UNITED STATES DEPARTMENT OF THE INTERIOR, Stewart L. Udall, *Secretary*

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CALANOID COPEPODS FROM EQUATORIAL WATERS OF THE PACIFIC OCEAN

By GEORGE D. GRICE

FISHERY BULLETIN 186

From Fishery Bulletin of the Fish and Wildlife Service

VOLUME 61

[Contribution No. 1072, Woods Hole Oceanographic Institution]

Published by the U.S. Fish and Wildlife Service • 1961

Printed at the U.S. Government Printing Office, Washington

For sale by the Superintendent of Documents, U.S. Government Printing Office,
Washington 25, D.C.—Price 45 cents

Library of Congress catalog card for the series, Fishery Bulletin of the Fish and Wildlife Service:

U. S. *Fish and Wildlife Service.*
Fishery bulletin. v. 1–
Washington, U. S. Govt. Print. Off., 1881–19

v. in illus., maps (part fold.) 23–28 cm.

Some vols. issued in the congressional series as Senate or House documents.
Bulletins composing v. 47– also numbered 1–
Title varies: v. 1–49, Bulletin.
Vols. 1–49 issued by Bureau of Fisheries (called Fish Commission, v. 1–23)

1. Fisheries—U.S. 2. Fish-culture—U.S. I. Title.

SH11.A25 639.206173 9—35239*

Library of Congress [59r55b1]

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ABSTRACT

A systematic study was made of the calanoid copepods found in 14 zooplankton samples, four of which were obtained from within the recently discovered equatorial undercurrent (Cromwell current), collected between 5° N. and 5° S. and 130° E. and 120° W.

One hundred and ten species belonging to 18 families were recorded. Descriptive notes, measurements and figures were given for most species with citations to previous occurrences in the Pacific Ocean.

Except for *Scolecithricella tenuiserrata* (Giesbrecht), the copepod species in samples collected from within the equatorial undercurrent were not very different from those in samples obtained adjacent to the current. The numerical abundance and species diversity in equatorial waters were briefly compared with that reported for the northwestern Pacific Ocean. *Acrocalanus andersoni* Bowman, *Chirundina indica* Sewell and *Haloptilus fertilis* (Giesbrecht) were reported for the first time from the Pacific Ocean.

Three species, *Xanthocalanus dilatus, Amallophora smithae* and *Scolecithricella tropica,* are described as new, and hitherto unknown males of *Gaetanus miles* Giesbrecht and *G. minor* Farran are briefly illustrated from juvenile specimens. It was proposed that *Euchirella brevis* Sars is a synonym for *E. amoena* Giesbrecht; *Euchaeta consimilis* Farran for *E. concinna* Dana; *Scoecithrix longicornis* Scott, and *Scolecithricella spinipedata* Mori for *Scolecithricella ctenopus* (Giesbrecht); and *Centropages pacificus* Chiba for *C. elongatus* Giesbrecht.

CALANOID COPEPODS FROM EQUATORIAL WATERS OF THE PACIFIC OCEAN

By GEORGE D. GRICE, *Woods Hole Oceanographic Institution* [1]

The present paper concerns the calanoid copepods found in plankton samples collected along the equator, an area which has been relatively unexplored taxonomically.

Systematic studies on calanoid copepods have made these microcrustaceans one of the better known groups of the holoplankton of the Pacific Ocean. Extensive taxonomic reports are available for the north Pacific (Brodsky, 1950), the northeast Pacific (Davis, 1949), the western Pacific (Vervoort, 1946; Tanaka, 1953), and the Pacific sector of the Antarctic (Vervoort, 1957). In addition there are numerous smaller but nevertheless valuable papers concerning the calanoid copepods of more restricted areas. Although there remain large, unexplored areas, these recent papers and certain of the older ones (e.g., Scott, 1909) provide a framework for a zoogeographic study of Pacific calanoids and, moreover, show where additional investigations are needed.

Most of the laboratory work of this study was done in Honolulu, Hawaii, in 1958 and 1959 under a fellowship from the John Simon Guggenheim Memorial Foundation. I wish to express my appreciation to the Foundation for the opportunity to make this study. The U.S. Fish and Wildlife Biological Laboratory furnished space for the work, the use of their library facilities and a part of their extensive plankton collections. It is a pleasure to acknowledge the cooperation of Thomas S. Aus-

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Fishery Bulletin 186. Approved for publication July 21, 1960.

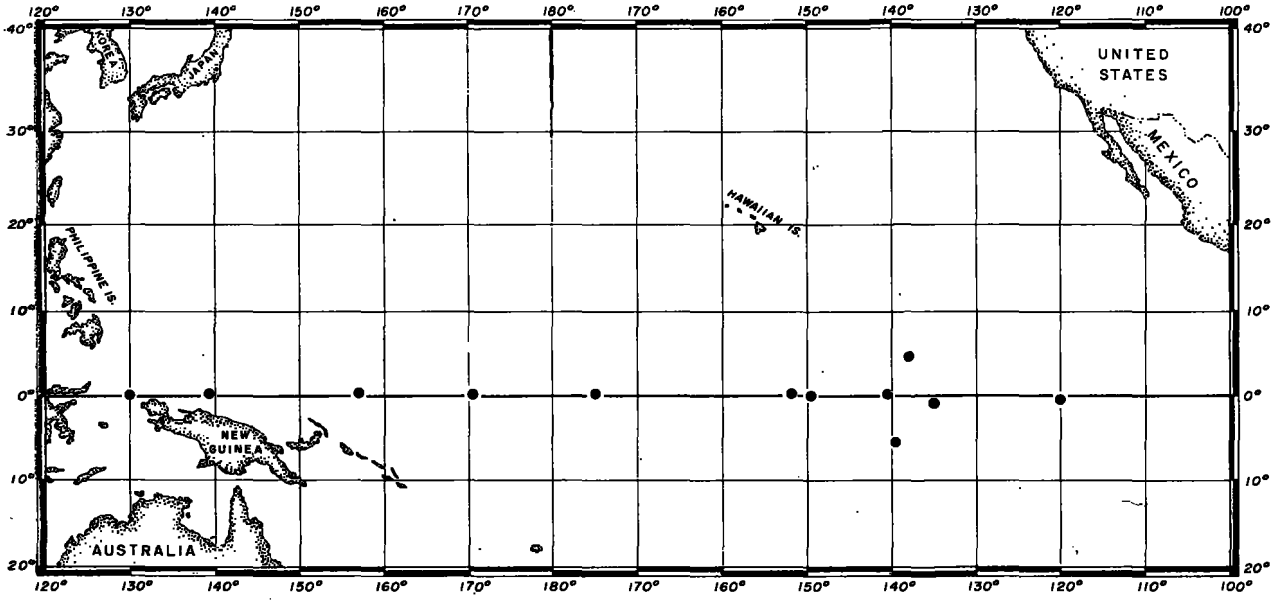

FIGURE 1. Positions where plankton samples were obtained.

tin and E. C. Jones. I wish also to thank Dr. Paul Illg for his advice during the course of the work, Dr. Thomas E. Bowman for reviewing the manuscript, and my wife, Joan, for assistance in completing the drawings.

MATERIALS

The present report is based on the examination of 14 plankton samples collected between 5° N. and 5° S. latitude and between 130° E. and 120° W. longitude in the Pacific Ocean (fig. 1). The pertinent data associated with each plankton collection are presented in table 1. Hydrographic data associated with these collections are given by King, Austin, and Doty (1957) for the research vessel *Hugh M. Smith*, cruise 31, and by Austin (1957) for cruise 35. Processed reports containing hydrographic data have been issued for *Orsom* cruise 56–4 (Legand, 1957), for *Stranger* and *Horizon* cruises (Scripps Institution of Oceanography, 1957), and for *Satsuma* and *Kagoshima* cruises (Japanese Hydrographic Office, 1956).

Four of the 14 samples (*Smith* cruise 31, stations 94, 144, 178, and cruise 47, station 31) were obtained from the recently discovered equatorial undercurrent (Knauss and King, 1958) by means of closing net gear. In addition, one oblique tow (*Smith* cruise 35, station 63) apparently passed within the undercurrent at least during part of the tow.

The three samples obtained on cruise 47 were oriented with respect to the undercurrent. One sample (cruise 47, station 31) was collected within the current, and the other two were obtained from below it (cruise 47, station 29) and from above it (cruise 47, station 30).

Six collections (*Smith* cruise 35, station 63, *Stranger* 34, *Orsom* 10, *Horizon* 32, *Satsuma* 32, and *Kagoshima* 613) were selected from a large number of plankton samples obtained by vessels participating in a large scale quasi-synoptic study (Operation Equapac) in Pacific equatorial waters. The samples used in the present studies are those obtained nearest to the Equator by each of the vessels.

METHODS

Owing to the large volume of most of the samples, except *Kagoshima* 613, it was not practical to examine the entire contents of each. In order to estimate the percentage representation and the numerical abundance of the common species, small quantities of the original samples were examined. These sub-samples, the sizes of which are given in table 2, were obtained by means of a plankton splitter (McEwen, Johnson, and Folsom, 1954). On

TABLE 1.—*Plankton station data*

Research vessel	Agency	Cruise No.	Station No.	Position	Date	Time[1]	Size of net	Mesh (mm.)	Depth[2] (m.)	Water filtered (m.³)
					1955					
Hugh M. Smith	U.S. Fish and Wildlife Service.	31	94–2	00°11′S 119°58′W	Nov. 7	0916–0946 ZT	1 m.	0.65	146–72 CN	590.2
Do	do	31	132–2	04°40′N 138°14′W	Nov. 17	0921–0950 ZT	1 m.	.65	119–63 CN	690.8
Do	do	31	144–2	00°16′N 140°12′W	Nov. 20	1000–1036 ZT	1 m.	.65	122–61 CN	38.0
Do	do	31	153–3	05°31′S 139°54′W	Nov. 22	1008–1039 ZT	1 m.	.65	126–63 CN	966.4
Do	do	31	178–2	00°21′N 151°40′W	Dec. 6	0917–0947 ZT	1 m.	.65	146–68 CN	283.8
					1958					
Do	do	47	30	00°00′ 149°36′W	Oct. 27	1118–1151 ZT	1 m.	.65	surface	1342.0
Do	do	47	31	00°00′ 149°33′W	do	1153–1246 ZT	1 m.	.65	100 CN	880.0
Do	do	47	29	00°00′ 149°38′W	do	0953–1112 ZT	1 m.	.65	500 CN	922.0
					1956					
Do	do	35	63–1	01°10′S 134°57′W	Aug. 19	2116–2152 ZT	1 m.	.66	169 Q	
Stranger	Scripps Institution of Oceanography.		34	00°01′N 174°59′W	Sept. 15	0352 GMT	1 m.	.56	0–140 Q	
Orsom	Institut Français d'Océanie.	56–4	10	00°35′N 170°11′E	Oct. 4	2338–2457 LT	50 cm.	.366	150 Q(?)	616.0
Horizon	Scripps Institution of Oceanography.		32	00°03′S 157°00′E	Aug. 25	0428 GMT	1 m.	.56	0–280 Q	
Satsuma	Japan Hydrographic Office.		32	00°29′N 139°49′E	Aug. 18	2100–2210 ZT	45 cm.	.33	0–150 Q	20.71
Kagoshima-Maru	Kagoshima University, Japan.		613	00°38′N 130°20′E	Aug. 1	0725–0955 ZT	22.5 cm.	.11	0–50 V	

[1] ZT, zone time; LT, local time; GMT, Greenwich mean time.
[2] CN, closing net; Q, oblique open net; V, vertical open net.

TABLE 2.—*List of species and number of specimens in each sub-sample*

["X" indicates the species was found during the examination of other fractions of original sample]

Species	*Hugh M. Smith*									*Stranger*	*Orsom*	*Horizon*	*Satsuma*	*Kagoshima*
	94	132	144	153	178	30	31	29	63	34	10	32	32	613
1. Calanus tenuicornis	2	1		3	2							1		
2. Nannocalanus minor	1	44	2	21	41		2	X	2	6	6	12		
3. Canthocalanus pauper									1	1		2		
4. Neocalanus gracilis	X	8		6			17			X	X		X	
5. N. robustior				1	X				1	X				
6. Undinula vulgaris													X	
7. U. darwini	1	1	4	72	57	20	11	X	39	6	2	11	6	
8. Eucalanus attenuatus		1		15	4	1	15		15	X		11		
9. E. mucronatus												2		
10. E. subtenuis	1	85	86	2	173		39		45					
11. E. pileatus													1	
12. E. subcrassus									3	X	4			
13. Rhincalanus cornutus	X		1	1			3	48	9	1	2	1	5	
14. R. nasutus	1													
15. Paracalanus aculeatus			X	3	3		1		11	3	4	1		
16. P. parvus	X													
17. P. dubia														1
18. Acrocalanus longicornis				2			1		1	X				
19. A. andersoni										1	X			1
20. A. monachus										X	X	3		
21. Calocalanus pavo				1					1	1	1	X		
22. C. plumulosus													X	
23. Clausocalanus arcuicornis	3	75	4	9	27	15	11		3	12	18	9	5	
24. C. furcatus		30		14	3		1		6	6		4	1	
25. Euaetideus giesbrechti	1		1					X	X					
26. E. acutus	5	2	3	X	11	X	4		X	X				
27. E. bradyi	13		3						X					
28. Chiridius poppei	2								X					
29. Gaetanus miles								2	X					
30. G. minor								6	3			X		
31. Euchirella bella				X			X		X	X				
32. E. venusta									X					
33. E. pulchra									X					
34. E. amoena		X	X	X	X				X					
35. E. curticauda											X			
36. E. maxima								X						
37. Pseudochirella sp								X						
38. Chirundina streetsi												X		
39. C. indica									X					
40. Undeuchaeta plumosa									X			X	1	
41. U. intermedia									1			X		
42. Euchaeta marina		1	X	33	8	34	12		7	5	X	3		
43. E. wolfendeni		1							1	5		4	2	
44. E. media									1					
45. E. tenuis								1	1			X		
46. E. concinna													4	
47. E. longicornis	2	4												
48. E. spinosa								X						
49. Phaenna spinifera	3	X					X		1		X	X		
50. Xanthocalanus dilatus n. sp.			X											
51. Amallophora smithae n. sp.			X											
52. Scolecithrix danae		2	4	18	5	X	26	X	17	3	1	7	6	
53. S. bradyi	14	4	X		1		1							
54. Scolecithricella ctenopus	1				1					1	X			
55. S. abyssalis	8		X					1	1					
56. S. vittata	4													
57. S. tenuiserrata			6		9		2		1	2				
58. S. marginata			X		X									
59. S. tropica n. sp.	4	4			2									
60. S. sp.			X											
61. Scaphocalanus echinatus									X					
62. S. longifurca	1							X	1					
63. Scottocalanus securifrons												X		
64. S. farrani								X						
65. S. sedatus								X			X			
66. Temoropia mayumbaensis	X										X			
67. Metridia venusta			7											
68. Pleuromamma xiphias									X		X		1	
69. P. abdominalis	2							13	7		X	1	5	
70. P. indica													1	
71. P. quadrungulata								5	X					
72. P. gracilis	1							12	X			1	X	
73. P. borealis									X		X		1	
74. Centropages gracilis		1		X	X	7				X			X	
75. C. elongatus				X								X	X	
76. C. calaninus						X						1		
77. Lucicutia flavicornis	15	3	X		11		3	X		1			1	
78. L. ovalis		X		1	4				X	2	1	1		
79. Heterorhabdus spinifrons			2					3	1				X	
80. H. papilliger	5	6	10		27		9	1	1	X	X			
81. Haloptilus longicornis	19	12	43	X	26		50		1	X	1	X	13	
82. H. acutifrons	X													
83. H. fertilis												X		
84. H. ornatus									X					
85. H. spiniceps	X									X	X	X	X	
86. H. austini	1													
87. Augaptilus longicaudatus	X													
88. Euaugaptilus hecticus							2			X			X	

TABLE 2.—*List of species and number of specimens in each sub-sample*—Continued

["X" indicates the species was found during the examination of other fractions of original sample]

Species	*Hugh M. Smith*									*Stranger*	*Orsom*	*Horizon*	*Satsuma*	*Kagoshima*
	94	132	144	153	178	30	31	29	63	34	10	32	32	613
89. *Arietellus setosus*									X					
90. *A. giesbrechti*								X						
91. *A. plumifer*	1								X					
92. *A. aculeatus*									X					
93. *Candacia longimana*												X	X	
94. *C. guggenheimi*								X						
95. *C. tenuimana*								X						
96. *C. aethiopica*						X						X	X	
97. *C. pachydactyla*		X		X	X	X			1	X	X	X		
98. *C. curta*								X			X	X		
99. *C. bipinnata*			X		X									
100. *C. varicans*							1		X					
101. *C. catula*					X				1	X	X	X		
102. *C. bispinosa*				3	X					X	X		1	
103. *C. simplex*	X	5	X	X	1									
104. *C. truncata*		X		1		X			X	1	X	8	15	
105. *Pontella securifer*						X	X							
106. *P. tenuiremis*												X		
107. *Labidocera detruncata*						X						X		
108. *Pontellina plumata*		X			X	7	X		X	1	X	1		
109. *Acartia danae*	1	1			X									
110. *A. negligens*				2	2	70	5		X	X	27		X	
Unidentified copepodids	22	70	18	5	22	0	0	41	44	30	2	23	28	5
Number of specimens in sub-sample	134	361	194	213	440	154	216	133	228	88	67	106	97	7
Sub-sample size	1/16	1/64	1/8	1/256	1/16	1/32	1/4	1/64	1/512	1/256	1/256	1/256	1/2	all
Number of copepods per cubic meter	3.6	33.4	40.8	56.4	24.8	3.7	2.3	9.2			27.8		9.3	
Number of species	34	27	26	27	31	15	25	25	55	35	31	39	29	2

completing the analysis of the sub-sample, portions of the original sample were examined for species not found in the aliquot. The species in each sample are listed in table 2 along with the number of specimens of each found in the aliquot.

Representatives of most species from each station were segregated by sex and placed in labeled vials. This material will be deposited in the U.S. National Museum.

GENERAL REMARKS

Species composition

A total of 110 species of calanoid copepods was found in the samples (table 2). Of these, three species belonging to the genera *Xanthocalanus, Amallophora,* and *Scolecithricella* are described as new, and three species, *Acrocalanus andersoni, Chirundina indica,* and *Haloptilus fertilis,* are reported for the first time from the Pacific Ocean.

The collections examined were obtained from along the Equator from 120° W. to 130° E., a distance of approximately 5,800 miles (fig. 1). Many of the species were widely distributed and occurred in samples collected in the eastern Pacific (east of 170° W.) and those collected in the western Pacific (west of 170° W.). Disregarding the small collection made at *Kagoshima* station 613, the most frequently occurring species were *Nannocalanus minor, Undinula darwini, Clausocalanus arcuicornis,* and *Scolecithrix danae.* These four species were present in all but one or two samples.

A study of table 2 will reveal that there were at least 6 species which were frequently found (4 or more samples) in the eastern Pacific, but which were not found in the samples examined from the western Pacific. One of these, *Eucalanus subtenuis,* was the most abundant copepod in three of the eastern Pacific samples and its apparent absence from the western Pacific samples is noteworthy. It is not, however, restricted to the eastern Pacific, as it has been reported from Japan (Fukase, 1957; Tanaka, 1956a) and from the Dutch East Indies (Vervoort, 1946). The other eastern Pacific species have also been reported from these two areas.

Equatorial undercurrent samples

Four of the fourteen samples examined were obtained from within the equatorial current (*Smith* 94, 144, 178, 31). The species composition of these samples, when compared with

samples collected from adjacent waters—north (*Smith* 132), south (*Smith* 153), and above (*Smith* 30) and below (*Smith* 29) the undercurrent—was not particularly distinctive. *Scolecithricella tenuiserrata,* although apparently absent from one undercurrent sample (*Smith* 94), did appear in the other three samples and also in two other samples (*Smith* 63, *Stranger* 34) that were collected from depths where the undercurrent could be located, if present, but several hundred miles west of its known limits. Knauss (1959), has indicated that the current may extend as far west as about 160° E.; in that event the above two samples could have been collected from the current. Even if *S. tenuiserrata* is typically found within the undercurrent, it cannot be considered as an "indicator" *sensu stricto* of the current. In addition to the present samples, this species has been reported from near the Great Barrier Reef (Farran, 1936) and from Japan (Tanaka, 1953).

Numerical abundance

The number of copepods calculated for those collections in which a current meter was employed, varied from 2.3 to 56.4 with a mean of 21.8 copepods per cubic meter (table 2). These data may be compared to numerical data presented by Brodsky (1952) for the northwestern Pacific Ocean. Using only those collections in which closing nets were used (*Smith* 94, 132, 144, 153, 178, and 31), a mean number of 26.8 copepods per cubic meter was calculated for depths between approximately 50 and 150 meters in the eastern Pacific Ocean. Brodsky's data included numerical abundances for seven different vertical levels. For the 50 to 100–m. level he gave a figure of 5,040 calanoids per cubic meter and for the 100 to 200–m. level, 320 per cubic meter. Nine species were present at the former level and ten at the latter level. In comparison, there were no less than 25 species in any of the aforementioned eastern Pacific closing net samples.

TAXONOMY

For each species I have given references to its occurrence in the Pacific Ocean, with the exception of those early records summarized by Giesbrecht and Schmeil (1898) and those cited by Vervoort (1946, 1957). The former reference has usually been omitted in the following sections. I have given measurements for several individuals of a species and usually at all stations where it occurred. The total-length measurements are from the tip of the forehead to the end of the furca, without regard to the telescoped portions of the abdominal segments, and are recorded in mm. unless otherwise indicated. Except for *Pseudochirella,* copepodids which could not be assigned to a species are not mentioned.

Included under Remarks are certain taxonomic or ecological notes and usually a few brief statements on the diagnostic characters of the species. It is hoped that the specific characters mentioned and the figures presented for each species will be useful to others making identifications of tropical calanoid copepods. All illustrations were made with a camera lucida.

Family CALANIDAE

Calanus tenuicornis Dana, 1849

Pacific records: Vervoort, 1946. Also, Yamada, 1933; Johnson, 1942; Mori, 1942; Davis, 1949; Brodsky, 1950; Motoda, Iizuka, and Anraku, 1950; Motoda and Anraku, 1951; Anraku, 1952; Honjo, 1952; Motoda and Anraku, 1952b; Nakai, 1952; Anraku, 1953; Tanaka, 1953; Yamazi, 1953a; 1953c; Anraku, 1954a; 1954b; Motoda and Anraku, 1954; Tsuruta and Chiba, 1954a; 1954b; Yamazi, 1954b; 1954d; Bowman, 1955; Chiba, Tsuruta, and Maéda, 1955; Motoda and Anraku, 1955; Nagaya et al., 1955; Yamazi, 1955a; Chiba, 1956; Tanaka, 1956a; Heinrich, 1957a; Honjo et al., 1957; Heinrich, 1958b; Yamazi, 1958a; 1958b; Brodsky, 1959; Lindberg, 1959; Ponomareva, 1959.

Vessel:	*Station*	*Occurrence*
Hugh M. Smith	94	1 female, 1.87 mm.; 1 male, 1.80 mm.
Do	132	present.
Do	153	1 female, 1.75 mm.; 1 male, 1.56 mm.
Do	178	present.
Horizon	32	1 female, 1.68 mm.

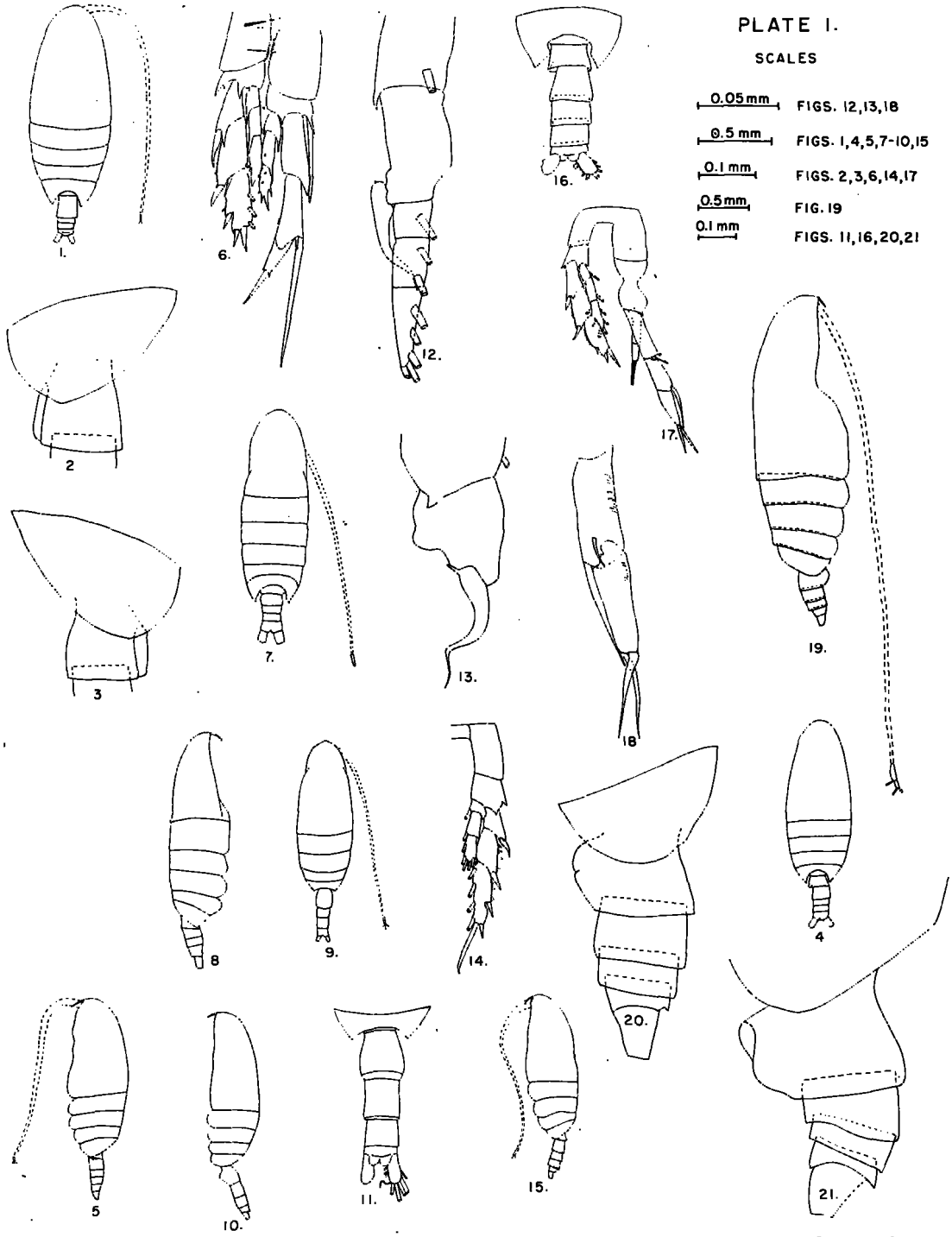

PLATE 1—(1) *Nannocalanus minor*, female, dorsal view; (2) posterior part of thorax and genital segment, left side; (3) posterior part of thorax and genital segment, right side; (4) male, dorsal view; (5) lateral view; (6) fifth pair of feet; (7) stage V female, dorsal view; (8) lateral view; (9) *Canthocalanus pauper*, female, dorsal view; (10) lateral view; (11) posterior part of thorax and abdomen, dorsal view; (12) endopod of first foot, lateral view; (13) first and second basipodal segments of first foot, oblique view; (14) fifth foot; (15) male, lateral view; (16) posterior part of thorax and abdomen, dorsal view; (17) fifth pair of feet; (18) distal two segments of left fifth foot; (19) *Neocalanus gracilis*, female, lateral view; (20) posterior part of thorax and abdomen, lateral view; (21) *Neocalanus robustior*, female, posterior part of thorax and abdomen, lateral view.

Remarks: Most of the present specimens have their furcal setae eroded. Bowman (1955) has previously observed this in specimens collected from the northeastern Pacific. He attributed this erosion to protozoan parasites which were present in the furcae. The majority of my specimens also contain these parasites in the furcae. Bowman (1955) has fully figured *C. lighti*, a species which differs morphologically from *tenuicornis* only in size.

Nannocalanus minor (Claus, 1863)

(PLATE 1, FIGS. 1–8)

Pacific records: Vervoort, 1946. Also, as *Calanus minor;* Yamada, 1933a; Mori, 1937; 1942; Wilson, 1942; Anraku, 1952; Chiba, 1952c; Honjo, 1952; Nakai, 1952; Tanaka, 1953; Yamazi, 1953a; 1953b; 1953c; Anraku, 1954b; Motoda and Anraku, 1954; Tsuruta and Chiba, 1954b; Yamazi, 1954b; 1954d; Chiba, Tsuruta, and Maéda, 1955; Hida and King, 1955; Motoda and Anraku, 1955; Nagaya et al., 1955; Yamazi, 1955d; Chiba, 1956; Tanaka, 1956a; Honjo et al., 1957; Yamazi, 1958a. As *Nannocalanus minor;* Wilson, 1950; Brodsky, 1955; Rose, 1955; Heinrich, 1957b; 1958a; Brodsky, 1959.

Vessel:	Station	Occurrence
Hugh M. Smith	94	1 female, 1.73 mm.
Do	132	14 females, 1.56–1.70 mm.; 7 males, 1.39–1.43 mm.
Do	144	1 female, 1.73 mm.
Do	153	10 females, 1.58–1.67 mm.; 3 males, 1.44–1.46 mm.
Do	178	25 females, 1.51–1.65 mm.; 12 males, 1.31–1.51 mm.
Do	31	1 female, 1.75 mm.
Do	29	1 female, 1.80 mm.
Do	63	1 female, 1.80 mm.
Stranger	34	6 females, 1.53–1.70 mm.
Orsom	10	2 females, 1.58, 1.61 mm.; 4 males 1.24–1.46 mm.
Horizon	32	9 females (stage V), 1.53–1.70 mm.

Remarks: All the above female specimens belong to *N. minor* f. *major* (Sewell, 1929). Although Sewell (1947) has recently recognized two forms of the male (f. *major* and f. *minor*), I was unable to distinguish these forms among the above specimens. Presumably, they are all referable to f. *major* as Vervoort (1946) has reported smaller males (1.20–1.29) from one *Snellius* station (113) in Netherlands East Indies.

Canthocalanus pauper (Giesbrecht, 1888)

(PLATE 1, FIGS. 9–18)

Pacific records: Vervoort, 1946. Also, as *Calanus pauper;* Mori, 1937; 1942; Honjo, 1952; Yamazi, 1953a; 1953b; Anraku, 1954b; Johnson, 1954; Tsuruta and Chiba, 1954b; Motoda and Anraku, 1955; Nagaya et al., 1955. As *Canthocalanus pauper;* Wilson, 1942; 1950; Tanaka, 1953; Brodsky, 1955; Rose, 1955; Tanaka, 1956a; Yamazi, 1958a.

Vessel:	Station	Occurrence
Hugh M. Smith	63	1 female, 1.42 mm.
Stranger	34	1 male, 1.31 mm.
Orson	32	2 females, 1.42, 1.46 mm.; 1 male, 1.36 mm.

Remarks: This small copepod is most easily recognized by the peculiarly shaped spine on the second basipodal segment of the first pair of feet (figs. 12, 13) in the female and the structure of the fifth pair of feet (figs. 17, 18) in the male.

Neocalanus gracilis (Dana, 1849)

(PLATE 1, FIGS. 19–20)

Pacific records: Vervoort, 1946; 1957. Also, as *Calanus gracilis;* Mori, 1942; Honjo, 1952; Tsuruta and Chiba, 1954b; Motoda and Anraku, 1955; Nagaya et al., 1955; Chiba, 1956; Honjo et al., 1957. As *Neocalanus gracilis;* Tanaka, 1953; Hida and King, 1955; Tanaka, 1956a; Yamazi, 1958a.

Vessel:	Station	Occurrence
Hugh M. Smith	94	present.
Do	132	8 females (stage V), 2.34–2.48 mm.
Do	153	1 female, 3.09 mm.
Do	31	2 females, 3.33 mm.
Stranger	34	4 females, 3.01–3.06 mm.
Orsom	10	1 female, 2.96 mm.
Satsuma	32	1 female, 2.11 mm.

Remarks: Vervoort (1946) has listed the differences between this species and *Neocalanus robustior* (Giesbrecht). The adult females of *N. gracilis* are smaller (maximum 3.33) and the genital segment is less produced ventrally (fig. 20). No males were encountered in the present collections.

Neocalanus robustior (Giesbrecht, 1888)

(PLATE 1, FIG. 21)

Pacific records: Vervoort, 1946. Also, as *Calanus robustior;* Mori, 1937; Honjo, 1952; Yamazi, 1953a; Tsuruta and Chiba, 1954b; Chiba, Tsuruta, and Maéda, 1955; Nagaya et al., 1955; Chiba 1956; Honjo et al., 1957. As *Neocalanus robustior;* Wilson, 1942; 1950; Tanaka, 1953; Brodsky, 1955; Tanaka, 1956a; Yamazi, 1958a.

Vessel:	Station	Occurrence
Hugh M. Smith	153	1 female, 4.08 mm.
Do	178	1 female, 3.40 mm.
Do	63	1 female (stage V), 2.99 mm., 3 females, 3.80–3.89 mm.
Stranger	34	1 female, 3.61 mm.

Remarks: The large size (greater than 3.4 mm.) and greatly produced genital segment (fig. 21) of this species distinguishes it from *N. gracilis.* No males were found in the present samples.

Undinula vulgaris (Dana, 1849)

Pacific records: Vervoort, 1946. Also, as *Calanus vulgaris:* Yamada, 1933a; Mori, 1937; 1942; Chiba, 1952c; Honjo, 1952; Anraku, 1954b; Tsuruta and Chiba, 1954b; Motoda and Anraku, 1955; Chiba, 1956; Honjo et al., 1957. As *Undinula vulgaris;* Wilson, 1942; Johnson, 1949; Wilson, 1950; Tanaka, 1953; Johnson, 1954; Brodsky, 1955; Hida and King, 1955; Rose, 1955; Tanaka, 1956a; Yamazi, 1958a.

Vessel:	Station	Occurrence
Satsuma	32	1 male, 2.04 mm.

Remarks: Both Vervoort (1946) and Wilson (1950) speak of the great abundance of this species in the Netherlands East Indies and near the Hawaiian Islands, respectively. Scott (1909) also found it abundantly in the Malay Archipelago area as did Johnson (1949) in Bikini Lagoon and Tanaka (1956a) in the Izu region of Japan. In view of its extreme scarcity in the present collections, it is apparently more of an insular and nearshore species in contradistinction to *Undinula darwini,* a widespread species in the present collections.

Undinula darwini (Lubbock, 1860)

(PLATE 2, FIGS. 1–9)

Pacific records: Vervoort, 1946. Also, as *Calanus darwini;* Yamada, 1933a; Mori, 1937; 1942; Anraku, 1952; Honjo, 1952; Nakai, 1952; Yamazi, 1953a; 1953b; 1953c; Anraku, 1954b; Chiba and Tsuruta, 1954; Yamazi, 1954b; Motoda and Anraku, 1955; Nagaya et al., 1955; Yamazi, 1955a; 1955d; Chiba, 1956; Honjo et al., 1957; Yamazi, 1958b. As *Undinula darwini;* Wilson, 1942; 1950; Tanaka, 1953; Johnson, 1954; Brodsky, 1955; Rose, 1955; Tanaka, 1956a; Heinrich, 1957b; 1958a; Yamazi, 1958a; 1958b.

Remarks: All female specimens of this species have a group of inwardly projecting spines on the inner sides of the fifth thoracic segment (fig. 1). Also characteristic of this sex is the shape of the genital segment, which in dorsal view, is seen to narrow anteriorly (fig. 1).

The three forms of the female of this species (described by Sewell, 1929) are distinguished by the shape of the left fifth thoracic margin and spinulation of the proximal segments of the first antennae. The right fifth thoracic margin in all three forms is rounded and has

Vessel:	Station	Occurrence (*measurement in mm.; number of specimens in paren.*)			
		f. *typica* female	f. *symmetrica* female	f. *intermedia* female	male
Hugh M. Smith	94				(1)
Do	132		1.97(1)		
Do	144	1.90(1)	1.87–2.04(7)		1.80(3)
Do	153	1.90–2.00(2)	1.80–1.90(7)		present.
Do	178	present	1.84–1.90(20)		1.60–1.67(4)
Do	30	2.00(2)	1.95–2.04(4)		
Do	31	1.90–2.18(2)	2.00(1)		(2)
Do	29				(1)
Do	63	1.90(1)	1.94–2.04(5)		(8)
Stranger	34	2.04(1)	2.04(1)	2.07(1)	(3)
Orsom	10			1.90(1)	1.73(1)
Horizon	32		2.04(1)	1.94–2.07(4)	
Satsuma	32	1.80(1)		1.84–1.90(5)	1.63(1)

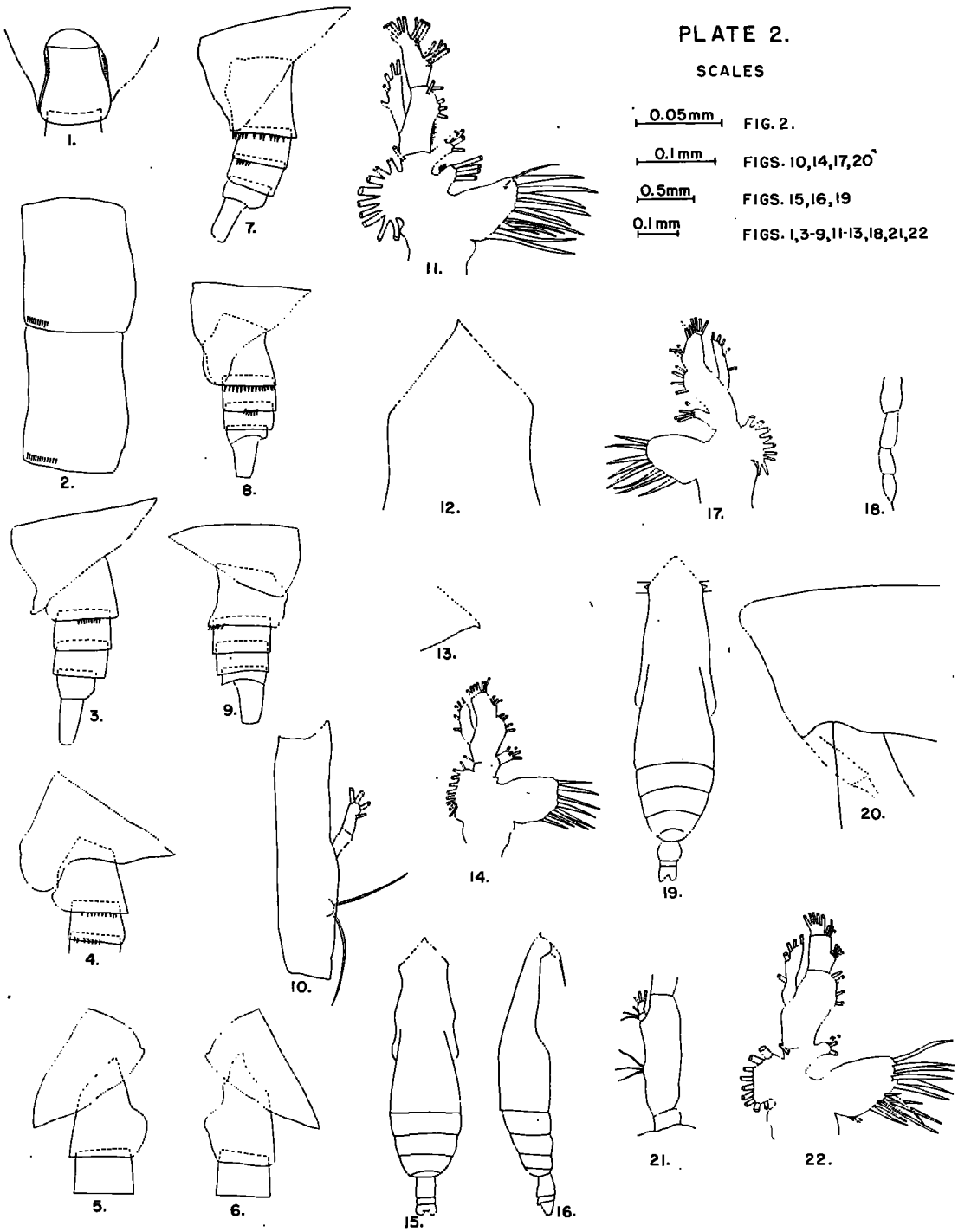

PLATE 2.—(1) *Undinula darwini* f. *typica*, female, posterior part of thorax and genital segment, dorsal view; (2) segments 6 and 7 of first antenna; (3) posterior part of thorax and abdomen, left side; (4) posterior part of thorax and abdomen, left side; (5) *U. darwini* f. *symmetrica*, female, posterior part of thorax and genital segment, right side; (6) posterior part of thorax and genital segment, left side; (7) *U. darwini* f. *intermedia*, female, posterior part of thorax and abdomen, left side; (8) posterior part of thorax and abdomen, left side; (9) posterior part of thorax and abdomen, right side; (10) *Eucalanus attenuatus*, female, second basal segment and endopod of mandible; (11) first maxilla; (12) *E. mucronatus*, stage IV, female, forehead, dorsal view; (13) forehead, lateral view; (14) first maxilla; (15) stage V, male, dorsal view; (16) lateral view; (17) first maxilla; (18) fifth foot; (19) *E. subtenuis* var. *japonica*, female, dorsal view; (20) forehead, lateral view; (21) basal segments and endopod of mandible; (22) first maxilla.

a small notch. In forma *typica*, both segments 6 and 7 of the first antennae have a row of spinules along the distal margin (fig. 2). The left fifth thoracic margin is somewhat variable in shape. Typically, it is produced into a point which is directed ventrally (fig. 3). In a few individuals this margin was expanded and rounded (fig. 4). In forma *symmetrica*, a row of spinules is also present on segments 6 and 7 of the first antennae, but the two thoracic margins are symmetrical (figs. 5, 6). In forma *intermedia*, spinules are present on segments 3 through 7 of the first antennae, and the left fifth thoracic margin is usually more or less triangular in shape (fig. 7). In several specimens, this margin was rounded similar to that of forma *symmetrica* (fig. 8). Most examples of forma *intermedia* also had a small group of spines situated on the left mid-lateral margin of the second abdominal segment.

Chiba (1953a) has recently discussed and presented figures of small (40–60μ) spherical bodies which he detected within the furcae of the female of this species. He considered these objects to be eggs and analogized the "egg chamber" (furca) to the brood sac of daphnids. I too have seen these bodies in the furcae of this species. They are possibly protozoan parasites but not the reproductive eggs of the species.

Family EUCALANIDAE

Eucalanus attenuatus (Dana, 1849)

(PLATE 2, FIGS. 10, 11)

Pacific records: Vervoort, 1946. Also, Yamada, 1933a; Tanaka, 1935a; Mori, 1937; Johnson, 1942; Mori, 1942; Wilson, 1942; Brodsky, 1950; Wilson, 1950; Anraku, 1952; Honjo, 1952; Tanaka, 1953; Yamazi, 1953c; Anraku, 1954b; Johnson, 1954; Tsuruta and Chiba, 1954b; Yamazi, 1954d; Brodsky, 1955; Chiba, Tsuruta and Maéda, 1955; Hida and King, 1955; Motoda and Anraku, 1955; Nagaya et al., 1955; Rose, 1955; Yamazi, 1955a; 1955d; Chiba, 1956; Tanaka, 1956a; Honjo et al., 1957; Heinrich, 1958a; 1958b; Yamazi, 1958a; Brodsky, 1959; Lindberg, 1959; Ponomareva, 1959.

Vessel:	Station	Occurrence
Hugh M. Smith	132	1 female, 3.89 mm.
Do	153	present.
Do	178	2 females, 3.61, 3.80 mm.; 1 male, 2.96 mm.
Do	30	1 female, 3.16 mm.
Do	31	5 males, 2.92–3.06 mm.
Do	63	2 females, 3.90, 4.08 mm.
Stranger	34	1 female, 3.06 mm.
Horizon	32	7 females, 3.90–4.28 mm.; 1 female (stage V) 3.20 mm.

Remarks: Vervoort (1946) noted that there were large variations in the sizes of his specimens (females, 3.55–5.80; males 2.95–4.35) from the Netherlands East Indies, but he could find no anatomical differences between the size groups. Tanaka (1956a) likewise observed that there were large size variations (female, 4.32–6.19; male, 3.24–4.67) in the lengths of specimens obtained from the Izu region of Japan. He reported differences (shape of genital segment, presence of hair on female, relative lengths of segments of fifth pair of feet in the male) between the larger specimens of this species and suggested that a northern variety may have been present. The lengths of the present specimens were not nearly so variable as those reported by Vervoort or Tanaka.

Eucalanus mucronatus Giesbrecht, 1888

(PLATE 2, FIGS. 12–18)

Pacific records: Vervoort, 1946; 1957. Also, Yamada, 1933; Tanaka, 1935a; Honjo, 1952; Nakai, 1952; Tanaka, 1953; Yamazi, 1953a; Anraku, 1954b; Chiba, Tsuruta, and Maéda, 1955; Motoda and Anraku, 1955; Nagaya et al., 1955; Tanaka, 1956a; Honjo et al., 1957; Yamazi, 1958a; 1958b.

Vessel:	Station	Occurrence
Horizon	32	1 female (stage IV), 2.07 mm.; 1 male (stage V), 2.55 mm.

Remarks: Juveniles of this species were found in one collection. They are easily recognized by the pointed forehead, which is present in both sexes.

Eucalanus subtenuis Giesbrecht, 1888

(PLATE 2, FIGS. 19–21; PLATE 3, FIGS. 1–4)

Pacific records: Vervoort, 1946. Also, Mori, 1937; Tanaka, 1935a; Johnson, 1942; Mori, 1942; Wilson, 1942; 1950; Tanaka, 1953; 1956a; Fukase, 1957; Honjo et al., 1957; Heinrich, 1958b.

Vessel:	Station	Occurrence
Hugh M. Smith	94	1 female, 3.12 mm.
Do	132	13 females, 2.55–2.96 mm.
Do	144	10 females, 2.40–2.60 mm.
Do	153	present.
Do	178	15 females, 2.65–2.72 mm.; 6 males, 2.45–2.52 mm.
Do	31	15 females, 2.55–2.79 mm.
Do	63	16 females, 2.69–2.96 mm.; 1 male, 2.51 mm.

Remarks: All of the present specimens are referable to *E. subtenuis* var. *japonica* Fukase, 1957. This variety is distinguished from *subtenuis* chiefly by the number of setae on the mandibular palpus (both sexes) and the structure of the fifth feet of the male. There are 3 setae on the mandibular palpus (fig. 21; fig. 3) and the distal segment of the fifth foot is longer than the terminal spine (fig. 4). In *subtenuis* there are 2 setae on the mandibular palpus and the terminal spine of the fifth foot is longer than the distal segment.

According to Fukase, Tanaka's (1935a) *E. subtenuis* and Mori's (1937) *E. mucronatus* are both referable to *subtenuis* var. *japonica*.

This species was present in seven of the samples and in four of these (*Smith* 132, 144, 178, 63) it was the most abundant species.

Eucalanus pileatus Giesbrecht, 1888

(PLATE 3, FIGS. 5–12)

Pacific records: Scott, 1909; Tanaka, 1935a; Wilson, 1950; Tanaka, 1953; 1956a.

Vessel:	Station	Occurrence
Satsuma	32	2 females, 1.80 and 1.94 mm.

Remarks: This species closely resembles *E. subcrassus* and the two may prove to be conspecific. Until a detailed study is made of each, it seems best to keep them separate. The females may be distinguished as follows (Pacific specimens):

1. Size. *E. pileatus*, 1.80–2.41; *E. subcrassus*, 2.23–2.82. (length data from Tanaka, 1935a; Mori, 1937; Vervoort, 1946; and present data). Farran (1936) has reported *E. subcrassus* with total lengths of 1.84–2.92 from the Great Barrier Reef. He did not record *E. pileatus*.

2. Shape of forehead. In dorsal view anterior end of forehead more produced in *E. pileatus* (fig. 7) than in *E. subcrassus* (plate 3, fig. 15).

3. Shape of genital segment. *E. pileatus*, greatest diameter at a point approximately one-half the length of the segment (fig. 10); *E. subcrassus*, greatest diameter in lower third of segment (plate 3, fig. 16).

Eucalanus subcrassus Giesbrecht, 1888

(PLATE 3, FIGS. 13–17)

Pacific records: Vervoort, 1946. Also, Tanaka, 1935a; Mori, 1937; 1942; Wilson, 1950; Anraku, 1952; Honjo, 1952; Tanaka, 1953; Anraku, 1954b; Tsuruta and Chiba, 1954b; Brodsky, 1955; Chiba, Tsuruta, and Maéda, 1955; Motoda and Anraku, 1955; Nagaya et al., 1955; Rose, 1955; Tanaka, 1956a; Honjo et al., 1957; Yamazi, 1958a.

Vessel:	Station	Occurrence
Hugh M. Smith	63	3 females, 2.44–2.52 mm.
Stranger	34	3 females, 2.24–2.48 mm.
Orsom	10	4 females, 2.31–2.48 mm., 3 males (stage V), 2.11–2.18 mm.

Remarks: Vervoort (1946) stated that there are 4 setae on the second basal joint of the first maxilla. The present specimens, however, have 5 (fig. 17).

Rhincalanus cornutus (Dana, 1849)

(PLATE 3, FIGS. 18–19)

Pacific records: Vervoort, 1946. Also, Yamada, 1933; Tanaka, 1935a; Mori, 1937; 1942; Wilson, 1942; 1950; Honjo, 1952; Tanaka, 1953; Anraku, 1954b; Tsuruta and Chiba, 1954b; Chiba, Tsuruta and Maéda, 1955; Hida and King, 1955; Nagaya et al., 1955; Rose, 1955;

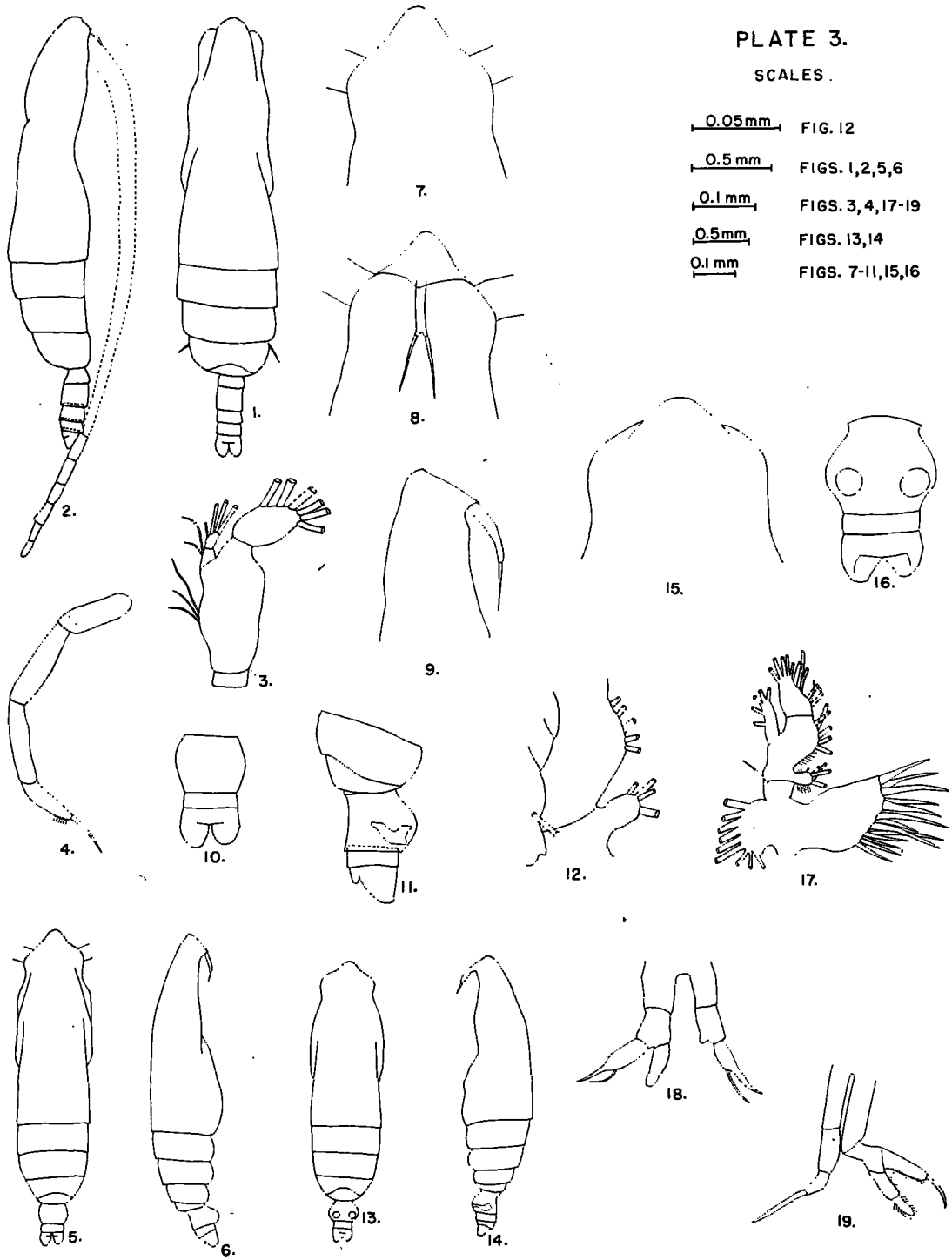

PLATE 3.—(1) *Eucalanus subtenuis* var. *japonica*, male, dorsal; (2) lateral; (3) mandible palpus; (4) fifth foot; (5) *E. pileatus*, female, dorsal view; (6) female, lateral view; (7) forehead, dorsal view; (8) forehead, ventral view; (9) forehead, lateral view; (10) abdomen, dorsal view; (11) posterior part of thorax and abdomen, lateral view; (12) first maxilla (part); (13) *E. subcrassus*, female, dorsal view; (14) lateral view; (15) forehead, dorsal view; (16) abdomen, dorsal view; (17) first maxilla; (18) *Rhincalanus cornutus*, stage V, male, fifth pair of feet; (19) adult male, fifth pair of feet.

Chiba, 1956; Tanaka, 1956a; Honjo et al., 1957; Yamazi, 1958a.

Vessel:	Station	Occurrence
Hugh M. Smith	94	2 females, 2.79, 3.20 mm.
Do	144	1 female, 3.09 mm.
Do	153	1 male, 2.89 mm.
Do	31	2 females, 3.33; 2 males (stage V), 2.70, 2.80 mm.
Do	29	18 females, 3.20–3.33 mm.; 6 males, 2.79–2.86 mm.
Do	63	3 females, 3.09–3.24 mm.
Stranger	34	1 female, 3.09 mm.
Orsom	10	2 males, 2.69, 2.72 mm.
Horizon	32	2 females, 3.40 mm.; 1 male (stage V), 2.52 mm.
Satsuma	32	1 male, 2.95 mm.

Remarks: All of the above females belong to *R. cornutus* f. *typica* Schmaus. This species was widely distributed in the samples.

Rhincalanus nasutus Giesbrecht, 1888

Pacific records: Vervoort, 1946; 1957. Also, Yamada, 1933; Tanaka, 1935a; Johnson, 1942; Brodsky, 1950; Anraku, 1952; Honjo, 1952; Tanaka, 1953; Anraku, 1954b; 1954c; Chiba and Tsuruta, 1955; Tanaka, 1956a; Honjo et al., 1957; Heinrich, 1958a; Yamazi, 1958a.

Vessel:	Station	Occurrence
Hugh M. Smith	94	4 females, 4.08–4.37 mm.

Remarks: This species occurred in but one sample which was collected in the eastern Pacific by a closing net at a depth between 146 and 172 meters. As Vervoort (1946) mentioned, it is primarily a subsurface species.

Family PARACALANIDAE

Paracalanus aculeatus Giesbrecht, 1888

(PLATE 4, FIGS. 1–3)

Pacific records: Vervoort, 1946; 1957. Also, Yamada, 1933a; 1933b; Mori, 1942; Anraku, 1952; Chiba, 1952a; 1952b; Honjo, 1952; Nakai, 1952; Anraku, 1953; Tanaka, 1953; Yamazi, 1953c; Anraku, 1954b; Tsuruta and Chiba, 1954b; Chiba, Tsuruta, and Maéda, 1955; Motoda and Anraku, 1955; Nagaya et al., 1955; Rose, 1955; Chiba, 1956; Tanaka, 1956b; Honjo et al., 1957; Yamazi, 1958a.

Vessel:	Station	Occurrence
Hugh M. Smith	144	1 female, 1.0 mm.
Do	153	2 females, 1.09, 1.17 mm.
Do	178	2 females, 1.10 mm.
Do	31	1 female, 1.10 mm.
Do	63	9 females, 1.04–1.16 mm.
Stranger	34	4 females, 1.07–1.17 mm.
Orsom	10	3 females, 1.07–1.12 mm.
Horizon	32	2 females, 1.05, 1.10 mm.

Remarks: All the present specimens belong to *P. aculeatus* f. *major* Sewell, 1929. It was widely distributed in the present collections, but no males were observed.

Paracalanus parvus (Claus, 1863)

Pacific records: Vervoort, 1946; 1957. Also, Mori, 1942; Lowe, 1936; Chiba, 1949; Kokubo, 1950; Yamazi, 1950; 1951; Anraku, 1952; Honjo, 1952; Motoda and Anraku, 1952a; Yamazi, 1952a; 1952b; 1952c; Anraku, 1953; Tanaka, 1953; Yamazi, 1953a; 1953b; 1953c; Anraku, 1954a; 1954b; Tsuruta and Chiba, 1954b; Yamazi, 1954a; 1954b; 1954c; 1954d; 1954e; Chiba, Tsuruta, and Maéda, 1955; Motoda and Anraku, 1955; Nagaya et al., 1955; Nakai, 1955; Rose, 1955; Yamazi, 1955a; 1955b; 1955c; 1955d; Chiba, 1956; Shen and Bai, 1956; Tanaka, 1956b; Honjo et al., 1957; Légaré, 1957; Yamazi, 1957; 1958a; 1958b; Brodsky, 1959; Lindberg, 1959.

Vessel:	Station	Occurrence
Hugh M. Smith	94	2 females, 0.99 mm.

Remarks: Although this is a cosmopolitan species, it was observed in but one sample. Possibly its small size permitted most of the specimens to pass through the meshes of the nets employed or perhaps it is not too abundant in the waters sampled.

Paracalanus dubia Sewell, 1912

(PLATE 4, FIGS. 4–12)

Pacific records: Rose, 1955.

Vessel:	Station	Occurrence
Kagoshima	613	1 female, 0.49 mm.

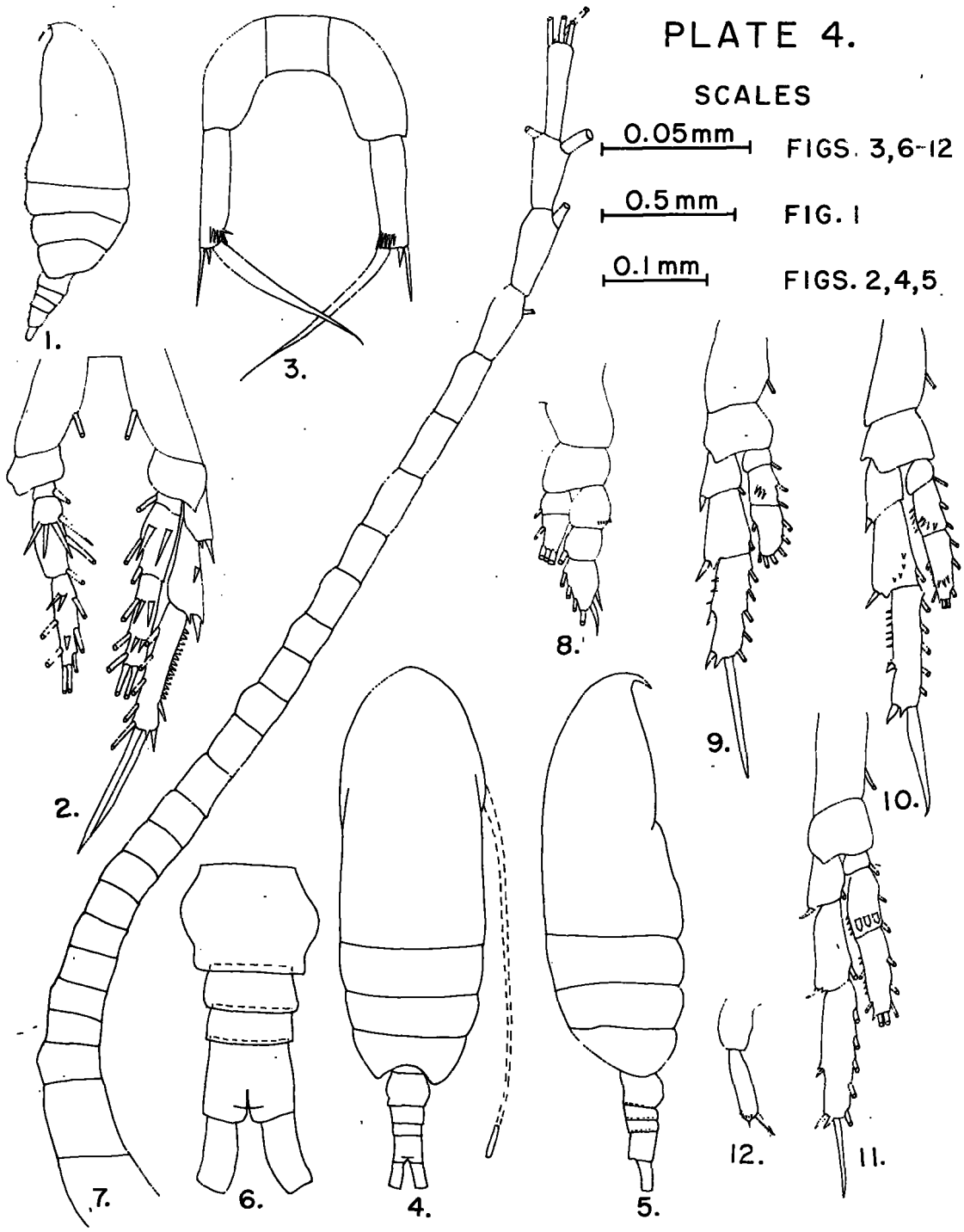

PLATE 4.—(1) *Paracalanus aculeatus*, female, lateral view; (2) fourth pair of feet (one exopod missing); (3) fifth pair of feet; (4) *P. dubia*, female, dorsal view; (5) lateral view; (6) abdomen, dorsal view; (7) first antenna; (8) first foot; (9) second foot; (10) third foot; (11) fourth foot; (12) fifth foot.

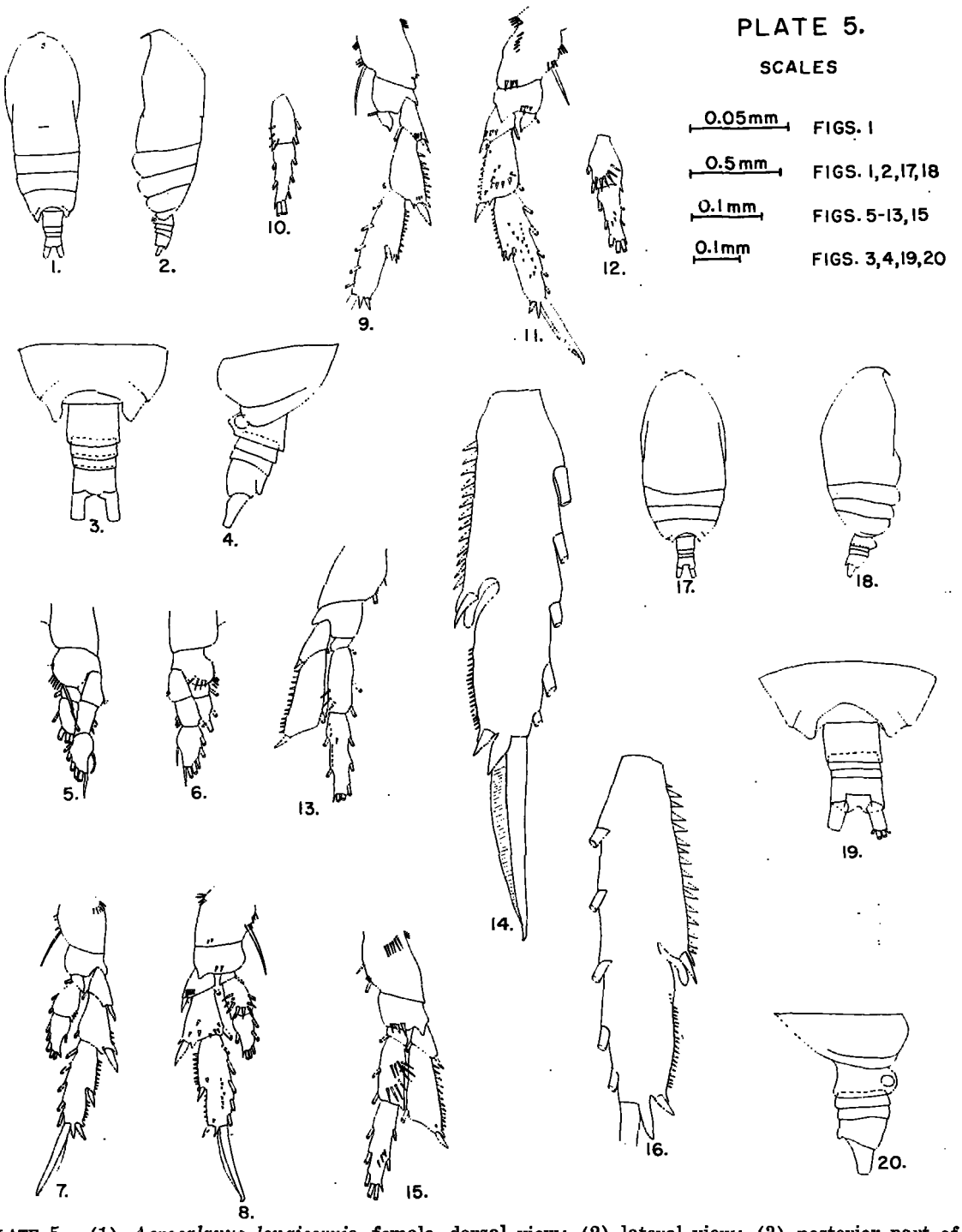

PLATE 5.—(1) *Acrocalanus longicornis*, female, dorsal view; (2) lateral view; (3) posterior part of thorax and abdomen, dorsal view; (4) posterior part of thorax and abdomen, lateral view; (5) first foot, anterior; (6) first foot, posterior; (7) second foot, anterior; (8) second foot, posterior; (9) third foot, anterior, without distal 2 segments of endopod; (10) distal 2 segments of endopod of third foot, anterior; (11) third foot, posterior, without distal 2 segments of endopod; (12) distal 2 segments of endopod, posterior; (13) fourth foot, anterior, without third exopodal segment; (14) third exopodal segment of fourth foot, anterior; (15) fourth foot, posterior, without third exopodal segment; (16) third exopodal segment of fourth foot, posterior; (17) *A. andersoni*, female, dorsal view; (18) lateral view; (19) posterior part of thorax and abdomen, dorsal view; (20) posterior part of thorax and abdomen, lateral view.

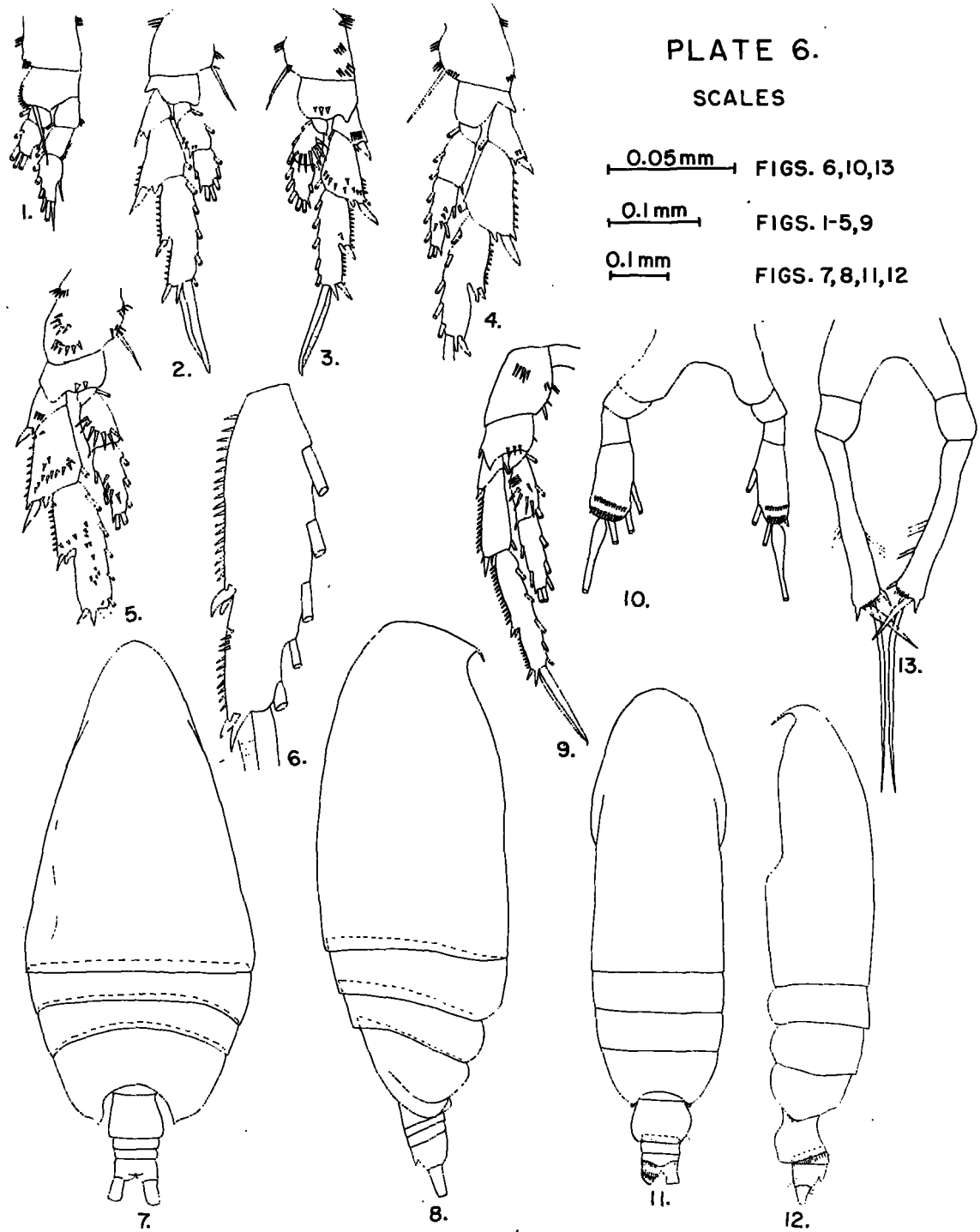

PLATE 6.—(1) *Acrocalanus andersoni*, first foot, anterior; (2) second foot, anterior; (3) second foot, posterior; (4) third foot, anterior; (5) third foot, posterior; (6) third exopodal segment of fourth foot, posterior; (7) *A. monachus*, female, dorsal view; (8) lateral view; (9) fourth foot, posterior; (10) *Calocalanus pavo*, female, fifth pair of feet; (11) *C. plumulosus*, female, dorsal view; (12) lateral view; (13) fifth pair of feet.

Remarks: The forehead of the present specimen as well as the spination of certain of the first four pairs of swimming feet differ somewhat from Sewell's description. The fifth pair of feet of Sewell's *P. serratipes* are similar to those of *P. dubia* but the former is a larger species (1.10 mm.).

The small spinules on the distal end of the terminal segment of the fifth feet can best be seen under oil immersion. The other feet, except the first pair, were also examined under oil in order to ascertain the number of setae, surface spines and lateral teeth on the various segments.

Only one specimen was obtained and this was partly destroyed in the process of dissection.

Acrocalanus longicornis Giesbrecht, 1888

(PLATE 5, FIGS. 1–16)

Pacific records: Vervoort, 1946. Also, Yamada, 1933; Mori, 1937; 1942; Wilson, 1942; 1950; Tanaka, 1953; Tsuruta and Chiba, 1954b; Chiba, Tsuruta and Maéda, 1955; Nagaya et al., 1955; Rose, 1955; Yamazi, 1955a; Tanaka, 1956b; Honjo et al., 1957; Yamazi, 1958a.

Vessel:	Station	Occurrence
Hugh M. Smith	153	2 females, 1.20, 1.22 mm.
Do	31	1 female, 1.26 mm.
Do	63	2 females, 1.19, 1.24 mm.
Stranger	34	7 females, 1.17–1.27 mm.

Remarks: The presence of a partial suture between the head and first thoracic segment (figs. 1, 2) and the spination of the swimming feet, particularly the number of teeth (more than 18) on the distal part of the third exopodal segment of the fourth pair of feet (figs. 14, 16), distinguished this species from others in the genus.

Acrocalanus andersoni Bowman, 1958

(PLATE 5, FIGS. 17–20; PLATE 6, FIGS. 1–6)

Pacific records: None.

Vessel:	Station	Occurrence
Stranger	34	1 female, 0.95 mm.
Orsom	10	3 females, 1.12–1.17 mm.
Kagoshima	613	1 female, 1.12 mm.

Remarks: This species was recently described from specimens obtained from the south Atlantic coast of the United States (Bowman, 1958). It is recognized by the lack of partial suture between the head and first thoracic segment (figs. 17, 18) and the number of lateral teeth (11) on the distal part of the third exopodal segment of the fourth pair of feet (fig. 6).

Acrocalanus monachus Giesbrecht, 1888

(PLATE 6, FIGS. 7–9)

Pacific records: Scott, 1909; Farran, 1936; Mori, 1937; 1942; Wilson, 1942; 1950; Tanaka, 1953; Tsuruta and Chiba, 1954b; Chiba, Tsuruta, and Maéda, 1955.

Vessel:	Station	Occurrence
Stranger	34	2 females, 1.02, 1.05 mm.
Orsom	10	1 female, 1.00 mm.
Horizon	32	3 females, 1.00–1.10 mm.

Remarks: The truncate appearance of this species in lateral view (fig. 8) readily distinguishes it from others in the genus.

Calocalanus pavo (Dana, 1849)

(PLATE 6, FIG. 10)

Pacific records: Vervoort, 1946. Also, Yamada, 1933a; Mori, 1937; Johnson, 1942; Mori, 1942; Wilson, 1942; 1950; Tanaka, 1953; Yamazi, 1953b; 1953c; Johnson, 1954; Tsuruta and Chiba, 1954b; Yamazi, 1954d; Brodsky, 1955; Chiba, Tsuruta, and Maéda, 1955; Nagaya et al., 1955; Rose, 1955; Yamazi, 1955d; Chiba, 1956; Tanaka, 1956b; Heinrich, 1957b; Honjo et al., 1957; Heinrich, 1958b; Yamazi, 1958a; 1958b.

Vessel:	Station	Occurrence
Hugh M. Smith	153	1 female, 0.85 mm.
Do	63	1 female, 1.00 mm.
Stranger	34	1 female, 1.19 mm.
Orsom	10	1 female, 0.97 mm.
Horizon	32	1 female, 1.00 mm.

Remarks: Bernard (1958) has recently revised the genus *Calocalanus* based on material collected in the Bay of Algiers. She proposed the family Calocalanidae, which consists of the genus *Calocalanus* s. str. and two new genera, *Leptocalanus* and *Dolichocera*. She has also

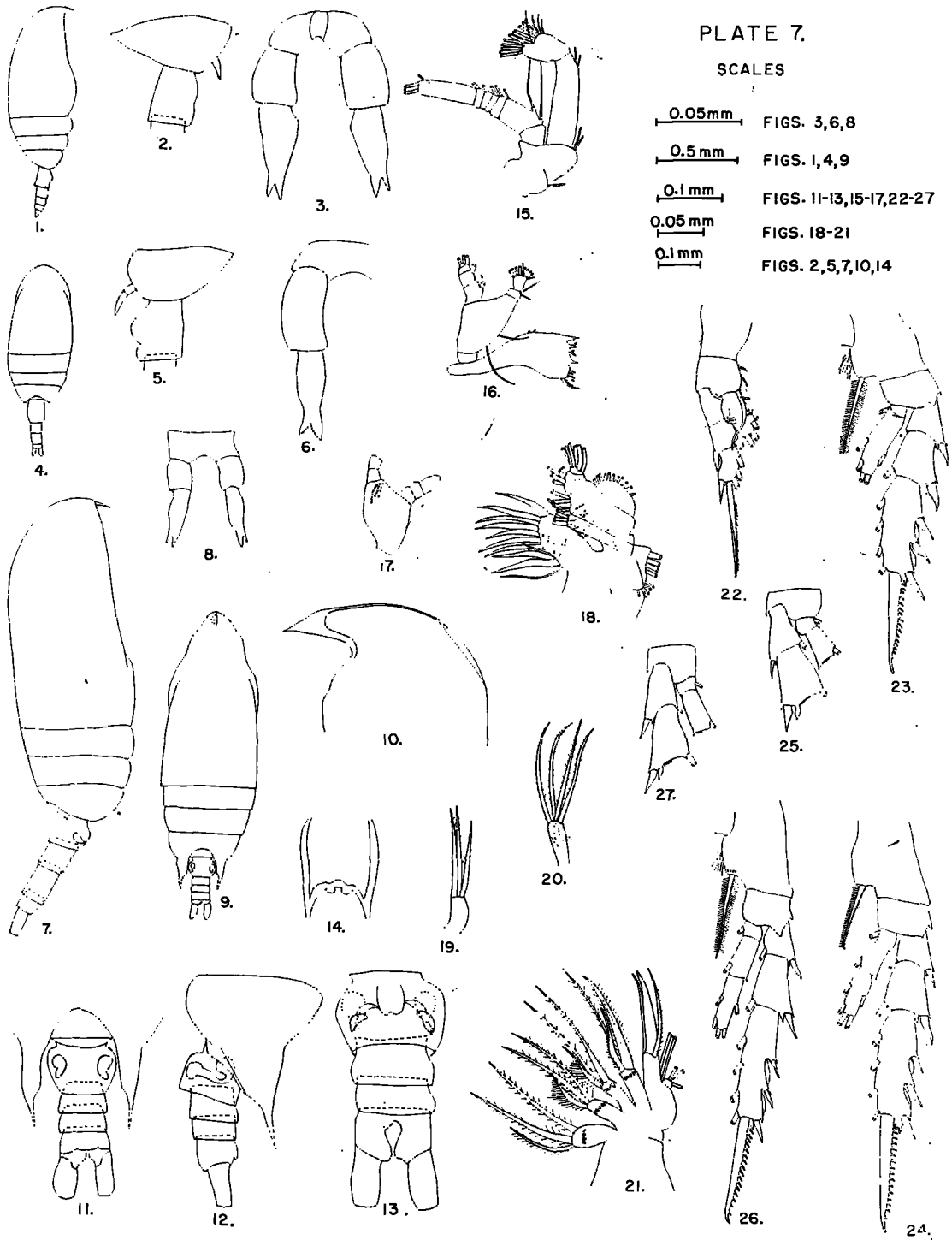

PLATE 7.—(1) *Clausocalanus arcuicornis* f. *major*, female, lateral view; (2) posterior part of thorax and genital segment, lateral view; (3) fifth pair of feet; (4) *C. arcuicornis* f. *minor*, female, dorsal view; (5) posterior part of thorax and genital segment, lateral view; (6) fifth foot; (7) *C. furcatus*, female, lateral view; (8) fifth pair of feet; (9) *Euaetideus giesbrechti*, female, dorsal view; (10) forehead, lateral view; (11) posterior part of thorax and abdomen, dorsal view; (12) posterior part of thorax and abdomen, lateral view; (13) abdomen, ventral view; (14) rostrum; (15) second antenna; (16) mandible; (17) mandible palpus (other side); (18) first maxilla; (19) second inner lobe of first maxilla; (20) third inner lobe of first maxilla; (21) second maxilla; (22) first foot, anterior; (23) second foot, posterior; (24) third foot, posterior; (25) second basipodal segment and first and second segments of endopod and exopod of third foot, anterior; (26) fourth foot, posterior; (27) second basipodal segment and first and second segments of endopod and exopod of fourth foot, anterior.

described two new species and presented descriptions of five hitherto unknown males. *Calocalanus gracilis* Tanaka, 1956, is not included in her revision.

Calocalanus plumulosus (Claus, 1863)

(PLATE 6, FIGS. 11–13)

Pacific records: Scott, 1909; Farran, 1929; 1936; Dakin and Colefax, 1940; Mori, 1942; Wilson, 1942; Anraku, 1953; Tanaka, 1953; Tanaka, 1956b; Heinrich, 1957b; 1958b; Yamazi, 1958a.

Vessel:	Station	Occurrence
Satsuma	32	2 females, 0.87 mm.

Remarks: According to Bernard's revision (see Remarks under preceding species), this species belongs to a new genus, *Leptocalanus*. The descriptions presented by Tanaka (1956b) and Bernard (1958) of the male are quite different and the two are not unispecific.

Family PSEUDOCALANIDAE

Clausocalanus arcuicornis (Dana, 1849)

(PLATE 7, FIGS. 1–6)

Pacific records: Vervoort, 1946; 1957. Also, Yamada, 1933; Johnson, 1942; Mori, 1942; Brodsky, 1950; Nakai, 1952; Anraku, 1954b; Tsuruta and Chiba, 1954b; Brodsky, 1955; Chiba, Tsuruta, and Maéda, 1955; Motoda and Anraku, 1955; Nagaya et al., 1955; Rose, 1955; Chiba, 1956; Tanaka, 1956b; Heinrich, 1957b; Honjo et al., 1957; Heinrich, 1958a; Yamazi, 1958a; Brodsky, 1959; Lindberg, 1959; Ponomareva, 1959.

Vessel:	Station	Occurrence (*measurement in mm.; number of specimens in paren.*)		
		f. *minor*, female	f. *major*, female	male
Hugh M. Smith	94	1.26–1.29(2)		
Do	132	1.07–1.24(17)		
Do	144	present	1.34–1.46(8)	present.
Do	153	1.15–1.25(4)	1.37(1)	
Do	178	1.08–1.28(21)	1.33(1)	
Do	30		1.43–1.56(14)	1.21–1.26(2)
Do	31	1.19–1.31(4)	1.42–1.53(5)	
Do	63	1.33(1)	1.51(1)	
Stranger	34	1.16–1.28(10)		
Orsom	10	1.16–1.24(13)	1.53(1)	
Horizon	32	1.14–1.24(6)	1.30–1.46(2)	
Satsuma	32	1.08–1.12(3)		

Remarks: I have tentatively equated the females of this species to two forms which were described by Sewell, 1929. The two forms are distinguished by size and the total and relative lengths of the segments of the fifth feet. Forma *major* is large (1.30–1.60 mm.), and the fifth pair of feet is small (fig. 2). The distal segment is about twice as long as the proximal one (fig. 3). Forma *minor* is distinguished by its small size and its longer fifth feet (fig. 5). The distal and proximal segments are about equal in length.

Tanaka (1956b) has described two types of males of this species which differ in size and in the structure of the fifth feet. Although rare in the present collections, males with fifth feet referable to Tanaka's large form were found in the sample from the *Hugh M. Smith*, station 30.

Clausocalanus furcatus (Brady, 1883)

(PLATE 7, FIGS. 7–8)

Pacific records: Vervoort, 1946. Also, Mori, 1937; 1942; Wilson, 1942; Brodsky, 1950; Wilson, 1950; Nakai, 1952; Anraku, 1953; Tanaka, 1953; Yamazi, 1953c; Anraku, 1954b; Tsuruta and Chiba, 1954b; Motoda and Anraku, 1955; Nagaya et al., 1955; Rose, 1955; Chiba, 1956; Tanaka, 1956b; Honjo et al., 1957; Heinrich, 1958a.

Vessel:	Station	Occurrence
Hugh M. Smith	132	present.
Do	153	present.

Vessel:	Station	Occurrence
Do	178	2 females, 1.10, 1.12 mm.
Do	31	1 female, 1.14 mm.
Do	63	5 females, 1.00–1.17 mm.
Stranger	34	4 females, 1.12–1.19 mm.
Horizon	32	3 females, 1.02–1.19 mm.
Satsuma	32	1 female, 1.05 mm.

Remarks: This species is easily distinguished from the preceding by its short genital segment (fig. 7) and very small fifth feet (figs. 7, 8).

Family AETIDEIDAE

Euaetideus giesbrechti (Cleve, 1904)

(PLATE 7, FIGS. 9–27)

Pacific records: Vervoort, 1957. Also, as *Aetideus giesbrechti;* Johnson, 1942; Mori, 1942; Honjo, 1952; Anraku, 1954b; 1954c; Chiba, Tsuruta, and Maéda, 1955; Motoda and Anraku, 1955; Nagaya et al., 1955; Chiba, 1956; Honjo et al., 1957; Tanaka, 1957a; Yamazi, 1958a. As *Euaetideus giesbrechti*; Heinrich, 1957b; 1958a; 1958b.

Vessel:	Station	Occurrence
Hugh M. Smith	94	1 female, 1.95 mm.
Do	144	1 female, 1.95 mm.
Do	29	1 female, 1.97 mm.
Do	63	2 females, 1.97 mm.

Remarks: Vervoort (1957) has recently described a new species of *Euaetideus* (*E. australis*) as well as redescribed and figured the other three species (*E. giesbrechti, E. bradyi, E. acutus*) in this genus. The latter three species were represented in the present collections and as all three of them differ in a few details from Vervoort's descriptions, I have included a brief discussion and several figures of each of them. The chief differences between my specimens of *E. giesbrechti* and those described by Vervoort are listed below. The numbers in parenthesis are those given by Vervoort.

1. Second antennae (fig. 15). Four (3) setae on distal segment of exopod. Seven (6) setae on outer lobe and 9 (8) setae on inner lobe of endopod.

2. First maxillae (figs. 18–20). Second basal segment with 4 (5) setae. Second inner lobe with 3 (2) setae. Three (4) setae on the first segment of the endopod. It should be pointed out that Vervoort stated that the first maxilla of *E. giesbrechti* is like that of *E. australis.* The second basal segment of the first maxilla of the latter species is shown to have 4 setae, which agrees, in this respect, with the number on the present specimens.

The three species found in the present collections are distinguished by the shape of the anterior margin of the head (dorsal view); the character of the rostrum; and the posterior lateral thoracic margins. In *E. giesbrechti* the forehead is evenly rounded and the rostral plate is not visible (fig. 9). There are two small knobs between the rostral spines (fig. 14), and the posterior lateral thoracic margins have a characteristic shape (fig. 12). This species is also larger (1.95–2.00) than the other two.

Euaetideus acutus (Farran, 1929)

(PLATE 8, FIGS. 1–2)

Pacific records: Vervoort, 1957. Also, as *Aetideus acutus;* Tanaka, 1957a.

Vessel:	Station	Occurrence
Hugh M. Smith	94	5 females, 1.65–1.70 mm.
Do	132	2 females, 1.65, 1.70 mm.
Do	144	3 females, 1.70 mm.
Do	153	1 female, 1.70 mm.
Do	178	9 females, 1.55–1.65 mm.
Do	30	1 female, 1.61 mm.
Do	31	2 females, 1.55, 1.65 mm.
Do	63	1 female, 1.60 mm.
Stranger	34	1 female, 1.60 mm.

Remarks: Certain differences were noted in the second antennae and first maxillae of the present specimens and the descriptions and figures of these appendages given by Vervoort. These differences are summarized below:

1. Second antennae. Same as that described for *E. giesbrechti.* Vervoort shows 3 setae on the terminal segment of the exopod and 6 setae on the outer lobe and 8 setae on the inner lobe of the endopod.

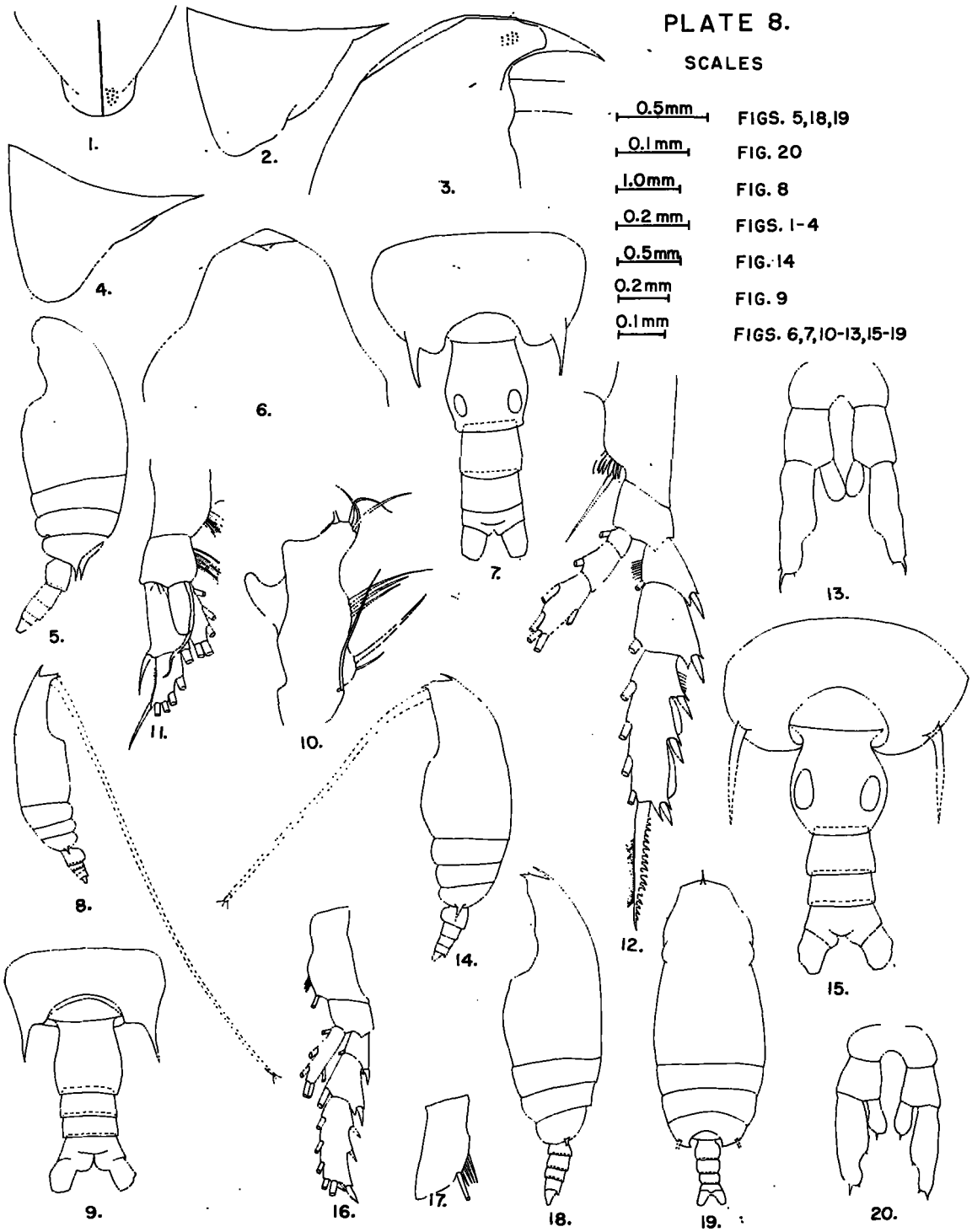

PLATE 8.—(1) *Euaetideus acutus*, female, forehead, dorsal view; (2) fourth and fifth thoracic segments, lateral view; (3) *E. bradyi*, female, forehead, lateral view; (4) fourth and fifth thoracic segments, lateral view; (5) *Chiridius poppei*, female, lateral view; (6) forehead, ventral view; (7) posterior part of thorax and abdomen, dorsal view; (8) *Gaetanus miles*, female, lateral view; (9) posterior part of thorax and abdomen, dorsal view; (10) first basipodal segment of maxilliped; (11) first foot; (12) fourth foot; (13) stage V, male, fifth pair of feet; (14) *Gaetanus minor*, female, lateral view; (15) posterior part of thorax and abdomen, dorsal view; (16) second foot; (17) first basipodal segment of fourth foot; (18) stage V, male, lateral view; (19) dorsal view; (20) fifth pair of feet.

2. First maxillae. Same as that described for *E. giesbrechti.* Vervoort shows 5 setae on the second basal segment, 2 setae on the second inner lobe and 4 setae on the first segment of the endopod.

E. acutus may be identified by the large rostral plate which is visible in dorsal view (fig. 1) and the character of the posterior lateral thoracic margins (fig. 2).

Euaetideus bradyi (A. Scott, 1909)

(PLATE 8, FIGS. 3–4)

Pacific records: Vervoort, 1957; Also, as *Aetideus bradyi;* Tanaka, 1957a.

Vessel:	Station	Occurrence
Hugh M. Smith	94	12 females, 1.60–1.65 mm.
Do	144	3 females, 1.65 mm.
Do	63	1 female, 1.70 mm.

Remarks: The second antennae differ from that figured by Vervoort in the manner described above for *E. giesbrechti.* The first maxilla of the present specimens has 4 setae on the basal segment and 3 setae on the second inner lobe. Vervoort showed 5 and 2 setae, respectively, on these parts of the maxilla. The anterior margin of the head of this species appears to be pitted similar to that of the preceding two species.

E. bradyi is distinguished from the above two species by the absence of knobs between the rostral spines and the character of the posterior lateral thoracic margins (fig. 4). In lateral view, a short hair is visible just dorsad of the base of the rostrum. I have not observed this hair in the other two species.

Chiridius poppei Giesbrecht, 1892

(PLATE 8, FIGS. 5–7)

Pacific records: Scott, 1909; Farran, 1929; Tanaka, 1937; Wilson, 1942; Brodsky, 1950; Tanaka, 1953; 1957a.

Vessel:	Station	Occurrence
Hugh M. Smith	94	2 females, 1.59, 1.83 mm.
Do	63	1 female, 1.70 mm.

Remarks: This species was found in two samples collected in the eastern Pacific. Vervoort (1957) suggested that *C. poppei* and *C. gracilis* Farran, 1905 may represent different size groups of the same species. He has also indicated how the two forms differ.

Gaetanus miles Giesbrecht, 1888

(PLATE 8, FIGS. 8–13)

Pacific records: Scott, 1909; Farran, 1936; Wilson, 1942; Brodsky, 1950; Tanaka, 1953; 1957b. As *G. secundus* Esterly, 1911; Johnson, 1942.

Vessel:	Station	Occurrence
Hugh M. Smith	29	2 females, 3.40, 3.50 mm.
Do	63	2 females, 3.52 mm.; 1 male (stage V), 2.89 mm.

Remarks: The female of this species is easily recognized by the elongate antennae which exceed the furca by the last 9 segments. Accompanying the females in the collection from *Smith* 63 was an immature male (stage V) which is apparently referable to this species. The fifth feet are shown in figure 13. The adult male is undescribed, although Esterly (1911) mentions that he has observed this sex, presumably in company with the females of his *G. secundus* (=*G. miles*).

Gaetanus minor Farran, 1905

(PLATE 8, FIGS. 14–20)

Pacific records: Vervoort, 1957. Also, Anraku, 1954b; 1954c; Tanaka, 1957b; Heinrich, 1958b.

Vessel:	Station	Occurrence
Hugh M. Smith	29	2 females, 2.18 mm.
Do	63	2 females, 2.15, 2.24 mm.; 1 male (stage V), 1.87 mm.
Horizon	32	1 female, 2.00 mm.

Remarks: The female is distinguished from *G. miles* by the short antennae and the presence of numerous small spines (fig. 17) on the first basipodal segment of the fourth feet. Rose (1933) states that the endopods of the second feet are composed of 2 segments. These endopods of the present specimens, as well as the one figured by Scott (1909), consist of only 1 segment (fig. 16). Associated with the females in the collection from *Smith* 63 was a juvenile

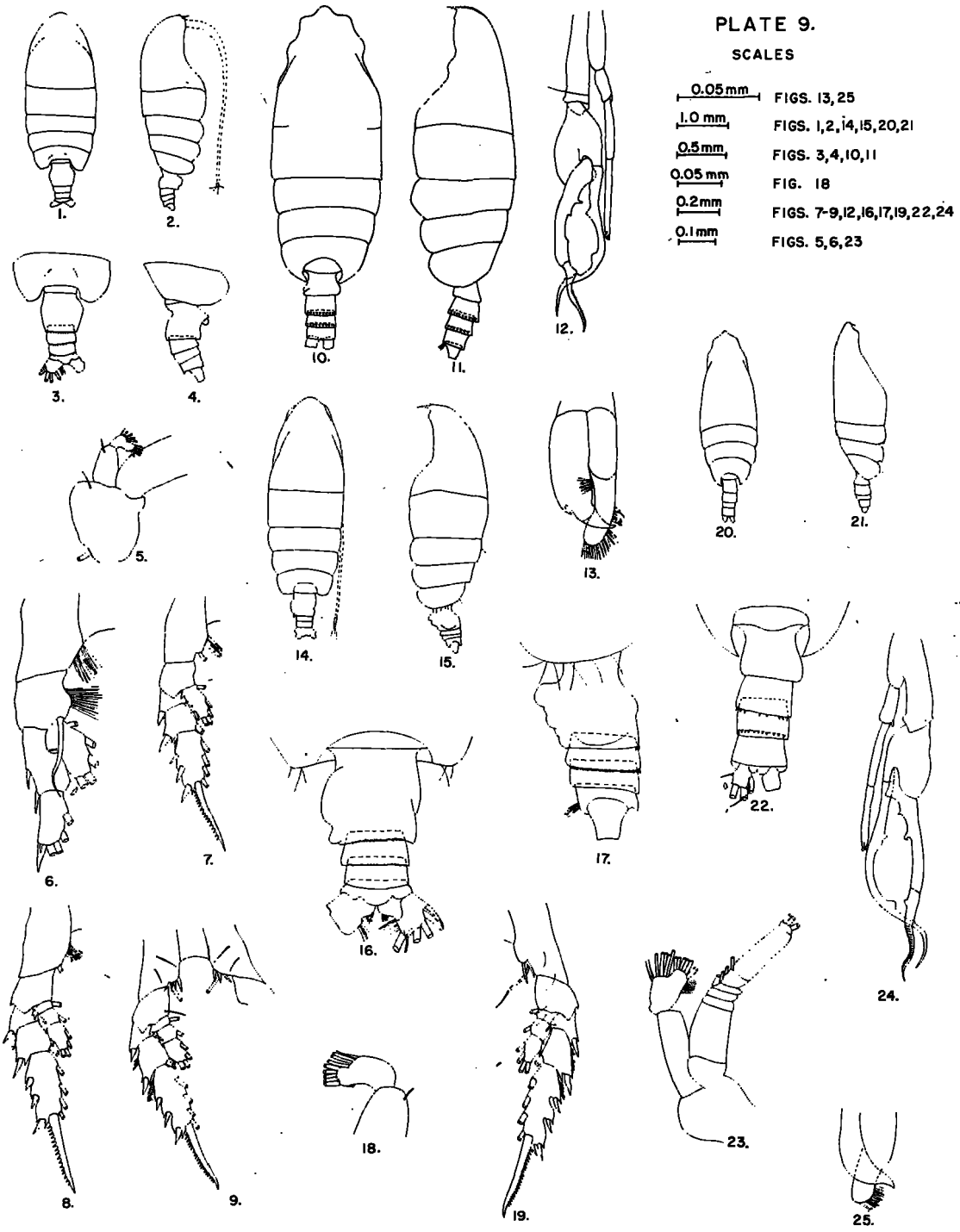

PLATE 9.—(1) *Euchirella bella*, female, dorsal view; (2) lateral view; (3) posterior part of thorax and abdomen, dorsal view; (4) posterior part of thorax and abdomen, lateral view; (5) endopod of second antenna; (6) first foot; (7) second foot; (8) third foot; (9) fourth foot; (10) male, dorsal view; (11) lateral view; (12) fifth pair of feet; (13) terminal part of left fifth foot; (14) *E. venusta*, female, dorsal view; (15) lateral view; (16) abdomen, dorsal view; (17) abdomen, lateral view; (18) endopod of second antenna; (19) fourth foot; (20) male, dorsal view; (21) lateral view; (22) abdomen, dorsal view; (23) second antenna; (24) fifth pair of feet; (25) terminal part of left fifth foot.

male (stage V), which is apparently referable to this species (figs. 18–20). The male of this species has been hitherto unknown.

Euchirella bella Giesbrecht, 1888

(PLATE 9, FIGS. 1–13)

Pacific records: Vervoort, 1949; Wilson, 1950.

Vessel:	Station	Occurrence
Hugh M. Smith	153	2 females, 3.90, 4.18 mm.; 1 male, 3.33 mm.
Do	31	2 females, 3.80 mm.; 1 male, 3.36 mm.
Do	63	1 female, 3.80 mm.
Stranger	34	1 female, 3.80 mm.

Remarks: The species of female *Euchirella* are distinguished by the shape of the genital segment, number of setae on the endopod of the second antennae and the spination of the first basipodal segment of the fourth pair of feet. The males are identified by the structure of the fifth feet. The genital segment of *E. bella* is nearly symmetrical in dorsal view (figs. 1, 3) and is produced in ventral view (figs. 2, 4). The second segment of the endopod of the second antennae in the specimens examined has 5 setae on the outer and 5 setae on the inner lobe (fig. 5). Giesbrecht and Schmeil (1898) state that there are 6 and 5 setae on these respective lobes. The males in the present collections have 6 setae on the external lobe and 7 on the internal lobe, the 2 most internal ones being very small and slender. Vervoort (1949) indicated that there were 6 setae on each lobe. The number of spines on the first basipodal segment of the fourth feet is variable. Some specimens have 5 on each side and others have 4 on one side and 3 on the other (fig. 9). Scott (1909) and Sewell (1947) have also noted a variable number of spines on this segment.

Wilson (1950) has erroneously synonymized *E. amoena* with this species. See discussion of this under *E. amoena* below.

Euchirella venusta Giesbrecht, 1888

(PLATE 9, FIGS. 14–25)

Pacific records: Scott, 1909; Farran, 1929; Vervoort, 1949; Wilson, 1950; Tanaka, 1953; 1957b.

Vessel:	Station	Occurrence
Hugh M. Smith	63	4 females, 4.37–4.84 mm.; 1 male, 3.80 mm.

Remarks: The female is identified by the knob-like protrusion from the left posterior margin of the genital segment (fig. 16); the presence of 4 setae on the inner lobe and 5 setae on the external lobe of the endopod of the second antennae (fig. 18); and the two long spines on the first basipodal segments of the fourth pair of feet. Sewell (1947) has recently described the male, additional figures of which are given herein (figs. 20–25). The second antennae (fig. 23) have 6 setae on the outer lobe and 7 setae on the inner lobe, 2 of which are small. Sewell reported 6 setae on each lobe. The structure of the fifth feet agrees quite well with Sewell's figure of this appendage.

Euchirella pulchra (Lubbock, 1856)

(PLATE 10, FIGS. 1–4)

Pacific records: Esterly, 1905; Scott, 1909; Johnson, 1942; Wilson, 1942; Davis, 1949; Vervoort, 1949; Brodsky, 1950; Wilson, 1950; Tanaka, 1953; 1957b.

Vessel:	Station	Occurrence
Hugh M. Smith	63	1 female, 3.42 mm.

Remarks: The genital segment is produced into a rounded swelling to the left (fig. 2). The second segment of the endopod of the second antennae has 6 setae on each lobe (fig. 3). This is the number reported also by Tanaka (1957b), but Giesbrecht and Schmeil (1898) and Vervoort (1952) stated that the internal lobe has 5 setae. Possibly the very small, innermost seta on the internal lobe was overlooked. An additional identification character is the presence of 2 spines on the first basipodal segment of the fourth pair of feet (fig. 4).

Euchirella amoena Giesbrecht, 1888

(PLATE 10, FIGS. 5–10)

Synonymy

Euchirella amoena Giesbrecht, 1888, Atti Acc. Lincei. Rend., Ser. 4, 4, sem. 2: 336.

Euchirella brevis, Sars, 1905. Bull. Mus. Oceanogr., Monaco, 26: 12.

Euchirella bella (partim), Wilson, 1950, U.S.N.M., Bull. 100, 14: 218.

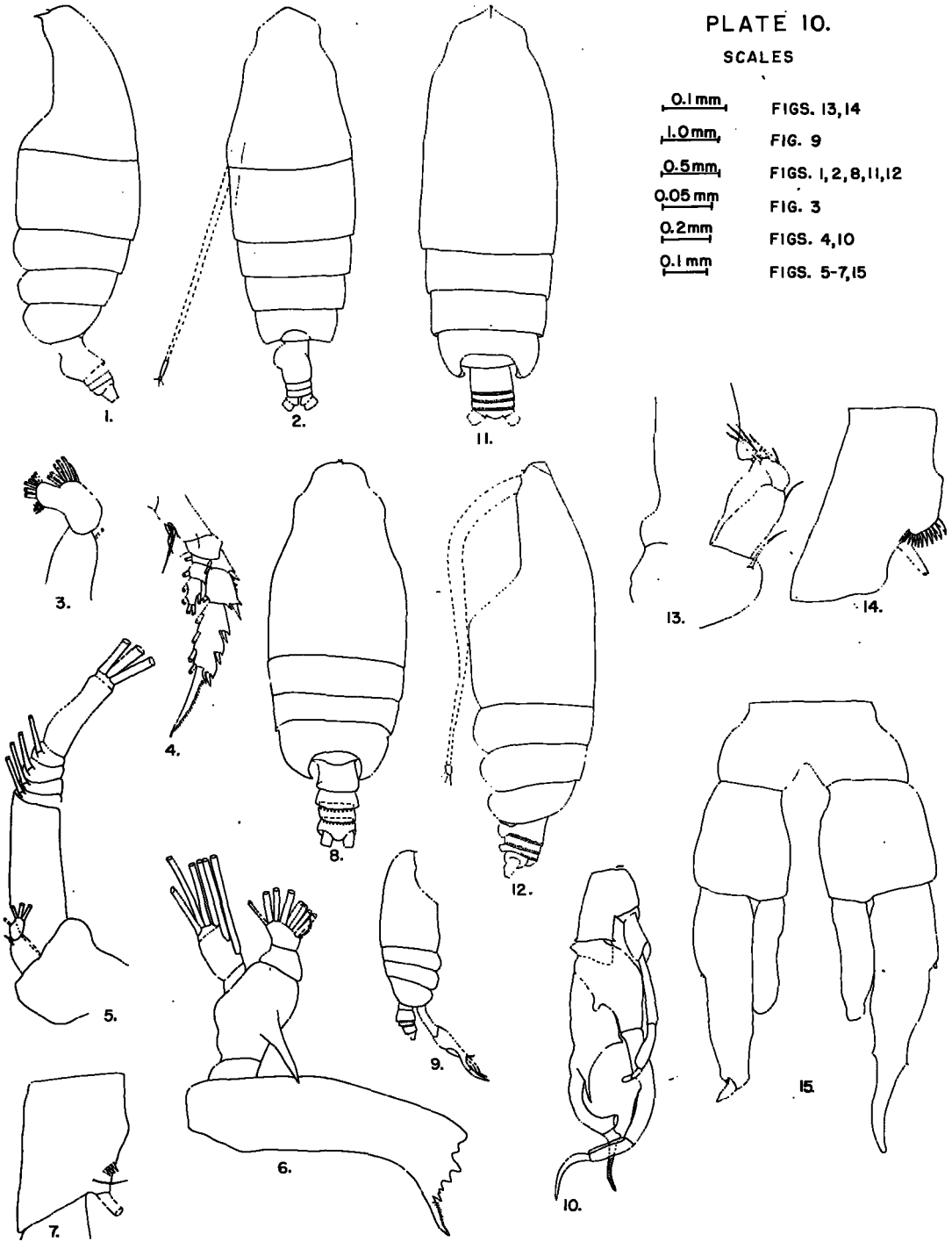

PLATE 10.—(1) *Euchirella pulchra*, female, lateral view; (2) dorsal view; (3) endopod of second antenna; (4) fourth foot; (5) *E. amoena*, female, second antenna; (6) mandible; (7) first basipodal segment of fourth foot; (8) male, dorsal view; (9) lateral view; (10) fifth pair of feet; (11) *E. curticauda*, female, dorsal view; (12) lateral view; (13) endopod of second antenna; (14) first basipodal segment of fourth foot; (15) *E. maxima*, stage V, male, fifth pair of feet.

Pacific records: Esterly, 1905; Scott, 1909; Farran, 1929; Mori, 1937; Wilson, 1942; Brodsky, 1950; Wilson, 1950; Tanaka, 1953; Chiba, Tsuruta, and Maéda, 1955; Nagaya et al., 1955; Chiba, 1956; Tanaka, 1957b; Yamazi, 1958a.

Vessel:	Station	Occurrence
Hugh M. Smith	132	1 male, 3.20 mm.
Do	144	1 female, 3.70 mm.
Do	153	2 females, 3.61, 3.70 mm.; 3 males, 3.33 mm.
Do	178	1 female, 3.80 mm.
Do	63	1 male, 3.33 mm.

Remarks: Fleminger (1956) is no doubt correct in placing Sars' (1905) *brevis* (described from female) in synonymy with Giesbrecht's (1888) *amoena* (described from male). This synonymy is further substantiated by Mori's (1937) description of the female of *amoena*. Although Mori did not describe the fourth pair of feet, the total length, abdomen-cephalothorax ratio, length of the first antennae, length of the endopod of the second antennae and the number of setae on the distal segment of the endopod of the second antennae clearly establish that Mori's *E. amoena* and Sars' *E. brevis* are unispecific.

As Fleminger has stated, Wilson's synonymy of *E. amoena* under *E. bella* is an error. The male of *E. bella* was described by Sewell (1947) and Vervoort (1949); neither author was cited by Wilson. It should be noted, however, that Dr. Wilson's paper was published nine years after his death.

Euchirella curticauda Giesbrecht, 1888

(PLATE 10, FIGS. 11–14)

Pacific records: Esterly, 1906; Scott, 1909; Johnson, 1942; Mori, 1942; Wilson, 1942; Davis, 1949; Brodsky, 1950; Wilson, 1950; Anraku, 1952; Tanaka, 1953; 1957b.

Vessel:	Station	Occurrence
Orsom	10	2 females, 3.52, 3.62 mm.

Remarks: This species is recognized by the presence of a crest, absence of a rostrum (fig. 12) and the presence of a comb of spines on the first basipodal segment of the fourth pair of feet (fig. 14).

Euchirella maxima Wolfenden, 1905

(PLATE 10, FIG. 15)

Pacific records: Scott, 1909; Wilson, 1950.

Vessel:	Station	Occurrence
Hugh M. Smith	29	1 female (stage V), 5.79 mm.; 1 male (stage V), 5.70 mm.

Remarks: A male and female were obtained in the 500 m. collection made at the above station. Both sexes have a crest on the forehead. Sewell (1929) has described the stage V individuals of this species.

Pseudochirella sp.

Vessel:	Station	Occurrence
Hugh M. Smith	29	4 juveniles, 6.93–7.14 mm.

Remarks: These large juvenile copepods could not be assigned to a species. They were obtained from the 500–meter plankton tow.

Chirundina streetsi Giesbrecht, 1895

(PLATE 11, FIGS. 1–4)

Pacific records: Esterly, 1906; Scott, 1909; Farran, 1929; Johnson, 1942; Brodsky, 1950; Wilson, 1950; Tanaka, 1953; 1957b.

Vessel:	Station	Occurrence
Horizon	32	1 female, 4.94 mm.

Remarks: This species is distinguished from the following one by its large size, pronounced crest on forehead (fig. 1), and the presence of 2 spines on the first exopodal segment of the first feet (fig. 4).

Chirundina indica Sewell, 1929

(PLATE 11, FIGS. 5–20)

Pacific records: None.

Vessel:	Station	Occurrence
Hugh M. Smith	63	1 female, 4.66 mm.

Remarks: I have compared in some detail (figs. 5–20) the present species with the descriptions of *C. indica* provided by Sewell (1929, 1947). On the basis of his description the latter species is distinguished from *C.*

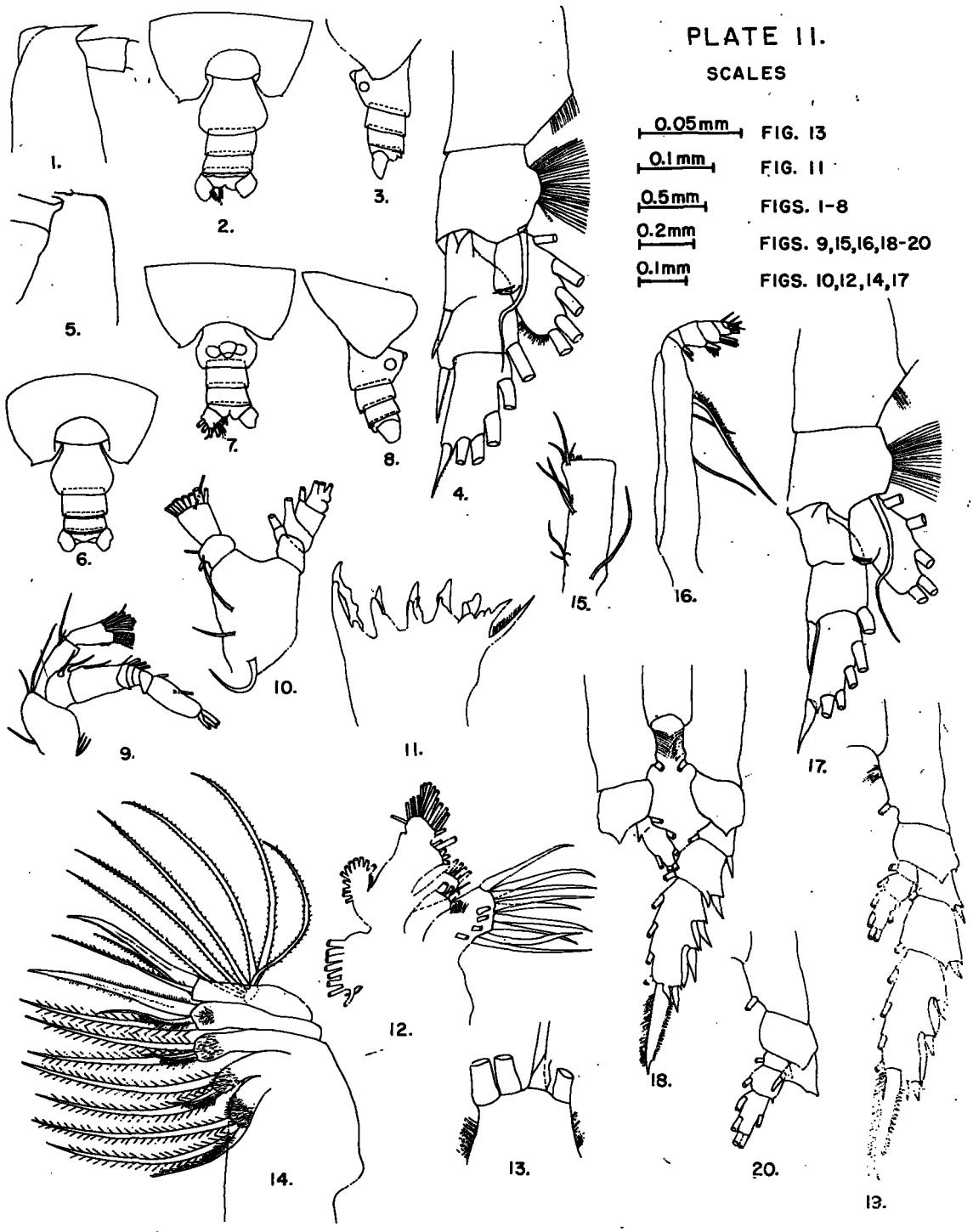

PLATE 11.—(1) *Chirundina streetsi*, female, forehead, lateral view; (2) posterior part of thorax and abdomen, dorsal view; (3) abdomen, lateral view; (4) first foot; (5) *C. indica*, forehead, lateral view; (6) posterior part of thorax and abdomen, dorsal view; (7) posterior part of thorax and abdomen, ventral view; (8) posterior part of thorax and abdomen, lateral view; (9) second antenna; (10) mandible palpus; (11) gnathal lobe of mandible; (12) first maxilla; (13) terminal part of third inner lobe of first maxilla; (14) second maxilla; (15) first basipodal segment of maxilliped; (16) distal part of maxilliped; (17) first foot; (18) second pair of feet (one exopod and one endopod missing); (19) third foot; (20) fourth foot (distal part of exopod missing).

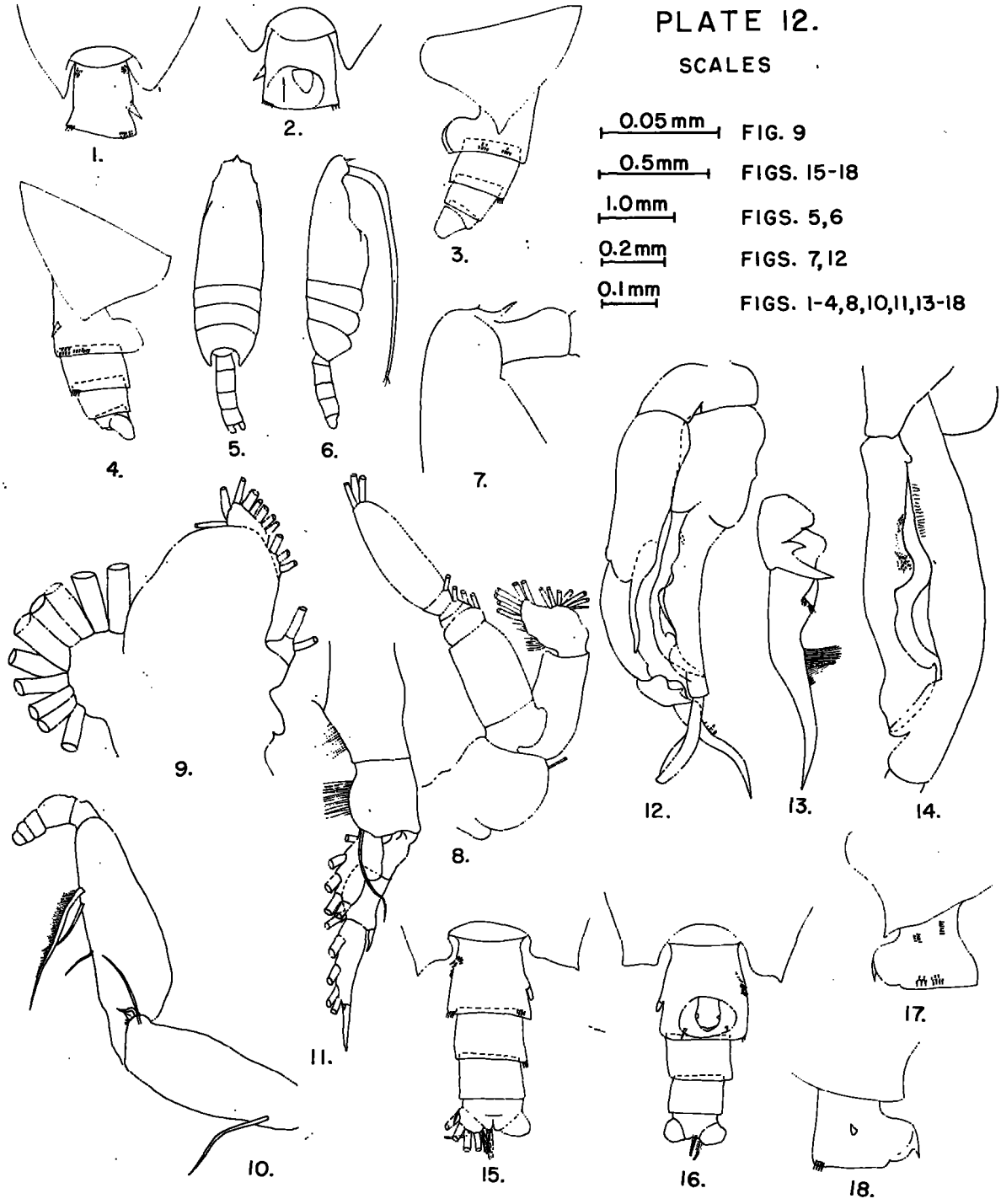

PLATE 12.—(1) *Undeuchaeta plumosa*, female, genital segment, dorsal view; (2) ventral view; (3) posterior part of thorax and abdomen, left side; (4) posterior part of thorax and abdomen, right side; (5) male, dorsal view; (6) lateral view; (7) forehead, lateral view; (8) second antenna; (9) first maxilla (part); (10) maxilliped (setae on distal part omitted); (11) first foot; (12) fifth pair of feet; (13) terminal part of left fifth foot; (14) right fifth foot (part); (15) *U. intermedia*, female, dorsal view; (16) abdomen, ventral view; (17) genital segment, left side; (18) genital segment, right side.

streetsi by its low crest, the smoothly rounded posterior thoracic margins and the presence of but 1 external spine on the first exopodal segment of the first feet. Except for the posterior thoracic margins, which have 1 small projection (figs. 7–9), my specimen agrees with Sewell's *indica*. In details of the mouth parts, two minor differences were noted. Sewell's specimens have 6 setae on the outer lobe of the second antenna, while the present specimen has 7 (fig. 10); the exopod of the mandible has 9 setae (Sewell probably referred to the distal segment); the present specimen has 10, one of which is extremely small (fig. 11).

The projections on the posterior thoracic margins may be a variable character as Vervoort (1957) has observed in several species of a related genus, *Undeuchaeta*. It seems best therefore to refer the present species to *C. indica*.

Undeuchaeta plumosa (Lubbock, 1856)

(PLATE 12, FIGS. 1–14)

Pacific records: Vervoort, 1957. Also, Brodsky, 1950; Heinrich, 1957b; Tanaka, 1957b.

Vessel:	Station	Occurrence
Hugh M. Smith	63	1 male, 3.52 mm.
Horizon	32	1 female, 3.47 mm.
Satsuma	32	1 female, 3.41 mm.

Remarks: The female is distinguished by the presence of a spine on the right side of the genital segment (figs. 1, 2) near the dorsal surface, and the male by the structure of the fifth feet (figs. 12–14).

Undeuchaeta intermedia A. Scott, 1909

(PLATE 12, FIGS. 15–18)

Pacific records: Vervoort, 1957. Also, Johnson, 1942; Brodsky, 1950 (as *U. bispinosa*)

Vessel:	Station	Occurrence
Hugh M. Smith	63	4 females, 3.99–4.28 mm.
Horizon	32	3 females, 3.99–4.08 mm.

Remarks: The large ventral spine-like protrusion of the genital segment in the female (figs. 17, 18) distinguishes this species from the preceding one.

Family EUCHAETIDAE

Euchaeta marina (Prestandrea, 1833)

(PLATE 13, FIG. 1)

Pacific records: Scott, 1909; Marukawa, 1921; Yamada, 1933b; Mori, 1937; Dakin and Colefax, 1940; Mori, 1942; Wilson, 1942; Brodsky, 1950; Motoda, Iizuka, and Anraku, 1950; Wilson, 1950; Anraku, 1952; Honjo, 1952; Nakai, 1952; Anraku, 1953; Chiba, 1953b; Tanaka, 1953; Anraku, 1954b; Tsuruta and Chiba, 1954b; Chiba, Tsuruta, and Maéda, 1955; Motoda and Anraku, 1955; Nagaya et al., 1955; Rose, 1955; Chiba, 1956; Heinrich, 1957b; Honjo et al., 1957; Gilmartin, 1958; Heinrich, 1958a; Tanaka, 1958; Yamazi, 1958a; Lindberg, 1959.

Vessel:	Station	Occurrence
Hugh M. Smith	132	1 male, 3.12 mm.
Do	144	1 female, 3.61 mm.
Do	153	2 females, 3.32, 3.42 mm.
Do	178	1 female, 3.06 mm.
Do	30	3 females, 2.96–3.06 mm.;1 male, 2.99 mm.
Do	31	present.
Do	63	4 females, 3.40–3.60 mm.; 1 male, 3.37 mm.
Stranger	34	4 females, 3.13–3.26 mm.; 5 males, 3.06–3.23 mm.
Orsom	10	3 females, 3.13–3.23 mm.
Horizon	32	2 females, 3.13, 3.23 mm.

Remarks: This is probably the most widespread species in the genus. It occurred in ten of the present samples and in two (*Smith* 153 and 30), it comprised a fairly significant percentage of the total number of copepods.

Euchaeta wolfendeni A. Scott, 1909

(PLATE 13, FIGS. 2–9)

Pacific records: Farran, 1936; Mori, 1937; Wilson, 1950; Honjo, 1952; Tanaka, 1953; Tsuruta and Chiba, 1954b; Chiba, Tsuruta, and Maéda, 1955; Nagaya et

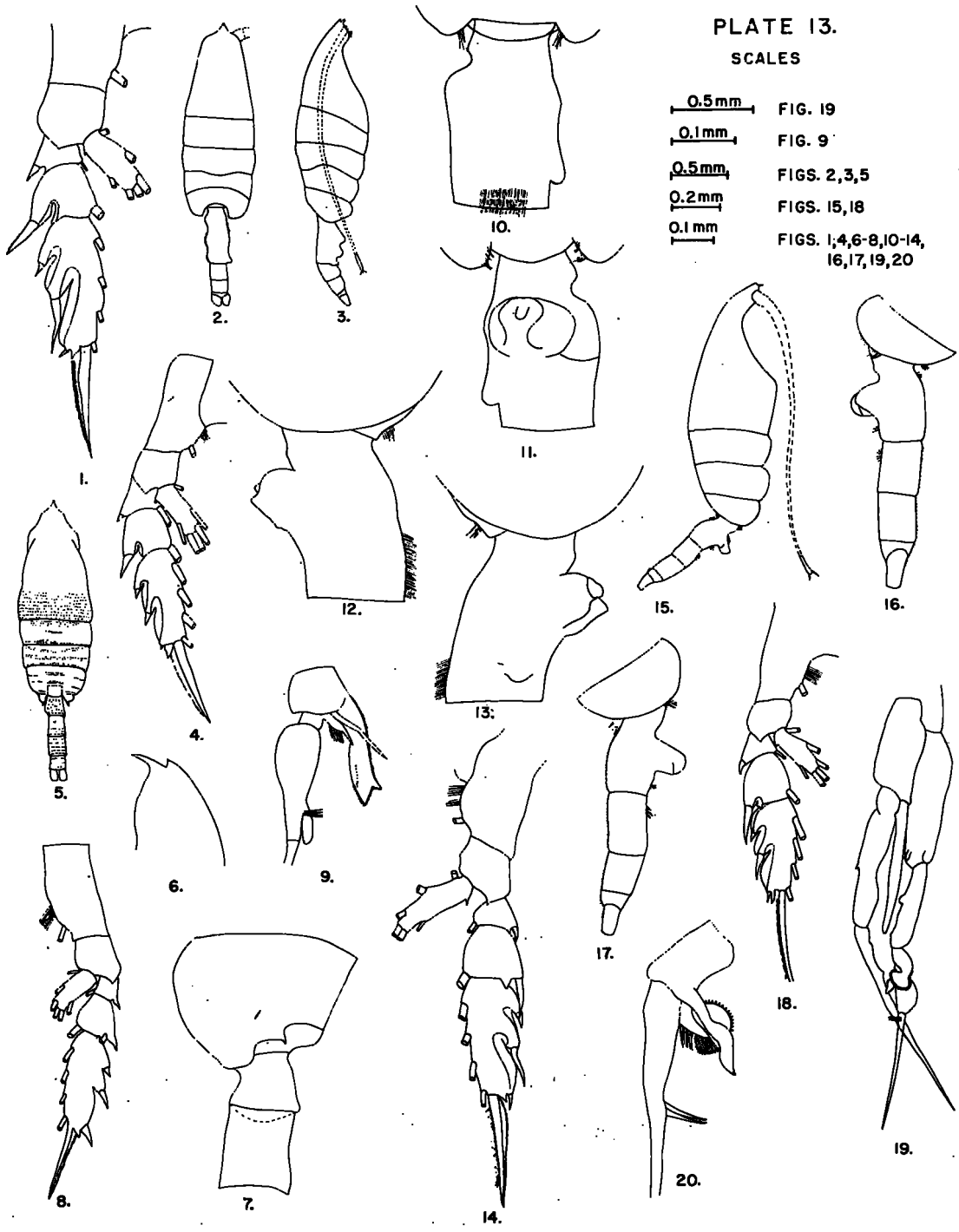

PLATE 13.—(1) *Euchaeta marina*, female, second foot; (2) *E. wolfendeni*, female, dorsal view; (3) lateral view; (4) second foot; (5) male, dorsal view; (6) forehead, lateral view; (7) posterior part of thorax and first two abdominal segments, lateral view; (8) second foot; (9) terminal part of left fifth foot; (10) *E. media*, female, genital segment, dorsal view; (11) genital segment, ventral view; (12) genital segment, left side; (13) genital segment, right side; (14) second foot; (15) *E. tenuis*, female, lateral view; (16) posterior part of thorax and abdomen, left side; (17) posterior part of thorax and abdomen, right side; (18) second foot; (19) male, fifth pair of feet; (20) terminal part of left fifth foot.

al., 1955; Chiba, 1956; Honjo et al., 1957; Tanaka, 1958; Yamazi, 1958a.

Vessel:	Station	Occurrence
Hugh M. Smith	132	1 female, 2.50 mm.
Do	63	1 female, 2.52 mm.
Stranger	34	3 females, 2.24–2.38 mm.; 2 males, 2.21, 2.35 mm.
Horizon	32	1 female, 2.55 mm.; 3 males, 2.31–2.44 mm.
Satsuma	32	2 females, 2.38, 2.40 mm.; 1 male, 2.31 mm.

Remarks: The female is distinguished by the long genital segment, the right posterior margin of which is produced into a rounded knob (fig. 2). The relative lengths of the outer-edge spines on the second and third exopodal segments of the second feet (fig. 4) are also diagnostic (cf. *E. marina*, plate 13, fig. 1). The male is identified by the structure of the terminal part of the left fifth foot (fig. 9).

Euchaeta media Giesbrecht, 1888

(PLATE 13, FIGS. 10–14)

Pacific records: Vervoort, 1957. Also, Johnson, 1942; Brodsky, 1950; Tsuruta and Chiba, 1954b; Chiba, Tsuruta, and Maéda, 1955; Nagaya et al., 1955; Heinrich, 1957b; Honjo et al., 1957; Tanaka, 1958.

Vessel:	Station	Occurrence
Hugh M. Smith	63	1 female, 3.52 mm.

Remarks: The female of *E. media* is recognized by the characteristic swelling on the left side and the knob-like protrusion on the right side of the genital segment (figs. 10, 11). The middle spine on the outer edge of the third exopodal segment of the second pair of feet is elongate and the spine on the second exopodal segment reaches beyond the base of the proximal spine on the third segment (fig. 14).

Euchaeta tenuis Esterly, 1906

(PLATE 13, FIGS. 15–20)

Pacific records: Esterly, 1906; Scott, 1909; Brodsky, 1950. As *E. solida*, Esterly, 1911.

Vessel:	Station	Occurrence
Hugh M. Smith	29	4 females, 5.60–5.98 mm.; 3 males, 5.03–5.22 mm.
Do	63	1 female, 5.13 mm.; 1 male, 4.75 mm.
Do	32	present.

Remarks: The large and asymmetrical ventral protrusions (figs. 16, 17) of the female genital segment will identify this species. The outer-edge spines of the second pair of feet (fig. 18) are also diagnostic. In the male the structure of the second segment of the left fifth foot (figs. 19, 20) is characteristic. It is dilated and coarsely serrate.

Euchaeta concinna Dana, 1849

(PLATE 14, FIGS. 1–13)

Synonymy:

Euchaeta consimilis Farran, 1936, Great Barrier Reef Exped. 1928–29. Sci. Rept. 5(3): 90.

Pacific records: Scott, 1909; Farran, 1936; Mori, 1937; Dakin and Colefax, 1940; Wilson, 1950; Tanaka, 1953; Rose, 1955; Honjo et al., 1957; Heinrich, 1958b; Tanaka, 1958. As *E. consimilis;* Farran, 1936; Rose, 1955.

Vessel:	Station	Occurrence
Satsuma	32	3 females, 2.52–2.55 mm.; 1 male, 2.24 mm.

Remarks: Farran (1936) described *E. consimilis* from 4 female specimens collected near the Great Barrier Reef. He also found *E. concinna* in his collections, but this species was observed only inside the reef where it was one of the most characteristic of the copepods. According to Farran, *consimilis* differs, morphologically, from *concinna* in the form of the protrusion on the right side of the genital segment in the female (see Farran's fig. 6) and in size. As Farran pointed out, Sewell (1929) observed "a considerable degree of variation" in the form of the genital protrusion in *concinna* collected in the Indian Ocean. The latter author suggested that this variation may be correlated with egg laying which causes the protrusion to increase in size.

The size of specimens, as recorded in the literature is also variable.

Source:	Female	Male
Mori, 1937 (Japan)	3.0 mm.	
Tanaka, 1958 (Japan)	2.87–3.25 mm.	

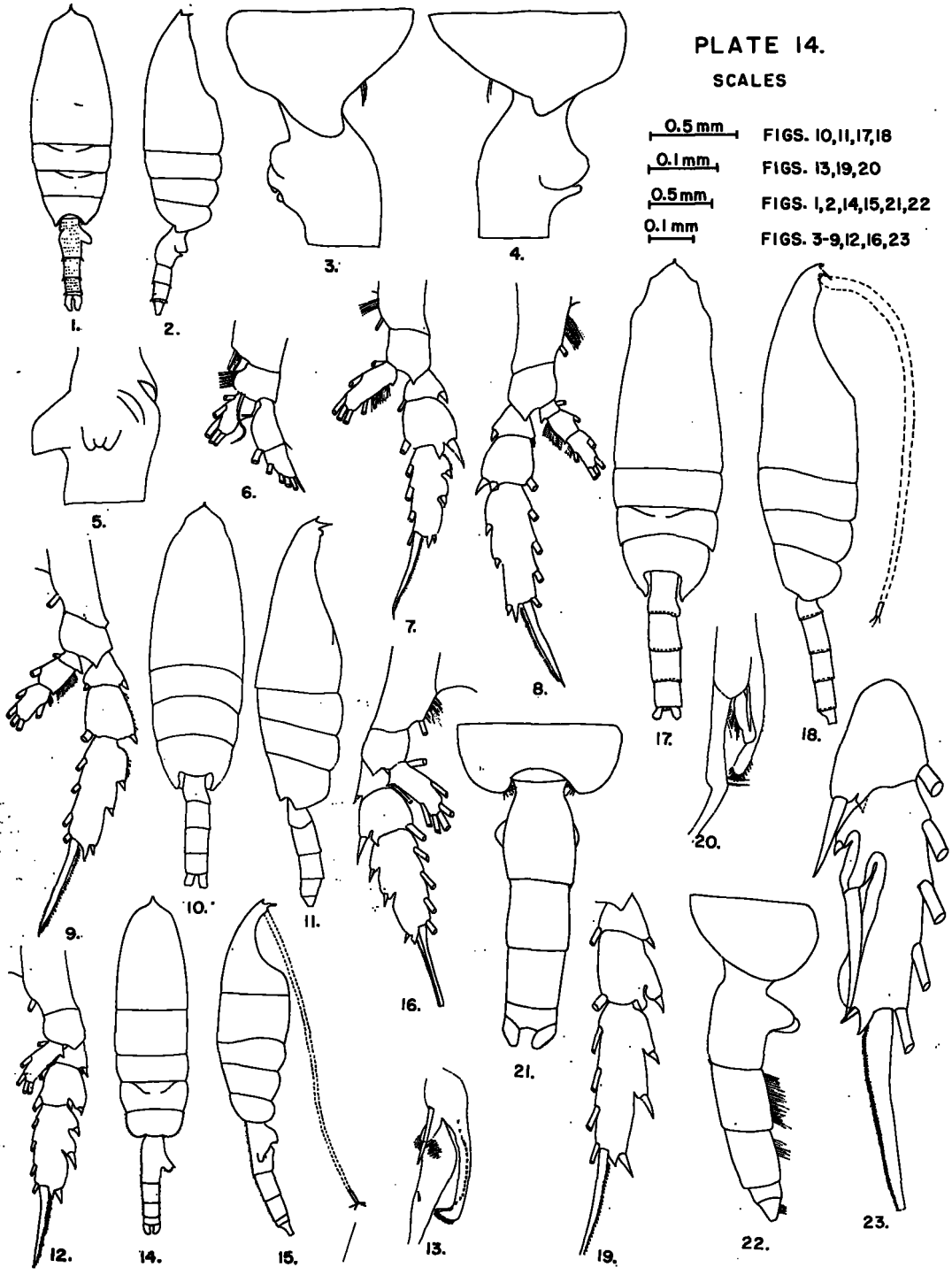

PLATE 14.—(1) *Euchaeta concinna*, female, dorsal view; (2) lateral view; (3) posterior part of thorax and genital segment, left side; (4) posterior part of thorax and genital segment, right side; (5) genital segment, ventral side; (6) first foot; (7) second foot; (8) third foot; (9) fourth foot; (10) male, dorsal view; (11) lateral view; (12) second foot; (13) terminal part of left fifth foot; (14) *E. longicornis*, female, dorsal view; (15) lateral view; (16) second foot; (17) male, dorsal view; (18) lateral view; (19) exopod of second foot; (20) terminal part of left fifth foot; (21) *E. spinosa*, female, posterior part of thorax and abdomen, dorsal view; (22) lateral view; (23) second and third segments of exopod of second foot.

Vessel:	*Station*	*Occurrence*
Giesbrecht and Schmeil, 1898 (tropical Pacific)	3.3 mm.	2.75 mm.
Heinrich, 1958b (tropical Pacific)	2.5 mm.	----------
Farran, 1936 (inside Barrier Reef)	3.25–3.40 mm.	2.54–2.76 mm.
Farran, 1936 (outside Barrier Reef)	2.36–2.67 mm.	----------
Dakin and Colefax, 1940 (Australia)	3.75 mm.	2.6 mm.
Sewell, 1929 (Indian Ocean)	2.5–3.5 mm.	2.4–3.0 mm.
Wolfenden, 1905 (Indian Ocean)	2.75–3.0 mm.	----------

In view of the wide size range in both sexes and the variable nature of the genital segment in the female, it seems best to consider *E. consimilis* as a synonym of *E. concinna.*

Euchaeta longicornis Giesbrecht, 1888

(PLATE 14, FIGS. 14–20)

Pacific records: Scott, 1909; Farran, 1929; 1936; Mori, 1937; Wilson, 1950; Honjo, 1952; Nakai, 1952; Tanaka, 1953; Anraku, 1954b; Chiba, Tsuruta, and Maéda, 1955; Nagaya et al., 1955; Honjo et al., 1957; Tanaka, 1958.

Vessel:	*Station*	*Occurrence*
Hugh M. Smith	94	3 females, 2.88 mm.
Do	132	8 females, 2.65–2.92 mm.; 1 male, 2.65 mm.

Remarks: The female genital segment has a large protrusion on the right side from which arises a smaller spine-like process.

Wilson (1950) described the male sex of this species. I have compared my single male specimen (except the body, which was destroyed in dissection) to one identified by G. O. Sars and loaned to me by the U.S. National Museum. The two are unispecific. In the Museum specimen a small spine is present on the superior-lateral margins of the fifth thoracic segment as is also found on the male of *E. wolfendeni* (see plate 13, fig. 7). I probably overlooked these spines in my specimen and therefore they are not shown in the figure given of the male (fig. 18).

Euchaeta spinosa Giesbrecht, 1892

(PLATE 14, FIGS. 21–23)

Pacific records: Esterly, 1905; Johnson, 1942; Brodsky, 1950; Wilson, 1950; Tanaka, 1953; 1958. As male of *Undeuchaeta major;* Esterly, 1905.

Vessel:	*Station*	*Occurrence*
Hugh M. Smith	29	1 female, 6.94 mm.

Remarks: The ventral projections of the genital segment (fig. 22) are visible in dorsal view. The middle spine on the outer margin of the third exopodal segment of the second feet is greatly elongate, and the spine on the second exopodal segment surpasses the tip of the first spine on the third segment (fig. 23).

Family PHAENNIDAE

Phaenna spinifera Claus, 1863

(PLATE 15, FIG. 1)

Pacific records: Scott, 1909; Farran, 1929; Mori, 1937; Wilson, 1942; 1950; Tanaka, 1953; Anraku, 1954b; 1954c; Tsuruta and Chiba, 1954b; Chiba, Tsuruta, and Maéda, 1955; Motoda and Anraku, 1955; Nagaya et al., 1955; Chiba, 1956; Honjo et al., 1957; Yamazi, 1958a. As *Onchocalanus nudipes;* Wilson, 1942.

Vessel:	*Station*	*Occurrence*
Hugh M. Smith	94	present.
Do	132	3 females, 1.87–1.90 mm.
Do	31	1 female, 1.60 mm.
Do	63	present.
Orsom	10	1 female, 1.87 mm.
Horizon	32	present.

Remarks: The globular thorax, small abdomen, and lack of fifth feet (in the female) make this species easily recognized. Vervoort (1950) placed Wilson's *Onchocalanus nudipes* in synonymy with *Phaenna spinifera.*

Xanthocalanus dilatus n. sp.

(PLATE 15, FIGS. 2–11)

Vessel:	*Station*	*Occurrence*
Hugh M. Smith	144	2 females, 1.56, 1.60 mm.

Description: The head and first thoracic segment and fourth and fifth thoracic segments are separate (figs. 2, 3). The posterior lateral margins of the first thoracic segment are dis-

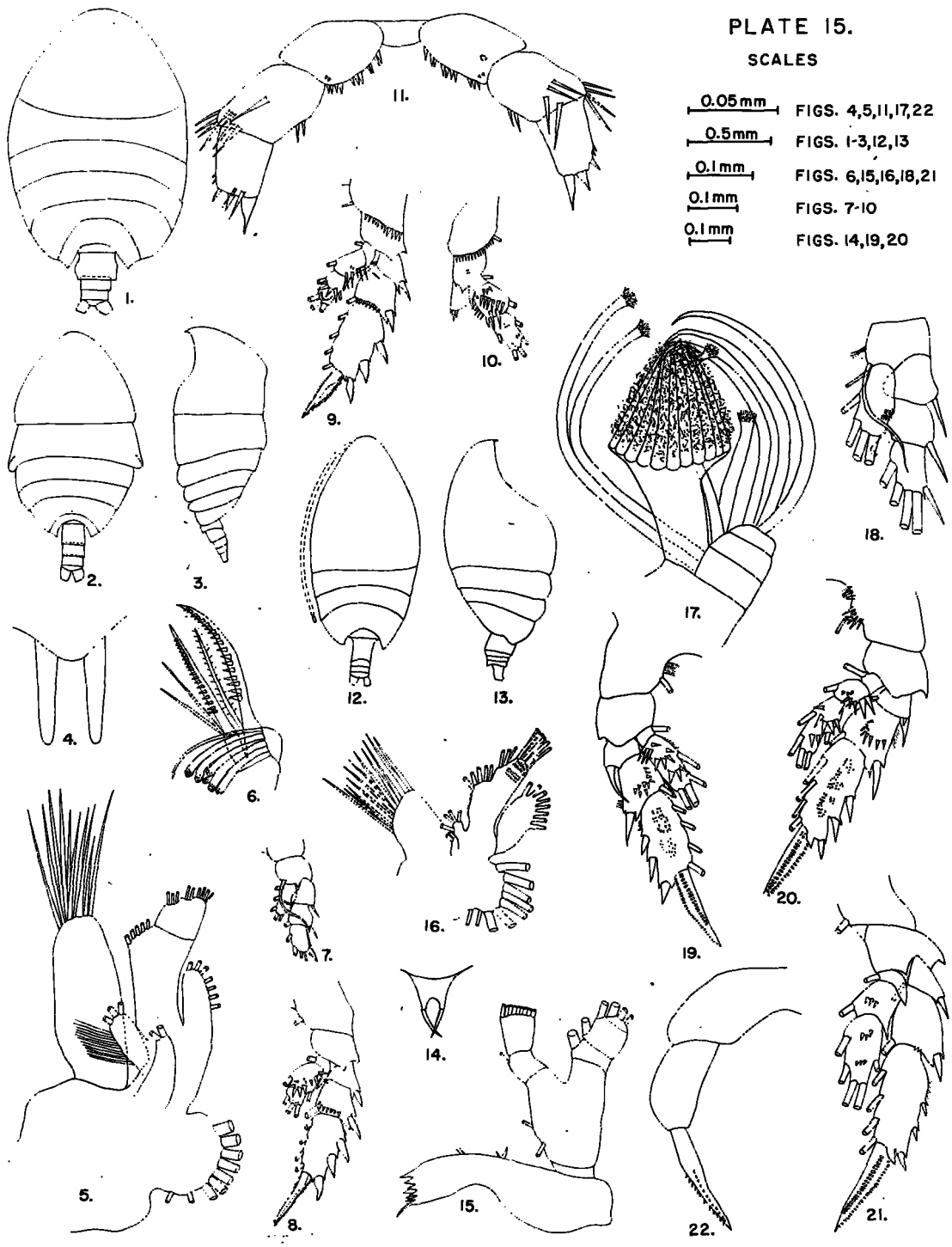

PLATE 15.—(1) *Phaenna spinifera*, female, dorsal view; (2) *Xanthocalanus dilatus* n.sp., female, dorsal view; (3) lateral view; (4) rostrum; (5) first maxilla, (6) terminal part of second maxilla; (7) first foot; (8) second foot; (9) third foot; (10) fourth foot (distal two segments of exopod missing); (11) fifth pair of feet (figs. 2–6 and 11 of holotype, figs. 7–10 of paratype); (12) *Amallophora smithae* n. sp., female, dorsal view; (13) lateral view; (14) rostrum; (15) mandible; (16) first maxilla; (17) terminal part of second maxilla; (18) first foot; (19) second foot; (20) third foot; (21) fourth foot; (22) fifth foot (figs. 12–22 of holotype).

tended and there is a distinct dilation on the dorsal surface of the head. The rostrum is straight and club-like (fig. 4).

The first antennae of both specimens are broken off near the proximal end. Although somewhat mutilated, the second antennae appear to have 1 seta on the first segment of the endopod. The second segment of the endopod has 14 setae on the distal margin (8 on the inner lobe and 6 on the outer lobe). The exopod has a total of 6 setae but some may be missing from the various segments.

The mandible has 3 setae on the basipod, 11 setae on the endopod and 6 on the exopod.

The first maxilla (fig. 5) has the following number of setae: 9 on the external lobe, 7 on the exopod, 9 on the endopod, 5 on the second basal segment, 2 on the second internal lobe and 3 on the third internal lobe.

The terminal part of the second maxilla (fig. 6) has 6 sensory organs and 1 worm-like appendage.

The exopods of the first 4 pairs of feet are 3-segmented (figs. 7–10), although the second and third exopodal segments of the fourth pair are broken off. The endopod of the first foot consists of 1 segment, of the second foot of 2 segments and of the third and fourth feet of 3 segments. The endopodal segments of the second and third feet have numerous spines arising from their posterior surfaces. A row of spines is present at the junction of the first and second basipodal segments, on the posterior side, of the third and fourth feet. The fifth foot (fig. 11) consists of 3 segments, all of which are furnished with either marginal or surface spines.

Remarks: This species differs from other described *Xanthocalanus* in (1) the dilations of the dorsal surface of the head and lateral margins of the first thoracic segment, (2) the spines on the basipodal segments of the third and fourth feet, and (3) the details of the fifth pair of feet. The fifth pair of feet closely resemble those of *X. agilis* Giesbrecht but *agilis* lacks the characteristic dilations of the head and first thoracic segment of the present species. In addition, *X. agilis* is a larger species (2.40 mm.). The presence of spines on the basipodal segments may also be found in other species of *Xanthocalanus*. Figures of these segments are available for only a few species.

The name proposed for this species is derived from the Latin word "dilato" and refers to the characteristic protrusions on the head and first thoracic segment. The holotype (U.S.N.M. No. 104, 420) and 1 paratype (No. 104, 421) have been deposited in the U.S. National Museum.

Amallophora smithae n. sp.

(PLATE 15, FIGS. 12–22)

Vessel:	*Station*	*Occurrence*
Hugh M. Smith	144	1 female, 1.40 mm.

Description: The head and first thoracic segments and the fourth and fifth thoracic segments are fused (fig. 12). In lateral view the posterior margin of the cephalothorax has a small indentation (fig. 13).

The first antennae are short and do not reach the end of the cephalothorax. Each antenna consists of 23 segments.

The endopod of the second antenna is slightly less than three-fourths the length of the exopod. Endopodal segment 1 has 2 setae. Segment 2 has 8 setae on the inner lobe and 7 setae on the outer lobe. The exopod has 8 setae all of which are densely plumose.

The basal segment of the mandibular palpus has 2 setae (fig. 15). There are 9 setae on the distal segment of the endopod and 1 seta on the proximal segment. The exopod has a total of 6 setae.

The first maxilla (fig. 16) has the following number of setae: 11 on the first inner lobe, 2 on the second inner lobe, 4 on the third inner lobe, 5 on the second basal segment, 9 on the endopod, 8 on the exopod and 9 on the external lobe. Two groups of small spines are present on the surface of the endopod.

The terminal part of the second maxilla (fig. 17) has 1 enlarged sensory organ, 4 smaller sensory organs and 3 worm-like appendages.

The first and second basal segments of the maxilliped have 7 and 5 setae, respectively. The 5 endopodal segments have the following number of setae: 4, 4, 3, 3 (plus 1 external seta), and 4.

The first pair of feet have 3-segmented exopods and 1-segmented endopods (fig. 18). The

second pair of feet have exopods composed of 3 segments and endopods of 2 segments while the succeeding 2 pairs of feet each have 3-segmented exopods and endopods (figs. 19–21). The terminal spine of the second, third, and fourth pair of feet is characterized by an outer serrate margin and an inner row of small perforations. The endopods of the second and third feet have large spines arising from their surfaces. Numerous smaller spines are present on the 2 distal exopodal segments of the second and third feet. The fourth feet have a reduced number of spines.

The fifth feet (fig. 22) are small and consist of 2 segments. There is a stout and finely toothed spine arising from the distal segment.

Remarks: This species is closely related to *A. vorax* (Esterly, 1911). It differs from Esterly's species in the segmentation of the cephalothorax, cephalothorax-abdomen ratio, and the structure of the fifth feet. The fourth and fifth thoracic segments are separate in *A. vorax* but fused in *A. smithae*. Davis (1949) also reported that these segments in his specimen of *A. vorax* were fused. The cephalothorax is 6½ times longer than the abdomen in *A. vorax* according to Esterly; in the present species it is approximately 4 times the length of the abdomen. Davis stated that the abdomen of his specimen was longer than that reported by Esterly. In *A. vorax* there are two spines on the distal segment of the fifth feet. In *A. smithae* there is one robust spine.

Vervoort (1957) has discussed the genus *Amallophora* and pointed out differences between it and the genus *Xanthocalanus*. The structures of the maxillae and fifth feet appear to exclude the present species from the genus *Xanthocalanus* although the articulated rostral filaments are unlike those found in *Amallophora*. If Brodsky (1950) is correct in assigning Esterly's species (described as *Scolecithrix vorax*) to the genus *Amallothrix* then perhaps the present species should also be placed in this genus. Until the *Xanthocalanus–Amallothrix–Amallophora* complex is revised, I am referring the present species to the genus *Amallophora*.

The species is named for the research vessel *Hugh M. Smith*. The holotype is deposited in the U.S. National Museum (No. 104, 422).

Family SCOLECITHRICIDAE

Scolecithrix danae (Lubbock, 1856)

Pacific records: Esterly, 1905; Scott, 1909; Farran, 1929; Yamada, 1933; Farran, 1936; Mori, 1937; Dakin and Colefax, 1940; Johnson, 1942; Mori, 1942; Wilson, 1942; 1950; Anraku, 1952; Honjo, 1952; Nakai, 1952; Tanaka, 1953; Anraku, 1954b; Johnson, 1954; Tsuruta and Chiba, 1954b; Chiba, Tsuruta, and Maéda, 1955; Hida and King, 1955; Motoda and Anraku, 1955; Nagaya et al., 1955; Chiba, 1956; Honjo et al., 1957; Heinrich, 1958a; Yamazi, 1958a.

Vessel:	Station	Occurrence
Hugh M. Smith	132	present.
Do	144	present.
Do	153	present.
Do	178	present.
Do	30	present.
Do	31	3 females, 2.04–2.14 mm.
Do	29	3 females, 2.01–2.04 mm.
Do	63	4 females, 2.04–2.14; 3 males, 2.07–2.21 mm.
Stranger	34	2 females, 2.00, 2.04 mm.
Orsom	10	2 females, 2.01, 2.11; 1 male, 1.97 mm.
Horizon	32	3 females, 2.04; 2 males, 2.04, 2.11 mm.
Satsuma	32	2 females, 1.90, 2.00 mm.

Remarks: The posteriorly directed ventral protrusion on the female genital segment and the structure of the fifth feet of the male serve to identify this species. Figures of both these characters are given in Rose, 1933.

Scolecithrix bradyi Giesbrecht, 1888

(PLATE 16, FIGS. 1–5)

Pacific records: Esterly, 1905; Farran, 1929; 1936. As *Scolecithricella bradyi;* Scott, 1909; Mori, 1937; 1942; Wilson, 1942; 1950; Honjo, 1952; Tanaka, 1953; Chiba, Tsuruta, and Maéda, 1955; Motoda and Anraku, 1955; Nagaya et al., 1955; Chiba, 1956; Honjo et al., 1957.

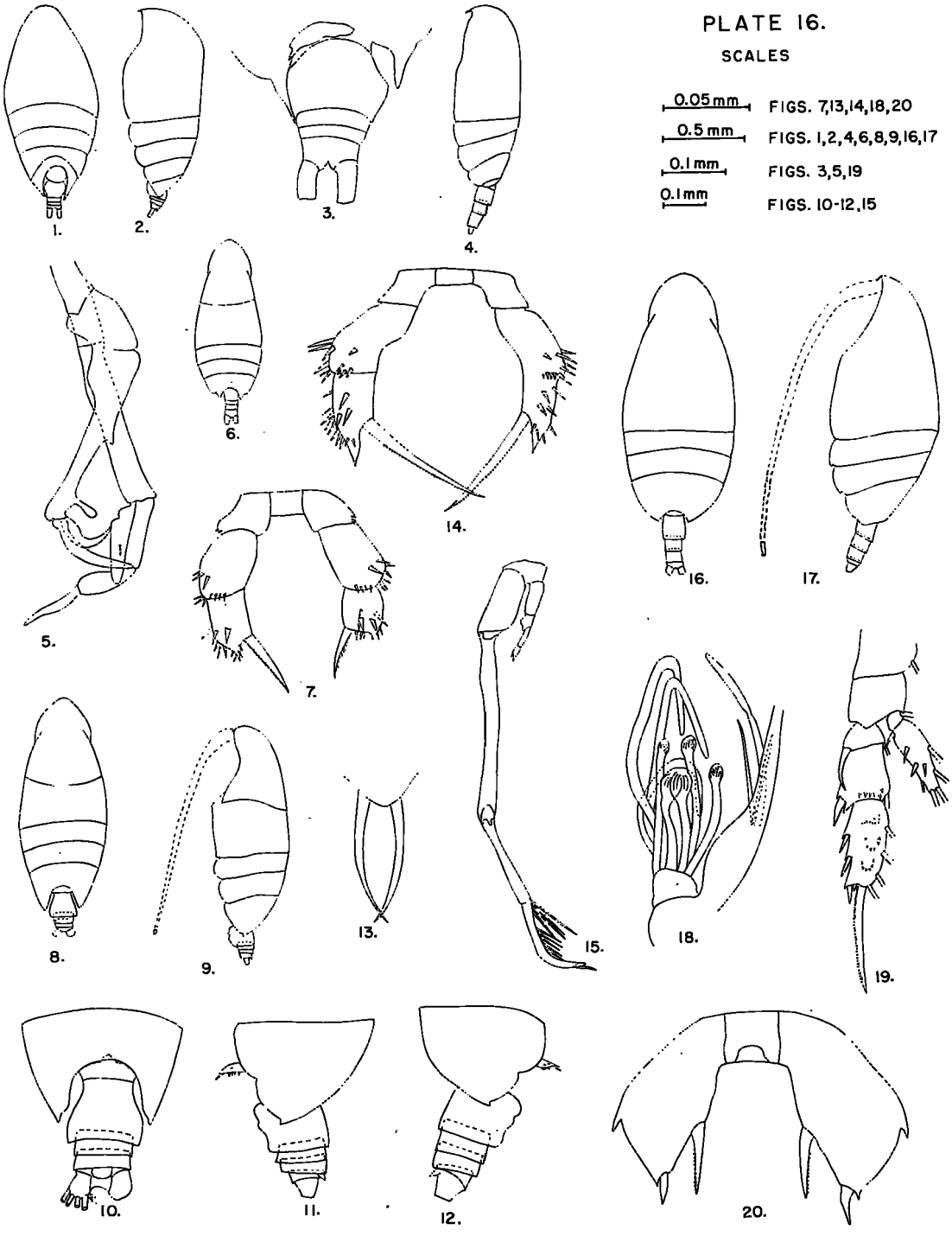

PLATE 16.—(1) *Scolecithrix bradyi*, female, dorsal view; (2) lateral view; (3) posterior part of thorax and abdomen, ventral view; (4) male, lateral view; (5) fifth pair of feet; (6) *Scolecithricella ctenopus*, female, juvenile, dorsal view; (7) fifth pair of feet; (8) adult, dorsal view; (9) lateral view; (10) posterior part of thorax and abdomen, dorsal view; (11) left side; (12) right side; (13) rostrum; (14) fifth pair of feet; (15) male, fifth pair of feet; (16) *S. abyssalis*, female, dorsal view; (17) lateral view; (18) terminal part of second maxilla; (19) second foot; (20) fifth pair of feet.

Vessel:	Station	Occurrence
Hugh M. Smith	94	11 females, 1.36–1.41; 2 males, 1.51, 1.56 mm.
Do	132	4 females, 1.33–1.36 mm.
Do	144	present.
Do	178	present.
Do	31	present.

Remarks: The asymmetrical posterior thoracic margins, the right one of which extends beyond the genital segment (fig. 1), serve to identify the female of this species. The male is recognized by the structure of the fifth feet (fig. 5).

Scolecithricella ctenopus (Giesbrecht, 1888)

(PLATE 16, FIGS. 6–15)

Synonymy:

Scolecithrix ctenopus Giesbrecht, 1888, Atti Acc. Lincei Rend., ser. 4, 4 sem. 2: 338.

Scolecithricella ctenopus Sewell, 1929, Mem. Ind. Mus., 10: 212.

Scolecithrix longicornis T. Scott, 1894, Trans. Linn. Soc., Zool., 6: 50.

Scolecithricella spinipedata Mori, 1937, The pelagic Copepoda from the neighbouring waters of Japan, p. 53.

Pacific records: Scott, 1909; Farran, 1936; Tanaka, 1953.

Vessel:	Station	Occurrence
Hugh M. Smith	94	1 juvenile female, 1.28 mm.
Do	178	2 females, 1.49, 1.53; 1 male, 1.54 mm.
Stranger	34	1 female, 1.46; 1 male, 1.46 mm.
Orsom	10	1 female, 1.48 mm.

Remarks: Farran (1936) found two females which differed in size, segmentation of thorax and structure of fifth feet. He also reviewed the records and descriptions of *S. longicornis* (Scott, 1894) and considered it a synonym of *S. ctenopus*.

The present female specimens also fall into two size groups, the smaller of which is very similar to Farran's small specimen. The head and thorax in this form are separated by a fine line (in Farran's specimen they were fused) and a faint line is also seen to separate the fourth and fifth thoracic segments (fig. 6). Although the fifth feet are fairly well differentiated, the genital segment is undeveloped in this small specimen. In the larger form (figs. 8–14) the head and first thoracic segment are incompletely fused and the fourth and fifth thoracic segments are completely fused. The genital segment is well developed as are the fifth feet.

Although it is slightly larger, Mori's *S. spinipedata*, is, in my opinion, a synonym of *S. ctenopus*.

Scolecithricella abyssalis (Giesbrecht, 1888)

(PLATE 16, FIGS. 16–20)

Pacific records: Scott, 1909; Mori, 1937; Tanaka, 1937; Wilson, 1942; 1950; Anraku, 1952; Tanaka, 1953; Brodsky, 1955; Chiba, Tsuruta, and Maéda, 1955; Nagaya et al., 1955; Chiba, 1956.

Vessel:	Station	Occurrence
Hugh M. Smith	94	6 females, 1.87–1.90 mm.
Do	144	1 female, 1.74 mm.
Do	29	1 female, 2.21 mm.
Do	63	1 female, 1.87 mm.

Remarks: Some variation was noted in the structure of the fifth feet of this species. Several specimens did not have the small spine-like protrusion near the terminal spine as shown in the fifth feet figured here (fig. 20).

Scolecithricella vittata (Giesbrecht, 1892)

(PLATE 17, FIGS. 1–8)

Pacific records: Farran, 1936; Wilson, 1950; Tanaka, 1953.

Vessel:	Station	Occurrence
Hugh M. Smith	94	2 females, 1.66 mm.

Remarks: As in the preceding species, variation was noted in the fifth feet of this species. The terminal seta in one specimen was approximately twice the length of the proximal one (fig. 8) while in the other specimen it was somewhat shorter (fig. 4).

Scolecithricella tenuiserrata (Giesbrecht, 1892)

(PLATE 17, FIGS. 9–21; PLATE 18, FIG. 1)

Pacific records: Farran, 1936; Tanaka, 1953.

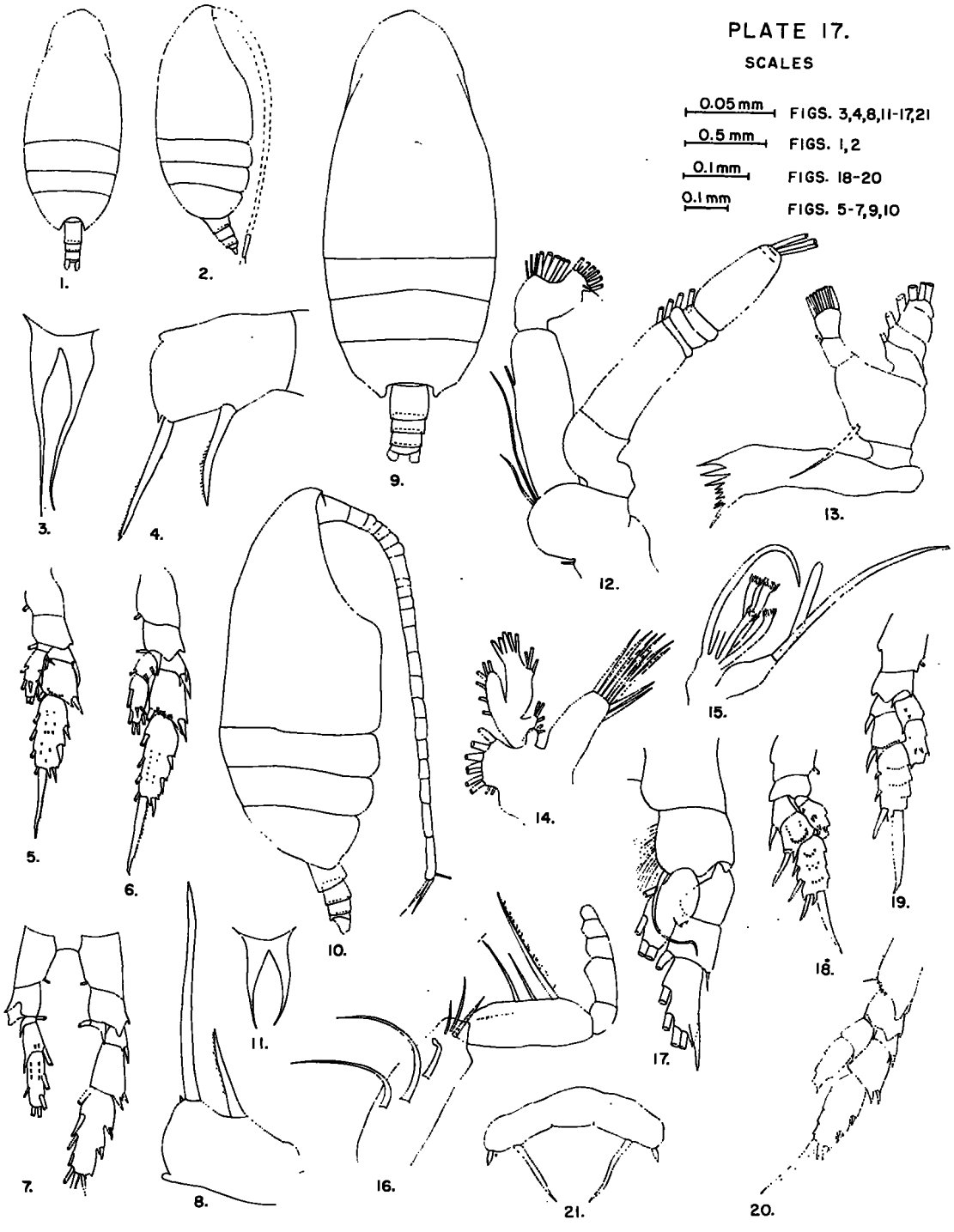

PLATE 17.—(1) *Scolecithricella vittata*, female, dorsal view; (2) lateral view; (3) rostrum; (4) fifth foot; (5) second foot; (6) third foot; (7) fourth pair of feet (one exopod and one endopod missing); (8) fifth foot; (9) *S. tenuiserrata*, female, dorsal view; (10) lateral view; (11) rostrum; (12) second antenna; (13) mandible; (14) first maxilla; (15) terminal part of second maxilla; (16) maxilliped (setae on endopod not shown); (17) first foot; (18) second foot (setae not shown); (19) third foot (setae not shown); (20) fourth foot (setae not shown); (21) fifth pair of feet.

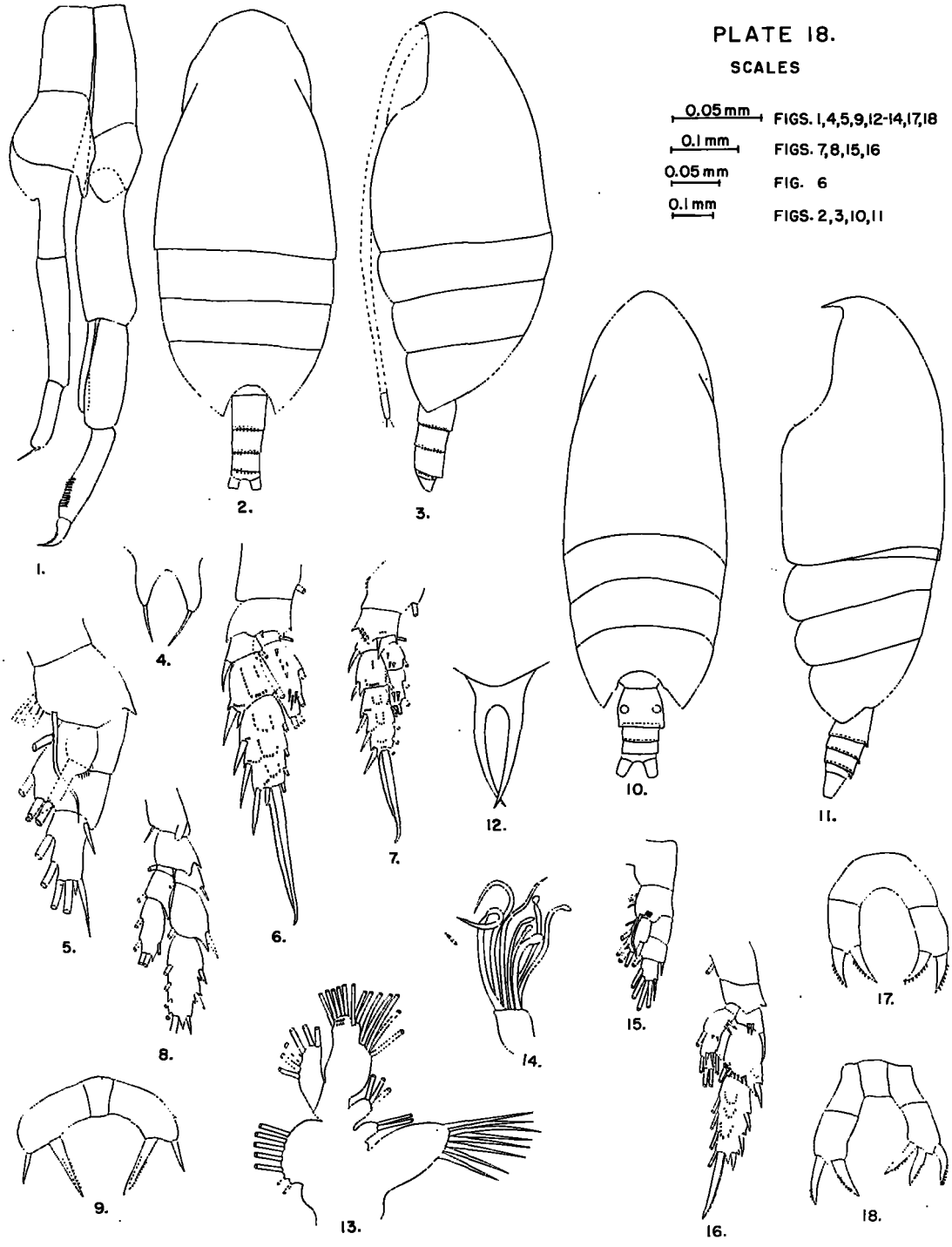

PLATE 18.—(1) *Scolecithricella tenuiserrata*, male, fifth pair of feet; (2) *S. marginata*, female, dorsal view; (3) lateral view; (4) rostrum; (5) first foot; (6) second foot; (7) third foot; (8) fourth foot; (9) fifth pair of feet; (10) *Scolecithricella tropica* n. sp., female, dorsal view; (11) lateral view; (12) rostrum; (13) first maxilla; (14) terminal part of second maxilla; (15) first foot; (16) second foot; (17) fifth pair of feet; (18) fifth pair of feet, abnormal (figs. 10–18 of paratype).

Vessel:	Station	Occurrence
Hugh M. Smith	144	1 female, 1.08 mm.; 1 male, 1.17 mm.
Do	178	4 females, 1.05–1.10 mm.; 4 males, 1.0–1.27 mm.
Do	31	present.
Stranger	34	3 females, 1.02–1.10 mm.

Remarks: Because of the difficulty encountered in identifying this species, I have included several figures of the female and a figure of the fifth feet of a specimen that I consider to be the male of this species. Giesbrecht and Schmeil (1898) stated that the second basal segment of the first maxilla of the female has 5 setae. The present specimens have 3 setae on this segment. Although these authors indicated that the male of this species is questionable, they gave the length as 1.45 mm. as compared to 1.15 mm. for the female. The present males are also larger than the females.

Scolecithricella marginata (Giesbrecht, 1888)

(PLATE 18, FIGS. 2–9)

Pacific records: Scott, 1909; Wilson, 1942.

Vessel:	Station	Occurrence
Hugh M. Smith	144	2 females, 1.05 mm.
Do	178	2 females, 1.00, 1.02 mm.

Remarks: The small size and fifth feet (fig. 9) serve to identify this species.

Scolecithricella tropica n. sp.

(PLATE 18, FIGS. 10–18)

Vessel:	Station	Occurrence
Hugh M. Smith	94	4 females, 1.22–1.30 mm.
Do	132	5 females, 1.15–1.27 mm.
Do	178	2 females, 1.13, 1.14 mm.

Description: Of the 11 specimens of this species examined, none was intact. The following description is based, therefore, on several specimens and even with these a discussion of certain appendages will not be possible.

The cephalothorax is considerably longer than the abdomen, the ratio of these two body parts is approximately 4.4: 1.0 (figs. 10, 11). The posterior thoracic border has a well-defined indentation at a point just anterior to the apex. The genital segment is longer than the combined lengths of the next 2 segments. The rostral filaments are long and apparently not articulated to the base (fig. 12).

The first maxilla (fig. 13) has the following number of setae: 2 on the second inner lobe, 3 on the third inner lobe, 5 on the second basal segment, 8 on the endopod, and 6 on the exopod.

The terminal portion of the second maxilla (fig. 14) has 5 sensory and 3 worm-like appendages.

The first pair of feet (fig. 15) has a 3-segmented exopod and 1-segmented endopod. A group of small spines is present on the second basal segment near the distal margin. The exopod of the second pair of feet consists of 3 segments and the endopod of 2 segments (fig. 16). Two spines are present on the surface of the first exopodal segment, a group of large and small spines on the second segment and three groups of spines on the third exopodal segment. Five large and 2 small spines are present on the second endopodal segment.

As in certain other species of *Scolecithricella*, the fifth feet are variable. Most of the specimens examined have 2, approximately equal, terminal spines (fig. 17) but at least 2 specimens were observed to have 3 on one side and 2 on the other (fig. 18).

This species is distinguished from other species of *Scolecithricella* by the indentation on the posterior thoracic margin and the structure of the fifth feet.

Remarks: An undissected female from Station 94 was selected as the holotype (U.S.N.M. No. 104, 416). This specimen and 6 paratypes (Nos. 104, 417–104, 419) have been deposited in the U.S. National Museum.

Scolecithricella sp.

(PLATE 19, FIGS. 1–5)

Vessel:	Station	Occurrence
Hugh M. Smith	144	2 males, 1.20, 1.22 mm.

Remarks: Two male specimens which are apparently referable to the genus *Scolecithri-*

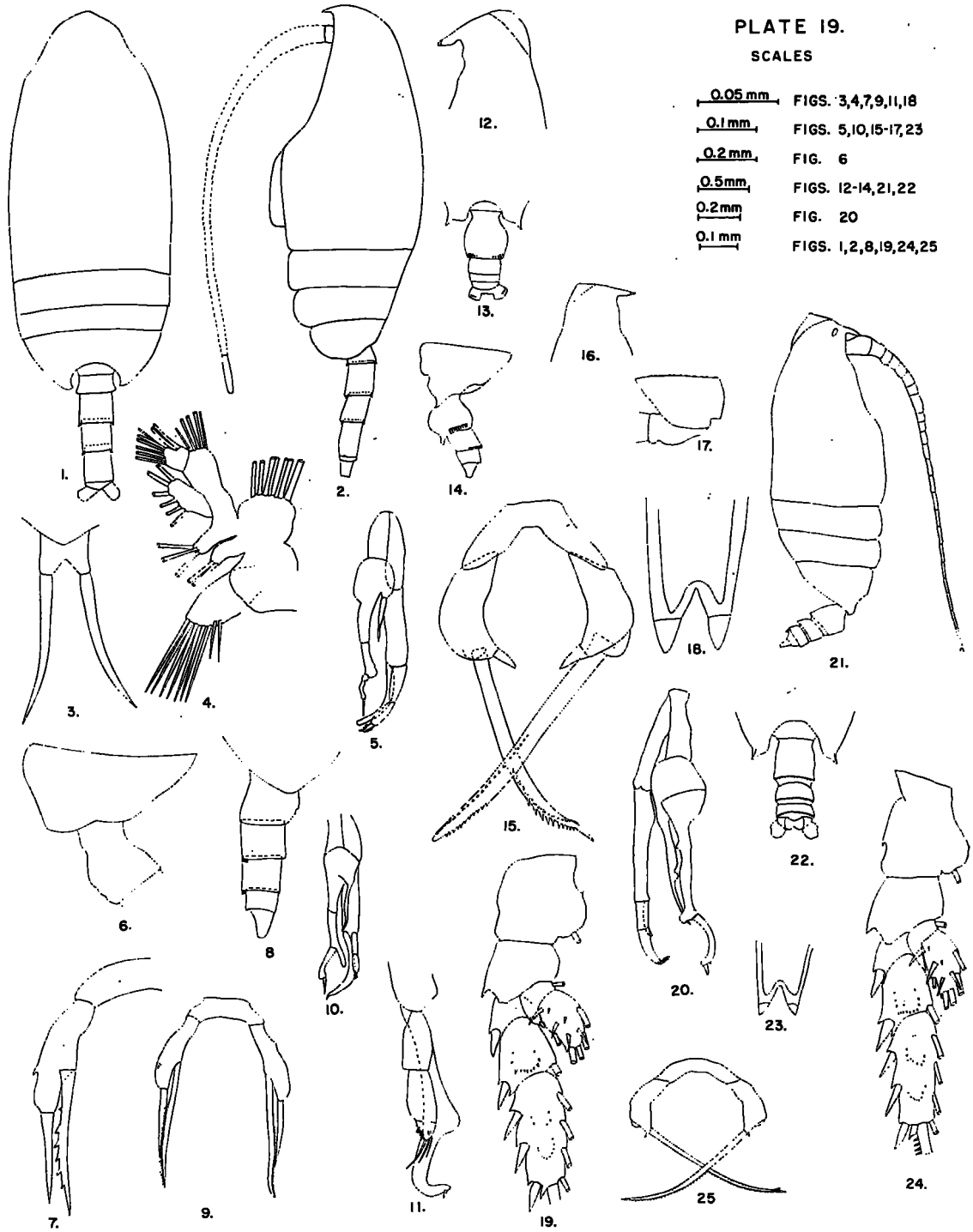

PLATE 19.—(1) *Scolecithricella sp.*, male, dorsal view; (2) lateral view; (3) rostrum; (4) first maxilla; (5) fifth pair of feet; (6) *Scaphocalanus echinatus*, female, posterior part of thorax and genital segment; (7) fifth foot; (8) *S. longifurca*, female, posterior part of thorax and abdomen, lateral view; (9) fifth pair of feet; (10) male, fifth pair of feet; (11) left fifth foot; (12) *Scottocalanus securifrons*, female, forehead, lateral view; (13) abdomen, dorsal view; (14) posterior part of thorax and abdomen, lateral view; (15) fifth pair of feet; (16) *S. farrani*, male, forehead, lateral view; (17) posterior part of thorax and genital segment, lateral view; (18) rostrum; (19) second foot; (20) fifth pair of feet; (21) *S. sedatus*, female, lateral view; (22) abdomen, dorsal view; (23) rostrum; (24) second foot; (25) fifth pair of feet.

cella were found in the above sample. As the males of several described females, including the preceding species, are not known, I hesitate to describe the present species as new.

Scaphocalanus echinatus (Farran, 1905)

(PLATE 19, FIGS. 6, 7)

Pacific records: Farran, 1929, 1936; Mori, 1937; Wilson, 1950; Honjo, 1952; Tanaka, 1953; Tsuruta and Chiba, 1954a; Chiba, 1956; Honjo et al., 1957.

Vessel:	Station	Occurrence
Hugh M. Smith	63	1 female, 2.00 mm.

Remarks: *S. echinatus* resembles *S. longifurca* but the inner edge setae on the fifth feet of the former species are coarsely toothed (fig. 7).

Scaphocalanus longifurca (Giesbrecht, 1888)

(PLATE 19, FIGS. 8–11)

Pacific records: Tanaka, 1953. As *Scolecithricella longifurca*, Scott, 1909. As ?*Scaphocalanus gracilicauda*, Tanaka, 1937.

Vessel:	Station	Occurrence
Hugh M. Smith	94	1 male, 1.53 mm.
Do	29	2 females, 1.87, 1.94 mm.
Do	63	1 female, 1.94 mm.

Remarks: The similarity of this species to *S. subbrevicornis* has been pointed out by Farran (1929) and Vervoort (1951). The latter author has indicated that Tanaka's *S. gracilicauda* (male) is identical to a male doubtfully referred by Rose (1942) to *S. dentata*. Vervoort (1951) suggests that these two males may be the male of *S. longifurca*. I, too, have found a male specimen which I am tentatively referring to *S. longifurca* rather than to *S. subbrevicornis*, as figured by Vervoort, because of the small size of the present specimen (1.53). Vervoort's specimens measured 2.19 mm. and Tanaka's single specimen was 1.75 mm. The former author has also suggested (1957) that Wilson's (1950) records of *S. subbrevicornis* are probably referable to *S. longifurca*.

Scottocalanus securifrons (T. Scott, 1894)

(PLATE 19, FIGS. 12–15)

Pacific records: Scott, 1909; Farran, 1929; Tanaka, 1937; Brodsky, 1950; Wilson, 1950; Tanaka, 1953; Hida and King, 1955; Heinrich, 1958b.

Vessel:	Station	Occurrence
Horizon	32	1 female, 4.08 mm.

Remarks: The ventral surface of the genital segment is produced posteriorly and partly overlaps the following segment (fig. 14). The spine on the left fifth foot is thicker than that on the right (fig. 15). These two characters will identify the female of this species. No male has been found in the present samples.

Scottocalanus farrani A. Scott, 1909

(PLATE 19, FIGS. 16–20)

Pacific records: Scott, 1909; Wilson, 1950.

Vessel:	Station	Occurrence
Hugh M. Smith	29	1 male, 3.50 mm.

Remarks: The structure of the fifth pair of feet particularly the relative lengths of the exo- and endopods and the presence of a tooth-like process on the second basal segment of the right foot will identify the male of this species. No females were found.

Scottocalanus sedatus Farran, 1936

(PLATE 19, FIGS. 21–25)

Pacific records: Farran, 1936.

Vessel:	Station	Occurrence
Hugh M. Smith	29	1 female, 3.40 mm.
Orsom	10	1 female, 3.30 mm.

Remarks: This species is distinguished by the long setae and small, outwardly directed spines on the terminal segments of the fifth pair of feet (fig. 25).

Family TEMORIDAE

Temoropia mayumbaensis T. Scott, 1894

(PLATE 20, FIGS. 1–12)

Pacific records: Scott, 1909; Farran, 1929; 1936; Wilson, 1942; Heinrich, 1957b.

Vessel:	Station	Occurrence
Hugh M. Smith	94	6 females, 0.94–0.99; 3 males, 0.88–0.92 mm.
Orsom	10	2 females, 0.98 mm.

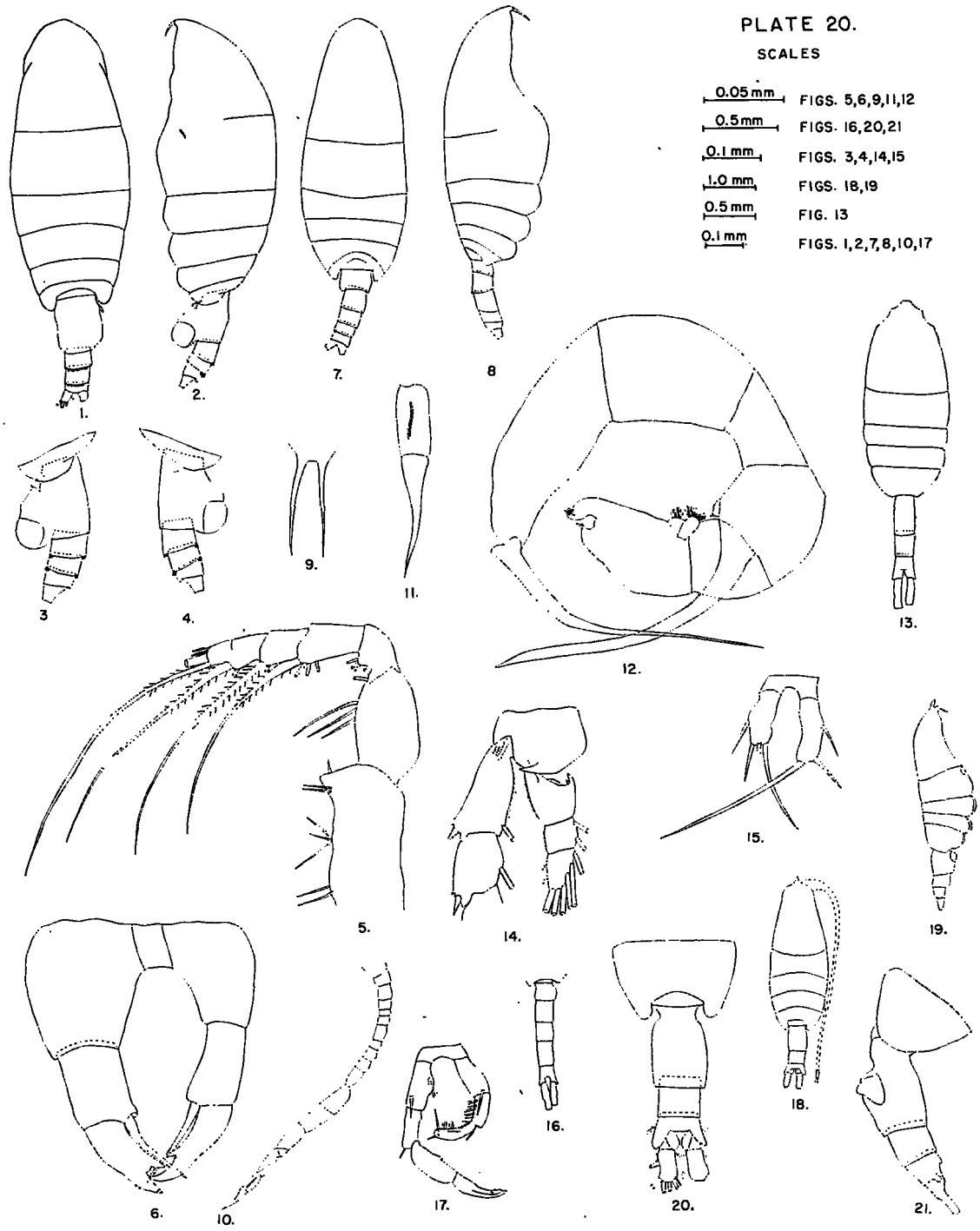

PLATE 20.—(1) *Temoropia mayumbaensis*, female, dorsal view; (2) lateral view; (3) posterior part of thorax and abdomen, left side; (4) posterior part of thorax and abdomen, right side; (5) maxilliped; (6) fifth pair of feet; (7) male, dorsal view; (8) lateral view; (9) rostrum; (10) first antenna; (11) distal two segments of first antenna; (12) fifth pair of feet; (13) *Metridia venusta*, female, dorsal view; (14) second foot (third exopodal segment omitted); (15) fifth pair of feet; (16) male, abdomen, dorsal view; (17) fifth pair of feet; (18) *Pleuromamma xiphias*, female, dorsal view; (19) lateral view; (20) posterior part of thorax and abdomen, dorsal view; (21) posterior part of thorax and abdomen, lateral view.

Remarks: The small size and large ventral protrusion on the genital segment (figs. 3, 4) will identify the female. The geniculate right antenna and the pointed terminal segment of this antenna (figs. 10, 11) will aid in recognizing the male sex.

Family METRIDIIDAE

Metridia venusta Giesbrecht, 1889

(PLATE 20, FIGS. 13–17)

Pacific records: Vervoort, 1957.

Vessel:	Station	Occurrence
Hugh M. Smith	144	1 juvenile female, 2.88 mm.; 1 male, 2.82 mm.

Remarks: This species is recognized by the asymmetrical furca. In both sexes the left furca is longer than the right one (figs. 13, 16).

Pleuromamma xiphias (Giesbrecht, 1888)

(PLATE 20, FIGS. 18–21, PLATE 21, FIGS. 1–5)

Pacific records: Vervoort, 1957. Also, Johnson, 1942; Mori, 1942; Brodsky, 1950; Anraku, 1952; Honjo, 1952; Anraku, 1954b; Tsuruta and Chiba, 1954a; 1954b; Chiba, Tsuruta, and Maéda, 1955; Hida and King, 1955; Nagaya et al., 1955; Chiba, 1956; Heinrich, 1957b; Honjo et al., 1957; Heinrich, 1958b; Yamazi, 1958a.

Vessel:	Station	Occurrence (*measurements in mm.; number of specimens in paren.*)			
		f. *typica* female	f. *typica* male	f. *edentata* female	f. *abyssalis* male
Hugh M. Smith	94	3.02(2)			
Do	29		3.13(1)	2.75–3.06(11)	3.06(1)
Do	63			2.75–2.82(2)	
Orsom	10		2.79–3.02(3)		
Horizon	32	3.06(1)			
Satsuma	32	2.85–3.13(5)	2.99–3.06(4)		

Remarks: All three forms of this species appeared in the above cited samples. Figures and descriptions of these have been presented by Steuer (1932). The female of forma *abyssalis* is not known. The female of forma *typica* and forma *edentata* are distinguished by the teeth on the first and second antennal segments. In forma *typica* these segments each has a large tooth (fig. 6) while in forma *edentata* these segments have only small teeth (fig. 10). Although Steuer mentions that segment 16 of the first antenna is smaller than segment 17 in forma *edentata*, these length differences are difficult to observe.

The male of forma *edentata* is unknown. Forma *typica* is easily recognized by the greatly asymmetrical and hairy abdomen (fig. 7) while the male of forma *abyssalis* has a less asymmetrical and less hairy abdomen (fig. 12). The small tooth on segment 17 (fig. 13) makes this specimen referable to what Steuer termed subform *thermophila* of forma *abyssalis*.

Pleuromamma abdominalis (Lubbock, 1856)

(PLATE 21, FIGS. 6–15)

Pacific records: Vervoort, 1957. Also, Johnson, 1942; Mori, 1942; Brodsky, 1950; Anraku, 1952; Honjo, 1952; Anraku, 1954a; 1954b; Tsuruta and Chiba, 1954b; Chiba, Tsuruta, and Maéda, 1955; Hida and King, 1955; Nagaya et al., 1955; Chiba, 1956; Heinrich, 1957b; Honjo et al., 1957; Heinrich, 1958a; Yamazi, 1958a.

Vessel:	Station	Occurrence
Hugh M. Smith	63	1 male, 4.28 mm.
Orsom	10	2 females, 3.99, 4.08 mm.; 2 males, 3.99, 4.08 mm.
Satsuma	32	1 female, 4.25 mm.; 1 male, 4.18 mm.

Remarks: The large spine-like protrusion on the forehead of this species (figs. 19, 3) readily distinguishes it from other species in the genus.

Pleuromamma indica Wolfenden, 1905

(PLATE 22, FIGS. 1–7)

Pacific records: Tanaka, 1953.

Vessel:	Station	Occurrence
Satsuma	32	1 male, 2.04 mm.

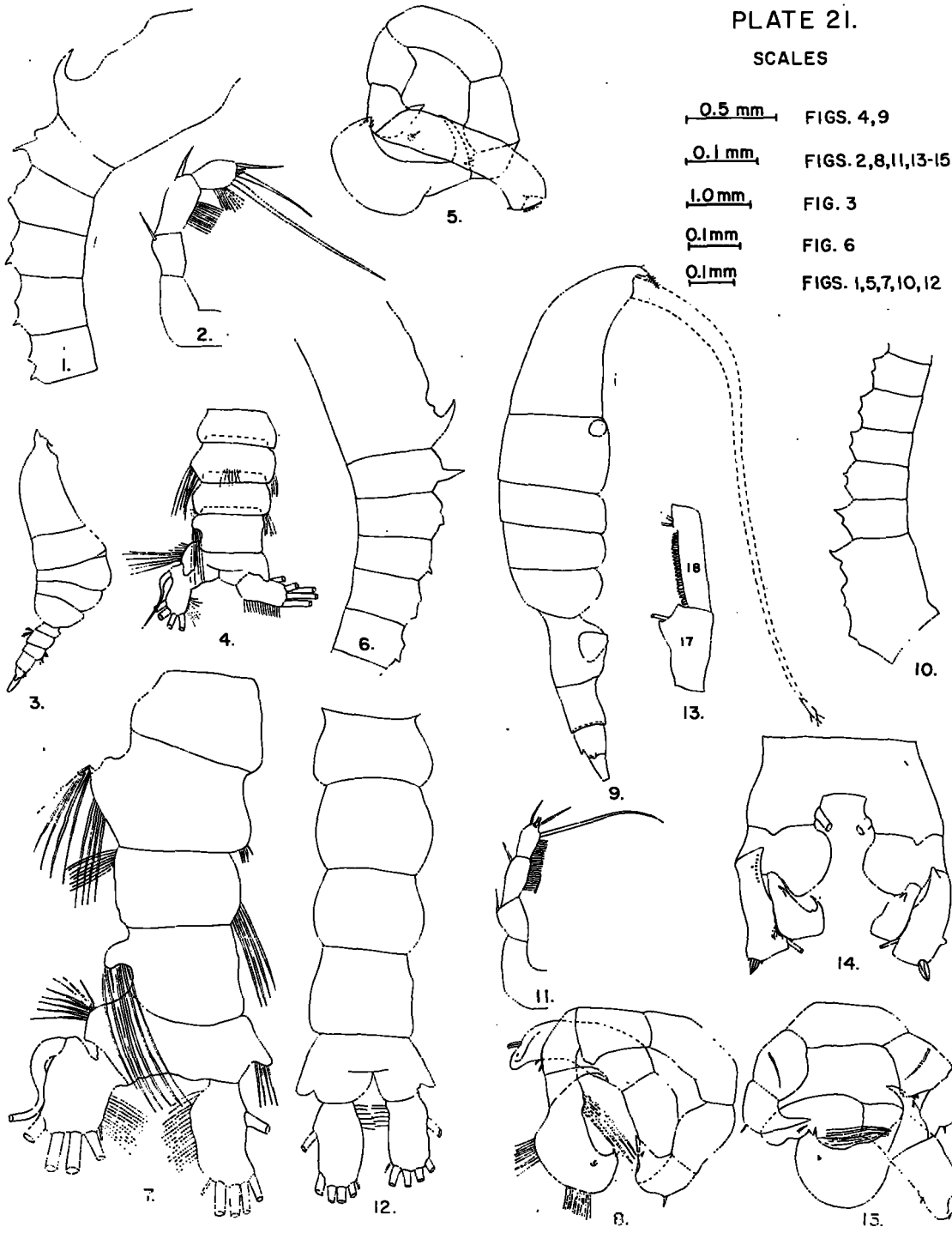

PLATE 21.—(1) *Pleuromamma xiphias*, female, proximal part of first antenna; (2) fifth foot; (3) male, lateral view; (4) abdomen, dorsal view; (5) fifth pair of feet; (6) *P. abdominalis* f. *typica*, female, proximal part of first antenna; (7) male, abdomen, dorsal view; (8) fifth pair of feet; (9) *P. abdominalis* f. *edentata*, female, lateral view; (10) proximal part of first antenna; (11) fifth foot; (12) *P. abdominalis* f. *abyssalis*, male, abdomen, dorsal view; (13) segments 17 and 18 of right first antenna; (14) second pair of feet (distal end of exopods and endopods not shown); (15) fifth pair of feet.

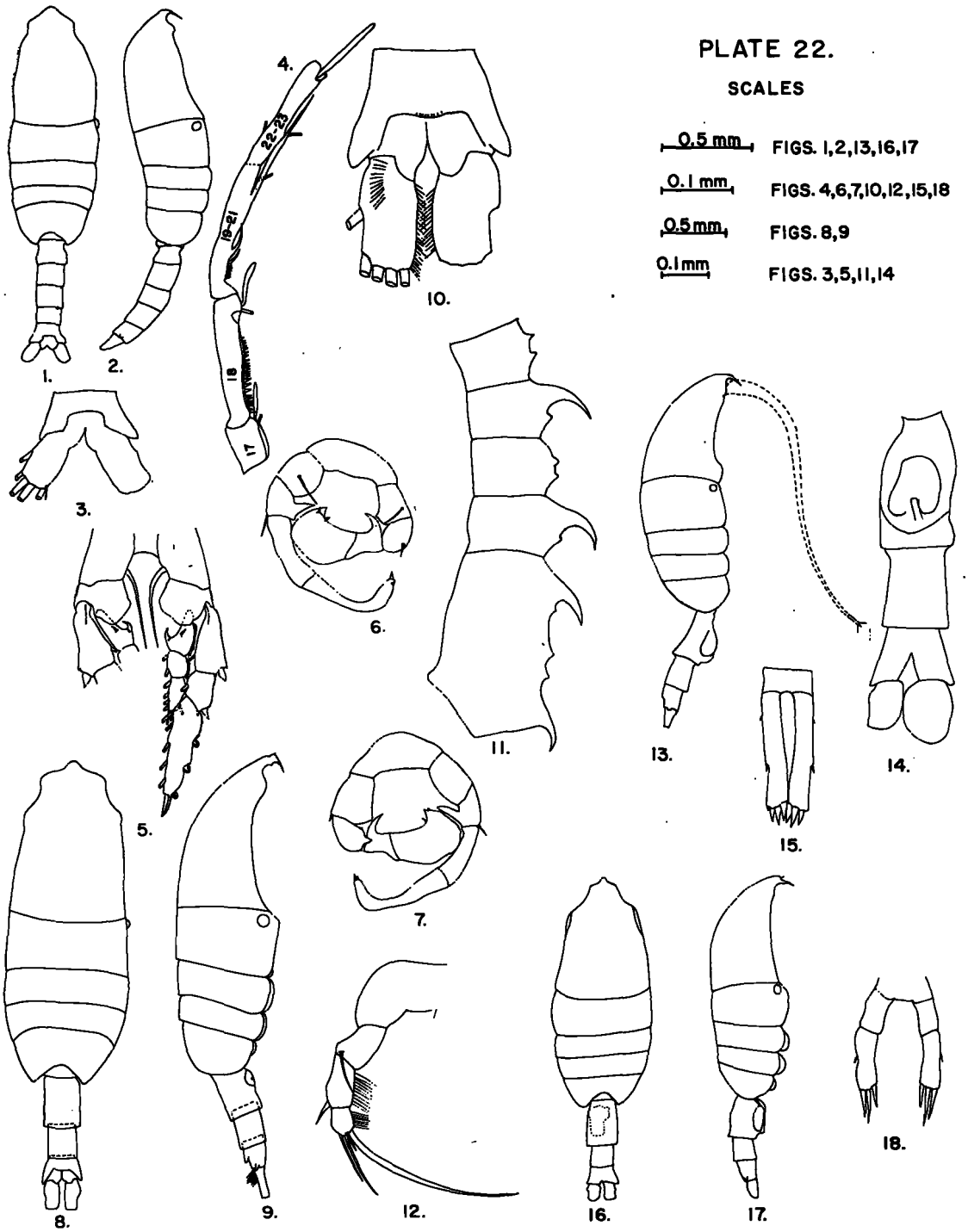

PLATE 22.—(1) *Pleuromamma indica*, male, dorsal view; (2) lateral view; (3) anal segment and furcae, dorsal view; (4) segments 17 to 23 of right first antenna; (5) second pair of feet (only part of one foot shown); (6) fifth pair of feet, anterior side; (7) posterior side; (8) *P. quadrungulata* f. *typica*, female, dorsal view; (9) lateral view; (10) anal segment and furcae, dorsal view; (11) proximal part of first antenna; (12) fifth foot; (13) *P. gracilis* f. *minima*, female, lateral view; (14) abdomen, ventral view; (15) fifth pair of feet; (16) *P. borealis*, female, dorsal view; (17) lateral view; (18) fifth pair of feet.

Remarks: Only a single male of this species was found. It is distinguished from males of *abdominalis* and other species by the symmetrical abdomen (fig. 1), divergent furcae (fig. 3) and absence of teeth on segment 17 of the right first antenna (fig. 4). The first segment of both endopods of *indica* are indented and claw-like (fig. 5) in contradistinction to *abdominalis* which has this claw-like indentation on only one endopod.

Pleuromamma quadrungulata (Dahl, 1893)

(PLATE 22, FIGS. 8–12)

Pacific records: Vervoort, 1957. Also, Brodsky, 1950.

Vessel:	Station	Occurrence
Hugh M. Smith	29	1 female, 3.77 mm.
Do	63	1 female, 3.51 mm.

Remarks: The above specimens are referable to forma *typica* Steuer, 1932. It is distinguished from forma *psychrophila* Steuer, 1931, by the presence of a large curved tooth on the fourth segment of the first antennae (fig. 11). In forma *psychrophila* this tooth is reduced in size and not curved.

Pleuromamma gracilis (Claus, 1863)

(PLATE 22, FIGS. 13–15)

Pacific records: Esterly, 1905; Scott, 1909; Farran, 1929; 1936; Mori, 1937; Tanaka, 1937; Dakin and Colefax, 1940; Johnson, 1942; Mori, 1942; Wilson, 1942; Brodsky, 1950; Wilson, 1950; Anraku, 1952; Honjo, 1952; Tanaka, 1953; Anraku, 1954b; Tsuruta and Chiba, 1954b; Chiba, Tsuruta, and Maéda, 1955; Nagaya et al., 1955; Chiba, 1956; Heinrich, 1957b; Honjo et al., 1957; Heinrich, 1958a; 1958b; Yamazi, 1958a.

Vessel:	Station	Occurrence
Hugh M. Smith	94	1 female, 1.80 mm.
Do	29	6 females, 2.01–2.07 mm.
Do	63	1 female, 1.90 mm.
Horizon	32	1 female, 1.94 mm.
Satsuma	32	1 female, 1.97 mm.

Remarks: All the specimens obtained of this species are referable to Steuer's (1932) forma *minima*. This form is distinguished from forma *piseki* (Farran, 1929) and *maxima* (Steuer, 1932) by the divergent margins of the anal segment (fig. 14) and by the fused second basal and exopodal segments of the fifth feet (fig. 15). In most of the present specimens the left furca is enlarged (fig. 14).

Pleuromamma borealis (Dahl, 1893)

(PLATE 22, FIGS. 16–18)

Pacific records: Farran, 1929; Brodsky, 1950; Wilson, 1950.

Vessel:	Station	Occurrence
Hugh M. Smith	63	1 female, 2.01 mm.
Orsom	10	1 female, 1.83 mm.
Satsuma	32	2 females, 1.90 mm.

Remarks: The long spines on the fifth feet of the female (fig. 18) distinguished this species from the preceding one.

Family CENTROPAGIDAE

Centropages gracilis (Dana, 1849)

(PLATE 23, FIGS. 1–3)

Pacific records: Scott, 1909; Yamada, 1933; Farran, 1936; Mori, 1937; Dakin and Colefax, 1940; Mori, 1942; Wilson, 1950; Tanaka, 1953; Tsuruta and Chiba, 1954b; Chiba, Tsuruta, and Maéda, 1955; Nagaya et al., 1955; Chiba, 1956; Honjo et al., 1957; Yamazi, 1958a.

Vessel:	Station	Occurrence
Hugh M. Smith	132	3 females, 1.90–1.97 mm.
Do	153	present.
Do	178	2 females, 2.00 mm.
Do	30	3 females, 1.97–2.01 mm.; 1 male, 2.04 mm.
Stranger	34	1 female, 1.90 mm.
Satsuma	32	1 male, 1.84 mm.

Remarks: The female is recognized by the spines on the sides on the second abdominal segment and the short spine-like protrusions on the inner sides of the second exopodal segments (fig. 1) of the fifth feet. The thumb of the chela of the right foot of the male has a

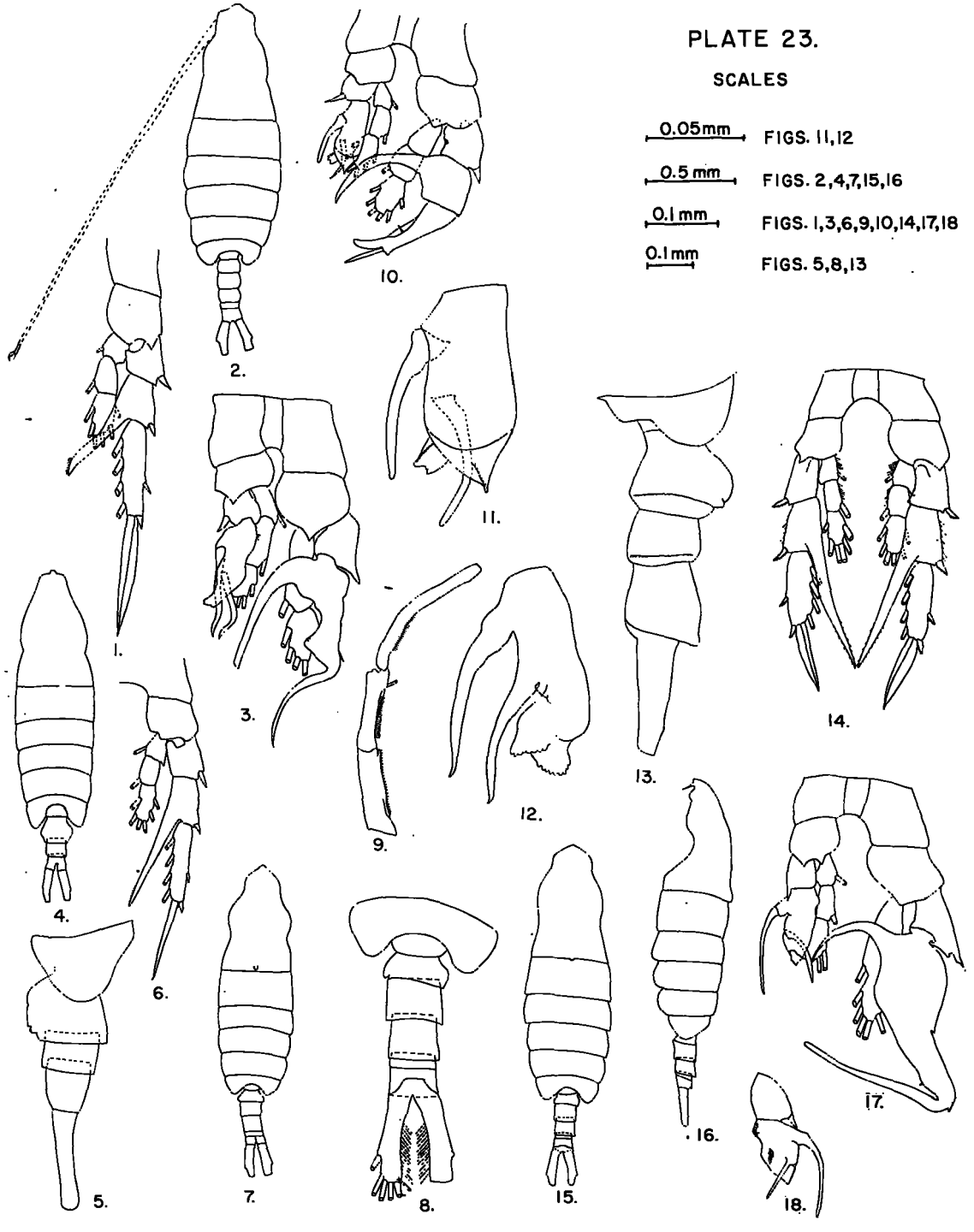

PLATE 23.—(1) *Centropages gracilis*, female, fifth foot; (2) male, dorsal view; (3) fifth pair of feet; (4) *C. elongatus*, female, dorsal view; (5) posterior part of thorax and abdomen, lateral view; (6) fifth foot; (7) male, dorsal view; (8) posterior part of thorax and abdomen, dorsal view; (9) segments 17 to 21 of right first antenna; (10) fifth pair of feet; (11) terminal part of exopod of left fifth foot; (12) terminal part of exopod of left fifth foot, other side; (13) *C. calaninus*, female, posterior part of thorax and abdomen, lateral view; (14) fifth pair of feet; (15) male, dorsal view; (16) lateral view; (17) fifth pair of feet; (18) exopod of left fifth foot.

pronounced triangular protrusion which is absent in other species in the genus (fig. 3).

Centropages elongatus Giesbrecht, 1896

(PLATE 23, FIGS. 4–12)

Synonymy:

Centropages pacificus Chiba, 1956, Jour. Shimonoseki College of Fisheries, 6(1): 47–48.

Pacific records: Scott, 1909; Mori, 1937; 1942; Wilson, 1942; Johnson, 1954; Tsuruta and Chiba, 1954b; Chiba, Tsuruta, and Maéda, 1955; Nagaya et al., 1955; Yamazi, 1958a.

Vessel:	Station	Occurrence
Hugh M. Smith	153	1 female, 1.87 mm.
Horizon	32	2 males, 1.74, 1.76 mm.
Satsuma	32	1 female, 1.66 mm.

Remarks: The female genital segment is only slightly asymmetrical (figs. 4, 5) and the abdomen lacks the spines which are present in the preceding species and in a related species (*C. violaceus*). The spine-like extensions of the second exopodal segments of the fifth feet exceed the distal end of the third exopodal segments (fig. 6). The male is recognized by the structure of the fifth feet, particularly the long external spine near the distal end of the thumb (fig. 10) and the form of the left exopod (figs. 11, 12).

Chiba (1956) has described a new species, *C. pacificus* (based on males), from specimens collected in the Bikini area. I believe these specimens are the males of *C. elongatus*, a species which has also been reported from Bikini by Johnson (1954).

Mori (1937) stated in his discussion of this species that the last thoracic segments of the female are pointed. He also presented a figure showing this point on one lateral margin. However, no mention was made of the pointed margins of the last thoracic segments by Giesbrecht (1896) in his original description of the species nor in the synopsis of this species presented later by Giesbrecht and Schmeil (1898). The latter authors stated that *C. elongatus* is related to *C. violaceus* which has round posterior thoracic margins. The present specimens also have rounded margins (fig. 5).

Centropages calaninus (Dana, 1849)

(PLATE 23, FIGS. 13–18)

Pacific records: Scott, 1909; Farran, 1936; Mori, 1937; Dakin and Colefax, 1940; Mori, 1942; Wilson, 1942; 1950; Tanaka, 1953; Tsuruta and Chiba, 1954b; Chiba, Tsuruta, and Maéda, 1955; Nagaya et al., 1955; Chiba, 1956; Gilmartin, 1958; Yamazi, 1958a.

Vessel:	Station	Occurrence
Hugh M. Smith	30	1 female, 2.18 mm.; 1 male, 2.06 mm.
Horizon	32	3 females, 1.97–2.04 mm.; 5 males, 1.80–2.00 mm.

Remarks: The anal segment of the female has a small knob on the ventral surface near the posterior end and the spine-like protrusions of the second exopodal segments of the fifth feet exceed the tip of the third exopodal segments (figs. 13, 14). The male is recognized by the structure of the fifth feet, especially the long and bent thumb of the chela (fig. 17).

Family LUCICUTIIDAE

Lucicutia flavicornis (Claus, 1863)

(PLATE 24, FIGS. 1–4)

Pacific records: Esterly, 1905; Scott, 1909; Farran, 1929; Mori, 1937; Dakin and Colefax, 1940; Johnson, 1942; Mori, 1942; Wilson, 1942; Davis, 1949; Brodsky, 1950; Wilson, 1950; Anraku, 1952; Honjo, 1952; Tanaka, 1953; Anraku, 1954b; Tsuruta and Chiba, 1954b; Chiba, Tsuruta, and Maéda, 1955; Motoda and Anraku, 1955; Nagaya et al., 1955; Chiba, 1956; Heinrich, 1957b; Honjo et al., 1957; Heinrich, 1958a; Yamazi, 1958a.

Vessel:	Station	Occurrence
Hugh M. Smith	94	12 females, 1.46–1.90 mm.; 7 males, 1.43–1.77 mm.
Do	132	3 males, 1.29–1.66 mm.
Do	144	4 females, 1.63–1.80 mm.; 5 males, 1.44–1.48 mm.
Do	178	3 females, 1.36–1.53 mm.; 7 males, 1.28–1.42 mm.

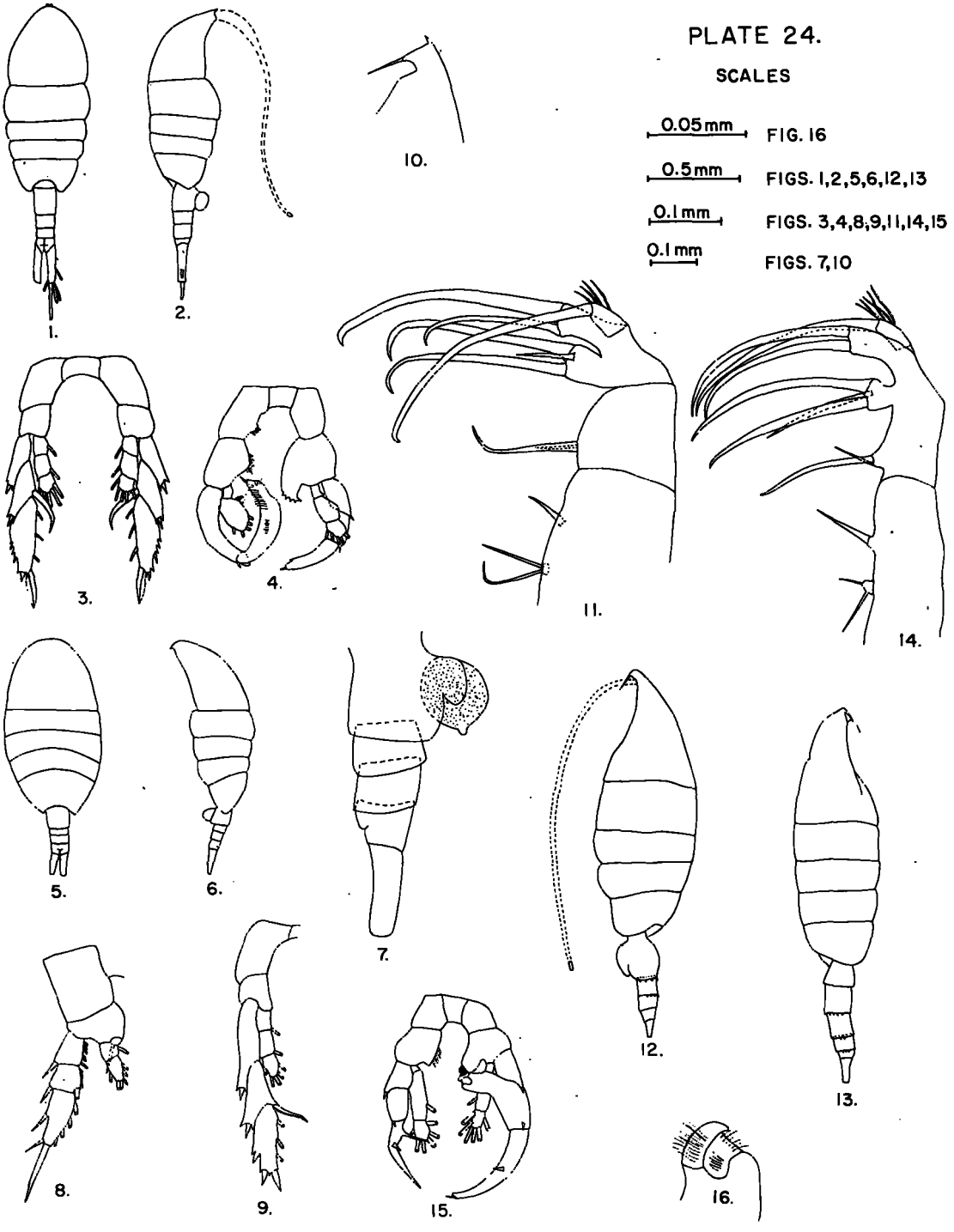

PLATE 24.—(1) *Lucicutia flavicornis*, female, dorsal view; (2) lateral view; (3) fifth pair of feet; (4) male, fifth pair of feet; (5) *L. ovalis*, female, dorsal view; (6) lateral view; (7) abdomen, lateral view; (8) first foot; (9) fifth foot; (10) *Heterorhabdus spinifrons*, female, forehead, lateral view; (11) second maxilla; (12) *H. papilliger*, female, lateral view; (13) male, lateral view; (14) second maxilla; (15) fifth pair of feet; (16) distal end of protrusion of second right exopodal segment.

Vessel:	Station	Occurrence
Do	31	3 females, 1.41–1.55 mm.
Do	29	present.
Stranger	34	1 female, 1.39 mm.
Satsuma	32	1 female, 1.26 mm.

Remarks: The female is distinguished from other species of the genus by the short anal segment (figs. 1, 2) and by the form of the fifth feet (fig. 3). The male is recognized by the protrusion of the second basipodal segment of the left foot and the long terminal segment of the right exopod (fig. 4).

Other authors, including Farran, 1929, mention that considerable variation occurs in the length of this species. In at least one collection (*Smith* 94), two size groups were noted as follows: females 1.46–1.53 (6); 1.87–1.90 (6); males 1.39–1.53 (7); 1.77 (1) mm.

Lucicutia ovalis Wolfenden, 1911

(PLATE 24, FIGS. 5–9)

Pacific records: Farran, 1929; 1936; Mori, 1937; Wilson, 1950; Tanaka, 1953; Anraku, 1954b; Tsuruta and Chiba, 1954b; Chiba, Tsuruta, and Maéda, 1955; Motoda and Anraku, 1955; Nagaya et al., 1955; Chiba, 1956; Honjo et al., 1957; Yamazi, 1958a.

Vessel:	Station	Occurrence
Hugh M. Smith	132	2 females, 1.32, 1.36 mm.
Do	153	1 female, 1.37 mm.
Do	178	3 females, 1.34–1.36 mm.
Do	63	1 female, 1.46 mm.
Stranger	34	1 female, 1.39 mm.
Orsom	10	present.
Satsuma	32	1 female, 1.44 mm.

Remarks: The female is most easily recognized by its small size, the two-segmented endopod of the first feet (fig. 8), and the structure of the fifth feet (fig. 9).

Family HETERORHABDIDAE

Heterorhabdus spinifrons (Claus, 1863)

(PLATE 24, FIGS. 10–11)

Pacific records: Vervoort, 1957. Also, Brodsky, 1950; Tanaka, 1953.

Vessel:	Station	Occurrence
Hugh M. Smith	144	present.
Do	29	3 females, 2.69–3.57 mm.; 3 males, 3.04–3.20 mm.
Do	63	1 male, 2.41 mm.
Satsuma	32	3 females, 2.10–2.18 mm.

Remarks: In both sexes the forehead is prolonged into a point (fig. 10), a character which will identify this species. In the female, one of the distal 3 spines of the maxilliped is small and slender (fig. 11).

Heterorhabdus papilliger (Claus, 1863)

(PLATE 24, FIGS. 12–16)

Pacific records: Esterly, 1905; Scott, 1909; Farran, 1929; 1936; Mori, 1937; Tanaka, 1937; Dakin and Colefax, 1940; Johnson, 1942; Mori, 1942; Wilson, 1942; Brodsky, 1950 Wilson, 1950; Anraku, 1952; Honjo, 1952; Tanaka, 1953; Anraku, 1954a; 1954b; 1954c; Chiba, Tsuruta, and Maéda, 1955; Motoda and Anraku, 1955; Nagaya et al., 1955; Chiba, 1956; Heinrich, 1957b; Yamazi 1958a.

Vessel:	Station	Occurrence
Hugh M. Smith	94	2 females, 2.04, 2.07 mm.; 3 males, 1.80–1.94 mm.
Do	132	2 females, 1.87, 1.90 mm.; 1 male, 1.87 mm.
Do	144	1 female, 2.14 mm.; 1 male, 2.11 mm.
Do	178	6 females, 1.80–1.87 mm.; 6 males, 1.70–1.84 mm.
Do	29	1 female, 2.00 mm.
Do	31	4 females, 1.90–1.94 mm.; 1 male, 1.97 mm.
Do	63	2 females, 1.77, 1.97 mm.
Stranger	34	1 female, 1.94 mm.
Orsom	10	1 female, 1.84 mm.

Remarks: The female forehead is rounded (fig. 12) and the 3 distal spines of the maxilliped are all about equal in length in both sexes (fig. 14).

Family AUGAPTILIDAE

Haloptilus acutifrons (Giesbrecht, 1892)

(PLATE 25, FIGS. 1–8)

Pacific records: Vervoort, 1957. Also, Johnson, 1942; Brodsky, 1950; Tanaka, 1953; Anraku, 1954b; Chiba, Tsuruta, and Maéda, 1955; Nagaya et al., 1955; Chiba, 1956; Yamazi, 1958a.

Vessel:	Station	Occurrence
Hugh M. Smith	94	1 female, 3.80 mm.

Remarks: Although closely resembling *H. oxycephalus*, *H. acutifrons* may be distinguished by (1) its small size, (2) less produced forehead (fig. 1) and (3) structure of the gnathal lobe of the mandible (fig. 3).

Haloptilus fertilis (*Giesbrecht*, 1892)

(PLATE 25, FIGS. 9–11)

Pacific records: none.

Vessel:	Station	Occurrence
Hugh M. Smith	32	1 male, 2.47 mm.

Remarks: The male is recognized by its small size and structure of the fifth feet (fig. 11).

Haloptilus longicornis (Claus, 1863)

Pacific records: Scott, 1909; Farran, 1929; 1936; Mori, 1937; Johnson, 1942; Mori, 1942; Wilson, 1942; Brodsky, 1950; Wilson, 1950; Tanaka, 1953; Yamazi, 1953c; Chiba, Tsuruta, and Maéda, 1955; Nagaya et al., 1955; Chiba, 1956; Heinrich, 1957b; Honjo et al., 1957; Heinrich, 1958b; Yamazi, 1958a.

Vessel:	Station	Occurrence
Hugh M. Smith	94	present.
Do	132	9 females, 1.80–1.90 mm.
Do	144	present.
Do	153	Do
Do	178	Do
Do	31	Do
Do	63	Do
Stranger	34	Do
Orsom	10	Do
Horizon	32	Do
Satsuma	32	5 females, 1.77–1.83 mm.

Remarks: The long first antennae which exceed the end of the furca and the knob-like button on the forehead will identify the female. No males were found.

As the occurrence records indicate, this was a widespread species in the present collections. It was also the most abundant species of *Haloptilus* and occurred in fair numbers in several samples (*Smith* 94, 144, 31).

Haloptilus ornatus (Giesbrecht, 1892)

(PLATE 25, FIGS. 12–16)

Pacific records: Scott, 1909; Mori, 1937; Johnson, 1942; Wilson, 1942; Wilson, 1950; Tanaka, 1953; Anraku, 1954b; Chiba, Tsuruta, and Maéda, 1955; Nagaya et al., 1955; Chiba, 1956.

Vessel:	Station	Occurrence
Hugh M. Smith	63	1 female, 4.56 mm.

Remarks: This is a large species and has a rounded forehead. As in other species of *Haloptilus*, the form of the gnathal lobe of the mandible is also diagnostic (fig. 13).

Haloptilus spiniceps (Giesbrecht, 1892)

(PLATE 25, FIGS. 17–20; PLATE 26, FIGS. 1–5)

Pacific records: Scott, 1909; Farran, 1929; 1936; Mori, 1937; Dakin and Colefax, 1940; Johnson, 1942; Wilson, 1942; 1950; Tanaka, 1953.

Vessel:	Station	Occurrence
Hugh M. Smith	94	1 female, 3.99 mm.
Stranger	34	1 female, 3.70 mm.
Orsom	10	present.
Horizon	32	1 female, 3.80 mm.
Satsuma	32	1 female, 3.80 mm.

Remarks: The short pointed forehead (fig. 17) which is curved downward in lateral view (fig. 18) and the structure of the gnathal lobe of the mandible (fig. 20) will identify the female of this species. No male has been found.

Haloptilus austini Grice, 1959

Pacific records: Grice, 1959.

Vessel:	Station	Occurrence
Hugh M. Smith	94	2 females, 3.16, 3.33 mm.

Remarks: I have recently described this species. It has a rounded forehead and, as in other species of *Haloptilus*, the gnathal lobe of the mandible is diagnostic.

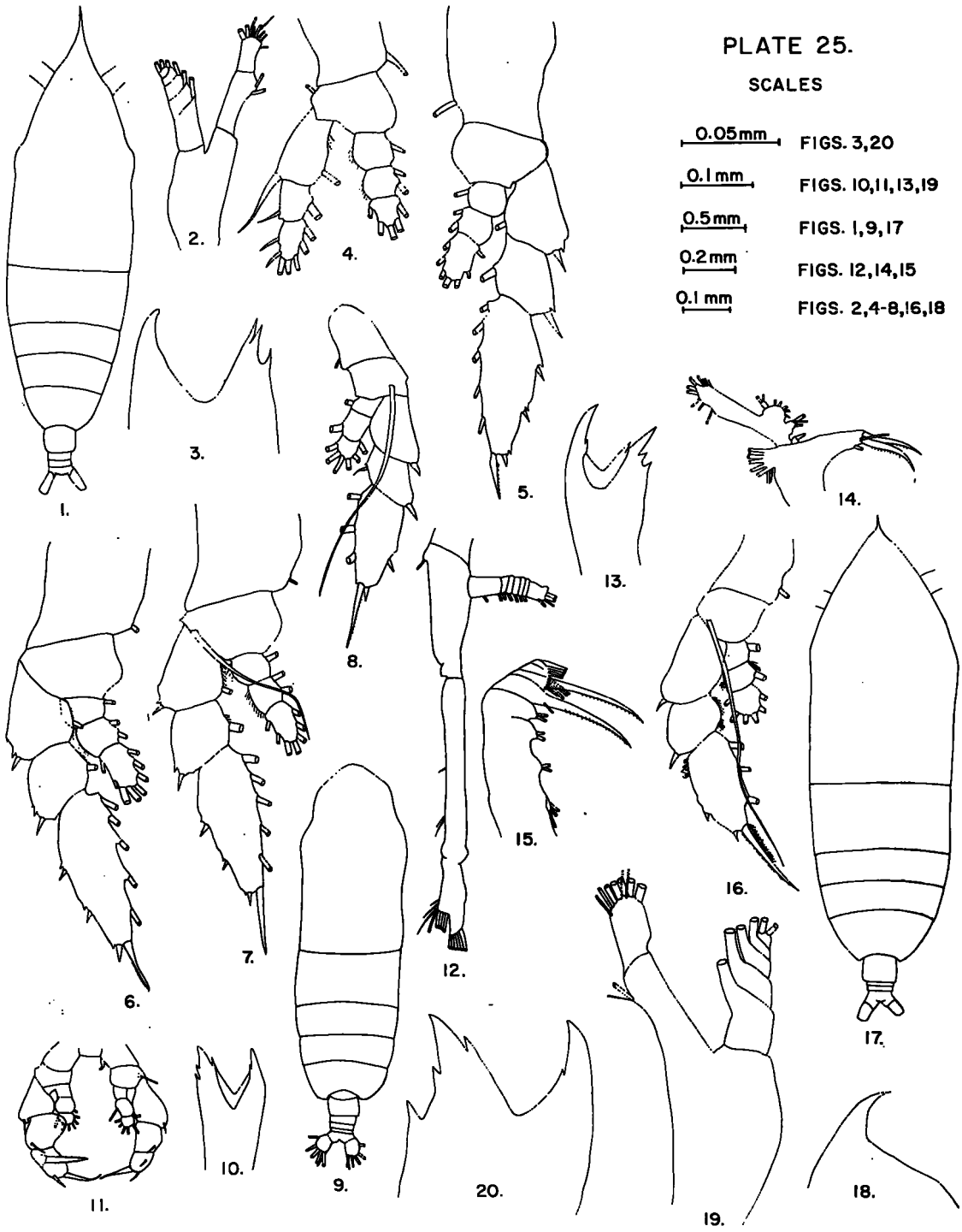

PLATE 25.—(1) *Haloptilus acutifrons*, female, dorsal view; (2) mandible palpus; (3) gnathal lobe of mandible; (4) first foot; (5) second foot; (6) third foot; (7) fourth foot; (8) fifth foot; (9) *H. fertilis*, male, dorsal view; (10) gnathal lobe of mandible; (11) fifth pair of feet; (12) *H. ornatus*, female, second antenna; (13) gnathal lobe of mandible; (14) first maxilla; (15) second maxilla; (16) fifth foot; (17) *H. spiniceps*, female, dorsal view; (18) forehead, lateral view; (19) mandible palpus; (20) gnathal lobe of mandible.

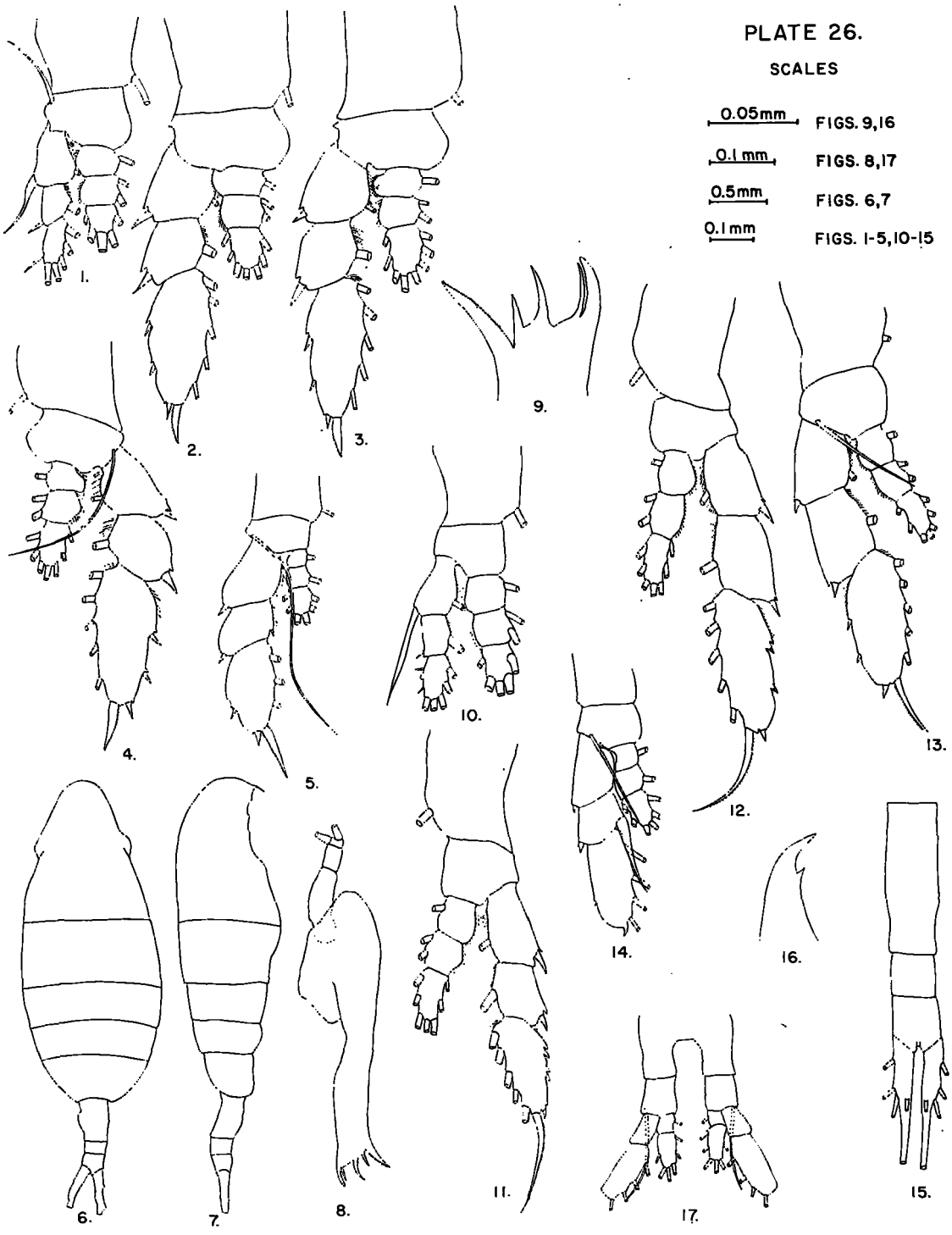

PLATE 26.—(1) *Haloptilus spiniceps*, female, first foot; (2) second foot; (3) third foot; (4) fourth foot; (5) fifth foot; (6) *Augaptilus longicaudatus*, female, dorsal view; (7) lateral view; (8) mandible; (9) gnathal lobe of mandible; (10) first foot; (11) second foot; (12) third foot; (13) fourth foot; (14) fifth foot; (15) *Euaugaptilus hecticus*, female, abdomen; (16) gnathal lobe of mandible; (17) fifth pair of feet.

Augaptilus longicaudatus (Claus, 1863)

(PLATE 26, FIGS. 6–14)

Pacific records: Esterly, 1905; Scott, 1909; Farran, 1929; 1936; Wilson, 1942; Brodsky, 1950; Wilson, 1950; Tanaka, 1953.

Vessel:	Station	Occurrence
Hugh M. Smith	94	1 female, 3.60 mm.

Remarks: The asymmetrical genital segment (fig. 6), mandibular dentition (fig. 8), and structure of the fifth feet (fig. 14) will identify the female. No males were observed in the present collections.

Euaugaptilus hecticus (Giesbrecht, 1889)

(PLATE 26, FIGS. 15–17)

Pacific records: Farran, 1929; Wilson, 1950; Tanaka, 1953. As *Augaptilus hecticus;* Scott, 1909.

Vessel:	Station	Occurrence
Hugh M. Smith	31	2 females, 2.70 mm.
Stranger	34	1 female, 2.28 mm.
Satsuma	32	1 female, 2.38 mm.

Remarks: The very long genital segment (fig. 15), claw-like mandibular blade (fig. 16) and the 2-segmented exopods of the fifth feet (fig. 17) serve to identify this species.

Family ARIETELLIDAE

Arietellus setosus Giesbrecht, 1892

(PLATE 27, FIGS. 1–4)

Pacific records: Esterly, 1905; Scott, 1909; Esterly, 1911; Farran, 1929; Johnson, 1942; Wilson, 1942; Brodsky, 1950; Wilson, 1950.

Vessel:	Station	Occurrence
Hugh M. Smith	63	1 male, 3.99 mm.

Remarks: The posterior thoracic margins are widely divergent (figs. 1, 3) and the forehead terminates in an acute point (fig. 2). Only the male has been found in the present samples.

Arietellus giesbrechti Sars, 1905

(PLATE 27, FIG. 5)

Pacific records: Wilson, 1950; Tanaka, 1953.

Vessel:	Station	Occurrence
Hugh M. Smith	29	1 male, 4.75 mm.

Remarks: In the male the left posterior thoracic margin is slightly longer than the right. The fifth feet, shown here (fig. 5), are also diagnostic. No females were observed.

Arietellus plumifer Sars, 1905

(PLATE 27, FIGS. 6–10)

Pacific records: Wilson, 1950.

Vessel:	Station	Occurrence
Hugh M. Smith	94	1 juvenile female.
Do	63	1 female, 5.51 mm.

Remarks: The posterior margins of the thorax are symmetrical and turned upward (figs. 6, 7, 9), and the head has a small point (figs. 7, 8). No males were found.

Arietellus aculeatus (T. Scott, 1894)

(PLATE 27, FIGS. 11–14)

Pacific records: Scott, 1909; Farran, 1929; Wilson, 1950.

Vessel:	Station	Occurrence
Hugh M. Smith	63	1 juvenile female, 4.08 mm.

Remarks: The forehead is produced into a long point (fig. 11). The posterior thoracic margins are asymmetrical and the spinous protrusion of the right side is more divergent and longer than the one on the left (figs. 11, 13).

Farran (1929) has suggested that *A. armatus* Wolfenden, 1911 is probably a synonym of *A. aculeatus*. Wilson (1950), however, recognized *armatus* as a valid species and redescribed both sexes.

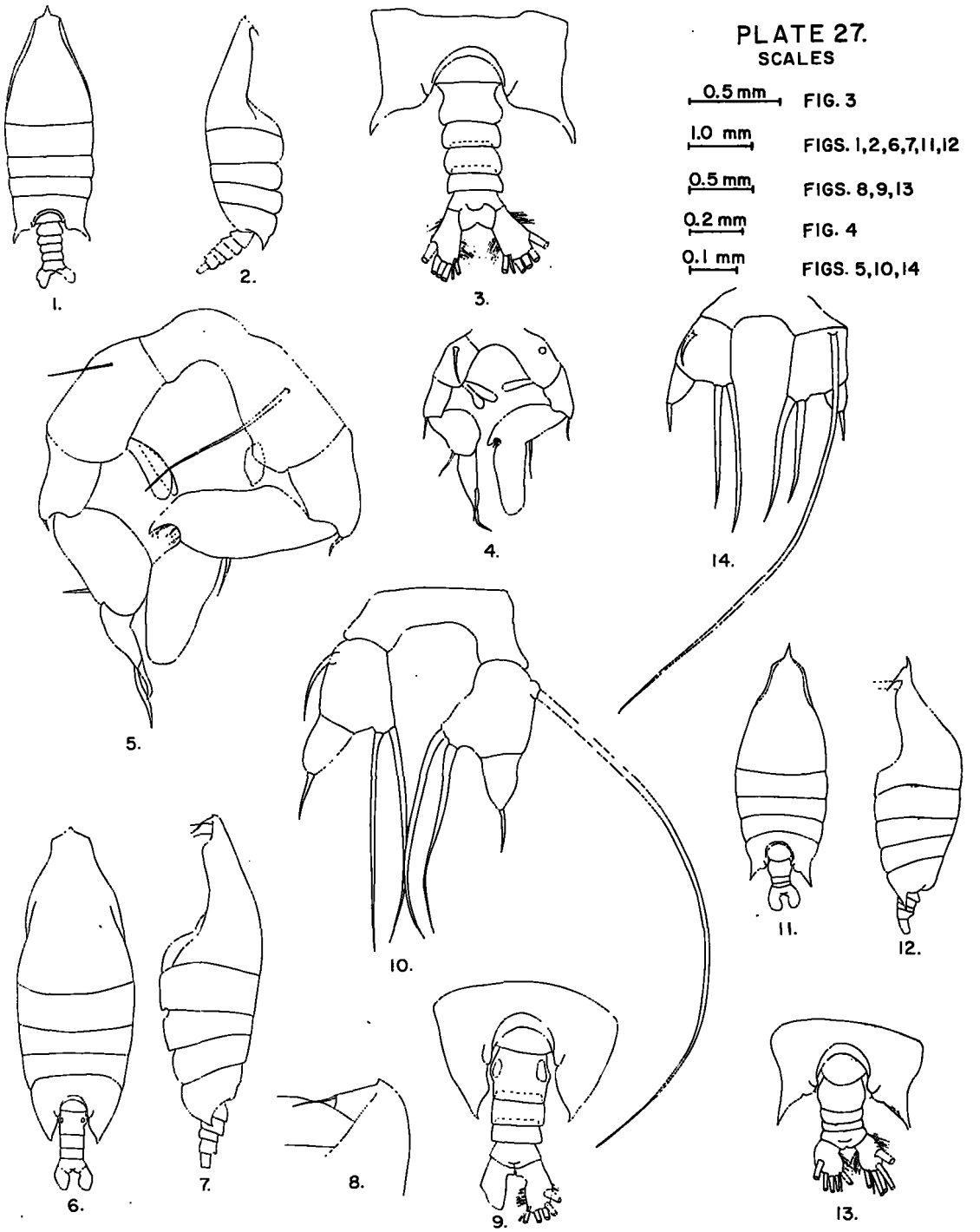

PLATE 27.—(1) *Arietellus setosus*, male, dorsal view; (2) lateral view; (3) posterior part of thorax and abdomen, dorsal view; (4) fifth pair of feet; (5) *A. giesbrechti*, male, fifth pair of feet; (6) *A. plumifer*, female, dorsal view; (7) lateral view; (8) forehead, lateral view; (9) posterior part of thorax and abdomen, dorsal view; (10) fifth pair of feet; (11) *A. aculeatus*, juvenile female, dorsal view; (12) lateral view; (13) posterior part of thorax and abdomen, dorsal view; (14) fifth pair of feet.

Family CANDACIIDAE

Candacia longimana (Claus, 1863)

(PLATE 28, FIGS. 1–12)

Pacific records: Scott, 1909; Farran, 1929; 1936; Mori, 1937; 1942; Wilson, 1942; 1950; Honjo, 1952; Tanaka, 1953; Anraku, 1954b; Tsuruta and Chiba, 1954b; Chiba, Tsuruta, and Maéda, 1955; Nagaya et al., 1955; Chiba, 1956; Heinrich, 1957b; Honjo et al., 1957; Yamazi, 1958a.

Vessel:	Station	Occurrence
Horizon	32	2 females, 2.82, 2.92 mm.; 1 male, 2.69 mm.
Satsuma	32	1 female, 2.89 mm.

Remarks: Twelve species of *Candacia* were found in the collections. For each species, excepting *C. guggenheimi* which has recently been described (Grice and Jones, 1960), I have usually included figures of the dorsal and lateral views of both sexes. Figures are also given of the fifth feet of each species and, for most species, figures of certain of the cephalic appendages (gnathal lobe of the mandible, second maxilla and maxilliped) are given. The females of the species herein described are easily recognized by the forms of the genital segment and fifth feet. The males are recognized by the character of the spine-like protrusion of the right posterior thoracic margin, the structure of the abdomen and the form of the fifth feet.

The female of *C. longimana* has a symmetrical genital segment (fig. 1), the basal tooth of the mandible is tricuspate (fig. 3), and the fifth foot terminates in 3 sub-equal points (figs. 4, 5). The right posterior thoracic margin of the male ends in an irregular protrusion (figs. 6, 7) which in lateral view is seen to turn upward (fig. 9). The right side of the genital segment has a large finger-like protrusion. The right fifth foot is chelate (fig. 11) and the distal margin of the last segment of the left foot ends in 3 small points (fig. 12).

Candacia guggenheimi Grice and Jones, 1960

Pacific records: Grice and Jones, 1960.

Vessel:	Station	Occurrence
Hugh M. Smith	29	present.

Remarks: This species has recently been described elsewhere (Grice and Jones, 1960). The genital segment of the female has two small spines on the dorsal surface and the genital segment of the male has a bilobed protrusion extending from the right side.

Candacia tenuimana (Giesbrecht, 1889)

(PLATE 28, FIGS. 13–18; PLATE 29, FIGS. 1–4)

Pacific records: Scott, 1909; Johnson, 1942; Wilson, 1942; 1950.

Vessel:	Station	Occurrence
Hugh M. Smith	29	1 female, 2.07 mm.; 1 male, 2.20 mm.

Remarks: The female genital segment is slightly asymmetrical, the right side being more produced than the left (fig. 13, 15). The basal tooth of the mandible has 2 unequal cusps (fig. 17). The innermost spine-like protrusion of the distal segment of the fifth foot (fig. 18) is considerably longer than the other two. The spine-like protrusion on the right posterior thoracic margin of the male has a bifid tip (fig. 1, 2) and the genital segment is produced to the right in the form of a narrow, curved, spine-like process (fig. 2). As in the preceding species, the right fifth foot is chelate (fig. 4).

Candacia aethiopica (Dana, 1849)

(PLATE 29, FIGS. 5–16)

Pacific records: Streets, 1877; Esterly, 1905; Scott, 1909; Farran, 1929; Yamada, 1933a; Tanaka, 1935b; Farran, 1936; Mori, 1937; Dakin and Colefax, 1940; Johnson, 1942; Mori, 1942; Wilson, 1942; 1950; Tanaka, 1953; Anraku, 1954b; Tsuruta and Chiba, 1954b; Chiba, Tsuruta, and Maéda, 1955; Nagaya et al., 1955; Chiba, 1956; Honjo et al., 1957; Gilmartin, 1958.

Vessel:	Station	Occurrence
Hugh M. Smith	30	1 male, 2.24 mm.
Horizon	32	1 female, 2.21 mm.; 3 males 2.18–2.24 mm.
Satsuma	32	1 female, 1.97 mm.

Remarks: Of the two spine-like protrusions on the female genital segment, the one on the left is the larger (figs. 5, 7). The basal tooth of the mandible has 3 cusps, the middle one of which is the larger (fig. 9). The distal segment of the fifth foot has 1 external spine, 3

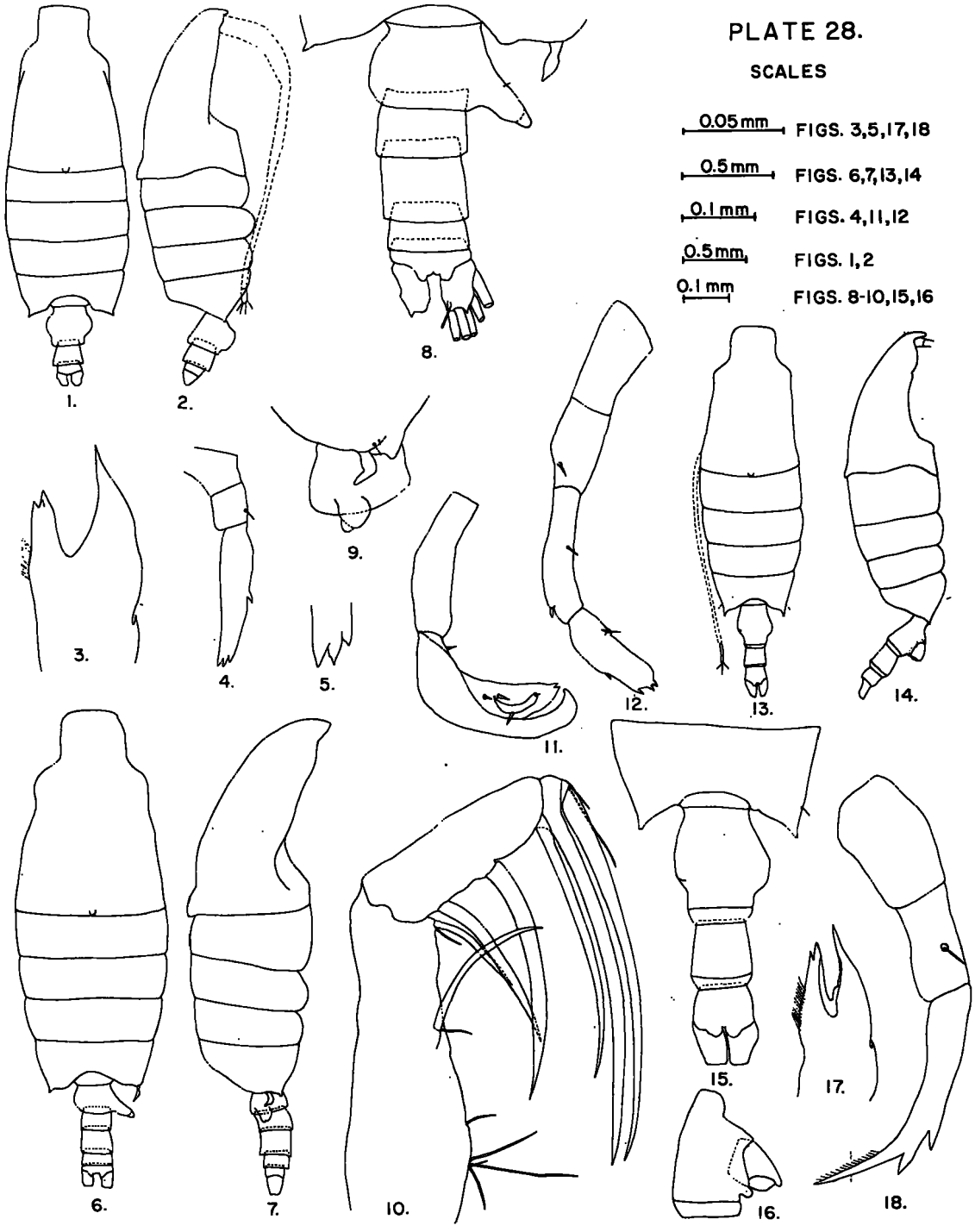

PLATE 28.—(1) *Candacia longimana*, female, dorsal view; (2) lateral view; (3) gnathal lobe of mandible; (4) fifth foot; (5) tip of fifth foot; (6) male, dorsal view; (7) lateral view; (8) abdomen, dorsal view; (9) posterior lateral corner of thorax and genital segment, right side; (10) second maxilla; (11) right fifth foot; (12) left fifth foot; (13) *C. tenuimana*, female, dorsal view; (14) lateral view; (15) posterior part of thorax and abdomen, dorsal view; (16) genital segment, lateral view; (17) gnathal lobe of mandible; (18) fifth foot.

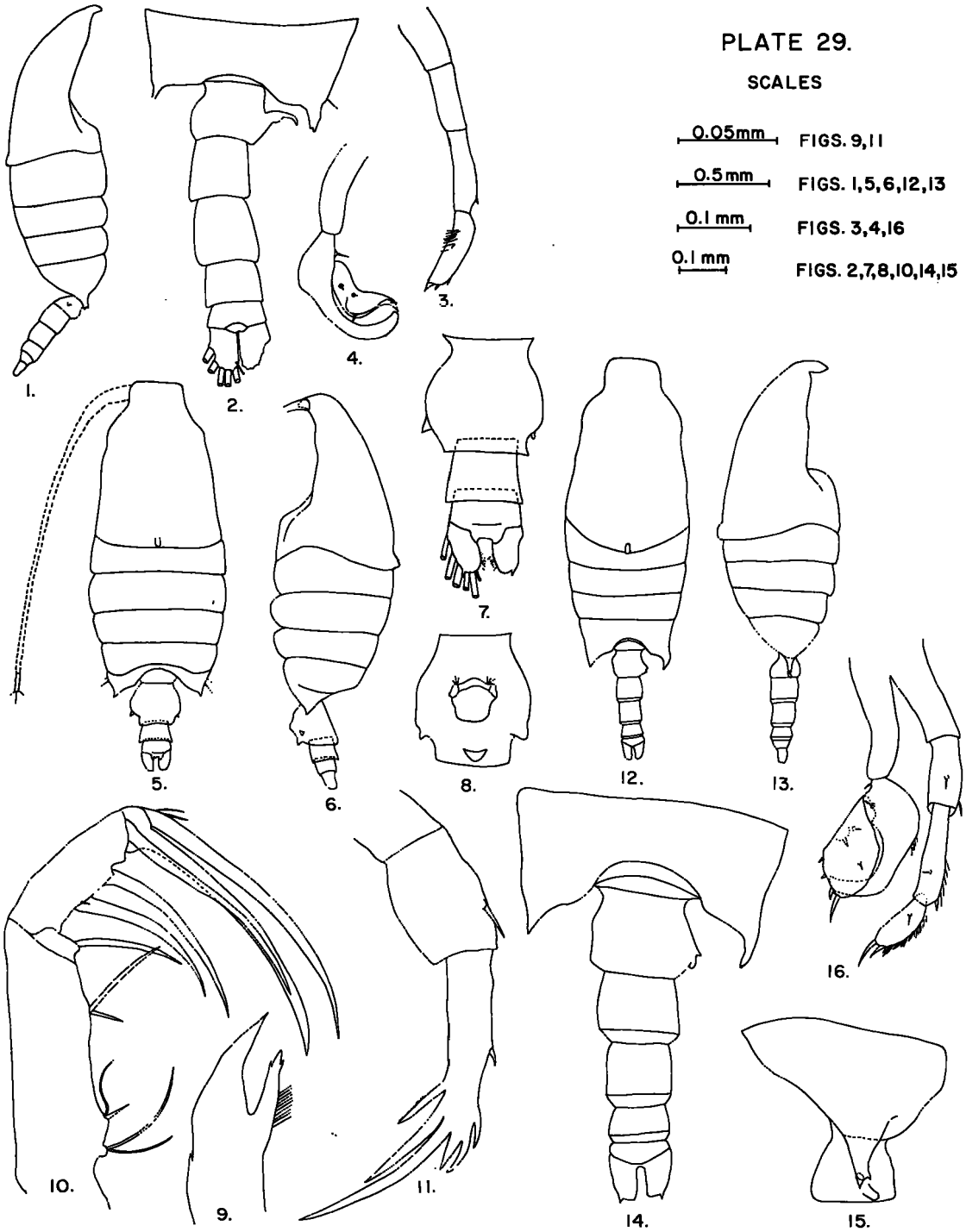

PLATE 29.—(1) *Candacia tenuimana*, male, lateral view; (2) posterior part of thorax and abdomen, dorsal view; (3) left fifth foot; (4) right fifth foot; (5) *C. aethiopica*, female, dorsal view; (6) lateral view; (7) abdomen, dorsal view; (8) genital segment, ventral view; (9) gnathal lobe of mandible; (10) second maxilla; (11) fifth foot; (12) male, dorsal view; (13) lateral view; (14) posterior part of thorax and abdomen, dorsal view; (15) posterior lateral corner of thorax and genital segment, right side; (16) fifth pair of feet.

terminal points and 3 internal, apparently unarticulated, setae (fig. 11). The male has a bifid spine-like protrusion (lateral view) extending from the right posterior margin of the thorax (figs. 13, 15). There is a rounded tubercle and a spine-like point arising from the right side of the genital segment (fig. 14). The chela of the right fifth foot is broad and spinous (fig. 16).

Candacia pachydactyla (Dana, 1849)

(PLATE 30, FIGS. 1–9)

Pacific records: Scott, 1909; Tanaka, 1935; Mori, 1937; Dakin and Colefax, 1940; Wilson, 1942; 1950; Chiba, 1952c; Tanaka, 1953; Tsuruta and Chiba, 1954b; Chiba, Tsuruta, and Maéda, 1955; Hida and King, 1955; Nagaya et al., 1955; Chiba, 1956; Honjo et al., 1957; Yamazi, 1958a.

Vessel:	Station	Occurrence
Hugh M. Smith	132	2 males, 2.52 mm.
Do	153	1 female, 2.82 mm.; 1 male, 2.07 mm.
Do	178	2 males, 2.52 mm.
Do	30	4 females, 2.48–2.55 mm.; 1 male, 2.48 mm.
Do	63	1 female, 2.88 mm.; 4 males, 2.45–2.72 mm.
Stranger	34	3 females, 2.62–2.65 mm.; 2 males, 2.38, 2.52 mm.
Orsom	10	1 male, 2.48 mm.
Horizon	32	6 females, 2.55–2.62 mm.; 6 males, 2.31–2.55 mm.

Remarks: This is a robust species and is easily distinguished by the coarse spine-like protrusions of the genital segment of the female (figs. 1, 2). The basal tooth of the mandible ends in 3 very unequal cusps (fig. 3). The distal segment of the fifth feet ends in 3 points, the innermost one of which is curved (fig. 4). The right posterior margin of the thorax of the male (figs. 5, 6) is similar to that of *C. aethiopica* but the protrusion of the genital segment is quite large (fig. 7). The thumb of the chela on the right fifth foot ends in a long spine as does the distal segment of the left foot (figs. 8, 9).

Candacia curta (Dana, 1849)

(PLATE 30, FIGS. 10–14; PLATE 31, FIGS. 1–3)

Pacific records: Esterly, 1905; Scott, 1909; Farran, 1935b; Farran, 1936; Mori, 1937; Johnson, 1942; Wilson, 1942; 1950; Tanaka, 1953; Tsuruta and Chiba, 1954b; Chiba, Tsuruta, and Maéda, 1955; Nagaya et al., 1955; Chiba, 1956; Honjo et al. 1957; Yamazi, 1958a. As *C. bicornuta;* Mori, 1932.

Vessel:	Station	Occurrence
Hugh M. Smith	29	2 females, 2.48. 2.62 mm.; 2 males, 2.28, 2.34 mm.
Orsom	10	1 female, 2.44 mm.; 1 male, 2.20 mm.
Horizon	32	1 female, 2.58 mm.

Remarks: The female genital segment is slightly asymmetrical in dorsal view (fig. 10) and has a spine-like protrusion on the ventral side (fig. 11). This spine-like protrusion originates from the right side of the segment (fig. 12). The basal tooth of the mandible has 3 cusps, the lowermost one of which arises from behind the other two (fig. 13). There are 2 points on the distal end of the fifth foot and another point a short distance back of the distal end (fig. 14). The right posterior thoracic margin of the male ends in a hooked spine-like point (fig. 1) and there is a curved, pointed protrusion from the right side of the genital segment (fig. 2). The chela of the fifth foot is also diagnostic (fig. 3).

Candacia bipinnata (Giesbrecht, 1889)

(PLATE 31, FIGS. 4–7)

Synonymy:

Candacia bipinnata (Giesbrecht, 1889, Atti Acc. Lincei Rend., ser. 4, 5 sem. 1: 815).

Candacia pectinata (not of Brady, 1878) Esterly (1905, Univ. Calif. Publ. Zool., 2(4): 193); Mori (1937, The pelagic Copepoda from the neighboring waters of Japan, p. 83); Dakin and Colefax (1940, Publ. Univ. Sydney Dept. Zool. Monogr. 1, p. 105). (*C. pectinata* Brady, 1878=*C. armata* Boeck, 1873.)

Pacific records: Esterly, 1905; Scott, 1909; Tanaka, 1929; Yamada, 1933; Tanaka, 1935b; Mori, 1937; Dakin and Colefax, 1940; Johnson, 1942; Wilson, 1942; Davis, 1949; Motoda, Iizuka, and Anraku, 1950; Brodsky, 1950; Wilson, 1950; Anraku, 1952; Honjo, 1952; Anraku, 1953; Tanaka, 1953; Anraku, 1954b; Chiba, Tsuruta, and Maéda, 1955; Motoda and Anraku, 1955; Nagaya et al., 1955; Chiba, 1956; Honjo et al., 1957;

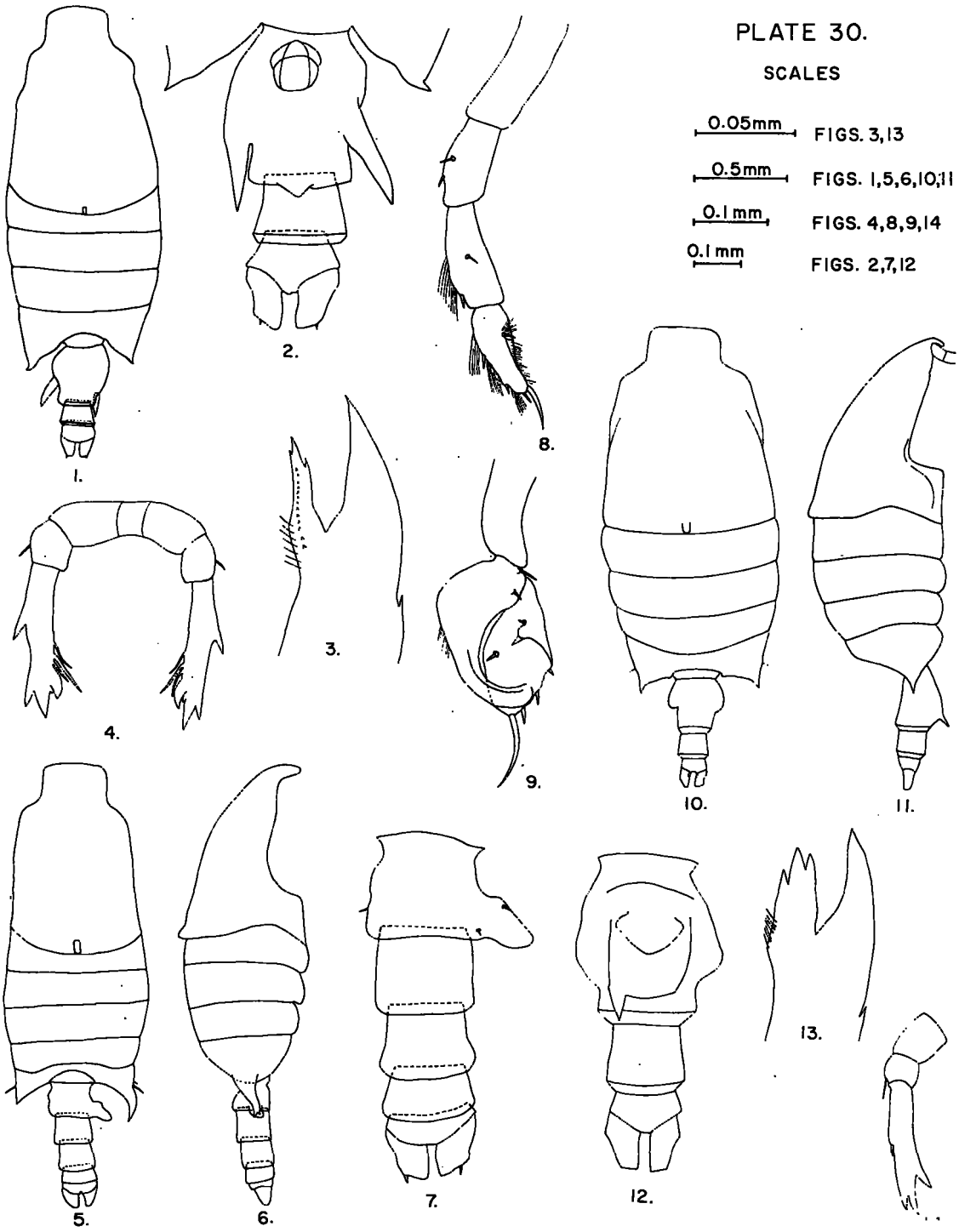

PLATE 30.—(1) *Candacia pachydactyla*, female, dorsal view; (2) abdomen, ventral view; (3) gnathal lobe of mandible; (4) fifth pair of feet; (5) male, dorsal view; (6) lateral view; (7) abdomen, dorsal view; (8) left fifth foot; (9) right fifth foot; (10) *C. curta*, female, dorsal view; (11) lateral view; (12) abdomen, ventral view; (13) gnathal lobe of mandible; (14) fifth foot.

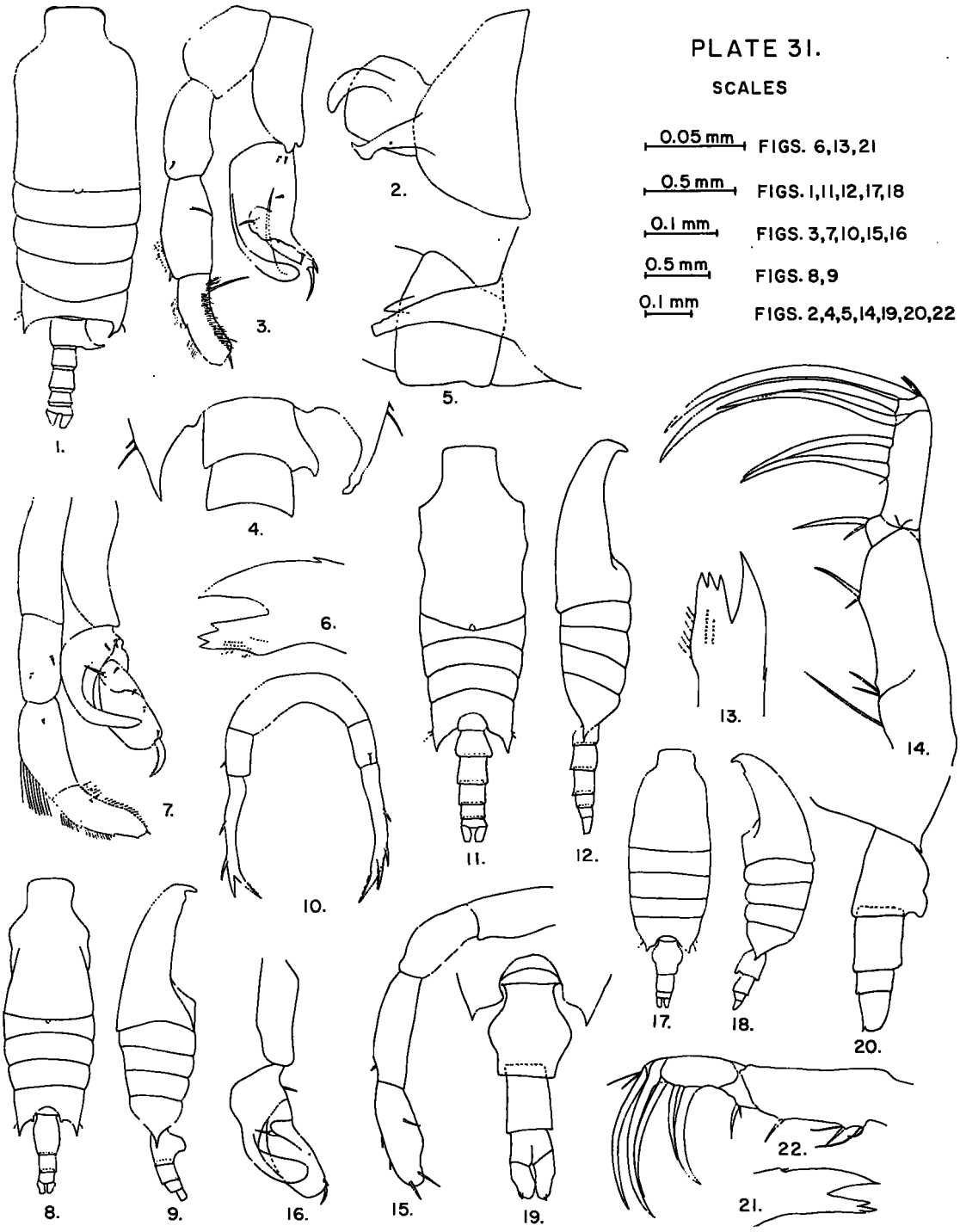

PLATE 31.—(1) *Candacia curta*, male, dorsal view; (2) posterior part of thorax and genital segment, right side; (3) fifth pair of feet; (4) *C. bipinnata*, male, posterior part of thorax and abdomen, dorsal view; (5) posterior part of thorax and abdomen, right side; (6) gnathal lobe of mandible; (7) fifth pair of feet; (8) *C. varicans*, female, dorsal view; (9) lateral view; (10) fifth pair of feet; (11) male, dorsal view; (12) lateral view; (13) gnathal lobe of mandible; (14) second maxilla; (15) left foot; (16) right foot; (17) *C. catula*, female, dorsal view; (18) lateral view; (19) abdomen, dorsal view; (20) abdomen, lateral view; (21) gnathal lobe of mandible; (22) second maxilla.

Yamazi, 1958a; Brodsky, 1959; Lindberg, 1959. As *C. bipunctata* [=*C. bipinnata*?]; Yamazi, 1953a.

Vessel:	Station	Occurrence
Hugh M. Smith	178	1 male, 1.90 mm.
Do	144	1 male, 2.28 mm.

Remarks: Only two males of this species were found. The right posterior lateral protrusion of the thorax is characteristic. This protrusion exceeds the end of the genital segment and its tip, as seen in dorsal view, is irregular (fig. 4). In lateral view the distal end appears to be somewhat truncate (fig. 5). A small, posteriorly directed hook arises from the right side of the genital segment (fig. 4). The basal tooth of the gnathal lobe of the mandible is tricuspate (fig. 6). The thumb of the chela of the right fifth foot has a stout spine at its tip.

In regard to the above indicated synonymy, Sars (1903) redescribed *C. armata* (Boeck, 1873) and pointed out that *C. pectinata* (Brady, 1878) is a synonym of the former species. *C. armata* is a north Atlantic species which occurs along the east coast of the United States as far south as off Beaufort, North Carolina (Fleminger and Bowman, 1956), and along the coast of Europe probably as far south as off Spain. It has also been reported from the Mediterranean Sea (Rose, 1934) and from the Adriatic Sea (Hure, 1955).

I have examined specimens identified by Esterly (1905) and labeled *C. bipinnata* ♀, *C. pectinata* ♂, which were loaned to me by Dr. Abraham Fleminger of the Scripps Institution of Oceanography. Included in the vial were two females, *C. bipinnata*. Esterly's figure of the fifth foot of his female *C. pectinata* is probably that of a stage V female *C. bipinnata*, a species which also occurred in his collections. The figure of the genital segment of his male *C. pectinata* is clearly referable to *C. bipinnata*. Esterly stated in regard to *C. bipinnata* that he did not find the male of this species.

Mori (1937) reported only the male of *C. pectinata* from Japanese waters. His figures and description of this species indicate that it is actually *C. bipinnata*. The protrusion of the right posterior lateral margin of the thorax, the form of the hook on the right side of the genital segment, and the structure of the fifth pair of feet all agree with those of *C. bipinnata*. Mori also presented figures of male *C. bipinnata* which are not unlike those of his *C. pectinata*.

Dakin and Colefax's (1940) *C. pectinata* (both sexes) which were questionably referred to this species are also *C. bipinnata*. I have examined specimens which were obtained from the east coast of Australia and which are similar to the figures presented by these authors for *C. pectinata*. These copepods are stage V female and adult male *C. bipinnata*.

As to other reports of *C. pectinata* from the Pacific Ocean, Scott (1909) has previously stated that Brady's (1883) figures of this species "represents at least four distinct species, none of which are identical with it" (*C. pectinata=C. armata*). *C. pectinata* has also been reported by Honjo (1952) and Honjo et al. (1957). As the species is included in lists, without descriptions or figures, these records too are questionable and in need of confirmation.

Candacia varicans (Giesbrecht, 1892)

(PLATE 31, FIGS. 8–16)

Pacific records: Farran, 1929; Johnson, 1942; Wilson, 1942; 1950.

Vessel:	Station	Occurrence
Hugh M. Smith	31	2 males, 2.14, 2.18 mm.
Do	63	1 female, 2.55 mm.; 2 males, 2.26, 2.28 mm.

Remarks: The female has a long and symmetrical genital segment (fig. 8) which is produced on the ventral side (fig. 9). The fifth feet are slightly asymmetrical and terminate in two rather long, but unequal, points (fig. 10). The thorax and genital segment of the male are symmetrical (figs. 11, 12). The basal tooth of the mandible ends in three approximately equal cusps. The right fifth foot is chelate (fig. 16).

Candacia catula (Giesbrecht, 1889)

(PLATE 31, FIGS. 17–22; PLATE 32, FIGS. 1–6)

Pacific records: Scott, 1909; Tanaka, 1935b; Farran, 1936; Mori, 1937; Dakin and Colefax, 1940; Mori, 1942; Wilson, 1942; Anraku, 1952; Tanaka, 1953;

Tsuruta and Chiba, 1954b; Chiba, Tsuruta, and Maéda, 1955; Nagaya et al., 1955; Yamazi, 1958a.

Vessel:	Station	Occurrence
Hugh M. Smith	178	present.
Do	63	2 females, 1.56, 1.63 mm.; 2 males, 1.46, 1.53 mm.
Stranger	34	7 females, 1.60–1.67 mm.; 2 males, 1.53, 1.62 mm.
Orsom	10	1 female, 1.53 mm.; 1 male, 1.43 mm.
Horizon	32	1 female, 1.59 mm.

Remarks: This is a small species, the females of which have a symmetrical genital segment (figs. 17, 19). The ventral surface is produced into a lobe (figs. 18, 20). The basal tooth of the mandible ends in 3 cusps, the lowermost one of which is quite small (fig. 21). The fifth foot terminates in 3 unequal points (fig. 1). The male posterior thoracic margins are symmetrical (figs. 2, 4) and the chela of the right fifth foot is small. The thumb of the chela has a long spine protruding from its tip (fig. 6).

Candacia bispinosa (Claus, 1863)

(PLATE 32, FIGS. 7–14)

Pacific records: Scott, 1909; Farran, 1929; Tanaka, 1935b; Farran, 1936; Mori, 1937; Johnson, 1942; Wilson, 1942; 1950; Honjo, 1952; Tanaka, 1953; Anraku, 1954b; Tsuruta and Chiba, 1954b; Chiba, Tsuruta, and Maéda, 1955; Motoda and Anraku, 1955; Nagaya et al., 1955; Chiba, 1956; Heinrich, 1957b; Honjo et al., 1957; Heinrich, 1958a; Yamazi, 1958a.

Vessel:	Station	Occurrence
Hugh M. Smith	153	3 females, 1.66–1.80 mm.
Do	178	1 female, 1.60 mm.
Stranger	34	1 female, 1.67 mm.; 1 male, 1.73 mm.
Orsom	10	1 female, 1.56 mm.; 1 male, 1.56 mm.
Satsuma	32	1 male, 1.70 mm.

Remarks: This species and the following two species, *C. simplex* (Giesbrecht) and *C. truncata* (Dana), differ in a few details (e.g., structure of right, first antenna in male and fifth feet in both sexes) from the preceding nine species. It has been suggested by Sars (1903) that these three may have to be removed from the genus *Candacia*.

The female of *C. bispinosa* has two spine-like protrusions arising from the genital segment (fig. 7). These protrusions, particularly the one on the left side, are quite variable in shape and in size. In one specimen (*Smith* 178) the left protrusion reaches nearly to the anal segment. There is a small rounded knob arising from the ventral side of the genital segment near the posterior end (fig. 8). The pre-anal segment is asymmetrical. The left side is dilated near the anterior end, but there is some variation in the size of the protrusion. The ventral surface of this segment may or may not have a row of hairs arising from near the posterior end. The basal tooth of the mandible is undivided, but one or more spine-like processes are present on this tooth (fig. 9). The large terminal finger-like protrusion of the distal segment of the fifth foot is finely serrate on both sides (fig. 12).

Segment 20 of the right first antenna of the male is swollen distally (fig. 13). There are 3 outer edge spines on the distal segment of the right fifth foot (fig. 14). The proximal spine is shorter than the distal two spines. The penultimate segment of the left fifth foot is enlarged and the outer edge seta of the distal segment is shorter than the terminal ones.

Candacia simplex (Giesbrecht, 1889)

(PLATE 32, FIGS. 15–18; PLATE 33, FIGS. 1–5)

Pacific records: Scott, 1909; Farran, 1929; 1936; Mori, 1937; Johnson, 1942; Mori, 1942; Wilson, 1942; 1950; Tanaka, 1953; Tsuruta and Chiba, 1954b; Chiba, Tsuruta, and Maéda, 1955; Nagaya et al., 1955; Rose, 1955; Chiba, 1956.

Vessel:	Station	Occurrence
Hugh M. Smith	94	1 female, 1.93 mm.
Do	132	8 females, 1.73–1.87 mm.; 3 males 1.73–1.83 mm.
Do	144	present.
Do	153	1 female, 1.67 mm.
Do	178	2 females, 1.90 mm.; 1 male, 1.80 mm.

Remarks: The genital segment of the female is slightly asymmetrical and has a group of small hair-like structures which are visible on the right side (figs. 15, 16). The terminal finger of the distal segment of the fifth foot is

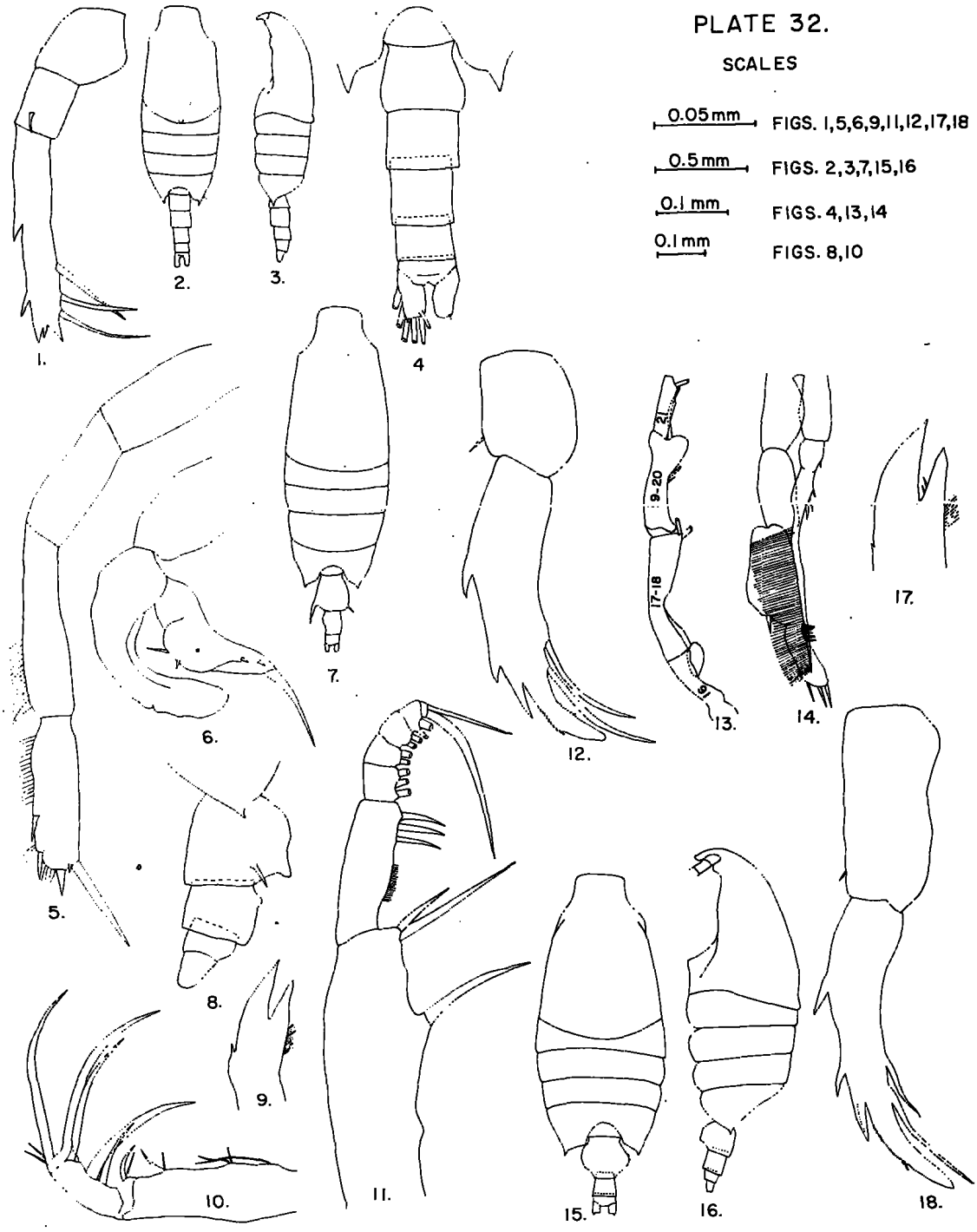

PLATE 32.—(1) *Candacia catula*, female, fifth foot; (2) male, dorsal view; (3) lateral view; (4) abdomen, dorsal view; (5) left fifth foot; (6) right fifth foot; (7) *C. bispinosa*, female, dorsal view; (8) abdomen, right side; (9) gnathal lobe of mandible; (10) second maxilla; (11) maxilliped; (12) fifth foot; (13) male, segments 16 to 21 of right first antenna; (14) fifth pair of feet; (15) *C. simplex*, female, dorsal view; (16) lateral view; (17) gnathal lobe of mandible; (18) fifth foot.

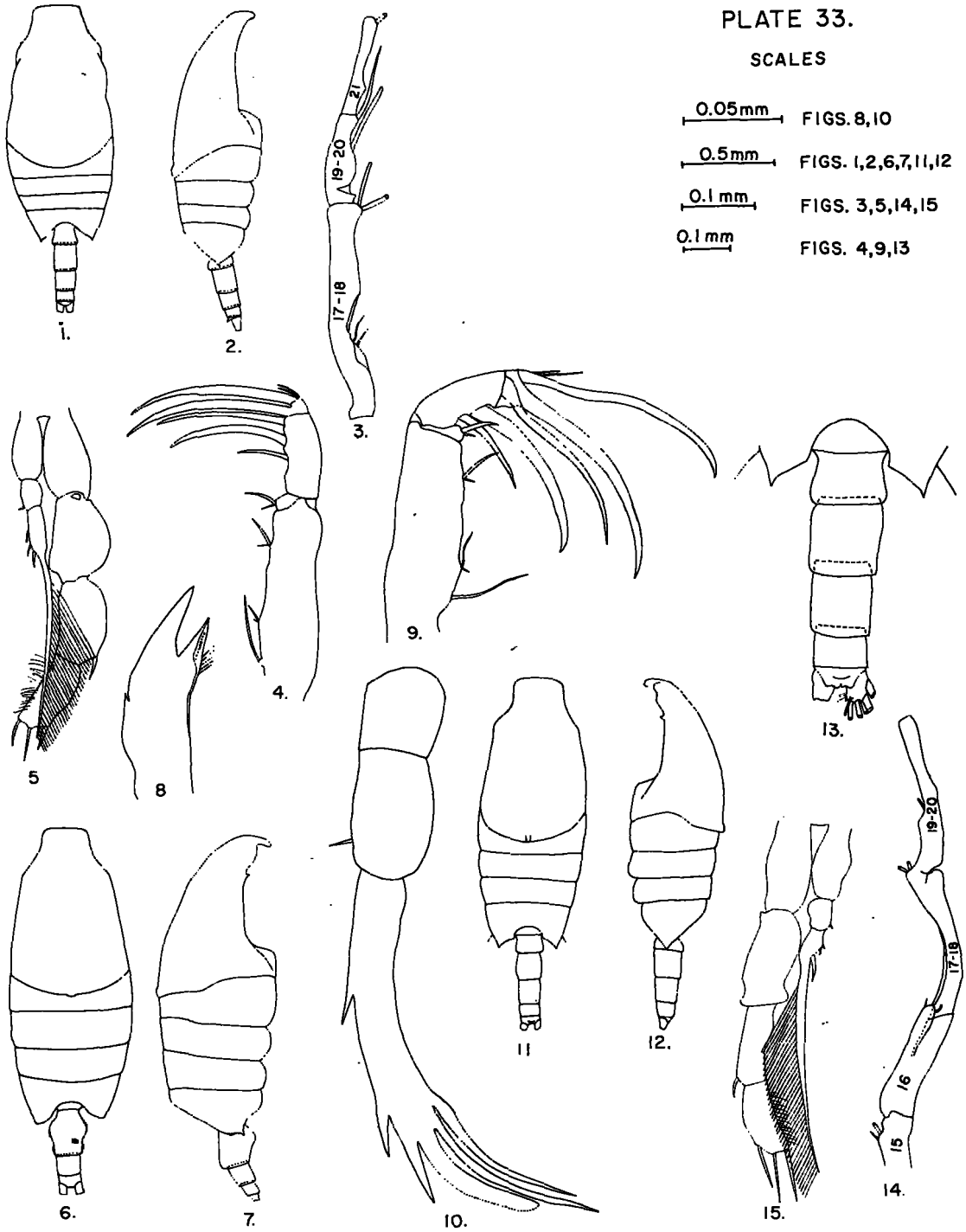

PLATE 33.—(1) *Candacia simplex*, male, dorsal view; (2) lateral view; (3) segments 17 to 21 of right first antenna; (4) second maxilla; (5) fifth pair of feet; (6) *C. truncata*, female, dorsal view; (7) lateral view; (8) gnathal lobe of mandible; (9) second maxilla; (10) fifth foot; (11) male, dorsal view; (12) lateral view; (13) abdomen, dorsal view; (14) segments 15 to 20 of right first antenna; (15) fifth pair of feet.

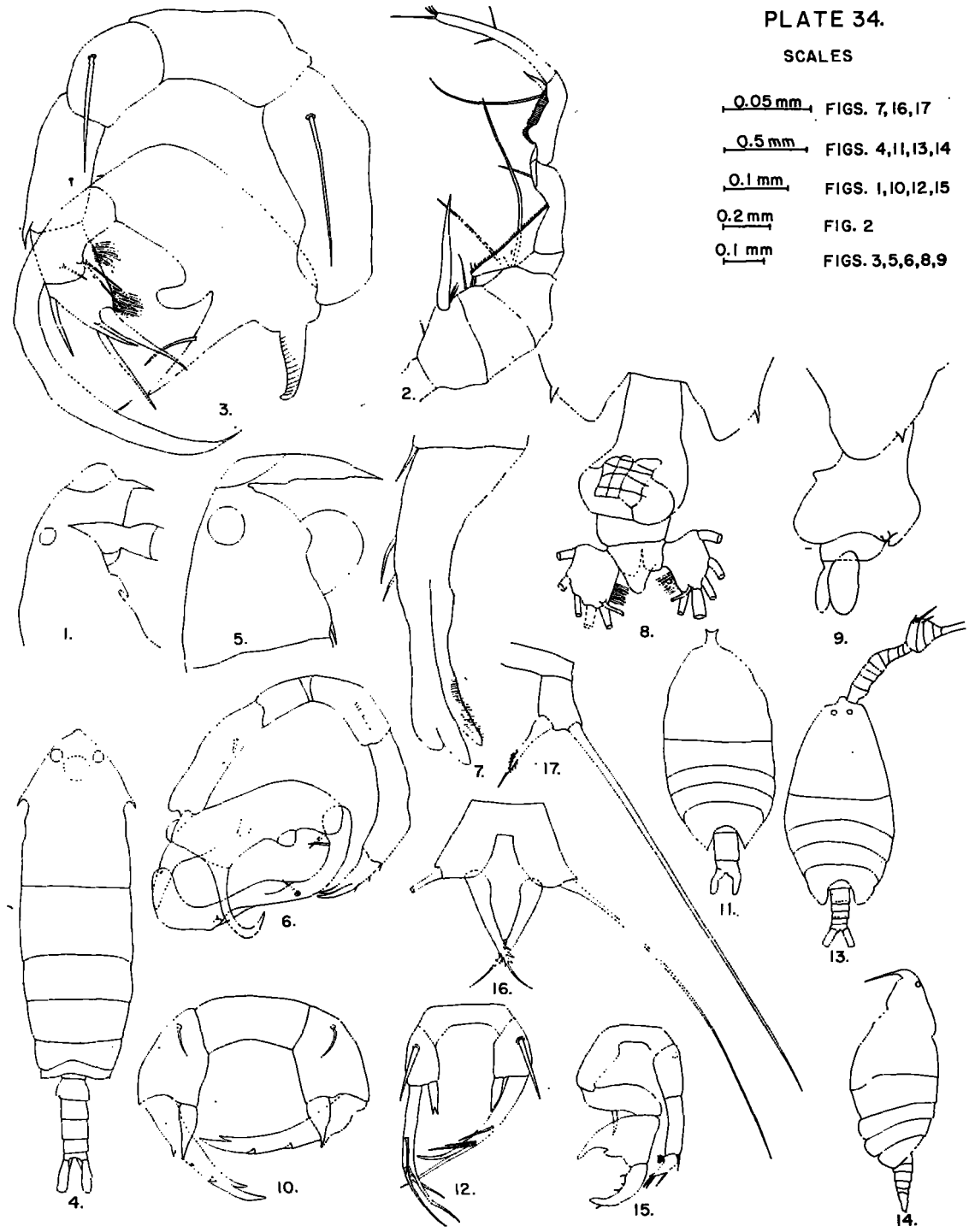

PLATE 34.—(1) *Pontella securifer*, male, forehead, lateral view; (2) distal end of right first antenna; (3) fifth pair of feet; (4) *P. tenuiremis*, male, dorsal view; (5) forehead, lateral view; (6) fifth pair of feet; (7) left fifth foot; (8) *Labidocera detruncata*, female, abdomen, dorsal view; (9) lateral view; (10) fifth pair of feet; (11) *Pontellina plumata*, female, dorsal view; (12) fifth pair of feet; (13) male, dorsal view; (14) lateral view; (15) fifth pair of feet; (16) *Acartia danae*, female, fifth foot; (17) *A. negligens*, female, fifth pair of feet.

finely serrate on the external margin (fig. 18). Of the 2 internal setae on this segment, the distal one is approximately twice the length of the proximal one. The male thorax and abdomen are symmetrical (figs. 1, 2). The right fifth foot is similar to that of *C. bispinosa* (fig. 5). The left fifth foot terminates in 3 setae, the middle one of which is the longer. The penultimate segment is not particularly enlarged.

Candacia truncata (Dana, 1849)

(PLATE 33, FIGS. 6–14)

Pacific records: Scott, 1909; Yamada, 1933a; Tanaka, 1935b; Farran, 1936; Mori, 1937; Dakin and Colefax, 1940; Mori, 1942; Wilson, 1942; Tanaka, 1953; Anraku, 1954b; Tsuruta and Chiba, 1954b; Chiba, Tsuruta, and Maéda, 1955; Motoda and Anraku, 1955; Nagaya et al., 1955; Chiba, 1956; Heinrich, 1957b; Honjo et al., 1957; Yamazi, 1958a; 1958b; Grice and Jones, 1960. As *C. turgida*: Wilson, 1950.

Vessel:	Station	Occurrence
Hugh M. Smith	132	3 females, 1.90–2.00 mm.; 2 males, 2.11 mm.
Do	153	3 males, 1.97–2.11 mm.
Do	30	present.
Do	63	1 female, 1.87 mm.
Stranger	34	7 females, 1.94–2.04 mm.; 3 males, 1.94–1.97 mm.
Orsom	10	3 females, 1.97–2.04 mm.; 1 male, 2.06 mm.
Horizon	32	11 females, 1.84–2.00 mm.; 5 males, 1.94–2.00 mm.
Satsuma	32	5 females, 1.87–1.90 mm.; 3 males, 1.87–2.00 mm.

Remarks: The female genital segment is symmetrical and finely pubescent on the lateral margins (fig. 16). The terminal finger of the distal segment of the fifth foot is finely serrate along its outer distal margin (fig. 10). The proximal seta on the internal margin is slightly shorter than the distal one. The male thorax and abdomen are symmetrical (figs. 11, 12). Segment 16 of the right first antenna is produced into an elongate process (fig. 14). The distal spine on the terminal segment of the right fifth foot (fig. 15) is considerably larger than the preceding two spines. The terminal seta on some specimens is articulated to this segment while in others it is not.

Family PONTELLIDAE

Pontella securifer Brady, 1883

(PLATE 34, FIGS. 1–3)

Pacific records: Scott, 1909; Farran, 1936; Dakin and Colefax, 1940; Wilson, 1942; 1950; Tanaka, 1953.

Vessel:	Station	Occurrence
Hugh M. Smith	30	2 females, 4.40, 4.46 mm.
Do	31	1 male, 4.40 mm.

Remarks: Both sexes have a large lens situated at the base of the rostrum. Figures of the male sex are given (figs. 1–3).

Pontella tenuiremis Giesbrecht, 1889

(PLATE 34, FIGS. 4–7)

Pacific records: Wilson, 1942; 1950.

Vessel:	Station	Occurrence
Horizon	32	1 male, 2.80 mm.

Remarks: The structure of the fifth feet (figs. 6, 7) distinguishes the male of this species from other *Pontella*. No females were found.

Labidocera detruncata (Dana, 1849)

(PLATE 34, FIGS. 8–10)

Pacific records: Scott, 1909; Yamada, 1933; Farran, 1936; Mori, 1937; Dakin and Colefax, 1940; Mori, 1942; 1950; Tanaka, 1953; Anraku, 1954b; Chiba, Tsuruta, and Maéda, 1955; Nagaya et al., 1955; Chiba, 1956; Yamazi, 1958a; 1958b.

Vessel:	Station	Occurrence
Hugh M. Smith	30	1 female, 2.72 mm.
Do	32	1 female, 2.68 mm.

Remarks: The lateral margins of the last thoracic segment (figs. 8, 9) are pointed and the genital segment is asymmetrical. These

two characters plus the structure of the fifth feet (fig. 10) will identify the female. No male was found in the present collections.

Pontellina plumata (Dana, 1849)

(PLATE 34, FIGS. 11–15)

Pacific records: Scott, 1909; Farran, 1929; 1936; Mori, 1937; Dakin and Colefax, 1940; Mori, 1942; Wilson, 1950; Anraku, 1952; Tanaka, 1953; Anraku, 1954b; Tsuruta and Chiba, 1954b; Chiba, Tsuruta, and Maéda, 1955; Motoda and Anraku, 1955; Nagaya et al., 1955; Chiba, 1956; Heinrich, 1958a; Yamazi, 1958a.

Vessel:	Station	Occurrence
Hugh M. Smith	132	1 female, 1.66 mm.; 2 males, 1.49, 1.59 mm.
Do	178	present.
Do	30	9 females, 1.43–1.84 mm.; 1 male, 1.56 mm.
Do	31	2 females, 1.62, 1.80 mm.
Do	63	present.
Stranger	34	2 females, 1.56, 1.63 mm.
Orsom	10	present.
Horizon	32	present.

Remarks: The female is distinguished by the symmetrically pointed posterior margins of the last thoracic segment (fig. 11) and the right furca. This furca is fused to the anal segment. The posterior lateral margins of the last thoracic segment of the male are rounded (figs. 13, 14) and the right fifth foot is chelate (fig. 15).

Family ACARTIIDAE

Acartia danae Giesbrecht, 1889

(PLATE 34, FIG. 16)

Pacific records: Scott, 1909; Farran, 1929; 1936; Mori, 1937; Dakin and Colefax, 1940; Johnson, 1942; Mori, 1942; Wilson, 1942; Davis, 1949; Wilson, 1950; Anraku, 1952; Tanaka, 1953; Anraku, 1954b; Motoda and Anraku, 1955; Heinrich, 1957b; Honjo et al., 1957; Heinrich, 1958a; Yamazi, 1958a; 1958b.

Vessel:	Station	Occurrence
Hugh M. Smith	94	present.
Do	132	1 female, 1.12 mm.
Do	178	present.

Remarks: The female has a large spine on the first segment of the first antennae and the posterior lateral margins of the thorax end in a large point. The external seta on the fifth foot (fig. 16) is slightly more than twice the length of the internal spine.

Acartia negligens Dana, 1849

(PLATE 34, FIG. 17)

Pacific records: Scott, 1909; Farran, 1929; 1936; Mori, 1937; 1942; Wilson, 1942; 1950; Anraku, 1952; Honjo, 1952; Tanaka, 1953; Anraku, 1954b; Tsuruta and Chiba, 1954b; Chiba, Tsuruta, and Maéda, 1955; Motoda and Anraku, 1955; Nagaya et al., 1955; Chiba, 1956; Heinrich, 1957b; 1958a; Yamazi, 1958a; 1958b.

Vessel:	Station	Occurrence
Hugh M. Smith	153	2 females, 1.05, 1.10 mm.
Do	178	present.
Do	30	10 females, 1.08–1.21 mm.
Do	31	5 females, 1.10–1.17 mm.
Do	63	present.
Stranger	34	2 females, 1.08, 1.12 mm.
Orsom	10	14 females, 1.10–1.16 mm.
Satsuma	32	present.

Remarks: In contradistinction to *A. danae*, the posterior lateral margins of the last thoracic segment have a series of very small points. The external seta on the fifth foot (fig. 17) is more than four times the length of the internal spine.

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☆U.S. GOVERNMENT PRINTING OFFICE: 1961—597171