

COPEPODA FROM DEEP-SEA HYDROTHERMAL VENTS

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ABSTRACT

Copepods belonging to the orders Poecilostomatoida and Siphonostomatoida are described from deep-sea hydrothermal vents in the eastern Pacific (Galapagos Rift, East Pacific Rise, Juan de Fuca spreading zone, and Guaymas Basin) and on the Mid-Atlantic Ridge at 26°08.3'N, 44°49.6'W and 23°22.160'N, 44°57.072'W. Based on a study of 44 collections of copepods from deep-sea vents, 27 new copepods are described: POECILOSTOMATOIDA: Clausidiidae: *Hyphalion captans* new genus, new species; Erebonasteridae new family: *Erebonaster protentipes* new genus, new species; family uncertain: *Laitmatobius crinitus* new genus, new species. SIPHONOSTOMATOIDA: Dirivultidae Humes and Dojiri, 1980: *Aphotopontius* new genus, with the following new species: *A. forcipatus*, *A. arcuatus*, *A. baculigerus*, *A. flexispina*, *A. limatulus*, and *A. mammillatus*; *Stygiopontius* new genus, with the following new species: *S. quadrispinosus*, *S. cinctiger*, *S. flexus*, *S. hispidulus*, *S. mucroniferus*, *S. pectinatus*, *S. sentifer*, and *S. verruculatus*; *Exrima* new genus, with two new species: *E. singula* and *E. dolichopus*; *Rhogobius contractus* new genus, new species; *Scotoecetes introrsus* new genus, new species; *Ceuthoecetes acanthothrix* new species; *Ceuthoecetes cristatus* new species; *Ceuthoecetes introversus* new species; *Nilva torifera* new genus, new species; Ecbathyriiontidae new family: *Ecbathyriion prolixicauda* new genus, new species; family uncertain: *Fissuricola caritus* new genus, new species. In addition, new records of *Ceuthoecetes aliger* Humes and Dojiri, 1980, are included.

Although all these copepods are probably associated with invertebrate hosts, only three associations are known with some degree of certainty: *Erebonaster protentipes* with a *Nuculana*-like protobranch bivalve, *Stygiopontius sentifer* with the polychaete *Alvinella*, and *Stygiopontius pectinatus* with the shrimps *Rimicaris chacei* and *Rimicaris exoculata*. Species of *Aphotopontius*, *Stygiopontius*, *Exrima*, *Ceuthoecetes*, and *Nilva* occur in washings of vestimentiferans, the polychaete *Alvinella*, the gastropod *Neomphalus*, and the bivalves *Bathymodiolus* and *Calyptogena*, but whether there is a real association in these cases between copepod and host is uncertain. The prominent mandibular palp of *Erebonaster protentipes* is remarkable among the Poecilostomatoida. Only one copepod genus, *Stygiopontius*, has been found at vents both in the eastern Pacific and on the Mid-Atlantic Ridge.

The unexpected discovery in 1977 (Corliss and Ballard, 1977) of abundant vent fauna on the Galapagos Rift (Grassle, 1983) has led to subsequent studies that have provided much information on the characteristics of deep-sea hydrothermal vent areas. In these aphotic environments under high water pressure the water temperature in the vents ranges to 14.72°C, substantially above the 2.01°C ambient temperature of the area away from the vents (Hessler and Smithey, 1983). For dense populations of organisms in the immediate vicinity of the vents the base of the food chain is chemosynthetic production of organic carbon by bacterial oxidation (Jannasch, 1983) by means of chemoautotrophic bacteria. The amount of suspended food in the water at the vents has been estimated at 300-500 times greater than immediately outside vent areas and four times greater than in productive surface waters (Ballard and Grassle, 1979). The zoological composition of vent communities is relatively constant and the life span of a given vent is rather short (Desbruyères and Laubier, 1983). It is clear that the copepods in vent areas live under very different conditions than copepods in the upper water column and shallow seas.

Areas of sea floor spreading, where hydrothermal discharge takes place, include the Galapagos Rift, the East Pacific Rise, the Guaymas Basin in the Gulf of

California, and the Juan de Fuca spreading zone. Hydrothermal vents in these regions of the eastern Pacific, believed to persist for only several years to several decades (Grassle, 1985), support communities composed of remarkable assemblages of macroscopic invertebrates (Grassle, 1983; Newman, 1985), including many large vestimentiferan worms (Jones, 1985). On the Mid-Atlantic Ridge, with black smoker-type venting, in 3,620 and 3,700 m near 26°08'N, 44°49'W, several types of organisms, including fishes, anemones, vestimentiferans, shrimps and brachyurans have been observed (Rona, 1985; Rona et al., 1986).

Although marine copepods are best known as free-living in planktonic or shallow-water habitats, a growing number of species associated with invertebrates in the deep sea (in depths of 1,000 m or more) has been recorded during the last few decades. Some of these associated species are shown in Table 1. In addition, there are other copepods known from the deep sea that probably live in association with invertebrates but whose hosts are unknown. Among these may be cited various siphonostomes: *Altopontius altus* Stock (1985a), in 5,300 m, from the Central Indian Basin, several siphonostomes from Greenland and Iceland in depths of 2,500–4,060 m in the northeastern Atlantic (Boxshall, 1979), and *Hyalopontius* (= *Megapontius*) *pleurospinosus* Heptner, 1968, in 3,860–7,100 m, from the Kurile-Kamchatka Trench.

Two siphonostomes have been described from hydrothermal vent areas: *Benthoxynus spiculifer* Humes (1984), from the Juan de Fuca spreading zone off the coast of the state of Washington, and *Ceuthoecetes aliger* Humes and Dojiri (1980a), from the East Pacific Rise and the Galapagos Rift. In addition, *Dirivultus dentaneus* Humes and Dojiri (1980b), was found on the vestimentiferan *Lamelibrachia barhami* Webb in 1,125 m off southern California. A large free-living calanoid copepod, *Isaacscalanus paucisetus*, has been described by Fleminger (1983) from the East Pacific Rise.

It has been my good fortune to be able to study large collections of copepods from several deep-sea hydrothermal vent areas, both in the eastern Pacific and in the mid-Atlantic. In the course of this work more than 22,000 copepods in 44 collections from deep-sea vents have been examined in detail. Twenty-seven new species in 11 new genera, including 2 new families, comprising both Poecilostomatoida and Siphonostomatoida, are described here. In addition, one already known species, *Ceuthoecetes aliger*, is reported. A list of the taxa considered in this work, including related forms known from deep-sea areas, follows.

POECILOSTOMATOIDA Thorell, 1859	647
Clausidiidae Embleton, 1901	647
<i>Hyphalion</i> new genus	647
<i>Hyphalion captans</i> new species	649
Erebonasteridae new family	655
<i>Erebonaster</i> new genus	655
<i>Erebonaster protentipes</i> new species	656
Family uncertain	663
<i>Laitmatobius</i> new genus	663
<i>Laitmatobius crinitus</i> new species	663
SIPHONOSTOMATOIDA Thorell, 1859	668
Dirivultidae Humes and Dojiri, 1980	668
<i>Aphotopontius</i> new genus	669
<i>Aphotopontius forcipatus</i> new species	670
<i>Aphotopontius arcuatus</i> new species	676
<i>Aphotopontius baculigerus</i> new species	681
<i>Aphotopontius flexispina</i> new species	685
<i>Aphotopontius limatulus</i> new species	691
<i>Aphotopontius mammillatus</i> new species	696

<i>Stygiopontius</i> new genus	702
<i>Stygiopontius quadrispinosus</i> new species	702
<i>Stygiopontius cinctiger</i> new species	707
<i>Stygiopontius flexus</i> new species	711
<i>Stygiopontius hispidulus</i> new species	715
<i>Stygiopontius mucroniferus</i> new species	719
<i>Stygiopontius pectinatus</i> new species	723
<i>Stygiopontius sentifer</i> new species	724
<i>Stygiopontius verruculatus</i> new species	730
<i>Exrima</i> new genus	734
<i>Exrima singula</i> new species	735
<i>Exrima dolichopus</i> new species	736
<i>Rhogobius</i> new genus	739
<i>Rhogobius contractus</i> new species	740
<i>Scotoecetes</i> new genus	747
<i>Scotoecetes introrsus</i> new species	749
<i>Ceuthoecetes</i> Humes and Dojiri, 1980	755
<i>Ceuthoecetes aliger</i> Humes and Dojiri 1980	755
<i>Ceuthoecetes acanthothrix</i> new species	755
<i>Ceuthoecetes cristatus</i> new species	759
<i>Ceuthoecetes introversus</i> new species	759
<i>Nilva</i> new genus	763
<i>Nilva torifera</i> new species	763
Ecbathyriontidae new family	768
<i>Ecbathyrion</i> new genus	770
<i>Ecbathyrion prolixicauda</i> new species	770
Family uncertain	778
<i>Fissuricola</i> new genus	778
<i>Fissuricola caritus</i> new species	782

MATERIALS AND METHODS

The copepods reported in this study were collected by means of box cores or slurp guns operated by deep-sea submersibles (ALVIN, CYANA, PISCES IV) at vents in the eastern Pacific, or by dredge (RESEARCHER, RESOLUTION) on the Mid-Atlantic Ridge. Many thousands of specimens, picked from the sediment and preserved in 10% formalin for several days, then changed to 80% ethanol, were available for examination. The copepods associated with shrimps were first noticed in the gill chambers of the shrimps. Later other specimens were found in sediment in jars containing shrimps preserved in ethanol or were washed from the gill chambers by gently pipetting 70% ethanol over the gills.

All specimens were studied and measured in lactic acid, following the wooden slide method described by Humes and Gooding (1964). Several dissections of each species, including both sexes if available, were necessary in order to determine the structure of the mouthparts and appendages. The length of the body does not include the setae on the caudal rami. The segments of the first antenna were measured along their posterior nonsetiferous margins. In the formulas for leg armature Roman numerals represent spines, Arabic numerals indicate setae. All drawings were made with the aid of a camera lucida. The letter after the explanation of each figure refers to the scale at which it was drawn. The abbreviations used are: A₁ = first antenna; A₂ = second antenna, L = labrum, MD = mandible, MX₁ = first maxilla, MX₂ = second maxilla, MXPD = maxilliped, and P₁ = leg 1.

Order POECILOSTOMATOIDA Thorell, 1859

Family Clausidiidae Embleton, 1901

Hyphalion new genus

Diagnosis.—Clausidiidae. Body not modified or transformed. Urosome 6-segmented in female, 5-segmented in male. First antenna 6-segmented. Second antenna 3-segmented, third segment with 3 long recurved claws. Labrum with pos-

Table 1. Associated deep-sea copepods (in 1,000 m or more) and their hosts

Copepod	Depth (m)	Locality	Host
Poecilostomatoidea			
Clausiidae			
<i>Pherma curticaudatum</i> C. B. Wilson, 1923	1,282	off Lower California	from an unidentified polychaete
<i>Rhabdopus salmacinae</i> Southward, 1964	1,390	51°10'N, 11°47'W	from tube of <i>Salmacina setosa</i> , a polychaete
<i>Serpulidicola josephellae</i> Humes, 1979	2,506	west of Ireland, 50°27.3' to 50°26.8'N, 13°20.9' to 13°19.9'W	from tubes of <i>Josephella</i> sp., a polychaete
<i>Serpulidicola omphalopomae</i> Southward, 1964	1,020–1,450	continental slope between British Isles and France, 46°38'N, 05°13'W to 48°33'N, 10°07'W	on <i>Omphalopoma stellata</i> , a polychaete
Nereicolidae			
<i>Selioides bolbroei</i> Levensen, 1878	1,345	Denmark Strait, 65°24'N, 29°00'W	on <i>Harmothoe nodosa</i> , a polychaete
Position uncertain <i>Ophelicola drachi</i>	4,706 and 4,475	Gulf of Gascogne, 46°30.8'N, 10°19.5'W and 44°22.9'N, 04°54.8'W	on Opheliidae, undetermined polychaetes
Pseudanthessiidae			
<i>Solitaricola bipes</i> Stock, 1985	1,035	off Sri Lanka	<i>Flabellum</i> sp., a solitary coral
Siphonostomatoidea			
Brychiopontiidae			
<i>Brychiopontius falcatus</i> Humes, 1974	4,426–4,435	west of Ireland, 50°04.7'N, 15°44.8'W	from <i>Oneirophanta mirabilis</i> , a holothurian
Dirivultidae			
<i>Benthoxynus spiculifer</i> Humes, 1984	1,580	Axial Seamount, Juan de Fuca spreading zone, 48°59'N, 130°02'W	from tubes of vestimentiferan (not <i>Lamellibrachia</i> or <i>Riftia</i>)
<i>Ceuthoecetes aliger</i> Humes and Dojiri, 1980	2,595	East Pacific Rise, 20°51'N, 109°4.9'W	washed from tentacular crown of large vestimentiferan
<i>Ceuthoecetes aliger</i> Humes and Dojiri, 1980	2,482	Galapagos Rift, 00°48.1'N, 86°07'W	washed from tentacular crown of large vestimentiferan
<i>Dirivultus dentaneus</i> Humes and Dojiri, 1980	1,125	off southern California, 32°19.6'N, 117°19.08'W	washed from tentacular crown of <i>Lamellibrachia barhami</i> , a vestimentiferan
Nicothoidae			
<i>Chonistoma enaulis</i> Boxshall and Lincoln, 1983	3,008–3,016	North Atlantic, 34°57'N, 32°55'W	from cyst on <i>Dendromunna</i> , an isopod
<i>Hadrothoe crosnieri</i> Humes, 1975	810–1,020	southwestern Madagascar, 21°26.5'S, 43°11'E	from rostrum of <i>Aristeus virilis</i> , a penaeid shrimp
<i>Homoeoscelis frigida</i> Hansen, 1923	1,836	south of Jan Mayen, 69°13'N, 08°23'W	in branchial chamber of <i>Diastylis polaris</i> , a cumacean
<i>Homoeoscelis frigida</i> Hansen, 1923	1,395	south of Jan Mayen, 69°31'N, 07°06'W	in branchial chamber of <i>Diastylis</i>

Table 1. Continued

Copepod	Depth (m)	Locality	Host
<i>Sphaeronella bradfordae</i> Boxshall and Lincoln, 1983	1,373	Chatham Rise, east of New Zealand, 45°24.5'S, 173°59.8'E	from <i>Haploniscus</i> , an isopod
<i>Sphaeronella nannonisci</i> Hansen, 1923 Position uncertain	1,039	west of Ireland, 64°45'N, 29°06'W	in marsupium of <i>Nannoniscus simplex</i> , an amphipod
<i>Gomphopodarion byssoicum</i> Humes, 1974	4,426– 4,435	west of Ireland, 50°04.7'N, 15°44.8'W	from <i>Oneirophanta mirabilis</i> , a holothurian

teroverventral margin entire. Mandible with 3 spines and 1 seta. First maxilla with 5 setae. Second maxilla with first segment having 1 seta, second segment with 3 spines and 1 seta. Maxilliped in female 2-segmented, second segment with extremely long seta; in male, 4-segmented, first segment with 1 inner seta, second segment enlarged, triangular; long terminal claw.

Legs 1–4 biramous with 3-segmented rami. Leg 5 2-segmented, second segment with 3 spines and 1 seta.

Type-species.—*Hyphalion captans* new species.

Gender neuter.

Etymology.—The generic name is a combination of the Greek word *hyphalos*, meaning under the sea, and the diminutive suffix *-ion*.

Hyphalion captans new species

Figures 1a–i, 2a–j, 3a–e, 4a–d

Type Material.—4 ♀♀, 5 ♂♂, and 7 copepodids in 2,007 m, Guaymas Basin, Gulf of California, 27°00.5'N, 111°24.6'W, 5 August 1985, DSRV ALVIN dive no. 1613. Holotype ♀, allotype, and 7 paratypes (2 ♀♀, 3 ♂♂) deposited in the National Museum of Natural History, Smithsonian Institution, Washington, D.C.

Female.—Body (Fig. 1a) elongate, flattened. Length 2.06 mm (1.94–2.17 mm) and greatest width 0.63 mm (0.62–0.64 mm), based on 4 specimens. Greatest dorsoventral thickness 0.40 mm. Segment bearing leg 1 fused with cephalosome. Epimeral areas of pedigerous segments rounded. Ratio of length to width of prosome 1.67:1. Ratio of length of prosome to that of urosome 1.18:1.

Segment bearing leg 5 (Fig. 1b) 109 × 264 μm, with fifth pair of legs arising slightly ventrally. Genital segment 176 × 290 μm, much broader than long in dorsal view, its lateral margins roundly expanded. Genital areas located dorso-laterally on expanded portions of genital segment (Fig. 1c), each genital area bearing 2 small setae 26 μm and 29 μm. Four postgenital segments from anterior to posterior 176 × 220, 148 × 185, 104 × 148, and 99 × 121 μm. Anal segment (Fig. 1d) with 2 pairs of broad anteroventral striated scales approximately 13 × 15 μm.

Caudal ramus (Fig. 1e) elongate, 187 × 59 μm, ratio of length to width 3.17:1. Outer lateral seta 65 μm. Dorsal seta 70 μm. Innermost terminal seta 91 μm. All these setae smooth. Outermost terminal seta 117 μm and minutely barbed. Two long median terminal setae 244 μm (outer) and 400 μm (inner), both with minute barbules along their midregions.

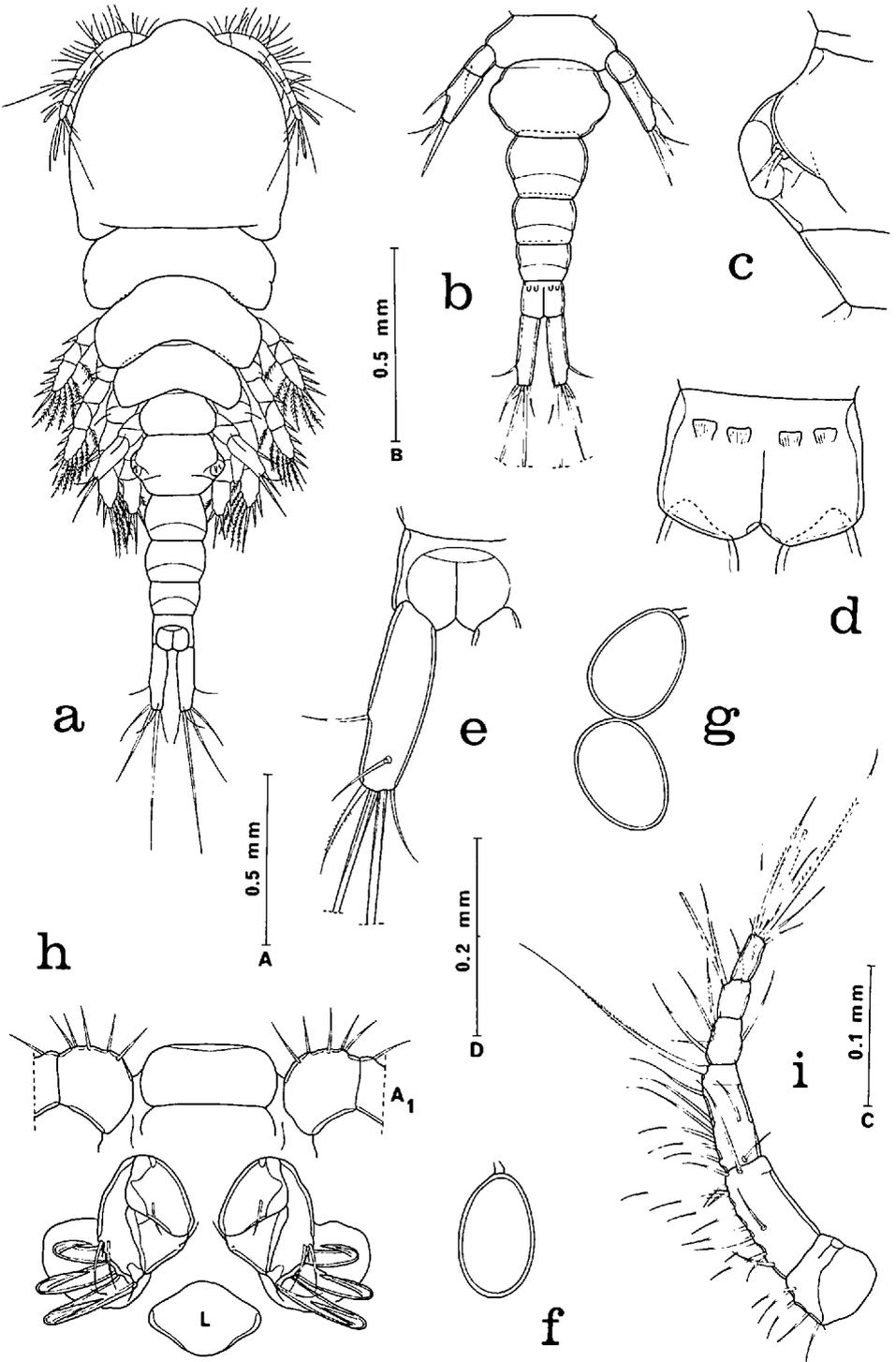


Figure 1. *Hyphalion captans* new genus, new species, Female: a, dorsal (scale A); b, urosome, ventral (B); c, genital area, dorsal (C); d, anal segment, ventral (C); e, caudal ramus, dorsal (D); f, egg sac, ventral (A); g, egg sac, ventral (A); h, rostrum, second antenna, and labrum, ventral (D); i, first antenna, ventral (D).

Egg sac containing 1 egg, $374 \times 231 \mu\text{m}$ (Fig. 1f), or 2 eggs, both approximately $350 \times 230 \mu\text{m}$ (Fig. 1g).

Body surface smooth, without visible sensilla.

Rostrum (Fig. 1h) broad and projecting forward. First antenna (Fig. 1i) 6-segmented and $390 \mu\text{m}$ long. Lengths of segments: 10 ($22 \mu\text{m}$ along anterior margin), 96, 96, 43, 39, and $44 \mu\text{m}$, respectively. Formula for armature: 5, 15, 9, 5, 2 + 1 aesthete, and 7 + 1 aesthete. All setae smooth except few on segments 3–6 with minute barbules. Second antenna (Fig. 2a) 3-segmented and $330 \mu\text{m}$ long including terminal claws. First and second segments with single seta. Third segment recurved, bearing 3 inner subterminal setae, terminally with 3 very long recurved sickle-shaped prehensile claws, longest $145 \mu\text{m}$, and 2 setae. All setae and claws smooth. Second antennae capable of being drawn toward each other midventrally (Fig. 1h), with 6 claws forming kind of basket.

Labrum (Fig. 1h) broad and unornamented, its posteroventral margin rounded and entire.

Mandible (Fig. 2b) flexed, bearing terminally 3 barbed spines and 1 haired seta. Paragnath (Fig. 2c) minute rounded lobe with few setules. First maxilla (Fig. 2d) thumb-shaped with 5 setae (4 long minutely barbed, 1 short smooth). Second maxilla (Fig. 2e) 2-segmented. First segment massive with 1 delicately haired seta. Second segment smaller, bearing 3 spines, barbed or spinulose, and 1 haired seta. Maxilliped (Fig. 2f) 2-segmented. First segment unarmed. Second segment with 2 very small inner setae, terminally with 2 small setules and 1 very prominent long ($230 \mu\text{m}$) barbed seta. In preserved specimens 2 long setae of opposite maxilliped crossing each other like fencers' swords (Fig. 2g).

Ventral area between maxillipeds and first pair of legs as in Fig. 2g, with very small median sclerotization in front of intercoxal plate of leg 1.

Legs 1–4 (Figs. 2h, j, 3a, b) biramous with 3-segmented rami. Armature as follows:

P_1	coxa	0-1	basis	1-I	exp	I-0; I-1; III,I,4
					enp	0-1; 0-1; I,5
P_2	coxa	0-1	basis	1-0	exp	I-0; I-1; III,I,5
					enp	0-1; 0-2; II,I,3
P_3	coxa	0-1	basis	1-0	exp	I-0; I-1; III,I,5
					enp	0-1; 0-2; II,II,2
P_4	coxa	0-1	basis	1-0	exp	I-0; I-1; II,I,5
					enp	0-1; 0-2; I,III,1

Intercoxal plate of leg 1 smooth, but in legs 2–4 with small spinules on anterior surface. Inner seta on coxa of all 4 legs sword-shaped. Inner spine on basis of leg 1 $55 \mu\text{m}$ long, minutely barbed. Spines on all legs barbed, those on exopods similar to that shown in Fig. 2i.

Leg 5 (Fig. 3c) 2-segmented. First segment $78 \times 65 \mu\text{m}$, its dorsal seta $75 \mu\text{m}$. Second segment $156 \times 70 \mu\text{m}$, ratio 2.23:1, outer marginal spine $83 \mu\text{m}$, subterminal spine $88 \mu\text{m}$, terminal spine $146 \mu\text{m}$, and seta $99 \mu\text{m}$. All 3 spines barbed, but seta smooth.

Leg 6 probably represented by 2 setae on genital area (Fig. 1c).

Color of living specimens unknown.

Male.—Body (Fig. 3d) resembling that of female in general form. Length 1.75 mm (1.71–1.82 mm) and greatest width 0.53 mm (0.50–0.55 mm), based on 5 specimens. Greatest dorsoventral thickness 0.34 mm. Ratio of length to width of prosome 1.90:1. Ratio of length of prosome to that of urosome 1.17:1.

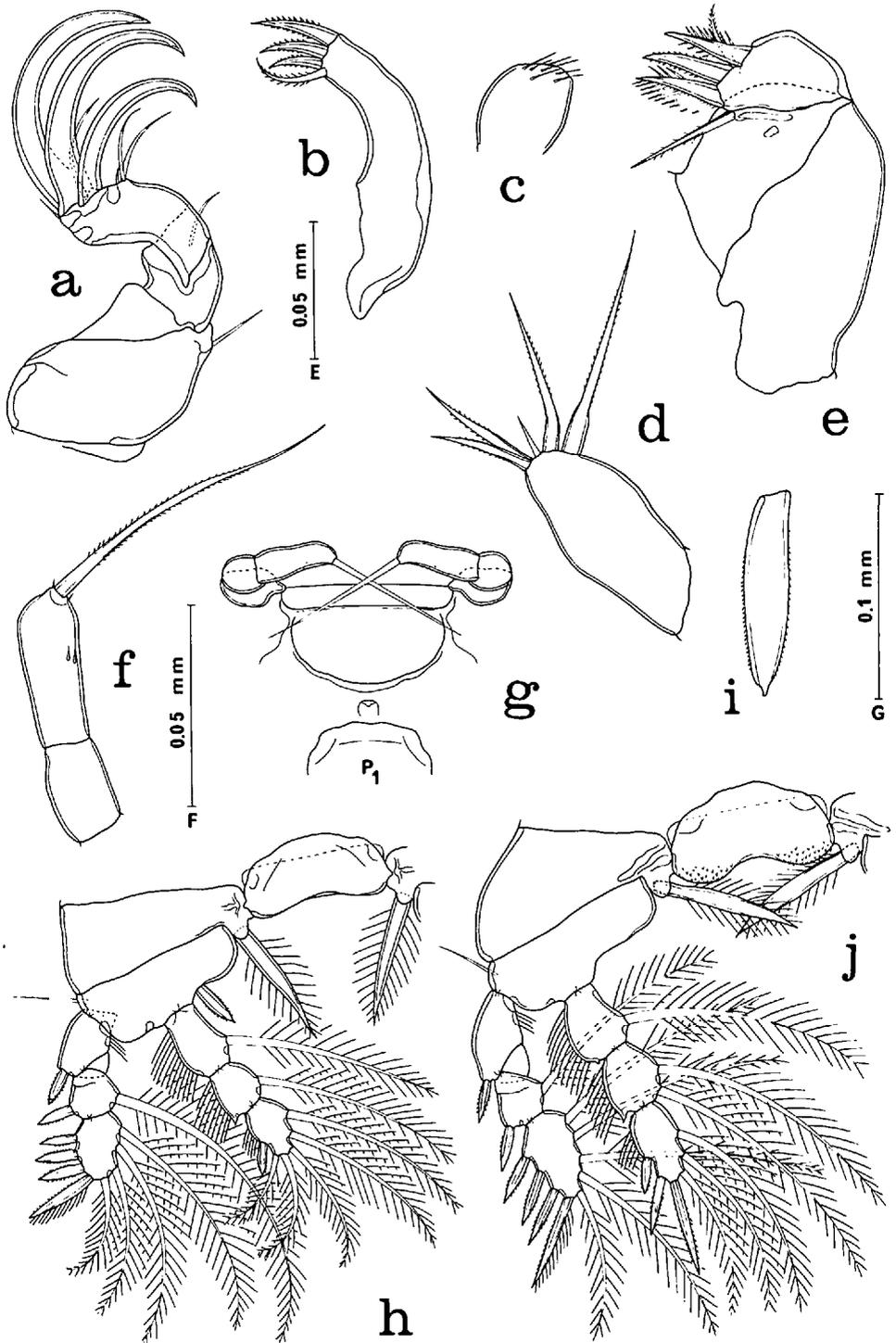


Figure 2. *Hyphalion captans* new genus, new species. Female: a, second antenna, antero-outer (scale C); b, mandible, anterior (E); c, paragnath, anterior (F); d, first maxilla, anterior (E); e, second maxilla, antero-inner (G); f, maxilliped, inner (C); g, maxillipeds and region between them and first pair of legs, ventral (D); h, leg 1 and intercoxal plate, anterior (D); i, spine on outer side of second segment of exopod of leg 2, anterior (F); j, leg 2 and intercoxal plate, anterior (D).

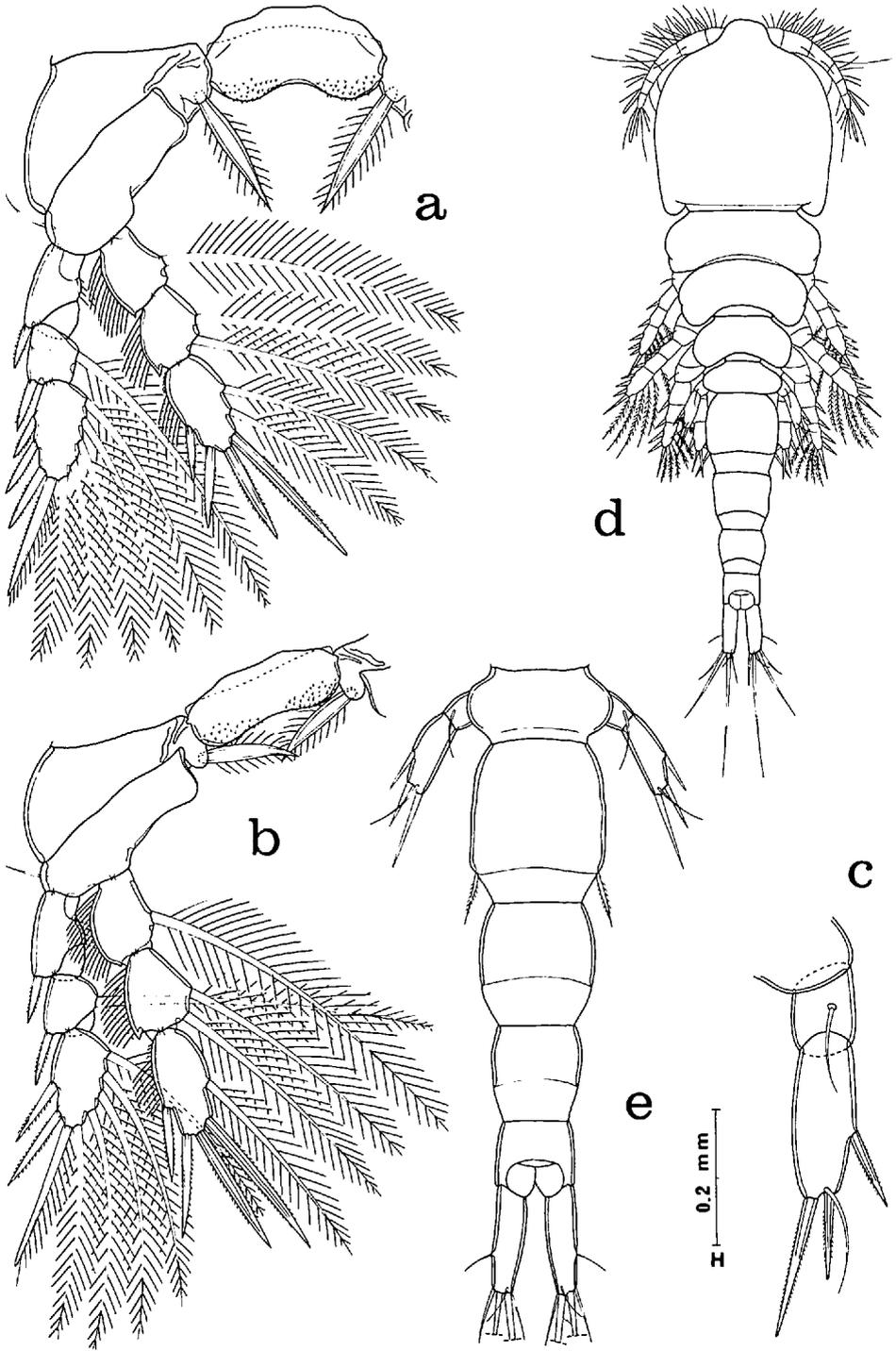


Figure 3. *Hyphalion captans* new genus, new species. Female: a, leg 3 and intercoxal plate, anterior (scale D); b, leg 4 and intercoxal plate, anterior (D); c, leg 5, dorsal (D). Male: d, dorsal (A); e, urosome, dorsal (H).

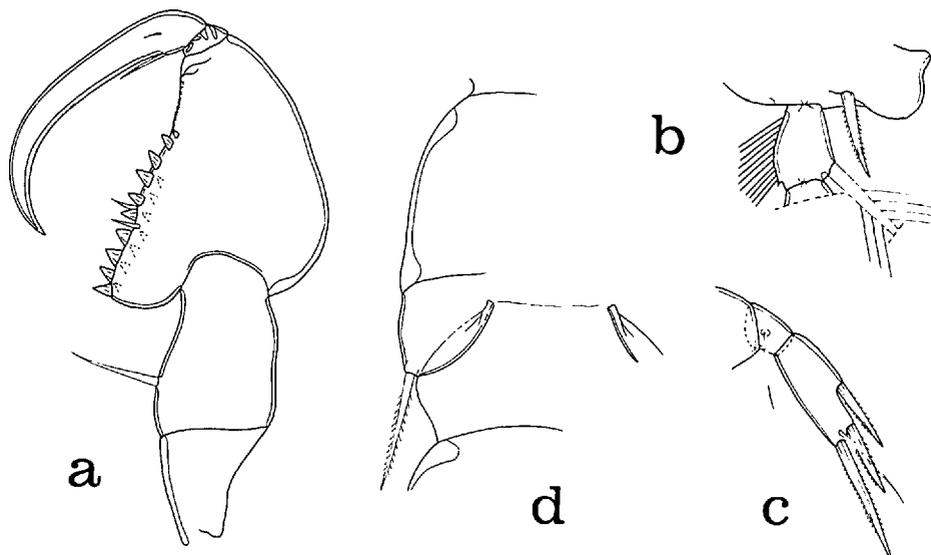


Figure 4. *Hyphalion captans* new genus, new species. Male: a, maxilliped, antero-inner (scale G); b, inner spine on basis of leg 1, anterior (C); c, leg 5, dorsal (D); d, leg 6, ventral (C).

Segment of leg 5 (Fig. 3e) $109 \times 205 \mu\text{m}$. Genital segment $229 \times 200 \mu\text{m}$, only slightly longer than wide, in dorsal view with nearly parallel sides. Three post-genital segments from anterior to posterior 174×177 , 135×143 , and $104 \times 117 \mu\text{m}$. Anal segment with 4 ventral scales as in female.

Caudal ramus similar to that of female, but slightly shorter, $151 \times 48 \mu\text{m}$, ratio 3.15:1.

Body surface smooth as in female.

Rostrum, first antenna, second antenna, labrum, mandible, paragnath, first maxilla, and second maxilla like those of female. Maxilliped (Fig. 4a) 4-segmented (assuming proximal part of claw to represent fourth segment), but small third segment obscure and not well defined. First segment with 1 inner smooth seta. Large triangular second segment with inner surface having 2 small setae, 2 rows of spines, and distal row of minute spinules. Small third segment with sclerotized pieces but unarmed. Claw $122 \mu\text{m}$, recurved, bearing 2 unequal proximal setae but lacking fine ornamentation.

Legs 1–4 as in female, but inner spine on basis of leg 1 longer, $60 \mu\text{m}$, and more slender (Fig. 4b).

Leg 5 (Fig. 4c) in general similar to that of female. First segment $49 \times 39 \mu\text{m}$, its dorsal seta $65 \mu\text{m}$. Second segment $114 \times 47 \mu\text{m}$, ratio 2.43:1, outer marginal spine $69 \mu\text{m}$, subterminal spine $75 \mu\text{m}$, terminal spine $117 \mu\text{m}$, and seta $78 \mu\text{m}$.

Leg 6 (Fig. 4d) consisting of posteroventral flap on genital segment bearing 1 pinnate seta $79 \mu\text{m}$.

Color unknown.

Etymology. — The specific name *captans*, Latin meaning grasping or seizing, refers to the long prehensile claws on the second antennae.

Remarks. — Although the distinctions between the Clausidiidae Embleton, 1901, and the Clausiidae Giesbrecht, 1895, in respect to many features are not always sharp, and the two families may actually represent a single group (Humes and Ho, 1967; see Wilson and Illg, 1955), the concept of the Clausidiidae is a useful

one. The genus *Hemicyclops* Boeck, 1859, best illustrates certain general features of the family: (1) the urosome of the female being 5-segmented where the female is known (3-segmented in *Clausidium* Embleton, 1901) and that of the male 6-segmented where the male is known (5-segmented in *Clausidium* and *Tychidion* Humes, 1973); (2) the 7-segmented first antenna (7-segmented also in *Clausidium* and *Tychidion*, 6-segmented in other genera); (3) the 4-segmented second antenna (3-segmented in *Tychidion*); (4) the mandible with usually four terminal elements (five in *Tychidion*); (5) the maxilliped usually 4-segmented (but may be reduced, especially in the female); (6) the basis of leg 1 with an inner spine (except in *Cotylomolgus* Humes and Ho, 1967, a genus which may actually be close to the clausiid line), and (7) the full expression of 3-segmented rami in legs 1-4. (Gooding, 1963, discussed in detail the various clausidiid and clausiid genera known at that time.)

The new genus *Hyphalion* shows many of these clausidiid features, but at the same time possesses characters that separate it from the other genera in the Clausiidae. These include: (1) the 6-segmented urosome in the female and 5-segmented urosome in the male; (2) the 3-segmented second antenna, strongly prehensile with three large terminal claws; and (3) the 2-segmented nonprehensile maxilliped with long terminal seta in the female, but 4-segmented prehensile maxilliped in the male.

The existing genera of the Clausidiidae stand apart from the new genus as follows: (1) with a 7-segmented first antenna (*Clausidium*, *Hemicyclops*); (2) with a 4-segmented second antenna (*Myzomolgus* Bocquet and Stock, 1957, *Hippomolgus* Sars, 1917, *Conchylurus* Bocquet and Stock, 1957, *Leptinogaster* Pelseener, 1929, and *Cotylomolgus* Humes and Ho, 1967); and (3) with 5 elements on the mandible (*Tychidion*).

Erebonasteridae new family

Diagnosis.—Body not modified or transformed. Urosome in both sexes 5-segmented. Caudal ramus with 6 setae. First antenna 6-segmented. Second antenna 4-segmented. Mandible with 4 distal setae and large palp bearing 4 setae. First maxilla slightly bilobed. Second maxilla with clawlike second segment. Maxilliped 4-segmented, larger and more prehensile in male.

Legs 1-4 biramous, 3-segmented. Basis of leg 1 with inner spine. Endopod of leg 4 with 0-1; 0-2; I,II,2. Leg 5 with elongate free segment bearing 4 setae.

Erebonaster new genus

Diagnosis.—Body elongate, not modified or transformed. Segment bearing leg 1 distinctly separated from cephalosome. Urosome in both sexes 5-segmented. Caudal ramus elongate with 6 setae, 1 terminal seta greatly elongated.

Rostrum rounded, prominent. First antenna 6-segmented, with aesthete on segments 3, 5, and 6, and with aesthete added on segment 2 in male. Second antenna 4-segmented, with terminal setae but without claws. Labrum finely spinulose. Mandible with 4 distal setae and having prominent palp with 4 large setae. First maxilla bilobed with 5 setae. Second maxilla 2-segmented, second segment clawlike. Maxilliped 4-segmented, with 2 setae on first segment and with terminal claw armed with 1 seta in female, with 3 setae in male.

Legs 1-4 with 3-segmented rami. Basis of leg 1 with inner spine. Leg 4 lacking inner seta on coxa, and endopod 0-1; 0-2; I,II,2.

Leg 5 greatly elongated, slender, 2-segmented. First segment with 1 seta, second segment with 4 setae, 1 much elongated.

Leg 6 in male with 2 setae.

Spermatophore elongate, sausage-shaped.

Type-species.—*Erebonaster protentipes* new species.

Gender.—Masculine.

Etymology.—The generic name is a combination of the Greek words *erebos*, a place of nether darkness, and *naster*, an inhabitant, alluding to the deep-sea habitat.

***Erebonaster protentipes* new species**

Figures 5a–e, 6a–h, 7a–e, 8a–g

Type Material.—55 ♀♀, 98 ♂♂, and 102 copepodids in 2,022 m, from box cores, Guaymas Basin, Gulf of California, 27°01.0'N, 111°25.0'W, 19 January 1982, DSRV ALVIN dive no. 1176. Holotype ♀, allotype, and 143 paratypes (48 ♀♀, 95 ♂♂) deposited in the National Museum of Natural History, Smithsonian Institution, Washington, D.C.

Other Specimens.—3 ♀♀, 5 ♂♂, 7 copepodids from 2 *Nuculana*-like protobranch bivalves, in box core, in 2,004 m, Guaymas Basin, 27°00.7'N, 111°24.4'W, 6 August 1985, DSRV ALVIN dive no. 1614; 2 ♂♂ from tube core, in 2,002 m, Guaymas Basin, 27°0.7'N, 111°24.4'W, 31 July 1985, DSRV ALVIN dive no. 1608; 1 ♂ from tube core, in 2,012 m, Guaymas Basin, 27°05'N, 110°24.5'W, 29 July 1985, DSRV ALVIN dive no. 1607.

Female.—Body (Fig. 5a) elongate and flattened. Length 1.59 mm (1.49–1.68 mm) and greatest width 0.43 mm (0.41–0.44 mm), based on 10 specimens. Greatest dorsoventral thickness 0.22 mm. Segment bearing leg 1 distinctly separated from cephalosome, with epimeral areas not prominent. Segments bearing legs 2–4 with epimera expanded posteriorly, somewhat pointed or rounded. Ratio of length to width of prosome 1.64:1. Ratio of length of prosome to that of urosome 0.76:1, urosome longer than prosome.

Segment of leg 5 (Fig. 5b) 176 × 396 μm. Genital segment (Fig. 5c) 231 × 297 μm, wider than long, with expanded lateral margins in dorsal view. Ventral surface with pair of golden brown, comet-shaped areas (Fig. 5b). Genital areas (Fig. 5c) situated dorsolaterally near middle of segment. Each area with 2 setae 13 μm and 78 μm. Three postgenital segments from anterior to posterior 132 × 187, 104 × 163, and 154 × 121 μm.

Caudal ramus (Fig. 5d) elongate, 265 μm long, 26 μm wide in proximal third, and 21 μm wide in distal third, ratio of length to average width approximately 11.5:1. Outer lateral seta 78 μm, dorsal seta 31 μm, outermost terminal (slightly subterminal) seta 83 μm, innermost terminal seta 49 μm, and 2 median terminal setae very unequal, outer 85 μm, inner 440 μm. All setae smooth.

Egg sac (Fig. 5e) elongate, 550 × 176 μm, containing many eggs, ranging from 88–104 μm in diameter.

Body surface with few sensilla and refractile points as in Fig. 5a, b.

Rostrum (Fig. 6a) prominent and bluntly rounded. First antenna (Fig. 6b) 6-segmented, relatively short, 224 μm. Lengths of segments: 26 (66 μm along anterior margin), 73, 6, 7, 9, and 30 μm, respectively. Formula for armature: 3, 15, 2 + 1 aesthete, 2, 2 + 1 aesthete, and 5 + 1 aesthete. Spinules on both sides of segment 1 and on posterior side of segments 2–6. All setae smooth. Second antenna (Fig. 6c) 4-segmented. Formula: 1, 1, 3, and 2 + 4. First segment with 2 groups of outer setules and inner row of hairlike setules. Second segment with few outer setules and 2 small inner setules. Third segment with distal inner transverse row of spinules. Fourth segment with 2 transverse rows of spinules. All setae smooth.

Labrum (Fig. 6d) with central oval spinose piece connected to lateral spinose

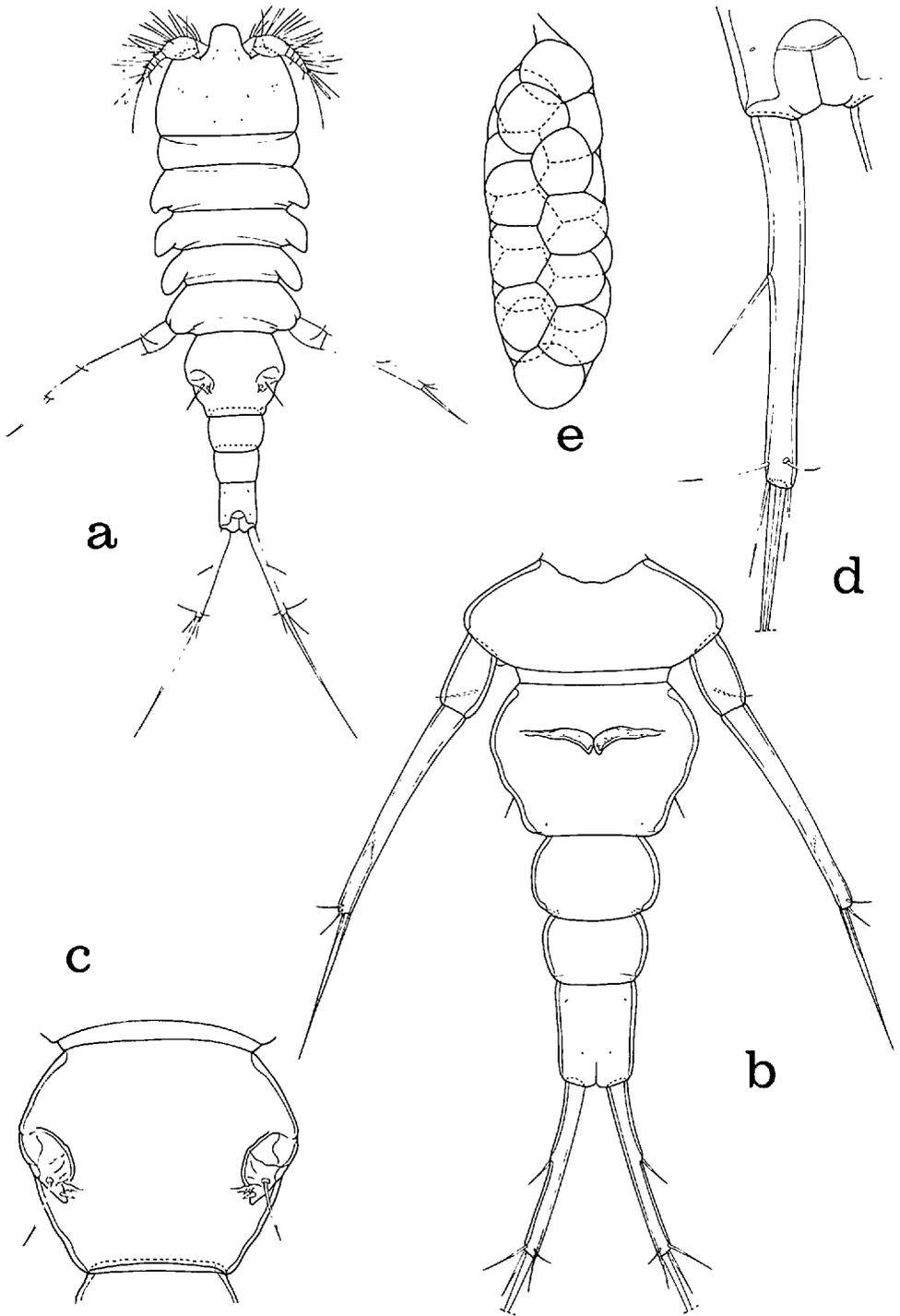


Figure 5. *Erebonaster protentipes* new genus, new species. Female: a, dorsal (scale A); b, urosome, ventral (H); c, genital segment, dorsal (D); d, caudal ramus, dorsal (C); e, egg sac, dorsal (H).

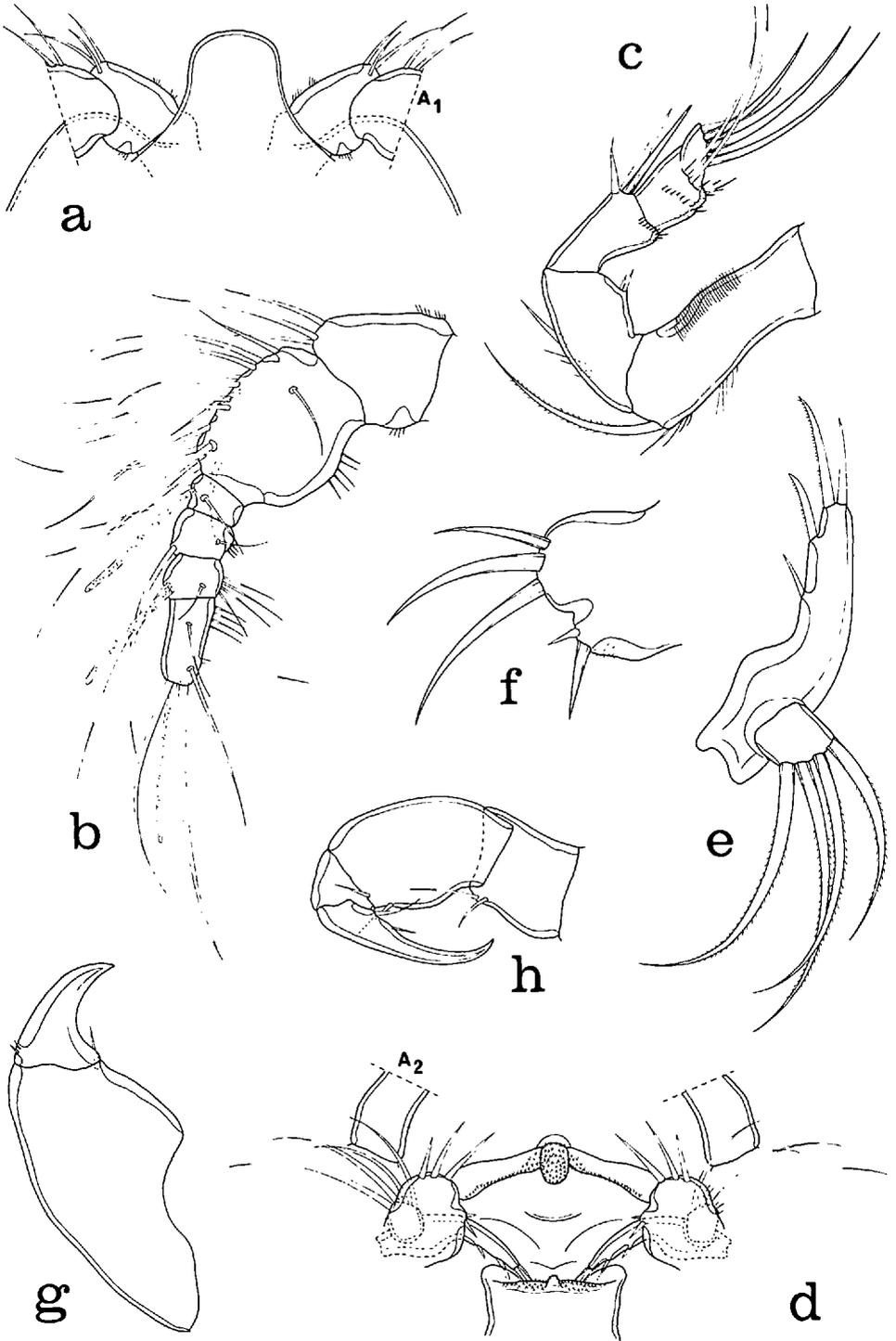


Figure 6. *Erebonaster protentipes* new genus, new species. Female: a, rostrum, dorsal (scale C); b, first antenna, ventral (G); c, second antenna, anterior (E); d, oral area, showing labrum, labium, and mandibles and first maxillae in position, ventral (G); e, mandible, posterior (F); f, first maxilla, posterior (F); g, second maxilla, posterior (G); h, maxilliped, postero-inner (G).

bars. Labium (fused paragnaths ?) similarly with central piece (but smaller) and lateral bars. Mandible (Fig. 6e) bearing 4 distal setae, 2 smooth, 2 unilaterally pectinate, and having prominent proximal palp bearing 4 long finely barbed setae. First maxilla (Fig. 6f) bilobed, smaller inner lobe with 2 unequal setae and patch of minute spinules, larger outer lobe with 3 setae. All setae smooth. Second maxilla (Fig. 6g) 2-segmented, large first segment with 1 small distal inner seta, smaller second segment clawlike with 2 very small proximal outer setae. Maxilliped (Fig. 6h) 4-segmented, assuming proximal part of claw to represent fourth segment. Both first and second segments with 2 inner distal setae. Small third segment unarmed. Claw 88 μm with 1 proximal inner seta.

Legs 1–4 (Fig. 7a–d) biramous with 3-segmented rami. Formula for armature as follows:

P_1	coxa	0-1	basis	1-1	exp	I-0; I-1; III,I,3
					enp	0-1; 0-1; I,II,3
P_2	coxa	0-1	basis	1-0	exp	I-0; I-1; III,I,4
					enp	0-1; 0-2; I,II,3
P_3	coxa	0-1	basis	1-0	exp	I-0; I-1; III,I,5
					enp	0-1; 0-2; I,II,3
P_4	coxa	0-0	basis	1-0	exp	I-0; I-1; I,II,3
					enp	0-1; 0-2; I,II,2

Coxa of legs 1–3 with inner pinnate seta, but coxa of leg 4 lacking such seta; all coxae with 2 outer rows of spinules. Basis of leg 1 with outer seta and inner spine 42 μm ; basis with anterior surficial row of spinules and other spinules near insertion of spine and on margin between rami. Basis of legs 2–4 with row of setules on inner margin. Outer sides of both rami with spinules. Spines of exopod and endopod with extremely minute barbs.

Leg 5 (Fig. 7e) greatly elongated and slender, held in some specimens almost at right angle to body. First segment 104 \times 62 μm , its seta 36 μm . Second segment 340 \times 27 μm (width taken at level of seta), ratio 12.6:1. Dorsal seta 25 μm , long terminal stout seta 211 μm , and 2 adjacent small slender setae 38 μm . All setae smooth.

Leg 6 probably represented by 2 unequal setae on genital area 13 μm and 78 μm (Fig. 5c).

Color of living specimens unknown.

Male.—Body (Fig. 8a) more slender than in female. Length 1.36 mm (1.24–1.64 mm) and greatest width 0.30 mm (0.29–0.32 mm), based on 10 specimens. Greatest dorsoventral thickness 0.18 mm. Ratio of length to width of prosome 1.9:1. Ratio of length of prosome to that of urosome 0.67:1, urosome longer than prosome.

Segment of leg 5 (Fig. 8b) 104 \times 275 μm . Genital segment quadrate, 180 \times 195 μm . Three postgenital segments from anterior to posterior 125 \times 159, 117 \times 135 and 177 \times 100 μm .

Caudal ramus (Fig. 8b) shorter than in female, 172 μm long, 23 μm wide in proximal third, and 21 μm wide in distal third, ratio 7.8:1.

Body surface with few sensilla and refractile points (Fig. 8a, b).

Rostrum as in female. First antenna resembling that of female but 1 aesthete added on second segment (Fig. 8c). Second antenna, labrum, mandible, first maxilla, and second maxilla like those of female. Maxilliped (Fig. 8d) larger than in female. First segment with 2 inner distal setae, second segment with 2 inner distal setae and longitudinal row of spinules. Small third segment unarmed. Claw 112 μm , with 3 setae on proximal half. All setae smooth.

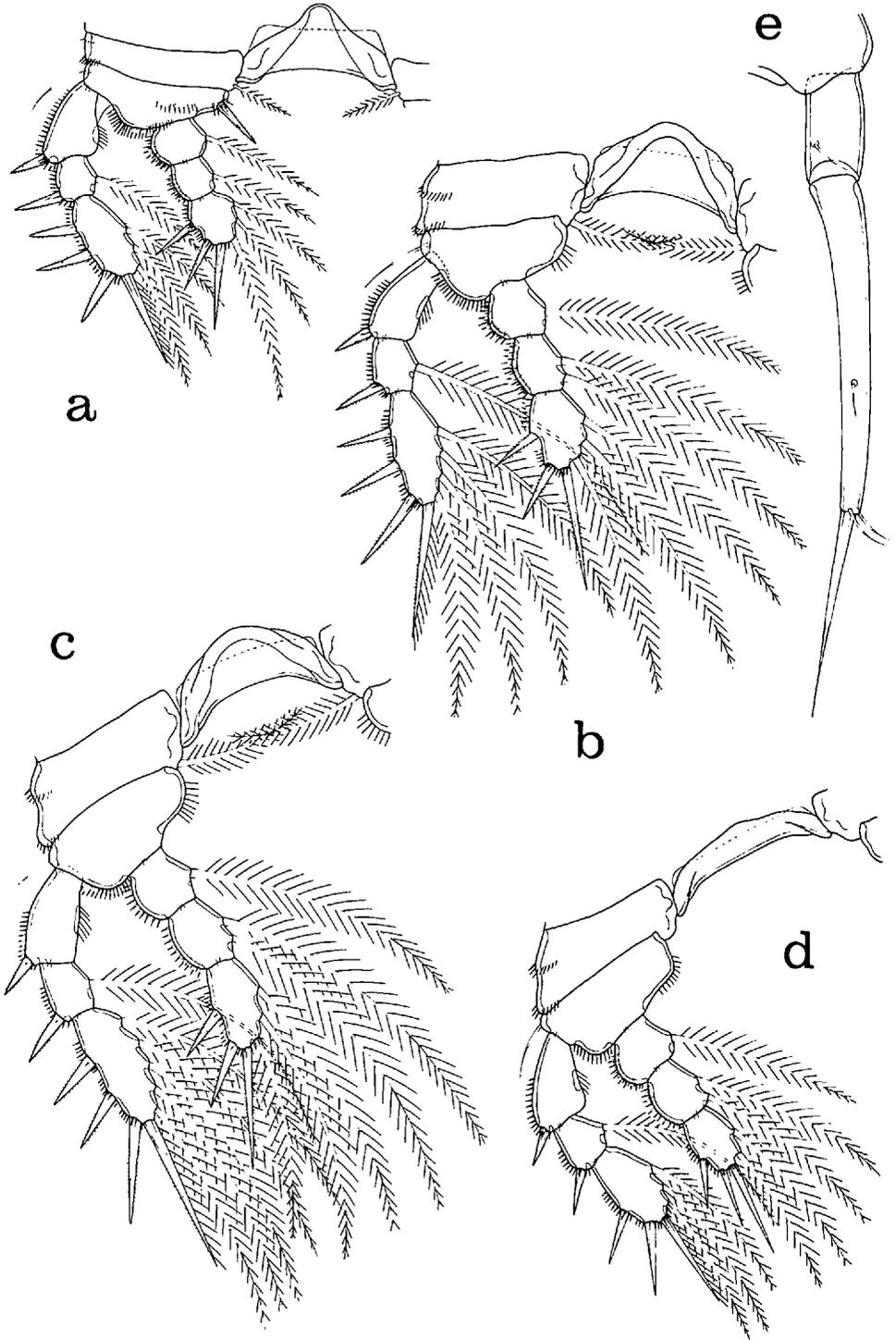


Figure 7. *Erebonaster protentipes* new genus, new species. Female: a, leg 1 and intercoxal plate, anterior (scale C); b, leg 2 and intercoxal plate, anterior (C); c, leg 3 and intercoxal plate, anterior (C); d, leg 4 and intercoxal plate, anterior (C); e, leg 5, dorsal (D).

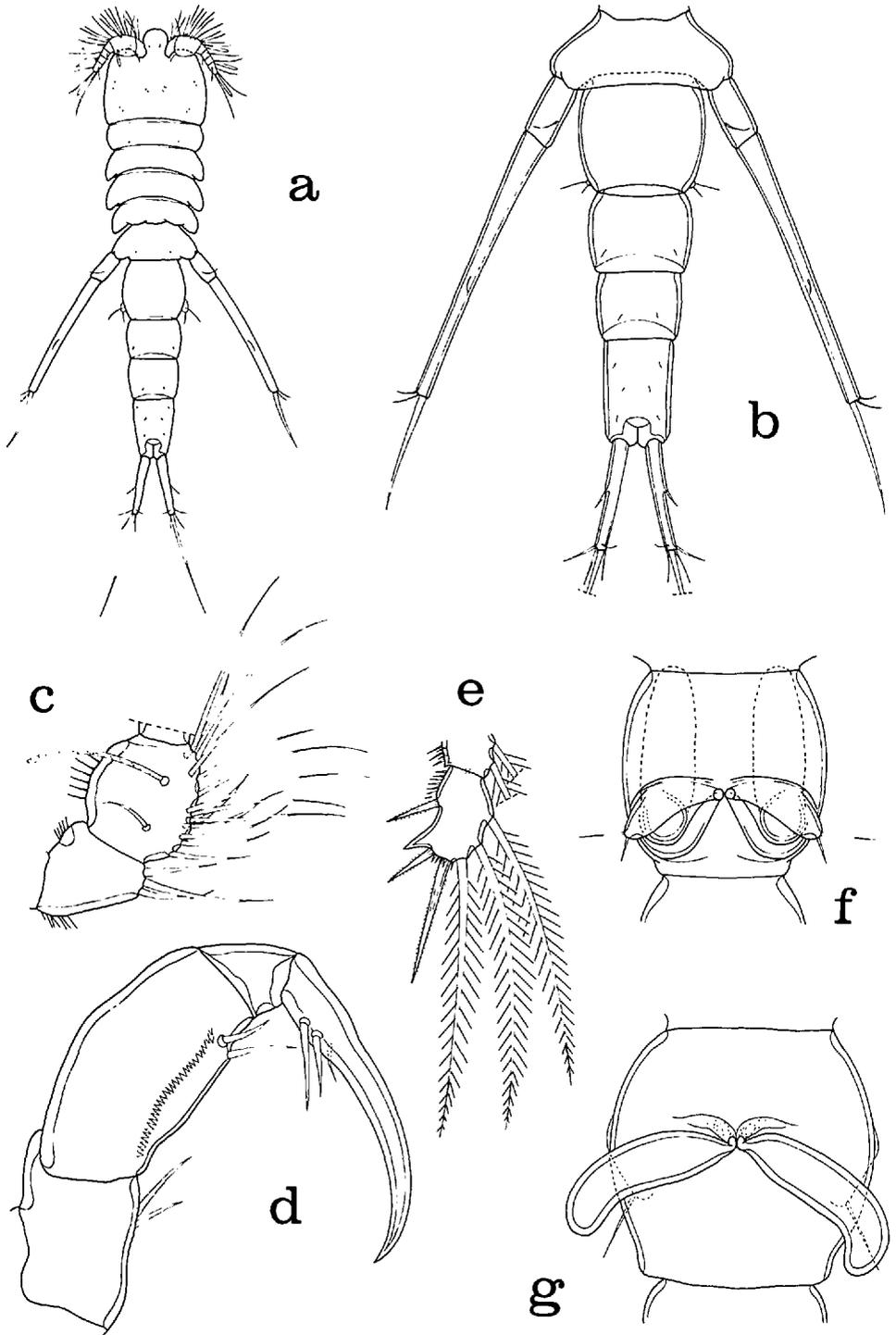


Figure 8. *Erebonaster protentipes* new genus, new species. Male: a, dorsal (scale A); b, urosome, dorsal (H); c, first and second segments of first antenna, ventral (G); d, maxilliped, postero-inner (E); e, third segment of endopod of leg 2, anterior (G); f, genital segment, ventral (D); g, spermatophores attached to genital segment of female, ventral (D).

Legs 1–4 as in female, except slight sexual dimorphism in endopod of leg 2, with outer distal spiniform process (Fig. 8e).

Leg 5 resembling that of female.

Leg 6 (Fig. 8f) usual posteroventral flap on genital segment bearing 2 smooth setae 26 μm and 52 μm .

Spermatophore (Fig. 8g) 195 \times 49 μm , sausage-shaped, attached medially to golden brown crescentic areas on ventral side of genital segment.

Color of living specimens unknown.

Etymology.—The specific name is a combination of the Latin words *protentus*, stretched out or extended, and *pes*, a foot, alluding to the appearance of leg 5 in this species.

Remarks.—Specimens of *Erebonaster protentipes* were first noticed by Linda Morse-Porteus during sorting of box and tube core samples from the Guaymas Basin. Since some of these copepods occurred in vials containing small bivalves (*Nuculana*-like protobranchs), the possibility of association with the bivalves arose. Consequently, specimens of *Nuculana*-like bivalves in three vials were examined by slightly opening the valves and gently rinsing the mantle cavity, with the following results:

FROM ALVIN dive no. 1614, vial containing 2 *Nuculana*-like bivalves: 4 *Erebonaster* (1 ovigerous ♀, 1 ♂, 2 copepodids) loose in vial, 3 *Erebonaster* (1 ovigerous ♀, 2 ♂♂) from bivalve 22 mm long, 8 *Erebonaster* (1 ovigerous ♀, 2 ♂♂, 5 copepodids) from bivalve 19 mm long;

FROM ALVIN dive no. 1608, vial containing 1 *Nuculana*-like bivalve: 2 ♂♂ loose in vial, no copepods in bivalve 19.5 mm long;

FROM ALVIN dive no. 1607, vial containing 4 *Nuculana*-like bivalves: no copepods loose in vial, 1 ♂ from bivalve 18 mm long, no copepods from 3 bivalves 17.6, 17.6, and 13.9 mm long.

There is little doubt that *Erebonaster protentipes* is associated with a *Nuculana*-like bivalve, the species of which has yet to be determined.

The most striking feature in both sexes of the new copepod, visible without dissection, is the greatly elongated leg 5, held in many specimens at almost a right angle with the body. Detailed features of particular interest include the mandible with its 4 distal setae and large palp bearing 4 prominent setae, the second maxilla with the second segment forming a stout claw, and the first segment of the maxilliped with 2 setae.

The palp on the mandible is the single feature that distinguishes the *Erebonasteridae* from other poecilostomatoid families. Only a few poecilostomes show what could be construed as a mandibular palp. In his new family Mantridae, Leigh-Sharpe (1934) described the mandible of *Mantra speciosa* as having a 2-branched palp (his fig. 4). However, it seems to me that Leigh-Sharpe's single female, found in the bivalve *Chama*, may be referred to the Cyclopoida, family Cyclopinidae Sars, 1913. In 1968 I had the opportunity to study the holotype of *Mantra speciosa*, mounted on a slide in euparal, sent to me from the Zoologisch Museum, Amsterdam. The mouthparts are gnathostome-like, reminiscent of the Cyclopinidae. Other similarities with the Cyclopinidae include the armature of leg 1 and the 2-segmented leg 5 with the second segment having 3 setae.

In the *Gastrodelpyidae* List, 1890 (including *Gastrodelpys* List, 1890, and *Sabellacheres* M. Sars, 1862, both associated with polychaete annelids), the mandible is S-shaped with a spinulose process articulating at the proximal bend (Dudley, 1964, figs., 2D, 9c for example). It would require imagination, however, to interpret this process as a palp. Nevertheless, the nauplii of both genera have a

mandible with both exopod and endopod; in the first copepodid of *Sabellacheres*, Dudley described a mandible of different form, consisting of a lobe "with three apical, flattened, fringed blades, one apical seta, and one lateral seta" (her fig. 12F).

A suggestion of a palp may be seen in the Echiurophilidae Delamare-Deboutteville and Nunes-Ruivo, 1955, where in their figure 5 a small exopod is shown on the mandible of the male of their new genus and species, *Echiurophilus fizeii*, found in an echiurid.

In *Cotylemyzon vervoorti* Stock, 1982, an ectoparasite of a polychaete worm, the mandible was described as having a palp "justement d'importance capitale, car il n'y a pas de Poecilostomatoidea connus avec un tel palpe" (Stock, 1982, fig. 9). However, Ho (1984, p. 140) considered a palp to be lacking, the structure interpreted by Stock as a palp being nothing more than a slight protrusion bearing several setae as in *Cotylomolgus lepidonoti* Humes and Ho, 1967.

To my knowledge, mandibles in other poecilostomatoids lack a definitive palp. Mandibular palps are, of course, well known among many Cyclopoida (including notodelphyoids) and in Siphonostomatoida, for example, the Asterocheridae. The question arises whether *Erebonaster* should be regarded as a cyclopoid or a poecilostomatoid. The mouthparts, except for the mandibular palp, are more poecilostomatoid than cyclopoid. The maxillipeds show sexual dimorphism and the male first antenna is not geniculate. Both sexes have a typical poecilostome first maxilla. For these reasons *Erebonaster* is considered here as belonging to the Poecilostomatoida.

Family uncertain

Laitmatobius new genus

Diagnosis.—Male. Body unmodified. Segment bearing leg 1 separated from cephalosome. Urosome 6-segmented. Caudal ramus with 6 setae.

First antenna 5-segmented, with aesthete on last segment. Second antenna 4-segmented, with 4 setiform terminal claws. Labrum indented medially. Mandible with 2 spines and 1 seta followed by long lash. First maxilla bilobed, lobes with 2 and 3 setae, respectively. Second maxilla 2-segmented, second segment with 3 elements. Maxilliped 4-segmented (assuming proximal part of claw to represent fourth segment), third segment showing subdivision; long slender claw.

Legs 1–4 biramous with 3-segmented rami. Third segment of endopod in legs 2–4 armed as I,II,3; I,III,2, and I,III,1, respectively. Exopod of leg 4 with third segment II,I,5.

Leg 5 with small free segment bearing 2 setae.

Female.—Unknown.

Type-species.—*Laitmatobius crinitus* new species.

Gender.—Masculine.

Etymology.—The generic name is formed from the Greek words *laitma*, the deep sea, and *bios*, life, alluding to the habitat in great depths.

Laitmatobius crinitus new species

Figures 9a–g, 10a–h, 11a–f

Type Material.—45 ♂♂ in 2,004 m, Guaymas Basin, Gulf of California, 27°00'N, 111°30'W, 24 August 1985, DSRV ALVIN dive no. 1629. Holotype and 40 paratypes deposited in the National Museum of Natural History, Smithsonian Institution, Washington, D.C.

Other Specimens.—16 ♂♂ in 2,003 m, Guaymas Basin, 27°00'N, 111°30'W, 23 August 1985, DSRV ALVIN dive no. 1628.

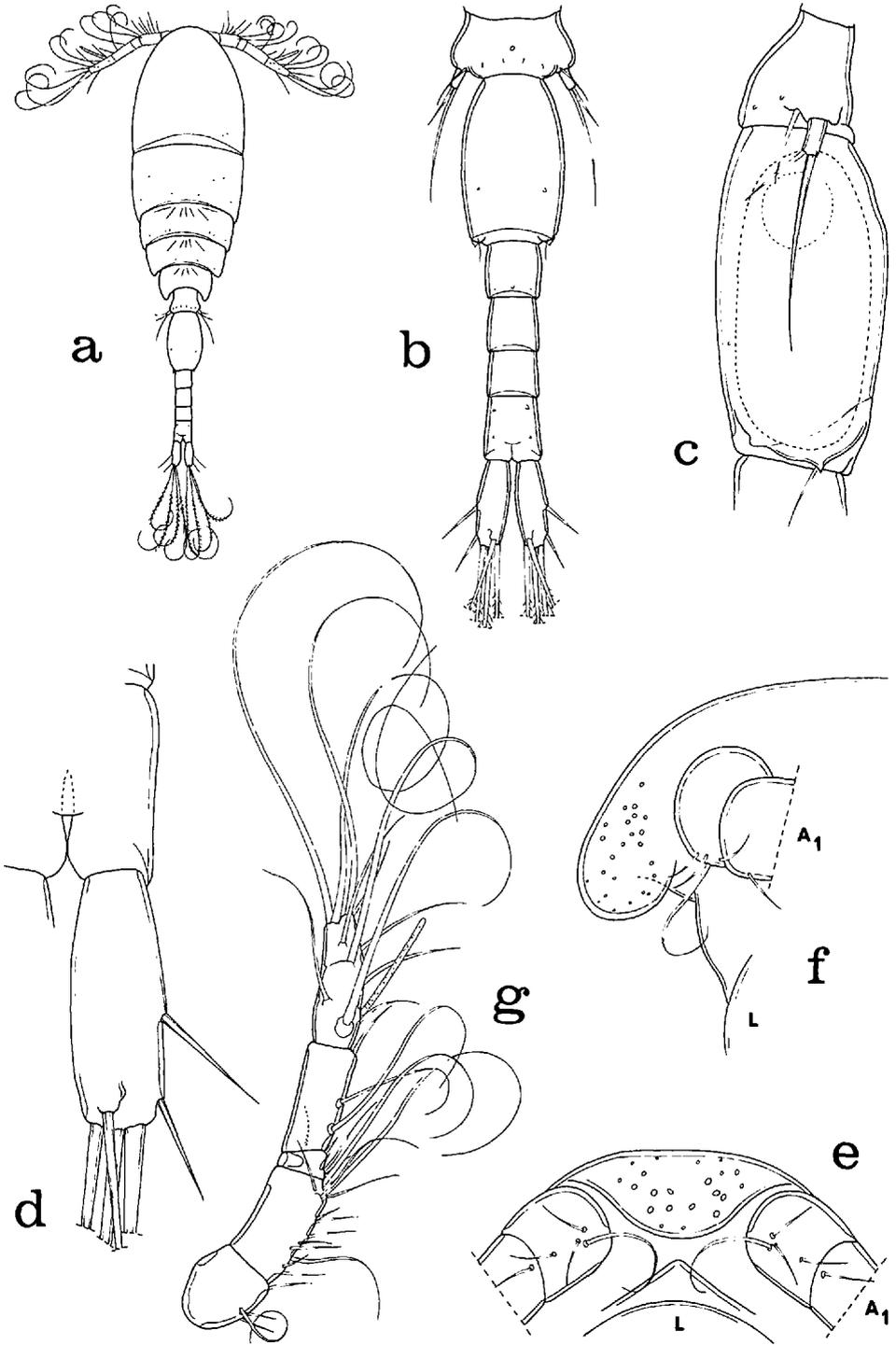


Figure 9. *Laitmatobius crinitus* new genus, new species. Male: a, dorsal (scale A); b, urosome, dorsal (D); c, segment bearing leg 5 and genital segment, lateral (G); d, caudal ramus, dorsal (E); e, rostrum, ventral (G); f, rostrum, lateral (G); g, first antenna, ventro-inner (C).

Male.—Body (Fig. 9a) slender, fusiform. Length 1.31 mm (1.29–1.38 mm) and greatest width 0.35 mm (0.33–0.39 mm), based on 10 specimens. Greatest dorsoventral thickness 0.28 mm. Segment bearing leg 1 longer than following pedigerous segments and distinctly separated from cephalosome. Epimeral areas of metasomal segments not prominent. Segments bearing legs 2–4 dorsally with longitudinal and oblique sclerotized bars. Ratio of length to width of prosome 2.3:1. Ratio of length of prosome to that of urosome 1.45:1.

Segment of leg 5 (Fig. 9b) $65 \times 109 \mu\text{m}$. Genital segment elongate, $170 \times 108 \mu\text{m}$, and $82 \mu\text{m}$ in dorsoventral thickness (Fig. 9c). Four postgenital segments from anterior to posterior 57×57 , 55×55 , 34×55 , and $65 \times 62 \mu\text{m}$.

Caudal ramus (Fig. 9d) elongate, $84 \times 31 \mu\text{m}$ (width taken at middle), wider at distal end than at base. Ratio 2.71:1. Outer lateral seta $42 \mu\text{m}$ and smooth, outermost terminal seta $36 \mu\text{m}$ and smooth. Dorsal seta, innermost terminal seta, and 2 median terminal setae long (approximately $330 \mu\text{m}$), all curled and therefore not measurable precisely, and with delicate lateral hairs.

Body surface with sensilla and refractile points as in Fig. 9a, b.

Rostrum (Fig. 9e, f) shallowly rounded in ventral view but forming blunt lobe in lateral view. Surface with conspicuous refractile areas. First antenna (Fig. 9g) 5-segmented, $242 \mu\text{m}$ long. Fifth segment showing partial crease but still entire segment. Lengths of segments: 26 ($55 \mu\text{m}$ along anterior margin), 62, 10, 78, and $86 \mu\text{m}$, respectively. Formula for armature: 4, 13, 4, 4, and $11 + 1$ aesthete. All setae smooth. Segments 2, 4, and 5 with certain setae very long and curled. Second antenna (Fig. 10a, b) 4-segmented, $276 \mu\text{m}$ ($112 \mu\text{m}$, first segment, + $164 \mu\text{m}$) with 4 small terminal claws. First segment unusually long and slender. Formula: 1, 1, 3, and $2 + \text{IV}$. Seta on first segment very small. All setae naked. Third and fourth segments with spinules on posterior surface.

Labrum (Fig. 10c) with 2 posteroventral lobes bluntly pointed, surface bearing refractile points. Mandible (Fig. 10d) elongate, basal portion bearing 2 spinulose outer spines and 1 inner seta plumose both laterally and superficially; distal portion of mandible forming long lash with its proximal outer area expanded and serrate. Paragnath not seen. First maxilla (Fig. 10e) bilobed, smaller lobe bearing 3 nearly equal setae and row of minute spinules, larger lobe with 2 unequal setae. All setae minutely barbed. Second maxilla (Fig. 10f) 2-segmented. First segment expanded and unarmed. Small slender second segment bearing 1 naked subterminal seta and 2 terminal spines both with long spinules. Maxilliped (Fig. 10g) 4-segmented (assuming proximal part of claw to represent fourth segment). First segment short, broad with row of small spinules distally. Second segment elongate with 2 patches of spinules and 2 small unequal setae; 2 sensilla on postero-outer surface. Small third segment unarmed, with sclerotization suggesting division of segment. Claw slender, $230 \mu\text{m}$ long, with 1 small inner seta near base.

Ventral area between maxillipeds and first pair of legs (Fig. 10h) not protuberant, with cruciform median sclerotization.

Legs 1–4 (Fig. 11a–d) biramous with 3-segmented rami. Formula for armature as follows:

P_1	coxa	0-1	basis	1-0	exp	I-0; I-1; II,I,4
					enp	0-1; 0-1; I,5
P_2	coxa	0-1	basis	1-0	exp	I-0; I-1; I,II,5
					enp	0-1; 0-2; I,II,3
P_3	coxa	0-1	basis	1-0	exp	I-0; I-1; I,II,5
					enp	0-1; 0-2; I,III,2
P_4	coxa	0-1	basis	1-0	exp	I-0; I-1; I,II,5
					enp	0-1; 0-2; I,III,1

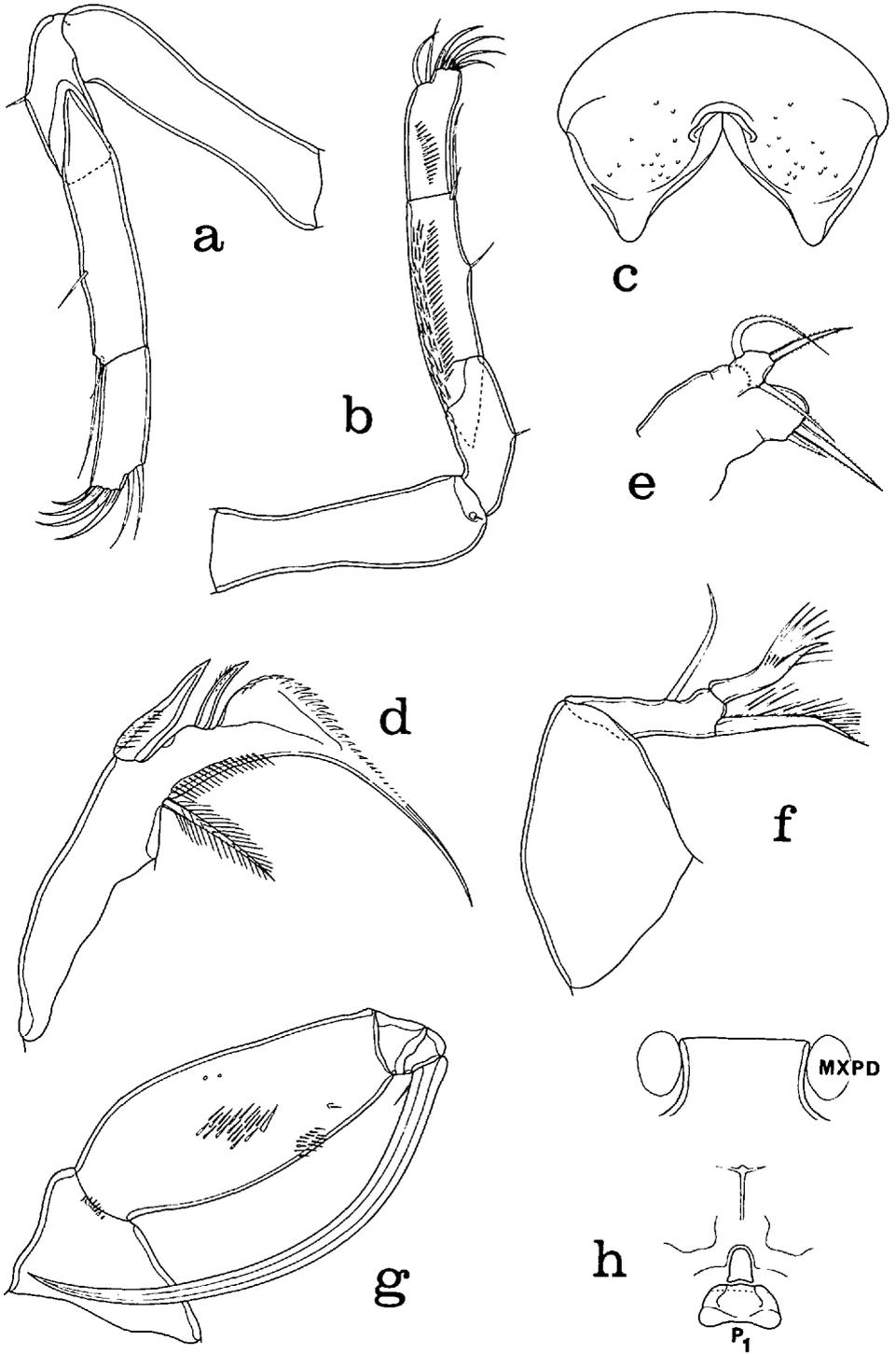


Figure 10. *Laitmatobius crinitus* new genus, new species. Male: a, second antenna, anterior (scale E); b, second antenna, posterior (E); c, labrum, ventral (G); d, mandible, posterior (F); e, first maxilla, anterior (E); f, second maxilla, postero-outer (E); g, maxilliped, antero-inner (G); h, area between maxillipeds and first pair of legs, ventral (H).

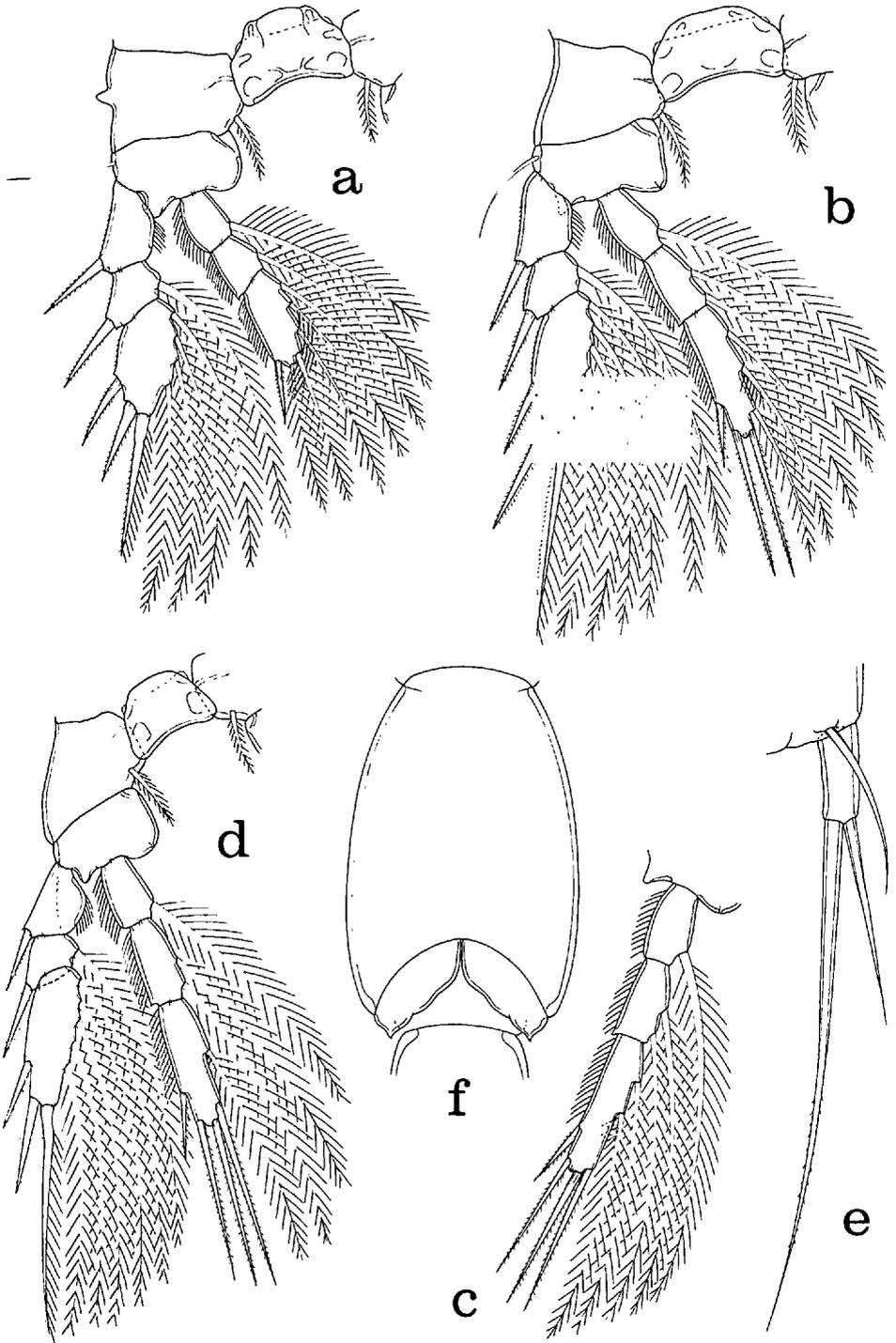


Figure 11. *Laitmatobius crinitus* new genus, new species. Male: a, leg 1 and intercoxal plate, anterior (scale C); b, leg 2 and intercoxal plate, posterior (C); c, endopod of leg 3, anterior (C); d, leg 4 and intercoxal plate, anterior (C); e, leg 5, dorsal (F); f, genital segment with leg 6, ventral (G).

Coxa of leg 1 with outer weakly sclerotized protuberance. Basis of legs 2–4 with interruption in sclerotization of inner margin. Certain setae on third segment of endopod of legs 2–4 with several unusually strong proximal spinules on outer (distal) margin.

Leg 5 (Fig. 11e) with small unornamented free segment $21 \times 8 \mu\text{m}$. Two unequal terminal setae $57 \mu\text{m}$ (outer) and smooth, and $121 \mu\text{m}$ (inner) with few delicate hairs. Adjacent dorsal seta $42 \mu\text{m}$.

Leg 6 (Fig. 11f) usual posteroventral flap on genital segment, in most specimens without setae, but in 2 males with 1 seta $36 \mu\text{m}$ long as in Fig. 9c.

Extruded spermatophore not seen.

Color of living specimens unknown.

Female.—Unknown.

Etymology.—The specific name is from Latin meaning having long hair and referring to the long curled setae on the first antennae and caudal rami.

Remarks.—The lack of females of *Laitmatobius crinitus* makes assignment to family difficult, and in my judgement unwise until females can be obtained for study. The new copepod is undoubtedly poecilostomatoid. It probably belongs near the less modified and transformed poecilostomatoid families, but without knowledge of the female its familial position remains uncertain.

The affinities of *Laitmatobius* are clearly with the poecilostomatoid family Oncaeidae Giesbrecht, 1892, and particularly with species of *Lubbockia* Claus, 1862 (Boxshall, personal communication) (see Heron and Damkaer, 1978, for descriptions of several species of *Lubbockia*). Several features of the appendages suggest this relationship: (1) the segmentation of the male first antenna, (2) the armature of the mandible, (3) the form of the first maxilla, (4) the structure of the second maxilla, (5) the formula for the armature of legs 1–4, and (6) the nature of leg 5.

Several features of *L. crinitus* (male only) have particular interest: (1) the 5-segmented first antenna; (2) the weakly prehensile 4-segmented second antenna; (3) the medially incised labrum; (4) the mandible with 3 elements plus a long lash; (5) the second maxilla with the second segment having 2 spines and 1 seta; (6) legs 1–4 biramous with 3-segmented rami; and (7) the free segment of leg 5 with 2 setae.

Order SIPHONOSTOMATOIDA Thorell, 1859

Family Dirivultidae Humes and Dojiri, 1980

Diagnosis.—Siphonostomes with body unmodified or slightly so. Urosome in female 5-segmented, in male 6-segmented. Caudal ramus with 6 setae. Rostrum weakly developed. First antenna with aesthete on penultimate segment, in female with 9–18 segments, in male with 10–12 segments. Second antenna with small exopod, at most 21-segmented; second endopod segment with 3 terminal setae or 1 recurved claw plus few small setae.

Oral cone short, no true siphon. Mandible long slender blade with minutely serrate tip, palp lacking. First maxilla bilobed. Second maxilla 2-segmented with large seta on first segment or this segment unarmed. Maxilliped 4-segmented with terminal claw, often long and slender.

Legs 1–3 biramous with 3-segmented rami. Leg 4 with 3-segmented exopod and 2-segmented endopod. Endopod of leg 2 (rarely of leg 1 also) showing sexual dimorphism or alike in both sexes. Number of inner setae on third segment of

exopod of legs 1–4 usually 4,4,5,4, rarely 4,4,5,5 or 2,4,5,4. Formula for endopod of leg 4 as 0-0; I,1, - 0-0; 1,1, - or 0-0; 1.

Leg 5 sexually dimorphic.

Remarks.—The nine genera here included in the Dirivultidae have six features in common: (1) the first antenna with the aesthete located on the penultimate segment, (2) the second antenna with a small exopod, at most 1-segmented, (3) a small oral cone, not a true siphon, (4) the mandible a slender blade with minutely serrate tip and lacking a palp, (5) legs 1–3 with 3-segmented rami, and (6) leg 4 with a 3-segmented exopod and 2-segmented endopod.

Beyond this uniformity we find exceptions in other features. The number of segments in the first antenna of the female is 9–18, in the male 10–12. The terminal armature of the second antenna consists of 3 principal setae (*Aphotopontius*, *Stygiopontius*, *Rhogobius*, *Scotoecetes*, *Fissuricola* and *Benthoxynus*), 2 setae (*Exrima*), or 1 recurved claw plus a few small setae (*Dirivultus*, *Ceuthoecetes*, and *Nilva*).

The second maxilla has a large seta on the first segment (*Aphotopontius*, *Stygiopontius*, *Exrima*, *Scotoecetes*, and *Benthoxynus*), but this seta is absent in *Rhogobius*, *Ceuthoecetes*, *Dirivultus*, and *Nilva*.

The number of inner setae on the third segment of the exopod in legs 1–4 is usually 4,4,5,4, but 4,4,5,5 in *Exrima*, and 2,4,5,4 in *Benthoxynus*. The formula for leg 4 is 0-0; I,1 or 0-0; 1,1 in *Aphotopontius* and *Stygiopontius*; 0-0; I,1 in *Rhogobius*, *Scotoecetes*, *Ceuthoecetes*, *Dirivultus*, and *Nilva*; 0-0; I in *Exrima*; and 0-0; 1 in *Benthoxynus*.

Sexual dimorphism is seen in the armature of the endopod of leg 2 in *Aphotopontius*, *Stygiopontius*, and *Rhogobius* (slight), in both leg 1 and 2 in *Scotoecetes*. No sexual dimorphism occurs in the legs of *Dirivultus*, *Benthoxynus*, or *Nilva*.

Leg 5 in the female is 2-segmented with the formula 1,3 in *Aphotopontius*, *Stygiopontius*, *Exrima*, and *Rhogobius*; with the first segment fused to the body and the formula 1,2 (*Scotoecetes*); with the 2 segments fused but separated from the body and bearing 4 setae (*Ceuthoecetes* and *Nilva*); with a minute free segment bearing 1 seta (*Dirivultus*); or a small lobe with 3 setae (*Benthoxynus*).

Leg 5 in the male is 2-segmented with the formula 1 and 3 + 2 (*Aphotopontius*, *Stygiopontius*); with the first segment fused to the body and the formula 1 and 3 + 2 (*Rhogobius*, *Ceuthoecetes*, and *Nilva*); with the first segment fused to the body and the formula 1,2 (*Dirivultus*); with a small ridge bearing 3 setae (*Scotoecetes*); or represented only by 2 setae (*Benthoxynus*).

In spite of these exceptions the assemblage of six new genera described here falls under the umbrella of the revised diagnosis of the family Dirivultidae as given above. At present there seems to be no satisfactory way of grouping the genera in the family in natural categories.

Aphotopontius new genus

Diagnosis.—Body unmodified. Segment bearing leg 1 fused with cephalosome. Urosome in female 5-segmented, in male 6-segmented. Caudal ramus with 6 setae.

Rostrum poorly defined. First antenna of female 10- or 12-segmented, with aesthete on penultimate segment (in 2 species first segment subdivided, giving appearance of 12 segments); in male 12-segmented and geniculate, with specialized process on segment 5. Second antenna with 2-segmented protopod, 1-segmented exopod, and 2-segmented endopod. Oral cone short, no true siphon. Mandible elongate blade without palp. First maxilla with outer lobe bearing 3 setae and

inner lobe having 4 setae. Second maxilla with first segment bearing 1 seta. Second segment attenuated and clawlike. Maxilliped 4- or less often 5-segmented with long slender claw.

Legs 1-4 biramous with 3-segmented rami, except 2-segmented endopod in leg 4. Basis of leg 1 with inner spine. Endopods of legs 1-3 with second segment having 2 inner setae and 2 distal outer spiniform processes. Third segment of endopod of leg 2 in male showing sexual dimorphism in armature, having I,II,3 or 1,2,3. Third segment of endopod of leg 3 with 1,I,3. Endopod of leg 4 with formula usually 0-1; I,1, rarely 0-1; 1,1.

Leg 5 in female elongate, carried laterally, and 2-segmented, formula 1,3; in male carried ventrally, first segment fused with body and bearing 1 seta, with 1 small suboval free segment bearing 5 setae, median 2 broad and hyaline, formula 1,5.

Leg 6 in female represented by 1 seta, in male by 2 setae.

Egg sac, in 3 species where known, with 2 eggs.

Type-species.—*Aphotopontius forcipatus* new species.

Gender.—Masculine.

Etymology.—The generic name is formed from the Greek words *aphos*, without light, and *pontios*, in the sea, alluding to the habitat of the members of the genus.

Remarks.—The presence of an inner seta on the first segment of the endopod of leg 4 serves to distinguish *Aphotopontius* from the related multispecific genus *Stygiopontius* (see below). Additional means of separating *Aphotopontius* from other dirivultid genera will be found in the key to genera on page 785.

Aphotopontius forcipatus new species

Figures 12a-j, 13a-e, 14a-g, 15a-f

Type Material.—15 ♀♀, 22 ♂♂, in 1,818 m, Magic Mountain, Explorer Ridge, 49°45.6'N, 130°16.1'W, 01 July 1984, DSRV PISCES IV dive no. P-1494. Holotype ♀, allotype, and 30 paratypes (11 ♀♀, 19 ♂♂) deposited in the National Museum of Natural History, Smithsonian Institution, Washington, D.C.

Female.—Body (Fig. 12a) unmodified. Length 0.77 mm (0.70–0.86 mm) and greatest width 0.31 mm (0.28–0.35 mm), based on 10 specimens. Greatest dorsoventral thickness 0.21 mm. Segment of leg 1 fused with cephalosome. Epimeral areas of segments bearing leg 1 rounded, those of segments bearing legs 2 and 3 slightly pointed, and those of segment bearing leg 4 rounded. Ratio of length to width of prosome 1.68:1. Ratio of length of prosome to that of urosome 2.04:1.

Segment bearing leg 5 (Fig. 12b) $47 \times 91 \mu\text{m}$. Genital segment $83 \times 99 \mu\text{m}$, broadest at midregion and tapering posteriorly. Genital areas located dorsolaterally near middle of segment. Each area (Fig. 12c) bearing slender seta $26 \mu\text{m}$. Three postgenital segments from anterior to posterior 26×55 , 15.5×52 , and $31 \times 46 \mu\text{m}$.

Caudal ramus (Fig. 12d) greatly elongated, $79 \times 14 \mu\text{m}$ (width taken at middle), ratio 5.64:1. Outer lateral seta $66 \mu\text{m}$, set close to outermost terminal seta $42 \mu\text{m}$, dorsal seta $50 \mu\text{m}$, innermost terminal seta very short, $7 \mu\text{m}$; all these setae smooth. Two median terminal setae $195 \mu\text{m}$ (outer) and $346 \mu\text{m}$ (inner), both with few small barbs along their midregions.

Body surface smooth.

Egg sac not seen.

Rostral area (Fig. 12e) weakly developed. First antenna (Fig. 12f) $286 \mu\text{m}$ long not including setae. Lengths of 12 segments: 5 ($13 \mu\text{m}$ along anterior margin), 3,

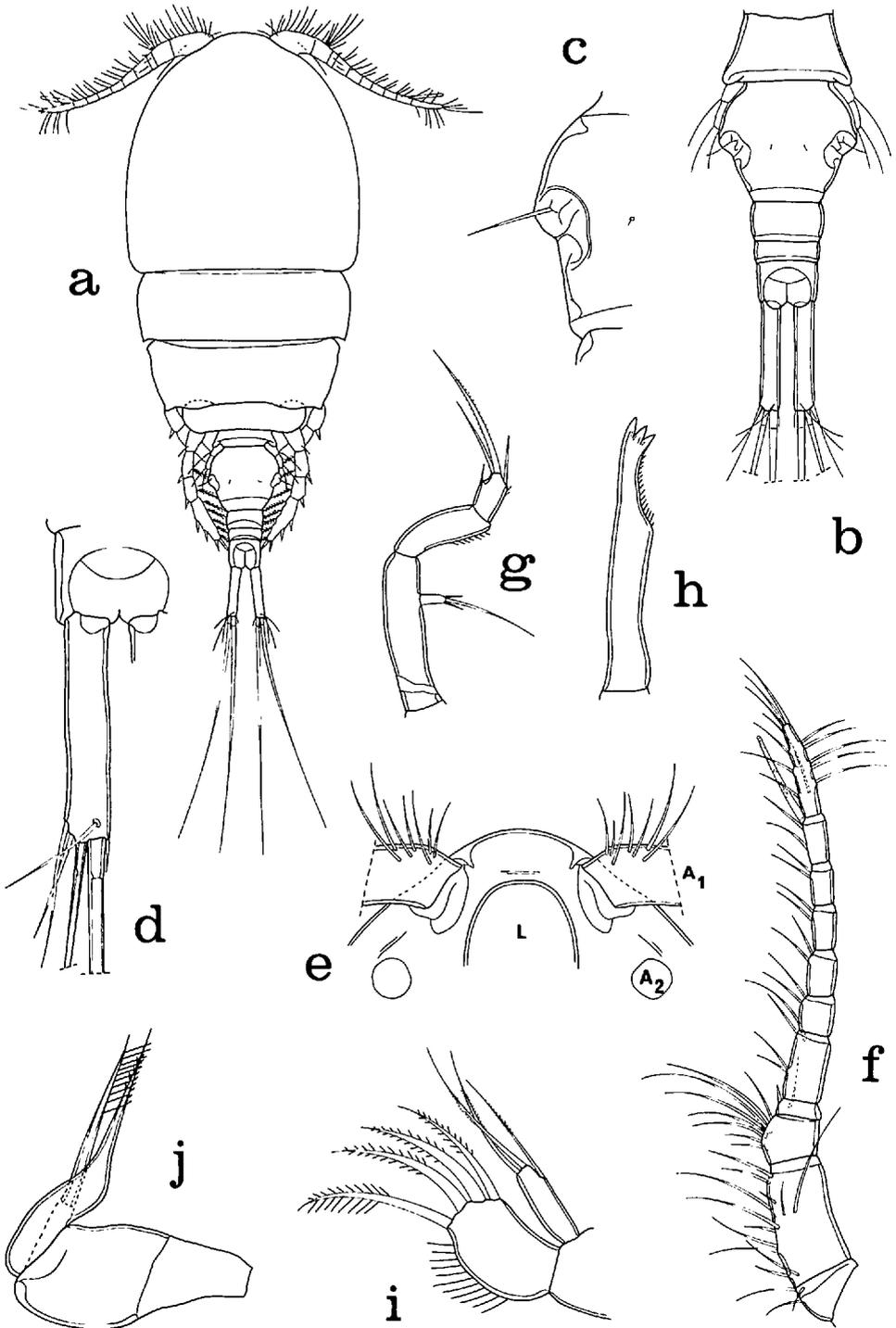


Figure 12. *Aphotopontius forcipatus* new genus, new species. Female: a, dorsal (scale B); b, urosome, dorsal (C); c, genital area, dorsal (E); d, caudal ramus, dorsal (E); e, rostral area, ventral (G); f, first antenna, posteroventral (G); g, second antenna, antero-inner (E); h, mandible, anterior (F); i, first maxilla, posterior (F); j, second maxilla, anterior (F).

46, 15, 7, 33, 19, 21, 21, 21, 22, and 41 μm , respectively. Armature: 1, 2, 12, 8, 2, 4, 2, 2, 2, 2, 2 + 1 aesthete, and 12. All setae smooth.

Second antenna (Fig. 12g) 100 μm long not including setae and slender. Protopod 2-segmented. Exopod 1-segmented with 3 smooth setae. Endopod 2-segmented, first segment with inner distal row of spinules, second segment with few similar spinules and 4 setae, 2 short and smooth, 2 long with short lateral barbules.

Oral cone similar to that of *Aphotopontius flexus* below. Mandible (Fig. 12h) 117 μm long, with subterminal row of short spinules and 3 terminal teeth. First maxilla (Fig. 12i) with small slender outer lobe bearing 3 setae and larger inner lobe having 4 setae and inner marginal row of setules. All setae with short hairs or spinules. Second maxilla (Fig. 12j) with smooth basal segment bearing slightly sinuose unilaterally barbed claw and lobe carrying spinulose seta. Maxilliped (Fig. 13a) 4-segmented. First segment with distal inner seta 39 μm . Long second segment with 2 inner setae. Third segment having slight indication of subdivision but this not complete, bearing 1 distal seta. Fourth segment cylindrical with 1 distal seta and long terminal claw with few minute barbules along distal concave side.

Legs 1–4 (Fig. 13b–e) biramous with rami 3-segmented except for 2-segmented endopod in leg 4. Spine and setal formula as follows:

P_1	coxa	0-0	basis	1-I	exp	I-1; I-1; II,I,4
					enp	0-1; 0-2; 1,2,3
P_2	coxa	0-1	basis	1-0	exp	I-1; I-1; II,II,4
					enp	0-1; 0-2; 1,2,3
P_3	coxa	0-1	basis	1-0	exp	I-1; I-1; II,II,5
					enp	0-1; 0-2; 1,I,3
P_4	coxa	0-0	basis	1-0	exp	I-1; I-1; II,II,4
					enp	0-1; I,1

Coxae of legs 1 and 4 without inner seta. Leg 1 with basis having inner barbed spine 27 μm . Endopod of leg 2 with 2 terminal setae slightly stouter than adjacent setae and somewhat spiniform in appearance. Leg 4 (Fig. 13e) with exopod 175 μm . First segment of endopod 30 \times 20 μm , its seta 68 μm . Second segment 58 \times 20 μm (length 63 μm including spiniform process), inner seta 70 μm , and terminal barbed spine 66 μm .

Leg 5 (Fig. 14a) 2-segmented, relatively short. First segment 22 \times 17 μm , its seta 45 μm ; second segment 17.5 \times 11 μm , its 3 setae from inner to outer 40, 36, and 28 μm . All setae with short hairs.

Leg 6 probably represented by seta on genital area (Fig. 12c).

Color of living specimens unknown.

Male. — Body (Fig. 14b) slightly larger than in female, with cephalosome relatively broader. Length 0.87 mm (0.80–0.94 mm) and greatest width 0.37 mm (0.35–0.39 mm), based on 10 specimens. Greatest dorsoventral thickness 0.25 mm. Epimeral areas of segments bearing legs 1 and 4 pointed. Ratio of length to width of prosome 1.55:1. Ratio of length of prosome to that of urosome 2.06:1.

Segment bearing leg 5 (Fig. 14c) 39 \times 78 μm . Genital segment 68 \times 93 μm , broader than long, with rounded lateral margins in dorsal view. Four postgenital segments from anterior to posterior 36 \times 65, 34 \times 60, 26 \times 57, and 36 \times 52 μm .

Caudal ramus similar to that of female but larger, 95 \times 17 μm , ratio 5.6:1.

Body surface smooth as in female.

Rostrum (Fig. 14d) small with broadly rounded posteroventral margin.

First antenna (Fig. 14e) geniculate, 12-segmented, 286 μm long as drawn. Lengths of segments: 8 (39 μm along anterior margin), 5, 81, 29, 5, 17, 62, 23, 49, 83, 62,

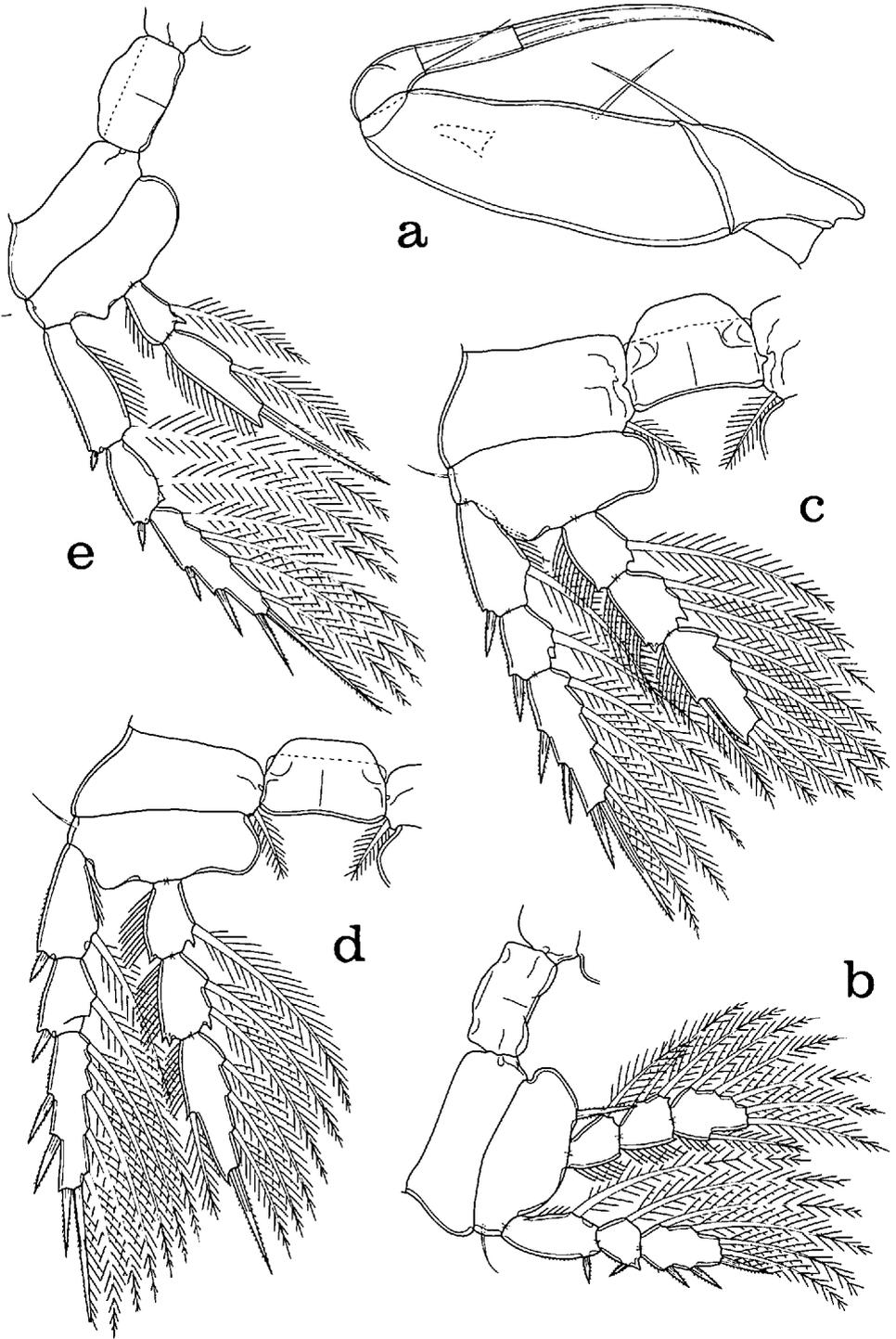


Figure 13. *Aphotopontius forcipatus* new genus, new species. Female: a, maxilliped, posterior (scale F); b, leg 1 and intercoxal plate, anterior (G); c, leg 2 and intercoxal plate, anterior (G); d, leg 3 and intercoxal plate, anterior (G); e, leg 4 and intercoxal plate, anterior (G).

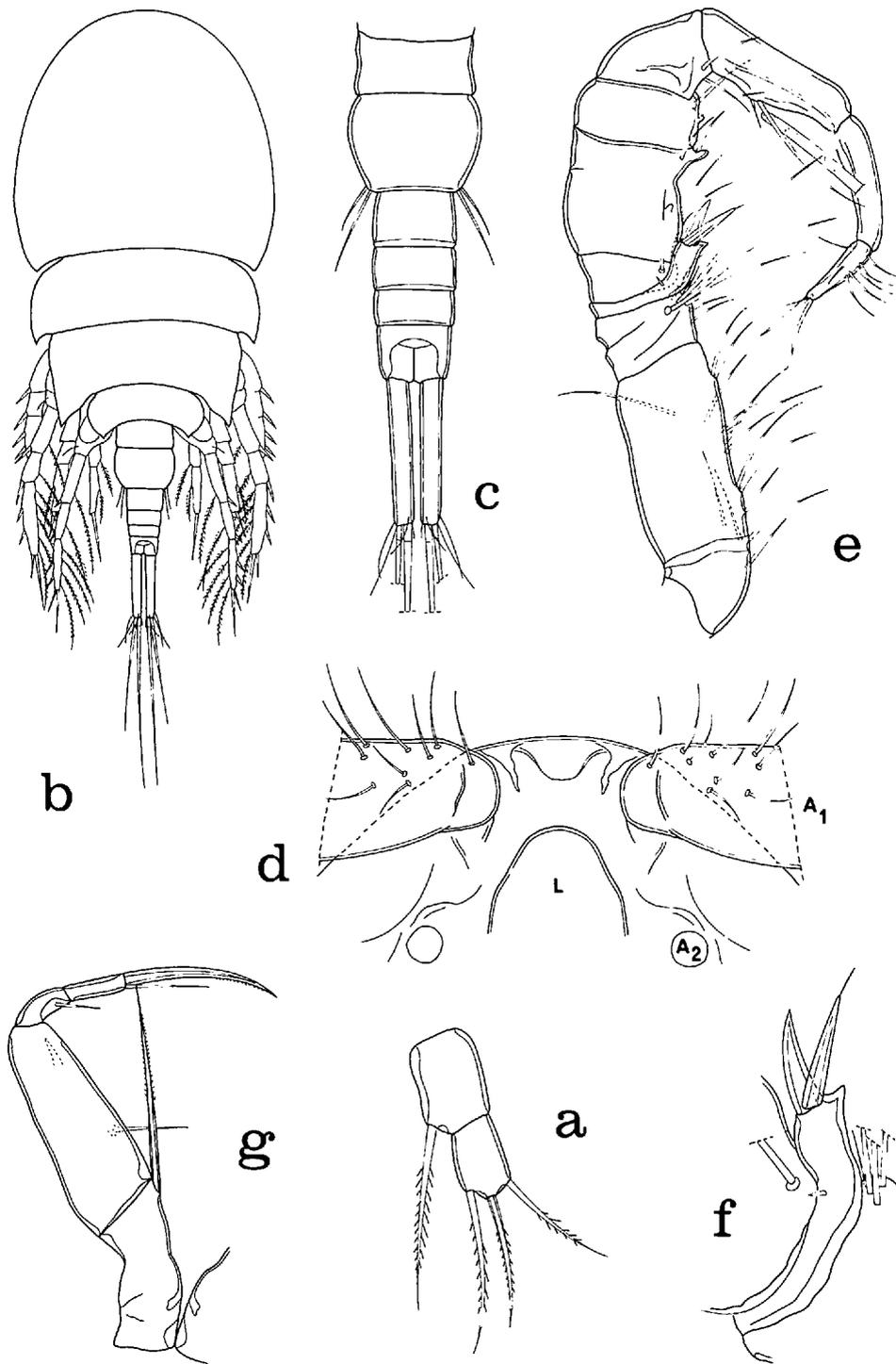


Figure 14. *Aphotopontius forcipatus* new genus, new species. Female: a, leg 5, lateroventral (scale F). Male: b, dorsal (H); c, urosome, dorsal (C); d, rostrum, ventral (G); e, first antenna, posteroventral (G); f, fifth segment of first antenna, posteroventral (F); g, maxilliped, posterior (G).

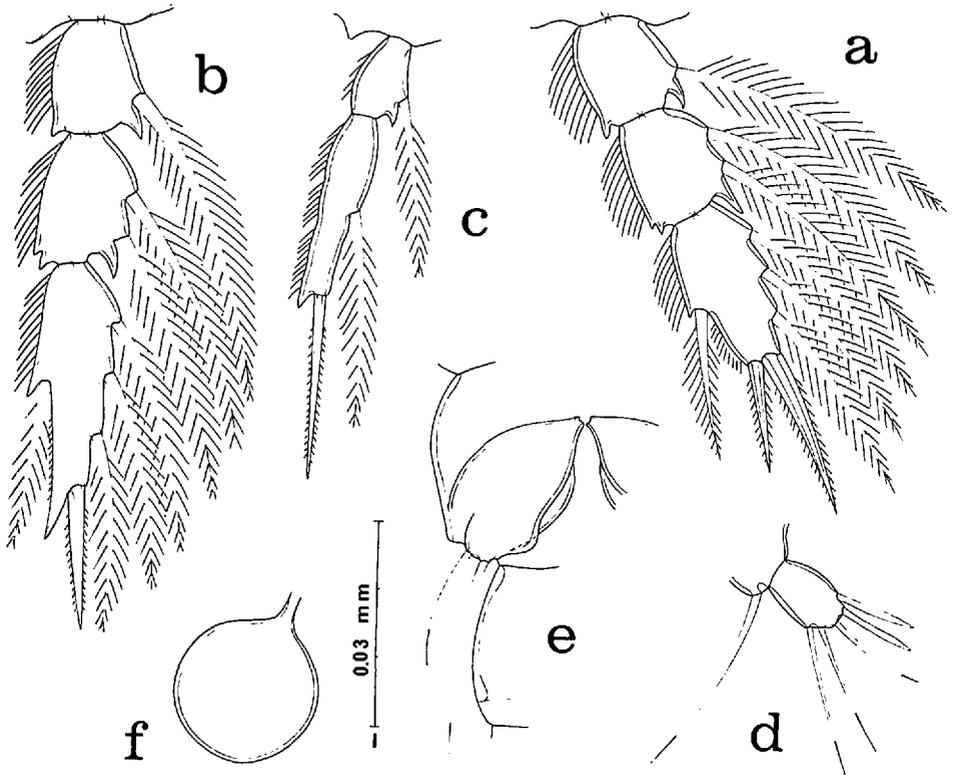


Figure 15. *Aphotopontius forcipatus* new genus, new species. Male: a, endopod of leg 2, anterior (scale G); b, endopod of leg 3, anterior (G); c, endopod of leg 4, anterior (G); d, leg 5, ventral (E); e, leg 6, ventral (E); f, spermatochore, attached to female, dorsal (I).

and 36 μm , respectively. Armature: 1, 2, 12, 7, 2, 2, 4, 2, 2, 3, 1 aesthete, and 10. Fifth segment (Fig. 14f) with large inner process bearing 2 conspicuous spines resembling jaws of scissors, one spine 23 μm , other 28 μm with terminal filament 7 μm . Seventh segment with small distal inner thumblike lobe. Aesthete on segment 11 in most specimens directed proximally.

Second antenna, oral cone, mandible, first maxilla, and second maxilla like those of female. Maxilliped (Fig. 14g) resembling that of female but seta on first segment 99 μm long, more than 2 times longer and having minute barbules.

Leg 1 as in female. Leg 2 like that of female but endopod (Fig. 15a) having 2 terminal spines rather than setae and adjacent row of spinules more conspicuous than in female. Leg 3 resembling that of female but terminal spiniform process on third segment of endopod larger (Fig. 15b). Leg 4 like that of female but second segment of endopod longer (Fig. 15c). First segment 34 \times 24 μm (36 μm long including spiniform process), its seta 90 μm . Second segment 84 μm long (91 μm with spiniform process), 21.5 μm wide proximally, 13 μm wide distally. Inner seta 104 μm . Terminal spine 85 μm .

Leg 5 (Fig. 15d) situated ventrally. Free segment 26 \times 15.5 μm , with 5 smooth setae (3 slender, 2 stout) from outer to inner 47, 47, 36, and 20 μm . Adjacent dorsal seta 70 μm . All setae smooth.

Leg 6 (Fig. 15e) with 2 smooth setae 52 μm and 65 μm .

Spermatochore (Fig. 15f) globular, 18 \times 18 μm .

Color unknown.

Etymology.—The specific name *forcipatus*, Latin meaning pertaining to scissors or forceps, alludes to the scissorlike spines on segment 3 of the first antenna of the male.

Remarks.—*Aphotopontius forcipatus* may be recognized by the genital segment of the female being wider than long with moderately expanded rounded lateral margins, the elongate caudal ramus (5.6:1 in both sexes), the apparently 4-segmented maxilliped, and in the male the 2 conspicuous spines on the fifth segment of the first antenna.

Aphotopontius arcuatus new species

Figures 16a–g, 17a–h, 18a–e, 19a, b

Type Material.—269 ♀♀, 2 ♂♂ from washings of vestimentiferans (see Jones, 1985) and the bivalve *Calyptogena magnifica* Boss and Turner, in 2,618 m, Clam Acres, East Pacific Rise, 20°50.0'N, 109°06.0'W, 04 May 1982, DSRV ALVIN dive no. 1221. Holotype ♀, allotype, and 264 paratypic females deposited in the National Museum of Natural History, Smithsonian Institution, Washington, D.C.

Other Specimens.—551 ♀♀, 5 ♂♂, from washings of vestimentiferans and *Calyptogena*, in 2,612 m, Clam Acres, East Pacific Rise, 20°50.0'N, 109°06.0'W, 25 April 1982, DSRV ALVIN dive no. 1219; 12 ♀♀ from washings of the bivalve *Bathymodiolus thermophilus* Kenk and Wilson, in 2,451 m, Galapagos Rift, 00°48.0'N, 86°13.0'W, 01 December 1979, DSRV ALVIN dive no. 984; 50 ♀♀, in 2,616 m, Clam Acres, East Pacific Rise, 20°50.0'N, 109°06.0'W, 10 May 1982, DSRV ALVIN dive no. 1226; 2 ♀♀, in 2,615 m, Clam Acres, East Pacific Rise, 20°50.0'N, 109°06.0'W, 17 April 1982, DSRV ALVIN dive no. 1211; 6,035 ♀♀, in 2,633 m, Clam Acres, East Pacific Rise, 20°50.0'N, 109°06.0'W, 20 April 1982, DSRV ALVIN dive no. 1214; 2 ♀♀, in 2,635 m, Biocyarise, East Pacific Rise, 12°48.6'N, 103°56.7'W, 17 March 1984, DSRV CYANA dive no. 84-40.

Female.—Body (Fig. 16a) with moderately broad prosome. Length 0.82 mm (0.81–0.87 mm) and greatest width 0.37 mm (0.35–0.40 mm), based on 10 specimens. Greatest dorsoventral thickness approximately 0.19 mm. Segment bearing leg 1 fused with cephalosome, with acutely pointed epimeral areas. Epimera of segments bearing legs 2 and 3 subtruncate, those of segment bearing leg 4 subattenuate. Ratio of length to width of prosome 1.38:1. Ratio of length of prosome to that of urosome 1.47:1.

Segment bearing leg 5 (Fig. 16b) $44 \times 96 \mu\text{m}$ in dorsal view. Genital segment (Fig. 16c, d) $130 \mu\text{m}$ long, anterior half laterally expanded ($127 \mu\text{m}$ wide) with margins recurved and hooklike, posterior half not expanded ($81 \mu\text{m}$ wide) with nearly parallel lateral margins and having pair of small posterolateral spiniform processes. At junction of 2 halves, sclerotizations suggesting bipartite origin of segment. Genital areas located laterally and slightly dorsally on expanded anterior half of segment. Each area (Fig. 16c) with single long slender seta $40 \mu\text{m}$. Three postgenital segments from anterior to posterior 52×65 , 29×56 , and $39 \times 55 \mu\text{m}$. Anal segment with group of posteroventral spinules on each side (Fig. 16e).

Caudal ramus (Fig. 16e) elongate, $104 \times 16 \mu\text{m}$ including triangular ventral terminal flange, ratio 6.5:1. Outer margin of ramus bowed inwardly and having several small marginal spinules distally. Outer lateral seta $112 \mu\text{m}$, close to outermost terminal seta $104 \mu\text{m}$ (here displaced subterminally). Dorsal seta $120 \mu\text{m}$. Innermost terminal seta short, $20 \mu\text{m}$, slender. Two long median terminal setae $209 \mu\text{m}$ (outer) and $473 \mu\text{m}$ (inner), both with short lateral spinules. Other setae smooth.

Body surface smooth, without sensilla.

Egg sac (Fig. 16f) $255 \mu\text{m}$ long, containing 2 eggs $180 \times 130 \mu\text{m}$ and $187 \times 143 \mu\text{m}$.

Rostral area (Fig. 17f) not well defined. First antenna (Fig. 16g) $396 \mu\text{m}$ long, not including setae. Lengths of its 10 segments: 78 ($117 \mu\text{m}$ along anterior margin),

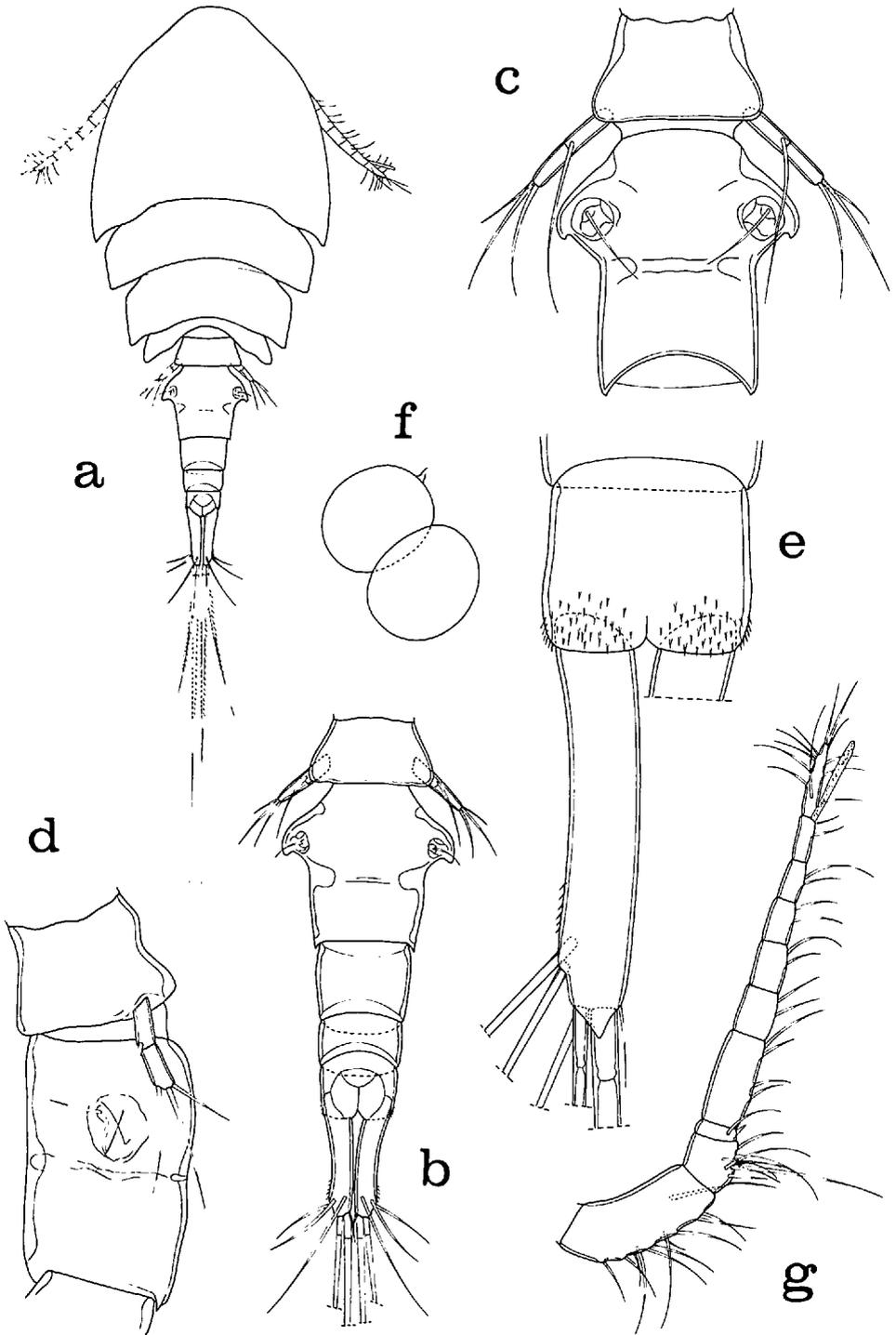


Figure 16. *Aphotopontius arcuatus* new genus, new species. Female: a, dorsal (scale H); b, urosome, dorsal (C); c, segment bearing leg 5 and genital segment, dorsal (G); d, segment bearing leg 5 and genital segment, lateral (G); e, anal segment and caudal ramus, ventral (F); f, egg sac, ventral (H); g, first antenna, anterodorsal (C).

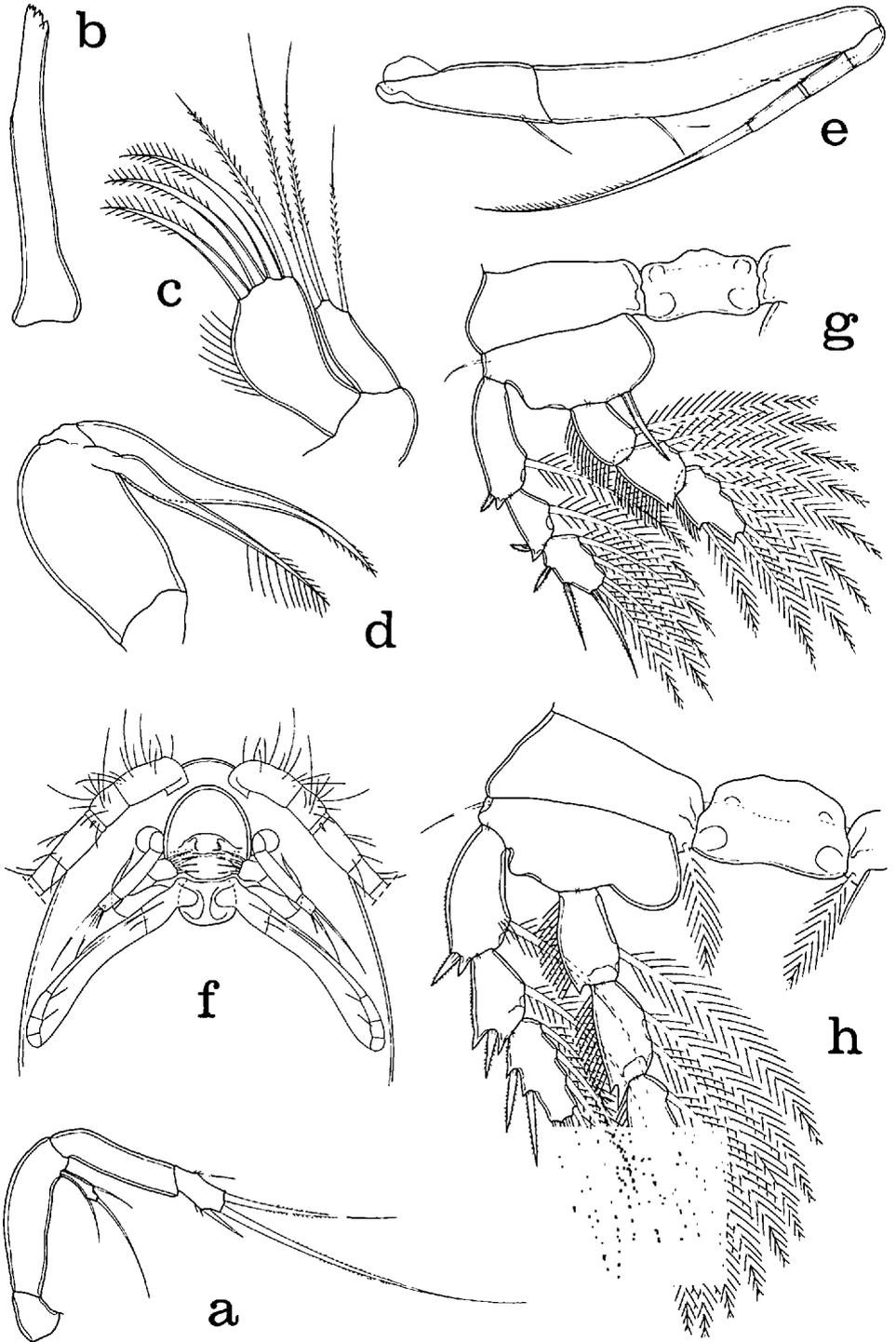


Figure 17. *Aphotopontius arcuatus* new genus, new species. Female: a, second antenna, antero-inner (scale G); b, mandible, anterior (F); c, first maxilla, posterior (F); d, second maxilla, posterior (F); e, maxilliped, anterior (G); f, rostral area, oral cone, and mouthparts, ventral (D); g, leg 1 and intercoxal plate, anterior (G); h, leg 2 and intercoxal plate, anterior (G).

23, 10, 65, 31, 31, 31, 29, 29, and 55 μm , respectively. Armature: 12, 8, 2, 4, 2, 2, 2, 2 + 1 aesthete, and 12. All setae smooth.

Second antenna (Fig. 17a) resembling that in congeners. Without fine ornamentation except for few small spinules near insertions of inner and outer setae on second segment of endopod.

Oral cone (not true siphon) short, as in Fig. 17f. Mandible (Fig. 17b) 78 μm long, with finely bifurcated terminal teeth. First maxilla (Fig. 17c) and second maxilla (Fig. 17d) resembling those in congeners. Maxilliped (Fig. 17e) unusually long and slender, 5-segmented. Segments 1 and 2 together 247 μm , segments 3, 4, 5, together with claw 221 μm . Each segment with 1 smooth seta. Fifth segment bearing slender terminal claw 110 μm with inner distal spinules.

Arrangement of appendages of cephalosome as in Fig. 17f.

Legs 1–4 (Figs. 17g, h, 18a, b) biramous with 3-segmented rami, except for 2-segmented endopod of leg 4. Spine and setal formula as follows:

P_1	coxa	0-0	basis	1-I	exp	I-1; I-1; II,I,4
					enp	0-1; 0-2; 1,2,3
P_2	coxa	0-1	basis	1-0	exp	I-1; I-1; II,II,4
					enp	0-1; 0-2; 1,2,3
P_3	coxa	0-1	basis	1-0	exp	I-1; I-1; II,II,5
					enp	0-1; 0-2; 1,I,3
P_4	coxa	0-0	basis	1-0	exp	I-1; I-1; II,II,4
					enp	0-1; I,1

Inner spine on basis of leg 1 39 μm long and finely barbed. Outer spine on second segment of exopod directed proximally. First segment of exopod of leg 2 with several long spinules on anterior surface near insertions of inner seta (Fig. 17h). Leg 4 (Fig. 18b) with exopod 172 μm . Endopod with first segment 32×11 μm , its inner seta 86 μm ; second segment 46×10 μm , its terminal barbed spine 88 μm and its inner seta 86 μm .

Leg 5 (Fig. 18c) 2-segmented. First segment 28×11 μm , its seta 88 μm . Second segment 24×10 μm , its 3 setae 80, 63, and 30 μm , respectively.

Leg 6 probably represented by seta on genital area (Fig. 16c).

Color of living specimens unknown.

Male. — Body (Fig. 18d) moderately broad as in female. Length 0.59 mm (0.57–0.61 mm) and greatest width 0.24 mm (0.23–0.25 mm), based on 2 specimens. Greatest dorsoventral thickness 0.16 mm. Ratio of length to width of prosome 1.41:1. Ratio of length of prosome to that of urosome 1.64:1.

Segment bearing leg 5 (Fig. 18e) 42×60 μm . Genital segment 65×73 μm , with rounded lateral margins. Four postgenital segments from anterior to posterior 39×55 , 30×43 , 18×39 , and 31×39 μm . Anal segment with posteroventral spinules as in female.

Caudal ramus similar to that in female but shorter, 57×14 μm , ratio 4:1.

Body surface and rostral area as in female.

First antenna (Fig. 19a) geniculate, 12-segmented, 180 μm long. Lengths of segments: 6 (23 μm along anterior margin), 4, 35, 15, 5, 6, 23, 15, 16, 37, 30, and 24 μm , respectively. Armature: 1, 2, 12, 7, 2, 2, 4, 2, 2, 3, 1 aesthete, and 10. Fifth segment with inner extension bearing smooth spiniform seta 27 μm .

Second antenna, oral cone, mandible, first maxilla, second maxilla, and maxilliped similar to those in female.

Legs 1, 3, and 4 as in female. Leg 2 with endopod having formula 0-1; 0-2; 1,II,3 as in congeners.

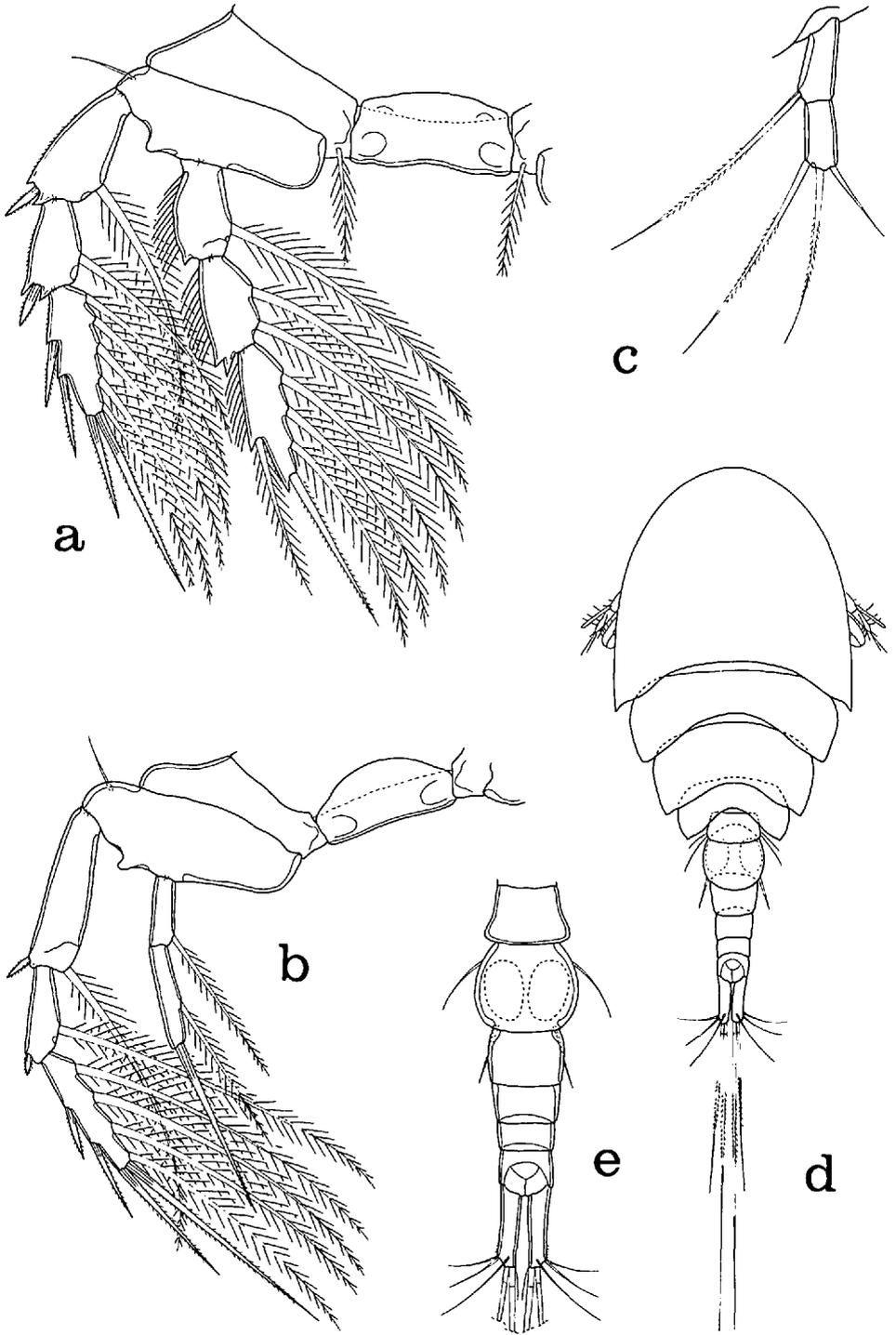


Figure 18. *Aphotopontius arcuatus* new genus, new species. Female: a, leg 3 and intercoxal plate, anterior (G); b, leg 4 and intercoxal plate, anterior (G); c, leg 5, dorsolateral (E). Male: d, dorsal (D); e, urosome, dorsal (C).

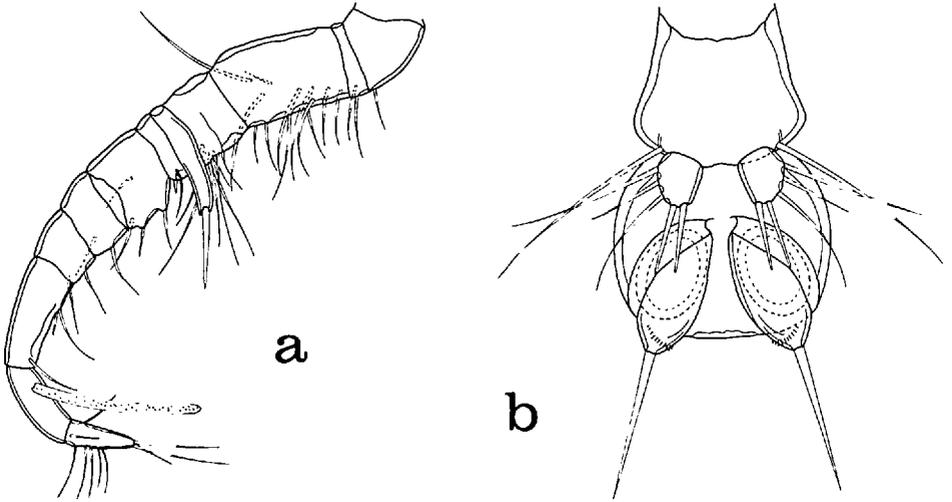


Figure 19. *Aphotopontius arcuatus* new genus, new species. Male: a, first antenna, posteroventral (scale E); b, leg 5 and leg 6, ventral (E).

Leg 5 (Fig. 19b) situated ventrally. Free segment $16.5 \times 14 \mu\text{m}$, with 5 smooth setae from outer to inner 50, 22, 45, 25, and $25 \mu\text{m}$; 2 innermost setae broad. Adjacent dorsal seta $66 \mu\text{m}$.

Leg 6 (Fig. 19b) with 1 smooth seta $50 \mu\text{m}$, and bearing crescentic row of minute spinules.

Spermatophore unknown.

Color unknown.

Etymology.—The specific name *arcuatus*, Latin meaning arched or bowed, refers to the slightly concave outer margin of the caudal ramus.

Remarks.—*Aphotopontius arcuatus* may be recognized by the concave outer margin of the caudal ramus, the unusually long slender maxilliped, the genital segment of the female expanded in its anterior part with recurved hooklike margins, the presence of ventral surficial spinules on the anal segment, and the presence of only one seta on leg 6 in the male.

Aphotopontius baculigerus new species

Figures 20a–j, 21a–f, 22a–g

Type Material.—22 ♀♀, 16 ♂♂, in 2,457 m, Galapagos Rift, $00^{\circ}48.0'N$, $86^{\circ}13.0'W$, 30 November 1979, DSRV ALVIN dive no. 983. Holotype ♀, allotype, and 30 paratypes (17 ♀♀, 13 ♂♂) deposited in the National Museum of Natural History, Smithsonian Institution, Washington, D.C.

Female.—Body (Fig. 20a) moderately slender. Length 1.01 mm (0.97–1.03 mm) and greatest width 0.44 mm (0.42–0.45 mm), based on 10 specimens. Greatest dorsoventral thickness 0.31 mm. Epimeral areas of segments bearing legs 3 and 4 pointed posteriorly. Ratio of length to width of prosome 1.61:1. Ratio of length of prosome to that of urosome 2:1.

Segment bearing leg 5 (Fig. 20b) $60 \times 127 \mu\text{m}$. Genital segment $86 \times 116 \mu\text{m}$, wider than long, in dorsal view expanded in anterior two thirds and constricted in posterior third. Segment bearing pair of small posterolateral spiniform processes. Genital areas located dorsolaterally near middle of segment. Each area

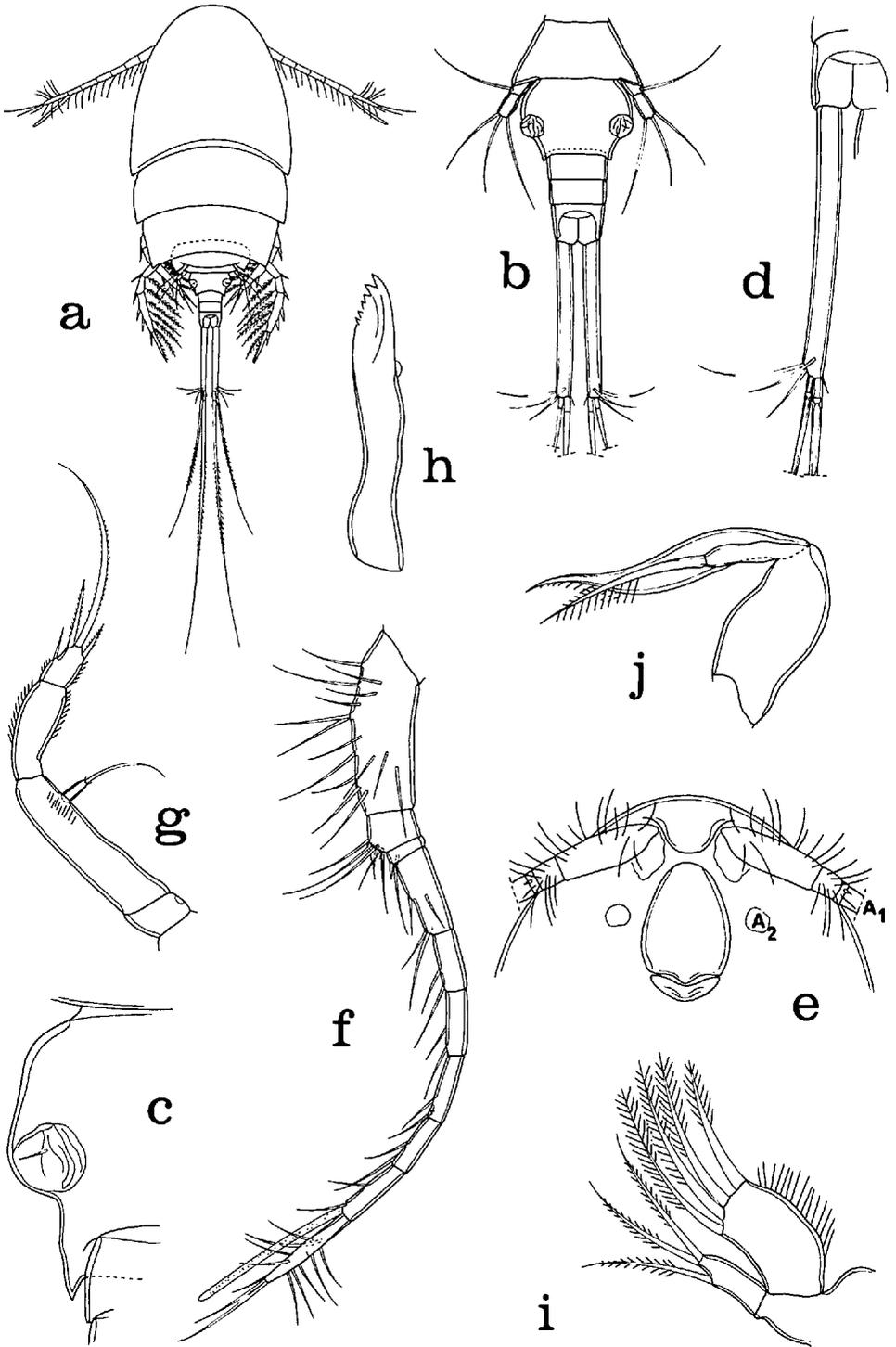


Figure 20. *Aphotopontius baculigerus* new genus, new species. Female: a, dorsal (scale B); b, urosome, dorsal (H); c, genital area, dorsal (E); d, caudal ramus, dorsal (C); e, rostrum and oral cone, ventral (H); f, first antenna, posteroventral (C); g, second antenna, postero-outer (G); h, mandible, anterior (E); i, first maxilla, posterior (E); j, second maxilla, posterior (E).

(Fig. 20c) with small erect seta. Three postgenital segments from anterior to posterior 30×68 , 23×62 , and $49 \times 55 \mu\text{m}$.

Caudal ramus (Fig. 20d) long and slender, $192 \times 14 \mu\text{m}$, ratio 13.7:1; in another female $164 \times 15 \mu\text{m}$, ratio 11:1. Outer lateral seta $81 \mu\text{m}$, dorsal seta $52 \mu\text{m}$, outermost terminal seta $39 \mu\text{m}$, and innermost terminal seta very short, $7 \mu\text{m}$; all these setae smooth. Two long median terminal setae $286 \mu\text{m}$ (outer) and $572 \mu\text{m}$ (inner), both with minute lateral spinules along midregions.

Body surface smooth, without fine ornamentation.

Egg sac not seen.

Rostrum (Fig. 20e) with weak broadly rounded posteroventral margin. First antenna (Fig. 20f) $520 \mu\text{m}$ long not including setae. Lengths of its 10 segments: 88 ($125 \mu\text{m}$ along anterior margin), 23, 9, 60, 42, 48, 48, 43, 48, and $73 \mu\text{m}$, respectively. Armature: 15, 8, 2, 4, 2, 2, 2, 2, 2 + 1 aesthete, and 12. All setae naked.

Second antenna (Fig. 20g) $143 \mu\text{m}$ long, not including setae. Segmented and armed as in congeners. Row of slender spinules on basis near insertion of exopod, and on both sides of 2 segments of endopod.

Rostrum (Fig. 20e) small, broadly rounded. Oral cone (Fig. 20e) low, oval in outline. Mandible (Fig. 20h) $99 \mu\text{m}$ long, first maxilla (Fig. 20i), and second maxilla (Fig. 20j) resembling those of congeners. Maxilliped (Fig. 21a) 4-segmented plus claw, with long setules on inner proximal part of seta on first segment and on inner side of fourth segment.

Legs 1–4 (Fig. 21b–e) biramous with 3-segmented rami, except for 2-segmented endopod of leg 4. Spine and setal formula as follows:

P_1	coxa	0-0	basis	1-1	exp	I-1; I-1; II,I,4
					enp	0-1; 0-2; 1,2,3
P_2	coxa	0-1	basis	1-0	exp	I-1; I-1; II,II,4
					enp	0-1; 0-2; I,II,3
P_3	coxa	0-1	basis	1-0	exp	I-1; I-1; II,II,5
					enp	0-1; 0-2; I,I,3
P_4	coxa	0-0	basis	1-0	exp	I-1; I-1; II,II,4
					enp	0-1; I,1

Coxae of legs 1 and 4 without inner seta; those of legs 2 and 3 with long plumose inner seta. Basis of leg 1 with inner apparently smooth spine $48 \mu\text{m}$. Outer spine on second segment of exopod of leg 1 recurved proximally. Third segment of endopod of leg 2 with 2 terminal barbed spines. Outer and terminal spines on exopods of legs 3 and 4 stout, rodlike, but with attenuate tips (Fig. 21f). Exopod of leg 4 $257 \mu\text{m}$, long, with stout rodlike outer spines. Endopod with first segment $42 \times 34 \mu\text{m}$ ($49 \mu\text{m}$ long including spiniform process), its seta $114 \mu\text{m}$; second segment $122 \mu\text{m}$ long ($138 \mu\text{m}$ including spiniform process), $31 \mu\text{m}$ in greatest width proximally and $16 \mu\text{m}$ in least width distally, its inner seta $120 \mu\text{m}$ and terminal spine $102 \mu\text{m}$. Hairlike spinules on outer margin of first segment and both outer and inner margins of second segment.

Leg 5 (Fig. 22a) with first segment $34 \times 23 \mu\text{m}$, its seta $99 \mu\text{m}$. Second segment $31 \times 18 \mu\text{m}$, subterminal seta $83 \mu\text{m}$, and 2 terminal setae $74 \mu\text{m}$ and $104 \mu\text{m}$; all setae minutely barbed.

Leg 6 probably represented by seta on genital area (Fig. 20c).

Color of living specimens unknown.

Male. — Body (Fig. 22b) resembling female in general form. Length 0.80 mm (0.78 – 0.83 mm) and greatest width 0.32 mm (0.32 – 0.33 mm), based on 10 specimens.

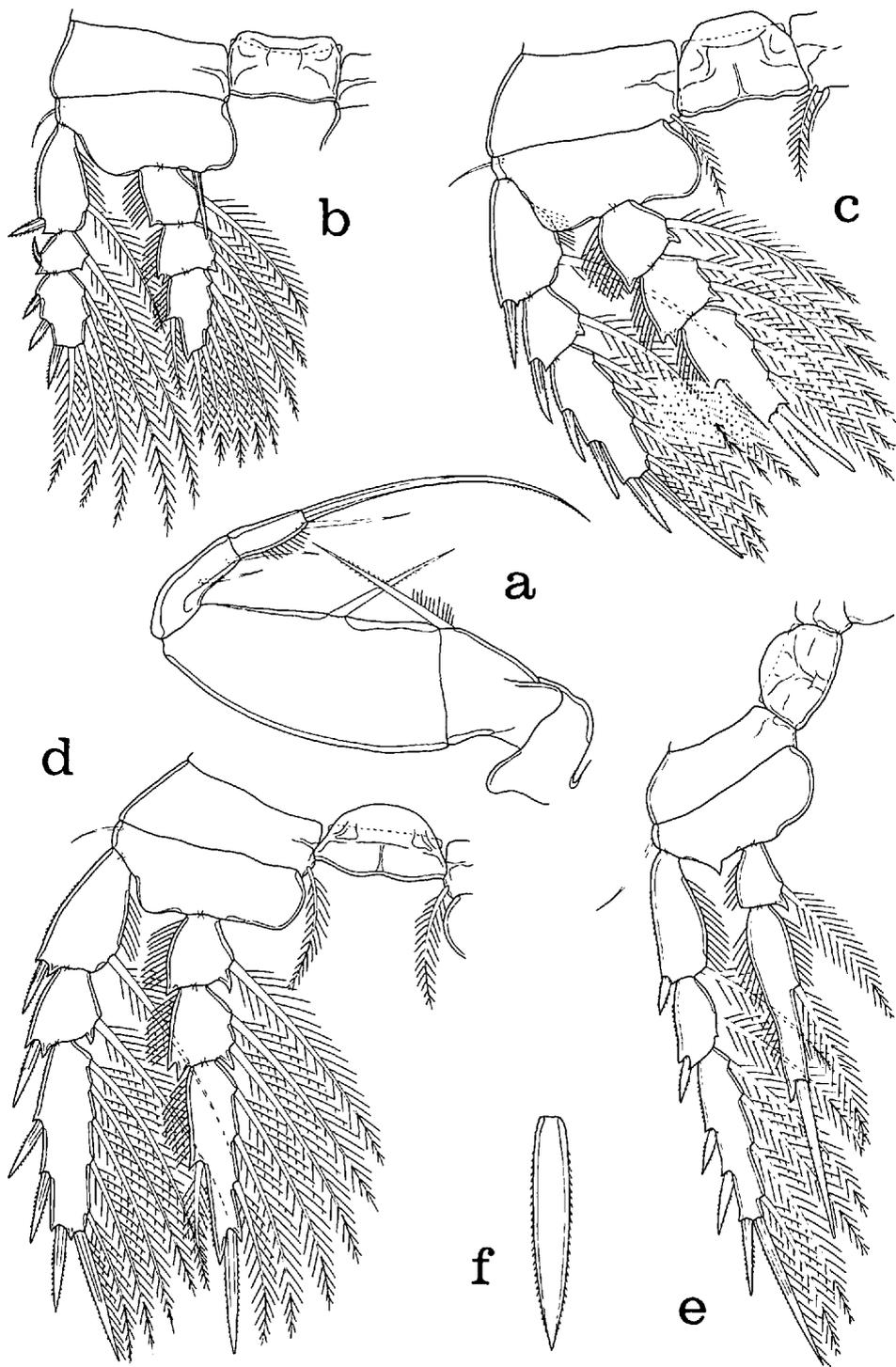


Figure 21. *Aphotopontius baculigerus* new genus, new species. Female: a, maxilliped, anterior (scale E); b, leg 1 and intercoxal plate, anterior (C); c, leg 2 and intercoxal plate, anterior (C); d, leg 3 and intercoxal plate, anterior (C); e, leg 4 and intercoxal plate, anterior (C); f, second outer spine on third segment of exopod of leg 4, anterior (F).

Greatest dorsoventral thickness 0.17 mm. Epimera of segments of legs 2 and 3 pointed, those of leg 4 rounded. Ratio of length to width of prosome 1.58:1. Ratio of length of prosome to that of urosome 1.65:1.

Segment bearing leg 5 (Fig. 22c) $49 \times 70 \mu\text{m}$. Genital segment $57 \times 86 \mu\text{m}$, broader than long, with rounded lateral margins in dorsal view. Four postgenital segments from anterior to posterior 34×55 , 29×49 , 21×47 , and $34 \times 44 \mu\text{m}$.

Caudal ramus (Fig. 22c) resembling that of female but shorter, $120 \times 13 \mu\text{m}$, ratio 9.2:1.

Body surface and rostrum as in female.

First antenna (Fig. 22d) $390 \mu\text{m}$ long, 12-segmented. Lengths of segments: 5 ($34 \mu\text{m}$ along anterior margin), 7, 52, 26, 8, 13, 39, 29, 44, 73, 60, and $36 \mu\text{m}$, respectively. Armature: 1, 2, 12, 7, 2, 2, 4, 2, 2, 3, 1 aesthete, and 10. Fifth segment (Fig. 22e) with spine $15.5 \mu\text{m}$ long and adjacent spiniform process, and bearing small spinule on posteroventral surface of segment.

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

Leg 5 (Fig. 22f) situated ventrally. Free segment $28 \times 16 \mu\text{m}$, with 5 smooth setae from inner to outer 52, 39, and $78 \mu\text{m}$, all slender, and 17 and $17 \mu\text{m}$, both broad and somewhat spatulate. Adjacent dorsal seta smooth, $78 \mu\text{m}$.

Leg 6 (Fig. 22g) with 2 long smooth setae $65 \mu\text{m}$ and $62 \mu\text{m}$.

Spermatophore seen only inside genital segment of male (Fig. 22g).

Color unknown.

Etymology.—The specific name *baculigerus*, Latin *baculus*, a rod, and *gero*, to bear, refers to the stout rodlike spines on the exopod of leg 4.

Remarks.—The elongate caudal rami (ratio 13.7:1 in the female, 9.2:1 in the male) distinguishes *Aphotopontius baculigerus* from its congeners. The new species is further characterized by the formula 1,II,3 on the third segment of the endopod of leg 2 in the female (instead of 1,2,3), and by the genital segment of the female being wider than long.

Aphotopontius flexispina new species

Figures 23a–g, 24a–g, 25a–d

Type Material.—83 ♀♀ from washings of vestimentiferans and the bivalve *Calyptogena magnifica* Boss and Turner, in 2,618 m, Clam Acres, East Pacific Rise, $20^{\circ}50.0'N$, $109^{\circ}06.0'W$, 04 May 1982, DSRV ALVIN dive no. 1221. Holotype and 79 paratypes deposited in the National Museum of Natural History, Smithsonian Institution, Washington, D.C.

Other Specimens.—4 ♀♀, in 2,616 m, Clam Acres, East Pacific Rise, $20^{\circ}50.0'N$, $109^{\circ}06.0'W$, 10 May 1982, DSRV ALVIN dive no. 1226; 13 ♀♀, in 2,615 m, Clam Acres, East Pacific Rise, $20^{\circ}50.0'N$, $109^{\circ}06.0'W$, 17 April 1982, DSRV ALVIN dive no. 1211; 1 ♀, in 2,618 m, Clam Acres, East Pacific Rise, $20^{\circ}50.0'N$, $109^{\circ}06.0'W$, 09 May 1982, DSRV ALVIN dive no. 1225.

Female.—Body (Fig. 23a) with moderately broad prosome. Length 0.81 mm (0.78–0.85 mm) and greatest width 0.39 mm (0.37–0.41 mm), based on 10 specimens. Greatest dorsoventral thickness 0.23 mm. Segment bearing leg 1 fused with cephalosome. Epimeral areas of segment bearing leg 1 pointed, other epimera rounded. Ratio of length to width of prosome 1.28:1. Ratio of length of prosome to that of urosome 1.49:1.

Segment bearing leg 5 (Fig. 23b) $57 \times 96 \mu\text{m}$, laterally expanded. Genital segment (Fig. 23c) $101 \times 114 \mu\text{m}$, wider than long, laterally expanded in anterior third, narrower ($78 \mu\text{m}$) in posterior two-thirds. Genital areas (Fig. 23c) located dorsolaterally on rounded lateral expansions. Each area with slender seta $20 \mu\text{m}$.

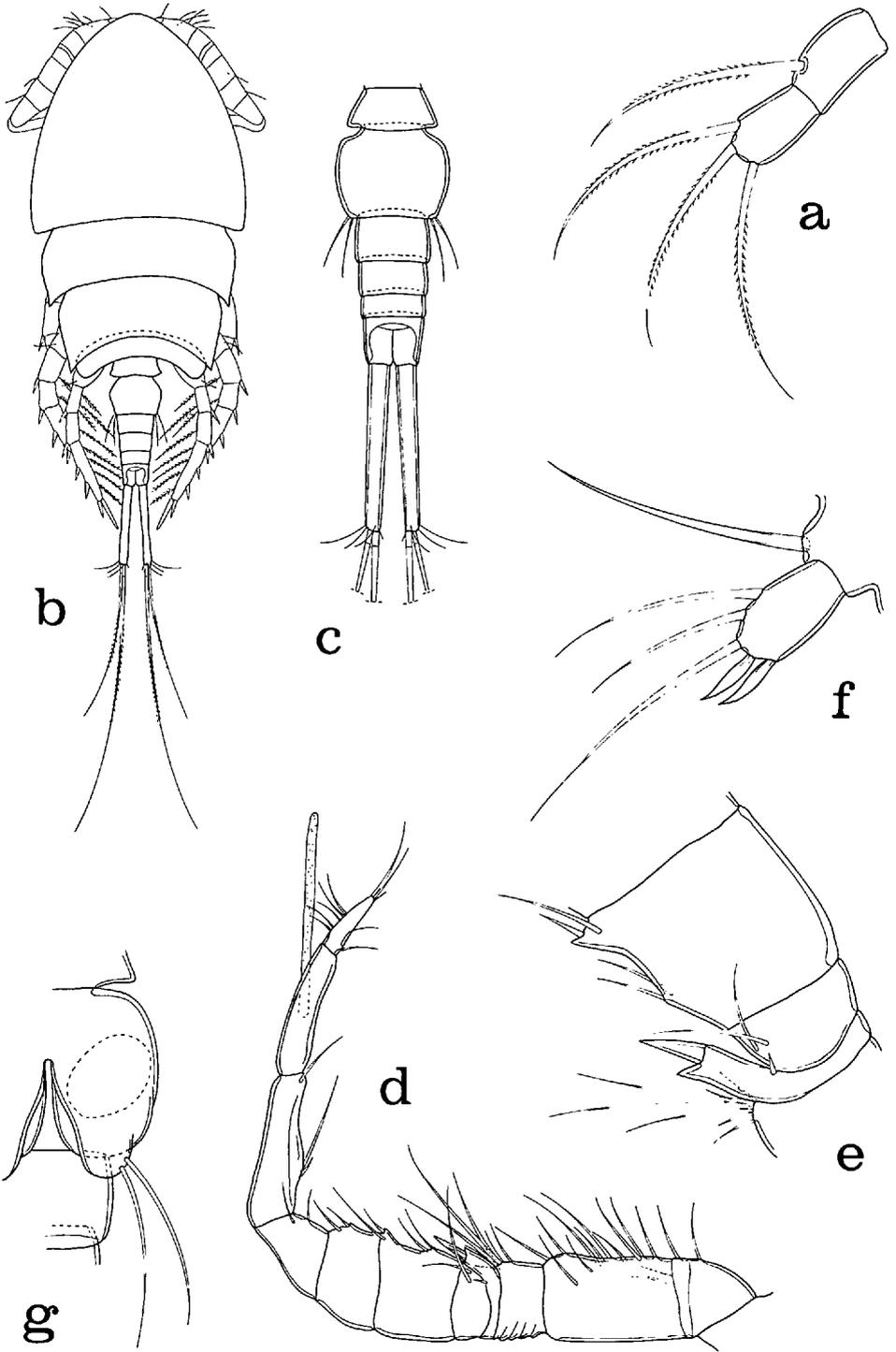


Figure 22. *Aphotopontius baculigerus* new genus, new species. Female: a, leg 5, dorsal (scale E). Male: b, dorsal (H); c, urosome, dorsal (C); d, first antenna, posteroventral (G); e, segments 5, 6, and 7 of first antenna, posteroventral (F); f, leg 5, ventral (F); g, leg 6, ventral (E).

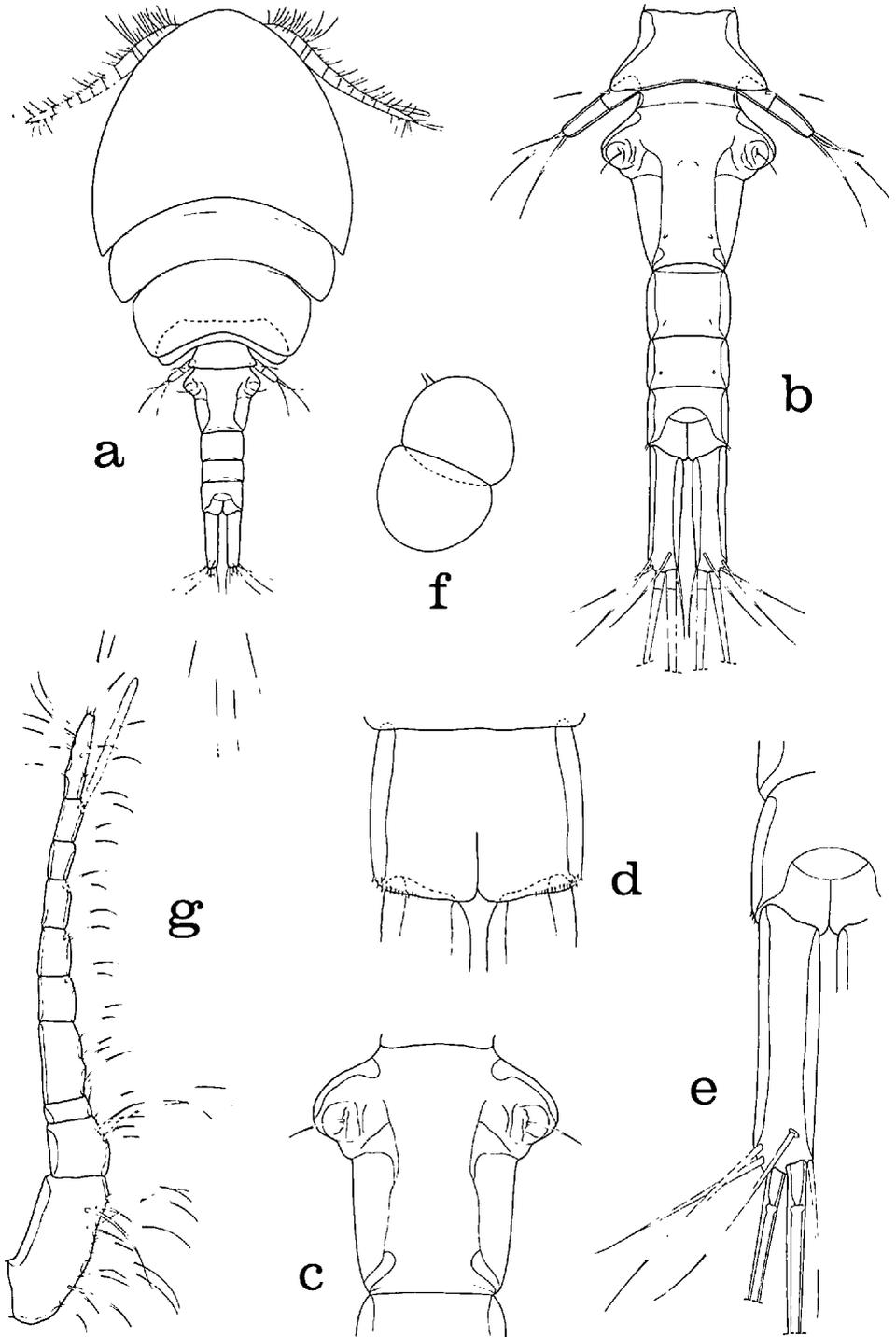


Figure 23. *Aphotopontius flexispina* new genus, new species. Female: a, dorsal (scale H); b, urosome, dorsal (C); c, genital segment, dorsal (G); d, anal segment, ventral (F); e, caudal ramus, dorsal (E); f, egg sac, ventral (H); g, first antenna, posteroventral (G).

Three postgenital segments from anterior to posterior 49×62 , 35×57 , and $47 \times 55 \mu\text{m}$. Anal segment (Fig. 23d) ventrally with posterolateral spinules.

Caudal ramus (Fig. 23e) elongate, $88 \times 21 \mu\text{m}$, ratio 4.2:1. Outer lateral seta $83 \mu\text{m}$, placed close to outermost terminal seta $70 \mu\text{m}$, dorsal seta $78 \mu\text{m}$, innermost terminal seta $50 \mu\text{m}$, all these setae smooth. Two long median terminal setae $187 \mu\text{m}$ (outer) and $308 \mu\text{m}$ (inner), both with very short lateral spinules along their midregions.

Body surface with few sensilla on urosome (Fig. 23b).

Egg sac (Fig. 23f) $264 \times 176 \mu\text{m}$, usually containing 2 eggs, $143 \times 176 \mu\text{m}$, $130 \times 176 \mu\text{m}$. Two females with single egg $187 \times 165 \mu\text{m}$ on both sides.

Rostral area not defined. First antenna (Fig. 23g) $296 \mu\text{m}$ long not including setae. Lengths of its 10 segments: 45 ($79 \mu\text{m}$ along anterior margin), 25, 10, 37, 22, 22, 22, 21, 19, and $40 \mu\text{m}$, respectively. Armature: 15, 8, 2, 4, 2, 2, 2, 2, 2 + 1 aesthete, and 12. All setae naked.

Second antenna (Fig. 24a) bent. Protopod with second segment having outer spinules. Exopod with 3 setae. Endopod with first segment unornamented. Second segment with 2 short smooth setae on each side and 2 long terminal barbed setae. Few spinules near insertion of inner short seta.

Oral cone (Fig. 24b) short. Mandible (Fig. 24c) $83 \mu\text{m}$ long, and first maxilla (Fig. 24d) resembling those of congeners. Second maxilla (Fig. 24e) with second segment swollen in proximal part. Maxilliped (Fig. 24f) 5-segmented, though third and fourth segments not clearly separated but indicated by setation. First segment with inner rounded protuberance and seta with short spinules. Second segment with stout inner spine having row of spinules on distal margin and showing distinctly recurved bent tip. Third and fourth segments combined, armed with 2 slender smooth setae. Fifth segment with 1 slender smooth seta and large terminal unilaterally strongly pectinate claw.

Legs 1–4 (Figs. 24g, 25a–c) with 3-segmented rami, except for 2-segmented endopod of leg 4. Spine and setal formula as follows:

P_1	coxa	0-1	basis	1-I	exp	I-1; I-1; II,I,4
					enp	0-1; 0-2; 1,2,3
P_2	coxa	0-1	basis	1-0	exp	I-1; I-1; II,II,4
					enp	0-1; 0-2; 1,2,3
P_3	coxa	0-1	basis	1-0	exp	I-1; I-1; II,II,5
					enp	0-1; 0-2; 1,I,3
P_4	coxa	0-0	basis	1-0	exp	I-1; I-1; II,II,4
					enp	0-1; I-1

Coxae of legs 1–3 with inner plumose seta; coxa of leg 4 without inner seta. Basis of leg 1 with inner barbed spine $42 \mu\text{m}$. Leg 4 (Fig. 25c) with exopod $190 \mu\text{m}$. Endopod with first segment $34 \times 20 \mu\text{m}$, its inner plumose seta $78 \mu\text{m}$. Second segment 68 (including terminal spiniform process) $\times 18 \mu\text{m}$, its terminal barbed spine $91 \mu\text{m}$ and its inner seta $110 \mu\text{m}$; spinules along outer margin of this segment.

Leg 5 (Fig. 25d) 2-segmented, elongate, slender, $55 \times 11 \mu\text{m}$. First segment $25 \times 11 \mu\text{m}$, its smooth dorsal seta $27 \mu\text{m}$. Second segment $30 \times 11 \mu\text{m}$, its 3 setae $62 \mu\text{m}$ and $60 \mu\text{m}$, both barbed, and $39 \mu\text{m}$, smooth.

Leg 6 probably represented by seta on genital area (Fig. 23c).

Color of living specimens unknown.

Male. — Unknown.

Etymology. — The specific name *flexispina*, Latin *flexus*, bent, and *spina*, a spine, refers to the bent condition of the spine on the second segment of the maxilliped.

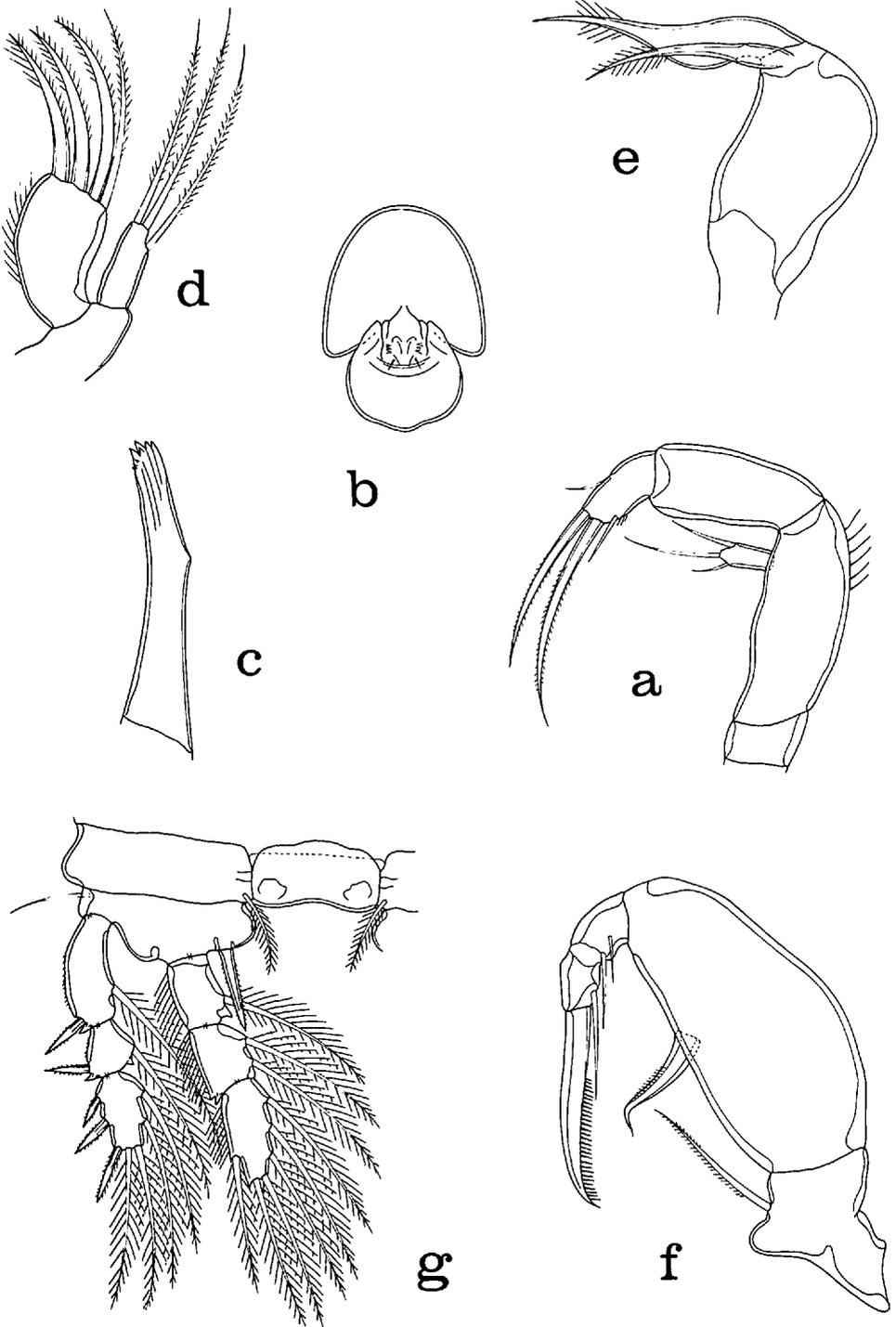


Figure 24. *Aphotopontius flexispina* new genus, new species. Female: a, second antenna (scale F); b, oral cone, ventral (C); c, mandible, anterior (F); d, first maxilla, anterior (F); e, second maxilla, posterior (F); f, maxilliped, posterior (E); g, leg 1 and intercoxal plate, anterior (G).

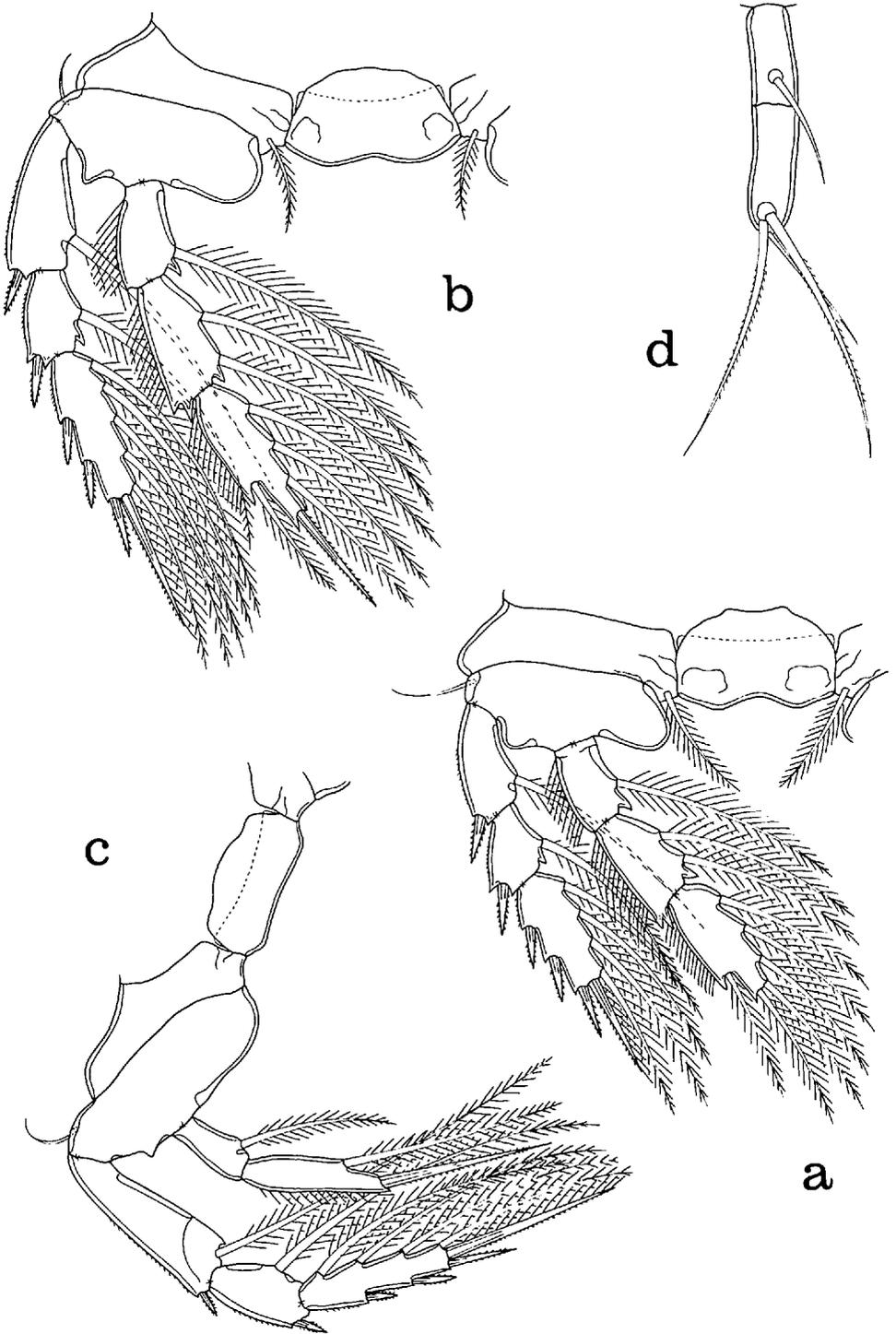


Figure 25. *Aphotopontius flexispina* new genus, new species. Female: a, leg 2 and intercoxal plate, anterior (scale G); b, leg 3 and intercoxal plate, anterior (G); c, leg 4 and intercoxal plate, anterior (G); d, leg 5, dorsal (F).

Remarks. — *Aphotopontius flexispina* may be recognized by the spine on the second segment of the maxilliped having a sharply bent recurved tip, the claw of the maxilliped being strongly pectinate, and the genital segment of the female being wider than long, expanded in its anterior third.

Aphotopontius limatulus new species

Figures 26a–k, 27a–f, 28a–g

Type Material. — 137 ♀♀, 75 ♂♂, in 2,457 m, Rose Garden, Galapagos Rift, 00°48.0'N, 86°13.0'W, 30 November 1979, DSRV ALVIN dive no. 983. Holotype ♀, allotype, and 214 paratypes (133 ♀♀, 71 ♂♂) deposited in the National Museum of Natural History, Smithsonian Institution, Washington, D.C.

Other Specimens. — 167 ♀♀, 14 ♂♂, in 2,618 m, Clam Acres, East Pacific Rise, 20°50.0'N, 109°06.0'W, 04 May 1982, DSRV ALVIN dive no. 1221; 2 ♀♀, in 2,490 m, Galapagos Rift, 00°48.0'N, 86°09.0'W, 08 December 1979, DSRV ALVIN dive no. 991; 2 ♀♀, in 2,618 m, Clam Acres, East Pacific Rise, 20°50.0'N, 109°06.0'W, 09 May 1982, DSRV ALVIN dive no. 1225; 2 ♂♂, in 2,482 m, Galapagos Rift, 00°48.0'N, 86°09.0'W, 06 December 1979, DSRV ALVIN dive no. 989; 8 ♀♀, in 2,482 m, Galapagos Rift, 00°47.9'N, 86°09.3'W, 20 February 1979, DSRV ALVIN dive no. 895; 13 ♀♀, 2 ♂♂, in 2,451 m, Galapagos Rift, 00°48.0'N, 86°13.0'W, 01 December 1979, DSRV ALVIN dive no. 984; 1 ♀, in 2,616 m, Clam Acres, East Pacific Rise, 20°50.0'N, 109°06.0'W, 07 May 1982, DSRV ALVIN dive no. 1223.

Female. — Body (Fig. 26a) moderately slender. Length 1.00 mm (0.98–1.11 mm) and greatest width 0.44 mm (0.41–0.47 mm), based on 10 specimens. Greatest dorsoventral thickness 0.32 mm. Epimeral areas of segments bearing legs 1–4 pointed posteriorly. Ratio of length to width of prosome 1.48:1. Ratio of length of prosome to that of urosome 1.61:1.

Segment bearing leg 5 (Fig. 26b) $68 \times 138 \mu\text{m}$. Genital segment $83 \times 125 \mu\text{m}$, wider than long, in dorsal view with rounded lateral expansions. Genital areas situated dorsolaterally just posterior to middle of segment. Each area (Fig. 26c) with one small seta. Three postgenital segments from anterior to posterior 39×76 , 23×70 , and $44 \times 62 \mu\text{m}$. Anal segment with slender spinules posteroventrally (Fig. 26d).

Caudal ramus (Fig. 26e) elongate, $159 \times 16 \mu\text{m}$, ratio 10:1. Outer lateral seta $80 \mu\text{m}$, dorsal seta $57 \mu\text{m}$, outermost terminal seta $70 \mu\text{m}$, and innermost terminal seta short, $10 \mu\text{m}$, all these setae smooth. Two long median terminal setae $308 \mu\text{m}$ (outer) and $572 \mu\text{m}$ (inner), both with short lateral spinules.

Body surface without apparent sensilla.

Egg sac not seen.

Rostrum (Fig. 26f) with broad posteroventral margin. First antenna (Fig. 26g) $484 \mu\text{m}$ long, not including setae. Lengths of its 10 segments: 94 ($125 \mu\text{m}$ along anterior margin), 26, 9, 57, 42, 45, 46, 42, 43, and $60 \mu\text{m}$, respectively. Last segment with slight indication of subdivision. Armature: 15, 8, 2, 4, 2, 2, 2, 2, 2 + 1 aesthete, and 12. All setae smooth.

Second antenna (Fig. 26h) $133 \mu\text{m}$ long, not including setae. Segmented and armed as in congeners. Both segments of endopod with lateral spinules.

Oral cone (Fig. 26f) low, oval in outline. Mandible (Fig. 26i) and first maxilla (Fig. 26j) resembling those of congeners. Second maxilla (Fig. 26k) with sinuous second segment (claw) resembling those of congeners. Maxilliped (Fig. 27a) arising from distinct basal area. Seta on first segment barbed and having few spinules near base, this seta longer than smooth seta on second segment. Third and fourth segments fused, bearing 2 smooth setae. Fifth segment bearing 1 smooth seta and having row of spinules on inner margin. Claw with minute barbs near recurved tip.

Legs 1–4 (Fig. 27b–e) biramous with 3-segmented rami, except for 2-segmented endopod of leg 4. Spine and setal formula as follows:

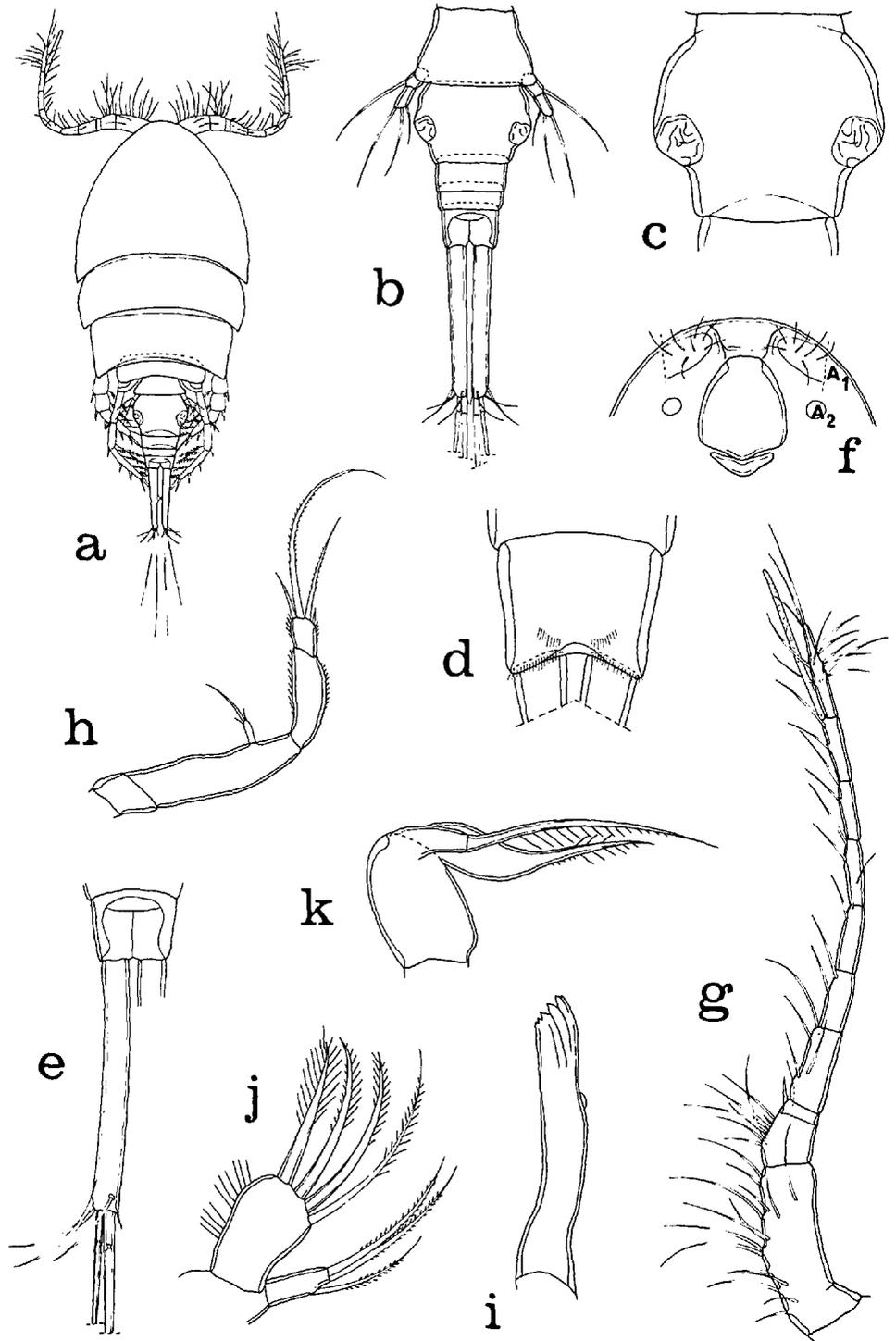


Figure 26. *Aphotopontius limatulus* new genus, new species. Female: a, dorsal (scale B); b, urosome, dorsal (D); c, genital segment, dorsal (G); d, anal segment, ventral (E); e, caudal ramus, dorsal (C); f, rostrum and oral cone, ventral (D); g, first antenna, dorsal (C); h, second antenna, antero-outer (G); i, mandible, anterior (E); j, first maxilla, anterior (E); k, second maxilla, posterior (E).

P_1	coxa 0-0	basis 1-I	exp I-1; I-1; II,I,4
			enp 0-1; 0-2; 1,2,3
P_2	coxa 0-1	basis 1-0	exp I-1; I-1; II,II,4
			enp 0-1; 0-2; 1,II,3
P_3	coxa 0-1	basis 1-0	exp I-1; I-1; II,II,5
			enp 0-1; 0-2; 1,I,3
P_4	coxa 0-0	basis 1-0	exp I-1; I-1; II,II,4
			enp 0-1; I-1

Coxae of legs 1 and 4 without inner seta; those of legs 2 and 3 with long pinnate inner seta. Basis of leg 1 with inner barbed spine $47\ \mu\text{m}$. First and second segments of exopod of leg 1 with outer hairs. Outer spine on second segment of exopod of leg 1 directed proximally. Endopod of leg 3 with third segment bearing terminal barbed spine. Exopod of leg 4 $260\ \mu\text{m}$ long. Endopod with first segment $47 \times 30\ \mu\text{m}$, its seta $94\ \mu\text{m}$; second segment elongate, $130 \times 23\ \mu\text{m}$ including terminal spiniform process, its inner seta $112\ \mu\text{m}$ and terminal barbed spine $104\ \mu\text{m}$; this segment with hairs proximally on both outer and inner margins, and with spinules distally along outer margin.

Leg 5 (Fig. 27f) with first segment $39 \times 26\ \mu\text{m}$, its minutely barbed seta $117\ \mu\text{m}$. Second segment elongate, $31 \times 17\ \mu\text{m}$, subterminal inner smooth seta $47\ \mu\text{m}$, inner terminal seta $91\ \mu\text{m}$, and outer terminal seta $68\ \mu\text{m}$, both terminal setae finely barbed.

Leg 6 probably represented by seta on genital area (Fig. 26c).

Color of living specimens unknown.

Male.—Body (Fig. 28a) similar in general form to that of female. Length $0.88\ \text{mm}$ ($0.85\text{--}0.95\ \text{mm}$) and greatest width $0.36\ \text{mm}$ ($0.34\text{--}0.39\ \text{mm}$), based on 10 specimens. Greatest dorsoventral thickness $0.24\ \text{mm}$. Epimera of segments bearing legs 3 and 4 slightly more pointed than in female. Ratio of length to width of prosome 1.57:1. Ratio of length of prosome to that of urosome 1.75:1.

Segment bearing leg 5 (Fig. 28b) $50 \times 78\ \mu\text{m}$. Genital segment $65 \times 86\ \mu\text{m}$, wider than long. Four postgenital segments from anterior to posterior 44×63 , 31×60 , 23×55 , and $39 \times 47\ \mu\text{m}$. Anal segment with ventral spinules as in female.

Caudal ramus (Fig. 28b) $133 \times 15.5\ \mu\text{m}$, ratio 8.6:1.

Body surface and rostrum as in female.

First antenna (Fig. 28c) 12-segmented, $363\ \mu\text{m}$ long. Lengths of 12 segments: 29 ($39\ \mu\text{m}$ along anterior margin), 4, 75, 9, 5, 7, 47, 34, 49, 91, 65, and $37\ \mu\text{m}$, respectively. Armature: 1, 2, 12, 7, 2, 2, 4, 2, 2, 3, 1 aesthete, and 10. Fifth segment (Fig. 28d) with 2 unequal inner spines, 1 stout $15.5\ \mu\text{m}$, other more slender $31\ \mu\text{m}$. Seventh segment with 1 distal inner process bearing spinelike seta. Eighth segment with similar smaller process and seta.

Second antenna, oral cone, mandible, first maxilla, second maxilla, and maxilliped resembling those of female.

Legs 1, 3, and 4 as in female. Leg 2 with endopod (Fig. 28e) having formula 1,II,3; 2 terminal spines barbed, adjacent 2 inner setae, though pinnate, slightly spiniform with less tapered tips than usual.

Leg 5 (Fig. 28f) situated ventrally, and thus only distal parts of setae showing in dorsal view (Fig. 28b). Free segment $20 \times 18\ \mu\text{m}$, with 5 smooth setae, from outer to inner 61, 57, and $56\ \mu\text{m}$, all slender, and $10\ \mu\text{m}$ and $10\ \mu\text{m}$, both stout. Adjacent dorsal smooth seta $99\ \mu\text{m}$.

Leg 6 (Fig. 28) with 2 smooth setae $78\ \mu\text{m}$ and $94\ \mu\text{m}$.

Spermatophore seen only inside genital segment of male (Fig. 28g).

Color unknown.

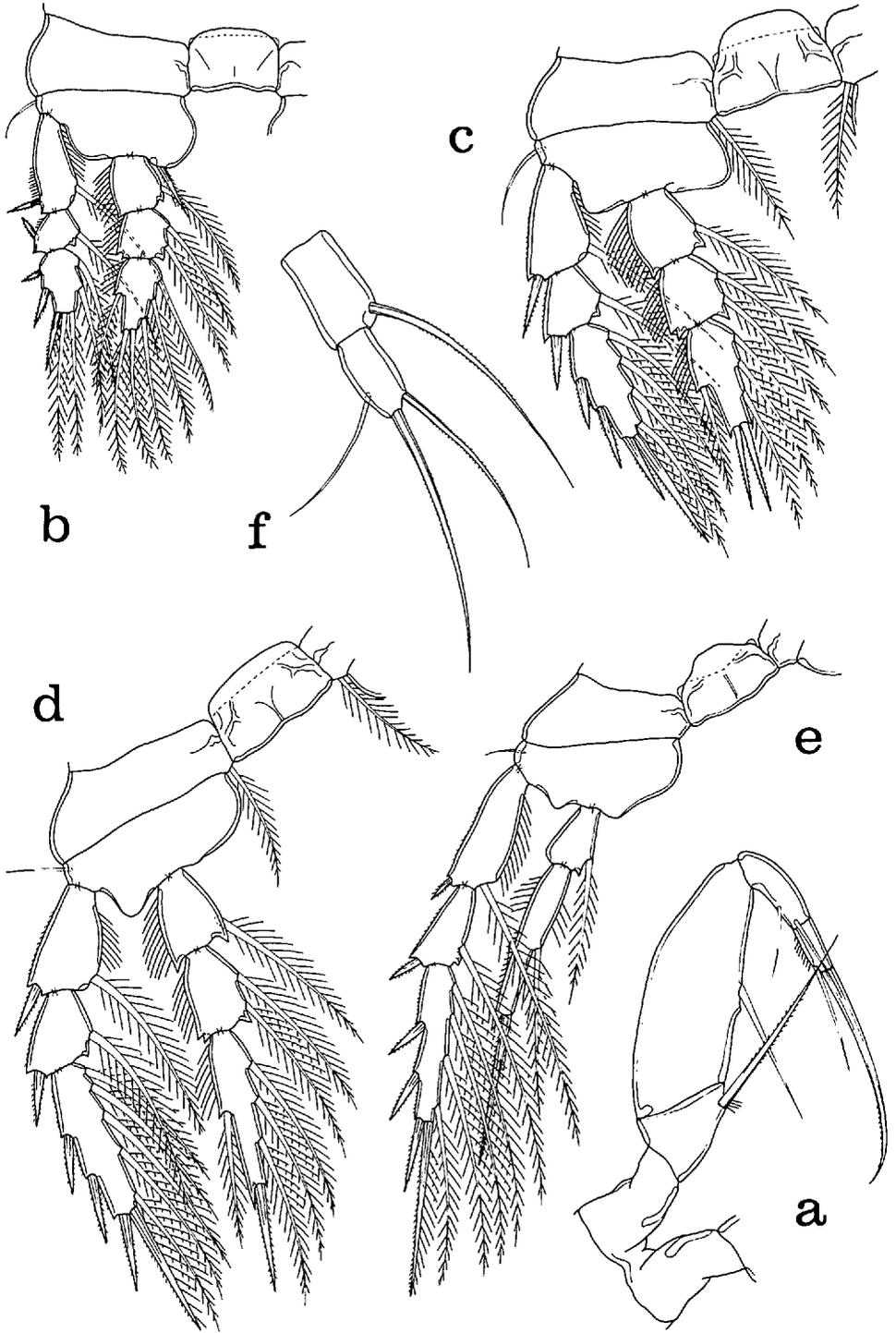


Figure 27. *Aphotopontius limatulus* new genus, new species. Female: a, maxilliped, posterior (scale G); b, leg 1 and intercoxal plate, anterior (C); c, leg 2 and intercoxal plate, anterior (C); d, leg 3 and intercoxal plate, anterior (C); e, leg 4 and intercoxal plate, anterior (C); f, leg 5, dorsal (E).

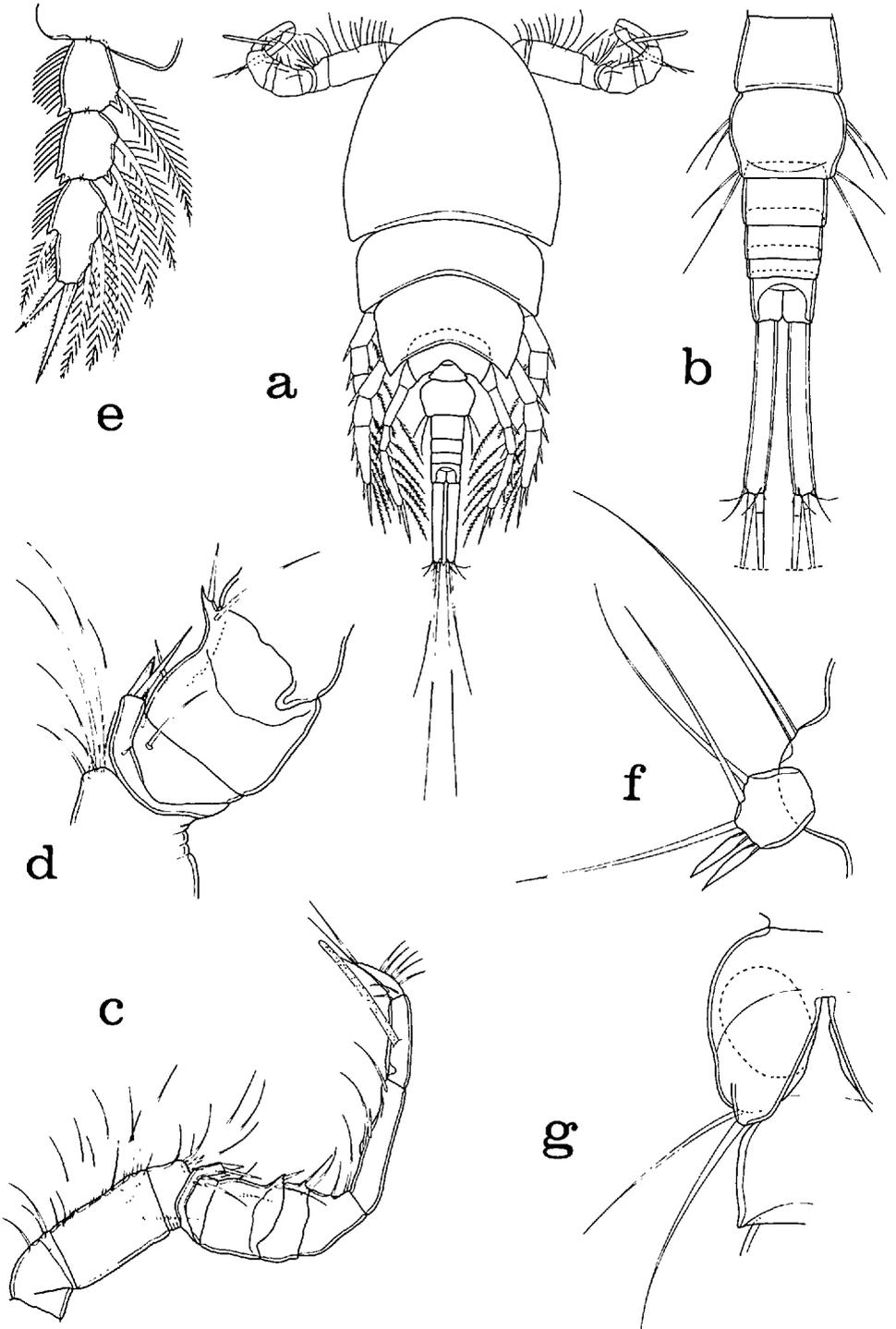


Figure 28. *Aphotopontius limatulus* new genus, new species. Male: a, dorsal (scale H); b, urosome, dorsal (C); c, first antenna, posteroventral (C); d, segments 5, 6, and 7 of first antenna, anterior (E); e, endopod of leg 2, anterior (C); f, leg 5, ventral (F); g, leg 6, ventral (E).

Etymology.—The specific name *limatulus*, Latin meaning polished or elegant, refers to the general form of this species.

Remarks.—*Aphotopontius limatulus* may be distinguished by the long caudal ramus (ratio 10:1 in the female, 8.6:1 in the male), by the genital segment of the female being wider than long, and by the third segment of the endopod of leg 2 of the male having the formula 1,II,3.

Aphotopontius mammillatus new species

Figures 29a–j, 30a–k, 31a–i

Type Material.—154 ♀♀, 22 ♂♂, and 8 copepodids from washings of vestimentiferans, in 2,000 m, Guaymas Basin, Gulf of California, 27°00.5'N, 111°24.4'W, 07 August 1985, DSRV ALVIN dive no. 1615. Holotype ♀, allotype, and 168 paratypes (149 ♀♀, 19 ♂♂) deposited in the National Museum of Natural History, Smithsonian Institution, Washington, D.C.

Other Specimens.—8 ♀♀, 1 ♂, in 2,457 m, Galapagos Rift, 00°48.0'N, 86°13.0'W, 30 November 1979, DSRV ALVIN dive no. 983; 455 ♀♀, 72 ♂♂, in 2,618 m, Clam Acres, East Pacific Rise, 20°50.0'N, 109°06.0'W, 04 May 1982, DSRV ALVIN dive no. 1221; 22 ♀♀, 6 ♂♂, in 2,012 m, Guaymas Basin, Gulf of California, 27°00.5'N, 111°24.5'W, 29 July 1985, DSRV ALVIN dive no. 1607; 362 ♀♀, 6 ♂♂, 1 copepodid, in 2,493 m, Galapagos Rift, 00°47.6'N, 86°06.4'W, 21 January 1979, DSRV ALVIN dive no. 880; 300 ♀♀, 975 ♂♂, in 2,451 m, Galapagos Rift, 00°48.0'N, 86°13.0'W, 07 December 1979, DSRV ALVIN dive no. 990; 37 ♀♀, 24 ♂♂, in 2,490 m, Galapagos Rift, 00°48.0'N, 86°09.0'W, 08 December 1979, DSRV ALVIN dive no. 991; 1 ♀, in 2,518 m, Galapagos Rift, 00°47.0'N, 86°08.0'W, 10 December 1979, DSRV ALVIN dive no. 993; 12 ♀♀, in 2,482 m, Galapagos Rift, 00°47.9'N, 86°09.3'W, 20 February 1979, DSRV ALVIN dive no. 895; 49 ♀♀, 12 ♂♂, in 2,451 m, Galapagos Rift, 00°48.0'N, 86°13.0'W, 01 December 1979, DSRV ALVIN dive no. 984; 1 ♀, in 2,447 m, Galapagos Rift, 00°48.9'N, 86°13.3'W, 15 February 1979, DSRV ALVIN dive no. 890; 205 ♀♀, 37 ♂♂, in 2,633 m, Clam Acres, East Pacific Rise, 20°50.0'N, 109°06.0'W, 20 April 1982, DSRV ALVIN dive no. 1214.

Female.—Body (Fig. 29a) unmodified. Length 0.94 mm (0.88–1.01 mm) and greatest width 0.46 mm (0.44–0.48 mm), based on 10 specimens. Greatest dorsoventral thickness 0.26 mm. Segment bearing leg 1 fused with cephalosome. Epimeral areas of segments bearing legs 1–4 well developed, those of segment bearing leg 4 formed as in Fig. 29b. Ratio of length to width of prosome 1.39:1. Ratio of length of prosome to that of urosome 1.84:1.

Segment bearing leg 5 (Fig. 29c) $78 \times 156 \mu\text{m}$ in dorsal view, with acute flared posterolateral angles. Genital segment laterally constricted just anterior to midregion; length $143 \mu\text{m}$ including posterolateral spines, width at broad anterior part $130 \mu\text{m}$, width at narrowed posterior part $96 \mu\text{m}$. Genital areas located dorso-laterally on posterior region of anterior part. Each area (Fig. 29d) bearing slender seta $26 \mu\text{m}$. Three postgenital segments from anterior to posterior 42×78 , 26×65 , and $52 \times 65 \mu\text{m}$.

Caudal ramus (Fig. 29e) elongate, $55 \times 26 \mu\text{m}$, ratio of length to width 2.1:1. Outer lateral seta $104 \mu\text{m}$, close to outermost subterminal seta $52 \mu\text{m}$, dorsal seta $109 \mu\text{m}$, all 3 of these setae with very fine delicate hairs. Innermost terminal seta $86 \mu\text{m}$ and haired. Two long median terminal setae $308 \mu\text{m}$ (outer) and $594 \mu\text{m}$ (inner), both with short lateral spinules.

Body surface smooth, without apparent sensilla.

Egg sac (Fig. 29f), seen on only 1 female, $242 \times 151 \mu\text{m}$, containing 2 eggs approximately $120 \times 148 \mu\text{m}$.

Rostral area (Fig. 29g) not well defined. First antenna (Fig. 29h) $396 \mu\text{m}$ long, not including setae. Lengths of its 10 segments: 88 ($117 \mu\text{m}$ along anterior margin), 29, 13, 52, 32, 32, 31, 29, 30, and $47 \mu\text{m}$, respectively. Fourth segment showing indistinct partial subdivision. Last segment with suggestion of 2 subdivisions. Armature: 15, 8, 2, 4, 2, 2, 2, 2, 2 + 1 aesthete, and 12. All setae smooth.

Second antenna (Fig. 29i) $169 \mu\text{m}$ long excluding setae and slender. Exopod

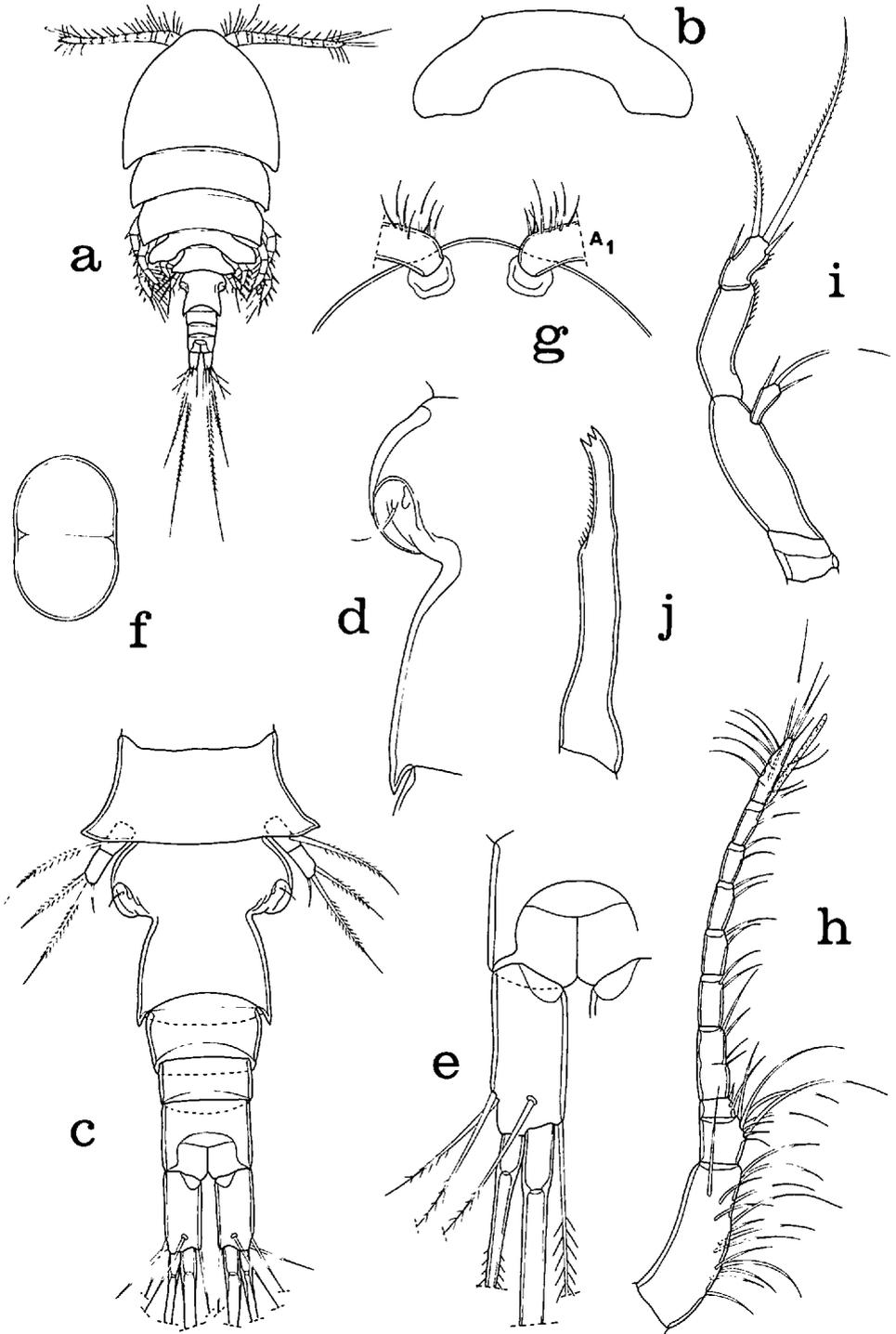


Figure 29. *Aphotopontius mammillatus* new genus, new species. Female: a, dorsal (scale A); b, tergum of segment bearing leg 4, dorsal (D); c, urosome, dorsal (C); d, genital area, dorsal (E); e, caudal ramus, dorsal (E); f, egg sac, dorsal (H); g, rostral area, ventral (D); h, first antenna, posteroventral (C); i, second antenna, antero-inner (G); j, mandible, anterior (E).

1-segmented with 3 smooth setae. Endopod 2-segmented, first segment with inner distal row of spinules; second segment with similar spinules and 4 setae, 2 short and smooth, 2 long with lateral barbules.

Oral cone short, not true siphon. Mandible (Fig. 29j) 117 μm long, with sub-terminal row of short spinules and 3 terminal teeth. First maxilla (Fig. 30a) with small slender outer lobe bearing 3 setae and larger inner lobe having 4 setae and outer marginal row of setules. All setae with short hairs or setules. Second maxilla (Fig. 30b) with smooth basal segment bearing slightly sinuous, unilaterally barbed claw and lobe carrying spinulose seta. Maxilliped (Fig. 30c) 5-segmented. First segment with 1 distal inner seta, second segment with 1 inner seta, third segment unarmed, fourth segment with 1 distal inner seta, and fifth segment with 1 distal inner seta and long slender terminal claw unilaterally pectinate distally.

Legs 1-4 (Fig. 30d, f, h, i) biramous with 3-segmented rami, except for 2-segmented endopod of leg 4. Spine and setal formula as follows:

P_1	coxa	0-1	basis	1-1	exp	I-1; I-1; II,I,4
					enp	0-1; 0-2; 1,2,3
P_2	coxa	0-1	basis	1-0	exp	I-1; I-1; II,II,4
					enp	0-1; 0-2; 1,2,3
P_3	coxa	0-1	basis	1-0	exp	I-1; I-1; II,II,5
					enp	0-1; 0-2; 1,I,3
P_4	coxa	0-0	basis	1-0	exp	I-1; I-1; II,II,4
					enp	0-1; 1,1

Basis of leg 1 with inner spine 21 μm and having mammilliform inner margin (Fig. 30e). Outer spine on second segment of exopod of leg 1 directed proximally. Inner margin of basis in leg 2 with rounded expansion (Fig. 30f), in leg 3 with truncate expansion (Fig. 30h), and in leg 4 lacking expansion (Fig. 30i). One abnormal endopod of leg 2 with third segment armed with 1,I,3 (Fig. 30g). Leg 4 with exopod 195 μm long. Endopod (Fig. 30j) with first segment $26 \times 14 \mu\text{m}$, its inner seta 80 μm ; second segment $42 \times 14 \mu\text{m}$, its inner seta 96 μm and its terminal seta 78 μm . All 3 setae with lateral hairs.

Leg 5 (Fig. 30k) 2-segmented, elongate, and slender. First segment $29 \times 14 \mu\text{m}$, its seta 96 μm (corresponding to dorsal seta in forms such as lichomolgids). Second segment $27 \times 8 \mu\text{m}$, subterminal inner seta 78 μm , inner terminal seta 96 μm , both haired, and short smooth outer terminal seta 23 μm .

Leg 6 probably represented by seta on genital area (Fig. 29d).

Color of living specimens unknown.

Male.—Body (Fig. 31a) resembling in general form that of female. Length 0.66 mm (0.63–0.72 mm) and greatest width 0.29 mm (0.26–0.31 mm), based on 10 specimens. Greatest dorsoventral thickness 0.16 mm. Epimeral areas of segment bearing leg 4 more pointed than in female (Fig. 31b). Ratio of length to width of prosome 1.59:1. Ratio of length of prosome to that of urosome 1.61:1.

Segment bearing leg 5 (Fig. 31c) $47 \times 78 \mu\text{m}$. Genital segment $70 \times 88 \mu\text{m}$, subquadrate, dorsally with pair of prominent posterolateral spinelike processes. Four postgenital segments from anterior to posterior 39×55 , 31×49 , 18×47 , and $31 \times 47 \mu\text{m}$. First postgenital segment with pair of posterolateral spines (Fig. 31c, d).

Caudal ramus resembling that of female but smaller, $36 \times 17 \mu\text{m}$, ratio 2.1:1.

Body surface and rostral area as in female.

First antenna (Fig. 31e) geniculate, 12-segmented, 224 μm long. Lengths of segments: 3 (21 μm along anterior margin), 4, 34, 14, 5.5, 8, 27, 21, 24, 44, 36, and 22.5 μm , respectively. Armature: 1, 2, 12, 7, 2, 2, 4, 2, 2, 3, 2 knobs + 1

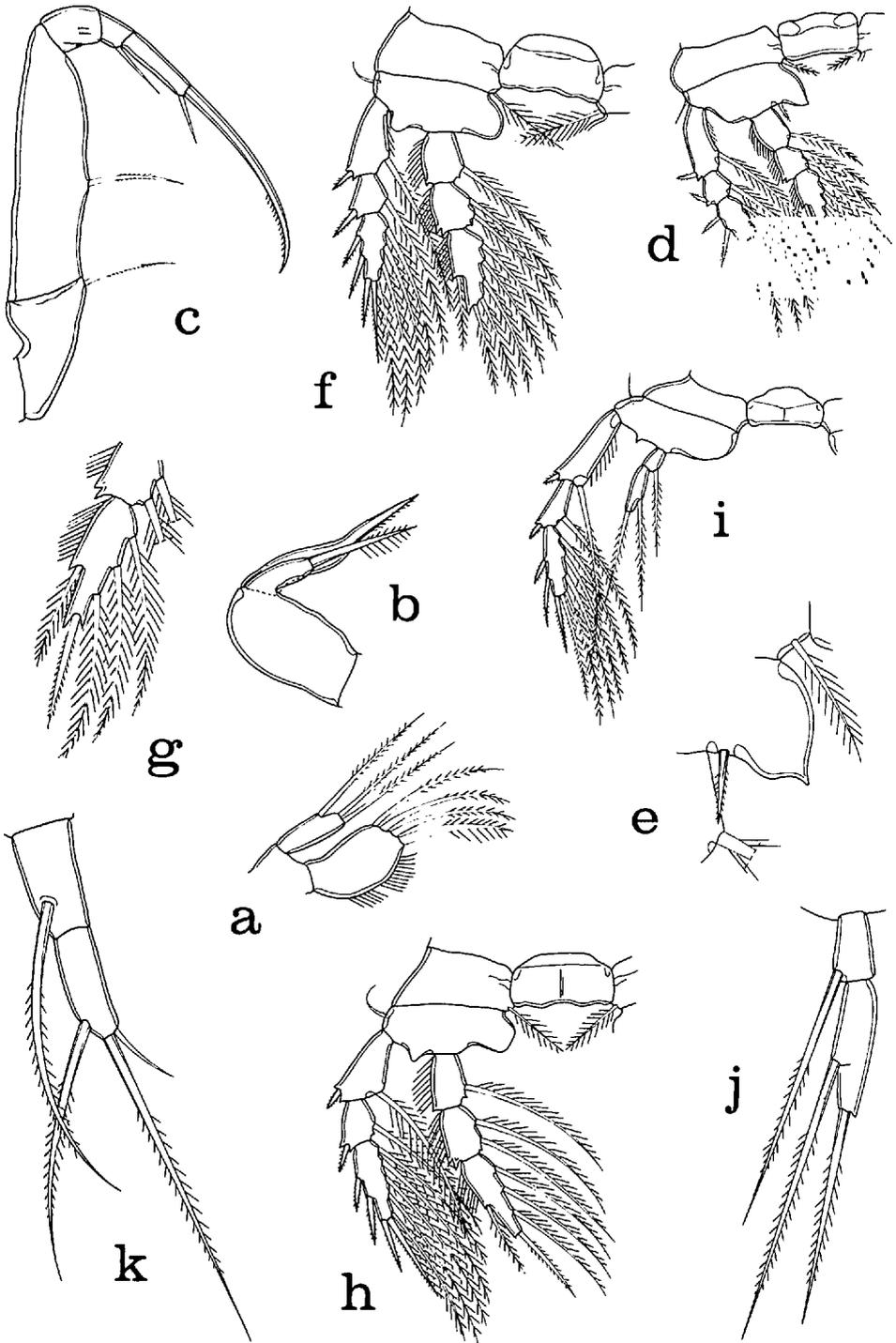


Figure 30. *Aphotopontius mammillatus* new genus, new species. Female: a, first maxilla, posterior (scale G); b, second maxilla, posterior (G); c, maxilliped, anterior (G); d, leg 1 and intercoxal plate, anterior (D); e, inner margin of basis of leg 1, anterior (E); f, leg 2 and intercoxal plate, anterior (D); g, abnormal third segment of endopod of leg 2, anterior (C); h, leg 3 and intercoxal plate, anterior (D); i, leg 4 and intercoxal plate, anterior (D); j, endopod of leg 4, anterior (E); k, leg 5, dorsal (F).

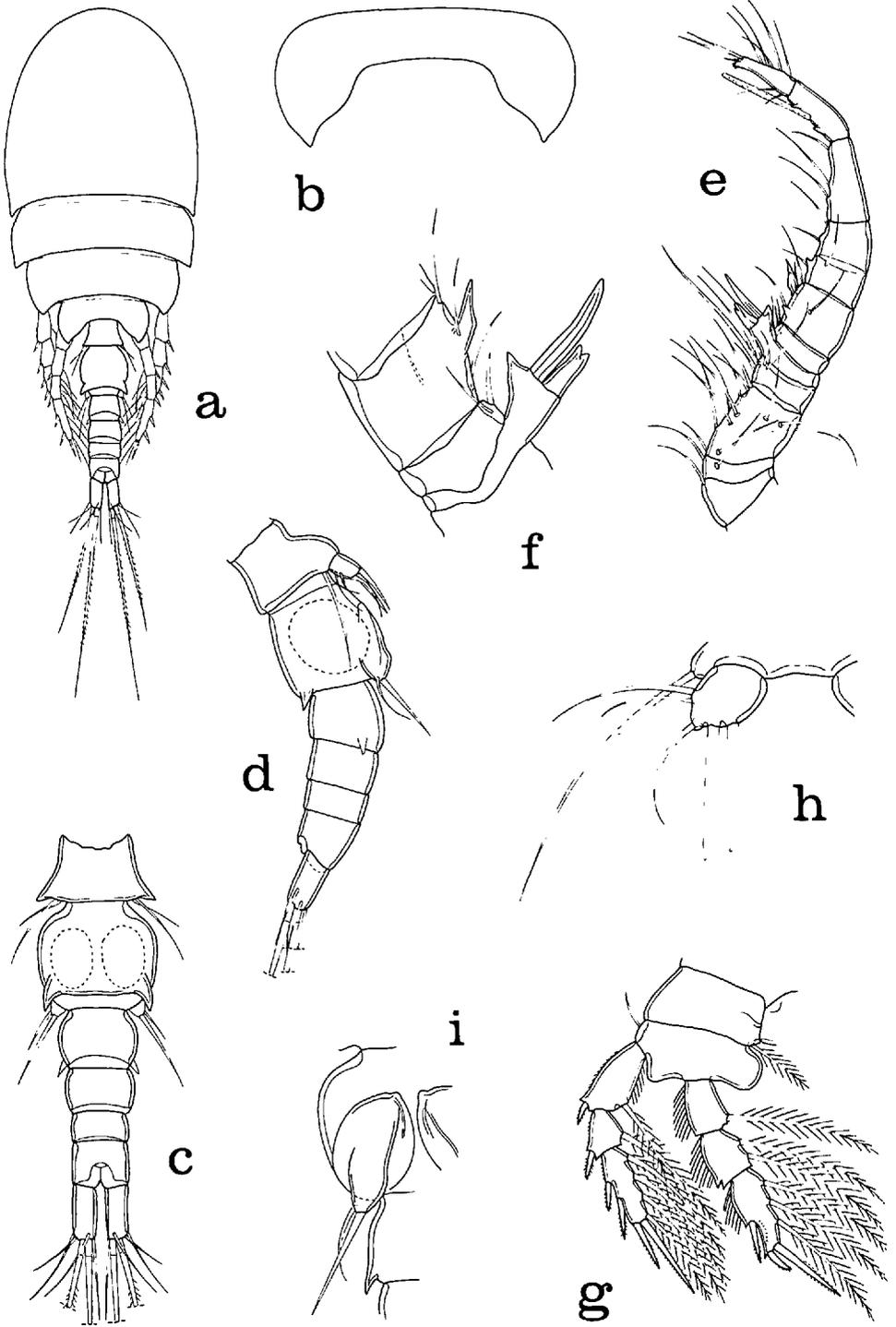


Figure 31. *Aphotopontius mammillatus* new genus, new species. Male: a, dorsal (scale H); b, tergum of segment bearing leg 4, dorsal (G); c, urosome, dorsal (C); d, urosome, lateral (C); e, first antenna, posteroventral (G); f, segments 5, 6, and 7 of first antenna, anterodorsal (F); g, leg 2, anterior (C); h, leg 5, ventral (F); i, leg 6, ventral (G).

aesthete, and 10. Fifth segment (Fig. 31f) with large process bearing 2 large stout spines, one spine 12 μm with bifurcate tip, other spine 26 μm and nonbifurcate (whole resembling scissors). Seventh segment with tapered spinous process and small spine. Eighth segment with 1 small spine.

Second antenna, oral cone, mandible, first maxilla, second maxilla, and maxilliped similar to those of female.

Legs 1, 3, and 4 as in female. Leg 2 (Fig. 31g) with spines on third segment of exopod more prominent than in female. Endopod with third segment having formula I,II,3; distal outer margin of segment concave, with submarginal row of minute spines.

Leg 5 (Fig. 31h) situated ventrally (Fig. 31d). Free segment 20 \times 13 μm , with 5 smooth setae from outer to inner 42, 23, 30, 33, and 30 μm . Two innermost of these setae stout. Adjacent dorsal seta 77 μm . All setae smooth.

Leg 6 (Fig. 31i) with 2 smooth setae 51 μm and 39 μm .

Spermatophore unknown.

Color unknown.

Etymology.—The specific name *mammillatus*, Latin meaning breastlike, alludes to the shape of the inner margin of the basis of leg 1.

Remarks.—*Aphotopontius mammillatus* may be recognized by the mammilliform inner margin of the basis of leg 1, by the laterally constricted genital segment in the female, and by both the genital segment and first postgenital segment of the male having a pair of posterolateral, posteriorly directed spiniform processes.

Among the thousands of siphonostomatoid copepods observed only one case of amplexus was seen. In this pair, a male and a female *Aphotopontius mammillatus* (from DSRV ALVIN dive no. 984), the male clung dorsally over the urosome of the female, embracing the postgenital segments of the female with its maxillipeds.

KEY TO THE FEMALES OF *APHOTOPONTIUS*

- | | |
|---|-----------------------|
| 1a. Caudal ramus with ratio of length to width 10:1 or greater | 2a |
| 1b. Caudal ramus with ratio of length to width 6.5:1 or less | 3a |
| 2a. Genital segment with small posterolateral spiniform processes; caudal ramus 13.7:1 | <i>A. baculigerus</i> |
| 2b. Genital segment without posterolateral spiniform processes; caudal ramus 10:1 | <i>A. limatulus</i> |
| 3a. Genital segment of female laterally indented, hourglass-shaped; formula for leg 4 as 0-1; 1,1 | <i>A. mammillatus</i> |
| 3b. Genital segment of female rounded laterally or not hourglass-shaped; formula for leg 4 as 0-1; 1,1 | 4a |
| 4a. Outer margin of caudal ramus slightly concave; genital segment with anterior half expanded forming recurved hooklike margin | <i>A. arcuatus</i> |
| 4b. Outer margin of caudal ramus straight; genital segment with rounded margins, anterior half with margin not recurved or hooklike | 5a |
| 5a. Genital segment expanded in anterior third; maxilliped with seta (spine) on second segment having recurved bent tip | <i>A. flexispina</i> |
| 5b. Genital segment expanded at midregion; seta on second segment of maxilliped straight | <i>A. forcipatus</i> |

KEY TO THE MALES OF *APHOTOPONTIUS* (MALE OF *A. FLEXISPINA* UNKNOWN)

- | | |
|--|-----------------------|
| 1a. Genital segment and first postgenital segment both having pair of posterolateral spiniform processes; endopod of leg 4 with 0-1; 1,1 | <i>A. mammillatus</i> |
| 1b. Genital segment and first postgenital segment without spiniform processes; endopod of leg 4 with 0-1; 1,1 | 2a |
| 2a. Leg 6 with 1 seta; maxilliped and its claw very long and slender; caudal ramus with outer edge slightly concave | <i>A. arcuatus</i> |

- 2b. Leg 6 with 2 setae; maxilliped and its claw not unusually long or slender; caudal ramus with outer margin straight 3a
 3a. Caudal ramus with ratio 5.6:1 *A. forcipatus*
 3b. Caudal ramus much longer, at least 8.6:1 4a
 4a. Caudal ramus with ratio 8.6:1; ventral surface of anal segment with spinules *A. limatulus*
 4b. Caudal ramus with ratio 9.2:1; ventral surface of anal segment smooth *A. baculigerus*

Stygiopontius new genus

Diagnosis.—Body unmodified. Segment bearing leg 1 fused with cephalosome. Urosome in female 5-segmented, in male 6-segmented. Caudal ramus with 6 setae. Egg sac, where known, containing 1 or 2 large eggs.

Rostrum mostly weakly defined. First antenna 10-segmented in female (though in 3 species apparently 12-segmented but first 3 segments not clearly defined), with aesthete on penultimate segment. In male 12-segmented, with fifth segment bearing inner spine or spines, aesthete on penultimate segment. Second antenna with 1-segmented exopod and 2-segmented endopod. Oral cone short, no true siphon. Mandible, first maxilla, second maxilla, and maxilliped resembling in general form those of *Aphotopontius*.

Legs 1–4 biramous, with 3-segmented rami, except 2-segmented endopod in leg 4. Arrangement of inner coxal setae varying specifically, 0,0,0,0; 1,1,0,0; 0,1,0,0; or 1,1,1,0. Exopod of leg 4 with third segment having I,II,4 or II,II,4. Basis of leg 1 with inner spine. Endopod of leg 4 with formula 0-0; 1,1 or 0-0; I,1. In male formula for third segment of endopod of leg 2 with I,II,I,2, inner of 2 terminal spines about as long as entire endopod (in female this formula 1,2,3).

Leg 5 2-segmented, in female situated ventrolaterally, in male ventrally. First segment with 1 seta. Second segment in female with 3 setae, in male with 5 setae.

Leg 6 in female represented by 1 seta, in male by 2 setae.

Type-species.—*Stygiopontius quadrispinosus* new species.

Gender.—Masculine.

Etymology.—The generic name is formed from the Greek words *stygios* meaning of the Styx or the nether world and *pontios* meaning in the sea.

Remarks.—The first antenna in the female should probably be considered as 10-segmented. In cases where it appears to be 12-segmented, as in *S. quadrispinosus*, *S. hispidulus*, and *S. sentifer*, the additional segments are only subdivisions of segment 1.

The absence of an inner seta on the first segment of the endopod of leg 4 distinguishes *Stygiopontius* from the related multispecific genus *Aphotopontius* (see above). Additional means of separating *Stygiopontius* from other dirivultid genera will be found in the key to genera on page 785.

Stygiopontius quadrispinosus new species

Figures 32a–j, 33a–g, 34a–i

Type Material.—1,534 ♀♀, 10 ♂♂, in 1,853 m, Pogo Peaks, Explorer Ridge, 49°45.5'N, 130°16.2'W, 23 June 1985, DSRV PISCES IV dive no. P-1492. Holotype ♀, allotype, and 708 paratypes (700 ♀♀, 8 ♂♂) deposited in the National Museum of Natural History, Smithsonian Institution, Washington, D.C.; 400 paratypic ♀♀ in the National Museum of Natural Sciences, Ottawa, Canada.

Other Specimens.—463 ♀♀, 779 ♂♂, in 1,808 m, Magic Mountain, Explorer Ridge, 49°45.6'N, 130°16.1'W, 02 July 1985, DSRV PISCES IV dive no. P-1495.

Female.—Body (Fig. 32a) with broad cephalosome. Length 0.85 mm (0.81–0.90 mm) and greatest width 0.37 mm (0.35–0.39 mm), based on 15 specimens. Great-

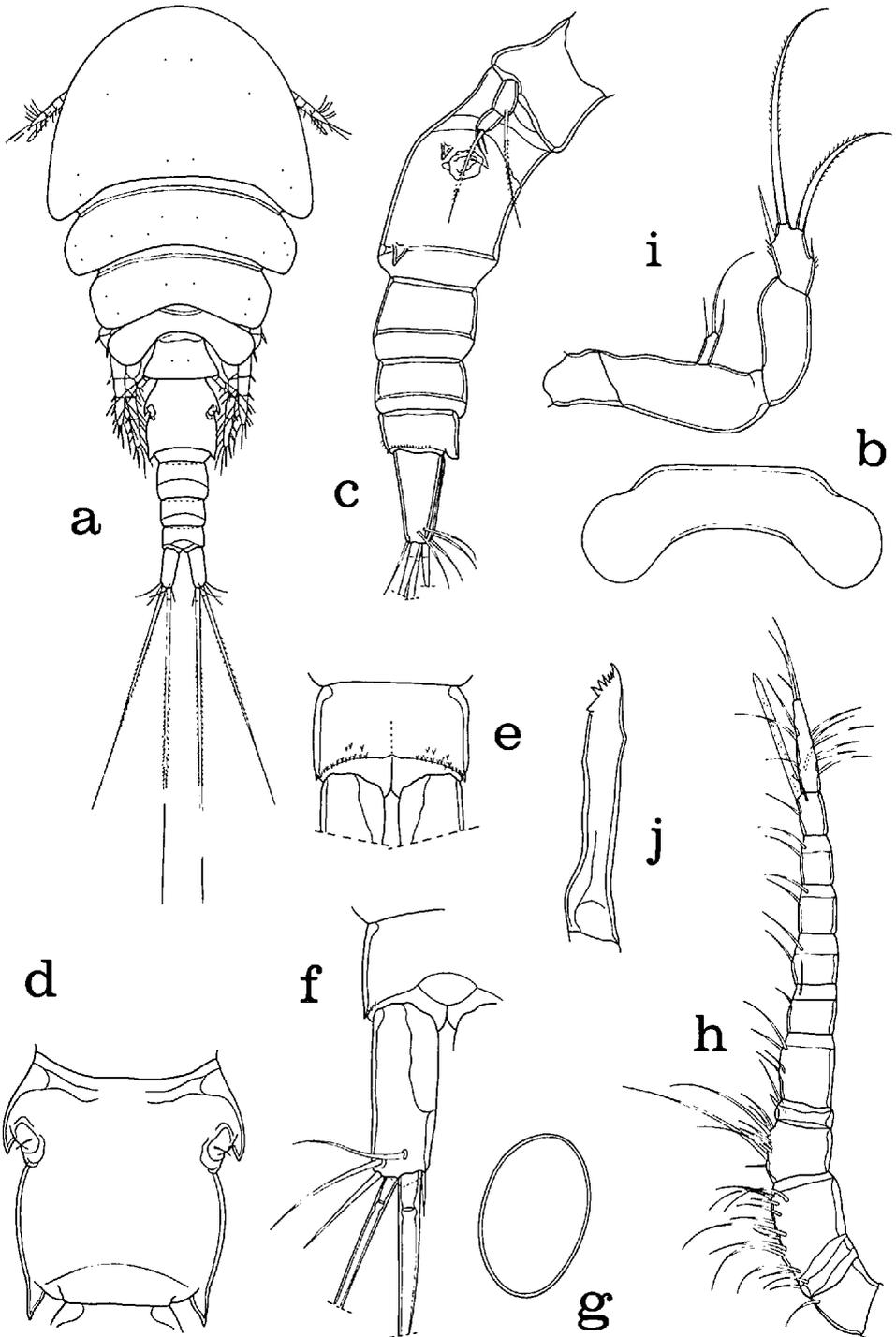


Figure 32. *Stygiopontius quadrispinosus* new genus, new species. Female: a, dorsal (scale H); b, tergum of segment bearing leg 4, dorsal (C); c, urosome, lateral (C); d, genital segment, dorsal (G); e, anal segment, ventral (E); f, caudal ramus, dorsal (E); g, egg sac, ventral (H); h, first antenna, posteroventral (G); i, second antenna, antero-inner (E); j, mandible, posterior (E).

est dorsoventral thickness 0.25 mm. Segment bearing leg 1 fused with cephalosome. Epimeral areas of segments bearing legs 1 and 2 rounded, those of segment bearing leg 3 truncate, and those of segment bearing leg 4 rounded as in Fig. 32b. Ratio of length to width of prosome 1.25:1. Ratio of length of prosome to that of urosome 1.34:1.

Segment bearing leg 5 (Fig. 32c) $65 \times 114 \mu\text{m}$ in dorsal view, with flared posterolateral angles. Genital segment (Fig. 32d) slightly constricted at junction of anterior two thirds of segment. Length $114 \mu\text{m}$, width in anterior third $112 \mu\text{m}$, width in posterior part of segment $99 \mu\text{m}$; with 2 pairs of spiniform processes as in Fig. 32c, d. Genital areas located laterally in anterior part of segment. Each area bearing single small seta. Three postgenital segments from anterior to posterior 49×78 , 39×68 , and $31 \times 60 \mu\text{m}$. Anal segment posteriorly with small lateral and ventral spines (Fig. 35e).

Caudal ramus (Fig. 35f) elongate, $57 \times 23.5 \mu\text{m}$, ratio 2.43:1. Outer lateral seta $43 \mu\text{m}$, dorsal seta $36 \mu\text{m}$, outermost terminal seta $32 \mu\text{m}$, innermost terminal seta $10 \mu\text{m}$ and hyaline; all these setae naked. Two long median terminal setae $220 \mu\text{m}$ (outer) and $460 \mu\text{m}$ (inner), both with very small barbs midway along their lengths.

Body surface sparsely ornamented with refractile points (sensilla ?) as in Fig. 32a.

Egg sac (Fig. 32g) containing single egg $231 \times 154 \mu\text{m}$.

Rostral area not well defined. First antenna (Fig. 32h) $294 \mu\text{m}$ long, not including setae. Lengths of its 12 segments: 16 ($23 \mu\text{m}$ along anterior margin), 10, 26, 21, 10, 34, 24, 24, 24, 24, 21, and $32 \mu\text{m}$, respectively. Armature: 1, 2, 12, 8, 2, 4, 2, 2, 2, 2, 2 + 1 aesthete, and 12.

Second antenna (Fig. 32i) $107 \mu\text{m}$ long in bent position and not including setae.

Oral cone, mandible (Fig. 32j) $95 \mu\text{m}$ long, first maxilla (Fig. 33a), second maxilla (Fig. 33b), and maxilliped (Fig. 33c) similar in major respects to those in congeners described below.

Legs 1-4 (Fig. 36d-g) biramous with 3-segmented rami, except for 2-segmented endopod in leg 4. Spine and setal formula as follows:

P_1	coxa	0-0	basis	1-1	exp	I-1; I-1; II,I,4
				enp	0-1; 0-2;	1,2,3
P_2	coxa	0-0	basis	1-0	exp	I-1; I-1; II,II,4
				enp	0-1; 0-2;	1,2,3
P_3	coxa	0-0	basis	1-0	exp	I-1; I-1; II,II,5
				enp	0-1; 0-2;	1,1,3
P_4	coxa	0-0	basis	1-0	exp	I-1; I-1; II,II,4
				enp	0-0;	1,1

Coxa in all 4 legs lacking inner seta. Basis of leg 1 with inner spine $16 \mu\text{m}$ and with inner margin rounded, in some specimens with minute indentation. Leg 4 with inner margin of basis slightly expanded. Exopod of leg 4 $164 \mu\text{m}$. Endopod of leg 4 (Fig. 34a) with unarmed first segment $29 \times 15.5 \mu\text{m}$. Second segment $55 \times 21 \mu\text{m}$, its inner seta $66 \mu\text{m}$ and its terminal seta $83 \mu\text{m}$, both with lateral spinules.

Leg 5 (Fig. 34b) 2-segmented. First segment $22 \times 14 \mu\text{m}$, its long barbed seta $85 \mu\text{m}$. Second segment $21 \times 10 \mu\text{m}$, its 3 terminal setae $61 \mu\text{m}$ (barbed), $26 \mu\text{m}$, and $13 \mu\text{m}$ (both smooth).

Leg 6 probably represented by seta on genital area (Fig. 32c).

Color unknown.

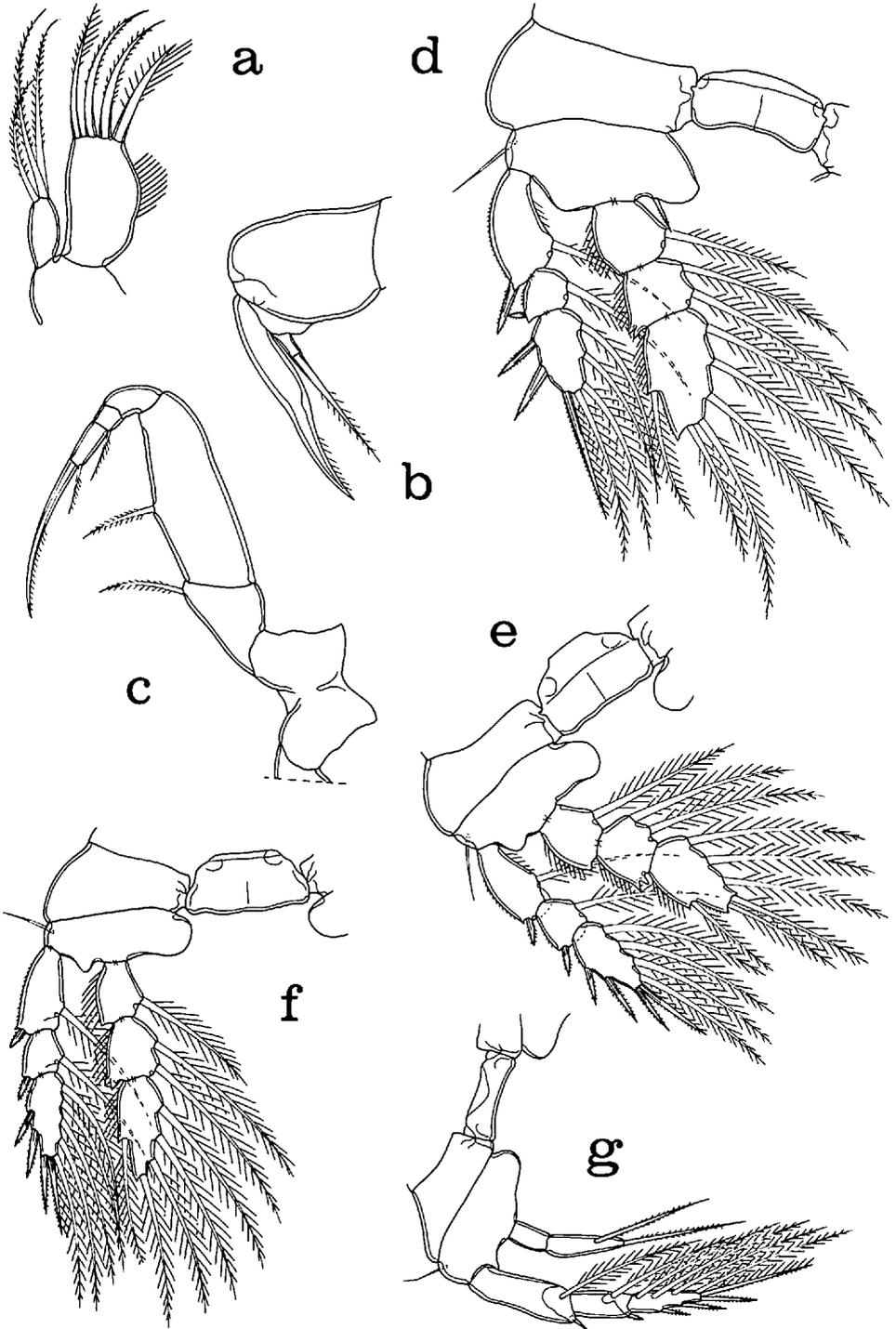


Figure 33. *Stygiopontius quadrispinosus* new genus, new species. Female: a, first maxilla, posterior (scale E); b, second maxilla, posterior (E); c, maxilliped, posterior (G); d, leg 1 and intercoxal plate, anterior (G); e, leg 2 and intercoxal plate, anterior (C); f, leg 3 and intercoxal plate, anterior (C); g, leg 4 and intercoxal plate, anterior (C).

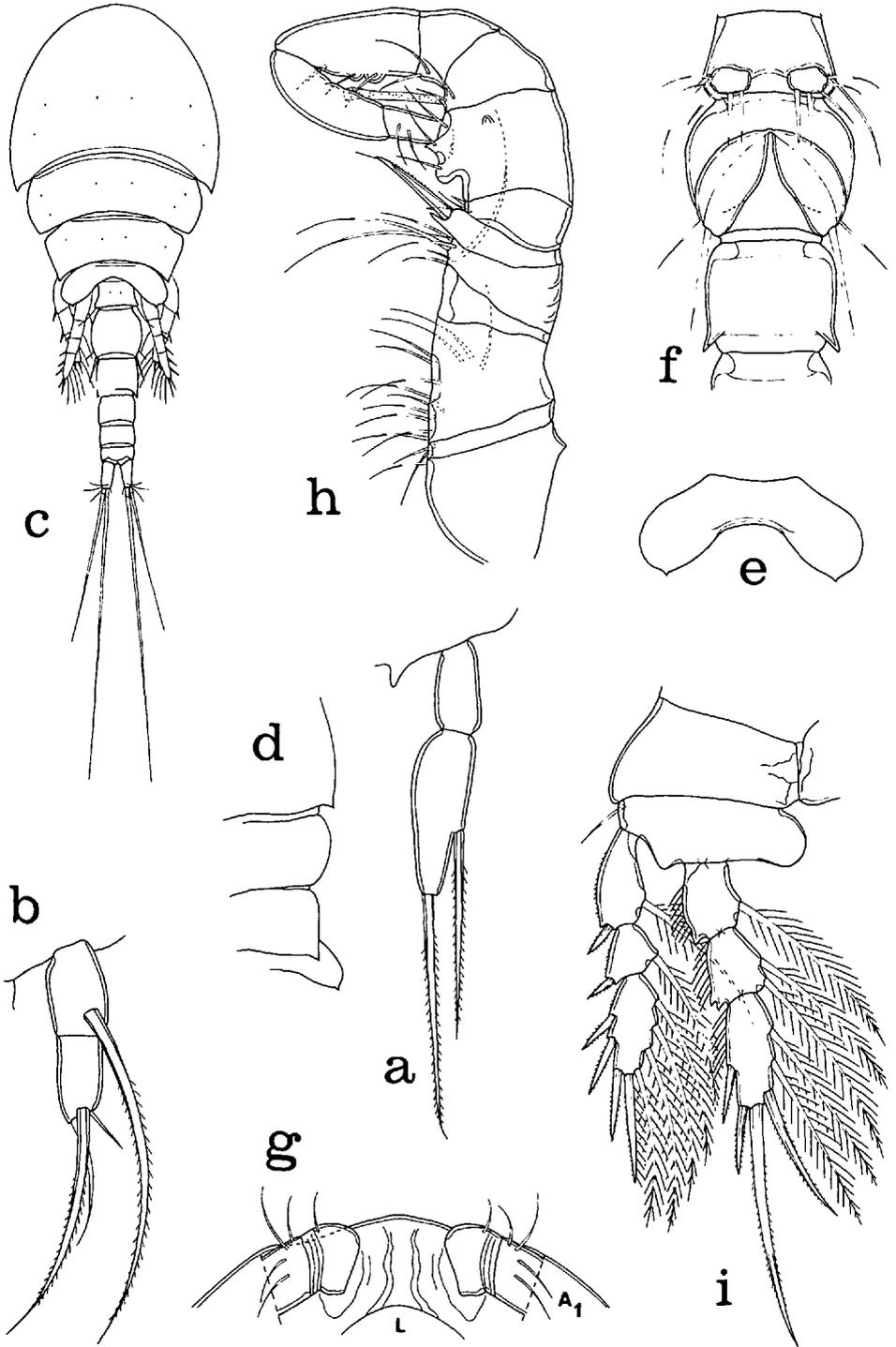


Figure 34. *Stygiopontius quadrispinosus* new genus, new species. Female: a, endopod of leg 4, anterior (scale E); b, leg 5, dorsal (F). Male: c, dorsal (H); d, epimera of segments bearing legs 1-4, dorsal (D); e, tergum of segment bearing leg 4, dorsal (C); f, segment bearing leg 5, genital segment, and first postgenital segment, ventral (G); g, rostral area, ventral (G); h, first antenna, posteroventral (F); i, leg 2, anterior (G).

Male.—Body (Fig. 34c) resembling that of female. Length 0.67 mm (0.63–0.72 mm) and greatest width 0.30 mm (0.28–0.33 mm), based on 15 specimens. Greatest dorsoventral thickness 0.18 mm. Ratio of length to width of prosome 1.31:1. Ratio of length of prosome to that of urosome 1.32:1. Epimeral areas of segments bearing legs 1 and 3 acutely pointed (Fig. 37d), those of segment bearing leg 4 with minute point (Fig. 34d, e).

Segment bearing leg 5 (Fig. 34f) $45 \times 71 \mu\text{m}$. Genital segment $68 \times 83 \mu\text{m}$ in dorsal view, lacking spiniform processes seen in female. First postgenital segment $55 \times 65 \mu\text{m}$, with pair of posterolateral spiniform processes (Fig. 34f). Second, third, and fourth postgenital segments 44×56 , 30×49 , and $26 \times 45 \mu\text{m}$. Anal segment with small spines as in female.

Caudal ramus similar to that of female but smaller, $42 \times 18 \mu\text{m}$, ratio 2.33:1. Body surface ornamented as in female.

Rostral area weakly defined but showing 2 sclerotized bars (Fig. 34g). First antenna (Fig. 34h) strongly geniculate, 12-segmented. Armature: 1, 2, 12, 7, 2, 2, 4, 2, 2, 3, 1 aesthete, and 10. Fifth segment with prominent inner process bearing stout spine $22 \mu\text{m}$ long, unilaterally barbed and with subterminal filament $5.5 \mu\text{m}$, and short spine $6.5 \mu\text{m}$. Seventh segment with inner knob and spiniform process and having posterior surficial sclerotized knob. Eighth segment with very small spiniform process. Tenth segment with 2 small inner knobs.

Second antenna, oral cone, mandible, first maxilla, second maxilla, and maxilliped resembling those of female.

Legs 1, 3, and 4 as in female. Leg 2 (Fig. 34i) with spines on third segment of exopod more prominent than in female. Endopod with third segment having formula I,II,I,2, inner of 2 terminal spines unusually long, $112 \mu\text{m}$, as long as entire endopod.

Leg 5 (Fig. 34f) situated ventrally. Free segment $12 \times 18.5 \mu\text{m}$, with 5 setae from outer to inner 23, 14, 23, 24, and $24 \mu\text{m}$. Adjacent seta long, $57 \mu\text{m}$.

Leg 6 (Fig. 34f) with 2 setae, one stout, $42 \mu\text{m}$, other slender, $29 \mu\text{m}$.

Spermatophore not seen.

Color unknown.

Etymology.—The specific name *quadrispinosus*, Latin meaning four-spined, alludes to the two pairs of spiniform processes on the genital segment of the female.

Remarks.—*Stygiopontius quadrispinosus* may be recognized by a combination of characters: (1) the genital segment of the female constricted laterally and having two pairs of spiniform processes, (2) the first postgenital segment having a pair of small posterolateral spiniform processes, and (3) the innermost terminal seta on the caudal ramus being very short, shorter than the ramus itself.

Stygiopontius cinctiger new species

Figures 35a–f, 36a–h, 37a–d

Type Material.—49 ♀♀, in 2,616 m, Clam Acres, East Pacific Rise, $20^{\circ}50.0'N$, $109^{\circ}06.0'W$, 10 May 1982, DSRV ALVIN dive no. 1226. Holotype and 45 paratypes deposited in the National Museum of Natural History, Smithsonian Institution, Washington, D.C.

Other Specimens.—5 ♀♀, in 2,616 m, Clam Acres, East Pacific Rise, $20^{\circ}50.0'N$, $109^{\circ}06.0'W$, 07 May 1982, DSRV ALVIN dive no. 1223.

Female.—Body (Fig. 35a) with moderately broad prosome. Length 1.00 mm (0.94–1.08 mm) and greatest width 0.60 mm (0.56–0.63 mm), based on 10 specimens. Greatest dorsoventral thickness 0.29 mm. Segment of leg 1 fused with cephalosome. Epimeral areas of segments bearing legs 1–4 rounded. Ratio of length

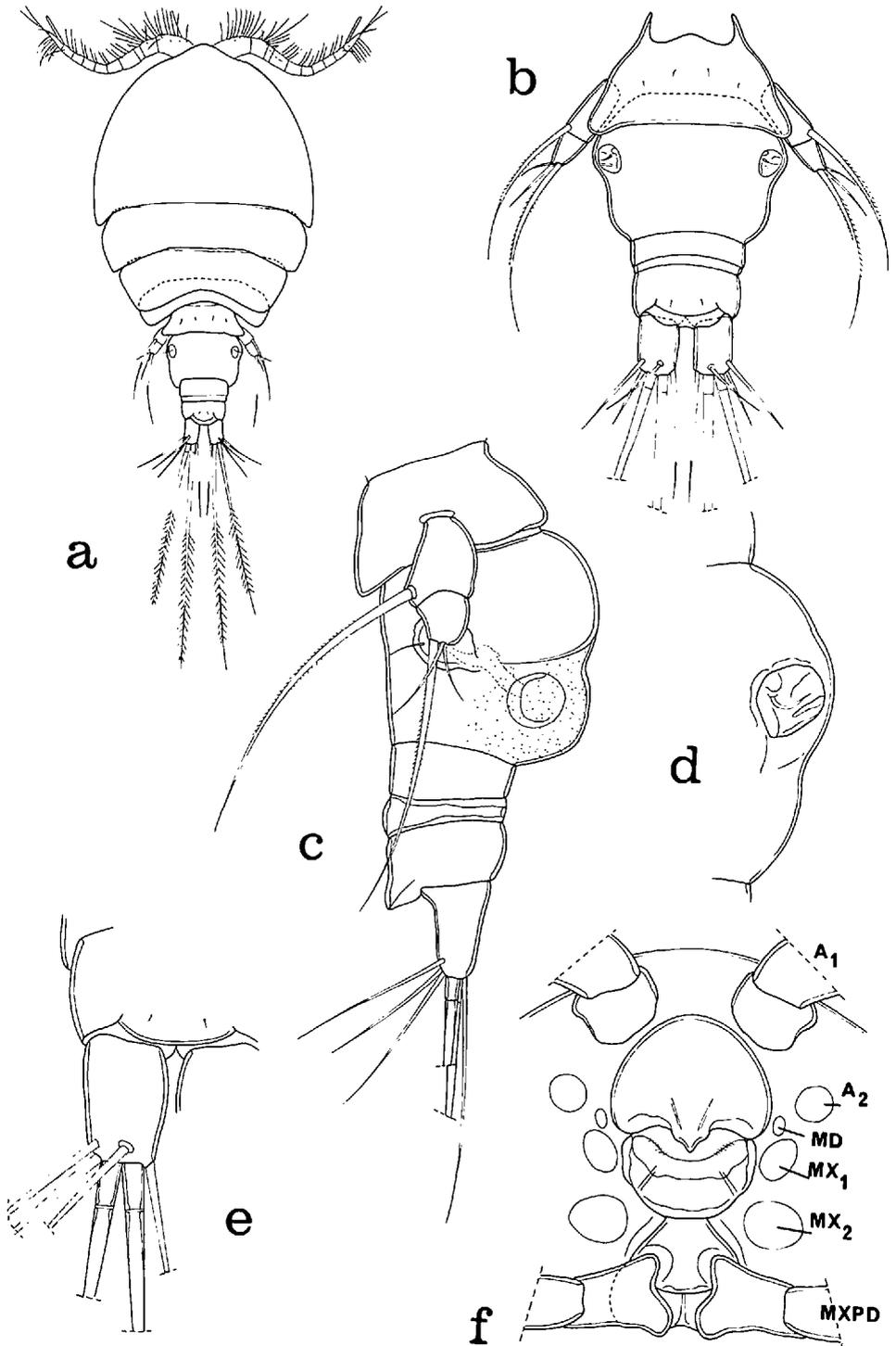


Figure 35. *Stygiopontius cinctiger* new genus, new species. Female: a, dorsal (scale B); b, urosome, dorsal (D); c, urosome, lateral (C); d, genital area, dorsal (G); e, caudal ramus, dorsal (G); f, rostral and oral area, ventral (C).

to width of prosome 1.16:1. Ratio of length of prosome to that of urosome 1.86:1.

Segment bearing leg 5 (Fig. 35b) $112 \times 200 \mu\text{m}$. Genital segment broad, $133 \times 205 \mu\text{m}$, widest in anterior half. Genital areas located dorsolaterally in anterior half. Each area bearing single small seta (Fig. 35d). Posterior half of genital segment with light brown band ventrally and showing 2 oval areas (Fig. 35c).

Caudal ramus (Fig. 35e) $60 \times 39 \mu\text{m}$, ratio 1.54:1. Outer lateral seta $99 \mu\text{m}$, dorsal seta $65 \mu\text{m}$, outermost terminal seta $69 \mu\text{m}$, and innermost terminal seta $146 \mu\text{m}$, all these setae smooth. Two long median terminal setae $390 \mu\text{m}$ (outer) and $560 \mu\text{m}$ (inner), both pinnate with lateral setules along distal two-thirds.

Body surface with very few hairs (sensilla) as in Fig. 35a.

Egg sac unknown.

Rostral area (Fig. 35f) not developed. First antenna (Fig. 36a) $385 \mu\text{m}$ long not including terminal setae. Lengths of its 10 segments: 83 ($130 \mu\text{m}$ along anterior margin), 31, 13, 34, 31, 31, 30, 27, 29, and $42 \mu\text{m}$, respectively. Armature: 15, 8, 2, 4, 2, 2, 2, 2 + 1 aesthete, and 12. All setae smooth.

Second antenna (Fig. 36b) with second segment of protopod having outer setules. Exopod with 3 setae. Two-segmented endopod with first segment having inner setules, second segment with 2 unequal terminal setae with distal outer barbs, 2 short smooth setae, and outer and inner setules.

Oral cone (Fig. 35f) short. Mandible (Fig. 36c) slender blade with small distal teeth. First maxilla (Fig. 36d) with inner branch bearing 4 stout setae, outer branch with 3 slender setae. Second maxilla (Fig. 36e) with large basal segment bearing distal seta with spinules unilaterally. Second segment forming claw with distal setules. Maxilliped (Fig. 36f) 4-segmented plus claw (though third segment partially subdivided). Armature: 1, 1, 2 + 1, 1, and long claw distally pectinate along concave side.

Legs 1-4 (Figs. 36g, h, 37a, b) segmented and armed as follows:

P_1	coxa	0-1	basis	1-I	exp	I-1; I-1; II,I,4
					enp	0-1; 0-2; 1,2,3
P_2	coxa	0-1	basis	1-0	exp	I-1; I-1; II,II,4
					enp	0-1; 0-2; 1,2,3
P_3	coxa	0-0	basis	1-0	exp	I-1; I-1; II,II,5
					enp	0-1; 0-2; 1,I,3
P_4	coxa	0-0	basis	1-0	exp	I-1; I-1; I,II,4
					enp	0-0; I,1

Coxa in legs 1 and 2 with inner seta. Basis of leg 1 with inner setiform smooth spine $26 \mu\text{m}$. Leg 4 with exopod $178 \mu\text{m}$. Endopod with first segment $29 \times 21 \mu\text{m}$, second segment $57 \times 25 \mu\text{m}$, terminal finely barbed spine $117 \mu\text{m}$, inner pinnate seta $138 \mu\text{m}$.

Leg 5 (Fig. 37c) elongate, 2-segmented, $101 \times 38 \mu\text{m}$ with 2 segments combined. Seta on first segment $180 \mu\text{m}$ and finely barbed. Second segment with long finely barbed seta $195 \mu\text{m}$, 1 short minutely barbed seta $75 \mu\text{m}$, and another short smooth seta $47 \mu\text{m}$.

Leg 6 probably represented by seta on genital area (Fig. 35d).

Spermatophores seen attached to ventral surface of posterior half of genital segment in 1 female (Fig. 37d). Each spermatophore, partially emptied, $155 \times 70 \mu\text{m}$, with long neck.

Color unknown, except for pale brownish band on ventral side of posterior half of genital segment in specimens preserved in ethanol.

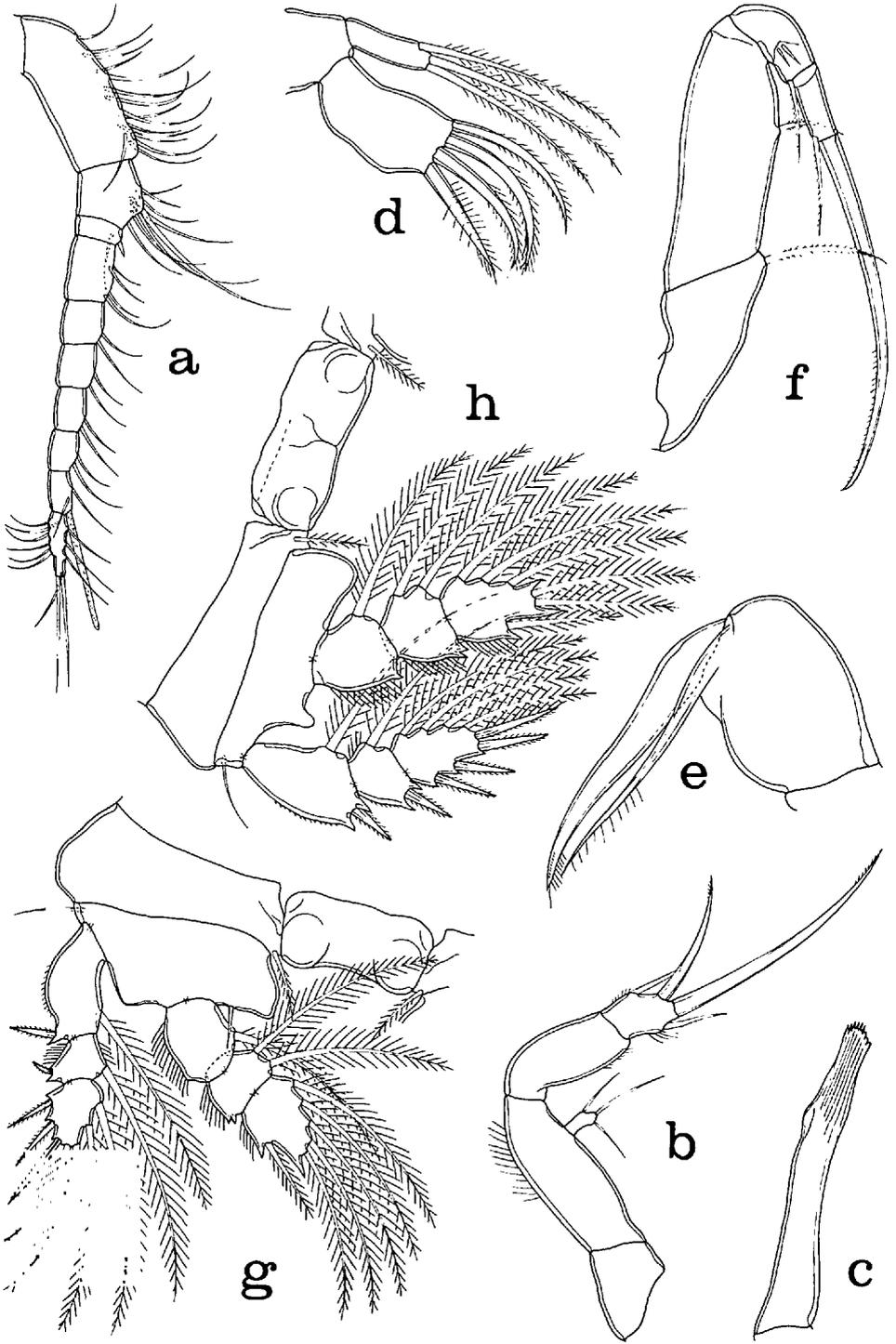


Figure 36. *Stygiopontius cinctiger* new genus, new species. Female: a, first antenna, anterodorsal (scale C); b, second antenna, antero-inner (G); c, mandible, anterior (G); d, first maxilla, posterior (G); e, second maxilla, posterior (G); f, maxilliped, posterior (G); g, leg 1 and intercoxal plate, anterior (C); h, leg 2 and intercoxal plate, anterior (C).

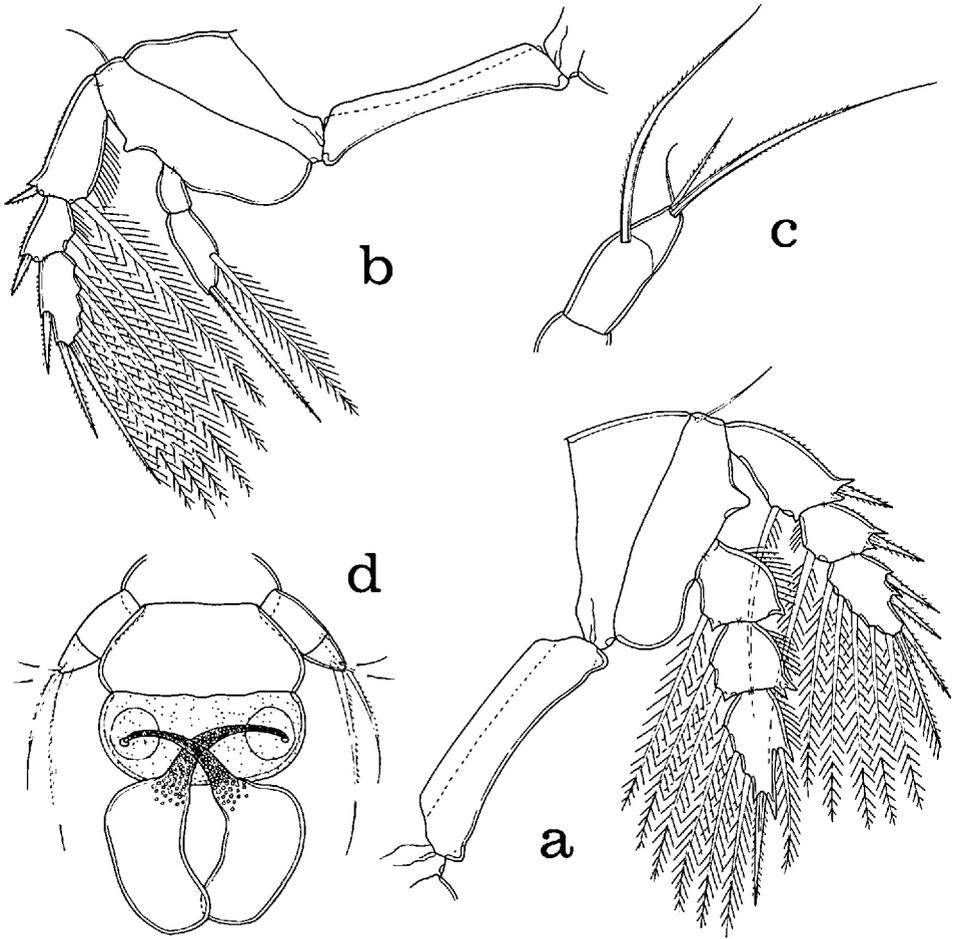


Figure 37. *Stygiopontius cinctiger* new genus, new species. Female: a, leg 3 and intercoxal plate, anterior (scale C); b, leg 4 and intercoxal plate, anterior (C); c, leg 5, dorsal (C); d, fifth pair of legs, genital segment, and spermatophores, ventral (D).

Male.—Unknown.

Etymology.—The specific name *cinctiger*, Latin *cinctus*, a band or belt, and *gero*, to carry, refers to the light brown color on the ventral surface of the posterior half of the genital segment.

Remarks.—*Stygiopontius cinctiger* may be recognized by the band of light brown color on the ventral surface of the posterior half of the broad genital segment.

***Stygiopontius flexus* new species**

Figures 38a–1, 39a–i

Type Material.—50 ♀♀ from mats of the bacterium *Beggiatoa* and from washings of vestimentiferans, in 2,000 m, Guaymas Basin, Gulf of California, 27°00.5'N, 111°24.4'W, 07 August 1985, DSRV ALVIN dive no. 1615. Holotype and 44 paratypes deposited in the National Museum of Natural History, Smithsonian Institution, Washington, D.C.

Female.—Body (Fig. 38a) with broad prosome. Length 1.11 mm (1.03–1.18 mm) and greatest width 0.58 mm (0.50–0.64 mm), based on 10 specimens. Greatest

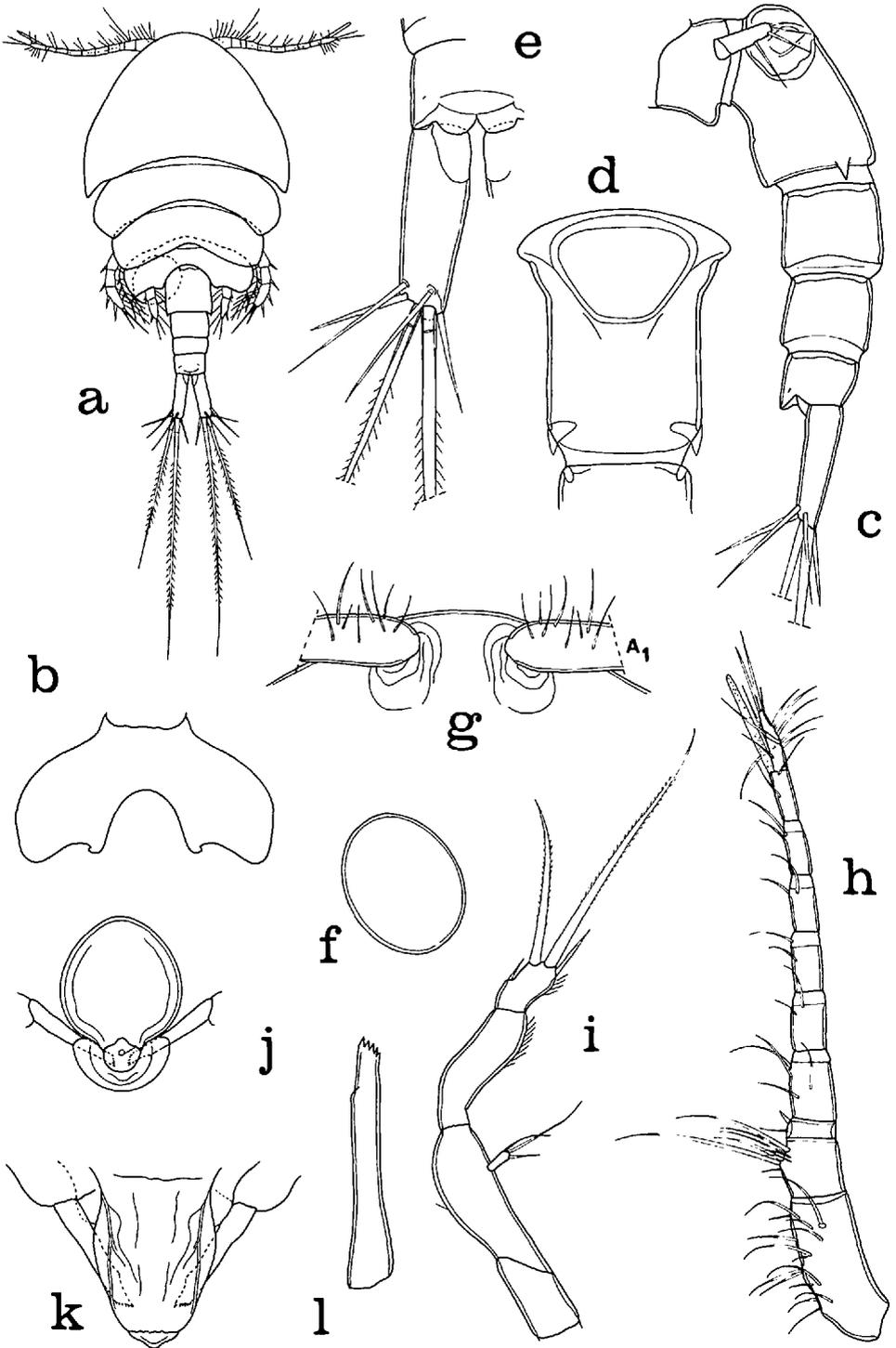


Figure 38. *Stygiopontius flexus* new genus, new species. Female: a, dorsal (scale A); b, tergum of segment bearing leg 4, dorsal (H); c, urosome, lateral (C); d, genital segment, dorsal (C); e, caudal rami, dorsal (C); f, egg sac, ventral (D); g, rostral area, ventral (C); h, first antenna, posteroventral (C); i, second antenna, antero-inner (G); j, oral cone, showing positions of mandibles, ventral (C); k, oral cone with mandibles, posterior (C); l, mandible, posterior (G).

dorsoventral thickness 0.24 mm. Segment bearing leg 1 fused with cephalosome. Epimeral areas of segments bearing legs 1–3 rounded, those of segment bearing leg 4 shaped as in Fig. 38b. Ratio of length to width of prosome 1.15:1. Ratio of length of prosome to that of urosome 1.57:1.

Urosome flexed. Segment bearing leg 5 protruding dorsally, and longer dorsally than ventrally (Fig. 38c), $88 \times 130 \mu\text{m}$ in dorsal view. Genital segment (Fig. 38d) $148 \times 112 \mu\text{m}$ (dorsal view), with parallel sides and pair of posterolateral spinelike processes. Genital areas located ventrolaterally at anterior end of segment. Three postgenital segments from anterior to posterior 107×109 , 78×96 , and $57 \times 57 \mu\text{m}$.

Caudal ramus (Fig. 38e) elongate, $138 \times 44 \mu\text{m}$, ratio 3.14:1. Outer lateral seta $104 \mu\text{m}$, dorsal seta $93 \mu\text{m}$, outermost terminal seta $74 \mu\text{m}$, and innermost terminal seta $79 \mu\text{m}$, all spinelike and smooth. Two long median terminal setae $445 \mu\text{m}$ (outer) and $700 \mu\text{m}$ (inner), both with extremely fine hairs.

Body surface smooth except for pair of minute sensilla on anal segment (Fig. 38a).

Egg sac (Fig. 38f) containing 1 egg $143 \times 121 \mu\text{m}$.

Rostral area (Fig. 38g) not well defined. First antenna (Fig. 38h) $440 \mu\text{m}$ long without setae. Lengths of 10 segments: 79 ($117 \mu\text{m}$ along anterior margin), 31, 13, 47, 39, 40, 40, 36, 37, and $40 \mu\text{m}$, respectively. Armature: 15, 8, 2, 4, 2, 2, 2, 2, 2 + 1 aesthete, and 12. All setae smooth.

Second antenna (Fig. 38i) $170 \mu\text{m}$ long not including setae, and closely resembling those of congeners.

Oral cone (Fig. 38j, k) formed by large labrum and smaller labium. Mandible (Fig. 38l) $127 \mu\text{m}$ long, slender, with several small teeth terminally; fitted between labrum and labium (Fig. 38j). First maxilla (Fig. 39a), second maxilla (Fig. 39b), and maxilliped (Fig. 39c) similar in major respects to those of congeners. Maxilliped with setae on first and second segments barbed and claw pectinate distally.

Legs 1–4 (Fig. 39d–f, h) biramous with 3-segmented rami, except for 2-segmented endopod of leg 4. Spine and setal formula as follows:

P_1	coxa	0-1	basis	1-I	exp	I-1; I-1; II,I,4
					enp	0-1; 0-2; 1,2,3
P_2	coxa	0-1	basis	1-0	exp	I-1; I-1; II,II,4
					enp	0-1; 0-2; 1,2,3
P_3	coxa	0-0	basis	1-0	exp	I-1; I-1; II,II,5
					enp	0-1; 0-2; 1,1,3
P_4	coxa	0-0	basis	1-0	exp	I-1; I-1; II,II,4
					enp	0-0; 1,1

Inner coxal seta absent in legs 3 and 4. Inner margin of basis in legs 1 and 2 with rounded expansion, but in legs 3 and 4 lacking such expansion. Slender spinules on posterior surface of third segment of endopod of leg 3 (Fig. 39g), this endopod showing abnormal formula with forked seta. Exopod of leg 4 $217 \mu\text{m}$ long. Endopod of leg 4 (Fig. 39h) with unarmed first segment $40 \times 26 \mu\text{m}$. Second segment $73 \times 29 \mu\text{m}$, subterminal inner seta $85 \mu\text{m}$ and terminal seta $109 \mu\text{m}$, both with extremely minute barbs.

Leg 5 (Fig. 39i) 2-segmented, elongate. First segment $31 \times 12 \mu\text{m}$, its smooth seta $52 \mu\text{m}$. Second segment $26 \times 10 \mu\text{m}$, its smooth setae from ventral to dorsal 49, 40, and $49 \mu\text{m}$.

Leg 6 represented by seta on genital area.

Color of living specimens bright red.

Male. — Unknown.

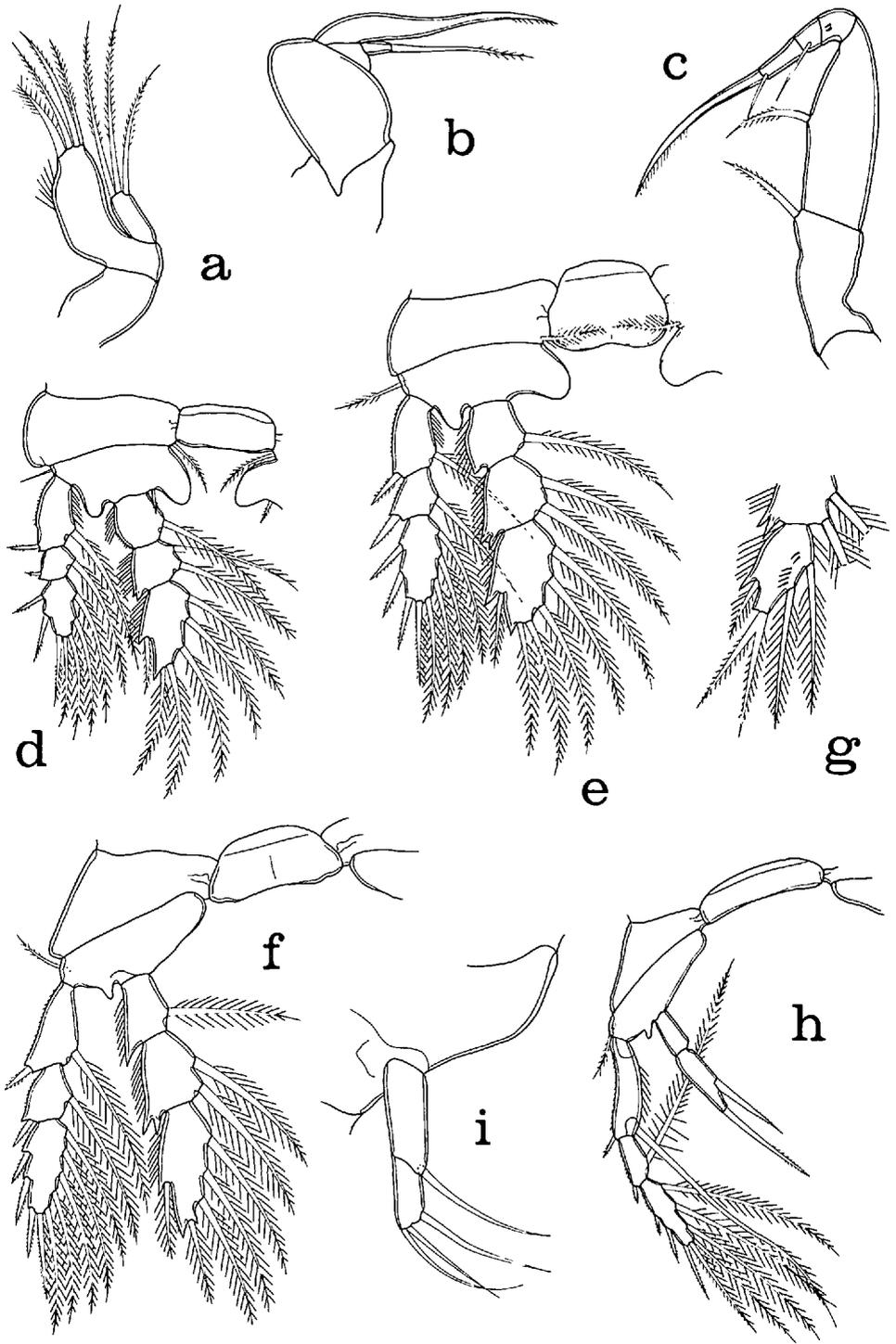


Figure 39. *Stygiopontius flexus* new genus, new species. Female: a, first maxilla, posterior (scale G); b, second maxilla, posterior (G); c, maxilliped, posterior (C); d, leg 1 and intercoxal plate, anterior (D); e, leg 2 and intercoxal plate, anterior (D); f, leg 3 and intercoxal plate, anterior (D); g, abnormal third segment of endopod of leg 3, posterior (D); h, leg 4 and intercoxal plate, anterior (D); i, leg 5, ventral (E).

Etymology.—The specific name *flexus*, Latin meaning bent, refers to the flexed condition of the body in preserved specimens.

Remarks.—*Stygiopontius flexus* may be recognized by the flexed urosome, with the genital areas far forward on the genital segment which is longer than wide, with parallel sides and posterolateral spiniform processes.

The appearance of the mats of *Beggiatoa* on which living red specimens of *S. flexus* were seen is shown in color in fig. 1 of Grassle (1983).

Stygiopontius hispidulus new species

Figures 40a–g, 41a–h, 42a–c

Type Material.—123 ♀♀, from slurp of alvinellid polychaetes, in 2,635 m, location Pogonord, Biocyarise, East Pacific Rise, 12°49.1'N, 103°56.9'W, 09 March 1984, DSRV CYANA dive no. 84-32. Holotype and 116 paratypes deposited in the Muséum National d'Histoire Naturelle, Paris.

Other Specimens.—81 ♀♀, from slurp on chimney, in 2,635 m, location Actinoir, Biocyarise, East Pacific Rise, 12°48.8'N, 103°56.8'W, 15 March 1984, DSRV CYANA dive no. 84-38; 140 ♀♀ from washings of the polychaete *Alvinella* and the bivalve *Calypptogena*, in 2,617 m, Clam Acres, East Pacific Rise, 20°50.0'N, 109°06.0'W, 19 April 1982, DSRV ALVIN dive no. 1213; 14 ♀♀, in 2,625 m, location Pogonord, Biocyarise, East Pacific Rise, 12°49.1'N, 103°56.9'W, 11 March 1984, DSRV CYANA dive no. 84-34; 38 ♀♀, in 2,635 m, location Parigo, Biocyarise, East Pacific Rise, 12°48.8'N, 103°56.6'W, 15 March 1984, DSRV CYANA dive no. 84-38; 33 ♀♀, in 2,616 m, Clam Acres, East Pacific Rise, 20°50.0'N, 109°06.0'W, 10 May 1982, DSRV ALVIN dive no. 1226; 1 ♀, in 2,618 m, Clam Acres, East Pacific Rise, 20°50.0'N, 109°06.0'W, 09 May 1982, DSRV ALVIN dive no. 1225; 2 ♀♀, in 2,615 m, Clam Acres, East Pacific Rise, 20°50.0'N, 109°06.0'W, 17 April 1982, DSRV ALVIN dive no. 1211; 38 ♀♀, in 2,616 m, Clam Acres, East Pacific Rise, 20°50.0'N, 109°06.0'W, 07 May 1982, DSRV ALVIN dive no. 1223.

Female.—Body (Fig. 40a) with slightly broadened prosome. Length 1.14 mm (1.03–1.20 mm) and greatest width 0.55 mm (0.51–0.59 mm), based on 20 specimens. Greatest dorsoventral thickness 0.28 mm. Segment of leg 1 fused with cephalosome. Epimeral areas of segment of leg 1 pointed, those of leg 2 rounded, those of leg 3 truncate, and those of leg 4 rounded. Ratio of length to width of prosome 1.27:1. Ratio of length of prosome to that of urosome 1.49:1.

Segment bearing leg 5 (Fig. 40b) 104 × 185 μm. Genital segment (Fig. 40c) nearly as long as wide, widest in anterior half, 180 μm, with lateral spiniform processes, narrower in posterior half, 140 μm, with similar but smaller spiniform processes. Genital areas located dorsolaterally in anterior half of segment. Each area bearing single small seta. Three postgenital segments from anterior to posterior 78 × 120, 65 × 109, and 42 × 94 μm. Anal segment (Fig. 40e) with few lateroventral posterior spines.

Caudal ramus (Fig. 40d) moderately elongate, 101 × 44 μm, ratio 2.30:1. Outer lateral seta 91 μm, dorsal seta 83 μm, outermost terminal seta 52 μm, all smooth. Innermost terminal seta 122 μm with lateral hairs. Two long median terminal setae 430 μm (outer) and 590 μm (inner), both with lateral setules. One female with abnormal caudal ramus on one side (Fig. 40e).

Body surface with few small sensilla (Fig. 40a).

Egg sac (Fig. 40f), seen in only 1 female, with 3 eggs, sac 450 × 330 μm.

Rostral area (Fig. 40g) not developed. First antenna (Fig. 41a) 385 μm long not including setae. Length of its 12 segments: 21 (45 μm along anterior margin), 14, 44, 31, 13, 49, 34, 34, 31, 34, 33, and 36 μm, respectively. Armature: 1, 2, 12, 8, 2, 4, 2, 2, 2, 2 + 1 aesthete, and 12. All setae smooth.

Second antenna (Fig. 41b) with inner setules on second protopodal segment, exopod 1-segmented with 3 setae, endopod with first segment having few outer setules, second segment having 3 setae, middle seta long, and few outer spinules.

Oral cone (Fig. 40g), mandible (Fig. 41c) 117 μm long, first maxilla (Fig. 41d),

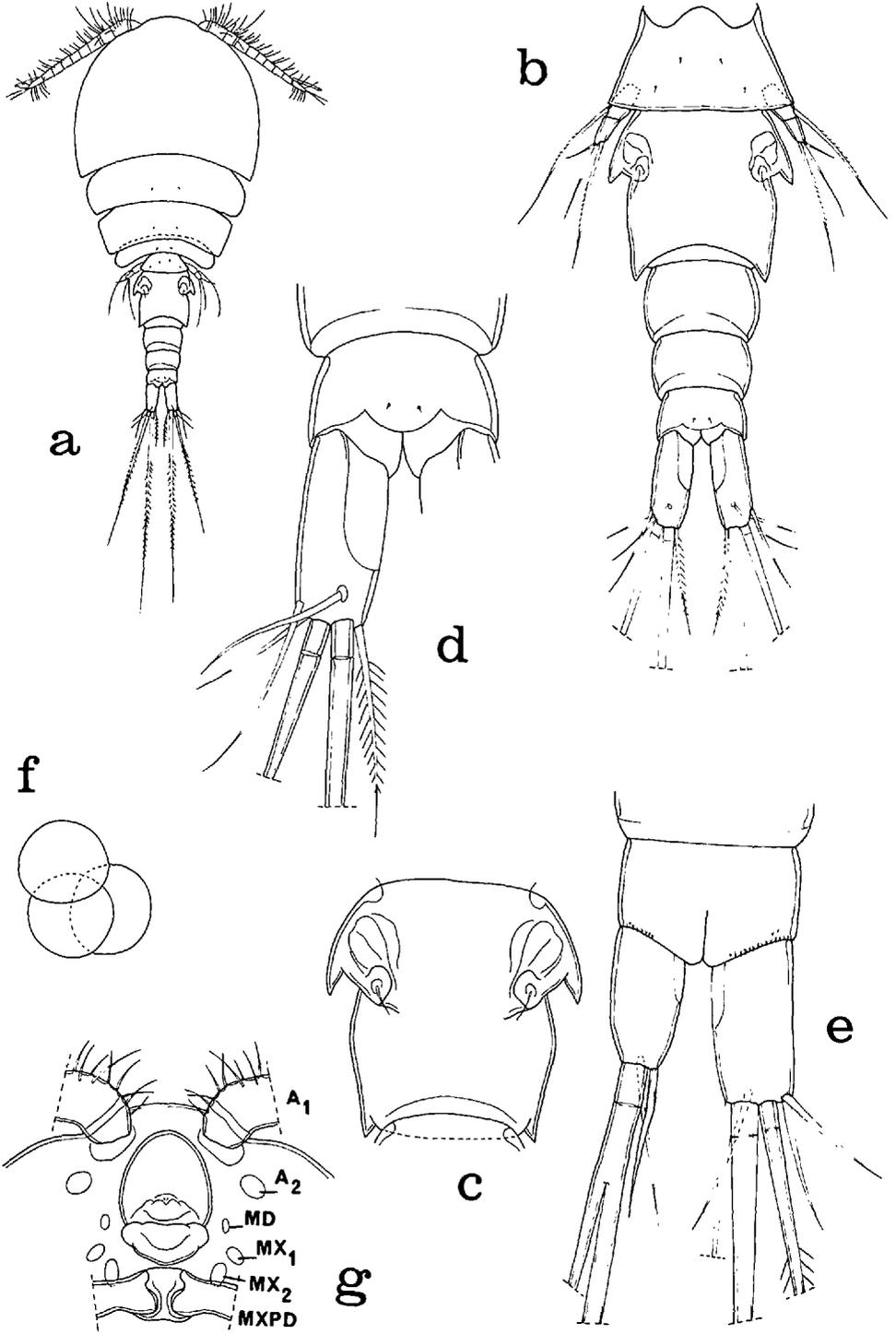


Figure 40. *Stygiopontius hispidulus* new genus, new species. Female: a, dorsal (scale A); b, urosome, dorsal (D); c, genital segment, dorsal (C); d, anal segment and caudal ramus, dorsal (G); e, anal segment and caudal ramus, right ramus abnormal, ventral (G); f, egg sac, lateral (A); g, rostral area, oral cone, and positions of mouthparts, ventral (D).

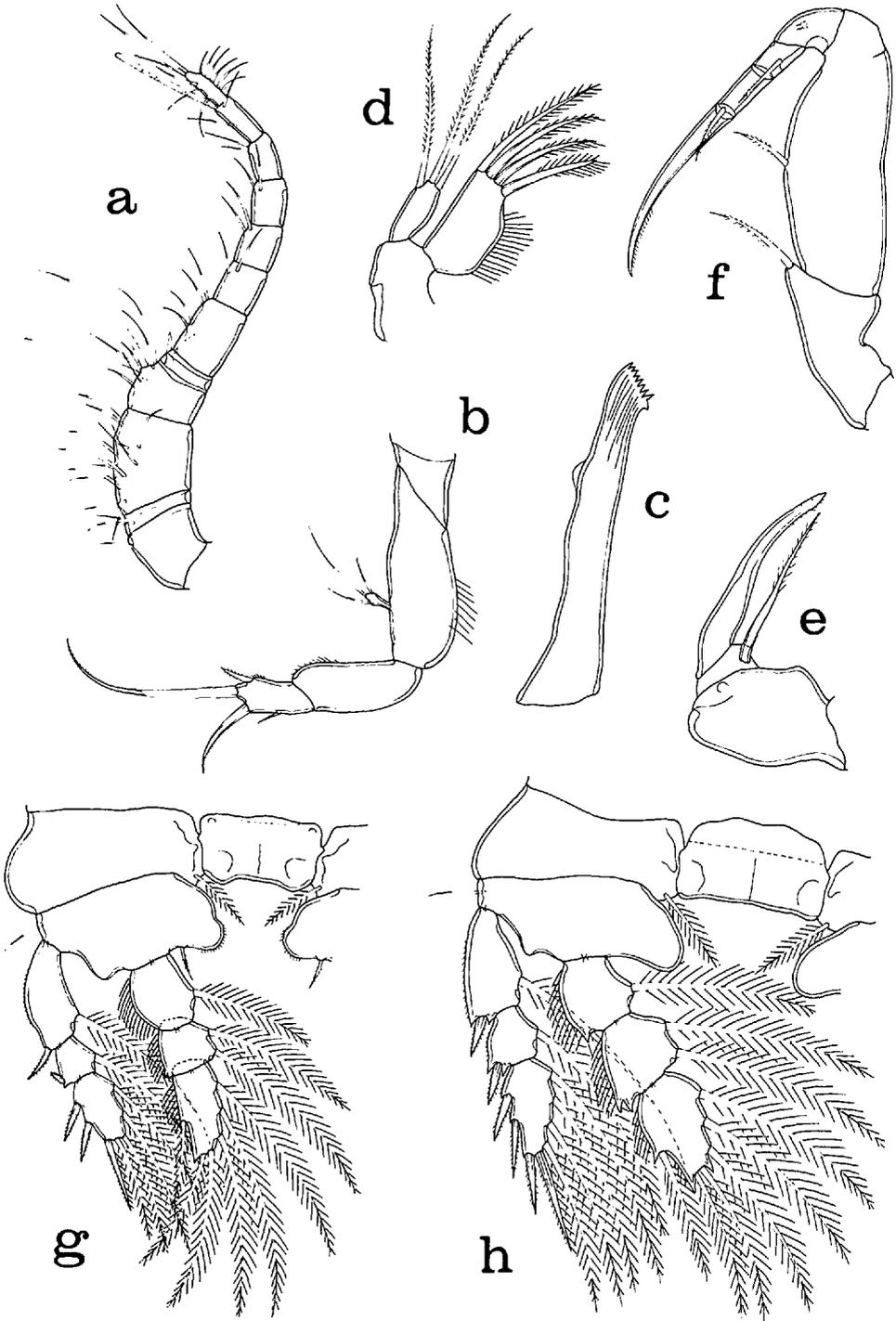


Figure 41. *Stygiopontius hispidulus* new genus, new species. Female: a, first antenna, posteroventral (scale C); b, second antenna, antero-inner (G); c, mandible, posterior (E); d, first maxilla, posterior (G); e, second maxilla, posterior (G); f, maxilliped, posterior (G); g, leg 1 and intercoxal plate, anterior (C); h, leg 2 and intercoxal plate, anterior (C).

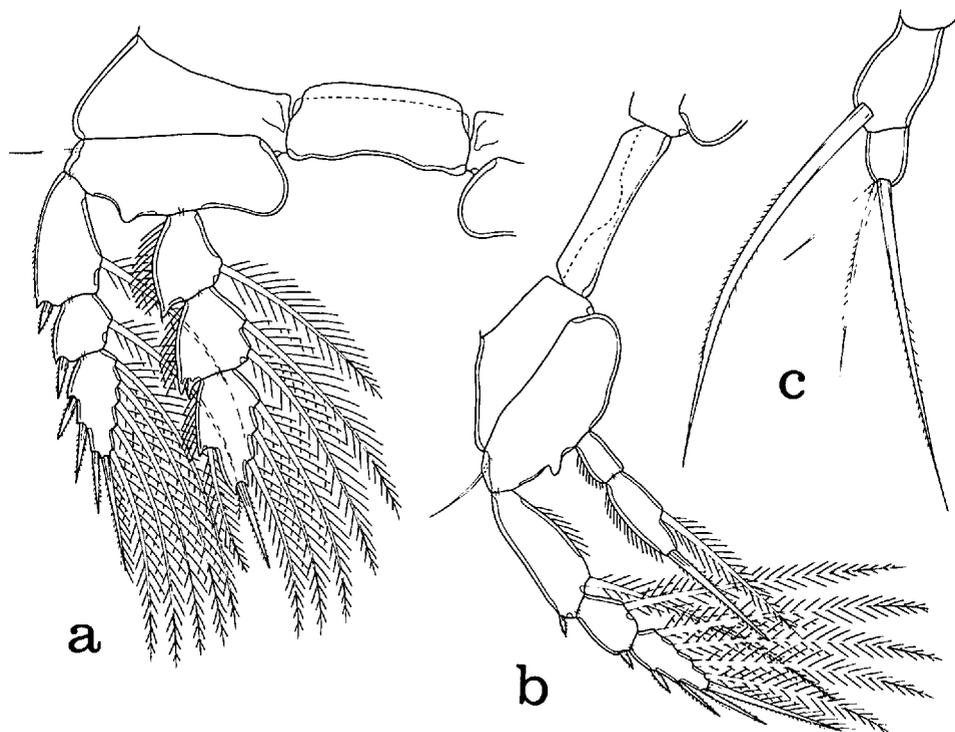


Figure 42. *Stygiopontius hispidulus* new genus, new species. Female: a, leg 3 and intercoxal plate, anterior (scale C); b, leg 4 and intercoxal plate, anterior (C); c, leg 5, dorsal (E).

second maxilla (Fig. 41e), and maxilliped (Fig. 41f) not differing greatly from those in congeners.

Legs 1-4 (Figs. 41g, h, 42a, b) biramous with 3-segmented rami, except for 2-segmented endopod in leg 4. Spine and setal formula as follows:

P_1	coxa	0-1	basis	1-I	exp	I-1; I-1; II,I,4
					enp	0-1; 0-2; 1,2,3
P_2	coxa	0-1	basis	1-0	exp	I-1; I-1; II,II,4
					enp	0-1; 0-2; 1,2,3
P_3	coxa	0-0	basis	1-0	exp	I-1; I-1; II,II,5
					enp	0-1; 0-2; 1,I,3
P_4	coxa	0-0	basis	1-0	exp	I-1; I-1; II,II,4
					enp	0-0; I,1

Inner coxal seta on legs 3 and 4 lacking. Leg 4 with exopod 198 μm long. Endopod with first segment $35 \times 21 \mu\text{m}$, second segment $65 \times 26 \mu\text{m}$, its terminal barbed spine 87 μm , its inner pinnate seta 104 μm . Both endopodal segments with outer hairs.

Leg 5 (Fig. 42c) 2-segmented, 57 μm long. First segment 23 μm wide, its long barbed seta 133 μm . Second segment smaller, 13 μm wide, its 3 setae from outer to inner 36 μm (smooth), 65, and 109 μm (both barbed).

Leg 6 probably represented by seta on genital area (Fig. 40c).

Color unknown.

Male. — Unknown.

Etymology. — The specific name *hispidulus*, diminutive of Latin *hispidus*, meaning bristly, alludes to the small spines on the inner margin of the basis of leg 1.

Remarks. — Three other species of *Stygiopontius* with the genital segment in the female having two pairs of spiniform processes are similar in general aspect to the new species. These differ from *Stygiopontius hispidulus*, however, in several respects. In *Stygiopontius quadrispinosus* the innermost terminal seta on the caudal ramus is very short, distinctly less than the length of the ramus; the third segment of the endopod of leg 3 is armed with 1,1,3; and the length of the body of the female is shorter, 0.85 mm. In *Stygiopontius mucroniferus*, described below, the genital segment is not indented laterally and the body length is 1.78 mm. In *Stygiopontius pectinatus*, described below, the two terminal setae on the second antenna are clawlike and strongly pectinate and the claw of the maxilliped is conspicuously pectinate.

***Stygiopontius mucroniferus* new species**
Figures 43a–h, 44a–g, 45a–c

Type Material. — 2 ♀♀, in 2,004 m, Guaymas Basin, Gulf of California, 27°00.5'N, 111°24.4'W, 4 August 1985, DSRV ALVIN dive no. 1612. Holotype deposited in the National Museum of Natural History, Smithsonian Institution, Washington, D.C.

Female. — Body (Fig. 43a) with flattened broad prosome. Length 1.78 and greatest width 0.80 mm, based on two specimens. Greatest dorsoventral thickness 0.32 mm. Segment bearing leg 1 fused with cephalosome. Epimeral areas of segments bearing legs 1–4 expanded and pointed posteriorly. Ratio of length to width of prosome 1.12:1. Ratio of length of prosome to that of urosome 1.19:1.

Segment bearing leg 5 (Fig. 43b) $121 \times 248 \mu\text{m}$. Genital segment (Fig. 43c) quadrate, $264 \times 253 \mu\text{m}$ (length $242 \mu\text{m}$ without spiniform processes). Pair of prominent spinelike lateral processes on anterior third of segment; posterolateral corners of segment drawn out in acute spiniform processes. Genital areas situated dorsolaterally in anterior half of segment. Each area with small slender seta. Three postgenital segments from anterior to posterior 121×167 , 110×154 , and $88 \times 132 \mu\text{m}$.

Caudal ramus (Fig. 43d) elongate, $180 \times 57 \mu\text{m}$, ratio 3.16:1. Outer lateral seta $91 \mu\text{m}$, dorsal seta $122 \mu\text{m}$, outermost terminal seta $83 \mu\text{m}$, innermost terminal seta $135 \mu\text{m}$; all these setae smooth. Two median terminal setae $510 \mu\text{m}$ (outer) and $825 \mu\text{m}$ (inner), both minutely barbed along their midregions.

Body surface smooth, without observable sensilla.

Egg sac in holotype containing 1 egg (Fig. 43e) $220 \times 187 \mu\text{m}$; in paratype with 3 eggs (Fig. 43f), average size $155 \times 133 \mu\text{m}$.

Rostrum (Fig. 43g) broad but shallow. First antenna (Fig. 43h) $616 \mu\text{m}$ long. Lengths of its 10 segments: 138 ($198 \mu\text{m}$ along anterior margin), 49, 20, 70, 57, 52, 52, 49, 47, and $49 \mu\text{m}$, respectively. Armature: 15, 8, 2, 4, 2, 2, 2, 2, 2 + 1 aesthete, and 12. All setae naked.

Second antenna (Fig. 44a) resembling that of congeners. Oral cone (Fig. 43g) elongate. Mandible (Fig. 44b) $212 \mu\text{m}$ long, first maxilla (Fig. 44c), and second maxilla (Fig. 44d) similar to those in congeners. Maxilliped (Fig. 44e) fairly stout, with minutely barbed elements on first and second segments stout and spiniform. Claw bluntly pointed.

Legs 1–4 (Figs. 44f, g, 45a, b) biramous with 3-segmented rami, except for 2-segmented endopod of leg 4. Spine and setal formula as follows:

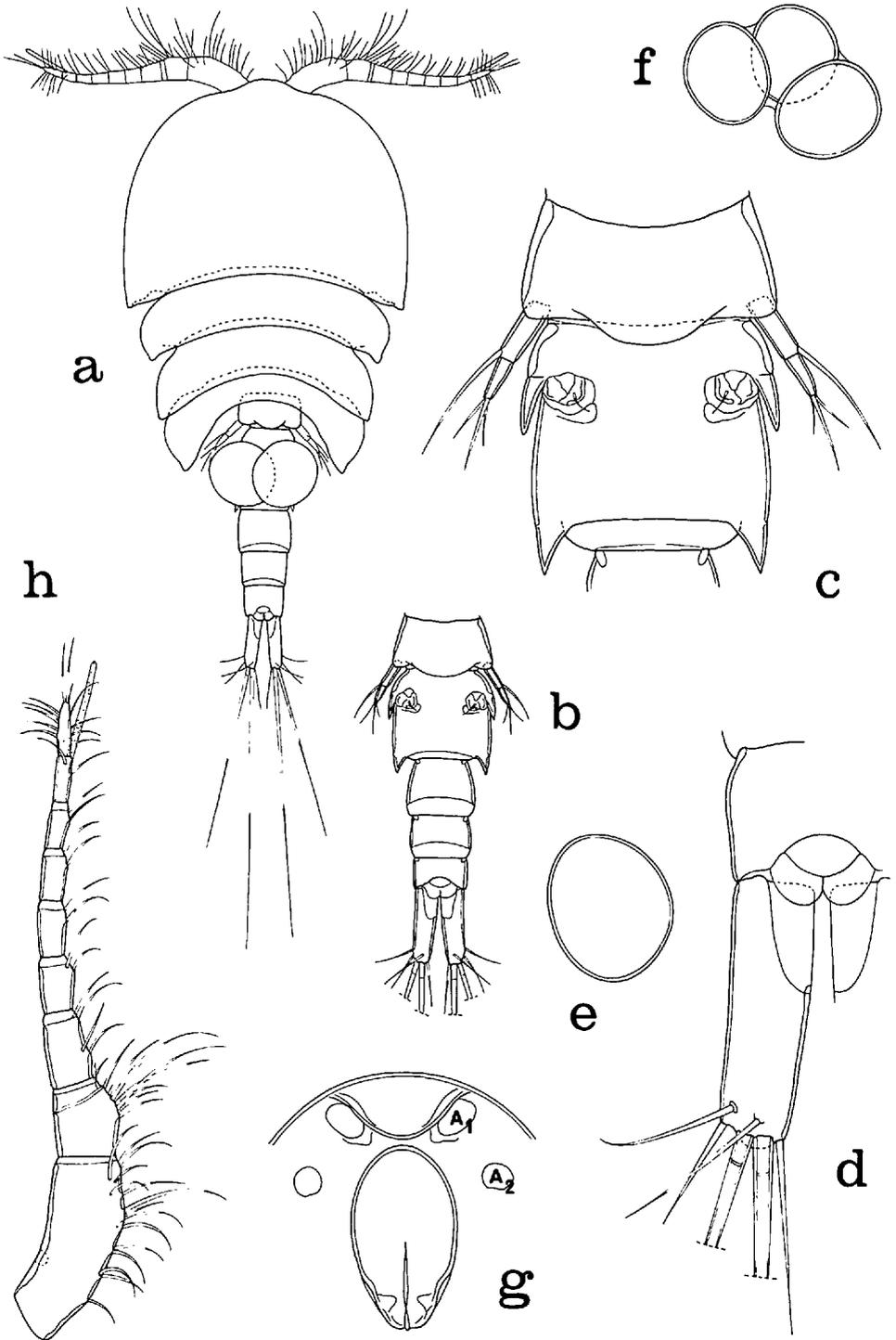


Figure 43. *Stygiopontius mucroniferus* new genus, new species. Female: a, dorsal (scale A); b, urosome, dorsal (B); c, segment bearing leg 5 and genital segment, dorsal (D); d, caudal ramus, dorsal (C); e, egg sac, ventral (H); f, egg sac, ventral (H); g, rostrum and oral cone, ventral (H); h, first antenna, dorsal (D).

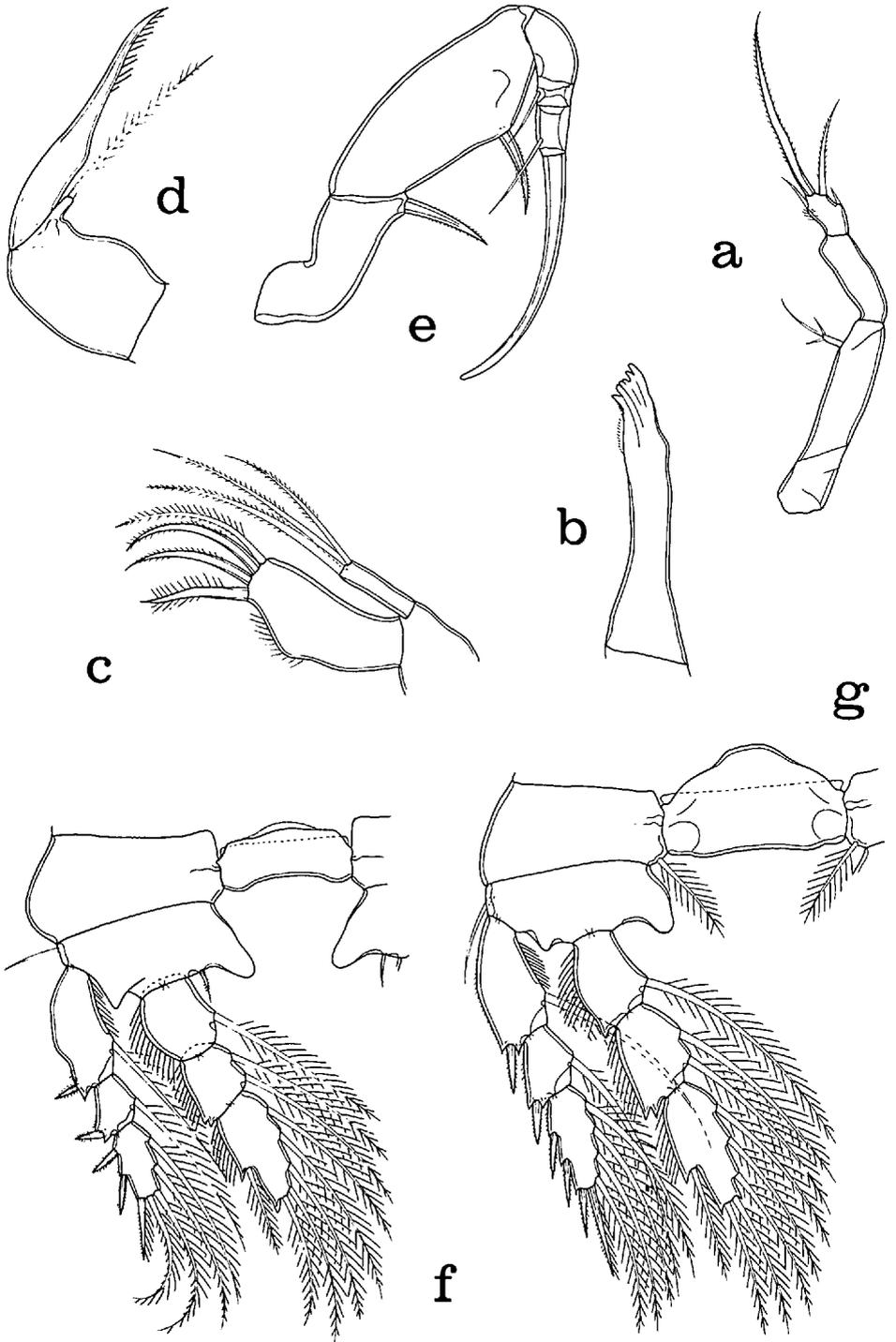


Figure 44. *Stygiopontius mucroniferus* new genus, new species. Female: a, second antenna, anterio-internal (scale D); b, mandible, posterior (C); c, first maxilla, posterior (C); d, second maxilla, posterior (C); e, maxilliped, posterior (D); f, leg 1 and intercoxal plate, anterior (D); g, leg 2 and intercoxal plate, anterior (D).

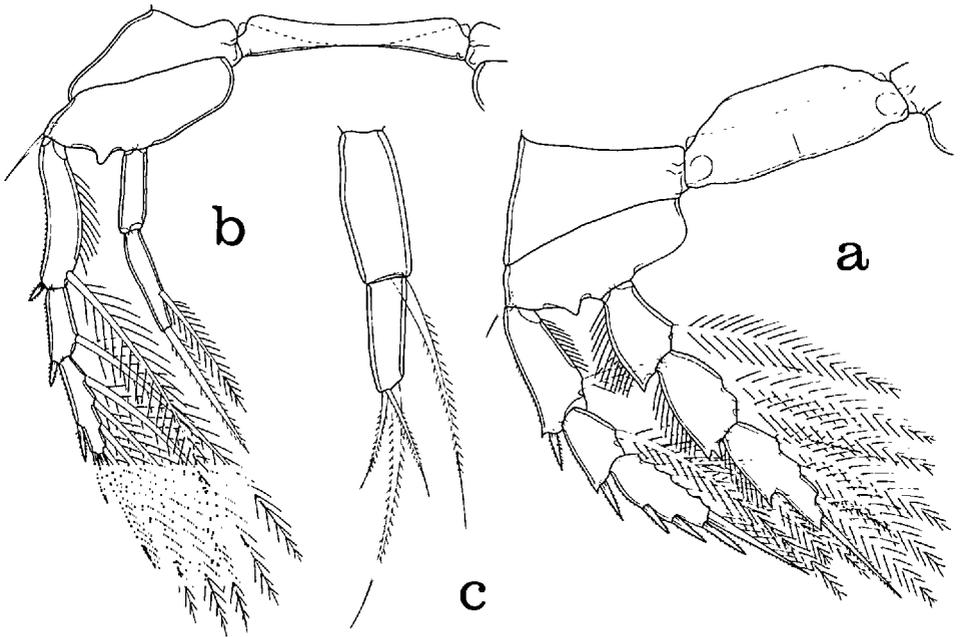


Figure 45. *Stygiopontius mucroniferus* new genus, new species. Female: a, leg 3 and intercoxal plate, anterior (scale D); b, leg 4 and intercoxal plate, anterior (D); c, leg 5, ventral (G).

P_1	coxa	0-0	basis	1-I	exp	I-1; I-1; II,I,4
					enp	0-1; 0-2; 1,2,3
P_2	coxa	0-1	basis	1-0	exp	I-1; I-1; II,II,4
					enp	0-1; 0-2; 1,2,3
P_3	coxa	0-0	basis	1-0	exp	I-1; I-1; II,II,5
					enp	0-1; 0-2; 1,I,3
P_4	coxa	0-0	basis	1-0	exp	I-1; I-1; I,II,4
					enp	0-0; 1,1

Coxae of legs 1, 3, and 4 lacking inner seta. Basis of leg 1 with slender minutely barbed spine 30 μm long. Inner margin of basis of legs 1 and 2 expanded in prominent lobe. Leg 1 with exopod having group of spinules near spines on first and second segment and near middle spine on third segment. Leg 4 with formula for third segment of exopod I,II,4, with only 1 outer spine. Exopod of leg 4 308 μm . Endopod of leg 4 (Fig. 45b) with unarmed first segment 75 \times 23 μm ; second segment 104 \times 22 μm , its inner seta 126 μm and its terminal seta 143 μm , both setae laterally haired.

Leg 5 (Fig. 45c) 2-segmented, elongate. First segment 55 \times 29 μm , its seta 118 μm . Second segment 48 \times 16 μm , with 3 terminal setae 40, 52, and 110 μm . All setae with lateral setules.

Leg 6 probably represented by seta on genital area (Fig. 43c).

Color unknown.

Male. — Unknown.

Etymology. — The specific name *mucroniferus*, Latin *mucro*, a sharp point, and *fero*, to carry or bear, alludes to the two pairs of spiniform processes on the genital segment.

Remarks.—*Stygiopontius mucroniferus* is distinguished from its congeners by its large size and by the genital segment having two pairs of spiniform processes but lacking evident lateral indentations.

Stygiopontius pectinatus new species

Figures 46a–k, 47a–f

Type Material.—297 ♀♀ from more than 100 shrimps, *Rimicaris exoculata* Williams and Rona, 1986, in 3,620–3,650 m, TAG Hydrothermal Field, Mid-Atlantic Ridge, 26°08.3'N, 44°49.6'W, 03 August 1985, NOAA RV RESEARCHER. Holotype and 292 paratypes deposited in the National Museum of Natural History, Smithsonian Institution, Washington, D.C.

Other Specimens.—21 ♀♀ from *Rimicaris exoculata*, in 3,522 m, Mid-Atlantic Ridge, 23°22.160'N, 44°57.072'W, 17 December 1985, JOIDES (Joint Oceanographic Investigations Deep Earth Section), RV RESOLUTION, leg 106 of Ocean Drilling Program, site 649; 4 ♀♀ from 13 shrimps, *Rimicaris chacei* Williams and Rona, 1986, same collection data.

Female.—Body (Fig. 46a) with moderately broad prosome. Length 1.01 mm (0.94–1.08 mm) and greatest width 0.53 mm (0.51–0.54 mm), based on 10 specimens. Greatest dorsoventral thickness 0.26 mm. Segment bearing leg 1 fused with cephalosome. Epimeral areas of segments bearing legs 1 and 2 pointed posteriorly, those of segments of legs 3 and 4 less so. Ratio of length to width of prosome 1.15:1. Ratio of length of prosome to that of urosome 1.53:1.

Segment bearing leg 5 (Fig. 46b) broad, $65 \times 152 \mu\text{m}$. Genital segment (Fig. 46c) only slightly longer than wide, $172 \times 164 \mu\text{m}$ (length including processes), with pair of inwardly directed spiniform processes on slightly expanded anterior half and another pair of smaller spiniform processes posteriorly. Genital areas (Fig. 46c) located dorsolaterally near anterior spiniform processes. Each area with 1 small seta. Three postgenital segments from anterior to posterior 73×99 , 52×86 , and $23 \times 85 \mu\text{m}$. Anal segment with posteroventral row of minute spines.

Caudal ramus (Fig. 46d) $52 \times 31 \mu\text{m}$, ratio 1.68:1. Outer lateral seta $78 \mu\text{m}$, dorsal seta $70 \mu\text{m}$, outermost terminal seta $73 \mu\text{m}$, all smooth. Innermost terminal seta $146 \mu\text{m}$ with inner setules. Two long median terminal setae $341 \mu\text{m}$ (outer) with outer spinules and inner hairlike setules and $561 \mu\text{m}$ (inner) with few small lateral spinules. Ventral surface of ramus with 1 small setule.

Body surface smooth except for pair of minute sensilla (setules ?) on dorsal surface of anal segment (Fig. 46d).

Egg sac (Fig. 46e) containing 1 egg, $253 \times 154 \mu\text{m}$ and $231 \times 148 \mu\text{m}$ in 1 female.

Rostrum (Fig. 46f) broadly rounded posteroventrally. First antenna (Fig. 46g) $300 \mu\text{m}$ long, not including setae. Lengths of 10 segments: 42 ($78 \mu\text{m}$ along anterior margin), 21, 12.5, 31, 26, 26, 26, 24, 26, and $37 \mu\text{m}$, respectively. Armature: 15, 9, 2, 4, 2, 2, 2, 2 + 1 aesthete, and 12. All setae smooth. Second antenna (Fig. 46h) $140 \mu\text{m}$ long, not including setae. Second segment with prominent outer setules. Fourth segment terminally with 1 straight spinelike seta $22 \mu\text{m}$, and 2 recurved spiniform setae $36 \mu\text{m}$ and $21 \mu\text{m}$, both strongly pectinate with long setules along concave side.

Oral cone oval with opening between labrum and labium in ventral view showing tips of mandibles (Fig. 46f). Mandible (Fig. 46i) $90 \mu\text{m}$ long, first maxilla (Fig. 46j), and second maxilla (Fig. 46k) resembling those of congeners. Maxilliped (Fig. 47a) with recurved claw pectinate with long setules along concave edge.

Legs 1–4 (Fig. 47b–e) biramous with 3-segmented rami, except for 2-segmented endopod of leg 4. Spine and setal formula as follows:

P_1	coxa 0-1	basis 1-1	exp I-1; I-1; II,I,4
			enp 0-1; 0-2; 1,2,3
P_2	coxa 0-1	basis 1-0	exp I-1; I-1; III,I,4
			enp 0-1; 0-2; 1,2,3
P_3	coxa 0-1	basis 1-0	exp I-1; I-1; III,I,5
			enp 0-1; 0-2; 1,I,3
P_4	coxa 0-0	basis 1-0	exp I-1; I-1; III,I,4
			enp 0-0; I,1

Coxa in legs 1–3 with inner seta, but in leg 4 without such seta. Inner barbed spine on basis of leg 1 31 μm long. Spines on exopods of legs 1–4 with strong barbs, especially in legs 2–4. Leg 4 with exopod 159 μm long. Endopod with first segment 26 \times 18 μm ; second segment 68 μm long including spiniform process and 21 μm wide; terminal barbed spine 49 μm , inner plumose seta 130 μm . Few hairlike setules on outer and inner edges of second segment.

Leg 5 (Fig. 47f) with first segment 47 \times 31 μm , its seta 120 μm ; second segment 32 \times 21 μm , its 3 setae 120, 70, and 41 μm . Shortest seta smooth, others with lateral setules.

Leg 6 probably represented by seta on genital area (Fig. 46c).

Spermatophore not seen.

Color of living specimens unknown.

Male. — Unknown.

Etymology. — The specific name *pectinatus*, Latin meaning provided with combs, alludes to the comblike setae on the second antenna and on the claw of the maxilliped.

Remarks. — The conspicuous features of *Stygiopontius pectinatus* which differentiate it from congeners are the terminal pectinate setae on the second antenna and the strongly pectinate claw of the maxilliped.

Stygiopontius sentifer new species

Figures 48a–j, 49a–f, 50a, b

Type Material. — 422 ♀♀ from washings of tubes of the polychaete *Alvinella pompejana* Desbruyères and Laubier, 1980, in 2,617 m, Clam Acres, East Pacific Rise, 20°50.0'N, 109°06.0'W, 19 April 1982, DSRV ALVIN dive no. 1213. Holotype and 417 paratypes deposited in the National Museum of Natural History, Smithsonian Institution, Washington, D.C.

Other Specimens. — 2 ♀♀ with alvinellid polychaetes, in 2,635 m, location Parigo, Biocyarise, East Pacific Rise, 12°48.8'N, 103°56.8'W, 15 March 1984, DSRV CYANA dive no. 84-38; 4 ♀♀ with polychaetes, in 2,635 m, location Parigo, Biocyarise, East Pacific Rise, 12°48.40'N, 103°56.60'W, 23 March 1984, DSRV CYANA dive no. 84-41; 2 ♀♀ in slurp of *Alvinella*, in 2,600 m, location Pogonord, Biocyarise, East Pacific Rise, 12°49.1'N, 103°56.9'W, 09 March 1984, DSRV CYANA dive no. 84-32; 3 ♀♀ from slurp of sediment, in 2,635 m, location Pogosud, Biocyarise, East Pacific Rise, 12°48.6'N, 103°56.7'W, 10 March 1984, DSRV CYANA dive no. 84-33; 2 ♀♀ with polychaetes, in 2,635 m, location Pogonord, Biocyarise, East Pacific Rise, 12°48.6'N, 103°56.7'W, 10 March 1984, DSRV CYANA dive no. 84-43; 46 ♀♀, in 2,616 m, Clam Acres, East Pacific Rise, 20°50.0'N, 109°06.0'W, 10 May 1982, DSRV ALVIN dive no. 1226; 2 ♀♀, in 2,618 m, Clam Acres, East Pacific Rise, 20°50.0'N, 109°06.0'W, 09 May 1982, DSRV ALVIN dive no. 1225; 39 ♀♀, in 2,616 m, Clam Acres, East Pacific Rise, 20°50.0'N, 109°06.0'W, 07 May 1982, DSRV ALVIN dive no. 1223.

Female. — Body (Fig. 48a) unmodified, with broad prosome. Length 1.20 mm (1.11–1.30 mm) and greatest width 0.61 mm (0.59–0.63 mm), based on 10 specimens. Greatest dorsoventral thickness 0.25 mm. Segment bearing leg 1 fused with cephalosome. Epimeral areas of segment of leg 1 slightly pointed, those of

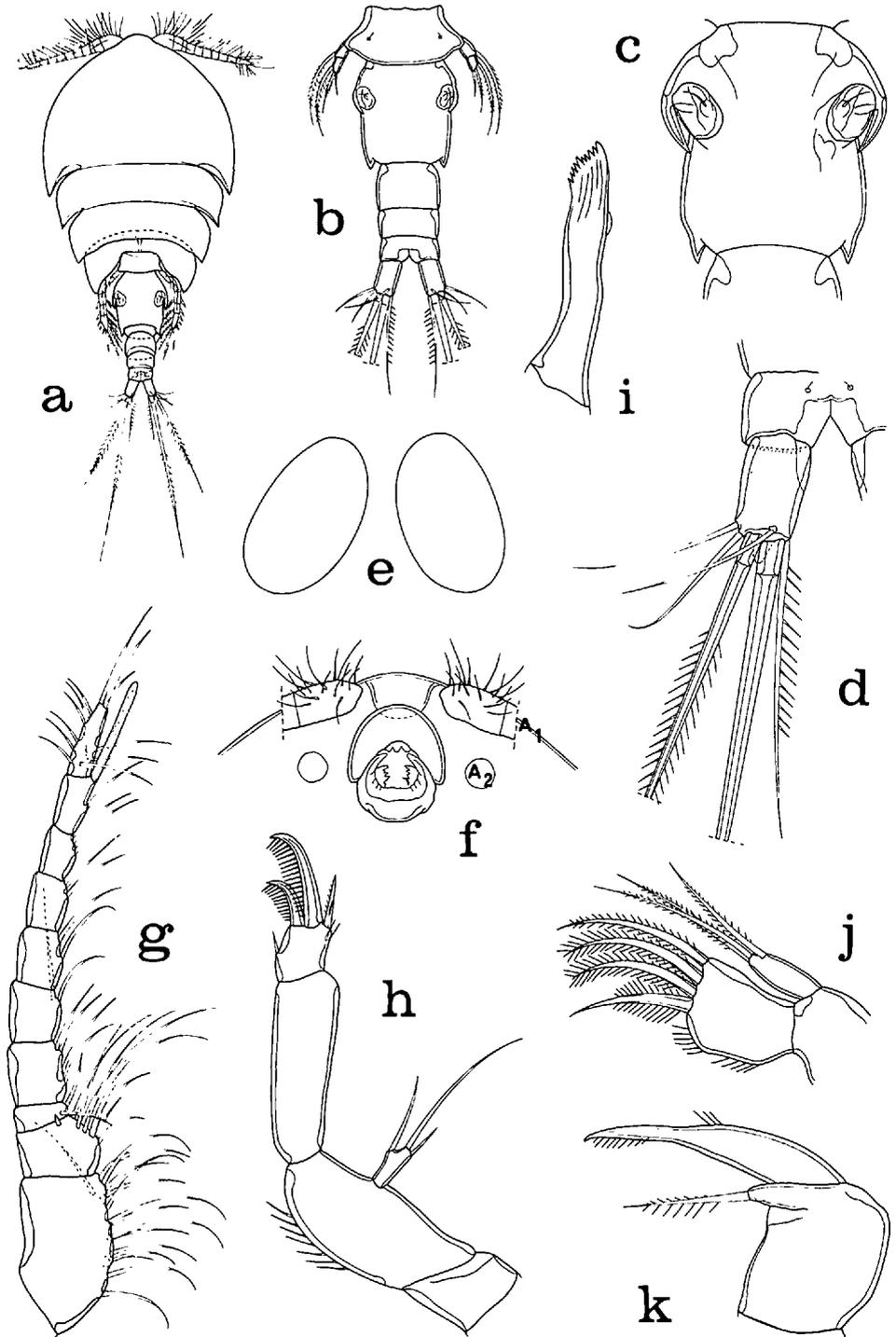


Figure 46. *Stygiopontius pectinatus* new genus, new species. Female: a, dorsal (scale A); b, urosome, dorsal (H); c, genital segment, dorsal (C); d, caudal ramus, dorsal (D); e, two egg sacs of one female, ventral (H); f, rostrum and oral cone, ventral (D); g, first antenna, ventral (G); h, second antenna, antero-inner (E); i, mandible, posterior (E); j, first maxilla, posterior (E); k, second maxilla, posterior (E).

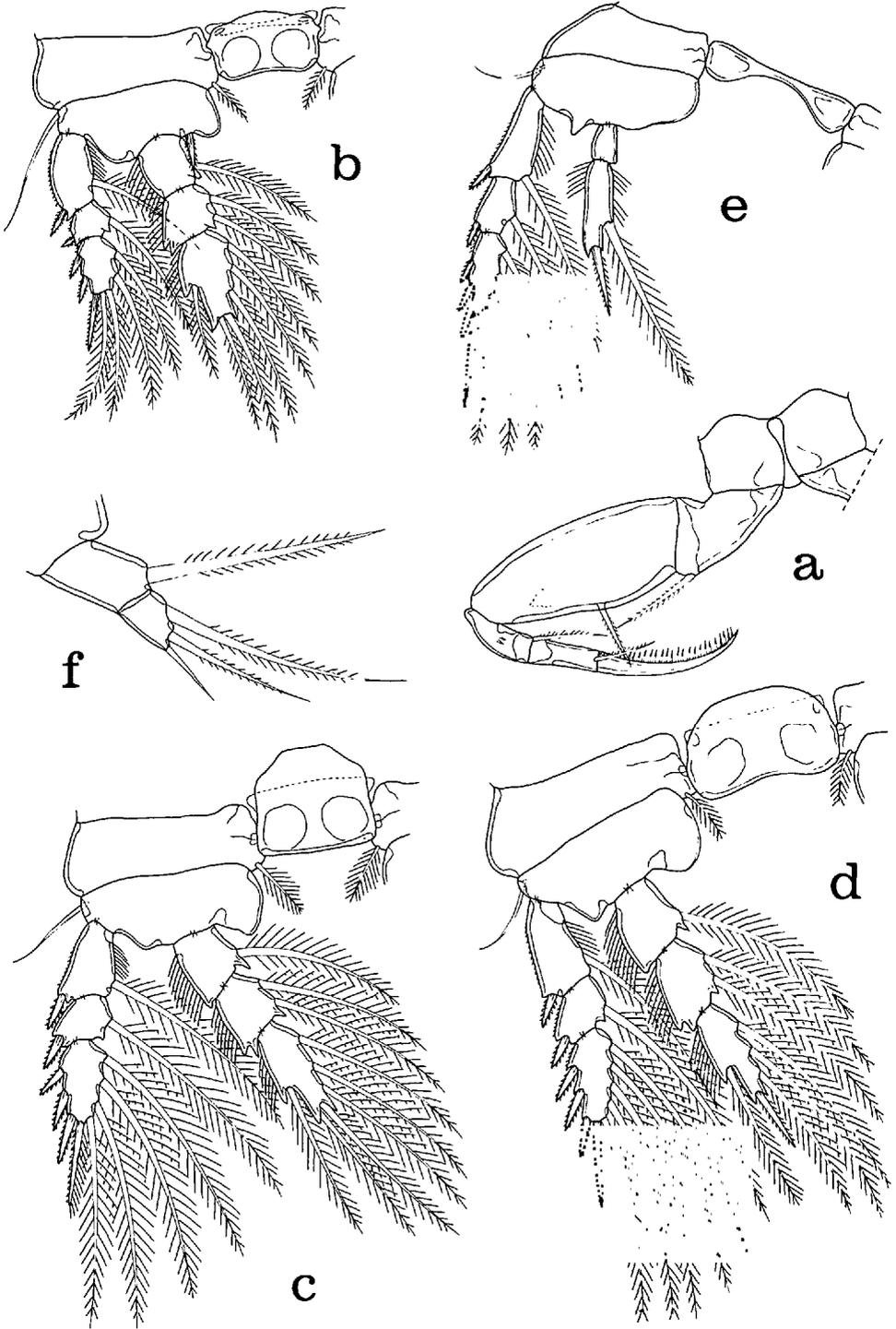


Figure 47. *Stygiopontius pectinatus* new genus, new species. Female: a, maxilliped, posterior (scale G); b, leg 1 and intercoxal plate, anterior (C); c, leg 2 and intercoxal plate, anterior (C); d, leg 3 and intercoxal plate, anterior (C); e, leg 4 and intercoxal plate, anterior (C); f, leg 5, dorsal (G).

segments of legs 2 and 3 a little truncated, and those of segment of leg 4 rounded. Ratio of length to width of prosome 1.09:1. Ratio of length of prosome to that of urosome 1.35:1.

Segment bearing leg 5 (Fig. 48b) $130 \times 216 \mu\text{m}$ in dorsal view, with flaring subtruncate lateral angles. Genital segment (Fig. 48c) $187 \mu\text{m}$ long, anterior third (width $198 \mu\text{m}$) with pair of lateral posteriorly directed digitiform lobes and separated by constriction from posterior two thirds (width $156 \mu\text{m}$) having slightly convex lateral margins and pair of small posterolateral spiniform processes. Genital areas located dorsolaterally on anterior half of segment. Each area (Fig. 48c) bearing 1 small seta. Three postgenital segments from anterior to posterior 78×122 , 78×104 , and $62 \times 91 \mu\text{m}$.

Caudal ramus (Fig. 48d) moderately elongate, $91 \times 36 \mu\text{m}$, ratio of length to width 2.53:1. Outer lateral seta (set far distally) $88 \mu\text{m}$, dorsal seta $65 \mu\text{m}$, outermost terminal seta $60 \mu\text{m}$, innermost terminal seta short, $35 \mu\text{m}$. All these setae smooth. Two long median terminal setae $451 \mu\text{m}$ (outer) and $737 \mu\text{m}$ (inner), both with short lateral spinules along their midregions. Few minute spinules at distal outer corner of ramus.

Body surface smooth, without detectable sensilla.

Egg sac (Fig. 48e) $330 \times 209 \mu\text{m}$, containing 2 large eggs approximately $192 \times 205 \mu\text{m}$.

Rostral area (Fig. 48f) not defined. First antenna (Fig. 48g) $398 \mu\text{m}$ long not including setae. Lengths of its 12 segments: 4.5 ($29 \mu\text{m}$ along anterior margin), 5, 17.5, 11, 6, 52, 35, 34, 34, 32, 34, and $36 \mu\text{m}$, respectively. Armature: 1, 2, 12, 8, 2, 4, 2, 2, 2, 2 + 1 aesthete, and 12. All setae smooth.

Second antenna (Fig. 48h) $195 \mu\text{m}$ long excluding setae. Second segment of protopod with few outer setules. Exopod 1-segmented with 3 setae. Endopod 2-segmented. First segment unornamented. Second segment with outer and inner spinules and 4 setae, 2 long with minute lateral spinules, 2 short and smooth.

Oral cone short (Fig. 48f), no true siphon. Mandible (Fig. 48i) $107 \mu\text{m}$ long, terminally with several small teeth and spinules. First maxilla (Fig. 48j) similar to that in congeners. Second maxilla (Fig. 49a) with claw having minutely pointed tip and bearing inner distal setules, 2 terminal setae unusually long. Maxilliped (Fig. 49b) 5-segmented. First segment with distal inner barbed seta. Second segment rather massive, bearing large thornlike inner seta finely spinulose on both surfaces. Third segment bearing 2 minute spinules; second and third segments having 1 spinulose seta; claw short and stout, in anterior view slightly angular, with row of outer spinules (Fig. 49c).

Legs 1-4 (Figs. 49d-f, 50a) biramous with 3-segmented rami, except for 2-segmented endopod of leg 4. Spine and setal formula as follows:

P_1	coxa 0-1	basis 1-I	exp I-1; I-1; II,I,4
			enp 0-1; 0-2; 1,2,3
P_2	coxa 0-1	basis 1-0	exp I-1; I-1; III,I,4
			enp 0-1; 0-1; 1,2,3
P_3	coxa 0-0	basis 1-0	exp I-1; I-1; III,I,5
			enp 0-1; 0-2; 1,I,3
P_4	coxa 0-0	basis 1-0	exp I-1; I-1; II,II,4
			enp 0-0; I-1

Basis of leg 1 with inner setiform barbed spine $21 \mu\text{m}$ long; inner lobe of basis with small spines (Fig. 49d). Basis of leg 2 with smooth inner lobe (Fig. 49e). Coxae of legs 3 and 4 lacking inner seta. Leg 4 (Fig. 50a) with exopod $200 \mu\text{m}$ long. Endopod with unarmed first segment $32 \times 24 \mu\text{m}$; second segment $62 \times$

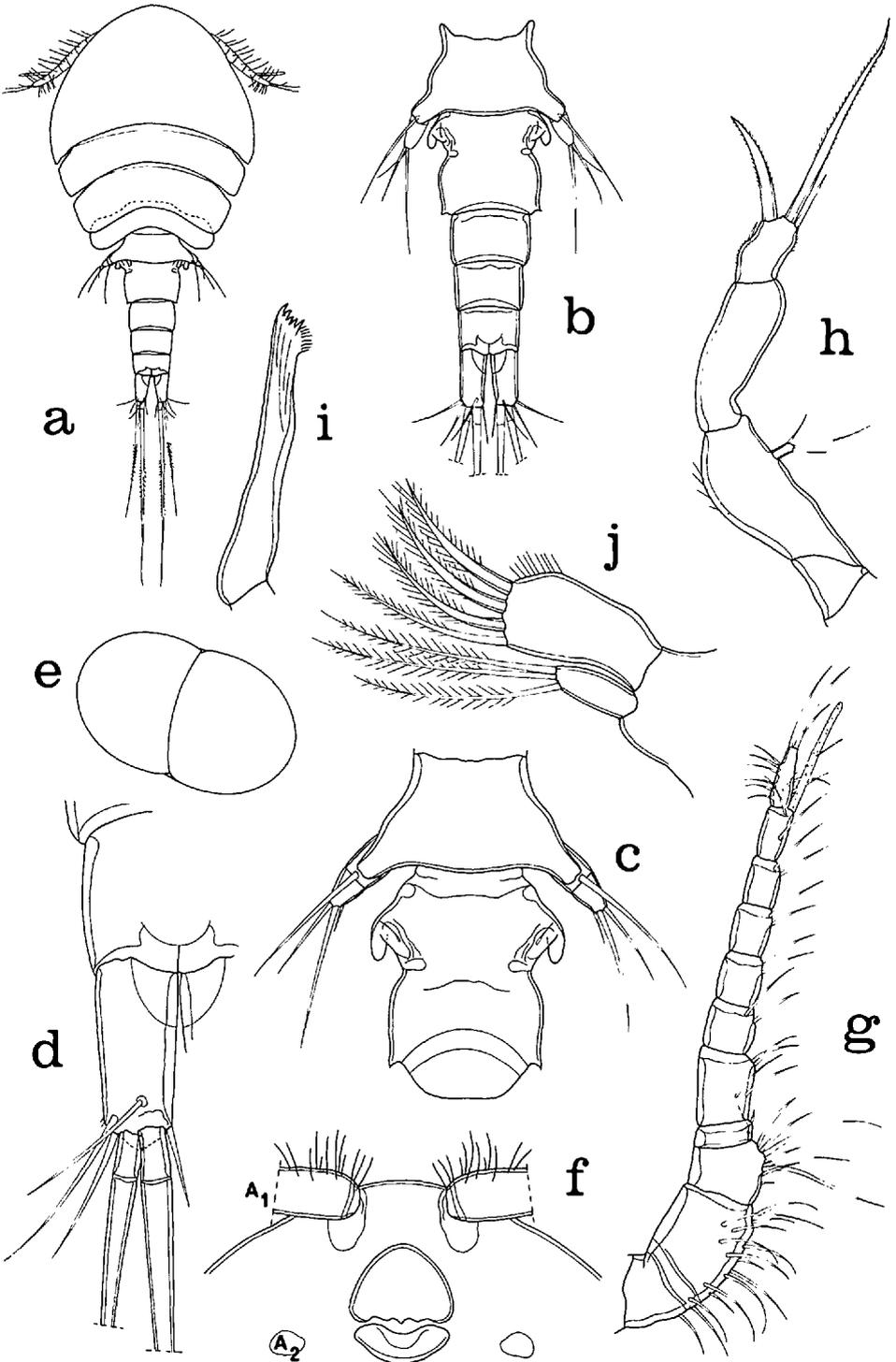


Figure 48. *Stygiopontius sentifer* new genus, new species. Female: a, dorsal (scale A); b, urosome, dorsal (H); c, segment bearing leg 5 and genital segment, dorsal (D); d, caudal ramus, dorsal (G); e, egg sac, dorsal (H); f, rostral area and oral cone, ventral (D); g, first antenna, posteroventral (C); h, second antenna, antero-inner (G); i, mandible, posterior (E); j, first maxilla, anterior (E).

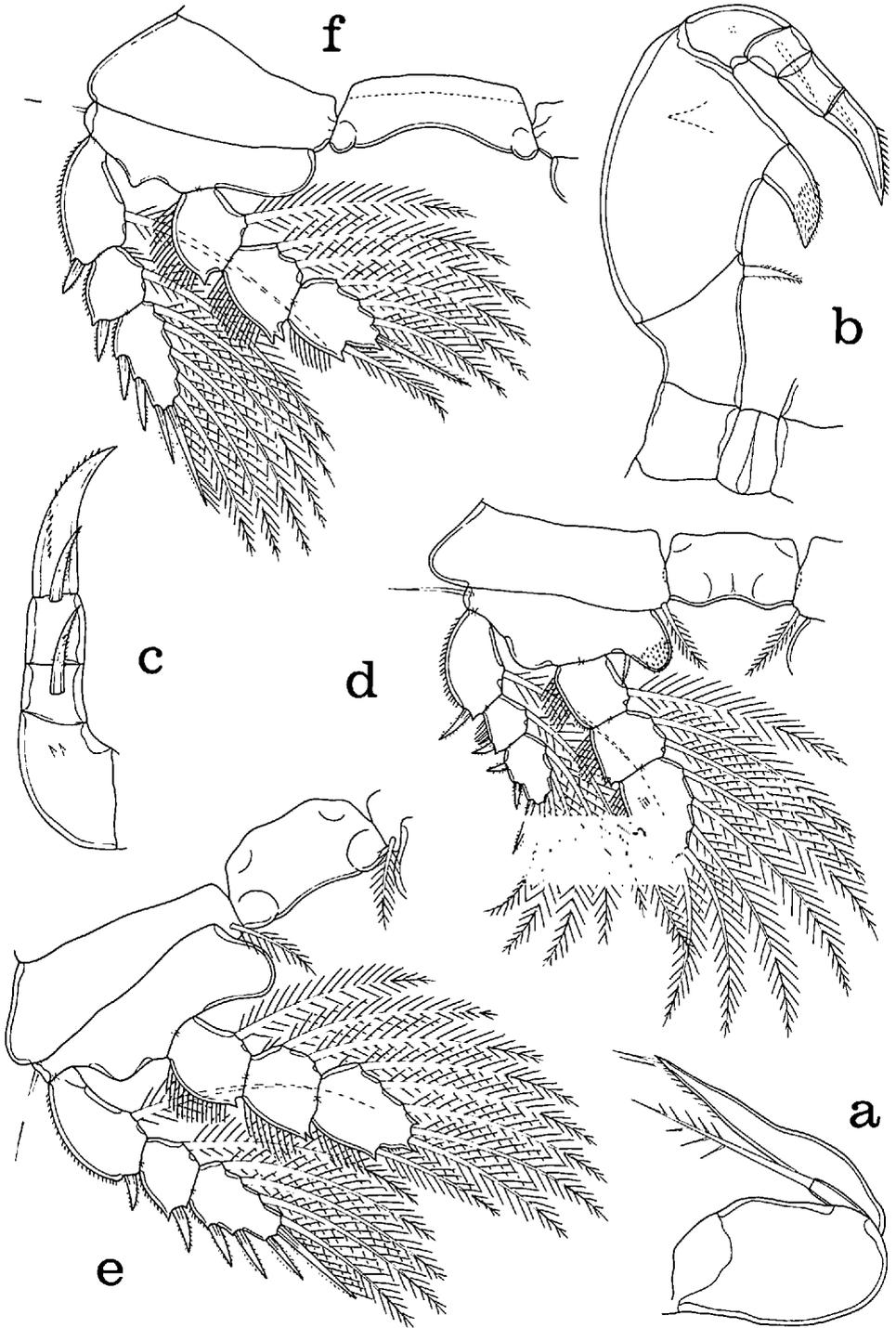


Figure 49. *Stygiopontius sentifer* new genus, new species. Female: a, second maxilla, posterior (scale E); b, maxilliped, anterior (G); c, last three segments of maxilliped and claw, posterior (E); d, leg 1 and intercoxal plate, anterior (C); e, leg 2 and intercoxal plate, anterior (C); f, leg 3 and intercoxal plate, anterior (C).

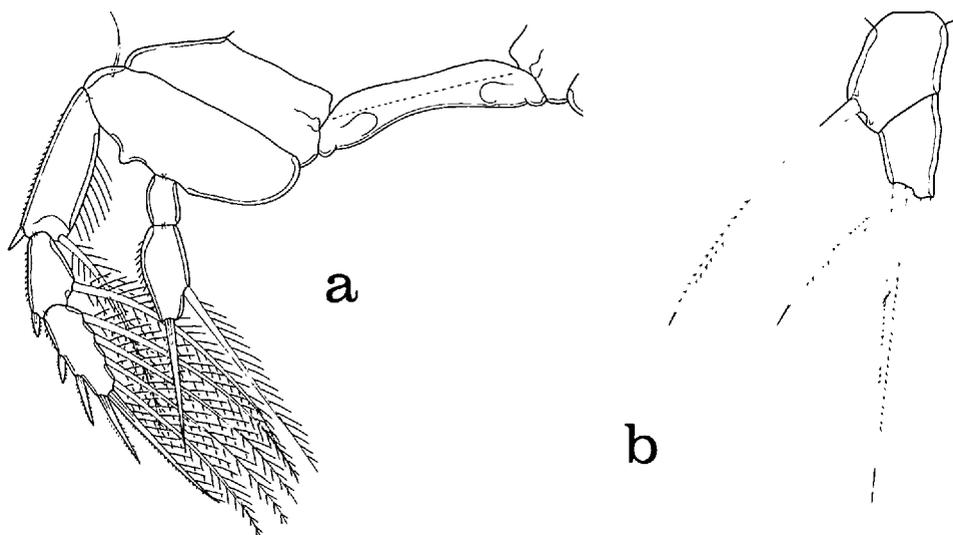


Figure 50. *Stygiopontius sentifer* new genus, new species. Female: a, leg 4 and intercoxal plate, anterior (scale C); b, leg 5, dorsolateral (G).

31 μm , its terminal barbed spine 91 μm , its inner plumose seta 146 μm ; outer margin of second segment with row of short hairs.

Leg 5 (Fig. 50b) 2-segmented and relatively short, 82 \times 42 μm . First segment 55 \times 42 μm , its seta 140 μm ; second segment 42 \times 26 μm , its setae 150, 98, and 44 μm . All setae except shortest minutely barbed.

Leg 6 probably represented by seta on genital area (Fig. 48c).

Color of living specimens unknown.

Male. — Unknown.

Etymology. — The specific name *sentifer*, Latin *sentis*, a thorn, and *fero*, to carry, alludes to the thornlike seta on the second segment of the maxilliped.

Remarks. — *Stygiopontius sentifer* may be recognized by the thornlike seta on the second segment of the maxilliped.

Stygiopontius verruculatus new species

Figures 51a–g, 52a–i

Type Material. — 41 $\delta\delta$, 4 copepodids, in 2,616 m, Clam Acres, East Pacific Rise, 20°50.0'N, 109°06.0'W, 10 May 1982, DSRV ALVIN dive no. 1226. Holotype, 38 paratypes, and 2 copepodids deposited in the National Museum of Natural History, Smithsonian Institution, Washington, D.C.

Male. — Body (Fig. 51a) with broad prosome. Length 0.84 mm (0.81–0.88 mm) and greatest width 0.40 mm (0.42–0.46 mm) based on 10 specimens. Greatest dorsoventral thickness 0.20 mm. Segment bearing leg 1 fused with cephalosome and having rounded epimera. Epimeral areas of segments bearing legs 2–4 progressively more pointed. Ratio of length to width of prosome 1.17:1. Ratio of length of prosome to that of urosome 1.38:1.

Segment bearing leg 5 (Fig. 51b) 42 \times 117 μm . Genital segment 151 \times 174 μm , wider than long with sides slightly rounded or with slight anterior shoulders as in Fig. 51a. Four postgenital segments from anterior to posterior 60 \times 99,

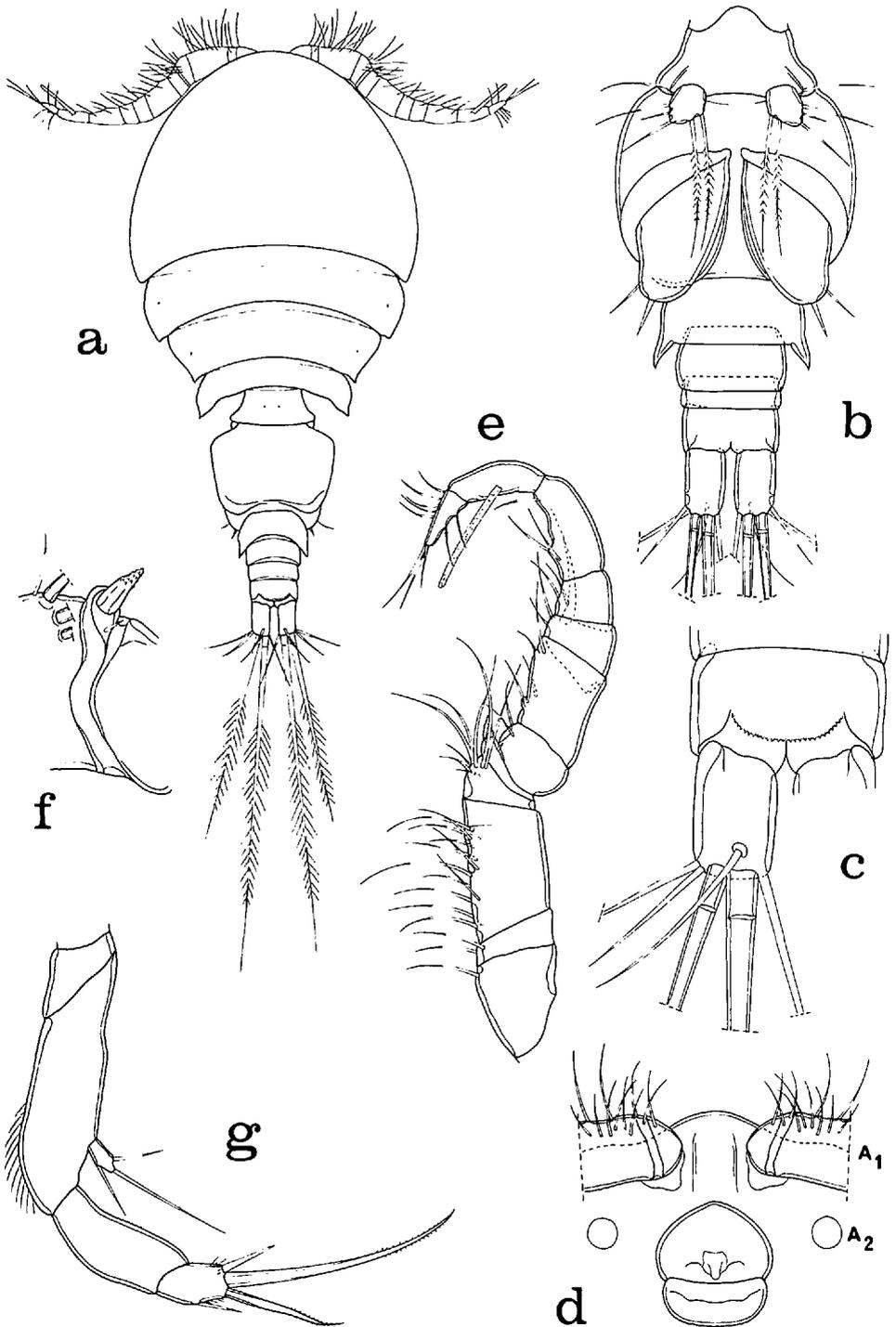


Figure 51. *Stygiopontius verruculatus* new genus, new species. Male: a, dorsal (scale H); b, urosome, ventral (C); c, caudal ramus and anal segment, dorsal (E); d, rostral area and oral cone, ventral (C); e, first antenna, posteroventral (G); f, segment 5 of first antenna, posteroventral (F); g, second antenna, antero-inner (E).

44 × 79, 26 × 70, and 36 × 68 μm. First postgenital segment with pair of prominent posterolateral spiniform processes (length of segment including these processes 78 μm and greatest width at processes 109 μm). Anal segment with broad operculum having small marginal spines.

Caudal ramus (Fig. 51c) relatively short, 47 × 29 μm, ratio 1.62:1. Outer lateral seta 78 μm, dorsal seta 60 μm, outermost terminal seta 47 μm, and innermost terminal seta 122 μm, all smooth. Two long median terminal setae 286 μm (outer) and 480 μm (inner), both with long lateral spinules.

Body surface with very few small sensilla (Fig. 51a).

Rostral area (Fig. 51d) not well developed. First antenna (Fig. 51e) 286 μm as drawn. Lengths of its 12 segments: 14 (36 μm along anterior margin), 11, 51, 6, 2, 22, 47, 35, 29, 53, 52, and 26 μm, respectively. Armature: 1, 2, 12, 8, 2, 2, 4, 2, 2, 3, 1 aesthete, and 10. Fifth segment with stout spine approximately 15 μm long with minutely spinulose tip (Fig. 51f).

Second antenna (Fig. 51g), oral cone (Fig. 51d), mandible (Fig. 52a) 107 μm long, first maxilla (Fig. 52b) with small accessory seta on exopod, and second maxilla (Fig. 52c) resembling those of congeners. Maxilliped (Fig. 55d) 4-segmented plus claw. First segment with 1 seta. Second segment lacking seta but having spherical knob (Fig. 52e) approximately 5.5 × 6 μm. Third segment with 1 seta and 2 setules. Fourth segment with 1 seta. All setae minutely barbed. Claw pectinate distally.

Legs 1–4 (Fig. 52f–i) biramous with 3-segmented rami except 2-segmented endopod in leg 4. Spine and setal formula as follows:

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

Coxae of all 4 legs lacking inner seta. Inner spine on basis of leg 1 small, 12 μm long, and apparently smooth. Leg 2 with third segment having proximal outer spine directed distally and crossing next spine like blades of scissors; outermost spine on third segment of endopod unusually small and setiform. Leg 4 with exopod 138 μm long. Endopod with first segment 18 × 14 μm; second segment 42 × 19 μm, its distal barbed spine 81 μm and its inner pinnate seta 104 μm.

Leg 5 (Fig. 51b) placed ventrally. Free segment 31 × 25 μm, its 5 setae from outer to inner 44, 20, 39, 104, and 104 μm, 2 innermost long setae weakly pinnate, other setae smooth. Seta on body adjacent to free segment 70 μm.

Leg 6 (Fig. 51b) forming usual posteroventral flap, bearing 2 smooth setae, one slender and 31 μm, other stouter, spiniform, 23 μm.

Spermatophore not seen.

Color unknown.

Female. — Unknown.

Etymology. — The specific name *verruculatus*, Latin *verrucula*, meaning a small wart, and the suffix *-atus*, provided with, refers to the ball-like excrescence on the second segment of the maxilliped.

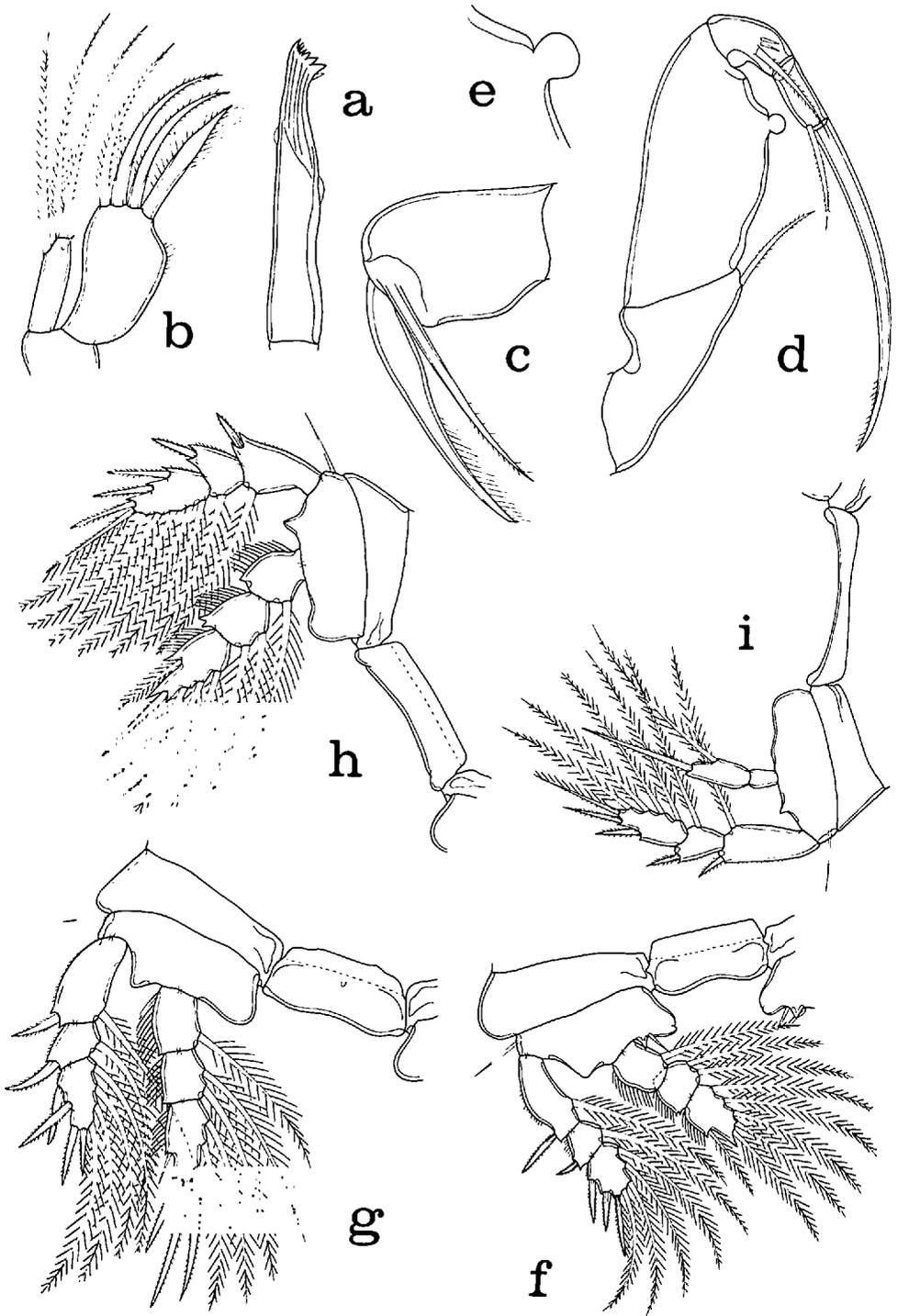


Figure 52. *Stygiopontius verruculatus* new genus, new species. Male: a, mandible (scale E); b, first maxilla, anterior (E); c, second maxilla, posterior (E); d, maxilliped, posterior (E); e, knob on second segment of maxilliped, posterior (I); f, leg 1 and intercoxal plate, anterior (C); g, leg 2 and intercoxal plate, anterior (C); h, leg 3 and intercoxal plate, anterior (C); i, leg 4 and intercoxal plate, anterior (C).

Remarks.—*Stygiopontius verrulatus* can be immediately recognized by the small ball-like process on the second segment of the maxilliped.

KEY TO THE FEMALES OF *STYGIOPONTIUS*

- 1a. Genital segment without spiniform processes; second postgenital segment unusually short *S. cinctiger*
- 1b. Genital segment with at least 1 pair of spiniform processes; second postgenital segment not unusually short 2a
- 2a. Maxilliped with seta on second segment much enlarged, thornlike, spinulose; genital segment with anterior pair of linguiform lobes and posterior pair of spiniform processes *S. sentifer*
- 2b. Maxilliped with seta on second segment not enlarged; genital segment with 1 or 2 pairs of spiniform processes, but lacking lobes 3a
- 3a. Genital segment with 1 pair of posterior spiniform processes; third segment of endopod of leg 3 with 1,1,3 *S. flexus*
- 3b. Genital segment with 2 pairs of spiniform processes; third segment of endopod of leg 3 with other formula 4a
- 4a. Third segment of exopod of leg 4 with I,II,4; caudal ramus 3.16:1; body length 1.78 mm *S. mucroniferus*
- 4b. Third segment of exopod of leg 4 with II,II,4; caudal ramus ratio not greater than 1.70:1; body length not greater than 1.20 mm 5a
- 5a. Third segment of endopod of leg 3 with 1,1,3; caudal ramus with innermost terminal seta very short, 10 μ m, about one-sixth length of ramus *S. quadrispinosus*
- 5b. Third segment of endopod of leg 3 with 1,I,3; caudal ramus with innermost terminal seta longer than ramus 6a
- 6a. Clawlike seta on fourth segment of second antenna and claw of maxilliped conspicuously pectinate, with long erect spinules; anterior pair of spiniform processes on genital segment elongate and directed inwardly *S. pectinatus*
- 6b. Setae on fourth segment of second antenna neither clawlike nor pectinate and claw of maxilliped having only minute distal spinules; anterior pair of spiniform processes on genital segment relatively short and directed posteriorly *S. hispidulus*

Exrima new genus

Diagnosis.—Female: Body unmodified. Segment of leg 1 fused with cephalosome. Urosome 5-segmented. Caudal ramus with 6 setae.

Rostrum undeveloped. First antenna 9-segmented with aesthete on penultimate segment. Second antenna with 1-segmented exopod and 2-segmented endopod.

Oral cone short, no true siphon. Mandible slender blade without palp. First maxilla with angular inner lobe bearing 4 setae, outer lobe with 3 setae. Second maxilla with first segment bearing seta and second segment proximally swollen. Maxilliped with 4 segments and terminal claw.

Legs 1–4 biramous, with 3-segmented rami, except for 2-segmented endopod in leg 4. Leg 4 with last segment of exopod II,I,5 and endopod 0-0; I.

Leg 5 2-segmented, formula 1,3.

Leg 6 represented by seta on genital area.

Male.—Unknown.

Type-species.—*Exrima singula* new species.

Gender.—Feminine.

Etymology.—The generic name is a combination of Latin *ex*, out of, and *rima*, a crack or fissure, referring to the habitat.

Remarks.—The new genus *Exrima* may be distinguished from other genera in the Dirivultidae by the 9-segmented first antenna and by the endopod of leg 4 having the formula 0-0; I. Additional means of separating *Exrima* from other genera in the family will be found in the key to genera on page 785.

Exrima singula new species

Figures 53a-f, 54a-g, 55a-c

Type Material.—15 ♀♀ from washings of vestimentiferans and the bivalve *Calyptogena*, in 2,612 m, Clam Acres, East Pacific Rise, 20°50.0'N, 109°06.0'W, 24 April 1982, DSRV ALVIN dive no. 1219. Holotype and 11 paratypes deposited in the National Museum of Natural History, Smithsonian Institution, Washington, D.C.

Female.—Body (Fig. 53a) with moderately broad prosome. Length 1.01 mm (0.97–1.07 mm) and greatest width 0.48 mm (0.46–0.52 mm), based on 10 specimens. Segment bearing leg 1 fused with cephalosome. Epimeral areas of segments bearing legs 1–4 pointed. Ratio of length to width of prosome 1.40:1. Ratio of length of prosome to that of urosome 1.84:1.

Segment bearing leg 5 (Fig. 53b) $91 \times 117 \mu\text{m}$. Genital segment (Fig. 53c) $114 \mu\text{m}$ long ($130 \mu\text{m}$ including posterolateral spiniform processes). Anterior half of segment slightly expanded, width $109 \mu\text{m}$, posterior half with nearly parallel sides, width $94 \mu\text{m}$. Genital areas located dorsolaterally just in front of middle of segment. Each area with 1 seta $35 \mu\text{m}$. Three postgenital segments from anterior to posterior 60×84 , 44×81 , and $50 \times 75 \mu\text{m}$. Anal segment with ventral and lateral spinules (Fig. 53d).

Caudal ramus (Fig. 53d) $55 \times 29 \mu\text{m}$, ratio 1.90:1. Outer lateral seta, placed subterminally, $130 \mu\text{m}$. Dorsal seta $65 \mu\text{m}$. Outermost terminal seta $104 \mu\text{m}$. All three of these setae smooth. Innermost terminal seta $247 \mu\text{m}$ with lateral setules. Two long median terminal setae $320 \mu\text{m}$ (outer) and $583 \mu\text{m}$ (inner), both with lateral setules (Fig. 53a). Ramus with inner distal margin ventrally with conical process, and with distal ventral surface having transverse row of spinules.

Body surface with very few hairs or sensilla (Fig. 53a).

Egg sac unknown.

Rostral area (Fig. 53e) undeveloped. First antenna (Fig. 53f) $380 \mu\text{m}$ long not including terminal setae. Lengths of 9 segments: 60 ($99 \mu\text{m}$ along anterior margin), 26, 43, 30, 30, 31, 31, 34, and $69 \mu\text{m}$, respectively. Armature: 14, 10, 4, 2, 2, 2, 2 + 1 aesthete, and 13. All setae smooth. Aesthete $91 \mu\text{m}$ long.

Second antenna (Fig. 54a) with 2-segmented protopod, second segment with few spinules on both sides. Exopod minute, with 1 seta. Endopod 2-segmented, first segment with outer spinules, second segment with few outer spinules, 1 short outer seta and 1 short inner seta, and 2 long terminal setae, the longer $200 \mu\text{m}$ with small lateral barbules.

Oral cone (Fig. 53e) short, in ventral view slightly pointed anteriorly. Mandible (Fig. 54b) $87 \mu\text{m}$, with small terminal teeth and subterminal row of minute spinules. First maxilla (Fig. 54c) with slender outer lobe bearing 3 plumose setae, stouter inner lobe with inner haired margin having rounded prominence and bearing 4 terminal plumose setae. Second maxilla (Fig. 54d) 2-segmented, first segment with 1 long seta having prominent setules, second segment elongate, swollen proximally but slender distally and haired in distal half. Maxilliped (Fig. 54e) 4-segmented. First and second segments with inner pinnate seta. Third and fourth segments slender, third with 2 setae, fourth with 1 seta and terminal smooth claw.

Legs 1–4 (Figs. 54f, g, 55a, b) biramous with 3-segmented rami, except for 2-segmented endopod in leg 4. Spine and setal formula as follows:

$$\begin{array}{l} P_1 \text{ coxa } 0-0 \text{ basis } 1-I \text{ exp } I-1; I-1; II, I, 4 \\ \text{enp } 0-1; 0-2; 1, 2, 3 \\ P_2 \text{ coxa } 0-1 \text{ basis } 1-0 \text{ exp } I-1; I-1; II, II, 4 \\ \text{enp } 0-1; 0-2; 1, 2, 3 \end{array}$$

P₃ coxa 0-1 basis 1-0 exp I-1; I-1; II,II,5
 enp 0-1; 0-2; 1,I,3
 P₄ coxa 0-0 basis 1-0 exp I-1; I-1; II,I,5
 enp 0-0; I

Coxa in legs 2 and 3 having inner pinnate seta, but in legs 1 and 4 lacking seta. Basis with inner margin much expanded in all 4 legs. Inner margin of basis of leg 1 with minutely barbed spine 35 μm . Third segment of endopod of leg 1 with prominent terminal pointed process. Exopod of leg 4 224 μm long. Endopod with first segment 34 \times 21 μm ; second segment 73 \times 31 μm , with terminal barbed spine 60 μm , and having few inner marginal setules.

Leg 5 (Fig. 55c) 2-segmented, first segment 41 \times 21 μm , ratio 1.95:1, with its seta 81 μm ; second segment 24 \times 16.5 μm , with its 3 setae from outer to inner 68, 78, and 74 μm . All setae haired. Ratio of length of first segment to that of second segment 1.71:1.

Leg 6 probably represented by seta on genital area (Fig. 53c).

Color of living specimens unknown.

Male. — Unknown.

Etymology. — The specific name *singula*, Latin *singulus* meaning single or one at a time, refers to the single spine on the endopod of leg 4.

Remarks. — *Exrima singula* may be recognized by its genital segment being slightly wider in the anterior half (with rounded margins) than in its posterior half (with sides parallel), the anal segment not being wider than the preceding segment, the third segment of the maxilliped having 2 setae, and leg 4 having 0-0; I.

Exrima dolichopus new species

Figures 56a-g, 57a-f, 58a-c

Type Material. — 2 ♀♀, in 2,630 m, location Parigo, Biocyarise, East Pacific Rise, 12°46.6'N, 103°56.7'W, 14 March 1984, DSRV CYANA dive no. 84-37. Holotype deposited in the Muséum National d'Histoire Naturelle, Paris.

Female. — Body (Fig. 56a) with prosome not broadened. Length 1.13 mm (1.12–1.15 mm) and greatest width 0.50 mm (0.48–0.52 mm), based on 2 specimens. Segment bearing leg 1 fused with cephalosome. Epimeral areas of segments bearing legs 1 and 2 rounded, those of segments bearing legs 3 and 4 pointed. Ratio of length to width of prosome 1.55:1. Ratio of length of prosome to that of urosome 1.70:1.

Segment bearing leg 5 (Fig. 56b) 117 \times 117 μm , dorsally with oval expansion incomplete anteriorly. Genital segment 148 μm long, divided in 2 parts just anterior to midregion, smaller anterior part 120 μm wide, larger posterior part 156 μm wide, both parts with rounded lateral margins. Bipartite nature of segment seen in ventral view (Fig. 56c). Posterolateral corners with small spiniform process. Genital areas located dorsolaterally at constriction between 2 parts of segment. Each area with 1 very small seta. Three postgenital segments from anterior to posterior 86 \times 107, 57 \times 110, and 52 \times 127 μm . Anal segment with ventral spinules (Fig. 56d).

Caudal ramus (Fig. 56d) 104 \times 57 μm , ratio 1.82:1, lateral margins slightly irregular. Outer lateral seta, placed subterminally, 104 μm , outermost terminal seta 102 μm , and dorsal seta 62 μm . All 3 of these setae smooth. Innermost terminal seta 109 μm with delicate lateral setules. Two long median terminal setae 220 μm (outer) and 470 μm (inner), both with spinules along their midregions. Ventral surface of ramus with subterminal spinules.

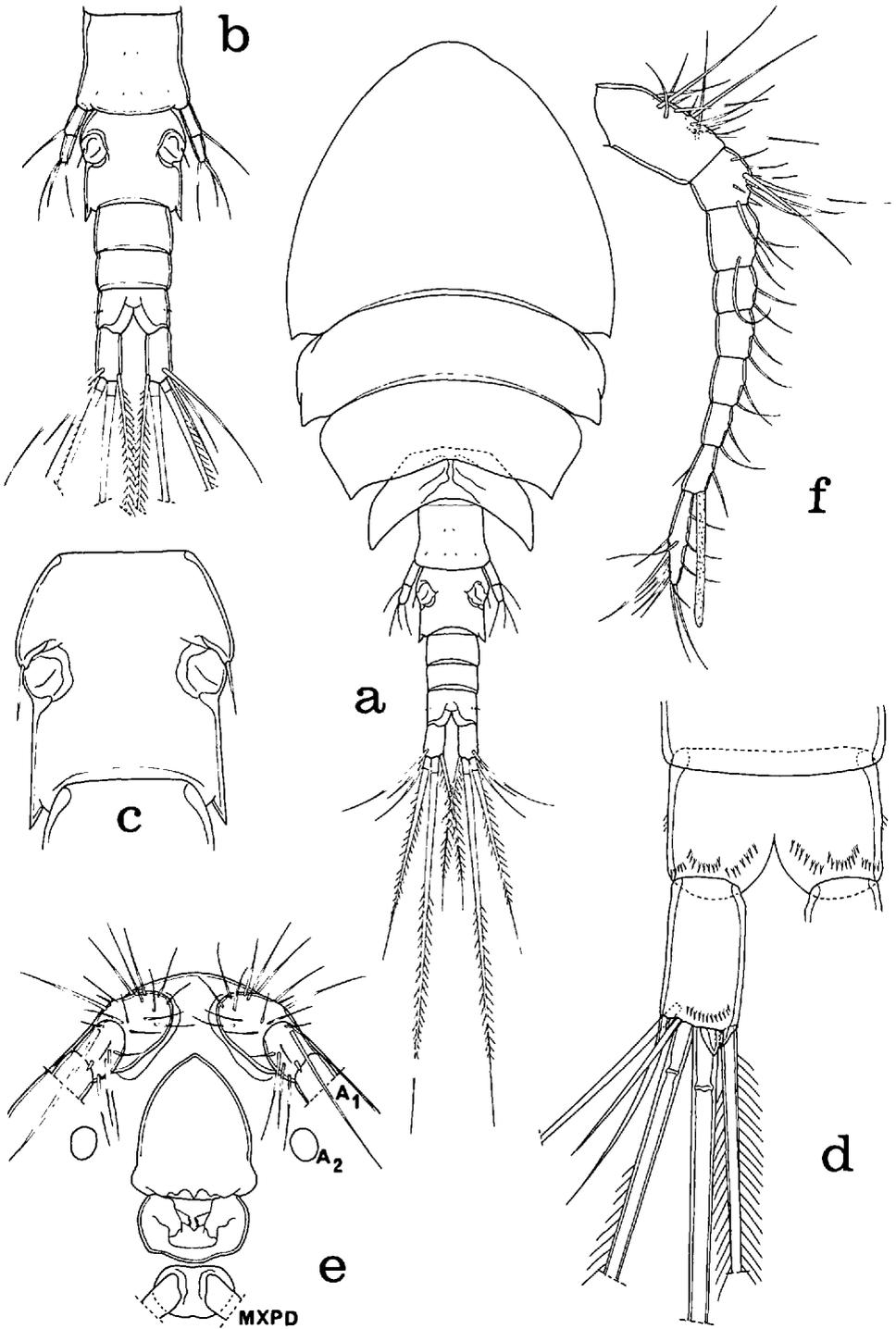


Figure 53. *Exrima singula* new genus, new species. Female: a, dorsal (scale H); b, urosome, dorsal (D); c, genital segment, dorsal (G); d, anal segment and caudal ramus, ventral (E); e, rostral area and oral cone, ventral (C); f, first antenna, posteroventral (C).

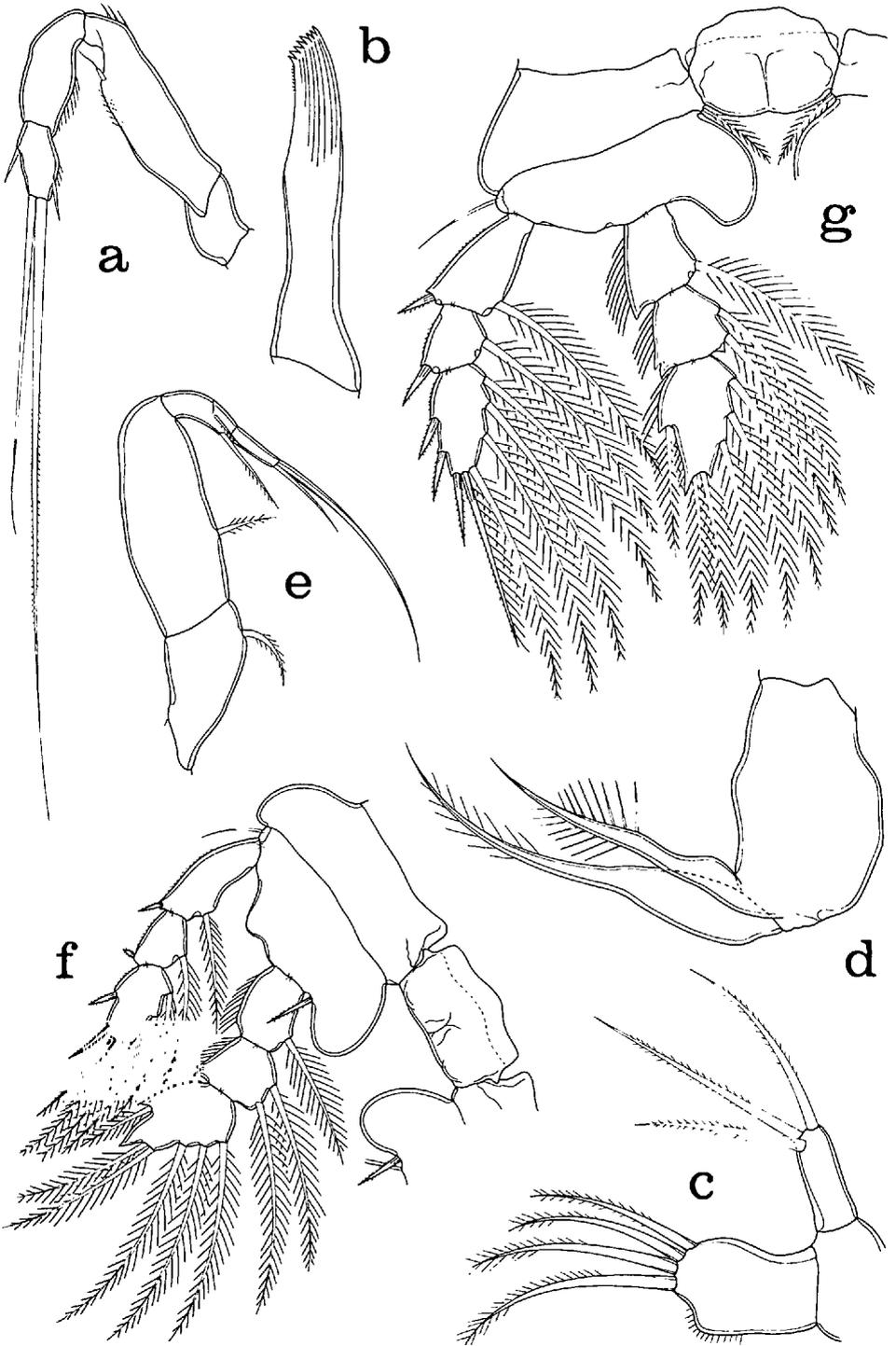


Figure 54. *Exrima singula* new genus, new species. Female: a, second antenna, antero-inner (scale E); b, mandible, anterior (F); c, first maxilla, posterior (F); d, second maxilla, posterior (F); e, maxilliped, anterior (G); f, leg 1 and intercoxal plate, anterior (C); g, leg 2 and intercoxal plate, anterior (C).

Body surface with very few hairs or spinules (Fig. 56a).

Egg sac unknown.

Rostral area (Fig. 56e) undeveloped. First antenna (Fig. 56f) 400 μm long, not including terminal setae. Lengths of segments: 65 (101 μm along anterior margin), 31, 55, 37, 32, 32, 32, 32, and 55 μm , respectively. Armature: 14, 10, 4, 2, 2, 2, 2, 2 + 1 aesthete, and 13. All setae smooth.

Second antenna (Fig. 56g) with unornamented 2-segmented protopod. Exopod minute with 1 seta. Endopod with first segment having spinules on outer margin, second segment with few outer spinules, 2 short smooth setae, and 2 long terminal barbed setae.

Oral cone (Fig. 56e) short. Mandible (Fig. 57a) 88 μm long. First maxilla (Fig. 56b) and second maxilla (Fig. 57c) similar to those in *Exrima singula*. Maxilliped (Fig. 57d) also resembling that species but third segment bearing only 1 seta and claw shorter and distally pectinate.

Legs 1–4 (Figs. 57e, f, 58a, b) biramous with 3-segmented rami, except for 2-segmented endopod in leg 4. Spine and setal formula as follows:

P_1	coxa	0-0	basis	1-I	exp	I-1; I-1; II,I,4
					enp	0-1; 0-2; 1,2,3
P_2	coxa	0-1	basis	1-0	exp	I-1; I-1; II,II,4
					enp	0-1; 0-2; 1,2,3
P_3	coxa	0-1	basis	1-0	exp	I-1; I-1; II,II,5
					enp	0-1; 0-2; 1,I,3
P_4	coxa	0-0	basis	1-0	exp	I-1; I-1; II,I,5
					enp	0-0; I

Coxa in legs 2 and 3 with inner seta having well-developed setules only along inner side. Basis with inner margin greatly expanded in all 4 legs. Inner barbed spine on basis of leg 1 37 μm . Exopod of leg 1 with terminal spine on third segment having strong spinules on both sides. Leg 4 with exopod 226 μm long. Endopod with first segment $34 \times 23.5 \mu\text{m}$; second segment $83 \times 29 \mu\text{m}$ with inner marginal setules and terminal barbed spine 74 μm .

Leg 5 (Fig. 58c) 2-segmented. First segment elongate, $73 \times 15.5 \mu\text{m}$, ratio 4.7:1, its seta 78 μm . Second segment short, $21 \times 13 \mu\text{m}$, its 3 setae from outer to inner 62, 68, and 31 μm . All setae with delicate lateral setules. Ratio of length of first segment to that of second segment 3.48:1.

Leg 6 probably represented by minute seta on genital area.

Color of living specimens unknown.

Male. — Unknown.

Etymology. — The specific name *dolichopus* is a combination of the Greek words *dolichos*, long, and *pous*, foot, alluding to the unusually long leg 5.

Remarks. — *Exrima dolichopus* differs from *E. singula* in two easily observable features: (1) the bipartite nature of the genital segment with the anterior part being narrower than the posterior part, and (2) the elongate slender leg 5.

Rhogobius new genus

Diagnosis. — Body unmodified. Segment bearing leg 1 fused with cephalosome. Urosome in female 5-segmented, constricted at level of first postgenital segment; in male 6-segmented and not constricted. Caudal ramus with 6 setae.

Rostrum not defined. First antenna of female 10-segmented, with aesthete on penultimate segment, in male 11-segmented and geniculate, with fourth segment bearing prominent spine. Second antenna with 1-segmented exopod. Oral cone

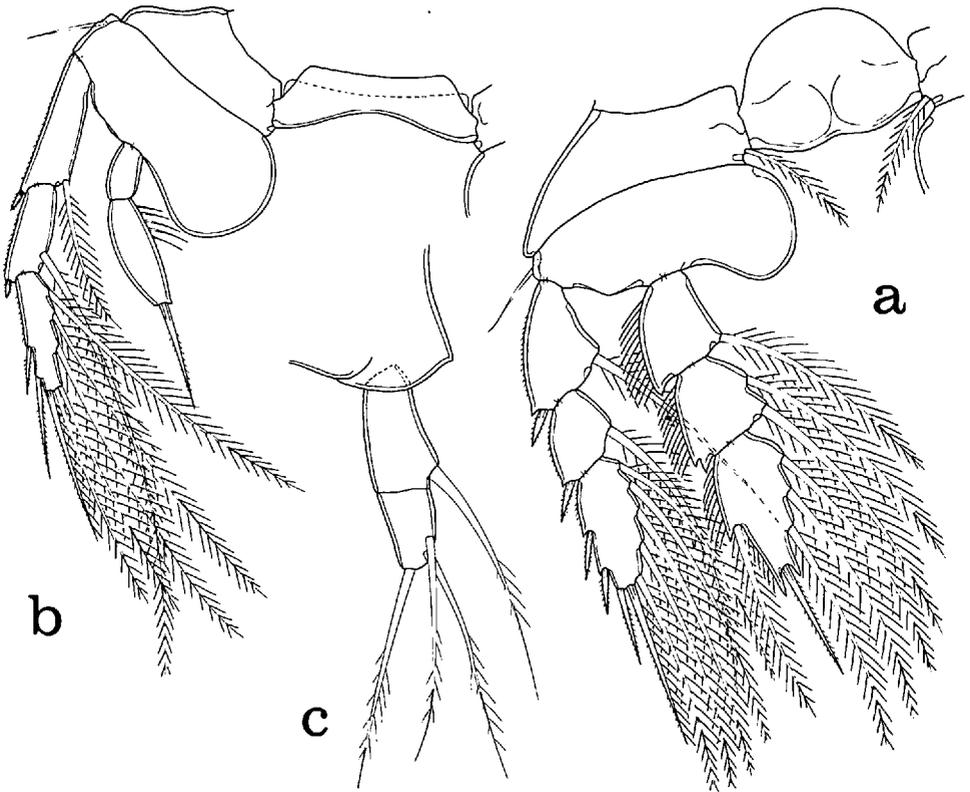


Figure 55. *Exrima singula* new genus, new species. Female: a, leg 3 and intercoxal plate, anterior (scale C); b, leg 4 and intercoxal plate, anterior (C); c, leg 5, dorsal (E).

short, no true siphon. Mandible elongate blade without palp. First maxilla with both inner and outer lobes bearing 3 setae. Second maxilla with first segment unarmed. Maxilliped 4-segmented plus claw.

Legs 1–4 with 3-segmented rami, except 2-segmented endopod in leg 4. Basis of leg 1 with inner spine. Sexual dimorphism slight, with armature same in both sexes. Endopod of leg 4 with formula 0-1; I,1.

Leg 5 in female 2-segmented, carried laterally, formula 1,3, in male carried ventrally, formula 1,5.

Leg 6 represented in female by seta on genital area, in male by 2 such setae.

Type-species.—*Rhogobius contractus* new species.

Gender.—Masculine.

Etymology.—The generic name is a combination of the Greek words *rhox*, *rhogos*, meaning a cleft or narrow passageway, and *bios*, living with, and alludes to the habitat of these copepods.

***Rhogobius contractus* new species**

Figures 59a–g, 60a–i, 61a–i

Type Material.—29 ♀♀, 9 ♂♂, in 2,482 m, Galapagos Rift, 00°47.9'N, 86°09.3'W, 20 February 1979, DSRV ALVIN dive no. 895. Holotype ♀, allotype, and 36 paratypes (28 ♀♀, 8 ♂♂) deposited in the National Museum of Natural History, Smithsonian Institution, Washington, D.C.

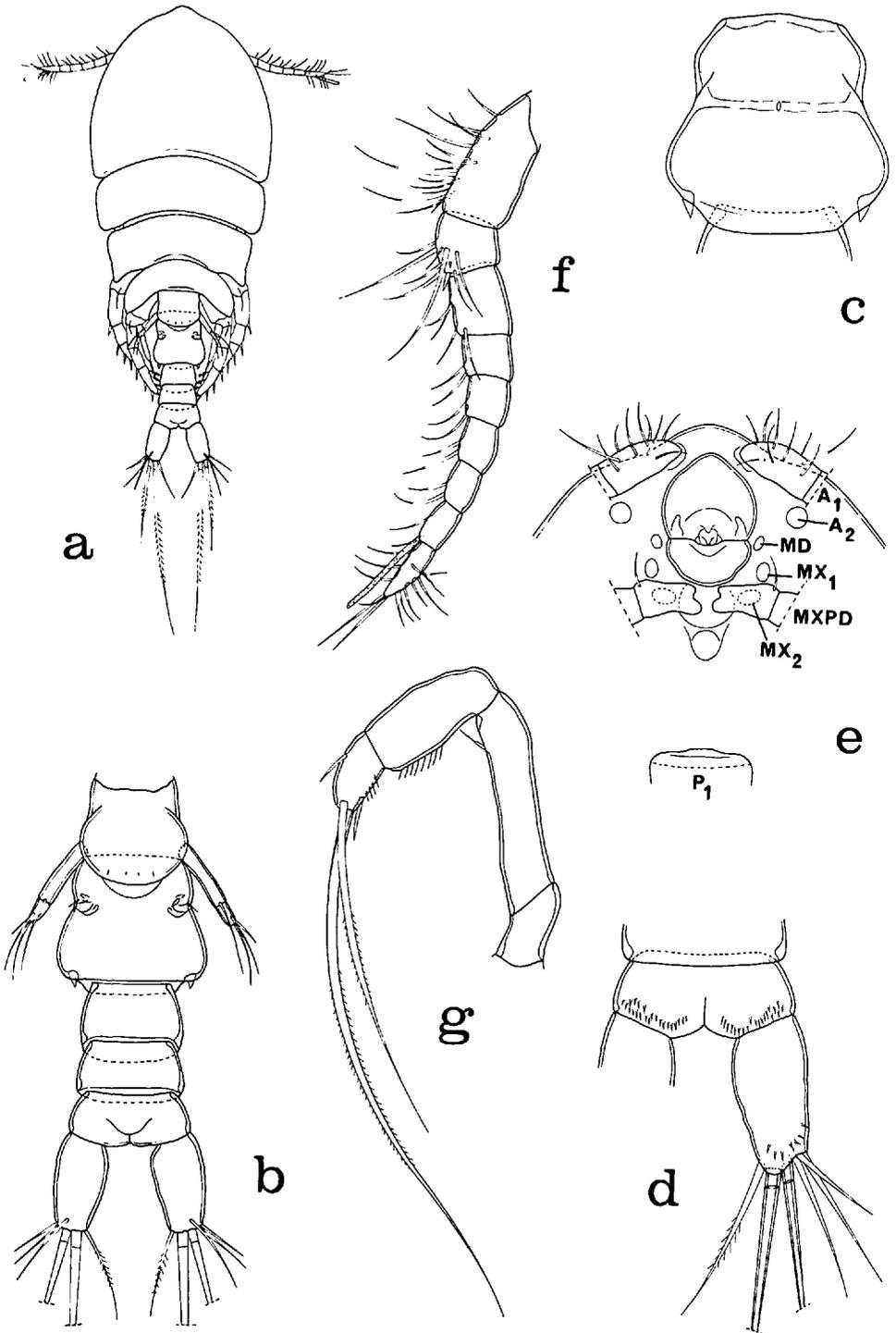


Figure 56. *Exrima dolichopus* new genus, new species. Female: a, dorsal (scale B); b, urosome, dorsal (D); c, genital segment, ventral (C); d, anal segment and caudal ramus, ventral (C); e, rostral and oral area showing positions of mouthparts, ventral (D); f, first antenna, posteroventral (C); g, second antenna, antero-inner (E).

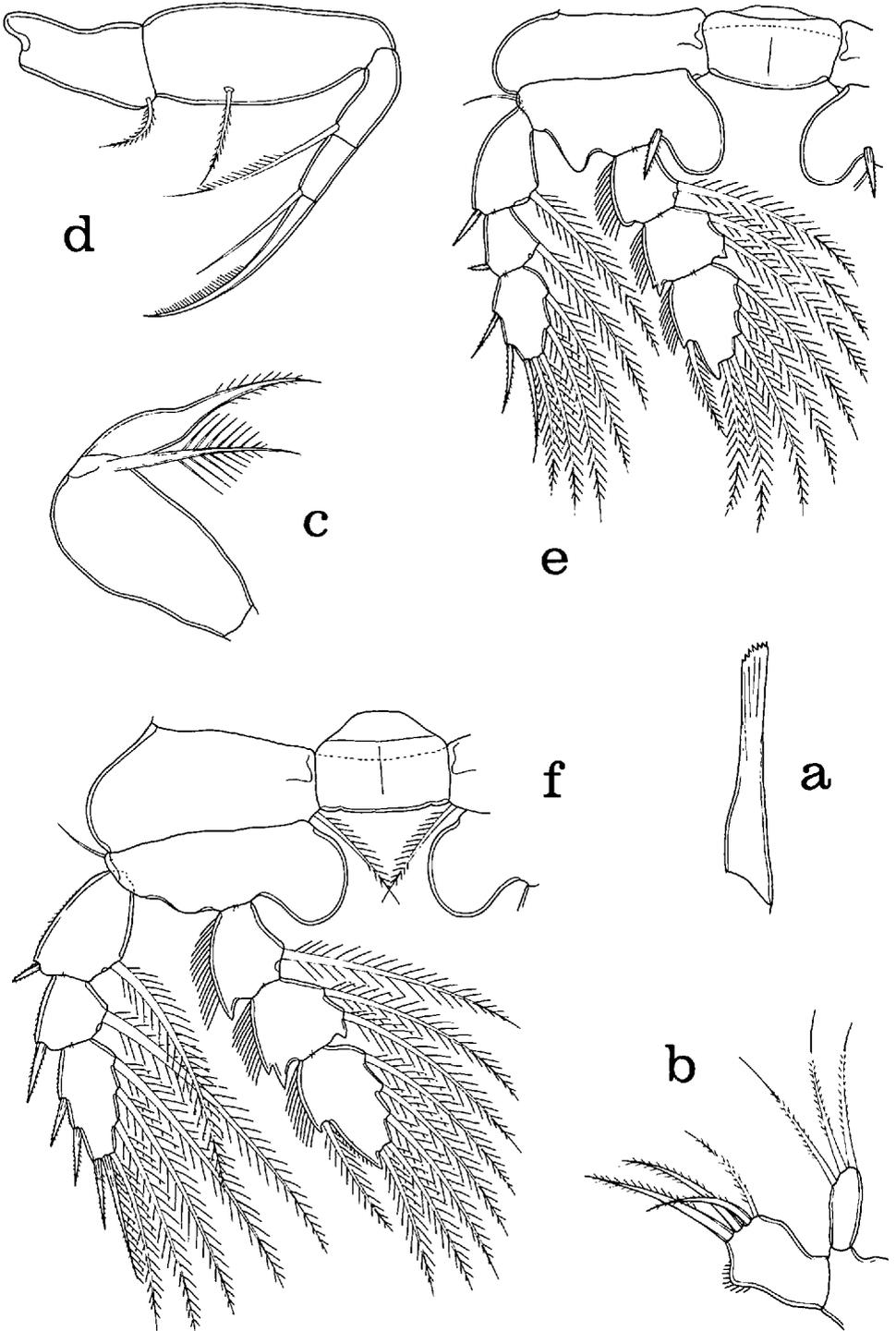


Figure 57. *Exrma dolichopus* new genus, new species. Female: a, mandible, anterior (E); b, first maxilla, anterior (E); c, second maxilla, posterior (E); d, maxilliped, posterior (G); e, leg 1 and intercoxal plate, anterior (C); f, leg 2 and intercoxal plate, anterior (C).

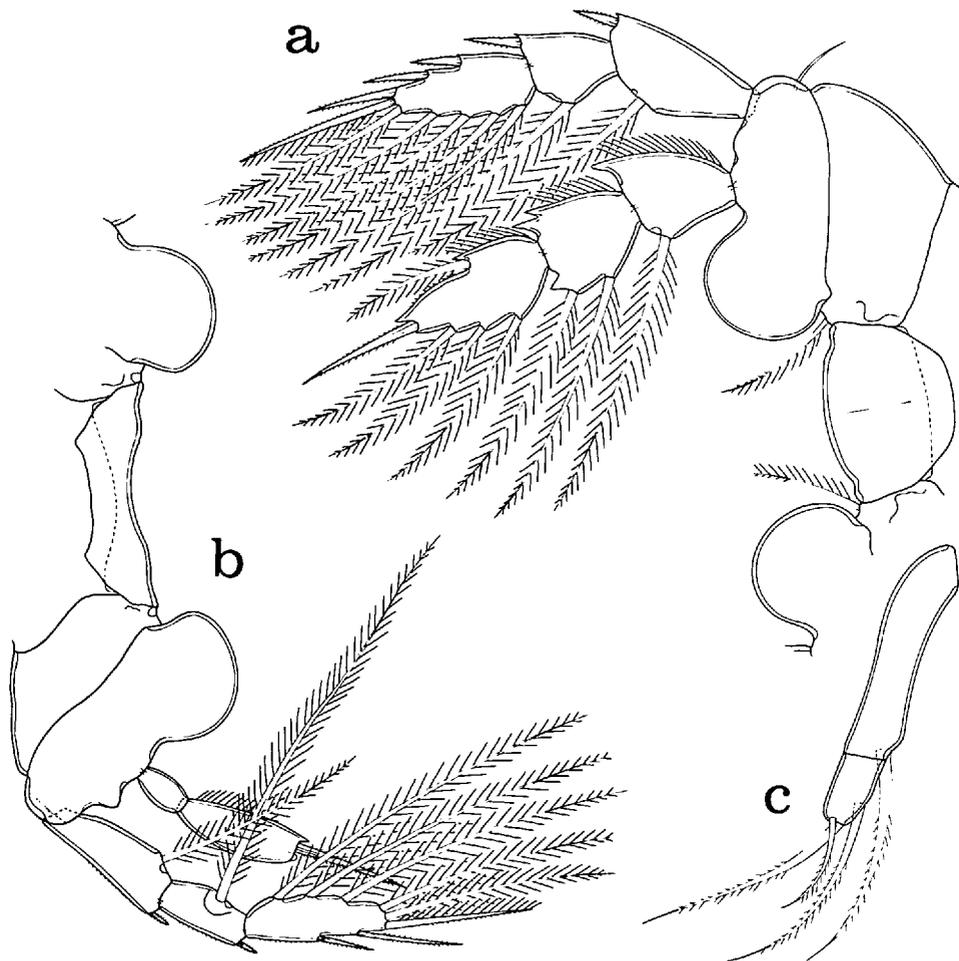


Figure 58. *Exrima dolichopus* new genus, new species. Female: a, leg 3 and intercoxal plate, anterior (C); b, leg 4 and intercoxal plate, anterior (C); c, leg 5, ventral (E).

Other Specimens. — 3 ♀♀, 15 ♂♂, 2 copepodids, in 2,482 m, Galapagos Rift, 00°48.0'N, 86°09.0'W, 06 December 1979, DSRV ALVIN dive no. 989; 2 ♀♀, 2 ♂♂, in 2,447 m, Galapagos Rift, 00°48.9'N, 86°13.3'W, 15 February 1979, DSRV ALVIN dive no. 890; 11 ♀♀, 2 ♂♂, in 2,625 m, location Parigo, Biocyarise, East Pacific Rise, 12°48.6'N, 103°56.7'W, 24 March 1984, DSRV CYANA dive no. 84-42; 2 ♀♀, in 2,625 m, location Pogodus, Biocyarise, East Pacific Rise, 12°48.6'N, 103°56.7'W, 16 March 1984, DSRV CYANA dive no. 84-39; 7 ♀♀, 3 ♂♂, location Parigo, Biocyarise, East Pacific Rise, 12°48.6'N, 103°56.7'W, 14 March 1984, DSRV CYANA dive no. 84-42; 15 ♀♀, 15 ♂♂, in 2,490 m, Galapagos Rift, 00°48.0'N, 86°09.0'W, 08 December 1979, DSRV ALVIN dive no. 991; 16 ♀♀, 20 ♂♂, in 2,451 m, Galapagos Rift, 00°48.0'N, 86°13.0'W, 07 December 1979, DSRV ALVIN dive no. 990.

Female. — Body (Fig. 59a) with broadly rounded prosome. Length 0.79 mm (0.70–0.94 mm) and greatest width 0.40 mm (0.35–0.42 mm), based on 10 specimens. Greatest dorsoventral thickness 0.24 mm. Segment bearing leg 1 fused with cephalosome but boundary probably indicated by minute lateral protuberances. Epimeral areas of segment bearing leg 1 somewhat pointed but remaining epimera rounded. Ratio of length to width of prosome 1.36:1. Ratio of length of prosome to that of urosome 2.46:1.

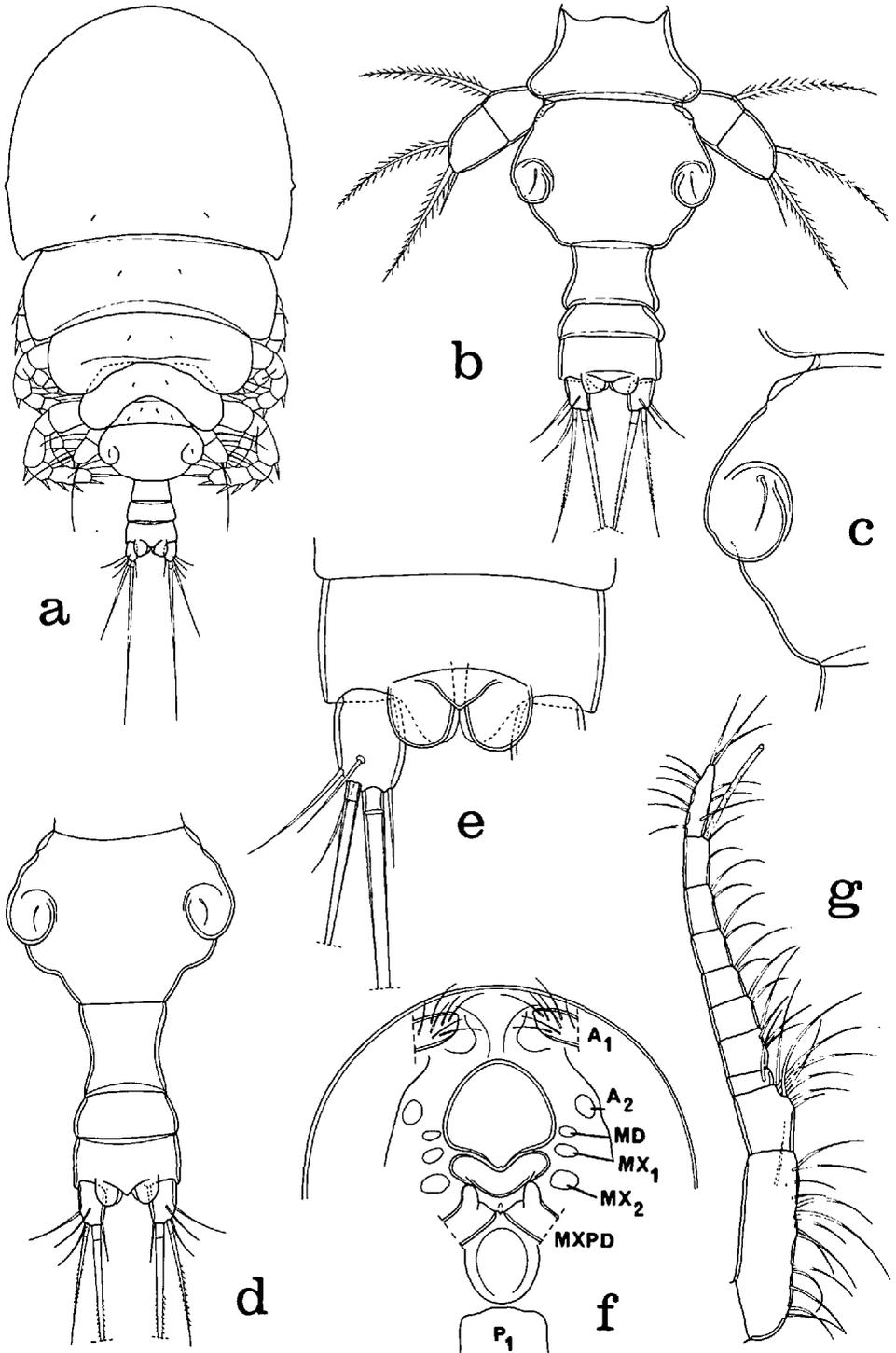


Figure 59. *Rhogobius contractus* new genus, new species. Female: a, dorsal (scale H); b, urosome, dorsal (C); c, genital area, dorsal (E); d, urosome posterior to segment bearing leg 5, dorsal (C); e, caudal ramus and anal segment, dorsal (F); f, rostral area and oral region, showing positions of mouthparts and protuberance posterior to maxillipeds, ventral (D); g, first antenna, ventral (G).

Segment bearing leg 5 (Fig. 59b) $57 \times 122 \mu\text{m}$. Genital segment $101 \times 148 \mu\text{m}$, wider than long. Genital areas located dorsolaterally at midregion (widest part). Each area (Fig. 59c) bearing 1 small seta. Three postgenital segments 47×65 , 26×78 , and $29 \times 75 \mu\text{m}$ in Fig. 59b. First postgenital segment constricted, narrower than other segments, and capable of extension (Fig. 59d). Anal segment with 2 broad rounded flaps at either side of open V-shaped operculum.

Caudal ramus (Fig. 59e) minute, $23 \times 18 \mu\text{m}$, ratio 1.28:1. Outer lateral seta $39 \mu\text{m}$, dorsal seta $29 \mu\text{m}$, outermost terminal seta $26 \mu\text{m}$, and innermost terminal seta $18 \mu\text{m}$, all smooth. Two long median terminal setae $91 \mu\text{m}$ (outer) and $200 \mu\text{m}$ (inner), both minutely barbed midway.

Body surface with few sensilla (Fig. 59a).

Egg sac unknown.

Rostral area weakly developed (Fig. 59f). First antenna (Fig. 59g) $265 \mu\text{m}$ long, not including setae. Lengths of its 10 segments: 55 ($88 \mu\text{m}$ along anterior margin), 29, 9, 23, 13, 13, 18, 19, 20, and $36 \mu\text{m}$, respectively. Armature: 15, 8, 2, 4, 2, 2, 2, 2 + 1 aesthete, and 12. All setae smooth.

Second antenna (Fig. 60a) $143 \mu\text{m}$ long excluding setae. Protopod 2-segmented. Exopod 1-segmented with 3 setae. Endopod 2-segmented, second segment elongate and slender, bearing 4 setae, 2 larger setae finely barbed, and few minute subterminal spinules on each side.

Oral cone (Fig. 59f) short, no true siphon. Mandible (Fig. 60b) $117 \mu\text{m}$ long, terminally with 3 minute teeth and row of spinules. First maxilla (Fig. 60c) with inner lobe bearing 3 setae, outer lobe with 3 setae, 2 of them somewhat stouter than others and having few minute barbules. Second maxilla (Fig. 60d) with first segment unarmed, second segment attenuated, slightly sigmoid. Maxilliped (Fig. 60e) 4-segmented. First segment with 1 distal inner seta, second segment with 1 minute inner seta, and both third segment and fourth segment with distal seta. Claw short, $45 \mu\text{m}$, recurved.

Ventral surface between maxilliped and first pair of legs with median prominence (Fig. 59f).

Legs 1-4 (Fig. 60f-i) biramous with 3-segmented rami, except for 2-segmented endopod of leg 4. Spine and setal formula as follows:

P_1	coxa	0-0	basis	1-1	exp	I-1; I-1; II,I,4
					enp	0-1; 0-2; 1,2,3
P_2	coxa	0-0	basis	1-0	exp	I-1; I-1; II,II,4
					enp	0-1; 0-2; 1,2,3
P_3	coxa	0-0	basis	1-0	exp	I-1; I-1; II,II,5
					enp	0-1; 0-2; 1,I,3
P_4	coxa	0-0	basis	1-0	exp	I-1; I-1; II,II,4
					enp	0-1; I,1

Leg 1 with basis having stout inner barbed spine $31 \mu\text{m}$ long, and outer spines on exopod with terminal flagella. Intercostal plates of legs 3 and 4 unusually expanded. Spine on endopod of leg 3 short, $36 \mu\text{m}$. Leg 4 with exopod $169 \mu\text{m}$ long. Endopod with first segment $22 \times 18 \mu\text{m}$, its plumose inner seta $133 \mu\text{m}$; second segment $60 \times 25 \mu\text{m}$, its terminal barbed spine $65 \mu\text{m}$ and its plumose seta $100 \mu\text{m}$.

Leg 5 (Fig. 61a) 2-segmented, with weak division of segments, $88 \times 36 \mu\text{m}$ with segments taken together; first segment $44 \times 36 \mu\text{m}$, its plumose seta $101 \mu\text{m}$, second segment $44 \times 31 \mu\text{m}$, its plumose setae $96 \mu\text{m}$ and $104 \mu\text{m}$, and its shorter smooth seta $39 \mu\text{m}$.

Leg 6 probably represented by seta on genital area (Fig. 59c).

Color of living specimens unknown.

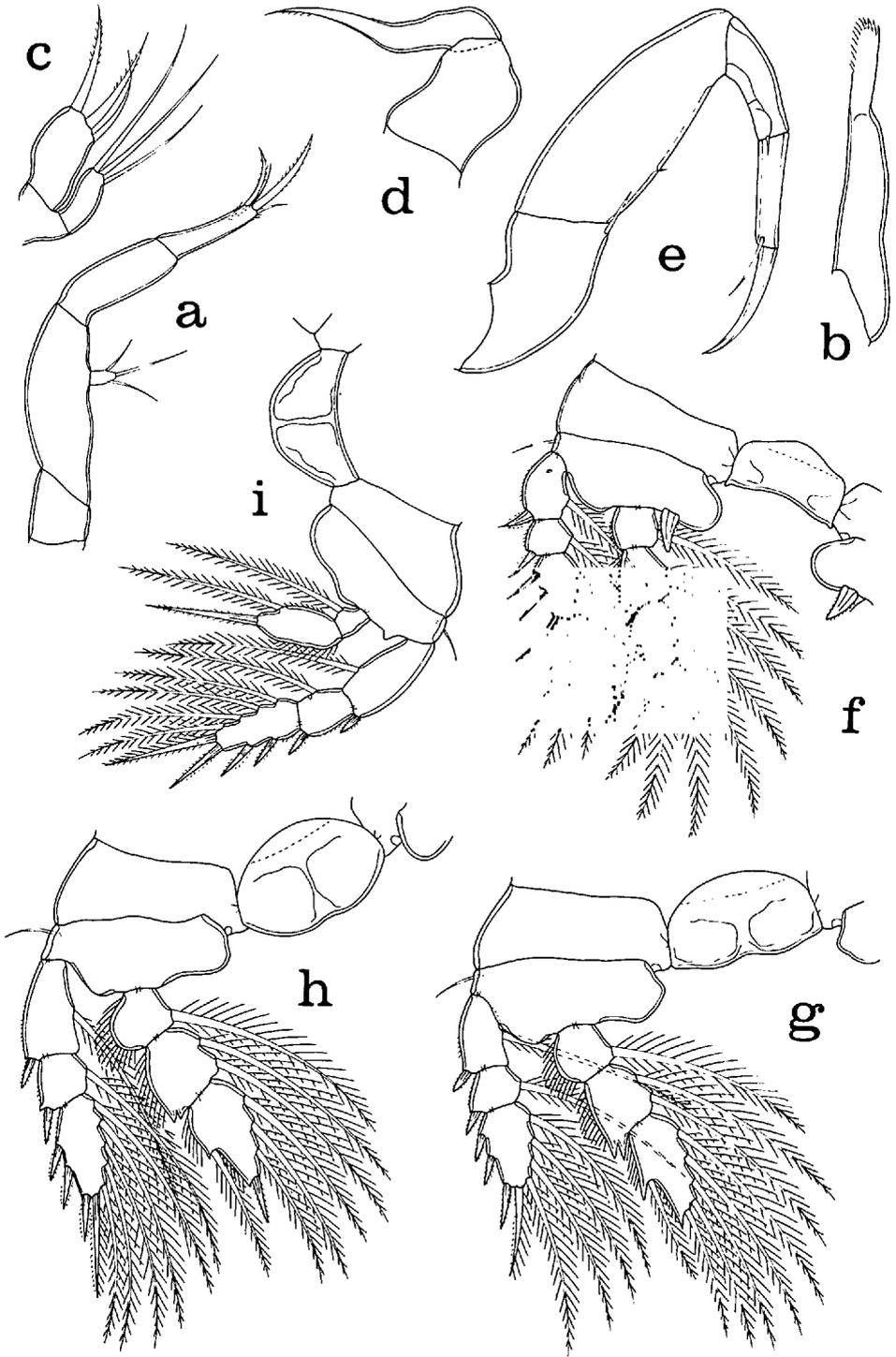


Figure 60. *Rhogobius contractus* new genus, new species. Female: a, second antenna, anterodorsal (scale E); b, mandible, posterior (E); c, first maxilla, anterior (E); d, second maxilla, posterior (E); e, maxilliped, posterior (E); f, leg 1 and intercoxal plate, anterior (C); g, leg 2 and intercoxal plate, anterior (C); h, leg 3 and intercoxal plate, anterior (C); i, leg 4 and intercoxal plate, anterior (C).

Male.—Body (Fig. 61b) similar in general form to that of female. Length 0.66 mm (0.60–0.71 mm) and greatest width 0.31 mm (0.31–0.33 mm), based on 10 specimens. Greatest dorsoventral thickness 0.23 mm. Ratio of length to width of prosome 1.26:1. Ratio of length of prosome to that of urosome 2.21:1.

Segment bearing leg 5 (Fig. 61c) short, $23 \times 83 \mu\text{m}$. Genital segment in some specimens globose, much wider than long, $93 \times 138 \mu\text{m}$, as in Fig. 61d, but in other specimens relatively longer, less globose, $120 \times 143 \mu\text{m}$, broadest anteriorly and smoothly tapered posteriorly (Fig. 61c). Four postgenital segments from anterior to posterior 39×71 , 34×62 , 21×55 , and $26 \times 55 \mu\text{m}$.

Caudal ramus resembling that of female, but slightly smaller, $21 \times 15 \mu\text{m}$, ratio 1.4:1.

Body surface and rostral area as in female.

First antenna (Fig. 61e) 11-segmented, $205 \mu\text{m}$ long as drawn. Lengths of segments: 12 ($28 \mu\text{m}$ along anterior margin), 55, 9, 3, 6.5, 30, 17, 17, 44, 36, and $32 \mu\text{m}$, respectively. Armature: 1, 15, 8, 2, 2, 4, 2, 2, 3, 1 aesthete, and 12. Fourth segment bearing spine $24 \mu\text{m}$, with slight irregularities on distal margin (Fig. 61f).

Second antenna, oral cone, mandible, first maxilla, second maxilla, and maxilliped similar to those in female.

Legs 1 and 4 as in female. Leg 2 resembling that of female, but third segment of endopod with 2 outermost setae shorter and spiniform; outer terminal spiniform process larger and having subterminal ridge with minute spinules continuing along outer margin of segment (Fig. 61g). Leg 3 similar to that of female, but third segment of endopod having round terminal outer process with minute spinules continuing along outer side of segment (Fig. 61h).

Leg 5 (Fig. 61i) placed ventrally. Free segment $26 \times 33 \mu\text{m}$, bearing 2 inner gladiolate setae $35 \mu\text{m}$ and 3 outer slender setae $42 \mu\text{m}$ (smooth), $78 \mu\text{m}$, and $83 \mu\text{m}$, both with few delicate hairs. Adjacent dorsal seta $90 \mu\text{m}$ with few fine hairs.

Leg 6 (Fig. 61d) with 2 smooth setae $52 \mu\text{m}$ and $34 \mu\text{m}$.

Spermatophore unknown.

Color unknown.

Etymology.—The specific name *contractus*, Latin meaning contracted or drawn together, alludes to the varying degree of constriction of the first postgenital segment in the female.

Remarks.—While *Rhogobius* conforms in several ways to *Aphotopontius* (e.g., the armature of legs 1–4, the structure of leg 5, the second antenna, and the maxilliped), the new genus differs in four points, namely, three setae instead of four on the outer lobe of the first maxilla, the lack of a seta on the first segment of the second maxilla, the constricted first postgenital segment in the female, and the two lobes at either side of the anal operculum.

Scotoecetes new genus

Diagnosis.—Body unmodified. Segment bearing leg 1 set off from cephalosome only laterally. Urosome in female 5-segmented, in male 6-segmented. Caudal ramus with 6 setae, innermost terminal seta minute.

Rostrum not developed. First antenna in female 11-segmented with aesthete on penultimate segment (though last segment often showing subdivision). First antenna in male 10-segmented, geniculate, with aesthete on penultimate segment and prominent inner knobbed process on fourth segment.

Second antenna with 1-segmented exopod and 2-segmented endopod. Oral cone short, no true siphon. Mandible elongate blade without palp. First maxilla with

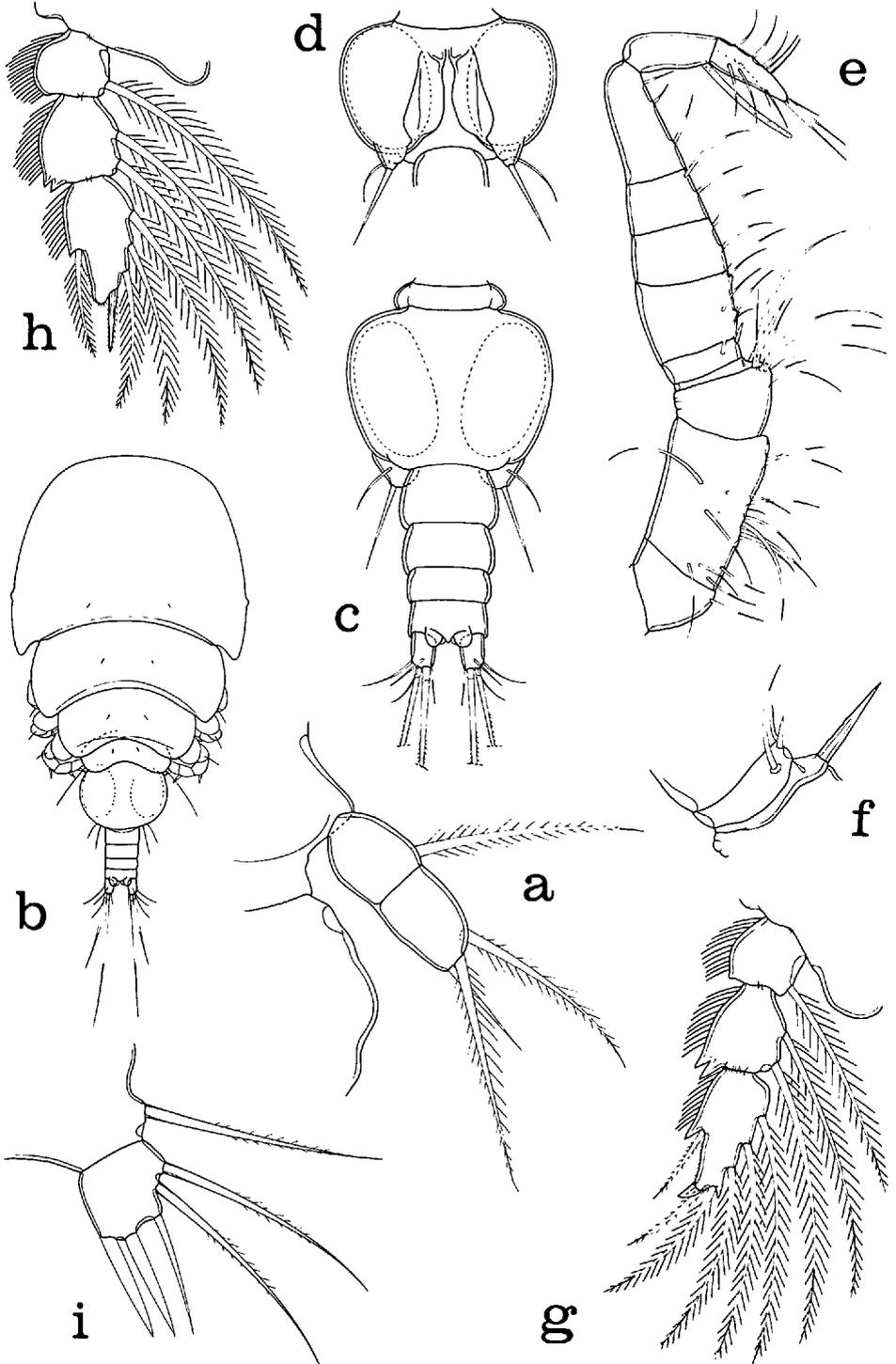


Figure 61. *Rhogobius contractus* new genus, new species. Female: a, leg 5, ventral (scale G). Male: b, dorsal (H); c, urosome, dorsal (C); d, genital segment, ventral (C); e, first antenna, posteroventral (E); f, segments 4 and 5 of first antenna, anterodorsal (F); g, endopod of leg 2, anterior (G); h, endopod of leg 3, anterior (G); i, leg 5, ventral (E).

asymmetrical inner lobe bearing 4 setae, outer lobe with 4 setae. Second maxilla with basal segment having 1 seta and claw. Maxilliped 5-segmented with slender recurved claw.

Legs 1–4 biramous with 3-segmented rami, except for 2-segmented endopod in leg 1 of female and 3-segmented endopod in male, and in leg 4 in both sexes. Formula for endopod of leg 1 in female 0-1; 1,2,3 + 2, that for endopod of leg 4 in both sexes 0-0; I,1. All legs lacking inner coxal seta. Sexual dimorphism in legs 1 and 2, endopod of leg 1 of male 0-1; 0-2; 1,2,3. Last segment of endopod of leg 2 in male with 1,II,3.

Leg 5 in female with 2 incompletely separated segments, formula 1;2. In male this leg reduced to small ridge bearing 3 setae.

Leg 6 in female without seta, in male with spine or seta.

Type-species.—*Scotoecetes introrsus* new species.

Gender.—Masculine.

Etymology.—The generic name is derived from the Greek words *skotos*, the darkness of the nether world, and *oeketes*, an inhabitant, referring to the aphotic habitat in the deep-sea.

***Scotoecetes introrsus* new species**
Figures 62a–h, 63a–g, 64a–f, 65a–g

Type Material.—208 ♀♀, 26 ♂♂, in 2,630 m, with vestimentiferans, location Parigo, East Pacific Rise, 12°46.6'N, 103°56.7'W, 24 March 1984, DSRV CYANA dive no. 84-37. Holotype ♀, allotype, and 244 paratypes (202 ♀♀, 22 ♂♂) deposited in the Muséum National d'Histoire Naturelle, Paris.

Other Specimens.—23 ♀♀, 6 ♂♂, in 2,635 m, from sample basket, location Parigo, Biocyarise, East Pacific Rise, 12°48.8'N, 103°56.8'W, 15 March 1984, DSRV CYANA dive no. 84-38; 18 ♀♀, 9 ♂♂, in 2,635 m, location Pogosud, Biocyarise, East Pacific Rise, 12°48.6'N, 103°56.7'W, 16 March 1984, DSRV CYANA dive no. PL39; 114 ♀♀, 12 ♂♂, in 2,635 m, with *Neomphalus*, location Pogosud, Biocyarise, East Pacific Rise, 12°48.6'N, 103°56.7'W, 25 March 1984, DSRV CYANA dive no. 84-43; 117 ♀♀, 3 ♂♂, in 2,635 m, with polychaetes, location Parigo, Biocyarise, East Pacific Rise, 12°46.6'N, 103°56.7'W, March 1984, DSRV CYANA dive no. 84-41; 5 ♀♀, in 2,635 m, location Parigo, Biocyarise, East Pacific Rise, 12°46.6'N, 103°56.7'W, March 1984, DSRV CYANA dive no. 84-31.

Female.—Body (Fig. 62a) unmodified. Length 1.73 mm (1.65–1.79 mm) and greatest width 0.70 mm (0.66–0.74 mm), based on 10 specimens. Greatest dorsoventral thickness 0.34 mm. Segment bearing leg 1 slightly separated from cephalosome. Epimeral areas of segments of legs 1 and 2 pointed, those of segments of legs 3 and 4 more rounded. Ratio of length to width of prosome 1.49:1. Ratio of length of prosome to that of urosome 1.75:1.

Segment bearing leg 5 (Fig. 62b, c) 112 × 218 μm. Genital segment 231 μm long, in dorsal view broadest in anterior third (239 μm wide) and with nearly parallel sides posteriorly (156 μm wide). Genital areas located dorsolaterally on broad anterior third of segment. Each area without seta. Three postgenital segments from anterior to posterior 133 × 138, 107 × 130, and 112 × 133 μm.

Caudal ramus (Fig. 62d) elongate, 221 × 57 μm, with indentation along proximal fourth of inner margin. Ratio of length to width 3.88:1. Outer lateral seta 180 μm, close to outermost terminal seta 175 μm, dorsal seta 58 μm, all 3 setae smooth. Innermost terminal seta very short, 8 μm, and naked. Two long median terminal setae 583 μm (outer) and 869 μm (inner), both with lateral spinules.

Body surface with few sensilla or hairs.

Egg sac with single egg 244 × 195 μm (Fig. 62e) or 2 eggs both 242 × 169 μm (Fig. 62f).

Rostral area (Fig. 63a) not well defined. First antenna (Fig. 62g) 780 μm long,

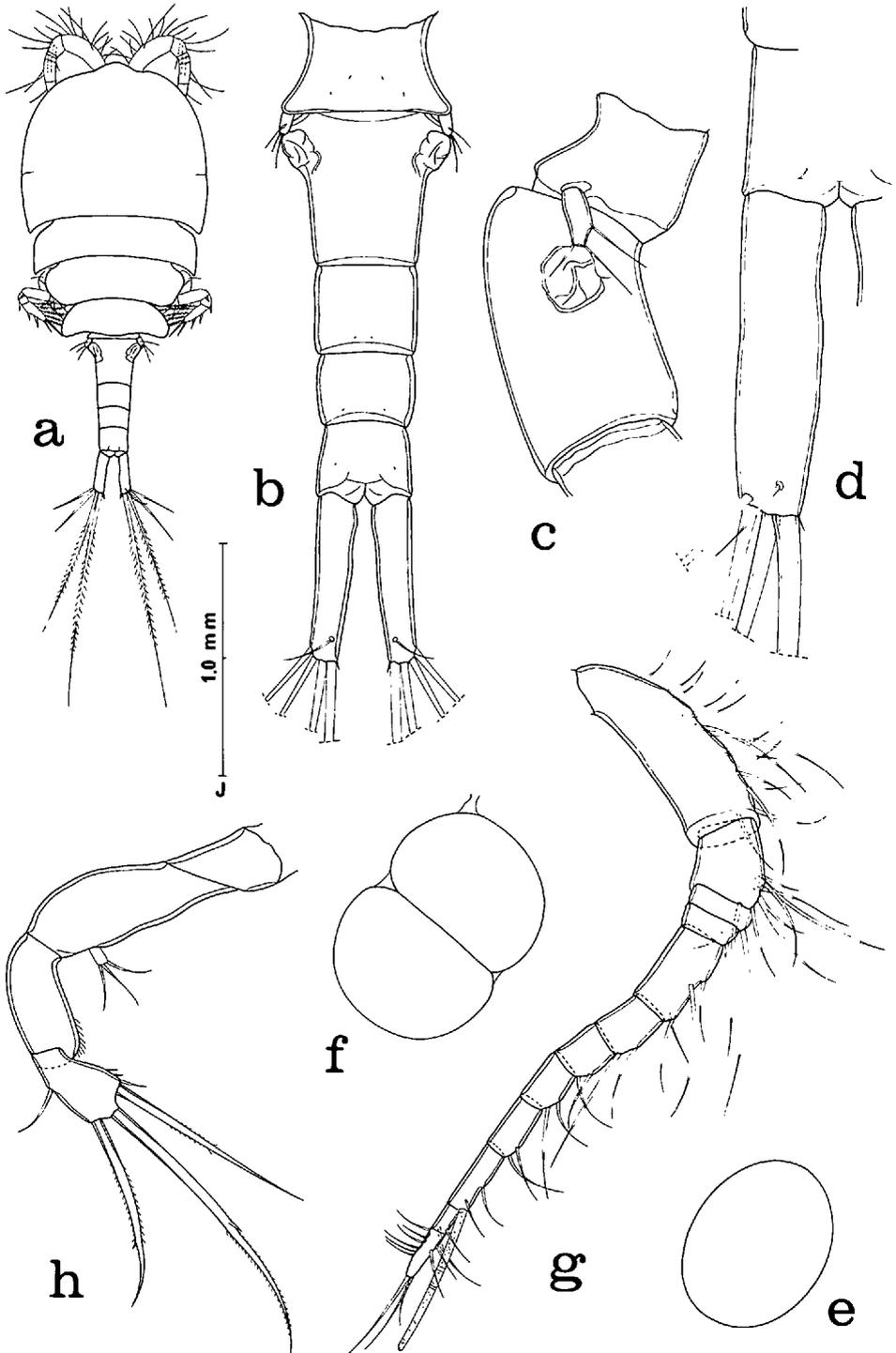


Figure 62. *Scotoecetes introrsus* new genus, new species. Female: a, dorsal (scale J); b, urosome, dorsal (H); c, segment bearing leg 5 and genital segment, lateral (D); d, caudal ramus, dorsal (C); e, egg sac, dorsal (H); f, egg sac, dorsal (H); g, first antenna, posteroventral (D); h, second antenna, anterior (C).

not including setae. Lengths of 11 segments: 169 (238 μm along anterior margin), 60, 13, 23, 86, 57, 57, 55, 62, 65, and 83 μm , respectively. Armature: 15, 8, 1, 4, 2, 2, 2, 2, 2 + 1 aesthete, and 12. All setae smooth. Aesthete 149 μm long with 2 "joints."

Second antenna (Fig. 62h) with 2-segmented protopod. One-segmented exopod with 3 setae. Endopod 2-segmented, first segment with row of outer spinules, second segment with 1 small inner smooth seta, 3 long terminal barbed setae (2 inner setae with slight bend at two-thirds length), and small subterminal smooth seta with few adjacent spinules.

Oral cone (Fig. 63a) short. Mandible (Fig. 63b) slender, 185 μm long, terminally with 2 large teeth and several smaller ones. First maxilla (Fig. 63c) with slender outer lobe bearing 4 finely barbed setae, inner outer lobe with angular prominence on outer edge and bearing 4 setae, 1 finely barbed, 3 with longer barbs especially distally. Second maxilla (Fig. 63d) 2-segmented, first segment stout with 1 long seta, second segment slender, clawlike, and slightly sinuous, with comb of spinules distally. Maxilliped (Fig. 63e) slender, 5-segmented. First and second segments with inner barbed seta. Third segment with minute spinule. Fourth and fifth segments with single barbed seta. Claw recurved with comb of spinules distally.

Legs 1-4 (Figs. 63f, g, 64a, b) biramous with 3-segmented rami, except for 2-segmented endopod in leg 1 and leg 4. Spine and setal formula as follows:

P_1	coxa	0-0	basis	1-1	exp	I-1; I-1; II,I,4
					enp	0-1; 1,2,3 + 2
P_2	coxa	0-0	basis	1-0	exp	I-1; I-1; II,II,4
					enp	0-1; 0-2; 1,2,3
P_3	coxa	0-0	basis	1-0	exp	I-1; I-1; II,II,5
					enp	0-0; 0-2; 1,I,3
P_4	coxa	0-0	basis	1-0	exp	I-1; I-1; II,II,4
					enp	0-0; I,1

Inner spine on basis of leg 1 setiform, 117 μm long, finely barbed. Outer spines on exopod slender setiform and smooth except for spine on second segment being more spinelike. Endopod with second and third segments fused, with only slight indication of separation. Outer terminal seta 117 μm long, held inwardly at nearly right angle to segment. Spines on exopods of legs 2-4 normally spiniform. Leg 4 with exopod 300 μm long. Endopod with unarmed first segment $68 \times 29 \mu\text{m}$, second segment $94 \times 27 \mu\text{m}$, terminal barbed spine 143 μm and inner plumose seta 148 μm .

Leg 5 (Fig. 64c) small, $52 \times 23 \mu\text{m}$, with incomplete subdivision into 2 segments. Dorsal seta 65 μm , 2 terminal setae 78 μm and 45 μm , all setae smooth.

Leg 6 not represented by seta.

Color of living specimens unknown.

Male. — Body (Fig. 64d) resembling that of female in general form. Length 1.37 mm (1.30-1.42 mm) and greatest width 0.55 mm (0.53-0.58 mm), based on 10 specimens. Greatest dorsoventral thickness 0.25 mm. Ratio of length to width of prosome 1.40:1. Ratio of length of prosome to that of urosome 1.14:1.

Segment bearing leg 5 (Fig. 64e) $78 \times 125 \mu\text{m}$. Genital segment $161 \times 187 \mu\text{m}$, in dorsal view with rounded edges. Four postgenital segments from anterior to posterior 117×114 , 88×104 , 75×92 , and $82 \times 94 \mu\text{m}$.

Caudal ramus similar to that of female but smaller, $169 \times 39 \mu\text{m}$, ratio 4.33:1. Body surface and rostral area as in female.

First antenna (Fig. 64f) geniculate, probably 10-segmented, though proximal

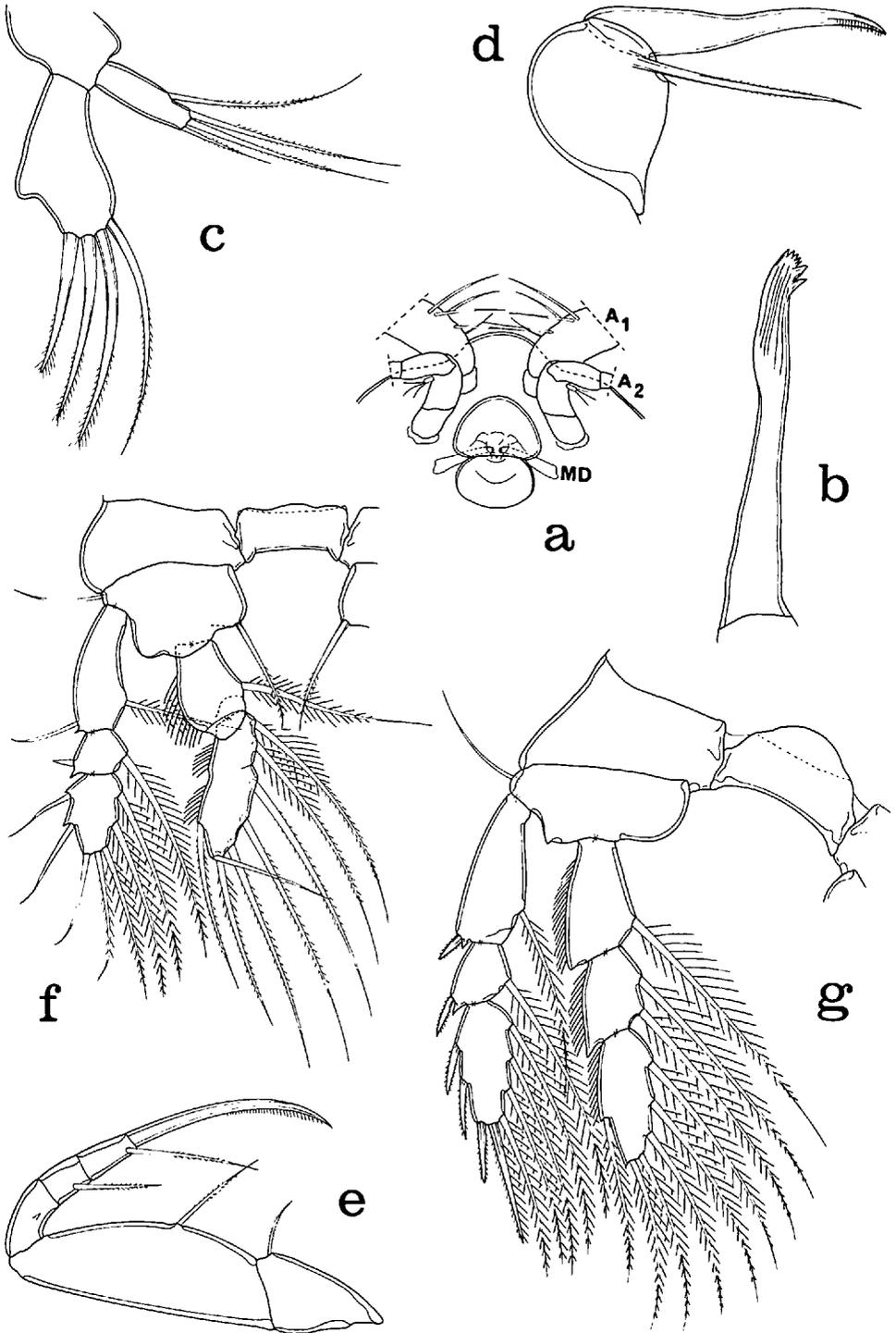


Figure 63. *Scotoecetes introrsus* new genus, new species. Female: a, rostral area and oral cone, ventral (scale H); b, mandible, ventral (G); c, first maxilla, anterior (G); d, second maxilla, posterior (G); e, maxilliped, posterior (G); f, leg 1 and intercoxal plate, anterior (D); g, leg 2 and intercoxal plate, anterior (D).

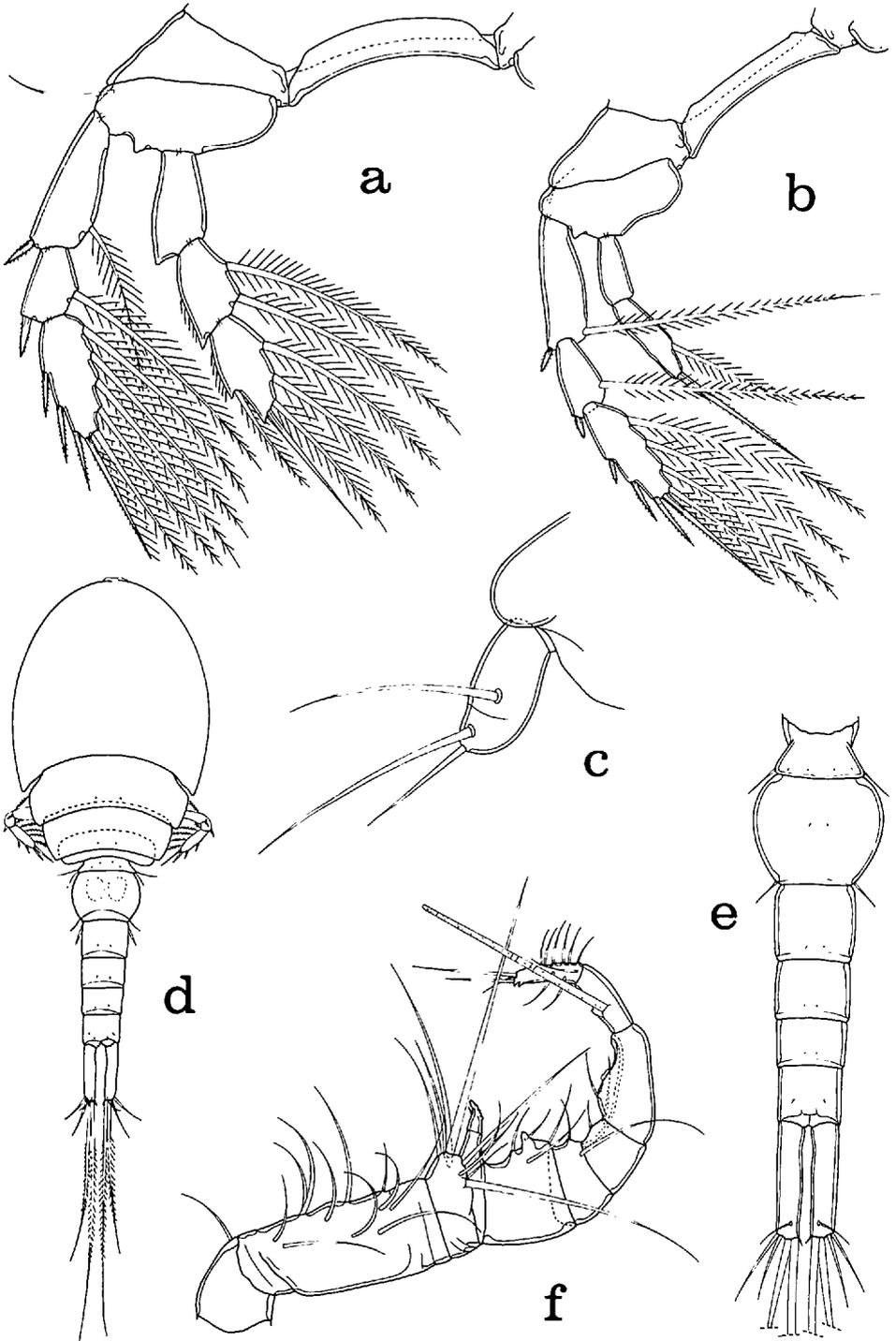


Figure 64. *Scotoecetes introrsus* new genus, new species. Female: a, leg 3 and intercoxal plate, anterior (scale D); b, leg 4 and intercoxal plate, anterior (D); c, leg 5, dorsal (E). Male: d, dorsal (A); e, urosome, dorsal (H); f, first antenna, posteroventral (C).

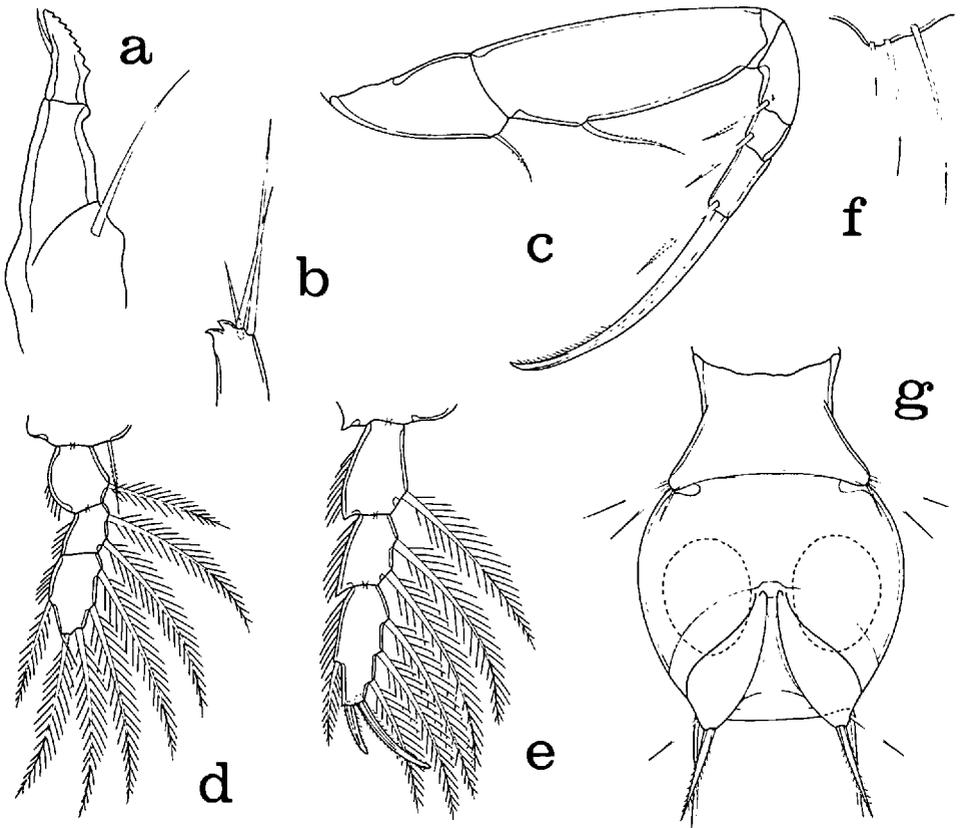


Figure 65. *Scotoecetes introrsus* new genus, new species. Male: a, process on fourth segment of first antenna, anterodorsal (scale F); b, tip of first antenna, posteroventral (F); c, maxilliped, posterior (C); d, endopod of leg 1, anterior (D); e, endopod of leg 2, anterior (D); f, leg 5, lateral (F); g, segment bearing leg 5 and genital segment, ventral (C).

segments difficult to distinguish. Lengths of segments: 31 ($78 \mu\text{m}$ along anterior margin), 104, 23, 5, 64, 47, 44, 79, 60, and $36 \mu\text{m}$, respectively. Armature: 1, 11, 8, 1 + process, 4, 2, 2, 1, 1 aesthete, and 12. Fourth segment with prominent inner process (Fig. 65a) bearing stout spine finely knobbed along distal edge and having hyaline setule on proximal edge. Last segment with 2 small terminal hooklike processes (Fig. 65b).

Second antenna, oral cone, mandible, first maxilla, and second maxilla resembling those of female. Maxilliped (Fig. 65c) similar to that of female but in addition having seta on third segment.

Legs 1–4 resembling those of female, but sexual dimorphism in endopods of legs 1 and 2. Endopod of leg 1 (Fig. 65d) 3-segmented, formula 0-1; 0-2; 1,2,3, with small outer terminal seta turned inward, short, $24 \mu\text{m}$. Endopod of leg 2 (Fig. 65e) with formula 0-1; 0-2; 1,II,3, 2 spines $47 \mu\text{m}$ and $91 \mu\text{m}$.

Leg 5 (Fig. 65f, g) consisting of ridge with 3 smooth setae, from dorsal to ventral 62, 42, and $16 \mu\text{m}$.

Leg 6 (Fig. 65g) usual posteroventral flap on genital segment bearing smooth seta $36 \mu\text{m}$ and barbed spine $57 \mu\text{m}$.

Spermatophore not seen.

Color unknown.

Etymology.—The specific name *introrsus*, Latin meaning toward the inside or inwards, alludes to the turning inward of the seta on the tip of leg 1.

Remarks.—Although *Scotoecetes* shows many similarities with other genera in the Dirivultidae, four features distinguish the new genus: (1) the outer lobe of the first maxilla bearing four setae, (2) the 2-segmented endopod in leg 1 of the female, (3) a reduction of the number of setae on leg 5 of the female to three, and (4) leg 5 in the male reduced to a low ridge with three setae.

Ceuthoecetes Humes and Dojiri, 1980

Ceuthoecetes aliger Humes and Dojiri, 1980

Material Studied.—287 ♀♀, in washings of vestimentiferans and bivalves, in 2,614 m, Clam Acres, East Pacific Rise, 20°50.0'N, 109°06.0'W, 04 May 1982, DSRV ALVIN dive no. 1221; 12 ♀♀, in 2,616 m, Clam Acres, East Pacific Rise, 20°50.0'N, 109°06.0'W, 10 May 1982, DSRV ALVIN dive no. 1226; 1 ♀, in 2,615 m, Clam Acres, East Pacific Rise, 20°50.0'N, 109°06.0'W, 17 April 1982, DSRV ALVIN dive no. 1211; 23 ♀♀, in 2,618 m, Clam Acres, East Pacific Rise, 20°50.0'N, 109°06.0'W, 09 May 1982, DSRV ALVIN dive no. 1225.

Remarks.—The original description of *Ceuthoecetes aliger* was based on a relatively small number of specimens (10 ♀♀, 27 ♂♂, and 41 copepodids), all that were then available (Humes and Dojiri, 1980). A female was selected as holotype (USNM 180375) and 4 ♀♀ were deposited as paratypes (USNM 180377). The allotype male (USNM 180376) and 21 male paratypes (USNM 180377) are now believed to represent not *C. aliger*, but a new species of *Ceuthoecetes*, described below, as *Ceuthoecetes cristatus*.

The recognition that these males belong to the new species is well supported by anatomical evidence. In all siphonostomatoid copepods studied during this work there is no sexual dimorphism in the shape and proportions of the second segment of the maxilliped. The shape of this segment in *C. aliger* and *C. cristatus* is, however, obviously different, being elongate and slender in the female of the former and much stouter in the male of the latter. The observations made on opposite sexes are believed to be reliable, taking into account the lack of sexual dimorphism in this appendage.

The characters of the female of *Ceuthoecetes aliger* are fully shown in the original description and need no further mention here.

Ceuthoecetes acanthothrix new species

Figures 66a–i, 67a–g

Type Material.—693 ♂♂, in washings of vestimentiferans and bivalves, in 2,618 m, Clam Acres, East Pacific Rise, 20°50.0'N, 109°06.0'W, 04 May 1982, DSRV ALVIN dive no. 1221. Holotype and 688 paratypes deposited in the National Museum of Natural History, Smithsonian Institution, Washington, D.C.

Other Specimens.—13 ♂♂, from washings of vestimentiferans and *Calyptogena*, in 2,612 m, Clam Acres, East Pacific Rise, 20°50.0'N, 109°06.0'W, 25 April 1982, DSRV ALVIN dive no. 1219; 62 ♂♂, in 2,616 m, Clam Acres, East Pacific Rise, 20°50.0'N, 109°06.0'W, 10 May 1982, DSRV ALVIN dive no. 1226; 14 ♂♂, in 2,490 m, Galapagos Rift, 00°48.0'N, 86°09.0'W, 08 December 1979, DSRV ALVIN dive no. 991; 1 ♂, in 2,450 m, Galapagos Rift, 00°48.0'N, 86°13.0'W, 05 December 1979, DSRV ALVIN dive no. 988; 8 ♂♂, in 2,618 m, Clam Acres, East Pacific Rise, 20°50.0'N, 109°06.0'W, 09 May 1982, DSRV ALVIN dive no. 1225; 1 ♂, in 2,451 m, Galapagos Rift, 00°48.0'N, 86°13.0'W, 01 December 1979, DSRV ALVIN dive no. 984; 11 ♂♂, in 2,447 m, Galapagos Rift, 00°48.0'N, 86°13.3'W, 15 February 1979, DSRV ALVIN dive no. 890; 4 ♂♂, in 2,615 m, Clam Acres, East Pacific Rise, 20°50.0'N, 109°06.0'W, 17 April 1982, DSRV ALVIN dive no. 1211; 70 ♂♂, in 2,635 m, Biocyarise, East Pacific Rise, 12°48.6'N, 103°56.7'W, 24 March 1984, DSRV CYANA dive no. 84-42.

Male.—Body (Fig. 66a) with cephalosome a little pointed anteriorly. Length 1.01 mm (0.91–1.08 mm) and greatest width 0.39 mm (0.36–0.41 mm), based on 10

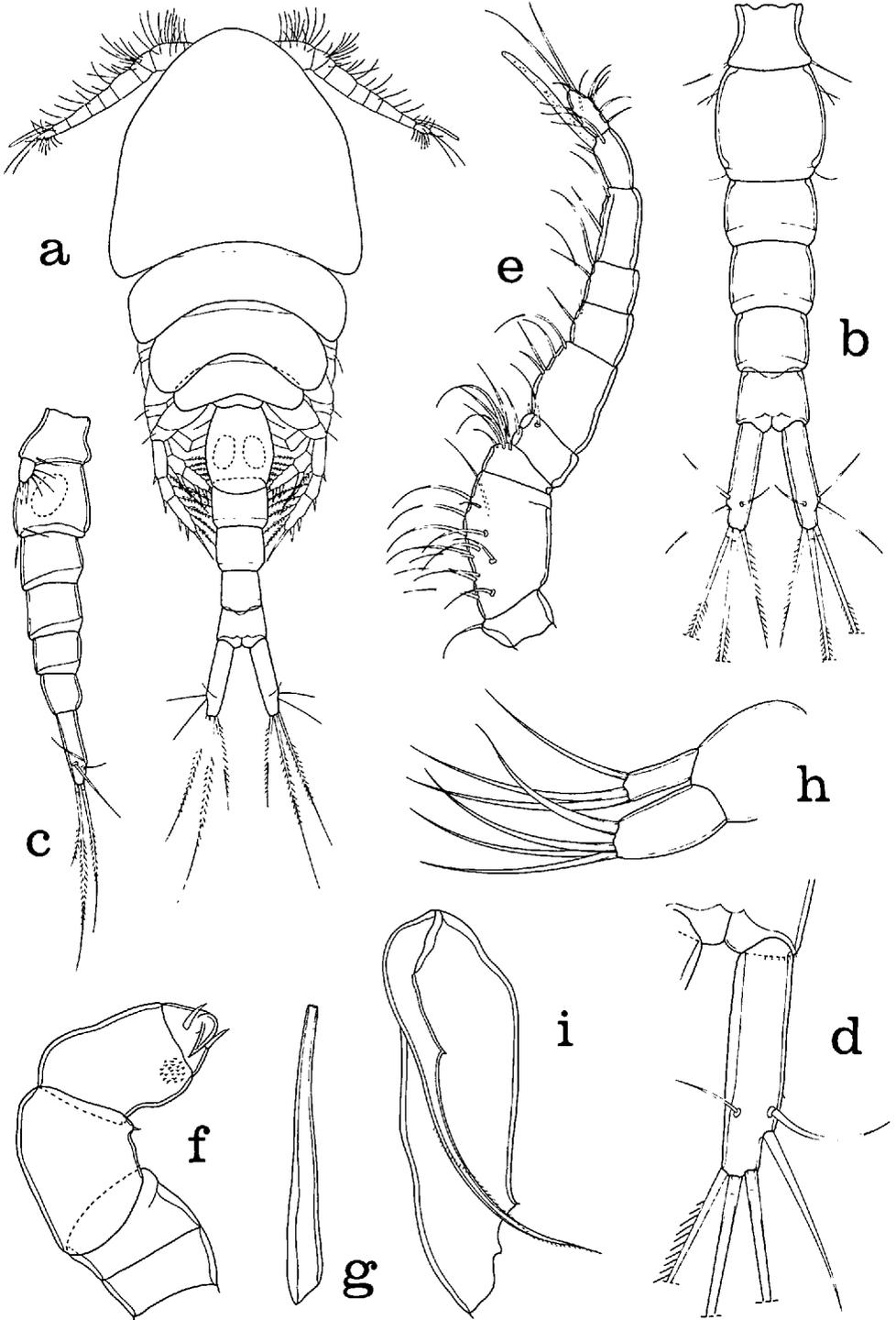


Figure 66. *Ceuthoecetes acanthothrix* new species. Male: a, dorsal (scale H); b, urosome, dorsal (D); c, urosome, lateral (H); d, caudal ramus, dorsal (G); e, first antenna, ventral (G); f, second antenna, antero-inner (F); g, mandible, anterior (F); h, first maxilla, anterior (F); i, second maxilla, posterior (F).

specimens. Greatest dorsoventral thickness about 0.22 mm. Ratio of length to width of prosome 1.43:1. Ratio of length of prosome to that of urosome 1.16:1.

Segment bearing leg 5 (Fig. 66b) $70 \times 88 \mu\text{m}$. Genital segment $114 \times 117 \mu\text{m}$, nearly as long as wide, with slightly convex lateral margins as seen in dorsal view, and lacking dorsal ridge (Fig. 66c). Four postgenital segments from anterior to posterior 75×91 , 75×86 , 60×73 , and $60 \times 75 \mu\text{m}$.

Caudal ramus (Fig. 66d) $114 \times 30 \mu\text{m}$, ratio 3.8:1. Outer lateral seta $68 \mu\text{m}$, dorsal seta $38 \mu\text{m}$ and outermost terminal seta (displaced subterminally) $91 \mu\text{m}$, all smooth. Innermost terminal seta $172 \mu\text{m}$, 2 median terminal setae $286 \mu\text{m}$ (inner) and $221 \mu\text{m}$ (outer), all with lateral hairs.

Body surface smooth and rostrum weakly developed.

First antenna (Fig. 66e) 10-segmented, strongly geniculate in some specimens, extended in others. Length approximately $275 \mu\text{m}$. Lengths of segments: 15, 42 ($70 \mu\text{m}$ along anterior margin), 5, 19, 47, 26, 21, 39, 29, and $24 \mu\text{m}$, respectively. Armature: 1, 14, 7, 3, 4, 2, 2, 2, 2 + 1 aesthete, and 11. All setae smooth.

Second antenna (Fig. 66f) small, $64 \mu\text{m}$ long. Exopod minute, spinuliform. First endopod segment with distal patch of small spinules. Second endopod segment with terminal claw and 2 setae.

Labrum, oral cone, mandible (Fig. 66g) $65 \mu\text{m}$ long, first maxilla (Fig. 66h), and second maxilla (Fig. 66i) similar to those in congeners. Maxilliped (Fig. 67a) with stout second segment, claw $78 \mu\text{m}$.

Legs 1-4 (Fig. 67b-e) segmented as in congeners. Formula for armature as follows:

P_1	coxa 0-0	basis 1-I	exp I-1; I-1; II,I,4
			enp 0-1; 0-2; 1,2,3
P_2	coxa 0-0	basis 1-0	exp I-1; I-1; III,I,4
			enp 0-1; 0-2; 1,2,3
P_3	coxa 0-0	basis 1-0	exp I-1; I-1; II,I,5
			enp 0-1; 0-2; 1,I,3
P_4	coxa 0-0	basis 1-0	exp I-1; I-1; II,I,4
			enp 0-0; I,1

Leg 1 (Fig. 67b) with pair of prominent knobs on edge of intercoxal plate, inner setiform element on basis $73 \mu\text{m}$ long and smooth. Leg 2 (Fig. 67c) with stout blunt spines on exopod; endopod with few erect spinules on distal side of both setae on second segment and proximalmost seta on third segment. Leg 3 (Fig. 67d) with spines on exopod 18, 75, 44, 48, and $80 \mu\text{m}$ long from proximal to distal; distalmost element on endopod spiniform. Leg 4 (Fig. 67e) with exopod $195 \mu\text{m}$. Endopod with first segment $42 \times 23 \mu\text{m}$; second segment $70 \times 18 \mu\text{m}$, terminal spine $133 \mu\text{m}$, inner seta $135 \mu\text{m}$.

Leg 5 (Fig. 67f) held ventrally, free segment $36 \times 23 \mu\text{m}$, both terminal broad hyaline elements $34 \mu\text{m}$, 3 outer setae 44, 31, and $27 \mu\text{m}$ from distal to proximal; adjacent dorsal seta $47 \mu\text{m}$. All setae smooth.

Leg 6 (Fig. 67g) forming posteroventral flap on genital segment bearing 2 unequal setae $44 \mu\text{m}$ and $52 \mu\text{m}$.

Color of living specimens unknown.

Female. — Unknown.

Etymology. — The specific name *acanthothrix*, from Greek *acanthos*, a spine, and *thrix*, a hair, refers to the erect spinules on certain setae on the second and third segments of the endopod of leg 2.

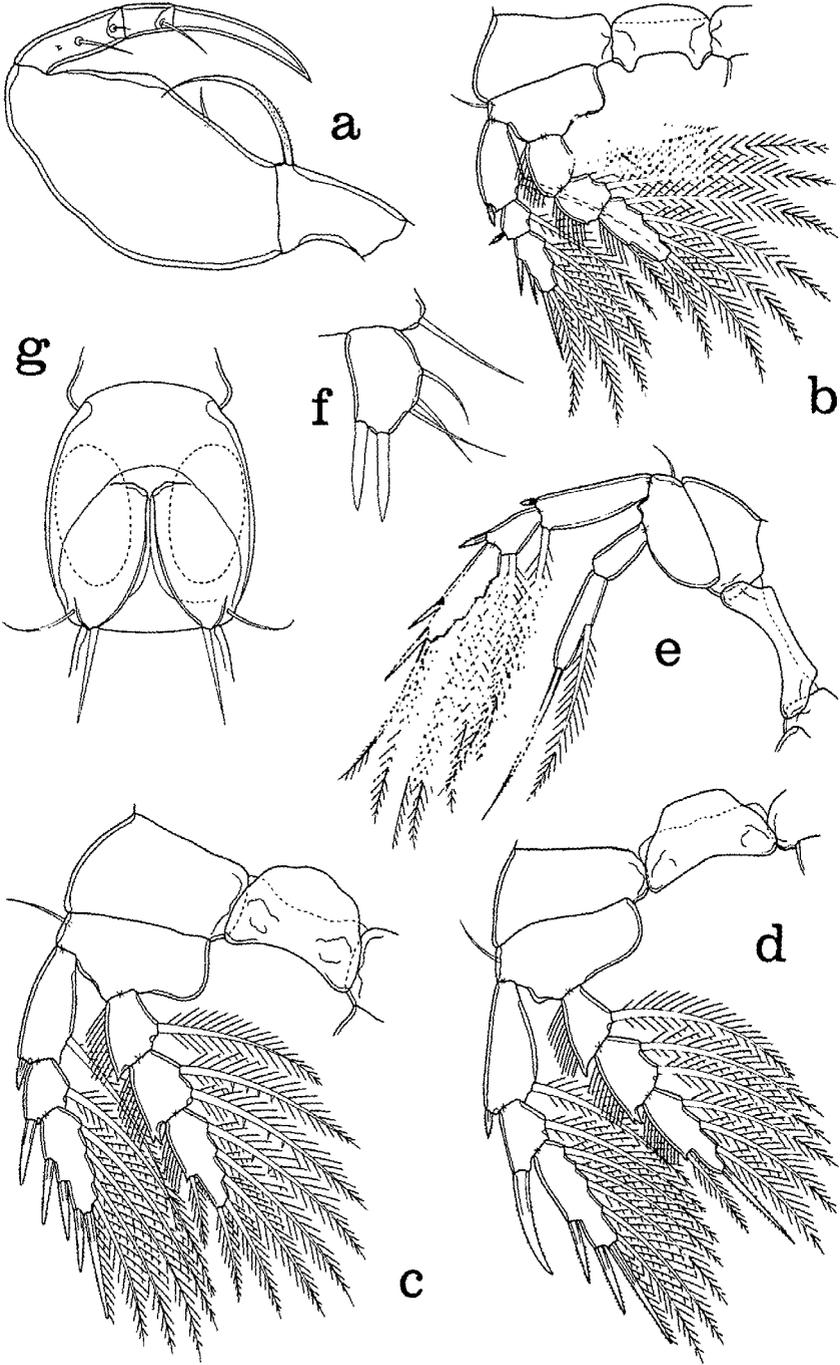


Figure 67. *Ceuthoecetes acanthothrix* new species. Male: a, maxilliped (scale G); b, leg 1 and intercoxal plate, anterior (C); c, leg 2 and intercoxal plate, anterior (C); d, leg 3 and intercoxal plate, anterior (C); e, leg 4 and intercoxal plate, anterior (C); f, leg 5, ventral (E); g, genital segment with leg 6, ventral (G).

Remarks.—The male of *Ceuthoecetes acanthothrix* is distinguished by the erect spinules in leg 2 on the distal side of both setae on the second segment and the proximalmost seta on the third segment.

Ceuthoecetes cristatus new species

Type Material.—The males already deposited in the National Museum of Natural History comprise the holotype (USNM 180376) and 21 paratypes (USNM 180377).

Material Studied.—2,322 ♂♂, in 2,618 m, Clam Acres, East Pacific Rise, 20°50.0'N, 109°06.0'W, 04 May 1982, DSRV ALVIN dive no. 1221; 581 ♂♂, from washings of vestimentiferans and *Calyptogena*, in 2,612 m, Clam Acres, East Pacific Rise, 20°50.0'N, 109°06.0'W, 25 April 1982, DSRV ALVIN dive no. 1219; 317 ♂♂, in 2,616 m, Clam Acres, East Pacific Rise, 20°50.0'N, 109°06.0'W, 10 May 1982, DSRV ALVIN dive no. 1226; 68 ♂♂, in 2,618 m, Clam Acres, East Pacific Rise, 20°50.0'N, 109°06.0'W, 09 May 1982, DSRV ALVIN dive no. 1225; 26 ♂♂, in 2,615 m, East Pacific Rise, 20°50.0'N, 109°06.0'W, 17 April 1982, DSRV ALVIN dive no. 1211; 1,845 ♂♂, in 2,633 m, from washings of vestimentiferans, Clam Acres, East Pacific Rise, 20°50.0'N, 109°06.0'W, 20 April 1982, DSRV ALVIN dive no. 1214; 5 ♂♂, in 2,635 m, Biocyarise, East Pacific Rise, 12°48.6'N, 103°56.7'W, 24 March 1984, DSRV CYANA dive no. 84-42.

Etymology.—The specific name *cristatus*, Latin meaning crested, alludes to the dorsal ridges on the genital and first postgenital segments.

Remarks.—The males described by Humes and Dojiri (1980a, figs. 18–28) as those of *Ceuthoecetes aliger* represent an undescribed species of *Ceuthoecetes* that is here named *Ceuthoecetes cristatus*. Since the description and figures given by Humes and Dojiri adequately point out the important features, another description is not warranted here.

Among the large numbers of males no females were found. This resulted in spite of a very careful search involving individual examination in lactic acid of more than 5,000 specimens under a magnification of $\times 300$.

Ceuthoecetes introversus new species

Figures 68a–h, 69a–f, 70a–d

Type Material.—6 ♂♂, in 2,618 m, Clam Acres, East Pacific Rise, 20°50.0'N, 109°06.0'W, 04 May 1982, DSRV ALVIN dive no. 1221. Holotype and 3 paratypes deposited in the National Museum of Natural History, Smithsonian Institution, Washington, D.C.

Other Specimen.—1 ♂, in 2,451 m, Galapagos Rift, 00°48.0'N, 86°13.0'W, 01 December 1979, DSRV ALVIN dive no. 984.

Male.—Body (Fig. 68a) with broad prosome. Length 1.42 mm (1.10–1.50 mm) and greatest width 0.61 mm (0.50–0.68 mm), based on 6 specimens. Greatest dorsoventral thickness 0.35 mm. Segment bearing leg 1 fused with cephalosome. Epimeral areas of pedigerous segments for most part rounded. Tergum of segment bearing leg 4 with posterior margin having 2 small median lobes. Ratio of length to width of prosome 1.18:1. Ratio of length of prosome to that of urosome 1.18:1.

Segment of leg 5 (Fig. 68b) $86 \times 143 \mu\text{m}$. Genital segment $133 \times 174 \mu\text{m}$, wider than long, dorsoventral thickness $170 \mu\text{m}$ (Fig. 68d). Refractile points on ventral surface. Four postgenital segments from anterior to posterior 117×138 , 117×120 , 83×99 , and $78 \times 91 \mu\text{m}$.

Caudal ramus (Fig. 68c) elongate, $99 \times 27 \mu\text{m}$, ratio 3.67:1. Outer lateral seta $81 \mu\text{m}$, dorsal seta $50 \mu\text{m}$, both smooth. Outermost terminal seta (set subterminally) $114 \mu\text{m}$, innermost terminal seta $210 \mu\text{m}$, and 2 median terminal setae $350 \mu\text{m}$ (outer) and $460 \mu\text{m}$ (inner), all with delicate lateral hairs.

Body surface with few sensilla and refractile points (Fig. 68a).

Rostral area (Fig. 68e) not prominent. First antenna (Fig. 68f) 10-segmented, slightly geniculate, $300 \mu\text{m}$ long. Lengths of segments: 11 ($36 \mu\text{m}$ along anterior

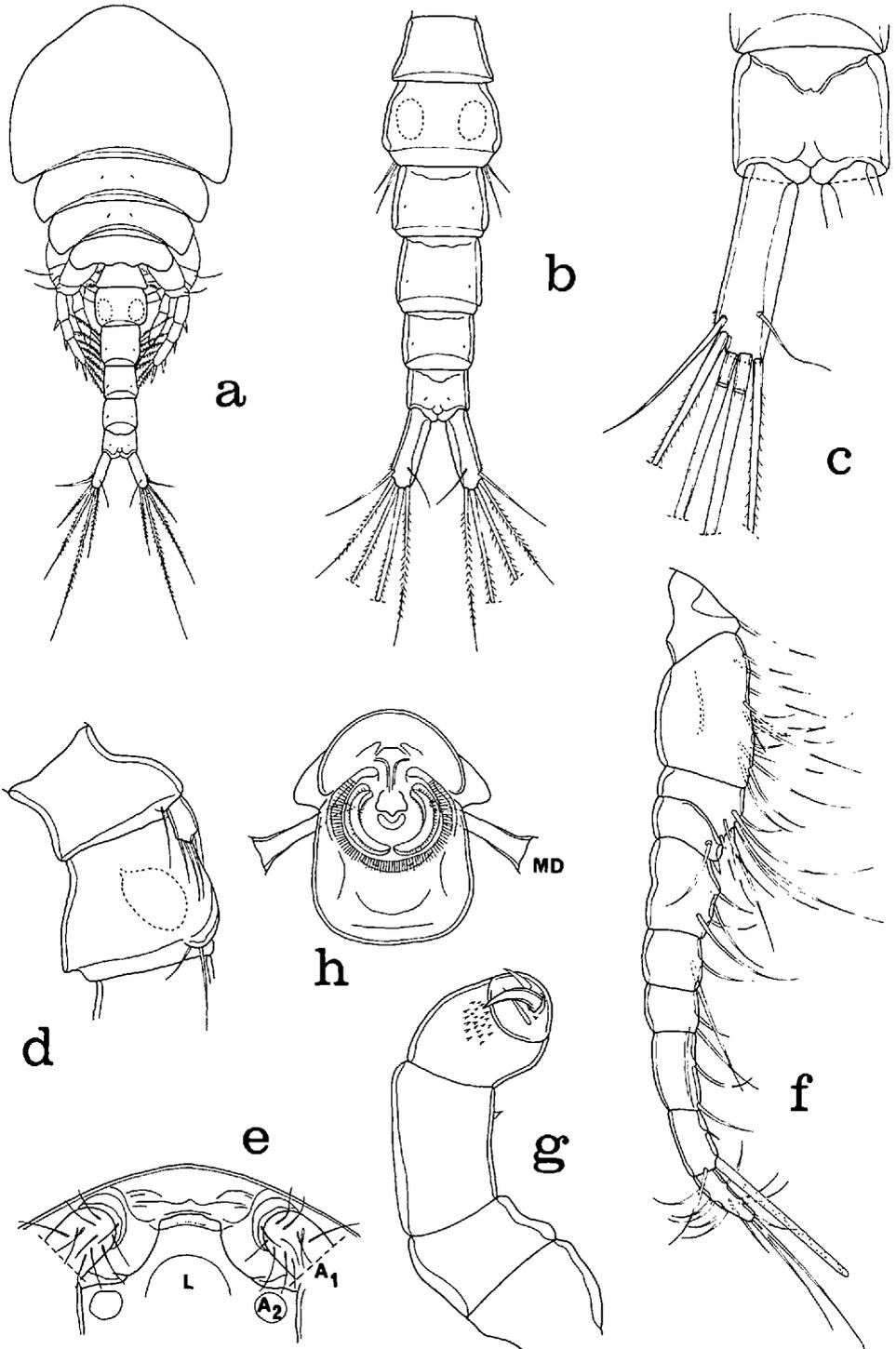


Figure 68. *Ceuthoecetes introversus* new species. Male: a, dorsal (scale A); b, urosome, dorsal (H); c, anal segment and caudal ramus, dorsal (G); d, segment bearing leg 5 and genital segment, lateral (D); e, rostral area, ventral (D); f, first antenna, anterodorsal (G); g, second antenna, antero-inner (F); h, oral cone, with mandibles in position, ventral (G).

margin), 49, 14, 21, 42, 26, 23, 36, 32, and 27 μm , respectively. Armature: 1, 14, 8, 2, 4, 2, 2, 2, 2 + 1 aesthete, and 12. One seta on fourth segment short and spiniform. All setae smooth. Slender longitudinal sclerotized bar on posteroventral surface of second segment. Second antenna (Fig. 68g) 85 μm long, with minute exopod. Endopod 2-segmented, first segment with patch of small spines, second segment with clawlike spine and 3 setae, one of them minute.

Oral cone (Fig. 68h) short, with tip showing outer unclosed ring with setules and 2 semilunar bars with minute spinules. Mandible (Fig. 69a) elongate, 78 μm , distal part slender with slightly expanded tip having row of spinules. First maxilla (Fig. 69b) slender, smaller outer lobe with 3 setae, larger inner lobe with 4 setae. All setae with extremely small spinules. Second maxilla (Fig. 69c) 2-segmented, first segment elongate and unarmed, second segment forming long claw 138 μm , concave margin with angular prominence tipped with minute setule, and having few setules distally. Maxilliped (Fig. 69d) 4-segmented. First segment with long seta minutely barbed. Second segment much swollen and bearing 1 inner smooth seta. Third segment slender with 2 unequal smooth setae and 2 very small spines. Fourth segment little less than one-half length of third, bearing 1 smooth distal seta. Claw stout, 78 μm , without ornamentation.

Legs 1-4 (Figs. 69e, f, 70a, b) with 3-segmented rami, except for 2-segmented endopod in leg 4. Formula for armature as follows:

P_1	coxa 0-0	basis 1-I	exp I-1; I-1; II,I,4
			enp 0-1; 0-2; 1,2,3
P_2	coxa 0-0	basis 1-0	exp I-1; I-1; II,II,4
			enp 0-1; 0-2; I,II,3
P_3	coxa 0-0	basis 1-0	exp I-1; I-1; I,II,5
			enp 0-1; 0-2; 1,I,3
P_4	coxa 0-0	basis 1-0	exp I-1; I-1; I,II,4
			enp 0-0; I,1

Basis of leg 1 with finely barbed inner spine 52 μm . Third segment of exopod of leg 1 with proximal outer spine directed inward (Fig. 69e), instead of outward as in other species. Spines on exopods of legs 2 and 3 much stouter than those in legs 1 and 4, and very minutely barbed; exopod spines of leg 3 from proximal to distal being 23, 34, 42, 47, and 78 μm long. Leg 4 with exopod 208 μm . Endopod with first segment 44 \times 31 μm ; second segment 70 \times 26 μm (greatest width) with outer marginal hairs, terminal finely barbed spine 147 μm , and inner plumose seta 161 μm .

Leg 5 (Figs. 68d, 70c) situated ventrally. Free segment 36 \times 31 μm , without fine ornamentation; bearing 5 smooth setae, 2 inner broad hyaline setae 34 μm long, and 3 slender outer setae from inner to outer 65, 44, and 36 μm . Adjacent seta (dorsal) 70 μm .

Leg 6 (Figs. 68d, 70d) usual posteroventral flap on genital segment bearing 2 smooth setae 67 μm and 52 μm .

Extruded spermatophore not seen.

Color of living specimens unknown.

Female.—Unknown.

Etymology.—The specific name *introversus*, Latin meaning toward the inside or inward, alludes to the inwardly directed seta on the exopod of leg 1.

Remarks.—Features useful in the separation of *Ceuthoecetes introversus* from its congeners are: (1) the proximal outer spine on the third segment of the exopod of leg 1 directed inward rather than outward, (2) the stout outer spines on the

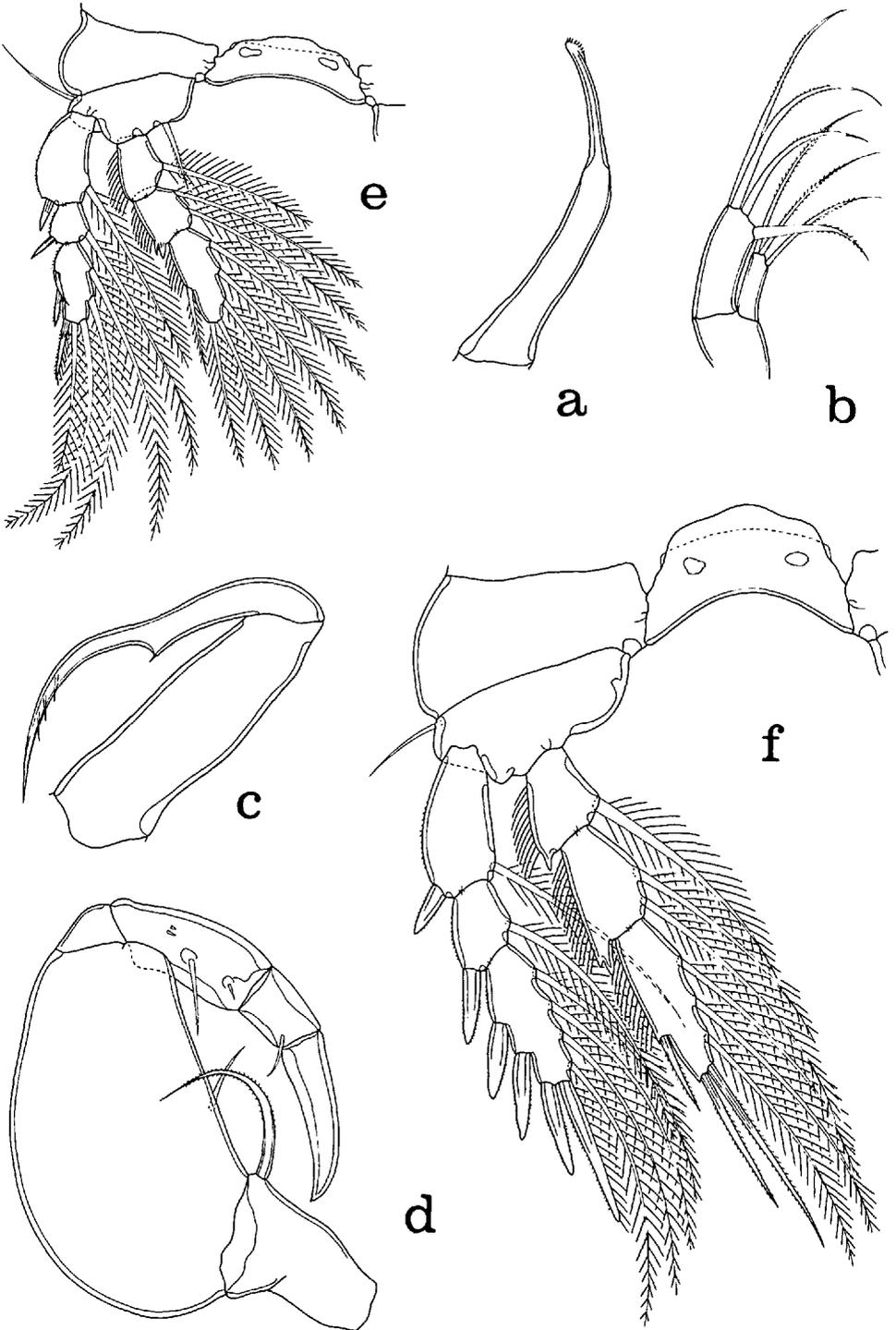


Figure 69. *Ceuthoecetes introversus* new species. Male: a, mandible, ventral (scale F); b, first maxilla, posterior (E); c, second maxilla, posterior (E); d, maxilliped, inner (G); e, leg 1 and intercoxal plate, anterior (C); f, leg 2 and intercoxal plate, anterior (C).

exopod of legs 2 and 3, and (3) the outer spine on the second segment of the exopod of leg 2 not elongate and nearly equal in length to the next distal spine.

A comparison of selected features of males of the genus *Ceuthoecetes* may be made as follows:

Character	Species		
	<i>C. acanthothrix</i>	<i>C. cristatus</i>	<i>C. introversus</i>
Length of spine on second segment of P ₃ Exp	75 μm	103 μm	34 μm
Armature of third segment of P ₂ Enp	1,2,3	1,2,3	I,II,3
Erect spinules on certain setae of P ₁ Enp	present	absent	absent
Proximalmost spine on third segment of P ₁ Exp	directed outward	directed outward	directed inward
Outer spines on P ₂ and P ₃ exp	tapered	tapered	stout
Inner spine on P ₁ basis	73 μm	78 μm	52 μm

Nilva new genus

Diagnosis.—Body unmodified. Segment bearing leg 1 fused with cephalosome. Urosome in female 5-segmented, in male 6-segmented (but last 2 postgenital segments indistinctly separated). Genital segment with dorsal hump. Caudal ramus with 6 setae.

Rostrum weakly defined. First antenna 10-segmented, similar in 2 sexes, with aesthete on penultimate segment. Second antenna short, terminally with 1 strongly flexed claw and 2 small setae. Oral cone short, no true siphon. Mandible elongate, slender, without palp. First maxilla with outer lobe having 3 setae, inner lobe with 4 setae. Second maxilla with basal segment bearing long clawlike element consisting of proximal stouter portion separated by constriction from long setiform portion. Maxilliped 5-segmented including claw.

Legs 1–4 biramous with 3-segmented rami, except 2-segmented endopod in leg 4. Coxae in all 4 legs lacking inner seta. Basis of leg 1 with inner setiform spine. Endopods of legs 1–3 with second segment having 2 inner setae. Leg 3 with formula for third segment of endopod 1,I,3. Endopod of leg 4 armed as 0-0; I,1.

Leg 5 in female with 1 + 3 setae, both segments fused into single segment; in male, with free segment armed with 2 + 3 setae and adjacent dorsal seta on body.

Leg 6 not represented by seta.

Type-species.—*Nilva torifera* new species.

Gender.—Feminine.

Etymology.—The generic name is an anagram of ALVIN, the name of the deep-sea research vessel by means of which the specimens were collected.

Nilva torifera new species Figures 71a–i, 72a–g, 73a–f

Type Material.—30 ♀♀, 206 ♂♂, from washings of vestimentiferans and the bivalve *Calyptogena*, in 2,618 m, Clam Acres, East Pacific Rise, 20°50.0'N, 109°06.0'W, 04 May 1982, DSRV ALVIN dive no.

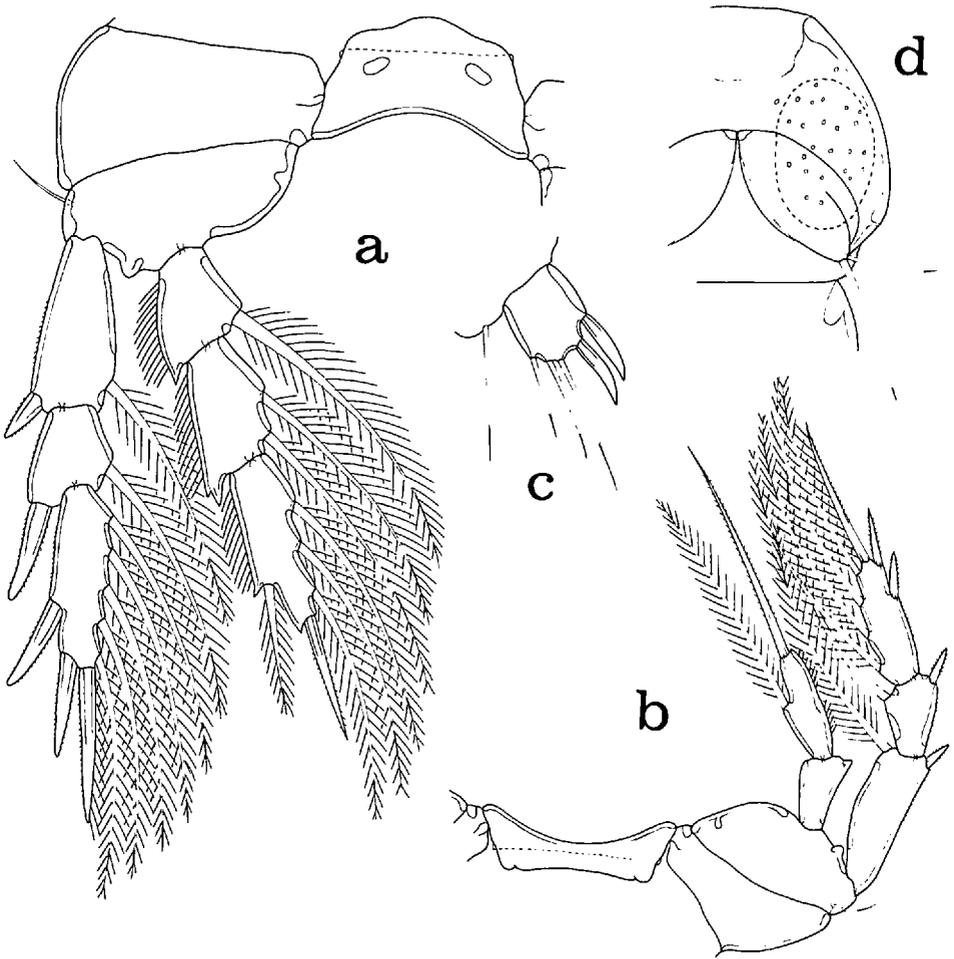


Figure 70. *Ceuthoecetes introversus* new species. Male: a, leg 3 and intercoxal plate, anterior (scale C); b, leg 4 and intercoxal plate, anterior (C); c, leg 5, ventral (G); d, leg 6, ventral (G).

1221. Holotype ♀, allotype, and 228 paratypes (25 ♀♀, 203 ♂♂) deposited in the National Museum of Natural History, Smithsonian Institution, Washington, D.C.

Other Specimens.—9 ♀♀, 86 ♂♂, in washings of vestimentiferans and *Calyptogena*, in 2,612 m, Clam Acres, East Pacific Rise, 20°50.0'N, 109°06.0'W, 25 April 1982, DSRV ALVIN dive no. 1219; 2 ♀♀, 7 ♂♂, in 2,635 m, location Parigo, Biocyarise, East Pacific Rise, 12°48.6'N, 103°56.7'W, 24 March 1984, DSRV CYANA dive no. 84-42; 1 ♂, in 2,630 m, location Parigo, East Pacific Rise, 12°46.6'N, 103°56.7'W, 14 March 1984, DSRV CYANA dive no. 84-37; 8 ♂♂, same data; 4 ♀♀, 36 ♂♂, in 2,616 m, Clam Acres, East Pacific Rise, 20°50.0'N, 109°06.0'W, 10 May 1982, DSRV ALVIN dive no. 1226; 2 ♀♀, in 2,490 m, Galapagos Rift, 00°48.0'N, 86°09.0'W, 08 December 1979, DSRV ALVIN dive no. 991; 3 ♂♂, in 2,618 m, Clam Acres, East Pacific Rise, 20°50.0'N, 109°06.0'W, 09 May 1982, DSRV ALVIN dive no. 1225; 1 ♂, in 2,447 m, Galapagos Rift, 00°48.9'N, 86°13.3'W, 15 February 1979, DSRV ALVIN dive no. 890; 3 ♀♀, 2 ♂♂, in 2,451 m, Galapagos Rift, 00°48.0'N, 86°13.0'W, 07 December 1979, DSRV ALVIN dive no. 990.

Female.—Body (Fig. 71a) slightly modified, with broad prosome and slender urosome. Length 0.79 mm (0.67–0.88 mm) and greatest width 0.29 mm (0.25–0.34 mm), based on 10 specimens. Greatest dorsoventral thickness 0.19 mm. Segment bearing leg 1 fused with cephalosome. Epimeral areas of pedigerous

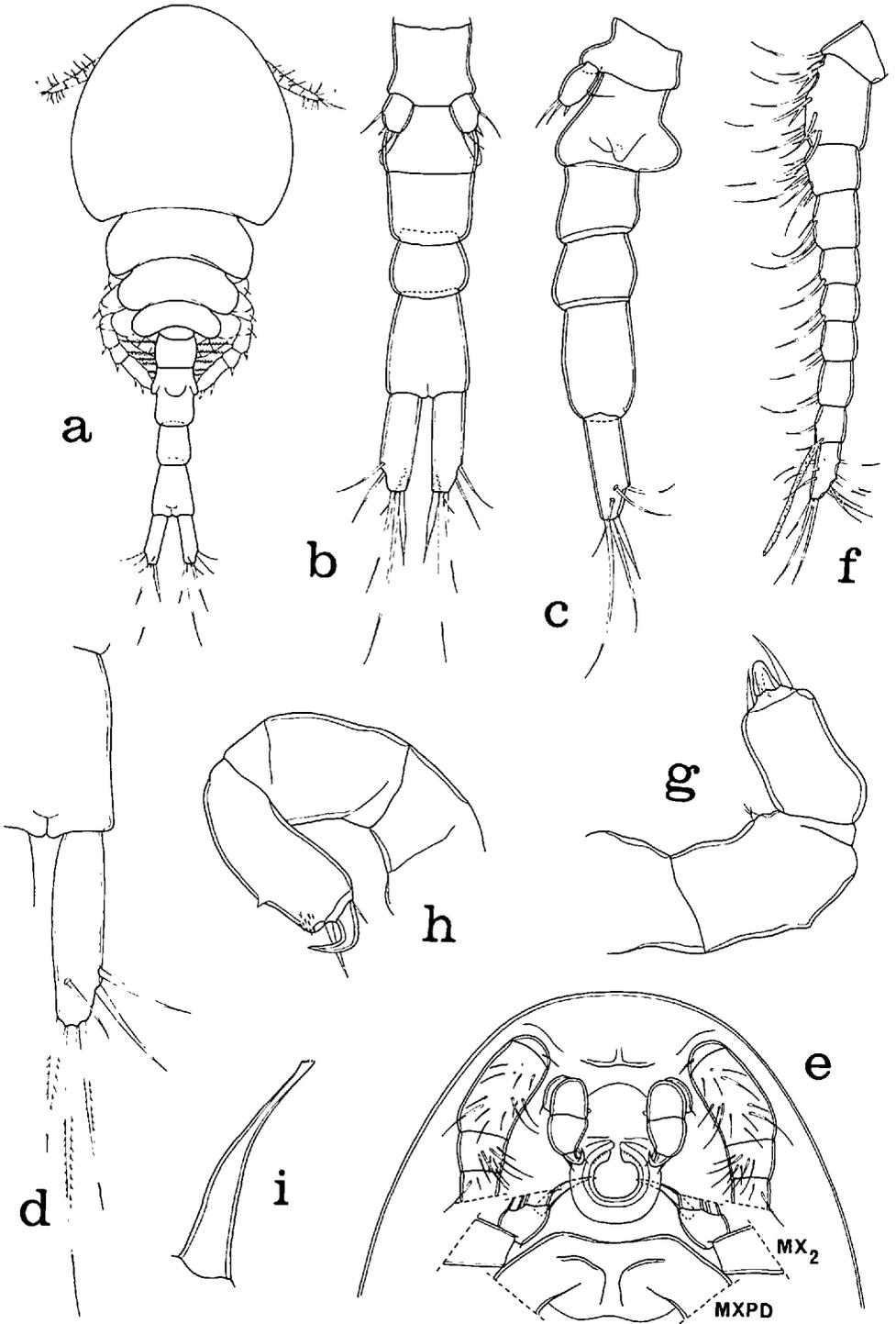


Figure 71. *Nilva torifera* new genus, new species. Female: a, dorsal (scale H); b, urosome, ventral (C); c, urosome, lateral (C); d, caudal ramus, dorsal (G); e, cephalosome, showing rostral area and oral cone, ventral (G); f, first antenna, antero-outer (G); g, second antenna, antero-outer (F); h, second antenna, postero-inner (F); i, mandible, anterior (F).

segments rounded. Ratio of length to width of prosome 1.48:1. Ratio of length of prosome to that of urosome 1.46:1.

Segment bearing leg 5 (Fig. 71b) $57 \times 62 \mu\text{m}$. Genital segment $57 \times 73 \mu\text{m}$ in dorsal view, $65 \times 91 \mu\text{m}$ in lateral view (Fig. 71c) with conspicuous dorsal hump and 2 lateral protrusions. Three postgenital segments from anterior to posterior 47×60 , 47×57 , and $78 \times 61 \mu\text{m}$.

Caudal ramus (Fig. 71d) elongate, $91 \times 26 \mu\text{m}$, ratio 3.5:1. Outer lateral seta $47 \mu\text{m}$, dorsal seta $34 \mu\text{m}$, and outermost terminal seta (here displaced subterminally) $52 \mu\text{m}$; all these setae smooth. Innermost terminal seta $70 \mu\text{m}$, slightly swollen proximally, with very delicate lateral spinules. Two long median terminal setae $170 \mu\text{m}$ (inner) and $114 \mu\text{m}$ (outer), both with short weak lateral spinules.

Body surface smooth without apparent sensilla.

Egg sac not seen.

Rostral area (Fig. 71e) not defined. First antenna (Fig. 71f) $233 \mu\text{m}$ long, not including setae. Lengths of its 10 segments: 6 ($24 \mu\text{m}$ along anterior margin), 34, 21, 29, 19, 19, 19, 21, 15.5, and $26 \mu\text{m}$, respectively. Armature: 1, 12, 8, 4, 2, 2, 2, 2, + 1 aesthete, and 12. All setae smooth.

Second antenna (Fig. 71g, h) short, as in Fig. 74e, bent, estimated length $120 \mu\text{m}$. Both segments of protopod unarmed. Exopod minute, $2 \mu\text{m}$ long, with 3 very small setae. Endopod probably 2-segmented, with small first segment bearing outer spiniform process and patch of small spines distally; small second segment with terminal armature consisting of 1 strongly flexed claw $16 \mu\text{m}$ and 2 setae.

Oral cone (not true siphon) short, with terminal sclerified interrupted ring having minute teeth anteriorly (Fig. 71e). Mandible (Fig. 71i) $56 \mu\text{m}$ long, with distal half slender and having few terminal extremely minute spinules. First maxilla (Fig. 72a) with slender outer lobe bearing 3 smooth setae and larger rectangular inner lobe with 4 setae, 3 smooth and 1 with few obscure hairs. Second maxilla (Fig. 72b) with smooth basal segment bearing long claw composed of proximal stouter portion (segment ?) having few distal inner spinules followed by constriction and then setiform portion bearing few distal hairs. Maxilliped (Fig. 72c) 5-segmented with last segment forming claw. First segment with long distal inner seta. Long second segment with inner marginal seta. Third and fourth segments with 1 seta. Claw with short spinules near tip.

Legs 1-4 (Fig. 72d-g) biramous with 3-segmented rami, except for 2-segmented endopod in leg 4. Spine and setal formula as follows:

P_1	coxa	0-0	basis	1-I	exp	I-1; I-1; II,I,4
					enp	0-1; 0-2; 1,2,3
P_2	coxa	0-0	basis	1-0	exp	I-1; I-1; III,I,4
					enp	0-1; 0-2; 1,2,3
P_3	coxa	0-0	basis	1-0	exp	I-1; I-1; II,I,5
					enp	0-1; 0-2; 1,I,3
P_4	coxa	0-0	basis	1-0	exp	I-1; I-1; II,I,4
					enp	0-0; I,1

Coxae in all 4 legs unarmed. Basis in leg 1 with inner weakly barbed setiform spine $36 \mu\text{m}$ long. Leg 3 with outer seta on second segment of exopod $21 \mu\text{m}$ long. Leg 4 with exopod $160 \mu\text{m}$ long. Endopod with unarmed first segment $37 \times 23 \mu\text{m}$. Second segment $55 \times 19 \mu\text{m}$ with terminal barbed spine $65 \mu\text{m}$, and inner plumose seta $68 \mu\text{m}$.

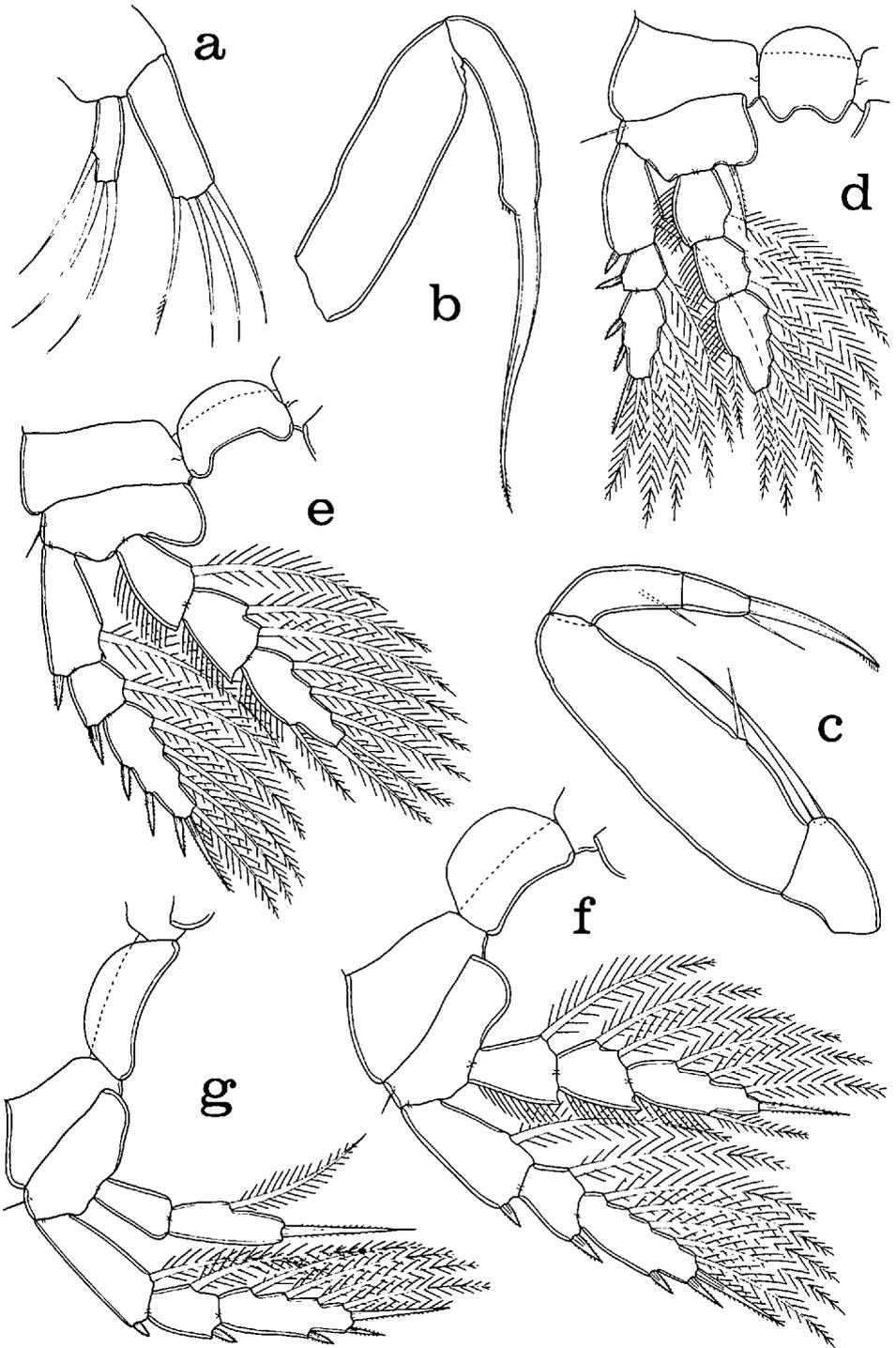


Figure 72. *Nilva torifera* new genus, new species. Female: a, first maxilla, anterior (scale F); b, second maxilla, anterior (F); c, maxilliped, anterior (E); d, leg 1 and intercoxal plate, anterior (G); e, leg 2 and intercoxal plate, anterior (G); f, leg 3 and intercoxal plate, anterior (G); g, leg 4 and intercoxal plate, anterior (G).

Leg 5 (Fig. 73a) $33 \times 33 \mu\text{m}$, with 4 smooth setae from outer to inner 29, 11, 19, and $22 \mu\text{m}$.

Leg 6 not represented by seta.

Color of living specimens unknown.

Male.—Body (Fig. 73b) with prosome more slender than in female. Length 0.84 mm (0.79–0.96 mm) and greatest width 0.33 mm (0.30–0.34 mm), based on 10 specimens. Greatest dorsoventral thickness 0.22 mm. Ratio of length to width of prosome 1.83:1. Ratio of length of prosome to that of urosome 1.38:1.

Segment bearing leg 5 (Fig. 73c) $65 \times 96 \mu\text{m}$, protruding ventrally (Fig. 73d). Genital segment $47 \times 73 \mu\text{m}$, with dorsal hump as in female. Four postgenital segments from anterior to posterior 70×63 , 75×70 , and $88 \times 73 \mu\text{m}$ (2 indistinctly separated segments both $44 \mu\text{m}$ long).

Caudal ramus like that of female but shorter, $83 \times 26 \mu\text{m}$, ratio 3.19:1.

Body surface, rostral area, first antenna, second antenna, oral cone, and mouthparts as in female.

Legs 1, 2, and 4 as in female. Leg 2 similar to that of female but outer spine on second segment of exopod much larger, $44 \mu\text{m}$ long (Fig. 73e).

Leg 5 (Fig. 73f) situated ventrally. Free segment approximately $36 \times 36 \mu\text{m}$, bearing from inner to outer 2 stout hyaline spiniform elements $19 \mu\text{m}$, 1 slender seta $33 \mu\text{m}$, and 2 shorter setae about $12 \mu\text{m}$. Dorsal outer seta adjacent to free segment $35 \mu\text{m}$. All setae smooth. Ventral surface of free segment with 2 or 3 crescentic sclerotizations.

Leg 6 (Fig. 73f) protruding ventrally and armed with 2 unequal smooth setae $21 \mu\text{m}$ and approximately $10 \mu\text{m}$ in length.

Spermatophore unknown.

Color of living specimens unknown.

Etymology.—The specific name is a combination of the Latin words *torus*, a hump, and *fero*, to bear, referring to the dorsal hump on the genital segment in both sexes.

Remarks.—The general body form of *Nilva torifera* is obviously different from that in other genera of the Dirivultidae. However, several features suggest the inclusion of *Nilva* with the Dirivultidae: (1) the first antenna with an aesthete on the penultimate segment, (2) the second antenna with a minute exopod, (3) the terminally serrate slender blade of the mandible without a palp, (4) legs 1–3 with 3-segmented rami, and (5) leg 4 with the exopod 3-segmented and the endopod 2-segmented. Without better understanding of the significance of differences among the dirivultid genera when compared with *Nilva*, it seems prudent to place this new genus in the Dirivultidae for the time being.

Ecbathyriontidae new family

Diagnosis.—Body unmodified. Urosome in female 4-segmented, in male 5-segmented. Caudal ramus with 6 setae. First antenna 18-segmented in female with aesthete on segment 15, in male 17-segmented with aesthete on segment 15. Second antenna with 1-segmented exopod. Short oral cone. Mandible slender blade with serrate tip and lacking palp. First maxilla bilobed. Second maxilla with large seta on first segment. Maxilliped with slender claw.

Legs 1–4 biramous with 3-segmented rami. Basis of leg 1 without inner spine or seta. Endopods of all 4 legs with second segment having 2 inner setae and exopods with third segment armed with 4,4,4,3 setae. Endopod of leg 4 with 0-1; 0-2; 1,1,2. Leg 5 with ovoid free segment bearing 3 setae in female, 5 setae in male.

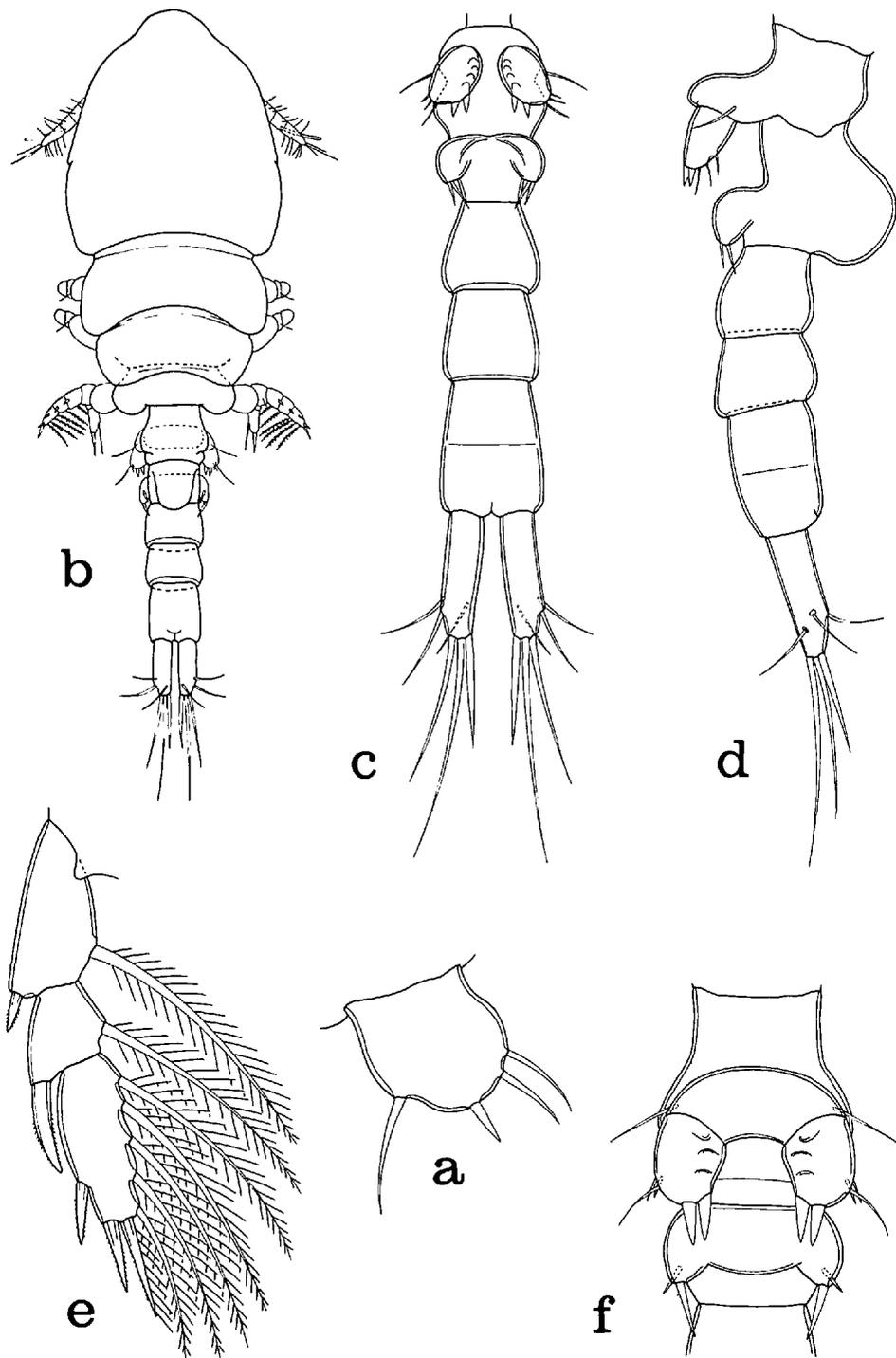


Figure 73. *Nilva torifera* new genus, new species. Female: a, leg 5, ventral (scale F). Male: b, dorsal (H); c, urosome, ventral (C); d, urosome, lateral (C); e, exopod of leg 3, anterior (G); f, leg 5 and leg 6, ventral (G).

Ecbathyrion new genus

Diagnosis.—Body unmodified. Segment bearing leg 1 fused with cephalosome. Urosome in female 4-segmented, in male 5-segmented. Caudal ramus with 6 setae.

Rostrum small and inconspicuous. First antenna 18-segmented in female, with aesthete on segment 15; in male 17-segmented, with aesthete on segment 15. Second antenna with 1-segmented exopod and 2-segmented endopod. Oral cone short, no true siphon. Mandible elongate blade without palp. First maxilla with outer lobe bearing 3 setae and inner lobe having 4 setae. Second maxilla with basal segment bearing claw and 1 seta. Maxilliped 5-segmented with long slender claw.

Legs 1–4 biramous with 3-segmented rami. Coxa of legs 1–3 lacking inner seta, but seta present in leg 4. Basis of leg 1 without inner spine. Exopods of legs 1–4 with third segment having inner setae arranged as 4,4,4,3. Endopods of legs 1–4 with second segment having 2 inner setae. Endopod of leg 4 with formula 0-1; 0-2; 1,I,2. No sexual dimorphism in armature of legs.

Leg 5 with first segment fused with body and bearing 1 seta; second segment in female bearing 3 setae, in male 3 slender outer setae and 2 stout inner setae. In both sexes leg 5 placed ventrally.

Leg 6 represented in female by 1 seta, in male by 2 setae.

Type-species.—*Ecbathyrion prolixicauda* new species.

Gender.—Neuter.

Etymology.—The generic name is a combination of the Greek words *ek*, meaning out of or from, and *bathus*, meaning deep, plus the diminutive *-ion*.

Ecbathyrion prolixicauda new species

Figures 74a–j, 75a–e, 76a–g

Type Material.—110 ♀♀, 15 ♂♂, in 2,457 m, Galapagos Rift, 00°48.0'N, 86°13.0'W, 30 November 1979, DSRV ALVIN dive no. 983. Holotype ♀, allotype, and 116 paratypes (104 ♀♀, 12 ♂♂) deposited in the National Museum of Natural History, Smithsonian Institution, Washington, D.C.

Other Specimens.—36 ♀♀, 3 ♂♂, in 2,493 m, Galapagos Rift, 00°47.0'N, 86°08.0'W, 24 January 1979, DSRV ALVIN dive no. 883; 22 ♀♀, in 2,482 m, Galapagos Rift, 00°47.9'N, 86°09.3'W, 20 February 1979, DSRV ALVIN dive no. 895; 1 ♀, in 2,490 m, Galapagos Rift, 00°48.0'N, 86°09.0'W, 08 December 1979, DSRV ALVIN dive no. 991; 12 ♀♀, 3 ♂♂, in 2,451 m, Galapagos Rift, 00°48.0'N, 86°13.0'W, 01 December 1979, DSRV ALVIN dive no. 984; 16 ♀♀, 3 ♂♂, in 2,451 m, Galapagos Rift, 00°48.0'N, 86°13.0'W, 07 December 1979, DSRV ALVIN dive no. 990.

Female.—Body (Fig. 74a) unmodified. Length 1.06 mm (1.01–1.11 mm) and greatest width 0.32 mm (0.31–0.33 mm), based on 10 specimens. Greatest dorsoventral thickness 0.21 mm. Segment bearing leg 1 fused with cephalosome and having slightly pointed epimera. Epimeral areas of segments bearing legs 3 and 4 rounded posteriorly. Ratio of length to width of prosome 1.37:1. Ratio of length of prosome to that of urosome 0.88:1.

Segment bearing leg 5 (Fig. 74b) $44 \times 89 \mu\text{m}$. Genital segment $125 \times 133 \mu\text{m}$, slightly longer than wide, with lateral aliform pointed expansions in anterior half; width of segment in posterior half $64 \mu\text{m}$. Genital areas located dorsolaterally on posterior part of pointed lateral expansions. Each area (Fig. 74c) bearing 1 small seta. Two postgenital segments from anterior to posterior $47 \times 55 \mu\text{m}$ and $68 \times 44 \mu\text{m}$ (width taken at middle). Posterior half of anal segment with small spinules along outer margin (Fig. 74d).

Caudal ramus (Fig. 74d) very long and slender, $275 \times 10.5 \mu\text{m}$, ratio of length to width 26:1. Six setae. Outer lateral subterminal seta $72 \mu\text{m}$, dorsal seta $61 \mu\text{m}$, outermost terminal seta $44 \mu\text{m}$, and innermost terminal seta $30 \mu\text{m}$, all smooth.

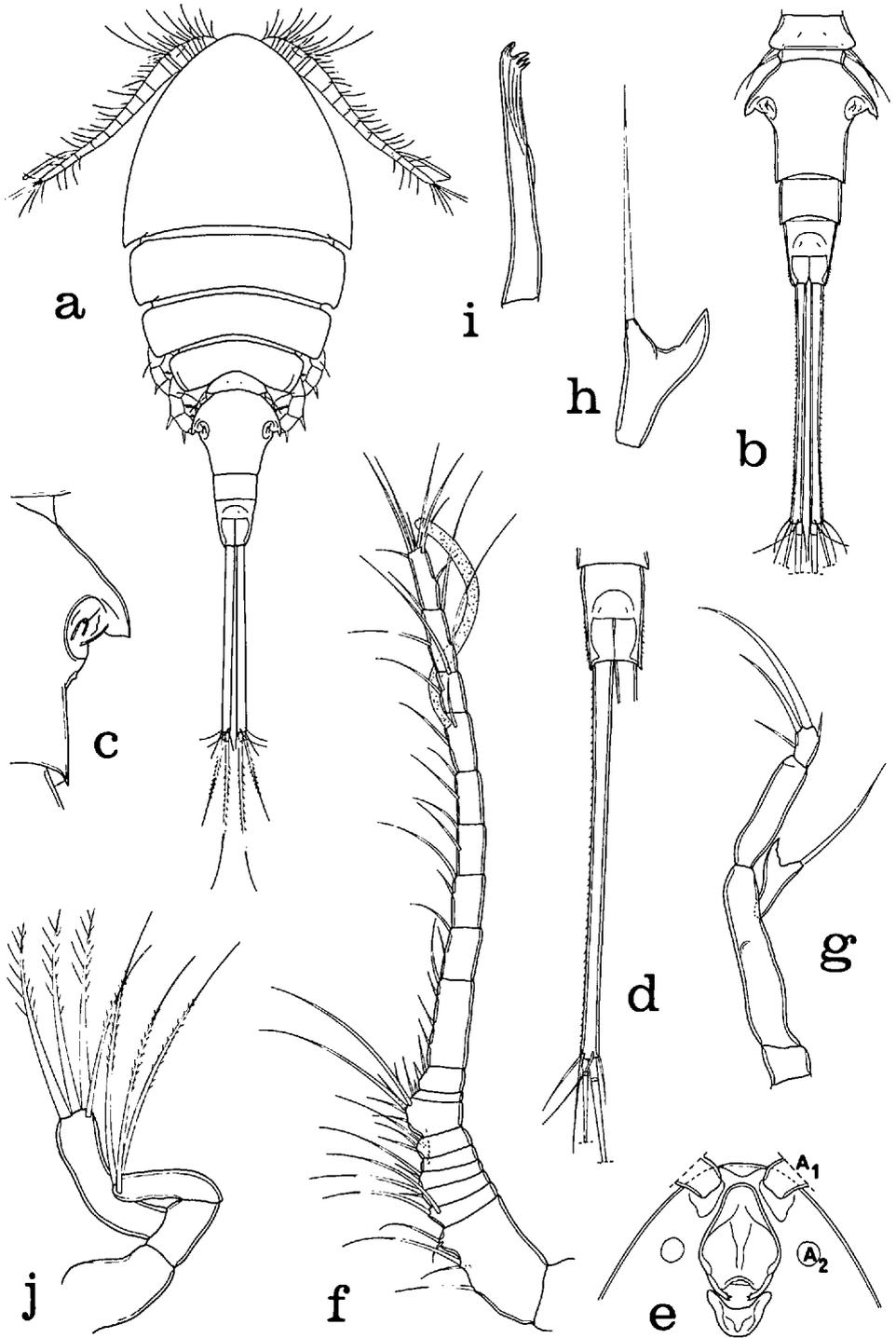


Figure 74. *Ecbathyrion prolixicauda* new genus, new species. Female: a, dorsal (scale H); b, urosome, dorsal (D); c, genital area, dorsal (G); d, caudal ramus, dorsal (C); e, rostrum and oral cone, ventral (D); f, first antenna, ventral (G); g, second antenna, anterior (G); h, exopod of second antenna, posterior (F); i, mandible, anterior (E); j, first maxilla, anterior (E).

Two long median terminal setae 130 μm (outer) and 240 μm (inner), both with minute lateral hairs along midregion. Outer margin of ramus with row of small spinules.

Rostrum (Fig. 74e) small and broadly but shallowly rounded posteriorly. First antenna (Fig. 74f) 380 μm long, not including setae. Lengths of its 18 segments: 42 (61 μm along anterior margin), 7.5, 7, 5.5, 6, 10, 12, 5, 10, 44, 25, 25, 24, 25, 27.5, 21, 28.5, and 30 μm , respectively. Armature: 5, 2, 2, 2, 1, 3, 6, 2, 2, 4, 2, 2, 2, 2 + 1 aesthete, 4, and 8. All setae smooth. Aesthete on segment 80 μm long and stout, reaching beyond tip of antenna. One seta on segments 8 and 9 short and spiniform.

Second antenna (Fig. 74g) 230 μm long including long clawlike seta. Protopod 2-segmented, with long slender second segment bearing exopod $34 \times 18 \mu\text{m}$ with prominent flaring pointed projection on distal side (Fig. 74h) and carrying 1 smooth seta 65 μm . Endopod 2-segmented, first segment long and slender without ornamentation, second segment short with 1 outer and 1 inner short seta and 2 long unequal smooth slightly clawlike terminal setae.

Oral cone (not true siphon) short, in ventral view (Fig. 74e) showing tips of mandibles between labrum and labium. Mandible (Fig. 74i) slender, 92 μm , with 4 small terminal teeth. First maxilla (Fig. 74j) with slender lobes, outer lobe bearing 3 setae, inner lobe having 4 setae. Second maxilla (Fig. 75a) with smooth basal segment having hump on inner margin; bearing long sinuous claw with unilateral long setules and adjacent long seta with few prominent long setules. Maxilliped (Fig. 75b) slender and 5-segmented. First segment with 1 seta. Elongate second segment with 1 seta. Short third segment unarmed. Both short fourth segment and long fifth segment with 1 seta. Long slender slightly recurved smooth terminal claw.

Legs 1–4 (Figs. 75c–e, 76a) biramous with 3-segmented rami. Spine and setal formula as follows:

P_1	coxa	0-0	basis	1-0	exp	I-1; I-1; II,I,4
					enp	0-1; 0-2; 1,2,3
P_2	coxa	0-0	basis	1-0	exp	I-1; I-1; III,I,4
					enp	0-1; 0-2; 1,2,3
P_3	coxa	0-0	basis	1-0	exp	I-1; I-1; III,I,4
					enp	0-1; 0-2; 1,2,3
P_4	coxa	0-1	basis	1-0	exp	I-1; I-1; II,II,3
					enp	0-1; 0-2; 1,I,2

Coxa of legs 1–3 lacking inner seta, but coxa of leg 4 having pinnate seta (Fig. 76a). Basis of legs 1–3 with outer seta of medium length but basis of leg 4 having unusually long outer seta (Fig. 76a). Legs 1–4 with number of inner setae on third segment of exopod 4,4,4,3.

Leg 5 (Fig. 76b) with first segment fused with body and bearing 1 outer seta 55 μm . Second segment suboval, $26 \times 22 \mu\text{m}$, bearing 1 outer seta 65 μm and 2 widely spaced terminal setae 44 μm (inner) and 34 μm (outer). All setae apparently smooth. Two extremely small spinules near insertion of outer terminal seta. Entire leg 5 placed ventrally and largely hidden from sight in dorsal view (Fig. 74a).

Leg 6 probably represented by seta on genital area (Fig. 74c).

Color of living specimens unknown.

Male. — Body (Fig. 76c) more slender than in female. Length 0.81 mm (0.77–0.84 mm) and greatest width 0.21 mm (0.20–0.22 mm), based on 10 specimens. Greatest dorsoventral thickness 0.17 mm. Ratio of length to width of prosome 1.92:1. Ratio of length of prosome to that of urosome 0.92:1.

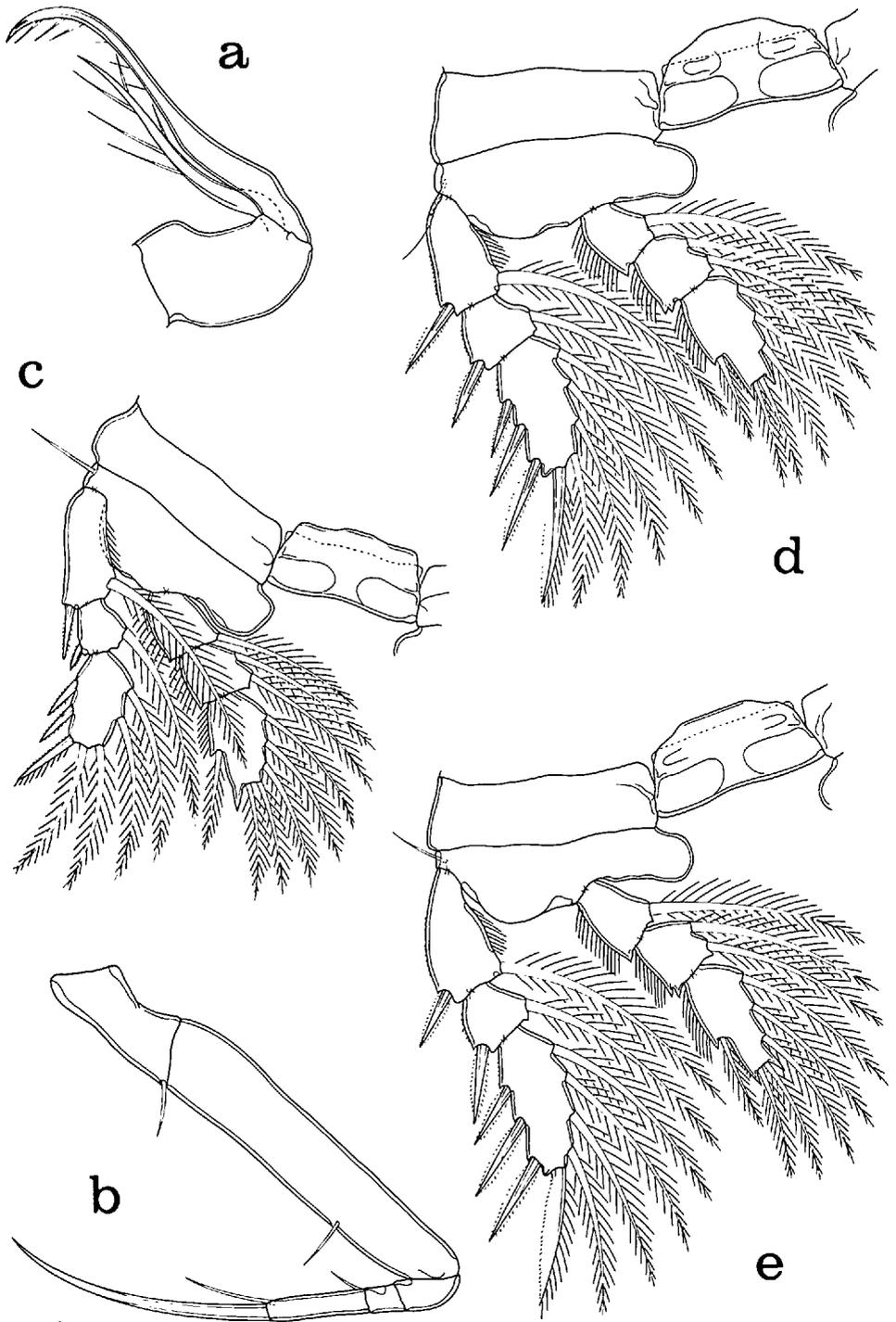


Figure 75. *Ecbathyrion prolixicauda* new genus, new species. Female: a, second maxilla, anterior (scale E); b, maxilliped, anterior (E); c, leg 1 and intercoxal plate, posterior (G); d, leg 2 and intercoxal plate, anterior (G); e, leg 3 and intercoxal plate, anterior (G).

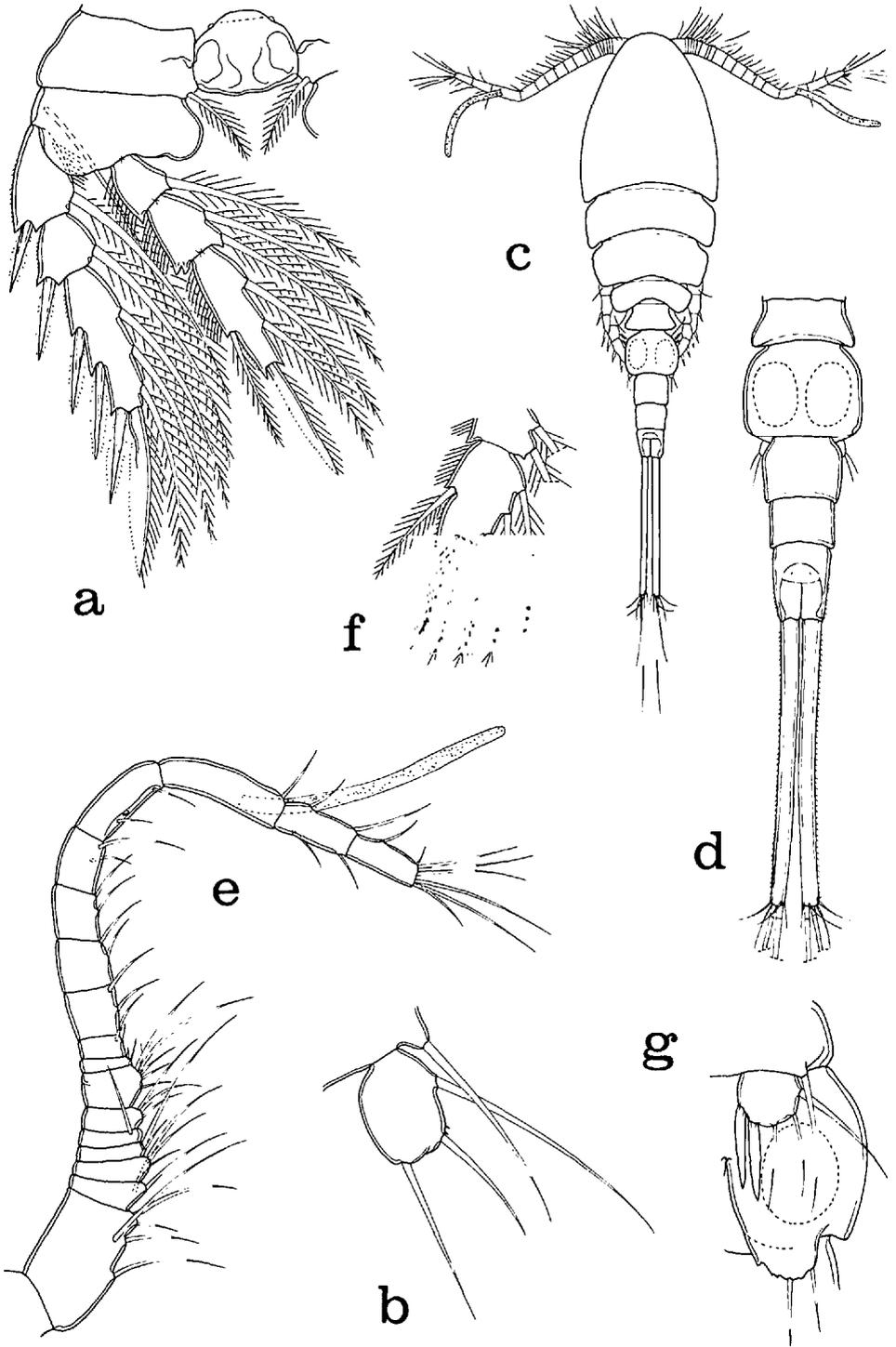


Figure 76. *Ecbathyron prolixicauda* new genus, new species. Female: a, leg 4 and intercoxal plate, anterior (scale G); b, leg 5, ventral (E). Male: c, dorsal (H); d, urosome, dorsal (C); e, first antenna, ventral (E); f, third segment of endopod of leg 1, anterior (E); g, leg 5 and leg 6, ventral (E).

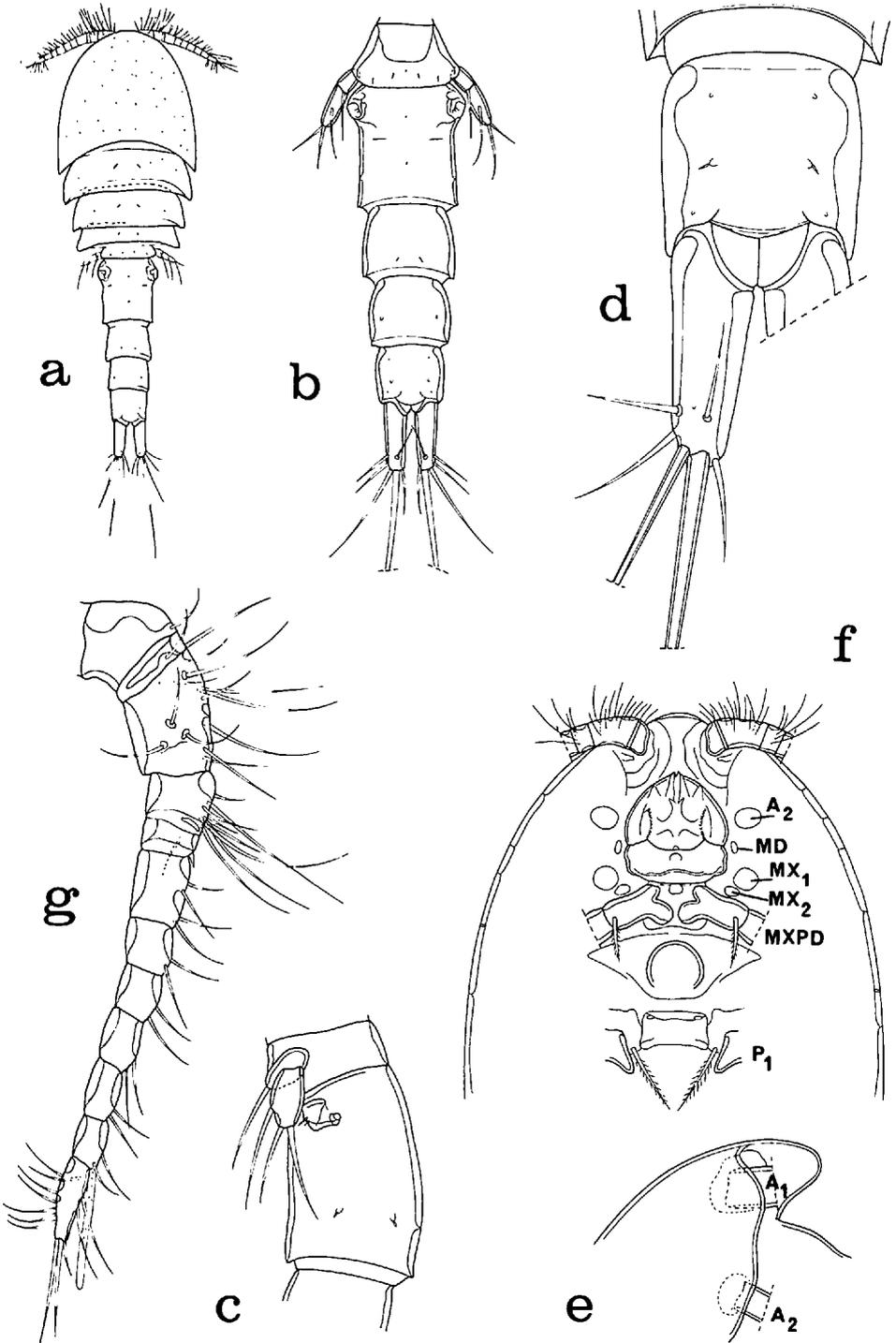


Figure 77. *Fissuricola caritus* new genus, new species. Female: a, dorsal (scale A); b, urosome, dorsal (H); c, segment bearing leg 5 and genital segment, lateral (D); d, anal segment and caudal ramus, dorsal (G); e, rostrum, lateral (C); f, cephalosome, ventral (D); g, first antenna, anterodorsal (G).

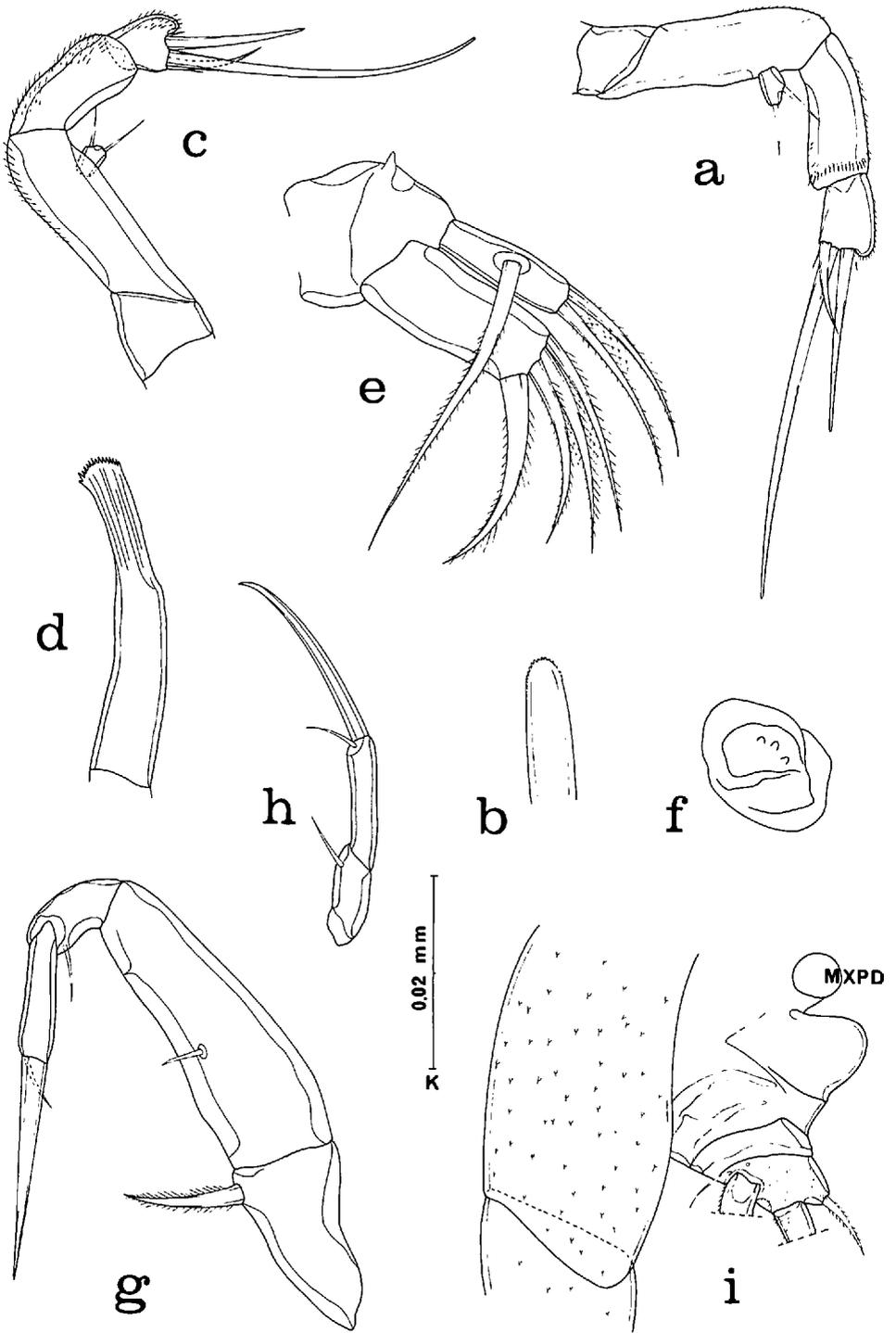


Figure 78. *Fissuricola caritus* new genus, new species. Female: a, second antenna, postero-inner (scale E); b, tip of longest terminal seta on fourth segment of second antenna, postero-inner (K); c, second antenna, antero-outer (E); d, mandible, posterior (F); e, first maxilla, postero-outer (F); f, vestige of second maxilla, ventral (F); g, maxilliped, anterior (E); h, last two segments and claw of maxilliped, postero-inner (E); i, area between maxillipeds and first pair of legs, showing ventral protuberance, lateral (C).

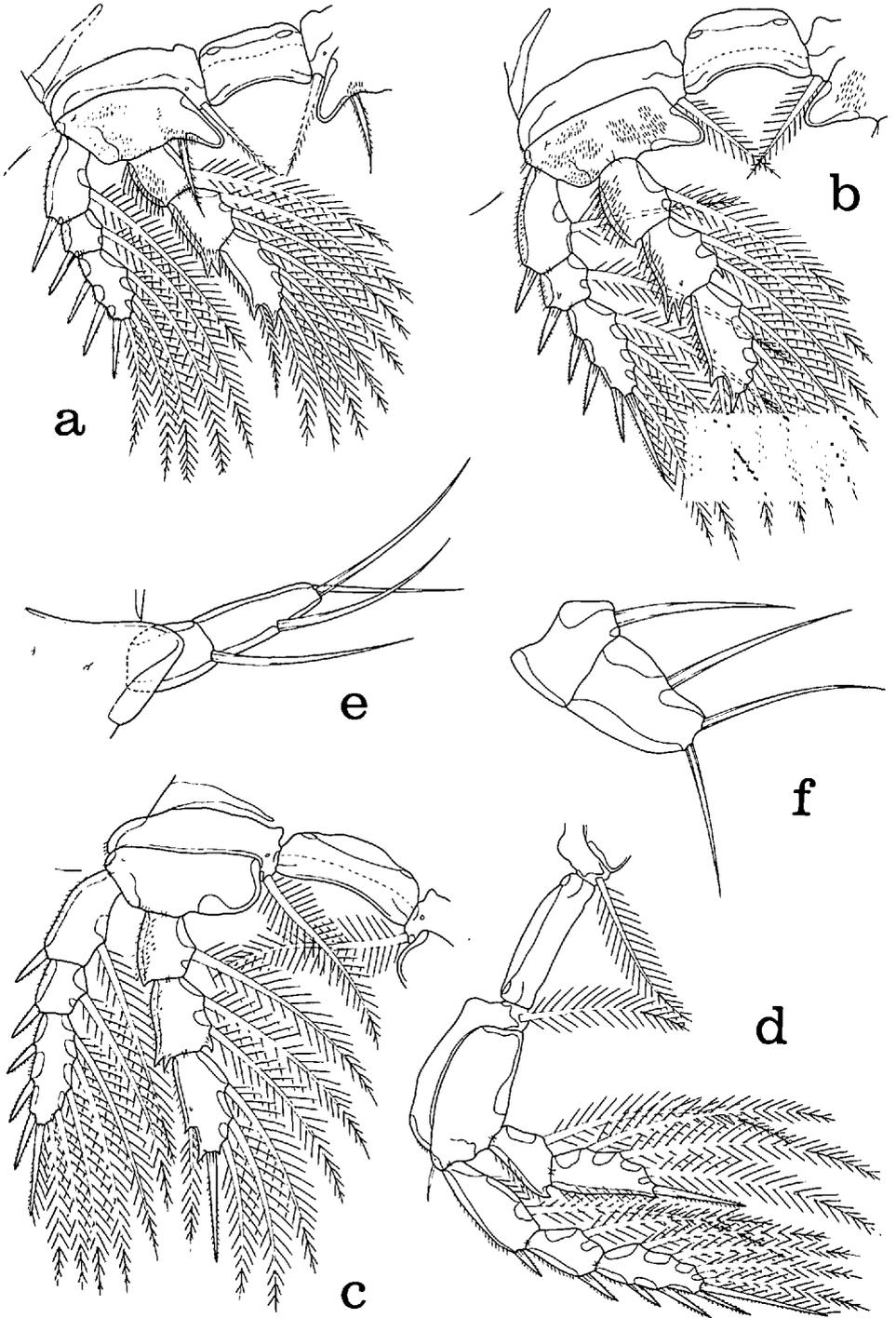


Figure 79. *Fissuricola caritus* new genus, new species. Female: a, leg 1 and intercoxal plate, anterior (scale C); b, leg 2 and intercoxal plate, anterior (C); c, leg 3 and intercoxal plate, anterior (C); d, leg 4 and intercoxal plate, anterior (C); e, leg 5, dorsal (G); f, leg 5, antero-outer (G).

Segment bearing leg 5 (Fig. 76d) $34 \times 65 \mu\text{m}$. Genital segment $68 \times 81 \mu\text{m}$. Three postgenital segments from anterior to posterior 44×52 , 34×44 , and $52 \times 36 \mu\text{m}$ (width taken at middle).

Caudal ramus resembling that of female but shorter, $198 \times 10.5 \mu\text{m}$, ratio 18.9:1.

Body surface and rostrum as in female.

First antenna (Fig. 76e) geniculate, 17-segmented, approximately $300 \mu\text{m}$ long not including setae. Lengths of segments: 31 ($50 \mu\text{m}$ along anterior margin), 5.5, 5.5, 5.5, 5.5, 9, 12, 5.5, 7.5, 13.5, 19, 19, 19, 34, 42, 28, and $26 \mu\text{m}$, respectively. Armature: 5, 2, 2, 2, 1, 3, 6, 2, 2, 2, 2, 2, 2, 1 + aesthete, 4, and 8. Segments 16 and 17 weakly separated.

Second antenna, oral cone, mandible, first maxilla, second maxilla, and maxilliped as in female.

Legs 1–4 resembling those of female. Endopod of leg 1 with third segment having stouter terminal spiniform process (Fig. 76f) than in female.

Leg 5 (Fig. 76g) with free segment $17 \times 22 \mu\text{m}$, bearing 3 slender outer setae and 2 stout hyaline lamellate inner setae. Leg placed ventrally and concealed in dorsal view of entire animal.

Leg 6 (Fig. 76g) with 2 slender setae arising on somewhat irregular distal edge.

Spermatophore, seen only inside body of male (Fig. 76d), approximately $34 \times 23 \mu\text{m}$.

Color unknown.

Etymology.—The specific name *prolixicauda*, Latin *prolixus*, long or extended, and *cauda*, tail, alludes to the very long caudal rami.

Remarks.—*Ecbathyrion prolixicauda* may be distinguished from other copepods described here by the following features: (1) the reduction in the number of urosomal segments to four in the female and five in the male, (2) the multisegmented first antenna, with 18 segments in the female and 17 segments in the male, (3) the peculiarly shaped exopod on the second antenna, (4) the greatly elongated caudal rami, ratio in the female 26:1, in the male 18.9:1, and (5) the 3-segmented endopod of leg 4.

Family uncertain

Fissuricola new genus

Diagnosis.—Female. Body unmodified. Segment of leg 1 fused with cephalosome. Urosome 5-segmented. Caudal ramus with 6 setae.

Rostrum weak. First antenna 12-segmented with aesthete on penultimate segment. Second antenna with 1-segmented exopod and 2-segmented endopod.

Oral cone short, no true siphon. Mandible slender blade without palp. First maxilla with inner lobe bearing 4 setae, outer lobe with 3 setae. Second maxilla represented only by small sclerotized remnant. Maxilliped with 4 segments and terminal claw.

Legs 1–4 biramous with 3-segmented rami, except for 2-segmented endopod in leg 4. Leg 4 with last segment of exopod II,II,4 and endopod with 0-1; I,3.

Leg 5 2-segmented, with formula I,3.

Leg 6 represented by 2 minute setae on genital area.

Male.—Unknown.

Type-species.—*Fissuricola caritus* new species.

Table 2. Dives at hydrothermal sites and copepods recovered

Dive No.	Date	Location	Position and copepods	Depth	Pilot(s), observer(s)
DSRV ALVIN					
1979					
880	21 Jan	Galapagos Rift	00°47.6'N, 86°06.4'W <i>Aphotopontius mammillatus</i>	2,493 m	Hollis, Hessler, Williams
833	24 Jan	Galapagos Rift	00°47.0'N, 86°08.0'W <i>Ecbathyron prolixicauda</i>	2,493 m	Hollis, Hessler, Sanders
890	15 Feb	Galapagos Rift	00°48.9'N, 86°13.3'W <i>Aphotopontius mammillatus</i> <i>Ceuthoecetes acanthothrix</i> <i>Nilva torifera</i>	2,447 m	Foster, Kristof, Crane
895	20 Feb	Galapagos Rift	00°47.9'N, 86°09.3'W <i>Aphotopontius mammillatus</i> <i>Aphotopontius limatulus</i> <i>Rhogobius contractus</i>	2,482 m	Ellis, Grassle, Holcomb
983	30 Nov	Galapagos Rift	00°48.0'N, 86°13.0'W <i>Aphotopontius baculigerus</i> <i>Aphotopontius limatulus</i> <i>Aphotopontius mammillatus</i> <i>Ecbathyron prolixicauda</i>	2,457 m	Ellis, Hessler, Cohen
984	1 Dec	Galapagos Rift	00°48.0'N, 86°13.0'W <i>Aphotopontius arcuatus</i> <i>Aphotopontius limatulus</i> <i>Aphotopontius mammillatus</i> <i>Ceuthoecetes acanthothrix</i> <i>Ceuthoecetes introversus</i> <i>Ecbathyron prolixicauda</i>	2,451 m	Hollis, Turner, Wirsén
988	5 Dec	Galapagos Rift	00°48.0'N, 86°13.0'W <i>Ceuthoecetes acanthothrix</i>	2,450 m	Hollis, Grassle, Childress
989	6 Dec	Galapagos Rift	00°48.0'N, 86°09.0'W <i>Aphotopontius limatulus</i> <i>Aphotopontius mammillatus</i> <i>Rhogobius contractus</i>	2,482 m	Ellis, Smith, Berg
990	7 Dec	Galapagos Rift	00°48.0'N, 86°13.0'W <i>Aphotopontius limatulus</i> <i>Aphotopontius mammillatus</i> <i>Ecbathyron prolixicauda</i> <i>Nilva torifera</i> <i>Rhogobius contractus</i>	2,451 m	Hollis, Jones, Tuttle
991	8 Dec	Galapagos Rift	00°48.0'N, 86°09.0'W <i>Aphotopontius limatulus</i> <i>Aphotopontius mammillatus</i> <i>Ceuthoecetes acanthothrix</i> <i>Ecbathyron prolixicauda</i> <i>Nilva torifera</i> <i>Rhogobius contractus</i>	2,490 m	Ellis, Grassle, Sanders
993	10 Dec	Galapagos Rift	00°47.0'N, 86°08.0'W <i>Aphotopontius mammillatus</i>	2,518 m	Ellis, Hessler, Cohen
1982					
1176	19 Jan	Guaymas Basin	17°01.0'N, 111°25.0'W <i>Erebomaster protentipes</i>	2,022 m	Hollis, Goodwin, Edmond
1211	17 Apr	East Pacific Rise	20°50.0'N, 109°06.0'W <i>Aphotopontius arcuatus</i> <i>Aphotopontius flexispina</i> <i>Ceuthoecetes acanthothrix</i>	2,615 m	Hollis, Smith, Cronkite

Table 2. Continued

Dive No.	Date	Location	Position and copepods	Depth	Pilot(s), observer(s)
			<i>Ceuthoecetes aliger</i> <i>Ceuthoecetes cristatus</i> <i>Stygiopontius hispidulus</i>		
1213	19 Apr	East Pacific Rise	20°50.0'N, 109°06.0'W <i>Stygiopontius sentifer</i>	2,617 m	Hollis, Hessler, Lutz
1214	20 Apr	East Pacific Rise	20°50.0'N, 109°06.0'W <i>Aphotopontius arcuatus</i> <i>Aphotopontius mammillatus</i>	2,633 m	Brown, Wirsen, Gaill
1219	25 Apr	East Pacific Rise	20°50.0'N, 109°06.0'W <i>Ceuthoecetes cristatus</i> <i>Aphotopontius arcuatus</i> <i>Ceuthoecetes aliger</i> <i>Ceuthoecetes cristatus</i> <i>Exrma singula</i> <i>Nilva torifera</i>	2,612 m	Hollis, Nerolich, Dinet
1221	4 May	East Pacific Rise	20°50.0'N, 109°06.0'W <i>Aphotopontius arcuatus</i> <i>Aphotopontius flexispina</i> <i>Aphotopontius limatulus</i> <i>Aphotopontius mammillatus</i> <i>Ceuthoecetes aliger</i> <i>Ceuthoecetes cristatus</i> <i>Ceuthoecetes introversus</i>	2,618 m	Hollis, Jones, Karl
1223	7 May	East Pacific Rise	20°50.0'N, 109°06.0'W <i>Aphotopontius limatulus</i> <i>Stygiopontius cinctiger</i> <i>Stygiopontius hispidulus</i> <i>Stygiopontius sentifer</i> <i>Nilva torifera</i>	2,616 m	Hollis, Tuttle, Arp
1225	9 May	East Pacific Rise	20°50.0'N, 109°06.0'W <i>Aphotopontius flexispina</i> <i>Aphotopontius limatulus</i> <i>Ceuthoecetes acanthothrix</i> <i>Ceuthoecetes aliger</i> <i>Ceuthoecetes cristatus</i> <i>Nilva torifera</i> <i>Stygiopontius hispidulus</i> <i>Stygiopontius sentifer</i>	2,618 m	Hollis, Childress, Burns
1226	10 May	East Pacific Rise	20°50.0'N, 109°06.0'W <i>Aphotopontius arcuatus</i> <i>Aphotopontius flexispina</i> <i>Ceuthoecetes aliger</i> <i>Ceuthoecetes cristatus</i> <i>Fissuricola caritus</i> <i>Nilva torifera</i> <i>Stygiopontius cinctiger</i> <i>Stygiopontius hispidulus</i> <i>Stygiopontius sentifer</i> <i>Stygiopontius verruculatus</i>	2,616 m	Brown, Baross, Contreras Urruachua
	1985				
1607	29 July	Guaymas Basin	27°00.7'N, 111°24.4'W <i>Aphotopontius mammillatus</i> <i>Erebonaster protentipes</i>	2,012 m	Grassle, Gleason, Salzig
1608	31 July	Guaymas Basin	27°00.7'N, 111°24.4'W <i>Erebonaster protentipes</i>	2,002 m	Foster, Gagosian, Pace
1612	4 Aug	Guaymas Basin	27°00.7'N, 111°24.4'W <i>Stygiopontius mucroniferus</i>	2,004 m	Foster, Karl, Nelson

Table 2. Continued

Dive No.	Date	Location	Position and copepods	Depth	Pilot(s), observer(s)
1613	5 Aug	Guaymas Basin	27°00.5'N, 111°24.6'W <i>Hyphalion captans</i> <i>Stygiopontius hispidulus</i>	2,007 m	Hardiman, Grassle, Dinet
1614	6 Aug	Guaymas Basin	27°00.7'N, 111°24.4'W <i>Erebonaster protentipes</i>	2,004 m	Collasius, Wirsén, Novitsky
1615	7 Aug	Guaymas Basin	27°00.5'N, 111°24.4'W <i>Aphotopontius mammillatus</i> <i>Stygiopontius flexus</i>	2,000 m	Foster, Jannasch, Romero
1628	23 Aug	Guaymas Basin	27°00'N, 111°30'W <i>Laitmatobius crinitus</i>	2,003 m	Aguiar, Berg, Olson
1629	24 Aug	Guaymas Basin	27°00'N, 111°30'W <i>Laitmatobius crinitus</i>	2,004 m	Collasius, Olson, Edwards
DSRV PISCES IV					
1983					
P-1492	23 June	Explorer Ridge	49°45.5'N, 130°16.2'W <i>Stygiopontius quadrispinosus</i>	1,853 m	Shepherd, Johnson, Tunnickliffe
P-1494	1 July	Explorer Ridge	49°45.6'N, 130°16.1'W <i>Aphotopontius forcipatus</i>	1,818 m	Witcombe, Johnson, Tunnickliffe
P-1495	2 July	Explorer Ridge	49°45.6'N, 130°16.1'W <i>Stygiopontius quadrispinosus</i>	1,808 m	Witcombe, Botros, Juniper
DSRV CYANA					
1984					
84-31	—	East Pacific Rise	12°49.1'N, 103°56.9'W <i>Scotoecetes introrsus</i>	2,635 m	—
84-32	9 Mar	East Pacific Rise	12°49.1'N, 103°56.9'W <i>Stygiopontius hispidulus</i> <i>Stygiopontius sentifer</i>	2,635 m	Arnoux, Martinossi, Laubier
84-33	10 Mar	East Pacific Rise	12°48.6'N, 103°56.7'W <i>Stygiopontius sentifer</i>	2,635 m	Nivaggioli, Potier, Hessler
84-34	11 Mar	East Pacific Rise	12°49.1'N, 103°56.9'W <i>Stygiopontius hispidulus</i>	2,630 m	Arnoux, Martinossi, Khripounoff
84-37	14 Mar	East Pacific Rise	12°46.6'N, 103°56.7'W <i>Exrima dolichopus</i> <i>Nilva torifera</i> <i>Scotoecetes introrsus</i>	2,630 m	Nivaggioli, Potier, Tunnickliffe
84-38	15 Mar	East Pacific Rise	12°48.8'N, 103°56.8'W <i>Scotoecetes introrsus</i> <i>Stygiopontius hispidulus</i> <i>Stygiopontius sentifer</i>	2,635 m	Arnoux, Martinossi, Boury-Esnault
84-39	16 Mar	East Pacific Rise	12°48.6'N, 103°56.7'W <i>Rhogobius contractus</i> <i>Scotoecetes introrsus</i>	2,635 m	Nivaggioli, Potier, Rio
84-40	17 Mar	East Pacific Rise	12°48.6'N, 103°56.7'W <i>Aphotopontius arcuatus</i>	2,635 m	Arnoux, Martinossi, Segonzac
84-41	23 Mar	East Pacific Rise	12°48.6'N, 103°56.7'W <i>Scotoecetes introrsus</i> <i>Stygiopontius sentifer</i>	2,635 m	Nivaggioli, Martinossi, Alayse
84-42	24 Mar	East Pacific Rise	12°48.6'N, 103°56.7'W <i>Ceuthoecetes acanthothrix</i> <i>Ceuthoecetes cristatus</i> <i>Nilva torifera</i> <i>Rhogobius contractus</i>	2,635 m	Arnoux, Potier, Desbruyères

Table 2. Continued

Dive No.	Date	Location	Position and copepods	Depth	Pilot(s), observer(s)
84-43	25 Mar	East Pacific Rise	12°48.6'N, 103°56.7'W <i>Scotoecetes introrsus</i> <i>Stygiopontius sentifer</i>	2,635 m	Nivaggioli, Martinossi, Gaill
	1985		RV RESEARCHER		
—	3 Aug	Mid-Atlantic Ridge	26°08.3'N, 44°49.6'W <i>Stygiopontius pectinatus</i>	3,620– 3,650 m	Rona and team of scientists
			DV RESOLUTION		
—	17 Dec	Mid-Atlantic Ridge	23°22.160'N, 44°57.072'W <i>Stygiopontius pectinatus</i>	3,522 m	Humphris (JOIDES)

Gender.—Masculine.

Etymology.—The generic name *Fissuricola* is formed from Latin *fissura*, a cleft or fissure, and *-cola*, an inhabitant, referring to the habitat.

***Fissuricola caritus* new species**

Figures 77a–g, 78a–i, 79a–f

Type Material.—10 ♀♀, in 2,616 m, Clam Acres, East Pacific Rise, 20°50.0'N, 109°06.0'W, 10 May 1982, DSRV ALVIN dive no. 1226. Holotype and 5 paratypes deposited in the National Museum of Natural History, Smithsonian Institution, Washington, D.C.

Female.—Body (Fig. 77a) elongate and slender. Length 1.26 mm (1.19–1.34 mm) and greatest width 0.43 mm (0.39–0.47 mm), based on 8 specimens. Greatest dorsoventral thickness (at level of protuberance between maxillipeds and first pair of legs) 0.28 mm. Segment of leg 1 fused with cephalosome. Epimeral areas of segments of legs 1–4 pointed. Ratio of length to width of prosome 1.56:1. Ratio of length of prosome to that of urosome 1.01:1.

Segment of leg 5 (Fig. 77b) $83 \times 143 \mu\text{m}$. Genital segment longer than wide $190 \mu\text{m}$ long, $172 \mu\text{m}$ wide in expanded anterior fourth, $146 \mu\text{m}$ wide in posterior two thirds with nearly parallel margins. Genital areas situated dorsolaterally in anterior rounded fourth. Each area with 2 minute setae $8 \mu\text{m}$ and $3 \mu\text{m}$ (Fig. 77c). Three postgenital segments from anterior to posterior 117×143 , 101×120 , and $83 \times 99 \mu\text{m}$.

Caudal ramus (Fig. 77d) elongate, $109 \times 36 \mu\text{m}$ in greatest dimensions, ratio 3.03:1. Outer lateral seta $39 \mu\text{m}$, dorsal seta $52 \mu\text{m}$ (in some specimens directed anteriorly), outermost terminal seta $47 \mu\text{m}$, innermost terminal seta $46 \mu\text{m}$, and 2 long terminal median setae (unjointed) $165 \mu\text{m}$ (outer) and $375 \mu\text{m}$ (inner). All these setae smooth.

Body surface with many sensilla (Fig. 77a).

Egg sac unknown.

Rostrum projecting in lateral view (Fig. 77e) but appearing undeveloped in ventral view (Fig. 77f). First antenna (Fig. 77g) $300 \mu\text{m}$ long, 12-segmented with aesthete on penultimate segment. Lengths of segments: 18 ($42 \mu\text{m}$ along anterior margin), 10, 36, 23, 14, 34, 21, 23, 23, 26, 19, and $38 \mu\text{m}$, respectively. Armature: 1, 2, 12, 8, 2, 4, 2, 2, 2, 2, 2 + 1 aesthete, and 12. All setae smooth. Second antenna (Fig. 78a, c) with 2-segmented protopod having row of outer spinules.

Table 3. Copepods found at seven deep-sea hydrothermal locations. Exact positions may be found in text

00°48.8'N, 86°11'W Galapagos Rift 2,447–2,493 m	20°50.0'N, 109°06.0'W East Pacific Rise 2,616–2,635 m	12°48.8'N, 103°56.7'W East Pacific Rise 2,630–2,635 m	27°00.7'N, 111°24.4'W Guaymas Basin 2,000–2,022 m
<i>Aphotopontius arcuatus</i>	<i>Aphotopontius arcuatus</i>	<i>Aphotopontius arcuatus</i>	<i>Aphotopontius mammillatus</i>
<i>Aphotopontius baculigerus</i>	<i>Aphotopontius flexispina</i>	<i>Ceuthoecetes acanthothrix</i>	<i>Erebonaster protentipes</i>
<i>Aphotopontius limatus</i>	<i>Aphotopontius limatus</i>	<i>Ceuthoecetes cristatus</i>	<i>Hyphalion captans</i>
<i>Aphotopontius mammillatus</i>	<i>Aphotopontius mammillatus</i>	<i>Exrma dolichopus</i>	<i>Laitmatobius crinitus</i>
<i>Ceuthoecetes acanthothrix</i>	<i>Ceuthoecetes acanthothrix</i>	<i>Nilva torifera</i>	<i>Stygiopontius flexus</i>
<i>Ceuthoecetes introversus</i>	<i>Ceuthoecetes aliger</i>	<i>Rhogobius contractus</i>	<i>Stygiopontius hispidulus</i>
<i>Ecbathyrion prolixicauda</i>	<i>Ceuthoecetes cristatus</i>	<i>Scotoecetes introrsus</i>	<i>Stygiopontius mucroniferus</i>
<i>Nilva torifera</i>	<i>Ceuthoecetes introversus</i>	<i>Stygiopontius hispidulus</i>	
<i>Rhogobius contractus</i>	<i>Exrma singula</i>	<i>Stygiopontius sentifer</i>	
	<i>Fissuricola caritus</i>		
	<i>Nilva torifera</i>		
	<i>Stygiopontius cinctiger</i>		
	<i>Stygiopontius hispidulus</i>		
	<i>Stygiopontius sentifer</i>		
	<i>Stygiopontius verruculatus</i>		
49°45.5'N, 130°16.6'W Explorer Ridge 1,808–1,853 m	26°08.3'N, 44°49.6'W Mid-Atlantic Ridge 3,620–3,650 m	23°22.160'N, 44°57.072'W Mid-Atlantic Ridge 3,522 m	
<i>Aphotopontius forcipatus</i>	<i>Stygiopontius pectinatus</i>	<i>Stygiopontius pectinatus</i>	
<i>Stygiopontius quadrispinosus</i>			

Exopod 1-segmented with 2 setae. Endopod 2-segmented, first segment with outer and posterior surficial spinules, second segment with outer spinules and 5 terminal elements, outer setule, outer seta, much longer inner seta, smaller seta, and, innermost, 1 small obscure setule. Two median unequal long setae with blunt minutely dentate tips as in Fig. 78b.

Oral cone short, broad (Fig. 77f).

Mandible (Fig. 78d) slender blade 77 μm long with finely serrated tip. First maxilla (Fig. 78e) with basis having small conical process. Slender outer lobe with 2 terminal setae and 1 long (80 μm) surficial seta located at about midlength. Inner lobe with 4 terminal setae, innermost stouter than others. All setae with setules. Second maxilla represented only by sclerotized rudiment (Fig. 78f). Maxilliped (Fig. 78g) 4-segmented. First segment with prominent pinnate inner distal seta. Elongate second segment with small inner smooth seta. Slender third and fourth segments both with 1 distal smooth seta. Claw (Fig. 78h) 69 μm long, smooth, slightly recurved. Mouthparts positioned as in Fig. 77f.

Ventral median area between maxillipeds and first pair of legs produced (Figs. 77f, 78i).

Legs 1–4 (Fig. 79a–d) with 3-segmented rami, except for 2-segmented endopod in leg 4. Formula for armature as follows:

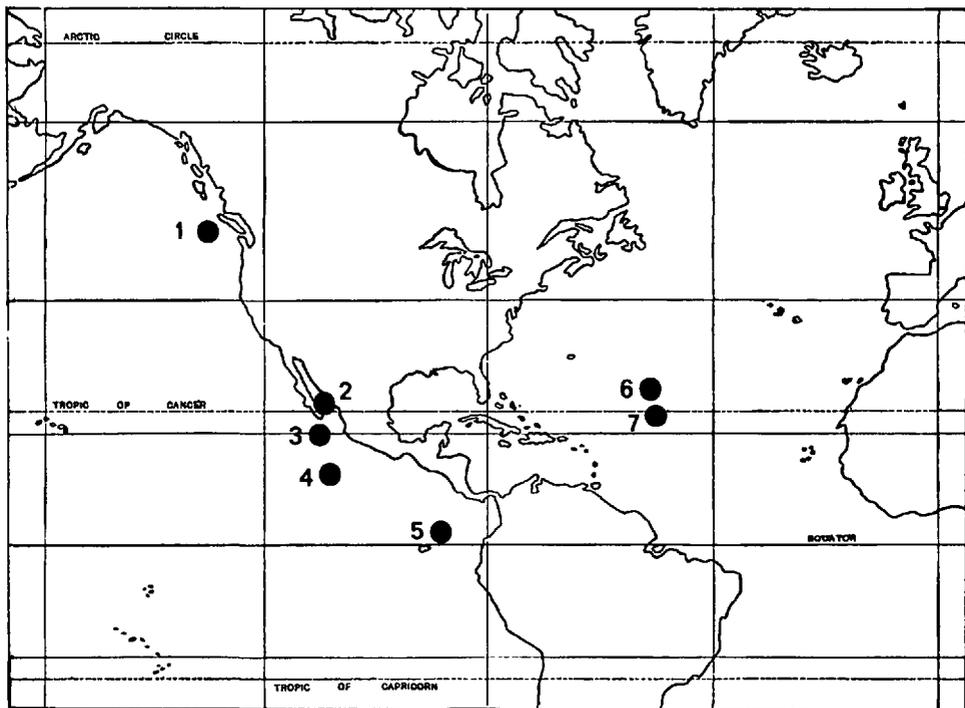


Figure 80. Approximate locations of deep-sea hydrothermal vents where copepods were collected. 1 = Explorer Ridge, 49°45.5'N, 130°16.2'W; 2 = Guaymas Basin, Gulf of California, 27°00'N, 111°30'W; 3 = East Pacific Rise, 20°50.0'N, 109°06.0'W; 4 = East Pacific Rise, 12°48.8'N, 103°56.8'W; 5 = Galapagos Rift, 00°47.6'N, 86°06.4'W; 6 = Mid-Atlantic Ridge, 26°08.3'N, 44°49.6'W; 7 = Mid-Atlantic Ridge, 23°22.160'N, 44°57.072'W.

P₁ coxa 0-1 basis 1-I exp I-1; I-1; II,I,4
 enp 0-1; 0-2; 1,2,3
 P₂ coxa 0-1 basis 0-1 exp I-1; I-1; III,I,4
 enp 0-1; 0-2; 1,2,3
 P₃ coxa 0-1 basis 1-0 exp I-1; I-1; III,I,5
 enp 0-1; 0-2; 1,I,3
 P₄ coxa 0-1 basis 1-0 exp I-1; I-1; II,II,4
 enp 0-1; I,3

Legs 1–3 with sclerite proximal to coxa. Inner coxal seta in all 4 legs long and pinnate. Basis in legs 1 and 2 with patches of spinules on anterior surface and inner margin narrowly expanded. Basis of leg 1 with inner spine 65 μ m, barbed along midregion. Endopods of legs 1–4 with inner spinules. Leg 4 with exopod 125 μ m long. Endopod with first segment 47 \times 30 μ m (53 μ m long including spiniform process) and its inner plumose seta 190 μ m; second segment 73 \times 31 μ m (77 μ m long including spiniform process), its terminal barbed spine 52 μ m and 3 inner plumose setae from distal to proximal 160, 156, and 120 μ m.

Leg 5 (Fig. 79e, f) 2-segmented. First segment 27 \times 55 μ m, its dorsal seta 81 μ m. Second segment 62 \times 40 μ m, its 3 setae from outer to inner 91, 91, and 74 μ m. All setae smooth.

Leg 6 represented by 2 minute setae on genital area (Fig. 77c).

Color of living specimens unknown.

Male. — Unknown.

Etymology. — The specific name *caritus*, Latin meaning lacking, alludes to the absence of a fully formed second maxilla.

Remarks. — While the absence of a fully formed second maxilla and the unusual formula of 0-1; I,3 for the endopod of leg 4 suggest that *Fissuricola caritus* might well be placed in a new family, lack of knowledge of males cautions against this step at the present time.

KEY TO GENERA OF POECILOSTOMATOID AND SIPHONOSTOMATOID
COPEPODS PRESENTLY KNOWN FROM HYDROTHERMAL VENTS

- 1a. First antenna with 6 or fewer segments; second antenna without exopod (Poecilostomatoida) 2a
- 1b. First antenna with 10 or more segments; second antenna with small exopod (Siphonostomatoida) 4a
- 2a. Leg 5 with formula 1,2 *Laitmatobius* 4a
- 2b. Leg 5 with formula 1,4 3a
- 3a. Mandible with large prominent palp; urosome in both sexes 5-segmented; endopod of leg 4 with 0-1; 0-2; I,II,2 *Erebonaster*
- 3b. Mandible without palp; urosome 5-segmented in female, 6-segmented in male; endopod of leg 4 with 0-1; 0-2; I,III,1 *Hyphalion*
- 4a. Urosome of female 4-segmented, male 5-segmented; endopod of leg 4 3-segmented *Ecbathyrion*
- 4b. Urosome of female 5-segmented, male as far as known 6-segmented; endopod of leg 4 2-segmented 5a
- 5a. Second maxilla vestigial; endopod of leg 4 with 0-1; I,3 *Fissuricola*
- 5b. Second maxilla well formed; endopod of leg 4 with either 1 or 2 terminal elements 6a
- 6a. First segment of endopod of leg 4 without inner seta 7a
- 6b. First segment of endopod of leg 4 with 1 inner seta 13a
- 7a. Second antenna elongate, last segment with setae or spines 8a
- 7b. Second antenna short, last segment with small hooklike claw 11a
- 8a. Endopod of leg 4 with second segment bearing only 1 element 9a
- 8b. Endopod of leg 4 second segment bearing 2 elements 10a
- 9a. First antenna of female 18-segmented; leg 5 in female small lobe with 3 setae, in male 2 setae only *Benthoxynus*
- 9b. First antenna of female 9-segmented; leg 5 in female 2-segmented with formula 1,3 *Exrima*
- 10a. Endopod of leg 1 in female 2-segmented; leg 5 in female with 1,2, in male reduced to ridge with 3 setae *Scotoecetes*
- 10b. Endopod of leg 1 in female 3-segmented; leg 5 in female with 1,3, in male with 1,5 *Stygiopontius*
- 11a. First antenna 10-segmented; leg 5 in female single segment with 1,3, in male with 1,5 12a
- 11b. First antenna in female 13-segmented, in male 12-segmented; leg 5 in female minute with 1 seta, in male with 1,2 *Dirivultus*
- 12a. Genital segment with prominent rounded dorsal hump *Nilva*
- 12b. Genital segment without such hump (though 1 species with transverse ridge) *Ceuthoecetes*
- 13a. First maxilla with both inner and outer lobes bearing 3 setae; second maxilla with first segment unarmed; first postgenital segment in female constricted *Rhogobius*
- 13b. First maxilla with inner lobe with 4 setae, outer lobe with 3 setae; second maxilla with first segment armed with seta; first postgenital segment in female not constricted *Aphotopontius*

CONCLUSIONS

From this study of deep-sea copepods at hydrothermal vent areas we may conclude that:

Poecilostomatoid and siphonostomatoid copepods are abundant and diverse at hydrothermal vents (Tables 2, 3) with the siphonostomatoids showing greater

diversity. Twenty-nine species in 13 genera and 4 families are known at present from such deep-sea habitats.

Although none of the samples studied were collected quantitatively, the abundance of copepods in certain collections, for example, more than 8,000 in washings of vestimentiferans from DSRV ALVIN dive no. 1214, indicates that they may occur in great numbers.

Families well represented in shallow littoral seas, such as the Asterocheridae, Artotrogidae, and Dyspontiidae, are apparently absent from vent areas.

Although copepods from relatively few vent areas have been obtained for study (Fig. 80), it appears that genera may be widespread in these unusual environments around the world. The genus *Stygiopontius*, for example, is known both from the eastern Pacific and the Mid-Atlantic Ridge. However, the species in the two areas are different (Table 3).

Although the color of these deep-sea copepods while alive is mostly unknown, the bright red color observed in *Stygiopontius flexus* suggests that the copepods are similar to other deep-sea crustaceans in having red bodies.

The number of eggs carried by females is small, in siphonostomatoids often with only one or two eggs in each egg sac. Presumably fertilized eggs must be extruded often in order to produce the large numbers of adults sometimes observed.

Certain copepods from deep-sea vents show associations with host animals; for example, *Erebonaster protentipes* in the mantle cavity of a *Nuculana*-like protobranch bivalve, *Stygiopontius sentifer* with the polychaete *Alvinella pompejana*, and *Stygiopontius pectinatus* in the gill chambers of the shrimps *Rimicaris exoculata* and *Rimicaris chacei*.

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