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PLANKTONIC COPEPODS FROM BAHÍA FOSFORESCENTE, PUERTO RICO, AND ADJACENT WATERS

By Juan G. González and Thomas E. Bowman[1]

Beginning in the fall of 1957, an investigation of the plankton along the southwestern coast of Puerto Rico, from Bahía Montalva on the east to Posa de Don Eulalio on the west, was carried out by Dr. Robert E. Coker and Juan G. González. A map of the area showing the stations at which plankton samples were collected routinely for 2 years is given in figure 1. A description of the region, together with an account of the methods of collection and an analysis of the climatic and hydrographic conditions, is given by Coker and González (1960) in their ecological study of the copepod populations. The present paper is a taxonomic treatment of the planktonic copepods and is limited to the species that occur regularly in the bays and the inner

[1] González: Institute of Marine Biology, University of Puerto Rico, Mayagüez; Bowman: Associate Curator, Division of Crustacea, Smithsonian Institution.

part of the shelf. Offshore species that occasionally are carried into the inner shelf and bays are not included.

In the descriptions that follow we use the terms employed by Gooding (1957) for regions of the copepod body and the following abbreviations:

A1–A2	antennae 1–2
Md	mandible
Mx1–Mx2	maxillae 1–2
Mxp	maxilliped
P1–P5	swimming legs 1–5
Re, Re1–Re3	exopod, exopod segments 1–3
Ri, Ri1–Ri3	endopod, endopod segments 1–3
B1–B2	basipod segments 1–2
PedSeg 1–PedSeg 5	pedigerous segments 1–5

For most species the synonomies given are limited to those recording occurrences along the Atlantic coasts of North and South America. For a few species we have thought it useful to give full synonomies and more complete descriptions. Only western Atlantic distribution records are given in detail for widely distributed species.

This study was initiated by Dr. Robert E. Coker, and his advice and encouragement have been most helpful. Dr. Friedrick Kiefer kindly examined specimens of *Oithona hebes* for us and compared them with Brazilian specimens that he had earlier described, and Dr. Harry Yeatman read the section on *Longipedia helgolandica* and has permitted us to cite his records for this species.

Order Calanoida

Family Paracalanidae

Head and PedSeg 1, PedSegs 4 and 5 fused. Male head with small middorsal protuberance. Rostrum with 2 usually filiform appendages. Anal segment long. A1 23–25-segmented in female, with fewer segments in male. Ri of A2 longer than Re. Mouthparts reduced in male. Re of P1–P4 3-segmented, Ri of P1 2-segmented, Ri of P2–P4 3-segmented. Ri of P1–P4 often with spinules on posterior surfaces. Re3 of P1–P4 with 2 outer spines and 5 inner setae; terminal spine not serrate. Female P5 very small, sometimes absent, uniramose, composed of 2 short segments; left P5 of male 5-segmented, much longer than right.

Bernard (1958) removed *Calocalanus* from the Paracalanidae to the new family Calocalanidae. Only 2 genera remain in the Paracalanidae, and they may be distinguished as follows:

Acrocalanus Giesbrecht	*Paracalanus* Boeck
Re2 of P2–P4 with spinulose outer margins	Outer margins smooth
Proximal part of outer margin of Re3 of P2–P4 less than twice as long as distal part	Proximal part nearly or more than twice as long as distal part
Female P5 absent	Female P5 2-segmented, distal segment with 2 unequal terminal setae

Two species of *Acrocalanus* occur in the Atlantic Ocean (Bowman, 1958), but both are oceanic species and are not found in the inshore waters of Puerto Rico. The 3 species of *Paracalanus* that occurred in our collections are considered below.

Key to Females of Local Species of *Paracalanus*

1. Very small species, usually less than 0.5 mm. long; rostral filaments thick and blunt; terminal setae of P5 short and stout . . . . . . **crassirostris**
   Larger species, usually more than 0.75 mm. long; rostral filaments filiform; medial terminal seta of P5 long and slender 2
2. A1 longer than body; B1 of P3–P4 without surface spinules . . . **aculeatus**
   A1 shorter than body; B1 of P3–P4 with surface spinules . . . . . **parvus**

In our collections, *P. crassirostris* is one of the 2 most common calanoids, especially in the bays. *P. parvus* is common, more consistently on the inner shelf than in the bays. *P. aculeatus* rarely occurs in inshore waters and may be characterized as an offshore species.

Paracalanus aculeatus Giesbrecht

FIGURES 2*a–e*

Paracalanus aculeatus Giesbrecht, 1888, p. 332; 1892, pp. 164, 169–170, pl. 9, figs. 20, 26, 30.—Dahl, 1894, pl. 21.—Cleve, 1900, pp. 78–80.—Farran, 1929, p. 222.—Davis, 1950, p. 93 (table).—Carvalho, 1952, pp. 142–143, pl. 1, figs. 11–12.—Wickstead, 1956, pp. 8–9.—Grice, 1960a, p. 220.—Légaré, 1961, table 5.—Zoppi, 1961, table 4.—Breuer, 1962, p. 167.—Cervigón, 1962, p. 183.—Grice and Hart, 1962, p. 293.—Fish, 1962, pp. 10–11.—Björnberg, 1963, pp. 25–26.

FEMALE.—Length 1.02–1.08 mm. Prosome:urosome = 3.5–3.8. Head rather vaulted, rostral filaments filiform. Prosome without dorsal hump. Innermost caudal seta more than twice as long as caudal ramus. A1 longer than body. Third lobe of B1 of Mxp with 3 setae. P2–P4, B1 without surface spinules; Ri2 with prominent spinules on posterior surface. Re2 of P4 with row of rather broad, blunt, thin-walled spinules on posterior surface. Inner terminal spine of P5 2.5–3.0 times as long as outer terminal spine, considerably longer than distal segment.

MALE.—Not found in our collections.

DISTRIBUTION.—A circumtropical species. Along the Atlantic coast of the United States it is a common offshore species in waters south of Cape Hatteras (unpublished data from M/V *Theodore N. Gill* collections). North of Cape Hatteras it is present in the Gulf Stream (Cleve, 1900; Grice and Hart, 1962) but not in coastal or shelf water since it was not reported by Bigelow and Sears (1939), Deevey (1952a, 1952b, 1956, 1960), or Cronin, Daiber, and Hulbert (1962). In the South Atlantic it occurs south of the latitude of Rio de Janeiro (Farran, 1929; Björnberg, 1963). Cleve (1900) recorded it from several localities along South America between Trinidad and French Guiana. Throughout its range it is found typically in offshore rather than coastal waters. In the Puerto Rican collections it is very rare in inshore waters, but fairly common offshore.

Paracalanus crassirostris F. Dahl

FIGURES 2*f–n*, 3*a*

Paracalanus crassirostris F. Dahl, 1894a, p. 12, pl. 1, figs. 27, 28—Thompson and Scott, 1903, p. 243.—Giesbrecht and Schmeil, 1898, p. 24.—Sewell, 1929, pp. 72–76, fig. 27.—Pesta, 1916, p. 4.—Gurney, 1927, pp. 144–147, figs. 16B–D, 17A–E.—Deevey, 1948, pp. 21–22; 1952a, p. 92; 1952b, p. 144, fig. 13; 1956, p. 134; 1960, p. 29.—Davis, 1950, p. 93 (table).—Davis and Williams, 1950, pp. 521, 523 (tables).—Grice, 1956, p. 62 (ftn.); 1960a, p. 223.—Breuer, 1962, p. 167.—Jeffries, 1962, passim.—Björnberg, 1963, p. 28.—Cuzon du Rest, 1963, passim.

Paracalanus crassirostris f. *typica* Früchtl, 1923, p. 456; 1924, pp. 36–39.

FEMALE.—Length 0.47–0.50 mm. Prosome:urosome = 3.2–3.5. Head rather low; forehead somewhat produced; rostral filaments thick and blunt, not filiform. Innermost caudal seta more than twice as long as caudal ramus. A1 nearly as long as body. Third lobe of B1 of Mxp with 2 setae. P2–P4 as in figures 2*j–l*; surface armature poorly developed; no surface spinules on B1 and B2. P5 short; terminal setae short and stout.

MALE.—Length 0.35–0.37 mm. Prosome:urosome = 3.2. Prosome relatively shorter than in female; forehead less produced; rostrum triangular. A1 about as long as prosome, with fewer segments than in female. P1–P4 as in female. P5 with short terminal setae.

DISTRIBUTION.—Mouth of Tocantin River, Brazil (Dahl); Brazil coast (Björnberg); Indian Ocean, several localities (Früchtl, Sewell, Thompson and Scott); Suez Canal (Gurney); Tisbury Great Pond, Martha's Vineyard; Long Island Sound; Delaware Bay (Deevey); Raritan Bay (Jeffries); Florida coast (Davis, Davis and Williams, Grice); Louisiana (Cuzon du Rest). The species appears to be limited mainly to tropical and subtropical coastal waters, frequently in brackish water. It is widespread in coastal waters of the Indian Ocean but has not been found in the coastal waters of Japan although the latter have been thoroughly investigated (summary in Yamazi, 1956). It has not been reported from the Mediterranean or eastern Atlantic.

Collections made during the 1959 and 1960 Smithsonian-Bredin Expeditions indicate that *P. crassirostris* is probably widespread in suitable inshore localities in the Caribbean. Specimens were collected at the following localities: Man of War Bay, Tobago; Marigot Bay and Castries Harbor, Saint Lucia; Progresso, Yucatan.

Remarks.—The minute size, blunt rostral filaments, and short terminal setae of P5 will serve to identify *P. crassirostris*. Davis (1944) described *P. c.* var. *nudus* from Chesapeake Bay, characterized as follows:

1. Surface armature of P1–P4 reduced, limited to Ri2 of P3 and P4, which are similar to Ri2 of the Puerto Rican specimens.
2. Last 2 segments of A1 equal in length. The validity of this criterion is doubtful since it appears from the arrangement of the setae that the narrow terminal segment is missing in Davis' drawing (pl. 1, fig. 5) although this segment is shown in his lateral view of the female (pl. 1, fig. 4). A1 has 24 segments in both drawings, but in figure 5 the long basal segment is shown as divided into 2 segments. In Puerto Rican specimens the basal segment usually is not divided, but a suture is occasionally present, in which case A1 is 25-segmented.
3. The terminal segment of P5 is relatively long.

Puerto Rican specimens show more resemblance to those described by Gurney (1927) from the Suez Canal than to Davis' *P. c.* var. *nudus*. Specimens examined from off Cape Kennedy, Fla., are indistinguishable from Puerto Rican specimens. Deevey's (1948) specimens from Tisbury Great Pond agreed in all respects with Gurney's description and not with *P. c.* var. *nudus*.

Paracalanus parvus (Claus)

Figures 3*b–i*

Calanus parvus Claus, 1863, pp. 173–174, pl. 26, figs. 10–14; pl. 27, figs. 1–4.

Paracalanus parvus (Claus).—Boeck, 1865, pp. 232–233.—Cleve, 1900, pp. 80–81.—Farran, 1929, pp. 221–222.—Wilson, 1932a, p. 26; 1932b, pp. 38–39, fig. 21.—Vervoort, 1946, pp. 130–132 [literature and synonomy].—Bigelow and Sears, 1938, pp. 336–337, fig. 34.—Oliveira, 1945, p. 455, pl. 3, fig. 5; pl. 4, figs. 3–6; 1947, p. 459, fig. 8.—Carvalho, 1945, pp. 93–94, pl. 7, fig. 4; 1952, pp. 143–144, pl. 1, figs. 13–14.—Sutcliffe, 1948, p. 235.—Davis, 1950, p. 204 (table).—King, 1950, p. 128 (table).—Deevey, 1952a, p. 92; 1952b, pp. 142–144, fig. 13; 1960, p. 29, figs. 8, 11.—Grice, 1956, pp. 62–64; 1960, p. 223; 1962a, p. 287, passim.—Woodmansee, 1958, pp. 253–254.—Légaré, 1961, table 5.—Zoppi, 1961, table 4.—Breuer, 1962, p. 167.—Cronin, Daiber, and Hulbert, 1962, p. 87.—Björnberg, 1963, pp. 27–28.—Reeve, 1964, passim.

Scolecithrix ancorarum Oliveira, 1947, pp. 460–461, pl. 3, figs. 1–8.

FEMALE.—Length 0.73–0.93 mm. Prosome:urosome = 2.8–3.2. Head moderately high, rostral filaments filiform. Prosome usually with distinct dorsal hump in region of Mx1. Innermost caudal setae only half as long as caudal ramus. A1 nearly as long as body. Third lobe of B1 of Mxp with 2 setae. B1 of P3 and P4 with lateral rows of spinules and surface spinules as shown in figure. Inner terminal spine of P5 5–6 times as long as outer terminal spine, only a little longer than distal segment.

MALE.—Length 0.76–0.78 mm. Prosome:urosome = 2.3–2.5. Head not as flat as in female. Spinules on B1 of P3 and P4 reduced or missing. P5 as in figure 3*i*.

DISTRIBUTION.—Worldwide, in tropical, temperate, and sometimes Arctic seas, usually in coastal waters.

Oliveira's (1947) *Scolecithrix ancorarum* is obviously a *Paracalanus*. The size (1 mm.) and thin rostral filaments rule out *P. crassirostris*. The short antennae and the presence of spinules on B1 of P4 place it in *P. parvus* rather than *P. aculeatus*.

Family Pseudocalanidae

Small calanoids, head and PedSeg 1 (at least in female), PedSegs 4 and 5 fused. Innermost and outermost caudal setae very short, 4 subequal terminal setae. A1 24-segmented in female, with fewer segments in male. Re of A2 longer than Ri. Mouthparts reduced in male. Re of P1–P4 3-segmented, Ri of P1 1-segmented, Ri of P2 2-segmented, Ri of P3–P4 3-segmented. Re3 of P2–P4 with 3 outer spines and 4 inner setae, terminal spine serrate. Female P5 very small or absent, uniramose, composed of 2–3 short segments; right male P5 5-segmented, left P5 shorter.

Genus *Clausocalanus* Giesbrecht

Rostral filaments spiniform in female, atrophied in male. B2 of P2 and P3 very wide, distal margin dentate. Female P5 3-segmented, without setae, distal segment bifurcate at tip. Male left P5 long, 5-segmented, right P5 minute, 1–3-segmented.

Clausocalanus furcatus (Brady)

FIGURES 3*j*–*k*, 4*a*

Drepanopus furcatus Brady, 1883, pp. 77–78, pl. 4, figs. 1, 2; pl. 24, figs. 12–15.

Clausocalanus furcatus (Brady).—Giesbrecht, 1888, p. 334; 1892, pp. 186–194, pl. 36, figs. 32, 33, 35.—Dahl, 1894, p. 12.—Cleve, 1900, pp. 56–57.—Farran, 1929, pp. 225–226.—Davis, 1950, p. 92 (table).—Wilson, 1950, p. 190.—

Carvalho, 1952, p. 144, pl. 1, figs. 15–17.—Wickstead, 1956, pp. 10–11.—Grice, 1960, p. 220.—Grice and Hart, 1962, passim.—Légaré, 1961, table 5.—Zoppi, 1961, table 4.—Breuer, 1962, p. 167.—Cervigón, 1962, pp. 183–184.—Björnberg, 1963, pp. 31–33, fig. 16.

FEMALE.—Length 1.1–1.6 mm. Prosome:urosome = about 2.5. Head not vaulted, rostral filaments very slightly curved posteriad. Genital segment shorter than 2d or 3d urosome segments; spermathecae highly refractile and conspicuous. Caudal rami nearly twice as long as broad. A1 segments 4, 6, 8, 18, and 22 each with 1 aesthete.

MALE.—Length 1.1–1.2 mm. Urosome segment 2 shorter than segments 3 and 4 combined. Left P5 unisegmental.

DISTRIBUTION.—Worldwide in warm waters. In the western Atlantic it has been found from south of Montauk Point, Long Island (40°44′ N., 71°41′ W., Grice and Hart, 1962) to off Mar del Plata, Argentina (Farran, 1929). It is an oceanic species, found only rarely in our collections.

Family Centropagidae

None of prosome segments fused. Female A1 24–25-segmented; one of male A1 prehensile. Male mouthparts not reduced. Re and Ri of P1–P4 3-segmented in marine genera. Female P5 biramous, natatory, right Re2 produced mediad into strong spine. Male P5 biramous, Ri well developed and bearing setae, right P5 stronger.

Genus *Centropages* Krøyer

Urosome 3-segmented, genital segment often asymmetrical. A1 24-segmented. Re of A2 longer than Ri. Distal setae of Mx2 long, robust, sparsely armed with setules. Re3 of P4 with 3 outer spines. Re of left male P5 2-segmented; Re of right male P5 3-segmented, Re2 and Re3 together forming a claw.

Centropages furcatus (Dana)

FIGURES 4*b–g*

Catopia furcata Dana, 1849, p. 25; 1852, pp. 1173–1174, pl. 79, figs. 1a–d.
Centropages furcatus (Dana).—Cleve, 1900, p. 52.—Foster, 1904, p. 73.—Farran, 1929, p. 255.—Bigelow and Sears, 1939, p. 345 [*furcata*].—Wilson, 1942, p. 177; 1950, pp. 186–187.—Carvalho, 1945, p. 95, pl. 7, fig. 6; 1952, p. 145.—Davis, 1950, p. 92 (table).—King, 1950, p. 128 (table).—Wickstead, 1956, p. 12.—Grice, 1956, pp. 52–53; 1960, p. 224.—Grice and Hart, 1962b.—Légaré, 1961, table 5.—Zoppi, 1961, table 4.—Breuer, 1962, p. 167.—Cervigón, 1962, p. 184.—Fish, 1962, p. 15.—Björnberg, 1963, pp. 42–43, fig. 23.
Manaia vilificata Oliveira, 1947, pp. 466–467, fig. 10 (text), pl. 6, figs. 1–9.

FEMALE.—Length 1.6–1.7 mm. Prosome rather narrow. Ventral eye strongly produced. PedSeg 5 symmetrical, produced on either side into long point; on rounded medial to each point is shorter spine. Genital segment produced into triangular lobes on either side and into rounded ventral lobe on right side. Anal segment twice as long as preceding segment. Right caudal ramus very slightly longer and wider than left. A1 slightly longer than body; anterior margins of segments 1, 2, and 5 produced into sharp teeth. P5 as in figures 4*e–f*.

MALE.—Length 1.2–1.3 mm. Segments 15–16 of prehensile antenna with very small teeth on anterior margin. P5 as in figure 4*g*.

DISTRIBUTION.—Circumtropical. In the western Atlantic from the Gulf Stream offshore from Chesapeake Bay (Grice, 1962a, 1962b, station II) to the south of Rio de Janeiro. It is rare in the area of the Puerto Rican study but is common farther offshore. On the 1959 Smithsonian-Bredin Expedition it was collected at Man of War Bay, Tobago; Marigot Bay, Saint Lucia; and Prince Rupert Bay, Dominica. Oliveira's (1947) *Manaia velificata* is clearly an immature *Centropages furcatus*.

Family Temoridae

Head and PedSeg 1 separate, PedSegs 4 and 5 fused or free. Urosome 3-(rarely 4-)segmented in female, 5-segmented in male. A1 24–25-segmented; right A1 of male prehensile. Ri of P1–P4 with less than 3 segments. P5 uniramous in both sexes.

Genus *Temora* Baird

Body short and compact; head much higher than posterior prosome. PedSegs 4 and 5 fused. Female urosome 3-segmented. Head with 2 delicate rostral filaments. Caudal rami long and narrow, sometimes asymmetrical. A1 24-segmented. Ri of A2 7-segmented, only slightly longer than Re. Re of P1–P4 3-segmented; Ri 2-segmented. Female P5 3-segmented. Male P5 very asymmetrical; left P5 longer, 4-segmented, Ri represented by medial process of B2 forming chela with 4th segment; right P5 3-segmented.

Temora stylifera (Dana)

FIGURES 4*h–k*

Calanus stylifera Dana, 1849, p. 13.

Temora stylifera (Dana).—Giesbrecht, 1892, pp. 328–338, pl. 17, figs. 1, 2, 4–13, 19, 22; pl. 38, figs. 26, 29.—Dahl, 1894, p. 12.—Cleve, 1900, p. 88.—Farran 1929, pp. 257–258.—Wilson, 1932b, p. 104, fig. 69; 1942, p. 209; 1950, p. 343, pl. 34, fig. 526.—Bigelow and Sears, 1939, p. 345.—Carvalho, 1945, p. 97, pl. 8, figs. 9a–c; 1952, pp. 147–148, pl. 1, figs. 28–32.—Oliveira, 1945, p. 455.—Davis, 1950, p. 94 (table).—King, 1950, p. 128 (table).—Deevey, 1952a, p. 90; 1952b, pp. 131 (table), 147; 1960, p. 33.—Grice, 1960a, p. 220

(table).—Grice and Hart, 1962a, passim; 1962b.—Wickstead, 1956, pp. 13–14.—Légaré, 1961, table 5.—Zoppi, 1961, table 4.—Breuer, 1962, p. 167.—Cervigon, 1962, p. 184.—Fish, 1962, pp. 15–16.—Björnberg, 1963, pp. 46–48, fig. 25.

FEMALE.—Length 1.4–1.9 mm. Posterior corners of PedSeg 5 produced into long, ventrally curving points. Caudal rami symmetrical. Caudal setae nearly as long as rami; left next-to-innermost seta longer than right. B1 of P1 with inner seta. Medial spine of P5 much longer than apical spines.

MALE.—Length 1.4–1.6 mm. Prehensile A1 with combs of spinules on segments 17-19. Re of left P2 2-segmented, of right P2 3-segmented. Terminal segment of left P5 very broad.

DISTRIBUTION.—Although it has been taken near Cape Sable, Nova Scotia (Bigelow, 1926, p. 307), *T. stylifera* is not common north of Delaware Bay. It is abundant in coastal waters south of Cape Hatteras and in the Gulf of Mexico. It is widespread in the Caribbean and along the coast of South America at least as far south as Guaratúba Bay, Brazil (Carvalho, 1945; Björnberg, 1963). In our collections it was taken occasionally in the shelf area but not in the bays.

REMARKS.—PedSeg 5 is pointed in only 2 species of *Temora*, *T. stylifera* and *T. discaudata*, and the latter species is distinguished readily by its asymmetrical caudal rami. Moreover, the 2 species are probably allopatric, with *T. stylifera* limited to the Atlantic and *T. discaudata* to the Indo-Pacific. Pacific records of *T. stylifera* given by Wilson (1942, 1950) are erroneous; all Pacific specimens in the U.S. National Museum identified by Wilson as *T. stylifera* are actually *T. discaudata*. Other Pacific accounts of *T. stylifera* are either unillustrated records in faunal works or misidentifications. Mori's (1937) illustrations of *T. stylifera* are of an immature female because the posterior corners of the cephalosome are produced into points and the distal segment of P5 is shorter than in the adult. Undoubtedly the symmetrical anal segment and caudal rami led Mori to misidentify this immature *T. discaudata*.

Chiba (1953a) described the male *T. stylifera* from the Sea of Japan, but his drawing of P5 clearly places his specimens in *T. discaudata*. Later in the same year (1953b) he again described the male *T. stylifera*, but the specimen illustrated was immature, with short caudal rami and incompletely developed P5, and was doubtless a young *T. discaudata*.

Temora turbinata (Dana)

FIGURES 5*a–e*

Calanus turbinatus Dana, 1849, p. 12.

Temora turbinata (Dana).—Giesbrecht, 1892, pp. 329, 336–338, pl. 17, figs. 14, 17, 18, 21; pl. 38, fig. 27.—Cleve, 1900, p. 88.—Wilson, 1932a, p. 33;

1932b, pp. 106–107, fig. 71.—Sutcliffe, 1948, p. 235.—Davis, 1950, p. 94 (table).—King, 1950, p. 128 (table).—Deevey, 1952a, p. 90; 1952b, p. 131 (table); 1960, p. 16 (table).—Grice, 1956, pp. 66–67; 1960a, p. 223.—Grice and Hart, 1962b.—Légaré, 1961, table 5.—Zoppi, 1961, table 4.—Breuer, 1962, p. 167.—Cervigón, 1962, p. 184.—Reeve, 1964, passim.

Female.—Length 1.1-1.3 mm. Posterior corners of PedSeg 5 rounded. Anal segment shorter than preceding segment, slightly asymmetrical. Right caudal ramus slightly longer than left, next-to-innermost caudal setae swollen at base, especially the right seta. P5 as in figure 5*d*.

Male.—Length 1.0-1.2 mm. Anal segment asymmetrical, longer on left side. P5 as in figure 5*e*.

Distribution.—On the east coast of the United States north of Cape Hatteras it is uncommon and is listed usually as a stray from the south. The most northern record appears to be that of Bigelow (1926, p. 293) from the Gulf of Maine. It is common in coastal waters south of Cape Hatteras (unpublished observations) and in the Gulf of Mexico.

On Smithsonian-Bredin Expeditions it was collected at Castries Harbor, Saint Lucia, and at Mujeres Harbor, Quintana Roo, Yucatan, Mexico. In the Puerto Rico collections, *T. turbinata* was found only rarely in the bays but was fairly common in the shelf area, where it was taken much more frequently than *T. stylifera*.

Remarks.—*T. longicornis*, which replaces *T. turbinata* north of Cape Hatteras, is similar but can be distinguished easily by the long anal segment and symmetrical caudal rami.

Family Pseudodiaptomidae

Head and PedSeg 1 fused or separate. Urosome of 3-4 segments in female, 5 segments in male; female caudal ramus at least 2.5 times as long as broad. Female A1 20–22-segmented; right male A1 prehensible, with reduced number of segments. Re and Ri of P1–P4 3-segmented. Female P5 non-natatory, without Ri, Re 2-segmented. Right male P5 without Ri, Re 2–3-segmented with terminal hook; Ri of left P5 present or absent, Re 2–3-segmented.

Genus *Pseudodiaptomus* Herrick

Female P5 without spines or processes on inner margin of Re1. B2 of left male P5 without long curved process on inner margin.

Pseudodiaptomus cokeri, new species

Figures 6–9

Female.—Length 1.35–1.50 mm. In dorsal view prosome (0.97–1.02) 1.7–1.9 times as long as urosome (0.52–0.59). Head fused with

PedSeg 1; PedSegs 4 and 5 separate; PedSeg 5 very short and narrower than other segments. Forehead rather strongly convex. Posterior margins of PedSegs 2, 3, and 4 serrate laterally; serrations extend dorsally on PedSeg 4. Posterior corners of PedSeg 5 rounded, each armed posteriorly with a group of long, fine hairs and a number of shorter, fine hairs. Urosome 3-segmented. Genital segment strongly produced ventrally; genital operculum conspicuous, bearing a few setules on posterior margin; posterior part of segment produced dorsally into lobe; segment armed with groups of spines and setae as shown in figures 6*a–c*. Middle part of segment 2 produced dorsally into hump bearing 2 platelike lobes; right lobe more conspicuous and more elevated. Caudal rami long and narrow, about 7 times as long as wide; left ramus a little longer than right; medial margins bearing long setules; distal halves of lateral margins with shorter setules.

A1 reaching slightly beyond posterior margin of genital segment, 21-segmented. Ri1 of A2 with 4 dentate spines on lateral margin. Md palp with 4-segmented Re and 2-segmented Ri; gnathal lobe with 9 teeth. Mx1 and Mx2 normal; setal armature as shown in figures 7*a* and 9. Mxp with Ri of 4 segments; segments 1–3 with peculiar bifurcate setae.

P1–P4 with armature of spines and setae characteristic of the genus and surface spinules as in figures 6*d–f*, 7*b–c*. P5 symmetrical. B2 with a few spinules on distolateral corner. Re 2-segmented; distal margin of Re1 produced into rounded lobe, proximal to which is slender spine on lateral margin, a row of spinules on anterior surface, and sometimes a row of spinules on medial margin. Re2 very similar to that of *P. coronatus;* shorter medial branch of bifurcate terminal spine about as long as or slightly shorter than setose mediodistal process.

Egg sacs subequal, left sac slightly larger than right.

MALE.—Much smaller than female, length 0.93–1.0 mm. In lateral view prosome (0.67–0.72) about 2.3 times as long as urosome (0.27–0.33 mm). Serrations on posterior margins of PedSegs 3 and 4 present or absent, sometimes present on PedSeg 3 but not on PedSeg 4. Posterior margin of PedSeg 5 without setae. Posterior margins of urosome segments 2–4 armed with dentate spines; spines narrow and closely spaced on ventral surface, becoming broader and more widely separate laterad and dorsad. Urosome segment 2 without spines dorsally, with V-shaped group of slender spines on ventral surface slightly posterior to middle of segment, apex of V anteriad.

Urosome segment 3 sometimes with smaller transverse row of spines at about middle of ventral surface. Caudal rami about twice as long as wide, with fine hairs on medial margins but not on lateral margins.

A1 reaching about to posterior margin of urosome segment 2. Left A1 21-segmented, like that of female but with larger aesthetascs. Right A1 19-segmented; geniculation between segments 17 and 18; segment 3 bearing 3 very long setae; segments 4–7 very short; segment 9 with long, heavily chitinized spine; segments 10–11, 13–16, and 18 with shorter spines. Segment 17 with dentate lamella on anterior margin; segment 18 with partial suture near proximal end; segment 19 the longest.

Mouthparts and P1–P4 as in female. Right P5 slightly shorter than left. B1 with 4–5 stout spines on medial margin. B2 about 1.6 times as long as wide; proximal part of medial margin with row of 4 spines posterior to which is brush of spinules; lateral margin with a few well-separated spinules. Re1 wider than long; medial margin bearing slender seta with globular base, produced distally into rounded lobe bordered with spinules; anterior part of distal margin spinulose, posterior part with strong lateral spine and peculiar bilobed appendage; inner lobe of appendage longer, distally spinose; outer lobe bearing curved setule at apex. Re2 about as wide as long; medial margin produced in middle, where it bears a seta with angular process at base; lateral margin evenly rounded, with spine at distolateral corner. Claw slightly longer than Re2, strongly curved, produced at base into bilobed process bearing seta on each lobe.

B1 of left P5 slightly longer than wide; inner margin strongly convex, armed with 2–3 heavy dentate spines; anterior surface with row of 4 spines near distal margin. B2 elongate; medial margin armed along most of length with brush of about 3 rows of spinules; posterior surface with curved row of spinules bounded proximally by slender seta; lateral margin with a few widely spaced setae. Lateral margin of Re1 with spine near distal end and seta proximal to spine; medial margin with seta at distal end. Re2 with acute apex bearing minute seta; near apex are 1 lateral seta and 3 medial setae arranged as shown in figures 7*h–i*; most proximal medial seta very small and in some views hidden by larger seta distal to it. Ri about .75 as long as Re; apex and distal .4 of medial margin spinulose.

Color.—Without pigment except for pairs of red spots on dorsal surface, indicated by stippling in figure 6*a*; a pair at the anterior margin of PedSeg 2, a pair in the middle of PedSeg 4, and pairs on the posterior parts of the genital segment and urosome segment 2.

Types.—Holotype, female, USNM 107790; allotype, male, USMN 107791; and 187 paratypes (46 females, 63 males, 78 copepodids), from Bahía Fosforescente, Puerto Rico, collected Apr. 13, 1957.

Distribution.—In the Puerto Rico collections, *P. cokeri* was taken only in Bahía Fosforescente. It was collected at Marigot Bay and Castries Harbor, St. Lucia, and at St. Johns, Antigua, by Smithsonian-

Bredin Expeditions and at Oyster Bay, Falmouth, Jamaica, by W. S. Glidden of the U.S. Navy Oceanographic Office. All these collections were made at night, indicating that *P. cokeri* lives on or near the bottom during the day. Jacobs (1961) observed that *P. coronatus* is not truly pelagic but sinks rapidly when not swimming and can cling tightly to substrata. He found that it occurred in great numbers near the bottom. Jacob's findings are probably applicable to *P. cokeri* also.

REMARKS.—*P. cokeri* resembles most closely *P. coronatus* Williams, a species that occurs in coastal waters of eastern North America, from Nova Scotia (Willey, 1923) to Florida and the Gulf of Mexico (Davis, 1950; Grice, 1956; Woodmansee, 1958). Grossly, the most obvious difference is the appearance of the paired egg sacs; in *P. cokeri* they are subequal; in *P. coronatus* the right sac is reduced to a pair of eggs. Females of the 2 species also can be distinguished by differences in the genital and second urosomal segments; in particular the distinctive dorsal hump and lobes on the second urosomal segment of *P. cokeri* are missing in *P. coronatus*. The males differ chiefly in the structural details of P5. To aid in comparison, P5 of *P. coronatus* is illustrated in figure 7*k*. Its chief differences from *P. cokeri* are: (1) the presence of a spiniforn process on the right B1; (2) the spines on the left B1 are longer and more numerous; (3) there is no bilobed appendage on the right Re1 and the distal spine is heavier.

Family Pontellidae

Head separated from PedSeg 1, often with lateral hooks. PedSegs 4 and 5 fused or separate. Rostrum forked, usually ending in 2 strong prongs, often with thickened base bearing a lens, rarely absent. Eyes usually prominent, often with 1 or 2 pairs of dorsal lenses and a ventral lens. Urosome often asymmetrical, 1–3-segmented in female, 5-segmented in male, male genital opening on left side. Female A1 16–24-segmented, last 2 segments always fused; right A1 of male prehensile, sometimes strongly modified. A2 with B2 and Ri1 fused, terminal segments of Re shortened. Md blade with 5–7 teeth. B1 of Mx1 large; B2, Re, and Ri relatively small. Distal setae of Mx2 long and robust, coarsely plumose. B1 of Mx2 large, with long setae; B2 and Ri relatively small; Re of P1–P4 3-segmented; Ri of P1 2–3, of P2–P4 2-segmented. Female P5 small; Re of 1–2 segments; Ri of 1 segment or absent. Male P5 uniramous, each member 3–4-segmented; right P5 with chela.

Genus *Calanopia* Dana

Head without lateral hooks or lenses. PedSegs 4 and 5 fused; posterior corners pointed. Female urosome 2-segmented; male urosome segment 2 often asymmetrical. Female A1 17-segmented; male right A1 with 4 segments distal to geniculation. Ri of P1–P4 2-segmented. Female P5 uniramous, 3–4-segmented. Male P5 4-segmented, the 2 distal segments forming a chela.

Calanopia americana Dahl

Figures 5*f–j*

Calanopia americana Dahl, 1894, p. 12, pl. 1, figs. 23–26.—A. Scott, 1909, p. 181, pl. 48, figs. 11–15.—Esterly, 1911, pp. 222–223, pl. 2, figs. 12, 15; pl. 3, figs. 27, 32; pl. 4, fig. 39.—T. Scott, 1912, p. 537, pl. 13, figs. 1–6.—Farran, 1929, p. 274.—Jesperson, 1940, p. 67.—Wilson, 1942, p. 172, fig. 2.—Davis, 1950, pl. 91 (table).—King, 1950, p. 129 (table).—Carvalho, 1952, p. 149, pl. 1, figs. 37–39.—Wickstead, 1956, pp. 15–16.—Bowman, 1957, passim, fig. 3h.—Woodmansee, 1958, p. 256.—Grice, 1960, p. 220.—Breuer, 1962, p. 167.—Fish, 1962, pp. 17–18.—Björnberg, 1963, pp. 58–59, fig. 30.—Reeve, 1964, passim.

Female.—Length 1.4–1.6 mm. Prosome:urosome = 2.8. Pointed corners of PedSeg 5 relatively short. Genital segment slightly longer than posterior urosome segment. Distal segment of P5 ending in 3 spines; middle spine much longer than others.

Male.—Length 1.4 mm. Urosome segment 2 without processes. Right A1, segment proximal to geniculation with strong process at proximal end of anterior margin perpendicular to segment. P5 as in figure 5*j*.

Distribution.—Warmer parts of the western Atlantic. The most northern record is Jesperson's rather surprising one south of Iceland (62°40′ N., 19°05′ W.). As Jesperson suggested, the 3 specimens were very probably carried there by the Gulf Stream. South of Cape Hatteras *C. americana* is found regularly along the coast and offshore (unpublished observations). It occurs in the Gulf of Mexico, the Caribbean, and south to the southern coast of Brazil (Björnberg, 1963). Smithsonian-Bredin Expeditions have collected it at English Harbor, Antigua; Marigot Bay, Saint Lucia; and off Crown Point, Tobago. A net tow made in Lameshur Bay, Saint John, Virgin Islands, by Dr. John Randall at our request obtained numerous specimens of *C. americana.*

In the Puerto Rico collections, *C. americana* was obtained only from net tows made at night in Bahía Fosforescente. The collections from Tobago, Saint Lucia, Antigua, and Saint John were also made at night. Clarke (1934), working in Bermuda, found that during the day *C. americana* lives very close to the bottom and probably buries itself in the mud. At night it moves up close to the surface. The robust outer spines on Re of P1–P4 may assist *Calanopia* in clinging to the bottom during the day.

Family Acartiidae

Body narrow; head and PedSeg 1 separated; PedSegs 4 and 5 fused. Rostrum absent or consisting of 2 delicate filaments. Urosome 3-segmented in female, 5-segmented in male. Upper lip large, prominent, trilobed. A1 long and slender; segments poorly defined and reduced in number; setae generally plumose, some very long and arising from swellings of the segments. Right A1 of male prehensile, but not greatly modified. Ri of A2 slender, much longer than Re. Mxp much reduced, smaller than Mx2. P1–P4 slender; Ri 2-segmented, Re 3-segmented, outer spines reduced; inner setae long. Female P5 very small, uniramous, 2–3-segmented. Male P5 uniramous, prehensile; left P5 3-segmented; right P5 4-segmented.

Genus *Acartia* Dana

Prosome slender, usually widest posterior to middle, 2.5–4 times as long as urosome. Genital segment not laterally expanded. Male urosome segment 4 very small, sometimes partly fused with segment 5. Female A1 of 17–18 rather poorly defined segments. Mouthparts of male and female alike. B2 of A2 fused with Ri1, forming long slender segment armed with 9 setae. Gnathal lobe of Md with large gap between 2 anterior teeth; Re of palp much shorter than Ri. Mx1 with Ri apparently absent. Mx2 with long sparsely setose curved setae reaching forward to mouth. Mxp with B1 apparently absent; B2 broad; Ri much reduced. Female P5 3-segmented, segment 3 modified into long spine. Right male P5 larger than left, segment 3 with large inner lobe, segment 4 in form of curved clasper.

REMARKS.—Steuer (1915, 1923) divided *Acartia* into 2 groups, "Acartiae arostratae" and "Acartiae rostratae," according to whether or not rostral filaments are present. He further divided the genus into 8 subgenera, of which 2 were arostrate and 6 rostrate. Gurney (1931) removed 1 arostrate subgenus (*Acartiella*) to the family Tortanidae and raised the rostrate subgenus *Paracartia* to its former full generic rank, leaving 6 subgenera of *Acartia*.

We believe that a thorough study of the genus *Acartia* must be carried out before the correctness of Steuer's action can be assessed, and we therefore reserve judgment.

Acartia lilljeborgii Giesbrecht

FIGURES 10*a–e*, 11*a*

Acartia lillgeborgii Giesbrecht, 1889, p. 25.

Acartia lilljeborgii Giesbrecht.—Giesbrecht, 1892, pp. 508, 518–521, 523, pl. 30, figs. 8, 20, 30; pl. 43, figs. 1, 19.—Dahl, 1894, p. 23.—Breuer, 1962, p. 167.

Acartia (*Odontacartia*) *lilljeborgi* Giesbrecht.—Steuer, 1915, p. 397; 1923, pp. 114–115, figs. 122–125.

Acartia lilljeborghii Giesbrecht.—Carvalho, 1952, pp. 150–151, pl. 1, figs. 40–41.—Légaré, 1961, table 5.—Zoppi, 1961, table 4.—Björnberg, 1963, pp. 61–62, fig. 32.
Acartia Fariae Oliveira, 1945, p. 459, pl. 6, figs. 1, 2, 8.
Lahmeyeria turrisphari Oliveira, 1947, pp. 463–465, pl. 4, figs. 1–8.

Female.—Length 1.15–1.20 mm. Rostral filaments present. PedSeg 5 produced into long spiniform process, dorsal to which are 2–3 minute spines. Urosome short; posterior margins of genital segment and urosome segment 2 armed with spinules; anal segment and caudal rami each with lateral groups of hairs. Caudal rami twice as long as wide. A1 about as long as body; proximal segments with margins produced into strong spines as in figure 10*d*. Segment 2 of P5 longer than broad, with median shelf distal to middle; segment 3 naked, slender, 3 times as long as segment 2, subequal to seta of segment 2.

Male.—Length 1.02–1.04 mm. PedSeg 5 with shorter spiniform process than in female, single large dorsal spine about half as long as process, and minute spinule above dorsal spine. Posterior margins of urosome segments 2, 3, and 4 armed with spinules; segment 1 with group of hairs on each lateral surface; segment 2 with groups of fine spinules on lateral surfaces, extending onto ventral surface; segment 5 and proximal part of caudal ramus with lateral clumps of hairs. Caudal ramus about as wide as long. A1 without spiniform processes. P5 as in figure 11*f*.

Distribution.—On the Pacific coast of South America it is known from the widely separated type localities, Valparaiso, Chile, and Guayaquil, Ecuador. On the Atlantic coast it has been collected along the coast of southern Brazil and the Gulf of Cariaco, Venezuela. Smithsonian-Bredin Expeditions have taken it at Marigot Bay and Castries Harbor, Saint Lucia, and Progresso, Yucatan, Mexico. The U.S. National Museum has specimens from Cardenas Bay, Cuba. In Puerto Rico it occurred both in the bays and over the shelf.

The armature of A1 and the pointed PedSeg 5 of *Acartia fariai* show clearly that Oliveira's (1945) species is synonymous with *A. lilljeborgii*. *Lahmeyeria turrisphari* Oliveira (1947) is an immature *A. lilljeborgii* in which the hooks on A1 are not fully developed. The illustrations of P2-P5 depict immature appendages.

Acartia spinata Esterly

Figures 10*f–i*, 11*b*, 12*a*

Acartia spinata Esterly, 1911, p. 224, pl. 1, figs. 3, 5; pl. 2, figs. 16, 19; pl. 3, fig. 24; pl. 4, figs. 37, 45.—Clarke, 1934, passim.—Moore, 1949, pp. 61–62.—Davis, 1950, pp. 90–91.—Woodmansee, 1958, p. 255.—Grice, 1960a, p. 224; 1962b.—Owre, 1962, p. 493 (list).—Reeve, 1964, passim.

Acartia (*Acanthacartia*) *spinata* Esterly.—Steuer, 1915, p. 396; 1923, pp. 25–26, figs. 115–121.

FEMALE.—Length 1.16–1.24 mm. Rostral filaments present. PedSeg 5 rounded, posterior margin armed with dorsal series of 3–5 spinules and ventral series of 3–6 spinules. Posterior margins of genital and second urosome segments with dorsal rows of spinules. Caudal rami about 1.6 times as long as wide, dorsal surface covered with fine hairs. A1 about as long as body; segment 1 with spine on ventral surface; segment 2 with spine at proximal end of anterior margin and row of 3–5 smaller spines on posterior margin. Segment 2 of P5 more than twice as long as wide; segment 3 about 2.5 times as long as segment 2, bent inward distal to middle, about half as long as seta of segment 2.

MALE.—Length 0.97–1.11 mm. Posterior margins of urosome segments 2–4 with dorsal rows of spinules; segment 2 with a few groups of lateral spinules; segment 4 with lateral bunch of hairs; caudal ramus slightly wider than long. A1 without spines. P5 as in figure 12*a*.

DISTRIBUTION.—Bermuda (Esterly, Clarke, Moore); between Long Island and Bermuda (Grice); vicinity of Biscayne Bay, Fla. (Davis, Woodmansee, Reeve); Knight's Key, Fla. (Grice). Smithsonian-Bredin Expeditions have collected it in Fort de France Harbor, Martinique; near Pigeon Point, Tobago; and off Cocoa Point, Barbuda. It is abundant in Lameshur Bay, Saint John, Virgin Islands. In the Puerto Rican collections it occurred both in the bays and over the shelf. In Bermuda and in Biscayne Bay, Fla., *A. spinata* appears to be more abundant in the open waters outside the bays than in the bays themselves (Clarke, 1934; Woodmansee, 1958); Owre (1962) reports it from the Florida Current 10 miles east of Miami.

Acartia tonsa Dana

FIGURES 11*c–f*

Acartia tonsa Dana, 1849, p. 26.—Giesbrecht, 1889, p. 25; 1892, pp. 508, 518–522, pl. 30, figs. 7, 24, 34; pl. 43, figs. 6, 10.—Cleve, 1900, p. 44; 1901, p. 4.—Foster, 1904, pp. 75–77.—Scott, 1914, p. 8.—Wilson, 1932b, pp. 160–162, figs. 109a–d.—Sutcliffe, 1948, p. 234.—Davis, 1950, p. 91 (table).—Davis and Williams, 1950, passim.—King, 1950, p. 129 (table).—Carvalho, 1952, p. 152.—Bousfield, 1955, p. 36 (table).—Breuer, 1957, p. 143; 1962, p. 167.—Simmons, 1957, p. 177.—Woodmansee, 1958, p. 251.—Grice, 1960a, p. 221.—Bowman, 1961, passim.—Darnell, 1961, p. 555.—Cronin, Daiber, and Hulbert, 1962, pp. 77, 80–81.—Grice and Hart, 1962a, p. 294; 1962b.—Cervigón, 1962, p. 185.—Jeffries, 1962, passim.—Cuzon du Rest, 1963, passim.—Reeve, 1964, passim.

Acartia (*Acanthacartia*) *tonsa* Dana.—Steuer, 1915, p. 396; 1923, pp. 23–24, figs. 106–109.

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Acartia gracilis Herrick, 1887, p. 7.—Foster, 1904, pp. 75–76.
Acartia giesbrechti Dahl, 1894, p. 13, figs. 15–18.—Björnberg, 1963, p. 66.
Acartia (*Acanthacartia*) *giesbrechti* Dahl.—Steuer, 1915, p. 396; 1923, p. 23, figs. 102–105.
Acartia tonsa var. *cryophylla* Björnberg, 1963, pp. 64–66, fig. 34.

FEMALE.—Length 0.87–0.97 mm. Rostral filaments present. Prosome:urosome = about 3.6. Posterior margins of PedSeg 5 smooth or with dorsal series of minute spinules. Posterior margins of genital and second urosome segments smooth or with a few dorsal spinules. Caudal rami about 1.6 times as long as wide. A1 reaching slightly beyond posterior margin of genital segment, without hooks or spines. Segment 2 of P5 with blunt process at anterior distal angle; segment 3 about 1.5 times as long as segment 2 and subequal to seta on segment 2, with swollen base and conspicuous barbed section proximal to slender tapered tip.

MALE.—Length 0.77–0.80 mm. Urosome segments 1 and 5 with lateral tufts of hair; dorsal posterior margins of segments 2–4 with delicate spinules. Caudal rami about as long as wide. P5 as in figure 11*f*.

DISTRIBUTION.—*A. tonsa* originally was described from Port Jackson, just north of Sydney, Australia. Since then it has been found along both coasts of North and South America and, more recently, in European waters, where it has been considered by some investigators to be a recent immigrant. Its global distribution is summarized by Remy (1927), who first discovered it in Europe. More recent reports on its occurrence in Europe are summarized by Conover (1957) and Schwarz (1960). Its distribution on the east coast of North America north of Cape Hatteras is summarized by Bowman (1961), who overlooked the 2 northernmost records, those of Steuer (1923) from the Bay of Fundy, and of Bousfield (1955) from the Miramichi estuary, New Brunswick. The most southern record in the western Atlantic is that of T. Scott (1914) from the Falkland Islands.

A. tonsa has been reported from 3 localities in the Indian Ocean: Java Sea (Cleve, 1901), Maldives (Wolfenden, 1905), and just north of the delta of the Indus River, 25° N., 67° E. (Cleve, 1904). These records are unsupported by illustrations or discussion, and we consider them highly questionable. In fact, there is some doubt in our minds that the *Acartia tonsa* from Pacific South America described by Giesbrecht is the one Dana described from Australia since Dana's description was so lacking in detail and his species has not been found for a second time along the Australian coast.

In Bahía Fosforescente, *A. tonsa* was outnumbered only by *Oithona hebes*. In the shelf area it was much less abundant and ranked 12th among the copepods.

Family Tortanidae

With the characters of the only genus, *Tortanus.*

Genus *Tortanus* Giesbrecht

Head without lateral hooks. Eye large, without lenses. Rostrum absent. Horsehoe-shaped plated fringe with hairs anterior to upper lip. Head and PedSeg 1 separated. PedSeg 5 fused with or separate from PedSeg 4, pointed and sometimes asymmetrical in female, rounded in male. Urosome 2–3-segmented and usually asymmetrical in female, 5-segmented in male. Caudal rami usually very asymmetrical in female, less so in male. A1 17-segmented, male right A1 prehensile, thickened in middle. Ri of A2 a little longer than Re. B2 of Md palp long; outermost tooth of gnathal lobe large and well separated from other teeth. Mx1 reduced to basal segment bearing short broad proximal lobe and long narrow distal lobe, the latter with 2 long and 1 shorter apical setae. Mx2 with much reduced proximal lobes. Mxp with well-developed basal segment armed with strong setae; endopod much reduced. Re of P1–P4 3-segmented; Ri of P1 2- or 3-segmented, of P2–P4 2-segmented. P5 uniramous in both sexes; 2–3-segmented and sometimes asymmetrical in female; right P5 of male forming a chela.

Tortanus compernis, new species

FIGURES 11*g*, 12*b–i*, 13*a–j*

Very similar to *T. setacaudatus* Williams but differing as follows:

FEMALE.—Length 1.14–1.19 mm. Prosome more slender, length: width = about 2.7 (about 2.3 in *T. setacaudatus*). Urosome more slender; anal spine smaller. Caudal rami not so straight; lateral margins concave; bent inward and in contact or nearly so near base; more slender, length:width = 5.4 (left ramus) and 4.6 (right ramus) (3.6 in both rami in *T. setacaudatus*). Distal segment of P5 with inner tooth widely separated from 2 outer teeth; inner margin with 3 setae near distal end.

MALE.—Length 1.02–1.08 mm. Length : width of prosome = 2.8–3.0 (2.4 in *T. setacaudatus*). Urosome segment 2 with lobe on posterior part of right margin larger, of different shape (cf. figs. 12*h*, 12*l*), bearing 2 short hairs on posterior margin. Caudal rami as in female, bent inward near proximal end; right ramus slightly longer than left. A1 as in *T. setacaudatus*, but segments slightly narrower. Segment 2 of P5 armed at tip with curved process, long heavy seta, and slender seta arising at base of heavy seta and crossing base of curved process.

Types.—Female holotype, USNM 109553, and 12 paratypes (2 males, 3 females, 7 juveniles), USNM 109554, from Bahía Fosforescente, Puerto Rico, Feb. 4, 1957.

Distribution.—This species is rather uncommon in the bays. *T. compernis* is the 3rd species of *Tortanus* to be reported from the western North Atlantic and the 1st from the West Indies. *T. discaudatus* (Thompson and Scott) is a northern species whose southern record is at the mouth of Delaware Bay (Deevey, 1960). *T. setacaudatus* Williams ranges south from Woods Hole (Wilson, 1932b), around Florida, and into coastal waters of the Gulf of Mexico. Grice (1960a) reports it from the west coast of Florida, and there are specimens in the U.S. National Museum from Biscayne Bay, Fla., and the Laguna Madre of Texas. Foster's (1904) *Tortanus* sp. from Louisiana is probably *T. setacaudatus*, as is the inadequately described *Calanus americanus* Herrick (1887) from Mobile Bay, Ala.

Remarks.—The specific epithet *compernis* (from the Latin "compernis," meaning "knock-kneed") refers to the characteristic shape of the caudal rami.

Order Harpacticoida

Family Longipediidae

Body elongate. Head fused with PedSeg 1; rostrum large, linguiform. Epimera of PedSegs 2–4 well developed; posterior corners angularly produced. Urosome narrowing posteriorly. Genital segment of female with transverse dorsal groove ending laterally in spine on either side. Anal operculum with terminal central spine and usually smaller ones on either side. Caudal rami short. A1 5-segmented. Re of A2 6-segmented. Ri of Md 2-segmented, Re 1-segmented. Re and Ri of P1–P4 3-segmented. Re3 of P2 very long. Distal segment of P5 more or less elongate, with 5 setae in female, 6–8 in male. Nauplius with long median caudal spine. Contains one genus, *Longipedia*.

Longipedia Claus, 1863

Although *Longipedia* is not a holoplanktonic genus, it appears to leave the bottom and swim freely more frequently than most other harpacticoids. Since we have collected it occasionally with plankton nets towed in Bahía Fosforescente, we are including it in this paper.

L. coronata Claus (1863), the type species by monotypy, cannot be assigned with confidence to any of the species currently recognized, and it has become customary to give the name *L. coronata* to the species fully described under this name by Sars (1903). Eventually a neotype of *L. coronata* Claus sensu Sars should be selected to legalize this practice and prevent confusion.

Longipedia helgolandica Klie

FIGURES 15, 16*a–c*

Longipedia minor helgolandica Klie, 1949, pp. 97–100, figs. 1–3.—Noodt, 1956, p. 44; 1957, pp. 153, 224.

Longipedia coronata Claus.—Williams, 1906, p. 651; 1907, p. 72.—Fish, 1925, pp. 145, 146 (lists).—Wilson, 1932b, pp. 170–171, fig. 16.—[?] Nicholls, 1941, p. 384, fig. 1.—King, 1950, p. 129 (table).—[?] Pesta, 1959, p. 98, figs. 1–3.

DIAGNOSIS.—A small *Longipedia,* about 0.8–0.9 mm. long. Margins of urosome segments smooth dorsally, minutely serrate ventrally. Anal operculum with long central spine and 2 pairs of lateral spines, outer pair much smaller than inner. Caudal setae unarmed. Re3 of P1 with 2 inner setae. Outer spine of Re3 of P2 inserted distad to proximal inner spine, present in both sexes. Female P5 as in figure 16*b;* male P5–P6 as in figure 16*c*.

FEMALE.—Length, excluding rostrum and caudal setae, 0.78–0.93 mm. Prosome about 3 times as long as wide, about 1.2 times as long as urosome. Ventral margin of head with numerous fine setae as in *L. coronata.* Posterior margins of urosome segments smooth on dorsal and lateral parts; ventral margins of segments 2, 3, and 4 finely serrate. Anal operculum similar to that of *L. coronata;* central spine longer than rest of segment, reaching beyond caudal rami; 2 pairs of lateral spines, inner one well developed, curving mediad, with small medial to its base, outer one very small. Caudal rami about 1.4 times as long as wide at base, without surface spinules. Caudal setae as in *L. coronata:* 2 dorsal, 2 ventral, 3 terminal. Outer 2 terminal setae jointed near base; inner seta not jointed, shorter and more slender than other terminal seta. Longest seta about 0.85 as long as body. All caudal setae naked.

A1 as in *L. coronata.* A2, terminal segment of Re with 3 sparsely plumose setae as in *L. coronata* plus a short naked seta; second segment of Ri with 5 setae. Gnathal lobe of Md with 2 blunt teeth, followed by 2 teeth jointed at their bases, a rounded tooth, a pointed tooth, and a longer blade. Md palp as in *L. coronata* except that distal endopod segment has 5 rather than 6 apical setae. Mx1, Mx2, and Mxp as in *L. coronata.*

P1, Re3 with 2 inner setae. P2 as in *L. coronata,* Ri3 more than twice as long as Ri1 and Ri2 combined; long outer seta situated slightly distal to proximal inner spine; middle terminal seta deeply serrate on medial border. P3 and P4 like those of *L. coronata.*

P5 closely resembling figures of *L. coronata* P5 by Scott (1909, pl. 59, fig. 7), Gurney (1927, fig. 122B), and Nicholls (1941, fig. 1). Re about 2.5 times as long as greatest width, with 5 marginal setae and an acute distal tooth. Relative lengths of the setae, numbered proximal to distal: $5>3>2=4>1$.

Male.—Urosome segments 3, 4, and 5 finely serrate on ventral margins, smooth on dorsal and lateral margins. A1 with setal armature shown in figure 15*d*. Terminal segment claw-shaped, bearing 2 setae and 2 aesthetascs. Penultimate segment subrectangular, bearing long plump aesthetasc. Antepenultimate segment with aesthetasc about as long but thinner than that on penultimate segment. P1 as in female. P2 without reduction in number of setae on Ri3; apex of Ri produced into short spiniform process posterior to the 3 large terminal setae. Ri2 of P4 in addition to large distal seta with very fine seta inserted on posterior surface near inner margin at about middle of margin.

P5 much smaller than in female. Re about 1.25 times as long as wide, bearing 6 setae of relative lengths shown in figure 16*c*. P6 consisting of broad flap bearing outer long slender seta, middle heavier seta, and inner short spiniform seta.

Distribution.—Vicinity of Helgoland (Klie); Bad St. Peter, on west coast of Schleswig-Holstein, West Germany (Noodt); ?Gulf of Naples, Italy (Pesta); Woods Hole, Mass. (Fish); Marthas Vineyard, Mass. (Wilson); Narragansett Bay, R.I. (Williams); off Fort Myers, Fla. (King); Big Pine Key, Fla. (Yeatman, in litt.); Bahía Fosforescente, Puerto Rico (this paper); St. Johns, Antigua (this paper); Marigot Bay, St. Lucia (this paper); Progresso, Yucatán, Mexico (this paper).

Remarks.—The Puerto Rican specimens agree in all particulars with Klie's description, except that Klie found Re of A2 to be 7-segmented while in our specimens it is 6-segmented. We believe that Klie's subspecies should be given specific rank. *L. minor* and *L. helgolandica* are probably to some extent sympatric, as Klie (1949, p. 100) indicates, and evidence of intergradation is nonexistent. We consider that the differences between *L. minor* and *L. helgolandica* are of about the same magnitude as the differences between other species of *Longipedia*.

All published North American records of *Longipedia* appear to be referable to *L. helgolandica*. Wilson's (1932) specimens of *L. coronata* from Katama Bay, Marthas Vineyard, Mass., which are deposited in the U.S. National Museum, closely resemble the Puerto Rican specimens. We have also identified specimens from Marigot Bay, Saint Lucia, taken in a plankton tow during the 1959 Smithsonian-Bredin Expedition to the West Indies. Dr. Harry C. Yeatman (in litt.) has collected specimens of a *Longipedia* from Big Pine Key, Fla., which he believes to be conspecific with the Puerto Rican species.

The records of *L. coronata* by Williams (1906, 1907) from Rhode Island, by Fish (1925) from Woods Hole, Mass., and by King (1950) from off Fort Myers, Fla., probably are all misidentifications: these authors almost undoubtedly had specimens of *L. helgolandica.*

Two records of *Longipedia* from South America are known to us. Carvalho's (1952) *L. coronata* from the Bay of Santos, Brazil, cannot be identified with certainty since Carvalho's drawings do not show sufficient detail and his description does not include characters useful in distinguishing the species of *Longipedia.* His figure 45 shows the 4 outer setae of Re of P5 to be subequal as in *L. coronata,* but Re is considerably shorter in relation to its width than in *L. coronata.* A reexamination of Carvalho's specimens is needed.

Jakobi (1954) described *L. mourei* from the Bay of Paranaguá, Brazil. It agrees with *L. helgolandica* in the dorsal margins of the urosome segments being smooth and in having 2 inner setae on Re3 of P1. It differs from all other species of *Longipedia* in that the female P5 has only 4 setae in addition to the terminal spine.

Nicholls' (1941) *Longipedia coronata* may be conspecific with *L. helgolandica.* The presence of 2 inner setae on Re3 of P1 and the structure of P5 exclude it from *L. coronata.* The outer pair of lateral spines on the anal operculum are relatively larger than in *L. helgolandica* and more like those of *L. coronata.* Nicholls' specimens were about 1 mm. in length, slightly larger than our specimens of *L. helgolandica* but smaller than *L. coronata.*

Pesta's (1959) specimen of *L. coronata* from the Gulf of Naples may be *L. helgolandica.* The small size (0.71 mm.) and the relative lengths of the setae on Re of P5 agree with *L. helgolandica* rather than with *L. coronata.* Pesta seems to have based his identification on the presence of 5 rather than 6 setae on Re3 of P1; however, it is possible that Pesta confused the exopod and endopod of this leg, for his figure 2, labelled "Engl. Exp. P1 ♀," is actually an illustration of the endopod. Ri3 of P1 has 5 setae in all species of *Longipedia.* P5 in Pesta's specimen is shaped more like that of *L. helgolandica* than the narrower P5 of *L. minor.*

Family Tachidiidae

Body elongated. Urosome nearly as broad as or much narrower than prosome. A1 4–9-segmented, usually with plumose setae. Re of A2 1–3-segmented. Re and Ri of Mx1 usually reduced. Re of P1 2–3-segmented, with 1 inner seta on middle segment and 5–6 appendages on distal segment. Ri of P1 not prehensile, 2–3-segmented, with inner setae on all segments. Ri of P2 2–3-segmented; Ri of P4 3-segmented. Armature of P1–P4 rather variable. Ri2 of male P2 often produced into pointed process; one seta of distal segment rarely modified weakly. Re of P2 and P3 sometimes more strongly developed in male than in female. Rami of P5 either separate or fused; male P5 sometimes a single plate (from Lang, 1948, p. 281).

Genus *Euterpina* Norman

Rostrum produced into strong point. Caudal ramus somewhat longer than wide. A1 of female 7-segmented, without plumose setae; in male prehensile, with plumose setae. Re of A2 1-segmented. B of Md without setae. Mx1 with rudimentary Re and Ri. Mx2 with small 2-segmented Ri. Mxp very slender, with long terminal claw. P1 with short 2-segmented rami and weak sexual dimorphism; Re1 with inner seta; Re2 with 7, Ri2 with 6 appendages. P2–P4 with 3-segmented rami; Ri shorter and more slender than Re; Re1 and Re2 with outer spines. B of P1–P4 without outer setae. Ri of male P2 sometimes (always?) 2-segmented. Female P5 a long, nearly square-cornered plate with 4 terminal spines, 1 outer spine, and proximal outer seta. Male P5 fused at base, divided at tip by median groove reaching halfway to base, armed with 2 terminal spines on either side, 1 outer spine with seta arising at its base, and proximal outer seta (from Lang, 1948, p. 285).

Euterpina acutifrons (Dana)

FIGURES 14*d–l*

Harpacticus acutifrons Dana, 1847, p. 153.

Euterpe acutifrons (Dana).—Dahl, 1894, p. 13.—Cleve, 1900, pp. 65–66.—Davis, 1950, p. 97 (table).

Euterpina acutifrons (Dana).—Carvalho, 1945, pp. 103–104, pl. 5, fig. 22; 1952, pp. 163–164, pl. 2, figs. 85–88.—Lang, 1948, pp. 285–287, fig. 142, map 343 [synonomy, distribution].—King, 1950, p. 130 (table).—Grice, 1956, pp. 56–57.—Woodmansee, 1958, p. 256.—Deevey, 1960, p. 33.—Légaré, 1961, p. 206.—Zoppi, 1961, table 4.—Björnberg, 1963, pp. 71–72, fig. 37.

With the characters of the genus, which is monotypic. Length of Puerto Rico specimens: female, 0.53–0.60 mm.; male, 0.46 mm.

DISTRIBUTION.—Worldwide in tropical and subtropical coastal waters (see Lang, 1948, map 343, p. 1588). Although never abundant in the Puerto Rico samples, *E. acutifrons* occurred regularly in the bays and over the shelf and was the most common planktonic harpacticoid.

Family Ectinosomidae

Body slender, usually without noticeable boundary between prosome and urosome. Eye absent. PedSeg 1 fused with head. Female genital segment without transverse suture. A1 short, not more than 7-segmented in female. Re of A2 at most 3-segmented;

terminal segment with setae only at apex. Md usually well developed. Mx2 with large basal segment bearing at most 3 endites. Mxp very characteristic; 3-segmented; middle segment usually long. Re of P1 3-segmented, without inner seta on Re1; Ri sometimes prehensile and 2-segmented, usually nonprehensile and 3-segmented. P2–P4 usually with 3-segmented rami; Ri sometimes 2-segmented. P5 similar in male and female, 2-segmented; medial lobe of segment 1 with 2 apical setae. 1 egg sac.

Genus *Microsetella* Brady and Robertson

Body fusiform, compressed laterally. Rostrum short, immobile, bent ventrad, and not visible from above. Caudal rami short, the 2 middle terminal setae very long. Female A1 6-segmented; segment 3 elongate. Re of A2 3-segmented. Md well developed; gnathal lobe with few teeth; Re very small; Ri large, with single enlarged seta on middle of inner margin. Re and Ri of P1–P4 3-segmented; Ri longer than Re. P5 of female foliaceous; distal segment with 3 marginal and 1 surface setae. 2 species.

Microsetella norvegica (Boeck)

FIGURES 16*d–e*

Setella norvegica Boeck, 1865, p. 281.
Microsetella norvegica (Boeck).—Wilson, 1932a, p. 38; 1932b, pp. 176–177, fig. 21.—Lang, 1948, pp. 230–232, fig. 122–1 [synonomy, literature, distribution].—Carvalho, 1952, p. 155, pl. 2, figs. 47–50.—Deevey, 1952b, p. 146; 1956, p. 139.—Fish, 1955, pp. 242–249 [life history].
Microsetella atlantica Brady and Robertson.—Cleve, 1900, pp. 69–70.

FEMALE.—Longest caudal seta about as long as body; next longest about as long as urosome. Medial seta on inner lobe of segment 1 of P5 about half as long as outer seta. Length 0.35–0.53 mm.

MALE.—Smaller than female; length 0.33–0.42 mm. P5 much reduced.

DISTRIBUTION.—A eurythemic and euryhaline species, widely distributed in all oceans. In the Puerto Rican collections it was taken on the shelf but not in the bays.

Order Cyclopoida

Family Corycaeidae

Prosome cylindrical or conical, 2–4-segmented. Head with pair of prominent ocular lenses located close together, sometimes contiguous. Posterior corners of PedSeg 3 and usually PedSeg 4 produced into points. PegSeg 5 very short. Urosome 2–3-segmented. Caudal rami usually narrow and long, with 3 terminal and 1 lateral setae. A1

6-segmented, with nonplumose setae and without aesthetascs, not geniculate in male. A2 prehensile, with long spines on B1 and B2; terminal spine longer in male than in female. Mx2 2-segmented, ending in strong hook. Mxp 3-segmented. Re of P1–P4 3-segmented; Ri of P1–P3 3-segmented; Ri of P4 1-segmented or absent. P5 represented by 2 unequal setae.

Genus *Corycaeus* Dana

Setae of B1 and B2 of female A2 nonplumose; seta of B2 of male A2 finely plumose on 1 margin. Urosome 3-segmented (2-segmented in subgenus *Agetus*). Ventral process rounded. Re of P1–P3 with 1–1–3 outer spines. P4 with rudimentary Ri consisting of small knob bearing 1 or 2 setae; Re with 0–1–1 outer spines.

Subgenus *Ditrichocorycaeus* M. Dahl

Small species characteristic of coastal plankton. Seta of B1 of A2 3 times longer than seta of B2 in female, only slightly longer in male.

Corycaeus (*Ditrichocorycaeus*) *amazonicus* F. Dahl

Figures 17*a–e*

Corycaeus amazonicus F. Dahl, 1894b, p. 71.—M. Dahl, 1912, pp. 69–71, pl. 10, figs. 1–10.—Farran, 1929, p. 296.—M. S. Wilson, 1949, p. 325.—Grice, 1956, pp. 54–55; 1960, p. 221.—Deevey, 1960, pp. 33–34.—Björnberg, 1963, p. 83, fig. 44.

Female.—Length 1.12 mm. Genital segment inflated dorsally. Genital and anal segments subequal; caudal rami slightly longer than genital segment. Re3 of P1 incised at apex so that terminal spine is set at an angle. Re2 and Re3 of P4 subequal; outer seta of Re1 extends beyond distal margin of Re2.

Male.—Length 0.88 mm. Anal segment about ⅔ as long as genital segment; caudal rami slightly longer than anal segment.

Distribution.—East coast of the United States from Block Island Sound, R.I. (Deevey), to Port Aransas, Tex. (M. S. Wilson); Bermuda, Tortugas (M. Dahl); mouth of Amazon River, Brazil (F. Dahl); Rio de Janeiro, Brazil (Farran). In the Puerto Rican collections it appeared in small numbers in the bays and over the shelf.

Corycaeus (*Ditrichocorycaeus*) *subulatus* Herrick

Figures 17*f–h*, 18*a–c*

Corycaeus subulatus Herrick, 1887, pp. 48–49, pl. 1, figs. 7A–B.
Corycaeus lubbocki Giesbrecht.—C. B. Wilson, 1932a, p. 42.
Corycaeus (*Ditrichocorycaeus*) *americanus* M. S. Wilson, 1949, pp. 321–326, pl. 18, figs. 1–14.—King, 1950, p. 131 (table).—Grice, 1956, pp. 55–56; 1960, pp. 221–222.—Deevey, 1960, pp. 33–34.—Cronin, Daiber, and Hulbert, 1962, p. 72 (table).

FEMALE.—Length 1.1–1.2 mm. Genital segment inflated dorsally, about twice as long as anal segment. Caudal rami divergent, longer than urosome. Re3 of P1 as in *C. amazonicus*. Proportional lengths of Re1–Re3 of P4 approximately 27:15:20; outer seta of Re1 long as in *C. amazonicus*.

MALE.—Length 0.85–1.0 mm. Genital segment about twice as long as anal segment. Caudal rami about ¾ as long as urosome.

DISTRIBUTION.—Atlantic coast of the United States, from Block Island Sound, R. I. (Deevey), to Port Aransas, Tex. (M. S. Wilson). In the Puerto Rican collections it occurred in small numbers in the bays and on the shelf.

REMARKS.—Although Herrick's description and illustrations differ in some respects from those of M. S. Wilson, we believe the discrepancies can be attributed to Herrick's inaccuracies. We place *C. americanus* in synonomy with *C. subulatus* for the following reasons:

1. Herrick's statement "The inner ramus of the fourth feet is reduced to a process bearing two long setae" places his species in the subgenus *Ditrichocorycaeus*.
2. The length of the caudal rami shown in Herrick's figure 7 eliminates all known species of *Ditrichocorycaeus* except *americanus*.
3. Other species of *Corycaeus* with long caudal rami (e.g., *Urocorycaeus* spp.) are not inhabitants of coastal water.
4. Mobile Bay, Ala., the type locality for *C. subulatus*, is within the range of *C. americanus*.

Genus *Farranula* C. B. Wilson

Prosome 2-segmented. PedSeg 4 fused with PedSeg 3; posterior corners not produced into points. Ventral process beak shaped in female, rounded in male. Urosome 2-segmented. Setae of B1 and B2 of A2 plumose in both sexes. Re of P1–P4 with 0–0–1 outer spines. Ri of P4 absent.

Farranula gracilis (Dana)

FIGURES 18*d–g*

Corycaeus gracilis Dana, 1849, p. 35.—F. Dahl, 1894, p. 69.—Légaré, 1961, table 5.—Zoppi, 1961, table 4.

Corycaeus (*Corycella*) *gracilis* Dana.—M. Dahl, 1912, pp. 108–111, pl. 14, figs. 11–21; pl. 15, figs. 15, 16, 29, 30.

Corycella gracilis (Dana).—Björnberg, 1963, pp. 85–86, fig. 47.

Corycaeus carinatus Giesbrecht.—Wheeler, 1901, p. 192, fig. 30.

Corycella carinata (Giesbrecht).—Wilson, 1932a, p. 41; 1932b, p. 362, fig. 220.

FEMALE.—Length 0.94 mm. Urosome in lateral view as in figure 18*g* with part of dorsal margin subparallel to ventral margin.

MALE.—Smaller than female, and with longer caudal rami.

Remarks.—This species has been misidentified by Wheeler, Wilson, and probably other authors. Wheeler's illustrations, reprinted in Wilson (1932b), agree closely with M. Dahl's figures of *F. gracilis*, said by Dahl to be an Atlantic species. *F. carinata* has a rather different urosome shape (see Dahl, 1912, pl. 15, fig. 22) and is considered by Dahl to be a Pacific species.

The urosome of *F. concinna* (Dana) is similar in shape to that of *F. gracilis* but is lower and longer. Although M. Dahl states that it is a Pacific species, Moore (1949), Björnberg (1963), and Owre (1962) have reported it from the Atlantic.

Family Oithonidae

Prosome and urosome quite distinct; prosome moderately wide; urosome narrow. Female A1 rather long, armed with long setae, without aesthetascs; both male A1 geniculate, terminal segment with aesthetasc. A2 2–4-segmented; Re absent. Mouthparts biting. Re and Ri of P1–P4 2- or 3-segmented. P5 a small conical segment (sometimes lacking) with 1–2 apical setae; another seta on side of segment anterior to P5.

Genus *Oithona* Baird

Head rounded or produced into beak-shaped rostrum. A2 2–3-segmented. Md with small 1-segmented Ri and 4-segmented Re; B2 with 2 setae on medial margin. Re and Ri of Mx1 1-segmented. Re and Ri of P1–P4 3-segmented except Ri of P1, rarely 2-segmented.

Members of the genus *Oithona* are among the most numerous and characteristic plankters of inshore waters throughout the world. The genus is large and the characters used to separate some of the species are slight. Some species have been described inadequately; e.g., such important characters as P5 and the terminal setae of the Md have been omitted in some descriptions. Identification consequently is sometimes difficult, and we therefore give rather detailed diagnoses of the Puerto Rican species and the artificial key below.

Kiefer (1935) removed the species of *Oithona* having 2 terminal setae on P5 and established the genus *Dioithona* for them. His decision, based on long experience with freshwater cyclopoids where the armature of the rudimentary P5 has high taxonomic value, has not been generally followed. We are not convinced that the genus should be divided on the basis of a single character; a thorough revision, using all available characters, is needed to determine the validity of Kiefer's action. Of the Puerto Rican species, only *Oithona oculata* is a *Dioithona*.

Key to Females of the Inshore Puerto Rican Species of *Oithona*

1. Re3 of P4 with 3 outer setae; anal segment short, about half as long as preceding segment; A1 reaches about to middle of Ped Seg 1; Ri of P1 2-segmented. **O. simplex** Farran
   Re3 of P4 with 2 outer setae; anal segment subequal to preceding segment; A1 reaches beyond Ped Seg 1; Ri of P1 3-segmented 2
2. Head with dorsal ocular lenses; genital segment with transverse dorsal ridge; P5 with 2 terminal setae. . . . . **O. oculata** Farran
   Head without dorsal lenses; genital segment without dorsal ridge; P5 with 1 terminal seta 3
   Head rather pointed; prosome about 1.5 times as long as urosome, with spots of blue pigment on ventral surface; B2 of Md with 2 heavy blunt terminal setae; egg sacs compact, with about 8 eggs in each. **O. hebes** Giesbrecht
3. Head truncate; prosome about 1.2 times as long as urosome, without ventral pigment; B2 of Md with long pointed terminal seta armed with coarse setules; egg sacs loose, with more than 20 eggs in each. **O. nana** Giesbrecht

Oithona hebes Giesbrecht

FIGURES 19, 20*a–b*

Oithona hebes Giesbrecht, 1891, p. 475; 1892, pp. 538, 549, pl. 34, figs. 8–9.—Grandori, 1912, p. 15.—Farran, 1913, p. 191 (key).—Rosendorn, 1917, p. 44.—Pesta, 1921, p. 551, fig. G5.—Kiefer, 1929, pp. 9–10; 1936, pp. 320–322, figs. 1–5.—Rose, 1933, p. 280, fig. 354.—Lindberg, 1950, p. 274 (key).
[?] *Oithona ovalis* Herbst, 1955, pp. 214–215, figs. 27, 28a–c.—Björnberg, 1963, pp. 76–77.
Oithona minuta T. Scott.—Coker and González, 1960.
[not] *Oithona hebes* Giesbrecht.—Wilson, 1942, p. 196.

FEMALE.—Length 0.53–0.56 mm. Prosome:urosome = about 1.5. Prosome oval, widest at posterior end of cephalosome. Head rather pointed anteriorly. Rostrum absent. Last 3 urosome segments subequal. Caudal ramus about 3 times as long as wide; lateral marginal seta inserted at proximal ⅓ of margin, 0.75 as long as lateral apical seta; relative lengths of apical setae (lateral apical seta = 1) 1:3.0:4.7:2.4; dorsal seta = 2.5. A1 reaches anterior margin of PedSeg 2. B2 of Md bears 2 heavy, equal setae, armed on margins with short setules; Ri bears 5 setae. Re of P1–P4 armed as follows:

Outer seta: 1–1–3, 1–1–3, 1–1–3, 1–1–2.
Inner setae: 0–1–4, 1–1–5, 1–1–5, 1–1–5.

Distal inner seta of Ri2 of P4 very robust. P5 with single long terminal seta.

MALE.—Length 0.48–0.54 mm. Prosome:urosome = about 1.4. Head wider than in female, truncate anteriorly. A1 usually folded in characteristic position as in figure 20*a*. A2, segment 3 relatively longer and narrower than in female. Setae on B2 of Md somewhat weaker than in female.

COLOR.—Distinctive pattern of blue pigment on ventral surface of prosome: ⊥-shaped patch in center of head between and behind ganglia; a spot at base of each A2 and a spot in midline between these (female) or a little more posterior (male); a much brighter and more conspicuous spot behind B1 of each P1.

This is the only species of *Oithona* in the Puerto Rican bays investigated that has pigment in the prosome; hence, identification is easy in freshly preserved collections.

REMARKS.—*Oithona hebes* was described briefly by Giesbrecht in 1889 from 2 females collected at the mouth of the Guayaquil River, Ecuador. Grandori (1912) reported 3 females from Laguna Veneta, Italy, but his identification was not supported by any description or illustration and must be considered questionable. Although listed in generic revisions, the species was not discovered again until Kiefer (1936) received several females and 2 males from Maria Farinha, in northeast Brazil, and redescribed it. The Puerto Rican specimens fit closely the accounts of *O. hebes* given by Giesbrecht and by Kiefer except that the caudal rami are relatively longer. In the specimens from Ecuador and from Brazil the rami are only about twice as long as wide, while in the Puerto Rican specimens the rami are 3 times as long as wide. A number of specimens from Puerto Rico were sent to Dr. Kiefer at Konstanz; he kindly compared them with his Brazilian specimens and reported good agreement except in the length:width ratio of the caudal rami. Dr. Kiefer also pointed out a character that we had overlooked: the robust distal inner seta of Ri2 of P4.

In the genus *Oithona*, considerable significance is given to the relative lengths of the caudal setae. Unfortunately, Giesbrecht gives no information on these setae in his accounts of *O. hebes*, and the lateral apical setae were broken in Kiefer's specimens. After receiving Puerto Rican specimens from us, Dr. Kiefer reexamined his Brazilian material and confirmed his earlier report on the incompleteness of the caudal setae, but he also wrote: "Nachdem diesen Befunden muss ich aber annehmen, das die äusserste Endborste auch bei den brasilianischen Tieren mindestens halb so lang wie die innerste war" (in litt., March 2, 1963).

In his key to the species of *Oithona*, the late K. Lindberg (1950) separates *O. dissimilis* and *O. hebes* by the relative lengths of their medial and lateral apical caudal setae. Lindberg indicates that the medial apical seta is about 4 times as long as the lateral apical seta in *O. hebes* but not more than 2.5 times as long in *O. dissimilis*. (In his original description of *O. dissimilis* (1940), the ratio is 2.2–2.3). Thus, in Lindberg's key the Puerto Rican specimens run to *O. dissimilis;* however, in *O. dissimilis*, from brackish water on the east coast of India, the head is truncate rather than pointed anteriorly;

A1 is a little longer, reaching the middle of the posterior margin of PedSeg 4; and Re3 of P1 has only 2 instead of 3 outer spines. Lindberg gives no indication as to the source of his information on the caudal setae of *O. hebes*. Pesta (1921) and Rose (1933) repeated Giesbrecht's illustrations and diagnosis without adding any details; hence, Lindberg's information on the caudal setae of *O. hebes* was not taken from any literature known to us.

At our request, Dr. Peter Dohrn kindly searched for *Oithona hebes* in the Giesbrecht collection at the Naples Zoological Station and reported (in litt., May 4, 1963) that it is not present. Fortunately, through the kindness of Dr. Harold Loesch, Instituto Nacional de Pesca del Ecuador, we obtained several plankton samples from Guayaquil, Ecuador, the type locality of *O. hebes*. Some of these samples contained specimens of *O. hebes* agreeing closely with the descriptions of Giesbrecht and of Kiefer. As shown in figure 20*b*, the caudal ramus is twice as long as wide, and the medial apical seta is about twice as long as the lateral apical seta, contrary to the statement in Lindberg's key.

The identity of *Oithona hebes* is clarified by these findings, but there remains the problem of how to treat the Puerto Rican form, which differs only in the proportions of the caudal ramus. Should it be considered a distinct species, a subspecies of *O. hebes*, or included under *O. hebes* without further nominal status? We are arbitrarily following the last course here but wish to emphasize that a decision cannot be made until reasonably complete information is available on the distribution of the 2 forms and the presence or absence of intergrades.

O. ovalis Herbst, from Cananéia, Brazil, appears to be very close to, if not identical with, *O. hebes*. Other species that resemble *O. hebes* in having 2 thick setae on B2 of Md are *O. minuta* T. Scott (1894) and *O. brevicornis* Giesbrecht (1891). *O. minuta*, from the Gulf of Guinea, differs in that P5 has 2 terminal setae (placing it in *Dioithona* Kiefer, 1935); the genital segment has lateral spinulose areas, and the lateral apical setae of the caudal rami are very long. *O. brevicornis*, originally described from Hong Kong, differs in having a well-developed rostrum. A species of *Oithona* identified as *O. brevicornis* by Wilson (1932a, 1932b) and Grice (1960a, 1960b) occurs along the east and Gulf of Mexico coasts of the United States. Wilson reported it from Chesapeake Bay (1932a) and Penzance Pond, Woods Hole, Mass. (1932b), and Grice found it to be abundant in nearshore and estuarine waters along the west coast of Florida.

One of us (Bowman) has identified this species from off Jacksonville, Fla., and from Laguna Madre of Texas. The identity of the United States species with the Hong Kong species is questionable since in the former the head is more rounded in dorsal view, the rostrum is not so strongly curved, and the lateral marginal seta of the caudal ramus is shorter than the ramus. Giesbrecht's descriptions of *O. brevicornis* are quite limited, and a detailed study of Hong Kong specimens is badly needed. In addition to the difference in rostral development, differences in the setae of B2 of the Md distinguish the American *O. brevicornis* from *O. hebes*. In the former the marginal setules are fewer and more widely spaced on the inner seta than on the outer seta, whereas in *O. hebes* the 2 setae are alike. In both species, Ri bears 5 setae although Rosendorn (1917) shows only 4 setae in *O. brevicornis*.

Oithona hebes was very abundant in the Puerto Rican bays. It was less numerous on the shelf but still ranked 4th among the copepods.

Oithona nana Giesbrecht

FIGURES 20*c–g*

Oithona nana Giesbrecht, 1892, pp. 541–546, 549, pl. 4, fig. 8; pl. 34, figs. 10, 11, 20, 24, 26, 34, 35, 42; pl. 44, figs. 2, 6.—Williams, 1907, p. 72.—Grandori, 1912, p. 14.—Gurney, 1927, pp. 159–160.—Carvalho, 1952, p. 167, pl. 2, figs. 95, 96.—Yamazi, 1956, p. 166, pl. 16, figs. 6A, B.—Grice, 1960a, p. 222; 1960b, pp. 487–488, figs. 7–11.—Tanaka, 1960, pp. 59–60, pl. 26, figs. 1–4.—Björnberg, 1963, p. 75, fig. 39.

Oithonina nana (Giesbrecht).—Sars, 1913, p. 5.—Wilson, 1932b, pp. 316–317, figs. 190c–d.—Davis, 1950, p. 90.—Davis and Williams, 1950, pp. 523–525 (tables).—King, 1950, p. 130 (table).—Woodmansee, 1958, pp. 254–255.

FEMALE.—Length 0.60–0.66 mm. Prosome:urosome = about 1.2. Head truncate anteriorly. Rostrum absent. Anal segment slightly shorter than 2 preceding segments, about as long as caudal ramus. Caudal ramus about 2.3 times as long as wide; lateral marginal seta inserted slightly proximal to middle of margin, about 0.8 as long as ramus. Lateral apical seta short, about half as long as ramus. A1 reaches middle of pedigerous segment 3. B2 of Md with long terminal seta armed on margins with strong setules and a much shorter slender seta; Ri with 4 setae. Re of P1–P4 armed as follows:

Outer setae: 1–1–3, 1–1–3, 1–1–3, 1–1–2.
Inner setae: 1–1–4, 1–1–5, 1–1–5, 1–1–5.

P5 with single terminal seta.

MALE.—Length 0.45–0.55 mm. Prosome:urosome = about 1.1. A1 typically folded as in *O. hebes*. P5 and P6 with single terminal setae.

REMARKS.—*O. nana* can be identified by the long urosome and A1 and the characteristic terminal seta on B2 of Md. The egg sacs are characteristic, being oval, rather loose, and usually having more than 20 eggs in each. In the other bay species of *Oithona*, the sacs are compact and have fewer eggs.

DISTRIBUTION.—Widespread in temperate and tropical coastal waters. In the Puerto Rican collections it was common both in the bays and on the shelf.

Oithona oculata **Farran**

FIGURES 20*h–i*, 21*a–e*

Oithona oculata Farran, 1913, pp. 188–189, pl. 30, figs. 8, 9; pl. 31, figs. 2–9.—Rosendorn, 1917, pp. 37–39.—Kiefer, 1929, p. 10.—Sewell, 1947, pp. 254–255.—Tanaka, 1960, pp. 60–61, pl. 26, figs. 5–10.—Björnberg, 1963, p. 76.—Vervoort, 1964, pp. 25–26.

Dioithona oculata (Farran).—Kiefer, 1935, p. 322.

FEMALE.—Length 0.65–0.70 mm. Prosome:urosome = about 1.5. Head rounded anteriorly. Rostrum absent, but head is slightly produced in front of and between A1 (fig. 20*h*). Genital segment with sclerotized transverse dorsal ridge in middle. Last 3 urosome segments and caudal ramus subequal. Caudal ramus about 2.8 times as long as wide; lateral marginal seta inserted slightly proximal to middle of margin, half as long as lateral apical seta; relative lengths of apical seta (lateral apical = 1) 1:3.4:4.1:1.9; dorsal seta = 1.1. Head with pair of lenses surrounded by blue pigment. A1 reaches middle of PedSeg 2. B2 of Md with 2 slender plumose setae; Ri with 5 setae. Re of P1–P4 armed as follows:

Outer setae: 1–1–3, 1–1–3, 1–1–3, 1–1–2.
Inner setae: 1–1–4, 1–1–5, 1–1–5, 1–1–5.

Terminal seta of P4 slightly longer than Re. P5 consists of short broad basal segment with long outer seta and narrow distal segment bearing 2 apical setae reaching posterior margin of genital segment. Egg sacs each with 8 eggs.

MALE.—Length about 0.60 mm. Prosome:urosome = about 1.4. Terminal segment of A1 drawn out into point distal to insertion of setae and aesthetascs. Seta of P6 reaches beyond middle of urosome segment 3.

REMARKS.—The conspicuous ocular lenses, the transverse ridge on the genital segment, and the 2 terminal setae on P5 separate *O. oculata* from other Puerto Rican species of *Oithona*. The ridge on the genital segment is not mentioned by Farran and not shown in his illustrations. We have not seen material from the type locality (Christmas Island, Indian Ocean), but we have examined specimens from Ifaluk Atoll, Caroline Islands, also studied by Vervoort (1964) and identified by him as *Oithona oculata*. The Ifaluk specimens closely resemble the Puerto Rican specimens and have the dorsal transverse ridge on the genital segment. The only difference we have noted is that the caudal ramus is slightly shorter in relation to its width in the Ifaluk specimens (cf. figs. 21*c*, 21*d*).

Farran also shows shorter terminal setae on P5 in the Christmas Island specimens, perhaps because the distal parts of these setae are very delicate and difficult to see.

Oithona alia (Kiefer, 1935), from India, resembles *O. oculata* but differs in lacking ocular lenses and in having the inner terminal seta of P5 much shorter than the outer seta. Other differences given by Kiefer are of doubtful significance.

Distribution.—Christmas Island, Indian Ocean (Farran); Samoa (Rosendorn); Nicobar Island (Sewell); Cape of Good Hope (Tanaka); Ifaluk Atoll, Caroline Islands (Vervoort); coast of Brazil (Björnberg). Our Puerto Rican specimens constitute the 2nd Atlantic record for this species. We have also identified specimens from Lameshur Bay, St. John, Virgin Islands.

Oithona simplex Farran

Figures 21*f–i*

Oithona simplex Farran, 1913, pp. 187–188, pl. 29, figs. 10–14; pl. 30, figs. 1, 2.—Rosendorn, 1917, pp. 44–46.—Gurney, 1927, p. 160.—Kiefer, 1929, p. 9.—Grice, 1960a, pp. 222–223; 1960b, p. 488, figs. 12–18.—Tanaka, 1960, pp. 64–65, pl. 28, figs. 1–6.

Female.—Length 0.36–0.43 mm. Prosome:urosome = about 2.0. Prosome rather heavyset in dorsal view; head broadly rounded anteriorly; rostrum absent. Anal segment about twice as wide as long; caudal ramus rather short, about 1.5 times as long as wide, lateral marginal seta inserted near proximal end, nearly as long as ramus. Lateral apical seta about twice as long as ramus. Relative lengths of apical setae (lateral apical seta = 1): 1:2:3:1.3. A1 reaches to or slightly beyond posterior margin of PedSeg 1. B2 of Md bearing a long stiff seta armed with a few large setules and a slender finely plumose seta; Ri with 5 setae. Ri of P1 2-segmented. Re of P1–P4 armed as follows:

Outer setae: 1–1–3, 1–1–3, 1–1–3, 1–1–3.
Inner setae: 1–1–4, 1–1–5, 1–1–5, 1–1–5.

P5 with single terminal seta.

Male.—Length about that of female. Prosome:urosome = about 1.4. Anal segment very short, as in female. A1 typically folded in U-shape.

Remarks.—*O. simplex* can be distinguished from the other Puerto Rican species of *Oithona* by its small size, plump prosome, short urosome, short anal segment, the setae on B2 of the Md, and the 2-segmented Ri of P1. As Grice (1960b) has pointed out, it differs in several respects form Farran's description. The prosome:urosome ratio is greater; A1 is shorter; the small inner seta of Re1 and the inner seta on Ri1 of P1 were missing in Farran's specimens; Re2 of P4 has 1 inner setae (2 in Farran's specimens), and the terminal seta of Re3 of P4 is relatively shorter in the Puerto Rican specimens.

Distribution.—Indian Ocean (Farran, Rosendorn, Tanaka), Suez Canal (Gurney), South China Sea (Tanaka), west of Bay of Biscay (Rosendorn), mouth of Amason River (Rosendorn), west coast of Florida (Grice). In the Puerto Rico collections it was one of the most common species in the bays as well as over the shelf.

Literature Cited

Bernard, Michelle

1958. Révision des *Calocalanus* (Copépodes Calanoida), avec description d'un genre nouveau et deux espèces nouvelles. Bull. Soc. Zool. France, vol. 83, pp. 1–15.

Bigelow, Henry Bryant

1926. Plankton of the offshore waters of the Gulf of Maine. Bull. U.S. Bur. Fish., vol. 40, pt. 2, 509 pp., 134 figs.

Bigelow, Henry B., and Sears, Mary

1939. Studies of the waters of the continental shelf, Cape Cod to Chesapeake Bay, III: A volumetric study of the zooplankton. Mem. Mus. Comp. Zool. Harvard College, vol. 54, no. 4, pp. 183–378.

Björnberg, Tagea K. S.

1963. On the marine free-living copepods off Brazil. Bol. Inst. Oceanogr. Univ. São Paulo, vol. 13, fasc. 1, pp. 1–142.

Boeck, Axel

1865. Oversigt over de ved Norges Kyster iagttagne Copepoder henhörende til Calanidernes, Cyclopidernes og Harpactidernes Familier. Vidensk.-Selskab. Forhand. for 1864, pp. 226–281.

Bousfield, E. L.

1955. Ecological control of the occurrence of barnacles in the Miramichi estuary. Bull. Nat. Mus. Canada, no. 137, pp. 1–69.

Bowman, Thomas E.

1957. A new species of *Calanopia* (Copepoda: Calanoida) from the Caribbean Sea. Proc. U.S. Nat. Mus., vol. 107, no. 3382, pp. 39–45.

1958. A new species of *Acrocalanus* (Copepoda: Calanoida) from off the southeastern coast of the United States. Bull. Mar. Sci. Gulf and Caribbean, vol. 8, no. 2, pp. 118–124.

1961. The copepod genus *Acartia* in Chesapeake Bay. Chesapeake Sci., vol. 2, nos. 3–4, pp. 206–207.

Brady, George Stewardson

1883. Copepoda. Vol. 8 (pt. 23) *of* Zoology *in* Thomson and Murray, Report on the scientific results of the voyage of H.M.S. *Challenger* . . . 1873–76, 142 pp., 55 pls.

Breuer, Joseph P.

1957. An ecological survey of Baffin and Alazan Bays, Texas. Publ. Inst. Mar. Sci. Univ. Texas, vol. 4, pp. 134–155.

1962. An ecological survey of the lower Laguna Madre of Texas, 1953–1959. Publ. Inst. Mar. Sci. Univ. Texas, vol. 8, pp. 153–183.

Carvalho, J. de Paiva
1945. Copépodos de Caiobá e Baía de Guaratúba. Arq. Mus. Paranaense, vol. 4, art. 3, pp. 83–116, pls. 6–12.
1952. Sôbre uma coleção de copépodos, não parasíticos, de Baía de Santos e suas adjacências. Bol. Inst. Oceanogr. Univ. São Paulo, vol. 3, fascs. 1–2, pp. 131–187.

Cervigón, Fernando
1962. Contribución al conocimiento de los copépodos pelágicos de las costas de Venezuela. Mem. Soc. Ciencias Nat. LaSalle, vol. 22, no. 63, pp. 181–197.

Chiba, Takuo
1953a. Studies on the pelagic Copepoda from the Japan Sea, 3: On the genus of *Temora* Baird 1850. Bull. Japanese Soc. Sci. Fisheries, vol. 18, no. 12, pp. 695–697.
1953b. On the distribution of the plankton in the East China Sea and Yellow Sea, 8: Description on the male of the pelagic Copepoda, *Temora stylifera* and *T. discaudata*. Bull. Japanese Soc. Sci. Fisheries, vol. 19, no. 6, pp. 722–725.

Clarke, George L.
1934. The diurnal migration of copepods in St. George's Harbor, Bermuda. Biol. Bull., vol. 67, no. 3, pp. 456–460.

Claus, Carl
1863. Die freilebenden Copepoden mit besonderer Berücksichtigung der Fauna Deutschlands, der Nordsee und des Mittelmeeres, 230 pp., 37 pls.

Cleve, Per Theodor
1900. The seasonal distribution of Atlantic plankton organisms, 369 pp.
1901. Plankton from the Indian Ocean and the Malay Archipelago. Kongl. Svenska Vetensk. Akad. Handl., vol. 35, no. 5, 58 pp., 8 pls.
1904. Report on plankton collected by Mr. Thorild Wulff during a voyage to and from Bombay. Ark. Zool., vol. 1, pp. 329–381, pls. 16–19.

Coker, Robert E., and Juan G. González
1960. Limnetic copepod populations of Bahía Fosforescente and adjacent waters, Puerto Rico. Journ. Elisha Mitchell Sci. Soc., vol. 76, no. 1, pp. 8–28.

Conover, Robert J.
1957. Notes on the seasonal distribution of zoopolankton in Southampton waters with special reference to the genus *Acartia*. Ann. Mag. Nat. Hist., ser. 12, vol. 10, pp. 63–67.

Cronin, L. Eugene; Daiber, Joanne C.; and Hulbert, E. M.
1962. Quantitative seasonal aspects of zooplankton in the Delaware River Estuary. Chesapeake Sci., vol. 3, no. 2, pp. 63–93.

Cuzon du Rest, Rene P.
1963. Distribution of the zooplankton in the salt marshes of southeastern Louisiana. Publ. Inst. Mar. Sci. Univ. Texas, vol. 9, pp. 132–155.

Dahl, Friedrich
1894a. Die Copepodenfauna des unteren Amazonas. Ber. Naturforsch. Ges. Freiburg, new series, vol. 8, pp. 10–23, pl. 1.
1894b. Über die horizontale und verticale Verbreitung der Copepoden im Ocean. Verhandl. Deutschen Zool. Ges., vol. 4, pp. 61–80.

DAHL, MARIA
1912. Die Copepoden der Plankton-Expedition, 1: Die Corycaeinen. Vol. 2 G. f. *in* Hensen, Ergebnisse . . . der Plankton-Expedition der Humboldt-Stiftung, iv+134 pp., 15 pls., 1 map.

DANA, JAMES DWIGHT
1847. Conspectus Crustaceorum quae in orbis terrarum circumnavigatione, Carlo Wilkes e classe Reipublicae Foederatae duce, lexit et descripsit Jacobus D. Dana, Pars I. Proc. American Acad. Arts Sci., vol. 1, pp. 149–154.
1849. Conspectus Crustaceorum quae in orbis terrarum circumnavigatione, Carlo Wilkes e Classe Reipublicae Foederatae Duce, lexit et descripsit Jacobus D. Dana, Pars II. Proc. American Acad. Arts Sci., vol. 2, pp. 9–61.

DARNELL, REZNEAT M.
1961. Trophic spectrum of an estuarine community, based on studies of Lake Pontchartrain, Louisiana. Ecology, vol. 42, no. 3, pp. 553–568.

DAVIS, CHARLES C.
1944. On four new species of Copepoda new to Chesapeake Bay, with a description of a new variety of *Paracalanus crassirostris* Dahl. Chesapeake Biol. Lab. Publ., no. 61, pp. 1–11.
1950. Observations of plankton taken in the marine waters of Florida in 1947 and 1948. Quart. Journ. Florida Acad. Sci., vol. 12, pp. 67–103.

DAVIS, CHARLES C., and WILLIAMS, R. H.
1950. Brackish water plankton from mangrove areas in southern Florida. Ecology, vol. 31, pp. 519–531.

DEEVEY, GEORGIANA B.
1948. The zooplankton of Tisbury Great Pond. Bull. Bingham Oceangr. Coll., vol. 12, art. 1, pp. 1–44.
1952a. A survey of the zooplankton of Block Island Sound, 1943–1946. Bull. Bingham Oceangr. Coll., vol. 13, art. 3, pp. 65–119.
1952b. Quantity and composition of the zooplankton of Block Island Sound, 1949. Bull. Bingham Oceangr. Coll., vol. 13, art. 3, pp. 120–164.
1956. Oceanography of Long Island Sound, 1952–1954, 5: Zooplankton. Bull. Bingham Oceanogr. Coll., vol. 15, pp. 113–155.
1960. The zooplankton of the surface waters of the Delaware Bay region. Bull. Bingham Oceanogr. Coll., vol. 17, art. 2, pp. 5–53.

ESTERLY, CALVIN O.
1911. Calanoid Copepoda from the Bermuda Islands. Proc. Amer. Acad. Arts Sci., vol. 47, no. 7, pp. 219–226, pls. 1–9.

FARRAN, G. P.
1913. Plankton from Christmas Island, Indian Ocean, 2: On Copepoda of the genera *Oithona* and *Paroithona*. Proc. Zool. Soc. London, 1913, pp. 181–193, pls. 27–31.
1929. Copepoda. Pt. 10 *of* Crustecea *in* vol. 8, no. 3, *of* Zoology *in* Natural history report *of* British Antarctic ("Terra Nova") Expedition, 1910, pp. 203–306, 37 figs., 4 pls.

FISH, ARTHUR G.
1962. Pelagic copepods from Barbados. Bull. Mar. Sci. Gulf and Caribbean, vol. 12, no. 1, pp. 1–38.

Fish, Charles J.
1955. Observations on the biology of *Microsetella norvegica*. Deep-Sea Res., suppl. vol. 3 (Papers in Marine Biology and Oceanography), pp. 242–249.

Foster, E.
1904. Notes on the free-swimming copepods of the waters in the vicinity of the Gulf Biologic Station, Louisiana. Bull. Gulf Biol. Sta., vol. 2, pp. 69–79.

Fruchtl, F.
1923. Cladocera und Copepoda der Aru-Inseln. (Vorlaufige Mitteilung: Artenlist und kurze diagnosen der neuen Formen). Abh. Senck. Naturf. Ges., vol. 37, no. 4, pp. 449–457, pl. 26.
1924. Die Cladoceren—und Copepoden—Fauna des Aru-Archipels: Mit Beiträgen zur Kenntnis der strukturellen Anomalien indo-pazifischer Plankton-Copepoden. Arb. Zool. Inst. Univ. Innsbruck, vol. 2, no. 2, pp. 3–114, figs. 1–79.

Giesbrecht, Wilhelm
1888. Elenco dei Copepodi pelagici raccolti dal tenente di vascello Gaetano Chierchia durante il viaggio della R. Corvetta "Vettor Pisani" negli anni 1882–1885, e dal tenente di vascello Francesco Orsini nel Mar Rosso, nel 1884. Atti Rend. Accad. Lincei, Rome, ser. 4, vol. 4, sem. 2, pp. 330–338.
1889. [Same title.] Atti Rend. Accad. Lincei, Rome, ser. 4, vol. 5, sem. 2, pp. 24–29.
1891. [Same title.] Atti Rend. Accad. Lincei, Rome, ser. 4, vol. 7, sem. 1, pp. 474–481.
1892. Systematik und Faunistik der pelagischen Copepoden des Golfes von Neapel und der angrenzenden Meeresabschnitte. Fauna und Flora des Golfes von Neapel, monogr. 19, 831 pp., 54 pls.

Giesbrecht, Wilhelm, and Schmeil, Otto
1898. Copepoda, 1: Gymnoplea. Das Tierreich, lief. 6 (Crustacea), 196 pp., 31 text figs.

Gooding, Richard U.
1957. On some Copepoda from Plymouth, mainly associated with invertebrates, including three new species. Journ. Mar. Biol. Assoc., vol. 36, pp. 195–221.

Grandori, Remo
1912. I copepodi. Pp. 1–41 *in* Carazzi and Grandori. Ricerche sul plancton della Laguna Veneta, vii+64 pp., 7 tables.

Grice, George C.
1956. A qualitative and quantitative seasonal study of the Copepoda ot Alligator Harbor. Florida State Univ. Studies, no. 22, pp. 37–76.
1960a. Calanoid and cyclopoid copepods collected from the Florida Gulf Coast and Florida Keys in 1954 and 1955. Bull. Mar. Sci. Gulf and Caribbean, vol. 10, no. 2, pp. 217–226.
1960b. Copepods of the genus *Oithona* from the Gulf of Mexico. Bull. Mar. Sci. Gulf and Caribbean, vol. 10, no. 4, pp. 485–490.

Grice, George D., and Hart, Arch D.
1962a. The abundance, seasonal occurrence and distribution of the epizooplankton between New York and Bermuda. Ecol. Monogr., vol. 32, no. 4, pp. 287–309.

1962b. The abundance, seasonal occurrence and distribution of the epizooplankton between New York and Bermuda. Appendix to Ref. 62–4, Woods Hole Oceanographic Institution [unpublished manuscript].

GURNEY, ROBERT
1927. Report on the Crustacea: Copepoda and Cladocera of the plankton. *In* Zoological results of the Cambridge Expedition to the Suez Canal, 1924. Trans. Zool. Soc. London, vol. 22, no. 2, pp. 139–172.

HERBST, HANS VOLKMAR
1955. Cyclopoida Gnathostoma (Crustacea Copopoda) von der brasilianischen Atlantikküste. Kieler Meeresf., vol. 11, no. 2, pp. 214–229.

HERRICK, CLARENCE L.
1887. List of the fresh-water and marine Crustacea of Alabama, with descriptions of the new species and synoptical keys for identification. Mem. Denison Sci. Assoc., vol. 1, no. 1, pp. 1–56, pls. 1–9. [Also *in* Geol. Surv. Alabama Bull., no. 1, vol. 5, pp. 1–56, pls. 1–9.]

JACOBS, JÜRGEN
1961. Laboratory cultivation of the marine copepod *Pseudodiaptomus coronatus* Williams. Limnol. and Oceanogr., vol. 6, no. 4, pp. 443–446.

JAKOBI, HANS
1954. Harpacticoida (Cop. Crust.) da microfauna do substrato arenolodoso do "Mar de Dentro" (Ilha do Mel—Baía de Paranaguá—Brazil). Dusenia, vol. 5, no. 5–6, pp. 209–232.

JEFFRIES, HARRY P.
1962. Copepod indicator species in estuaries. Ecology, vol. 43, no. 4, pp. 730–732.

JESPERSON, P.
1940. Non-parasitic Copepoda. Zool. Iceland, vol. 3, pt. 33, pp. 1–116.

KIEFER, FRIEDRICH
1929. Copepoda, 2: Cyclopoida Gnathostoma. Vol. 53 *in* Das Tierreich, xvi+102 pp., 42 text figs.
1935. Zur Kenntnis der Oithonidae (Crustacea Copepoda Cyclopoida). Zool. Anz., vol. 112, no. 11–12, pp. 322–327.
1936. Brasilianische Ruderfusskrebse (Crustacea Copepoda), gesammelt von Herrn Otto Schubart, 3: Zur Kenntnis der *Oithona hebes.* Giesbrecht. Zool. Anz., vol. 114, no. 11–12, pp. 320–322.

KING, JOSEPH E.
1950. A preliminary report on the plankton of the west coast of Florida. Quart. Journ. Florida Acad. Sci., vol. 12, no. 2, pp. 109–137.

KLIE, WALTER
1949. Harpacticoida (Cop.) aus dem Bereich von Helgoland und der Kieler Bucht 1. Kieler Meeresf., vol. 6, pp. 90–128.

LANG, KARL
1948. Monographie der Harpacticiden, 2 vols., 1682 pp.

LÉGARÉ, JOSEPH HENRI
1961. Estudios preliminares del zooplancton en la region de Cariaco. Bol. Inst. Oceanogr. Cumaná, vol. 1, no. 1, pp. 191–218.

LINDBERG, KNUT
1940. Cyclopoïdes (Crustacés Copépodes) de l'Inde. Rec. Indian Mus., vol. 42, pt. 3, pp. 519–526.
1950. Cyclopoïdes nouveaux ou peu connus (Crustacés Copépodes). Mém. Mus. Nat. Hist. Nat. Paris, new series, vol. 29, no. 3, pp. 259–297.

MOORE, HILARY B.
1949. The zooplankton of the upper waters of the Bermuda area of the North Atlantic. Bull. Bingham Oceanogr. Coll., vol. 12, art. 2, pp. 1–97.

MORI, TAKAMOCHI
1937. The pelagic Copepoda from the neighboring waters of Japan, 150 pp., 80 pls.

NICHOLLS, A. G.
1941. Littoral Copepoda from South Australia, 1: Harpacticoida. Rec. South Australian Mus., vol. 6, no. 4, pp. 381–427.

NOODT, WOLFRAM
1956. Verzeichnis der im Eulitoral der schleswig-holsteinischen Küsten angetroffenen Copepoda Harpacticoidea. Schr. Naturw. Ver. Schleswig-Holstein, vol. 28, no. 1, pp. 42–64.
1957. Zur Ökologie der Harpacticoidea (Crust. Cop.) des Eulitorals der Deutschen Meeresküste und der angrenzenden Brackgewässer. Zeitschr. Morphol. Okol. Tiere, vol. 46, pp. 149–242.

OLIVEIRA, LEJEUNE P. H. DE
1945. Contribuição ao conhecimento dos Crustáceos do Rio de Janeiro: Ordem Eucopepoda. Mém. Inst. Oswaldo Cruz, vol. 42, fasc. 2, pp. 449–472.
1947. Estudos sôbre o microplankton capturado durante a viagem do navio hidrográfico Lahmeyer nas baíes de Ihla Grande e Sepetiba. Mém. Inst. Oswaldo Cruz, vol. 44, fasc. 3, pp. 441–488.

OWRE, HARDING B.
1962. Plankton of the Florida Current, 8: A list of the Copepoda. Bull. Mar. Sci. Gulf and Caribbean, vol. 12, no. 3, pp. 489–495.

PESTA, OTTO
1916. Crustacea, I: Copepoda. Pp. 1–10 *in* Michaelsen, Beiträge zur Kenntnis der Meeresfauna Westafricas.
1959. Harpacticoiden (Crust. *Copepoda*) aus submarinen Höhlen und den benachbarten Litoralbezirken am Kap von Sorrent (Neapel). Pubbl. Stat. Zool. Napoli, vol. 30, suppl., pp. 95–177.

REEVE, M. R.
1964. Studies on the seasonal variation of the zooplankton in a marine sub-tropical in-shore environment. Bull. Mar. Sci. Gulf and Caribbean, vol. 14, no. 1, pp. 103–122.

REMY, PAUL
1927. Note sur un copépode de l'eau saumâtre du canal de Caen à la mer [*Acartia* (*Acanthacartia*) *tonsa* Dana]. Ann. Biol. Lacustre, vol. 15, pp. 169–186.

ROSE, MAURICE
1933. Copépodes pélagiques. Faune de France, no. 26, 374 pp.

ROSENDORN, ILSE
1917. Die Gattung *Oithona*. Wiss. Ergebn. Deutschen Tiefsee-Exped., vol. 23, pp. 1–58, figs. 1–4, 1 map.

SARS, GEORGE OSSIAN
1903. Copepoda Harpacticoida. Vol. 5 *of* An account of the Crustacea of Norway, pts. 1, 2, pp. 1–28, pls. 1–16.
1913. Copepoda Cyclopoida. Vol. 6 *of* An account of the Crustacea of Norway, pts. 1, 2 (Oithonidae, Cyclopinidae, Cyclopidae [part]), pp. 1–80.

SCHWARZ, S.
1960. Zur Crustaceenfauna der Brackwassergebiete Rügens und des Darss. (*Acartia tonsa, Caligus lacustris, Microdeutopus gryllotalpa*). Hydrobiologia, vol. 16, no. 3, pp. 293–300.

SCOTT, ANDREW
1909. The Copepoda of the *Siboga* Expedition, 1: Free-swimming, littoral and semi-parastic Copepoda. Monogr. 29a (livr. 44) *in* Weber, Siboga-Expeditie, 323 pp., 69 pls.

SCOTT, THOMAS
1894. Report on Entomostraca from the Gulf of Guinea. Trans. Linn. Soc. London, Ser. 2 (Zoology), vol. 6, pt. 1, pp. 1–161, pls. 1–15.
1912. The Entomostraca of the Scottish National Antarctic Expedition, 1902–4. Trans. Roy. Soc. Edinburgh, vol. 48, pt. 3, no. 24, pp. 521–599, pls. 1–14.
1914. Remarks on some Copepoda from the Falkland Islands collected by Mr. Rupert Vallentin, F. L. S. Ann. Mag. Nat. Hist, ser. 8, vol. 13, pp. 1–11, pls. 1–2.

SEWELL, R. B. SEYMOUR
1929, 1931. The Copepoda of Indian Seas: Calanoida. Mem. Indian Mus., vol. 10, pp. 1–221, 81 figs., 1929; pp. 223–407, figs. 82–131, 6 pls., 1932.
1947. The free-swimming planktonic Copepoda: Systematic account. Sci. Rep. John Murray Exped., 1933–34, vol. 8, no. 1, pp. 1–303.

SIMMONS, ERNEST G.
1957. An ecological survey of the upper Laguna Madre of Texas. Publ. Inst. Mar. Sci. Univ. Texas, vol. 4, pp. 156–200.

STEUER, ADOLF
1915. Revision der Gattung *Acartia* Dana (Dritte vorläufige Mitteilung über die Copepoden der Valdivia-Expedition. Zool Anz., vol. 45, no. 9, pp. 392–397.
1923. Bausteine zu einer Monographie der Copepodengattung *Acartia*. Arb. Zool. Inst. Univ. Inssbrück, vol. 1, pt. 5, pp. 1–56, 5 pls.
1926. Revision der Copepodengattung *Tortanus* Giesbrecht. Boll. Soc. Adratica Sci. Nat. Trieste, vol. 29, pp. 49–69.

SUTCLIFFE, WILLIAM H., JR.
1948. A list of calanoid copepods from the plankton at Beaufort, N.C. Journ. Elisha Mitchell Sci. Soc., vol. 64, no. 2, pp. 234–236.

TANAKA, OTOHIKO
1960. Pelagic Copepoda. Biol. Res. Japanese Antarctic Res. Exp., no. 10, pp. 1–95, pls. 1–40.

THOMPSON, ISAAC COOKE, and SCOTT, ANDREW
1903. Report on the Copepoda collected by Prof. Herdman, at Ceylon, in 1902. No. 7 *in* Part 1 (Supplementary Reports) *of* Herdman, Report to the Government of Ceylon on the Pearl Oyster Fisheries of the Gulf of Manaar, pp. 227–307, pls. 1–20.

VERVOORT, WILLEM
1946. The Copepoda of the Snellius Expedition, 1. Temminckia, vol. 8, pp. 1–181.
1964. Free-living Copepoda from Ifaluk Atoll in the Caroline Islands with notes on related species. U.S. Nat. Mus. Bull. 236, 431 pp., 151 text figs.

WHEELER, WILLIAM MORTON
1901. The free-swimming copepods of the Woods Hole region. Bull. U.S. Fish Comm., vol. 19, pp. 157–192.

WICKSTEAD, JOHN H.
1956. A note on some pelagic copepods from the West Indies. Journ. Barbados Mus. Hist. Soc., vol. 24, no. 1, pp. 3–38.

WILLEY, ARTHUR
1923. Ecology and the partition of biology. Trans. Roy. Soc. Canada, ser. 3, vol. 17, pp. 1–9.

WILLIAMS, LEONARD W.
1906. Notes on marine Copepoda of Rhode Island. American Nat., vol. 40, pp. 639–660.
1907. List of the Rhode Island Copepoda, Phyllopoda, and Ostracoda, with new species of Copepoda. Ann. Rep. Comm. Inland Fish. Rhode Island, 37, spec. pap. no. 30, pp. 69–79, pls. 1–3.

WILSON, CHARLES BRANCH
1932a. The copepod crustaceans of Chesapeake Bay. Proc. U.S. Nat. Mus., vol. 80, no. 2915, pp. 1–54, pls. 1–5.
1932b. The copepods of the Woods Hole Region, Massachusetts. U.S. Nat. Mus. Bull. 158, xix+635 pp., 41 pls.
1942. The copepods of the plankton gathered during the last cruise of the *Carnegie*. No. 1 *of* Biology *in* Scientific Results of Cruise 7 of the *Carnegie* during 1928–1929 under the command of Capt. J. P. Ault (Carnegie Institute of Washington Publication 536), v+237 pp., 16 charts, 136 figs.
1950. Copepods gathered by the United States Fisheries Steamer *Albatross* from 1887 to 1909, chiefly in the Pacific Ocean. U.S. Nat. Mus. Bull. 100, vol. 14, pt. 4, ix+441 pp., 36 pls.

WILSON, MILDRED S.
1949. A new species of copepod of the genus *Corycaeus* from the North American coast. Proc. U.S. Nat. Mus., vol. 99, no. 3239, pp. 321–326, pl. 18.

WOLFENDEN, RICHARD NORRIS
1905. Notes on the collection of Copepoda. No. 27 *in* vol. 2 *of* Gardiner, The Fauna and Geography of the Maldive and Laccadive Archipelagoes, pp. 989–1040, pls. 96–100.

WOODMANSEE, ROBERT A.
1958. The seasonal distribution of the zooplankton off Chicken Key in Biscayne Bay, Florida. Ecology, vol. 39, no. 2, pp. 247–262.

YAMAZI, ISAMU
1956. Plankton investigation in inlet waters along the coast of Japan, 19: Regional characteristics and classification of inlet waters based on the plankton communities. Publ. Seto. Mar. Biol. Lab., vol. 5, no. 2, pp. 157–196, pls. 16–23.

ZOPPI, EVELYN
1961. Distribución vertical del zooplancton en el Golfo y extremo este de la Fosa de Cariaco. Bol. Inst. Oceanogr. Cumaná, vol. 1, no. 1, pp. 219–247.

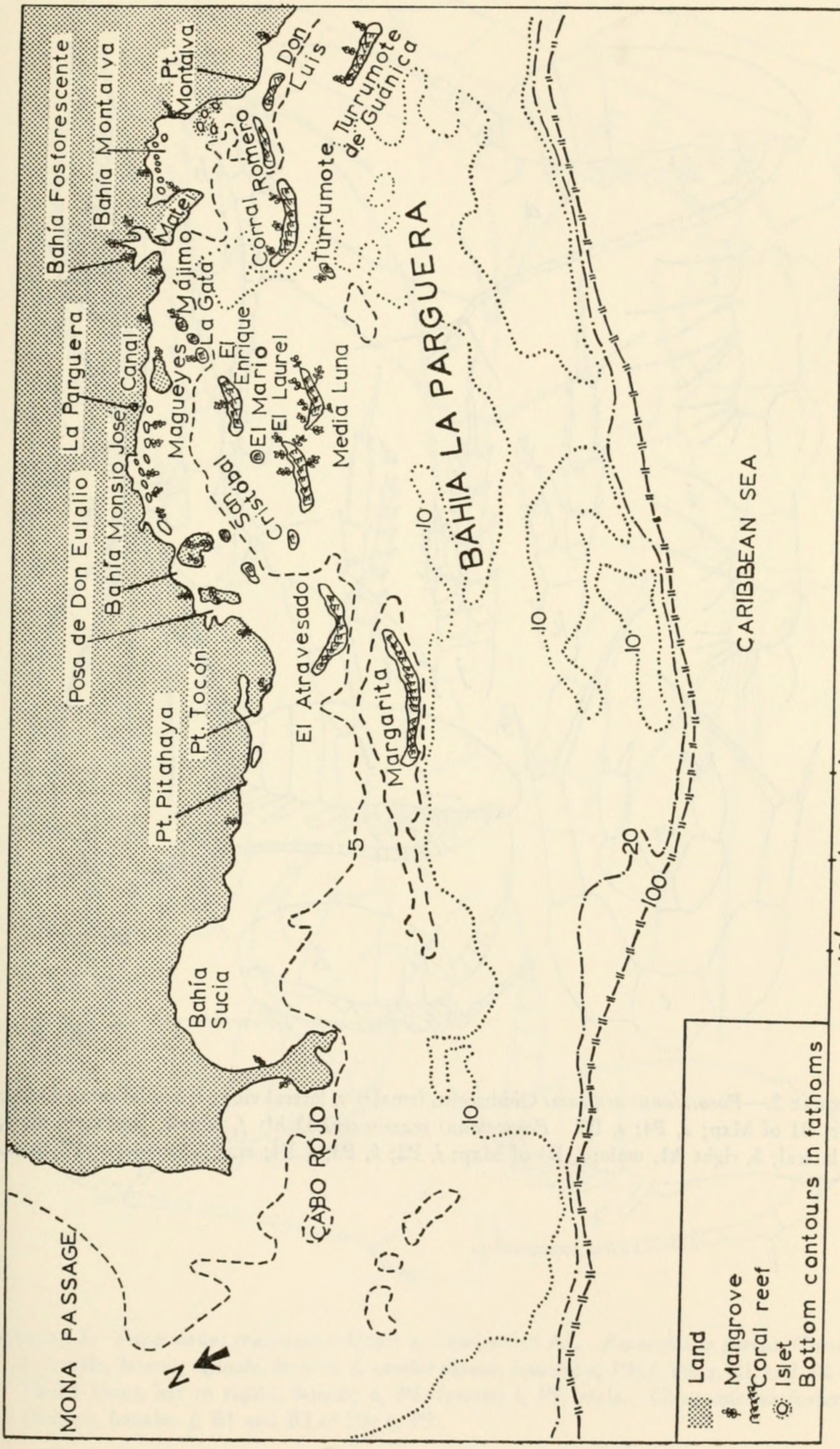


FIGURE 1.—Southwest coast of Puerto Rico, showing region where plankton samples were collected.

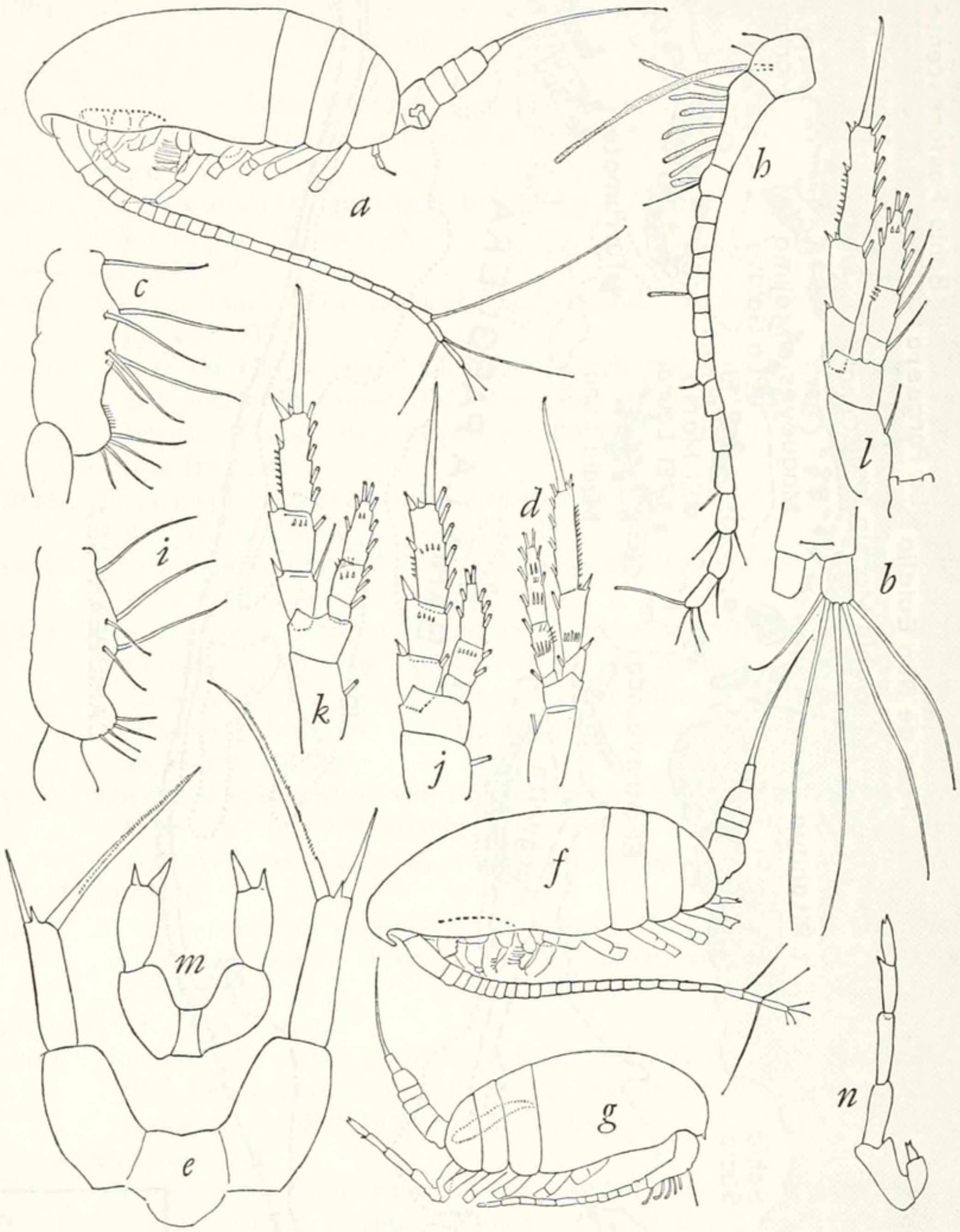


FIGURE 2.—*Paracalanus aculeatus* Giesbrecht, female: *a*, lateral view; *b*, caudal rami, dorsal; *c*, B1 of Mxp; *d*, P4; *e*, P5. *Paracalanus crassirostris* Dahl: *f*, female, lateral; *g*, male, lateral; *h*, right A1, male; *i*, B1 of Mxp; *j*, P2; *k*, P3; *l*, P4; *m*, P5, female; *n*, P5, male.

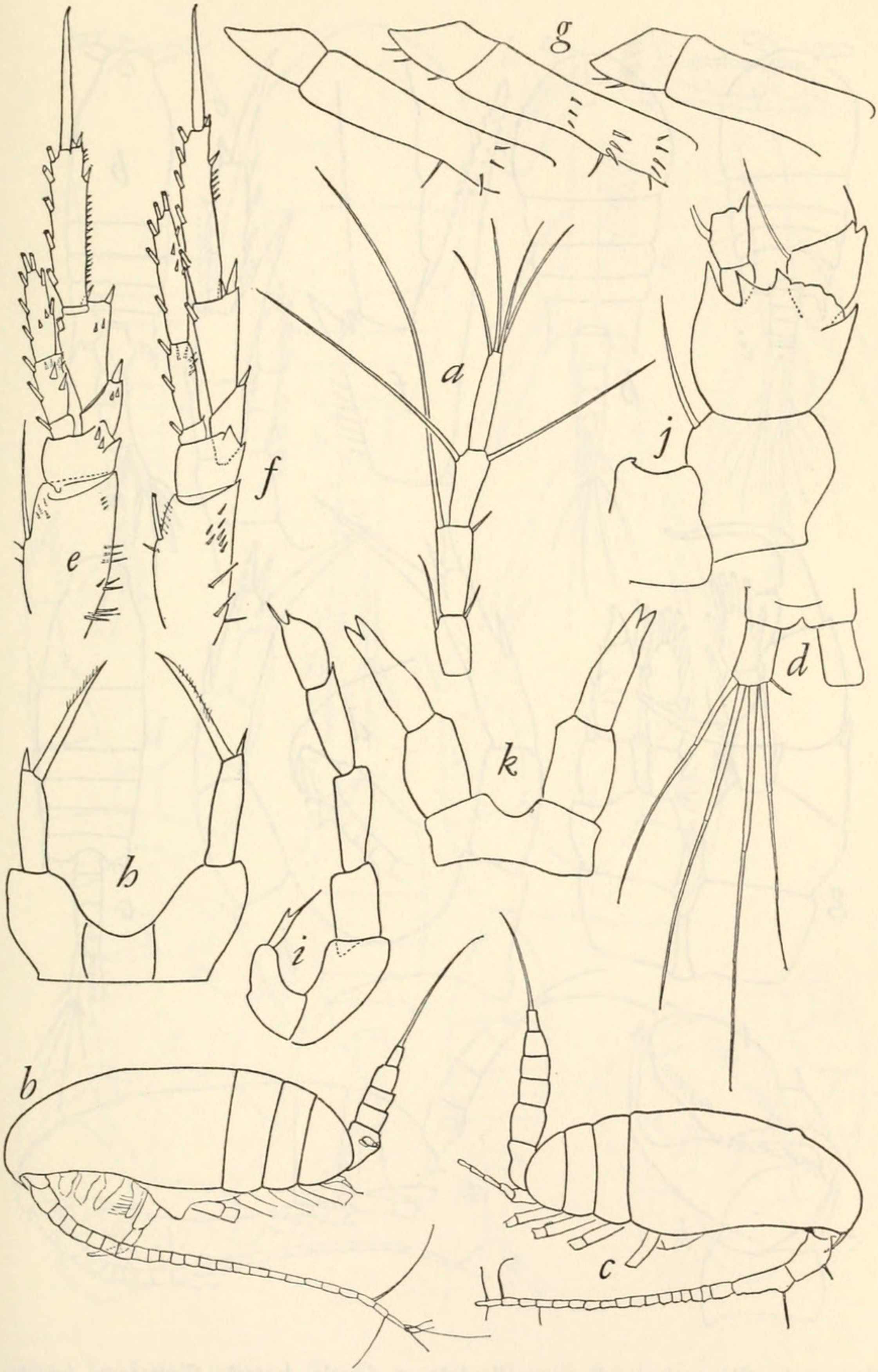


FIGURE 3.—*Paracalanus crassirostris* Dahl: *a*, distal end of A1. *Paracalanus parvus* (Claus): *b*, female, lateral; *c*, male, lateral; *d*, caudal ramus, female; *e*, P3; *f*, P4; *g*, B1 and B2 of P2–P4 (from left to right), lateral; *h*, P5, female; *i*, P5, male. *Clausocalanus furcatus* (Brady), female: *j*, B1 and B2 of P3; *k*, P5.

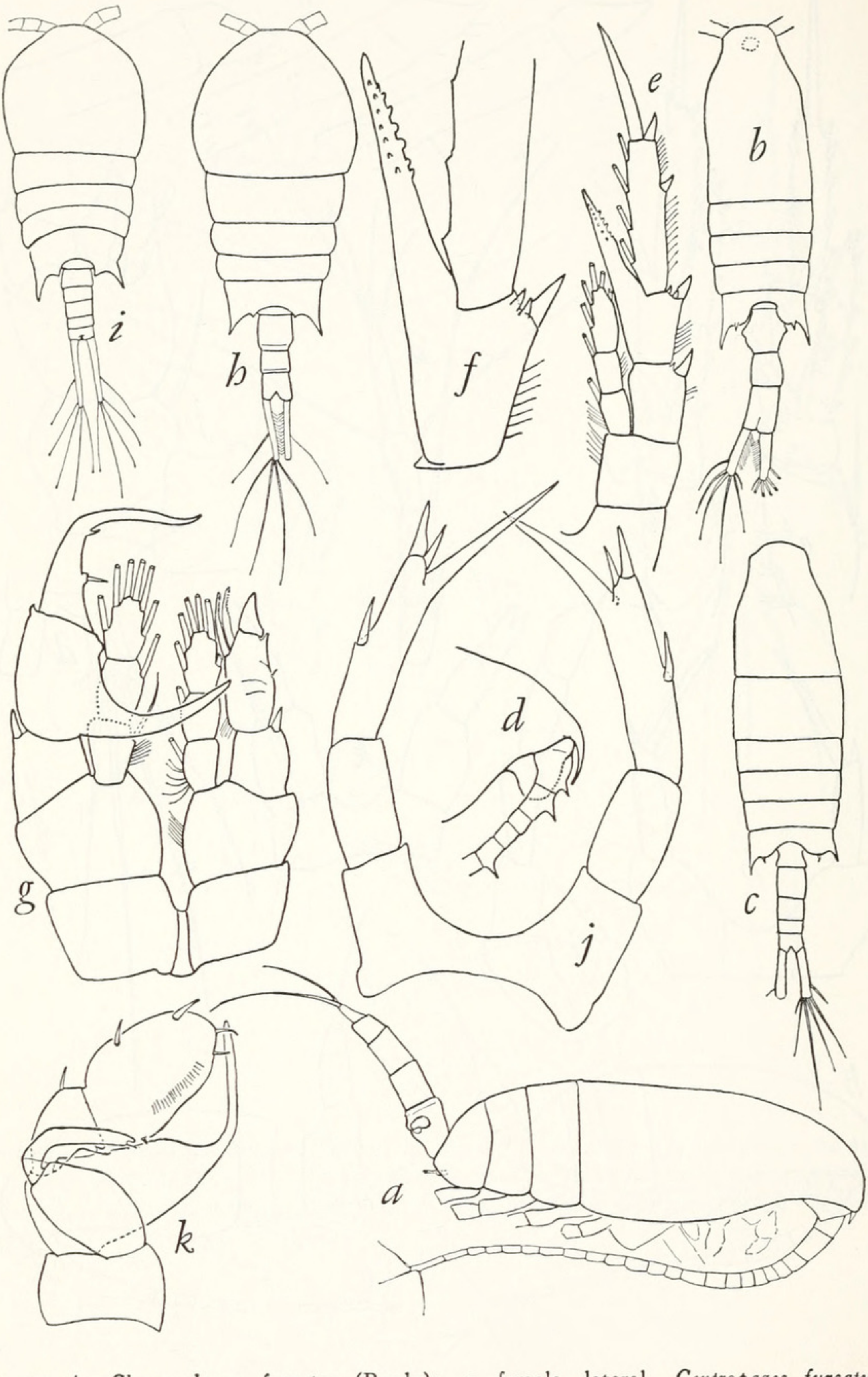


FIGURE 4.—*Clausocalanus furcatus* (Brady): *a*, female, lateral. *Centropages furcatus* (Dana): *b*, female, dorsal; *c*, male, dorsal; *d*, head of female, lateral; *e*, P5, female; *f*, Ri2 of P5, female; *g*, P5, male. *Temora stylifera* Dana: *h*, female, dorsal; *i*, male, dorsal; *j*, P5, female; *k*, P5, male.

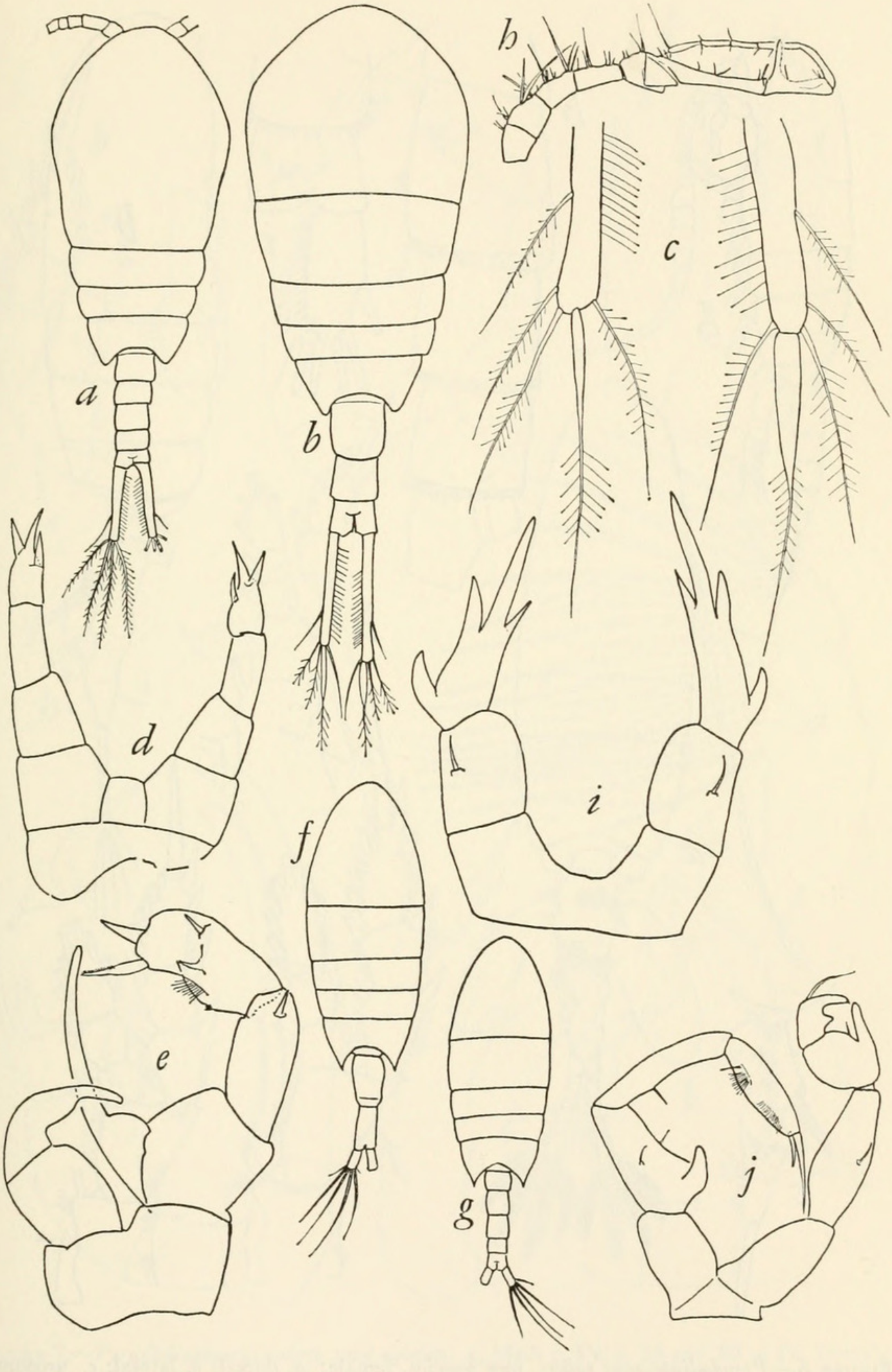


FIGURE 5.—*Temora turbinata* (Dana): *a*, male, dorsal; *b*, female, dorsal; *c*, caudal rami, female, dorsal; *d*, P5, female; *e*, P5, male. *Calanopia americana* Dahl: *f*, female, dorsal; *g*, male, dorsal; *h*, A1, male; *i*, P5, female; *j*, P5, male.

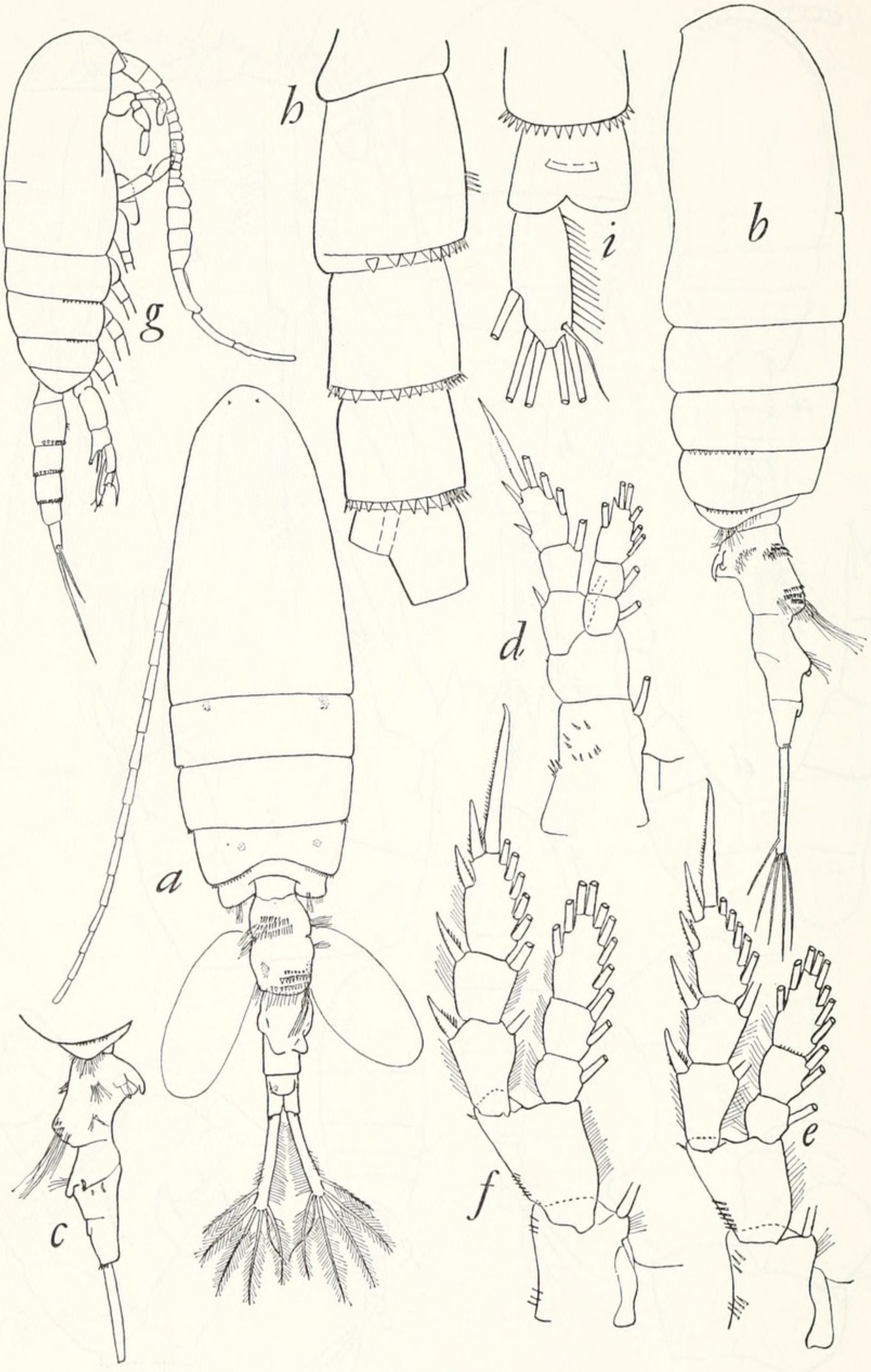


FIGURE 6.—*Pseudodiaptomus cokeri*, new species, female: *a*, dorsal; *b*, lateral; *c*, urosome, right aspect; *d*, P1; *e*, P2; *f*, P3. Male: *g*, lateral; *h*, urosome, lateral; *i*, urosome segments 4–5 and caudal rami, dorsal.

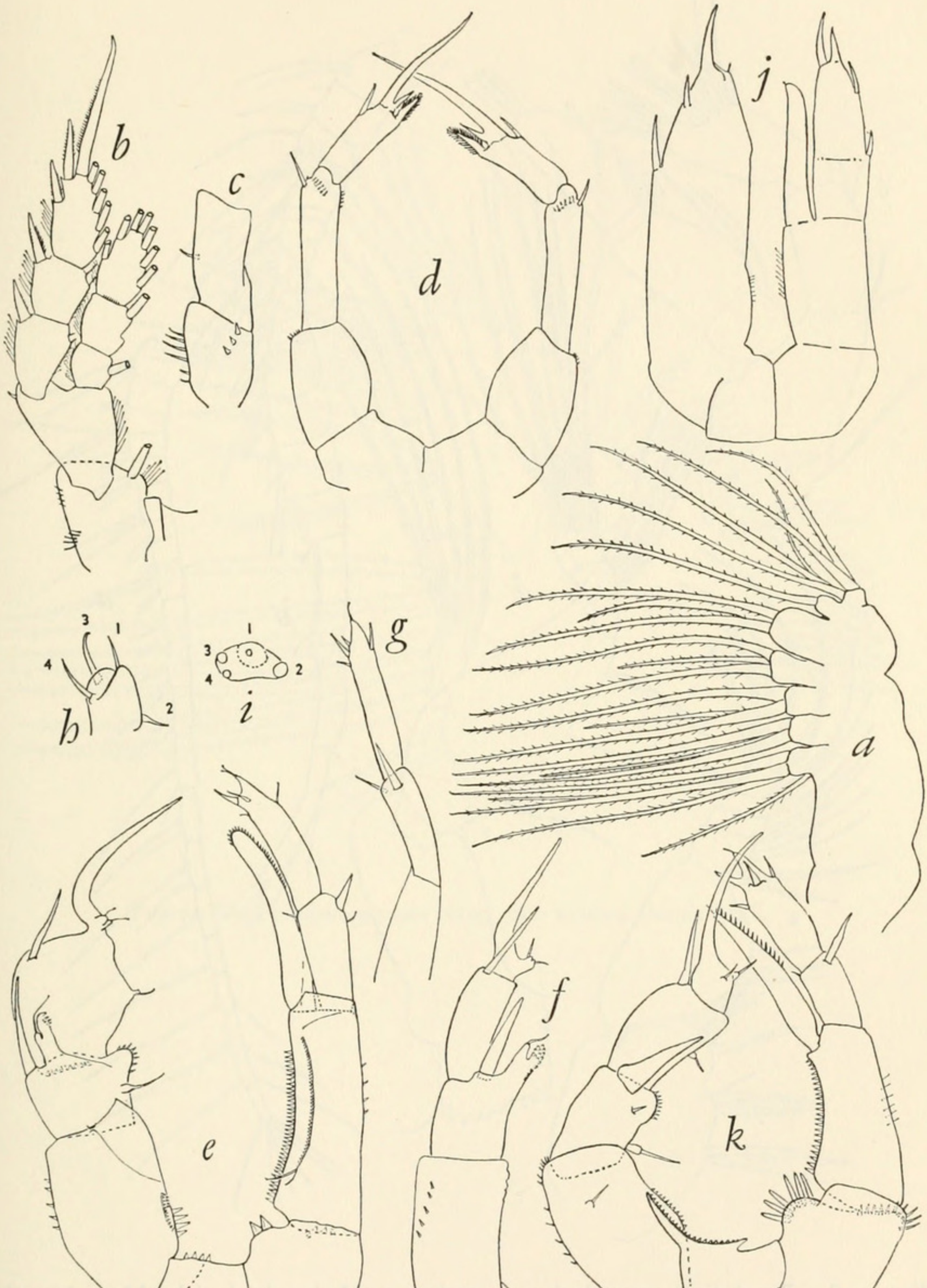


FIGURE 7.—*Pseudodiaptomus cokeri*, new species: *a*, Mx2; *b*, P4; *c*, B1 and B2 of P4, lateral; *d*, P5, female; *e*, P5, male; *f*, right P5, male, lateral; *g*, left P5, male, lateral; *h*, left P5, male, apex of Re2, posterolateral; *i*, same, plan of setae (1=anterior, 2=lateral, 3–4=medial); *j*, P5, male copepodite V. *Pseudodiaptomus coronatus* Williams: *k*, P5, male.

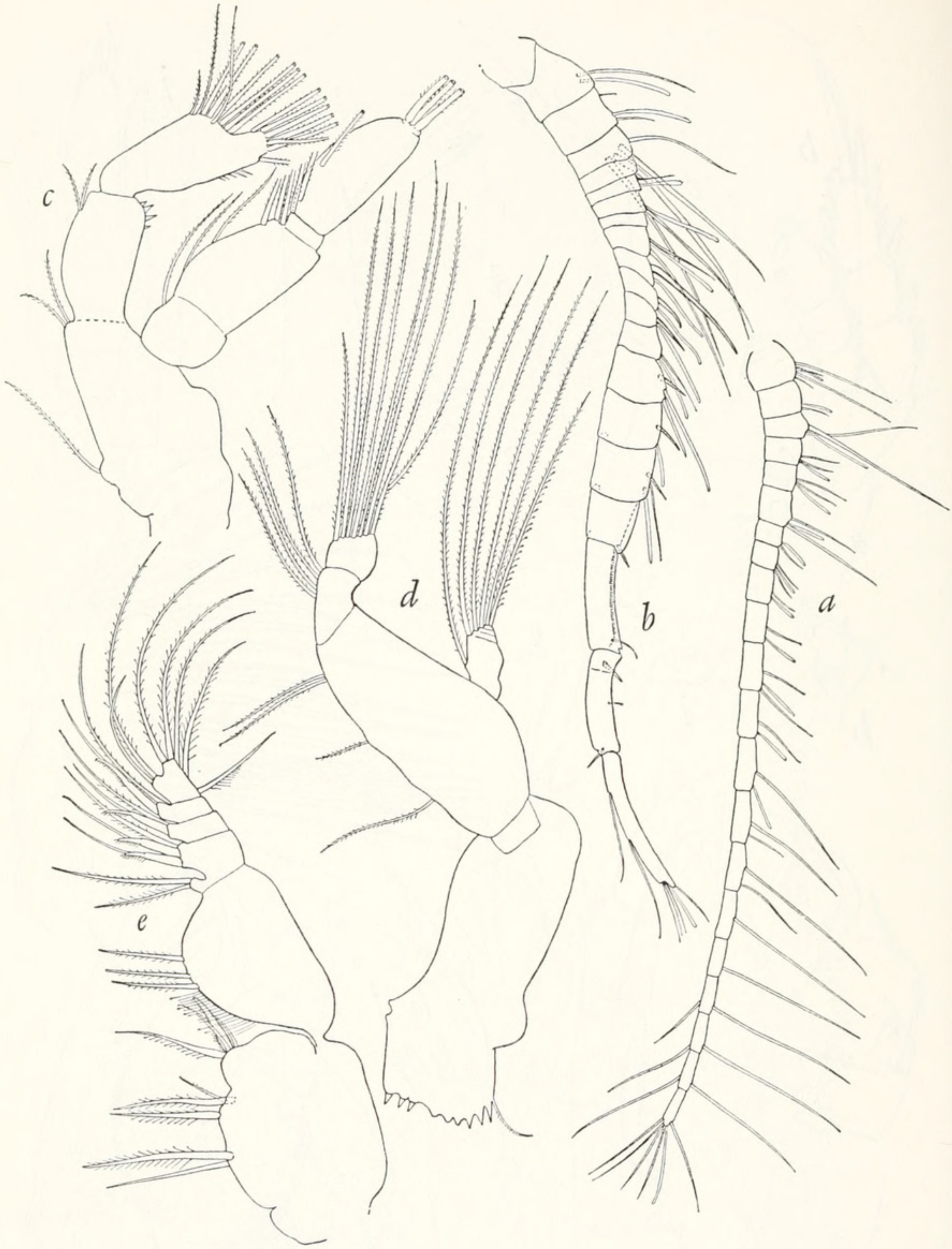


FIGURE 8.—*Pseudodiaptomus cokeri*, new species: *a*, A1, female; *b*, right A1, male; *c*, A2, female; *d*, Md, female; *e*, Mxp, female.

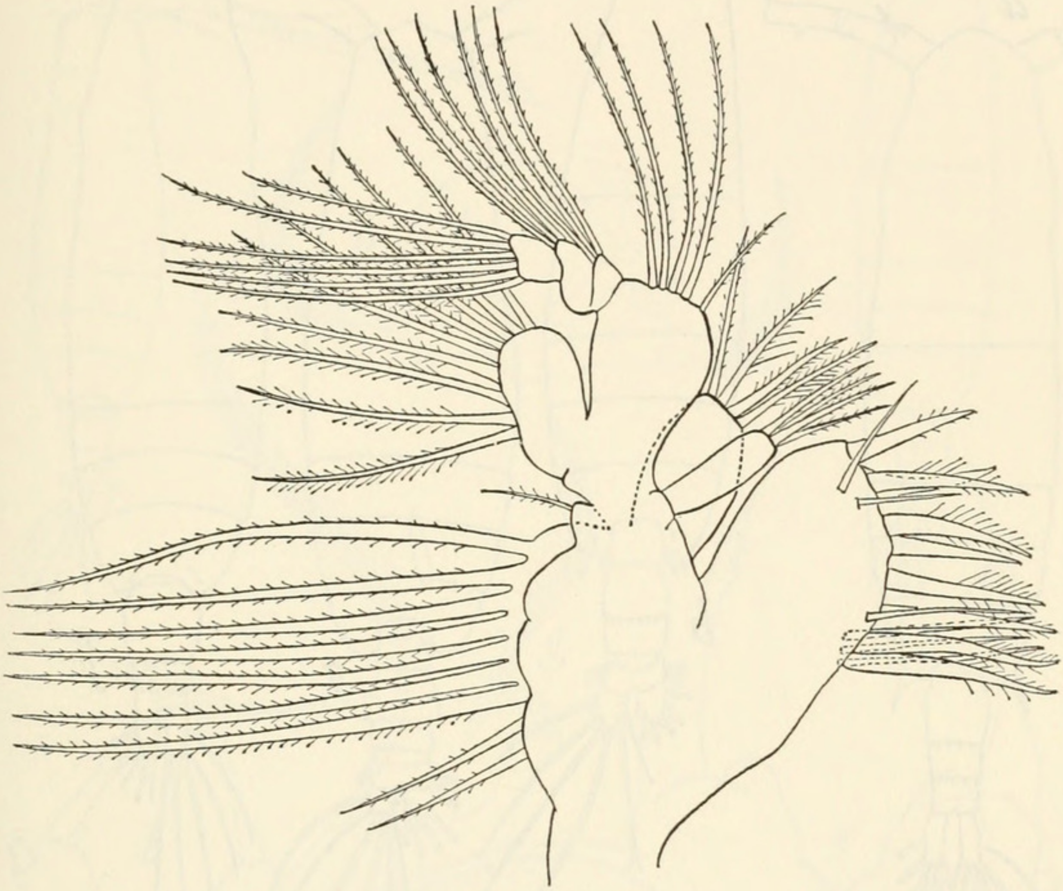
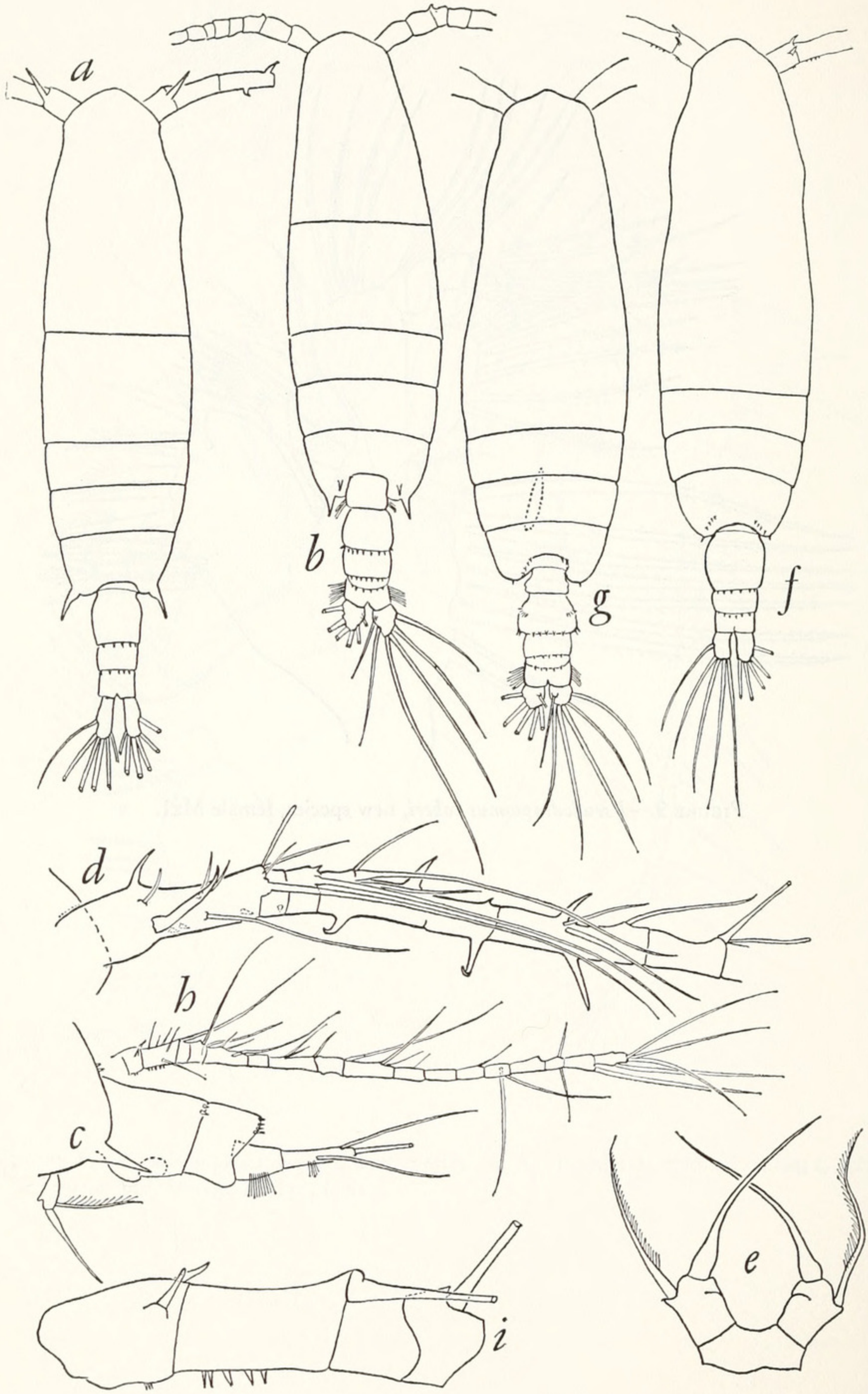


FIGURE 9.—*Pseudodiaptomus cokeri*, new species, female Mx1.



a
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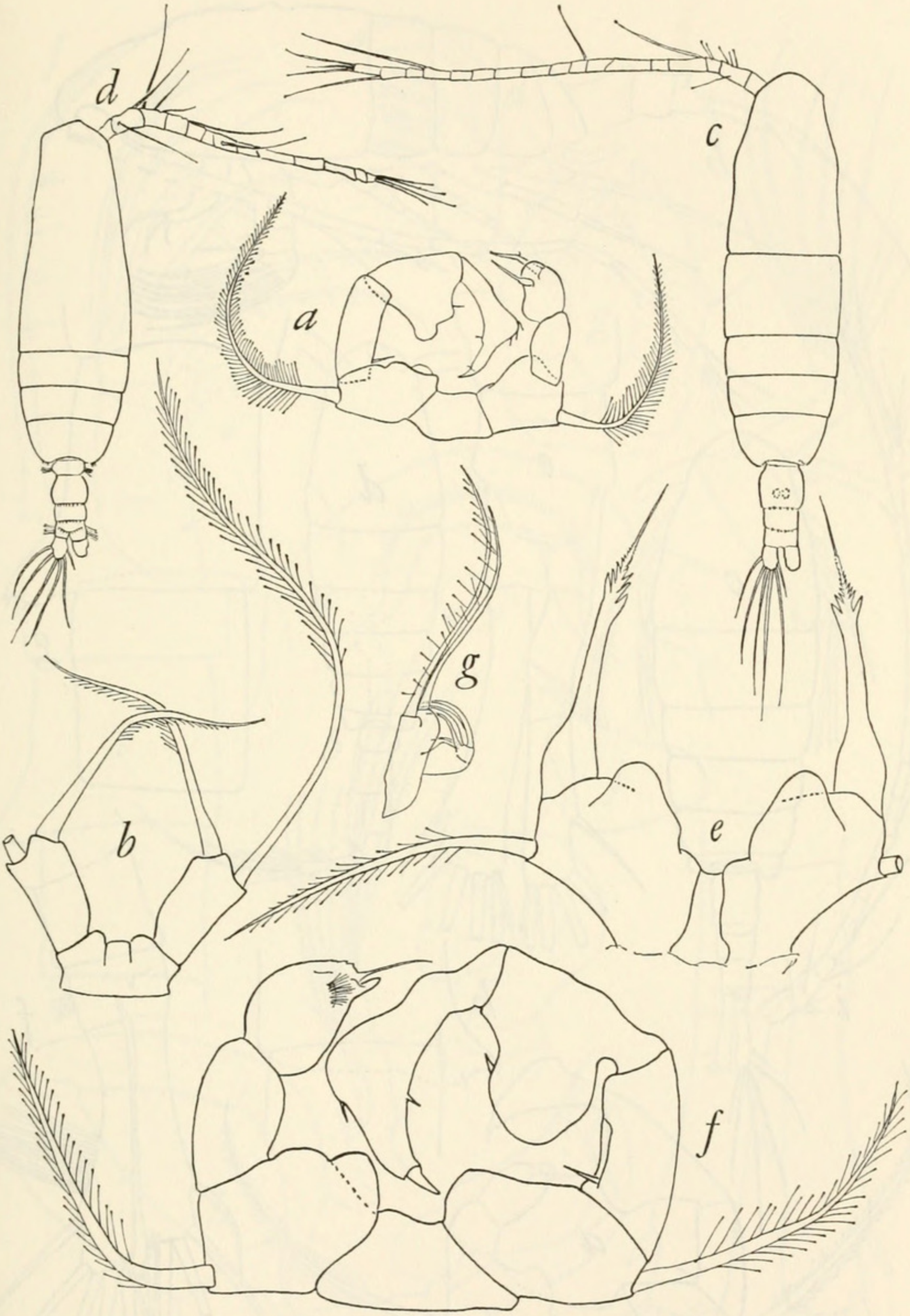

FIGURE 11.—*Acartia lilljeborgii* Giesbrecht: *a*, P5, male. *Acartia spinata* Esterly: *b*, P5, female. *Acartia tonsa* Dana: *c*, female, dorsal; *d*, male dorsal; *e*, P5, female; *f*, P5, male. *Tortanus compernis*, new species: *g*, Mxp.

FIGURE 10 (p. 292).—*Acartia lilljeborgii* Giesbrecht: *a*, female, dorsal; *b*, male, dorsal; *c*, PedSeg 5 and urosome of female, lateral; *d*, proximal segments of female A1, ventral; *e*, P5, female. *Acartia spinata* Esterly: *f*, female, dorsal; *g*, male, dorsal; *h*, A1, female; *i*, proximal segments of A1, female.

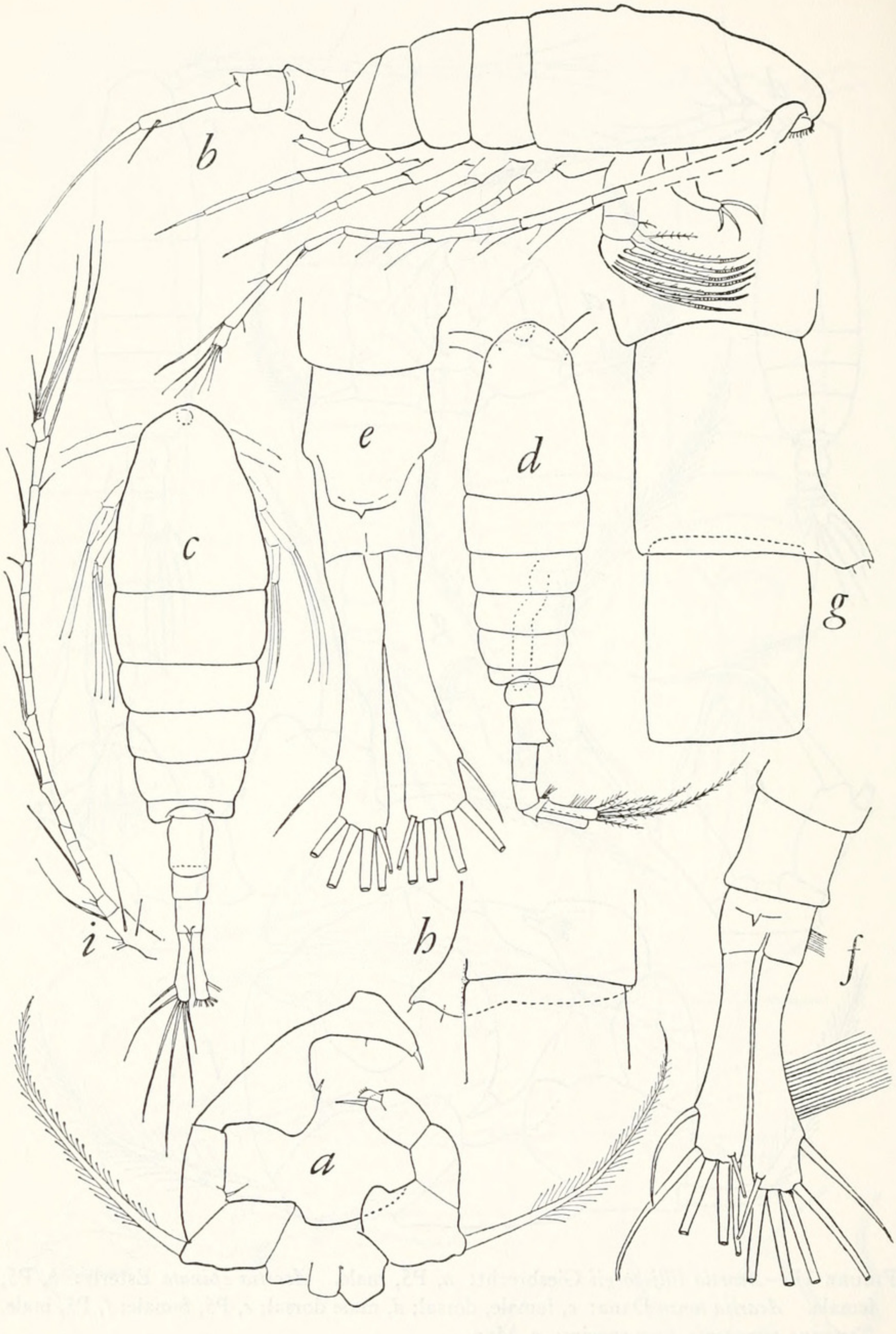

FIGURE 12.—*Acartia spinata* Esterly: *a*, P5, male. *Tortanus compernis*, new species: *b*, female, lateral; *c*, female, dorsal; *d*, male, dorsal; *e*, posterior end of urosome and caudal rami, female; *f*, same, male; *g*, urosome segments 2 and 3, male, dorsal; *h*, posterior part of urosome segment 2, ventral; *i*, A1, female.

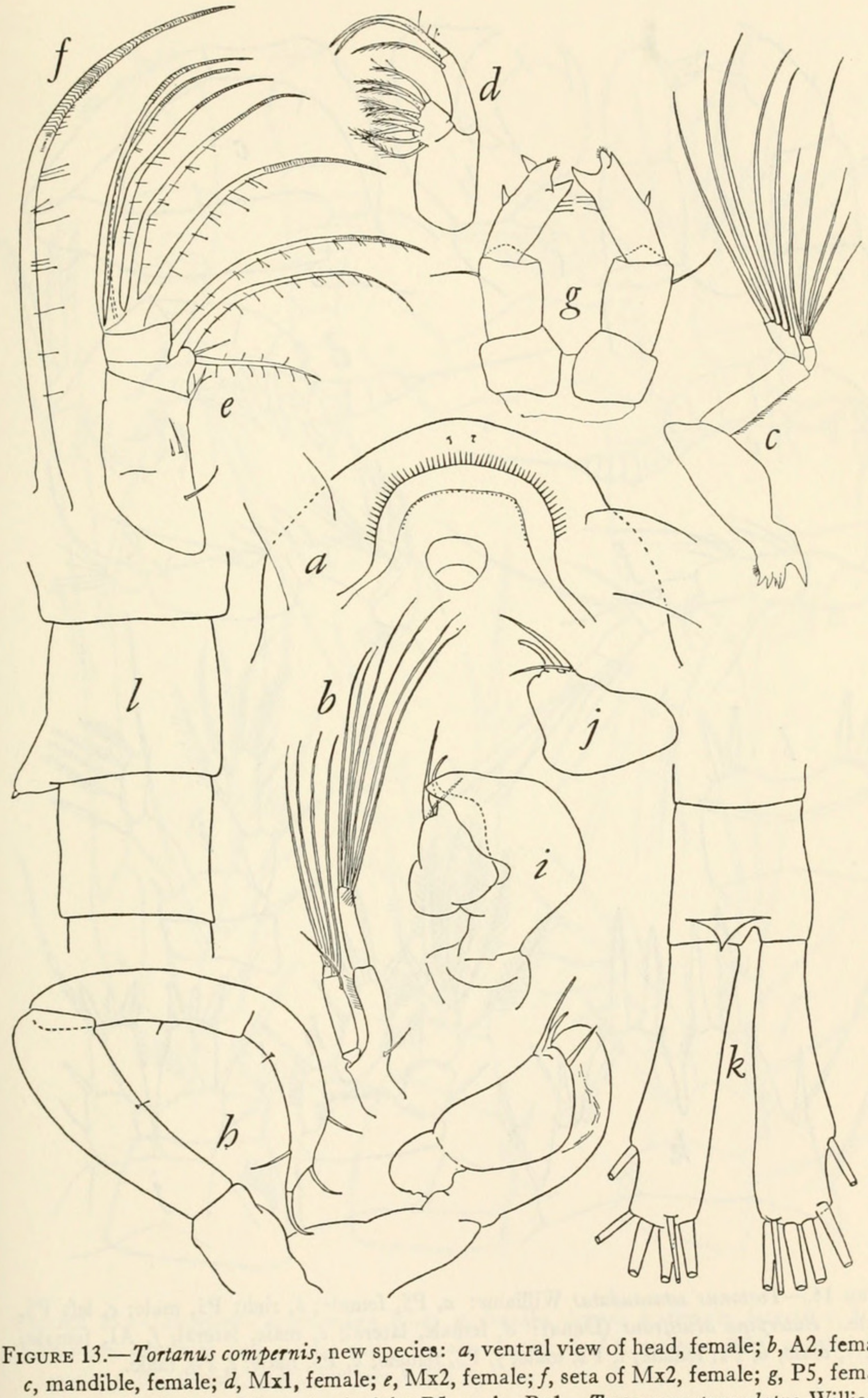

FIGURE 13.—*Tortanus compernis*, new species: *a*, ventral view of head, female; *b*, A2, female; *c*, mandible, female; *d*, Mx1, female; *e*, Mx2, female; *f*, seta of Mx2, female; *g*, P5, female; *h*, P5, male; *i*, right P5, male; *j*, right P5, male, Rel. *Tortanus setacaudatus* Williams, Biscayne Bay, Florida: *k*, anal segment and caudal rami, female, dorsal; *l*, urosome segments 2 and 3, male, ventral.

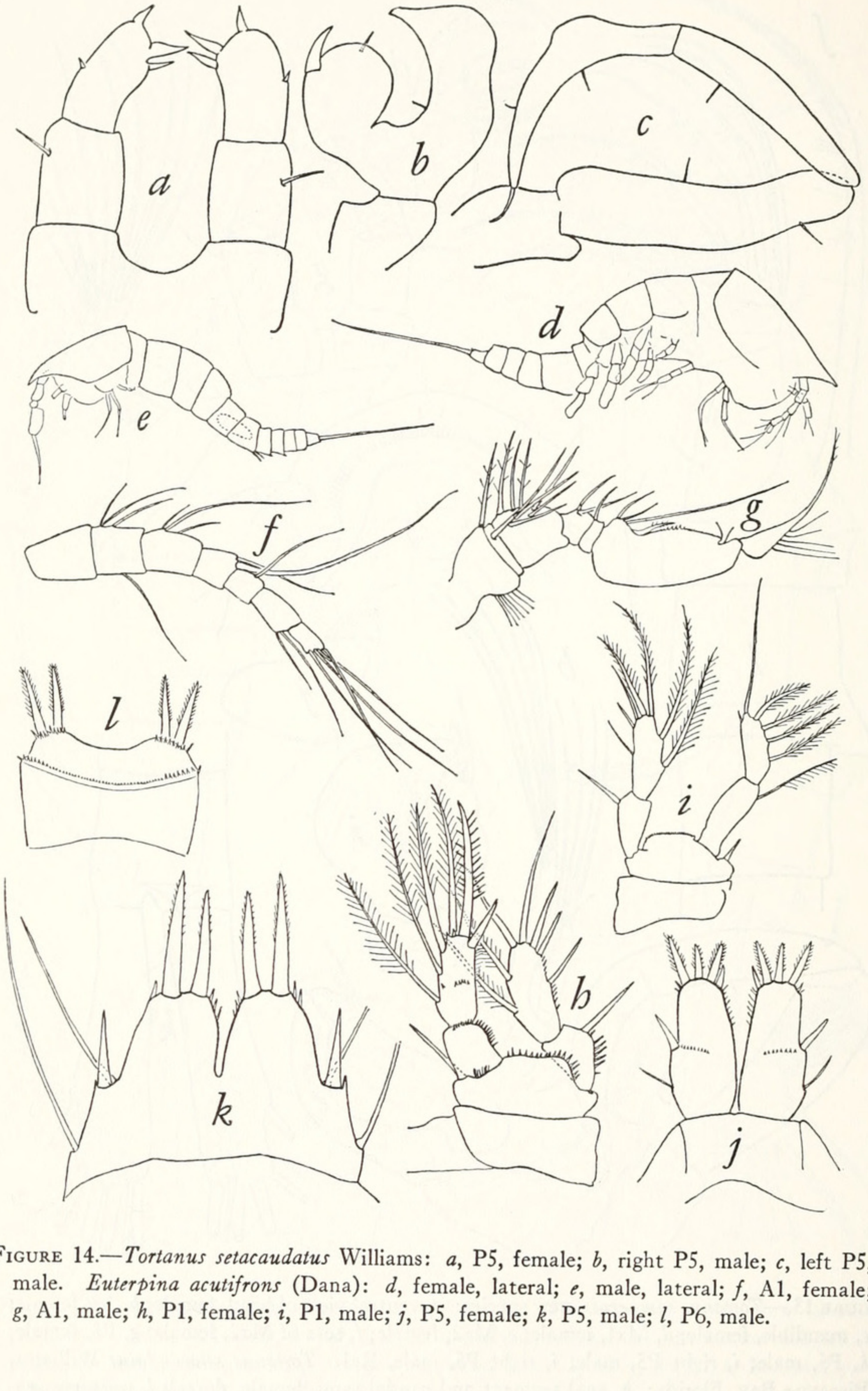

FIGURE 14.—*Tortanus setacaudatus* Williams: *a*, P5, female; *b*, right P5, male; *c*, left P5, male. *Euterpina acutifrons* (Dana): *d*, female, lateral; *e*, male, lateral; *f*, A1, female; *g*, A1, male; *h*, P1, female; *i*, P1, male; *j*, P5, female; *k*, P5, male; *l*, P6, male.

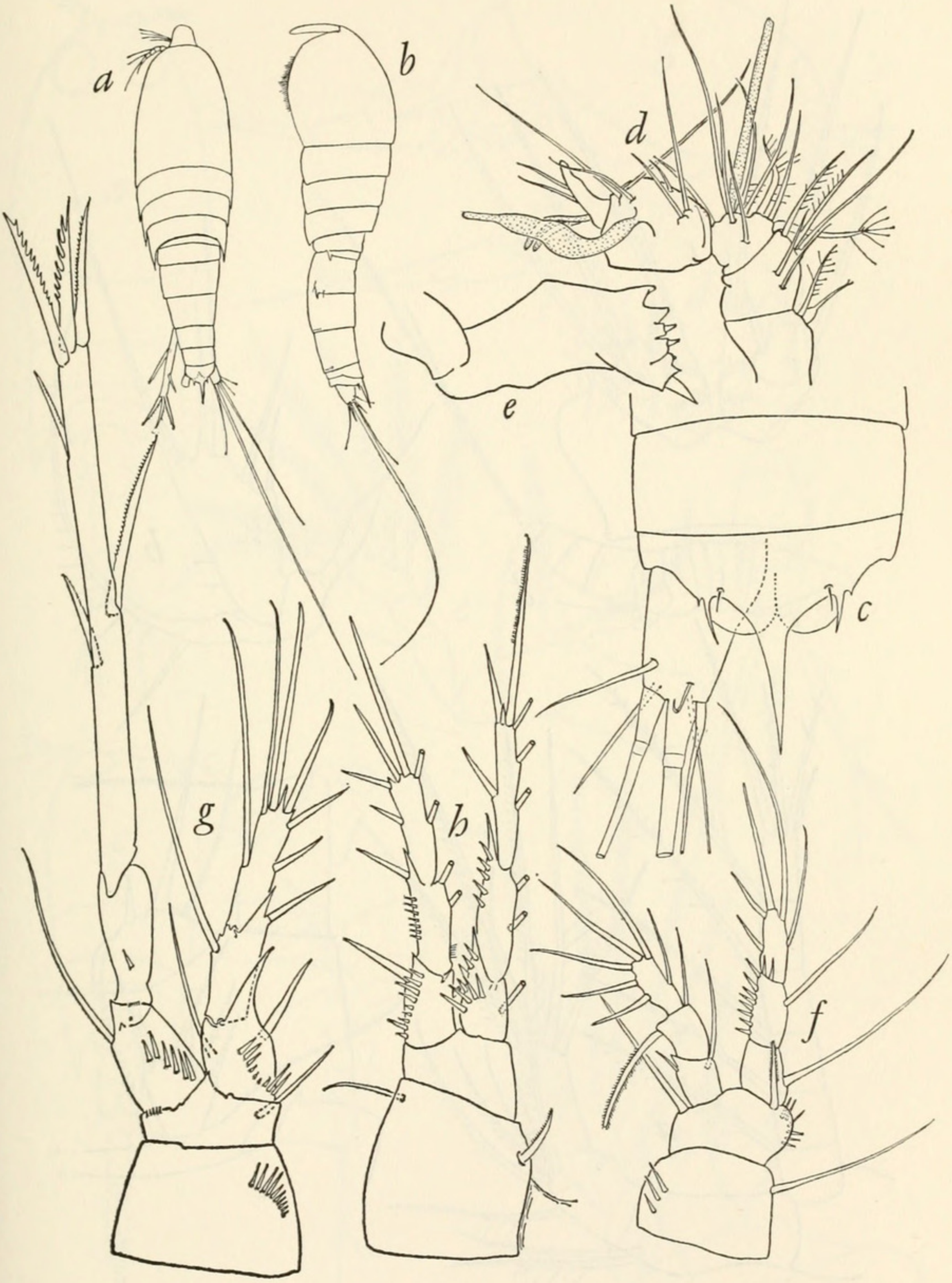

FIGURE 15.—*Longipedia helgolandica* Klie: *a*, female, dorsal; *b*, female, lateral; *c*, last 2 urosome segments and caudal rami, female, dorsal; *d*, A1, male; *e*, Md, gnathal lobe, female; *f*, P1, female; *g*, P2, female; *h*, P3, female.

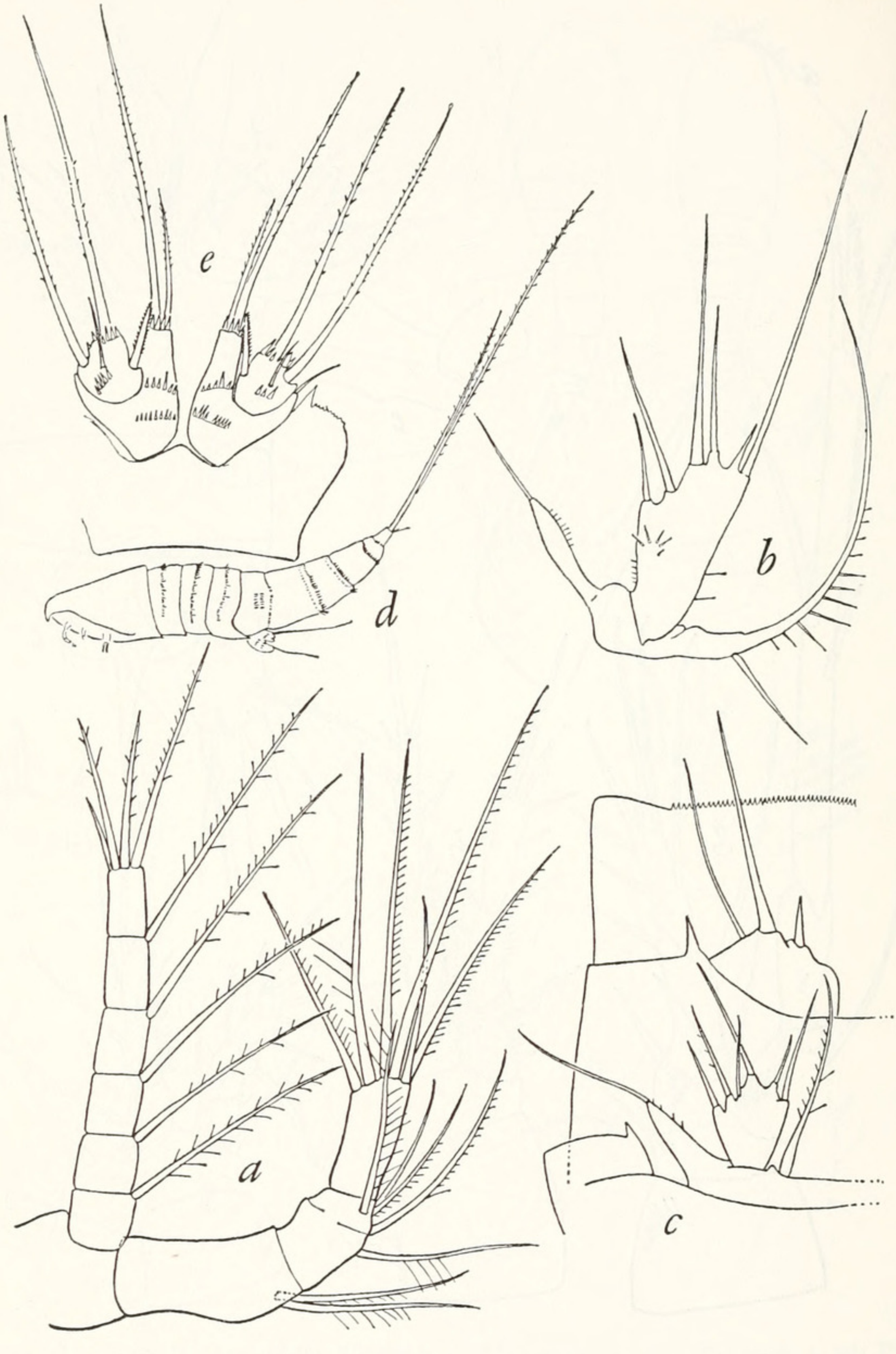

FIGURE 16.—*Longipedia helgolandica* Klie: *a*, A2, female; *b*, P5, female; *c*, P5 and P6 in situ, male. *Microsetella norvegica* (Boeck): *d*, female, lateral; *e*, P5, female.

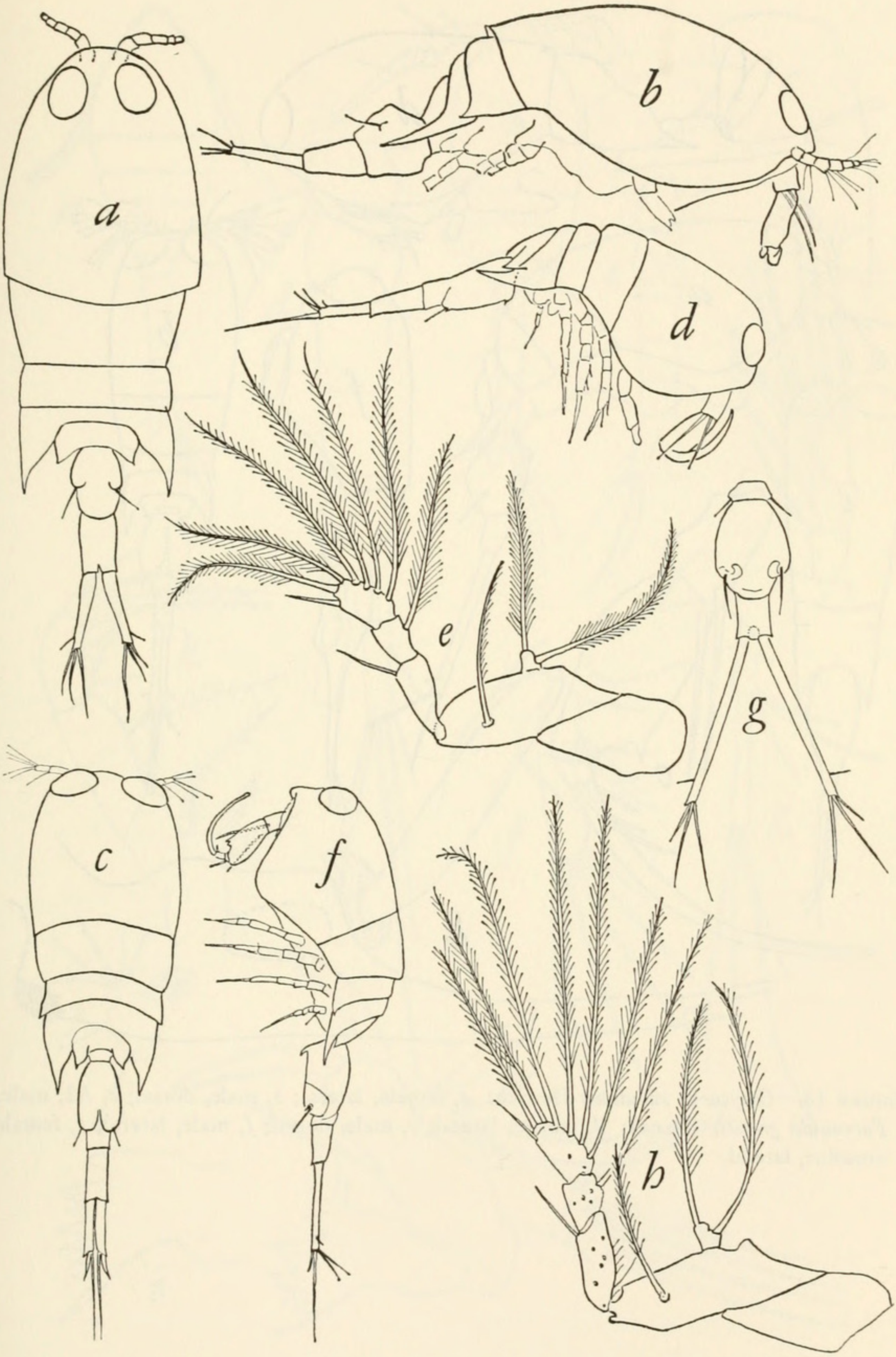

FIGURE 17.—*Corycaeus amazonicus* Dahl: *a*, female, dorsal; *b*, female, lateral; *c*, male, dorsal; *d*, male, lateral; *e*, P4, female. *Corycaeus subulatus* Herrick: *f*, male, lateral; *g*, male urosome, dorsal; *h*, P4, female.

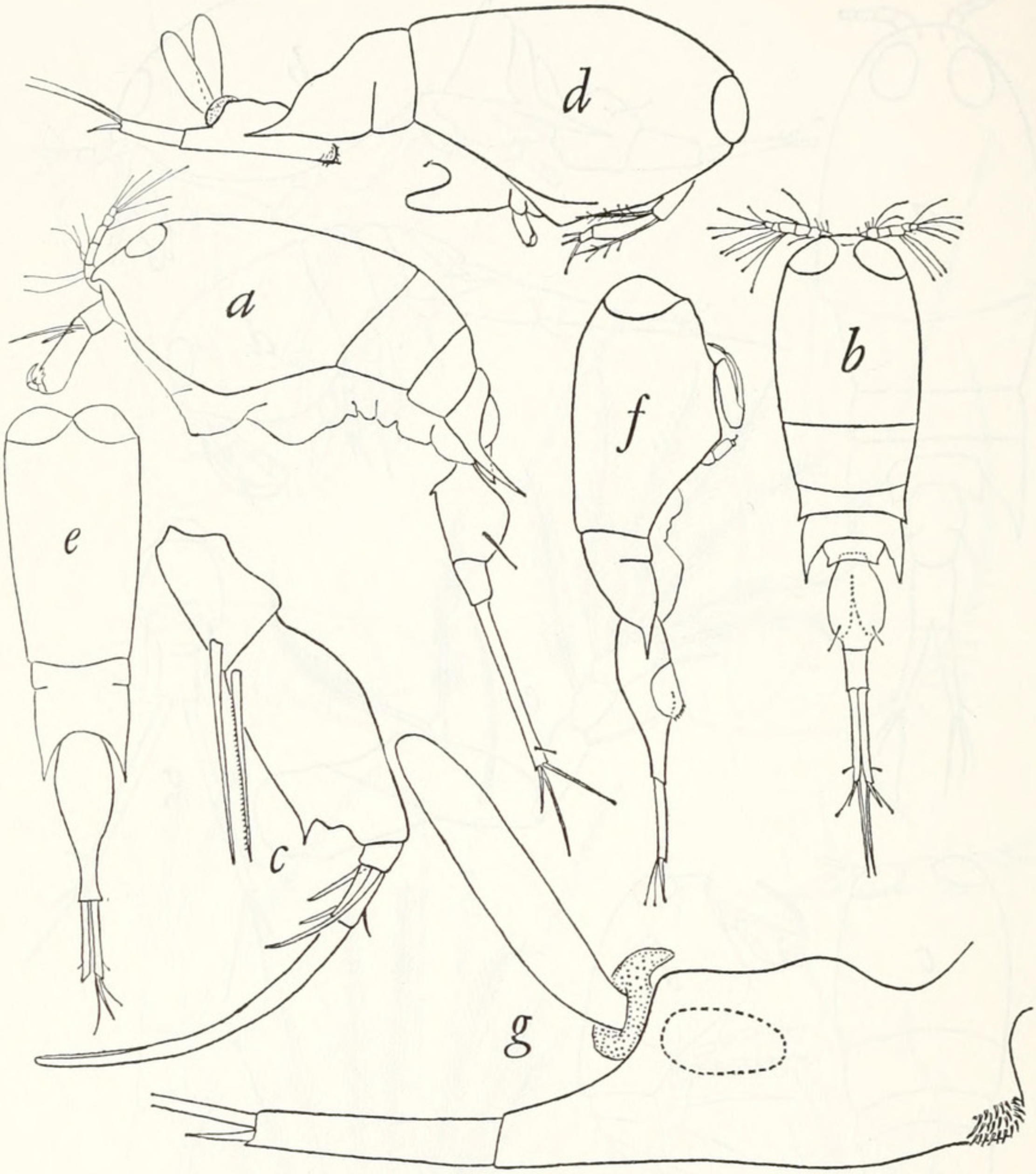

FIGURE 18.—*Corycaeus subulatus* Herrick: *a*, female, lateral; *b*, male, dorsal; *c*, A2, male. *Farranula gracilis* (Dana): *d*, female, lateral; *e*, male, dorsal; *f*, male, lateral; *g*, female urosome, lateral.

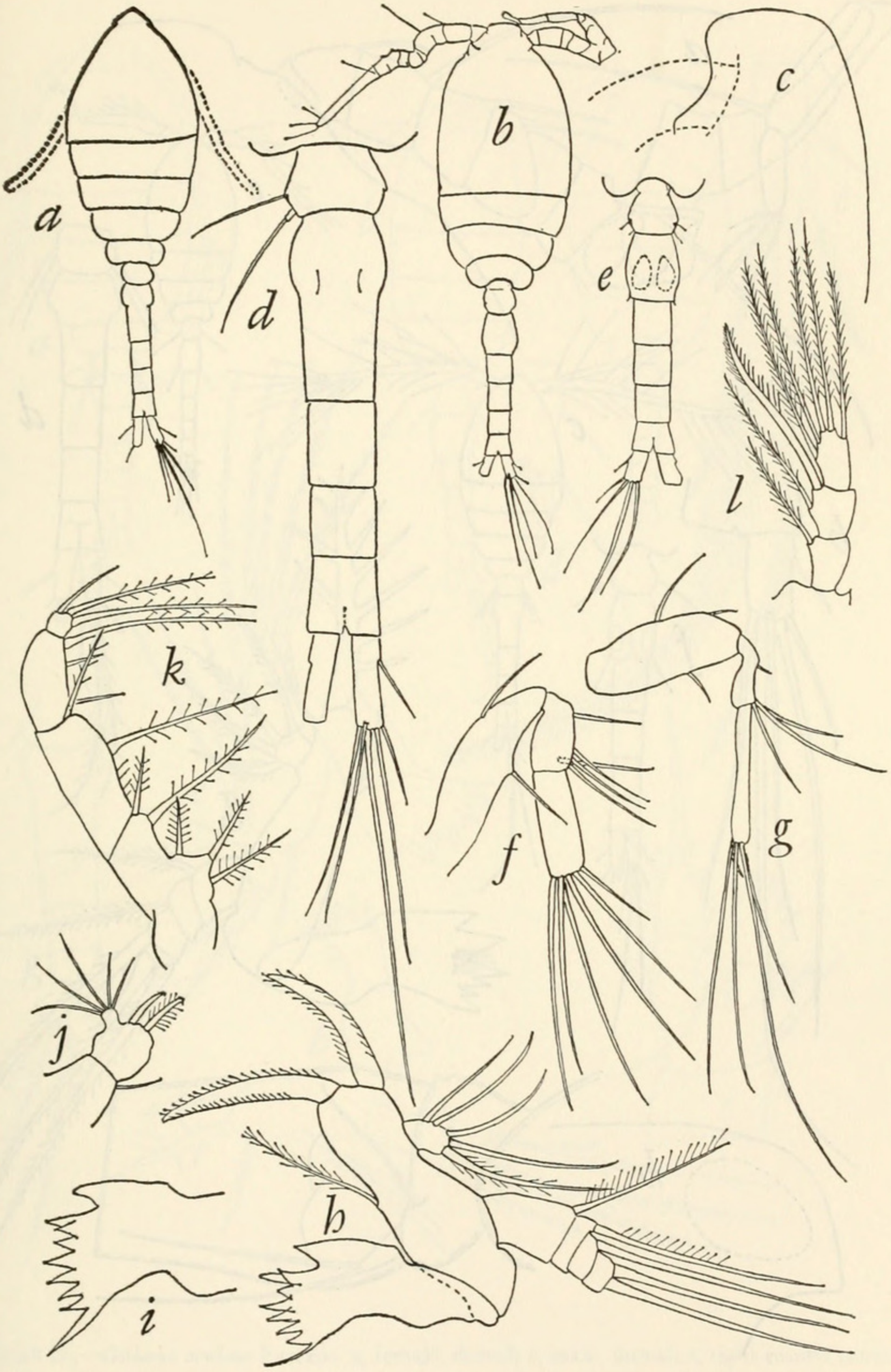

Figure 19.—*Oithona hebes* Giesbrecht: *a*, female, dorsal; *b*, male, dorsal; *c*, female head, lateral; *d*, female urosome, dorsal; *e*, male urosome, dorsal; *f*, A2, female; *g*, A2, male; *h*, Md, female; *i*, Md, gnathal lobe, female; *j*, Md, B2, male; *k*, Mxp, male; *l*, P4, female.

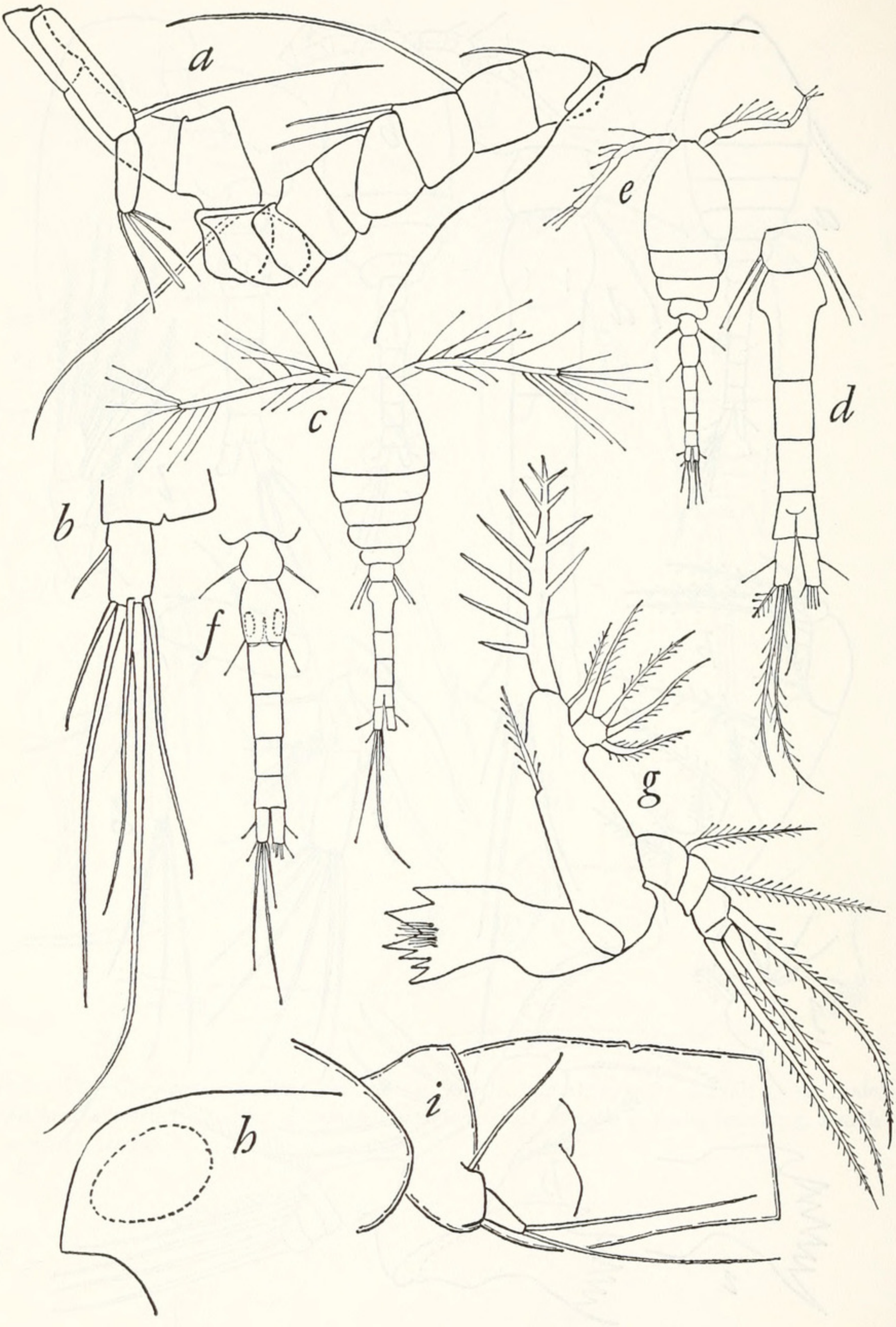

FIGURE 20.—*Oithona hebes* Giesbrecht: *a*, A1, male; *b*, left caudal ramus, female from Guayaquil, Ecuador. *Oithona nana* Giesbrecht: *c*, female, dorsal; *d*, female urosome, dorsal; *e*, male, dorsal; *f*, male urosome, dorsal; *g*, Md, female. *Oithona oculata* Farran: *h*, female head, lateral; *i*, urosome segments 1–2, female, lateral, showing P5.

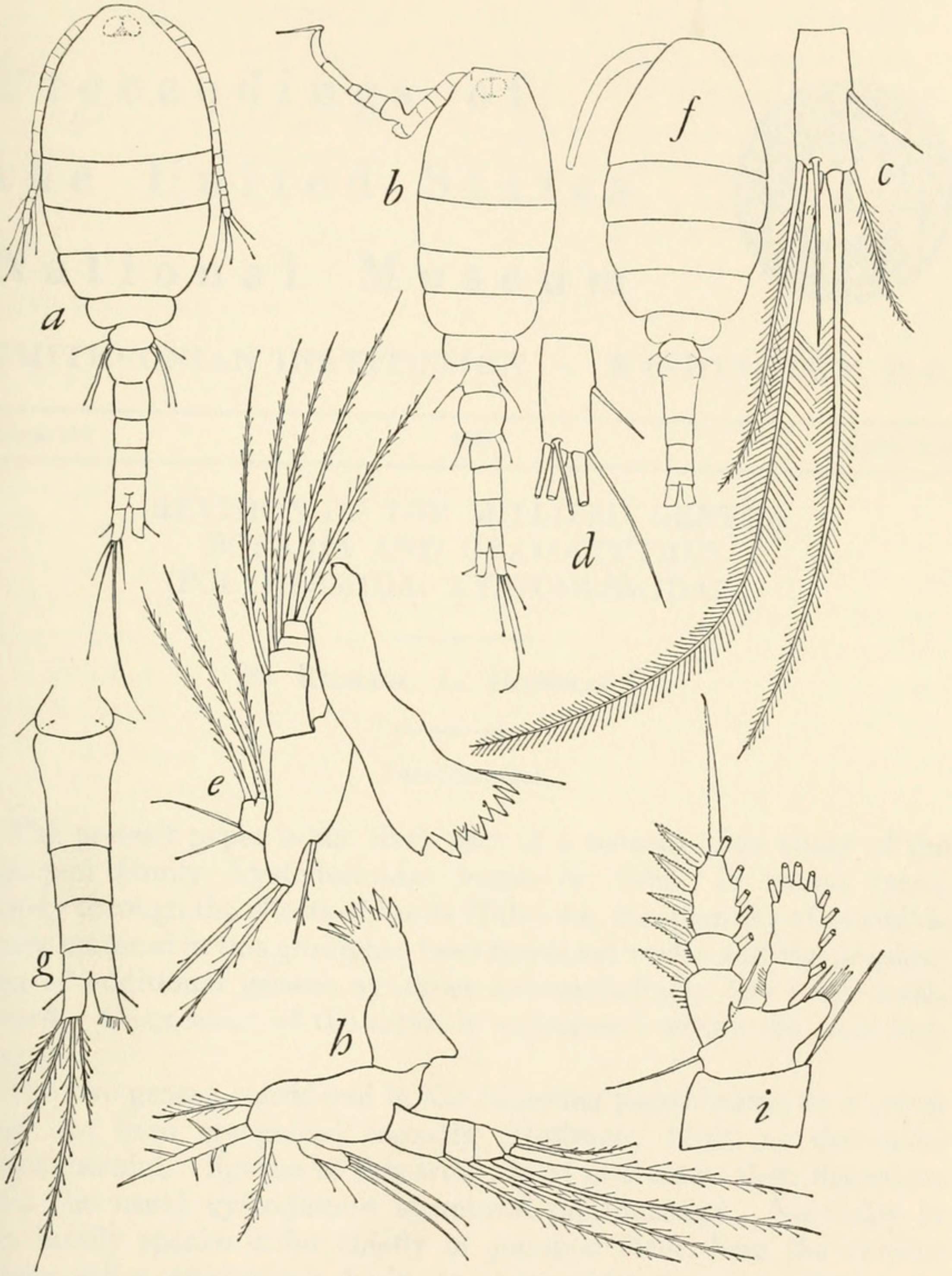

FIGURE 21.—*Oithona oculata* Farran: *a*, female, dorsal; *b*, male, dorsal; *c*, right caudal ramus, female; *d*, right caudal ramus, female from Ifaluk Atoll, Caroline Islands; *e*, Md, female. *Oithona simplex* Farran: *f*, female, dorsal; *g*, female urosome, dorsal; *h*, Md, female; *i*, P1, female.

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