain the name *Orbitacolax*. Work to result in revisions of the diagnosis of all bomolochid genera is underway by the senior author.

All material has been preserved in 70 percent alcohol and deposited in the collections of the Smithsonian Institution.

All figures were drawn with the aid of a Wild drawing tube. Specimens were also examined with a Cambridge Stereoscan Microscope in order to clarify certain anatomical features not easily seen

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by conventional means. These observations have been incorporated into the descriptions and the illustrations.

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All measurements are taken from the holotype.

Pumiliopes capitulatus, new species

FIGURES 1-12

MATERIAL EXAMINED.—A single collection containing 2 females (holotype USNM 143616) from the eye of *Clupanadon punctatus* (USNM 6495) from Hong Kong.

FEMALE.—Body form as in Figure 1. Total length of holotype 1.53 mm, greatest width 0.75 mm (measured across widest part of cephalon). Cephalon about as long as wide. Genital segment (Figure 2) wider than long ($215\mu \times 118\mu$). Abdomen (see Figure 2) 3-segmented: segments measure 71μ , 38μ , and 65μ long respectively; each of last 2 segments narrower than preceding one; first 2 segments each with transverse posteroventral band of fine spinules, last segment with 2 ventral patches of scales and row of fine spinules on each outer posterior corner. Caudal rami (Figure 3) nearly 3 times as long as wide ($62\mu \times 24\mu$); each ramus with patch of 12-15 scales on ventral surface and 6 setae; longest seta (106μ) with stout base.

First antenna (Figure 4) 5-segmented; basal part (first 2 segments) 289μ long, remaining segments 35μ , 18μ , and 24μ long respectively, no aesthetes visible on either of last 2 segments. Rostrum without hooks. Second antenna (Figure 5) 3-segmented; basal segment with seta on outer distal corner; second segment with short, blunt medial seta; last segment subdivided, outer part with row of 14–16 prominent recurved hooklets and short terminal seta, inner part armed with stout claw arising near midlength, 3 stout setae constricted in their posterior third, and 2 additional setae (one very short). Labrum without ornamentation. Mouthparts consisting of mandible, paragnath, first maxilla, and second maxilla as in Figure 6. Labium represented by row of spinules posterior to mouth. Maxilliped (Figure 7) with short, heavily sclerotized nearly straight hook, without accessory process.

Legs 1–4 biramous; rami 2-segmented except for leg 4 endopod. Leg 1 (Figure 8) coxopod with stout, unarmed spine on outer corner and stout seta on inner margin near margin of interpodal plate; basipod with elongate patch of scalelike spinules near endopod attachment area; exopod first segment with short seta on outer distal corner, last segment with 3 short outer setae and 6 longer inner setae; endopod first segment with seta on inner margin and row of fine spinules near distal margin, second segment lobate with 6 terminal setae and row of scalelike spinules along proximal portion of outer edge; interpodal plate covered with large patch of prominent scalelike spinules. Leg 2 (Figure 9) basipod with patch of prominent scalelike spinules near endopod attachment area and short seta on opposite side; exopod first segment with large patch of prominent scalelike spinules on outer margin and short seta on outer distal corner, last segment with row of spatulate spinules on outer border, two weak setae on outer border and strong outwardly curved terminal spine (tip of spine expanded); endopod first segment with prominent patch of scalelike spinules on outer border and short seta on inner distal corner, last segment with patch of scalelike spinules along outer border and 5 sparsely plumose setae along inner to terminal border. Leg 3 (Figure 10) armed as in leg 2 except basipod lacks scalelike spinules, spinules along outer edge of last exopod segment in 3 groups, endopod last segment with 3 terminal setae. Leg 4 (Figure 11) basipod, and exopod armed essentially as in leg 3; endopod 3-segmented, each of first two

segments with scalelike spinules along outer border and seta on inner distal corner, last segment small and bearing few scalelike spinules and 3 terminal setae (middle one much longer than other 2). Leg 5 (Figure 12) with scalelike patches as in the figure, short seta near midlength of outer edge and 3 terminal setae (outermost shortest and middle longest). Leg 6 (see Figure 2) represented by 3 prominent setae on midlateral border of genital segment.

Neither specimen was ovigerous.

MALE.—Unknown.

ETYMOLOGY.—The specific name *capitulatus* is Latin for "ending in a small head," referring to the tips of the exopod spines of legs 2–4.

REMARKS.—The only previously described species of *Pumiliopes* was described by Shen, 1957, as *P. opisthopteri* from the eye of *Opisthopterus tar-doore* (C & V) from China. The new species described here can be easily separated from Shen's species by the presence of scalelike spinules on the rami of the thoracic legs of the new species, by the nature of the maxilliped claw (strongly curved in *opisthopteri* and nearly straight in *capitulatus*), and by nature of the tips of the spines on the exopods of legs 2–4 of the new species.

Pumiliopes squamosus, new species

FIGURES 13–24

MATERIAL EXAMINED.—A single collection containing 3 females (holotype USNM 143618, 2 paratypes USNM 143619) from the eye of *Sardinella zunasi* (USNM 71109) from Nagasaki, Japan.

FEMALE.—Body form as in Figure 13. Total length of holotype 1.32 mm and greatest width 0.77 mm (measured across widest part of cephalon). Cephalon about as long as wide. Genital segment (Figure 14) wider than long ($265\mu \times 106\mu$). Abdomen (see Figure 14) 3-segmented (segmentation indistinct); segments measure 48μ , 33μ , and 66μ long respectively, each of last 2 segments narrower than preceding one; first 2 segments each with transverse posteroventral band of fine spinules, last segment with 2 ventral prominent patches of scalelike spinules and row of spinules along each outer distal corner. Caudal rami (Figure 15) nearly twice as long as wide ($65\mu \times 35\mu$); each ramus with patch of 35–45 scalelike spinules on ventral surface and 6 setae; longest seta (165μ) with stout base.

First antenna (Figure 16) 5-segmented and armed like that of *capitulatus*: basal part (first 2 segments) 259 μ long, remaining segments 47 μ , 15 μ , and 106 μ long respectively. Rostrum without hooks. Second antenna (Figure 17) like that of *capitulatus* except outer edge with about twice as many hooklets in double row. Labrum (Figure 18) with 2 large patches of scalelike spinules. Remaining mouthparts as in preceding species. Maxilliped (Figure 19) similar to that of *capitulatus* except that claw of *squamosus* is somewhat more curved.

Legs 1-4 biramous; rami 2-segmented except for leg 4 endopod. Leg 1 (Figure 20) coxopod with stout plumose seta on outer corner (in *capitulatus* this armature is in form of naked, heavily sclerotized spine); basipod with transverse patch of scalelike spinules along distal border; exopod armed as in preceding species; endopod also armed as in preceding species except for increased number of scalelike spinules on outer edges of segments; interpodal plate with 2 large patches of scalelike spinules. Leg 2 (Figure 21) armed essentially as in *capitulatus* except exopod last segment with longer spinules on outer edge and relatively shorter terminal spine with normally produced tip (expanded in *capitulatus*). Leg 3 (Figure 22) as in leg 2 except endopod last segment bears 3 setae instead of 5. Leg 4 (Figure 23) armed as in *capitulatus* except for addition of scalelike spinules on basipod and smaller terminal spine on tip of exopod. Leg 5 (Figure 24) as in *capitulatus* except for patch of scalelike spinules near inner distal corner rather than small pointed spinules present in *capitulatus*. Leg 6 (see Figure 14) represented by 3 well-developed setae at midmargin of genital segment (bases of setae obscured ventrally by ventral ridge).

Egg sacs containing approximately 150 eggs in a single layer.

MALE.—Unknown.

ETYMOLOGY.—The specific name *squamosus* is Latin for "scaly," referring to the abundance of scalelike spinules on the legs and abdomen and caudal rami.

REMARKS.—This species can be separated from Shen's species by the presence of scalelike spinules on various appendages. The maxilliped hook of *squamosus* seems to be intermediate in curvature between *opisthopteri* and *capitulatus*. The new species can be separated from *capitulatus* by the normal tips on the terminal exopod spines of *squamosus* whereas in *capitulatus* they are ex-

panded. It can be further separated by the nature of the spinules on the last exopod segment of legs 2-4 and by the presence of a large patch of scalelike spinules on the basipod of legs 3 and 4 of *squamosus*.

Pumiliopsis plautus, new species

FIGURES 25-38

MATERIAL EXAMINED.—Three collections containing 10 females (holotype USNM 143620, and 9 paratypes USNM 143621) from the eyes of 25 *Sardinella sirm* (USNM 190004-8) and 5 *Sardinella leiogaster* (120872) from the Philippines (*Albatross* collections).

FEMALE.—Body form as in Figure 25. Total length of holotype 3.33 mm and greatest width 1.21 mm (measured at widest part of cephalon). Cephalon slightly wider than long. Dorsal surface of rostrum depressed in form of cushionlike pad and bearing rostral hooks ventrally. Segmentation of thorax indistinct. Genital segment (Figure 26) wider than long (525 μ x 325 μ), expanded laterally with dorsal and ventral ridges (leg 6 inserted between); posterior corners each produced to form tear-shaped process. Abdomen 3-segmented: first 2 segments each with transverse band of fine spinules and indistinctly separate, third segment somewhat bulbous ventrally with 2 patches of scalelike spinules; segments measure 124 μ , 195 μ , and 83 μ long respectively. Caudal rami (Figure 27) longer than wide (136 μ x 83 μ); each ramus with patch of scalelike spinules and bearing 6 setae (longest 354 μ long).

Oral area as in Figure 28. First antenna (Figure 29) 6-segmented; basal part (first 3 segments) 295 μ long, remaining segments 65 μ , 30 μ , and 65 μ long respectively, aesthete present on penultimate segment. Second antenna (Figure 30) with 2-3 rows of hooklets on outer edge of last segment, pectinate spine, 4 terminal stout (but weak) spines, and 2 setae. Labrum (Figure 31) with 2 large patches of scalelike spinules. Mandible, paragnath, first and second maxilla as in Figure 31. Labium represented by dense triangular patch of spinules posterior to mouth area. Maxilliped (Figure 32) hook nearly straight, directed posteriorly and with accessory process on inner (concave) margin (it should be noted that this process does not correspond to the accessory process found on the convex margin of some other bomolochids).

Legs 1-4 biramous, rami 2-segmented except for endopod of leg 4. Leg 1 (Figure 33) coxopod with inner stout seta and bifurcate, highly plumose seta on dorsal surface of outer distal corner (Figure 34); basipod with patches of spinules as indicated in Figure 33; exopod first segment with outer spine, second segment with 3 outer spines (middle one directed inwardly and not easily seen from ventral aspect, all spines on outer edge of exopod with scales as indicated in Figure 34) and 6 terminal setae; endopod first segment with transverse row of scalelike spinules and inner seta, last segment with band of scalelike spinules along outer edge and 6 outer to terminal setae. Leg 2 (Figure 35) coxopod without ornamentation; basipod with 2 patches of scalelike spinules on ventral surface and dorsal seta on outer distal corner; exopod first segment with large patch of scalelike spinules along outer edge, spine at outer distal corner, and patch of larger spinules transversing distal margin, last segment with 3 outer spines (each with very fine spinules along outer edge), terminal spine bearing row of heavy spinules, and 2 terminal setae; endopod first segment with patch of small scalelike spinules and row of thick hairs along outer edge, last segment with few scalelike spinules along outer edge, row of thick hairs along proximal half of outer edge, 2 short outer spines, and 5 terminal to inner setae (outermost much shorter than other 4); all outer hairs on endopod segments are thick and of uniform thickness throughout their lengths, many forked or spatulate at tips (see Figure 36). Leg 3 (Figure 36) as in leg 2 except endopod with 3 terminal setae and minor variations as indicated in figure. Leg 4 (Figure 37) coxopod, basipod, and exopod as in leg 3; endopod 3-segmented, first segment with modified hairs along outer edge, patch of scalelike spinules near outer edge, and short inner seta, second segment armed as first except inner seta much longer, last segment with 3 terminal setae (outermost shortest and middle longest). Leg 5 (Figure 38) greatly enlarged; basal segment with very long, finely spinulose seta, last segment with 3 patches of scalelike spinules and 4 short setae (one near mid-outer margin, one sub-terminal and 2 terminal). Leg 6 represented by 3 setae on lateral margin of genital segment.

Egg sacs flattened and containing approximately 250 eggs.

MALE.—Unknown.

ETYMOLOGY.—The specific name *plautus* is Latin,

meaning "flat footed," referring to the greatly expanded and enlarged fifth leg of the female.

REMARKS.—This very bizarre bomolochid can be easily separated from the only previously described member of the genus, *P. sardinellae* (Bennet), and the following new species by the nature of the fifth leg. Further, the flagella on the setae of the first antenna, on the setae on the rami of leg 1, and on the outer margins of the endopods of legs 2-4 are thickened, filiform, and in some cases forked or spatulate at their tips.

Pumiliopsis emarginatus, new species

FIGURES 39-62

MATERIAL EXAMINED.—One collection containing 10 females and 4 males (holotype USNM 143622, allotype male USNM 143623, paratypes 9 females, 3 males USNM 143624) from the eyes of 18 *Sardinella perforata* (USNM 190241) from Manila, Philippines (*Albatross* collection).

FEMALE.—Body form as in Figure 39. Total length 3.24 mm and greatest width 1.18 mm (measured at widest part of cephalon). Cephalon more or less rounded. Rostrum (Figure 40) conical with small ventral sensilla on each side of bifurcate tip and 2 dorsal hooks near base. Length of rostrum 236 μ , width at base 224 μ . Genital segment (Figure 41) almost twice as wide as long (324 μ x 531 μ), length measured from anterior edge to end of posterolateral sclerotization. Abdomen apparently 2-segmented; first segment relatively long (401 μ) without ornamentation, tapering gradually; second segment short (65 μ) with 4-5 uneven longitudinal rows of scalelike spinules and row of fine spinules around posterolateral edge. Caudal rami (Figure 42) longer than wide (77 μ x 59 μ); each ramus with 2-3 uneven longitudinal rows of scalelike spinules and 6 setae (longest seta 159 μ).

First antenna (Figure 43) 5-segmented, second segment incompletely divided. Basal 2 segments measure 325 μ , remaining 3 measure 74 μ , 33 μ , and 71 μ long respectively; no aesthetes visible. Second antenna (Figure 44) with several rows of small, closely placed spinules on third segment, 4 hooked spines and 2 setae distally. Labrum with 2 patches of scalelike spines as in Figure 45. Mandible, paragnath, first and second maxilla as in Figure 45. First maxilla with 3 setae, innermost sparsely plumose, outer 2 naked, middle seta very long

(325 μ). Labium represented by a single row of short spines posterior to mouth. Maxilliped (Figure 46) hook strong, nearly straight without accessory process.

Legs 1-4 biramous, rami 2-segmented except endopod of leg 4. Leg 1 (Figure 47) coxopod with broad inner seta, and outer plumose seta visible under exopod; basipod with 2 patches of scalelike spinules; exopod first segment with outer spine, second segment with 3 outer spines and 6 plumose setae; endopod first segment with outer patch of scalelike spinules and inner seta, second segment with 6 setae. Leg 2 (Figure 48) basipod with 2-3 rows of scalelike spinules ventrally and short dorsal seta; exopod first segment with 2 distinct patches of scalelike spinules on outer edge, one spine on outer distal corner and patch of stout spinules at distal margin, second segment with 3 naked outer spines, terminal spine armed with stout spinules and 3 terminal setae, outer edge of segment armed with 3 patches of stout spinules; endopod first segment with short inner seta, second segment with 5 inner to terminal setae and 2 short outer setae, outer margin of segment fringed with 2 patches of short hairs. Leg 3 (Figure 49) basipod with short dorsal seta, exopod and first segment of endopod as in leg 2; endopod second segment with short inner seta and 4 terminal setae (outermost 2 short). Leg 4 (Figure 50) basipod, exopod and first segment of endopod as in leg 3; endopod second segment with inner seta, third segment with 3 terminal setae (middle one longest). Leg 5 (Figure 51) basal segment with one dorsal seta, last segment without surface ornamentation, truncate distally and bearing 4 setae (one outer and 3 terminal). Leg 6 represented by 3 short, stout setae on lateral margin of genital segment (see Figure 41).

Egg sacs flattened and containing approximately 250 eggs.

MALE.—Body form as in Figure 52. Total length 0.97 mm, greatest width 0.38 mm measured at widest part of cephalon. Cephalon slightly wider than long with slightly protruding, rounded rostrum (not produced as in female). Genital segment slightly longer than wide (218 μ x 207 μ), outer distal corners produced. Abdomen (Figure 53) 2-segmented: first segment (57 μ long) with transverse patch of fine spinules; second segment (59 μ long) with one transverse and 2 nearly longitudinal rows of scalelike spinules (spinules in transverse row elongate). Caudal rami (Figure 53) longer than

wide (41 μ x 30 μ), each ramus with patch of scalelike spinules and 6 setae (longest seta 590 μ , more than half total body length).

First antenna (Figure 54) 5-segmented, with most setae finely plumose and aesthetes on fourth and fifth segments; segments measure 59 μ , 100 μ , 35 μ , 23 μ , and 38 μ long respectively. Second antenna (Figure 55) with spinelike process on second segment, third segment with several rows of spinules, 4 hooked spines and 2 setae, and long pectinate spine. Mouthparts as in Figure 56. Labrum with scalelike spinules similar to female. Maxilliped (Figure 57) base with one seta; second segment stout with outer row of long hairs, proximal triangular process, 2-3 rows of strong, teethlike spines and 2 setae on inner edge; third segment in form of 2-segmented claw, second segment with one seta and finely toothed at tip.

Legs 1-4 biramous, each ramus 3-segmented except leg 4 endopod. Leg 1 (Figure 59) coxopod with inner plumose seta and row of long spinules on outer distal corner; basipod with 2 patches of broad scalelike spinules, blunt spine on inner edge, and dorsal seta near outer distal corner; exopod first segment with fine spinules on outer edge, outer pectinate spine and 2-3 heavy spinules on outer distal corner, second segment with inner plumose seta, outer spine and slender spinules on outer edge, third segment with 3 outer spines and 4 terminal to inner setae, outer edge with slender spinules; endopod first and second segments each with transverse row of elongate scalelike spinules and inner seta, third segment with 5 setae. Leg 2 (Figure 59) coxopod with short spinules on outer distal corner; basipod with row of slender spinules on inner distal edge and row of spatulate, scalelike spinules on outer distal edge between insertion of endopod and exopod; exopod first segment with outer row of scalelike spinules, one outer spine and few stout spinules on outer distal corner, second segment with inner plumose seta, outer spine and small spinules on outer edge, third segment with 3 outer spines (last 2 with teethlike outer spinules), 5 terminal to inner setae, outer edge of segment with 2 patches of spinules; endopod first segment with row of slender spinules and inner seta, second segment with row of spinules and 2 inner setae, third segment with 2 short terminal spines and 2 inner setae. Leg 3 (Figure 60) basipod with uneven row of blunt spinules on inner distal corner, exopod and endopod similar to leg 2 except outer edge of exopod

second segment without ornamentation. Leg 4 (Figure 61) basipod as in leg 3; exopod similar to leg 3 except last segment with 4 plumose setae; endopod 2-segmented, first segment with row of scalelike spinules and inner plumose seta, second segment elongate with 3 terminal setae (middle longest) and distal row of slender spinules. Leg 5 (Figure 62) basal segment with long, finely plumose dorsal seta, last segment with row of fine spinules on inner distal edge, inner distal bipectinate spine and outer distal plumose seta.

ETYMOLOGY.—The specific name *emarginatus* is Latin for “notched at the apex,” referring to the shape of the rostrum in the female.

REMARKS.—The female of this species can be separated from that of *P. sardinellae* (Bennet) by the following: the abdomen of *P. emarginatus* is 2-segmented (3-segmented in *P. sardinellae*); the last segment of the endopod of leg 3 of *P. emarginatus* has 3 inner to terminal setae (*P. sardinellae* with 5). In the male, the exopods of legs 1–4 are 3-segmented in *P. emarginatus* (2-segmented in *P. sardinellae*). The female of this species can be separated from *P. plautus* by the nature of the fifth leg.

Orbitacolax nudus, new species

FIGURES 63–73

MATERIAL EXAMINED.—One collection containing 9 females (holotype USNM 143625, paratypes USNM 143626) from the eyes of 7 *Herklotsieuthys punctatus* (USNM 190059) from Toumindao Island, Philippines (*Albatross* collection).

FEMALE.—Body form as in Figure 63. Total length 1.77 mm, greatest width 0.88 mm (measured at widest part of cephalon). Cephalon wider than long. Rostrum slightly produced, with 2 prominent dorsal hooks and 2 smaller ventral ones (Figure 66). Genital segment (Figure 64) wider than long ($177\mu \times 277\mu$). Abdomen 3-segmented: first segment with ventral transverse band of small, scalelike spinules; last 2 segments indistinctly separated, each with 2 patches of scalelike spinules; length of segments 94μ , 52μ , and 75μ respectively. Caudal rami (Figure 65) longer than wide ($56\mu \times 35\mu$), each ramus with large ventral patch of scalelike spinules and 6 setae (longest 195μ).

First antenna (Figure 66) 5-segmented; basal part 289μ long, remaining segments 35μ , 18μ ,

24μ respectively, aesthetes present on fourth and fifth segments. Second antenna (Figure 67) with blunt spine on second segment, several rows of closely placed spinules, long pectinate spine, 4 hooked spines and 2 setae on third segment. Labrum with 2 patches of scalelike spinules as in Figure 68. Mandible, first maxilla, second maxilla, and paragnath as in Figure 68. Labium represented by 2 patches of spines posterior to mouth. Maxilliped (Figure 69) hook sickle-shaped, without accessory process.

Legs 1–4 biramous, rami 3-segmented, segmentation in leg 1 indistinct. Leg 1 (Figure 70) coxopod with broad, inner seta and outer dorsal seta; basipod with 2 patches of scalelike spinules; exopod first segment with outer spine, second segment (incompletely separated from third) with outer spine, third segment with outer spine and 7 setae; endopod first segment with transverse row of scalelike spinules and inner seta, second segment (incompletely separated from third) with outer band of scalelike spinules and inner seta, third segment with 5 terminal plumose setae. Leg 2 (Figure 71) basipod with 2 ventral patches of scalelike spinules and dorsal seta; exopod first segment with patch of scalelike spinules around outer edge, spine on outer distal corner and patch of spinules on distal margin, second segment with outer spine and large patch of spinules on outer margin, third segment with 2 outer spines, one terminal spine armed with barbed spinules, 2 terminal setae, and 2 patches of spinules on outer and distal margins; endopod first segment with large patch of scalelike spinules on outer edge and one short inner seta, second segment with patch of scalelike spinules on outer to distal margin and 2 inner setae, third segment with patch of scalelike spinules on outer to distal margin and 3 terminal setae (middle longest). Leg 3 similar to leg 2 except endopod second and third segments with one less seta each. Leg 4 (Figure 72) similar to leg 3 except endopod third segment with no surface ornamentation. Leg 5 (Figure 73) basal segment with one dorsal seta, last segment with fine hairs as in figure, one outer seta beyond midmargin of segment and 3 terminal setae (middle longest). Leg 6 represented by 3 setae on dorsolateral border of genital segment.

MALE.—Unknown.

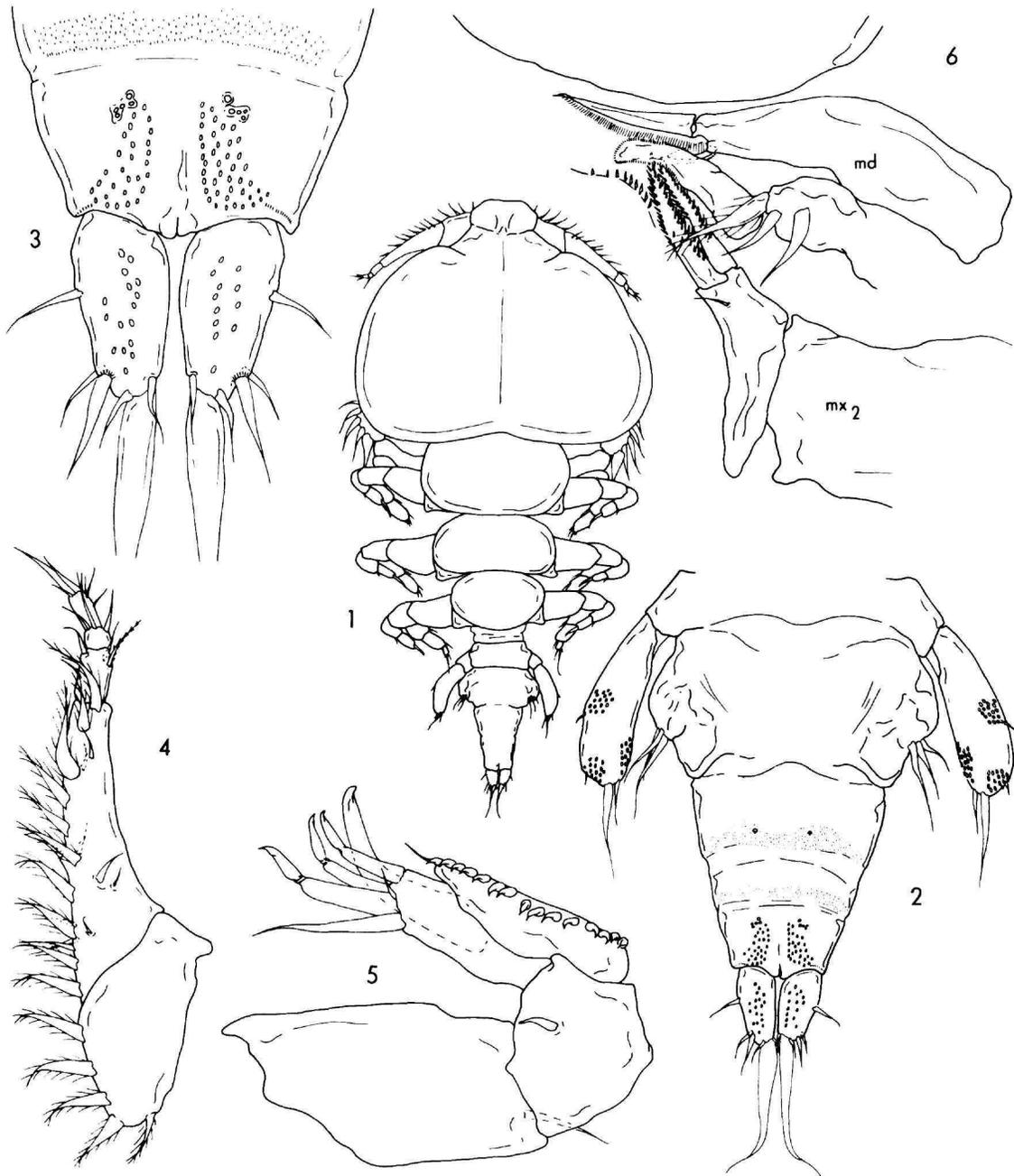
ETYMOLOGY.—The specific name *nudus* is from Latin meaning “naked” and refers to the lack of an accessory spine on the maxilliped hook.

REMARKS.—This new species can be separated from all 7 previously described *Orbitacolax* by its lack of an accessory spine on the maxilliped hook. It can be further separated from *O. analogus* Vervoort, *O. leptoscari* (Yamaguti), *O. oniscoides* Vervoort, and *O. uniuqis* Shen because the distal tips of leg 5 of the 4 preceding species bear only 2 well-developed setae (outermost either lacking or very reduced). The remaining 3 previously described species all appear more closely related to *O. nudus*.

Their legs are described and illustrated as densely spinulose as in *O. nudus*. This species can be separated from these 3 (*O. aculeatus* (Pillai), *O. dactylopterusi* (Carvalho), and *O. hapalogenyus* (Yamaguti and Yamasu) because leg 5 of *O. nudus* bears only a single patch of spinules whereas the preceding 3 bear 2. Other variations in the arrangement of spinule patches and numbers of setae on legs 1–4 serve to separate *O. nudus* from the previously described species of *Orbitacolax*.

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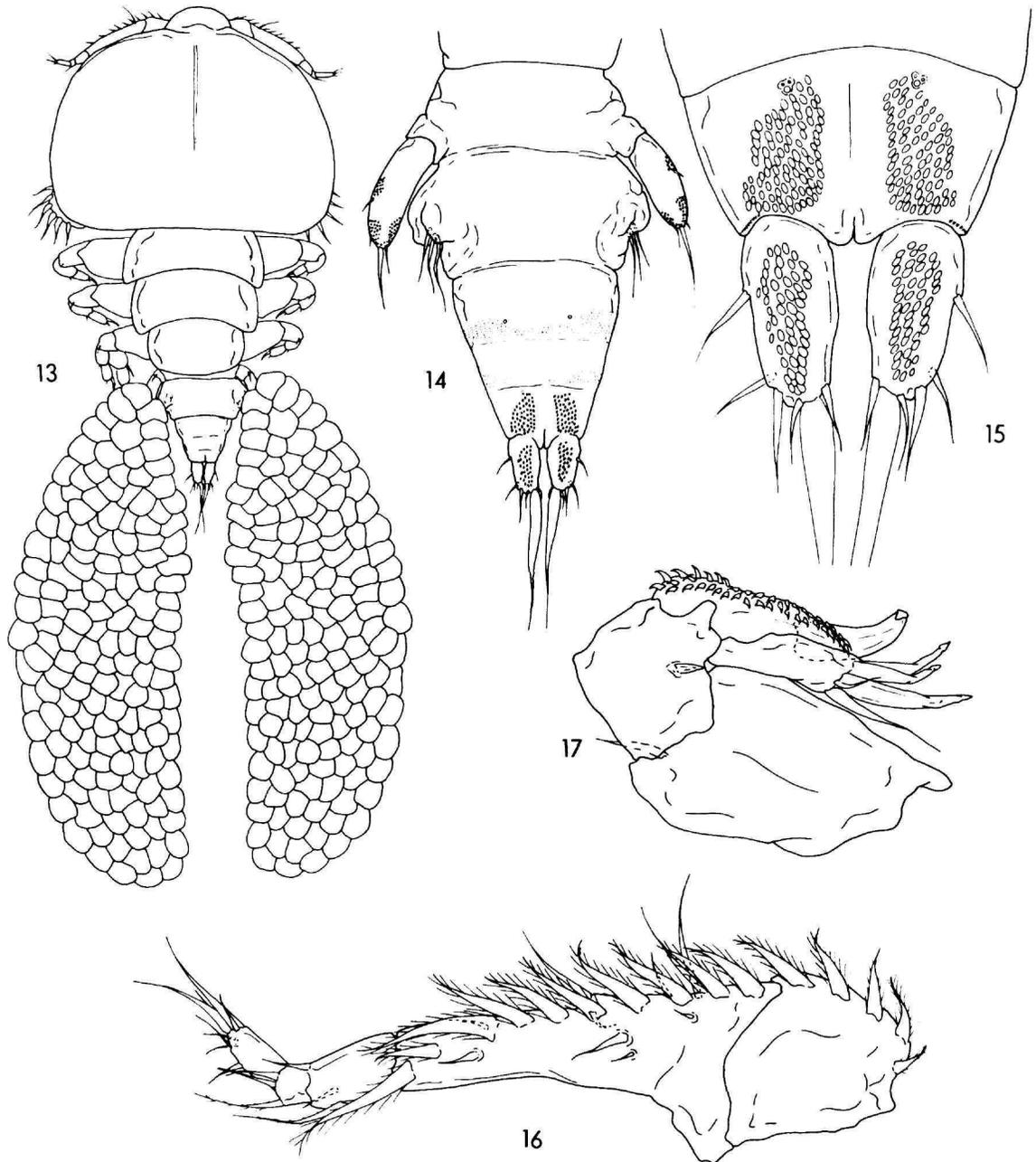
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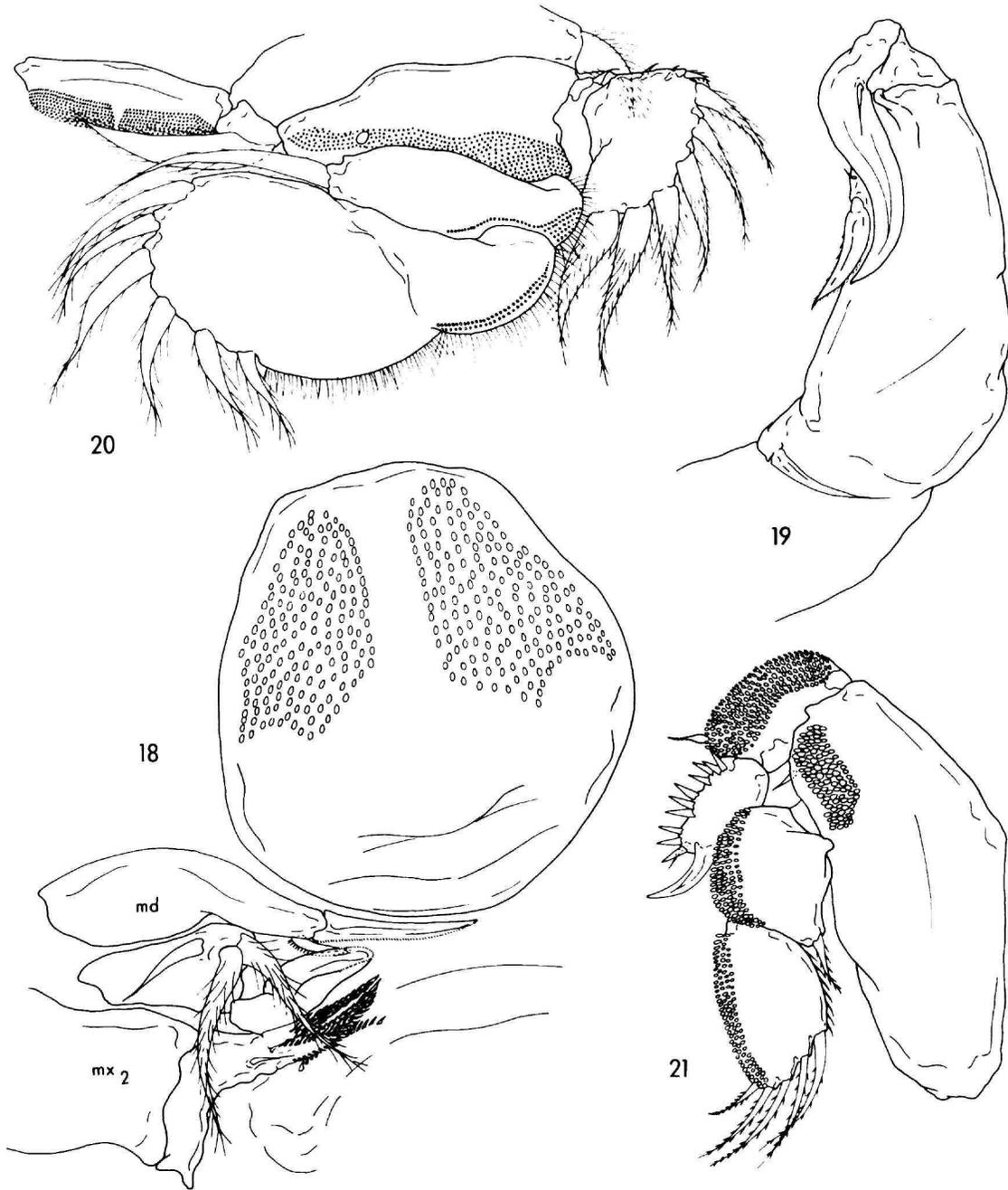
FIGURES 1-6.—*Pumiliopes capitulatus*, new species, female: 1, dorsal; 2, genital segment and abdomen, ventral; 3, last abdominal segment and caudal rami, ventral; 4, first antenna; 5, second antenna; 6, labrum, mandible (md), first maxilla, second maxilla (mx₂), labium.



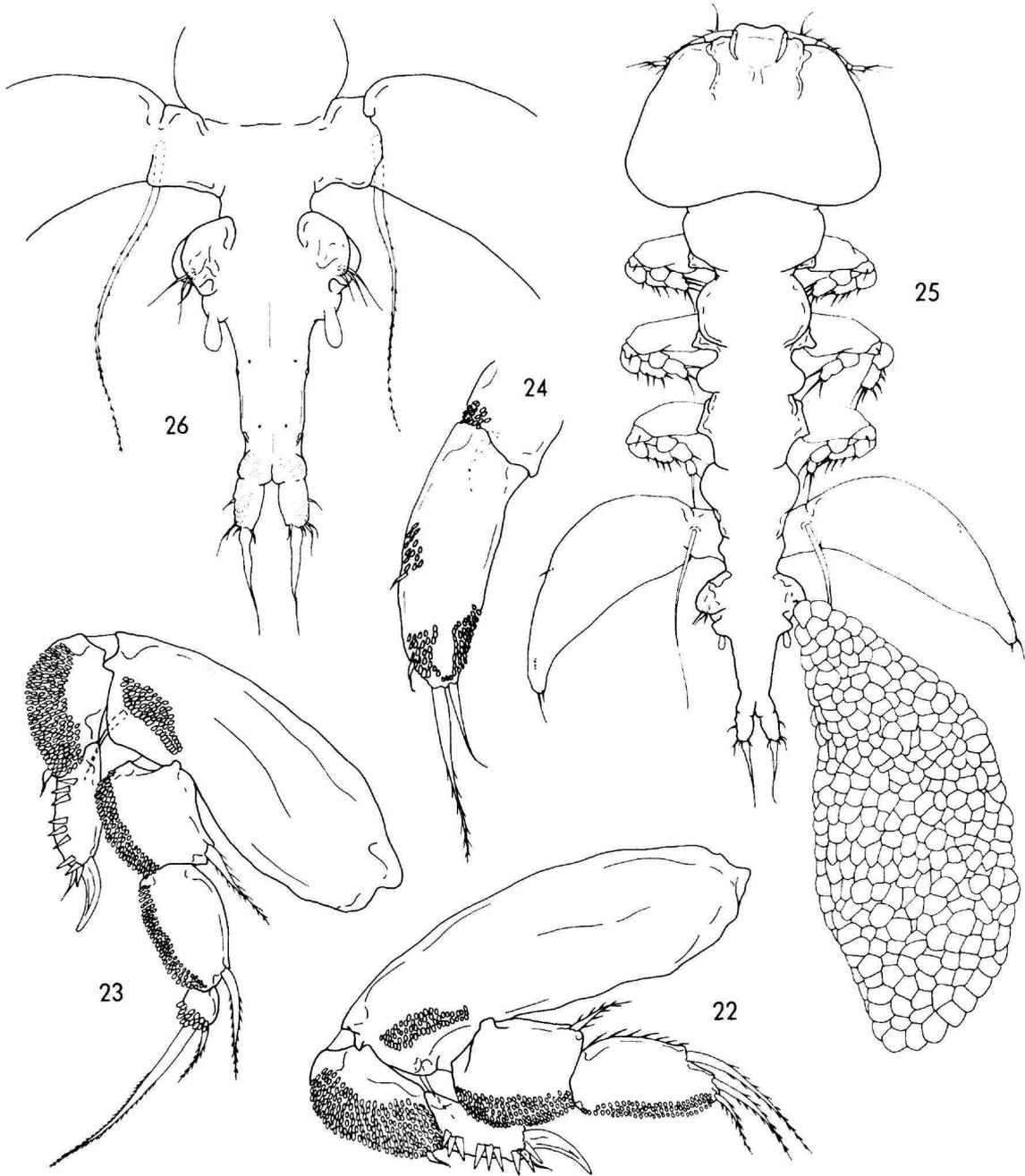
FIGURES 7-12.—*Pumiliopes capitulatus*, new species, female (continued): 7, maxilliped; 8, leg 1; 9, leg 2; 10, leg 3; 11, leg 4; 12, leg 5.



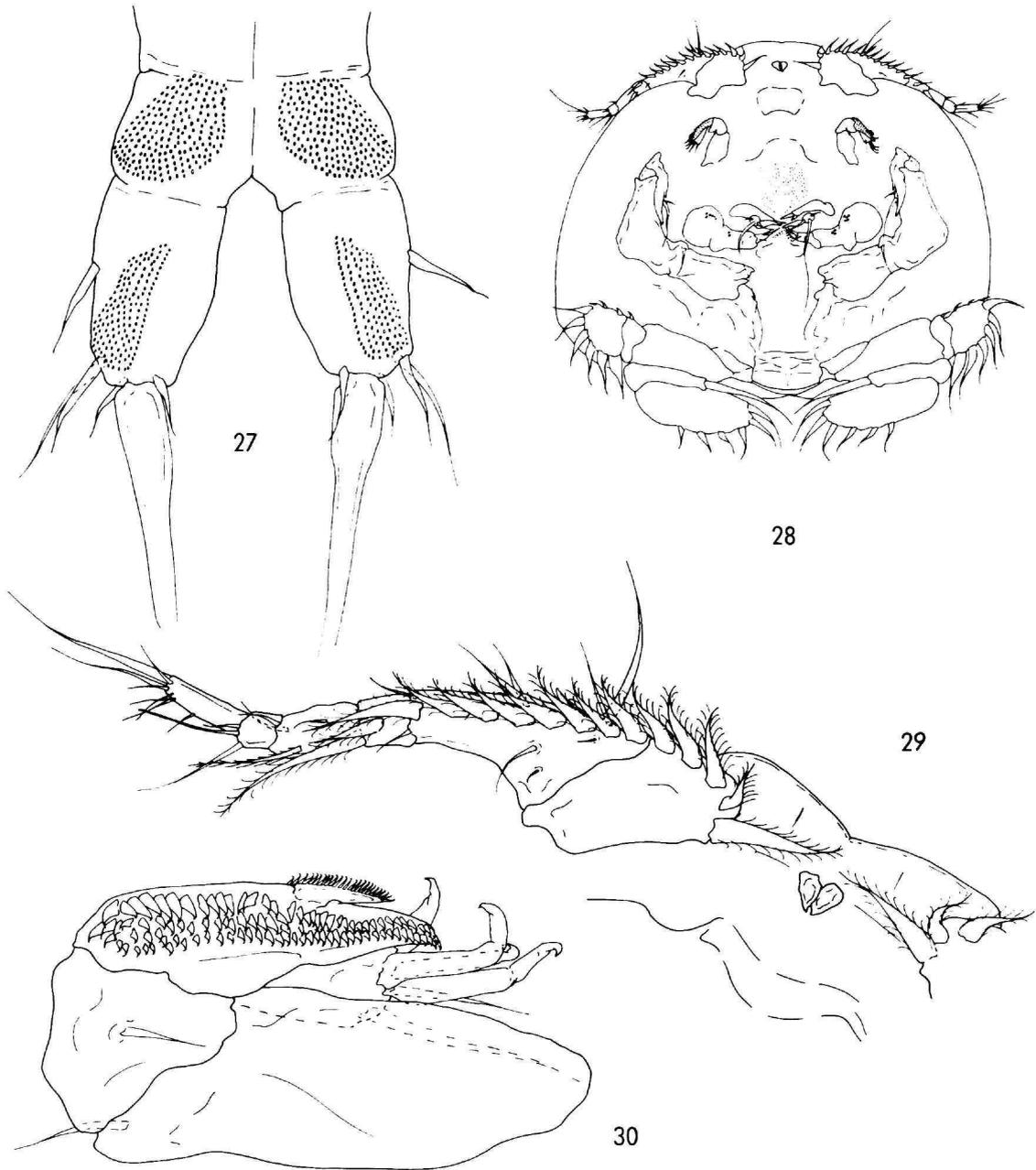
FIGURES 13-17.—*Pumiliopes squamosus*, new species, female: 13, dorsal; 14, genital segment and abdomen, ventral; 15, last abdominal segment and caudal rami, ventral; 16, first antenna; 17, second antenna.



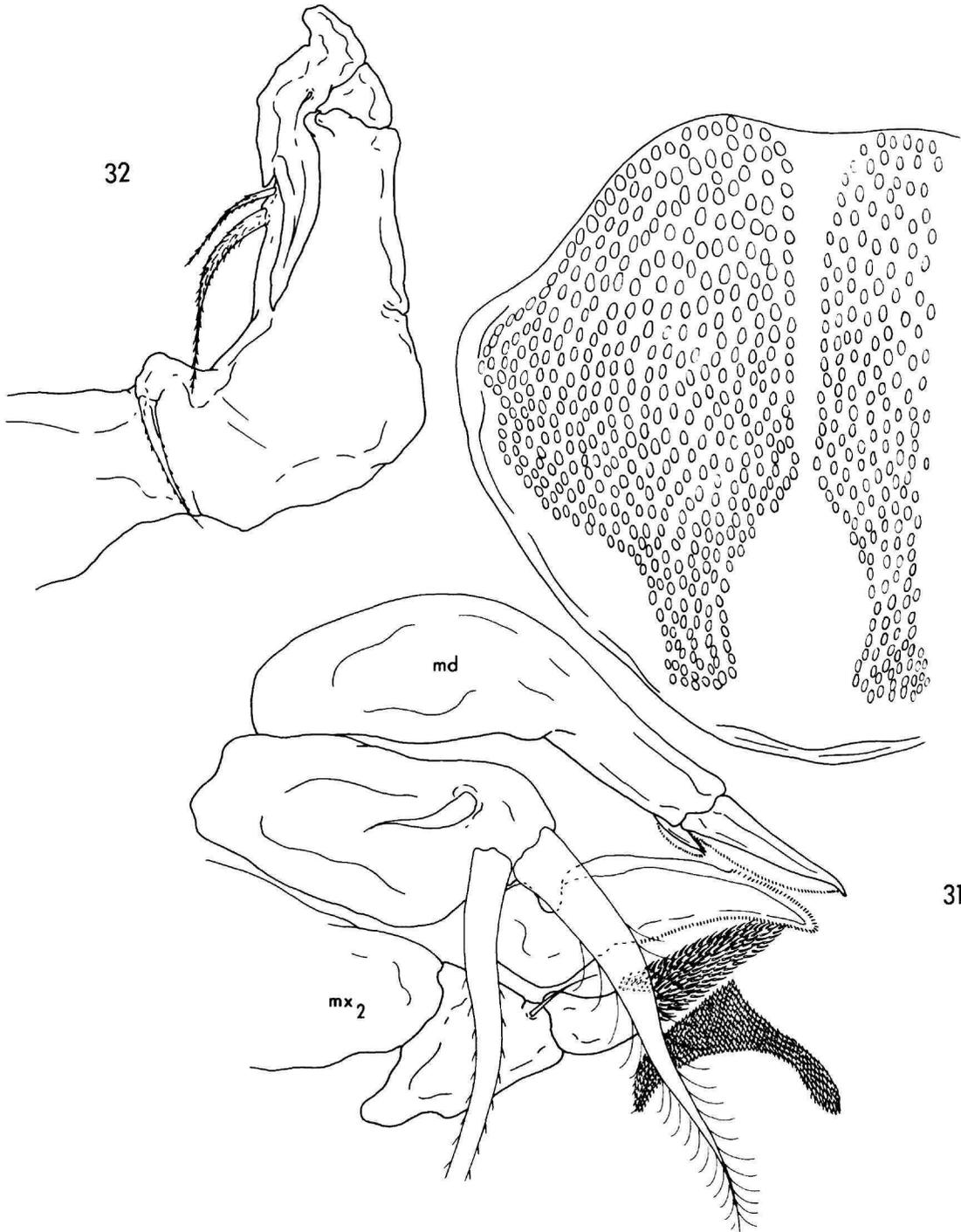
FIGURES 18-21.—*Pumiliopes squamous*, new species, female (continued): 18, labrum, mandible (md), first maxilla, paragnath, second maxilla (mx₂), labium; 19, maxilliped, 20, leg 1; 21, leg 2.



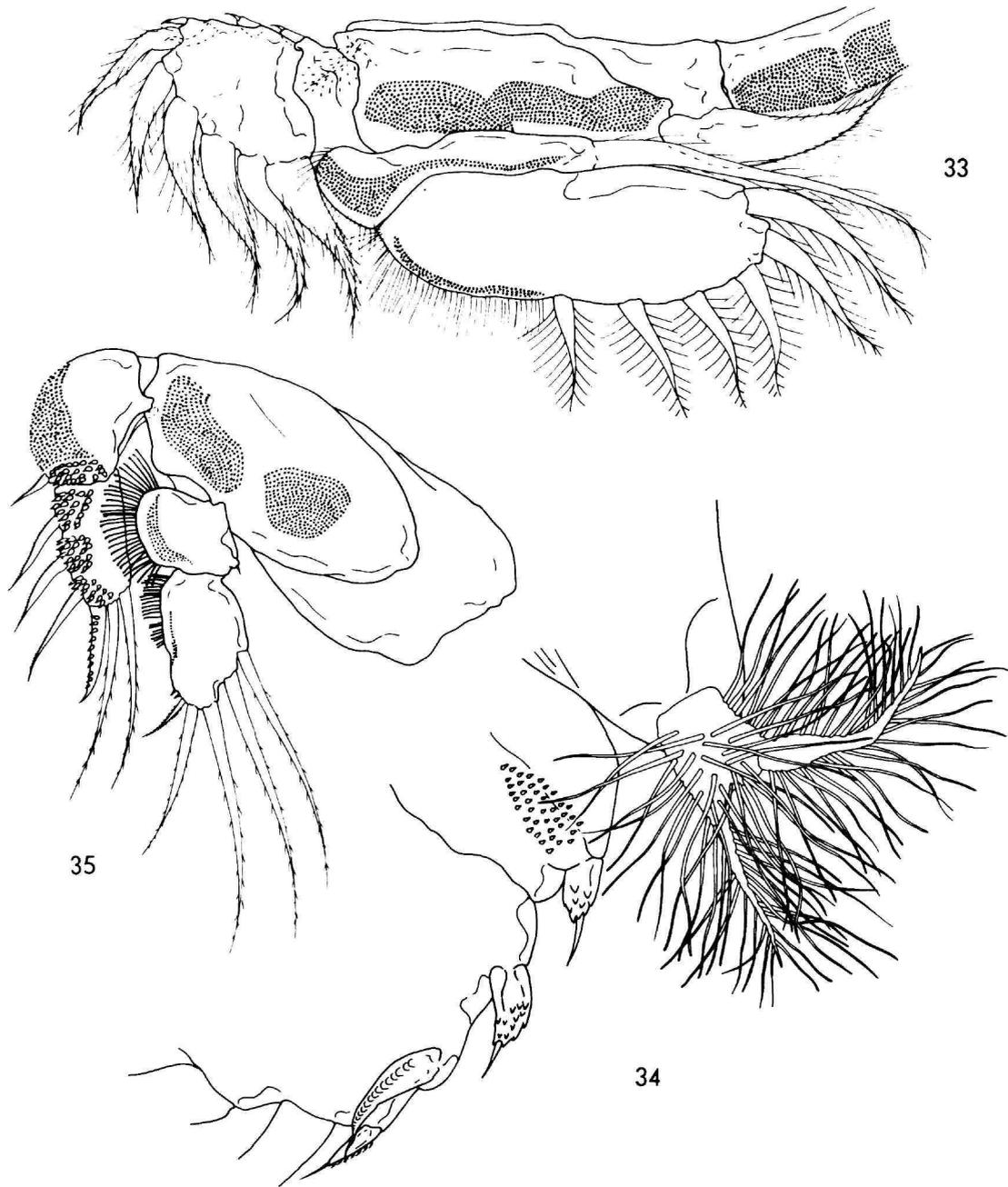
FIGURES 22-26.—*Pumiliopes squamosus*, new species, female (continued): 22, leg 3; 23, leg 4; 24, leg 5. *Pumiliopsis plautus*, new species, female: 25, dorsal; 26, genital segment and abdomen, ventral.



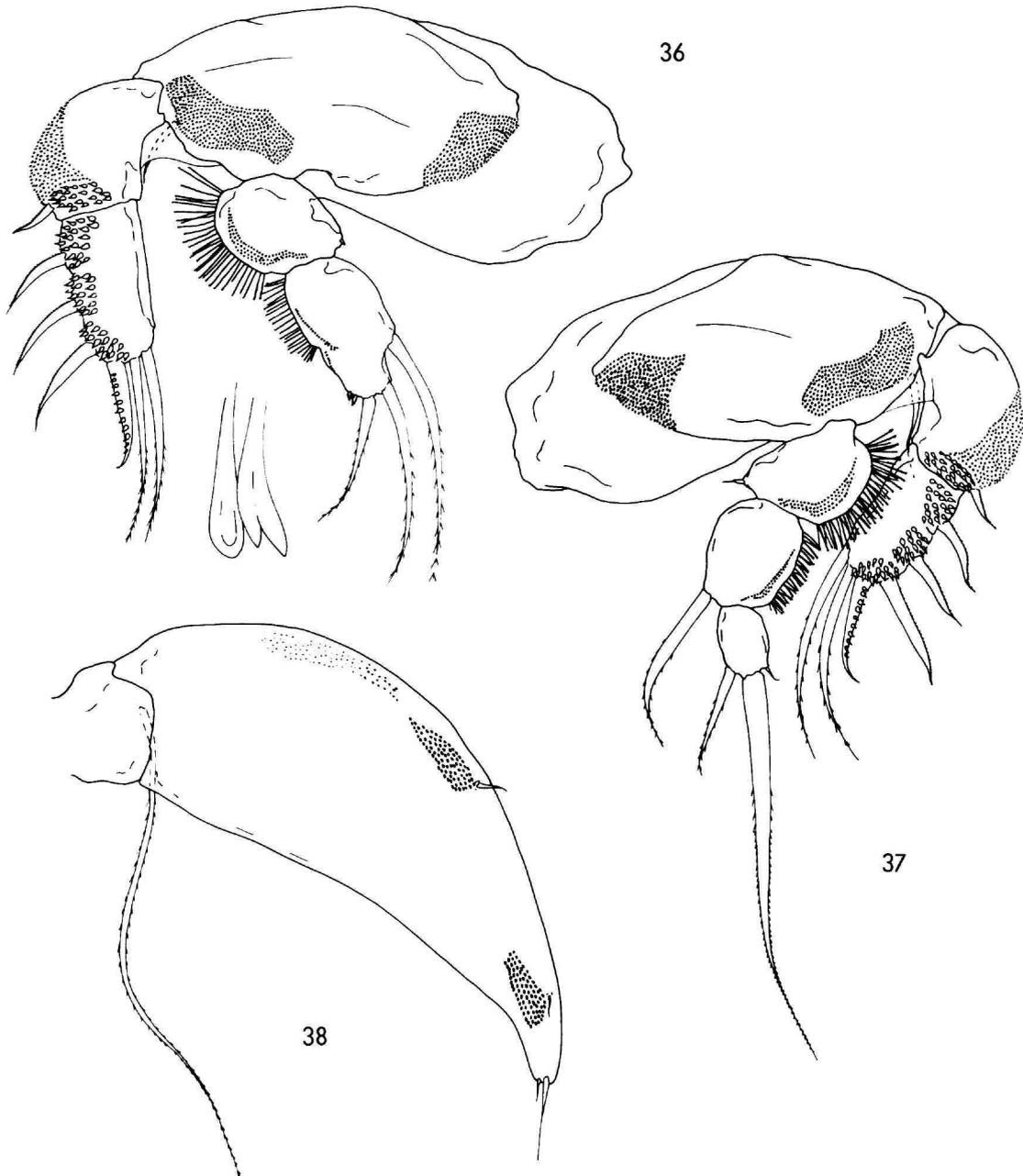
FIGURES 27-30.—*Pumiliopsis plautus*, new species, female (continued): 27, last abdominal segment and caudal rami, ventral; 28, oral area; 29, rostrum and first antenna, ventral; 30, second antenna.



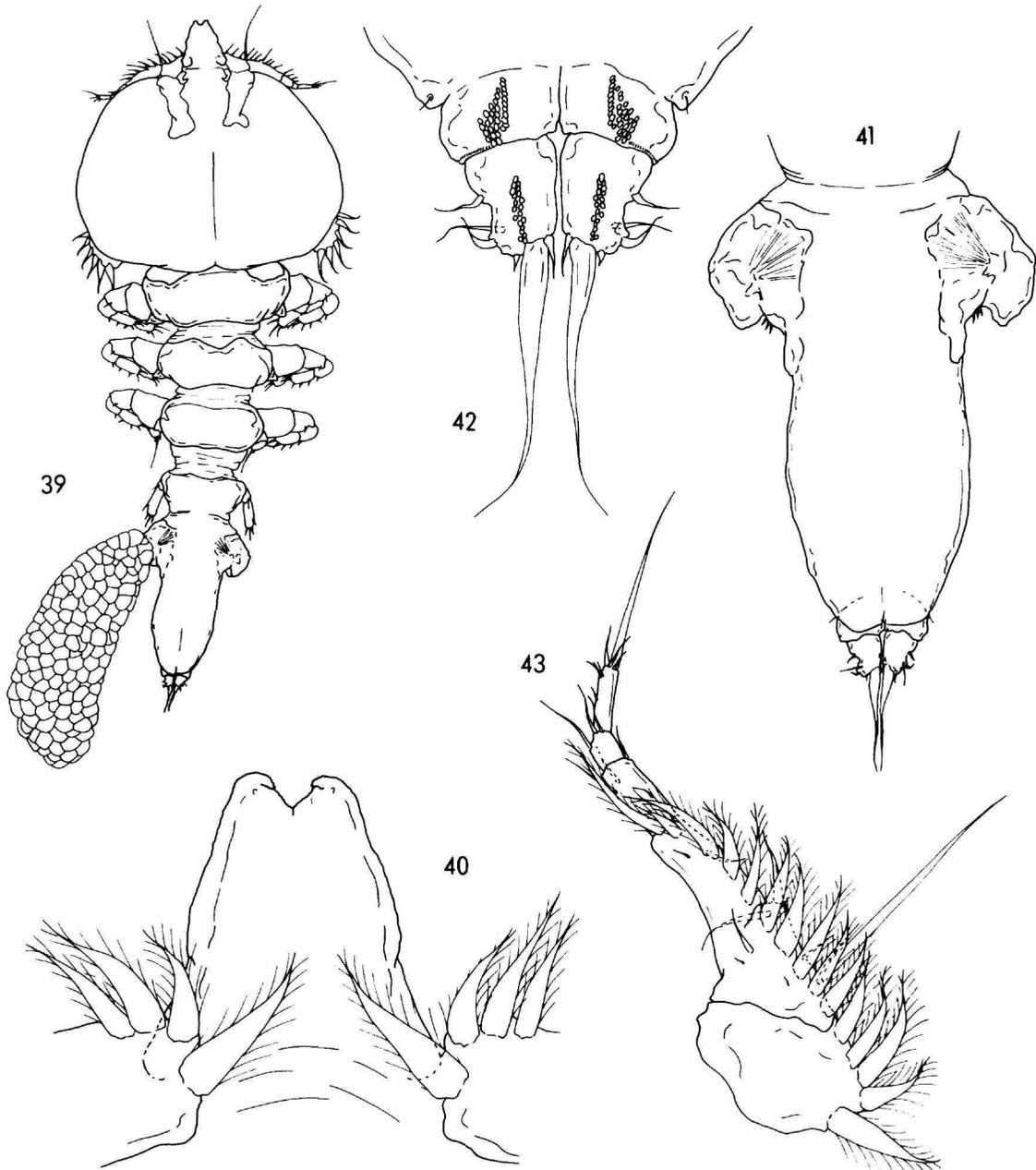
FIGURES 31-32.—*Pumiliopsis plautus*, new species, female (continued): 31, labrum, mandible (md), first maxilla, paragnath, second maxilla (mx₂), labium, 32, maxilliped.



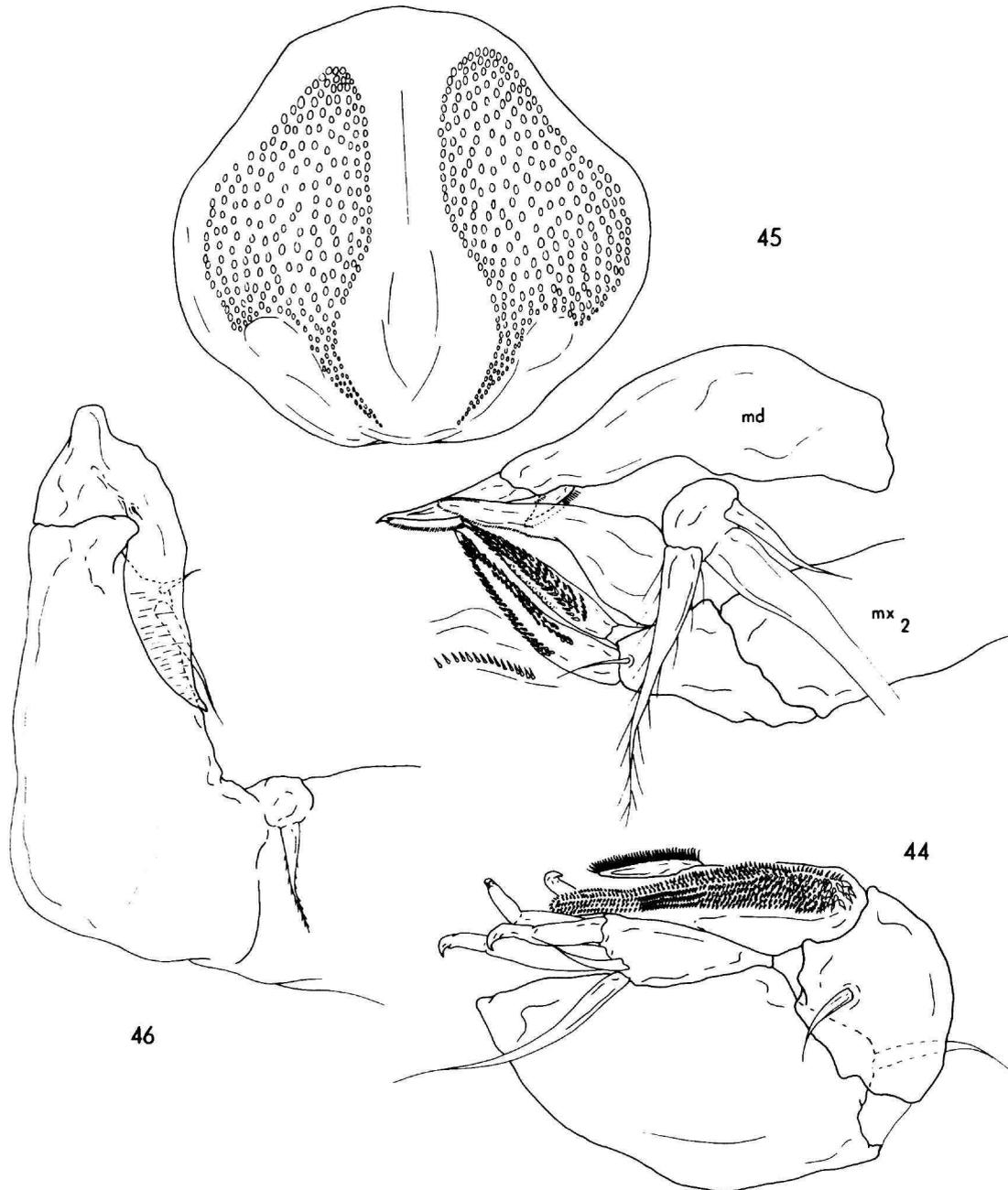
FIGURES 33-35. *Pumiliopsis plautus*, new species, female (continued): 33, leg 1; 34, leg 1 coxopod seta and outer edge exopod, dorsal; 35, leg 2.



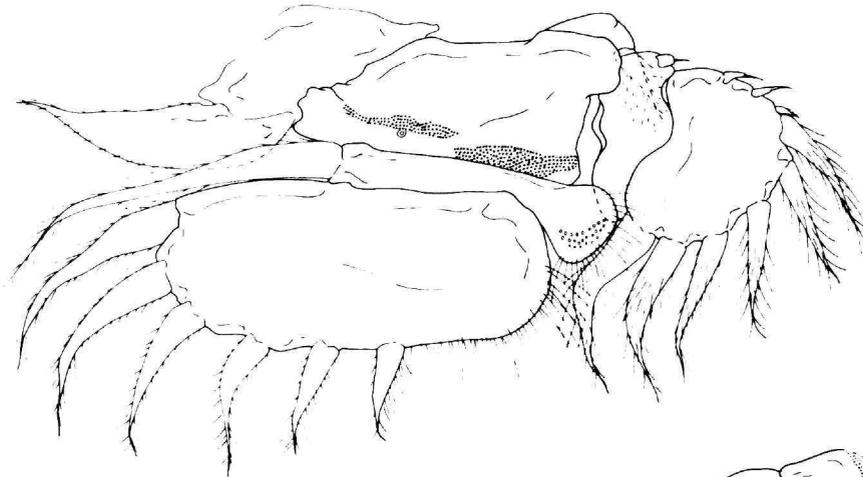
FIGURES 36-38.—*Pumiliopsis plautus*, new species, female (continued): 36, leg 3 with enlarged detail of endopod hairs; 37, leg 4; 38, leg 5.



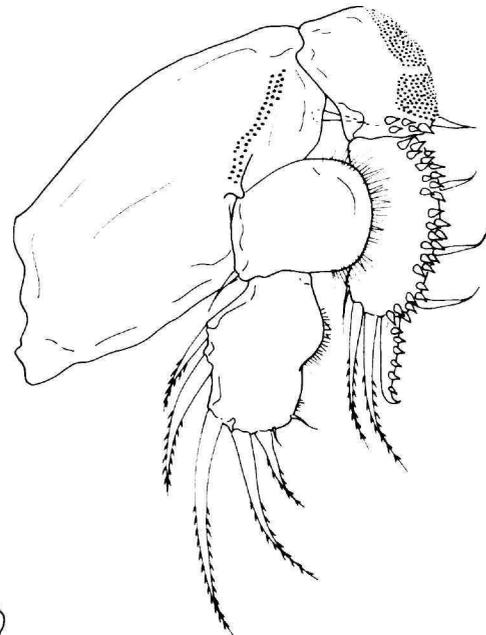
FIGURES 39-43.—*Pumiliopsis emarginatus*, new species, female: 39, dorsal; 40, rostrum, ventral; 41, genital segment and abdomen, ventral; 42, last abdominal segment and caudal rami, ventral; 43, first antenna.



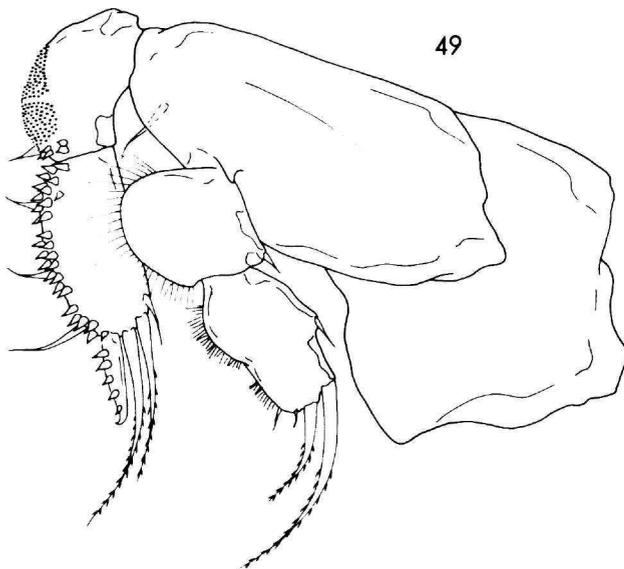
FIGURES 44-46.—*Pumiliopsis emarginatus*, new species, female (continued): 44, second antenna; 45, labrum, mandible (md) first maxilla, paragnath, second maxilla (mx.), labium; 46, maxilliped.



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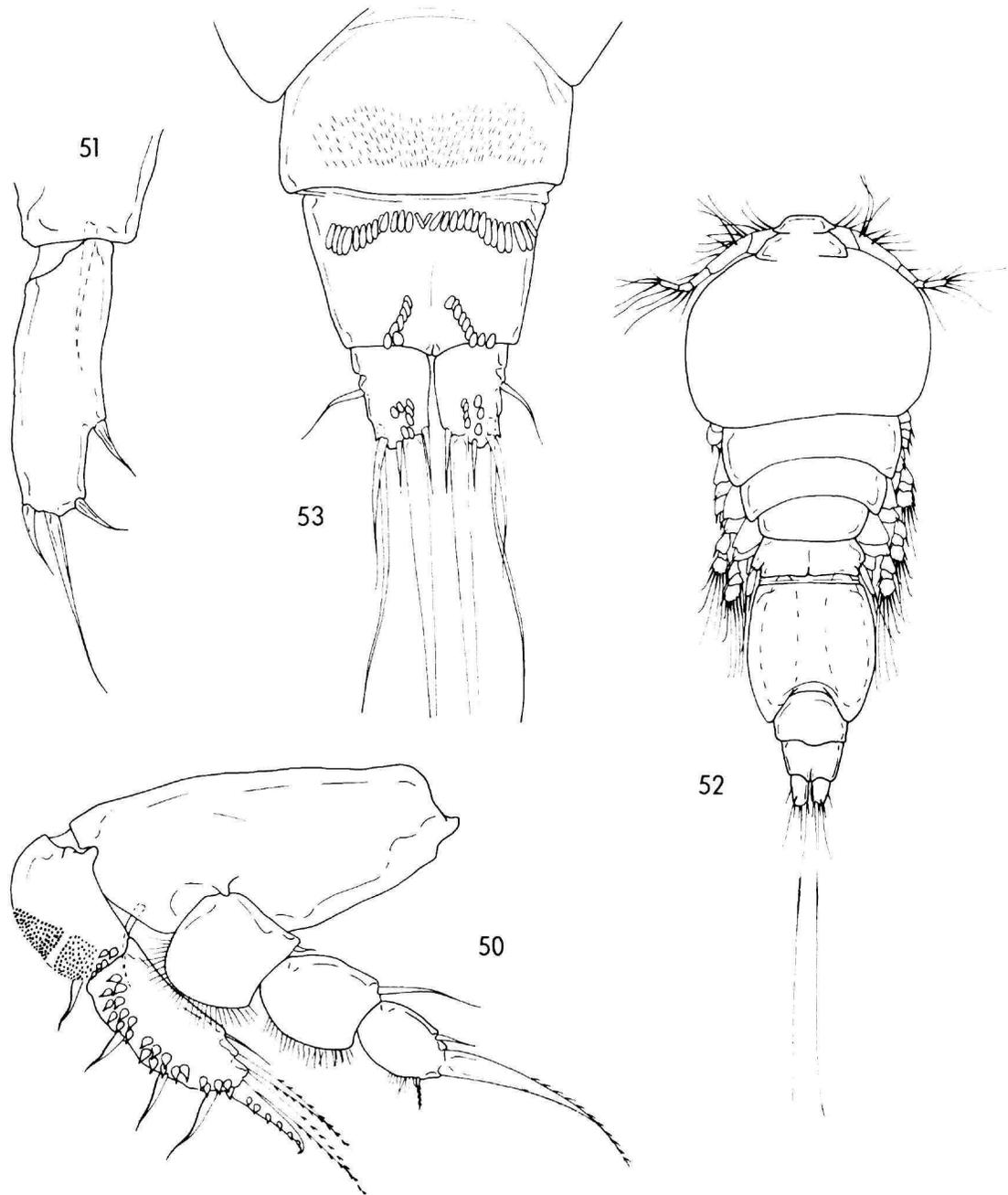


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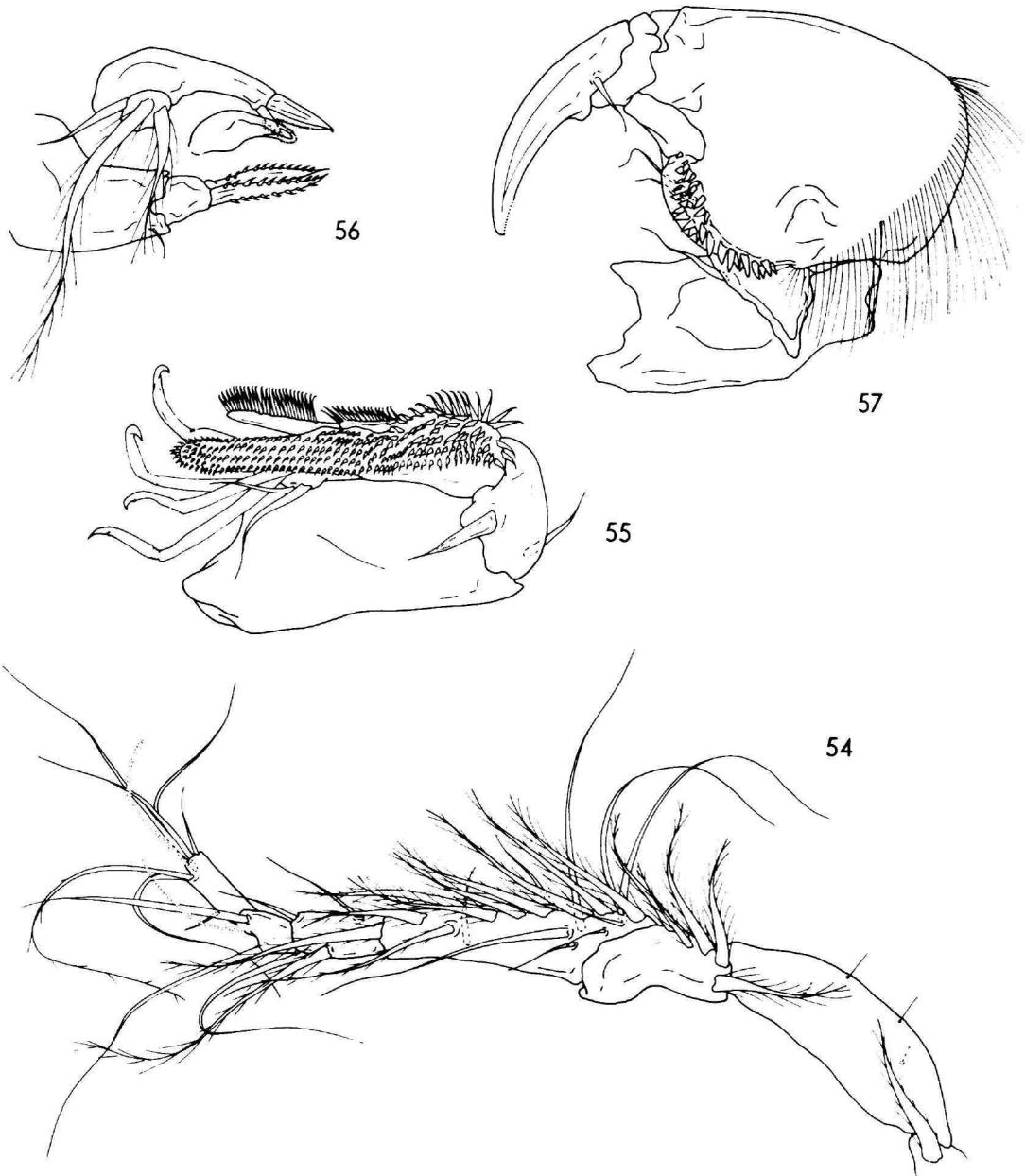


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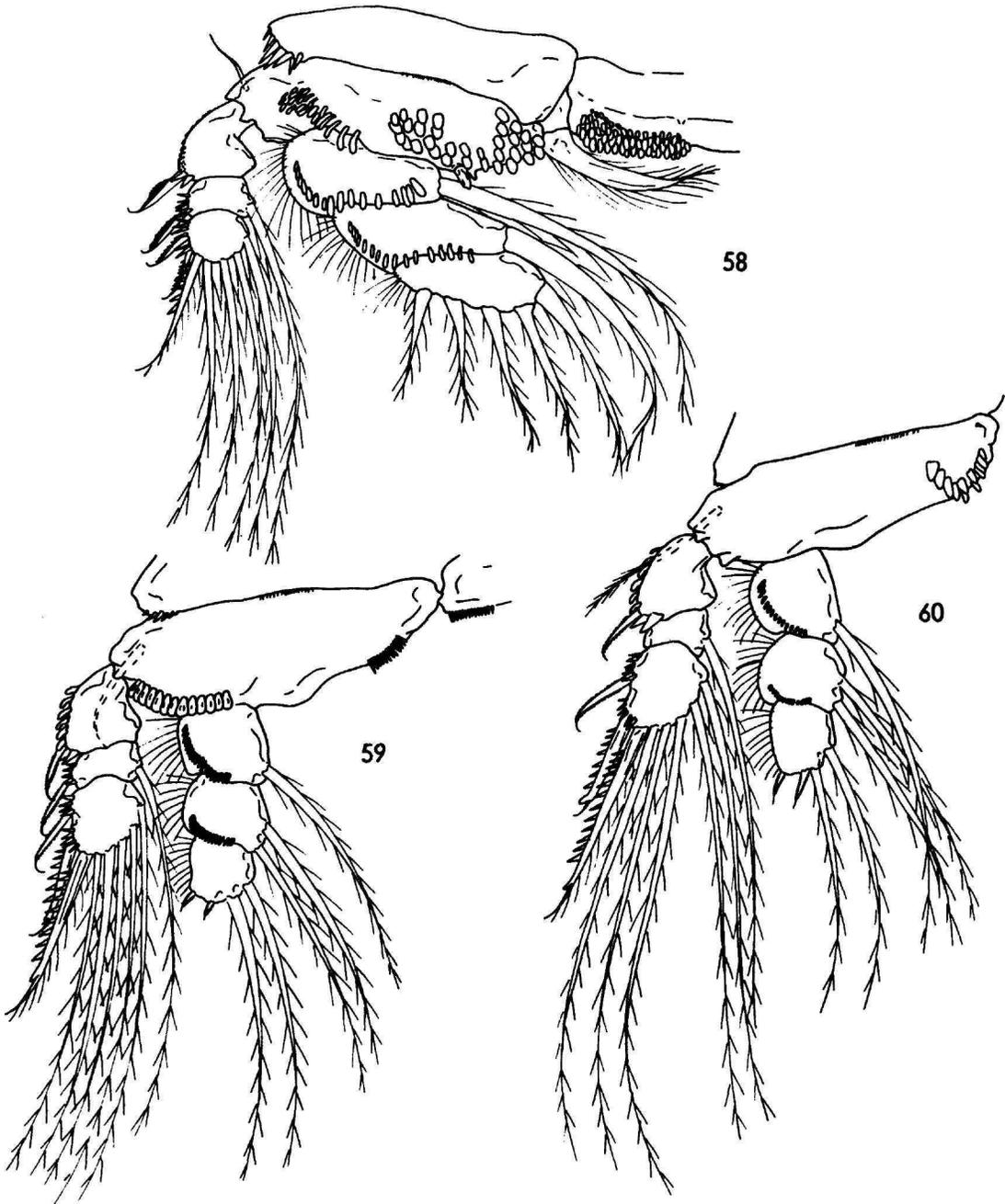
FIGURES 47-49.—*Pumiliopsis emarginatus*, new species, female (continued): 47, leg 1; 48, leg 2; 49, leg 3.



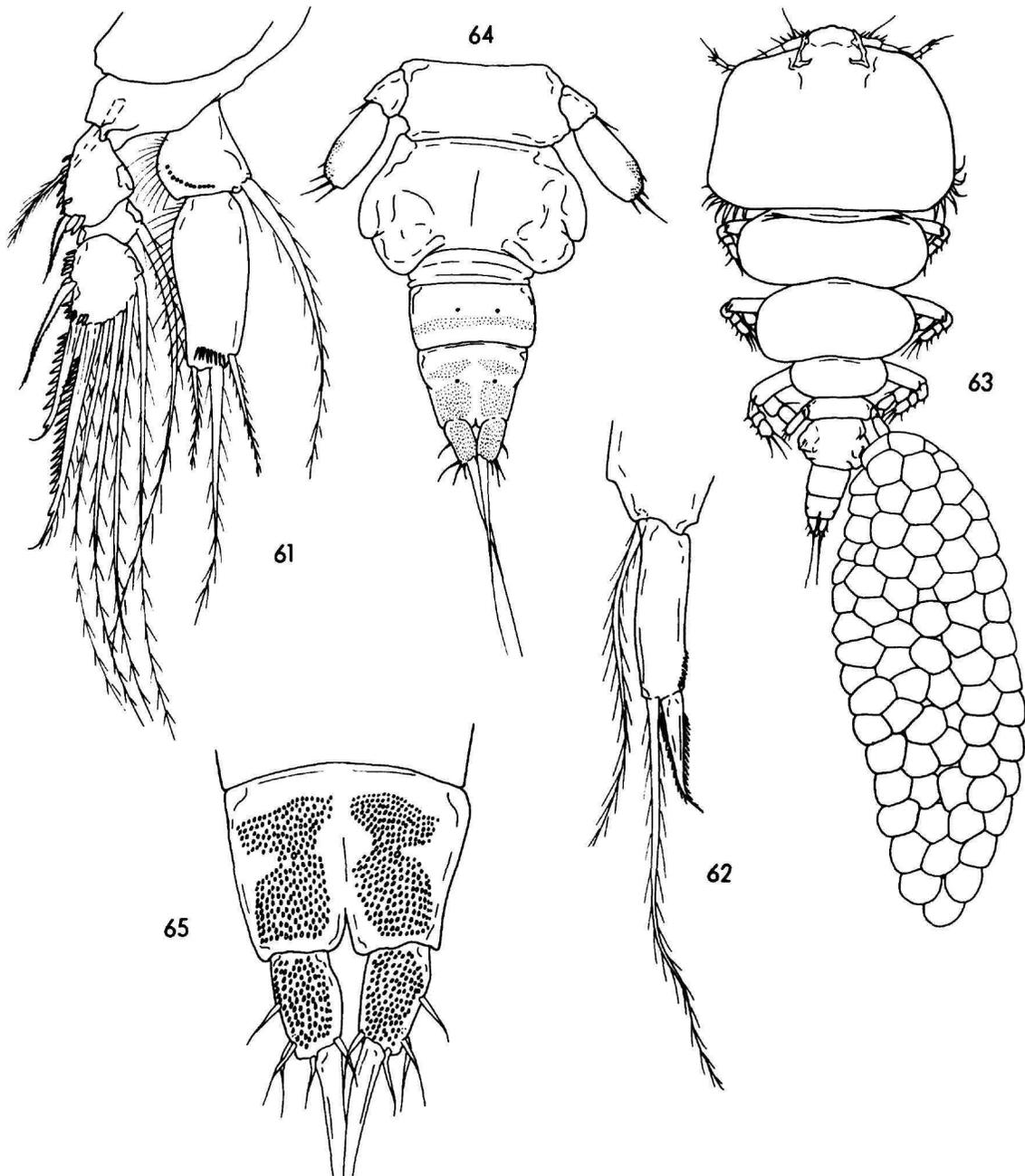
FIGURES 50-53.—*Pumiliopsis emarginatus*, new species, female (continued): 50, leg 4; 51, leg 5.
Male: 52, dorsal; 53, last abdominal segment and caudal rami, ventral.



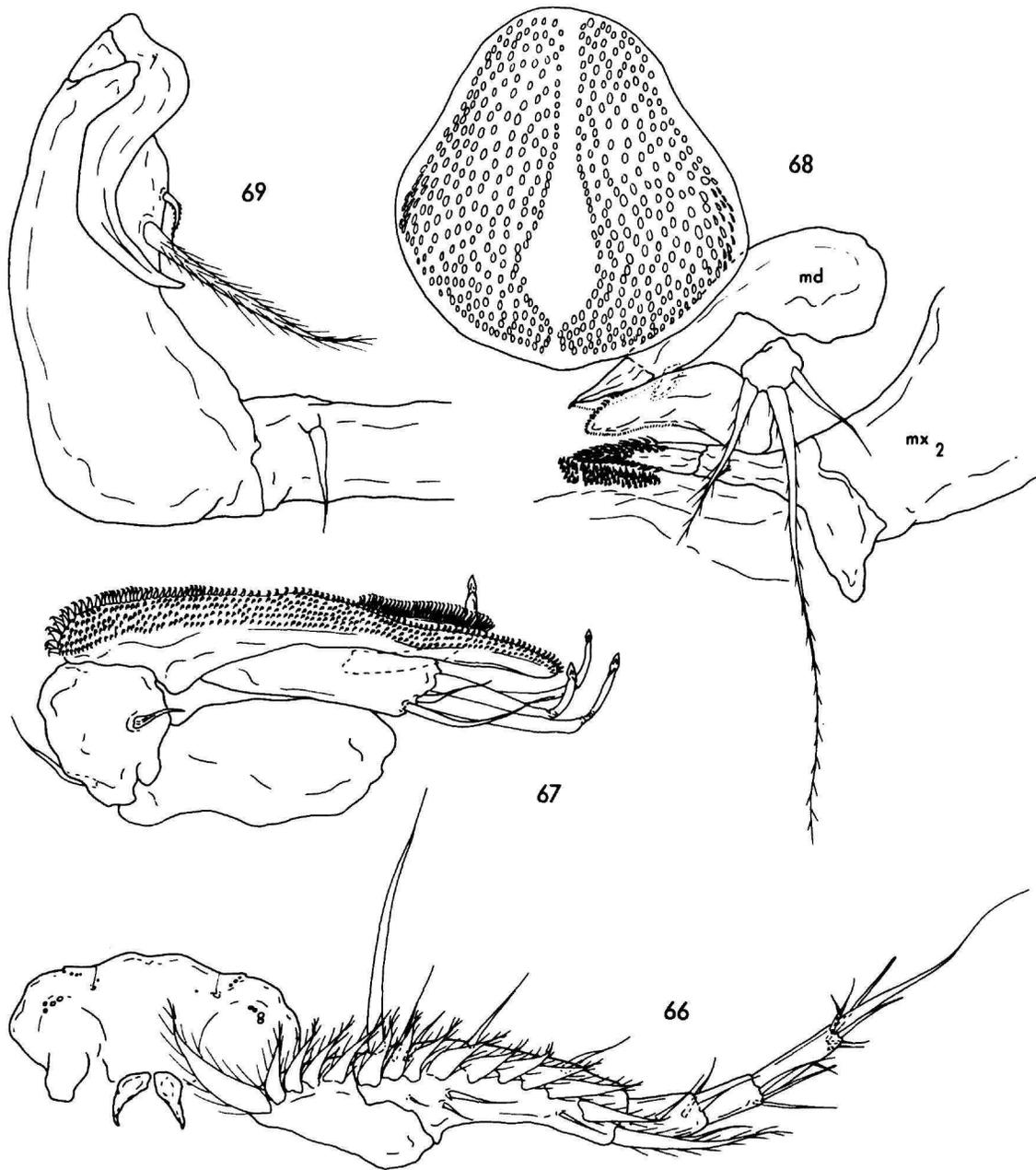
FIGURES 54-57.—*Pumiliopsis emarginatus*, new species, male (continued): 54, rostrum and first antenna, ventral; 55, second antenna; 56, mandible, first maxilla, paragnath, second maxilla; 57, maxilliped.



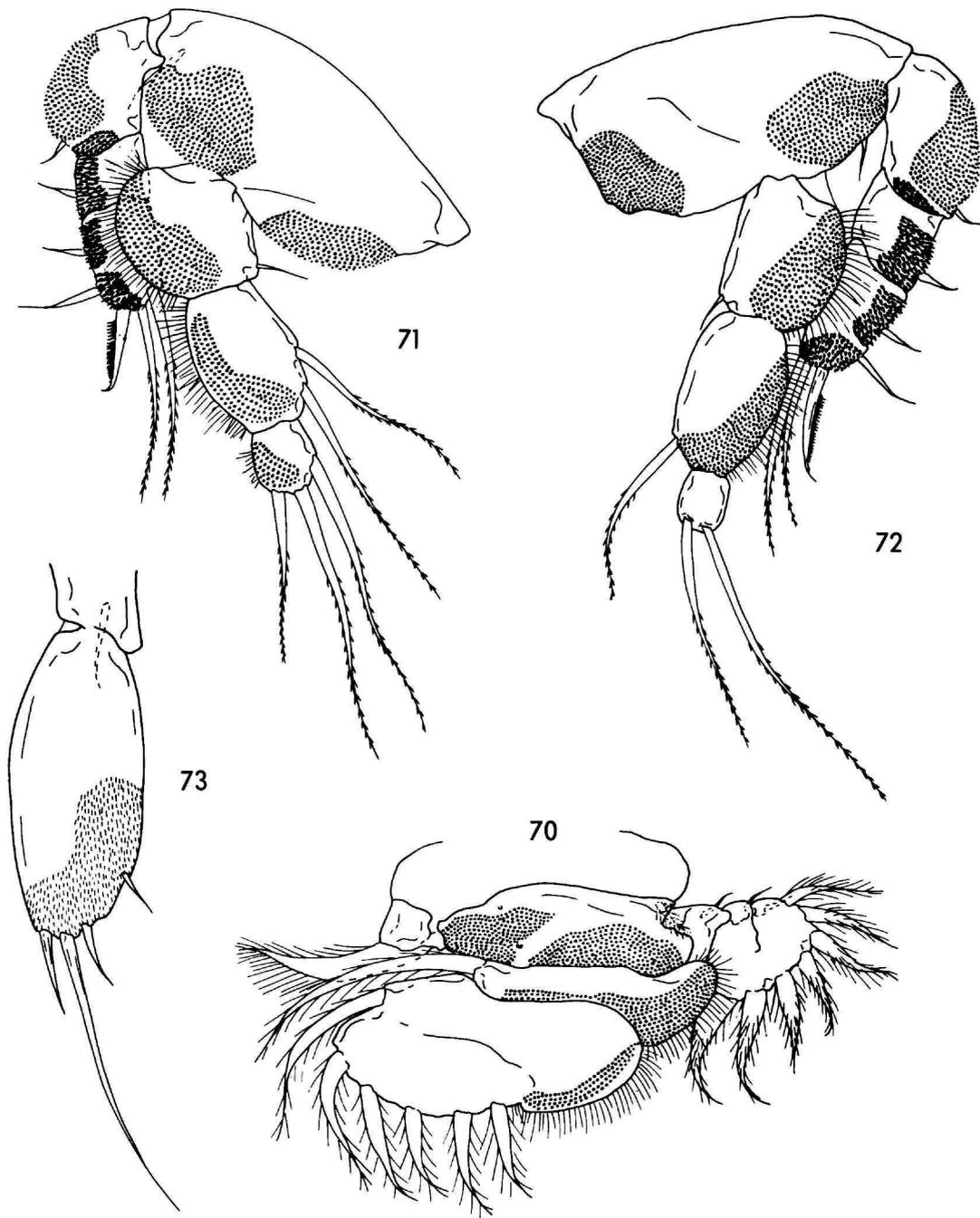
FIGURES 58-60.—*Pumilioopsis emarginatus*, new species, male (continued): 58, leg 1; 59, leg 2; 60, leg 3.



FIGURES 61-65.—*Pumiliopsis emarginatus*, new species, male (continued): 61, leg 4; 62, leg 5. *Orbitacolax nudus*, new species, female: 63, dorsal; 64, genital segment and abdomen, ventral; 65, last abdominal segment and caudal rami, ventral.



FIGURES 66-69.—*Orbitacolax nudus*, new species, female (continued): 66, rostrum and first antenna, ventral; 67, second antenna; 68, labrum, mandible (md), first maxilla, paragnath, second maxilla (mx₂), labium; 69, maxilliped.



FIGURES 70-73.—*Orbitacolax nudus*, new species, female (continued): 70, leg 1; 71, leg 2; 72, leg 4; 73, leg 5.

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