

CALANOID COPEPODS FROM THE CENTRAL NORTH PACIFIC OCEAN

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ABSTRACT

A systematic study was made of the calanoid copepods in seven plankton samples collected between lat. 30°00' N. and lat. 42°20' N. along long. 155° W.

Sixty-four species belonging to 17 families are recorded. Measurements, descriptions, and illustrations are given for

most of the species. Two species, *Euchirella unispina* and *Euchaeta wrighti*, are described as new, and the hitherto unknown female of *Centropages elegans* Giesbrecht is described for the first time. *Calocalanus tenuis* Farran is reported for the first time from the Pacific Ocean.

The systematics and distribution of the planktonic copepods of the North Pacific have been widely studied, but such investigations have largely been limited to peripheral waters. Outstanding are the papers by: Esterly (1905, 1906, 1911, 1913, 1924) and Davis (1949) for the eastern Pacific; by Mori (1937), Tanaka (1956a, 1956b, 1957a, 1957b, 1958, 1960, 1961, 1962, 1963, 1964a, 1964b, 1964c), and Vervoort (1946) for the western Pacific; by Brodsky (1950) for the northern North Pacific; and by Grice (1962) for the equatorial Pacific. The copepod fauna of the vast area of the open North Pacific, however, has been relatively little studied, although several early expeditions visited the area and yielded lists of local species (Dana, 1853, 1855; Brady, 1883; Giesbrecht, 1895; Wilson, 1942, 1950).

This paper is devoted to the systematic study of the calanoid copepods in plankton samples from the central North Pacific taken during cruise 29 of the research vessel *Hugh M. Smith* of the Bureau of Commercial Fisheries. Most of the laboratory work for the study was completed at the Bureau of Commercial Fisheries Biological Laboratory, Honolulu, Hawaii, in 1958 and 1959 under a fellowship from the International Cooperation Administration of the United States.

MATERIALS AND METHODS

The materials for this study consisted of seven plankton samples collected between lat.

30° 00' N. and lat. 42° 20' N. along long. 155° W. The samples were taken in oblique hauls with a 1-m. (mouth diameter) net. The front and middle sections of the net were made of 30XXX silk grit gauze (apertures averaging 0.65 mm. in width), and the rear section and bag of 56XXX silk grit gauze (apertures averaging 0.31 mm. in width). The hauls were from a depth of 140 m. and lasted about 30 minutes. The amount of water strained during each haul was measured by a flowmeter in the mouth of the net. The collecting methods for plankton samples adopted by the Biological Laboratory, Honolulu, have been described in detail by King and Demond (1953).

The pertinent data for each plankton sample are given in table 1. Hydrographic data obtained during *Hugh M. Smith* cruise 29 have been published by Graham (1957).

Only small quantities of the original samples were examined. Subsamples were obtained by using the Folsom Plankton Sample Splitter (McEwen, Johnson, and Folsom, 1954). The specimens of each species contained in the aliquot were counted to determine the numerical abundance of the common species. After I had completed the analysis of the subsample, I examined the remainder of the original sample for species not found in the aliquot or to obtain additional specimens, which were often needed to complete the description of a species. Table 2 shows the sizes of the subsamples examined, the list of species and the number of specimens

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TABLE 1.—Data on plankton samples collected in the North Pacific Ocean, May 6–13, 1955

[All samples from 140 m. to surface]

Station No.	Position	Date (1955)	Time (local time)	Water filtered
8	30°00' N., 155°00' W.	May 6	0756–0827	1457
5	31°54' N., 154°49' W.	May 7	0742–0818	2390
7	33°54' N., 154°48' W.	May 8	0722–0753	1674
9 ¹	35°52' N., 154°53' W.	May 9	0707–0737	-----
13	38°23' N., 154°51' W.	May 11	0715–0748	1851
15	40°08' N., 155°02' W.	May 12	0721–0751	1844
16	42°20' N., 154°57' W.	May 13	0714–0744	1058

¹ The net was torn during the tow.

of each found in the aliquot, and the calculated number of copepods per cubic meter of water.

GENERAL REMARKS

The collections contained 64 species of calanoid copepods. Two species, *Euchirella unispina* and *Euchaeta wrighti*, were new. One species, *Calocalanus tenuis* Farran, 1926, had not been previously recorded from the Pacific Ocean. The hitherto unknown female of *Centropages elegans* Giesbrecht, 1895, was discovered and described.

The number of species increased from 14 at

TABLE 2.—Species and number of specimens in each subsample of plankton

"X" indicates the species found from collections in the North Pacific Ocean, May 6–13, 1955, in other fractions of original sample]

Species	Station number						
	3	5	7	9	13	15	16
1. <i>Calanus glacialis</i>		X	1	15	15	9	X
2. <i>C. pacificus</i>					X	8	12
3. <i>C. tenuicornis</i>	40	17	2	2	5	1	
4. <i>C. plumchrus</i>					24	66	376
5. <i>C. cristatus</i>					2	X	
6. <i>Nannocalanus minor</i>	76	85	5	18	1		
7. <i>Neocalanus gracilis</i>	14	30	11	50	5		
8. <i>N. robustior</i>	86	9	6				
9. <i>Eucalanus attenuatus</i>	X	X	X	X	13	10	
10. <i>E. elongatus</i>	10	18	24		34	8	
11. <i>E. bungii</i>		2	13		49	30	30
12. <i>Mecynocera clausii</i>		2	4	1			
13. <i>Paracalanus parvus</i>					1		
14. <i>Calocalanus pavo</i>		X	3				
15. <i>C. tenuis</i>					4		
16. <i>Pseudocalanus minutus</i>							1
17. <i>Clausocalanus arcuicornis</i>	100	7	14	8	38	6	6
18. <i>C. perygens</i>			1		1		
19. <i>Ctenocalanus vanus</i>		1	4	2	4	1	10

TABLE 2.—Species and number of specimens in each subsample of plankton—Continued

["X" indicates the species found from collections in the North Pacific Ocean, May 6–13, 1955, in other fractions of original sample]

Species	Station number						
	3	5	7	9	13	15	16
20. <i>Aetideus pacificus</i>							X
21. <i>Euaetideus acutus</i>	4	2	X	1			
22. <i>Euchirella truncata</i>	1	1	X	5	X		
23. <i>E. unispina</i> n. sp.	3	X	X	6			
24. <i>E. amoena</i>	2	X	X	1			
25. <i>E. rostrata</i>		12	1	18	3	6	
26. <i>Undeuchaeta plumosa</i>		X		7			
27. <i>Euchaeta marina</i>	2	X					
28. <i>E. spinosa</i>	5	6	X	6	X		
29. <i>E. media</i>		X		16	X		
30. <i>E. pubera</i>		1	X				
31. <i>E. wrighti</i> n. sp.	X						
32. <i>Phaenna spinifera</i>	X	X	1				
33. <i>Lophothrix latipes</i>	1	X	X				
34. <i>Scolecithrix danae</i>	16	2	X				
35. <i>S. bradyi</i>	X	X	X	1			
36. <i>Scolecithricella minor</i>							X
37. <i>S. dentata</i>		X				1	X
38. <i>S. ovata</i>		X	X				
39. <i>S. vittata</i>		X					
40. <i>S. auropecten</i>		3	1		1		
41. <i>Metridia lucens</i>							X
42. <i>Centropages bradyi</i>		X		1	38	13	
43. <i>C. elongatus</i>	20	X	X				
44. <i>C. violaceus</i>	X	X	2				
45. <i>C. elegans</i>	24	6	2				
46. <i>Lucicutia flavicornis</i>	8	X	X				1
47. <i>Heterorhabdus papilliger</i>		8	2	6	16	15	7
48. <i>H. abyssi</i>				4			
49. <i>Heterostylites longicornis</i>		X	X				
50. <i>Haloptilus longicornis</i>	544	44	3				
51. <i>H. fertilis</i>	X	X					
52. <i>H. spiniceps</i>	12	X	X				
53. <i>Augaptilus spinifrons</i>		X					
54. <i>Arietellus aculeatus</i>	4						
55. <i>A. setosus</i>		X	X				
56. <i>Candacia ethiopica</i>	24	2	5	1			
57. <i>C. bipinnata</i>					6	5	X
58. <i>C. varicans</i>	4		X				
59. <i>C. longimana</i>	4	X	X				
60. <i>Paracandacia bispinosa</i>	144	20	1				
61. <i>Pontellopsis regalis</i>	X						
62. <i>Pontellina plumata</i>			X				
63. <i>Acartia danae</i>	4						
64. <i>A. negligens</i>	12	4	X				
Unidentified copepods	26	8	6	21	75	9	14
Number of specimens in subsample	1,190	290	112	190	335	188	457
Subsample size	1/8	1/32	1/16	1/8	1/64	1/128	1/256
Number of copepods per cubic meter	6.5	3.9	1.1	2.4	11.6	13.1	110.6
Number of species	33	48	40	21	23	16	14

the northernmost station to 48 at the second southernmost. Except for *Clausocalanus arcuicornis*, none of the species occurred at all the stations. The common species toward the north-

ern end of the area were *Calanus glacialis*, *C. pacificus*, *C. plumchrus*, *Eucalanus bungii*, *Ctenocalanus vanus*, *Heterorhabdus papilliger*, and *Candacia bipinnata*. The common species toward the southern end of the area were *Calanus tenuicornis*, *Nannocalanus minor*, *Neocalanus gracilis*, *N. robustior*, *Eucalanus elongatus*, *Euchaeta spinosa*, *Centropages elongatus*, *Haloptilus longicornis*, *Candacia ethiopica*, *Paracandacia bispinosa*, and *Acartia negligens*. *Euchirella rostrata* was fairly common in the area except at the extreme ends. *Euchaeta media* was common at one station and *Centropages bradyi* at two.

The calculated number of copepods per cubic meter of water varied from 1.1 at station 7 to 110.6 at the northernmost station (table 2). In comparison, Grice (1962) obtained 2.3 to 3.7 calanoids per cubic meter of water for tows at the surface and at 0 to 100 m. in the equatorial Pacific; however, he calculated a mean number of 26.8 copepods per cubic meter of water for depths between about 50 and 150 m. Brodsky (1952) reported a far greater abundance of copepods in the northwestern Pacific—5,040 per cubic meter of water for the 50- to 100-m. level, and 320 for the 100- to 200-m. level.

Of all the previous studies only Brady (1883) and Wilson (1942) reported planktonic copepods from the area under consideration. Brady listed the following nine species of calanoid copepods obtained in a surface plankton sample collected on July 21, 1875, from *Challenger* station 256 (lat. 30°22' N., long. 154°56' W.), which corresponds closely to station 3 of the present collections:

Undinula vulgaris
U. darwini
Euchaeta marina
Pleuromamma abdominalis
Centropages violaceus
Candacia truncata
Labidocera acutifrons
L. detruncata
Pontellopsis villosa

Of these only *Euchaeta marina* and *Centropages violaceus* were in the present collections. Of the remaining species, five were reported from the area by Wilson (1942), and two,

Pleuromamma abdominalis and *Candacia truncata*, were obtained from equatorial waters by Grice (1962).

Wilson (1942) reported 48 species of calanoid copepods in plankton samples collected in early October in 0 to 100-m. tows at *Carnegie* stations 141–145 (between lat. 29°02' N. and lat. 34°06' N., and between long. 145°30' W. and long. 160°44' W.). These stations are in about the same area as the three southern stations of the present collections. Of the 48 species the following 26 were not in the present collections:

Megacalanus longicornis
 **Canthocalanus pauper*
 **Undinula vulgaris*
 **U. darwini*
 **Paracalanus aculeatus*
P. pygmaeus
Acrocalanus gibber
A. gracilis
 **A. longicornis*
Calocalanus styliremis
Microcalanus pusillus
M. pygmaeus
 **Clausocalanus furcatus*
 **Euchirella curticauda*
 **E. pulchra*
Euchaeta acuta
E. tonsa
 **Centropages calaninus*
Lucicutia clausii
 **Haloptilus acutifrons*
 **Candacia simplex*
 **Pontella tenuiremis*
Pontellopsis villosa
 **Labidocera detruncata*
L. acutifrons
L. neri

Most of these species are tropical or subtropical; 13 species (marked with an asterisk) were found by Grice (1962) in equatorial waters of the Pacific Ocean. If the difference in dates of collection is considered, seasonal changes may account for the absence of many tropical or subtropical copepods in the present collections that were reported in the two previous studies.

SYSTEMATIC ACCOUNT

The copepods were stained with methyl blue in lactic acid and dissected in lactic acid. All illustrations were made with a camera lucida. The total length was measured from the tip of the forehead to the ends of the caudal rami along a sagittal plane. The urosome was measured from the anterior margin of the genital segment to the ends of the caudal rami. These measurements excluded the telescoped portions of the segments. The proportional lengths of the urosomal segments, however, included the telescoped portions.

The anatomical terms used in the descriptions below are defined as follows: Cephalosome—the anterior portion of the body including the first anatomically thoracic segment bearing the maxillipeds. Metasome—the tagma composed of those thoracic segments normally bearing swimming legs; that is, the second to sixth anatomically thoracic segments. Prosome—the cephalosome and metasome, thus, the portion of the body anterior to the major articulation. Urosome—the portion of the body posterior to the articulation. In conformity with the prevailing convention, the perianal ring is counted as the last segment. The terminal urosomal structures may be fused into the so-called caudal furca, a complex composed of the perianal ring and the caudal rami, and sometimes an additional urosomal segment.

FAMILY CALANIDAE

Calanus finmarchicus s.l. Jashnov, 1955
(Plate 1, figs. 1–4)

Occurrence

Calanus glacialis

- Sta. 5. 3 adult females, 3.45 to 3.84 mm.
- Sta. 7. 7 adult females, 3.55 to 3.84 mm.
- Sta. 9. 14 adult females, 3.55 to 3.79 mm.; 1 adult male, 3.10 mm.
- Sta. 13. 19 adult females, 3.69 to 4.30 mm.; 2 adult males, 3.63 to 3.66 mm.
- Sta. 15. 13 adult females, 3.40 to 3.84 mm.; 7 adult males, 3.20 to 3.70 mm.

Sta. 16. 1 adult female, 3.40 mm.

Calanus pacificus

- Sta. 13. 6 adult females, 2.80 to 3.00 mm.
- Sta. 15. 18 adult females, 2.73 to 3.01 mm.; 3 adult males, 2.67 to 2.80 mm.
- Sta. 16. 18 adult females, 2.62 to 2.97 mm.; 8 adult males, 2.64 to 2.87 mm.

Remarks

C. finmarchicus s. l. has been extensively studied by Jashnov (1955, 1957a, 1957b, 1958, 1961), Brodsky (1948, 1950, 1959, 1962, 1965), and Grainger (1961). The specimens in the present collections can be divided into two size groups. The large form is identified with *C. glacialis* Jashnov, 1955, and the small form is probably referable to *C. pacificus* Brodsky, 1948.

C. glacialis is an arctic species, widely distributed in the polar basin and marginal seas (Jashnov, 1955; Grainger, 1961). This species has also been reported from the Sea of Okhotsk by Ponomareva (1961) but has not been previously recorded from the open Pacific Ocean.

The female of *C. glacialis* has a total length of 3.40 to 4.30 mm. The proportional lengths of the prosome and the urosome are about 3.5–3.7:1. The genital segment is wider than long (53:47), and the caudal ramus is 1.4 times longer than wide (fig. 1). The inner margin of the coxa of the fifth leg has a conspicuous concavity and 17 to 29 teeth (fig. 2). The third endopodal segment of the fifth leg has 5 or 6 setae.

The total length of female *C. pacificus* varies from 2.62 to 3.01 mm. The proportional lengths of the prosome and the urosome are about 3.28–3.47:1. The genital segment is slightly longer than wide (51:49), and the caudal ramus 1.6 times as long as wide (fig. 3). The coxa of the fifth leg has a conspicuous concavity and 24 to 36 teeth along the inner margin (fig. 4). The distal segment of the endopod of the fifth leg has 5 or 6 setae as does that of *C. glacialis*.

The males of the two forms are also readily distinguished from each other by size. Males of *C. glacialis* are 3.10 to 3.70 mm., those of *C. pacificus* 2.64 to 2.87 mm.

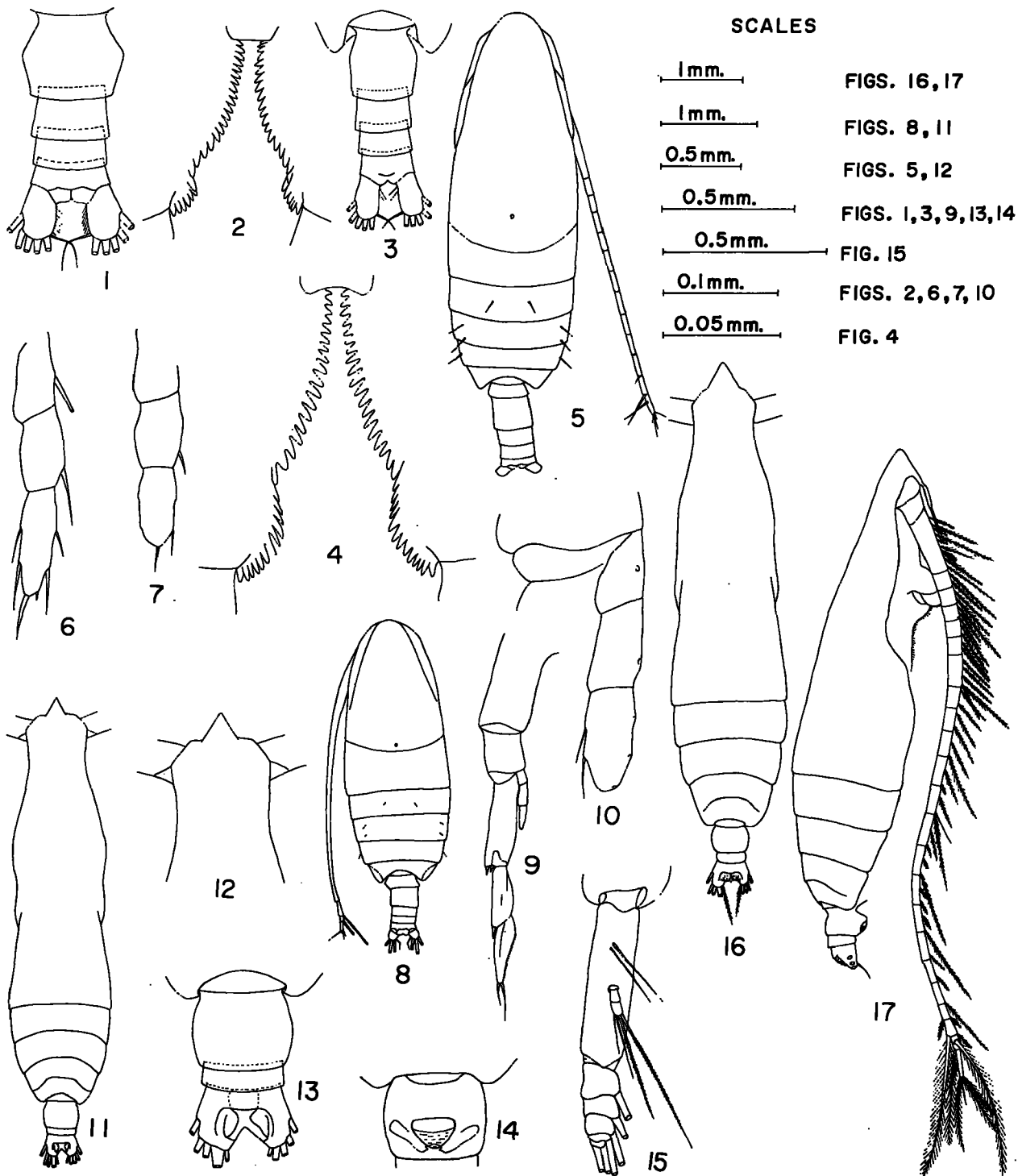


PLATE 1.—Figs. 1–2, *Calanus glacialis*. Female: fig. 1, urosome, dorsal view; fig. 2, inner margins of coxae of fifth pair of legs. Figs. 3–4, *Calanus pacificus*. Female: fig. 3, urosome, dorsal view; fig. 4, inner margins of coxae of fifth pair of legs. Figs. 5–7, *Neocalanus gracilis*. Male: fig. 5, habitus, dorsal view; figs. 6–7, endopods of left fifth legs. Figs. 8–10, *Neocalanus robustior*. Male: fig. 8, habitus, dorsal view;

fig. 9, left fifth leg; fig. 10, endopod of left fifth leg. Figs. 11–15, *Eucalanus attenuatus*, small form. Female: fig. 11, habitus, dorsal view; fig. 12, forehead, dorsal view; fig. 13, urosome, dorsal view; fig. 14, genital segment, ventral view; fig. 15, mandibular palp. Figs. 16–17, *Eucalanus attenuatus*, large form. Female: fig. 16, habitus, dorsal view; fig. 17, habitus, lateral view.

The distal portions of the swimming legs were missing in all specimens.

Calanus tenuicornis Dana, 1849

Occurrence

- Sta. 3. 10 adult females, 1.71 to 1.83 mm.
- Sta. 5. 17 adult females, 1.68 to 2.04 mm.; 1 adult male, 1.88 mm.
- Sta. 7. 13 adult females, 1.78 to 2.22 mm.
- Sta. 9. 2 adult females, 1.90 to 1.98 mm.
- Sta. 13. 5 adult females, 1.88 to 2.22 mm.
- Sta. 15. 1 adult female, 1.91 mm.

Remarks

This species can easily be recognized by the elongate antennules and the absence of the hooked spiniform process on the anterior aspect of the basis of the first leg that appears in the species of *Neocalanus*.

Most of the present specimens, like those observed by Bowman (1955) and Grice (1962), had protozoan parasites in the caudal rami and the setae were consequently eroded.

Bowman (1955) found that specimens off the California coast included two different types of *C. tenuicornis* Dana that were distinguishable from each other mainly by their size. He created a new species, *C. lighti*, for the large and elongate form. The present collections have no specimen identifiable with *C. lighti*.

Calanus plumchrus Marukawa, 1921

Occurrence

- Sta. 13. 24 fifth copepodids, 3.93 to 4.41 mm.
- Sta. 15. 66 fifth copepodids, 3.84 to 4.03 mm.
- Sta. 16. 376 fifth copepodids, 3.84 to 4.32 mm.

Remarks

The specimens of the present collections are identical with the fifth copepodid of *Calanus tonsus* Brady described by Campbell (1934), except that they are smaller than Campbell's (4.5-5.0 mm., from the Strait of Georgia) and have 8 setae, instead of 7, on the third endopodal segment of the third leg.

Tanaka (1956a), who compared adult specimens of *C. plumchrus* from the North Pacific with *C. tonsus* Brady from the Antarctic, reported that the two forms are not identical.

Calanus cristatus Krøyer, 1848

Occurrence

- Sta. 13. 6 fifth copepodids, 6.1 to 6.8 mm.
- Sta. 15. 1 fifth copepodid, 6.1 mm.

Nannocalanus minor (Claus, 1863)

Occurrence

- Sta. 3. 14 adult females, 1.70 to 2.20 mm.; 3 adult males, 1.55 to 1.88 mm.
- Sta. 5. 75 adult females, 1.84 to 2.24 mm.; 10 adult males, 1.65 to 2.01 mm.
- Sta. 7. 21 adult females, 1.81 to 2.07 mm.; 11 adult males, 1.71 to 1.88 mm.
- Sta. 9. 15 adult females, 1.84 to 2.04 mm.; 3 adult males, 1.84 to 1.88 mm.
- Sta. 13. 1 adult female, 2.21 mm.

Remarks

Sewell (1929) divided females of this species, mainly by size, into two different forms, namely f. *major* and f. *minor*. Later Sewell (1947) also recognized two forms of the male. I was unable to distinguish these forms among the present specimens.

Neocalanus gracilis (Dana, 1849)

(Plate 1, figs. 5-7)

Occurrence

- Sta. 3. 8 adult females, 3.00 to 3.20 mm.
- Sta. 5. 30 adult females, 3.16 to 3.46 mm.; 7 adult males, 2.80 to 2.83 mm.
- Sta. 7. 16 adult females, 3.26 to 3.55 mm.; 5 adult males, 2.73 to 2.93 mm.
- Sta. 9. 47 adult females, 3.26 to 3.74 mm.; 3 adult males, 2.83 to 3.06 mm.
- Sta. 13. 6 adult females, 3.45 to 3.64 mm.

Remarks

In the male, the first metasomal segment is separate from the cephalosome. The distance between a small process on the dorsodistal surface of the cephalosome and the articulation between the cephalosome and the first meta-

somal segment is nearly equal to the length of the first metasomal segment (fig. 5). The endopod of the left fifth leg (fig. 6) is not as well developed as that of the fourth leg; in some specimens its setae are almost completely reduced (fig. 7).

Neocalanus robustior (Giesbrecht, 1888)
(Plate 1, figs. 8-10)

Occurrence

- Sta. 3. 28 adult females, 4.03 to 4.32 mm.; 7 adult males, 3.16 to 3.45 mm.
Sta. 5. 7 adult females, 4.03 to 4.22 mm.; 11 adult males, 3.36 to 3.45 mm.
Sta. 7. 12 adult females, 4.12 to 4.41 mm.; 3 adult males, 3.36 to 3.55 mm.

Remarks

This species can easily be distinguished from *N. gracilis*—the female by its large size, the shape of the genital segment, and the shape of the external margin of the maxilla, and the male by the location of the small process at the dorsodistal margin of the cephalosome (fig. 8). The left fifth leg of the male (fig. 9) has a rudimentary 3-segmented endopod, the distal segment of which, in some specimens, has 2 or 3 small setae (fig. 10).

FAMILY EUCALANIDAE

Eucalanus attenuatus (Dana, 1849)
(Plate 1, figs. 11-17; plate 2, figs. 1-16; plate 3, figs. 1-13)

Occurrence

Both small and large forms were taken.

Small form

- Sta. 3. 1 adult female, 4.51 mm.;
1 fifth copepodid male, 3.55 mm.
Sta. 5. 2 adult females, 4.51 to 4.70 mm.;
1 fifth copepodid male, 3.64 mm.

Large form

- Sta. 5. 1 fifth copepodid male, 5.56 mm.
Sta. 7. 3 adult females, 6.62 to 6.91 mm.;
1 fifth copepodid female, 5.66 mm.;
4 fifth copepodid males, 5.56 to 6.04 mm.

- Sta. 9. 2 fifth copepodid females, 5.47 to 5.56 mm.;
1 fifth copepodid male, 5.47 mm.
Sta. 13. 5 adult females, 6.52 to 6.81 mm.;
25 fifth copepodid females, 5.56 to 6.14 mm.;
1 adult male, 6.00 mm.;
28 fifth copepodid males, 5.56 to 6.04 mm.
Sta. 15. 11 adult females, 6.52 to 7.00 mm.;
14 fifth copepodid females, 5.47 to 5.95 mm.;
17 fifth copepodid males, 5.56 to 6.04 mm.

The present collections have two forms of *E. attenuatus* differing from each other mainly in size of the body and in number of setae of the mandibular palp. The small form seems to agree in anatomical details with the description given by Giesbrecht (1892) to this species, but the large form apparently has not been described. Both forms are described below.

Small Form

The small form is described in less detail than the large form and mainly for comparison.

Description of Female

In a specimen 4.70 mm. long the proportions of the prosome to the urosome are about 7.2:1 (plate 1, fig. 11). Those of the 2 free urosomal segments and the caudal furca are 49:16:35 (plate 1, figs. 13 and 14). The genital segment is wider than long (55:45). The height of the produced, triangular part of the forehead (plate 1, fig. 12) is about four-fifths the length of the base. The mandibular palp (plate 1, fig. 15) has 2 setae on the basis, 4 setae on the second endopodal segment, and 6 setae on the exopod.

Description of Immature Male

Only 2 fifth copepodid males were found. These immature forms can readily be identified by the setal arrangement on the mandible, which is the same as that of the adult female.

Large Form

Detailed descriptions of adult females, fifth copepodid female, adult male, and fifth copepodid male follow.

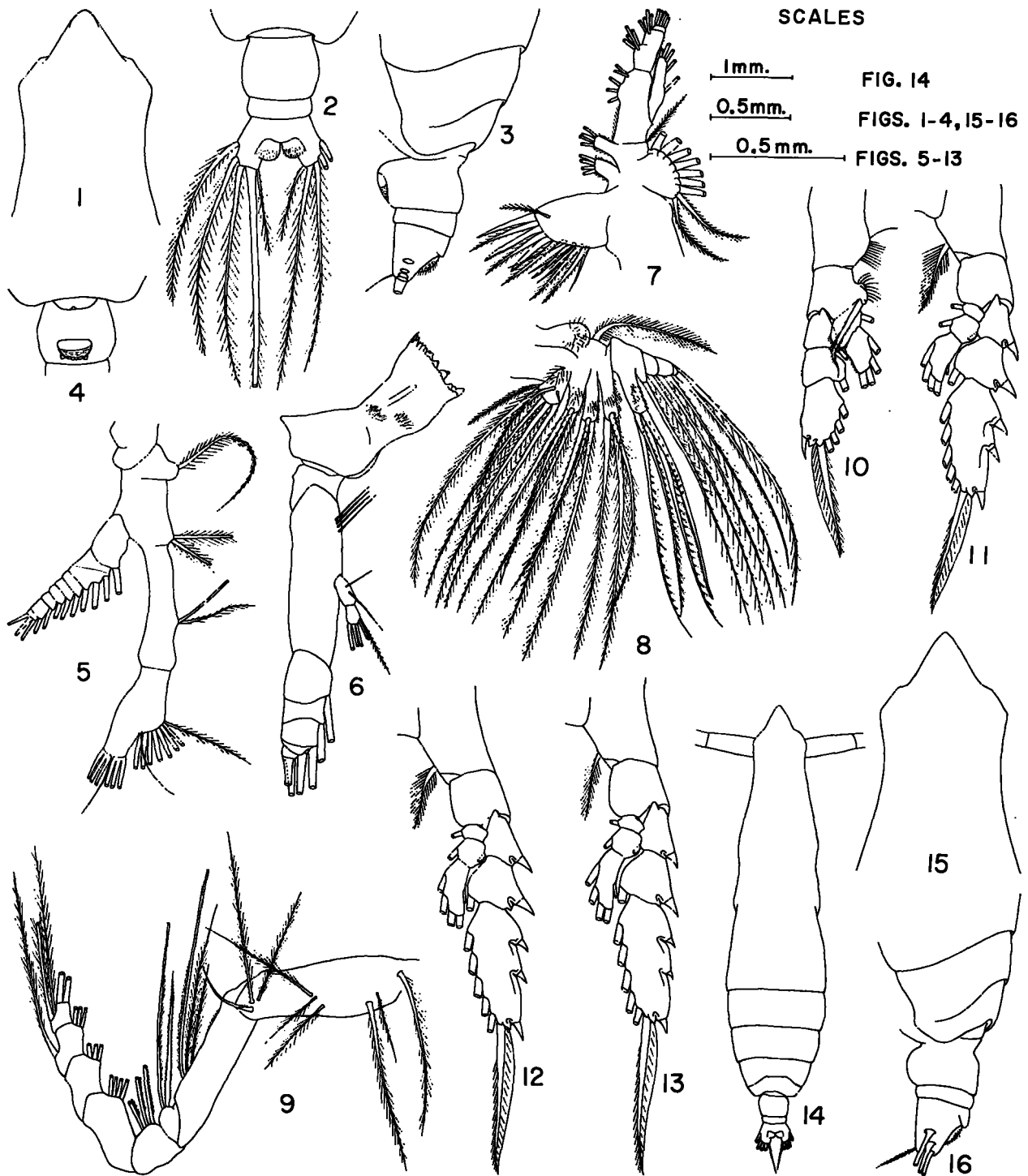


PLATE 2. Figs. 1-16, *Eucalanus attenuatus*, large form. Female: fig. 1, forehead, dorsal view; fig. 2, urosome, dorsal view; fig. 3, posterior part of metasome and urosome, lateral view; fig. 4, genital segment, ventral view; fig. 5, antenna; fig. 6, mandible; fig. 7,

maxillule; fig. 8, maxilla; fig. 9, maxilliped; fig. 10, first leg; fig. 11, second leg; fig. 12, third leg; fig. 13, fourth leg. Fifth copepod females: fig. 14, habitus, dorsal view; fig. 15, forehead, dorsal view; fig. 16, posterior part of metasome and urosome, lateral view.

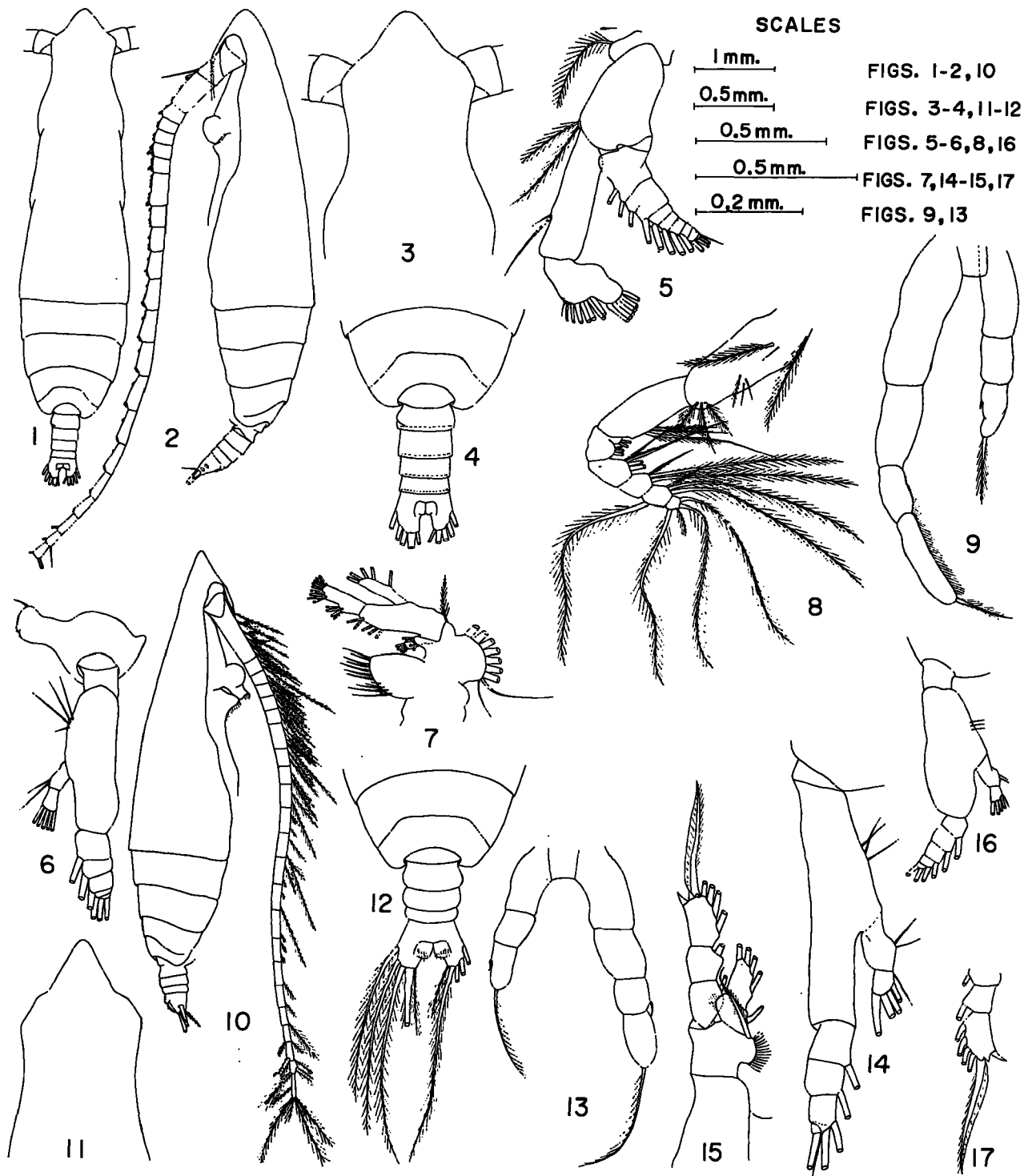


PLATE 3. Figs. 1-13, *Eucalanus attenuatus*, large form. Male: fig. 1, habitus, dorsal view; fig. 2, habitus, lateral view; fig. 3, forehead, dorsal view; fig. 4, posterior part of metasome and urosome, dorsal view; fig. 5, antenna; fig. 6, mandible; fig. 7, maxillule; fig. 8, maxilliped; fig. 9, fifth pair of legs. Fifth copepodid

male: fig. 10, habitus, lateral view; fig. 11, forehead, dorsal view; fig. 12, posterior part of metasome and urosome, dorsal view; fig. 13, fifth pair of legs. Figs. 14-17, *Eucalanus elongatus*. Female: fig. 14, mandibular palp; fig. 15, first leg. Male: fig. 16, mandibular palp; fig. 17, exopod of first leg.

Description of Adult Female

The total lengths of 19 adult females range from 6.52 to 7.00 mm. The prosome is much longer than the urosome (plate 1, fig. 16), and the ratio of these two body parts is about 7.6:1. The anterior region of the head (plate 2, fig. 1) is markedly constricted in front of the antennules and is triangular in dorsal view; the height is about two-thirds the length of the base. The first metasomal segment is fused with the cephalosome. The fourth and fifth metasomal segments are not completely separated, but are fused in the ventrolateral regions (plate 2, fig. 3). The posterolateral corners of the metasome are smoothly rounded.

The urosome consists of 2 free segments and the compound caudal furca. The first or genital segment is composed of 2 fused segments, and the caudal furca is formed of 2 segments fused with the rami. The proportional lengths of the segments and caudal furca, from anterior to posterior, are 45:18:37.

The genital segment (plate 2, fig. 2) is wider than long (55:45); ventrally it projects in a round swelling, bearing the genital aperture (plate 2, figs. 3 and 4). The left caudal ramus is slightly larger than the right. The second medial terminal seta on the left ramus is markedly stouter and much longer than the others.

The antennule (plate 1, fig. 17) has 23 free segments; the first and second and the eighth and ninth segments are fused. The last 6 segments extend beyond the caudal rami. Each segment carries one or several strong plumose setae that are often reddish.

The exopod of the antenna (plate 2, fig. 5) is 8-segmented, has 12 setae, and reaches about the end of the first endopodal segment. The first endopodal segment is about 1.3 times as long as the second and has 2 setae along the inner edge, two-fifths the length of the segment from the distal end. The second endopodal segment has 8 long setae and 1 short seta on the internal lobe and 6 long setae and 1 short seta on the external lobe.

The mandibular palpus (plate 2, fig. 6) is 1.7 times as long as the mandibular blade and is biramous. The basis is more or less cylindrical and has 4 setae at the upper portion of the internal margin. The endopod arises from near

the middle of the basis and is 2-segmented; the first segment has 2 short setae and the second 1 short seta and 4 long setae.

In the maxillule (plate 2, fig. 7), the first inner lobe has 15 spines, and each of the second and third inner lobes has 4 setae. The first outer lobe is rather small and has 9 setae. The second outer lobe is not pronounced and has a single plumose seta. The basis has 5 setae along the internal margin and carries laterally an exopod and distally an endopod. The exopod has 5 setae. The endopod is 3-segmented; the first 2 segments are partially fused and each has 4 setae, and the small apical segment has 5 setae.

The maxilla (plate 2, fig. 8) is well developed. The outer margin of the coxa has a round swelling with hairs. Next to the swelling is a markedly depressed portion from which arises a long, plumose seta. The various lobes are well developed. The first lobe has 6 setae and a small spine, each of the second to fourth lobes has 3 setae, the fifth lobe carries 3 setae and a long spine, and the sixth lobe has a single seta. In addition, the segments of the endopod have setae as follows: 1 on the first, 2 on the second, and 2 on the terminal segment.

The coxa of the maxilliped (plate 2, fig. 9) is composed of 4 lobes: the proximal lobe has 1 seta; the second, 2 setae; and the third and fourth lobes, 3 setae each. The basis has 3 setae just distad of the midpoint and 2 on the distal lobe. The endopod consists of 5 segments, which have 3, 4, 3, 3 + 1, and 2 + 2 setae, respectively.

The coxa of the first leg (plate 2, fig. 10) lacks setae, but its inner margin is fringed with hairs. The basis has a curved, plumose seta at the internal apex. The exopod is 3-segmented. The first and second segments are devoid of external spines, but each has 1 internal seta; the third segment has 1 external spine at the distal corner, a slender terminal spine, and 4 internal setae. The endopod is 2-segmented: the first segment has a single internal seta; the second segment 2 internal and 2 terminal setae.

The second to fourth legs (plate 2, figs. 11-13) are alike. The coxa has an internal plumose seta, but the basis lacks setae. Both the exopod and the endopod are 3-segmented. Each of the first and second exopodal segments has 1 strong external spine and 1 internal seta; the third

segment has 3 external spines, 5 internal setae, and 1 slender terminal spine. Each of the first and second endopodal segments has 1 internal seta. The third segment has 1 external seta, 2 internal setae, and 2 terminal setae. The fifth pair of legs is lacking.

Description of Fifth Copepodid Female

The total lengths of 42 specimens range from 5.47 to 6.14 mm. The prosome is about 7.8 times as long as the urosome. The body shape (plate 2, figs. 14 and 15) resembles that of the adult female. The genital segment shows a distinct ventral swelling (plate 2, fig. 16), but is not so strongly swollen as that of the adult female, and lacks the genital opening.

The segmental composition of the antennule is exactly like that of the adult female. The setal arrangement appears to be the same. The antennae, masticatory appendages, and the swimming legs are all similar to those of the adult female, but the internal lobe of the second endopodal segment of the antenna has 7 long setae instead of 8, and the second to fourth endopodal segments of the maxilliped have 3, 2, and 3 setae instead of 4, 3, and 4.

Description of Adult Male

The adult male was described from a single specimen. The total length is 6.00 mm.; the ratio of the prosome to the urosome is about 6:1. The forehead in dorsal view (plate 3, figs. 1 and 3) is almost triangular, but the apex is smoothly rounded and much less produced than in the adult female. The first metasomal segment is fused with the cephalosome. The fourth and fifth metasomal segments are not completely separated, but are fused in the ventrolateral regions (plate 3, fig. 2). The posterolateral corners of the metasome are smoothly rounded.

The urosome (plate 3, fig. 4) consists of 4 free segments and the caudal furca, a complex composed of the anal segment fused with the caudal rami. The segments and caudal furca have the following proportional lengths, from anterior to posterior: 17:22:18:13:30.

The genital segment is slightly produced on the left side, and has a distinct genital operculum. The left caudal ramus is slightly larger than the right. The second medial terminal seta

on the left ramus is markedly stouter and much longer than the others.

The antennule (plate 3, fig. 2) has 24 free segments, only the eighth and ninth of which are fused; the last 7 segments extend beyond the caudal furca. The antenna (plate 3, fig. 5) is very similar to that of the female but the basis is stouter.

The mandible (plate 3, fig. 6) differs from that of the female in two respects: it is smaller, and the mandibular blade is degenerated and has a single spinelike tooth. The basis has 4 setae at the upper portion of the internal margin, as does that of the female. The endopod arises just distad of the midpoint of the basis and has 2 setae on the first segment and 5 on the second segment.

The maxillule (plate 3, fig. 7), maxilla, and the maxilliped (plate 3, fig. 8) are much smaller than those of the adult female but resemble the latter in shape and in details of setal arrangement.

The first to fourth pairs of legs are nearly identical with those of the female. The left and right fifth legs (plate 3, fig. 9) are both uniramous. The left one is 4-segmented; the distal segment is tipped with a seta, and the last two segments are fringed with hairs along the inner margins. The segments in the left fifth leg have the proportional lengths of 39:21:14:26. The right fifth leg is also 4-segmented, but the last 2 segments are incompletely separated. The distal segment is tipped with a seta, and the third segment has a small spine on its inner edge. The right fifth leg is short—it reaches about the middle of the second segment of the left leg. The segments have the proportional lengths of 48:24:28 (third + fourth).

Description of Fifth Copepodid Male

The total length of 51 specimens ranges from 5.47 to 6.04 mm. The proportional lengths of the prosome and urosome are 7.7:1. The general body shape (plate 3, fig. 10) resembles that of the fifth copepodid female. The head in dorsal view (plate 3, fig. 11) has a triangular frontal part that ends in a blunt point. The urosome (plate 3, fig. 12) consists of 3 free segments and the caudal furca.

The antennule (plate 3, fig. 10) has 23 free

segments. The first and second and the eighth and ninth segments are fused, as in the adult female and fifth copepodid female. The antennae, masticatory appendages, and the first to fourth pairs of legs are identical with those of the fifth copepodid female. The fifth pair of legs (plate 3, fig. 13) is not fully developed. The left one is 4-segmented; the third segment carries a small outer spine, and the distal segment is tipped with a long seta. The right fifth leg is 3-segmented; the distal segment is tipped with a long seta and has a small external spine.

Remarks

The two forms of *E. attenuatus* closely resemble each other in general anatomy but are clearly distinct in size of the body and in setation of the mandibular palp. The total length of the adult female is 4.51 to 4.70 mm. in the small form and 6.52 to 7.00 mm. in the large form. The mandibular palp of the large form has 4 setae on the basis, 2 setae on the first endopodal segment, and 5 setae on the second; the palp of the small form has 2 setae on the basis, no seta on the first endopodal segment, and 4 setae on the second.

The biological significance of the morphological differences shown by the large form cannot be evaluated on the basis of the materials on hand. A. Fleminger (personal communication), however, regards the large forms as ecophenotypic variants.

Eucalanus elongatus (Dana, 1849) (Plate 3, figs. 14-17)

Occurrence

- Sta. 3. 10 adult females, 5.95 to 6.40 mm.
- Sta. 5. 17 adult females, 6.24 to 6.91 mm.;
1 fifth copepodid male, 4.80 mm.
- Sta. 7. 23 adult females, 6.05 to 7.00 mm.;
1 adult male, 4.60 mm.
- Sta. 13. 9 adult females, 6.14 to 6.72 mm.;
1 adult male, 4.70 mm.;
13 fifth copepodid males, 4.60 to 4.90 mm.
- Sta. 15. 3 adult females, 6.30 to 6.70 mm.;
4 fifth copepodid males, 4.70 to 4.80 mm.

Remarks

Giesbrecht (1892) described three varieties of *E. elongatus*, namely, *hyalinus*, *inermis*, and *bungii*. Johnson (1938) raised *inermis* and *bungii* to the status of species. The specimens listed here are identical with *hyalinus* and are mainly characterized by the pointed posterolateral corners of the metasome. The mandible has 3 short setae on the proximal part of the basis and 4 long setae plus 1 short seta on the second endopodal segment (figs. 14 and 16). The third exopodal segment of the first leg has 1 external spine (figs. 15 and 17).

Eucalanus bungii Giesbrecht, 1892 (Plate 4, figs. 1-3)

Occurrence

E. bungii bungii Johnson, 1938

- Sta. 16. 19 adult females, 5.51 to 6.08 mm.;
- 3 fifth copepodid females, 4.27 to 4.75 mm.;
- 4 fifth copepodid males, 4.27 to 4.56 mm.

E. bungii californicus Johnson, 1938

- Sta. 5. 1 fifth copepodid female, 4.22 mm.;
- 1 fifth copepodid male, 4.12 mm.
- Sta. 7. 4 adult females, 5.66 to 5.95 mm.;
- 3 fifth copepodid females, 4.22 to 4.51 mm.;
- 6 fifth copepodid males, 4.12 to 4.51 mm.
- Sta. 13. 7 adult females, 5.70 to 6.40 mm.;
- 20 fifth copepodid females, 4.30 to 4.80 mm.;
- 22 fifth copepodid males, 4.00 to 4.30 mm.
- Sta. 15. 20 adult females, 5.28 to 6.40 mm.;
- 2 fifth copepodid males, 4.20 to 4.40 mm.
- Sta. 16. 4 adult females, 5.70 to 6.27 mm.

Remarks

Eucalanus bungii can be easily distinguished from *E. elongatus* by the rounded postero-

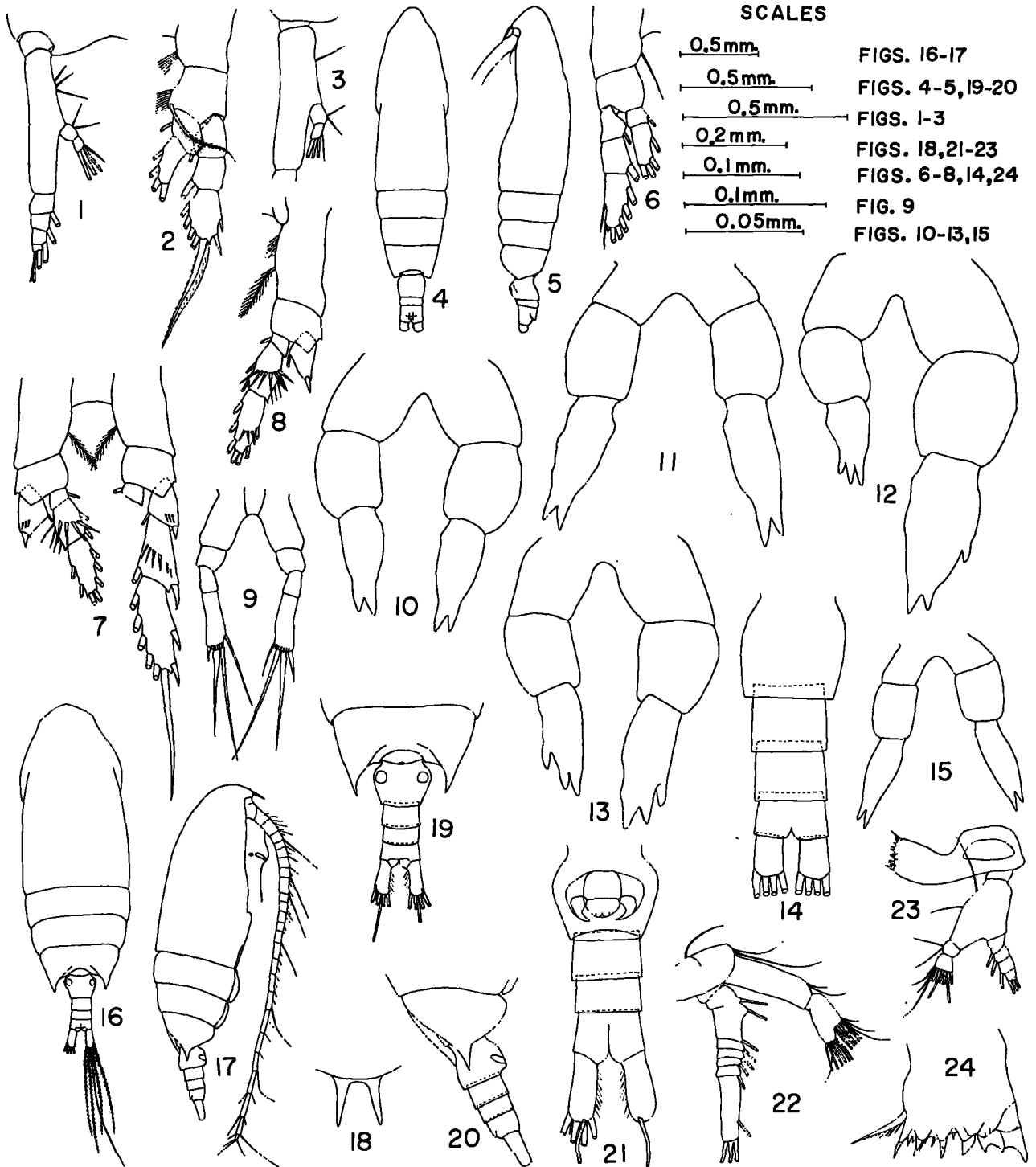


PLATE 4. Figs. 1-3, *Eucalanus bungii*. Female: fig. 1, mandibular palp (*E. bungii bungii*); fig. 2, first leg (*E. bungii bungii*); fig. 3, mandibular palp (*E. bungii californicus*). Figs. 4-9, *Calocalanus tenuis*. Female: fig. 4, habitus, dorsal view; fig. 5, habitus, lateral view; fig. 6, first leg; fig. 7, second pair of legs; fig. 8, third leg; fig. 9, fifth pair of legs. Figs. 10-13, *Clausocalanus arcuicornis*. Female: fig. 10, fifth pair of legs, large form; fig. 11, fifth pair of legs, small

form; figs. 12-13, abnormal fifth pairs of legs. Figs. 14-15, *Clausocalanus pergens*. Female: fig. 14, urosome, dorsal view; fig. 15, fifth pair of legs. Figs. 16-24, *Aetideus pacificus*. Female: fig. 16, habitus, dorsal view; fig. 17, habitus, lateral view; fig. 18, rostrum; fig. 19, posterior part of metasome and urosome, dorsal view; fig. 20, *idem*, lateral view; fig. 21, urosome, ventral view; fig. 22, antenna; fig. 23, mandible; fig. 24, cutting edge of mandibular blade.

lateral margins of the last metasomal segment and the presence of 2 external spines on the terminal exopodal segment of the first leg (fig. 2). By the setation of the mandibular palp, the specimens of the present collections can be divided into two forms that Johnson (1938) described as subspecies—*E. bungii bungii*, which has 3 setae on the basis of the palp (fig. 1), and *E. bungii californicus*, which has a single seta on this structure (fig. 3). Since these two forms are distinguishable from each other only on the basis of this apparently insignificant character, however, it seems better to recognize them as ecophenotypic variants than as subspecies.

Finding all possible transitions between Giesbrecht's (1892) varieties *hyalinus* and *bungii* in the *Snellius* plankton samples, Vervoort (1946) disagreed with Johnson's (1938) idea of elevating these varieties to specific level. The present materials, however, are in favor of Johnson's (1938) treatment in the absence of any intermediate forms.

Mecynocera clausii Thompson, 1888

Occurrence

- Sta. 5. 4 adult females, 1.05 to 1.08 mm.;
1 fifth copepodid male, 0.99 mm.
Sta. 7. 5 adult females, 1.05 to 1.15 mm.;
2 fifth copepodid males, 0.99 mm.
Sta. 9. 1 adult female, 1.08 mm.

Remarks

This species can be recognized by the exceptionally long antennule, which is about twice as long as the body, and the comparatively small size of the copepod itself. According to T. Scott (1894), the fifth leg in both sexes of this species is 5-segmented. The three males in the present collections have 4-segmented fifth legs and 4-segmented urosomes, indicating that they are immature.

FAMILY PARACALANIDAE

Paracalanus parvus (Claus, 1863)

Occurrence

- Sta. 13. 1 adult female, 1.00 mm.

Remarks

I find it curious that we took only one specimen of this reportedly cosmopolitan species.

Calocalanus pavo (Dana, 1849)

Occurrence

- Sta. 5. 2 adult females, 1.08 to 1.12 mm.
Sta. 7. 10 adult females, 1.05 to 1.18 mm.

Remarks

Although widely distributed in the tropical and subtropical regions of all three great oceans, this species was found at only two of the stations.

Calocalanus tenuis Farran, 1926

(Plate 4, figs. 4-9)

Occurrence

- Sta. 13. 4 adult females, 1.15 to 1.24 mm.

Description of Female

The body (figs. 4 and 5) is slender and fusiform; the anterior end of the cephalosome is vaulted. The cephalosome and the first metasomal as well as the fourth and fifth metasomal segments are completely fused. The urosome consists of 3 free segments and the caudal rami. The segments and caudal rami have the following proportional lengths, from anterior to posterior: 38:15:32:15. The genital segment is slightly broader than long in the proportions of 56:44. The caudal ramus is about as broad as it is long.

The first leg (fig. 6) has a 3-segmented exopod and a 2-segmented endopod. The coxa has a seta on the internal margin. The exopod has 0, 0, 2 external spines, 1, 1, 4 internal setae, and a terminal seta. The endopod has 1, 2 internal setae and 2 terminal setae.

The second leg (fig. 7) carries a plumose seta on the internal margin of the coxa. The 3-segmented endopod has 1, 2, and 7 setae, respectively. There are 4 spines, in a transverse row, on the posterior surface and 4 spines on the external margin of the second endopodal segment. The exopod is also 3-segmented, with 1, 1, 2 external spines and 1, 1, 5 internal setae in addition to a terminal seta. The posterior surfaces of the first and second exopodal segments carry 3 and 6 spines, respectively.

The endopod of the third leg (fig. 8) is 3-segmented. The segments have 1, 2, 7 setae, as does the endopod of the second leg. In addition, the second segment has 6 spines on the posterior surface and 4 spines on the external

margin, and the third segment has 3 small spines on the posterior surface.

The fifth leg (fig. 9) is uniramous and 4-segmented. The segments have the proportional lengths of 35:13:17:35. The fourth segment has 1 distally situated external spine, 1 terminal spine, 2 distally situated internal setae, and a row of spinules at the bases of these spines and setae. As shown in figure 9, the right and left legs are different in the lengths of the external spines and the upper internal setae.

Remarks

Calocalanus tenuis was first described from the Bay of Biscay by Farran (1926); it has not been reported from the Pacific. The specimens in the present collections are poor, because some appendages are broken off. They are, however, readily recognized by the slender, fusiform body and the characteristic shape of the fifth leg.

FAMILY PSEUDOCALANIDAE

Pseudocalanus minutus (Kroyer, 1848)

Occurrence

Sta. 16. 1 adult female, 1.26 mm.

Clausocalanus arcuicornis (Dana, 1849) (Plate 4, figs. 10-13)

Occurrence

Sta. 3. 7 large females, 1.51 to 1.60 mm.;
14 small females, 1.38 to 1.48 mm.;
2 males, 1.40 mm.

Sta. 5. 4 large females, 1.51 to 1.58 mm.;
3 small females, 1.12 to 1.41 mm.;
1 male, 1.28 mm.

Sta. 7. 6 large females, 1.50 to 1.55 mm.;
5 small females, 1.12 to 1.46 mm.

Sta. 9. 4 large females, 1.58 to 1.70 mm.;
3 small females, 1.28 to 1.50 mm.;
1 male, 1.42 mm.

Sta. 13. 7 large females, 1.65 to 1.83 mm.;
20 small females, 1.37 to 1.58 mm.;
1 male, 1.23 mm.

Sta. 15. 5 large females, 1.68 to 1.83 mm.;
21 small females, 1.20 to 1.51 mm.;
1 male, 1.14 mm.

Sta. 16. 5 small females, 1.28 to 1.31 mm.;
1 male, 1.46 mm.

Remarks

Sewell (1929), who studied material from the Indian Seas, divided females of *C. arcuicornis* into two forms, namely f. *minor* and f. *major*, mainly differing in the structure of the fifth pair of legs and the proportional lengths of the prosome and urosome. Grice (1962) found two female forms of this species in the equatorial Pacific and tentatively identified these with the two forms described by Sewell (1929). The females of the present collection also fall into two groups that are separable mainly by the total lengths and the shapes of the fifth pairs of legs.

The total lengths of the large form range from 1.50 to 1.83 mm. The prosome is 2.7 to 3.1 times as long as the urosome. In the fifth leg (fig. 10), the proximal segment is stouter and is longer than or as long as the following segment, and the terminal segment is shorter than the preceding two segments combined. The general shape of the fifth pair of legs is similar to that of f. *major* described by Sewell (1929), but my specimens are much larger than the 1.17 mm. reported by him.

The total length of the small form is 1.12 to 1.58 mm. The proportional lengths of the prosome and urosome are about equal to those in the large form. The proximal segment of the fifth leg (fig. 11) is slightly narrower and is shorter than the following segment. The terminal segment is longer than or as long as the preceding two segments combined. This small form seems to correspond to f. *major* described by Grice (1962) in total length and shape of the fifth pair of legs, but is not identical with Sewell's *major* in shape of the fifth pair of legs.

Two females from station 9 had abnormal fifth pairs of legs (figs. 12 and 13).

Clausocalanus pergens Farran, 1926 (Plate 4, figs. 14 and 15)

Occurrence

Sta. 7. 1 adult female, 0.85 mm.

Sta. 13. 1 adult female, 0.94 mm.

Remarks

This species can be distinguished from *C.*

arcuicornis mainly by its smaller size and other, minor, differences. The prosome is 2.5 to 2.8 times as long as the urosome. The caudal ramus (fig. 14) is longer than wide (63:37). The segments of the fifth leg (fig. 15) have the proportional lengths of 21:29:50, from proximal to distal.

Ctenocalanus vanus Giesbrecht, 1888

Occurrence

- Sta. 5. 2 adult females, 1.06 to 1.08 mm.
- Sta. 7. 6 adult females, 1.08 to 1.13 mm.
- Sta. 9. 2 adult females, 1.14 mm.
- Sta. 13. 4 adult females, 1.08 to 1.17 mm.
- Sta. 15. 1 adult female, 1.26 mm.
- Sta. 16. 5 adult females, 1.26 to 1.28 mm.;
5 fifth copepodid males, 1.26 to 1.28 mm.

Remarks

This species was at all the stations except the southernmost, although not in large numbers. It can easily be recognized by the ctenoid form of the external spines of the third exopodal segment of the third and fourth legs.

FAMILY AETIDEIDAE

Aetideus pacificus Brodsky, 1950

(Plate 4, figs. 16-24; plate 5, figs. 1-7)

Occurrence

- Sta. 16. 5 adult females, 2.21 to 2.30 mm.

A complete description is given here because Brodsky's original description is brief and seems to disagree in some anatomical details with the present specimens.

Description of Female

The total lengths of five adult females range from 2.21 to 2.30 mm. The prosome is about 3.4 times as long as the urosome. The general outline of the prosome is ovate. In dorsal aspect the greatest width is at the fusion of the cephalosome and the first metasomal segment (plate 4, fig. 16). The first metasomal segment is completely fused with the cephalosome. The fourth and fifth metasomal segments are also completely fused. The cephalosome in dorsal aspect is slightly dilated in the oral region and is smoothly rounded anteriorly. The rostrum

consists of two rather slender processes (plate 4, fig. 18).

The posterolateral corners of the metasome are produced into acute points, which in dorsal view are slightly curved inward (plate 4, fig. 19) and in lateral aspect point straight backward (plate 4, fig. 20). These points do not reach the distal margin of the genital segment in either dorsal or lateral view.

The urosome (plate 4, figs. 19-21) is 4-segmented; the segments and the caudal rami have the following proportional lengths, from anterior to posterior: 31:17:14:13:25. The genital segment in dorsal aspect is slightly wider than long (29:25) and has broadly rounded sides. The caudal rami are about 2.5 times as long as broad, and have 4 terminal setae of subequal length, a long ventral seta that is longer than the terminal setae, and a short external seta.

The antennule is 24-segmented; when it is applied against the body, its last 2 segments extend beyond the end of the caudal ramus (plate 4, fig. 17).

The endopod of the antenna (plate 4, fig. 22) is slightly shorter than the exopod. The first endopodal segment is styliform and has 2 setae almost at the distal end of the internal margin. The second endopodal segment is about half the length of the first and has 6 + 1 setae on the external lobe and 8 setae on the internal lobe. The first and second exopodal segments are incompletely separated; the former has no setae, but the latter has 2 setae proximally along the internal margin and 1 seta at the distal end of that margin. The third to sixth segments are fully separated; each has a strong seta. The seventh segment is elongate and has an internal seta at about two-thirds the length of the segment from the proximal end, and 3 apical setae.

The mandibular palp (plate 4, fig. 23) has a squarish basis with 2 setae along the internal margin. The endopod is 2-segmented and has 2 setae on the first segment and 9 + 2 on the second. The exopod is 5-segmented; each of the proximal 4 segments has a strong seta, and the distal segment 2 apical setae. The cutting edge of the mandibular blade (plate 4, fig. 24) is armed with about six groups of teeth and a basal seta.

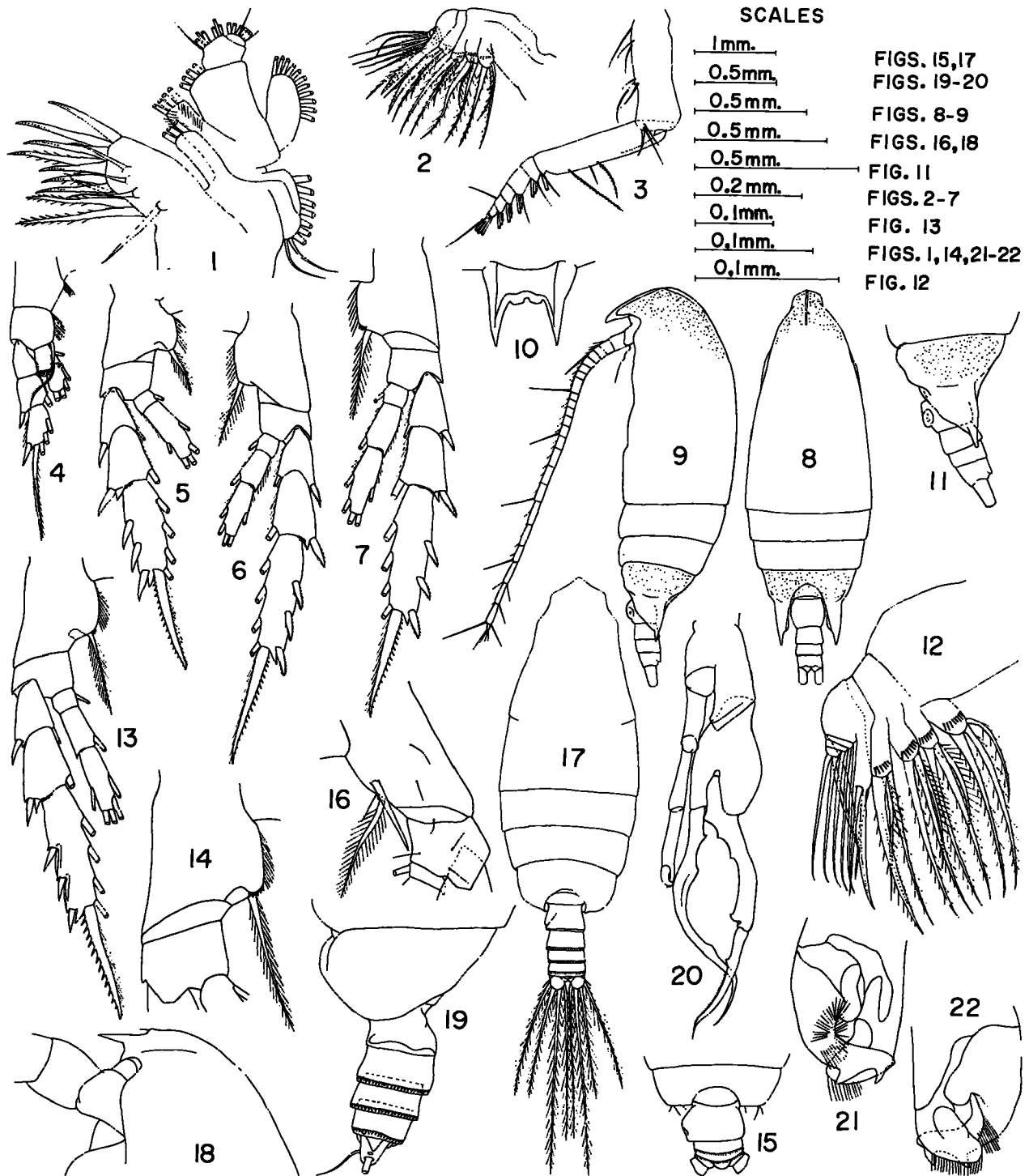


PLATE 5. Figs. 1-7, *Actideus pacificus*. Female: fig. 1, maxillule; fig. 2, maxilla; fig. 3, maxilliped; fig. 4, first leg; fig. 5, second leg; fig. 6, third leg; fig. 7, fourth leg. Figs. 8-14, *Euaetideus acutus*. Female: fig. 8, habitus, dorsal view; fig. 9, habitus, lateral view; fig. 10, rostrum; fig. 11, posterior part of metasome and urosome, lateral view; fig. 12, maxilla; fig. 13, fourth leg; fig. 14, basipod of fourth leg. Figs.

15-22, *Euchirella truncata*. Female: fig. 15, posterior part of metasome and urosome, dorsal view; fig. 16, basipod of fourth leg. Male: fig. 17, habitus, dorsal view; fig. 18, forehead, lateral view; fig. 19, posterior part of metasome and urosome, lateral view; fig. 20, fifth pair of legs, posterior aspect; fig. 21, terminal part of left fifth leg, posterior aspect; fig. 22, *idem*, anterior aspect.

The maxillule (plate 5, fig. 1) is well developed. The first inner lobe has 9 strong spines along the internal margin, 4 relatively small spines on the posterior surface, and 1 small spine on the anterior surface. The second and third inner lobes are elongate and have 3 and 4 setae, respectively. The first outer lobe is low and has 9 setae. The basis bears 4 setae at the apex of the internal margin. The exopod has 11 setae. The endopod is 2-segmented, and carries 4 + 3 setae on the first segment and 6 + 2 setae on the second.

The maxilla (plate 5, fig. 2) has 5 well-developed lobes. Each of the first to fourth lobes bears 2 spiniform, spinulose setae of equal length, a short spinulose seta, and a few small spinules near the insertions of the setae. One of the 2 spiniform setae on the fourth lobe is much stouter than the other. The fifth lobe carries a strong dagger-shaped spine in addition to 2 slender setae. The endopod has 6 setae—1 on each of the proximal 3 segments and 3 on the terminal segment.

The maxilliped (plate 5, fig. 3) consists of a long basipod and a short endopod. The coxa has three groups of 3 setae each and is about as long as the basis, which has a row of spinules proximally, 3 scattered setae distally, and 2 setae at the extreme apex. The endopod has 5 segments, which have the following numbers of setae, from proximal to distal: 4, 4, 3, 3 + 1, and 4.

The first pair of legs (plate 5, fig. 4) has 3-segmented exopods and 1-segmented endopods. The coxa has no setae, but bears hairs along the proximal portion of the internal margin. The internal margin of the basis is fringed with hairs and has a curved seta at the distal end. The first exopodal segment lacks setae or spines. The second exopodal segment has an internal seta and an external spine. The internal margin of the spine appears to be slightly denticulate. The third exopodal segment has an external spine with a slightly denticulate internal margin. In addition, the segment has 3 internal setae and a long terminal spine, which has a lamella along the external margin and a row of hairs along the internal margin. Halfway along its external margin the endopod has a round tubercle which has a transverse row of small, acute spinules. In addition, the endopod has 3

internal setae, 2 terminal setae, and some small spinules at the base of the middle internal seta.

The coxa of the second leg (plate 5, fig. 5) has a considerably curved internal margin, which has a row of hairs and a short, thick seta. The basis has no hairs or setae. The exopod is 3-segmented. Each of the first and second segments has an external spine and an internal seta. In anterior aspect a row of small spinules lies along the distal border of the second segment. The third segment has 3 external spines, 4 internal setae, and a dagger-shaped terminal spine armed with 17 triangular teeth. The endopod is 2-segmented, with 1 seta on the first and 5 setae on the second segment, and reaches to about the distal border of the second exopodal segment.

The basipod and exopod of the third leg (plate 5, fig. 6) are similar to those of the second leg, but the external spines of the exopod are fringed with fine hairs and the terminal spine is armed with 19 acute, triangular teeth. The endopod is 3-segmented, with 1 seta on each of the first and second segments and 5 setae on the third, and extends slightly beyond the distal border of the second exopodal segment. A row of very fine spinules lies along the distal border of the second endopodal segment.

The fourth leg (plate 5, fig. 7) differs from the third in the following particulars: About 4 small, acute spines are at the insertion of the seta on the coxa. The endopod is longer, reaching to a line including one-third of the length of the third exopodal segment. The terminal spine is also absolutely shorter, and armed with 18 teeth along the external edge. The fifth pair of legs is absent.

Remarks

The armature of the mandibular blade of the present specimens disagrees with the original description of the species by Brodsky (1950) but agrees with his description for *Aetideus armatus*.

I recently compared female specimens of *A. armatus* and *A. pacificus* from the Pacific coast of North America and found that, although the species are alike in anatomical details of the appendages, they are clearly distinguishable from each other by the size and general shape

of the body. *A. armatus* is 1.80 to 2.02 mm. total length (about 50 specimens) and has metasomal processes that extend beyond the distal end of the genital segment. *A. pacificus*, as described above, has a slender body of 2.20 to 2.43 mm. (seven specimens) and has metasomal processes that do not reach the distal end of the genital segment. The male of *A. pacificus* is not known.

Euaetideus acutus (Farran, 1929)
(Plate 5, figs. 8-14)

Occurrence

- Sta. 3. 3 adult females, 1.65 to 1.68 mm.
Sta. 5. 5 adult females, 1.68 to 1.78 mm.
Sta. 7. 1 adult female, 1.65 mm.
Sta. 9. 1 adult female, 1.68 mm.

Remarks

The female of this species can easily be distinguished by the following characters: The rostrum is very heavy and, in dorsal aspect, distinctly set off from the remainder of the head (fig. 8); the rami (fig. 10) are separated by a deep, U-shaped incision, at the base of which are two small knobs; the posterolateral corners of the metasome are produced into acute points that extend slightly beyond the distal border of the second urosomal segment (fig. 11); the dorsum of the prosome (figs. 8 and 9) has a pitted structure that is particularly visible at the forehead and on the last segment.

The antennae and the mouth parts were figured and described in detail by Vervoort (1957). The present specimens generally agree with his description except for the maxilla. The dagger-shaped spines on the fourth and fifth lobes of the maxilla (fig. 12) are almost identical in diameter, but different in length—the one on the fourth lobe is the longer. Each of the first to fourth lobes has a row of acute spinules, instead of irregular rows of spinules.

The first to fourth pairs of legs in general agree with those figured by Vervoort (1957). Some additional characters in the present specimens are as follows: In stained specimens, a line of demarcation is clearly visible between the first and second endopodal segments of the second leg. A row of fine spinules lies along the

distal border of the second exopodal segment in the second to fourth legs and on the distal border of the second endopodal segment in the third to fourth legs. The coxa of the fourth leg has about 5 acute spinules at the insertion of the internal seta (figs. 13 and 14).

Euchirella truncata Esterly, 1911
(Plate 5, figs. 15-22)

Euchirella truncata Esterly, 1911, p. 322; plate 26, fig. 5; plate 28, fig. 35; plate 29, fig. 63; plate 30, fig. 71; plate 31, fig. 104.

Euchirella propria Esterly, 1911, p. 321, plate 27, figs. 14 and 20; plate 30, figs. 67 and 83; plate 31, fig. 85.

Occurrence

- Sta. 3. 1 adult female, 5.40 mm.
Sta. 5. 5 adult females, 5.56 to 6.06 mm.;
1 adult male, 4.60 mm.
Sta. 7. 5 adult females, 5.85 to 6.24 mm.;
7 adult males, 4.60 to 5.08 mm.
Sta. 9. 2 adult females, 5.71 to 6.14 mm.;
3 adult males, 4.89 to 4.99 mm.
Sta. 13. 1 adult female, 6.81 mm.

Euchirella truncata was originally described by Esterly (1911) from females obtained in the San Diego, Calif., region of the eastern Pacific. As suggested by Vervoort (1963), *Euchirella propria*, erected on males alone by Esterly (1911), seems to be synonymous with *E. truncata*, for in the present study the two forms were found in the same samples and were closely similar in size as well as in anatomical details.

E. truncata has also been recorded from the South Atlantic as *E. gracilis* (Wolfenden, 1911), from the North Atlantic as *E. intermedia* (With, 1915), and from the Gulf of St. Lawrence as *E. acadiana* (Willey, 1919).

Description of Female

The female can easily be recognized by the shape of the genital segment, which is more swollen on the left side (fig. 15), and by the presence of a single strong spine on the coxa of the fourth leg (fig. 16).

Description of Male

The total length ranges from 4.60 to 5.08 mm. The prosome is about 4.2 times as long as the urosome. The cephalosome and the first

metasomal segment as well as the fourth and fifth metasomal segments are fused (fig. 17). The forehead is smoothly rounded and has a strong rostrum (fig. 18). The posterolateral margins of the metasome are rounded (fig. 19).

The urosome consists of 5 free segments and the caudal rami which have the following proportional lengths, from anterior to posterior: 23:22:18:19:6:12. The last segment is almost completely telescoped into the fourth segment. The caudal rami are as long as they are wide. The distal margins of the second to fourth segments are each fringed by a row of small triangular spinules.

The uniramous left fifth leg (fig. 20) consists of 5 segments, the third of which reaches as far as the distal end of the basis of the right leg. The distal segment is small and inserted a short distance before the end of the fourth segment; the two segments together thus form a chela (figs. 21 and 22). Distally on the last segment are 2 teeth, which are curved outward. The right fifth leg consists of a well-developed, 2-segmented basipod, a 2-segmented exopod, and a 1-segmented endopod. The first exopodal segment bears 4 triangular processes along the internal margin—3 on the proximal half, and 1 near the distal end of the margin. The distal segment has a triangular process along the internal margin, at about one-third the length from the proximal end, and a row of small teeth distal to the process. The endopod is S-shaped and has 3 triangular processes along the external margin.

Euchirella unispina, new species

(Plate 6, figs. 1–21; plate 7, figs. 1–11)

Occurrence

- Sta. 3. 6 adult females, 4.28 to 4.56 mm.
- Sta. 5. 7 adult females, 4.60 to 4.70 mm.;
1 adult male, 3.84 mm.
- Sta. 7. 3 adult females, 4.70 to 4.80 mm.;
1 adult male, 3.93 mm.
- Sta. 9. 3 adult females, 4.60 to 4.89 mm.;
3 adult males, 3.93 to 4.03 mm.

Description of Female

The total length is from 4.28 to 4.89 mm. The prosome is about 4.3 times longer than the urosome. The first metasomal segment is fused with the cephalosome, but a line of demarca-

tion is often visible in stained specimens. The fourth and fifth metasomal segments are completely fused. The forehead in dorsal aspect (plate 6, fig. 1) is slightly triangular and in lateral aspect (plate 6, fig. 2) smoothly curved into a powerful rostrum. The rostrum is single, points forward, and has an acute apex. The base of the rostrum has a distinct constriction from which 2 sensory hairs arise.

The posterolateral margins of the metasome are rounded. The urosome (plate 6, figs. 3–5) is 4-segmented; the segments and the caudal rami have the following proportional lengths, from anterior to posterior: 51:12:12:11:14. The genital segment is about as long as it is wide and slightly asymmetrical in dorsal aspect, as it is produced distally on the left side. The caudal rami are wider than long (24:19) and have 4 strong, subequal terminal setae, a short, strong external seta, and a curved internal seta.

The 24-segmented antennule reaches the end of the caudal ramus when folded back. The arrangement of the various setae and the aesthetes is illustrated in plate 6, figure 6.

The antenna (plate 6, fig. 7) has a short endopod, about equal to the first 2 exopodal segments combined. The first endopodal segment has 1 seta near the distal end of the internal margin, and the second endopodal segment has 8 setae on the internal and 6 + 1 setae on the external lobe. The exopod is 7-segmented; the proximal segment is produced into a triangular process near the distal end of the internal margin. Each of the 4 intermediate segments has 1 strong, plumose seta, and the elongate distal segment has 3 apical setae.

The cutting edge of the mandibular blade (plate 6, fig. 8) is armed with five groups of strong teeth and 2 basal spines. The posterior surface of the basis has a small process. The endopod is 2-segmented; the first segment lacks setae, but the second segment bears 9 apical setae. The exopod is 5-segmented, the segments together having 6 setae.

In the maxillule (plate 6, fig. 9), the first inner lobe is elongate, and has 12 strong spines plus 1 small spine. The second and third inner lobes are well developed; the second has 4 setae of subequal length and the third 1 large plus 2 small setae. The first outer lobe is low and has 8 setae. The basis is elongate and has 1

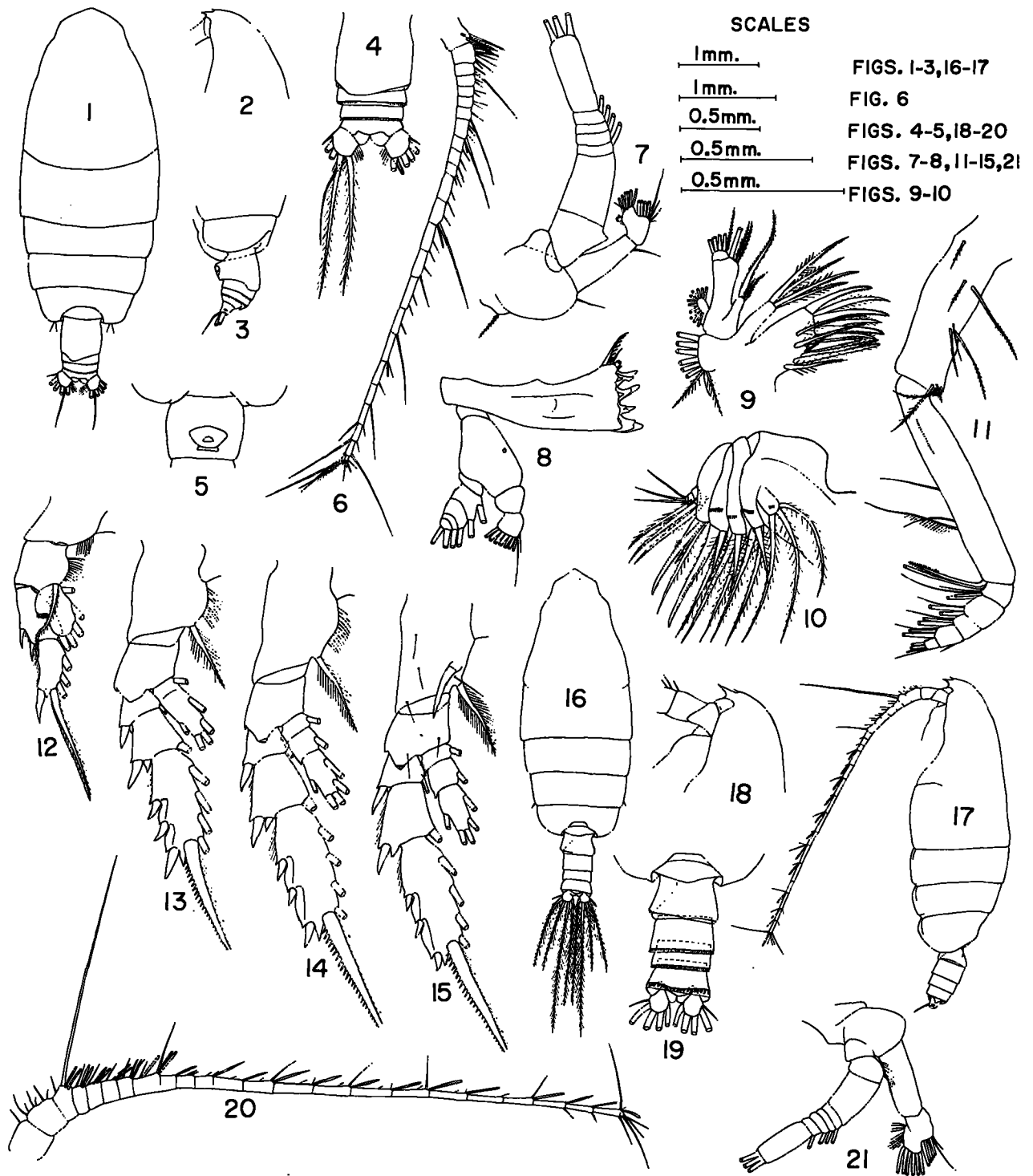


PLATE 6. Figs. 1-21, *Euchirella unispina*, new species. Female: fig. 1, habitus, dorsal view; fig. 2, forehead, lateral view; fig. 3, posterior part of metasome and urosome, lateral view; fig. 4, urosome, dorsal view; fig. 5, genital segment, ventral view; fig. 6, antennule; fig. 7, antenna; fig. 8, mandible; fig. 9,

maxillule; fig. 10, maxilla; fig. 11, maxilliped; fig. 12, first leg; fig. 13, second leg; fig. 14, third leg; fig. 15, fourth leg. Male: fig. 16, habitus, dorsal view; fig. 17, habitus, lateral view; fig. 18, forehead, lateral view; fig. 19, posterior part of metasome and urosome, dorsal view; fig. 20, left antennule; fig. 21, antenna.

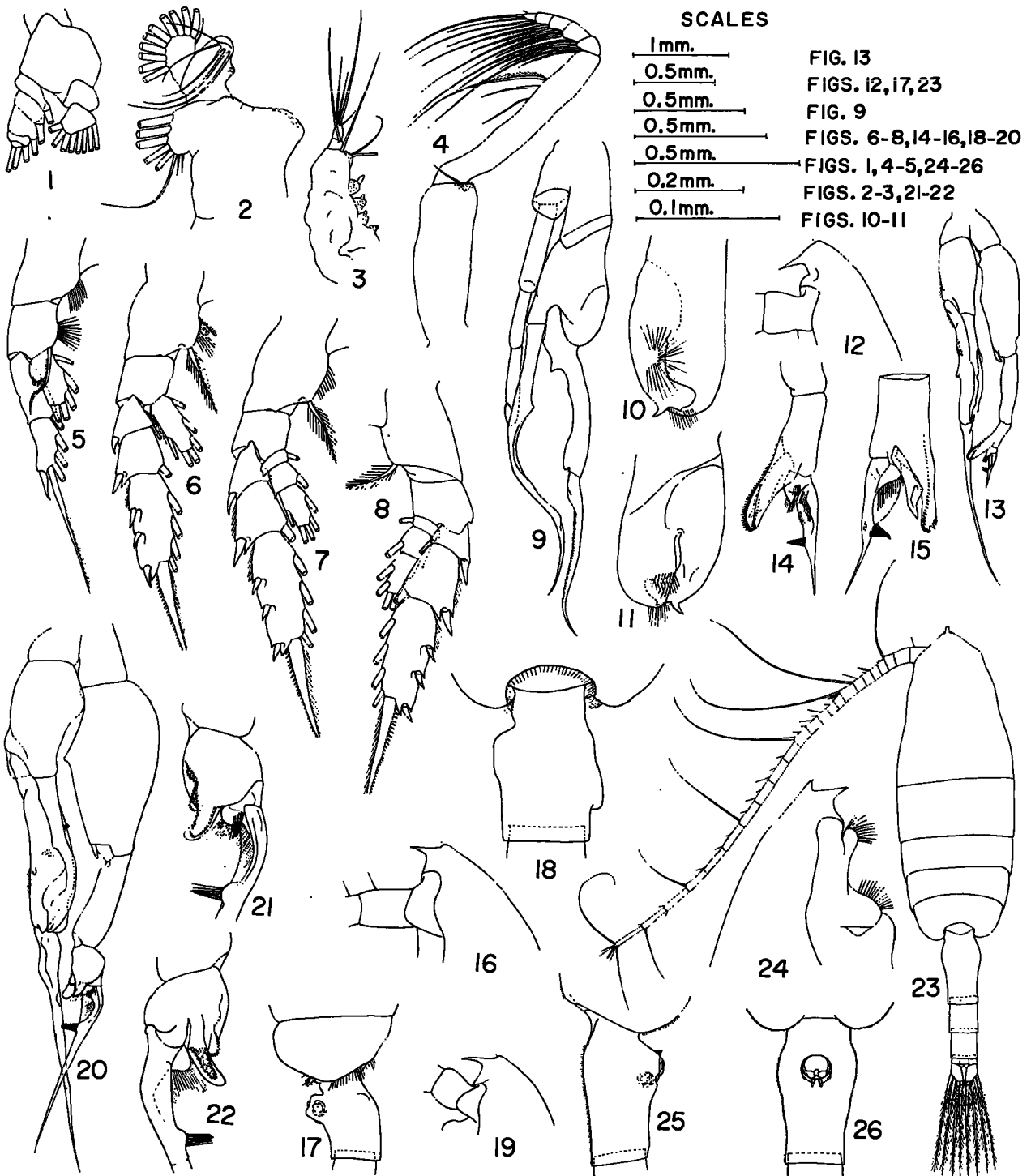


PLATE 7. Figs. 1-11, *Euchirella unispina*, new species. Male: fig. 1, mandibular palp; fig. 2, maxillule; fig. 3, maxilla; fig. 4, maxilliped; fig. 5, first leg; fig. 6, second leg; fig. 7, third leg; fig. 8, fourth leg; fig. 9, fifth pair of legs, posterior aspect; fig. 10, terminal part of left fifth leg, posterior aspect; fig. 11, *idem*, anterior aspect. Figs. 12-15, *Euchaeta spinosa*. Male: fig. 12, forehead, lateral view; fig. 13, fifth pair of legs, anterior aspect; fig. 14, distal part of left fifth leg, anterior aspect; fig. 15, *idem*, posterior as-

pect. Figs. 16-22, *Euchaeta media*. Female: fig. 16, forehead, lateral view; fig. 17, posterior part of metasome and genital segment, lateral view; fig. 18, *idem*, dorsal view. Male: fig. 19, forehead, lateral view; fig. 20, fifth pair of legs, anterior aspect; fig. 21, middle part of exopod of left fifth leg, anterior aspect; fig. 22, *idem*, posterior aspect. Figs. 23-26, *Euchaeta wrighti*, new species. Female: fig. 23, habitus, dorsal view; fig. 24, forehead, lateral view; fig. 25, genital segment, lateral view; fig. 26, *idem*, ventral view.

large and 2 small setae at the inner apex. The endopod and the exopod are small and 1-segmented, and have 5 and 11 setae, respectively.

The maxilla (plate 6, fig. 10) is short and has 5 prominent lobes. Each of the first to fourth lobes has a transverse row of small spinules on the posterior surface. The first lobe has in addition 3 long spinulose setae and 1 short, spinulose seta; the second and third lobes each have 2 long spinulose setae and one short spinulose seta; and each of the fourth and fifth lobes has one strong, dagger-shaped spine, 1 long spinulose seta, and 1 short spinulose seta. The endopod seems to be 4-segmented. Each of the first 3 segments has 1 spinulose seta. These setae are about equally long. The terminal segment has 3 short setae. In addition, the second and third segments each have a tiny seta.

The maxilliped (plate 6, fig. 11) has a slender basipod, and a short endopod that is about one-half the length of the basis. The coxa has four groups of setae, composed of 1, 2, 3, and 3 setae, respectively. Some scattered spinules are at the insertions of the setae of the last group. The basis has 3 setae at the middle and 2 setae at the distal end of the internal margin, in addition to a row of spinules along the proximal portion of the same margin. The endopod consists of 5 segments which have 4, 3, 3, 3 + 1, and 4 setae, respectively.

The first pair of legs (plate 6, fig. 12) has 2-segmented exopods and 1-segmented endopods. The basipod is fringed with hairs along the internal margin and has a seta at the distal end of the same margin. The endopod is slightly shorter than the first exopodal segment, and its external margin has a round tubercle that bears a transverse row of spinules on the anterior surface. The endopod has 3 internal setae and 2 apical setae. The first exopodal segment has 1 internal seta and 2 subequal external spines. The second exopodal segment has 1 strong external spine, 3 internal setae, and 1 long apical spine.

In the basipod of the second leg (plate 6, fig. 13), the coxa is fringed with hairs only along the internal margin and has an internal seta. The endopod is a single segment (a line of fusion is visible in stained specimens) that is slightly shorter than the combined length of

the first and second exopodal segments. The endopod has 3 internal setae, 1 external seta, and 2 apical setae. The first and second exopodal segments each have 1 internal seta and 1 strong external spine. The third exopodal segment is longer than the first and second segments combined and has 3 strong external spines, 4 internal setae, and 1 long terminal spine that is armed with a row of acute teeth along the external margin.

The third leg (plate 6, fig. 14) is slightly larger than the second, but its basipod and exopod are similar in anatomical details to those of the second. The endopod is 3-segmented; the segments have 1, 1, and 5 setae, respectively. There are 2 triangular, flattened processes along the external margin of the first endopodal segment.

The fourth leg (plate 6, fig. 15) is slightly smaller than the third, and its coxa has a strong spine in addition to a stout internal seta. The spine extends beyond the distal end of the segment. Furthermore, the posterior surface of the coxa has 4 delicate setae, one of which is immediately distal to the insertion of the spine. Two such setae are also on the posterior surface of the basis. The exopod and endopod are anatomically similar to those of the third leg. The fifth pair of legs is absent.

Description of Male

The total length ranges from 3.84 to 4.03 mm. The proportional length of the prosome to the urosome is about 3.7:1. The prosome is more slender than in the female and has a low triangular forehead in dorsal aspect (plate 6, fig. 16). In lateral view the forehead is smoothly rounded into a strong rostrum and devoid of crests (plate 6, fig. 18). The cephalosome and the first metasomal segment, as well as the fourth and fifth metasomal segments, are completely fused, as they are in the female. The posterolateral margins of the metasome are rounded.

The urosome (plate 6, fig. 19) consists of 5 free segments and the caudal rami. The segments and the caudal rami have the following proportional lengths, from anterior to posterior: 25:24:17:19:6:9. The distal margins of the second to fourth urosomal segments are each fringed with a row of small spinules.

The 24-segmented antennule (plate 6, figs. 17 and 20) reaches the end of the second urosomal segment when applied against the body. Articulations between the 8th and 9th, the 11th and 12th, and the 23d and 24th segments are incomplete.

In the antenna (plate 6, fig. 21), the endopod is much better developed than in the female, reaching about two-thirds the length of the exopod. The basipod and the first endopodal segment, however, are devoid of setae.

The mouth parts are all reduced. The mandible (plate 7, fig. 1) lacks the mandibular blade. In the maxillule (plate 7, fig. 2), the first inner lobe is reduced to a mere round process that lacks setae or spines, and the second and third inner lobes are absent. The basis has no setae. The endopod is small, with 5 setae, but the exopod is much better developed than in the female and has 10 large setae plus 1 small seta.

In the maxilla (plate 7, fig. 3), the first to fourth lobes lack setae or spines. The fifth lobe has 2 setae. The endopod is 2-segmented and has 1 seta on the first and 4 setae on the second segment. In addition, there is a seta at the insertion of the endopod. The coxa of the maxilliped (plate 7, fig. 4) has a single seta and some scattered spinules on the distal lobe.

The legs of the male differ from those of the female in certain respects. In the first leg (plate 7, fig. 5), the first exopodal segment lacks external spines. The endopod of the second leg (plate 7, fig. 6) is a single segment without a visible line of fusion. The fourth leg (plate 7, fig. 8) lacks coxal spines and closely resembles the third (plate 7, fig. 7), but differs from the same leg of the female.

The fifth pair of legs (plate 7, fig. 9) consists of a uniramous left leg and a well-developed, biramous right leg. The left leg has 5 segments. The small distal segment is inserted a short distance proximal to the end of the preceding segment; the 2 segments together thus form a minute chela. The distal segment carries 2 teeth apically. The external tooth, which is the larger, curves outward, the internal one inward (plate 7, figs. 10 and 11). The right leg consists of a 2-segmented basipod, a 1-segmented endopod, and a 2-segmented exopod. The basipod is well developed, reaching the middle of the third segment of the left leg.

The endopod is S-shaped, and has a triangular prominence along the external margin, one-third the length from the proximal end. The first exopodal segment has 2 prominences along the proximal one-third of the internal margin; the distal one of these is much larger than the other. The distal segment is S-shaped and has a row of small teeth along the internal margin.

Remarks

This species is closely related to *E. truncata*, but the female can easily be distinguished from that of the latter by her smaller size and the shape of the genital segment. The male of this species is characterized by the shapes of the teeth on the terminal segment of the left fifth leg and by the arrangement of the prominences on the exopod and endopod of the right fifth leg.

Type material of *E. unispina* from station 5 has been deposited in the U.S. National Museum as follows: Holotype female (USNM 113238); allotype male (USNM 113239); six females as paratypes (USNM 113240).

Euchirella amoena Giesbrecht, 1888

Occurrence

- Sta. 3. 1 adult female, 3.84 mm.;
1 adult male, 3.20 mm.;
3 fifth copepodid females, 2.89 to 3.07 mm.;
4 fifth copepodid males, 3.00 to 3.09 mm.
- Sta. 5. 2 adult females, 3.74 to 3.84 mm.;
3 adult males, 3.45 to 3.55 mm.;
2 fifth copepodid males, 3.26 mm.
- Sta. 7. 1 fifth copepodid female, 3.13 mm.;
1 fifth copepodid male, 3.16 mm.
- Sta. 9. 1 fifth copepodid female, 3.00 mm.

Remarks

The male of this species had been known as *E. amoena* and the female as *E. brevis*, until Grice (1962) synonymized them.

The female is well characterized by the stout, almost globose body, the last metasomal segment (with a pointed ridge on its posterolateral margin), and by the presence of 4 small acute teeth near the base of the internal seta of the coxa of the fourth leg.

The adult male can be recognized easily by the characteristic fifth pair of legs, which has a strong spine on the internal margin of the first segment of the right exopod. The fifth copepodid male is distinguished by the mandible, which, like that of the adult female, has a strong spine on the basis.

Euchirella rostrata Claus, 1866

Occurrence

- Sta. 5. 12 adult females, 3.26 to 3.45 mm.
Sta. 7. 22 adult females, 3.36 to 3.64 mm.;
1 adult male, 2.97 mm.
Sta. 9. 17 adult females, 3.36 to 3.74 mm.;
1 adult male, 3.00 mm.
Sta. 13. 3 adult females, 3.60 to 3.80 mm.
Sta. 15. 6 adult females, 3.80 to 4.00 mm.

Remarks

This species is one of the most common in the present collections, but the male is rare.

Undeuchaeta plumosa Lubbock, 1856

Occurrence

- Sta. 5. 4 adult females, 3.74 to 3.93 mm.
Sta. 9. 5 adult females, 3.84 to 4.12 mm.;
2 adult males, 3.55 to 3.72 mm.

Remarks

The present specimens are in full agreement with the figures given by Grice (1962).

FAMILY EUCHAETIDAE

Euchaeta marina (Prestandrea, 1833)

Occurrence

- Sta. 3. 1 fifth copepodid female, 2.90 mm.;
3 adult males, 3.60 to 3.74 mm.
Sta. 5. 1 adult female, 3.55 mm.

Remarks

According to Grice (1962), this species is fairly common in the equatorial Pacific Ocean, but it seems to be rare in the central North Pacific.

Euchaeta spinosa Giesbrecht, 1892
(Plate 7, figs. 12-15)

Occurrence

- Sta. 3. 5 adult females, 6.24 to 6.43 mm.;
1 adult male, 6.24 mm.

- Sta. 5. 13 adult females, 6.33 to 6.91 mm.;
7 adult males, 5.97 to 6.24 mm.
Sta. 7. 3 adult females, 6.33 to 6.72 mm.;
1 adult male, 6.33 mm.
Sta. 9. 2 adult females, 6.33 mm.;
4 adult males, 6.14 to 6.52 mm.
Sta. 13. 3 adult females, 6.81 to 7.20 mm.

Remarks

The female of this species can easily be recognized by the high frontal prominence of the head, the slender rostrum, and the asymmetrical genital segment.

The male has a very slender body with a triangularly produced forehead (fig. 12). The right fifth leg (fig. 13) has a 2-segmented exopod and a 1-segmented endopod; the endopod is as long as the first segment of the exopod. The left fifth leg has a 3-segmented exopod and a small rudimental endopod. The second exopodal segment has distally a projection which is as long as the segment itself and which has a row of acute, triangular teeth along the margin (figs. 14 and 15).

Euchaeta media Giesbrecht, 1888
(Plate 7, figs. 16-22)

Occurrence

- Sta. 5. 2 adult females, 4.03 to 4.12 mm.
Sta. 9. 11 adult females, 4.22 to 4.51 mm.;
5 adult males, 3.79 to 4.03 mm.
Sta. 13. 1 adult female, 4.51 mm.

The female (figs. 16-18) is well characterized by the shape of the genital segment, but the description of the male is rather incomplete (Wilson, 1950). The following description was made from the specimens from station 9.

Description of Male

The total length ranges from 3.79 to 4.03 mm. The proportional lengths of the prosome and urosome are 2.2:1. The forehead in dorsal aspect is produced triangularly, but in lateral view is smoothly rounded into a slender rostrum that is curved slightly downward (fig. 19). The antennule is 23-segmented and reaches to about the distal end of the metasome.

The right fifth leg (fig. 20) consists of a stout basipod, a 2-segmented exopod, and a 1-segmented endopod. The endopod is shaped like a ladle and is equal in length to the proxi-

mal exopodal segment. The second exopodal segment is like an elongated spine, enlarged at its base and acuminate at the tip. The left fifth leg has a much stouter basipod, a 3-segmented exopod, and a rudimental endopod. Three projections arise from the mediiodistal corner of the second exopodal segment, and two of them have a row of teeth along the margin (figs. 21 and 22). The third exopodal segment is tapered distally into a slender spine; the proximal portion of the segment is hollow along the internal margin, which is fringed with long hairs; at the distal end of the hollow portion is a small knob, which has a few slender spines.

Remarks

Tanaka (1958) considered *Euchaeta acuta* var. *pacifica*, established solely on the male by Esterly (1911), synonymous with *E. media*. Esterly's description of the fifth pair of legs (the only structure described) however, seems too brief for a positive identification of the form.

Euchaeta pubera Sars, 1907

Occurrence

Sta. 5. 1 adult female, 3.84 mm.

Sta. 7. 3 adult females, 4.32 to 4.41 mm.

Remarks

The female is well characterized by the evenly rounded posterolateral corners of the metasome; the symmetrical genital segment, which in dorsal aspect is equally swollen on each side; and the hooklike process at the right side of the genital orifice. The posterior part of the body is covered with fine hairs.

Euchaeta wrighti, new species

(Plate 7, figs. 23-26; plate 8, figs. 1-3)

Occurrence

Sta. 3. 1 adult female, 2.73 mm.

Description of Female

The proportional lengths of the prosome and urosome are about 2:1. The general shape of the body is slender (plate 7, fig. 23). The cephalosome and the first metasomal segment, as well as the fourth and fifth metasomal segments, are fused, but a line of fusion between

the cephalosome and the first metasomal segment is clearly visible after staining. The forehead in both dorsal and lateral view is produced into a process, which carries a sensory hair (plate 7, fig. 24). The rostrum is strong, pointing straight downward. The posterolateral margins of the metasome are smoothly rounded.

The urosome is 4-segmented; the segments, with the caudal rami, have the following proportional lengths, from anterior to posterior: 44:22:17:6:11.

The genital segment (plate 7, figs. 25 and 26) is long and slender. In dorsal aspect it is almost perfectly symmetrical—equally swollen on both sides. At about one-third the length from the proximal end it has a large genital swelling clearly visible in lateral aspect. The distal portion of the metasome and the whole urosome are densely covered with very fine hairs.

The antennule is 23-segmented, and, when fully extended, reaches as far as the end of the caudal ramus. The maxillule is best described by reference to plate 8, figure 1. In the maxilla, one of the 6 apical setae has long spines, in addition to short spinules that cover it entirely.

The basipod of the first leg (plate 8, fig. 2) is fringed with hairs along the internal margin and has the customary curved seta on the distal medial end of the basis. The exopod is 2-segmented. The external margin of the first segment is almost straight and has a fine spine near the distal end; the internal margin has a single seta. The second segment has a fine external spine, 3 internal setae, and 1 terminal spine, which is about four times as long as the segment. The endopod is a single segment; its external margin has a round tubercle armed with a row of fine spinules, the internal margin has 3 setae, and the apex 2 setae.

The coxa of the second leg (plate 8, fig. 3) has a row of hairs and a strong seta on the internal margin. The exopod is 3-segmented, with relatively small external spines. Of these spines the one on the second segment is the largest, but it does not reach as far as the base of the first external spine of the third segment. The terminal spine of the exopod is about as long as the third exopodal segment. The endopod is a single segment and is slightly shorter than the first 2 exopodal segments combined.

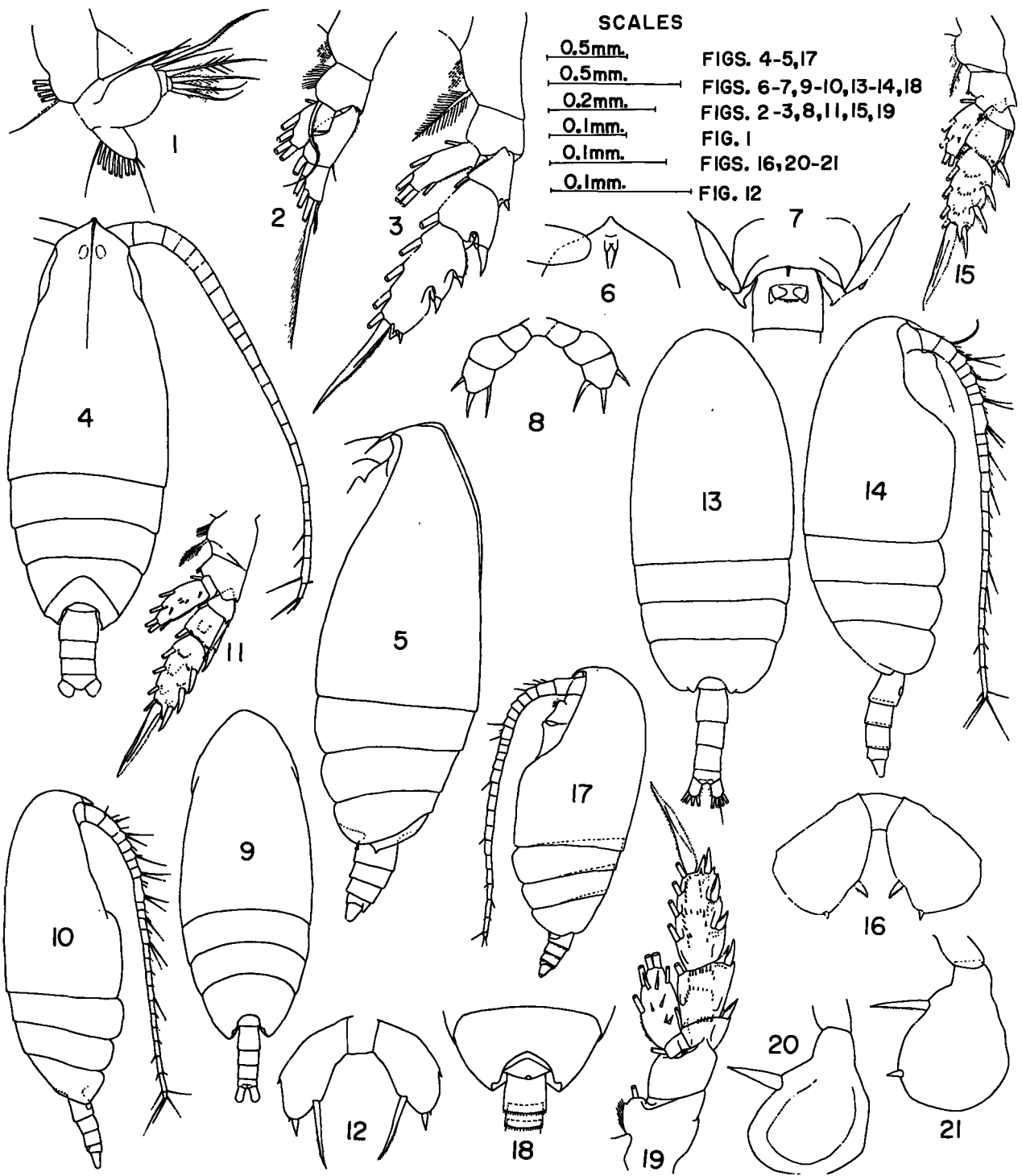


PLATE 8, Figs. 1-3, *Euchaeta wrighti*, new species. Female: fig. 1, maxillule; fig. 2, first leg; fig. 3, second leg. Figs. 4-8, *Lophothrix latipes*. Female: fig. 4, habitus, dorsal view; fig. 5, habitus, lateral view; fig. 6, forehead, ventral view; fig. 7, posterior part of metasome and genital segment, ventral view; fig. 8, fifth pair of legs. Figs. 9-12, *Scolecithricella minor*. Female: fig. 9, habitus, dorsal view; fig. 10, habitus, lateral view; fig. 11, second leg; fig. 12, fifth pair of

legs. Figs. 13-16, *Scolecithricella dentata*. Female: fig. 13, habitus, dorsal view; fig. 14, habitus, lateral view; fig. 15, second leg; fig. 16, fifth pair of legs. Figs. 17-21, *Scolecithricella ovata*. Female: fig. 17, habitus, lateral view; fig. 18, posterior part of metasome and anterior part of urosome, dorsal view; fig. 19, second leg; fig. 20, left fifth leg; fig. 21, right fifth leg.

Remarks

Although only a single specimen was found, I believe that its characters are sufficiently distinct to consider it as a member of a valid species. The present specimen, in general shape of the body, appears to be related to *E. plana* Mori, 1937, redescribed by Tanaka (1958). The obvious difference in the location of the genital swelling, however, prevents it from being referred to that species.

The only specimen was accidentally destroyed.

FAMILY PHAENNIDAE

Phaenna spinifera Claus, 1863

Occurrence

- Sta. 3. 10 adult females, 1.84 to 2.11 mm.;
1 adult male, 1.94 mm.
Sta. 5. 5 adult females, 1.91 to 2.40 mm.
Sta. 7. 5 adult females, 2.02 to 2.11 mm.

Remarks

This species can readily be recognized by the nearly rounded body in dorsal aspect. In details the present specimens are in full agreement with the figures given by Giesbrecht (1892).

FAMILY SCOLECITHRICIDAE

Lophothrix latipes (T. Scott, 1894) (Plate 8, figs. 4-8)

Occurrence

- Sta. 3. 1 adult female, 3.06 mm.
Sta. 5. 9 adult females, 3.03 to 3.16 mm.
Sta. 7. 1 adult female, 3.23 mm.

Remarks

This species can be recognized by the following characters: The head has a long, low crest and two large ocular lenticels that are clearly visible in stained specimens (figs. 4 and 5). The rostrum consists of a thickened, incised basal portion, which has two fine rostral filaments (fig. 6). The posterolateral corner of the metasome (fig. 7) is produced into a point, the tip of which in dorsal or ventral view curves inward and reaches to about the middle of the genital segment. The fifth leg (fig. 8) is uniramous and 4-segmented; it is considerably

dilated toward the distal end and has 3 spines on the apex. The inner spine is the longest.

Scolecithrix danae (Lubbock, 1856)

Occurrence

- Sta. 3. 3 fifth copepodid females, 1.50 to 1.55 mm.;
2 adult males, 2.07 to 2.10 mm.
Sta. 5. 8 adult females, 2.01 to 2.17 mm.;
6 adult males, 2.11 to 2.17 mm.
Sta. 7. 4 adult females, 2.14 to 2.17 mm.;
1 adult male, 2.11 mm.

Remarks

The female of this species can readily be distinguished by her very robust body and by the genital segment, which has a ventral projection in the form of a shovel. Giesbrecht (1892) and Rose (1942) have described and figured this species in detail.

Scolecithrix bradyi Giesbrecht, 1888

Occurrence

- Sta. 3. 1 adult female, 1.22 mm.
Sta. 5. 2 adult females, 1.32 mm.;
1 adult male, 1.51 mm.
Sta. 7. 5 adult females, 1.32 to 1.38 mm.
Sta. 9. 1 adult female, 1.40 mm.

Remarks

The asymmetrical last metasomal segment and the extremely short urosome identify the female of this species and the structure of the fifth pair of legs identifies the male. Figures of these characters have been given by Grice (1962).

Scolecithricella minor (Brady, 1883) (Plate 8, figs. 9-12)

Occurrence

- Sta. 16. 1 adult female, 1.42 mm.

Remarks

The urosome of the female has a characteristic shape; it is markedly narrow as compared with its robust prosome (figs. 9 and 10). The posterolateral margin of the metasome in lateral view is triangularly produced into a blunt tip, which reaches the middle of the genital segment. The first exopodal segment of the sec-

ond leg (fig. 11) has a long external spine that extends beyond the distal margin of the second exopodal segment. The fifth leg (fig. 12) consists of a basal portion, common to both legs, and a plate-shaped apical segment, which has a long internal spine, a short, strong apical spine, and a small external spine. An additional small spine is located immediately lateral to the apical spine.

Scolecithricella dentata (Giesbrecht, 1892)
(Plate 8, figs. 13-16)

Occurrence

- Sta. 5. 1 adult female, 1.48 mm.
- Sta. 15. 1 adult female, 1.55 mm.
- Sta. 16. 1 adult female, 1.68 mm.

Remarks

The following characters mainly serve to identify the female of this species: The prosome is nearly elliptical in dorsal aspect (fig. 13); its posterolateral margin in lateral aspect (fig. 14) has a distinct incision that is also clearly visible in dorsal view. The external spine of the first exopodal segment of the second leg (fig. 15) is long, slightly curved inward, and reaches the distal margin of the second exopodal segment. On the third exopodal segment of the same leg, 3 small teeth lie along the external margin immediately proximal to each of the second and third external spines. The fifth leg (fig. 16) is laminate and almost rectangular; it has a tiny spine at the tip and a larger spine on the internal margin.

Scolecithricella ovata (Farran, 1905)
(Plate 8, figs. 17-21)

Occurrence

- Sta. 5. 1 adult female, 1.98 mm.
- Sta. 7. 1 adult female, 1.88 mm.

Remarks

The female of this species can easily be distinguished by the posterolateral margin of the metasome, which has a distinct notch visible in either lateral or dorsal view (figs. 17 and 18), and by the second and fifth pairs of legs. The coxa of the second leg (fig. 19) has a distinct notch on the external margin; the roundly produced internal margin also has a distinct notch, in addition to a row of hairs and a seta.

The fifth leg (fig. 20) is shaped like a paddle with a cylindrical "handle" by which it is attached to a common basal portion. The internal margin of the paddle-shaped portion has a well-developed spine. One specimen had a small second internal spine close to the distal end of the right leg (fig. 21).

Scolecithricella vittata (Giesbrecht, 1892)

Occurrence

- Sta. 5. 2 adult females, 1.74 to 1.80 mm.

Remarks

The female is readily recognized by the characteristic fifth pair of legs. Figures of this and other characters have been given by Grice (1962).

Scolecithricella avropecten (Giesbrecht, 1892)
(Plate 9, figs. 1-4)

Occurrence

- Sta. 5. 9 adult females, 2.17 to 2.37 mm.
- Sta. 7. 6 adult females, 2.11 to 2.34 mm.
- Sta. 13. 1 adult female, 2.40 mm.

Remarks

The female of this species can be identified easily by the posterolateral margin of the metasome, which in lateral view has a round depression (fig. 1), and by the fifth pair of legs (fig. 2). Figures of the mouth parts and the swimming legs have been given by Rose (1942) and Giesbrecht (1892).

Two specimens possessed abnormal fifth pairs of legs (figs. 3 and 4) but appeared to be identical with the normal specimens in all other details.

FAMILY METRIDIIDAE

Metridia lucens Boeck, 1865

Occurrence

- Sta. 16. 2 adult females, 2.68 to 2.78 mm.;
- 9 fifth copepodid females, 1.90 to 2.07 mm.;
- 4 fifth copepodid males, 1.73 to 1.84 mm.

Remarks

This species is easily recognized by two characters. The posterolateral margin of the met-

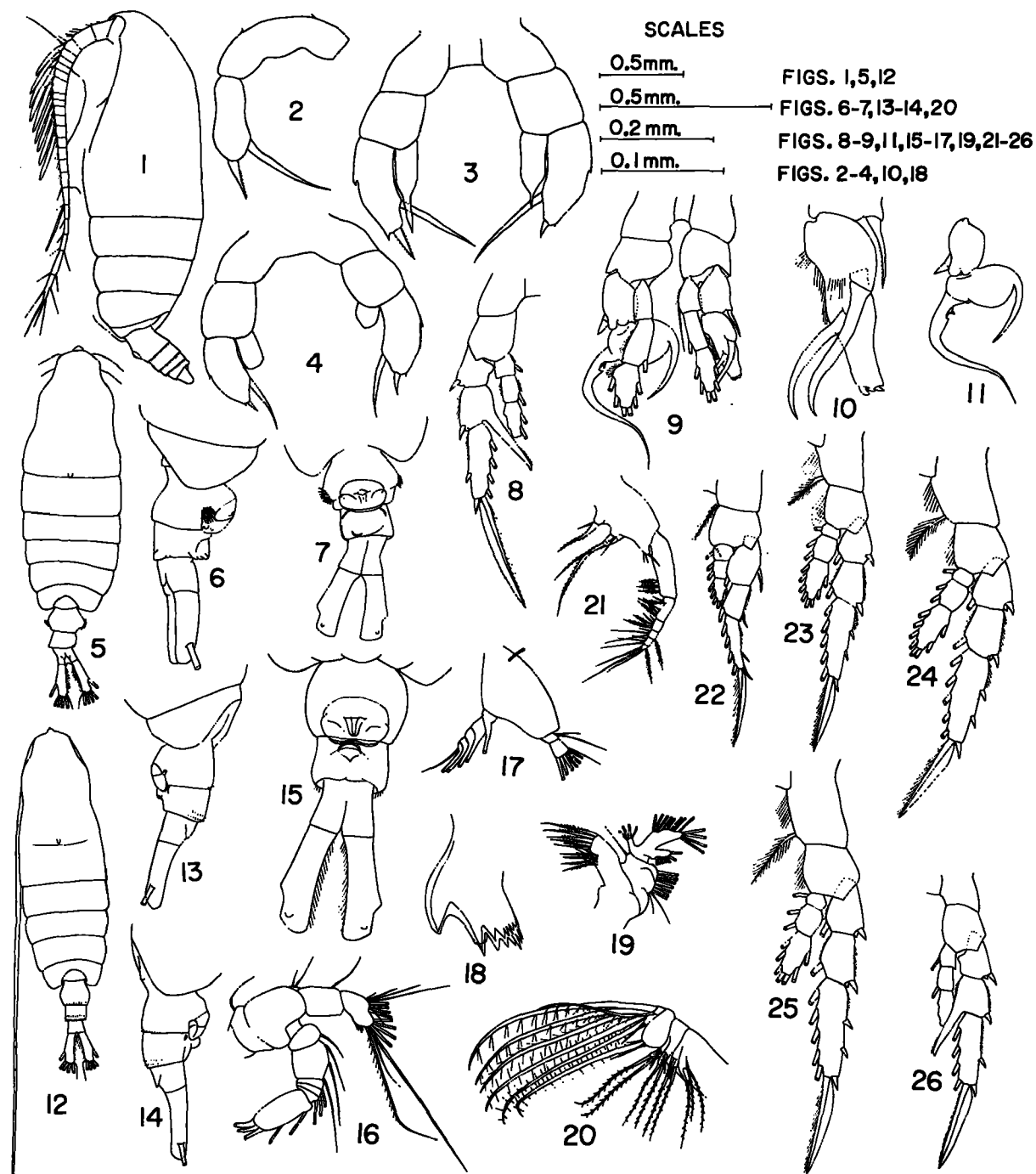


PLATE 9. Figs. 1-4, *Scolecithricella auropecten*. Female: fig. 1, habitus, lateral view; fig. 2, fifth leg; figs. 3-4, abnormal fifth pairs of legs. Figs. 5-11, *Centropages violaceus*. Female: fig. 5, habitus, dorsal view; fig. 6, posterior part of metasome and urosome, lateral view; fig. 7, *idem*, ventral view; fig. 8, fifth leg. Male: fig. 9, fifth pair of legs, anterior aspect; fig. 10, distal part of exopod of left fifth leg; fig. 11, exopod of right fifth leg. Figs. 12-26, *Centropages*

elegans. Female: fig. 12, habitus, dorsal view; fig. 13, posterior part of metasome and urosome, viewed from left side; fig. 14, *idem*, viewed from right side; fig. 15, *idem*, ventral view; fig. 16, antenna; fig. 17, mandibular palp; fig. 18, cutting edge of manducatory plate; fig. 19, maxillule; fig. 20, maxilla; fig. 21, maxilliped; fig. 22, first leg; fig. 23, second leg; fig. 24, third leg; fig. 25, fourth leg; fig. 26, fifth leg.

asome is produced into a point. In the second leg, the basis has a hook on the distal margin and the internal margin of the first endopodal segment is proximally provided with a deep invagination guarded by 3 strong teeth.

Brodsky (1950) distinguished the Pacific form of *Metridia lucens* from the Atlantic form and gave it a new name, *Metridia pacifica*. Damkaer (1964 and personal communication) examined specimens from both the Pacific and the Atlantic and found no morphological differences to warrant two species.

FAMILY CENTROPAGIDAE

Centropages bradyi Wheeler, 1900

Occurrence

- Sta. 5. 1 adult female, 1.95 mm.
- Sta. 9. 1 adult male, 1.74 mm.
- Sta. 13. 30 adult females, 1.91 to 2.08 mm.;
8 adult males, 1.78 to 1.91 mm.
- Sta. 15. 11 adult females, 2.00 to 2.24 mm.;
2 adult males, 1.97 to 2.00 mm.

Remarks

This species is characterized by the rounded posterolateral corners of the metasome, the symmetrical genital segment, and the large caudal rami, each of which has a fingerlike projection between the two lateral terminal setae.

Centropages elongatus Giesbrecht, 1896

Occurrence

- Sta. 3. 7 adult females, 1.74 to 1.90 mm.;
7 adult males, 1.65 to 1.80 mm.
- Sta. 5. 1 adult female, 1.91 mm.
- Sta. 7. 1 adult female, 1.91 mm.;
1 adult male, 1.81 mm.

Remarks

The present specimens are in agreement with the figures given by Grice (1962).

Centropages violaceus (Claus, 1863) (Plate 9, figs. 5-11)

Occurrence

- Sta. 3. 1 adult female, 2.17 mm.;
4 adult males, 2.04 to 2.11 mm.
- Sta. 5. 3 adult females, 2.11 to 2.14 mm.;
4 adult males, 2.04 to 2.17 mm.

- Sta. 7. 11 adult females, 2.14 to 2.24 mm.;
2 adult males, 2.14 to 2.17 mm.

Remarks

The female of this species can be distinguished by the genital segment, which in dorsal aspect (fig. 5) is slightly asymmetrical—the right side is slightly more swollen. The swellings of both the right and left sides have a group of spinules (figs. 6 and 7). The second urosomal segment ventrally lacks the knoblike projection shown in the figure by Giesbrecht (1892). In the fifth leg (fig. 8) the spiniform projection of the second exopodal segment is slightly shorter than the third exopodal segment and has a row of stiff hairs along the internal distal margin.

The male of this species can be identified by the fifth pair of legs (figs. 9-11). The second exopodal segment of the right leg is nearly elliptical; the spinous projection of the segment bends sharply outward. The terminal claw has a deep notch at the proximal portion of the internal margin; in this notch is an acute tooth.

Centropages elegans Giesbrecht, 1895 (Plate 9, figs. 12-26; plate 10, figs. 1-6)

Centropages elegans Giesbrecht, 1895, p. 256,
plate 4, figs. 1-2.

Occurrence

- Sta. 3. 21 adult females, 1.86 to 2.04 mm.;
10 adult males, 1.84 to 1.97 mm.
- Sta. 5. 16 adult females, 1.94 to 2.14 mm.;
9 adult males, 1.84 to 2.01 mm.
- Sta. 7. 3 adult females, 2.01 to 2.07 mm.;
4 adult males, 1.94 to 2.04 mm.

Description of Female

The total length of the specimens ranges from 1.86 to 2.14 mm. The prosome is about three times as long as the urosome. The cephalosome in dorsal aspect has a small semicircular projection at the tip and a knoblike process at the posterodorsal margin (plate 9, fig. 12). The first metasomal segment is incompletely separated from the cephalosome—a line of joint is visible only on the dorsal region. The posterolateral margins of the metasome are smoothly rounded.

The urosome (plate 9, figs. 13-15) is 3-segmented; the segments and the caudal rami have

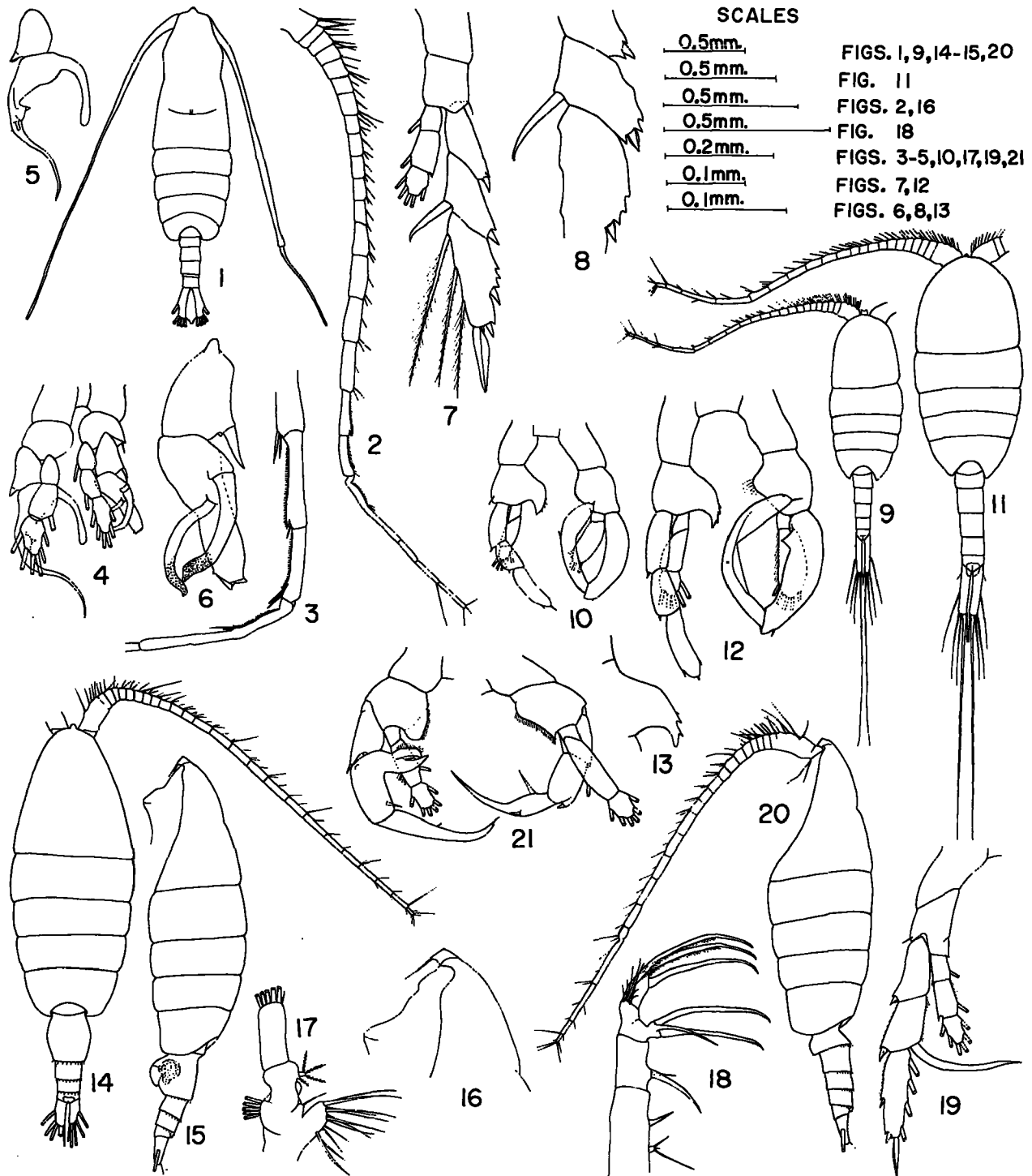


PLATE 10. Figs. 1-6, *Centropages elegans*. Male: fig. 1, habitus, dorsal view; fig. 2, right antennule; fig. 3, geniculated region of right antennule; fig. 4, fifth pair of legs, anterior aspect; fig. 5, exopod of right fifth leg; fig. 6, exopod of left fifth leg. Figs. 7-13, *Lucicutia flavicornis*. Female: fig. 7, fifth leg; fig. 8, abnormal exopod of left fifth leg. Male: fig. 9, habitus, dorsal view; fig. 10, fifth pair of legs, posterior aspect. Figs. 11-13, male abnormal in fifth pair of legs: fig.

11, habitus, dorsal view; fig. 12, fifth pair of legs, posterior aspect; fig. 13, inner projection of basis of left fifth leg. Figs. 14-21, *Heterorhabdus papilliger*. Female: fig. 14, habitus, dorsal view; fig. 15, habitus, lateral view; fig. 16, forehead, lateral view; fig. 17, maxillule; fig. 18, maxilla; fig. 19, fifth leg. Male: fig. 20, habitus, lateral view; fig. 21, fifth pair of legs, anterior aspect.

the following proportional lengths, from anterior to posterior: 28:20:16:36.

The genital segment is symmetrical, wider than long, and has dorsally a row of small spinules along its distal margin. The second urosomal segment has ventrally a knoblike projection and dorsally 2 rows of small spinules along the distal border. The caudal rami are symmetrical and about 3.5 times as long as wide.

The antennule is 24-segmented; the last 5 segments extend beyond the end of the caudal ramus. The endopod of the antenna (plate 9, fig. 16) is short—about one-half the length of the exopod. The second endopodal segment has 8 + 1 setae on the internal lobe and 6 + 1 setae on the external lobe.

The mandibular palp (plate 9, fig. 17) has a triangular basis, which has a seta on the posterior surface. The exopod is 5-segmented; each of the first to fourth segments has 1 seta, and the terminal segment 2 setae. The endopod is small; the first segment has 2 setae, and the second segment 7 setae. The mandibular blade (plate 9, fig. 18) consists of a large separate tooth and a plate with about 7 acute teeth.

The maxillule is relatively small; details of its structure are shown in plate 9, figure 19.

The maxilla (plate 9, fig. 20) is well developed. The first to fourth lobes each bear 2 + 1 spinose setae. The fifth lobe is much better developed; it has 1 long spinose seta and 2 small spiniform setae. The endopod has 5 long spinose setae, 1 short spinose seta, and a small spiniform seta.

The coxa of the maxilliped (plate 9, fig. 21) is stout and has 3 well-developed lobes. The first lobe has 1 spinose seta plus 1 spiniform seta, the second lobe 2 spinose setae plus 1 spiniform seta, and the third lobe 3 small spiniform setae. The basis is about as long as the coxa and carries 3 setae distally. The endopod is also as long as the coxa and is 5-segmented.

The basipod of the first leg (plate 9, fig. 22) is stout and has an internal seta on each segment. The endopod is 3-segmented and shorter than the first and second exopodal segments combined. The first segment has 1 internal seta; the second segment, 2 internal setae; and the third segment, 3 internal setae, 1 external seta, and 2 terminal setae. The exopod is also 3-

segmented; it has 1 + 1 + 2 external spines, 1 + 1 + 4 internal setae, and 1 terminal spine.

The second and third pairs of legs (plate 9, figs. 23 and 24) are similar. On the basipod, only the coxa has an internal seta. The endopod is 3-segmented and extends slightly beyond the distal border of the second exopodal segment. The segments have 1, 2, and 8 setae, respectively. The exopod is also 3-segmented; the first and second segments each have 1 external spine and 1 internal seta. The third segment has 3 external spines, 5 internal setae, and 1 terminal spine.

The fourth leg (plate 9, fig. 25) differs from the third leg only in the number of setae on the third endopodal segment—it has 7 setae instead of 8.

The basipod of the fifth leg has no setae (plate 9, fig. 26). The exopod is 3-segmented. The first segment has 1 external spine and a round projection along the internal margin. The second segment has 1 external spine and a strong spiniform projection from the internal margin. This projection is shorter than the third exopodal segment and has distally a row of stiff hairs along the internal margin. The third exopodal segment has 2 external spines, 4 internal setae, and a terminal spine. The endopod is also 3-segmented; it has 1 seta on the first segment, 1 on the second, and 6 on the third.

Description of Male

The total length ranges from 1.84 to 2.04 mm. The proportional lengths of the prosome and urosome are 2.8:1. The first metasomal segment is incompletely separated from the cephalosome; a line of separation is visible only on the dorsal side. The posterolateral corners of the metasome are smoothly rounded (plate 10, fig. 1). The urosome is 5-segmented; the segments and the caudal rami have the following proportional lengths, from anterior to posterior: 15:17:17:5:14:32. The caudal rami are about 3 times as long as wide.

The left antennule is 24-segmented; the last 2 segments extend beyond the end of the caudal ramus. The right antennule (plate 10, figs. 2 and 3) is modified for grasping the female. The external margins of the 17th to 19th segments are each fringed with a row of acute teeth.

The 18th and 19th segments are articulated by a "knee joint."

The antenna, the mouth parts, and the first to fourth pairs of legs are similar to those of the female.

The fifth pair of legs (plate 10, figs. 4-6) is asymmetrical—the right exopod is modified into a grasping organ in the form of a powerful chela. The left exopod is 2-segmented; the distal segment has two strong, curved spines, the distal parts of which are densely pitted.

Remarks

This species was established by Giesbrecht (1895) upon a single male specimen from the northeastern Pacific. As the species does not appear in any other lists, the present specimens constitute the first record since the original discovery. The female is described here for the first time. Sixteen female specimens have been deposited in the U.S. National Museum (USNM 113375, 113376).

FAMILY LUCICUTIIDAE

Lucicutia flavicornis (Claus, 1863)
(Plate 10, figs. 7-13)

Occurrence

- Sta. 3. 2 adult females, 1.41 to 1.43 mm.
Sta. 5. 12 adult females, 1.38 to 1.94 mm.;
6 adult males, 1.45 to 1.48 mm.
Sta. 7. 1 adult male, 1.51 mm.
Sta. 15. 3 adult females, 1.65 to 1.94 mm.
Sta. 16. 1 adult female, 2.04 mm.
1 adult male, 1.66 mm.

Remarks

The female of this species can be distinguished by the elliptical prosome and the shape of the fifth pair of legs (fig. 7). The female from station 16 had an abnormal left fifth leg—2 teeth were present proximal to the external spine of the second exopodal segment (fig. 8).

The body of the male (fig. 9) is shaped like that of the female. The left antennule is 21-segmented and slightly modified for grasping the female. The basis of the left fifth leg (fig. 10) has internally a large projection pointed distally. The internal edge of this projection has 5 or 6 teeth. In the right fifth leg, both the exopod and the endopod are 2-segmented.

The proximal exopodal segment is slightly curved inward and lacks processes on the internal margin.

Four male specimens abnormal in the shape of the fifth pair of legs were from stations 5 and 7. The general shape of the body of these males (fig. 11) does not differ from that of the normal male, but the fifth pair of legs (figs. 12 and 13) differs in the following aspects: The projection on the internal margin of the basis in the left leg is tapered distally, with 3 to 4 acute teeth along the internal edge. The first exopodal segment of the right leg has proximally a triangular process along the internal margin. The second exopodal segment of the same leg is pronouncedly curved.

FAMILY HETERORHABDIDAE

Heterorhabdus papilliger (Claus, 1863)
(Plate 10, figs. 14-21)

Occurrence

- Sta. 5. 15 adult females, 1.88 to 2.24 mm.;
14 adult males, 1.98 to 2.07 mm.
Sta. 7. 15 adult females, 1.91 to 2.31 mm.;
6 adult males, 1.94 to 2.14 mm.
Sta. 9. 4 adult females, 2.17 to 2.21 mm.;
2 adult males, 2.14 to 2.17 mm.
Sta. 13. 4 adult females, 2.41 to 2.54 mm.;
12 adult males, 2.27 to 2.65 mm.
Sta. 15. 11 adult females, 2.40 to 2.62 mm.;
4 adult males, 2.55 to 2.62 mm.
Sta. 16. 18 adult females, 2.48 to 2.58 mm.;
10 adult males, 2.48 to 2.55 mm.

Remarks

This species is one of the most common in the present collections. It can be identified readily by the triangularly produced forehead in lateral aspect (figs. 16 and 20) and the 3 equal terminal spines of the maxilla (fig. 18). In the fifth leg of the female (fig. 19), the second exopodal segment has internally a long, curved spine, which is longer than the third exopodal segment. The fifth pair of legs (fig. 21) of the male has a beaklike projection on the internal margin of the second right exopodal segment.

Heterorhabdus abyssalis (Giesbrecht, 1889)
(Plate 11, figs. 1-6)

Occurrence

- Sta. 9. 3 adult females, 2.47 to 2.69 mm.;
1 adult male, 2.41 mm.

Remarks

This species is recognized by the rounded forehead in lateral aspect (fig. 2) and the structure of the maxilla (fig. 4), the distal lobe of which has 2 spines of equal length and 1 slightly shorter spine. In the fifth pair of legs of the female (fig. 3), the internal spine of the second exopodal segment is about as long as the third exopodal segment and is fringed with fine hairs along the upper margin. The fifth pair of legs in the male (figs. 5 and 6) is characterized by the laminar protrusion on the internal margin of the right basis and the conical internal projection of the second segment of the right exopod.

Heterostylites longicornis (Giesbrecht, 1889)

Occurrence

- Sta. 5. 2 adult females, 2.80 to 2.83 mm.;
1 adult male, 2.90 mm.
Sta. 7. 1 adult female, 2.90 mm.

Remarks

This species is closely similar to the species of *Heterorhabdus* but can easily be distinguished from the latter by the longer antennule, the armament of the mandibular blade, and the better developed endopod of the maxilla. In the female, the second exopodal segment of the fifth leg has a compound spine, with 6 to 7 points, medial to the regular external spine.

H. longicornis is distinguished from *H. major* only by its smaller size; there are practically no anatomical differences. The female of *H. longicornis*, according to Giesbrecht and Schmeil (1898), measures about 3.0 mm., but that of *H. major* measures about 5.0 mm.

FAMILY AUGAPTILIDAE

Haloptilus longicornis (Claus, 1863)

Occurrence

- Sta. 3. 136 adult females, 2.00 to 2.24 mm.
Sta. 5. 44 adult females, 2.17 to 2.44 mm.

- Sta. 7. 3 adult females, 2.14 to 2.34 mm.

Remarks

This species was one of the most common at the southern stations, but not a single male was found. The female can be recognized by the knoblike projection on the forehead, when viewed from above, and the very long antennule.

Haloptilus fertilis (Giesbrecht, 1892)
(Plate 11, figs. 7-20)

Occurrence

- Sta. 3. 2 adult males, 2.89 to 3.16 mm.
Sta. 5. 3 adult males, 2.93 to 3.13 mm.

This species was erected on the basis of a male from the Mediterranean Sea (Giesbrecht, 1892). Grice (1962) obtained a single male from equatorial waters of the Pacific. The following description is based on the five adult males in the present collections.

Description of Males

The total length ranges from 2.89 to 3.16 mm. The proportional lengths of the prosome and urosome are about 5.6:1. The first metasomal segment is separated from the cephalosome, but the fourth and fifth metasomal segments are fused. The cephalosome in dorsal aspect has a broadly triangular forehead, and the oral region is more or less dilated. The posterolateral margins of the metasome are smoothly rounded (fig. 7).

The urosome (fig. 8) is 5-segmented. The first segment is nearly as long as the combined lengths of the succeeding 3 segments. The figure by Giesbrecht (1892, plate 42, fig. 5), however, shows the second to fourth urosomal segments relatively longer than those of the present specimens.

The right antennule is normal, 25-segmented, and reaches as far as the end of the caudal ramus. The 23-segmented left antennule (fig. 9) is modified for grasping the female. Each of the 14th to 16th segments has a swollen outer margin, and each of the 17th to 19th segments has a serrated lamella along the same margin. A knee joint is found between the 18th and 19th segments.

In the antenna (fig. 10), the exopod is only about one-third the length of the endopod. The

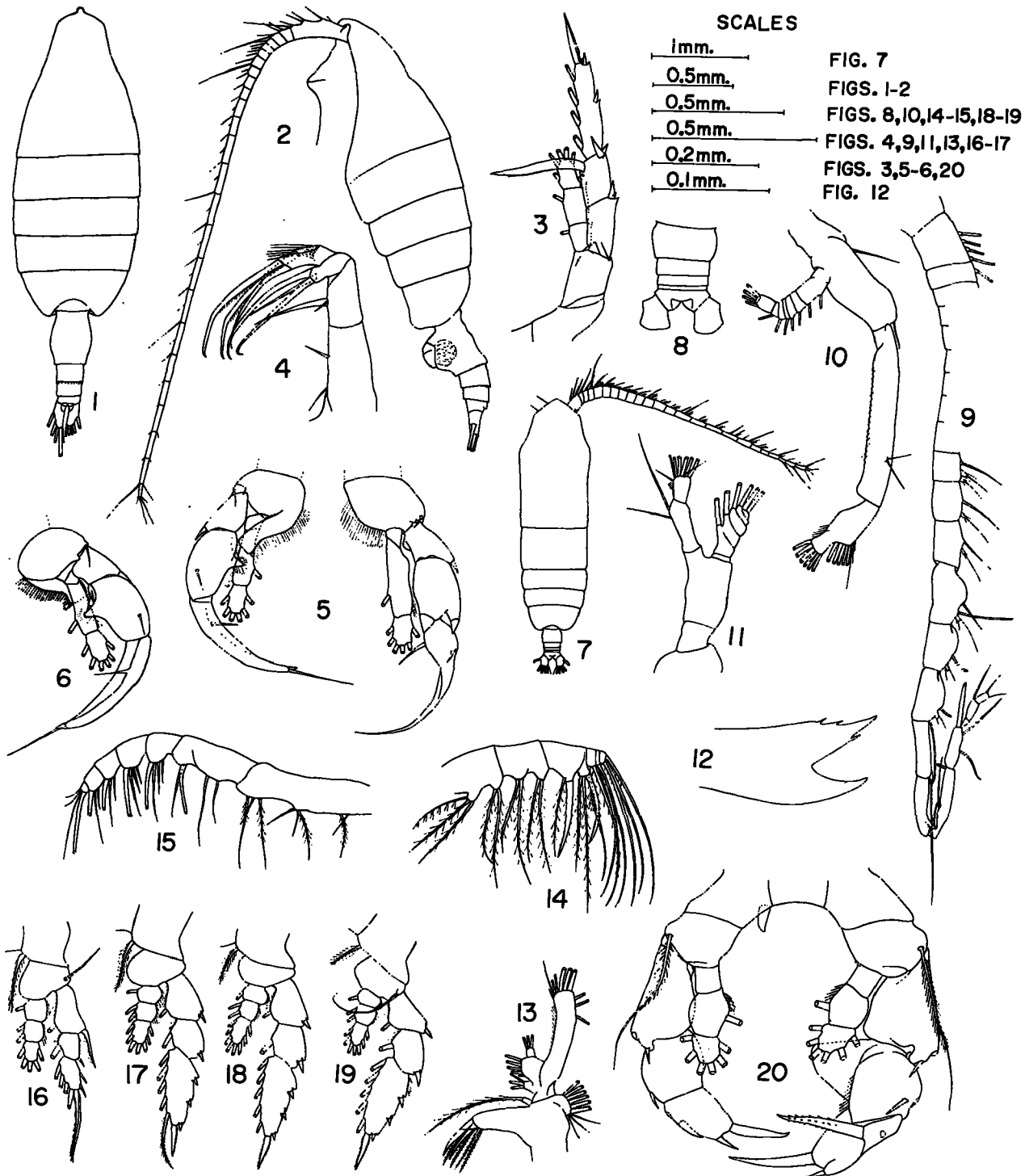


PLATE 11. Figs. 1-6, *Heterorhabdus abyssalis*. Female: fig. 1, habitus, dorsal view; fig. 2, habitus, lateral view; fig. 3, fifth leg. Male: fig. 4, maxilla; fig. 5, fifth pair of legs, anterior aspect; fig. 6, right fifth leg, posterior aspect. Figs. 7-20, *Haloptilus fertilis*. Male: fig. 7, habitus, dorsal view; fig. 8, uro-

some, dorsal view; fig. 9, left antennule; fig. 10, antenna; fig. 11, mandibular palp; fig. 12, mandibular blade; fig. 13, maxillule; fig. 14, maxilla; fig. 15, maxilliped; fig. 16, first leg; fig. 17, second leg; fig. 18, third leg; fig. 19, fourth leg; fig. 20, fifth pair of legs posterior aspect.

exopod is 8-segmented, and the endopod 2-segmented. The first segment of the endopod is about 2.5 times as long as the second.

The mandibular palp (fig. 11) is slender and lacks setae on the basis. The endopod is slightly longer than the exopod. The cutting edge (fig. 12) of the mandibular blade consists of 2 strong rostral teeth, the inner of which has 2 small acute teeth along the internal margin and another along the external margin.

In the maxillule (fig. 13), the first inner lobe and the exopod are elongate. The first inner lobe has distally 7 spiniform setae, 2 of which are notably strong. The second and third inner lobes are small, and have 1 and 3 setae, respectively.

The maxilla (fig. 14) bears 6 well-developed lobes. The first lobe has 3 setae, each of the second to fourth lobes 2 setae, the fifth lobe 1 seta plus 1 strong spine, and the sixth lobe 2 setae plus 1 strong spine. The spine of the sixth lobe is slightly smaller than that of the fifth lobe. The endopod is 3-segmented and has 7 setae.

The coxa of the maxilliped (fig. 15) has 3 lobes, which have 2, 3, and 3 setae, respectively. The basis has 2 lobes, each with 2 setae. The endopod is 5-segmented; the first and second segments each have 4 setae, the third and fourth have 3, and the fifth has 4.

The basipod of the first leg (fig. 16) has 1 internal seta on the coxa and 1 external seta on the basis. Both the exopod and the endopod are 3-segmented. The first and second exopodal segments each have 1 internal seta and 1 external spine. The external spine of the first segment is notably long, extending beyond the end of the spine on the second segment. The third exopodal segment has 2 external spines, 4 internal setae, and 1 terminal spine. The endopod is about as long as the first 2 exopodal segments combined and has 1 seta on the first segment, 2 on the second, and 5 on the third.

The second to fourth pairs of legs (figs. 17-19) are similar. The coxa has 1 internal seta. The basis is naked in the second and third legs but has an external seta in the fourth leg. The exopod is 3-segmented; the first and second segments each have 1 external spine and 1 internal seta; and the third segment has 3 external spines, 5 internal setae, and 1 terminal

spine. The endopod is also 3-segmented. The first segment bears 1 seta, and the second segment 2 setae. The third segments of the second and fourth legs have 7 setae, but that of the third leg has 8 setae.

The fifth pair of legs (fig. 20) is asymmetrical. The coxa of the left leg has a strong tooth on the internal margin. The basis in both the right and the left legs has a long plumose external seta. The second exopodal segment of the right leg has a large, conical protrusion on the internal margin. The right and left third exopodal segments both have 2 external spines and 1 large terminal spine; the first external spine of the right third exopodal segment is spinose and as long as the terminal spine. The endopods of both legs are 3-segmented; the first segment lacks setae, but the second and third segments have 1 seta and 6 setae, respectively.

Remarks

The present specimens are in full agreement with the description by Giesbrecht (1892) except for the urosome, which seems to be somewhat shorter than that figured by him. This difference may be due to the telescoping of the segments. The female is not known.

Haloptilus spiniceps (Giesbrecht, 1892)

Occurrence

Sta. 3. 6 adult females, 4.41 to 4.80 mm.

Sta. 5. 5 adult females, 4.12 to 4.99 mm.

Sta. 7. 2 adult females, 4.50 to 4.60 mm.

Remarks

This species can readily be distinguished from the other species of the genus by the short, hooked, spiniform projection of the forehead, viewed from the side.

Augaptilus spinifrons Sars, 1907 (Plate 12, figs. 1-5)

Occurrence

Sta. 5. 1 adult female, 3.55 mm.

Remarks

The female of this species can be identified by five characters: The anterior end of the body is produced into an acute spiniform process that is pointed downward (figs. 1 and 2)—

the tip of the process appears to be divided into two minute points. The rostrum consists of two slender filaments. The mandibular palp (fig. 3) is uniramous and has 4 segments; the distal segment has 2 long plumose setae. The mandibular blade is armed with 5 rostral teeth (fig. 4). The fifth leg (fig. 5) has a long seta on the posterior surface of the basis that extends beyond the end of the exopod. This seta is much longer than that figured by Sars (1925).

This species has been recorded from the Azores and off Gibraltar by Sars (1907, 1925) and from the Great Barrier Reef by Farran (1936).

FAMILY ARIETELLIDAE

Arietellus aculeatus (T. Scott, 1894) (Plate 12, figs. 6-16)

Rhincalanus aculeatus T. Scott, 1894, p. 31, plate 2, figs. 11-24.

Arietellus setosus Giesbrecht and Schmeil, 1898, p. 124.

Arietellus aculeatus, A. Scott, 1909, p. 143, plate 44, figs. 4-7; Farran, 1929, p. 270; Wilson, 1950, p. 165.

Occurrence

- Sta. 3. 1 adult male, 3.60 mm.;
1 fifth copepodid male, 2.90 mm.

This species was originally erected on the basis of a single immature male from the Gulf of Guinea and placed in the genus *Rhincalanus* (T. Scott, 1894). Afterward it was made a synonym of *Arietellus setosus* by Giesbrecht and Schmeil (1898). A. Scott (1909) found a single mature female in the *Siboga* plankton. Upon this female and the immature male, A. Scott reestablished his father's species. Farran (1929) reported a mature male from off New Zealand but gave no detailed description. The following description is from an adult male referable to this species in the present collections.

Description of Male

The total length is 3.60 mm. The proportions of the prosome to the urosome are 4:1. The first metasomal segment is separated from the cephalosome, but the fourth and fifth metasomal segments are completely fused. The fore-

head has a very strong spiniform process, which is curved slightly downward in lateral aspect (fig. 7). The rostrum is composed of two slender filaments, which are almost hidden between the basal portions of the antennules. The spiniform projections of the last metasomal segments are slightly asymmetrical and rather divergent, but the tips are curved slightly inward. Of these projections the right one is slightly longer, reaching to the middle of the fourth urosomal segment (fig. 6). The urosome is 5-segmented; the second to fourth segments are of nearly equal length.

The left antennule is modified for grasping the female and is 19-segmented. Figure 8 shows the arrangement of the setae and aesthetes.

The antenna (fig. 9) is composed of a rather small basipod, a 2-segmented endopod, and a 6-segmented exopod. The endopod is longer than the exopod; both are slender.

The mandibular palp (fig. 10) lacks an endopod; the basis is longer than the exopod. The mandibular blade (fig. 11) is armed with 4 large teeth, 3 of which are grouped.

The maxillule (fig. 12) has 2 inner lobes, of which the first has 5 spines and the second a single spine. The single outer lobe has 8 setae. The exopod is relatively large, with 3 setae at the apex. The endopod is absent.

The maxilla and maxilliped are similar to those of *A. setosus* as figured by Giesbrecht (1892).

The coxa in the first pair of legs (fig. 13) has an internal seta, and the basis has an internal and an external seta. The endopod is 3-segmented; the first segment has 1 internal seta, the second segment 2 internal setae, and the third segment 2 internal setae, 1 external seta, and 2 terminal setae. The exopod is also 3-segmented; the first and second segments each have 1 external spine and 1 internal seta. The third segment has 4 internal setae, 2 external spines, and a terminal spine.

The basipod of the second leg (fig. 14) has a single seta on the internal margin of the coxa. The endopod is 3-segmented; it has 1 internal seta on the first segment, 2 internal setae on the second segment, and 8 setae on the third segment. The exopod is also 3-segmented; the first and second segments each have 1 internal seta and 1 slender, curved external spine. The

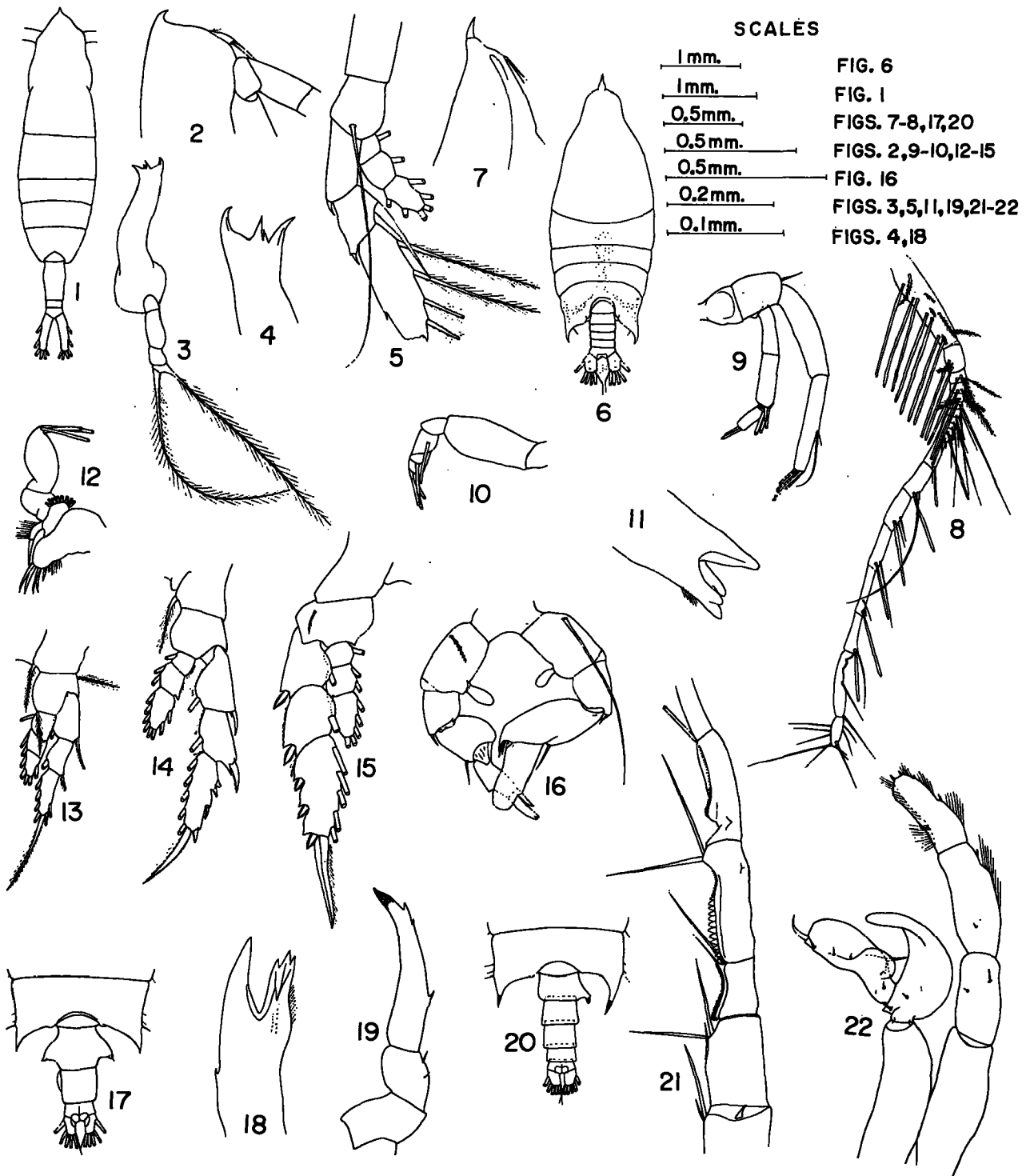


PLATE 12. Figs. 1-5, *Augaptilus spinifrons*. Female: fig. 1, habitus, dorsal view; fig. 2, forehead, lateral view; fig. 3, mandible; fig. 4, mandibular blade; fig. 5, fifth leg. Figs. 6-16, *Arietellus aculeatus*. Male: fig. 6, habitus, dorsal view; fig. 7, forehead, lateral view; fig. 8, left antennule; fig. 9, antenna; fig. 10, mandibular palp; fig. 11, mandibular blade; fig. 12, maxillule; fig. 13, first leg; fig. 14, second leg; fig. 15,

fourth leg; fig. 16, fifth pair of legs, posterior aspect. Figs. 17-22, *Candacia bipinnata*. Female: fig. 17, posterior part of metasome and urosome, dorsal view; fig. 18, mandibular blade; fig. 19, fifth leg. Male: fig. 20, posterior part of metasome and urosome, dorsal view; fig. 21, geniculated region of right antennule; fig. 22, fifth pair of legs, posterior aspect.

third segment has 5 internal setae, 3 small external spines, and 1 strong terminal spine almost as long as the segment.

The third and fourth legs (fig. 15) are similar. The basipod has a single seta on the posterior surface of the basis. The exopod is 3-segmented; the first and second segments each have 1 internal seta and 1 external spine; the third segment has 5 internal setae, 3 external spines, and 1 strong terminal spine nearly as long as the segment. The endopod is also 3-segmented; the first segment has 1 internal seta, and the second segment 2 internal setae. The number of setae on the third segment is 8 in the third leg and 7 in the fourth leg.

The fifth pair of legs (fig. 16) is asymmetrical. Both the right and the left legs have a 3-segmented exopod and a small, lamelliform endopod. The endopods of both legs have nearly the same shape, but the left one is slightly larger. The third exopodal segment of the left leg has a low, triangular projection on the external margin and 2 apical clawlike spines, the outer of which is larger and terminates with 2 points. The third exopodal segment of the right leg is lamelliform and lacks spines or setae.

Remarks

Because of one long frontal spiniform process, *A. aculeatus* appears to be closely related to *A. armatus* Wolfenden, 1911, which Farran (1929) considered as a probable synonym of the former. Wilson (1950), however, re-described both sexes of *A. armatus* as a valid species.

The present specimen seems to differ only slightly from *A. armatus* described by either Wolfenden (1911) or Wilson (1950) in that the frontal process is comparatively short and both endopods of the fifth pair of legs are simple instead of forked.

Arietellus setosus Giesbrecht, 1892

Occurrence

- Sta. 5. 1 adult male, 3.93 mm.
- Sta. 7. 2 adult males, 4.03 to 4.12 mm.

Remarks

This species can readily be distinguished

from the other species of the genus by the short and slightly curved spiniform process of the forehead and the strong spiniform projections of the last metasomal segment. These characters have been figured by Grice (1962).

FAMILY CANDACIIDAE

Candacia ethiopica Dana, 1849

Occurrence

- Sta. 3. 2 adult females, 2.47 to 2.60 mm.;
2 adult males, 2.48 to 2.50 mm.
- Sta. 5. 3 adult females, 2.83 to 2.97 mm.;
5 adult males, 2.47 to 2.93 mm.
- Sta. 7. 5 adult females, 2.77 to 3.03 mm.;
7 adult males, 2.50 to 2.67 mm.
- Sta. 9. 1 adult female, 3.00 mm.

Remarks

The female is easily distinguished from the other species of the genus by the small lateral and ventral spiniform processes of the genital segment and by the terminal segment of the fifth leg, which has 7 spines.

The male is recognized by the spiniform projection of the left posterolateral corner of the metasome; the tip of this projection is divided into 2 points. The genital segment has 2 triangular processes on the right margin. These characters have been figured by Grice (1962).

Candacia bipinnata Giesbrecht, 1889 (Plate 12, figs. 17-22)

Occurrence

- Sta. 13. 3 adult females, 2.90 to 3.00 mm.;
3 adult males, 2.77 to 2.83 mm.
- Sta. 15. 3 adult females, 2.84 to 2.90 mm.;
2 adult males, 2.86 to 2.94 mm.
- Sta. 16. 3 adult females, 3.06 to 3.16 mm.;
5 adult males, 2.75 to 3.02 mm.

Remarks

The genital segment of the female (fig. 17) has lateral conical projections; the tips of the projections are produced into small spines. The second urosomal segment has a flaplike protrusion on the ventral margin. The male is distinguished from the other species of the genus by the shape of the last metasomal segment and the genital segment (fig. 20).

Occurrence

- Sta. 3. 1 adult female, 2.50 mm.
- Sta. 7. 1 adult female, 2.80 mm.

Remarks

The female is recognized by the symmetrical genital segment, the fifth pair of legs, and the shape of the manibular blade (see Grice, 1962, plate 31, figs. 8, 10, and 13).

Candacia longimana Claus, 1863

Occurrence

- Sta. 3. 1 adult male, 3.19 mm.
- Sta. 5. 1 adult male, 3.20 mm.
- Sta. 7. 1 adult male, 3.55 mm.

Remarks

The male of this species can be identified by the spiniform process on the right posterolateral margin of the metasome, the conical process on the right margin of the genital segment, and the structure of the fifth pair of legs (see Grice, 1962, plate 28, figs. 6, 8, 11, and 12).

Paracandacia bispinosa (Claus, 1863)

Occurrence

- Sta. 3. 14 adult females, 1.74 to 1.91 mm.;
12 adult males, 1.88 to 1.94 mm.
- Sta. 5. 20 adult females, 1.74 to 2.01 mm.;
17 adult males, 1.94 to 2.11 mm.
- Sta. 7. 9 adult females, 1.84 to 1.91 mm.;
5 adult males, 2.04 to 2.11 mm.

Remarks

This species is one of the most common from the southern stations. The genital segment of the female is nearly triangular when viewed from above. Each side of the segment is produced into a small spine; the spine of the left side is longer and directed backward. The male can be distinguished by the shape of the geniculated portion of the right antennule. These characters have been figured by Grice (1962).

The species was transferred by Grice (1963) from the genus *Candacia* to his new genus *Paracandacia*.

Pontellopsis regalis (Dana, 1849)
(Plate 13, figs. 1-14)

Occurrence

- Sta. 3. 1 adult female, 3.20 mm.

Description of Female

The total length is 3.20 mm. The ratio of the prosome to the urosome is 4.6:1. The first metasomal segment is separated from the cephalosome. The forehead in dorsal aspect (fig. 1) is broadly rounded and has a projection over the base of the rostrum. The last metasomal segment, consisting of the fused fourth and fifth metasomal segments, is produced posterolaterally into acute spiniform processes directed backward. In dorsal aspect these processes appear to reach two-thirds the length of the genital segment (fig. 2).

The urosome is 2-segmented. The genital segment in dorsal aspect is slightly asymmetrical. Its width increases toward the posterior margin, where each side is projected posteriorly into a conical process; the right process is shorter than the left and has a minute, spiniform bristle at the apex. The anal segment and the caudal rami are symmetrical; their combined length is slightly shorter than the genital segment.

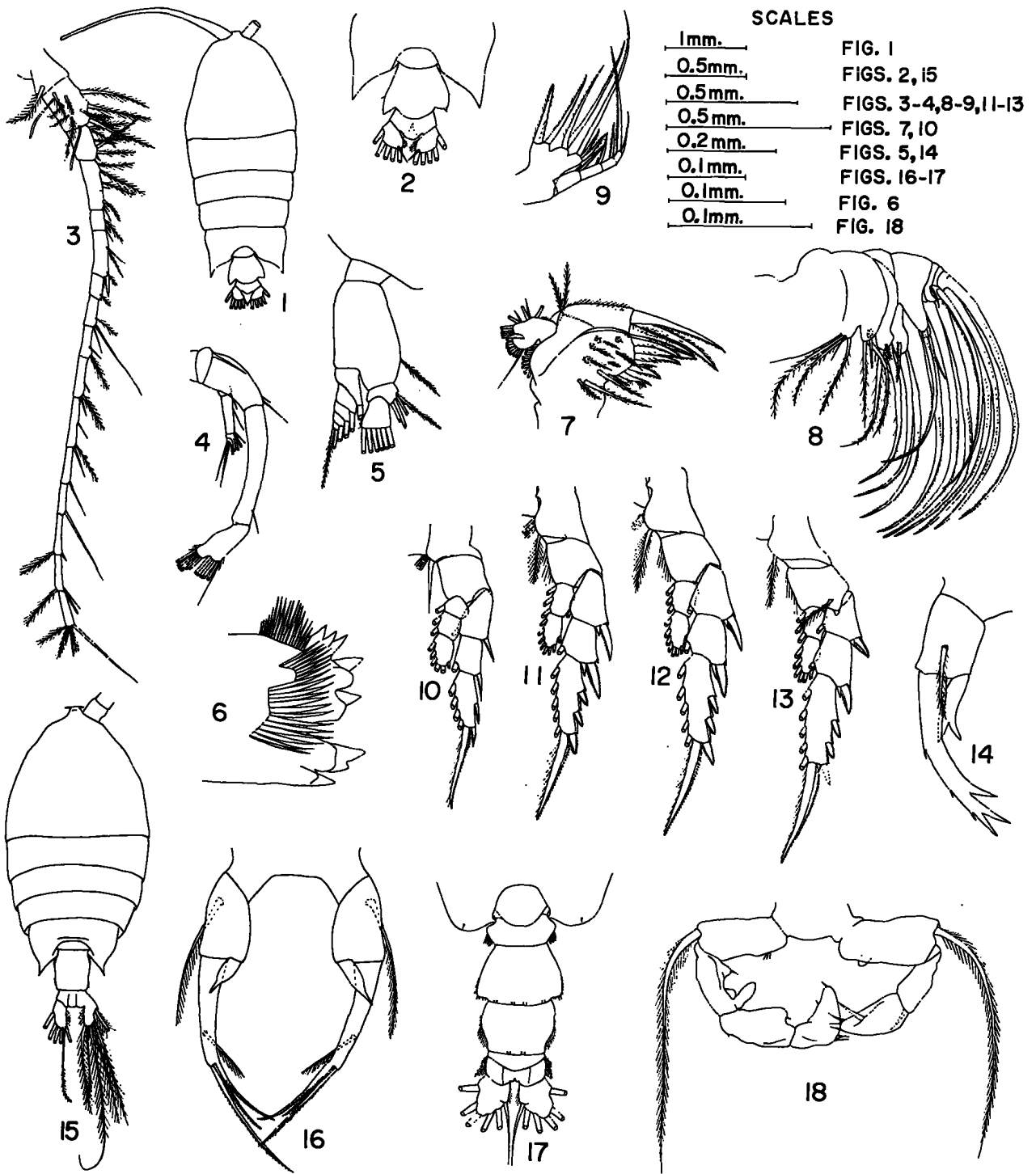
The antennule (fig. 3) is 16-segmented and reaches the middle of the second metasomal segment. The exopod of the antenna (fig. 4) is very small—about one-third the length of the endopod.

The mandibular blade (fig. 6) has five groups of teeth, in addition to three rows of strong spines on each side.

The first and second inner lobes of the maxillule (fig. 7) are well developed; the first has 6 spines along the internal margin and 10 on the posterior surface, and the second has 3 strong spines on the tip. The third inner lobe is small; it has 3 setae. The basis, endopod, and exopod are fused.

The maxilla (fig. 8) is strongly developed and has 5 lobes on the basipod. The endopod has 6 strong spines plus 1 small spine.

The maxilliped (fig. 9) consists of 1-segmented basipod and a 4-segmented endopod.



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PLATE 13. Figs. 1-14, *Pontellopsis regalis*. Female: fig. 1, habitus, dorsal view; fig. 2, posterior part of metasome and urosome, dorsal view; fig. 3, antennule; fig. 4, antenna; fig. 5, mandibular palp; fig. 6, mandibular blade; fig. 7, maxillule; fig. 8, maxilla; fig. 9, maxilliped; fig. 10, first leg; fig. 11, second leg; fig. 12,

third leg; fig. 13, fourth leg; fig. 14, fifth leg. Figs. 15-16, *Pontellina plumata*. Female: fig. 15, habitus, dorsal view; fig. 16, fifth pair of legs. Figs. 17-18, *Acartia negligens*. Male: fig. 17, posterior part of metasome and urosome, dorsal view; fig. 18, fifth pair of legs.

The basipod is broad and has 3 lobes, which have 2, 2, 3 spines, respectively.

The basipod of the first leg (fig. 10) has a single seta on the internal margin of the coxa. The exopod is 3-segmented. Each of the first and second segments has an internal seta and an external spine. The third segment has 2 external spines, 4 internal setae, and a terminal spine that is serrated along the outer margin. The endopod is also 3-segmented. The first segment has a single internal seta, the second segment 2 internal setae, and the third segment 6 setae.

The second and third pairs of legs (figs. 11 and 12) are similar. The basipod carries a single internal seta on the coxa. The exopod is 3-segmented. Each of the first and second segments has an internal seta and a strong external spine. The third segment has 3 external spines, 5 internal setae, and a strong terminal spine that is serrated along the external margin. The endopod is 2-segmented. The first segment has 3 internal setae and 1 external seta. The second segment has 8 setae.

The fourth pair of legs (fig. 13) is similar to the third, but the basis has a seta on the posterior surface and the second endopodal segment has 7 setae instead of 8.

The basipod of the fifth leg (fig. 14) has a plumose seta on the posterior surface of the basis. The exopod and endopod each consist of a single segment. The exopod has a forked tip, a strong spine along the internal margin, and 3 small spines along the external margin. The endopod also has a forked tip; it is about one-third the length of the exopod.

Remarks

In the shape of the urosome the present specimen is not in full agreement with the description given by Giesbrecht (1892). According to A. Fleminger (personal communication), however, it is not outside the usual variability shown by the species.

Pontellina plumata (Dana, 1849)
(Plate 13, figs. 15-16)

Occurrence

Sta. 7. 1 adult female, 1.94 mm.

Remarks

A single female referable to the above species was in the present collections. The specimen agrees in every detail with the description and figures given by Giesbrecht (1892) except for the structure of the endopod of the fifth leg (fig. 16). The sizes of the right and left endopods are slightly unequal, and each is single-pointed, not forked.

FAMILY ACARTIIDAE

Acartia danae Giesbrecht, 1889

Occurrence

Sta. 3. 1 adult female, 1.20 mm.

Remarks

The female can be recognized by the large spine on the first segment of the antennule, the pointed posterolateral corners of the metasome, and the structure of the fifth pair of legs.

Acartia negligens Dana, 1849
(Plate 13, figs. 17-18)

Occurrence

Sta. 3. 3 adult females, 1.23 to 1.30 mm.
Sta. 5. 5 adult females, 1.22 to 1.28 mm.;
1 adult male, 1.15 mm.
Sta. 7. 7 adult females, 1.25 to 1.28 mm.;
1 adult male, 1.18 mm.

Remarks

In the female, the fifth pair of legs is somewhat similar to that of *A. danae*, but the posterolateral corners of the metasome are rounded and have small spines. The shape of the urosome and the fifth pair of legs of the male can best be described by reference to figures 17 and 18.

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