JU-SHEY HO

Parasitic Copepods of the Family Chondracanthidae from Fishes of Eastern North America

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ABSTRACT

Ho, Ju-shey. Parasitic Copepods of the Family Chondracanthidae from Fishes of Eastern North America. *Smithsonian Contributions to Zoology,* number 87, 39 pages. 1971.—Nineteen species representing nine genera of chondrachanthid copepods are known to occur on fishes off the Atlantic and the Gulf coast of North America. They are: *Acanthochondria cornuta*, A. cyclopsetta, A. exilipes, A. galerita, A. phycidis, Acanthochondrites annulatus*, Berea ancoralis*, Blias prionoti*, Chondracanthodes deflexus*, C. radiatus, Chondracanthus cottunculi, C. janebennettae, C. merluccii, C. nodosus, C. wilsoni, Heterochondria crassicornis*, Pseudochondracanthus diceraus*, P. hexaceraus,* and *Rhynchochondria longa**. A redescription is given for all species except eight that are marked with an asterisk, since they have already been treated elsewhere in a revision of the chondracanthid genera (Ho, 1970). A new form, *Chondracanthus wilsoni* new species, is described and a key to the nineteen eastern North American species is given.

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Ju-shey Ho

Parasitic Copepods of the Family Chondracanthidae from Fishes of Eastern North America

Introduction

So far as I am aware, twenty-four species of cyclopoid copepods belonging to the family Chondracanthidae have been reported to occur on the fishes off the Atlantic and the Gulf coast of North America. They were reported by Bere (1930, 1936), Causey (1953, 1955a, 1955b, 1960), Ho (1967, 1970), Pearse (1947, 1952a, 1952b), Rathbun (1886), and Wilson (1908, 1932, 1935). Specimens of these twenty-four species, including the type specimens studied by the above six investigators, were deposited in the United States National Museum (USNM).

In the summer of 1967, while I was making a revisional study of the family, all chondracanthid copepods in the collections of USNM were reexamined. This restudy has revealed that six of the twenty-four reported species are conspecific with other species, that the specimens from Woods Hole, Massachusetts, reported as *Oralien triglae* by Wilson (1932) are actually a species *(Rebelula bouvieri)* of the family Sphyriidae, and that the specimen from Dry Tortugas, Florida, identified as *Chondracanthus nodosus* by Wilson (1935) is actually a new species. Consequently, in accordance with my recently revised genera of the Chondracanthidae (Ho 1970) and with the addition of a species newly recorded off Florida, there are now nineteen species representing nine genera known to occur in this region. It is worthy of note here that they all belong to the subfamily Chondracanthinae.

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As pointed out by Ho (1970), the large number of species in a family may be the result of successful adaptive diversification, but in the case of the Chondracanthidae (about 170 species), it is, at least, partly due to the failure of some previous investigators to recognize variant features which are actually individual and nonspecific, and partly due to inadequate and incomplete original descriptions which misled subsequent investigators to describe new species from specimens actually belonging to known species. Therefore, in the course of revising the family Chondracanthidae, it is necessary to reexamine every specimen, regardless of type specimen or nontype specimen, reported in the past for verifying its proposed identification. The purpose of presenting here the redescriptions of species occurring in the eastern North America is, accordingly, to clarify the past confusion in specific identification and to present an orderly basis for future study of the species of the North American chondracanthid copepods. Since eight of these nineteen species are type species of their genera and have already been redescribed in the revision of the genera (Ho 1970), the following redescriptions deal only with the remaining eleven species, but all nineteen species are included in the key.

In addition to reexamination of the specimens deposited in USNM, I have also studied some chondracanthids that were collected by myself from Apalachee Bay, Florida and on board research vessel *Oregon* (during Cruise 105, off Georgia and Florida) and research vessel *Albatross IV* (during Cruise 66–3,

off Massachusetts and Maine). The type specimens of some species deposited in the Universitetets Zoologiske Museum (UZM), Copenhagen, Denmark, were also studied to confirm some specific identifications.

I wish to thank Dr. Arthur G. Humes (Department of Biology, Boston University, Boston) for arranging financial support for this study from his grants (GB 1809, GB 5838, and GB 8381X) from the National Science Foundation and to Dr. Roger F. Cressey (United States National Museum, Washington, D.C.) and Dr. Torben Wolff (Universitetets Zoologiske Museum, Copenhagen) for making available to me for study the chondracanthid copepods deposited in their museums. The Bureau of Commercial Fisheries, Fish and Wildlife Service, gave me the opportunity to collect parasitic copepods on board R/V *Oregon* and R/V *Albatross IV*.

Key to the Nineteen Species of Chondracanthidae Known from Eastern North America

1. Trunk region with outgrowths in form of processes, protrusions, or knobs; posterior processes present 2
   Trunk region without outgrowths; with or without posterior processes 9
2. Three pairs of unmodified legs present, all biramous; both sexes with an accessary antennule ..... ***Rhynchochondria longa*** Ho 1967
   Two pairs of legs present, either lobate or rudimentary; accessary antennule either present or absent (when present, only in male) 3
3. Two pairs of legs partially modified, with saclike protopod and rodlike rami (*Chondracanthodes* Wilson 1932) 4
   Two pairs of legs modified, either trilobate or bilobate (*Chondracanthus* Delaroche 1811) 5
4. First antenna small and filiform; head without lateral processes. ***Chondracanthus deflexus*** Wilson 1932
   First antenna large and lobate; head with a pair of long posterolateral processes ***C. radiatus*** (Müller 1776)
5. Posterodorsal portion of head protruded into a large crestlike outgrowth; abdomen greatly elongated ..... ***C. janebennettae*** Causey 1953
   Posterodorsal portion of head smooth; abdomen not elongated 6
6. Trunk region with only one or two pairs of lateral outgrowths; legs bilobate 7
   Trunk region with more than four pairs of lateral outgrowths; legs trilobate 8
7. First antenna large, with triangular basal portion; head without posterolateral processes ***C. cottunculi*** Rathbun 1886
   First antenna small, with evenly swollen basal portion; head bearing a pair of posterolateral processes ..... ***C. merluccii*** (Holten 1802)
8. First antenna extremely small; claw of maxilliped with only one hooklet; caudal ramus with usual long terminal process ..... ***C. nodosus*** (Müller 1776)
   First antenna large and fleshy; claw of maxilliped bearing numerous spinules; caudal ramus lacking long terminal process ..... ***C. wilsoni*** new species
9. Posterior processes present 10
   Posterior process absent 17
10. One pair of modified legs present; male without first antennae and legs (*Pseudochondracanthus* Wilson 1908) 11
    Two pairs of modified legs present; male with first antennae and legs 12
11. Head with only one pair of lateral processes; mandible bearing more teeth (56 on convex side and 34 on concave side) ..... ***P. diceraus*** Wilson 1908
    Head with two pairs of lateral processes; mandible bearing less teeth (23 on convex side and 14 on concave side) ..... ***P. hexaceraus*** Wilson 1935
12. Legs unilobate; posterior end of body with a median lobe. ***Acanthochondrites annulatus*** (Olsson 1886)
    Legs bilobate; posterior end of body without median lobe (*Acanthochondria* Oakley 1927) 13
13. Rami of lobate legs extremely short and broad. ..... ***A. phycidis*** (Rathbun 1886)
    Rami of lobate legs long and cylindrical 14

14. First antenna small and filiform; posterior process longer than the last trunk segment ***A. exilipes*** Wilson 1932
    First antenna large and lobate; posterior process distinctly shorter than the last trunk segment 15
15. Rami of lobate legs at least four times longer than the protopod. ***A. cyclopsetta*** Pearse 1952
    Rami of lobate legs at most two times longer than the protopod 16
16. Oral region flanked with a pair of small processes; labrum bearing denticles on posterior surface; and rami of legs bluntly pointed. ..... ***A. galerita*** (Rathbun 1886)
    Oral region without processes; labrum with smooth posterior surface; and rami of legs not pointed ..... ***A. cornuta*** (Müller 1776)
17. Second antenna uncinate and legs unilobate. ***Heterochondria crassicornis*** (Krøyer 1837)
    Second antenna non-uncinate and legs biramous 18
18. Second antenna clavate and legs bilobate ..... ***Berea ancoralis*** (Bere 1936)
    Second antenna trifurcate and legs partially modified, with lobate protopod and rodlike rami ..... ***Blias prionoti*** Krøyer 1863

Acanthochondria cyclopsetta Pearse 1952

FIGURE 1

Acanthochondria cyclopsetta Pearse 1952b: 37–38, figs. 145–149.—Yamaguti 1963: 276, pl. 238: fig. 5.

MATERIAL STUDIED.—From USNM: 1 female (mounted on slide) on gill of *Cyclopsetta chittendeni* Norman, off Padre Island, Texas (USNM 92664, type).

REMARKS.—Since only one specimen mounted in balsam is known of this species, it is impossible to make a satisfactory redescription of it. I have, however, made three illustrations (Figures 1*a, b, c*) to supplement the original description given by Pearse. There is not the slightest doubt that this species is a valid one in *Acanthochondria.* The following combination of characters distinguishes it from the rest of the species in the genus: the large size (10.58 mm long); the swollen, fleshy first antenna; the spinules on posterior margin of the labrum; and the long, attenuated, bilobate legs. The eggs are rather small for such a large sized copepod, each egg being only about 118 μ in diameter.

No pygmy male was seen on the slide, but Pearse (1952b: 38) has noted that the male was "attached to female, but lost."

The most outstanding feature of this species is the bilobate, long legs, a condition which has never been seen in any other known species of *Acanthochandria.*

Acanthochondria exilipes Wilson 1932

FIGURES 2–4

Acanthochondria exilipes Wilson 1932: 501–502, pl. 37: figs. a–e.—Yamaguti 1963: 277.

MATERIAL STUDIED.—From USNM: 1 female on gills of *Lopholatilus chameleonticeps* Goode and Bean, Woods Hole, Massachusetts, 1914 (USNM 59777, type); 55 females, with males attached, on gills of *L. chameleonticeps,* Woods Hole, Massachusetts, 1914 (USNM 59778, paratypes); 11 females, with males attached, on gills of *L. chameleonticeps,* south of Nantucket, Massachusetts, 21 July 1902 (USNM 59776); 1 female, with male attached, on *Lopholatilus* species, off Martha's Vineyard, Massachusetts (USNM 6084); and 7 females, with males attached, on anterior and posterior ends of gill cavity of *L. chameleonticeps,* off Martha's Vineyard, Massachusetts, 23 August 1881 (USNM 6089).

FEMALE.—Body (Figures 2*a, b*) rather long. Head elliptical, distinctly longer than wide in extended specimen (Figure 2*a*) but nearly as long as wide in contracted specimen (Figure 2*c*). First pedigerous segment nearly as wide as head, and second one only slightly wider. Third pedigerous segment much larger than fourth; a small lateral bulge located between these two segments. Posterior processes longer than fourth pedigerous segment. A pair of small vermiform processes (Figure 2*d*) located on posterior surface of trunk, to one of which the dwarf male is attached. Genital segment (Figure 2*d*) bearing a pair of spiniform elements on midventural surface and abdomen, a pair of setules on dorsal surface. Caudal ramus (Figure 2*e*) with 3 setae, 1 knoblike process and an abruptly narrowed spiniform terminal process; all naked. Egg sac slightly shorter than body in extended specimen, containing many rows of small eggs.

First antenna (Figure 2*f*) small, not much swollen at basal region, and rather flattened; armature being:

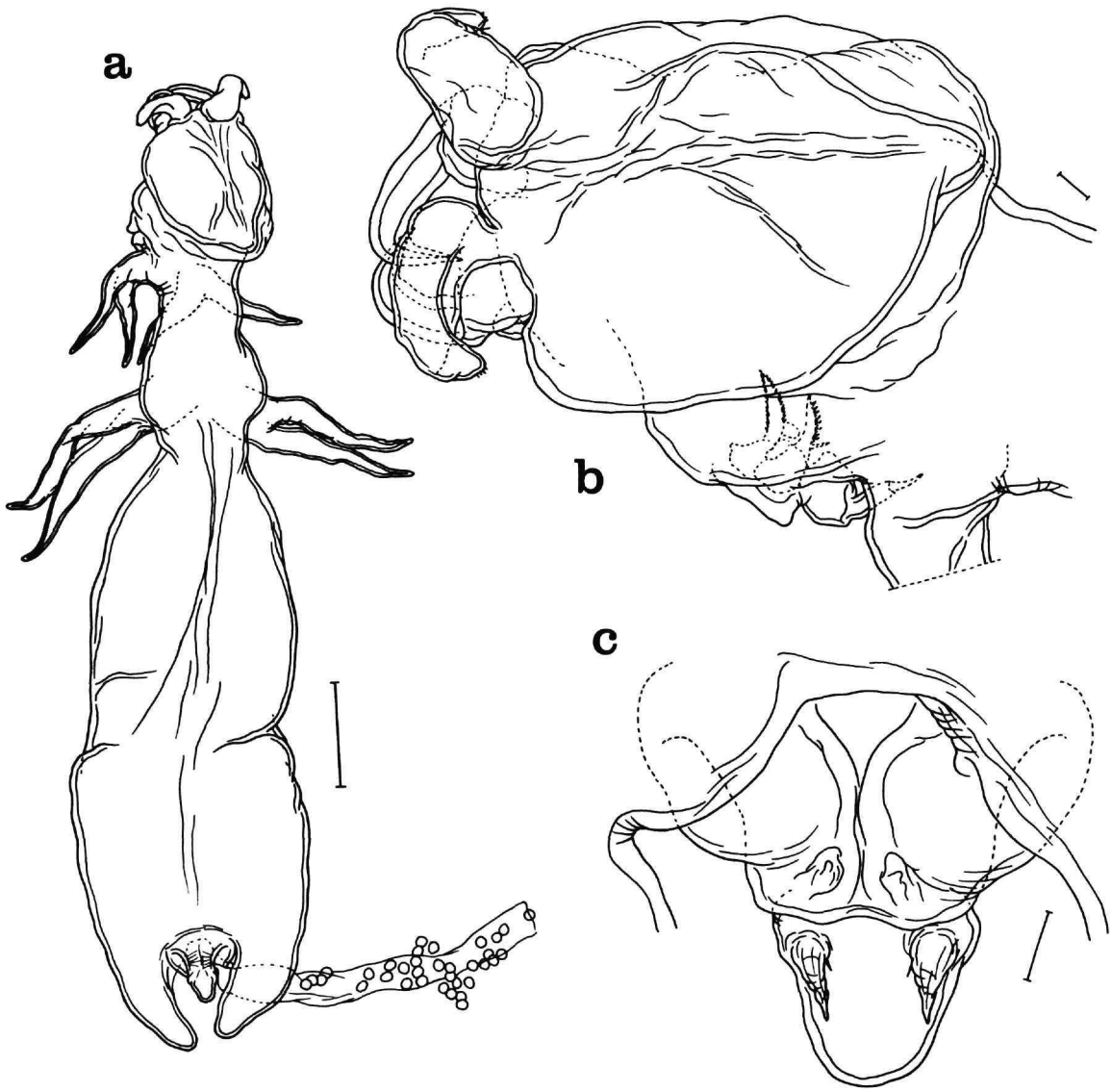

FIGURE 1.—*Acanthochondria cyclopsetta* female: *a*, body of holotype, dorsal; *b*, head and part of neck, dorsolateral; *c*, genito-abdomen, ventral. Scale: 1 mm in *a*; 0.1 mm in *b*, *c*.

1–1–2–8. Second antenna (Figure 2*g*) indistinctly 2-segmented, with usual recurved terminal hook.

Labrum with denticles on posterior surface and shaped as in *A. galerita*. Mandible (Figure 3*a*) 2-segmented, with about 37 to 41 teeth on convex side and 32 to 34 teeth on concave side. Paragnath (Figure 3*b*) bearing rather few but coarser spinules. First maxilla (Figure 3*c*) bearing only 2 elements, with spinules on both inner and outer surfaces. Second maxilla (Figure 3*d*) 2-segmented, of a typical form, bearing a row of about 16 teeth on terminal process. Maxilliped (Figure 3*e*) 3-segmented; first

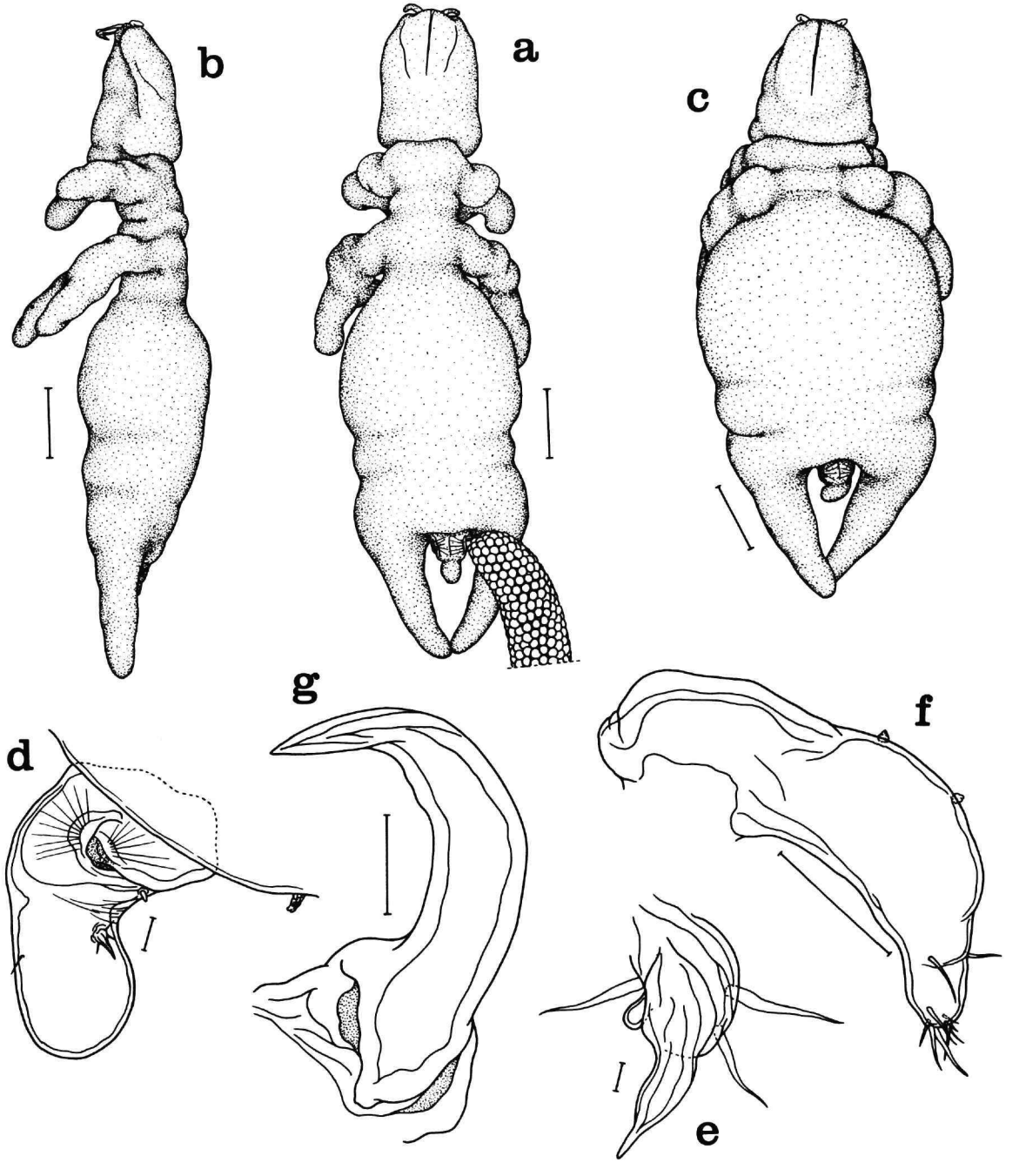

FIGURE 2.—*Acanthochondria exilipes* female: *a*, body of syntype, dorsal; *b*, same, lateral; *c*, body of a contracted specimen, dorsal; *d*, genito-abdomen, lateral; *e*, caudal ramus; *f*, first antenna; *g*, second antenna. Scale: 1 mm in *a*, *b*, *c*; 0.1 mm in *d*, *f*, *g*; 0.01 mm in *e*.

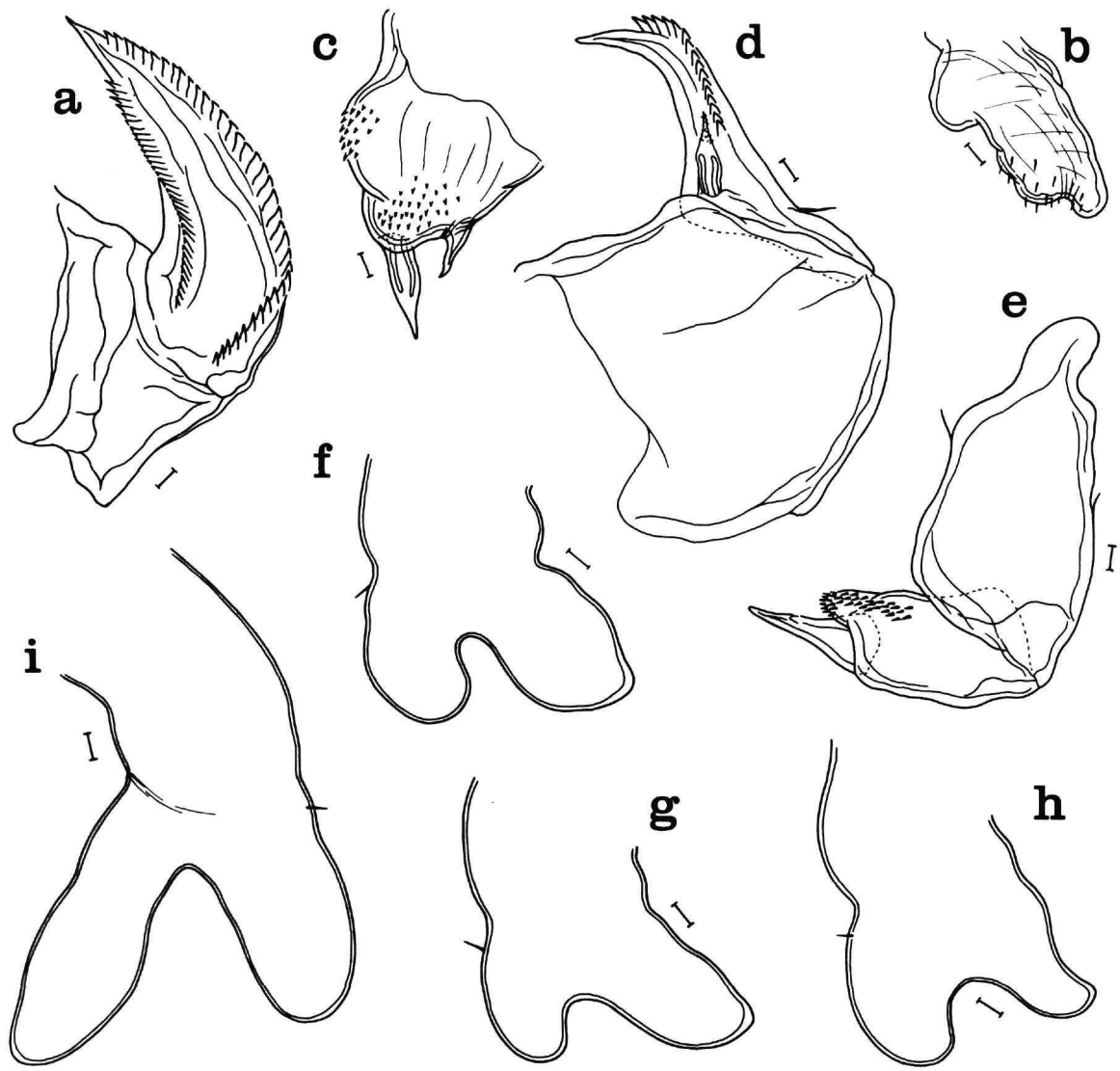

FIGURE 3.—*Acanthochondria exilipes* female: *a*, mandible; *b*, paragnath; *c*, first maxilla; *d*, second maxilla; *e*, maxilliped; *f*, leg 1; *g*, slightly abnormal leg 1; *h*, abnormal leg 1; *i*, leg 2. Scale: 0.01 mm in *a*, *b*, *c*, *d*, *e*; 0.1 mm in *f*, *g*, *h*, *i*.

segment unarmed, second segment with rows of denticles distributed in two patches, and terminal segment a claw with a small hooklet.

Leg 1 (Figure 3*f*) much smaller than leg 2 (Figure 3*i*). Both legs with longer endopod; exopod shorter than protopod. A minute outer seta on both protopods. An abnormal leg 1 (Figure 3*h*) seen on left side of a specimen which has a slightly abnormal leg (Figure 3*g*) on the opposite side.

MEASUREMENTS.—Body 8.74 mm in extended specimen and 7.44 mm in contracted one; head 1.78 × 1.31 mm; genital segment 0.49 × 0.74 mm; abdomen 0. 53 × 0.38 mm; egg sacs 7.36 mm and 7.99 mm; egg 184 μ.

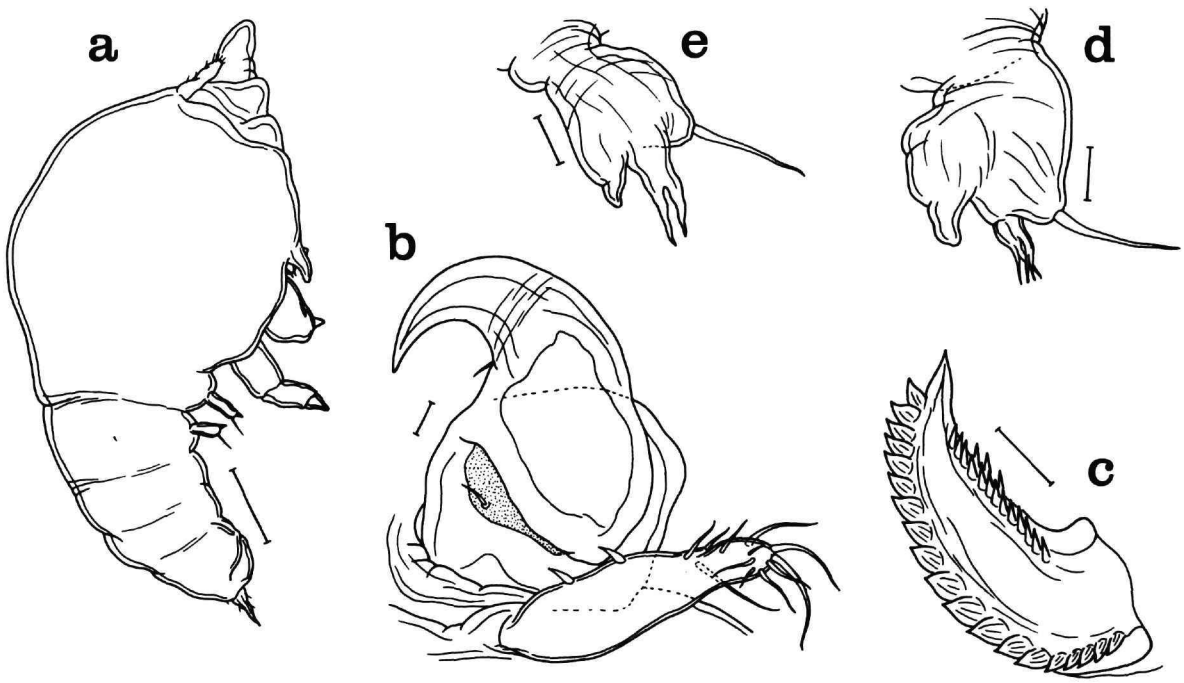

FIGURE 4.—*Acanthochondria exilipes* male: *a*, body, lateral; *b*, first and second antennae; *c*, terminal blade of mandible; *d*, leg 1; *e*, leg 2. Scale: 0.1 mm in *a*; 0.01 mm in *b*, *c*, *d*, *e*.

MALE.—Body (Figure 4*a*) 0.38 × 0.41 mm, with cephalothorax slightly longer than metasome plus urosome. Metamerism on body rather distinct. A small seta on lateral surface of second pedigerous segment. Genital segment with usual ventrolateral ridge. Caudal ramus different from female in having rather indistinct knoblike process and evenly tapered terminal process.

First antenna (Figure 4*b*) cylindrical, armature as usual, being: 1–1–2–2–8. Second antenna (Figure 4*b*) 2-segmented, with a seta on each segment; terminal hook rather small. Rostral area bearing a median protrusion.

Labrum with sexual dimorphism as observed in *A. phycidis*. Mandible (Figure 4*c*) bearing 18 to 19 teeth on convex side and 11 to 13 teeth on concave side, where there is an additional row of 3 teeth. Paragnath and maxilliped resembling those of female. First and second maxilla with same sexual dimorphism as in *A. galerita*.

Leg 1 (Figure 4*d*) larger than leg 2 (Figure 4*e*), both bearing a long outer seta on protopod. First exopod different from second in having 2 bipartite elements.

REMARKS.—As pointed out by Wilson (1932: 502) this species can be easily recognized by its posterior processes being longer than the last trunk segment (fourth pedigerous segment). Although this character is shared with *A. soleae* (Krøyer 1838), *A. exilipes* can be distinguished from it by its small first antenna (in relation to the size of the head), the elliptical head, and the nature of the rami on both legs.

Acanthochondria galerita (Rathbun 1886)

FIGURES 5–7

Chondracanthus galeritus Rathbun 1886: 317–319, pl. 8: figs. 1–7; pl. 10: figs. 1–7.

Acanthochondria galerita (Rathbun).—Oakley 1930: 186.—Wilson 1932: 505, figs. 209b.—Yamaguti 1963: 277.

A. albigutta Pearse 1952a: 225–227, figs. 103–110.—Causey 1955a: 12, pl. 1: figs. 6–7; 1960: 333.—Yamaguti 1963: 276.

MATERIAL STUDIED.—From USNM: (following collections are all from oral cavities of *Paralichthys*

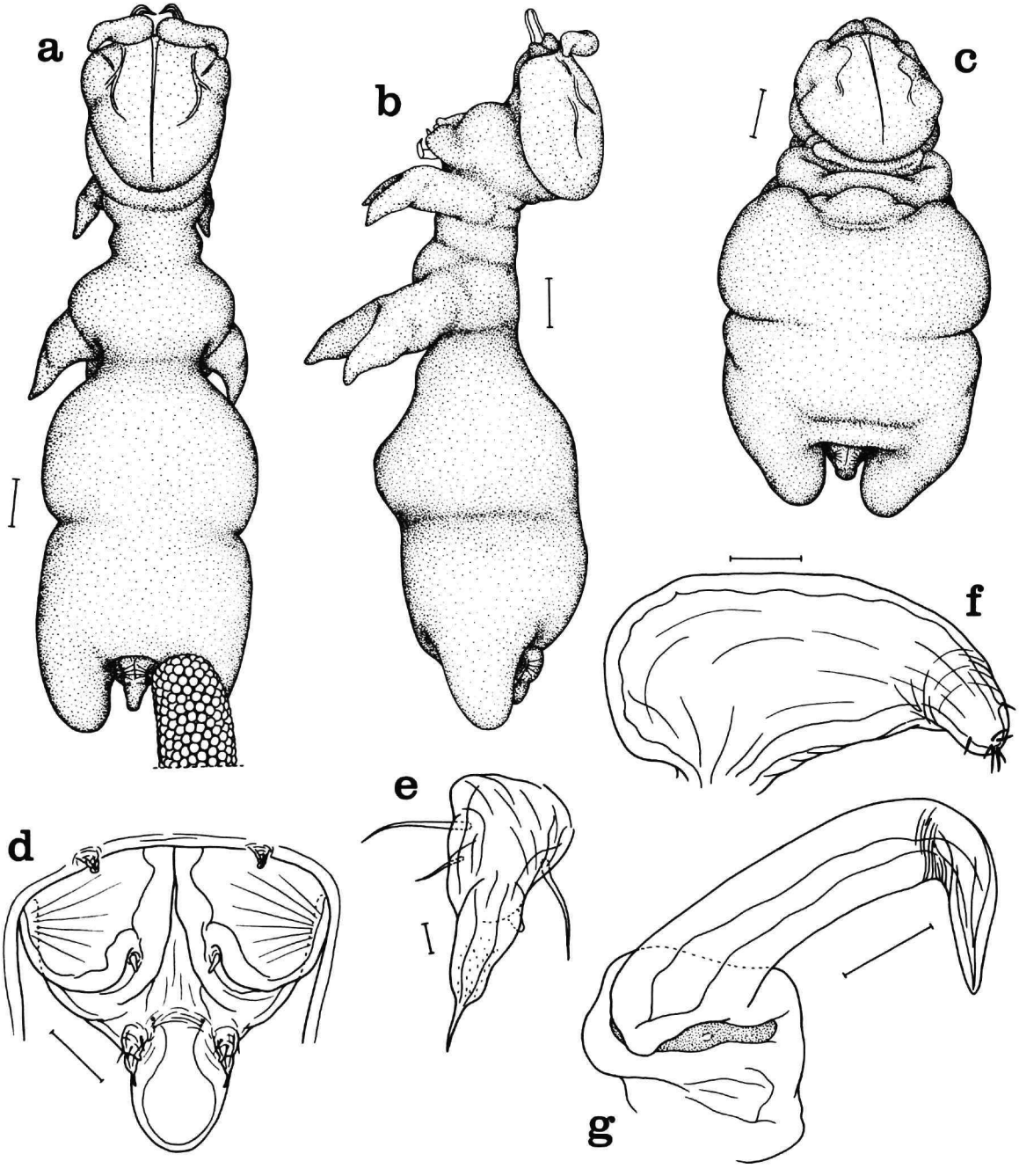

FIGURE 5.—*Acanthochondria galerita* female: *a*, body of syntype, dorsal; *b*, same, lateral; *c*, body of a contracted specimen, dorsal; *d*, genito-abdomen, ventral; *e*, caudal ramus; *f*, first antenna; *g*, second antenna. Scale: 1 mm in *a*, *b*, *c*; 0.1 mm in *d*, *e*, *f*, *g*.

dentatus (Linnaeus) in Woods Hole, Massachusetts) 14 females, with males attached, and 1 young female, 8 August 1883 (USNM 6036, co-type); 6 females, with males attached, 28 August 1883 (USNM 6077, co-type); 5 females, with males attached, 30 August 1883 (USNM 6082); 1 female, with male attached, 8 August 1883; 28 females, with males attached, 14 August 1883; 15 females, with males attached, 15 July 1904 (USNM 59782); 18 females, with males attached, 15 August 1900 (USNM 59814); 6 females, with males attached, 10 July 1906 (USNM 54129); and 2 females, with males attached, 29 July 1913 (USNM 79599).

The following two collections were labeled as *Acanthochondria albigutta* Pearse and mounted on slide: 1 females, with male attached, on *P. albiguttus* Jordan and Gilbert, Alligator Harbor, Florida, 10 May 1952 (USNM 93696, type); and 1 young female, with a copepodid male attached, on *P. albiguttus*, Alligator Harbor, Florida, 1 June 1952 (USNM 93697).

FEMALE.—Body (Figures 5*a, b, c*) of varied appearance according to different states of contraction. Head deflected backward in extended specimens (Figure 5*b*) and indistinctly divided into anterodorsal "hood" portion (with dorsal carapace) and posteroventral "cheek" portion which is the main contractile portion of the head and bears mouth parts on its posteroventral surface. Oral region flanked by a pair of small processes (Figure 6*a*). First pedigerous segment narrower than head, but second wider. Third pedigerous segment with rounded and slightly protruded anterior corners in contracted specimen (Figure 5*c*) but not in extended specimen (Figure 5*a*). Posterior processes short and blunt. A pair of small vermiform processes (Figure 5*d*) located on posterior surface of trunk. Genital segment (Figure 5*d*) much larger than abdomen, with a pair of hyaline, obtuse elements on ventral surface. Abdomen (Figure 5*d*) carrying a pair of setules on anterodorsal surface. Caudal ramus (Figure 5*e*) bearing 3 setae and 1 blunt knob, and terminating in a characteristic spiniform process as shown in figure. Egg sac nearly as long as body, containing many rows of small eggs.

First antenna (Figure 5*f*) large, with swollen base, armed with 6 terminal and 2 subterminal setae. Second antenna (Figure 5*g*) indistinctly 2-segmented, terminal segment a slender, recurved hook.

Labrum (Figure 6*a*) with denticles on posterior surface. Mandible (Figure 6*b*) 2-segmented, terminal blade bearing about 57 slender teeth on convex side and 37 on concave side. Paragnath (Figure 6*c*) bilobed, with spinulose ventral lobe. First maxilla (Figure 6*d*) bearing an element. Second maxilla 2-segmented, with distal process (Figure 6*e*) bearing a small, simple setule, a large, spiniform seta with hyaline tip, and a row of about 12 teeth. Maxilliped (Figure 6*f*) 3-segmented, proximal 2 segments of usual form, but terminal hook being peculiar in having 2 hooklets on concave surface and a patch of spinules on outer surface at base.

Leg 1 (Figure 6*g*) much smaller than leg 2 (Figure 6*h*), both having bluntly pointed rami and slightly smaller exopod. Protopod bearing a small outer seta.

MEASUREMENTS.—Body 6.70 mm in extended specimen and 4.65 mm in contracted one; head (carapace) 1.36 × 1.31 mm; genital segment 0.36 × 0.46 mm; abdomen 0.30 × 0.18 mm; egg sacs 6.32 mm and 6.51 mm; egg 162 μ.

MALE.—Body (Figure 7*a*) 0.53 × 0.29 mm, having rather small metasome plus urosome, which together are only about half as long as the cephalosome. Main flexure on body located between first and second pedigerous segment. A setule on lateral surface of third pedigerous segment. Genital segment with usual ventro-lateral ridges. Abdomen greatly reduced, bearing a pair of small setules on dorsal surface. Caudal ramus resembling that of female.

First antenna (Figure 7*b*) cylindrical, bearing usual armature of 1–1–2–2–8. Second antenna (Figure 7*b*) 2-segmented, bearing one seta on each segment. Rostral area with median protrusion located between bases of first and second antennae.

Labrum (Figure 7*c*) different from female in having median protrusion and lateral conical processes. Mandible with 33 teeth on concave side and 16 on convex side. Paragnath as in female. First maxilla (Figure 7*d*) with slight sexual dimorphism in the three elements. Second maxilla without teeth on terminal process. Maxilliped different from female in terminal hook lacking basal patch of spinules and with only one hooklet.

Leg 1 (Figure 7*e*) and leg 2 (Figure 7*f*) alike, only different in size. Both with long outer seta on protopod, bifurcate exopod, and simple endopod.

REMARKS.—The most outstanding features of this species are the bluntly pointed rami of the legs, the

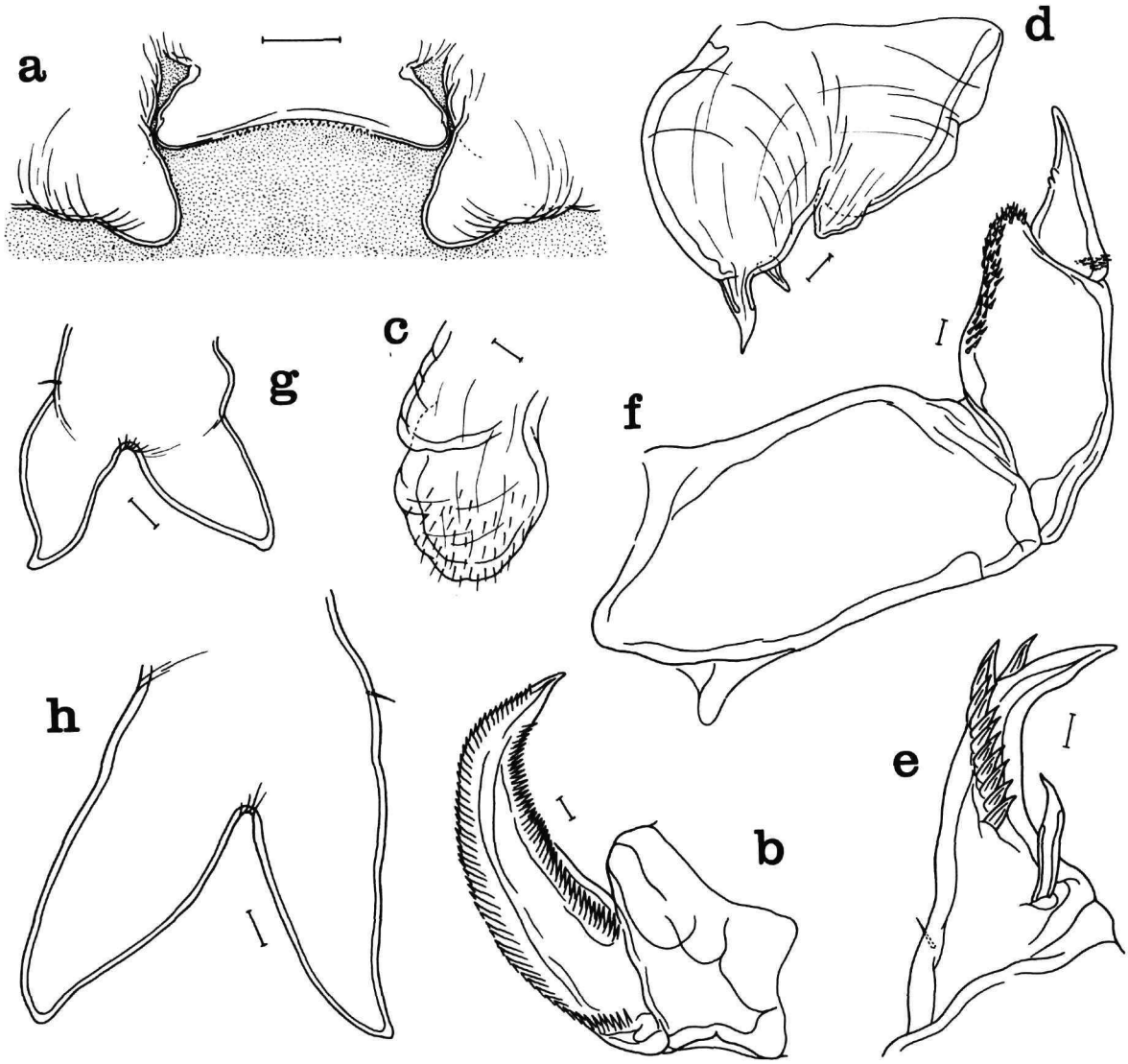

FIGURE 6.—*Acanthochondria galerita* female: *a*, labrum and oral lobes, ventral; *b*, mandible; *c*, paragnath, *d*, first maxilla; *e*, terminal segment of second maxilla; *f*, maxilliped; *g*, leg 1; *h*, leg 2. Scale: 0.1 mm in *a*, *g*, *h*; 0.01 mm in *b*, *c*, *d*, *e*, *f*.

abruptly narrowed terminal processes on the caudal ramus, and the hoodlike head which remains distinct regardless of the state of contraction.

The species described by Pearse (1952a) as *A. albigutta* is in all probability conspecific with the present species. The rather pointed rami in the two pairs of legs, the swollen first antenna, the denticulated posterior margin of the labrum, and the hoodlike head are all reminiscent of *A. galerita*. The only major difference that I can see is the possession of a pair of relatively narrow posterior processes. Since all available specimens in the collection of USNM (Pearse's type specimens) are mounted in balsam on slides, it is difficult to determine whether this difference is real or the result of distortion after mounting.

Of the two type specimens of *A. albigutta*, one is

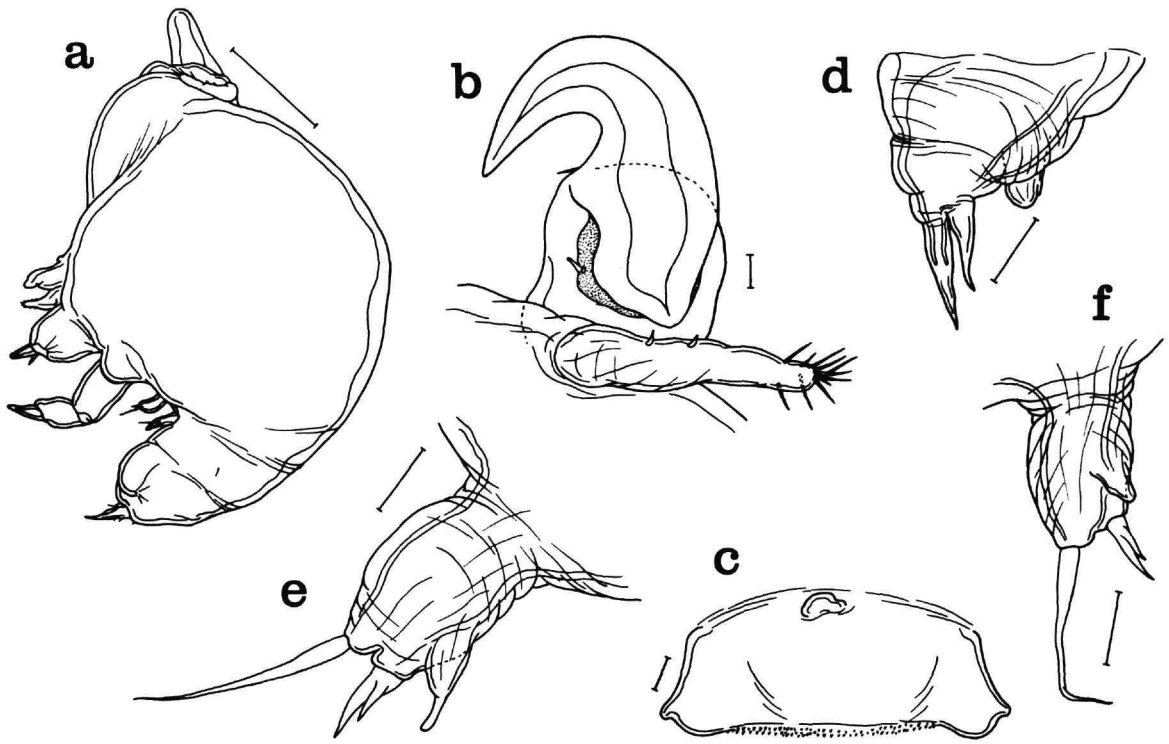

FIGURE 7.—*Acanthochondria galerita* male: *a*, body, lateral; *b*, first and second antennae; *c*, labrum, ventral; *d*, first maxilla; *e*, leg 1; *f*, leg 2. Scale: 0.1 mm in *a*; 0.01 mm in *b*, *c*, *d*, *e*, *f*.

ovigerous (No. 93693, measuring 9.60 × 3.52 mm) and the other nonovigerous (No. 93697, measuring 4.86 × 1.39 mm). It is noteworthy that the former carries a typical chondracanthid-form dwarf male and the latter, which was designated by Pearse as "type" of *A. albigutta*, an unmodified copepodid male. Although I did not have the opportunity to reexamine Causey's collections of *A. albigutta*, his "supplementary material" (Causey 1955a:12, pl. 1 : figs. 6, 7) provide further evidence that *A. albigutta* is synonymous with *A. galerita*.

Acanthochondria phycidis (Rathbun 1886)

FIGURES 8–10

Chondracanthus phycidis Rathbun 1886: 320–323, pl. 9: figs. 1–6, pl. 10: figs. 8–13.—Fowler 1912: 476.

Chondracanthus chilensis Wilson 1918: 11–15, figs. 1–6.—Stuardo and Fagetti 1960: 200.

Acanthochondria phycidis (Rathbun).—Oakley 1930: 186.—Wilson 1932: 504–505, figs. 299c.—Yamaguti 1963: 278.

A. purpurae Oakley 1930: 193–195, figs. 6A–D.—Yamaguti 1963: 278.

A. chilensis (Wilson).—Oakley 1930: 186.—Yamaguti 1963: 276.

MATERIAL STUDIED.—From USNM: 3 females and 2 young females, with males attached, off Martha's Vineyard, Massachusetts, 1883 (USNM 6066, type); 7 females and 8 young females, with males attached, on gills of *Urophycis tenuis* (Mitchill), off Martha's Vineyard, Massachusetts, 1883 (USNM 6067, cotype); 1 female on "trout," Falkland Islands, 13 April 1927 (USNM 60481, labeled as *A. clavata*); 5 females and 2 young females, with males attached, on "mullet" in Port Stanley, Falkland Islands, 15 March 1927 (USNM 60485, labeled as *Chondracanthodes deflexus*); 3 females and 1 young female, with males attached, on gills of *Merluccius gayi* (Guich), Valparaiso, Chile, March 1961 (USNM 51043). From author's collection: 28 females, with males attached, at bases of gill arches of *U. regius* (Walbaum), from

following ten stations of R/V *Oregon* Cruise 105-5741 (1 female, 29°45′N 80°13′W → 29°38′N 80°12′W), 5757 (3 females, 30°03′N 80°07′W → 29°56′N 80°10′W), 5759 (3 females, 30°02′N 80°08′W → 29°35′N 80°09′W), 5763 (4 females 29°59′N 80°09′W → 29°51′N 80°10′W), 5767 (4 females, 29°51′N 80°11′W → 29°44′N 80°11′W), 5791 (1 female, 24°23′N 82°42′W → 24°23′N 82°47′W), 5793 (3 females, 24°18′N 82°53′N → 24°19′N 83°00′W), 5795 (3 females, 24°16′N 82°30′W → 24°16′N 82°38′W), 5798 (3 females, 29°14′N 80°05′W → 29°09′N 80°03′W), and 5802 (3 females, 29°15′N 80°05′W → 29°09′N 80°02′W).

FEMALE.—Body (Figures 8*a*, *b*) rather short and stout. Head nearly as long as wide, with greatest width in its posterior two thirds, and the narrowed anterior margin less than half of this width. Postero-ventral surface of head at oral area greatly swollen, with lateral swellings visible in dorsal view. First pedigerous segment broadest, with posterior corners slightly indented and forming a small lobe. Fourth pedigerous segment forming last trunk segment, which

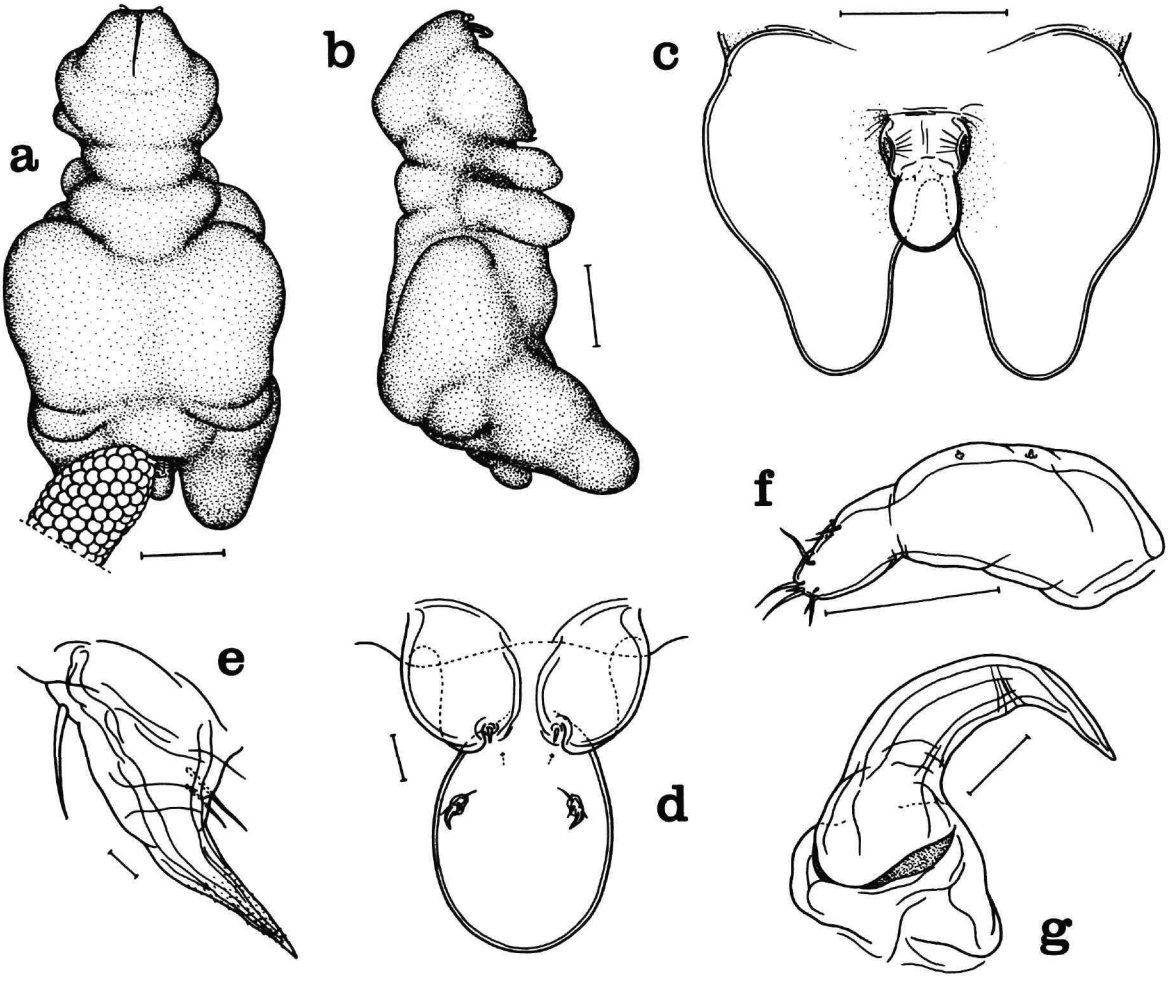

FIGURE 8.—*Acanthochondria phycidis* female: *a*, body, dorsal; *b*, same, lateral; *c*, posterior part of trunk and genito-abdomen, dorsal; *d*, genito-abdomen, ventral; *e*, caudal ramus; *f*, first antenna; *g*, second antenna. Scale: 1 mm in *a*, *b*, *c*; 0.1 mm in *d*, *e*, *f*, *g*.

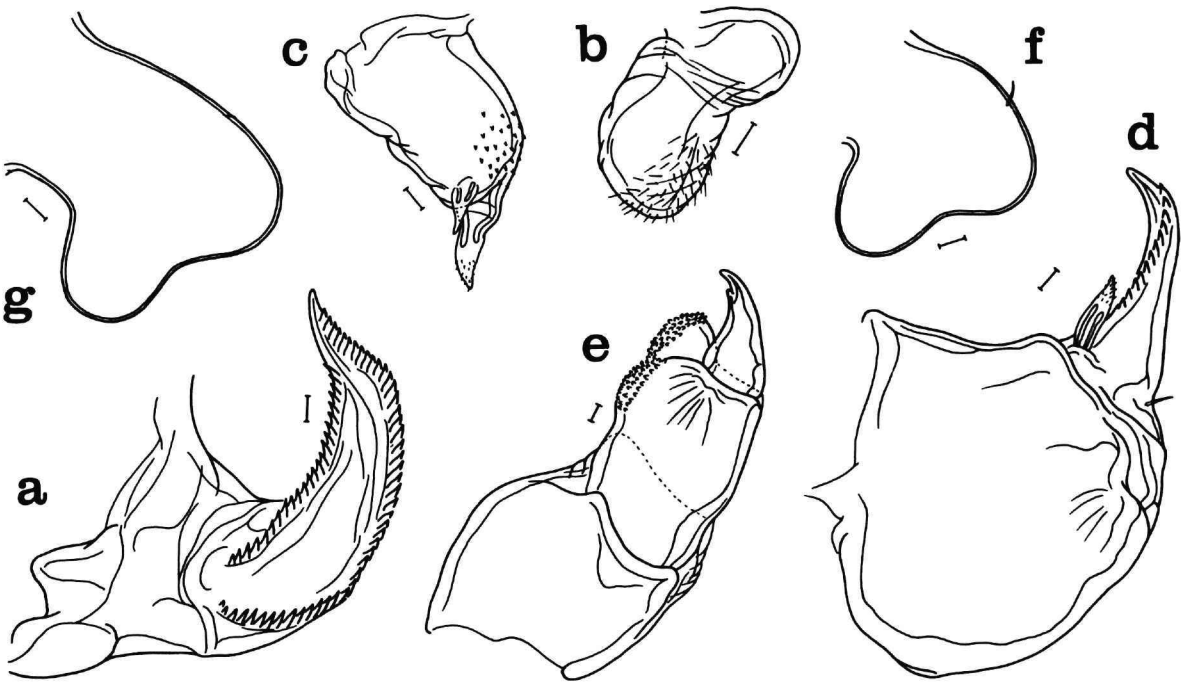

FIGURE 9.—*Acanthichondria phycidis* female: *a*, mandible; *b*, paragnath; *c*, first maxilla; *d*, second maxilla; *e*, maxilliped; *f*, leg 1; *g*, leg 2. Scale: 0.01 mm in *a*, *b*, *c*, *d*, *e*; 0.1 mm in *f*, *g*.

is characteristically bent ventrad in all alcoholized specimens; protruding posterolaterally into a stout, blunt posterior process (Figure 8*c*). Genital segment (Figure 8*d*) with egg sac attachment area situated dorsolaterally and bearing a pair of blunt, hyaline setae at midventral region. Abdomen (Figure 8*d*) oval, bearing a pair of setules on anterodorsal surface. Caudal ramus (Figure 8*e*) of usual form, located on anteroventral surface of abdomen. Egg sac cylindrical, longer than body.

First antenna (Figure 8*f*) fleshy, only slightly swollen at basal portion, with usual armature of 1–1–2–2–8. Second antenna (Figure 8*g*) 2-segmented, terminal segment a recurved claw.

Labrum shaped as in *A. galerita* and fringed with denticles on posterior margin. Mandible (Figure 9*a*) bearing about 58 teeth on convex side and 44 teeth on concave side. Paragnath (Figure 9*b*) bilobate with a smaller naked basal lobe and a larger spinulose terminal lobe. First maxilla (Figure 9*c*) an oval lobe bearing 2 terminal elements and covered with small spinules on dorsal (posterior) and inner surfaces. Second maxilla (Figure 9*d*) of usual form, bearing a row of 12 teeth on terminal process. Maxilliped (Figure 9*e*) short and stout, with usual armature.

Both leg 1 (Figure 9*f*) and leg 2 (Figure 9*g*) indistinctly bilobate, stout, and covered with very fine spinules; outer seta on protopod very small; and exopod indistinguishable from protopod.

MEASUREMENTS.—Body 6.32 mm; head 1.75 × 1.70 mm; genital segment 0.38 × 0.53 mm; abdomen 0.55 × 0.35 mm; egg sacs 7.06 mm and 7.95 mm; egg 232 μ.

MALE.—Body (Figure 10*a*) 0.80 × 0.37 mm; with widest portion on posterior part of cephalosome which is oval in dorsal view. Second and third pedigerous segments rather well separated, but fourth pedigerous segment indistinctly fused with urosome. A small seta on dorsolateral surface of second and third pedigerous segments. Abdominal portion (Figure 10*b*) bearing a pair of setules on dorsal surface. Caudal ramus (Figure 10*b*) as in female.

First antenna (Figure 10*c*) elongate and cylindrical, armature as in female. Second antenna (Figure

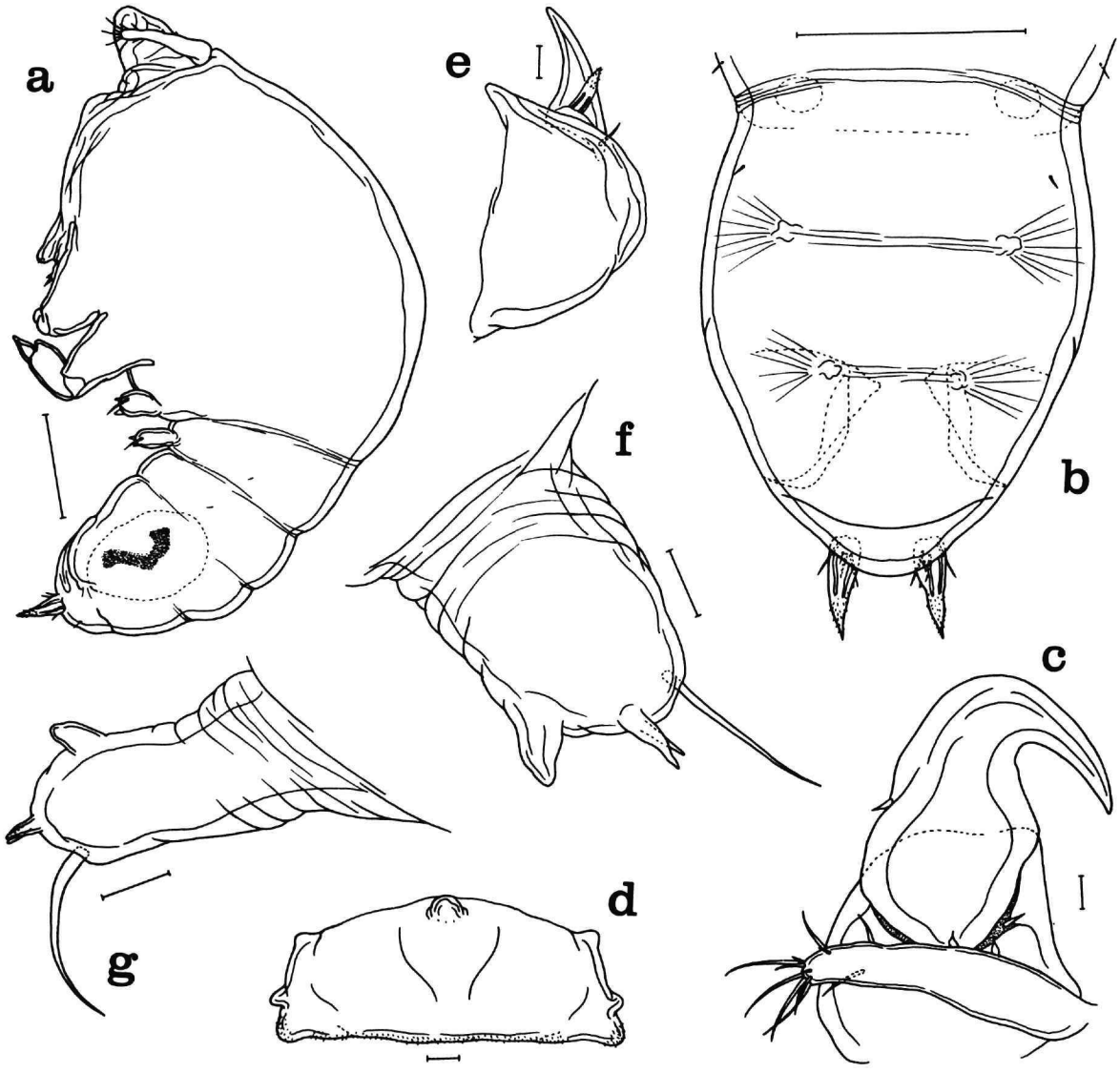

FIGURE 10.—*Acanthochondria phycidis* male: *a*, body, lateral; *b*, posterior part of body, dorsal; *c*, first and second antennae; *d*, labrum, ventral; *e*, second maxilla; *f*, leg 1; *g*, leg 2. Scale: 0.1 mm in *a*, *b*; 0.01 mm in *c*, *d*, *e*, *f*, *g*.

10*c*) 2-segmented, terminal segment a recurved hook bearing a small hyaline element on outer surface. A blunt knob in rostral area between bases of two pairs of antennae.

Labrum (Figure 10*d*) shaped as in female, but having a rounded median knob. Mandible with usual sexual dimorphism. Paragnath and first maxilla as in female. Second maxilla (Figure 10*e*) with simple short terminal process. Maxilliped showing very slight sexual dimorphism in having indistinct hooklet on terminal claw.

Leg 1 (Figure 10*f*) more swollen than leg 2 (Figure 10*g*), both bearing a long outer seta on protopod, a bluntly pointed endopod, and a smaller exopod

composed of two elements. Number of elements in exopod of leg 1 variable, ranging from one to three, sometimes even different between two members of same pair.

REMARKS.—*A. phycidis* is distinctive in having a small cylindrical first antenna, lateral swellings in head, indistinctly bilobated thoracic legs, and stubby posterior processes. The very characteristic poorly bilobated condition of the thoracic legs is also known in *A. limandae* (Krøyer 1863), but the latter is different from *A. phycidis* in having a pair of large, swollen, fleshy first antennae.

A. purpurae Oakley 1930 is apparently conspecific with this species. The only difference between the two species is their size of the body, the former being 10.5 mm long (Oakley 1930:193), while the largest specimen of *A. phycidis* is only 6.32 mm in length. The seven specimens contained in USNM 60485 are definitely attributable to what Oakley has described as *A. purpurae*. They were, however, mislabeled as *"Chondracanthodes deflexus."* These specimens were found on "mullet" from the same locality of Oakley's *A. purpurae* (Falkland Islands). A closer observation of these seven South American specimens has further confirmed that Oakley's *A. purpurae* is the same species as *A. phycidis*. The largest specimen measures 11.16 mm, nearly twice as long as the largest North American specimen.

A. chilensis (= *C. chilensis*) is apparently another synonym of *A. phycidis*. It was first reported by Wilson (1918) on the gills of the hake *(Merluccius gayi)* from Valparaiso, Chile. When Stuardo and Fagetti (1960) made an extensive survey of the copepod parasites of the same species of hake in the Bay of Valparaiso, however, they did not find again this particular parasite. The largest type specimen of *A. chilensis* in USNM 51043 measures 11.53 × 4.92 mm, which is much larger than the North Atlantic specimens and about the size of those found in the Falkland Islands.

Chondracanthodes radiatus (Müller 1776)

FIGURE 11

Lernaea radiata Müller 1776: 226; 1788: 39, pl. 33: fig. 4.—H. Milne Edwards 1840: 504.
Anops radiatus (Müller).—Oken 1815: 357.
Entomoda radiata (Müller).—Lamarck 1816: 233.
Lernentoma radiata (Müller).—Blainville 1822: 440.
Chondracanthus radiatus (Müller).—Cuvier 1830: 258.—Krøyer 1863: 251, pl. 14: figs. 1a–e.—Bassett-Smith 1899: 494.—Brian 1908: 17.—Stephensen 1913: 341.—Wilson 1920: 6L.—Hansen 1923: 45–46.—Oakley 1930: 187.
Chondracanthoides radiatus (Müller).—Yamaguti, 1963: 283.

MATERIAL STUDIED.—From UZM: 2 females and 1 young female on *Macrurus fabricii* L., Greenland. From author's collection: 1 female on wall of operculum of *Macrurus bairdii* (Goode and Bean), Sta. 5753 (29°29′N 79°56′W →29°23′N 79°57′W) of R/V *Oregon* Cruise 105.

FEMALE.—Body (Figures 11*a, b, c*) greatly swollen and stout. Head distinctly wider than long, deflected ventrally, and extended posterolaterally into a long attenuated process; dorsal surface bearing a median sclerite and a small swelling in posterior region. First pedigerous segment incompletely separated from cephalosome, bearing a large, rounded, dorsal swelling. Trunk voluminous, divided into three portions, with each portion bearing a pair of processes: first pair on anterior corner of trunk, with a small basal swelling on anterior surface; second pair on midlateral portion of trunk and bent ventrally; and third pair on posterior corner of trunk directed posteriorly. Genito-abdomen and caudal ramus of usual form. Egg sac unknown. First antenna (with right one broken off in the specimen drawn) large, fleshy, and tipped with 8 setae. Second antenna 2-segmented, with uncinate terminal segment. Oral appendages as in *C. deflexus*. Two pairs of modified legs present (see Figure 11*c*), with greatly swollen protopod protruding laterally into a blunt process and carrying a small outer seta; both rami rod-like, covered with fine denticles; endopod longer than exopod.

MEASUREMENTS.—Body 6.51 mm; head 1.59 × 2.33 mm.

MALE.—Not seen.

REMARKS.—This species is similar to *C. tuberofurcatus* Kabata and Gusev 1966 in having a pair of large, fleshy first antennae and a pair of posterolateral processes in the head. The cephalic process in *C. radiatus*, however, is much longer and attenuated and the first pair of processes in the trunk region is not furcated distally as in *C. tuberofurcatus*.

Two of Krøyer's three type specimens of *C. radiatus* deposited in UZM are ovigerous and the third one is a young nonovigerous female. This young female

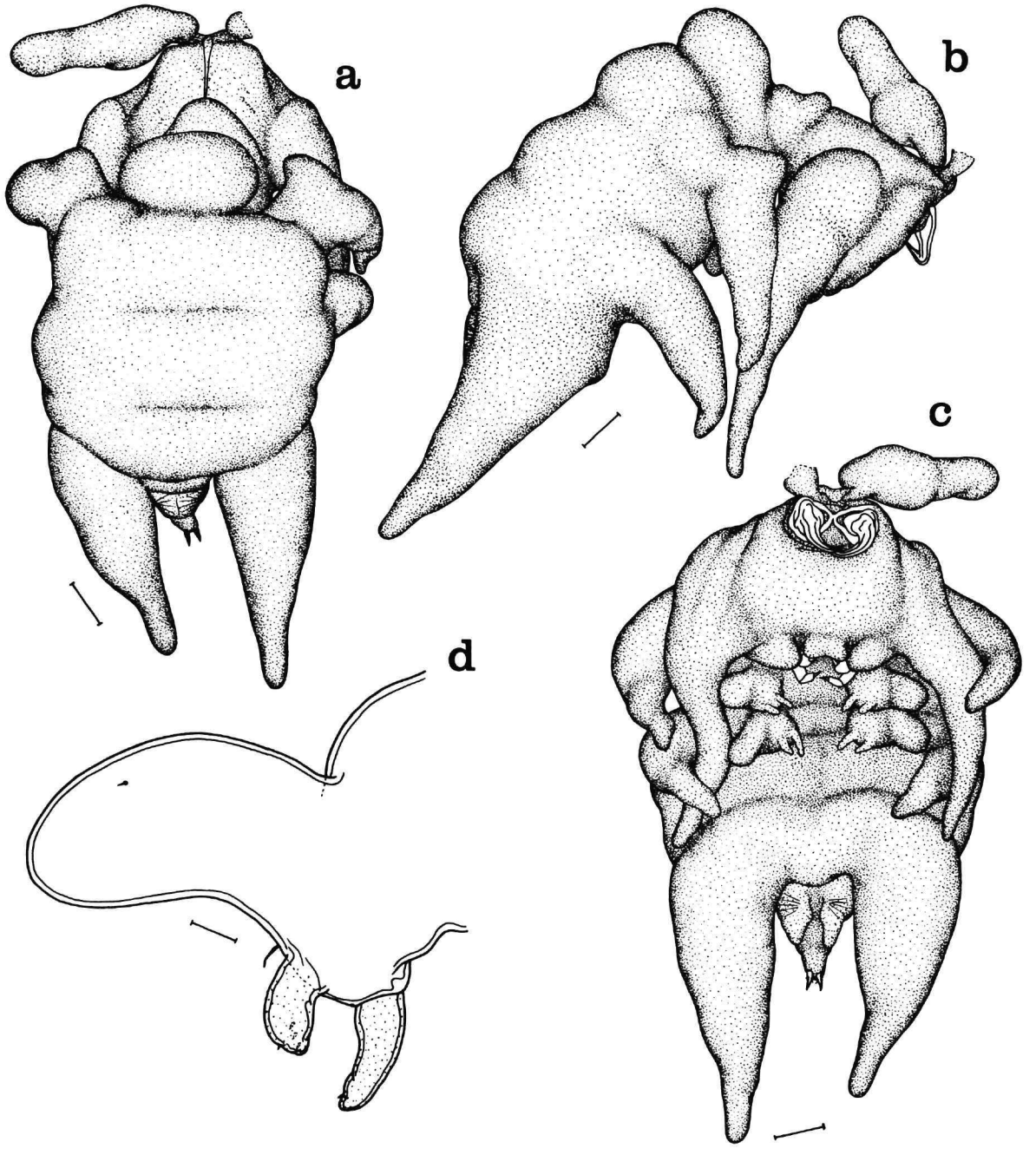

FIGURE 11.—*Chondracanthodes radiatus* female: *a*, body, dorsal; *b*, same, lateral; *c*, same, ventral; *d*, leg 1 of holotype. Scale: 1 mm in *a*, *b*, *c*; 0.1 mm in *d*.

measures 5.39 mm and has all the body processes developed as in the ovigerous one, but they are shorter and smaller. One of the two ovigerous females has all mouth parts and the first pair of legs taken off, and the other one has the right second antenna and all oral appendages except the maxillipeds removed. The dissected two first legs were kept in a separate vial; one of them is here illustrated in Figure 11*d*. These two ovigerous females measure 9.38 mm and 10.21 mm in length respectively, and a detached complete egg sac is 14.98 mm long. No male was found, although it was described by Krφyer.

The specimen taken off Florida differs from the ones from Greenland in having a smaller body, more attenuated body processes, and a comparatively swollen trunk. These differences are regarded as merely geographical variations.

As pointed out by Hansen (1923:46), the specimen described by Brian (1912) as *C. radiatus* is not the same as Müller's *radiatus*. From Brian's description and figures, it seems to me that he was dealing with a specimen of *C. deflexus*. The possession of short, clavate, and simple lateral processes on the body, small first antennae, and the absence of cephalic processes are all very convincing.

Chondracanthus cottunculi Rathbun 1886

FIGURES 12–14

Chondracanthus cottunculi Rathbun 1886: 322–324, pl. 11: figs. 1–7.—Fowler 1912: 475.—Wilson 1932: 477–498, fig. 297c.—Yamaguti 1963: 272.

Chondracanthopsis cottunculi (Rathbun).—Oakley 1930: 196.

MATERIAL STUDIED.—From USNM: 1 female, with male attached, on *Cottunculus* species, south of Block Island, Rhode Island, 23 July 1884 (USNM 8454, type); 2 females, with males attached, in branchial

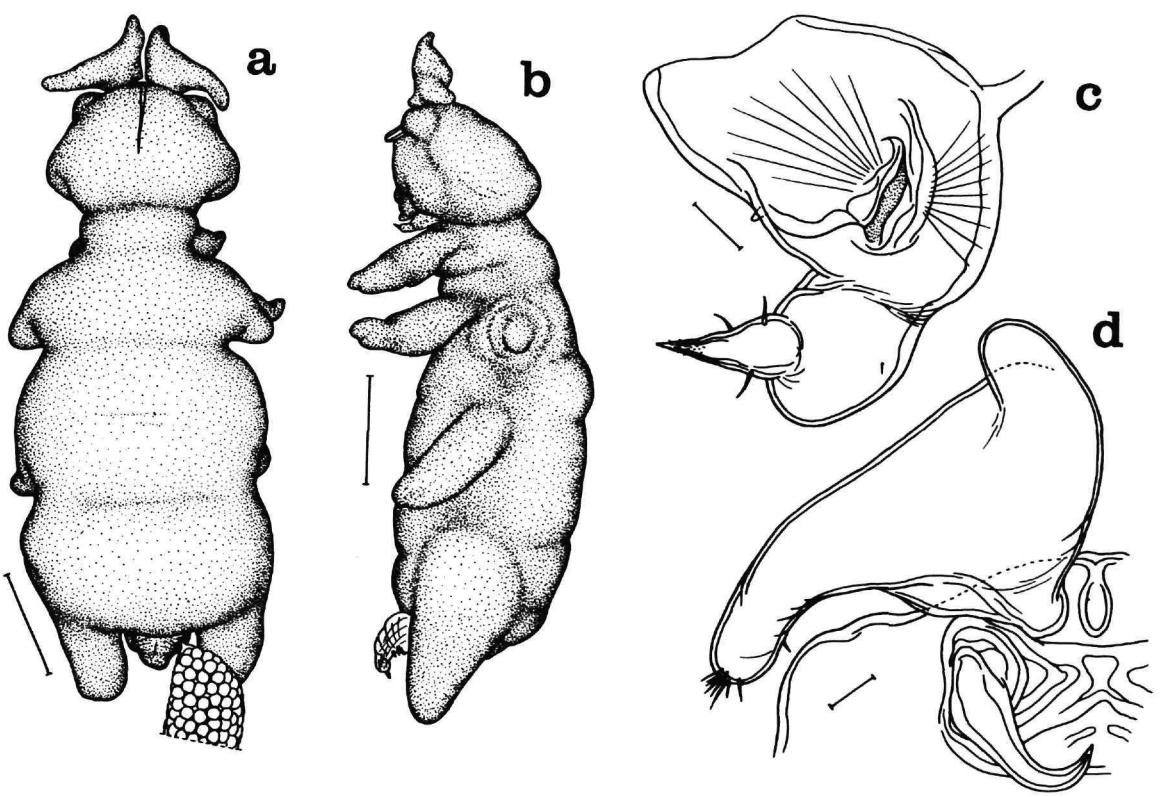

FIGURE 12.—*Chondracanthus cottunculi* female: *a*, body of syntype, dorsal; *b*, same, lateral; *c*, genito-abdomen, lateral; *d*, first and second antenna. Scale: 1 mm in *a*, *b*; 0.1 mm *c*, *d*.

cavities of *C. thomsoni* (Gunther), 1883 (USNM 6139); and 2 females, with males attached, in branchial cavities of *C. microps* Collet, off Martha's Vineyard, Massachusetts, 21 September 1883 (USNM 6166).

FEMALE.—Body (Figures 12*a, b*) rather plump. Head distinctly wider than long, with small rounded knob at each anterior corner and swollen posterolateral surface (not in the form of a process). First pedigerous segment distinctly narrower than head, but second pedigerous segment protruded laterally forming widest part of body. Third pedigerous segment larger than fourth and bearing a short, cylindrical ventral process. Posterior process blunt. Genital segment (Figure 12*c*) about twice as large as abdomen, carrying a pair of midventral elements. Caudal ramus (Figure 12*c*) of typical form. Egg sac only a little shorter than body, with many rows of small eggs.

First antenna (Figure 12*d*) large, flattened subtriangular, and fleshy; armed with 8 terminal setae and an isolated seta on posterior surface of distal portion. Second antenna (Figure 12*d*) of usual form, 2-segmented and uncinate.

Labrum with smooth posterior margin. Mandible (Figure 13*a*) 2-segmented, terminal blade bearing about 39 teeth on convex side and 37 teeth on concave side. Paragnath (Figure 13*b*) a bilobate lobe with spinules on inner surface of terminal lobe. First maxilla (Figure 13*c*) bearing 2 elements and an inner swelling. Second maxilla (Figure 13*d*) 2-segmented, bearing a row of about 13 teeth on terminal process. Maxilliped (Figure 13*e*) 3-segmented unarmed, second segment with rows of denticles distributed in two patches, and terminal segment a short claw with a hooklet.

Leg 1 (Figure 13*f*) smaller than leg 2 (Figure 13*g*), both bilobate, with stout conical endopod and longer exopod with bent tip. A small outer seta on both protopods.

MEASUREMENTS.—Body 7.69 mm (in extended specimen); head 1.33 × 1.73 mm; genital segment 0.48 × 0.65 mm; abdomen 0.38 × 0.31 mm; egg sacs 6.07 mm and 6.24 mm; egg 192 μ.

MALE.—Body (Figure 14*a*) 0.95 × 0.49 mm, with distinct metamerism on body; cephalosome about as long as metasome plus urosome, but distinctly wider.

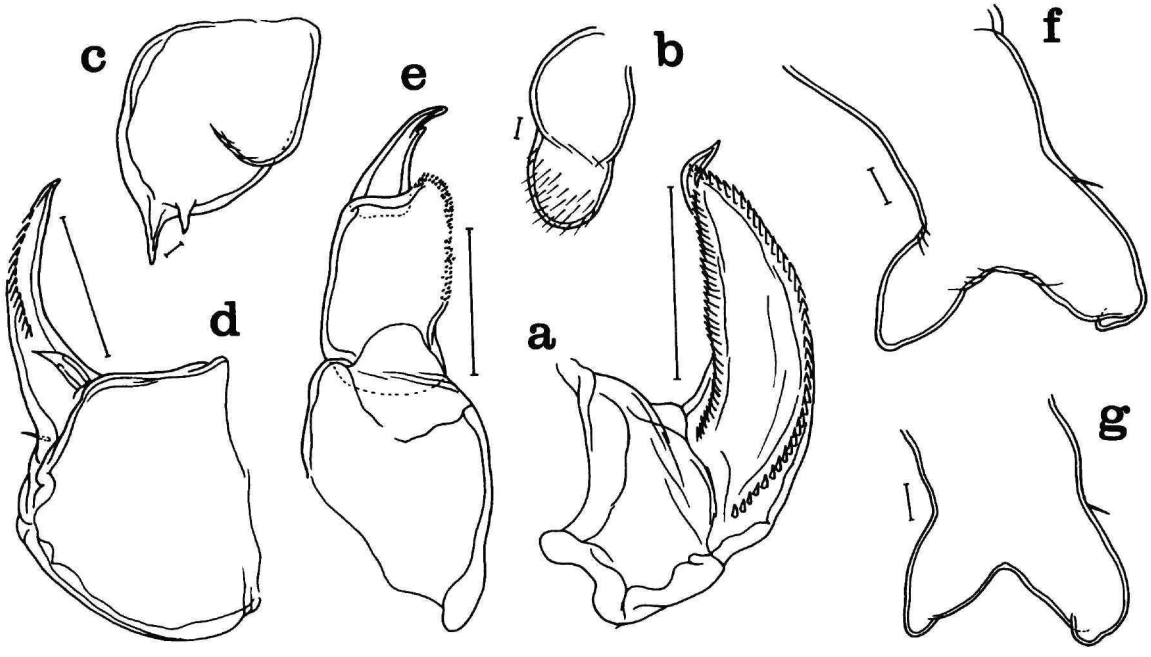

FIGURE 13.—*Chondracanthus cottunculi* female: *a*, mandible; *b*, paragnath, *c*, first maxilla; *d*, second maxilla; *e*, maxilliped; *f*, leg 1; *g*, leg 2. Scale: 0.1 mm in *a, d, e, f, g;* 0.01 mm in *b, c.*

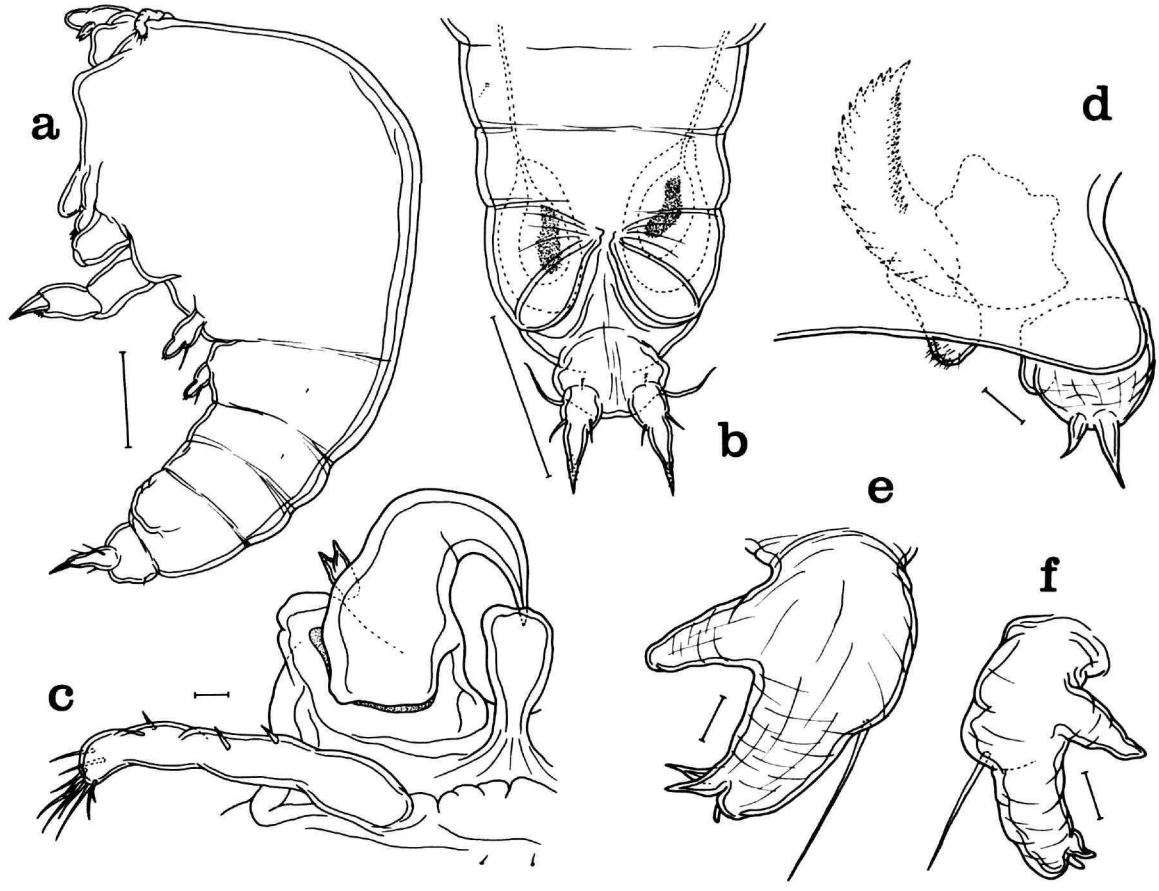

FIGURE 14.—*Chondracanthus cottunculi* male: *a*, body, lateral; *b*, urosome, ventral; *c*, first and second antennae; *d*, mouth parts, ventral; *e*, leg 1; *f*, leg 2. Scale: 0.1 mm in *a*, *b*; 0.01 mm in *b*, *c*, *d*, *e*, *f*.

A small seta on lateral surface of second and third pedigerous segment. Genital segment and abdomen relatively well separated (Figure 14*b*). A pair of spermatophores (Figure 14*b*) seen inside body of one male. Caudal ramus (Figure 14*b*) as in female.

First antenna (Figure 14*c*) cylindrical, armature being: 1–1–2–2–8. Second antenna (Figure 14*c*) 2-segmented, with terminal recurved hook bearing a bifurcate process (accessary antennule) on its ventrolateral surface. A median protrusion located between bases of first and second antenna (see Figure 14*c*).

Labrum (Figure 14*d*) as in female, with smooth posterior margin. Mandible (Figure 14*d*) and first maxilla (Figure 14*d*) with usual sexual dimorphism. Paragnath (Figure 14*d*) and maxilliped as in female. Second maxilla differing from female in having a row of only 4 teeth on terminal process.

Leg 1 (Figure 14*e*) larger than leg 2 (Figure 14*f*), both with rather prominent rami in the form of a cylindrical process. Exopods larger than endopods; tipped with 3 elements in first but only 2 in second. A long outer seta on each protopod.

REMARKS.—The male of this species was neither described nor figured in Rathbun's (1886) original description; he only remarked (page 324) that "males were attached to most of the females." Wilson (1932: 498) stated that the male was "unknown." The male is, however, in reality rather peculiar in having an accessary antennule-like element on the second an-

tenna. A similar element was also found in the male of *C. pinguis* Wilson 1912 by Kabata (1968).

C. cottunculi was transferred to the genus *Chondracanthopsis* by Oakley (1930). Heegaard (1945) suggested that it should be included in *Acanthocanthopsis*. However, as stated by Ho (1970:9), these two genera are not valid.

This species can very easily be distinguished from other species of *Chondracanthus* by the following combination of characters: without a cephalic process, only one pair of processes on the body, short posterior processes, and a large, subtriangular first antenna.

Chondracanthus janebennettae Causey 1953

FIGURES 15–17

Chondracanthus janebennettae Causey 1953: 10, fig. 10; 1955a: 11–12, pl. 3: figs. 13–16.—Yamaguti 1963: 273, pl. 246: fig. 2.

MATERIAL STUDIED.—From USNM: 1 female, with male attached, on flounder, Grand Isle, Louisiana (USNM 79714, labeled as *C. distortus*). From au- with male attached, on *Paralichthys lethostigmus* Jordan and Gilbert, Pascagoula, Mississippi (USNM 97622); 1 female, with male attached, on *P. lethostigmus,* Pascagoula, Mississippi (USNM 97623); and 2 females, with males attached, on gills of *P. albiguttus* Jordan and Gilbert, Grande Isle, Louisiana (USNM 79714, labeled as *C. distortus*). From author's collection: 11 females, with males attached, on wall of opercula of *Ancylopsetta quadrocellata* Gill, St. George Island, Florida, 12 July 1965.

FEMALE.—Body (Figures 15*a, b*) rather broad and flat. Head well-demarcated from first pedigerous segment, with posterodorsal surface and posteroventral corners protruded into a large, blunt lobe; a pair of small processes in oral area. An elongate sclerite on middorsal surface anterior to dorsal lobe (see Figure 15*c*). First and second pedigerous segments narrower than head, forming an indistinct neck region. Third pedigerous segment broadest, with posterior corners protruded backward into a long, attenuate process. Fourth pedigerous segment (Figure 15*d*) shaped as the third, but narrower; its posterior corners protruded into a long, attenuate posterior process. Genital segment (Figure 15*e*) small, attached to posterodorsal surface of trunk. Abdomen (Figure 15*e*) transformed into long, attenuate caudal process, carrying caudal rami at its basal portion on lateroventral surface. Caudal ramus (Figure 15*f*) armed with 3 setae (1 outer and 2 inner) on basal portion; spinulose terminal portion with forked tip. Egg sac cylindrical, longer than body, with only a few rows of eggs.

First antenna (Figure 15*g*) fleshy, with basal portion greatly enlarged and distal half narrowed and turned ventrally, bearing 11 small setae on terminal and subterminal surface. Second antenna (Figure 15*h*) 2-segmented, terminal segment a strongly recurved, slender hook.

Labrum (Figure 16*a*) bearing denticles on posterior surface. Mandible (Figure 16*b*) 2-segmented, terminal segment bearing on convex side a complete row of 106 teeth and another incomplete row of 23 teeth, and on concave side a row of 66 teeth. Paragnath (Figure 16*c*) a small lobe armed with several spinules. First maxilla (Figure 16*d*) an oval lobe bearing 2 elements. Second maxilla (Figure 16*e*) 2-segmented robust and unarmed; second segment an attenuate process, bearing 1 small simple seta, 1 large spinulose seta, a row of about 16 teeth on posterior surface, and a single tooth on anterior surface close to tip. Maxilliped (Figure 16*f*) 3-segmented; first segment unarmed; second segment bearing rows of spinules distributed in two patches; and distal segment a claw with a patch of denticles on base and 6 to 8 small blunt teeth on inner edge of hook.

Leg 1 (Figure 16*g*) bilobate, with small protopod bearing an outer seta, both endopod and exopod long and attenuate. Leg 2 (Figure 16*h*) as in leg 1, only with more slender rami.

MEASUREMENTS.—Body 5.92 mm; head 1.50 × 1.68 mm; genital segment 0.38 × 0.50 mm; abdomen 1.17 × 0.23 mm; egg sacs 8.37 mm and 7.81 mm; egg 156 μ.

MALE.—Body (Figure 17*a*) 0.63 × 0.30 mm, with widest portion in posterior part of cephalosome, which is incompletely fused with first pedigerous segment. Metamerism on body rather distinct. Genital segment (Figure 17*b*) rather wide, but abdomen narrow and protruded into a small lobe posteriorly. Caudal ramus (Figure 17*b*) as in female.

First antenna (Figure 17*c*) cylindrical, armature being: 1–1–1–3–8. Second antenna (Figure 17*c*) 2-segmented, with a recurved terminal segment.

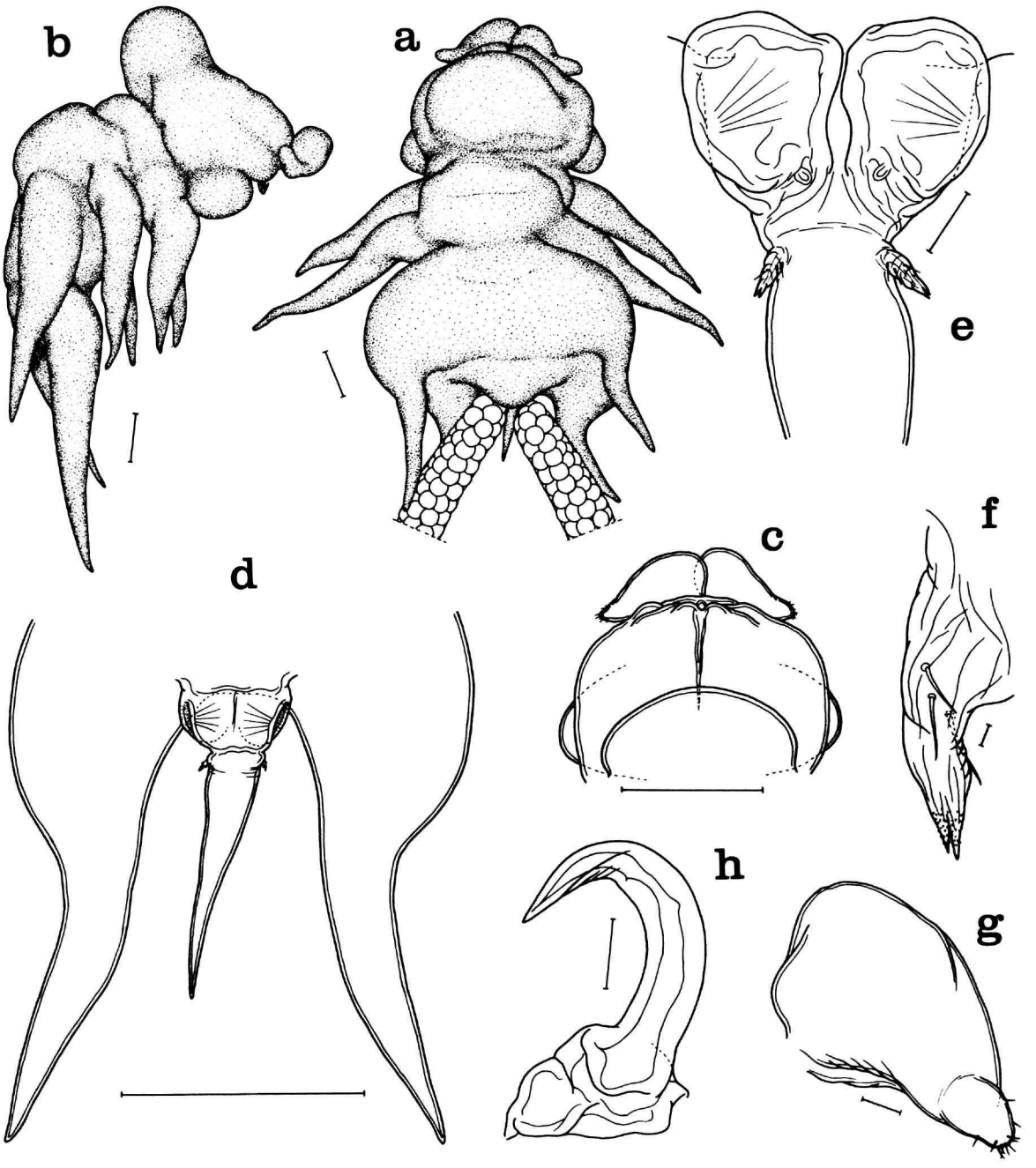

FIGURE 15.—*Chondracanthus janebennettae* female: *a*, body, dorsal; *b*, same, lateral; *c*, head, anterodorsal; *d*, posterior part of body, dorsal; *e*, genito-abdomen, ventral; *f*, caudal ramus; *g*, first antenna; *h*, second antenna. Scale: 1 mm in *a*, *b*, *c*, *d*; 0.1 mm in *e*, *f*, *g*, *h*.

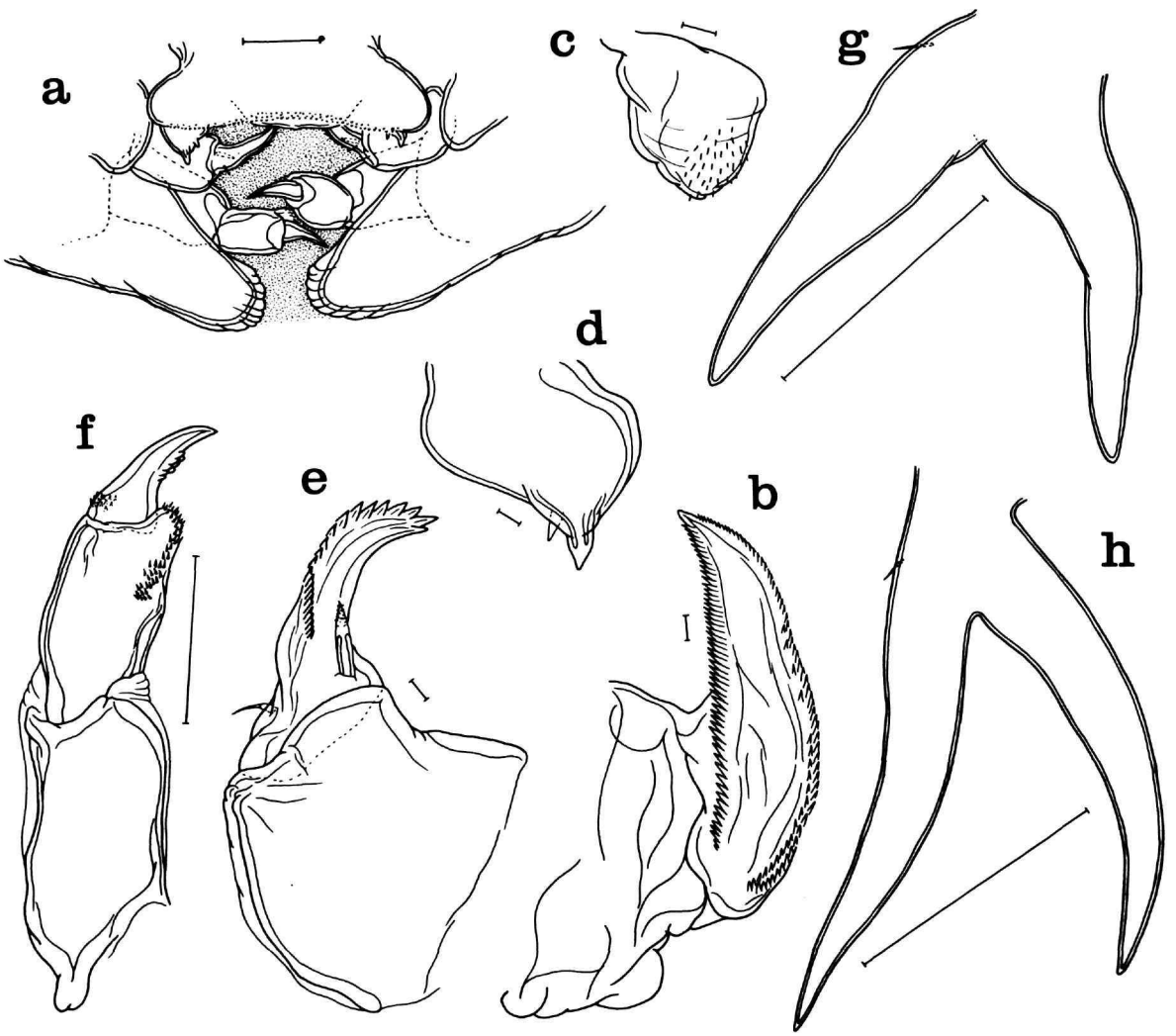

FIGURE 16.—*Chondracanthus janebennettae* female: *a*, oral area and mouth parts, ventral; *b*, mandible; *c*, paragnath; *d*, first maxilla; *e*, second maxilla; *f*, maxilliped; *g*, leg 1; *h*, leg 2. Scale: 0.1 mm *a*, *f*; 0.01 mm *b*, *c*, *d*, *e*; 1 mm in *f*, *g*, *h*.

Labrum, paragnath, and first maxilla as in female. Mandible and second maxilla (Figure 17*d*) exhibiting usual sexual dimorphism. Maxilliped (Figure 17*e*) different from female in having only one hooklet on terminal claw.

Leg 1 (Figure 17*f*) and leg 2 similar, biramous, with large, robust protopod bearing a long outer seta. Exopod a slender process with forked tip and endopod a small lobe tipped with a conical knob.

REMARKS.—The present species is characteristic in having, in the female, attenuated lateral processes on trunk, a large crestlike dorsal lobe on the cephalosome, and the abdomen prolonged into an attenuate, cylindrical caudal process. The last character is not found in any other known species of *Chondracanthus*. The presence of a large number of teeth on the mandible, the second maxilla, and the terminal claw of the maxilliped is also unique in the genus.

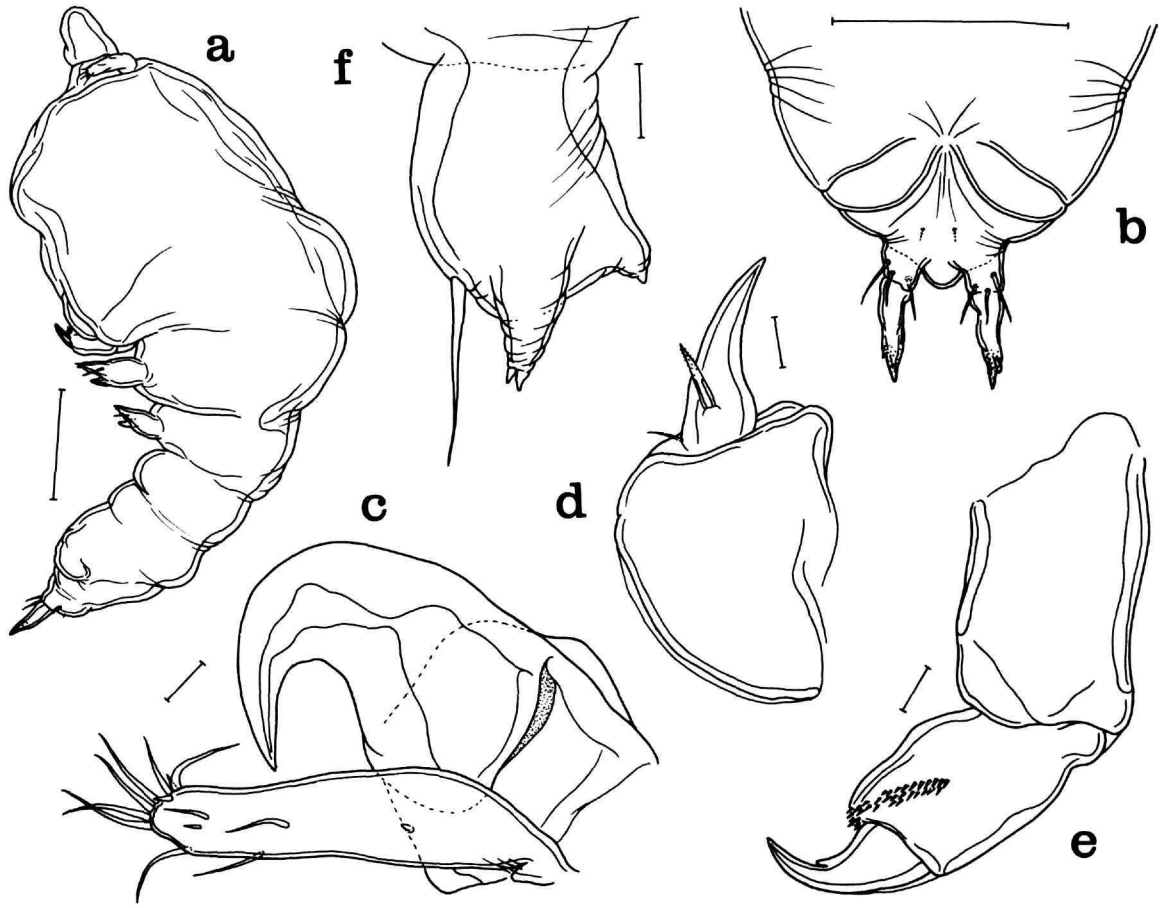

FIGURE 17.—*Chondracanthus janebennettae* male: *a*, body, lateral; *b*, posterior part of body, ventral; *c*, first and second antenna; *d*, second maxilla; *e*, maxilliped; *f*, leg 1. Scale 0.1 mm in *a*, *b*; 0.01 mm *c*, *d*, *e*, *f*.

Chondracanthus merluccii (Holten 1802)

FIGURES 18–20

Lernaea merluccii Holten 1802: 135–136, pl. 3: fig. 2.

Chondracanthus merluccii (Holten).—Krøyer 1837: 278–280, pl. 3: figs. 9a–d.—H. Milne Edwards 1840: 503.—Heller 1866: 756.—Olsson 1868: 34.—Richiardi 1880: 151.—Stossich 1880: 253.—Valle 1880: 73.—Carus 1885: 354.—T. Scott 1892: 262; 1900: 166–167; 1906: 372.—Bassett-Smith 1896: 161; 1899: 494.—Schimkewitsch 1896: 339, pl. 14: figs. 5–7, 11–20.—Brian 1898: 21; 1906: 97, pl. 7: fig. 4.—Norman and T. Scott 1906: 217.—T. Scott and A. Scott 1913: 180, pl. 20: fig. 10; pl. 47: fig. 8; pl. 53: figs.16–19.—Stock 1915: 71.—Oakley 1930: 188, figs. 2A–D.—Wilson 1932: 498, pl. 1: fig. a, figs. 298a–e.—El Saby 1933: 865–866, pl. 2: figs. 7–9.—Leigh-Sharpe 1934: 113.—Pesta 1934: 48, fig. 29.—Oorde-de Lint and Schuurmans Stekhoven 1936: 109, fig. 52.—Barnard 1948: 251; 1955: 286–287, figs. 23a–b.—Carvalho 1951: 143.—Rose and Vaissière 1952: 171.—Nunes-Ruivo 1956: 35–36.—Szidat 1955: 2; 1961: 3, fig. 1b.— Markewitsch 1956: 85, fig. 39.—Capart 1959: 111.—Yamaguti 1963: 273, pl. 248: fig. 5.—O'Riordan 1966: 376.

C. xyphiae Guérin 1829–44, pl. 9: fig. 20.

C. merlangi Krøyer 1863: 331.—Yamaguti 1963: 273.

C. stramineus Wilson 1923a: 10–11, pl. 1: fig. 13, pl. 2: figs. 14–15.—Yamaguti 1963: 274, pl. 248: fig. 2.

Chondracanthus species Wilson 1923b: 14.

MATERIAL STUDIED.—From USNM (all found in oral cavities of *Merluccius bilinearis* (Mitchill)): 2

females, England, 1884 (USNM 8454); 8 females and 3 young females, with males attached, fish market in Washington, D. C. (USNM 37874); 20 females and 8 young females, with males attached, Woods Hole, Massachusetts, 22 July 1924 (USNM 56635); 19 females, with males attached, Woods Hole, Massachusetts, June 1914 (USNM 59783); 1 female, Woods Hole, Massachusetts, 20 October 1903 (USNM 59786); 35 females, with males attached, Woods Hole, Massachusetts, 13 August 1902 (USNM 59780); 15 females, with males attached, fish market in Washington, D. C. (USNM 59775); 60 females, with males attached, Woods Hole, Massachusetts, 20 October 1903 (USNM 59787); 33 females and 1 young female, with males attached, Woods Hole, Massachusetts, 1 November 1898 (USNM 59797); 21 females and 4 young females, with males attached, Woods Hole, Massachusetts, 14 August 1902 (USNM 59785); 34 females, with males attached, Casco Bay, Maine, 14 August 1902 (USNM 59784); 19 females with males attached, Block Island, Rhode Island, 14 June 1884 (USNM 59796); 2 females and 2 young females, with males attached, Woods Hole, Massachusetts, 22 July 1924 (USNM 59815); 36 females, with males attached, fish market in Washington, D. C., 5 January 1909; and 15 females, with males attached, Casco Bay, Maine, 24 July 1873 (USNM 60543). From author's collection: 6 females, with males attached, on roof of mouth cavities of *M. bilinearis,* from stations 5763 (29°59′N 80°10′W → 29°51′N 80°10′W), 5793 (24°18′N 82°53′W → 24°19′N 83°00′W), and 5795 (24°16′N 82°30′W → 24°16′N 82°38′W) of R/V *Oregon* Cruise 105.

FEMALE.—Body (Figures 18*a*, *b*) with only one pair of lateral processes. Head bearing a small process at each posterolateral corner. Anterior margin of head (Figure 18*c*) truncated and much narrower than rounded posterior margin. First pedigerous segment small, narrower than head. Second pedigerous segment wider than head, with shoulderlike rounded anterior corners. Third pedigerous segment broadest carrying a large cylindrical, lateral process on each lateroventral surface. Fourth pedigerous segment produced posterolaterally into a blunt, cylindrical posterior process and bearing a midventral swelling just in front of genital segment (see Figure 18*b*). Genito-abdomen (Figure 18*d*) smaller than the ventral knob just in front of it. Abdomen (Figure 18*d*) small. Caudal ramus (Figure 18*e*) attached ventrally to abdomen in anterior area; basal portion bearing 1 dorsal and 2 ventral setae, and terminal portion an attenuated process bearing spinules. Egg sac cylindrical, nearly twice as long as body.

First antenna (Figure 18*f*) fleshy, consisting of a swollen basal portion and two small terminal segments, armature being: 1–1–2–2–8. Second antenna (Figure 18*g*) 2-segmented, terminal segment a strong recurved hook.

Labrum as in *C. janebennettae.* Mandible (Figure 19*a*) 2-segmented, terminal segment falcate, bearing about 31 large teeth on convex side and 20 smaller teeth on concave side. Paragnath (Figure 19*b*) with a small lobule at base; spinules only on distal surface. First maxilla (Figure 19*c*) bearing two terminal elements and a small knob on inner surface. Second maxilla (Figure 19*d*) 2-segmented; first segment robust and unarmed; second segment an attenuate process, bearing 1 small simple seta, 1 large barbed seta, and a row of about 9 large teeth. Maxilliped (Figure 19*e*) 3-segmented; first segment unarmed; second segment bearing rows of denticles distributed in two patches, and distal segment a claw with a hooklet.

Leg 1 (Figure 18*c*) bilobate, with bluntly pointed rami; endopod larger than exopod; and only protopod bearing an outer small seta. Leg 2 (Figure 19*f*) nearly three times larger than leg 1, with cylindrical rami longer than protopod, which carries a small outer seta. Both legs covered with fine spinules.

MEASUREMENTS.—Body 10.44 mm; head 1.51 × 1.89 mm; genital segment 0.41 × 0.55 mm; abdomen 0.10 × 0.14 mm; egg sacs 11.23 mm and 10.94 mm; 192 μ

MALE.—Body (Figure 20*a*) 0.97 × 0.39 mm, with widest portion on posterior part of cephalosome. Cephalosome larger than metasome plus urosome. Last two thoracic segments and genital completely fused. Abdomen (Figure 20*b*) carrying a pair of setules on dorsal surface. Caudal ramus (Figure 20*b*) as in female but much smaller.

First antenna asymetrically developed in one of the males from off Florida (Figure 20*c*). A normally developed first antenna with armature of 1–2–2–8. Second antenna (Figure 20*c*) 2-segmented, with recurved terminal hook. Labrum and oral appendages as in female, except mandible and second maxilla

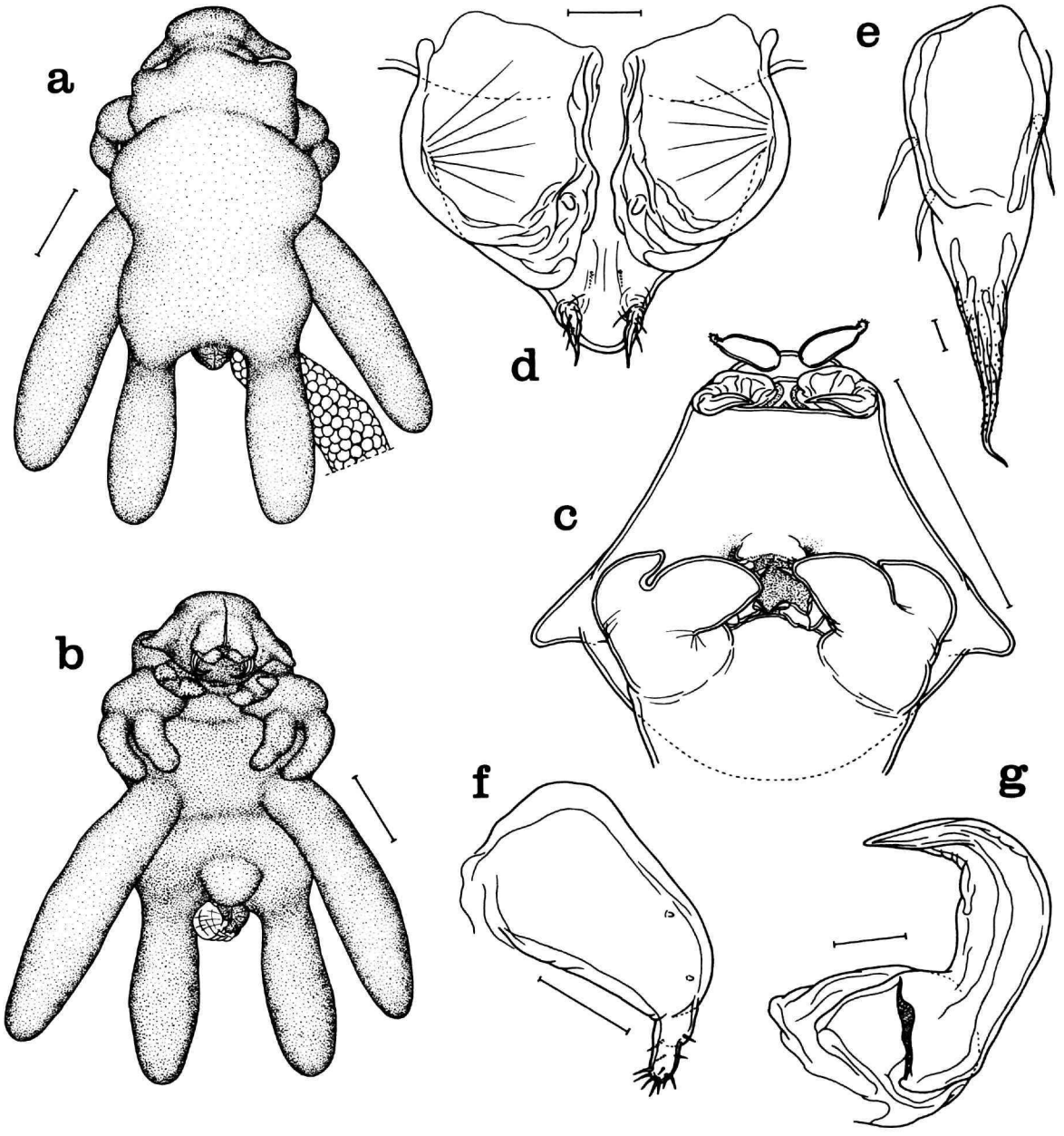

FIGURE 18.—*Chondracanthus merluccii* female: *a*, body, dorsal; *b*, same, ventral; *c*, head and leg 1, ventral; *d*, genito-abdomen, ventral; *e*, caudal ramus; *f*, first antenna; g, second antenna. Scale: 1 mm in *a*, *b*, *c*; 0.1 mm in *d*, *e*, *f*, *g*.

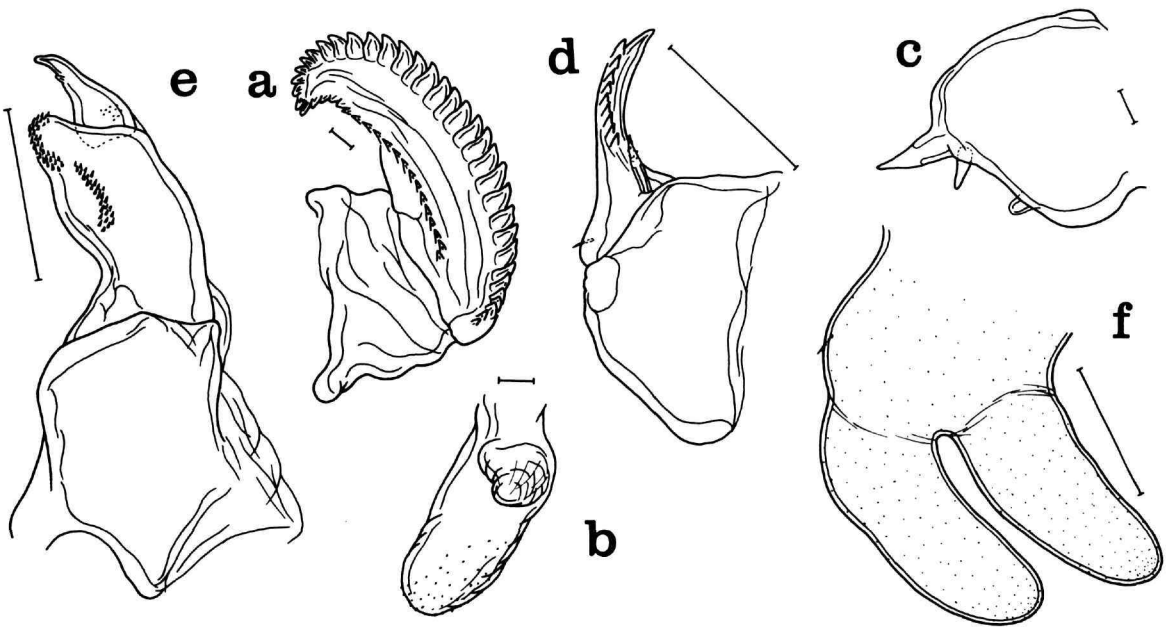

FIGURE 19.—*Chondracanthus merluccii* female: *a*, mandible; *b*, paragnath; *c*, first maxilla; *d*, second maxilla; *e*, maxilliped; *f*, leg 2. Scale: 0.01 mm in *a*, *b*, *c*; 0.1 mm in *d*, *e*; 0.5 mm in *f*.

(Figure 20*d*) which exhibit usual sexual dimorphism. A conical knob (Figure 20*c*) in rostral area located between bases of two pairs of antennae.

Leg 1 (Figure 20*e*) larger than leg 2 (Figure 20*f*), both having an inflated protopod bearing a long outer seta, a bluntly pointed endopod, and a rather sharply pointed exopod carrying a seta.

REMARKS.—The considerably smaller specimens taken from hakes caught off Florida (author's collection) are only about half of the size of specimens taken in the other parts of the Atlantic Ocean. The specimens from South Africa differ from those occurring in other waters in having a pair of very small cephalic processes. This feature was emphasized by Wilson (1932) in distinguishing them as a new species, *C. stramineaus*.

T. Scott and A. Scott (1913) have reported that occasionally more than one male may be found on a female, but, in the course of this study, I have not encountered such a polyandrous condition.

C. palpifer Wilson 1912 is the only species of *Chondracanthus* that is closely related to the present species. It was first reported by Wilson (1912) from Nanaimo, British Columbia, and later by Fraser (1920) from Vancouver, British Columbia, and by Brian (1944) and Szidat (1955) from Argentina. It is morphologically different from *C. merluccii* in the absence of cephalic processes and in having unequally developed rami in leg 2 (with the exopod distinctly larger than the endopod). The occurrence of *C. palpifer* on *M. hubbsi* Marini in the Western South Atlantic and *C. merluccii* on *M. bilinearis, M. merluccius,* and *M. capensis* in the North Atlantic and the Eastern South Atlantic seems to support Szidat's (1955, 1961) hypothesis that *M. hubbsi* originated from the North Pacific stock of hake *(M. productus)* and not from the North Atlantic stock *(M. bilinearis)*. Szidat found that the parasite fauna of *M. hubbsi* (occurring off the coast of Brazil and Argentina) is nearly identical with that of *M. productus* in the Eastern North Pacific but distinctly different from that of *M. bilinearis* in the Western North Atlantic.

During Cruise 16 of R/V *Anton Bruun,* I had an opportunity to examine more than 5000 hakes *(M. gayi gayi)* caught in the trawl at twelve stations off the Peruvian coast, but not a single one bore chondracanthid copepods. As mentioned previously in con-

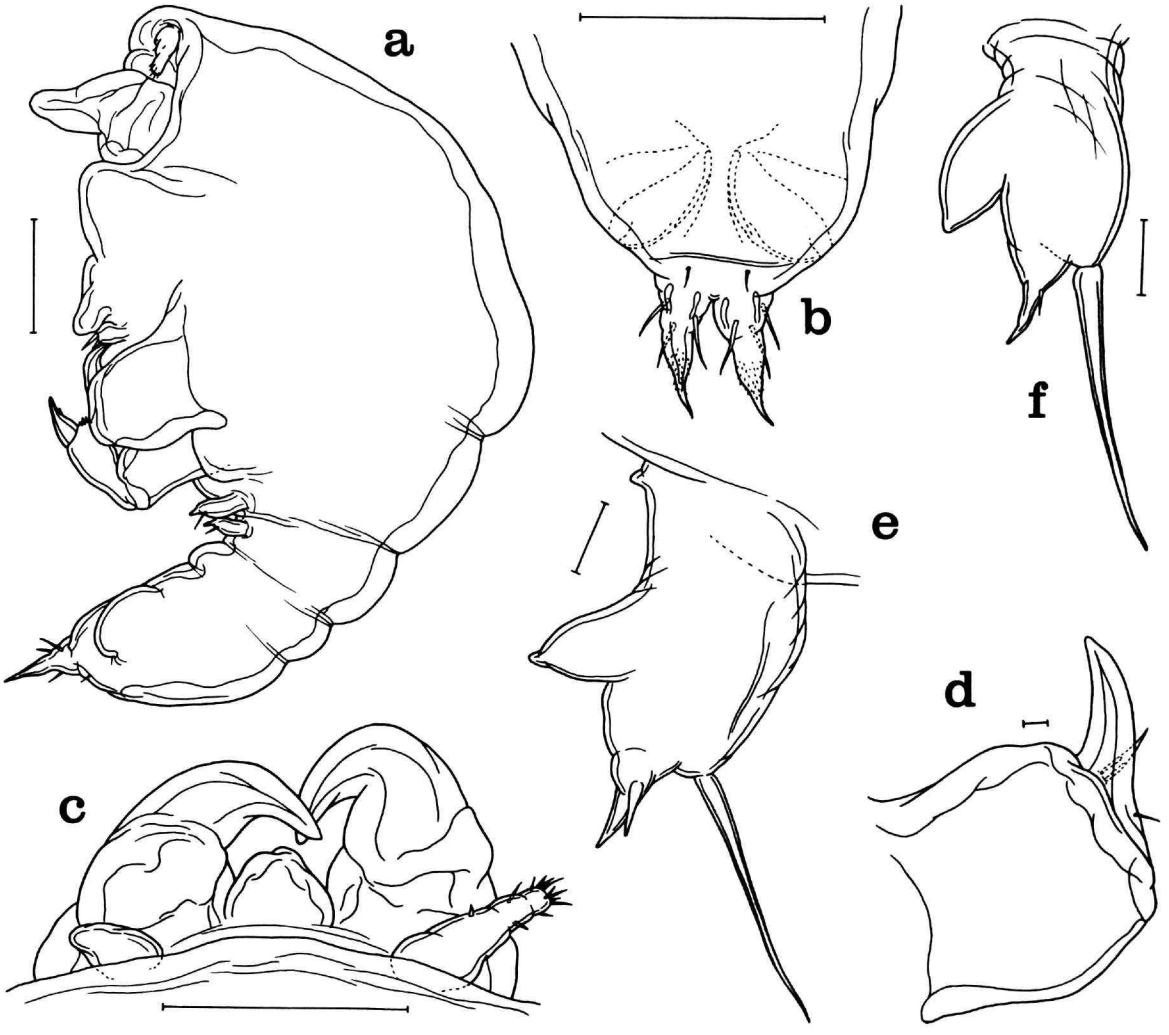

FIGURE 20.— *Chondracanthus merluccii* male: *a*, body, lateral; *b*, posterior part of body, dorsal; *c*, first and second antennae (left first antenna atrophied); *d*, second maxilla; *e*, leg 1; *f*, leg 2. Scale: 0.1 mm in *a*, *b*, *c*; 0.01 mm in *d*, *e*, *f*.

nection with *Acanthochondria phycidis*, when Stuardo and Fagetti (1960) made an extensive survey on the copepod parasites of *M. gayi gayi* in the Bay of Valparaiso, Chile, they too did not find a single chondracanthid parasite on the hake.

Chondracanthus nodosus (Müller 1776)

FIGURES 21–23

Lernaea nodosa Müller 1776: 227; 1788: 40, pl. 33: fig. 5.—Lamarck 1816: 231.

Lernentoma nodosa (Müller).—Blainville 1822: 441.

Chondracanthus nodosus (Müller).—Krøyer 1837: 196; 1838: 133–135, pl. 3: figs. 2a–f; 1863: 332.—H. Milne Edwards 1840: 503.— Olsson 1868: 34.—Bassett-Smith 1899: 494.—T. Scott and A. Scott 1913: 176, pl. 48: figs. 13–16, pl. 52: figs. 1–3.—Stephensen 1913: 341–342.—Wilson 1920: 6L.—Hansen 1923: 45.—Leigh-Sharpe and Perkins 1924: 291–294, figs. 4–6.—Heegaard 1947: 7, fig. 8.

C. williamsoni T. Scott 1909: 76–77, pl. 3: figs. 8–17.

Chondracanthopsis nodosus (Müller).—Oakley 1930: 196,

figs. 7A–D.—Wilson 1932: 508, pl. 39: figs. 2a–g.—Leigh-Sharpe 1933: 113.—Oorde-de Lint and Schuurmans Stekhoven 1936: 111, figs. 60A, B.—Sinderman 1961: 111.—Williams 1963: 510–516.—Yamaguti 1963: 284, pl. 246: fig. 2.

MATERIAL STUDIED.—All recorded on *Sebastes marinus* (Linnaeus). From UZM: 2 females, with males attached, Greenland; 5 females, with males attached, Greenland, December 1891; 1 female, with

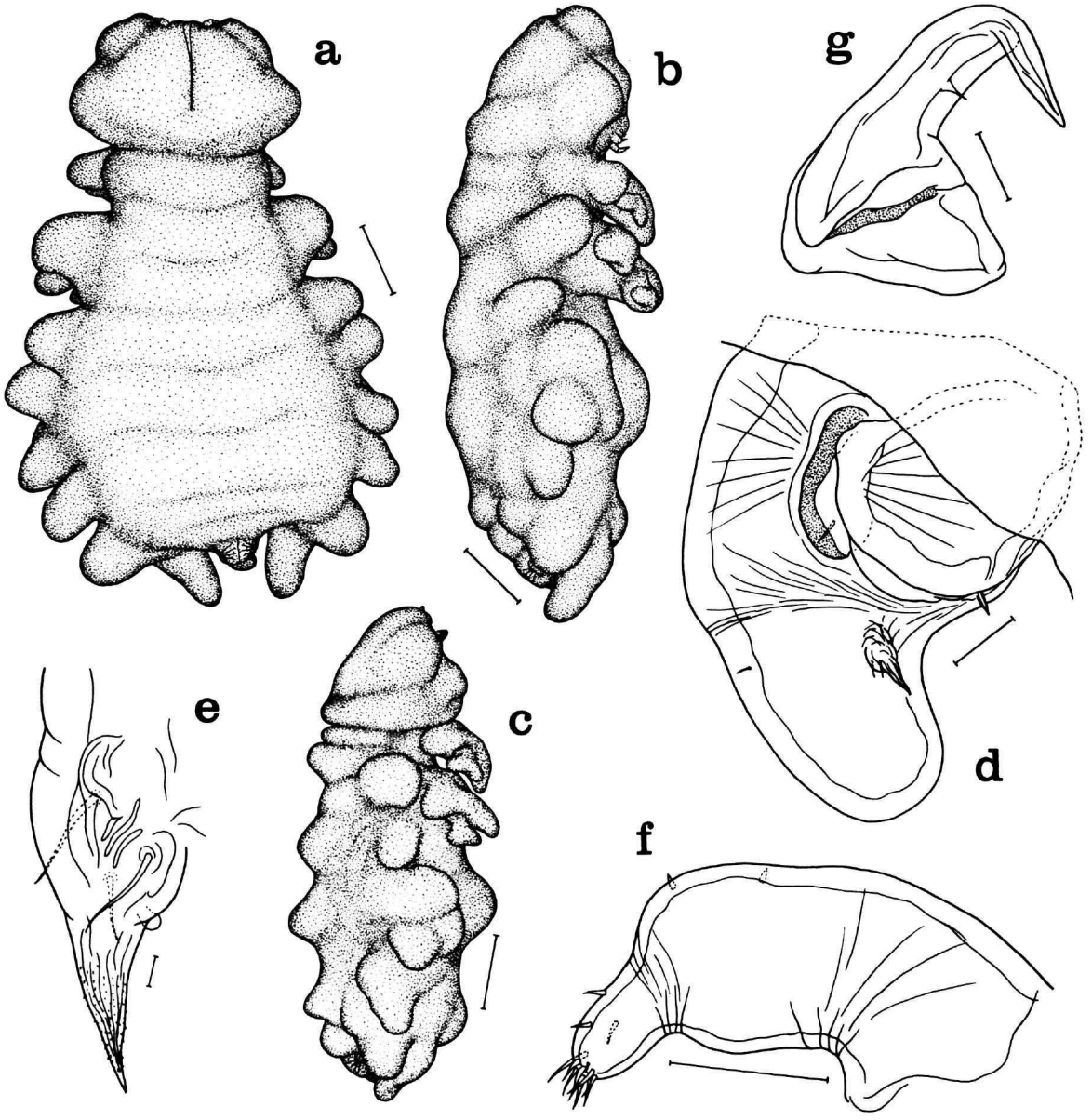

FIGURE 21.—*Chondracanthus nodosus* female: *a*, body, dorsal; *b*, same, lateral; *c*, body of a contracted specimen, lateral; *d*, genito-abdomen, lateral; *e*, caudal ramus; *f*, first antenna; *g*, second antenna. Scale: 1 mm in *a*, *b*, *c*; 0.1 mm in *d*, *f*, *g*; 0.01 mm in *e*.

male attached, Norway; 10 females, with males attached, 3 July 1902, Norway; 4 females, with males attached, outside Denmark; 6 females, with males attached, outside Denmark; 1 females, outside Denmark; 4 females, with males attached, 11 July 1902, Denmark; 2 females, 13 August 1868, Skagen, Denmark; and 7 females, with males attached, the Kattegat, Denmark. From USNM: 4 females, with males attached, Massachusetts Bay, 1878 (USNM 60541). From author's collection: 8 females, with males attached, on wall of branchial cavities, Sta. 1–3 (41°47′N 69°34′W → 41°46′N 69°33′W) of R/V *Albatross IV* Cruise 66–3.

FEMALE.—Body (Figure 21*a, b, c*) with many short and rounded protrusions. Head protruded posterolaterally into rounded swellings. Both neck and trunk regions extensible; an extended specimen (Figure 21*b*) with longer neck and lower dorsal knobs, but a contracted specimen (Figure 21*c*) showing shorter neck and higher dorsal knobs. Second pedigerous segment protruded laterally into a large lobe. Trunk region bearing five lateral knobs, two ventral protrusions (which probably indicate respectively the third and fourth pedigerous segments), and a pair of posterior processes; four dorsal knobs variable in height with different state of contraction. Genital segment (Figure 21*d*) carrying two midventral elements as usual in chondracanthids. Abdomen (Figure 21*d*) globular, carrying a pair of small setules on dorsal surface. Caudal ramus (Figure 21*e*) bearing on basal portion 3 setae and a small lobule; terminal portion attenuated into spinulose process. Egg sac long, cylindrical, with many rows of eggs.

First antenna (Figure 21*f*) fleshy; with enlarged basal portion carrying two elements and with small cylindrical terminal portion, twelve elements. Second antenna (Figure 21*g*) 2-segmented, with recurved terminal segment.

Labrum with smooth posterior margin. Mandible (Figure 22*a*) bearing 47 to 54 teeth on convex side and 40 to 43 teeth on concave side. Paragnath (Figure 22*b*) bilobated distally, both lobe spinulose. First

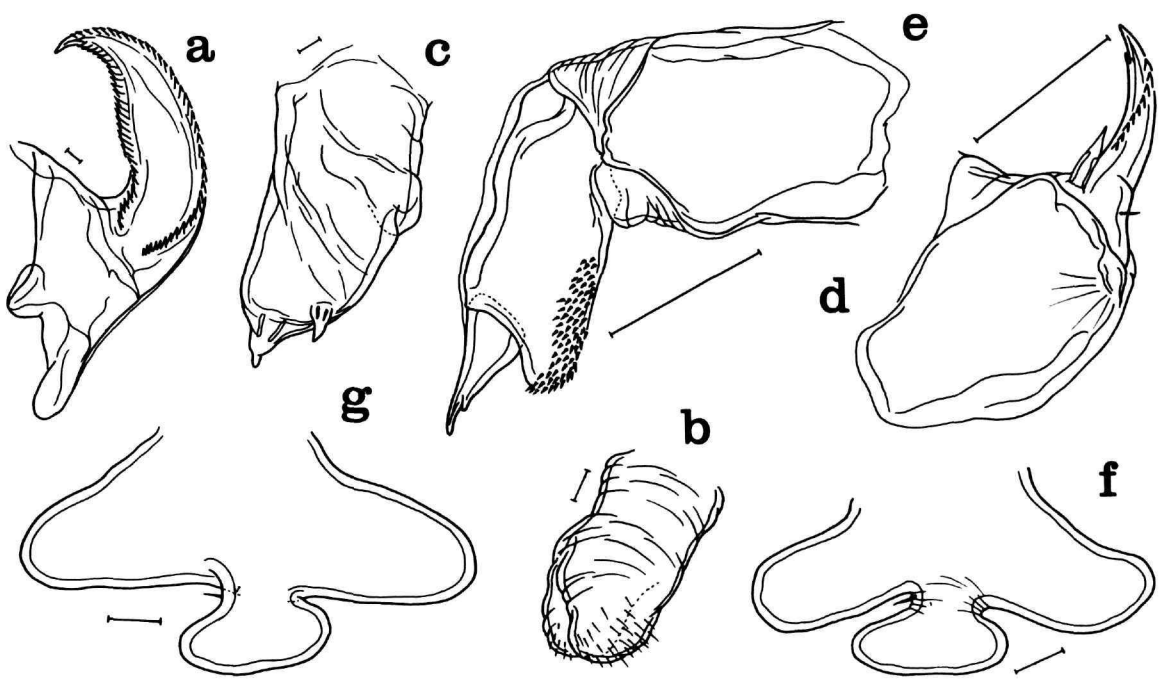

FIGURE 22.—*Chondracanthus nodosus* female: *a*, mandible; *b*, paragnath; *c*, first maxillia; *d*, second maxilla; *e*, maxilliped; *f*, leg 1; *g*, leg 2. Scale: 0.01 mm in *a, b, c;* 0.1 mm *d, e;* 0.2 mm in *f, g*.

maxilla (Figure 22*c*) bearing 2 terminal elements and a basal lobule. Second maxilla (Figure 22*d*) 2-segmented; terminal segment an attenuated process bearing 1 small simple setule, 1 large, spiniform seta, a row of about 9 teeth on posterior surface, and a single tooth on anterior surface. Maxilliped (Figure 22*e*) 3-segmented, armature of usual form.

Both leg 1 (Figure 22*f*) and leg 2 (Figure 22*g*) similar in structure, with coxal portion probably bilaterally protruded into a pair of large alae and basis and both rami fused to form the so-called "boot." A small seta on outer surface of basis. Some specimens have exopodal portion of "boot" bluntly attenuated and much longer than endopodal portion. Surface of both legs sparsely scattered with fine spinules.

MEASUREMENTS.—Body 6.70 mm; head 1.62 × 2.58 mm; genital segment 0.54 × 0.62 mm; abdomen 0.38 × 0.26 mm; egg sacs 7.35 mm and 7.09 mm; egg 298 μ.

MALE.—Body (Figure 23*a*) small, 0.69 × 0.35 mm. Cephalosome rather thick and globular. Metamerism on metasome rather distinct. Third pedigerous segment bearing a setule on dorsolateral surface and fourth pedigerous segment, a pair of setules on middorsal surface. Genito-abdomen (Figure 23*b*) having essentially a typical chondracanthid form. Abdomen

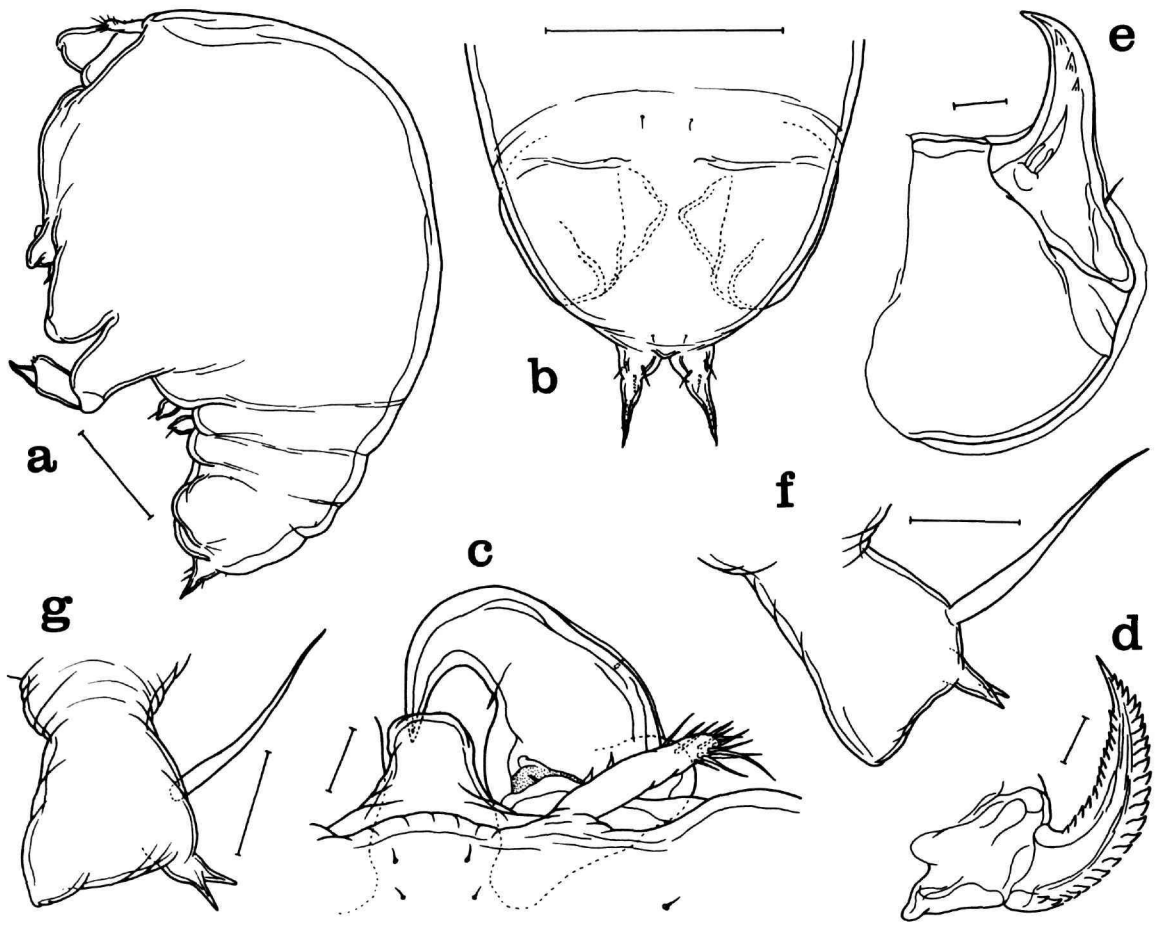

FIGURE 23.—*Chondracanthus nodosus* male: *a*, body, lateral; *b*, urosome, dorsal; *c*, first and second antennae; *d*, mandible; *e*, second maxilla; *f*, leg 1; *g*, leg 2. Scale: 0.1 mm in *a*, *b*; 0.2 mm in *c*; 0.01 mm in *d*, *e*, *f*, *g*.

indistinguishably fused with genital segment. Caudal ramus as in female.

First antenna (Figure 23*c*) elongate and cylindrical, bearing 2 stouter elements in proximal portion and 12 more slender elements in distal portion. Some specimens having one or both first antennae atrophied. Second antenna (Figure 23*c*) 2-segmented; first segment stout, bearing a small dorsal seta; second segment a recurved hook bearing 2 setae (1 inner and other outer). Rostral area protruded into a blunt lobe.

Sexual dimorphism in mouth parts occurring in mandible (Figure 23*d*) and second maxilla (Figure 23*e*), the former being different in having proportionately larger and smaller number of teeth and the latter in absence of anterior tooth and having fewer posterior teeth (about 2 to 4).

Both leg 1 (Figure 23*f*) and leg 2 (Figure 23*g*) saccular, with constriction near proximal portion. Protopod bearing a large, long, outer seta; exopod represented by a small forked lobe and endopod, a larger conical lobe.

REMARKS.—This species is similar to *C. zei* Delaroche 1811 and different from the remaining species of *Chondarcanthus* in having two pairs of trilobate legs. It can be very easily distinguished from *C. zei*, however, by the nature and number of the body processes in the trunk region and in having a pair of extremely small first antennae.

The specimens from the New England coast are somewhat smaller than those from the Greenland. The largest Greenlandian specimen measures 9.78 mm (in UZM).

An extremely doubtful structure, the so-called "conjunctive tube," was described by Leigh-Sharpe and Perkins (1924) in this species. According to them, the female embeds its head in a tumor on the gill arch and a conjunctive tube, which is bifurcate at its tip, arises from the gill arch and is attached to the vulvae of the female, with one bifurcation to each vulva. A cross section of this tube showed scattered inside certain small cells consisting almost entirely of a deeply staining nucleus with scanty cytoplasm and having two or three projections. They suggested that these cells were spermatozoa. They described small tumors on the gill arches containing "the remains of what appear to be male animals." When they traced the conjunctive tube into the tumor, they found an encapsulated male. Although they did not definitely draw a conclusion from their observations, it seems doubtful to me that the epigynic male embedded in the tumor is the one who fertilized the eggs by sending the spermatozoa down through the "conjunctive tube." If one accepts their findings and this implication, what, then, is the function of having another pygmy male attached in the vicinity of the genital segment of the female, a condition which we observe in each species of the Chondracanthidae where both sexes are known? I find that their discoveries are rather difficult to accept. It is noteworthy that of the eight females of *C. nodosus* studied by them, only one had the "conjunctive tube" connected to its vulvae and the remaining seven had no conjunctive tubes attached.

This parasite seems to occur exclusively on red fishes (*Sebastes* species) in the North Atlantic Ocean. Sindermann (1961) and Williams (1963) have studied the occurrence of *C. nodosus* on red fish of different fishing grounds in the Western North Atlantic and the Eastern North Atlantic. Both of them concluded that *C. nodosus* is a possible parasitological indicator of different stocks of red fish, since the incidence of infestation varied on different fishing grounds. As they have suggested, however, further detailed and extensive study on this matter is needed.

Chondracanthus wilsoni, new species

FIGURE 24

Chondracanthopsis nodosus (Müller).—Wilson 1935: 344.

MATERIAL STUDIED.—From USNM: 1 young female, without male attached, on gill of *Spariosoma viride*, Dry Tortugas, Florida (USNM 64013).

FEMALE.—Body (Figures 24*a*, *b*) without distinct tagmatization. Cephalosome wider than long and lacking processes. First pedigerous segment with rounded lateral surface; nearly as wide as cephalosome. Second pedigerous segment with lateral surface distinctly protruded. Remaining pedigerous segments indistinctly fused, bearing three pairs of lateral protrusions, the middle one slightly bipartite. Posterior process short and blunt. A pair of vermiform processes (with right one broken off in specimen drawn) (Figure 24*c*) located on ventral surface just in front of genito-abdomen. Genital segment (Figure 24*c*) slightly larger than abdomen which is not of usual elliptical form but squarish. Caudal ramus (Figure 24*c*) a fleshy process bearing three small spinules.

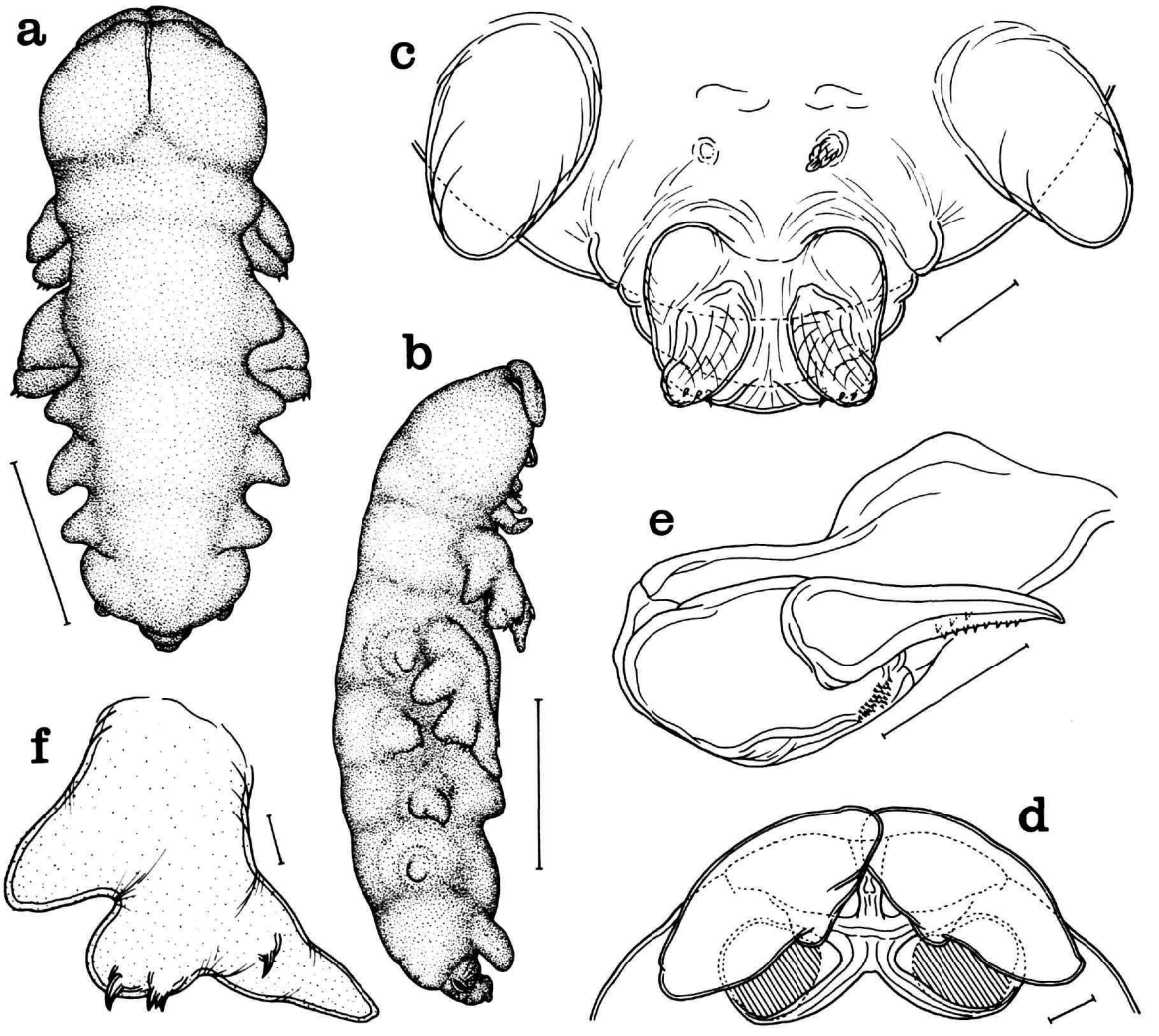

FIGURE 24.—*Chondracanthus wilsoni* female: *a*, body of holotype, dorsal; *b*, same, lateral; *c*, posterior end of body, ventral; *d*, anterior end of head, ventral; *e*, maxilliped; *f*, leg 2. Scale: 1 mm in *a*, *b*; 0.1 mm in *c*, *d*, *e*, *f*.

First antenna (Figure 24*d*) large, fleshy, and plump. Second antenna of usual form, 2-segmented, with terminal recurved hook. Maxilliped (Figure 24*e*) 3-segmented, first and second segments resembling those of *C. nodosus* but terminal claw different in having two rows (8 and 3) of hooklets. Two pairs of legs similar (Figures 24*b*, *f*), trilobate and covered with fine denticles. Protopod with large outer protrusion, exopod a rounded lobe bearing 2 spines (one of them tripartite), and endopod a longer protrusion bearing a spine on its basal portion.

MEASUREMENTS.—Body 4.23 mm; head 0.98 × 1.27 mm; genital segment 0.19 × 0.37 mm; abdomen 0.20 × 0.26 mm.

MALE.—Unknown (probably attached to right vermiform process of female and lost with it).

ETYMOLOGY.—The species is named in commemoration of Dr. Charles B. Wilson who pioneered in

studying North American parasitic copepods and discovered this parasite.

REMARKS.—Although only one young female specimen is known, it is still justifiable to recognize it as a new species, for certain features on the body are significantly different from the other known species of *Chondracanthus*. It most closely resembles *C. nodosus*, but nevertheless distinctly differs from it in having a larger, fleshy first antenna, a number of hooklets on the claw of maxilliped, and hook-like spines on the rami of both trilobate thoracic legs.

It is impossible to determine whether this only known young female has attained fully developed sets of lateral processes on the body. Although the general apearance of *C. wilsoni* is strongly reminiscent of *C. nodosus*, this young female differs from an ovigerous female of the latter in having one less pair of lateral processes in the trunk region.

This is the third known species of *Chondracanthus* that possesses trilobate, modified legs (the others being *C. zei* and *C. nodosus*).

Psuedochondracanthus hexaceraus Wilson 1935

FIGURES 25–26

Pseudochondracanthus hexaceraus Wilson 1935: 348–350, pl. 4: figs. 50–57.

Pseudochondracanthoides hexaceraus (Wilson).—Yamaguti 1963: 293, pl. 59: figs. 2a–g.

MATERIAL STUDIED.—From USNM: 3 females and 1 young female, with male attached to only one female, on *Spheroides splengleri* (Bloch), Dry Tortugas, Florida (USNM 64014, type).

FEMALE.—Body (Figures 25*a, b*) rather short and stout, with first pedigerous segment completely fused with cephalosome and distinctly separated from rest of body. Head possessing two pairs of lateral processes, with posterior pair larger and bearing surficial denticles (visible only in lactic acid under high power with oil immersion) on their distal half. Dorsal part of cephalosome with well-developed median sclerites (like an inverted Y) and slightly raised posteriorly. Trunk squarish, covered with surficial scale-like sclerotization (see Figure 25*c*), except ventromedical region; posterior corners not well-protruded. Genital segment (Figure 25*c*) bearing a suckerlike ventral depression; egg sac attachment area situated dorsolaterally. Abdomen (Figure 25*c*) very small, completely fused with genital segment. Caudal ramus (Figure 25*c*) lobular, carrying one ventral seta and one subterminal process bearing spinules.

First antenna (Figures 25*d*) fleshy, with basal portion greatly swollen, bearing 6 terminal setae. Second antenna of a typical chondracanthid form with recurved terminal segment.

Labrum (Figure 25*e*) with protruded posterior corners and smooth posterior margin. Mandible (Figure 25*f*) indistinctly 2-segmented; terminal segment falcate, armed with 23 teeth on convex side and 14 teeth on concave side. Paragnath (Figure 25*e*) a small lobe bearing fine spinules. First maxilla (Figure 25*e*) bearing 2 setae. Second maxilla (Figure 25*g*) 2-segmented; first segment robust and unarmed; second segment a bilaterally denticulated process bearing on basal portion 1 setule and 1 spiniform seta with hyaline tip. Maxilliped (Figure 25*h*) 3-segmented, short, and robust. First segment unarmed, second segment protruded at distomedial corner where it is armed with fine denticles, and terminal segment a claw without hooklet.

Leg 1 (Figure 25*i*) a large, fleshy, swollen process terminating in two small lobes (representing rami). Protopodial region carrying an outer seta.

MEASUREMENTS.—Body 1.55 mm; head 0.63 × 0.52 mm; genital segment 0.25 × 0.22 mm; abdomen 0.05 × 0.19 mm; egg sacs 0.82 mm and 0.88 mm; egg 120 μ.

MALE.—Body (Figure 26) 0.25 × 0.13 mm, with metasome strongly recurved, and indistinctly segmented. First antenna not seen; second antenna and oral appendages as in female, except usual dimorphism shown in mandible and second maxilla. Thoracic legs not seen.

REMARKS.—In his original description of this species, Wilson (1935) wrote that his material consisted of "four females, two of them with egg strings and two with attached males." However, among the four type specimens from USNM, I have found one of the two females without "egg strings" to be an immature adult (only 0.93 mm long) and the other, a slightly more mature one with eggs still held inside its trunk. Only one of the two ovigerous females carried a pygmy male; the missing male on the other female was probably removed by Wilson. I have dissected the mature female without egg sacs in order to study the oral appendages. The male was removed from its

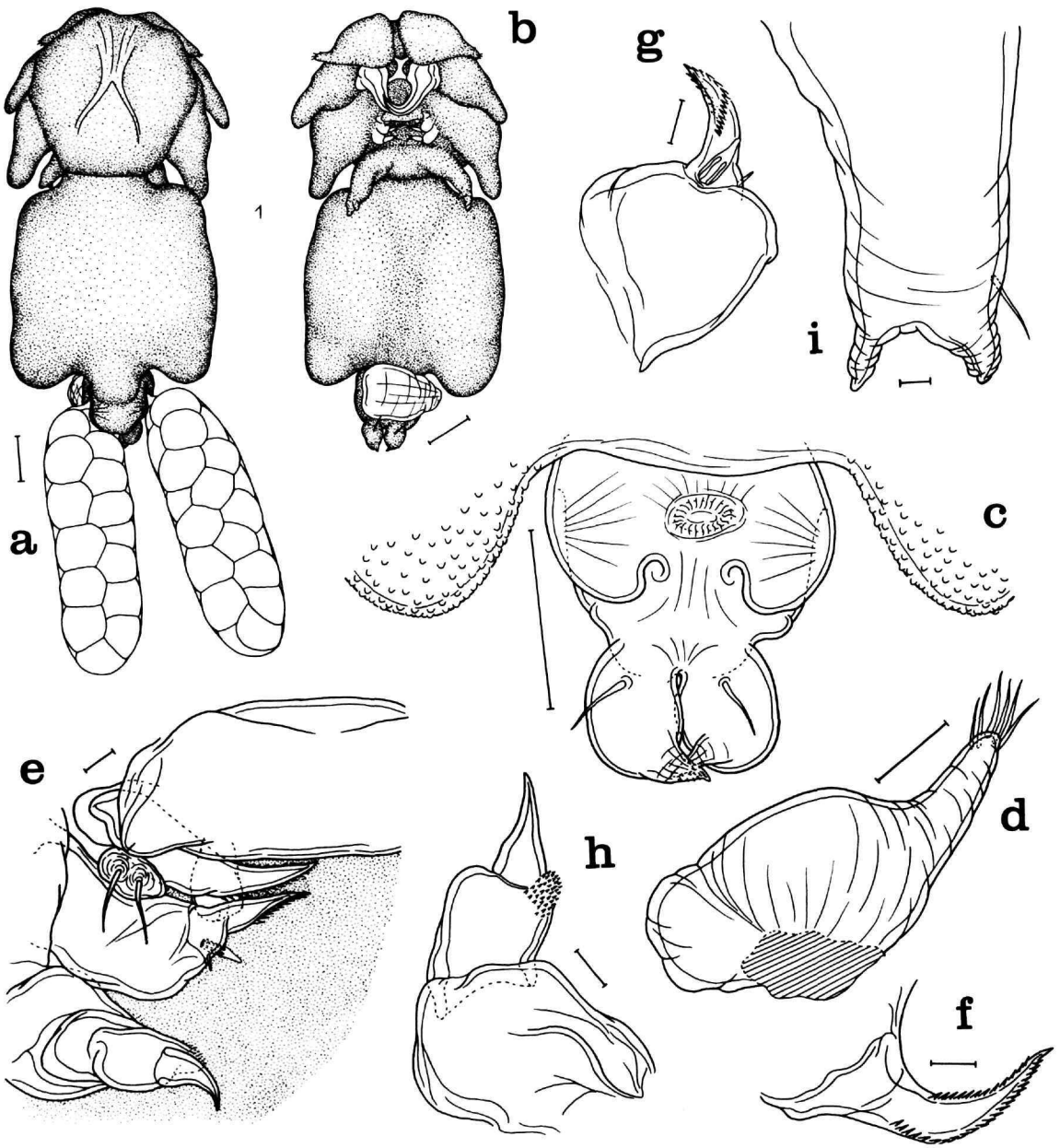

FIGURE 25.—*Pseudochondracanthus hexaceraus* female: *a*, body of syntype, dorsal; *b*, same, ventral; *c*, posterior end of body, ventral; *d*, first antenna; *e*, mouth parts, ventral; *f*, mandible; *g*, second maxilla; *h*, maxilliped; *i*, leg 1. Scale: 0.1 mm in *a*, *b*, *c*; 0.05 mm in *d*; 0.01 mm in *e*, *f*, *g*, *h*, *i*.

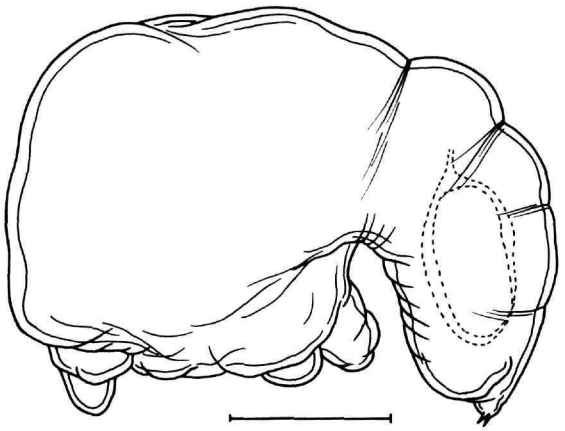

FIGURE 26.—*Pseudochondracanthus hexaceraus* male: lateral. Scale 0.05 mm.

female in order to make Figure 26, but no dissection was attempted on this only known specimen. This intact male has been returned to the original vial in the collection of USNM.

Considerable discrepancies exist between Wilson's original description and my observations. There are only two pairs of lateral processes in the head region and the Wilson's third pair is actually the modified first pair of legs. Thus the name of the species, *hexaceraus*, seems inappropriate. I was not able to find "the rudimentary legs on the free segment" as Wilson described (on p. 349) and illustrated (in fig. 57). The first antenna is not "four-segmented" in the terminal portion. The second maxilla was incorrectly described as the first maxilla and the maxilliped as the second maxilla.

Literature Cited

Barnard, K. H.

1948. New Records and Descriptions of New Species of Parasitic Copepoda of South Africa. *The Annals and Magazine of Natural History*, series 12, 1(4): 242–254, figures 1–8.

1955. South African Parasitic Copepoda. *Annals of the South African Museum*, 41(5): 223–312, figures 1–33.

Bassett-Smith, P. W.

1896. A List of the Parasitic Copepoda of Fish Obtained at Plymouth. *The Journal of the Marine Biological Association of the United Kingdom*, new series, 4: 155–163.

1899. A Systematic Description of Parasitic Copepoda Found on Fishes, with an Enumeration of the Known Species. *Proceedings of the Zoological Society of London*, pages 438–507, plate 26.

Bere, R.

1930. The Parasitic Copepods of the Fish of the Passamaquoddy Region. *Contributions to Canadian Biology and Fisheries, Being Studies from the Biological Stations of Canada*, new series, 5(13): 423–430, plates 1–2.

1936. Parasitic Copepods from Gulf of Mexico Fish. *The American Midland Naturalist*, 17(3): 577–625, plates 1–12.

Blainville, H. M. D. de

1822. Mémoire sur les Lernées (*Lernaea*, Lin.). *Journal de Physique, de Chemie, d'Histoire naturelle et des Arts*, 95: 372–380, 437–447, figures 1–17.

Brian, A.

1898. Catalogo di Copepodi Parassiti dei Pesci della Liguria. *Atti della Società Ligustica di Scienze Naturali e Geografiche*, 9: 1–31, plates 1–4.

1906. *Copepodi Parassiti dei Pesci d'Italia*. 187 pages, 21 plates, Genova.

1908. Note Préliminaire sur les Copépodes Parasites des Poissons Provenant des Campagnes Scientifiques de S. A. S. le Prince Albert I^{er} de Monaco ou Déposés dans les Collections du Musée Océanographique. *Bulletin de l'Institute Océanographique*, 110: 1–19, figures 1–7.

1912. Copépodes Parasites des Poissons et des Échinides Provenant des Campagnes Scientifiques de S. A. S. le Prince Albert I^{er} de Monaco (1886–1910). *Résultats des Campagnes Scientifiques*, 38: 1–58, plates 1–12.

1944. Copepodos Parasitos de Peces y Cetaceos del Museo Argentino de Ciencias Naturales. *Anales del Museo Argentino de Ciencias Naturales*, 41(14): 193–220, plates 1–10.

Capart, A.

1959. Copépodes Parasites. *Expédition Océanographique Belge dans les Eaux Côtières Africaines de l'Atlantique Sud (1948–1949), Résultats Scientifiques*, 3(5): 57–126, figures 1–37.

Carus, J. V.

1885. *Prodromus Faunae Mediterranae sive Descriptio Animalium Maris Mediterranei Incolarum. Pars I. Coelenterate, Echinodermata, Vermes, Arthropoda*. xiii + 524 pages. Stuttgart.

Carvalho, J. de P.

1951. Notas Sôbre Alquns Copépodos Parasitos de Peixes Marítimos da Costa do Estado de São Paulo. *Boletino do Instituto Paulista de Oceanografia*, 2(2): 135–144.

Causey, D.

1953. Parasitic Copepoda from Grand Isle, Louisiana. *Occasional Papers of the Marine Laboratory, Louisiana State University*, 7:1–18, figures 1–22.

1955a. Parasitic Copepoda from Gulf of Mexico Fish. *Occasional Papers of the Marine Laboratory, Louisiana State University,* 9: 1–19, plates 1–3.

1955b. The External Morphology of *Blias prionoti* Krøyer, a Copepod Parasite of the Sea Robins *(Prionotus). Publication of the Institute of Marine Science,* 4(1): 7–12, figures 1–7.

1960. Parasitic Copepoda from Mexican Coastal Fishes. *Bulletin of Marine Science of the Gulf and Caribbean,* 10(3): 323–337, figures 1–2.

Cuvier, G. L.

1830. *Le Règne Animal.* Nouvelle édition, volume 4, pages 255–258.

El Saby, M. K.

1933. The Internal Anatomy of Several Parasitic Copepoda. *Proceedings of the General Meetings for Scientific Business of the Zoological Society of London,* 4: 861–869, plates, 1–3.

Fowler, H. W.

1912. Crustacea of New Jersey. *Annual Report of the New Jersey State Museum for 1911,* pages 29–650.

Fraser, C. M.

1920. Copepods Parasitic on Fish from the Vancouver Island Region. *The Transaction of the Royal Society of Canada,* series 3, 13(5): 45–68, plates 1–8.

Guérin-Meneville, F. E.

1829–1844. Crustaces. *Iconographie du Règne Animal,* Volume 2.

Hansen, A. V.

1923. Crustacea Copepoda, 2. Copepoda Parasita and Semiparasita. *The Danish Ingolf-Expedition,* 3 (7): 1–92, plates 1–5.

Heegaard, P. E.

1945. Some Parasitic Copepods from Fishes in the Uppsala University Collections. *Arkiv for Zoologi,* 35A(18): 1–27, figures 1–54.

1947. Discussion of the Mouth Appendages of the Copepods. *Arkiv for Zoologi,* 40A(3): 1–8, figures 1–8.

Heller, C.

1866. Carcinologische Beiträge zur Fauna des Adriatischen Meers. *Verhandlungen der Kaiserlich-Königlichen Zoologisch-botanischen Gesellschaft in Wien,* 1: 723–760.

Ho, J. S.

1967. A New Cyclopoid Copepod (Chondracanthidae) Parasitic on the Armored Sea Robin from the Florida Straits. *The Journal of Parasitology,* 53(2): 406–411, figures 1–29.

1970. Revision of the Genera of the Chondracanthidae, a Copepod Family Parasitic on Marine Fishes. *Beaufortia, Zoological Museum of the University of Amsterdam,* 17(229): 105–218.

Holten, H. S.

1802. Anmaekninger til Beskrivelsen over *Zeus guttatus,* sant Beskrivelser over Tvende Nye Arter *Lernaeer. Skrivter af Naturistorie-Selskabet, Kjøbenhavn,* 5(2): 125–137, plate 3.

Kabata, Z.

1968. Some Chondracanthidae (Copepoda) from Fishes of British Columbia. *Journal of the Fisheries Research Board of Canada,* 25(2): 321–345, figures 1–93.

Kabata, Z., and A. V. Gusev

1966. Parasitic Copepoda of Fishes from the Collection of the Zoological Institute in Leningrad. *The Journal of the Linnean Society of London, (Zoology),* 46(309): 155–207, figures 1–176.

Krøyer, H.

1837. Om Snyltekrebsene, Isaer Med Hensyn til den Danske Fauna. *Naturhistorisk Tiddskrift, Kjøbenhavn,* 1(2): 172–208, plate 2; 1(3): 252–304, plate 3; 1(5): 475–506, plate 5; 1(6): 605–628, plate 6.

1838. Om Snyltekrebsene, Isaer Med Hensyn til den Danske Fauna. *Naturhistorisk Tiddskrift, Kjøbenhavn,* 2(1): 8–52, plate 1; 131–157, plate 3.

1863–64. Bidrag til Kundskab om Snylterkrebsene. *Naturhistorisk Tiddskrift, Kjøbenhavn,* 3(2): 75–426, plates 1–18.

Lamarck, J. B. P. de

1816. *Histoire Naturelle des Animaux sans Vertèbres.* Volume 5, 612 pages. Paris.

Leigh-Sharpe, W. H.

1933. A Second List of Parasitic Copepods of Plymouth, with a Description of Three New Species. *Parasitology,* 25(1): 113–118.

1934. A Third List of Parasitic Copepods of Plymouth, with Notes. *Parasitology,* 26(2): 112–113.

Leigh-Sharpe, W. H., and M. G. L. Perkins

1924. Some Parasitic Copepoda from Iceland, with an Account of *Peniculus clavatus,* the Conjunctive Tubes of *Chondracanthus nodosus* and the Males of *Clavella dubia. Parasitology,* 16(3): 289–295, figures 1–6.

Markewitsch, A. P.

1956. *Parasitic Copepoda of Fishes of USSR.* 259 pages, figures 1–153, (in Russian). Kiev.

Milne Edwards, H.

1840. *Histoire Naturelle des Crustacés, Comprenant l'Anatomie, la Physiologie et la Classification de ces Animaux.* Volume 3, 605 pages, plates 29–42. Paris.

Müller, O. F.

1776. *Zoologiae Danicae Prodromus, seu Animalium Daniae et Norvegiae Indigenarium Characteres, Nomina, et Synonyma Imprimis Popularium.* xxxii + 282 pages. Havniae.

1788. *Zoologia Danica, seu Animalium Daniae et Nowegiae Rariorum ac Minus Notorum, Descriptiones et Historia.* Volume 1, pages 1–52, plate 33. Havniae.

Norman, C. A. M., and T. Scott
1906. *The Crustacea of Devon and Cornwall.* 232 pages. London: William Wesley and Son.

Nunes-Ruivo, L.
1956. Copépodes Parasites de Peixes dos Mares de Angola. Trabalhos da Missao de Biologia Maritima. *Anais da Junta de Investigações do Ultramar, Lisboa,* 9(2): 1–45, plates 1–7.

Oakley, C. L.
1930. The Chondracanthidae (Crustacea: Copepoda); with a Description of Five New Genera and One New Species. *Parasitology,* 22(2): 182–201, figures 1–8.

Oken, L.
1815–16. *Lehrbuch Naturgescrichte, (3, Zoologie).* Volume 2, pages 181 and 357.

Olsson, P.
1868–69. Prodromus Faunae Copepodorum Parasitantium Scandinaviae. *Acta Universitatis Lundensis, Lunds Universitets Ars-Skrift for Ar 1868, III, Afdelningen for Mathematik och Naturvetenskap,* 8: 1–49.

Oorde-de Lint, G. M. van, and J. H. Schuurmans Stekhoven, Jr.
1936. Copepoda Parasitica. *Die Tierweit der Nord und Ostesee,* 31(10c): 73–197.

O'Riordan, C. E.
1966. Parasitic Copepods in the Collections of the National Museum of Ireland. *Proceedings of the Royal Irish Academy,* 64B(20): 371–378.

Pearse, A. S.
1947. Parasitic Copepods from Beaufort, North Carolina. *Journal of the Elisha Mitchell Scientific Society,* 63(1): 1–16, figures 1–51.
1952a. Parasitic Crustaceans from Alligator Harbor, Florida. *The Quarterly Journal of the Florida Academy of Sciences,* 15(4): 187–243, figures 1–143.
1952b. Parasitic Crustaceans from the Texas Coast. *Publication of the Institute of Marine Science,* 2(2): 5–42, figures 1–157.

Pesta, O.
1934. Krebstiere Oder Crustacea, I. Ruderfusser Oder Copepoda. 4. Monstrilloida; 5. Notodelphyoida; 6. Caligoida; 7. Lernaeoida. *Die Tierwelt Deutschlands und der Angrenzenden Meeresteile nach Ihrem Merkmalen und nach Iher Lebenswise,* part 29, 68 pages, figures 1–42.

Rathbun, R.
1886. Descriptions of Parasitic Copepoda Belonging to the Genera *Pandarus* and *Chondracanthus. Proceedings of the United States National Museum,* 9: 310–324, plates 5–11.

Richiardi, S.
1880. Contribuzione alla Fauna d'Italia. I. Catalogo Sistematico dei Crostacei che Vivono sul Corpo Degli Animali Acquatici. *Catalog Degli Espositori e delle Cose Esposte, Espozitione Internazionale di Pesca in Berlino,* pages 147–152. Pisa.

Rose, M., and R. Vaissière
1952. Catalogue Préliminaire des Copépodes de l'Afrique du Nord. *Bulletin de la Société d'Histoire Naturelle de l'Afrique du Nord,* 43: 164–176.

Schimkewitsch, W.
1896. Studien über Parasitische Copepoden. *Zeitschrift für Wissenschaftliche Zoologie,* 61(3): 339–362, plates 14–16.

Scott, T.
1892. Additions to the Fauna of the Firth of Forth. *Tenth Annual Report of the Fishery Board for Scotland, Part III, Scientific Investigations,* pages 244–272, plates 7–13.
1900. Notes on Some Crustacean Parasites of Fishes. *Eighteenth Annual Report of the Fishery Board for Scotland, Part III, Scientific Investigations,* pages 144–188, plates 5–8.
1906. A Catalogue of Land, Fresh-water, and Marine Crustacea Found in the Basin of the River Forth and Its Estuary. *Proceedings of the Royal Physical Society of Edinburgh,* 16: 97–190, 267–386.
1909. Some Notes on Fish Parasites. *Twenty-sixth Annual Report of the Fishery Board for Scotland, Part III, Scientific Investigations,* pages 73–92, plate 3.

Scott, T., and A. Scott
1913. *The British Parasitic Copepoda.* Ray Society, London, volume 1, pages 1–152; volume 2, plates 1–72.

Sindermann, C. J.
1961. Parasitological Tags for Redfish of the Western North Atlantic. *International Commission for the Northwest Atlantic Fisheries, Special Publication* No. 3, pages 111–117.

Stephensen, K.
1913. Grønlands Krebsdyr og Pycnogonider (Conspectus Crustaceorum et Pynogonidorum Groenlandiae). *Meddelelser om Grønland,* 22: 335–351.

Stock, V.
1915. On Some of the Parasitic Copepods of the Bay of Fundy Fish. *Contributions to Canadian Biology, Being Studies from the Marine Biological Stations of Canada, 1911–1914, Marine Biology,* 1: 69–71.

Stossich, M.
1880. Prospetto della Fauna del Mare Adriatico. Parte III. Class V. Crustacea. *Bolletino della Società Adriatica di Scienze Naturali in Trieste,* 6(1): 178–271.

Stuardo, J., and E. Fagetti
1960. Copepodos Parásitos Chilenos. II. Estudio Preliminar de los Copépodes Parásitos de *Merluccius gayi gayi* en la Bahía de Valparaíso. *Revista de Biologia Marina,* 10(1–3): 195–200.

Szidat, L.
1955. La Fauna Parásitos de *"Merluccius hubbsi"* como Caracter Auzilliar para la Solucion de los Problemas Sistematicos y Zoogeograficos del Genero

"Merluccius" L. *Comunicaciones del Instituto Nacional de Investigacion de la Ciencias Naturales. Museo Argentino de Ciencias Naturales "Bernardino Rivadavia,"* 3(1): 1–54.

1961. Versuch Einer Zoogeographie des Süd-Atlantik mit Hilfe von Leitparasiten der Meeresfische. *Parasitologische Schriftenreihe,* 13: 1–58, figures 1–54.

Valle, A.

1880. Crostacei Parassiti dei Pesci del Mare Adriatico. *Bolletino della Società Adriatica di Scienze Naturali in Trieste,* 6(1): 55–90.

Williams, I. C.

1963. The Infestation of the Redfish *Sebastes marinus* (L.) and *S. mentella* Travin (Scleroparei: Scorpaenidae) by the Copepods *Peniculus clavatus* (Müller), *Sphyrion lumpi* (Krøyer) and *Chondracanthopsis nodosus* (Müller) in the Eastern North Atlantic. *Parasitology,* 53(3/4): 501–525, figures 1–3.

Wilson, C. B.

1908. North American Parasitic Copepods: A List of Those Found Upon the Fishes of the Pacific Coast, with Description of New Genera and Species. *Proceedings of the United States National Museum,* 35: 431–481, plates 46–83.

1912. Parasitic Copepods From Nanaimo, British Columbia, Including Eight Species New to Science. *Contributions to Canadian Biology, Being Studies from the Marine Biological Stations of Canada, 1906–1910, Marine Biology,* 9: 85–101, plates 3–9.

1918. *Chondracanthus chilensis* a New Species of Parasitic copepod. *Anales de Zoologia Aplicada,* 5(1): 11–15, figures 1–6.

1920. Report on the Parasitic Copepoda Collected During the Canadian Arctic Expedition, 1913–18. *Report of the Canadian Arctic Expedition,* volume 7: *Crustacea,* Part L: 3L–16L.

1923a. New Species of Parasitic Copepods from Southern Africa. *Meddelanden fran Göteborgs Musei Zoologiska Avdelning,* 19: 1–12, plates 1–2.

1923b. Parasitic Copepods in the Collection of the Riksmuseum at Stockholm. *Arkiv for Zoologi,* 15A(3): 1–15, plates 1–2.

1932. The Copepods of the Woods Hole Region, Massachusetts. *United States National Museum Bulletin,* 158: 1–635, figures 1–316, plates 1–41.

1935. Parasitic Copepods from the Dry Tortugas. *Papers from Tortugas Laboratory,* 29: 329–347, plates 1–6.

Yamaguti, S.

1963. *Parasitic Copepoda and Branchiura of Fishes.* vii + 1104 pages, plates 1–333. New York, London, Sydney: Interscience Publishers.

Index

[Names of new species in italics]

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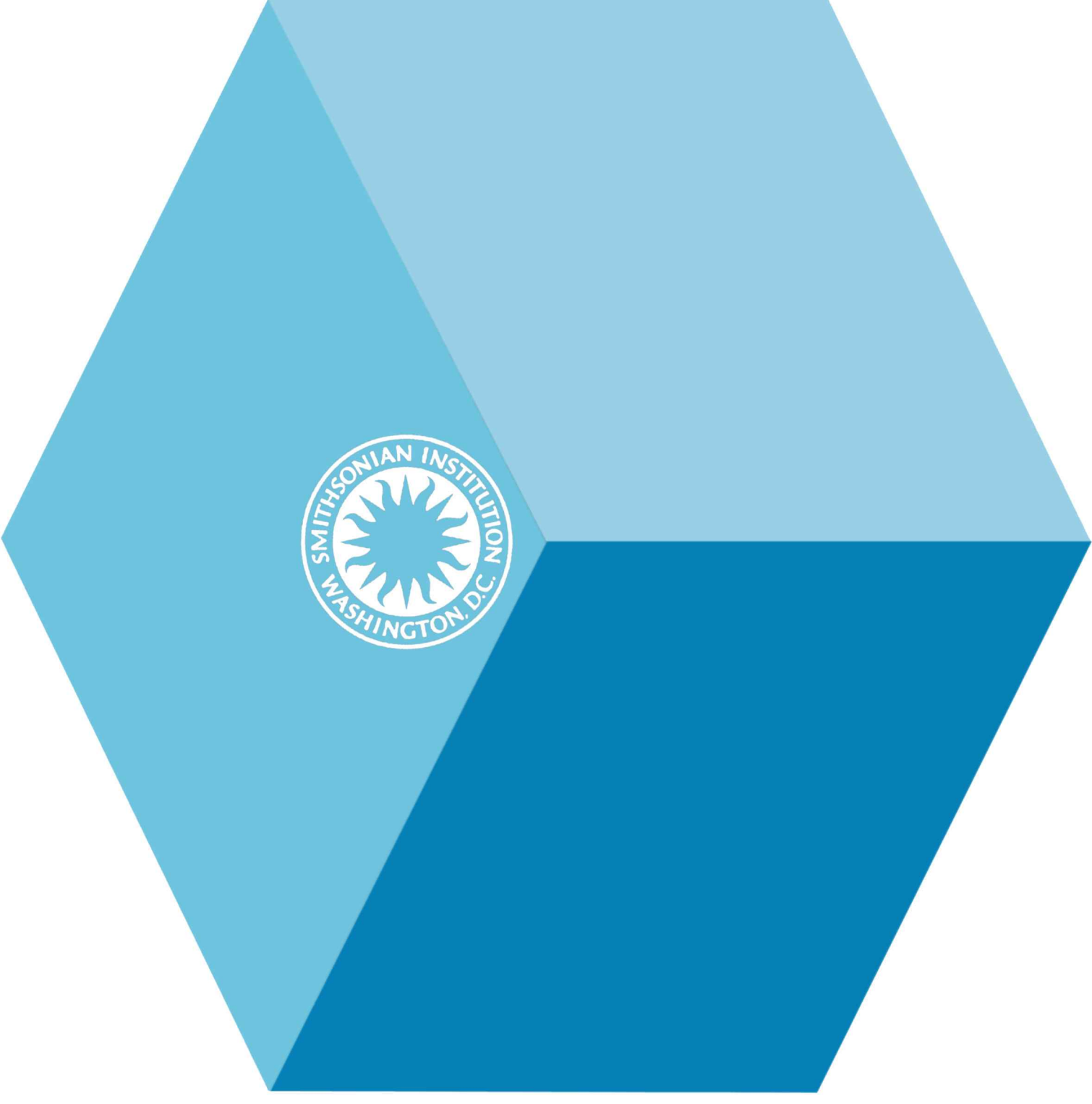
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