

The Parasitic Copepods
of Indo-West Pacific
Lizardfishes (Synodontidae)

ROGER CRESSEY
and
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ABSTRACT

Cressey, Roger, and Hillary Boyle Cressey. The Parasitic Copepods of Indo-West Pacific Lizardfishes (Synodontidae). *Smithsonian Contributions to Zoology*, number 296, 71 pages, 53 figures, 2 tables, 1979.—Eighteen species of parasitic copepods (12 new species) are described from Indo-West Pacific Lizardfishes. Twelve species are taeniacanthids, 10 of the genus *Metataeniacanthus* Pillai. Species of *Metataeniacanthus* are very host specific and aided in the identifications of the hosts. The caligid genus *Abasia* Wilson, formerly with 2 species is expanded to now include 6 species (3 new). The genus *Alicaligus* Shiino is placed in synonymy with *Abasia*. The species included are *Metataeniacanthus aquilonius* new species; *M. conepigri* new species; *M. epigri* new species; *M. gibbsi* new species; *M. indiscretus* new species; *M. nudus* new species; *M. pacificus* new species; *M. solidus* new species; *M. synodi* Pillai; *M. vulgaris* new species; *Parataeniacanthus longicervis* Pillai; *Taeniacanthus sauridae* Yamaguti and Yamasu; *Abasia inflata* new species; *A. pillaii* new species; *A. platyrostris* Pillai; *A. pusilla* new species; *A. tripartita* (Shiino); *Lernanthropus temminckii* Nordmann.

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The Parasitic Copepods of Indo-West Pacific Lizardfishes (Synodontidae)

*Roger Cressey
and Hillary Boyle Cressey*

Introduction

In 1973 Dr. I. Paperna of The Hebrew University sent the first author a collection of parasitic copepods from the Red Sea and East Africa containing a single specimen of a new species of *Metataeniacanthus* from a Red Sea *Synodus*. We subsequently examined several additional Red Sea and Indian Ocean *Synodus* housed in the Smithsonian collections to obtain additional material. These early collections contained not only more material of the Red Sea species but other new species as well. This led us to undertake a comprehensive examination of Indo-West Pacific lizardfishes for parasitic copepods. We examined 1954 lizardfishes and collected 18 species of parasitic copepods (12 new) described below. All of the species reported in this paper are considered by us to be specific parasites of synodontid fishes.

Representative lizardfishes from the Atlantic and Eastern Pacific Ocean were also examined. The Eastern Pacific hosts were generally devoid of parasitic copepods and those found were so few as not to indicate any host preferences. Of the Atlantic hosts examined, only *Synodus foetens* (L.) was commonly parasitized by a copepod, *Abasia pseudo-rostris* Wilson (1908), described from the same host and redescribed by Pillai (1963b).

The genus *Metataeniacanthus* Pillai is expanded

from the original description of *M. synodi* to now include 10 species. The genus *Abasia* Wilson, formerly consisting of one Atlantic and one Indian Ocean species, now includes 6 species, 3 new and one synonymizing Shiino's *Alicaligus tripartitus*.

Based initially on the specificity of the species of *Metataeniacanthus*, the first author is publishing separately a revision of the Indo-West Pacific *Synodus*.

All material has been preserved in 70 percent alcohol and deposited in the collections of the Smithsonian Institution and British Museum (Natural History).

All figures were drawn with the aid of a Wild drawing tube. Specimens were also examined with a Cambridge stereoscan microscope. The descriptions and illustrations of *Metataeniacanthus* and *Abasia* incorporate observations made with the SEM; several SEM photographs of *Abasia* species are contained herein.

ACKNOWLEDGMENTS.—We thank the many curators of the following collections who either made lizardfish and copepod collections available or sent host specimens to us for study: The Australian Museum, Sydney; The Academy of Natural Sciences of Philadelphia, Philadelphia; The British Museum (Natural History), London; The Bernice P. Bishop Museum, Honolulu; The California Academy of Sciences, San Francisco; The Field Museum of Natural History, Chicago; Kyoto University, Kyoto; The Los Angeles County Museum, Los Angeles; The Museum of Comparative Zoology, Cam-

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bridge, Mass.; The National Museum of New Zealand, Wellington; The Queensland Museum, Brisbane; Rijksmuseum van Natuurlijke Historie, Lieden; Smithsonian Institution, Washington; The Western Australian Museum, Perth; National Taiwan University, Taiwan; Zoologisches Institut und Zoologisches Museum, Hamburg. We also thank Dr. Krishna Pillai and Mr. A. Chandran, Trivandrum, India for sending us parasitic copepods from Indian lizardfish.

The illustrations of *Lernanthropus temminckii* Nordmann were done by Nancy A. Zacks.

Metataeniacanthus Pillai, 1963

DIAGNOSIS.—*Female*: Lateral margins of carapace directed ventrad flanking oral area. Abdominal segments usually indistinctly divided. Abdomen about half total body length. Cephalic appendages as in *Taeniacanthus*. Maxilliped with a short claw, closely appressed to preceding segment. Leg 1 with broadly flattened rami. Second endopod segment of legs 2 and 3 with 1 inner seta. Legs 2–4 with 3-segmented rami. Caudal rami each with 1 lateral outer seta, one subterminal and 4 terminal setae (middle two much longer than outer two).

Male: Body form typically cyclopoid. Lateral margins of cephalon not directed ventrad. Abdomen 3-segmented. Appendages in general as in female except maxilliped with heavily toothed claw, expanded at tip.

TYPE-SPECIES.—*Metataeniacanthus synodi* Pillai, 1963a.

DISCUSSION.—When Pillai, 1963a, proposed the genus *Metataeniacanthus* based on the single species *M. synodi* he stated that the genus was provisional and its status depended on the discovery of additional species. The additional species described herein leave no doubt as to the validity of this genus.

The high degree of host specificity will enable R. Cressey to redefine the Indo-West Pacific lizardfishes of the genus *Synodus*. Most museum specimens in this group were identified as *Synodus variegatus* (Lacepède). As we began to collect different species of *Metataeniacanthus* from this material the misidentification of many of the hosts became apparent. Since no specialist was working in this host group R. Cressey was advised by ichthyologists that he should consider working out the systematics of Indo-West Pacific *Synodus* as well. The results of this work with *Synodus* will be reported elsewhere. Without firm host identifications the host-parasite data is of little value. The discovery of these additional species of *Metataeniacanthus* will enable the first author to revise the systematics of a host group based initially on the host-specificity of their parasitic copepods.

The host-parasite relationships present some intriguing problems. Why does *Synodus hoshinonis* harbor two species of *Metataeniacanthus* separated by the Malay archipelago? Why are some common Indo-West Pacific species such as *Synodus binotatus* Schultz without *Metataeniacanthus*? This host species is often collected with *Synodus variegatus* and *S. englemani*, both of which commonly harbor *Metataeniacanthus*. Why do individuals of *Metataeniacanthus synodi* usually orient with the head toward the distal end of the gill filament, contrary to all the other species of *Metataeniacanthus*? This peculiar orientation is unlike that of parasitic copepods of gill filaments in general. Usually the posterior of the parasite is oriented toward the distal end of the gill filament with the eggs exposed beyond the filament tip.

The genus is apparently restricted to the Indo-West Pacific. The spine and seta formula for legs 2–4 differ only on the third segment of the exopods as shown in Table 1.

Key to Species of *Metataeniacanthus* Females

1. Legs 2 and 3 exopod last segment with sensilla(e) at base of spines2
 Legs 2 and 3 exopod last segment lacking sensillae, parasitic on gills and pseudobranch of
 Synodus hoshinonis Tanaka *M. nudus*, new species
2. Legs 2 and 3 exopod last segment with paired sensillae at base of each spine3
 Legs 2 and 3 exopod last segment with single sensilla at base of each spine, parasitic on
 gills of *S. variegatus* (Lacepède) *M. vulgaris*, new species
3. Abdomen not visibly segmented4
 Abdomen visibly segmented, parasitic on gills of *Trachinocephalus myops* (Schneider)
 *M. synodi* Pillai

Key to Species of *Metataeniacanthus* Females (cont'd)

- 4. Leg 5 longest seta longer than free segment5
 Leg 5 longest seta shorter than free segment6
- 5. Leg 4 exopod last segment with 4 spines, 3 setae, parasitic on gills of *S. englemanni* Schultz
 *M. epigri*, new species
 Leg 4 exopod last segment with 3 spines, 4 setae, parasitic on gills of *S. hoshinonis* Tanaka
 *M. pacificus*, new species
- 6. Leg 4 exopod last segment with 3 spines, 4 setae7
 Leg 4 exopod last segment with 4 spines, 3 setae8
- 7. Leg 5 innermost seta shorter than adjacent seta, parasitic on gills and pseudobranch of *Synodus* species (undescribed) *M. indiscretus*, new species
 Leg 5 innermost seta slightly longer than adjacent seta, parasitic on gills and pseudobranch of *S. macrops* Tanaka *M. aquilonius*, new species
- 8. Ventral surface of abdomen, between insertion of caudal rami, with no ornamentation9
 Ventral surface of abdomen, between insertion of caudal rami, with prominent spinules, parasitic on gills of *S. indicus* Day *M. gibbsi*, new species
- 9. Leg 4 exopod heavily sclerotized, last segment ending in pointed tip, parasitic on pseudobranch of *S. variegatus* (Lacepède) *M. solidus*, new species
 Leg 4 exopod last segment not heavily sclerotized, bent dorsally, parasitic on gills and pseudobranch of *S. jaculum* Russell and Cressey *M. conepigri*, new species

***Metataeniacanthus synodi* Pillai**

FIGURES 1-3, 45

MATERIAL EXAMINED.—Three paratype ♀ deposited in the Smithsonian Institution by Dr. Pillai; collected from the gills of *Synodus indicus* (Day) at Trivandrum, India on 15 March 1961. Remaining material all from gills of *Trachinocephalus myops* (Schneider) at the following localities: 1 ♀ from Sydney, Australia; 3 ♀ from 11 hosts from Japan; 4 ♀ from 7 hosts from Formosa Strait; 9 ♀ from China coast; 7 ♀ from 15 hosts from the Philippines (USNM collection); 3 ♀ from 1 host from off Viet Nam; 5 ♀ from 1 host from Gulf of Thailand; 4 ♀ from 1 host from Gopaldur, India; 33 ♀ from 4 hosts from the Arabian Sea (17°25'N, 71°39'E) R/V *Anton Bruun*, Cruise 4B; 8 ♀ from 24 hosts from the Mozambique Channel (19°50'S, 36°21'E) R/V *Anton Bruun*, Cruise 8.

Female: Body form as in Figures 1a and 1b. Total length 2.1 mm, greatest width 0.58 mm (measured at widest part of cephalon). Cephalon wider than long (0.58 × 0.39 mm), fused with first thoracic segment. Thoracic segments 2-4 clearly articulated (see Figure 1a) or not (see Figure 1b). Area of egg sac attachment (Figure 1c) fused with abdomen. Abdomen about half total body length, segments measure 424, 324, 177, and 141 μm respectively; no ornamentation at posterior tip. Caudal rami (Figure 1d) about 3 times as long as wide (88.5 × 29.5

μm), each bearing one lateral, one subterminal and 4 terminal setae (longest 306.8 μm).

First antenna (Figure 1e) 7-segmented (Pillai, 1963a, considered the first antenna to be 6-segmented but his 3rd segment is actually subdivided and in light of other species described herein, we consider 7 segments a more accurate description); an aesthete is present on each of last 2 segments in addition to setae. Second antenna (Figure 1f) 3-segmented, first and second segments bearing one seta each, last segment with row of fine spinules along posterior edge continuing along edge of blunt process on ventral side, tip armed with 3 hooklike spines and 3 setae. Postantennal hook (Pillai's maxillary hook) (Figure 1g) slightly recurved. Oral area as in Figure 2a. Labrum posterior edge finely spinulose. Mandible, first maxilla, and second maxilla as in figure. Paragnath (Figure 2b) pos-

TABLE 1.—Spine and seta formulae for the exopod last segments of legs 2-4 of *Metataeniacanthus* species (Arabic numbers = setae, Roman = spines)

	legs 2 & 3	leg 4
<i>synodi</i> , <i>vulgaris</i> , <i>nudus</i>	III:5	III:5
<i>pacificus</i>	III:5	III:4
<i>epigri</i>	III:5	IV:3
<i>indiscretus</i> , <i>aquilonius</i>	III:4	III:4
<i>conepigri</i> , <i>gibbsi</i> , <i>solidus</i>	III:4	IV:3

terior distal edge lobed with a single row of spines in pits near base of lobes. Maxilliped (Figure 2c) with short distal hook (Pillai shows no distal hook but hook is held close to basal part of maxilliped and difficult to see).

Legs 1-4 biramous; rami 3-segmented; Leg 1 (Figure 2d) basipod with plumose stout spine on outer distal corner and long plumose seta near interpodal plate; exopod (Figure 2e) first 2 segments each with a plumose seta on outer edge, inner edge of second segment with stout seta, third segment with 7 setae; endopod first 2 segments each with an inner seta, third segment with 7 setae, outer 2 much shorter than others; interpodal plate with posterior spinose process as in figure. Leg 2 (Figure 2f) basipod with outer naked seta; exopod first 2 segments each with slender, naked spine on outer distal corner, third segment with 3 slender, naked outer spines and 5 finely plumose distal to inner setae, inner margin of outermost seta densely plumose near base; a pair of short processes near base of outer spine of second segment and first 2 outer spines of third segment; a pair of setules near base of distalmost spine on third segment; endopod first 2 segments each with a single inner seta, third segment bearing 3 spines and 3 setae, outer 2 spines modified as in Figure 3a. Leg 3 (Figure 3b) similar to leg 2 except exopod outer spines with hyaline fringe, setules on exopod last segment of leg 2 replaced by blunt processes on leg 3, dense plumosities on outermost seta of exopod last segment not present in leg 3. Leg 4 (Figure 3c) basipod and exopod as in leg 3 except for lack of blunt processes near bases of outer spines on leg 4, each exopod segment with a setule near outer edge; endopod armed as in leg 3 except only 2 spines and 1 seta on distal segment. Leg 5 (Figure 3d) basal segment with outer seta; last segment with 4 setae, terminalmost longest, other 3 of about equal length. Leg 6 (see Figure 1c) represented by 3 short setae at area of egg sac attachment.

Egg sac cylindrical, extending to beyond middle of abdomen.

Male: Unknown.

REMARKS.—Pillai collected this copepod from the gills of *Synodus indicus*. We examined many specimens of this species but did not recover this parasite. We did, however, find this copepod a common parasite of *Trachinocephalus myops*. Unlike other species of *Metataeniacanthus* this species

generally attaches to the gill filament of the host with the head oriented toward the distal part of the filament. Most parasitic copepods that attach to gill filaments do so with the eggs exposed distally. We can offer no explanation as to why this species would orient its body in the opposite direction. Ovigerous females were collected with two different body forms (Figures 1a and 1b). No correlation could be found with host, site of infestation, geographic area, or size of parasite to account for this variation. The variation might depend on the age of the parasite, but this could not be properly evaluated from preserved material. All specimens considered were ovigerous.

Metataeniacanthus vulgaris, new species

FIGURES 4-5, 46

MATERIAL EXAMINED.—Holotype ♀ (USNM 171326) and 4 ♀ paratypes (USNM 171327) from the gills of 2 *Synodus variegatus* (Lacepède) collected by L. P. Schultz from Tutuila Reef, Samoa, 4 June 1939. All of the following collections are from the gills of the same host species. One collection containing 1 ♀ from off Zanzibar. Twelve collections containing 65 ♀ from the Seychelles. Five collections containing 10 ♀ from off Ceylon. Three collections containing 9 ♀ from off western Sumatra. One collection containing 1 ♀ from off China. Seven collections containing 33 ♀ from the Philippines. Three collections containing 22 ♀ from the Celebes. Two collections containing 5 ♀ and 1 ♂ from Noumea, New Caledonia. Four collections containing 35 ♀ from off Palau Islands. Eleven collections containing 42 ♀ from off Queensland, Australia (Great Barrier Reef). One collection containing 7 ♀ from Trobriand Islands, New Guinea. One collection containing 2 ♀ from the Solomon Islands. Six collections containing 49 ♀ from the Marshall Islands. Six collections containing 29 ♀ from off Fiji. One collection containing 1 ♀ from off Tonga Islands. One collection containing 2 ♀ from off Samoa.

Female: Body form as in Figure 4a. Total length 3.03 mm, greatest width 0.58 mm (measured at widest part of cephalon). Cephalon wider than long (0.52 × 0.58 mm), fused with first thoracic segment. Fourth and fifth thoracic segments incompletely divided. Genital segment and area of egg sac at-

tachment (Figure 4b) wider than long ($129 \times 295 \mu\text{m}$), not distinctly separated from abdomen. Abdomen more than half total body length (1.84 mm), unsegmented, cylindrical, with very fine spinules at posterior tip (see Figure 4c). Caudal rami (Figure 4c) longer than wide ($94.4 \times 35.4 \mu\text{m}$), each bearing one lateral, one subterminal and 4 terminal setae (longest $289 \mu\text{m}$).

First antenna (Figure 4d) 7-segmented, an aesthaete on each of last 2 segments: segments measure 91, 71, 24, 15, 24, 18, and $29 \mu\text{m}$ long respectively; most setae on first 4 segments finely plumose. Second antenna (Figure 4e) 3-segmented; first and second segments bearing 1 seta each; last segment with row of fine spinules along posterior edge continuing along edge of blunt process on ventral side, tip of segment armed with larger blunt process also edged with fine spinules, 3 hooked spines and 3 setae. Postantennal hook (Figure 4f) recurved apically. Oral area as in Figure 4g. Mandible with 2 subequal bladlike processes at tip, each finely toothed. Paragnath distally trilobed with medial row of 8-11 blunt spinules recessed in pits. Second maxilla with 3 distal processes, shortest unarmed, longest with row of fine spinules, third with hooked spinules on each side. Maxilliped (Figure 4h) base with 2 inner, naked setae, short seta at base of terminal hook; hook with slight outward curve at tip and reaching to base of lateral setae on basal segment.

Legs 1-4 biramous; rami 3-segmented except 2-segmented exopod of first leg. Leg 1 (Figure 5a) basipod with stout plumose seta on outer corner and longer seta on inner edge near interpodal plate; exopod first segment with 1 outer seta, last segment with 3 short outer setae, 6 longer distal to inner setae; endopod first segment with short inner seta, second segment with longer inner seta, last segment with 7 setae (outer 2 short). Leg 2 (Figure 5b) basipod with naked seta on outer distal corner; exopod first segment with stout finely spinulose spine on outer distal corner, inner edge of segment with short, thick hairs, second segment with outer spinulose spine and inner seta, last segment bearing small papilla with minute sensilla near base of each 3 outer spinulose spines, terminal to inner edge with 5 setae; endopod first segment outer edge fringed with hairs, 1 inner distal seta, second segment similar to first, last segment with 3 outer spinulose spines, 3 terminal to inner setae (outermost short). Leg 3

(Figure 5c) similar to leg 2 except endopod last segment with 3 outer spines and only 2 terminal setae; outer distal spine of exopod first segment with rows of spinules near base not seen with light microscope but seen with SEM. Leg 4 (Figure 5d) similar to leg 3 except exopod last segment lacking papilla near base of 3 spines; endopod last segment with only 2 outer spines and 1 terminal seta. Leg 5 (Figure 5e) basal segment with dorsal outer seta; last segment with 4 setae of nearly equal length (2 outer, 2 terminal). Leg 6 (see Figure 4b) represented by 3 setae at area of egg sac attachment.

Egg sac cylindrical, nearly as long as abdomen, curving over abdomen.

Male: Body form similar to other males of genus. Total length 0.79 mm, greatest width 0.23 mm. Cephalon slightly longer than wide ($0.26 \times 0.23 \text{ mm}$). Genital segment longer than wide ($177 \times 132 \mu\text{m}$). Abdomen 3-segmented, segments wider than long, measuring $29 \times 82 \mu\text{m}$, $29 \times 75 \mu\text{m}$, $44 \times 67 \mu\text{m}$ respectively. Caudal rami longer than wide ($59 \times 29 \mu\text{m}$), each ramus bearing one lateral, 2 subterminal and 3 terminal setae (longest $218 \mu\text{m}$).

Cephalic appendages, except maxilliped, similar to female. Maxilliped (Figure 5f) basal segment with single seta, second segment with single seta and 2 raised, semicircular rows of blunt spinules, terminal claw with single seta, inner edge toothed, terminal teeth largest.

Leg 1 similar to female. Spine and seta formula for legs 2-4 follows. Roman numerals refer to spines, Arabic to setae.

	P ₂				P ₃				P ₄			
	exo		endo		exo		endo		exo		endo	
seg 1	I	0	0	1	I	0	0	1	I	0	0	1
seg 2	I	1	0	1	I	1	0	1	I	1	0	1
seg 3	III	4	III	damaged	III	4	III	2	III	4	II	1

Legs 2 and 3 lack sensillae at bases of exopod spines. Leg 5 similar to female except inner terminal seta about twice as long as other setae on leg. Leg 6 absent.

ETYMOLOGY.—The Latin *vulgaris* ("common") alludes to the wide range of the host and its parasite.

REMARKS.—The female of this species can be separated from all known species of *Metateaniacanthus* by the single sensilla near the base of the exopod spines of legs 2 and 3. This species is a common parasite of the gill filaments of *Synodus varie-*

gatus, occurring throughout most of its range except the southernmost Indian Ocean and mid-Pacific.

***Metataeniacanthus solidus*, new species**

FIGURES 6, 7

MATERIAL EXAMINED.—Holotype ♀ (USNM 171324) and 1 ♀ paratype (USNM 171325) from the area behind the filaments of the pseudobranch and on the operculum inner surface of *Synodus variegatus* collected off Wailangilala Island, Fiji, 26 May 1965. One collection containing 2 ♀ from the pseudobranch and inner surface of the operculum of the same host collected in the Caroline Islands. One collection containing 2 ♀ from the pseudobranch of the same host collected at Bikini, Marshall Islands. One collection containing 1 ♀ from the inner operculum of the same host species collected at Tonga Islands. One collection containing 1 ♀ from the inner operculum on the same host species collected by B. Russell at Lizard Island, Queensland, 10 November 1975.

Female: Body form as in Figure 6a. Total length 3.64 mm, greatest width 0.53 mm (measured at widest part of cephalon). Cephalon as long as wide, fused with first thoracic segment. Second, third, and fourth thoracic segments distinctly divided. Genital segment and area of egg sac attachment wider than long ($401 \times 177 \mu\text{m}$). Abdomen more than half body length (2.06 mm) unsegmented, without spinules at posterior tip, about 4 times as long as wide ($2.06 \times 0.51 \text{ mm}$). Caudal rami (Figure 6b) longer than wide ($71 \times 41 \mu\text{m}$) armed with setae as in other species of genus, longest seta $313 \mu\text{m}$.

First antenna (Figure 6c) 7-segmented, armed as in *M. vulgaris*. Second antenna (Figure 6d) armed as in *M. vulgaris* except terminal hooks less recurved. Oral area as in Figure 6e. Mandible as in other members of genus. Paragnath bilobed at tip with short row of spinules near tip. First maxilla with 2 short anteriorly directed setae and 2 long posteriorly directed setae. Second maxilla with 3 processes at tip, shortest unarmed, other 2 with hooklike spinules on two sides. Maxilliped (Figure 6f) base with 3 inner, naked setae, seta at base of terminal hook, hook slightly curved and not reaching to base of lateral setae on basal segment.

Legs 1-4 biramous, rami 3-segmented. Leg 1 (Figure 6g) basipod with stout plumose seta on

outer distal corner and longer seta on inner edge near interpodal plate; exopod 3-segmented, first segment with plumose seta on outer distal corner, second segment with shorter plumose seta on outer margin and stout plumose seta on inner margin, third segment with 2 outer setae and 5 longer terminal to inner setae; endopod armed as in *M. epigri*. Leg 2 (Figure 6h) armed as in *M. conepigri*. Leg 3 (Figure 7a) as in *M. conepigri* except terminal spine on last endopod segment of *M. solidus* much longer relative to segment length. Leg 4 (Figure 7b) armed with spines and setae as in *M. conepigri* and exopod segments heavily sclerotized but outer edge not contorted inwardly as in *M. conepigri*. Leg 5 (Figure 7c) armed as in *M. conepigri* except terminal 2 setae equal in length (outermost shorter in *M. conepigri*). Leg 6 (Figure 7d) represented by 3 setae at area of egg sac attachment. Egg sac as in *M. conepigri*.

Male: Unknown.

ETYMOLOGY.—The Latin *solidus* ("dense," "thick," "hard") alludes to the heavy sclerotization on the exopods of legs 2-4.

REMARKS.—This species can be separated from all other *Metataeniacanthus* by the nature of the sclerotized exopod of leg 4.

Although this copepod is found on the same host, *Synodus variegatus*, as *M. vulgaris* and in 3 of the 4 collections with *M. vulgaris* it occupies a different infestation site. It has never been collected from the primary gill filaments but, so far, has always been found either on the inner operculum wall or on the pseudobranch.

***Metataeniacanthus epigri*, new species**

FIGURES 8-10, 47

MATERIAL EXAMINED.—Holotype (USNM 171313) and 28 ♀ paratypes (USNM 171314) from the gills of *Synodus englemani* Schultz (paratypes USNM 152981) collected at Bikini, 8 July 1946. Seven collections containing 27 ♀ from the Red Sea near Aquaba. A single collection containing 1 ♀ from off Zanzibar. A single collection containing 3 ♀ from the Comores Islands. Two collections containing 9 ♀ from Nossi Bè, Malagasy Republic. Four collections containing 12 ♀ and 1 ♂ from Caragados Islands. Twenty three collections containing 236 ♀ and 3 ♂ from the Seychelles. Two collections containing

11 ♀ from off Male, Maldive Islands. One collection containing 2 ♀ from the South China Sea off Viet Nam. Seven collections containing 17 ♀ from Big Hope Island and Endeavour Reef off Australia. Two collections containing 55 ♀ from off the Philippines. Two collections containing 4 ♀ from Indonesia. Three collections containing 24 ♀ from near Trobriand Islands, New Guinea. Three collections containing 36 ♀ from off New Britain. Three collections containing 6 ♀ from off Ambon Island. One collection containing 75 ♀ and 1 ♂ from Celebes. Two collections containing 5 ♀ from the Solomon Islands. Two collections containing 3 ♀ and 1 ♂ from the Marianas Islands. Four collections (exclusive of types) containing 68 ♀ from the Marshall Islands. Three collections containing 14 ♀ from Palau Islands. One collection containing 7 ♀ from Tonga Islands. One collection containing 1 ♀ from Fiji. One collection containing 1 ♀ from Samoa. One collection containing 4 ♀ from Tahiti. One collection containing 2 ♀ from Gambier Islands. All above collections from the gill filaments of *Synodus englemani*.

Female: Body form as in Figure 8a. Total length 1.94 mm, greatest width 0.42 mm (measured at widest part of cephalon). Cephalon wider than long (0.34 × 0.42 mm) with low rounded rostrum. Genital segment and area of egg sac attachment (Figure 8b) wider than long (118 × 230 μm), not distinctly separated from abdomen and seen as a prominent ventral projection when viewed laterally. Abdomen almost half body length (0.94 mm), unsegmented, cylindrical, tapering gradually, with fine spinules near base of caudal rami (Figure 8c). Caudal rami (Figure 8c) almost 3 times as long as wide (94 × 32 μm), each ramus with 6 setae, innermost terminal finely plumose, longest 324 μm.

First antenna (Figure 8d) 7-segmented with aesthete on last 2 segments; segments measure 83, 68, 24, 24, 32, 24, and 35 μm long respectively, basal segments with 25 plumose setae. Second antenna (Figure 8e) 3-segmented, armed essentially as in other species. Oral area as in Figure 8f; labrum with fine spinules along posterior edge, mandible similar to other species, paragnath conspicuously trilobed and bearing row of spinules, remaining mouth parts as in other species. Maxilliped (Figure 8g) claw not reaching to base of setae on basal segment.

Legs 1-4 biramous, rami 3-segmented. Leg 1 (Figure 9a) basipod with stout plumose seta on

outer corner and longer plumose seta on inner edge near interpodal plate; exopod 3-segmented, first segment with a seta on outer distal corner, second with a seta on outer and one on inner edge, last segment with 7 setae; endopod first segment with inner seta (segment indistinctly separated from basipod), second segment with an inner seta, last segment with 7 setae (outer 2 much shorter than other 5). Leg 2 (Figure 9b) basipod with naked seta on outer distal corner; exopod first segment with long, slender, finely spinulose spine on outer distal corner, inner edge with thick hairs, second segment with 2 blunt sensillae near base of outer spine and 1 inner seta, last segment with a pair of blunt sensillae near base of each of the 3 outer spines (Figure 9c) and terminal to inner edge with 5 finely plumose setae; endopod first segment outer edge fringed with hairs and one seta on inner edge, second segment outer edge with hairs and inner edge with hairs and one seta, last segment with 3 outer spines (proximal 2 about 1/2 length of distal-most) each with hyaline fringe on distal half of outer margin, terminal to inner margin of segment with 3 finely plumose setae plus hairs on inner margin. Leg 3 (Figure 9d) similar to leg 2 except exopod second segment more elongate and endopod last segment with one less seta. Leg 4 (Figure 10a) basipod with naked seta on outer distal corner; exopod first segment with long outer recurved spinulose spine and inner edge with hairs, second segment with short slender outer spine and one inner seta, last segment with 4 outer to terminal slender, spinulose spines and 3 inner finely plumose setae; endopod first and second segments outer edges with hairs and one long finely plumose seta on inner edge of each, last segment outer edge with few hairs, 2 short outer finely spinulose spines and one long terminal seta (distal half finely spinulose). Leg 5 (Figure 10b) basal segment with naked dorsal seta, last segment with 4 finely spinulose seta (innermost considerably longer than others). Leg 6 (see Figure 8b) represented by 3 naked setae at area of egg sac attachment.

Eggs sacs cylindrical, extending entire length of abdomen.

Male: Body form as in Figure 10c. Total length 0.96 mm, greatest width 0.37 mm. Cephalon somewhat wider than long (0.37 × 0.30 mm). Genital segment (Figure 10d) slightly longer than wide (153 × 142 μm). Abdomen (see Figure 10c) 3-seg-

mented; segments wider than long, measuring $59 \times 89 \mu\text{m}$, $47 \times 74 \mu\text{m}$, and $38 \times 59 \mu\text{m}$, respectively. First abdominal segment with lateral lobate processes anteriorly. Caudal rami (Figure 10e) longer than wide ($56 \times 24 \mu\text{m}$) each ramus bearing one lateral, 2 subterminal and 3 terminal setae (longest $236 \mu\text{m}$).

Rostrum (Figure 10f) with ventral sclerotized plate bearing anteriorly directed spinelike process. Cephalic appendages as in female except maxilliped. Maxilliped (Figure 10g) second segment with saddle-shaped process on inner margin, edges of process ornamented with rows of spinules, 2 setae on inner margin of second segment; claw with heavily serrate inner margin, tip somewhat expanded and serrate as indicated in the figure.

Legs 1–4 similar to female except exopods lack sensillae at bases of outer spines and exopod segments relatively shorter. Leg 2 illustrated by Figure 10h. Leg 5 basically as in female, innermost terminal seta broken off on both specimens. Leg 6 absent.

ETYMOLOGY.—The Latin *epigri* ("wooden peg") alludes to the sensillae at the bases of the outer exopod spines of female legs 2 and 3.

REMARKS.—This is a common parasite of *Synodus englemani* and found throughout most of its range, except, as in *M. vulgaris*, it has not been collected in the southernmost host range in the Indian Ocean or easternmost Pacific. The female can be easily separated from *M. vulgaris* females by the 2 sensillae at the bases of the outer exopod spines of legs 2 and 3 of *M. epigri*. The female can be separated from *M. synodi* females by the much longer setae on the fifth legs of *M. epigri*.

Metataeniacanthus coneigri, new species

FIGURES 11–12, 48

MATERIAL EXAMINED.—Holotype ♀ (USNM 171311) and 6 ♀ paratypes (USNM 171312) from the gills of *Synodus jaculum* Russell and Cressey collected at Palau Island, 26 August 1956. One collection containing 2 ♀ from the pseudobranch of *S. jaculum* collected at the Comores Islands. One collection containing 21 ♀ from the gills and pseudobranch of *S. jaculum* collected at Mahé, Seychelles. Two collections each containing 1 ♀ from the gills of *S. jaculum* collected in the South China

Sea. One collection containing 4 ♀ from the gills of *S. jaculum* collected at Blanche Bay, New Britain. One collection containing 1 ♀ from the pseudobranch of *S. jaculum* collected near Negros Island, Philippines. One collection containing 3 ♀ from the pseudobranch of *S. jaculum* collected at Palau Islands, 6 April 1974. One collection containing 2 ♀ from Queensland, Australia.

Female: Body form as in Figure 11a. Total length 1.79 mm, greatest width 0.42 mm (measured at widest part of cephalon). Genital segment and area of egg sac attachment (Figure 11b) wider than long ($348 \times 124 \mu\text{m}$). Abdomen about half body length, unsegmented, cylindrical, without spinules posteriorly. Caudal ramus (Figure 11c) more than twice as long as wide ($89 \times 35 \mu\text{m}$) and armed as in *M. epigri* except no setae are plumose, longest seta $283 \mu\text{m}$.

First antenna, second antenna, oral appendages as in *M. epigri*. Maxilliped (Figure 11d) hook nearly reaching base of 2 mid-lateral setae.

Legs 1–4 biramous, rami 3–segmented. Leg 1 as in *M. epigri*. Leg 2 (Figure 11e) similar to *M. epigri* except exopod spines relatively much shorter and with one less exopod seta. Leg 3 (Figure 12a) as in *M. epigri* except for one less exopod seta. Leg 4 (Figure 12b) exopod with outer edge of last segment dorsally recurved inward with outer setae directed inward giving segment a twisted appearance; endopod as in *M. epigri*. Leg 5 (Figure 12c) stouter than *M. epigri*, setae on terminal segment non-plumose, innermost seta only slightly longer than adjacent seta (in *M. epigri* this seta is nearly twice the length of the adjacent one). Leg 6 (see Figure 11b) represented by 3 naked setae at area of egg sac attachment.

Egg sacs cylindrical, extending slightly beyond caudal rami.

Male: Unknown.

ETYMOLOGY.—The Latin *con* ("with") plus *epigri*, alludes to the close systematic relationship of the hosts of these 2 parasites.

REMARKS.—This species can be separated from *M. vulgaris* by the 2 sensillae at the bases of the outer spines on the exopods of legs 2 and 3 of *M. coneigri*. It can be separated from *M. synodi*, *M. epigri*, as well as *M. vulgaris* by the presence of only 4 setae and 3 spines on the last exopod segment of *M. coneigri* (other 3 species have 4 setae). It can be further separated from *M. epigri* by the

much longer terminal setae on the fifth leg of *M. epigri*.

The new species occurs throughout most of its host's range and is most often collected from on or under the pseudobranch.

Metataeniacanthus gibbsi, new species

FIGURES 13–15, 49

MATERIAL EXAMINED.—Holotype ♀ (USNM 171315) and 6 ♀ paratypes (USNM 171316) from the gills of *Synodus indicus* Day collected off East Africa (10°3'N, 51°15'E) during Cruise 9, Station 449, of the R/V *Anton Bruun*. Two additional collections containing 12 ♀ collected as above off East Africa (Stations 442 and 465). One collection containing 113 ♀ collected at 3°25'N, 47°14'E, "Meteor" Station 140. One collection containing 4 ♀ collected during Cruise 1, Station 22. (Andaman Sea) as above. One collection containing 2 ♀ from the Gulf of Mannar, Sri Lanka. One collection containing 1 ♀, 1 ♂ from Trivandrum, India. One collection containing 1 ♀ from Madras, India. One collection containing 2 ♀ collected from Rawley Shoals, West Australia. All above material collected from the gills of *Synodus indicus*.

Female: Body form as in Figure 13a. Total length 1.34 mm, greatest width 0.28 mm (measured at widest part of cephalon). Cephalon slightly wider than long (0.27 × 0.28 mm). Cephalon folded laterally as in Figure 13b. Free thoracic segments incompletely divided dorsally. Genital segment and area of egg sac attachment (Figure 13c) wider than long (118 × 194 μm), not distinctly separated from abdomen. Abdomen more than half total body length (0.83 mm), unsegmented, cylindrical, and bearing prominent spinules on ventral surface between insertion of caudal rami (Figure 13d). Caudal rami (see Figure 13d) longer than wide (44 × 18 μm), each bearing 6 setae (longest 165 μm), 2 plumose as in figure.

First antenna (Figure 13e) 7-segmented, an aesthete on each of last 2 segments, segments measure 68, 53, 24, 18, 21, 18, and 24 μm long respectively. Second antenna (Figure 13f) armed with spines and setae as in other species of the genus; spinules along posterior edge and terminal process fine and in a single row. Oral area as in Figure 14a. Maxilliped (Figure 14b) with conspicuous hook,

recurved at tip; hook nearly reaching base of 2 long setae of basal segment.

Legs 1–4 biramous, rami 3-segmented. Leg 1 (Figure 14c) armed as in other species of genus, interpodal plate with patch of scales along posterior edge. Leg 2 (Figure 14d) and Leg 3 (Figure 14e) similar to *M. epigri* except present species bears only 4 plumose setae on exopod last segment instead of 5. Leg 4 (Figure 15a) also as in *M. epigri* except outer exopod spines of present species naked. Leg 5 (Figure 15b) with 3 subequal terminal setae. Leg 6 (see Figure 13c) represented by 3 setae at area of egg sac attachment.

Egg sac extending slightly more than half the length of the abdomen.

Male: Body form as in Figure 15c. Total length 0.97 mm, greatest width 0.30 mm (measured at widest part of cephalon). Cephalon slightly wider than long (301 × 271 μm). Free thoracic segments indistinctly divided dorsally. Genital segment (Figure 15d) longer than wide (254 × 207 μm), posterior corners lobate, conforming to shape of spermatophore within. Abdomen 3-segmented, segments measure length and width respectively 71 × 83 μm, 59 × 77 μm, and 47 × 71 μm; last segment with spinules posteriorly between caudal rami. Caudal rami (Figure 15e) longer than wide (59 × 30 μm), longest seta 124 μm.

First antenna, second antenna, and mouth parts as in female. Maxilliped (Figure 15f) hook with serrate inner edge and macelike tip opposed by heavily ornamented area on basal segment as indicated in figure.

Leg 1 basically as in female except segmentation of exopod (Figure 15g) more distinct. Leg 2 (Figure 15h) armed with spines and setae as in female but lacking sensillae on exopod, exopod spines with heavier spinules than female, and exopod segments relatively shorter than in female. Leg 3 as in leg 2 except one less seta on endopod last segment. Leg 4 exopod similar to legs 2 and 3; endopod (Figure 15i) outer spines with heavier spinules and more spatulate than female. Leg 6 absent.

ETYMOLOGY.—Species is named for Dr. Robert Gibbs, who facilitated the loans of much of the host material examined in this study.

REMARKS.—The female of this copepod can be distinguished from all other female members of the genus by the patch of stout spinules on the abdomen between the bases of the caudal rami.

This parasite was collected from nearly all collections of the host species and, like the host, it has not been collected outside of the Indian Ocean.

Metataeniacanthus pacificus, new species

FIGURES 16-17, 50

MATERIAL EXAMINED.—Holotype ♀ (USNM 171322), and 5 ♀ paratypes (USNM 171323) from the gills of 1 *Synodus hoshinonis* Tanaka from MacClesfield Bank, South China Sea, 13 June 1964. One collection containing 10 ♀ from the gills of the same host collected from the same area. One collection containing 10 ♀ from the gills of the same host collected in the Arafura Sea (*Challenger Expedition*).

Female: Body form as in Figure 16a. Total length 1.25 mm, greatest width 0.24 mm (measured at widest part of cephalon). Cephalon slightly longer than wide (0.29×0.24 mm) fused with first thoracic segment (bearing leg 1). Thoracic segments 2, 3, and 4 separate (see Figures 16a and 16b). Genital segment and area of egg sac attachment (Figure 16c) wider than long (165×71 μm), separated from fifth thoracic segment and abdomen by slight lateral constriction. Abdomen about one-third total body length (0.45 long \times 0.18 mm wide), widest anteriorly and tapering posteriorly with patch of spinules between caudal rami (see Figure 16d). Caudal rami (Figure 16d) longer than wide (45×18 μm), each ramus with 3 plumose and 3 naked setae, longest seta 236 μm.

First antenna (Figure 16e) 7-segmented (third and fourth segments incompletely divided), one aesthete on each of last 2 segments; segments measure 59, 47, 18, 12, 26, 18, and 29 μm long respectively. Second antenna (Figure 16f) 3-segmented, armed as in other species of genus with spinules along posterior edge of last segment somewhat more widely spaced than other species, except the species to be described from *Synodus fuscus*. Postantennal hook (Figure 16g) long, slender, recurved apically. Oral area (Figure 17a) as in other species of genus except paragnath distinctly trilobed apically and without medial row of spinules; first maxilla with 2 long and 2 short setae. Maxilliped (Figure 17b) hook short and slightly curved, not reaching to base of lateral setae.

Legs 1-4 biramous, rami 3-segmented. Leg 1 (Figure 17c) armed as in other species of genus;

posterior edge of interpodal plate with bilobed spinulose process. Leg 2 (Figure 17d) basipod with outer distal seta; exopod first segment with naked spine on outer distal corner, second segment with 2 long sensillae near base of outer spine one inner seta, last segment with 2 sensillae near base of each of 3 outer spines (Figure 17e), terminal to inner edge with 5 plumose setae; endopod first segment with inner seta, second segment with inner seta, last segment with 3 short outer spines and 3 terminal to inner setae (1 short, 2 long). Leg 3 as in leg 2 except endopod last segment with only 2 terminal setae. Leg 4 (Figure 17f), basipod with outer seta; exopod first segment with slender outer spine, second segment with outer spine and inner seta, last segment with 3 outer spines and 4 terminal to inner setae; endopod first and second segments similar to legs 2 and 3, last segment with 2 short outer spines and one long naked terminal seta. Leg 5 (Figure 17g) basal segment with outer seta, last segment with 4 naked setae (2 outer and 2 terminal, innermost twice length of others). Leg 6 (see Figure 16c) represented by 3 short setae on genital segment.

Egg sac cylindrical, extending beyond tip of abdomen.

Male: Unknown.

ETYMOLOGY.—The Latin *pacificus* alludes to the parasite collected from *S. hoshinonis* in the Pacific part of its range only.

REMARKS.—*Metataeniacanthus pacificus* can be separated from all other species of the genus by the long setiform sensillae at the bases of the outer exopod spines of legs 2 and 3. It is also the only species with the combination of 5 setae and 3 spines on the last exopod segments of legs 2 and 3, and 4 setae and 3 spines on the corresponding segment of leg 4.

This parasite is so far recorded only from its host in the South China Sea and the Arafura Sea and appears to be restricted to *Synodus hoshinonis* occurring in the western Pacific Ocean. *Metataeniacanthus nudus*, described below, parasitizes Indian Ocean members of the same host species.

Metataeniacanthus nudus, new species

FIGURES 18-19, 50

MATERIAL EXAMINED.—Holotype ♀ (USNM 171320), and 8 ♀ paratypes (USNM 171321) from

the area of the pseudobranch of 6 *Synodus hoshinonis* Tanaka (USNM 217772) collected from the Andaman Sea during Cruise I of the R/V *Anton Bruun*, Station 21 (9°54'N, 97°42'E), 24 March 1973. Two additional collections containing 3 ♀ from the same site on the same species of host from the Andaman Sea (10°37'N, 97°34'E and 13°28'N, 97°19'E), R/V *Anton Bruun*, Cruise I, stations 22 and 37.

Female: Body form as in Figure 18a. Total length 2.94 mm, greatest width 0.65 mm (measured at widest part of cephalon). Cephalon wider than long (0.65 × 0.48 mm), fused with first thoracic segment. Second, third, and fourth thoracic segments free, each narrower than the segment anterior to it. Fifth segment incompletely separated from genital segment. Genital segment and area of egg sac attachment (Figure 18b) wider than long (289 × 89 μm), incompletely separated from abdomen. Abdomen less than half total length, 4-segmented, segments measuring 342, 242, 89, and 94 μm long respectively, last segment with short ventral row of spinules near insertion of caudal rami. Caudal rami (Figure 18c) longer than wide (48 × 32 μm), armed with one lateral, one subterminal, and 4 terminal setae, middle 2 with short plumosities.

First antenna (Figure 18d) 7-segmented, armed as in other members of genus; segments measure 53, 74, 30, 41, 65, 56, and 63 μm long; respectively. Second antenna (Figure 18e) 3-segmented, armed with spines and setae as in other members of genus. Oral area as in Figure 18f. Mandible as in other members of genus. Paragnath with weakly lobate tip. First maxilla bearing 2 long and 2 short setae. Second maxilla as in other members of genus. Maxilliped (Figure 18g) base with 2 inner, short setae, terminal hook long, reaching beyond base of 2 inner setae, tip strongly recurved.

Legs 1–4 biramous; rami 3-segmented. Leg 1 (Figure 19a) armed with spines and setae as in all other species of genus. Leg 2 (Figure 19b) armed with spines and setae as in *M. vulgaris*, spines on last endopod segment more prominent than in other species. Leg 3 as in leg 2 except one less seta on endopod last segment. Leg 4 (Figure 19c) exopod spines and setae as in *M. vulgaris*; endopod last segment with 2 prominent spines and 1 seta, seta with short spinules on edge rather than plumosities. Leg 5 (Figure 19d) with 1 lateral, 1 subterminal, and 2 terminal setae, all spinulose, innermost with

stout base. Leg 6 (Figure 18b) represented by 3 setae at area of egg sac attachment.

Egg sac short, extending only to end of second abdominal segment.

Male: Unknown.

ETYMOLOGY.—The Latin *nudus* ("naked") alludes to the lack of sensilla at the bases of the outer exopod spines of legs 2–4.

REMARKS.—This species can be separated from all other *Metataeniacanthus* by the lack of sensillae at the bases of the outer exopod spines of legs 2–4. Furthermore, it is unique within the genus in that the maxilliped claw extends well beyond the bases of the setae on the first maxilliped segment.

This species, collected from *Synodus hoshinonis* in the Andaman Sea, has same host species as *M. pacificus*. The two parasites, however, are geographically separated by the Malay archipelago. Examination of specimens of *S. hoshinonis* from both geographic areas, each with its own *Metataeniacanthus* species as a parasite, are inconclusive, and they are considered here as one species. The Indian Ocean population of the host extends to East Africa and the Red Sea. The parasite (*M. nudus*), however, has so far only been collected in the Andaman Sea.

Metataeniacanthus indiscretus, new species

FIGURES 20–22, 51

MATERIAL EXAMINED.—Holotype ♀ (USNM 171317), allotype ♂ (USNM 171318) and 21 ♀ 1 ♂ paratypes (USNM 171319) collected during Cruise I of the R/V *Anton Bruun*, Station 22 (10°37'N, 97°34'E) from the gills and pseudobranch of *Synodus* species (undescribed). Three collections containing 22 ♀ from the gills and pseudobranchs of the same host in the South China Sea (16°N, 114°E). One collection containing 3 ♀ from the gills of the same host from Netherlands Indies (Indonesia) by Longley. One collection containing 4 ♀ from the gills of the same host collected in the Andaman Sea during Cruise I, Station 28 of the R/V *Anton Bruun*.

Female: Body form as in Figure 20a. Total length 1.28 mm, greatest width 0.29 mm (measured at widest part of cephalon). Cephalon somewhat wider than long (0.29 × 0.25 mm), fused with first thoracic segment. Remaining thoracic segments separate but incompletely divided dorsally. Genital segment

about as long as wide and narrower than abdomen. Abdomen more than half total body length and inflated in ovigerous females, unsegmented, cylindrical, no spinules could be seen at posterior tip. Caudal rami small, longer than wide ($44 \times 24 \mu\text{m}$), longest seta $218 \mu\text{m}$, armed as in other members of the genus.

First antenna (Figure 20*b*) 6-segmented, an aesthete on each of last 2 segments, segments measure 33, 27, 25, 21, 18, and $24 \mu\text{m}$ respectively. Second antenna (Figure 20*c*) armed as in other members of the genus, last segment with a row of heavy spinules along posterior edge more widely spaced than in most species of the genus; terminal spinulose process with finer spinules. Postantennal hook (Figure 20*d*) recurved apically, large and generally visible from dorsal aspect. Oral area as in Figure 20*e*. Spinules along edge of both terminal processes heavy and more widely spaced than in other species of the genus. Maxilliped (Figure 20*f*) basal segment partly divided near mid-area, proximal part narrower than distal, terminal hook short, not reaching base of lateral setae on basal segment.

Legs 1-4 biramous, rami 3-segmented. Leg 1 (Figure 20*g*) basipod with stout plumose seta on outer distal corner and another on inner margin; exopod first segment with recurved seta on outer distal corner, second segment with one inner and one outer seta, third segment with 7 inner to outer setae; endopod first and second segments each with one inner seta, third segment with 7 inner to outer setae. Leg 2 (Figure 20*h*) basipod with naked seta on outer distal corner; exopod first segment with finely spinulose seta on outer distal corner, second segment with an inner plumose seta and on outer finely spinulose seta, third segment with 3 outer to terminal finely spinulose setae and 4 terminal to inner plumose setae, a pair of short sensillae near bases of spinulose setae of second and third segments; endopod first and second segments each with an inner plumose seta, third segment with 3 short, outer spines and 3 terminal setae. Leg 3 (Figure 21*a*) armed as in leg 2 except one less plumose seta on third segment of exopod and endopod. Leg 4 (Figure 21*b*) armed as in leg 3 except no sensillae at base of outer exopod setae and only one spine and one seta on terminal endopod segment. Leg 5 (Figure 21*c*) unsegmented, bearing one outer and 3 terminal setae, ramus weakly sclerotized and quite unlike other known members of the genus. Leg 6

(Figure 21*d*) represented by 3 short setae at area of egg sac attachment.

Male: Body form as in Figure 21*e*. Total length 0.65 mm, greatest width 0.23 mm (measured at widest part of cephalon). Cephalon about as long as wide. Genital segment (Figure 22*a*) longer than wide ($135 \times 100 \mu\text{m}$). Abdomen (see Figure 21*e*) 3-segmented, segments incompletely divided, measuring $35 \times 56 \mu\text{m}$, $30 \times 53 \mu\text{m}$, and $35 \times 47 \mu\text{m}$ length and width respectively. Caudal ramus (Figure 22*b*) about twice as long as wide ($35 \times 18 \mu\text{m}$), longest seta $130 \mu\text{m}$.

First antenna (Figure 22*c*) armed as in female except aesthete on penultimate segment nearly as long as entire antenna. Second antenna as in female except terminal segment relatively longer. Postantennal hook (Figure 22*d*) small, pointed. Oral area as in female. Maxilliped (Figure 22*e*) hook with serrate inner edge and macelike tip opposed by ornamented area on second segment.

Leg 1 as in female. Leg 2 (Figure 22*f*) armed with spines and setae as in female but lacking sensillae on exopod, segments of exopod relatively shorter than in female. Leg 3 as in leg 2 except endopod last segment with one less seta. Leg 4 (Figure 22*g*) armed with spines and setae as in female but segments in both rami relatively shorter. Leg 5 (Figure 22*h*) unsegmented, bearing one lateral and 3 terminal naked setae. Leg 6 absent.

ETYMOLOGY.—The Latin *indiscretus* ("undivided") alludes to the fusion of segments of the fifth leg.

REMARKS.—The female of this species can be separated from all known *Metataeniacanthus* females by the nature of leg 5. In all other species leg 5 is clearly 2-segmented. In *M. indiscretus* leg 5 is unsegmented.

The host of this parasite is a new species being described separately by the first author.

Metataeniacanthus aquilonius, new species

FIGURES 23-24, 52

MATERIAL EXAMINED.—Holotype ♀ (USNM 171309) 64 paratype ♀ (USNM 171310) collected from the gills of *Synodus macrops* Tanaka collected off Kochi, Japan, 22 October 1976. One collection containing 1 ♀ from the Gulf of Aden. Two collections containing 5 ♀ from off Somalia, R/V *Anton*

Bruun, Cruise 9, Stations 463, 468. One collection from the Arabian Sea (17°25'N, 70°39'E), *Anton Bruun*, Cruise 4B, Station 202A. One collection containing 1 ♀ from the Andaman Sea (92°53'E, 11°49'N). One collection containing 1 ♀ from off Hong Kong. One collection containing 1 ♀ from the Formosa Strait (26°N, 121°E). One collection containing 10 ♀ from off Owase, Japan. One collection containing 1 ♀ from the Japan Sea off the Shimane Prefecture. All collections above were from the gills and pseudobranch (Hong Kong coll.) of *Synodus macrops*.

Female: Body form as in Figure 23a. Total length 2.95 mm, greatest width 0.40 mm (measured at widest part of cephalon). Cephalon slightly wider than long (0.43 × 0.41 mm). Thoracic segments bearing legs 2–5 distinct but not divided dorsally. Genital segment and area of egg sac attachment (Figure 23b) wider than long (0.29 × 0.13 mm). Abdomen more than half total body length (1.67 mm), unsegmented, cylindrical, and bearing fine spinules between insertion of caudal rami (Figure 23c). Caudal rami (see Figure 23c) longer than wide (100 × 35 μm), each bearing 6 setae, longest 2 with short plumosities (longest 277 μm).

First antenna (Figure 23d) 7-segmented, an aesthete on each side of last 2 segments, segments measure 65, 27, 18, 24, 24, 21, and 32 μm long respectively. Second antenna (Figure 23e) tip armed with 3 recurved spines and 3 setae, spinules along edge of last segment somewhat stouter and not as fine as in most other species described here. Post-antennal hook (Figure 23f) strongly recurved. Oral area (Figure 23g) basically as in other species; paragnath tip weakly lobed. Maxilliped (Figure 23h) hook slightly recurved, not reaching base of 2 lateral setae.

Legs 1–4 biramous, rami 3-segmented. Leg 1 (Figure 24a) armed as in other species of genus. Leg 2 (Figure 24b) armed with spines and setae as in *M. gibbsi*; 2 sensillae at bases of exopod spines of last 2 segments, distalmost outer spine of last endopod segment about twice length of proximal 2. Leg 3 (Figure 24c) armed as in leg 2 except one less seta on endopod last segment. Leg 4 (Figure 24d) armed as in leg 3 except sensillae lacking at bases of exopod spines and one less spine and seta on endopod last segment. Leg 5 (Figure 24e) with setae as in other members of genus, innermost only slightly longer than others on free segment, single

row of spinules near base of innermost seta. Leg 6 (see Figure 23b) represented by 3 short setae at area of egg sac attachment.

Egg sac not extending to caudal rami.

Male: Unknown.

ETYMOLOGY.—The Latin *aquilonius* ("north") alludes to its range in the northern hemisphere of the Indo-West Pacific.

REMARKS.—This species can be separated from all other species of *Metataeniacanthus* except *M. indiscretus* by the spine and seta formula (see Table 1). It can be separated from *M. indiscretus* by the nature of leg 5. The fifth leg of the new species is 2-segmented whereas in *M. indiscretus* it is one-segmented.

Metataeniacanthus aquilonius has so far been found throughout the range of its host, extending from the Gulf of Aden across the northern Indian Ocean into the West Pacific to Japan. The copepod has been collected from the gills and the pseudobranch of *Synodus macrops*.

Parataeniacanthus Pillai, 1963

Parataeniacanthus longicervis Pillai, 1963

FIGURES 25, 26

MATERIAL EXAMINED.—13 ♀ 1 ♂ from the gills of *Saurida undosquamis* (Richardson) from the following localities: R/V *Anton Bruun*, Cruise 4B, Station 209A (20°49'N, 60°41'E) and Station 216A (21°49'N, 68°55'E), Cruise 1, Station 28A (11°52'N, 92°49'E), R/V *Cape St Mary*, Cruise 20, South China Sea (16°6'N, 114°41'E); 2 ♀ from the gills of *Saurida elongata* (Temminck and Schlegel) from Hong Kong.

Female: The female of this species was described by Pillai (1963) and only a few points will be added here to that description. Illustrations of diagnostic features are included so that the reader can identify material of this species without reference to the original description. Body form as in Figure 25a. Total length 4.07 mm. Greatest width 1.16 mm (measured at widest part of cephalon). Caudal rami (Figure 25c) twice as long as wide (248 × 118 μm). Oral area typically taeniacanthid. Maxilliped (Figure 25d) with variable number of teeth (6–9) on prominent claw.

Legs 1–4 biramous, rami 3-segmented. Leg 2 (Figure 25e) as in Pillai except 3 outer spines of

endopod fringed on outer edge. Leg 3 (Figure 25f) as in Pillai except very small spinules near base of exopod distalmost outer spine (Pillai notes these on leg 4 only). Leg 4 (Figure 25g) as in Pillai with pair of small spinules near base of each outer spine on segments 2 and 3. Leg 5 (Figures 26a) lamelliform, innermost seta (short claw of Pillai) heavily sclerotized, truncate, spinelike. Leg 6 (see Figure 25b) represented by 3 short setae at area of egg sac attachment.

Male: Body form as in Figure 26b. Total length 3.18 mm. Greatest width 0.83 mm (measured at widest part of cephalon). Cephalon 0.64 mm long. Genital segment slightly wider than long ($354 \times 324 \mu\text{m}$). Abdomen 4-segmented, each segment wider than long, measuring $354 \times 277 \mu\text{m}$, $313 \times 248 \mu\text{m}$, $248 \times 218 \mu\text{m}$, and $195 \times 177 \mu\text{m}$ respectively. Caudal ramus nearly 3 times as long as wide ($153 \times 57 \mu\text{m}$), longest seta $678 \mu\text{m}$. Appendages as in female except maxilliped (Figure 26d). Maxilliped basal segment with row of rounded teeth, claw with distal double row of teeth.

REMARKS.—This species is apparently an occasional parasite on species of *Saurida*. Pillai (1963a: 120) reported it from *Saurida tumbil* (Bloch) but we did not recover it from this host. Unlike *Metataeniacanthus*, legs 1–4 of both sexes are identical. In *Metataeniacanthus* the legs of males are more delicate and less modified.

Taeniacanthus Sumpf, 1871

Taeniacanthus sauridae Yamaguti and Yamasu, 1959

FIGURES 27, 28

MATERIAL EXAMINED.—13 ♀ 1 ♂ from gills of 12 *Saurida elongata* (Temminck and Schlegel) (USNM 136243) collected in the Philippines (1909 *Albatross* collection), 1 ♀ from the gills of *Saurida gracilis* (Quoy and Gaimard), 2 ♀ from the gills of *Saurida longimanus* Norman (USNM 136050 and 136213) also from same collection area as above, 1 ♀ from the gills of *Saurida undosquamis* (Richardson) collected during Cruise 1 of the R/V *Anton Bruun* in the Andaman Sea ($9^{\circ}13'N$, $97^{\circ}51'E$), 3 March 1963.

Female: The female of this species was adequately described by the authors and no further description will be included here except where differences were noted or to enable the reader to identify this

parasite without reference to the original description. Body form as in Figure 27a. First antenna 7-segmented. Maxilliped (Figure 27b) basal segment with 2 setae on inner margin (Y and Y note only 1), 2 short setae near base of claw, claw bifid at tip. Leg 2 (Figure 27c) as in Y and Y but comblike folds on outer margins of exopod segments and last 2 endopod segments seen as sclerotized areas on specimens recorded above. Legs 3 and 4 as in Figures 27d and 27e.

Male: Body form as in Figure 27f. Total length 0.84 mm, greatest width 0.34 mm (measured at widest part of cephalon). Cephalon somewhat wider than long ($336 \times 271 \mu\text{m}$). Thoracic segment bearing leg 1 fused with cephalon. Thoracic segments bearing legs 2–5 free. Genital segment (Figure 28a) wider than long ($153 \times 106 \mu\text{m}$). Abdomen (see Figure 27f) 3-segmented, each segment wider than long and measuring $83 \times 41 \mu\text{m}$, $77 \times 35 \mu\text{m}$, and $71 \times 41 \mu\text{m}$ respectively. Caudal rami about twice as long as wide ($47 \times 20 \mu\text{m}$), longest seta $212 \mu\text{m}$.

Oral area and mouthparts as in female. Maxilliped (Figure 28b) basal segment with prominent seta near inner mid-margin, 2 rows of knoblike spinules on distal two-thirds with a short row of pointed spinules proximal to knobs; claw with a basal seta and toothed as in the figure.

Leg 1 as in female. Legs 2–4 biramous, rami 3-segmented. Leg 2 (Figure 28c) exopod first segment with slender spine on outer distal corner, second segment with inner plumose seta and outer distal spine, last segment with 3 outer spines and 5 terminal to inner setae; endopod first segment with inner plumose seta, second segment with 2 inner setae, last segment with 3 stout, toothed, outer spines and 3 inner setae. Leg 3 (Figure 28d) exopod as in leg 2 except one less spine and one additional seta on last segment, endopod as in leg 2 except terminal-most toothed spine of last segment much longer than other 2, and 1 less inner seta. Leg 4 (Figure 28e) exopod as in leg 3; endopod first and second segments each with an inner seta, last segment with 2 toothed spines and 1 terminal seta. Leg 5 (Figure 28f) basipod with an outer seta; free segment with one outer lateral and 3 terminal setae, all setae of about equal length (inner 2 slightly longer than outer 2). Leg 6 absent.

REMARKS.—The original description of this copepod was based on the collection of 4 ♀ from the gills of *Saurida argyrophanes* (Richardson), now

considered (Norman) a synonym of *Saurida undosquamis*, collected from the Inland Sea of Japan. This copepod appears to be an occasional parasite on Indo-Pacific *Saurida* based on the collections reported here. The females can be easily separated from other species of the genus by the peculiar bifurcate maxilliped claw.

Taeniastrotus Cressey, 1969

Taeniastrotus species

As this paper was going to press we received a collection of what appears to be new species of *Taeniastrotus* Cressey. The parasites (8♀) were collected from the body surface "between the scales" of *Trachinocephalus myops* at Trivandrum, India by Mr. A. Chandran of the University of Kerala.

We expect to publish a detailed description of this new species separately.

Abasia Wilson, 1908

DIAGNOSIS.—*Female*: Frontal lunule absent or present. Rostrum prominent, generally produced beyond anterior margin of first antenna. Lateral margins of carapace folded ventrally. Thoracic area reduced. Genital segment large, comprising about one-third total body length. Abdomen 2-segmented. Caudal rami small, bearing 6 setae, terminal 3 setae about equal in length. First antenna typically caligoid. Second antenna uncinata. First maxilla present (second maxilla of Pillai, 1963b). Second maxilla with stout terminal flagellum (first maxilliped of Pillai, 1963b). Maxilliped robust with well-developed claw (second maxilliped of Pillai, 1963b). Sternal furca absent. Legs 1-4 as in other caligoids but showing varying degrees of reduction.

Male: Frontal lunules present. Lateral margins of carapace not folded ventrally. Second antenna dactylate. Other appendages generally as in female.

TYPE-SPECIES.—*Abasia platyrostris* Wilson, 1908; gender, f.

DISCUSSION.—The new species of *Abasia* described herein have characters differing from one another

TABLE 2.—Segmentation of the third leg exopods and endopods of the species of *Abasia*

	exopod	endopod
<u>pseudorostris</u>	3	2
<u>platyrostris</u>	2	2
<u>tripartita</u>	2	1
<u>pusilla</u>	2	0
<u>pillaii</u>	2	0
<u>inflata</u>	1	0

to the extent that some authors might consider them to represent more than one genus. In view of the morphological characters that they have in common, their preference for synodontid fishes, we prefer to consider the group as members of one plastic genus. The reduction of the female third leg is represented in several stages as indicated by Table 2.

If the reduction were in discrete groups, the case for more than one genus might be supported. *Abasia pusilla* and *A. pillaii* are the only 2 with similar segmentation. The close relationship of these 2 species has been pointed out above. Pillai (1963b) points out that although Wilson (1908) states that *A. pseudorostris* attaches to the roof of the mouth, with the anterior of the cephalon buried in the flesh, the structure of the anterior of the animal does not support this claim. The senior author's experience collecting this Atlantic species is that the copepod is found in the gill area, not buried, and was never collected from the roof of the mouth.

In 1974, Kabata published SEM photos of the mouth tubes of 3 species of caligid copepods. These photos and the diagrammatic illustrations demonstrate the presence of a tooth structure, in addition to the mandible, within the mouth tube, near the tip of the labium. He designated this structure as the *strigil* (p. 1587) and described it in some detail. We found the same structure in SEM photos of the mouth tubes of *Abasia* species.

Key to Species of *Abasia* Females

1. Leg 2 rami 3-segmented2
 Leg 2 rami indistinctly 2-segmented, leg 4 lacking*A. inflata*, new species
2. Leg 3 biramous3
 Leg 3 uniramous, endopod represented by single seta4

Key to Species of *Abasia* Females (cont'd)

3. Leg 3 exopod and endopod both 2-segmented, first antenna basal segment setae with stout spinules *A. platyrostris* Pillai
 Leg 3 exopod or endopod (but not both) 2-segmented 5
4. Abdomen 2-segmented, first segment only slightly narrower than genital segment, second segment enveloped anteriorly and laterally by first segment *A. pillaii*, new species
 Abdomen 1-segmented, less than one third width of genital segment *A. pusilla*, new species
5. Leg 3 exopod 2-segmented, endopod 1-segmented *A. tripartita* (Shiino)
 Leg 3 exopod 3-segmented, endopod 2-segmented *A. pseudorostris* Wilson

***Abasia platyrostris* Pillai, 1963**

FIGURES 29, 53

MATERIAL EXAMINED.—9 ♀ 3 ♂ from the buccal cavity of 2 *Synodus ulae* Schultz from Honolulu, Hawaii. One ♀ from the buccal cavity of *Saurida undosquamis* (Richardson) from the Arabian Sea (20°49'N, 69°41'E) R/V *Anton Bruun*, Cruise 4B, Station 209A. One ♀ paratype donated to the Smithsonian collections by Dr. Pillai from the buccal cavity of *Synodus indicus* collected at Trivandrum, India. One ♀ from all Western Australia.

Female: Body form as in Figure 29a. This species was well described by Pillai and only a few additional details are added here. Caudal rami (Figure 29b) longer than wide (100 × 65 μm) armed with plumose setae as in the figure, longest 147 μm. First antenna (Figure 29c) 2-segmented; first segment armed with 23 setae, distalmost setae armed with stout spinules ("conspicuously pectinate" of Pillai, p. 7); second segment armed with 12 setae and 1 aesthete.

Leg 2 (Figure 29d) rami 2-segmented; exopod first 2 segments each with a stout, inwardly directed spine on the outer distal corners; endopod first segment outer distal corner with a row of stout spinules; interpodal plate with a prominent distal fringe. Leg 3 (Figure 29e) rami 2-segmented; exopod last segment with 3 spines and 3 short setae (Pillai shows only 2 setae); endopod segments with a row of stout spinules on outer edges. Leg 4 (Figure 29f) ramus 2-segmented with a spine on the outer distal corner of the first and 3 short spines on the distal end of the second segment, all spines with a short row of spinules near their bases. Legs 5 and 6 each reduced to a single seta on genital segment.

REMARKS.—Pillai (1963b:5), reported this copepod from the buccal cavity of *Saurida tumbil* (Bloch) and *Synodus indicus* (Day) all from Trivandrum,

India. Kazachenko (1975:212) reports this copepod from the gills of *S. tumbil* and *S. undosquamis* (Richardson) from off the coast of northwestern Australia. Our examinations of synodontid fishes resulted in the additional record of the parasite from *Synodus ulae* Schultz. It seems that this copepod, although probably restricted to synodontid fishes, is an occasional parasite on a number of species within that family. In view of the past unsettled status of Indo-West Pacific *Synodus* systematics it seems reasonable to treat the record of this parasite from *S. indicus* as tentative.

***Abasia pusilla*, new species**

FIGURES 30, 31, 39a-c, 53

MATERIAL EXAMINED.—Holotype ♀ (USNM 171333), allotype (USNM 171334) and 5 paratypes (USNM 171335), 2 ♀, (1 ♀ prepared for SEM study) from the gills of 5 *Synodus ulae* from Wakanoura, Japan. Three ♀ from 1 *Synodus ulae* from Misaki, Japan; 1 ♀ from the gills of *Synodus ulae* from Kochi, Japan; 1 ♀ from the gills of *Synodus ulae* from Japan; and 1 ♀ from Okinawa.

Female: Body form as in Figures 30a and 30b. Total length 4.96 mm, greatest width 2.23 mm. Cephalon slightly longer than wide (1.77 × 1.58 mm) with lateral margins folded ventrally to encompass host gill filament. Thoracic segments indistinctly separated from cephalon. Genital segment wider than long (2.23 × 1.57 mm), globose. Abdomen unsegmented, somewhat longer than wide (0.62 × 0.51 mm), constricted in posterior third, probably indicating fused segmentation. Caudal rami (Figure 30c) longer than wide (118 × 71 μm) each bearing 6 plumose setae, longest 165 μm.

Rostrum projecting forward with indistinct frontal lunules (SEM photo, Figure 39a, indicates lunule is well developed but difficult to see with light microscope) and bearing a well-defined rugose

area ventrally at mid point of anterior margin (Figure 39b). First antenna (Figure 30d) of usual caligid type, first segment with 24 sparsely plumose setae, second segment with 12 setae and 1 aesthete. Second antenna (Figure 30e) with robust basal segment and a short claw bearing 2 short setae. Tip of mandible (Figure 30f) bearing 12 teeth. First maxilla (Figure 30g) as in the figure. Second maxilla (Figure 30h) second segment with a prominent spine on inner distal corner (Figure 39c), terminal claw with rows of spinules as indicated in the figure and Figure 39d. Maxilliped (Figure 30i) with stout base and short, recurved, terminal claw.

Leg 1 (Figure 30j) biramose; basipod with an inner and an outer seta; exopod 2-segmented, first segment with a short spine on outer distal corner, second segment with 4 terminal setae, outer 2 with lateral spinules, innermost with short plumosities, remaining seta naked; endopod reduced, bearing one, short, terminal seta. Leg 2 (Figure 31a) coxopod with broad hyaline membrane along outer edge; basipod with short seta on outer edge and broad hyaline membrane along inner margin; exopod 3-segmented, first segment with broad hyaline membrane on outer edge, a long finely spinose spine on outer distal corner, and an inner seta, second segment with a long finely spinose spine on outer distal corner (Figure 39e) and an inner seta, last segment with 2 outer spines and 6 setae; endopod 3-segmented, first segment with a row of spinules along outer distal third and an inner seta, second segment with a row of spinules along outer margin and 2 inner setae, last segment with a short row of spinules on outer margin and 6 setae; interpodal plate with a broad posterior hyaline membrane. Leg 3 (Figure 31b) coxopod and basipod forming a lamella, outer distal corner bearing a seta, inner margin bearing a plumose seta near exopod and a broad hyaline membrane to interpodal plate; exopod 2-segmented, first segment heavily sclerotized with stout spine on outer distal corner, second segment with 2 terminal setae; endopod represented by single seta. Leg 4 (Figure 31c) coxopod and basipod indistinctly divided with seta on outer distal corner; exopod 2-segmented, first segment with short, stout spine on outer distal corner, second segment with 2 terminal, short, stout spines; entire leg weakly developed. Legs 5 and 6 absent.

Male: Body form as in Figure 31d. Total length

2.10 mm, greatest width 0.88 mm. Cephalon slightly longer than wide (0.99×0.88 mm), lateral margins not folded ventrally; frontal lunules more developed than female. Genital segment (Figure 31e) about as long as wide (0.61×0.59 mm), rounded, widest near middle. Abdomen 2-segmented (see Figure 31e), first segment much wider than long (206×53 μ m), second segment only slightly wider than long (248×230 μ m). Caudal rami 118 μ m long and 71 μ m wide, each with 6 plumose setae, 2 short lateral, 3 terminal, 1 subterminal; longest seta 153 μ m.

Appendages as in female except as follows. Second antenna with dactylate tip (Figure 31f). Maxilliped with claw longer than in female relative to basal segment. Legs 1-4 as in female. Legs 5 and 6 represented by 2 setae and 1 seta on lateral margins of genital segment as indicated in Figure 31e.

ETYMOLOGY.—The Latin *pusilla* ("small") refers to the size of the abdomen when compared to the other species of the genus.

REMARKS.—This species can be separated from the previously described species (*A. pseudorostris* Wilson and *A. platyrostris* Pillai) by the reduction of the leg 3 endopod. It can be further separated from these 2 species plus the following 2 new species by the reduced development of the abdomen in *A. pusilla*.

This species so far is restricted to *Synodus ulae* from Japan. In 2 collections this species was found with another species of *Abasia*, described below.

Abasia inflata, new species

FIGURES 32, 33, 39f, 40, 53

MATERIAL EXAMINED.—Holotype ♀ (USNM 171328) and 3 paratype ♀ (USNM 171329) from the gills of *Saurida gracilis* from the Philippines. One ♀ from the Philippines. One ♀ from Trobriand Islands, New Guinea. One ♀ from New Georgia, Solomons Islands. Four ♀ from Ambon and Kabaena Islands, Molluccas. All other material from the gills of the same host species as the types.

Female: Body form as in Figure 32a-c. Total length 2.25 mm, greatest width 0.96 mm. Cephalon slightly longer than wide (0.90×0.73 mm), dorsal surface papillose (Figures 39f, 40a). Genital segment about as long as wide (0.88×0.90 mm), wider than cephalon. Abdomen 2-segmented; first segment inflated with other posterior corners produced, ex-

tending to or slightly beyond caudal rami, about as wide as genital segment; second segment (Figure 32*d*) much smaller. Caudal rami (see Figure 32*d*), wider than long ($47 \times 35 \mu\text{m}$), with 6 plumose setae (longest $94 \mu\text{m}$).

Rostrum (Figure 32*e*) with 2 fleshy lobes projecting beyond first antennae. Frontal lunules absent (not seen with light or scanning electron microscope). Mid-ventral rugose area (Figures 40*b,c*) present as in previous species. First antenna (Figure 32*f*) of usual caligoid type; basal segment relatively smaller than in preceding species, no aesthetes seen. Second antenna (Figure 32*g*) uncinata, claw more curved than in preceding species. Mouth tube with mandible and strigil (see Kabata, 1974:1587) within (Figure 40*d*). Mandible (Figure 32*h*) as in other species of the genus. First maxilla (Figure 32*i*) simple, with tip bearing 3 setae, one very broad, with spinules on distal half. Second maxilla (Figure 32*j*) with short distal claw (Figure 40*e*) bearing rows of spinules, an inner distal spinulose spine, and a palmate process (Figure 40*f*) on outer edge near base of distal claw. Maxilliped (Figure 32*k*) as in preceding species.

Leg 1 (Figure 33*a*) weakly developed; exopod 1-segmented, bearing a lateral outer spine where segmentation occurs in other species, 4 short terminal setae, armed as in the figure; endopod small, bearing a short distal seta. Leg 2 (Figure 33*b*) with broad hyaline membranes as in previous species; exopod 2-segmented, first segment with well-developed outer distal spine and an inner seta, last segment with an outer well-developed spine, 2 weak outer spines and 4 terminal to inner plumose setae; endopod 2-segmented (segmentation weak), first segment with an inner plumose seta, last segment with 5 outer to inner plumose setae. Leg 3 (Figure 33*c*) reduced to a single segment bearing 1 subterminal spine and 2 short terminal spines, longest armed with rows of spinules. Legs 4-6 absent.

Male: Unknown.

ETYMOLOGY.—The Latin *inflata* ("swollen") alludes to the 2 lobes on the rostrum.

REMARKS.—This species is characterized by the fleshy lobes of the rostrum and the absence of frontal lunules in the female (males were not found but we suspect that since the rostral area of males is usually less modified a frontal lunule would probably be seen).

To date this species has only been found on the gills of *Saurida gracilis* and restricted to the western Pacific Ocean.

Abasia tripartita (Shiino, 1955)

FIGURES 34, 35, 41, 42, 43, 44*a, b*, 53

Alicalgus tripartitus Shiino 1955:56-61.

MATERIAL EXAMINED.—One ♀ and 1 ♂ from the gills of *Synodus ulae* Schultz from Wakanoura, Japan. One ♀ from the same host from Misaki, Japan. Three collections containing 15 ♀ and 2 ♂ from the gills of *Synodus hoshinonis* from Japan.

Female: Body form as in Figure 34*a,b*. Total length 3.55 mm, greatest width 2.04 mm (measured at widest part of genital segment). Cephalon slightly wider than long ($1.42 \times 1.27 \text{ mm}$), folded laterally. Thoracic segments fused with cephalon dorsally. Genital segment wider than long ($2.04 \times 1.37 \text{ mm}$), globular in dorsal view but flattened dorsoventrally, dorsal surface papillose (Figure 41*a*). Abdomen 2-segmented, nearly as long as wide ($1.09 \times 1.26 \text{ mm}$); first segment encompassing second laterally, distal corners extend beyond caudal rami. Caudal rami (Figure 34*c*) longer than wide ($106 \times 54 \mu\text{m}$) armed with 2 outer lateral, 3 terminal, and 1 sub-terminal plumose setae, longest $189 \mu\text{m}$.

Rostrum with distinct frontal lunules (Figures 41*b-f*, 42*a*) and ventral rugose area (Figure 42*b,c*). First antenna (Figure 34*d*) with 2 segments, about equal in length, armed as in figure, an aesthete on last segment. Second antenna (Figure 34*e*) not as robust as other species of genus; claw recurved, bearing 2 setae. Mouth tube truncate at tip (Figure 42*d*). Tip of mandible (Figure 34*f*) bearing 12 teeth. Strigil within mouth tube (Figure 42*e,f*). First maxilla (Figure 34*g*) basically as in other species of genus, bearing one long, stout seta and 2 shorter ones. Second maxilla (Figure 34*h*; Figure 43*a,b*) armed as in other species, palmate process (Figure 43*c*) near base of terminal processes small, longest terminal process with rows of spinules. Maxilliped (Figure 34*i*) stout, armed as in other species of genus.

Leg 1 (Figure 35*a*) biramous, basipod with an inner and outer seta; exopod 2-segmented, first segment with a short spine on outer distal corner, second segment with 3 spines and a sparsely plumose

seta distally (Figure 43*d,e*): endopod reduced to a short process bearing a small distal knob. Leg 2 (Figure 35*b*) basipod with an outer naked seta; exopod 3-segmented, first segment with a prominent outer spinulose spine (Figure 43*f*) and an inner seta, second segment armed as in first, third segment with 3 outer spines (distalmost longest and fringed with a hyaline membrane along outer edge and short plumosities on inner) and 5 setae; endopod 3-segmented, first segment with patch of prominent spinules on outer distal corner (Figure 44*a*) and an inner seta, second segment with prominent spinules along outer edge and 2 inner setae, last segment with 6 setae. Leg 3 (Figure 35*c*) basipod lamelliform, bearing a naked seta and patch of setules on outer edge, a short hyaline membrane and plumose seta on inner edge, and a patch of spinules near insertion of interpodal plate; exopod 2-segmented, first segment heavily sclerotized with a stout spine distally, second segment with 4 setae, outer 3 naked and broad, innermost finely plumose; endopod 1-segmented bearing a patch of setules distally and an inner seta. Leg 4 (Figure 35*d*; Figure 44*b*) as in *A. platyrostris*. Legs 5 and 6 absent. Egg strings of usual caligoid type.

Male: Body form as in Figure 35*e*. Total length 2.30 mm, greatest width 1.20 mm (measured at widest part of cephalon). Cephalon about as long as wide. Genital segment (Figure 35*f*) somewhat wider than long ($543 \times 502 \mu\text{m}$), widest anteriorly. Abdomen 2-segmented, first segment wider than long ($35 \times 183 \mu\text{m}$), second segment longer than wide ($271 \times 230 \mu\text{m}$). Caudal rami armed as in female, about twice as long as wide ($136 \times 71 \mu\text{m}$), longest seta $295 \mu\text{m}$. Frontal lunule and rostral area (Figure 35*g*) well developed. Appendages as in female except second antenna more dactylate with second segment bearing rugose areas on inner surface (Figure 35*h*).

REMARKS.—The specimens described here agree with the description by Shiino in 1955 of the new genus and species, *Alicaligus tripartitus*, from *Sarda orientalis* in Japan. Considering the diversity within the genus *Abasia* demonstrated by the species described in this paper, it seems obvious that *Alicaligus* is also a member of *Abasia* and we have regarded it here as such. Shiino's reasons for regarding his material as representing a new genus seemed valid at the time, but the additional material described here clarifies the concept of *Abasia*. The host for

Shiino's material must be regarded as accidental. As part of a comprehensive survey of copepods parasitic on scombrid fish, we have examined several specimens of *Sarda orientalis* and have not recovered *A. tripartita*. In view of the host preferences of the other species of *Abasia*, it seems reasonable to regard synodontid fishes as the preferred hosts for *A. tripartita* as well.

We have changed the specific name, *tripartitus*, to the feminine form, *tripartita*, to agree with the feminine *Abasia*.

Abasia pillaii, new species

FIGURES 36, 37, 44*c,d*, 53

MATERIAL EXAMINED.—Holotype ♀ (USNM 171330), allotype ♂ (USNM 171331), and 4 ♀ 1 ♂ paratypes (USNM 171332) collected from the gills of 4 *Synodus englemani* caught during the *Albatross* expedition in the Philippines. Three ♀ 2 ♂ from the gills of the same host from off Negros Island, Philippines. Three ♀ from the gills of the same host caught off Ambon Island, Moluccas (Amboyna, British Museum 58.4.21.473),

Female: Body form as in Figure 36*a,b*. Total length 2.47 mm, greatest width 1.23 mm (measured at widest part of genital segment). Cephalon longer than wide, $1.45 \times 0.90 \text{ mm}$ respectively. Genital segment wider than long ($1.23 \times 0.90 \text{ mm}$), wider than cephalon. Abdomen 2-segmented; first segment somewhat inflated with distal end extending slightly beyond caudal rami, second segment small and enveloped by first segment anteriorly and laterally. Caudal rami (Figure 36*c*) small ($70 \times 53 \mu\text{m}$), armed with 6 setae as in other members of the genus, longest seta $153 \mu\text{m}$.

Rostrum somewhat produced with frontal lunules well-developed, rugose area on ventral surface as in other species of the genus. First antenna (Figure 36*d*) first segment with 24 sparsely plumose setae, second segment with 11 setae and 2 aesthetes. Second antenna (Figure 36*e*) with heavily sclerotized terminal claw bearing 2 short setae near base. Mandible of usual caligoid type with 12 teeth at tip (Figure 36*f*). Strigil (Figure 44*c,d*) comblike blade posterior to mandible within mouth tube. First maxilla (Figure 36*g*) simple, with 3 setae as in other species of the genus. Second maxilla (Figure 36*h*) with stout terminal claw bearing rows of

spinules, a short, spinulose, subterminal spine and a spinose spatulate process near base of terminal spines (Figure 36i). Maxilliped (Figure 36j) basal segment stout with a short recurved claw.

Leg 1 (Figure 37a) basipod with a seta on the outer distal corner and another on posterior margin medial to endopod; exopod 2-segmented, first segment with a weak spine on outer distal corner, second segment with a short outer spine, 2 partially spinulose terminal spines, 1 longer terminal seta and 1 very short inner seta; endopod rudimentary, bearing a short terminal seta. Leg 2 (Figure 37b) armed as in *A. pusilla* except endopod first segment of *A. pillaii* with spinules along entire edge (rather than distal third) and no spinules on outer edge of last segment. Leg 3 (Figure 37c) as in *A. pusilla* except spine on outer distal corner of *A. pillaii* much heavier and longest terminal seta of last segment spinulose in *A. pillaii*. Leg 4 similar to that of *A. pusilla*. Legs 5 and 6 absent. Egg strings of usual caligoid type.

Male: Body form as in Figure 37d. Total length 1.49 mm. Greatest width 0.74 mm. Genital segment (Figure 37e) ovate, as wide as long ($406 \times 406 \mu\text{m}$). Abdomen 2-segmented; first segment small and weakly sclerotized; second segment slightly longer than wide ($207 \times 171 \mu\text{m}$) with sclerotized integument around most of segment. Caudal rami longer than wide ($82 \times 57 \mu\text{m}$) armed as in female.

Appendages as in female except second antenna (Figure 37f) with shorter claw and rugose area on basal segment as indicated in figure. Leg 4 (Figure 37g) weakly developed with a spine on outer distal corner of first segment and 3 spines on the last segment as indicated in the figure. Legs 5 and 6 represented by setae on the lateral margins of the genital segment (see Figure 37e).

ETYMOLOGY.—This species is named for Dr. N. Krishna Pillai as a tribute to his outstanding contributions to the study of Indian Ocean parasitic copepods.

REMARKS.—This species seems to be very close to *A. pusilla*. The 2 species can be easily separated by the greater development of the genital segment of the female of *A. pillaii* (compare Figures 30a and 36a). The appendages of these 2 species are very similar and suggest that they are more closely related to each other than to any other species. The

new species can be separated from the other known species of *Abasia* by the nature of the female third leg. In *A. pusilla* and *pillaii* the endopod of leg 3 is reduced to a single seta with no discernable ramus. The female leg 3 exopod of *A. inflata* is further reduced to a single weakly developed ramus representing the entire third leg.

This new species so far has only been found on *Synodus englemani* caught in the Moluccas and Philippines. It is interesting to note that its closest relative, *A. pusilla*, has only been reported from *S. ulae* in Japan.

Lernanthropus Blainville, 1822

Lernanthropus temminckii Nordmann, 1864

FIGURE 38

MATERIAL EXAMINED.—Eight ♀ from the gills of *Saurida tumbil* (Bloch) collected at Trivandrum, India, October 1977 by Mr. A. Chandran. One ♀ from the gills of *Saurida tumbil* collected in the Bay of Bengal during Cruise 1 of the R/V *Anton Bruun*, Station 47B. One ♂ from the gills of *Saurida tumbil* collected in the Gulf of Thailand, 17 June 1961. One ♀ from the gills of *Saurida undosquamis* (Richardson) collected off Somalia during Cruise 9 of the R/V *Anton Bruun*, December 1964.

Female: Body form as in Figure 38. The average total length for 6 of the specimens from Trivandrum is 5.52 mm (4.80–5.85 mm). The total length of the specimen collected off Somalia is 7.95 mm. Caudal rami about 4 times as long as wide ($236 \times 59 \mu\text{m}$), widest proximally, gradually narrowing to tip; 2 well-developed setae in proximal third and 2 small terminal setae (spines?).

Leg 1 exopod with 5 short stout spines; endopod with a single seta about as long as ramus. Leg 2 exopod with 3 terminal spines, inner spine longest; endopod reduced to an unarmed, knoblike process. Legs 3 and 4 produced as long slender processes.

REMARKS.—Nordmann described this copepod (1864:501) from "*Saurus lacerta*" from the East Indies. It had not been recorded since. It appears to be specific, although not common, to *Saurida* species and so far only known from the Indian Ocean and South Pacific.

Appendix

Indo-West Pacific Lizardfish Examined and Their Copepod Parasites

(number of fish examined in parentheses)

- Synodus englemani* Schultz (227)
 Metaenaianthus epigri, new species
 Abasia pillai, new species
Synodus species (undescribed) (8)
 Metaenaianthus indiscretus, new species
Synodus hoshinonis Tanaka (43)
 Metaenaianthus nudus, new species
 Metaenaianthus pacificus, new species
 Abasia tripartita (Shiino)
Synodus indicus (Day) (112)
 Metaenaianthus gibbsi, new species
Synodus jaculum Russell and Cressey (62)
 Metaenaianthus coneigri, new species
Synodus macrops Tanaka (70)
 Metaenaianthus aquilonius, new species
Synodus ulae Schultz (60)
 Abasia platyrostris Pillai
 Abasia pusilla, new species
 Abasia tripartita (Shiino)
Synodus variegatus (Lacepède) (654)
 Metaenaianthus vulgaris, new species
Trachinocephalus myops (Schneider) (165)
 Metaenaianthus synodi Pillai
 Taeniastratus species
- Saurida elongata* (Temminck and Schlegel) (3)
 Parataenaianthus longicervis Pillai
 Taenaianthus sauridae Yamaguti and Yamasu
Saurida gracilis (Quoy and Gaimard) (161)
 Taenaianthus sauridae Yamaguti and Yamasu
 Abasia inflata, new species
Saurida longimanus Norman (20)
 Taenaianthus sauridae Yamaguti and Yamasu
Saurida tumbil (Bloch) (55)
 Lernanthropus temminckii Nordmann
Saurida undosquamus (Richardson) (103)
 Parataenaianthus longicervis Pillai
 Taenaianthus sauridae Yamaguti and Yamasu
 Abasia platyrostris Pillai
 Lernanthropus temminckii Nordmann
Synodus binotatus Schultz (131)
Synodus capricornis Cressey and Randall (5)
Synodus doaki Russell and Cressey (10)
Synodus fuscus Tanaka (16)
Synodus kaianus (Gunther) (23)
Synodus rubromarmoratus Russell and Cressey (13)
Synodus sageneus (Waite) (6)
Synodus similis McCullough (5)
 No parasitic copepods

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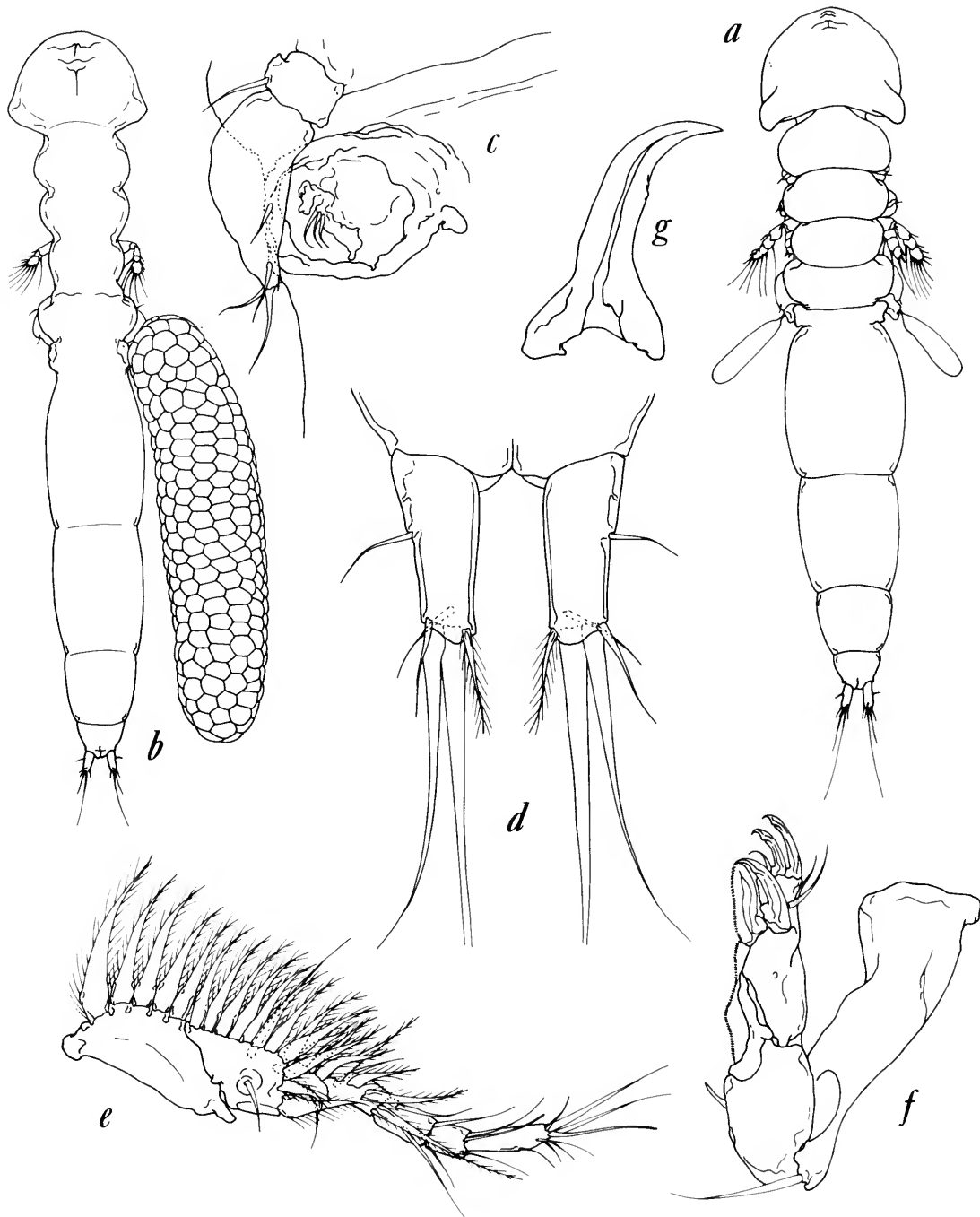


FIGURE 1.—*Metaeniacanthus synodi*, female: *a*, *b*, dorsal; *c*, area of egg sac attachment; *d*, caudal rami; *e*, first antenna; *f*, second antenna; *g*, postantennal hook.

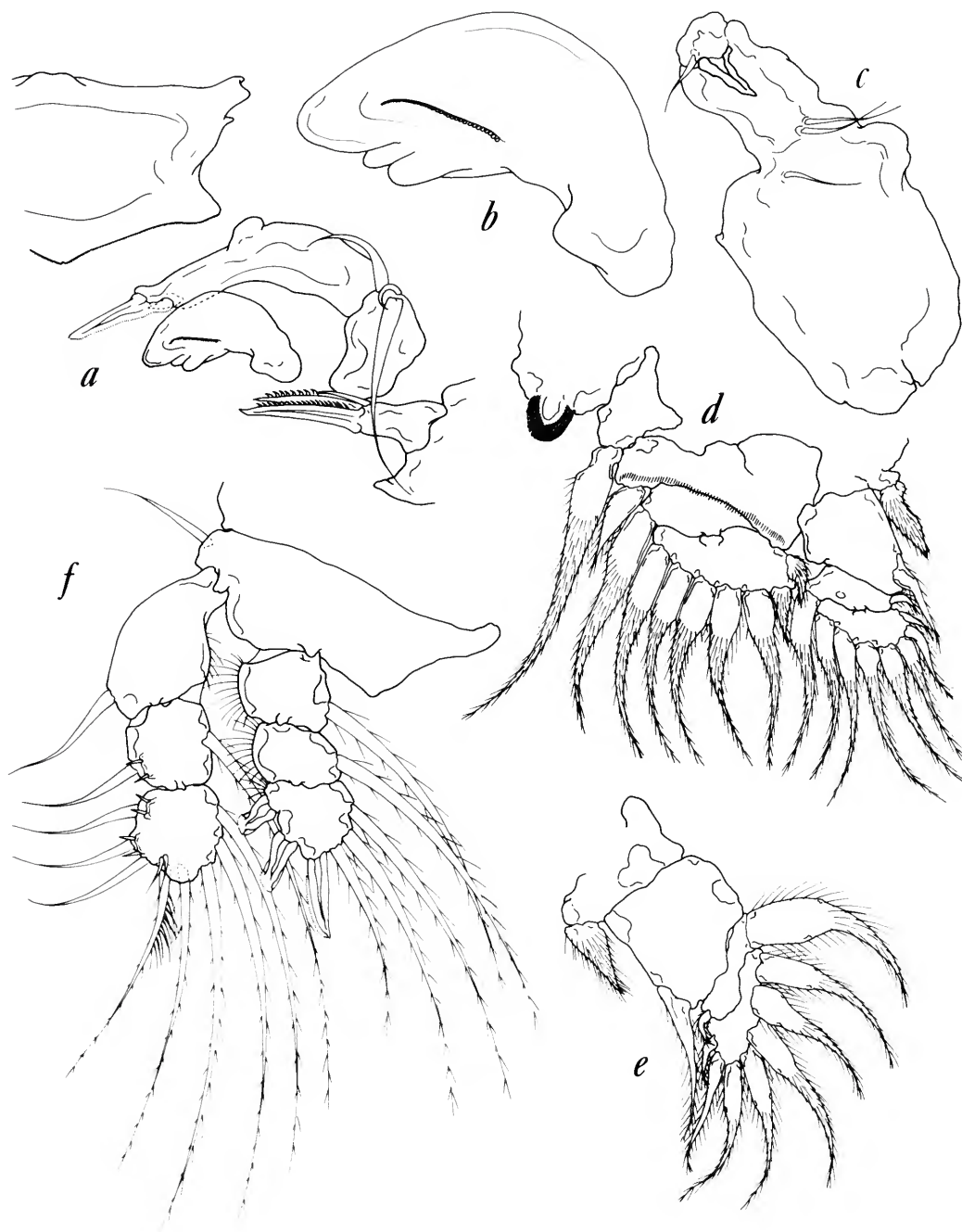


FIGURE 2.—*Metataeniacanthus synodi*, female: a, oral area; b, paragnath; c, maxilliped; d, first leg and interpodal plate; e, exopod of first leg; f, second leg.

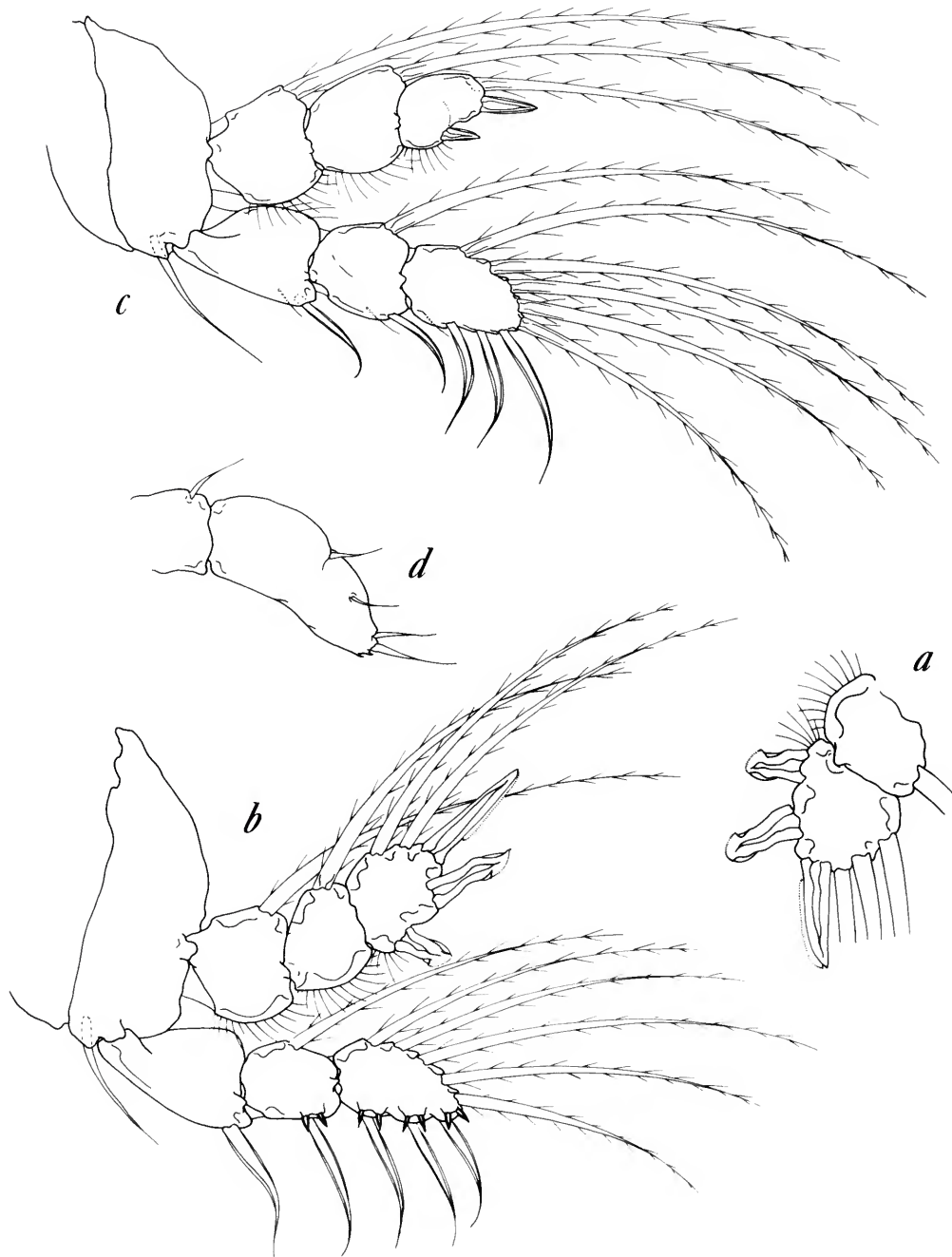


FIGURE 3.—*Metataeniacanthus synodi*, female: a, last two segments of leg 2 endopod; b, third leg; c, fourth leg; d, fifth leg.

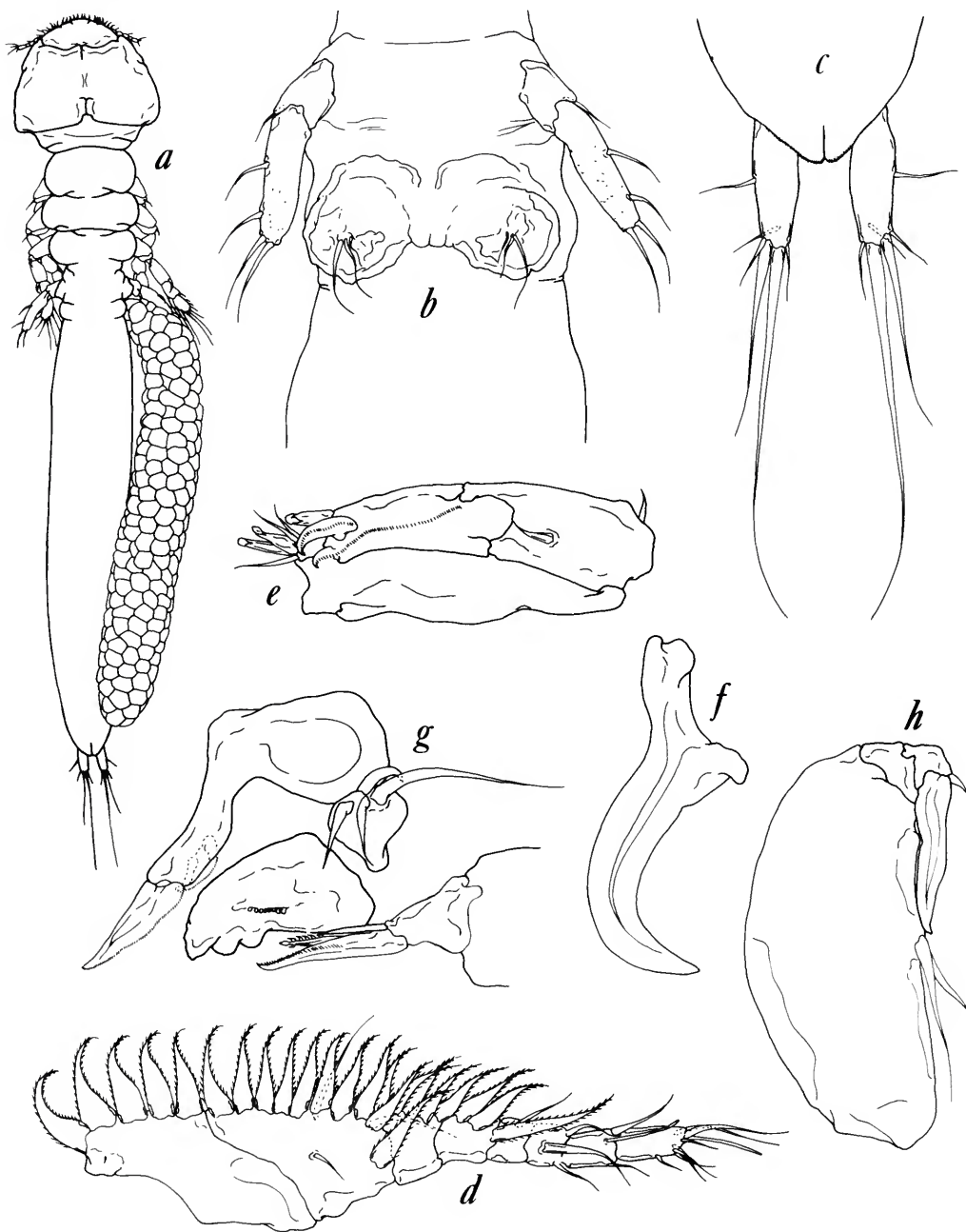


FIGURE 4.—*Metataeniacanthus vulgaris*, new species, female: *a*, dorsal; *b*, area of egg sac attachment; *c*, caudal rami; *d*, first antenna; *e*, second antenna; *f*, postantennal hook; *g*, oral area; *h*, maxilliped.

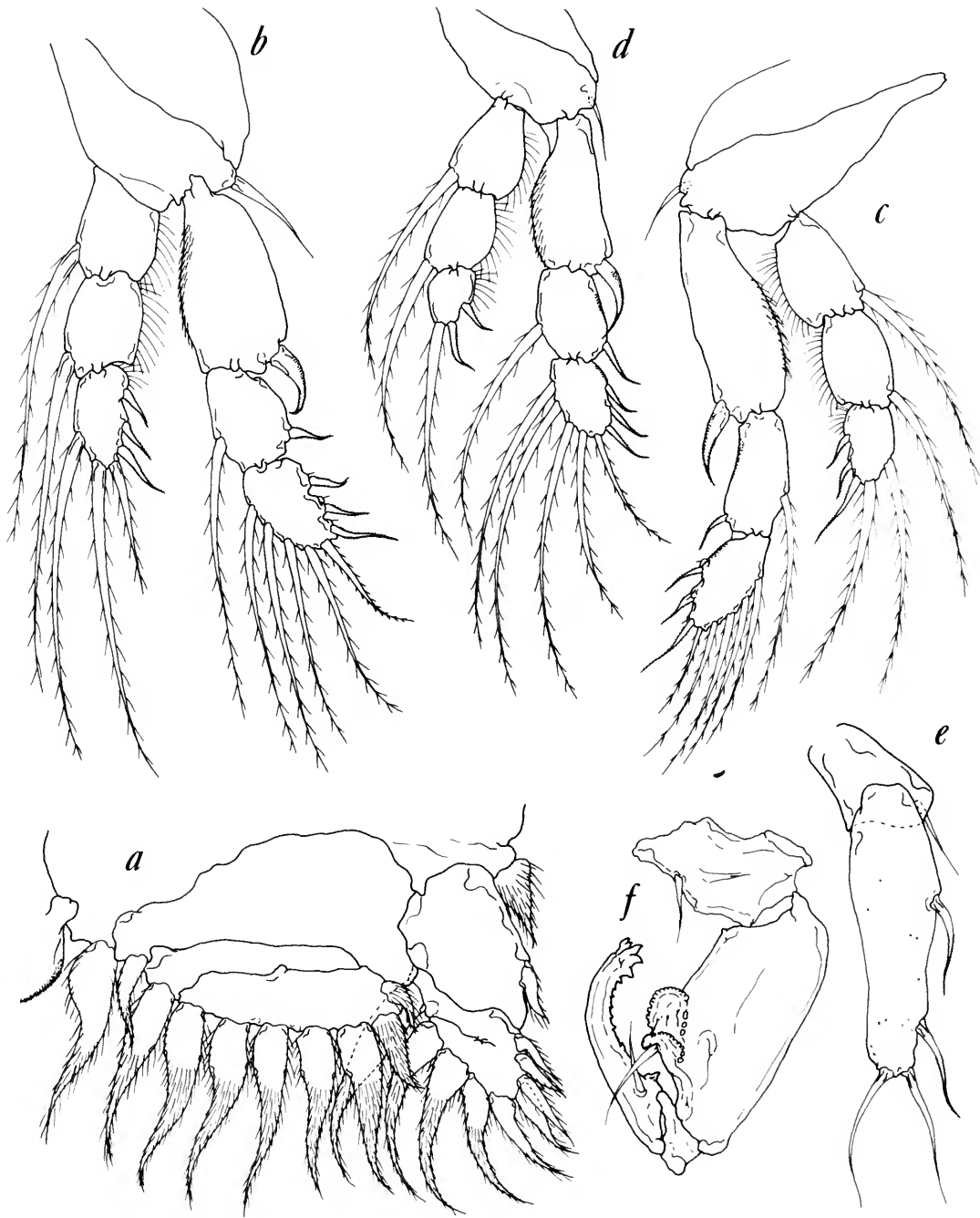


FIGURE 5.—*Metataeniacanthus vulgaris*, new species, female: *a*, first leg; *b*, second leg; *c*, third leg; *d*, fourth leg; *e*, fifth leg; male: *f*, maxilliped.

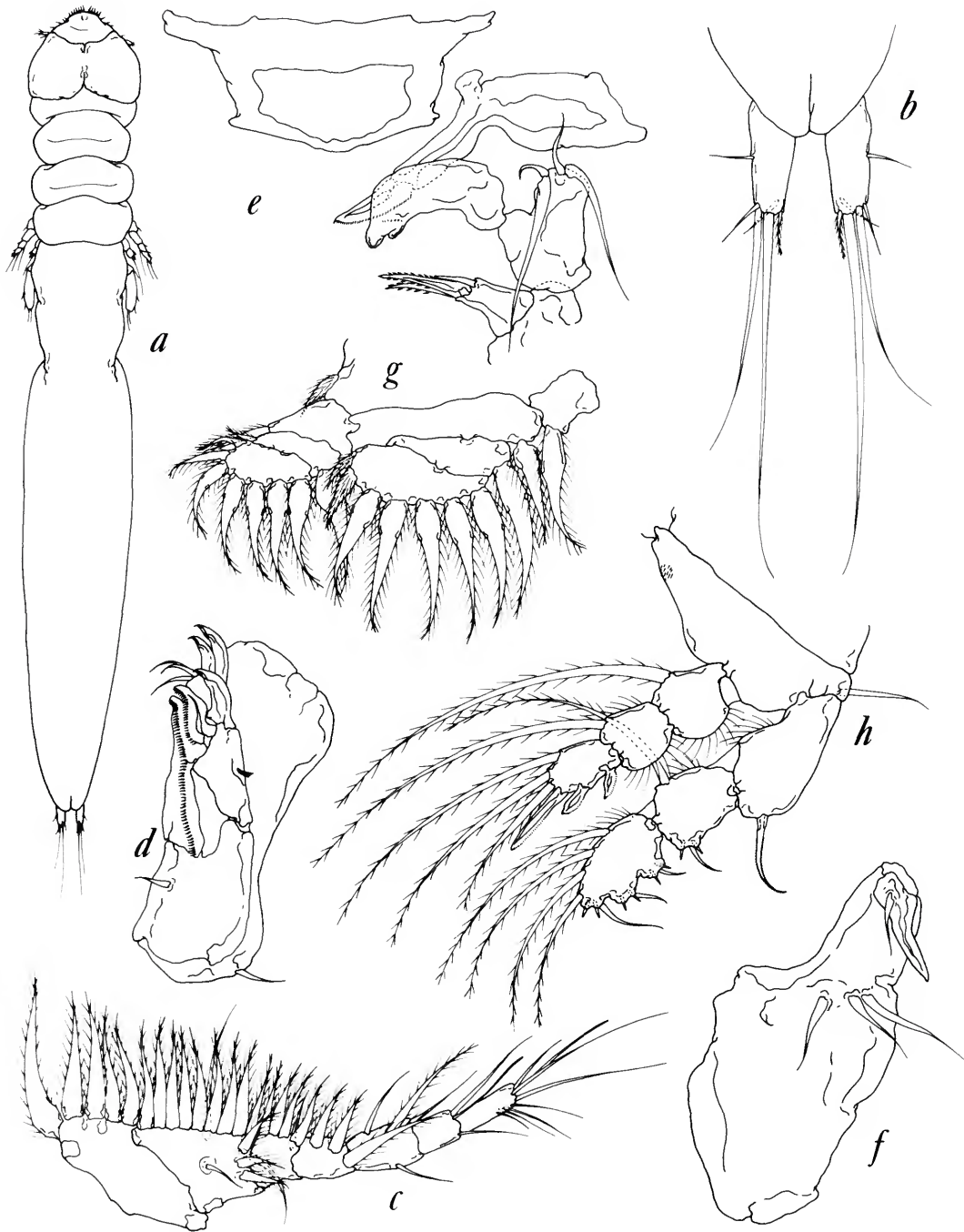


FIGURE 6.—*Metataeniacanthus solidus*, new species, female: *a*, dorsal; *b*, caudal rami; *c*, first antenna; *d*, second antenna; *e*, oral area; *f*, maxilliped; *g*, first leg; *h*, second leg.

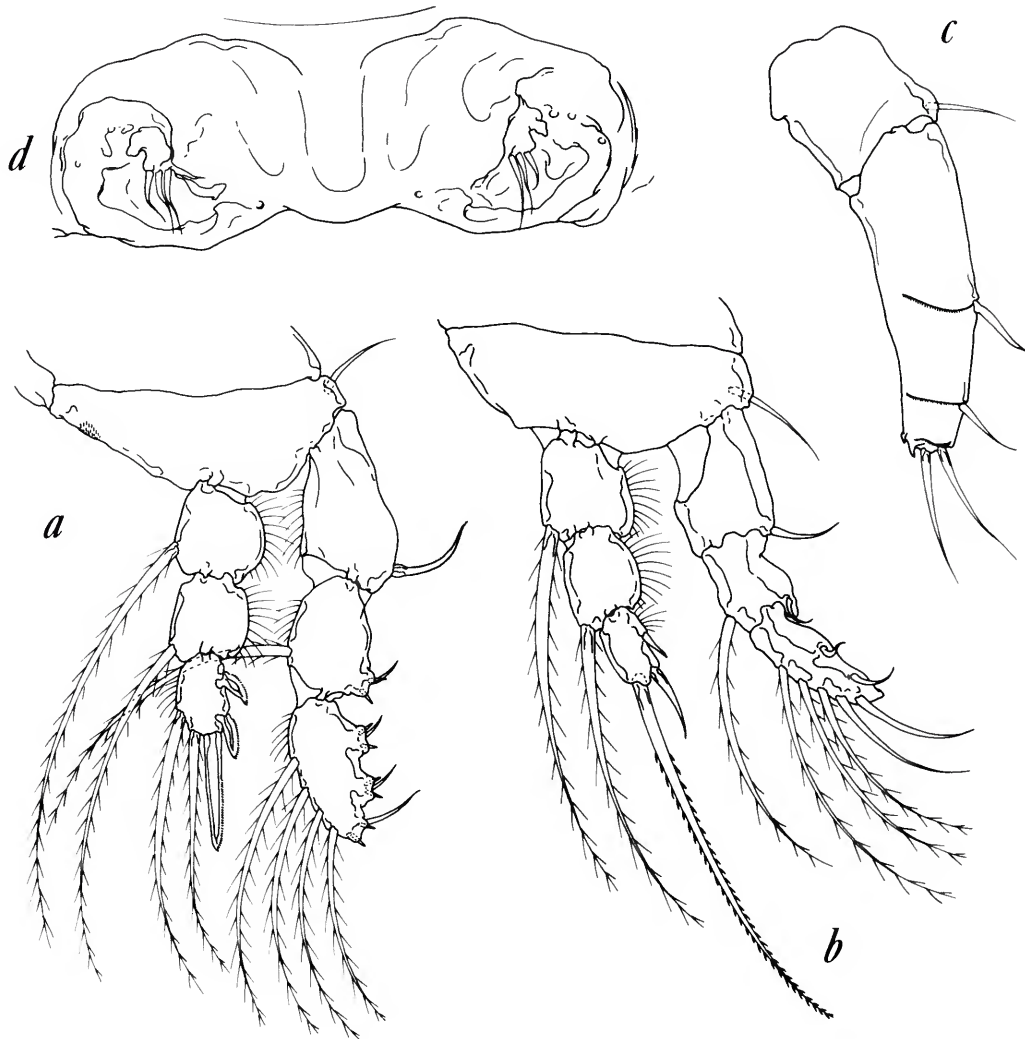


FIGURE 7.—*Metataeniacanthus solidus*, new species, female: *a*, third leg; *b*, fourth leg; *c*, fifth leg; *d*, sixth leg at area of egg sac attachment.

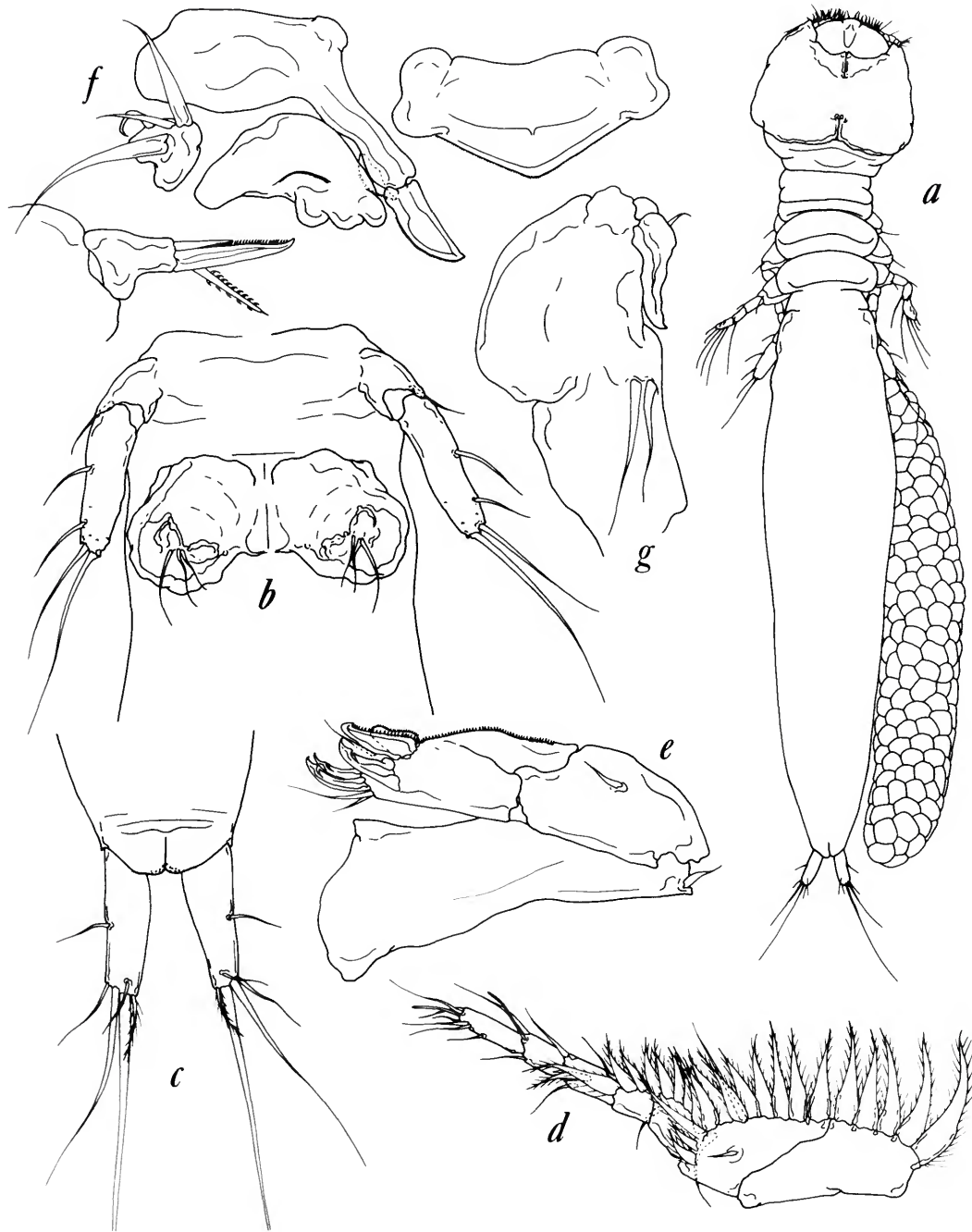


FIGURE 8.—*Metataeniacanthus epigri*, new species, female: *a*, dorsal; *b*, area of egg sac attachment; *c*, caudal rami; *d*, first antenna; *e*, second antenna; *f*, oral area; *g*, maxilliped.

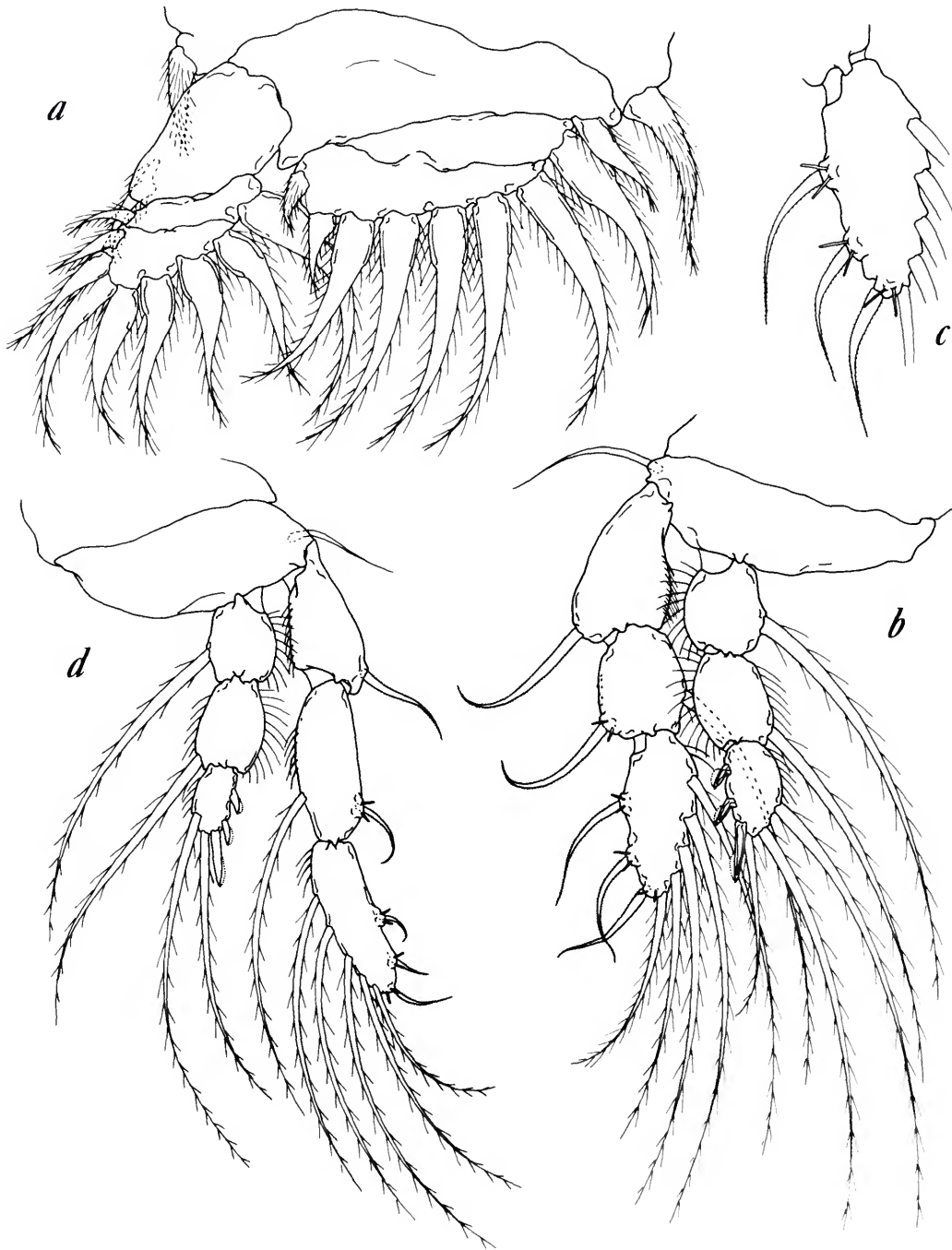


FIGURE 9.—*Metataeniacanthus epigri*, new species, female: *a*, first leg; *b*, second leg; *c*, second leg, exopod last segment; *d*, third leg.

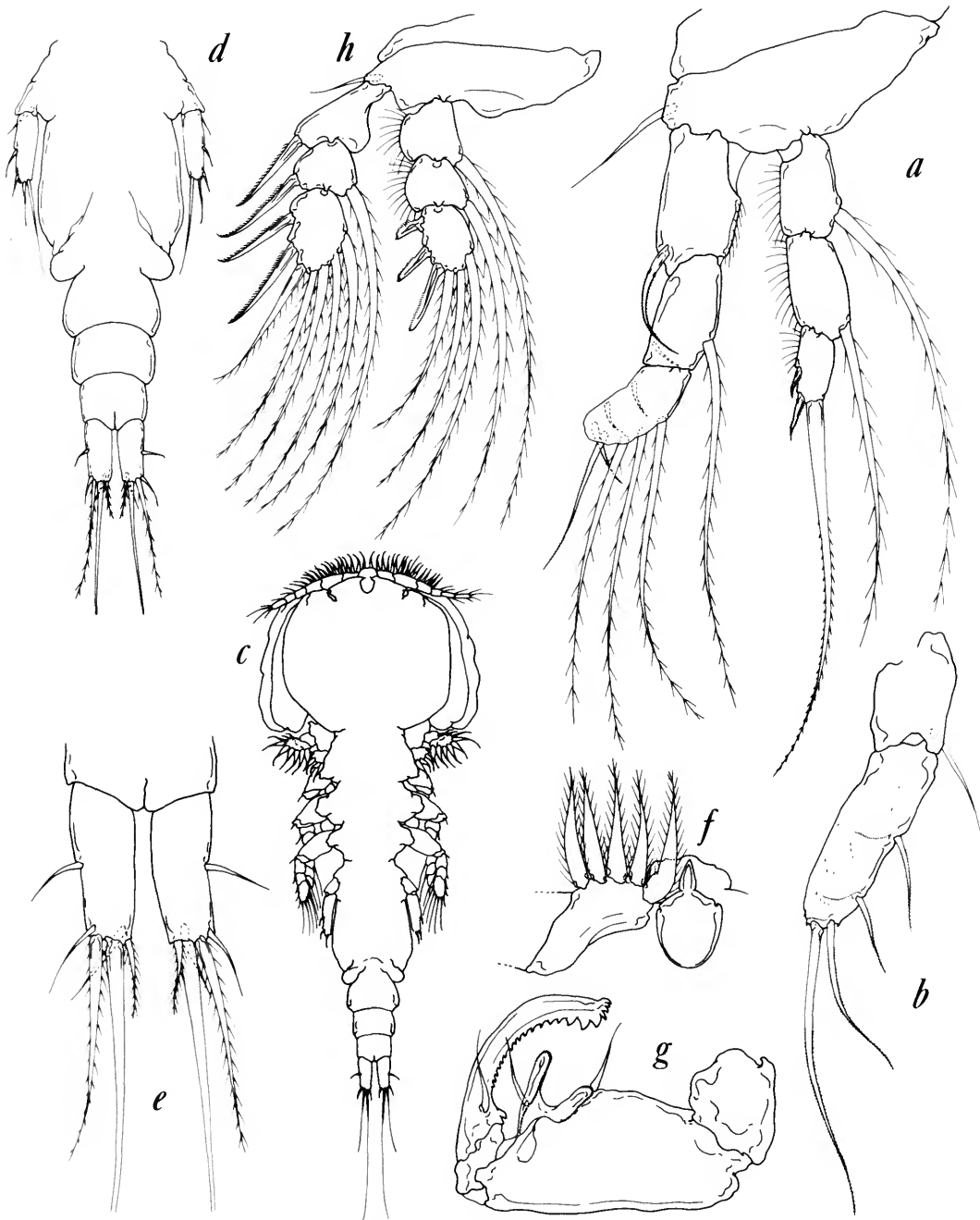


FIGURE 10.—*Metataeniacanthus epigri*, new species, female: *a*, fourth leg; *b*, fifth leg; male: *c*, dorsal; *d*, genital segment and abdomen; *e*, caudal rami; *f*, rostral area, ventral; *g*, maxilliped; *h*, second leg.

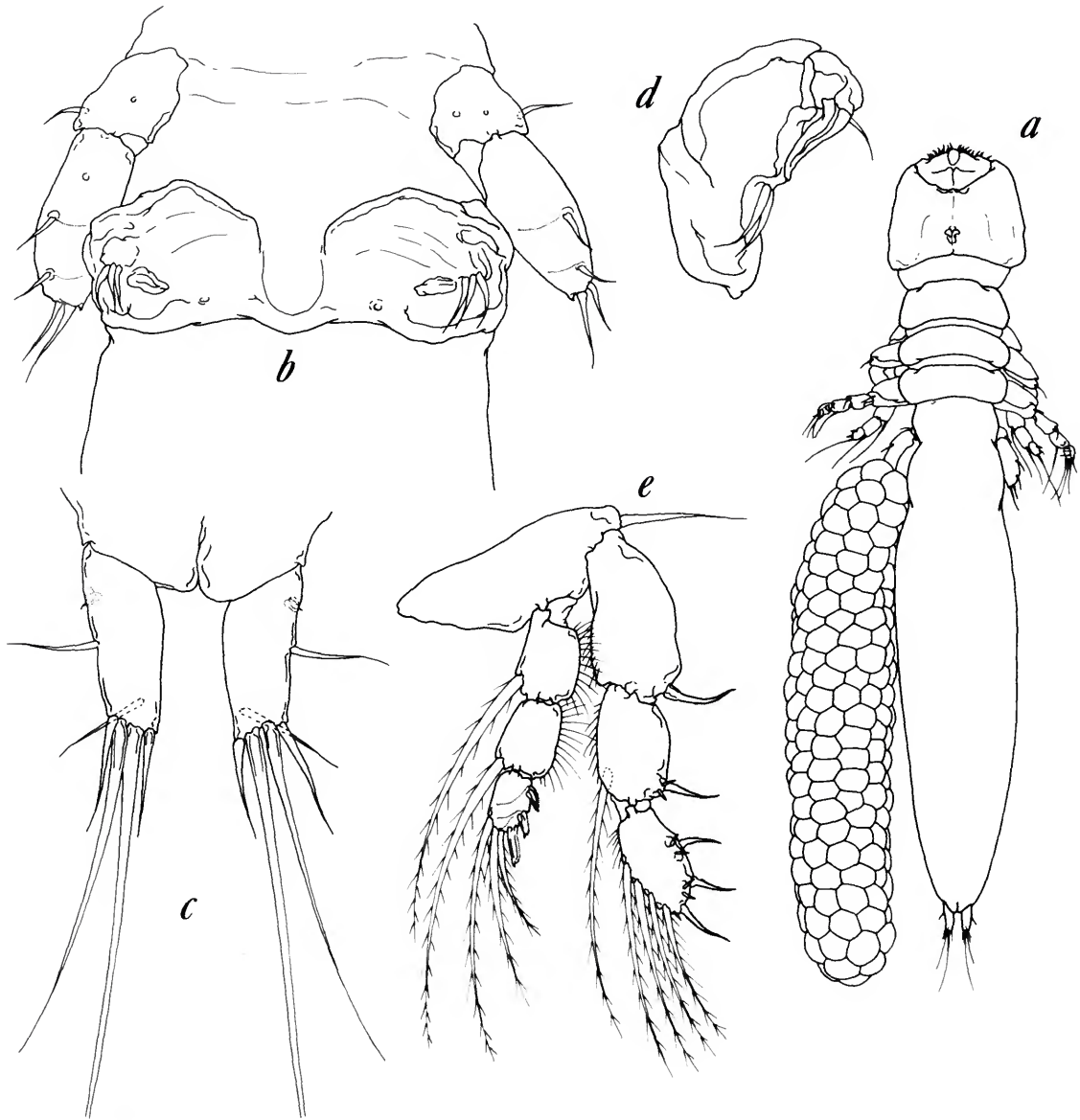


FIGURE 11.—*Metataeniacanthus coneigri*, new species, female: a, dorsal; b, area of egg sac attachment; c, caudal rami; d, maxilliped; e, second leg.

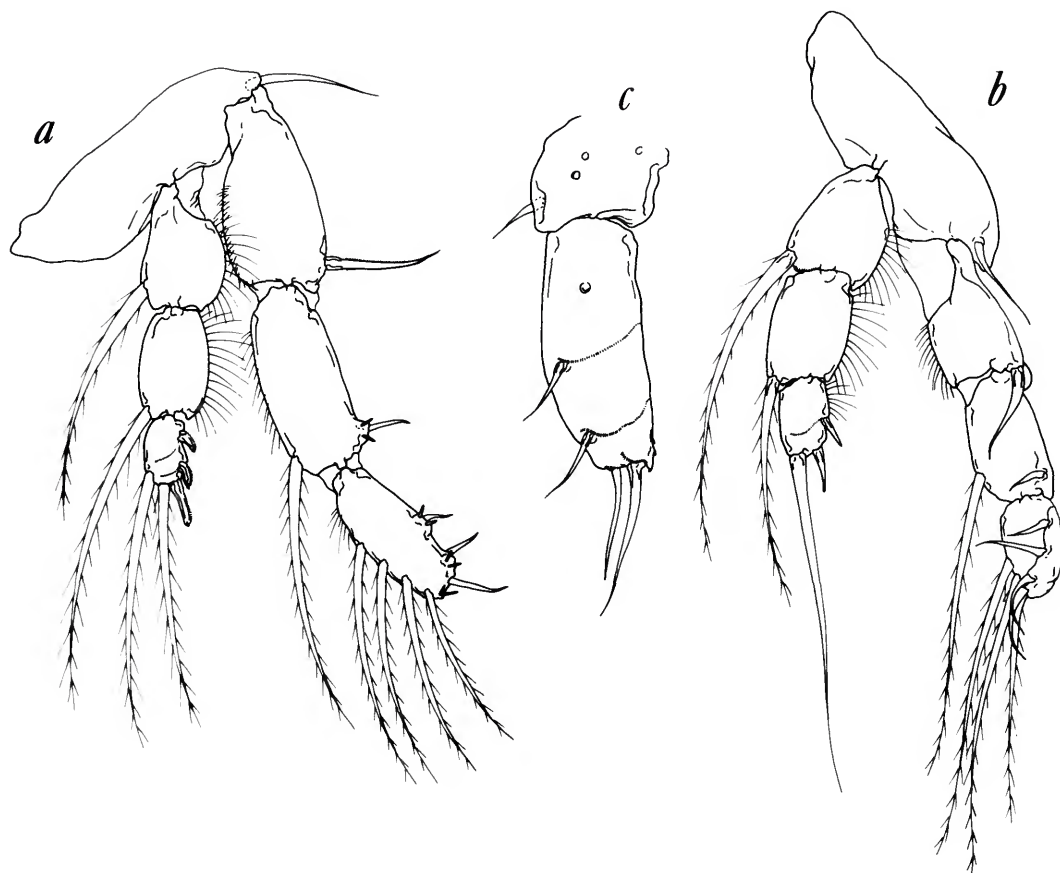


FIGURE 12.—*Metataeniacanthus conepigri*, new species, female: *a*, third leg; *b*, fourth leg; *c*, fifth leg.

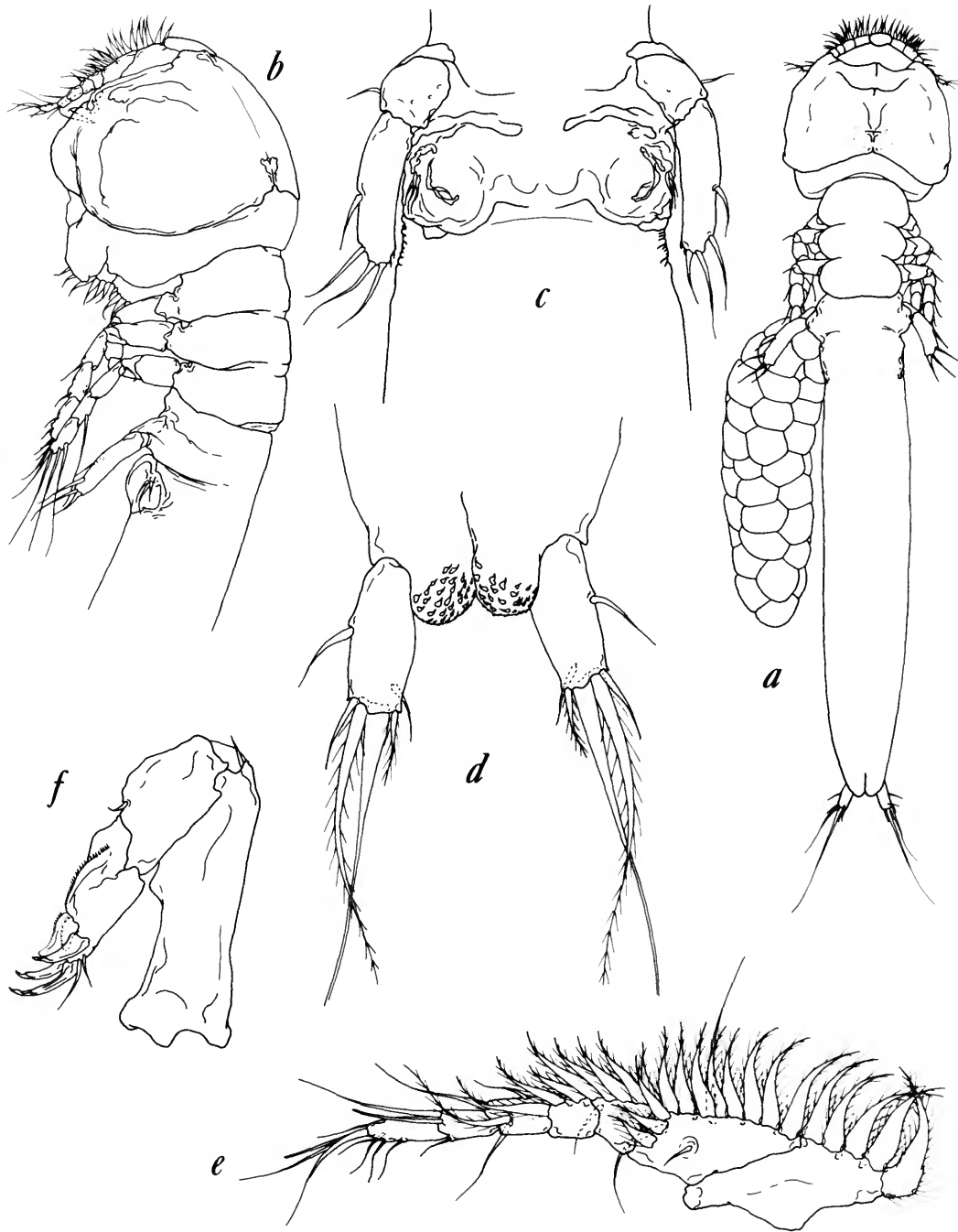


FIGURE 13.—*Metataeniacanthus gibbsi*, new species, female: *a*, dorsal; *b*, anterior half, lateral; *c*, area of egg sac attachment; *d*, caudal rami; *e*, first antenna; *f*, second antenna.

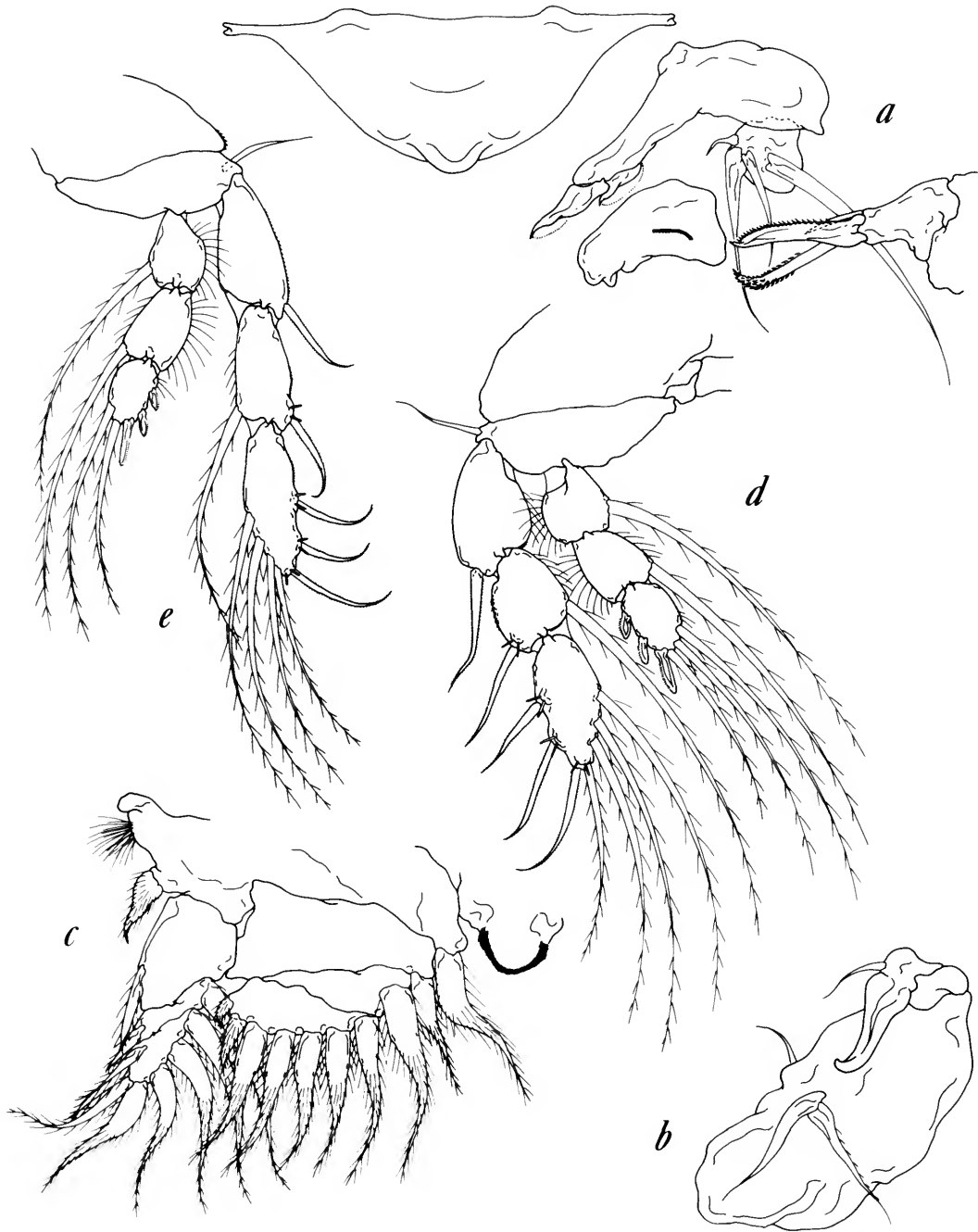


FIGURE 14.—*Metataeniacanthus gibbsi*, new species; female: *a*, oral area; *b*, maxilliped; *c*, first leg and interpodal plate; *d*, second leg; *e*, third leg.

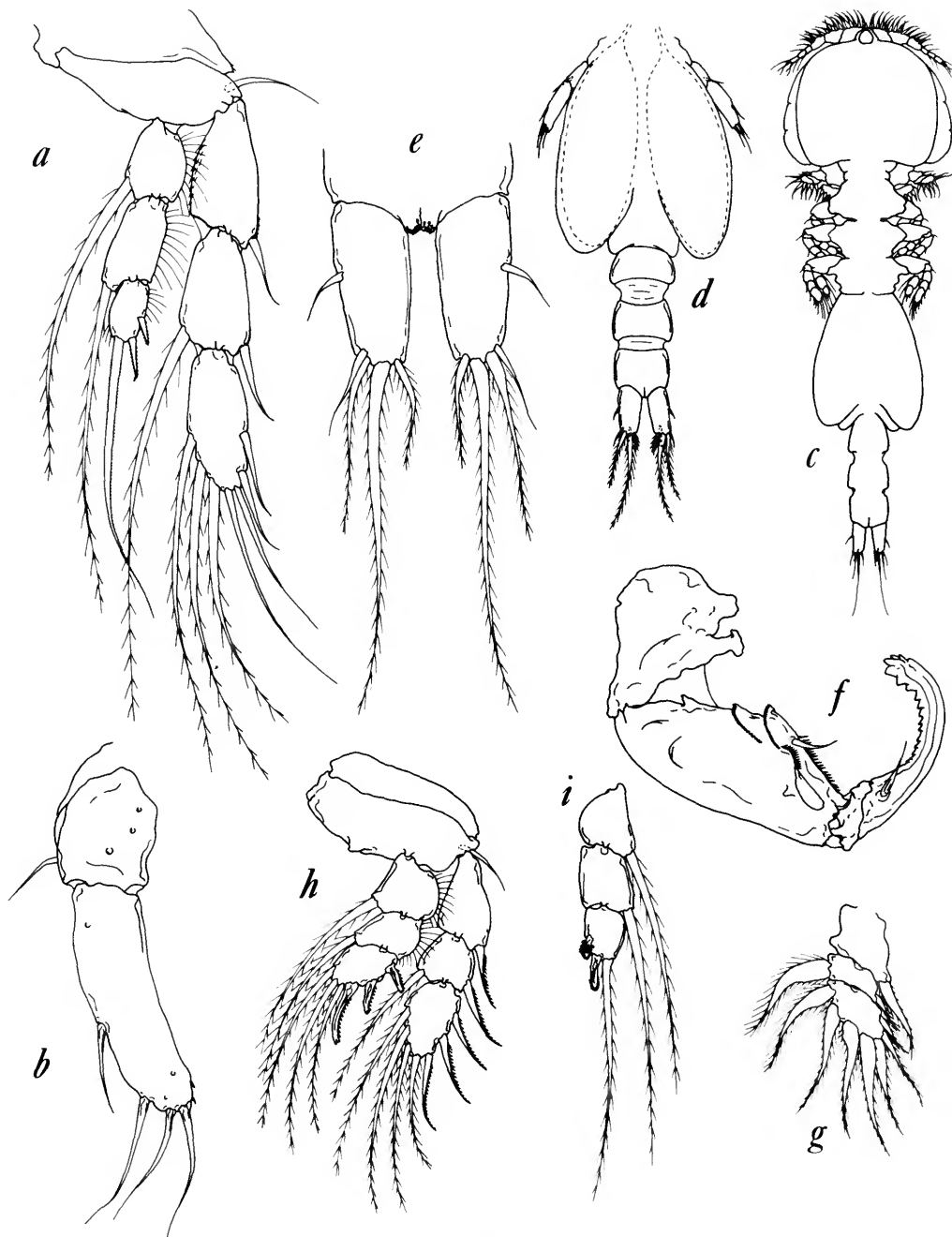


FIGURE 15.—*Metataeniacanthus gibbsi*, new species, female: *a*, fourth leg; *b*, fifth leg; male: *c*, dorsal; *d*, genital segment and abdomen; *e*, caudal rami; *f*, maxilliped; *g*, first leg exopod; *h*, second leg; *i*, fourth leg endopod.

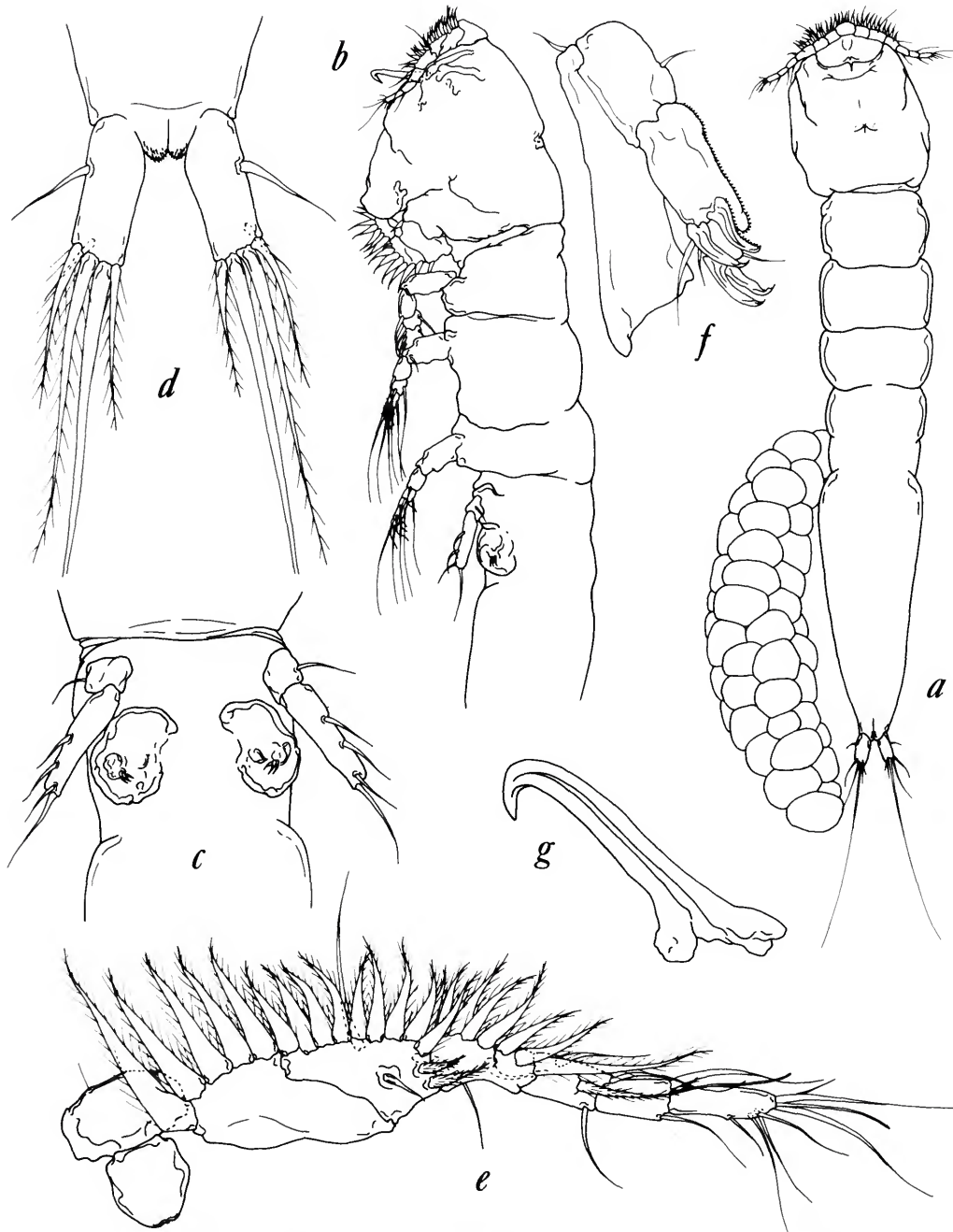


FIGURE 16.—*Metataeniacanthus pacificus*, new species, female: *a*, dorsal; *b*, anterior half, lateral; *c*, area of egg sac attachment; *d*, caudal rami; *e*, first antenna; *f*, second antenna; *g*, postantennal hook.



FIGURE 17.—*Metataeniacanthus pacificus*, new species, female: a, oral area; b, maxilliped; c, first leg; d, second leg; e, last segment of second leg exopod; f, fourth leg; g, fifth leg.

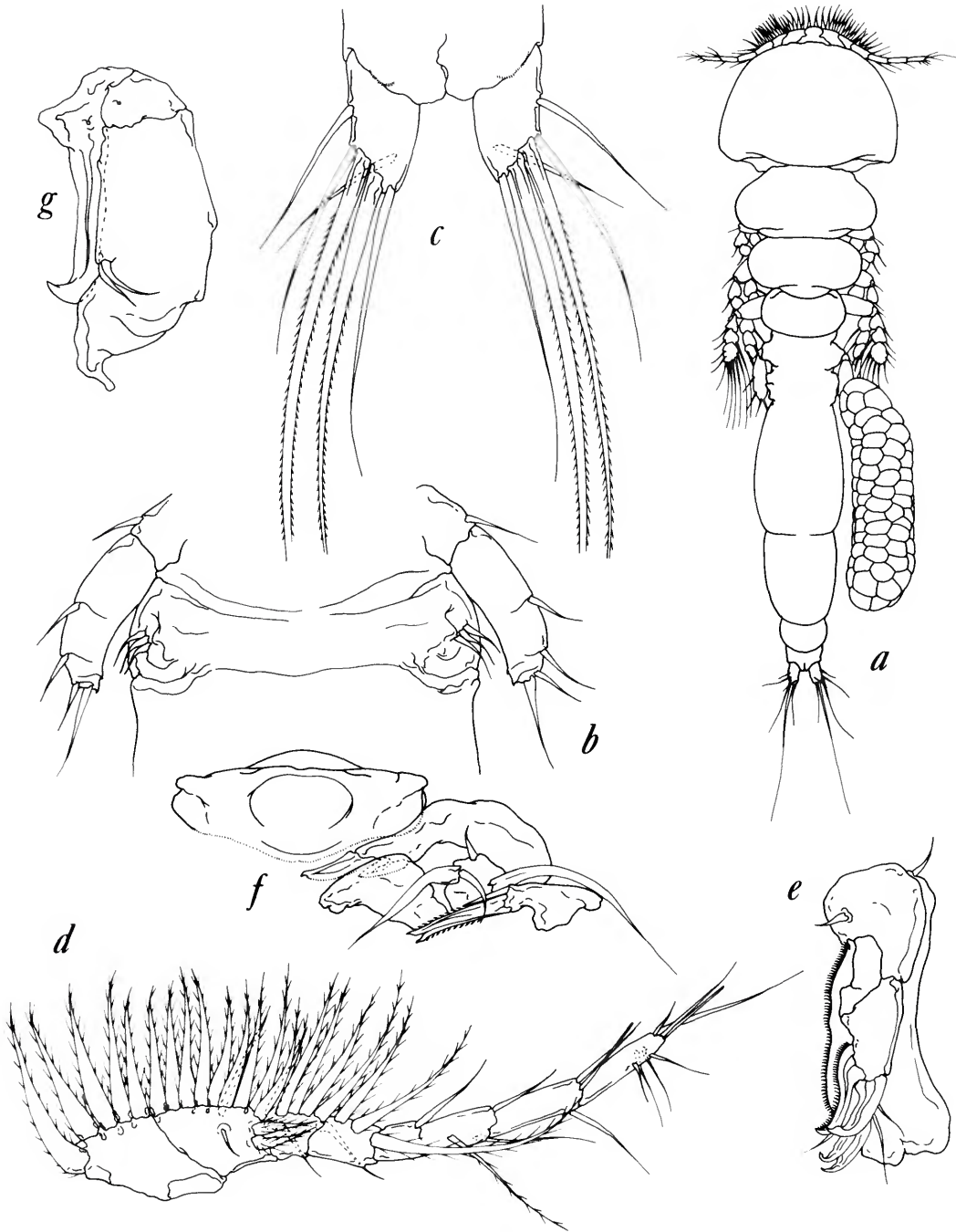


FIGURE 18.—*Metaeniaicanthus nudus*, new species, female: *a*, dorsal; *b*, area of egg sac attachment; *c*, caudal rami; *d*, first antenna; *e*, second antenna; *f*, oral area; *g*, maxilliped.

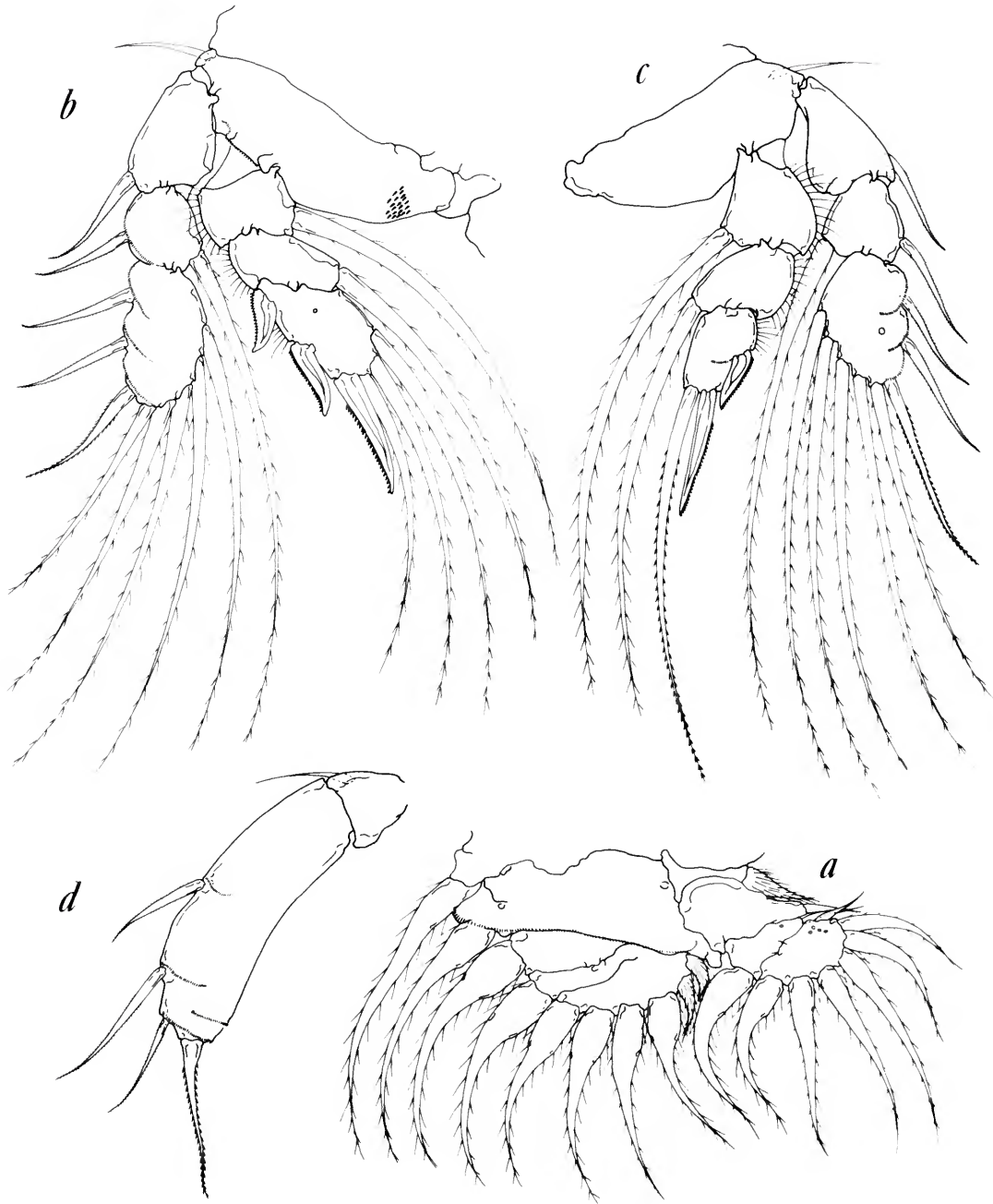


FIGURE 19.—*Metataeniacanthus nudus*, new species, female: *a*, first leg; *b*, second leg; *c*, fourth leg; *d*, fifth leg.

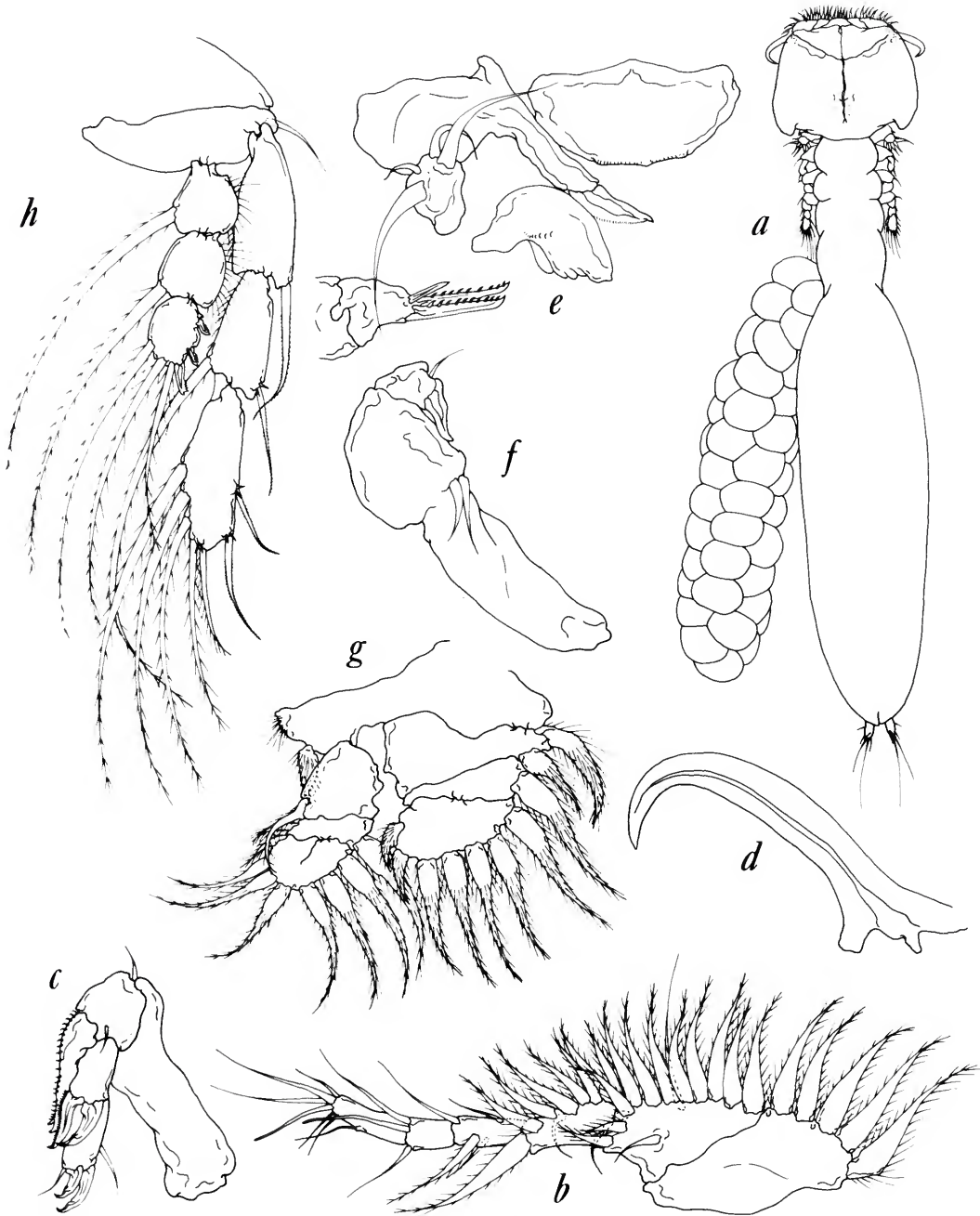


FIGURE 20.—*Metataeniacanthus indiscretus*, new species, female: *a*, dorsal; *b*, first antenna; *c*, second antenna; *d*, postantennal hook; *e*, oral area; *f*, maxilliped; *g*, first leg; *h*, second leg.

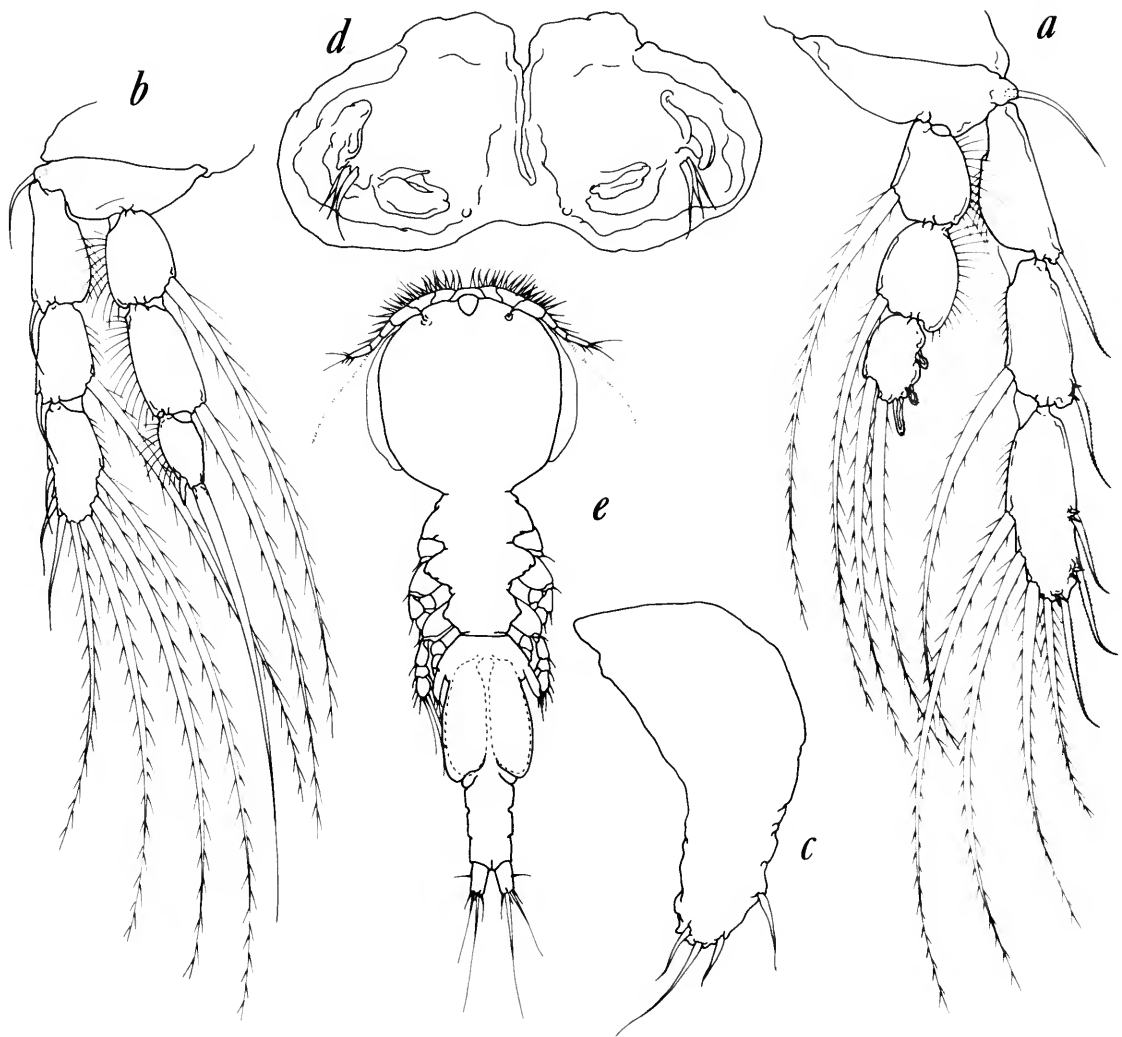


FIGURE 21.—*Metataeniacanthus indiscretus*, new species, female: *a*, third leg; *b*, fourth leg; *c*, fifth leg; *d*, sixth leg at area of egg sac attachment; male: *e*, dorsal.

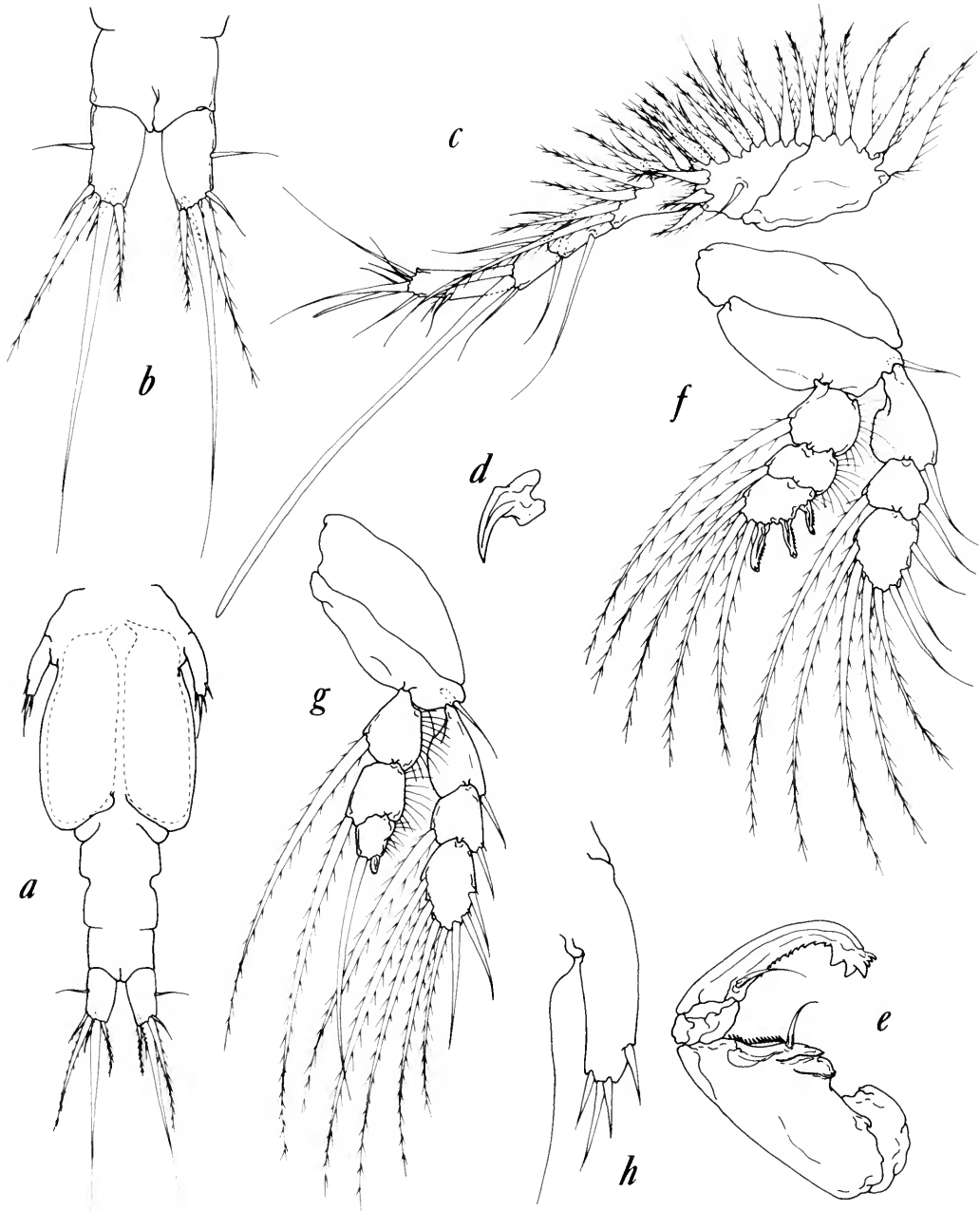


FIGURE 22.—*Metalaeniacanthus indiscretus*, new species, male: *a*, genital segment and abdomen; *b*, caudal rami; *c*, first antenna; *d*, postantennal hook; *e*, maxilliped; *f*, second leg; *g*, fourth leg; *h*, fifth leg.

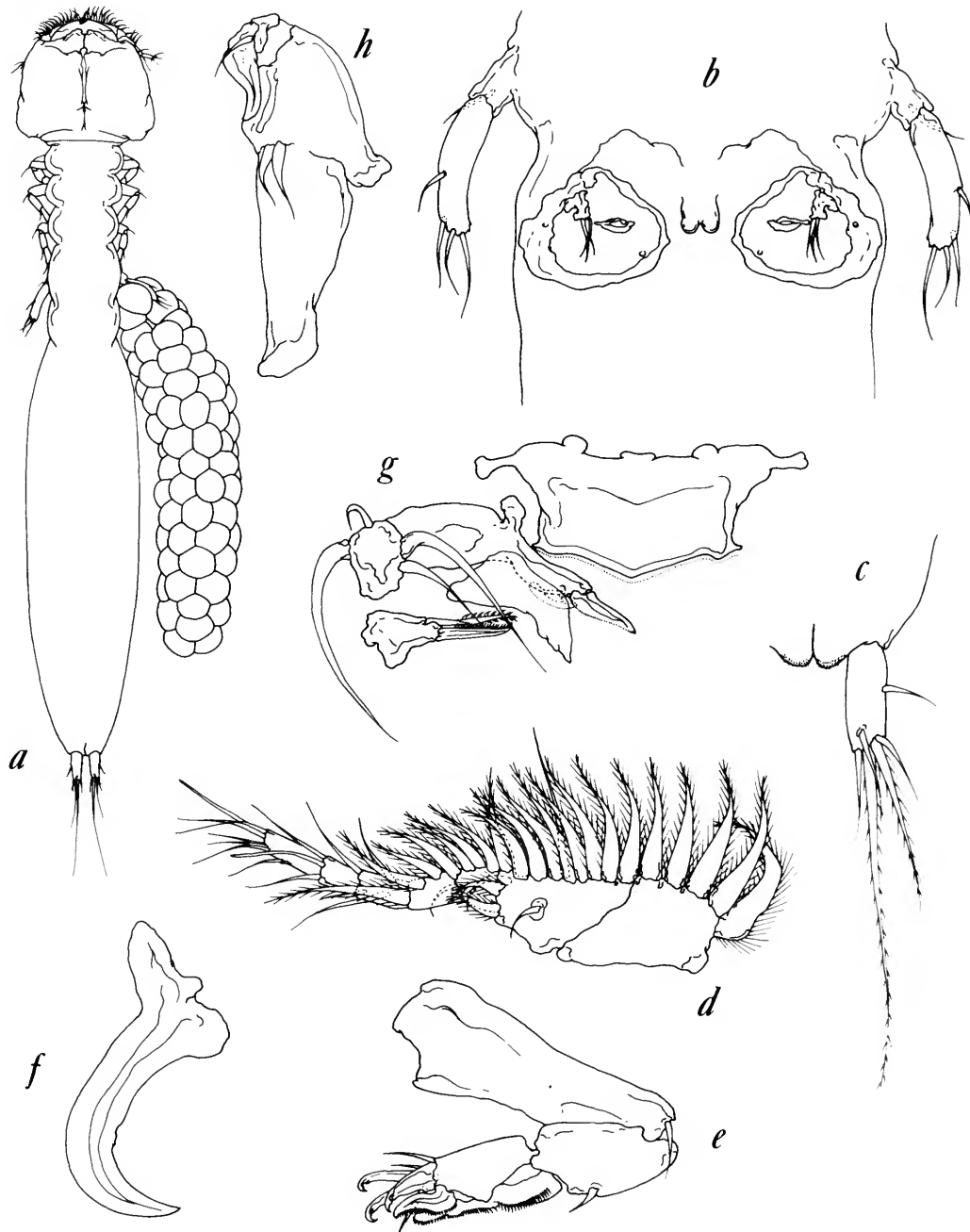


FIGURE 23.—*Metataeniacanthus aquilonius*, new species, female: *a*, dorsal; *b*, area of egg sac attachment; *c*, caudal rami; *d*, first antenna; *e*, second antenna; *f*, postantennal hook; *g*, oral area; *h*, maxilliped.

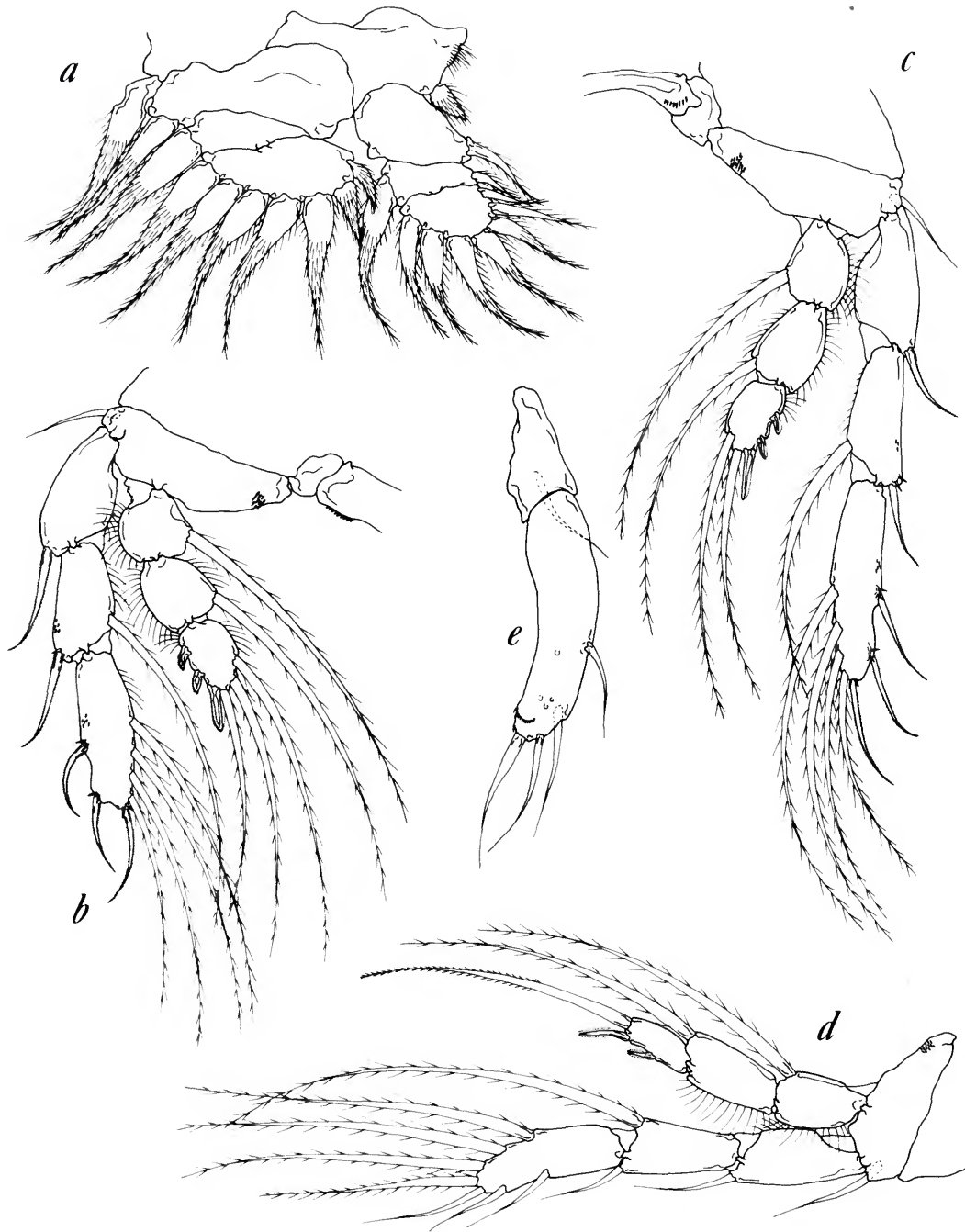


FIGURE 24.—*Metataeniacanthus aquilonius*, new species, female: *a*, first leg; *b*, second leg; *c*, third leg; *d*, fourth leg; *e*, fifth leg.

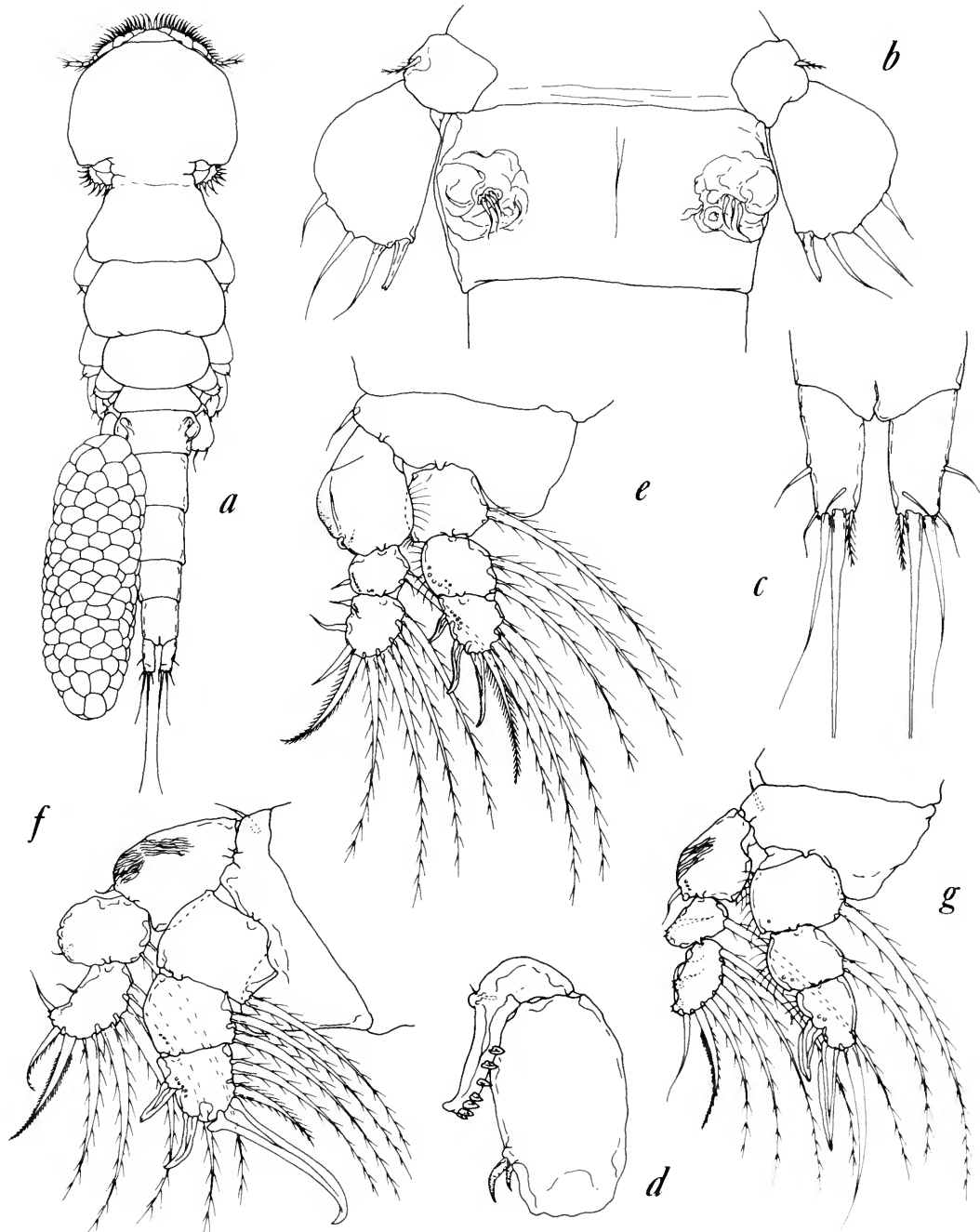


FIGURE 25.—*Parataeniacanthus longicervis* Pillai, female: *a*, dorsal; *b*, area of egg sac attachment; *c*, caudal rami; *d*, maxilliped; *e*, second leg; *f*, third leg; *g*, fourth leg.

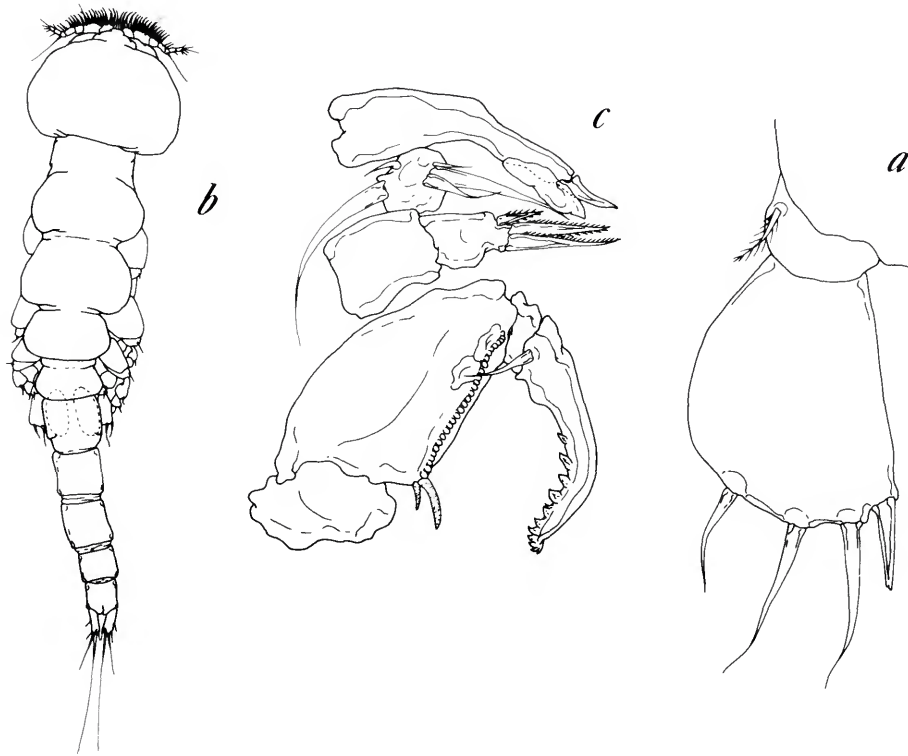


FIGURE 26.—*Parataeniacanthus longicervis* Pillai, female: *a*, fifth leg; male: *b*, dorsal; *c*, oral area including maxilliped.

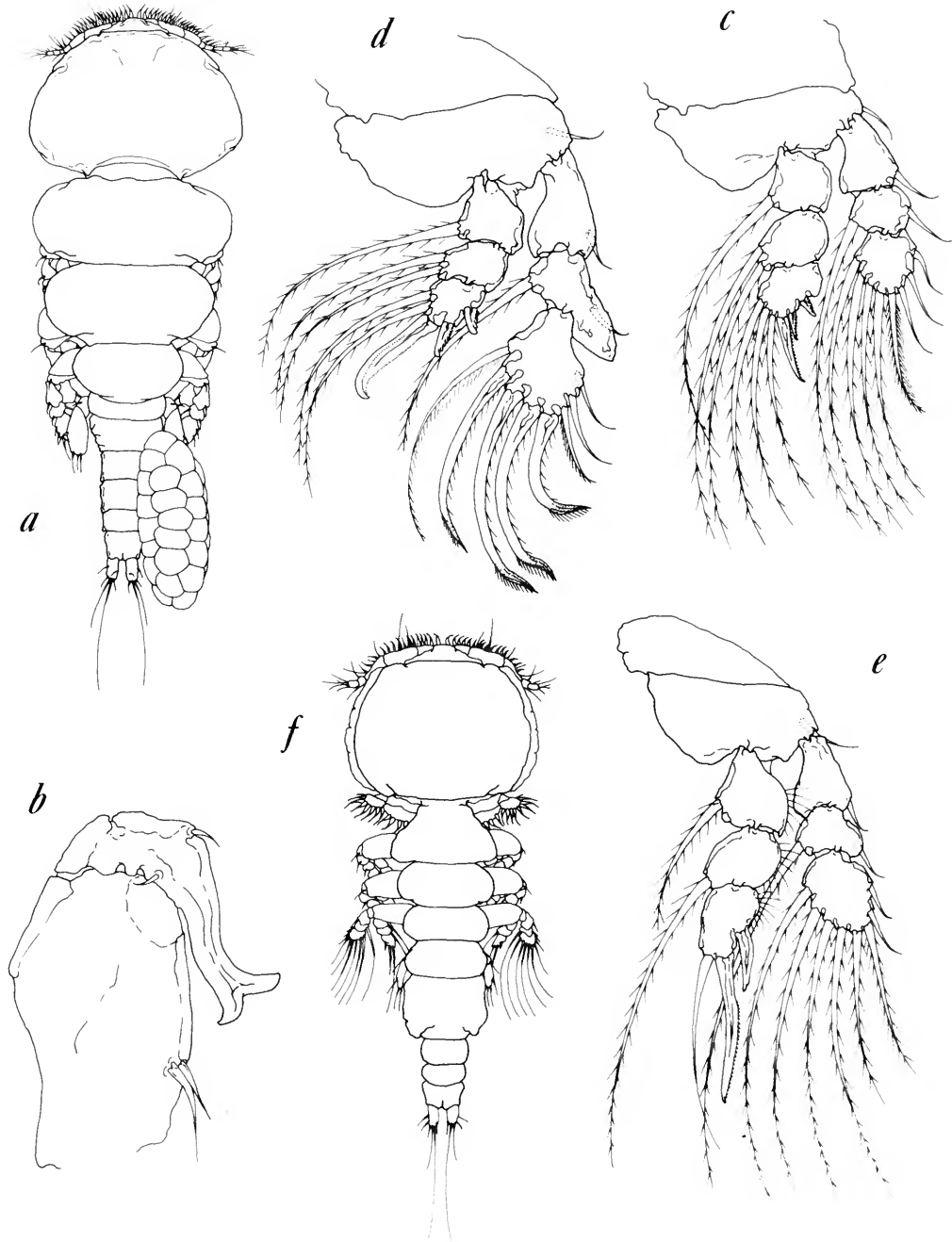


FIGURE 27.—*Taeniacanthus sauridae* Yamaguti & Yamasu, female: *a*, dorsal; *b*, maxilliped; *c*, second leg; *d*, third leg; *e*, fourth leg; male: *f*, dorsal.

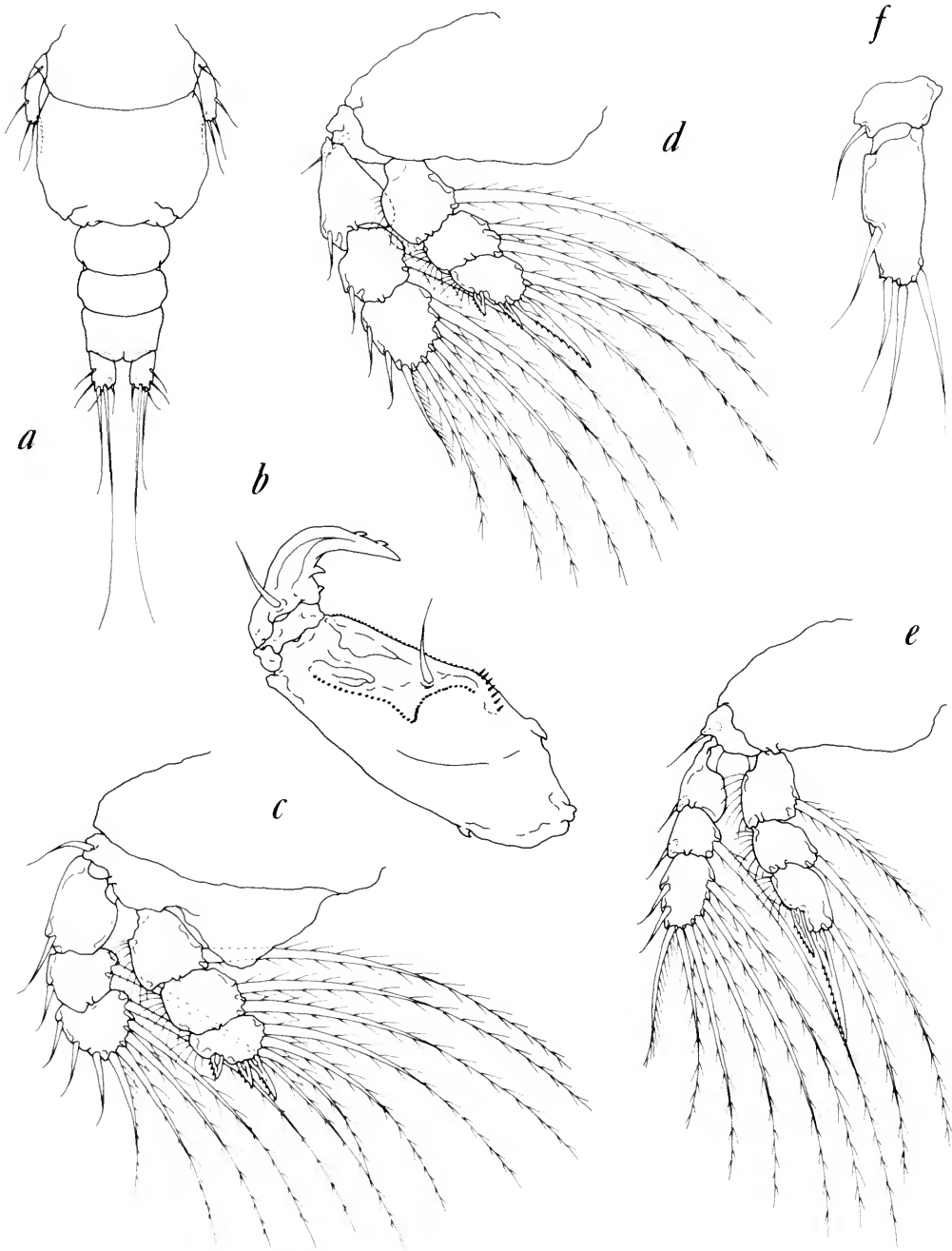


FIGURE 28.—*Taeniacanthus sauridae* Yamaguti & Yamasu, male: *a*, genital segment and abdomen; *b*, maxilliped; *c*, second leg; *d*, third leg; *e*, fourth leg; *f*, fifth leg.

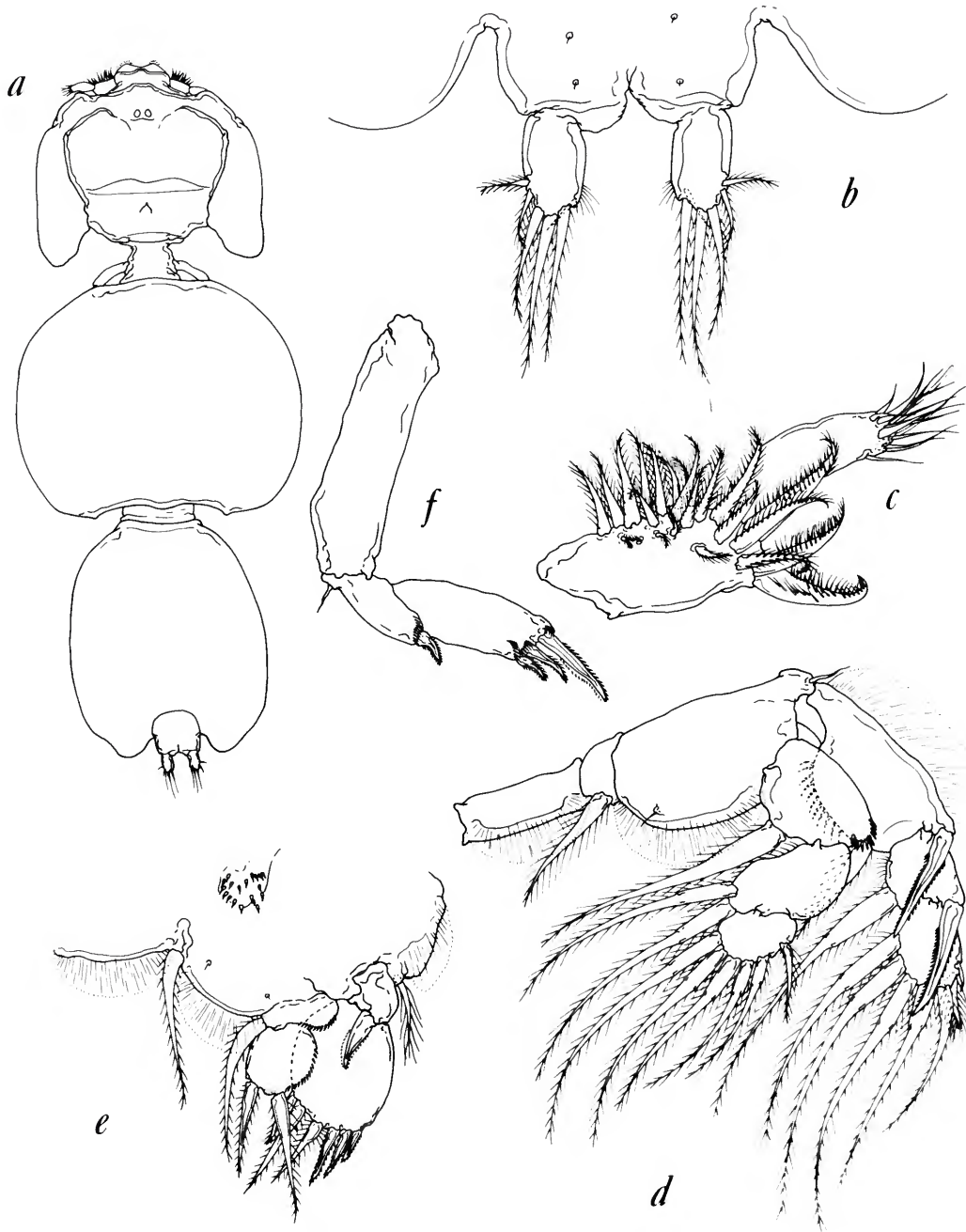


FIGURE 29.—*Abasia platyrostris* Pillai, female: a, dorsal; b, caudal rami; c, first antenna; d, second leg; e, third leg; f, fourth leg.

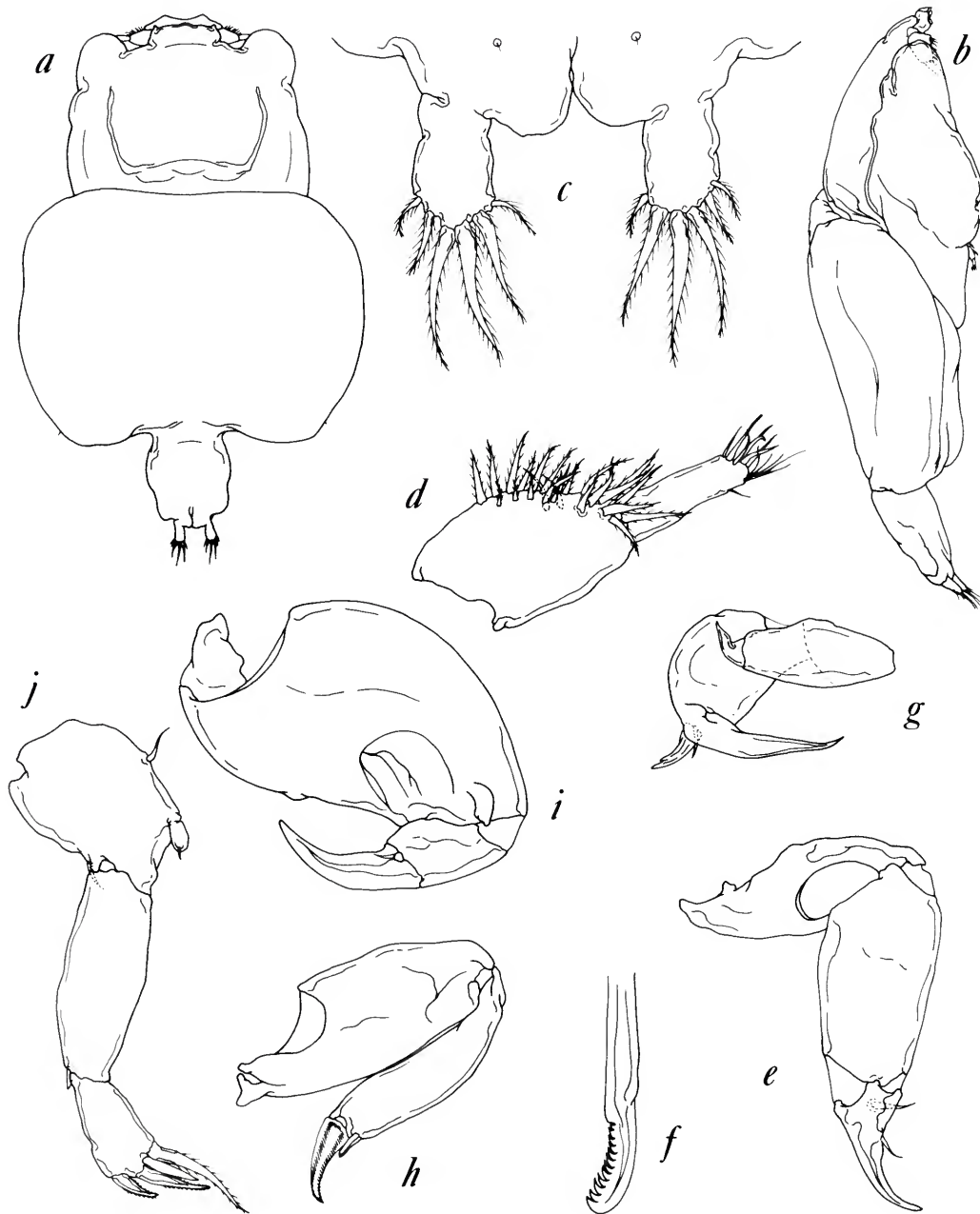


FIGURE 30.—*Abasia pusilla*, new species, female: *a*, dorsal; *b*, lateral; *c*, caudal rami; *d*, first antenna; *e*, second antenna; *f*, tip of mandible; *g*, first maxilla; *h*, second maxilla; *i*, maxilliped; *j*, first leg.

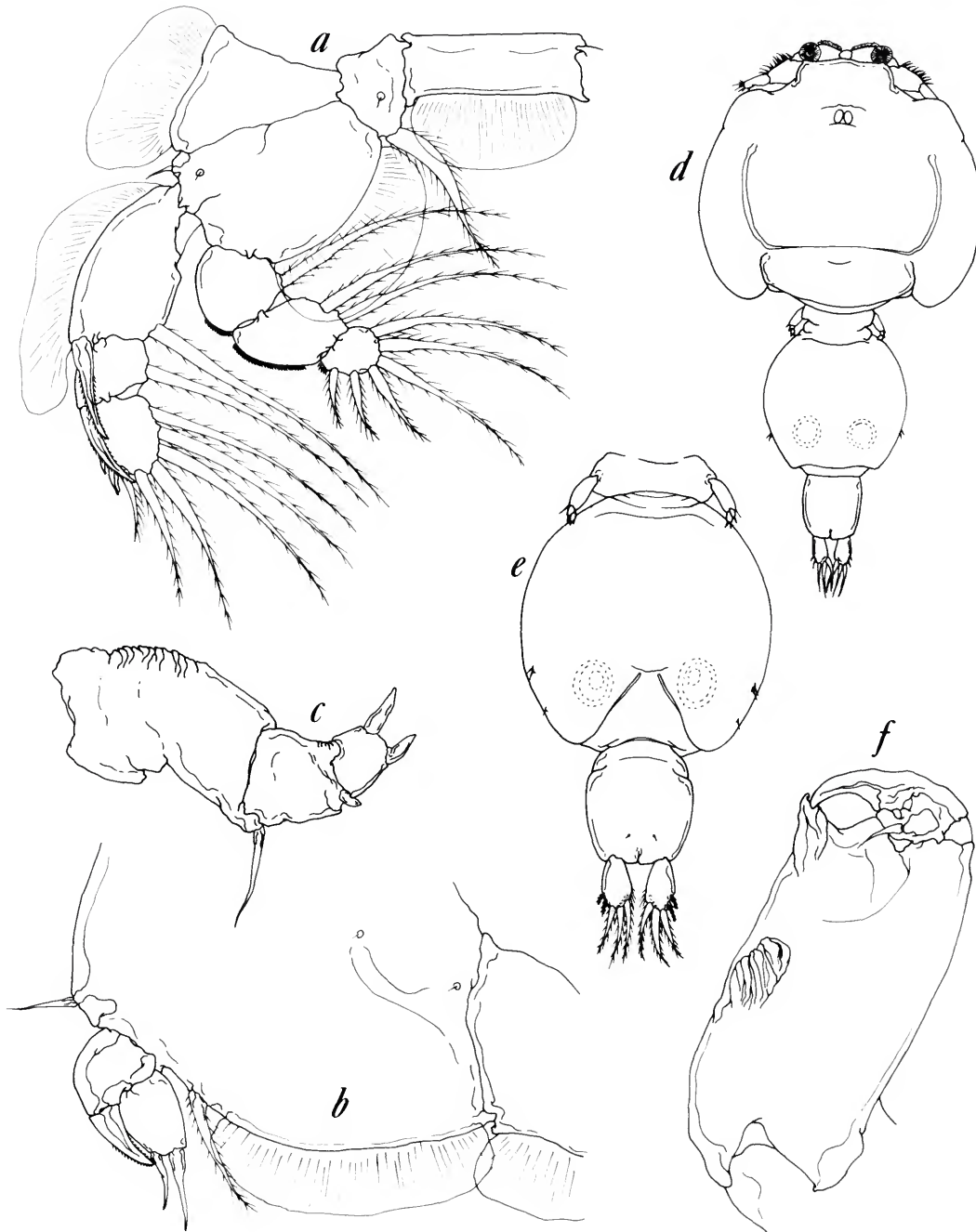


FIGURE 31.—*Abasia pusilla*, new species, female: *a*, second leg; *b*, third leg; *c*, fourth leg; male: *d*, dorsal; *e*, genital segment and abdomen, ventral; *f*, second antenna.

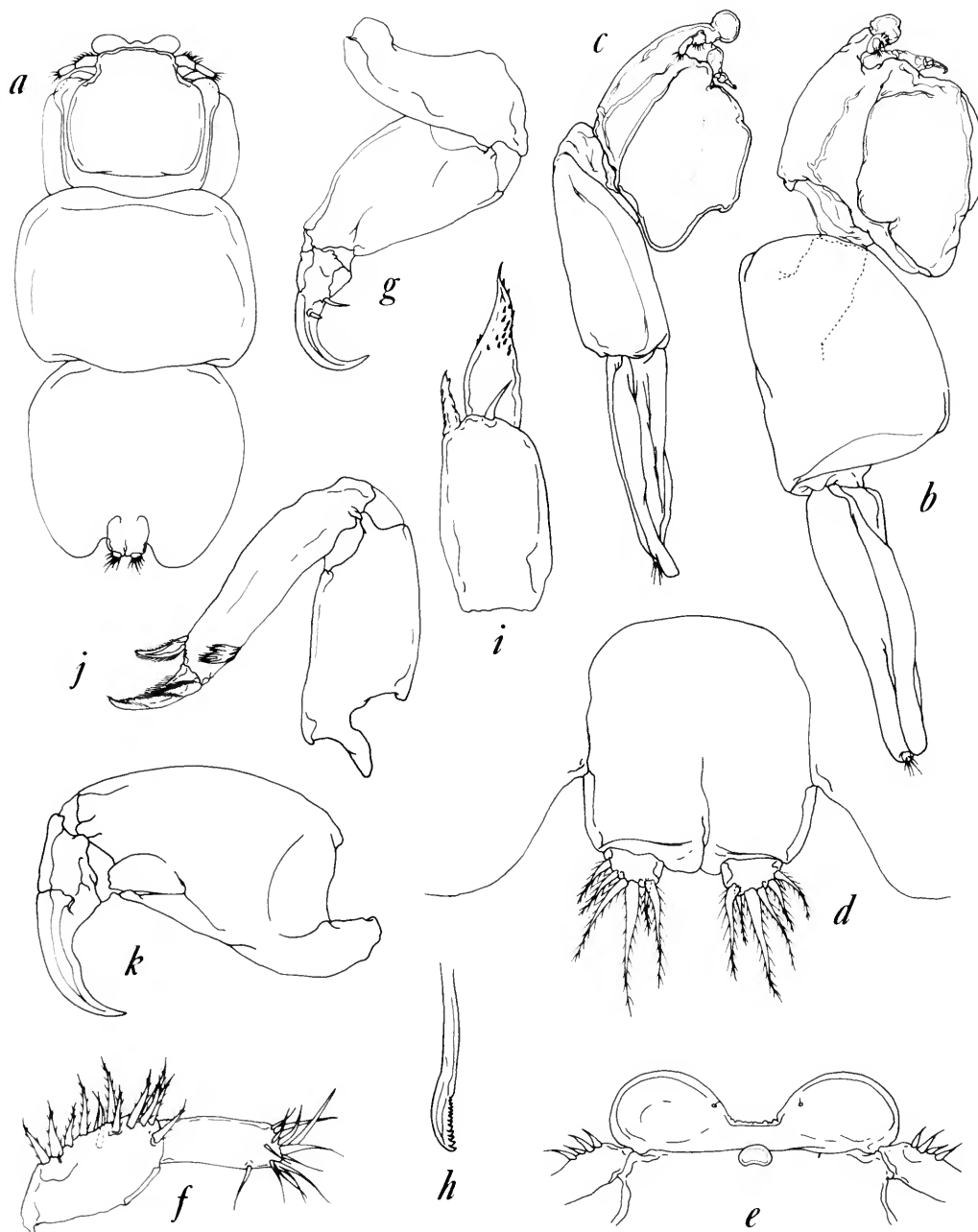


FIGURE 32.—*Abasia inflata*, new species, female: *a*, dorsal; *b*, lateral; *c*, lateral; *d*, second abdominal segment and caudal rami; *e*, rostrum, ventral; *f*, first antenna; *g*, second antenna; *h*, tip of mandible; *i*, first maxilla; *j*, second maxilla; *k*, maxilliped.

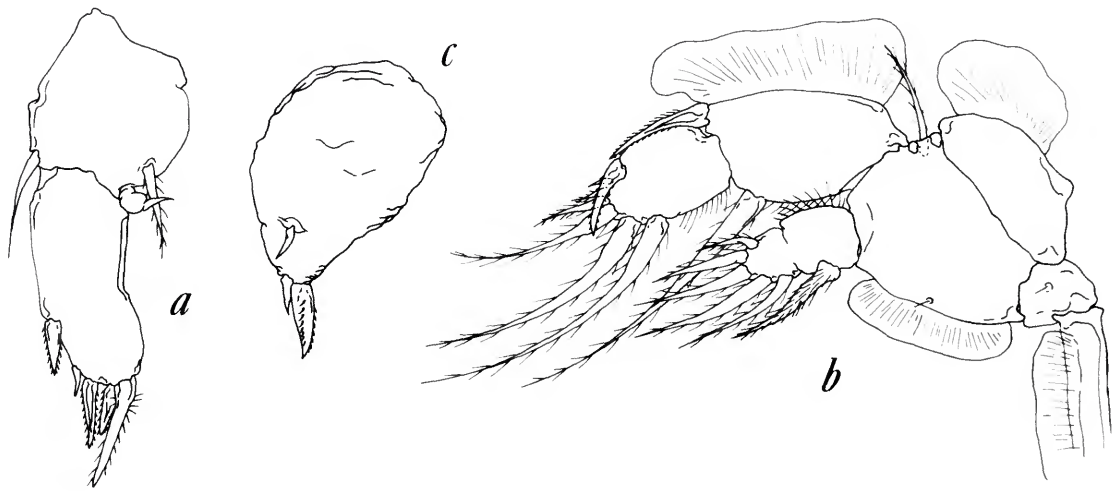


FIGURE 33.—*Abasia inflata*, new species, female: *a*, first leg; *b*, second leg; *c*, third leg.

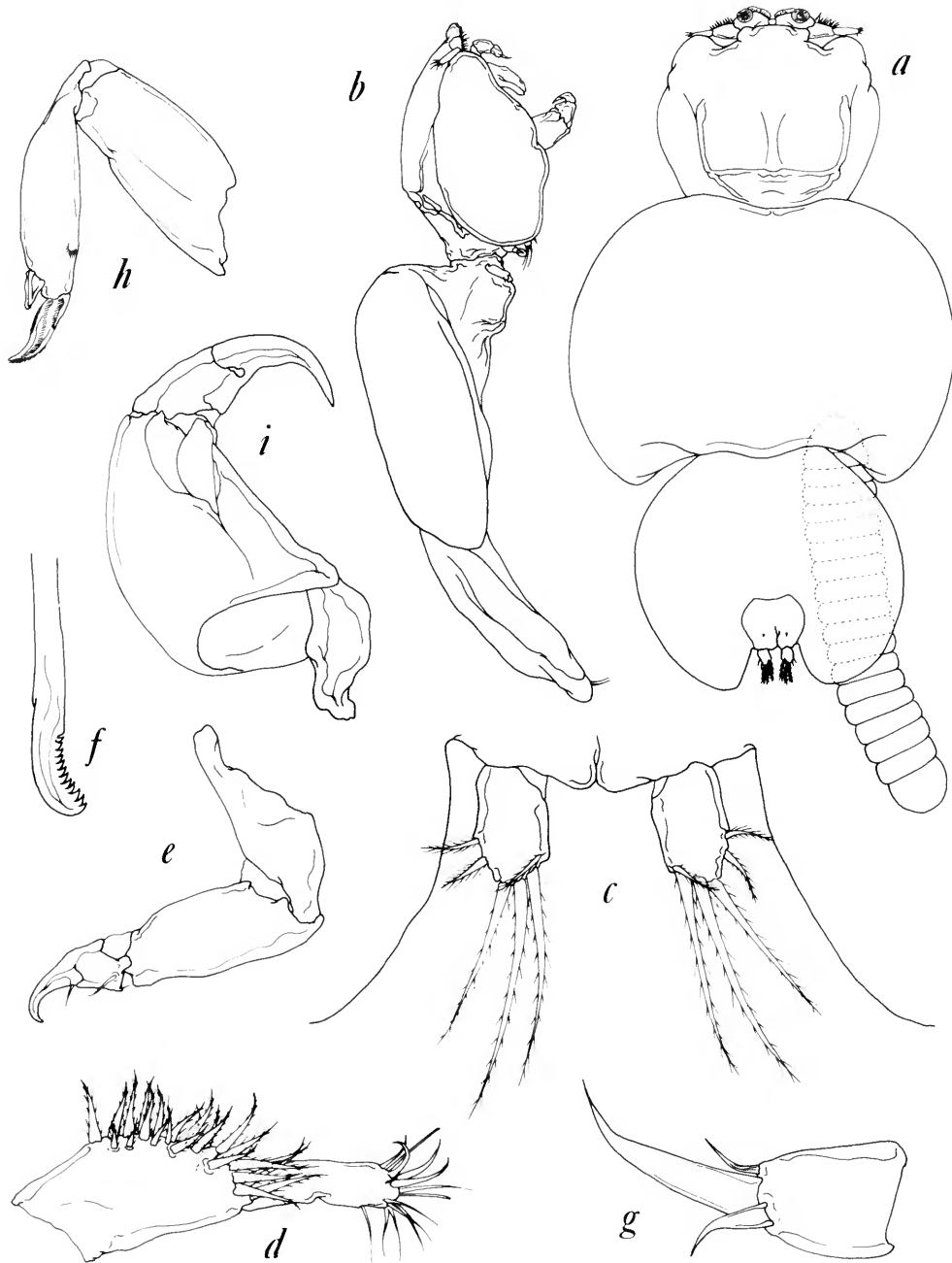


FIGURE 34.—*Abasia tripartita* (Shiino), female: *a*, dorsal; *b*, lateral; *c*, caudal rami; *d*, first antenna; *e*, second antenna; *f*, tip of mandible; *g*, first maxilla; *h*, second maxilla; *i*, maxilliped.

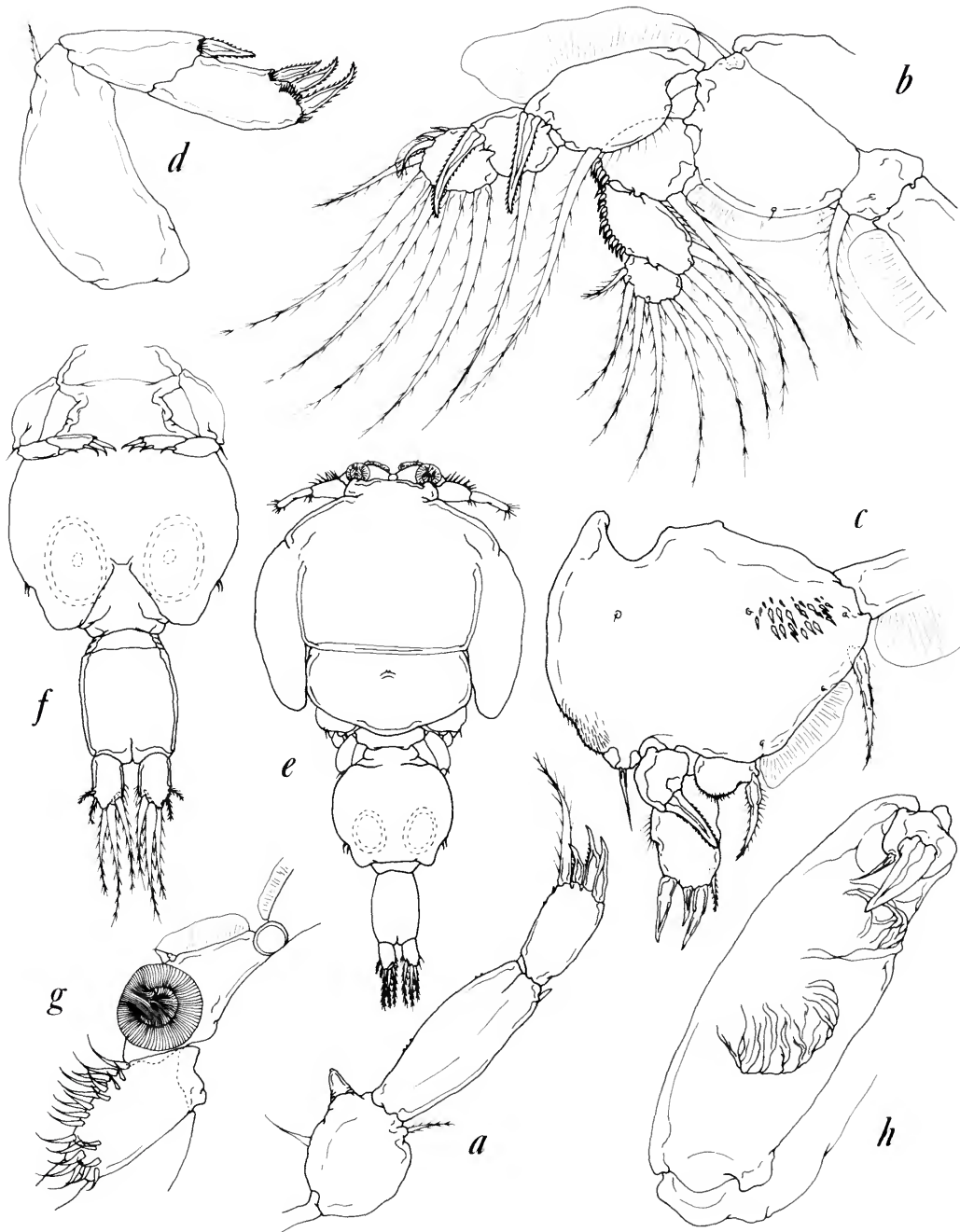


FIGURE 35.—*Abasia tripartita* (Shiino), female: *a*, first leg; *b*, second leg; *c*, third leg; *d*, fourth leg; male: *e*, dorsal; *f*, genital segment and abdomen, ventral; *g*, frontal lunule and adjacent rostral area, ventral; *h*, second antenna.

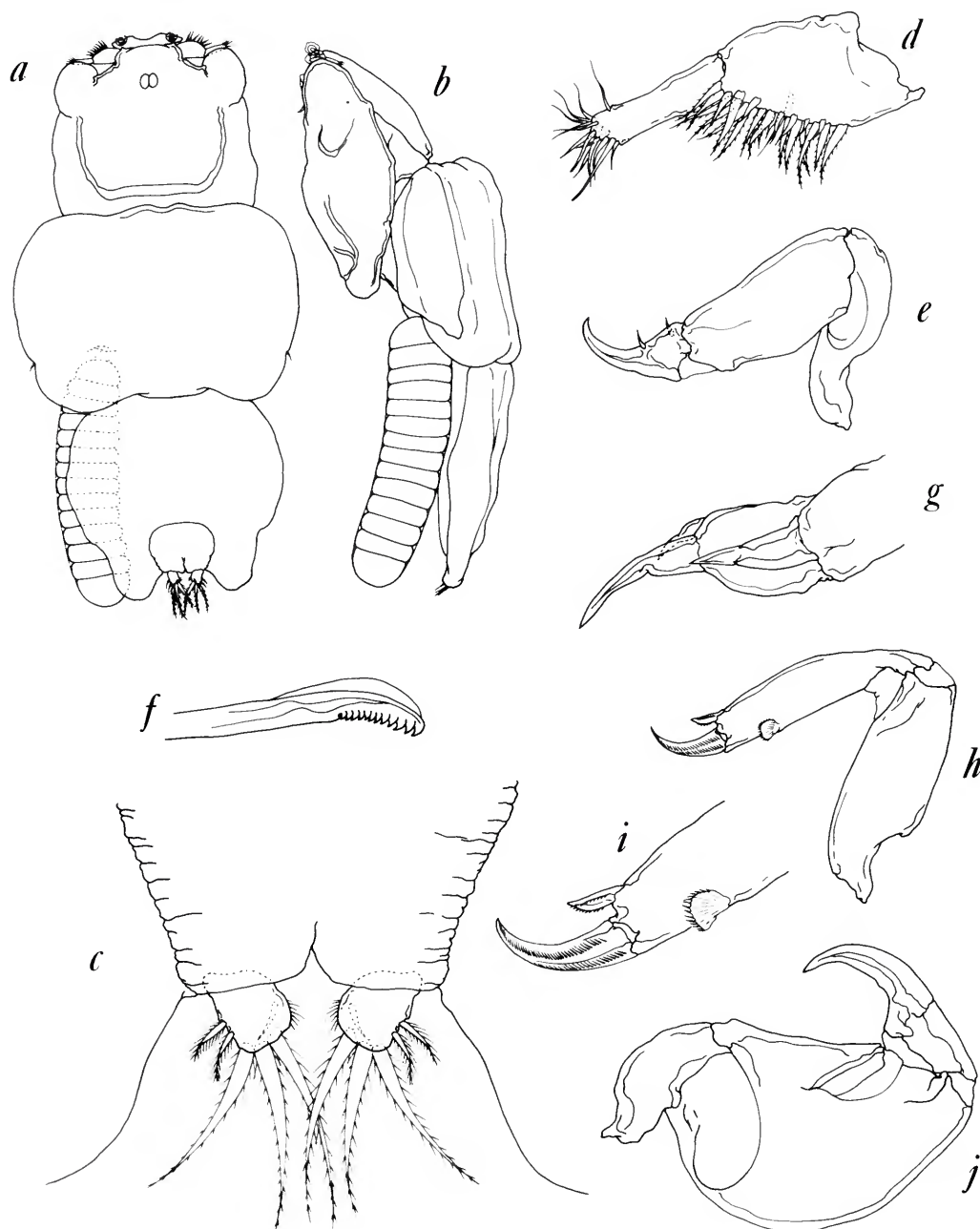


FIGURE 36.—*Abasia pillaii*, new species, female: *a*, dorsal; *b*, lateral; *c*, caudal rami; *d*, first antenna; *e*, second antenna; *f*, tip of mandible; *g*, first maxilla; *h*, second maxilla; *i*, tip of second maxilla; *j*, maxilliped.

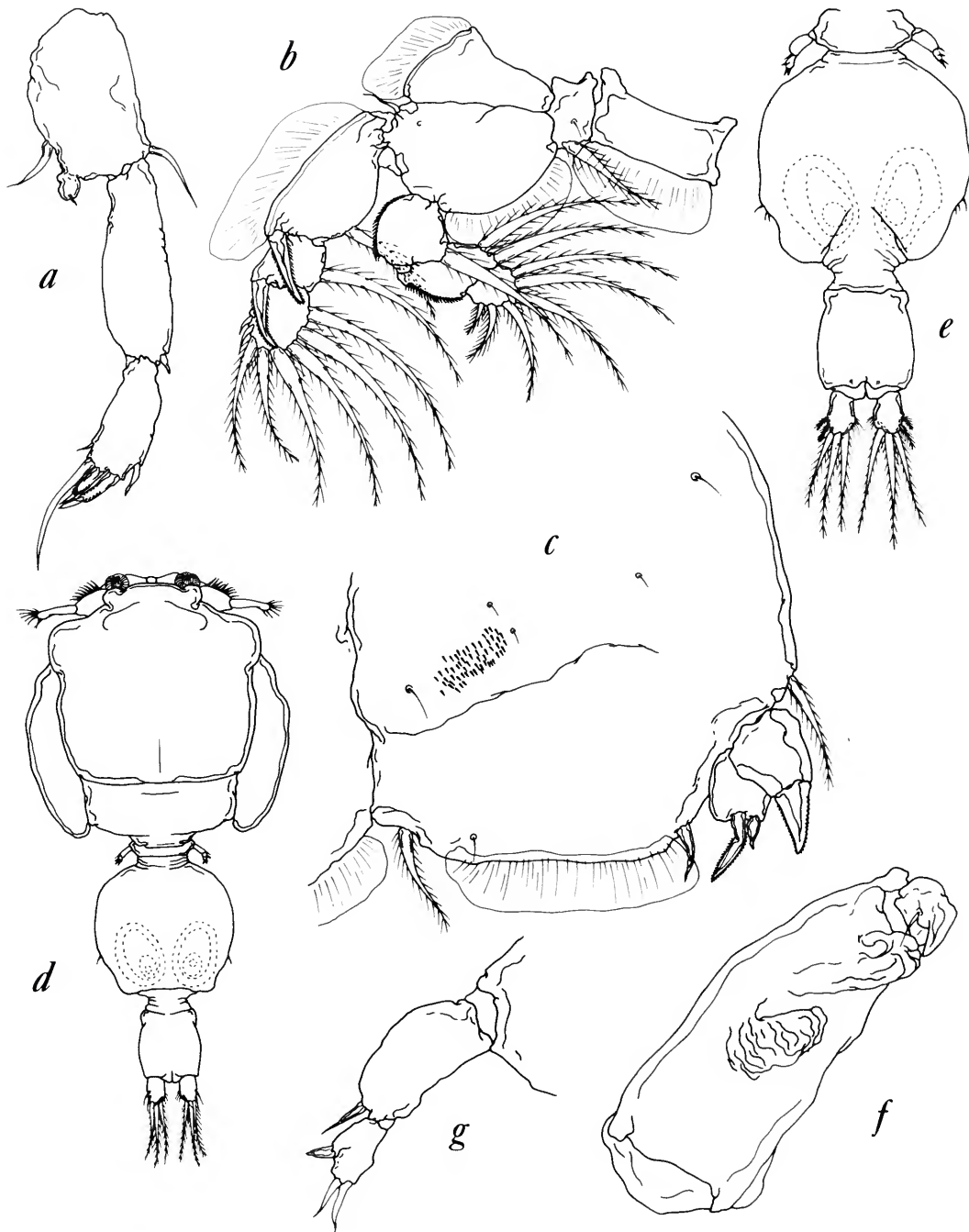


FIGURE 37.—*Abasia pillaii*, new species, female: *a*, first leg; *b*, second leg; *c*, third leg; male: *d*, dorsal; *e*, genital segment and abdomen, ventral; *f*, second antenna; *g*, fourth leg.

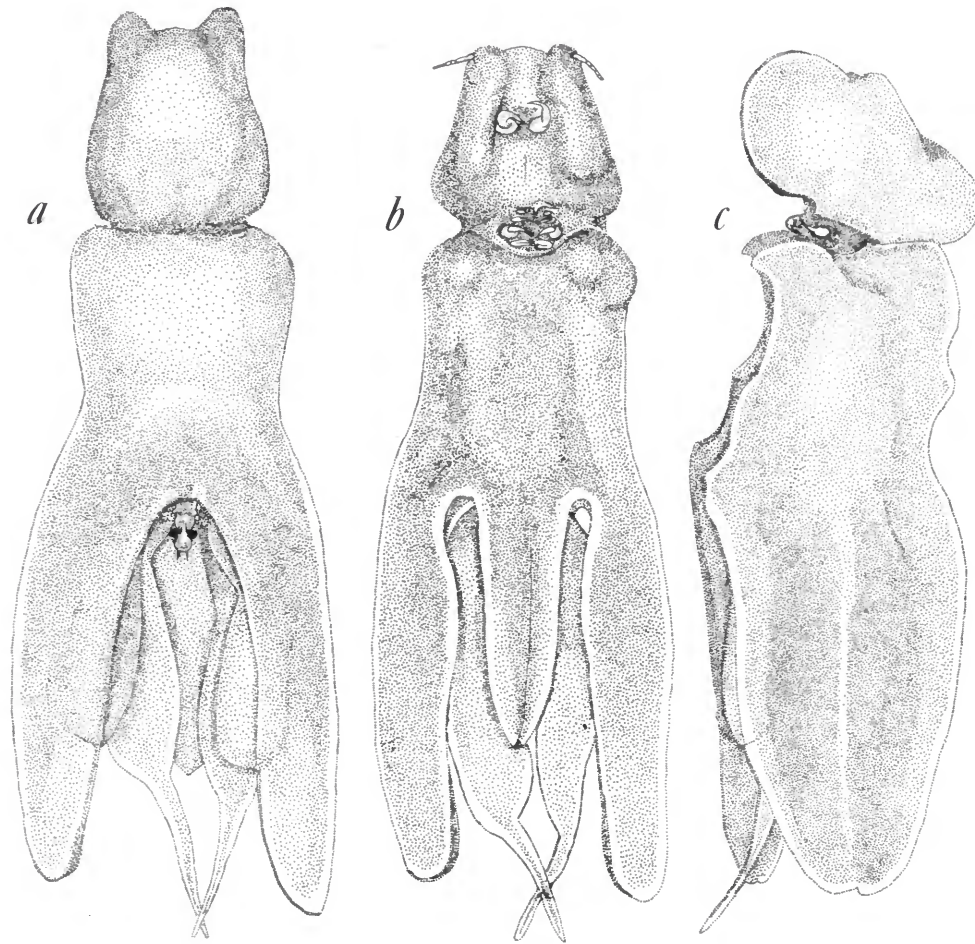


FIGURE 38.—*Lernanthropus temminckii* Nordmann, female: *a*, dorsal; *b*, ventral; *c*, lateral.

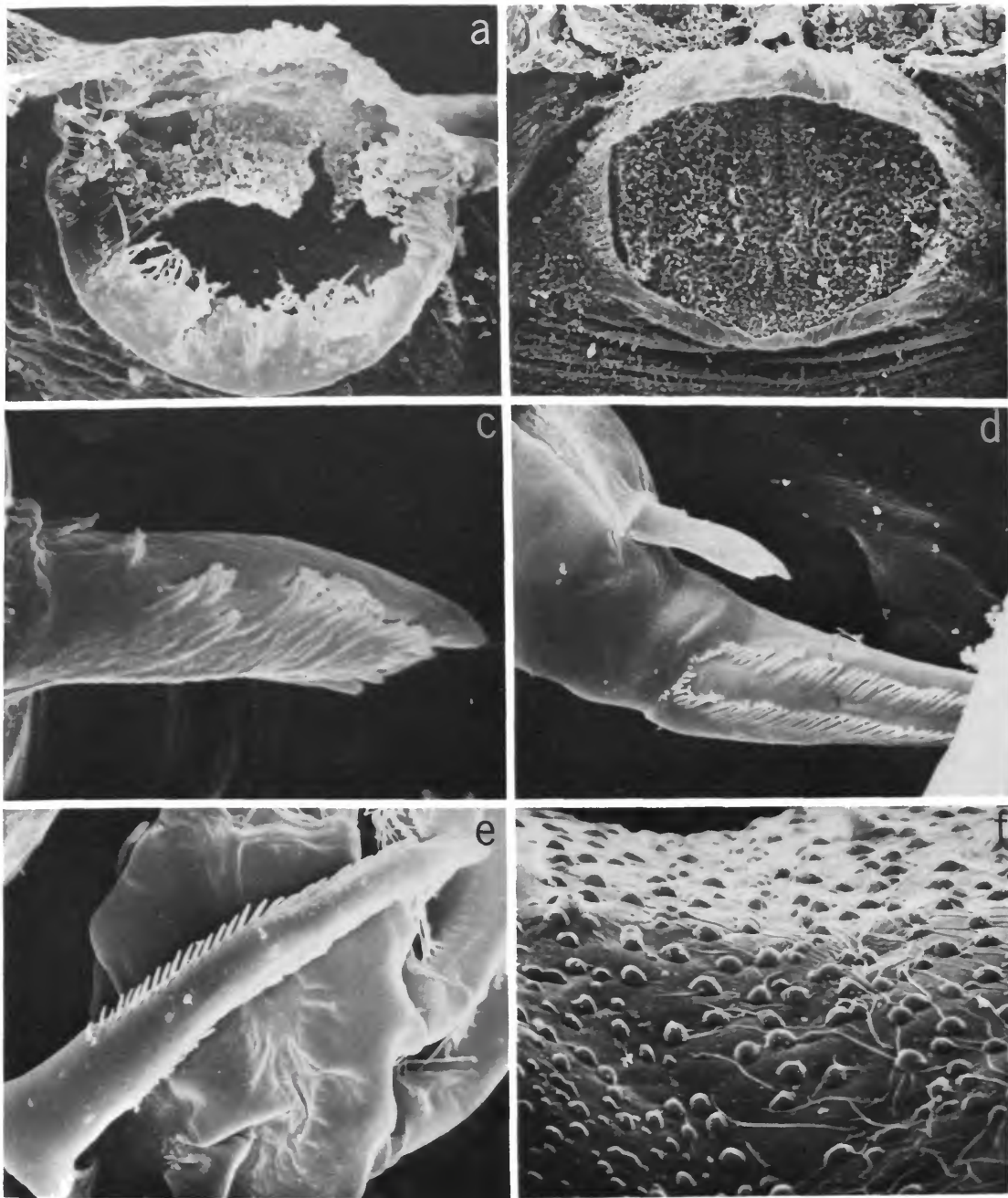


FIGURE 39.—*Abasia pusilla*, new species, female: *a*, frontal lunule, $\times 2475$; *b*, rostrum, ventral, $\times 1765$; *c*, basal spine of second maxilla, $\times 5600$; *d*, basal spine and base of distal process on second maxilla, $\times 1375$; *e*, exopod outer spine of leg 2, $\times 1680$. *Abasia inflata*, new species, female: *f*, dorsal surface of carapace, $\times 2430$.

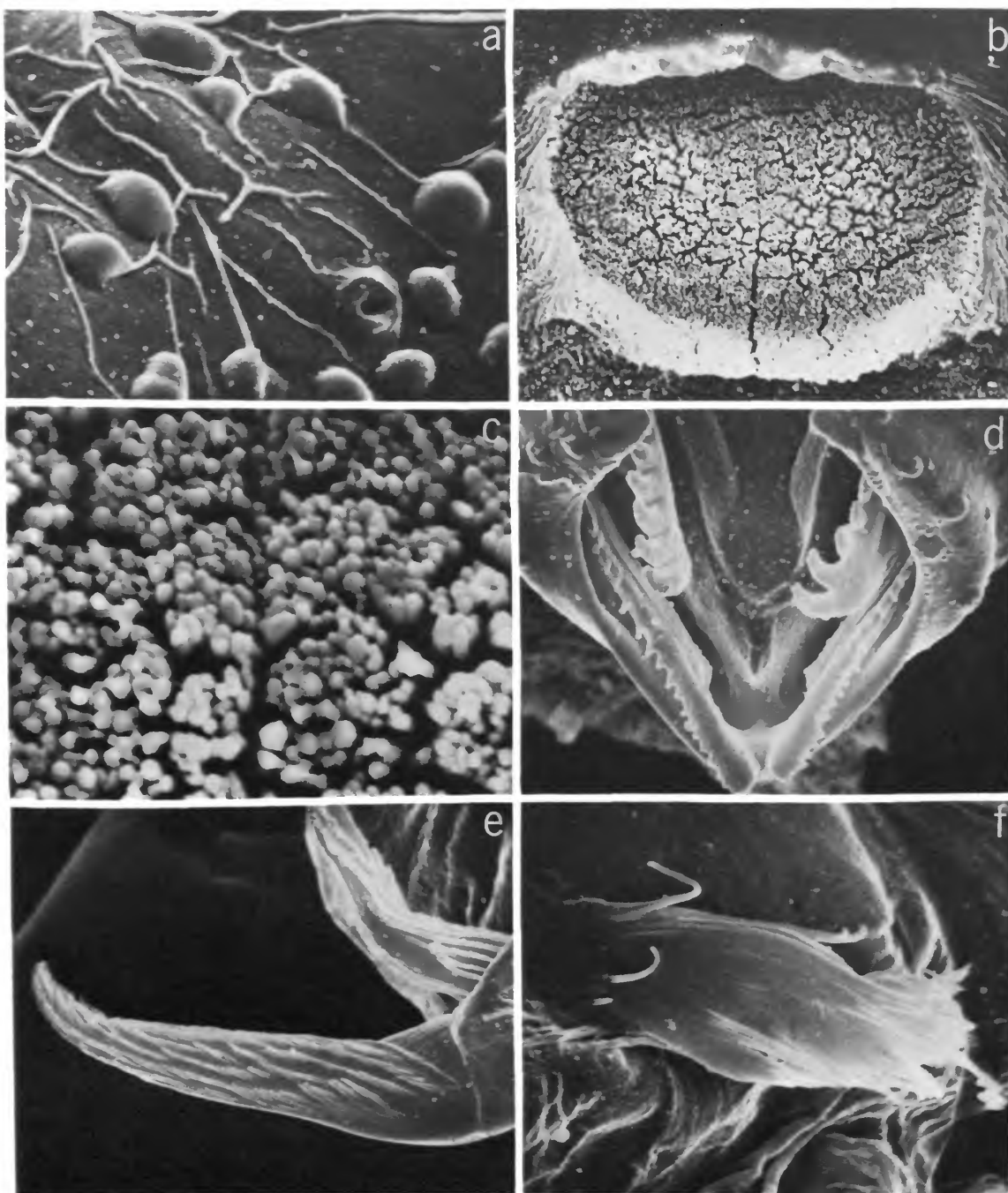


FIGURE 40.—*Abasia inflata*, new species, female: *a*, dorsal surface of carapace, $\times 6075$; *b*, rostrum, ventral, $\times 3000$; *c*, rostrum, ventral, $\times 15,000$; *d*, tip of mouth tube, labrum removed, $\times 3600$; *e*, tip of second maxilla, $\times 1440$; *f*, process near tip of second maxilla, $\times 5000$.

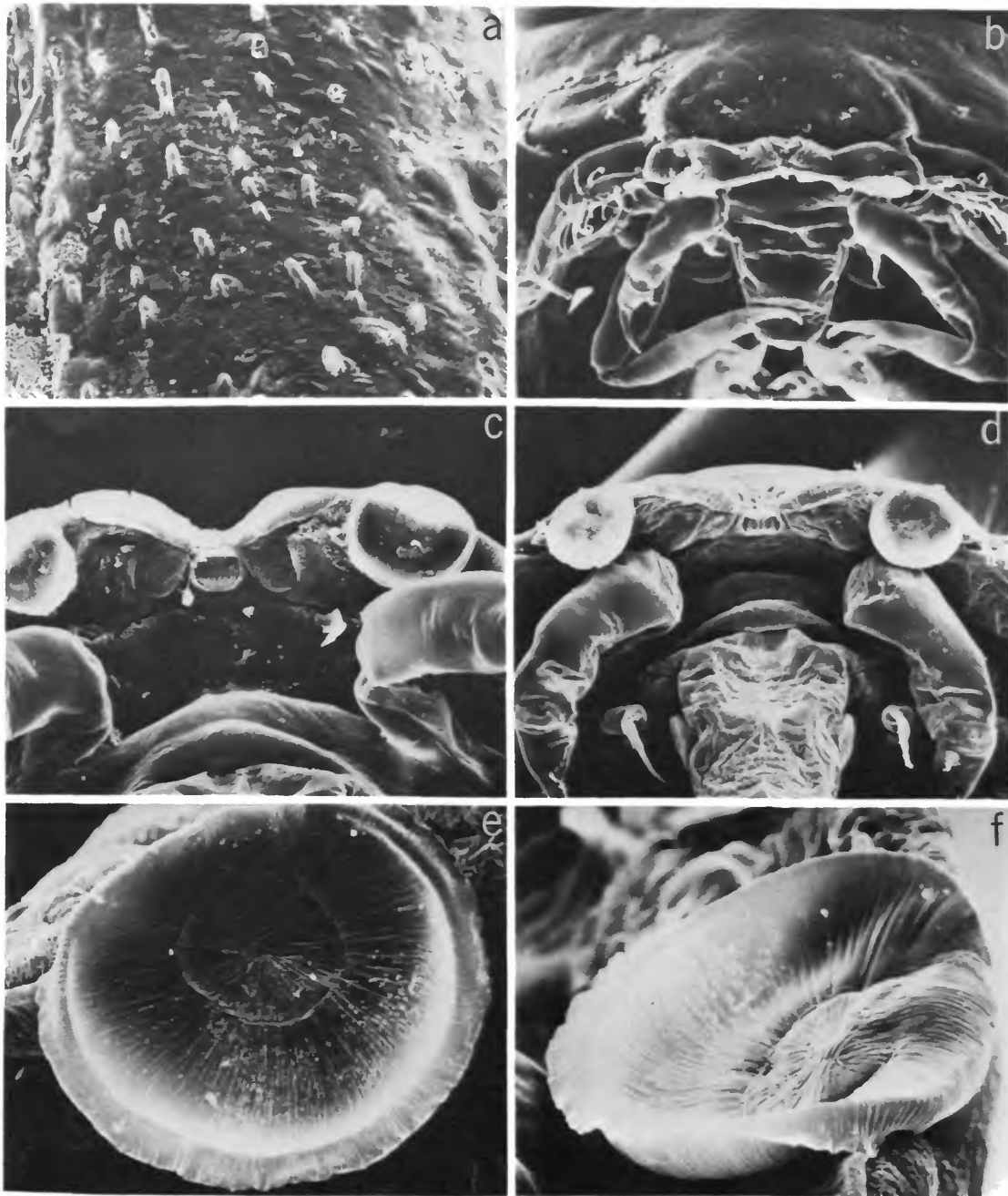


FIGURE 41.—*Abasia tripartita* (Shiino), female: *a*, dorsal surface of genital segment, $\times 1500$; *b*, cephalon, anterior view, $\times 165$; *c*, rostral area, ventral, $\times 300$; *d*, cephalon, ventral view of anterior half, $\times 270$; *e*, frontal lunule, $\times 1265$; *f*, frontal lunule, $\times 1470$.

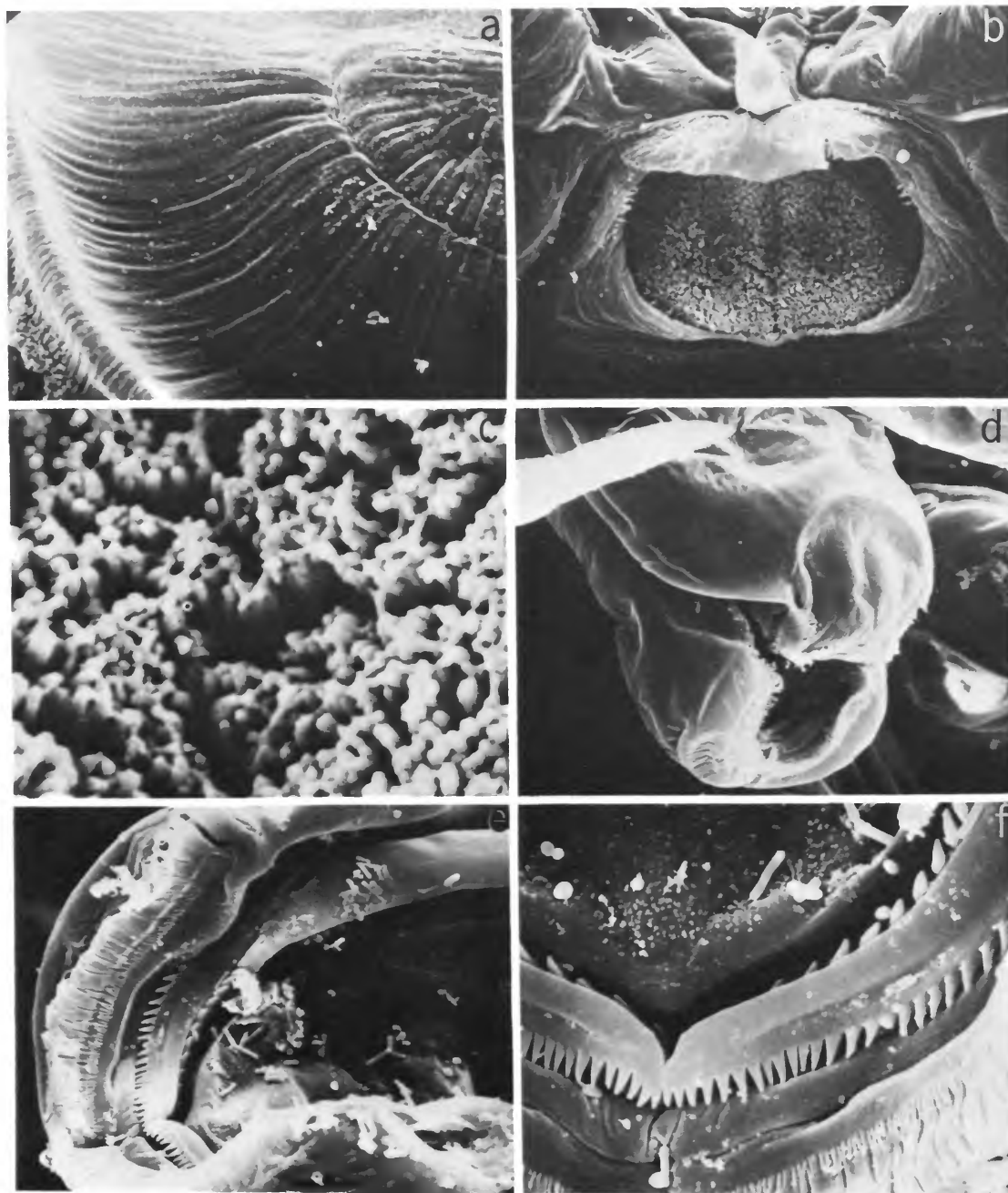


FIGURE 42.—*Abasia tripartita* (Shiino), female: *a*, edge of frontal lunule, $\times 3000$; *b*, rostrum, $\times 2000$; *c*, detail of rostrum, $\times 15,000$; *d*, tip of mouth tube, labrum uppermost, $\times 560$; *e*, tip of mouth tube, labrum removed, $\times 1430$; *f*, strigil within mouth tube, $\times 2600$.

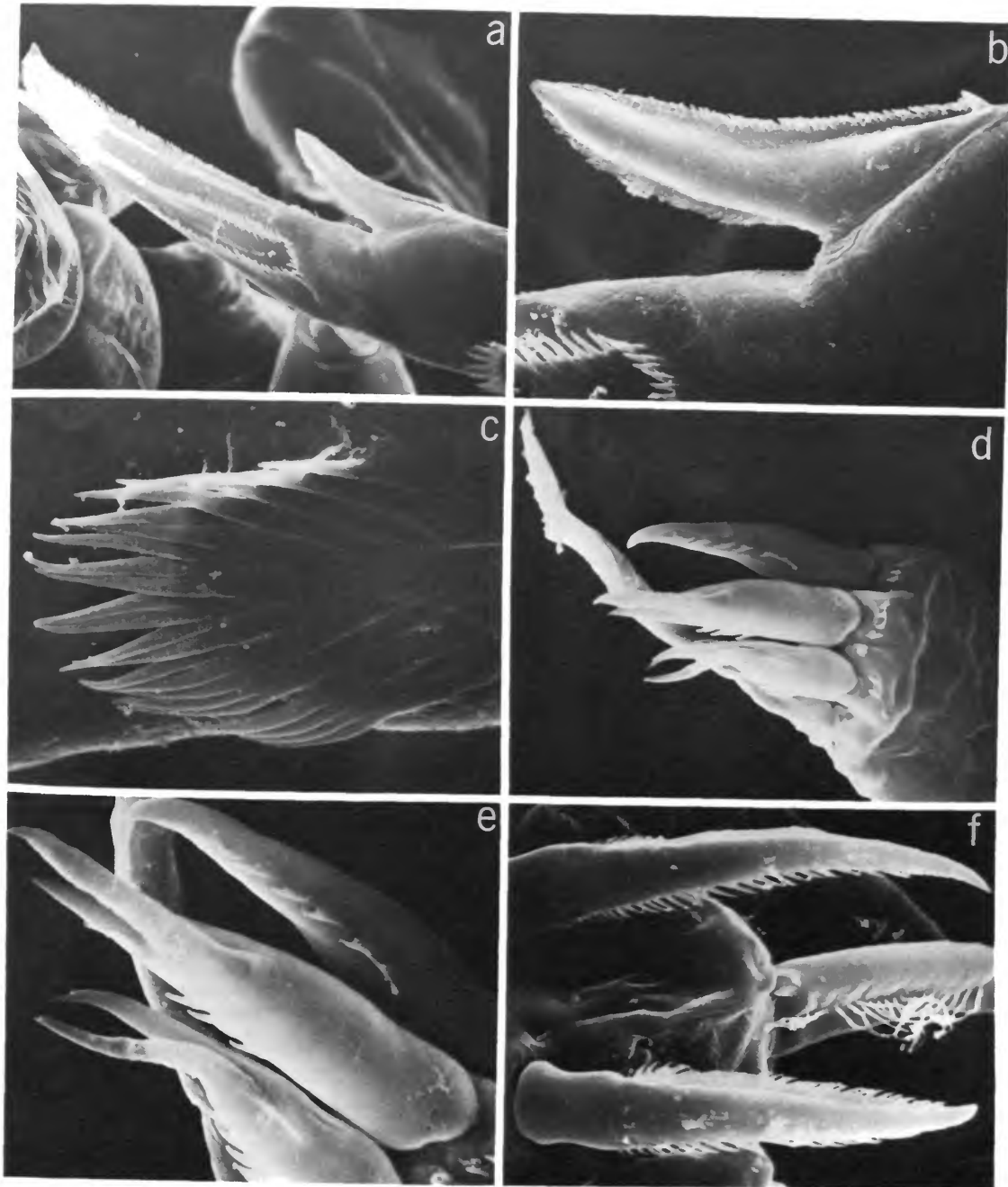


FIGURE 43.—*Abasia tripartita* (Shiino), female: *a*, tip of second maxilla, $\times 1000$; *b*, spine on distal corner of second maxilla, $\times 2500$; *c*, process at base of flagellum of second maxilla, $\times 4700$; *d*, tip of leg 1 exopod, $\times 1400$; *e*, spines at tip of leg 1 exopod, $\times 3000$; *f*, exopod spines of leg 2, $\times 1200$.

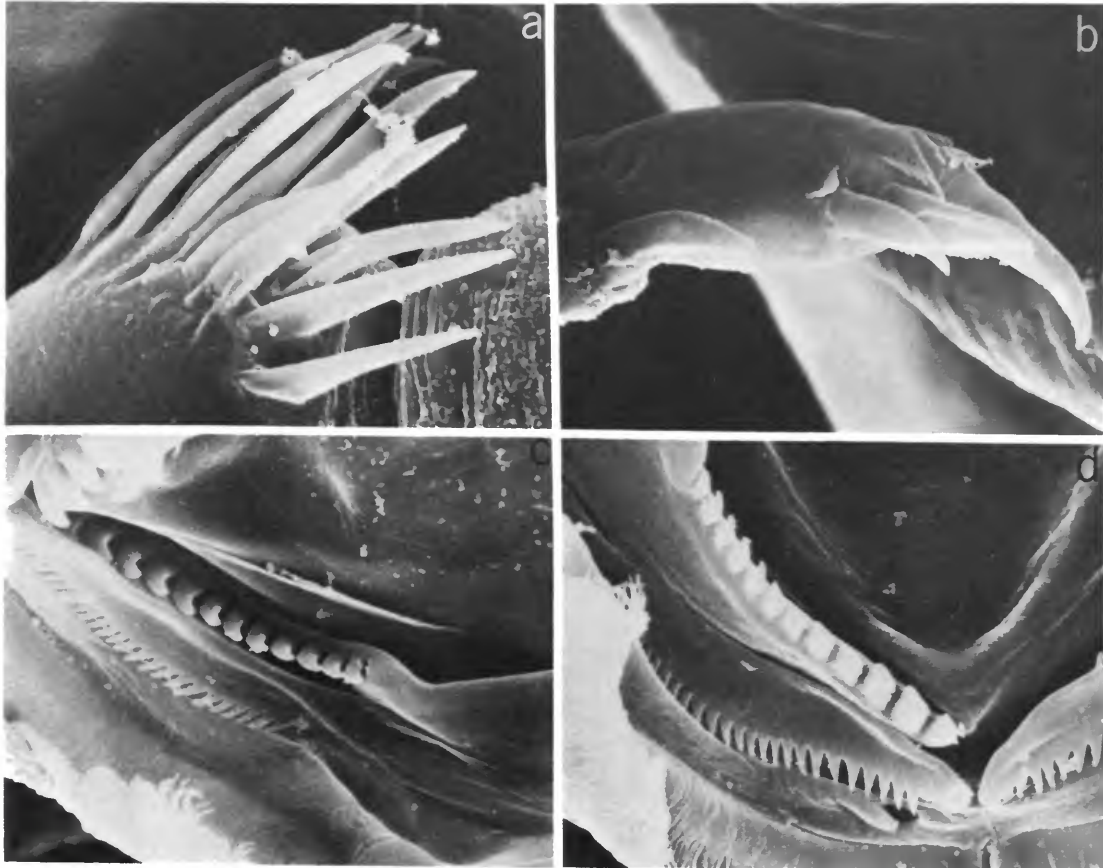


FIGURE 44.—*Abasia tripartita* (Shiino), female: *a*, spines on outer distal corner of endopod first segment of leg 2, $\times 4000$; *b*, tip of leg 4, $\times 1200$. *Abasia pillaii*, new species, female: *c*, mandible and strigil within mouth tube, $\times 1800$; *d*, mandible and strigil within mouth tube, $\times 2000$.

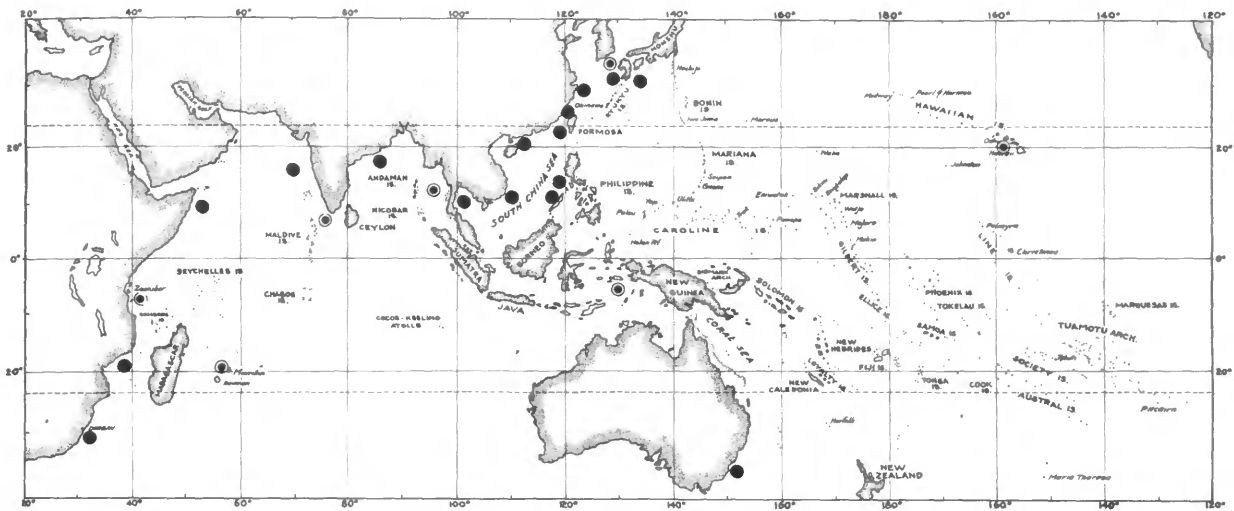


FIGURE 45.—Distribution of *Metataeniacanthus synodi* Pillai, 1963, and its host *Trachinocephalus myops* (Schneider, 1801). (Dots within circles = unparasitized.)

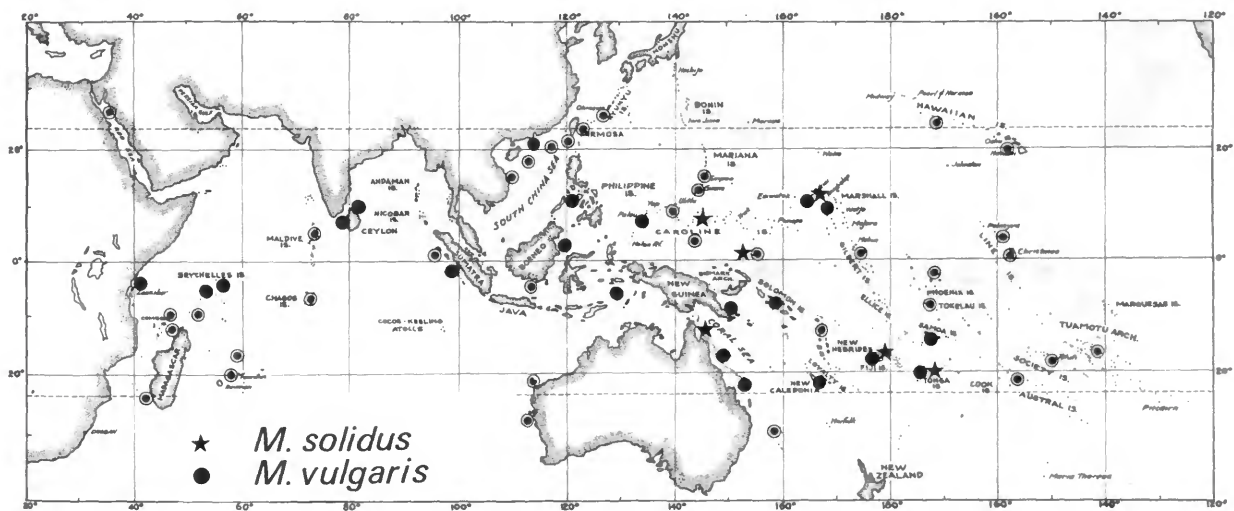


FIGURE 46.—Distribution of *Metataeniacanthus vulgaris*, new species, and *M. solidus*, new species, and their host *Synodus variegatus* (Lacepède, 1803). (Dots within circles = unparasitized.)

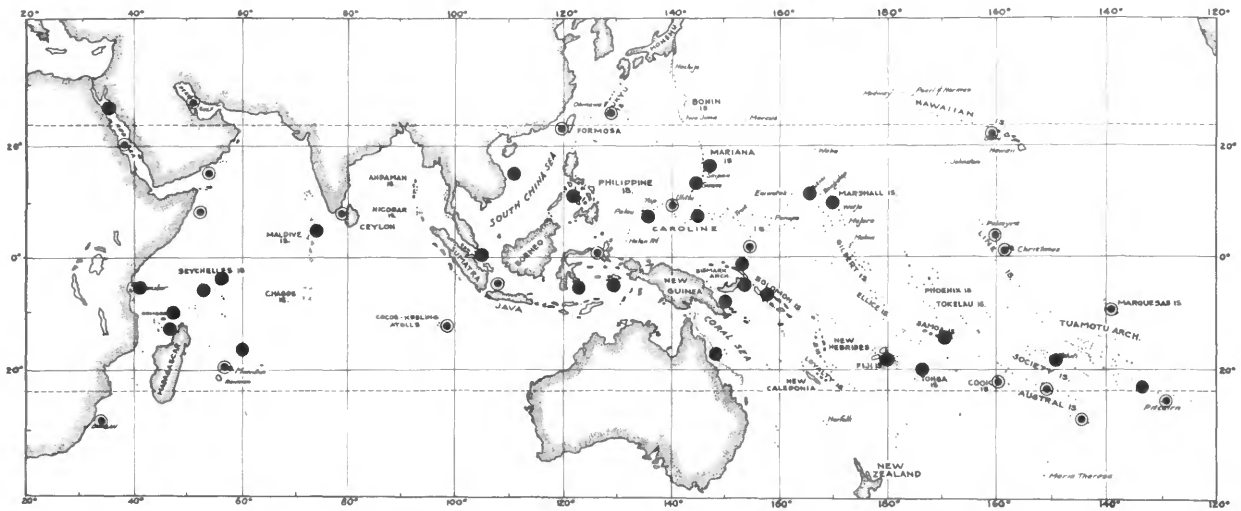


FIGURE 47.—Distribution of *Metataeniacanthus epigri*, new species and its host *Synodus englemani* Schultz, 1953. (Dots within circles = unparasitized.)

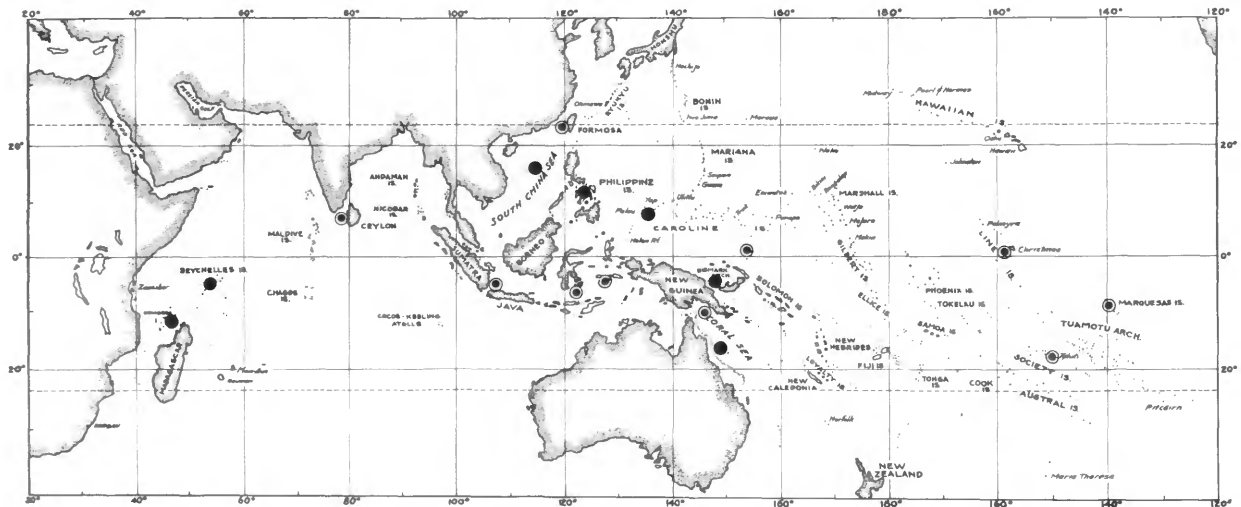


FIGURE 48.—Distribution of *Metataeniacanthus coneigri*, new species and its host *Synodus jaculum* Russell and Cressey, 1979. (Dots within circles = unparasitized.)

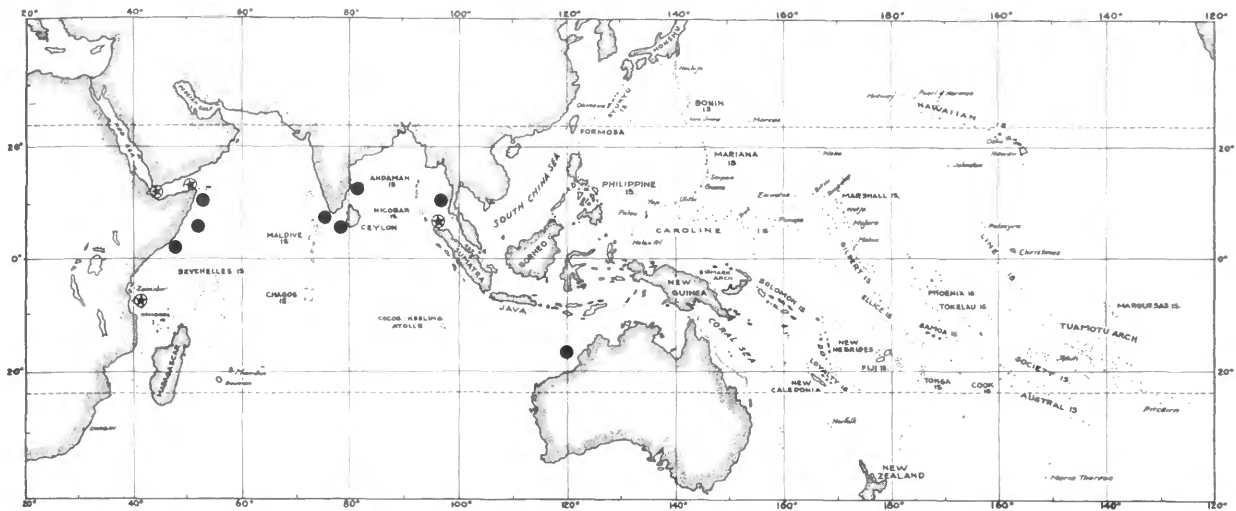


FIGURE 49.—Distribution of *Metataeniacanthus gibbsi*, new species and its host *Synodus indicus* (Day, 1973). (Stars within circles = unparasitized.)

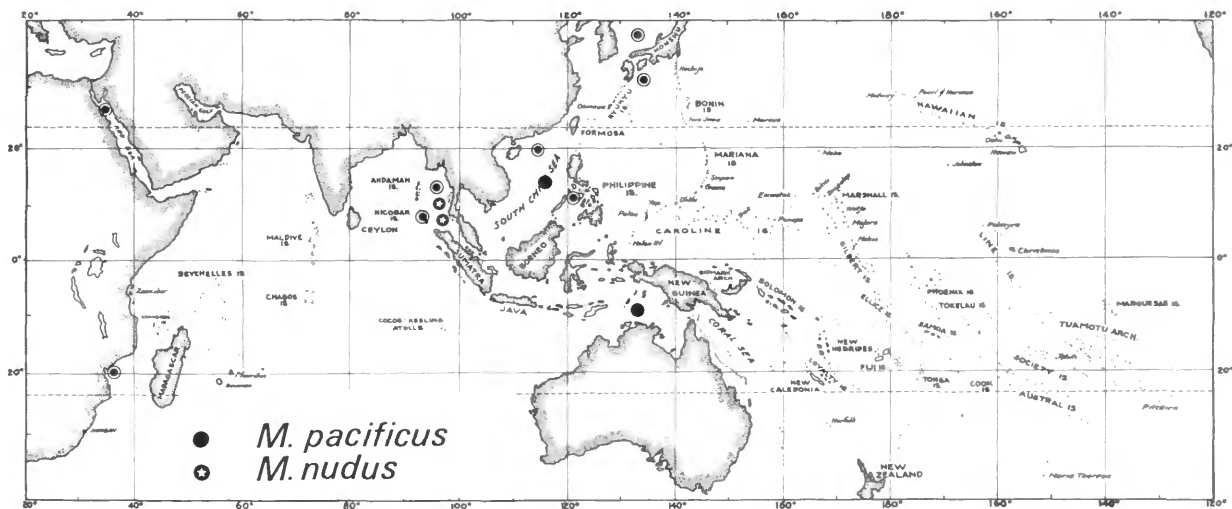


FIGURE 50.—Distribution of *Metataeniacanthus pacificus*, new species and *M. nudus*, new species and their host *Synodus hoshinonis* Tanaka, 1917. (Dots within circles = unparasitized.)

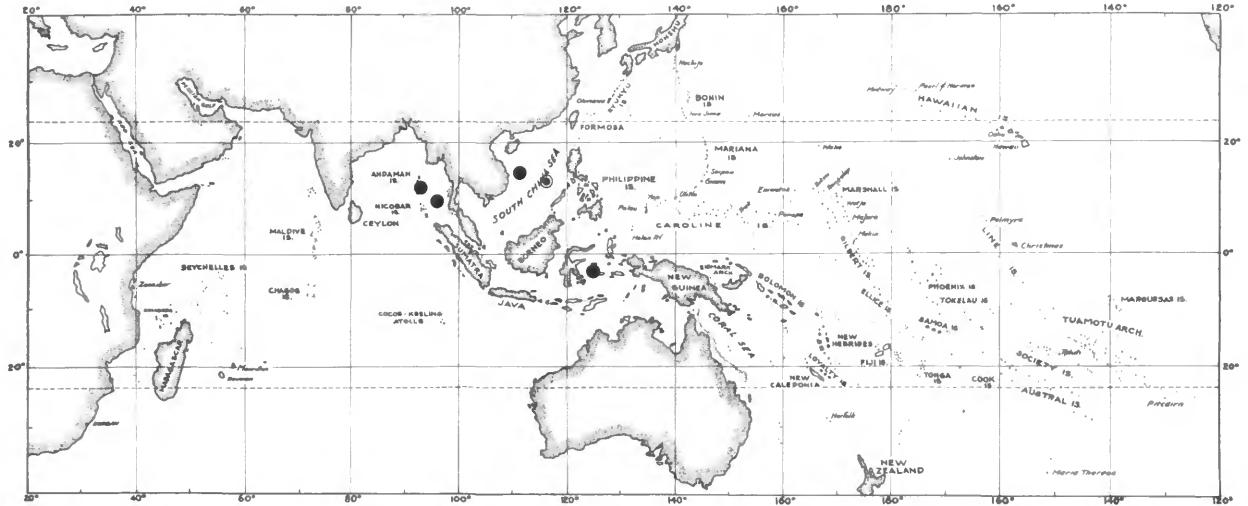


FIGURE 51.—Distribution of *Metataeniacanthus indiscretus*, new species and its host *Synodus* species (undescribed). (Dots within circles = unparasitized.)

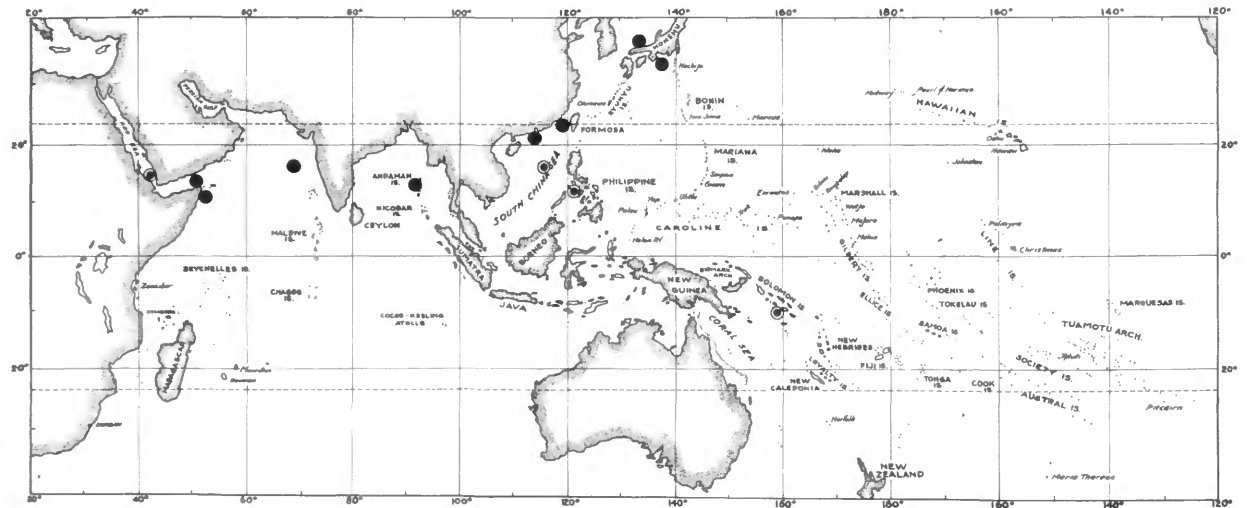


FIGURE 52.—Distribution of *Metataeniacanthus aquilonius*, new species and its host *Synodus macrops* Tanaka, 1917. (Dots within circles = unparasitized.)

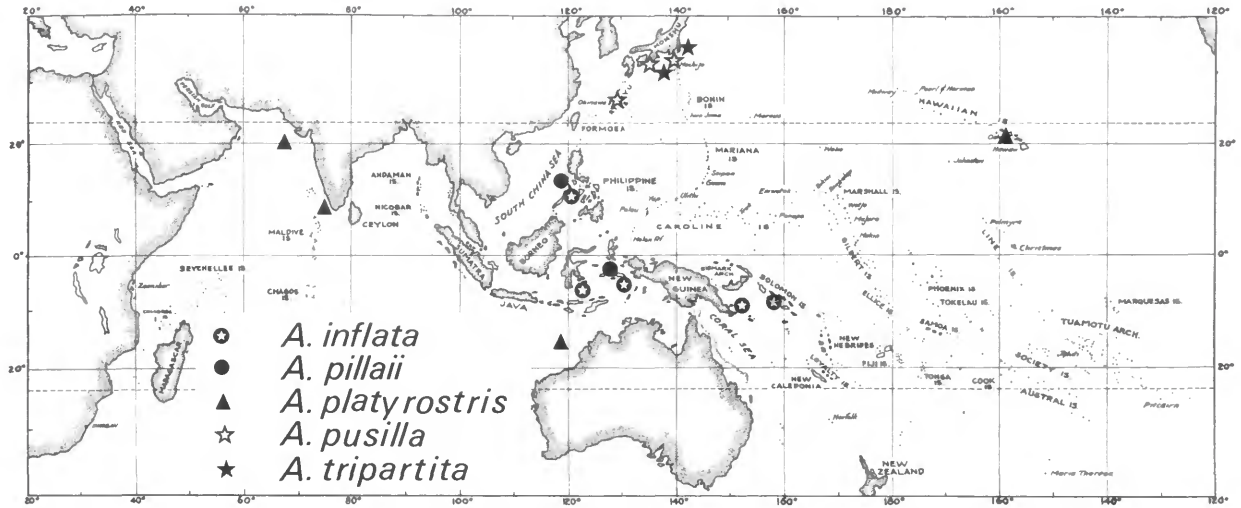


FIGURE 53.—Distribution of the 5 known species of *Abasia* in the Indo-West Pacific.

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Manuscripts intended for series publication receive substantive review within their originating Smithsonian museums or offices and are submitted to the Smithsonian Institution Press with approval of the appropriate museum authority on Form SI-36. Requests for special treatment—use of color, foldouts, casebound covers, etc.—require, on the same form, the added approval of designated committees or museum directors.

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Front matter (preceding the text) should include: **title page** with only title and author and no other information, **abstract page** with author/title/series/etc., following the established format, **table of contents** with indents reflecting the heads and structure of the paper.

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Text-reference system (author/year/page within the text, with the full reference in a "Literature Cited" at the end of the text) must be used in place of bibliographic footnotes in all scientific series and is strongly recommended in the history and technology series: "(Jones, 1910:122)" or ". . . Jones (1910:122)."

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