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ERRATA

Page 912
113(114). Date of Coronephthya Utinomi is 1966.

Page 914
Caption. Insert: 16. Daniela koreni von Koch (after Stiasny, 1941).

Page 917
182(25). Colonies with a consolidated axial support composed of sclerites firmly united by horny material and/or $CaCO_3$ (except in nodes if present) but without a chambered central core.

Page 927
278(283). Genus should be: Villogorgia Duchassaing & Michelotti, 1860 (s.l.).

Page 930
306(307) and 307(308). Date of Muricea Lamouroux is 1821, not 1921.

Page 942
434(23). Second line should read:
zooids, siphonozooids and sometimes also mesozooids), anchored in soft

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GEOGRAPHIC VARIATION IN WHITE-WINGED DOVES WITH REFERENCE TO POSSIBLE SOURCE OF NEW FLORIDA POPULATION

John W. Aldrich

Abstract.—The white-winged dove (*Zenaida asiatica*) became established in southern Florida apparently from a release of 10 captive-reared pairs in 1959. Original stock is said to have been imported from Tampico, Tamaulipas, Mexico, in 1956. The new Florida population resembles native populations in the Gulf of Mexico lowlands and West Indies in being of relatively smaller size than those from other parts of the species' range in Mexico and Central America. There are slight average differences in color between populations in the Gulf of Mexico-West Indies region but the overlap is extensive and color is considered unreliable for identification. In measurements there is also great individual variation and overlap among populations, but significant differences exist between populations in certain measurements. There is so much overlap and lack of agreement in size and color characters that all populations in the Gulf of Mexico-West Indies region are considered as belonging to one subspecific taxon, *Zenaida a. asiatica*. Southern Florida specimens most closely resemble samples from Hispaniola and Cuba in combined size characters, and it is suggested that the Florida population may have originated in either of those two islands and reached Florida in avicultural trade through Tampico. Natural range extension from Cuba is considered a possibility.

The white-winged dove (*Zenaida asiatica*) is said to have become established as a breeding bird in southern Florida from a release of captive-reared individuals at Princeton, near Homestead, Dade County, Florida, by Frank M. Williams in 1959 (Saunders, 1980). There is a discrepancy between reports over the mode of release (Lovett Williams, pers. comm.), but in any case the doves apparently took up residence in Mr. Williams' avocado groves and nearby areas. By 1968 there were about 200 birds, which subsequently spread to surrounding areas (Fisk, 1968). Throughout the summer of 1970, flocks of up to 15 white-winged doves were observed regularly at widely scattered localities over a 40 square mile area of farmland and groves north of Homestead (Ogden, 1970; Owre, 1973). The species now appears to be well adapted to its new environment and has expanded its range northward along both Atlantic and Gulf Coasts of Florida to Fort Lauderdale and

Naples, possibly accelerated by captures and releases by state officials away from the point of origin (Williams, 1978).

The stock from which the southern Florida population of white-wings sprang originally was thought to have descended from six to eight birds from Venezuela and four from Mexico imported in 1954 (Fisk, 1968). However, Saunders (1980) says that he has learned through personal conversations and correspondence with aviculturalist Frank M. Williams that the four pairs of white-winged doves which were the forebears of the ten pairs released at Princeton in March 1959 were imported from Tampico, Tamaulipas, Mexico, in 1956.

The continuing doubt as to the exact native range of the ancestors of the present southern Florida population has prompted a new study of geographical variation within the species to try to find characters that will identify the Florida birds with a specific original population.

Preliminary examination of specimens of the new southern Florida population indicates that it was derived from one of the groups of relatively small white-winged doves inhabiting the eastern lowlands of Mexico, southern Texas, and the Greater Antilles. In recent years, those populations generally have been referred to the nominate race *Zenaida a. asiatica* (Linnaeus, 1758:163) with the type locality of Jamaica, West Indies (American Ornithologists' Union, 1957; Bond, 1956; Peters, 1961; Saunders, 1968a, 1968b:28). In that general area only one population, that from the Yucatan Peninsula, has been distinguished subspecifically from *Z. a. asiatica*. That population, described as having shorter wings and tail and having the back paler and grayer than *asiatica,* was named *Z. a. peninsulae* by Saunders (1968a). The type locality is San Felipe, near the mouth of the Rio Lagartos, northeastern Yucatan.

White-winged doves from Texas were described by Audubon (1844) and named *Columba trudeauii* without reference to Linnaeus' *asiatica*. Stone (1899:17) synonymized *trudeauii* with *Melopelia leucoptera* (Linnaeus, 1758:164), and that name, in turn, was considered a synonym of *Zenaida asiatica* (Linnaeus, 1758:163) by Ridgway (1916), an opinion which has prevailed since then. The type locality of *trudeauii* was restricted to the "Lower Rio Grande Valley" by Ridgway (1916).

Procedure

Having limited the probable origin of the ancestors of the new southern Florida white-wings on the basis of the general characteristics of the present birds and the alleged source of the stock, specimen samples were brought together from as many different parts of that general area as possible. These included the following samples: West Indies islands of Cuba 2 ♂, 2 ♀ and Hispaniola 7 ♂, 6 ♀; Jamaica (topotypical *asiatica*) 4 ♂, 6 ♀; southern

Florida (new population) 8 ♂, 5 ♀; southern Texas and northern Tamaulipas (representing *trudeauii*) 14 ♂, 4 ♀; southeastern San Luis Potosi and southern Tamaulipas (general area of Tampico) 10 ♂, 5 ♀; Veracruz and Tabasco (representing the southern Gulf Coast) 7 ♂, 6 ♀; Yucatan Peninsula (representing *peninsulae*) 18 ♂, 17 ♀.

The seven series of specimens were compared with each other, sex for sex, with respect to size and color. Measurements used in all comparisons were: chord of folded wing, tail length (from insertion of two central tail feathers to tip of longest feather), length of exposed culmen, tarsus, and middle toe (without claw).

All available adult specimens, irrespective of date of collection, were included in the measurements to maximize the sample size, despite the danger of including non-resident migrants. The measurements were examined to determine if migrant specimens might have distorted the results. Specimens of those populations which, because of their more southerly distributions, might be expected to include some migrants were grouped by arbitrary breeding season (April to August) and nonbreeding season (September to March). Despite what appear to be seasonal differences in a few measurements, it is believed that lumping the measurements without regard to season of the year has not distorted the overall measurement results importantly.

Differences between means for all measurements of all populations were submitted to an analysis of variance, with post-hoc testing. T-tests were employed separately to determine the significance of differences between mean measurements of certain populations and between sexes. $P < 0.05$ is considered significant. A discriminant analysis procedure (BMD07M) was also utilized to determine which of the candidate populations the southern Florida doves most closely resemble.

For color comparison only specimens taken from April to August (breeding season) were used. Comparisons were made with illumination by both "McBeth Examolite Fixture" and by natural daylight in shade.

Size Comparisons

The numbers of specimens, means, standard deviations, standard errors and ranges of measurements on which the t-tests were performed are shown in Table 1. Directions and probability of significance of differences between means of wing, tarsus, and middle toe measurements are shown in Table 2.

Sex differences in size.—Table 1 shows the probability of significant differences in mean measurements of males and females in the populations measured, as determined by the t-tests. Greater length in males is indicated in all measurements except the exposed culmen, tarsus and middle toe of Jamaican birds, but the differences are significant in only the greater length

Table 1.—Comparison of measurements (in mm) of white-winged dove population samples. Underlined probabilities of differences between sexes (L = male longer, S = male shorter) indicate significant differences.

	♂					♀					
Population	n	Range	Mean	SD	SE	n	Range	Mean	SD	SE	P
				Wing							
Jamaica	4	144.1–159.4	153.50	7.31	3.66	6	146.4–153.6	150.28	3.02	1.23	L0.4
Hispaniola-Cuba	9	149.1–159.3	155.04	3.16	1.05	8	147.2–155.3	152.70	3.23	1.14	L0.2
S. Florida	8	150.1–162.8	157.69	4.03	1.43	5	147.0–153.9	150.92	2.54	1.13	L0.01
S. Texas-N. Tamaulipas	14	152.3–163.1	155.69	3.06	0.82	4	143.8–149.0	146.78	2.17	1.08	L0.001
S. E. San Luis Potosi-S. Tamaulipas	10	150.6–158.3	155.03	2.81	0.89	5	147.0–152.3	148.66	2.14	0.96	L0.001
Veracruz-Tabasco	7	150.7–162.3	156.90	4.02	1.52	6	145.5–153.8	151.05	3.15	1.43	L0.02
Yucatan Peninsula	18	140.3–160.2	150.94	5.13	1.21	17	140.7–155.8	147.24	5.02	1.22	L0.05
				Tail							
Jamaica	4	98.7–111.1	104.60	6.26	3.13	6	86.3–98.1	95.03	4.34	1.77	L0.05
Hispaniola-Cuba	9	95.4–110.0	103.93	4.66	1.55	8	86.5–105.8	99.28	5.79	2.05	L0.1
S. Florida	8	87.5–116.2	104.25	9.81	3.47	5	97.4–105.0	100.78	2.78	1.24	L0.05
S. Texas-N. Tamaulipas	13	100.1–116.3	106.99	4.98	1.38	4	92.3–100.7	96.73	3.72	1.86	L0.01
S. E. San Luis Potosi-S. Tamaulipas	10	99.5–108.3	104.61	2.96	0.94	5	92.8–100.8	98.30	3.18	1.42	L0.01
Veracruz-Tabasco	6	96.4–111.8	106.48	5.38	2.20	6	92.4–106.3	100.35	5.41	2.21	L0.1
Yucatan Peninsula	18	91.7–115.5	103.39	6.25	1.47	17	91.8–104.4	99.44	3.98	0.97	L0.02

Table 1.—Continued.

Population	♂					♀					P
	n	Range	Mean	SD	SE	n	Range	Mean	SD	SE	
			Exposed culmen								
Jamaica	4	18.0–19.8	18.93	0.74	0.37	6	18.0–20.6	19.10	0.87	0.35	S0.9
Hispaniola-Cuba	8	19.1–20.8	19.78	0.65	0.23	8	18.1–21.7	19.68	1.04	0.37	L0.9
S. Florida	8	18.7–21.4	20.01	0.91	0.32	4	18.2–20.4	19.63	0.99	0.50	L0.9
S. Texas-N. Tamaulipas	13	18.6–22.2	20.03	1.08	0.30	3	17.1–19.7	18.57	1.33	0.77	L0.1
S. E. San Luis Potosi-S. Tamaulipas	10	18.7–21.1	20.05	0.91	0.29	5	19.0–20.2	19.64	0.46	0.21	L0.4
Veracruz-Tabasco	7	18.8–21.4	19.77	0.93	0.35	6	19.0–20.8	19.52	0.79	0.32	L0.9
Yucatan Peninsula	18	18.7–21.4	19.71	0.78	0.17	17	17.3–20.0	19.01	0.82	0.20	L0.02
			Tarsus								
Jamaica	4	23.01–25.1	23.80	0.91	0.46	6	23.0–25.7	24.37	0.90	0.37	S0.4
Hispaniola-Cuba	9	24.1–26.3	25.19	0.69	0.23	8	24.0–25.9	24.98	0.63	0.22	L0.9
S. Florida	8	25.4–27.9	26.19	0.81	0.29	5	24.8–25.8	25.30	0.35	0.15	L0.05
S. Texas-N. Tamaulipas	14	23.3–26.2	24.92	0.79	0.21	4	23.3–24.7	23.88	0.66	0.33	L0.05
S. E. San Luis Potosi-S. Tamaulipas	10	23.1–25.5	24.66	0.70	0.22	5	23.4–25.2	24.26	0.71	0.32	L0.4
Veracruz-Tabasco	7	23.9–25.5	24.94	0.77	0.29	6	23.1–24.6	23.97	0.67	0.27	L0.05
Yucatan Peninsula	18	23.3–25.9	24.29	0.79	0.19	17	23.0–25.6	23.98	0.69	0.17	L0.4
			Middle Toe								
Jamaica	4	22.1–24.8	23.08	1.59	0.80	6	22.2–24.6	23.95	0.90	0.37	S0.4
Hispaniola-Cuba	9	24.0–25.6	24.99	0.57	0.17	8	23.0–25.9	24.58	1.15	0.41	L0.4
S. Florida	8	24.9–26.5	25.73	0.49	0.18	5	23.2–25.0	24.28	0.66	0.30	L0.001
S. Texas-N. Tamaulipas	14	22.3–25.7	24.14	1.07	0.29	4	22.0–24.5	23.28	1.10	0.55	L0.2
S. E. San Luis Potosi-S. Tamaulipas	10	22.2–25.3	23.90	1.04	0.33	5	22.2–25.0	23.26	1.21	0.54	L0.4
Veracruz-Tabasco	7	23.3–25.2	23.76	0.67	0.25	6	21.5–24.0	22.60	0.86	0.35	L0.02
Yucatan Peninsula	18	21.8–26.0	24.08	1.22	0.29	17	21.2–24.7	23.02	1.08	0.26	L0.02

Table 2.—Probability of difference *P* in mean measurements of white-winged dove samples.[1] Significant differences are underlined. Populations in left column are longer (L) or shorter (S) than those to the right. Values for males in upper diagonal; those for females in lower diagonal.

Wing

Male

		Jam	Yuc	Ver	SLP	Tex	Fla	Hisp
	n	4	16	7	8	14	8	9
Jam	6	—	L0.4	S0.4	S0.9	S0.4	S0.4	S0.9
Yuc	15	S0.1	—	S0.02	S0.1	S0.01	S0.01	S0.05
Ver	6	L0.9	L0.1	—	L0.4	L0.5	S0.9	L0.4
SLP	5	S0.4	L0.1	S0.4	—	S0.5	S0.2	S0.9
Tex	4	S0.1	S-	S0.1	S0.4	—	S0.2	L0.9
Fla	5	L0.9	L0.1	S-	L0.2	L0.05	—	L0.2
Hisp	8	L0.2	L0.01	L0.4	L0.05	L0.01	L0.4	—

Female

Tarsus

Male

		Jam	Yuc	Ver	SLP	Tex	Fla	Hisp
	n	4	16	7	8	14	8	9
Jam	6	—	S0.4	S0.1	S0.2	S0.05	S0.001	S0.02
Yuc	15	S0.4	—	S0.2	S0.5	S0.1	S0.001	S0.02
Ver	6	S0.4	L0.9	—	L0.4	L-	S0.01	S0.9
SLP	5	S0.9	L0.4	L0.5	—	S0.4	S0.01	S0.2
Tex	4	S0.4	L-	S0.9	S0.5	—	S0.01	S0.5
Fla	5	L0.1	L0.001	L0.01	L0.02	L0.01	—	L0.02
Hisp	8	L0.2	L0.01	L0.02	L0.1	L0.02	S0.4	—

Female

Middle toe

Male

		Jam	Yuc	Ver	SLP	Tex	Fla	Hisp
	n	4	16	7	8	14	8	9
Jam	6	—	S0.4	S0.4	S0.5	S0.2	S0.01	S0.01
Yuc	15	S0.1	—	L0.9	L0.5	S0.9	S0.01	S0.1
Ver	6	S0.05	S0.9	—	S0.9	S0.5	S0.001	S0.01
SLP	5	S0.4	L0.9	L0.4	—	S0.4	S0.001	S0.01
Tex	4	S0.4	L0.9	L0.4	L-	—	S0.001	S0.05
Fla	5	L0.9	L0.02	L0.01	L0.2	L0.2	—	L0.02
Hisp	8	L0.4	L0.01	L0.01	L0.1	L0.1	L0.9	—

Female

---

[1] Abbreviations of populations: Jam, Jamaica; Yuc, Yucatan Peninsula; Ver, Veracruz-Tabasco; SLP, S. E. San Luis Potosi-S. Tamaulipas; Tex, S. Texas-N. Tamaulipas; Fla, S. Florida; Hisp, Hispaniola-Cuba.

of male Yucatan Peninsula wing, tail, culmen and tow; the S. E. San Luis Potosi-S. Tamaulipas wing and tail; Veracruz-Tabasco wing, tarsus and toe; the S. Texas-N. Tamaulipas wing, tail and tarsus; the S. Florida wing, tarsus and tow; and the Jamaica tail. There are no significant sex differences in Hispaniola-Cuba dove measurements.

Population differences in size.—The analysis of variance indicated that there are no significant differences between any two populations of white-winged doves measured in either tail or culmen lengths, so no further comparisons were made using those measurements. However, the analysis of variance indicated there quite probably are differences between some populations in mean wing, tarsus and middle toe lengths, as shown by the underlined percentages of probability in Table 2.

No significant differences are indicated by post-hoc tests in any measurement between Jamaica, Yucatan Peninsula or S. E. San Luis Potosi-S. Tamaulipas birds. Also, no significant differences were found between means of any measurements of S. E. San Luis Potosi-S. Tamaulipas, Veracruz-Tabasco, and S. Texas-N. Tamaulipas groups. The Hispaniola-Cuba and S. Florida series of specimens do show many significant differences from other populations, being larger in all cases, although differing from each other only in lengths of male tarsus and toe, which are longer in Florida birds; no significant differences appear between females of those two populations. The discriminant analysis confirmed the greater similarity between the S. Florida and Hispaniola-Cuba populations than between either of them and any other population. A classification procedure indicated that, on the basis of combined characters, six out of eight of the S. Florida males and four out of five of the females most closely resemble Hispaniola-Cuba specimens of the same sex, whereas two males and one female are closer to other populations.

It appears from t-tests that S. Florida and Hispaniola-Cuba populations not only resemble each other most closely, but that together they have longer wings, tarsi and toes than those of the combined populations from Jamaica, Yucatan Peninsula and S. E. San Luis Potosi-S. Tamaulipas. Veracruz-Tabasco and S. Texas-N. Tamaulipas specimens, although closer to Jamaica, Yucatan Peninsula and S. E. San Luis Potosi-S. Tamaulipas combined, are intermediate in measurements between that combined group and the combined S. Florida and Hispaniola-Cuba populations.

In attempting to sort out morphologically distinct geographical groups within the area covered in this study on the basis of measurements, we are confronted with an extremely variable and heterogeneous total population. There is a tendency for longer measurements, particularly those of wing, tarsus and middle toe, to be in the S. Florida and Hispaniola-Cuba areas, and for smaller measurements to be in the Yucatan Peninsula, Jamaica and S. E. San Luis Potosi-S. Tamaulipas groups. S. Texas-N. Tamaulipas and

Veracruz-Tabasco measurements are intermediate in various respects, but closer to the latter group.

Color Comparisons

Sex differences in color.—Females usually differ from males in slightly duller color, with the purplish hue of the crown and hindneck less pronounced or wanting, the rump less bluish gray, and the metallic gloss on the sides of the neck less distinct (noted by Ridgway, 1916, and verified in present study).

Population differences in color.—All seven geographic populations show considerable individual variation among specimens of both sexes, in addition to that caused by staining with grease and dirt. Taking the individual differences into account, when viewed in series there is an indication of geographical variation in the shade (dark or pale) and tone (grayish or rufescent) of color of the various population samples. Birds from S. Florida and Veracruz-Tabasco are alike in averaging darkest with respect to the shade of brown above and below and in the purplish coloration of the hindneck and crown. They are also relatively grayish in tone. Hispaniola-Cuba and Texas-N. Tamaulipas specimens average paler and somewhat more rufescent or buffy than S. Florida and Veracruz-Tabasco, and those from S. E. San Luis Potosi-S. Tamaulipas, Yucatan Peninsula, and Jamaica (which are quite similar to each other) average still paler and less rufescent than Hispaniola-Cuba and S. Texas-N. Tamaulipas birds. However, the color differences between all populations are slight and only discernible in mass effect of series of specimens. The individual variation between specimens in the series representing each population is so great, and the overlap in characters so complete, that it would be difficult to place most specimens in a particular population on the basis of color. In some instances the color variation may be due to plumage soiling or wear, and in others to museum age (fading or foxing). For example, the relatively pale and rufescent color of the Cuba-Hispaniola specimens may have resulted from fading and foxing during the period since collection; they were taken between 1915 and 1930. On the other hand, the recentness of collection of the S. Florida and Veracruz-Tabasco specimens (1940–1977) could have been responsible for their relatively darker and more grayish coloration. All in all, color differences noted in the specimens studied are too slight and overlapping to be a valid basis for separation of geographic populations.

Summary and Conclusions

Male white-winged doves average larger than females and are significantly larger, in all measurements except culmen, in certain populations. Males in general are more brightly colored than females.

In each of the seven geographical populations compared, sex by sex, there is considerable individual variation in both size and color, but also apparent average geographic differences in both respects. Color differences are considered unreliable. According to the analysis of variance and t-tests, the geographical differences between some populations in wing, tarsus, and middle toe are significant. No significant differences in tail or culmen were found by either test.

Although the results of the t-tests indicate three groups of populations—large, intermediate, and small, with the combined S. Florida and Hispaniola-Cuba population the largest and most distinct—the lack of agreement between measurements and color in distinguishing any two groups as well as the considerable individual variation and overlap between regional samples in these characters makes subspecific distinctions and grouping into different taxa dubious. Additional breeding specimens of all populations, but particularly from Jamaica, are necessary to demonstrate more definitely any differences or similarities that may exist between doves of the several geographic areas considered in this study. On the basis of present information it is recommended that all of the populations discussed herein remain combined in a single subspecies for which the name *Zenaida a. asiatica* (Linnaeus, 1758), originally applied to the Jamaican white-winged doves, has priority. Synonyms are: *leucoptera* (Linnaeus, 1758), *trudeauii* (Audubon, 1844), and *peninsulae* Saunders, 1968a. It should be noted that if further study shows that subspecific separation of the combined Hispaniola-Cuba-S. Florida population is warranted none of the above names would be applicable.

Although the study was not as conclusive as one might wish, it appears that the new southern Florida white-winged dove population originated from stock obtained in either Hispaniola or Cuba. It would seem quite possible that the birds were captured on one of those islands and shipped to the port of Tampico where they were obtained by Mr. Williams, the aviculturalist who liberated them or their progeny in Florida. However, we cannot be certain the pioneers of the new population, all or in part, did not find their way independently across the 100 mile wide Straits of Florida from Cuba.

It is possible that the new Florida population has evolved the distinctive characters noted for it, especially darker plumage coloration and exceptionally long tarsus and toe, in the course of becoming established in its present environment as have, apparently, the newly established eastern United States house finches (*Carpodacus mexicanus*). That population appears to have evolved a more dusky coloration and a significantly shorter tarsus and middle toe than the average of its California forebears since its first arrival on the Atlantic seaboard in 1940 (Aldrich and Weske, 1978). The fact that the new Florida white-winged dove aggregation is believed to have originated from a few hand-picked captive-reared ancestors (Saunders, 1980) suggests that the distinctive characters noted may have resulted from genetic changes during captive propagation. Further collecting and study of white-winged dove specimens in Florida as well as elsewhere will be necessary to shed additional light on these interesting possibilities.

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94(3), 1981, pp. 652–653

SHASTRINA, A NEW GENUS OF HETEROHELICID FORAMINIFERA FROM THE EOCENE OF INDIA

Richard W. Huddleston and Prabha Kalia

Abstract.—Shastrina Singh and Kalia, 1970 was established without a definite fixation of a type-species, and under the International Code of Zoological Nomenclature (ICZN) is unavailable with its original authors and publication date. The genus *Shastrina* is established here in compliance with the rules of the ICZN for the first time.

Singh and Kalia (1970) established the new foraminiferal genus *Shastrina* from the Eocene of India, assigning to it two species, *S. udbodhaka* Singh and Kalia, 1970 and *S. sundara* Singh and Kalia, 1970. However, neither species was designated as the type-species, nor was there any reference to a previously described form as being the type-species.

It is probable that Singh and Kalia (1970) intended *Shastrina udbodhaka* to represent the type-species of *Shastrina.* In the legend for plate 22, Singh and Kalia (1970:169) attached the formula "gen. et sp. nov." to *Shastrina udbodhaka,* while only labeling *S. sundara* with "sp. nov." The indication of "gen. nov., sp. nov." or its exact equivalent can only be accepted as a definite fixation of the type-species if applied before 1931 (ICZN, Article 68a). Singh and Kalia (1970:167) commented that "the type-species has one to two distinctly developed chambers of the uniserial stage," but at least one developed chamber in a uniserial stage can be observed in the illustrations of both *Shastrina udbodhaka* and *S. sundara* (Singh and Kalia, 1970; Pl. 22; Pl. 23).

The status of *Shastrina* is further complicated by the listing in Singh (1971:1173, table 2) of the names *Shastrina udbodhaka* gen. et sp. nov. and *S. sundara* sp. nov. Singh (1971) did not describe or define these forms, thus *Shastrina* Singh, 1971 is a *nomen nudum* (ICZN, Article 13a; p. 151). Neither *Shastrina udbodhaka* nor *S. sundara* can be given subsequent designation as type-species for *Shastrina* Singh and Kalia, 1970 to retain original authorship and date (ICZN, Article 69).

A similar taxonomic problem occurred with the foraminiferal genus *Meandrospiranella* Salaj, 1969. Salaj (1967) established *Meandrospiranella* and described two species, *M. samueli* and *M. irregularis,* but failed to designate which species was the type-species. This problem was later corrected (Salaj, 1969).

Family Heterohelicidae
Shastrina Huddleston and Kalia

Type-species.—Shastrina udbodhaka Singh and Kalia, 1970:167, 169; Pl. 22, fig. 3, 4; Pl. 23, fig. 7.

Diagnosis.—Diagnosis and differentiation as given in Singh and Kalia (1970:167) as follows:

"Test helicospiral, initially triserial, gradually becoming biserial and ultimately uniserial. Chambers moderately inflated, wider than long; sutures distinct, depressed, oblique in the earlier stages but straight in uniserial stage. Aperture loop-shaped with a raised border, interior-marginal in the specimens which have attained only the biserial stage, terminal and elliptical in outline in the specimens which have attained uniserial stage without any tooth or internal sophon. Wall calcareous coarsely perforate radial in microstructure; surface densely hispid."

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NEW RECORDS FOR CAPRELLIDAE IN CALIFORNIA, AND NOTES ON A MORPHOLOGICAL VARIANT OF *CAPRELLA VERRUCOSA* BOECK, 1871

Dan C. Marelli

Abstract.—Recent collections of caprellid amphipods from Humboldt Bay, San Francisco Bay, and Elkhorn Slough (a small estuary associated with Monterey Bay), California have yielded specimens of *Caprella scaura,* new to North America, and *Caprella alaskana,* representing a southern range extension. Specimens of *Caprella mutica* were also collected, and *Caprella acanthogaster humboldtiensis* is treated herein as a junior synonym of *C. mutica.* Notes are included on an undescribed morphological variant of *Caprella verrucosa.*

The caprellidean amphipods of central California are incompletely known. Dougherty and Steinberg (1953) examined caprellids from the Dillon Beach area, Moss Beach, and the Pacific Grove-Monterey areas of central California, and more recently the caprellids of the American North Pacific have been studied by Laubitz (1970) and Martin (1977). Laubitz examined the fauna from the Gulf of Alaska to southern Oregon, and Martin covered the caprellids from the Oregon-California border to Fort Bragg, California. The composition of the whole central California region caprellid fauna has not been recently studied.

During 1978 and 1979 caprellids were collected from sites in Humboldt Bay, San Francisco Bay, and Monterey Bay, California. Specimens were obtained from the entrained cooling water of steam-electric power plants at Potrero and Hunter's Points in San Francisco Bay, and at the Moss Landing power plant in Elkhorn Slough, Moss Landing, California. Collections at power plants were made approximately once a week from March 1978 through March 1979. Some specimens were also collected during the spring of 1980 at the Humboldt Bay power plant, and a small amount of material was collected by hand from the floating docks at the Oyster Point yacht harbor, San Francisco Bay.

In these collections, I found one species of caprellid previously unknown from North America, *Caprella scaura*; a southern range extension for another species, *C. alaskana*; and an undescribed morphological variant of *C. verrucosa. C. mutica* was also collected during this study, and *C. acanthogaster humboldtiensis* is treated herein as a junior synonym of *C. mutica.*

Specimens of each species have been deposited in the National Museums of Canada, Museum of Natural Sciences, Ottawa.

Caprella mutica Schurin, 1935
Figs. 1C–F

Caprella mutica Schurin, 1935:198–199, Fig. 1; 1937:27–28, Figs. 7–8.—Utinomi, 1947:75.—Stschapora, Mokyevsky and Pasternak, 1957:87.—Vassilenko, 1967:208.—McCain and Steinberg, 1970:32.—Arimoto, 1971:18.—Vassilenko, 1974:201, Fig. 119.—Arimoto, 1976:111, Fig. 59.
Caprella acanthogaster humboldtiensis Martin, 1977:154, Fig. 3.
Caprella acanthogaster sensu Carlton, 1979:433.

Material examined.—Approximately 50 adult specimens from each of Humboldt and San Francisco Bays, and approximately 30 adult specimens from Elkhorn Slough.

Discussion.—*Caprella mutica* closely resembles *C. acanthogaster* Mayer, 1890. Both are characteristically heavily spined dorsally on pereonites 3 through 7, and in both species the male pereonites 1 and 2 are elongated. In addition, the gnathopods and ventral spination in these two species are similar. However, Vassilenko (1974) lists characters by which the males of these species may be distinguished. In *C. acanthogaster* (Fig. 1A) the cephalon, pereonite 1, and pereonite 2 are not setose; the cephalon and pereonite 1 each sometimes bear one pair of dorsal ''spined teeth'' or denticles; pereonite 2 always bears one or a few pairs of dorsal denticles; spines on the ventral edge of pereonites 3 and 4 do not form a border. For *C. mutica* (Fig. 1C) Vassilenko states: cephalon, pereonite 1, pereonite 2, and gnathopod 2 setose; cephalon, pereonite 1, and pereonite 2 smooth dorsally (i.e., denticles not present); spines on the ventral edge of pereonites 3 and 4 form a border.

I examined a 15.6 mm male specimen of *Caprella acanthogaster* from the Zoologisches Museum, Hamburg (Fig. 1B) (syntype ex K-21884b) which had listed as its locality Amur, China. This specimen had the following characteristics: cephalon, pereonite 1, and pereonite 2 not setose; cephalon and pereonite 1 smooth dorsally; pereonite 2 with 1 pair of small spines dorsally. The ventral spines on pereonites 3 and 4 did not give the impression of a border, but the ventral spines were more prominent than the dorsal spines found on pereonites 3 and 4. In addition, the gills of this specimen were long and slender. In the material examined from California, the males have the following characteristics: cephalon, pereonite 1, and pereonite 2, as well as gnathopod 2, setose, especially in larger specimens; cephalon and pereonite 1 smooth dorsally; pereonite 2 occasionally with 1 pair of small spines postero-dorsally in larger males. The ventral spines on pereonites 3 and 4 are less prominent than the dorsal spines on these pereonites, and the gills are oval, not long and slender (Fig. 1C). Some large (about 20 mm) paratype males of *C. acanthogaster humboldtiensis* Martin, 1977 were examined and have the following characteristics: cephalon, pereonites 1 and

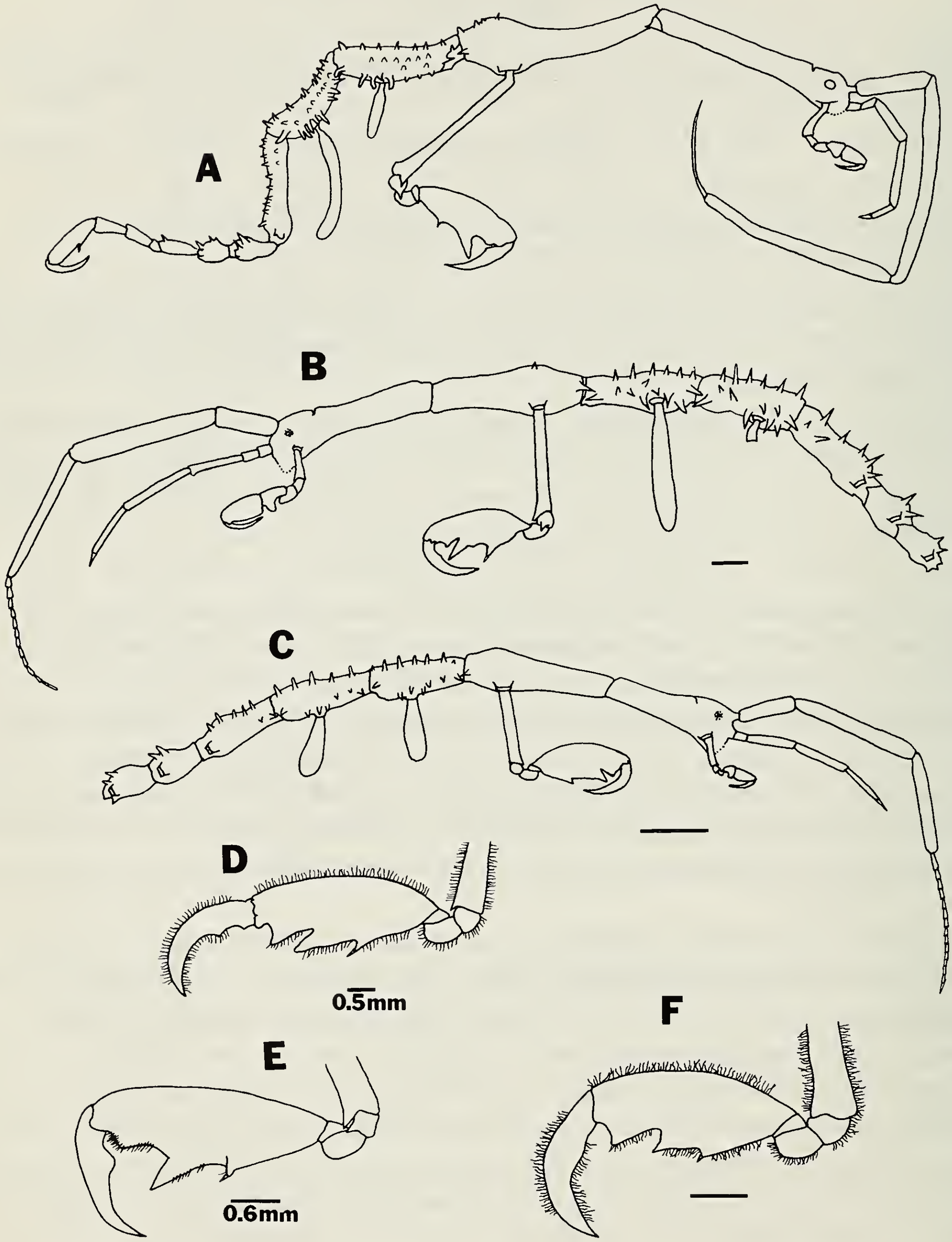

Fig. 1. A, *Caprella acanthogaster,* lateral view of male after Mayer, 1903; B, *C. acanthogaster,* lateral view of paratype from Hamburg Museum; C, *C. mutica,* lateral view of typical male collected from California; D, *C. mutica,* second gnathopod of a typical male collected from California; E, *C. acanthogaster,* second gnathopod of male after Vassilenko, 1974; F, *C. mutica,* second gnathopod of male after Vassilenko, 1974. Scale bars equal 1 mm except where otherwise noted.

2, and gnathopod 2 very setose; cephalon and pereonite 1 smooth dorsally; pereonite 2 with 1 pair of small spines dorsally. The ventral spines on pereonites 3 and 4 are less prominent than the dorsal spines on those pereonites, and the gills are oval, not long and slender.

Arimoto (1976) has described and illustrated both *Caprella mutica* and *C. acanthogaster* s.s. The description and figures he included for *C. mutica* are, for the most part, from Schurin (1935), and the material Arimoto examined was limited to one immature male. Therefore, Arimoto's information on *C. mutica* is of little use in the further diagnosis of *C. mutica* and *C. acanthogaster.* The description and figures of *C. acanthogaster* contained in Arimoto (1976) are more useful, since many specimens were examined, and since the figures provided depict mature specimens of various sizes from several localities. Arimoto (1976) describes the second pereonites of male *C. acanthogaster* as being setose distally, and the second gnathopod as sometimes being setose. He also states that the cephalon bears a pair of small spines, that pereonite 1 is smooth dorsally, and that pereonite 2 bears 4 pairs of spines dorsally.

Mayer (1903) describes *Caprella acanthogaster* males as having pereonite 2 and gnathopod 2 setose, and further states that pereonite 1 is smooth dorsally, but that pereonite 2 occasionally has a tubercle dorsally. Mayer's description is interesting, since he identified the syntype of *C. acanthogaster* in the Hamburg Museum.

I have not been able to locate type-material or specimens of *Caprella mutica,* but in comparing the available descriptions and figures of *C. mutica* with descriptions, figures, and specimens of *C. acanthogaster* and *C. acanthogaster humboldtiensis,* I discovered another difference in species character states. The second gnathopods of *C. acanthogaster* and *C. mutica,* although similar, show distinct differences. That of the *C. acanthogaster* syntype has an extremely large tubercle bearing the poison spine. The tubercle which bears the poison spine on the specimens collected in the present study and on those collected by Martin (1977), although large (especially in more mature males), is not nearly as large in comparison to the size of the propodus as is that of *C. acanthogaster* (Fig. 1D). This observation is supported by Vassilenko's (1974) figures, which indicate the differences between the second gnathopods of *C. acanthogaster* and *C. mutica* males (Figs. 1E and 1F), and also by Arimoto's (1976) figures. Vassilenko (1974) and Arimoto (1976) also figure the long, slender gills of *C. acanthogaster* which were noted on the syntype.

The foregoing descriptions and observations lead to the following conclusions: the specimens collected in Humboldt Bay, San Francisco Bay, and Elkhorn Slough are identical in appearance to those collected by Martin

(1977) in Humboldt Bay; that these specimens are specimens of *Caprella mutica,* and therefore that *C. acanthogaster humboldtiensis* Martin, 1977 is a junior subjective synonym of *C. mutica* Schurin, 1935. It is also apparent that, although similar in appearance, *C. mutica* and *C. acanthogaster* s.s. are distinct species, and Vassilenko (1974) separated them correctly on the basis of anterior setation, ventral spination, gnathopod morphology, and gill morphology outlined herein. Arimoto's (1976) descriptions seem to contradict somewhat the diagnosis of Vassilenko (1974). Arimoto has described *C. acanthogaster* as sometimes being setose anteriorly, and in his Fig. 91 has depicted both a setose male, and a non-setose male. The setose male also has a dorsally smooth pereonite 2, and possesses gills which are much shorter and more oval that those of the similarly sized non-setose male. Additionally, the second gnathopods of the males figured by Arimoto (1976) are somewhat different, with the second gnathopod of the non-setose specimen appearing very much like that on the syntype of *C. acanthogaster.* Not having seen Arimoto's specimens, one cannot make a definite judgement, but the illustrations seem to indicate that Arimoto (1976) described and illustrated *C. acanthogaster* from a mixed lot of *C. acanthogaster* and *C. mutica.*

The presence of dorsal spines on the first pereonite in *Caprella acanthogaster* is probably significant, even though they are not always present; however, I believe that the dorsal spines on the second pereonite are less reliable. It appears that pereonite 2 always has at least 1 pair of dorsal spines in *C. acanthogaster,* and that pereonite 2 in *C. mutica* is smooth dorsally, although occasionally possessing 1 pair of small dorsal spines (possibly only in larger specimens). Laubitz (1970) has noted that body spination is often variable, and that more thorough studies should include examinations of the mouthparts, therefore I plan to compare the mouthpart morphologies of *C. mutica* and *C. acanthogaster* as well as further examine other characters in a future study.

Remarks.—Martin (1977) has reported the introduction of this species (as *Caprella acanthogaster humboldtiensis*) into California, probably from Japan, and Carlton (1979) has noted its presence in San Francisco Bay. Carlton (1979) uses the name *C. acanthogaster* for this species, but since he is referring to *C. acanthogaster humboldtiensis* of Martin (1977), this *C. acanthogaster* is synonymous with *C. mutica.* I have not seen specimens of *C. acanthogaster* s.s. in San Francisco Bay.

The collections made for the present study extend the known range of *Caprella mutica* in California southward to Monterey Bay. Its total range at present includes the Sea of Japan (McCain and Steinberg, 1970; Arimoto, 1976), Humboldt Bay (Martin, 1977), San Francisco Bay (Carlton, 1979), and Monterey Bay, California.

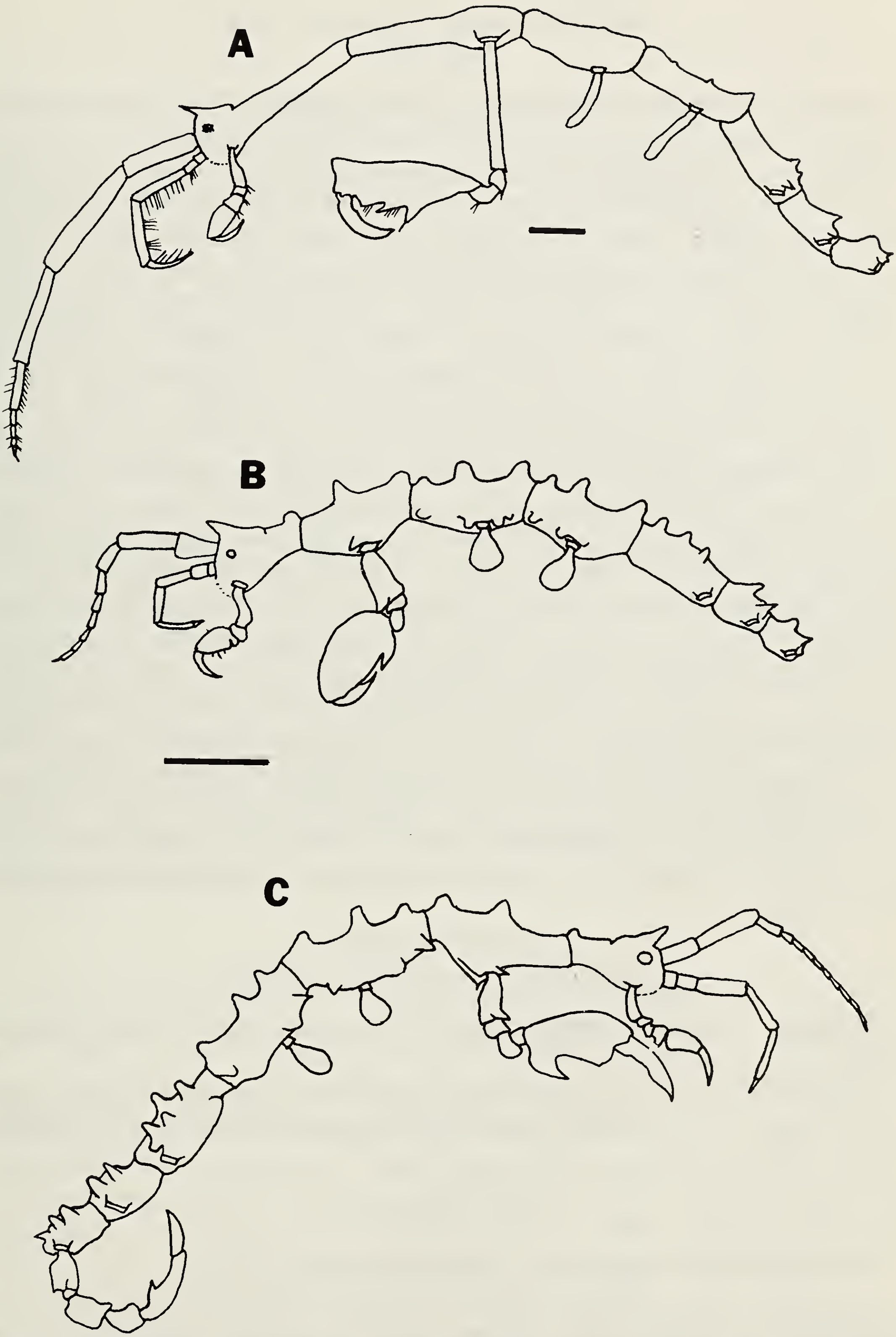

Fig. 2. A, *Caprella scaura,* lateral view of typical male from California; B, *C. verrucosa,* lateral view of a typical specimen after Laubitz, 1970; C, *C. verrucosa,* lateral view of a specimen with a ventral spine after Mayer, 1903. Scale bars equal 1 mm.

Caprella scaura Templeton, 1836
Fig. 2A

Material examined.—Approximately 25 specimens from San Francisco Bay, and approximately 10 specimens from Elkhorn Slough.

Discussion.—Specimens of this species were compared with 4 specimens of *Caprella scaura* from the British Museum, and with descriptions and figures in McCain (1968), Vassilenko (1974), and Arimoto (1980). In addition, Diana Laubitz examined specimens from San Francisco Bay, and confirmed that they were indeed *C. scaura.* This species closely resembles a common central California species, *C. californica,* but differs in the absence of a ventral spine between the insertions of the second gnathopods, and the possession of 2 pairs of short dorsal tubercles on pereonite 5 (Fig. 2A).

Remarks.—The collection of *Caprella scaura* in San Francisco Bay and Elkhorn Slough represents a new California and North American record for the species. It has previously been reported from: St. Croix and St. Barthélemy, Virgin Islands; Cocos Island, Costa Rica; Mayaguez, Puerto Rico; Ilha Sao Sebastiano, Santa Catarina, Victoria, Rio de Janeiro and 28°S, Brazil; Mjillones, Chile; Cumberland Bay, Isla Mas a Tierra, Juan Fernandez Isles; Hoshu, Kyushu and the Inland Sea, Japan; Vladivostok; Sydney and Kangaroo Island, Australia; Riviere Noire, Mauritius; and South Africa (McCain and Steinberg, 1970). It is not known if this new record represents an introduction to California, since *C. scaura* may be easily confused with *C. californica,* but the possibility of an introduction cannot be ruled out.

The specimens of *Caprella scaura* collected during this study resemble *C. scaura typica* of Arimoto (1980). However, McCain (1968) lists *C. scaura* var. *typica* as a variety of *C. scaura* s.s., and I have followed his designation in this paper.

Caprella alaskana Mayer, 1903

Material examined.—Approximately 10 specimens from San Francisco Bay.

Discussion.—This species is characterized by extremely variable spination (Laubitz, 1970; Martin, 1977), and immature stages can be confused with *C. ferrea.* However in the adult stage *C. alaskana* is much more slender than *C. ferrea,* and *C. ferrea* bears a pair of small tubercles on the cephalon (Laubitz, 1970). If dorsal tubercles are present on *C. alaskana,* the tubercle on the cephalon is unpaired (Laubitz, 1970).

Remarks.—The collection of *Caprella alaskana* in San Francisco Bay represents a southern range extension for this species, previously known from the Aleutian Islands to Trinidad Bay, California (Laubitz, 1970; Martin, 1977).

Caprella verrucosa Boeck, 1871
Fig. 2B, C

Material examined.—Approximately 25 specimens from San Francisco Bay, and 10 specimens from Elkhorn Slough.

Discussion.—*Caprella verrucosa* is a very distinctive species, bearing a triangular cephalic projection and large dorsal tuberculations on all pereonites (Fig. 2B). This species generally does not possess a ventral spine between the insertions of the second gnathopods, but many specimens from San Francisco Bay and Elkhorn Slough were found to have such a spine. This condition has not been previously reported, although Mayer (1903:Fig 2C) figured a specimen which appears to have a ventral spine, and the syntype in the collection of the California Academy of Sciences (CASIZ type-series # TY 00156 syntype male) also possesses such a spine. Laubitz (personal communication) has noted the presence of a ventral spine on specimens of *C. verrucosa* from the Friday Harbor, Washington area, and states that the spine seems to be present on specimens from protected waters. It is my observation that the size of the spine decreases with increasing body size. It is not known whether the spined form is an ecotype or an ecophenotype, and therefore the term morphological variant is used here. Further study will be necessary in order to determine whether the observed variation is genetic or is a result of environmental expression.

Remarks.—The presence of a ventral spine on *Caprella verrucosa* seems to have little significance, except that in current taxonomic keys (e.g., Laubitz, 1970; McCain, 1975; Martin, 1977) the presence of this character may cause an individual not familiar with the Caprellidae to make an erroneous species determination.

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I wish to thank Diana Laubitz of the National Museums of Canada for her kind assistance with some of the species determinations. I would also like to thank Jon D. Standing for his invaluable suggestions, and Dustin Chivers of the California Academy of Sciences who provided access to collections and offered many helpful recommendations.

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ONUPHIS SIMONI, A NEW SPECIES OF POLYCHAETE (POLYCHAETA:ONUPHIDAE) FROM SOUTH FLORIDA

Stuart L. Santos, Randy Day, and Stanley A. Rice

Abstract.—A new species of the polychaete genus *Onuphis, O. simoni,* is described from the shallow estuarine habitat throughout south Florida. The new species most closely resembles *Onuphis nebulosa* Moore, 1911.

Several ecological studies dealing with Florida's west coast (Taylor, 1971; Simon and Dauer, 1972; Santos and Simon, 1974; Dauer and Simon, 1975, 1976; Santos, 1979) revealed that a species of onuphid polychaete was a major component of the benthic infauna. This same species was collected from the Indian River Lagoon on the east coast of Florida (Virnstein *et al.*, unpublished; Santos, unpublished). Examination of the literature and the specimens indicated that they belonged to an undescribed species. This species is described in the present paper.

Onuphis simoni, new species
Fig. 1a–e

Onuphis eremita oculata.—Santos and Simon, 1974.—Dauer, 1974.
Onuphis sp.—Taylor, 1971.—Simon and Dauer, 1977.—Santos and Simon, 1980.—Dauer and Conner, 1980.

Material examined.—FLORIDA: West Coast: Seahorse Key near Cedar Key, 1960, J. L. Taylor, 250 specimens (FSBC I 22163). Boca Ciega Bay, 25 September 1963, J. L. Taylor and C. Saloman, 44 specimens (FSBC I 13315). Lower Tampa Bay, 19 October 1963, J. L. Taylor and C. Saloman, 194 specimens (FSBC I 12815). Tampa Bay, 1963, J. L. Taylor, 8 specimens (USNM 45592). Lassing Park, St. Petersburg, 24 January 1970, S. L. Santos, 5 specimens (USNM 55719) and 3 specimens (USNM 50268). Upper Tampa Bay, 10 September 1963, J. L. Taylor and C. Saloman, 17 specimens (FSBC I 12014). Upper Tampa Bay, Courtney Campbell Causeway, ca. 4 km west of the Ben T. Davis municipal beach, ca. 50 m offshore, 22 February 1980, S. L. Santos, R. Lombardo and G. Churchill, holotype (USNM 61098), 35 paratypes (USNM 61099) and 10 paratypes (Allan Hancock Foundation POLY 1326). Big Pine Island, Ft. Meyers, 27 November 1959, R. T. Paine, 10 specimens. Rookery Bay, 5 April 1980, S. L. Santos, L. S. Weinland and K. Thoemke, 21 specimens. Isles of Capri, Big Marco Pass, 28, 29 or 30

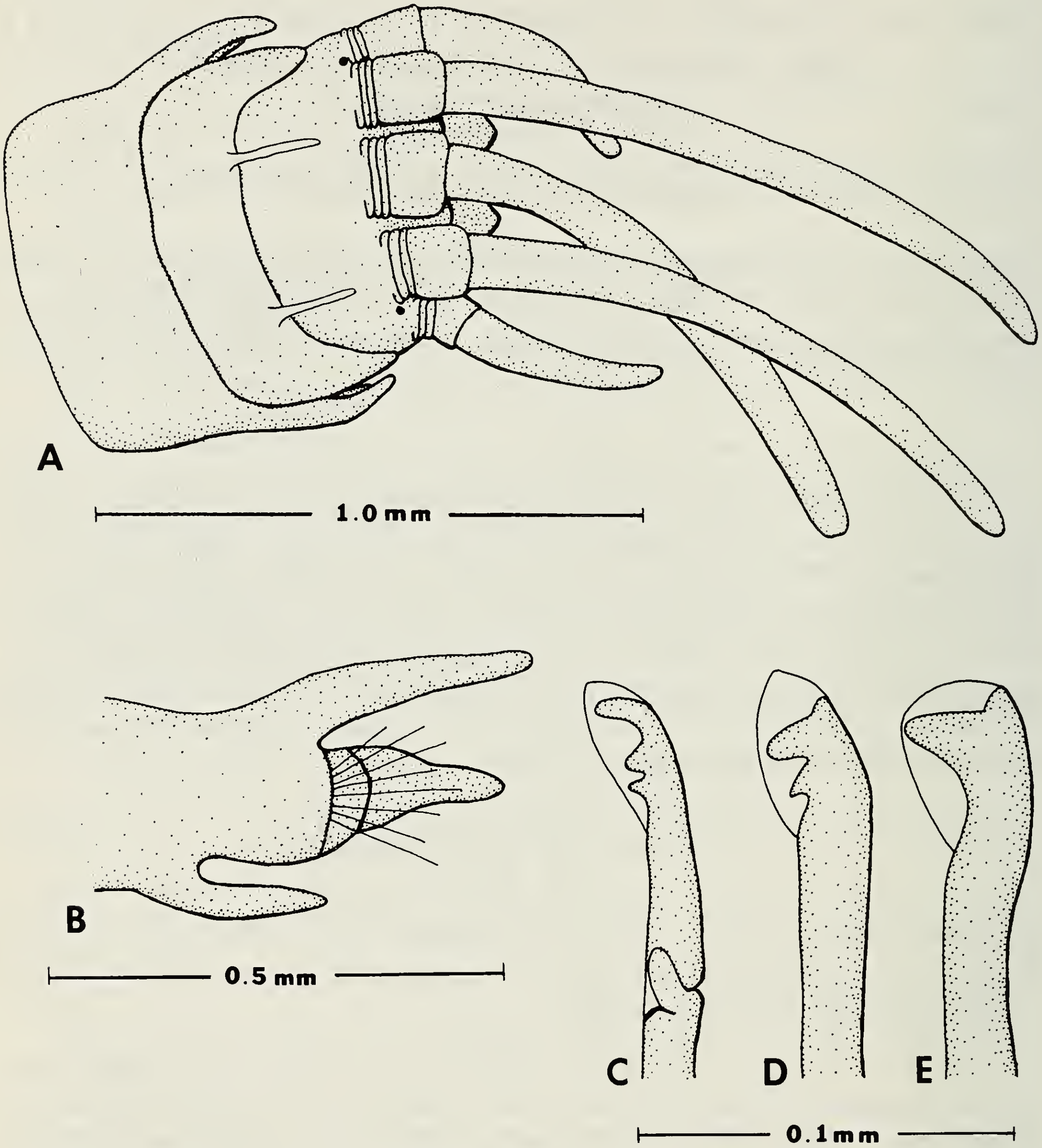

Fig. 1. *Onuphis simoni*: A, Anterior end, dorsal view; B, Third parapodium, left side, anterior view; C, Pseudocompound hooded hook from setiger 2; D, Large simple tridentate hooded hook from setiger 6; E, Subacicular bidentate hooded hook from setiger 18.

December 1965, C. D. Long, 4 specimens (USNM 58168). East Coast: Indian River Lagoon: near St. Lucie Inlet, 10 April 1980, S. L. Santos, 1 specimen. One-half mile south of Sebastian Inlet, 13 February 1980, K. Fauchald and S. L. Santos, 5 specimens and 10 March 1980, S. L. Santos and S. A. Rice, 5 specimens. One-half mile south of Goat Creek, 1979, K. Cairns, M. Capone, P. Mikkelsen and R. W. Virnstein, 3 specimens.

Description.—Length of holotype 49.6 mm, width (including parapodia but not setae) 1.04 mm, specimen complete, comprising more than 240 seg-

Table 1.—Summary statistics on variable characters of *Onuphis simoni*. Specimens chosen for examination represent a cross section from all recorded geographic locations. In all cases n = 22.

	Range	Mean	Standard deviation
Width at widest point (including parapodia)	0.80–1.44 mm	1.15	0.17
Branchiae			
Start on setiger #	6–8	6.55	0.60
Maximum filaments	4	invariant	
Cirriform ventral cirri to setiger #	6–8	7.36	0.95
Anterior pseudocompound hooks to setiger #	4–6	4.57	0.58
Large hook starts on setiger #	4–6	4.84	0.47
Subapicular hooded hooks start on setiger #	14–18	16.64	1.14

ments. Anterior 8–10 segments cylindrical, median and posterior segments dorsally flattened. Anterior of holotype with dark pigment spots at dorsolateral intersegmental junctions, transforming to dorsal segmental transverse bars at about setiger 14.

Prostomium (Fig. 1a) small, oval with 2 triangular frontal antennae; 5 occipital antennae with short ceratophores, each having 4 annulations, distalmost being 2–3 times longer than the other 3 combined. Brown pigment ring present at base of styles. Inner lateral occipital antennae longest, reaching to about midlength of setiger 5; median occipital antennae slightly shorter, reaching to setiger 4; outer lateral occipital antennae shortest, only reaching to about setiger 2. Pair of small eyespots between bases of inner and outer lateral occipital antennae. Pair of globular ventral palps and a pair of short peristomial cirri present.

First 2–3 pair of parapodia directed forward. Anterior 12 parapodia with ovoid presetal, rounded acicular and conical postsetal lobes (Fig. 1b), following parapodia with acicular and postsetal lobes becoming shorter. Dorsal cirri digitate, longer than postsetal lobe; longest in anterior 10–15 setigers, becoming shorter thereafter. Ventral cirri cirriform in anterior 6–8 setigers, transitional in next few, and appearing pad-like in remainder.

Branchiae first present from setigers 6–8 (Table 1); first several branchiae single filaments, increasing to a maximum of 4 filaments posteriorly and decreasing to 2 in the far posterior segments.

Pygidium with 2 pairs of anal cirri, both located ventral to anus; dorsalmost pair about 4 times as long as ventral pair. Ventral pair difficult to discern in some specimens.

Limbate and pectinate setae, pseudocompound, large simple and subacicular hooks present. Limbate setae present in most setigers, pectinate setae first present from setigers 4–17, number of teeth varying from 6–11, normally one seta per bundle (1 specimen contained 2 in setiger 6). Tridentate pseudocompound hooded hooks (Fig. 1c) present in first 1–4, 5 or 6 setigers (Table 1), distal tooth larger than others. One large tridentate hooded hook present from setigers 4, 5 or 6 to setigers 14, 15, 16 or 17 (Table 1); shaft 2–3 times as thick as pseudocompound hooks, distal tooth erect. Pair of bidentate hooded subacicular hooks (Fig. 1e) present from setigers 15–18 (Table 1) and continuing to far posterior segments.

Maxillary formulae based on dissection of a large specimen is:

$$1 + 1,\ 10 + 11,\ 10 + 0,\ 5 + 9,\ 1 + 1$$

Biology.—*Onuphis simoni* constructs a tube of fine sand grains, resembling a limp phoronid tube. It is found in the shallow subtidal often in high densities (up to 78,000/m^2) especially in *Thalassia* beds (Santos and Simon, 1974). The female lays her eggs in the tube and broods the young until they are able to build tubes of their own (usually until they reach a size of 10–20 setigers, SLS, personal observation).

Type-locality.—Old Tampa Bay, Tampa, Florida, USA, ca. 4 km west of the Ben T. Davis municipal beach, ca. 50 m offshore in fine sand.

Distribution.—West Coast of Florida from Sea Horse Key south to Naples; East coast of Florida in the Indian River Lagoon.

Etymology.—This species is named in honor of Dr. Joseph L. Simon, our former graduate advisor, in recognition of his contributions to the fields of Marine Ecology and Invertebrate Zoology.

Remarks.—Examination of specimens from many localities revealed a high degree of variability in certain characters, especially in the pigmentation patterns and in placement and number of teeth in the pectinate setae. Some individuals were very heavily pigmented on the dorsal surface of the prostomium and the first 3 setigers; others were not pigmented at all on these surfaces save for the eyespots. In still others, the transverse segmental bands started anteriorly and gradually transformed into dark intersegmental spots located on the dorsolateral surface. We examined the pectinate setae of several individuals with scanning electron microscopy and found extreme variability both as to the anteriormost placement and to the number of teeth. The anteriormost placement ranged from the fourth to the seventeenth setiger; number of teeth ranged from 6–11 with no apparent pattern (i.e. tooth number was not consistent in individual specimens nor in an anterior-posterior gradient). We feel that the pectinate setae are very fragile and easily lost in preserved specimens of *O. simoni*; therefore, we do not advocate the use of this character nor that of pigmentation for a specific diagnosis. While these may be strong characters in some onuphid taxa, we chose to ignore them. Table 1 presents some of the characters used by other investigators to delineate species of *Onuphis,* and the variability of these characters in *O. simoni* collected from various localities throughout its known range.

Because we did not find characters consistently varying, we did not feel that we were dealing with more than one species.

Superficially, *O. simoni* most closely resembles *O. nebulosa* Moore, 1911. It is distinguished from *O. nebulosa* by being about half as large, by the more anterior origination of the subacicular hooks, and by the total absence of compound spinigers.

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AN ADDITION TO THE FISH FAUNA OF THE GULF OF MAINE WITH RECORDS OF RARE SPECIES

Hugh H. DeWitt, Paul A. Grecay, John S. Hacunda, B. Paul Lindsay, Richard F. Shaw, and David W. Townsend

Abstract.—*Xenolepidichthys dalgleishi* is reported for the first time in the Gulf of Maine; other fishes rare in the Gulf of Maine are reported.

Since the fall of 1969 the first author and various of his students have maintained a file on the occurrences of rare and unusual fishes in the Gulf of Maine, both of specimens collected by or turned over to them, and of reports from friends. Most of the records concern species well known south of the Gulf, but which have been reported from it only a few times. For some species the records are more significant. *Lampris guttatus* and *Sphyraena borealis* are here reported for the first time from well within the Gulf, and *Xenolepidichthys dalgleishi* is added to the fauna of the Gulf.

We have used the order and nomenclature given by Robbins *et al.* (1980). Unless otherwise noted, specimens are in the fish collection at the Ira C. Darling Center of the University of Maine, Orono (UMDC).

We wish to thank the fishermen who have either saved the ''odd'' specimens for us, have made photographs and other information available, or who have given of their time and hospitality. Mr. William Townsend of East Sullivan, Maine, sent us records of sightings and specimens from eastern Maine.

Xenolepidichthys dalgleishi Gilchrist, spotted tinselfish

Two specimens, 78.7 and 79.1 mm SL, were collected in shrimp trawls as follows: 6 mi S of Small Point, Maine (ca. 43°36′N, 69°50′W), in 90–100 m, 3 January 1975, by Lester Savage (UMDC 383-1); and 12 mi S of South Bristol, Maine (ca. 43°40′N, 69°33′W), in 100–160 m, 26 March 1976, by Bruce Morton (UMDC 382-1). This species has been recorded once from the continental shelf off the New Jersey coast by Fowler (1937) who misidentified it as *Grammicolepis brachiusculus* Poey. It has been recorded elsewhere from waters of South Africa, British Honduras, southern Brazil, Japan, the Philippines (Karrer, 1968) and the western Caribbean (Mowbray, in Breeder, 1927, as *G. squamilineatus*; Bullis and Struhsaker, 1970). Unreported collections have been made in the northern Gulf of Mexico. The present specimens are the first from the Gulf of Maine and were obtained

Table 1.—Measurements and counts from two specimens of *Xenolepidichthys dalgleishi* from the Gulf of Maine.

UMDC Cat. No.	383-1	382-1		383-1	382-1
Measurements (mm)			Counts		
Standard length	78.7	79.1	1st dorsal fin	V	V
Head length	24.9	24.4	2nd dorsal fin	27	28
Orbital diameter	10.7	11.7	Anal fin	II, 28	II, 28
Snout length	7.3	7.5	Caudal fin	15	15
Interorbital width	6.8	7.4	Pectoral fin	15 and 15	14 and 14
Cheek depth	7.2	7.7	Pelvic fin	I, 6	I, 6
Anal fin base length	47.1	48.4	Dorsal body spines	31	31
Dorsal fin base length	44.0	47.7	Ventral body spines	27	27
Body depth[1]	63.8	70.6			
Caudal peduncle length	9.7	8.8			
Caudal peduncle depth	4.6	5.0			
Dorsal peduncle length[2]	11.0	10.6			
Snout to dorsal origin	38.7	41.9			
Snout to anal origin	54.8	56.1			
Pectoral to 1st anal spine[3]	29.2	30.7			
Pectoral to pelvic distance[3]	21.8	24.7			
Caudal fin length	20.0	17.7			

[1] From base of 1st dorsal spine to base of 1st anal spine.

[2] From base of last dorsal fin ray to midbase of caudal fin.

[3] From lower edge of pectoral base to base of 1st anal spine or pelvic fin.

more than 200 miles inside the edge of the continental shelf. Because the species is not common anywhere and the present records represent a range extension of some 650 km, some counts and measurements are presented in Table 1. A related species, *Daramattus americanus,* has been described from the outer portion of Georges Bank (Nichols and Firth, 1939; Bigelow and Schroeder, 1953; Robbins *et al.,* 1980). It can be distinguished from *X. dalgleishi* in having flat, blade-like projections, composed of scales, on the sides of the body.

Lampris guttatus (Brünnich), opah

A specimen (96.5 cm SL, 52 kg) was found washed ashore on Great Cranberry Island, Maine (ca. 44°14′N, 68°15′W), on 14 December 1979 by Karl Wedge and Wesley Bracey, Jr. Measurements and photographs were obtained and the specimen was discarded. This pelagic species (Fowler, 1933) is rare but widely distributed in open waters of the Atlantic and Pacific (Jordan and Evermann, 1896–1900; Smith, 1961) and is frequently taken off the coast of Europe (Jordan and Evermann, 1905). Previous Gulf of Maine records include one each from Browns Bank in 1932 and Georges Bank in 1947 (Bigelow and Schroeder, 1953). This is the first reported occurrence from the inner Gulf of Maine.

Centropristis striata (Linnaeus), black sea bass

One (identified from a photograph, specimen discarded) was collected in a lobster trap near Baker Island, Maine (ca. 44°16′N, 68°15′W), on 30 January 1973 by Wesley Bracey, Jr., Great Cranberry Island, Maine, and one ripe male (29.5 cm SL) was collected in the same manner on 15 October 1980, south of White Island (ca. 43°46′N, 69°34′W) in approximately 60 m by Lawrence Lane, Nobleboro, Maine (UMDC 381-1). The species is known from Atlantic coastal waters from northern Florida to Cape Cod and occasionally Maine (Bigelow and Schroeder, 1953). It is occasionally taken during summer in the Gulf of Maine, but is considered rare; Pemaquid Point and Matinicus Island, Maine, are the northernmost records (Bigelow and Schroeder, 1953). Those reported here are the only known specimens collected during winter and fall in the Gulf of Maine.

Pogonias cromis (Linnaeus), black drum

One specimen (116 cm TL, 27.3 kg) was collected on 14 July 1978 by Paul Callahan of South Bristol, Maine, in a floating mackerel trap in 7–13 m in Johns Bay, Maine (ca. 43°50′N, 69°31′W). The specimen was discarded. The species ranges from Argentina northward to New Jersey (Silverman, 1979), rarely to southern New England (Bigelow and Welsh, 1925), with a single specimen reported from the Bay of Fundy (Bleakney, 1963). Previous Gulf of Maine records include two or three specimens from Provincetown, Massachusetts, one specimen from the Mystic River, Boston (Bigelow and Welsh, 1925), and one specimen taken from a fish weir in Halls Harbor, Bay of Fundy, Nova Scotia, in 1947 (Bleakney, 1963). This is the third reported specimen north of Cape Cod.

Sphyraena borealis DeKay, northern sennet

One specimen, 62 mm (prob. TL), was collected by James Renwick in a commercial shrimp trawl on 28 January 1974 approximately 7 km S of Schoodic Point, Maine (ca. 44°17′N, 68°02′W). The specimen is in the Sumner High School collection, East Sullivan, Maine. The species is known from the Atlantic and Gulf of Mexico coasts from Panama to Cape Cod (Bigelow and Schroeder, 1953). The only previous Gulf of Maine record is an approximately 5 cm specimen from Nauset Beach, Cape Cod, Massachusetts, in 1930 (Bigelow and Schroeder, 1953). This is the first reported occurrence north of Cape Cod.

Ariomma bondi Fowler, silver rag

Three specimens (113, 125, and 133 mm SL) were caught during August 1979, in Johns Bay, Maine (ca. 43°51′N, 69°31′W), in a mackerel trap by Paul Callahan of South Bristol, Maine (UMDC 380-1). The species is known from deeper waters of the continental shelf on both sides of the Atlantic (Horn, 1972). There are eight previous Gulf of Maine records, from off Sandwich, Provincetown, and Salisbury, Massachusetts, and off Georges Bank, 1950–1969 (Horn, 1972). This is the first reported occurrence along the Maine coast and, except for one specimen from the southern Gulf of St. Lawrence (McKay and Thomas, 1969), the northernmost record in the western Atlantic.

Paralichthys oblongus (Mitchill), fourspot flounder

One specimen, 21.5 cm SL, was trawled in Johns Bay, Maine (ca. 43°51′N, 69°31′W), on 20 July 1978 in 30 m (UMDC 365-1). The species ranges from Tortugas, Florida, to the waters off Nova Scotia (Ginsburg, 1952), but is found primarily between Delaware Bay and southern New England (Bigelow and Schroeder, 1953). Previous Gulf of Maine records are Gloucester and Salem, Massachusetts (Goode and Bean, 1879a, 1879b), Sheepscot Bay, Maine, in 1958 (Scattergood and Coggins, 1958), and Passamaquoddy Bay and Bay of Fundy in 1958 (Leim and Day, 1959). This is a southern species rarely seen in the Gulf of Maine.

Monacanthus hispidus (Linnaeus), planehead filefish

One adult (photographed and discarded) was captured in a lobster trap off Great Cranberry Island, Maine (ca. 44°14′N, 68°15′W), during June 1971 by Wesley P. Bracey, Jr., and a 111 mm SL specimen was captured in a lobster trap approximately 100 m from shore, SE of Hay Island, Maine (ca. 43°50′N, 69°33′W), in 6 m by Don Stanley of South Bristol, Maine, on 10 September 1980 (UMDC 384-1). The species has a tropical range in the western Atlantic from Brazil northward and is occasionally taken at Woods Hole. Strays are taken as far north as St. Margaret Bay and Halifax Harbor, Nova Scotia (Bigelow and Schroeder, 1953), and Wilsons Beach and Ketch Harbor, New Brunswick (Leim and Day, 1959). Previous Gulf of Maine records are as follows: from Hingham, Lynn, Nahant and Boston Harbor in Massachusetts Bay and on Cape Cod (dates unknown); four specimens off Provincetown between 1929 and 1951, one off Portland Lightship in 1931, one off Seguin Island, Maine, in 1927; 181 fry from the northeastern and one specimen off the western part of Georges Bank in 1927 and 1930 (Bigelow and Schroeder, 1953); from Ketch Harbor and Wilsons Beach, New Brunswick, in 1950 (Leim and Day, 1959). This is a southern species rarely taken in the eastern Gulf of Maine.

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A RESUMÉ OF THE MEMBERS OF THE GENUS *CAMBARINCOLA* (ANNELIDA: BRANCHIOBDELLIDA) FROM THE PACIFIC DRAINAGE OF THE UNITED STATES

Perry C. Holt

Abstract.—There are eight known species of the branchiobdellid genus *Cambarincola* in the Pacific drainage of the United States. Of these *C. fallax* Hoffman, 1963, and *C. mesochoreus* Hoffman, 1963, are most probably introductions. *C. barbarae,* new species, may be, since its nearest relatives appear to be forms found in Mexico and the south-central portions of the United States and it occurs on introduced hosts. Two species, *C. gracilis* Robinson, 1954, and *C. macrocephelus* Goodnight, 1940 are extensively redescribed; they and the two new species (*C. barbarae, C. serratus*), are illustrated. *C. montanus* and *C. shoshone* are briefly treated. A key, synonymies, type-specimens, diagnoses, and locality data are presented for all species.

Of the 42 nominal species of the branchiobdellid genus *Cambarincola* Ellis, 1912, four have been recorded as occurring in the Pacific drainage of the United States. Two of these require extensive redescriptions. In addition, I have at hand western specimens of two species previously known only from the eastern United States, and of two new species. As another in my series of reports on North American branchiobdellids I present herein a summary of the taxonomic knowledge of these species.

The first assignment of a western species to the genus *Cambarincola* begins with that of specimens from Eugene, Oregon, as the types of *C. inversa* Ellis, 1919:259. Altman (1936:71) assigned specimens from the same locality to Ellis's species. Goodnight (1939:11) reported the species as "Northwestern," later (1940a:70–71) listing new localities for it in Oregon and Washington. This species, however, belongs to *Sathorilus* Holt, 1968 and the first species that can now be placed in the genus was recognized and described by Goodnight (1940b:57) and assigned to his new genus *Triannulata*. Later this species (*montanus*) was redescribed and placed in the genus *Cambarincola* (Holt, 1974:67–70). Goodnight (1943:100), with minimal descriptive data, recognized *C. macrocephalus* which is redescribed herein. Robinson (1954) named *C. gracillis* and presented a reasonably good description thereof, but present information requires a new description which is also part of this report. With the publication of the diagnosis and description of *C. shoshone* Hoffman, 1963, the list of western species came to an end. Since then there may possibly have been a few references to these species in compendia and other publications not devoted to the genus, but I know of none other than the emendation mentioned above.

In spite of the extensive additions in the last two decades to our knowledge of the genus *Cambarincola* in other regions, there are still too many undescribed species and too few geographical data to allow for any additional speculations about the history of the genus or its relationships with other genera (Holt, 1969, inter alia). The earlier speculations about close affinities of the eastern and western branchiobdellid faunas seem to be confirmed (Holt, 1968a:84). The presence in the West of two (*C. fallax, C. mesochoreus*), and possibly another (*C. barbarae*), eastern species on hosts that were likewise introduced suggests that a natural experiment in competition may be occurring between these species and their western and now sympatric relatives. The outcome of any such postulated competition will furnish data for the acceptance or rejection of my idea that the western crayfish fauna is relictual and by implication that the major brachiobdellid radiation occurred earlier than that of their principal hosts (Holt, 1969:215–216).

The western branchiobdellid fauna seems to be relatively depauperate: ¾ as many species of *Cambarinocola* occur in Florida (Holt, 1973a, 1973c) as are known in all the vastly greater in extent and apparently more varied western region. The possibility that this appearance is an artifact of collecting cannot be ignored, but I doubt it.

The materials are in my possession, ultimately to become part of the collections of Virginia Polytechnic Institute and State University or those of the National Museum of Natural History. ''PCH'' followed by a numeral indicates the catalog number of collections in my care. All collections recorded under ''Material examined'' were taken by my wife and me, aided by our daughter, unless otherwise noted.

Measurements were done with a calibrated ocular micrometer, but are best regarded as approximations. Most measurements are presented as averages with the extremes in size of the object measured given in parentheses.

In all figures the animal, or part, is illustrated with its anterior part to the reader's right. Further details concerning my methods of collecting and treating materials may be found in my earlier works (Holt, 1960:57, 62–70, et seq.).

Genus *Cambarincola* Ellis, 1912

Astacobdella Leidy, 1851:206.
Branchiobdella.—Moore, 1894:427 (in part).
Bdellodrilus.—Pierantoni, 1912:24 (in part).

Cambarincola Ellis, 1912:481; 1919:25.—Hall, 1914:190.—Stephenson, 1930: 801.—Yamaguchi, 1932:454; 1933:191; 1934:189.—Goodnight, 1939:11; 1940a: 170–171; 1940b:30; 1943:100.—Holt and Hoffman, 1959:97.—Hoffman, 1963:271.—Hobbs *et al.*, 1967:52.—Holt, 1954:168; 1955:27; 1963:97; 1964:1; 1967:5; 1969:197; 1973a:84; 1973b:9; 1973c:677; 1973d:21; 1974:66; 1978:472.

Diagnosis.—Body terete without specialized projections (other than peristomial tentacles in some species); anterior nephridia opening through common pore on dorsum of segment III; deferent ducts entering ental end of spermiducal gland; prostate arising at commissure of spermiducal gland and ejaculatory duct; penis muscular, protrusible, noneversible; bursa subpyriform to spherical (modified from Hobbs *et al.*, 1967:52).

Key to the Western Species of *Cambarincola*

1.	Prostate differentiated	2
–	Prostate not differentiated	6
2.	Peristomial tentacles present	3
–	Peristomial tentacles absent	5
3.	Dental formula 5/5	*C. fallax*
–	Dental formula 1/1	4
4.	Peristomium with 4 dorsal tentacles, 4 lateral lobes, 4 ventral lobes	*C. montanus*
–	Peristomium with 4 dorsal tentacles, no lateral lobes, lower lip with 1 median indentation	*C. macrocephelus*
5.	Dental formula 1/4	*C. gracilis*
–	Dental formula 5/5	*C. serratus*
6.	Dental formula 3/3	*C. shoshone*
–	Dental formula 5/4	7
7.	Small worms, jaws unequal in size	*C. barbarae*
–	Larger worms, jaws of similar size	*C. mesochoreus*

Cambarincola barbarae, new species

Fig. 1

Type-specimens.—Holotype, USNM 54639, and 5 paratypes, PCH 1101, taken on *Procambarus* (*Scapulicambarus*) *clarkii* (Girard, 1852) from (?) irrigation ditch, 3.1 miles east of Solvang, Santa Barbara County, California, 3 July 1960, by Perry C. and Virgie F. Holt.

Diagnosis.—Relatively small worms (average length of 5 specimens of type-series 2.2 mm, holotype 1.9 mm); lips entire, separated by broad lateral indentations; no detectable oral papillae; no dorsal ridges; jaws unequal in size, upper more than twice length of lower, with prominent lateral flanges,

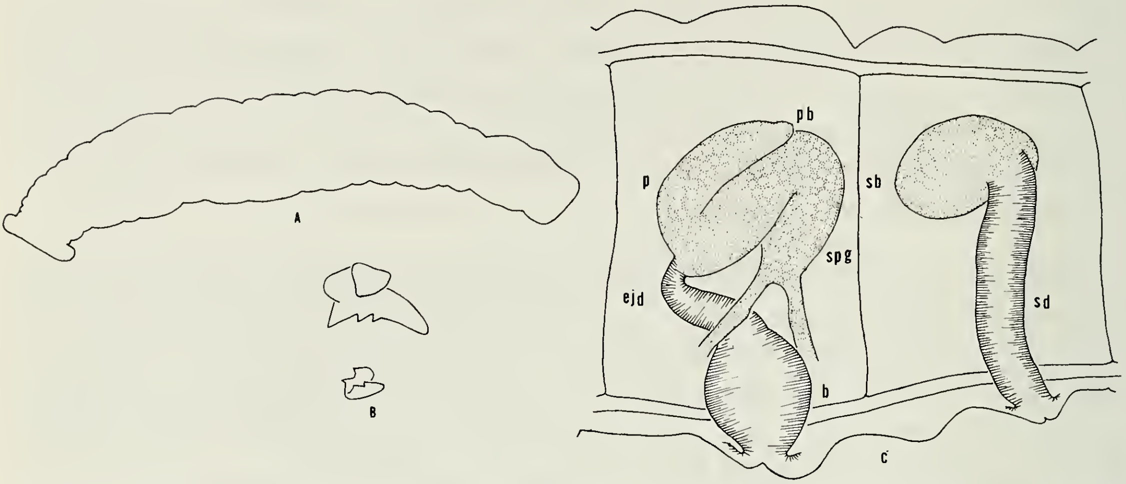

Fig. 1. *Cambarincola barbarae*: A, Lateral view of entire animal; B, Oblique view of jaws; C, Lateral view of reproductive systems. Abbreviations: b, bursa; ejd, ejaculatory duct; p, prostate; pb, prostatic bulb; sb, spermathecal bulb; sd, spermathecal ectal duct; spg, spermiducal gland; vd, vas deferens.

prominent median tooth, dental formula 5/4; bursa small, ovate, about ⅓ body diameter; ejaculatory duct of normal proportions; spermiducal gland without deferent lobes, long, sharply reflexed at near its midlength; prostate non-differentiated, ending entally at flexure of spermiducal gland, with small ental bulb; spermatheca greater in total length than body diameter, ectal duct more than twice length of oval bulb, no ental process.

Etymology.—For Santa Barbara County, California.

Description.—Specimens of *Cambarincola barbarae* are small and externally unprepossessing worms. The dimensions of 5 specimens of the type-series, including the holotype, are as follows: *total length,* 2.2 mm (1.5–3.0 mm); *greatest diameter,* 0.4 mm (0.3–0.5 mm); *head length,* 0.4 mm (0.3–0.4 mm); *head diameter,* 0.2 mm (0.2–0.2 mm); *diameter, segment I,* 0.2 mm (0.2–0.2 mm); *diameter sucker,* 0.2 mm (0.2–0.2 mm).

There are no dorsal ridges, lobes of the lips, or oral papillae. The head is marked, other than the peristomial one, by a shallow external sulcus at the level of the single internal pharyngeal one. The nephridiopore is obscure and the clitellum is inconspicuous.

The jaws are distinctive. The upper is large, more than twice the anteroposterior dimension (length) of the lower and is provided with wide flanges that are deflected ventrad along the lateral margins of the pharynx. It bears a large, prominent tooth at its apex and 2 rather small lateral ones. The lower jaw is of more usual size and configuration: triangular in lateral view, subrectangular *en face* view, with 4 teeth, the median ones somewhat larger than the lateral ones and separated by a prominent depression.

The bursa is relatively small, a little more than ⅓ in length that of the body diameter. Its width is ⅔ that of its length; there is no external constriction that demarcates the penial sheath; internally 2 folds project into the bursal atrium.

The spermiducal gland is long, almost ⅔ in length that of the body diameter, but bent back upon itself so that the ectal portion is somewhat longer than the ental, and narrower, part. There are no deferent lobes. The prostate is non-differentiated, ends entally at the flexure of the spermiducal gland, and possesses a small obscure prostatic bulb.

The spermatheca is greater in length than the diameter of its segment, with an unusually long ectal duct which comprises more than half the total length of the organ. The bulb is bent backwards, so that it lies alongside the dorsal margin of the gut and is, in shape, elongate ovoid with a thin wall. There is no ental process.

Variations.—None of significance. The clitellum is sometimes more prominent than indicated, apparently as a consequence of differences in contraction of the specimen. The spermathecal bulb is in some specimens directed forwards and is, in some cases, globose.

Affinities.—The closest relative of *Cambarincola barbarae* is *C. susanae* Holt, 1973c, from Mexico. The two species are of similar size and general facies. The jaws are equally disparate in size with the same dental formula. But the upper jaw of *C. susanae* lacks the lateral flanges of that of *C. barbarae* and the teeth are borne on a raised triangular platform or ridge instead of occupying the more common marginal position as do those of *C. barbarae* (Holt, 1973c:27–28, fig. 12d). The reproductive systems differ in only minor details: the spermiducal gland of *C. susanae* has small deferent lobes, its spermatheca is not so long and the spermathecal bulb is proportionately smaller. For further discussions of the relationships of *C. susanae* see Holt (1973c:15–16; 28).

Host.—Procambarus (*Scapulicambarus*) *clarkii* (Girard, 1852).

Distribution.—The type-locality, and Sonoma County, California.

Material examined.—The 6 specimens of the type-series and 5 specimens (PHC 1106) taken on *Procambarus clarkii,* from a pool 4.3 miles southeast of Sebastopol, Sonoma County, California, 7 July 1960.

Remarks.—Cambarincola barbarae occurs upon an introduced species (Hobbs, 1972:72) which also serves as a host for *C. mesochoreus* Hoffman, 1963, and *C. fallax* Hoffman, 1963. The former species is widespread in the Mississippi Valley and the latter in the Appalachians and were probably introduced with their host. This may be so for *C. barbarae.*

Cambarincola fallax Hoffman, 1963

Cambarincola fallax Hoffman, 1963:356–359.—Hobbs, Holt, and Walton, 1967:54–55.—Holt, 1969:207; 1973c:681; 1974:69.

Type-specimens.—"Holotype and four paratypes, USNM 29945, from *Cambarus longulus* subsp. collected in Maiden Spring Creek, about 1 mile east of Wardell, Tazewell County, Virginia . . . . Additional paratypes from the same collection, PCH 904" (Hoffman, 1963:356).

Diagnosis.—"Upper lip with short, slender peristomial tentacles; prosomites (anterior segmental annuli) raised; dental formula 5/5, jaws of same size and shape; prostate with terminal bulb and histologically dissimilar to spermiducal gland" (Hobbs *et al.,* 1967:54).

Description.—Hoffman's (1963:356–358) description is extensive and adequate and applies as well to the specimen from California as to the Virginian material.

Variation.—See Hoffman (1963:358).

Affinities.—Hoffman (1963) did not treat the affinities of *C. fallax* under a distinct heading, but he associated *C. fallax* with *C. philadelphicus* in his discussions and keys (e.g., pp. 340–341). There can be no doubt that the relatives of *C. fallax* are to be sought among the eastern species of the genus with a histologically differentiated prostate that terminates in a clear vacuolated space ("prostatic bulb") and that its peristomial tentacles and 5/5 dental formula are distinctive.

Host.—Procambarus (S.) clarkii.

Distribution.—The Appalachian uplands and the Coastal Range of California north of San Francisco. The host of the California specimen is an inhabitant of the lower Mississippi River Valley. Associated with *C. fallax* in its only known location in California are another eastern species (*C. mesochoreus*) and a newly described one (*C. barbarae*) that has as its closest relative the widespreading Mexican *C. susanae.* This suggests that all the branchiobdellids were introduced from Louisiana or Texas, but *C. fallax* is not at home in lowland waters, has not been found within the eastern range of *P. clarkii,* and is with unlikely associates in California. The example of *Xironogiton instabilis* (Holt, 1974:7, 11), found in both the eastern *and* western mountains, forecloses any ready assumptions about the origins of the western population of *C. fallax.*

Material studied.—One specimen taken on *Procambarus* (*S.*) *clarkii,* from a pool 4.3 miles south of Sebastopol, Sonoma County, California, 7 July 1960.

Cambarincola gracilis Robinson, 1954
Fig. 2

Cambarincola gracilis Robinson, 1954:466, figs. 1–4.—Holt and Hoffman, 1959:103.—Hoffman, 1963:369, figs. 77–79.

Type-specimens.—Holotype and 10 paratypes, USNM 26110, taken on *Pacifastacus* (*Pacifastacus*) *leniusculus klamathensis* (Stimpson, 1957)

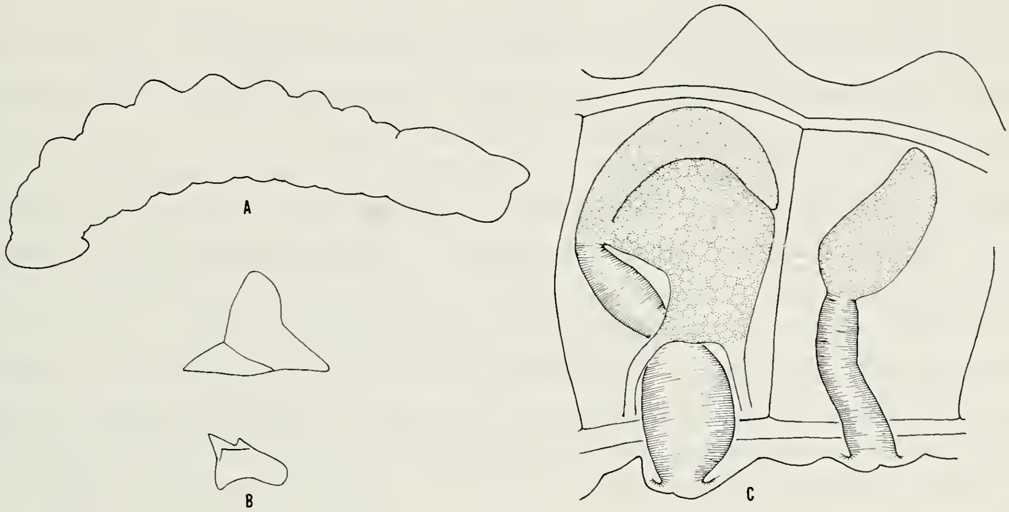

Fig. 2. *Cambarincola gracilis*: A, Lateral view of specimen from Douglas County, Oregon; B, Same of jaws; C, Same of reproductive system.

from creek on campus of Whitman College, Walla Walla, Walla Walla County, Washington, 11 August 1952, by A. G. Rempel; 2 paratypes, USNM 26111, taken on *P. l. klamathensis* from Klamath River, 1 mile west of Ash Creek, Siskiyou County, California, 27 October 1952, by Harold Wolf; 9 paratypes, USNM 26112, taken on *P.* (*P.*) *l. trowbridgii* (Stimpson, 1857) from Burdette Creek, Burnaby, British Columbia, 21 May 1942, by G. Clifford Carl (from labels of type-series).

Diagnosis.—Small to medium-sized worms (holotype measures 1.8 mm); lips obscurely lobed, lower with median emargination, lateral indentations broad; oral papillae present (not detectable in holotype); prominent dorsal ridges on segments II–VIII, jaws unequal in size, dental formula 1/4; bursa ovate; spermiducal gland stout, without deferent lobes; prostate differentiated, in length about ½ that of spermiducal gland; spermatheca with long ectal duct, elongate clavate bulb (unexpanded in holotype), without ental process.

Description.—The following description is based upon material collected by me and my wife. The holotype has been carefully compared with this material, however, and any discrepancies between it and my material noted.

Cambarincola gracilis is composed of small worms, although the paratypes from British Columbia (which are macerated and almost unidentifiable except for the jaws) are longer than the average. Five worms from Myrtle Creek, Douglas County, Oregon, have the following dimensions: *total length,* 1.9 mm (1.6–2.0 mm); *greatest diameter,* 0.4 mm (0.4–0.5 mm); *head length,* 0.4 mm (0.4–0.5 mm); *head diameter,* 0.3 mm (0.2–0.3 mm); *diameter, segment I,* 0.3 mm (0.2–0.3 mm); *diameter, sucker,* 0.3 mm (0.3–0.3 mm).

The upper lip, as noted by Robinson (1954:467) protrudes beyond the lower one. It is subdivided by shallow indentations into 4 indistinct lobes (contra Robinson, 1954:467). The lateral indentations which separate the upper and lower lips are relatively wide and deep. The lower lip is marked by a minute median indentation (not easily seen in most specimens, including the type-series). Several, about 8, oral papillae are present, but not easily detected in some specimens, again including the holotype. The head usually shows no external annular grooves other than the shallow one that delimits the peristomium. There is one pharyngeal sulcus.

Segments I to VII bear dorsal ridges, but that of segment I is low and may lack supernumerary muscles. The anterior nephridiopore is obscure and is not marked by a prominent nephridial vesicle. Robinson (1954) does not mention these ridges and her drawing (Fig. 1) does not clearly show them.

The jaws are dissimilar in size: the upper is approximately twice the length of the lower, has dorsally directed lateral flanges and bears a single large acutely triangular tooth which is in length about ½ that of the jaw; the lower is of more usual proportions, though the 2 median teeth are prominent. Robinson's (1954:467) comment about the "excavated and somewhat triangular base" of the jaws of *C. macrodonta* applies, but she did not give proper attention to the dorsolateral extensions of the upper jaw of *C. gracilis* and I cannot see, though they may be there, the 2 "weakly developed tubercules" of the upper jaw. Her figs. 2a and 2c of the jaws are almost identical to my independently drawn Fig. 2B. The dental formula is, then, 1/4, since the "tubercles" of the upper jaw are most likely only undulations of its margin. The jaws are relatively light in color, a medium shade of brown, for their size.

Robinson, as Hoffman (1963:369) noted, made a commendable effort to describe and illustrate the reproductive systems, but the literature available to her (she obviously missed my earlier paper, Holt, 1949) was not adequate for a proper description of these organs. What she does say and her illustrations (Robinson, 1954:figures 3 and 4) do not conflict with, and indeed confirm, the following description of the reproductive systems.

The spermiducal gland is slightly flexed at its midlength. It is difficult to measure because of this flexure, but its dorsal border extends to the dorsal border of the gut and its ental end begins near the dorsal, ental end of the bursa. There are no detectable deferent lobes. The prostate is about the size, in both length and diameter, of the spermiducal gland, is differentiated, but lacks an ental bulb.

The bursa presents no unusual features. There is no external constriction of the bursa at the ectal border of the penial sheath which composes about half the organ. There is a prominent atrial fold.

The spermatheca has a long, at least half the total length of the organ, ectal duct. The spermathecal bulb is clavate. In the specimen illustrated the posterior side is collapsed or wrinkled. The organ, if extended, would equal or exceed in length the diameter of the body. An ental process is lacking.

Variations.—An exterior sulcus of the head, at approximately the level of the pharyngeal one, is present as a shallow, obscure groove in some specimens, but not in the holotype. It is possible that Robinson detected lateral teeth in younger specimens, though I have not done so. I suspect that such teeth may be present in the immatures of some species and disappear with growth or wear with age. Oral papillae are undetectable in the holotype, but are so in some other specimens. Robinson's material was fixed in ethyl or isopropyl alcohol and stained with hematoxylin; mine in alcohol-formalin and mounted unstained. Some apparent variations, for instance, the lesser prominence of the dorsal ridges, are undoubtedly due to these differences in treatment.

Affinities.—The affinities of *Cambarincola gracilis* are obscure. Robinson (1954:468) compared the species with *Cambarincola macrodontus* Ellis, 1912, the type of the genus, and *C. inversa* Ellis, 1919. The nominal species *inversa* is not a member of the genus *Cambarincola* (Hoffman, 1963:276) and need not be considered here. *Cambarincola macrodontus* does have a short differentiated prostate, but otherwise is quite unlike *C. gracilis,* including the absence of a prostatic bulb in the latter. In fact, *C. gracilis* shares one or another feature with several other species of the genus, but perhaps more with *C. toltecus* Holt, 1973, than any other. Indeed, my description of the latter applies with only two major exceptions, and a few minor ones that are of little significance, to *C. gracilis. Cambarincola toltecus* is composed of somewhat larger worms; the holotype is 2.7 mm long, the spermiducal gland is not proportionately as large and the prostate doubtfully has an ental bulb. The only important differences involve the jaws and the spermatheca. The upper jaw of *C. toltecus,* while larger than the lower, is not markedly so and lacks the prominent laterodorsal flanges of *C. gracilis.* The dental formula is the same. The spermathecal bulb of *C. toltecus* is irregularly spatulate and its wall is thick and glandular (Holt, 1973b:29–30). One is tempted to postulate that *C. gracilis* is an advanced member of a stock represented today by the more primitive *C. toltecus* (cf Holt, 1973b:6–7, 30, for a discussion of these points and the affinities of *C. toltecus*).

Hosts.—*Pacifastacus* (*Pacifastacus*) *leniusculus klamathensis* (Stimpson, 1857), *P. l. trowbridgii* (Stimpson, 1857), *Procambarus* (*Scapulicambarus*) *clarkii.*

Distribution.—*Cambarincola gracilis* is known from southern California northward to southern British Columbia and is second to *C. montanus* in commonness among my collections of western members of the genus. It occurs with *C. barbarae, C. mesochoreus,* and *C. montanus* at Solvang, Santa Barbara County, California. One of these species (*C. mesochoreus*) is a dominant member of the branchiobdellid fauna of its home, the lower plains of the central United States; *C. gracilis* shares dominance with *C. montanus* (it would be interesting to compare the ecological niches of all these species) among the western species of *Cambarinocola.*

Material examined.—One specimen (PCH 421) taken on *Pacifastacus* (*P.*) *leniusculus klamathensis* at junction of Steamboat and Umpqua Rivers, Douglas County, Oregon, 12 July 1939, by James W. Bee; 2 specimens (PCH 1101) taken on *Procambarus clarkii* from an (?) irrigation ditch, 3.1 miles east of Solvang, Santa Barbara County, California, 3 July 1960; 4 specimens (PCH 1109) taken on *P. l. klamathensis* from tributary to Rogue River, 5.0 miles north of Rogue Elk, Jackson County, Oregon, 11 July 1960; 12 specimens (PCH 1112) taken on *P. l. klamathensis,* 8.3 miles south of Tiller, Douglas County, Oregon, 11 July 1960; 12 specimens (PCH 1112) taken on *P. l. klamathensis* from North Fork of Umpqua River, at Winchester, Douglas County, Oregon, 11 July 1960; 20 specimens (PCH 1113) taken on *P. l. klamathensis,* 12.6 miles south of Cottage Grove, Douglas County, Oregon, 11 July 1960; 9 specimens (PCH 1117) taken on *P. l. leniusculus* from Mary's River, 4.8 miles east of Blodgett, 12 July 1960; 3 specimens (PCH 1118) taken on *P. l. klamathensis* at Burnt Woods, Lincoln County, Oregon, 12 July 1960; 5 specimens (PCH 1120) taken on *P. l. klamathensis,* 8.6 miles northeast of Toledo, Lincoln County, Oregon, 12 July 1960; 10 specimens (PCH 1121) taken on *P. l. leniusculus* from Siletz River, 24.2 miles southeast of Kernville, Lincoln County, Oregon, 12 July 1960; 6 specimens (PCH 1122) taken on *P. l. leniusculus* from Slick Rock Creek, 5.0 miles southwest of Rose Lodge, Lincoln County, Oregon, 13 July 1960; 2 specimens (PCH 1123) taken on *P. l. klamathensis* from Widow Creek, Lincoln County, Oregon, 13 July 1960; 16 specimens (PCH 1124) taken on *P. l. klamathensis* from South Yamhill River, 1.6 miles west of Valley Junction, Polk County, Oregon; 12 specimens (PCH 1126) taken on *P. l. klamathensis* from Little Pudding Creek, 7.9 miles southwest of Silverton, Marion County, Oregon, 13 July 1960; 9 specimens (PCH 1127) taken on *P. l. klamathensis* from Butte Creek, 6.0 miles northwest of Silverton, Marion-Clackamas County line, 13 July 1960; 2 specimens (PCH 1128) taken on *P. l. klamathensis* from Salmon River, at Brightwood, Clackamas County, Oregon, 13 July 1960; 4 specimens (PCH 1129) taken on *P. l. klamathensis,* 4.8 miles southwest of Skamokawa, Wahkiakum County, Washington, 14 July 1960; 5 specimens (PCH 1130) taken on *P. l. klamathensis* from Gray's River, 21.0 miles east of Gray's River, Wahkiakum County, Washington, 14 July 1960; 5 specimens (PCH 1132) taken on *P. l. klamathensis* from West Fork Hoquiam River, 14.5 miles south of Humptulips, Gray's Harbor County, Washington, 16 July 1960; 1 specimen (PCH 1134) taken on *P. l. leniusculus,* 3.0 miles south of Amanda Park, Gray's Harbor

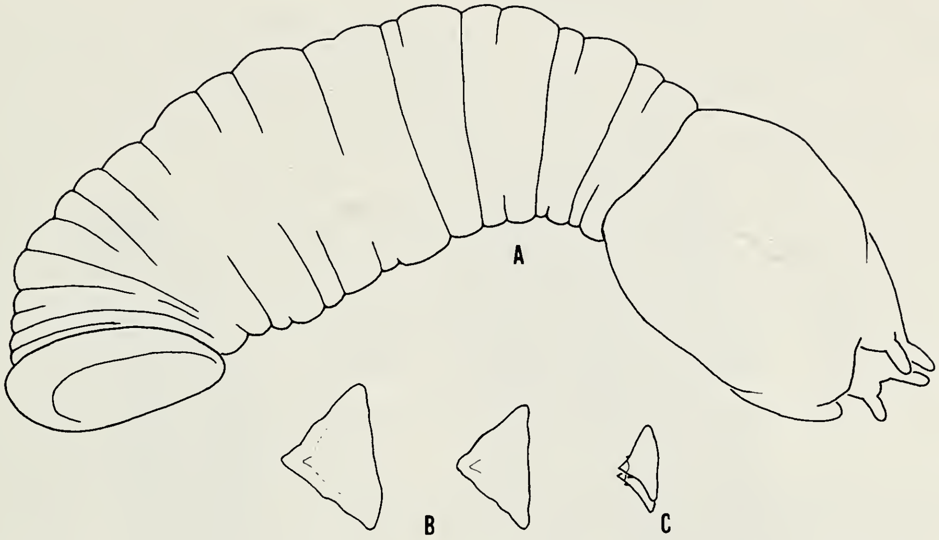

Fig. 3. *Cambarincola macrocephelus*: A, Lateral view of specimen from Gooding County, Idaho; B, *En face* view of jaws; C, Dorsal view of jaws of younger specimen in place.

County, Washington, 16 July 1960; 4 specimens (PCH 1137) taken from Mill Creek at Forks, Clallam County, Washington, 16 July 1960; 3 specimens (PCH 1142) taken from (?) irrigation ditch, 7.2 miles east of Ellensburg, Kittitas County, Washington, 18 July 1960. (See Robinson, 1954:467 for additional locality records.)

Cambarincola macrocephalus Goodnight, 1943
Figs. 3–4

Cambarincola macrocephela Goodnight, 1943:100–101, figs. 1–2.—Holt, 1969:209; 1963b:10.

Cambarincola macrocephala.—Holt and Hoffman, 1959:103.—Hoffman, 1963:312–314, Figs. 14–17, 19.

Cambarincola macrocephelus, Holt, 1973b:10.

Type-specimen.—USNM 20598, taken on *Pacifastacus* (*Hobbsastacus*) *gambelli* (Girard, 1852) from Polecat Creek, Teton County, Wyoming, 16 August 1941, by Robert C. Brown (Goodnight, 1943).

Diagnosis.—Large worms (average about 5.0 mm); upper lip bearing 4 tentacles, lower with shallow median emargination; oral papillae absent; head large, approaching ⅓ entire body in size; dorsal ridges absent; jaws large, triangular, subequal in size, dental formula 1/1 (? 3/3); bursa subglobose; spermiducal gland long, slender, extending to dorsal border of coelom, with prominent deferent lobes; prostate differentiated, without prostactic bulb, equal in length to, slightly greater in diameter than, spermiducal gland; spermatheca long, slender, narrowing entally.

Description.—Goodnight's (1943) original description is inadequate. But

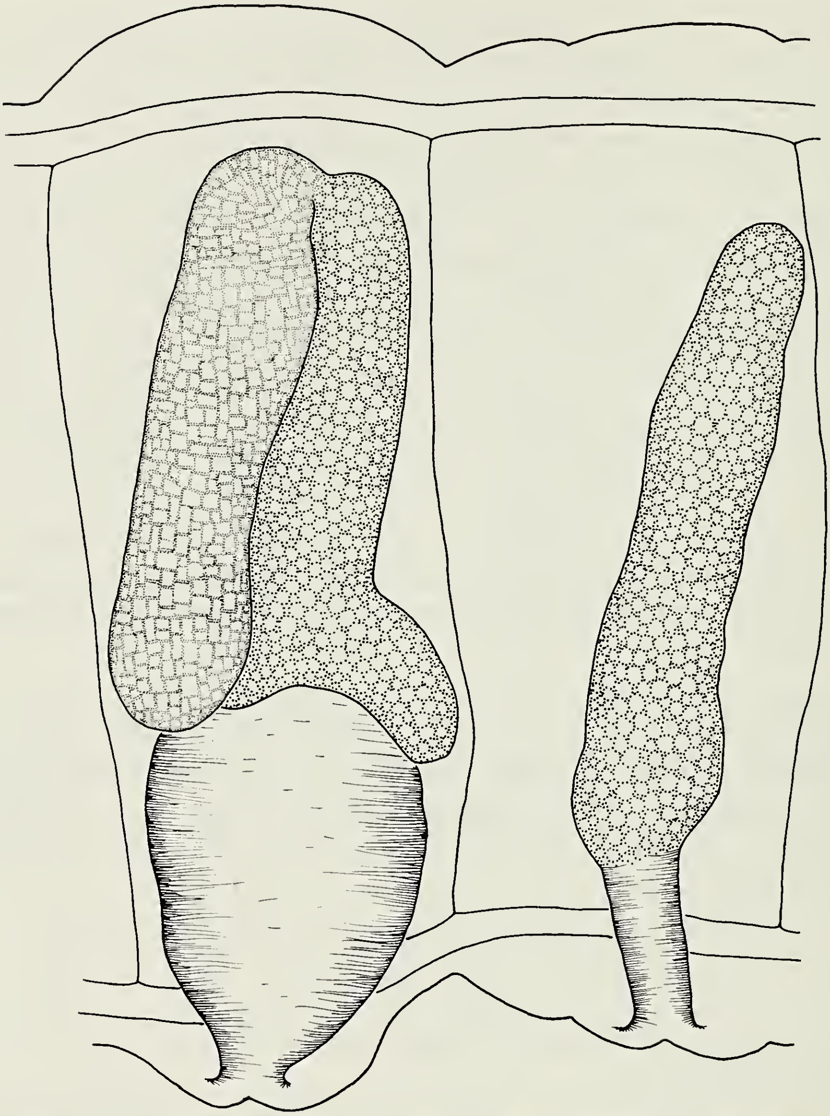

Fig. 4. *Cambarincola macrocephelus*: Lateral view of reproductive systems of specimen from Gooding County, Idaho.

the size, tentaculation of the upper lip and the shape of the jaws of his holotype are, on the basis of my knowledge of the branchiobdellids of the area, diagnostic. Hoffman also examined the holotype and concluded that the material upon which the following redescription is based is conspecific with Goodnight's. But Hoffman (1963:312–314) worked under limitations that no longer exist and his description of this material requires emendment.

Members of *Cambarincola macrocephalus* are large worms, larger than Goodnight (1943:100) suggests: preserved mature worms are about 5.0 mm long. Two fully mature and 3 subadult (some reproductive structures present, but not fully developed) worms which comprise the total unsectioned material in my collection have the following dimensions: *total length,* 3.7

mm (2.6–5.6 mm); *greatest diameter,* 0.9 mm (9.5–1.4 mm); *head length,* 1.1 mm (0.8–1.6 mm); *head diameter,* 0.7 mm (0.5–1.0 mm); *diameter, segment I,* 0.6 mm (0.4–1.0); *diameter, sucker,* 0.6 mm (0.4–1.0).

The upper lip bears 4 tentacles delimited by slight constrictions basally; a shallow, median indentation is characteristic of the lower. Oral papillae are not detectable. The peristomium is obscurely marked by a very shallow sulcus (contra Hoffman, 1963:313) and tapers towards its labial border. Other external sulci of the head are absent; 2 internal pharyngeal ones are distinct. The head is most distinctive in its proportions: almost ⅓ of the length of the total body, greater in diameter than either segment I or the sucker and noticeably pyriform, it is, for the size of the worm, a proportionately huge mass of muscles.

The anterior annuli of the body segments, though apparently lacking supernumerary muscles, are slightly greater in diameter than the posterior ones, all are greater in diameter than their antero-posterior dimensions. Hoffman (1963:113–114) states that the anterior segments of the holotype are tripartite and illustrates this feature: this is not true of the Idaho material and I suspect that he is in error on this point. The matter is worthy of note, since the anterior annuli of anterior segments of some species are marked by superficial annular indentations. At first glance those of *C. macrocephalus* are, but this is an optical illusion created by seeing the segmental annuli of the worms on both sides simultaneously. The sucker is slightly greater in diameter than segment I. The anterior nephridiopore is obscure.

The jaws are large, though not disproportionately so for the size of the animal, medium dark brown and triangular in both lateral and *en face* aspects. Hoffman (1963:313) stated that the dental formula is 3/3; Goodnight (1943:100) that the jaws lack teeth. My interpretation is that the jaws, subequal in size and shape, bear a single tooth at their apex, though there appear to be lateral teeth on the jaws of younger animals.

The bursa is large, somewhat less than the diameter of its segment in length. If the ectal ''outlet duct'' of the bursa is, as it should be, considered a part of its structure, the bursa is subcylindrical rather than ''subglobose'' (Hoffman, 1963:113) and the penial sheath composes approximately ½ of the organ.

The spermiducal gland runs ventro-dorsad from border to border of the coelom and is rather slender, somewhat greater in diameter than the prostate. It is of the usual histological structure and bears prominent deferent lobes (Fig. 4). Hoffman (1963:313) describes the prostate as histologically similar to the spermiducal gland (non-differentiated). This is not so. The prostate is differentiated, but lacks an ental bulb. At the time he wrote, all the members of the genus we knew with differentiated prostates also possessed an ental bulb, hence the error.

The spermatheca is long, slender, reaches almost to the dorsal border of the coelom and is greater in diameter immediately entad to the junction of spermathecal bulb and ectal duct. The bulb is slender, irregularly indented or "twisted," tapers to its ental end, lacks an ental process, appears unusually thick-walled in the animal mounted entire, but serially sectioned material reveals the usual histology.

Variations.—None other than the usual ones related to size.

Affinities.—Although several species of *Cambarincola* have been recognized since Hoffman wrote on the genus, the only pertinent consideration is the possible relationship of *C. macrocephelus* and *C. montanus* (Goodnight, 1940). The latter seems to be composed of somewhat larger worms (average length, 5.8 mm) with 4 dorsal tentacles and 2 median and 4 ventral lobes of the peristomium; an enormous prostate; a spermatheca with a long ectal duct and globose bulb. It is western in distribution, though not known from the upper Snake River drainage. Otherwise Hoffman's designation of *C. holti* Hoffman, 1963, from Kentucky, "which differs in its smaller size, particularly that of the head, and longer glandular organs of the male reproductive system," as the closest relative, in the sense of structural similarities, still applies.

Host.—Pacifastacus (*Hobbsastacus*) *gambelli* (Girard, 1852).

Distribution.—The upper reaches of the Snake River drainage in Idaho and Wyoming.

Material examined.—Two mature specimens, 3 immature ones, mounted entire, one serially sectioned animal (PCH 785) taken on *Pacifastacus gambelli* from Riley Creek, Gooding County, Idaho, 14 July 1958. This is the same material upon which Hoffman's (1963) account is based. Hoffman worked in my laboratory under my supervision and the corrections of and additions to his description are required by the advances I have made in my understanding of the branchiobdellids in the intervening years. I have no doubt that this material is conspecific with Goodnight's poorly preserved and mounted holotype. In addition, 5 specimens, poorly preserved, taken on *P. gambelli* from the South Fork of the Snake River, by P. Andriano, 28 August 1952, are tentatively assigned to *C. macrocephelus.*

Nomenclatural note.—The spelling of this species has varied (Holt and Hoffman, 1959:103; Hoffman, 1963:312–314; Holt, 1969:209; Holt, 1973b:10) because of my uncertainty as to whether Goodnight's (1943:100–101) original spelling as *macrocephela* should be regarded as an emendable error. Authorities who have advised us differ (See Article 32 (a) (iii) of the International Code of Zoological Nomenclature). In view of other errors in Goodnight's writings and his reference to "head large" in his diagnosis of the species, I herein, nonetheless, revert to my original view that the original spelling of the species' name was an egregious and correctible error. Thus, in accordance with Article 30 (a), (i) (2) of the International Code of Zoological

Nomenclature, the spelling becomes "macrocephalus" (see Holt, 1973b: 9–10). I am grateful to Dr. George Steyskal for suggesting this solution of what had become for me a vexing problem.

Cambarincola mesochoreus Hoffman, 1963

Cambarincola vitrea (in part).—Ellis, 1919:257–258.
Cambarincola macrodonta (in part).—Ellis, 1919:257.
Cambarincola mesochorea Hoffman, 1963:307–311.—Holt, 1969:209.
Cambarincola mesochoreus.—Holt, 1963b:10.

Type-specimens.—"Holotype and four paratypes, USNM 29939, from *Orconectes* sp. collected . . . . 1.5 miles east of Adyville, Perry County, Indiana, by P. C. Holt, July 28 1958 . . . Additional paratypes . . . PCH 815" (Hoffman, 1963:307, 309).

Diagnosis.—Relatively large worms (average length about 3.5 mm; lips entire; no detectable oral papillae; no dorsal ridges; jaws subequal in size, dental formula 5/4; bursa small, subspherical; spermiducal gland slender, recurved; without deferent lobes; prostate equal to or greater in diameter, greater in length than spermiducal gland, non-differentiated, no ental bulb; spermatheca slender, elongate, subfusiform, with ental process (modified from Hoffman, 1963:307–308.

Description.—Hoffman (1963:307–308) presents an adequate description.

Variation.—None noted, except for the usual variations in size and relative positions of reproductive organs.

Affinities.—Hoffman (1963:306–307) regarded *Cambarincola restans* Hoffman, 1963, and *C. mesochoreus* as closely related on the basis of similarities between their reproductive systems. The head of *C. restans* is disproportionately large and there are deferent lobes of the spermiducal gland.

Host.—Procambarus (*Scapulicambarus*) *clarkii.*

Distribution.—As questionably noted for *C. barbarae* and more certainly for *C. fallax, C. mesochoreus* is an introduced species, known in California from Santa Barbara, Merced, and Sonoma Counties.

Material examined.—Four specimens (PCH 1101) taken on *Procambarus clarkii,* 31 miles east of Solvang, Santa Barbara County, California, 3 July 1960; 27 specimens (PCH 1102) taken on *P. clarkii* from irrigation ditch, 2.9 miles west of Los Banos, Merced County, California, 5 July 1960; 8 specimens (PCH 1103) taken on *P. clarkii* from irrigation ditch, 2.0 miles east of Los Banos, Merced County, California; 15 specimens (PCH 1104) taken on *P. clarkii* from Deadman's Creek, 7.1 miles west of Merced, Merced County, California, 5 July 1960; 10 specimens (PCH 1106) taken on *P. clarkii,* 4.3 miles southeast of Sebastopol, Sonoma County, California, 7 July 1960.

Cambarincola montanus (Goodnight)

Triannulata montana Goodnight, 1940:56–57; Liang, 1963:570; Holt, 1969:195.
Cambarincola montanus.—Holt, 1974a:67–70.

Type-specimen.—Holotype, USNM 2056, from the Kalmi River, Washington, on *Pacifastacus* species.

Diagnosis.—Large worms, about 6.0 mm in length; lips with 4 dorsal tentacles, 4 prominent lateral, 4 prominent ventral lobes; no oral papillae; no dorsal ridges; jaws massive, dental formula 1/2 (5/5 in immature forms); bursa subpyriform, about ⅓ segmental diameter in length; spermiducal gland proportionately small, about ⅓ segmental diameter in length, with anterior deferent lobe; prostate subequal to spermiducal gland in length, 1½ times in diameter that of spermiducal gland, no ental bulb, histologically differentiated; spermatheca about ½ segmental diameter in length, ectal duct long, bulb globose, no ental process.

A previous treatment of *C. montanus* (Holt, 1974a:67–70) was based upon some of the material included in this study. Little new can be added herein, except to note 16 additional localities from which specimens have been studied.

Distribution.—Goodnight (1940:57) reported *C. montanus* from "North Fork of the Clearwater River near Bovril, Idaho." [His designation of some of these specimens as paratypes is no longer relevant to such studies as these, since he long ago "lost" his collections (pers. comm.)]. But it is unlikely he was mistaken, so *C. montanus* is known from southern California to northwest Washington and eastward into Idaho. The species is represented in more of my collections (27) than any other western member of the genus.

Material examined.—Five specimens (PCH 421) taken on *Pacifastacus klamathensis* Stimpson at the junction of the Steamboat and Umpqua Rivers, Douglas County, Oregon, 12 July 1939, by James W. Bee; 9 specimens (PCH 921) taken on *P. klamathensis* from Purdy Creek, 6 miles north of Gig Harbor, Pierce County, Washington, 26 June and 13 July 1959, by Darwin E. Norby; 3 specimens (PCH 1101) taken on *Procambarus* (*S.*) *clarkii* 3.1 miles east of Solvang, Santa Barbara County, California, 3 July 1960; 1 specimen (PCH 1117) taken on *Pacifastacus leniusculus* from Mary's River, 4.8 miles east of Blodgett, Benton County, Oregon, 12 July 1960; 2 specimens (PCH 1118) taken on *P. klamathensis* from small stream at U.S. Post Office in Burnt Woods, Lincoln County, Oregon, 12 July 1960; 2 specimens (PCH 1120) taken on *P. klamathensis* from small stream, 8.6 miles northeast of Toledo, Lincoln County, Oregon, 12 July 1960; 3 specimens (PCH 1121) taken on *P. leniusculus* from the Siletz River, 24.3 miles southeast of Kernville, Lincoln County, Oregon, 12 July 1960; 3 specimens

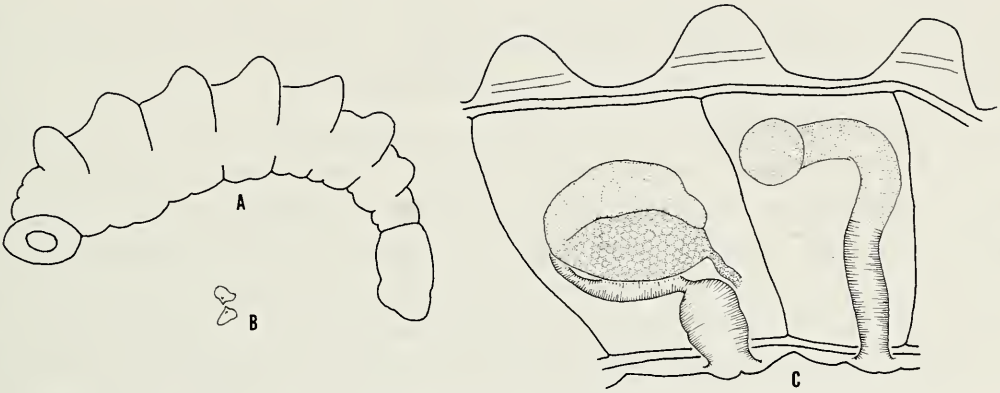

Fig. 5. *Cambarincola serratus,* new species: A, Lateral view of holotype; B, same of jaws; C, same of reproductive systems.

(PCH 1122) taken on *P. leniusculus* from Slick Rock Creek, 5.0 miles southwest of Rose Lodge, Tillamook County line, Oregon, 13 July 1960; 3 specimens (PCH 1125) taken on *P. klamathensis* from Salt Creek, 3.5 miles northwest of Dallas, Polk County, Oregon; 13 specimens (PCH 1126) taken on *P. klamathensis* from Little Pudding Creek, 7.9 miles southwest of Silverton, Marion County, Oregon; 1 specimen (PCH 1139) taken on *P. klamathensis* from a small stream at U.S. Highway 830, 4.8 miles southeast of Skamokawa, 14 July 1960; 4 specimens (PCH 1132) taken on *P. klamathensis* from West Fork of Hoquiam River, 14.5 miles south of Humptulips, Grays Harbor County, Washington, 16 July 1960; 1 specimen (PCH 1136) taken from Nolan Creek, 21.5 miles south of Forks, Jefferson County, Washington, 16 July 1960; 2 specimens (PCH 1139) taken from Minter Creek, 3.8 miles west of Wauna, Pierce County, Washington, 17 July 1960; 2 specimens (PCH 1142) taken from a warm pool (? irrigation ditch) 7.2 miles east of Ellensburg, Kittitas County, Washington, 18 July 1960.

Cambarincola serratus, new species
Fig. 5

Type-specimens.—Holotype, USNM 54638; 3 paratypes, PCH 785, taken on *Pacifastacus* (*Hobbsastacus*) *connectens* (Faxon, 1914) from Idaho State Fish Hatchery, Riley Creek, Gooding County, Idaho, 14 July 1958; 2 paratypes, PCH 784, taken on *P. connectens* from spring tributary to Snake River, Hagerman, Gooding County, Idaho, 14 July 1958.

Diagnosis.—Small worms (holotype 1.7 mm in length); lips entire; oral papillae present; dorsal ridges on segments II–VIII prominent; jaws light yellow; triangular in lateral view, quadrangular *en face* view, dental formula 5/5; bursa small, about ⅓ body diameter in length; spermiducal gland short, subcylindrical; prostate subequal in length, slightly shorter than spermiducal gland, composed of highly vacuolated cells; spermatheca with long ectal duct, cylindrical bulb expanded entally.

Etymology.—From Latin *serratus,* saw-like.

Description.—*Cambarincola serratus* is composed of some of the smallest worms of the genus. The holotype has the following dimensions: *total length,* 1.7 mm; *greatest diameter,* 0.3 mm; *head length,* 0.3 mm; *head diameter,* 0.2 mm; *diameter, segment I,* 0.2 mm; *diameter, sucker,* 0.2 mm. The holotype and 4 paratypes have the following average dimensions: *total length,* 1.6 mm (1.3–1.7 mm); *greatest diameter,* 0.4 mm (0.3–0.5 mm); *head length,* 0.3 mm (0.2–0.3 mm); *head diameter,* 0.2 mm (0.1–0.2 mm); *diameter, segment I,* 0.1 mm (0.1–0.2 mm), *diameter, sucker,* 0.2 mm (0.2–0.2 mm).

The lips are entire; an indeterminate number of oral papillae are present. External sulci of the head are confined to that delimiting the peristomium. There is one internal pharyngeal sulcus. The dorsal ridges of segments II–VIII are very pronounced and serve immediately to identify the species.

The jaws are proportionately small; about $^1/_7$ to $^1/_6$ the diameter of the head in width. The teeth are small and blunt, very difficult to count in the usual type of preparations and are uniform in length, except for a slightly greater size of the median ones.

The spermiducal gland is small, about twice its diameter and less than half that of the body in length. It narrows slightly as it approaches its function with the ejaculatory duct and normally lies horizontally within its segment. There are no detectable deferent lobes.

The prostate is subequal to the spermiducal gland in length and somewhat less than the latter in diameter. Its ental portion is markedly narrowed, but no prostatic bulb is evident. The organ is composed of very large cells that appear to be filled with a clear fluid and are highly vacuolated. The prostate is often difficult to see in whole mounts.

The bursa is cylindrical, twice as long as thick and about ⅔ the diameter of the segment in length. Penial sheath and atrial portions of the bursa are subequal.

The spermatheca is composed of a very long ectal duct, a median thick-walled section that contains spermatozoa and a long cylindrical, thin-walled spermathecal bulb that runs dorsally to the gut posteriorad for more than the length of the segment. There is no ental process. The total length of the organ cannot be determined in whole mounts, but must exceed twice the diameter of segment V.

Variations.—None have been noticed, except the usual ones of slight differences of size and the positions of the reproductive organs in their respective segments.

Affinities.—The unique combination of the exaggeratedly raised dorsal ridges, the highly vacuolated prostate and the extremely long spermatheca sharply separates *C. serratus* from all of its congeners. In its general facies, one is immediately reminded of species of *Pterodrilus*. The latter genus is, indeed, considered a specialized branch of small worms derived from a "primitive" stock of the genus *Cambarincola* (Holt, 1968b:3–5) and *C. serratus* may be considered a western vicariant of an eastern species of *Pterodrilus*. The similarity extends to the diet of each: diatoms are a prominent part of the food of the species of *Pterodrilus* as of *C. serratus*. None of the known species of *Cambarincola* closely resembles *C. serratus* and for now it must be considered a disjunct representative of those members of the genus with differentiated prostates: the "Philadelphica Section" of Hoffman (1963).

Host.—*Pacifastacus* (*Hobbsastacus*) *connectens* (Faxon, 1914).

Distribution.—Tributaries of the Snake River, Gooding County, Idaho.

Material examined.—The type-series.

Cambarincola shoshone Hoffman

Cambarincola shoshone Hoffman, 1963:319–320.—Holt, 1969:209.

Type-specimens.—"Holotype and three paratypes, USNM 29941, from *Pacifastacus gambelii connectans* (=*P.*(*H.*) *connectens*) collected in Riley Creek in the Idaho Fish Hatchery near Hagerman, Gooding County, Idaho, by Perry C. (and Virgie F.) Holt, 14 July 1958. Topotypes from the same collection, PCH 785" (Hoffman, 1963:319).

Diagnosis.—Small worms, somewhat less than 2.0 mm in length; lips entire; no dorsal ridges; jaws small, dental formula 3/3; bursa small, about ⅓ body diameter in length; spermiducal gland larger than bursa with deferent lobes; prostate slender, shorter, about ⅓ spermiducal gland in length, nondifferentiated, no ental bulb; spermatheca with ental bulb (emended from Hoffman, 1963:319–320).

Remarks.—This species has not appeared in any subsequent collections, therefore nothing can be added to Hoffman's treatment. He adequately described and illustrated the material and considered *Cambarincola branchiophilus* Holt, 1954, as its closest relative, a reasonable supposition at the time, but the sad fact is that until many new species are named and a long and intensive effort is devoted to monographing the genus, no speculation about the affinities of any species of the genus *Cambarincola* is entirely plausible.

Acknowledgments

I am grateful to Virgie F. Holt, my wife, and my daughter, Susan E. H. West, for their help in collecting almost all the material upon which this account is based. Dr. Horton H. Hobbs, Jr., has as usual supplied host identifications and in various other crucial and often intangible ways made my studies of the branchiobdellids possible. The National Science Foundation supported the field work; the Department of Biology, Virginia Polytechnic Institute and State University has been generous with time.

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BICORNIFERA LINDENBERG, 1965 EMEND. KEIJ, 1969 (MICROPROBLEMATICA) FROM THE TYPE BYRAM MARL (OLIGOCENE), MISSISSIPPI

D. Haman, K. L. Finger, and R. W. Huddleston

Abstract.—The occurrence of *Bicornifera* Lindenberg emend. Keij (1969) is documented for the first time from the Oligocene Byram Marl of Mississippi. Observations are made on the morphologic variation of the taxon.

Lindenberg (1965) established the genus *Bicornifera* for problematic microfossils of unknown affinity obtained from lower to middle Oligocene strata in the North Tyrol, Austria. He designated *Bicornifera alpina* as type-species for the genus and also described *B. longa* in this work. Lindenberg (1965:18) noted that the genus also occurred in coeval marls in northern Slovenia and Turkey.

Lindenberg's (1965) generic concept of this problematic taxon was emended by Keij in 1969. This emendation was based on specimens of *B. lindenbergi* Keij (1969) obtained from the upper Oligocene of Escornebéou, S. W. France. In addition, Keij (1969:245) briefly described and illustrated a single, poorly preserved specimen retrieved from an upper Oligocene Alabama sample, which he left in open nomenclature.

The present note documents additional occurrences of this taxon in the New World and provides further information on its geographic extent.

We were prompted to select the Byram Marl for examination following a request from S. J. St. Romain (University of New Orleans, pers. comm. 9/19/79) for information concerning some problematica he had obtained from the Byram Formation. These forms proved to be *Bicornifera,* and represented the first recorded, if not documented, occurrence of this taxon in Mississippi.

Our specimens are virtually identical to the form Keij (1969:Fig. 7) illustrated as *Bicornifera* n. sp. The new specimens exhibit a range in length of 0.39 mm–0.47 mm, in L_2 (Länge der beiden Hauptkammern of Lindenberg, 1965) of 0.25 mm–0.34 mm, in maximum width of 0.14 mm–0.15 mm, and in height of 0.13 mm–0.16 mm. The dimensions of Keij's specimen (length 0.42 mm, width 0.17 mm, height 0.17 mm) fall within the ranges quoted above for our specimens. In addition, we have observed considerable variation in the degree of cameral inflation, in the development of flange-like lips around the main apertures and in the development of the distal prolongation. A detailed article, in preparation, will document the morphologic

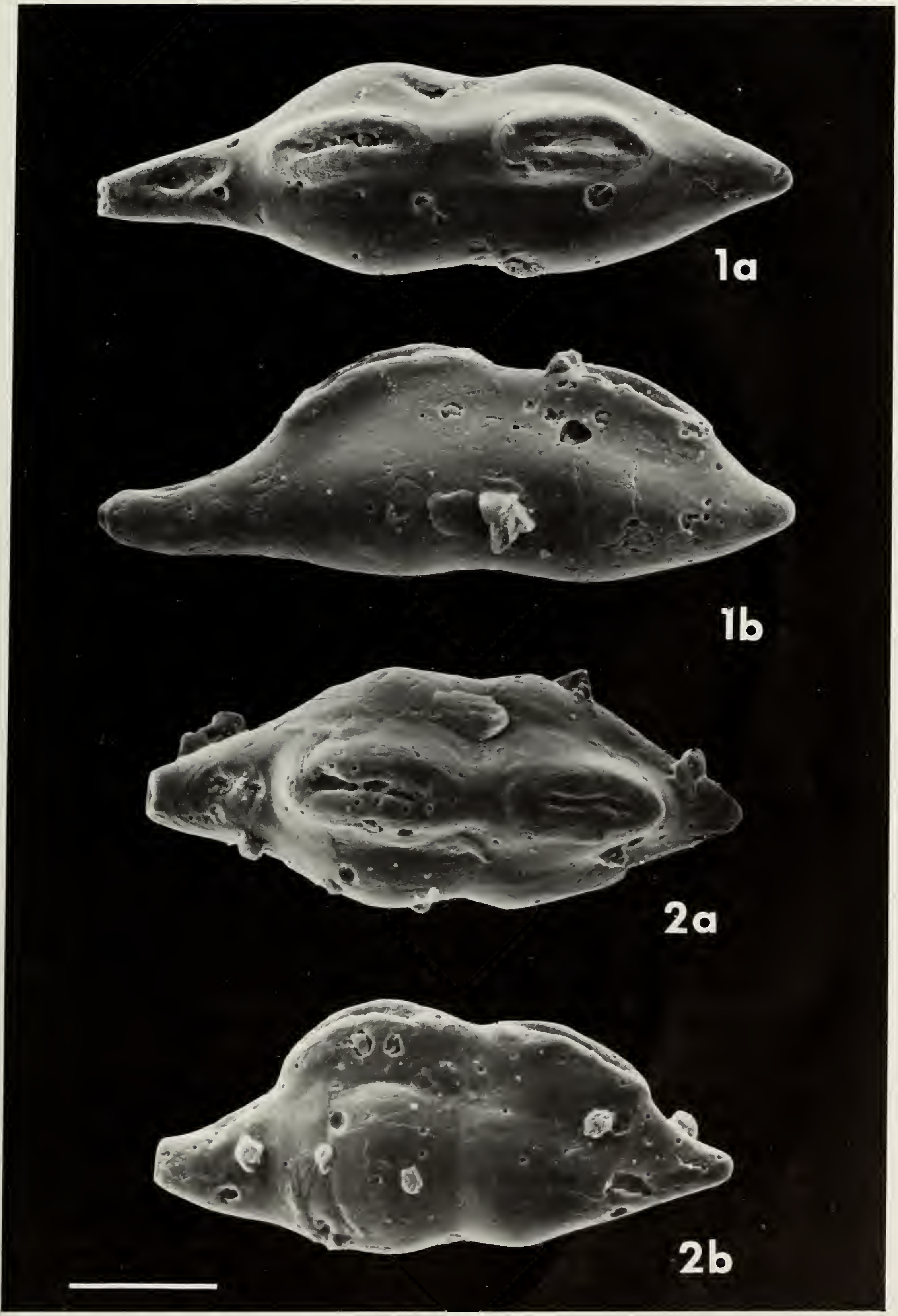

Fig. 1. *Bicornifera* sp. Keij, 1969: 1a, 1b, Dorsal and side views of elongate specimens; 2a, 2b, Dorsal and side views of specimen with well developed flange-like lips around main apertures. Bar = 100 μm.

variation and ultrastructure of these specimens. SEM study of our specimens suggests that the proximal opening illustrated by Keij (1969:Fig. 7b) is probably the result of test fragmentation. We have evidence from complete specimens to indicate that the proximal part of the test is not perforated in any manner. Keij (1969) commented that his *Bicornifera* n. sp. somewhat resembled *B. longa* Lindenberg, the only difference being that the Alabama specimen was more thick-set. We question this statement because *B. longa* exhibits well developed proximal and distal prolongations that have secondary apertures on their dorsal surfaces. *Bicornifera* n. sp. of Keij (1969) does not demonstrate these features and neither do ours. We have elected at present to follow the philosophy of Keij (1969) and retain our specimens of *Bicornifera* in open nomenclature.

Acknowledgments

We are indebted to Samuel J. St. Romain (University of New Orleans) for providing us with specimens of *Bicornifera* from Mississippi and for acting as the catalyst for our study of these forms, and to Chevron Oil Field Research Company for publication permission and assistance.

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NOTES ON BLENNIID FISHES OF THE TRIBE OMOBRANCHINI, WITH DESCRIPTIONS OF TWO NEW SPECIES

Victor G. Springer

Abstract.—*Omobranchus robertsi* and *Omox lupus,* new species, are described from New Guinea. *Omobranchus meniscus* Springer and Gomon is synonymized with *Omobranchus smithi* (Visweswara Rao). Range extensions and miscellaneous information are provided for several species of Omobranchini.

Springer (1972) revised all the genera, except *Omobranchus* Ehrenberg, of the blenniid fish tribe Omobranchini. Springer and Gomon (1975) revised *Omobranchus* and gave additional information on other genera and species of Omobranchini. Accumulation of information on species of Omobranchini since 1975 is presented in this report.

I follow the methods of Springer (1972) and Springer and Gomon (1975) except for enumeration of the cephalic sensory pores, for which I follow only Springer and Gomon (who included one more pore position in the supratemporal series than did Springer, 1972). Institutional abbreviations are the same as those used by Springer and Gomon, with the additions of: ROM = Royal Ontario Museum, Toronto; FSM = Florida State Museum, Gainesville; UMMZ = University of Michigan Museum of Zoology, Ann Arbor.

Enchelyurus kraussi (Klunzinger)

Springer (1972) reported *E. kraussi* from numerous localities ranging from the Gulf of Aqaba south to Aldabra in the eastern Indian Ocean eastward to the Marianas, Trobriand, and southern Great Barrier Reef islands. Masuda *et al.* (1975) reported *E. kraussi* from the Ryukyu Islands. The following new collections, while not extending the range of *E. kraussi,* represent additional locality records: near Giligaon, Negros Oriental, Philippines, 09°06.5′N, 122°55.4′E (USNM 225060); near Maloh, Negros Oriental, 09°03.1′N, 122°59.1′E (USNM 225058); Maloh, Negros Oriental, 09°03.1′N, 122°59.7′E (USNM 225057); Solino Island, Mindanao, Philippines, 08°51.4′N, 123°24.6′E (USNM 225059); Umboi Island, Papua-New Guinea, 06°41.9′S, 147°53.1′E (USNM 225062); Lolorua Island, Port Moresby, Papua-New Guinea, 09°29′45″S, 147°06′40″E (USNM 225063); Panapompom Island, Louisade Archipelago, Papua-New Guinea, 10°47′S, 152°24′E (USNM 225061).

Laiphognathus multimaculatus Smith

Springer (1972) reported *L. multimaculatus* from Tanzania, Mozambique, Ceylon, northern Gulf of Thailand, northern Borneo, and the Solomon Islands. Additional specimens are now available from: Kendrew Island, Dampier Archipelago, Western Australia, ca. 20°35′S, 116°35′E (WAM P.25111-019); Kampung Pasir Putih, Halmahera, Indonesia, 00°53′N, 127°41′E (USNM 224825); and Jalun Island, Hermit Islands, Papua-New Guinea, 01°31′12″S, 145°01′30″E (USNM 224419, 224420). I collected the Jalun Island specimens from a crevice in the face (dropoff) of a live reef on the inner protected (east) side of the island, which is in the Hermit Islands lagoon, at a depth of about 10 m. Specimens from other localities are reported from reefs and tide pools and at depths under 8 m. Except for a specimen reported as *Omobranchus* sp. by Springer and Gomon (1975), which was reportedly collected at a depth of 10.7–13.7 m, *Laiphognathus* is known from greater depths than any other species of Omobranchini, which are usually taken at depths under 3 m, and often much shallower.

Omobranchus elegans (Steindachner)

Springer and Gomon (1975) reported the range of *O. elegans* as occurring in southern Korea and southern Japan, at about 37°N latitude (see their Fig. 4). They missed Ueno's (1971) records of *O. elegans* from nonspecified areas along the coast of Hokkaido from 42–44°N latitude. The southern limit of *Omobranchus elegans* is about 35°N latitude. The species is, thus, the most northerly restricted and occurring of all Omobranchini.

Omobranchus elongatus (Peters)

Springer and Gomon (1975) gave the distribution of *O. elongatus* as extending from the east coast of Africa eastward to the Philippines and Ambon Island, Indonesia. Recent collections extend the range to: Batanta Island, Irian Jaya, Indonesia, 00°48.2′S, 130°52.8′E (USNM 224482); mainland in lee of Samei Island, Irian Jaya, Indonesia, 03°05.0′S, 132°29.8′E (USNM 224481); Muschu Island, Papua-New Guinea, 03°23.1′S, 143°33.2′E (USNM 224483); and Fairfax Harbor, Papua-New Guinea, 09°35.5′S, 147°04.0′E (USNM 224480).

Omobranchus ferox (Herre)

Springer and Gomon (1975) gave the distribution of *O. ferox* as Mozambique, Ceylon, India (northeast coast), Singapore, Nias Island (off northwest Sumatra), northeast Gulf of Thailand, Hong Kong, and Philippine Islands. Additional specimens are now available from East Vernon Island, Northern Territory, Australia, 12°05′S, 131°06′E (USNM 224477); Cape

Ward Hunt, Papua-New Guinea, 08°04.2′S, 148°08.4′E (USNM 224478); and Balikpapam Harbor, Borneo, 01°15′S, 116°50′E (AMS 19355-030).

The specimen from Papua-New Guinea, a male, had the following meristics: dorsal fin XII, 19 (total elements 31); anal fin II, 22; vertebrae 10 + 27 = 37. The numbers of segmented and total dorsal-fin elements and caudal and total vertebrae are each one less than the minimum previously reported for the species.

Omobranchus germaini (Sauvage)

Springer and Gomon (1975) reported *O. germaini* from Taiwan, Hong Kong, Philippines, Singapore, Ambon Island, New Caledonia, and western, northern, and eastern Australia. Specimens are now available from the following localities: Kampung Pasir Putih, Halmahera, Indonesia, 00°53′N, 127°41′E (USNM 224604, 224916); Misool Island, Indonesia, 02°03.1′S, 130°06.4′E (USNM 224605); Flores Island, Indonesia, ca. 08°30′S, 121°00′E (FSM 23836); and Croker Island, Northern Territory, Australia, 11°01.7′S, 132°32.7′E (USNM 224734).

Omobranchus lineolatus (Kner) and *Omobranchus punctatus* (Valenciennes)

Kner (1868b) described *Petroscirtes semilineatus* from Kandavu, Fiji Islands. Springer and Gomon (1975) placed *P. semilineatus* in the synonymy of *O. punctatus* and questioned the provenance of Kner's type because subsequent collecting had failed to show the presence of *O. punctatus* in the Fiji Islands. Recent collections from Viti Levu, Fiji Islands (AMS 1.19179-001) include specimens of *O. punctatus*. For this reason I now accept Kner's (1868a, b) type-locality for *O. lineolatus,* Kandavu, which Springer and Gomon also questioned.

One of the Viti Levu specimens of *O. punctatus* is a metamorphosed specimen 16.2 mm SL, one mm shorter than the smallest metamorphosed specimen available to Springer and Gomon (1975:Table 4).

Bath (1980) reported *O. punctatus* from the Suez Canal, a considerable range extension for the species, which was previously known in the western Indian Ocean area only from southeastern Africa, Persian Gulf, northwestern Arabian Gulf, and the Maldive Islands.

Omobranchus robertsi, new species
Fig. 1

Holotype (only known specimen).—USNM 216985, male, 48.1 mm SL, mangrove lined tributary of Guiavi Creek on mainland opposite western end of Parama Island, Papua-New Guinea, 09°01.2′S, 143°21.6′E, T. R. Roberts (Fly 75-32), 15 December 1975.

Fig. 1. *Omobranchus robertsi,* USNM 216985, holotype, male, 48.1 mm SL. Drawn by P. K. Hollingsworth.

Description.—Bilaterally paired structures are reported left-right. Dorsal fin XIII, 19. Anal fin II, 20 (genotypically II, 21; radiograph indicates that third from posteriormost anal-fin pterygiophore lacks an articulating fin ray). Pectoral fins 13-13. Pelvic fins I, 2-I, 2. Caudal fin 7-13-6. Vertebrae 12 + 26 (posteriormost pleural ribs articulate with 11th centrum, indicating normal precaudal count is probably 11; *ergo* 11 + 27). Epipleural ribs on 14 anteriormost vertebrae. Upper jaw teeth I-21-I. Lower jaw teeth I-22-I.

Sensory pores: interorbital 3; infraorbital 8-8; mandibular 3-3; preopercular 6-6; supratemporal 5 (includes median supratemporal); bi-pored lateral-line tubes 1-2, extending posteriorly on both sides to below third dorsal-fin spine; anterior and posterior nasal pores present.

Gill opening on each side reaching ventrally to opposite dorsalmost pectoral-fin ray. Lower-lip flap present. No median fleshy crest present dorsally on head. Ventral hypural plate autogenous; no autogenous hypural 5; one epural. Head length 21.6% SL; caudal-fin length 18.7% SL; fifteenth dorsal-fin ray length 17.2% SL.

The color pattern is indicated on Fig. 1, but is supplemented here. The most conspicuous dark markings are: two spots anteriorly on dorsal fin; spot just dorsal and posterior to axil of pectoral fin; and short, slender, dark marks just posterior to infraorbital pores at 2, 4, and 5 o'clock positions. Two dusky bands separated by pale interspaces extend ventrally from orbit, anteriormost extends across ventral surface of lower jaw to opposite side; dusky band incorporating short, slender, dark mark extending dorsally from about midlevel of cheek across top of head to midlevel of cheek on opposite side; broad, faint, dusky band extends dorsally from ventral level of opercular region across predorsal area to ventral level of opercle on opposite side. There are about 13 incomplete dusky bands on each side of the body.

Comparisons.—*Omobranchus robertsi* might be keyed to *O. punctatus* or *O. verticalis* in Springer and Gomon's (1975) key to the species of *Omobranchus,* but does not conform with the majority of the characters given in either of the final two key couplets leading to these two species. *Omobranchus robertsi* differs from *O. punctatus* (and all other species of *Omobranchus*) in having a dark spot on the region of the body near the pectoral-fin axil as the most conspicuous marking on the body. It also differs from *O. punctatus* in having conspicuous dark spots in the anterior dorsal-fin membranes, in having both anal-fin spines of males conspicuous externally, and in having fewer teeth (males of *O. punctatus* of the same size as the type of *O. robertsi* have about 5 to 8 more teeth in either jaw; Springer and Gomon, 1975:figs. 49–50). *Omobranchus robertsi* can be differentiated from various *O. punctatus* populations on the basis of many meristic characters (see Springer and Gomon, 1975:Table 13). Compared with those populations of *O. punctatus* closest geographically (New Guinea; Bougainville) to the type-locality of *O. robertsi, O. robertsi* has at least three fewer lateral-line tubes; the tubes end below the third dorsal-fin spine, as opposed to the 7th–9th for the *O. punctatus* populations; and has 6–10 fewer epipleural ribs.

In having dark spots anteriorly in the membranes of the dorsal fin, *O. robertsi* is similar, among the species of *Omobranchus,* only to *O. verticalis, O. aurosplendidus,* and possibly *O. smithi.* It differs from *O. verticalis* (known only from southern Queensland) in having more than 10 precaudal vertebrae, in having more teeth in either jaw for its size (21–22 vs. 17 for *O. verticalis*), and in not having the dusky bands on the body with dark margins. It differs from *O. aurosplendidus* and *O. smithi* in lacking a fleshy crest on top of the head, from the former species in having many fewer dorsal- and anal-fin rays and vertebrae and from the latter species in lacking a dark crescentic marking extending dorsally from the orbit.

Etymology.—Named for Tyson R. Roberts, who collected the holotype and made it available to me.

Omobranchus rotundiceps obliquus (Garman)

Springer and Gomon (1975) reported *O. r. obliquus* from numerous localities ranging from the Nicobar Islands east to the Hawaiian Islands. Two new collections, while not extending the eastward range, fill in noticeable gaps in the known distribution: Kat Island, Ninigo Islands, 01°07′45″S, 144°30′00″E (USNM 224697); and Ponape, Eastern Caroline Islands, ca. 07°00′N, 158°14′E (USNM 223013, 223474, 223355).

Omobranchus smithi (Visweswara Rao)

Visweswara Rao (1974) described *Cruantus smithi* from the Godavari Estuary (ca. 16.5°N, 82°E), India. The journal containing the description was for the year 1973, but bore a printed publication date of 18 October 1974. Springer and Gomon (2 April 1975) synonymized *Cruantus* Smith with *Omobranchus* and described *O. meniscus* from Thailand. I believe that *O. meniscus* is a junior subjective synonym of *O. smithi.* My attempts to borrow specimens of *O. smithi* and obtain additional information on the species from its author were unsuccessful. The name *Cruantus smithi* first appeared as a *nomen nudum* (Visweswara Rao, 1971).

Omox biporos Springer

Springer (1972) and Springer and Gomon (1975) reported the distribution of *O. biporos* as northern Gulf of Thailand; Madang and Port Moresby, Papua-New Guinea; and Palau Islands. Specimens are now available from: Cuyo Island, Philippines, 10°48′54″N, 121°00′30″E (USNM 224469, 219306); Irian Jaya, Indonesia, 03°05.0′S, 132°29.8′E (USNM 224468); Misool Island, Indonesia, 02°03.1′S, 130°06.4′E (USNM 224237); Batanta Island, Indonesia, 00°48.2′S, 130°52.8′E (USNM 224236); Croker Island, Northern Territory, Australia, 11°01.7′S, 132°32.7′E (USNM 224696, 224734); Lizard Island, Queensland, Australia, 14°40′S, 145°30′E (AMS I.19467-002); Canala Bay, New Caledonia, ca. 21°S, 165°E (BPBM 22525); and Ponape, Eastern Caroline Islands, ca. 06°57′30″N, 158°00′08″E (USNM 224384).

Omox lupus, new species

Holotype.—USNM 223710, male, 28.0 mm SL, Cape Ward Hunt, Papua-New Guinea, 08°04.2′S, 148°08.4′E, 0–1 m, mangrove swamp, B. B. Collette (BBC 1696), 17 June 1979.

Paratypes.—USNM 223711, male, 29.7 mm SL, cleared and stained, collected with the holotype; USNM 223712, male, 26.2 mm SL, mainland along SW corner in lee of Samei Island, Irian Jaya, Indonesia, 03°5.0′S, 132°29.8′E, 0–1.5 m, mangrove swamp along small river (freshwater), B. B. Collette (BBC 1737), 4 July 1979.

Description.—This description is based on all three types with the characters for each specimen given in the same order as presented above. Dorsal fin XII, 16; XII, 16; XII, 16. Anal fin II, 18; II, 19; II, 19. Pectoral fins (left-right) 12-12; 12-12; 10-12. Pelvic fins I, 2; I, 2; I, 2. Caudal fin 6-13-6; 6-13-5; 6-13-5. Vertebrae 10 + 25; 10 + 25; 10 + 25. Epipleural ribs (left-right, cleared and stained specimen only) 12-11. Upper jaw teeth I-26-I; 0-31-I; I-24-I. Lower jaw teeth I-24-I; I-26-I; II-24-I.

Sensory pores: interorbital 4; 4; 5; infraorbital 8; 8; 8; mandibular 3; 3; 3; preopercular 6; 6; 6; supratemporal 5; 5; 5 (median predorsal commissural pore absent in all specimens); no bi-pored lateral-line tubes in any specimen; anterior and posterior nasal pores present.

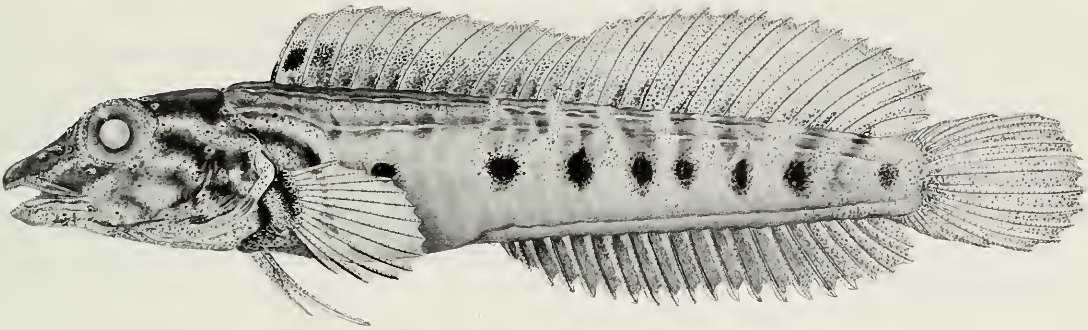

Fig. 2. *Omox lupus,* USNM 223711, paratype, male, 29.7 mm SL. Drawn by P. K. Hollingsworth.

Gill opening extending ventrally to opposite level of pectoral-fin ray (left-right) 9-8; 10-12; 10-10. No fleshy crest on top of head. Ventral hypural plate autogenous; no autogenous hypural 5; one epural. Dorsal and caudal fins attached by membranes anterior to caudal-fin base. Premaxillary and dentary canines about same height, but dentary canines stronger. Shortest pelvic-fin ray more than half length of longest.

The following characters are based on the cleared and stained specimen: rostral cartilage not ossified; infraorbital bones 4-4; nasal bones separate, not impinging; frontals separate, not fused; pterosphenoids, if present, not evidenced on external surface of cranium; basisphenoid with belophragm; post-temporal without ventral arm, with sensory canal incorporated; dentaries united by suturing joint; interopercle with posteriorly projecting spur; postcleithra, two on each side, normal.

Snout length 10.0, 10.5, 10.9% SL; snout tip to rictus 10.0, 10.2, 9.5% SL; greatest head width —12.5, 12.2% SL; body depth at anus 15.5, 15.2, 13.9% SL.

The color pattern of all three specimens is essentially the same as that portrayed in Fig. 2 (the cleared and stained paratype), except that in the holotype and other paratype the dusky bands extending dorsally from the dark midlateral body spots are dorsally as dark as the midlateral spots.

Comparisons.—*Omox lupus* keys to *O. biporos,* the only other species of *Omox,* in the key to the genera and species of Omobranchini in Springer (1972). *Omox lupus* differs from *O. biporos* in having: a longer snout (10.0–10.9% SL in the SL range of 26.2–29.7 mm vs. 7.1–8.1% in the SL range of 25.9–53.7 mm); a more compressed head (maximum width about 12% SL vs. about 15%); fewer pectoral-fin rays (typically 12 vs. 12–13, more than 90% of specimens with 13); more dentary incisor teeth at a given size (25–26 in males at SL range of 26.2–29.7 mm vs. 20–22 in males at SL range of 27.7–35.1 mm); the rostral cartilage unossified; and in color pattern (head markings are more horizontally oriented in *O. lupus,* more vertical, if apparent, in *O. biporos*; body has distinct spotted appearance in male *O. lupus,* diffusely dusky, diffusely spotted, or dusky banded in *O. biporos*).

Both species of *Omox* were collected at the same station in Irian Jaya, Indonesia.

Etymology.—The species name is derived from the Latin word for wolf, in reference to the wolflike snout of the species, and is used here as a noun in apposition.

Parenchelyurus hepburni (Snyder)

Springer (1972) and Springer and Gomon (1975) recorded *P. hepburni* from numerous localities from Mauritius and the Amirante Islands eastward to the Marshall and Samoa islands. Specimens from Tulear, southwestern Madagascar, 23°20′S, 43°41′E (UMMZ 186051) represent a slight western range extension for the species, which has not yet been recorded from, but should be expected to occur on, the east coast of Africa. Other new locality records are: Chagos Islands (ROM, 6°34′S, 72°24′E, R. Winterbottom, in litt.); and Ponape, Eastern Caroline Islands, 06°59′45″N, 158°11′00″E (USNM 223243).

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Specimens from Ponape were collected during an expedition funded by a grant from The Max and Victoria Dreyfus Foundation, V. G. Springer, principal investigator. Specimens from the Hermit and Ninigo Islands were collected during an expedition funded by The Lewis and Rosa Strauss Memorial Fund, V. G. Springer, principal investigator.

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GONODACTYLUS LIGHTBOURNI, A NEW STOMATOPOD CRUSTACEAN FROM BERMUDA

Raymond B. Manning and C. W. Hart, Jr.

Abstract.—*Gonodactylus lightbourni,* a new species collected in moderate depths off Bermuda, is described. It is the eleventh species of the genus to be recognized in the western Atlantic.

Among the unidentified stomatopods in the collection of the Bermuda Biological Station was one lot containing four specimens of a small *Gonodactylus* taken in 64–91 m by the "Northstar" Expeditions under the direction of J. H. R. Lightbourn and Arthur T. Guest. These specimens represent an undescribed species which is named herein.

All of the specimens have been deposited in the National Museum of Natural History, Smithsonian Institution, Washington, under USNM catalog numbers. Measurements are in millimeters; total length is abbreviated to TL.

We thank Wolfgang Sterrer, Director, Bermuda Biological Station, for making these specimens available for study. The illustrations were prepared by Lilly King Manning. This report is Contribution #863 from the Bermuda Biological Station for Research, Incorporated. Our work in Bermuda was supported in part by the Smithsonian Institution through its Scholarly Studies Program and the Secretary's Fluid Research Fund; this support is gratefully acknowledged.

Gonodactylus lightbourni, new species
Fig. 1

Material.—Bermuda, south shore, 2 miles off Castle Roads, 64–91 m, 25 September 1976, R/V "Northstar" Expeditions, J. H. R. Lightbourn, Arthur T. Guest, John C. Markham, leg.: 1 female, TL 25 mm (holotype, USNM 181443), 1 male juvenile, TL 10 mm, 2 female juveniles, TL 9.5 and 11 mm (paratypes, USNM 181444).

Description.—Rostral plate (Fig. 1*a*) longer than broad, rounded laterally, anterior margins sloping anteriorly to slender median spine. Ocular scales small, erect, rounded dorsally. Lateral process of sixth thoracic somite more rounded and broader than that of seventh somite, latter rectangular. Anterior 5 abdominal somites unarmed posterolaterally. Sixth abdominal somite with 6 carinae, submedians and intermediates rather broad, each armed posteriorly. Abdominal width-carapace length index of holotype 760. Telson

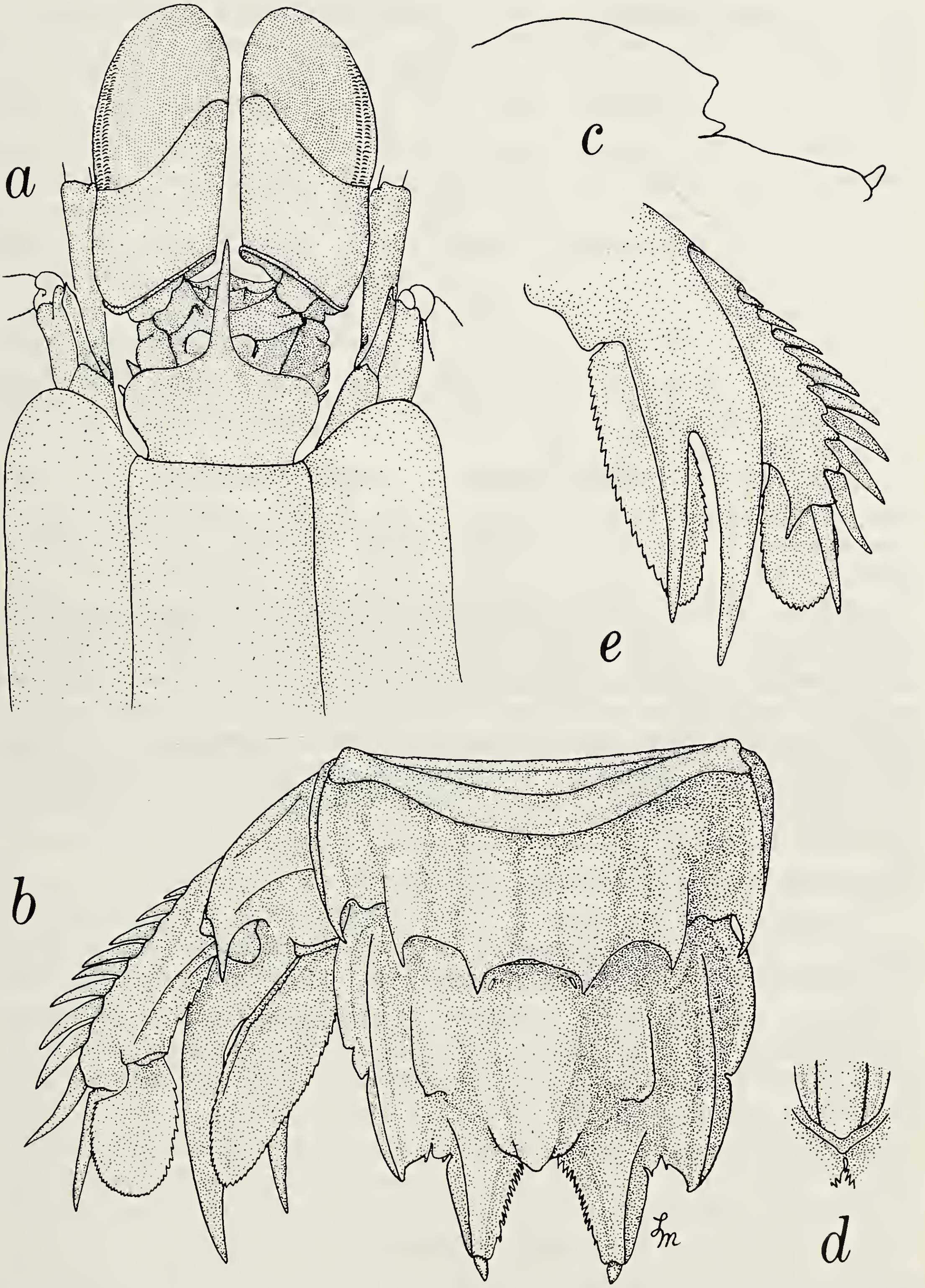

Fig. 1. *Gonodactylus lightbourni*, new species, female holotype, TL 25 mm: *a*, Anterior part of body; *b*, Sixth abdominal somite, telson, and uropod; *c*, Apex of median carina of telson, lateral view; *d*, Same, dorsal view; *e*, Uropod, ventral view.

(Fig. 1*b*) slightly longer than broad (flexed ventrally, appearing shorter in Fig. 1), of oerstedii-type, lacking dorsal tubercles on carinae. Dorsal carinae of telson, other than accessory intermediates, well defined. Median carina broad, tapering posteriorly to blunt apex, apical spine of holotype possibly damaged. Accessory median carinae very short, low, fused posteriorly with median carina to form anchor (Fig. 1*d*). Knob appearing as acute lobe in lateral view (Fig. 1*c*), with distinct median tubercle (Fig. 1*d*). Anterior submedian carinae each ending in blunt lobe or tubercle. Submedian teeth broad, inner margins lined with minute denticles, movable apices present. Intermediate teeth broad, apices blunt. Lateral teeth low, poorly developed, damaged on left side. Two anteriorly recessed intermediate denticles present, inner set on rounded lobe. Uropod (Fig. 1*b, e*) slender, outer margin of proximal segment with 10–11 graded, movable spines; endopod slender, rounded mesially and laterally.

Measurements.—Female holotype, TL 25 mm; 3 juveniles 9.5, 10, and 11 mm. Other measurements of holotype: rostral plate length 1.8, width 1.6; carapace length 5.0; fifth abdominal somite width 3.8; telson length 3.8, width 3.5.

Remarks.—*Gonodactylus lightbourni* is the eleventh species of the genus to be recorded from the western Atlantic, and only the third to be collected at Bermuda; *G. bredini* Manning and *G. spinulosus* Schmitt have been recorded from shallow water Bermudan localities (Manning, 1969, 1973). It differs from all of the known American species in the shape of the rostral plate, in which the basal part is broadly rounded laterally rather than produced into an angular lobe. The rostral plate is similar to that found in the Indo-West Pacific *G. espinosus* Borradaile (see Manning, 1967, fig. 8a), but the median spine is longer in *G. lightbourni.*

The apparently unique shape of the rostral plate in *G. lightbourni* prompted us to reexamine the shape of the plate and the ocular scales in material of the nine western Atlantic species available to us; these are shown in Fig. 2. The ocular scales of the western Atlantic species are not particularly distinctive; they are relatively small in all of the species examined, unlike those found in the common Indo-West Pacific *G. chiragra* (Fabricius) and its closest relatives.

Gonodactylus lightbourni can be distinguished from the other western Atlantic species with an oerstedii-type telson and which lack dorsal spinules on the telson carinae by the presence of indistinct posterior tubercles on the median and anterior submedian carinae of the telson and by the distinct median tubercle on the knob. In some of these features this new species resembles *G. petilus,* but in that species the rostral plate is shaped differently, being less constricted basally (compare the rostra in Figs. 1*a* and 2*g*), the abdomen and telson are more slender, the median and submedian dorsal carinae of the telson terminate in distinct spines, the accessory median

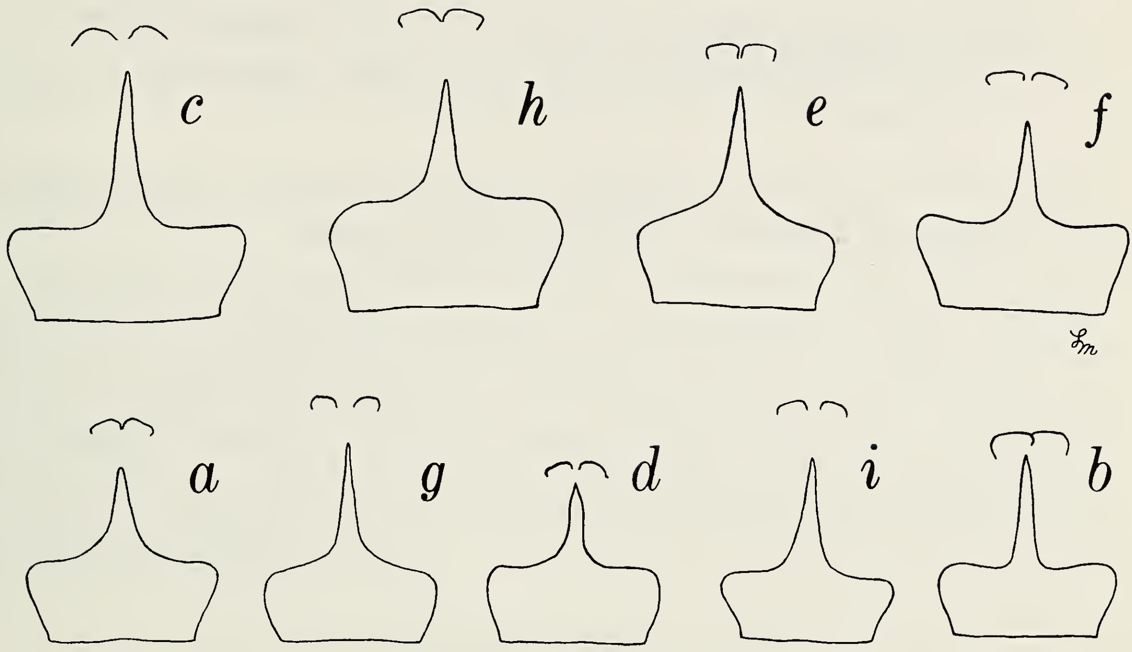

Fig. 2. Rostral plate and ocular scales of *Gonodactylus* spp.: *a, G. austrinus* Manning, 1969, male paratype, TL 50 mm, Fernando de Noronha, USNM 119264; *b, G. curacaoensis* Schmitt, 1924, female lectotype, TL 48 mm, Curaçao, USNM 57527; *c, G. lacunatus* Manning, 1966, female paratype, TL 28 mm, Abrolhos Islands, USNM 113252; *d, G. oerstedii* Hansen, 1895, male, TL 48 mm, Florida, USNM 7524; *e, G. minutus* Manning, 1969, female paratype, TL 27 mm, Brazil, USNM 18490; *f, G. bredini* Manning, 1969, male holotype, TL 59 mm, Grenadines, USNM 119140; *g, G. petilus* Manning, 1970, male holotype, TL 18 mm, Panama, USNM 128327; *h, G. torus* Manning, 1969, male paratype, TL 33 mm, Florida, USNM 119261; *i, G. spinulosus* Schmitt, 1924, female holotype, TL 32 mm, Barbados, USNM 68945.

carinae are longer, the knob lacks a median projection, and the lateral teeth of the telson are sharper.

Like *G. torus* Manning and *G. petilus* Manning, *G. lightbourni* lives in relatively deep water, 64–91 m; this helps to explain why its presence in Bermudan waters has gone undetected until now.

Etymology.—This species is named for Mr. J. H. R. Lightbourn, whose interest in the marine fauna of Bermuda has resulted in the ''Northstar'' explorations in deep water there. The dredging and trapping operations carried out by Mr. Lightbourn have materially added to the knowledge of the marine fauna of Bermuda.

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SPIONIDAE (POLYCHAETA: ANNELIDA) FROM HAWAII, WITH DESCRIPTIONS OF FIVE NEW SPECIES

Linda A. Ward

Abstract.—Five new species of spionid polychaetes from Oahu, Hawaii are described: *Australospio mokapu, Laonice papillibranchiae, Polydora kaneohe, Polydora pilikia,* and *Pygospio muscularis.* Ecological data and known distribution around the island of Oahu are included. A table summarizing the major morphological characteristics of the species of *Pygospio* is provided, as well as a list of the 29 known species of spionids from Hawaii, including information on their habitats in Hawaiian waters and their zoogeographical distribution.

Introduction

Examination of polychaetous annelids collected from the intertidal and subtidal waters of Oahu, Hawaii between 1975 and 1980 has yielded five new species of Spionidae described herein. Ecological information and known distribution around the island is provided. Abbott (1946) was the first to record a spionid species from Oahu. Since then Hartman (1966) reviewed the Hawaiian polychaetes and reported only two species of spionids: *Polydora websteri* and *Pseudopolydora antennata.* Additional spionids have been reported in the literature, particularly in reports on environmental surveys, but in many cases specimens were only identified to genus and are not available for further study. Extensive studies of more than 6000 spionids from a variety of collections in Hawaiian waters have yielded 29 species representing 19 genera (Appendix I). Twenty-eight of the species came from waters around Oahu, while the other species, *Spiophanes bombyx,* was collected from deep water off of Kahalui, Maui, and from anchialine ponds which are shoreline pools without surface connection to the sea and which have waters of measureable salinity and show tidal rhythms (Maciolek and Brock, 1974) on the island of Hawaii. The nitric acid-formalin decalcification method (Brock and Brock, 1977) provides a rapid means of extracting polychaetes, particularly the small boring polydorids, in excellent condition from calcareous substrata. The use of this technique has revealed that spionids are major components previously overlooked (Hartman, 1966; Amerson and Shelton, 1976), of the polychaete fauna of Hawaiian and Johnston Atoll reefs (Ward, 1980, 1981).

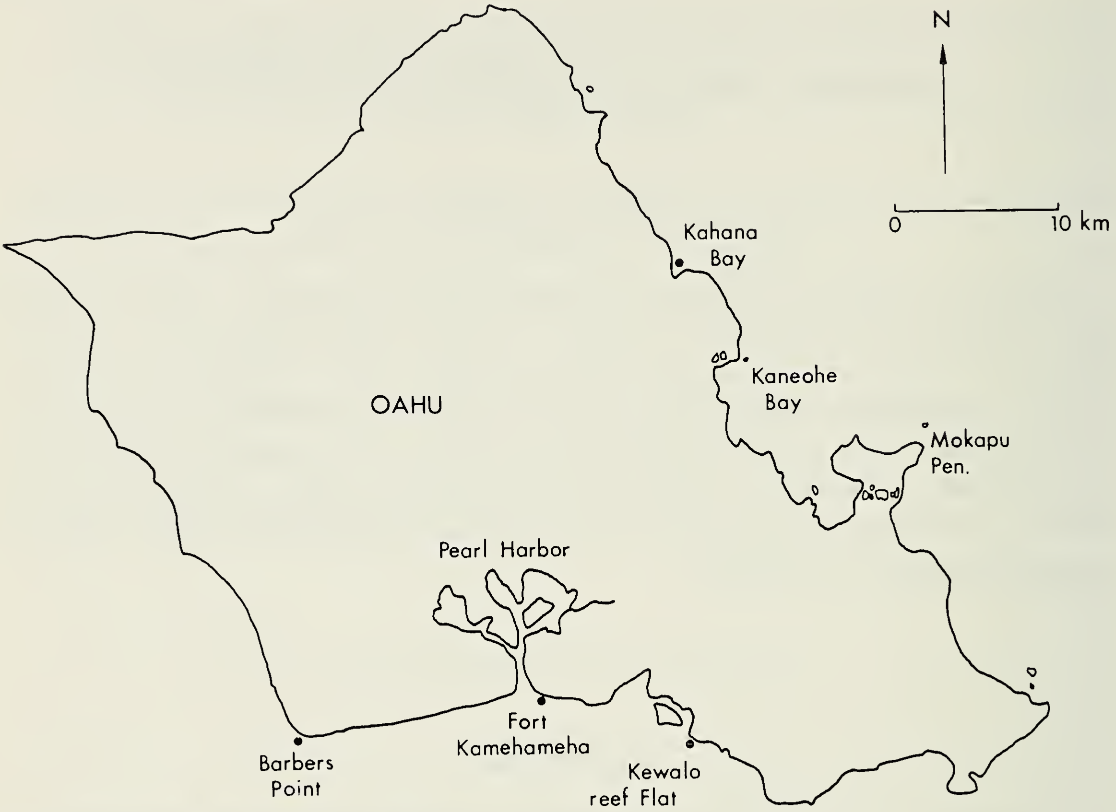

Fig. 1. Oahu, Hawaii showing collecting areas.

Appendix I lists collection data and zoogeographical distribution for the 29 species of spionids from Hawaii.

The holotypes and one set of paratypes are deposited in the Bernice Pauahi Bishop Museum (BPBM), Honolulu, Hawaii. Additional paratypes are deposited in the National Museum of Natual History, Smithsonian Institution (USNM), Washington, D.C. Material is also deposited in the Processing Center, Naval Ocean Systems Center (NOSC), Kailua, Hawaii.

Keys, illustrations, and descriptions of Hawaiian spionids will be given in the *Annelida: Polychaeta* chapter of the revision of *Reef and Shore Fauna of Hawaii* (section 3) presently in preparation through Bishop Museum.

Station Data

Following is the collection information on Oahu for the 5 new species of spionids: *Australospio mokapu, Laonice papillibranchiae, Polydora kaneohe, Polydora pilikia,* and *Pygospio muscularis* (Figs. 1 and 2). Number of specimens are in parentheses.

BARBERS POINT, 21°17′50″N, 157°7′38″W, 1.2 miles W of the Chevron Oil Company pipeline, coll. B. L. Burch, 5.5 m depth, sand, May 1977 *L. papillibranchiae* (1); June 1978 *L. papillibranchiae* (4).

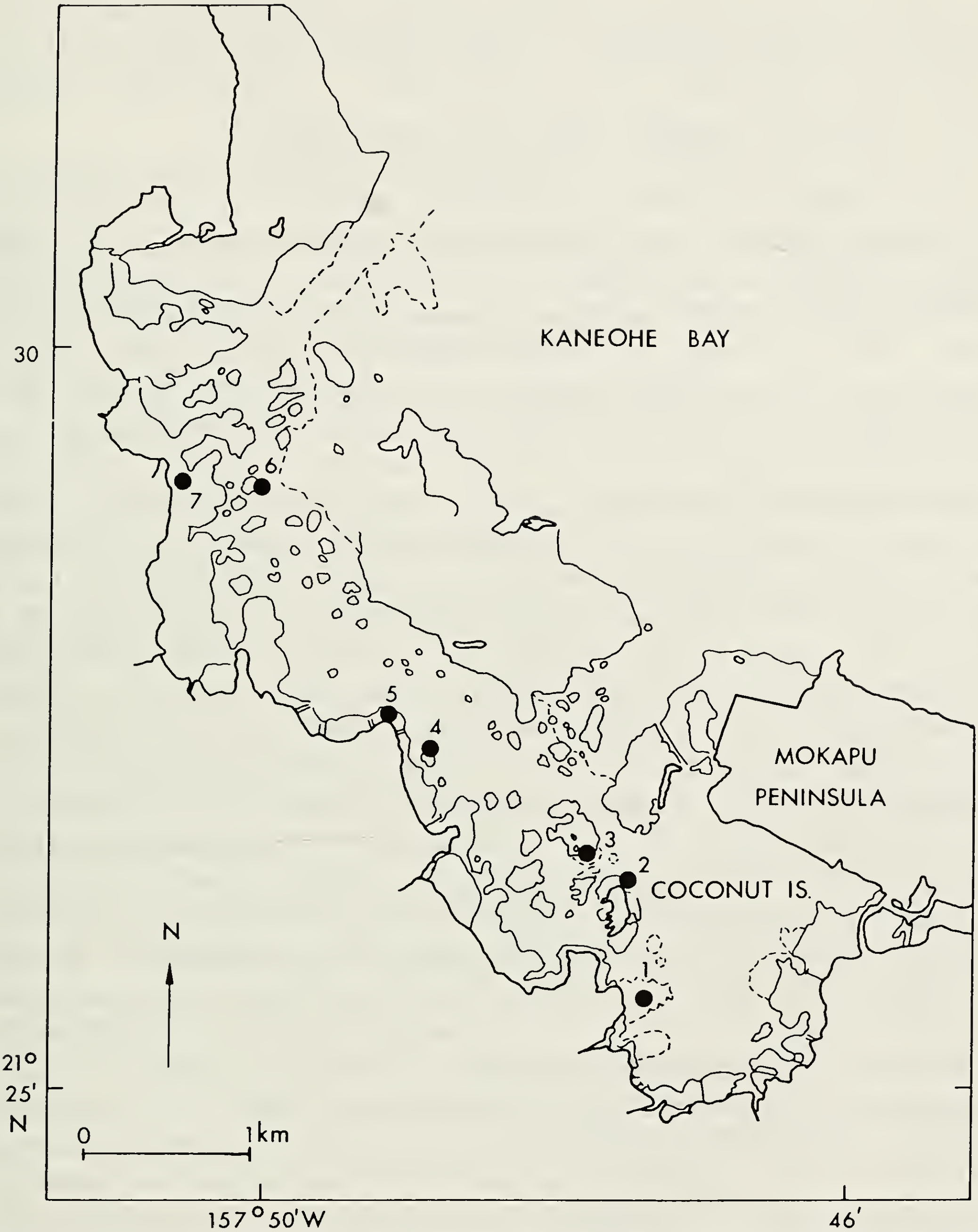

Fig. 2. Kaneohe Bay, Oahu showing collecting sites (map after Banner and Bailey 1970).

PEARL HARBOR, 1. Ford Island power plant, 21°21′42″N, 157°57′42″W, coll. J. G. Grovhoug and W. J. Cooke, 26 Oct. 1978, 6.1 m depth, silt and rubble, NOSC 780036HA sample A *P. pilikia* (2); NOSC 780036HA sample B *P. pilikia* (50). 2. Pearl Harbor power plant #3, 21°20′59″N, 157°58′10″W, coll. J. G. Grovhoug and W. J. Cooke, 26 Oct. 1978, 7.6 m depth, silt and rubble, NOSC 780036HA sample B *P. pilikia* (2).

FORT KAMEHAMEHA, 29°19′55″N, 157°57′18″W, 1. Coll. J. H. Bailey-Brock, Apr. 1978, 125 m from shore, 0.5 m depth, sand and coral rubble *P.*

muscularis (11); 2. Coll. M. B. Wagner, spring 1978, 425 m from shore, 0.5 m depth, sand and coral rubble *P. pilikia* (16), *P. muscularis*. (1).

KEWALO, 21°17′42″N, 157°51′36″W, coll. L. A. Ward, 25 Feb. 1978, 27 m from shore, 0.75 m depth, coral rock *P. muscularis* (3).

MOKAPU PENINSULA, 1. Naval Ocean Systems Center, Ulupau microcosm facility, 21°27′36″N, 157°44′12″W, coll. R. S. Henderson, silt and coral rubble from a 1.4 m^2, 500 liter tank (see Henderson *et al.*, 1976), NOSC 760004HA Tank U7503-2, 2 March 1976 *A. mokapu* (1); NOSC 760089HA Tank 9, 30 Nov. 1976 *A. mokapu* (1); NOSC 760089HA Tank 11, 1 Dec. 1976 *A. mokapu* (1); NOSC 760089HA Tank 12, 1 Dec. 1976 *A. mokapu* (1). 2. Sweep Pier lagoon, 21°27′21″N, 157°47′01″W, coll. R. S. Henderson, 8 Jan. 1979, 6 m depth, silt, NOSC 790002HA station 1 *A. mokapu* (3).

KANEOHE BAY, 1. Station 1, 21°25′31″N, 157°47′27″W (Fig. 2, station 1), coll. R. E. Brock, 5 Oct. 1976, NOSC 760091HA: sample 3-1-367, lagoon floor, 7.6 m, silt and rubble *P. pilikia* (4); sample 3-7-373, reef slope, 3.6 m, coral rock *P. pilikia* (33); sample 3-11-377, reef crest, 1.2 m, coral rock *P. pilikia* (165); sample 3-17-383, reef flat, 1 m, silt and rubble *P. pilikia* (503). 2. Station 1, 21°25′31″N, 157°47′27″W (Fig. 2, station 1), coll. J. K. F. White, 1 m, boring in coral settlement blocks, Dec. 1977, 4 month exposure *P. kaneohe* (1), *P. pilikia* (2); coll. Apr. 1978, 8 month exposure *P. pilikia* (1). 3. Windward reef flat, Coconut Island, 21°26′28″N, 157°47′22″W (Fig. 2, station 2), coll. J. K. F. White, 2 m, boring in coral settlement blocks, Nov. 1977, 3 months exposure *P. pilikia* (2); Dec. 1977, 4 months exposure *P. pilikia* (31). 4. Checker Reef, 21°26′31″N, 157°47′41″W (Fig. 2, station 3), coll. L. C. Hubbell, 23 Apr. 1976, 3 m, sand, NOSC 760069HA *P. kaneohe* (2); coll. J. K. F. White, Nov. 1977, 2 m, boring in coral settlement block, 3 months exposure *P. pilikia* (3). 5. Station 4, 21°27′14″N, 157°48′46″W (Fig. 2, station 4), coll. J. G. Grovhoug and R. S. Henderson, 27 Feb. 1975, 3 m, silt covering coral rubble, NOSC 750001HA (Sta. KBBS 28) *P. pilikia* (1). 6. Station 5, 21°27′34″N, 157°49′07″W (Fig. 2, station 5), coll. R. E. Brock, 6 Oct. 1976, NOSC 760091HA, sample 2-5-398, reef slope, 9 m, coral rock *L. papillibranchiae* (2), *P. pilikia* (12); sample 2-8-401, reef crest, 1 m, coral rock, *P. pilikia* (13); sample 2-24-417, reef flat, 0.76 m, coral rock, *P. pilikia* (18). 7. Station 6, 21°29′05″N, 157°50′06″W (Fig. 2, station 6), coll. R. E. Brock, 12 Oct. 1976, NOSC 760091HA, sample 1A-4-479, lagoon floor, 9 m, silt and rubble *P. pilikia* (12), *L. papillibranchiae* (1); sample 1A-7-483, reef crest, 1 m, coral rock *Polydora pilikia* (2). 8. Station 7, 21°29′11″N, 157°50′33″W (Fig. 2, station 7), coll. R. E. Brock, 7 Oct. 1976, NOSC 760091HA, sample 1-8-449, reef slope, 2.4 m, coral rock *P. pilikia* (43); sample 1-11-452, reef crest, 1 m, coral rock *P. pilikia* (2); sample 1-24-465, reef flat, 1 m, coral rock *P. pilikia* (11).

KAHANA BAY, 21°33′36″N, 157°52′33W, 1. Coll. L. A. Ward, 16 May

1980, 10 m from shore, 1 m, shifting sand *P. muscularis* (11); 2. Coll. M. B. Wagner, spring 1978, 15 m from shore, 1 m, shifting sand *P. muscularis* (250).

Australospio mokapu, new species
Fig. 3

Material examined.—Mokapu Peninsula, Oahu, Hawaii: Experimental tanks at NOSC Ulupau microcosm facility, silt and coral rubble—holotype (BPBM R640), paratype (R641) and 2 paratypes (USNM 64344, 64656). Sweep Pier lagoon, 6 m, silt—3 specimens.

Description.—All 7 specimens are anterior fragments. The largest fragment, the holotype, is 20 mm long and 2.3 mm wide for 64 setigers. The body is pinkish-brown in alcohol without any distinct color pattern.

Prostomium anteriorly trilobed, tapering as caruncle nearly to posterior margin of setiger 1 (Fig. 3a). 1–3 pairs of small, circular eyes present; occipital tentacle absent; tentacular palps missing from all 7 specimens. Peristomium raised, forming small lateral wings, extending as low ridge around caruncle (Fig. 3a).

Setiger 1 reduced in size, with capillary notosetae and neurosetae. Notopodia with 2 tiers of winged capillaries on setigers 1–5; 4 tiers of heavy, granular, winged capillaries on setigers 6–9; and 2 tiers of thin, winged capillaries from setiger 10 to end of fragment. Neuropodia with 2 tiers of winged capillaries on setigers 1–5; 4 tiers of heavy, granular, winged capillaries and geniculate setae with fine hairs (Fig. 3b) on setigers 6–9; 2 tiers of winged capillaries from setiger 10 accompanied by 2 to 3 granular sabre setae from setiger 15 and bidentate hooded hooks (Fig. 3c) from setiger 25. Tridentate neuropodial hooded hooks (Fig. 3d) occurring on some posterior setigers in some specimens including holotype.

Cirriform branchiae starting on setiger 1 and continuing to end of fragment. In anterior setigers branchiae attached basally to notopodial lamellae and in posterior setigers connected by easily detachable thin membrane with notopodial lamellae.

Notopodial lamellae short and rounded on setigers 1–3 (Fig. 3e), broader and leaf-like from setiger 4, increasing in size towards posterior end of fragment (Fig. 3f). Neuropodial lamellae small and subtriangular on setigers 1–3 (Fig. 3e), becoming larger and broader from setiger 4, dividing into 4 lateral lobes from setiger 14 (10–13 in paratypes) (Fig. 3f), then produced into 4 papillar-shaped projections (Fig. 3g) from setiger 16–23 in holotype (but not present in paratypes). Neuropodial lamellae single, elongate lobes in posterior setigers (Fig. 3h). Shape of pygidium unknown.

Remarks.—*Australospio mokapu* differs from the closely related Australian species *A. trifida* Blake and Kudenov, 1978, by the shape of the notopodial lamellae, the presence of a thin, delicate membrane connecting

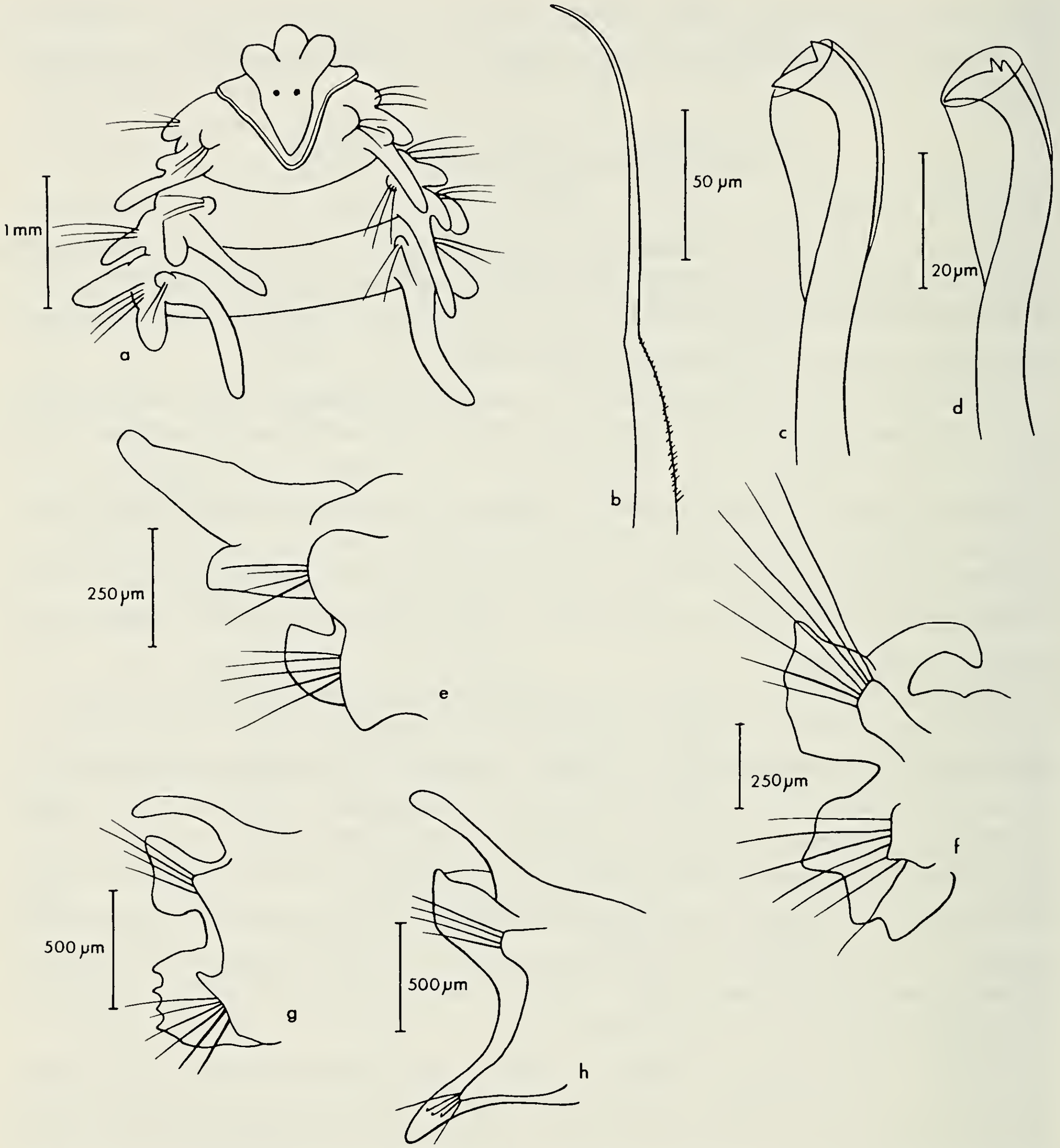

Fig. 3. *Australospio mokapu* (holotype): a, Anterior end, dorsal view; b, Geniculate seta; c, Bidentate neuropodial hooded hook; d, Tridentate neuropodial hooded hook; e, Anterior setiger, frontal view; f, Setiger 14, frontal view; g, Setiger 16, frontal view; h, Posterior setiger, frontal view.

posterior branchiae and notopodial lamellae, neuropodial hooded hooks first occurring on setiger 25 and the occurence of tridentate hooded hooks on some setigers as well as the holotype having neuropodial lamellae with 4 papillar-shaped lobes. This last character may be an artifact of preservation or due to the worm being ovigerous.

Etymology.—This species is named for the type-locality, Mokapu Peninsula, Oahu.

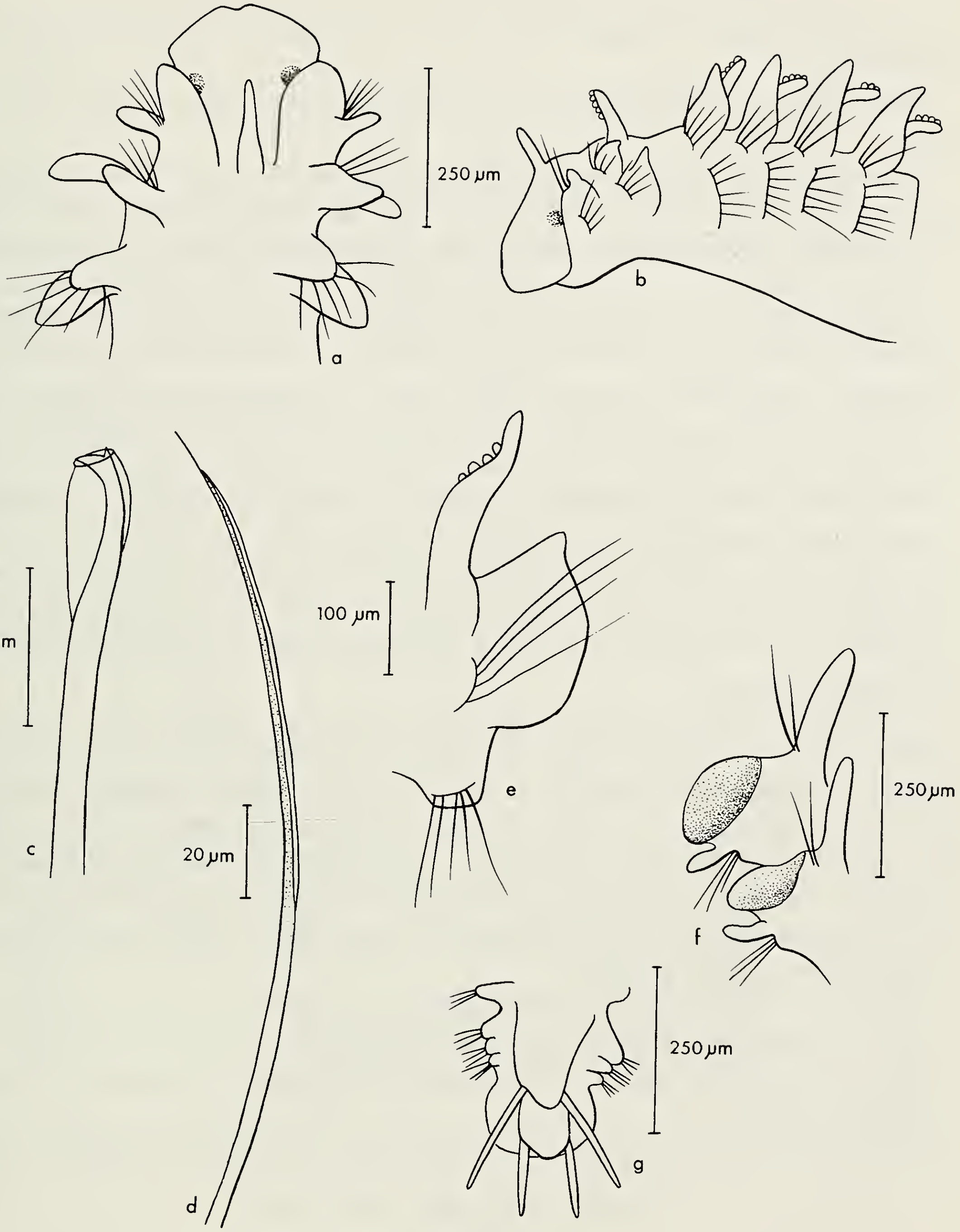

Fig. 4. *Laonice papillibranchiae* (holotype): a, Anterior end, dorsal view; b, Anterior end, lateral view; c, Bidentate neuropodial hooded hook; d, Sabre neuroseta; e, Anterior setiger, frontal view; f, Two posterior setigers showing lateral interramal pouches (stippled area): g, Pygidium, dorsal view.

Laonice papillibranchiae, new species
Fig. 4

Material examined.—Oahu, Hawaii: Barbers Point, sand, 5.5 m—5 specimens, holotype (BPBM R642). Kaneohe Bay, reef slope on coral rock, 9 m; silt and rubble on lagoon floor, 9 m—3 specimens, 2 paratypes (USNM 64345).

Description.—The holotype is 12 mm long and 0.4 mm wide for 87 setigers.

Prostomium anteriorly blunt, tapering posteriorly to middle of setiger 1; bearing long, thin occipital tentacle and pair of large, pale eyes (Fig. 4a, b). Peristomium inconspicuous, tentacular palps missing from all 8 specimens.

Setiger 1 reduced in size, bearing capillary notosetae and neurosetae. All notosetae and anterior neurosetae consisting of 2 tiers of limbate capillaries without granulations; anterior tier of capillaries shorter than posterior tier. Bidentate neuropodial hooded hooks (Fig. 4c) beginning on setigers 16 to 19 and continuing posteriorly along with several alimbate capillaries. Two granular sabre neurosetae (Fig. 4d) present, starting on setigers 9 or 12.

Branchiae free of notopodial lamellae, starting on setiger 2; branchiae absent from posterior third of body. First pair small and digitiform, becoming longer from setiger 3 and reaching full-size on setiger 6. Branchiae with pinnules or papillae on one side giving them appearance similar to pinnate branchiae of *Prionospio* (Fig. 4e). Low dorsal ridges extending across dorsum from setiger 17.

Notopodial lamellae small, digitiform on setiger 1 (Fig. 4b), becoming foliose and larger from setiger 2 (Fig. 4e), decreasing in size in posterior setigers. Neuropodial lamellae smaller than notopodial lamellae, subtriangular on setigers 1 and 2 (Fig. 4b), becoming subquadrate thereafter (Fig. 4e). Lateral interramal pouches (Fig. 4f) present between neuropodial lamellae of setigers 12 and 13, continuing to within few setigers of end of body. Pygidium (Fig. 4g) consisting of 3 large lobes with 4 long, thin dorsolateral cirri, easily lost.

Remarks.—The presence of pinnules or papillae on the branchiae of *Laonice papillibranchiae* is unique for this genus.

Etymology.—This species is named for the pinnules or papillae that occur on the branchiae.

Polydora kaneohe, new species
Fig. 5

Material examined.—Kaneohe Bay, Oahu, Hawaii: Checker Reef, sand, 3 m—holotype (BPBM R643) and paratype (BPBM R644); boring in coral settlement block, 1 m—paratype (USNM 64346).

Description.—The holotype, a complete specimen, is 9 mm long and 0.8 mm wide for 61 setigers, while the longest anterior fragment is 8.7 mm long and 0.8 mm wide for 48 setigers.

Prostomium anteriorly incised, tapering as caruncle to posterior margin of setigers 2 or 3 (Fig. 5a). Two pairs of eyes and small occipital tentacle

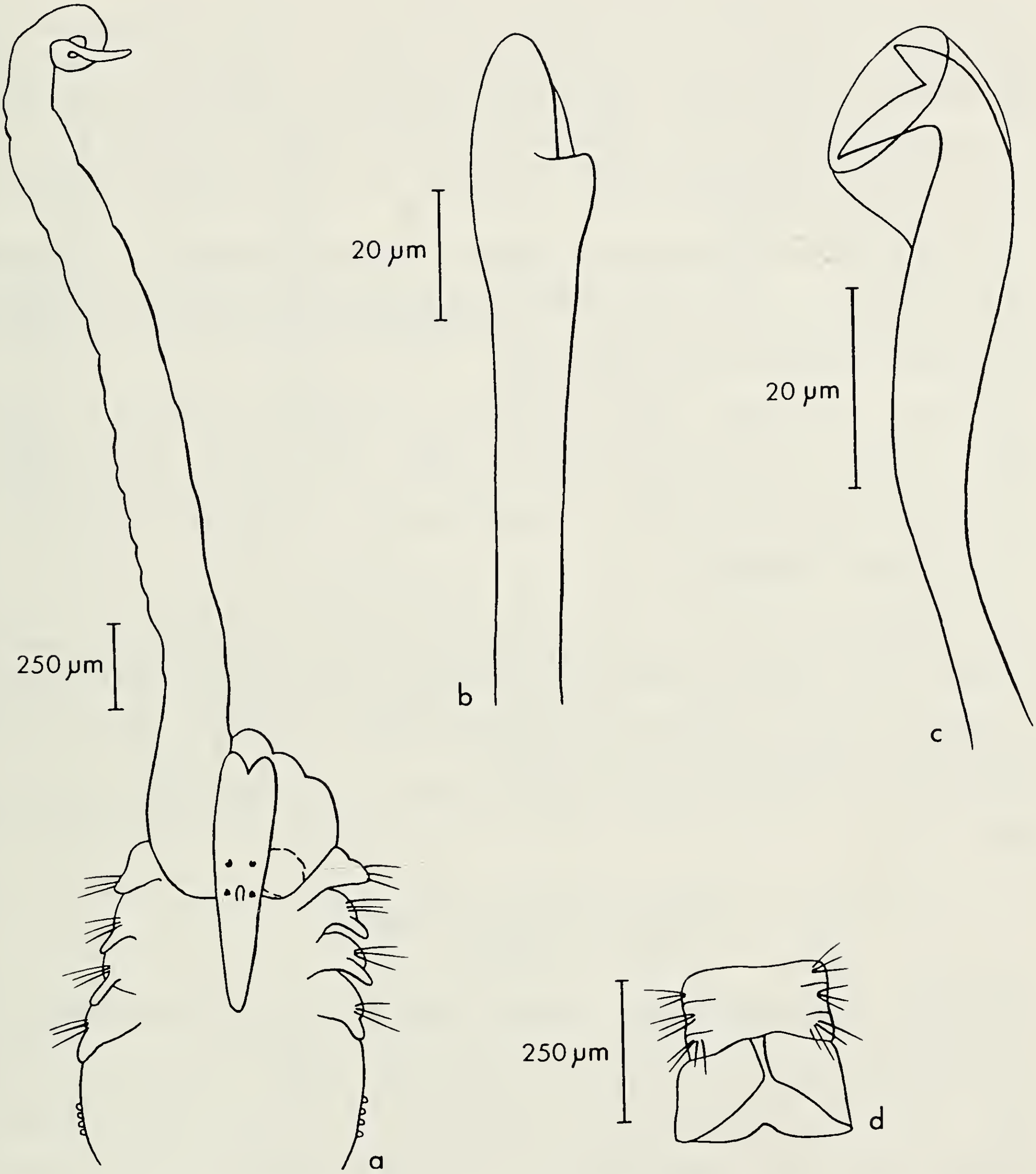

Fig. 5. *Polydora kaneohe* (holotype, a–c; paratype BPBM R644, d) a, Anterior end, dorsal view; b, Modified spine of setiger 5; c, Bidentate neuropodial hooded hook; d, Pygidium, dorsal view.

present (Fig. 5a). Peristomium extending beyond prostomium ventrally, bearing pair of curled tentacular palps in the holotype but extending to setigers 9 to 15 in paratypes.

Setiger 1 reduced in size, lacking notopodial lobes and notosetae; neurosetae winged capillaries. Setigers 2, 3 and 4 with winged capillaries in both rami. Setiger 5 with dorsal and ventral fascicles of winged capillaries and curved row of heavy, modified spines alternating with pennoned setae. Spines simple, falcate, with broad shelf forming subdistal concavity (Fig. 5b).

Bidentate neuropodial hooded hooks with closely applied apical tooth and constriction of shaft (Fig. 5c) starting on setiger 7 (setiger 6 in paratype USNM 64346), continuing to end of body without accompanying capillaries. Five neuropodial hooks per fascicle in first few setigers, increasing to 7 or 8 per fascicle in following setigers. Posterior notosetae including capillaries and short acicular spines.

Strap-like branchiae starting on setiger 7, reaching full-size on setiger 10 and continuing to within few setigers of pygidium. Pygidium missing in holotype and damaged in paratypes, cup-shaped with dorsal notch and piece missing from ventral section (Fig. 5d).

Remarks.—The major spines of setiger 5 of *Polydora kaneohe* are most similar to those of *Polydora alloporis* Light, 1970, and *P. narica* Light, 1969, in having a broad shelf with a concavity. *Polydora kaneohe* differs from these 2 species in having an occipital tentacle and short acicular spines in the posterior notopodia.

This species was found within a coral settlement block which was decalcified. Whether the worm was occupying a previously formed burrow within the block, or is capable of boring is not known. Other species of this genus are known to bore in calcareous materials (Blake and Evans, 1973), so it is possible that this species is a bioeroder.

Etymology.—This species is named for the type-locality, Kaneohe Bay, Oahu.

Polydora pilikia, new species

Fig. 6

Material examined.—Oahu, Hawaii: Pearl Harbor, silt and rubble—54 specimens. Fort Kamehameha, sand with coral rubble, 0.5 m—16 specimens. Kaneohe Bay: lagoon floor, silt with coral rubble—16 specimens; reef slope, coral rock—88 specimens; reef slope, silt covering coral rubble—1 specimen; reef crest, coral rock—182 specimens; reef flat, coral rock—29 specimens; reef flat, silt and coral rubble—503 specimens; coral settlement blocks—39 specimens, holotype (BPBM R645), 5 paratypes (BPBM R646), 5 paratypes (USNM 64347).

Description.—The holotype, a complete specimen, is 8.7 mm long and 0.48 mm wide for 70 setigers.

Prostomium anteriorly incised with caruncle extending to anterior margin of setiger 5 (Fig. 6A). Eyes absent or up to 3 circular pairs, sometimes fused together; occipital tentacle absent. Peristomium inconspicuous, with tentacular palps extending back to setiger 17.

Setigers 1–4 and 6 with capillary setae in both rami. Setiger 5 bearing dorsal fascicle of geniculate setae, ventral fascicle of winged capillaries and curved row of heavy, modified spines alternating with pennoned setae.

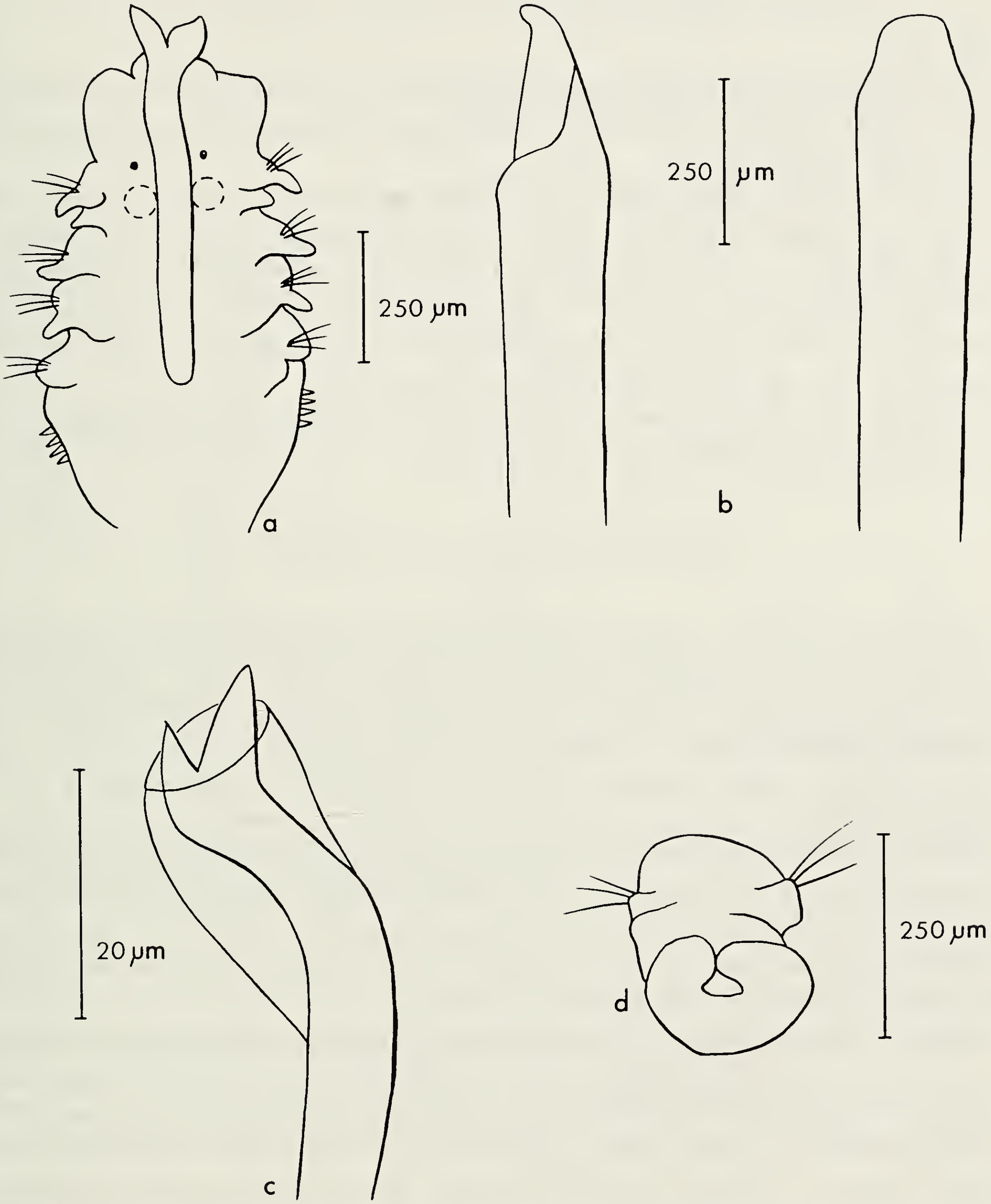

Fig. 6. *Polydora pilikia* (holotype): a, Anterior end, dorsal view; b, Modified spines of setiger 5, two views; c, Bidentate neuropodial hooded hook; d, Pygidium, dorsal view.

Spines varying in shape depending on viewing angle and amount of wear of apex. Spines simple, falcate with subterminal protuberance, and shelf forming concavity and extending as lateral flange (Fig. 6b); apical end of spine pointed or blunt.

Bidentate neuropodial hooded hooks (Fig. 6c) lacking constriction of shaft, starting on setiger 7 and continuing to end of body, accompanied by several capillaries. Posterior notosetae including capillaries and short acicular spines.

Strap-like branchiae beginning on setiger 8 or 9, but lacking from posterior third of body. Pygidium damaged in holotype, cup-shaped with dorsal notch in paratypes (Fig. 6d).

Remarks.—The major spines of the fifth setiger of *Polydora pilikia* are similar to those of *Polydora socialis* (Schmarda, 1861) and *P. concharum* Verrill, 1880, as described by Blake (1971) and *P. giardi* (Mesnil, 1896) but it differs from these 3 species in having acicular spines in the posterior notopodia. It differs from *P. concharum* and *P. socialis* in the shape of the pygidium. This species is a bioeroder of coral rock.

Etymology.—This species is named for the Hawaiian word meaning trouble because of the difficulties in identifying it.

Pygospio muscularis, new species
Fig. 7

Material examined.—Oahu, Hawaii: Fort Kamehameha, sand with coral rubble, 0.5 m—12 specimens. Kewalo reef flat, coral rock—3 specimens. Kahana Bay, shifting sand—261 specimens, holotype (BPBM R647), 10 paratypes (BPBM R648), 10 paratypes (USNM 64348).

Description.—The complete holotype is 3.8 mm long and 0.47 mm wide for 35 setigers.

Prostomium subconical with entire anterior margin tapering as caruncle to posterior margin of setiger 2, with small occipital tentacle between pair of tentacular palps, and 2 pairs of crescent-shaped eyes (Fig. 7b). Peristomium forming collar laterally and ventrally and bearing pair of tentacular palps extending posteriorly to setiger 7 (Fig. 7b).

Setiger 1 reduced in size, uniramous with single neuropodial lobe shifted dorsally; setae short, granular, winged capillaries. Both notopodia and neuropodia of setigers 2–7 with granular, winged capillaries; notosetae of 2 types: numerous, short, stout capillaries in anterior part of fascicle and longer, thinner capillaries in posterior part; all neurosetae short, stout capillaries. Notopodia from setiger 8 up to end of body with long, thin, winged capillaries. Bidentate neuropodial hooded hooks, with closely applied apical tooth, without constricted shaft (Fig. 7c), starting on setiger 8; fascicle bearing 14 hooks continuing to end of body, without accompanying capillaries.

Setiger 8 enlarged, about twice length of adjacent setigers, with muscular appearance due to gizzard-like structure (Fig. 7a) (as in *Polydora socialis* and *Carazziella reishi,* see Blake, 1971, 1979).

Branchiae strap-like, free of notopodial lamellae and occurring on setigers 7–18 (in holotype, 7–20 in paratypes). Notopodial lamellae of setiger 1 small, digitiform, subtriangular on setigers 2–7 (Fig. 7b), and becoming indistinctly

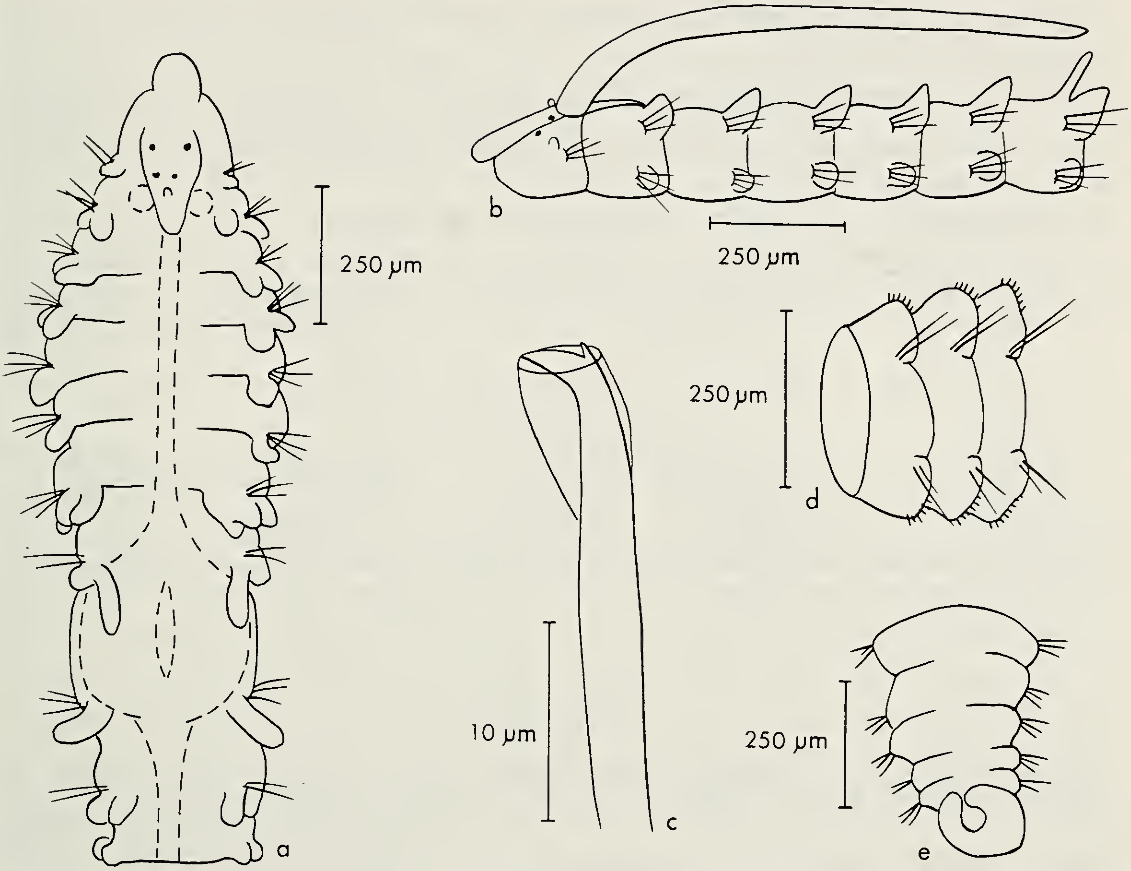

Fig. 7. *Pygospio muscularis* (holotype): a, Anterior end, dorsal view, with gut indicated by broken lines; b, Anterior end, lateral view; c, Bidentate neuropodial hooded hook; d, Posterior setigers, dorsolateral view; e, Pygidium, dorsal view.

digitiform posteriorly (Fig. 7d). Neuropodial lamellae on setigers 2–7 subquadrate and smaller than notopodial lamellae (Fig. 7b), small, rounded close to body wall from setiger 8 to posterior end of body (Fig. 7d). Pygidium cup-shaped with dorsal notch (Fig. 7e), as in polydorids.

Remarks.—Table 1 summarizes the major characteristics and geographical distributions of the species of *Pygospio* and provides a means of comparing the 4 species.

Feeding.—Observations on live worms helped to elucidate the feeding methods of this species. As is typical of the family, these worms are surface-deposit feeders which pick up sand grains and detritus from the surrounding area with their tentacular palps (Fauchald and Jumars, 1979); they can also pick up particles from the water column with their tentacular palps. The grinding action of the gizzard-like structure, visible through the thin body wall, probably serves to abrade the bacterial/algal film covering the sand grains, which is then digested.

Etymology.—*Pygospio muscularis* is named for the heavy, muscularized eighth setiger.

Table 1.—A summary of the major morphological characteristics and geographical distribution of species of *Psygospio*.

	P. californica Hartman, 1936	*P. dubia* Monro, 1930	*P. elegans* Claparède, 1863*	*P. muscularis* n. sp.
A. Characteristic				
Prostomium	round	incised	incised	round
Occipital tentacle	absent	present	absent	present
Setigers with branchiae	19 to last ¼ of body	2, 3, 7–13	11–13 to end of body (males also on 2)	7–18 or 20
Start of hooded hooks	setigers 23	setigers 17–20	setigers 8–9	setiger 8
Setiger 8	not enlarged	not enlarged	not enlarged	enlarged
Pygidium	4 lobes	variable	4 lobes	cup-shaped
B. Distribution	California	Falkland Is.	Cosmopolitan	Hawaii

* As described by Foster, 1971.

Discussion

Recent studies of spionid polychaetes from Hawaii have yielded 29 species representing 19 genera (Appendix I). Five of these species, belonging to 4 genera, are new to science and are described in this paper. Of the 29 species, 9 are cosmopolitan; 2 possibly have cosmopolitan distributions; 6 have been recorded from Indian and/or Pacific Ocean locations; 5 are new species endemic to Hawaii; and 7 have an indeterminable range since the species have not been identified (Appendix I).

Fauchald (1976) stated that more research was needed on tropical polychaetes and that previous sampling techniques were unsuitable for obtaining the smaller polychaetes in the tropics. Kohn and Lloyd (1973a, b), Kohn and White (1977) and Hutchings (1974) have extracted polychaetes from coral rock by carefully clipping the material away, a method that is likely to damage spionids and other small polychaetes. Spionids were not found to be numerically important constituents of the polychaete faunas in these studies. As previously mentioned, use of the nitric acid-formalin dissolution method of Brock and Brock (1977) recently has shown that spionids are conspicuous components of the reefs of Hawaii and Johnston Atoll, where they form up to 50 and 75%, respectively, of the polychaete faunas (Ward, 1980). The low number of spionid species reported from Indonesia by Kohn and Lloyd (1973a), the Philippines by Pillai (1965), Palau by Takahasi (1941), Guam by Kohn and White (1977), and the Marshall Islands by Woodwick (1964) versus the large number of species reported from Japan by Okuda (1937) and Imajima and Hartman (1964), southeastern Australia by Blake and Kudenov (1978), and Day and Hutchings (1979), Hawaii by Ward (1981) and California by Hartman (1969) is certainly a reflection of the intensity of sampling, collecting techniques used, and type of substrata investigated, rather than a difference in tropical versus nontropical locations. This can be seen in the large numbers of species recorded from Hawaii (Ward, 1981, and in prep.) which is an area that has been under investigation for some years. As the nitric acid-formalin dissolution method is used more on samples collected from tropical and subtropical regions, one can expect the spionids to be recognized as a numerically important and diverse family of polychaetes.

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Appendix I

The relative depths, types of substrata and habitats from which the 29 species of Hawaiian Spionidae have been reported.

	Depth Substratum								Habitat									Distribution				
Species	Shallow (up to 40 m)	Deep (about 400 m)	Coral rock	Mixed (coral rock, sediment)	Mud	Oyster shells	Sand	Silt	Anchialine ponds	Canal/Stream	Channel bottoms	Lagoon floor	Microcosm tanks	Oyster mariculture tanks	Reef crest	Reef flat	Reef slope	Cosmopolitan	Possibly Cosmopolitan	Indian and/or Pacific Ocean	Hawaiian	Indeterminable
Aonides oxycephala	√							√					√					√				
Australospio mokapu	√			√				√				√	√								√	
Boccardiella sp.	√		√												√							√
Carazziella reishi	√		√												√	√	√			√		
Dispio uncinata	√						√					√						√				
Laonice papillibranchiae	√		√	√			√					√					√				√	
Malacoceros sp.	√				√					√												√
Microspio granulata	√		√	√			√					√	√			√				√		
Minuspio sp.	√			√	√			√				√	√			√						√
Polydora armata	√		√	√			√	√				√	√		√	√	√	√				
Polydora kaneohe	√		√	√												√					√	
Polydora pilikia	√		√	√								√			√	√	√				√	
Polydora tridenticulata	√		√	√								√			√	√	√			√		
Polydora websteri	√		√		√	√				√				√	√		√	√				
Prionospio sp.	√		√	√	√		√	√				√	√			√	√					√
Pseudopolydora antennata	√		√	√						√			√			√		√				
Pseudopolydora corallicola	√		√	√				√					√			√				√		
Pseudopolydora sp.	√		√			√				√				√		√						√
Pygospio muscularis	√		√	√			√					√				√					√	
Rhynchospio sp.	√			√												√						√
Scolelepis squamata	√			√									√					√				
Scolelepis sp.	√							√					√									√
Spio filicornis	√		√	√			√	√				√	√		√	√		√				
Spio pettiboneae	√			√									√						√			
Spiophanes berkeleyorum		√					√	√			√									√		
Spiophanes bombyx	√	√			√		√		√		√							√				
Spiophanes wigleyi		√			√		√				√								√			
Streblospio benedicti	√				√					√								√				
Tripolydora spinosa	√		√												√	√				√		

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A NEW *GREGGELIX* (MOLLUSCA: PULMONATA: HELMINTHOGLYPTIDAE) FROM BAJA CALIFORNIA SUR, MEXICO

Walter B. Miller

Abstract.—A new species of the pulmonate land snail genus *Greggelix, G. punctata,* is described from Baja California Sur, Mexico. Relationships within the genus are discussed.

The malacofauna of Baja California exhibits sharply distinct regional divisions (Miller, 1973; Christensen, 1979). The south-central, montane, midsection of the peninsula is relatively inaccessible and malacologically unexplored, but those portions that have been explored show characteristically a typical association of 4 genera of large land snails, namely the bulimulids *Berendtia* Crosse and Fischer, 1869, *Spartocentrum* Dall, 1895, and *Rabdotus* Albers, 1850, and the helminthoglyptid *Greggelix* W. B. Miller, 1972.

In July 1971, while examining specimens of *Greggelix* in the collection of the U.S. National Museum, I noticed one lot (USNM 190288) of 6 shells labelled "*Sonorella*" *loehri,* whose sculpture was radically different from that of typical *loehri.* Instead of the usual dense granulations of *G. loehri,* the sculpture consisted of regularly spaced, punctate papillae arranged in parallel, descending rows. The lot had been collected by Nelson and Goldman on 30 October 1905, and the locality was listed as "Guajadanni," which is currently spelled Guajademi. This lot indicated that yet another undescribed species of *Greggelix* might inhabit the mid-section of the Sierra de la Giganta.

Accordingly, in October 1972, my graduate students Carl C. Christensen, Peter N. D'Eliscu, David B. Richman, and Richard L. Reeder, and I, accompanied by a visiting Belgian entomologist, Charles Gaspar, set out to explore the mid-section of the Sierra de la Giganta immediately west of Mulege. We drove westerly on winding desert roads along the Rio Mulege Valley, past a ranch named El Potrero, until we came to the end of the road at the foot of the escarpment which forms the east wall of the Sierra de la Giganta. A small ranch, located there, is aptly named Pie de la Cueta. From there, a trail led over the mountains to the Guajademi ranch, on the Pacific side of the range, about 5 kilometers from Pie de la Cueta.

We explored several rockslides along the trail, on the Gulf slope as well as on the Pacific slope, and we found the typical associations of the 4 genera of large land snails mentioned above. The bulimulid species were the well-known *Berendtia taylori* (Pfeiffer, 1861). *Rabdotus lamellifer* (Pilsbry, 1897), and *Spartocentrum irregulare* (Gabb, 1868); the helminthoglyptid *Greggelix,* however, turned out to have the same sculpture as the USNM lot No. 190288 and to be a new species, which is described below. The following abbreviations for repositories of materials are employed: ANSP—Academy of Natural Sciences of Philadelphia; CAS—California Academy of Sciences; CCC—personal collection of Carl C. Christensen; FMNH—Field Museum of Natural History; RLR—personal collection of Richard L. Reeder; USNM—National Museum of Natural History; UTEP—University of Texas at El Paso; WBM—personal collection of Walter B. Miller.

Greggelix punctata, new species
Figs. 1A–C, 2A, 3A, B

Description of shell holotype.—Shell strongly depressed, with a flat spire, wide umbilicus, and broadly flaring peristome; color light-brown, with typical narrow, dark-brown band above periphery. Embryonic shell of 1½ whorls sculptured from the beginning with light, radial wrinkles superimposed with scattered papillae. Postembryonic whorls with light growth wrinkles, superimposed with evenly spaced, punctate papillae, arranged in gradually descending parallel rows; this sculpture persists on the body whorl, below the periphery and into the umbilicus. The aperture is round, with margins converging to the thin parietal callus, and the peristome is strongly reflected; the columellar margin is slightly reflected over the umbilicus. Diameter 20.7 mm, height 10.8 mm, umbilicus width 3.7 mm, number of whorls 4¼.

Anatomy.—The anatomy is typically that of *Greggelix* as described by Miller (1972). In the reproductive system there is a short, bulbous, somewhat spherical verge in the short saccular penis. The epiphallic caecum and the spermathecal diverticulum are exceptionally long. In the 6 specimens examined, there is no dart apparatus and no vestige of any mucus glands. The body wall of the extended animal is light gray, and the mantle collar secretes a bright chartreuse-colored mucus; the edge and the back of the foot are also chartreuse.

Variations in the shells of the paratypes.—There is remarkably little variation in shell measurements in over 40 specimens in the type lot; the largest shell measures 22.7 mm in diameter while the smallest measures 19.2 mm. All have a very flat spire, broadly flaring aperture, and the distinctive sculpture of evenly spaced, punctate papillae arranged in gradually descending parallel rows.

Disposition of types.—Holotype: USNM 792140; Paratypes: USNM 792141; ANSP 353390; CAS 018890; FMNH 199000; UTEP 8276; CCC 2951; RLR 0191; WBM 5998.

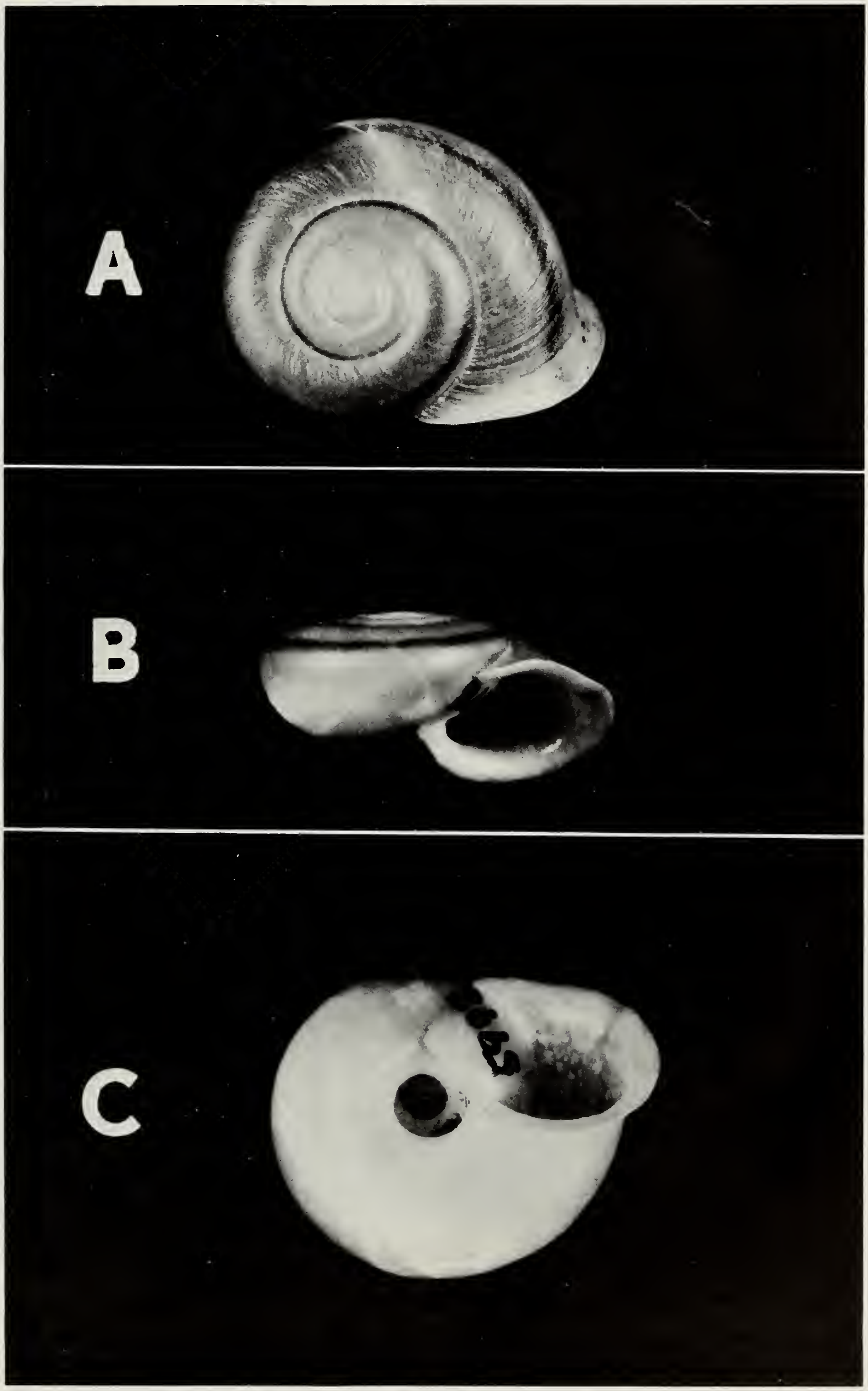

Fig. 1. Holotype of *Greggelix punctata,* USNM 792149: A, Dorsal view; B, Side view; C, Umbilical view. Maximum diameter 20.7 mm.

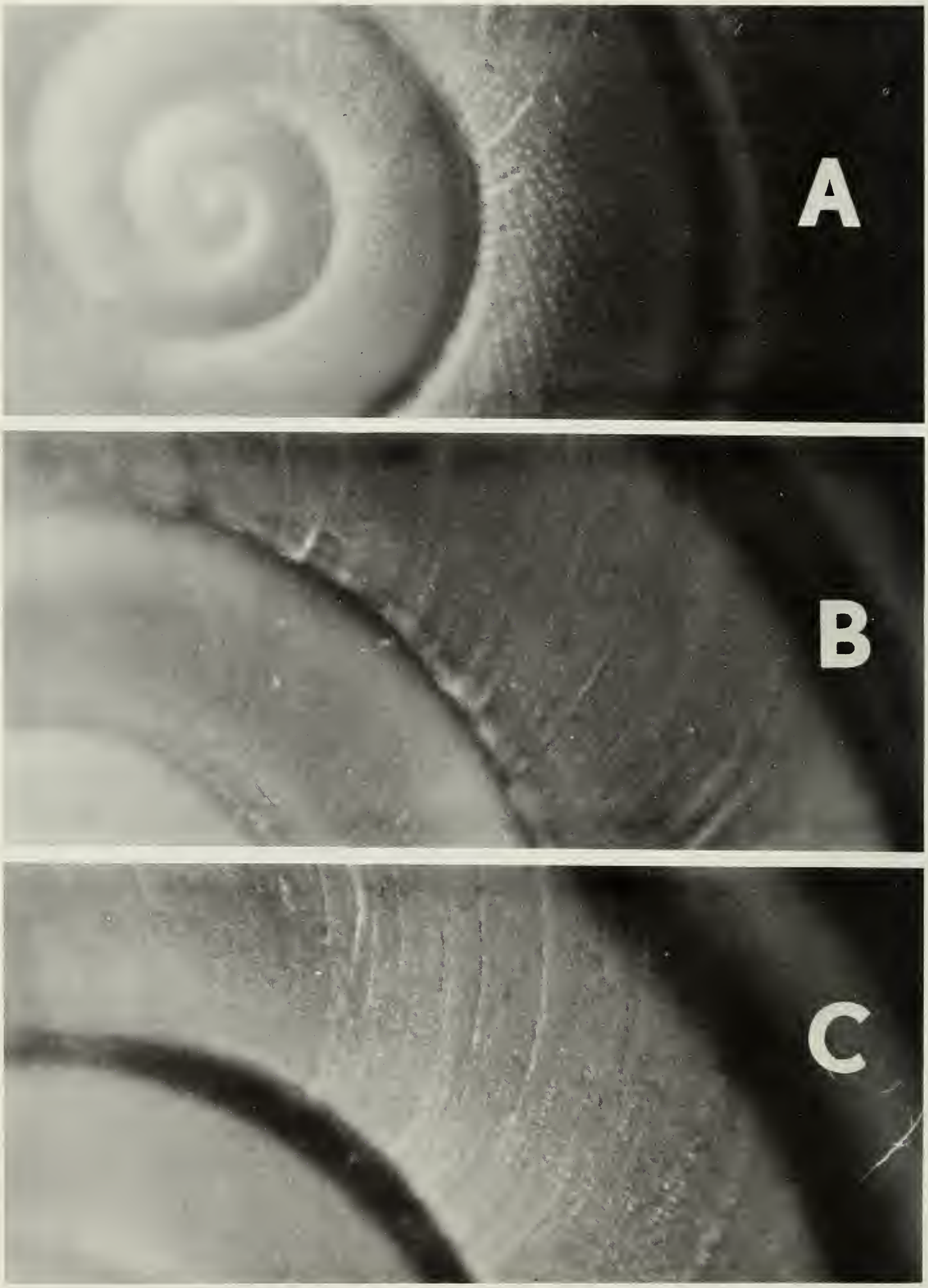

Fig. 2. Shell sculpture of *Greggelix*. A, *Greggelix punctata,* 10× ; B, *Greggelix indigena,* 12×; C, *Greggelix loehri,* 12×.

Type-locality.—Baja California Sur, Mexico. Gulf slope of Sierra de la Giganta, SW of Mulege, along trail from Pie de la Cueta (2.9 miles S of El Potrero) to Guajademi, in rock-slide along trail about 1½ miles from Pie de la Cueta (or about ¾ mile from trail summit) at ca. 2450 ft. elevation.

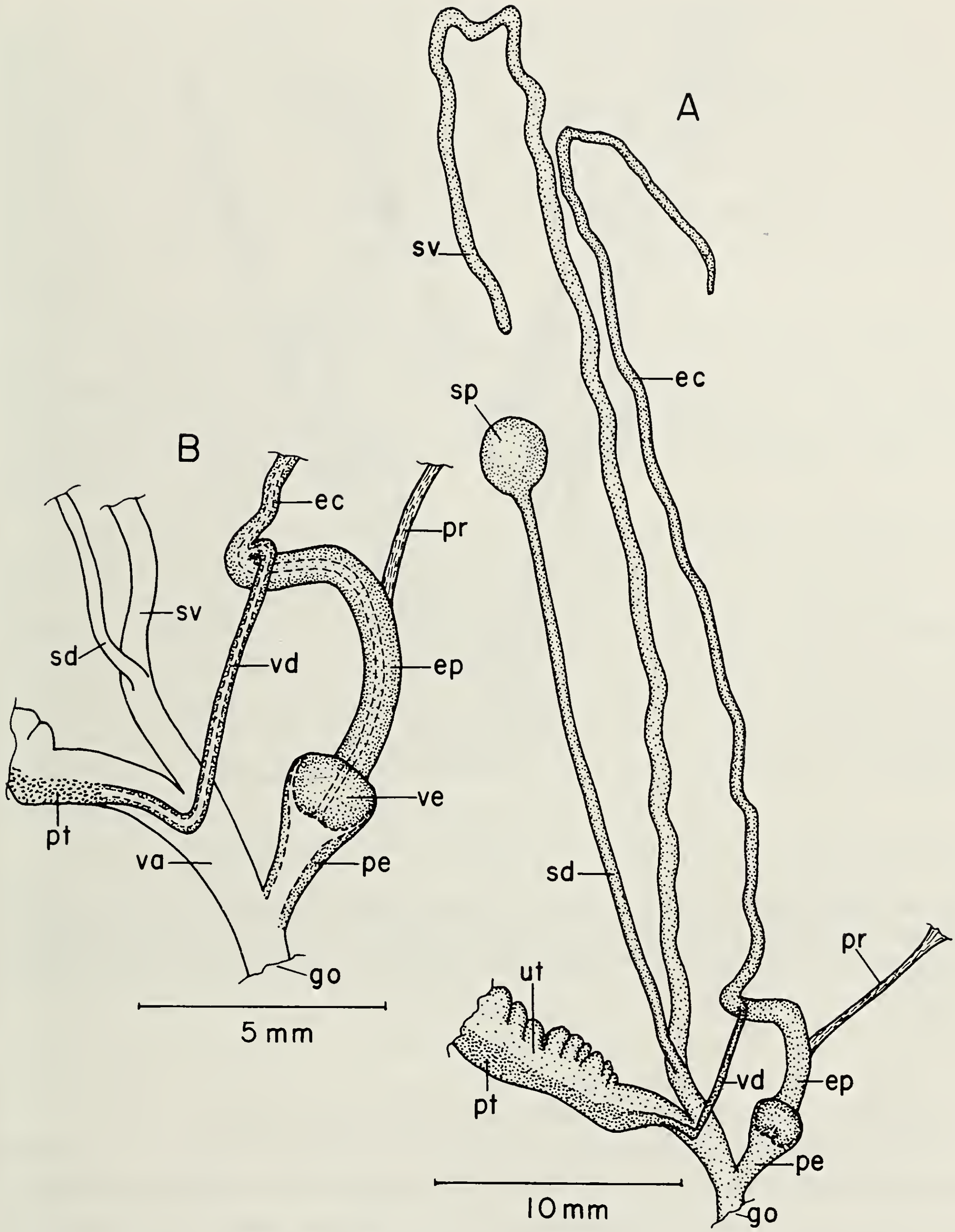

Fig. 3. A. Distal reproductive structures of *Greggelix punctata*; B. Details of distal male reproductive structures of *G. punctata,* showing internal arrangement as seen in transparency. All structures to scale as indicated, projected from permament whole mount; ec, epiphallic caecum; ep, epiphalus; go, genital orifice; pe, penis; pr, penial retractor; pt, prostate; sd, spermathecal duct; sp, spermatheca; sv, spermathecal diverticulum; ut, uterus; va, vagina; vd, vas deferens; ve, verge.

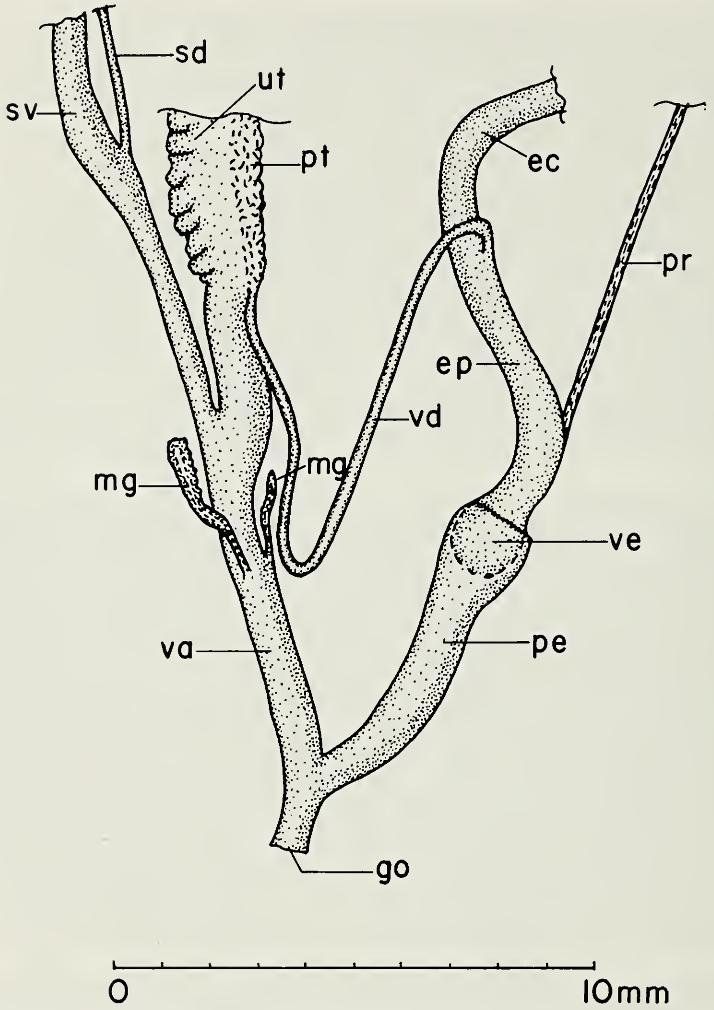

Fig. 4. Distal reproductive structures of *Greggelix loehri*, WBM 6002, showing two rudimentary mucus glands (mg) inserted on the vagina. Verge (ve) shown as seen in transparency. All structures to scale as indicated, projected from permanent whole mount; abbreviations as in Fig. 3.

Etymology.—Named for the distinctive punctate papillae.

Distribution.—*Greggelix punctata* has been found only at 3 localities along the trail from Pie de la Cueta to Guajademi, namely the type-locality, a second locality only 1.0 mile from Pie de la Cueta, and a third locality on the Pacific slope of the Sierra de la Giganta about ¾ mile beyond the trail summit, in the vicinity of Guajademi. It undoubtedly occurs in other rockslides in the general area SW of Mulege, but it does not occur far to the south, in the area around San Javier where it is replaced by *Greggelix loehri* (Gabb, 1868), nor far southwesterly, in the areas of La Purisima and San Jose de Comondu where it is replaced by *G. indigena* (Mabille, 1895). Northwest of Mulege, in the vicinity of San Jose de Magdalena, it is again replaced by *G. indigena.*

Discussion.—*Greggelix punctata* can be instantly distinguished from the other 2 described species of *Greggelix,* namely *G. loehri* and *G. indigena,* by its shell sculpture of regularly, evenly spaced, punctate papillae arranged in gradually descending parallel rows over the entire shell; on fresh, juvenile shells, the papillae are tipped with hair-like periostracal projections. In *G. indigena* (Fig. 2B) occasional papillae can be found on the first 2 or 3 whorls, but they are totally absent from the body whorl; some specimens occasionally show faint traces of spiral grooves on the upper surface of the body whorl.

In *G. loehri* (Fig. 2C), the shell surface is thickly granulose; in typical *G. loehri,* the granulose sculpture is concentrated on the raised growth lines; in other specimens, the granulose sculpture is continuous over the entire surface and completely obliterates the underlying growth lines. Jules Mabille named the completely granulose shells *Helix steganella* Mabille, 1895, and *Helix invecta* Mabille, 1895.

In my article (Miller, 1972) describing the genus *Greggelix,* I stated that although I had examined the types of *H. steganella, H. invecta,* and *H. loehri,* I had been unable to find any typical specimens of *H. loehri* in a sample of shells from San Javier sent to me by Charlotte Church. Subsequently, I collected large numbers of additional shells from San Javier and I found completely intergrading forms from typical *loehri* to typical *invecta* and *steganella,* in the same population. I can now concur, without reservations, with Pilsbry (1916) and Hanna and Smith (1968) that Mabille's names *invecta* and *steganella* are synonyms of *loehri.*

Concerning the reproductive anatomies of all described species of *Greggelix,* I can find no consistently different, distinguishing characters that would serve for diagnosis among the species. All have similar verges, epiphallic caeca, spermathecal diverticula, etc. There are variations in the lengths of the penis and the vagina in *G. loehri, G. indigena,* and *G. punctata,* but the number of live adults has been too low to permit statistically convincing findings. In *G. loehri,* however, all of 7 specimens examined did have minute, rudimentary mucus glands inserted directly on the vagina (Fig. 4); 2 of the specimens had 2 such glands each, while the other 5 specimens had only one gland each. No such glands have been found in any of 8 *G. punctata* specimens examined nor in any of 8 *G. indigena* specimens. Statistically, it is not yet possible to state conclusively that all *G. loehri* specimens can be expected to have mucus glands, nor can it be said with certainty that no *G. punctata* nor *G. indigena* specimens have such glands. The presence of rudimentary mucus glands in *G. loehri* appears to be evidence that the gene, or genes, for these structures have not been completely eliminated or repressed from the genome. It is presumed that the absence of a dart sac in *Greggelix,* as well as the absence of mucus glands in *G. punctata* and *G. indigena* evolved as secondary simplifications from a fully equipped helminthoglyptid ancestor.

Acknowledgments

I am grateful to my friends and colleagues Carl C. Christensen, Charles Gaspar, Peter N. D'Eliscu, David Richman, and Richard L. Reeder for their support, encouragement, and assistance in the discovery and collection of large numbers of specimens of this new species.

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THE RELATIVE POSITION OF THE LEFT AND RIGHT LAMELLAE OF THE FURCA IN THE ORDER MYODOCOPIDA (CRUSTACEA: OSTRACODA)

Louis S. Kornicker and Anne C. Cohen

Abstract.—The anterior claw of the right lamella of the furca is always anterior to the anterior claw of the left lamella in the ostracode order Myodocopida. The constancy of this relationship, independent of ontogeny or sex, has not been noted previously. In the sister group of the Myodocopida, the order Halocyprida, a similar relationship of the left and right lamellae does not appear to be present in the suborder Cladocopina, and in the suborder Halocypridina, the relationship holds for the superfamily Thaumatocypridoidea, but not for the superfamily Halocypridoidea.

All members of the superfamily Cypridinoidea Baird, 1850, the only superfamily in the ostracode order Myodocopida Sars, 1865 (sensu Kornicker and Sohn, 1976:3), have a well developed caudal furca posterior to the anus. Because of its position relative to the anus, the caudal furca has been considered a telson (Bowman, 1971:169). The furca (or telson) consists of 2 lamellae, each bearing claws and bristles or only claws, along the ventral margin (Fig. 1a, b).

The Cypridinoidea comprises 5 families. The shapes of the lamellae of the furca as well as the distribution of the claws and bristles are sufficiently characteristic to identify some of the families, but are especially useful for identification at the generic and specific levels.

A previously unnoted feature of the furca of the Myodocopida is documented here: the anterior claw of the right lamella always lies slightly anterior to that of the left lamella. Examination of more than 100 males and females of several species in all 5 families in the Cypridinoidea indicates that the relative positions of the right and left lamellae are constant throughout the superfamily. Although the relationship has been illustrated many times (Table 1), its constancy has not been noted previously. An additional asymmetry was observed on the furca of the large ostracode "*Gigantocypris* sp." (Cypridinidae: Cypridinoidea). The anterior edge of the right lamella bears a broad sclerotized internal structure not present on the left lamella (Fig. 1c).

In growth stages of Cypridinoidea reared from parents collected at Belize, the anterior position of the right furcal lamella is already present in the 1st

Table 1.—Cypridinoidea having right furcal lamella anterior to left (n.d. = no data).

Species*	Sex	Developmental stage	Reference
Philomedidae			
Euphilomedes nodosa	♀	adult	Poulsen (1962: fig. 159b″)
Euphilomedes bradyi	♂	adult	Poulsen (1962: fig. 169j)
Euphilomedes schornikovi	♂	A-1 instar	Kornicker and Caraion (177: Fig. 21i)
Euphilomedes sinister	♀	adult	Kornicker (1974: fig. 7d)
Igene walleni	♀	adult	Kornicker (1975: fig. 238m)
Paraphilomedes tricornuta	♂	adult	Poulsen (1962: fig. 180k′)
Philomedes interpuncta	♀	n.d.	Müller (1894: pl. 3:16)
Philomedes aspera	n.d.	n.d.	Müller (1894: pl. 3:17)
Philomedes levis	♀	n.d.	Müller (1894: pl. 3:18)
Philomedes rotunda	n.d.	juvenile	Kornicker (1975: fig. 146a)
Philomedes heptathrix	♂	adult	Kornicker (1975: fig. 149j)
Philomedes tetrathrix	♀	adult	Kornicker (1975: fig. 153c)
Philomedes ramus	♀	adult	Kornicker (1975: fig. 169m)
Philomedes lofthousae	♀	adult	Kornicker (1975: figs. 175e, d, 176a)
Philomedes levis	♀	adult	Kornicker (1974: fig. 4n)
Philomedes charcoti	♀	adult	Kornicker (1971: fig. 5o)
Philomedes trithrix	♀	adult	Kornicker (1971: fig. 7h)
Scleroconcha gallardoi	♀	adult	Kornicker (1971: fig. 18f)
Tetragonodon rhamphodes	♀	juvenile	Kornicker (1968: fig. 5e)
Cypridinidae			
Azygocypridina rudjakovi	♂	adult	Kornicker (1970a: fig. 8e)
Codonocera cruenta	n.d.	adult?	Müller (1906b: pl. 8:6)
Cypridina norvegica	♀	adult	Sars (1922: pl. 2c)
Cypridina mediterrania	♀	adult?	Müller (1894: pl. 2:25, 26)
Cypridina squamosa	♀	adult	Müller (1894: pl. 2:31)
Cypridina squamosa	♂	adult	Müller (1894: pl. 2:35)
Cypridina asymmetrica	♂	adult	Müller (1906b: pl. 6:4)
Cypridina castanea	♀	adult	Müller (1906a: pl. 33:16)
Cypridinodes species	n.d.	juvenile	Kornicker (1970b: fig. 12e)
Doloria pectinata	♀	A-1 instar	Kornicker (1975: fig. 48b)
Isocypridina quatuorsetae	♂	adult	Kornicker (1975: fig. 124a, b)
Paradoloria dorsoserrata	♂	adult	Kornicker (1976a: fig. 21b, g)
Pyrocypris lepidophora	♀	adult	Müller (1906b: p. 3:19)
Skogsbergia costai	♀	adult	Kornicker (1974: fig. 3j)
Skogsbergia squamosa	♀	A-1 instar	Kornicker (1974: fig. 2d)
Rutidermatidae			
Rutiderma rostrata	♂	adult	Poulsen (1965: fig. 3o)
Rutiderma normani	♀	adult	Poulsen (1965: fig. 4l)
Rutiderma hartmanni	♀	adult	Poulsen (1965: fig. 8g′)
Rutiderma mortenseni	♂	adult	Poulsen (1965: fig. 11k)
Rutiderma ovata	♂	adult	Kornicker (1975: fig. 423a)

Table 1.—Continued.

Species*	Sex	Developmental stage	Reference
Sarsiellidae			
Cymbicopia brevicosta	♂	adult	Kornicker (1975: fig. 399f)
Eusarsiella verae	♂	adult	Poulsen (1965: fig. 36h)
Sarsiella capsula	♀	juvenile	Müller (1894: pl. 1:8)
Sarsiella levis	♂	juvenile	Müller (1894: pl. 1:28)
Sarsiella levis	♂	adult	Müller (1894: pl. 4:36)
Sarsiella capsula	♀	adult	Müller (1894: pl. 4:37)
Sarsiella janiceae	♀	adult	Kornicker (1976b: fig. 4k)
Sarsiella neapolis	♀	adult	Kornicker (1974: fig. 15i)
Spinacopia variabilis	♀	adult	Kornicker (1969: fig. 6g)
Spinacopia sandersi	♂	adult	Kornicker (1969: fig. 13r)
Spinacopia antarctica	♂	juvenile	Kornicker (1970a: fig. 14g)
Cylindroleberididae			
Asterope mariae	♂	adult	Sars (1922: pl. 10:1)
Asteropteron nodulosum	♂	adult	Poulsen (1965: fig. 68g′)
Asteropteron skogsbergi	♀	juvenile	Poulsen (1965: fig. 71h)
Cycloleberis americana	♀	juvenile	Poulsen (1965: fig. 85k)
Cycloleberis galatheae	♀	adult	Poulsen (1965: fig. 88f)
Cycloleberis bradyi	♂	adult	Poulsen (1965: fig. 92d′, d″)
Cycloleberis christiei	♀	adult	Kornicker and Maddocks (1977: fig. 3a)
Cylindroleberis oblonga	♂	juvenile	Müller (1894: pl. 1:10)
Cylindroleberis teres	♀	adult	Müller (1894: pl: 5:24)
Cylindroleberis lobianci	♀	unknown	Müller (1894: pl. 5:32)

* Species names are as they appear in reference source.

ostracodid stage. Observations were made on 1st instars of 13 *Skogsbergia* sp. (Cypridinidae), 4 *Parasterope* sp. (Cylindroleberididae), 5 *Harbansus* sp. (Philomedidae), and 10 *Sarsiella* sp. (Sarsiellidae).

The sister group of the Myodocopida, the superorder Halocyprida, includes the suborders Cladocopina and Halocypridina (sensu Kornicker and Sohn, 1976:3). The Halocypridina includes the superfamilies Thaumatocypridoidea and Halocypridoidea (Kornicker and Sohn, 1976:3). An examination of a few specimens and a brief review of the literature suggest that members of the Thaumatocypridoidea (Fig. 1d), like the Myodocopida, have the anterior claw of the right lamella anterior to the anterior claw of the left lamella. On the other hand, no fixed relationship between the lamella appears to be present in the Halocypridoidea (Fig. 1e; Müller, 1894, pl. 5:49) and Cladocopina.

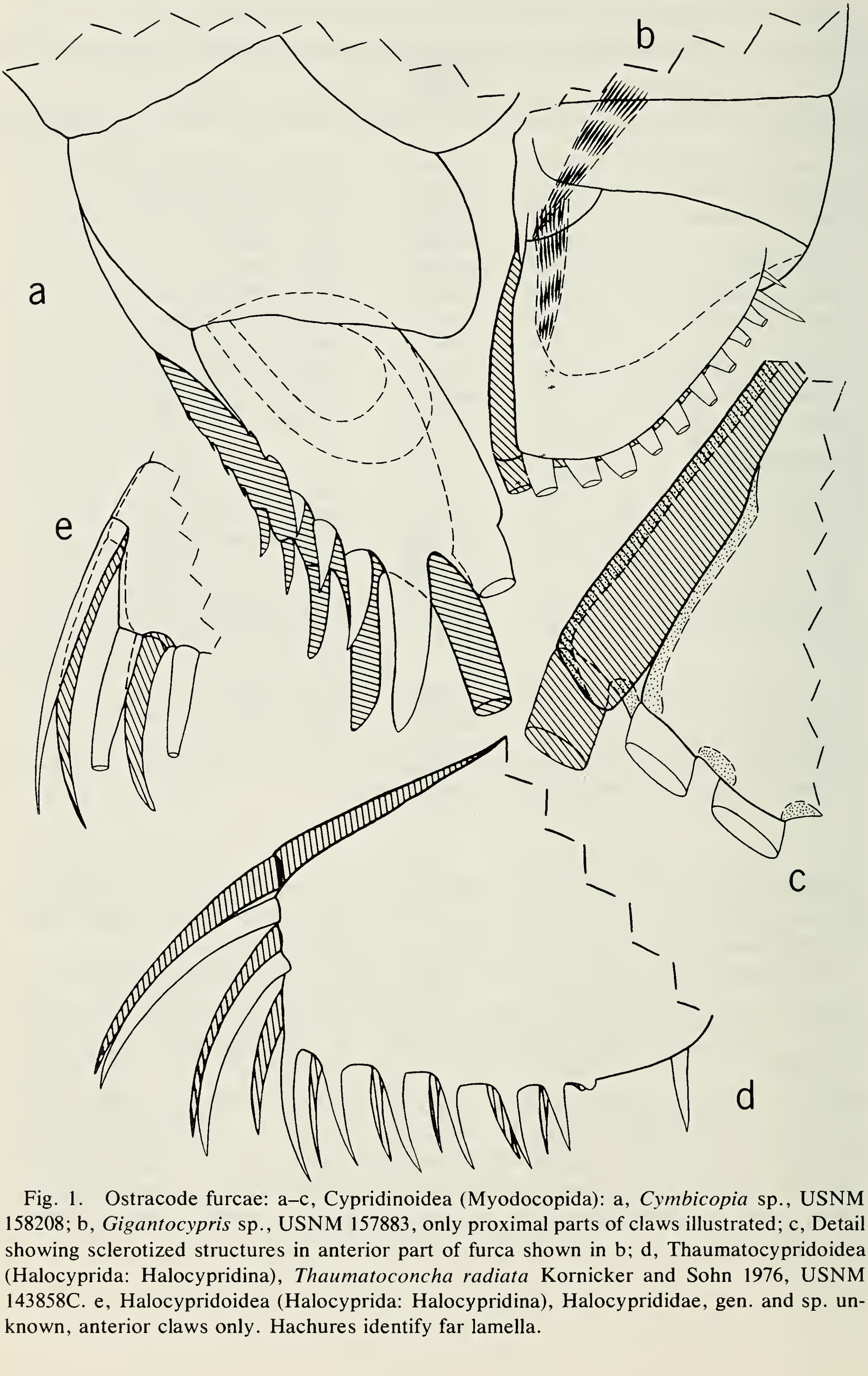

Fig. 1. Ostracode furcae: a–c, Cypridinoidea (Myodocopida): a, *Cymbicopia* sp., USNM 158208; b, *Gigantocypris* sp., USNM 157883, only proximal parts of claws illustrated; c, Detail showing sclerotized structures in anterior part of furca shown in b; d, Thaumatocypridoidea (Halocyprida: Halocypridina), *Thaumatoconcha radiata* Kornicker and Sohn 1976, USNM 143858C. e, Halocypridoidea (Halocyprida: Halocypridina), Halocyprididae, gen. and sp. unknown, anterior claws only. Hachures identify far lamella.

Acknowledgments

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A NEW SPECIES OF *EUDACTYLINA* (COPEPODA, EUDACTYLINIDAE) PARASITIC ON BLACK SHARK FROM CHILE

Ju-shey Ho and Laurie E. McKinney

Abstract.—*Eudactylina chilensis,* new species, is described from specimens from the gills of a black shark, *Aculeola nigra* De Buen, collected from Coquimbo, Chile. This is the first record of *Eudactylina* from the southeastern Pacific Ocean.

Eudactylina is a genus of siphonostomatoid copepods found exclusively on the gills of elasmobranchs. This genus comprises 24 nominal species, but none of them are known from the southeastern Pacific Ocean. Only 4 species of *Eudactylina* have been hitherto reported from the Pacific Ocean: *E. acanthii* A. Scott from the Sea of Japan (Gussev, 1951) and the Vancouver Island region (Kabata, 1979), *E. aspera* Heller near Java (Heller, 1868) and Australia (Kabata, 1970), *E. papillosa* Kabata from Australia (Kabata, 1970), and *E. similis* T. Scott off Vancouver Island (Kabata, 1976).

E. aspera is the most widely distributed species of *Eudactylina.* In addition to the western South Pacific, where it was first discovered, it has also been reported from the Gulf of Mexico (Bere, 1936; Cressey, 1970), the Indian Ocean near Madagascar (Cressey, 1967), and the Mediterranean off Tunisia (Essafi and Raibau, 1977). The first species of *Eudactylina* from the southeastern Pacific Ocean reported herein is morphologically very close to this widely distributed species of *Eudactylina.*

Specimens of the new *Eudactylina* described below were collected by Prof. Dr. Juan Carvajal of the Instituto de Ciencias Biologicas, Universidad Católica de Chile, Santiago. We are grateful to Prof. Dr. Carvajal for his generosity in placing his collection of *Eudactylina* at our disposal.

Eudactylina chilensis, new species
Figs. 1–4

Material examined.—29 females and 7 males on gills of *Aculeola nigra* De Buen collected from Coquimbo, Chile during a 5-year (1967–1972) survey of cestodes of Chilean sharks. 6 females and 4 males dissected for studying appendages. Holotype, allotype, and 12 paratypes (10 females and 2 males) deposited in the U.S. National Museum of Natural History, Smithsonian Institution, Washington, D.C.

Female.—Body (Fig. 1A) bearing numerous denticles on dorsal and lat-

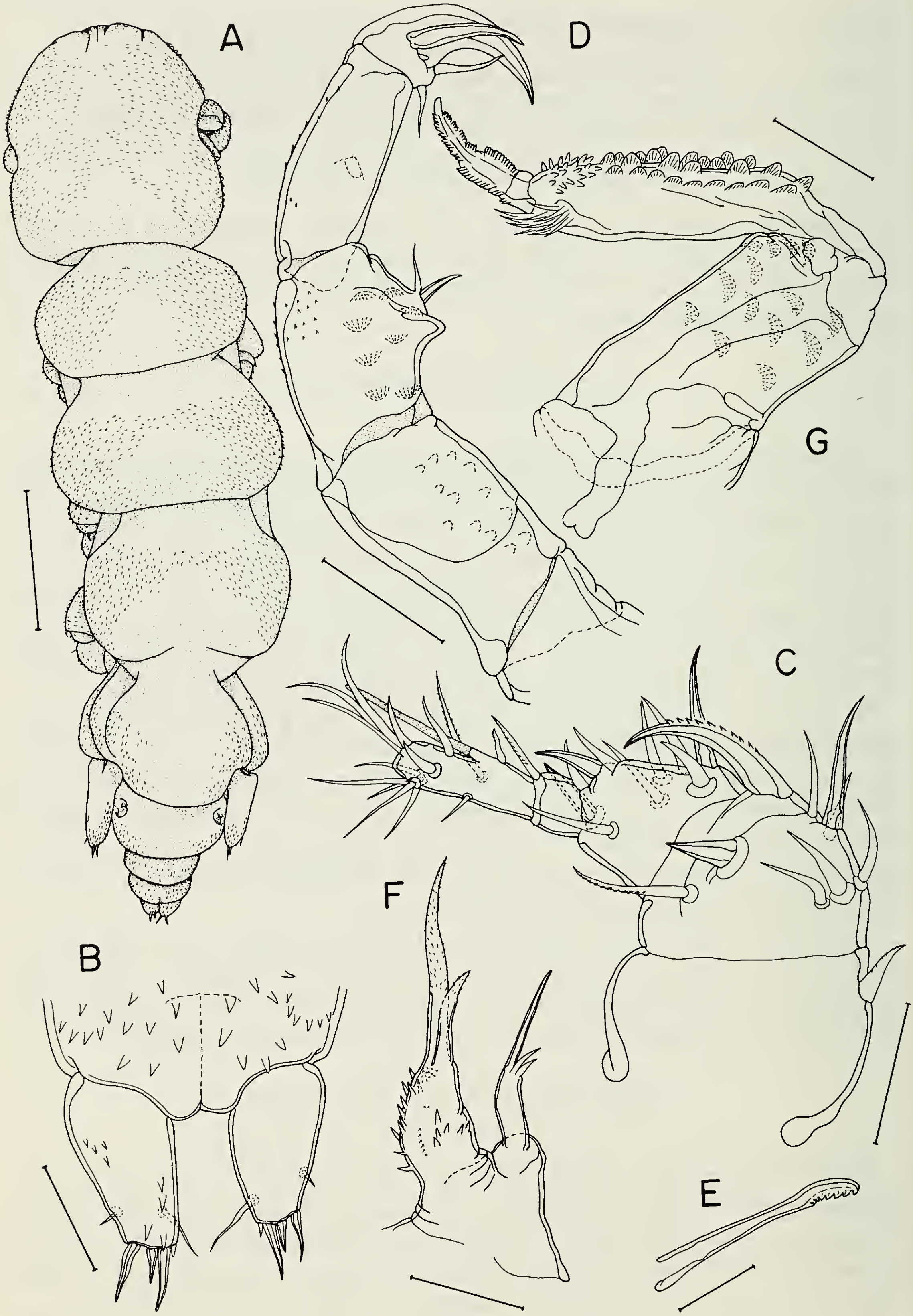

Fig. 1. *Eudactylina chilensis,* female: A, Habitus, dorsal; B, Caudal rami, ventral; C, First antenna, dorsal; D, Second Antenna, lateral; E, Mandible, lateral; F, First maxilla, posterior; G, Second maxilla, outer. Scale: 0.3 mm in A; 0.05 mm in B, C, D, G; 0.03 mm in E; 0.04 mm in F.

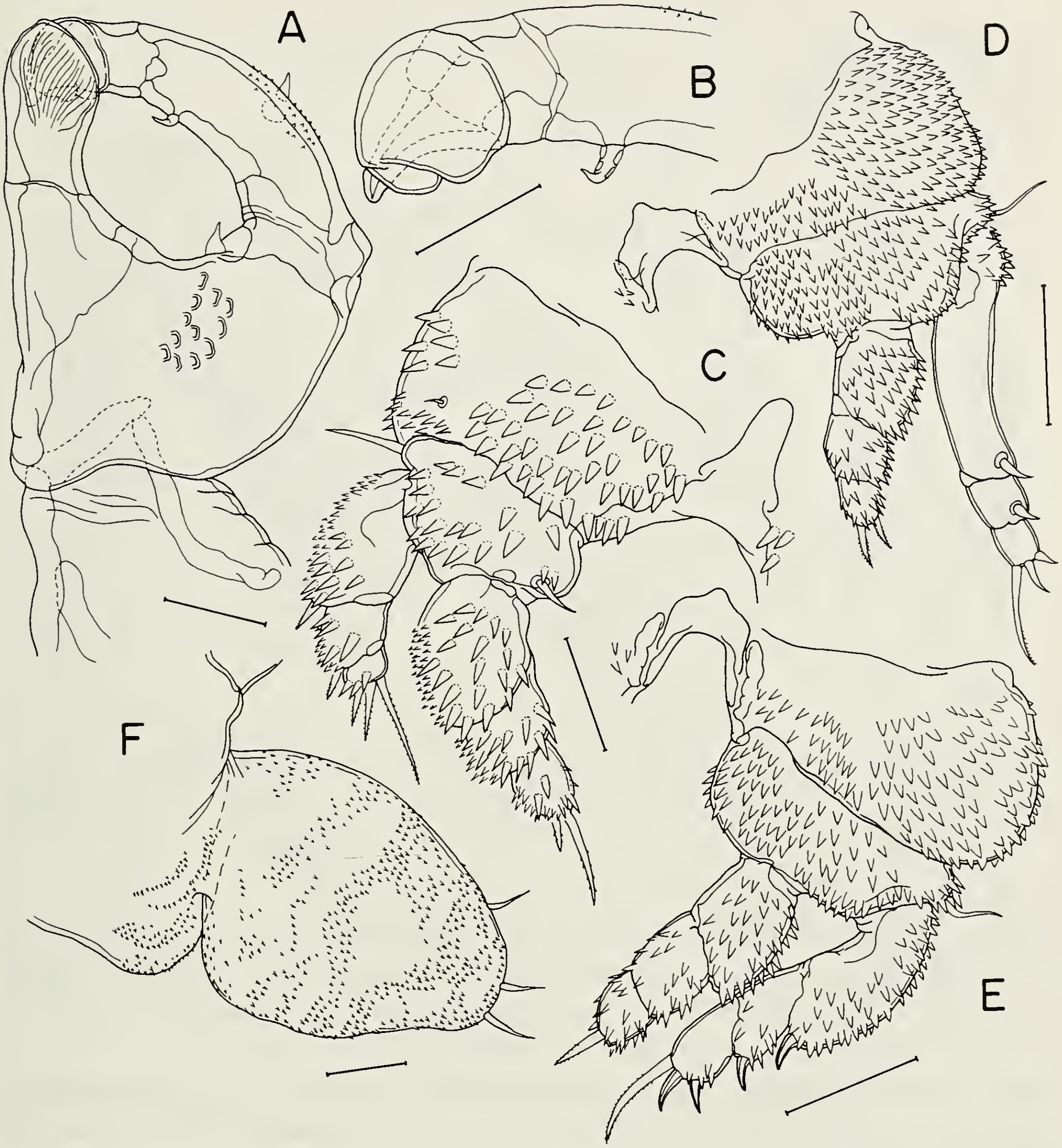

Fig. 2. *Eudactylina chilensis,* female: A, Maxilliped, outer; B, Tip of maxilliped claw, outer; C, Leg 1, anterior; D, Leg 2, anterior; E, Leg 3, anterior; F, Leg 5, outer. Scale: 0.05 mm in A, C, F; 0.04 mm in B; 0.1 mm in D, E.

eral surfaces, particularly of cephalothorax and pedigerous somites. Cephalothorax (containing first pedigerous somite) with a distinct lateral notch. Third pedigerous somite widest, about 356 to 507 μm (average of 10 specimens 420 μm). Fifth pedigerous somite widely fused with genital segment and bearing a small seta in dorsodistal corner (Fig. 2F). Abdomen 2-segmented, covered sparsely with denticles. Caudal ramus (Fig. 1B) with or without spinules on ventral surface. Dorsal surface bearing subterminal short outer seta and another long inner seta. Distal edge truncate, bearing 3 spines and 1 small inner element. Total length of body 1.64 to 1.99 mm (average of 10 specimens 1.78).

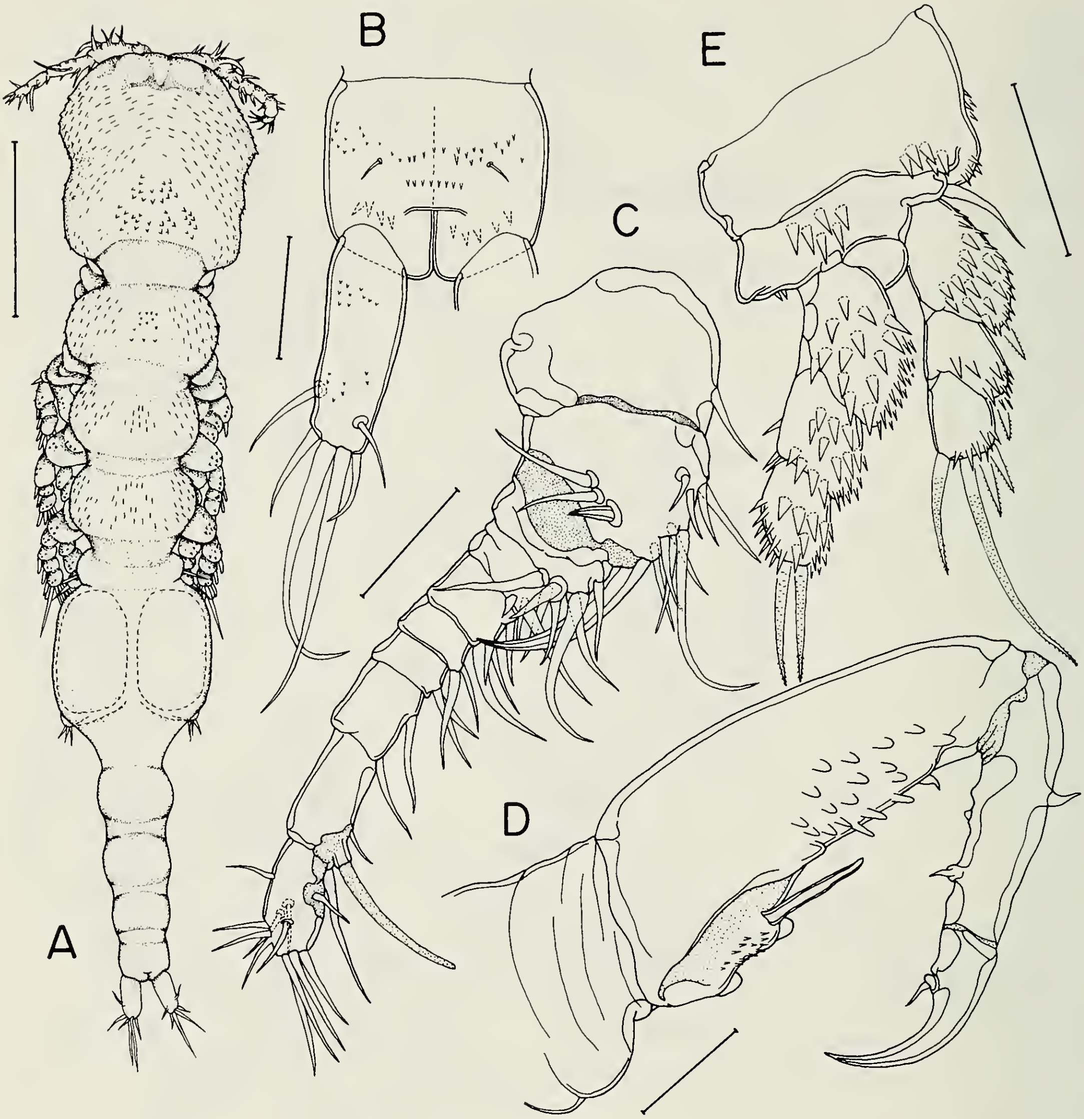

Fig. 3. *Eudactylina chilensis,* male: A, Habitus, dorsal; B, Anal segment and caudal rami, dorsal; C, First antenna, dorsal; D, Maxilliped, outer; E, Leg 1, anterior. Scale: 0.2 mm in A; 0.05 mm in B, C, D, E.

First antenna (Fig. 1C) 5-segmented, with distal 3 segments bending at right angle with 2 robust proximal segments. First segment with 1 spinulose seta on anterior margin. Second segment armed with a strong, curved, and serrated hook at anterodistal corner, a stout spine on dorsal surface, a slender subterminal spine on anterior margin, 1 spinulose seta on dorsal surface and 5 simple setae on anterior surface. Third segment bearing 3 spines and 7 simple setae. Fourth segment with 1 spinulose seta at disto-outer corner. Terminal segment about 3 times longer than wide, with 3 (2 of them spinulose) setae and 1 aesthete near middle region, followed distally by 2 setae on dorsal surface and a group of 5 setae on posterior surface, and tipped

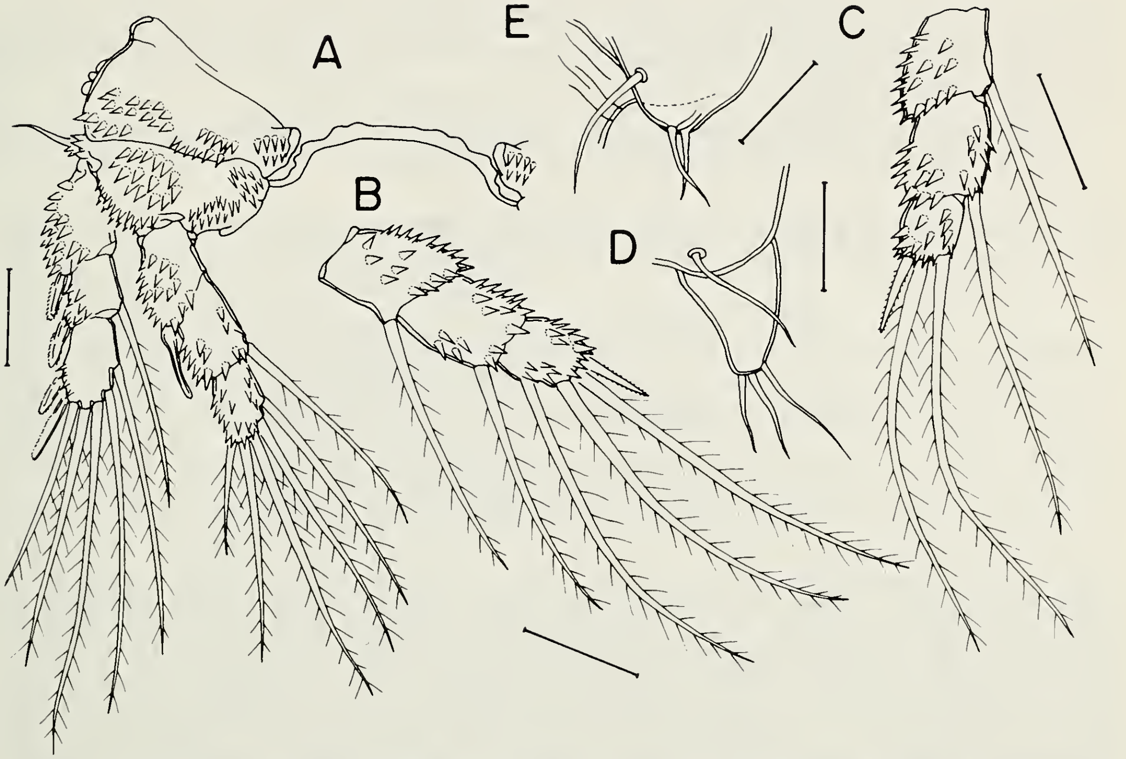

Fig. 4. *Eudactylina chilensis,* male: A, Leg 2, anterior; B, Endopod of leg 3, anterior; C, Endopod of leg 4, anterior; D, Leg 5, dorsal; E, Leg 6, ventral. Scale: 0.05 mm in A, B, C; 0.03 mm in D, E.

with 4 setae. Second antenna (Fig. 1D) 3-segmented; first segment unarmed, second segment with a heavily sclerotized medial spur bearing at its base 1 seta and 1 weak spine. Terminal segment armed distally with a large hook, a spine, 2 setae, and a small hyaline process. Membranous flaps on inner surface of first and second segments but spinules on anterior surfaces of second and third segments.

Mandible (Fig. 1E) with terminal teeth (3 small proximal and 5 large distal). First maxilla (Fig. 1F) biramous, with a denticulate endopod carrying 2 spinulose setae and a slender exopod tipped by 1 long and 2 short setae. Second maxilla (Fig. 1G) 2-segmented; basal segment larger, with membranous flaps on outer surface; terminal segment with rows of membranous flaps on anterior surface, a patch of denticles on anterodistal surface and a cluster of setae on posterodistal surface. Terminal claw nearly half as long as terminal segment, with bilaterally serrate cuticular membrane. Maxilliped (Fig. 2A) a powerful chelate attachment apparatus consisting of 3 segments. Basal segment membranous but reinforced with sclerotized bars. Middle segment largest, with its posterodistal corner protruded to form a receptacle; several cuticular flaps on outer surface and one stout seta on distal margin opposite terminal receptacle. Terminal segment cylindrical and curved, bearing a patch of denticles and 2 opposite hyaline setae in middle region; distal portion ending in a short uncinate claw covered with a broad cuticular membrane (Fig. 2B).

First 4 pairs of legs biramous with 3-segmented rami, their spines (Roman numerals) and setae (Arabic numerals) as follows:

Leg 1	Prp 0-0; 1-1	Exp 1-0; 1-0; 3
		Enp 0-0; 0-0; 2
Leg 2	Prp 0-0; 1-0	Exp I-0; I-0; II,1
		Enp 0-0; 0-0; 2
Leg 3	Prp 0-0; 1-0	Exp I-0; I-0; II,1
		Enp 0-0; 0-0; 1
Leg 4	Prp 0-0; 1-0	Exp I-0; I-0; II,1
		Enp 0-0; 0-0; 1

Endopod of leg 1 (Fig. 2C) longer and larger than exopod. First segment of exopod in leg 2 (Fig. 2D) greatly prolonged and slightly curved. Leg 3 (Fig. 2E) and leg 4 similar, with equally developed rami. Anterior and lateral surfaces of all 4 pairs of legs covered with numerous cuticular spines, except second exopod. Leg 5 (Fig. 2F) laterally compressed, oval, and covered with spinules (more on outer than inner surface); distal margins bearing 3 small setae.

Male.—Body (Fig. 3A) similar to female, but more slender and having inconspicuous fifth pedigerous somite and 4-segmented abdomen. Caudal ramus (Fig. 3B) about 2.8 times longer than wide, carrying distally 1 inner seta, 1 outer seta and 4 terminal setae. Total length of body 1.36 to 1.59 mm (average of 7 specimens 1.47); cephalothorax widest, 260 to 343 μm (average of 7 specimens 305).

First antenna (Fig. 3C) 9-segmented, with a robust base composed of first 2 segments. Armature on these segments: 1, 13 (including a short spine and an uncinate spinulose claw), 10, 4, 2, 2, 2, 2 + 1 aesthete, and 12. Second antenna, mandible, first maxilla, and second maxilla as in female. Maxilliped (Fig. 3D) subchelate and 3-segmented. Basal segment small, membranous. Middle segment long, bearing in membranous basal region 2 obtuse protrusions with a patch of spinules between them and 1 long, sturdy spine; distal to these a patch of cuticular spines. Terminal segment cylindrical, with 2 setae and 1 uncinate claw that bears a basal seta.

First 4 pairs of legs (Figs. 3E, 4A–C) biramous and trimerite as in female, but with different armature:

Leg 1	Prp 0-0; 1-0	Exp I-0; I-0; 4
		Enp 0-0; 0-0; 2
Leg 2	Prp 0-0; 1-0	Exp I-0; I-1; II,5
		Enp I-0; 0-1; 5

Leg 3	Prp 0-0; 1-0	Exp I-0; I-1; II,5
		Enp 0-1; 0-1; I,3
Leg 4	Prp 0-0; 1-0	Exp I-0; I-0; II,5
		Enp 0-1; 0-1; I,2

Leg 5 (Fig. 4D) with free segment tipped with 3 relatively long setae. Leg 6 (Fig. 4E) represented by 3 setae on a posteroventral ridge in genital segment (Fig. 3A).

Remarks.—Based on the segmentation of legs 1 through 4, the females of *Eudactylina* can be separated into two groups. One group, consisting of 11 species, has 3-segmented rami in all swimming legs and the other group, consisting of 13 species, has reduced number of segments in some of their legs, either endopod or both endopod and exopod. *E. chilensis* belongs to the former group. Having a notch on the side of the cephalothorax, a modified long and curved second exopod, and a broad free segment of leg 5 carrying 3 short setae, *E. chilensis* resembles most closely *E. aspera* Heller of the former group. However, the new species can be distinguished from *E. aspera* by the following combined characteristics: (1) lack of a spur on the basal segment of the second antenna, (2) the simple (instead of bifurcate) terminal claw on the second maxilla, and (3) the caudal ramus being tipped with 3 spines and 1 small spinous seta (instead of 2 tubercles).

The males of *Eudactylina* are rarely found. Up to date, only *E. acuta* van Beneden, *E. alata* Pillai, and *E. similis* T. Scott have records of their males. The male of *E. chilensis* is distinguishable from these 3 males in having 3 segments on both rami of legs 1 through 4 and an armature of II,5 on the terminal segment of the exopod legs 2 through 4.

An unique armature is seen in the male of *E. chilensis* on the basal segment of the second endopod (see Fig. 4A). The presence of this large, blunt, and articulated outer spine is not only unique in the *Eudactylina,* but also in the entire Order Siphonostomatoida.

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A SMALL, MATURE MALE *ARCHITEUTHIS* (CEPHALOPODA: OEGOPSIDA) WITH REMARKS ON MATURATION IN THE FAMILY

Ronald B. Toll and Steven C. Hess

Abstract.—A small, functionally mature male *Architeuthis* (gladius length = 179 mm) is described from the Straits of Florida. Aspects of development and reproduction of male architeuthids are discussed.

Several unusual cephalopods were found during a study of the feeding ecology of the broadbill swordfish, *Xiphias gladius,* in the Straits of Florida. Among these were the fragmentary remains of a small squid that was assigned to the family Architeuthidae based on characters of the mantle, fins, gladius, and viscera. The specimen was a mature male with fully developed genitalia and the remains of two ruptured spermatophores.

This specimen (ML = 167+ mm, GL = 179 mm) is the smallest functionally mature *Architeuthis* known. Its size and state of maturity raise several questions regarding the life history of the "giant squid."

Abbreviations and measurements are as defined by Voss (1963) and Cohen (1976).

Historical Resumé

There have been numerous accounts of specimens belonging to *Architeuthis,* but only six functionally mature males (with spermatophores) have been reported. Steenstrup (1857) reported a specimen of *A. dux* (TL > 377 cm) from the western Atlantic. In a later paper (1882), he indicated that the specimen was a male with "seminal capsules" (spermatophores). Sasaki (1929) reported a specimen of *A. japonica* (ML = 1100 mm) from Japanese waters. Voss (1956) described a specimen of *A. physeteris* (ML = 612 mm) from off the Mississippi Delta. Knudsen (1957) reported on a specimen (ML = 1010 mm) identified as *Architeuthis* sp. from Danish waters. Kjennerud (1958) described a mature architeuthid (ML = 1000 mm) from Norway. Roper and Young (1972) reported a small male (ML = 664 mm) from the east coast of Florida in the collections of the Rosenstiel School of Marine and Atmospheric Science, University of Miami. Subsequent examination of this specimen (UMML 31.1762) revealed the presence of spermatophores.

Other reports of male architeuthids include Storm (1897), ML unknown, Joubin (1900), ML = 460 mm, Brinkmann (1916), ML = 1310 mm, Nordgård (1928), ML = 1370 mm, Frost (1934), ML = 1560 mm, and Clarke (1962), ML = 385 mm. These reports did not mention the state of development of the genitalia or whether spermatophores were present. The sex of Frost's poorly illustrated specimen remains in doubt (Lu and Roper, pers. comm.). Another doubtful record is that of Owen (1881), identified as *Plectoteuthis grandis* (=*Architeuthis* sp.). His material, consisting of an arm fragment, was considered by Steenstrup (1882) to be a hectocotylus.

Prior to our specimen, Clarke's record represented the smallest adult or pre-adult *Architeuthis* of either sex.

Roper and Young (1972) reported on two juvenile *Architeuthis,* a male (ML = 45 mm) and a female (ML = 57 mm), both with undeveloped genitalia. This is the only report of juveniles from this family.

Iwai's (1956) account of two small architeuthids (ML = 92 mm and 104 mm) is a misidentification (Roper and Young, 1972).

Results

Description.—One male, ML = 167+ mm, GL = 179 mm (from stomach of *Xiphias gladius,* female, 205 cm lower fork length), sportfishing vessel WILDCATTER, Straits of Florida off Fort Lauderdale, 21 June 1978, UMML 31.1761.

Mantle cylindrical anterior to fin insertion, tapering posteriorly to acute point; mantle wall thickest dorsolaterally (3.5–4.0 mm), becoming thin over midline of gladius; anterior margin damaged.

Fins long (FLI = 48), moderately wide (FWI = 40), thick medially, tapering laterally, damaged marginally. Fins diverge anteriorly, insert on dorsolateral wall of mantle, converge posteriorly, insert on dorsal midline of mantle and gladius, terminate in acute point. Fin musculature discontinuous across dorsal midline, separated by narrow longitudinal strip of elastic connective tissue (Fig. 1A).

Funnel damaged; funnel valve and organ missing.

Funnel-mantle locking cartilage straight and simple.

Nuchal cartilage strong, long (NCLI = 14) and wide, with strong raised median ridge bearing longitudinal cleft; base thin, broadly rounded anteriorly and laterally, pointed posteriorly (Fig. 1B).

All structures of *head* anterior to posterior wall of cephalic cartilage missing.

Gladius strong; vanes long (VLI = 84) and narrow (VWI = 11) with narrow anterior shoulders widening posteriorly to form gently curved, convex, lateral margins; vanes widest in anterior ⅓, narrowing posteriorly, entire gladius becoming V-shaped in cross section in posterior ⅓ with lateral borders of vanes and rachis thickened; posterior tip damaged; free rachis short (FRLI = 16) and moderately broad (FRWI = 6); terminating anteriorly in acute point; borders of free rachis parallel for most of its length (Fig. 1C).

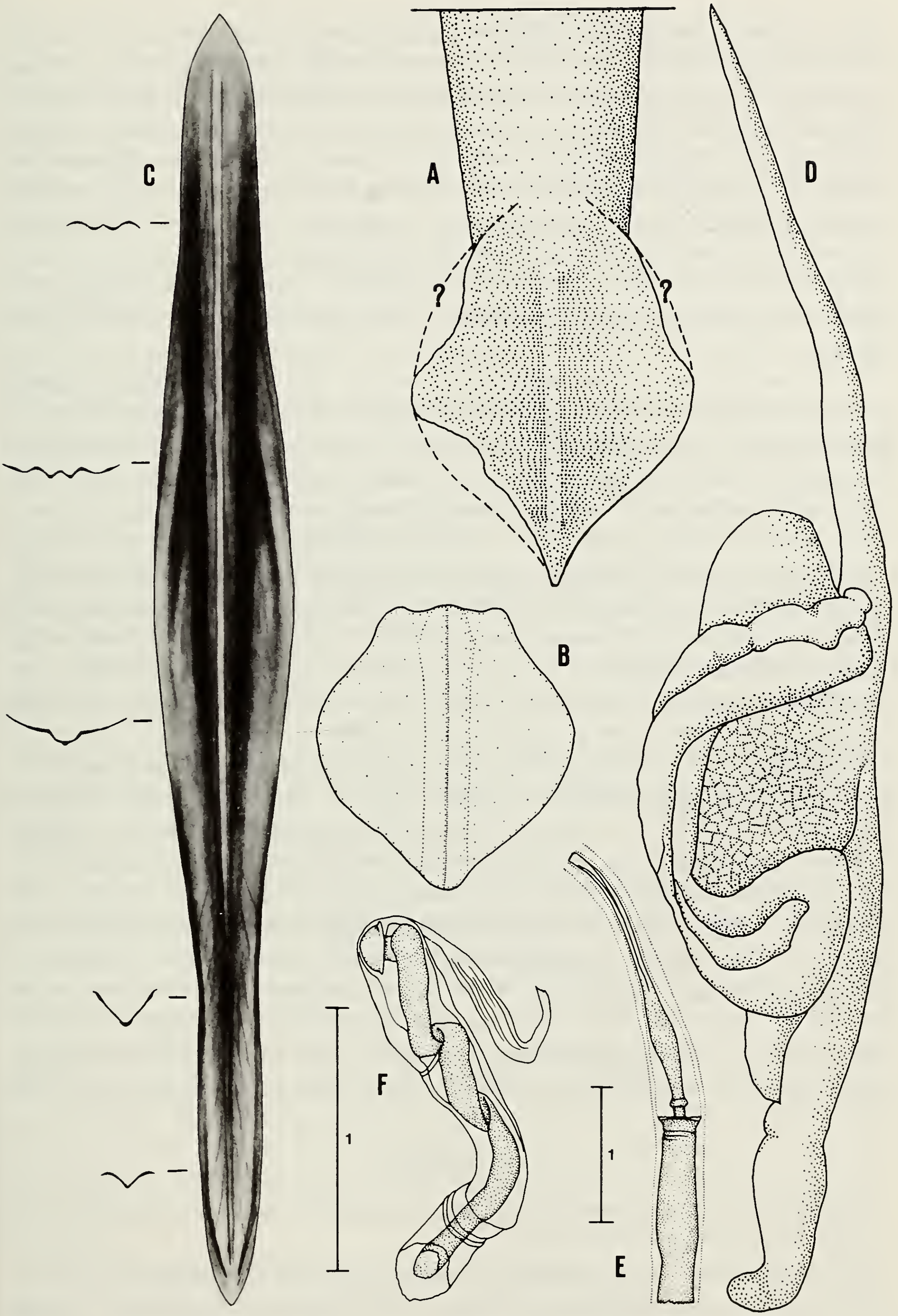

Fig. 1. *Architeuthis* sp. UMML 31.1761: A, Dorsal view of fins and posterior mantle; B, Nuccal cartilage; C, Ventral view of gladius with cross sections; D, Male genitalia (testis and vas deferens not shown); E, Spermatophore, junction of cement body and ejaculatory apparatus; F, Cap region of same. Scales in mm.

Viscera damaged but identifiable; *gills* long with approximately 50 pairs of lamellae; gills broad proximally, narrow distally; base of gills lie anterior to mantle midpoint; *esophagus* long, narrow, entering thin-walled stomach that is subequal in size to *spiral caecum*; *caecum* thin-walled, long, enlarged anteriorly, tapering posteriorly; *digestive gland* bulbous, length approximately 1.5 times greatest diameter of spiral caecum; *rectum* thin-walled, tapering towards *anus* that possesses 2 *anal flaps*; *ink sac* sub-triangular, narrowing to stout ink duct that inserts near anus.

Stomach and caecal contents were examined. Remains of cephalopods (soft tissue, gladius fragments) and fishes (lens, vertebrae, other bones) were found.

Testis lanceolate, 61 mm long, 24 mm wide, 5 mm thick, bevelled towards margins; *vas deferens* damaged; spermatophore glands coiled into flattened ovoid capsule, 31 mm long, 17 mm wide, 13 mm thick; *Needham's sac* subequal in length to spermatophore glands, tapering to point anteriorly with small posterior diverticulum that extends at 90° to long axis of sac; *penis* 60 mm long, 3 mm wide, tapered distally, communicates through anterolateral wall of Needham's sac; penis elliptical in cross section basally, becoming teardrop-shaped medially; firm, cylindrical ridge originates inside Needham's sac and continues along proximal ⅓ of inner wall of penis; ridge bears longitudinal groove; anteriorly ridge and groove become less pronounced; external crenulate keel begins at terminus of internal ridge and continues to within 5 mm of penial tip (Fig. 1D).

Fragments of 2 ruptured *spermatophores* were present, one in Needham's sac, one in the spermatophoric duct. They are characterized as follows: sperm mass cylindrical, without sculpture; cement body cylindrical, slightly narrower than sperm mass, flared at oral end to form collar (damaged aborally); ejaculatory apparatus arises from center of collar, tubular, ¼ diameter of cement body, with prominent annulus short distance oral of cement body; ejaculatory apparatus widens orally then narrows abruptly to thin tube (damaged orally); spiral structure present on aboral portion of ejaculatory apparatus (Fig. 1E); cap slightly enlarged, contains 3 irregular loops of inner tube of ejaculatory apparatus; cap thread strap-like, transparent, with fine longitudinal striations, offset slightly from apex of cap (Fig. 1F).

Discussion

Identification of the present specimen as *Architeuthis* sp. was based on several morphological characters.

The morphology of the gladius is in good agreement with that of a specimen of *A. japonica* described by Sasaki (1929:226, pl. XX, fig. 11). Damage to the posterior tip of the gladius of our specimen prevented determining the presence of a conus as shown by Sasaki. The gladius figured for *Ar-*

chiteuthis sp. by Roper and Young (1972:Fig. 1C) also is similar to our material. The two gladii differ substantially only in the width of the posterior ¼. This may be an artifact of interpretation of the degree of ventral curvature, a difficulty inherent in the illustration of gladii. This same discrepancy is apparent in the gladius of *Architeuthis* sp. (=*A. japonica, fide* Pfeffer, 1912) illustrated by Mitsukuri and Ikeda (1895, pl. X, fig. 2). The gladius of *A. dux* illustrated by Steenstrup (1889, pl. 4), while often referred to in later literature, is too diagrammatic for adequate comparison.

The gill lamellae count of 50 for our specimen agrees closely with the counts of 50 and 55 reported for *Architeuthis* spp. by Roper and Young (1972). The male architeuthid noted earlier (UMML 31.1762) has approximately 57 gill lamellae.

The fin length index of 48 from our specimen appears somewhat large in comparison to most other records from *Architeuthis*. If GL is substituted for ML in the computation of this index, a reasonable alternative in the case of a damaged mantle, an index of 45 results. This value drops to approximately 43 if the assumption is made that actual ML must exceed GL in an intact specimen as suggested by the measurements of *Architeuthis harveyi* (Cadenat, 1936) and *Architeuthis* sp. (Rae, 1950). Our reevaluated indices fall within the known range of FLI values reported for the genus. These values include 39 for *Architeuthis clarkei* (Robson, 1933) and *A. japonica* (Mitsukuri and Ikeda, 1895), 45 for *Architeuthis* sp. (Clarke, 1962), and 48 for *A. physeteris* (Joubin, 1900).

This same rationale can be applied to our FWI of 40. In this case the FWI value is reduced to 37 or 36, only slightly exceeding the value of 33 for *Architeuthis* sp. (Kjennerud, 1958).

To date, the male genitalia of *Architeuthis* have not been described or illustrated satisfactorily. A posterior diverticulum of Needham's sac, as described above, was noted both in our specimen and the larger architeuthid in the University of Miami collections (UMML 31.1762). To our knowledge, this structure is not found in any other oegopsid and may prove to be a character diagnostic of the family.

The grooved ridge noted in Needham's sac and the penis is similar to the ridge and groove system found in the spermatophore glands of *Loligo pealei* used to move the forming spermatophore (Drew, 1919). The structure described here may function in the transport of spermatophores from the storage organ into and down the penis. It is possible that the elongate penis acts as an intromittent organ, with the keel providing strength and aiding in orientation.

The description of spermatophore morphology must be regarded with caution. Ruptured spermatophores often show morphological artifacts. For this reason, comparison with illustrations of other architeuthid spermatophores (Voss, 1956, Fig. 10C; Knudsen, 1957, Fig. 3) is impossible.

The uniqueness of this specimen prompts a reconsideration of the life history of members of this family. Several hypotheses may be formulated.

1) The specimen represents a new taxon of architeuthid that does not attain large size.

2) The specimen indicates that maturation may be followed by substantial growth. That is, growth may continue for some period following the onset of spermatophore production. There is evidence to support this hypothesis. Spermatophore measurements from members of the Lepidoteuthidae, Histioteuthidae, and Cranchiidae show that a range of spermatophore sizes can occur within a single male (Hess, in prep). This condition has been noted also in the Architeuthidae (Knudsen, 1957; Kjennerud, 1958; Hess, in prep.). Given that spermatophore length is related to mantle length (Drew, 1919; Hess, in prep.), these measurements would suggest the production of spermatophores over an extended period of time, during which the animal has grown. A second, less likely alternative is that the animal does not grow appreciably, but that the spermatophore glands alone have increased in size.

Conversely, spermatophore measurements from members of the Loliginidae, Pickfordiateuthidae, Ommastrephidae, and Enoploteuthidae show far less variability in size. This situation could arise if the animals grew little during spermatophore production or if multiple mating occurs. In the latter case, spermatophores produced between successive copulations would be more nearly equal in size. Data concerning the reproductive behavior of squids is limited, but observations of *Loligo opalescens* by McGowan (1954) indicate that males die after copulation. If this is the case in the Oegopsida, multiple copulation cannot explain the consistency found in spermatophore sizes.

3) The specimen is an aberrant individual exhibiting precocious maturation and is without further significance in considerations of the usual life history of architeuthids. Precocious maturation has been observed in the squid *Loligo* (*Doryteuthis*) *plei* (Hixon, pers. comm.). Cohen (1976) also reported small mature *L. plei,* but did not regard these specimens as examples of precocious maturity.

While the first two hypotheses are not mutually exclusive, the paucity of material precludes determination of the validity of either. Although it cannot be discounted, the authors feel that the third hypothesis is least likely.

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AUSTRALONUPHIS VIOLACEA, A NEW POLYCHAETE (ONUPHIDAE) FROM THE SOUTHEAST PACIFIC OCEAN

N. Rozbaczylo and J. C. Castilla

Abstract.—A new species of *Australonuphis* Paxton, 1979, *A. violacea* from the southeast Pacific Ocean off Chile is described. This constitutes the second record of the genus *Australonuphis* along the west coast of America and the first for the southeast Pacific. The new species most closely resembles *A. casamiquelorum* (Orensanz, 1974) from the southwest Atlantic Ocean.

During 1971–1978 while working in a long term sandy macrofauna sampling (J. C. Castilla, principal investigator) several specimens of a big onuphid polychaete were collected in the sandy beach of Los Molles (32°15′S, 71°33′W). These specimens and others collected recently by 2 of our students (C. Luxoro and L. Sierralta) in another sandy beach of central Chile, Playa de Cachagua (32°35′S, 71°28′W), belong to a new species, described herein. The species is a member of the genus *Australonuphis* Paxton, which is recorded for the first time in the Chilean fauna. As a result of the present study, the number of onuphids known from the coast of Chile is now 14 species in 6 genera (Rozbaczylo, in preparation).

The generic name *Australonuphis* was recently proposed by Paxton (1979) as a substitute for *Americonuphis* Orensanz (1974) since the latter was preoccupied by *Americonuphis* Fauchald, 1973.

Australonuphis Paxton (1979) and *Americonuphis* Fauchald (1973), together with *Paranorthia* Moore (1903) and *Rhamphobrachium* Ehlers (1887), form a group that includes species with 2 or more anterior setigers with prolonged parapodia and armed with special setae. While *Paranorthia* and *Rhamphobrachium* includes species that have the first 2 or 3 anterior segments with enlarged parapodia, *Australonuphis* and *Americonuphis* includes macropodous onuphids with the anterior 5–7 parapodia greatly enlarged. These 2 genera can be easily distinguished from each other by the direction of parapodia of the 5 anterior setigers, the distinctive kinds of setae in these setigers and the presence or absence of a digital process at the base of dorsal cirri in parapodia of postmodified setigers. In *Americonuphis* parapodia of modified segments are directed anteroventrally and provided with compound or pseudocompound bidentate hooded hooks and dorsal cirri without basal appendages, whereas *Australonuphis* has parapodia of anterior setigers directed anterolaterally and armed with long, distally curved pseudocompound hooks, and behind the modified setigers with a digital process at the base of dorsal cirri.

Type-material and additional specimens of the new species have been deposited in the collections of the following institutions: Museo Nacional de Historia Natural, Santiago (MNHN); Sala de Sistemática, Laboratorio de Zoología, Pontificia Universidad Católica de Chile, Santiago (SSUC); National Museum of Natural History, Smithsonian Institution, Washington (USNM).

Australonuphis Paxton, 1979

Type-species.—*Americonuphis casamiquelorum* Orensanz, 1974, by original designation.

Diagnosis.—Onuphids with the anterior 5–7 parapodia greatly enlarged and directed anterolaterally and armed with pseudocompound hooks, with or without minute subdistal spine. More posterior parapodia are dorsolateral in position and have limbate setae, with or without weak pseudoarticulation, pectinate setae from setigers 6–7 and entire subacicular hooks, starting relatively far posteriorly (setiger 50–75). Prostomium with 2 ovate frontal antennae, a pair of globular ventral palps and 5 occipital antennae with ringed ceratophores and relatively short ceratostyles. Peristomium with a pair of short tentacular cirri. Branchiae begin on setiger 6–7 with 1 to 3 filaments pectinately arranged above the dorsal cirri to a maximum of 7 filaments where the branchiae are best developed. Dorsal cirri with basal swelling from setiger 6–7, developing gradually into digitate basal process. Anterior ventral cirri subulate and replaced by ventrolateral thick pads by setigers 11–24. The proboscidial armature is well developed and resembles that of other onuphids.

Australonuphis Paxton, includes the following species:

A. casamiquelorum (Orensanz), 1974:100–104, pl. 9, figs. 1–14. From Cassino (Rio Grande do Sul, Brasil) to Caleta de los Loros (Golfo San Matías, Argentina), in sandy bottoms, between the lower mid-littoral zone down to 14 m.

A. hartmanae (Friedrich), 1956:63–65, fig. 5a–c. Playa de las Flores, El Salvador, in an intertidal sandy beach.

A. parateres Paxton, 1979:273–277, figs. 2, 3, 9–18. Southern to eastern Australia, from Adelaide, South Australia, to Yeppoon, Queensland, in surf beaches.

A. teres (Ehlers), 1868:293–295. Eastern Australia, from Lakes Entrance, Victoria, to Maroochydore, Queensland, in surf beaches.

A. violacea n. sp. Central Chile, from Playa de Pichidangui (32°06′S) to Playa de Cachagua (32°35′S), in intertidal and subtidal sandy beaches.

Australonuphis violacea, new species
Figs. 1–3

Diagnosis.—Large and fleshy species; total length unknown but over 20 cm long and more than 350 setigers. The anterior 6–7 segments are characteristically blue-violet pigmented. The first 5 pairs of parapodia greatly enlarged and directed anterolaterally, and provided with 4–5 long and stout, distally curved pseudocompound hooks, with or without a small subdistal spur; following parapodia are dorsolateral in position. Branchiae first present from setiger 6 with 2 or 3 filaments in pectinate arrangement; the maximum number of branchial filaments is 7 at setiger 9–13. Limbate setae from setiger 6. Pectinate setae are present from setiger 6 or 7, each has about 15 teeth. Subacicular hooks, one per parapodium, from setiger 60; after setiger 75–80 they occur 2 in a parapodium. Cutting plates of mandibles are oval, with calcified cutting edge with an indentation. Maxillary formula: MI = falcate; MII = 7 + 7; MIII = 7 + 0; MIV = 7 − 8 + 8; MV = 1 + 1.

Material.—Central Chile: Los Molles, 32°15'S, 71°33'W, May 1978, M. Sánchez, coll., holotype (MNHN 80007); Los Molles, March 1976, O. Mena, coll., paratype (MNHN 80008); Los Molles, May 1975, E. González, coll., 2 specimens (SSUC 5593); Los Molles, November 1971, R. Becerra, coll., 3 specimens (SSUC 5592); Playa de Pichidangui, 32°06'S, 71°33'W, January 1962, P. Sánchez, coll., 1 specimen (SSUC 230-1); Playa de Cachagua, 32°35'S, 71°28'W, February 1979, C. Luxoro and L. Sierralta, coll., 1 specimen (SSUC 5596); Playa de Cachagua, April 1979, L. Sierralta, coll., 2 specimens (SSUC 5597); Playa de Cachagua, May 1979, L. Sierralta, coll., 1 specimen (USNM 67041).

Description.—All specimens are incomplete; the largest (paratype MNHN 80008) has 352 setigers and is 220 mm long and 9 mm wide. Holotype has 72 setigers and is 70 mm long and 8.5 mm wide.

Body large, robust, circular in cross-section anteriorly and somewhat depressed posteriorly. All individuals are marked with a characteristic brilliantly iridescent dark blue-violet color, involving the anterior 6–7 segments; the color persists in alcohol. The anterior region (Figs. 1a, b) is greatly modified and broader than the rest of the body, with the first 5 parapodia notably thicker and larger (Figs. 2a, b) than the other. The anterior segments are much longer than those farther back, they are strongly convex above and somewhat swollen at the front edge, with deep segmental furrows dorsally and ventrally; following segments are short and closely crowded, less convex above, nearly flat and with only a slight contriction between them on the ventral surfaces. Parapodia of the first 5 setigers are characteristically anterolaterally directed; parapodia 6 and 7 are transitional; the remainder of the parapodia are characteristically dorsolateral in position.

Peristomium and the first 6–7 setigers are entirely dark blue-violet colored with the exception of the styles of the occipital antennae, the peristomial

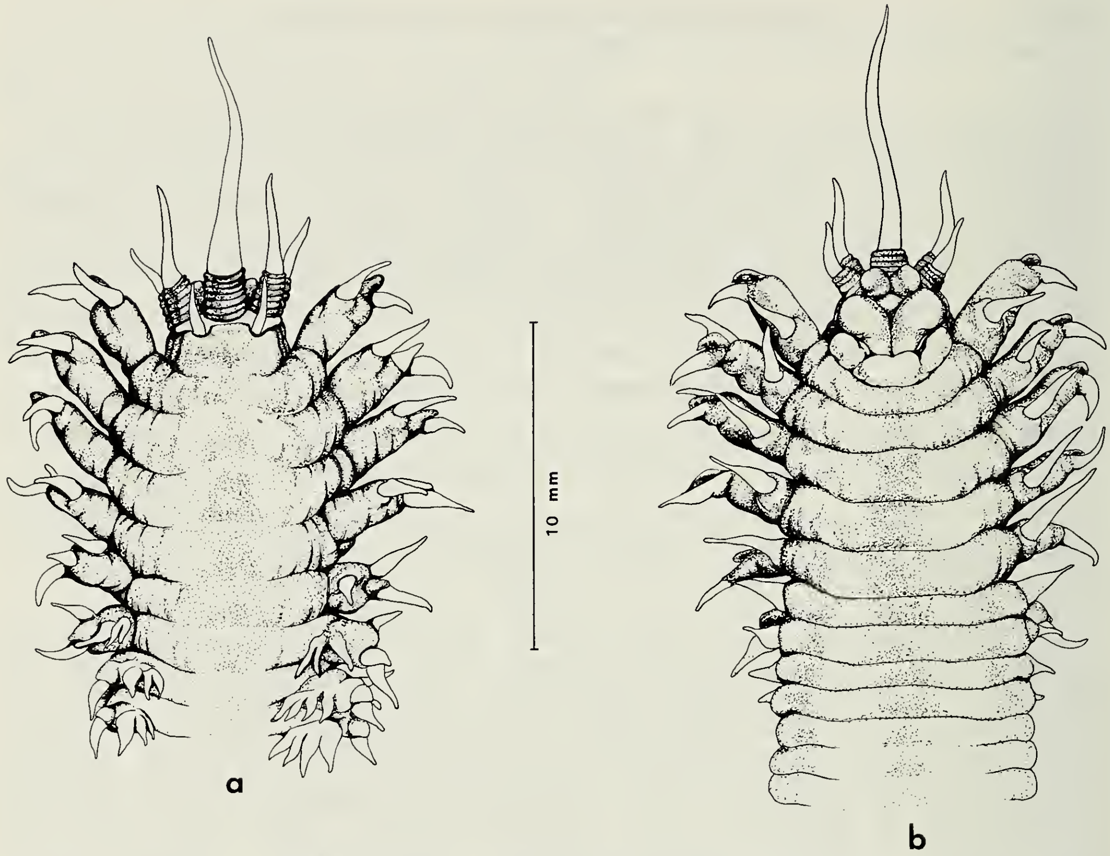

Fig. 1. *Australonuphis violaceus*: a, Anterior end, dorsal view; b, Anterior end, ventral view.

cirri, ventrolateral surface of palps, dorsal and ventral cirri and postsetal lobes which are yellow cream colored as is the rest of the body.

The prostomium (Fig. 1a) is small, nearly hidden by the bases of the antennae; it bears 2 ovate frontal antennae and 5 short occipital antennae with ringed ceratophores and tapering styles. There are no eyes. Ventrally in front of the mouth (Fig. 1b) there is a pair of thick, globular labial palps that are basally fused and deeply divided distally; the palpal bases overlie the oral aperture, while the anterior edge of the peristomium forms a swollen and wrinkled lower lip. The 3 dorsal occipital antennae are longer than the 2 lateroventral ones. The median unpaired one is the longest and, turned backwards, reaches setiger 4. The styles of the inner lateral pair are about twice the length of the outer lateral ones and about half the length of the median one. The ceratophores of the 3 dorsal occipital antennae are yellowish brown, whereas the ceratophores of the outer lateral antennae have the same blue-violet color as the first segments. Each of the outer lateral ceratophores has 6–8 annulations; each of the inner lateral ceratophores has 7–10 annulations; the median ceratophore has 8–10 annulations; in all ceratophores the distalmost annulation is a little longer than the others.

Fig. 2. *Australonuphis violaceus*: a, First parapodium, posterior view; b, Parapodium 3, posterior view; c, Parapodium 6; d, Parapodium 17; e, Parapodium 50.

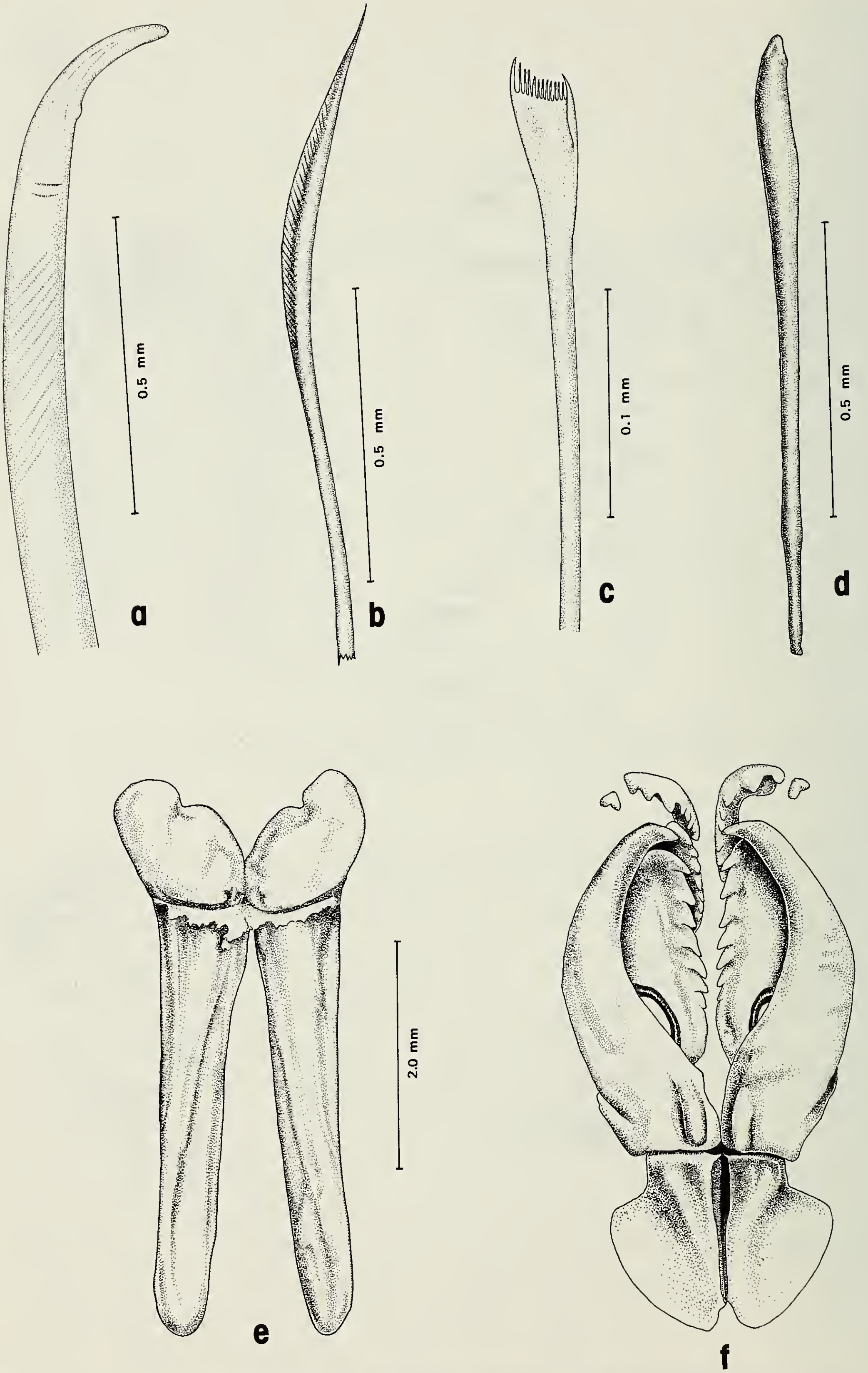

Fig. 3. *Australonuphis violaceus*: a, Pseudocompound hook from parapodium 3; b, Limbate notoseta, middle parapodium; c, Pectinate seta, middle parapodium; d, Subacicular hook from setiger 100; e, Mandibles; f, Maxillae.

The peristomium is about as long as the second setigerous ring at its middorsum and a little longer than the first one, and bears on its anterior margin a pair of smooth and tapering tentacular cirri which are as long as the peristomium.

Parapodia of 5 anterior setigers (Figs. 2a, b) are greatly enlarged, stout, and directed anterolaterally; maximal development is reached in the second parapodium. All first 5 parapodia are basically similar in structure. The dorsal and ventral cirri and the postsetal lobes are long and all similar to one another; presetal lobe large and subrectangular to oval, demarcated basally by a transverse fold joined to the base of the postsetal lobe. From the sixth setiger the parapodia are gradually dorsolateral in position. The dorsal cirrus is simple and cirriform on the first 5 setigers. From setiger 6 it has a branchia on its dorsal edge. The branchiae have at first 2 or 3 filaments in pectinate arrangement (Fig. 2c); farther back the branchiae increase in size and number of pinnae (Fig. 2d). Where best developed, from setiger 9–13 for the next 10–15 setigers, the number of branchial filaments is 6 or 7; then the number of branchial filaments diminishes to 5 or 6 and are continued far back. Occasionally 4 filaments can be found in some posterior segments. In the longest individual (posteriorly incomplete), consisting of 352 setigers, the branchiae still are present on the last setiger, and have 6 filaments. In general, the number of branchial filaments in median and posterior setigers vary erratically along the body and even within the parapodia of the same segment.

From setiger 7 the dorsal cirrus is basally swollen eventually developing a short digitate basal appendix, curved towards lateral sides of the body. The appendix increases in size posteriorly (Fig. 2e). The dorsal cirri gradually became broader and subcordiform in anteromedian segments. In posterior segments they decrease in size, so that in the last segments present they appear as a lateral appendix of the branchial trunk. Furthermore, from setiger 7 a more or less cirriform appendix appears next to the base of the dorsal cirrus. From approximately parapodia 12 to 15 this appendix gradually becomes a rounded lobe. At about parapodia 40 this lobe moves ventrally fusing with the presetal lobe and the thick ventrolateral pads, resulting in a presetal lip. The presetal lobe is large in the first segments, and gradually reduced from setiger 7, and by setigers 65–70 it is completely replaced by the new presetal lip.

Postsetal lobes are nearly triangular; they are slightly shorter than the ventral cirri in the anterior segments; farther back they gradually decrease in length, but retain their triangular form along the body.

Ventral parapodial cirri are subulate. They are large in the first segments, diminishing in length from setiger 8; they are absent after setigers 17–25. While the ventral cirri are diminishing in length, thick pads develop in their bases in the ventrolateral zone of the segments.

The first 5 setigers are armed with 4–5 stout, distally curved pseudocompound hooks (Fig. 3a), amber-colored (in some cases 1 or 2 small recently formed hooks appear ventrally), and 1 or 2 simple superior setae. A subdistal spur may be present on the concave margin of the hooks.

The next following setigers have numerous slightly limbate setae (Fig. 3b), in 2 fascicles; those in the superior fascicles are longer and more slender than the inferior ones. Pectinate setae (Fig. 3c), each with about 15 teeth, are present from setiger 6 or 7 to the last one (parapodium 352 in the longest incomplete specimen), and number 3 or 4 in a fascicle.

Distally entire subacicular hooks (Fig. 3d) are first present from about setiger 60. They occur at first singly in a parapodium; from setiger 75–80 on they occur 2 to a parapodium.

In some of the preserved animals the distal ends of the mandibles project from the mouth.

Mandibles and maxillae (Figs 3e, f) of 2 specimens have been examined. The proboscidial armature (seen in dissection from Paratype SSUC 230-1 and drawn after removal from Paratype MNHN) is well developed. The mandibles are a little longer than the maxillary carriers and forceps together. The mandibular bases are free from one another for nearly their entire length. The distal plates of the mandibles are oval, calcified, and have an indentation in the cutting edge. Maxillae I are falcate; maxillae II have 7 teeth on either side; maxilla III, present on the left side only, has 7 teeth; maxilla IV has 7–8 left and 8 right; maxilla V on either side is a single tooth.

The tube is fragile, soft and cylindrical. It consists of a thin transparent parchmentlike base covered on the outside with a thin layer of fine sand grains. The tube becomes flattened without the worm. The soft and fragile tubes formed by *A. violaceus* appear to be only temporary.

Etymology.—The specific name is derived from the Latin and refers to the characteristic blue-violet pigmentation on the anterior 6–7 segments.

Type-locality.—Central Chile: Los Molles sandy beach (32°15′S, 71°33′W), at the lower midlittoral zone.

Distribution.—Australonuphis violacea is found in sandy beaches from Playa de Pichidangui (32°06′S) to Playa de Cachagua (32°35′S), between the low midlittoral zone and the infralittoral zone.

Relationships.—Australonuphis violacea resembles *A. casamiquelorum* in many respects, but differs at least in the following features: color pattern, number of branchial filaments, distribution of ventral cirri and subacicular hooks, the shape of the pseudocompound hooks, the number of teeth on the jaw-pieces. In *A. casamiquelorum* the anterior halves of the first 4–5 segments, including the peristomium, are slightly grayish-green colored, while in *A. violacea* the peristomium and the first 6–7 segments are entirely dark blue-violet colored. The number of branchial filaments is up to 4 in *A. casamiquelorum* and up to 7 in *A. violacea.* Ventral parapodial cirri are cirriform to setiger 10–16 in *A. casamiquelorum,* while in *A. violacea* they reach setiger 24. Subacicular hooks usually first present from setiger 50–56 may even be present from setiger 25–26 in *A. casamiquelorum,* in *A. violacea* they are first present from about setiger 60. In *A. casamiquelorum* the pseudocompound hooks of anterior setigers are pointed and are only slightly curved distal to the spur; in *A. violacea* the hooks are distinctly curved and distally blunt. In the former species, the pseudocompound hooks have a subdistal articulation that involves the whole seta, while in the latter there is a subdistal pseudoarticulation that involve only half of the seta at the internal margin. The number of teeth on the jaw-pieces of *A. violacea* is greater than in *A. casamiquelorum.*

Australonuphis casamiquelorum is known from the south western Atlantic Ocean (Rio Grande do Sul, Brasil to Golfo San Matías, Argentina), while *A. violacea* is known from the south eastern Pacific Ocean in the central part of Chile.

Ecological remarks.—All the specimens of *A. violacea* obtained in Los Molles sandy beach were collected from the Lower Fringe of the beach (Sánchez *et al.,* in press). Other species characteristic of this Fringe are: the polychaete *Nephtys impressa,* the mole crab *Emerita analoga,* and juveniles of the bivalve *Mesodesma donacium.* In free diving observations at the same beach in 1972 a dense population of *A. violacea* was found beyond the surf zone at 4–5 m of depth (it was not possible to carry out observations in the surf area). Up to 10–15 individuals per m^2 were counted. *A. violacea* is easily identified subtidally due to the characteristic blue-violet pigmentation of the anterior segments, which the individuals usually stretch out of their tubes.

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A NEW SPECIES OF PIPEFISH (PISCES: SYNGNATHIDAE: *MICROGNATHUS*) FROM TAHITI

Ronald A. Fritzsche

Abstract.—Micrognathus pygmaeus, characterized by a low number of trunk rings (14), short snout (3.2–3.4 in head), and small size at maturity, is described from Taone, Tahiti.

The genus *Micrognathus* is one of the more complex in the family Syngnathidae and its taxonomy is poorly known. Most of the species are inadequately described, and some recently described species transcend the limits of the nominal subgenera included in *Micrognathus* (Herald and Dawson, 1974). Most syngnathids frequent relatively shallow water, but a few members of the genus *Micrognathus* are typically found at depths of 20 to 137 meters (Herald and Randall, 1972; Fritzsche, 1975). The deep living habits of these species of *Micrognathus* have contributed to a paucity of specimens and a resultant lack of taxonomic information. However, the specimens described here were collected from relatively shallow water. Perhaps the small size of these fish has been responsible for the lack of observations by previous investigators.

Both the holotype and paratype are deposited in the National Museum of Natural History, Smithsonian Institution (USNM). Measurements are given in millimeters (mm). Terminology and definitions follow Fritzsche (1980).

Micrognathus pygmaeus, new species
Fig. 1

Holotype.—USNM 207933 (23 mm SL, male); Tahiti, Taone, lagoon 1–2 km E of Papeete, depth about 3 m; 1965; R. L. Sixberry. *Paratype.*—USNM 215775 (20 mm SL, female); same data as holotype.

Diagnosis.—(Data for holotype are given first if different from paratype.) Dorsal-fin rays 18, pectoral-fin rays 11, anal-fin rays 2–3, caudal-fin rays 10, trunk rings 14, tail rings 30–29; dorsal fin covering 1 + 4 rings; brood pouch covering first 10 tail rings; head 7.1–7.4 in SL; snout 3.4–3.2 in head; dorsal-fin base 1.6–1.7 in head.

Description.—Head ridges smooth, indistinct. Snout ridge slightly concave. Supraorbital ridge smooth, weakly developed, with distinct cirrus.

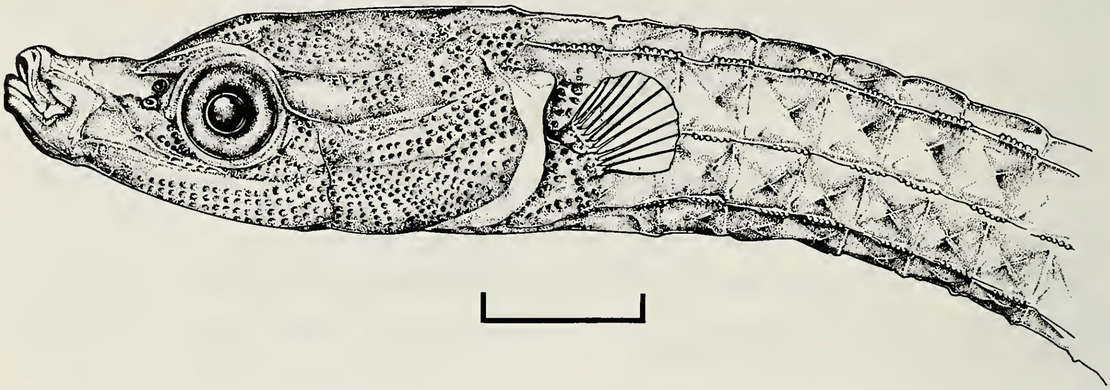

Fig. 1. Head and anterior body of the holotype of *Micrognathus pygmaeus* (USNM 207933); 23 mm SL. Horizontal bar represents 1 mm.

Prenuchal ridge obsolete, nuchal ridge absent. Opercular ridge extending almost full length of opercle. Pectoral-fin base with indistinct ridges. Body ridges rugose to serrate with serrations increasing in distinctness posteriorly. Maxillary with strong, median, dorsal spinous process. Pouch-protecting plates weakly developed, pouch closure of the everted type of Herald (1959). Body ridge pattern typical of *Micrognathus,* i.e., lateral trunk ridge deflected ventrad at anal ring thence continuous with inferior tail ridge; superior tail and superior trunk ridges discontinuous; inferior trunk and tail ridges discontinuous. Scutella on trunk and anterior portion of tail about half height of individual rings. Pectoral fin crossing 1.0–1.2 trunk rings. Color entirely light tan to white; no concentrations of pigment evident.

Remarks.—Micrognathus pygmaeus most closely resembles *M. brevirostris* (Rüppell) from which it differs in the number of trunk rings (14 rather than 15–17), head 7.1–7.4 rather than 8.0–10.2 in SL, and snout 3.2–3.4 rather than 2.2–3.2 (usually 2.2–2.9) in head. *Micrognathus pygmaeus* might also be confused with *M. nitidus* (Günther), but the latter has a distinct banded color pattern and well developed spines on the snout ridge which distinguish it from *M. pygmaeus.*

Etymology.—From the Greek *pygmaios* (dwarf), in reference to its small size, used here as a noun in apposition.

Discussion.—Micrognathus pygmaeus cannot be placed in any of the three subgenera of the genus as they are presently defined. This quandary is similar to the one faced by Herald and Dawson (1974) in their treatment of *M. erugatus,* which they were unable to place in a subgenus of *Micrognathus.* This suggests that the present subgenera of *Micrognathus* are artificial and in need of reexamination.

The holotype of *M. pygmaeus* is one of the smallest known mature male pipefishes. Only three other species are as small or smaller at maturity; *Micrognathus brevirostris* (25 mm; Herald, 1953); *Doryrhamphus excisus*

(23 mm; Duncker, 1915); and *D. paulus* (24.5 mm; Fritzsche, 1980). The brood pouch of the holotype contained seven eggs.

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OCCURRENCES OF SHRIMPS (NATANTIA: PENAEIDEA AND CARIDEA) IN CENTRAL CALIFORNIA AND OREGON

Jon D. Standing

Abstract.—Records are given for ten species of shrimps collected in central California and Oregon. These include six northern range records, one southern range record, and three intermediate occurrences. Particularly noteworthy are the new localities and observations reported for the freshwater shrimp, *Syncaris pacifica,* and the estuarine shrimp, *Palaemon macrodactylus.* Some of the northern range records may represent temporary range expansions that are established by larvae recruited from the south during warm water periods.

The shrimps of California were last reviewed comprehensively by Schmitt (1921). Since then, most workers have focused on specific taxa (Chace, 1951; Hart, 1964; Wicksten, 1977, 1978). Crossing taxa in this paper, I report new range records and other occurrences for ten species of Penaeidea and Caridea.

The records are based on my own collections, on those of some colleagues, and on certain museum material that came to my attention. In no case were any museum holdings examined exhaustively. Specimens are lodged in the California Academy of Sciences (CAS), the Moss Landing Marine Laboratory (MLML), the National Museum of Natural History (USNM), and the Allan Hancock Foundation (AHF).

Suborder Natantia
Section Penaeidea
Family Penaeidae
Subfamily Penaeinae

Penaeus (*Farfantepenaeus*) *californiensis* Holmes, 1900

Penaeus canaliculatus Holmes, 1895:581.

Penaeus californiensis Holmes, 1900:218, pl. 4, figs. 64–69.—Burkenroad, 1938:67, figs. 10–11 & 14–15.—Brusca, 1973:218, fig. 7.29.—Palacios, 1968:341, figs. 5–6.—Word & Charwat, 1976:17.—Edwards, 1978:151.—Holthuis, 1980:39.

Penaeus brevirostris.—in part, Rathbun, 1902a:287; 1904:146.—Schmitt, 1921:21, fig. 9.—Burkenroad, 1934:91.

Penaeus brasiliensis.—in part, Schmitt, 1935:16.
Penaeus californicus.—Carlisle, 1969:239.

Previous records.—PERU: Off Paita (Holthuis, 1980). MEXICO: Concepcion Bay, Baja California, 1926; Angeles Bay, Baja California, 1926, 31–42 m; and Lagunaje de las Lomitas, Esquinapa, Sinaloa, 1919 (Burkenroad, 1938). Off the west coast of Mexico, from Puerto Peñasco to Salina Cruz (Edwards, 1978). CALIFORNIA, USA: Off Anaheim and San Francisco Bay (Holmes, 1895). Off San Diego (Rathbun, 1902a). Off Santa Monica (Burkenroad, 1938). Santa Monica Bay (Carlisle, 1969). Off Oxnard, 21 m, and off Palos Verdes, 10 m (Word & Charwat, 1976).

Material examined.—CALIFORNIA, USA: Elkhorn Slough, near Red House and in Rubis Creek, Monterey Bay, 14 June 1978 and 8 May 1980, 2 specimens, MLML A0598 and Access. No. 024; Moss Landing Harbor, Monterey Bay, 27 December 1979–26 February 1980, 9 specimens, 7 ♂♂ (carapace lengths to orbit of 31–37 mm) and 2 ♀♀ (carapace lengths 45 and 53 mm), CAS 013366–013368, 013380, and 013384–013386; San Francisco Bay, central bay, near Potrero Power Plant, 23 May 1978, 1 ♀ specimen (length 42 mm), USNM 181206; San Francisco Bay, north bay, near China Camp, March 1980, 1 ♀ specimen (50 mm), CAS 013337.

Remarks.—These records are to the north of all previous ones, except for the two specimens recorded from San Francisco Bay by Holmes (1895). Thus, this shrimp would seem to be a rare visitor to San Francisco Bay. However, there was some incidental, sporadic fishing for this species in San Francisco Bay during the last century (Rathbun, 1883).

Penaeus californiensis is the most important commercial shrimp present in a fishery located along the Pacific coast of Mexico, especially in the Gulf of California, where it is trawled offshore and trapped or netted in coastal lagoons (Edwards, 1978). It is also fished in Central America and Ecuador (Holthuis, 1980). Recently, the shrimp has been the subject of aquaculture studies in Mexico (Edwards, 1978).

Section Caridea

Family Atyidae

Syncaris pacifica (Holmes, 1895)

Miersia pacifica Holmes, 1895:577, pl. 21, figs. 27–28.
Syncaris pacifica.—Holmes, 1900:213.—Hedgpeth, 1968:512, figs. 1–2; 1975:5, figs. 1–2.

Previous records.—CALIFORNIA, USA: Sonoma County (Holmes, 1895). Salmon Creek, Santa Rosa Creek, Atascadero Creek, and Blucher Creek, Sonoma County; Stemple Creek and Lagunitas (Papermill) Creek, Marin County; Napa River, near Calistoga, Napa County (Hedgpeth, 1968).

Salmon Creek and East Austin Creek, Sonoma County; and Lagunitas Creek, Marin County (Hedgpeth, 1975).

Material examined.—CALIFORNIA, USA: Lagunitas Creek, north of State Park at bridge, Marin County, 7 December 1979, 19 specimens, CAS 013379; Sonoma Creek, near Glen Ellen, Sonoma County, 15 September 1979 and 9 October 1979, 16 specimens, CAS 013369, 013378, 013382, and 013387; Huichica Creek, near highway 12-121 crossing, Napa County, 14 and 19 October 1979, 19 specimens, CAS 013370 and 013381.

Remarks.—The records from Sonoma and Huichica Creeks represent new drainage localities for this freshwater shrimp. In Sonoma Creek, they were found just south of Kenwood to somewhat north of Boyes Springs, a stream distance of about 11 km. An earlier effort to collect them downstream from these sites was unsuccessful (Hedgpeth, 1968). In Huichica Creek, located between Sonoma Creek and the Napa River, the shrimp was found only in one locality of one kilometer length and was most concentrated in a single deep pool.

My search extended, in the fall of 1979, to many other localities in Napa and southern Marin Counties. No shrimp were located in the Napa River or in any of its tributaries, although ''promising'' habitat was present in sections of Dry Creek. The last known collection from this area was taken in 1960 at Calistoga (L. Eng, California Department of Fish and Game, pers. comm.). Searching the streams in southern Marin County also proved fruitless, except for a well-known collecting site on Lagunitas Creek.

This shrimp is particularly interesting because of its limited distribution (parts of only three counties), sporadic occurrence, and specific habitat requirements. Hedgpeth (1968) has characterized the principal habitat of *Syncaris* as the warm, slower reaches of lowland streams. While this description is appropriate for some localities, observations at East Austin, Sonoma, and Huichica Creeks suggest a cool water habitat of deep continuously-flowing pools and fast-running shallow stretches. In pools the shrimp are usually located around eroded tree roots. In shallow stretches they find cover around the sedge *Cyperus eragrostis*.

Syncaris seems to be highly susceptible to man-caused habitat disturbances, perhaps having already become extinct in some streams (Hedgpeth, 1975). Human activities that may affect them include dredging, filling, and various kinds of pollution. To prevent the extinction of this species, Hedgpeth (1975) has advocated an endangered status for the shrimp, cessation of activities such as dredging, and rehabilitation of certain streams.

However, another man-caused disturbance may be at least as important as those noted above. *Syncaris* appears to be incapable of co-existing with introduced fish species, particularly centrarchids. Instead, the shrimp is almost always associated with native California fisheries, including salmonids. A similar observation has been made in Hawaii where atyid shrimps seem to be incompatible with introduced mosquito fish (Edmondson, 1929). In California, some of the introduced fishes are also thought to be responsible for the local elimination of other, native fish species (Moyle, 1976a, b).

Syncaris is the only atyid shrimp remaining in western North America (Hedgpeth, 1975). Future efforts to protect this species should certainly consider the role of introduced fishes. Separating the effects of these fishes from other disturbance effects may prove challenging, however, because most introduced fishes themselves are found in disturbed habitats (Moyle, 1976b).

Family Palaemonidae
Subfamily Palaemoninae

Palaemon macrodactylus Rathbun, 1902b

Palaemon macrodactylus Rathbun, 1902b:52, fig. 24.—Balss, 1924:50.—Holthuis, 1950:7.—Newman, 1963:120, fig. 1.—Little, 1969:70, figs. 1–6.—Carlton, 1975:18; 1979:687.

Leander macrodactylus.—Parisi, 1919:76.—Kubo, 1942:36, figs. 7–9 & 19–30.

Leander serrifer longidactylus.—Yu, 1930:570, fig. 4.

Not *Leander macrodactylus*.—Yoshida, 1941:26, pl. 6, fig. 4 [=*Palaemon gravieri* (Yu)].

Previous records.—(Northeastern Pacific Ocean) CALIFORNIA, USA: San Francisco Bay (Newman, 1963; Little, 1969; Carlton & Kuris, 1975; Carlton, 1979). Los Angeles Harbor (Carlton, 1975; 1979).

Material examined.—CALIFORNIA, USA: Off Kirby Park, Dairy's, and Moss Landing Harbor, Elkhorn Slough, Monterey Bay, 11 April–18 October 1979, 58 larvae and 2 juveniles CAS 013389–013395.

Remarks.—The larvae of this species were identified from Little (1969). The record represents an important intermediate locality in California for the discontinuous distribution of this exotic species. Because this shrimp does not occur along the outer coast, it was probably transported to Elkhorn Slough rather recently from San Francisco Bay, either as fishing bait or possibly in water ballast.

Newman (1963) has suggested that *Palaemon* was introduced to San Francisco Bay in the early 1950's, by ships returning from Korea or Japan. In 1962 it appeared in the Los Angeles area (Carlton, 1979). The Los Angeles population may have been secondarily introduced from San Francisco Bay, or introduced directly from the western Pacific Ocean. The shrimp has also been introduced to Australia and is economically important in northern China and Japan (Holthuis, 1980).

Subfamily Pontoniinae

Pontonia californiensis Rathburn, 1902c

Pontonia californiensis Rathbun, 1902c:902; 1904:33, fig. 11.—Ritter, 1913:497.—Borradaile, 1917:391.—Schmitt, 1921:38, fig. 23.—Holthuis, 1951:145, pl. 46–47.—Word & Charwat, 1976:169.

Previous records.—CALIFORNIA, USA: Off Santa Cruz Island (34°00′N, 119°29′30″W), 55 m, 1889, *Albatross* Sta. 2945 (Rathbun, 1902c, 1904; Ritter, 1913). Off Santa Rosa Island, 27–29 m, 1941, 1940 Allan Hancock Expedition Sta. 1284-41 (Holthuis, 1951). Engels Bank, 26 m (Word & Charwat, 1976).

Material examined.—CALIFORNIA, USA: Off San Jose Creek Beach, Carmel (36°34′N, 121°56′W), 43 m, 2 October 1975, 1 specimen in the ascidian *Ascidia paratropa,* MLML A0539.

Remarks.—This specimen represents a northern range extension of 2°34′ in latitude and the first individual collected beyond the southern California bight.

The occurrence of only a few records for *Pontonia californiensis* suggests that these shrimp are either rare or cryptic, perhaps occurring as obligate symbionts with large solitary ascidians. Specimens have been collected from *Ascidia paratropa* (this record) and *A.* (=*Phallusia*) *vermiformis* (Ritter, 1913). Other Pontoniinae are associated with sponges, cnidarians, molluscs, echinoderms, and ascidians (Borradaile, 1917; Bruce, 1976).

Family Alpheidae

Synalpheus lockingtoni (Coutière, 1909)

Alpheus leviusculus Lockington, 1878:478.

Synalpheus lockingtoni.—Coutière, 1909:21, fig. 1.—Rathbun, 1910:606.—Schmitt, 1921:77, fig. 54 & pl. 12, fig. 1.—Carlton & Kuris, 1975:404.—Word & Charwat, 1976:63.

Not *Alpheus edwardsi leviusculus.*—Dana, 1852a:543, pl. 34, fig. 3a–f.

Previous records.—ECUADOR: Baia di S. Elena (Rathbun, 1910). BAJA CALIFORNIA, MEXICO: Off Puerto Escondido, off Puerto Mulege, and ‘‘other points’’ in the Gulf of California (Lockington, 1878). CALIFORNIA, USA: Off San Nicolas Island, 419–545 m, *Albatross* Sta. 4421 (Coutière, 1909). Off Venice Beach, Santa Monica Bay (33°59′N, 118°28′W), and west shore of Catalina Harbor, Santa Catalina Island, intertidal (Schmitt, 1921). Off Whites Point, Palos Verdes, intertidal, and San Diego Bay, intertidal (Word & Charwat, 1976).

Material examined.—CALIFORNIA, USA: Elkhorn Slough, Monterey Bay (36°52′N, 121°46′W), 18 July 1930, 1 specimen, collected by G. E. MacGinitie, CAS 013334.

Remarks.—This record represents a northern range extension of 2°53′ in latitude. The specimen referred to here has been mentioned previously (Carlton & Kuris, 1975, p. 404; J. T. Carlton, pers. comm.) but the data given therein were incomplete for establishing the record.

Family Hippolytidae

Heptacarpus brachydactylus (Rathbun, 1902c)

Spirontocaris brachydactyla Rathbun, 1902c:898; 1904:93, fig. 41.—Schmitt, 1921:72, fig. 48.
Heptacarpus brachydactylus.—Holthuis, 1947:12.—Word & Charwat, 1976:107.

Previous records.—CALIFORNIA, USA: Off Santa Cruz Island (34°00′N, 119°29′W), 486 m, *Albatross* Sta. 2948 (Rathbun, 1902c). Off San Diego, 763 m, *Albatross* Sta. 2928 (Rathbun, 1904).

Material examined.—CALIFORNIA, USA: Monterey Bay (36°45′N, 122°0′W), 576–695 m, 12 October 1973 and 14 August 1974, 3 specimens, MLML A0189 and A0493.

Remarks.—These specimens represent a northern range extension of 2°45′ in latitude and the first specimens collected beyond the southern California bight.

Heptacarpus decorus (Rathbun, 1902c)

Spirontocaris decora Rathbun, 1902c:896; 1904:79, fig. 33.—Schmitt, 1921:61, fig. 38.
Hippolyte decora.—Williamson, 1915:377.
Heptacarpus decorus.—Holthuis, 1947:12.—Word & Charwat, 1976:113.—Butler, 1980:214, pl. 7C.

Previous records.—BRITISH COLUMBIA, CANADA: Off Gabriola Island, Strait of Georgia, 91 m, 1961 (Butler, 1964, 1980). WASHINGTON, USA: Strait of Juan de Fuca, 278 and 208 m, *Albatross* Sta. 3454 and 3461; near Flattery Rocks, 313 m, *Albatross* Sta. 2866 (Rathbun, 1904). OREGON, USA: Heceta Bank, 91 m, *Albatross* Sta. 2886 (Rathbun, 1904). CALIFORNIA, USA: Off Santa Cruz Island, 274 m, *Albatross* Sta. 2946 (Rathbun, 1902c). Off Point Conception, 265 m, *Albatross* Sta. 2893; off Santa Rosa Island, 95 m, *Albatross* Sta. 2956; off San Diego, 227 m, *Albatross* Sta. 2935 (Rathbun, 1904). Off Palos Verdes Peninsula, 22 m; and off Dana Point, 87 m (Word & Charwat, 1976).

Material examined.—CALIFORNIA, USA: Monterey Bay, 128 m, 12 February 1931 and 9 March 1931, collected by G. E. MacGinitie, CAS 013429.

Remarks.—This record, an intermediate locality, provides further evidence that the distribution of this species is continuous along the west coast of North America.

Lysmata californica (Stimpson, 1866)

Hippolysmata californica Stimpson, 1866:48; 1871:123.—Holmes, 1900:180, pl. 2, fig. 38.—Rathbun, 1904:56.—Schmitt, 1921:49, fig. 27.—Holthuis, 1947:19.—Limbaugh, *et al.*, 1961:249, fig. 7.—Ricketts & Calvin, 1968:144.

Hippolyte lineata.—Lockington, 1877:35.

Lysmata californica.—Chace, 1972:124.—Brusca, 1973:216, fig. 7.28.—Word & Charwat, 1976:145.

Previous records.—BAJA CALIFORNIA, MEXICO: Sebastion Viscaino Bay and Guadalupe Island (Limbaugh, *et al.*, 1961). Off Ensenada (Ricketts & Calvin, 1968). Off La Paz (Brusca, 1973). CALIFORNIA, USA: Off San Diego (Stimpson, 1866). Off Santa Catalina Island (Lockington, 1877). Off San Pedro, intertidal (Holmes, 1900). Off Santa Barbara (Rathbun, 1904). Off San Simeon (35°39′N, 121°11′W), intertidal; Los Angeles Harbor breakwater, 6 m; off Bunker Point, Palos Verdes, 6–12 m; and Lunada Bay, Palos Verdes, intertidal (Word & Charwat, 1976).

Material examined.—CALIFORNIA, USA: Monterey Bay, 20 June 1905, collected by G. E. MacGinitie, CAS 013427; Moss Landing Harbor, Monterey Bay, 27 February 1979 to 15 January 1980, 31 specimens, CAS 013383, 013388, and 013397–013402; off Coyote Point, south San Francisco Bay, 2 July 1977, 2 specimens, AHF 744-1; off Sacramento Landing, Tomales Bay (38°13′N, 122°54′W), August 1977, 4 specimens, CAS 013336.

Remarks.—All of the specimens studied here were collected to the north of the previous range record; the Tomales Bay locality is 2°34′ in latitude north of San Simeon.

Although Holmes (1900:181) states that the telson is "much shorter than the uropods," the specimens from Tomales Bay have the telson only subequal to the uropods.

This pen-striped shrimp is a facultative cleaning symbiont on certain large fishes and spiny lobsters (Limbaugh, *et al.*, 1961). It supports a small bait fishery located on the breakwater in San Pedro Bay, California, where it is known as the "red rock shrimp" (Turner & Sexsmith, 1965).

Spirontocaris lamellicornis (Dana, 1852)

Hippolyte lamellicornis Dana, 1852a:24; 1852b:576, pl. 36, fig. 6.—Williamson, 1915:330.

Spirontocaris lamellicornis.—Walker, 1898:277.—Holmes, 1900:208.—Rathbun, 1904:62, fig. 18.—Schmitt, 1921:53, fig. 29.—Holthuis, 1947:8.—

Word & Charwat, 1976:151.—Hayashi, 1977:158.—Butler, 1980:169, pl. 6D.

Previous records.—USSR: Off Commander (Komandorskie) Islands, Bering Sea (Rathbun, 1904). ALASKA, USA: Captains Harbor, Unalaska, 16 m; off Port Etches, 22–33 m; Sitka Harbor, 27 m (Rathbun, 1904). BRITISH COLUMBIA, CANADA: Gulf of Georgia, 123 m, *Albatross* Sta. 2863 (Rathbun, 1904). WASHINGTON, USA: Strait of Juan de Fuca, 97 m, *Albatross* Sta. 3460; Bellingham Bay, 20 m, *Albatross* Sta. 3612; off Destruction Island, 59 m, *Albatross* Sta. 2869; off Grays Harbor, 88–106 m, *Albatross* Sta. 2870 and 3046–3048 (Rathbun, 1904). Presidents Channel, Puget Sound, 192 m (Word & Charwat, 1976). OREGON, USA: Off Columbia River, 124 m, *Albatross* Sta. 2882; off Oregon 69–141 m, *Albatross* Sta. 3057–3059 (Rathbun, 1904). CALIFORNIA, USA: Off Point Arena (39°00′N, 123°49′W), 93 m, *Albatross* Sta. 3351 (Rathbun, 1904).

Material examined.—CALIFORNIA, USA: Monterey Bay, 128 m, 3 September 1931, collected by G. E. MacGinitie, CAS 013428; Santa Monica Bay (33°58′N, 118°36′W), 183–186 m, 28 July 1958, 6 specimens, AHF 892-02 (*fide* M. Wicksten).

Remarks.—All of the specimens recorded here were collected south of the previous range record; the Santa Monica Bay locality is 3°58′ in latitude south of Point Arena.

Family Crangonidae

Crangon (*Crangon*) *handi* Kuris & Carlton, 1977

Crangon handi Kuris & Carlton, 1977:543, figs. 1–2.

Previous records.—BAJA CALIFORNIA, MEXICO: Bahía Colnett (Kuris and Carlton, 1977). CALIFORNIA, USA: Off Shell Beach, Sonoma County (38°25′N, 123°6′W), and off other localities in southern Sonoma, Santa Cruz, Monterey, San Luis Obispo, and Orange Counties, including the Channel Islands, intertidal to 55 m (Kuris and Carlton, 1977).

Material examined.—OREGON, USA: North Cove, Cape Arago (43°29′N, 124°24′W), 17 August 1978, 1 juvenile specimen, CAS 019053.

Remarks.—This specimen extends the known northern range of this species by 5°04′ of latitude and represents the first record from Oregon.

Discussion

This paper adds new range records and occurrences to our knowledge of shrimp distributions in the northeastern Pacific. Among the species studied here, the distributions of *Pontonia californiensis* and *Heptacarpus brachydactylus* are based on only a few locality records (four and three, respectively). The northern range limit is imperfectly known for *Crangon handi,* and possibly for *Heptacarpus decorus.* The southern range limits of *Synalpheus lockingtoni, Heptacarpus decorus, Lysmata californica,* and *Spirontocaris lamellicornis* are even less well documented. A more comprehensive review of shrimp biogeography would seem to require new collections and further study of existing museum holdings.

The most intriguing general pattern to emerge from this study concerns the five species having new northern range records in California: *Penaeus californiensis, Pontonia californiensis, Synalpheus lockingtoni, Heptacarpus brachydactylus,* and *Lysmata californica.* Previously, these species have been recorded mainly or entirely from localities south of Point Conception, California. It is now apparent that they sometimes occur in central California.

The records for these shrimps could represent previously unreported localities within their "normal" ranges. However, it is perhaps more likely that they reflect temporary range expansions, especially for the better-known species. If so, these shrimps were probably not members of reproducing northern populations. Instead, it is likely that they were migrants from southern California which were transported to the north as larvae.

The *Penaeus californiensis* specimens, for example, may have belonged to a single larval cohort, since they were all about the same size (except for sexual differences). They were also large enough to be several years old. Surface water temperatures taken at the Bodega Marine Laboratory show a warm period in the winter of 1976–1977. In that year temperatures averaged 12.5°C from November to February, while a ten year mean for these same months was only 11.1°C. The *Penaeus* could have been recruited to central California during this period.

The Davidson Current would seem to be the most likely larval transport mechanism for these temporary range expansions. This northward flowing surface current appears inshore and parallel to the southward flowing California Current in the winter (Pirie, *et al.,* 1975). It brings relatively warm, high salinity water close to shore and has been detected from Baja California to Vancouver Island. The strength of this current and the temperature of its water exhibit considerable variability, both within and between seasons. In central California, unusually warm winters have occurred in, but were not restricted to, the following years: 1858–59, 1925–26, 1929–31, 1936–37, 1940–41, 1957–60, 1969–70, 1976–77 (Skogsberg, 1936; Skogsberg and Phelps, 1946; Hubbs, 1948; Bolin and Abbott, 1963; Standing, personal observations). Hydrographic conditions that are favorable to temporary northern range expansions seem to occur at intervals of about five to ten years, sometimes recurring in consecutive years.

For most of these warm winters, there are crustacean examples of northern range expansions. The galatheid *Pleuroncodes planipes* was recorded at localities to the north of its usual range off southern Baja California in 1859, 1941, 1957, 1959, and 1960 (Radovich, 1961), extending as far as San Francisco at least once (Holmes, 1900). In 1957–58 the euphausiids *Nyctiphanes simplex* and *Euphausia eximia* were collected north of their previously recorded ranges (Brinton, 1960). The former species is usually found south of Point Conception but was taken at Cape Mendocino in April 1958. The spiny lobster *Panulirus inflatus* is normally distributed in the Gulf of California and north to Magdalena Bay. However, specimens were collected at Guadalupe Island in 1948 and off San Diego in 1961 and 1962, perhaps arriving as larval recruits during warm periods (Fitch, 1962, 1963). Very extensive but temporary range expansions also include those for the hippid *Emerita analoga* and the portunid *Euphylax dovi*. The former species was recorded from Kodiak Island, Alaska in 1903 and from Vancouver Island, British Columbia in 1969 (Butler, 1959; Efford, 1969). The latter species has been collected in Santa Monica Bay and Monterey Bay (Word, 1976; Chivers, 1979). Zinsmeister (1974) gives examples of the same phenomenon for some mollusc species.

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DESCRIPTION OF THREE NEW SPECIES OF SHRIMPS (CRUSTACEA: DECAPODA: CARIDEA) FROM PACIFIC ISLANDS

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Abstract.—Descriptions of *Discias musicus* from the Marianas Islands, *Periclimenes bayeri* from the Marshall Islands, and *Pontonia hurii* from the Marshall and Tuamotu islands are provided for what were previously *nomina nuda*.

In 1952 and 1953 a study of Pacific Decapod Crustacea was carried out under the auspices of the Pacific Science Board of the National Research Council of the United States. I was stationed then at the United States National Museum (now National Museum of Natural History), where I enjoyed the hospitality of Dr. Fenner A. Chace, Jr. at the Department of Invertebrate Zoology. The study resulted in a preliminary list of the specimens examined (Holthuis, 1953), but a fuller account has not yet been published, although the manuscript for it was practically finished. Through some oversight, in the list that was published in 1953 four undescribed species were mentioned under a manuscript name (*Discias musicus,* on p. 52; *Rhynchocinetes hiatti,* on p. 54; *Periclimenes* (*Harpilius*) *bayeri,* on p. 56; and *Pontonia hurii,* on p. 57). In a few instances these names have been cited in later literature, but only one has been legalized through the publication of a description and figures, namely *Rhynchocinetes hiatti,* which has been extensively dealt with by Holthuis and Hayashi (1967). The other three names are still *nomina nuda,* an undesirable state of affairs which will be terminated by the publication of the present paper that contains their descriptions. The descriptions and discussions are taken from the original manuscript, but some effort has been made to bring the discussion up to date.

It is a pleasure to express, although belatedly, my thanks to the Pacific Science Board for financially enabling me to work at the U.S. National Museum, and to my colleagues at the Museum for their kind help and advice, and for all they did to make my stay such a thoroughly enjoyable one.

Discias musicus, new species

Discias musicus Holthuis, 1953:52 (*nomen nudum*).
Discias n. sp. Cloud, 1959:436.

Material examined.—Lagoon West of Saipan, Marianas Islands; immediately shoreward of barrier reef flat; Location C-7a; 10 April 1949; leg. Preston E. Cloud, Jr.—1 specimen, total length 9 mm.

Description.—The rostrum is short and fails to reach the end of the first segment of the antennular peduncle. In dorsal view it is rather broad. The apex is broadly rounded with a minute tooth at the tip. The lateral margins in their distal part are almost parallel, proximally they diverge and merge with the orbital margin. No spinules are observed on the rostrum. The lateral margins of the rostrum are somewhat upturned and there is a distinct median longitudinal carina over the dorsal surface. This carina is highest in the basal part of the rostrum. The carapace is smooth and bears a rather small antennal spine on the lower orbital margin.

The abdomen strongly resembles that of *Discias exul* Kemp, 1920, as figured in the original publication. The telson bears 2 pairs of dorsal spines, which are well developed. The anterior pair stands somewhat in advance of the middle of the telson. The posterior pair is placed slightly closer to the posterior margin of the telson than to the anterior spines. The posterior margin is rounded and bears 3 pairs of spines, the intermediate of which is longest.

The eyes are short and broad. The cornea is broadly rounded and has about the same length and breadth as the stalk.

The antennular peduncle has the stylocerite short and rather broad. It reaches somewhat beyond the middle of the basal segment, but largely fails to reach the end of this segment. The apex is rounded but ends in a minute sharp point. The second segment of the peduncle is shorter than the third. Both segments together are shorter than the first. The 2 flagella are simple, the outer has the basal part thickened.

The scaphocerite reaches somewhat beyond the antennular peduncle. It is almost 3 times as long as broad. The top is truncate, both lateral margins are convex. The outer is naked and does not end in a spine. The antennal peduncle reaches somewhat beyond the middle of the scaphocerite, but fails to reach the end of the antennular peduncle. No spines are present on the antennal peduncle.

The mandible lacks a palp. The incisor process ends in 2 small teeth. The molar process is longer and more slender than the incisor process. It ends in a sharp point and bears a row of spinules along the lower margin. The other oral parts show no appreciable differences from those described by Kemp (1920) for *Discias exul*. The first maxilliped has the exopod reduced, the caridean lobe is well developed but the exopod itself shows only as a short and blunt lobule. The last segment of the third maxilliped is not as strongly broadened as in *Discias exul* or *D. serratirostris* Lebour and has more the shape of that of *D. atlanticus* Gurney. The exopod reaches slightly beyond the end of the antepenultimate segment of the maxilliped. The branchial formula is as in *D. exul*.

The first pereiopod strongly resembles that of *D. exul* and other species of *Discias*. The shape of the fingers is highly specialized. The dactylus is

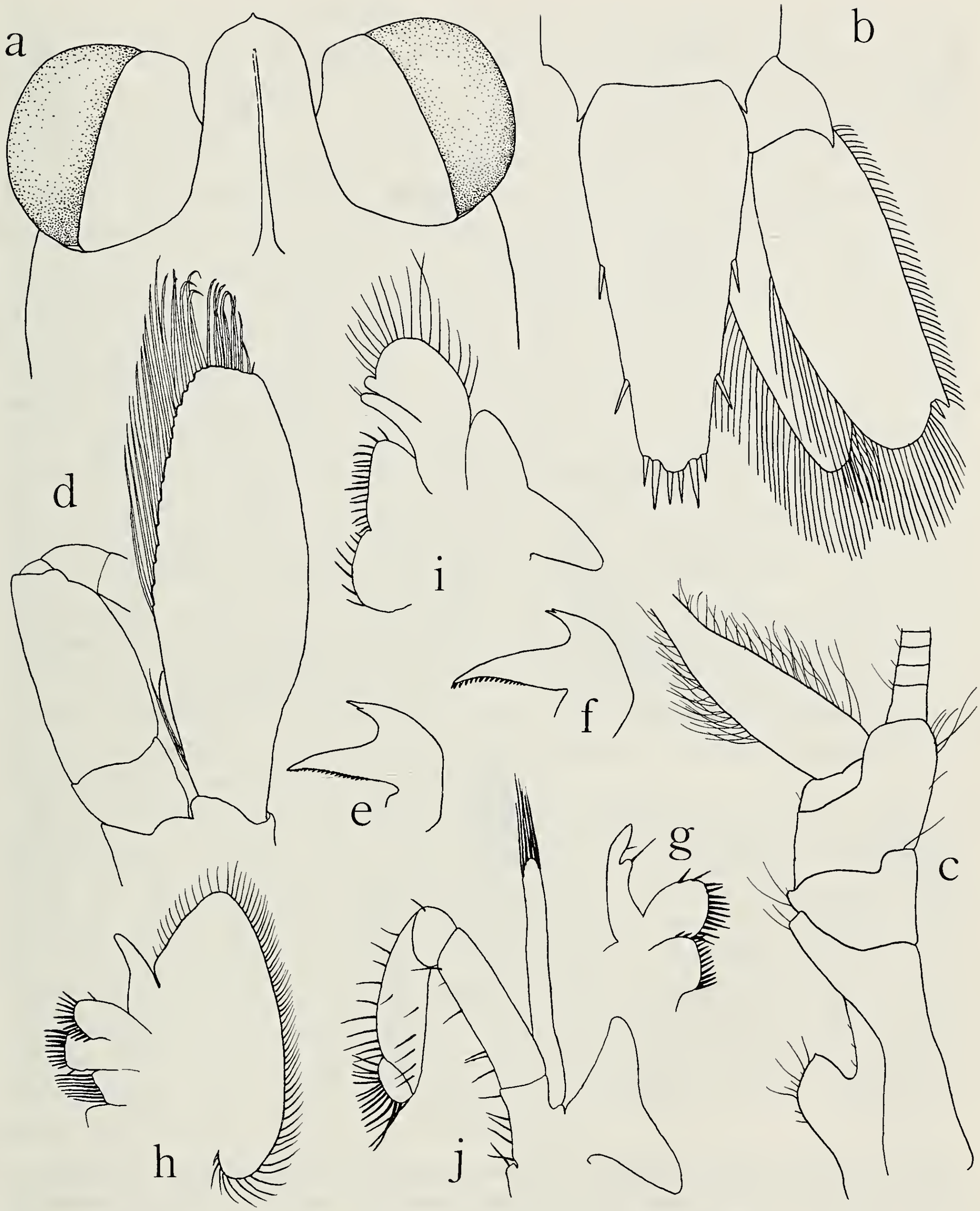

Fig. 1. *Discias musicus,* holotype: a, Rostrum and eyes, dorsal view; b, Telson and uropods; c, Antennula; d, Antenna; e, Left mandible; f, Right mandible; g, Maxillula; h, Maxilla; i, First maxilliped; j, Second maxilliped. a, c, d, g–j, ×40; b, ×30; e, f, ×65.

about semicircular, thin and hollowed out on the inside, being saucer-shaped as described by Kemp for *D. exul.* Its lower margin is minutely crenulate and the teeth continue in narrow striae which run inward from the margin of the dactylus and are placed perpendicular to this margin. The fixed finger

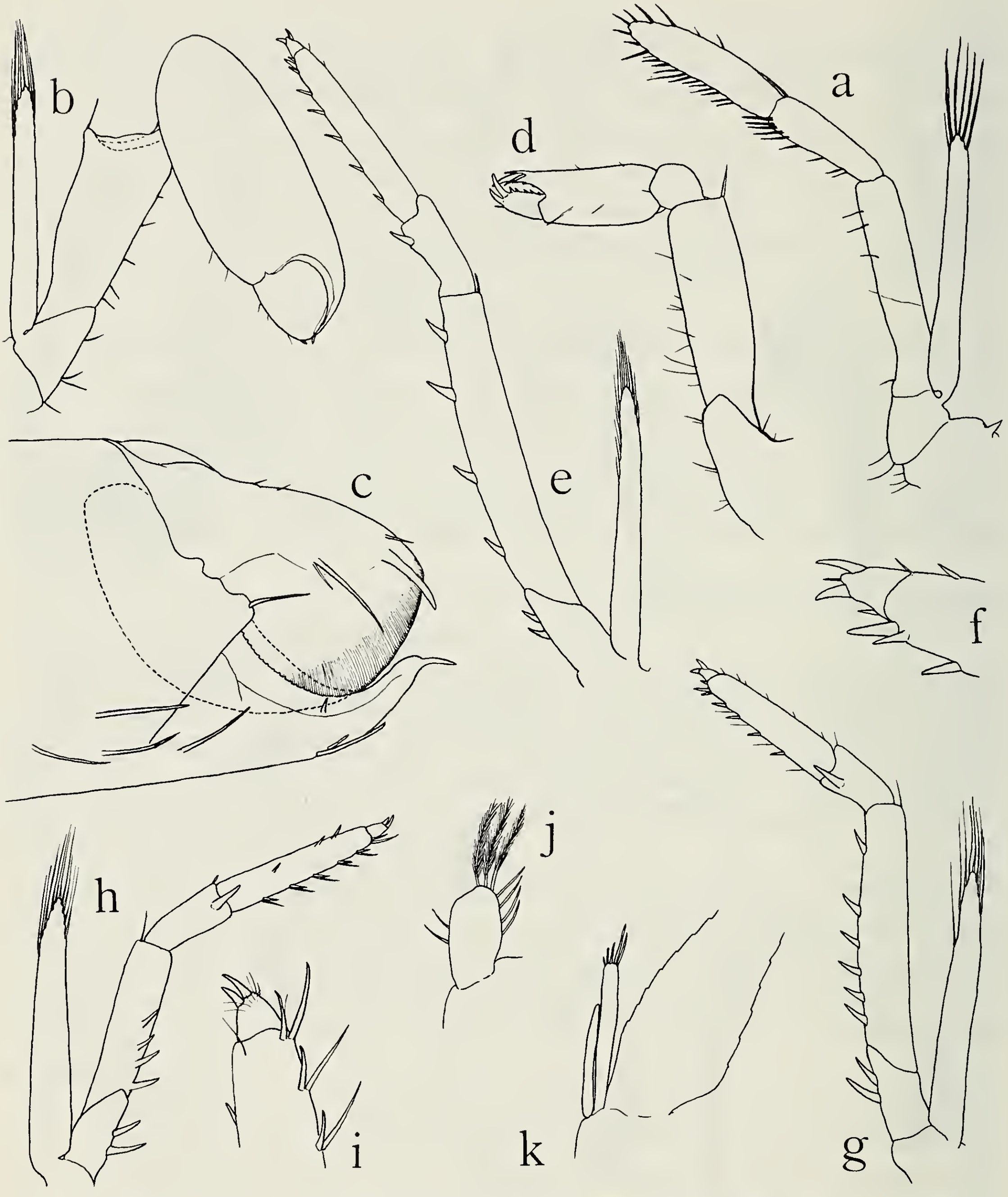

Fig. 2. *Discias musicus*, holotype: a, Third maxilliped; b, First pereiopod; c, Fingers of first pereiopod; d, Second pereiopod; e, Third pereiopod; f, Dactylus of third pereiopod; g, Fourth pereiopod; h, Fifth pereiopod; i, Dactylus of fifth pereiopod; j, First pleopod, endopod; k, Second pleopod, base of endopod. a, b, d, e, g, h, ×30; c, f, i, ×100; j, k, ×50.

is boat-shaped: being deeply channelled for the reception of the dactylus. The inner margin of the fixed finger bears denticles which are placed at rather regular intervals. When examining the chela under a microscope it shows that the lower margin of the dactylus and the inner margin of the fixed finger lie in the same plane, as they come into focus at the same time.

Therefore it seems that with the opening and closing of the chela the lower margin of the dactylus rubs against the inner margin of the fixed finger; as the margin of the dactylus is ribbed and that of the fixed finger is denticulate, the chela probably acts as a kind of stridulating organ, which might explain the function of this peculiarly shaped chela. The outer margin of the fixed finger is not denticulate, but straight. The second pereiopod resembles that of *D. exul.* The dactylus is about half as long as the palm, it ends in 2 heavy claws and has the cutting edge provided with a row of spinules. On the fixed finger some strong spines are present. The carpus is short and almost spherical, it is about ⅓ as long as the chela. The merus is somewhat longer than the chela and carpus combined. It bears a strong spine at the anterodorsal angle. Of the following pereiopods the third pair is longest. The dactylus is short and ends in 2 strong claws. The propodus is about 8 times as long as the dactylus and bears a row of well developed spines on its posterior margin. The carpus is about half as long as the propodus and bears a very strong spine in the distal part of its posterior margin. The merus is as long as the distal 3 segments combined. Its posterior margin bears four very strong spines. The ischium bears 2 posterior spines. The fourth pereiopod has a shape similar to that of the third leg, though it is shorter and more robust. The fifth leg differs from the previous two in having the claws of the dactylus curved anteriorly. The propodus bears, apart from the usual posterior spines, some spines on the rest of the surface. The carpus, merus, and ischium are armed as in the previous 2 legs.

The first pleopod of the holotype, a male, has the endopod small and quadrangular in outline. The inner margin bears 2, the outer 4 non-plumose setae. On the top of this endopod there are 3 plumose setae. The second pleopod has the endopod provided with both an appendix interna and an appendix masculina; the latter is longer than the former and bears some spine-like hairs on the top. The third to fifth pleopods have the endopod provided with an appendix interna. The uropods are elongate. The exopod has the outer margin straight, this margin bears a row of short hairs over its entire length, there are no serrations. The margin ends in a tooth at the inner side of which there is a movable spine.

Remarks.—Of the genus *Discias* until now 5 species were known: *Discias serrifer* Rathbun, 1904, the type of the genus, from the Galapagos Islands (from coral reef) and Juan Fernandez (from calcareous algae, 30–40 m deep); *Discias exul* Kemp, 1920, from the Andaman Islands, and Heron Island of the Great Barrier Reef of Australia (in both localities with sponges in shallow water); *Discias atlanticus* Gurney, 1939, from Bermuda (shallow water), east coast of Florida (33 m), Guadeloupe (15–20 m), West Africa (40 and 50 m), the Red Sea (depth unknown), and Kenya (200 m); *Discias serratirostris* Lebour, 1949, from Bermuda (30 m), and the east coast of Florida (27 m); and *Discias mvitae* Bruce, 1976, from Kenya (1 m deep). The present new species differs from the above 5 species (1) by having the rostrum without serrate margins, (2) by lacking the mandibular palp, (3) by the very short dactyli of the last 3 pereiopods, which end into 2 claws.

In the shape of the rostrum *Discias musicus* shows most resemblance to *Discias serrifer* and *D. atlanticus*. In *D. serratirostris, D. exul,* and *D. mvitae* it is triangularly pointed. *Discias serrifer* differs from the new species in having the outer margin of the uropodal exopods serrate. In *D. atlanticus* the telson has the posterior margin ending in a sharp point. *Discias mvitae* is at once distinguished by the presence of a posteromedian tooth on the second abdominal somite. *Discias exul,* the only other Indo-West Pacific species of the genus, is closely related to *D. musicus*. Apart from the difference in the shape of the rostrum, and the other differences mentioned in the description, *D. exul* seems to have no spine on the carpus of the last 3 pereiopods, at least such spines are neither mentioned nor figured by Kemp (1920); furthermore the number of spines on the propodi of the last 3 legs is greater in *D. musicus* than in *D. exul.* The stridulating organ, from which the specific name for the present species is derived, probably also is present in the other species of this genus.

Apart from the listing of the species in my 1953 enumeration, the species, as *Discias* n. sp., has also been mentioned by Preston E. Cloud in his account of the shoal-water ecology of Saipan. Cloud's record is based on the type of *D. musicus* of which he was the collector.

Periclimenes bayeri, new species

Periclimenes (*Harpilius*) *bayeri* Holthuis, 1953:56 (*nomen nudum*).
Periclimenes bayeri Bruce, 1972:403 (*nomen nudum*).

Material examined.—Polim reef flat next to Tipongowakaram Pass in Ship Pass, Kapingamarangi Atoll, 1°2′0″N, 154°45′14″E; 12 August 1954; George Vanderbilt Foundation Expedition, no. 137.—14 specimens, total length 13–19 mm (including 1 ovigerous female, 19 mm).

Latoback Island, Rongerik Atoll, Marshall Islands; lagoon reef; 20 and 21 August 1947; F. M. Bayer no. 257, 273.—2 ovigerous females total length 19 and 20 mm.

Ine village, Arno Atoll, Marshall Islands; sea reef; June–September 1950; R. W. Hiatt no. E.1-207.—1 specimen total length 14 mm.

Ine village, Arno Atoll, Marshall Islands; outer edge of sea reef; from head of *Pocillopora* spec.; June–September 1950; R. W. Hiatt no. E.1-634.—1 specimen total length 14 mm.

Description.—The rostrum is long and reaches to or somewhat beyond the scaphocerite. The proximal part of the rostrum is deep, the ultimate half is slender and directed upwards. The upper margin bears 7 or 8 teeth, the first of which is smaller than the rest and is placed behind the orbit. The second tooth stands over or just behind the orbit. The teeth are regularly distributed over the rostrum. The lower margin of the rostrum bears 3 to 5, usually 4 teeth. The ultimate part of the lower margin is devoid of teeth. The midrib of the rostrum merges with the posterior orbital margin and there is no postorbital ridge. The lower orbital angle is somewhat produced and has the tip rounded. The antennal spine is placed some distance below this angle and somewhat behind the anterior margin of the carapace. The hepatic spine is slightly larger than the antennal, it is placed behind and below the antennal spine. The anterolateral angle of the carpace is rectangularly rounded.

The pleura of the abdominal segments are rounded, those of the first 3 are more broadly rounded than those of the fourth and fifth segment. The pleura of the sixth segment end in an acute angle, the posterolateral angle is produced into a sharp point. The telson is about as long as the fifth and sixth abdominal segments combined. The anterior of the 2 dorsal pairs of spines lies in the middle of the telson, the posterior pair is placed about midway between the anterior pair and the posterior margin of the telson. This posterior margin is broad and rounded. Of the 6 pairs of posterior spines, the intermediate are longest, the submedian are slightly shorter and more slender, while the outer spines are slightly less than half as long as the intermediate.

The eyes have the cornea rounded and distinctly shorter than the eyestalk.

The stylocerite is slender and pointed, it reaches beyond the middle of the basal segment of the antennular peduncle. The anterolateral spine of this segment is strong and overreaches the second segment. The second peduncular segment is about as long as and broader than the third. The fused part of the upper antennular flagellum consists of 14 to 19 articles. The free part of the shorter ramus is very short and has 2 or 3 articles.

The scaphocerite reaches with somewhat less than half its length beyond the antennular peduncle. The outer margin is slightly concave and ends in a strong final tooth, which far overreaches the lamella. The lamella is broadest in the proximal part and gradually narrows towards the truncate top. A distinct spine is placed in the outer part of the antennal peduncle near the base of the scaphocerite. The antennal peduncle fails by far to reach the middle of the scaphocerite.

The mouthparts are of the usual shape. The incisor process of the mandible ends in 3 teeth, the outer of which are broad and blunt. The maxillula has both upper and lower lacinia slender and the palp is bilobed. The endite of the maxilla is simple. The first maxilliped has the endites of coxa and basis separated by a deep notch, the palp is not large but distinct, the caridean lobe is small and the epipod is hardly bilobed. The second maxilliped is normal in shape, it bears an epipod, but no podobranch could be found. The third maxilliped is slender, it reaches about to the end of the

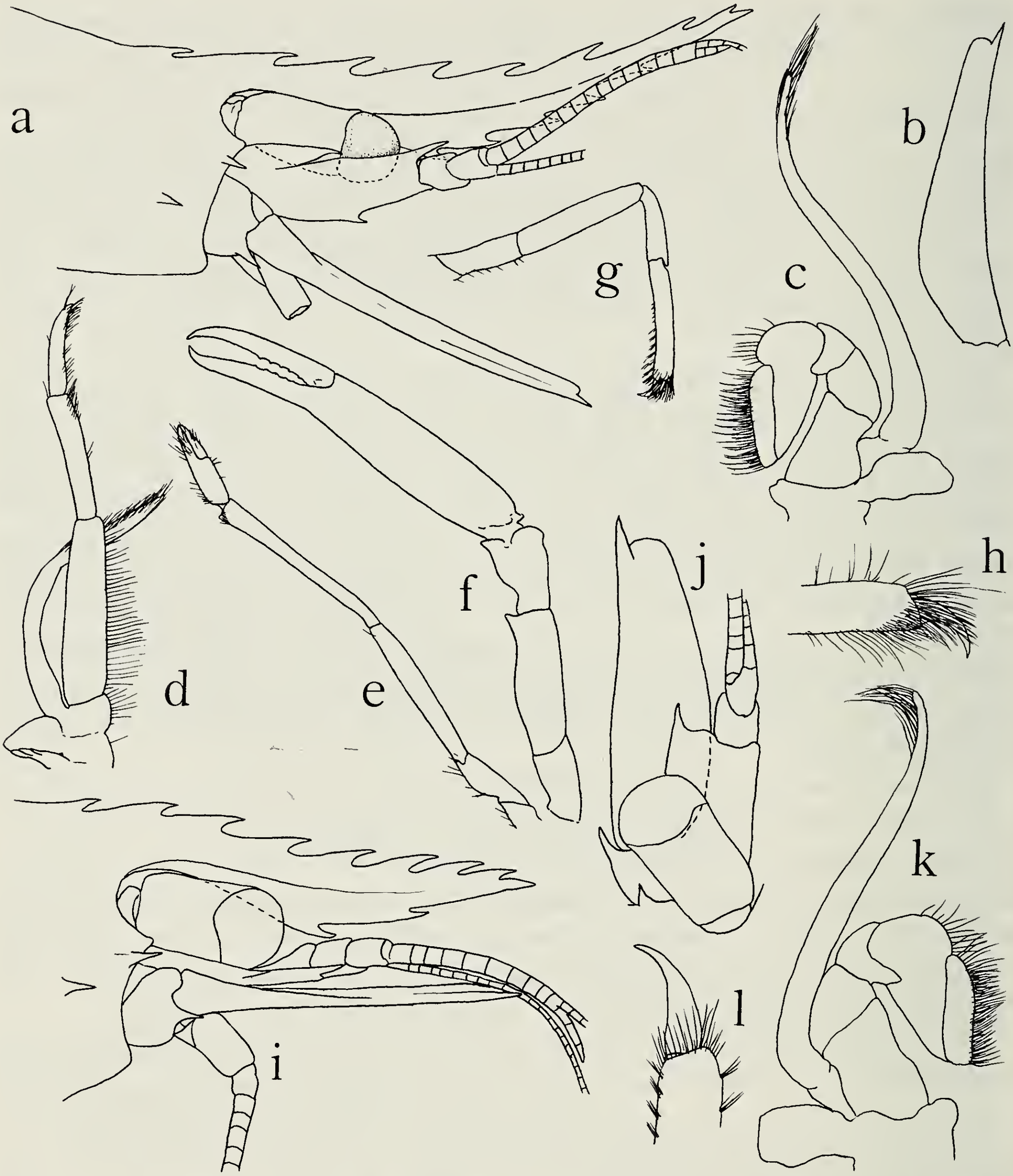

Fig. 3. a–h, *Periclimenes bayeri*: a, Anterior part of body in lateral view; b, Scaphocerite; c, Second maxilliped; d, Third maxilliped; e, First pereiopod; f, Second pereiopod; g, Fifth pereiopod; h, Dactylus of third pereiopod. a, b, d–g, Holotype from Arno Atoll (Hiatt, no. E 1-634); c, h, Paratype from Kapingamarangi. i–l, *Periclimenes consobrinus*, syntype from Ternate: i, Anterior part of body in lateral view; j, Eye, antennula and antenna in dorsal view; k, Second maxilliped; l, Dactylus of fifth pereiopod. a, d, ×15; b, e, ×10; c, h, k, l, ×25; f, ×6; g, ×7; i, j, ×12.

antennal peduncle. The last segment is slightly more than ⅔ the length of the penultimate and it is half as long as the antepenultimate segment. The exopod reaches far beyond the antepenultimate segment. An arthrobranch is present.

The first pereiopod reaches with the chela beyond the scaphocerite. The fingers are slightly shorter than the palm. The carpus is fully twice as long as the chela and is distinctly longer than the merus. The second pereiopods reach with the larger part of the chela beyond the scaphocerite. The fingers are about ⅔ of the length of the palm. Their cutting edges bear about 5 to 7 small teeth in the proximal half; the ultimate half is entire. The palm is cylindrical and slightly swollen. The carpus is short and conical, it is less than half as long as the palm. The merus is slightly longer to 1.5 times as long as the carpus, and is swollen in the middle. The anterior margin bears a spine on the lower outer and a rounded tooth on the lower inner side. No spines are present on the short ischium. The last 3 legs are very similar. The third reaches about to the end of the scaphocerite. The dactylus is simple, short and strongly curved. It is largely concealed by long hairs that are implanted on the distal margin of the propodus. The propodus is about 4 times as long as the dactylus and about 1.5 times as long as the carpus. The posterior margin bears hairs. The merus is longer than the propodus.

The pleopods of the females are normal. The uropods are ovate. The outer margin of the exopod ends in a tooth, which at its inner side is provided with a distinct movable spine.

The eggs are numerous and rather small, being 0.5 to 0.6 mm in diameter.

Remarks.—The species is most closely related to *Periclimenes lutescens* (Dana) and to *P. consobrinus* (De Man), resembling both in the general shape of the legs and body. Both *P. bayeri* and *P. consobrinus* can be distinguished from *P. lutescens* (1) by the shape of the second maxilliped, the medial border of the last and penultimate segments of which do not form a single line as in *P. lutescens,* in which also the last segment is far more elongate (see Bruce, 1972:411, fig. 1), and (2) by the total absence of a postorbital ridge; this ridge is very distinct in *P. lutescens* (see, e.g. Kemp, 1922:235, fig. 72) and not shown in the 2 other species (see Figs. 3a and 3i of the present paper).

In *P. consobrinus* the new species finds its closest ally. The differences between the two are in the following points:

1. In *P. consobrinus* the rostrum is less slender distally and more straight; its lower margin bears 1 or 2 (seldom 3) teeth (cf. Figs. 3a and 3i).
2. In *P. consobrinus* the scaphocerite is wider, with the outer margin less concave (cf. Figs. 3b and 3j).
3. The dactyli of the last 3 pereiopods in *P. consobrinus* are less strongly curved; they are more clearly visible as the hairs in the distal part of the propodus are shorter (reaching at most to the middle of the dactylus) and much less dense (cf. Figs. 3h and 3l).

For comparison with the new species the following material of *P. consobrinus* has been consulted:

1. A syntype from Ternate, coll. W. Kükenthal, in the "De Man collection" of the Zoological Museum, Amsterdam.

2. An ovigerous female from Amboina, 4 specimens from Beo, Talaud Islands, and an ovigerous female from Ternate, all collected by the Snellius Expedition and at present preserved in the collection of the Rijksmuseum van Natuurlijke Historie, Leiden. These specimens have been incorrectly identified by myself as *Periclimenes lutescens* in 1952 (Holthuis, 1952:89). The Snellius specimens from Kera near Timor and from Ake Selaka, Halmahera also mentioned by me in 1952 as *Periclimenes lutescens* proved to be correctly identified.

It was Bruce (1972:412, fig.1; 1975a:26, 27, figs.15, 16; 1976:10; 1978:118, 132) who first pointed out that *P. consobrinus* (De Man, 1902) is a good species, distinct from *P. lutescens* (Dana, 1852), after I had synonymized the two (Holthuis, 1952:88). Examination of the above mentioned syntype specimen of *Harpilius consobrinus* De Man in the Amsterdam Zoological Museum fully confirmed Bruce's views. Unfortunately the only morphological difference between the 2 species mentioned by Bruce is the shape of the second maxilliped, a feature which is very similar in *P. consobrinus* and *P. bayeri*. Therefore it seemed useful to mention here other characters in which *P. consobrinus* differs from *P. lutescens* and *P. bayeri*. As nothing is known about the color of living specimens of *P. bayeri* it is impossible to say whether in that respect it has more resemblance to *P. lutescens* or *P. consobrinus* (see the colored figures of these two species in Bruce, 1975a).

Host.—One of the type-specimens of *P. bayeri* from Arno Atoll is reported from *Pocillopora* sp., a madrepore genus that is also host to *P. consobrinus*.

Etymology.—It is a great pleasure to name this new species for Dr. Frederick M. Bayer of the Smithsonian Institution, who collected part of the type material, and also in other respects added considerably to the knowledge of Pacific and other Crustacea.

Pontonia hurii, new species

Pontonia hurii Holthuis, 1953:57; Wiens, 1962:275; Bruce, 1975:162 (*nomina nuda*).

Material examined.—Arno Atoll, Marshall Islands; from mantle cavity of rock clam, *Spondylus* spec.; June-September 1950; R. W. Hiatt no. E.2-389.—1 ovigerous female total length 22 mm.

Tepatahiti Island, Raroia Atoll, Tuamotu Islands; off patch reef in lagoon opposite island, 25–30 feet of water; from *Spondylus* spec.; 27 August 1952; J. P. E. Morrison no. 2227.—8 specimens, total length 17–27 mm (including 3 ovigerous females, 24–27 mm).

Description.—The rostrum almost reaches the end of the basal segment of the antennular peduncle. It is narrowly triangular in dorsal view, being

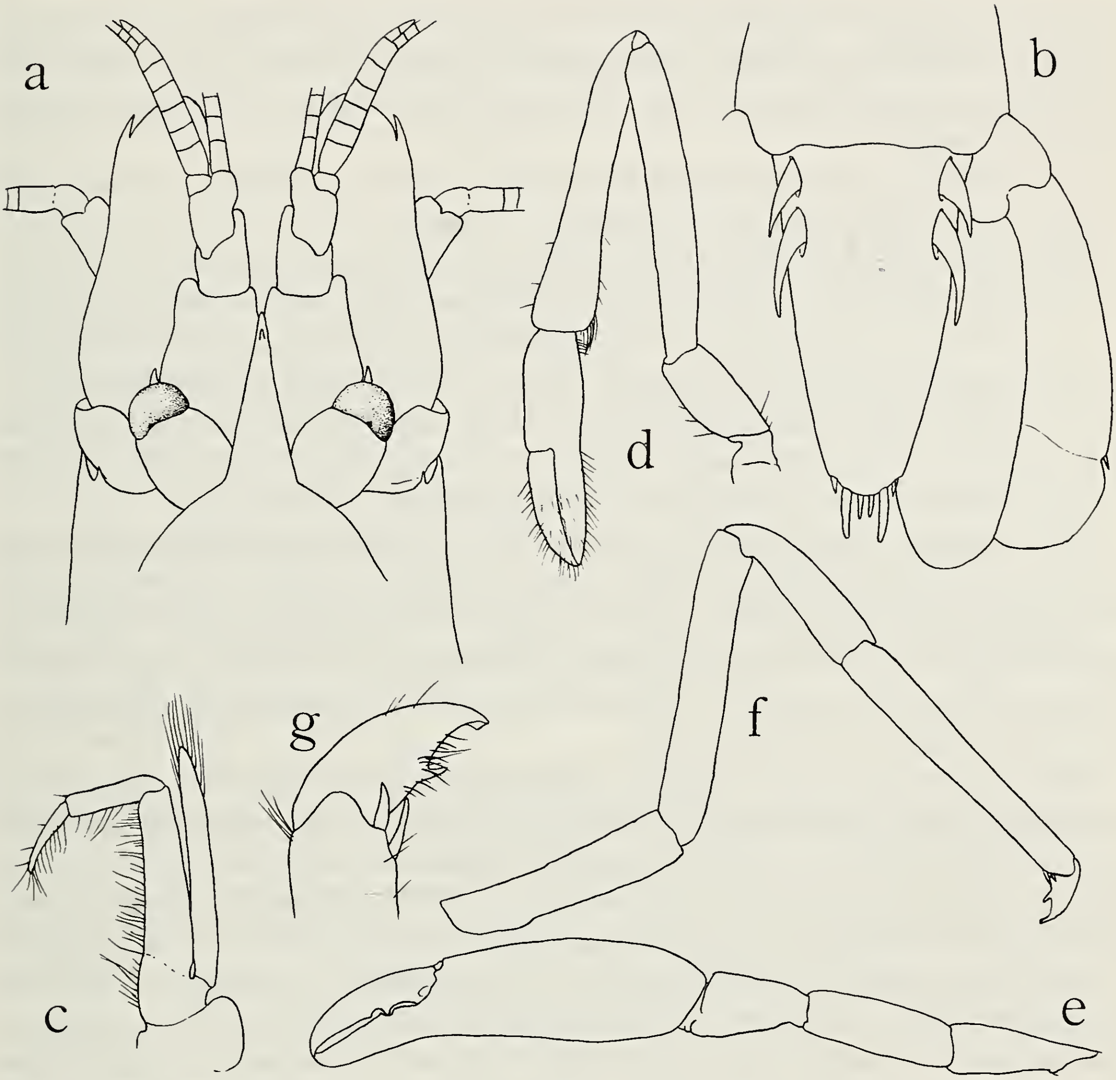

Fig. 4. *Pontonia hurii*: a, Anterior part of body in dorsal view; b, Telson and uropod; c, Third maxilliped; d, First pereiopod; e, Second pereiopod; f, Third pereiopod; g, Dactylus of third pereiopod. a–d, f, g, holotype; e, paratype from Raroia Atoll. a–d, f, ×12.5; e, ×5; g, ×40.

depressed at the base and compressed near the top. Just before the apex the dorsal margin of the rostrum bears a small but distinct tooth, which sometimes reaches almost as far as the top. No other teeth are present on the rostrum. The carapace bears a small but distinct antennal spine on the anterior margin.

The abdomen has all pleura rounded, also the posterolateral angle of the sixth abdominal segment is rounded. The sixth segment is slightly longer than the fifth. The telson is about as long as the fifth and sixth segments combined. The 2 pairs of dorsal spines are very strong and placed close together in the anterior third of the telson. The anterior spines reach beyond the base of the posterior, which reach about to the middle of the telson. The posterior margin of the telson bears the usual 3 pairs of spines. The intermediate of these are broad and truncate at the top, the inner spines are slender and much shorter, while the outer pair is again somewhat shorter than the inner.

The eyes have the cornea globular, and shorter and narrower than the stalk. A very small ocellus is present.

The basal segment of the antennular peduncle has the stylocerite short and blunt; it reaches to or slightly beyond the middle of the basal segment. The anterolateral angle of the basal segment is rounded and produced somewhat beyond the base of the second segment. The second and third segments are of about equal length and breadth, being narrower and shorter than the first segment. The outer flagellum of the antennula has the 2 rami fused for 5 to 7 segments, 2 or 3 segments of the shorter ramus are free.

The scaphocerite distinctly overreaches the antennular peduncle. It is about twice as long as broad. The outer margin is straight, slightly concave or slightly convex. The final tooth is rather small and is far overreached by the lamella. The antennal peduncle is slender and reaches as far forwards as the antennular peduncle. There are no spines on the antennal peduncle near the base of the scaphocerite.

The mandible is quite typical; the incisor process ends in 3 teeth. The maxillula has the lower lacinia slender, like that of the female of *Pontonia katoi* Kubo figured in my Siboga report (Holthuis, 1952:161, fig. 75c); the lower of the 2 lobes of the palp ends in a short upturned tooth-like point. The maxilla, the first and second maxilliped are as in *Pontonia pinnophylax* (Otto), except that the epipod of the first maxilliped is bilobed. The third maxilliped fails to reach the end of the basal segment of the antennular peduncle; it is slender. The penultimate segment is somewhat longer than the ultimate. The antepenultimate segment is rather narrow and is about as long as the 2 others combined. The exopod is large and reaches beyond the end of the antepenultimate segment.

The first pereiopod reaches with about half the carpus beyond the scaphocerite. The fingers are about as long as the palm. The carpus is somewhat less than half as long again as the chela and is about as long as the merus. The second legs are heavy and equal. They reach with the chela or part of the carpus beyond the scaphocerite. The fingers are more than half as long as the palm. They bear each 2 teeth in the proximal half of the cutting edge; those of the dactylus are placed slightly before those of the fixed finger. The teeth of the dactylus are rather sharp, the proximal is distinctly larger than the distal. The proximal tooth of the fixed finger is broad and crenulate, the distal tooth small and pointed. The palm is slightly swollen. The carpus is about $^2/_5$ of the length of the palm, it narrows proximally. The merus is about 1.5 times or less as long as the carpus and about as long as the ischium. The third leg reaches with about half the propodus beyond the scaphocerite. The dactylus is biunguiculate. The apex of the dactylus is transversely flattened and abruptly truncate, becoming thereby chisel-shaped. The second tooth of the dactylus is placed in the middle of the posterior margin. The propodus is more than 4 times as long as the dactylus; its posterior margin is unarmed except for 1 or 2 spines in the extreme distal part. The carpus is somewhat more than half as long as the propodus. The merus is about as long as the propodus and slightly longer than the ischium. The fourth and fifth legs are similar to the third. The fifth leg reaches just beyond the scaphocerite.

The endopod of the first pleopod of the male is of the usual shape, being elongate ovate with the inner margin somewhat concave slightly above the middle. The proximal ¾ of the inner margin bears only a few hairs, while the rest is thickly fringed with setae. In the second pleopod of the male the appendix masculina is somewhat shorter than the appendix interna. Appendices internae are present on the second to fifth pleopods in both sexes. The protopod of the uropod ends dorsally in a lobe. Both exo- and endopod are rather broad. The outer margin of the exopod ends in a short movable spine.

The eggs are numerous and small, 0.6 to 0.8 mm in diameter. The males are smaller than the females.

Remarks.—The present species differs from all known species of the genus in the possession of chisel-tipped dactyli of the last 3 pairs of pereiopods, while the arrangement of the spines on the dorsal surface of the telson also immediately distinguishes *P. hurii* from other *Pontonia* species; in the latter respect it comes closest to *P. medipacifica* Edmondson, a species which, however, can immediately be distinguished by its short rostrum.

Types.—The holotype is the specimen from Arno, the other specimens are paratypes. The holotype, which lacks both second legs, at first was the only specimen of this species available to me. I hesitated to describe a new species from this incomplete material and wanted additional material badly. It so happened that at that time Dr. J. P. E. Morrison was at the Tuamotu Islands with the 1952 Pacific Science Board Expedition. Through the kindness of Dr. Fenner A. Chace, Jr., Dr. Morrison was informed about my need for material of commensal shrimps from *Spondylus*. Dr. Morrison's efforts to secure material of *Spondylus* met with success when he received several specimens of this mollusk from Mr. Huri Estell of Raroia, Tuamotu Islands. These mollusks indeed contained commensal shrimps, which on examination in Washington proved to belong to the desired species. This probably is the first time that type-material was collected at request.

Etymology.—On Dr. Morrison's request the new species is named for Mr. Huri Estell in recognition of the invaluable help Mr. Estell has rendered the 1952 Tuamotu Expedition of the Pacific Science Board.

Host.—So far no species of *Pontonia* had been reported from *Spondylus*, most Indo-West Pacific species of the genus are commensals of Ascidians.

The only Indo-West Pacific Pontoniinae reported from *Spondylus* are *Paranchistus nobilii* Holthuis, 1952 (from *Spondylus gaederopus* L.) and *P. spondylis* Suzuki, 1971 (from *S. barbatus* Reeve).

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THE CLEPTINAE OF THE WESTERN HEMISPHERE (CHRYSIDIDAE: HYMENOPTERA)

Lynn Siri Kimsey

Abstract.—The Cleptinae of the Western Hemisphere are reviewed. Keys to species and redescriptions of species are presented for the genera *Cleptes* and *Cleptidea,* found in this region. Three new species, *fritzi, rufifemur,* and *rufigaster,* and a new subgenus *Neocleptes,* of *Cleptes* are described.

Cleptinae are the most primitive group in the Chrysididae. Members of this subfamily form a close link with the Bethylidae. There are only two genera, *Cleptes* and *Cleptidea,* in the Cleptinae and they share the following primitive characteristics: dentate tarsal claws, males with five visible abdominal segments, females with four, females with an unspecialized ovipositor tube consisting of segments V–VIII, and male genitalia with a pincerlike volsella. Cleptinae differ from bethylids by the lack of a true sting and two fewer visible abdominal segments.

This subfamily is often treated as a distinct family, Cleptidae. However, there are many characteristics which form close links to the rest of the Chrysididae. Cleptines have no true sting, only a tubular ovipositor, which characterizes chrysidids. The reduced wing venation and dentate tarsal claws are found also in the chrysidid subfamilies Elampinae, Amiseginae, and Loboscelidiinae, and the number of visible abdominal segments is the same in the latter two.

Cleptines can be distinguished by the medial facial groove, transverse pronotal groove, reduced wing venation: forewing with a short radial sector (RS stub) and weakly sclerotized cubital cell, tarsal claws with one subsidiary tooth, the abdomen ventrally convex with four external segments in the females and five in the males, an unspecialized robust ovipositor, and male genitalia with digitus forming an opposable lobe on the cuspis.

There is little recent literature on Cleptinae in the western hemisphere. Móczár (1962) discussed the placement of American *Cleptes* in various subgenera. In contrast *Cleptidea,* originally described by Mocsáry (1904), was most recently discussed by Ducke (1907).

The genus *Cleptes* is predominantly holarctic, whereas *Cleptidea* is neotropical. There is apparently no geographic overlap between these two genera. However, I have recently seen two male *Cleptes* from Argentina sent to me by Manfredo Fritz. These specimens are unlike any of the North American species and belong to the new subgenus *Neocleptes* described below.

For the sake of brevity the following abbreviations are used: MOD = midocellus diameter; F = flagellomere, as in F-I; T = tergum, as in T-I the first segment of the apparent abdomen.

Cleptidea Mocsáry, 1904

Type-species.—*Cleptes aurora* Smith.

Generic diagnosis.—Head much wider than long; eyes large and bulging (Fig. 7); midocellus as wide or wider than antennal socket; malar space about 1.0 MOD; pronotum with medial groove joining posterior foveate groove (Fig. 3); scutellum and metanotum strongly convex or produced in profile; propodeal teeth elongate and spinelike, three to four times as long as broad (Fig. 1); tarsal claws with subparallel tooth on apical half (Fig. 5); body with extensive white markings.

Discussion.—The large size of the ocelli suggests that *Cleptidea* may be primarily nocturnal or crepuscular. No host is known for any member of this genus but they may be parasitic on tenthredinoid sawflies as in *Cleptes*. The hosts may in fact be argid sawflies which are much commoner in the neotropics than tenthredinids.

Key to the Species of *Cleptidea*

1\. Head and abdomen without whitish markings 2
– Head and abdomen with whitish markings 3
2\. Propodeum blackish; forewing slightly tinted between two brown bands .... *fasciata* (Dalman)
– Propodeum orange; forewing yellow with one brown band on apical half .... *xanthomelas* (Mocsáry)
3\. Metanotum longer than broad apicomedially; body metallic green, blue, purple or blackish with whitish markings, and red if any restricted to scutellum 4
– Metanotum shorter than broad apicomedially; body blackish or brown and extensively red on thorax; with whitish markings 5
4\. Scutellum red .... *aurora* (Smith)
– Scutellum blue to black .... *magnifica* (Ducke)
5\. Metanotum convex in posterior view; F-II longer than wide and more than half as long as F-I; coxae bluish black without white markings; pronotum blackish .... *mutilloides* (Ducke)
– Metanotum emarginate in posterior view; F-II wider than long and less than one third as long as F-I; coxae with extensive whitish markings; pronotum reddish .... *buyssoni* (Ducke)

Cleptidea aurora (Smith)
Figs. 1, 3, 5, 7, 9

Cleptes aurora Smith, 1874:452. Holotype ♀; "Ega, Brazil" (BMNH).

Diagnosis.—Head metallic blue, except face with two large whitish marks along lower two thirds of ocular margins; thorax blue, except scutellum reddish and propodeal teeth apically whitish; coxae and femora whitish beneath and blue above; wings hyaline between two brown bands; T-I anteriorly whitish and posteriorly purple; rest of abdomen purple. Male pedicel over twice as long as wide; F-I about 2.5 times as long as wide; F-II about as long as wide or wider. Female pedicel 2.0–2.5 times as long as wide; F-I about 3.5 times as long as wide; F-II about as long as wide. Malar space about 1.5 MOD long; metanotal projection longer than wide and apical margin weakly emarginate (Fig. 3). Male genitalia (Fig. 9); cuspis foliaceous, outer surface covered with fine short setae; digitus smooth; paramere broadly lobate apically, ventral surface covered with fine short setae; aedeagus with subapical teeth and medial tuft of setae.

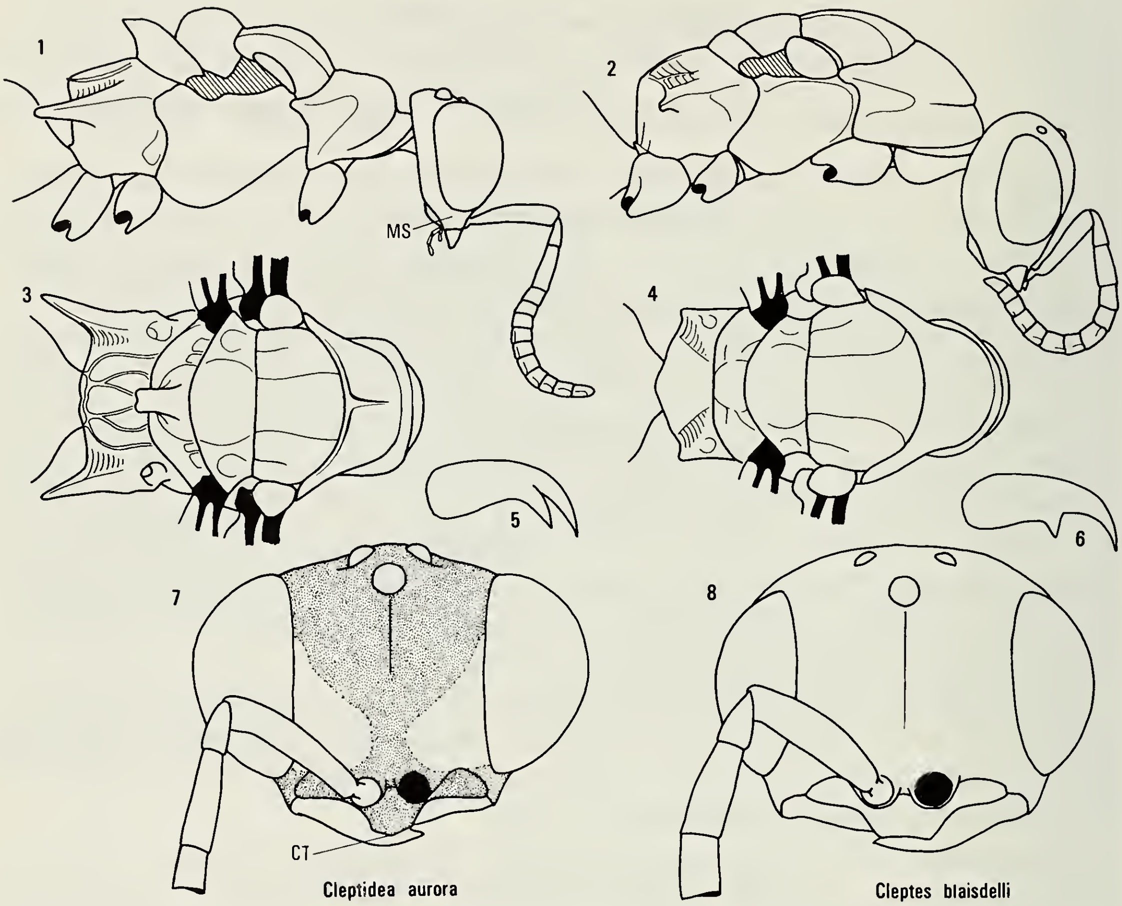
Distribution.—COLOMBIA: Putumayo, Mocoa; ECUADOR; BOLIVIA: Mapiri; BRAZIL: Pará; Faro and Obidos, Amazonas; Rio Tapura. Collection months were August, September, December and February. Seven males and five females were seen including the type.

Discussion.—This species very closely resembles *magnifica* and less closely *buyssoni*. All three appear to be more closely related to each other than to the other species in this genus, based on the strongly elevated scutum, scutellum and metanotum, and extensive blue and white maculation. *C. aurora* can be distinguished from *magnifica* by the red scutellum and from *buyssoni* by the metanotal process which is longer than wide.

Cleptidea buyssoni (Ducke)
Fig. 10

Cleptes buyssoni Ducke, 1905:100. Holotype ♂, "Oyapook" (Paris).

Diagnosis.—Head metallic blue, except face with two large whitish marks along lower two thirds of ocular margins; pronotum blue with whitish anterior rim and posterior fourth; scutum purplish; mesopleuron blue; scutellum and metanotum red; propodeum black, except apical half of teeth white; coxae and femora blue dorsally and whitish ventrally or basally; wings hyaline between two brown bands; T-I anteriorly whitish, posteriorly bluish black; T-II–III blackish with lateral white spot; T-IV (♀) or IV-V (♂) bluish black. Male pedicel less than twice as long as wide; F-I slightly less than three times as long as wide; T-II about 1.5 times longer than wide. Female pedicel twice as long as wide; F-I about three times as long as wide; F-II



Figs. 1–8. External morphology of cleptine genera, clypeal truncation (CT), malar space (MS). Figs. 1–2. Lateral view of thorax. Figs. 3–4. Thoracic dorsum. Figs. 5–6. Hindtarsal claw. Figs. 7–8. Front view of head.

slightly longer than wide. Malar space about 1.0 MOD long; metanotal projection posteriorly truncate, wider than long. Male genitalia (Fig. 10); cuspis foliaceous with basal patch of short curled setae; digitus covered with large dome-shaped sensillae; paramere curved and broad, almost reaching aedeagus in dorsal view; aedeagus capitate with a subapical cluster of teeth.

Distribution.—PANAMA: Canal Zone, Barro Colorado Island in June (R. Silberglied and A. Aiello) and July (L. S. Kimsey) and Balboa in April (M. L. Siri); BRAZIL: Pará, Oyapook in June (A. Ducke). Two males and four females were seen, including the type.

Discussion.—Closely related to *magnifica* and *aurora, buyssoni* can be distinguished by the extensive blue and white coloration and relatively low metanotal projection which is shorter than wide. The male genitalia of *buyssoni* resembles that of *aurora,* although it differs in having large domelike sensillae on the digitus, much shorter wavy setae on the cuspis, and no fine short setae covering the ventral surface of the paramere and cuspis.

Cleptidea fasciata (Dalman)

Cleptes fasciata Dalman, 1823:90. Holotype ♀; "Brasilia," (Stockholm?).

Diagnosis.—Head reddish, except face and mandibles black; thorax reddish, except propodeum black; coxae and femora orange; wings hyaline between two brown bands, one subbasal and one subapical; T-I yellowish to whitish; T-II blackish with large lateral whitish spot; T-III black, usually with small basolateral whitish spot; T-IV (♀) or IV–V (♂) blackish. Male pedical twice as long as wide; F-I slightly more than three times as long as wide; F-II about 1.5 times as long as wide. Female F-I length about three times width; F-II slightly longer than wide. Malar space about 1 MOD long; metanotal process posteriorly truncate and shorter than wide.

Distribution.—GUATEMALA: Yepocapa (June); PANAMA: Canal Zone, Balboa (June), Barro Colorado Island (July); PERU: Yurac 67 mi E Tingo Maria (December), Colonia Perene (Rio Perene) 18 m NE La Merced, Junin (January); BRAZIL: Santa Catarina, Nova Teutonia (October through March), Santerem; ARGENTINA: Horco Molle near Tucumán (April). Two males and 25 females were seen.

Discussion.—Although I have been unable to locate the type of *fasciata* the coloration as described by Dalman (1823) and Ducke (1907) is sufficient to distinguish it from other species of *Cleptidea*. This species is most closely related to *mutilloides* and *xanthomelas,* which are characterized by a relatively low metanotal projection and red and black coloration. *C. fasciata* can be distinguished from these two species by the black propodeum, two banded wings, and F-II longer than wide. All of the species of *Cleptidea* are relatively rare, but *fasciata* is the most commonly collected. Unfortunately neither of the males examined had intact genitalia.

Cleptidea magnifica (Ducke)

Fig. 11

Cleptes magnifica Ducke, 1905:99. Holotype ♂, "Oyapook" (Paris).

Diagnosis.—Head metallic blue, except face with two large whitish marks along lower two thirds of ocular margins; entire thorax blue, except apical half of propodeal teeth whitish; coxae blue dorsally, white ventrally; femora blue; wings hyaline between two brown bands; T-I anteriorly whitish, posteriorly purplish blue; rest of abdomen purplish blue. Male pedicel twice as long as broad; F-I three times as long as wide; F-II almost twice as long as broad; malar space over 1.5 MOD long; pronotum strongly bilobate; metanotal process. Female pedicel twice as long as wide, F-I length three times width, F-II 1.5 times as long as wide. Male genitalia (Fig. 11); cuspis apically capitate; digitus with long pointed lateral process; paramere apically expanded with weakly sclerotized lobe, not reaching aedeagus; aedeagus with single, elongate, subapical pointed lobe.

Distribution.—BRAZIL: Pará; Obidos in December (A. Ducke), Oyapook in June (A. Ducke); Amazonas; Tabatinga in October (A. Ducke). Two males and one female were seen, including the type.

Discussion.—A striking species, *magnifica* can be easily confused with *aurora.* These two species are readily separated by the all blue scutellum of *magnifica* versus the all red one of *aurora.* The genitalia of this species is unique in *Cleptidea*; the paramere and cuspis are somewhat capitate apically and the digitus has an elongate basomedial projection.

Cleptidea mutilloides (Ducke)
Fig. 12

Cleptes mutilloides Ducke, 1902:91. Lectotype ♂; Pará, Brazil (Paris), new designation.

Diagnosis.—Head bluish, except face with two large white marks along lower two thirds of ocular margins; pronotum blackish, except lobes yellowish; meso- and metathorax reddish orange dorsally and blackish ventrally; propodeum blackish, except apical half of teeth whitish; coxae brownish with blue highlights; femora bluish; wings clear with one submedial band. Male pedicel 1.5 times as long as wide; F-I three times as long as wide; F-II 1.5 times longer than wide. Malar space 1.0 MOD long; metanotal process weakly elevated, much wider than long. Male genitalia (Fig. 12); cuspis foliaceous with basal tuft of short setae; digitus covered with large dome-shaped sensillae; paramere broad, almost reaching aedeagus in dorsal view; aedeagus apically rounded with four to five stout apical spines.

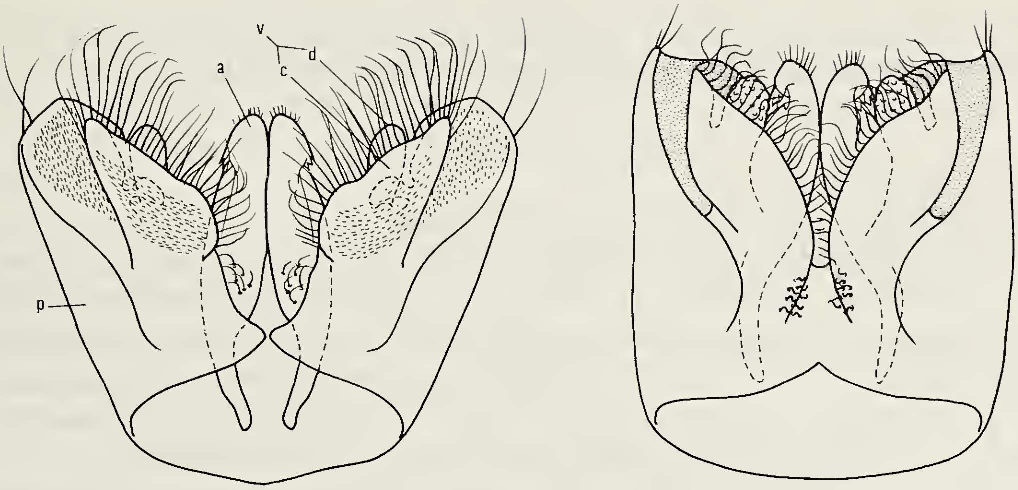
Distribution.—BRAZIL: Pará in February, March, May and October (A. Ducke), Faro in February (A. Ducke); ARGENTINA: Horco Molle near Tucumán in April (L. Stange). Seven males and ten females were seen, including the type.

Discussion.—*Cleptidea mutilloides* can be distinguished by the white marks on the face and abdomen, metanotal projection apically truncate and wider than long, and thorax red, except black pronotum. The genitalia is distinctive, the aedeagus has about four apical spines with no subapical teeth or lobe, and the digitus is covered with large domelike sensillae.

Cleptidea xanthomelas (Mocsáry)
Fig. 13

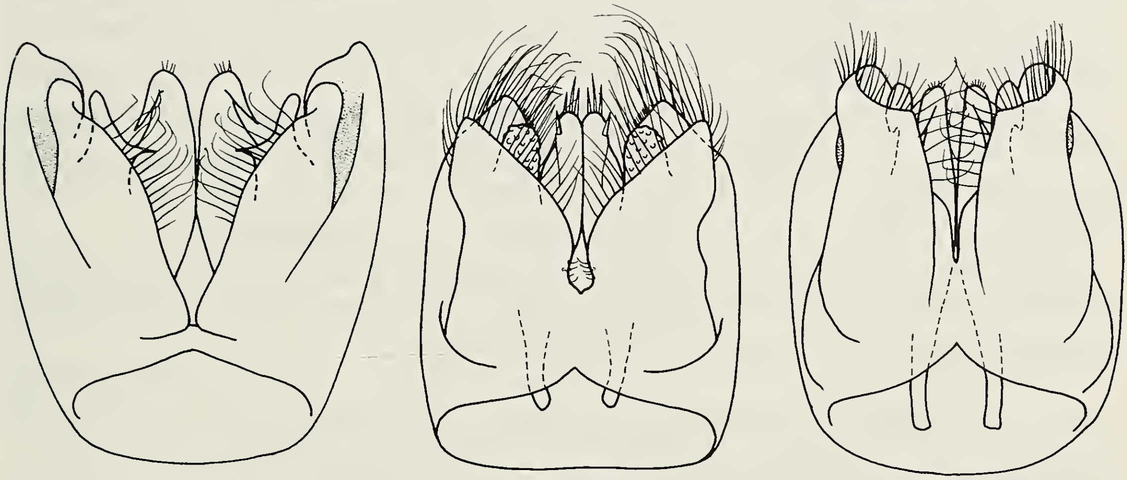
Cleptes xanthomelas Mocsáry, 1889:36. Lectotype ♀; Blumenau, Brazil (HMN), new designation.

Diagnosis.—Head black; entire thorax, except scutum black; coxae orange wings yellow with one, subapical brown band; T-I–IV or V reddish



9 aurora

10 buyssoni



11 magnifica

12 mutilloides

13 xanthomelas

Figs. 9–13. *Cleptidea,* male genital capsules; aedeagus (a), paramere (p), volsella (v), cuspis (c), digitus (d).

orange. Male pedicel 1.5 times as long as wide; F-I three times as long as wide; F-II as long as wide. Female pedicel twice as long as wide. F-I length three times width; F-II slightly longer than wide. Malar space 1.0 MOD long; metanotal process weakly produced, wider than long. Male genitalia (Fig. 13); cuspis strongly curved apically with obtuse angle near digitus; digitus subapically lobate; paramere apically curved and rounded, not reaching aedeagus; aedeagus with single, elongate, subapical pointed lobe.

Distribution.—COLOMBIA: Putamayo, Mocoa, August (M. Cooper); ECUADOR; BRAZIL (lectotype); BOLIVIA: Mapiri; MEXICO: Veracruz, Fortin de las Flores, July (Wasbauer and Slansky). One male and ten females were seen.

Discussion.—*C. xanthomelas* is the reddest species in the group containing *mutilloides* and *fasciata.* Additional diagnostic characteristics for this species are the yellow wings with a single brown band, and male genitalia with an elongate cuspis which protrudes beyond the paramere, hooked digitus and aedeagus with an elongate, pointed subapical lobe.

Cleptes Latreille, 1802

Type-species.—Sphex semiaurata Linnaeus.

Generic diagnosis.—Head about as wide as long or longer; eyes small and not bulging; midocellus as wide as or narrower than antennal socket; malar space usually longer than 1.0 MOD (Fig. 8); scutellum and metanotum weakly obtuse in profile, if at all (Fig. 2); propodeal teeth triangular, less than twice as long as broad (Fig. 4); tarsal claws with perpendicular submedial tooth (Fig. 6); body without extensive whitish markings.

Discussion.—Móczár (1962) divided the American *Cleptes* into two subgenera, *Leiocleptes* and *Melanocleptes*. Typical *Cleptes* is an Old World taxon but the introduction of *semiauratus* into New Jersey established the presence of this subgenus in North America. The two new species, *rufifemur* and *rufigaster*, have the reddish abdomen and pronotum with a foveate groove along the posterior margin characteristic of *Cleptes* s.s. These species show that typical *Cleptes* is holarctic. In addition there is a new subgenus, *Neocleptes*, found in Argentina, also described below.

North American *Cleptes* have been recorded as parasites of tenthredinoid sawflies. Females apparently gnaw a hole in the host cocoon and oviposit on the host pupa or prepupa (?) (Clausen 1940).

Key to the Subgenera and Species of *Cleptes*

1. Terga all green, blue, purple, black or dark brown 2
– Two or more terga reddish orange to yellow 5
2. Pronotum with elongate medial depression or groove along posterior margin (as in Fig. 22); head and thorax coarsely punctured, dorsum with punctures less than one puncture diameter apart (subgenus *Neocleptes* Kimsey) .... *fritzi* Kimsey
– Pronotum without elongate medial depression or groove along posterior margin; head and thorax sparsely punctured, dorsum with punctures usually over two puncture diameters apart (subgenus *Melanocleptes* Móczár 3
3. Head, thorax, and abdomen concolorous, abdomen entirely purple to blue; malar space shorter than or as long as 1.0 MOD ....
.... *purpuratus* Cresson
– Head and thorax concolorous, at least T-I–II black or dark brown with some green or blue highlights along lateral margins in some specimens; malar space longer than 1 MOD 4
4. Male head and thorax bright green; female head and thorax bronze or copper with gold and green highlights .... *speciosus* Aaron

– Male and female head and thorax blue to purple ...... *alienus* Patton

5. Pronotum without two large pits, pit row or groove next to posterior margin (Fig. 23); head and thorax dark greenish blue to purple, often becoming blackish dorsally in females (subgenus *Leiocleptes* Móczár) .... *blaisdelli* Bridwell

– Pronotum with two large submedial pits, pit row or groove next to posterior margin (Fig. 22); head and thorax bluish green, green or bronze (subgenus *Cleptes*) 6

6. Forewing with anterior vein of discoidal cell weakly indicated or lacking (Fig. 20); femora red to yellow .... *rufifemur* Kimsey

– Forewing with anterior vein of discoidal cell strongly indicated (Fig. 21); male femora blue or green, female femora blue or green (*rufigaster*) or reddish (*semiauratus*) 7

7. Mesopleuron covered with fine ridges (Fig. 19); clypeal truncation as wide as, or narrower than diameter of antennal socket (Fig. 17); New Jersey .... *semiauratus* (Linnaeus)

– Mesopleuron without fine ridges (Fig. 18); clypeal truncation wider than diameter of antennal socket (Fig. 16); California .... *rufigaster* Kimsey

Cleptes (*Melanocleptes*) *alienus* Patton

Fig. 14

Cleptes aliena Patton, 1879:66. Holotype ♀; Como, Wyoming, lost?

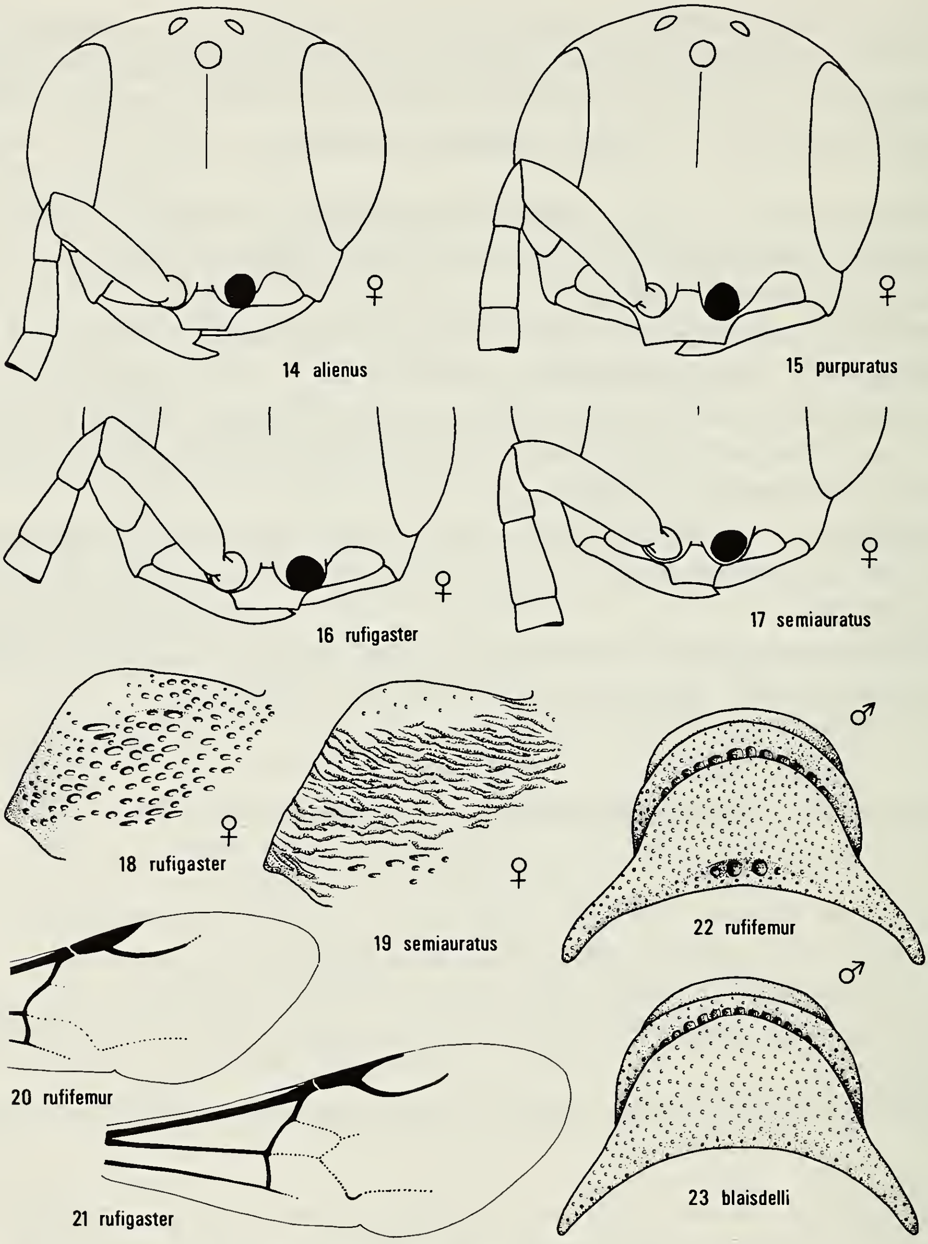
Cleptes americana Provancher, 1881:304. Holotype ♀, lost? (the ♂ specimen, labelled lectotype in the Laval Collection, Quebec is incorrect and may not be the same species). Preocc. by *americana* Cresson, 1879. New synonymy.

Cleptes provancheri Aaron, 1885:212. New name for *americana* Provancher.

Male.—Head, thorax, femora, and tibiae blue to purple; terga black to dark brown, with bluish highlights along lateral margin or on apical segments in some specimens. Pedicel slightly longer than wide; F-I 2.5 times as long as wide; F-II length 1.6 times width; malar space 2.0 MOD long; pronotum evenly convex, punctures about two puncture diameters apart; forewing discoidal cell strongly indicated. Genitalia as in Fig. 26.

Female.—Pedicel 2.0 to 3.0 times as long as wide; F-I twice as long as wide; F-II longer than wide (Fig. 14).

Distribution.—CALIFORNIA: Plumas, Sierra, Nevada, Tuolumne, Modoc, Alpine and Kern Counties; NEVADA: Washoe, Elko Counties; UTAH: Box Elder and Cache Counties; OREGON: Klamath and Lake Counties; IDAHO: Valley and Butte Counties; WYOMING: Teton and Carbon Counties; COLORADO: Boulder County; GEORGIA: Colquitt County; ALBER-



Figs. 14–23. Details of *Cleptes* species. Figs. 14–17. Front view of head. Figs. 18–19. Detail of mesopleural face. Figs. 20–21. Forewing. Figs. 22–23. Pronotum, dorsal view.

TA: Lethbridge. Collection dates were April and June through August for 21 males and 16 females.

Discussion.—The taxonomy of species in *Melanocleptes* is difficult and historically confused. Several critical types are apparently lost, including those of *alienus* and *americana*. Because of this the new synonymy given here is based on examination of original descriptions, and redescriptions by Aaron (1885) and Provancher (1881). More detailed work on this group may reveal that *alienus, purpuratus,* and *speciosus* are synonymous, with several color morphs, especially in females. Krombein (1979) gave a substantially different arrangement of species in *Leiocleptes* and *Melanocleptes,* placing *alienus* in the former. According to the subgeneric divisions presented by Móczár (1962) *alienus,* based on Patton's description, actually belongs in *Melanocleptes,* due to the darkly colored abdomen with some metallic highlights. The description of *americana* agrees with that of *alienus,* which has priority. There are no series of specimens that could be referred to *americana.* In fact, except for coloration, the American *Melanocleptes* are virtually inseparable, even the male genitalia are essentially the same. Hosts reported for *alienus* are several species of *Neodiprion* (Diprionidae) (from collection labels, and Smith, 1962).

Cleptes (*Melanocleptes*) *purpuratus* Cresson

Figs. 15, 26

Cleptes purpurata Cresson, 1879:x. Holotype ♀, Vancouver (ANSP).
Cleptes americana Cresson, 1879:x. Lectotype ♀, Nevada (ANSP).
Cleptes insperata Aaron, 1885:212. Holotype ♀, Montana (ANSP). New synonymy.

Male.—Head, thorax, and abdomen purple to bluish; femora and tibiae purple or blue; wings brown stained. Clypeal truncation much wider than antennal socket diameter; pedicel about 1.5 times as long as wide; F-I 2.3 to 2.7 times as long as wide; F-II slightly less than twice as long as wide; malar space 1.0 MOD long (Fig. 15); pronotal punctures one puncture diameter apart; mesopleural punctures circular, about one puncture diameter apart; forewing discoidal cell faintly stained. Genitalia (Fig. 26); paramere apically rounded, inner margin strongly convex with large transparent lobe; cuspis short and broadly rounded apically; digitus apex rounded and almost reaching cuspis apex in length; aedeagus with long slender subapical projection.

Female.—Pedicel about twice as long as wide; F-II 1.0 to 1.5 times as long as wide.

Distribution.—CALIFORNIA: Yolo, Nevada, Tuolumne, Sacramento, Alpine, Monterey, Lake, Inyo, Sierra and Modoc Counties; NEVADA: Washoe and Douglas Counties; UTAH: Juab County. Specimens were collected in April through August and the total specimens examined were 354 males and 30 females. The types of *purpurata* and *insperata* were seen.

Discussion.—As stated previously under *alienus* the three species in *Melanocleptes* are difficult to separate. Characteristically both sexes in *purpuratus* have an all purple or blue abdomen. This species also tends to be larger than the other two but there is a great deal of size overlap among the three. Krombein (1979) placed *insperatus* in *Leiocleptes,* but examination of the types of *insperatus* and *purpuratus* indicated that they were conspecific and belong in *Melanocleptes*. Dahlsten (1961, 1967) reported *purpuratus* as a parasite of *Neodiprion* sp.

Cleptes (*Melanocleptes*) *speciosus* Aaron

Cleptes speciosa Aaron 1885:212. Holotype ♀; Montana (ANSP).

Male.—Head and thorax bright green to bluish green; femora and tibiae green; wings brown stained; abdomen dark brown to black, except lateral margins may be green or blue. Clypeal apex wider than antennal socket diameter; pedicel about 1.5 times as long as wide; F-I 2.0 to 2.25 times as long as wide; F-II 1.5 to almost 2.0 times as long as wide; malar space longer than 1.0 MOD; pronotal punctures about one puncture diameter apart; forewing discoidal cell faintly indicated; mesopleural punctures elongate at least anteriorly and one puncture diameter apart. Male genitalia like Fig. 26; paramere apically rounded with gently emarginate inner margin; cuspis short and broadly rounded apically; digitus slender and digitate.

Female.—Head and thorax bronze to copper with green and gold highlights; abdomen dark brown. Pedicel slightly less than twice as long as wide; F-I almost twice as long as wide; F-II as long as wide; pronotal punctures two puncture diameters apart; mesopleuron with some striae, punctures elongate and about one puncture diameter apart.

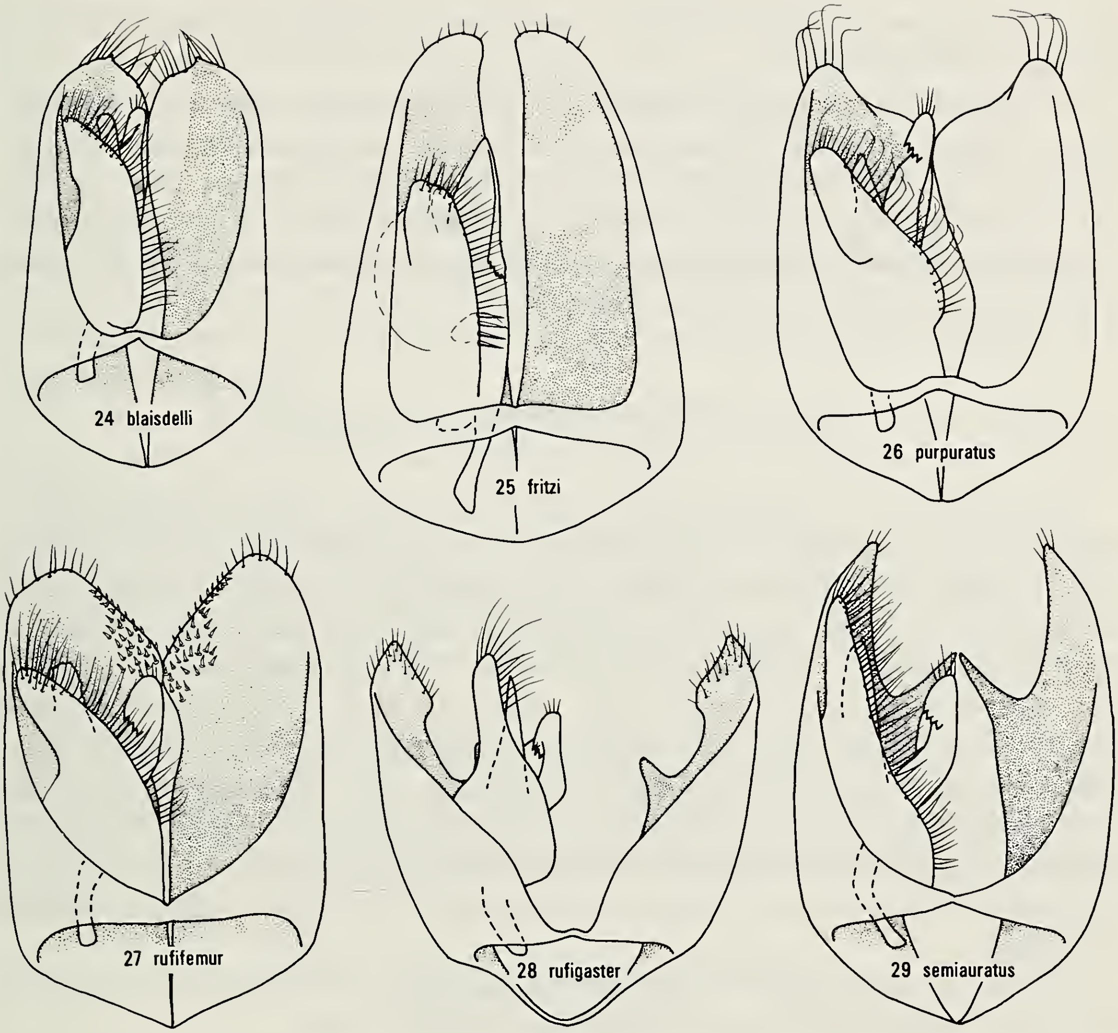
Distribution.—CALIFORNIA: Yolo, San Luis Obispo, Tuolumne, Orange, Los Angeles, Napa, Monterey, Lassen, Modoc, Nevada, Alameda and Placer Counties; NEVADA: Ormsby County; UTAH; COLORADO; WASHINGTON; OREGON; IDAHO; NORTH DAKOTA; SOUTH DAKOTA; ALBERTA; BRITISH COLOMBIA; SASKATCHUWAN. The collection dates were May through September. A total of 98 males and 74 females were examined, including the type.

Discussion.—The female of *speciosus* is relatively easy to recognize, because of its bronze coloration. Although there are no structural features that separate female *speciosus* from female *alienus,* I am restricting the concept of *speciosus* to coppery or bronze colored females and associated males. The male of this species is easily confused with male *alienus*. Unless more reliable external characteristics can be found, separating males of these two species may only be possible with female associations. *Cleptes speciosus* does appear to be restricted to states west of the 100th meridian.

Cleptes (*Leiocleptes*) *blaisdelli* Bridwell
Figs. 2, 4, 6, 8, 23, 24

Cleptes blaisdelli Bridwell, 1919:x. Holotype ♂; Poway, California (USNM).

Male.—Head and thorax blue to purple; femora blue; abdomen reddish orange or with apical segments black with some blue highlights. Pedicel 1.5



Figs. 24–29. *Cleptes,* male genital capsules.

times as long as wide; F-I 2.5 times as long as wide; F-II slightly longer than wide; malar space 1.2 to 2.0 MOD long (Fig. 6); pronotum evenly convex (Figs. 2, 4), punctures 3 to 4 puncture diameters apart or more; forewing discoidal cell lacking or with faintly stained remnants. Genitalia (Fig. 24); paramere broadly rounded apically, with small medial lobe, inner margin of paramere strongly rounded along a broad weakly sclerotized lobe; cuspis apically tapered but blunt; digitus apically rounded.

Female.—Femora brown; abdomen red, some specimens with apical segments brown. Pedicel twice as long as wide; F-I slightly more than twice as long as wide.

Distribution.—CALIFORNIA, Riverside County: Box Springs Mountains, Riverside (F. G. Andrews), San Jacinto Mountains: Herkey Creek and Keen Camp (E. S. Ross); San Diego County: (E. P. Van Duzee), Borrego (J. W. MacSwain); Tulare County: Wood Lake (N. W. Frazier); Santa Barbara County: Santa Ynez (B. Jarvis); in the months of March through

June. Six males and four females were seen. The type was examined for me by A. S. Menke.

Discussion.—Superficially *blaisdelli* resembles both *rufifemur* and *rufigaster* (subgenus *Cleptes*) but the structure of the pronotum and red coloration of the abdomen places it in the subgenus *Leiocleptes*. This species can also be distinguished by the blue male femora and faint or lacking forewing discoidal cell. The distribution of *blaisdelli* appears to be restricted to the Upper and Lower Sonoran Zones.

Cleptes (*Cleptes*) *rufifemur*, new species
Figs. 20, 22, 27

Holotype male.—Length 5.0 mm; head and thorax blue with purple highlights, except some black on propodeum; scape, coxae and femora brown; T-I–II orange; T-III–V dark brown becoming black apically, except orange lateral spots on III; wings brown stained; discoidal cell faintly indicated (Fig. 22). Pedicel 1.7 times as long as wide; F-I 2.7 times as long as wide; F-II 1.6 times as long as wide; malar space 0.7 MOD long; pronotum with two large submedial pits in a depressed band along posterior margin (Fig. 20), punctures 1.5 to 2.0 puncture diameters apart; mesopleuron smooth with round punctures about 2 puncture diameters apart. Genitalia (Fig. 27); paramere apically rounded, inner margin entire and smoothly convex; cuspis relatively short, apex not much exceeding apex of digitus; digitus apically rounded.

Female.—Pedicel about twice as long as wide, F-I 1.7 times as long as wide, F-II wider than long, malar space 1.2 MOD long.

Distribution.—Holotype male: California, Yolo County, Davis, May 28, 1960 (A. S. Menke, UCD). Paratypes: 10 males and 1 female; California: Yolo County, Davis (A. S. Menke, R. E. Rice), Winters (J. L. Campbell); Alameda County, Berkeley, Oakland (C. Koehler), Albany (W. H. Tyson); Lake County, Borax Lake (M. E. Irwin); Napa County, Monticello Dam (M. E. Irwin). Seven other males were seen from Santa Cruz Island, Canada del Medio, California, collected in April and May. Paratype collection dates are April through June and August.

Discussion.—Although closely related to *rufigaster, rufifemur* can be distinguished by the all-red legs, and absent or weakly indicated discoidal cell.

Cleptes (*Cleptes*) *rufigaster*, new species
Figs. 16, 18, 21, 28

Holotype male.—Length 6.0 mm; head and thorax bluish green with some purple highlights, except vertical face of propodeum black; scape, coxae and femora blue green; tibiae and tarsi reddish; T-I–IV reddish orange; T-

V bluish; wings brown tinted; forewing discoidal and cubital cells strongly indicated, vein remnants darkly stained (Fig. 21). Pedicel 1.7 times as long as wide; F-I length 2.4 times width; F-II length 1.6 times width; malar space 1.2 MOD; clypeal apex wider than antennal socket (Fig. 16); pronotum with a depressed pit row along posterior margin, punctures 2.0 to 2.5 puncture diameters apart; mesopleuron with extensive ridging and punctures elongate, 1.0 to 2.0 puncture diameters apart; propodeal teeth blunt and apically truncate. Male genitalia (Fig. 28); paramere apically pointed, deeply notched subapically on inner margin with a digitate projection; cuspis elongate; digitus pointed apically.

Female.—Head, thorax and femora black with blue and green highlights; terga reddish. Pedicel twice as long as wide; F-I 1.7 times as long as wide; F-II wider than long.

Distribution.—Holotype male: California, Placer County, 4 mi S Rocklin, May 26/29, 1979 (M. S. Wasbauer and P. Adams, UCD). Paratypes: 1 male, California, Napa County, Mt. Saint Helena, May 7, 1930 (E. C. VanDyke); 1 female, Los Angeles County, Tanbark Flat, April 24, 1952 (D. S. Thompson).

Discussion.—The shape of the paramere in *rufigaster* is unusual for the nearctic *Cleptes,* however, it is quite similar to that of *semiauratus.* This species can be distinguished from *rufifemur* by the dark blue or black femora and from *semiauratus* by the smoother mesopleuron and wider clypeal truncation.

Cleptes (*Cleptes*) *semiauratus* (Linnaeus)
Figs. 17, 19, 29

Sphex semiaurata Linnaeus, 1761:413. Holotype ♂; Sweden (Linnaean Society Collection, Burlington House, London).

Male.—Head and thorax bluish green; femora blue to green; T-I–II reddish; T-IV–V blue. Clypeal apex narrower than antennal socket diameter; pedicel 1.5 times as long as wide; F-I over twice as long as wide; F-II slightly less than twice as long as wide; pronotum with foveate groove along posterior margin; malar space about 1.0 MOD long (Fig. 17); pronotal punctures about one puncture diameter apart or less; forewing discoidal cell strongly indicated; mesopleuron coarsely sculptured with extensive ridging (Fig. 19). Male genitalia (Fig. 29); paramere apically tapered to a point, inner margin with elongate pointed process; cuspis slender and elongate; digitus slender and apically acute.

Female.—Head and thorax coppery with gold and green highlights; femora yellow orange; T-I–III orange; T-IV bluish; forewing with two faint brown bands.

Distribution.—USA: New Jersey, Metuchen; Europe.

Discussion.—A European species, *semiauratus* is undoubtedly adventive in New Jersey and only a few specimens have been recorded from this locality. Coloration in this species is sexually dimorphic with males tending to have a bluer or greener head and thorax, and females tending to be bronze colored. Hosts reported in the European literature include, *Pristophora* sp., *Nematus* spp., and *Pachynematus* spp. in the Tenthredinidae (Gauss, 1964). This species can be distinguished from North American *Cleptes* s.s. by the narrow clypeal truncation, extensively ridged mesopleuron especially in the female, blue male femora and complete strongly sclerotized forewing discoidal cell.

Cleptes (*Neocleptes*), new subgenus

Type-species.—*Cleptes fritzi* Kimsey, present designation.

Diagnosis.—Head, thorax, and abdomen metallic; pronotum with medial depression or groove along posterior margin; head and thorax coarsely punctate, punctures generally much less than one puncture diameter apart and usually contiguous.

Discussion.—The single species in this group, *fritzi,* has the southernmost distribution of any species of *Cleptes.* The reason for such a disjunct distribution of *Cleptes* in the western hemisphere is unclear. *Neocleptes* seems to more closely resemble the palearctic *Chrysocleptes* Móczár and *Oxycleptes* Móczár rather than the three nearctic subgenera.

Cleptes (*Neocleptes*) *fritzi,* new species
Fig. 25

Holotype male.—Length 6.0 mm. Head, thorax, and abdomen bright green with T-I and posterior part of T-II–III darker and somewhat bluish; legs, except tarsi green; forewing discoidal cell with anterior veins weakly indicated, cubital cell and Cu-a heavily sclerotized; wing membrane lightly brown stained. Pedicel length 1.2 times width; F-I 2.3 times as long as wide; F-II 1.5 times as long as wide; malar space 0.7 MOD; clypeal apex slightly wider than antennal socket diameter; vertex and facial punctures almost contiguous, pronotum with an elongate medial depression along posterior margin, pronotal punctures less than 0.5 puncture diameter apart; mesopleural punctures mostly contiguous; propodeal teeth short, almost peglike. Male genitalia (Fig. 25); paramere evenly tapered apically, inner margin simple; cuspis broadly rounded apically with four basal spines; digitus unclear; aedeagus subtriangular apically with a dentate lobe one third of distance below apex.

Female.—Unknown.

Distribution.—Holotype male: Argentina, Entre Rios, Palmar Colon, December 1973 (M. Fritz, UCD). Paratype male, same data as type.

Discussion.—*C. fritzi* appears to be the only *Cleptes* found in the southern hemisphere. The bright green body, pronotum with a posterior groove, the coarsely punctate thorax and unusual male genitalia make this a distinctive species.

Acknowledgments

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PHALLODRILINAE (OLIGOCHAETA: TUBIFICIDAE) FROM THE EAST COAST OF FLORIDA, WITH DESCRIPTION OF A NEW SPECIES OF *ADELODRILUS*

Christer Erséus and Michael S. Loden

Abstract.—Four species of the subfamily Phallodrilinae are reported from subtidal coarse sands off Hutchinson Island, Florida. Taxonomic notes are given for *Peosidrilus biprostatus* Baker and Erséus, *Phallodrilus sabulosus* Erséus, and *Phallodrilus* sp. *Adelodrilus acochlearis* n. sp., distinguished from previously known *Adelodrilus* by its lack of "giant" penial setae, is described.

The Phallodrilinae Brinkhurst, 1971 comprise the most species-rich subfamily within the marine Tubificidae. Previous taxonomic accounts of Phallodrilinae from the east coast of Florida have been published by Erséus (1979a, b, c, 1980), using a collection from the Miami area. This report is based on specimens which were collected at Hutchinson Island by personnel of Applied Biology, Inc. during oceanic sampling funded by Florida Power and Light, Co. (cf. Gallagher and Hollinger, 1977). One of the species found is new to science; two others are new to the Florida fauna.

Sand samples taken with a Shipek grab were fixed in the field with 10% buffered seawater formalin. The worms were sorted from sieved fractions of the samples. Microscopical studies were made on whole specimens mounted in resin. Material of all species but *Phallodrilus* sp. has been deposited at the United States National Museum of Natural History (USNM), Washington, D.C., and at the Museum of Zoology, Louisiana State University (LSU), Baton Rouge, Louisiana.

Peosidrilus biprostatus Baker and Erséus, 1979

Peosidrilus biprostatus Baker and Erséus, 1979:506-508, figs. 1-2.

Material examined.—USNM 64618 (3 spms), and LSU 3146 (3 spms), all from off Hutchinson Island, Florida, 27°19.1′N, 80°13.2′W, seaward margin of beach terrace about 0.5 km from shore, 8.2 m depth; very coarse calcareous sand (collectors, Gallagher *et al.*; 12 Dec. 1976).

Remarks.—Peosidrilus biprostatus was previously known only from New Jersey and North Carolina (Baker and Erséus, 1979). This new record thus extends its known distribution considerably.

The new specimens are 5.7–7.0 mm long, and they consist of 44–57 segments, which on average is shorter than the specimens described from New Jersey and North Carolina (6.9–9.5 mm, 54–62 segments). The somatic setae are slightly more numerous in the new material, generally 4–5 per bundle throughout the body (3–4 per bundle in the original material). The penial setae count 4–11 per bundle, on average fewer than in the original material (7–13 per bundle). The penial setae are slightly larger, up to about 50 μm long, in the new material (only 30–37 μm in original individuals). With the exception of these small differences, the worms fit the original description very precisely.

Habitat.—Sublittoral, medium to very coarse sands, known from 5.5–73 m depth.

Distribution.—Florida (new record), North Carolina and New Jersey (all NW Atlantic).

Phallodrilus sabulosus Erséus, 1979

Fig. 1A

Phallodrilus sabulosus Erséus, 1979b:188–189, figs. 1–2.

Material examined.—USNM 64619 (2 spms), and LSU 3148 (2 spms), all from off Hutchinson Island, Florida, 27°22.9′N, 80°13.9′W, a trough that parallels the shoreline, about 11 m depth; poorly sorted, coarse to very coarse calcareous sand (collectors, Gallagher *et al.*; 12 Dec. 1976).

Remarks.—Previously, only two specimens of this species were known and described (Erséus, 1979b). The type-locality is close to Miami, Florida, and thus the new record is not very remarkable from the zoogeographical point of view. However, the new material adds valuable information on the morphological variation of the species.

The only complete specimen is 6.1 mm long and consists of 61 segments (the only complete type-specimen was 5.5 mm, 44 segments). There are up to 5 bifid setae per bundle in anterior segments (maximally 4 in the type-material), and up to 4, occasionally 5, setae per bundle in segments posterior to the clitellum (maximally 3 in the types).

The very characteristic penial setae (Erséus, 1979b:fig. 2) are present in all the new specimens; always one seta at each male pore, and they are about 60 μm long. The spermathecal setae (op. cit.:fig. 2) are located in segment X in three of the four new worms, in IX in the fourth individual. This variation in location of the spermathecal setae was already obvious in the type-material (op. cit.:189), but, in the new material, the number of spermathecal setae varies, too. There is not always only one seta at each side of the worm; in two specimens there is an extra spermathecal seta, giving bisetal bundles at one side, unisetal "bundles" at the other side of the segment.

The type-specimens were mature, but not post-copulatory, and thus their

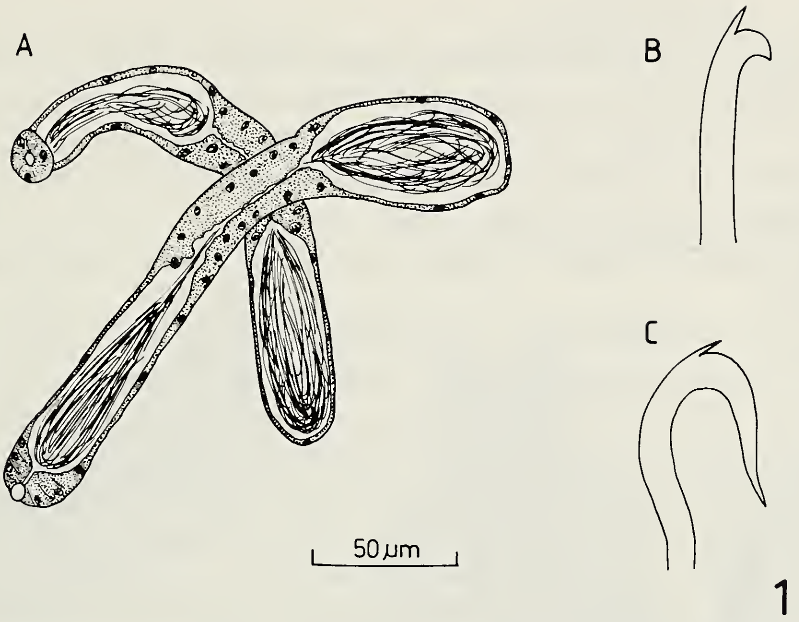

Fig. 1. *Phallodrilus sabulosus*: A, Spermathecae, as seen in oblique view of a whole-mounted specimen. *Adelodrilus acochlearis*: B, Free-hand drawing of anterior, somatic seta; C, Free-hand drawing of posterior, dorsal, somatic seta.

spermathecae were not quite fully developed (cf. op. cit.:fig. 1). In the new material, however, two specimens have sperm in their spermathecae, which now can be more accurately described (Fig. 1A). The spermathecae are 190–225 µm long, maximally 27–38 µm wide, and each consists of a slender, duct-like outer part, and an inner oval ampulla. Sperm are present in random masses, both in the dilated outer portion of the ducts, and in the very thin-walled ampullae.

Habitat.—Sublittoral coarse sands, known from 3–11 m depth.

Distribution.—Florida (NW Atlantic).

Phallodrilus sp.

Material examined.—Four specimens from off Hutchinson Island, Florida, 27°20.7′N, 80°12.8′W, shallow trough about 0.6 km W of southern tip of Pierce Shoal, 11 m; coarse sand (collectors, Whiting *et al.*; 3 Mar. 1977).

Remarks.—These specimens are very similar to *Phallodrilus leukodermatus,* described from Bermuda by Giere (1979), but the status of the new material will have to be discussed in context with other *Phallodrilus* worms from the Caribbean area (Erséus, in prep.).

Adelodrilus acochlearis, new species
Figs. 1B–C, 2

Etymology.—Derived from Latin "cochleare" (spoon); an *Adelodrilus* species "without spoons" (i.e. without giant penial setae).

Holotype.—USNM 64616.

Type-locality.—Off Hutchinson Island, Florida, 27°21.6′N, 80°13.2′W, shallow trough midway between beach terrace and Pierce Shoal, an offshore bar, about 11 m depth; coarse to very coarse calcareous sand, with some shell fragments in granule class and minute amounts of silt and clay (collectors, Whiting *et al.*; 10 Sept. 1976).

Paratypes.—USNM 64618 (5 spms), and LSU 3147 (3 spms), all from the type-locality.

Description.—Length (fixed specimens) 2.5–3.3 mm, 30–37 segments. Diameter in whole-mounted, slightly compressed specimens: 0.11–0.16 mm at segment V, 0.15–0.20 mm at clitellum, 0.06–0.10 mm posteriorly. Prostomium large, more or less spherical. Clitellum thin, extending over ½X–XII. Somatic setae all bifid, 3–5 per bundle anteriorly, 3–4 (occasionally 2 or 5) per bundle posteriorly. Anterior dorsal setae, and all ventral setae with upper tooth shorter and much thinner than lower tooth (Fig. 1B). In dorsal bundles of most posterior segments, a large proportion of setae aberrant (Fig. 1C), with lower tooth extremely long, curved downwards, and ectal tip that parallels the setal shaft; upper tooth short and thin, very similar to upper teeth of the "normal" setae. Bifids 45–62 μm long, 1.5–2.5 μm thick at node. Ventral setae of XI modified into penial bundles (Fig. 2, ps), each of which consists of about 8–12 (exact number difficult to establish) straight setae in a more or less circular formation. Penial setae 30–50 μm long, 0.5–1 μm thick at middle, entally slightly thicker, ectally with small "club" bearing apical hook. Ectal ends of penial setae protruding into small copulatory sacs (Fig. 2, cs), one posterior to each atrial opening. Male pores paired, in posterior part of XI, located in line with ventral somatic setae. Spermathecal pores paired, located laterally in anterior-most part of X.

Pharyngeal glands poorly developed. Male genitalia (all structures paired) (Fig. 2): vas deferens (vd) dilated, appears muscular, most probably devoid of cilia (not established for this species, but a common feature of the genus); vas longer than atrium, convoluted and appears filled with sperm; vas entering pear-shaped atrium slightly sub-apically; atrium (a) 58–71 μm long, 35–43 μm wide, clearly divided into two histologically different portions; ental atrial portion with granulated and ciliated inner epithelium, whereas ectal portion neither granulated nor ciliated, but appearing very stiff and swollen, probably due to vacuolization of large cells of inner epithelium; outer atrial lining of muscles very slender, maximally about 1 μm thick; outer tip of atrium pointed and protruding through opening of small copulatory sac (cs); two prostate glands present, one (pr 1) entering atrium at junction between vas and atrium, another (pr 2) attached to middle, posterior face of atrium. Spermathecae (Fig. 2, s) consisting of short ducts and slender ampullae. Ampullae 90–130 μm long, of varying width (maximally 33–44 μm), but often wider entally than ectally and sometimes with con-

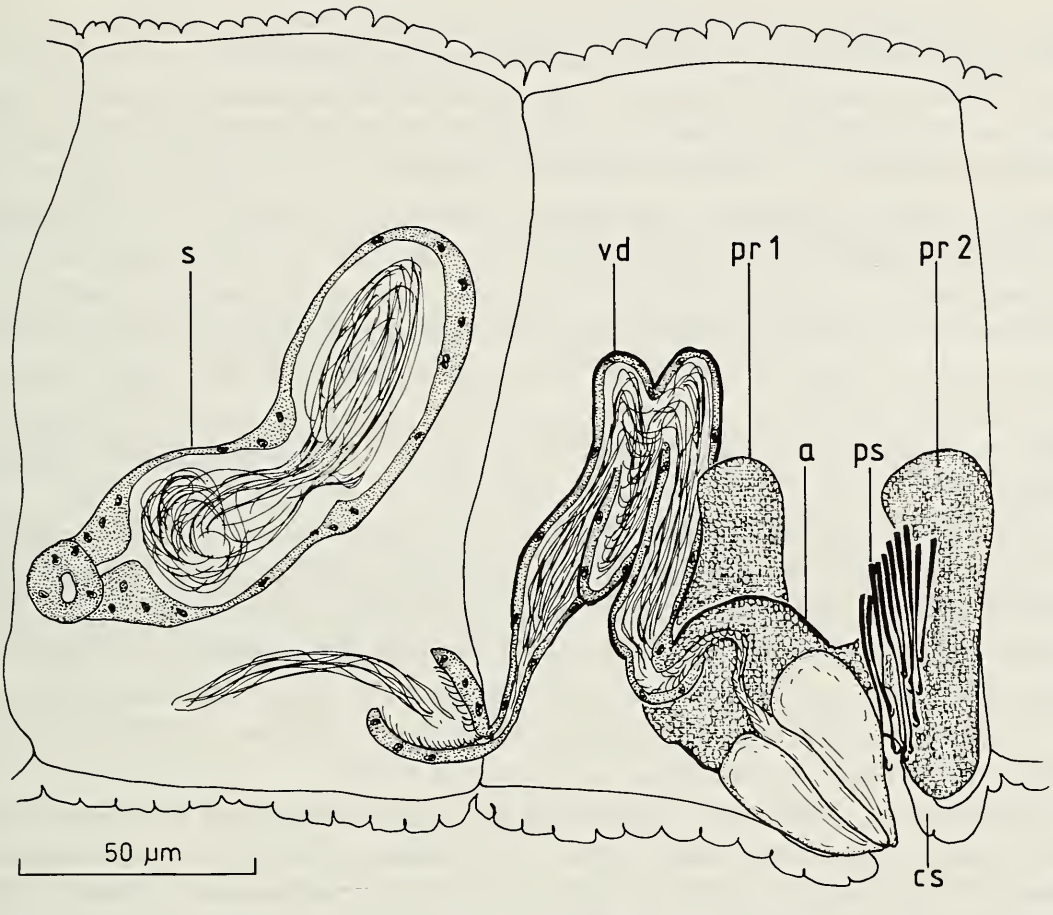

Fig. 2. *Adelodrilus acochlearis*: Lateral view of genitalia in segments X and XI. a, atrium; cs, copulatory sac; pr 1, anterior prostate gland; pr 2, posterior prostate gland; ps, penial setae; s, spermatheca; vd, vas deferens.

striction at their ectal-to-middle part. Sperm in random masses in spermathecae.

Remarks.—*Adelodrilus acochlearis* n. sp. is unique within *Adelodrilus* with regard to three main characters (for comparisons with other *Adelodrilus,* cf. Erséus, 1978, 1979d): (1) It lacks the "giant" penial setae, which characterize the modified setal bundles at the male pores of all congeners (cf. Discussion). (2) It possesses a type of dorsal, posterior setae (Fig. 1C) which is not known for any other member of *Adelodrilus*. (3) Its atria are histologically bipartite (Fig. 2, a), all other species have atria that are uniformly granulated and ciliated along all of their lengths.

Habitat.—Sublittoral very coarse sand, 11 m depth.

Distribution.—Known only from the type-locality (Florida, NW Atlantic).

Discussion

When the generic definition of *Adelodrilus* was discussed by Erséus (1979d), great taxonomic importance was ascribed to the "giant" penial setae, structures that characterize all previously known members of the genus, and which are believed to aid in sperm transfer (op. cit.). Still, of course, the occurrence of these large setae in most species certainly supports the view that *Adelodrilus* is a monophyletic, very homogeneous group of marine tubificids. However, the new species, *A. acochlearis,* somewhat weakens this homogeneity. The absence of "giant" setae in *A. acochlearis* is probably linked with the evolution of the bipartite atria, in which the ectal part has become swollen, stiff and pointed, and which probably has taken over the role of introducing sperm into the spermathecal opening of the concopulatant; there is no longer a functional need for the "giant" setae. In the closely related, monotypic genus *Bermudrilus* Erséus, 1979, this evolution has apparently gone farther; true penes are developed (cf. Erséus, 1979d).

All these facts would support the lumping of *Adelodrilus* and *Bermudrilus* if it were not for the prostate glands: in *Bermudrilus,* there is only one anterior pair of prostates, and no posterior glands as in *Adelodrilus.* We therefore conclude that the new species *acochlearis* should be placed in *Adelodrilus,* and that *Bermudrilus* should be kept apart from *Adelodrilus.*

The generic definition of *Adelodrilus* given by Erséus (1978) does not need to be revised to include *A. acochlearis* n. sp.

To date, five species of *Adelodrilus* have been described from the U.S. east coast: *A. anisosetosus* Cook, 1969 (Massachusetts), *A. voraginus* (Cook, 1970) (deep sea off Massachusetts), *A. magnithecatus* Erséus, 1979 (N. Carolina), *A. multispinosus* Erséus, 1979 (New Jersey), and *A. acochlearis* n. sp. (Florida).

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SPIONIDAE (ANNELIDA: POLYCHAETA) FROM THE GALÁPAGOS RIFT GEOTHERMAL VENTS

Nancy J. Maciolek

Abstract.—Three new species of spionid polychaetes have been collected from biological communities associated with geothermal vents along the Galápagos Rift. Each species belongs to a separate genus, 2 of which are new. *Xandaros acanthodes,* new genus and species, has branchial and neurosetal features unique to the family. A new genus, *Laubieriellus,* is erected for *L. grasslei,* new species, and *Prionospio salzi* Laubier, 1970. A new species, *Prionospio* (*Minuspio*) *sandersi,* is also described from vent communities. Samples taken as part of a study of the infaunal diversity in sediments near vent areas contained *Aurospio dibranchiata* Maciolek, 1981, recently described from several Atlantic locations. This is the first Pacific record for *A. dibranchiata.*

The discovery of unique biological communities associated with geothermal vents along the Galápagos Rift has led to several studies of the animals found in these assemblages (Grassle *et al.,* 1979). Recently, Jones (1981) described *Riftia pachyptila,* the large vestimentiferan which dominates several of these vent communities. Dr. Howard L. Sanders of the Woods Hole Oceanographic Institution found many small polychaetes associated with *Riftia,* as well as with other vent species such as the large mussels and clams. These organisms were brought on board ship and were held for a time in containers of natural or artificial seawater. This water was later passed through fine-meshed screens to retain the smaller epifaunal organisms. Additional epifaunal polychaetes were found on slate fouling panels placed near active vents by Drs. Ruth Turner of Harvard University and Carl J. Berg of the Marine Biological Laboratory, Woods Hole.

A study by Dr. J. Frederick Grassle (WHOI) of the macrofaunal diversity in sediments peripheral to the vents yielded several infaunal species of polychaetes.

Polychaetes from the above studies include 3 new species belonging to the family Spionidae. A new genus and species, *Xandaros acanthodes,* is an epifaunal species associated with the mussels and *Riftia pachyptila.* A new genus, *Laubieriellus,* is erected to include a new species, *L. grasslei,* found both in association with the larger organisms and on the slate fouling panels placed near the vents. The third new species, *Prionospio* (*Minuspio*) *sandersi,* is represented by a single specimen found in association with *R. pachyptila.* These genera and species are described below. An additional species, *Aurospio dibranchiata,* recently described from several locations in the Atlantic Ocean (Maciolek, 1981), was found in the sediment samples.

Holotypes and paratypes have been deposited in the National Museum of Natural History, Smithsonian Institution (USNM), Washington, D.C. Additional specimens have been retained by Drs. H. L. Sanders (HLS) and J. F. Grassle (JFG) at the Woods Hole Oceanographic Institution and by Drs. R. D. Turner and C. J. Berg (CJB) at the Marine Biological Laboratory, Woods Hole.

Xandaros, new genus

Type-species.—Xandaros acanthodes, new species. Gender, masculine.

Diagnosis.—Prostomium anteriorly rounded, without posterior keel, lacking eyes and occipital tentacle. Peristomium well-developed, partly fused to setiger 1, not elaborated into wings or hood. Palps inserted at anterior dorsal junction of prostomium and peristomium. Setiger 1 lacking notopodial lamellae and setae, neuropodial lamellae bilobed, with capillary setae. Branchiae beginning on setiger 4, continuing for several setigers; elongate, cylindrical, with wrinkled appearance. No interramal or interparapodial pouches. Notopodial setae all capillaries. Neuropodial capillaries of setigers 1 and 2 mostly replaced by unhooded, recurved acicular spines from setiger 3, these spines grading into bidentate hooded hooks by middle of body and continuing to last setiger; ventral sabre setae lacking. Pygidium with 4 unequal lobes.

Remarks.—Xandaros is a unique spionid in several respects. Modified setae are present in the neuropodia from setiger 3, and the intergradational change of these setae from unhooded acicular spines to recurved, bidentate hooded hooks is singular in the family. *Scolecolepides* spp. have ventral acicular spines in some anterior setigers, but these do not grade into hooded hooks. *Pygospio dubia* has similar spines, but these are found in place of hooded hooks in posterior setigers. The neuropodial hooded hooks found in *Xandaros* are somewhat similar to, but not identical with, the half-hooded hooks in several species of *Spiophanes.* In that genus, the hoods extend only from the tip of the main tooth to the shaft beneath, leaving the apical tooth and entire distal part of the hook open. In *Xandaros,* the hoods do not extend completely over the apical tooth, but do extend beyond the distal part of the hook, thus being somewhat larger than those in *Spiophanes. Xandaros* is also unusual in having branchiae from setiger 4, rather than from setiger 1 or 2, as is typical for most spionid genera. The presence of branchiae from setiger 4 and acicular neurosetae also suggest a close relationship to the family Paraonidae. The presence of dorsal palps and hooded hooks, however, clearly allies this genus with the Spionidae. A single species is known.

Etymology.—*Xandaros* (Greek), a fabulous sea-creature.

Xandaros acanthodes, new species
Figs. 1, 2

Material examined.—GALÁPAGOS RIFT geothermal vents. "Garden of Eden," 0°47.7′N, 86°7.7′W, 2482 m, *Alvin* Dive 884, 25 January 1979, mussel washings, 11 paratypes (USNM 65924). "Rose Garden," 0°48.3′N, 86°13.5′W, 2447 m, *Alvin* Dive 984, 1 December 1979, mussel washings, holotype (USNM 65922) and 22 paratypes (USNM 65923). *Alvin* Dive 990, 7 December 1979, washings from *Riftia pachyptila,* #14, 1 paratype (USNM 65925), #41, 6 paratypes (USNM 65926).

Description.—Small species, 0.3 mm wide and 6 mm long for approximately 55 setigers. Color in alcohol white. Anterior region of body flattened, more cylindrical posteriorly. Prostomium rounded anteriorly, ending indistinctly at anterior margin of setiger 1 (Fig. 1A); no occipital tentacle or eyes. Peristomium distinct ventrally and laterally, fused dorsally with setiger 1, not developed into wings or hood (Fig. 1A, B). Palps short, thick, inserted dorsally at anterior junction of prostomium and peristomium (Fig. 1A, B). Setiger 1 lacking notopodial lobes and setae (Fig. 1B). Notopodial lobes digitiform, poorly developed in anterior setigers (Fig. 2A, B), reduced to small globular prominences in posterior setigers (Fig. 2C). Neuropodial lamellae bilobed in setiger 1 (Fig. 1B), rounded in anterior setigers (Fig. 2A), reduced posteriorly to oval ventral elongations (Fig. 2B, C). Branchiae from setiger 4 (Fig. 1A, B), continuing to setigers 10–13; branchiae inserted on bases of parapodia (Fig. 1A), free from dorsal lamellae; branchiae elongate, wrinkled in appearance except for smooth, rounded tip, heavily ciliated for most of length excluding tip (Fig. 1C, D); posterior pairs shorter than anterior pairs. Notopodial setae all capillaries, clear, lacking granulations, similar along length of body, numbering up to 10 per fascicle, arranged in single row. Neuropodial setae changing along length of body; capillaries of setigers 1 and 2 mostly replaced on setigers 3–10 with recurved, unhooded acicular spines (Fig. 2D, F), these spines becoming thinner and straighter in setigers 11–15 (Fig. 2G), then replaced by bidentate hooks with half-hoods (Fig. 2H, I) from setiger 16 to end of body; spines and hooded hooks accompanied by 4–5 large (Fig. 2D) and 2–3 short, thin (Fig. 2E) capillaries throughout. Pygidium with 2 dorsal and 2 larger ventral lobes (Fig. 1E, F).

Entymology.—*akanthus* (Greek), thorn; *-odes* (Greek), suffix meaning like; *acanthodes,* thorny. The specific name refers to the presence of spine-like setae in several setigers.

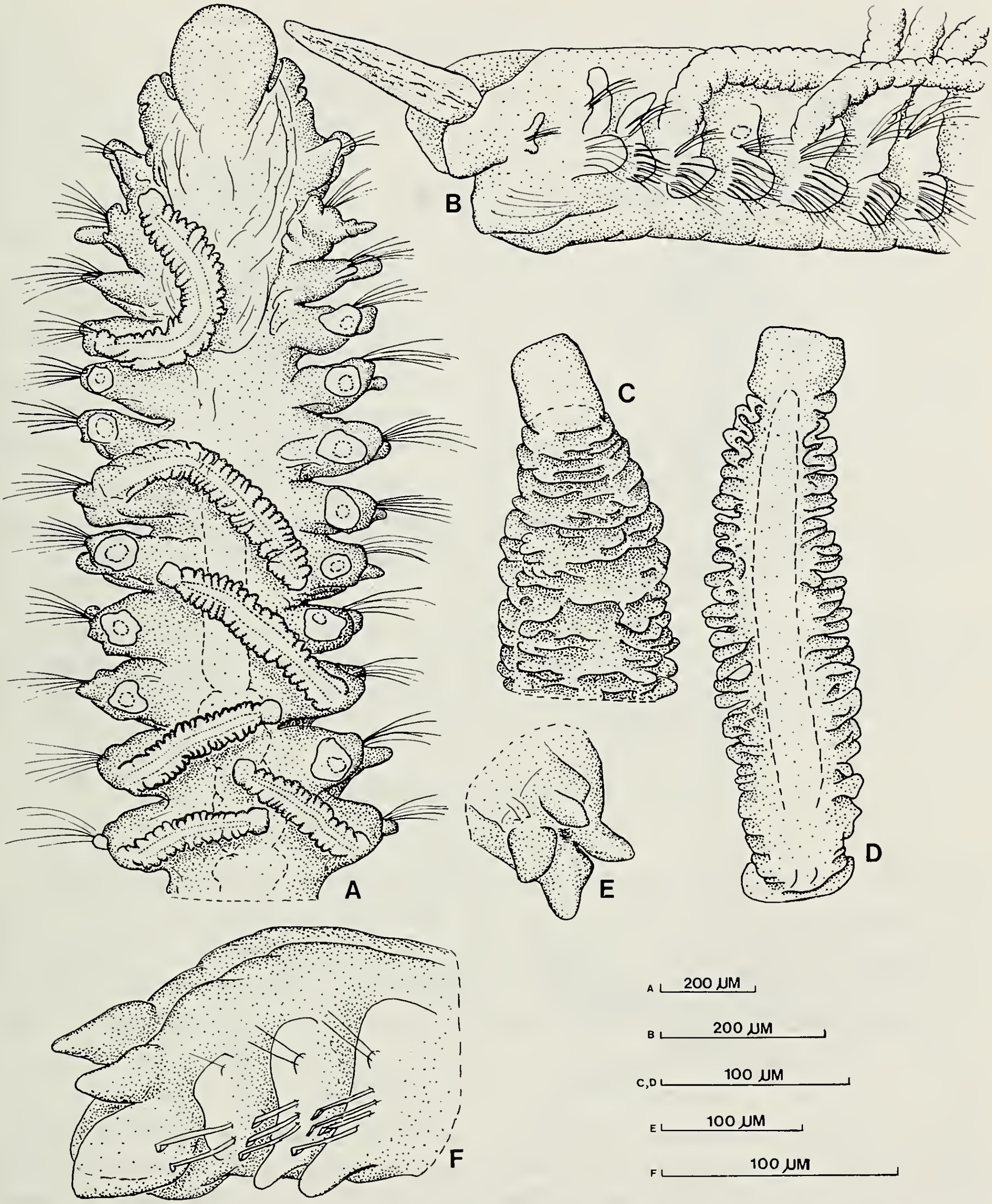

Fig. 1. *Xandaros acanthodes*: A, Anterior end, dorsal view, palps and several branchiae removed; B, Anterior end, lateral view; C, Distal tip of branchia in lateral view; D, Entire branchia, dorsal view; E, Pygidium, posterior view; F, Pygidium and last 3 setigers, lateral view.

Laubieriellus, new genus

Type-species.—Laubieriellus grasslei, new species. Gender, masculine.

Diagnosis.—Prostomium anteriorly rounded, or with slight medial incision, prolonged posteriorly as a keel, lacking occipital tentacle. Peristomium

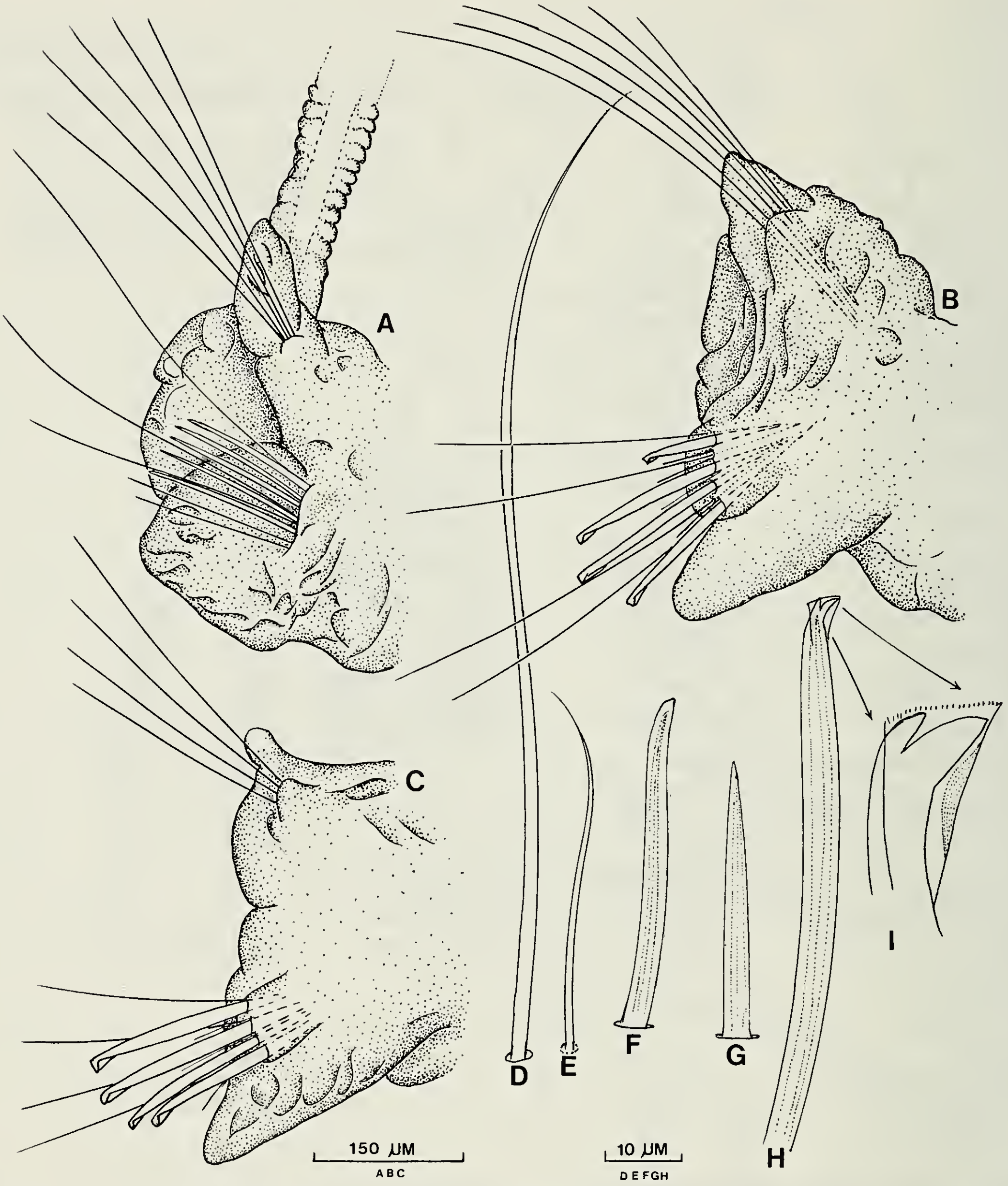

Fig. 2. *Xandaros acanthodes*: A, Setiger 13, anterolateral view; B, Setiger 27, anterior view; C, Setiger 34, anterior view; D, Capillary seta from setiger 28; E, Short capillary seta from setiger 7; F, Recurved neuropodial spine from setiger 10; G, Straight neuropodial spine from setiger 14; H, Bidentate hooded hook; I, Detail of hooded hook (not to scale).

only partly fused with, and therefore fairly distinct from, setiger 1. Branchiae numbering 4 pairs from setiger 2; each gill elongate, cylindrical, smooth, distinct from notopodial lamella. Neuropodial presetal lamellae connected in ventral crests on several anterior setigers from setiger 2. Notopodial postsetal lamellae connected in dorsal crests on several postbranchial setigers. Anterior setae all capillaries, multidentate hooded hooks in posterior neuropodia, notopodial hooks lacking. Pygidium with 2 short ventrolateral lobes and 1 longer dorsomedial cirrus, or 3 subequal lobes.

Remarks.—*Laubieriellus* is established to include 2 species: the type-species, *L. grasslei,* described below, and *Prionospio salzi* Laubier, 1970, described from the Mediterranean coast of Israel. The lack of notopodial hooded hooks is considered to be a taxonomic character of sufficient weight to warrant separation of these species from the genus *Prionospio,* which has notopodial hooks. The occurrence of ventral crests in both species is also a unique characteristic of this genus.

In describing *Prionospio salzi,* Laubier (1970) explained the lack of notopodial hooks by concluding that the specimens represented ''old larvae.'' However, the holotype (USNM 42621) of *P. salzi* does not appear to be a larval form; on the contrary, it lacks larval setal types, and has a prostomium which is elongated into a posterior keel, which larval forms lack (Hannerz, 1956). Laubier (1970) described the anterior end of his species as underdeveloped, with a very reduced prostomium and poorly developed peristomium. The holotype does indeed appear to have an anteriorly reduced prostomium, as Laubier has figured; however, the peristomium appears to be well-developed.

Etymology.—This genus is named for Dr. Lucien Laubier of the Centre Océanologique de Bretagne, who recognized the unique characteristics of *P. salzi,* and who has contributed greatly to polychaete systematics.

Laubieriellus grasslei, new species

Figs. 3, 4

Material examined.—GALÁPAGOS RIFT geothermal vents. ''Rose Garden,'' 0°48.2′N, 86°13.5′W, 2447 m, *Alvin* Dive 984, 1 December 1979, washings from slate fouling panels, holotype (USNM 65913), 20 paratypes (USNM 65914), 13 additional specimens (CJB). *Alvin* Dive 890, 15 February 1979, 3 specimens (USNM 65920). *Alvin* Dive 894, 19 February 1979, collected in amphipod trap, 21 paratypes (USNM 65916). *Alvin* Dive 984, 1 December 1979, 2 specimens (HLS). *Alvin* Dive 990, 7 December 1979, washings from *Riftia pachyptila,* 3 specimens (HLS). ''Mussel Bed,'' 0°47.9′N, 86°9.2′W, 2493 m, *Alvin* Dive 879, 20 January 1979, washings from mussels, 9 specimens (USNM 65918). *Alvin* Dive 880, 21 January 1979, washings from mussels, 3 specimens (USNM 65919). *Alvin* Dive 985, 20 February 1979, 3 paratypes (USNM 65917). *Alvin* Dive 989, 6 December 1979, 8 specimens (HLS). ''Garden of Eden,'' 0°47.7′N, 86°7.7′W, 2482 m, *Alvin* Dive 884, 25 January 1979, washings from mussels, 4 paratypes (USNM 65915). *Alvin* Dive 891, 16 February 1979, 15 specimens (HLS). *Alvin* Dive 993, 10 December 1979, 2518 m, crab trap washings #7, 1 specimen (HLS).

Description.—Small species, measuring up to 0.75 mm wide and 11.5 mm long for 43 setigers. Color in alcohol yellowish white. Prostomium broadly rounded on anterior margin, occasionally with slight medial incision (Fig.

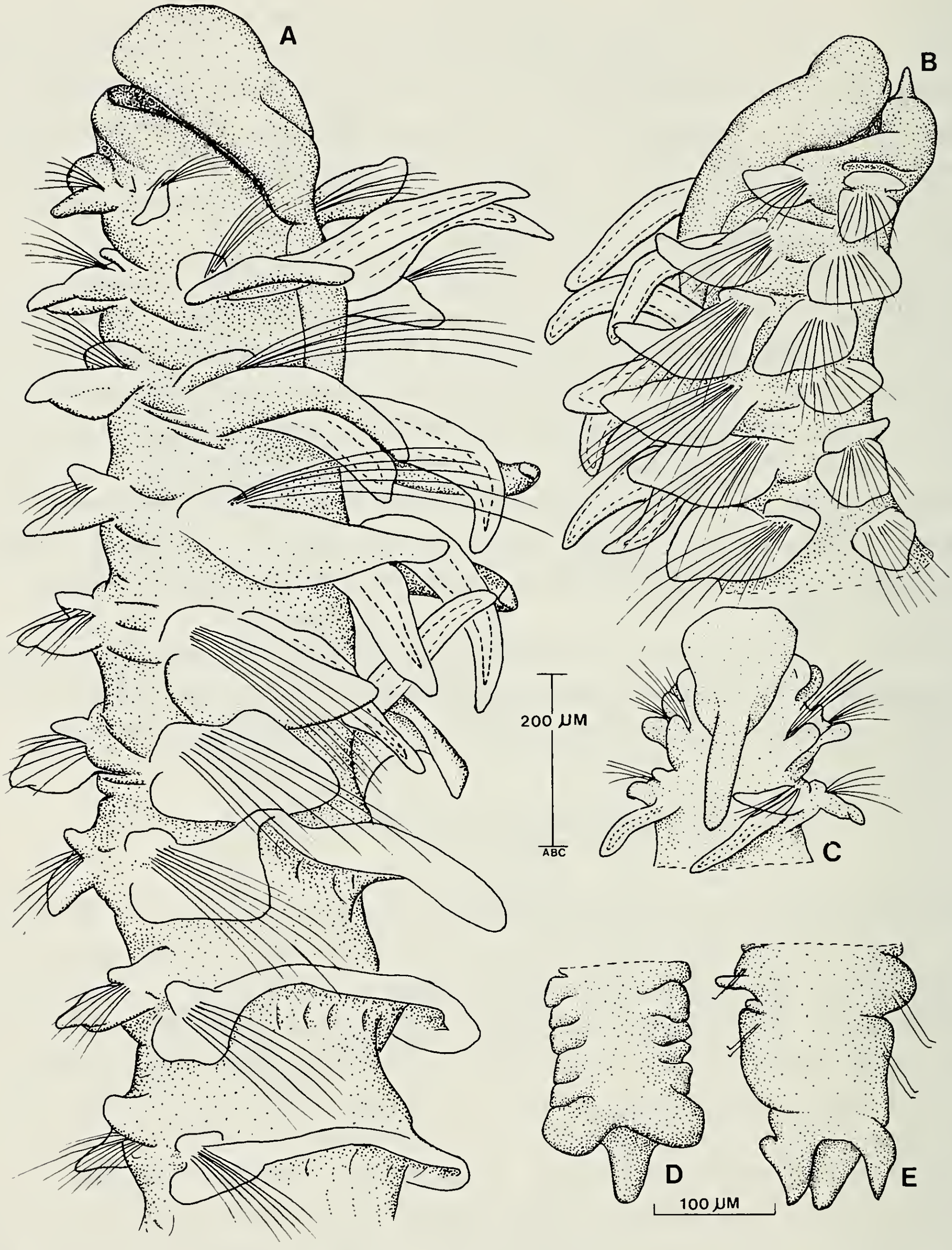

Fig. 3. *Laubieriellus grasslei*: A, Anterior end, dorsolateral view; B, Anterior end, lateral view; C, Anterior end, dorsal view; D, E, Pygidium, ventral view.

3A–C), inflated in mid-region, extending as narrow keel to base of setiger 2 in smaller specimens (Fig. 3C) or setiger 3 in larger specimens (Fig. 3A, B); lacking eyes or occipital tentacle (Fig. 3A–C). Palps inserted dorsally at posterior junction of prostomium and peristomium. Peristomium mostly distinct from setiger 1, widely separated ventrally and laterally, with thin membranous connection dorsally forming presetal lobe of notopodium on

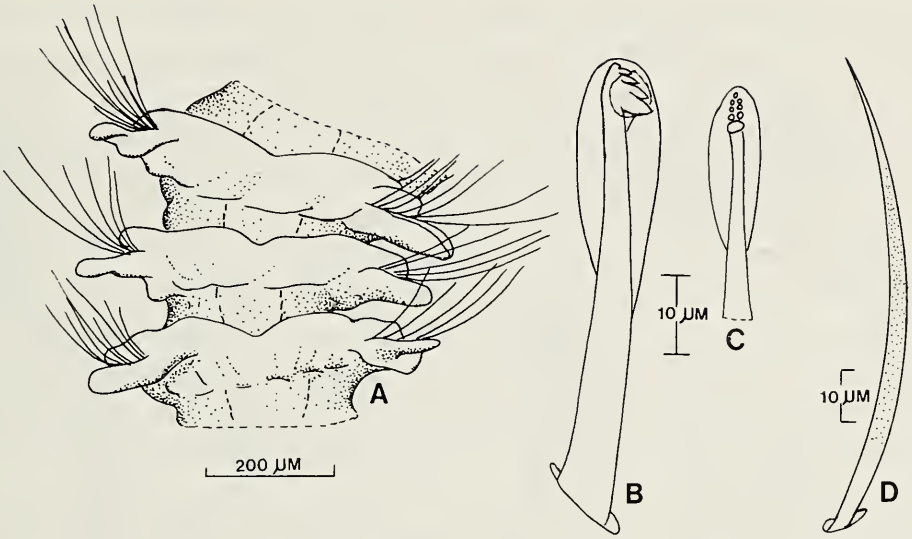

Fig. 4. *Laubieriellus grasslei*: A, Setigers 5–7, ventral view, showing crests formed by presetal neuropodial lamellae; B, C, Neuropodial hooded hook; D. Ventral sabre seta.

setiger 1, not developed into wings or hood (Fig. 3A–C). Setiger 1 with well-developed notopodial and neuropodial lamellae, both rounded, smaller than on following setigers (Fig. 3B). Notopodial lamellae of branchial region with medial edge elongated over dorsum; connected in large dorsal crests on setigers 7, 8 and 9 (Fig. 3A), and low dorsal ridges on setigers 10–12; lamellae reduced to small digitiform lobes in posterior setigers. Neuropodial lamellae rounded throughout, largest in branchial region (Fig. 3B), reduced thereafter, becoming low ridges in posterior setigers; presetal lamellae connected in ventral crests from setiger 2, these crests largest on setigers 6–11 (Fig. 4A). Branchiae numbering 4 pairs, on setigers 2–5; each gill smooth, elongate, heavily ciliated, equal in length or pair 1 slightly longer (Fig. 3A). Anterior setae all capillaries, arranged in 2 rows, with anterior row shorter than posterior row; setal numbers reduced in posterior setigers to 6–10 in notopodium, 1–3 in neuropodium; each seta striated, lightly granulated, with narrow, clear sheath. Neuropodial multidentate hooded hooks from setiger 10, numbering up to 7 per fascicle; hooks with 3 pairs of apical teeth above main tooth, surmounted by single apical tooth (Fig. 4B, C), with inconspicuous secondary hood (Fig. 4B); notopodial hooks lacking. Ventral sabre setae from setiger 10–11, usually 2, rarely 1, per fascicle; each moderately granulated, with narrow sheath (Fig. 4D). Pygidium with 2 short, rounded, ventrolateral lobes and 1 slightly longer, thinner, dorsomedial cirrus (Fig. 3D), or 3 subequal lobes (Fig. 3E).

Remarks.—*Laubieriellus grasslei* is closely related to *L. salzi* (Laubier), with which it shares the generic characteristics of anterior ventral crests and the lack of notopodial hooded hooks. The 2 species are also similar in having neuropodial hooks from setiger 10 and in the shape of the pygidium (see below). *L. grasslei* differs from *L. salzi* in having a much larger prostomium, a more widely separated peristomium and setiger 1, 7 rather than 4 small teeth on the hooded hooks, and the presence of dorsal crests on setigers 7, 8, and 9 rather than on setigers 8, 9, and 10 as in *L. salzi.* The dorsal crests are higher and more elaborate in *L. grasslei* than in *L. salzi.*

The pygidial shape of *L. grasslei* varies somewhat, from 3 subequal lobes to 2 short lobes and 1 longer cirrus. The largest specimen examined was mature, with oocytes in the coelom; therefore, its pygidium (Fig. 3D) is considered to be that of the adult of the species. The variability observed in smaller specimens may be due to growth. The pygidium of *L. salzi* has 2 short lateral lobes and 1 slightly longer medial cirrus, similar to that of the mature *L. grasslei.*

Laubieriellus grasslei is a common species in the Galápagos Rift geothermal vent communities, and appears to be opportunistic in nature, occurring in association with several other species, including the vestimentiferan, *Riftia pachyptila,* and the large mussel (as yet unnamed), as well as on the slate fouling panels placed near the vents.

Etymology.—This species is named in honor of Dr. J. Frederick Grassle of the Woods Hole Oceanographic Institution, in recognition and appreciation of his enthusiastic commitment to research of the highest quality.

Prionospio (*Minuspio*) *sandersi,* new species
Fig. 5

Material examined.—GALÁPAGOS RIFT geothermal vents. "Rose Garden," 0°48.2'N, 86°13.5'W, 2447 m, *Alvin* Dive 983, 30 November 1979, washings #30 from *Riftia pachyptila,* holotype (USNM 65921).

Description.—Holotype complete with 33 setigers, measuring 0.5 mm wide and 3.2 mm long. Color in alcohol white with bright golden pigment on dorsal edge of setiger 1 (Fig. 5B). Prostomium broadly rounded on anterior margin, narrowing posteriorly, ending at base of setiger 1 (Fig. 5A, B); eyes lacking. Peristomium distinct ventrally and laterally, fused with setiger 1 dorsally, not developed into wings or hood (Fig. 5A); palps inserted dorsally at posterior junction of prostomium and peristomium. Noto- and neuropodial lamellae of setiger 1 well-developed, but smaller than in following setigers (Fig. 5A); notopodial lamellae oval with slightly acuminate tips; neuropodial lamellae smaller, rounded (Fig. 5A). Lamellae of subsequent setigers largest in branchial region; notopodial lamellae broadly oval with medial edge elongated over dorsum in setigers 2–5, with tips somewhat tapered thereafter; lamellae reduced in posterior setigers but retaining small acuminate tip throughout; dorsal ridges or crests lacking (Fig. 5A); neuropodial lamellae rounded throughout, reduced in posterior setigers. Bran-

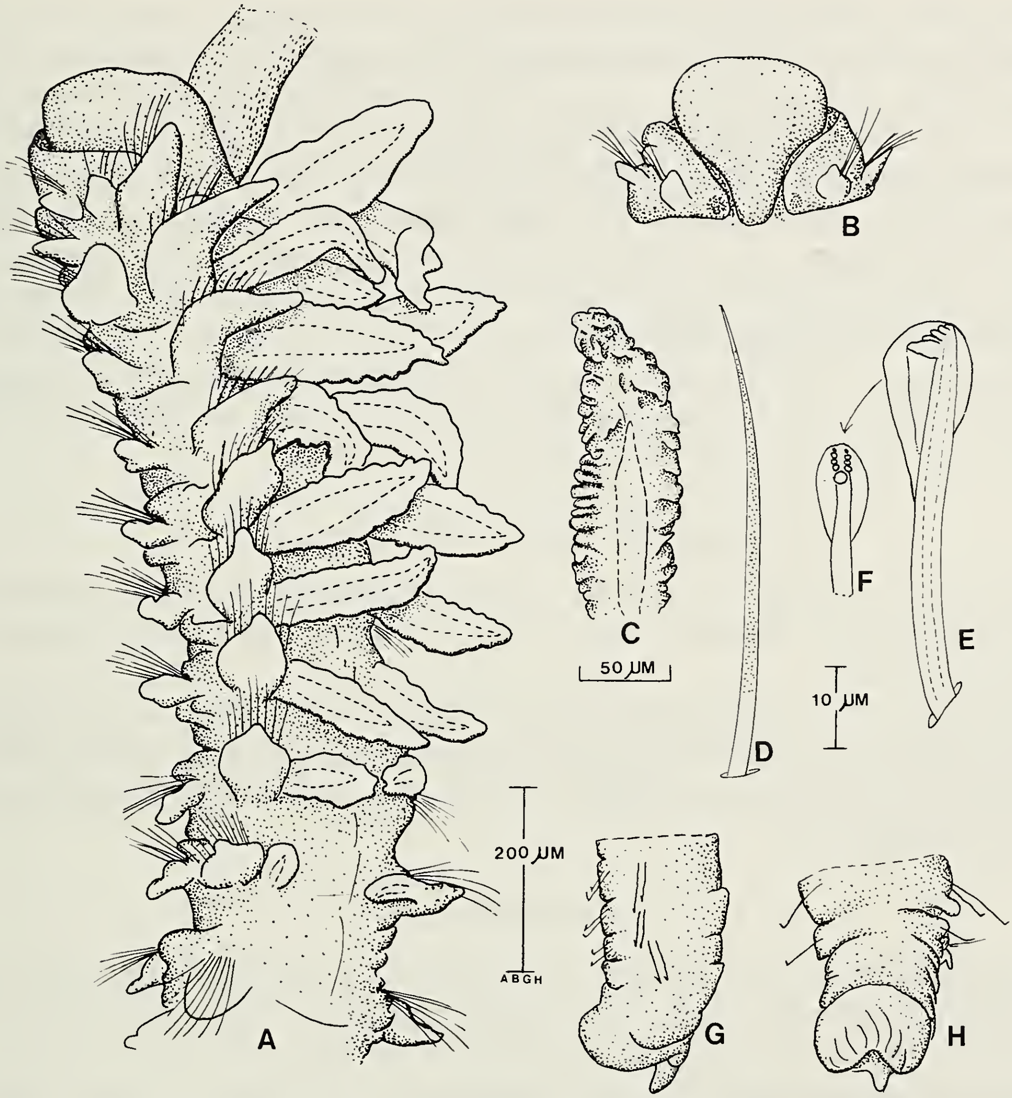

Fig. 5. *Prionospio* (*Minuspio*) *sandersi*: A, Anterior end, dorsolateral view; B, Prostomium, dorsal view; C, Branchia, dorsal view, showing details of wrinkled surface; D, Ventral sabre seta; E, F, Hooded hook; G, Pygidium, lateral view; H, Pygidium, ventral view.

chiae numbering 9 pairs, on setigers 2–10; each gill wide, robust, lacking digitiform pinnules but appearing wrinkled (Fig. 5A, C); largest gill on setiger 4, smaller thereafter, short and stubby on setiger 9, smaller than dorsal lamellae on setiger 10 (Fig. 5A). Anterior setae all capillaries, narrow, not heavily granulate. Multidentate hooded hooks in neuropodia from setiger 15, in notopodia from setiger 29; hooks with 4 pairs of small teeth above main tooth, with secondary hood (Fig. 5E, F); numbering up to 3–4 per neuropodial fascicle, up to 1–2 per notopodial fascicle. Ventral sabre setae from setiger 14; 1 per neuropodium (Fig. 5D). Pygidium cup-shaped, with deeply rounded ventral edge and small dorsal elongation (Fig. 5G, H).

Remarks.—The shape of the pygidium of *P. sandersi* is unusual for an adult *Prionospio.* The structure suggests the typical arrangement (2 short lateral lobes, 1 long medial cirrus) of the *Prionospio* pygidium in that the dorsal elongation represents the long medial cirrus, and the rounded ventral portion represents a fusion of the 2 ventrolateral cirri. This is similar to the form seen in juvenile *Prionospio* (Blake, pers. comm.), and it is possible that the holotype is not a fully developed adult. However, the presence of wide, wrinkled-appearing branchiae readily separates this species from other *Prionospio* (*Minuspio*) species.

Etymology.—This species is named in honor of Dr. Howard L. Sanders of the Woods Hole Oceanographic Institution, whose commitment to science of the highest quality is a continual inspiration.

Aurospio dibranchiata Maciolek, 1981

Material examined.—*Gilliss* Sta. 301, 18 February 1979, 0°35′N, 86°05′W, 20 km south of "Mounds" area, 2730 m, infaunal box core samples, 9 specimens (JFG).

Remarks.—The specimens from the Pacific are identical in all morphological characters with the Atlantic specimens described by Maciolek (1981). Branchiae are present on setigers 3 and 4, and neuropodial hooded hooks start on setiger 10.

Acknowledgments

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SYSTEMATIC POSITION OF THE GENUS *GLYPTOZARIA* IREDALE (PROSOBRANCHIA: GASTROPODA)

Richard S. Houbrick

Abstract.—The genus *Glyptozaria* comprises two living and one extinct species and is confined to deep-water environments in the western Pacific where it is best known from the Australian region. Anatomical, radular, opercular, and shell characters derived from the study of the type-species, *Glyptozaria opulenta* (Hedley), indicate its placement in the Cerithiidae rather than the Turritellidae, its previous familial assignment. An historical review of the literature, synonymy, and discussion of the systematics are presented.

Monographic studies of the family Cerithiidae Fleming have revealed a number of genera whose assignment to the family is uncertain. Many genera are poorly defined and based only on shell characters. As a result, some taxa are erroneously referred to the Cerithiidae and others, which belong there, are assigned to related families, such as the Turritellidae Woodward.

This study was prompted by examination of a large series of tiny, deep-water cerithiacean snails dredged off the coast of Queensland, Australia by HMAS *Kimbla*. These specimens are in the genus *Glyptozaria* Iredale, 1924 and conspecific with *Glyptozaria opulenta* (Hedley, 1907). Several specimens preserved in alcohol allowed me to examine the operculum, radula, and gross anatomy. Although too poorly preserved for histological sections or accurate sex determination, the material provided the additional characters necessary for a proper diagnosis of the genus and definitive assignment to the family Cerithiidae.

The following account presents a brief nomenclatural history of the genus, a new description of the type-species and genus, a synonymy with commentary, and a discussion of the systematic position of *Glyptozaria* and some aspects of its distribution and biology.

Historical Review

The proper familial assignment of *Glyptozaria* has been uncertain. The type-species of the genus, *G. opulenta,* was originally described as a *Turritella* species by Hedley (1907:292) without knowledge of the operculum or radula. Iredale (1924:248) proposed the genus *Glyptozaria*, noting that all Australian turritellids had a sinus in the outer lip while *Turritella opulenta*

Hedley lacked this feature. He suggested that *Glyptozaria* resembled *Argyropeza* Melvill and Standen, 1901. Iredale (1925:267–268) later remarked that *Turritella opulenta* had been transferred to the genus *Mathilda* Semper, 1865, by Tate, but that this assignment was as unsatisfactory as *Turritella*. Both Thiele (1929:181) and Wenz (1939:653) placed the genus in the Turritellidae with a query. Thiele (1929:181) referred *G. opulenta* to the genus *Tachyrhynchus* Mörch, 1868. Cotton and Godfrey (1931:59) and Iredale and McMichael (1962:47) listed the genus under the Turritellidae without comment. Marwick (1957:164) also regarded *Glyptozaria* as a turritellid but assigned it to the subfamily Turritellopsinae Marwick along with the genera *Kimberia* Cotton and Woods, 1935 and *Turritellopsis* Sars, 1878. Garrard (1972:331–332) followed Marwick's (1957:164) arrangement but noted that the placement of *Glyptozaria* in the family Turritellidae was open to doubt. He believed that the genus was intermediate between the Turritellidae and Cerithiidae and suggested that discovery of other species in the future might warrant the establishment of a separate family to accommodate them.

Laseron (1951:332–333) believed that *Glyptozaria* was congeneric with a large snail described by Iredale (1929:186) as *Mathildona euglypta*. Iredale (1929) believed that *M. euglypta* was closely related to the genus *Mathilda* Semper but Laseron (1951) considered *Mathildona* to be a synonym of *Glyptozaria* and stated that he did not think the latter genus had any connection with the Turritellidae. Laseron (1951) referred *Glyptozaria* to the family Pyramidellidae Gray, perhaps the most unusual assignment given it by any author.

Materials and Methods

Numerous dry lots and a few specimens preserved in alcohol were examined with a Wild stereomicroscope and measurements of the shell and animal made with an ocular micrometer. Drawings of the animal were made using a camera lucida. Scanning electron micrographs of the shell and radula were taken with a Cambridge Mark II Stereoscan scanning electron microscope.

The following abbreviations appear in the text: AMS, Australian Museum, Sydney; ANSP, Academy of Natural Sciences of Philadelphia; HMAS, Her Majesty's Australian Ship.

Material Examined

JAPAN: ANSP 243278, Tosa.

QUEENSLAND, AUSTRALIA: AMS C117193, 24.5 mi E of Lady Musgrave Is, 339–348 m, HMAS *Kimbla*, Sta. 3; AMS C117192, 25 mi E of Lady Musgrave Is, 348–357 m, HMAS *Kimbla*, Sta. 2; AMS C117185, NE of Lady Musgrave Is, 365 m, HMAS *Kimbla*, Sta. 24; AMS C117183, E of

North West Is, 284 m, HMAS *Kimbla,* Sta. 22; AMS C117183, E of Lady Elliot Is, 476–531 m, HMAS *Kimbla,* Sta. 1.

Family Cerithiidae Fleming, 1828

Glyptozaria Iredale, 1924

Glyptozaria Iredale, 1924:248 (Type-species, by original designation, *Turritella opulenta* Hedley, 1907).—Thiele, 1929:181.—Cotton and Godfrey, 1931:59.—Cotton and Woods, 1935:382.—Wenz, 1939:653.—Laseron, 1951:332.—Marwick, 1957:164.—Iredale and McMichael, 1962:47.—Garrard, 1972:331–334.

Generic description.—Shell thin, slender, turreted, having angulate whorls and overall cancellate sculpture. Protoconch smooth, suture deep. Aperture ovate with slight anterior siphonal canal. Operculum ovate, corneous, moderately spiral with subcentral nucleus. Radula taenioglossate with long, curved, nearly smooth marginals. Animal with broad head and large eyes. Mantle edge bilobed and papillate. Stomach large, rectum wide. Osphradium vermiform; pallial gonoducts open.

Remarks.—This genus comprises two living species, *Glyptozaria opulenta* (Hedley, 1907) and *G. columnaria* Cotton and Woods, 1935, and a fossil species from the Middle Miocene of Victoria, *G. transenna* (Tenison-Woods, 1879) (Garrard, 1972:334). Although these tiny deep-water snails bear some resemblance to *Turritella* species, I believe they should be assigned to the Cerithiidae. Iredale (1924:248) also noted the cerithiid aspect of *Glyptozaria* when he compared it with *Argyropeza* Melvill and Standen, 1901. My recent review of this group (Houbrick, 1980) refers it to the Cerithiidae; however, I do not agree that *Glyptozaria* resembles *Argyropeza* species because the protoconchs of species in that genus are completely different from those of *Glyptozaria* species.

Many of the smaller turritellid genera are based on tiny deep water species for which only the shells are known. The assignment of *Glyptozaria* to the Turritellidae has been questioned by several authors (Thiele, 1929:181; Wenz 1939:653; Garrard, 1927:332). Marwick's (1957:164) referral of *Glyptozaria* to the subfamily Turritellopsinae is unsatisfactory because the radula of the type-species of *Turritellopsis* Sars, 1878, the type-genus, lacks marginal teeth. Other species, referred to *Turritellopsis,* have normal taenioglossate radulae; thus, the subfamily appears to be a somewhat artificial group.

Cerithiid characters in *Glyptozaria* are shells with a distinctly defined anterior siphonal canal, former varices on the body whorl, cancellate sculpture due to axial riblets and spiral cords, and an operculum with a subcentral nucleus and ovate shape. The gross anatomical features of the head-foot and mantle edge are unlike those described for *Turritella* species. The radula is also not like those depicted for *Turritella* species. The marginal teeth resemble those of *Clavocerithium taeniatum* (Quoy and Gaimard) and *Rhinoclavis sordidula* (Gould), both cerithiids (see Houbrick, 1978:71, 126), but do not taper as much at their distal ends. The marginal teeth of *Glyptozaria* also resemble those depicted by Troschel (1861:153, pl. 12, fig. 13) for *Turritella lactea* Möller, 1842, which is a *Mesalia* or *Tachyrhynchus* species. The genus *Mesalia* Gray is unknown anatomically and the features of its aperture, particularly the shallow anterior siphonal canal, render its assignment to the Turritellidae suspect. *Tachyrhynchus* Mörch, 1868 is similar to *Mesalia* and equally unknown, anatomically. As mentioned earlier, Thiele (1929:181) referred *Glyptozaria* to this group. I suggest that *Tachyrhynchus* is also inappropriately placed in the Turritellidae because both the aperture and anterior canal appear to be unlike those of *Turritella* species, but are more like those of *Glyptozaria*. I further suggest that *Glyptozaria, Tachyrhynchus* and *Mesalia* are more properly assigned to the Cerithiidae, perhaps as a subfamily. There is, however, not enough anatomical evidence to justify proposal of such a group at this time.

Some smaller, deep-water turritellid snails of the genus *Colospira* Donald, 1900, subgenus *Ctenocolpus* Iredale, 1925, may superficially resemble *Glyptozaria* species in sculpture but are easily distinguished from them by the lack of an anterior siphonal canal.

The assignment of *Glyptozaria* to the Pyramidellidae (Laseron, 1951:332) is not correct because *Glyptozaria* has a taenioglossate radula and lacks a heterostrophic protoconch. Laseron's (1951:333) referral of *Mathildonia euglypta* Iredale, 1929 to the genus *Glyptozaria* is also inappropriate because the former has a typical mathildid protoconch, tilted on its axis, not at all like that of *Glyptozaria* species.

Glyptozaria opulenta (Hedley, 1907)
Figs. 1–3

Turritella opulenta Hedley, 1907:292, pl. 54, fig. 9 (Holotype: AMS, c.16764; Type-locality: 146 meters off Narrabeen, Tasman Sea).

Glyptozaria opulenta (Hedley).—Iredale, 1924:248; 1925:267–268; Cotton and Godfrey, 1931:59, pl. 2, fig. 5; Allan, 1950:92; Laseron, 1951: 333, fig. 91; Marwick, 1957:164, figs. 69–70; Garrard, 1972:332, pl. 29, fig. 15.

Shell description (Fig. 1; Table 1).—Shell small, ranging in length from 6–8.6 mm, elongate and having apical angle of 16 degrees. Teleconch comprising about 10 convex, angulate whorls with cancellate sculpture. Embryonic shell (protoconch I) inflated, smooth, one and a half whorls and with straight lip. First 7 whorls of teleoconch each with weak axial riblets and 2 strong spiral cords bearing pointed beads where they cross the axial rib-

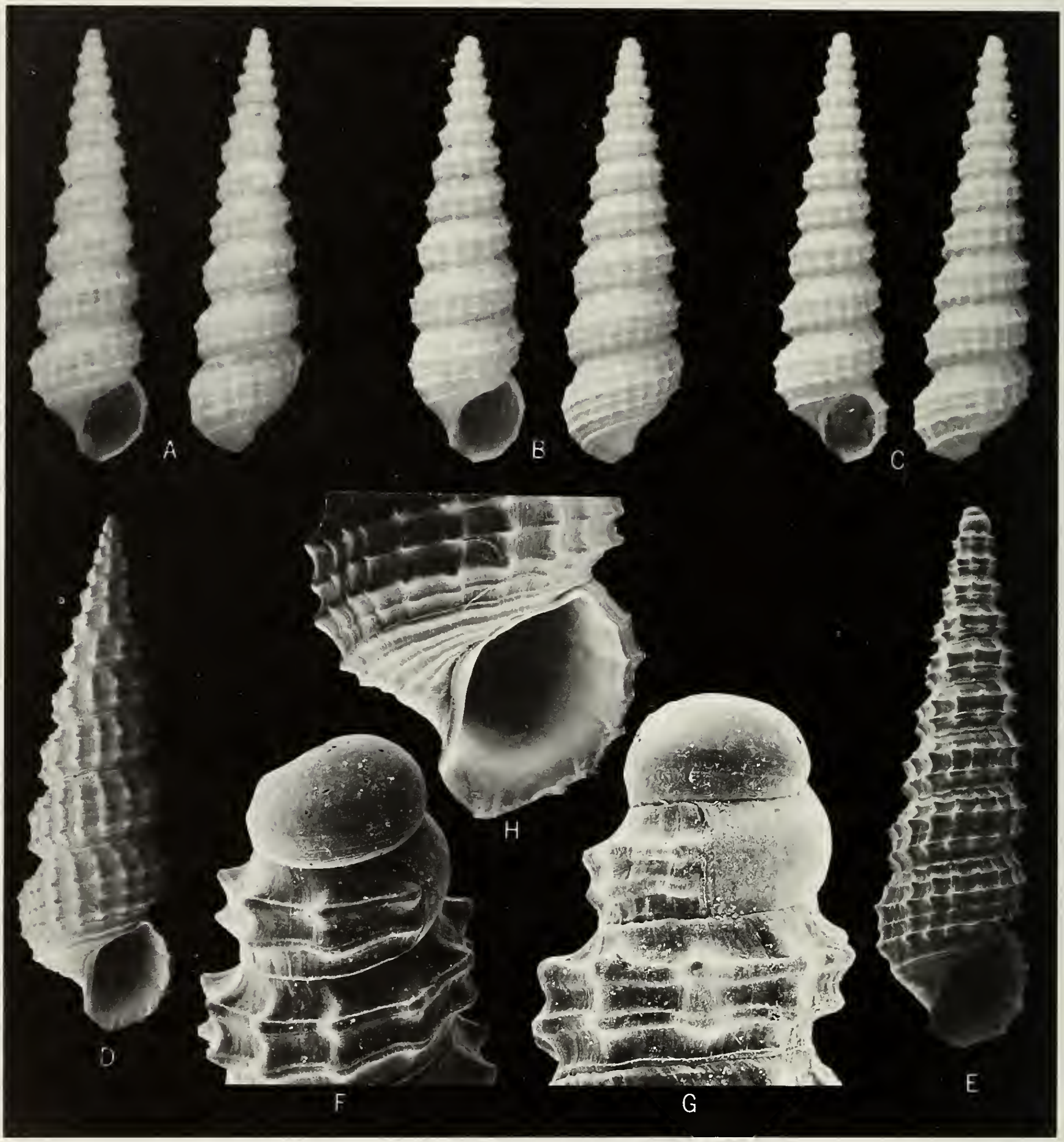

Fig. 1. *Glyptozaria opulenta* showing variations in shell sculpture and form. A–C, Shells from 339–348 meters depth, 23°33.7′S, 150°37′E, 24.5 mi E of Lady Musgrave Is, Queensland; AMS C117193. A, Live-collected specimen demonstrating shiny shell (7.5 mm long); B, Shell of dead specimen 8.1 mm long; C, Same as B, 8 mm long. D–H, SEM micrographs of shells from 342–357 meters depth, 23°44′S, 152°49′E, 0.25 mi E of Lady Musgrave Is, Queensland; AMS C117192. D, Specimen showing well-developed anterior siphonal canal and details of outer lip sculpture (9×); E, Details of shell sculpture and large body whorl varix opposite outer lip (17×); F, G, Protoconch showing smooth embryonic whorls, straight lip of embryonic shell and sharp transition between embronic and juvenile sculpture (120× and 95×); H, Detail of aperture, anterior siphonal canal and sculpture of lower body whorl (35×).

lets. Eighth whorl with 3 spiral cords, the middle one being weakest. Penultimate and body whorls each with 4 spiral cords overlaying about 20 weak axial riblets. Upper cord weak, the next strong, the third weak, and the lower one strong. Upper portion of each whorl deeply impressed at suture

Fig. 2. Scanning electron micrographs of the radula of *Glyptozaria opulenta*: A, Portion of radular ribbon with some of the marginal teeth folded back (500×); B, Half row, showing smooth sickle-like marginal teeth and their relationship to lateral teeth when folded in normal position (1000×); C, Half row, showing lateral teeth (1000×); D, Detail of rachidian and lateral teeth showing basal plates and cusps (2000×).

Table 1.—Analysis of shell characters (measurements in mm).

Statistic	n = 15	$\bar{x}$	SD	Range
Shell length		6.85	0.69	5.9–8.6
Shell width		1.81	0.15	1.7–2.2
Aperture length		1.26	0.18	1.0–1.6
No. whorls		10	0.59	9–11
No. axial ribs		20	2.25	17–25

$\bar{x}$, mean.
SD, standard deviation.

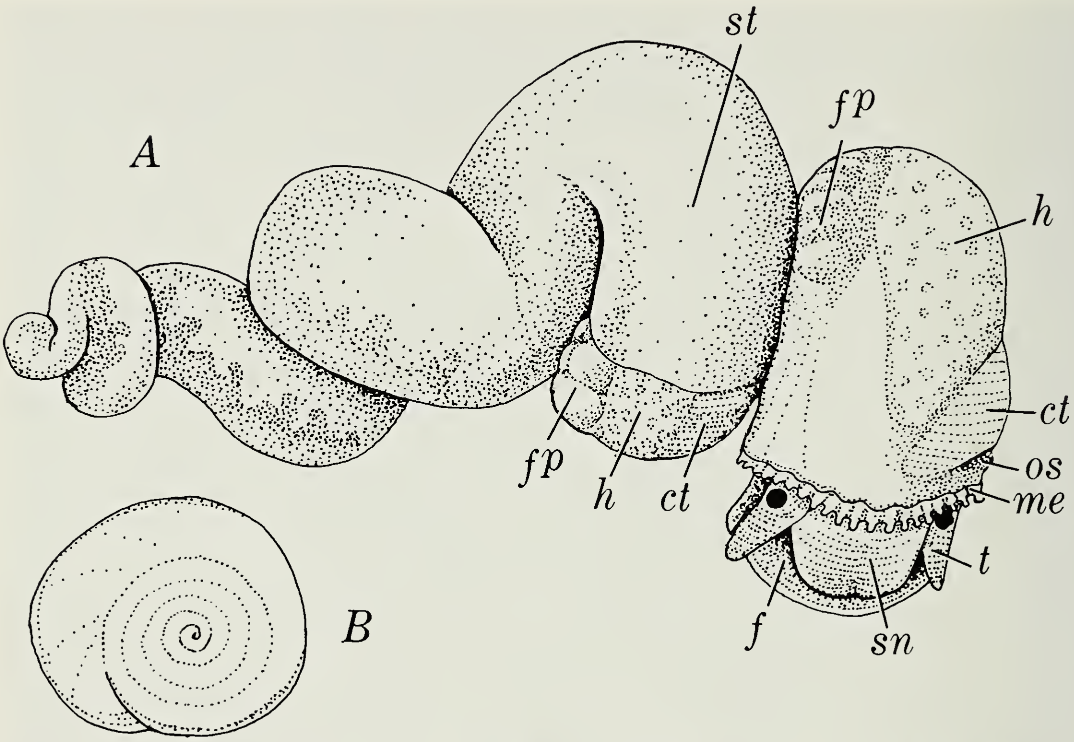

Fig. 3. A, Animal of *Glyptozaria opulenta* removed from shell (5 mm long); B, Operculum. *Abbreviations*: *ct*, ctenidium; *f*, foot; *fp*, fecal pellet; *h*, hypobranchial gland; *me*, mantle edge; *os*, osphradium; *sn*, snout; *st*, stomach; *t*, tentacle.

and framing sutural ramp. Strong varix on body whorl opposite outer lip. Suture straight, impressed. Base of body whorl moderately compressed and bearing 5 spiral cords. Aperture ovate, a little over one-fifth length of shell. Columella nearly straight, slightly concave. Anterior siphonal canal short, wide, and shallow. No anal canal. Outer lip convex, slightly crenulate at edge, with interior weakly incised spiral lines. Shell color white, translucent. Operculum (Fig. 3B) ovate, thin, corneous, outwardly concave and moderately spiral with sub-central nucleus.

Radula (Fig. 2).—Radula tiny, fragile, taenioglossate (2 + 1 + 1 + 1 + 2). Rachidian tooth 'T'-shaped, deeply impressed on sides of basal plate (Fig. 2D). Top of rachidian moderately convex and bearing large pointed central cusp flanked on each side with 4–5 tiny denticles that are nearly fused. Basal plate of rachidian with narrow neck and having wide, elongate baso-lateral projections. Lateral tooth (Fig. 2C, D) rhomboidal with outer elongate, lateral projection inserting onto radular basal membrane. Lateral serrated on inner top half with a tiny inner denticle, a large elongate cusp and 5–6 sharp denticles, respectively. Basal plate of lateral tooth slightly convex at bottom and bearing small, blunt, central peg. Marginal teeth (Fig. 2B, C) long, curving and spatulate at base where inserted on basal radular membrane. Marginals tapering to blunt point at tips. Inner marginal tooth with 2 microscopic denticles on inner surface of tip. Outer marginal smooth.

Animal (Fig. 3).—Preserved animal comprising about 7 whorls, color nearly white, lightly pigmented with tan, on head-foot. Foot (Fig. 3, *f*) of moderate size, bearing propodial mucus gland. Head broad and short bearing wide, bilobed snout (Fig. 3, *sn*) and 2 thick cephalic tentacles (Fig. 3, *t*), each with a large black eye on the outer part of the tentacular, peduncular stalk. Mantle edge (Fig. 3, *me*) bilobed and with tiny short papillae. Stomach (Fig. 3, *st*) large, about 2 whorls long. Mantle cavity spacious, about one and a half whorls deep. Thin, vermiform osphradium (Fig. 3, *os*) adjacent to monopectinate ctenidium (Fig. 3, *ct*) that has thick filaments. Hypobranchial gland wide (Fig. 3, *h*), relatively thin, composed of tear-shaped ridges containing numerous fine spherules. Rectum large, filled with large, ovoid fecal pellets (Fig. 3, *fp*) comprised of fine detritus. Pallial gonoducts open, details unknown. Sexes probably separate. Spawn unknown, but direct development indicated by form of embryonic shell.

Remarks.—This species is the type-species of the genus. It is so distinctively sculptured that there is little chance it will be confused with its two other congeners. There is some variability in the axial and spiral sculpture. The anterior siphonal canal (Fig. 1H) is present in adults with fully developed outer lips but is usually lacking in immature or broken specimens. Live-collected shells have a translucent, glistening, white color (Fig. 1A) while shells of dead animals tend to be more chalky and opaque (Fig. 1B, C).

The four specimens I examined from Tosa, Japan (ANSP 243278) are larger than those from Australia and average about 11 mm in length. They also have shallower anterior siphonal canals and broader apertures. Although they may differ enough to constitute a separate species, I am reluctant to make a decision until more comparative material from Japan is available. Should they prove to be distinct, the geographic range of *Glyptozaria opulenta* would be considerably diminished. In this paper, I regard them to be conspecific.

Nomura and Niino (1940:68–69, pl. 1, fig. 3) described *Bittium urasimanum*, a deep-water species dredged off the coast of Hukui Prefecture in the Japan Sea, which is similar to *Glyptozaria opulenta* but differs by lacking strong spiral sculpture and a cancellate appearance.

Glyptozaria opulenta somewhat resembles the turritellid species *Colospira curialis* (Hedley, 1907); however, the sculptural details of the latter are quite different and it lacks an anterior siphonal canal.

Biology and distribution.—This species lives in depths ranging from 72–531 meters. Garrard (1972:332) cited a depth range of 115–155 meters but the specimens examined from deep water off Queensland were all taken in deeper depths of 284–531 meters. The substrate was a fine gray mud. The radula, large stomach, and fecal pellets point to detrital or deposit feeding. The small, bulbous, unsculptured protoconch or embryonic shell (Fig. 1F, G) with straight lip indicates a direct development (see Jablonski and Lutz, 1980:331). This species and its two congeners appear to be confined to the Indo-west-Pacific. *Glyptozaria* is recorded mostly from East Australia but also occurs as far south as Melbourne. I note only one record from Japan.

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NEW SPECIES OF *SATHODRILUS* HOLT, 1968, (CLITELLATA: BRANCHIOBDELLIDA) FROM THE PACIFIC DRAINAGE OF THE UNITED STATES, WITH THE SYNONYMY OF *SATHODRILUS VIRGILIAE* HOLT, 1977

Perry C. Holt

Abstract.—Four new species of the genus *Sathodrilus* Holt, 1968, are diagnosed, described, illustrated, and their ranges given. *Sathodrilus virgiliae* Holt, 1977, is shown to be a junior subjective synonym of *Cambarincola inversa* Ellis, 1919. *Sathodrilus lobatus* Holt, 1977, includes *Sathodrilus wardinus,* new species. Other new species treated are *S. attenuatus, S. chehalisae,* and *S. shastae.*

Some years ago a report was published on members of the genus *Sathodrilus* Holt, 1968, from the Pacific Northwest of the United States (Holt, 1977). Since that work further new species have been recognized among the materials in the collections, and to present them and to reduce to synonymy a name (*Sathodrilus virgiliae*) proposed in the paper mentioned is the purpose of this report.

Methods of handling and presenting material have been recorded before (i.e., Holt, 1977:116). All measurements are given in millimeters with the extremes of a series enclosed in parentheses.

Holotypes are deposited in the collections of the National Museum of Natural History; all other specimens are in my collections at Virginia Polytechnic Institute and State University (identified with the initials ''PCH''). Unless otherwise stated, all collections used were taken by Virgie F. Holt and me.

My thanks are due the National Science Foundation and Virginia Polytechnic Institute and State University for financial support; to my wife, Virgie F. Holt, for various types of assistance; to Dr. Horton H. Hobbs, Jr., for host identifications, reading the manuscript and over three decades of friendly encouragement.

Sathodrilus Holt, 1968

Type-species.—*Sathodrilus carolinensis,* by original designation.

Diagnosis.—See Holt, 1977:16–17.

Sathodrilus attenuatus, new species
Fig. 1

Type-specimens.—Holotype, USNM 65227, and 36 paratypes, PCH 1113, taken on *Pacifistacus* (*Pacifastacus*) *leniusculus klamathensis* (Stimpson, 1957) from Elk Creek, about 12.6 miles south of Cottage Grove, Douglas County, Oregon, 11 July 1960.

Diagnosis.—Slender, medium-sized worms (holotype 3.0 mm long); no dorsal ridges; lips entire; no oral papillae; jaws slight, subrectangular *en face* view, dental formula 4/4–(?) 5/4; bursa small, subspherical; spermiducal gland flexed, U-shaped, with prominent deferent lobes; prostate short, non-differentiated; spermatheca with long ectal duct, long clavate bulb, no ental process.

Entymology.—Latin, *thinned, stretched out,* in reference to the slender body of the animals.

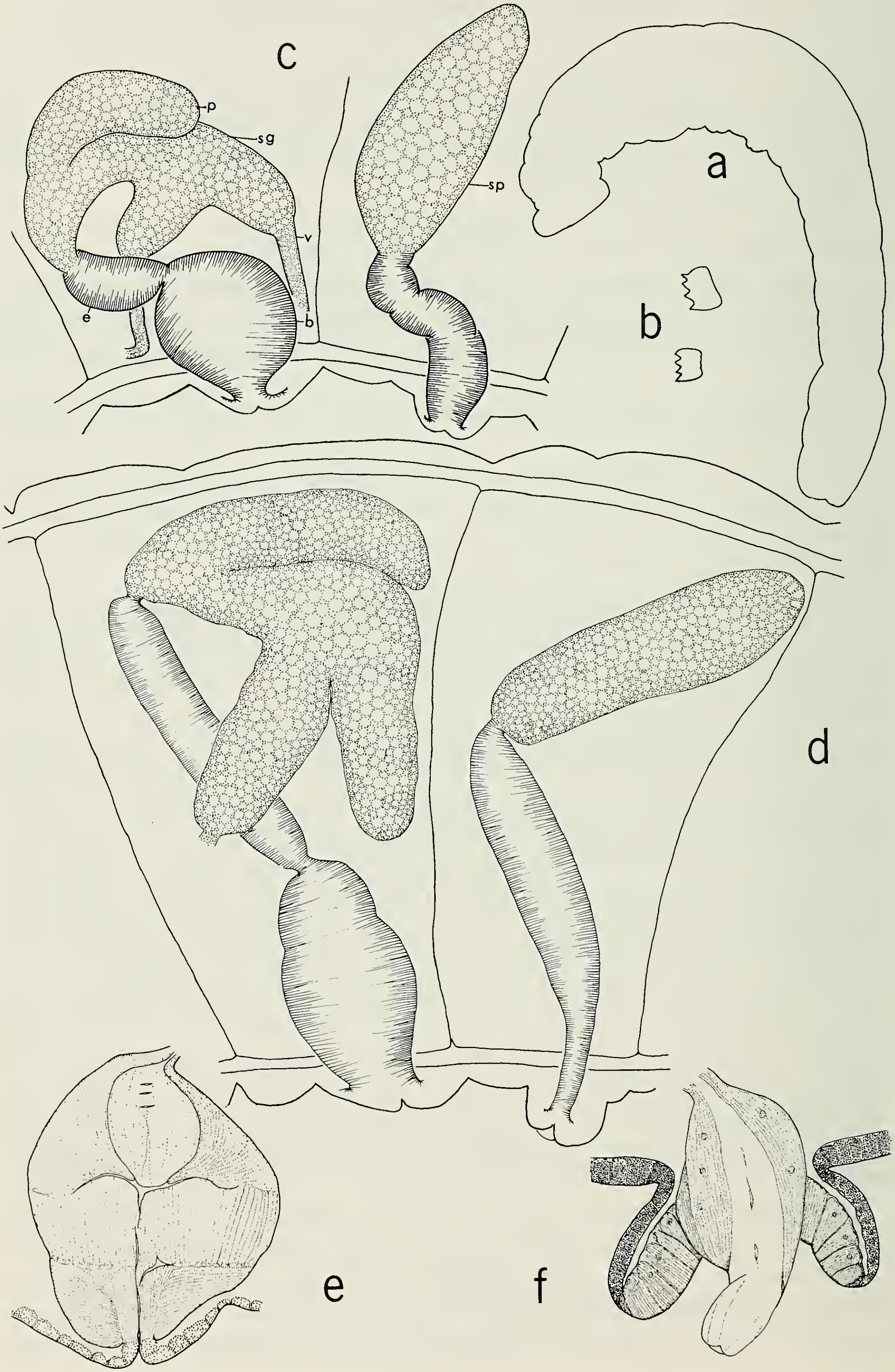
Description.—Members of *Sathodrilus attenuatus* are small to medium-sized worms of slender appearance, increasing from segment I gradually in diameter to the greatest thickness in segment VIII. The head, slightly greater in diameter than segment I, is also slender.

The holotype and 4 paratypes have the following dimensions: total length, 2.7 (2.2–3.1); greatest diameter, 0.4 (0.4–0.5); head length, 0.5 (0.4–0-5); head diameter, 0.2 (0.2–0.3); diameter, segment I, 0.2 (0.2–0.2); diameter, sucker, 0.3 (0.2–0.3).

The lips are entire, except for the lateral indentations that form them. There are no oral papillae. Dorsal ridges are absent and the body outline is consequently relatively smooth, though the sulci that demarcate the segments and posterior annuli of segments are usually distinct. The head is slender and tapers towards the mouth; the peristomial sulcus is shallow; an indistinct external sulcus of the head is present slightly anterior to the level of the single pharyngeal sulcus. The anterior nephridiopore is undetectable in well prepared whole mounts. The clitellum is thin, but distinct.

The jaws are proportionately small: of the usual triangular shape in lateral view; subrectangular *en face* view. They are light yellow. The dental formula is difficult to determine: the teeth are small and in some specimens a lateral tooth of the upper jaw is not easily seen, if indeed it is present, but the dental formula may be 5/4, though the paratype from which the jaws were drawn (Fig. 1) and most specimens in which the teeth can be counted appear to have only 4 teeth on the upper jaw.

The spermiducal gland is about ⅔ the body diameter in total length, but usually lies longitudinally in the coelom and its dorsal border reaches only a short distance beyond the mid-portion of the segment. Entally, the vasa deferentia widen to form 2 large and prominent deferent lobes; ectally, the spermiducal gland decreases in diameter towards its junction with the ejac-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ulatory duct. The prostate arises some distance entad to this junction, is non-differentiated, relatively short, ending entally at about the mid-length of the spermiducal gland and lacks an ental bulb.

The ejaculatory duct is thick with an expanded lumen. The subspherical bursa is small, its dorsal border hardly, if at all, extending beyond the ventral border of the gut; the retracted penis is about ⅓ of that of the bursa in length and relatively short in the everted position (Fig. 1f). The bursal atrium is filled with a thick atrial fold (Fig. 1e).

The spermatheca is not unusual. Its ectal duct is long and bent underneath the gut; the bulb is elongated, clavate to cylindrical, and extends approximately to the dorsal border of the gut. There is no ental process, but the wall of the ental end may be thickened (Fig. 1c).

Variations.—The uncertainty in the number of teeth borne by the upper jaw, reflecting a possibly real variation, has been mentioned. The prostate may lie in a plane different from that of the spermiducal gland, appearing to be a branch of the latter as in *S. inversus* (Holt, 1977:130). The bulb of the spermatheca is of irregular outline ("wrinkled") in some specimens and has a rudimentary ental process (Fig. 1c) in others. The usual differences associated with position of structures and degree of contraction at death are apparent.

Affinities.—The closest relative of *S. attenuatus* is *S. inversus* (Ellis, 1912). The latter has a dorsal ridge on segment VIII, a dental formula of 5/4 with a triangular upper jaw; a larger spermiducal gland without deferent lobes; a longer bursa enclosing a longer, more membranous penis; and a thin-walled median portion of the spermatheca. (But compare *S. chehalisae* below.)

Hosts.—*Pacifastacus* (*P.*) *leniusculus leniusculus* (Dana, 1852), *P. l. klamathensis.*

Distribution.—Streams of the Cascade and Coastal Ranges in Oregon and Washington to the headwater streams of the Snake River in Wyoming.

Material examined.—OREGON: 3 specimens, PCH 1111, taken on *P. l. klamathensis* from Myrtle Creek, 1.2 miles west of Tiller, Douglas County, 11 July 1960; 9 specimens, PCH 1112, taken on *P. l. klamathensis* from North Fork of Umpqua River at Winchester, Douglas County, 11 July 1960; type-series; 13 specimens, PCH 1114, taken on *P. l. klamathensis* from Row

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Fig. 1. *Sathodrilus attenuatus*: a, Lateral view of holotype; b, *En face* view of jaws of a paratype; c, Lateral view of reproductive systems of holotype (b, bursa; e, ejaculatory duct; p, prostate; sg, spermiducal gland; sp, spermatheca; v, vas deferens); d, Lateral view of reproductive systems of specimen from Yakima County, Washington; e, Optical section through bursa and penis of a paratype; f, Optical section of everted bursa and penis of a specimen from Yakima County, Washington.

River, 2.0 miles east of Cottage Grove, Lane County, 11 July 1960; 6 specimens, PCH 1117, taken on *P. l. leniusculus* from Mary's River, 4.8 miles southeast of Blodgett, Benton County, 12 July 1960; 2 specimens, PCH 1119, taken on *P. l. klamathensis* from a small stream, 14.4 miles east of Toledo, Lincoln County, 12 July 1960; 9 specimens, PCH 1121, taken on *P. l. leniusculus* from Siletz River, 24.3 miles southeast of Kernville, Lincoln County, 12 July 1960; 12 specimens, PCH 1124, taken on *P. l. klamathensis* from South Yamhill River, 1.6 miles west of Valley Junction, Polk County, 13 July 1960; 2 specimens, PCH 1126, taken on *P. l. klamathensis* from Little Pudding Creek, 7.9 miles southwest of Silverton, Marion County, 13 July 1960. WASHINGTON: 5 specimens, PCH 1120, taken on *P. l. klamathensis* from Gray's River, 21.0 miles east of Gray's River, Wahkiakum County, 14 July 1960; 4 specimens, PCH 1133, taken on *P. l. klamathensis* from Humptulips River at Humptulips, Gray's Harbor County, 16 July 1960.

Remarks.—I have 5 specimens, PCH 1501, taken on *Pacifastacus gambelli* (Girard, 1852) from Crawfish Creek at the base of Moose Falls, Yellowstone National Park, Wyoming, summer 1961, by R. C. Powell, that differ from those of *S. attenuatus* in being somewhat shorter and more corpulent in appearance, with more prominent external sulci of the head and an additional internal sulcus that is probably the result of a greater degree of contraction. Internally, the ejaculatory duct of the Yellowstone specimens appears to be longer than that of *S. attenuatus* and there is possibly an ental bulb of the prostate. The jaws of these specimens are difficult to interpret; they may be triangular *en face* view with a 1/2 or 3/4 dental formula.

Four specimens, PCH 1811, taken on *Pacifastacus* (*P.*) *l. klamathensis* from the Naches River at the confluence of the Naches and Tieton Rivers, Yakima County, Washington, 13 August 1964, were also thought at first to represent a new species. The spermatheca of one of these specimens has an exceedingly long ectal duct and is set off from the spermathecal bulb by a constriction. The ejaculatory duct is long and there is no ental bulb of the prostate. The apparent differences in the reproductive systems of the members of these populations from those of *S. attenuatus* are subtle (Fig. 1c, d) and until additional material is available they are best regarded as possibly geographical variants, but more likely further study will reveal that the apparent differences are intra-populational throughout the range of the species.

Note.—This species was omitted from the earlier account (Holt, 1977) because in my initial studies of the material collected in 1960 I assigned the species to the genus *Cambarincola*. As the years passed, the concepts of the genera *Sathodrilus* and *Cambarincola* have been refined and *attenuatus* must be placed in *Sathodrilus* as the genus is now understood. There are many congeners native to other areas of the species treated herein and the limits of the genera concerned may shift as these species are accorded proper treatment.

Sathodrilus chehalisae, new species
Fig. 2a–c

Type-specimens.—Holotype and 7 paratypes, USNM 65228; 4 paratypes, 1 serially sectioned, PCH 1813, taken on *Pacifastacus* (*P.*) *leniusculus trowbridgii* (Stimpson, 1857) from Chehalis River at Adna, Lewis County, Washington, 15 August 1964.

Diagnosis.—Small worms (holotype 1.8 mm in length); no dorsal ridges; head without external sulci, except peristomial one; upper lip with 4 short, blunt lobes, lower (?) entire; no oral papillae; one internal pharyngeal sulcus; jaws small, medium dark brown, dental formula 3/2; bursa small, subglobose, about ⅓ body diameter in length, penial sheath about ½ total bursal length; spermiducal gland less than body diameter in length, without deferent lobes; prostate about ⅔ spermiducal gland in length, subequal to latter in diameter, with indistinct ental bulb; spermatheca greater than body diameter in length, spermathecal bulb elongate clavate, about ⅔ of total organ in length, with obscure short ental process.

Etymology.—For the Chehalis River.

Description.—The average dimensions of the holotype and 4 paratypes of *S. chehalisae* are as follows: total length, 1.8 (1.7–2.1); greatest diameter, 0.3 (0.2–0.3); head length, 0.3 (0.3–0.3); head diameter, 0.2 (0.2–0.2); diameter, segment I, 0.2 (0.2–0.2); diameter, sucker, 0.2 (0.1–0.3).

The anterior annuli of the body segments are slightly greater in diameter than the posterior ones, but the supernumerary muscles of these annuli are very slight and difficult to detect in intact specimens. The clitellum is not prominent; the anterior nephridiopore is undetectable in material mounted entire. The upper lip bears 4 short, blunt lobes that are easily overlooked, the lower has no detectable lobes and the peristomium as a whole is often slightly expanded (campanulate). There are no external sulci of the head, except the peristomial one.

There are no oral papillae. The jaws are triangulate, medium brown in color and relatively small; bearing on the upper one a prominent median tooth and 2 obscure lateral teeth, on the lower 2 distinct paramedian teeth.

The spermiducal gland is of modest proportions and lacks deferent lobes. The prostate arises at about the level of the ectal third of the spermiducal gland, is subequal to the latter in diameter, non-differentiated, and ends entally in an obscure ental bulb at the level of the ental end of the spermiducal gland.

The ejaculatory duct is a relatively long slender tube without any distinctive features and is difficult to distinguish in animals mounted entire.

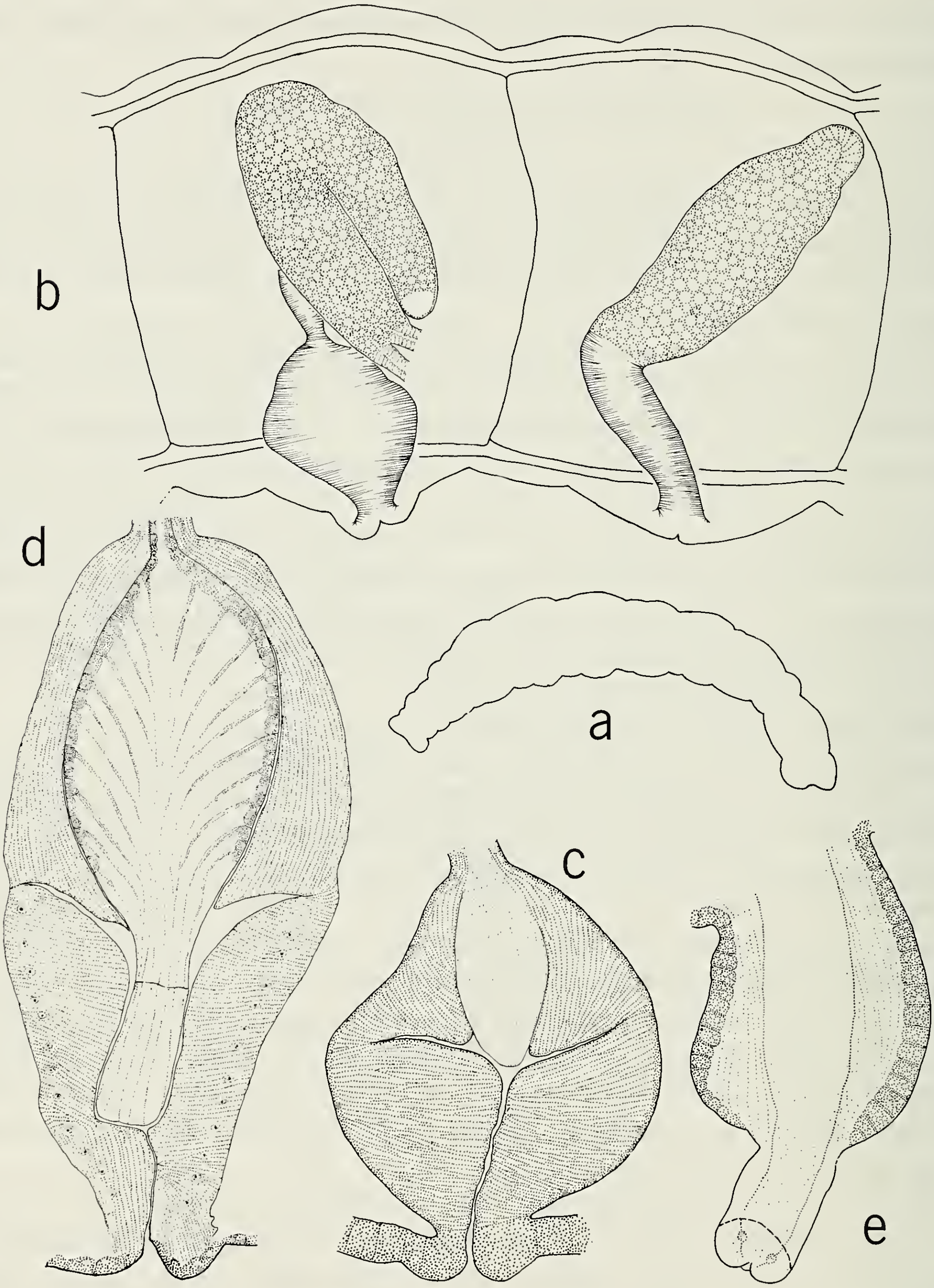


Fig. 2. *Sathodrilus chehalisae*: a, Lateral view of holotype; b, Lateral view of reproductive systems of holotype; c, Optical section of bursa and penis. *Sathodrilus inversus*: d, Optical section of bursa and penis of specimen from Yakima County, Washington; e, Optical section everted bursa and penis of specimen from Benton County, Oregon.

The atrial region composes most of the bursa; the penial sheath is a thin layer of muscle composing the ental end of the bursa and enclosing a short, but distinctly membranous, penis (Fig. 2c).

The spermatheca is composed of a relatively long, slender ectal duct, an elongate bulb and an obscure ental bulb. The spermathecal bulb is inclined anteriad and its wall, variously "twisted" or wrinkled, is composed of the usual thin epithelial layer. The ental process of the organ is less in diameter than the bulb, relatively short and composed of a layer of taller epithelial cells.

Variations.—The number of teeth borne by the jaws is somewhat uncertain, though confirmed by the number in a specimen sectioned tranversely: in immature animals the dental formula may be 5/4. Otherwise, no variations other than the usual ones of different degrees of contraction at death were noted.

Affinities.—*Sathodrilus chehalisae* has the general facies of *S. inversus*: the two species are closely related in the sense of being of similar appearance; indeed, specimens of *S. chehalisae* were passed by at first as specimens of the latter. The lips of *S. chehalisae* are more often expanded than those of *S. inversus* and its jaws are darker and somewhat larger. There is no detectable dorsal ridge of segment VIII in *S. chehalisae*. The spermiducal gland of the latter is proportionately smaller and its prostate is adherent to the spermiducal gland and has an indistinct prostatic bulb. The bursa of *S. chehalisae* is smaller (? shorter) and the ejaculatory duct, though not of uniform diameter throughout, lacks a distinct median expansion. *S. attenuatus,* another close relative of *S. chehalisae,* differs, among other features, in jaw structure and the absence of a prostatic bulb.

Host.—*Pacifastacus* (*P.*) *leniusculus trowbridgii.*

Material examined.—The type-series.

Sathodrilus inversus (Ellis, 1919), new combination
Fig. 2d, e

Cambarincola inversa Ellis, 1919:259–260.
? *inversa,* Hoffman, 1963:294.
Sathodrilus virgiliae Holt, 1977:128–131.

Type-specimens.—USNM 16780, Eugene, Oregon, taken on Astacus [=*Pacifastacus*] *klamathensis* by J. E. Gutberlet (from Ellis, 1919:259); paratypes: "Five, Cat. No. 17680, U.S.N.M., and 15 others collected with the type" (Ellis, 1919:259).

Diagnosis.—"Small slender worms . . . ; body outline smooth, segment VIII [often] with obscure dorsal ridge with minute supernumerary muscles; upper lip with 4 short lobes, lower lip entire; no oral papillae; jaws small, light brown, dental formula 5/4; bursa long, cylindrical, slightly greater than

⅔ body diameter in length, penial sheath about ½ total bursal length; spermiducal gland large, approximately twice the body diameter in length; prostate about ½ spermiducal gland in length, usually not adherent to latter; spermatheca with long ectal duct; long spermathecal bulb, no ental process'' (Holt, 1977:128).

Remarks.—Hoffman (1963:294), working in my laboratory, recognized that Ellis's species *inversa* was not a member of the genus *Cambarincola* and promised with my concurrence that I would erect a new genus for it. In the interval extending over about 14 years between his work and my paper (Holt, 1977) describing species of the genus *Sathodrilus* from the Pacific Northwest, this promise was forgotten. It was only after my paper was printed that I remembered I had not seen specimens of Ellis's species again in my collections: specimens that both Hoffman and I had compared with the types. The types were again sent me from the National Museum of Natural History and as I feared *S. virgiliae* is a junior subjective synonym of *inversus*. Hoffman's promise has been kept and my gross error corrected.

Ellis (1919:259) only illustrated the jaws of *S. inversus*. These illustrations and his description fit my specimens and agree with my shorter independent account. The number of teeth are variable, as Ellis maintained. His discussion of the size and shape of the body accords well with mine. His report also includes non-diagnostic comments about the gut and the statement that the spermatheca is ''simple, long, and tubular . . . .'' The dorsal ridge on segment VIII (Holt, 1977:130) was not noticed by Ellis and is often obscure.

Material examined (additions to the previous records (Holt, 1977:131)).—OREGON: 1 specimen, PCH 1117, taken on *P.* (*P.*) *l. leniusculus* from Mary's River, 4.8 miles east of Blodgett, Benton County, 12 July 1960. WASHINGTON: 15 specimens, PCH 1142, taken from a small stream, 7.2 miles east of Ellensburg, Kittitas County, 18 July 1960; 10 specimens, PCH 1811, taken on *P.* (*P.*) *l. klamathensis* from Naches River, 5.0 miles northwest of Naches, Yakima County, 13 August 1964; 8 specimens, PCH 1812, taken on *P.* (*P.*) *l. klamathensis* from the outflow of Lake Kachess, about 16 miles west of Cle Elum, Kittitas County, 13 August 1964.

Drawings (Figs. 2d, e) of optical sections of the penes of two specimens are included in this account for comparison with similar illustrations for other species. Compare, for instance, the corresponding illustrations for *S. attenuatus* (Figs. 1e, f) above.

Sathodrilus shastae, new species

Fig. 3a–e

Type-specimens.—Holotype, USNM 65230, and 4 paratypes, PCH 1818, taken on *Pacifastacus* (*Hobbsastacus*) *fortis* (Faxon, 1914) from the headwaters of Fall River, Thousand Springs Ranch, Shasta County, California, 19 August 1964.

Diagnosis.—Medium-sized worms (holotype 3.8 mm in length); lips entire; no oral papillae; no dorsal ridges; dental formula 1/1; bursa elongate, fusiform; penial sheath not externally delimited, about ½ bursa in length; penis membranous tube, lying partially free in bursal atrium; ejaculatory duct long, thick; spermiducal gland slender, long, exceeding twice body diameter in length, with anterior deferent lobe, no prostate; spermatheca spatulate with short ectal duct, obscure ental process.

Etymology.—For Mount Shasta. The type-locality is a spring fed by the melting of snow on Mount Shasta and issues through the lava debris at the foot of the mountain.

Description.—*Sathodrilus shastae* is composed of medium-sized worms. The holotype and 4 paratypes have the following dimensions: total length 3.8 (3.5–4.4); greatest diameter, 0.8 (0.5–0.8); head length 0.7 (0.6–0.9); head diameter 0.5 (0.4–0.7); diameter, segment I, 0.5 (0.4–0.6); diameter, sucker, 0.5 (0.4–0.7).

The lips are entire and there are no oral papillae. Other than the peristomial one, there is a very shallow external sulcus of the head at the level of the posterior of the 2 pharyngeal sulci. There are no dorsal ridges. The clitellum is not unusual.

The jaws are prominent, triangular *en face* view and bear one prominent tooth each at the apex. Slight undulations of the jaws may give the impression of lateral teeth, but none could be unambiguously found.

The spermiducal gland is remarkably long, approximately twice the diameter of segment VI, and relatively slender. The posterior vas deferens enters the gland somewhat ectad of its ental end, thereby producing a short, but prominent anterior deferent lobe. There is no evidence of a prostate or prostatic protuberance.

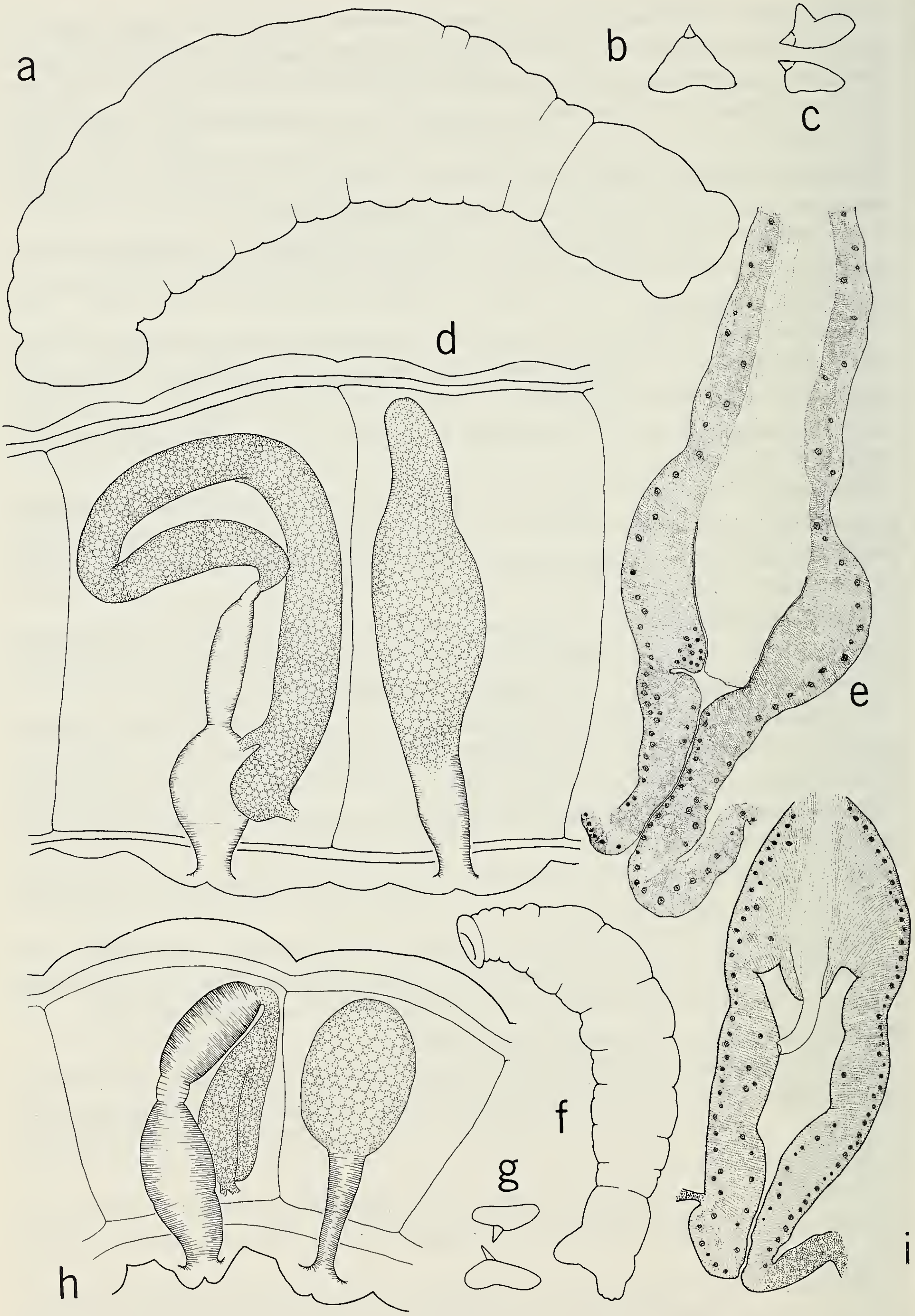
The ejaculatory duct is of medium proportionate length and is notably muscular and thick.

The atrial region of the bursa is reduced, appearing as the ectal outlet duct of the organ. The penial sheath is greater in diameter than the ectal portion of the bursa and subequal in length. The penis projects into a reduced atrial cavity as a membranous tube.

The spermatheca is composed of a relatively short ectal duct, a fusiform bulb which is clearly seen in serial sections as flattened between the gut and body wall, and a narrow ental portion which extends dorsad of the gut as an obscure ental process.

Variations.—None of note in the available material. As is usual the spermiducal gland and spermatheca may assume slightly different positions within the coelom.

Affinities.—The relatives of *S. shastae* must be sought among its congeners without prostates and all of these are found in regions remote from northern California. *S. norbyi* from the Snake River drainage is a much smaller worm with a minute prostate or prostatic protuberance and is oth-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erwise rather unlike *S. shastae*. Other members of the genus from the Pacific Northwest have patent prostates and in various ways each is quite unlike *S. shastae* (Holt, 1977:120–131).

Among the species without prostates or prostatic protuberances, *S. veracruzicus* Holt, 1968, is Mexican, and *S. hortoni* (Holt, 1973) and *S. okaloosae* are from Florida. These three species are all small worms, about ½ the size of *S. shastae,* have dental formulae of 5/4 or 1/4, with jaws very much unlike those of *S. shastae* which resemble those of some species of *Cambarincola*. They also differ in various features of the spermathecae and the proportions of the male efferent apparatus.

Sathodrilus megadenus Holt, 1968, from Haralson County, Georgia, is of approximately the same size with approximately the same exterior appearance as *S. shastae,* but differs in several respects: there is small prostatic protuberance borne on the long spermiducal gland which lacks deferent lobes; the bursa is proportionately larger; the spermatheca has a much more pronounced ental process (Holt, 1968:302–305). As noted before, the determination of true (phylogenetic) relationships of branchiobdellids at this stage of our knowledge of them is uncertain at best.

Host.—Pacifastacus (*H.*) *fortis.*

Material examined.—The type-series and an animal serially sectioned.

Sathodrilus wardinus, new species

Fig. 3f–i

Sathodrilus lobatus Holt, 1977 (in part).

Type-specimens.—Holotype and one paratype, USNM 65229; 5 paratypes, PCH 921, taken on *Pacifastacus* (*P.*) *leniusculus klamathensis* from Purdy Creek, 6.0 miles north of Gig Harbor, Pierce County, Washington, by Darwin E. Norby, 26 June 1959.

Diagnosis.—Small worms; body outline smooth; peristomium campanulate, upper lip with 6, lower with 2 lobes, laterally 4 lobes; no oral papillae; jaws small, dark brown, dental formula 3/2; bursa cylindrical, slender, about ½ body diameter in length, penial sheath about ⅔ of bursal length; ejaculatory duct subequal to bursa in diameter; spermiducal gland slender, about ⅔ body diameter in length; prostate subequal to spermiducal gland in di-

←

Fig. 3. *Sathodrilus shastae*: a, Lateral view of holotype; b, *En face* view of upper jaw of a paratype; c, Lateral view of jaws of a paratype; d, Lateral view of reproductive systems of holotype; e, Median section of bursa, penis, and ental end of ejaculatory duct of a paratype. *Sathodrilus wardinus*; f–h, holotype: f, Lateral view of entire animal; g, Lateral view of jaws; h, Lateral view of reproductive systems. i, Specimen from Pierce County, Washington, median section of bursa and penis.

ameter, about ⅔ length of latter; spermatheca with long, narrow ectal duct subglobose bulb, no ental process.

Etymology.—An anagram; perhaps best regarded as an arbitrary combination of letters.

Description.—Small worms, the holotype is about 2.0 mm in length; it and 4 paratypes have the following dimensions: total length, 2.0 (1.8–2.2); greatest diameter, 0.4 (0.3–0.4); head length, 0.4 (0.4–0.5); head diameter, 0.2 (0.2–0.3); diameter, segment I, 0.2 (0.2–0.3); diameter, sucker, 0.2 (0.2–0.3).

The body outline is smooth. Though the major annulation of segment VIII is noticeably, though not greatly raised, there are no supernumerary muscles present. There is a single external sulcus of the head at about the level of the single pharyngeal one, but it is very shallow and often not readily noticed. The peristomium is flared, campanulate, often much more than in the holotype. The upper lip bears 4 blunt lobes, the lower 2, and 2 lateral lobes are usually apparent on each side. Oral papillae are absent. The jaws are small and dark and it is difficult to determine the dentition in most specimens mounted entire, but in one sub-mature animal the jaws are light in color and the teeth clearly seen: the dental formula is 3/2.

The spermiducal gland is distinctive. In length it is subequal to the coelom in which it lies, about ⅔ the total diameter of segment VI. Throughout rather slender, it is rounded at the point of entry of the vasa deferentia, expands slightly and tapers to a narrow, obscure tube at its junction with the ejaculatory duct. The ental end of the prostate is marked by a small, clear prostatic bulb and reaches the ental end of the spermiducal gland to which it closely adheres. The prostate is about ⅓ the length and diameter of the spermiducal gland.

The ejaculatory duct is a thick muscular tube except at the constrictions at its junctions with the spermiducal gland and the penial sheath of the bursa. The duct itself is composed of an outer epithelial layer, a thick layer of muscle fibers oriented lengthwise of the duct and an inner epithelium, presenting in sections a noticeable resemblance to the structure of the penial sheath.

The penial sheath is more than ½ the total length of the bursa in length and the bursa as a whole is rather slender, ⅜ its own length in diameter, and elongated, approaching ½ the body diameter in length. The atrium of the bursa is expanded and the penis projects into it as a slender, membranous tube.

The spermatheca consists of a long, slender ectal duct and an expanded, ovoid bulb, without any evidence of an ental process.

Variations.—In some specimens from Minter Creek, Pierce County, Washington, the spermathecal bulb is not expanded and appears as a thick walled, closed entally, tube. No other variations, other than the usual ones of size, degrees of contraction and slight variations in position of the reproductive organs were noted.

Affinities.—*Sathodrilus wardinus* is superficially remarkably similar to *S. lobatus* Holt, 1977, and, without a careful study of the reproductive systems, is easily confused with the latter. The campanulate and extensively lobed peristomia of both species present almost identical appearances. They differ in the number of lobes: 6 dorsal, 3 lateral on each side and 2 ventral for a total of 14 in *S. lobatus*; while *S. wardinus* is furnished with only 4 dorsal lobes, 2 lateral ones on each side and 2 ventral ones for a total of 10. The jaws of the two species are similar, but apparently differ in the number of teeth they bear: the dental formula of *S. wardinus* is questionably 3/4; that of *S. lobatus,* 5/4. The spermiducal gland of *S. wardinus* is smaller and shorter and the spermatheca is of the common pattern of ectal duct and expanded bulb, while the spermatheca of *S. lobatus* is distinctive with a long and thick ectal duct, a fluid filled expanded median portion and a long, slender "ental process" always filled with spermatozoa.

Hosts.—*Pacifastacus* (*P.*) *leniusculus klamathensis*; *P.* (*P.*) *l. trowbridgii.*

Distribution.—*Sathodrilus wardinus* is known only from two locations in Pierce County, Washington, among the eastern foothills of the Olympic Mountains. *S. lobatus* is common on the Olympic Peninsula and the two very similar species may be sympatric.

Material examined.—The type-series; 8 specimens, PCH 923, mounted entire 2 serially sectioned ones; typotypes, taken by Darwin E. Norby, 13 July 1959; 3 specimens, PCH 1139, taken on *P.* (*P.*) *l. trowbridgii* from Minter Creek, 3.8 miles west of Wauna, Pierce County, Washington, 17 July 1960 (assigned to *S. lobatus* Holt, 1977:125).

Note

This is the eighth and possibly the last of a series of papers on the branchiobdellids of the Pacific Drainage of the Northwestern United States. There remain in my collections some scattered materials, some perhaps "lost" in the collections, but mostly that sent to me by students of crayfish. Among these people I want to especially thank Mr. William H. Clark for his efforts, though most of his material is unidentifiable. (Students of fishes and crayfishes tend to collect their material in poor fixatives—for branchiobdellids—and to overfill their collecting bottles. I regret this.)

There are other single specimens, identified in the collections, that I have chosen to omit. Perhaps later I can bring all of these materials together, though I know that the materials on which all these reports are based are but a random sample of the branchiobdellid fauna of the Pacific Drainage.

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OCCURRENCE OF *MYSIDOPSIS ALMYRA* BOWMAN, 1964 (MYSIDACEA) IN THE PATAPSCO RIVER ESTUARY (UPPER CHESAPEAKE BAY), MARYLAND, U.S.A.

Stephen A. Grabe

Abstract.—*Mysidopsis almyra* Bowman has been reported from estuarine waters of eastern Mexico (Price, 1978), northwards around the perimeter of the Gulf of Mexico, south to the Florida Everglades (Stuck *et al.*, 1979), and from the St. Johns' River on Florida's Atlantic coast (Price and Vodopich, 1979). Stuck *et al.* (1979) noted that *M. almyra* was the dominant mysid in oligohaline-mesohaline areas of Gulf of Mexico estuaries. This note documents the occurrence of *M. almyra* from the Patapsco River (39°10′N, 76°28′W), a tributary of the upper Chesapeake Bay and extends the northern range ca. 1300 km. Specimens have been identified by Dr. T. E. Bowman and are deposited in the United States National Museum of Natural History, Washington, D.C.

Mysidopsis almyra was collected during each of the first 4 dates (10 and 25 July, 13 August, and 10 September 1980) of a one year program designed to examine spatial and temporal distribution of macroplankton in the Patapsco River. Collections were made at 3 stations ca. 3 m in depth and one station ca. 1.5 m in depth during both day and night flood and ebb tides. 0.505 mm mesh nets were mounted in a 60-cm bongo frame and towed at near-surface (deeper stations only) and near-bottom depths; the bongo frame was mounted in an epibenthic sled for near-bottom collections. Sample volume averaged 104 m^3 (range: 32 to 143 m^3). Temperature, dissolved oxygen, salinity and pH were measured with each collection.

Densities of *M. almyra* ranged from 0 to 6900 1000 m^{-3}. On 10 September densities averaged 1100 1000 m^{-3} for 55 samples. *Mysidopsis almyra* was the dominant species on this date, making up >49% of the invertebrate macroplankton. The population structure on 10 September was: ♀♀ 57.5% (brooding ♀♀ 19.1%); ♂♂ 23.6%; juveniles 23.4%, The male : female sex ratio was 0.4:1. *Mysidopsis almyra* was rare on the July and August dates. The population structure in the Patapsco River was quite similar to other areas reported in the literature (Price, 1978; Price and Vodopich, 1979; Stuck *et al.*, 1979a) in that sexually mature females were predominant. Sex ratios in other studies were also similar to that found in this study: 0.3:1 and 0.4:1

Table 1.—Mean abundance (no. 1000 m^{-3}) of *Mysidopsis almyra* by sample depth, photoperiod, and tide from the Patapsco River, Maryland, 11 July to 10 September 1980.

	Collection depth		Photoperiod		Tide	
	Surface	Bottom	Day	Night	Flood	Ebb
Surface	—	—	2	418	145	263
Bottom	—	—	57	652	444	261
Day	—	—	—	—	53	13
Night	—	—	—	—	598	511
Mean	206	352	33	553	318	262

in Price (1978), 0.5:1 (Price and Vodopich, 1979) and a mean male : female ratio of 0.6:1 for 17 sites reported by Stuck *et al.* (1979a).

Mysidopsis almyra was more abundant in near-bottom collections and on flood tides (Table 1). The change in vertical stratification by photoperiod (Table 1) indicated that *M. almyra* undergoes nocturnal vertical migrations.

Clutch size of brooding females was measured on 13 August (n = 16) and 10 September (n = 291). Clutch size averaged 13.4 eggs (range: 5–26) and 12.2 larvae (range: 2–24). These clutch sizes are somewhat larger than those reported by Price (1978) for Galveston Bay, Texas ($\bar{x}$ = 5.4; range: 3–10) and Mexico ($\bar{x}$ = 9.0; range: 4–15), and by Price and Vodopich (1979) for the St. Johns' River, Florida ($\bar{x}$ = 4.0; range: 3–6).

Sediments at the deeper stations were generally a very fine silt covered with a thin, yellow-brown flocculent layer. At the most bayward station coarse sand was also found. The littoral station had areas of silt, sand, herbaceous debris, and hydroids. Ranges of physicochemical parameters on 10 September were: temperature 23.7–28.8°C; dissolved oxygen 4.7–16.0 mg l^{-1}; salinity 8.7–13.0‰; pH 6.9–9.0. The most abundant macroplankton species, other than *M. almyra,* on the 10 September date were: *Rhithropanopeus harrisii* (Decapoda, Xanthidae) larvae (457 1000 m^{-3}), *Lironeca ovalis* (Isopoda, Cymothoidae) juveniles (184 1000 m^{-3}), *Argulus alosae* (Branchiura) (148 1000 m^{-3}), and *Neomysis americana* (Mysidacea) (126 1000 m^{-3}).

Whether *M. almyra* inhabits other Atlantic coast estuaries north of Florida is open to conjecture. The only long-term coastal/estuarine study in which mysids were studied was Williams' (1972) decade-long investigation in North Carolina; *M. almyra* was not found in this study, nor by Hopkins (1965), nor by Wigley and Burns (1971) in their extensive treatment of Atlantic coast mysids.

Acknowledgments

Appreciation is extended to Dr. T. E. Bowman for identifying *M. almyra* and to both the Maryland Power Plant Siting Program and Normandeau

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CALASELLUS LONGUS, A NEW GENUS AND SPECIES OF TROGLOBITIC ASELLID FROM SHAVER LAKE, CALIFORNIA (CRUSTACEA: ISOPODA: ASELLIDAE)

Thomas E. Bowman

Abstract.—A new genus, *Calasellus,* is proposed for *Asellus californicus* and a new species from Shaver Lake, Fresno Co., California, *C. longus.* The latter is described and illustrated and compared with *C. californicus.* *Calasellus* appears to be most similar to *Asellus* (*Phreatoasellus*) from Japan.

Three species of asellid isopods are known from California. *Caecidotea tomalensis* Harford, 1877, has been collected in 3 counties adjoining San Francisco Bay: Marin, San Francisco, and San Mateo (Bowman, 1974). *Caecidotea sequoiae* Bowman, 1975, has been found only in Liburn Cave, Tulare County. *Asellus* (*Phreatoasellus*) *californicus* (Miller, 1933) has been reported from a well in Lake County and springs in Santa Clara and Napa Counties (Bowman, 1975). The last 2 species are blind and unpigmented troglobites. *Caecidotea tomalensis* is an epigean species.

The new species described herein, the third California troglobitic asellid, is obviously congeneric with *A. californicus,* which I assigned provisionally to the subgenus *Phreatoasellus* Matsumoto, 1962 (Bowman, 1975). The present study has convinced me that the distinctive characters common to both species entitle them to be separated from other Asellidae and placed in a new genus.

Calasellus, new genus

Diagnosis.—Blind, unpigmented. Body slender, elongate. Mandible with 3-merous palp. Maxilla 1 inner ramus with 5 setae. ♂ pereopod 1 propus slender, palm without processes but with several proximal spines. Dactyl of pereopods 2–7 with accessory unguis. ♂ pleopod 2 endopod with basal spur; bulbous base with fissure and labial spur; distal part produced into long cylindrical process; fissure contained in fine stylet (cannula) originating on base and running parallel to cylindrical process. Pleopod 4 exopod pyriform. Pleopod 5 exopod rudimentary or absent.

Type-species.—*Asellus californicus* Miller, 1933.

Etymology.—*Cal* from *Cal*ifornia, + *Asellus.* Gender masculine.

Relationships.—*Calasellus* most closely resembles *Asellus* (*Phreatoasel-

lus) Matsumoto, comprising 5 species from Japan, but Matsumoto's subgenus lacks the accessory unguis on pereopods 2–7, has a very different ♂ pleopod 2 endopod, has an oval pleopod 4 exopod and a well developed oval pleopod 5 exopod.

Calasellus longus, new species
Figs. 1–3

Material examined.—California, Fresno County, Shaver Lake, in Sierra National Forest about 35 miles (56 km) NW of Fresno, elevation 3500 ft (1068 m); collected April 1977 by Michael Lassner in spring box, cold, dark water, depth 2–3 ft: 10 ♂, 1 ♀. A 14 mm ♂ is the holotype (USNM 184223); the other specimens are paratypes (USNM 184224).

Etymology.—From the Latin "longus" = "long," referring to the elongate body and very long antennae 2.

Description.—Body linear, about 5.4× as long as wide; length of largest ♂ 14 mm, of ♀ with small oostegites 8 mm. Coxae visible in dorsal view. All body segments rather setose. Head nearly twice as wide as long in ♂, about 1.5× in ♀; anterior margin slightly concave; postmandibular lobes weakly developed. Telson oval, about 1.4× as long as wide in ♂, 1.3× in ♀; caudomedial lobe moderately developed in ♂, quite low in ♀.

Antenna 1 reaching slightly beyond segment 4 of antenna 2 peduncle; flagellum 9–11-merous; last 8 segments each with esthete. Antenna 2 about 1.5× body length, flagellum with up to 115 segments.

Mandibles with 4-cuspate incisors and lacinia; spine-row with 13 and 14 spines on right and left mandibles; setae on palp rather sparse. Maxilla 1, apex of outer lobe with 13 large spines and 3 subterminal setae; inner lobe with 5 plumose setae. Maxilliped very setose, with 5 retinacula.

Pereopod 1 similar in ♂ and ♀; propus nearly 2× as long as wide, palm straight, without processes, with 2 robust proximal spines; dactyl flexor margin with a few spines on distal half. Pereopods 2–7 slender, elongate, dactyl with accessory unguis.

♂ pleopod 1 slightly shorter than pleopod 2; protopod quadrate, with 3–4 retinacula; endopod about 5.5× as long as protopod and 4× as long as wide, tapering gradually to narrowly rounded apex, medial margin slightly convex, with 6–7 setae on distal half; lateral margin slightly concave, armed with setae except at base. ♂ pleopod 2 protopod about as wide as long, unarmed; exopod proximal segment with 1 lateral seta, distal segment oval with 8 lateral setae and 3 long medial setae, catch lobe well developed; endopod produced into very long slender cylindrical process gradually tapering and curving slightly laterad distally, stylet seta-like, as long as process. ♀ pleopod 2 subtriangular, with 3 short apical setae and 1 short lateral seta. Exopod of pleopod 3 about 1.6× as long and 3× as wide as endopod,

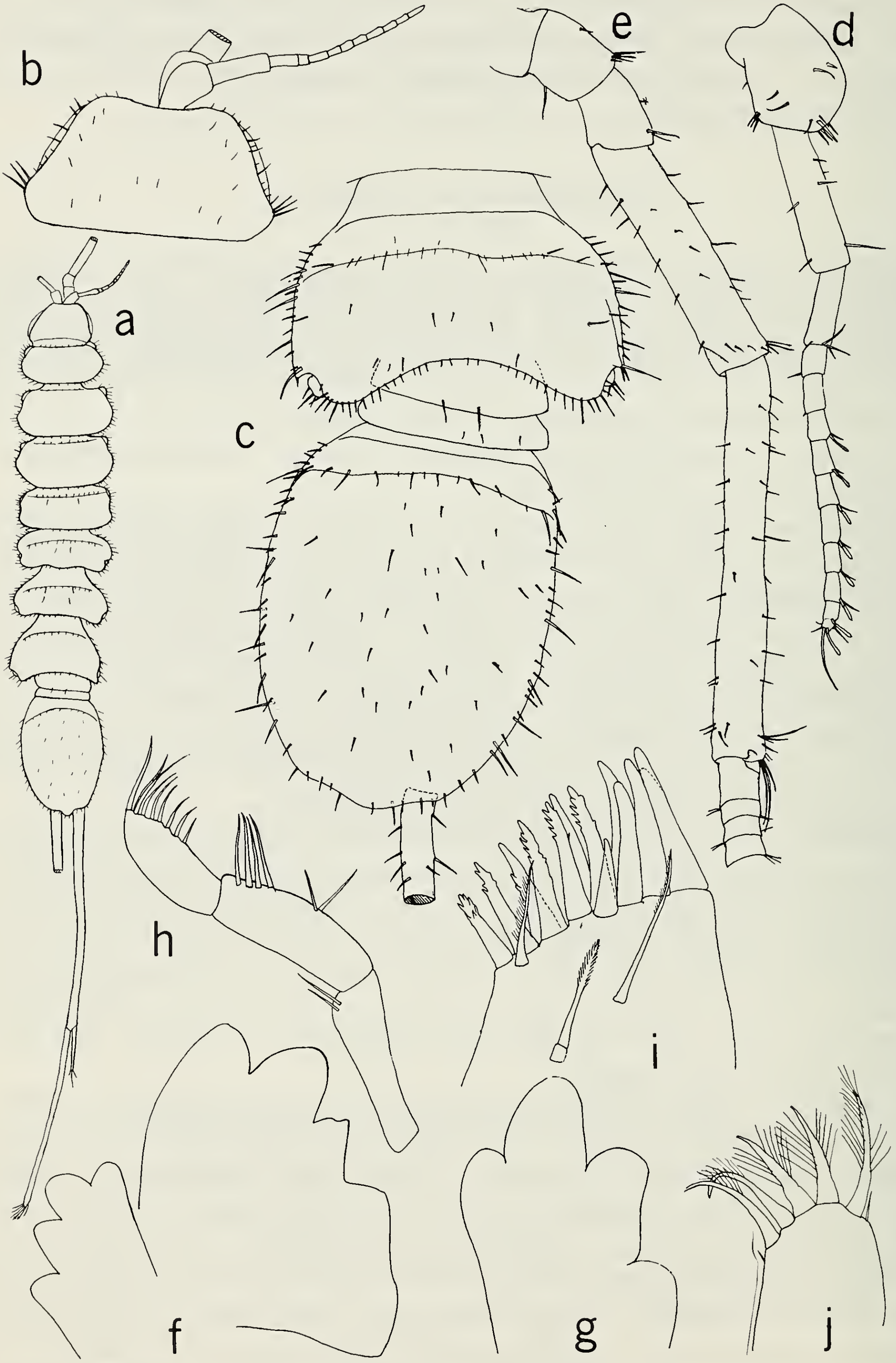

Fig. 1. *Calasellus longus*: a, ♂, dorsal; b, ♂ head, dorsal; c, ♀ pereonite 7, pleon, and telson, dorsal; d, Antenna 1; e, Antenna 2 peduncle; f, Incisor and lacinia of left mandible; g, Incisor of right mandible; h, Palp of left mandible; i, Maxilla 1, outer lobe; j, Maxilla 1, inner lobe.

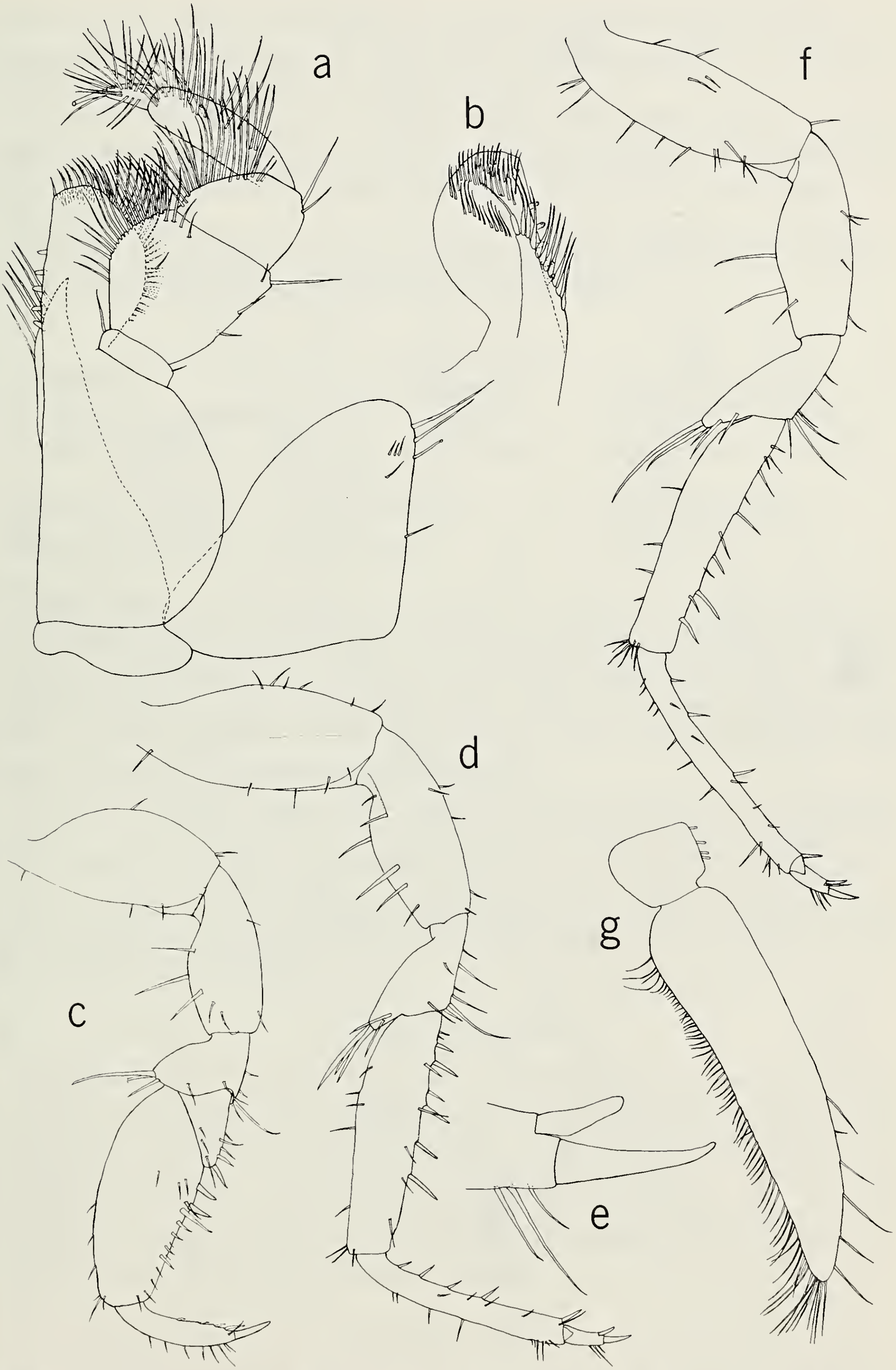

Fig. 2. *Calasellus longus*: a, Maxilliped; b, Endite of maxilliped; c, ♂ pereopod 1; d, ♂ pereopod 2; e, Distal end of dactyl, ♂ pereopod 2; f, ♂ pereopod 4; g, ♂ pleopod 1.

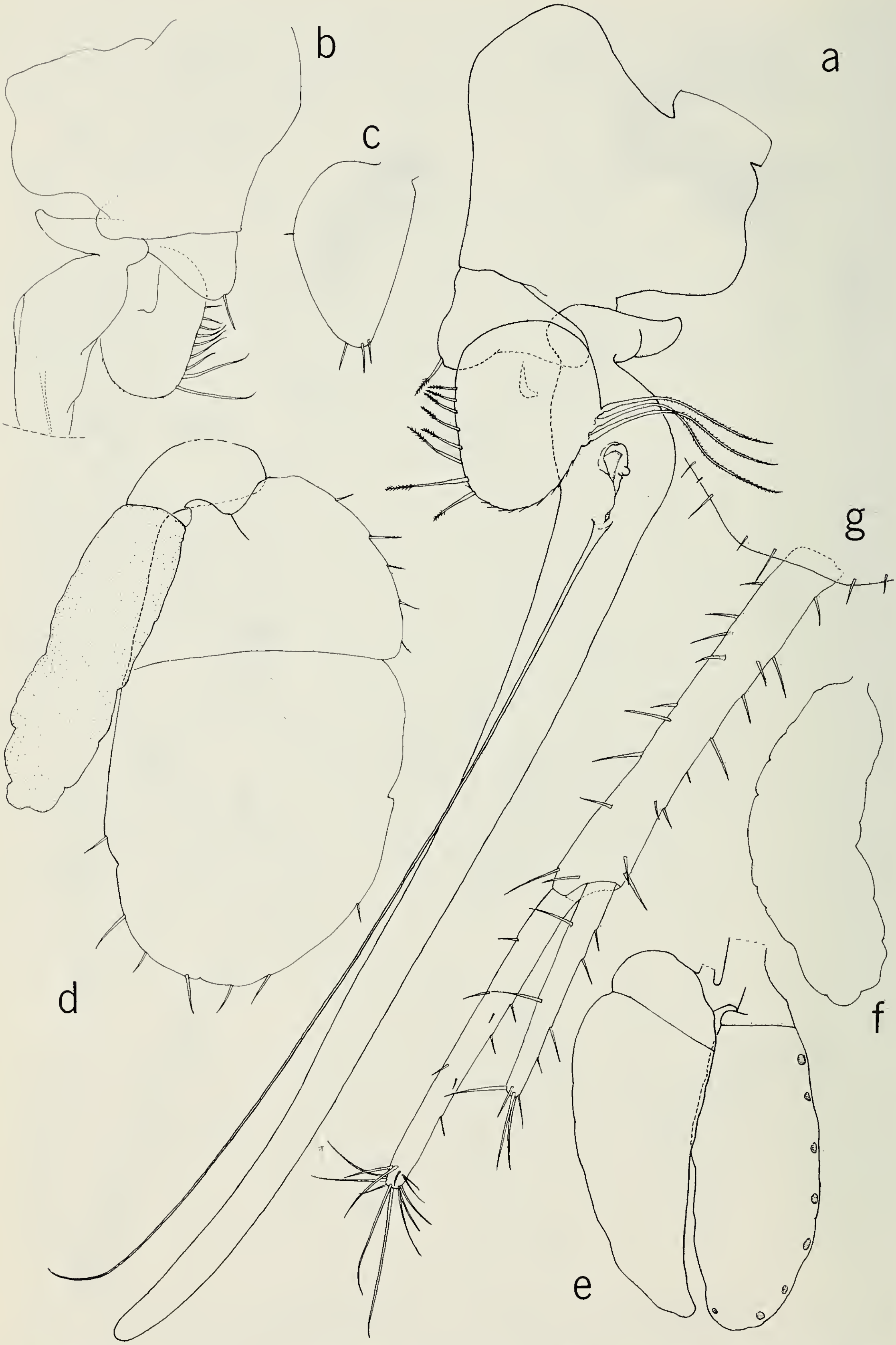

Fig. 3. *Calasellus longus*: a, ♂ pleopod 2, anterior; b, ♂ pleopod 2, posterior; c, ♀ pleopod 2; d, ♂ pleopod 3; e, ♂ pleopod 4; f, ♂ pleopod 5; g, ♀ uropod.

distal segment nearly 2× as long as proximal segment, suture between segments transverse. Pleopod 4 exopod distal segment nearly 5× as long as proximal segment. Pleopod 5, exopod absent.

Uropods slender, linear; ♂ uropod about 0.8× body length, endopod slightly shorter than protopod, about 4× as long as exopod; ♀ uropod about 0.36× body length, endopod about 0.84× as long as protopod, about 1.5× length of exopod.

Affinities.—*Calasellus longus* is similar in many respects to *C. californicus*. The most obvious differences are listed below.

	C. californicus	*C. longus*
Antenna 2	0.75× body length	1.5× body length
♂ pleopod 1	Length = 2× width	Length = 4× width
♂ pleopod 2	Endopod 2× exopod length	Endopod 6× exopod length
Pleopod 3 exopod	Suture oblique	Suture transverse
Pleopod 5 exopod	Rudimentary	Absent

The absence of the pleopod 5 exopod in *C. longus* is unusual and not, to my knowledge, found elsewhere in the superfamily Aselloidea, although absence of this exopod is characteristic of other superfamilies of Asellota. *Asellus* (*Asellus*) *amamiensis* Matsumoto, 1961 has a much reduced pleopod 5 exopod, but has a maxilla 1 inner ramus with 4 setae, placing it in the genus *Asellus,* well removed from *Calasellus.*

Habitat.—Shaver Lake is not a natural body of water, but is a reservoir for water power formed by Shaver Lake dam, 198 feet high, completed in 1927, across Stevenson Creek tributary, which is in the drainage system of the San Joaquin River. Having evolved long before 1927, *C. longus* is not native to Shaver Lake, but to the aquifer that supplies the spring from which the isopods were collected.

Acknowledgments

The Shaver Lake asellids passed through several hands before reaching me. They were collected by Michael Lassner, then a graduate student at the University of California, Davis, who gave them to Dr. Peter Moyle, Department of Zoology. Dr. Moyle gave them to Dr. James T. Carlton, then a graduate student at the same University, who in turn gave them to Mr. Ernest W. Iverson, Allan Hancock Foundation, from whom I received the specimens. My thanks go to all these people.

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94(3), 1981, pp. 873–877

HOLOTHURIA (*PLATYPERONA*) *ROWEI*, A NEW SEA CUCUMBER FROM FLORIDA (ECHINODERMATA: HOLOTHUROIDEA)

David L. Pawson and Cynthia A. Gust

Abstract.—*Holothuria* (*Platyperona*) *rowei*, new species, is described on the basis of a single specimen from Key Largo, Florida. There are now four species in the subgenus *Platyperona*; three of these occur in the Atlantic Ocean.

The subgenus *Holothuria* (*Platyperona*), in the sense of Rowe (1969), currently comprises three species, the type-species *H.* (*P.*) *difficilis* Semper, 1868 from the Indo-Pacific (Rowe, 1969), *H.* (*P.*) *sanctori* Delle Chiaje, 1823 from the Mediterranean, eastern Atlantic, St. Helena and Ascension Islands (Pawson, 1978), and *H.* (*P.*) *parvula* from the western Atlantic (Deichmann, 1930). While checking identifications of western Atlantic holothurians in the collections of the National Museum of Natural History, one of us (CAG) found that a single specimen formerly identified as *H.* (*P.*) *parvula* actually represents a new species, which is described below.

Family Holothuriidae Ludwig, 1894

Holothuria (*Platyperona*) *rowei*, new species
Fig. 1

Diagnosis.—Tables with approximately 20 perforations in disc; spires usually thorny, tapering to form blunt points. Buttons typically with 3 pairs of perforations, and with small knobs lying on or near central longitudinal ridges. Edges of buttons thickened to form a conspicuous ridge.

Material examined.—HOLOTYPE USNM E9469, Key Largo, Florida; collected summer, 1950 by F. Lyman, 1 specimen.

Etymology.—This species is named for Dr. F. W. E. Rowe of the Australian Museum, who has contributed much to our knowledge of the holothuriid holothurians.

Description.—Single specimen in fair condition, cylindrical, strongly contracted; total length 32 mm, diameter approximately 8 mm. Mouth anteroventral, surrounded by approximately 20 tentacles; anus posterior. Conspicuous tube feet scattered on ventral surface, not restricted to radii; dorsal feet less numerous papilliform. Color in alcohol variegated light brown. Genital caeca well developed; other details of internal anatomy not determined.

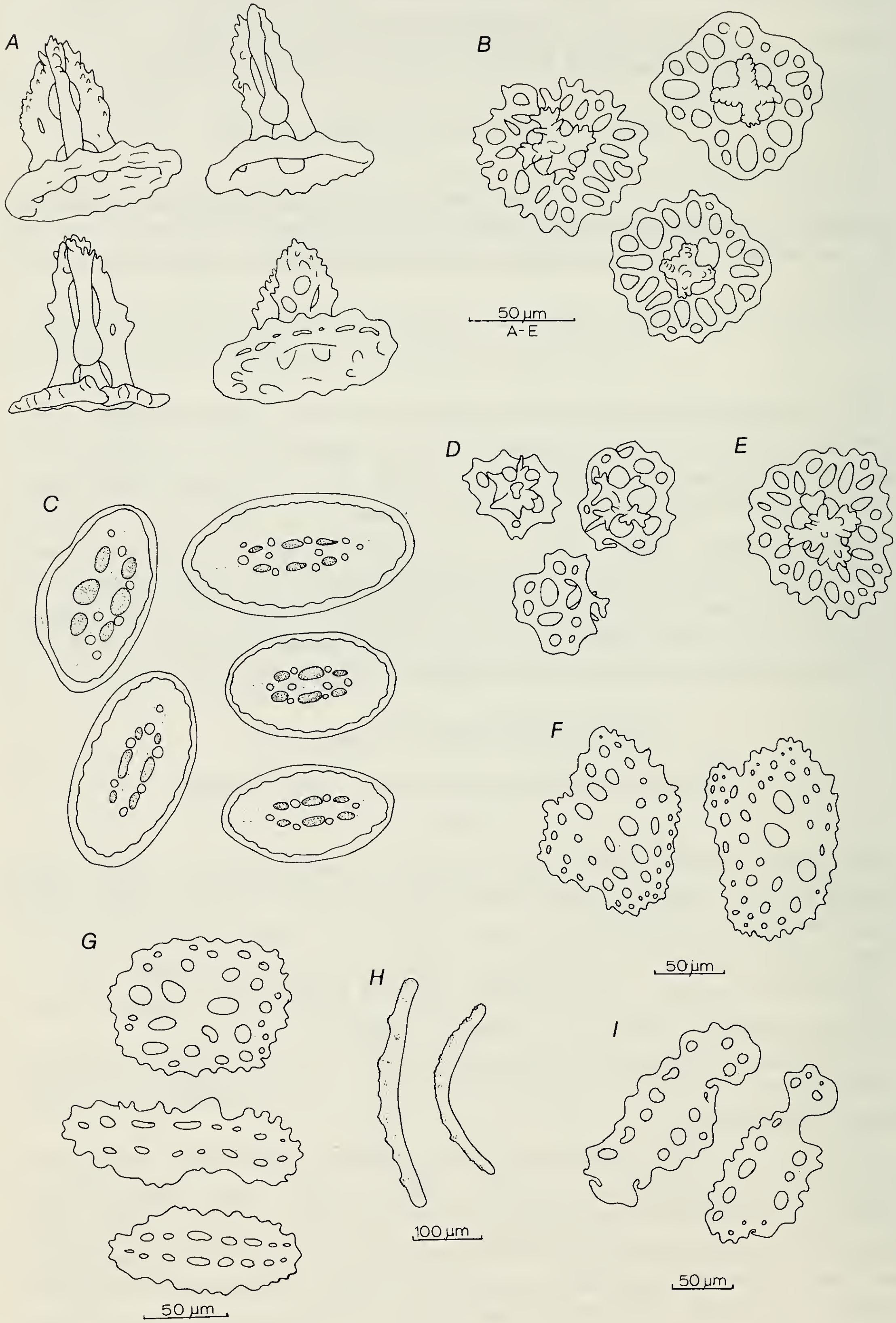
A
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Table 1.—Comparison of dimensions (in μm) of body wall ossicles in the three Atlantic species of *Holothuria* (*Platyperona*). Specimens studied approximately equal in size.

	H. (*P.*) *parvula*	*H.* (*P.*) *sanctori*	*H.* (*P.*) *rowei*
Tables			
Mean disc diameter	72	71	68
Range	52–88	64–76	60–80
Mean spire height	47	48	60
Range	32–64	36–68	44–64
Buttons			
Mean length	101	143	100
Range	92–108	120–146	80–116
Mean width	44	64	58
Range	40–48	56–76	48–72

Ossicles in dorsal and ventral body wall numerous tables and immense numbers of buttons. Tables (Fig. 1A, B) with circular discs carrying approximately 20 circular to angular perforations. For dimensions of tables see Table 1. In some tables 12 perforations larger than others. Spire elongate, thorny, tapering to a blunt point; 1 crossbar usually present. Buttons elongate oval (Fig. 1C), commonly with 3 pairs of perforations, the perforations opposite each other, not alternating. Small knobs always present on buttons, lying on or near weakly defined central longitudinal ridge. Edge of button with distinctive thickened rim, with scalloped inner margin. In some buttons, rim may appear as series of bead-like knobs. For dimensions of buttons see Table 1.

Ventral tube feet with conspicuous endplates approximately 250 μm in diameter. Walls of feet contain tables (Fig. 1E), often with more perforations than tables in body wall. Also present in walls are typical buttons, and perforated plate-like rods (Fig. 1G). Dorsal feet lack endplates. Walls of dorsal feet with typical tables, buttons, and numerous curved plates (Fig. 1F) with up to 100 perforations. Near distal extremities of feet, plates supplanted by perforated rods (Fig. 1I), present in small numbers.

Tentacle stems and digits with curved rods enormously variable in length

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Fig. 1. *Holothuria* (*Platyperona*) *rowei*: A, Tables from body wall, in profile view; B, Discs of tables from body wall; C, Buttons from body wall; D, Rudimentary tables from tentacle stem; E, Table from ventral tube foot; F, Curved perforated plate from dorsal tube foot; G, Plate-like rods from ventral tube foot; H, Rods from tentacle stems and digits; I, Perforated rods from near distal extremities of dorsal tube foot.

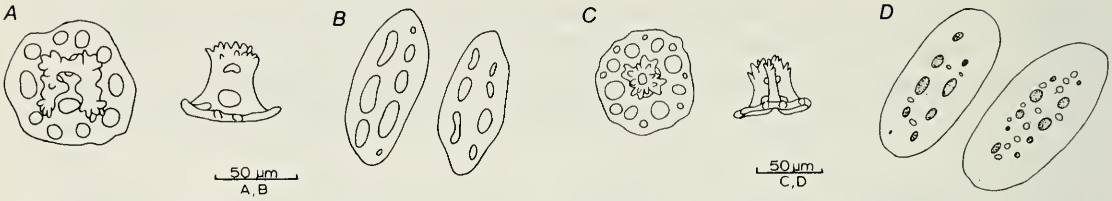

Fig. 2. A, B, Tables and buttons from body wall of *H.* (*P.*) *parvula* (Selenka); C, D, Tables and buttons from body wall of *H.* (*P.*) *sanctori* Delle Chiaje.

(40–500 µm long). Inner surfaces of rods smooth, outer surfaces with clusters of minute prickles (Fig. 1H). Also present in stems are rudimentary tables (Fig. 1D) with few perforations and short spires.

Remarks.—This new species resembles both *H.* (*P.*) *sanctori* and *H.* (*P.*) *parvula* in some respects, although it differs strikingly in possessing thickened edges on the buttons and in having tables with tapering spires rather than with abruptly truncated spires (see Figs. 1A–C and 2A, 2C). The buttons of *rowei,* like those of *sanctori* (Fig. 2D), carry small knobs, but the buttons of the former species are considerably smaller than those of *sanctori* (Table 1). The buttons of *rowei* approach in size those of *parvula* (Fig. 2B) but, as Deichmann has pointed out, the perforations in *parvula* buttons are alternating, not opposite, the buttons lack knobs, and they are narrower than those of *rowei* (Table 1).

The holotype of *rowei* is sexually mature, as were the specimens of *sanctori* and *parvula* examined. It is therefore not feasible to dismiss the specimen described here as a juvenile of a known species.

The 4 species of the subgenus *Holothuria* (*Platyperona*) are apparently closely related; they may be distinguished as follows:

1. Buttons always with thin smooth edges; central knobs present or absent 2
– Buttons with thickened, scalloped or knobbed edges and few central knobs .... *H.* (*P.*) *rowei,* new species
2. Buttons smooth, always lacking small central knobs 3
– Buttons usually with small central knobs. Eastern Atlantic and Mediterranean .... *H.* (*P.*) *sanctori* Delle Chiaje
3. Relatively narrow buttons (width : length = 0.44:1); western Atlantic .... *H.* (*P.*) *parvula* (Selenka)
– Relatively broad buttons (width : length = 0.56:1); Indo-Pacific ... . *H.* (*P.*) *difficilis* Semper

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ON SOME GENERA OF STOLONIFEROUS OCTOCORALS (COELENTERATA: ANTHOZOA), WITH DESCRIPTIONS OF NEW TAXA[1]

Frederick M. Bayer

Abstract.—Several stolonate octocorals, misinterpreted by previous authors owing to incomplete or misleading descriptions and inadequate illustrations, are reevaluated on the basis of new material. Revised taxonomic assignments are proposed for *Cyathopodium ingolfi* Madsen (new genus *Scyphopodium*), *Cyathopodium elegans* Deichmann (new genus *Stereotelesto*), *Telesto rigida* Wright & Studer (new genus *Bathytelesto*), *Sarcodictyon gardineri* Gohar (new genus *Rhodelinda*), *Sarcodictyon pacificum* Hickson (=*Cyathopodium tenue* [Dana]), *Sarcodictyon rugosum* Pourtalès (=*Scleranthelia rugosa*), and *Rolandia rosea* (Philippi) (=*Sarcodictyon roseum*). The distribution of *Scyphopodium ingolfi* is extended to the mid-Atlantic Ridge and South African waters and, as a Pleistocene fossil, to the Mediterranean Sea. A new stolonate octocoral from the Caribbean is described as *Tesseranthelia rhodora*.

Introduction

During dives aboard the submersible research vessel *Cynara,* in the Hellenic Trench south of Crete, Dr. Helmut Zibrowius collected fossil sponges covered with a stoloniferous octocoral that appeared to be nearly or quite contemporaneous. These specimens were similar to, if not identical with, a small Recent specimen from the mid-Atlantic Ridge found by Dr. Zibrowius while studying corals collected by the research vessel *Jean Charcot.* These are morphologically indistinguishable and agree in all significant details with specimens taken south of Iceland by the *Ingolf* Expedition and described by Madsen (1944:12) under the name *Cyathopodium ingolfi.* Assignment of those octocorals to the genus *Cyathopodium* Verrill, originally established for the tropical Pacific *Aulopora tenuis* Dana, was considered doubtful by Madsen, and was based heavily upon the allocation by Deichmann (1936:38) of a red stoloniferous coral from the West Indies to that genus. Unfortunately, Deichmann overlooked the fact that her coral is *Telesto corallina* described by Duchassaing in 1870. Although undoubtedly a member of the family Telestidae, *T. corallina* (along with *T. rubra* Hickson and *T. rigida* Wright & Studer) differs from other species of *Telesto* in having the sclerites of the polyp walls inseparably fused, a character it

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[1] Scientific contribution from the Rosenstiel School of Marine and Atmospheric Science, University of Miami.

shares with *Cyathopodium ingolfi* Madsen. *Cyathopodium tenue* has small, conical anthosteles arising from a delicate stolonic network and is not a telestid. In *C. ingolfi* the anthocodial sclerites are arranged quite differently from the condition in *C. elegans* and, apart from its inseparably fused red sclerites, this species has little in common with *C. tenue* (which is, moreover, an Indo-Pacific reef-dweller whereas *C. ingolfi* was taken from 1301 m in the North Atlantic and *C. elegans* from 70–180 m in the Antilles). The morphological, geographical, and bathymetrical evidence indicates that three genera are involved here: 1) the original and true *Cyathopodium*; 2) the false *Cyathopodium* of Deichmann, which is a telestid; and 3) the false *Cyathopodium* of Madsen, which he doubted in the first place and which fits no genus heretofore described.

This situation is further complicated by the fact that some shallow-water Pacific colonies of true *Cyathopodium* have been referred to *Sarcodictyon* Forbes (Hickson, 1930), a northeastern Atlantic genus, through misinterpretation of Herdman's ambiguous description of spicules firmly wedged together in *Sarcodictyon,* which really does not at all say that they are fused. The result is that some true *Cyathopodium* species are known under the generic name *Sarcodictyon,* and some *Clavularia*-like stoloniferans from the sub-Antarctic have been assigned to *Sarcodictyon* (Gohar, 1940) when, in fact, they have more in common with *Telesto rigida* Wright & Studer.

Examination of the type-specimens of *T. rigida* in the British Museum (Nat. Hist.) shows that tall secondary polyps are not produced in that species as reported by Wright & Studer (1889:261) and accepted by Laackmann (1909:73), Kükenthal (1913:233), and Deichmann (1936:40, 41). Thus *T. rigida* more closely resemble "*Sarcodictyon*" *gardineri* var. *rosea* Gohar from the sub-Antarctic.

The small, white stoloniferan from off Havana described as *Sarcodictyon rugosum* by Pourtalès (1867:113) and doubted by Hickson (1930:211) and Deichmann (1936:37) does, in fact, superficially resemble *Cyathopodium* but has platelike sclerites and is congeneric, if not even conspecific, with *Scleranthelia musiva* described by Studer (1878b) from off Cape Verde. Pourtalès' coral has now been found in some numbers from scattered locations in the Straits of Florida and West Indies, along with a single find of a red form that is distinctively different.

In the light of so much new material for interpretation of the old, this nomenclatural jumble is here amended.

Taxonomic Discussion

Cyathopodium Verrill

Cyathopodium Verrill, 1868:415 (type-species, *Aulopora tenuis* Dana, 1846:631, pl. 59, fig. 5; by monotypy.

non *Cyathopodium.*—Deichmann, 1936:38.—Madsen, 1944:11.
Sarcodictyon.—Hickson, 1930:209 (part).

Diagnosis.—Low, conical calices arise at wide intervals from narrow, ribbon-like, reticulating stolons; walls of stolons and calices rigid, consisting of inseparably fused sclerites, penetrated by minute pores; anthocodial sclerites small, none specially differentiated as opercular scales.

Distribution.—Tropical central and western Pacific, on reefs.

Remarks.—Of the Indo-Pacific species attributed to *Sarcodictyon* by Hickson (1930:211), it is probable that only one, *S. pacificum* Hickson, is actually a *Cyathopodium.*

Cyathopodium tenue (Verrill)

Fig. 1*b*

Aulopora tenuis Dana, 1846:630, pl. 59, fig. 5 (Raraka Island, Paumotu Archipelago).
Cyathopodium tenue.—Verrill, 1868:415.—Deichmann, 1936:38.
Cyathopodium tenuis.—Madsen, 1944:11, 14.
Sarcodictyon pacificum Hickson, 1930:212, pl. 2, figs. 1–6 (Marquesas; Tahiti).—Gohar, 1940:12, pl. 1, fig. 1.

Description.—See Hickson, 1930:212.

Material examined.—Three lots from Palau Islands, USNM 56586, 59105, 59114.

Remarks.—The walls of stolons and calices are of almost glassy translucence. All traces of their component sclerites are obliterated save immediately around the calicular margins, where sclerites in various stages of fusion can be observed. Color of the skeleton in a single colony may vary from carmine red to pale pink.

Records indicate that this species commonly inhabits the dead parts of other corals, such as *Millepora* (Dana), *Lobophyllia* (Hickson), *Turbinaria* and *Montipora* (present material), as well as reef rock (present material).

Scyphopodium, new genus

non *Cyathopodium* Verrill, 1868:415.
Cyathopodium.—Madsen, 1944:11.

Diagnosis.—Short, cylindrical anthosteles with rigid walls formed by a close calcareous meshwork of fused, branching sclerites arising from ribbon-like stolons also having rigid walls, encrusting solid objects; lower part of gastric cavity filled by intrusion of fused calcareous spicules, penetrated by 8 longitudinal canals; anthocodiae with irregularly tuberculate rods and crosses not fused and not arranged in converging points; white.

Type-species.—*Cyathopodium ingolfi* Madsen, 1944:12, here designated.

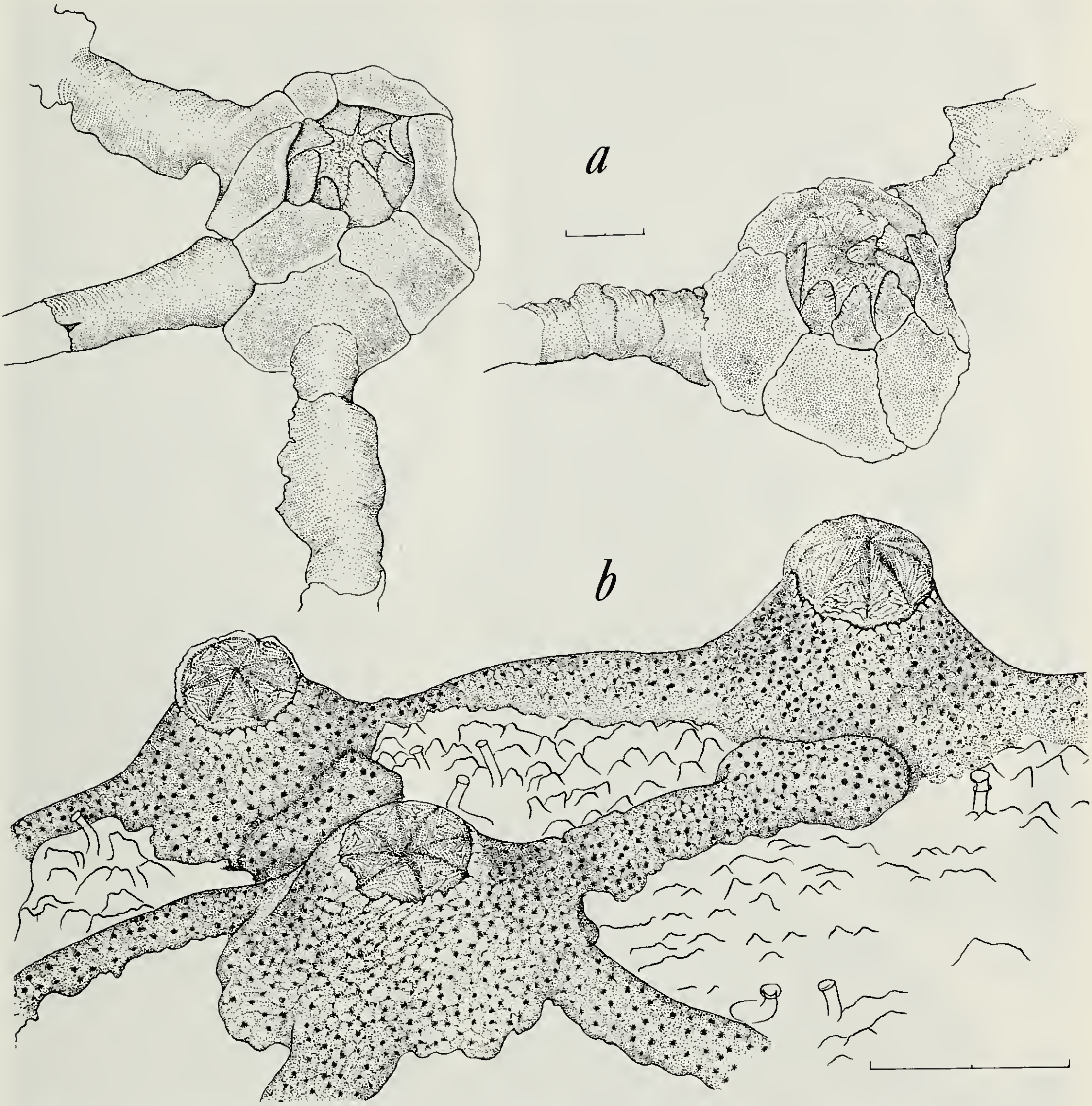

Fig. 1. a, *Tesseranthelia rhodora*; b, *Cyathopodium tenue*. Both scales = 1 mm.

Etymology.—From Greek σκύφος, cup + πόδιον, a little foot. Gender, neuter.

Remarks.—As Verrill's genus *Cyathopodium* was established for Dana's *Aulopora tenuis,* and Deichmann's *Cyathopodium elegans* is a Caribbean telestid, Madsen's doubt that his *C. ingolfi* belonged in the same genus was fully justified.

Scyphopodium ingolfi (Madsen)
Fig. 2

Cyathopodium ingolfi Madsen, 1944:12, figs. 9–14 (South of Iceland, 63°08′N, 15°40′W, 1301 m, bottom temperature 3.9°C; Ingolf Sta. 54, 18 May 1896).

Description.—See Madsen, 1944:12.

Material examined.—Azores, northeast of Corvo: 34°46.3′N, 29°37.9′W, 1949 m, *Jean Charcot* cruise MAPCO 1, dredge 2, 10 October 1979: small colony attached to *Solenosmilia variabilis* Duncan, USNM 59806.

Mediterranean Sea off Crete, 30 miles southeast of Gavdhos, in Hellenic Trench: 34°24′N, 24°26.9′E, *Cyana* dive 14, 2216 m, 11 September 1979, coll. H. Zibrowius; complex network of stolons with many calices, attached to (and probably contemporaneous with) fossil sponge: USNM 59805.

Off South Africa, in Agulhas Current: 35°10.5′S, 23°02′E, 500 m, Deutsche Tiefsee Exped. *Valdivia* sta. 103, 2 November 1898; several isolated calices and stolonic fragments, some with soft tissue; Berlin Museum.

Off South Africa, Natal: 27°59.5′S, 32°40.8′E, 550 m, *Meiring Naude* SM 86, 22 May 1976: one calicular base on stolon attached to scleractinian coral *Trochocyathus rawsonii* sensu Gardiner, 1904, non Pourtalès, 1874; South African Museum Cape Town, H2813.

Remarks.—The remaining characters of the fossilized material (Fig. 2) collected in the Hellenic Trench by Dr. H. Zibrowius agree in all respects with the detailed descriptions of *Cyathopodium ingolfi* given by Madsen (1944:12), and there is little doubt that they represent the same species. The stolons are more solidly calcified (Fig. 2) than in the *Ingolf* material, as might be expected in a richly developed adult colony. The specimens occur in a Pleistocene thanatocoenosis consisting mainly of large sponges and scleractinians. The age of *Desmophyllum cristagalli* Milne Edwards & Haime from the same sponge has been determined by C^{14} analysis to be 18,200 ± 500 years (H. Zibrowius, pers. comm. 27 January 1981).

It is possible that the octocorals were attached to the living sponges, or that they settled on the sponges after they were killed by some volcanic event in that geologically unstable area. The octocorals, like the sponges, are covered by manganese oxides.

The specimen from the Azores (USNM 59806), although very small, conforms very well with the original account of *C. ingolfi,* as does a broken calyx on a stolon attached to a scleractinian from off Natal (Fig. 2). The material collected by the *Valdivia* consists of polyps up to 1 cm tall, thus larger than the largest reported by Madsen. Most contain the soft tissue but the tentacles are completely retracted so their sclerites cannot be observed. One broken calyx with part of its stolon has been examined by SEM and shows an early stage in the development of the meshwork of fused sclerites

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Fig. 2. *Scyphopodium ingolfi*: Top, part of fossil colony from Hellenic Trench, ×10; Middle, broken stolon of same, ×34; Bottom, base of calyx of specimen from Natal, ×40. SEM stereo pairs.

in the stolon and proximal part of the calyx. Altogether, this remarkable material from widely separated localities leaves little doubt that *Scyphopodium ingolfi* (Madsen) is a widely distributed octocoral in depths from 500–1000+ m.

Stereotelesto, new genus

Telesto.—Hickson, 1900:480 (part).—Laackmann, 1909:41 et seq. (part).—Kükenthal, 1913:229 (part).
Cyathopodium.—Deichmann, 1936:38 (part).

Diagnosis.—Telestids with tall axial polyps, short lateral polyps not strictly in one plane; gastric cavities not filled in proximally with mesogloea containing sclerites; outer surface of body walls smooth, formed by inseparably fused tuberculate rods; anthocodiae with blunt, spinous rods longitudinally or *en chevron* below tentacles, forming 8 points, pinnules with flat rodlets. Color, red, anthocodial sclerites yellow to colorless.

Type-species.—*Telesto corallina* Duchassaing, 1870.

Etymology.—Greek στερεός, hard + *Telesto,* gender feminine.

Distribution.—West Indies; Indian Ocean (Maldive Islands).

Stereotelesto corallina (Duchassaing)

Telesto corallina Duchassaing, 1870:19 (Guadeloupe, 300 feet).—Bayer, 1961[1962]:34, figs. 1, 9b (Puerto Rico, 39–100 fath.).
Cyathopodium elegans Deichmann, 1936:38, pl. 2, figs. 1–4 (Barbados, 69 and 81 fath.).

Description.—See Bayer, 1961[1962]:34.

Records.—All of the specimens available to me, 9 lots, were dredged off Puerto Rico in 73–183 m by the Johnson-Smithsonian Deep Sea Expedition, except two from Barbados, one from 146 m collected by the University of Iowa Barbados-Antigua Expedition, the other from 50–400 m collected by John Lewis. The distribution of this species appears to be limited to the Antillean Arc.

Bathytelesto, new genus

Telesto (*Telesto*).—Wright & Studer, 1889:260 (part).
Telesto.—Laackmann, 1909:41 et seq. (part).—Kükenthal, 1913:229 (part).—Deichmann, 1936:40 (part).

Type-species.—*Telesto rigida* Wright & Studer, 1889, here designated.

Etymology.—From Greek βαθύς, deep + *Telesto,* gender feminine.

Diagnosis.—Telestids with tall axial polyps rarely producing short lateral polyps; gastric cavities not filled in proximally with mesogloea containing sclerites; body walls externally smooth, rigid but thin and brittle, filled with inseparably fused irregularly spinose rods; anthocodiae with prickly spindles placed longitudinally below tentacles in 8 strong septal and 8 weaker interseptal tracts, but sclerites absent from tentacles and pinnules. Color, light red.

Bathytelesto rigida (Wright & Studer)

Telesto rigida Wright & Studer, 1889:261, pl. 37, fig. 3; pl. 42, fig. 9 (west of Azores, 38°18′00″N, 34°48′00″W, 1675 fath., *Challenger* sta. 71, 27 June 1873).—Laackmann, 1909:73.—Kükenthal, 1913:229–236, passim.
non *Telesto rigida.*—Nutting, 1909:685 [=*Telesto californica* Kükenthal, 1913].

Description.—See Wright & Studer, 1889; Laackmann, 1909.

Remarks.—Examination of the type-specimens in the British Museum (Nat. Hist.), register no. 1890.4.11.33, shows that the tall lateral polyps produced by the primary polyps as described by Wright & Studer actually are primary polyps attached to other polyps; lateral polyps are scarce and the only ones observed were very short.

Sarcodictyon Forbes

Evagora Philippi, 1842:36 (type-species, *Evagora rosea* Philippi, 1842, by monotypy).—Kükenthal, 1916:458.—Molander, 1929:40.
non *Evagora* Péron & Lesueur, 1810 (Hydrozoa); nec Laporte & Gory, 1839 (Coleoptera).
Sarcodictyon Forbes *in* Johnston, 1847:179 (type-species, *Sarcodictyon catenata* Forbes *in* Johnston, 1847, by monotypy).
Rolandia Lacaze Duthiers, 1900:424 (type-species, *Rolandia coralloides* Lacaze Duthiers, 1900 = *Evagora rosea* Philippi, 1842, by monotypy).—Weinberg, 1978:166.
Sarcodictyon.—Thorpe, 1928:482 [doubtful].—Hickson, 1930:210 [part].

Diagnosis.—Simple, fully retractile polyps arise from narrow, ribbonlike, reticulating stolons sometimes fusing to form wider membranous expansions; sclerites in the form of small 6-radiates, commonly more or less flattened, sculptured by low to moderately prominent granulations and blunt prickles chiefly concentrated near the ends of the rays; many crosslike twinned sclerites present. Anthocodiae with few, small sclerites or none at all.

Type-species.—*Sarcodictyon catenatum* Forbes, by monotypy.

Distribution.—Northeastern Atlantic and Mediterranean waters.

Remarks.—There is no fusion of sclerites. The erroneous diagnosis given by Deichmann (1936) and Bayer (1956) repeated Hickson's misconception of the genus.

Discussion.—The relationship and affinities of this genus have been a matter of debate for years (Molander, 1915:42; 1929:40; Kükenthal, 1916:458; Hickson, 1894:331; 1930:209). Weinberg (1978:166) convincingly demonstrated that *Rolandia coralloides* Lacaze Duthiers, 1900, is not an encrusting growth form of *Corallium,* as had been suggested by Molander (1929:41), but is identical with *Evagora rosea* Philippi, 1842. As the generic name *Evagora* is twice preoccupied, he employed the junior synonym *Rolandia* Lacaze Duthiers, 1900. Weinberg ruled out of consideration the genus *Sarcodictyon,* having been misled by the supposition that the sclerites of *Sarcodictyon* are inseparably fused. This misconception resulted from Hickson's (1921:367; 1930:210) misinterpretation of Herdman's (1883:41) statement that "the different forms are produced by the union of a few simple spicules shaped like a wedge." This error unfortunately was perpetuated by Deichmann (1936:32), Gohar (1940:12) and me (Bayer, 1956:*F*184). The description and figures given by Herdman (1883), as well as an examination of actual specimens, demonstrate beyond a doubt that the sclerites are quite separable and that they consist principally of 6-radiates, with a large proportion of cross-shaped twinned forms that show distinct suture lines between "wedge-shaped" components. They differ in no generically significant way from the sclerites of *Rolandia rosea* illustrated in the drawings and SEM micrographs presented by Weinberg (1978:pls. 17, 18). Although *Rolandia rosea* and *Sarcodictyon catenatum* may prove to be conspecific, pending direct comparison it is preferable to maintain them as two species of a single genus the name of which is *Sarcodictyon* Forbes.

Sarcodictyon catenatum (Forbes)
Fig. 3

Sarcodictyon catenata Forbes *in* Johnston, 1847:179 (Youghal; Loch Fine; west coast of Scotland).—Gosse, 1858:276, pl. 9.—Herdman, 1883:31, pls. 1–3; 1895:163, pl. 8.

Sarcodictyon catenatum.—Thomson, 1927:8, pl. 2, fig. 17 [that part of the material from the Mediterranean may be *S. roseum* rather than *S. catenatum*].

Evagora catenata.—Kükenthal, 1916:461.

Sympodium catenatum.—Molander, 1915:43.

Description.—See Herdman, 1883, 1895.

Material examined.—Isle of Man, 1 mile north of the Calf of Man, 30 m, coll. N. S. Jones; USNM 59480.

Remarks.—The sclerites of *S. catenatum* from British waters (Fig. 3) have somewhat more prominent and sharper sculpturing than do those of

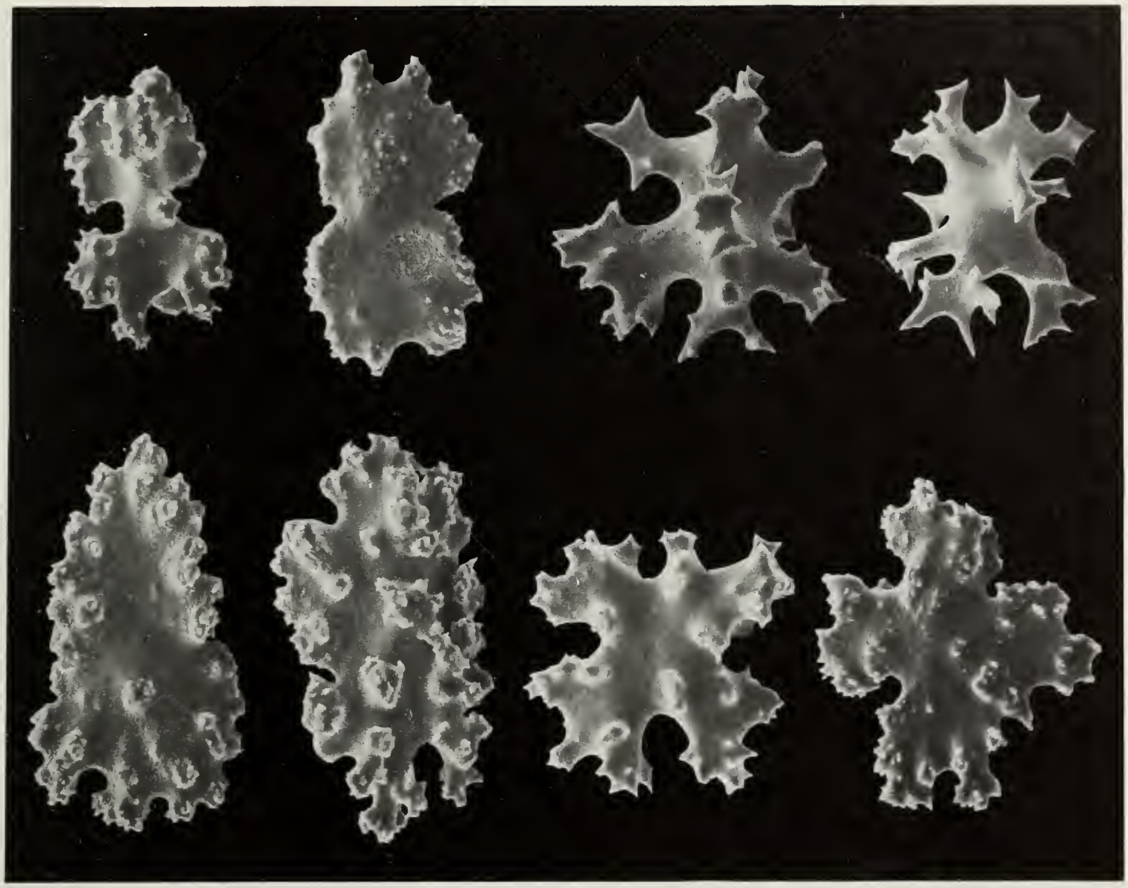

Fig. 3. *Sarcodictyon catenatum*. Sclerites, ×325.

S. roseum from the Mediterranean illustrated by Weinberg (1978:pls. 17, 18), but the proportion of cross-shaped sclerites is similarly high.

Gohar (1940:13), also misled by the inaccurate definition of the genus *Sarcodictyon,* described a new species of stoloniferan as *Sarcodictyon gardineri* with 2 varieties, *rosea* and *alba,* from *Discovery* expeditions in the Southern Ocean. Specimens agreeing closely with Gohar's descriptions have been taken at several localities in the Southern Ocean by the U.S.S. *Eltanin.* They show that "*Sarcodictyon*" *gardineri* is a tall, slender, *Clavularia*-like form with sclerites inseparably fused in the body wall, anthocodial sclerites arranged in chevrons and, in some cases, with spiculiferous intrusion tissue filling the extreme proximal part of the anthosteles. They bear a closer resemblance to *Telesto* (now *Bathytelesto*) *rigida* and *Cyathopodium* (now *Scyphopodium*) *ingolfi* than to *Sarcodictyon catenatum.* As these specimens have intrusion tissue with sclerites separable as in *Telestula* rather than fused into a rigid meshwork as in *Scyphopodium,* and have nothing at all to do with *Sarcodictyon,* it becomes necessary to establish a generic taxon to accommodate them.

Rhodelinda, new genus

Sarcodictyon.—Gohar, 1940:12 [part].

Diagnosis.—Anthosteles tall, simple, slightly clavate, with thin, brittle walls formed by inseparably fused sclerites, arising from ribbonlike stolons encrusting solid objects; fused, tuberculate spindles forming body walls arranged *en chevron* in 8 longitudinal tracts; basal part of gastric cavity with more or less extensive intrusion of mesogloea containing partially fused, irregularly branching sclerites not forming a firm calcareous lattice; anthocodiae fully retractile, armed with slender, thorny spindles converging in 8 points, the proximal ones becoming more or less transverse; color red, pink or white.

Type-species.—*Sarcodictyon gardineri* var. *rosea* Gohar, 1940.

Etymology.—From Greek ‘ρόδον, rose + meaningless suffix; gender, feminine.

Distribution.—Southern Ocean.

Rhodelinda gardineri (Gohar)
Fig. 4

Sarcodictyon gardineri var. *rosea* Gohar, 1940:13 (Tristan da Cunha, Gough Island, and other localities from 40–180 m; *Discovery* Exped.).

Description.—See Gohar, 1940:13.

Material.—Off Macquarie Island, 54°24′S, 159°01′E, to 54°25′S, 159°00′E, 79–93 m, *Eltanin* sta. 1417, 10 February 1965: 42 specimens, 36 attached to shells of *Chlamys delicatula* Hutton (all but 2 living when collected), 4 to shells of brachiopods, and 2 to stems of hydroids; of these, 10 on *Chlamys,* 4 on brachiopods, and 2 on hydroids were specially selected to show variation and assigned USNM no. 60218; remainder are under USNM no. 60219.

Off Macquarie Island, 54°32′S, 159°02′E, to 54°32′S, 159°01′E, 86–101 m, *Eltanin* sta. 1418, 10 February 1965: 8 specimens, 3 attached to shells of *Chlamys delicatula* alive when collected, 3 to hydroid stems, and 2 to brachiopod shells; USNM no. 60217.

The larger collection obtained at sta. 1417 probably does not indicate a denser population than at sta. 1418, but merely the longer duration of tow (53 minutes compared with 12 minutes at the latter).

Remarks.—Material in the present collection agrees with all aspects of

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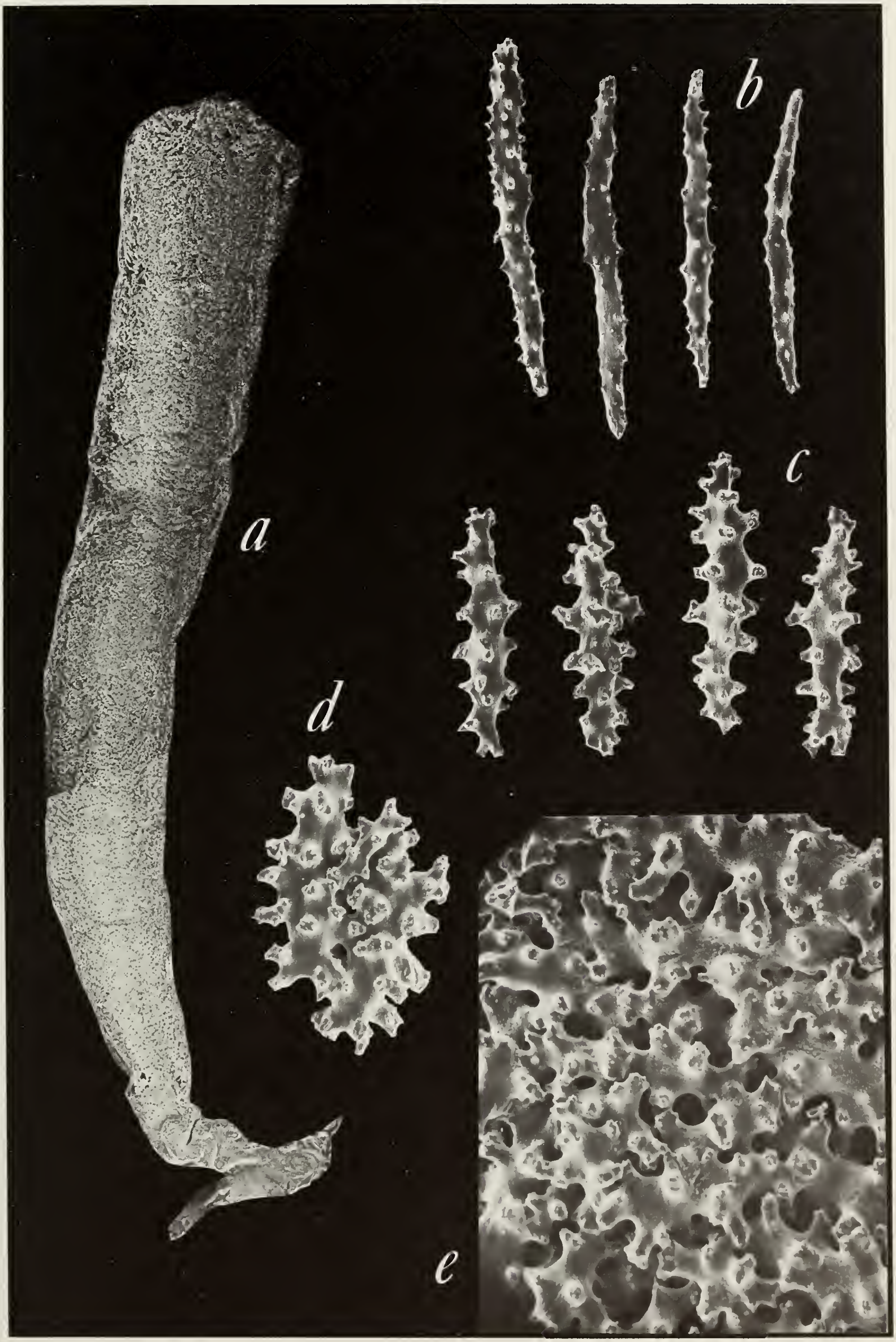
Fig. 4. *Rhodelinda gardineri*: a, Polyp, contracted, ×8; b, Anthocodial sclerites, ×130; c, Unfused anthostelar sclerites, ×130; d, Partly fused anthostelar sclerites, ×130; e, Fully fused anthostelar sclerites, ×195.


a
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e

Gohar's description, to which a few details can be added. The crowded polyps arise from ribbonlike stolons attached to hydroid stems and shells of lamellibranchs (*Chlamys delicatula*) and brachiopods. The stolons are 0.8 to 1.3 mm wide on a flat surface such as the brachiopod shells, but narrower if on hydroid stems or growing along the ribs of pectinid shells. The fully developed polyps are mostly 6–8 mm tall but in some colonies up to 16 mm exclusive of the anthocodiae, most of which are fully retracted; in other colonies, presumably younger, the tallest polyps do not exceed 4 or 5 mm. Distally the anthocodial diameter is as much as 2.2 mm but 1.5–1.8 mm is usual, and the proximal diameter is about 1 mm. The sclerites of the body wall are inseparably fused to form a rigid but brittle tube; distally they can be seen to lie *en chevron* in 8 longitudinal interseptal tracts, the distalmost sclerites unfused and extending as tapering points onto the thin anthocodial wall. Above the wide naked neck-zone, the anthocodial armature consists of numerous slender, prickly spindles arranged *en chevron* as 8 strong interseptal points below the tentacles; smaller, curved, prickly spindles and rods transversely surround the rachis of the tentacles but do not extend into the pinnules. The proximal sclerites of the interseptal points become transversely arranged and extend proximad a short distance as 8 distinct bands in the septal positions. Narrow secondary points occur septally between the interseptal major points. The color of all the colonies observed is bright, light red.

Comparisons.—These colonies are similar to species of *Clavularia* in general aspect but differ in the solidly fused sclerites. They resemble even more closely *Telesto rigida* Wright & Studer (now *Bathytelesto*), which has smaller polyps and completely unarmed tentacles. However, the latter was taken near the Azores at a depth of 1675 fathoms (3065 m), compared with depths of 79–101 m for the present specimens. Although study of additional material may show the two to be congeneric, the differently arranged anthocodial armature and the widely separated localities and depths warrant treating them as distinct genera for the present.

Scleranthelia Studer

Scleranthelia Studer, 1878a:137, 138 (no species included); 1878b:676; 1887:11.—Molander, 1929:29.—Aurivillius, 1931:33 (list of references).

Skleranthelia Studer, 1878b:634 (incorrect subsequent spelling without nomenclatural status; type-species, *Scleranthelia musiva* Studer, 1878, by subsequent monotypy), 676 (correctly spelled in list).—Bayer, 1956:*F*200.

Diagnosis.—See Aurivillius, 1931:34.

Remarks.—I overlooked the fact that the correct original spelling of this generic name was established by Studer (1878a:137) without included species in a preliminary paper rather than in his report of the same year upon the Alcyonaria of the *Gazelle* expedition (Studer, 1878b:634). In the latter paper he misspelled it at the generic heading but not in the explanation of the figure (p. 634), nor on the plate (1, fig. 4), nor in the list of species collected at the various stations (p. 676). Thus, my usage of the spelling "*Skleranthelia*" (Bayer, 1956:*F*200) was unjustified.

Some authors (Molander, 1929:29; Aurivillius, 1931:34) have considered *Scleranthelia* to be a membranous gorgonacean related to *Parisis,* an interpretation based upon superficial resemblances. Both do, indeed, have large, polygonal, platelike sclerites and calices of similar form. However, the plates of *Parisis* (Fig. 6d) are shaped and sculptured differently from those of *Scleranthelia,* which have deeply lobed margins especially conspicuous in those of the stolons (Fig. 5b). The anthocodiae of both are but weakly spiculated, in *Parisis* with minute double heads having a long, smooth waist, in *Scleranthelia* with irregular thorny stars and short rods, many of them twinned as shown by distinct cruciform suture lines. Such differences, together with the fact that species of *Parisis* are chiefly reef inhabitants of the Indo-Pacific, whereas *Scleranthelia* lives on the continental slope in the Atlantic where no species of Parisididae occurs, argue persuasively against Molander's conclusion.

A small stoloniferous coral described by Pourtalès (1868:113) as *Sarcodictyon rugosum,* which was lost sight of until cruises of the University of Miami Deep-Sea Biology Program obtained specimens of it, evidently belongs to the genus *Scleranthelia* and differs from *S. musiva* only in its reticulate growth form.

Scleranthelia rugosa (Pourtalès) growth form *rugosa*

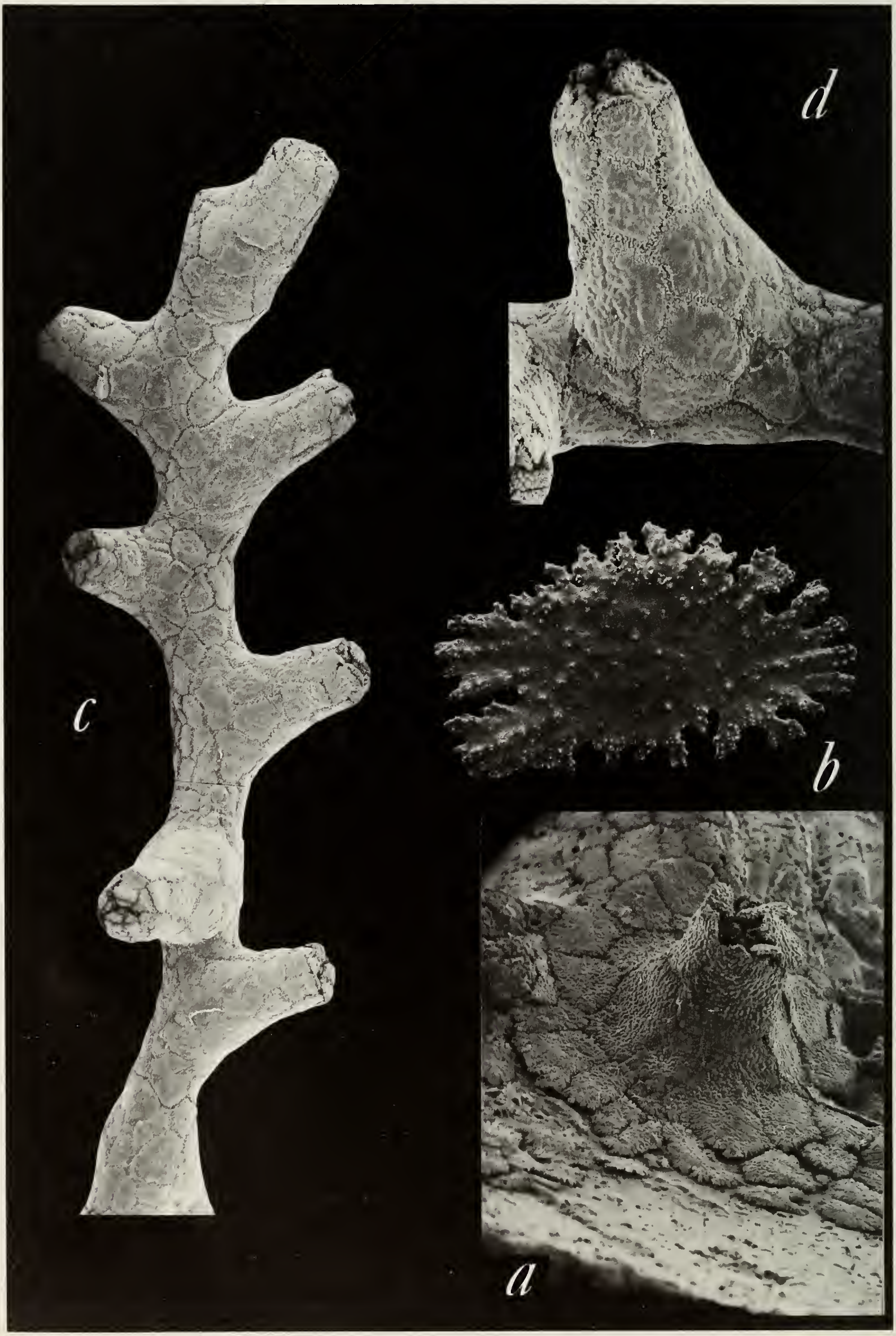
Figs. 5a, b

Sarcodictyon rugosum Poutalès, 1867:113 (off Havana, 270 fathoms).—Hickson, 1930:211.—Deichmann, 1936:37.

Scleranthelia musiva.—Carpine, 1964:3, figs. 1–3 (west coast of Corsica, 200–300 m; reticulate form).

Scleranthelia musiva var. *eugeniae* Aurivillius, 1931:34, fig. 6 (Azores, Pta. Delgada, 50–100 fm., *Josephine* Exped. d.86 K; both reticulate and membranous forms.

Description.—Colonies consist of conical calices 1–1.5 mm in diameter and up to about 5 mm tall arising from bandlike reticulating stolons about 0.75 mm wide; where the calices arise they may widen to 2.0–2.5 mm. On a hard substrate the stolons are very flat and the marginal plates thinly spread out, but on a porous substrate they are somewhat arched and the marginal plates are thick and have distinct edges. The spacing of calices varies from very close, with bases contiguous, to 5–10 mm apart. The calices vary in shape from low, bluntly conical to high conical or almost cylindrical,


d
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with truncated top. Secondary polyps never arise from the wall of primary polyps. The entire surface is covered by a layer of thick, polygonal, platelike sclerites closely fitting as in mosaic but not solidly fused. On the stolons the largest plates are roughly 0.75 mm in diameter, but those of the calicular walls may be larger, reaching a length of 1 mm. There is no consistency in the shape of these plates, and fracturing evidently has occurred in many places, especially near the edges of the stolons where the plates are extremely thin and may be firmly cemented to the substrate. The outer surface of the plates is covered with low, rounded undulations beset with minute prickles. Adjoining edges, like the inner surface, are covered with complex tubercles.

The anthocodiae are fully retractile and weakly spiculated. The only sclerites are thorny stars and short rods with a few simple projections, whose exact location in the anthocodia could not be determined. The sclerites of the calicular margin decrease in size distad on the base of the anthocodial wall, thus affording the flexibility necessary for retraction. In full retraction, the oral end of the calices is protected by several (not usually, if ever, 8) irregularly shaped marginal plates. The form and size of the tentacles cannot be determined owing to strong contraction and poor preservation.

Beneath the superficial layer of large plates is a layer, best developed under the calices, of very irregular, branching sclerites showing some fusion. In effect, these occupy the base of the gastric cavities and may be similar to the intrusion tissue of *Telestula* and the calcareous lattice of *Scyphopodium ingolfi,* but anatomical studies will be necessary to clarify this point. The entire surface is covered by a thin, horny cuticle. Color greyish white, anthocodiae bright purple in life, fading to brown in preservation; spicules colorless or translucent white.

Material.—North of Little Bahama Bank: 27°29.5′N, 78°37.5′W, 485–496 m, R/V *Gerda* sta. G-252, 5 February 1964; 1 colony on shell of *Murex pazi* occupied by hermit crab; USNM 55446.

Straits of Florida NW of Matanilla Shoal, Little Bahama Bank: 27°45′N, 79°18′W, 531 m, R/V *Gerda* sta. G-665, 17 July 1965; 3 colonies on clinker and fragments of rock; USNM 55448.

Straights of Florida, west of Matanilla Shoal: 27°20′N, 79°22′W, 494–512 m, R/V *Gerda* sta. G-261, 7 February 1964; colony on small rock; USNM 55447.

Northwest Providence Channel, Bahamas: 26°27′N, 78°40′W, 514–586 m;

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Fig. 5. *Scleranthelia rugosa*: a, Growth form *rugosa,* calyx, ×18; b, Growth form *rugosa,* sclerite from stolon, ×130; c, Growth form *musiva,* part of colony on gorgonian axis, ×13; d, Calyx of same, ×23.

R/V *Gerda* sta. G-707, 22 July 1965; colony on dead shell of gastropod *Tugurium*; USNM 55449.

Northwest Providence Channel, Bahamas: 25°57′N, 78°13′W, 540–576 m, R/V *Gerda* sta. G-678, 20 July 1965; colony on glass bottle; USNM 56630.

Straits of Florida off Great Isaac: 26°07′N, 79°11′W, 311–329 m, R/V *Gerda* sta. G-509, 2 March 1965; large colony extensively covering clinker; USNM 55025.

Dominican Republic, off Isla Saona: 18°04.2′N, 68°44.3′W, 395 m, R/V *Pillsbury* sta. P-1369, 10 July 1971; colonies extensively covering 2 dead shells of gastropod *Tugurium*; USNM 55024.

Off Martinique: 14°26.5′N, 60°59.2′W, 274–388 m, R/V *Pillsbury* sta. P-906, 9 July 1969; colony on small rock; USNM 55453.

Remarks.—There is little doubt that this octocoral is the *Sarcodictyon rugosum* described by Pourtalès (1867:113) so briefly that later authors have even questioned its alcyonarian nature. Hickson's quotation of Pourtalès' description would, indeed, lead one to agree that *S. rugosum* is not an octocoral, for it implies hexamerous rather than octamerous symmetry. However, in examining specimens that are, beyond doubt, the same species that Pourtalès described, one can readily understand why he wrote that the calices are closed "by means of *about* [italics mine] six irregular rough pieces meeting together." The sclerites are not arranged in relation to the anatomical symmetry of the polyps, so the marginal ones closing the aperture need not be 8. In those polyps in which the marginal plates are large, 5 to 7 are usual numbers, but often the plates are smaller, more numerous, and irregularly placed. Hickson's use of the word 'covered' instead of 'closed' also gives a connotation different from Pourtalès original. Pourtalès' description of "six or eight membranous septa" merely reflects the difficulty of observing this feature in specimens of such small size.

Pourtalès' assignment of this coral to the genus *Sarcodictyon* was remarkably perceptive and would be reasonable even now were it not for spicular characters of generic significance. Morphologically, *Sarcodictyon, Scleranthelia, Tesseranthelia* (new genus) and *Cyathopodium* form a series in which the sclerites progress from small, separate 6-radiates showing a tendency toward platelike development, through large, irregular plates derived from crudely 6-radiate forms, large, angular plates developed around the calicular apertures as an operculum, to sclerites rigidly fused except in the anthocodiae. However, as the fused sclerites of *Cyathopodium* are not large plates but small tuberculate rods, that genus is probably more closely related to *Sarcodictyon* than to *Tesseranthelia* (new genus).

When *S. rugosa* occupies a small or narrow substrate, such as the axis of dead gorgonians, tubes of polychaete worms, or slender sponges, the stolons tend to spread out in membranous form, surrounding the object (Fig. 5a). Several of the lots examined consist of this growth form, in close agreement with the original description of *S. musiva* (Studer, 1878b:634, pl. 1, fig. 4). In one lot (USNM 54858), the colonies cover a slender branching sponge that also supports some polychaete worm tubes and other epizoa; the stolons of *Scleranthelia* nearly or completely surround the narrow branches, but on a wider one they extend out in the reticular form of typical *S. rugosa*. This leaves no doubt that the membranous and reticular forms are related to the nature of the substrate and represent a single species. It is convenient to retain the junior name *musiva* to designate the membranous growth form. The material in the National Museum of Natural History has been subdivided accordingly.

Scleranthelia rugosa (Pourtalès), growth form *musiva* Studer
Figs. 5b, c, d

Scleranthelia musiva Studer, 1878b:634, pl. 1, fig. 4 (Cape Verde Is.: 15°52′N, 23°08′W, 115 fath., *Gazelle* Exped.).

Scleranthelia musiva var. *eugeniae* Aurivillius, 1931:34, fig. 6 (Azores, Pta. Delgada, 50–100 fath., *Josephine* Exped. d.86 K; both membranous and reticulate forms).

Description.—As for the reticular form except that stolons are sheetlike expansions. See Aurivillius, 1931:34.

Material.—Off Long Island, N.Y., about 75 miles south of Montauk Point: 37°37′50″N, 74°15′30″W, 262 m, *Albatross* sta. 2020, 21 May 1883; large colony on dead antipatharian axis; USNM 7437.

Off Great Inagua, Bahamas: 20°54.5′N, 73°28.2′W, 110–220 m, R/V *Pillsbury* sta. P-1143, 13 January 1970; colony on dead goronian axis, USNM 54857.—20°50′N, 73°34′W, 274–289 m, R/V *Pillsbury* sta. P-1140, 13 January 1970; large colony on dead gorgonian axis, USNM 54856.

Off San Pedro, Dominican Republic: 18°21′N, 69°14.3′W, 170–176 m, R/V *Pillsbury* sta. P-1303, 21 July 1970; several colonies on branching sponge, USNM 54858; one colony on dead gorgonian axis, USNM 55107.

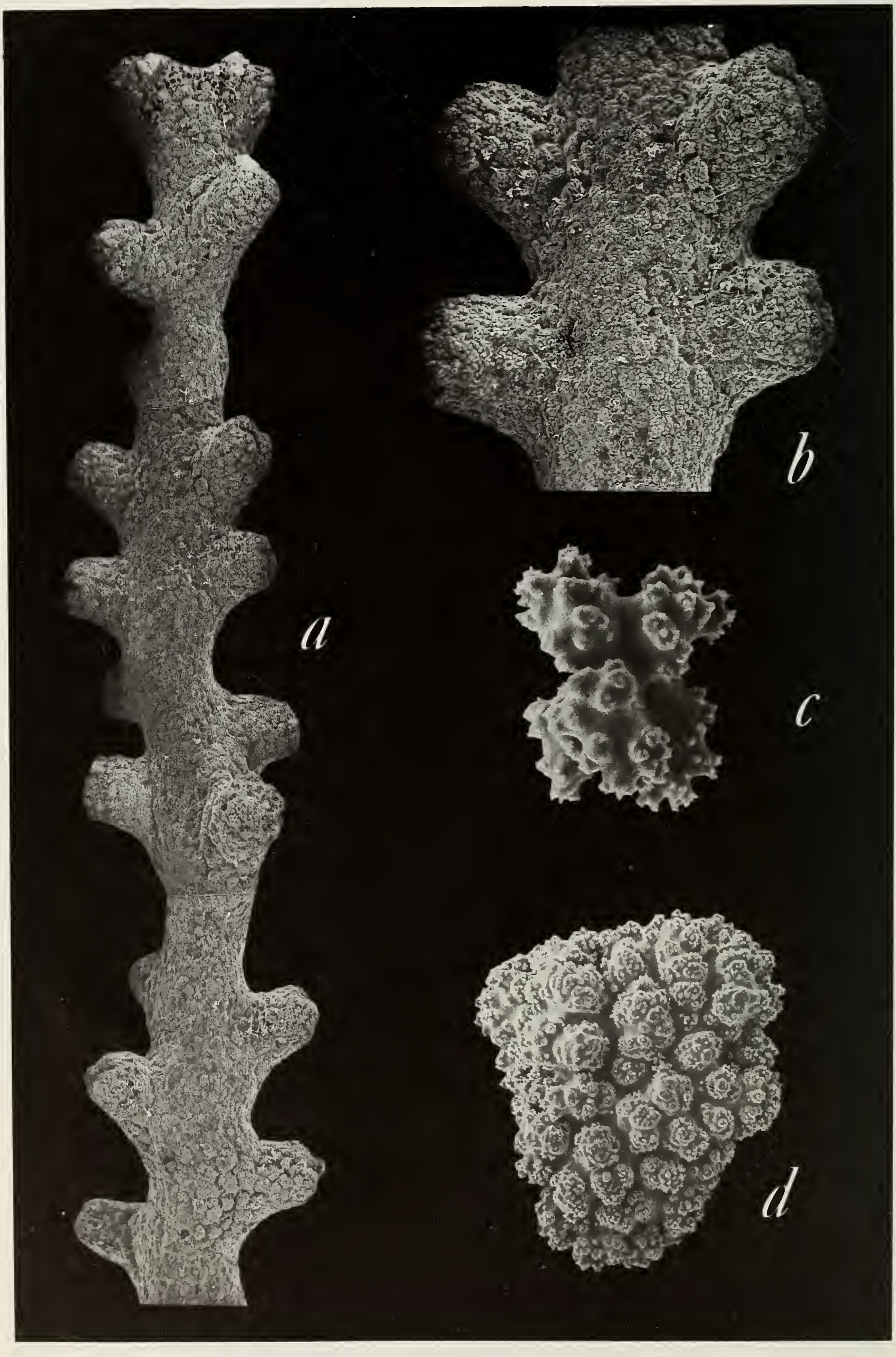
Off Santo Domingo, Dominican Republic: 18°21.4′N, 69°08.7′W, 165 m, R/V *Pillsbury* sta. P-1387, 9 July 1971; colony on dead gorgonian axis, USNM 55023.

Nicaragua, off Little Corn Island: 12°28′N, 82°28′W, 201 m, M/V *Oregon* sta. 3608, 2 June 1962; colony on fragment of gorgonian axis, USNM 55455.

Jamaica, off Pedro Bank: 17°17′N, 78°29′W, 146–183 m, M/V *Oregon* sta. 3554, 17 May 1962; colony on antipatharian axis, USNM 55454.

Venezuela, off Peninsula de Paria: 10°45′N, 62′00′W, 77–86 m, R/V *Pillsbury* sta. P-705, 18 July 1968; colony on branching polychaete worm tube, USNM 55452.

Off Guyana: 8°25′N, 58°08′W, 88–82 m, R/V *Pillsbury* sta. P-691, 15 July 1968; large colony on dead gorgonian axis, USNM 55451.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Remarks.—Colonies extensively covering denuded gorgonian axes (e.g., USNM 55107) closely resemble a gorgonacean with platelike sclerites.

Tesseranthelia, new genus

Diagnosis.—Narrow, ribbonlike stolons produce low, conical anthosteles at wide intervals; calicular walls formed by 6–8 large, closely fitted plates, apertures closed by well-differentiated triangular opercular scales; stolons covered by elongated, arched plates as wide as the stolons; anthocodiae with spinous rodlets. Color, red.

Type-species.—*Tesseranthelia rhodora,* new species.

Etymology.—From Ionic Greek τεσσερες, four, i.e., having four sides; hence, a square tessera as in mosaic + *Anthelia,* generic name of uncertain etymology in octocorals, possibly from Greek 'ανθήλη, dim. 'ανθήλιόν, flower, especially the plumose flower of a reed or, more likely, from 'Ανθήλεια, one of the Danaides. Gender, feminine.

Comparisons.—Growth form similar to *Scleranthelia* but having a well-differentiated operculum of triangular plates and a single row of long, arched sclerites covering the stolons.

Tesseranthelia rhodora, new species
Fig. 1a

Material.—Caribbean Sea off Dominican Republic: 18°21.4′N, 69°06.0′W, 149 m, R/V *Pillsbury* sta. P-1386, 9 July 1971; holotype colony attached to rock, USNM 56585.

Description.—Narrow, reticulating stolons 0.5–1.0 mm wide give rise at wide intervals to low, bluntly conical calices that may be situated at points of bifurcation. The calices are 3.5–4.5 mm in diameter, irregularly rounded in outline and about 1.5 mm tall; the calicular walls are covered by a single circlet of 5–6 roughly quadrangular plates, and the apertures closed by a well-differentiated operculum consisting of bluntly triangular scales basically 8 in number but sometimes more, possibly owing to breakage and repair. The tentacles contain small, spinous rodlets not organized as a crown and points. The stolons are covered by long, narrow, arched plates, set in a single series and presenting a segmented appearance. The large plates are almost glassily transparent and the granulated scupture of their inner surface clearly shows through the smooth outer surface. The sclerites are bright red.

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Fig. 6. *Parisis fruticosa*: a, Part of branch of syntype, USNM 770, ×13; b, Same ×23; c, 6-radiate sclerite, ×487; d, Coenenchymal plate, ×162.

Holotype colony.—USNM 56585.

Etymology.—From Rhodora, a kind of rhododendron, from *rhodora,* Neo-Latin botanical name. A noun in apposition.

Comparison.—Apart from its bright red color, *T. rhodora* superficially resembles *Scleranthelia rugosa.* Even disregarding color, it is distinguished from all other known species by its calices formed of a single circlet of squarish plates and closed by a clearly differentiated operculum and by the single series of arched plates covering the stolons.

Classification

The taxonomic classification of stolonate Octocorallia is unsatisfactory. For the time being, I would prefer to avoid the issue of the validity of the ordinal taxa Stolonifera and Telestacea, and assign the genera treated in the foregoing pages only to families, leaving readers to place the families according to whatever scheme of classification best agrees with their own convictions. Unfortunately, the question of the validity of the family Telestidae cannot be avoided, and that question inevitably involves the ordinal taxa.

The order Telestacea comprises those stolonate forms that vegetatively produce secondary polyps from the anthostelar walls of the primary individuals. It therefore includes the genera *Telesto* Lamouroux, in which secondary polyps are produced abundantly, and *Telestula* Madsen in which they are produced sparingly. As some species that originally were placed in *Clavularia* (e.g., *C. tubaria* Wright & Studer, *C. spiculicola* Nutting, and *C. expansa* Thomson & Dean) differ from *Telestula* in no way other than that their polyps usually remain simple and must therefore be placed in that genus, it follows that secondary budding from the primary polyps is not a diagnostic character even at the generic level, much less at familial or ordinal levels. Thus there remains no distinction either between Telestidae and Clavulariidae, or between Telestacea and Stolonifera. Nevertheless, it is convenient to group those genera that predominantly (but not invariably) produce secondary polyps in a separate subfamily even though it merges with those genera that never bud secondarily. Adopting this approach then, the stoloniferan genera can be arranged as follows:

Stolonifera: polyps arising from reticulating or membranous stolons; anthosteles may be connected laterally by transverse stolonic bars or platforms.

A. No calcareous skeleton developed; polyps and stolons invested by thin organic perisarc: Cornulariidae (*Cornularia*)
B. Calcareous skeleton in form of calcitic sclerites developed in addition to organic perisarc.
    1. Polyps retractile, divided into distinct anthocodial and anthostelar

parts by neck-zone with few or no sclerites, tentacles retractile within proximal anthostelar part.

a. Polyps not connected laterally by transverse platforms, but, if tall, sometimes by a few transverse stolonic bars: Clavulariidae.
   i. Polyps short, retracting almost flush into stolons, or producing low, conical or cylindrical calices: Sarcodictyiinae, new subfamily (*Cyathopodium, Sarcodictyon, Scleranthelia, Tesseranthelia, Trachythela*)
   ii. Polyps tall, cylindrical or trumpet-shaped, rarely or never budding secondary polyps laterally: Clavulariinae (*Bathytelesto, Clavularia, Rhodelinda, Scyphopodium*)
   iii. Polyps tall, cylindrical, commonly budding secondary polyps laterally.
      *. Monopodial: Telestinae (*Carijoa, Paratelesto, Telesto, Telestula*)
      †. Sympodial: Pseudocladochoninae (*Pseudocladochonus*)
b. Polyps connected laterally by regular or irregular transverse platforms: Tubiporidae (*Pachyclavularia, Tubipora*)

2. Polyps contractile but not retractile, not divided into anthocodial and anthostelar parts; colonies richly arborescent, axial polyps arising from spreading, stolonic holdfast: Coelogorgiidae (*Coelogorgia*)

Acknowledgments

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KEY TO THE GENERA OF OCTOCORALLIA EXCLUSIVE OF PENNATULACEA (COELENTERATA: ANTHOZOA), WITH DIAGNOSES OF NEW TAXA

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Abstract.—A serial key to the genera of Octocorallia exclusive of the Pennatulacea is presented. New taxa introduced are *Olindagorgia,* new genus for *Pseudopterogorgia marcgravii* Bayer; *Nicaule,* new genus for *N. crucifera,* new species; and *Lytreia,* new genus for *Thesea plana* Deichmann. *Ideogorgia* is proposed as a replacement name for *Dendrogorgia* Simpson, 1910, not Duchassaing, 1870, and *Helicogorgia* for *Hicksonella* Simpson, December 1910, not Nutting, May 1910. A revised classification is provided.

Introduction

The key presented here was an essential outgrowth of work on a general revision of the octocoral fauna of the western part of the Atlantic Ocean. The far-reaching zoogeographical affinities of this fauna made it impossible in the course of this study to ignore genera from any part of the world, and it soon became clear that many of them require redefinition according to modern taxonomic standards. Therefore, the type-species of as many genera as possible have been examined, often on the basis of original type material, and a fully illustrated generic revision is in course of preparation as an essential first stage in the redescription of western Atlantic species. The key prepared to accompany this generic review has now reached a stage that would benefit from a broader and more objective testing under practical conditions than is possible in one laboratory. For this reason, and in order to make the results of this long-term study available, even in provisional form, not only to specialists but also to the growing number of ecologists, biochemists, and physiologists interested in octocorals, the key is now presented in condensed form with minimal illustration.

In using the key, it must be kept in mind that some common species have been repeatedly described under different names, and many others have been assigned to the wrong genera. The key cannot reconcile the generic identification reached for any given specimen with the existing literature. One cautionary example, perhaps a typical one, is the genus *Heterogorgia.* None of the species described in that genus by Nutting (1910) in his *Siboga* monograph will key out to the genus *Heterogorgia,* because most of them are species of *Echinogorgia*—some of them valid species by default, others already described by earlier authors. Other species of *Echinogorgia* were described in still other genera in the same paper, and most of those placed in *Echinogorgia* actually belong in such genera as *Villogorgia* and *Menella.*

Although the key includes all common and well-known genera, some that may be valid are omitted for the present owing to incomplete information about them. Three new generic taxa are introduced, and one very common genus is included even though no available name applicable to it has yet been found in the literature. It is probable that some poorly-known genus established with inadequate description and no illustration will be found to apply to it. Several genera that have been treated as junior synonyms or as subgenera by previous authors are here restored to valid generic status on the basis of characters that warrant recognition, and it is possible that several more will be validated when comparative studies have been completed.

The serial key format employed here is a departure from the usual practice in octocorals, and was selected because morphologically similar forms are more closely grouped than is the case in the usual dichotomous format. It is essentially an outline key with the character statements serially numbered and printed without indentation, with the number of the alternate character statement appearing in parentheses. The key has been composed in a single long series not only to accommodate investigators with a limited working knowledge of octocoral systematics, but also because several of the traditional families are so ambiguous that it is impossible to break the key up by families in any defensible way. Where families are sufficiently well defined, they are noted at appropriate points in the key, but several are not mentioned.

Because the pennatulacean material available to me for study is not adequate for improving the summary of that order published by Kükenthal (1915), those genera are not included. I have, however, with considerable misgivings included the "soft coral" genera even though I have not had access to original type-material, because there is no comprehensive review of them comparable to Kükenthal's accounts of the gorgonians (1924) and sea pens (1915). My sources have been the original descriptions and later amplifications chiefly of Kükenthal, Tixier-Durivault and Utinomi, together with such collections as are at my disposal. This part of the key will no doubt be found full of faults, but if it serves to stimulate a reappraisal and a redescription of the "alcyonacean" genera it will have served a useful purpose.

It was not originally my intention to include illustrations in this preliminary version of the key, as the expanded version will be accompanied by diagnoses, synonymies, and scanning electron micrographs of sclerites and other skeletal structures and, wherever necessary, drawings of anthocodial armature and other features not adaptable to portrayal by SEM. As the project progressed, however, it became clear that at least some illustrations would be necessary to clarify verbal statements. Accordingly, some figures have been inserted at various points in the key. In selecting them, I have no doubt erred in the direction of scantiness, as it is not possible to illustrate every point where the user might go astray. In some major taxa where the characters seem quite straightforward, there are no illustrations at all, and in others I may have illustrated the obvious, but I have tried to illustrate those key statements that seemed most likely to prove troublesome to investigators not familiar with the organisms and with the rather subjective terminology that has been traditional in their description. The inconsistent appearance of the figures results from their selection from diverse sources. Some are from my own published papers, some from the work of other authors, and some drawn especially for this paper. In the interests of economy, pen and ink drawings have been used throughout in preference to scanning electron micrographs.

Key to Genera

1(4). Skeleton primarily non-spicular aragonite, formed as distinct corallites containing polyps, united by ribbonlike stolons or common coenosteum (HELIOPORACEA).

2(3). Corallites connected basally only by ribbonlike stolons, skeleton not massive, white; mesogloea of polyps containing sparsely distributed sclerites of calcite (Lithotelestidae) .... *Epiphaxum* Lonsdale, 1850

3(2). Corallites united by massive coenosteum, blue; mesogloea of polyps without sclerites (Helioporidae) .... *Heliopora* Blainville, 1830

4(1). Skeleton when present primarily spicular calcite, sometimes with a more or less calcified scleroproteinous axial support.

5(8). Solitary octocorals, polyps never forming colonies by vegetative budding.

6(7). Polyps large, up to 3.5 cm tall (Fig. 1); sclerites are spindles (Taiaroidae) .... *Taiaroa* Bayer & Muzik, 1976

7(6). Polyps smaller, less than 2 cm tall; sclerites are radiates and irregularly branched forms (Haimeidae) .... *Hartea* Wright, 1864[1]

8(5). Polyps forming colonies by vegetative budding.

9(22). Filaments of all septa but the asulcal pair rudimentary or absent in adult polyps; tentacles with pinnules in multiple

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[1] This genus may have been based upon a founder polyp of *Sarcodictyon* (pers. comm., Mr. R. L. Manuel).

rows on each side; sclerites, if present, minute (mostly 0.02–0.03 mm, rarely up to about 0.1 mm), flattened, ovate rods or disks, often absent altogether (Xeniidae).

10(15). Polyps retractile.

11(12). Polyps dimorphic .... *Fungulus* Tixier-Durivault, 1970

12(11). Polyps monomorphic.

13(14). Colonies membranous .... *Sympodium* Ehrenberg, 1834

14(13). Colonies forming upright, digitate lobes .... *Efflatounaria* Gohar, 1934

15(10). Polyps not retractile.

16(17). Colonies membranous .... *Anthelia* Larmarck, 1816

17(16). Colonies forming upright lobes.

18(19). Lobes digitate, polyps generally distributed, not limited to terminal capitulum .... *Cespitularia* Milne Edwards & Haime, 1850

19(18). Lobes capitate, polyps concentrated on well-defined capitulum.

20(21). Polyps always monomorphic .... *Xenia* Lamarck, 1816

21(20). Polyps dimorphic, at least when breeding .... *Heteroxenia* Kölliker, 1874

22(9). Filaments fully developed and permanently retained on all 8 septa; tentacles with pinnules in a single row on each side; sclerites usually present, of diverse form.

23(434). Colonies usually firmly attached to solid substrate by a spreading holdfast, sometimes anchored in soft substrate by rootlike projections of axial skeleton or of colonial coenenchyme; polyps monomorphic or dimorphic.

24(197). Skeleton consists only of sclerites, free or more or less firmly cemented together by horny or calcareous material, but sometimes absent entirely.

25(182). Colonies with no internal axial support, or one of loosely bound sclerites.

26(63). Polyps connected only at their bases, neither immersed in common coenenchyme nor joined to one another laterally.

27(28). Calcareous skeleton lacking; stolons and polyps invested by thin, horny perisarc (Cornulariidae) .. *Cornularia* Lamarck, 1816

28(27). Calcareous skeleton composed of sclerites present in addition to horny perisarc.

29(56). Proximal part of gastric cavity open to base of polyps, not filled with mesogloea containing sclerites (‘‘intrusion tissue’’).

30(53). Colonies arise from stolons that are ribbonlike or simple sheets not divided into two coenenchymal layers.

31(48). Sclerites of stolons and anthosteles not inseparably fused but may form clumps locally.

32(41). Anthocodiae retractile into tall, cylindrical anthosteles arising from ribbonlike, often anastomosing stolons.

33(34). Polyps simple, not producing lateral daughters, arising from stolons usually of ribbonlike or reticular form .... *Clavularia* Blainville, 1830

34(33). Tall axial polyps produce numerous daughters from their lateral walls.

35(36). Anthocodiae not retractile, oral region covered by infolded tentacles during contraction; colonies richly arborescent, polyps of last order very short; white .... *Coelogorgia* Milne Edwards & Haime, 1857

36(35). Anthocodiae fully retractile into anthosteles.

37(38). Sclerites of body walls slender, often branching and interlocking, sometimes fusing into smaller or larger clumps, ornamented with thorns and prickles; white (Fig. 2) .... *Carijoa* F. Müller, 1867

38(37). Sclerites of body walls coarse, blunt spindles, sculpture of outer surface often rounded, smoother and coarser than that of inner surface; red, orange, rarely white (Fig. 3).

39(40). Wall of axial polyp with multiple rings of solenia .... *Paratelesto* Utinomi, 1958

40(39). Wall of axial polyp with one ring of solenia .... *Telesto* Lamouroux,1812

41(32). Polyps retractile directly into stolons, producing at most only low, conical or short, cylindrical anthosteles.

42(45). Sclerites are tuberculate rods or spindles.

43(44). Sclerites are blunt spindles or rods of moderate size (less than 0.5 mm) with complex tubercles, more or less clearly derived from 6- and 8-radiates (Fig. 4); anthocodiae with few or no sclerites, fully retractile into scarcely projecting anthosteles in ribbonlike stolons that occasionally form a wide membrane; red, pink or yellow .... *Sarcodictyon* Forbes, 1847[2]

44(43). Sclerites are spindles of large size (1 mm) with small and rather simple tubercles or thorns; anthocodiae armed with distinct transverse crown and 8 points of converging spindles below the tentacles, retractile into low but distinct anthosteles, often preserved exsert; stolons commonly membranous; white .... *Trachythela* Verrill, 1922

45(42). Sclerites are large, flattened plates.

46(47). Calices bluntly conical, walls covered by few large plates,

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[2] Synonym: *Rolandia* Lacaze-Duthiers, 1900.

apertures closed by triangular plates forming distinct operculum; stolons thin, ribbonlike; red (Fig. 5) .... *Tesseranthelia* Bayer, 1981

47(46). Calices bluntly conical, or short cylinders with walls covered by numerous plates of decreasing size but not forming differentiated operculum; stolons ribbonlike or sheetlike; white (Fig. 6) .... *Scleranthelia* Studer, 1878

48(31). Sclerites of stolons and anthosteles rigidly and inseparably fused.

49(50). Polyps short, simple, with low, conical anthosteles; red .... *Cyathopodium* Verrill, 1868

50(49). Polyps tall, producing secondary polyps more or less abundantly from high, cylindrical anthosteles.

51(52). Axial polyps commonly producing shorter lateral polyps; anthocodiae with sclerites in both rachis and pinnules of tentacles .... *Stereotelesto* Bayer, 1981

52(51). Axial polyps infrequently producing shorter lateral polyps; anthocodiae with sclerites below tentacles in 8 septal and 8 interseptal rows, tentacles and pinnules without sclerites .... *Bathytelesto* Bayer, 1981

53(30). Colonies arise from stolons forming multilayered sheets or platforms.

54(55). Sclerites solidly fused except in anthocodiae; colonies forming rounded clumps of large size, transversely partitioned by stolonic platforms; red .... *Tubipora* Linnaeus, 1758

55(54). Sclerites not fused; colonies matlike, spreading, stolons composed of multiple irregular layers but not regularly successive platforms; purple or violet .... *Pachyclavularia* Roule, 1908

56(29). Proximal part of gastric cavity filled in with mesogloea containing sclerites.

57(58). Polyps producing daughters to form sympodial colonies (Pseudocladochonidae) .... *Pseudocladochonus* Versluys, 1907

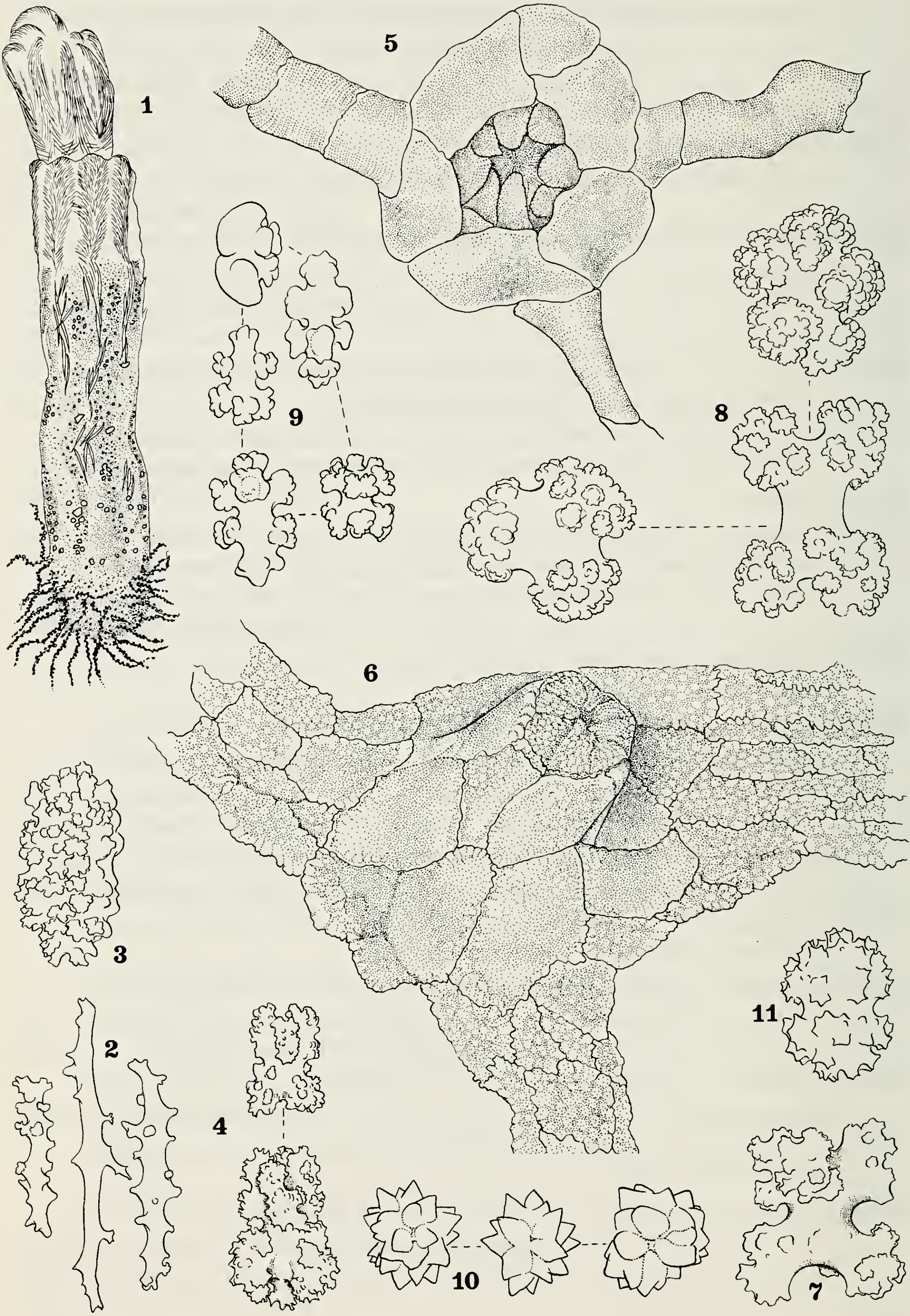
58(57). Polyps simple or producing daughters monopodially.

59(60). Sclerites of polyp walls not inseparably fused. Color, white or brownish .... *Telestula* Madsen, 1944

60(59). Sclerites of polyp walls rigidly fused. Color, red or pink, sometimes white.

61(62). Anthostelar walls composed of fused spindles *en chevron* in 8 longitudinal tracts; anthocodial sclerites in 8 points; mesogloeal intrusion tissue confined to basal part of gastric cavities. Color red .... *Rhodelinda* Bayer, 1981

62(61). Anthostelar walls composed of irregularly branching forms interlocked and rigidly fused; anthocodial sclerites not form-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ing 8 points; basal spicular intrusion of gastric cavities more extensive. Color, white or pinkish .. *Scyphopodium* Bayer, 1981

63(26). Polyps either partially united laterally or immersed in common coenenchyme.

64(65). Polyps partially united laterally by scanty coenenchyme, new polyps arising at various levels, together forming slender, upright clusters arising from encrusting base .... *Protodendron* Thomson & Dean, 1931

65(64). Polyps immersed in extensive common coenenchyme, forming membranous, lobate or arborescent colonies that may be large or massive.

66(67). Colonies with one dominant axial polyp with very long gastric cavity, having thick coenenchymal walls in which are embedded numerous short lateral polyps, forming flattened, usually unbranched bladelike capitulum arising from a slender sterile stalk attached to annelid tubes or other small objects .... *Pseudogorgia* Kölliker, 1870

67(66). No dominant axial polyp, regardless of colonial shape.

68(97). Coenenchyme divided into inner (medullar) and outer (cortical) layers, gastric cavities of polyps chiefly confined to cortical layer, not extensively penetrating medulla.[3]

69(94). Polyps monomorphic.

70(73). Colonies forming thick, encrusting sheets without conspicuous upright lobes or branches.

71(72). Sclerites predominantly 6-radiates (Fig. 7); surface of coenenchyme purplish red .... *Erythropodium* Kölliker, 1865

72(71). Sclerites mostly irregularly warted, blunt spindles; polyps retracting into hemispherical calices; reddish purple or orange thoughout .... *Anthopodium* Verrill, 1872

73(70). Colonies producing upright lobes or digitate processes, or arborescent structures.

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[3] Forms with this array of characters comprise the greater part of the suborder Scleraxonia in the system of Kükenthal.

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Figs. 1–11. 1, *Taiaroa tauhou* Bayer & Muzik, polyp, ×3; 2, *Carijoa riisei* (Duch. & Mich.), sclerites, ×105; 3, *Telesto sanguinea* Deichmann, sclerite, ×105; 4, *Sarcodictyon catenatum* Forbes, sclerites, ×140; 5, *Tesseranthelia rhodora* Bayer, calyx, ×25; 6, *Scleranthelia rugosa* (Pourtalès), calyx, ×25; 7, *Erythropodium caribaeorum* Duch. & Mich., sclerite, ×275; 8, *Titanideum frauenfeldii* (Kölliker), sclerites, ×275; 9, *Paragorgia* spp., sclerites, ×275; 10, *Asterospicularia randalli* Gawel, sclerites, ×275; 11, *Minabea* sp., sclerite, ×250.

74(75). Colonies lobate or digitate; medulla penetrated by solenia throughout but not separated from cortex by longitudinal boundary canals, sclerites coarse spindles sometimes branched as tripods, purple in medulla, white and/or purple in cortex .... *Briareum* Blainville, 1830

75(74). Colonies digitate or arborescent, medulla little penetrated by solenia, chiefly proximally, separated from cortex by boundary canals.

76(77). Medullar sclerites smooth, fusiform, branching, often anastomosing; colonies arborescent, fanshaped or bushy (Subergorgiidae) .... *Subergorgia* Gray, 1857

77(76). Medullar sclerites mostly long spinous rods or needles, intermixed with more or less abundant tuberculated spindles or rods that may have processes more or less branched; sclerites may fuse in larger or smaller clumps, but not throughout length of medulla.

78(83). Cortical sclerites include radiate forms.

79(80). Cortical sclerites are exclusively radiates (Fig. 8) .... *Titanideum* Verrill, 1863

80(79). Cortical sclerites include blunt, closely tuberculate spindles or oval bodies as well as radiate forms.

81(82). Non-radiate sclerites of cortex are stubby, oval bodies about 0.15 mm long .... *Homophyton* Gray, 1866

82(81). Non-radiate sclerites of cortex are blunt tuberculate spindles or rods up to 0.5 mm long ...... *Diodogorgia* Kükenthal, 1919

83(78). No radiate sclerites in cortex.

84(85). Colonies digitate, clavate, rarely if ever branching; cortex highly vesicular .... *Tripalea* Bayer, 1955

85(84). Colonies branched, often richly so; cortex not vesicular.

86(87). Trunk and/or main branches hollow, tubular; colonies either affixed to hard substrate by spreading holdfast, or anchored in soft substrate by spatulate expansion of trunk .... *Solenocaulon* Gray, 1862

87(86). Trunk and branches not hollow, tubular.

88(89). Polyps widely scattered on all sides, forming distinctly projecting but short, cylindrical calices, anthocodiae commonly preserved exsert; branches round, slender, producing tangled colonies often without evident main stem .... *Anthothela* Verrill, 1879

89(88). Polyps crowded, fully retractile into coenenchyme or forming at most only low, bluntly conical or hemispherical calices; branches more or less flattened, colonies arborescent, with conspicuous main stem.

90(91). Polyps fully retractile into edges of conspicuously flattened terminal branches; branch tips not fistulose .... *Alertigorgia* Kükenthal, 1908

91(90). Polyps usually forming inconspicuous or low hemispherical calices; branch tips fistulose.

92(93). Polyps crowded on three sides of branchlets and on front of large branches and trunk .... *Semperina* Kölliker, 1870

93(92). Polyps biserial, generally absent from front and back of colony .... *Iciligorgia* Duchassaing, 1870

94(69). Polyps dimorphic. Colonies upright, arborescent; cortical sclerites 6-, 7- and 8-radiate capstans, often more or less strongly modified as double clubs or ''opera glasses''(Fig. 9) medullar sclerites long, spinose, branching rods (Paragorgiidae).

95(96). Cortex separated from medulla by a distinct ring of boundary canals; sclerites colorless .... *Sibogagorgia* Stiasny, 1937

96(95). Cortex not separated from medulla by a ring of boundary canals; cortical sclerites commonly pink or red, medullar sclerites colorless or pink .... *Paragorgia* Milne Edwards & Haime, 1857

97(68). Coenenchyme not divided into inner and outer layers, gastric cavities of polyps extending throughout.

98(105). Polyps arranged in clusters or on branches that are retractile within common coenenchymal trunk.

99(100). Polyps in small clusters retractile within short, cylindrical trunks united in series by ribbonlike stolons .... *Maasella* Poche, 1914

100(99). Polyps on branches retractile within stout columnar trunk attached to or embedded in substrate; trunks solitary (Fig. 12).

101(102). Polyps widely spaced on ends of twigs comprising a loosely branched polyparium; trunk soft-walled (Fig. 12a) .... *Paralcyonium* Milne Edwards & Haime, 1850

102(101). Polyps crowded on numerous fingerlike branches and retractile within well-defined calices strengthened by abundant sclerites.

103(104). Polyps monomorphic. Sclerites predominantly spindles .... *Studeriotes* Thomson & Simpson, 1909

104(103). Polyps dimorphic. Sclerites predominantly capstans (Fig. 12b) .... *Carotalcyon* Utinomi, 1952

105(98). Polyps not in clusters or on branches retractile within common trunk.

106(171). Polyps scattered or in clusters on branchlets or lobes of arborescent or lobate but not massive colony.
107(108). Sclerites are small, stellate bodies similar to those of didemnid tunicates (Fig. 10) .... *Asterospicularia* Utinomi, 1951
108(107). Sclerites of various shapes but not stellate, or absent altogether.
109(134). Colonies capitate or digitate, branching little or not at all.
110(123). Polyps monomorphic.
111(112). Anthosteles distally flared to form a broad, octagonal collar into which the anthocodiae can be withdrawn (Fig. 13); sclerites are spiny spindles .... *Agaricoides* Simpson, 1905
112(111). Anthosteles not flared to form wide collar.
113(114). Polyps not retractile, with supporting bundle of spindles along one side, forming cluster at top of undivided trunk .... *Coronephthya* Utinomi
114(113). Polyps retractile, without supporting bundle, generally distributed on distal part of trunk.
115(120). Colonies digitate.
116(117). Colonial stalk covered by distinct horny cuticle; sclerites are minute oval or rounded platelets . *Ceratocaulon* Jungersen, 1892
117(116). Colonial stalk without conspicuous cuticle; sclerites not minute platelets.
118(119). Sclerites are thorny spindles, sometimes clubbed .... *Bellonella* Gray, 1862
119(118). Sclerites are double spindles ..... *Metalcyonium* Pfeffer, 1888[4]
120(115). Colonies capitate.
121(122). Sclerites are coarse, tuberculate spindles; polyps retract into conical calices formed by converging sclerites .... *Nidalia* Gray, 1834
122(121). Sclerites are capstans or thorny spheres .... *Metalcyonium* Pfeffer, 1888
123(110). Polyps dimorphic.
124(125). Colonies consist of a single large, cylindrical autozooid with many siphonozooids embedded in its wall .... *Bathyalcyon* Versluys, 1906
125(124). Colonies consist of many autozooids and siphonozooids in a capitulum borne on a sterile stalk.
126(127). Sclerites totally absent .... *Malacacanthus* J. Stuart Thomson, 1910

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[4] Utinomi (1964, JARE Sci. Rept. (E)23:7) recognized *Metalcyonium* only for capitate forms, considering Pfeffer's digitate type to be *Alcyonium*.

127(126). Sclerites always present in coenenchyme.

128(131). Capitulum digitate; polyps without sclerites.

129(130). Sclerites are clubs about 0.25 mm long .... *Acrophytum* Hickson, 1900

130(129). Sclerites are capstans up to 0.1 mm long (Fig. 11) .... *Minabea* Utinomi, 1957

131(128). Capitulum rounded or spheroidal, not digitate; polyps with sclerites.

132(133). Sclerites are capstans, double stars and thorny spindles; capitulum mushroom-shaped, sharply delimited from sterile stalk .... *Anthomastus* Verrill, 1878

133(132). Sclerites are large, tuberculate spindles; capitulum not sharply delimited from sterile stalk .... *Nidaliopsis* Kükenthal, 1906

134(109). Colonies repeatedly branching or multilobate.

135(138). Polyps retractile.

136(137). Colonies low, branches lobate; polyps weakly armed .... *Gersemia* Marenzeller, 1877

137(136). Colonies tall, branches slender; polyps strongly armed with well-formed crown and points ... *Siphonogorgia* Kölliker, 1874

138(135). Polyps not retractile.

139(156). Polyps without supporting bundle of spindles.

140(143). Colonial form umbellate (Fig. 14).

141(142). Polyps with strong armature of spindles *en chevron* forming 8 points but without transverse collaret; sclerites of coenenchyme few to many, either abundant small capstans or sparse spindles about 2.5 mm long, sometimes totally absent .... *Umbellulifera* Thomson & Dean, 1936

142(141). Polyps weakly armed with blunt, flattened rods in converging double rows; coenenchymal sclerites are capstans and tuberculate rods of small size (up to 0.12), rather sparse .... *Duva* Koren & Danielssen, 1883

143(140). Colonial form not umbellate.

144(147). Polyps situated on small terminal twigs ("lappets" or "catkins") (Fig. 15).

145(146). Coenenchyme with abundant leaf-clubs .... *Capnella* Gray, 1869

146(145). No leaf clubs .... *Litophyton* Forskål, 1775

147(144). Polyps scattered or in clusters on twigs and branches.

148(149). Cylindrical branches radiate outward from summit of short sterile stalk (Fig. 16) .... *Daniela* von Koch, 1891

149(148). Branches not radiating outward from summit of short sterile stalk, but originating at various levels in colony.

150(155). Colonies lobular, sterile trunk short, inconspicuous.

151(152). Polyps and branches with an outer layer of small (0.05–0.12 mm, flattened, tuberculate rods overlying larger, slender spindles up to 0.8 mm long ...... *Scleronephthya* Studer, 1887

152(151). No outer layer of small sclerites.

153(154). Sclerites of polyps arranged *en chevron* in 8 double rows forming conspicuous longitudinal ridges (Fig. 17); coenenchyme with capstans and clubs ... *Pseudodrifa* Utinomi, 1961

154(153). Sclerites of polyps not in 8 double rows forming longitudinal ridges; coenenchyme with irregular spindles and capstans .. .. *Drifa* Danielssen, 1887

155(150). Colonies not lobular.

156(157). Sterile stems arising from common base subdivide into sterile primary and secondary branches producing slender branchlets and twigs bearing scattered polyps; sclerites are curved spindles with projections taller on convex side and needles chiefly in twigs and branches, and small double stars, "brackets" and 4-rayed forms with 2 rays longer in basal parts; tentacles with small, finely granulated, lobed scales .... *Lemnalia* Gray, 1868

157(156). Sterile stems arising from common base produce digitate branches that subdivide at most only once, bearing polyps crowded on distal parts; sclerites are spindles, some thorny, some nearly smooth .... *Paralemnalia* Kükenthal, 1913

158(139). Polyps with supporting bundle of spindles.

159(160). Polyps arise directly from summit of sterile trunk .... *Coronephthya* Utinomi, 1966

160(159). Polyps arise from branches.

161(168). Polyps in lappets (catkins) or bundles on branchlets of abundantly ramified colonies.

162(163). Polyps in lappets (catkins) .... *Nephthea* Audouin, 1826

163(162). Polyps in bundles on branchlets.

164(165). Form of colonies umbellate (Fig. 14) .... *Morchellana* Gray, 1862

165(164). Form of colonies not umbellate.

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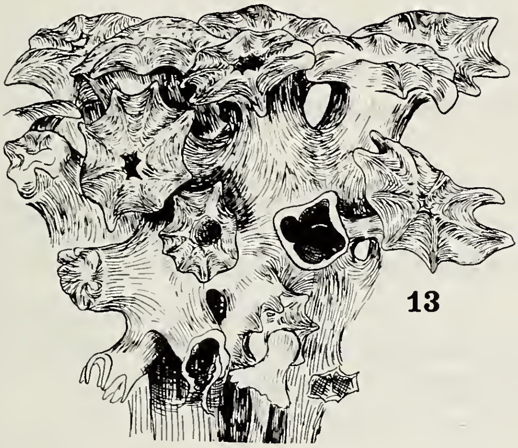
Figs. 12–19. 12, Colonies with retractile polyp-bearing branches: a, *Paralcyonium spinulosum* (delle Chiaje) (after Stiasny, 1941); b, *Carotalcyon sagamianum* Utinomi (after Utinomi, 1952); 13, *Agaricoides alcocki* Simpson, anthosteles of syntype, British Museum (Nat. Hist.), ×3; 14, Umbellate growth form, diagrammatic (after Thomson & Dean, 1931); 15, Catkins of *Litophyton*; 17, *Pseudodrifa nigra* (Pourtalès), 3 contracted polyps, scale = 1 mm; 18, Divaricate growth form, diagrammatic (after Thomson & Dean, 1931).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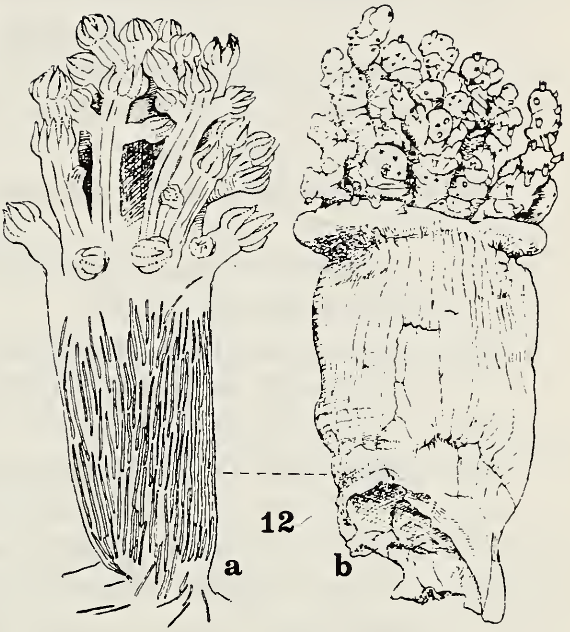

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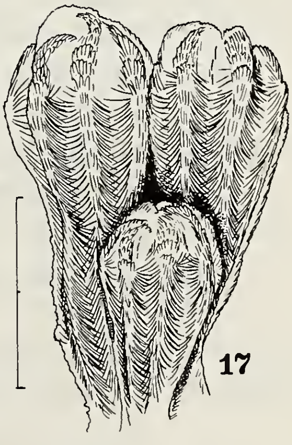
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166(167). Colonies divaricate (Fig. 18) .... *Roxasia* Tixier-Durivault & Prevorsek, 1957

167(166). Colonies glomerate (Fig. 19)......... *Spongodes* Lesson, 1831

168(161). Polyps not in lappets but scattered on branchlets of sparsely divided colonies.

169(170). Canal walls in interior of stem with few sclerites .... *Stereonephthya* Kükenthal, 1905

170(169). Canal walls in interior of stem with numerous sclerites forming irregular false axis[5]........ *Neospongodes* Kükenthal, 1903

171(106). Polyps generally distributed over surface of spreading or massive colonies with upper surface more or less folded or lobed.

172(179). Polyps monomorphic.

173(174). Colonies thin, membranous, spreading .... *Parerythropodium* Kükenthal, 1916

174(173). Colonies lobate or massive, not membranous.

175(176). Colonies upright, lobate, not massive; sclerites are thorny spindles and capstans (Fig. 20) ..... *Alcyonium* Linnaeus, 1758

176(175). Colonies thick, massive, upper surface plicate or lobate.

177(178). Predominant sclerites are stout, thorny or spinose double stars (Fig. 21); lobes of upper surface of colonies usually short and rounded...................... *Cladiella* Gray, 1869

178(177). Predominant sclerites are large, tuberculate spindles covered by superficial layer of small clubs (Fig. 22); upper surface of colonies with low, complex plication, or digitate processes, sometimes long and more or less branched .... *Sinularia* May, 1898

179(172). Polyps dimorphic.

180(181). Colonies with distinct sterile stalk and rounded, often marginally folded capitulum; inner coenenchymal sclerites are irregularly tuberculated spindles, in some species rather acute, in others stout and blunt; outermost sclerites weakly to moderately developed slender clubs (Fig. 23) .... *Sarcophyton* Lesson, 1834[6]

181(180). Colonies flattened, thick and spreading, sometimes with low sterile stalk not sharply delimited from capitulum, which is lobed or folded; sclerites of inner coenenchyme are stubby spindles ("tonnelets") with tubercles usually in transverse girdles (Fig. 24), sometimes more irregular; outer layer with slender clubs .... *Lobophytum* Marenzeller, 1886

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[5] Highly questionable.

[6] The distinction between *Sarcophyton* and *Lobophytum* is minimal.

182(25). Colonies with a consolidated axial support composed of sclerites firmly united by horny material and/or $CaCO_3$ but without a chambered central core, (except in nodes if present).

183(186). Axial skeleton continuous, composed of inseparably fused sclerites.

184(185). Sclerites of cortex are capstans often modified as double clubs and "opera glasses" .... *Corallium* Cuvier, 1798

185(184). Sclerites of cortex are irregular plates and spindles .... *Pleurocoralloides* Moroff, 1902[7]

186(183). Axial skeleton jointed, consisting of internodes composed of inseparably fused sclerites, alternating with nodes composed of sclerites bound together by flexible horny sheaths.

187(188). Branches arise from rigid calcareous internodes; ends of internodes nearly flat and radially grooved; sclerites are profusely tuberculated, rounded plates, medullar sclerites with tuberculate sculpture; color white (Parisididae) .... *Parisis* Verrill, 1864

188(187). Branches arise from flexible nodes; ends of internodes more or less conical and smooth, not radially grooved; sclerites of cortex of variable form, of medulla, smooth rods; color red, orange, yellow, rarely white (Melithaeidae).

189(190). Predominant sclerites are large, thorny spindles often unilaterally developed (Fig. 10), sometimes terminally more or less enlarged to form coarse thorn-clubs ..... *Acabaria* Gray, 1859

190(189). Spindles may be present but other forms occur in abundance.

191(192). Coenenchyme covered by a pavement layer of large, globular or pebblelike bodies externally ridged (Fig. 27) .... *Wrightella* Gray, 1870[8]

192(191). No pavementlike layer of spheroidal bodies.

193(194). Cortical sclerites include numerous leaf-clubs (Fig. 28) .... *Mopsella* Gray, 1857[8]

194(192). Cortical sclerites of diverse form but not predominantly leaf clubs.

195(196). Coenenchyme thin, polyps usually forming distinct calices in contraction; surface of internodes with anastomosing grooves and ridges; capstans more or less strongly modified as double

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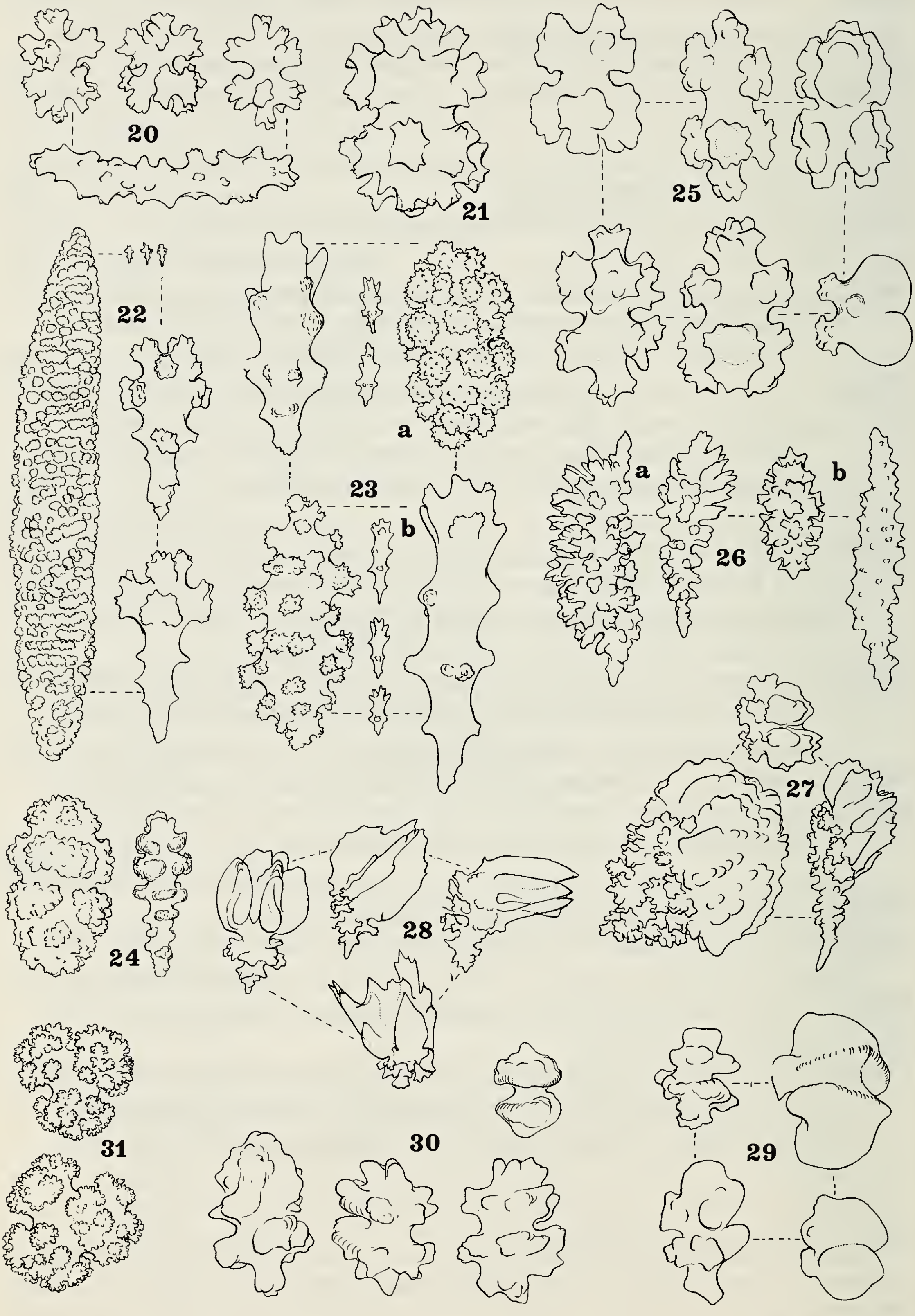
[7] The species originally assigned to this genus has not been found again. The illustrations published by Moroff (1902, Zool. Jahrb. (Syst.) 17:pl. 17, figs. 8, 10; pl. 18, figs. 19, 20) leave little doubt that *Pleurocoralloides formosum* as well as *Pleurocorallium confusum* are species of Melithaeidae.

[8] These nominal genera probably do not merit even subgeneric status.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wheels ("birotulates") (Fig. 29) .... *Melithaea* Milne Edwards & Haime, 1857[8,9]

196(195). Coenenchyme thicker, polyps fully retractile and not forming calices; surface of internodes marked by parallel grooves interrupted by pits; sclerites are spindles, clubs and small leafy spheroids (Fig. 30) .... *Clathraria* Gray, 1859[8]

197(24). In addition to sclerites (which may be absent), colonies have a proteinous axial support more or less extensively permeated by calcium carbonate.

198(325). Axial support has a hollow, cross-chambered central core.

199(204). Chambered core surrounded by terete, smooth sclerites cemented together by conspicuous horny sheaths.

200(201). Polyps retractile into a thick common coenenchyme, not forming prominent calices; branches thick; sclerites are compact triradiates (Fig. 31); color red ... *Ideogorgia*, nom. nov.[10]

201(200). Polyps not retractile, forming prominent calices; branches thin; sclerites spindles or plates.

202(203). Calices bluntly conical or hemispherical, little or no taller than wide, margins not forming conspicuous lobes or teeth; sclerites are stout, tuberculate, blunt spindles, rods, or thick plates, tentacles with crutch-shaped sclerites. Red or white .... *Keroeides* Studer, 1887

203(202). Calices cylindrical, taller than wide, margins with 8 distinct lobes filled with converging sclerites; sclerites slender, acute, prickly spindles; tentacles with small, curved spindles, no crutch-shaped bodies. White .... *Lignella* Gray, 1870

204(199). Chambered core of axis surrounded by concentric layers of

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[9] Synonyms: *Melitella* Gray, 1859, and *Birotulata* Nutting, 1911.

[10] Pro *Dendrogorgia* Simpson, 1910 (type-species, *Juncella elongata capensis* Hickson, 1904), not Duchassaing, 1870.

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Figs. 20–31. 20, *Alcyonium digitatum* Linnaeus, sclerites, ×225; 21, *Cladiella krempfi* (Hickson), sclerite, ×225; 22, *Sinularia* sp., large spindle and 3 clubs at same scale, ×30, and 2 clubs ×275; 23, *Sarcophyton* spp.: a, *S. trocheliophorum* Marenzeller, spindle and 2 clubs at same scale, ×70, and club, ×275; b, *S.* sp. cf. *spongiosum* Thomson & Dean, spindle and 3 clubs at same scale, ×70, and club ×275; 24, *Lobophytum crassum* Marenzeller, sclerites ×140; 25, *Corallium* spp., sclerites ×275; 26, *Acabaria* spp.: a, *A. crosslandi* Stiasny, sclerites ×140; b, *A. erythraea* (Ehrenberg), sclerites, ×140; 27, *Wrightella coccinea* (Ellis & Solander), sclerites, ×140; 28, *Mopsella* spp., leaf-clubs ×140; 29, *Melithaea ocracea* (Linnaeus), club and 3 birotulates, ×275; 30, *Clathraria rubrinodis* Gray, "leafy spheroids," i.e., capstans modified toward birotulate type, ×275. 31, *Ideogorgia capensis* (Hickson), sclerites, ×275.

hornlike scleroprotein that may contain calcareous deposits but not formed as sclerites.

205(218). Polyps not functionally differentiated into anthocodia and anthostele, contractile but not retractile within common coenenchyme, tentacles folding over oral disk in contraction.

206(207). Sclerites are small spindles and capstans, sometimes weakly developed as clubs, not individually conspicuous and not regularly arranged on calices .... *Calcigorgia* Broch, 1935

207(206). Sclerites are large spindles, very conspicuous on calices, where commonly arranged *en chevron* in 8 longitudinal double rows.

208(209). Distal ends of sclerites surrounding tentacle bases differentiated as sharp projecting spines forming a conspicuous thorny crown around infolded tentacles .... *Acanthogorgia* Gray, 1857

209(208). Distal ends of sclerites around tentacle bases not specially differentiated as spines, though the tips may project somewhat around calicular apex.

210(211). Calicular and coenenchymal sclerites with tubercles of outer side developed as foliate or spinous processes; calicular sclerites transversely arranged, separated from subtentacular sclerites by inconspicuous suture (where body wall may lack sclerites), but distal part of polyps not retractile within calices .... *Cyclomuricea* Nutting, 1908

211(210). Coenenchymal sclerites with tubercles of inner and outer sides similarly developed; polyps without suture separating calicular from subtentacular sclerites.

212(213). Calices short, cylindrical, margin with several projecting spindles; sclerites of tentacles abruptly smaller in size than those of calicular walls; no radiates in coenenchyme .... *Versluysia* Nutting, 1910

213(212). Calices short and verruciform to tall and cylindrical, sclerites arranged more or less distinctly *en chevron* in 8 double rows, the distal ones projecting little or not at all; sclerites of calices gradually merging with those of tentacle bases, which are not abruptly smaller; inner layer of coenenchyme with more or less abundant radiates.

214(215). Calices low, verruciform .... *Muricella* Verrill, 1869

215(214). Calices prominent, tall, cylindrical.

216(217). Calices clavate; sclerites of calicular walls only indistinctly *en chevron* .... *Anthogorgia* Verrill, 1868

217(216). Calices not clavate; sclerites of calicular walls *en chevron* in 8 longitudinal double rows ..... *Acalycigorgia* Kükenthal, 1908

218(205). Polyps functionally differentiated into anthocodia and anthostele, or fully retractile into common coenenchyme; spiculation of tentacular part of polyp not continuous with that of proximal part but separated by neck zone with few or no sclerites, permitting retraction of anthocodia into anthostele or directly into common coenenchyme.

219(250). Sclerites in the form of spindles with tubercular sculpture arranged in whorls, of moderate size (up to 0.3 mm, commonly less); when present, anthocodial sclerites are tapered, flat rodlets with scalloped or lobed edges, not usually forming a crown and points; core of axis narrow, cortex dense, with little or no loculation (Gorgoniidae).

220(221). The proteinous axis is flat and lamellar .... *Phycogorgia* Milne Edwards & Haime, 1850

221(220). The proteinous axis is nearly or quite cylindrical, or somewhat flattened in the basal part of colony.

222(227). Branches of axis anastomose to form a network.

223(224). Meshes of axial network filled in by coenenchyme, forming flat, more or less dissected, leaflike fronds .... *Phyllogorgia* Milne Edwards & Haime, 1850

224(223). Meshes of axial network not filled in by coenenchyme, forming net-like, reticulate fans.

225(226). Scaphoids present as well as spindles and capstans (Fig. 32) .... *Gorgonia* Linnaeus, 1758

226(225). Spindles and capstans only, no scaphoids (Fig. 33) .... *Pacifigorgia* Bayer, 1951

227(222). Branches of axis not anastomosing to form a meshwork.

228(229). Coenenchyme contains only spindles and capstans with symmetrically developed tuberculation .... *Lophogorgia* Milne Edwards & Haime, 1857

229(228). Many spindles and capstans modified in form or asymmetrically sculptured.

230(233). Numerous double wheels (i.e., capstans with tubercles fused into disks) present as well as spindles (Figs. 35, 36).

231(232). Double wheels large, lengths to 0.15 mm, spindles to 0.2 mm, some developed as leaf clubs (Fig. 35); anthocodiae weakly to moderately armed with flat rods 0.15–0.3 mm long .... *Adelogorgia* Bayer, 1958

232(231). Double wheels smaller, lengths to 0.05 mm, spindles 0.12–0.18 mm, not developed as clubs (Fig. 36); anthocodiae unarmed .... *Eugorgia* Verrill, 1868

233(230). No double wheels present.

234(239). Scaphoids present as well as spindles and capstans.

235(236). Polyps retractile into distinct verruciform calices; colonies small, loosely pinnate................. *Olindagorgia,* n. gen.[11]

236(235). Polyps retract flush with coenenchymal surface, not forming calices.

237(238). Colonies dichotomously branched, bushy; polyps retracting into edges of flat or triangular branches .... *Pterogorgia* Ehrenberg, 1834

238(237). Colonies pinnately branched, plumose; polyps in biserial tracts, rarely all around cylindrical or weakly flattened branches, retracting flush with coenenchymal surface .... *Pseudopterogorgia* Kükenthal, 1919

239(234). No scaphoids present.

240(241). Unilaterally spinose spindles present as well as symmetrical spindles and capstans, some capstans weakly modified as disk-spindles (Fig. 39) .... *Leptogorgia* Milne Edwards & Haime, 1857

241(240). No unilaterally spinose spindles present; sclerites predominantly symmetrical spindles or capstans and small clubs.

242(245). Clubs are wart-clubs; tubercles of head prominent and set in a regular transverse whorl (Fig. 40).

243(244). Blunt, cylindrical rods scantily distributed among tuberculate spindles and wart-clubs .... *Hicksonella* Nutting, 1910

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[11] *Olindagorgia,* n. gen. Small, loosely pinnate colonies under 10 cm in height; polyps biserial, usually alternate, retractile within prominent hemispherical calices, anthocodiae armed with small flat rods with more or less distinctly spatulate ends; coenenchymal sclerites consisting of acute spindles with compound tubercles in whorls, and scaphoids with surface of convex side weakly undulated. Type-species, *Pseudopterogorgia marcgravii* Bayer, 1961 [1962], Stud. Fauna Curacao 12:255, fig. 82. Holotype, USNM 50228, off Parahyba do Norte, Brazil, 6°59′30″S, 34°47′60″W, 20 fms (36.6 m), *Albatross* sta. 2758, 16 Dec. 1887.

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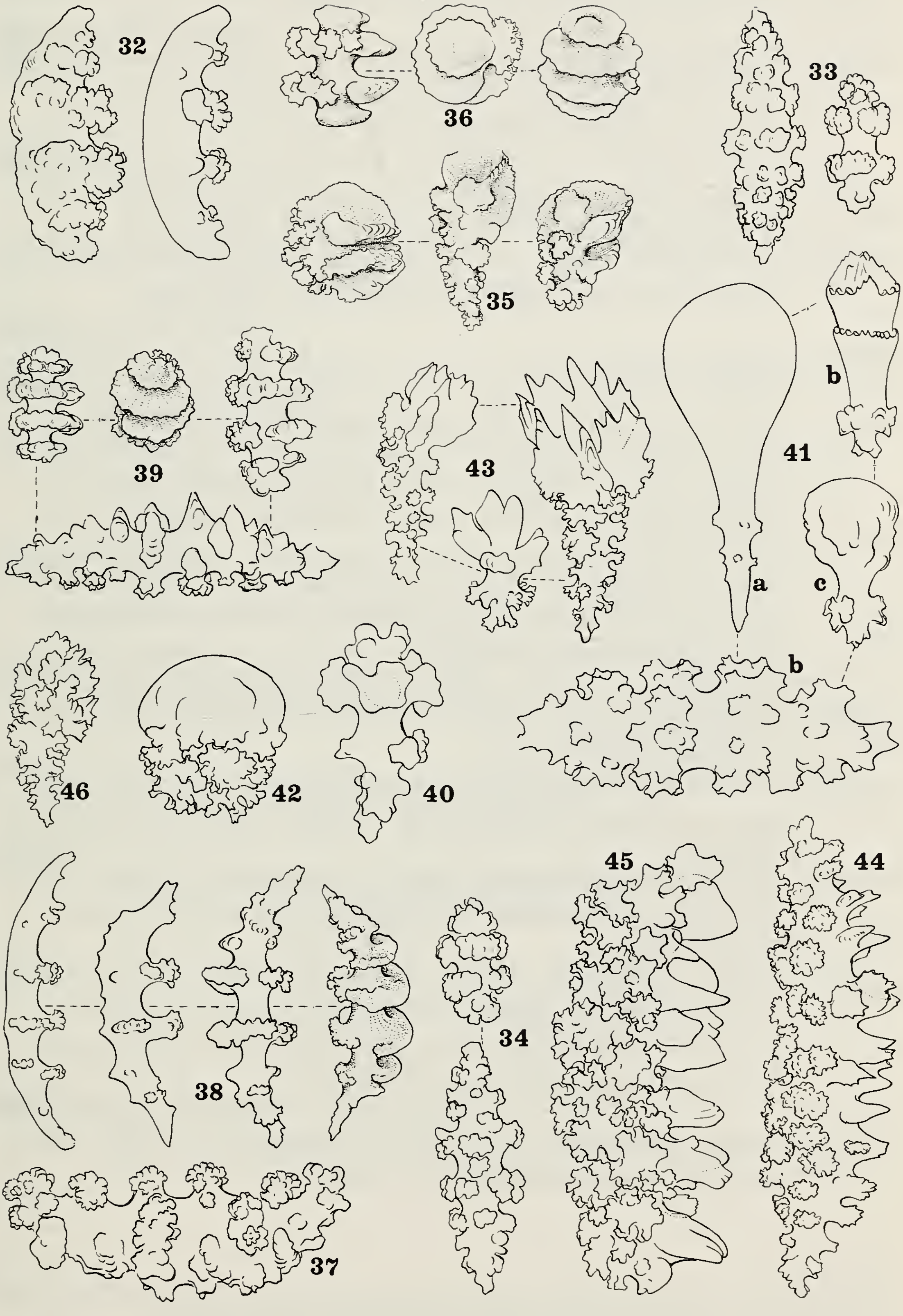
Figs. 32–46. 32, Scaphoids of *Gorgonia* spp., ×275; 33, spindle and capstan of *Pacifigorgia irene* Bayer, ×275; 34, Spindle and capstan of *Lophogorgia hebes* (Verrill), ×275; 35, Double wheel, leaf-club and intermediate form, *Adelogorgia phyllosclera* Bayer, ×140; 36, Double wheels of *Eugorgia ampla* Verrill, ×275; 37, Scaphoid of *Pterogorgia anceps* (Pallas) ×275; 38, Scaphoids of *Pseudopterogorgia* spp., ×275; 39, Asymmetrical spindle, capstan and double wheels of *Leptogorgia virgulata* (Lamarck), ×275; 40, Wart-club of *Rumphella* sp., ×275; 41, Spindle and balloon-clubs of *Eunicella* spp.: a, *E. modesta* Verrill; b, *E. papillosa* (Esper); c, *E. verrucosa* (Pallas), all ×275; 42, Globular wart-club of *Pseudoplexaura wagenaari* (Stiasny), ×140; 43, Foliate club and torches of *Eunicea* spp., ×140; 44, Unilaterally spinose spindle of *Muriceopsis flavida* (Lamarck), ×140; 45, Unilaterally spinose spindle of *Pseudoplexaura porosa* (Houttuyn), ×140; 46, Irregularly spinose club of *Psammogorgia arbuscula* (Verrill), ×140.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244(243). No cylindrical rods; wart clubs abundant .... *Rumphella* Bayer, 1955

245(242). Clubs are balloon-clubs (Fig. 41)....... *Eunicella* Verrill, 1869

246(247). Head of balloon-clubs smooth, teardrop-shaped, in some species more or less 3-flanged (Fig. 41a) .... *Eunicella* (*modesta* group)

247(246). Head of balloon-clubs sculptured with low, smooth tubercles or whorls of small points, trigonal in cross section.

248(249). Balloon-clubs with 2 or 3 whorls of upwardly directed points around head above shaft ("Dütenkeulen"; Fig. 41b) .... *Eunicella* (*alba* group)

249(248). Heads of balloon-clubs with low, smooth warts but no whorls of points (Fig. 41c) .... *Eunicella* (*verrucosa* group)

250(219). Fully developed sclerites usually longer than 0.3 mm and may be very large (lengths to 5 mm or more), with tubercular sculpture not in regular whorls; anthocodial sclerites when present are more or less curved or bent rods, sometimes flattened and often with prickly or tuberculate sculpture, commonly arranged as a crown and points; core of axis wide, cortex soft, loculated (usually abundantly so), the loculi filled with delicate fibrous substance or hard, non-spicular $CaCO_3$ composed of crystals radially arranged with respect to axis.

251(264). Coenenchyme with numerous club-shaped sclerites, often in a distinct superficial layer.

252(263). At least some coenenchymal sclerites purple or lavender, but may be limited to axial sheath of main trunk and proximal branches.

253(260). Clubs well-differentiated, mostly concentrated in outer coenenchyme; predominant large sclerites are uniformly tuberculated spindles.

254(255). Polyps unarmed or at most with a few small, flat rods, retracting flush into common coenenchyme, calicular apertures porelike, often gaping; clubs are wart-clubs with rounded head, sometimes almost globular (Fig. 42) .... *Pseudoplexaura* Wright & Studer, 1889[12]

255(254). Polyps with numerous sclerites, retracting into distinct calices that may be prolonged as a lower lip.

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[12] Those species having abundant clubs in the outer coenenchyme may prove to be generically distinct from the type-species, which has unilaterally spinose spindles.

256(257). Anthocodial armature chiefly tentacular, not forming a crown and points .... *Eunicea* Lamouroux, 1816 (sensu stricto)

257(256). Anthocodial armature below tentacles forming distinct crown and points; clubs are leaf-clubs with foliate or laciniate head, often obliquely set to form "torches" (Fig. 43).

258(259). Pale violet or lavender interior sclerites often limited to larger branches and main trunk; coenenchyme hard; calices with falcate lower lip........... *Eunicea* (*Euniceopsis* Verrill, 1907)

259(258). Reddish purple interior sclerites occur throughout colony; coenenchyme brittle and crumbly when dry; calices forming raised rim without falcate lower lip .... *Plexaura* Lamouroux, 1812

260(253). Clubs poorly differentiated, not in a definite surface layer; spindles unilaterally spinose (Figs. 44, 45).

261(262). Polyps with tentacular armature of small, flat rods, retracting into calices having at least a raised lower lip, sometimes an obliquely nariform verruca; colonies tall, plumose, or low, bushy .... *Muriceopsis* Aurivillius, 1931

262(261). Polyps unarmed, retracting flush with surface of coenenchyme, calicular apertures gaping; colonies tall, bushy .... *Pseudoplexaura* Wright & Studer, 1889[13]

263(252). No purple or lavendar sclerites; clubs are coarse, irregular thorn-clubs (Fig. 46); usually pink or red, uncommonly yellow or white.................... *Psammogorgia* Verrill, 1868

264(251). Club-shaped sclerites scarce and not concentrated in a surface layer, commonly absent altogether.

265(270). Predominant sclerites are stellate forms with 4 or more rays.

266(267). Stellate forms are 5- to many-rayed disks with central boss; outermost layer of coenenchyme filled with rosette-like "collar-button" sclerites (Fig. 47) .... *Bebryce* Philippi, 1841

267(266). Predominant sclerites are 4-rayed "butterflies" produced by hypertrophy of 4 rays of the 6-radiate capstans; outer layer without "collar-buttons," but small crosses with a spinose central boss may occur.

268(269). Colonies more or less planar or flabellate, sometimes irregularly straggling, not dichotomous, with short, crooked terminal branches bearing well-spaced polyps retracting within

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[13] Only *Pseudoplexaura porosa* (Houttuyn), type-species of the genus.

low, conical or hemispherical calices; rays of 4-radiate sclerites about equal in length (Fig. 48) .... *Nicaule,* n. gen.[14]

269(268). Colonies robustly bushy, dichotomous, with cylindrical branches usually long and straight or nearly so, bearing crowded polyps retracting into slitlike (occasionally porelike) apertures often with a raised, bilabiate rim (or, rarely, prominent bilabiate calices); 2 rays of 4-radiate sclerites usually stronger than the others (Fig. 49) .... *Plexaurella* Valenciennes, 1855

270(265). Stellate forms not predominant.

271(276). Coenenchyme with an outer layer of large, thick plates or flattened spindles, tightly fitted as in mosaic or with smaller spindles in interstices.

272(273). Branches long and ascending (rarely unbranched); calices with 8 marginal lobes formed by converging sclerites; outer surface of coenenchymal plates with undulated or "washboard" appearance .... *Thesea* Duchassaing & Michelotti, 1860

273(272). Branches short, crooked; calices without marginal lobes.

274(275). Polyps biserial; anthocodial armature with numerous sclerites converging in each section of the points; coenenchymal sclerites without spines .... *Scleracis* Kükenthal, 1919

275(274). Polyps on all sides, or absent from only one side of branches; anthocodial armature with only a few (1 or 2 pairs) large sclerites in each sector of the points; coenenchymal sclerites sometimes spiny .... *Paracis* Kükenthal, 1919

276(271). Coenenchymal sclerites may be large but not forming a pavementlike layer of thick plates.

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[14] *Nicaule crucifera,* n. gen., n. sp. Colony irregularly branched in one plane, about 30 cm tall, branches crooked, terminal branchlets up to 60 mm but mostly 30–40 mm long, diameter about 3 mm. Polyps on all sides, about 1.5–3.0 mm apart, retractile into low calices with 8 marginal lobes; anthocodiae occasionally preserved exsert, armature consisting of 8 points each composed of 2 bent, tuberculated rods about 0.4 mm long, above a transverse neck ring (collaret) 2–3 sclerites wide, composed of curved spindles (Fig. 48a); smaller, straight rodlets longitudinally placed extend upward from the points along the proximal part of the tentacles. Coenenchyme filled with elaborately tuberculated 6-radiate capstans (Fig. 48b) many of which develop into 4-rayed "butterflies" about 0.25 mm wide (Fig. 48c), similar to those of *Plexaurella,* by the suppression of 2 rays and elongation of the outer 4; a few may be 3-rayed and some approach the stellate forms of *Bebryce* by the development of 5 or 6 rays. Sclerites colorless. Axis with spacious central core and thin loculated cortex, soft, collapsing upon drying. Surface of coenenchyme overgrown by attached epizoa supporting a diverse community of small crustaceans. Color in life dull orange, polyps orange except for oral disk and oral surface of tentacles, which are white. Holotype, USNM 59482, Palau Islands, south point of Augulpelu Reef, 10 m, coll. Douglas Faulkner, 27 October 1971, by diving.

277(300). Calicular sclerites are thorn-scales or thorn-spindles.

278(283). Thorn-scales wider than high, consisting of two broad, diverging basal processes and a distal projection either foliate or spinose, usually strong but in some species inconspicuous; coenenchyme with 4-radiates having a central projection (Fig. 50) .... (*Villogorgia* s.l.).

279(280). Outer process an inconspicuous point, more or less flattened in a plane normal to that of base (Fig. 50a) .... *Villogorgia* (''Brandella'' type)

280(279). Outer process conspicuously projecting.

281(282). Outer process digitate or spinelike (Fig. 50b) .... *Villogorgia* (''Perisceles'' type)

282(281). Outer process foliate .... *Villogorgia* s.s. (''Acamptogorgia'' type)

283(278). Thorn-scales as high as, or higher than, wide, consisting of several diverging basal processes (sometimes only 2, but then not broad and flat); no 4-radiates in coenenchyme.

284(293). Anthocodia with few, large sclerites in crown points.

285(286). Calicular thorn-scales with rather short, blunt, serrated projection arising obliquely from a single, elongated root set longitudinally in calicular wall (Fig. 51) .... *Dentomuricea* Grasshoff, 1977

286(285). Calicular thorn-scales with spinelike outer projection arising marginally from complex, spreading base.

287(288). Coenenchymal sclerites elongate, without projecting spines .... *Paramuricea* Kölliker, 1865

288(287). Coenenchymal sclerites with projecting spines.

289(290). Coenenchymal sclerites not conspicuously large, projecting spines of only infrequent occurrence .... *Placogorgia* Studer, 1887

290(289). Coenenchymal sclerites large, platelike or scalelike, many or all with one or more spinelike projections.

291(292). Coenenchymal sclerites thick, coarse spindles or plates with one to several strong, projecting spines .... *Pseudothesea* Kükenthal, 1919[15]

292(291). Coenenchymal sclerites scalelike, with complicated margins

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[15] Although I have previously synonymized this genus with *Placogorgia* (Bayer, 1959, J. Wash. Acad. Sci. 49:54), it seems to be generically distinct, at least from the type-species of that genus. It may, however, be impossible to distinguish it from *Paracis,* from which it was distinguished by Kükenthal (1924, Tierreich 47:140–141, in key) on the basis of having sclerites of very diverse form, including strongly spinose, unilateral thorn-scales, but these occur in both *Pseudothesea* and *Paracis.*

and short but stout conical spike at or near middle of outer surface; scales at calicular margin with spine obliquely directed at distal edge (Fig. 52) .... *Lepidomuricea* Kükenthal, 1919

293(284). Anthocodiae with numerous, smaller sclerites, sometimes completely unarmed.

294(295). Base of calicular thorn-scales is a single elongated root set longitudinally in calicular wall, from the distal end of which a single stout, serrated process arises obliquely; coenenchyme with thorn-spindles (Fig. 53) .... *Muriceides* Studer, 1887

295(294). Base of calicular thorn-scales consists of diverging or branching root-processes.

296(297). Distal projection of calicular thorn-scales is a single strong spike; coenenchyme with thorn-spindles (Fig. 55) .... *Echinomuricea* Verrill, 1869

297(296). Distal projection of calicular thorn-scales is foliate or broadly lobate (Figs. 54, 56).

298(299). Projection of thorn-scales is a broad blade, thick or thin, often lobed marginally; coenenchyme with irregular spindles (Fig. 54) .... *Menella* Gray, 1870[16]

299(298). Projection of thorn-scales consists of several thick, usually pointed lobes; coenenchyme with coarse, irregular bodies with serrated outer surface, sometimes unilaterally spined spindles (Fig. 56) .... *Echinogorgia* Kölliker, 1865

300(277). Calicular sclerites are not thorn-scales or thorn-spindles, although marginal sclerites may have projecting edge.

301(324). Sclerites of coenenchyme include spindles, sometimes short and blunt; capstans, if present, not developed as disk spindles.

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[16] Synonym: *Plexauroides* Wright & Studer, 1889.

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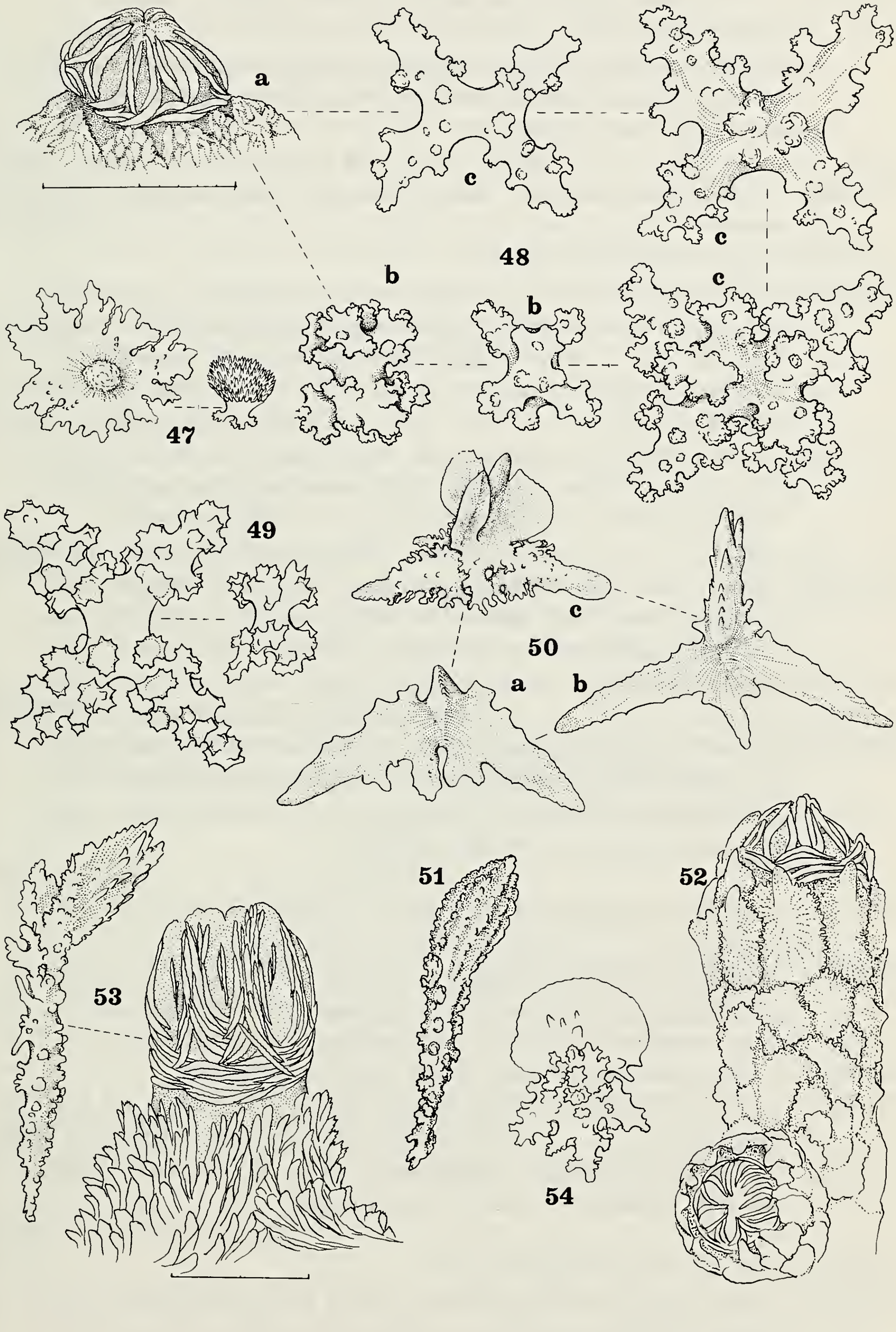
Figs. 47–54. 47, Stellate and rosette sclerites of *Bebryce cinerea* Deichmann, ×140; 48, *Nicaule crucifera* Bayer, n. sp.: a, Calyx with partly exsert anthocodia, ×25, scale = 1 mm; b, 6-radiate capstans, ×140; c, 4-rayed "butterflies," ×140; 49, Capstan and 4-rayed "butterfly" of *Plexaurella nutans* (Duch. & Mich.), ×140; 50, Calicular thorn-scales of *Villogorgia* spp.: a, "Brandella" type; b, "Perisceles" type; c, "Acamptogorgia" type, all ×105; 51, Calicular thorn-scale of *Dentomuricea meteor* Grasshoff, ×70, drawn from SEM, Grasshoff, 1977; 52, *Lepidomuricea ramosa* (Thomson & Henderson), calyx from type colony, British Museum (Nat. Hist.), ×10; 53, *Muriceides hirta* (Pourtalès), calicular thorn-scale ×70, and calyx with partly exsert anthocodia ×17; 54, Calicular thorn-scale of *Menella* sp., ×105.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302(303). Anthocodial armature asymmetrically developed, sclerites of abaxial side, neck zone distinct only on abaxial side so polyps fold inward toward axis, obliquely placed on shelflike calices; coenenchymal spindles commonly reaching 4 mm in length, somewhat sinuous (Fig. 57) .... *Hypnogorgia* Duchassaing & Michelotti, 1864

303(302). Anthocodial armature, when present, symmetrically developed.

304(309). Calices cylindrical, tubular.

305(306). Calices widely spaced in spiral around branches, sclerites are spindles, those of calices sometimes a little thicker at distal end, up to 0.5 mm in length, tubercles on outer side not developed as spines, placed *en chevron* in 8 double rows in calicular wall .... *Anthomuricea* Studer, 1887

306(307). Calices closely crowded on all sides; sclerites are long spindles (up to 3 mm in length) with tubercles of outer surface often spinelike, arrange in calicular wall longitudinally .... *Muricea* Lamouroux, 1921(s.l.)

307(308). Calices directed obliquely upward, the lower margin prolonged outward and upward as a projecting lip behind which the anthocodia retracts obliquely; calicular sclerites not converging to form marginal lobes other than the lower lip .... *Muricea* Lamouroux, 1921 (s.s.)

308(307). Calices vertically placed, lower margin not forming projecting lip, anthocodiae retracting vertically into truncated tips; marginal sclerites tending to converge as 8 calicular lobes, their tips projecting more or less distinctly .... (*Muricea*) *Eumuricea* Verrill, 1869

309(304). Calices hemispherical or conical, sometimes scarcely projecting.

310(321). Margins of calices divided into lobes or teeth composed of converging sclerites having no projecting terminal tooth; no outer coenenchymal layer of small capstans or spheres.

311(314). Calices with only 2 large lobes, one on each side.

312(313). Calices prominent; coenenchymal spindles less than 1.5 mm in length .... *Calicogorgia* Thomson & Henderson, 1906

313(312). Calices not especially conspicuous (Fig. 58); coenenchymal spindles commonly up to 7 mm in length .... *Caliacis* Deichmann, 1936

314(311). Calices with 8 marginal lobes.

315(316). Calices low and inconspicuous, often projecting little or not at all; sclerites are blunt spindles, sometimes almost spheroidal, with or without median waist (Fig. 59) .... *Euplexaura* Verrill, 1865

316(315). Calices hemispherical or dome-shaped, distinctly projecting; sclerites fusiform, more or less acute.

317(318). Anthocodial sclerites few and small or altogether absent .... *Anthoplexaura* Kükenthal, 1908

318(317). Anthocodial sclerites larger and more numerous.

319(320). Sclerites below the 8 anthocodial points may be transverse, but small and numerous, not forming distinct collaret .... *Astrogorgia* Verrill, 1868

320(319). Sclerites below the 8 anthocodial points large and bow-shaped, forming strong collaret .... *Muricella* Auct.[17]

321(310). If marginal calicular lobes present, component sclerites not distinctly converging; small capstans or spheres and double spheres in complete or incomplete outer layer of coenenchyme, those surrounding calicular orifice with a terminal spine or tooth.

322(323). Coenenchymal spindles overlain by a layer of capstans, sometimes larger at one end than the other; distal sclerites of calicular lobes with a strong, echinulate spine, forming a bristling barricade around calicular aperture (Fig. 60) .... *Heterogorgia* Verrill, 1868

323(322). Coenenchymal spindles overlain by incomplete layer of small, tuberculate spheres and double spheres, often (but not always) with a bifurcate outer projection (Fig. 61) .... *Lytreia,* n. gen.[18]

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[17] I have so far not been able to find a published name applicable to this generic taxon.

[18] *Lytreia,* n. gen. Sprawling, openly bushy colonies of moderate size (up to about 20 cm tall), with crooked branches not in one plane. Polyps retractile into low, bluntly conical calices scattered irregularly on all sides of branches; calicular margins with 8 lobes, in which sclerites only irregularly and indistinctly converge, those surrounding the aperture commonly with a projecting spine. Coenenchyme containing straight or curved, irregularly tuberculate spindles overlain by a superficial layer of small, tuberculate double heads some of which have a conspicuous, forked or doubly forked spine. Anthocodiae armed with a crown of about 4–5 transversely placed bow-shaped spindles surmounted by 8 points each composed of 2–3 pairs of bent spindles *en chevron.* Color dirty grey, the surface conspicuously overgrown by hydroids, polychaete worms and other epizoa; sclerites colorless. Type-species, *Thesea plana* Deichmann, 1936 (Mem. Mus. Comp. Zool. 53:123), from west of Dry Tortugas, Florida, in 42 fathoms (76 m), MCZ 4646. Deichmann (op. cit.:124, under *Thesea*? sp.) foresaw the need for this genus, but overlooked the presence, in *T. plana,* of the "small, delicate, bi-horned deposits" characteristic of *Thesea*? sp., which is identical. These sclerites are of very irregular and patchy distribution and, in some colonies, may be uncommon if not altogether absent.

324(301). In addition to spindles, sclerites of coenenchyme include capstans with warts more or less conspicuously modified as disks; calices prominent, conical or cylindrical, well separated, usually biserial; calicular margins and bases of tentacles often with stout, barlike rods; anthocodiae often preserved exsert .... *Swiftia* Duchassaing & Michelotti, 1864

325(198). Axial support does not have a chambered central core but is solid, unless the axis is jointed, in which case the calcareous internodes may be hollow, but not chambered.

326(408). Axis continuous.

327(340). Sclerites are tuberculate double heads or double clubs (Figs. 62–65) sometimes larger at one end (Ellisellidae).

328(329). Cortical sclerites are clubs with distinctly enlarged head and smaller handle surrounded by a whorl of tubercles (Fig. 62) .... *Junceella* Valenciennes, 1855

329(328). Cortical sclerites are double clubs with both ends roughly equal in size (Figs. 63–65).

330(331). Branching of colony lyrate, in one plane .... *Ctenocella* Valenciennes, 1855

331(330). Colonies not lyrate.

332(333). Colonies profusely branched, pinnate, ultimate branchlets each terminating in a single polyp shaped like a clay pipe .... *Riisea* Duchassaing & Michelotti, 1860

333(332). Colonies dichotomous or irregular, not pinnate, commonly unbranched.

334(337). Sclerites of calices and coenenchyme of about equal size (Fig. 63).

335(336). Colonies abundantly branched in one plane, terminal branches rather short and numerous .... *Verrucella* Milne Edwards & Haime, 1857

336(335). Colonies unbranched or with few long, whiplike branches .... *Toeplitzella* Deichmann, 1936

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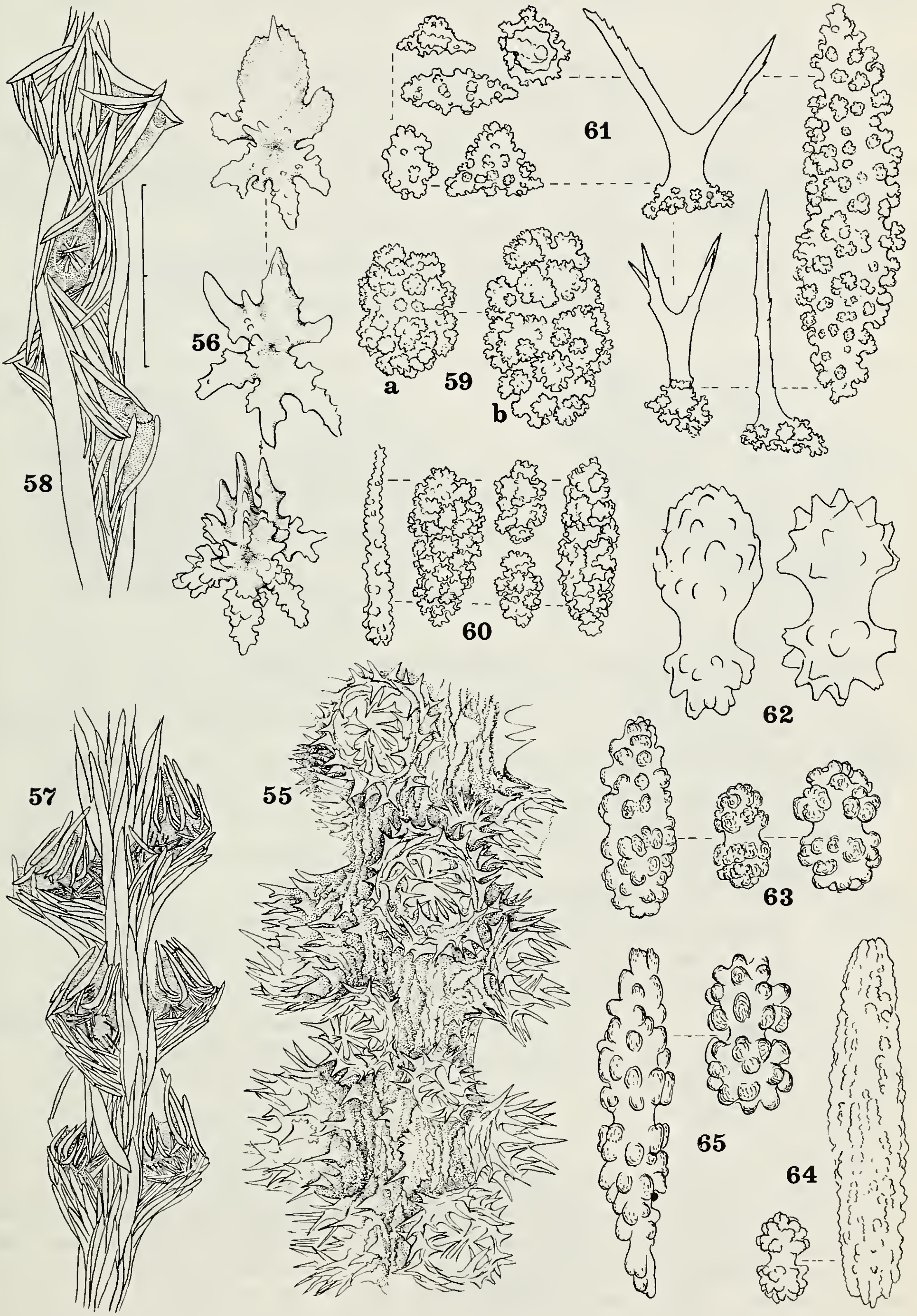
Figs. 55–65. 55, *Echinomuricea coccinea* (Stimson), part of type-colony, Peabody Museum, Yale, ×17; 56, Calicular thorn-scales of *Echinogorgia* spp., upper ×70, lower two ×105; 57, *Hypnogorgia pendula* Duch. & Mich., part of branch, ×10; 58, *Caliacis nutans* (Duch. & Mich.), part of branch, ×10, scale = 2 mm; 59, Sclerites of *Euplexaura* spp.: a, *E. erecta* Kükenthal, ×140; b, *E. capensis* Verrill, type, Museum of Comparative Zoology, Harvard, ×140; 60, Sclerites of *Heterogorgia verrucosa* Verrill, ×105; 61, Sclerites of *Lytreia plana* (Deichmann), ×105; 62, Sclerites of *Junceella juncea* (Pallas), ×275; 63, Sclerites of *Verrucella sanguinolenta* (Gray), ×275; 64, Sclerites of *Nicella dichotoma* (Gray), type, British Museum (Nat. Hit.), ×275; 65, Sclerites of *Ellisella atlantica* (Toeplitz), ×275.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337(334). Sclerites of calices distinctly longer than those of coenenchyme.
338(339). Colonies abundantly branched, often flattened or in one plane, terminal branches short and numerous (Fig. 64) .... *Nicella* Gray, 1870
339(338). Colonies unbranched or with few long, whiplike branches (Fig. 65) .... *Ellisella* Gray, 1858
340(327). Sclerites not double heads or double clubs.
341(344). Sclerites are minute disks or double disks (Ifalukellidae).
342(343). Branching in one plane, pinnate; sclerites numerous .... *Plumigorgia* Nutting, 1910
343(342). Branching bushy, dense, not pinnate; sclerites extremely sparse .... *Ifalukella* Bayer, 1955
344(341). Sclerites are scales.
345(386). Crystal orientation in scales is radial, extinction pattern under crossed Nicols cruciform; surface of axis longitudinally grooved, concentric layers undulating in cross section (Primnoidae).
346(349). Body scales of fully developed polyps not in regular longitudinal rows.
347(348). Colonies plumose, branching pinnate, opposite; polyps short (2 mm or less), in pairs or whorls of 3; all sclerites thin, smooth scales .... *Primnoeides* Wright & Studer, 1887
348(347). Colonies whiplike, unbranched; polyps tall (3 mm or more), in whorls of 15 or more; sclerites thick, discoidal platelets with nodose or tubercular sculpture .... *Ophidiogorgia* Bayer, 1980
349(346). Body scales arranged in longitudinal rows.
350(351). Adaxial side of polyps adnate to stem, abaxial side covered by 2 rows of numerous sickle-shaped scales; tentacles surrounded by many small scales not differentiated as an operculum .... *Armadillogorgia* Bayer, 1980
351(350). Adaxial side of polyps not adnate to stem (although some-

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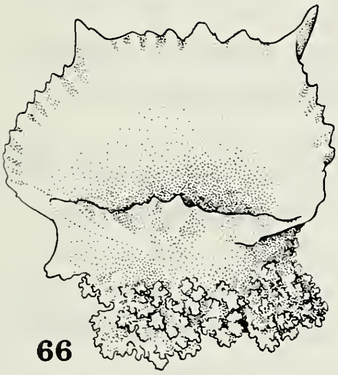
Figs. 66–74. 66, Body scale of *Ascolepis nodosa* (Kükenthal), ×100; 67, *Primnoella australasiae* Gray, whorl of polyps, ×20; 68, Polyps of *Thouarella hilgendorfi* (Studer), oral view ×50, lateral view ×40; 69, Polyp of *Parastenella doederleini* (Wright & Studer), oral view ×15; 70, Polyps of *Plumarella aurea* (Deichmann), ×25; 71, Polyps of *Amphilaphis regularis* Wright & Studer, syntype, British Museum (Nat. Hist.), ×25; 72, Polyp of *Pterostenella plumatilis* (Milne Edwards & Haime), oral view ×10, lateral view ×7; 73, Polyps of *Dasystenella acanthina* (Wright & Studer), syntype, British Museum (Nat. Hist.), ×12; 74, Polyp of *Candidella johnsoni* (Wright & Studer), oral view ×15.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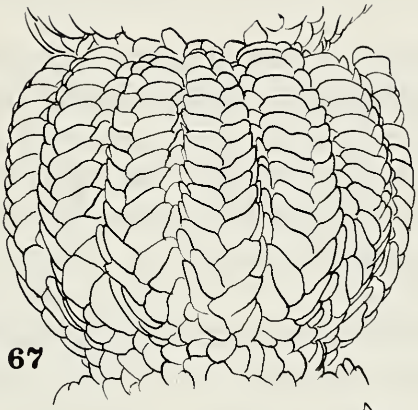
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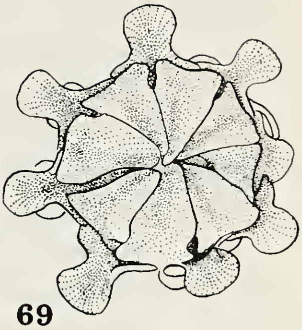
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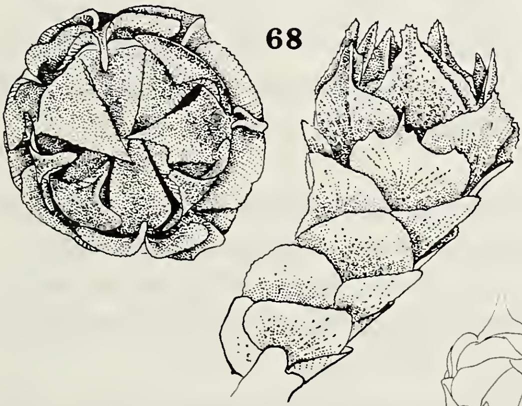
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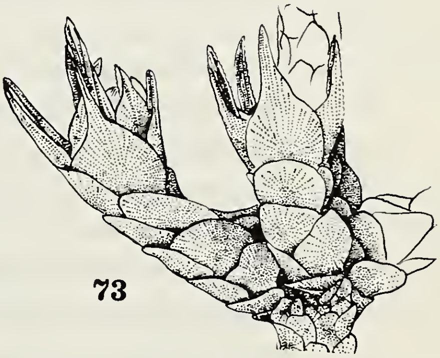
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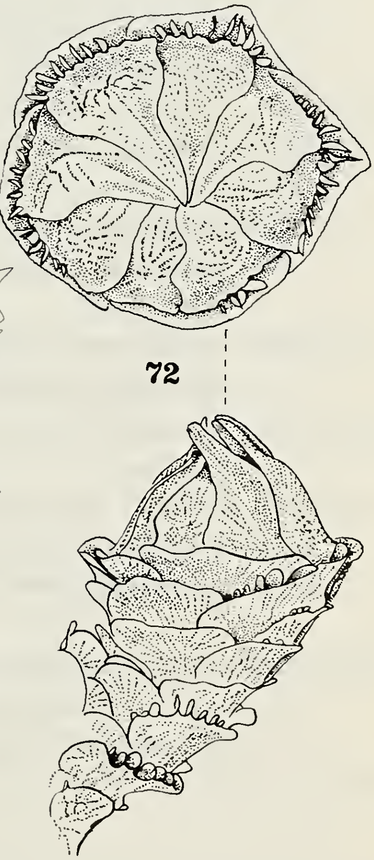
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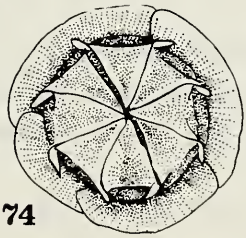
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times appressed), naked or more or less completely covered by sclerites.

352(353). Polyps always in whorls around unbranched stem, standing vertically or nearly so and proximally fused into more or less distinct "polyp-leaves" as in pennatulaceans .... *Callozostron* Wright, 1885, and *Ainigmaptilon* Dean, 1926

353(352). Polyps placed irregularly, in pairs, or in whorls, obliquely directed upward, downward, or strongly inturned, but never proximally fused.

354(373). Polyps completely covered all around by scales, adaxial side not more or less naked.

355(356). Body scales with external, sometimes dentate transverse crest dividing scales into distal, more or less concave or obliquely cup-shaped part and proximal, tuberculate base (Fig. 66) .... *Ascolepis* Thomson & Rennet, 1931

356(355). Body scales not divided by transverse crest.

357(366). Marginal scales 8.

358(361). Marginal scales forming two circles of 4 scales alternating in 2 transverse rows below operculum; opercular scales forming inner and outer rings of 4 scales each, alternating larger and smaller; marginals larger than operculars and folding inward over them.

359(360). Colonies unbranched (Fig. 67) .... *Primnoella* Gray, 1858[19]

360(359). Colonies abundantly branched (Fig. 68) .... *Thouarella* Gray, 1870

361(358). Marginal and opercular scales each forming a circle of 8 scales in a single transverse row; marginals not folding over operculars.

362(363). Opercular scales alternate with marginal scales; branching dichotomous (Fig. 69) .... *Parastenella* Versluys, 1906

363(362). Opercular scales vertically aligned with marginals; colonies pinnate.

364(365). Polyps alternately biserial or irregularly scattered but not in whorls or pairs; inner face of opercular scales with inconspicuous apical keel, or none (Fig. 70) .... *Plumarella* Gray, 1870

365(364). Polyps in pairs on proximal part of twigs, irregularly scattered on distal part; inner face of opercular scales with prominent apical keel (Fig. 71) ...... *Amphilaphis* Wright & Studer, 1887

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[19] This genus appears twice in the key.

366(357). Marginal scales fewer than 8.
367(370). Marginal scales 5.
368(369). Colonies pinnate, in one plane; marginal scales with short apical point but not produced as a spine (Fig. 72) .... *Pterostenella* Versluys, 1906
369(368). Colonies bottle-brush shaped, branching from all sides of main stem; marginal scales with long, serrated spine (Fig. 73) .... *Dasystenella* Versluys, 1906
370(367). Marginal scales fewer than 5.
371(372). Branching dichotomous; polyps tall (2.5–7.0 mm), standing vertically or only slightly upturned, always in whorls; marginals always 4; opercular scales overlap (Fig. 74) .... *Candidella* Bayer, 1954
372(371). Branching pinnate; polyps short (1 mm or less), set obliquely or turned inward toward axis, biserial or irregularly crowded but not in whorls; opercular scales do not overlap (Fig. 75) .... *Pseudoplumarella* Kükenthal, 1915
373(354). Adaxial side of polyps not covered by scales but remains partly or completely naked to accommodate strong bend inward toward stem.
374(375). Polyps irregularly crowded all around stem and branches, not in whorls; most polyps facing downward (but occasional individuals may face upward on any colony) .... *Primnoa* Lamouroux, 1812
375(374). Polyps usually in distinct whorls, polyps facing either upward or downward (in a few species, verticillate arrangement is obscured by crowding, but in this case polyps face upward).
376(381). Two pairs of abaxial body scales.
377(378). Members of the two pairs of body scales inseparably fused to form complete rings surrounding polyp; polyps face upward (Fig. 76) .... *Calyptrophora* Gray, 1866
378(377). Members of the two pairs of abaxial body scales extend nearly or completely around polyp and may meet adaxially but are not inseparably fused into rings; polyps face downward.
379(380). Only one pair of infrabasal scales between basal body scales and stem scales; colonies dichotomous (Fig. 77) .... *Paracalyptrophora* Kinoshita, 1908
380(379). Several pairs of infrabasal scales between basal body scales and stem scales; colonies pinnate or dichotomous (Fig. 78) .... *Arthrogorgia* Kükenthal, 1908
381(376). More than two pairs of abaxial body scales.
382(383). Polyps face downward; only 3 or 4 pairs of abaxial body scales (Fig. 79) .... *Narella* Gray, 1870

383(382). Polyps face upward; more than 4 pairs of abaxial body scales.

384(385). Polyps strongly curved inward toward axis; opercular scales distinctly differentiated from body scales, not overreached by marginals which do not bend inward over them; colonies usually pinnate, rarely dichotomous (Fig. 80) .... *Callogorgia* Gray, 1858

385(384). Polyps strongly appressed (but not adnate) to axis; opercular scales poorly differentiated from body scales and more or less conspicuously overreached by marginals, which can fold over them; colonies usually unbranched, in some species dichotomous with long, whiplike branches .... *Primnoella* Gray, 1858

386(345). Crystal orientation in scales is predominantly longitudinal, extinction nearly complete under crossed Nicols; surface of axis smooth or nearly so, concentric layers not undulating (Chrysogorgiidae).

387(393). Colonies unbranched, often spirally twisted.

388(389). Polyps placed uniserially along stem .. *Radicipes* Stearns, 1883

389(392). Polyps placed biserially along stem.

390(391). Distal body scales of polyps forming a distinctly differentiated operculum consisting of 8 triangular scales; abaxial body scales transverse .... *Chalcogorgia* Bayer, 1949

391(390). Distal body scales of polyps not forming an operculum; abaxial body scales longitudinal .... *Distichogorgia* Bayer, 1979

392(389). Polyps closely multiserial along stem, crowded but leaving naked longitudinal tract free of polyps .... *Helicogorgia* nom. nov.[20]

393(387). Colonies branched.

394(399). Colonies with terminal branches long, slender and whiplike,

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[20] Pro *Hicksonella* J. J. Simpson, 21 Dec. 1910, J. Roy. Microscop. Soc., part 6: 682 (type-species, *Juncella spiralis* Hickson, 1904, here designated); non Nutting, May 1910, Siboga-Exped. Monogr. 13*b*^{1}:14 (type-species, *Hicksonella princeps* Nutting, 1910, by original designation and monotypy).

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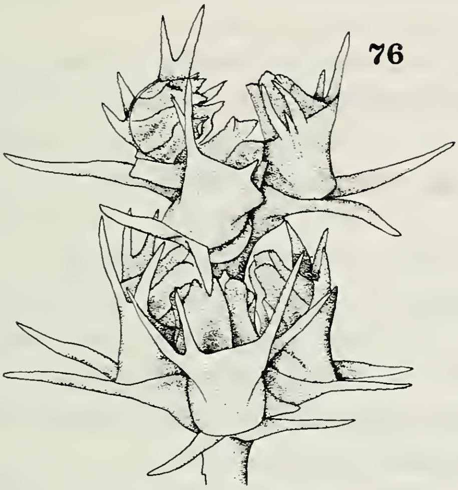
Figs. 75–80. 75, *Pseudoplumarella corruscans* (Thomson & Mackinnon), polyp of syntype, British Museum (Nat. Hist.), ×37; 76, *Calyptrophora clarki* Bayer, 2 whorls of polyps, ×10; 77, *Paracalyptrophora josephinae* (Lindstrom), whorl of polyps, ×15; 78, *Arthrogorgia ijimai* (Kinoshita), polyp, ×12; 79, Polyps of *Narella* spp.: a, *N. leilae* Bayer, ×10; b, *N. bowersi* (Nutting), ×10; 80, *Callogorgia gilberti* Nutting, whorl of polyps, ×30.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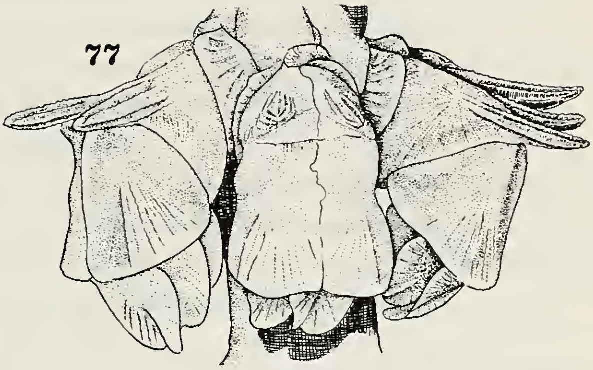
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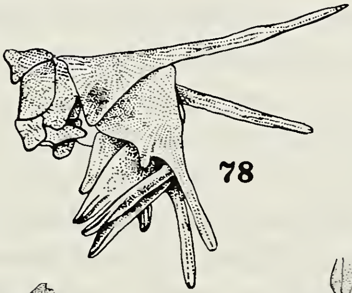
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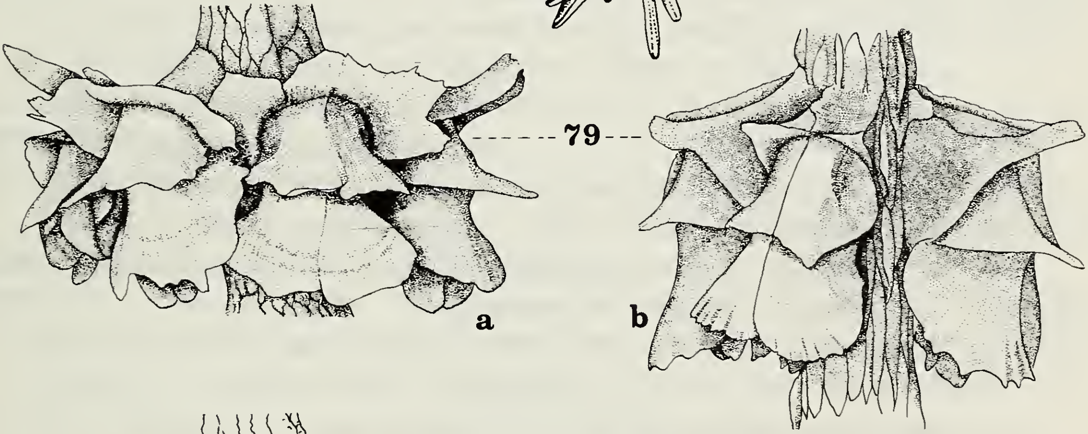
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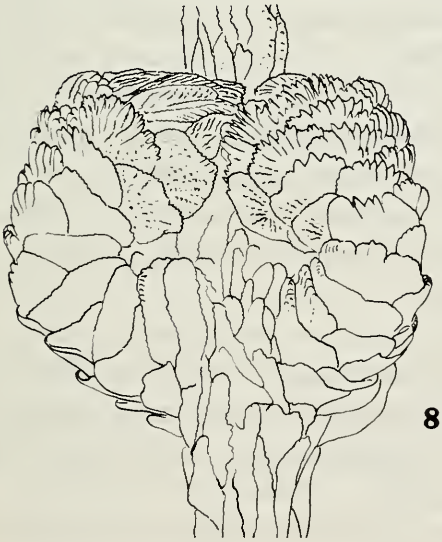
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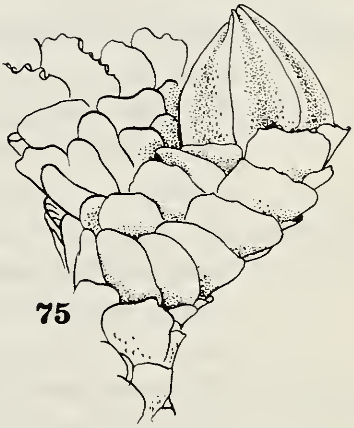
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originating directly from main stem or after a few bifurcations of primary branches.

395(396). Terminal branches simple, arising around the outside of the spirally coiled main stem; colonies not flabellate .... *Iridogorgia* Verrill, 1883

396(395). Terminal branches originating in one plane, colonies more or less distinctly lyrate.

397(398). Terminal branches slender and flexible. Sclerites exclusively in the form of small scales, or altogether absent .... *Trichogorgia* Hickson, 1905

398(397). Terminal branches stiff, more of less brittle. In addition to thin scales, sclerites include thick plates with closely set, stout, rounded projections on the outer surface .... *Pleurogorgia* Versluys, 1902

399(394). Colonies with terminal branches short, the last of several bifurcations of primary branches.

400(403). Colonies branched in one plane.

401(402). Branching profuse, pinnate, producing flabellate or plumose colonies, polyps small, coenenchyme extremely thin, sclerites small (up to 0.15 mm in length) .... *Stephanogorgia* Bayer & Muzik, 1976

402(401). Branching sparse, lateral or openly pinnate, producing loose, open colonies. Polyps large, coenenchyme thick, sclerites large (up to 0.45 mm in length) .... *Isidoides* Nutting, 1910

403(400). Colonies not branched in one plane.

404(405). Branches irregularly subdivided, originating on all sides of the main stem but not arranged in a spiral around it, forming colonies of dense bottle-brush shape. Axis very weakly calcified, without metallic iridescence .... *Xenogorgia* Bayer & Muzik, 1976

405(404). Branches dichotomously subdivided, originating either sympodially in a spiral around main stem or monopodially from the top of a tall, upright trunk. Axis strongly calcified, with conspicuous metallic iridescence especially in the younger parts.

406(407). Colonies sympodial, dichotomously subdivided lateral branches originating in a spiral around main stem. Axis commonly with brilliant iridescence extending even into the main stem .... *Chrysogorgia* Duchassaing & Michelotti, 1864

407(406). Colonies monopodial, dichotomously subdivided branches arising from the top of a tall, upright main trunk. Axis of branches with strong metallic lustre, of main trunk almost black, glossy .... *Metallogorgia* Versluys, 1902

408(326). Axis consists of proteinous nodes alternating with calcareous internodes not composed of fused sclerites (Isididae).

409(414). Polyps retractile.

410(411). Sclerites of polyps are strongly spinose spindles; calices prominent, distinctly separated .... *Muricellisis* Kükenthal, 1915

411(410). Sclerites of polyps are small rods with transverse girdles of tubercles.

412(413). Colonies branching from internodes, bushy or planar, coenenchyme thick, polyps not forming projecting calices; sclerites include clubs, colorless .... *Isis* Linnaeus, 1758

413(412). Colonies dichotomously branching from nodes, in one plane, coenenchyme thin, polyps forming hemispherical calices; sclerites chiefly radiate capstans, yellow or orange .... *Chelidonisis* Studer, 1890

414(409). Polyps not retractile.

415(422). Sclerites of polyps are large spindles, needles or rods, longitudinally arranged, and smaller, irregularly placed rods or scales.

416(417). Colonies unbranched .... *Lepidisis* Verrill, 1883

417(416). Colonies branched.

418(419). Branches arise from calcareous internodes .... *Keratoisis* Wright, 1869

419(418). Branches arise from horny nodes.

420(421). Colonies bushy, branching in whorls ..... *Acanella* Gray, 1870

421(420). Colonies flat and spreading, branching not in whorls .... *Isidella* Gray, 1857

422(415). Sclerites of polyps are scales or plates transversely arranged.

423(424). Scales smooth, with free margins smooth .... *Circinisis* Grant, 1976

424(423). Scales with granular or tubercular sculpture externally, with serrate or dentate free margin.

425(431). Polyps with distalmost sclerites forming operculum of 8 triangular or triradiate scales.

426(427). Colonies delicate, whiplike, not branched .... *Peltastisis* Nutting, 1910

427(428). Opercular scales triangular .... *Minuisis* Grant, 1976

428(427). Opercular scales triradiate.

429(430). Distal scales of polyps with projecting spine .... *Echinisis* Thomson & Rennet, 1928

430(429). Distal scales of polyps without projecting spine .... *Chathamisis* Grant, 1976

431(425). Distal sclerites of polyps not differentiated as an operculum of 8 scales, bases of tentacles covered by several transverse scales protecting oral disk during contraction.

432(433). Branching on all sides of main stem, colonies bottle-brush shaped .... *Primnoisis* Studer, 1887

433(432). Branching in one plane, pinnate or dichotomous .... *Mopsea* Lamouroux, 1816

434(23). Polyps colonial, polymorphic (always an oozooid with autozooids and sometimes also mesozooids), anchored in soft substrate by a fleshy, muscular, contractile peduncle (PENNATULACEA). For keys to genera see Kükenthal, 1915, Das Tierreich, Lief. 43.

Index to Key

Classification

Detailed comparative investigation of abundant specimens of many species of octocoral genera and families has eliminated more and more of the discontinuities between taxa that were the basis for classification of the subclass devised by Hickson, Kükenthal, and other students of Octocorallia, which became quite complex by the first quarter of the 20th Century. Even in the past decade, this classification was further subdivided by the addition of a new order, Gastraxonacea, by Utinomi and Harada (1973), and I, too, contributed to complexity by reviving the order Protoalcyonaria (Bayer and Muzik, 1976) proposed by Hickson (1894) but later abandoned by him. Although I must say in self defense that I still consider the introduction of vegetative reproduction to be a major step in the evolution of octocorals, I have to admit that in other coelenterate groups, such as Scleractinia, solitary forms are accepted along with colonial ones even in the same family and genus. As the solitary octocorals (other than *Taiaroa*) heretofore reported will in all likelihood prove to be founder individuals of colonial forms, as in the case of *Hartea* suggested by Mr. R. L. Manuel (pers. comm.), the Protoalcyonaria probably does not merit ordinal recognition although it may be a nominal taxon of convenience at subordinal level.

Something similar might be said for the order Xeniacea proposed for members of the family Xeniidae by Bock (1938) and accepted by Madsen (1944). The chief distinguishing character of this order recognized by Madsen is the exclusive occurrence of small, discoidal or biscuit-shaped sclerites, but Kükenthal (1902, 1906) and Hickson (1931) emphasized the presence of only one pair of septal filaments in fully developed autozooids. As minute, discoidal sclerites occur (in addition to larger spindles) in *Clavularia* and *Tubipora,* and as *Ceratocaulon* combines the presence of small discoidal sclerites with a full complement of 8 septal filaments, and the autozooids of *Xenia* have 8 filaments in their early developmental stages, no basis remains for recognition of Xeniacea at ordinal level.

Certain species of *Telestula* that originally were assigned to *Clavularia* bridge the gap between the order Stolonifera and Telestacea, *Pseudogorgia godeffroyi* that between Telestacea and Alcyonacea, and *Protodendron repens* and *Maasella radicans* that between Stolonifera and Alcyonacea. The separation of Alcyonacea from Gorgonacea is challenged by the families Paragorgiidae and Briareidae as was shown by Verseveldt (1940) when he proposed to remove both from the Gorgonacea (Scleraxonia), where they traditionally had been assigned, to the Alcyonacea. The scleroproteinous axis of the gorgonacean suborder Holaxonia would seem to be an unequivocal character, but even it is compromised by the species of *Keroeides, Lignella,* and *Ideogorgia* (nom. nov. for *Dendrogorgia* Simpson), which combine the characteristic cross-chambered proteinous medulla of the Holaxonia with the axial cortex composed of sclerites bound together by gorgonin typical of the Scleraxonia. Moreover, the calcium-filled loculi of the axial cortex of *Plexaurella* are but a short step removed from the axial sclerites of the Keroeididae. Indeed, only the families Ellisellidae, Ifalukellidae, Chrysogorgiidae and Primnoidae are unequivocally separated from the remaining Gorgonacea-Alcyonacea complex by their total lack of a chambered axial medulla, and each is characterized by morphological features that are conclusive and unmistakable.

On the basis of colonial organization and skeletal structure, the only clearly discontinuous major taxa (i.e., orders) are the Pennatulacea (which are not included in the key), the Helioporacea, and the restricted "Holaxonia." The Stolonifera, Telestacea, Gastraxonacea, Alcyonacea, Scleraxonia, and medullate Holaxonia are linked by intermediate forms that preclude concise definitions of orders. These groups are comprised of an uninterrupted series from *Clavularia* to complex holaxonians such as *Paramuricea.* The traditional subdivisions might be retained as a convenience at a quasi-subordinal level, but it must be recognized that no hard and fast boundaries can be drawn between them. In view of these considerations, a realistic classification is as follows.

- Order Helioporacea (=Coenothecalia)
  - Lithotelestidae: *Epiphaxum* (=*Lithotelesto*)
  - Helioporidae: *Heliopora*
- Order Alcyonacea
  - [Suborder Protoalcyonaria][21]
    - Taiaroidae: *Taiaroa*
  - [Suborder Stolonifera]
    - Cornulariidae: *Cornularia*
    - Clavulariidae
      - Clavulariinae: *Clavularia* (=*Hicksonia*), *Bathytelesto, Rhodelinda, Scyphopodium*
      - Sarcodictyiinae: *Sarcodictyon, Cyathopodium, Scleranthelia, Tesseranthelia, Trachythela*
      - Telestinae: *Telesto, Carijoa, Paratelesto, Telestula*
      - Pseudocladochoninae: *Pseudocladochonus*
    - Tubiporidae: *Tubipora, Pachyclavularia*
    - Coelogorgiidae: *Coelogorgia*
    - Pseudogorgiidae: *Pseudogorgia*
  - [Suborder Alcyoniina]
    - Paralcyoniidae (=Fasciculariidae, =Viguieriotidae); *Maasella* (=*Fascicularia*, =*Viguieriotes*), *Carotalcyon, Paralcyonium, Studeriotes*
    - Alcyoniidae: *Alcyonium, Acrophytum, Anthomastus, Bathyalcyon, Bellonella, Cladiella* (=*Lobularia*, =*Microspicularia*, =*Sphaerella*), *Lobophytum, Metalcyonium, Minabea, Malacacanthus, Nidaliopsis, Parerythropodium, Sarcophyton, Sinularia*
    - Asterospiculariidae: *Asterospicularia*
    - Nephtheidae: *Nephthea, Capnella* (=*Eunephthya*, =*Paranephthya*), *Coronephthya, Daniela, Drifa, Duva, Gersemia, Lemnalia, Litophyton* (=*Ammothea*), *Morchellana, Neospongodes, Paralemnalia, Pseudodrifa, Roxasia, Scleronephthya, Spongodes, Stereonephthya, Umbellulifera*
    - Nidaliidae
      - Nidaliinae: *Nidalia* (=*Cactogorgia*), *Agaricoides*
      - Siphonogorgiinae: *Siphonogorgia* (=*Chironephthya*)
    - Xeniidae: *Xenia, Anthelia, Ceratocaulon*?, *Cespitularia, Efflatounaria, Fungulus, Heteroxenia, Sympodium*

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[21] Taxa enclosed in square brackets are not considered to have taxonomic significance, but are included for convenience.

[Suborder Scleraxonia]
  Briareidae: *Briareum* (=*Solenopodium*)
  Anthothelidae
    Anthothelinae: *Anthothela*
    Semperininae: *Semperina* (=*Suberia*), *Iciligorgia, Solenocaulon*
    Spongiodermatinae: *Homophyton* (=*Spongioderma*), *Alertigorgia, Callipodium* (=*Anthopodium*?), *Diodogorgia, Erythropodium, Titanideum, Tripalea*
  Subergorgiidae: *Subergorgia*
  Paragorgiidae: *Paragorgia, Sibogagorgia*
  Coralliidae: *Corallium* (=*Hemicorallium*, =*Pleurocorallium*), *Pleurocoralloides*?
  Melithaeidae: *Melithaea* (=*Melitella*, =*Melitodes*, =*Birotulata*), *Acabaria, Clathraria, Mopsella, Wrightella*
  Parisididae: *Parisis* (=*Trinella*)
[Suborder Holaxonia]
  Keroeidididae: *Keroeides, Ideogorgia* (=*Dendrogorgia*), *Lignella*
  Acanthogorgiidae: *Acanthogorgia* (=*Boarella*), *Acalycigorgia, Anthogorgia, Calcigorgia, Cyclomuricea, Muricella, Versluysia*
  Plexauridae (including Muriceidae, Paramuriceidae)
    [Plexaurinae]: *Plexaura, Anthoplexaura, Eunicea, Euplexaura, Muriceopsis, Plexaurella, Psammogorgia, Pseudoplexaura*
    [Stenogorgiinae (=Paramuriceinae)]: *Swiftia* (=*Allogorgia*, =*Callistephanus*, =*Platycaulos*, =*Stenogorgia*), *Acanthacis, Astrogorgia, Bebryce, Calicogorgia, Dentomuricea, Echinogorgia* (=*Bovella*, =*Paraplexaura*, =*Trimuricea*?), *Echinomuricea, Heterogorgia, Hypnogorgia, Lepidomuricea, Lytreia, Menella* (=*Plexauroides*), *Muriceides* (=*Clematissa*, =*Trachymuricea*), *Nicaule, Paracis* (=*Discomuricea*), *Paramuricea, Placogorgia, Pseudothesea, Scleracis, Thesea* (=*Discogorgia*, =*Evacis*, =*Filigella*), *Villogorgia* (=*Acamptogorgia*, =*Brandella*, =*Perisceles*)
Gorgoniidae: *Gorgonia* (=*Rhipidogorgia*), *Adelogorgia, Eugorgia, Eunicella, Hicksonella* (=*Rhabdoplexaura*), *Leptogorgia* (=*Filigorgia*), *Lophogorgia, Olindagorgia, Pacifigorgia, Phycogorgia, Phyllogorgia* (=*Hymenogorgia*), *Pseudopterogorgia* (=*Antillogorgia*), *Pterogorgia* (=*Xiphigorgia*), *Rumphella*
Ellisellidae: *Ellisella* (=*Scirpearia*, =*Viminella*), *Ctenocella* (=*Dichotella*), *Junceella, Nicella, Riisea* (=*Herophile*), *Toeplitzella, Verrucella* (=*Phenilia*)
Ifalukellidae: *Ifalukella, Plumigorgia*
Chrysogorgiidae: *Chrysogorgia* (=*Dasygorgia*), *Chalcogorgia, Distichogorgia, Helicogorgia, Iridogorgia, Isidoides, Metallogorgia, Pleurogorgia, Radicipes* (=*Lepidogorgia*, =*Strophogorgia*), *Stephanogorgia, Trichogorgia* (=*Malacogorgia*), *Xenogorgia*

Primnoidae: *Primnoa, Ainigmaptilon (=Lycurus), Amphilaphis, Armadillogorgia, Arthrogorgia, Ascolepis, Callogorgia, Callozostron, Calyptrophora, Candidella (=Stenella), Dasystenella, Narella (=Stachyodes), Ophidiogorgia, Paracalyptrophora, Parastenella, Plumarella, Primnoella, Pseudoplumarella, Pterostenella*
Isididae
- Isidinae: *Isis, Chelidonisis*
- Muricellisidinae: *Muricellisis*
- Keratoisidinae: *Keratoisis, Acanella, Isidella, Lepidisis*
- Mopseinae: *Mopsea, Chathamisis, Circinisis, Echinisis, Minuisis, Peltastisis, Primnoisis*

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[22] This is a contribution from the Rosenstiel School of Marine and Atmospheric Science, University of Miami.

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A NEW XYSTODESMID MILLIPED GENUS AND THREE NEW SPECIES FROM PIEDMONT SOUTH CAROLINA (POLYDESMIDA: XYSTODESMIDAE)

Rowland M. Shelley

Abstract.—The new xystodesmid milliped genus *Furcillaria* is proposed for three new species in Piedmont South Carolina—*aequalis, convoluta,* and *laminata.* The acropodites of the gonopods of these species display proximal torsion and distal division into tibial, and variously modified solenomerite, branches. The former results in a crossing of the prostatic groove from medial to lateral sides as it runs along the stem of the acropodite; the latter imparts a forked appearance to the structure. Specific differences obtain in the relative lengths of the two branches; the degree of modification of the solenomerite branch; the presence, absence, and configuration of a medial flange at midlength of the acropodite; and the presence, absence, and configuration of a prefemoral process. The species are widely allopatric and occupy limited ranges; that of *aequalis* is nearly linear in shape. *Furcillaria* is closely related to *Dynoria,* the acropodites of which lack torsion, and the prostatic groove is therefore visible in medial view for its entire length along the stem of the structure. Of the species, *aequalis* and *convoluta* are closely related and appear to have a common ancestor, but *laminata,* which is quite different anatomically, represents a different phylogenetic line from another source.

The environments of piedmont South Carolina are an unlikely place to find xystodesmid millipeds. Much of the area is covered with dense stands of loblolly pine, *Pinus taeda,* and tracts of hardwoods large enough to provide sufficient leaf litter are mostly restricted to narrow bands along water courses. Cool, moist sites are rare in this part of the state, and droughts and diurnal temperatures around 100°F are common in summer. Despite these seemingly unfavorable conditions, however, the region harbors a diverse xystodesmid fauna. *Pachydesmus crassicutis incursus* Chamberlin, of the tribe Pachydesmini, occurs throughout the area (Shelley and Filka, 1979), and the tribe Rhysodesmini is represented by *Boraria stricta* (Brolemann) in the north and *Pleuroloma plana* Shelley in the south (Filka and Shelley, 1980; Shelley, 1980a). The known fauna of the tribe Apheloriini includes around a dozen species, some undescribed, in the genera *Brevigonus, Cleptoria, Croatania,* and *Sigmoria* (Hoffman, 1967; Shelley, 1976, 1977, 1980b).

The purpose of this contribution is to diagnose a fifth apheloriine taxon, *Furcillaria,* named for the forked condition of the male gonopods, which is comprised of three species.

Furcillaria is the third new apheloriine genus I have proposed for piedmont South Carolina xystodesmids, the others being *Croatania* and *Brevigonus* (Shelley, 1977, 1980b). The new genus was discovered in 1976 when I visited the area to ascertain the range and species composition of *Croatania. Furcillaria* is not as abundant as *Croatania,* however, and several return trips were required to obtain more material. Its species are widely allopatric, and meticulous sampling in intervening areas was necessary to determine whether additional forms existed. Thus, proposal of *Furcillaria* has been delayed pending these investigations, but current knowledge seems to be complete, and further fieldwork would probably yield only inconsequential information. Only 58 specimens were available for this study due to the rarity and restricted distributions of the three species; except for one male in the private collection of Richard L. Hoffman (RLH), all were collected by the author or an assistant and are deposited in the invertebrate research collection of the North Carolina State Museum (NCSM). Thus, in the locality sections of the ensuing species accounts, the collector's name is omitted for samples taken by the author alone, and the invertebrate catalog number is cited in parentheses for samples housed at the NCSM.

Furcillaria is closely related to *Dynoria* and therefore compels attention to this unrevised genus and the problems of its identity and characteristics. Ideally, they should be considered together in a single paper, but a revision of the latter is still several years away and more fieldwork is necessary in parts of its range. Thus, since the taxonomy of *Furcillaria* has been worked out, it seems desirable to establish the genus now rather than delay publication indefinitely for a related study. However, it is necessary to comment briefly on *Dynoria* at this time, so that *Furcillaria* will be adequately proposed and can be distinguished from the former if questions arise before the latter can be revised.

The original proposal of *Dynoria* by Chamberlin (1939) did not mention any discriminating features. *Dynoria icana* can be recognized from the sketchy drawing, however, thus enabling one to identify the genus although no diagnostic characters have ever been verbalized. Chamberlin's only comment about the gonopods of *Dynoria,* ". . . the blade of the telopodite . . . bears a smaller branch from its anterior surface or outer edge, this arising from about the middle of the length," is also applicable to *Furcillaria.* In both taxa the acropodites are divided distally into two branches, a solenomerite branch which carries the prostatic groove and may be further divided or modified, and an unmodified branch which is here labelled the tibial process to maintain consistency with previous designations for the rhysodesmine genera *Erdelyia* and *Pleuroloma* (Hoffman, 1962; Shelley, 1980a). Thus, this character is not diagnostic for *Dynoria,* but there is one feature about the genus which is unique and distinguishes it from all others in the Apheloriini. In *Furcillaria* and all other genera of the tribe the acropodites are twisted approximately 90° anteriomesiad at ¼ to ⅓ length, thus resulting in a crossing of the prostatic groove from medial to lateral sides as it runs along the stem of the acropodite. Consequently, one must view the gonopods medially and then laterally to follow the course of the channel. In *Dynoria,* however, the acropodite is not twisted, and consequently the prostatic groove is visible in medial view for its entire length along the stem of the acropodite, until it passes behind the solenomerite branch. Hence, the groove is completely masked in lateral view except for the distal portion on the solenomerite. Another way of describing this would be to say that the acropodites of *Dynoria* have been untwisted. Since this feature is unique to the two species currently in *Dynoria,* it seems appropriate to regard it as a generic-level character and to propose a new genus for forms with forked acropodites which display torsion. *Furcillaria* may therefore be defined as an apheloriine xystodesmid genus whose acropodites are distally divided into a tibial process and a variously modified solenomerite branch, and are also twisted some 90° anteriomesiad at ¼ to ⅓ length.

Taxonomic Characters

Color.—Although color and color pattern are generally poor taxonomic characters, the species of *Furcillaria* can be distinguished from sympatric apheloriine xystodesmids by the color of the paranota and metaterga. *Furcillaria aequalis* and *convoluta,* with solid black metaterga, have narrow red paranotal markings covering little more than the peritremata. Hence, they can be distinguished from sympatric species of *Cleptoria* and *Croatania,* which have much wider lateral spots extending mediad well beyond the peritremal thickenings onto the level surface of the paranota. North of the Enoree River in Union County, the only sympatric apheloriine species of comparable size to *convoluta* is *Croatania catawba* Shelley, which has yellow paranota. Hence, the two millipeds can be separated by color and size of paranotal spots. *Furcillaria laminata* is the only xystodesmid in its range displaying red metatergal stripes, enabling it to be identified in the field. *Sigmoria latior* (Brolemann), which also is striped in South Carolina, has not been encountered within the range of *laminata* but can be distinguished from it by smaller body size.

Gonopods.—The only anatomical structure of *Furcillaria* with taxonomic utility is the gonopod. The 4th and 5th sterna possess small to moderate, ventrally directed processes, but in contrast with *Croatania* (Shelley, 1977) they are too indistinct to identify the genus.

The most important fact about the gonopods of *Furcillaria* is that the acropodites display torsion. This, along with their forked condition, are the key diagnostic features of the genus.

Several features of the gonopods are useful at the specific level, and the first is the *in situ* configuration in the aperture. That of *laminata* is unique in that the acropodites lie over or under each other in the caudal half of the opening and project laterad only to the opposite side (Fig. 11). Thus, the structures are wholly encompassed by the aperture and do not overlap another segment. In contrast, the acropodites of *aequalis* and *convoluta* cross near midlength in the midline of the aperture and extend forward to varying lengths beyond the anterior margin, overlapping the 6th sternum (Figs. 1, 6).

Regarding gonopod structure, the prefemoral process is absent from *laminata,* thus distinguishing it from its congeners, and the process is equivalent in length in *aequalis* and *convoluta,* but rounded in the former and spiniform in the latter (Figs. 3–4, 8–9, 13–14). On the acropodite, *laminata* lacks the midlength flange on the medial surface, which is present in *aequalis* and *convoluta*. This lamina is more variable in *aequalis* than in *convoluta,* but is generally short and subtriangular in the former with from one to several teeth on the outer margin. In *convoluta,* the flange is broader and less clearly demarcated from the stem of the acropodite, and the margin is smooth though irregularly sculptured in some individuals. The flange terminates at the point (about ⅔ length) where the acropodite forks into the tibial and solenomerite branches. In *aequalis,* as the name implies, the two branches are subequal in length, whereas the tibial process is much shorter in the other two species. The solenomerite of *aequalis* is also a short, straight, simple blade, whereas it is highly modified in *convoluta* and *laminata*. In *convoluta* the solenomerite is thickened, twisted, and lined with ridges and grooves. It is also bent 90° submediad at midlength. In *laminata* the branch is further divided into three lamina, forming one of the most complex gonopod structures in the Apheloriini. The curvature of the acropodite is the final taxonomic character of the gonopods. It overhangs and extends well beyond the level of the prefemoral process (prefemur) in all three species. In *aequalis* and *laminata* the configuration is a smooth, continuous arch, but in *convoluta* the curve is bent sharply twice, at ⅓ length and about halfway on the solenomerite.

In summary, *aequalis* and *convoluta* possess a number of similarities and are most readily separated by the configuration of the solenomerite and its length relative to that of the tibial process. *Furcillaria laminata,* however, differs markedly from its congeners in several features and can be quickly identified by the striped color pattern, the *in situ* gonopodal configuration in which the acropodites lie wholly within the aperture, the complex, the subdivided solenomerite branch of the acropodite, and the absence of the prefemoral process and medial flange.

Furcillaria, new genus

Type-species.—Furcillaria aequalis, new species.

Description.—A genus of large, robust xystodesmids with the following characteristics:

Body composed of head and 20 segments in both sexes; size varying from 11–12.5 mm wide and 44–54 mm long; W/L ratio similarly varying from around 23.0–26.0%. Body essentially parallel-sided in midbody region, tapering at both ends.

Color in life variable; two species with solid black metaterga and narrow red paranotal spots covering little more than the peritremata; one species with brown base color, light red metatergal stripes, and wide, concolorous paranotal spots.

Head of normal appearance, smooth, polished. Epicranial suture distinct, terminating in interantennal region, not apically bifid; interantennal isthmus relatively wide; genae not margined laterally, with shallow central impressions, ends broadly rounded and projecting slightly beyond adjacent cranial margins. Antennae moderately slender, varying in length, becoming progressively more hirsute distally, with 4 conical sensory cones on ultimate article; no other sensory structures apparent. Facial setae reduced; epicranial and interantennal absent, clypeal and labral present, with or without frontal and genal setae.

Terga smooth, polished, becoming coriaceous in paranotal regions. Collum variably broad, ends subequal to or extending slightly beyond those of following tergite. Paranota moderately depressed, continuing slope of dorsum, caudolateral corners rounded on anteriormost segments, becoming blunt in midbody region and progressively more acute posteriorly. Peritremata distinct, strongly elevated above paranotal surface; ozopores located caudal to midlength, opening dorsad. Prozonites smaller than metazonites; strictures distinct, smooth.

Caudal segments normal for family.

Sides of metazonites irregular, with varying shallow, curved impressions. Strictures sharp, distinct. Pregonopodal sterna of males modified as follows: that of segment 4 with medial process of variable length but shorter than widths of adjacent coxae; sternum of segment 5 with two knoblike processes between 4th legs, distinct but varying in length, coalesced into single medial process in one species, with two slightly smaller and broader processes between 5th legs; sternum of segment 6 with or without shallow convex recession between 7th legs. Postgonopodal sterna generally flattened, with varying shallow grooves and depressions, strongly bilobed on segment 8 in some forms. Gonopores on 2nd leg pair of males moderately long, with round, apical knobs. Pregonopodal legs densely hirsute; postgonopodal legs becoming progressively less hirsute caudally. Coxae usually with blunt tubercles in caudal half of body; prefemoral spines relatively long and sharply pointed; tarsal claws bisinuate. Hypoproct moderately acute medially; paraprocts with margins strongly thickened.

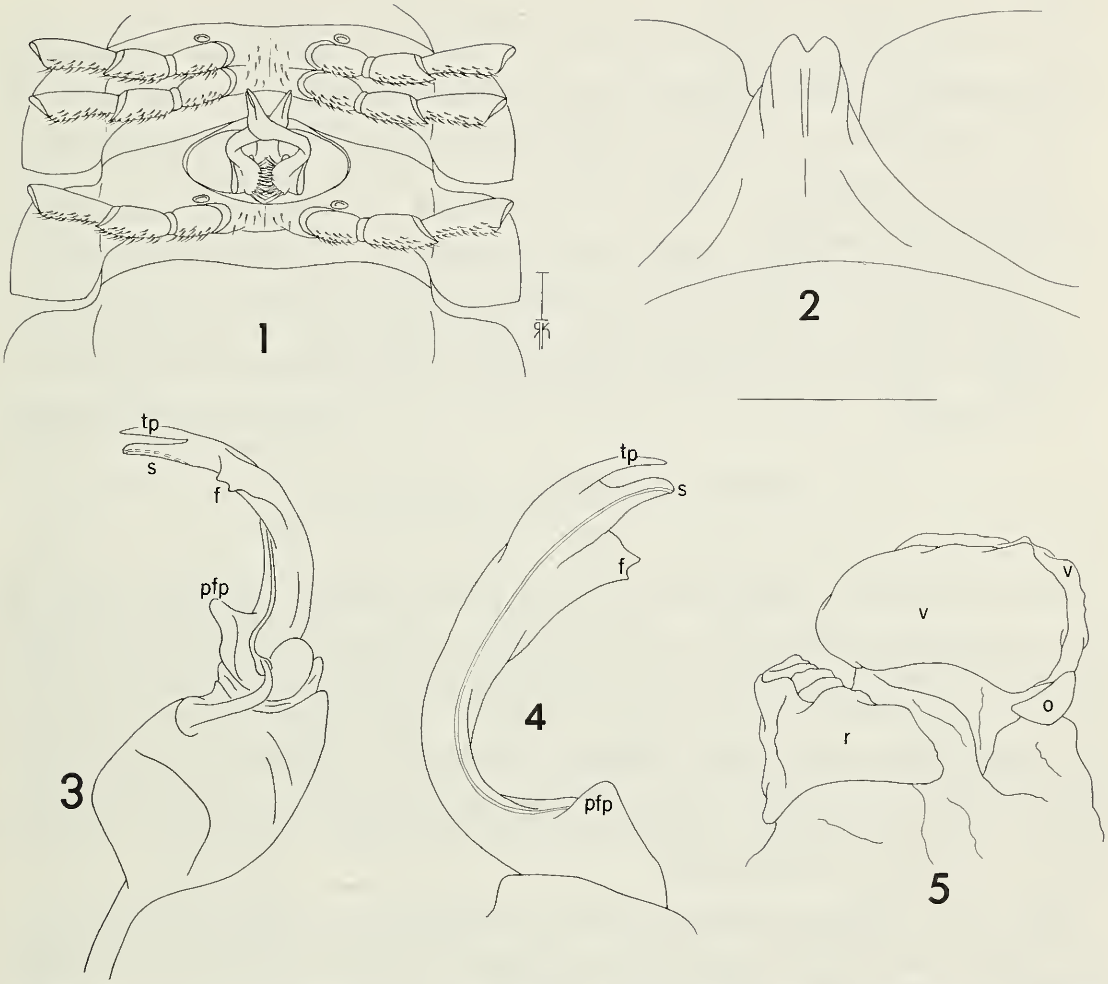
Gonopodal aperture ovoid to elliptical, with or without slight anteriolateral indentations, front flush with metazonal surface, sides elevated. Gonopods *in situ* with variable configurations, crossing at various points in midline of aperture. Coxae moderate in size, without apophyses, connected by membrane only, no sternal remnant. Prefemur small to moderate in size, with or without small to moderate prefemoral process on anteriomedial side; latter either blunt or narrow and spiniform in shape. Acropodite moderately thick and heavy, twisted about 90° anteriomesiad proximally, configuration either a smooth continuous arch or bent sharply at ⅓ length and apically, overhanging and extending well beyond level of prefemoral process (or prefemur), divided at ⅔ length into tibial process and another variously modified and subdivided branch carrying the prostatic groove; with or without broad or subtriangular flange on medial surface proximal to division. Tibial process short, straight, and sharply acute apically. Solenomerite varying from a simple, straight blade, to broad spatulate structure divided into three lamellae, to complex twisted projection with grooves and ridges; tip likewise varying from rounded, to uncate, to flattened with groove opening subterminally on inner surface of gonopod. Prostatic groove arising in pit on prefemur, proximal portion visible in medial view, crossing to lateral side on proximal third of acropodite and running along inner face, opening terminally or subterminally on solenomerite.

Cyphopodal aperture broad, encircling 2nd legs, sides flush with or slightly elevated above metazonal surface. Cyphopods *in situ* located lateral to 2nd legs, variously oriented in aperture, with valves or receptacle visible in openings. Receptacle small or large, located subdorsally to valves or cupped slightly around ventral side, surface roughened with folds and ridges. Valves moderate and subequal in size, surface finely granulate. Operculum usually relatively large, clearly visible under free end of valves.

Distribution.—Piedmont Plateau of South Carolina, ranging latitudinally from the Pacolet to the Savannah rivers, and longitudinally from the fall zone to nearly the base of the Blue Ridge escarpment. The encompassed area is roughly triangular in shape (Fig. 17), and each species occupies a narrow band in the generic range.

Species.—Three. Due to the intensity with which piedmont South Carolina has been investigated, it seems unlikely that additional species remain to be discovered.

Remarks.—Furcillaria aequalis and *laminata,* whose gonopods either do not (*laminata*) or barely (*aequalis*) extend beyond the anterior margin of the gonopodal aperture, both possess a recessed sternum between the posterior legs of segment 6. However, *convoluta,* whose gonopods extend well



Figs. 1–5. *Furcillaria aequalis:* 1, Gonopods *in situ,* ventral view of paratype. 2, Process of 4th sternum of holotype, caudal view. 3, Left gonopod of holotype, medial view (setation omitted from all dissected gonopod drawings). 4, The same, lateral view. 5, Left cyphopod of female paratype, caudal view. f, flange; o, operculum; pfp, prefemoral process; r, receptacle; s, solenomerite branch (=solenomerite); tp, tibial process; v, valves. Scale line for Fig. 1 = 1.0 mm; scale line for other figs. = 1.0 mm.

beyond the aperture and overlap the 6th sternum, lacks this cavity. This depression, common in apheloriine genera with curved or rounded acropodites, provides space for the apical curvatures when the body segments are compressed. Its presence in species of *Furcillaria* which do not seem to need it, and its absence from one which does, are curious features of their anatomies.

Key to Species of *Furcillaria* (Based Mainly on Adult Males)

1. Gonopod with prefemoral process and medial flange at midlength of acropodite; metaterga solid black in color, without stripes 2
– Without these gonopodal characters; metaterga brown with light red-

dish stripes along caudal margins; Pickens and Anderson counties .... *laminata,* new species

2\. Solenomerite a flat, simple blade, subequal in length to tibial process; flange relatively short, subtriangular, clearly demarcated from stem of acropodite, margin with one to several teeth; Saluda to McCormick counties .... *aequalis,* new species

– Solenomerite twisted, with several ridges and shallow grooves, much longer than tibial process, bent 90° near midlength; flange relatively broad and long, poorly demarcated from stem of acropodite, margin variable but smooth, without teeth; Spartanburg to Newberry counties .... *convoluta,* new species

Furcillaria aequalis, new species

Figs. 1–5

Type-specimens.—Male holotype (NCSM A1463) and one male and one female paratype collected by R. M. Shelley, 8 August 1976, from Edgefield Co., South Carolina, 11.3 mi. NW Edgefield, along SC highway 283 at Turkey Cr. (McCormick Co. line) in Sumter National Forest. Two male and two female paratypes, same collector, same date, Edgefield Co., 11.4 mi. NW Edgefield, along SC highway 68, 0.2 mi. N junction of SC highway 52, Sumter National Forest. Male and female paratypes deposited in Florida State Collection of Arthropods.

Diagnosis.—Solenomerite a simple, straight blade without lobes or projections, apically rounded, length subequal to that of tibial process; flange relatively short and subtriangular, clearly demarcated from stem of acropodite, margin with one to several sharply pointed teeth.

Holotype.—Length 50.6 mm, maximum width 11.9 mm, W/L ratio 23.5%, depth/width ratio 61.3%. Segmental widths as follows:

collum	8.5 mm	7th–11th	11.9
2nd	9.1	12th–14th	11.6
3rd	9.9	15th	11.0
4th	10.5	16th	10.4
5th	11.1	17th	9.0
6th	11.3	18th	7.0

Color in life: Peritremata bright red, smoothly grading into black base color on level surface of paranota; metaterga dark glossy black, without stripes; collum with suggestion of red stripe along anterior edge.

Head capsule smooth, polished, width across genal apices 5.4 mm; interantennal isthmus 1.9 mm, smooth; epicranial suture distinct and relatively deep, terminating in slight impression in interantennal region. Antennae reaching back to caudal edge of 3rd segment, becoming progressively more hirsute distally; first antennomere subglobose, 2–6 clavate, 7 short and truncate; relative lengths of antennomeres 2 > 3 = 6 > 4 = 5 > 1 > 7. Genae not margined laterally, with slight central impressions, ends broadly rounded and projecting slightly beyond adjacent cranial margins. Facial setae as follows: epicranial and interantennal absent, frontal 1-1, genal 1-1, clypeal about 10-10, labral about 14-14.

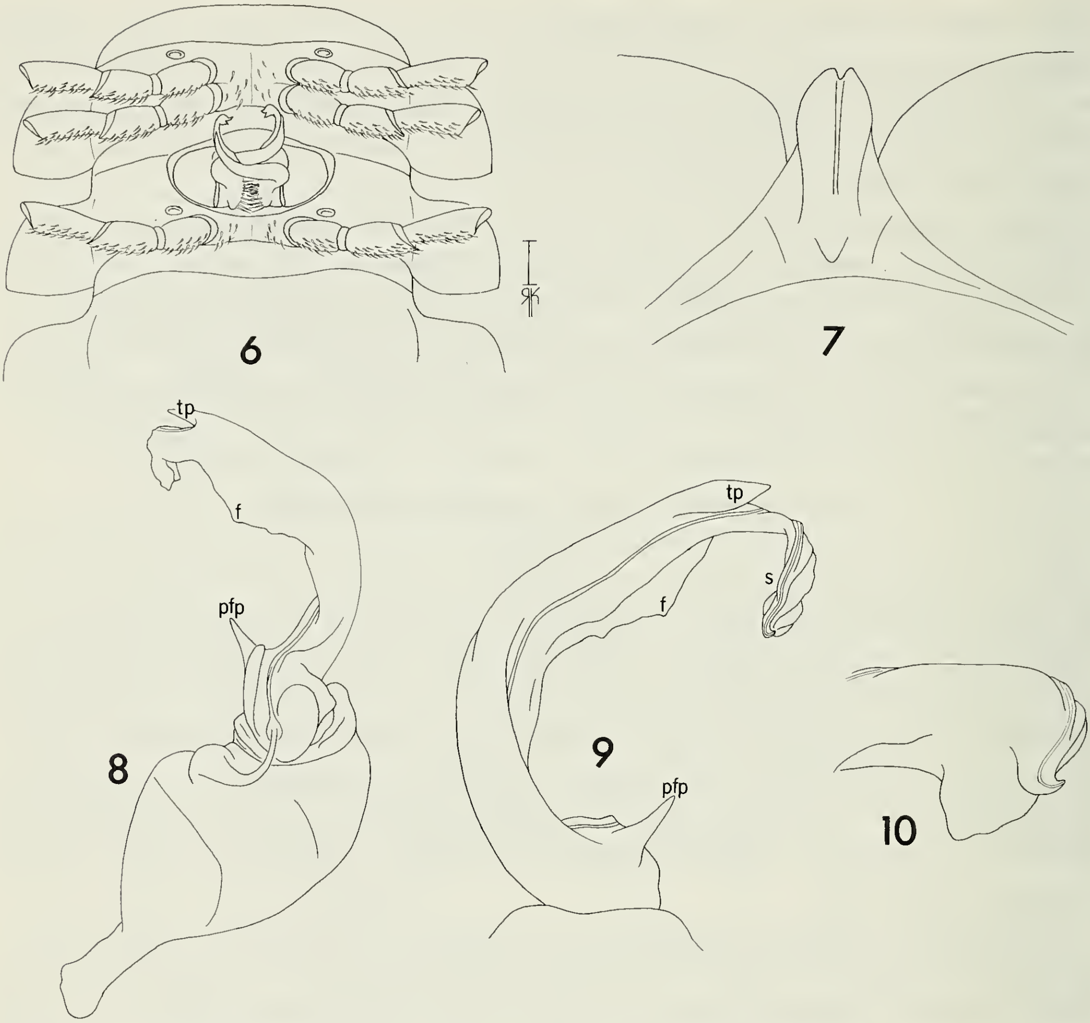
Terga smooth, polished, becoming moderately coriaceous on paranota. Collum broad, ends not extending beyond those of 2nd segment. Paranota moderately depressed, angled ventrad and continuing slope of dorsum, caudolateral corners rounded through segment 5, becoming progressively more pointed posteriorly. Peritremata thick and conspicuous, sharply set off from paranotal surface, produced slightly caudad beginning on segment 8. Ozopores located caudad to middle of peritremata, opening dorsad.

Sternum of segment 4 with small, apically divided process between 3rd legs (Fig. 2), shorter than width of adjacent coxae; of segment 5, produced into two conical paramedian knobs between 4th legs and two broader, smaller knobs between 5th legs; of segment 6, convexly recessed between 7th legs. Postgonopodal sterna generally glabrous, with varying shallow grooves and impressions, including transverse grooves originating between leg pairs and large, central depression. Minute coxal tubercles present on legs of segments 12–17; prefemoral spines beginning on segment 6, becoming progressively longer and more sharply pointed caudally; tarsal claws bisinuately curved. Hypoproct slightly pointed medially, paraprocts with margins strongly thickened.

Gonopodal aperture broadly ovoid, 4.0 mm wide and 2.3 mm long at midpoint, indented slightly on anteriolateral margin, front flush with metazonal surface, sides elevated and slightly thickened. Gonopods *in situ* (Fig. 1, of paratype) with acropodites crossing near midlengths in midline of aperture, extending slightly foward beyond anterior margin of aperture and just over 6th sternum. Gonopod structure as follows (Figs. 3–4): Prefemur small, with short, blunt prefemoral process directed toward tip of acropodite. Acropodite a smooth continuous arch overhanging and extending well beyond level of prefemoral process, with flange on medial surface proximal to division. Tibial process apically acute, length subequal to that of solenomerite. Latter a simple, flat, apically rounded blade. Flange relatively short and subtriangular, distinct and clearly demarcated from stem of acropodite, arising at about ⅓ length, terminating proximal to division of acropodite, with two sharply pointed teeth on outer margin. Prostatic groove crossing from medial to lateral sides, running along inner surface of acropodite to subterminal opening on inner surface of solenomerite.

Male paratypes.—The male paratypes agree closely with the holotype in all structural details.

Female paratype.—Length 49.1 mm, maximum width 11.7 mm, W/L ratio 23.8%, depth/width ratio 68.4%. Agreeing essentially with holotype in so-



Figs. 6–10. *Furcillaria convoluta:* 6, Gonopods *in situ,* ventral view of paratype. 7, Process of 4th sternum of holotype, caudal view. 8, Left gonopod of holotype, medial view. 9, The same, lateral view. 10, Apical portion of solenomerite of holotype, oblique medial view, showing uncate tip and subterminal, subtriangular lobe. Abbreviations as in Figs. 1–5. Scale line for Fig. 6 = 1.0 mm; line for other figs. = 1.0 mm.

matic features except paranota more strongly depressed, creating appearance of more highly arched body.

Cyphopodal aperture with edges flush with metazonal surface. Cyphopods *in situ* lying transversely in aperture, valves visible externally, receptacle on medial side adjacent to legs. Receptacle (Fig. 5) relatively small, located dorsally with respect to valves, not cupped around valves, surface with several low ridges and crests. Valves moderate, surface finely granulate. Operculum relatively large, located opposite receptacle or dorsolaterally in relation to valves.

Variation.—The gonopods of *aequalis* are quite uniform. In a few specimens the acropodite is more upright than in the holotype, forming less of an arch and extending only slightly beyond the level of the prefemoral process. The configuration of the prefemoral process varies slightly from the condition in the holotype, being more apically acute and wedge-shaped in some individuals, and shorter and blunter in others. The most conspicuous variation involves the shape of the flange, which may be acutely triangular with a single sharp point on the outer edge, or irregularly notched with several unequal teeth.

Etymology.—The specific name refers to the equivalent lengths of the solenomerite and tibial process.

Distribution.—Eastern Piedmont Plateau of southern South Carolina. The Savannah River appears to form the southern boundary, as *aequalis* occurs up to the river along SC highway 28 in McCormick County, but concerted efforts to find it across the river in Columbia and Richmond counties, Georgia, have been unproductive. There is no clear boundary on the northern side, but the species has not been collected outside of the Sumter National Forest. The range is narrow and linear, and extends from Saluda to McCormick counties (Fig. 17). Specimens were examined as follows:

SOUTH CAROLINA: *Saluda Co.,* 10.7 mi. W Saluda, at first creek off SC hwy. 38 in Sumter National Forest, F, 4 May 1977 (A1530). *Edgefield Co.,* 12 mi. NE Edgefield, along US hwy. 378 at Rocky Cr., 1.6 mi. W jct. US hwy. 25, M, F, 15 July 1979, R. M. Shelley and R. K. Tardell (A2820); 11.4 mi. NW Edgefield, along SC hwy. 68, 0.2 mi. N jct. SC hwy. 52, 2M, 2F, 8 August 1976 (A1464); 11.3 mi. NW Edgefield, along SC hwy. 283 at Turkey Cr. (McCormick Co. line), 2M, F, 8 August 1976 (A1463) TYPE LOCALITY; and 9.6 mi. NW Edgefield, along SC hwy. 35 at Turkey Cr., M, 5 May 1977 (A1532). *McCormick Co.,* 3.8 mi. S Modoc, M, 30 April 1960, L. Hubricht (RLH); 4.3 mi. SE Modoc, along SC hwy. 88 at Stevens Cr., F, 5 May 1977 (A1534); and 7.4 mi. SE Modoc, along SC hwy. 28, 1.0 mi. S jct. SC hwy. 200, 3M, 8 August 1976 (A1462).

Furcillaria convoluta, new species
Figs. 6–10

Type-specimens.—Male holotype (NCSM A1461) and two male and four female paratypes collected by R. M. Shelley, 5 August 1976, from Newberry Co., South Carolina, 9.4 mi. NW Newberry, along SC highway 32 at Indian Cr., Sumter National Forest. One male and two female paratypes, same collector, same location, 3 May 1977. Male and female paratypes deposited in Florida State Collection of Arthropods.

Diagnosis.—Solenomerite a complex, twisted structure, much longer than tibial process, bent 90° at midlength, with several narrow grooves and ridges, and subtriangular lobe shielding uncate tip; flange relatively long and broad, widest at midlength, poorly demarcated from stem of acropodite, margin smoothly irregular.

Holotype.—Length 53.4 mm, maximum width 12.3 mm, W/L ratio 23.0%, depth/width ratio 60.2%. Segmental widths as follows:

collum	8.2 mm	8th–13th	12.3
2nd	9.8	14th–15th	12.0
3rd	10.5	16th	11.0
4th	11.2	17th	9.6
5th	11.8	18th	7.6
6th–7th	12.1		

Color in life as described for *aequalis.*

Somatic features similar to those of *aequalis* with following exceptions: Width across genal apices 5.5 mm, interantennal isthmus 2.4 mm. Antennae extending back to middle of 3rd segment, relative lengths of antennomeres 2 > 3 > 4 = 5 = 6 > 1 > 7. Facial setae as follows: epicranial, interantennal, and frontal absent, genal 1-1, clypeal about 10-10, labral about 16-16.

Collum very broad, extending slightly beyond ends of following tergite.

Process of 4th sternum moderately large, length nearly equal to width of adjacent coxae (Fig. 7); knobs of segment 5 also much larger than in *aequalis,* anterior pair coalesced medially into single process in midline; 6th sternum not noticeably recessed between 7th legs, with slight groove in midline. Postgonopodal sterna strongly bilobed on segment 8, less so on segment 9, becoming flattened on 10 with wide, shallow, central impression and narrow transverse groove between leg pairs.

Gonopodal aperture subelliptical, 3.9 mm wide and 2.2 mm long at midpoint, indented along anteriolateral edge, front and sides elevated above metazonal surface, not thickened. Gonopods *in situ* (Fig. 6, of paratype) overlapping near midlength in region of flange, curving broadly over opposite side of aperture and extending forward over 6th sternum. Gonopod structure as follows (Figs. 8–10): Prefemur moderate, with moderately long, spiniform prefemoral process directed toward tip of acropodite. Acropodite forming arch with bend at ⅓ length and sharper distal bend on solenomerite, with flange on medial surface proximal to division. Tibial process apically acute, about half as long as solenomerite. Latter a complex twisted structure with several narrow grooves and low ridges, bent sharply (90°) at midlength, with distal, subtriangular, subterminal lobe shielding uncate tip. Flange relatively long and broad, poorly demarcated from stem of acropodite, arising at proximal bend, terminating at level of acropodal division, tapering smoothly to widest point at midlength; margin smooth but slightly irregular. Prostatic groove crossing from medial to lateral sides, running along inner surface of acropodite and a groove of solenomerite, opening apically on uncate tip.

Male paratypes.—The male paratypes agree closely with the holotype in all structural details.

Female paratype.—Length 50.8 mm, maximum width 11.7 mm, W/L ratio 23.0%, depth/width ratio 71.2%. Agreeing essentially with holotype in somatic features except paranota more strongly depressed, creating appearance of more highly arched body.

Cyphopodal aperture with sides flush with metazonal surface. Cyphopods *in situ* with valves oriented anterior-posterior in aperture, receptacle on anterior side of valves. Cyphopod structure as described for *aequalis*.

Variation.—There is less variation in the gonopods of *convoluta* than in those of *aequalis*. The only noticeable differences concern the shape of the prefemoral process and flange. The former is more acicular on some males, and the irregularities in the margin of the flange vary, although the general configuration of the structure is consistent in all specimens.

Etymology.—The specific name refers to the twisted condition of the solenomerite.

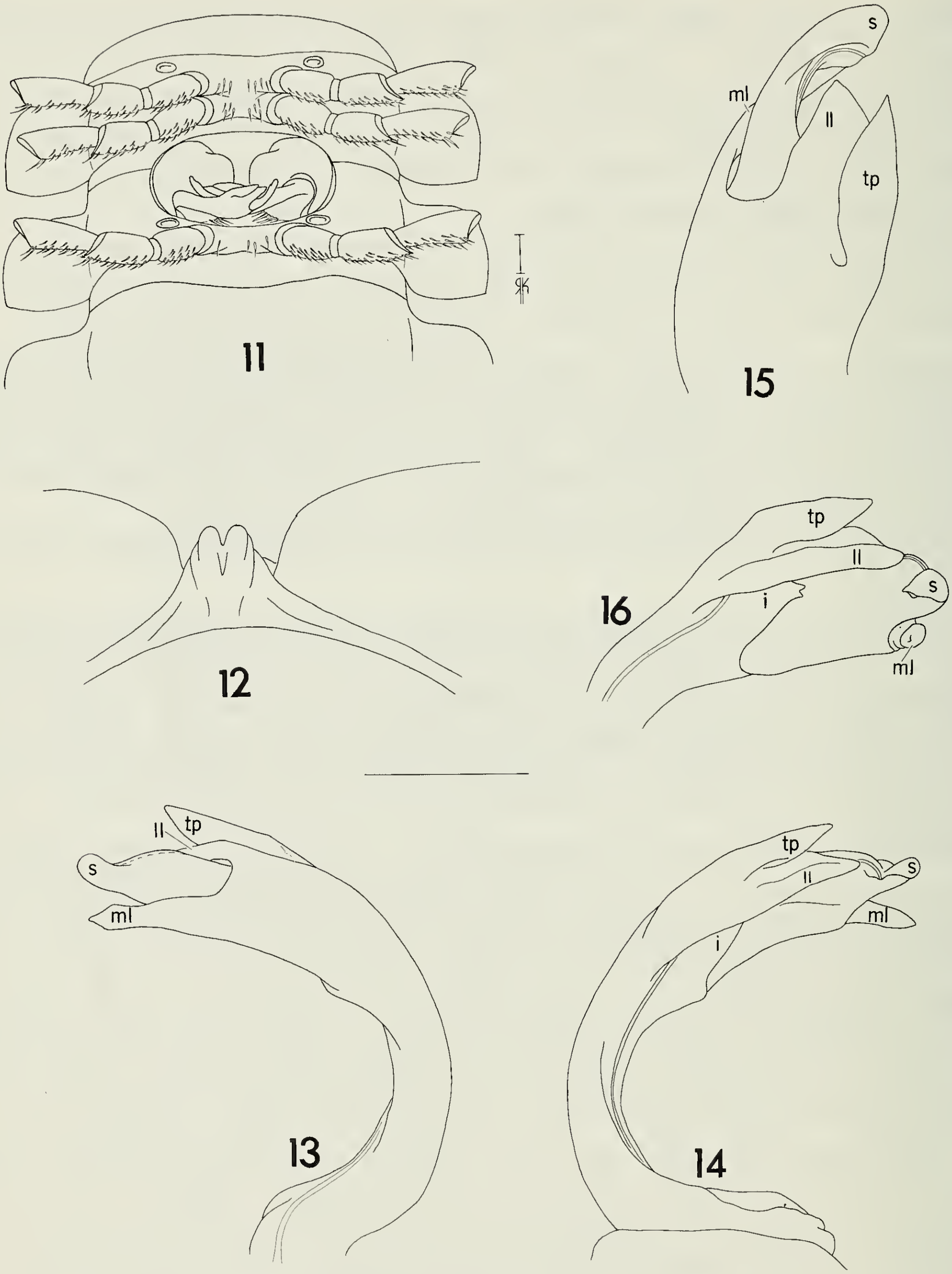
Distribution.—Central Piedmont Plateau of South Carolina from Spartanburg to Newberry counties. The area lies west of the Broad and south of the Pacolet rivers, and most of it is encompassed within the Enoree Division of the Sumter National Forest. The western and southern limits do not correspond to any known physiographic feature. Specimens were examined as follows:

SOUTH CAROLINA: *Spartanburg Co.,* 2.8 mi. S. Pacolet, along SC hwy. 150 at Isons Cr., M, 2F, 13 June 1978, R. M. Shelley and W. B. Jones (A2076); and 8 mi. E Woodruff, along SC hwy. 113 at Tyger R., M, 13 June 1978, R. M. Shelley and W. B. Jones (A1078). *Union Co.,* 6.4 mi. NW Union, along SC hwy. 279 at Fair Forest Cr., M, F, 2 May 1977 (A1511); 13 mi. SW Union, along SC hwy. 22 at Enoree R., Sumter National Forest, 3F, 2 May 1977 (A1512); and 7.3 mi. S Union, along SC hwy. 16 at Tyger R., Sumter National Forest, 3M, 5 August 1976 (A1460). *Laurens Co.,* 11.2 mi. NE Clinton, along SC hwy. 72 at Duncan Cr., Sumter National Forest, M, 9 May 1977 (A1563); and 6.4 mi. NE Clinton, along SC hwy. 26 at Duncan Cr., Sumter National Forest, 3M, 4F, 9 May 1977 (A1562). *Newberry Co.,* 9.4 mi. NW Newberry, along SC hwy. 32 at Indian Cr., Sumter National Forest, 3M, 4F, 5 August 1976 (A1461) and M, 2F, 3 May 1977 (A1519) TYPE LOCALITY.

Furcillaria laminata, new species

Figs. 11–16

Type-specimens.—Male holotype (NCSM A1616) and one female paratype collected by R. M. Shelley, 2 August 1977, from Pickens Co., South



Figs. 11–16. *Furcillaria laminata:* 11, Gonopods *in situ,* ventral view of paratype. 12, Process of 4th sternum of paratype, caudal view. 13, Left gonopod of holotype, medial view. 14, The same, lateral view. 15, Apical portion of telopodite of left gonopod, ventral view. 16, The same, subdorsal view. i, inner lamella; ll, lateral lobe of parasolenomerite; ml, medial lobe of parasolenomerite; s, solenomerite (≠ solenomerite branch); tp, tibial process. Scale line for Fig. 11 = 1.0 mm; line for other figs. = 1.0 mm.

Carolina, 8.5 mi. E Pickens (3.3 mi. NE Easley), along SC highway 192 at George's Creek. Two female paratypes, and two male and one female paratypes, same collector, same location, 8 May 1977 and 12 June 1978, respectively. Male and female paratypes deposited in Florida State Collection of Arthropods.

Diagnosis.—Distinguished by striped color pattern, *in situ* enclosure of acropodites wholly within gonopodal aperture, absence of prefemoral process and medial flange on telopodite, and division of solenomerite branch into three lamellae.

Holotype.—Length 44.2 mm, maximum width 11.3 mm, W/L ratio 25.6%, depth/width ratio 61.1%. Segmental widths as follows:

collum	7.8 mm	12th–14th	11.0
2nd	8.9	15th	10.5
3rd	10.0	16th	10.0
4th	10.7	17th	8.5
5th–11th	11.3	18th	6.0

Color in life: Paranota light red; metaterga brown with light red stripes along caudal edges connecting paranotal spots; collum with light red stripes along both anterior and caudal edges.

Somatic features similar to those of *aequalis* with following exceptions:

Width across genal apices 4.6 mm, interantennal isthmus 1.6 mm. Antennae extending back to middle of 3rd segment, relative lengths of antennomeres 2 > 3 > 6 > 4 = 5 > 1 > 7. Facial setae as follows: epicranial, interantennal, frontal, and genal absent, clypeal about 10-10, labral about 16-16.

Collum broad, extending slightly beyond ends of following tergite.

Process of 4th sternum small, length much shorter than width of adjacent coxae (Fig. 12, of paratype); knobs of segment 5 small, subsimilar to condition in *aequalis*; segment 6 with shallow, convex recession between 7th legs. Postgonopodal sterna strongly bilobed on segment 8, less so on segment 9, becoming flattened and plate-like on 10 and continuing posteriorly.

Gonopodal aperture ovoid, 4.2 mm wide and 2.8 mm long at midpoint, without anteriolateral indentations, front flush with metazonal surface, sides slightly elevated. Gonopods *in situ* (Fig. 11, of paratype) with acropodites lying nearly directly over one another in posterior half of aperture, crossing midline and extending to opposite side of aperture, not projecting beyond margin. Gonopod structure as follows (Figs. 13–16): Prefemur small, without prefemoral process. Acropodite a smooth continuous arch overhanging and extending well beyond prefemur, without flange on medial surface. Tibial process apically acute, about ⅔ as long as solenomerite branch. Latter further divided into three lamellae as follows: the solenomerite proper; a parasolenomerite shielding proximal portion of solenomerite on ventral side and extending forward as two lobes on either side of solenomerite; and a short, subtriangular lamella with two minute apical teeth on inner face of acropodite beneath proximal portion of solenomerite branch. Solenomerite curved slightly anteriodorsad, tapering gradually to rounded apex, with straight ridge on inner surface apically, extending proximad about ⅓ length of solenomerite. Lobes of parasolenomerite shorter than solenomerite but unequal; medial lobe longer than lateral, tapering to subacuminate tip; lateral lobe shorter, apically blunt and rounded. Prostatic groove crossing from medial to lateral sides, running along inner surface of acropodite, behind lateral lobe of parasolenomerite, and along lateral edge of solenomerite to subterminal opening on ridge on inner surface.

Male paratypes.—The male paratypes agree closely with the holotype in all structural details.

Female paratype.—Length 46.0 mm, maximum width 11.4 mm, W/L ratio 24.8%, depth/width ratio 68.4%. Agreeing essentially with holotype in somatic features except paranota more strongly depressed, creating appearance of more highly arched body.

Cyphopodal aperture with sides elevated above metazonal surface. Cyphopods *in situ* with side of receptacle visible in aperture, valves directed dorsolaterad. Receptacle large, cupped around medial side of valves, with lobe protruding through aperture, surface convoluted with deep folds and ridges. Valves moderate and equal in size, surface finely granulate. Operculum minute, hidden under free end of valves.

Variation.—The inner lamella on the gonopods of the male from Anderson County is slightly larger and more pronounced than on the type males, but otherwise the gonopods of males from both localities agree closely.

Etymology.—The specific name refers to the laminate condition of the gonopodal acropodite.

Distribution.—Central western Piedmont Plateau of South Carolina. With only two known localities, a full range description of *laminata* is impossible. However, both sites are between the Saluda and Toxaway-Savannah rivers, and the Pickens County site is only about 15 miles from the Blue Ridge Front. Thus, these physiographic features seem plausible range boundaries for *laminata*. The species is certainly rare, as in four years of fieldwork in piedmont South Carolina I have only encountered it five times, and only at these two sites. Consequently, it seems to warrant consideration for the "rare, exploitable, and vulnerable" category for arthropods other than Crustacea in the South Carolina endangered species list (Morse *et al.,* 1979). Specimens were examined as follows:

SOUTH CAROLINA: *Pickens Co.,* 8.5 mi. E Pickens (3.3 mi. NE Easley), along SC hwy. 192 at George's Cr., 2F, 8 May 1977 (A1558); M, F, 3 August 1977 (A1616); and 2M, F, 12 June 1978, R. M. Shelley and W. B. Jones (A2074) TYPE LOCALITY. *Anderson Co.,* 7.9 mi. SSE Anderson,

Fig. 17. Distribution of *Furcillaria* in South Carolina. Stars, *laminata*; squares, *convoluta*; dots, *aequalis*.

along SC hwy. 1459 at Rocky R., 3F, 7 May 1977 (A1551); and M, 2F, 2 August 1977 (A1615).

Ecology

The ecological requirements of *Furcillaria* are similar to those reported by Shelley (1977) for *Croatania*. Its species are not as plentiful as those of the latter genus, but *Furcillaria* is also available in the hottest, driest summer months, when few other diplopods are evident. *Furcillaria* also seems to have more specific habitat requirements, as I never found it in the purely or predominantly pine localities which *Croatania* occupies. Most of piedmont South Carolina is dominated by pine, but *Furcillaria* was always taken in environments with a large percentage of hardwoods, although beech woods and beech litter are avoided. The millipeds are typically found under thin layers of leaves close to water courses, most often along banks of small streams. The type locality of *laminata* consists of a large, subclimax, deciduous forest in a hilly region along an upper Piedmont stream. Several

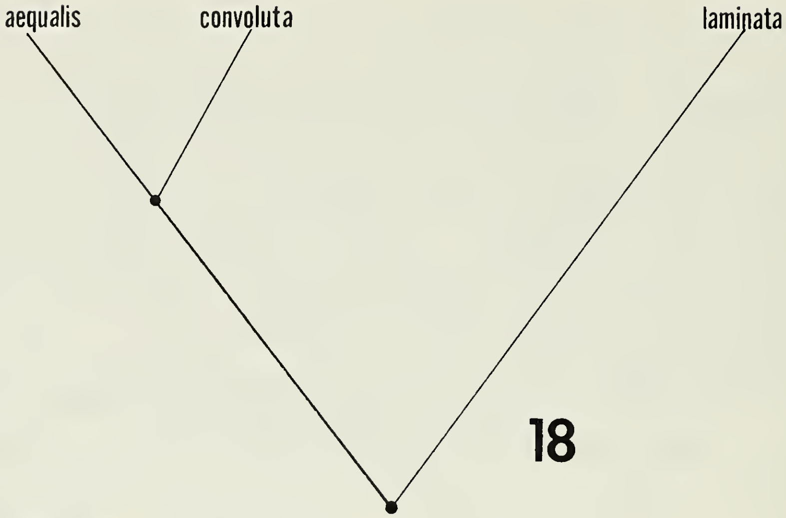


Fig. 18. Relationships in *Furcillaria.*

xystodesmids in addition to *laminata* were discovered in shallow, moist depressions on hillsides well above the water.

Distribution

Furcillaria occupies a roughly triangular area in piedmont South Carolina as shown in Fig. 17. The three species occupy limited, allopatric ranges, separated from each other by at least 30 miles. All are longer in the north–south direction than in the east–west; the range of *aequalis* is extremely narrow and nearly linear. The distributions also traverse moderate-size Piedmont rivers (such as the Enoree River by *convoluta*) rather than occurring along one side as does *Brevigonus shelfordi* (Loomis) (Shelley 1980b).

Relationships

Generic.—*Furcillaria* is most closely related to *Dynoria,* as explained in the introduction. Their ranges are mostly separated by the Savannah River, with *Furcillaria* occurring north-east in South Carolina, and *Dynoria* occurring south-west in Georgia and North Carolina. However, *Dynoria* extends slightly around headwater streams and occurs in the western fringe of Oconee County, South Carolina.

Specific.—The common properties of a prefemoral process, a medial flange, and a solenomerite lacking accessory lamellae point to a close relationship between *aequalis* and *convoluta.* The two appear to be sister species only one step removed from a common ancestor (Fig. 18); however, their significantly different gonopods suggest a lengthy period of isolation since dichotomy occurred. *Furcillaria laminata* is so entirely different that it can only represent a second phylogenetic line, probably from an earlier source. Their restricted and widely allopatric distributions, and reduced abundances, suggest that the species are much older inhabitants of South Carolina than such widespread newcomers as the species of *Cleptoria* and *Croatania*. *Furcillaria* appears to be a remnant of an early fauna that is now in natural decline. Thus, the extreme rarity of *laminata* indicates a need for species consideration of its conservation status.

Acknowledgments

Thanks are extended to Richard L. Hoffman, Radford College, for loan of his specimen of *aequalis*; to John E. Cooper, N.C. State Museum, for reviewing a preliminary draft of the manuscript; and to Renaldo G. Kuhler, N.C. State Museum scientific illustrator, for preparing figures 1, 6, and 11. This study was supported in part by National Science Foundation grant no. DEB 7702596.

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FIVE NEW POLYCHAETES OF THE FAMILIES EUNICIDAE AND ONUPHIDAE, COLLECTED IN 1975 AND 1976 DURING THE SOUTHERN CALIFORNIA BASELINE PROJECT

John F. Shisko

Abstract.—*Eunice caeca, E. multicylindri, Nothria exigua, Onuphis multiannulata,* and *O. segmentispadex* are described from the Southern California Bight.

Introduction

In a baseline study of the Southern California Bight, funded by the Bureau of Land Management in 1975, 777 stations were sampled between September 1975 and April 1976. The benthic samples used in the present study, listed in Appendix 1, were taken aboard the R/V *Velero* with a box coring device $^{1}/_{16}$ m^2. The samples were then sequentially washed through sieves with 1.0 mm and 0.5 mm meshes respectively, saturated with magnesium chloride in sea water for 30 minutes to relax the specimens, fixed in 10% formaldehyde, and stored in 70% ethanol.

Eunice caeca, new species
Fig. 1, Table 1

Material.—24774 (1, type).

Description.—The type is complete with 90 setigers. The pygidium is in the process of regeneration. The specimen is 110 mm long and 6 mm wide including the parapodia. A color pattern is lacking. The ventrum is deeply concave from setiger 4–6.

The prostomium is as long as wide with a fairly deep median cleft. Eyespots are absent; however, a patch of pigment is located posterior to the bases of the outer lateral occipital antennae. The occipital antennae are composed of cylindrical articles of irregular length. The outer lateral ones have 4 to 5 articles and barely reach setiger 1. The inner lateral antenna is incomplete. Irregular wrinkles on the tentacles add to the difficulty in counting articles. The first peristomial segment is longer than the prostomium and is 3 times as long as the second peristomial segment. The second peristomial segment bears the peristomial cirri. The peristomial cirri are wrinkled, equal the dorsal cirri of setiger 5 in both length and shape, and reach to the bases of the outer lateral occipital tentacles.

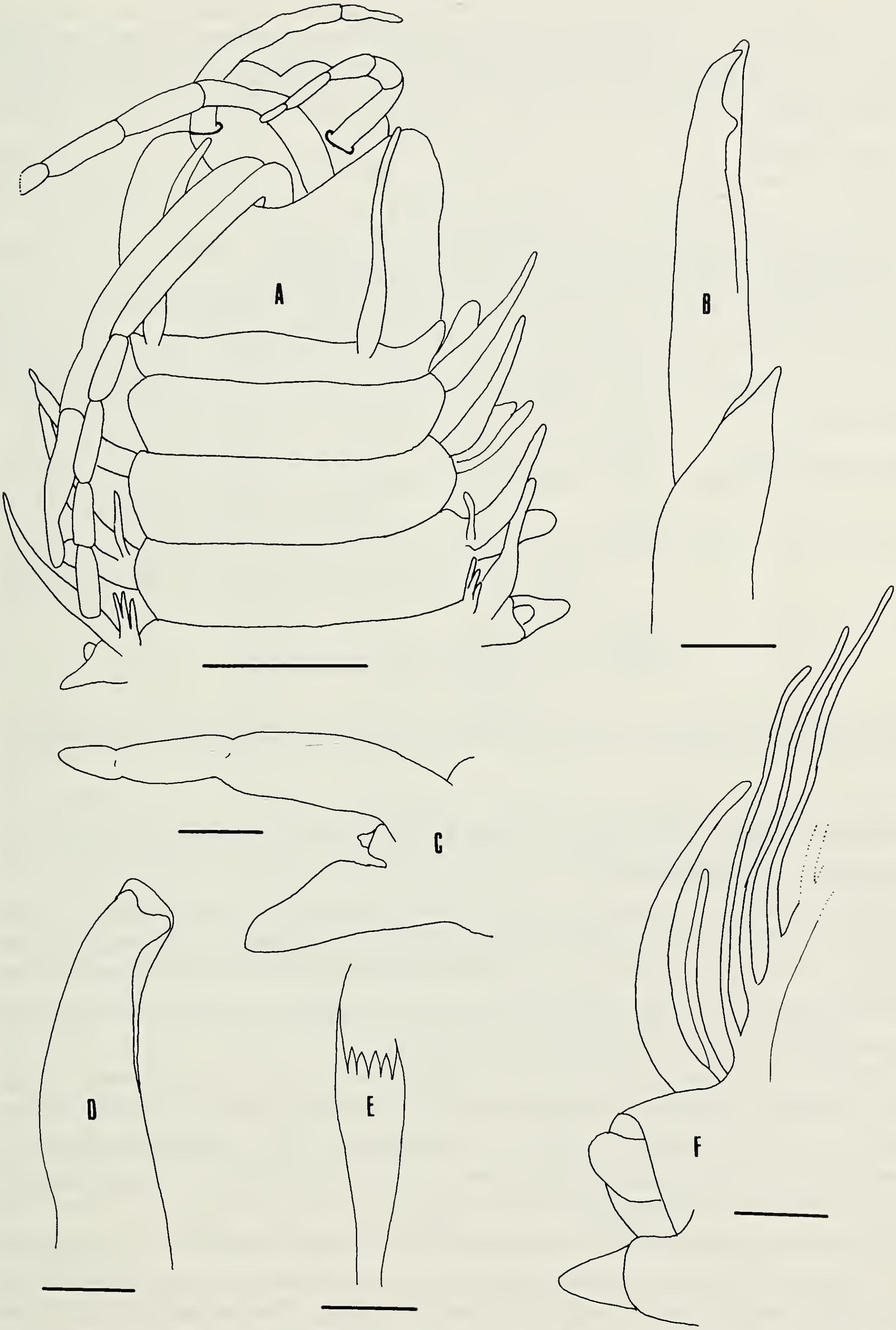

Fig. 1. *Eunice caeca:* A, Anterior end, dorsal view; B, Composite falciger, setiger 1; C, Parapodium, setiger 1; D, Subacicular hook, setiger 43; E, Pectinate seta, setiger 1; F, parapodium, setiger 9. Scales: A = 2.0 mm; B = 0.012 mm, C = 0.5 mm; D = 0.05 mm; E = 0.025 mm; F = 0.5 mm.

Table 1.—Material of Eunicidae from the Southern California Baseline Project. The table gives measurements on part of the material; the total number of specimens of each species can be found in the systematic account. The data in columns 3–6 refer to the number of setigers counted from the anterior end. A question mark indicates that the information was unattainable. The columns are:

1. Station number.
2. Length in mm, measured from the tip of the palpi to the posterior margin of the tenth setiger.
3. The number of the setiger on which the first branchia occurred.
4. The number of the setiger on which the last branchia occurred.
5. The number of the setiger on which the first subacicular hook occurred.
6. The total number of setigers present in fragmentary specimens.

	1.	2.	3.	4.	5.	6.
Eunice caeca	24774	14.4	2–3	46	42	
Eunice multicylindri	22952	2.5	3	27	19	44
		2.0	3	14	13	29
	23170	2.3	3	27	21	
	24356	3.0	3	?	24	31
		3.5	3	35	25	40
		2.4	3	26	21	
	TYPE	3.5	3	35	26	
	24367	2.7	3	31	22	
		3.0	3	36	26	
		2.5	3	35	26	56

The first setiger has a transverse presetal lobe, a conical setal lobe, and a transverse postsetal lobe.

The dorsal cirrus is long and slender in all segments, but is thicker in the first 5 or 6 setigers. The ventral cirri are short and stout in all setigers; from setiger 7 they have a knoblike tip on a stout base. The ventral cirri become cirriform posterior to the branchial segments. Neither dorsal or ventral cirri are annulated. The dorsal cirri are wrinkled.

Branchiae are first present from setiger 2 on one side, and from setiger 3 on the other side as a single filament. Branchiae are in a pectinate arrangement from setiger 5 with 3 to 5 filaments. The maximal number of filaments is 23. The branchiae cover the dorsum completely from setiger 8 to 40, and are present posteriorly to setiger 46.

Composite hooded hooks, capillary setae, and pectinate setae are present in all setigers. The composite, bidentate hooded hooks have a blunt hood which does not project beyond the tip of the hook. The hoods and the upper ends of the basal shafts are finely serrate. The capillary setae are straight and finely serrate along their entire length. Pectinate setae are straight; each has 4–7 teeth with only one margin drawn out into a fine tip. Yellow subacicular hooded hooks are first present from setiger 42; each is bidentate; up to 3 hooks may be present in posterior parapodia.

The pharyngeal apparatus is exposed in the type. Maxilla I is falcate; maxilla II has 6 teeth on the left and 5 teeth on the right; right combined maxilla III and IV has 8 teeth, left maxilla IV has 7 teeth. Each maxilla V has 1 tooth.

Discussion.—*Eunice caeca* closely resembles *E. semisegregata* Fauchald, 1969. The first branchia are pectinate with 6 filaments in *E. semisegregata* whereas the first branchia of *E. caeca* consists of a single filament. The maximum number of filamenta is 34–36 in *E. semisegregata*; the maximum is 24 in *E. caeca*. Subacicular hooks are present from setiger 51 in *E. semisegregata* and are present from setiger 42 in *E. caecus*.

Distribution.—*Eunice caeca* has been found at only one location, in trawl material near Tanner Bank at a depth of 1357 m.

Disposition of types.—Holotype is deposited in the National Museum of Natural History (USNM 63065).

Etymology.—The specific name is derived from the Latin ''caecus'' meaning blind; it is given because eyespots are absent.

Eunice multicylindri, new species

Fig. 2, Table 1

Material.—22952 (2); 22999 (1); 23087 (2); 23170 (1); 24356 (5, type); 24367 (4).

Description.—The type is complete with 115 setigers. It is 43 mm long and 1 mm wide. The specimen is uniformly pale yellow with a thin transverse line of red at the intersegmental furrows. This pigmentation disappears a year or so after preservation. Dark internal masses are present in each parapodium from setiger 25. There are 2 pairs of anal cirri. The dorsal pair is 3–5 times the length of the ventral pair.

The prostomium is nearly as long as it is wide and has a narrow shallow frontal incision. A pair of dark red eyes is located at the base of the inner lateral occipital tentacles. These eyes turn black a year or so after preservation. The outer lateral tentacles reach the first setiger and are made up of 4 cylindrical articles. The inner lateral occipital tentacles reach to setigers 4–5 and have 7 cylindrical articles of which the longest is the ceratophore. The median occipital tentacle is the longest and reaches setiger 6–7, it is made up of 7 cylindrical articles. The first peristomial segment is only slightly longer than the second. The combined lengths of the first and second peristomial segments is equal to the length of the peristomium. The peristomial cirri are equal in length but shorter than the dorsal cirrus of the first setiger. Neither the peristomial cirri nor the dorsal cirri possess articulations.

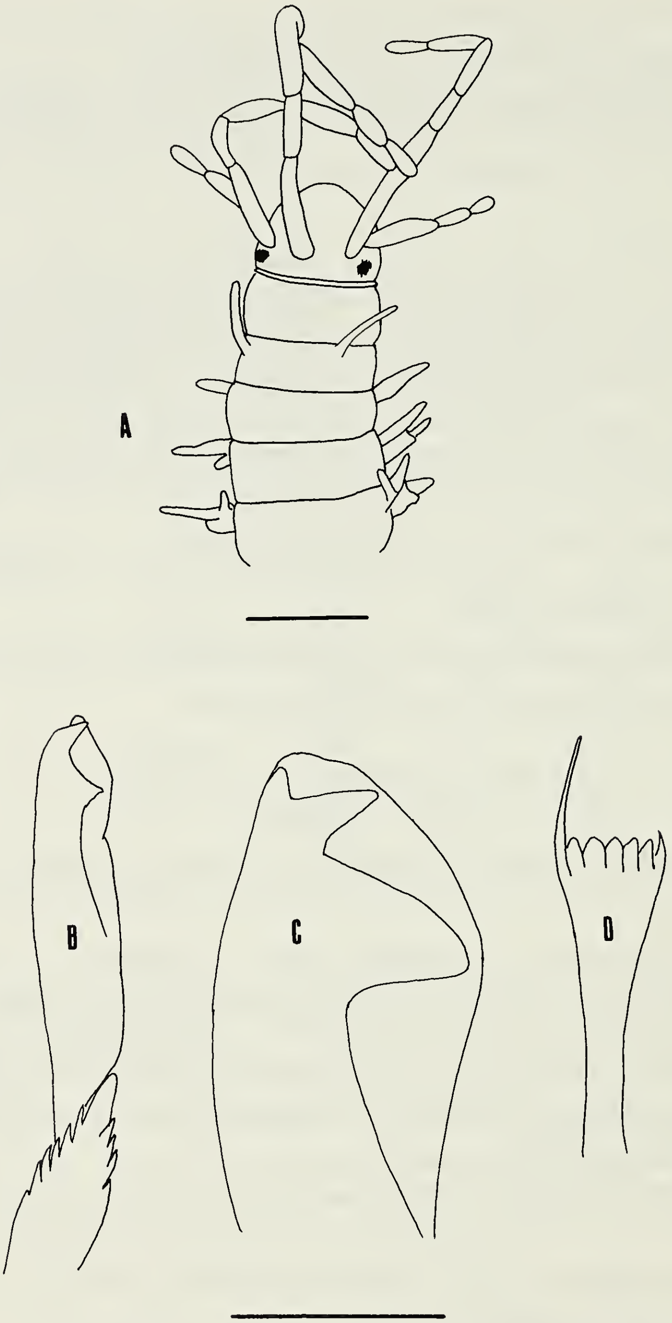

Fig. 2. *Eunice multicylindri:* A, Anterior end, dorsal view; B, Hooded hook, setiger 5; C, Subacicular hook, setiger 68; D, Pectinate seta, setiger 5. Scales: A = 0.5 mm; B–D = 0.025 mm.

The first setiger has a truncate presetal lobe which is continuous with an obliquely truncate postsetal lobe. The setal lobe lies between the presetal and postsetal lobes in a dorsal position and appears as a knoblike projection from which a blunt aciculum emerges. Dorsal cirri are slender throughout.

Ventral cirri are slender in the first 5 or 6 setigers and then become barrel shaped.

Branchiae are present from setiger 3 and disappear at setiger 25. They are simple on setigers 3–9. There are maximally 3 pectinately arranged filaments present. Each branchial filament is long and slender.

Composite hooded hooks, pectinate setae and capillary setae are present in all setigers. The composite bidentate hooded hooks have blunt hoods which are serrated along one margin. The distal end of the shaft is also serrate. The pectinate setae have 7 teeth and only one edge is drawn out into a slender top. The capillary setae are straight and are finely serrate along one margin. Yellow tridentate acicular hooks occur singly from setiger 19–25.

Tubes are absent.

The jaws were not dissected in any of the specimens.

Discussion.—*Eunice multicylindri* is closely related to both *E. vittata* (Delle Chiaje, 1828) and *E. vittatopsis* Fauchald, 1970. *E. vittata* and *E. vittatopsis* both possess articled peristomial and dorsal cirri. The cirri of *E. multicylindri* are smooth.

Distribution.—*Eunice multicylindri* is found from Santa Rosa Island to Tanner Bank in coarse sand. Its bathymetric range is 70–129 m.

Disposition of types.—Holotype and paratypes are deposited in the National Museum of Natural History (USNM 63066, 63067, 63068, 63069, 63070).

Etymology.—The specific name is derived from the Latin "multus" meaning many and the Greek "cylindrus" meaning cylinder; it is given because the tentacles are made up of a number of cylindrical articles.

Nothria exigua, new species
Fig. 3, Table 2

Material.—22958 (1); 22960 (1); 22965 (1); 22966 (1); 23004 (7); 23070 (18); 23077 (1); 23086 (7); 23087 (1); 23088 (7); 23092 (4); 23093 (1); 23100 (7); 23205 (10); 23229 (1); 24080 (56, type); 24081 (60); 24083 (9); 24084 (25); 24089 (2); 24100 (8); 24140 (2); 24365 (3); 24382 (5); 24384 (2).

Description.—The type is a nearly complete specimen with 99 setigers; it is 24 mm long and 1 mm wide. The dorsum of each anterior segment is crossed with a transverse bar of brown pigment, but the pigment fades and all segments posterior to setiger 25 are pale. The peristomium is uniformly brown. The pygidium terminates in 2 long anal cirri in complete specimens.

The prostomium is rounded with globular frontal antennae. The ceratophores of the occipital antennae have 3–4 annuli. The style of the median occipital tentacle reaches to setiger 9; the style of the outer lateral tentacles reaches to setiger 2 and the styles of the inner lateral tentacles reach to setiger

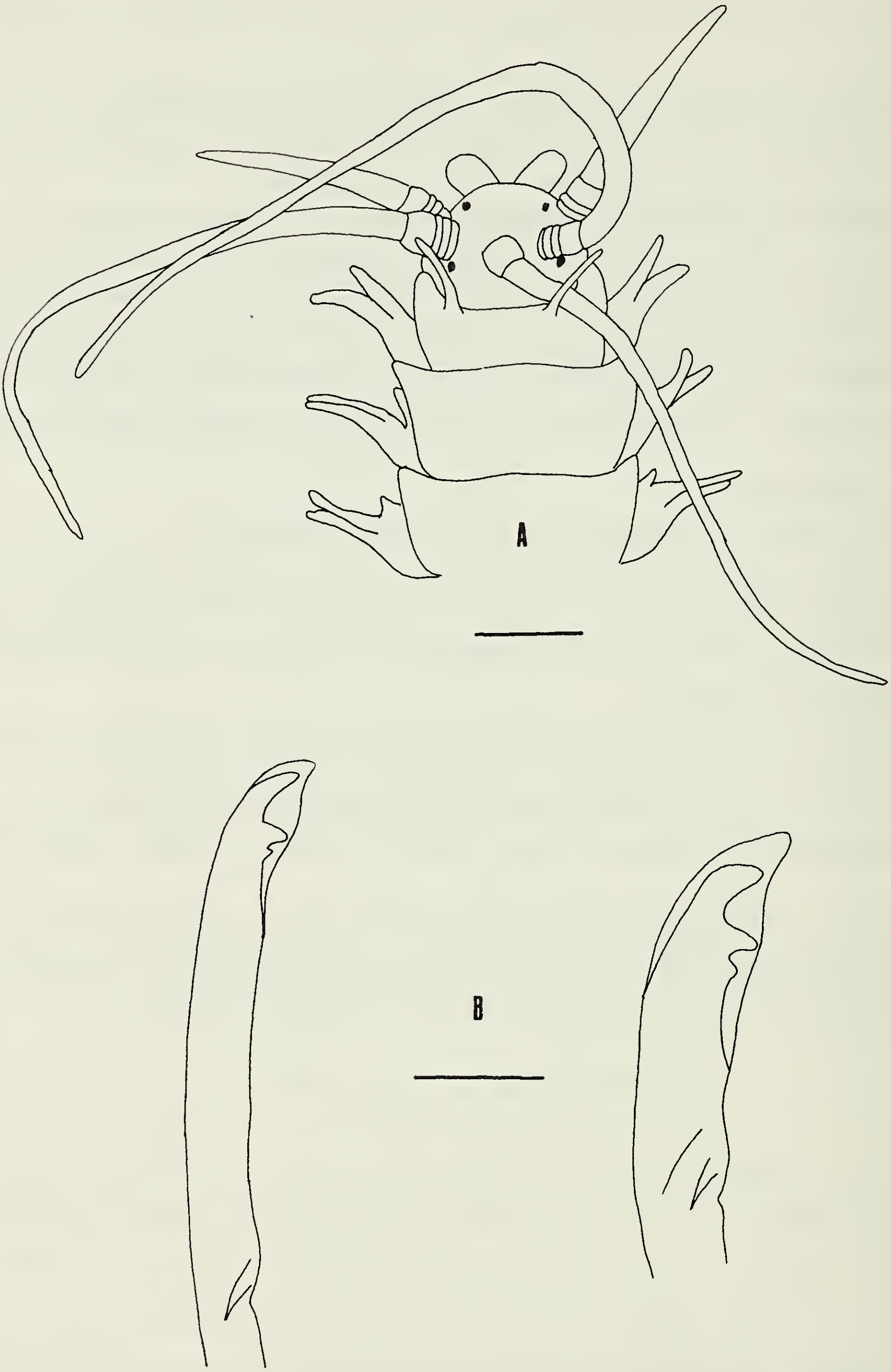

Fig. 3. *Nothria exigua:* A, Anterior end, dorsal view; B, Hooded hooks, setiger 1. Scales: A = 0.5 mm; B = 0.025 mm.

10. One pair of eyes is lateral to the inner occipital tentacle and another pair is located just posterior to the frontal antennae.

The first setiger has a transverse presetal lobe, the setal lobe is rounded and hooks project from both its anterior and posterior faces; the postsetal

Table 2.—Material of Onuphidae from the Southern California Baseline Project. The table gives measurements on part of the material; the total number of specimens of each species is found in the systematic account. A dash in a column means that the measurement does not apply, a question mark means that the measurement was unattainable. The data in columns 3–5 and 7–10 refer to the number of setigers counted from the anterior end. The columns are:

1. Station number.
2. Length in mm, measured from the tip of the palpi to the posterior margin of the tenth setiger.
3. The number of the setiger on which the first branchia occur.
4. The number of the setiger from which the ventral cirri become padlike.
5. The number of the setiger on which a pair of subacicular hooks first occur.
6. The number of annulations found on the ceratophore of the inner occipital tentacle.
7. The setiger to which the inner occipital tentacle reaches.
8. The number of anterior setigers with pseudocomposite hooks.
9. The first and last setiger in which composite spinigers occur.
10. The total number of setigers present in fragmentary specimens.

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
Nothria exigua									
22958	2.2	None	4	11	?	6	4	4–11	63
22960	2.6	None	4	11	3	6	4	5–12	?
24080	1.9	14	4	12	3	8	4	5–11	27
	1.5	14	4	11	3	9	3	5–11	
	1.7	12	4	12	3	11	3	4–11	
	2.0	14	4	13	3	8	4	4–12	27
	1.8	13	4	12	3	?	3	4–11	39
24089	2.0	13	4	11	4	7	?	4–12	39
	2.7	12	4	11	4	9	?	4–11	41
24100	2.6	11	4	15	4	?	4	5–12	81
	2.5	11	4	16	4	7	4	4–15	72
	2.0	14	4	15	3	6	4	5–14	100
24365	3.3	12	4	13	3	8	4	4–11	59
	2.8	13	4	14	3	10	3	4–13	28
	3.1	12	4	15	3	11	4	5–15	33
24382	1.9	16	5	14	4	11	4	5–13	33
	2.6	None	4	11	4	7	3	5–11	
	1.9	?	4	12	4	11	4	5–11	65
	2.6	20	4	12	4	?	4	4–12	29
TYPE	2.3	16	5	15	4	?	4	5–15	
24384	3.8	16	4	15	4	9	5	5–15	
	2.8	18	4	13	4	6	3	4–12	64
Onuphis multiannulata									
22966	4.2	1	6	10	23	23	4	—	101
24140	8.0	1	6	10	31	21	5	—	57
24380	5.1	1	7	10	28	21	6	—	38
24754	4.8	1	7	10	29	24	6	—	135
24759	4.5	1	8	10	26	22	7	—	137

Table 2.—Continued.

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
Onuphis segmentispadix									
22966	2.0	13	5	13	4	6	4	5–12	
23000	2.6	15	5	17	4	14	4	5–16	48
	2.0	13	5	17	3	13	3	5–16	60
23070	3.0	14	5	15	3	10	4	5–14	40
	2.6	14	5	16	4	11	4	5–15	
23100	4.1	10	5	18	4	11	4	5–16	90
24075	3.8	7	5	17	4	14	4	5–16	59
24080	3.2	10	5	18	4	17	5	5–16	55
24106	3.4	9	5	17	4	12	4	5–16	68
24240	1.4	14	4	12	3	11	3	5–11	
	1.9	12	5	13	3	16	3	4–12	69
	2.3	13	5	15	4	12	4	5–15	42

lobe is clavate, a fold on its anterior surface is visible just posterior to the setal lobe. Ventral cirri are first padlike from setiger 5.

Simple straplike branchiae are present from setiger 14–16.

Pseudocomposite tridentate hooded hooks are present in the first 4 setigers, accompianied by simple setae. Composite spinigers are present in setigers 5 through 15. A pair of subacicular hooks is present from setiger 16.

The tubes are thin and transparent.

Maxilla I is falcate; left maxilla II has 6 teeth, right maxilla II has 6 teeth; left maxilla III has 7 teeth, left maxilla IV has 7 teeth; and combined right maxilla III and IV has 8 teeth. Each maxilla V has 1 tooth.

Discussion.—*Nothria exigua* resembles both *N. rubrescens* (Augener, 1906) and *N. stigmatis* (Treadwell, 1922). *Nothria exigua* may be distinguished from *Nothria rubrescens* by the number of the annulations on the ceratophores. *Nothria exigua* has 3–4 annuli per ceratophore whereas these number 7–9 in *N. rubrescens. N. exigua* differs from *N. stigmatis* in that the branchia first occur before setiger 17 in *N. exigua* and after setiger 18 in *N. stigmatis.*

Disposition of types.—Holotype and paratypes are deposited in the National Museum of Natural History (USNM 63081, 63082, 63083, 63084, 63085).

Etymology.—The specific name is derived from the Latin "exiguus" meaning small; it is given because the animals are generally small.

Onuphis multiannulata, new species
Fig. 4, Table 2

Material.—22966 (1); 24140 (1, type); 24380 (1); 24754 (1); 24759 (1).

Description.—The type is incomplete with 57 setigers; it is 24 mm long and 3 mm wide including the parapodia. A pigment pattern is lacking, except that each of the occipital ceratophores have 5–6 distal annuli with brown pigmentation.

The prostomium is ovate with globular frontal antennae. The occipital ceratophores are distinctly annulated. In all cases the distalmost annulus is the longest. The median ceratophore has 24 annuli and its style reaches to setiger 12; the outer lateral ceratophores have 23 annuli and the style reaches to setiger 23; the inner lateral ceratophores have 31 annuli and the style reaches to setiger 21. There is 1 pair of clustered eyespots lateral to the inner occipital ceratophores. The peristomial cirri are slender and equal in length to the dorsal cirri of the first setiger.

The presetal lobe of the first setiger is truncate, the setal lobe is rounded. The postsetal lobe is clavate and diminishes in size to setiger 47 after which it is low and rounded. The dorsal and ventral cirri are of equal length and are clavate. The ventral cirri are padlike from setiger 7.

Branchiae are present from the first setiger as a single filament. A second filament is present by setiger 30 and a third by setiger 39.

Bidentate and tridentate pseudocomposite hooded hooks are present in the first 5 setigers. Setigers 6–9 have only simple limbate setae. Two bidentate subacicular hooks are present from setiger 10. Pectinate setae are present in median setigers; each has 13 fine teeth. Composite spinigers are absent.

Maxilla I is falcate; maxilla II right has 10 teeth, II left has 8–9 teeth; maxilla III left has 10 teeth, IV left has 7 teeth; combined right maxilla III and IV has 10–11 teeth; each maxilla V has 1 tooth. Mandibles are bidentate.

Tube absent.

Discussion.—*Onuphis multiannulata* is related to *O. branchiata* Treadwell, 1931, *O. eremita* Audouin and Milne Edwards, 1833, and *O. quinquedens* Day, 1951. *Onuphis multiannulata* can be distinguished from *O. branchiata* and *O. eremita* by the number of occipital ceratophore annulations. *Onuphis multiannulata* has 20–23 annulations, *O. eremita* has 15–17 and *O. branchiata* has only 8 annulations. *Onuphis multiannulata* is most closely related to *O. quinquedens,* which has only bidentate anterior hooded hooks.

Distribution.—*Onuphis multiannulata* has been found off Santa Rosa Island and on the Tanner and Cortes Banks. It occurs in fine to coarse sand and has a bathymetric range of 95–142 m.

Disposition of types.—Holotype and paratypes are deposited in the National Museum of Natural History (USNM 63071, 63072, 63073).

Etymology.—The specific name is derived from the Latin "multus" meaning many, and the Latin "annulus" meaning ring; it is given because the ceratophores have many annuli.

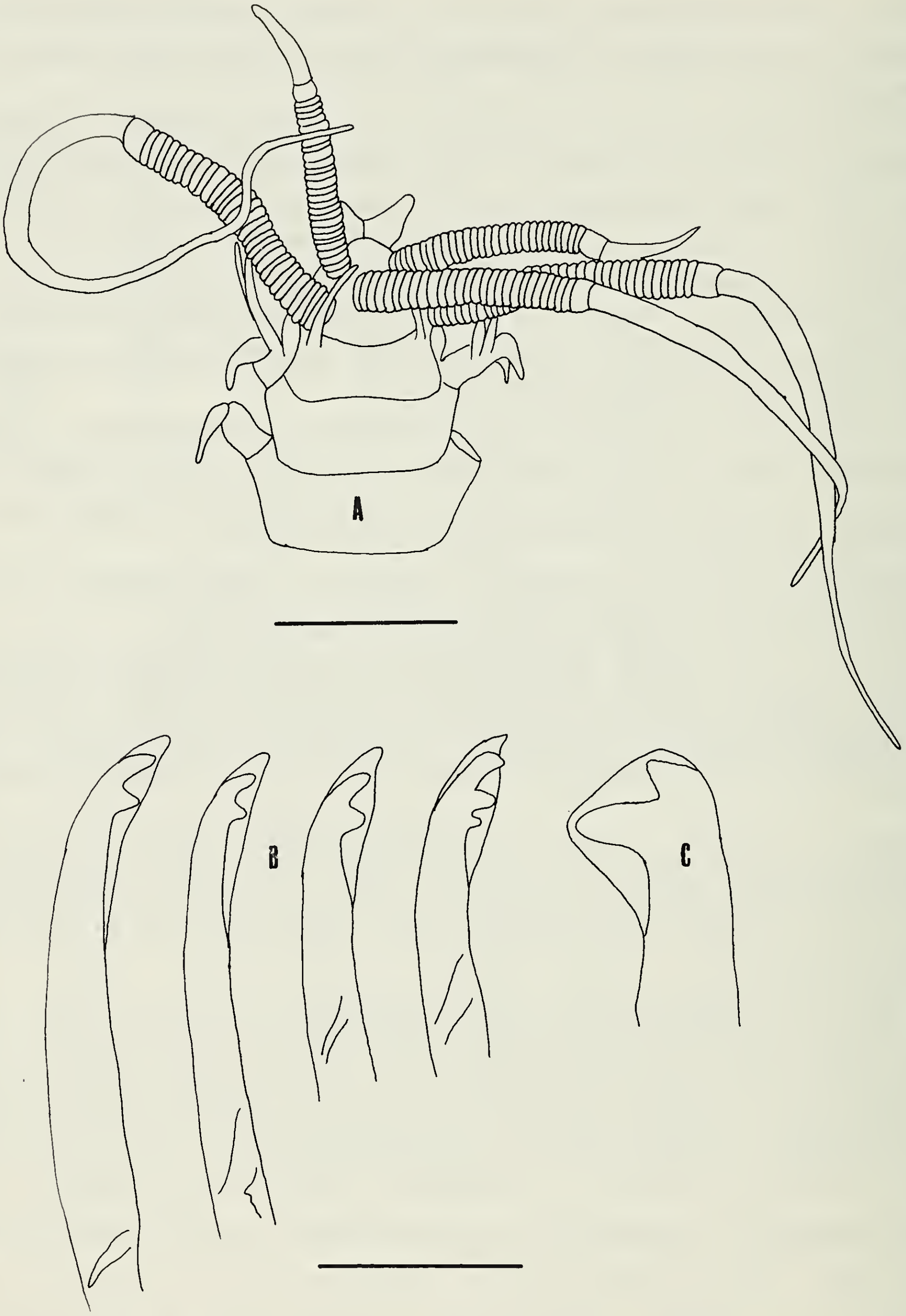

Fig. 4. *Onuphis multiannulata:* A, Anterior end, dorsal view; B, Hooded hooks, setiger 1; C, Subacicular hook, setiger 54. Scales: A = 1.0 mm; B–C = 0.05 mm.

Onuphis segmentispadix, new species

Fig. 5, Table 2

Material.—22966 (5); 22970 (8); 23000 (2); 23070 (6); 23071 (3); 23088 (4); 23098 (33); 23100 (2); 32102 (2); 23129 (5); 23241 (2); 23279 (111); 24075 (1);

24080 (4); 24100 (2); 24106 (4, type); 24108 (10); 24238 (2); 24240 (18); 24241 (1); 24253 (14); 24255 (2); 24259 (10); 24263 (40); 24268 (5); 24364 (1); 24368 (5); 24375 (25).

Description.—The type is incomplete with 68 setigers; it is 20 mm long and 1.5 mm wide including the parapodia. The dorsum is crossed by transverse brown bars through the first 31 setigers and is later pale. The peristomium is uniformly brown.

The prostomium is ovate with globular frontal antennae and palps. The ceratophores of the occipital tentacles have 4 annuli, the distalmost of which is equal in length to the combined lengths of the first 3 annuli. The pygidium, in a complete specimen, terminates with a pair of cirri. The style of the median occipital tentacle reaches setiger 11; the inner lateral styles reach setiger 10–12 and the outer lateral styles reach setiger 2–3.

Two pairs of eyespots are present. The anterior pair are located directly behind the frontal antennae; the posterior pair are lateral to the inner occipital tentacles; the anterior eyespots are poorly defined in the type but are clearly present in the paratypes.

The peristomium is narrower than the first setiger with the peristomial cirri being equal in length to the postsetal lobe of the first setiger.

The postsetal lobe of the first setiger is cirriform and it diminishes in size through setiger 14 behind which it becomes truncate and equal to the truncate presetal lobe. The setal lobe is rounded and extends beyond the presetal lobe. The ventral cirri are slender and cirriform in the first 4 setigers and padlike from setiger 5.

Branchiae are first present from setiger 9 as a single filament. A second filament is present from setiger 18. Four filaments in a pectinate arrangement are present at their maximum development.

Pseudocomposite tridentate hooded hooks are present in the first 4 setigers. These are accompanied by a few simple setae. Compound spinigers are present in setigers 5–15 in inferior positions with simple limbate setae in superior positions. Two bidentate subacicular hooks are present from setiger 16. Pectinate setae are present in median and posterior setigers; each has 10 coarse teeth. Each parapodium contains 3 slightly curved aciculae.

Maxilla I is falcate; maxilla II right has 8 teeth, II left has 8 teeth; maxilla III left has 8 teeth, maxilla IV left has 7 teeth, and combined right maxilla III and IV has 10 teeth. Each maxilla V has 1 tooth.

Tubes are very thin and transparent.

Discussion.—*Onuphis segmentispadix* is related to *O. cedroensis,* Fauchald, 1968. Both species have 4 ventral cirriform cirri, tridentate anterior hooks and 3–4 annulations on their ceratophores. These species can, however, be distinguished on the basis of the first appearance of the branchia and the presence of compound spinigers. The branchiae are first present in setigers 9–15 in *O. segmentispadix* whereas they are first present from se-

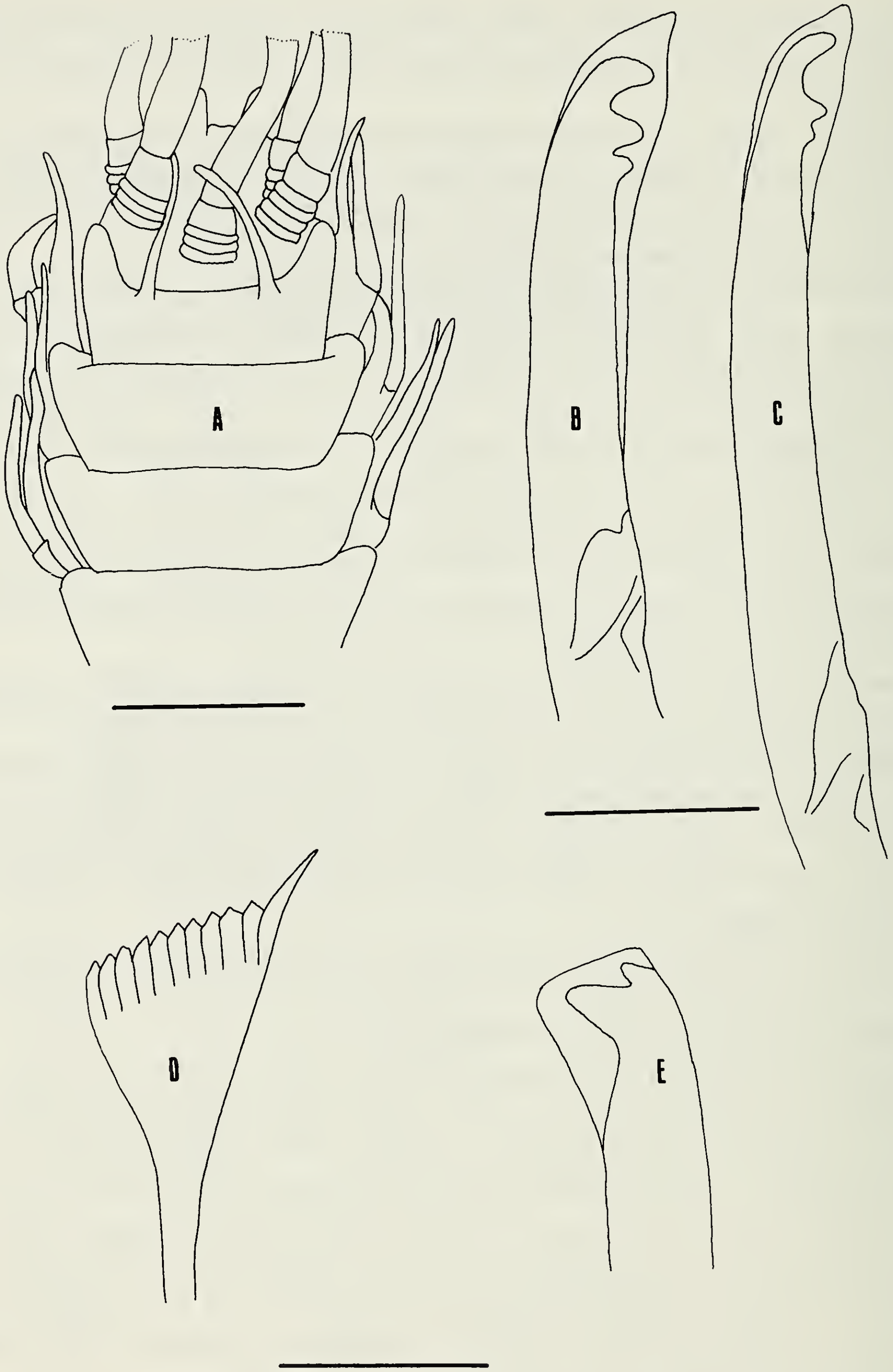

Fig. 5. *Onuphis segmentispadix:* A, Anterior end, dorsal view; B–C, Hooded hooks, setiger 1; D, Pectinate seta, setiger 1; E, Subacicular hook, median setiger. Scales: A = 0.5 mm; B–E = 0.025 mm.

tiger 6 in *O. cedroensis*. Compound spinigers are lacking in *O. cedroensis* whereas they are present in *O. segmentispadix*.

Distribution.—Onuphis segmentispadix is widely distributed off of the southern California coast. It has been found in substrates ranging from silt to coarse sand to gravel. It has a bathymetric range of 63–457 m.

Disposition of types.—Holotype and paratypes are deposited in the National Museum of Natural History (USNM 63074, 63075, 63076, 63077, 63078, 63079, 63080).

Etymology.—The specific name is derived from the Latin "segmentum" meaning segment or part, and the Latin "spadix" meaning nut-brown; it is given because the segments are dorsally brown in the anterior.

Acknowledgments

I would like to thank Dr. D. J. Reish for teaching me the basics; my coworkers on the BLM project for a terrific learning experience, especially Dr. Kristian Fauchald for his encouragement and tutelage; Joe Nagano for allowing me the time to put on the finishing touches; and a special thanks to Nancy A. Huerta for typing this and for putting up with my illegible handwriting etc.

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Hyperion Treatment Plant, 12000 Vista del Mar, Playa del Rey, California 90291.

Appendix 1

Station Data

22952	(103)	13 Oct. 1975, 33°51.46′N, 119°57.13′W, 87 m, coarse sand.
22958	(106)	14 Oct. 1975, 33°51.95′N, 119°59.98′W, 68 m, coarse sand.
22960	(108)	14 Oct. 1975, 33°51.92′N, 120°1.78′W, 61 m, fine sand with shell fragments.
22965	(113)	14 Oct. 1975, 33°52.8′N, 120°7.0′W, 83 m, coarse sand.
22966	(114)	14 Oct. 1975, 33°51.96′N, 120°8.1′W, 129 m, coarse sand.
22970	(138)	14 Oct. 1975, 33°51.6′N, 120°8.83′W, 396 m, medium sand.
22999	(153)	15 Oct. 1975, 33°49.98′N, 120°3.82′W, 100 m, medium to coarse sand.
23000	(165)	15 Oct. 1975, 33°48.97′N, 120°4.15′W, 127 m, fine sand with pebbles.
23004	(161)	16 Oct. 1975, 33°48.96′N, 120°0.9′W, 103 m, coarse sand.
23070	(173)	19 Oct. 1975, 33°41.7′N, 120°0.3′W, 124 m, medium sand with shell fragments.
23071	(174)	19 Oct. 1975, 33°40.94′N, 119°59.3′W, 129 m, medium sand with pebbles.
23077	(176)	19 Oct. 1975, 33°41.10′N, 119°57.4′W, 135 m, fine sand with pebbles.
23086	(179)	19 Oct. 1975, 33°39.99′N, 119°57.88′W, 140 m, medium sand with shell fragments.
23087	(177)	19 Oct. 1975, 33°39.99′N, 120°0.1′W, 120 m, sand and gravel.
23088	(178)	20 Oct. 1975, 33°39.82′N, 119°58.87′W, 129 m, fine sand and gravel.
23092	(182)	20 Oct. 1975, 33°39.0′N, 119°59.5′W, 133 m, coarse sand.
23093	(183)	20 Oct. 1975, 33°39.1′N, 119°58.17′W, 133 m, coarse sand.
23098	(188)	20 Oct. 1975, 33°38.6′N, 119°56.76′W, 299 m, fine to medium sand.
23100	(186)	20 Oct. 1975, 33°38.3′N, 119°59.9′W, 233 m, medium to coarse sand.
23102	(185)	20 Oct. 1975, 33°37.97′N, 119°59.99′W, 369 m, fine sand.
23129	(308)	4 Nov. 1975, 33°50.7′N, 120°10.94′W, 434 m, fine sand.
23170	(006)	6 Nov. 1975, 33°59.78′N, 120°22.33′W, 70 m.
23205	(084)	8 Nov. 1975, 33°52.94′N, 119°58.3′W, 65 m, fine sand and gravel.
23229	(204)	9 Nov. 1975, 34°23.97′N, 119°54.3′W, 41 m, silt and clay.
23241	(771)	10 Nov. 1975, 34°22.99′N, 119°51.1′W, 55 m, silt and clay.
23279	(070)	13 Nov. 1975, 33°53.98′N, 119°54.0′W, 166 m, medium sand.
24075	(436)	7 Jan. 1976, 33°29.2′N, 118°43.93′W, 414 m, fine sand.
24080	(439)	7 Jan. 1976, 33°29.1′N, 118°40.85′W, 225 m, fine to medium sand.
24081	(440)	7 Jan. 1976, 33°28.84′N, 118°39.87′W, 214 m, fine to medium sand.
24083	(432)	7 Jan. 1976, 33°29.98′N, 118°41.11′W, 275 m, silty and fine sand.
24084	(431)	7 Jan. 1976, 33°29.97′N, 118°42.5′W, 264 m, clay.
24089	(429)	7 Jan. 1976, 33°30.7′N, 118°44.7′W, 270 m, medium sand.
24100	(423)	7 Jan. 1976, 33°31.13′N, 118°42.99′W, 319 m, medium to coarse sand.
24106	(417)	8 Jan. 1976, 33°31.88′N, 118°41.95′W, 358 m, coarse silt and pebbles.
24129	(610)	9 Jan. 1976, 32°43.1′N, 119°4.86′W, 240 m, fine to medium sand.

Appendix 1

Station Data		
24140	(629)	10 Jan. 1976, 32°41.2′N, 119°9.97′W, 98 m, fine to medium sand.
24238	(028)	17 Jan. 1976, 33°58.3′N, 120°26.5′W, 135 m.
24240	(039)	17 Jan. 1976, 33°57.0′N, 120°25.5′W, 180 m, medium sand with shell fragments.
24241	(038)	17 Jan. 1976, 33°57.0′N, 120°23.95′W, 139 m, coarse sand and pebbles.
24253	(049)	17 Jan. 1976, 33°55.99′N, 120°23.98′W, 286 m, fine sand and silt.
24255	(051)	17 Jan. 1976, 33°55.91′N, 120°25.94′W, 345 m, medium to fine sand.
24259	(042)	17 Jan. 1976, 33°57.3′N, 120°28.5′W, 340 m, fine to medium sand.
24263	(040)	18 Jan. 1976, 33°56.97′N, 120°26.7′W, 246 m, fine to medium sand.
24268	(220)	18 Jan. 1976, 33°46.4′N, 119°50.1′W, 268 m, pebbles.
24356	(608)	17 Feb. 1976, 32°43.87′N, 119°9.86′W, 81 m, coarse sand.
24364	(584)	18 Feb. 1976, 32°35.79′N, 119°20.9′W, 129 m, fine to medium sand.
24365	(669)	18 Feb. 1976, 32°37.86′N, 119°16.77′W, 225 m, fine sand.
24367	(654)	18 Feb. 1976, 32°39.94′N, 119°14.96′W, 127 m, coarse sand.
24368	(647)	18 Feb. 1976, 32°40.97′N, 119°14.4′W, 390 m, silt and fine sand.
24375	(665)	18 Feb. 1976, 32°38.3′N, 119°12.97′W, 188 m, fine to medium sand with pebbles.
24380	(696)	18 Feb. 1976, 32°33.81′N, 119°16.61′W, 92 m, fine sand.
24382	(704)	18 Feb. 1976, 32°32.86′N, 119°17.64′W, 85 m, sand with pebbles.
24384	(720)	18 Feb. 1976, 32°30.99′N, 119°20.6′W, 144 m, sand with pebbles.
24754	(718)	2 April 1976, 32°31.1′N, 119°17.98′W, 100 m, fine to medium sand.
24759	(714)	2 April 1976, 32°31.0′N, 119°14.1′W, 89 m, medium sand.
24774	(575)	4 April 1976, 32°49.8′N, 119°29.86′W, 1357 m.

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94(4), 1981, pp. 984–1004

A NEW SPECIES OF *BOTHRIOLEPIS* (PLACODERMI: BOTHRIOLEPIDAE) FROM THE UPPER DEVONIAN OF VIRGINIA (USA)

Robert E. Weems, Kenneth A. Beem, and Timothy A. Miller

Abstract.—A new species of placoderm fish, *Bothriolepis virginiensis,* is described from specimens found in Upper Devonian rocks near Winchester, Virginia. This species is characterized by the combined occurrence of at least seven traits not found together in any other species of *Bothriolepis.* These traits are: 1, a largely fused head shield; 2, an exceptionally long premedian plate; 3, orbital fenestra that is longest at the midline of the head shield; 4, posterior oblique cephalic pit lines that meet near the center of the unobtected portion of the nuchal plate; 5, a strongly V-shaped border between the anterior median dorsal plate and the posterior median dorsal plate; 6, lack of a prominent medial crest on the anterior median dorsal plate; 7, fused elements in the distal pectoral fin segment. This is the oldest validly determined vertebrate animal so far described from Virginia. Traits of all described species of bothriolepids are summarized for comparison with our new species, but the intrafamilial relationships are still obscure because the family has undergone extensive parallel evolution. A detailed section of the type locality is given to aid future studies on the paleoecology and taphonomy of bothriolepids.

Geologic Setting

While studying Upper Devonian Chemung Formation outcrops in Maryland and Virginia, Beem discovered two beds about a meter apart that were rich in bony plates of *Bothriolepis* and scales of crossopterygians (beds 50 and 52, Appendix 1). The beds dip 40°–50° SE along U.S. Route 522 northwest of Winchester, Virginia (Fig. 1). Fragmentary acanthodian spines are possibly represented as well (Donald Kirkpatrick, personal communication). Although the lower bone-bearing bed (50) is a greenish-gray to medium-gray shale and the upper (52) is a grayish-brown, fine-grained sandstone, no obvious differences in vertebrate faunal content were noted. Most of the bony plates are of approximately equal size, are stacked imbricately along each bedding surface and appear to have been current sorted. The lack of extensive wear or breakage indicates that transport was not prolonged or distant. In addition to the vertebrate remains, rare linguloid brachiopods were found in the greenish-gray *Bothriolepis*-bearing bed, bed 50, which suggests that it accumulated in brackish water. Bed 52 may have accumulated in fresh water. Elsewhere in the outcrop, beds contain fragments of plants (32, 38,

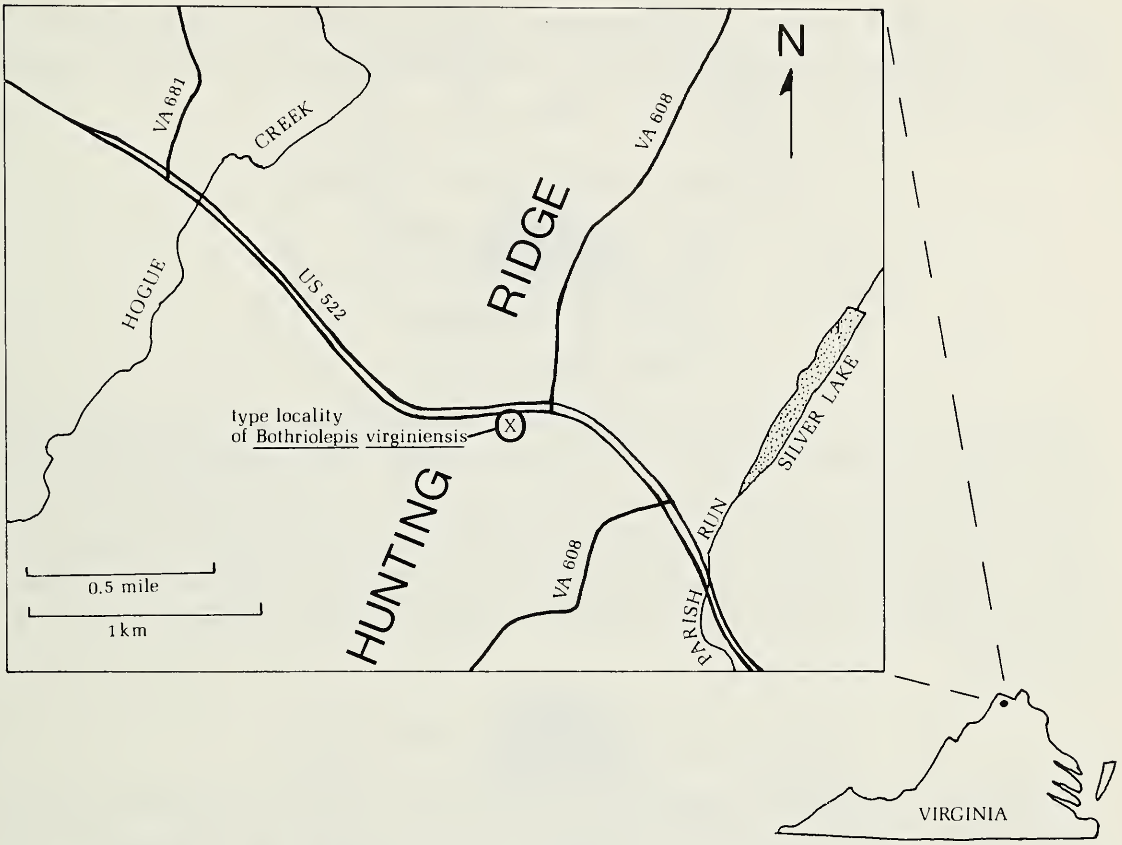

Fig. 1. Type locality of *Bothriolepis virginiensis* in the Chemung Formation (Upper Devonian).

40, and 62) or poorly preserved brachiopod and echinoderm molds (beds 17, 26, 41, and 68). Whereas much of the outcrop consists of monotonously interbedded medium-gray to grayish-orange siltstones and sandstones, two intervals (beds 16–25 and 46–63) are dominated by grayish-brown beds. From the suite of rock types and the fossils present, it seems likely that the rocks are marine, brackish, and freshwater in origin and formed in a marginal marine setting along the southeast edge of the Late Devonian Appalachian seaway. Because the *Bothriolepis*-bearing beds are in a dominantly grayish-brown part of the section and the remains of linguloid brachiopods are present in bed 50, the environment of postmortem vertebrate accumulation probably was a tidally influenced, brackish to freshwater lagoon.

Samples of greenish-gray shale from the lower *Bothriolepis*-bearing bed were analyzed for palynomorphs, but almost no plant matter of any kind was found in the samples (Robert Kosanke, United States Geological Survey, written communication, 1978). Therefore, in the absence of other diagnostic macrofossil or microfossil remains, the Late Devonian age assigned to these beds must rest on the presence of *Bothriolepis*, which is not known to occur outside of the Late Devonian except possibly in China (Denison 1978). The Chemung Formation has consistently been referred to the Upper Devonian in the past (Calver and Hobbs 1963).

SYSTEMATIC PALEONTOLOGY

Class: PLACODERMI
Order: Antiarcha
Family: Bothriolepidae
Genus: *Bothriolepis*

Diagnosis.—Ornamentation papilliform to vermiform; centronuchal plate partly borders orbital fenestra, not being excluded by postpineal plate; anterior median dorsal plate tapers both anteriorly and posteriorly from its central region, normally overlapping the anterior dorso-lateral plates and being overlapped by the mixilateral plates; posterior median dorsal plate narrows anteriorly from well behind its central region (modified from Denison 1978).

Bothriolepis virginiensis, new species

Holotype.—Largely complete head shield, U.S. National Museum of Natural History (USNM) 265220. Collected in 1977 from bed 50 (Appendix 1), south side roadcut on U.S. 522 through Hunting Ridge near Winchester, Virginia. Chemung Formation (Upper Devonian).

Referred specimens.—USNM 265221, USNM 265222, USNM 265223, USNM 265224, USNM 265225, USNM 265226, USNM 265227. Collected in 1977 and 1978 from beds 50 and 52. Other data as for holotype.

Diagnosis.—As for genus and in addition: dorsal head shield elements fully fused in adult individuals except for the extralateral and prelateral plates; pre-orbital rostrum elongate, forming 47% ± 4% of the total head shield length as measured along the midline and excluding the obtected nuchal area; orbital fenestra elliptically shaped, not constricted anteroposteriorly along the midline; premedian plate longer than wide; posterior cephalic pit lines meet nearly midway between the postpineal plate and the

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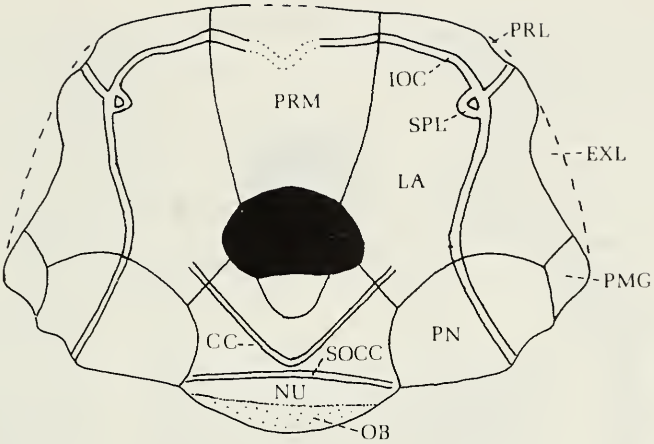
Fig. 2. Comparison of configurations of head shield elements in two specimens of *Bothriolepis virginiensis* and one specimen of *B. canadensis.* (Top) *B. virginiensis,* USNM 265220; (Middle) *B. virginiensis,* USNM 265221; (Bottom) *B. canadensis,* after Stensio (1948). CC, central sensory line; EXL, extralateral plate; IOC, infraorbital sensory line; LA, lateral plate; NU, nuchal plate; OB, obtected nuchal area; PMG, postmarginal plate; PN, paranuchal plate; PP, postpineal plate; PRL, prelateral plate; PRM, premedian plate; SOCC, supraoccipital cross-commissural pit-line groove; SPL, semicircular pit line.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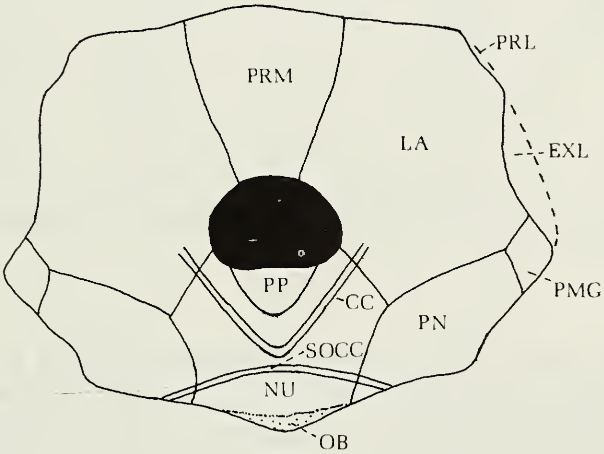
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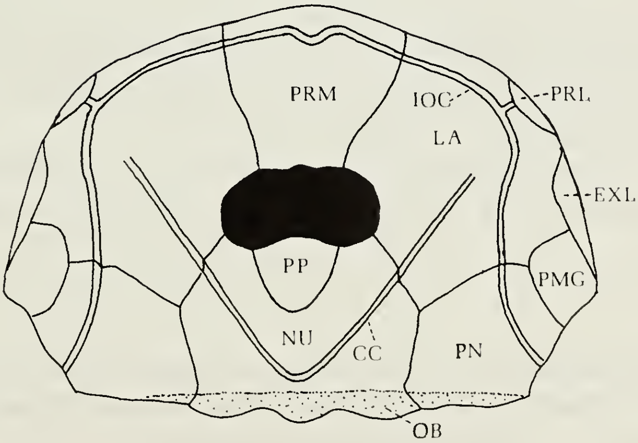
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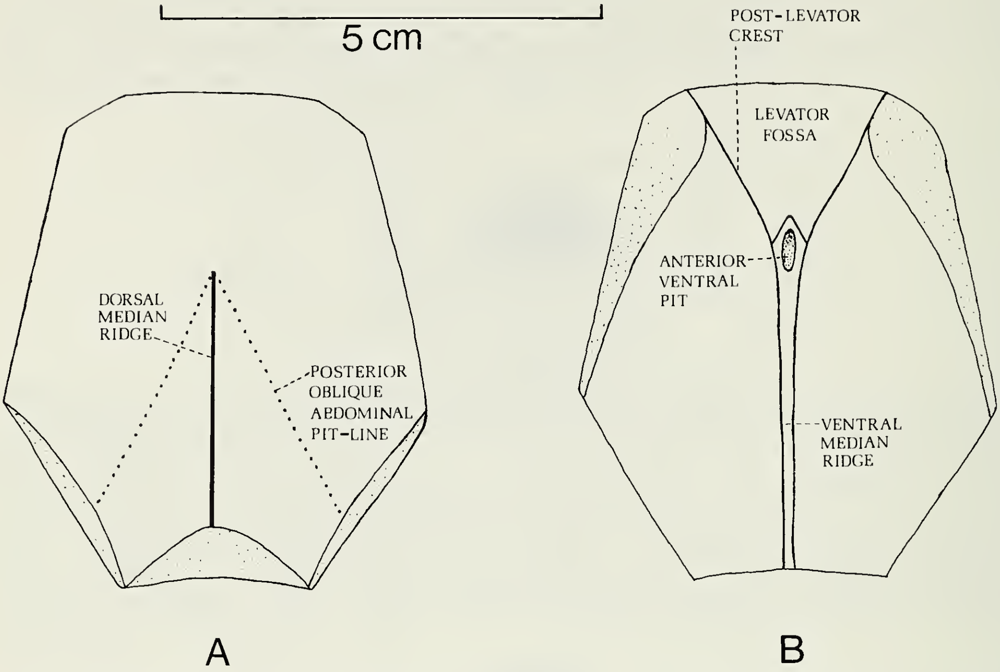

Fig. 3. Restoration of the anterior median dorsal plate of *Bothriolepis virginiensis* in (A) dorsal and (B) ventral view.

obtected nuchal area of the centronuchal plate along the midline; anterior median dorsal plate longer than wide, bearing only a faint trace of a median dorsal keel, deeply notched posteriorly into a V-shaped configuration where it borders the posterior median dorsal plate (depth/width ratio: 32% ± 7%); internally the postlevator crests running directly to the anterior ventral pit producing a W-shape to the posterior border of the levator fossa, levator fossa wider than long; semilunar plate probably much wider than long; elements in the distal pectoral fin segment fused and sutures obliterated; ornamentation papilliform; length of head shield and trunk armor measured dorsally along the midline estimated to be about 13 cm.

Restoration of the head shield (Fig. 2), the anterior median dorsal plate (Fig. 3), the dorsal armament (Fig. 4), and the ventral armament (Fig. 5) was attempted based on elements shown in Figs. 6 and 7. A tentative reconstruction of the animal is shown in Fig. 8.

Discussion.—The family Bothriolepidae is currently considered to include six genera (Denison 1978). Of these, all but *Bothriolepis* can be excluded

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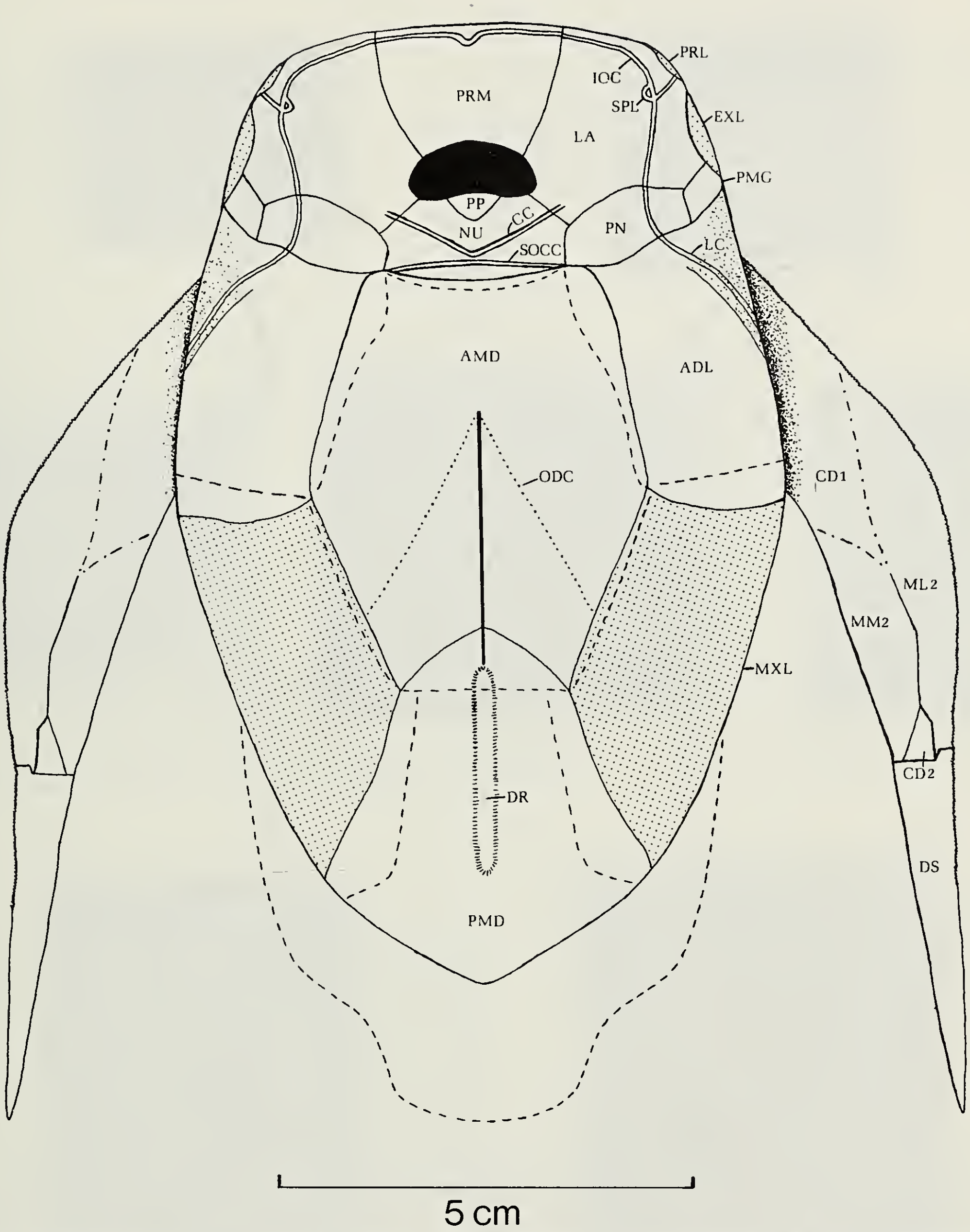
Fig. 4. Composite restoration of the armor of *Bothriolepis virginiensis* in dorsal view. The head shield appears differently from that shown in Fig. 2 because it slopes down and away in a strictly dorsal aspect. Dashed lines at bottom show the position of the posterior ventrolateral



plates, elsewhere they show the overlap relationships of plates where known. Dashed and dotted lines on the proximal segments of the pectoral fins show where plate boundaries are unknown but inferred from relationships seen elsewhere in *Bothriolepis*. Position of the lateral line canal on the anterior dorsolateral plate is inferred, as that plate is known only from an internal mold. Stippled elements are unknown but inferred from relations of surrounding elements. ADL, anterior dorsolateral plate; AMD, anterior median dorsal plate; CC, central sensory line; CD1, dorsal central plate 1; CD2, dorsal central plate 2; DR, dorsal ridge; DS, distal pectoral segment with constituent plates fused and sutures obliterated; EXL, extralateral plate; IOC, infraorbital sensory line; LA, lateral plate; LC, lateral line canal; ML2, lateral marginal plate 2; MM2, mesial marginal plate 2; MXL, mixilateral plate; NU, nuchal plate; ODC, posterior oblique dorsal sensory line groove; PMG, postmarginal plate; PN, paranuchal plate; PP, postpineal plate, PRL, prelateral plate; PRM, premedian plate; SOCC, supraoccipital cross-commissural pit-line groove; SPL, semicircular pit line.

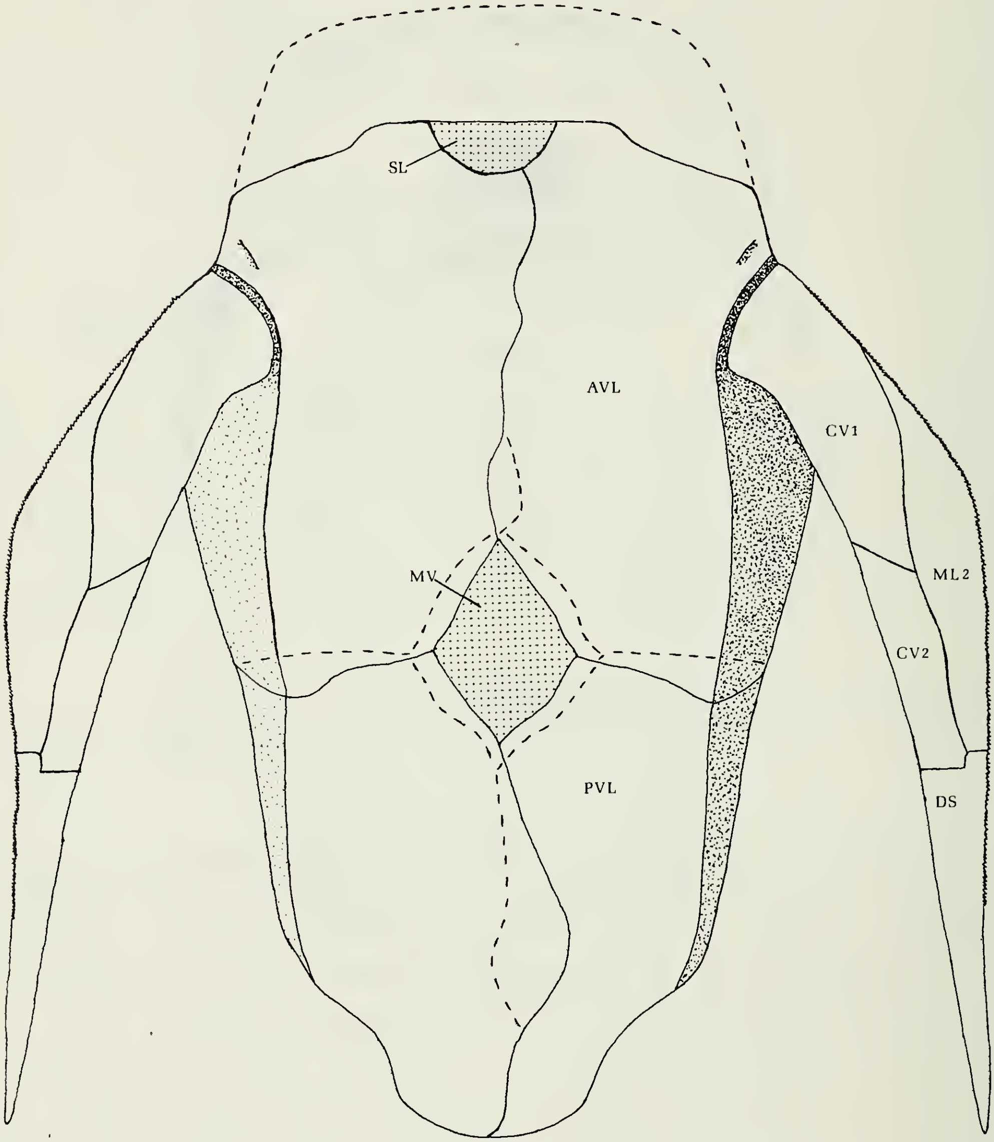


Fig. 5. Composite restoration of the armor of *Bothriolepis virginiensis* in ventral view. Dashed lines outline position of head at top and elsewhere show the overlap relationships of the various plates where known. Stippled elements are unknown but inferred from relations of surrounding elements. AVL, anterior ventrolateral plate; CV1, ventral central plate 1; CV2, ventral central plate 2; DS, distal pectoral segment with constituent plates fused and sutures obliterated; ML2, lateral marginal plate 2; MV, median ventral plate; PVL, posterior ventrolateral plate; SL, semilunar plate.

from further consideration with our material for the following reasons. In *Dianolepis* the postpineal plate excludes the nuchal from the orbit and the trunk shield has a prominent dorsal crest (Chang 1965). *Hillsaspis* (Stensio, 1969) has a very prominent medial dorsal crest. *Grossilepis* has both a posterior median dorsal plate that comes to a very shallow angle posteriorly and an anterior median dorsal plate of nearly uniform breadth along its

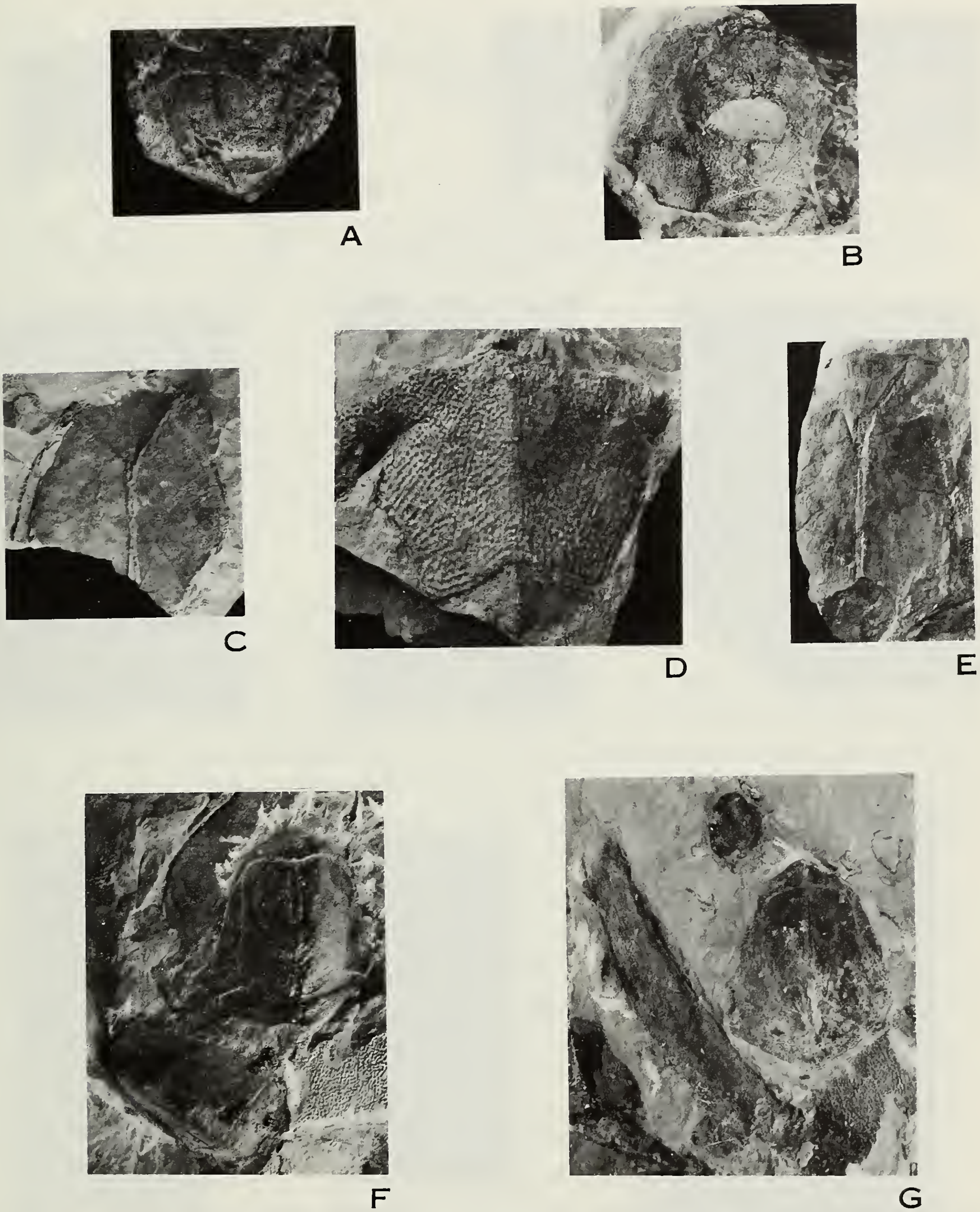


Fig. 6. A. Anterior part of distorted head shield, showing lateral line groove along anterior part of head shield. Length of rostrum 2.0 cm. USNM 265227. B. Dorsal view of head shield, holotype of *Bothriolepis virginiensis*. Length of head shield 4.1 cm. USNM 265220. C. Internal view of anteromedial dorsal plate, anterior half. Length as preserved, 4.8 cm. D. External view of anteromedial dorsal plate, posterior half. Length as preserved, 2.6 cm. USNM 265224. E. Internal view of natural mold of an anteromedial dorsal plate, anterior half. Length as preserved, 4.7 cm. F. (Upper right) Mold of internal surface of posteromedial dorsal plate, note pointed anterior (top) end, length, 3.8 cm; (lower left) natural mold of left anterodorsolateral plate; length, 3.4 cm. G. (Center right) Internal view of posteromedial dorsal plate, note pointed anterior (top) end; length, 4.3 cm; (left) natural mold of proximal segment of pectoral appendage, (top center) crossopterygian scale.

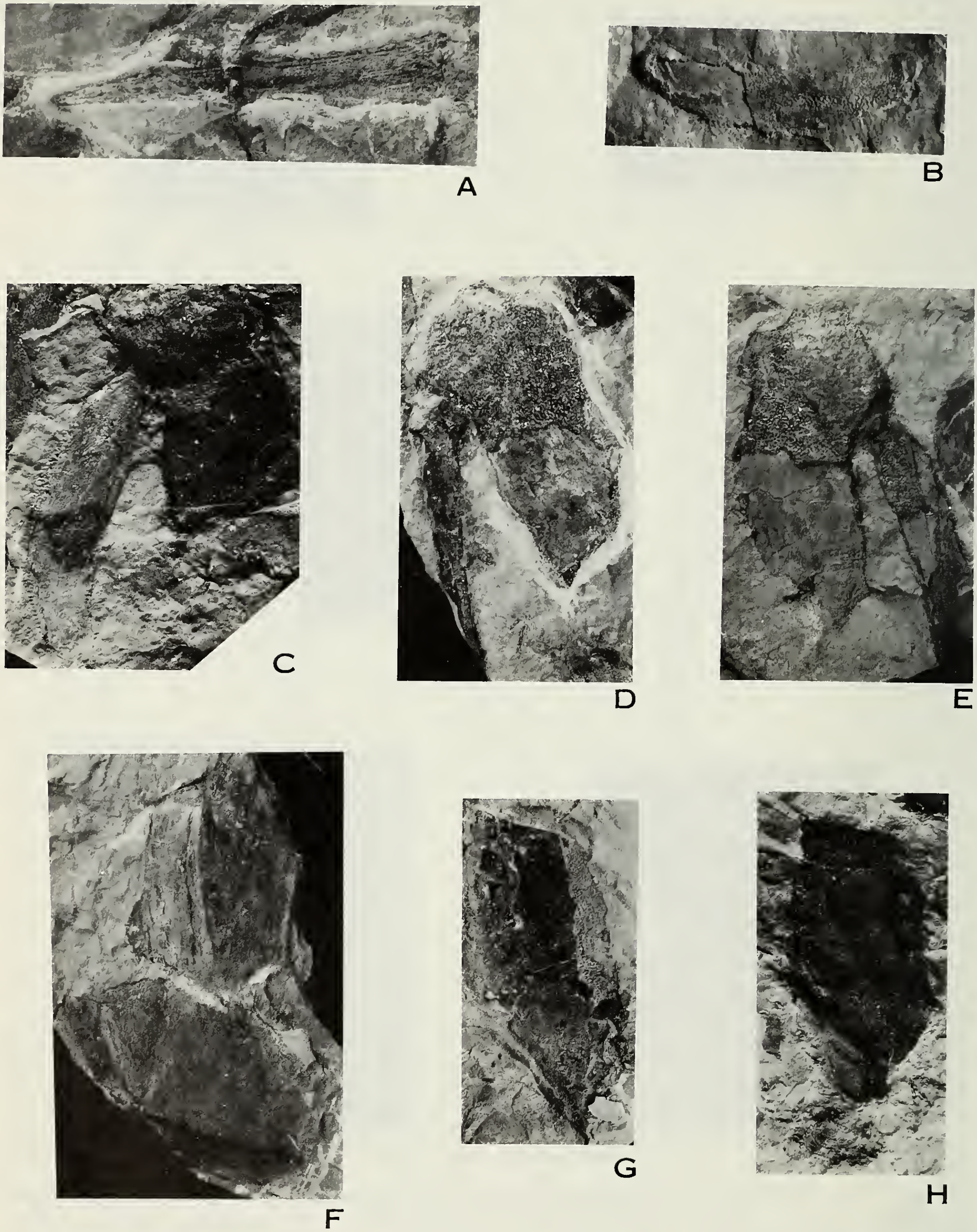


Fig. 7. A. Distal segment of a pectoral appendage. Length, 4.1 cm. B. Proximal segment of a pectoral appendage, ventral view. Length, 5.4 cm. C. Proximal left segment of a pectoral appendage articulated with its anteroventral element (latter seen in internal view). Proximal pectoral segment is 5.5 cm long as preserved. D. Proximal right segment of a pectoral appendage articulated with its anteroventral element (latter seen in external view). Length of anteroventral plate, 6.2 cm. E. Proximal left segment of a pectoral appendage articulated with its anteroventral element (latter seen in external view). Length of anteroventral plate, 6.3 cm. F. Internal molds of left anterodorsolateral plate (upper) and left posteroventral plate (lower).

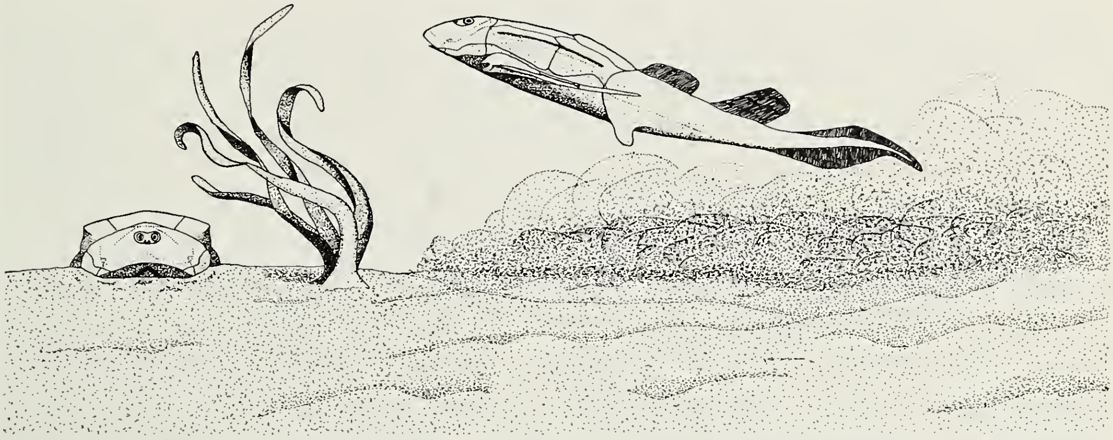


Fig. 8. Attempt at restoration of *Bothriolepis virginiensis* based on Figs. 4 and 5. Jaws and tail are based on the restorations given in Stensio (1948); plant hypothetical. Note the lack of a prominent ridge on the anterior median dorsal plate in both lateral and anterior views and the relatively close-set eyes. Length of the species estimated to be about 25 cm.

length, which overlaps the mixilateral plates (Stensio 1948). *Wudinolepis* is distinctive for its possession of a rostral circumorbital ridge and possibly for its small size (total shield length less than 2 cm) (Chang 1965). *Yunnanolepis* is distinctive with its very short premedian plate and correspondingly quite long postpineal and nuchal plates (Liu 1963); this genus may not be a bothriolepid at all (Zhang 1980). All of these character states are quite different from those present in our species, which agrees entirely with the definition of the genus *Bothriolepis* (Denison, 1978) as currently recognized.

The first species of *Bothriolepis* described from North America was *B. nitida* (Leidy, 1856a, 1856b), from the Chemung Formation of the Appalachian Mountains of Pennsylvania. Subsequently, six other species have been described: *B. canadensis* from the Escuminac Formation, Escuminac Bay, Quebec (Whiteaves 1880; Stensio 1948); *B. minor* from the Oneonta, Chemung, and Catskill formations of New York and Pennsylvania (Newberry 1889); *B. coloradensis* from the Elbert Formation of Colorado (Eastman 1904; Denison 1951); *B. traquairi* from the Escuminac Formation, Quebec (Bryant 1924); *B. stensioi* (Sohn, 1938) from the Escuminac Formation, Escuminac Bay, Quebec; and *B. darbiensis* from the Darby Formation, Wyoming (Denison 1951). Of these seven taxa, *B. traquairi* is so different from the others that it has generally not been considered to be a valid member of the genus *Bothriolepis* (Stensio, 1948; Denison, 1951),

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←

Length of anterodorsolateral plate, 4.8 cm. G. Internal view of left posteroventral plate. Length 6.8 cm. H. Internal view of left posteroventral plate; length, 5.8 cm. Crossopterygian scale at base.

though Denison (1978) has recently chosen to retain it in that genus. In any event, the extremely long and narrow ventral trunk shield is not typical of other *Bothriolepis* or of the species described in this paper. The type of *B. minor* may be inadequate to characterize a species and the name, therefore, may be a *nomen dubium* (Denison 1951), though Denison (1978) has most recently chosen to retain this taxon without comment. In either case, the anterior median dorsal plate that Newberry (1889:Pl. 20, Fig. 7), figured has a nearly planar posterior border, quite unlike the V-shaped posterior border of the anterior median dorsal plate of our species, which excludes that taxon from further consideration. *Bothriolepis stensioi,* based on a specimen from Escuminac Bay in the same area from which *B. canadensis* was found, was considered by Robertson (1938) to be only a variant of *B. canadensis.* This conclusion seems quite probable in view of the range of variability later documented in the osteology of *B. canadensis* by Stensio (1948) and in the sensory line system by Graham-Smith (1978). Neither Stensio (1948) nor Denison (1951, 1978) recognized *B. stensioi* and it is here considered to be a synonym of *B. canadensis. Bothriolepis canadensis* differs from our new species in the following traits: 1, the head shield elements are unfused, even in large specimens; 2, the premedian plate is not as elongated anteroposteriorly; 3, the orbital fenestra is constricted along the midline, giving it a peanut shape; 4, the posterior oblique cephalic pit lines meet much farther posteriorly on the centronuchal plate, nearly at the obtected nuchal area; 5, the border between the anterior and posterior median dorsal plates is only gently arched into a C-shaped configuration; 6, a median dorsal crest is well developed on the anterior median dorsal plate; 7, the semilunar plate appears to be much narrower than the corresponding element in our species; and 8, the maximum size attained is almost 50% greater than that indicated for our species, which is assumed to be adult since the head shield elements are fused. *Bothriolepis coloradensis* and *B. darbiensis* differ from our species in the presence of a Y-shaped configuration of the postlevator crests on the ventral surface of the anterior median dorsal plate, resulting from these crests meeting anterior to the anterior ventral pit and then extending posteriorly along a common ridge toward that pit. In our species the ridges extend independently to the anterior ventral pit and merge with it form both sides, resulting in a W-shaped configuration (Fig. 3). Additionally, both species attain a size about 50% larger than our species. *Bothriolepis nitida* is poorly known, although additional material from the type area has been uncertainly referred to that species. The type-specimen, consisting of a distal pectoral segment, differs from the corresponding element of our species by having prominent spines along its lateral border and by its size, which suggests it came from an animal at least 50% larger than our species.

Accepted species of *Bothriolepis* described from outside of North America (Denison 1978) include 3 species from Greenland, 15 from Britain, 1 from Belgium, 15 from the Soviet Union, 7 from China, and 1 from Antarctica; for appropriate references and detailed comparisons, see Table 1. Of all of the species described and reasonably well known, *B. favosa* from the Baltic region of the Soviet Union comes closest in overall proportions to our species, even though it is nearly twice as large.

The reasons for the peculiar fusion of most cranial elements in *B. virginiensis* (possibly also present in *Dianolepis,* but otherwise unknown in bothriolepids) are unclear. Possibly *B. virginiensis* attained a definite adult size and ceased growth, whereas other species may have continued very slow growth until death. Whatever the reason for fusion of most of the head shield elements, the exclusion of the extralateral and prelateral plates from this pattern seems clear; these plates border the mouth and obviously needed to be mobile during feeding (and respiration?). Intracranial mobility of the remaining elements of the head shield was apparently not necessary for the survival of this species.

The greatest diversity of bothriolepids is in China, and the only occurrences which may be as old as Middle Devonian come from there as well. China may be the center of bothriolepid evolution, with only the most vigorous forms gaining worldwide distribution late in the Devonian. Since North America, even allowing a pangean distribution of the Paleozoic land masses, would have been quite distant from China, the lack of any genus of bothriolepid in North America except *Bothriolepis* may reflect paleogeographic effects rather than an uneven pattern of collection and identification by paleoichthyologists.

Table 1 shows that the family Bothriolepidae has a mosaic distribution of character states, indicating that extensive parallel evolution has occurred in this group. Because the age distribution of these species in the Devonian is poorly known, we consider it to be premature to try to sort out which characters are of phylogenetic importance and which are not. Therefore, no attempt is made here to sort out the detailed evolutionary history of the family.

Paleoecology of *Bothriolepis virginiensis*

Species of the genus *Bothriolepis,* with their catfish-like shape and proportions, have been generally interpreted to have been mudgrubbing animals (Denison 1941). Because remains of this genus are largely, though not entirely, found in freshwater to brackish deposits, its preferred habitats have been assumed to be freshwater rivers and perhaps lakes (Denison 1978). These interpretations could be reasonably applied to *B. virginiensis* as well.

The presence of occasional scattered scales of at least one species of crossopterygian (Fig. 7H) makes it plausible to suggest that these animals may have been the chief predators upon *Bothriolepis.* Generally, Paleozoic

Table 1.—Comparison of selected characters in the species of the family Bothriolepidae. Location of the posterior cephalic pit line is determined by measuring the distance from the front of the obtected nuchal area to where the pit lines meet and dividing that by the distance from the obtected nuchal area to the rear of the postpineal plate along the midline, and multiplying the resulting ratio by 100. Other ratios multiplied by 100 as well. Configuration of the

	Location of posterior cephalic pit line	Rostrum/ head shield length	Orbit shape (width/length)	Premedian plate (width/ length)	Head shield elements
British Species					
1) *Bothriolepis alvesiensis*	28	35	180–190	~115	unfused
2) *B. cristata*	38	38	275	~100	unfused
3) *B. gigantea*	36	36	215	100–105	unfused
4) *B. hayi*	33	40	185	110	unfused
5) *B. hicklingi*	22	44	200	110	unfused
6) *B. hydrophila*	21–32	34	205–235	>100	unfused
7) *B. laverocklochensis*	31	~38	265	?	unfused
8) *B. leptocheira*	28	37	200	114–128	unfused
9) *B. macrocephala*	?	?	?	?	?
10) *B. major*	?	?	?	?	?
11) *B. obesa*	?	?	?	?	?
12) *B. paradoxa*	29	?	?	?	unfused
13) *B. stevensoni*	?	?	?	?	unfused
14) *B. taylori*	33	?	?	95–100	unfused
15) *B. wilsoni*	31	42	205	95	unfused
16) *Grossilepis brandi*	?	?	?	?	unfused
Greenland Species					
17) *B. groenlandica*	26–47	40	165	100–125	unfused
18) *B. jarviki*	17–26	?	?	~110	unfused
19) *B. nielseni*	?	?	?	?	?
Soviet Species					
20) *B. cellulosa*	18	43	205	85	unfused
21) *B. ciecere*	0	38	?	115	unfused
22) *B. curonica*	35?	~37	~145	~115	unfused
23) *B. extensa*	?	?	?	?	?
24) *B. favosa*	43	40	200	105	unfused
25) *B. jeremijevi*	?	?	?	?	?
26) *B. maendrina*	?	?	?	?	?
27) *B. maxima*	30	44	180	110	unfused
28) *B. obrutschewi*	?	?	?	?	unfused
29) *B. ornata*	?	?	?	?	?
30) *B. pavariensis*	38	~33	200	~175	unfused
31) *B. prima*	?	?	?	?	?
32) *B. sibirica*	?	?	?	?	?
33) *B. turanica*	?	?	?	?	?
34) *Grossilepis spinosa*	45	?	?	?	unfused
35) *G. tuberculata*	22	40	180	95	unfused

levator fossa is discussed in the text, as is the configuration of the posterior border of the anterior median dorsal plate. Lengths of fragmentary species were roughly computed by comparing the size of elements of each species (usually the anterior median dorsal plate) with the same element of *B. virginiensis* and making appropriate scaling corrections. Sources of data for each species are indicated at the end of the table.

Distal fin segment		Anterior median dorsal plate					
			Levator fossa				
External lateral margin	Width/ Length	Width/ Length	Width/ Length	Shape	Median keel	Posterior border shape	Total length of armor (cm)
?	?	70	?	?	low	∧	18–19
nearly smooth	23	~110	?	?	very high	⌒	10
smooth	~15	~95	?	?	low	∧	≥40
sparsely spiny	21	80	195	W	low	⌒	15
nearly smooth	?	~90	155	W	low	⌒	~20
smooth	24	87–95	235	W	high	⌒	≥10
?	?	~95	?	?	high	⌒	≥11
sparsely spiny	17	~75	95	W	low	∧	14
?	?	~135?	?	?	?	?	2.5
?	?	?	?	?	?	?	~12
?	?	~100	125	Y	high	—	~25
nearly smooth	?	~90	160	W	low	∧	20
?	?	~80	65	W	low	?	~25
spiny	15	~95	?	?	low	∧	25
?	?	~95	?	?	high	—	30
?	?	?	?	?	?	?	~7
sparsely spiny	24	75–100	100–140	W	high	∧	36
spiny	21	68–80	80	W	low	∧	27
smooth	20	~90?	?	?	low?	?	12
spiny	22	80–93	130	W	low	⌒	19
?	?	~80	140	Y	low	∧	~8
?	?	82–94	?	?	none	⌒	24
?	?	?	?	?	?	∧	~12
?	?	82–93	130	W	low	⌒	23
?	?	?	?	?	?	∧	~11
spiny	25	?	?	?	?	?	?
sparsely spiny	16	~95	130	W	low	⌒	50
?	?	?	?	?	?	?	~10
?	?	80	?	?	low	⌒	~25
?	?	~95	140	Y	low	⌒	~13
?	?	~100	90	W	?	?	~7
?	?	?	?	?	low?	⌒	~14
?	?	?	?	?	very high	?	~6
?	?	?	105	W	?	?	~15
spiny	?	~70–80	100	W	low	∧	~11

Table 1.—Continued.

	Location of posterior cephalic pit line	Rostrum/ head shield length	Orbit shape (width/length)	Premedian plate (width/ length)	Head shield elements
Chinese Species					
36) *B. kwangtungensis*	?	?	?	?	?
37) *B. lochangensis*	?	?	?	?	unfused
38) *B. niushoushanensis*	20	45	215	135	unfused?
39) *B. shaokuanensis*	25	36	175	~100	unfused
40) *B. sinensis*	?	?	?	?	?
41) *B. tungseni*	?	~38	~175	?	?
42) *B. yunnanensis*	?	?	~	?	?
43) *Dianolepis liui*	15	29	190	140	fused?
44) *Wudinolepis weni*	?	~40	~140	?	unfused?
45) *Yunnanolepis chii*	?	22	200	230	unfused
Australian Species					
46) *Hillsaspis gippslandiensis*	20	?	?	?	unfused
Antarctic Species					
47) *B. antarctica*	?	?	?	?	?
Belgian Species					
48) *B. lohesti*	?	?	?	?	?
American Species					
49) *B. canadensis*	5	34	230	118	unfused
50) *B. coloradensis*	?	?	?	?	unfused
51) *B. darbiensis*	45	?	?	?	unfused
52) *B. minor*	?	?	?	?	?
53) *B. nitida*	?	?	?	?	?
54) *B. traquairi*	?	?	?	?	?
55) *B. virginiensis*	40	47	170	93	fused

References. 1) Miles 1968, Stensio 1948; 2–8) Miles 1968; 9) Miles 1968, Egerton 1862, Stensio 1948; 10–16) Miles 1968; 17) Stensio 1948, Heintz 1930; 18–19) Stensio 1948; 20) Stensio 1948; 21) Lyarskaia and Savvaitova 1974; 22) Stensio 1948, Gross 1942; 23) Sergienko 1961; 24) Stensio 1948; 25) Rohon 1900; 26) Hoffman 1911; 27) Stensio 1948; 28) Stensio 1948, Gross 1942; 29) Stensio 1948; 30) Lyarskaia and Savvaitova 1974; 31) Stensio 1948, Gross 1942; 32) Obruchev and Sergienko 1961; 33) Obruchev 1939, Stensio 1948; 34) Stensio 1948, Gross 1942;

crossopterygians have impressive dental batteries, and they were probably quite capable of attacking a *Bothriolepis* of the relatively modest size of *B. virginiensis*.

Another, probably spurious report of a Paleozoic fish from Virginia.—At present, *B. virginiensis* is the oldest vertebrate animal from Virginia well enough known to be even tentatively reconstructed. Putative fish remains

Table 1.—Continued.

Distal fin segment		Anterior median dorsal plate					Total length of armor (cm)
			Levator fossa				
External lateral margin	Width/Length	Width/Length	Width/Length	Shape	Median keel	Posterior border shape	
?	?	50–52	45	W	high	∧	~16
?	?	105–115	130	W	low	⌢	~7
spiny	22	45	?	?	high	—	~15
?	?	?	?	?	?	?	~8
?	?	~70–80	100	W	?	?	~11
smooth	~15	80–90	?	?	low?	?	~12
?	?	80–85	100	W	high	—	~12
?	?	?	?	?	very high	?	~18
?	?	<100	?	?	high	?	<2
?	?	?	?	?	?	?	~12
spiny	~20	~105	325	W	very high	—	~10
spiny	~20	?	?	?	high	∧	~9
?	?	~100–105	155	W	low	⌢	~10
spiny	24	mostly 90–95	185	W	high	⌢	19
?	?	~95	170	Y	?	?	~20
smooth	21	?	150	Y	?	?	~20
?	?	±90?	?	?	low	—	~8
spiny	19	±90–100?	?	?	low?	?	~20
?	?	?	?	?	?	?	~8?
distally smooth	19	~85	140	W	low	∧	13

35) Stensio 1948; 36–37) P'an 1964; 38) Pan 1980; 39) Chang 1963; 40) Stensio 1948, Chi 1940; 41) Chang 1965; 42) Liu 1962; 43–44) Chang 1965; 45) Liu 1963; 46) Hills 1931, Stensio 1948; 47) Woodward 1921, Stensio 1948, White 1968; 48) Leriche 1931, Stensio 1948; 49) Stensio 1948, Denison 1951; 50–51) Denison 1951; 52) Newberry 1889, Denison 1951, Stensio 1948; 53) Leidy 1856a, 1856b, Denison 1951, Stensio 1948; 54) Bryant 1924; 55) this report.

from the Middle and Upper Ordovician Martinsburg Shale ("Formation No. III") near Lexington, Virginia, cited by Rogers (1882) are much older but are of very questionable validity. Rogers' specimens could not be found, but the remains were quite fragmentary, judged by their description. An attempt was made by Weems to relocate one of Rogers' localities, but the only fossils found in the indicated interval were fragments of graptolites.

Because cleavage in the rock was subparallel to bedding, most of the graptolite specimens broke out of the rock as carbonized rhomboidal fragments rather than as whole specimens. These rhomboids look rather like fish scales and may be what Rogers collected, because he did not report graptolite remains from these beds. Because other definitely known Ordovician fish localities seem to be in shallow marine environments (e.g., Eliuk 1973), fish in the deep-water Martinsburg flysch deposits are anomalous. Therefore, although Rogers' report cannot be refuted unless his specimens are relocated, it seems best for now to consider his a spurious report of Ordovician fish remains.

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Appendix 1

Measured section in Chemung Formation (Upper Devonian) along U.S. 522 (southwest side) at Hunting Ridge, Frederick County, Virginia; southeast end of outcrop. Color designations (in parentheses) based on the Rock Color Chart of the National Research Council (Goddard and others 1948).

Bed	Lithology	Thickness ft.	in.	m
73	Shale and siltstone, medium-gray (N5) to grayish-orange (10YR7/4), partly covered by talus and complexly faulted	153	0	46.65
72	Shale, medium-gray (N5), fissile	4	8	1.42
71	Sandstone, coarse-grained, medium-gray (N5)	0	2	0.05
70	Siltstone and shale interbedded, medium-gray (N5)	10	4	3.20
69	Shale, medium-gray (N5), partly covered by talus	56	4	17.17
68	Sandstone, medium- to coarse-grained, light-gray (N7), containing layers of brachiopod molds	11	10	3.61
67	Shale, medium-gray (N5) silty, containing cobbly layer 10 in. (0.25 m) below top	8	11	2.72
66	Siltstone, medium-gray (N5), sandy	3	11	1.19
65	Siltstone, variegated grayish-brown (5YR3/2)	4	6	1.37
64	Siltstone, medium-gray (N5), sandy to shaly and with a few fine-grained sandstone and shale interbeds	9	3	2.82
63	Siltstone, grayish-brown (5YR3/2), sandy to shaly and with a few fine-grained sandstone and shale interbeds	13	1	4.00
62	Sandstone, medium-grained, medium-gray (N5), 4 in. (0.10 m) conglomerate at base, plant fragments just above the conglomerate	17	9	5.41
61	Siltstone, medium-gray (N5) to greenish-gray (5GY6/1), shaly, fissile	1	2	0.36
60	Siltstone, grayish-brown (5YR3/2), shaly, fissile	9	4	2.84

Appendix 1.—Continued.

Bed	Lithology	Thickness ft.	in.	m
59	Sandstone, fine-grained, grayish-brown (5YR3/2)	0	5	0.13
58	Siltstone, grayish-brown (5YR3/2), shaly to sandy	23	0	7.02
57	Siltstone, grayish-brown (5YR3/2)	3	0	0.91
56	Sandstone, fine-grained, medium-gray (N5)	0	6	0.15
55	Shale, greenish-gray (5GY6/1) to grayish-brown (5YR3/2), silty, fissile	0	10	0.25
54	Sandstone, fine-grained, medium-gray (N5), massive	1	6	0.46
53	Shale, silty, and sandstone, fine-grained, interbedded, grayish-brown (5YR3/2)	17	9	5.42
52	Sandstone, fine-grained, grayish-brown (5YR3/2), silty, containing placoderm plates	1	11	0.58
51	Siltstone, grayish-brown (5YR3/2)	4	4	1.32
50	Shale, medium-gray (N5) to greenish-gray (5GY6/1) containing scattered placoderm plates and occasional linguloid brachiopod shells	2	0	0.61
49	Sandstone, fine-grained, light-gray (N7), massive, varying in thickness from 3 to 24 inches because upper surface has a rolling, sinusoidal geometry (ripples?); average thickness is	0	9	0.23
48	Shale, silty, fissile, siltstone, sandy, and sandstone, fine-grained, silty, thinly interbedded, grayish-brown (5YR3/2)	4	7	1.40
47	Sandstone, fine- to medium-grained, silty, and shale, silty, medium-gray (N5)	7	1	2.15
46	Shale, silty, and sandstone, fine-grained, silty, grayish-brown (5YR3/2)	7	10	2.40
45	Shale, greenish-gray (5GY6/1)	2	11	0.89
44	Sandstone, fine-grained, medium-gray (N5)	0	1	0.03
43	Siltstone, medium-gray (N5)	3	9	1.14
42	Siltstone, grayish-orange (10YR7/4)	0	3	0.08
41	Shale, medium-gray (N5) to grayish-orange (10YR7/4), silty, containing molds of crinoid columnals	2	2	0.66
40	Sandstone, medium-grained, medium-gray (N5) to grayish-orange (10YR7/4), crossbedded in upper part, containing plant fragments in lower part	6	11	2.11
39	Shale, silty, fissile, sandstone, fine-grained, and siltstone, shaly, fissile, thinly interbedded, ranges in color from light-gray (N7) to dark gray (N3)	20	6	6.26
38	Sandstone, fine-grained, light-gray (N7), massive, containing plant debris in upper part, crinoid columnal molds at base	0	10	0.25
37	Shale, dark-gray (N3), fissile, containing light-gray (N7) fine-grained sandstone partings	0	6	0.15
36	Sandstone, medium-grained, medium-gray (N5), massive, containing crinoid columnal molds	3	6	1.07
35	Shale, dusky-blue (5PB3/2), fissile	0	2	0.05
34	Sandstone, fine-grained, light-gray (N7)	0	4	0.10
33	Shale, medium-gray (N5), silty	0	3	0.08

Appendix 1.—Continued.

Bed	Lithology	Thickness ft.	Thickness in.	Thickness m
32	Sandstone, medium-grained, greenish-gray (5GY6/1), massive, containing abundant plant fragments in lower half	6	2	1.88
31	Sandstone, fine-grained, siltstone, sandy, and shale, silty, fissile, thinly interbedded, medium-gray to light-gray	7	3	2.21
30	Sandstone, fine-grained, light-gray (N7), cobbly	0	8	0.20
29	Shale, medium-gray (N5)	1	3	0.38
28	Siltstone, dusky-blue (5YR3/2), massive	4	1	1.24
27	Sandstone, fine-grained, silty, and shale, fissile, thinly interbedded, medium-gray (N5)	18	9	5.70
26	Sandstone, fine-grained, medium-gray (N5) to grayish-orange (10YR7/4), massive, containing molds of brachiopods and crinoid columnals just below top	1	2	0.36
25	Shale, grayish-brown (5YR3/2) to greenish-gray (5GY6/1), silty	0	2	0.05
24	Sandstone, fine-grained, grayish-brown (5YR3/2) to greenish-gray (5GY6/1), massive	1	4	0.41
23	Shale, grayish-brown (5YR3/2)	0	7	0.18
22	Sandstone, fine-grained, medium-gray (N5)	0	3	0.08
21	Shale, grayish-brown (5YR3/2)	0	6	0.15
20	Sandstone, fine-grained, medium-gray (N5), massive	2	8	0.81
19	Siltstone, medium-gray (N5), alternating with bands of fine-grained, medium-gray (N5) sandstone	4	3	1.30
18	Shale, variegated grayish-brown (5YR3/2), light-brown (5YR6/4) and medium-gray (N5), crumbly	14	2	4.32
17	Sandstone, fine-grained, grayish-orange (10YR7/4), containing brachiopod molds	0	10	0.25
16	Shale and siltstone, grayish-brown (5YR3/2), fissile	7	4	2.23
15	Shale, light-gray (N7)	0	11	0.28
14	Shale, medium-gray (N5) to grayish-orange (10YR7/4), fissile	1	9	0.53
13	Sandstone, fine-grained, medium-gray (N5), silty	0	6	0.15
12	Siltstone, light-gray (N7), crumbly	0	2	0.05
11	Sandstone, fine-grained, medium-gray (N5), silty, massive	5	5	1.65
10	Siltstone and shale, fissile, medium-gray (N5)	20	10	6.35
9	Sandstone, fine-grained, medium-gray (N5), shaly	1	3	0.38
8	Shale, medium-gray (N5), fissile	1	9	0.53
7	Siltstone, grayish-orange (10YR7/4)	0	5	0.13
6	Shale, medium-gray (N5), fissile, containing fine-grained sandstone partings	8	1	2.46
5	Sandstone, fine-grained, grayish-orange (10YR7/4), silty	4	7	1.40
4	Shale, grayish-orange (10YR7/4), fissile	1	6	0.46
3	Sandstone, fine-grained, grayish-orange (10YR7/4), shaly	0	10	0.25
2	Shale, greenish-gray (5GY6/1) to light-brown (5YR6/4), crumbly	61	10	18.85
1	Covered to end of culvert, northwest end of outcrop	74	0	22.56
Total thickness		677	4	206.49

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NINE NEW SPECIES OF *ANILOCRA* (CRUSTACEA: ISOPODA: CYMOTHOIDAE) EXTERNAL PARASITES OF WEST INDIAN CORAL REEF FISHES

Lucy Bunkley Williams and Ernest H. Williams, Jr.

Abstract.—Nine new species of *Anilocra* are described: *A. haemuli* from *Haemulon flavolineatum, H. aurolineatum, H. carbonarium, H. chrysargyreum, H. macrostomum, H. plumieri, H. sciurus, Epinephelus cruentatus, E. fulvus, E. guttatus,* and *Paranthias furcifer*; *A. holocentri* from *Holocentrus ascensionis*; *A. myripristis* from *Myripristis jacobus*; *A. acanthuri* from *Acanthurus chirurgus,* and *A. bahianus*; *A. chromis* from *Chromis multilineatus* and *C. cyaneus*; *A. abudefdufi* from *Abudefduf saxatilis; A. holacanthi* from *Holacanthus tricolor*; *A. chaetodontis* from *Chaetodon capistratus, C. ocellatus, C. sedentarius,* and *C. striatus*; and *A. partiti* from *Pomacentrus partitus.*

Anilocra laticauda Milne Edwards, 1840 and *A. leachii* Schioedte, 1866 are declared nomina dubia. The Martinique and Peru specimens of *A. laevis* are shown to represent 2 species: *A. haemuli* and *A. laevis,* respectively. A table distinguishing the species of genus *Anilocra* in the Caribbean Sea is included.

Introduction

Six species in the genus *Anilocra* Leach, 1818, have been described from the New World, *A. laticauda* Milne Edwards, 1840; *A. mexicana* Saussure, 1857; *A. laevis* Miers, 1877; *A. plebeia* Schioedte and Meinert, 1881; *A. acuta* Richardson, 1910; and *A. meridionalis* Richardson, 1914. Schioedte and Meinert (1881) synonymized *A. mexicana* Saussure and *A. laticauda* Milne Edwards; and Trilles (1975) suggested *A. laevis* Miers was a synonym of *A. laticauda.* Various other authors, summarized by Trilles and Vala (1975), have reported *Anilocra laticauda* from members of 11 families of marine fishes in the Caribbean Sea. Hochberg and Ellis (1972) and Williams and Williams (1977) have suggested that other species of *Anilocra* occur in the Caribbean. In the present study 1379 specimens of isopods in the genus *Anilocra* from the West Indies were examined (1198 were collected by the authors from 823 fishes) and separated into 9 species based on the characters listed in Table 1.

Materials and Methods

Host fishes were individually collected with multiprong and conventional spears, quinaldine fish relaxant, or handheld nets and lights at night, using

SCUBA and skin–diving techniques. Hosts were placed immediately into individual plastic bags and held in a mesh diving bag until moved to the laboratory (usually within 2 hours of capture). Isopods were removed, hosts were measured to the nearest millimeter, weighed to the nearest 0.1 gram and damage noted. Isopods were measured alive (total length and width) using slight pressure on the dorsal surface to straighten any curling, and preserved in 70% ethanol. Mouthparts and appendages were mounted in glycerine jelly. Whole isopods were photographed with a Nikon F2 camera with 55 mm Micro-Nikkor lens; an extension tube, and a 2× tele-converter were added to photograph some males. Drawings of the whole animal, dorsal and lateral views, were made from projections of these photographs. Telsons of the illustrated species were drawn in a natural or somewhat depressed position; therefore, the length of telsons in the dorsal views do not represent the actual total lengths. Total lengths of the telsons may be obtained by referring to the lateral views. Mouthparts and appendages were drawn with the aid of a Bausch & Lomb Tri-simplex micro-projector. Underwater photographs are by the senior author unless otherwise noted.

Comparative material included specimens from the National Museum of Natural History (USNM), the Rosenstiel School of Marine and Atmospheric Sciences, University of Miami (UMML); the Muséum National d'Histoire Naturelle, Paris (MNHN); the British Museum of Natural History (BMNH); Gulf Coast Research Laboratory (GCRL); Naturhistoriska Riksmuseet, Stockholm (NR); Museum of Comparative Zoology, Harvard (MCZ); Zoologisches Museum, Humbolt-Universitat, Berlin (ZMB); and Florida Atlantic University, vertebrate collection (FAU).

All measurements are in millimeters unless otherwise noted. Lengths of fish hosts are standard lengths in millimeters. Descriptions of isopods are made from specimens from the type-host only. Only materials personally collected or examined by the authors are used for the host and locality data of each species of *Anilocra*. All data are those of the authors unless otherwise noted. Additional biological information concerning these isopods will be reported elsewhere.

Anilocra haemuli, new species

Figs. 1, 2, 4, 5, 27I

Anilocra laevis Miers, 1877: 672–673, Martinique specimen only.
Anilocra laticauda.—Boone, 1921:95, in part; Bowman and Díaz-Ungría,

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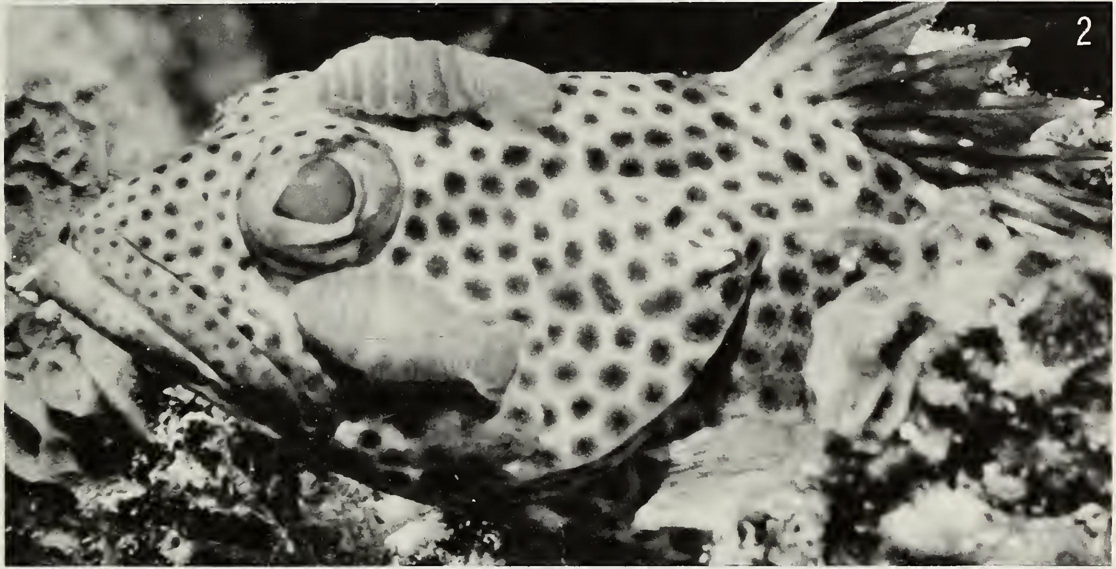
Figs. 1–3. ♀ *Anilocra* spp. on their host fishes: 1, *A. haemuli* on the coney, *Epinephelus fulvus;* 2, *A. haemuli* above and below eye of a redhind, *Epinephelus guttatus* (photograph by Herb Taylor); 3, *A. holocentri* on the squirrelfish, *Holocentrus ascensionis*.


1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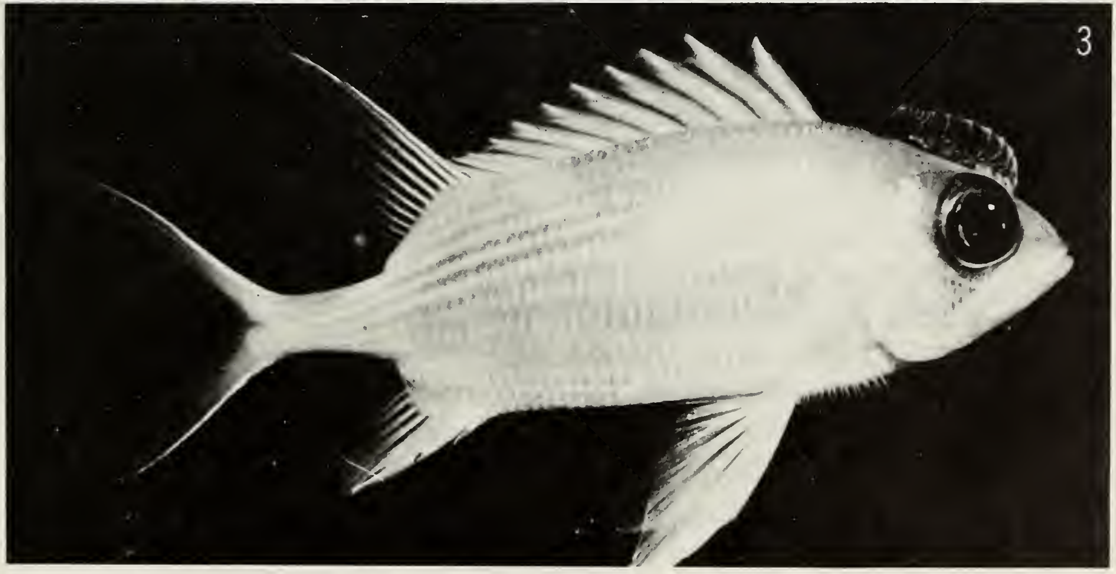
3

1957:112; Burnett-Herkes, 1975:124; Dowgiallo, 1979:35; Hochberg and Ellis, 1972:84, in part; Nierstrasz, 1915:79; Richardson, 1912:190, in part; Schioedte and Meinert, 1881:126; Trilles, 1975:306, in part; Trilles and Vala, 1975:967; Williams, E. and Williams, L., 1977:14; Williams, L. and Williams, E., 1977:15; Williams and Williams, 1978:28.

Isopods examined.—356 (225 females with a marsupium, 31 mature females without a marsupium, 74 immature females, 3 transitionals, and 23 males or juveniles).

Type-host and locality (date).—French grunt, *Haemulon flavolineatum* (Desmarest), La Parguera, Puerto Rico (August 1975 to August 1979).

Location.—Female attached beneath eye of host (Fig. 1). Immature females or transitionals attached adjacent to females, or beneath eye when adult females were not present. Males attached under adult females.

Type-specimens.—Holotype (female) USNM # 184796; allotype (male) USNM # 184797; 8 paratypes USNM # 184798–184805; 10 paratypes in author's collection.

Additional hosts and localities (date).—*Haemulon flavolineatum,* Puerto Rico, Morrillito near Caja de Muertos (20 November 1975), off Punta Cadena (21 July 1976), Culebra Island, southeast coast (11 March 1978), north coast (15 April 1978); St. John, U.S. Virgin Islands, Lameshure Bay (15 September 1970, USNM Acc. No. 294746; 2 March 1977), Europa Bay (16 February 1959, UMML 5109); St. Thomas, U.S. Virgin Islands, Mingo Cay (4 March 1977); Virgin Gorda, British Virgin Islands, The Baths (22 November 1975); Mosquito Island, British Virgin Islands, North tip of Colquhoun Reef (24–25 November 1975); Florida, U.S.A., Monroe County, ½ mi. SSW of Alligator Reef Light (30 April 1961, UMML CRR-F-296). Tomtate, *Haemulon aurolineatum* Cuvier, Puerto Rico, La Parguera (9 December 1975; 24 January, 7 April, 2 September, 20 October, 30 November, 4 December 1976; 22, 29 January, 17–18 February; 3, 26 March, 4 April 1977; 20 January, 18–19 March 1978); Morrillito near Caja de Muertos (20 November 1975); Jamaica, Montego Bay (10 July 1910, USNM 41797; 23 July 1910, USNM 41799). Smallmouth grunt, *Haemulon chrysargyreum* Günther, Puerto Rico, La Parguera (9 November 1975; 27 January, 13 July 1976; 28 January, 2 May 1977); St. John, U.S. Virgin Islands, Eagle Shoals (3 March 1977). Caesar grunt, *Haemulon carbonarium* Poey, Puerto Rico, Culebra Island, north coast (15 April 1978); St. John, U.S. Virgin Islands, Eagle Shoals (3 March 1977). Spanish grunt, *Haemulon macrostomum* Günther, Puerto Rico, La Parguera (17 December 1976). White grunt, *Haemulon plumieri* (Lacépède), Mexico, Cozumel, Yucatán (27 January 1885, USNM); Florida, U.S.A., Key West (9 October 1922, USNM; 8 December 1922, USNM), Dade County, Yellow Reef at Margot Fish Shoal (20 June 1961, UMML; 28 June 1963, UMML), Boca Chita Pass (3 August 1963, UMML).

Bluestripe grunt, *Haemulon sciurus* (Shaw), Florida, U.S.A., Miami, Rickenbacker Causeway (20 March 1948, UMML 32.307). Cora cora, *Orthopristis ruber* (Cuvier and Valenciennes), Venezuela, Isla de Margarita (19 September 1973, USNM 144032–144034). Coney, *Epinephelus fulvus* (Linnaeus), Puerto Rico, La Parguera (10 December 1976), Mona Island (14 April, 14 November 1975; 19–23 April 1976; 25 May 1977); St. John, U.S. Virgin Islands, Lameshure Bay (2 March 1977); St. Thomas, U.S. Virgin Islands, Buck Island (5 March 1977); St. Croix, U.S. Virgin Islands, Cane Bay (6, 8 March 1977), Fredericksted (9 March 1977); Dominican Republic, south coast, Bahía de Caldera (24 November 1978); Bahama Islands, Chub Cay (6 June 1976), Cat Island (8 June 1976), Crooked Island (12 June 1976), Long Island (14–15 June 1976), Great Inagua (17 April 1977), Aklins Island (21–22 April 1977), Long Cay (23 April 1977) Gum Cay (1 January 1964, UMML); Guadeloupe (12 September 1973, IS-493, MNHN). Red hind, *Epinephelus guttatus* (Linnaeus), Puerto Rico, La Parguera (1 November, 9 December 1975; 18 October 1976; 27–29 January, 5 February, 18 May 1977; 10 October 1978; 15 February 1979), Ensenada (1 February 1979); St. John, U.S. Virgin Islands, Lameshure Bay (9 November 1958, UMML 4991; 25 July, 13, 16, 18 September 1970, USNM Acc. No. 294746; 2 March 1977), Cabritte Horn Point (UMML 226, 100); St. Thomas, U.S. Virgin Islands, Buck Island (5 March 1977); Anegada, British Virgin Islands, White Horse Key (24 November 1975). Graysby, *Epinephelus cruentatus* (Lacépède), St. John, U.S. Virgin Islands, Riddle Bay (23 January 1959, UMML 4992); Dominican Republic, south coast, Bahía de Caldera (24 November 1978); Bahama Islands, Exuma Island (11 July 1959, UMML, WAS-BWI-10), Rum Cay (10 June 1976). Creole-fish, *Paranthias furcifer* (Valenciennes), Puerto Rico, Desecheo Island (28 February, 22 October 1975; 22 July 1976; 22–23 May 1977), Mona Island (14 April 1975; 22 April 1976), Monito Island (22 April 1976); Dominican Republic, south coast, Bahía de Caldero (24 November 1978); Colombia, South America, Punta Aguja (14 October 1977), Punta de Betín (12 October 1977). No Host Indicated—Jamaica, Montego Bay (6 August 1910, USNM; 7 July 1910, USNM; 29 June 1910, USNM 41796; Cuba, Cape Cajon (15 May 1914, USNM 53837); Havana (MCZ); Cuba (ZMB 4047, 4048) (1914, IS-482 MNHN); Brazil, Río de Janeiro (USNM); Barbados, near Pelican Island (14 May 1918, USNM); St. Croix, U.S. Virgin Islands (February 1894, USNM 33078), Cane Bay (July 1937, USNM 222), Christiansted (USNM 86348); St. Thomas, U.S. Virgin Islands (IS-294, IS-492 MNHN; MCZ 3151, 3152), Buck Island (30 July 1915, USNM 79302); Puerto Rico (1898–1899, USNM 44280); Dominica, B. W. I. (8 June 1964, USNM 112666–112667); Florida, U.S.A., Key West (15–27 April 1884, USNM; 11 December 1922, USNM; 9 May 1919, USNM; 19 May 1918, USNM; MCZ 3150); Upper Jewfish Bush Lake (30 January 1903, USNM 44263); Venezuela, Isla Cubagua, Punta de Piedras (31 October

Fig. 4. *Anilocra haemuli,* ♀ with marsupium: A, Lateral view; B, Dorsal view; C, Apex of maxilla 1; D, Maxilla 1; E, Apex of distal segment of mandibular palp; F, Mandibular palp; G, Distal lobes of maxilla 2; H, maxilla 2; I, Scales on maxilla 2; J, Apex of body of mandible; K, Body of mandible; L, Apex of palp of maxilliped; M, Seta from margin of maxilliped; N, Maxilliped. Mouthparts 29×, enlarged details of mouthparts 363×. Scale in mm.

Fig. 5. *Anilocra haemuli.* A–D, ♀ with marsupium: A, Pereopod 1, 10×; B, Pereopod 7, 10×; C, Left uropod, 10×; D, Frons and left antennae. E–M, ♂: E. Dorsal view; F, Pereopod 1; G, Pereopod 6; H, Pereopod 7; I, Left uropod; J, Natatory seta from uropod; K, Sensory seta from pleopod 2; L, Coupling seta from pleopod 2; M, Pleopod 2; N, Dactyl of ♀ pereopod 2, 10×. ♂ pereopod, uropod and pleopod 44×; setae 371×. Scales in mm.

1967, USNM 122768), Punta Araya, Gulf of Cariaco (USNM 107091); Martinique (Chafanjon, 1873–1884, IS-421 MNHN); Antillen (ZMB 3004); no locality (ZMB 4958).

Diagnosis.—Anterior margin of head truncate, flexed and produced into lobe between bases of antennae 1. Posteroventral angle of pereonite 6 slightly produced, of pereonite 7 produced, that of pereonite 7 overlapping pleonite 1. Shortest pereonite 2, longest 6. Body axis distorted less than 5°. Telson as wide as long to 1/6 wider than long. Pereopods 2–4 without swelling on outer margin of dactyl. Dactylus of pereopod 7 shorter than propodus. Uropod not reaching posterior margin of telson. Endopod of uropod extending beyond posterior end of exopod.

Further details.—Body oval, length-width ratio 2.5 (2.1–2.9). Head width-length ratio 2.1 (1.6–2.5). Antennae 1 8-merous. Antennae 2 9–10-merous, reaching from ⅔ length to posterior edge of pereonite 1. Distance between eyes 47% (42–51%) of head width. Distal segment of mandibular palp with 5–10 simple setae, second segment with or without setae. Pleotelson subcircular, posterior margin obtusely pointed. Color of body yellow to light brown in life; upper lateral surface (when attached to host) noticeably more pigmented.

Penis lobes of male separate. Appendix masculina of male pleopod 2 linear, with unmodified apex. Basis of pleopod 2 with 2 sensory and 4 coupling setae. Fifty-five females with oostegites were 21–40 long (mean 29.9); 8–15 wide (mean 11.7). Three females lacking oostegites were 29–34 long (mean 31.6); 11–13 wide (mean 12). Twelve immature females were 21–32 long (mean 28); 8–14 wide (mean 11.4). One transitional was 10 long, 3 wide; lacked appendix masculina and penis lobes. One male was 7 long, 2 wide; with pereopod 7 fully developed. Three juveniles were 4 long, 1 wide; with pereopod 7 reduced; appendix masculina reduced.

Remarks.—Seventy-five *Anilocra haemuli* were collected on 67 *Haemulon flavolineatum* 88–184 (mean 122) long; 30 on 22 *H. aurolineatum* 103–154 (mean 133.8) long; 8 on 7 *H. chrysargyreum* 123–158 (mean 147.6) long; 3 on 2 *H. carbonarium* 162–175 (mean 168.5) long; 1 on 1 *H. macrostomum* 115 long; 26 on 22 *Epinephelus guttatus* 143–279 (mean 181.3) long; 41 on 29 *Paranthias furcifer* 121–213 (mean 162.8) long; 72 on 55 *Epinephelus fulvus* 86–235 (mean 171.3) long; and 5 on 3 *Epinephelus cruentatus* 135–142 (mean 138.7) long.

This parasite was attached in the subocular region (Fig. 1) with 2 exceptions: a single female isopod was attached above the eye of a *Haemulon flavolineatum* (off Punta Cadena, Puerto Rico, 21 July 1976); and 1 female was attached above the eye of an *Epinephelus guttatus* which had additional female specimens attached below each eye (Fig. 2) (Wallin 1978) (St. Croix, June 1975—Herb Taylor, pers. comm.). The isopod caused slight to moderate damage of the tissue underlying the attachment site; in some cases,

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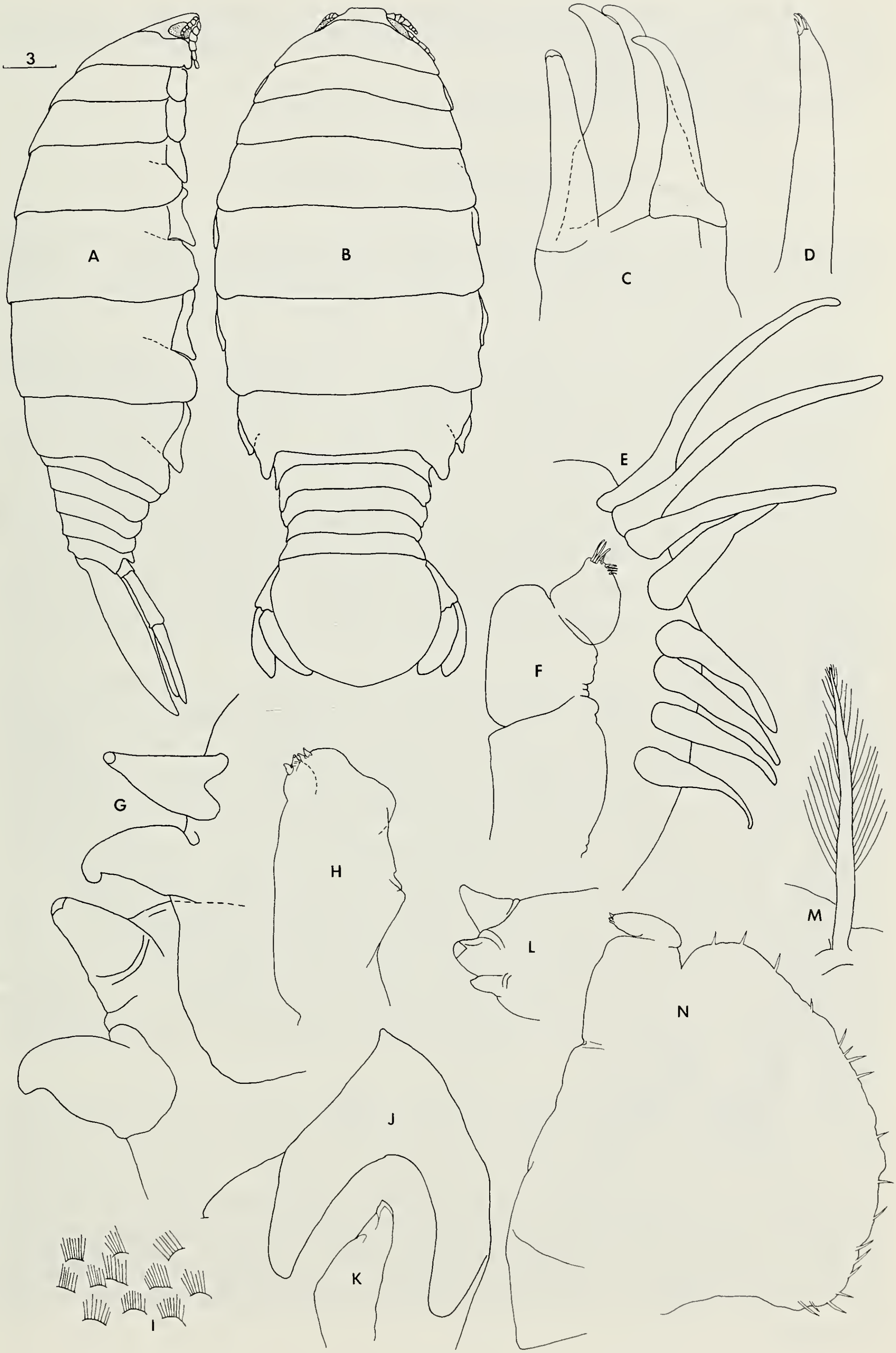
Fig. 6. *Anilocra holocentri*, ♀ with marsupium: A, Lateral view; B, Dorsal view; C, Apex of maxilla 1; D, Maxilla 1; E, Apex of distal segment of mandibular palp; F, Mandibular palp; G, Distal lobes of maxilla 2; H, maxilla 2; I, Scales on maxilla 2; J, Apex of body of mandible; K, Body of Mandible; L, Apex of palp of maxilliped; M, Seta from margin of maxilliped; N, Maxilliped. Mouthparts 29×, enlarged details of mouthparts 363×. Scale in mm.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bone deformation was observed. Often, on the *Haemulon* spp., the area of attachment of the parasite was pigmented with an orange color like that in the mouths of these fishes.

The name is taken from the genus of the type-host.

Anilocra holocentri, new species
Figs. 3, 6, 7, 27C

Anilocra laticauda.—Menzies and Glynn, 1968:46; Moore, 1902:172, in part.
Anilocra sp.—Collette and Talbot, 1972:111; Hochberg and Ellis, 1972:84, in part; Williams and Williams, 1977:15, in part.

Isopods examined.—52 (28 females with a marsupium, 5 mature females without a marsupium, 9 immature females, 1 transitional and 9 males).

Type-host and locality (date).—Squirrelfish, *Holocentrus ascensionis* (Osbeck), La Parguera, Puerto Rico (August 1976–February 1977).

Location.—Female attached in the interorbital region of the head (Fig. 3). Immature female or transitional usually attached anterior to female on the upper lip of the host or interorbitally when no adult female was present.

Type-specimens.—Holotype (female) USNM # 184813; allotype (male) USNM # 184814; 8 paratypes USNM # 184815–184822; 10 paratypes in authors' collection.

Additional hosts and localities (date).—Holocentrus ascensionis, La Parguera (24 February 1959, USNM 107833; 11 August 1964, USNM), west coast, Punta Cadena (21 July 1976), Corcega (8 February 1976), Aguadilla, Crashboat Pier (3 January 1976), Las Coronas (23 July 1976); St. John, U.S. Virgin Islands, Lameshure Bay (9 November 1958, UMML 4737 Voss Ref. No. 32, 2263; 2 August and 15 September 1970, USNM Acc. No. 294746; 2 March 1977), Europa Bay (16 February 1959, UMML 5110 Aquis. No. 226-100); St. Thomas, U.S. Virgin Islands, east end of Congo Cay (3 March 1977), Buck Island (5 March 1977). No Host Indicated.—Puerto Rico, Vieques Island (8 February 1899, USNM 32655); St. Thomas, U.S. Virgin Islands (February and April 1935, USNM 86371; MCZ 3151); St. Croix, U.S. Virgin Islands (ZMB 25667); Sandy Point, Patagonia, Strait of Magellan (March 1872, MCZ 3153).

Diagnosis.—Anterior margin of head truncate, flexed and produced into lobe between bases of antennae 1. Posteroventral angle of pereonite 7 slightly produced, that of pereonite 7 overlapping pleonite 1. Shortest pereonite 2, longest 6. Body axis distorted less than 5°. Telson as wide as long to $^2/_5$ wider than long. Pereopods 2–4 without swelling on outer margin of dactyl. Dactylus of pereopod 7 shorter than propodus. Uropod not reaching posterior margin of telson. Endopod of uropod extending beyond posterior end of exopod.

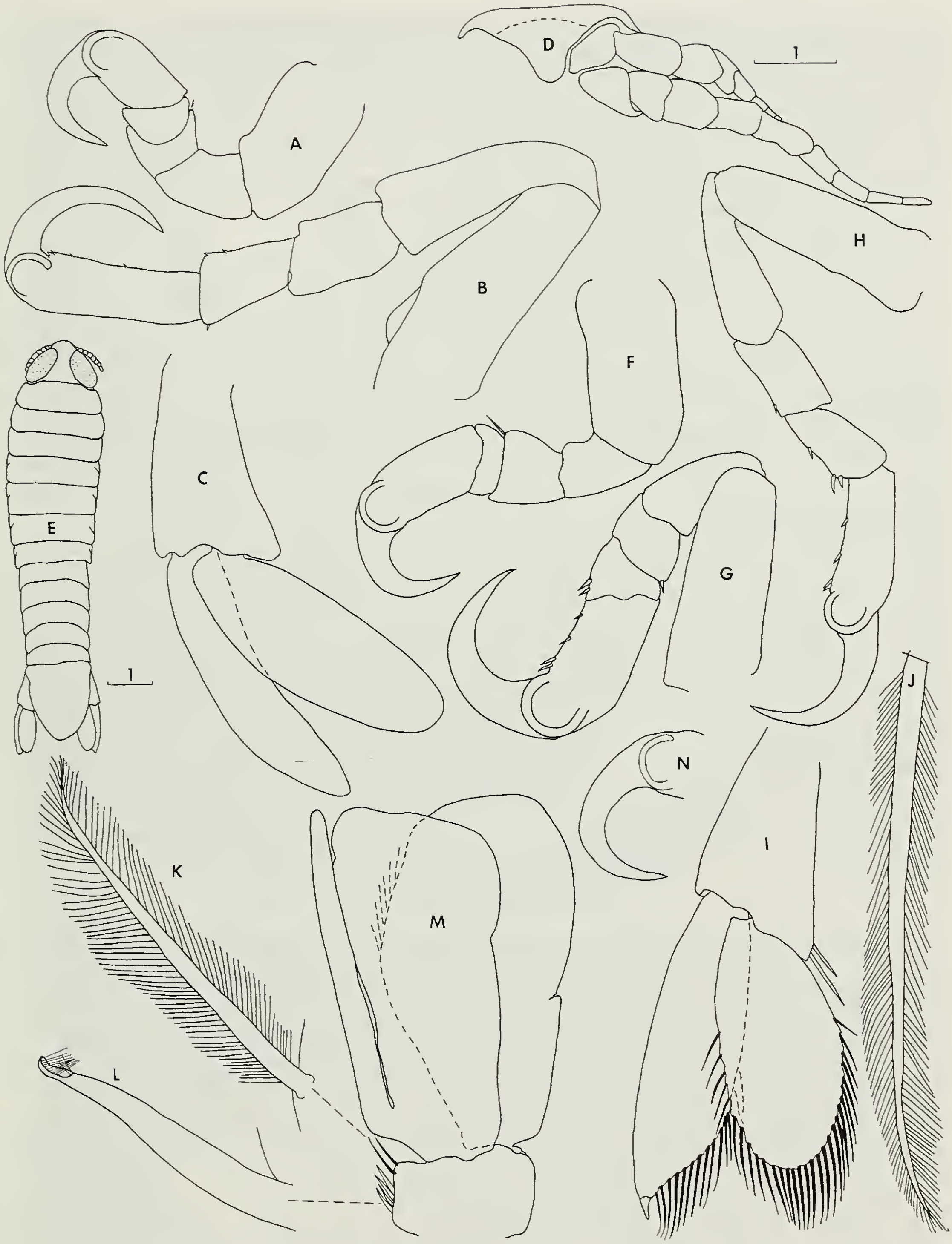


Fig. 7. *Anilocra holocentri*. A–D, ♀ with marsupium: A, Pereopod 1, 10×; B, Pereopod 7, 10×; C, Left uropod, 10×; D, Frons and left antennae. E–M, ♂: E, Dorsal view; F, Pereopod 1; G, Pereopod 6; H, Pereopod 7; I, Left uropod; J, Natatory seta from uropod; K, Sensory seta from pleopod 2; L, Coupling seta from pleopod 2; M, Pleopod 2. N, Dactyl of ♀ pereopod 2, 10×. ♂ pereopods, uropod, and pleopod 44×; setae 371×. Scales in mm.

Further details.—Body elongate oval, length-width ratio 2.7 (2.4–3.1). Head width-length ratio 3.3 (2.7–3.9). Antennae 1 8-merous. Antennae 2 9–10-merous, reaching from ½ length to almost posterior edge of pereonite 1. Distance between eyes 49% (46–53%) of head width. Distal segment of mandibular palp with 7–8 simple setae, second segment with or without setae. Pleotelson heart-shaped to round. Color of dorsal surface of body dark brown, ventral light brown in life.

Penis lobes of male separate. Appendix masculina of male pleopod 2 linear, with unmodified apex. Basis of pleopod 2 with 2 sensory and 4 coupling setae. Seventeen females with oostegites were 32–46 long (mean 29); 12–17 wide (mean 14.5). Four females lacking oostegites were 36–41 long (mean 39); 14–15 wide (mean 14.8). Six immature females were 13–35 long (mean 27.8); 7–13 wide (mean 10.2). One transitional was 13 long, 4 wide; lacked penis lobes, appendix masculina 67% length found in the male. Nine males were 5–9 long (mean 5.9); 1–2 wide (mean 1.3), with pereopod 7 fully developed to absent.

Remarks.—Thirty-seven *Anilocra holocentri* were collected from 28 *Holocentrus ascensionis* length 120–203 (mean 159.4). Some erosion of scales and loss of pigment ocurred in the area of isopod attachment. The immature females or transitionals usually attached anterior to the female on the upper lip of the host. In Florida, a ''squirrel fish'' was photographed with a female attached between the eyes and a male or transitional attached beneath 1 eye (Chess 1975).

The name is taken from the genus of the host.

Anilocra myripristis, new species

Figs. 8, 11, 12, 27B

Anilocra sp.—Colin, 1978:336, in part; Williams and Williams, 1977:15, in part.

''Isopod''—Böhlke and Chaplin, 1968:153.

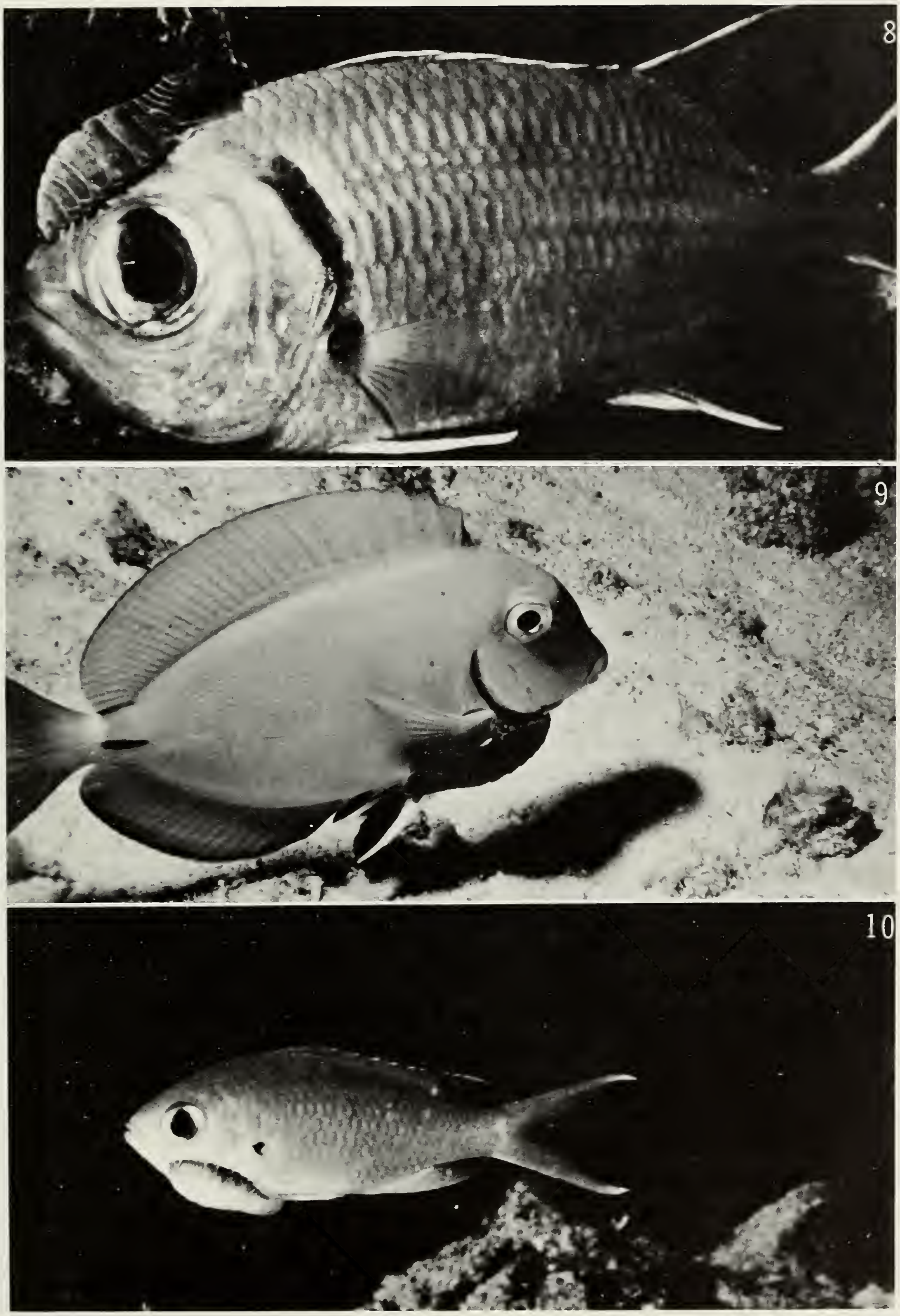
Isopods examined.—35 (19 females with a marsupium, 12 immature females, 1 transitional, and 3 males).

Type-host and locality (date).—Blackbar soldierfish, *Myripristis jacobus* Cuvier, Mona Island, Puerto Rico (April 1975–November 1980).

Location.—Female attached in the interorbital region of the head (Fig. 8). Immature female or transitional usually attached beneath eye, or interorbitally when no adult female present.

Type-specimens.—Holotype (female) USNM # 184823; allotype (male) USNM # 184824; 8 paratypes USNM # 184825–184832; 10 paratypes in authors' collection.

Additional localities (date).—Dominican Republic, south coast, La Caleta (23 November 1978), Bahía de Caldero (24 November 1978); Bahama Is-



Figs. 8–10. ♀ *Anilocra* spp. on their host fishes: 8, *A. myripristis* on the blackbar soldierfish, *Myripristis jacobus*; 9, *A. acanthuri* on the ocean surgeon, *Acanthurus bahianus*; 10, *A. chromis* on the brown chromis, *Chromis multilineatus*.

lands, New Providence Island (11 April 1955, UMML Neg. No. 444-449), Green Cay (21 July 1957, UMML Chaplin Collections; 14 May 1959, USNM 119497), San Salvador, Grahams Harbor (9, 11 June 1968, Ex II 68-5, 9, FAU), Cat Island (8 June 1976), Little Inagua (18 April 1977).

Diagnosis.—Anterior margin of head truncate, flexed and produced into lobe between bases of antennae 1. Posteroventral angle of pereonite 6 slightly produced, of pereonite 7 produced, that of pereonite 7 overlapping pleonite 1. Shortest pereonite 2, longest 6. Body axis distorted less than 5°. Telson $^1/_{10}$ more narrow to $^1/_{10}$ wider than long. Pereopods 2–4 without swelling on outer margin of dactyl. Dactylus of pereopod 7 shorter than propodus. Uropod extending beyond posterior margin of telson. Endopod of uropod extending beyond posterior end of exopod.

Further details.—Body elongate oval, length-width ratio 2.7 (2.3–3.1). Head width-length ratio 2.3 (2.0–2.7). Antennae 1 8-merous. Antennae 2 8–10-merous, reaching from ⅔ to ¾ length of pereonite 1. Distance between eyes 45% (35–49%) of head width. Distal segment of mandibular palp with 5–10 simple setae, second segment with or without setae, pleotelson square. Color of dorsal surface of body light redish-brown, ventral yellow in life.

Penis lobes of male separate. Appendix masculina of male pleopod 2 linear, with unmodified apex. Basis of pleopod 2 with 1 sensory and 4 coupling setae. Fifteen females with oostegites were 29–40 long (mean 34.8); 10–15 wide (mean 13.1). Nine immature females were 18–31 long (mean 26.3); 6–12 wide (mean 9.4). One transitional was 9 long, 2.5 wide; lacked penis lobes, appendix masculina not reduced. Three males were 6–7 long (mean 6.7); 1–2.5 wide (mean 1.5); with pereopod 7 reduced to fully developed.

Remarks.—Twenty-eight *Anilocra myripristis* were collected from 23 *Myripristis jacobus,* length 99–164 (mean 125.7). Some erosion of scales and loss of pigment occurred in the area of isopod attachment.

The name is taken from the genus of the host.

Anilocra acanthuri, new species

Figs. 9, 13. 14, 27A

Anilocra laticauda.—Bowman, Grabe, and Hecht, 1977:392; Richardson, 1912:190, in part; Trilles, 1975:306, in part.
Anilocra sp.—Williams and Williams, 1977:15, in part.

Isopods examined.—245 (75 females with a marsupium, 14 mature females without a marsupium, 70 immature females, 14 transitionals, and 72 males).

Type-host and locality (date).—Doctorfish, *Acanthurus chirurgus* (Bloch), La Parguera, Puerto Rico (April 1975–December 1978).

Location.—Female attached beneath and slightly anterior to the base of

Fig. 11. *Anilocra myripristis,* ♀ with marsupium: A, Lateral view; B, Dorsal view; C, Apex of maxilla 1; D, Maxilla 1; E, Apex of distal segment of mandibular palp; F, Mandibular palp; G, Distal lobes of maxilla 2; H, Maxilla 2; I, Scales from maxilla 2; J, Apex of body of mandible; K, Body of mandible; L, Apex of palp of maxilliped; M, Seta from margin of maxilliped; N, Maxilliped. Mouthparts 29×, enlarged details of mouthparts 363×. Scale in mm.

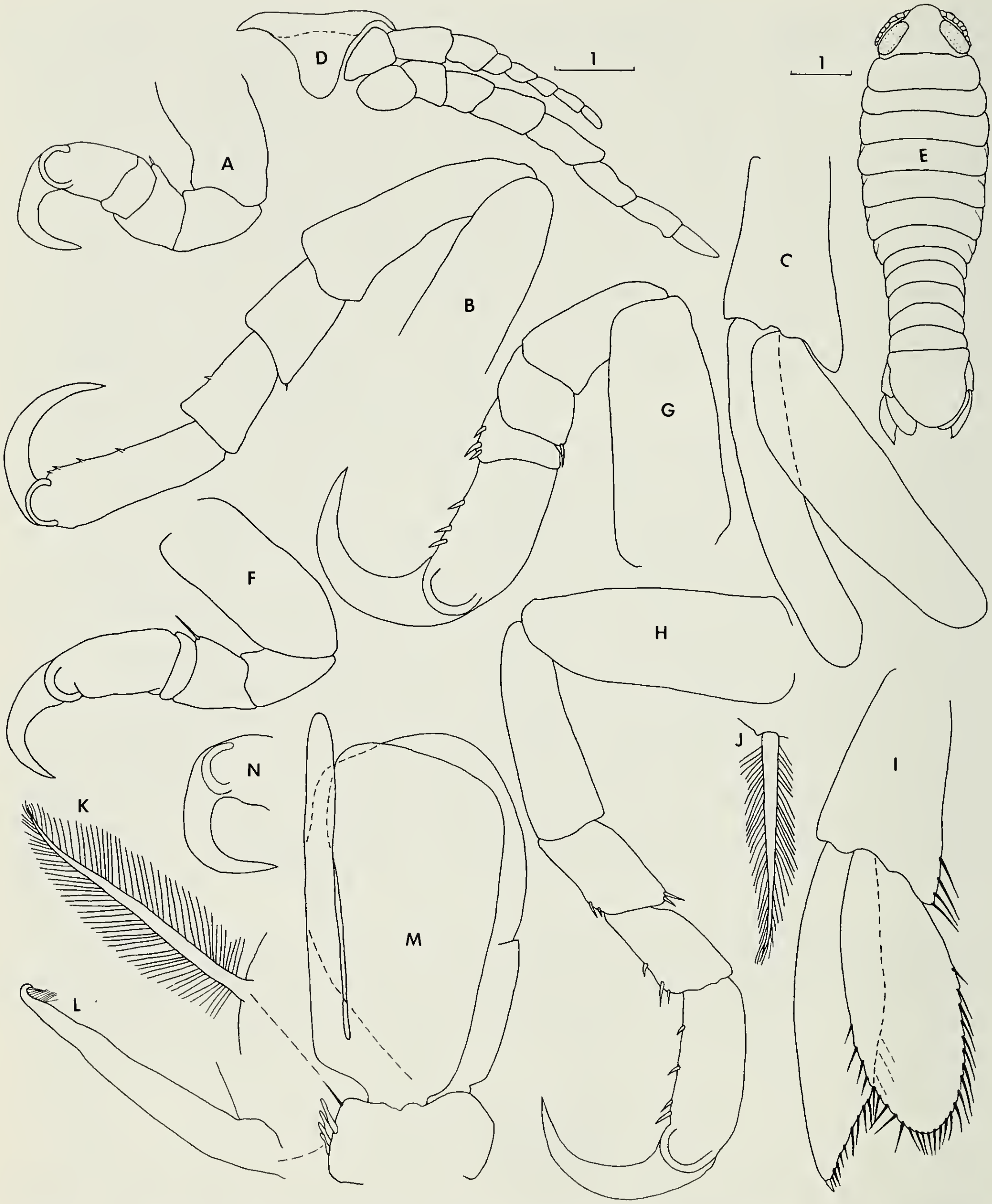


Fig. 12. *Anilocra myripristis*. A–D, ♀ with marsupium: A, Pereopod 1, 10×; B, Pereopod 7, 10×; C, Left uropod, 10×; D, Frons and left antennae. E–M, ♂: E, Dorsal view; F, Pereopod 1; G, Pereopod 6; H, Pereopod 7; I, Left uropod; J, Natatory seta from uropod; K, Sensory seta from pleopod 2; L, Coupling seta from pleopod 2; M, Pleopod 2. N, Dactyl of ♀ pereopod 2, 10×. ♂ pereopods, uropod, and pleopod 44×; setae 371×. Scales in mm.

the pectoral fin (Fig. 9). Transitionals were attached to the inner surfaces of the pectoral or pelvic fins, on the body near the female, or in the "female" position when no female was present; males were attached to the inner surfaces of the pectoral or pelvic fins.

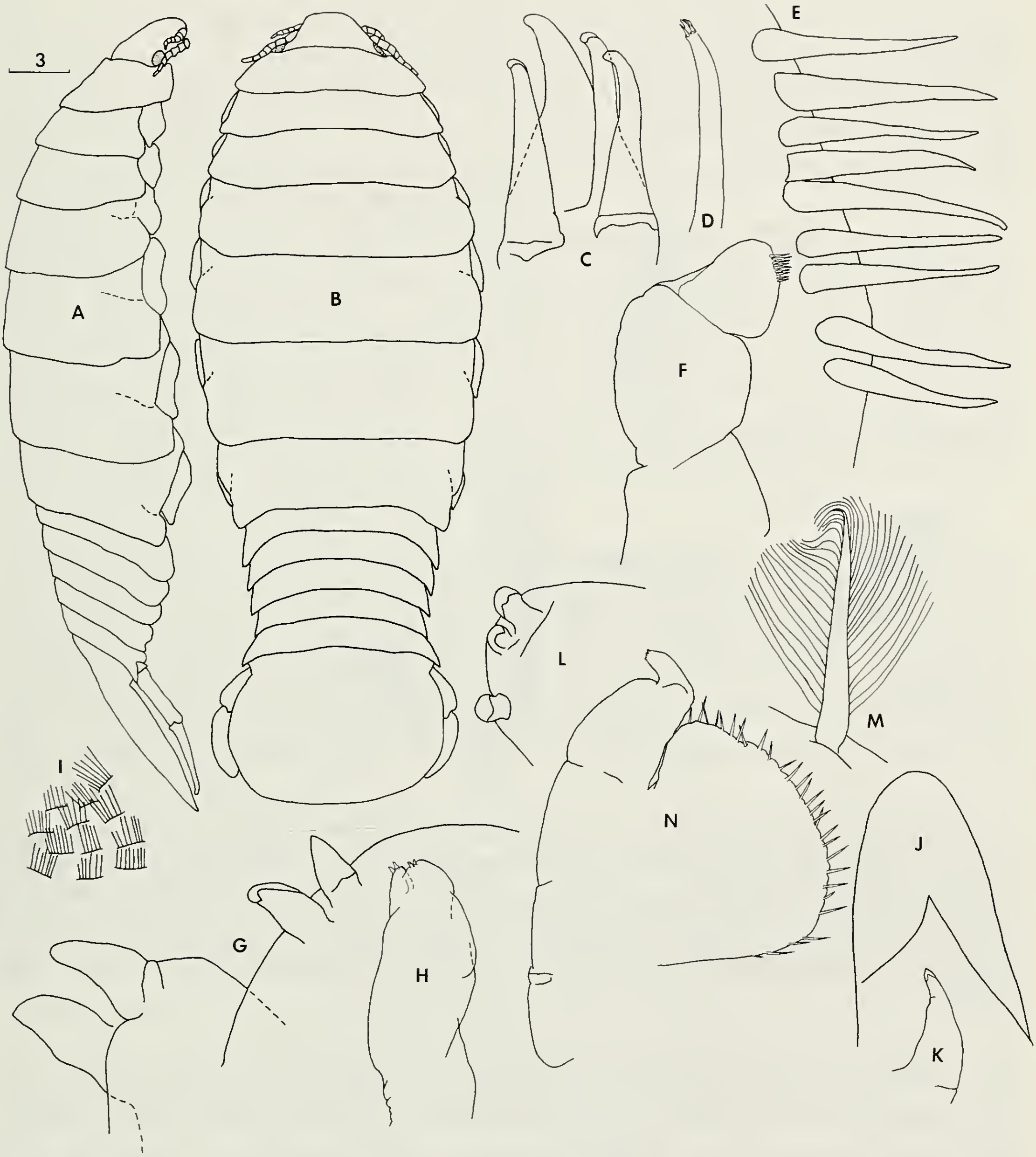


Fig. 13. *Anilocra acanthuri,* ♀ with marsupium: A, Lateral view; B, Dorsal view; C, Apex of maxilla 1; D, Maxilla 1; E, Apex of distal segment of mandibular palp; F, Mandibular palp; G, Distal lobes of maxilla 2; H, Maxilla 2; I, Scales on maxilla 2; J, Apex of body of mandible; K, Body of mandible; L, Apex of palp of maxilliped; M, Seta from margin of maxilliped; N, Maxilliped. Mouthparts 29×, enlarged details of mouthparts 363×. Scale in mm.

Type-specimens.—Holotype (female) USNM # 184767; allotype (male) USNM # 184768; 8 paratypes, USNM # 184769–184775; 10 paratypes in authors' collection.

Additional hosts and localities (date).—Acanthurus chirurgus, Puerto Rico, Corsega, north of Punta Cadena (6 February 1976), Las Coronas, south of Puerto Real (23 July 1976), Culebra Island, northeast coast (16

Fig. 14. *Anilocra acanthuri*. A–D, ♀ with marsupium: A, Pereopod 1, 10×; B, Pereopod 7, 10×; C, Left uropod, 10×; D, Frons and left antennae. E–M, ♂: E, Dorsal view; F, Pereopod 1; G, Pereopod 6; H, Left uropod; I, Natatory seta from uropod; J, Seta from exopod of pleopod 2; K, Sensory seta from pleopod 2; L, Coupling seta from pleopod 2; M, Pleopod 2. N, Dactyl of ♀ pereopod 2, 10×. ♂ pereopods, uropod, and pleopod 44×, setae 371×. Scales in mm.

April 1978), northwest part of Culebrita (11 March 1978); St. John, U.S. Virgin Islands, Lameshure Bay (21 December 1958, UMML 4989; 2 March 1977); St. Thomas, U.S. Virgin Islands, near Congo Cay (4 March 1977), Buck Island (5 March 1977); Anegada, British Virgin Islands, White Horse Key (24 November 1975); Bahama Islands, Bimini (3 July 1957, USNM 101838), Long Island (15 June 1976); Florida, U.S.A., Dade County, Bache Shoal (9 October 1958, UMML 4252, CRR-F 162, Neg. No. 392-5, and Voss Ref. No. 32,2262) Dade County, Long Reef (8 December 1959, UMML), Yellow Reef (28 June 1963, UMML), Tortugas (July and August 1930, USNM 97648, Manter No. 572; 29 June 1931, USNM 68372), Soldier Key (26 August 1954, USNM). Ocean surgeon, *Acanthurus bahianus,* Castelnau, Puerto Rico, Mona Island (14–15 November 1975; 19–23 April 1976; 26 May 1977); Dominican Republic, south coast, La Caleta (23 November 1978); Bahama Islands, Cat Island (8 June 1976), Conception Island (9 June 1976), Crooked Island (11–12 June 1976), Long Island (12–15 June, 1976), Aklins Island (21–22 April 1977), Long Cay (23 April 1977). No Host Indicated.—Puerto Rico, Piñeros Island, Roosevelt Roads Naval Station (21 March 1953, USNM 98185), Cabeza de Perro (16 March 1953, USNM 98184); St. Thomas, U.S. Virgin Islands (MNHN); Florida, Tortugas (USNM 97690, Carnegie Inst. No. 144662); Jamaica, Montego Bay (24 June 1910, USNM 41798); Cuba (ZMB 4048).

Diagnosis.—Anterior margin of head truncate, flexed and produced into lobe between bases of antennae 1. Posteroventral angles of pereonites not produced, that of pereonite 7 overlapping no pleonite. Shortest pereonite 2, longest 6. Body axis distorted less than 5°. Telson $^1/_{10}$ to $^2/_5$ wider than long. Pereopods 2–4 without swelling on outer margin of dactyl. Dactylus of pereopod 7 shorter than propodus. Uropod not reaching posterior margin of telson. Endopod of uropod not reaching the posterior end of exopod to extending beyond end of exopod.

Further details.—Body elongate oval, length-width ratio 2.9 (2.5–3.3). Head width-length ratio 2.2 (1.6–2.6). Antennae 1 8-merous. Antennae 2 8–10-merous, reaching from ½ length to beyond posterior edge of pereonite 1. Distance between eyes 65% (53–74%) of head width. Distal segment of mandibular palp with 5–12 simple setae, second segment with or without setae. Pleotelson oval. Color of dorsal surface of body black to lead-gray, ventral gray, in life.

Penis lobes of male separate. Appendix masculina of male pleopod 2 linear, with unmodified apex. Basis of pleopod 2 with 1 sensory and 4 coupling setae. Thirty-six females with oostegites were 29–40 long (mean 34.4); 9–14 wide (mean 12.0). Six females lacking oostegites were 35–40 long (mean 37); 11–13 wide (mean 12.5). Fifty-three immature females were 10–34 long (mean 20.1); 2–11 wide (mean 6). Ten transitionals were 7–10 long (mean 8.8); 1.5–3.0 wide (mean 2.2). Forty-nine males were 4–8 long (mean 5); 1–2 wide (mean 1.2), with pereopod 7 absent to fully developed.

Remarks.—One hundred fifty-four *Anilocra acanthuri* were collected on 74 *Acanthurus chirurgus* 58–211 (mean 139.3) long and 72 on 45 *Acanthurus bahianus* 106–178 (mean 136.9) long. Some erosion of scales occurred in the area of isopod attachment. The isopods from *A. bahianus* were slightly longer (32–43) and wider (11–15) than those from the type host, and the coxae were slightly longer.

Acanthurus chirurgus was frequently parasitized by another cymothoid isopod, *Agarna cumulus* (Haller), in the gill chamber. Of the 73 fish parasitized by *Anilocra acanthuri,* 38 were also parasitized by *Agarna cumulus.* In addition, of 214 fish collected without *Anilocra acanthuri,* 17 were parasitized by *Agarna cumulus.*

A specimen of *A. acanthuri* (USNM 101838) recorded from the blue tang, *Acanthurus coeruleus* Schneider, traced to the original field notes of the collector, was actually collected from *Acanthurus hepatus* (=*A. chirurgus*).

The name is taken from the genus of the host.

Anilocra chromis, new species
Figs. 10, 15, 16, 27G

Anilocra laticauda.—Boone, 1927:139, in part.
Anilocra sp.—Colin, 1978:337, in part; Hochberg and Ellis, 1972:84, in part; Smith and Tyler, 1972:153; Williams and Williams, 1977:15, in part.

Isopods examined.—301 (185 females with a marsupium, 20 mature females without a marsupium, 47 immature females, 28 transitionals, and 21 males).

Type-host and locality (date).—Brown chromis, *Chromis multilineatus* (Guichenot), La Parguera, Puerto Rico (August 1975–June 1978).

Location.—Attached beneath eye of host (Fig. 10).

Type-specimens.—Holotype (female) USNM # 184786; allotype (male) USNM # 184787; 8 paratypes USNM # 184788–184795; 10 paratypes in authors' collection.

Additional hosts and localities (date).—*Chromis multilineatus,* Puerto Rico, west coast, off Punta Cadena (21 July 1976), Corsega (6–8 February 1976), channel buoy off Añasco River (1 March 1975), Mona Island (13 April, 15–16 November 1975; 21 April 1976), Vieques Island (21 November 1975), Culebra Island (10 March, 18 April 1978), Congrejos (21 May 1956, USNM 101832); St. John, U.S. Virgin Islands, Lameshure Bay (21 December 1958, UMML Ref. No. 32,2264, 32,2267, 32,2268; 2 March 1977); St. Croix, U.S. Virgin Islands near Butler Bay (7 March 1977); Virgin Gorda, British Virgin Islands, The Baths (22 November 1975); Anegada, British Virgin Islands, White Horse Key (23–24 November 1975); Mosquito Island, British Virgin Islands (25 November 1975). Blue chromis, *Chromis cyaneus* (Poey), Dominican Republic, south coast, La Caleta (23 November 1978); Bahama Islands, Chub Cay (6 June 1976), Eleuthra (7 June 1976), Cat Island (8 June 1976), Conception Island (9 June 1976; 24 April 1977), Rum Cay (10 June 1976), Long Island (12–15 June 1976), Carrion Crow Harbor Reefs (14 November 1958, UMML Ref. No. 32,2265), Indian Cay (16 July 1959, UMML Neg. No. 450-453). No Host Indicated.—Anguila, British West Indies (17 July 1965, USNM Acc. No. 292647); Bahama Islands, Green Cay (14 May 1959, USNM 119497).

Diagnosis.—Anterior margin of head truncate, flexed and produced into lobe between bases of antennae 1. Posteroventral angles of pereonites not produced, that of pereonite 7 overlapping no pleonite. Shortest pereonite 2, longest 6. Body axis distorted less than 5°. Telson $^1/_{10}$ more narrow to $^1/_{10}$ wider than long. Pereopods 2–4 without swelling on outer margin of dactyl. Dactylus of pereopod 7 shorter than propodus. Uropod extending beyond posterior margin of telson. Endopod of uropod not reaching posterior end of exopod.

Fig. 15. *Anilocra chromis,* ♀ with marsupium: A, Lateral view; B, Dorsal view; C, Apex of maxilla 1; D, Maxilla 1; E, Apex of distal segment of mandibular palp; F, Mandibular palp; G, Distal lobes of maxilla 2; H, Maxilla 2; I, Scales on maxilla 2; J, Apex of body of mandible; K, Body of mandible; L, Apex of palp of maxilliped; M, Seta from margin of maxilliped; N, Maxilliped. Mouthparts 29×, enlarged details of mouthparts 363×. Scale in mm.

Further details.—Body oval, length-width ratio 2.6 (2.3–3.4). Head width-length ratio 2.2 (1.7–2.4). Antennae 1 8-merous. Antennae 2 9–10-merous, reaching from ⅓ to full length of pereonite 1. Distance between eyes 52% (45–63%) of head width. Distal segment of mandibular palp with 4–7 simple setae, second segment with or without setae. Pleotelson shield-shaped. Color of dorsal surface of body dark gray and off white, in life. Upper lateral surface (when attached to host) countershaded ¼ to ⅔ width of body, dark gray, the remainder of dorsal and all ventral off-white. Basis of pereopods on dark side, dark gray.

Penis lobes of male separate. Appendix masculina of male pleopod 2 linear, with unmodified apex. Basis of pleopod 2 with 1 sensory and 4 coupling setae. One hundred thirty-two females with oostegites were 16–28 long

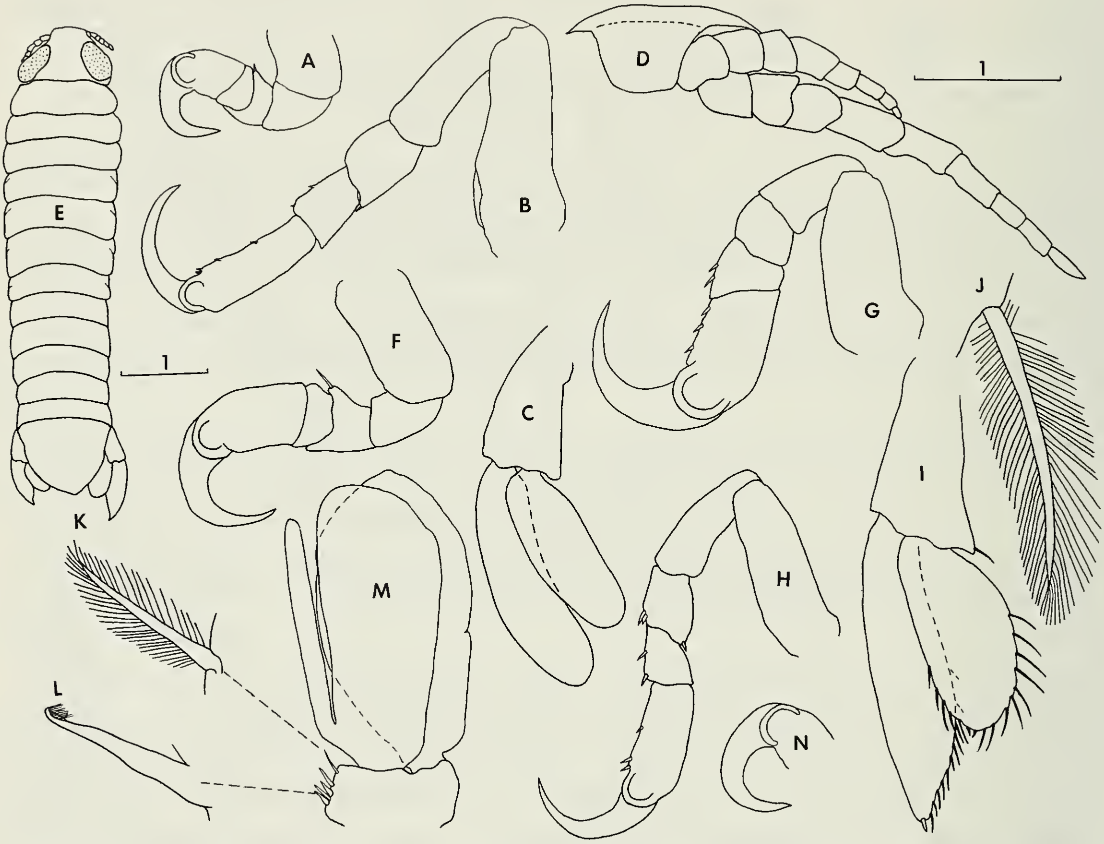


Fig. 16. *Anilocra chromis*. A–D, ♀ with marsupium: A, Pereopod 1, 10×; B, Pereopod 7, 10×; C, Left uropod, 10×; D, Frons and left antennae. E–M, ♂: E, Dorsal view; F, Pereopod 1; G, Pereopod 6; H, Pereopod 7; I, Left uropod; J, Natatory seta from uropod; K, Sensory seta from pleopod 2; L, Coupling seta from pleopod 2; M, Pleopod 2. N, Dactyl of ♀ pereopod 2, 10×. ♂ pereopod, uropod, and pleopod 44×, setae 371×. Scales in mm.

(mean 23.4); 6–12 wide (mean 9.1). Twenty females lacking oostegites were 20–25 long (mean 22); 8–10 wide (mean 8.6). Twenty-six immature females were 8–22 long (mean 16.5); 3–9 wide (mean 6). Sixteen transitionals were 8–16 long (mean 12.7); 2–6 wide (mean 3.9); lacking penis lobes; appendix masculina 25 to 67% of the length found in the male. Twelve males 4–9 long (mean 6.8); 1–2 wide (mean 1.6); with pereopod 7 absent to fully developed.

Remarks.—Two hundred six *Anilocra chromis* were collected on 186 *Chromis multilineatus*, length 42–122 (mean 79.4); and 78 on 68 *Chromis cyaneus*, length 18–78 (mean 50.9). The parasite was usually attached in the subocular region (Fig. 10). It was observed once (by the authors, 8 November 1978, submerged reef, east of Turrumote Reef, La Parguera; not collected) attached above the eye with no other *Anilocra chromis* present. Erosion of scales occurred in the region of isopod attachment. Female isopods with oostegites collected from *Chromis cyaneus* were slightly smaller, length 14–26 (mean 19), than those collected on *C. multilineatus*.

The name is taken from the genus of the hosts.

Anilocra abudefdufi, new species
Figs. 17, 19, 27H

Anilocra laticauda.—Boone, 1921:95, in part.

Isopods examined.—77 (48 females with a marsupium, 4 mature females without a marsupium, 13 immature females, 7 transitionals, 2 males, and 3 juveniles).

Type-host and locality (date).—Sergeant major, *Abudefduf saxatilis* (Linnaeus), Nalunega, San Blas Islands, Panama (25–30 October 1980).

Location.—Attached beneath eye of the host (Fig. 17).

Type-specimens.—Holotype (female) USNM # 184758; 9 paratypes USNM # 184759–184766; 41 paratypes in author's collection.

Additional hosts and localities (date).—*Abudefduf saxatiles,* Panama, Colon Reef (2 May 1911, USNM 43772), Torro Point (19 May 1911, USNM 43773), Ft. Randolf, Limón Bay (17 January 1978. GCRL, POD 121), San Blas Islands near Porvenier Island (January 1979, Dr. John Cubit, Coll.) Isla Arena and Isla del Rosario, near Cartegena, Colombia, S.A. (30 March 1978, Carol Sanner, Coll.). No Host Indicated.—Panama, Fort Sherman, Limón Bay, Colon (24 April 1972, Dawson 1542, GCRL), María Chiquita, Colon (27 April 1972, Dawson 1544, GCRL), Galeta Island, Colon (29 April 1972, Dawson 1546; 17 November 1972, Dawson 1601, GCRL), Devils Beach, Colon (16 November 1972, Dawson 1600, GCRL), Ft. Randolf, Limón Bay, Colon (13 November 1972, Dawson 1596; 7 March 1974, Dawson 1691, GCRL).

Diagnosis.—Anterior margin of head truncate, flexed and produced into lobe between bases of antennae 1. Posteroventral angle of pereonite 6 slightly produced, of pereonite 7 produced, that of pereonite 7 overlapping pleonite 1. Shortest pereonite 2, longest 6. Body axis distorted less than 5°. Telson $^1/_{10}$ more narrow to $^1/_5$ wider than long. Pereopods 2–4 with swelling on outer margin of dactyl. Dactylus of pereopod 7 shorter than propodus. Uropod not reaching posterior margin of telson to extending beyond posterior margin of telson. Endopod of uropod not reaching posterior end of exopod to extending beyond end of exopod.

Further details.—Body oval, length-width ratio 2.5 (2.2–2.9). Head width-length ratio 2.8 (2.3–3.4). Antennae 1 8-merous. Antennae 2 9–11-merous, reaching from ⅔ length to beyond posterior edge of pereonite 1. Distance between eyes 52% (47–63%) of head width. Distal segment of mandibular palp with 10–11 simple setae, second segment with or without setae. Pleotelson broadly rounded. Color of dorsal surface of body dark brown, countershaded to light brown to yellow. Upper lateral surface (when attached to host) countershaded ½ to ¾ width of body, dark brown, the remainder of dorsal and all ventral, light brown to yellow. Pereopods of dark side often dark brown.

Forty-six females with oostegites were 19–31 long (mean 26.4); 7.5–13.5

Figs. 17, 18. ♀ *Anilocra* spp. on their host fishes: 17, *A. abudefdufi* on the sergeant major, *Abudefduf saxatilis*; 18, *A. holacanthi* on the rock beauty, *Holacanthus tricolor*.

wide (mean 11.1). Four females without oostegites were 23–24.1 long (mean 23.7); 9.5–11 wide (mean 10.3). Thirteen immature females were 13–24 long (mean 18.2); 4–10 wide (mean 6.2). Seven transitionals were 7.8–11 long (mean 10.2); 2–3.5 wide (mean 2.8); lacked penis lobes, appendix masculina 25 to 50% length found in male. Two males were 7–8.5 long and 2 wide. Three juveniles were 4–4.5 long and 1 wide.

Remarks.—Fifty-one *Anilocra abudefdufi* were collected from 32 *Abudefduf saxatilis*, length 50–108 (mean 92.6); also 14 *Anilocra abudefdufi* were collected (by Carol Sanner and Dr. John Cubit) from 10 *Abudefduf*

Fig. 19. *Anilocra abudefdufi*, ♀ with marsupium: A, Lateral view; B, Dorsal view; C, Apex of maxilla 1; D, Maxilla 1; E, Apex of distal segment of mandibular palp; F, Mandibular palp; G, Distal lobes of maxilla 2; H, Maxilla 2; I, Scales on maxilla 2; J, Apex of body of mandible; K, Body of mandible; L, Apex of palp of maxilliped; M, Seta from margin of maxilliped; N, Maxilliped; O, Pereopod 1; P, Pereopod 7; Q, Left uropod; R, Frons and left antennae; S, Dactyl of pereopod 2. Mouthparts 29×, enlarged details of mouthparts 363×, pereopods and uropod 10×. Scales in mm.

saxatilis, length 80–125 (mean 99.4), and 10 *Anilocra abudefdufi* were collected (by Dr. C. E. Dawson) without host data.

The name is taken from the genus of the host.

Anilocra holacanthi, new species
Figs. 18, 20, 21, 27F

Anilocra laticauda.—Boone, 1930:16 (?); Hochberg and Ellis, 1972:84, in part.

Anilocra sp.—Williams and Williams, 1977:15, in part.

Isopods examined.—113 (58 females with a marsupium, 9 mature females without a marsupium, 23 immature females, 3 transitionals, and 20 males.

Type-host and locality (date).—Rock beauty, *Holacanthus tricolor* (Bloch), La Parguera, Puerto Rico (September 1975–February 1977).

Location.—Female attached beneath eye of the host (Fig. 18). Transitionals and males attached adjacent to the female, or beneath the eye when no female was present.

Type-specimens.—Holotype (female) USNM # 184806; allotype (male) USNM # 184807; 8 paratypes USNM # 184808–184812; 10 paratypes in authors' collection.

Additional hosts and localities (date).—Puerto Rico, west coast, Corsega (6 February 1976), Morrillito, near Caja de Muertos (20 November 1975), Desecheo Island (22 July 1976; 22–23 May 1977), Monito Island (22 April 1976), Mona Island (14–15 November 1975; 20–23 April 1976); St. John, U.S. Virgin Islands, Lameshure Bay (18 September 1970, USNM Acc. No. 294746; 2 March 1977); Virgin Gorda, British Virgin Islands, The Baths (22 November 1975); Dominican Republic, south coast, La Caleta (23 November 1978); Bahama Islands, Eleuthra (7 June 1976), Cat Island (8 June 1976), Conception Island (9 June 1976), Fowl Cay (13–14 June 1976), Long Island (15 June 1976); Jamaica, Discovery Bay (7 January 1980). No Host Indicated.—St. Thomas, U.S. Virgin Islands (MCZ 3151); no locality (NR 4956, 4957, 4959).

Diagnosis.—Anterior margin of head truncate, flexed and produced into lobe between bases of antennae 1. Posteroventral angle of pereonites 5–6 slightly produced, of pereonite 7 produced, that of pereonite 7 overlapping pleonite 1. Shortest pereonite 2, longest 6. Body axis distorted more than 10°. Telson as wide as long to ⅓ wider than long. Pereopods 2–4 with swelling on outer margin of dactyl. Dactylus of pereopod 7 shorter than propodus. Uropod not reaching posterior margin of telson. Endopod of uropod extending beyond posterior end of exopod.

Further details.—Body expanded oval, length-width ratio 2.2 (1.9–2.6). Head width-length ratio 2.6 (2.2–2.9). Antennae 1 8-merous. Antennae 2 9–10-merous, reaching from ⅔ length to near posterior edge of pereonite 1.

Fig. 20. *Anilocra holacanthi,* ♀ with marsupium: A, Lateral view; B, Dorsal view; C, Apex of maxilla 1; D, Maxilla 1; E, Apex of distal segment of mandibular palp; F, Mandibular palp; G, Distal lobes of maxilla 2; H, Maxilla 2; I, Scales on maxilla 2; J, Apex of body of mandible; K, Body of mandible; L, Apex of palp of maxilliped; M, Setae from margin of maxilliped; N, Maxilliped. Mouthparts 29×, enlarged details of mouthparts 363×. Scale in mm.

Distance between eyes 54% (49–58%) of head width. Distal segment of mandibular palp with 4–8 simple setae, second segment with or without setae. Pleotelson rectangular. Color of dorsal surface of body black to lead gray, ventral gray, in life.

Penis lobes of male separate. Appendix masculina of male pleopod 2 linear, with unmodified apex. Basis of pleopod 2 with no sensory and 4 coupling setae. Fifty females with oostegites were 21–33 long (mean 26); 9–14 wide (mean 11.9). Nine females lacking oostegites were 23–29 long (mean 25.6); 11–13 wide (mean 11.8). Twenty-three immature females were 11–25 long. (mean 20.2); 4–11 wide (mean 8.1). Three transitionals were 11–15 long (mean 12.7); 4–5 wide (mean 4.3); penis lobes present; appendix masculina 10 to 50% of the length present in males. Nineteen males were 4–7 long (mean 4.9); 1–2 wide (mean 1.3); with pereopod 7 absent to fully developed.

Remarks.—One hundred four *Anilocra holacanthi* were collected on 65 *Holacanthus tricolor,* length 52–171 (mean 104.8). Isopods attached in the suborbital region were very conspicuous on the bright yellow face of this host (Fig. 18). Erosion of scales and occasionally erosion of tissue occurred in the area of isopod attachment. Often a dark pigment occurred under the site of attachment. Extensive bone deformation was not observed.

The name is taken from the genus of the host.

Anilocra chaetodontis, new species
Figs. 22, 24, 25, 27E

Anilocra laticauda.—Hochberg and Ellis, 1972:84, in part; Moore, 1902:172, in part.

Anilocra sp.—Williams and Williams, 1977:15, in part.

Isopods examined.—189 (78 females with a marsupium, 10 mature females without a marsupium, 63 immature females, 5 transitional and 33 males).

Type-host and locality (date).—Foureye butterflyfish, *Chaetodon capistratus* Linnaeus, La Parguera, Puerto Rico (September 1974–March 1977).

Location.—Female attached beneath eye of the host (Fig. 22). Transitionals and males attached adjacent to females, or beneath the eye when no females were present.

Type-specimens.—Holotype (female) USNM # 184776; allotype (male) USNM # 184777; 8 paratypes USNM # 184778–184785; 10 paratypes in authors' collection.

Additional hosts and localities (date).—*Chaetodon capistratus,* Puerto Rico, Mona Island (14–15 November 1975; 20 April 1976), Culebra Island, southeast coast (10 March 1978), Morrillito, near Caja de Muertos (20 November 1975); St. John, U.S. Virgin Islands, Lameshure Bay (18 October 1958, UMML; 21 December 1958, UMML 4990, Ref. #32,2266; 16 September 1970, USNM Acc. No. 294746); St. Croix, U.S. Virgin Islands, Cane Bay (8 March 1977); Virgin Gorda, British Virgin Islands, The Baths (22 November 1975); Mosquito Island, British Virgin Islands (25 November 1975); Bahama Islands, Crooked Island (11–12 June 1976), Long Island (12 June 1976), Aklins Island (21–22 April 1977). Banded butterflyfish, *Chaetodon striatus* Linnaeus, Puerto Rico, La Parguera (2 November 1975; 18 August

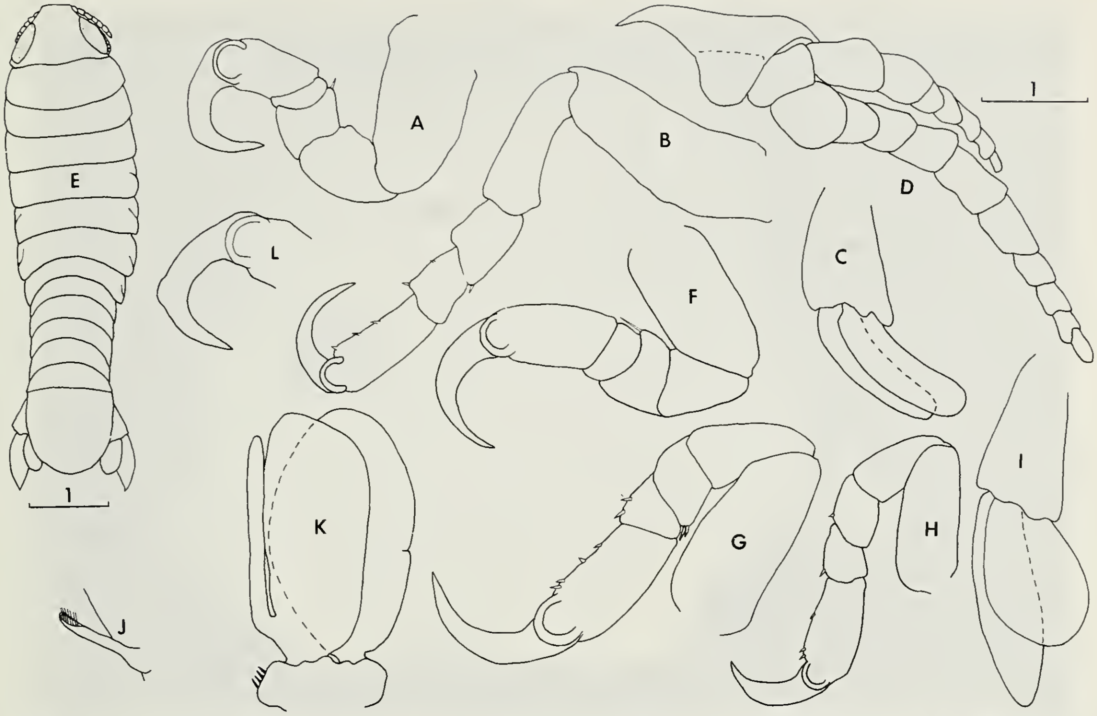
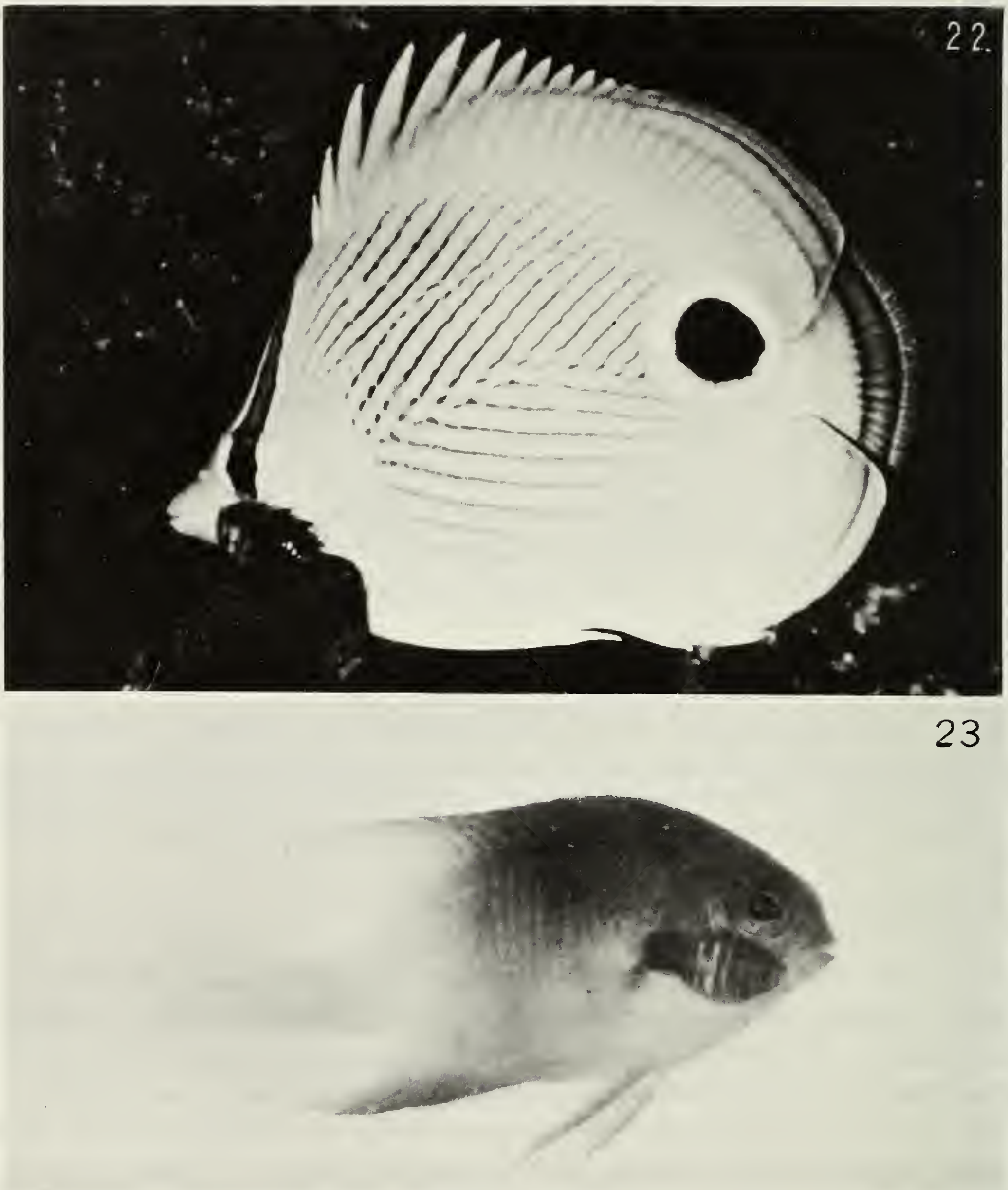


Fig. 21. *Anilocra holacanthi*. A–D, ♀ with marsupium: A, Pereopod 1, B, Pereopod 7, 10×; C, Left uropod, 10×; D, Frons and left antennae. E–M, ♂: E, Dorsal view; F, Pereopod 1; G, Pereopod 6; H, Pereopod 7; I, Left uropod; J, Coupling seta from pleopod 2; K, Pleopod 2. L, Dactyl of ♀ pereopod 2, 10×. ♂ pereopods, uropod, and pleopod 44×, seta 371×. Scales in mm.

1976; 13 June, 7 August 1977), Mona Island (22 April 1976); British Virgin Islands, Anegada, White Horse Key (24 November 1975); Bahama Islands, Great Inagua (16–17 April 1977), Little Inagua (18–19 April 1977). Spotfin butterflyfish, *Chaetodon ocellatus* Bloch, Puerto Rico, La Parguera (16 March, 12 November 1976; 18 February 1977); St. Thomas, U.S. Virgin Islands, Buck Island (5 March 1977); Bahama Islands, Chub Cay (6 June 1976), Bimini (1–7 February 1975, UMML). Reef butterflyfish *Chaetodon sedentarius* Poey, Puerto Rico, La Parguera (17 May, 14, 21 October 1977), Ensenada (16 January 1977). "Chaetodont," Puerto Rico, Arroyo (5 February 1899, USNM 985). No Host Indicated.—St. Thomas, U.S. Virgin Islands (ZMB 1504); St. Croix, U.S. Virgin Islands (NR 5570).

Diagnosis.—Anterior margin of head truncate, flexed and produced into lobe between bases of antennae 1. Posteroventral angle of pereonite 4 slightly produced, of pereonites 5–7 produced, that of pereonite 7 overlapping pleonite 2. Shortest pereonite 2, longest 6. Body axis distorted less than 5°. Telson as wide as long to $^1/_{10}$ wider than long. Pereopods 2–4 with swelling on outer margin of dactyl. Dactylus of pereopod 7 shorter than propodus. Uropod not reaching posterior margin of telson. Endopod of uropod extending beyond posterior end of exopod.



Figs. 22, 23. ♀ *Anilocra* spp. on their host fishes: 22, *A. chaetodontis* on the foureye butterflyfish, *Chaetodon capistratus*; 23, *A. partiti* on the bicolor damselfish, *Pomacentrus partitus*.

Further details.—Body expanded oval, length-width ratio 2.2 (1.9–2.5). Head width-length ratio 2.6 (2–3). Antennae 1 8-merous. Antennae 2 9–10-merous, reaching from ½ to ⅔ length of pereonite 1. Distance between eyes 53% (47–65%) of head width. Distal segment of mandibular palp with 7–12 simple setae, second segment with or without setae. Pleotelson broadly rounded. Color of dorsal surface of body black to lead gray, ventral gray, in life.

Fig. 24. *Anilocra chaetodontis,* ♀ with marsupium: A, Lateral view; B, Dorsal view; C, Apex of maxilla 1; D, Maxilla 1; E, Apex of distal segment of mandibular palp; F, Mandibular palp; G, Distal lobes of maxilla 2; H, Maxilla 2; I, Scales on maxilla 2; J, Apex of body of mandible; K, Body of mandible; L. Apex of palp of maxilliped; M, Seta from margin of maxilliped; N, Maxilliped. Mouthparts 29×, enlarged details of mouthparts 363×. Scale in mm.

Penis lobes of male separate. Appendix masculina of male pleopod 2 linear, with unmodified apex. Basis of pleopod 2 with 1 sensory and 4 coupling setae. Fifty-three females with oostegites were 18–28 long (mean 23); 8–13 wide (mean 10.6). Five females lacking oostegites were 22–26 long

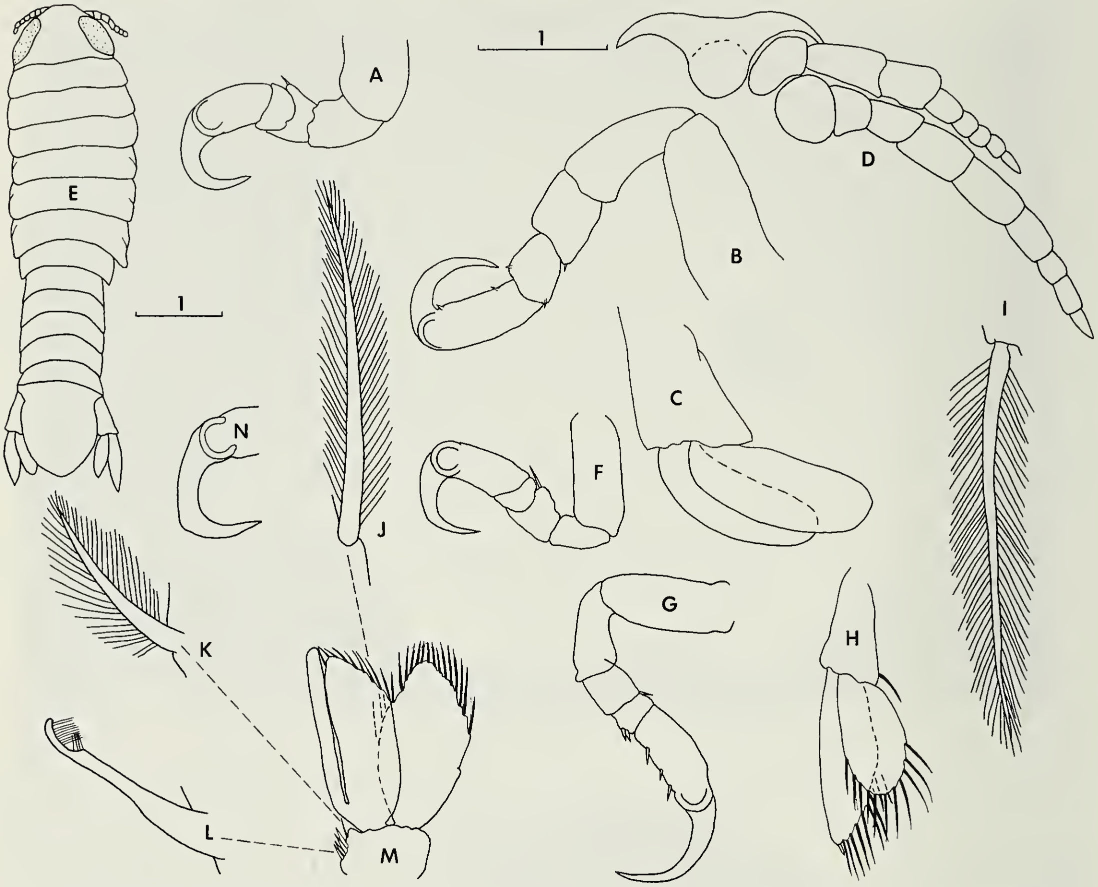


Fig. 25. *Anilocra chaetodontis.* A–D, ♀ with marsupium: A, Pereopod 1, 10×; B, Pereopod 7, 10×; C, Left uropod, 10×; D, Frons and left antennae. E–M, ♂: E, Dorsal view; F, Pereopod 1; G, Pereopod 6; H, Left uropod; I, Natatory seta from uropod; J, Seta from endopod of pleopod 2; K, Sensory seta from pleopod 2; L, Coupling seta from pleopod 2; M, Pleopod 2; N, Dactyl of a ♀ pereopod 2, 10×. ♂ Pereopods, uropod, and pleopod 44×, setae 371×. Scales in mm.

(mean 24.4); 10–12 wide (mean 11). Forty-one immature females were 7–25 long (mean 15.5); 3–12 wide (mean 6.3). Two transitionals were 6–8 long; 2 wide; penis lobes lacking or present; appendix masculina 67 to 75% length found in the male. Fourteen males were 4–5 long (mean 4.4); 1 wide; with pereopod 7 absent or reduced.

Remarks.—One hundred fifteen *Anilocra chaetodontis* were collected on 69 *Chaetodon capistratus,* length 47–94 (mean 73.4); 49 on 20 *Chaetodon striatus,* length 88–122 (mean 104.4); 10 on 4 *Chaetodon ocellatus,* length 68–126 (mean 103); 4 on 3 *Chaetodon sedentarius,* length 81–91 (mean 85). *Anilocra chaetodontis* attached in the subocular region (Fig. 22), but in one case, on a *Chaetodon striatus* with isopods attached below both eyes, a third was attached above the right eye (Great Inagua, Bahamas, 16 April 1977). Damage to the host varied from slight scale erosion to deep bone deformation (from the isopod attached above the eye).

The name is taken from the genus of the hosts.

Anilocra partiti, new species

Figs. 23, 26, 27D

Isopods examined.—13 (6 females with a marsupium, 2 females without a marsupium, 3 immature females, and 2 transitionals).

Type-host and locality (date).—Bicolor damselfish, *Pomacentrus partitus* Poey, Discovery Bay, Jamaica (7–9 January 1980).

Location.—Attached beneath eye of the host (Fig. 23).

Type-specimens.—Holotype (female) USNM # 184833; 5 paratypes USNM # 184834–184837.

Additional localities (date).—Jamaica, Río Bueno (10–11 January 1980).

Diagnosis.—Anterior margin of head truncate, flexed and produced into lobe between bases of antennae 1. Posteroventral angle of pereonite 7 slightly produced, that of pereonite 7 overlapping pleonite 1. Shortest pereonite 2, longest 6. Body axis distorted less than 5°. Telson $^1/_{20}$ to $^1/_6$ wider than long. Pereopods 2–4 with swelling on outer margin of dactyl. Dactylus of pereopod 7 longer than propodus. Uropod not reaching posterior margin of telson. Endopod of uropod not reaching posterior end of exopod.

Further details.—Body expanded oval, length-width ratio 2.0 (1.7–2.2). Head width-length ratio 2.4 (2.1–3.1). Antennae 1 8-merous. Antennae 2 9–10-merous, reaching from almost to posterior edge to beyond posterior edge of pereonite 1. Interocular distance 59% (50–69%) of head width. Distal segment of mandibular palp with 4–7 simple setae, second segment with or without setae. Pleotelson broadly rounded. Color of dorsal and ventral surfaces of body and pereopods black to slate gray in life. Six females with oostegites were 12–16 long (mean 13.7); 5.5–7.4 wide (mean 6.9). Two females lacking oostegites were 12.0–13.5 long; 6.0–6.5 wide. Three immature females were 8.3–12.0 long (mean 9.7); 3.7–4.5 wide (mean 4). Two transitionals were 7.6–9.0 long; 3.2–4.0 wide; lacking penis lobes; appendix masculina 25% length probably found in male.

Remarks.—These parasites were collected from 11 *Pomacentrus partitus,* length 31–51 (mean 43.2). Some erosion of scales occurred in the area of isopod attachment.

The name is taken from the specific epithet of the host.

Anilocra laevis Miers, 1877

Anilocra laevis Miers, 1877:672–673, pl. 68, fig. 6; Gerstaecker, 1901:264–265.

Isopods examined.—1 female syntype of *Anilocra laevis* 1879-21 (BMNH).

Type-host.—Unknown.

Type-locality.—Martinique and Peru.

Type-specimens.—"a specimen from each locality (Martinique and Peru) is in the collection" (BMNH) (Miers 1877).

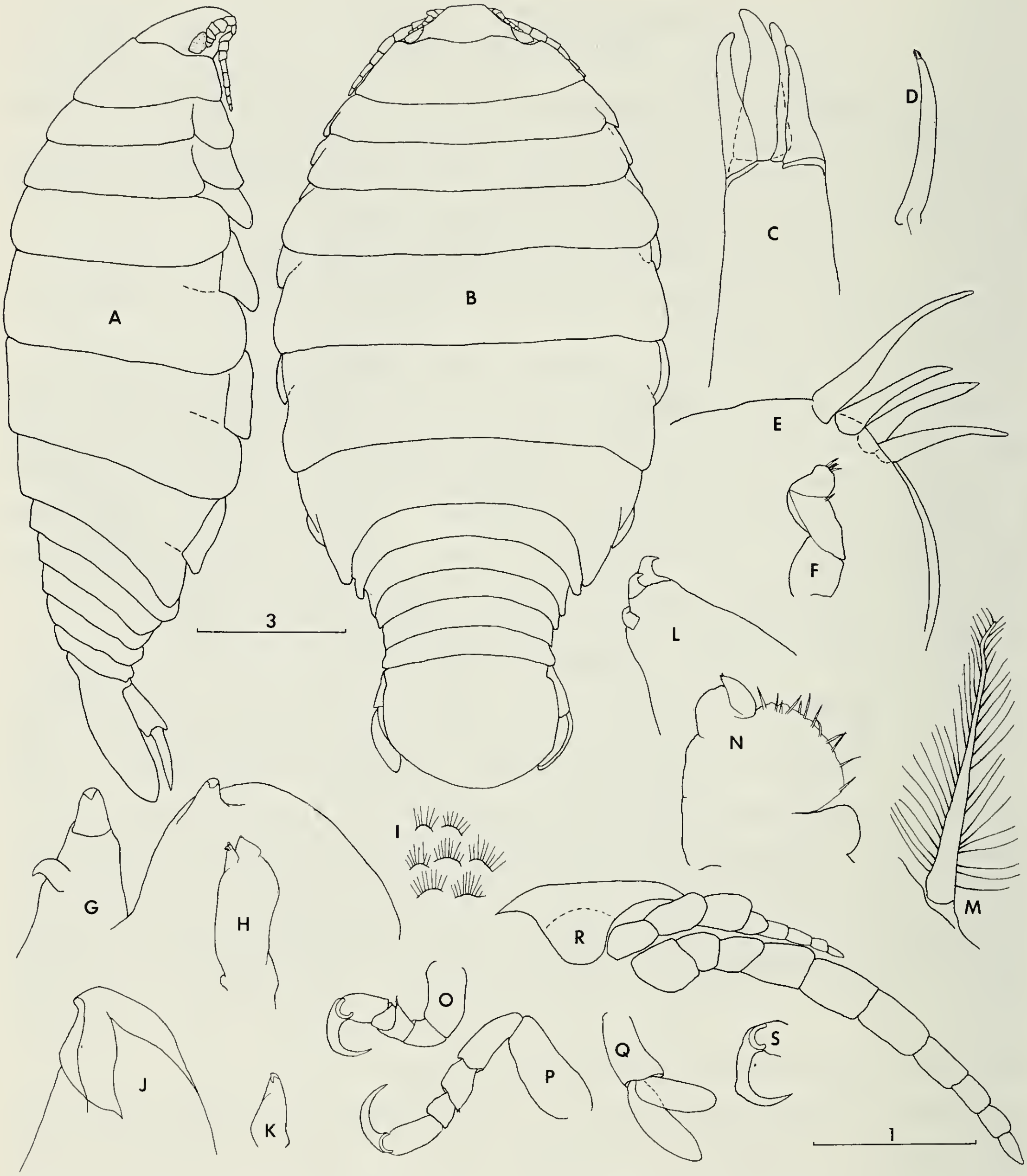
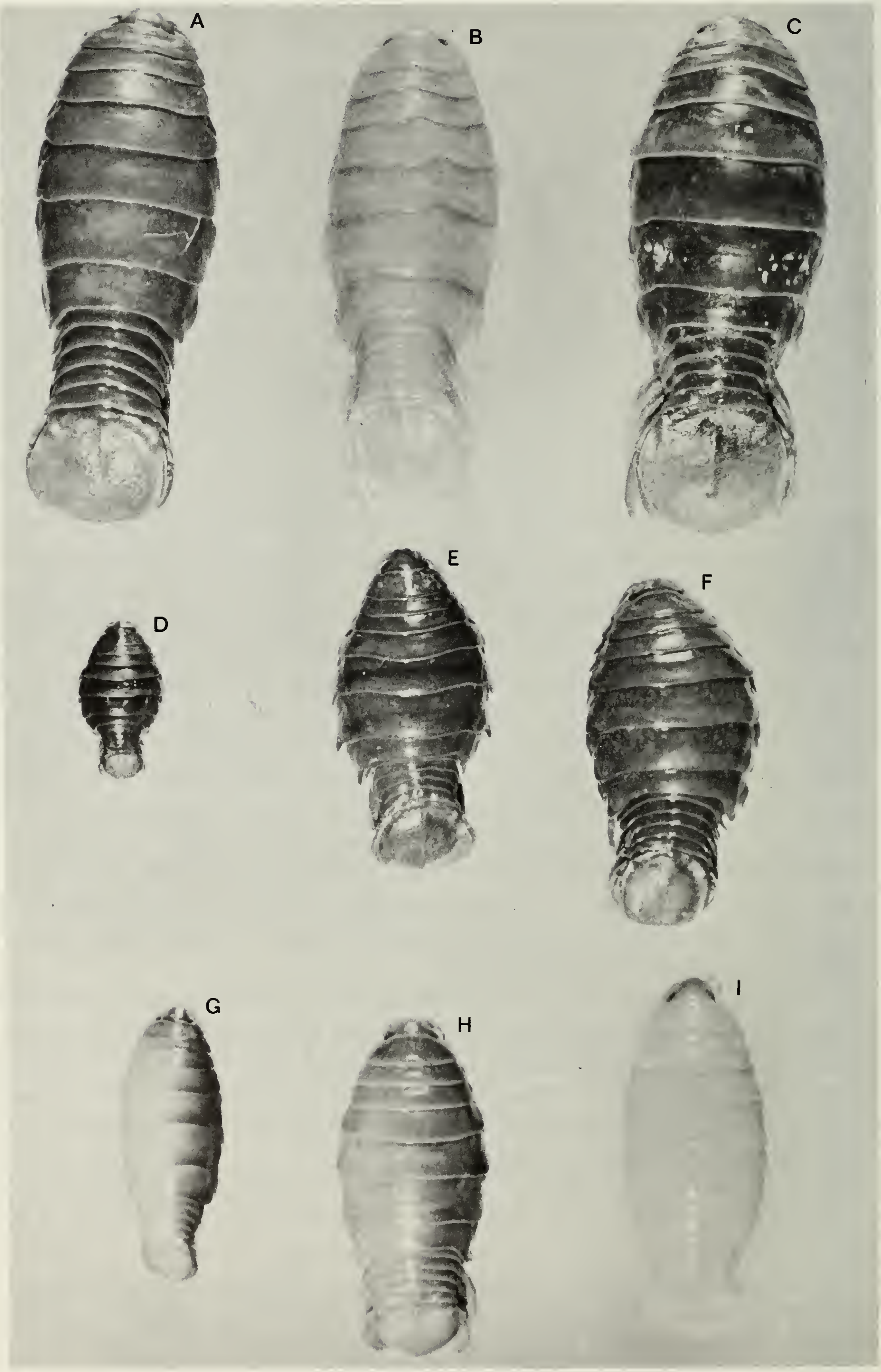


Fig. 26. *Anilocra partiti,* ♀ with marsupium: A, Lateral view; B, Dorsal view; C, Apex of maxilla 1; D, Maxilla 1; E, Apex of distal segment of mandibular palp; F, Mandibular palp; G, Distal lobes of maxilla 2; H, Maxilla 2; I, Scales on maxilla 2; J, Apex of body of mandible; K, Body of mandible; L, Apex of palp of maxilliped; M, Seta from margin of maxilliped; N, Maxilliped; O, Pereopod 1; P, Pereopod 7; Q, Left uropod; R, Frons and left antennae; S, Dactyl of pereopod 2. Mouthparts 29×, enlarged details of mouthparts 363×, pereopods and uropod 10×. Scales in mm.

Remarks.—The syntype of *A. laevis* from Peru is missing; only the syntype from Martinique remains in the British Museum of Natural History (Joan P. Ellis, pers. comm.). Miers (1877) provided measurements; illustrations of the dorsal view of the entire isopod, ventral view of frons and antennae, pereopod 7, and uropod; and a description for *A. laevis*. The measurements of the specimen of syntype (length 41.0; width 15.0) do not precisely correspond to the original measurement (length 40.2; width 15.9). The length-width ratio of the syntype (2.73) does not correspond to the length-width ratio of the measurements (2.53) or the ratio taken from the original figure (2.55). The dorsal view of Miers (1877, Pl. LXVIII, Fig. 6) does not correspond to the dorsal view of the syntype. The telson is wider than long in the syntype, but as long as wide in the figure and the width of pleonite 5 of the figure is approximately ¾ the length of the telson, but in the syntype this width is equal to the length of the telson. Because Miers (1877) illustrated light-shaded (Pl. LXIX, Fig. 4) and dark-shaded (Pl. LXIX, Fig. 5) isopods, and the illustration of *A. laevis* (Pl. LXVIII, Fig. 6) was dark-shaded, the figure must represent a dark-colored isopod. The syntype, however, is not dark, but light yellow in color. The illustration of the frons and antennae (Pl. LXVIII, Fig. 6a) do not agree with the syntype, because the bases of antennae 1 are covered by the frons in the illustration, but exposed on the syntype; and the frons extends posteriorly beyond the bases of antennae 2 in the figure, but only between the bases of antennae 1 in the syntype. Pereopod 7 (Pl. LXVIII, Fig. 6b) is not the same in the figure, where the merus is shorter than the carpus, and the syntype, where the merus is longer than the carpus. The uropods of the figure (Pl. LXVIII, Fig. 6c) and the syntype vary in the width of the basis. Twice the greatest width of the basis is approximately equal to the length of the exopod in the figure, but much less than the length of the exopod in the syntype. The description disagrees with the syntype by the posteroventral angle of pereonite 7 being broad, obtuse, and rounded instead of narrow, acute, and pointed; coxae 4 being obtuse, instead of acutely pointed posteriorly; bases of antennae 1 covered by the frons, instead of exposed; posteroventral angle of pereonite 6 not produced (posterior margins straight), instead of slightly produced; posterior margin of telson rounded, instead of obtuse pointed; and antennae 2 being 9-merous instead of 10-merous.

The length-width ratios and illustrations for *A. laevis* do not correspond with the remaining syntype, and many of the characters found in the description disagree with the syntype. Obviously *A. laevis* was not described from the syntype from Martinique, but from the syntype from Peru. Also, the 2 specimens represent 2 distinct species: *Anilocra laevis* from Peru, and *Anilocra haemuli* from Martinique.

Anilocra laevis may be distinguished from *A. haemuli* by having the bases of antennae 1 covered by the frons; a frons which extends posterior of the bases of antennae 2, instead of between the bases of antennae 1; posteroventral angle of pereonite 7 broad, obtuse and rounded, instead of acutely pointed; posterior margin of telson rounded, instead of obtusely pointed; coxae 4 obtuse, instead of acutely pointed posteriorly; and body darkly colored, instead of yellow to light brown in color.


A
B
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Anilocra laticauda Milne Edwards, 1840, nomen dubium

Anilocra laticauda Milne Edwards, 1840:259.

Type-host.—Unknown.

Type-locality.—Carribbean Sea ("la mer des Antilles").

Type-specimens.—Unknown.

Description.—Antennae 1 not nearly reaching posterior margin of head. Coxae 6 and 7 weakly pointed posteriorly. Pleotelson very large, expanded near midlength, notably wider than pleonite 5, rounded posteriorly. Uropod rami oval, inner same size as outer or smaller. Length about 14 lines (translation of original description in French).

Remarks.—The above paragraph is all that was given in the original description to identify a species described as *Anilocra laticauda* by Milne Edwards in 1840. The locality could apply to any of the 9 species described in the present work. The antennae length noted could apply to individual specimens in any of these 9 species. Depending on how the terms "weakly pointed" are interpreted, coxae 6 and 7 of individual specimens in any of 5 to 9 of these species could be so described. Individual specimens of all but 1 of these 9 species possess a pleotelson which is expanded near midlength, notably wider than pleonite 5, and rounded posteriorly. The uropod relationship in the original description could apply to individuals in any of 6 of these species. The length stated above falls approximately within the size ranges of 8 of these species. With no original illustration, no precise locality, and a very limited original description, the isopod described as *A. laticauda* cannot be identified. To aid in determining this species, a search was made for possible undesignated type material and/or redescriptions based on the original material of Milne Edwards (1840).

Two lots of specimens from the Muséum National d'Histoire Naturelle in Paris could have possibly been the type for *A. laticauda,* IS-492 and IS-294. Neither vial contained the printed label typical of the holotypes of H. Milne Edwards (J. Forest, pers. comm.). IS-492 contained 1 specimen of *A. haemuli* and 1 of *A. acanthuri.* The original description of *A. laticauda* lists the measurements for only a single specimen. Also, the original length 29.6 mm (14 lines), is much shorter than the length of either of these specimens, 34.5 and 36.5 mm. IS-492 contained a single specimen of *Anilocra haemuli* 32 mm in length. Trilles (1975) suggested that this specimen is much closer to the original length reported for *A. laticauda* and is more

←

Fig. 27. New species of *Anilocra,* ♀ with marsupia: A, *A. acanthuri*; B, *A. myripristis*; C, *A. holocentri*; D, *A. partiti*; E, *A. chaetodontis*; F, *A. holacanthi*; G, *A. chromis*; H, *A. abudefdufi*; I, *A. haemuli.* All 1.8×.

likely to represent the original type. *Anilocra laticauda* was originally described (above) with inner uropod rami (endopods) the same size or smaller, than the outer rami (exopods). However, the endopods are longer than the exopods in this specimen. Therefore, this specimen cannot be considered the type for *A. laticauda*. Neither lot IS-492 or 294, could possibly represent the original type for *A. laticauda*.

Anilocra laticauda has been redescribed seven times (Schioedte and Meinert 1881; Moore 1902; Richardson 1905; Nierstrasz 1915; Boone 1930; Bowman and Díaz-Ungría 1957; and Menzies and Glynn 1968). However, none of these redescriptions are based on the original material of Milne-Edwards. Schioedte and Meinert (1881) apparently did not use the original material of Milne Edwards in their redescription. They cite 9 localities, ranging from Maryland, U.S.A., through the Caribbean, and to the Straits of Magellan, for *A. laticauda*. From these specimens collected from a variety of widespread locations, and probably representing a variety of species, a female was selected which was described as yellow in color. *Anilocra haemuli* is the only species in the present work which could be described as yellow in color. The description and illustrations of *A. laticauda* by Schioedte and Meinert also closely agree with *A. haemuli*. Ironically, *A. haemuli* is one of the few species described in the present work which does not conform to the original description of *A. laticauda*. The endopod of the uropod of *A. laticauda* is equal to or shorter than the exopod; in *A. haemuli* the endopod is always longer than the exopod. The endopods and exopods described and illustrated for *A. laticauda* by Schioedte and Meinert (1881) conform to the description of *A. haemuli,* not to the original description of *A. laticauda*. Moore (1902) redescribed *A. laticauda* from 1 specimen of *A. holocentri* (USNM 32655) and 1 specimen of *A. chaetodontis* (USNM #985) collected in Puerto Rico. Richardson (1905) apparently used Moore's specimen of *A. holocentri* from the U.S. National Museum (Moore specimen: 35.5 × 14; Richardson specimen 36 × 14) in her redescription of *A. laticauda*. Richardson (1905) employed the drawings of *A. haemuli* from Schioedte and Meinert (1881) along with line drawings of mouthparts and pereopod 7 possibly from Moore's specimen of *A. holocentri*. Nierstrasz (1915) redescribed *A. laticauda* from 1 ovigerous female of *A. haemuli* (Nierstrasz, 1915, Fig. 7 and 8) and a male from St. Thomas, U.S.V.I., and a juvenile specimen from Venezuela. Boone (1930) redescribed *A. laticauda* from what was possibly a specimen of *A. holacanthi*. Bowman and Díaz-Ungría (1957) provided a short diagnosis of *A. laticauda* from a specimen of *A. haemuli* from Venezuela. Menzies and Glynn (1968) redescribed *A. laticauda* from a specimen of *A. holocentri* from Puerto Rico. The redescriptions of *A. laticauda* were based on different species of *Anilocra* and some were based on more than 1 species of *Anilocra*. The redescriptions of *A. laticauda* are of no value in determining the identity of the species originally described as *Anilocra laticauda*.

Table 1.—Characters distinguishing the species of *Anilocra* known from the Caribbean Sea.

Species:	*haemuli*	*holocentri*	*myripristis*	*acanthuri*	*chromis*	*abudefdufi*	*holacanthi**	*chaetodontis*	*partiti*†
Uropod reaching posterior margin of telson	no	no	yes	no	yes	yes/no	no	no	no
Endopod of uropod extending beyond posterior end of exopod	yes	yes	yes	yes/no	no	yes/no	yes	yes	no
Posterior ventral angle(s) slightly produced in pereonite(s)	6	7	6	—	—	6	5,6	4	7
Posterior ventral angle(s) produced in pereonite(s)	7	—	7	—	—	7	7	5,6,7	—
Posterior ventral angle of pereonite 7 overlapping pleonite(s)	1	1	1	—	—	1	1	2	1
Pereopods 2–4 with swelling on outer margin of dactyl	no	no	no	no	no	yes	yes	yes	yes
Length of females with a marsupium (mm)	≥21 (21–40)	≥32 (32–46)	≥29 (29–40)	≥29 (29–40)	≥16 ≤28 (16–28)	≥19 ≤31 (19–31)	≥21 (21–33)	≥18 ≤28 (18–28)	≤16 (12–16)
Color, dorsal surface of female	yellow to light brown	dark brown	light reddish brown	black to lead-gray	dark-gray and off-white	dark brown and light brown	black to lead-gray	black to lead-gray	black to slate-gray
Location on host	under eye	between eyes	between eyes	under pectoral fin	under eye	under eye	under eye	under eye	under eye

* Body axis distorted more than 10°, all other species in the table with body axis distorted less than 5°.

† Dactylus of pereopod 7 longer than propodus, all other species in the table with dactylus of pereopod 7 shorter than propodus.

The surviving evidence is too meager ever to determine what the name "*Anilocra laticauda*" was intended to designate. Beginning with Schioedte and Meinert (1881), the name has been variously misused for 100 years. The name "*Anilocra laticauda*" should not be salvaged; it is declared a nomen dubium, and should be dropped from usage.

Anilocra leachii Schioedte, 1866, nomen dubium

Anilocra leachii Schioedte, 1866:205, pl. 11, fig. 2; Schioedte, 1868:12, pl. 1, fig. 5.

Type-host.—Unknown.
Type-locality.—West Indies.
Type-specimen.—Unknown.
Description.—Unknown.

Remarks.—Schioedte (1866) labelled seven drawings of the mouthparts of an isopod "*Anilocra leachii,* Kr." No description or additional figures were provided. Schioedte (1868) noted *A. leachii* was very close to *A. laticauda*. The drawing of mouthparts should not constitute a description of a species. Furthermore, the illustration without additional figures, description, locality, or type-series is insufficient information to allow identification of the species of *Anilocra*. The name *Anilocra leachii* should be considered a nomen dubium.

Discussion

Anilocra of Caribbean fishes has been generally considered a single species over the past 140 years. This stability suggests that any species separated from the "*Anilocra laticauda* complex" must be morphologically very similar. Actually these species are morphologically diverse (Fig. 27). The survival of "*Anilocra laticauda* complex" was ensured by the combination of characters included in redescriptions based on different and multiple species of *Anilocra*.

Host specificity and location of adult females are very consistent in the 9 species of *Anilocra* described. Eight of the species are limited to 1 species or 1 genus of hosts, while 1 species infests 3 genera of hosts in 2 families. Only 4 adult female isopods were observed in abnormal positions on the host (as discussed in the species remarks) in more than 800 hosts which were collected and many thousands of hosts which were observed in the field.

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A CONTRIBUTION TO THE TAXONOMY OF THE TUBIFICINAE (OLIGOCHAETA: TUBIFICIDAE)

Ralph O. Brinkhurst

Abstract.—The former genera *Isochaeta* and *Peloscolex* are revised. Both names are rejected on the basis of inadequate description of the original type-species. *Isochaetides* is modified to include 8 species, all with bifid setae. *Varichaeta,* new genus, consists of 2 former *Isochaeta* species plus *V. pacifica,* new species, all with hair and pectinate setae and distinctive male ducts. *Peloscolex* now contains 8 unidentifiable taxa, the other species in the genus being attributed to *Tubificoides* (marine species), *Spirosperma* (8 species), *Baikalodrilus* (4 species), *Haber* (possibly as many as 9 species), and *Quistadrilus,* new genus, for *Peloscolex* sensu Holmquist, with 1 species.

Introduction

Investigation of specimens from Mowich Lake, Mount Rainier, Washington collected by G. Larson in 1966 led to the tentative identification of *Isochaeta nevadana* and a species said to resemble both *Peloscolex variegatus* Leidy and *P. nikolskyi* Last. and Sol. (Brinkhurst 1979). Recent collections of large numbers of these enables them to be redescribed, but the nomenclature cannot be settled without a revision of both *Isochaeta* and *Peloscolex* sensu Brinkhurst (1971). In the course of this study other relevant material collected by Mr. M. Barbour, J. Hiltunen, K. Stimpson, and Dr. M. Loden was brought to my attention, and examination of them has added to this manuscript.

Full bibliographic citations to all species named will be found in Brinkhurst (1971) if not cited in the text.

Isochaeta Pointner, 1911

Type-species.—*Isochaeta virulenta* Pointner, 1911.

The type-material of *I. virulenta* was traced to the University of Graz by Brinkhurst (1963), but despite subsequent work on the River Danube (in which it was first found) and other extensive studies in central Europe, the species has not been rediscovered. Hrabě (1966) reexamined the type and declared it to represent partially mature specimens of *Limnodrilus udekemianus* Clap. 1862. There is sufficient doubt about the existence of the species that it seems best to regard it as species dubium.

The species formerly associated with this genus now have to be reassigned.

Isochaetides Hrabě, 1966 (emended)

Definition.—Bifid setae in dorsal bundles. Vas deferens of one width, much longer than atrium, small prostate present, attached at ental end of atrium, penis sheaths thin or absent, penes usually elongate. Spermathecal setae modified, somatic setae bifid, ventrals of XI, X and XII slightly modified in one species.

Type-species.—*Limnodrilus baicalensis* Michaelsen, 1901 (by original definition).

Distribution.—W. Europe, Lake Baikal, USSR (S. Sakhalin) USA, ? Brazil. Fresh and brackish water.

Remarks.—The type-species of *Isochaetides* Hr. is *Limnodrilus baicalensis* Michaelsen, the types of which were recently examined by the author (Brinkhurst, in press). This species has bifid setae, modified spermathecal setae, long vasa deferentia, short atria not much wider than the former and no distinct cuticular penis sheaths. It is known from Lake Baikal, along with *I. arenarius* (Mich., 1926) which closely resembles the former. The types of both species are in the Zoological Museum of Hamburg University. A third European species, *I. michaelseni* (Last., 1937) has slightly modified genital setae in IX, X and XII but otherwise conforms to the generic type, as does the asiatic *I. suspectus* (Sok., 1964) apart from possession of distinct cuticular penis sheaths, and identifiable ejaculatory ducts.

Tubifex lacustris Cern., 1939 was synonymized with *I. baicalensis* by Brinkhurst (1963, 1966, 1971) on the basis of the similarity of the original descriptions, but zoogeographic considerations would support the position of Hrabě (1966) that the species are distinct but congeneric.

I. hamatus (Moore, 1905) is also recognized as a member of this complex, although it has not been redescribed from fresh material and the types are all immature. A species with very similar setae was described under the name *Psammoryctides curvisetosus* Br. and Cook, 1966, but was transferred to *Peloscolex* by Loden (1978). As the revision of that genus in this manuscript excludes it from *Peloscolex,* it seems more appropriate to place it here as *Isochaetides curvisetosus* (Br. and Cook, 1966) new combination. The relationship between these two North American species can only be clarified by the discovery of the latter in or adjacent to the type-locality of the former in the Acushnet River, above New Bedford, Mass., in brackish water.

Holmquist (1979) suggested that *Peloscolex freyi* Br., 1965 belongs here, and I would confirm that this be done rather than leave it in limbo as it cannot be incorporated within the redefined *Peloscolex* complex.

Siolidrilus adetus Marcus, 1949 was transferred to the genus by Hrabě (1967). Due to the nature of the prostate gland as originally described, and the absence of the spermatozeugmata that are characteristic of members of the Tubificinae, Brinkhurst (1971) aligned the monospecific genus with the Aulodrilinae. The prostate gland could in fact, be regarded as tubificine in nature, and it should be noted that spermatozeugmata were also said to be absent in *I. hamatus* although the specimens were thought to be only partially mature (Moore, 1905), and so the same may be true of *Siolidrilus*. The species is included here following the opinion of Hrabě (1977).

The genus now contains 9 species, most of which need redescribing.

Isochaetides: adetus (Marcus, 1949), *arenarius* (Mich., 1926), *baicalensis* (Mich., 1901), *curvisetosus* (Br. and Cook, 1966) n. comb., *freyi* (Br., 1965), n. comb., *hamatus* (Moore, 1905), *michaelseni* (Last., 1936), *suspectus* (Sok. 1964).

Four species assigned to this genus by Hrabě (1966, 1967) are excluded here primarily on the basis of differences in the male ducts, and secondarily by the nature of the setae, which are now conceded by me to exclude hair and pectinate setae in this genus as befits the original generic name. The following are listed under their original names with their present taxonomic status being indicated.

Limnodrilus newaensis Mich., 1903. Although transferred to *Isochaetides* by Hrabě (1966) on the basis of the lack of hair setae, the male ducts are very closely similar to those of *Tubifex tubifex* (Mull., 1774) and it has long been associated with *Tubifex* by me (e.g., Brinkhurst, 1971).

Limnodrilus pseudogaster Dahl, 1960. The species was redescribed by Baker (1980) who confirmed its placement in the genus *Tubificoides* Last., 1937.

Limnodrilus neotropicus Čern., 1939. The form of the male ducts and especially the cuticular penis sheaths, suggests that this species should be left within *Limnodrilus*. The species lacks the spiral muscles normally associated with the penes of *Limnodrilus,* and it needs redescribing. It was found in Lake Titicaca along with the poorly known *I. lacustris* already mentioned.

Limnodrilus lastoschkini Jar., 1948. The species was identified as *Psammoryctides deserticola* by Finogenova 1972.

Three other species were placed here by me (e.g., Brinkhurst 1971) but all three have hair setae in the dorsal bundles, and male ducts which differ from those of *Isochaetides* sensu strictu. The first, originally described as *Tubifex dojranensis* Hrabě, 1958 is now assigned to *Haber* Holmquist, 1978, as emended below. Two other species, along with a newly described species, are placed in the following new genus in which the vasa deferentia are short relative to the very long, thin atria, in contrast to the reverse in *Isochaetides*. They also possess hair and pectinate setae dorsally.

The species *I. tomilovi* Sem. and *I. koshovi* Sem. are mentioned by Semernoj and Tomilov (1972) and Semernoj (1973) but I have not seen descriptions of them.

Varichaeta, new genus

Holotype.—USNM 64728.

Paratypes.—USNM 64729–64735.

Etymology.—"Varichaeta"—Hair and pectinate setae present dorsally, so setae not all alike, as in *Isochaeta,* from which 2 of the included species were derived.

Definition.—Tubificine oligochaetes in which the male ducts each consist of vas deferens of variable length, a long tubular atrium receiving a small prostate gland near the ental end, and true penes with distinct penis sheaths. Spermathecal setae absent/unmodified, penial setae slightly modified/absent. Hair and pectinate setae present dorsally.

Type-species.—*Varichaeta pacifica,* n. sp. by original designation.

Distribution.—Israel, U.S.A. (Nevada, California, Washington, Alaska).

Varichaeta pacifica, new species
Fig. 1

Worms up to 15 mm long × 0.75 mm broad. Body wall with foreign matter in grooves. Dorsal setae 5–6 or even 10 smooth, long hair setae, 5–6 or up to 8 pectinate setae anteriorly, 2–3 hairs and 2–3 bifid setae in postclitellar bundles, ventral setae up to 6 anteriorly, with upper tooth longer and thinner than the lower, 3–4 in median segments, fewer posteriorly. Ventral setae of XI 3–4 or more bifid setae, slightly wider than normal. Male ducts each with short vas deferens, long tubular atrium with broadest part entally, in region of broadly stalked attachment of moderate-sized prostate gland, thin ejaculatory duct not abruptly demarcated from atrium, penis with large folded basal section capable of erection, large retractor muscles within, tip armoured with cuticular sheath. Spermathecae each with wide vestibule, followed by fairly elongate, cuticle-lined duct and then large, wide ampulla. Spermatozeugmata moderately long.

Type-locality.—Mowich Lake 5000 ft., Mount Rainier, near Seattle, Washington, U.S.A. Coll. P. M. Chapman and Brinkhurst. Other localities: Toolik Lake, Alaska (68°40′N, 149°25′W) 20 km north of Brooks Range. Coll. S. C. Mozley, 1980.

Etymology.—*pacifica,* from the Pacific N.W. of North America.

Varichaeta nevadana (Brinkhurst, 1965), new combination
Fig. 2A

Very small worms. Anterior dorsal bundles with 1–3 hair setae, 1–3 pectinate setae. Anterior ventral bundles with 3–6 setae, upper teeth longer and

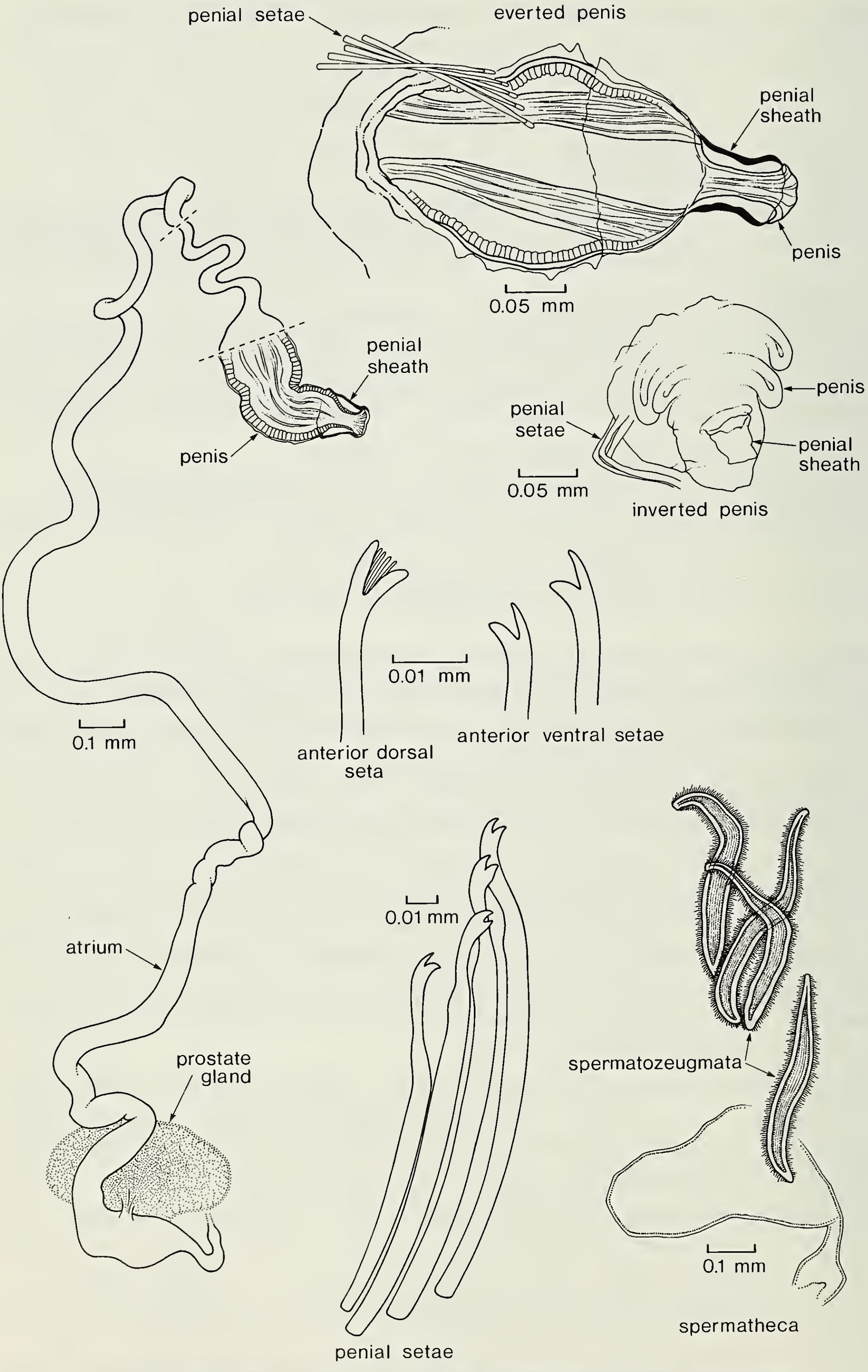

Fig. 1. *Varichaeta pacifica* (from type-series): Setae and reproductive system.

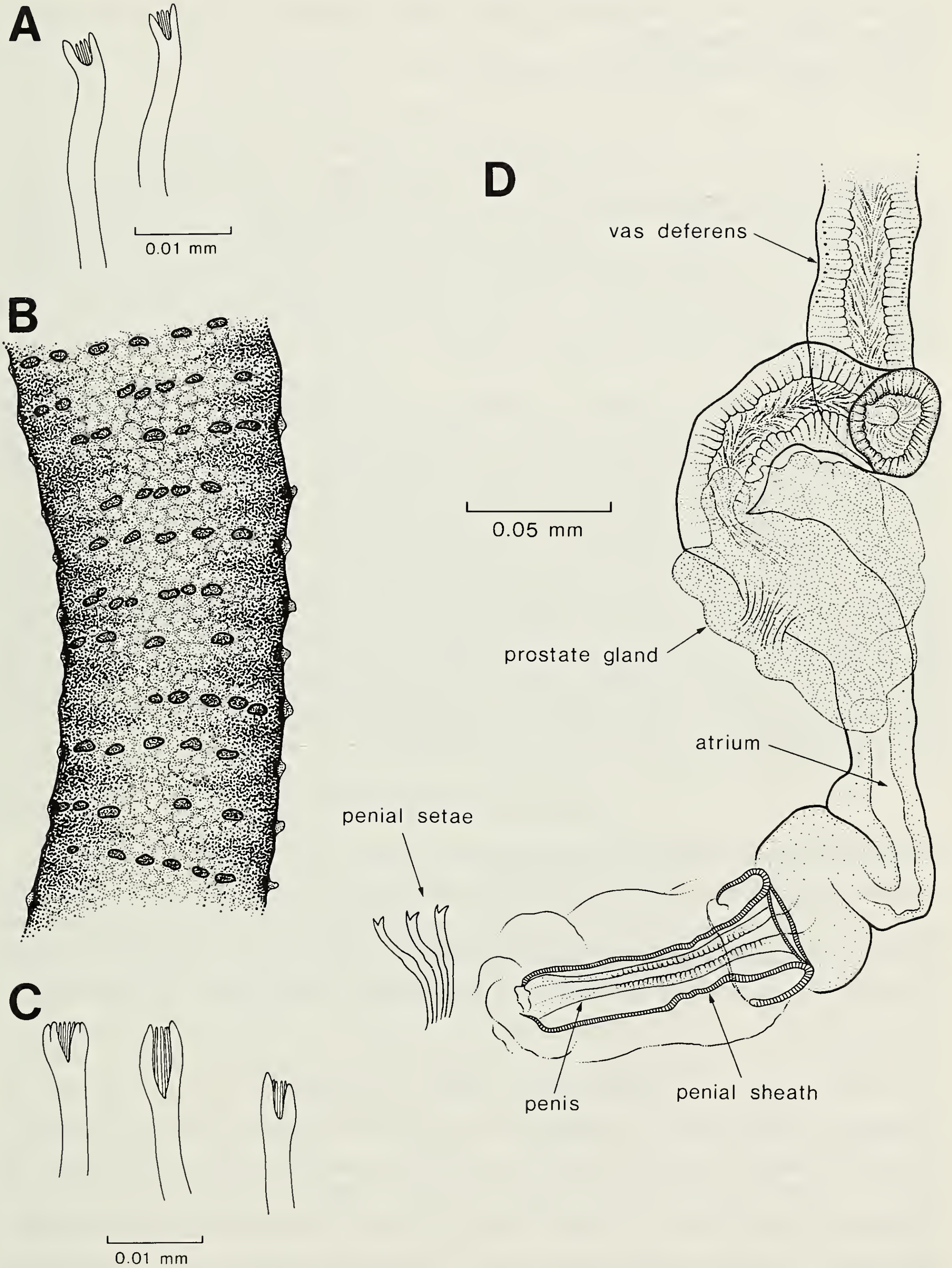

Fig. 2. A, *Varichaeta nevadana* (from type-series), anterior pectinate setae; B, *Embolocephalus velutinus,* body wall, from a photograph by Kasprzak (1976); C, *Embolocephalus beetoni* (from type-series), pectinate setae; D, *Tubifex superiorensis* (from Lake Michigan), ectal end of male duct with atrium, prostate, penis sheath and penial setae.

thinner than lower. No genital setae. Male ducts as in the genus, penis sheaths thin and indistinct.

Lake Tahoe, California/Nevada, U.S.A.

Varichaeta israelis (Brinkhurst, 1971), new combination

Worms about 7 mm long. Body wall with foreign matter adhering. Dorsal anterior bundles with 1 serrate hair and 2 pectinate setae. Anterior ventral bundles with 2–3 setae with upper tooth longer and thinner than lower and a single intermediate tooth. No genital setae. Male ducts with long vasa deferentia, otherwise as the genus, penis sheaths thin.

Salt spring by Lake Tiberias, Israel.

Discussion.—Two of these 3 species were originally described as members of the genus *Isochaeta* (now *Isochaetides*). The two genera differ in that *Isochaetides* species have long vasa deferentia, short atria, genital setae and quite long penes, and all the species lack hair and pectinate setae.

Other possible inclusions here would be *Tubifex solitarius* Semernoj, 1972 and the similar *Ilyodrilus sokolskayae* Brinkhurst, 1970 (=*I. orientalis* Sokolskaya, 1969) in which the male ducts more closely resemble *Ilyodrilus* (with wide vas deferens and posterior prostates on the atria so far as can be deduced from the drawings) but in which erectile penes like those of *V. pacifica* are present. Penial forms are duplicated in various genera, so the close relationship to *Varichaaeta* is unlikely.

Peloscolex Leidy, 1851

Type-species.—*Peloscolex variegatus* Leidy, 1851—dubious species.

Discussion.—The genus *Peloscolex* has been in need of revision for a long time because many species were associated with it on the basis of the papillate nature of the body wall (which may be papillate in many naidid or tubificid genera in fact) without due attention to the form of the male duct (Brinkhust 1971). The type-species was only very briefly described in the first instance, and the species was never rediscovered until a likely candidate was redescribed by me (Brinkhurst 1962). Although variously regarded as a genus or a subgenus of *Tubifex,* the name *Peloscolex* has been used for one of the largest assemblages of tubificids since the major monographs of the late 19th century despite the lack of a clearly defined type-species. Holmquist (1978, 1979) examined many species and produced detailed descriptions of many of the male ducts, but the revision, while clearing up many problems, created 2 difficulties. The first involves the recognition of another American species, originally described as *Embolocephalus multisetosus* Smith, 1900, as a possible synonym of *P. variegatus,* with the new name *E. confusus* Holmquist, 1979 being attributed to *P. variegatus* sensu Brinkhurst. This would cause considerable confusion to American biologists, especially as Holmquist also demonstrated that the male ducts of *multisetosus* differ from those of the bulk of freshwater "*Peloscolex*" species, which means that the name *Peloscolex* would become restricted to *multisetosus* and the European species *P. moszynskii* Kasp., 1971—which is apparently synonymous with *multisetosus*.

The recognition of *P. variegatus* sensu Brinkhurst as the type-species was defended by Brinkhurst (1979) on both morphological and ecological evidence, but the truth of the matter is that the original description of the type-species is too vague for any final decision to be reached. In the following account the contentious name *Peloscolex* will be restricted to 8 dubious taxa, and most of the major groupings recognized by Holmquist will be accepted as genera or subgenera.

The second issue raised by Holmquist's revision is the placement of a large number of species which she felt could not be attributed to any genus for certain. This opinion, while taxonomically rigorous, is not of much practical help to ecologists and others who need to cite species by some acceptable name. A very large percentage of tubificid species is poorly described and/or lacks type-specimens, and it is my view that most species should be attributed to clearly defined genera wherever possible. The following account is, therefore, an attempt to add to the process of revising *Peloscolex* begun by Holmquist while recognizing that such revisions will inevitably need to be updated from time to time in this family.

Three species described by Pop (1974) cannot be identified with any certainty and remain as dubious species in this genus. They are *P. arganoi, P. boitanii,* and *P. cottarelli.*

Two Russian species, *P. malevici* (described by Cekanovskaya 1975) and *P. chukotensis* (described by Morev 1979) cannot be assigned to genera until redescribed in more detail.

Other dubious species associated with the name *Peloscolex* are shown in the concluding list in this manuscript.

Spirosperma Eisen, 1879 (emended)

Definition.—Prostomium and at least first segment retractable within rest of body. Body wall with large sensory papillae in circles on each segment (Fig. 2B) and/or covered by a secreted layer with attached foreign matter, aggregated into papillae which can cover body wall and obscure sensory papillae (at least in preserved specimens) or reduced to a series of concentric rings even within a single species. Hair setae broad and sabre-like in most instances, bifid or pectinate dorsal setae often with small tips or lyre-shaped tips where better developed. Ventral setae may be simple-pointed in some or all bundles, but are unusually variable in tooth development thickness and curvature even on a single specimen. Hollow spermathecal setae may replace ventrals in X in mature specimens. Male ducts each with long vas deferens, usually separated into narrow and wide sections, atrium large, more-or-less crescentic in shape due to median attachment of large prostate glands, ejaculatory ducts variously developed, penes elongate in large sacs, with or without thin cuticular sheaths often little thicker than body-wall cuticle. Spermathecae with voluminous ampullae, often long ducts. Spermatozeugmata elongate, vermiform.

Type-species.—Spirosperma ferox Eisen, 1879.

Distribution.—Holarctic.

Synonyms.—Embolocephalus Randolph, 1892, *Orientodrilus* Holmquist, 1978.

The genus *Orientodrilus* was erected by Holmquist (1978) for the single species *O. nikolskyi* (Last. and Sol.), although she stated: "The genera *Embolocephalus, Spirosperma* and *Orientodrilus* may be closely related, considering not only the construction of their male organs but also the fact that they all have a cutaneous cover and strong head retractors. *Embolocephalus* and *Orientodrilus* on the one hand share the character of modified spermathecal setae, *Orientodrilus* and *Spirosperma* on the other hand the characters of crescent-shaped atria and long ejaculatory ducts." Such differences are incorporated within other tubificid genera and *Orientodrilus* is clearly intermediate between the other two genera proposed by Holmquist. The number of species involved is quite small. While I regard this as a single genus, the differences seem to be sufficient to merit subgeneric status for *Spirosperma* and *Embolocephalus*. The curvature of the atrium and length of vas deferens varies within both subgenera even according to the illustrations by Holmquist (1978, 1979).

Spirosperma (*Spirosperma*) Eisen, 1879, new subgenus

Definition.—Spirosperma species lacking simple-pointed ventral setae and modified spermathecal setae. Dorsal setae hairs and clearly pectinate setae. Body wall with or without papillae. Penis sheaths present.

Type-species.—Spirosperma ferox Eisen, 1879.

Species list.—

S. (*S.*) *ferox* (Eisen, 1879)

E. plicatus Randolph, 1892.
S. papillosus Beddard, 1895.

Europe, E. North America. Closely papillate to non-papillate. Anterior ventral setae sometimes with pectinations. Ejaculatory ducts long. Spermathecal ducts moderately long.

S. (*S.*) *tenuis* (Hrabě, 1931)

P. tenuis striatus Pop, 1977.
P. scodraensis Hrabě, 1958.

Yugoslavia (L. Ohrid, Prespa, Skadar). Ventral setae strongly recurved, thicker in *tenuis* than in *scodraensis*. Spermathecal ducts short.

S. (*S.*) *apapillatus* (Lastochkin and Sokolskaya, 1953)

P. a. sachalinensis Sokolskaya, 1964.
P. kamtschaticus Sokolskaya, 1961.

Asiatic USSR. Thin, non-papillate cutaneous covering. Ventral setae bluntly pointed, not strongly recurved. Spermathecal ducts long.

Remarks.—It seems better to follow Holmquist (1979) in separating *tenuis* from *apapillatus* at the same level as these are separated from *ferox*. The zoogeographic evidence then begins to suggest that subspecific rank could be applied to a near-holarctic *P. ferox* (none of these taxa being identified from western N. America yet).

The atria of *S. tenuis* (see Holmquist 1979, Fig. 13) are almost identical to those of *S. nikolskyi* (Holmquist 1978, Fig. 3) and *S. ferox* (Holmquist 1978, Fig. 2B) apart from the size of the penis (which varies within many genera, e.g. *Limnodrilus*) and so there is no basis for the separation of *Orientodrilus* (type *nikolskyi*) from *Spirosperma* (type *ferox*) according to this fundamental generic character of tubificids.

Spirosperma (*Embolocephalus*) Randolph, 1892, new rank as subgenus

Definition.—*Spirosperma* species with spermathecal setae present, penis sheaths absent, at least some simple-pointed ventral setae present, dorsal setae hairs and hair-like setae with small bifid to pectinate tips.

Type-species.—*Saenuris velutina* Grube, 1879.

Species list.—

S. (*E.*) *velutinus* (Grube, 1879)

Tubifex sarnensis Pierantoni, 1904.
Peloscolex cernosvitovi Hrabě, 1958.
Peloscolex fontinalis Hrabě, 1964.

Europe. Dorsal setae bifid or pectinate. Ventral setae all simple-pointed or with strongly reduced upper tip or occasionally clearly bifid. The ventral setae vary strongly in single specimens. Spermathecal setae are present in *P. cernosvitovi* (see Holmquist 1979). The male ducts of *E. velutinus* have been described by Holmquist (1979) and Martinez-Ansemil and Giani (1980), demonstrating the expected minor differences between specimens and/or illustrator's interpretation.

S. (*E.*) *nikolskyi* (Lastochkin and Sokolskaya, 1953)

Fig. 3

? *Tubifex* (*Peloscolex*) *nomurai* Yamamoto and Okada, 1940.
? *Peloscolex* sp. Yamaguchi, 1953 (=*P. yamaguchii* Brinkhurst, 1971).
Peloscolex kurenkovi Sokolskaya, 1961.
Peloscolex oregonensis Brinkhurst, 1965.
E. alaskensis Holmquist, 1979.
E. confusus Holmquist, 1979 (=*P. variegatus* sensu Brinkhurst).
Orientodrilus nikolskyi (L. and S.) Holmquist, 1978.

Holarctic. Dorsal setae variously pectinate, ventral setae of II–III or even IV with 1 or 2 simple-pointed setae as well as 1–2 bifid setae, the rest bifid.

Remarks.—*Peloscolex yamaguchii* is too poorly described to be sure of its position, but it does have spermathecal setae. In this and the older Japanese *T. nomurai* there is no mention of simple-pointed setae, but when these descriptions were published, such setae had yet to be described in any of these species, and they are a unique characteristic of these taxa. The hair setae are clearly serrate in many of these forms. The serration has not yet been seen in Great Lakes specimens. All have spermathecal setae, but only the glandular sacs were seen in *T. nomurai*.

The range of variation in the other taxa is no greater than that in the other variable species in the genus. They could be erected as subspecies if it were deemed necessary, as was done in the case of *E. stankovici* by Hrabě and others (see below).

The Mowich Lake specimens have 2–4 or sometimes 6 serrate hair setae, a similarly variable number of pectinate setae with thin tips, ventral setae of II–III a mixture of simple-pointed and bifids, usually 2 of each, sometimes 3, 1 posteriorly, bifids with upper teeth thinner and a bit longer than lower anteriorly. The ventral setae of X are modified spermathecal setae. The male ducts are long, the atria somewhat crescentic, the penes elongate with the cuticle slightly thicker than ordinary cuticle, and extending up the inside of the penis. The longer spermathecal ducts also have a cuticular lining. They have large ampullae and elongate spermatozeugmata (Fig. 3).

The serrate hair setae were observed in *P. oregonensis* by Timm and Medvedev (1972).

S. (*E.*) *carolinensis* (Brinkhurst, 1965)

U.S.A. (N. Carolina). Dorsal setae with minute tips, ? bifid. Ventral setae of II–VIII with 1 bifid, 1 simple-pointed seta.

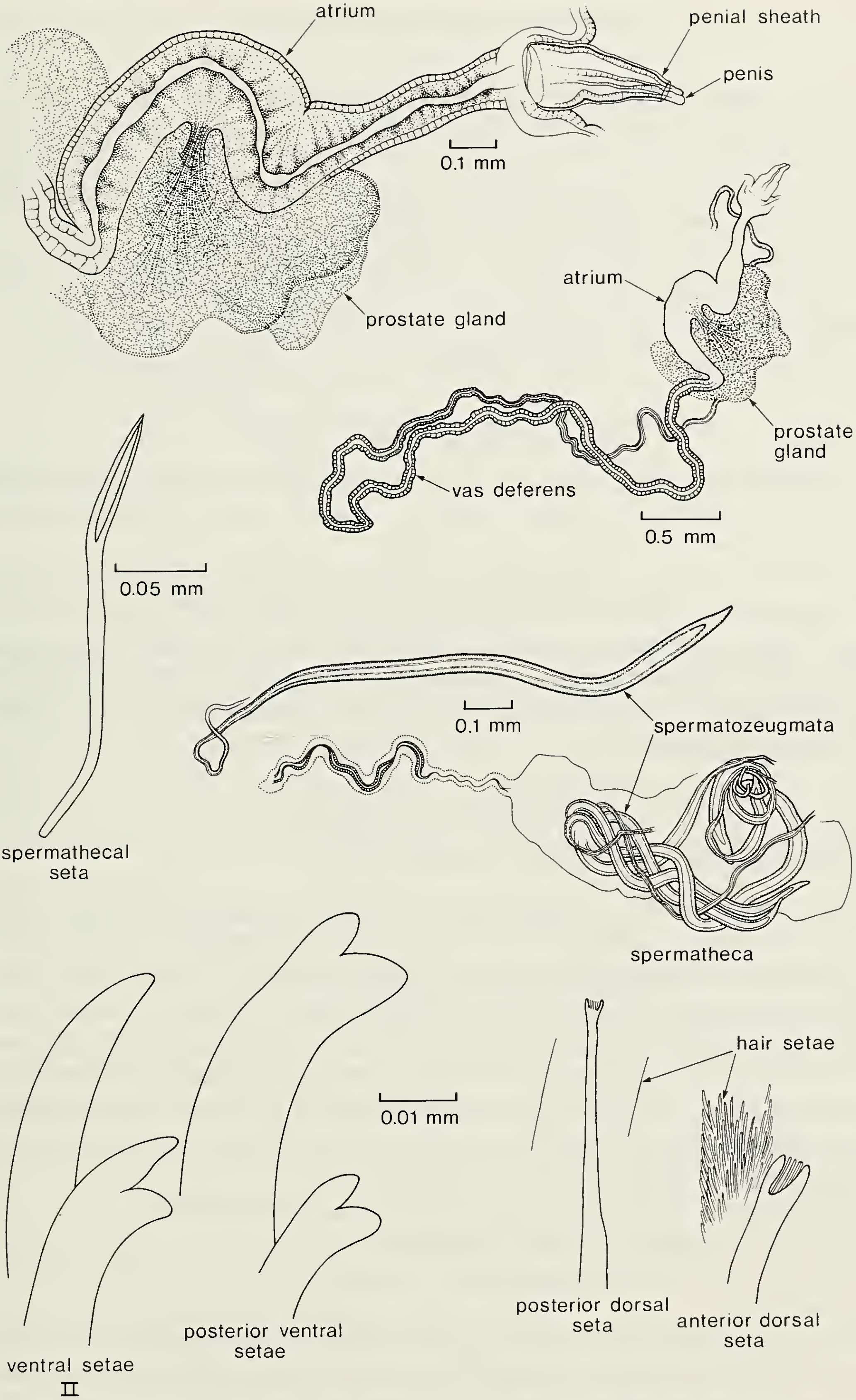

Fig. 3. *Embolocephalus nikolskyi* (from Mowich Lake), setae and reproductive structures.

S. (*E.*) *beetoni* (Brinkhurst, 1964)
Fig. 2C

U.S.A. (Lake Tahoe). Dorsal setae usually pectinate, can be bifid or webbed. Ventral setae bifid with teeth variously developed from about equal (usually in some anterior bundles) to those with rudimentary upper tips (usually posterior) or simple-pointed in some or even most bundles throughout. Setae may be enlarged in some near-posterior bundles.

Remarks.—The dorsal setae are not simply bifid as suggested by Holmquist (1979) though some setae may be in some bundles of the type. The illustration (Fig. 6B of Holmquist) shows so many interference fringes as to be hard to interpret, unlike the other, more useful illustrations (i.e. Fig. 7C).

S. (*E.*) *stankovici* (Hrabě, 1931)

Lake Ohrid and the R. Danube. Dorsal setae with hair setae varying from a few to 16–19 in postclitellar bundles, ventrals simple-pointed or bifid. Sensory papillae very large and prominent.

Remarks.—Various subspecies have been described, again emphasizing the considerable range of setal diversity and body wall formation in the group. These are subspecies *typica, sublitoralis,* and *litoralis* of the original account, plus another also named *litoralis* by Sapkarev (1953) in the belief that Hrabě had only named the first 2, and the more recent *istriensis* Pop, 1977, from the Danube.

Quistadrilus, new genus

Peloscolex Leidy, 1851, sensu Holmquist, 1978.

Definition.—Tubificine oligochaetes in which the male ducts each consist of long, winding vas deferens, opening apically (or slightly subapically) into long, tubular winding atrium, prostate gland moderate, opening entally into atrium, atrium ends abruptly above small penis in short penis sac, no penis sheath. Spermathecal ampullae long, tubular, ducts long, slightly narrower than ampullae. Spermatozeugmata long, narrow. Hair and pectinate setae present dorsally, setae very numerous especially posteriorly. No modified genital setae, ventral setae bifid. Circlets of prominent papillae and small papillae on body wall.

Type-species.—Embolocephalus multisetosus Smith, 1900.

Distribution.—Europe, North America.

Etymology.—From Holmquist, who separated the species from *Embolocephalus* et al.

Discussion.—Holmquist (1978) synonymized the type-species *E. multisetosus* with *P. variegatus* Leidy, but it seems to this author that it is better to leave the latter as an unidentifiable species, as discussed above. This decision requires a new genus for one species, *E. multisetosus* (including

P. moszynskii Kasp., 1971, the first European discovery of the species, also recorded by Juget and Lafont (1979)).[1]

The large papillae and large number of hair setae of this species are also found in *S. stankovici,* but the male ducts of *multisetosus* are quite different to those in the other genera in this complex. The atria are broad and curved over the entally-attached prostates, but continue as long, narrow sacs rather than distinct ejaculatory ducts before broadening again just before terminating in small, naked penes. The closest approximation to this type of male duct can be observed in *Baikalodrilus* (q.v.). Other characteristics, such as the long vermiform spermatozeugmata, resemble those of others in the wider assemblage but, while it is inconvenient to have monotypic genera, it seems to be stretching the limits too far to use this species as evidence to bridge the gap between *Baikalodrilus* and *Spirosperma* and so maintain most of the freshwater element of the former *Peloscolex* as a single genus under the latter name, with *Haber* and the marine *Tubificoides* as independent genera.

Baikalodrilus Holmquist, 1978 (emended)

Definition.—Body wall covered with secretion and foreign matter. Hair setae present, bifid setae with or without simple-pointed setae ventrally, no modified spermathecal setae. Prostomium, segment I and at least part of II retractile. Vas deferens moderately long and thin, opening apically to atrium. Prostate large, enters atrium ⅓ of length from ental end or less, ejaculatory duct short or absent, penes small, without cuticular sheaths. Spermathecal ampulla distinct from ducts, which vary in length, spermatozeugmata elongate.

Type-species.—Peloscolex kozovi Hrabě, 1969.

Distribution.—Lake Baikal.

Discussion.—The genus was designated by Holmquist (1978, 1979) for *P. kozovi* Hrabě, and a new species named *B. digitatus* Holmquist for material from Lake Baikal supplied as specimens of *P. werestschagini* Mich., 1933 (also restricted to that locality).

It would seem, from the unusual body form that *P. werestschagini* shares with the other two, that it must belong to this genus. It lacks the elaborate finger-like papillae of *B. digitatus* (though it should be noted that papillation varies in many species, and only a single specimen of the earlier species was observed). It is said to differ from *kozovi,* which also lacks the digitate processes, in the thickness of the secreted layer on the body wall and the presence of 1 rather than 2 anterior ventral setae.

The poorly-known *Tubifex inflatus* Mich., 1901 usually associated with *Peloscolex* in recent literature, has a very different body form to the above,

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[1] Now also Pfannkuche, O. 1981. Arch. Hydrobiol. (suppl.) 43:506–524, in the Elbe.

but the male ducts are not drastically different apart from the presence of a very short ejaculatory duct and a wider lumen. It seems convenient to place it here, with the other Baikal species. Examination of the types (Brinkhurst, in press) has added little to the solution of this problem, but new material from Baikal is on hand.

Haber Holmquist, 1978

Definition.—Tubificine oligochaetes in which the male ducts each consist of a long, winding vas deferens which widens abruptly before entering a relatively narrow atrium apically, prostate gland of moderate size enters medially, atrium narrows gradually to an ejaculatory duct, penis with thick basement membrane resembling cuticular penis sheath. Spermathecal and penial setae modified, in glandular sacs. Hair and pectinate setae present.

Type-species.—*Tubifex speciosus* Hrabě, 1931.

Distribution.—Balkan Lakes, Pyrenees, Britain, U.S.A. (New York), Asia (Amur River).

Discussion.—This genus is quite distinct and, as suggested by Holmquist (1978, 1979) contains the Balkan Lakes taxa[1] *speciosus* (Hr.), *zavreli* (Hr., 1942); *monfalconensis* Hr., *dojranensis* (Hr., 1958) plus the asiatic *amurensis* (Sol. and Hr., 1969), and the British *simsi* (Br., 1966).

The French species *P. pyrenaicus* Juget and Giani, 1974, and *P. turquini* Juget and Lafont, 1979 are now attributed to *Haber*. The former has spermathecal setae, penial setae in at least some specimens, hair and pectinate setae dorsally and cuticular penis sheaths of an odd form with basal folds reminiscent of those described in *Haber* species. The atria are not much wider than the vasa deferentia. The second species has much the same set of characteristics and both clearly belong here.

Finogenova (1972) demonstrated that *Ilyodrilus svirenkoi* Lastochkin is closely related to *H. speciosus,* then thought to be a *Tubifex* species.

Haber cf. *speciosus* Hrabě, 1931

Fig. 4

Single broken specimen, 0.15 mm wide at peristomium, small worm. Dorsal anterior setae 2–3 hairs and 3–4 pectinates with long lateral teeth and fine intermediate teeth, posteriorly 1 hair and 1 bifid seta with shorter teeth. Ventral setae anteriorly 3–7, teeth long and sharply pointed, the upper longer than the lower, 3 posteriorly with shorter teeth. Penial and spermathecal setae long, thin, hollow tipped, in glandular sacs. Cuticular basal membranes (?) in penes (resembling penis sheaths) present.

One mature specimen, coll. K. Stimpson, in a shallow riffle with swift current, large cobbles, 4.8 km upstream of railroad bridge, above Goudey Generating Station, Binghamton, Broome Co., New York, Susquehanna R., 2 August 1976. Smithsonian Institution USNM 065223.

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[1] Subspecific or specific ranks have yet to be determined.

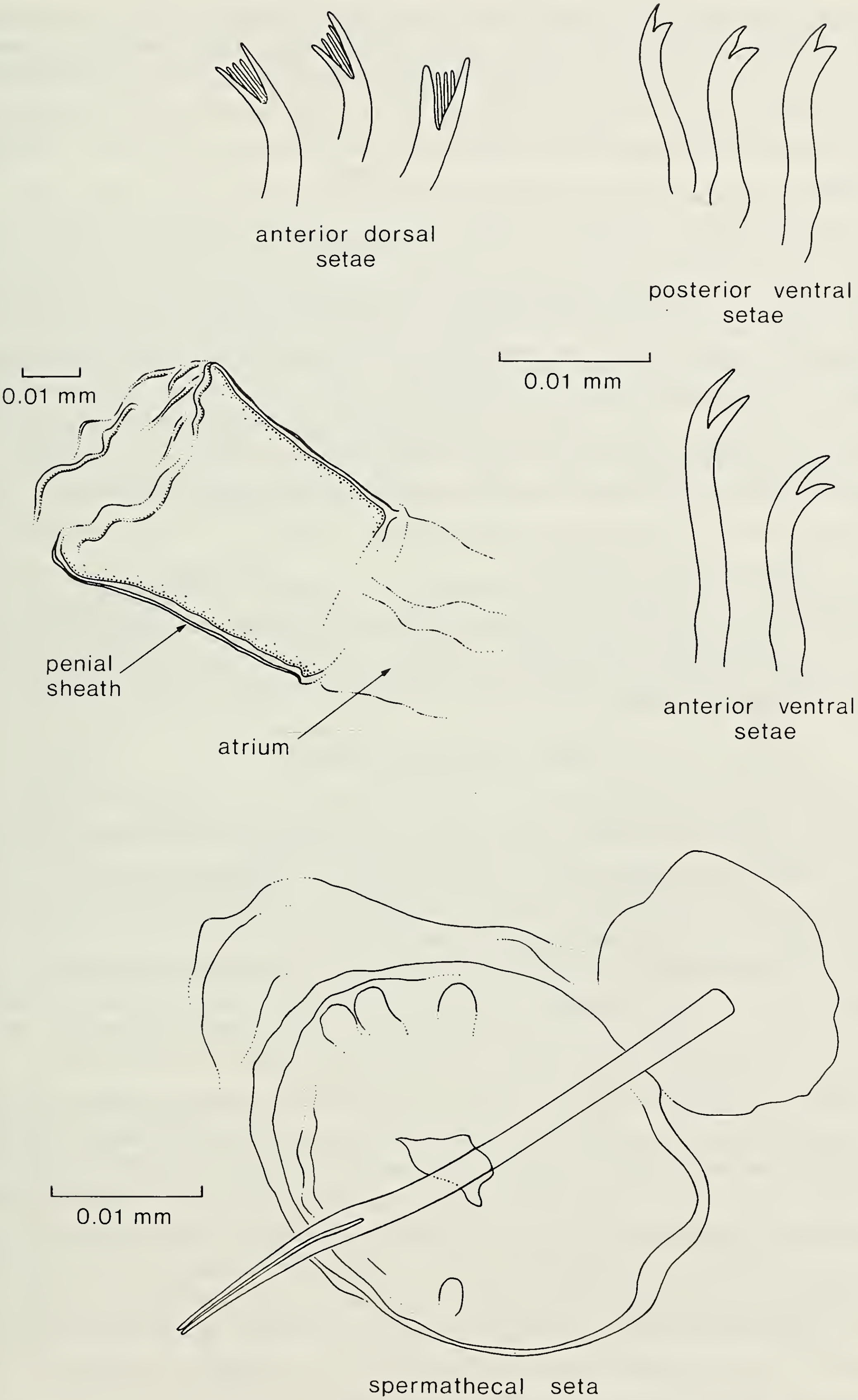

Fig. 4. *Haber* ? *speciosus* (from New York state), somatic and genital setae, penis sheath.

Remarks.—This single specimen (Fig. 4) clearly belongs to the genus, but it would be premature to identify the species. No further specimens have been found, but another possible congener was found by the same collector in the Hudson River (near Stuyvesant, New York, after junction of Schodack Creek and Hudson River, June 1977; Smithsonian Institution, USNM 065224).

Tubificoides Lastochkin, 1937, em. Brinkhurst and Baker (1979)

Definition.—Tubificine oligochaetes in which the male ducts each have moderately long vas deferens entering atrium subapically opposite to attachment of large prostate, isolating distal cap-like portion of atrium, rest of atrium somewhat cylindrical with distinct ectal end, penes with cuticular sheaths. Posterior dorsal setae, at least, frequently reduced to simple-pointed form resembling the hair setae (where present). Hair setae present or absent. Genital setae absent. Body wall variously papillate or naked.

Type-species.—*Tubificoides heterochaetus* Last (=*T. swirencowi* Jar., *non T. heterochaetus* (Mich.)).

Distribution.—Europe, North America, ? S. American (Marine).

Discussion.—The genus was extended by Brinkhurst and Baker (1979) to include many former *Peloscolex, Tubifex* and *Limnodrilus* species, all of them marine. The genus *Edukemius* Holmquist is regarded as a subgenus.

Other *Peloscolex* Species

With this interpretation we are now left with a few unplaced species. Several of these are clearly inadequately described from immature juveniles or are otherwise unidentifiable. These include 3 species described by Pop (1974) plus the 2 monotypic genera *Trachydrilus* and *Spilodrilus* of Piguet (1828) and 2 recent Russian species (see *Peloscolex*).

Three other species are the responsibility of the author, having been described in the earliest attempt to catalog the North American Tubificidae. *Peloscolex curvisetosus* (Br. and Cook) of Loden (1978) and *P. freyi* Br. have been transferred to the genus *Isochaetides*.

Peloscolex superiorensis Br. and Cook, 1966 has hair and pectinate setae, no spermathecal or penial setae, but does have a cylindrical penis sheath. In specimens from Lake Michigan collected by J. Hiltunen in 1964, the atria are little wider than the (broken) vasa deferentia (Fig. 2D). The moderate sized prostate gland appears to be attached quite near the apex of the atrium, though the junction of the atrium and vas is hard to determine. Ventral setae are present beside the penis sheaths as observed in *Varichaeta pacifica,* but the penis sheaths more strongly resemble those of a *Tubifex* or *Ilyodrilus* species. The presence of hair and pectinate setae suggests a possible relationship with these genera. There is no enlargement of the vas deferens, as in the latter, and the atria are too short for placement in *Varichaeta,* so I propose to place the species in the genus *Tubifex* pending a better description of the male ducts. This then creates the name *Tubifex superiorensis* (Brinkhurst and Cook, 1966), new combination.

Conclusion

As a result of this reexamination of the recent revision of the genus *Peloscolex* by Holmquist (1978, 1979) it seems possible to recognize the valuable comparative descriptions of the male ducts, body wall and setae in that study and to accept all but 3 of the genera proposed. Two are seen as subgenera of others (*Edukemius* within *Tubificoides, Embolocephalus* within *Spirosperma,* while *Orientodrilus* is merged with *Spirosperma.* The genus *Peloscolex* is restricted to the unidentifiable *P. variegatus* Leidy as originally described, plus a few unplaceable species.

The genus *Varichaeta* is separated from *Isochaetides,* and *Isochaeta* is left with a single unidentifiable species. These decisions are summarized as follows:

- *Isochaetides* (emended)
  - *I. baicalensis*
  - *I. arenarius*
  - *I. suspectus*
  - *I. michaelseni*
  - *I. hamatus*
  - *I. adetus*
  - *I. freyi* n.comb.
  - *I. curvisetosus*, n. comb.
  - *I. tomilovi* ? nom. nud.
  - *I. koshovi* ? nom. nud.
- *Isochaeta* (emended)
  - *I. virulenta*, sp. dub.
- *Varichaeta*, gen. nov.
  - *V. pacifica*, n. sp.
  - *V. nevadana*, n. comb.
  - *V. israelis*, n. comb.
- [1]*Haber* (emended)
  - *H. speciosus*
  - *H. zavreli*
  - *H. monfalconensis*
  - *H. dojranensis*, n. comb.
  - *H. simsi*, n. comb.
  - *H. pyrenaicus*, n. comb.
  - *H. turquini*, n. comb.
  - *H. svirenkoi*, n. comb.
  - ? *H. amurensis*, n. comb.
- *Peloscolex* (emended)
  - *P. variegatus*, sp. dub.
  - *P. arganoi*, sp. dub.
  - *P. boitanii*, sp. dub.
  - *P. cottarelli*, sp. dub.
  - *P. malevici*, sp. dub.
  - *P. debilis*, sp. dub.
  - *P. marinus*, sp. dub.
  - *P. pigueti*, sp. dub.
    (=*Trachydrilus plicatus*)
- *Spirosperma* (emended)
  - *S.* (*S*). *ferox*
  - *S.* (*S*). *tenuis*
  - *S.* (*S*). *apapillatus*
  - *S.* (*E*). *velutinus,* n. comb.
  - *S.* (*E*). *nikolskyi,* n. comb.
  - *S.* (*E*). *carolinensis,* n. comb.
  - *S.* (*E*). *beetoni,* n. comb.
  - *S.* (*E*). *stankovici,* n. comb.
- *Quistadrilus*, gen. nov.
  - *Q. multisetosus*, n. comb.
- *Baikalodrilus* (emended)
  - *B. kozovi*

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[1] Species limits to be determined.

- *B. digitatus*
- *B. werestschagini*, n. comb.
- *B. inflatus*, n. comb.

Tubificoides em. Brinkhurst and Baker, 1979

Tubifex

- *T. superiorensis*, n. comb.

Spilodrilus, gen. dub.

- *S. stellatus*, sp. dub.

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A NEW SUBSPECIES OF *SCHIZOEACA HARTERTI* WITH NOTES ON TAXONOMY AND NATURAL HISTORY OF *SCHIZOEACA* (AVES: FURNARIIDAE)

J. V. Remsen, Jr.

Abstract.—A new subspecies *Schizoeaca harterti bejaranoi,* is described from Dpto. Cochabamba, Bolivia, and existing information on the natural history of *Schizoeaca harterti* is summarized. After a discussion of species limits in the genus *Schizoeaca,* it is recommended that eight species should be recognized until further information is obtained.

Introduction

As I examined latitudinal trends in color variation in Andean birds, I found that populations of the Black-throated Thistletail, *Schizoeaca harterti* (Furnariidae), from Dpto. Cochabamba, Bolivia, differed in plumage characters from those of Dpto. La Paz, Bolivia. I propose to call the Cochabamba population:

Schizoeaca harterti bejaranoi, new subspecies

Holotype.—Louisiana State University Museum of Zoology (LSUMZ) No. 36040; male, collected by F. Steinbach (no. 14,375) on 3 September 1962 at kilometer 104, Prov. Chapare, Dpto. Cochabamba, Bolivia, elevation 3200 m (about 55 km ENE of the city of Cochabamba).

Description.—Entire dorsum Dresden Brown, becoming slightly more rufescent on forecrown. Remiges Raw Umber; outer edges of secondaries Dresden Brown, upper wing coverts Raw Umber, broadly edged Sudan Brown. Indistinct superciliary Ochraceous-Tawny. Lores mixed Chaetura Black and Buckthorn Brown, this combination extending to the subocular region. Malar region and auriculars Ochraceous-Tawny; some auriculars immediately behind eye Brussels Brown. Sides of neck Buckthorn Brown, noticeably but not sharply defined from lower throat and breast, which are closest to Light Drab with some feathers faintly tipped Buckthorn Brown. Chin and upper throat mixed black and white. Sides slightly darker and browner than breast. Belly closest to Light Drab. Flanks Dresden Brown, vent area slightly paler. Tail Brussels Brown (capitalized colors from Ridgway 1912).

Diagnosis.—Differs from nominate subspecies by having more extensively (and intensely) ochraceous cheeks and sides of neck, leaving a narrower area of pale brownish gray on throat (about as wide as width of dark throat patch). Other, less diagnostic differences are discussed below.

Measurements of holotype (in mm).—Wing (chord) 54.0, tail 96.3, tarsus 22.3, culmen (from base) 11.6.

Range.—Humid Temperate Zone of the eastern slope of the Andes in the Departamento de Cochabamba and adjacent Dpto. Santa Cruz, Bolivia, 2500–3500 m.

Specimens examined.—Schizoeaca h. harterti (28), all from Dpto. La Paz, Bolivia: Cotapata, 4.5 km WNW Chuspipata, 3300 m (8 ♂♂, 12 ♀♀, LSUMZ 95957–95976); 3 km NE Unduavi, 3400 m (♀, LSUMZ 90669); Hichuloma, 10,700 ft (5 ♂♂, 2 ♀♀, ANSP 120444, 120448–120453).

Schizoeaca h. bejaranoi (41): Dpto. Cochabamba, Bolivia: kilometer 104, Prov. Chapare, 3200 m (13 ♂♂, 5 ♀♀, 2 ?, LSUMZ 36027–36041, 37611–37615); Choro, Prov. Ayopaya, 3500 m (3 ♂♂, FMNH 217717–217718, LSUMZ 37616); Aduana (Incachaca), 3100 m (2 ♂♂, 1 ♀, FMNH 180138–180140); Incachaca, 2800–3100 m (5 ♂♂, 5 ♀♀, CM 85055, 85700, 85830, 85962–85964, 85972, 86036, 119725, 120298; ♂, FMNH 180136); San Benito, 3400 m (♂, FMNH 180142); 101 km (by road) southeast Espizana, Siberia cloud forest, Cordillera Oriental, 2989 m (1 ♂, 1 ♀, DMNH 67054–67055); Dpto. Santa Cruz: 30 km W Comarapa, 8200 ft (FMNH 293880). The latter two localities are probably very close to one another, if not identical; this patch of cloud forest on the Cochabamba-Santa Cruz road is apparently on the boundary between the two departments.

Etymology.—I take pleasure in naming this form for Gastón Bejarano B. of La Paz. Prof. Bejarano, often at tremendous personal sacrifice, has furthered the study of Bolivian fauna and flora through his encouragement and aid to visiting scientists. His incomparable knowledge of his country's topography and ecology has proved invaluable to my own studies and those of many others.

Remarks.—Although not a strikingly marked taxon, *bejaranoi* can be separated from the nominate race with nearly 100% certainty in the above series on the basis of extent of ochraceous color in the cheeks and sides of the neck. A similar trend of increasing extent or intensity of ochraceous or chestnut color in the southernmost form is widespread among polytypic Andean forest bird species and superspecies (Remsen, in prep.).

Another useful character to separate *bejaranoi* from the nominate race is the color of the lores and subocular region, which show a reduced tendency towards blackishness in *bejaranoi*. Using three categories for amount of black, ''heavy,'' ''moderate,'' and ''light to absent,'' the series of *bejaranoi* scored 0, 11 (27%), and 30 (73%) individuals in the respective categories, whereas the series of the nominate race scored 14 (50%), 11 (39%), and 3 (11%) individuals in the same procedure ($\chi^2 = 34.7$, $P < .001$). Additionally, in material of comparable age (same collecting year), the fore-

Table 1.—Means and ranges (parentheses) of measurements (mm) and weights (grams) of the two subspecies of *Schizoeaca harterti*.

		N[1]	Wing (chord)	Tail	Tarsus	Culmen (from base)	Body weight[3]
S. h. harterti	♂♂	11–13	52.4	96.9	22.2	11.4	13.6
			(49.2–55.6)	(92.6–110.1)	(20.1–23.5)	(10.3–13.4)	(12.5–15.5)
	♀♀	14–17	51.8	92.3	21.9	11.2	12.8
			(49.8–53.4)	(86.1–99.4)	(20.8–22.9)	(10.7–12.0)	(10.8–14.0)
	all	26–30	52.1	94.1	22.1	11.3	13.1
S. h. bejaranoi	♂♂	20–25	53.1	94.4	22.1	11.4	14.2
			(51.2–56.2)	(77.3–106.8)	(19.9–24.4)	(10.5–13.0)	(14–14.3)
	♀♀	19–20	50.9	88.4	21.8	11.5	13.2
			(49.3–53.9)	(85.5–93.5)	(20.9–22.6)	(10.5–12.8)	(13.1–13.2)
	all[2]	34–38	52.5	93.5	22.0	11.4	13.8

[1] Sample sizes varied between categories depending on suitability of specimen for measure in question.

[2] Total sample size for *bejaranoi* included two unsexed birds.

[3] Sample for *S. h. harterti* included two skeletal specimens. See Niethammer (1956) for additional body weights for *S. h. harterti*. Sample for *S. h. bejaranoi* for body weight was only four individuals (1 courtesy F. Vuilleumier).

crown of *bejaranoi* is slightly paler and more ochraceous than in individuals of the nominate form, the sides of the breast are paler and slightly more rufescent in *bejaranoi* than *harterti,* and the general facial coloration of *bejaranoi* is more extensively and intensely ochraceous. Post-mortem color changes in the breast and back plumage complicate further color comparisons.

Two subspecies (Table 1) are extremely similar in measurements (no significant difference in any mensural character by the Mann-Whitney U-test, $P < .05$). Sexual dimorphism is slight, with males larger than females in all 5 measurements in both subspecies.

Notes on *Schizoeaca harterti*

Vuilleumier (1969a) described the nest, young, and habitat of *S. harterti* about 10 km by road from the type locality of *bejaranoi*. Niethammer (1956) also gives some natural history information on *S. harterti* from Dpto. La Paz.

Although I have not observed *S. h. bejaranoi* in life, the following observations of *S. h. harterti* almost certainly apply as well to the former. In Dpto. La Paz, the species is found from timberline *pajonal* at about 3400 m down into cloud forest edge, approximately to 2900 m, where replaced by the ecologically similar furnariid *Synallaxis azarae*. From 27 May to 25

June 1980, *Schizoeaca harterti* was observed daily at Cotapata, 4.5 km WNW Chuspipata, 3300 m, and 23 specimens (20 skins, 2 skeletons, 1 in alcohol) were obtained. This thistletail was common (5–10 noted per day) in bamboo thickets and bushes at forest-edge often mixed with tall grass, but was seldom noted inside continuous forest. Most foraging took place within 1.5 m of the ground and within dense foliage rather than at its edge. Foraging movements were rather slow and deliberate, involving climbing rather slender stems, stretching acrobatically to glean prey items, and maneuvering through dense foliage. The flight was fluttery and weak, seldom covering distances greater than 1 m. Although occasionally seen in pairs, this species is not as consistently noted in pairs as are many of the taxonomically related and ecologically similar spinetails of the genus *Synallaxis*. At Cotapata, *Schizoeaca harterti* seldom joined mixed-species flocks of undergrowth birds. (*Cranioleuca albiceps, Basileuterus luteoviridis, Atlapetes rufinucha*).

None of the eight males of *S. h. harterti* was in full breeding condition, with testes ranging in size from 3 × 2 mm to 1 × 1 mm. In the 14 females collected, ovaries ranged from 4 × 2 to 8 × 5 mm and ova from minute to 1 × 1 mm. No relationship was found between gonad size and degree of skull ossification (ranging from 10 to 90%); Vuilleumier (1969a) found a breeding female of *S. h. bejaranoi* with an incompletely ossified skull. Fat condition ranged from "heavy" (1) to "moderate" (3) to "light" or "trace" (12) to no fat (6). The 19 stomachs examined (2 saved, LSUMZ Stomach Contents Collection) all contained insects, and two also contained 1–2 seeds 1 mm in diameter. The iris was pale brown in 14 individuals and brown in 5 others. The maxilla was dark gray or blackish. The mandible varied in its tendency to be solid dark gray (concolor with the maxilla) to two-toned with the base paler gray or fleshy gray. The tarsi and feet were blue-gray or light gray, but became much darker after death. None of the variability in soft part coloration showed any obvious relationship to sex or degree of skull ossification. Three specimens of *S. h. bejaranoi* with soft part color data show no differences from *S. h. harterti* in iris or tarsus color, but the mandibles of all three were described as paler than the maxillae with no indication of being bicolored.

Species Limits in *Schizoeaca* and Patterns of Geographic Variation

Vaurie (1971, 1980) considered the six *Schizoeaca* species recognized by Cory and Hellmayr (1925), Peters (1951), and Meyer de Schauensee (1966) to be members of a single polytypic species, *S. fuliginosa*. The reasons for changing the established taxonomy were primarily subjective and bore little direct relation to potential reproductive isolating mechanisms. Vaurie

(1980:73) stated that "My opinion that they are conspecific is based on their morphology, distribution, and ecology." As for morphology, Vaurie's (1980:73) statement that each form "differs only by various combinations of the same characters developed to greater or lesser degree" is misleading in giving the impression of gradation among the forms, when in fact each set of "combinations" is unique to each previously recognized species with virtually no tendency towards intergradation. Vaurie ignored the substantial size differences among the forms (up to 41% difference in mean body weight; Table 2) that themselves could act as isolating mechanisms. These differences counter Bergmann's Rule for within-species latitudinal variation; in this genus, the largest forms are found closest to the equator. Neither the allopatric distribution of the taxa nor their ecological similarity provides definite information concerning species limits. Furthermore, *S. helleri* (Parker and O'Neill, 1980) and *S. harterti* both extend in elevational distribution well below the timberline zone to which several of the other forms seem to be restricted (O'Neill and Parker 1976; Vuilleumier and Ewert 1978).

Vaurie (1980) did not discuss any behavioral or plumage differences that bear more directly on the question of isolating mechanisms. Although knowledge of vocalizations in this genus is incomplete, some comparative information on songs and calls is available. Call notes are very similar in several species (Parker and O'Neill 1980), but the songs of several taxa differ: T. A. Parker (pers. comm.) has found that the songs of *S. f. fuliginosa* and *S. f. plengei* are very similar, but those of *S. griseomurina* and *S. helleri* differ rather substantially from those of *S. fuliginosa* and from each other. In October 1980 T. S. Schulenberg (pers. comm.) obtained little response from breeding *S. helleri* in Dpto. Puno, Peru, to playbacks of songs of *S. fuliginosa plengei* from Dpto. La Libertad. In the first trial, a silent bird already moving toward the observer continued in the same direction when the *plengei* tape was turned on; it approached to within a few feet and then continued in the original direction without giving any vocal or visual responses. In the second trial, a *plengei* tape was played at ca. 15 sec intervals intermittently for 5 minutes to an already singing *helleri,* which continued to sing without changing its song or approaching more closely. Brief periods of silence seemed to be terminated in response to the playback, but this was the only reaction that could be interpreted as a response. At the end of the 5 minutes no further singing occurred and no further approach was observed. Although certainly not conclusive concerning species status (especially as no *helleri* recordings were available for testing intraspecific response), these trials provide no evidence for conspecificity.

Several species of *Schizoeaca* have colored throat patches that seem similar in feather structure to those found in many species of *Synallaxis* and *Asthenes,* several of which display these erectile feathers during intraspecific interactions (pers. obs.). Some species of *Asthenes* and *Synallaxis* are less strongly differentiated in plumage and morphology from one another

Table 2.—Body weight (grams) of nine forms in the genus *Schizoeaca*[1].

	Mean[2]	SD	Range	N
S. coryi[3]	16.8	0.87	15.5–17.5	4
S. f. fuliginosa[3]	18.5	—	18–19	2
S. f. peruviana	16.8	1.61	14–19.3	20
S. f. plengei	18.5	1.19	17–21	22
S. griseomurina	17.1	1.35	15.1–19.0	9
S. v. ayacuchensis	18.0	—	17.8–18.2	2
S. helleri	15.0	1.20	13.0–17	13
S. h. harterti	13.1	1.04	10.8–15.5	23
S. h. bejaranoi	13.7	0.59	13.1–14.3	4

[1] All weights taken from specimens at LSUMZ except those for *S. h. bejaranoi*. Both sexes are included in the samples.

[2] All means are significantly different (Mann-Whitney U-test, $P < .05$) except for *S. griseomurina* vs. *S. f. plengei* or *S. f. peruviana* and *S. f. plengei* vs. *S. f. peruviana* (excluding comparisons involving *coryi*, nominate *fuliginosa*, *ayacuchensis*, and *bejaranoi*).

[3] Weights from Vuilleumier and Ewert (1978).

than are the species of *Schizoeaca*. Perhaps differences in throat coloration within *Schizoeaca,* in concert with differences in facial pattern, could act as isolating mechanisms if secondary contact were to be established. Weak as these arguments are, they would seem to carry at least as much weight as those presented by Vaurie.

In light of the above arguments, I feel that the long-established species limits should be followed until some pertinent data are produced concerning isolating mechanisms. I propose recognizing eight species of *Schizoeaca*: the six species recognized by earlier authors, *coryi, fuliginosa* (with 4 races including *fumigata* [Borrero, 1960] which was apparently overlooked by Vaurie), *griseomurina, palpebralis, helleri,* and *harterti* (with 2 races); *S. perijana* (Phelps, 1977); and *S. vilcabambae* (Vaurie et al., 1972; here tentatively raised to species status and including *ayacuchensis* of the same authors to form another polytypic species).

The species of this genus, with their strong tendency for differentiation in isolation, are excellent subjects for the study of patterns of evolution in the Andes. Rather than standard clinal variation, this genus shows a rather chaotic pattern of character distribution. For example, two disjunct subspecies of *S. fuliginosa* (*S. f. fuliginosa* in northern Ecuador and *S. f. peruviana* in northern Peru, which differ from one another in only minor ways) are separated from one another by the very different *S. griseomurina,* which occupies the intervening region. Thus *griseomurina* separates two populations obviously more closely related to one another than either is to *griseomurina*. This pattern is also shown by *Diglossa carbonaria* (Vuilleumier, 1969b; Graves, 1981) and several other Andean bird taxa (Remsen, in prep.).

Similarly, two forms close to the latitudinal extremes of the range of the genus, *S. coryi* and *S. harterti,* share a buffy eyebrow, ochraceous cheek, rusty-tinged breast, and small size not shown by the eight geographically intervening forms. Squamation on the breast appears in *S. p. plengei, S. v. ayacuchenis,* and *S. v. vilcabambae*; *plengei* is separated from the other two by an intervening, non-squamated form, *S. palpebralis.* Similarities between *S. griseomurina* and *S. palpebralis,* separated from each other by *S. f. peruviana* and *S. f. plengei,* have already been pointed out by O'Neill and Parker (1976).

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Note added in proof.—Fieldwork in July–August 1981 (at 1 km S Chuspipata, 3050 m, Dpto. la Paz, Bolivia) showed that *Schizoeaca harterti* and *Synallaxis azarae* are syntopic from about 2900 to 3075 m, indicating that these two species are not altitudinal replacements and may not be ecologically similar as implied on p. 1070. Eleven specimens (8 skins, 3 skeletons, all LSUMZ) of *S. h. harterti* were collected at this locality; none was in breeding condition.

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NANNOCHARAX MACULICAUDA, A NEW SPECIES OF AFRICAN CHARACOID FISH (CHARACOIDEA: DISTICHODONTIDAE) WITH COMMENTS ON THE GENUS *HEMIGRAMMOCHARAX*

Richard P. Vari and Jacques Géry

Abstract.—A new species of African characoid of the genus *Nannocharax* is described from the upper Ivindo River system of Gabon. The high longitudinal scale count, elongate body form, and absence of marked head and body pigmentation other than a prominent caudal peduncle spot distinguish this species within the monophyletic assemblage formed by *Nannocharax* and *Hemigrammocharax* within the Distichodontidae. The validity of the currently used diagnostic character for *Hemigrammocharax* is discussed.

Introduction

As discussed by Vari (1979:332) the phylogenetic relationships within the monophyletic assemblage formed by *Nannocharax* and *Hemigrammocharax* of the Distichodontidae remain unresolved. The current distinction between these genera is based solely on the extent of the pored lateral line, a character of questionable validity both diagnostically and phylogenetically. Nonetheless, given the absence of a satisfactory subdivision of the group formed by these genera, the new species described here is assigned to *Nannocharax* in keeping with its possession of the traditional diagnostic character for the genus—a completely pored lateral line.

Nannocharax maculicauda, new species

Holotype.—MNHN (Muséum National d'Histoire Naturelle) 1981-608, 30.2 mm standard length (SL), collected September 2, 1964, by J. and G. Géry, in a still side arm of the upper Ivindo River opposite Bourassié, Gabon, at the juncture of the Djouah and Karouaga Rivers (approx. 1°20′N, 13°12′E) (see station 17, Géry, 1965:376–377).

Paratypes.—7 specimens (USNM [National Museum of Natural History] 224524, 3 specimens [1 cleared and stained], 23.5–28.7 mm SL; MNHN 1981-609, 1 specimen, 24.0 mm SL; Géry collection, 2 specimens, 23.1–23.3 mm SL; BM(NH) [British Museum (Natural History)] 1981-3.30:1, 1 specimen, 23.0 mm SL) taken with the holotype.

Diagnosis.—Within *Nannocharax*, the relatively high lateral-line count

Fig. 1. *Nannocharax maculicauda*, holotype, MNHN 1981-608, 30.2 mm SL.

(55–61 pored lateral-line scales between the lateral-line origin and the hypural joint) readily distinguishes *N. maculicauda* from all its congeners with the exception of *N. intermedius* (lateral line 47–55), *N. lineomaculatus* (45–53), *N. luapulae* (50), *N. niloticus* (50–55), and *N. occidentalis* (50–56). *Nannocharax maculicauda* can be distinguished from all of the above species by the large, longitudinally elongate ovoid dark spot on its caudal peduncle, a pigmentation pattern not found in the other species in the genus. The new species also lacks the vertical cross-bars found on the body in *N. intermedius, N. luapulae* and *N. niloticus* and the lateral midside stripes or spots or a combination of such pigmentation patterns that characterize *N. lineomaculatus* and *N. occidentialis.*

Among those species assigned to *Hemigrammocharax* by various authors (see Poll 1967, table opposite p. 124) only *H. ocellicauda* has a reported longitudinal scale count approximating that of *Nannocharax maculicauda.* Boulenger (1907:485) reported 50 longitudinal scales for *H. ocellicauda.* However, examination of the two syntypes of *H. ocellicauda,* which are in poor condition, reveals only about 43 longitudinal scale pockets plus 3 scales on the caudal fin (G. J. Howes, pers. comm.). Although sharing a similar pigmentation pattern, *Nannocharax maculicauda* differs from *Hemigrammocharax ocellicauda* in its possession of a completely pored lateral line, in its transverse scale row count (6½–7 scales above lateral line and 4½–5 below, in contrast to 6½ and 8½ for *H. ocellicauda*), and in body depth (5.9–6.7 in SL, in contrast to 4.9–5.3 for *H. ocellicauda*).

Description.—Table 1 gives a summary of morphometrics of the holotype and paratypes. Body elongate, sides slightly compressed, greatest body depth at anterior dorsal-fin origin. Predorsal body profile very slightly convex to interorbital region, straight to snout. Body profile at base of rayed dorsal fin straight, slightly posteroventrally sloped. Dorsal body profile posterior to rayed dorsal fin straight to caudal peduncle. Ventral body profile gently convex from tip of lower jaw to below pectoral-fin insertion, nearly

Table 1.—Morphometrics of *Nannocharax maculicauda*, new species. Standard length is expressed in mm. Measurements 1 to 10 are percentages of standard length; 11 to 14 are percentages of head length.

			Paratype (6)	
		Holotype	Range	Average
	Standard length	30.2	23.3–28.7	24.5
1	Greatest body depth	17.0	15.0–17.0	16.2
2	Snout to dorsal-fin origin	51.0	49.0–51.0	50.0
3	Snout to anal-fin origin	77.0	75.0–77.0	75.8
4	Snout to pelvic-fin origin	49.0	47.0–49.0	48.3
5	Snout to anus	70.0	67.0–69.0	67.8
6	Origin of rayed dorsal to hypural joint	51.0	51.0–53.0	52.0
7	Least depth of caudal peduncle	8.0	7.0–8.0	7.3
8	Pectoral-fin length	14.0	14.0–15.0	14.3
9	Pelvic-fin length	16.0	15.0–17.0	15.8
10	Head length	27.0	28.0–29.0	28.8
11	Orbital diameter	36.0	34.0–37.0	35.2
12	Snout length	27.0	24.0–27.0	25.3
13	Postorbital length	39.0	39.0–40.0	39.8
14	Interorbital width	22.0	20.0–22.0	21.2

straight from there to anus. Anal-fin base straight, slightly posterodorsally inclined. Head elongate, snout acute, conic; tip of snout overhangs anterior edge of lower jaw. Mouth relatively small. Nares large, approximate; anterior opening circular, posterior larger, crescent shaped. Eye diameter large relative to head length. Pupil ovoid, with pronounced anterior emargination of iris (Figs. 1 and 2).

Jaw teeth bicuspidate, in a single functional series in each jaw. 7 or 8 teeth on each dentary, tooth size gradually decreasing posteriorly; dentary replacement teeth arranged in a single series within an enlarged dentary replacement-tooth trench. Dentary movably attached to lateral surface of anterodorsal portion of angulo-articular (Fig. 3), without a laterosensory canal segment. Dentaries immovably joined syndesmotically along medial surfaces. Premaxilla with 6 or 7 teeth, tooth size gradually decreasing posteriorly, ultimate premaxillary tooth approximately one-third length of longest; a single series of partially formed replacement teeth embedded in flesh of inner surface of premaxilla. Premaxillae immovably attached syndesmotically along their medial surfaces; joined premaxillae mobile with respect to ethmoid region. Maxilla edentulous, posterior portion flat, plate-like (Fig. 4), extending nearly completely beneath first infraorbital bone when mouth is closed. Ectopterygoid toothless. Third, fourth and fifth infrapharyngobranchials and fifth ceratobranchial (lower pharyngeal) bearing patches of posteriorly-recurved, simple teeth. Gill rakers 3+6 on first gill-arch in

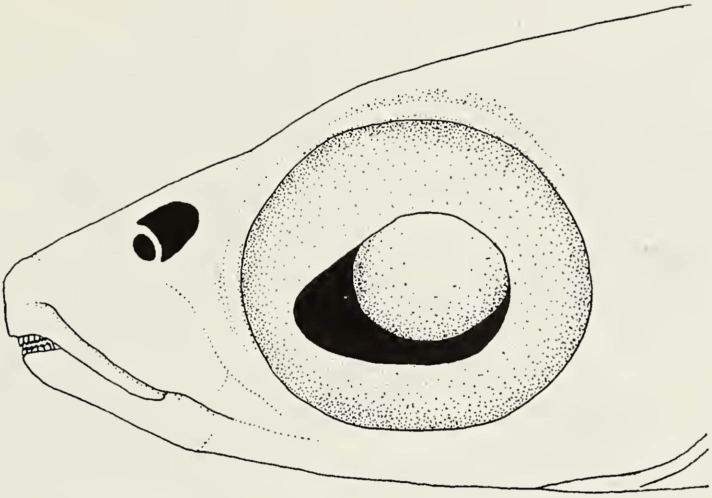

Fig. 2. Left lateral view of the head of *Nannocharax maculicauda*.

cleared and stained specimen. Branchiostegal rays 4; 3 rays attached to ceratohyal, 1 to epihyal. Gill membranes adherent to isthmus anteriorly. Frontoparietal fontanel extending slightly anterior of epiphyseal bar. Antorbital triangular, well ossified. First infraorbital large, plate-like with a branched laterosensory canal segment, covering most of maxilla laterally when mouth is closed. Second infraorbital having the form of a triangular plate anteriorly, only tube of laterosensory canal ossified posteriorly. Infraorbitals 3, 4 and 5 poorly developed, only laterosensory canal tubes ossified in largest specimens. Ossified portion of opercle reduced dorsally. Postcleithrum 1 lacking, postcleithra 2 and 3 fused into a single, ventrally curved element (Vari 1979, Fig. 35).

Scales ctenoid with 9 to 11 ctenii formed by a series of independent ossifications along edge of main body of scale; lateral line interrupted ("stutters") in 3 smallest specimens, complete in larger specimens. Scales in a longitudinal series 61 in holotype (59 in 5 paratypes, 58 in 1 paratype, 55 in 1 paratype); 0 to 2 pored lateral-line scales posterior to hypural joint; scale rows above lateral line to origin of rayed dorsal fin 7 in holotype (7 in 4 paratypes, 6½ in 3 paratypes); scale rows below lateral line to anal-fin origin 5 in holotype (5 in 3 paratypes, 4½ in 4 paratypes). Body scales extending in a triangular pattern onto middle rays of caudal fin.

Dorsal fin pointed, anterior rays longest; dorsal-fin rays iii-9-i in holotype (first unbranched ray very small) (ii-9-i in 3 paratypes, iii-9-i in 1 paratype, ii-8-i in 3 paratypes); dorsal-fin origin approximately on vertical through pelvic fin insertion. Anal fin emarginate, anal-fin rays ii-10-i in holotype (ii-10-1 in 1 paratype, ii-10 in 1 paratype, ii-9-i in 5 paratypes). Pectoral fin pointed, first ray longest, reaching two-thirds distance to pelvic-fin origin; pectoral-fin rays 12 in all specimens. Longest pelvic-fin rays reaching three-

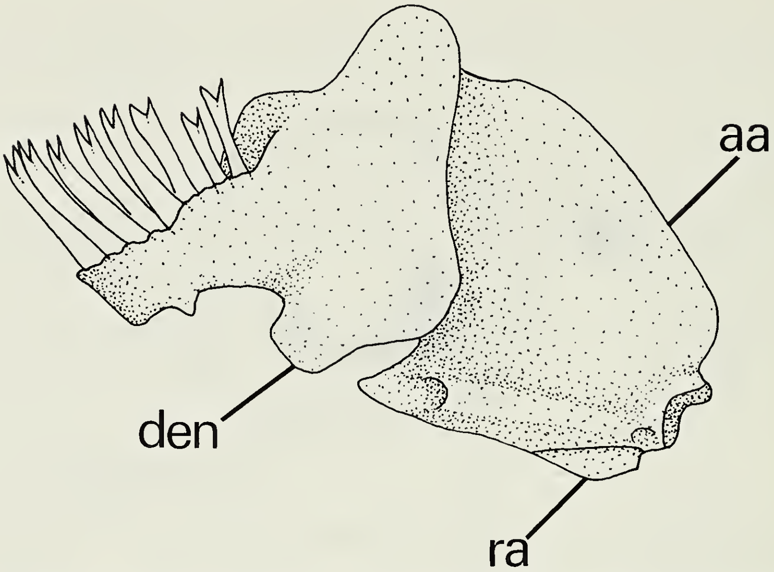

Fig. 3. Left lateral view of lower jaw of *Nannocharax maculicauda*, penultimate tooth in process of replacement; den—dentary, aa—angulo-articular, ra—retroarticular.

quarters distance to anus; pelvic-fin rays i-8-i in holotype (i-8-i in 5 paratypes, i-7-i in 2 paratypes). Caudal fin forked, with 17 branched rays, principal ray count 10/9. Adipose fin small, unscaled.

Total vertebral count including vertebrae of Weberian apparatus and fused PU_1+U_1, 41 in holotype (41 in 3 paratypes, 42 in 4 paratypes). Vertebral processes straddling dorsal aorta laterally arise from ventral surface of vertebrae 2, 3 and 4 (see Vari 1979, Fig. 30). First two full pleural ribs with proximal, posteriorly-directed flanges extending over dorsal surface of anterior gasbladder chamber. First full pleural rib with an anteriorly directed flange midway along its length; flange extends along anterolateral surface of anterior gasbladder chamber. Hypurals 1 and 2 fused into an autogenous element.

Coloration in alcohol.—Overall coloration pale yellow. Large number of dark chromatophores on dorsal and lateral portions of snout and along anterior margin of maxilla. A few scattered dark chromatophores along anterior margin of lower lip. Pale chromatophores in a dense patch over brain and visible through transparent frontals and parietals. Dorsal fin unpigmented other than for some chromatophores on last unbranched and first branched dorsal-fin rays. Caudal fin with chromatophores arranged along distal two-thirds of fin-ray margins. Anal fin with chromatophores on distal half of anterior fin rays. Pectoral and pelvic fins with a few scattered chromatophores along their distal portions. A series of chromatophores arranged longitudinally on body at base of rayed dorsal where that fin emerges from dorsal surface of body. A series of chromatophores occurs slightly lateral of midventral line, extending from between pelvic fins to rear of anal fin;

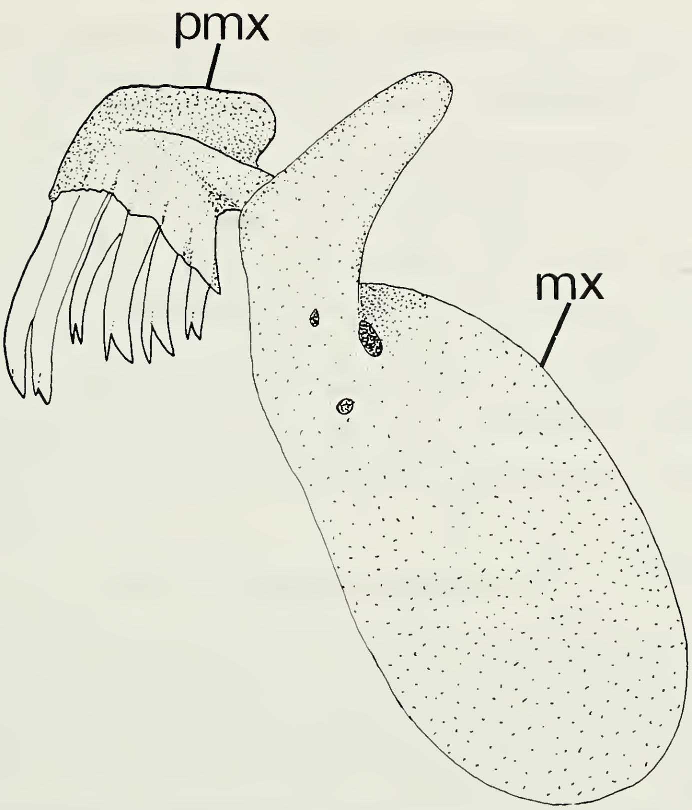

Fig. 4. Left lateral view of upper jaw of *Nannocharax maculicauda,* third premaxillary tooth in process of replacement; pmx—premaxilla, mx— maxilla.

chromatophore pigmentation most intense between anus and anal-fin origin with each lateral chromatophore series contacting its partner or being only slightly separated from it in that region. A large, strongly pigmented lateral spot on caudal peduncle and anterior portions of middle caudal rays. Spot horizontally elongate, rounded anteriorly, somewhat triangular on middle caudal rays posteriorly. Chromatophores lightly outlining scale margins on dorsal portion of body posterior to rayed dorsal fin.

Etymology.—maculicauda, from the Latin *macula,* spot, and *cauda,* tail; a noun in apposition, in reference to the caudal spot.

Relationships.—Nannocharax maculicauda possesses a series of characters derived within distichodontids (the absence of an inner row of dentary and premaxillary dentition; the absence of a laterosensory canal segment in the dentary; a horizontally expanded hyomandibula; the absence of postcleithrum 1; the fusion of postcleithra 2 and 3; anterior diverticuli of the swimbladder; a reduced, posteroventrally sloping sphenotic process; the reduction of the dorsal portion of the opercle; and a greatly reduced metapterygoid-quadrate fenestra) congruent with its placement within the monophyletic assemblage formed by *Nannocharax* and *Hemigrammocharax* within the family (Vari 1979:331). Given our poor understanding of the phylogenetic history of the components within the assemblage formed by *Nannocharax* and *Hemigrammocharax* it is impossible to advance a definitive hypothesis on the relationships of *Nannocharax maculicauda*. Nonetheless, it is noteworthy that this species does share derived characters (a relatively elongate body form and a partial encapsulation of the anterior chamber of the gasbladder by flanges of the first and second full pleural ribs) with at least *Nannocharax brevis, N. gobiodes, N. niloticus,* and *N. intermedius*. Further study is necessary to determine the distribution of these hypothesized derived characters within *Nannocharax* and *Hemigrammocharax*.

Remarks.—During the course of this study an additional derived character was found which distinguishes some (all?) *Nannocharax* species within the Distichodontidae. In contrast to the round pupil characteristic of most distichodontids and other characoids, the iris of *Nannocharax maculicauda* is anteriorly emarginate (Figs. 1 and 2). As a consequence the aperture of the pupil is horizontally ovoid, with this modification apparently increasing the fishes' visual field anteriorly. Within *Nannocharax* this modification also occurs in *N. seyboldi* (Schultz, 1942, pl. 35), *N. ansorgei,* and *N. altus* among species examined. A comparable correlation between an anteriorly expanded pupil and a somewhat to markedly elongate body form also occurs in the neotropical characoid genera *Ammocryptocharax* (Weitzman and Kanazawa, 1976, Fig. 1), *Klausewitzia* (Weitzman and Kanazawa, 1977, Fig. 2) and *Nannostomus* (Weitzman and Cobb, 1975, Figs. 2 and 5).

Comments on Nannocharax *and* Hemigrammocharax.—As discussed by Roberts (1967) and Vari (1979), the present distinction between *Nannocharax* and *Hemigrammocharax* is based on the completeness of the lateral line, which is of questionable value either as a diagnostic character or as an indicator of phylogenetic relationships. The present imprecision in the level of incompleteness of the lateral line that is diagnostic of *Hemigrammocharax* is reflective of this confusion. The type-species of the latter genus, *H. ocellicauda* (Boulenger), was illustrated as having only the eight anteriormost lateral line scales pored. Recently, however, Poll (1967) has included in the genus a series of species, some of which have a nearly complete series of laterosensory pores along the lateral line. Roberts (1967:252) also noted that in his material of *H. ocellicauda* the pored lateral line is not truncate as in the type, but rather ''stutters.'' These differences in the extent of poring may be reflective of the ontogenetic variability in pored lateral line scale number reported by Jubb and Gaigher (1971:15) for *Nannocharax multifasciatus* and found in *N. maculicauda* in this study.

More significantly, a hypothesis that a ''reduced'' lateral line defines a monophyletic group within the assemblage formed by *Nannocharax* and *Hemigrammocharax* is incongruent with the distribution of a series of other hypothesized derived characters. Some, although not all members of each genus, (*Nannocharax niloticus, N. ansorgei, N. gobioides, N. intermedius,* *Hemigrammocharax machadoi,* and *H. polli*) share the derived elimination of ossified infraorbitals 4 and 5. Similarly, an apomorphic lack of a fourth upper pharyngeal tooth plate and its associated dentition has been found in only a subunit of each genus (*Nannocharax fasciatus, N. niloticus,* and *Hemigrammocharax machadoi*). Finally, within each nominal genus there occur some species with the dorsal-fin origin posterior to the vertical through the pelvic-fin origin, another seemingly derived condition. The incongruence of the distribution of these characters with the present delimitation of *Nannocharax* and *Hemigrammocharax* together with the ontogenetic variability in the distinguishing generic character casts doubt on the monophyly of each genus. However, their redefinition along phylogenetic lines must await an in-depth analysis of the assemblage they form within the Distichodontidae.

Acknowledgments

The specimens of *Nannocharax maculicauda* which served as a basis for this study were collected during the 1964 Biological Mission to Gabon, CNRS, France. This paper represents the ninth in the series "Poissons du Basin de l'Ivindo" started by one of us (JG) in 1966. Gordon J. Howes provided information on the syntypes of *Hemigrammocharax ocellicauda.* Fig. 1 was taken by Susan Karnella. This paper benefitted by comments from Stanley H. Weitzman.

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NEW AND RARE OPHIDIIFORM FISHES FROM THE EASTERN ATLANTIC: CANARY ISLANDS TO THE CAPE OF GOOD HOPE

Daniel M. Cohen

Abstract.—Ten species of ophidiiform fishes were trawled from the upper continental slopes between the Canary Islands and the Cape of Good Hope in the eastern Atlantic:—Family Ophidiidae: *Brotulotaenia crassa,* off S. Africa; *Bassogigas* sp., possibly *gillii,* Agulhas, first record outside of western N. Atlantic; *Luciobrotula nolfi,* n. sp., 22°N–2°S, large specimens with distinctive pale head; *Monomitopus metriostoma,* 22°N and 10°N; *Spectrunculis grandis,* 27°S. Family Bythitidae: *Cataetyx bruuni,* 11°S, third record; *Cataetyx chthamalorhynchus,* n. sp., 33°S, distinctive high counts, dorsal 140, anal 100, vertebrae 77; *Cataetyx laticeps,* Canary Islands to Cape of Good Hope, senior synonym of *C. memoriabilis*; *Cataetyx niki,* n. sp., 35°S, Agulhas, low counts, dorsal 91, 95, vertebrae 54, 56, head large 3.2, 3.1 in standard length, body short, depth at vent 5.1, 5.6 in standard length; *Diplacanthopoma* sp., 26°N, possibly undescribed.

Introduction

This paper on ophidiiform fishes is based mostly on collections made by Soviet vessels trawling along the upper continental slope in the eastern Atlantic between the Canary Islands and the vicinity of the Cape of Good Hope. Relevant material from other sources also has been used. Although relatively few in number, the specimens reported upon are important as they include 10 species, three or more of which are undescribed, document the synonymy of two nominal species, and extend the known ranges of others. Classification, methods, and definitions follow Cohen and Nielsen (1978).

Family Ophidiidae

Brotulotaenia crassa Parr

Off South Africa, "Fiolent" trawl 31. 3 March 1974.

IOM uncat., 1 specimen, standard length 385 mm. Dorsal fin rays 125; anal fin rays 99; total vertebrae 92; head length 7 in standard length; body depth at vent 17.4 in standard length; preanal 3.5 in standard length; color of body light blue-gray, fins darker, muzzle dusky.

This specimen may be identified as *B. crassa* by comparing the data given above with the diagnostic table presented by Cohen (1974a, Table 2) and the key given by Shcherbachev (1980).

Although the locality for this specimen is imprecise, the fish may be considered as coming from within the known range of the species as given by Shcherbachev (1980).

Bassogigas sp.

Agulhas, "Fiolent." 1973.

IOM uncat., 1 specimen, standard length 810 mm. Dorsal fin rays 106; anal fin rays 84; pectoral fin rays 28; caudal fin rays 8; ventral fins with 2 rays in each; developed gill rakers 2 + 1+ 6 = 9; vertebrae 15 + 46 = 61.

Body depth at vent 6.2 in standard length. Head length 4.6 in standard length; dorsal profile rising rather abruptly from the interorbital to a hump on the nape. Eye small, 12.5 in head length. Anterior nostril a simple pore with no raised rim. Maxillary vertically expanded and free posteriorly, its depth approximately equal to the snout length. Opercular spine strong, short, sharp-pointed. Preopercle with a free posterior margin, lacking spines. Teeth granular; vomerine tooth patch V-shaped; median basibranchial tooth patches 2. Pectoral fin falling far short of vent, rounded, none of the rays modified. Lateral line single, distinct, originating near the upper angle of the gill opening and extending posteriorly dorsad to the midline of the body, not evident on the posterior one-fourth of the body. Color brown, darker on the head and fins.

Bassogigas has been restricted by Nielsen (1980) to a single species *B. gillii,* heretofore captured only in the tropical and temperate western North Atlantic. The present specimen represents a considerable extension of known range for the genus. The specific identity of this specimen, whether *B. gillii* or an undescribed species, will be reported on by J. G. Nielsen.

Luciobrotula nolfi, new species
Figs. 1, 2 (4a, 4b, 5)

Luciobrotula bartschi (not of Smith and Radcliffe *in* Radcliffe 1913), Nielsen and Nybelin, 1963:201, figs. 6–7.

Luciobrotula corethromycter (not of Cohen, 1964); Cohen, 1974b:109, footnote.

Luciobrotula sp., Nolf, 1980:88, pl. 11, figs. 12–13.

Holotype.—ZIL 45772; 22°10′N, 17°20′W, 860–810 m; "Zvezda Kryma" stat. 157.

Paratypes.—ZMMU P-16002; 09°04′N, 17°36.8′W, 950–980 m; "Poltava" stat. 71. IRSNB 506; 06°00′N, 04°15′E, 400 m; "Thierry," Guinean Trawling Survey II, 24 March 1964. USNM 198606; 02°30.9′N, 08°52′E, 549 m; "Ger-

Table 1.—Diagnostic characters in species of *Luciobrotula*.

Character	Species			
	L. nolfi	*L. corethromycter*	*L. bartschi*	*L. lineata*
Color	Large specimens with body and fins dark; head pale	Body usually pale, lighter than fins; head variable	As in *corethromycter*	—
Body shape (Fig. 3)	Relatively short in larger fish	Relatively long in larger fish	Intermediate	Relatively short
No. of abdominal centra (Table 3)	16	15–16	14–15	15
Termination of tubular lateral line	Near level of anal fin origin	As in *nolfi*	As in *nolfi*	Near level of dorsal fin origin
Otolith (Fig. 2)	No concavity in dorsal rim	Large specimens with pronounced concavity in dorsal rim	As in *nolfi*	—

onimo'' stat. 214, 5 Sept. 1963. ZMUC P77390, P77391, 02°09′N, 09°27′E, 260–650 m; ''Atlantide'' stat. 120.

Diagnosis and comparisons.—Diagnostic characters are summarized in Table 1. Among the four named species of *Luciobrotula, L. lineata,* known only from the holotype, is highly distinctive due to its short lateral line. *Luciobrotula bartschi, corethromycter,* and *nolfi* are quite similar to each other, in particular at sizes less than about 200 mm. In larger fishes, however, the unique color pattern and relatively shorter body of *nolfi* distinguish it from *corethromycter* and *bartschi.* When *L. corethromycter* was originally described, it was separated from *bartschi* on the basis of counts and measurements. Most of the original diagnostic characters have been invalidated by the study of additional material of *corethromycter.* Because of allometric growth a proper evaluation of morphometric characters in separating the two nominal species must await the availability of additional material of larger examples of *bartschi.* For the present, however, evidence from otoliths (Fig. 2) provides sufficient reason to recognize the two species as distinct.

Description.—Measurements are presented in Table 2 and counts in Tables 2 and 3.

Body relatively short, becoming more so with increase in absolute size (Fig. 3), depth at vent 4.7 to 7.6 in standard length. Tail not greatly extended

Table 2.—Measurements in mm and counts for *Luciobrotula nolfi*.

	Holotype	Paratypes				
Characters	ZIL 45772	ZMMU P-16002	IRSNB 506	USNM 198606	ZMUC P77391	ZMUC P77390
Standard length	355	590	400	255	164	137
Preanal length	202	312	230	138	78.5	66.2
Predorsal length	117	182	142	77.9	47.1	39.7
Head length	94.5	150	111	65.2	41.1	33.2
Body depth at vent	60.0	108	84.5	41.0	24.4	18.1
Snout length	23.5	37.5	30.3	17.0	9.7	7.5
Upper jaw length	47.2	79.8	59.1	33.4	20.4	16.9
Maxillary depth	15.0	29.5	19.1	10.8	6.6	5.7
Pectoral fin length	42.0	66.2	48.6	31.3	18.3	16.3
Ventral fin length	32.8	47.0	37.9	24.2	16.7	15.4
Horizontal diameter eye	9.5	13.3	11.1	7.1	4.7	4.6
Interorbital width	15.9	28.4	24.3	11.6	7.0	6.0
Dorsal fin rays	91	93	89	86	95	93
Anal fin rays	69	66	67	70	68	66
Pectoral fin rays	27	27	27	28	28	28
Vertebrae	16 + 37 = 53	16 + 38 = 54	16 + 37 = 53	16 + 38 = 54	16 + 37 = 53	16 + 38 = 54
Lateral scale rows	140	145	135	145	135	130

or whiplike. Head 3.6 to 4.1 in standard length, somewhat compressed posteriorly, depressed anteriorly. Dorsal fin originating behind nape, over midlength to posterior half of pectoral fin. Proximal three-fourths or more of vertical fins covered with thick, scale-covered skin. Caudal fin exserted, with 12 rays. Pectoral fin short, 2.0–2.3 in head length, broadly rounded and paddle-shaped with a fleshy, scale-covered, lobed base. Ventral fins immediately adjacent, each with two rays, the medial longer, which are joined proximally.

Body completely covered with small, cycloid scales arranged in regular rows. Head mostly covered with small scales; premaxillary sheath and snout naked.

Lateral line single, a tube extending along side of body about midway between the dorsal profile and midline, originating near angle of opercle and terminating close to level of vent. Pores present either directly on the lateral line or at the ends of short branches above or below the line as in *L. corethromycter* (Cohen, 1964, fig. 3). On head, lateral canal with a single pore mounted on a small papilla above the upper angle of the gill opening; supraorbital canal with three pores, one above the upper lip between two fleshy folds, two on the snout; infraorbital pores five to seven; preoperculomandibular pores seven or eight.

Snout depressed, mostly naked, the tip bearing a tuft of fleshy lappets,

Table 3.—Counts in species of *Luciobrotula*.

	Dorsal fin rays																	
	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100	101	102	103
nolfi	1	—	—	1	—	1	—	2	—	1								
corethromycter						1	3	2	3	4	4	2	—	2	—	—	—	1
bartschi		1	1	—	—	2												
lineata								1										

	Anal fin rays												Pectoral fin rays				
	66	67	68	69	70	71	72	73	74	75	76	77	25	26	27	28	29
nolfi	2	1	—	1	2										3	3	
corethromycter		1	3	—	2	7	5	2	1	—	—	1			1	7	
bartschi			1	—	2	—	2	—	1				1	1	—	3	
lineata												1					1

	Total vertebrae					Abdominal vertebrae		
	52	53	54	55	56	14	15	16
nolfi		3	3					6
corethromycter		1	1	14	6		11	10
bartschi	3	1	1	1		2	4	
lineata			1				1	

which are similar to those of *L. corethromycter* (Cohen, 1964, fig. 2). Opercular spine, near upper angle of opercle, broad, flattened and skin-covered, scarcely evident.

Eye elliptical, proportionally larger in small specimens, 7.2 to 11.3 times in head, 1.3 to 2.2 in interorbital. Interorbital distance 4.6 to 5.9 times in head length.

Posterior nostril a circular opening located at about mid-length on snout. Anterior nostril with a raised, fleshy rim, slightly closer to tip of snout than to posterior nostril.

Jaws large, extending one eye diameter or more beyond rear margin of eye. The suborbital sheaths the shaft of the maxillary; however, the broadly expanded posterior part of the bone is free. Branchiostegal rays eight and developed gill rakers three in all specimens. Wide bands of teeth present on the dentaries, premaxillaries and palatines; vomerine tooth patch with widely flaring wings. In the four smallest specimens all teeth are granular; in the two larger ones, however, irregular series of larger, sharp-pointed conical to needle-like teeth are present along the outer margins of the premaxillary and palatine, the center of the dentary, and on the vomer. There is a single median and two paired basibranchial tooth patches. There is also a tooth patch at the base of each fifth gill arch (incorrectly called a paired basibranchial tooth patch by Cohen 1964).

The saccular otolith is characterized by a large and high area of the inner

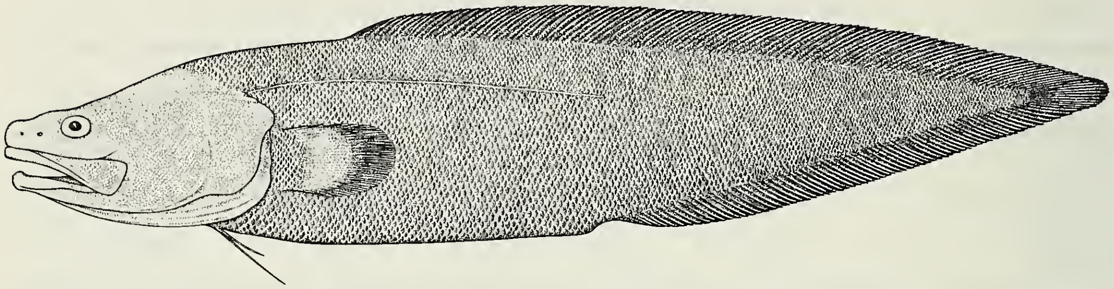

Fig. 1. *Luciobrotula nolfi*, holotype, ZIL 45772, standard length 355 mm. Drawn by Keiko Hiratsuka Moore.

face between the sulcus and the dorsal rim (Nolf, personal communication; Fig. 2, 4b).

Color in the two largest specimens is highly distinctive with the body and vertical fins dark brown and the head and pectoral fins nearly lacking in pigment. The third largest fish (the holotype) has the body and all fins dark and the head, although paler than the body, with considerable amounts of pigment. The fourth largest specimen has dark fins and both the body and head a medium brown. In the two smallest specimens the fins are dark and the body and head are light brown. This species appears to be characterized, therefore, by an ontogenetic change in color pattern with the body becoming darker and the head lighter as size increases.

Luciobrotula nolfi has been caught in the tropical eastern Atlantic from 22°10′N to 02°30′S at depths ranging from 260–650 m to 950–980 m.

This species is named for Dr. Dirk Nolf, who first called my attention to the fact that *Luciobrotula* from the eastern and western Atlantic are different and who graciously provided the information on otoliths included in the present paper.

Monomitopus metriostoma (Vaillant)

IOM uncat., 3 specimens; 22°50′N, 17°20′W; 1440–1520 m; "Zvezda Kryma" stat. 256. IOM uncat., 5 specimens; 9°55′N, 17°33′W; 750–780 m; "Poltava" stat. 70.

Selected counts and measurements are presented in Table 4. The three specimens collected by "Zvezda Kryma" differ from the "Poltava" specimens and those studied by Nielsen and Nybelin (1963) in having more pectoral fin rays (34–38 versus 27–31), a smaller eye (5.3 in head length versus 3.8–4.5), and a deeper habitat (1440–1520 m versus 190–850 m).

Of the 13 nominal species presently referred to *Monomitopus* (Cohen and Nielsen 1978), a genus much in need of revision, only *M. metriostoma* has been recorded from the eastern Atlantic, where it is apparently widely distributed (Nielsen and Nybelin 1963). Until the differences noted above can

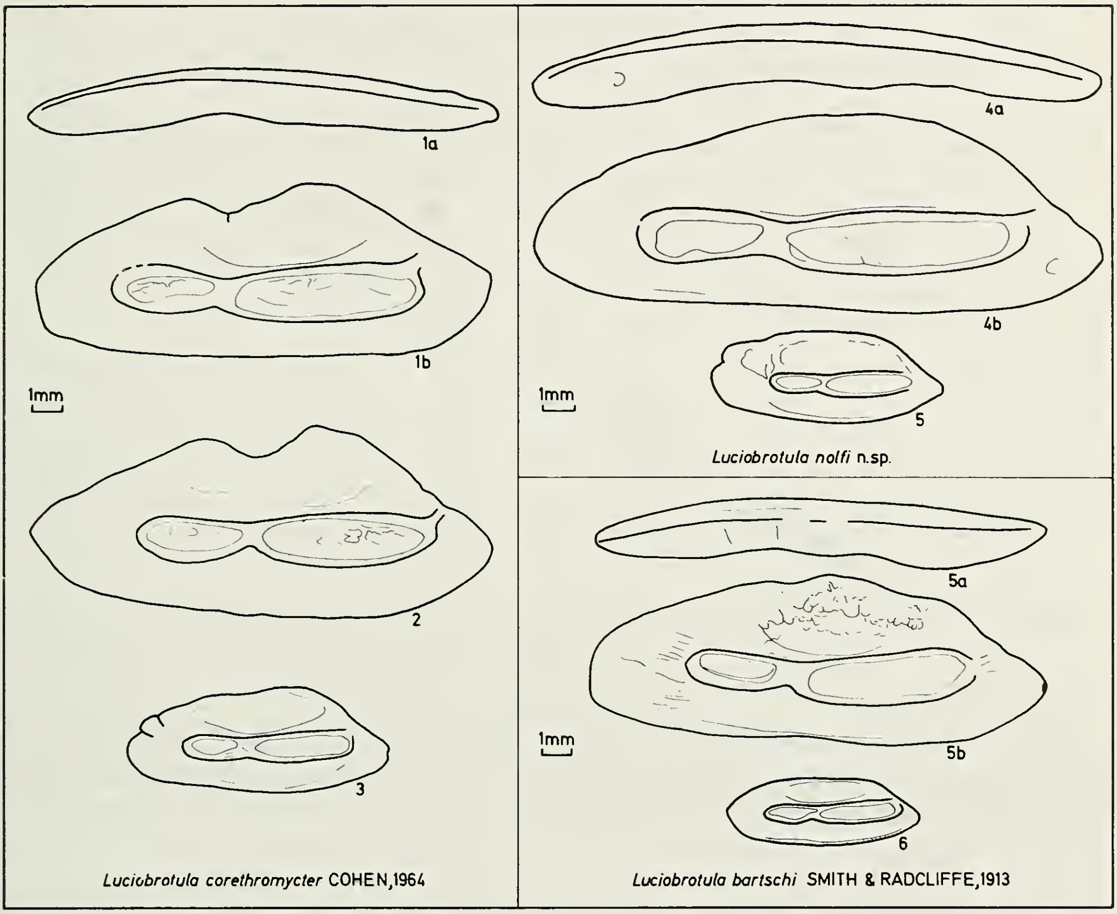

Fig. 2. Otoliths of three species of *Luciobrotula*. *L. corethromycter:* 1a) Ventral view, from a 47 cm total length (TL) fish; 1b) Left otolith, inner face, TL 47 cm; 2) Left, inner, TL 50 cm; 3) Left, inner, TL 23 cm. *L. nolfi:* 4a) Ventral view; 5b) Left, inner; 5) Left, inner, TL 14.8 cm. *L. bartschi:* 5a) Ventral view, TL 33 cm; 5b) Left, inner, TL 33 cm; 6) Left, inner, TL 17 cm. Drawing by Dirk Nolf, from Nolf (1980).

be more fully investigated it seems best to refer all of the present material to *M. metriostoma*.

Spectrunculus grandis (Günther)

26°42.5′S, 13°41.5′E, 800 m; "Poltava" stat. 489.

IOM uncat., 1 specimen, standard length 420 mm.

This specimen was included in a recent revision of the genus by Nielsen and Hureau (1980), who discussed variation, synonymy, and distribution.

Family Bythitidae

Genus *Cataetyx*

The present collection contains four species of this rarely encountered genus in which eight species were tentatively included by Cohen and Nielsen

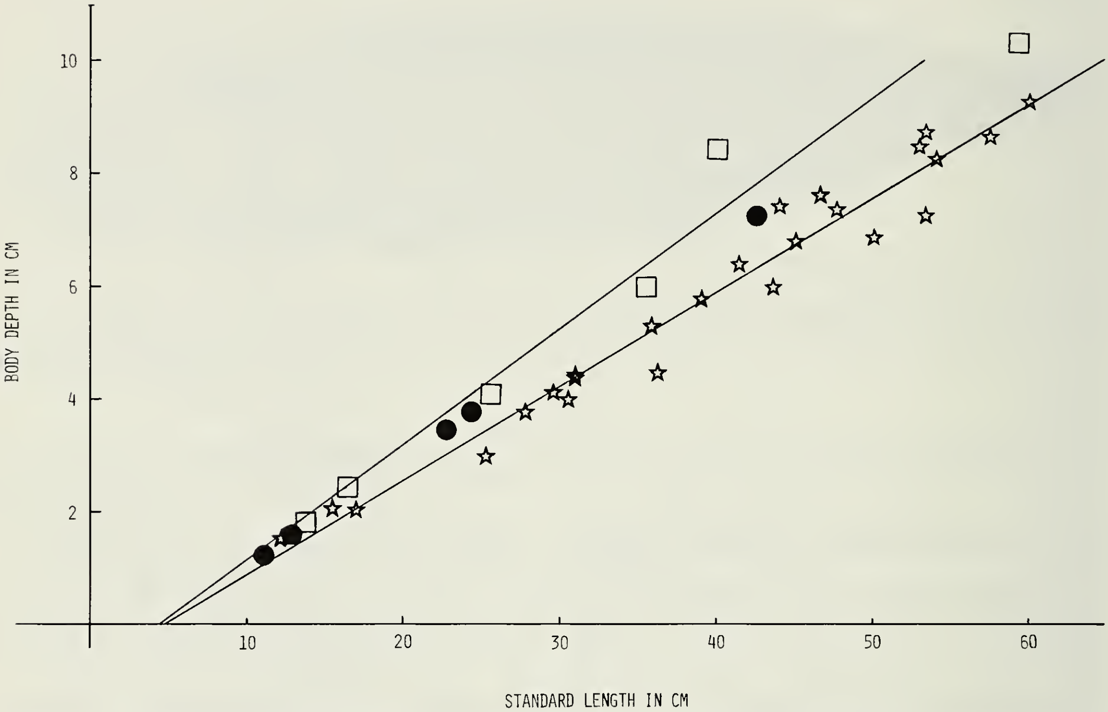

Fig. 3. Relationship between body depth at vent and standard length in three species of *Luciobrotula*. *L. nolfi*, squares; *L. corethromycter*, stars; *L. bartschi*, circles. Machine plotted least squares regressions shown for *L. nolfi* (upper line) and *L. corethromycter* (lower line).

(1978). In this paper two more are described as new, and one is placed in synonymy. Still other species remain to be described, variation analyzed, and interrelationships studied. These topics will be considered in a revision of the genus that is being prepared.

Cataetyx bruuni (Nielsen and Nybelin)

10°54′S, 13°23′E, 520 m; "Fiolent" trawl 79, 24 Feb. 1976.

IOM uncat., 2 specimens, a male 88 mm SL and a female 108 mm SL; additional data will be presented at a later date.

The present capture is the first record of the species since its original description (Nielsen and Nybelin 1963) and represents a third locality, which is geographically between the previous two.

Cataetyx chthamalorhynchus, new species

Figs. 4, 5

Holotype.—ZIL 45773, ♂, 33°04′S, 16°43′E, 1000 m, "Poltava" 425, 24 Jan. 1970.

Diagnosis.—A species of *Cataetyx* with granular teeth; dorsal fin rays about 140; anal fin rays 100; vertebrae 77; eyes directed dorsolaterally, 7.3

Table 4.—Counts and measurements in mm for *Monomitopus metriostoma*.

	Specimens							
Characters	"Zvezda Kryma" 256				"Poltava" 70			
Dorsal fin rays	102	104	104	102	102	—	100	—
Anal fin rays	85	88	88	85	—	85	—	—
Pectoral fin rays	34	38	35	29	—	29	—	—
Vertebrae	13 + 47 = 60	13 + 47 = 60	13 + 47 = 60	12 + 48 = 60	12 + 48 = 60	12 + 48 = 60	12 + 48 = 60	13 + ?
Standard length	205	201	206	147	138	135	120	110
Body depth at vent	39.3	33.9	36.5	25.4	21.9	19.3	18.5	15.9
Head length	47.2	43.0	44.1	33.5	32.0	29.4	27.0	23.2
Eye diameter, horizontal	9.0	8.1	8.3	8.3	7.1	7.8	6.8	5.4
Upper jaw length	22.5	20.5	23.8	17.6	15.7	16.0	14.3	12.9

in head; interorbital 6.8 in head; snout greatly depressed, with a sharp, retrorse spine behind the posterior nostril.

Description.—Measurements in mm: standard length 353; preanal length 183; predorsal length 130; head length 89.0; body depth at vent 44.3; snout length 29.6; upper jaw length 42.4; maxillary depth 11.9; pectoral fin length 37.2; pectoral fin base depth 14.6; ventral fin length 22.0; horizontal eye diameter 12.1; interorbital width 13.1. Dorsal fin rays about 140, precise number of rays not clear at posterior end of fin; anal fin rays 100; pectoral fin rays 28; branchiostegal rays 9; vertebrae 18 + 59 = 77; approximate number of lateral scale rows 205.

Body relatively slender, greatest depth between the head and dorsal fin origin, depth at vent 8 times in standard length. Head one-fourth of standard length, its dorsal outline sloping at about 30° to the orbital region, the snout rather flat; rear part of head about as broad as it is deep, snout strongly depressed. Predorsal distance about 37 percent of standard length. Vertical fins covered with loose, pigmented skin basally, the rays free distally. Caudal fin probably with 10 rays (perhaps slightly damaged). Pectoral fin 2.4 in head, covered with naked skin, not broad and paddle-shaped, borne on a fleshy scale-covered peduncle that is deeper than it is long. Ventral fins immediately adjacent to each other, each with a single ray, inserted more than an eye diameter behind the symphysis of the cleithra.

Body completely covered with small cycloid scales, mostly represented by scale pockets in this specimen. Head scales lacking from snout anterior to level of rear nostrils, sparsely distributed on rear part of snout; only a few scales on rear of lower jaw mandibles; present on branchial membranes between rays 6 and 8. No scales on expanded rear part of maxillary.

Lateral line not readily apparent (possibly due to abrasion), although traces of it can be seen in the midline of the tail. Lateral head canal with a

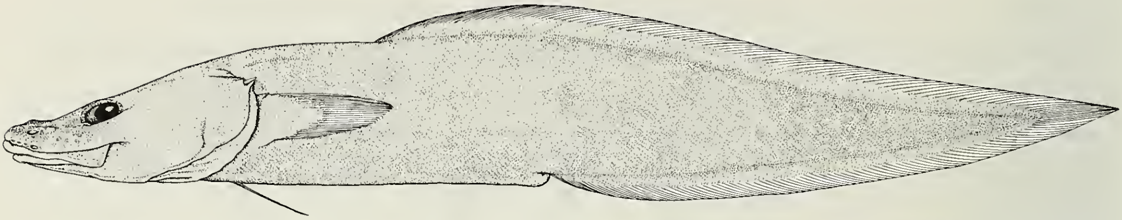

Fig. 4. *Cataetyx chthamalorhynchus,* holotype, ZIL 45773, standard length 353 mm. Drawn by Keiko Hiratsuka Moore.

single pore; skin naked over rear part of canal near pore. Supraorbital pore one, at tip of snout medial to anterior nostril. Infraorbital pores seven, in a row in the fold of skin over upper jaw. Preoperculo-mandibular canal with seven or eight pores, two at tip of lower jaw, three along lower jaw, and two or three in the preopercular fold. The snout bears rather prominent, pale-colored pit organs that contrast with the brown-pigmented skin around them and resemble scale pockets; the pit organs are interspersed with small brown papillae.

Snout strongly depressed, greatest width about equal to length. Lower jaw inferior. Posterior nostril a prominent pit located near mid-length of snout. Anterior nostril a short, thin-skinned tube at tip of snout. Eye elliptical, dorso-laterally directed, 7.4 in head, 1.1 in interorbital.

A strong, sharp-pointed spine projects near the upper angle of the opercle but does not extend beyond the opercular flap. A sharp, emergent, retrorse spine is present behind the posterior nostril. A sharp-pointed emergent spine is present on the cleithrum above the base of the pectoral peduncle.

The posterior end of maxillary falls slightly short of rear margin of eye. The suborbital sheaths the dorsal rim of the maxillary. Developed gill rakers three, interspersed with low spiny plates; two plates on the upper arm and 12 following the last gill raker. Wide bands of granular teeth on the dentaries and premaxillaries, narrow bands on the palatine and a broadly V-shaped patch on the head of the vomer.

Color probably a uniform brown, specimen rather abraded. Orobranchial cavity dusky.

Male intromittent organ on a short fleshy peduncle. Testes paired, scarcely developed. Lining of peritoneum black. Posterior bend of stomach extending beyond level of rear margin of pectoral fin.

The name is taken from the Greek *chthamalos,* low and *rhynchos,* snout and refers to the depressed snout of this species.

Discussion.—*Cataetyx chthamalorhynchus* may be easily distinguished from any named species of the genus by the diagnosis given above. A closely similar undescribed species has been recorded from New Zealand by McCann (1972) and incorrectly identified as *C. messieri* (Günther, 1878). I have examined McCann's specimen as well as additional material from New

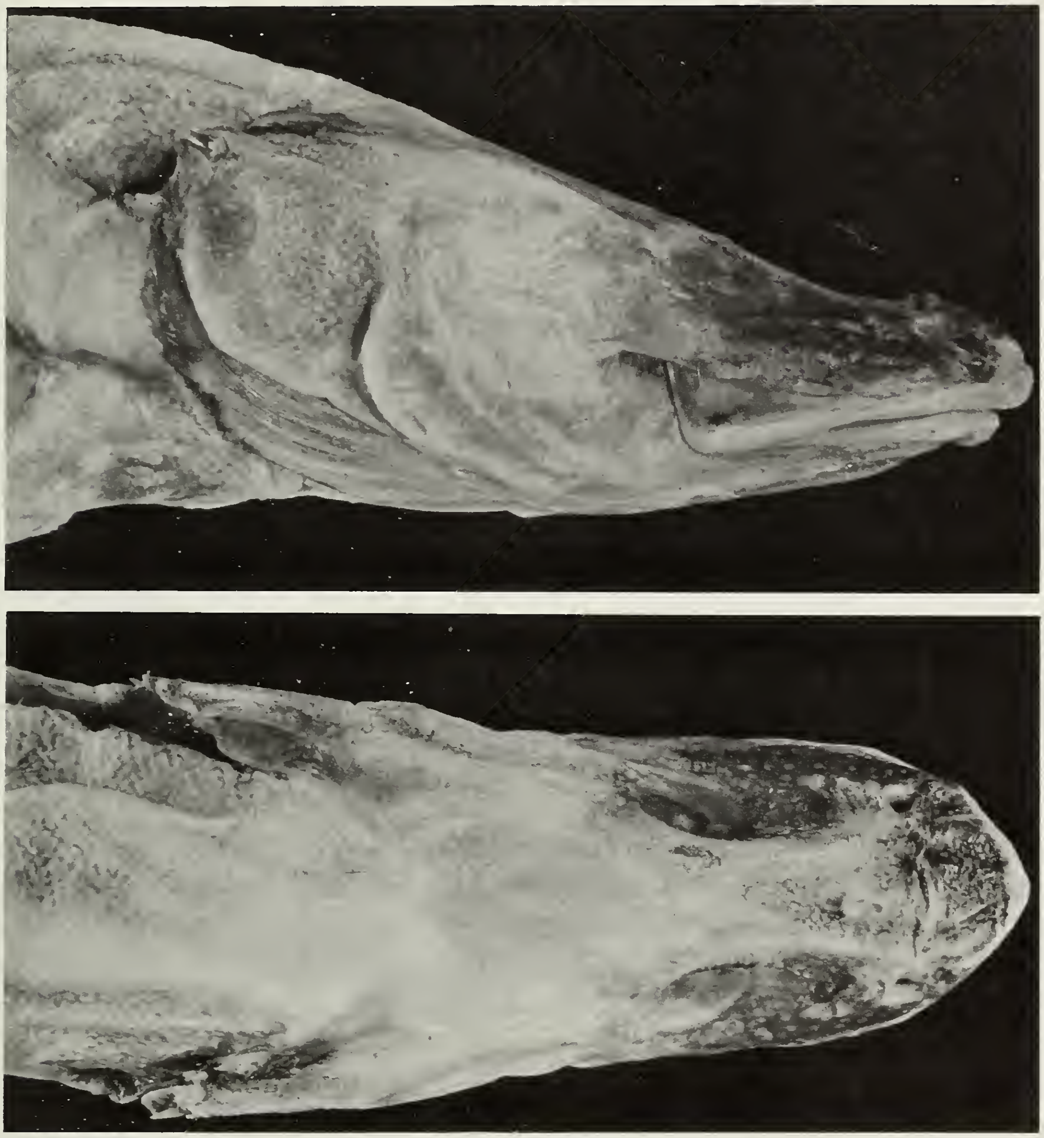

Fig. 5. *Cataetyx chthamalorhynchus*, holotype, ZIL 45773, head length 89 mm. Photographs by Joseph L. Russo.

Zealand and will report on them and discuss their differences from *C. chthamalorhynchus* in a subsequent paper. For the present, however, it is appropriate to mention that McCann's counts of 162 dorsal fin rays and 138 anal fin rays are greatly in error. My own counts, taken from an X-ray photograph of his specimen (NZOI E773), are 137 and 102, respectively. The dorsal and anal fin rays are deeply branched, and it seems likely that McCann counted a number of branches as entire rays.

Cataetyx laticeps Koefoed

Cataetyx messieri (not of Günther, 1887); Gilchrist, 1905.
Cataetyx memoriabilis Meyer-Rochow, 1970.

Five specimens from five localities ranging from near the Canary Islands, which is close to the type-locality of *C. laticeps,* to off the Cape of Good Hope, which is close to the type-locality of *C. memoriabilis.* Locality data and counts and measurements are given in Table 5.

Of the eight species tentatively assigned to *Cataetyx* by Cohen and Nielsen (1978), several are distinctive, flat-snouted, brown fishes that grow quite large (reaching 765 mm SL). Included in this category are *C. simus* Garman, 1899, from the tropical eastern Pacific; *C. laticeps* Koefoed, 1927, from near the Canary Islands, and *C. memoriabilis* from off the Cape of Good Hope (incorrectly identified as *C. messieri* by Gilchrist, 1905, who was followed by several subsequent authors). Similar-appearing fishes have been caught in the Gulf of Mexico and tropical western Atlantic (unreported), the Mediterranean (recorded as *C. laticeps* by Geistdoerfer and Rannou, 1971, 1972, and Relini Orsi and Gavagnin, 1974), and southwest of Ireland (N. Merrett, personal communication). The problem of whether specimens from all of the above localities represent a single species or two or more species or subspecies is beyond the scope of the present paper and will be addressed in a revision of *Cataetyx.* However, I believe that the five specimens reported here, which were caught near two type-localities and at intermediate localities, are conspecific with each other and with the type specimens of *C. laticeps* and *C. memoriabilis.*

Cataetyx laticeps was named on the basis of a single, relatively small fish (standard length 260 mm); *C. memoriabilis* was described from three larger examples. I have examined one of the type specimens of *C. memoriabilis* (ZMH 4321, a 638 mm SL ♀, listed as the holotype on p. 39 of the original description but as a paratype on p. 43) and an X-ray photograph of the holotype of *C. laticeps.*

In the original description of *C. memoriabilis,* that species is distinguished from *laticeps* on the basis of two characters. *C. memoriabilis*: branchiostegal rays seven; anus beyond the midpoint of the body. *C. laticeps*: branchiostegal rays nine; anus at the midpoint of the body. I find eight branchiostegal rays in the type specimen of *C. memoriabilis* that I have examined and eight or nine in the five other specimens that I have examined (Table 5). With regard to position of the anus, this character is apparently related to absolute size, with smaller specimens having it more anteriorly placed on the body (Fig. 6).

Cataetyx niki, new species

Figs. 7, 8

Holotype.—ZIL 45774, ♀, 35°04′S, 24°20′E, 1000 m, "Fiolent," 17 Aug. 1973.

Paratype.—USNM 226788, ♂, Agulhas, 1100 m, "Fiolent," 1973.

Diagnosis.—A large, brown species of *Cataetyx* with granular teeth; dor-

Table 5.—Measurements and counts on five eastern Atlantic specimens of *Cataetyx laticeps*.

Locality	27°36′N, 13°48′W 1450 m ZVEZDA KRYMA 313 IOM uncat.		22°30′N, 17°10′W 1200–1420 m ZVEZDA KRYMA 191 IOM uncat.		6°28′S, 11°08′E 1050 m FIOLENT 7.02.76 ZMMSU P-15053		33°36′S, 16°38′E 1200 m POLTAVA 430 USNM 226792		35°18′S, 18°29′E 1120–1200 m FIOLENT 28.03.74 ZMMSU P-15052	
Sex	♀		♂		♀		♀		♀	
	mm	%SL	mm	%SL	mm	%SL	mm	%SL	mm	%SL
Standard length	496		655		425		404		664	
Preanal length	269	54.0	372	56.8	239	56.2	214	53.0	371	55.9
Predorsal length	187	37.7	247	37.7	162	38.1	141	34.9	238	35.8
Head length	126	25.4	169	25.8	117	27.5	105	26.0	161	24.2
Body depth at vent	65.7	13.2	85.5	13.0	57.7	13.6	55.8	13.8	84.6	12.7
Snout length	29.4	5.9	38.4	5.9	27.2	6.4	22.3	5.5	39.8	6.0
Upper jaw length	48.4	11.8	79.5	12.1	55.4	13.0	46.6	11.5	75.7	11.4
Maxillary depth	18.2	3.7	26.7	4.1	17.8	4.2	13.6	3.4	26.7	4.0
Pectoral fin length	58.0	11.7	76.5	11.7	47.3	11.1	49.1	12.1	72.7	10.9
Pectoral fin base depth	21.2	4.3	27.6	4.2	17.9	4.2	18.3	4.5	30.5	4.6
Ventral fin length	38.0	7.7	58.2	8.9	39.0	9.2	31.2	7.7	34.9	5.3
Horizontal diameter eye	17.7	3.6	21.5	3.3	15.7	3.7	13.8	3.4	18.0	2.7
Interorbital width	21.2	4.3	27.5	4.2	18.4	4.3	16.6	4.1	24.1	3.6
Dorsal fin rays	99		107		98		105		106	
Anal fin rays	75		83		—		77		78	
Pectoral fin rays	30		30		29		30		30	
Branchiostegal rays	9		8		8		8		8	
Vertebrae	16 + 44 = 60		16 + 45 = 61		17 + 43 = 60		16 + 45 = 61		16 + 44 = 60	
Lateral scale rows	about 160		—		about 170		about 190		about 190	
Lateral canal pores	1		1		1		1		1	
Supraorbital canal	1		1		1		1		1	
Infraorbital canal	6		6		6		6		6	
Preoperculo-mandibular canal	9		10		9		9		9	

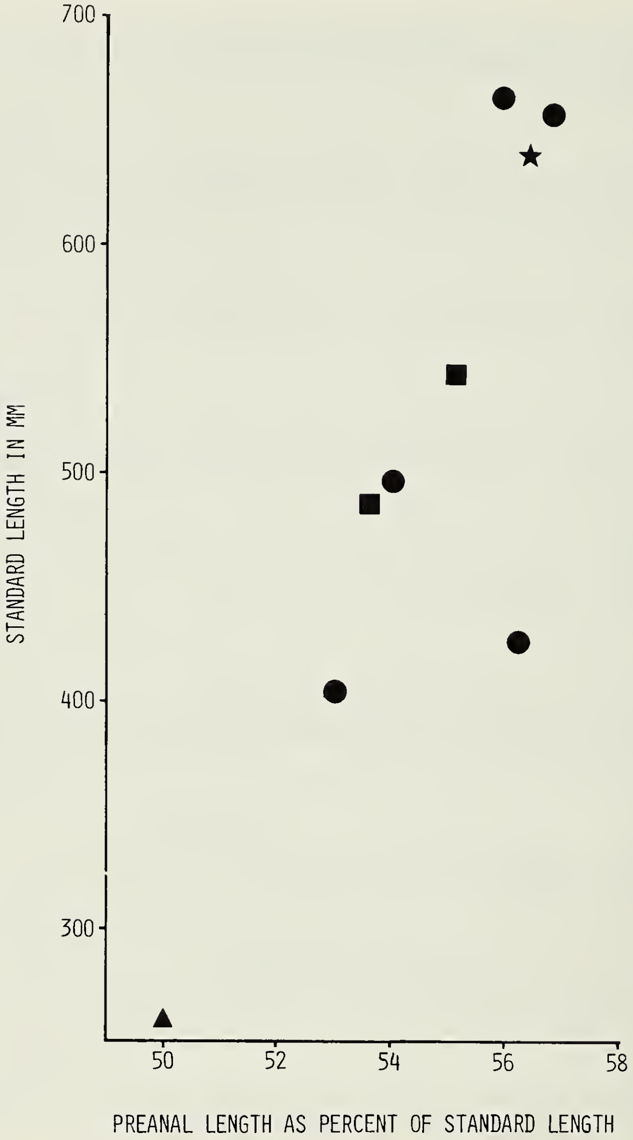

Fig. 6. Relationships of preanal length to standard length in eastern Atlantic *Cataetyx laticeps*. Triangle is holotype of *C. laticeps* (data from Koefoed 1927); squares are types of *C. memoriabilis* (data from Meyer-Rochow 1970); star is type of *C. memoriabilis* (my measurement); circles are specimens measured by me (Table 5). Drafted by Ruth Gibbons.

sal fin rays 91, 95; vertebrae 54, 56; interorbital 3.4, 3.6 times in head length; eyes directed more laterally than dorsally; head length 3.2, 3.1 in standard length; body depth at vent 5.1, 5.6.

Description.—Measurements in mm and counts are given for the holotype first followed by those of the paratype in parentheses. Standard length 640 (625), approximate as specimens are somewhat distorted; preanal length 450 (385), approximate; predorsal length 290 (275), approximate; head length 202 (200); body depth at vent 125 (111); snout length 51.0 (46.5); upper jaw

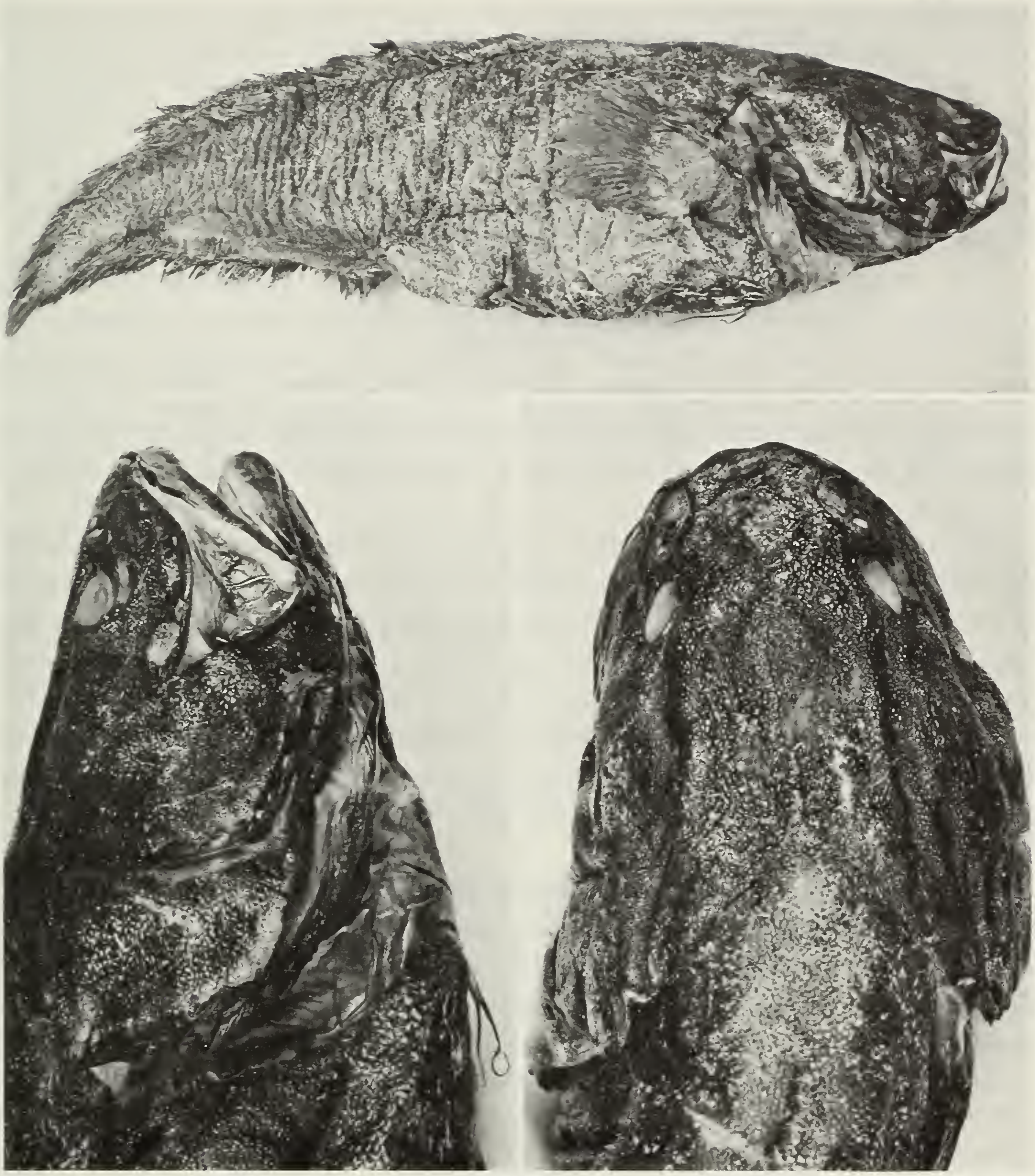

Fig. 7. *Cataetyx niki,* holotype, ZIL 45774, standard length 640 mm, head length 202 mm. Photographs by Joseph L. Russo.

length 97.5 (100); maxillary depth 30.0 (30.0); pectoral fin length 93.0 (88.0); pectoral fin base depth 60 (54.5); ventral fin length 72.0 (68.0); horizontal eye diameter 22.3 (22.0); interorbital width 58.5 (56.0). Dorsal fin rays 91 (95); anal fin rays 69 (77); pectoral fin rays 30 (29); branchiostegal rays 8 (9); vertebrae 16 + 38 = 54 (16 + 40 = 56); approximate number of lateral scale rows 205 (210).

Body relatively short and deep, the tail not long and attenuate. Head large, nearly one-third of standard length, broader than deep. Dorsal fin originating well posterior to nape at about 45 percent of standard length. Vertical fins covered with rather thin, scale-less skin. Caudal fin not exserted, with 10 rays. Pectoral fin short, 2.2–2.3 in head, broadly rounded and paddle-shaped, borne on a fleshy, scale-covered peduncle that is about as long as it is deep; skin covering the rays without scales. Ventral fins immediately adjacent, each with a single ray, inserted more than an eye diameter behind the symphysis of the cleithra.

Body completely covered with tiny cycloid scales. Head nearly completely covered with scales dorsally and laterally; scales present ventrally along rami of jaws and on branchial membranes over the middle rays; scales absent from anterior suborbital area, around and between the anterior and posterior nostrils, and at the tip of snout; a small patch of scales present on expanded posterior part of maxillary in the holotype but this area naked in the paratype.

Lateral line marked by a narrow, light-colored line that originates behind the lateral head pore, arches up slightly and descends part way to the midline at the level of the vent, where it is interrupted and resumes in the midline, extending posteriorly to nearly the end of the tail. Lateral head canal with a single large pore above the angle of gill opening. The single supraorbital pore at tip of snout medial to anterior nostril. The five infraorbital pores in a row in the fold of skin above the upper jaw. Preoperculo-mandibular canal with eight pores, two at tip of lower jaw, two along mandible, and four in the preopercular fold.

Snout depressed, about two times broader than long. Lower jaw inferior. Posterior nostril a prominent, thick-rimmed circular opening that is closer to eye than to tip of snout. Anterior nostril a short, fleshy tube, slightly flared distally, at tip of snout. Eye elliptical, 9.1 in head length and 2.5–2.6 in interorbital.

A strong, sharp-pointed spine is barely emergent near the upper angle of the opercle and does not extend beyond the opercular flap. No emergent spine beneath eye, in vicinity of posterior nostril, or on pectoral girdle above base of fin.

The jaws are broad and capacious, extending about an eye diameter beyond the rear margin of the eye. The suborbital sheaths the shaft of the maxillary; however, the broadly expanded posterior part of the bone is free. Developed gill rakers three, bearing spiny pads at their tips. Wide bands of small granular teeth present on the dentaries, premaxillaries, and palatines; the vomerine tooth patch is broadly V-shaped.

Color a uniform dark brown.

Male intromittent organ on a broad, bilobed peduncle. Only the male paratype was dissected; testes paired, about 8 cm long. Lining of peritoneum light brown. Posterior elbow of stomach at about level of rear margin of pectoral fin. Swimbladder very broad, extending posteriorly slightly beyond the stomach, with a tough thick wall.

This species is named for Dr. Nikolaii V. Parin.

Discussion.—Possible relationships will be discussed in a future paper. For the present I can say only that *C. niki* is not very similar to any known *Cataetyx* species and can be distinguished easily from all of them by the diagnosis given above.

Diplacanthopoma sp.

26°10′N, 15°10′W; 900 m; "Zvezda Kryma" stat. 143.

IOM uncat., 1 ♂. Measurements in mm: standard length 190, perhaps slightly longer as tip of tail may be regenerated; preanal length 94.8; predorsal length 62.1; body depth at vent 32.0; preventral length 45.2; head length 55.8; snout length 13.1; horizontal eye diameter 11.4; interorbital width 13.7 (approximate); upper jaw length 24.6; maxillary depth 9.0; pectoral fin base depth 9.6; pectoral fin length 31.2; ventral fin length 25.1. Dorsal fin rays 172 (possibly several more); anal fin rays 125 (possibly several more); pectoral fin rays 28; ventral fin rays 1-1; caudal fin rays ? 13 (fin possibly regenerated); vertebrae 20 + 56 = 76 (possibly more); branchiostegal rays 8 (the anterior one very small); approximate number of lateral scale rows 140. Head canal pores: lateral 2; supraorbital 2; infraorbital ? 5; preoperculo-mandibular 7.

This specimen constitutes the first record of the genus from the eastern Atlantic. Of the eight described species listed in *Diplacanthopoma* by Cohen and Nielsen (1978), most are so poorly known that proper identification of the present specimen is not now possible. It may represent an undescribed species, as it has notably higher dorsal and anal fin ray counts than any other specimen that I have examined. It will be treated in greater detail in a revision of the genus.

Acknowledgments

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Specimens examined are in the following collections, and I am grateful to the appropriate curators: Institute of Oceanology, Moscow (IOM); Institute Royal des Sciences Naturelles de Belgique (IRSNB); U.S. National Museum of Natural History (USNM); Zoological Institute, Leningrad (ZIL);

Zoological Museum, Moscow Lomonosov State University (ZMMSU); Zoological Museum, University of Copenhagen (ZMUC).

Drafts of the manuscript were read by Drs. B. Collette, J. G. Nielsen, and N. V. Parin.

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THE SPECIES OF *AUTOMATE* (CARIDEA: ALPHEIDAE) IN THE EASTERN PACIFIC OCEAN

Mary K. Wicksten

Abstract.—Two species of alpheid shrimp, genus *Automate,* occur in the eastern Pacific Ocean. *Automate rugosa* Coutière has been found in the Gulf of Panama and off western Mexico. A detailed description and the first illustrations of this species are provided. *Automate dolichognatha* De Man has been collected at Isla Clarion, off Panama, Colombia, Ecuador, and the Galápagos Islands. *Automate haightae* Boone is a junior synonym of *A. dolichognatha.*

Introduction

Two species of *Automate* have been recorded from the Pacific coast of central America. *Automate rugosa,* from the Gulf of Panama, was described in a few sentences without an illustration (Coutière 1900). De Man (1911) provided more details on the species. In 1931, L. Boone described *A. haightae* from the Islas Perlas, Panama, which is synonymized herein with *A. dolichognatha* De Man, not reported previously from the area.

Specimens of *Automate* spp. were found in the collections of the Allan Hancock Foundation, University of Southern California, and the U.S. National Museum of Natural History. The type of *A. haightae* was borrowed from the American Museum of Natural History for comparison with specimens from other areas.

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Automate dolichognatha De Man

Automate dolichognatha De Man, 1887:529–532, pl. 22, fig. 5.—De Man, 1911:139.—Banner and Banner, 1973:299–303, fig. 1.
Automate gardineri Coutière, 1902:337.—Chace, 1972:74.
Automate sp.—De Man, 1911:140, fig. 2.
Automate haightae Boone, 1931:184–187, fig. 22.
Automate johnsoni Chace, 1955:13–16, fig. 7.
See Banner and Banner 1973, for a more complete synonymy.

Type-locality.—Noordwachter Island, Indian Archipelago (Pulau Tuguan, Indonesia).

Recorded range.—Djibouti; Eylath, Israel; Maldive and Laccadive Archipelagoes; Malaysia; Japan; Marianas Islands; as far east as Samoa in the central Pacific (Banner and Banner 1973); North Carolina; Virgin Islands; Antigua Island; Barbados and Yucatan Peninsula (Chace 1972); North shore, Isla Tabogilla, Islas Perlas, Bahía de Panamá (Boone 1931).

Material examined.—Isla Clarion, Mexico (18°20′N, 114°44′W), shore, 27 March 1954, L. Pinkas and D. Joseph, 1 specimen. North shore, Isla Tabogilla, Islas Perlas, Panama (about 9°N, 79°W), holotype of *A. haightae.* Islas Secas, Panama (7°57′N, 82°01′25″W), shore, rock and reef, 4 Feb. 1935, R.V. *Velero III* sta. 446-35, 1 specimen. Wafer Bay, Isla Cocos (5°32′45″N, 87°00′10″W), shore, rock, 1 March 1933, *Velero III* sta. 105-33, 3 specimens. Port Utria, Colombia (5°59′10″N, 77°21′20″W), shore, rock, 23 Jan. 1935, *Velero III* sta. 413-35, 1 specimen. Bahía Cabita, Cabo Corrientes, Colombia (5°29′20″N, 77°29′35″W), shore, sand near stream, 13 Feb. 1934, *Velero III* sta. 229-34, 1 specimen. Isla Gorgona, Colombia (2°58′N, 78°11′15″W), shore, rock and sand, 22 Jan. 1935, *Velero III* sta. 405-35, 1 specimen. Isla Solanga, Ecuador (1°35′10″S, 80°51′55″W), 39 m, mud sample, 18 Jan. 1935, no station number, 1 specimen. Gardner Bay, Hood Island (Isla Española), Galápagos (1°23′05″S, 89°39′40″W), 18 m, rock and nullipores, 24 Jan. 1933, *Velero III* sta. 25-33, 1 specimen. Academy Bay, Indefatigable Island (Isla Santa Cruz), Galápagos (0°45′13″S, 90°20′28″W), shore, rock, 3 Feb. 1933, *Velero III* sta. 49-33, 1 specimen.

Color in life.—"Pale translucent gallstone yellow to nearly clear, fingers of chelae dull white, eggs cadmium orange" (Waldo L. Schmitt, unpubl. field notes). "Semi-translucent, creamy yellow" (Boone 1931).

Remarks.—I have compared the type of *A. haightae* and its description carefully to other specimens from the eastern Pacific as well as to the descriptions of *A. dolichognatha* given by De Man (1877), and Banner and Banner (1973). *Automate haightae* falls well within the limits of variation of *A. dolichognatha.* Boone failed to compare her specimen with any other species of *Automate* except *A. evermanni* Rathbun. The current synonymy of *A. haightae* with *A. dolichognatha* extends the range of this species across the Indo-West Pacific region into the eastern Pacific.

Automate rugosa Coutière

Figs. 1, 2

Automate rugosa Coutière, 1900:357.—De Man, 1911:140.

Type-locality.—Gulf of Panama.

Description.—Anterior margin of carapace deeply recessed posterior to eyes, with very low median lobe. Carapace inflated, smooth and unarmed, anterolateral angles rounded.

Pleuron of first abdominal somite with slightly convex margin, anterior

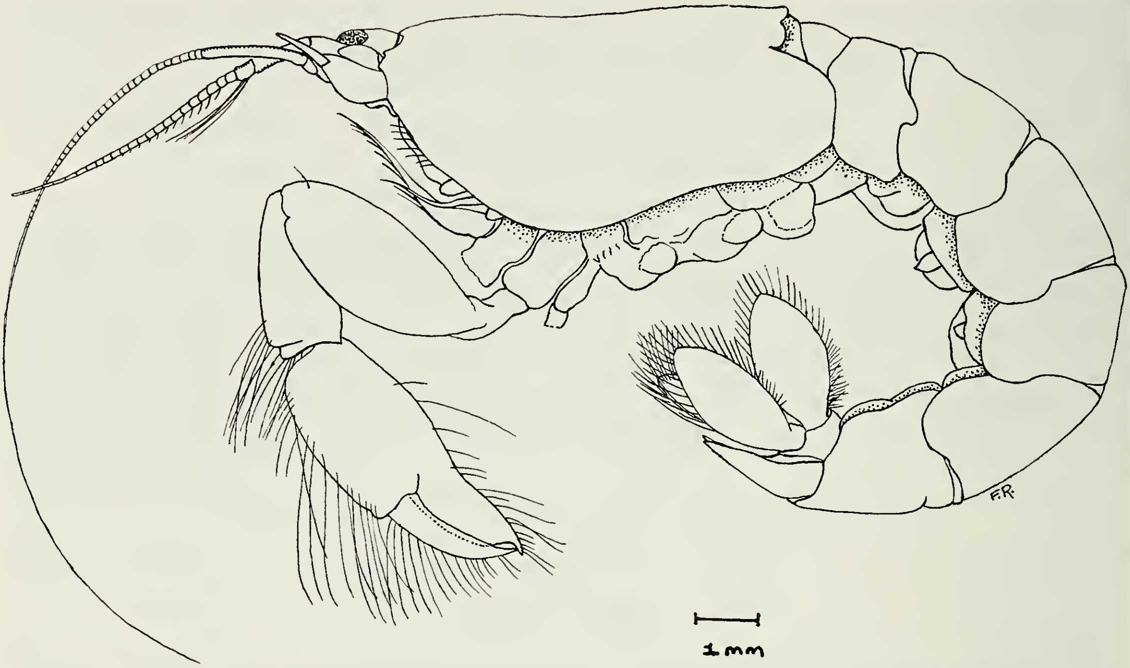

Fig. 1. *Automate rugosa*, female, total length 22.5 mm. South Bay, Isla Cedros, Mexico. *Velero IV* station 1703-49.

and posterior angles rounded. Pleura of second to fifth somites with sinuous margins and rounded angles. Sixth segment 1–1.3× as long as fifth, posterolateral angle directed posteriorly. Telson laterally constricted near base and converging to narrow posterior margin; dorsal surface unarmed; posterior margin transverse, without median projection, armed with pair of small lateral spines and pair of much longer, slender mesial spines.

Antennular peduncle with stylocerite broadly convex mesially, nearly straight laterally, short apical tooth not reaching end of basal antennular segment. Mesial surface of basal segment without ventral tooth. Second segment 1.3× as long as first and 3× as long as third. Lateral flagellum thickened almost to distal end.

Antennal peduncle longer than antennular peduncle. Antennal scale reaching more than 0.5× length of antennal peduncle, lateral margin straight, distal tooth short and stout, overreaching blade. Basal segment of peduncle without tooth at articulation with scale.

Mandible with 5 marginal teeth on incisor process, distal segment of palp broad. First maxilla with bilobed palp, proximal lobe slender, with tuft of setae; distal lobe larger, bearing fringe of teeth. Second maxilla with palp, scaphognathite, and bilobed endite. First maxilliped with broad, 3-jointed palp. Second maxilliped with elongate lobe at base of epipod. Third maxilliped exceeding antennal peduncle by length of its terminal segment. Ter-

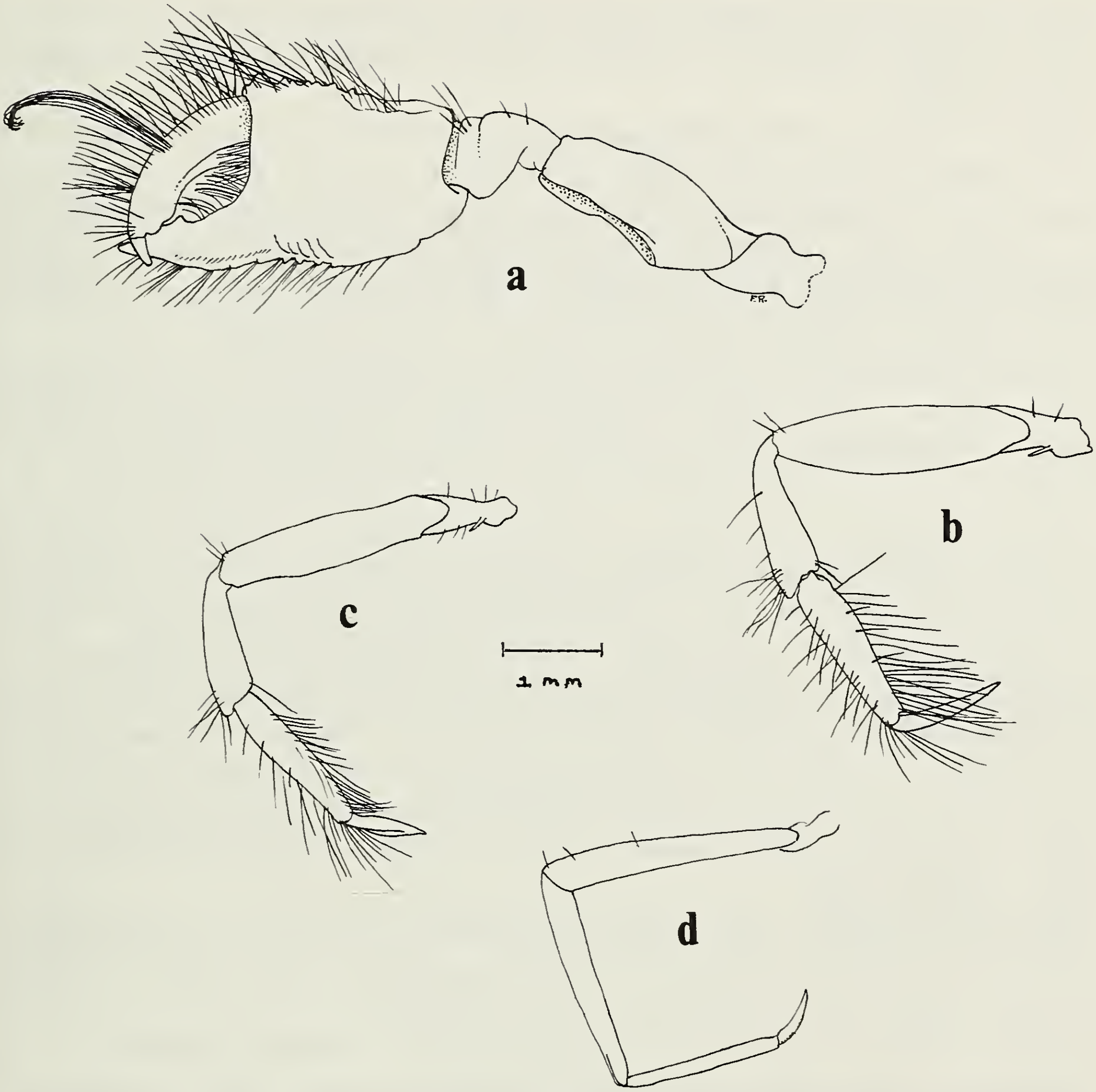

Fig. 2. *Automate rugosa:* a, Major chela; b, Third pereopod; c, Fourth pereopod; d, Fifth pereopod.

minal segment heavily setose. Penultimate segment greater than 0.5× length of terminal segment, setose, Antepenultimate segment slightly less than length of terminal segment, with rounded dorsal margin.

First pereopods very unequal. Major cheliped overreaching antennal peduncle by length of chela. Fingers shorter than palm, gaping. Movable finger armed with blunt proximal teeth on opposable margin. Tuft of long setae may be present on outer margin of movable finger. Fixed finger with blunt tooth at point of contact with movable finger. Patch of pile at proximal margin of gape of fingers. Palm about as long as broad, with rounded tubercles at distal margins. 5 slight ridges just proximal to base of fixed finger.

Carpus less than 0.5× length of palm. Merus subequal to palm, dorsal and ventral margins sinuous or rounded. Ischium about 0.5× length of merus, without spines.

Minor cheliped overreaching antennal peduncle by more than length of chela. Fingers shorter than palm. Low tooth on fixed finger at point of contact with movable finger. Patch of setae on fixed finger, filling much of gape of fingers. Crest bearing long setae along dorsal margin of palm, ending distally in 3 low teeth. Carpus slightly longer than palm. Merus shorter than palm, margins rounded. Ischium about 0.3× length of merus.

Second pereopod overreaching antennal peduncle by entire carpus and chela. Fingers about equal to palm. Carpus 5-jointed, ratio of articles 3:10:4:3:4. Merus 0.8× length of carpus. Ischium slightly shorter than merus.

Third pereopod overreaching antennal peduncle by dactyl and most of propodus. Dactyl slender, simple, about 0.6× length of propodus. Propodus without spines. Carpus about equal to propodus. Merus about 1.5× length of propodus. Ischium with spine. Fourth pereopod with spatulate dactyl, about 0.5× length of propodus. Propodus with slender marginal setae. Carpus about equal to propodus. Merus 1.5× length of carpus. Ischium about 0.3× length of merus, with spine. Fifth pereopod with slender dactyl, about 0.4× length of propodus. Propodus without spines. Carpus long, about 1.4× length of propodus. Merus about equal to carpus. Ischium 0.2× length of merus, without spine.

Material examined.—Off Turtle Bay, Mexico (27°39′05″N, 114°54′47″W–27°39′12″N, 114°54′12″W), 33–57 m, sand and mud, 18 Jan. 1940, 1 broken specimen. South Bay, Isla Cedros, Mexico (28°05′N, 115°21′W), 30 m, sand and mud, 5 March 1949, *Velero IV* sta. 1703-49, 2 broken specimens.

Remarks.—Despite the lack of illustrations, *A. rugosa* can be recognized by its brief description. Coutière (1900) remarked on the crests of the cheliped, a noticeable feature in the material examined. De Man (1911) in his key to the species of *Automate* mentioned the following features of *A. rugosa*: carpocerite not longer than antennular peduncle, proportion between length and height of the large chela in the female less than 2, the palm being just as long as high, upper and lower margin of the palm very rugose, and second legs as in *A. evermanni* (second carpal segment of second legs 3 or 4 times as long as the first). In my specimens, the carpocerite slightly exceeds the antennular peduncle, but the material otherwise agrees with the notes given by Coutière and De Man.

In lacking spines on the flexor margin of the propodus of the third and fourth pereopods, *A. rugosa* agrees with *A. anacanthopus* De Man, *A. evermanni* Rathbun, and *A. rectifrons* Chace. Like *A. anacanthopus* and *A. evermanni,* it has a small rostrum. The peculiar tuberculate chela with the ridges is quite unlike that of any other species of *Automate*.

The two records of *A. rugosa* suggest that it is strictly a subtidal species, unlike *A. dolichognatha.*

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A VOLUTID SPECIES RADIATION FROM NORTHERN HONDURAS, WITH NOTES ON THE HONDURAN CALOOSAHATCHIAN SECONDARY RELICT POCKET

Edward J. Petuch

Abstract.—A previously unknown species radiation of the relict Neogene volutid genus *Falsilyria* has been found to exist in a secondary relict pocket along northern Honduras. Three new species, *Falsilyria garciai, F. kotorai,* and *F. retemirabilis* are described and the living species of the genus are reviewed. An hypothesis is proposed, taking into account Pleistocene glacially-induced sea level fluctuations, as an explanation for the existence of five sibling species on the Honduran continental shelf and offshore banks. The relict nature of the Honduran gastropod fauna is discussed and its affinities to the fauna of the Pinecrest Beds Formation of the Pliocene Caloosahatchian Province of South Florida are outlined.

Introduction

The Caribbean Molluscan Province has recently been shown (Petuch 1981; Petuch, in press) to be composed of an array of discrete faunas, each differing in both species composition and geological age. Since the Caribbean region actually consists of a faunal mosaic in both time and space, I referred to this type of zoogeographical pattern as geographical heterochrony (Petuch, in press). In that study, the geographically heterochronous Caribbean was shown to contain two types of anachronistic faunas. I referred to these zoogeographical subunits as relict pockets. In turn, these isolate small areas were seen to be geographically interspersed within a matrix of wide-ranging, recently evolved species.

One type of relict pocket was discovered in the Gulf of Venezuela region (Petuch 1981) and contained a fauna that closely resembled, in both generic and species compositions, the molluscan assemblages of Pliocene Caribbean formations such as the Gurabo, Bowden, Gatun, and Mare. This type was referred to as a primary relict pocket. Another type of relict pocket was discovered in the Yucatan, Mexico and Roatan Island, Honduras areas and contained few relict species but many relict genera. This type was referred to as a secondary relict pocket. In essence, relict pockets represent areas where evolution and extinction have been greatly slowed or stopped and have resulted in intact Neogene faunas that are "frozen" in time.

The shallow water (0–50 m) areas off northern Honduras, from near Roatan Island to the Nicaragua border, contain many extant elements of the Neogene Caloosahatchian Molluscan Province (Petuch, in press). Here, a number of relict genera and species complexes have managed to survive and have undergone secondary speciation. These include the endemic Caloosahatchian genera *Cypraeorbis* (Cypraeidae), *Heilprinia* (Fasciolariidae), *Pleioptygma* (Mitridae), and *Falsilyria* (Volutidae), and complexes centered around several Caloosahatchian species. These will be discussed in detail later in this paper. I refer, collectively, to both the Northern Honduras continental shelf and bank areas and the area of the Yucatan Banks as the Caloosahatchian Secondary Relict Pockets.

The genus *Falsilyria* is a common and conspicuous component of the molluscan assemblages comprising the Honduran Caloosahatchian Secondary Relict Pocket. The genus first appears in the upper Eocene Inglis Limestone of Florida (S. Hoerle and E. Vokes 1978:106–107), where it is represented by two species. Probably an offshoot of *Lyria* s.s., *Falsilyria* was restricted to the Caloosahatchian Molluscan Province and evolved into five species by the lower Miocene. The evolution of the morphological characteristics of the genus, as a whole, parallel those of the genus *Voluta* of the Gatunian Province (S. Hoerle and E. Vokes 1978:107; Petuch 1980:117; Petuch, in press). There is a conspicuous gap, however, from the middle Miocene to the Recent, in which no known species of *Falsilyria* have been found in the fossil record.

Falsilyria was originally thought to be represented in the Recent by a single species, *F. demarcoi* (Olsson, 1965) (S. Hoerle and E. Vokes 1978:107). In 1980, however, I described a second living species, *F. morrisoni* (Petuch, 1980:115–117), from the north coast of Roatan Island. Since then, through the efforts of two active amateur malacologists, Dr. Emilio Garcia and Mr. Louis Kotora, I acquired a number of unusual forms of *Falsilyria*. These had been taken by commercial shrimp boats working along the Honduras coast and offshore banks. From the large suite of specimens, I found that there were actually several living *Falsilyria* species and that these represented a previously unknown species radiation or complex that was restricted to the confines of the refugium.

This paper gives a review of the living species of the genus, the descriptions of three new species and offers suggestions for patterns of evolution and speciation trends that can occur within secondary relict pockets. Specimens designated with USNM numbers are in the collection of the Division of Mollusks, National Museum of Natural History, Smithsonian Institution.

Systematic Section

Class Gastropoda
Order Caenogastropoda
Superfamily Volutacea Rafinesque, 1815
Family Volutidae Rafinesque, 1815
Subfamily Volutinae Rafinesque, 1815

Genus *Falsilyria* Pilsbry and Olsson, 1954

Falsilyria Pilsbry and Olsson, 1954:21.

Type-species.—*Lyria pycnopleura* Gardner, 1937, by original designation.

Diagnosis.—"Similar to *Voluta* Linné but with a narrower shell and higher spire; nucleus relatively small, consisting of but one (to two plus) rather loosely coiled whorls; sculpture formed by strong, smooth, nearly straight axial ribs, generally somewhat noded or coronated at the suture and with faint spirals showing around the base and on the canal; aperture semi-elliptical, the outer lip thickened by the last rib, smooth within; plaits on the columella and parietal wall are similar to those of *Voluta*; of these the four or five lower ones form large, strong, sharp folds which spiral deeply into the interior while above them the plaits on the parietal wall are small and weak; end of pillar appressed and turned sharply backwards to form a recurved beak forming a deep, siphonal notch; siphonal fasciole short but strong" (Pilsbry and Olsson 1954).

Diagnosis by Olsson 1965.—"Similar to *Voluta* in shape and parietal and columellar plaits, but distinguished by the constricted ends of the axial riblets bordering the suture. Sculpture of axial riblets smooth or crossed by encircling spirals."

Remarks.—Descriptions of fossil species of *Falsilyria,* together with a discussion on the evolution of the genus, were given by Hoerle and Vokes (1978:106–107, 120–128). The geographical range of the genus was discussed by myself (1980:117), as were the morphological relationships between the known Recent and fossil species.

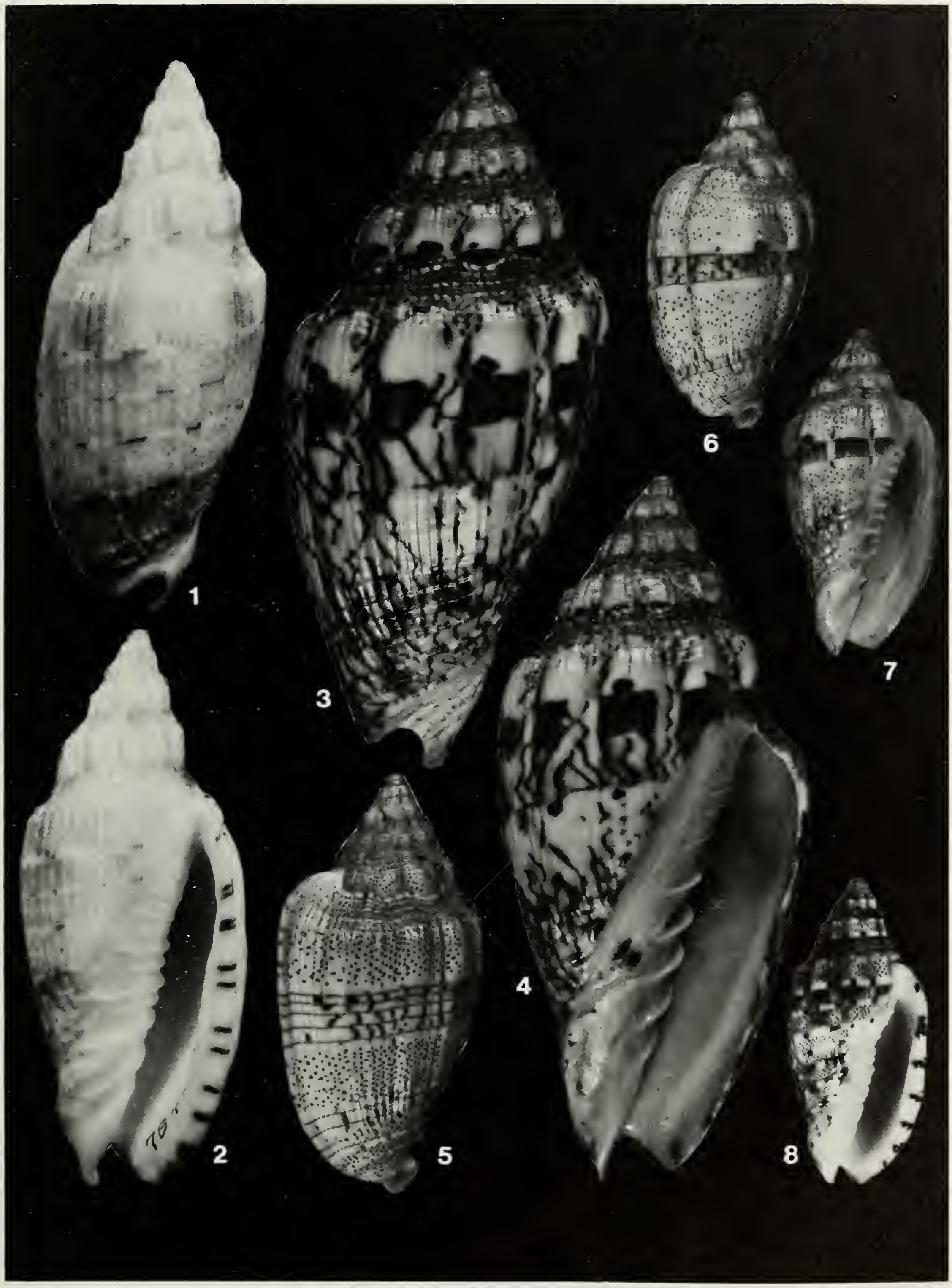
Falsilyria demarcoi (Olsson, 1965)
Figs. 5–7, 24, 25

Voluta demarcoi Olsson, 1965:662–663, pl. 81, figs. 7, 7a, pl. 82, figs. 1, 1a, 1b, 1c.

Falsilyria demarcoi.—Hoerle and Vokes, 1978:107.—Petuch, 1980:115–116, figs. 9, 10.

Material examined.—Length 70 mm, trawled by commercial shrimpers from 15 m depth off north coast of Roatan Island, Honduras, 1979, USNM 784646; length 45 mm, trawled by shrimpers, 35 m depth off Roatan Island, Honduras, February 1980, USNM 784645; lengths 52 mm, 56 mm, 85 mm, trawled by commercial shrimp trawlers from 35 m depth south of the Caratasca Cays, north coast of Honduras, collection of Dr. Emilio Garcia, Lafayette, Louisiana; length 54 mm, trawled by shrimpers from 35 m depth off north coast of Roatan Island, Honduras, 1979, collection of Dr. Geerat J. Vermeij, University of Maryland.

Distribution.—From the area around Roatan Island, Honduras, to the Honduras-Nicaragua border in depths from 2–50 m.



Figs. 1–8. Species of *Falsilyria:* 1, *F. morrisoni,* dorsal aspect of holotype (USNM 784485), length 73 mm; 2, *F. morrisoni,* ventral aspect of holotype; 3, *F. garciai,* dorsal aspect of holotype, length 71 mm; 4, *F. garciai,* ventral aspect of holotype; 5, *F. demarcoi,* dorsal aspect of specimen from Roatan Island, length 54 mm; 6, *F. demarcoi,* dorsal aspect of specimen from Roatan Island (USNM 784645), length 45 mm; 7, *F. demarcoi,* ventral aspect of same specimen; 8, *F. morrisoni,* ventral aspect of paratype (USNM 784486), length 45 mm.

Discussion.—Although Olsson designated the type-locality of *F. demarcoi* as ". . . about 105 miles off Mezquital, Texas, in 100 fathoms" (Olsson 1965:663), this is apparently in error. Neither this species nor any other member of the genus has been collected anywhere along the east coast of Mexico and Yucatan Banks, even though these areas are heavily fished at several depths by commercial shrimpers. The other locality given in the same paper, ". . . 5 fathoms (mud), Punta Patuca, Honduras" (Olsson 1965:663), appears correct and falls within the typical geographical and depth ranges of the species. The commercial shrimpers work the entire east coast of Central America from Yucatan south to Nicaragua and specimens of mollusks that are saved by the captains are often actually from several different localities. Since locality data on many of these specimens are sketchy or non-existent, it is not surprising that Olsson was misled in the geographical range of his new species. Unfortunately, these incorrect locality data have been carried on in the works of Weaver and duPont (1970:7), Hoerle and Vokes (1978:107), and others.

Falsilyria demarcoi has the widest distribution of the genus and it appears to range all along the mainland and the continental shelf of Honduras. Figure 24 shows a specimen of an unusually colorful population from the area near the Caratasca Cays. The specimen in Figs. 6 and 7 represents a dwarfed, but otherwise typically colored, individual from shallow water near Roatan Island.

Falsilyria garciai, new species

Figs. 3, 4

Material examined.—Holotype: Length 71 mm, width 34 mm, trawled by commercial shrimp boats from 35 m depth on Gorda Bank, off north coast of Honduras, 1980, USNM 784641. Paratype: Length 63 mm, same depth and locality as holotype, collection of Dr. Emilio Garcia, Layfayette, Louisiana.

Shell description.—Shiny, polished; body heavy, with 5 whorls; body whorl with 10 rounded axial ribs; all whorls with numerous sharply-defined minor axial ribs; anterior ¼ of shell with 7 large, raised, beaded cords; shoulder sharply defined, strongly coronated; spire high, scalariform; spire whorls coronated, heavily sculptured with 7 large, raised, beaded cords; 3 cords on shoulder, enhancing coronated appearance; protoconch glassy, composed of 3 whorls; aperture narrow, roughly $^3/_5$ of shell length; columella with 9 sharp-edged plications; base shell color cream-orange with 2 bands of deep purple-blue and sky-blue blotches, one band around midbody, one around anterior end; base color overlaid with numerous longitudinal dark brown zigzag flammules, some running entire length of shell; shoulder with scattered patches of dark brown dots; spire whorls blue-gray with radiating, fine, dark brown zigzag lines that cross over raised spiral cords, giving them speckled appearance; protoconch tan; interior of aperture flesh-pink; columellar region orange, becoming darker at anterior end.

Type-locality.—35 m depth on Gorda Bank, Honduras.

Distribution.—At present, known only from Gorda Bank.

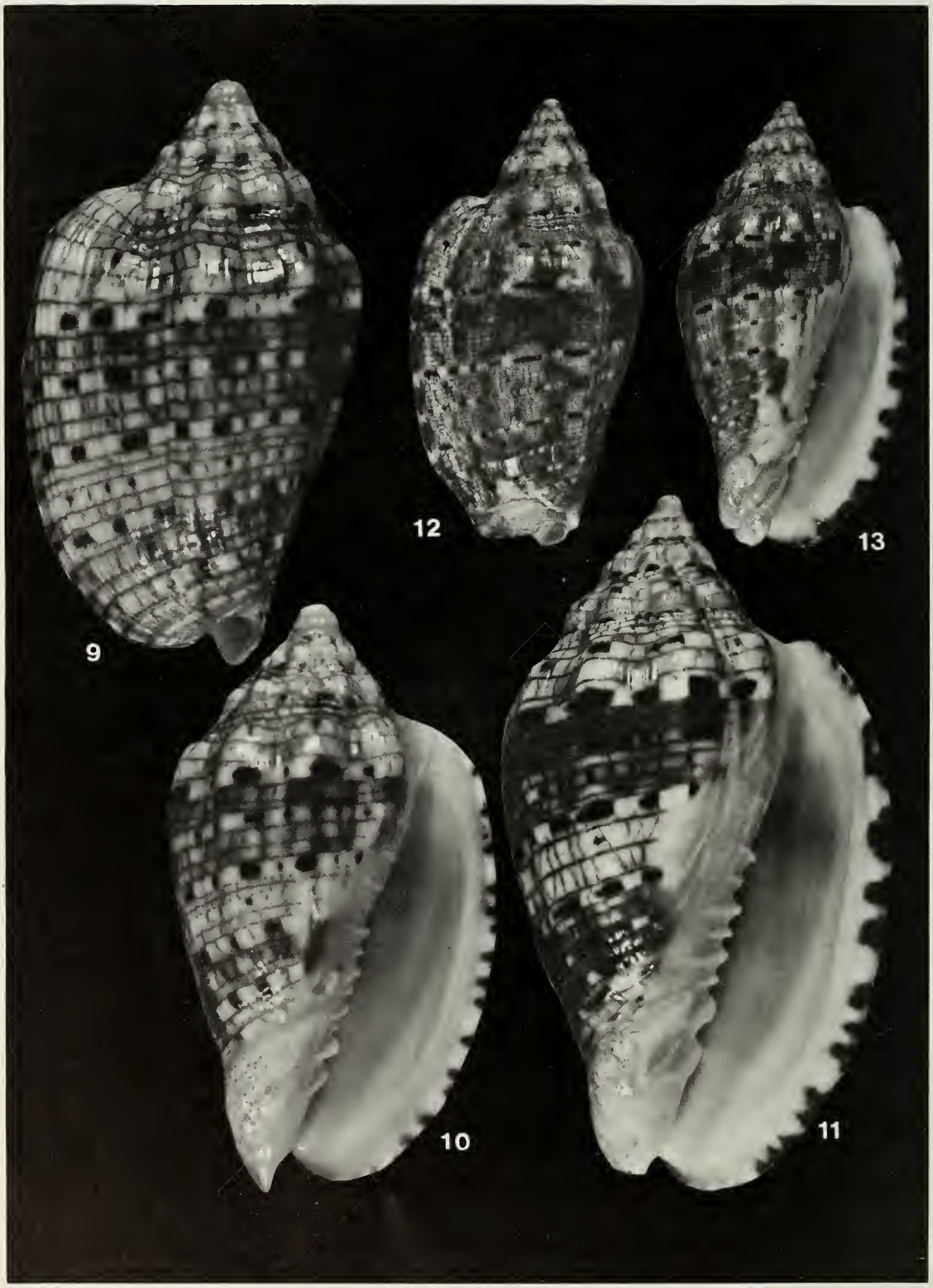
Etymology.—Named for Dr. Emilio Garcia, Lafayette, Louisiana, who first recognized the species as new and who has kindly donated the type and a large series of Honduran mollusks for study.

Discussion.—Of the known species of *Falsilyria,* both living and fossil, *F. garciai* is the only species with a color pattern of zigzag flammules. The sharp-angled shoulder coronations and the heavily sculptured spire whorls are closer to those of *F. morrisoni* than to those of any of the other living species. Unfortunately, the type-specimens both have thin lips, and judging from this thinness, probably represent subadult specimens. The rarity of this new species reflects the lack of extensive collecting on Gorda Bank. Furture work in that area may bring to light more specimens of this distinctive volute.

Falsilyria kotorai, new species
Figs. 9–11

Material examined.—Holotype: Length 49 mm, width 27 mm, brought up in lobster trap, occupied by hermit crab, from 36 m depth on Rosalind Bank, Honduras, January 1980, USNM 784642. Paratypes: Length 81 mm, same depth, locality, and date as holotype, USNM 784644; length 48 mm, same locality, collection of Dr. Emilio Garcia, Lafayette, Louisiana; length 76 mm, same depth, locality, and date as holotype, collection of Mr. Louis Kotora, St. Petersburg, Florida.

Shell description.—Shiny, polished; body heavy, thickened, with 4–5 whorls; body whorl with 7–10 rounded axial ribs; last whorl with numerous sharply-defined minor axial ribs towards edge of lip; spire low, roughly $^1/_4$–$^1/_5$ total shell length; spire whorls with 3 undulating, beaded spiral cords; protoconch very large for genus, with 3 bulbous whorls; aperture large, wide, lenticular, roughly ¾ of total shell length; columella with 12–14 thin, smooth, sharp-edged plications; lip thickened and flaring in adults; base shell color bright salmon-pink with 2 wide bands of wine-red and purple blotches, one band posterior to midbody line, one anterior; base color overlaid with 5–7 evenly-spaced revolving bands of black and white spots and secondary system of numerous evenly-spaced revolving brown lines connected by short, staggered, longitudinal lines, producing "brick wall" pattern; protoconch white at tip, turning to orange; interior of aperture salmon-pink, becoming orange towards edge of lip; edge of lip white with numerous black spots; columella orange, with white plications.



Figs. 9–13. Species of *Falsilyria:* 9, *F. kotorai,* dorsal aspect of holotype, length 49 mm; 10, *F. kotorai,* ventral aspect of holotype; 11, *F. kotorai,* ventral aspect of paratype (USNM 784644), length 81 mm; 12, *F. retemirabilis,* dorsal aspect of holotype, length 75 mm; 13, *F. retemirabilis,* ventral aspect of holotype.

Type-locality.—36 m depth on Rosalind Bank, Honduras.

Distribution.—At present, known only from Rosalind Bank.

Etymology.—Named for Mr. Louis Kotora, St. Petersburg, Florida, who first recognized the species as new and who kindly donated the type material.

Discussion.—Of the four other known Recent species of *Falsilyria,* the new species most closely resembles *F. demarcoi* and *F. retemirabilis,* n. sp. *Falsilyria kotorai* differs from *F. demarcoi* in having a lower spire, larger protoconch in proportion to shell size, and in lacking both the bright orange-peach base color and bands of fine brown specklings that are characteristic of Olsson's species. *Falsilyria kotorai* differs from *F. retemirabilis* in having a red and pink shell color, in having a coarse "brick" pattern instead of a fine "net" pattern, and in having a larger protoconch.

Falsilyria morrisoni Petuch, 1980
Figs. 1, 2, 8

Falsilyria morrisoni Petuch, 1980:115–117, figs. 1–6.

Material examined.—Lengths 73.4 mm (holotype) and 45.4 mm (paratype), 60 m depth off north coast of Roatan Island, Honduras, January, 1979, USNM 784485 (holotype) and 784486 (paratype); length 42 mm, same depth and locality as holotype, collection of Dr. Emilio Garcia, Lafayette, Louisiana.

Distribution.—At present, known only from off Roatan Island.

Discussion.—*Falsilyria morrisoni* is the only known living species to have beaded columellar plications (Petuch 1980:fig. 5). In having this character, *F. morrisoni* most closely resembles the fossil *F. mansfieldi* (Dall, 1916) and may be the direct descendant.

Falsilyria retemirabilis, new species
Figs. 12, 13

Material examined.—Holotype: Length 75 mm, width 38 mm, trawled by commercial shrimp boats from 20 m depth off Caratasca Cays, Honduras, November, 1980, USNM 784643.

Shell descripton.—Shiny, highly polished; body thick, heavy, with 5 whorls; body whorl smooth, with 11 low, flattened axial ribs; anterior ¼ shell with 4 wide, raised spiral cords; shoulder rounded, smooth; spire high; early spire whorls heavily sculptured with raised spiral threads, later whorls smooth; 3 slightly raised spiral threads on last spire whorl; protoconch glassy, composed of 3 whorls; aperture large, flaring, roughly ¾ total shell length; columella with 15 plications, 5 of which are larger than others; base shell color cream-yellow with 2 continuous bands of blue-gray, one above midbody line, one at anterior end; base shell color overlaid with numerous intermeshing, horizontally and vertically-oriented rows of tiny brown dots which form a fine net pattern over entire shell; net pattern, in turn, overlaid by 10 wide, revolving bands of alternating dark brown and violet-blue dashes; protoconch white at tip, turning orange; interior of aperture flesh-colored; columella cream-yellow with white plications.

Type-locality.—20 m depth off Caratasca Cays, Honduras.

Distribution.—At present, known only from the area near the Caratasca Cays.

Etymology.—From the Latin "rete," net, and "mirabilis," wonderful; in reference to the fine net pattern that is characteristic of this new species.

Discussion.—Unfortunately, this new species is known only from the holotype. The remarkable net pattern of *F. retemirabilis,* however, is unique among the known Atlantic Volutidae, setting it aside from all other members of the genus. Besides color pattern, the protoconch of *F. retemirabilis* differs from that of *F. demarcoi* in being larger and more bulbous. It is not as large, however, as that of *F. kotorai,* and is intermediate in form. The rarity of *F. retemirabilis,* like that of *F. garciai,* is again probably a direct result of the lack of collecting on the Honduran offshore banks.

Comparison of the Shell Morphologies of the Living *Falsilyria* Species

Color patterns.—The color patterns of the five known living species of *Falsilyria* are of three basic types: *1,* a pattern composed of two wide, continuous bands of fine spiral lines, one around the midbody, one around the anterior end, alternating with two spiral bands of fine speckles; *2,* a pattern composed entirely of fine, continuous or dotted spiral lines connected by short vertical lines, producing a "brick wall" or "net" pattern; *3,* a pattern composed primarily of zigzag vertical lines that run the length of the shell. All of these patterns, in turn, overlie an amorphous, secondary background pattern that is usually composed of large blotches of various colors or numerous spiral bands of large, dark dashes. In all, the various combinations of these distinctive patterns appear to be species specific. Even within the range of each species' pattern, however, considerable variation exists. This is evidenced by the color morphs of *F. demarcoi,* shown here in Figs. 5–7 and 24, and those of *F. kotorai* (Figs. 9–11).

The first type of color pattern is found in both *F. demarcoi* and the fossil *F. anoptos* (Hoerle and Vokes, 1978:pl. 5, figs. 4c, 4d) and in a modified form in *F. morrisoni.* Details of the second type of pattern are shown here, for *F. kotorai* (Fig. 15) and *F. retemirabilis* (Fig. 16). This brick-net type of pattern is also found in Indo-Pacific volutids such as *Harpulina aurisiaca* (Lightfoot, 1786) and *Lyria cloveriana* Weaver, 1963. The brick-net pattern is in direct contrast to the elongated vertical flammules of *F. garciai* (Fig.

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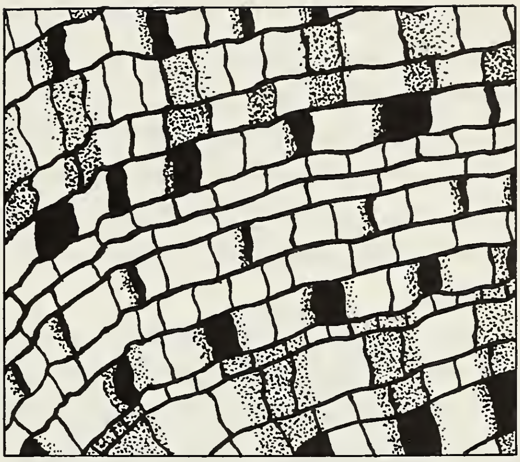

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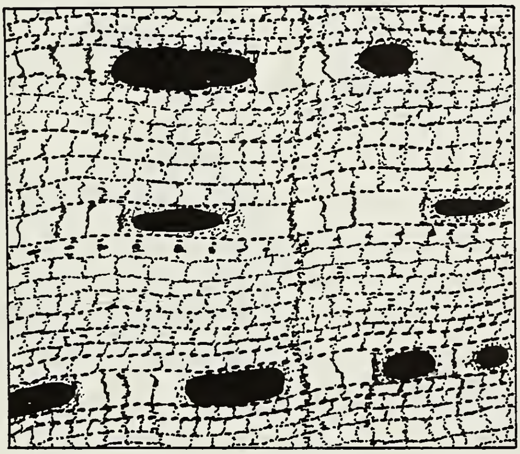

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Figs. 14–16. Details of the color patterns of the three new *Falsilyria* species, traced from photographs. Magnification approximately 10×. 14, *F. garciai*: 15, *F. kotorai*; 16, *F. retemirabilis*.

14). The zigzag pattern of *F. garciai* closely resembles the color pattern of the Brazilian *Voluta ebraea* Linnaeus, 1758, while the dotted band pattern of *F. demarcoi* and *F. morrisoni* is similar to that of the southern Caribbean *Voluta musica* Linnaeus, 1758.

All three types of color patterns are variations on a basic theme of fine spiral lines and dots and this is probably an ancestral morphological character for the whole genus. The similarity of color patterns between *Falsilyria* and *Voluta* most likely reflects a common ancestor for both genera (Hoerle and Vokes 1978:107; Petuch 1980:117). The retention of this ancestral color pattern may represent a trend towards morphological conservatism within both groups.

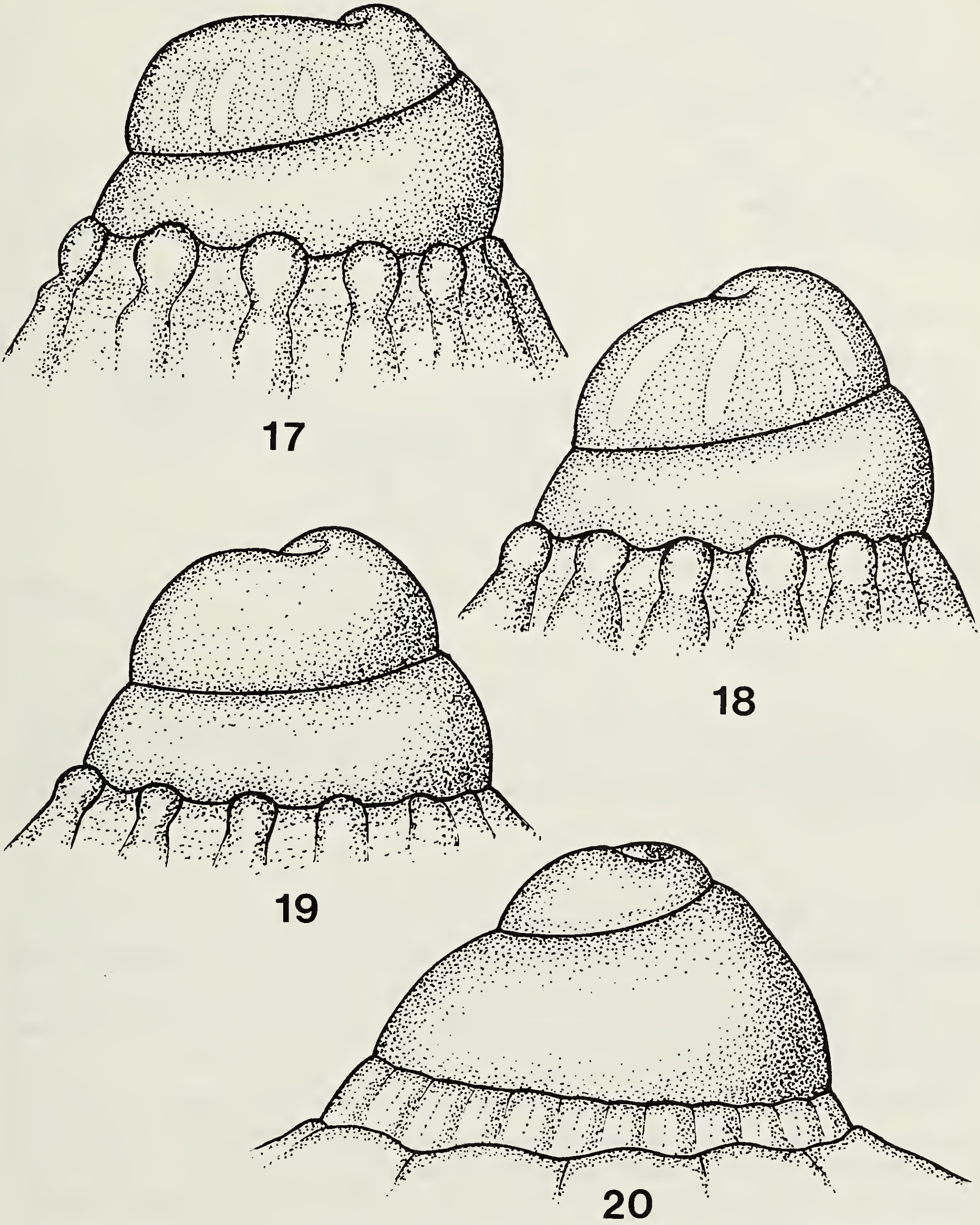
Protoconchs.—In the Volutidae, the protoconch is a powerful tool for species determinations. Since volutes undergo direct development, all embryonic stages take place within the egg capsule and eventually result in a crawl-away hatchling (Hyman 1967:306, 313). Environmental and physiological effects such as substrate type and diet do not affect the self-contained embryo as they would the adult shell. The protoconch, then, can be viewed as a direct genotypic indicator and not as a reflection of ecophenotypic variation.

Characteristically, all living *Falsilyria* species have protoconchs with 2½ whorls. The general form of the protoconchs of *Falsilyria* is quite different from that of the related genus *Voluta.* The protoconchs of *Falsilyria* differ in being smaller, cylindrical-shaped, and more exerted than those of *Voluta.* That genus can be seen to have protoconchs that are larger, broader, dome-shaped, and often ornamented with axial ribs. In having a smaller protoconch in proportion to total shell size, *Falsilyria* more closely resembles the genera *Lyria, Cordilyria, Enaeta,* and *Festilyria* than it does *Voluta.* Within this general form, however, two basic types of protoconchs can be discerned for the five living species.

The first type is found in *F. demarcoi, F. garciai,* and *F. retemirabilis,* and consists of the first and second nuclear whorls being roughly equal in size. This gives the protoconch a decidedly cylindrical appearance. In *F. demarcoi* (Fig. 19), the nuclear whorls are roughly parallel to the adult body whorl. On the other hand, both *F. garciai* (Fig. 17) and *F. retemirabilis* (Fig. 18) have nuclear whorls that are noticeably tilted to one side. This is especially obvious in *F. garciai,* which also has the first whorl flattened, producing a truncated appearance. This cylindrical-type protoconch is also found in the fossil *F. mansfieldi* (Dall, 1916) (S. Hoerle and E. Vokes 1978:pl. 5, figs. 4–5).

The second type of protoconch is found in *F. morrisoni* and *F. kotorai.* Although equally as exerted as the above-mentioned species, this type is more rounded, with the first whorl being smaller than the second (Fig. 20). Although differing greatly in shell shape and sculpture, *F. morrisoni* and *F. kotorai* have very similar protoconchs. The fossil *F. anoptos* also has a rounded protoconch (S. Hoerle and E. Vokes 1978:pl. 5, fig. 4e) and closely resembles that of *F. kotorai.*

The five living species can easily and consistently be separated by the shapes of their protoconchs. This was readily seen while examining several color forms of *F. demarcoi.* Although the shell coloration and size often differed greatly, the protoconchs were always identical in shape, size, and color. In *Falsilyria,* the two basic types of protoconchs occur throughout the geological range of the genus. There is no pattern to their occurrence and they do not appear to represent any type of derived or ancestral character state.



Figs. 17–20. Details of the protoconchs of four *Falsilyria* species. 17, *F. garciai*; 18, *F. retemirabilis*; 19, *F. demarcoi*; 20, *F. kotorai*.

Speciation Within a Secondary Relict Pocket

The pattern of speciation seen in *Falsilyria* appears to be the direct result of the separation of a wide-ranging ancestral stock into reproductively isolated gene pools. This separation was further reinforced by subsequent bar-

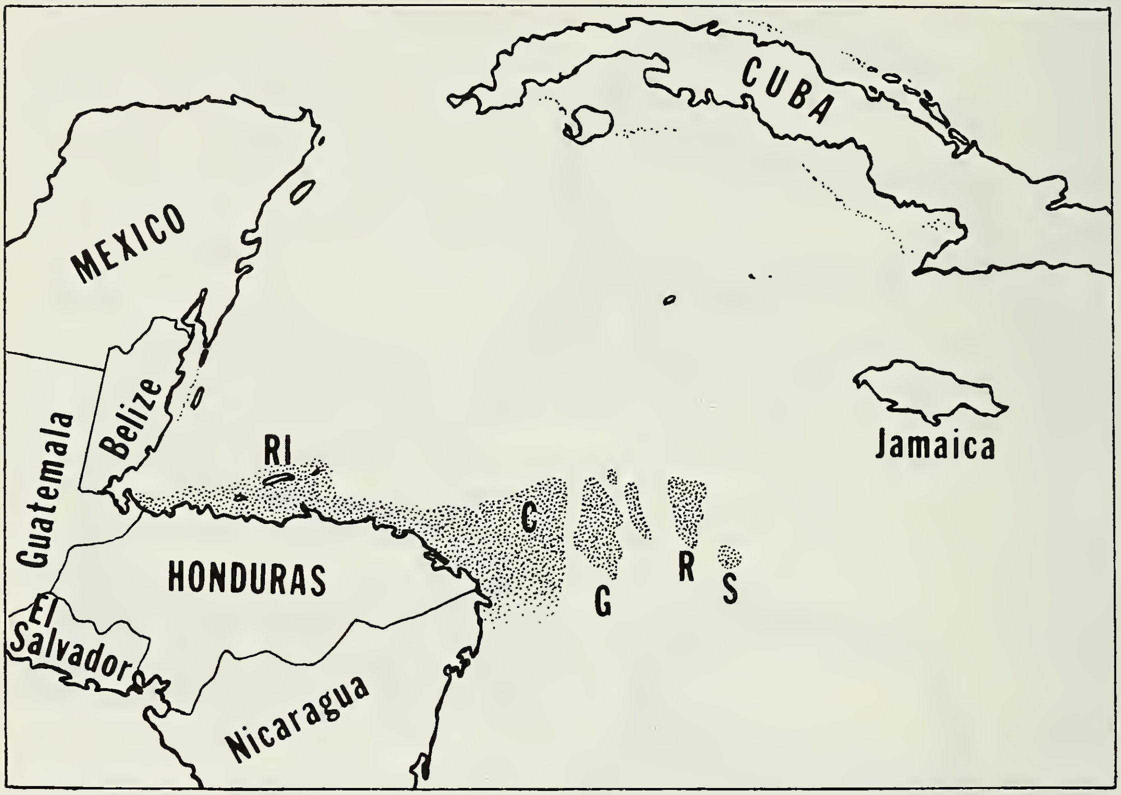


Fig. 21. Map of the Recent northwestern Caribbean Sea, showing the range of the Honduran Caloosahatchian Second Relict Pocket. RI—Roatan Island; C—Caratasca Cays; G—Gorda Bank; R—Rosalind Bank; S—Serranilla Bank. The banks can be seen to be separated by wide channels.

riers to dispersal of all the isolates. This is a classic example of a vicariance zoogeographic pattern and is one that is more commonly seen in insular terrestrial organisms. The topography of the Honduran Caloosahatchian Secondary Relict Pocket, however, produces an analogous island biogeographic pattern in a marine situation.

The area of the Caloosahatchian refugium is characterized by a series of adjacent, shallow water banks that are separated by wide, deep water channels (Fig. 21). These present barriers to dispersal for shallow water organisms that lack planktonic larvae. The effectiveness of these channel barriers varied greatly during the Pleistocene and depended, primarily, on high or low water stands during glacial and interglacial periods. During an extreme low water stand, such as one of minus 100 m in the mid-Pleistocene (CLIMAP members 1976:1131–1133; Emiliani 1971:183–197), the entire Honduran continental shelf, including the deep channels and bank regions, was exposed (Olsson 1972:120). During a high water stand, such as during the Sangamonian Interglacial Period, the Caribbean flooded the shelf and the shallow banks were again separated by deep, impassable channels.

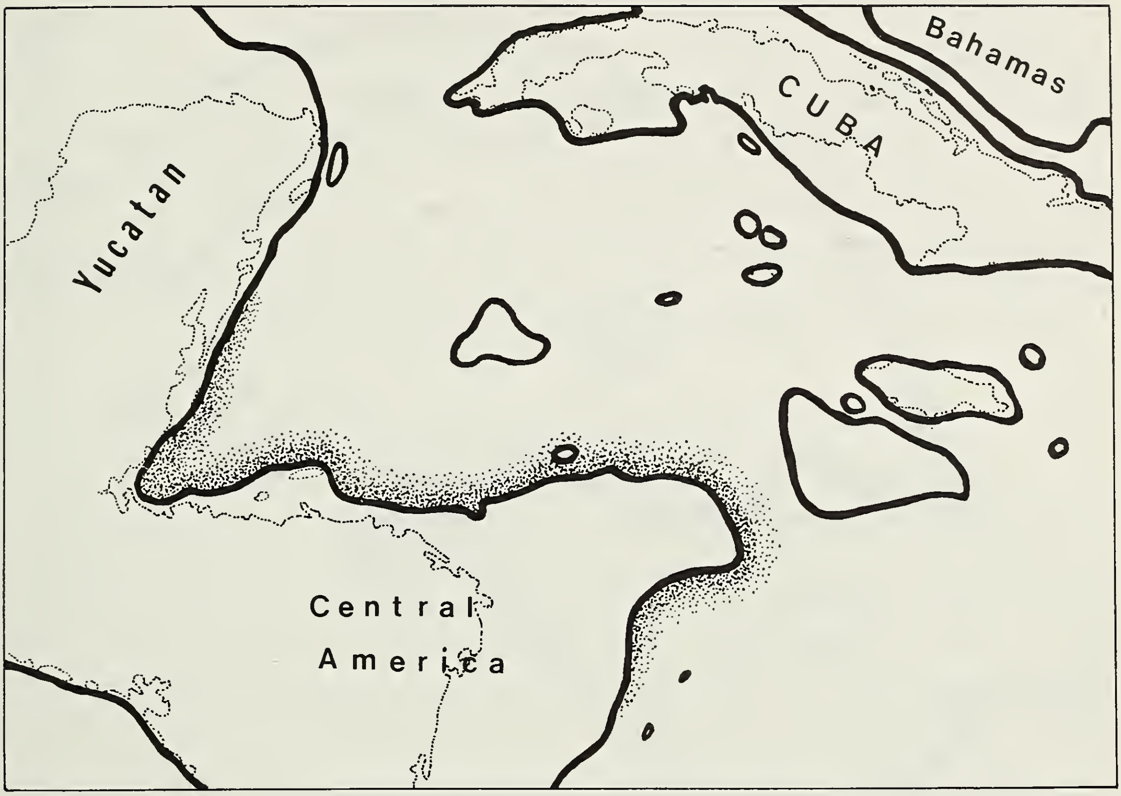


Fig. 22. Reconstruction of the Caribbean coastline during a peak Pleistocene low water stand, superimposed upon the outline of the Recent coast of Central America. Shading indicates the hypothetical range of the ancestral *Falsilyria* stock (after Petuch, in press).

The combination of a bank-channel topography and multiple glacial sea level fluctuations had a tremendous effect on the speciation and extinction of organisms such as *Falsilyria*. Being shallow water animals, with no species living much below 50 m depth, and also being animals with non-planktonic crawl-away young, *Falsilyria* was especially susceptible to reproductive isolation. In an attempt to explain the existence of five sibling species occurring within the same relict pocket, I here outline an hypothesis that involves a three-step speciation mechanism.

1. With an extreme sea level drop during a peak glacial period (CLIMAP members 1976:1137), the Honduran and Nicaraguan continental shelves were exposed. This resulted in a long continuous coastline bordering a steep drop-off. In the shallow water area, an ancestral *Falsilyria* stock could range along this entire coast with no barriers to reproduction or dispersal. A reconstruction of the Caribbean coastline during a Pleistocene low water stand and the hypothetical range of *Falsilyria* at that time are both given in Fig. 22.

2. With the advent of an interglacial period, sea levels began to rise, separating, one after the other, the various component banks along the

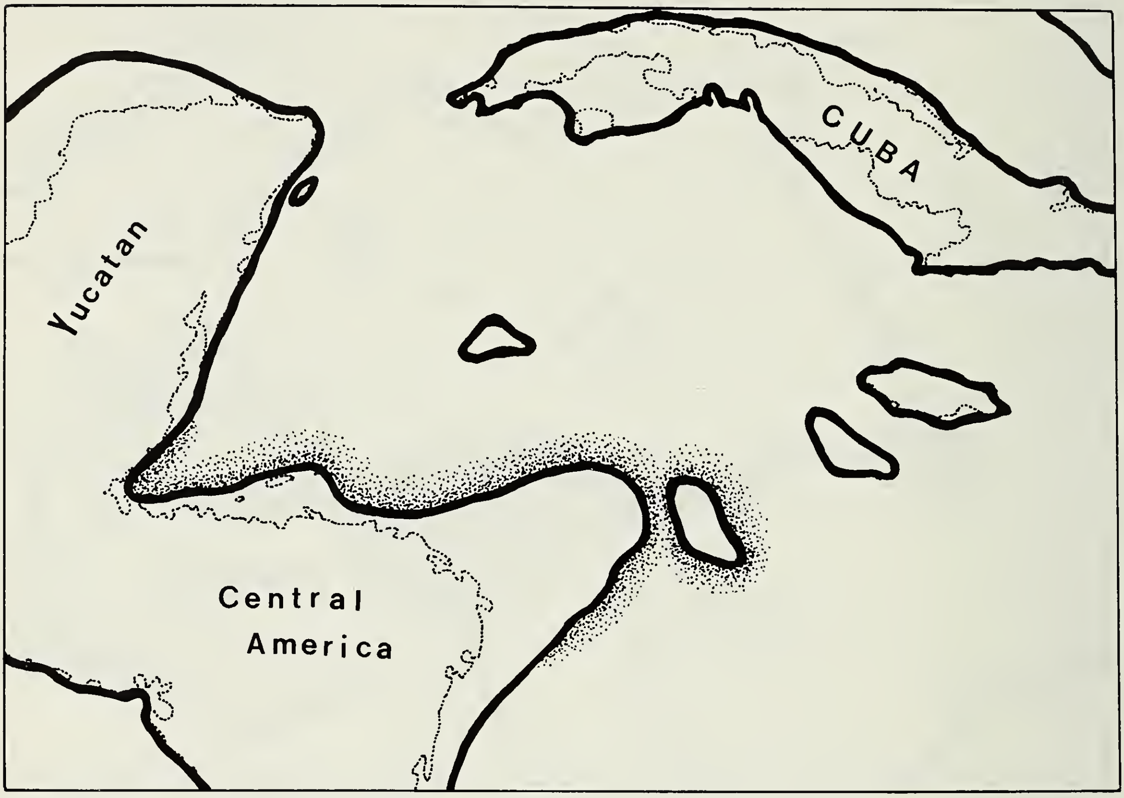


Fig. 23. Reconstruction of the Caribbean coastline at the beginning of an interglacial period, superimposed upon the outline of the Recent coast of Central America. Shading indicates the hypothetical range of the ancestral *Falsilyria* stock. This stage marks the beginning of isolation of the shallow banks by intervening deep channels (after Petuch, in press).

continental shelf. Due to its position at the end of the platform, the Rosalind-Serranilla Bank complex was probably among the first to separate from the fused mainland shelf and banks. A deep channel formed between this bank and the continental shelf, causing the bank population of *Falsilyria* to become isolated from the mainland stock. The sectioning of the once-continuous coastline and the isolation of a bank fauna are both shown in Fig. 23.

3. During full interglacial periods, such as at present, the Honduran continental shelf and offshore banks contained a series of shallow water areas (less than 35 m), each with its resident, non-dispersing population of *Falsilyria*. Over time, and together with the selection pressures caused by sea level fluctuations, these isolates would attain full species status. The reinvasion of *Falsilyria* onto the post-glacially flooded continental shelf would also set the stage for speciation by allowing a radiation into a variety of open niches. Together, these two formats would allow for allopatric speciation.

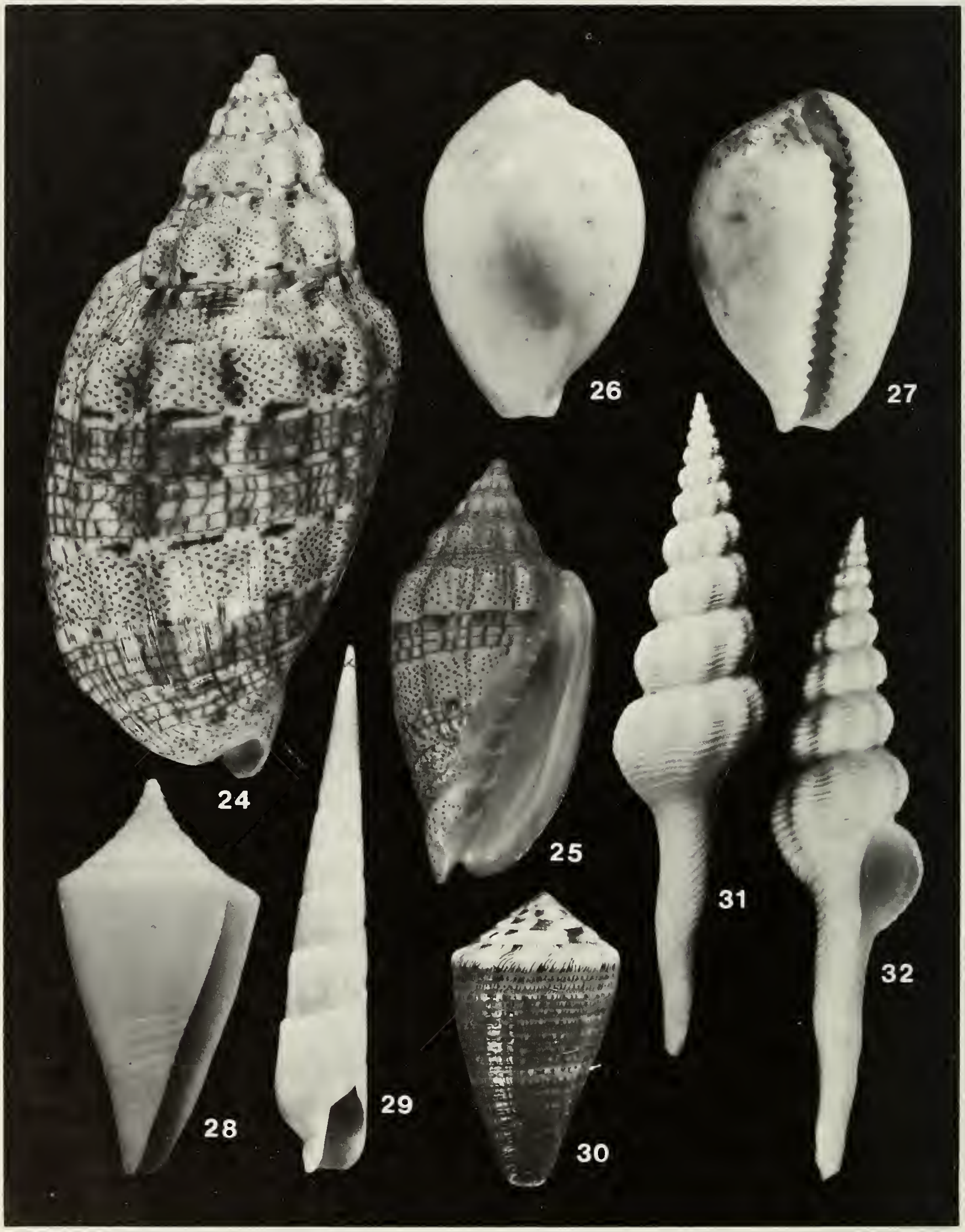
Considering that the Caribbean region was subject to at least ten major sea level fluctuations during the Pleistocene (CLIMAP members 1976; Emiliani 1971), it is not surprising that there are five sibling species of *Falsilyria* within the relict pocket. Three species are absolutely allopatric, with *F. garciai* apparently being confined to the Gorda Banks, *F. retemirabilis* to the Caratasca Cays, and *F. kotorai* to the outlying Rosalind Bank. Only *F. demarcoi* ranges along the entire continental shelf and is sympatric with *F. morrisoni* off Roatan Island and possibly Utila Island. The outermost bank, Serranilla Bank, most probably has a resident endemic species, but this area has yet to be sampled. Future work may turn up other endemic species when the smaller banks near Gorda Bank are sampled.

Characteristics of the Honduran Caloosahatchian Relict Gastropod Fauna

Coexisting with the *Falsilyria* species radiation are large numbers of other relict gastropod groups that, together with the volutes, give the refugium an archaic appearance. Most of these genera are also known to have crawl-away young and appear to have paralleled the same speciation pattern seen in the *Falsilyria* radiation. On the other hand, some groups have diverged only slightly from their ancestors in the Pliocene Pinecrest Beds Formation of South Florida.

Adding a Pliocene flavor to the relict pocket are several endemic Caloosahatchian genera and species complexes. Some of these relicts, such as *Pleioptygma* (*P. helenae* (Radwin and Bibbey, 1977)), *Heilprinia* (*H. dowianus* (Olsson, 1954)), and *Turbinella scolymoides* (Dall, 1890), have previously been discussed by myself (1980:115) and E. Vokes (1966:63). Since then, several other archaic groups have been collected. These included the first known living *Cypraeorbis* (Cypraeidae), a large *Ficus* in the *Ficus caloosahatchiensis* (B. Smith, 1907) species group (Ficidae), a large undescribed *Heilprinia,* several new *Conus* species (Conidae), an unusual *Myurellina* (Terebridae), members of the *Oliva carolinensis* Conrad, 1840 complex (Olividae), an apparent *Hindsiclava* (Turridae) species radiation, and trochid-like archaeogastropods that are probably referable to the "extinct" family Colloniidae.

A single specimen of a large (length 45 mm, width 30 mm) *Cypraeorbis* species (Figs. 26, 27) was taken in 1966 by the University of Miami R/V *Pillsbury,* at station P-598, near the northern end of the relict pocket. This undescribed species closely resembles *Cypraeorbis willcoxi* (Dall, 1890) from the Miocene Chipola Formation of North Florida, in both shape and size and also labial dentition. The North Florida Miocene influence is also present in the Conidae, with an undescribed 16 mm species of *Conus* (USNM 784647) (Fig. 28) from the Gorda Bank that closely resembles *C. rapunculus* S. Hoerle, 1976 from the Alum Bluff Group (S. Hoerle 1976:pl. 4, fig. 6). The Roatan Island endemic *Conus kulkulcan* Petuch, 1980 (USNM



Figs. 24–32. Species of *Falsilyria, Cypraeorbis, Conus, Myurellina,* and *Heilprinia:* 24, *Falsilyria demarcoi,* dorsal aspect of specimen from south of Caratasca Cays, length 85 mm; 25, *F. demarcoi,* ventral aspect of specimen from Roatan Island, length 53 mm; 26, *Cypraeorbis* sp., dorsal aspect of 45 mm specimen, P-598; 27, *Cypraeorbis* sp., ventral aspect of same specimen; 28, *Conus* sp., ventral aspect of specimen from Gorda Bank (USNM 784647), length 16 mm; 29, *Myurellina* sp., ventral aspect of specimen from Rosalind Bank, length 80 mm; 30, *Conus kulkulcan,* dorsal aspect of holotype (USNM 784487), length 21 mm; 31, *Heilprinia* sp., dorsal aspect of 190 mm specimen, P-602; 32, *Heilprinia* sp., ventral aspect of same specimen.

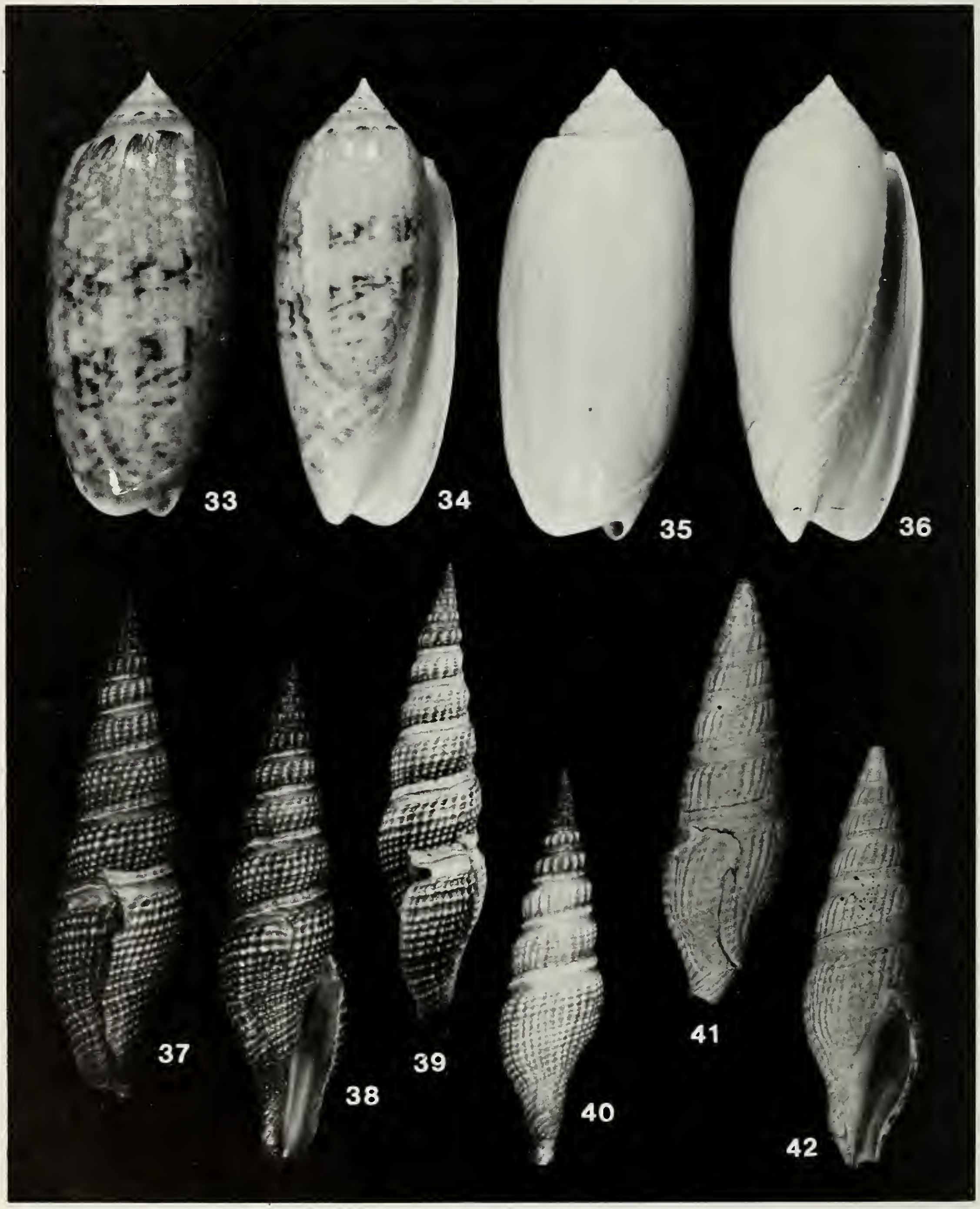
784487) (Fig. 30) may also be part of a Caloosahatchian relict stock that originated with the Chipolan *C. praecipuus* S. Hoerle, 1976 (S. Hoerle 1976:pl. 4, fig. 4). Besides the Honduran endemic *Heilprinia dowianus,* the relict genus *Heilprinia* is also represented by a large (190 mm) undescribed species (University of Miami, P-602) from near Rosalind Bank (Figs. 31, 32). In the same area, the Caloosahatchian genus *Myurellina* is represented by two relict pocket endemics, *M. stegeri* (Abbott, 1954) and a large (80 mm) undescribed species (Fig. 29).

Faunal affinity to the Pliocene Pinecrest Beds Formation of South Florida is particularly striking in two groups of Honduran caenogastropods. A large *Oliva* species, found along the northern end of the pocket near Roatan Island, is nearly identical to *Oliva carolinensis,* both in size and shape. To illustrate this point, a 65 mm specimen of this species (USNM 784648) (Figs. 33, 34) is shown next to a 69 mm fossil *O. carolinensis* from the Pinecrest Beds Formation at Sarasota, Florida (Figs. 35, 36). Along with the relict *Oliva,* a complex of large *Hindsiclava* turrids has been found on the outer banks. One of these, from Rosalind Bank, closely resembles the middle Pliocene *Hindsiclava perspirata* (Dall, 1890). For comparison, a 70 mm specimen (USNM 784649) (Figs. 37–39) and a 55 mm specimen (USNM 784649) (Fig. 40) of this large turrid are illustrated next to a 61 mm fossil specimen of *H. perspirata* from the Pinecrest formation at Sarasota, Florida (Figs. 41, 42). As can be seen, both the *Oliva* and the *Hindsiclava* closely resemble their Floridian ancestors.

Discussion

The speciation pattern in *Falsilyria* is also found in the Volutidae of other secondary relict pockets around the world. Some of the best examples are found in the Flindersian Secondary Relict Pockets of South and West Australia (Petuch, in press). Here, the relict Mio-Pliocene genera *Cottonia, Ericusa, Notopeplum, Notovoluta, Paramoria,* and *Pterospira,* have also survived into the Recent and have undergone secondary speciation. Other examples of relict volutes that have undergone reradiation after reduction of their original ranges are seen in the genera *Minicymbiola, Odontocymbiola,* and *Weaveria,* of the Platensian Relict Pocket (Petuch, in press) of Southern Brazil and Uruguay, and the genus *Athleta* (*Volutocorbis*) of Southeast Africa and the Mozambique channel.

Within the scheme of geographical heterochrony, the Caloosahatchian Secondary Relict Pockets, together, represent a temporal midpoint between the Recent Caribbean molluscan fauna and the intact Neogene fauna of the Gatunian Primary Relict Pocket in Venezuela. The glacial sea level fluctuations, with the accompanying alternating faunal separations and meldings, did not affect the Honduras area as much as they did the Florida Peninsula. This allowed a Mio-Pliocene Florida-type fauna to continue into the Recent



Figs. 33–42. Species of *Oliva* and *Hindsiclava:* 33, *Oliva* cf. *carolinensis,* dorsal aspect of specimen from north of Roatan Island (USNM 784648), length 65 mm; 34, *Oliva* cf. *carolinensis,* ventral aspect of same specimen; 35, *Oliva carolinensis,* dorsal aspect of fossil from Pinecrest Beds Formation, length 69 mm; 36, *Oliva carolinensis,* ventral aspect of same specimen; 37, *Hindsiclava* sp., dorsal aspect of specimen from Rosalind Bank (USNM 784649), length 70 mm; 38, *Hindsiclava* sp., ventral aspect of same specimen; 39, *Hindsiclava* sp., lateral aspect of same specimen showing anal notch; 40, *Hindsiclava* sp., dorsal aspect of specimen from Rosalind Bank (USNM 784649), length 55 mm; 41, *Hindsiclava perspirata,* dorsal aspect of fossil specimen from Pinecrest Beds Formation, length 61 mm; 42, *Hindsiclava perspirata,* ventral aspect of same specimen.

Caribbean, but in an altered state due to secondary speciation. With the exception of the living Pliocene fauna of the unevolved Gatunian Primary Relict Pocket, the rest of the Caribbean has evolved a new post-Pleistocene fauna that is considered the provincial indicator (Petuch, in press).

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THE SCALIBREGMATIDAE (ANNELIDA: POLYCHAETA) FROM SOUTH AMERICA AND ANTARCTICA COLLECTED CHIEFLY DURING THE CRUISES OF THE R/V *ANTON BRUUN,* R/V *HERO* AND USNS *ELTANIN*

James A. Blake

Abstract.—A total of 14 species in 8 genera are reported from South America and Antarctica. The generic synonymies of *Pseudoscalibregma* Ashworth are clarified. *Scalibregmides* Hartmann-Schröder is resurrected from synonymy and redefined. Six species are new to science: *Asclerocheilus tropicus, A. ashworthi, Hyboscolex equatorialis, Oligobregma notiale, Pseudoscalibregma usarpium,* and *Scalibregmides peruanum. Pseudoscalibregma collare* Levenstein, 1975 is redescribed and transferred to the genus *Oligobregma,* with its junior homonym, *P. bransfieldia collaris* Hartman, 1978, being renamed and redescribed as *O. hartmanae. Sclerocheilus antarcticus* Ashworth, 1915 is redescribed. A revised scheme to the scalibregmatid genera is presented, along with a list of valid species. *Proscalibregma linea* Hartman, 1967 has been determined to belong to the Opheliidae, while *Scalispinigera oculata* Hartman, 1967, and *S. cirrata* Hartman and Fauchald, 1971 are related to the Hesionidae.

Introduction

A large collection of Scalibregmatidae, provided by the Smithsonian Oceanographic Sorting Center forms the basis of the present report. These new materials were collected as part of the Southeastern Pacific Biological and Oceanographic Program (SEPBOP) off western South America by the R/V *Anton Bruun* and by the United States Antarctic Research Program (USARP) from western South America, subantarctic regions, and high Antarctic seas by the R/V *Hero* and USNS *Eltanin.* A small collection of unidentified scalibregmatids collected during the U.S. Navy's Deep Freeze I–IV programs (1956–59) were provided by the National Museum of Natural History, Smithsonian Institution (USNM). These new collections were compared with the previously identified USARP and other materials described by Hartman (1952, 1967, 1978). Analysis of all of these materials reveals the presence of a unique and highly endemic scalibregmatid fauna in South America and Antarctica.

In an earlier study of Australian scalibregmatids, it was necessary to review the genera and to redefine the basis for their separation (Kudenov and Blake 1978). A scheme was presented which simplified the generic definitions and listed all of the then known valid species. Unfortunately, a number of species, upon subsequent examination of their type-specimens, have proven to be generically misplaced. Furthermore, it is now apparent that the generic scheme is more complex and that some generic synonymies were misconstrued, especially as they pertain to the South American and Antarctic species. These problems are corrected in the present report including a revised outline of the genera which updates the list of valid species.

The following genera and species from South America and Antarctica are included in this report:

Asclerocheilus tropicus, new species
A. ashworthi, new species
Hyboscolex equatorialis, new species
H. oculatus (Ehlers, 1901), new combination
Oligobregma collare (Levenstein, 1975), new combination
O. hartmanae, new name
O. notiale, new species
Pseudoscalibregma bransfieldium (Hartman, 1967)
P. usarpium, new species
Scalibregma inflatum Rathke, 1843
Scalibregmides chilensis Hartmann-Schröder, 1965 emended
S. peruanus, new species
Sclerocheilus antarcticus Ashworth, 1915
Kebuita minuta Hartman, 1967

Asclerocheilus Ashworth, 1901

Type-species.—Asclerocheilus intermedius (Saint-Joseph, 1894).

Remarks.—There may be a quantitative basis for separating some species of *Asclerocheilus* by using the ratio between the lengths of the short and long tynes of the furcate setae. Scalibregmatids typically have unequal tynes, but in some species of *Asclerocheilus* these differences appear to be especially conspicuous. By measuring tyne lengths from the published figures of 3 species and those of the 2 new species and dividing longer lengths by the shorter ones, the following ratios are obtained: *A. tropicus* 2.66, *A. ashworthi* 2.64, *A. heterochaetus* 2.2, *A. beringianus* 1.7, *A. capensis* 1.7. Insufficient material is presently available to determine the extent of variability in these ratios, but the technique would appear to be useful, since scalibregmatids have so few taxonomic characters.

Asclerocheilus tropicus, new species
Fig. 1A–C

Material examined.—ECUADOR, *Anton Bruun* Sta. 6670, 8 May 1966, 02°11′28″S, 80°56′31″W, 8–9 m, SCUBA, holotype (USNM 65070).

Description.—Holotype complete, small, 1.8 mm long and 0.45 mm wide for 20 segments. Body narrow, with slight thickening in anterior and posterior segments. Color in alcohol: light tan.

Prostomium broadly heart-shaped, formed anteriorly into 2 large lateral wings (Fig. 1A); eyes orange, arranged as 2 longitudinal groups of separate ocelli; nuchal organs not observed. Peristomium simple, smooth ring.

Body surface with minute reticulations; anterior segments lacking annulations; posterior segments triannulate. Parapodia with simple tori throughout body; dorsal and ventral cirri lacking.

Setiger 1 with 2 rows of enlarged notopodial acicular spines in addition to simple capillaries; each spine curved, sharply pointed, with fine bristles near tip (Fig. 1B); capillary notosetae accompanied by furcate setae from setiger 2; each furcate seta with 2 short, unequal spinous tynes (Fig. 1C). Remaining notosetae and neurosetae all capillaries.

Pygidium simple, lacking cirri. Branchiae lacking.

Remarks.—*Asclerocheilus tropicus* is most closely related to *A. heterochaetus* Kudenov and Blake, 1978 from southeastern Australia and *A. acirratus* (Hartman, 1966b) from southern California, in having prostomial eyes. The eyes are arranged in 2 longitudinal lines in *A. tropicus,* as 2 inverted V-shaped structures in *A. heterochaetus* and as 2 pairs of transverse bars in *A. acirratus.*

The lateral anterior prostomial extensions of *A. tropicus* are broad and winglike, while those of *A. heterochaetus* and *A. acirratus* are narrow and provide a T-shape to the anterior end. *Asclerocheilus tropicus* and *A. acirratus* both have notopodial acicular spines on setiger 1, while *A. heterochaetus* has spines on setigers 1–4.

Distribution.—Ecuador, 8–9 m.

Asclerocheilus ashworthi, new species
Fig. 1D–F

Material examined.—SOUTH SHETLAND ISLANDS, off Elephant Island, *Eltanin* Sta. 408, 31 Dec. 1962, 61°16′S, 56°11′W, 223–225 m, Menzies trawl, holotype (USNM 60569).—SOUTH PACIFIC OCEAN, west of Antipodes Island, *Eltanin* Sta. 2144, 23 Mar. 1968, 49°07′S, 172°00′E, 384–397 m, camera grab, 1 specimen (USNM 69372).

Description.—Holotype incomplete. 3.0 mm long and 0.5 mm wide for 18 segments. Non-type specimen smaller, complete, 1.2 mm long and 0.2 mm wide for 30 segments. Body largest in anterior segments, tapering posteriorly. Color in alcohol: dark brown.

Prostomium expanded on frontal margin to form 2 lateral lobes (Fig. 1D); eyes lacking, nuchal organs not apparent. Peristomium simple achaetous ring.

Body surface mostly smooth throughout; anterior segments uniannulate, becoming triannulate in middle and posterior segments. Parapodia reduced to low, simple tori; dorsal and ventral cirri lacking.

Setiger 1 with enlarged notopodial acicular spines arranged in 2 rows; second row with accompanying capillaries; setiger 2 with single row of spines with capillaries and furcate setae; each spine curved, with fine bristles (Fig. 1E); furcate setae with 1 tyne being much shorter than other (Fig. 1F), tynes with inner borders of denticles; subsequent notopodia with capillaries and furcate setae. Neurosetae including capillaries and furcate setae.

Pygidium surrounded by 4 short stubby cirri. Branchiae absent.

Etymology.—This species is named for the late Dr. J. H. Ashworth of the University of Edinburgh, whose early studies on the Scalibregmatidae have proved so important in interpreting the systematics of the family.

Remarks.—Asclerocheilus ashworthi is most similar to *A. capensis* Day, 1963 from South Africa in lacking eyes and in having acicular spines on setigers 1–2. In *A. capensis,* the prostomium is expanded laterally into 2 very broad rounded lobes, while in *A. ashworthi,* the lateral extensions form a weakly-developed T-shaped arrangement. The acicular spines of setiger 2 are more delicate than those of setiger 1 in *A. capensis,* while in *A. ashworthi* the spines of setigers 1–2 are equally heavy.

Asclerocheilus ashworthi is also similar to *A. beringianus* Uschakov, 1955, a poorly known deep water species from the Bering Sea. The original account suggests that the prostomial extensions are more prominent than in *A. ashworthi* and that the acicular spines of setigers 1–2 differ in lacking bristles and in being distinctly sickle-shaped with a curved tip, instead of being heavily bristled and with a straighter shaft and tip.

Distribution.—South Pacific Ocean, near subantarctic islands, 223–397 m.

Hyboscolex equatorialis, new species
Fig. 2

Material examined.—ECUADOR, *Anton Bruun* Sta. 6670, 8 May 1966, 62°11′28″S, 80°56′31″W, 8–9 m, SCUBA, holotype (USNM 60571) and 8 paratypes (USNM 60572).—PERU, south of Callao, near Pucusano, *Anton Bruun* Sta. 65215, 29 Nov. 1965, SCUBA, 3 specimens (USNM 60573).

Description.—A small species, up to 5.4 mm long and 0.6 mm wide for 40 segments. Color in alcohol: light tan. Body arenicoliform, narrow anteriorly, then expanding in middle segments and narrowing again posteriorly; some posterior segments moniliform (Fig. 2B).

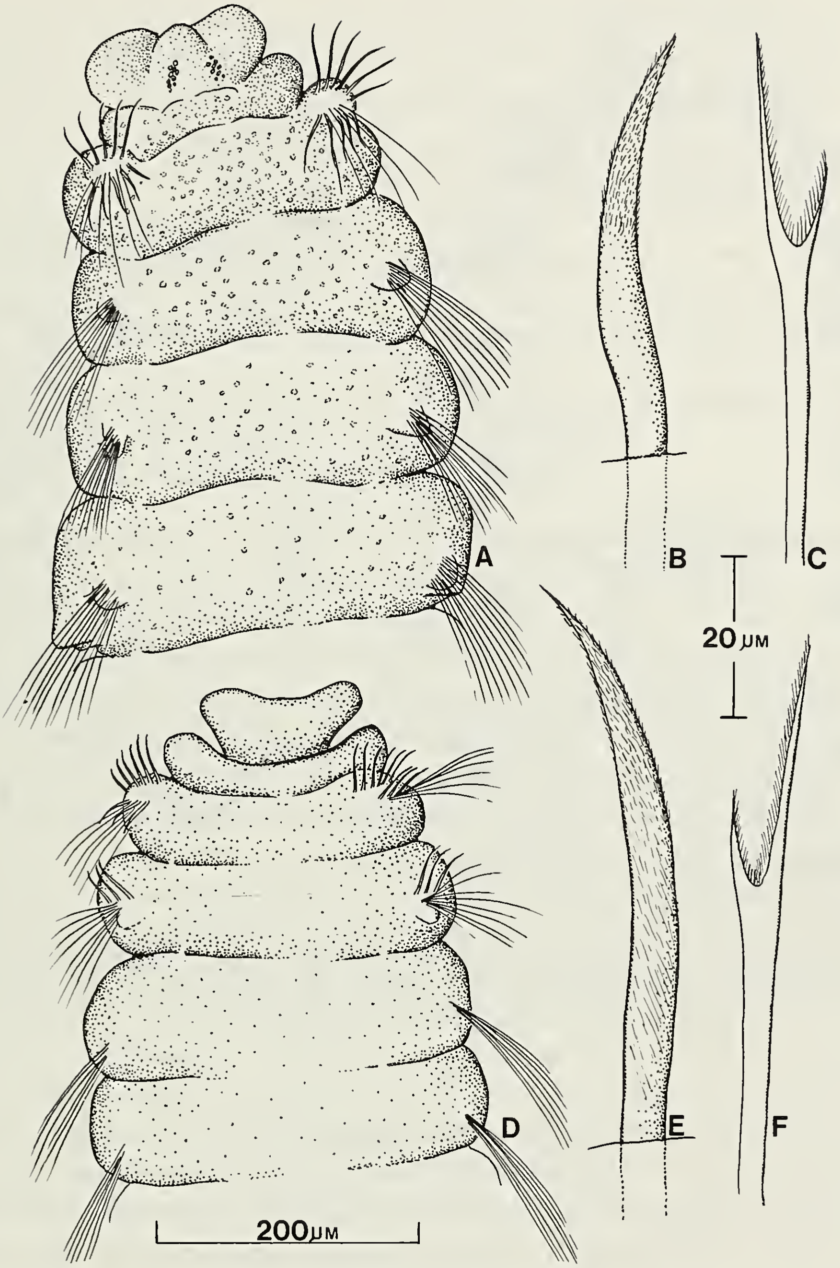

Fig. 1. *Asclerocheilus tropicus* (holotype, USNM 60570): A, Anterior end in dorsal view; B, Notopodial acicular spine from setiger 1; C, Furcate seta.—*Asclerocheilus ashworthi* (holotype, USNM 60569): D, Anterior end in dorsal view; E, Notopodial acicular spine from setiger 1; F, Furcate seta.

Prostomium widest anteriorly, forming 2 short lateral lobes (Fig. 2A); eyes composed of 2 groups of small red pigment spots, located on posterior edge of prostomium and extending posteriorly under the achaetous peristomium; nuchal organs not apparent.

First 3 setigers smooth, uniannulate; setigers 4 and 5 biannulate; segments triannulate from setiger 6 (Fig. 2A), continuing through middle segments;

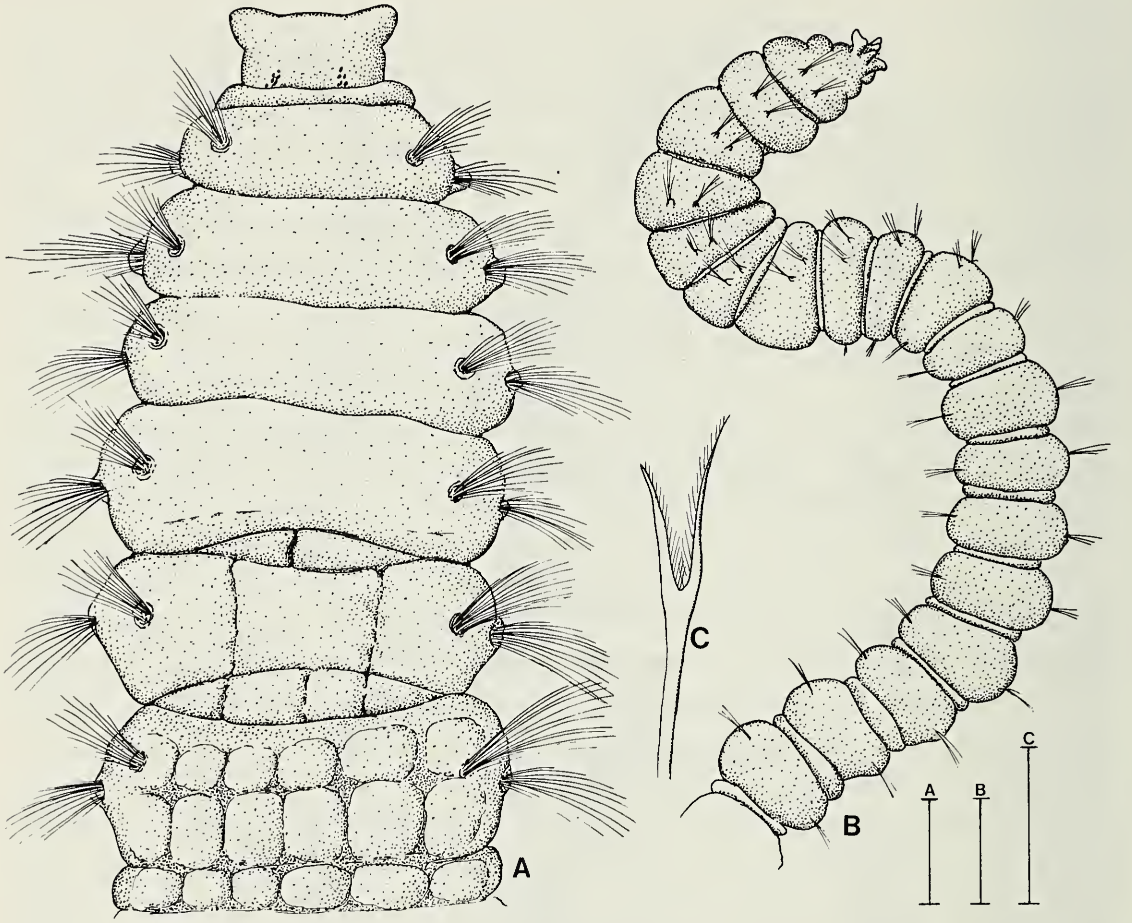

Fig. 2. *Hyboscolex equatorialis* (paratype, USNM 60572): A, Anterior end in dorsal view; B, Posterior end in twisted dorsolateral view; C, Furcate seta. Scale: A, 100 μm; B, 200 μm; C, 20 μm.

posterior segments biannulate, becoming gradually uniannulate in far posterior segments (Fig. 2B). Parapodia reduced to short conical tori.

Setae include noto- and neuropodial fascicles of long capillaries and shorter furcate setae with unequal tynes (Fig. 2C); furcate setae from setiger 2, with fine denticles on inner margins of tynes.

Pygidium with 4 short cirri surrounding anal opening (Fig. 2B). Branchiae lacking.

Remarks.—Hyboscolex equatorialis is similar to *H. pacificus* (Moore) from the eastern Pacific (ssp. *pacificus*) and Japan (ssp. *borealis*) in the general configuration of the prostomium, segmental annulations, parapodia and setae. *Hyboscolex pacificus* from California was said to lack anal cirri (Moore 1909), but reports from British Columbia (Berkeley 1930) and Japan (Imajima 1961) indicate that 4–6 cirri may be present. *Hyboscolex equatorialis* bears 4 anal cirri. The chief difference between the 2 species is with the arrangement of the eyes. In *H. equatorialis,* the eyes are arranged in an anterior posterior direction on the posterior part of the prostomium and extend under the peristomial segment. In *H. pacificus,* the eyes are in 2 parallel transverse rows on the lateral sides of the prostomium. The eye pattern of *H. equatorialis* also differs from the Australian species, *H. dicranochaetus* (Schmarda), in which the eyes are H-shaped (Kudenov and Blake 1978).

Distribution.—Ecuador and Peru, intertidal to 10 m.

Hyboscolex oculatus (Ehlers, 1901), new combination

Eumenia oculata Ehlers, 1901a:265; 1901b:181–182, pl. 22, figs. 15–16; Ashworth 1915:417. [Not Gravier 1911; Fauvel 1951].
Not *Sclerocheilus oculatus.*—Hartman 1967:135.

Remarks.—*Eumenia oculata* Ehlers, 1901 from southern Chile is a related species of *Hyboscolex* (type-specimen was examined by Ashworth 1915:417). Ehlers (1913) referred this species to *Oncoscolex dicranochaetus,* a position apparently supported by Hartman (1959:424) and Day (1961:417). Hartman (1967:135) identified some Antarctic specimens as *Sclerocheilus oculatus,* without explanation. An examination of Hartman's material has revealed that they are actually *S. antarcticus* Ashworth (see below). The records of *Eumenia oculata* by Gravier (1911) and Fauvel (1951) also appear to refer to *S. antarcticus* (see below). An inspection of the description and figures of *E. oculata* by Ehlers (1901a–b) and the comments by Ashworth (1915) on the type-specimen indicate that the species belongs to the genus *Hyboscolex* and differs from *H. equatorialis* as follows: 1) the prostomium of *H. oculatus* bears prominent frontal horns which appear to articulate with the anterior margin, while *H. equatorialis* has reduced frontal horns which are barely wider than the anterior margin of the prostomium; 2) the eyes of *H. oculatus* form V-shaped structures on either side of the prostomium, in contrast to single rows in *H. equatorialis.*

Distribution.—Southern Chile, intertidal. Type-locality: Tumbes Peninsula, near Talcahuano, approximately 36°42′S, 73°06′W.

Oligobregma collare (Levenstein, 1975), new combination
Fig. 3

Pseudoscalibregma collaris Levenstein, 1975:134, fig. 6a–d.
Pseudoscalibregma nr. *aciculata.*—Hartman 1967:133 [not Hartman 1965].
Asclerocheilus nigrocirrus Hartman, 1978:177–179, fig. 26a–d. New Synonymy.

Material examined.—DRAKE PASSAGE, *Eltanin* Sta. 126, 29 July 1962, 57°12′S to 57°14′S, 62°45′W to 62°51′W, 3733–3806 m, bottom trawl, 3 specimens (USNM 56653).—ROSS SEA Deep Freeze II, *Glacier* Sta. 11, 1 specimen (USNM 67617).—WEDDELL SEA, *Glacier* Sta. 69-19, 11 March 1969, 74°06′S, 32°36.3′W, 1622 m, anchor dredge, 2 specimens (USNM 46842); Sta. 69-22, 13 March 1969, 73°28.4′S, 30°26.9′W, 3111 m, anchor dredge, 1 specimen (USNM 46843); Sta. 69-23, 14 March 1969, 72°49.6′S, 30°29.7′W, 3697 m, anchor dredge, 1 specimen (USNM 46844); Sta. 69-27, 19 March 1969, 64°46.2′S, 41°30.1′W, 4575 m, epibenthic sled, holotype of *Asclerocheilus nigrocirrus* (USNM 46841).—BELLINGSHAUSEN SEA, western sector, off Thurston Island, *Eltanin* Sta. 941, Jan. 1964, 70°01′S, 98°43′W, 2562 m, 3 m Isaacs-Kidd midwater trawl, 1 specimen (USNM 60575).

Description.—A large species, up to 26 mm long and 5 mm wide for 43 segments. Color in alcohol: light tan to brown. Body expanded in anterior segments, then tapering to narrow posterior end.

Prostomium cordate, with 2 rounded lobes projecting from anterior margin (Fig. 3A); no eyes; with paired nuchal organs sometimes apparent lateral to posterior edge of prostomium. Peristomium well-developed, formed into large achaetous segment, sometimes appearing as 2 rings; proboscis saclike, lacking papillae.

Anterior 2 setigers smooth, becoming rugose from setiger 3; anterior and middle body segments triannulate (Fig. 3A), becoming quadriannulate in posterior segments (Fig. 3F). Anterior parapodia reduced to simple lobes; medial and posterior segments with prolonged conical noto- and neuropodia and short, conical dorsal and ventral cirri (Fig. 3E); cirri with grandular tips appearing iridescent by reflected light; small sense organs present between noto- and neuropodia (Fig. 3E).

Setigers 1–3 with heavy acicular spines in notopodia in addition to capillaries (Fig. 3B); spines arranged in 2 rows on setigers 1–2 and single row on setiger 3 (Fig. 3A); spines sickle-shaped, with dense cloak of bristles on apical ends (Fig. 3C); furcate setae from setiger 4, with each having long tynes and fine denticles (Fig. 3D). Neurosetae all capillaries.

Pygidium terminal, with lobate margin bearing up to 8 anal cirri (Fig. 3F). Branchiae absent.

Remarks.—*Asclerocheilus nigrocirrus* Hartman, 1978 from deep stations in the Weddell Sea agrees with *Pseudoscalibregma collaris* Levenstein, 1975 from the Scotia Sea. *Pseudoscalibregma bransfieldia collaris* Hartman, 1978, also from the Weddell Sea, is a junior homonym of Levenstein's species, but is distinct and is herein renamed (see below). *Pseudoscalibregma collaris* Levenstein is transferred to *Oligobregma* based on the presence of anterior notopodial spines and the absence of branchiae. Species of *Pseudoscalibregma* lack notopodial spines, but have branchiae (Kudenov and Blake 1978). *Oligobregma collare* is most closely related to *O. aciculatum* (Hartman, 1965) from the North Atlantic off New England. *Oligobregma collare* has notopodial spines on the first 3 setigers, while *O. aciculatum* has such spines only on setigers 1–2.

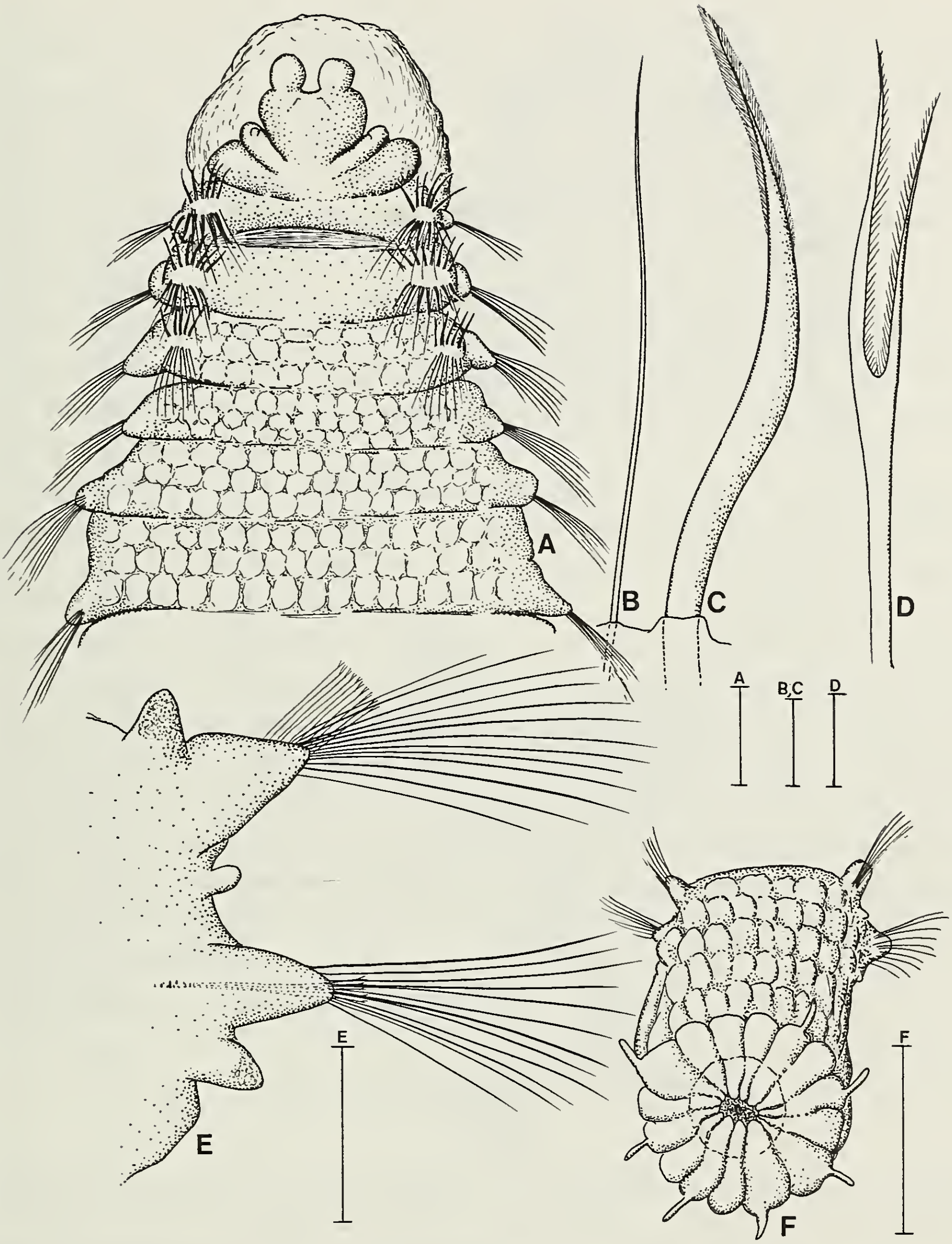

Fig. 3. *Oligobregma collare:* A, Anterior end in dorsal view, pharynx extended; B, Capillary notoseta from setiger 1; C, Acicular spine from setiger 1; D, Furcate seta; E, Setiger 20 in anterior view; F, Posterior end in terminal view. Scale: A, 300 μm; B–C, 50 μm; D, 20 μm; E, 500 μm; F, 500 μm.

Distribution.—Subantarctic and Antarctic, in 1622–6070 m.

Oligobregma hartmanae, new name
Fig. 4

Pseudoscalibregma bransfieldia collaris Hartman, 1978:181, figs. 29a–b, HOMONYM. [Not *Pseudoscalibregma collaris* Levenstein, 1975].

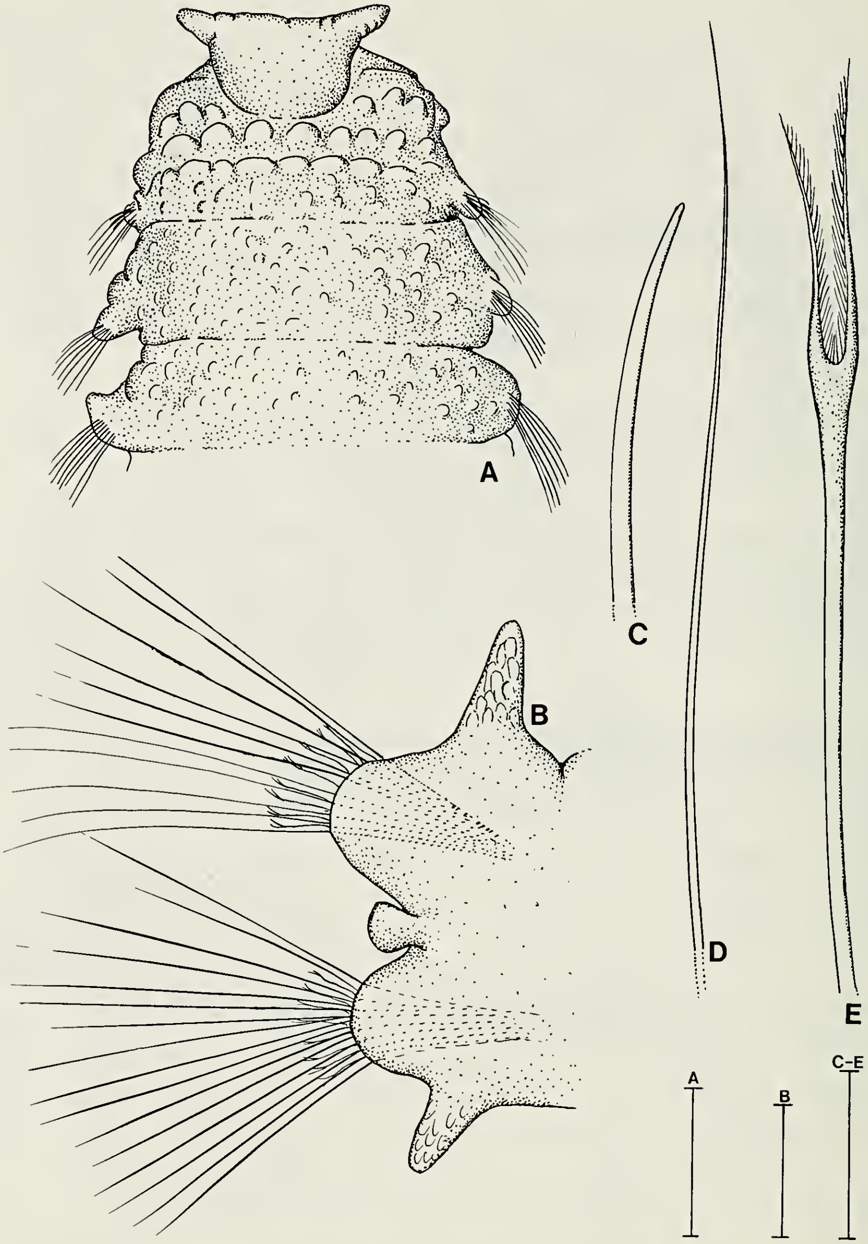

Fig. 4. *Oligobregma hartmanae* (holotype, USNM 46976): A, Anterior end in dorsal view; B, Posterior setiger in anterior view; C, Acicular notopodial spine from setiger 1; D, Capillary notoseta from setiger 1; E, Furcate seta. Scale: A, 300 μm; B, 100 μm; C–E, 20 μm.

Material examined.—WEDDELL SEA, *Glacier* Sta. 69-8, 2 March 1969, 77°36.2′S, 42°30′W, 585 m, anchor dredge, holotype of *P. bransfieldia collaris* (USNM 46976).

Description.—Holotype small, incomplete, 6 mm long and 2 mm wide for 22 setigerous segments. Anterior end of body expanded, narrowing posteriorly.

Prostomium with 2 short laterally directed processes (Fig. 4A); no eyes; no nuchal organs. Peristomium inflated, bearing several large papillae extending across dorsum. Dorsal surface of subsequent setigers bearing papillae arranged in 4–5 rows.

Parapodia of posterior setigers bearing distinct dorsal and ventral cirri (Fig. 4B); cirri with numerous bacillary glands; interramal sense organs cirriform.

Notosetae arranged in 2 tiers throughout, those of anterior tier shorter; setigers 1–2 with inconspicuous short, narrow blunt-tipped spines mixed with capillaries in first tier, numbering 8–10 per fascicle (Fig. 4C–D); furcate setae present from setiger 3; with unequal tynes and numerous denticles on inner margins (Fig. 4E).

Remarks.—*Pseudoscalibregma bransfieldia collaris* differs significantly from its stem form, *P. bransfieldium* (see below) and is here elevated to full species status. The subspecies name, *collaris* Hartman, 1978, is a junior homonym of *P. collaris* Levenstein, 1975, and is here renamed *hartmanae.* The species is transferred to *Oligobregma* based on the presence of short acicular spines in setigers 1–2. *Oligobregma hartmanae* differs from other congeners in the papillated nature of the peristomium. The species resembles *O. simplex* Kudenov and Blake, 1978, from Australia in lacking eyes. The latter species, however, has acicular spines in setigers 1–4, instead of 1–2. *Oligobregma hartmanae* also resembles *O. oculatum* Kudenov and Blake, 1978, from off New Caledonia in having acicular spines in setigers 1–2. The latter species, however, has a well-developed ocular area and lacks peristomial papillae.

Distribution.—Weddell Sea, in 505 m.

Oligobregma notiale, new species
Fig. 5

Material examined.—ANTARCTIC PENINSULA, Palmer Archipelago, *Hero* Sta. 447, 16 March 1970, 64°49′13″S, 63°30′03″W to 64°49′13″S, 63°30′15″W, 20–27 m, Blake trawl, holotype (USNM 60576) and 3 paratypes (USNM 60579); Sta. 448, 16 March 1970, 64°49′17″S, 63°30′10″W to 64°49′17″S, 63°30′32″W, 18–27 m, Blake trawl, paratype (USNM 60578); Sta. 1018, 15 Dec. 1971, 64°42′S, 62°38′W, 97 m, Petersen grab, paratype (USNM 60579); Gamma Island, Melchoir Harbor, *Staten Island* Sta. 63-32, 6 Feb. 1963, 64°19′S, 62°59′W, 45 m, dredged, coll. W. L. Schmitt, paratype (USNM 58965).—WEDDELL SEA, off Vahsel Bay, Deep Freeze IV, *Edisto* Sta. 20, Trawl 5, 28 Jan. 1959, 77°40′S, 35°30′W, 28 m, bottom trawl, coll. J. Tyler, paratype (USNM 58966).—ANTARCTICA, BUDD AND KNOX COASTS, Vincennes Bay, near Wilkes Station, Deep Freeze III, *Atka* Sta. 29, 27 Jan. 1958, 66°17′35″S, 110°18′40″E, 10 paratypes (USNM

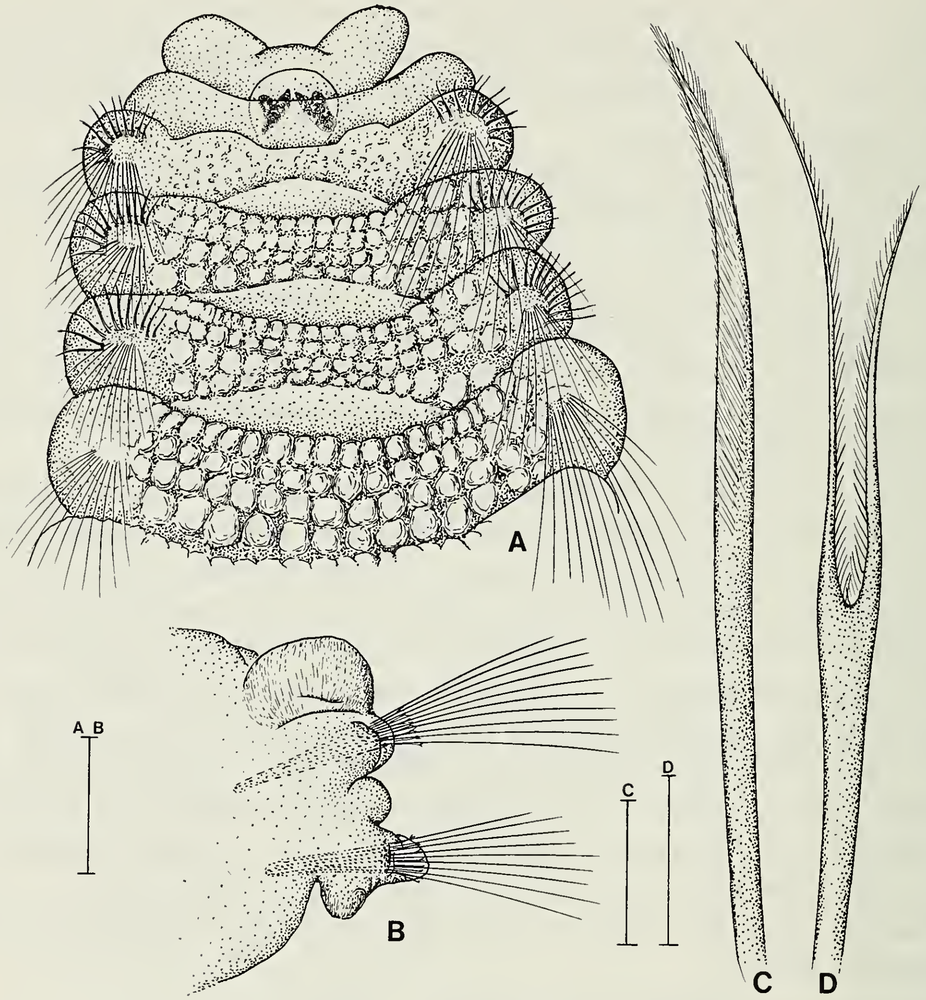

Fig. 5. *Oligobregma notiale* (paratype, USNM 60577): A, Anterior end in dorsal view; B, Posterior parapodium in anterior view; C, Notopodial acicular spine from setiger 1; D, Furcate seta. Scale: A–B, 500 μm; C, 30 μm; D, 20 μm.

58967).—ROSS SEA, *Eltanin* Sta. 2050, 22 Jan. 1968, 77°01′S, 168°38′E to 77°03′S, 168°23′E, 909–923 m, Blake trawl, paratype (USNM 60580).

Description.—A moderately large species, up to 13 mm long and 3 mm wide for 32 setigers on incomplete paratype. Color in alcohol: light tan to dark brown.

Prostomium with 2 broadly rounded frontal lobes projecting laterally (Fig. 5A); 2 elongated eyes present, each formed of numerous individual ocelli arranged in Y-shape; nuchal organs lobate, located on posterior margin of prostomium, usually concealed under peristomium. Peristomium smooth, sometimes superficially divided into 2 rings; proboscis simple, saclike when everted.

Body enlarged in anterior one-third, tapering posteriorly. Most segments quadriannulate (Fig. 5A); parapodial rami reduced to low mounds on anterior segments, becoming lobate in posterior segments and bearing ventral cirri, both inflated; with interramal cirri (Fig. 5B).

Setigers 1–3 with curved acicular spines in notopodia accompanying capillaries (Fig. 5A); spines numbering 8–12 per notopodium, bearing fine bristles on shaft, best seen near apex (Fig. 5C); subsequent notopodia and most neuropodia with furcate setae accompanying capillaries; furcate setae with unequal tynes, with numerous denticles along inner borders (Fig. 5D). Branchiae absent. Pygidium with 5 ventrally-placed cirri.

Etymology.—Notiale: Latin for southern.

Remarks.—Oligobregma notiale is most closely related to *O. oculatum* Kudenov and Blake, 1978, from New Caledonia in having a T-shaped prostomium with eyes. The latter species, however, has acicular notopodial spines on setigers 1–2, instead of 1–3 and the dorsal and ventral cirri of posterior parapodia are digitiform, instead of inflated.

Distribution.—Endemic to Antarctica, occurring in shallow depths of 18–97 m in most localities and 923 m in the Ross Sea.

Pseudoscalibregma Ashworth, 1901

Remarks.—The genus *Eusclerocheilus* Hartman, 1967 was referred to *Hyboscolex* Schmarda, 1861 by Kudenov and Blake (1978) and to *Pseudoscalibregma* by Hartman (1978). The latter decision is the correct one, because *E. bransfieldia*, the only named species of *Eusclerocheilus*, has dorsal and ventral cirri on the posterior parapodia. They are swollen and inflated, instead of the typical flattened cirri usually seen on species of Scalibregmatidae.

Scalibregmides Hartmann-Schröder, 1965, was erroneously referred to *Pseudoscalibregma* by Kudenov and Blake (1978), based on the assumption that the type-species, *S. chilensis* Hartmann-Schröder, 1965, possessed dorsal and ventral cirri in posterior parapodia. Following an examination of the holotype of *S. chilensis*, it is apparent that these structures are elongated postsetal lamellae rather than dorsal and ventral cirri. *Scalibregmides* is herein redefined as a valid genus (see below).

Pseudoscalibregma has 4 valid species: *P. parvum* (Hansen, 1878), the type-species, *P. pallens* Levenstein, 1962; *P. bransfieldum* (Hartman, 1967); and *P. usarpium*, new species (see below).

Pseudoscalibregma bransfieldium (Hartman, 1967)
Fig. 6

Eusclerocheilus bransfieldia Hartman, 1967:130–131, pl. 39.
Hyboscolex bransfieldia.—Kudenov and Blake, 1978: 440.
Pseudoscalibregma bransfieldia.—Hartman, 1978:180–181, fig. 28.

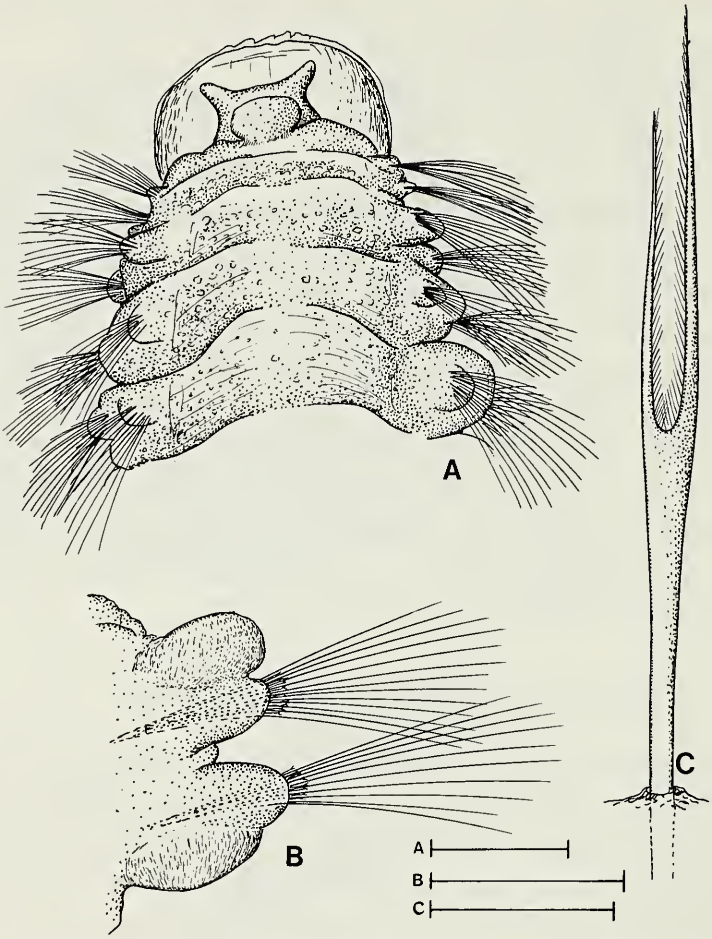

Fig. 6. *Pseudoscalibregma bransfieldium* (USNM 46974): A, Anterior end in dorsal view, pharynx extended; B, Posterior parapodium in anterior view; D, Furcate seta. Scale: A, 500 μm; B, 500 μm; C, 30 μm.

Material examined.—ANTARCTIC PENINSULA, *Eastwind* Sta. 1966-004A, 24 Jan. 1966, 67°53′S, 69°10.6′W, 335 m, coll. Pawson and Squires, 1 specimen (USNM 58971); BRANSFIELD STRAIT, *Eltanin* Sta. 997, 14 March 1964, 61°44′S, 55°56′W to 61°46′S, 55°54′W, 769 m, Blake trawl, holotype (USNM 55552).—WEDDELL SEA, *Glacier* Sta. 69-2, 25 Feb. 1969, 75°31′S, 30°08′W, 412 m, anchor dredge, 5 specimens (USNM 46973); Sta. 69-10, 4 March 1969, 77°50′S, 42°05.2′W, 659 m, anchor dredge, 1 specimen (USNM 46975).—ROSS SEA, *Eltanin* Sta. 2051, 22 Jan. 1968, 77°04′S, 168°19′E, 916 m, camera grab, 1 specimen (USNM 60581).

Description.—A moderately large species, up to 22 mm long and 3–6 mm wide in expanded thoracic region of 12–14 setigers, abdominal region with 16–20 setigers.

Prostomium with 2 short frontal horns (Fig. 6A); rounded nuchal crest on posterior part of prostomium; no eyes. Peristomium forming simple achaetous ring; proboscis saclike, with papillae on oral opening (Fig. 6A).

Parapodial rami well developed as rounded lobes, supported by 2–3 yellow acicula; dorsal and ventral cirri of posterior segments broad and inflated lobes (Fig. 6B).

Setae numerous, arranged in 3–5 rows in anterior parapodia; with fewer setae in 2–3 rows in posterior parapodia. Setae including capillaries, furcate setae and imbedded acicula; furcate setae with unequal tynes having teeth along their inner borders (Fig. 6C).

Pygidium with 3–4 indistinct lobes, lacking cirri.

Remarks.—Pseudoscalibregma bransfieldium differs from other species of the genus by having a rounded nuchal crest present on the prostomium and broad and inflated dorsal and ventral cirri on the posterior parapodia rather than elongated cirri.

Distribution.—Antarctica, in 355–916 m.

Pseudoscalibregma usarpium, new species
Fig. 7

Material examined.—ROSS SEA, *Eltanin* Sta. 1926, 27 Jan. 1967, 74°53′S, 175°10′W to 74°52′S, 174°42′W, 2143–2154 m, Blake trawl, holotype (USNM 60583).

Description.—Holotype posteriorly incomplete, 6 mm long and 1.3 mm wide for 27 setigers. Color in alcohol: pink. Body arenicoliform, with expanded portion over setigers 7–12. Segments heavily papillated (Fig. 7A) with anterior and posterior segments having 4 annulations, middle segments with 5 annulations.

Prostomium with 2 prominent diverging lobes (Fig. 7A); no eyes, no nuchal organs. Peristomium reduced, consisting of lobate achaetous ring enclosing prostomium.

Parapodia well-developed, with elliptical notopodium and triangular neuropodium (Fig. 7B); dorsal and ventral cirri present from setiger 12, with prominent bacillary glands (Fig. 7B); cirri somewhat globular, shorter than parapodial lobes; small indistinct interramal cirrus present throughout body.

Setae including both capillaries and furcate setae; capillary fascicles of anterior setigers arranged in 4–5 rows, with setae being unusually long, providing spinous appearance to anterior end; short furcate setae from setiger 3, visible only at bases of capillaries; furcate setae with subequal tynes bearing fine denticles on inner margins (Fig. 7C).

Branchiae absent. Nature of pygidium unknown.

Remarks.—Pseudoscalibregma usarpium differs from other species of the genus in the form of the prostomium, combined with the absence of eyes and the number and arrangement of the annuli with their numerous papillae. The presence of bacillary glands in the dorsal and ventral cirri is also unusual and has not been reported in related species.

Etymology.—Usarpium: coined from the abbreviated designation of the

United States Antarctic Research Program (USARP) under whose auspices the species was collected.

Distribution.—Ross Sea, in 2143–2154 m.

Scalibregma inflatum Rathke, 1843

Scalibregma inflatum Rathke, 1843:184, pl. 9, figs. 15–21.—Ehlers, 1900a:14; 1900b:219; 1901b:180.—Ashworth, 1901:237–309, pls. 13–15.—Fauvel, 1927:123, fig. 44a–f; 1941:289.—Monro, 1930:163.—Støp-Bowitz, 1945:67–72, fig. 2.—Imajima and Hartman, 1964:305.—Hartman, 1966a:45; 1967:134; 1969:313–314, figs. 1–4; 1978:181.—Day, 1967:390, fig. 27.2e–i.—Kudenov and Blake, 1978:428–430, figs. 1–2.

Scalibregma inflata.—Hartman and Fauchald, 1971:122, 125.

Material examined.—ARGENTINA, off Tierra del Fuego, *Hero* Sta. 677, 24 May 1971, 54°46.5′S, 64°23.5′W, 51 m, Petersen grab, 1 specimen (USNM 60584).—SOUTH SHETLAND ISLANDS, *Hero* Sta. 726, 26 Dec. 1971, 62°19.3′S, 59°11.8′W to 62°19.2′S, 59°11.7′W, 64–82 m, Blake trawl, 1 specimen (USNM 60587); Sta. 1060, 19 Dec. 1971, 62°19.0′S, 59°11.4′W, 44 m, Petersen grab, 1 specimen (USNM 60586).—ANTARCTIC PENINSULA, *Hero* Sta. 843, 26 Jan. 1972, 64°47.5′S, 64°07.2′W to 64°47.5′S, 64°07.1′W, 107 m, 1 specimen (USNM 60588); Sta. 1035, 16 Dec. 1971, 64°13.0′S, 61°05.4′W, 118 m, Petersen grab, 3 specimens (USNM 60585); Sta. 1070, 28 Jan. 1972, 64°47.7′S, 64°07.4′W, 100 m, Blake trawl, 2 specimens (USNM 60589); Sta. 1112, 4 Mar. 1972, 64°47.5′S, 64°07′W, 91–96 m, grab, 1 specimen (USNM 60590); Sta. 5411, 20 Mar. 1972, 65°05.3′S, 64°02.0′W to 65°04.7′S, 65°02.3′W, 50–92 m, 20 specimens (USNM 60591).—All specimens previously reported by Hartman (1967, 1978) from South America and Antarctica also examined (USNM).

Remarks.—*Scalibregma inflatum* is the most familiar species of the family. It is readily recognized by its T-shaped prostomium, lack of anterior acicular spines, branched gills on setigers 2–5 and prominent dorsal and ventral cirri in posterior parapodia. Kudenov and Blake (1978) suggested that the species may encompass several siblings once morphological variations have been studied in more detail. Unfortunately, *S. inflatum* does not appear to be a species which readily lends itself to the appropriate population studies necessary to test this hypothesis. A large sample of specimens from widespread localities will need to be accumulated in order to quantify the characters in question.

Distribution.—Australia; New Zealand; Antarctic seas; South America; North America; Europe; South Africa. Intertidal to continental shelf depths; abyssal depths (Hartman and Fauchald 1971).

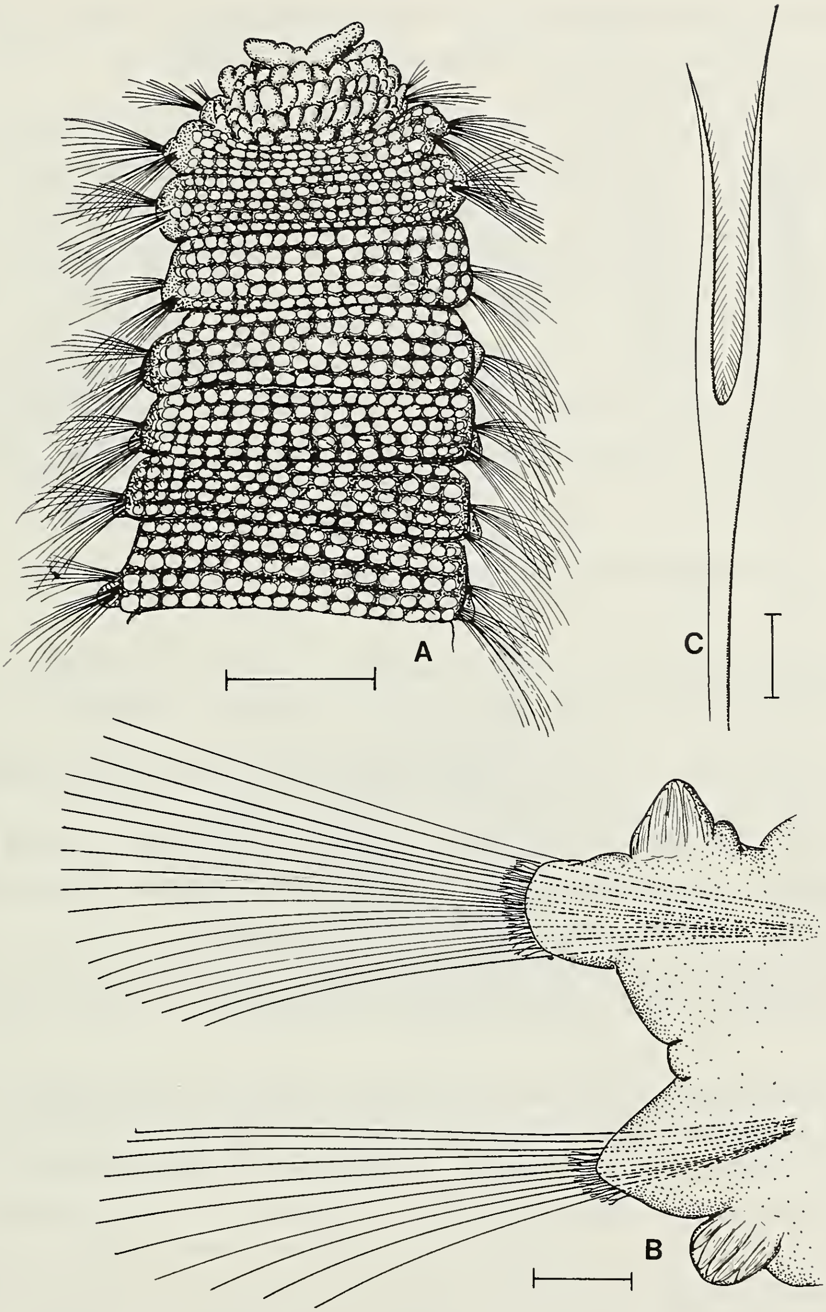

Fig. 7. *Pseudoscalibregma usarpium* (holotype, USNM 60583): A, Anterior end in dorsal view; B, Middle parapodium in anterior view; C, Furcate seta. Scale: A, 500 μm; B, 100 μm; C, 10 μm.

Scalibregmides Hartmann-Schröder, 1965

Type-species.—*Scalibregmides chilensis* Hartmann-Schröder, 1965.

Diagnosis.—Body elongate, arenicoliform; prostomium with 2 prominent lateral processes; branchiae absent; parapodia with prolonged noto- and neuropodial postsetal lamellae; interramal cirri absent; acicular setae lacking on anterior setigers; setae including simple capillaries and furcate setae; pygidium simple, lacking cirri.

Remarks.—*Scalibregmides* was referred to *Pseudoscalibregma* Ashworth by Kudenov and Blake (1978), who erroneously interpreted the diagnostic post-setal lamellae, mentioned by Hartmann-Schröder, as dorsal and ventral cirri. Examination of the holotype of the type-species of *Scalibregmides* showed that Hartmann-Schröder was correct and the genus is considered to be distinct.

Scalibregmides includes 2 species: *S. chilensis* Hartmann-Schröder, 1965, and *S. peruanus,* new species. The genus represents a separate new category in the generic scheme proposed by Kudenov and Blake (1978) (see Discussion, below).

Scalibregmides chilensis Hartmann-Schröder, 1965
Fig. 8

Scalibregmides chilensis Hartmann-Schröder, 1965:231–233, figs. 227–229.
Pseudoscalibregma chilensis.—Kudenov and Blake, 1978:439.

Material examined.—CHILE, Puerto Aguirre, 21 July 1958, mytilid bank, 10 m, coll. Stuardo, holotype (ZMH P-15148).

Description.—A large species, 28 mm long and 3.5 mm wide for 80 setigerous segments. Body enlarged in anterior one-third, tapering thereafter toward narrow posterior end. Color in alcohol: light tan.

Prostomium with 2 laterally projecting horns, articulating from rounded basal portions (Fig. 8A); eyes lacking. Peristomium forming simple achaetous ring.

Setigers 1–3 smooth, lacking annulations; segments becoming triannulate and heavily papillated from setiger 4, continuing to near posterior end, then changing to biannulate and finally uniannulate in far posterior setigers. Postsetal lamellae becoming apparent by setiger 12, arising slightly below small and swollen notopodial lobes and slightly above similar neuropodial lobes; postsetal lamellae gradually lengthen over subsequent segments, becoming long, cirriform lamellae in middle (Fig. 8B) and posterior setigers; notopodial lobes slightly shorter than neuropodial.

Setae including capillaries (Fig. 8C) and furcate setae with unequal tynes bearing fine denticles along inner borders (Fig. 8D).

Branchiae absent. Pygidium reduced to ring of papillae surrounding large anal opening.

Remarks.—*Scalibregmides chilensis* differs from its only congener, *S. peruanus* (see below) in having very distinct prostomial horns which articulate at the base, instead of 2 non-articulating rounded lobes. Furthermore, *S. chilensis* has much longer parapodial postsetal lamellae than *S. peruanus*

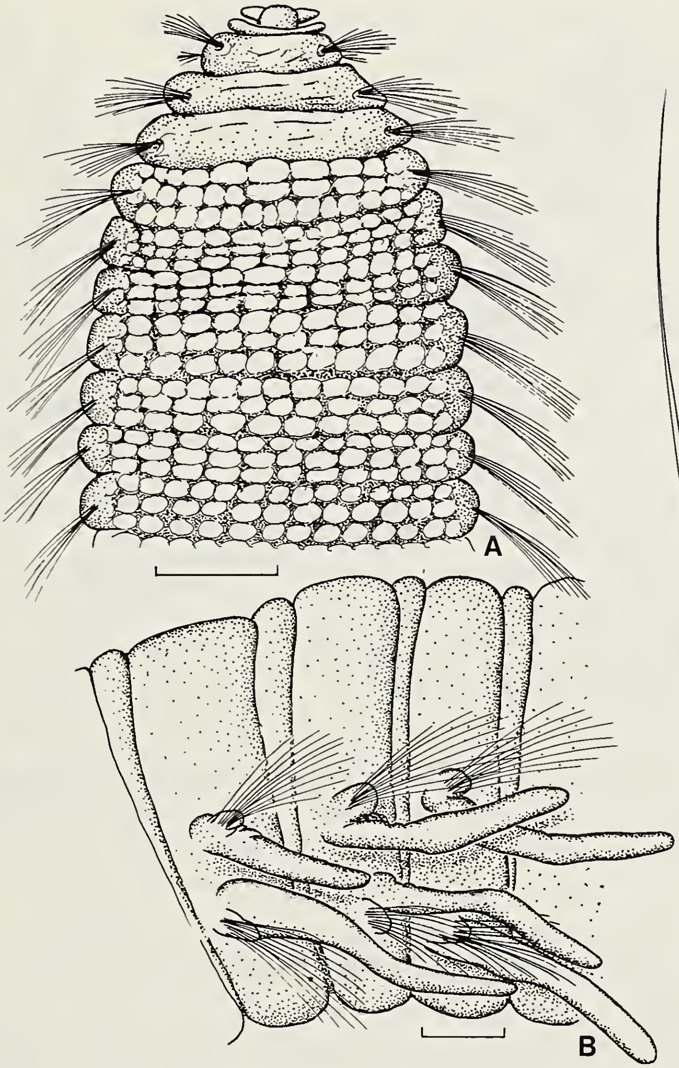

Fig. 8. *Scalibregmides chilensis* (holotype, ZMH P-15148): A, Anterior end in dorsal view; B, Group of 3 middle body segments in lateral view; C, Capillary notoseta; D, Furcate seta. Scale: A, 300 μm; B, 200 μm; C, 10 μm.

and has the first 3 segments smooth and non-annulated, instead of the first 4.

Distribution.—Chile, in 10 m.

Scalibregmides peruanus, new species
Fig. 9

Material examined.—PERU, island near Pucusana, south of Callao, *Anton Bruun* Sta. 65215, 29 Nov. 1965, 0–5 m, holotype (USNM 60582).

Description.—Holotype complete, with 52 setigerous segments, 6.4 mm long and 1 mm wide at expanded middle portion. Body light tan in alcohol.

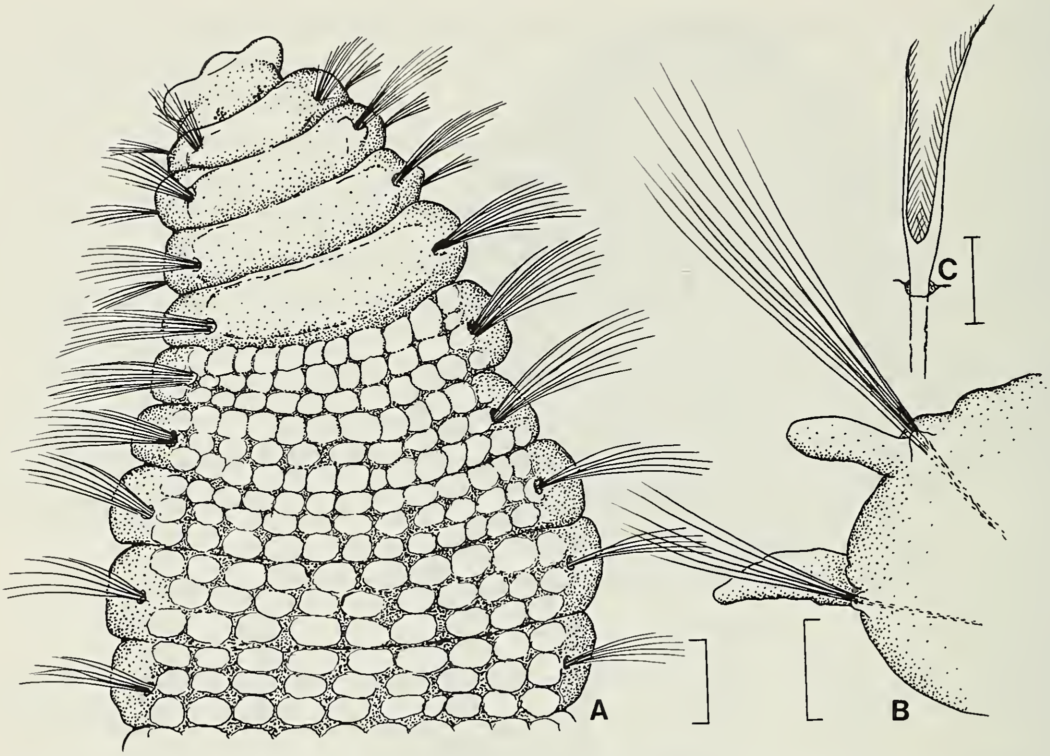

Fig. 9. *Scalibregmides peruanus* (holotype, USNM 60582): A, Anterior end in dorsal view; B, Middle parapodium in anterior view; C, Furcate seta. Scale: A, 200 μm; B, 100 μm; C, 10 μm.

Anterior end narrow, followed by expanded middle portion, then tapering to narrow posterior end.

Prostomium produced laterally into 2 rounded lobes, with small medial protuberance on anterior margin (Fig. 9A); eyes present as 2 distinct clusters of individual ocelli; no nuchal organs apparent. Peristomium reduced, recessed into setiger 1.

Setigers 1–4 smooth, lacking annulations; triannulate segments (Fig. 9A) from setiger 5 with prominent papillae continuing for two-thirds of body length; posterior segments lacking annulations, but with faint dorsal reticulations. Middle and posterior parapodia with notopodial and neuropodial fingerlike postsetal lamellae arising slightly posterior to short setal lobes (Fig. 9B).

Setae including both capillaries and furcate setae; anterior acicular spines lacking, although both short and long notopodial capillaries on setiger 1; short furcate setae from setiger 3, barely visible at base of capillaries, having subequal and fine denticles on inner margins (Fig. 9C).

Branchiae absent. Pygidium simple ring, lacking cirri.

Remarks.—See comments (above) under *S. chilensis.*

Distribution.—Peru, in 0–5 m.

Sclerocheilus antarcticus Ashworth, 1915
Fig. 10

Sclerocheilus antarcticus Ashworth, 1915:405–418, text-figs. 1–2, pl. 36, figs. 1–6.—Hartman, 1978:181–182.
Eumenia oculata.—Gravier, 1911:112, pl. 4, fig. 44 [not Ehlers, 1901]. *Fide* Ashworth, 1915.
?*Eumenia oculata*.—Fauvel, 1951:766 [not Ehlers, 1901].
Oncoscolex dicranochaetus.—Hartman, 1952:233; 1966a:45, pl. 14, figs. 1–5 [in part, not Schmarda, 1861].
?*Sclerocheilus minutus*.—Fauvel, 1951:766 [not Grube, 1851].
Sclerocheilus oculatus.—Hartman, 1967:135–136 [not Ehlers, 1901].

Material examined.—ANTARCTIC PENINSULA, Marguerite Bay, U.S. Navy Antarctic Exped. 1948, Sta. 234, 2 April 1948, 82 m, coll. D. C. Nutt, 1 specimen (USNM 23878); Neny Fjord, 20 Mar. 1940, 90 m, bottom dredge, 1 specimen (USNM 58972); Port Lockroy, off Wiencke Island, Anvers Island, *Staten Island* Sta. 63-9, 26 Jan. 1963, 64°48′S, 63°30′W, 61.5 m, dredged on mud bottom, 1 specimen (USNM 46408); Melchoir Island, *Staten Island* Sta. 63-25, 7 Feb. 1963, 64°19′S, 62°59′W, 45 m, 1 specimen (USNM 46409).—BRANSFIELD STRAIT, *Eltanin* Sta. 418, 2 Jan. 1963, 62°39′S, 56°10′W to 62°40′S, 56°08′W, 311–426 m, Blake trawl, 1 specimen (USNM 56627); Sta. 1002, 15 Mar. 1964, 62°40′S, 54°45′W, 265 m, Blake trawl, 1 specimen (USNM 56628); Sta. 1003, 15 Mar. 1964, 62°41′S, 54°43′W, 210–220 m, Blake trawl, 5 specimens (USNM 56629).

Description.—A moderate-sized species, up to 15 mm long and 2.5 mm wide for 43 setigers. Holotype 19 mm long and 3 mm wide with 43 setigers according to Ashworth (1915). Color in alcohol: light tan to dark brown.

Prostomium with 2 laterally-directed lobes, variable in shape, either broad (Fig. 10A) or narrow; entire anterior part of prostomium sometimes shrunken or withdrawn into peristomium; eyes prominent, forming inverted V-shape, with point of V directed anteriorly (Fig. 10A); tip of V separated on some specimens; nuchal organs present as lobate structures directly posterior to prostomium. Peristomium achaetous, variably convoluted, sometimes appearing as a double segment; everted proboscis lobate, saclike.

Segments of anterior and posterior regions generally smooth, mostly uniannulate; middle segments distinctly biannulate to quadriannulate. Parapodia reduced in anterior setigers to low lobes lacking cirri; digitiform ventral cirri present from about setigers 17–19 to end of body (Fig. 10B); lateral sense organs or interramal cirri present between noto- and neuropodia.

Setae of 3 types: 1) acicular notopodial spines occurring on setigers 1–3, sharply pointed and bearing a fine cloak of bristles (Fig. 10C), 2) furcate setae occurring from setiger 3–4 in noto- and neuropodia with subequal

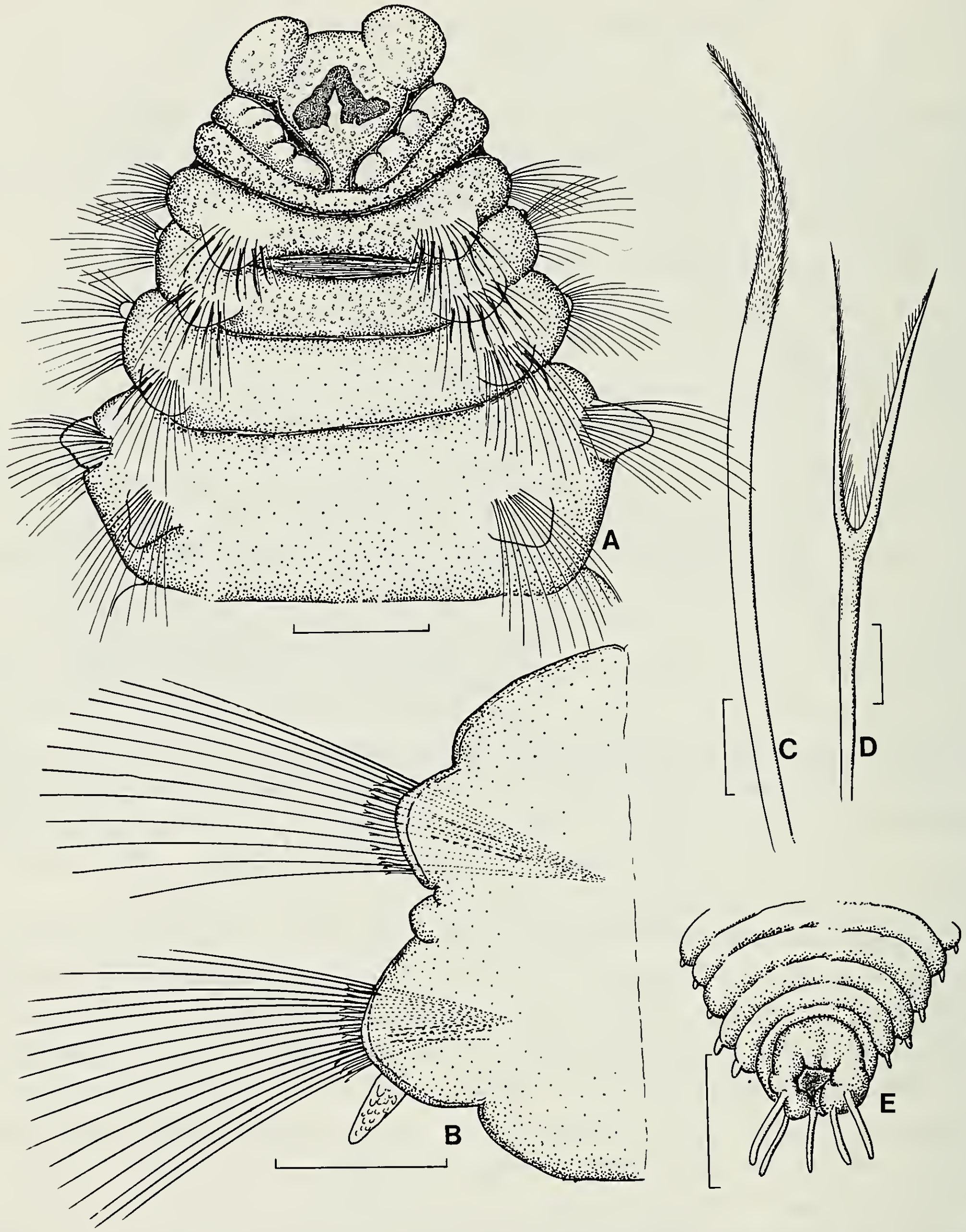

Fig. 10. *Sclerocheilus antarcticus:* A, Anterior end in dorsal view; B, Middle parapodium in anterior view; C, Notopodium acicular spine; D, Furcate seta; E, Posterior end in dorsal view. Scale: A, 200 μm; B, 100 μm; C, 30 μm; D, 10 μm; E, 200 μm.

tynes, bearing fine denticles along inner margins (Fig. 10D) and 3) capillaries of variable lengths and diameters occurring in both rami throughout body.

Branchiae absent. Pygidium with 4–5 ventrally-located cirri (Fig. 10E).

Remarks.—The specimens referred to *Oncoscolex dicranochaetus* Schmarda by Hartman (1952) and *Sclerocheilus oculatus* (Ehlers) by Hartman (1967) were examined and found to agree very well with Ashworth's

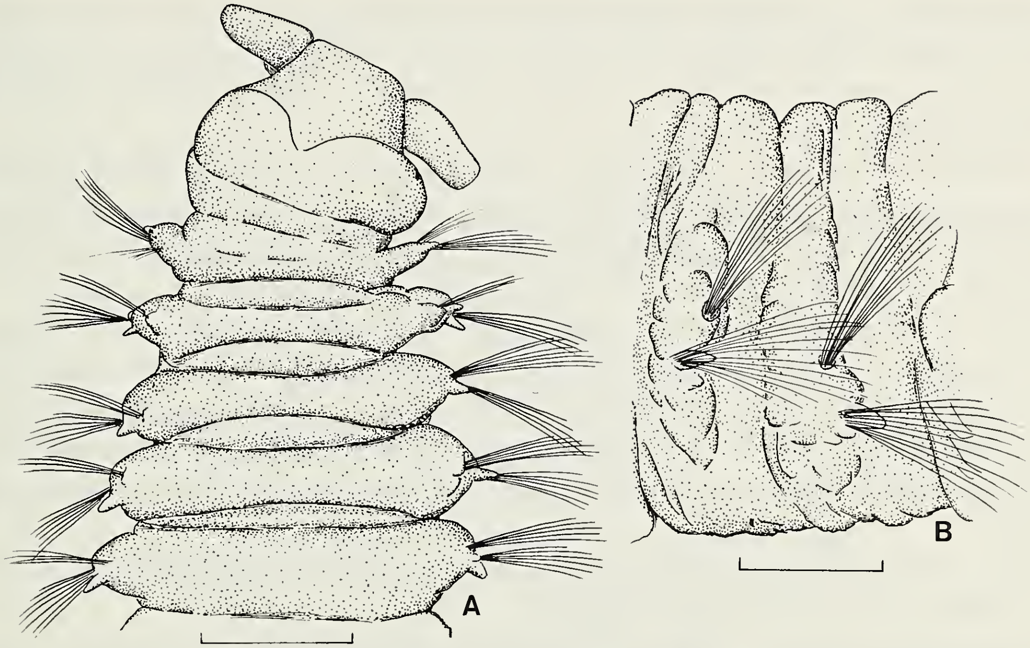

Fig. 11. *Kebuita minuta:* A, Anterior end in dorsal view; B, Two anterior setigers in lateral view. Scale: A, 300 μm; B, 200 μm.

(1915) excellent account of *S. antarcticus* [see also remarks under *Hyboscolex equatorialis*]. *S. antarcticus* differs from its closest relative, *S. minutus* Grube from the North Atlantic, in having notopodial acicular spines present on setigers 1–3, instead of only setiger 1.

Distribution.—Antarctica, in 45–426 m.

Kebuita minuta Hartman, 1967
Fig. 11

Kebuita minuta Hartman, 1967:131–132; 1978:179, fig. 27a–b [in part, specimen from *Glacier* Sta. 19-21 = *Notomastus* sp.].

Material examined.—SOUTH SHETLAND ISLANDS, *Eltanin* Sta. 993, 13 Mar. 1964, 61°25′S, 56°30′W to 56°32′W, 300 m, Blake trawl, 1 specimen (USNM 56622).—SOUTH ORKNEY ISLANDS, *Eltanin* Sta. 1079, 13 April 1964, 61°26′S to 61°24′S, 41°55′W, 593–598 m, Blake trawl, holotype (USNM 55553).—ANTARCTIC PENINSULA, *Eltanin* Sta. 272, 21 Oct. 1962, 64°54′S, 68°21′W, 412 m, 1 specimen (USNM 56625).—ROSS SEA, *Eltanin* Sta. 2012, 13 Jan. 1968, 73°59′S, 170°51′E to 73°58′S, 170°58′E, 589–608 m, Blake trawl, 1 specimen (USNM 60574).—WEDDELL SEA, 13 Mar. 1969, *Glacier* Sta. 69-21, 73°52′S, 31°18′W, 2288 m, epibenthic sled, 1 specimen (USNM 46991); Sta. 69-23, 14 Mar. 1969, 72°49.6′S, 30°29.7′W, 3687 m, anchor dredge, 1 specimen (USNM 46972).

Description.—A small species, up to 8 mm long and 3 mm wide at midbody region. Body narrow anteriorly and posteriorly, swollen in middle, appearing generally grublike or maggot-shaped. Color in alcohol: light tan to dark brown.

Prostomium narrow anteriorly, tapering posteriorly, with blunt anterior margin bearing 2 prominent lateral horns (Fig. 11A); eyes lacking; nuchal organs not apparent. Peristomium well-developed, overlapping prostomium dorsally; with mid-dorsal notch (Fig. 11A); everted proboscis saclike.

First 6–8 setigers narrower than those following, with first 4–5 having prominent annulations; subsequent segments smoother, swollen; posterior 8–10 segments more slender, terminating in simple pygidial ring lacking cirri. Notopodial lobes and cirri lacking; neuropodia with distinct setal lobes and small postsetal lamellae (Fig. 11B), best seen on anterior and posterior segments.

Setae all capillaries. Specimen from Ross Sea (*Eltanin* Sta. 2012) with ova measuring 80–85 μm in diameter.

Remarks.—Hartman (1967, 1978) reported the presence of furcate setae in this species, but despite careful inspection none have been observed.

Distribution.—Widespread localities in Antarctic and subantarctic seas, in 300–3687 m.

Discussion

The genera of the Scalibregmatidae were reviewed by Kudenov and Blake (1978) as part of a study of Australian species. They recognized 13 genera arranged into 3 main groups. While the basis for their arrangement remains valid, it is now apparent that some species were generically misplaced owing to a reliance on published descriptions rather than an examination of pertinent type-specimens. The outline presented below is revised from that of Kudenov and Blake (1978) to accommodate several nomenclatural changes at the species level. It also includes a new category (D) in Group I for *Scalibregmides* Hartmann-Schröder and an as yet unnamed genus.

Group I includes species having elongated or arenicoliform bodies and T-shaped prostomia. The 4 generic categories include: (A), species having dorsal and ventral cirri in posterior parapodia [Genera: *Scalibregma* Rathke, *Sclerobregma* Hartman, *Pseudoscalibregma* Ashworth, and *Oligobregma* Kudenov and Blake]; (B), species having only ventral cirri in posterior segments [Genera: *Parasclerocheilus* Fauvel, and *Sclerocheilus* Grube]; (C) species lacking dorsal and ventral cirri in posterior segments (also lacking postsetal lamellae) [Genera: *Cryptosclerocheilus* Blake, *Hyboscolex* Schmarda, and *Asclerocheilus* Ashworth]; (D), species lacking dorsal and ventral cirri but having markedly elongate and digitiform postsetal lamellae. *Scalibregmides* is the first genus in this latter category and lacks anterior acicular spines. A second genus, to include *Asclerocheilus californicus* Hartman, 1963, but yet to be named, will include species having anterior acicular spines.

I. Body arenicoliform; prostomium T-shaped with distinct lateral processes or horns.
  (A) Parapodia of posterior segments with dorsal and ventral cirri.
    (1) With branchiae; without acicular spines.
      Scalibregma Rathke, 1843
        (*Oligobranchus* Sars, 1846)
        S. inflatum Rathke, 1843 (type)
    (2) With branchiae; with acicular spines
      Sclerobregma Hartman, 1965
        S. branchiatum Hartman, 1965
        S. stenocerum Bertelsen and Weston, 1980
    (3) Without branchiae; without acicular spines
      Pseudoscalibregma Ashworth, 1901
        P. bransfieldium (Hartman, 1967)
        P. pallens Levenstein, 1962
        P. parvum (Hansen, 1878) (type)
        P. usarpium, new species
    (4) Without branchiae; with acicular spines
      Oligobregma Kudenov and Blake, 1978
        O. aciculatum (Hartman, 1965) (type)
        O. collare (Levenstein, 1978)
        O. hartmanae, new name
        O. notiale, new species
        O. oculatum Kudenov and Blake, 1978
        O. simplex Kudenov and Blake, 1978
  (B) Parapodia of posterior segments with ventral cirri, without dorsal cirri; without prolonged postsetal lamellae
    (1) With branchiae; with acicular spines
      Parasclerocheilus Fauvel, 1928
        P. branchiatus Fauvel, 1928 (type)
        P. capensis Day, 1961
    (2) Without branchiae; with acicular spines
      Sclerocheilus Grube, 1863
        S. antarcticus Ashworth, 1915
        S. deriugini Zachs, 1925
        S. minutus Grube, 1863 (type)
  (C) Parapodia of posterior segments reduced; without dorsal and ventral cirri; without prolonged postsetal lamellae
    (1) With branchiae; without acicular spines

        Cryptosclerocheilus Blake, 1972
            C. baffinensis Blake, 1972
                [Note: following a reexamination of slides of the setae of setiger 1 prepared from the types of *C. baffinensis,* I have determined that the acicular "spines" are merely worn capillaries. The genus remains valid, but the definition is revised to reflect the absence of acicular spines].
    (2) Without branchiae; without acicular spines
        Hyboscolex Schmarda, 1861 (see Day 1961 for literature)
            (*Oncoscolex* Schmarda, 1861)
            H. dicranochaetus (Schmarda, 1861)
            H. equatorialis, new species
            H. longisetus Schmarda, 1861 (type)
            H. oculatus (Ehlers, 1901), new combination
            H. pacificus (Moore, 1909)
            H. reticulatus (McIntosh, 1885)
            H. verrucosus Hartmann-Schröder, 1979
    (3) Without branchiae; with acicular spines
        Asclerocheilus Ashworth, 1901
            A. acirratus (Hartman, 1966), new combination
            A. ashworthi, new species
            A. beringianus Uschakov, 1955
            A. capensis Day, 1963
            A. heterochaetus Kudenov and Blake, 1978
            A. intermedius (Saint-Joseph, 1894) (type)
            A. tropicus, new species
(D) Parapodia of posterior segments reduced; without dorsal and ventral cirri; with prolonged postsetal lamellae
    (1) Without branchiae; without acicular spines
        Scalibregmides Hartmann-Schröder, 1965
            S. chilensis Hartmann-Schröder, 1965 (type)
            S. peruanus, new species
    (2) Without branchiae; with acicular spines
        Genus to be named for *Asclerocheilus californicus* Hartman, 1963

II. Body maggotlike; prostomium usually incised or entire, rarely with distinct lateral processes.
(A) Prostomium incised
    (1) With branchiae
        Polyphysia Quatrefages, 1865
        (*Eumenia* Oersted, 1843, preoccupied)
        (*Lipobranchus* Cunningham & Ramage, 1888)
            P. caulleryi (McIntosh, 1922)

- *P. crassa* (Oersted, 1843) (type)
- *P. crassa fauveli* (Laubier, 1959)
- *P. hysticis* (McIntosh, 1922)

(2) Without branchiae
Kebuita Chamberlin, 1919
(*Gwasitoa* Chamberlin, 1919
K. glabra (Ehlers, 1887) (type)
K. minuta Hartman, 1967
(B) Prostomium entire
(1) Without branchiae
Neolipobranchus Hartman & Fauchald, 1971
N. glabrus Hartman & Fauchald, 1971 (type)
III. Body elongated, slender; prostomium with 2 long frontal antennae; 2 prominent nuchal organs
(1) Without branchiae
Scalibregmella Hartman & Fauchald, 1971
S. antennata Hartman & Fauchald, 1971 (type)

Two genera, *Proscalibregma* Hartman, 1967, and *Scalispinigera* Hartman, 1967 were considered to be *incertae sedis* by Kudenov and Blake (1978). Examination of the type-specimens of the species of those genera now permits comment on their placement within the Polychaeta. *Proscalibregma linea* Hartman, 1967, from deep waters of Drake Passage, has uniramous parapodia and a ventral groove typical for species of the Opheliidae. Hence, this monotypic genus should be referred to that family, and possibly to the genus *Tachytrypane* McIntosh, 1885. *Scalispinigera* has 2 named species: *S. oculata* Hartman, 1967, from the Antarctic Peninsula and *S. cirrata* Hartman and Fauchald, 1971, from the deep North Atlantic. Both species are closely related to the Hesionidae in the structure of the pharyngeal region, parapodia and setae. The antennae, however, are reduced, a feature which is aberrant in Hesionidae.

A tabulation of scalibregmatid species reported by Day (1967) from South Africa, Kudenov and Blake (1978) from Australasia, and by the present investigator from South America and Antarctica reveals that each continent has a distinct suite of species. Only the cosmopolitan *Scalibregma inflatum* occurs throughout the southern hemisphere. *Polyphysia crassa,* a North Atlantic species, occurs in South Africa. The following list of species is limited to those scalibregmatids occurring south of 30° south latitude. No zoogeographic trends are evident at the generic level.

South Africa: *Asclerocheilus capensis, Hyboscolex longiseta, Parasclerocheilus capensis, Polyphysia crassa.*

Australasia: *Asclerocheilus heterochaetus, Oligobregma simplex, Hyboscolex dicranochaetus.*

South America: *Hyboscolex oculatus, Scalibregmides chilensis.*

Antarctica: *Asclerocheilus ashworthi, Kebuita minuta, Oligobregma hartmanae, O. collare, O. notiale, Pseudoscalibregma bransfieldium, P. usarpium, Sclerocheilus antarcticus.*

Cosmopolitan: *Scalibregma inflatum.*

Key to the Scalibregmatidae from South America and Antarctica

1\. Posterior parapodia with either long postsetal lamellae, short neuropodial lobes, dorsal and ventral cirri or only ventral cirri 5

– Parapodia reduced, lacking postsetal lamellae and dorsal and ventral cirri 2

2\. Anterior notopodia with acicular spines 3

– Anterior notopodia without acicular spines 4

3\. Anterior acicular spines limited to setiger 1; prostomial eyes arranged in 2 longitudinal groups; anterior margin of prostomium formed into 2 large, lateral wings (Fig. 1A) ... *Asclerocheilus ashworthi*

– Anterior acicular spines on setigers 1–2; no eyes; anterior margin of prostomium formed into 2 lateral lobes (Fig. 1D) ...... *Asclerocheilus tropicus*

4\. Prostomial eyes V-shaped; frontal horns prominent, articulating with anterior margin of prostomium ...... *Hyboscolex oculatus*

– Prostomial eyes forming single rows; frontal horns reduced, not articulating with anterior margin of prostomium (Fig. 2A) ...... *Hyboscolex equatorialis*

5\. Parapodia with elongated postsetal lamellae or short neuropodial lobes; no dorsal or ventral cirri 6

– Parapodia without postsetal lamellae or lobes; with dorsal and ventral cirri 8

6\. Parapodia with elongated postsetal lamellae; peristomium poorly developed, recessed into setiger 1 7

– Neuropodia with short postsetal lobes; peristomium well developed, notched, overlapping prostomium (Fig. 11A); body more or less maggotlike ...... *Kebuita minuta*

7\. Anterior margin of prostomium with 2 distinct frontal horns articulating with anterior margin (Fig. 8A); parapodial postsetal lamellae as long as 3–4 segments (Fig. 8B); eyes absent; first 3 segments smooth, non-annulated ...... *Scalibregmides chilensis*

– Anterior margin of prostomium with 2 non-articulating rounded lobes (Fig. 9A); parapodial postsetal lamellae 1–2 segments long (Fig. 9B); 2 clusters of eye spots present; first 4 segments smooth, non-annulated ...... *Scalibregmides peruanus*

8\. Posterior parapodia with both dorsal and ventral cirri; eyes lacking or arranged as 2 distinct groups of ocelli 9

– Posterior parapodia with ventral cirri; no dorsal cirri; eyes fused into a single, large inverted V (Fig. 10A) .... *Sclerocheilus antarcticus*

9. Some anterior setigers with branched gills .... *Scalibregma inflatum*

– Gills entirely absent 10

10. Acicular spines present on some anterior notopodia 11

– Acicular spines absent 13

11. Anterior notopodial spines prominent, occurring on setigers 1–3; peristomium smooth, lacking papillae 12

– Anterior notopodial spines inconspicuous, intermixed with longer capillaries on setigers 1–2; peristomium with numerous papillae (Fig. 4A) .... *Oligobregma hartmanae*

12. Dorsal and ventral cirri inflated, saclike, not tapering at tip; eyes present; anterior margin of prostomium with 2 broadly rounded laterally projecting lobes (Fig. 5A) .... *Oligobregma notiale*

– Dorsal and ventral cirri conical, tapering at tip; eyes absent; anterior margin of prostomium with 2 short rounded lobes projecting forward (Fig. 3A) .... *Oligobregma collare*

13. Rounded nuchal crest present posteriorly on prostomium (Fig. 6A); dorsal and ventral cirri broad, inflated (Fig. 6B); segmental papillae generally lacking .... *Pseudoscalibregma bransfieldium*

– Nuchal crest absent; dorsal and ventral cirri short, globular, not inflated (Fig. 7B); body segments heavily papillated (Fig. 7A) .... *Pseudoscalibregma usarpium*

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PRELIMINARY LIST OF FISHES FROM SOMBRERO ISLAND, PHILIPPINES, WITH FIFTEEN NEW RECORDS

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Roger C. Steene

Abstract.—The ichthyofauna of Sombrero Island, Philippines, was surveyed in preparation for the establishment of Sombrero Island as the first marine park in the Philippines. Collecting efforts and visual surveys showed a total of 240 species in 44 families, with collections accounting for 142 of these species. Fifteen species in seven families (Blenniidae, Syngnathidae, Solenichthyidae, Ophichthidae, Synodontidae, Platycephalidae, and Limnichthyidae) are recorded for the first time from Philippine waters.

Introduction

During the latter part of 1979 and early 1980, the ichthyofauna of Sombrero Island, Batangas, Philippines (120°49′E, 13°42′N), was studied in preparation for the establishment of Sombrero Island as a marine park. The study site is a very small island (not more than 15,000 sq m) located in the Verde Island Passage between the islands of Luzon and Mindoro (Fig. 1).

The following list of fishes of Sombrero Island (Table 1) is based primarily on those collected by the authors at four localities and sight records made at various locations by Murdy, Ferraris, and Steene. One large rotenone station was carried out on the western side of the island at a depth of approximately 5–7 m, over a dense coral bottom. Two small rotenone stations were made along the northeastern corner of the island among large boulders at a depth of 1 m and at 10 m on a coral bottom. Another small rotenone station was made at the southeastern corner at 1 m among large boulders. Rotenone was also used in some instances to collect certain species that were observed during visual surveys.

Visual surveys were conducted at four locations; eastern side of the island at 1–35 m, over mostly sand and coral rubble bottom; northwestern side at 1–2 m, over coral; northeastern side, 1–4 m, over large rocks and coral; and northwestern side in 20–25 m at the edge of the coral reef flat. Record keeping on surveys was facilitated by the use of an underwater tape recorder. Fishes that were observed but not collected are indicated by an asterisk (*) after their names in Table 1. We have adopted the phylogenetic arrangement proposed by Nelson (1976), except in a few cases where different family names are used due to recent revisions.

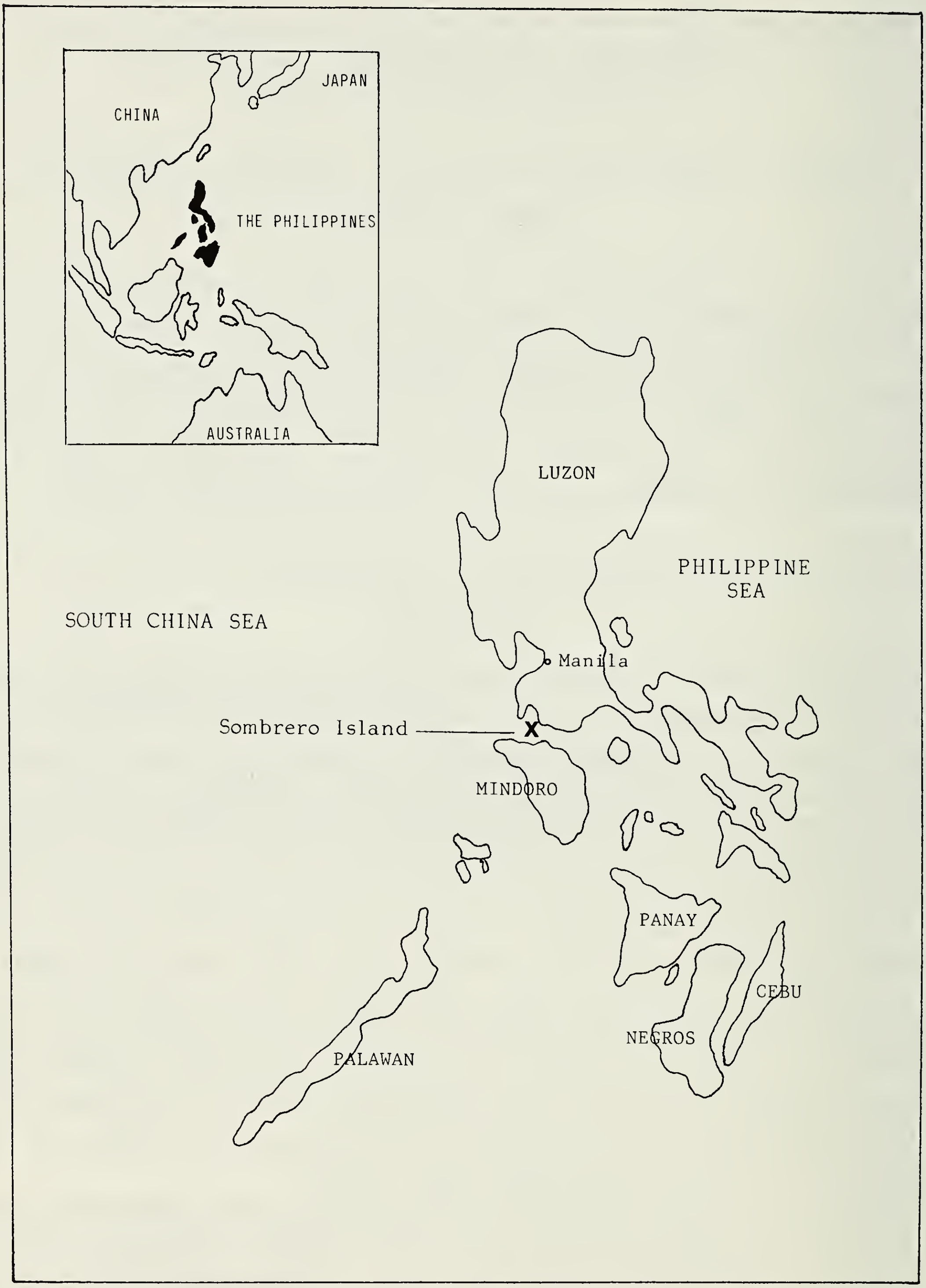

Fig. 1. The approximate location of Sombrero Island in relation to the major islands of the Philippines.

Fifteen species are reported for the first time from Philippine waters. These include six blennies, *Ecsenius oculus* and *E. opsifrontalis* (see McKinney and Springer 1976), *Entomacrodus epalzeocheilus* (see Springer 1972), *E. thalassinus longicirrus* (see Springer 1967), *Glyptoparus delicat-*

Table 1.—List of fishes of Sombrero Island, Philippines. Fishes were collected or observed at the following locations: (1) eastern side, 1–35 m, over sand and coral rubble bottom; (2) southeastern side at 1 m among large boulders; (3) northeastern side, 1–4 m, over large rocks and coral; (4) northwestern side, 1–2 m, over coral bottom; (5) northwestern side, 20–25 m, at edge of coral reef flat; (6) western side, 5–7 m, over coral bottom; and (7) northeastern side at 10 m, over coral bottom. C = collected, X = observed.

	LOCATION						
	Sand	Boulder		Coral			
SPECIES	1	2	3	4	5	6	7
Family: Muraenidae							
Gymnothorax margitophorus Bleeker, 1865						C	
Gymnothorax petelli Bleeker, 1856				C			
Gymnothorax zonipectis Seale, 1906						C	
Gymnothorax sp.						C	
Family: Ophichthidae							
Muraenichthys laticaudatus (Ogilby, 1897) R						C	
Family: Plotosidae							
Plotosus anguillaris (Bloch, 1794)*	X						
Family: Synodontidae							
Saurida gracilis (Quoy and Gaimard, 1824)*	X						
Synodus englemani Schultz, 1953 R						C	
Synodus sp.						C	
Family: Bythididae							
Brosmophyciops sp.						C	
Family: Antennariidae							
Antennarius coccineus (Lesson, 1830)						C	
Family: Holocentridae							
Adioryx cornutus (Bleeker, 1853)						C	
Family: Aulostomidae							
Aulostomus chinensis (Linnaeus, 1766)*		X		X		X	
Family: Fistulariidae							
Fistularia villosa Klunzinger, 1871*	X	X					
Family: Solenichthyidae							
Solenichthys armatus (Weber, 1913) R						C	
Family: Syngnathidae							
Choeroichthys brachysoma (Bleeker, 1855)						C	
Corythoichthys amplexus Dawson and Randall, 1975 R							C
Corythoichthys schultzi Herald, 1953 R							C
Dentirostrum janssi Herald and Randall, 1972 R							C
Dunckerocampus dactyliophorus (Bleeker, 1853)*	X						
Micrognathus sp.							C
Phoxocampus diacanthus (Schultz, 1943) R						C	

Table 1.—Continued.

	LOCATION						
	Sand	Boulder		Coral			
SPECIES	1	2	3	4	5	6	7
Family: Scorpaenidae							
Dendrochirus zebra (Cuvier, 1829)*					X		
Pterois antennata (Bloch, 1787)						C	
Scorpaenodes sp.						C	
Scorpaenopsis diabolus (Cuvier, 1829)		C					
Sebastipistes sp.						C	
Scorpaenidae (1 species)						C	
Family: Platycephalidae							
Thysanophrys arenicola Schultz, 1960 R						C	
Thysanophrys chiltoni Schultz, 1960						C	
Family: Serranidae							
Anthias mortoni Macleay, 1884						C	
Anthias squamipinnis (Peters, 1855)*	X		X		X		
Anthias tuka (Herre and Montalban, 1927)		C					
Anyperodon leucogrammicus (Valenciennes, 1828)						C	
Cephalopholis argus (Bloch and Schneider, 1801)						C	
Cephalopholis urodelus (Bloch and Schneider, 1801)*			X				
Epinephalus fasciatus (Forskål, 1775)	X					C	
Epinephalus summana (Forskål, 1775)						C	
Luzonichthys sp.						C	
Variola louti (Forskål, 1775)			X			C	
Family: Pseudochromidae							
Pseudochromis diadema Lubbock and Randall, 1978*					X		
Pseudochromis sp.			C			C	
Family: Pseudogrammatidae							
Pseudogramma polyacanthus (Bleeker, 1856)						C	
Family: Plesiopidae							
Plesiops corallicola Bleeker, 1853				C			
Family: Acanthoclinidae							
Acanthoplesiops sp.						C	
Family: Apogonidae							
Apogon angustata (Smith and Radcliffe, 1911)						C	
Apogon aureus (Lacepède, 1803)*	X						
Apogon bandanensis Bleeker, 1854						C	
Apogon coccineus Rüppell, 1835						C	
Apogon kallopterus Bleeker, 1856						C	
Apogon multitaeniatus Ehrenberg, 1828						C	
Apogon novemfasciatus Valenciennes, 1828						C	
Cheilodipterus macrodon (Lacepède, 1802)						C	

Table 1.—Continued.

	LOCATION						
	Sand	Boulder		Coral			
SPECIES	1	2	3	4	5	6	7
Family: Lutjanidae							
Lutjanus decussatus (Cuvier and Valenciennes, 1828)*				X			
Macolor niger (Forskål, 1775)*	X						
Family: Caesiodidae							
Caesio pisang Bleeker, 1853*			X				
Family: Nemipteridae							
Scolopsis bilineatus (Bloch, 1793)*	X	X	X	X	X		
Family: Lethrinidae							
Lethrinus harak (Forskål, 1775)*	X						
Family: Mullidae							
Parupeneus barberinus (Lacepède, 1802)*			X		X		
Parupeneus indicus (Shaw, 1803)*	X						
Parupeneus multifasciatus (Quoy and Gaimard, 1824)*	X						
Family: Chaetodontidae							
Chaetodon baronessa Cuvier, 1829	X	X	X			C	
Chaetodon citrinellus Cuvier, 1831*			X				
Chaetodon kleini Bloch, 1790*	X	X	X	X			
Chaetodon lineolatus Quoy and Gaimard, 1831*		X					
Chaetodon lunula (Lacepède, 1802)*			X				
Chaetodon melannotus Bloch and Schneider, 1801*		X					
Chaetodon mertensi Cuvier, 1831*					X		
Chaetodon punctatofasciatus Cuvier, 1831*			X				
Chaetodon rafflesi Bennett, 1830*		X	X				
Chaetodon selene Bleeker, 1853*			X				
Chaetodon striangulus (Gmelin, 1788)		X		X		C	
Chaetodon trifascialis Quoy and Gaimard. 1824						C	
Chaetodon trifasciatus Park, 1797	X		X	X		C	
Chaetodon vagabundus Linnaeus, 1758*		X					
Chaetodon xanthurus Bleeker, 1857*			X				
Heniochus varius (Cuvier, 1829)*		X					
Family: Pomacanthidae							
Centropyge bicolor Bloch, 1787*	X						
Centropyge vroliki (Bleeker, 1853)	X			X		C	
Genicanthus lamarck (Lacepède, 1802)*			X				
Family: Pomacentridae							
Abudefduf sordidus (Forskål, 1775)*	X						
Abudefduf vaigensis (Quoy and Gaimard, 1824)*	X	X	X				
Acanthochromis polyacanthus (Bleeker, 1855)						C	
Amblyglyphidodon aureus (Cuvier, 1830)*					X		

Table 1.—Continued.

	LOCATION						
	Sand	Boulder		Coral			
SPECIES	1	2	3	4	5	6	7
Amphiprion clarkii (Bennett, 1830)			X			C	
Chromis analis (Cuvier, 1830)*					X		
Chromis bicolor (Macleay, 1882)				X		C	
Chromis caerulea (Cuvier, 1830)	X	X	X			C	
Chromis retrofasciata Weber, 1913*		X					
Chromis ternatensis (Bleeker, 1856)						C	
Chromis xanthochir (Bleeker, 1851)						C	
Dascyllus reticulatus (Richardson, 1846)	X			X		C	
Dascyllus trimaculatus (Rüppell, 1828)	X	X	X	X	X	C	
Glyphididontops rex (Snyder, 1909)						C	
Plectroglyphidodon dickii (Lienard, 1839)*				X			
Plectroglyphidodon lacrymatus (Quoy and Gaimard, 1824)				X		C	
Plectroglyphidodon leucozona (Bleeker, 1859)						C	
Pomacentrus amboinensis Bleeker, 1868						C	
Pomacentrus brachialis Cuvier, 1830*		X	X	X			
Pomacentrus coelestis Jordan and Starks, 1901	X	X	X	X		C	
Pomacentrus molluccensis Bleeker, 1853				X		C	
Pomacentrus philippinus Evermann and Seale, 1907						C	
Pomacentrus rhodonotus Bleeker, 1853*	X						
Pomacentrus vaiuli Jordan and Seale, 1906						C	
Pomachromus richardsoni Snyder, 1909*	X	X	X	X			
Family: Cirrhitidae							
Cirrhitichthys falco Randall, 1963		X		X		C	
Cirrhitichthys serratus Randall, 1963*			X				
Paracirrhites arcatus (Cuvier, 1829)*			X				
Paracirrhites forsteri (Bloch and Schneider, 1801)*		X					
Family: Labridae							
Anampses meleagrides Cuvier and Valenciennes, 1839*	X		X				
Bodianus mesothorax (Bloch and Schneider, 1801)*		X		X	X		
Cheilinus oxycephalus Bleeker, 1853						C	
Cheilinus trilobatus Lacepède, 1802*			X				
Cirrhilabrus lubbocki Randall and Carpenter, 1980*					X		
Cirrhilabrus temminckii Bleeker, 1852						C	
Coris gaimard (Quoy and Gaimard, 1824)	X		X			C	
Coris variegata (Rüppell, 1835)*	X			X			
Epibulis insidiator (Pallas, 1770)						C	
Halichoeres centriquadrus (Lacepède, 1802)*			X	X			
Halichoeres hartzfeldii (Bleeker, 1852)*	X						
Halichoeres hoevenii (Bleeker, 1851)*					X		
Halichoeres margaritaceus (Valenciennes, 1839)*	X		X				
Halichoeres scapularis (Bennett, 1831)*	X		X				
Halichoeres trimaculatus (Quoy and Gaimard, 1834)*	X						

Table 1.—Continued.

	LOCATION						
	Sand	Boulder		Coral			
SPECIES	1	2	3	4	5	6	7
Halichoeres (2 species)						C	
Hemigymnus fasciatus (Bloch, 1792)*	X						
Hemigymnus melapterus (Bloch, 1791)*	X		X	X			
Hologymnosus (2 species)						C	
Labrichthys unilineata (Guichenot, 1847)			X	X		C	
Labroides dimidiatus (Valenciennes, 1839)	X	X	X	X		C	
Macropharygodon meleagris (Valenciennes, 1839)						C	
Pseudocheilinus evanidus Jordan and Evermann, 1902						C	
Pseudocheilinus hexataenia (Bleeker, 1857)				X		C	
Stethojulis trilineata (Bloch and Schneider, 1801)*		X					
Thalassoma amblycephala (Bleeker, 1856)*	X	X	X				
Thalassoma fuscum (Lacepède, 1802)*		X					
Thalassoma hardwicke (Bennett, 1830)*		X	X	X			
Thalassoma lunare (Linnaeus, 1758)	X	X	X	X		C	
Thalassoma janseni (Bleeker, 1856)*		X					
Thalassoma quinquevittata (Lay and Bennett, 1839)*		X					
Wetmorella triocellata Schultz and Marshall, 1954						C	
Family: Scaridae							
Scarus ghobban Forskål, 1775*	X						
Scarus gibbus Rüppell, 1828*	X						
Scarus rhoduropterus (Bleeker, 1861)*	X	X					
Scarus scaber Cuvier and Valenciennes, 1839*	X	X	X				
Scarus sordidus Forskål, 1775*	X						
Family: Mugiloididae							
Parapercis cephalopunctata (Seale, 1900)	X			X		C	
Parapercis polyopthalma Cuvier, 1829*			X				
Parapercis tetracantha (Lacepède, 1800)*	X		X		X		
Family: Limnichthyidae							
Limnichthys donaldsoni Schultz, 1960 R	C						X
Family: Tripterygiidae							
Enneapterygius (2 species)		C				C	
Helcogramma trigloides Bleeker, 1858				C			
Helcogramma (5 species)		C				C	
Family: Blenniidae							
Andamia sp.		C	C				
Atrosalarias fuscus (Rüppell, 1838)						C	
Cirripectes variolosus (Cuvier and Valenciennes, 1836)		C	C				
Crossosalarias macrospilus Smith-Vaniz and Springer, 1971 R						C	
Ecsenius bicolor (Day, 1888)	X	X	X			C	C
Ecsenius lividinalis Chapman and Schultz, 1952						C	
Ecsenius oculus Springer, 1971 R		C	C				

Table 1.—Continued.

	LOCATION						
	Sand	Boulder		Coral			
SPECIES	1	2	3	4	5	6	7
Ecsenius opsifrontalis Chapman and Schultz, 1952 R						C	C
Entomacrodus caudofasciatus (Regan, 1909)		C	C				
Entomacrodus decussatus (Bleeker, 1858)		C					
Entomacrodus epalzeocheilus (Springer, 1967) R		C					
Entomacrodus striatus Quoy and Gaimard, 1836			C				
Entomacrodus thalassinus longicirrus Springer, 1967 R		C	C				
Glyptoparus delicatulus Smith, 1959 R		C					
Istiblennius (2 species)		C					
Meicanthus atrodorsalis Gunther, 1877*				X			
Meicanthus grammistes (Cuvier and Valenciennes, 1836)	X		X			C	
Nannosalarias nativitatus (Regan, 1909)			C				
Parenchelyurus hepburni (Snyder, 1908)		C					
Plagiotremus rhinorhynchus (Bleeker, 1852)*	X						
Plagiotremus tapeinosoma (Bleeker, 1857)*				X			
Rhabdoblennius sp.		C					
Salarias sp.		C					
Family: Gobiidae							
Amblyeleotris fasciata (Herre, 1953)	X		X			C	
Amblyeleotris steinitzi (Klausewitz, 1974)*	X						
Asterropteryx semipunctatus (Rüppell, 1838)*	X						
Bathygobius cotticeps (Steindachner, 1879)				C			
Bryaninops sp.						C	
Callogobius sp.						C	
Cryptocentrus cinctus (Herre, 1936)*	X						
Eviota seebreei Jordan and Seale, 1906*			X				
Eviota smaragdus Jordan and Seale, 1906*			X				
Eviota (2 species)						C	
Fusigobius (2 species)						C	
Gnatholepis sp.						C	
Gobiodon (2 species)		C				C	
Istigobius sp.	X					C	
Paragobiodon modestus (Regan, 1908)						C	
Paragobiodon xanthosoma (Bleeker, 1852)						C	
Pleurosicya (3 species)						C	
Trimma macrophthalma (Tomiyama, 1936)						C	
Trimma okinawae (Aoyagi, 1948)						C	
Trimma (3 species)						C	
Valenciennea puellaris (Tomiyama, 1956)*	X						
Valenciennea sexguttatus (Valenciennes, 1837)*	X						
Valenciennea strigatus (Broussonet, 1782)*	X						
Family: Acanthuridae							
Acanthurus glaucopareius Cuvier, 1829*		X					
Acanthurus lineatus (Linnaeus, 1758)*		X		X			

Table 1.—Continued.

	LOCATION						
	Sand	Boulder		Coral			
SPECIES	1	2	3	4	5	6	7
Acanthurus mata (Cuvier, 1829)*			X				
Acanthurus pyroferus Kittlitz, 1834*			X				
Acanthurus triostegus (Linnaeus, 1758)*		X	X				
Ctenochaetus binotatus Randall, 1955						C	
Ctenochaetus striatus (Quoy and Gaimard, 1824)	X	X		X		C	
Naso lituratus (Bloch and Schneider, 1801)*		X	X				
Naso tuberosus Lacepède, 1802*			X				
Zebrasoma scopas (Cuvier, 1829)	X	X	X	X		C	
Family: Zanclidae							
Zanclus cornutus (Linnaeus, 1758)*	X		X	X			
Family: Gobiesocidae							
Diademichthys lineatus (Sauvage, 1883)*			X				
Lepidichthys frenatus Waite, 1904*			X				
Family: Callionymidae							
Synchiropus ocellatus (Pallas, 1774)						C	
Family: Balistidae							
Balistapus undulatus (Park, 1797)*		X					
Sufflamen chrysopterus (Bloch and Schneider, 1801)*		X					
Family: Monacanthidae							
Acreichthys melanocephalus (Bleeker, 1853)						C	
Oxymonacanthus longirostris (Bloch and Schneider, 1801)*				X			
Paraluteres prionurus (Bleeker, 1851)						C	
Family: Ostraciidae							
Ostracion meleagris Shaw, 1796*		X					
Family: Tetraodontidae							
Arothron nigropunctatus Bloch and Schneider, 1801		X				C	
Arothron sp.						C	
Canthigaster bennetti (Bleeker, 1854)*			X				
Canthigaster valentini (Bleeker, 1853)	X		X			C	
Family: Diodontidae							
Diodon holacanthus Linnaeus, 1758*			X				
Diodon literosus Shaw, 1806*			X				

ulus (see Smith 1959), and *Crossosalarias macrospilus* (see Smith-Vaniz and Springer 1971); four pipefishes, *Corythoichthys amplexus* and *C. schultzi* (see Dawson 1977a), *Dentirostrum janssi* (see Herald and Randall 1972), and *Phoxocampus diacanthus* (see Dawson 1977b); one ghost pipefish, *Solenichthys armatus* (see Herre 1953); one snake eel, *Muraenichthys* *laticaudatus* (see Herre 1953); one lizardfish, *Synodus englemani* (see Allen *et al.* 1976); one flathead, *Thysanophrys arenicola* (see Schultz 1966); and one tommy fish, *Limnichthys donaldsoni* (see Nelson 1978). These fishes are indicated by an (R) after their names in Table 1.

Fishes are deposited in the Marine Sciences Center, University of the Philippines; Australian Museum, Sydney; and the National Museum of Natural History, Washington, D.C.

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STUDIES ON EUPHAUSIACEAN CRUSTACEANS FROM THE INDIAN RIVER REGION OF FLORIDA. I. SYSTEMATICS OF THE *STYLOCHEIRON LONGICORNE* SPECIES-GROUP, WITH EMPHASIS ON REPRODUCTIVE MORPHOLOGY

Paula M. Mikkelsen

Abstract.—Reproductive organ morphologies in members of the *Stylocheiron longicorne* species-group are compared. Although reproductive structures of 3 of the 7 species are unique, those of *S. microphthalma, S. suhmii, S. affine,* and *S. longicorne* are very similar, with minor differences possibly attributable to maturity of the structures. Other allegedly species-specific characters (primarily eye structure) are variable and apparently related to size of the individual and habitat depth. The 4 species, interpreted as ontogenetic or ecotypic forms of a single polymorphic species, are synonymized under the name *Stylocheiron suhmii* G. O. Sars, 1883. The reliability of reproductive structures is restored for species diagnoses within the *S. longicorne* species-group to a level consistent with that in other euphausiids.

Introduction

The morphology of reproductive organs has long been considered important in crustacean taxonomy. When male and female members of a phenon possess unique sexual apparatuses, this suggests that successful interbreeding with other phena is prevented, promoting the reproductive isolation essential to the biological species concept (Mayr 1969). Similarly, when 2 such phena differ in certain somatic aspects, yet are identical in sexual morphology, they are usually assumed to belong to a single species because morphological compatibility of reproductive structures implies reproductive compatibility. The observed differences in the 2 phena must then be explained in other terms, such as individual variation, ecotypic response, or developmental stages.

In euphausiid crustaceans, details of mating and spermatophore transfer are still largely unknown, but the male petasma and female thelycum are generally accepted as being unique within a species. However, according to Brinton (1975), the genus *Stylocheiron* is an exception in that copulatory structures are only of secondary importance in species identification, and body proportions and the structure of the bilobed eye are allegedly more reliable. Brinton therefore proposed that the mechanisms involved in reproductively isolating the species of *Stylocheiron* must be fundamentally different than those in other euphausiid genera.

The 11 recognized species of *Stylocheiron* have been arranged by Hansen (1910) and subsequent authors into 3 species groups based on the terminal structure of the elongate third thoracic leg. The first group, containing only *S. carinatum* G. O. Sars, 1883, has long, parallel bristles on the propodus and dactyl. Members of the *S. maximum* species group (*S. abbreviatum* G. O. Sars, 1883, *S. maximum* Hansen, 1908, and *S. robustum* Brinton, 1962b) all possess a "true chela" with one major and several minor spines on the propodus, opposing an enlarged, secondarily-spined dactyl. Finally, the *S. longicorne* species group, characterized by a "false chela" formed by opposing sets of curved, serrate spines, consists of 7 species: *S. suhmii* G. O. Sars, 1883, *S. longicorne* G. O. Sars, 1883, *S. elongatum* G. O. Sars, 1883, *S. insulare* Hansen, 1910, *S. microphthalma* Hansen, 1910, *S. affine* Hansen, 1910, and *S. indicus* Silas and Mathew, 1967. Using eye structure, Lomakina (1978) further subdivided this group into the *S. affine* species group, having small pyriform eyes (*S. affine, S. suhmii, S. microphthalma,* and *S. insulare*), and the revised *S. longicorne* group with larger, more oblong eyes (*S. longicorne, S. elongatum,* and *S. indicus*). This arrangement, however, provides no taxonomic advantage over Hansen's *S. longicorne* species group and is therefore unnecessary.

During a survey of the euphausiids of central eastern Florida, 6 species of *Stylocheiron* were encountered. Males of *S. carinatum, S. elongatum,* and *S. abbreviatum* all showed sufficiently distinct petasmata for validation of species identifications based on somatic characters. However, the remaining 3 species (*S. suhmii, S. longicorne,* and *S. affine*) had nearly identical reproductive structures, but were separable using eye characteristics and body proportions. Thus, whereas the latter 3 species appeared to support Brinton's (1975) statement of unreliability of copulatory structures in *Stylocheiron,* the rule did not apply to others in the genus. The 3 species with similar sexual morphologies all belong to the *S. longicorne* species group. A re-evaluation of the 7 species in the group was therefore undertaken to determine (1) which species show unique, taxonomically reliable, reproductive morphologies, and (2) the degree of variability of other, allegedly more reliable, characters in those species showing similar reproductive morphologies.

Materials and Methods

Specimens from the central eastern Florida coast were collected by R/V *Gosnold* using a 6-foot Isaacs-Kidd Midwater Trawl at various depths and locations between Sebastian Inlet and Jupiter Inlet (Table 1). Repre-

Table 1.—Data for R/V *Gosnold* stations at which specimens of the *Stylocheiron longicorne* species group were collected.

Sta. no.	Date (1974)	Location	Gear depth (m)	PDR[1] depth (m)	Time (hr, EST[2])
G-130	17 Jan.	27°02.5′N, 79°58.1′W to 27°09.2′N, 79°58.5′W	50	90	2230–2330
G-131	18 Jan.	27°12.4′N, 79°58.1′W to 27°18.0′N, 79°59.7′W	50	91	0019–0120
G-144	22 Jan.	27°23.3′N, 79°33.5′W to 27°23.4′N, 79°32.7′W	250–75	720	0230–0629
G-159	23–24 Jan.	26°47.1′N, 79°47.3′W to 26°27.6′N, 79°46.7′W	200[3]	410–393	2030–0006
G-160	24 Jan.	26°49.7′N, 79°46.4′W to 26°50.8′N, 79°47.1′W	300–65	410	0010–0310
G-172	25 Jan.	27°19.7′N, 79°29.9′W to 27°19.8′N, 79°28.5′W	750[4]	750–700	1530–1807
G-173	25 Jan.	27°20.8′N, 79°28.0′W to 27°20.9′N, 79°27.2′W	150[3]	700	1827–2100

[1] PDR = Precision Depth Recorder; [2] EST = Eastern Standard Time; [3] estimated depth based on wire out; [4] plankton net hit bottom.

sentative specimens from these collections are cataloged into the Indian River Coastal Zone Museum (IRCZM), Fort Pierce, Florida, the National Museum of Natural History (USNM), Washington, D.C., the British Museum (Natural History) (BMNH), London, the Rijksmuseum van Natuurlijke Historie (RMNH), Leiden, the Instituut voor Taxonomische Zoölogie (Zoölogisch Museum) (ZMA), Amsterdam, the Zoologisk Museum, University of Copenhagen (ZMUC), and the Muséum National d'Histoire Naturelle (MNHN), Paris.

Material examined is listed in the Appendix. Body lengths, whenever cited, were measured (in millimeters) along a dorsomedial line from the tip of the rostrum to the tip of the telson. Specimens were preserved in 70% ethanol. Light microscopy photographs were made using a Wild M-400 Photomakroskop.

Both intact female anterior body portions (for thelycal examinations) and isolated eyes were prepared for scanning electron microscopy using the following procedure. Dehydration at 10 minute intervals in 85%, 95%, and 100% ethanol was followed by 3 solutions of increasing proportions (33.3%, 50%, and 66.6%) of acetone in 100% ethanol, then two 10 minute intervals in 100% acetone. After critical-point drying, the specimens were mounted on standard aluminum stubs with polyvinyl acetate (Bakelite) glue, sputter-coated with gold-palladium for 2 minutes, and examined using a Zeiss Novascan 30 scanning electron microscope.

For examinations using light microscopy, the entire sternal area, including the thoracic legs, was dissected from female specimens for thelycal examinations. Male petasmata were studied on intact first abdominal pleopods. Thelyca and petasmata of the various species were then cleared (from 10 to 15 minutes depending on the size of the specimen) in full-strength household bleach (Chlorox) until all internal tissue had completely dissolved. Partial dissolution of the exoskeleton never occurred, and even the finest setae were left undamaged. When handled carefully to prevent collapsing, high-power examination of the transparent structures (in water or alcohol on a concave slide) afforded an unobstructed view of all processes and setae without further manipulation. This technique allowed the features of the otherwise opaque thelycum to be clearly distinguished, and also eliminated the often-damaging necessity of "unrolling" the petasma to view the arrangement of processes. Line drawings were made from this material using a dissecting stereomicroscope equipped with a camera lucida.

The terms petasma, thelycum, and chela used throughout this paper are consistent with current usage in euphausiid literature, and do not necessarily indicate homology with structures of the same names in decapod crustaceans.

Reproductive Structures within the *Stylocheiron longicorne* Species Group

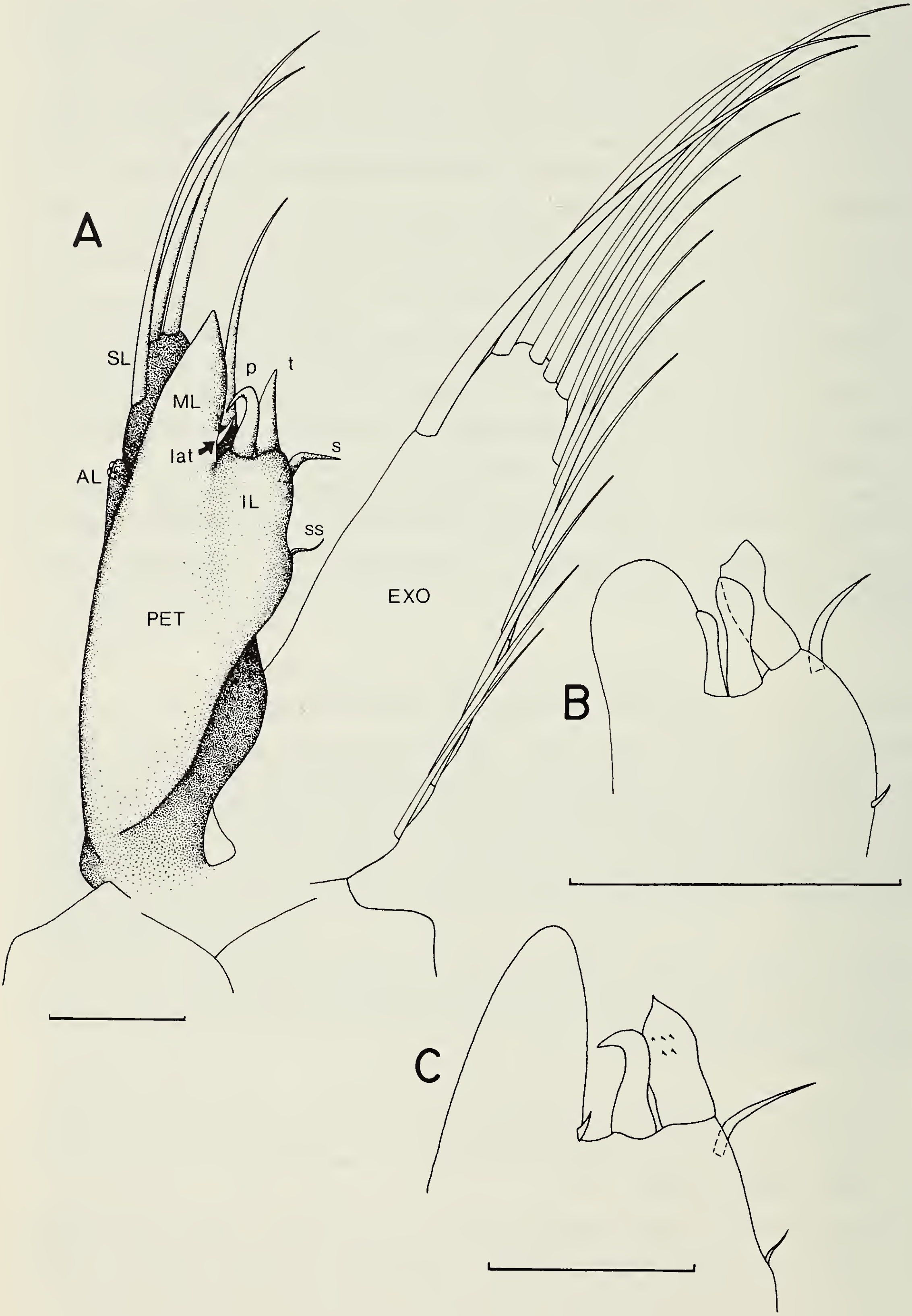
Petasmata.—The petasma (Fig. 1A) in the genus *Stylocheiron* is distinguished from that of other genera by the following features. The inner lobe (IL) is fused to the medial lobe (ML) and bears the usual spinous (s), terminal (t), and proximal (p) processes, the latter 2 subequal in size. A minute spine, herein called the secondary spinous process (ss), may be present proximal to the spinous process on the base of the inner lobe. The lateral process (lat) is inserted near the fusion of the inner and medial lobes. The medial lobe is rounded distally and never bears an additional process.

Of the 7 members of the *S. longicorne* species group, 3 species exhibit distinct petasmal features:

S. elongatum (Fig. 1A)—terminal process slender, acutely tapering; proximal process distally tapering and hooked; lateral process acute, minute (i.e., less than half height of terminal or lateral process) (G. O. Sars 1885; Brinton 1975).

S. insulare (Fig. 1B)—terminal process wide basally, tapering, obliquely truncate distally; proximal process tapering, rounded distally; lateral process rounded distally, more than half height of terminal or lateral process (Hansen 1910; Brinton 1975).

S. indicus (Fig. 1C)—terminal process broad, distally acute, curving posteriorly over concavity bearing 5–6 tooth-like processes in 2 rows; prox-


A
SL
ML
p
t
lat
s
AL
IL
ss
PET
EXO
B
C

imal process distally acute, strongly hooked; lateral process minute (Silas and Mathew 1967; Brinton 1975).

The remaining 4 species in the group show nearly identical petasmal structures, with subequal terminal and proximal processes with rounded distal ends. The lateral process is only slightly smaller than the other processes and is of similar shape. The 4 species are distinguished from one another in the literature by the following characteristics:

S. microphthalma (Fig. 2A)—terminal process distally rounded; proximal process subequal to terminal process, distally produced; both processes distally smooth (Hansen 1910).
S. suhmii (Fig. 2B)—terminal and proximal processes similar in shape and size, distally smooth (Boden *et al.* 1955).
S. affine (Fig. 2C)—terminal and proximal processes similar in size and shape; former armed distally with 2–3 teeth (Hansen 1910).
S. longicorne (Fig. 2D)—similar to *S. affine,* except terminal process with 6 teeth (Hansen 1910).

Such differences noted by previous workers are not sufficient to warrant specific separation. Material examined from all 4 "species" indicated that these differences, as well as oft-cited proportions of the processes, are well within the limits of individual variation, as seen, for example, in the range of variability documented by Banner (1950) in the petasmata of *S. maximum*. Moreover, differences noted in the proximal processes may be a result of viewing angle rather than the actual shape of the process itself. Petasmata are conventionally examined by "unfolding" the structure prior to examination. This manipulation results in a variety of viewing angles depending on the degree to which the petasma has been flattened. Thus, the bladelike proximal process may appear either broadly rounded or slightly produced according to orientation of the petasma.

The serrations of the terminal process in *S. affine* and *S. longicorne* are also not taxonomically significant. These 2 species respectively attain the second largest and largest adult sizes of the 4 under consideration (see below). Therefore, serrations may either appear only on petasmata of larger

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Fig. 1. Petasmal structure in the *Stylocheiron longicorne* species group: A, *S. elongatum*, 9.1 mm male, *Gosnold* Sta. 144; posterior view of entire first left pleopod; B, *S. insulare*, 6.5 mm male (adapted from Hansen 1910, and Brinton 1975); median and inner petasmal lobes; C, *S. indicus*, 8.75–12.0 mm male (adapted from Silas and Mathew 1967; length not specific); median and inner petasmal lobes. AL, auxiliary lobe; EXO, exopod; IL, inner lobe; ML, median lobe; PET, petasma; SL, setiferous lobe; lat, lateral process; p, proximal process; s, spinous process; ss, secondary spinous process; t, terminal process. Scale = 1.0 mm.

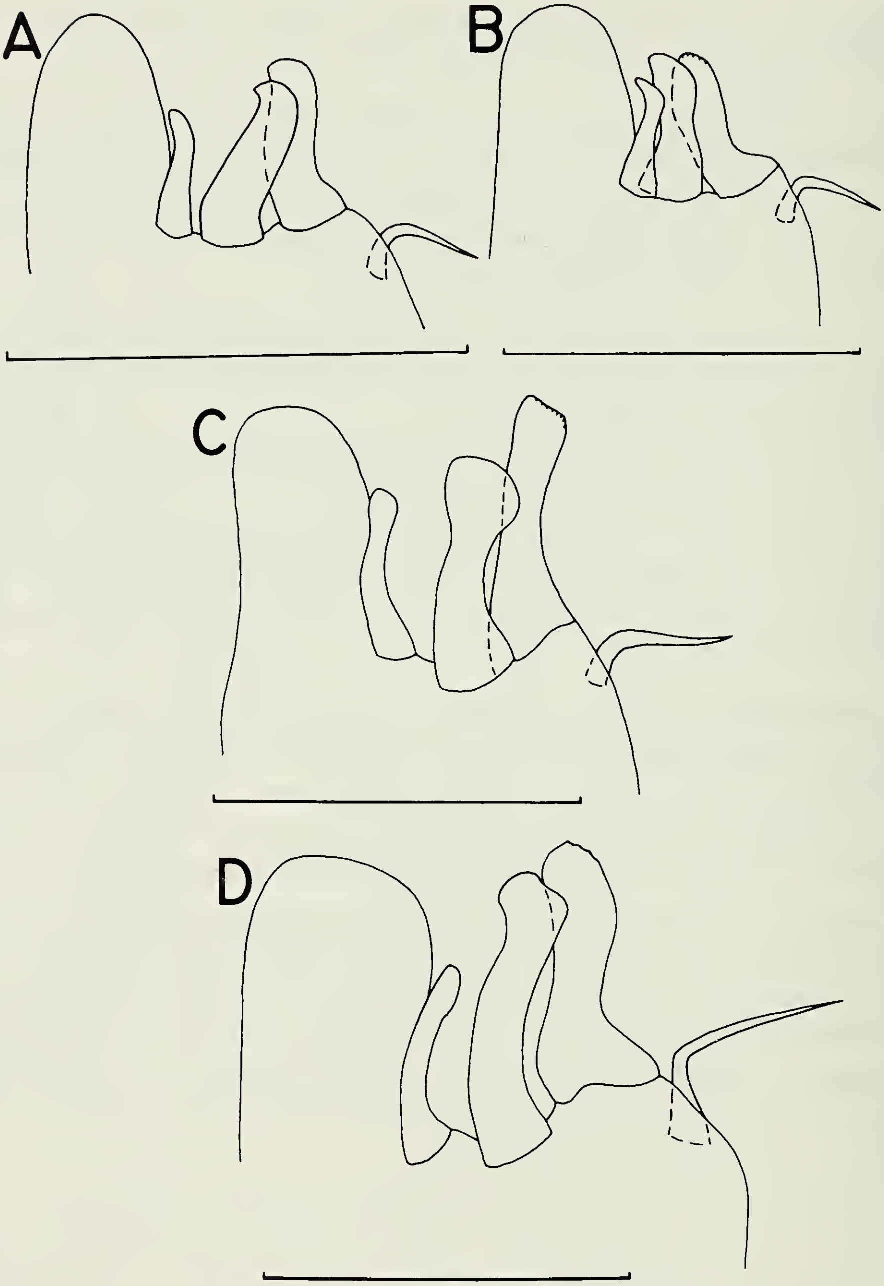


Fig. 2. Posterior views of median and inner petasmal lobes in the *Stylocheiron longicorne* species group. Orientation and scale as in Fig. 1. A, *S. microphthalma*, 5.5 mm male (adapted from Hansen 1910, and Boden *et al.* 1955); B, *S. suhmii*, 5.9 mm male, *Gosnold* Sta. 160; C, *S. affine*, 6.5 mm male, *Gosnold* Sta. 144; D, *S. longicorne*, 9.1 mm male, *Gosnold* Sta. 144.

individuals, or may merely be an indication of the full maturation of the structure. The latter contention is supported by my observation of a distally serrate terminal process on the petasma of a 5.9 mm male of *S. suhmii* (Fig. 2B), a form in which the terminal process is allegedly smooth.

Thelyca.—The diagnostic value of the female thelycum in euphausiids is generally accepted (Einarsson 1942; Costanzo and Guglielmo 1976a), but the structure has not been examined in all species. In the *S. longicorne* species group, only the thelyca of *S. suhmii* and *S. longicorne* have been described (Costanzo and Guglielmo 1976b). In the present study, thelycal structures from eastern Florida specimens of *S. elongatum, S. suhmii, S. affine,* and *S. longicorne* were examined; material of *S. microphthalma, S. indicus,* and *S. insulare* was insufficient for dissection and study.

As in other species of *Stylocheiron* (see Costanzo and Guglielmo 1976b), the thelycum of *S. elongatum* (Fig. 3A) is formed solely by the plates from the coxae of the sixth thoracic legs. The plates join mid-ventrally in the anterior half of the thelycum, forming a prominent ridge. Posterior to the ridge, the medial edges of the plates are free and parallel one another, then diverge at 180° before joining the posterior edges of the plates. A pair of stalked, oblong spermatophores (each 0.21 mm long, 0.07 mm wide, with a 0.15 mm long stalk) may be implanted in the quadrate spermatophore pocket (sp) formed by the plates. Four long, sparsely plumose setae, herein called primary setae (s′), originate from a flap on each side of the anterior portion of the thelycum, lateral to the mid-ventral ridge. Dorsal to this row lie 2 stout, plumose setae, herein called secondary setae (s″).

Costanzo and Guglielmo (1976b) reported a similar configuration for the thelyca of *S. suhmii* and *S. longicorne*. These 2 species differ from *S. elongatum* in that the plates are fused only in the anterior third of the mid-ventral area, and the free edges diverge immediately posteriorly, forming a V-shaped opening. The spermatophore pocket is shallow and U-shaped, rather than deep and quadrate as in *S. elongatum,* although the single or paired spermatophores are of a shape and size similar to that species. My study confirms the thelycal morphologies of *S. suhmii* and *S. longicorne* reported by Costanzo and Guglielmo (1976b), and shows that a similar configuration exists for *S. affine*. These 3 species appear to differ from one another only in the numbers of primary and secondary setae present at the anterior edge of the thelycum:

S. suhmii (Fig. 3B)—3 primary, 2 secondary setae (Costanzo and Guglielmo 1976b); 2–3 primary, 2 secondary setae (present study).
S. affine—3–4 primary, 2 secondary setae.
S. longicorne—5 primary, 4 secondary setae (Costanzo and Guglielmo 1976b). Specimens in the present study were divided according to eye and abdominal proportions into the "long" and "short" forms of Brinton (1962a) (see below). The "long" form exhibited the 5 primary and 4 secondary setal pattern previously reported; the "short" form showed 3 primary and 3 secondary setae.

The identical morphology, the variable and overlapping setal counts, and the increasing number of setae progressing from *S. suhmii* to *S. affine* to

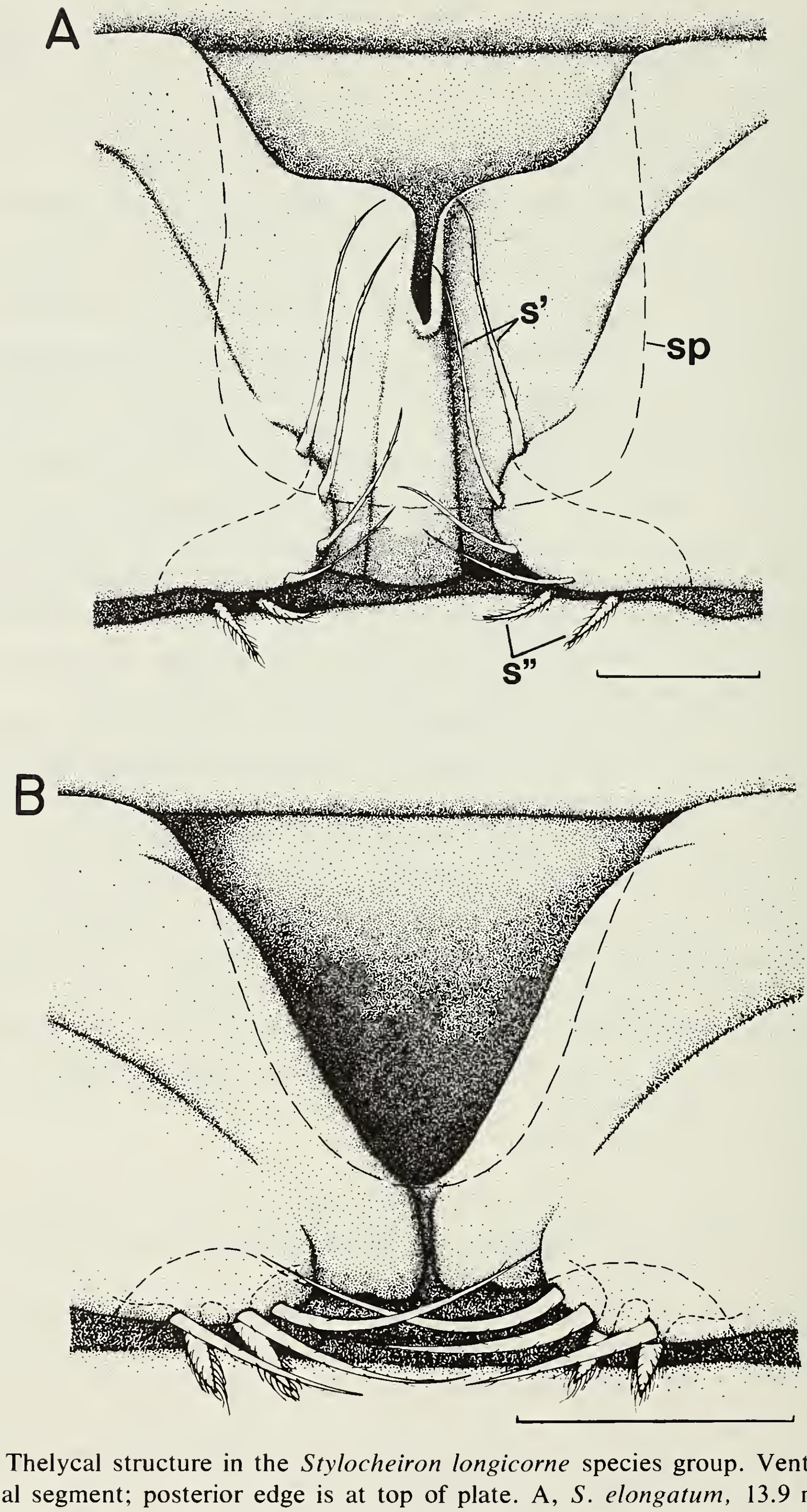


Fig. 3. Thelycal structure in the *Stylocheiron longicorne* species group. Ventral view of sixth sternal segment; posterior edge is at top of plate. A, *S. elongatum,* 13.9 mm female, *Gosnold* Sta. 144; B, *S. suhmii,* 7.4 mm female, *Gosnold* Sta. 159. sp, spermatophore pocket; s′, primary setae; s″, secondary setae. Scale = 1.0 mm.

S. longicorne (thus roughly with increasing body size), indicate that the thelycal structures are not sufficiently unique to be characteristic of 3 different species. Moreover, because of the similarity shown by the petasmata in males of the 4 species, I suspect that the thelycum of *S. microphthalma* should correspond closely in structure to those of females of the other 3 species.

The male and female reproductive anatomies of these 4 *Stylocheiron* species, as currently defined, are not species-specific in the sense utilized in other euphausiid descriptions. Brinton (1975) stated that copulatory structure in *Stylocheiron* is less reliable than other characters, but this unreliability may be the result of conferring specific status to 4 phena of a single species, because other members of the *S. longicorne* species group (as far as they have been examined) show structures sufficiently distinct to maintain specific ranking. Reduction of these 4 phena to conspecific status can be supported by other data, so that the reliability of reproductive morphology in these taxa can be restored. In the following sections, other reported morphological and ecological differences among the 4 ''species'' are reexamined in light of the polymorphic species hypothesis (see Table 2).

It is noteworthy that Brinton (1962a, 1975) described 5 forms of *S. affine* and 3 of *S. longicorne* from the Pacific and Indian Oceans, on the basis of greater variability in proportions of the eye and sixth abdominal segment than that shown by other members of this species group. However, geographic distributions within Brinton's study area of the forms of each species show slight overlap, suggesting that the observed morphological variation may be at least partly environmentally influenced. In my analysis, however, measurements and meristics of *S. affine* and *S. longicorne* will encompass the values for all forms of these species (*sensu* Brinton) combined under their respective species headings.

Eye Morphology

The single most important taxonomic character presently used to separate the 4 species is the number of enlarged ommatidia comprising the upper lobe of the eye. Hansen (1910) and subsequent authors counted ommatidia in lateral view using either (1) the aligned rows of bulbous external facets outlined at the upper edge, or (2) the internal crystalline cones within adjacent ommatidia. With this traditional method, only the most lateral ommatidia are seen, so that only a partial count is provided. Currently accepted ommatidial meristics for the 4 species increase progressively from *S. microphthalma* through *S. longicorne* (Table 2).

The partial ommatidial count using the lateral view of the eye has been consistently used as a taxonomic character, so total number of ommatidia has been infrequently recorded. Hypothetical geometric arrangements of

Table 2.—Comparative adult characteristics of *Stylocheiron microphthalma*, *S. suhmii*, *S. affine*, and *S. longicorne*.

	S. microphthalma	*S. suhmii*	*S. affine*	*S. longicorne*
Number of specimens examined[1]	23	215	74	76
Eye:				
Number of rows of facets visible in lateral view	2[a]	3[a]	4–8[e]	7–19[e]
Total number of facets (hypothetical)—see Fig. 4)	4	7	14–52	30–271
Eye length (mm)	0.40–0.58 0.49–0.54[e]	0.55–0.75 0.57–0.61[e]	0.70–1.20 0.61–1.25[e]	0.70–1.48 0.81–1.46[e]
Eye length / Width of lower lobe	1.45–2.11 ±2.0[a]	1.53–2.14 2.0[b]	1.63–2.33 1.5–2.0[h]	1.93–3.25 2.0[a]
Width of lower lobe / Width of upper lobe	2.25–3.67 2.5–3.0[e]	1.85–3.25 3.9–4.3[e]	1.27–2.18 1.45–2.55[e]	0.76–1.21 0.86–1.44[e]
Ommatidial diameter (μ):				
Upper lobe	42	50	56 [6][2]	52 [7]; 60 [13]
Lower lobe	12	20	23 [6]	27 [7]; 32 [13]
Adult size:				
Average cited body length (mm)	5.5–6.4[a]	6.0–7.0[e]	5.8–8.5[e]	6.5–13.0[c]
Maximum recorded body length (mm)	7.0[c]	7.9[d]	11.1[d]	15.3[d]
Eye length[e] / Body length	0.079–0.087	0.077–0.105	0.097–0.160	0.108–0.149
Length/depth of sixth abdominal segment	1.43–1.89 1.46–1.60[e]	1.50–1.92 1.66–1.69[e]	1.16–1.87 1.40–2.55[e]	1.19–2.15 1.63–2.60[e]
Length/width of antennal scale	12[a]	13–14[b]	13–14[a]	13–15[a]
Fecundity[f]	10–13	8–15	4–12	6–16
Thoracic integumental sensilla:[g]				
Length of entire structure (mm)	ND[3]	1.50	1.41	1.23
Length of major group (mm)	ND	0.47	0.47	0.35
Depth distribution: area of maximum abundance (m):				
Discrete depth collections:				
Brinton 1967	ND	0–200	50–250	100–350
Baker 1970	ND	0–100	0–150	50–460
Schroeder 1971	ND	0–400	140–400	200–300
Depth range collections:				
Ponomareva 1963	0–200	0–300	0–500	0–500
Roger 1974a	0–150	0–200	0–400	50–500

Data from: a, Hansen 1910; b, Hansen 1912; c, Boden *et al.* 1955; d, Schroeder 1971; e, Brinton 1975; f, Roger 1976; g, Mauchline and Nemoto 1977 (approximate measurements based on illustration); h, Lomakina 1978.

[1] Original data (without superscripts) are based on examination of Floridan specimens of *S. suhmii*, *S. affine*, and *S. longicorne*, and of the syntypes of *S. microphthalma* (see Appendix).

[2] Lateral number of rows in the upper eye lobe in the variable *S. affine* and *S. longicorne* as indicated in brackets.

[3] ND = no data.

hexagons, verified by SEM and light microscopy of the actual ommatidia, yielded 2 general patterns (Fig. 4). The first pattern, based on the eye of *S. microphthalma* with 2 rows in lateral view (Fig. 5A), is seen in all eyes with an even number of rows in lateral view. Initial observation of the eye of *S. microphthalma* indicated a total of 3 ommatidia (Fig. 5B), but closer scrutiny revealed a fourth, slightly smaller facet. This ommatidium must be included in the total of the upper lobe because it possesses a crystalline cone, a structure lacking in the rudimentary cells of the lateral areas (Kampa 1965). The resultant total of 4 ommatidia for *S. microphthalma* agrees with that previously reported by Brinton (1967).

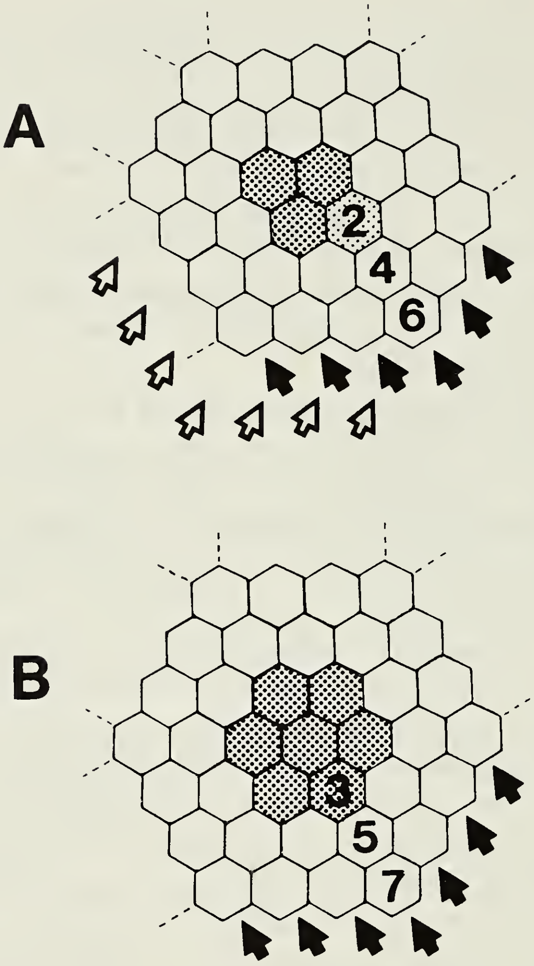
The even-numbered ommatidial pattern increases in size by the addition of facets around the perimeter of the 4-faceted core (Fig. 4A). Addition of a single ring of facets produces a hypothetical eye with 4 rows in lateral view and a total of 14 facets. Such an eye is indicative of *S. affine* (which may have from 4 to 8 rows in lateral view) but disagrees with Brinton's (1967) minimum total of 16 for this species.

Caution must be used when viewing eyes exhibiting the even-numbered format. Distortion of the eye may cause an improper anterolateral viewing angle, 60° clockwise from lateral, to be used. A miscount results because this angle yields an ''incorrect'' number of rows, i.e., one row greater than that generated in direct lateral view. For example, an eye with 6 rows in lateral view (indicated by solid arrows in Fig. 4A) yields an ''incorrect'' count of 7 rows when viewed from an anterolateral angle (open arrows in Fig. 4A). As will be discussed below, this error lead to Hansen's (1910) misinterpretation of eye meristics in the holotype of *S. suhmii,* and the unnecessary establishment of his species *S. microphthalma.*

The second generalized ommatidial pattern (Fig. 4B), seen in eyes with an odd number of laterally viewed rows, is based on a core of 7 hexagonal facets, exhibited by the eye of *S. suhmii* (Fig. 5D) with 3 rows visible in lateral view (Fig. 5C). This disagrees with the total of 8 ommatidia reported for this species by Brinton (1967). The number of facets increases in the same manner as in the even-numbered pattern, i.e., by the addition of cells around the perimeter. Misinterpretation of the number of rows in this type of eye is not a problem because lateral and anterolateral counts are identical.

Predicted totals for each species, according to currently accepted lateral counts, are listed in Table 2. In *S. longicorne,* the number of rows in lateral view is large, and the facets of the upper lobe are only slightly enlarged relative to those of the lateral areas (Fig. 6E–F). Total number of facets in such an eye is difficult to determine and examination of crystalline cones is necessary to delimit upper from lateral areas. This count is presently of little practical use, but expected totals are included in Fig. 4 and Table 2 for the sake of completeness.

Brinton's (1975) data on number of eye facets in lateral view compared with adult body length (Table 2) indicate that larger specimens should pos-



LAT.	TOTAL
2	4
4	14
6	30
8	52
10	80
12	114
14	154
16	201
18	253

LAT.	TOTAL
3	7
5	19
7	37
9	61
11	91
13	127
15	169
17	217
19	271

Fig. 4. Schematic ommatidial arrangement in *Stylocheiron*. A, Pattern for eyes with even number of facet rows in lateral view. Core structure is that of *S. microphthalma* (smaller fourth facet (see text) indicated by lighter stippling). B, Pattern for eyes with odd number of facet rows in lateral view. Core structure is that of *S. suhmii*. Solid arrows indicate angle of lateral view. Open arrows indicate "incorrect" anterolateral viewing angle. Charts list lateral counts and associated expected totals.

sess more facets. However, my examinations of eastern Florida specimens of *S. suhmii*, *S. affine*, and *S. longicorne*, plus the syntypes of *S. microphthalma* (from the Indo-Pacific), show that for a single given body length, a variety of eye structures may be found. For example, lateral counts of 2, 3, 6, and 7 facets were observed in specimens of identical body lengths. This indicates that eye structure is not strictly a size-related character, as Brinton's data suggested.

Other values pertaining to the eyes are frequently cited for these species (Table 2). (1) Length of the eye, as expected, generally increases with maximum body length (see below). However, data from the present study revealed even greater overlap than that reported by Brinton (1975), indicating that eye length is extremely variable and therefore not taxonomically useful.

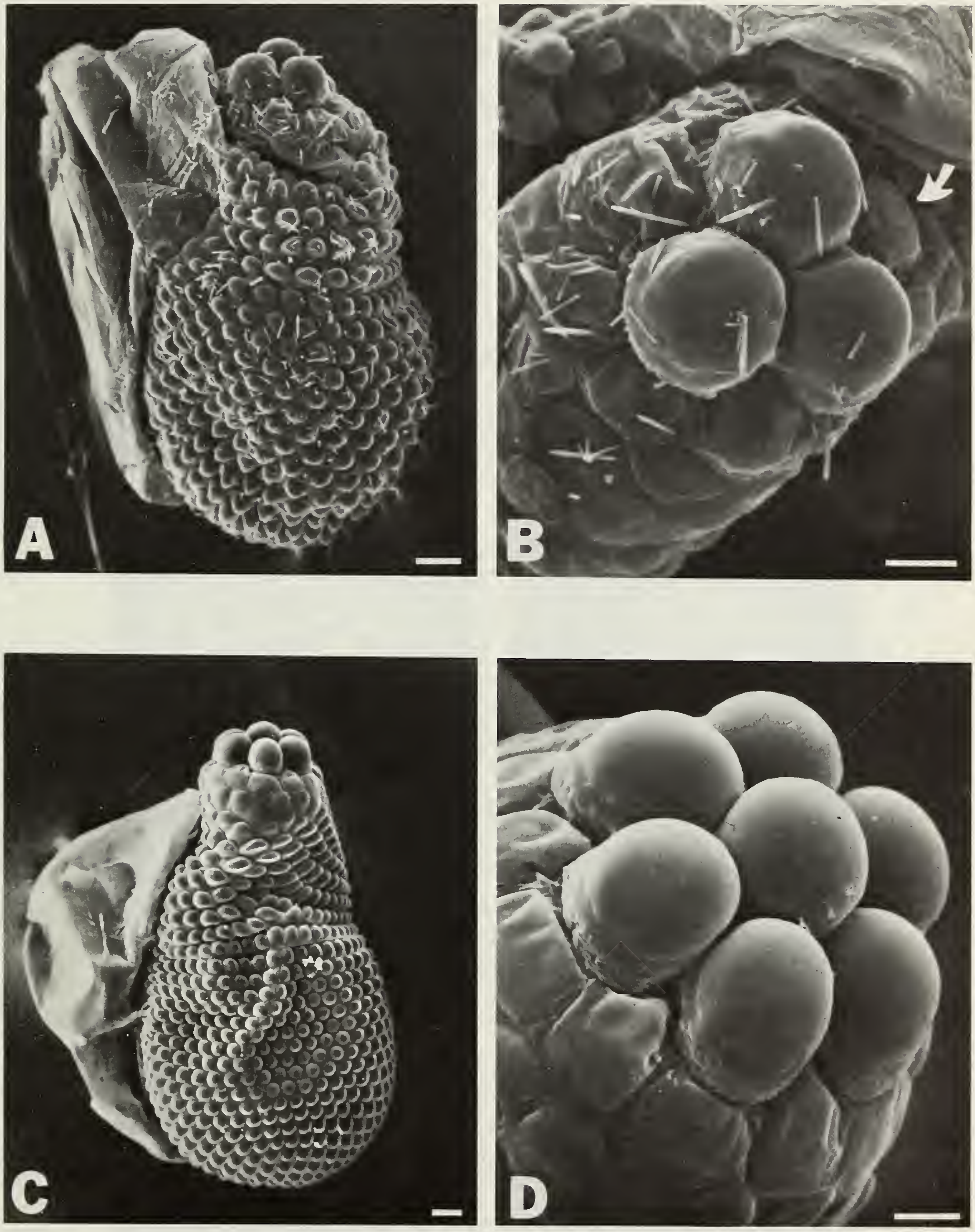
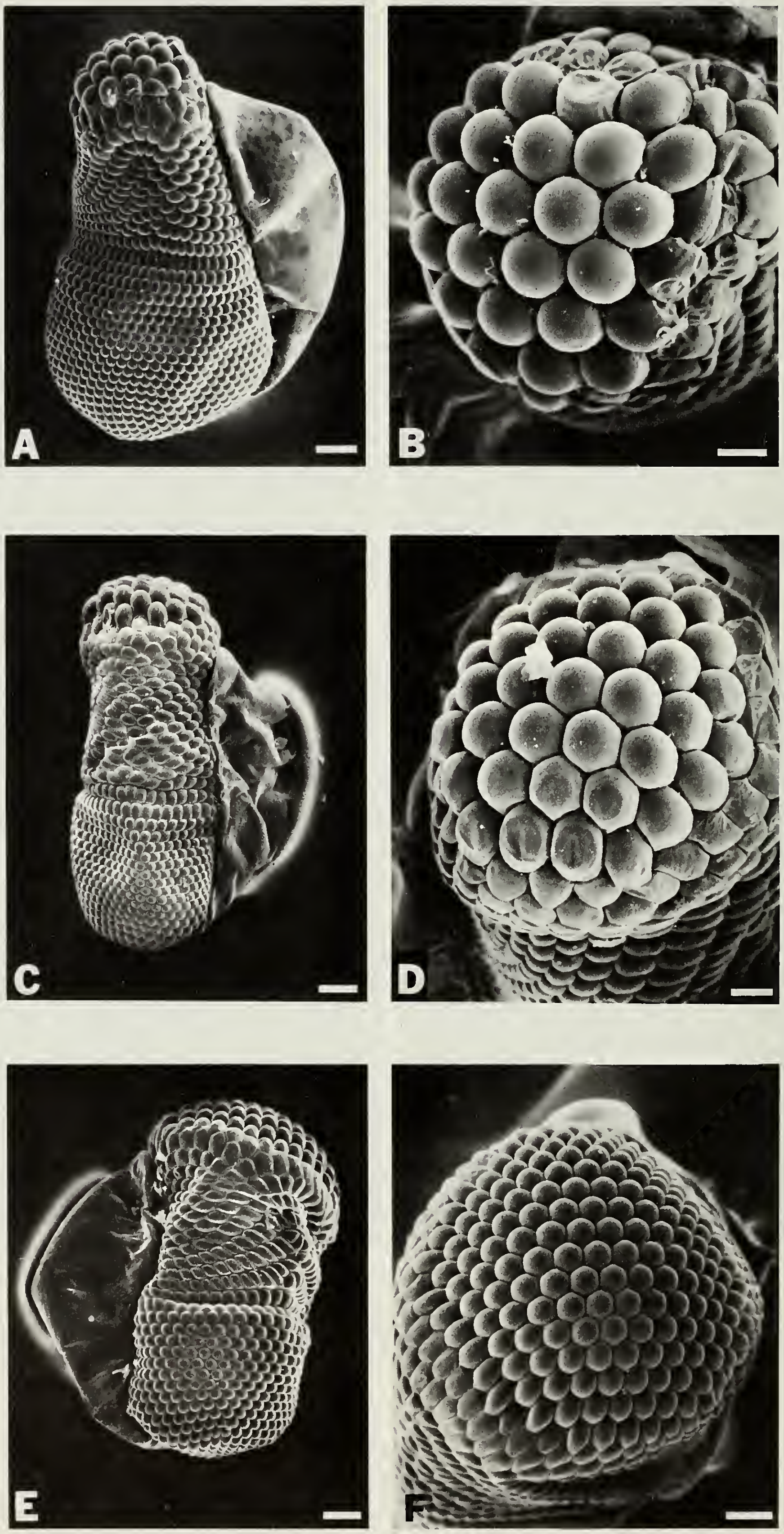


Fig. 5. Scanning electron micrographs of the eyes of *Stylocheiron*: A, *S. microphthalma*, right eye, male, USNM 49355; B, Same, enlarged view of upper lobe, arrow indicates smaller fourth ommatidium (see text); C, *S. suhmii,* right eye, female, *Gosnold* Sta. 160; D, Same, enlarged view of upper lobe. Scale = 40 μ (A, C), 20 μ (B, D).

(2) The ratio of eye-length to width of the lower lobe, generally recorded as ±2.0 for all 4 species, was confirmed by this study. (3) The ratio of the widths of the upper and lower lobes of the eye showed some overlap but in general decreased with increasing number of facets in the eye. Brinton's


A
B
C
D
E
F

(1975) data for *S. suhmii,* however, do not fit the general pattern found by him in the remaining 3 species, and by me in all 4 species. Because the upper eye width depends on the number of facets, a decrease in lobe ratio seems logical. Such a decrease was supported by measurements from SEM preparations (see Figs. 5–6 and Table 2) wherein ommatidial diameter increased in both lobes relative to increasing eye length and number of facet rows. The lobe ratio also illustrates the main feature subjectively used in this study to separate specimens of *S. affine* and *S. longicorne* having identical lateral row counts, namely, the width of the lower lobe. *S. affine* exhibited a distinctly pyriform eye, with a wider lower lobe (Fig. 6A), whereas the eye of *S. longicorne* was oblong with lobes of nearly equal width (Fig. 6C and E). No overlap in this ratio in these 2 species occurred either in Brinton's (1975) data or that of the present study. However, the dependence of this ratio on number of facets in the upper lobe means that the number of facets per se, previously used to separate species, is not a taxonomically valuable character.

Adult Size

Average and maximum recorded adult lengths are listed in Table 2. Both values generally increase as one progresses from *S. microphthalma* through *S. longicorne.* Although this does not rule out the possibility of 4 specimens having equal body length yet morphologically distinct eyes, it does indicate that animals with larger eyes do attain greater body lengths. Regrettably, data indicating the degree of variability in eye morphology within each form during its life history are unavailable.

The ratio of eye-length to body-length reflects an allometric increase in size of the eye relative to the body as overall size increases. As with eye length alone, this character displays considerable variation and overlap between species, and therefore is of limited taxonomic value.

Abdominal Morphology

Second in taxonomic value to characteristics of the eye among these 4 species has been the length-to-width ratio of the sixth abdominal segment.

←

Fig. 6. Scanning electron micrographs of the eyes of *Stylocheiron*: A, *S. affine*, left eye, female, *Gosnold* Sta. 144, 6 rows of facets in lateral view; B, Same, enlarged view of upper lobe, total of 30 facets; C, *S. longicorne* ("short form" of Brinton 1962a), left eye, female, *Gosnold* Sta. 144, 7 facet rows in lateral view; D, Same, enlarged view of upper lobe, total of 37 facets; E, *S. longicorne* ("long form" of Brinton 1962a), right eye, male, *Gosnold* Sta. 172, 13 facet rows in lateral view; F, Same, enlarged view of upper lobe, left eye, female, *Gosnold* Sta. 160, approximately 15 facet rows in lateral view. Scale = 100 μ (A, C, E, F), 40 μ (B, D).

Brinton's (1975) data from Pacific specimens (see Table 2) showed sufficient overlap to preclude this character being used alone to identify species. Furthermore, Atlantic specimens (see Table 2, original data) revealed even greater overlap, indicating this character to be extremely variable and thus of limited taxonomic value, at least for Atlantic material.

Other Morphological Characteristics

Other features recorded in the literature, although presumably species-specific, have not been accorded as much taxonomic value as those already discussed (see Table 2). These include:

(1) The length-to-width ratio of the antennal scale, which increases with increasing body length.

(2) Fecundity, in terms of numbers of ova in a mature female ovary (Roger 1976). These data were based on a very small number of specimens examined and showed no conclusive trend.

(3) The arrangement of thoracic integumental sensilla, believed to function as light receptors. This has only recently been reported (Mauchline and Nemoto 1977) in 3 of the species under consideration (that of *S. microphthalma* has not been examined). The structure is morphologically similar in all 3 species and consists of 4 small sensilla, quadrangularly arranged, plus a larger oblong sensillum, surrounded by 4 of smaller size. Both the length of the entire arrangement of sensilla and the length of the major sensilla group decrease slightly with increasing body length.

(4) Structure of the maxillae. Of the 7 elements of euphausiid mouthparts (labrum, mandibles, labia, maxillulae, maxillae, first and second thoracic limbs), only the maxillae are consistent enough in structure to be of taxonomic value in the genus *Stylocheiron*. Although the mouthparts of *S. microphthalma* have not been examined, the maxillae of *S. suhmii, S. affine,* and *S. longicorne* are similar in general configuration (Mauchline 1967). Furthermore, the maxillae in these 3 species lack the suture line, present in all other examined *Stylocheiron* species, that marks the fusing of the lobe of the third joint with the endopod. No other characteristics, such as setal arrangements or types, are useful in distinguishing the maxillae of these 3 species from each other.

(5) Structure of the "false chelae." Observations of the "false chelae" of Floridan *S. suhmii, S. affine,* and *S. longicorne* using SEM showed them to be similar in overall structure to previously published accounts for all 4 species under consideration. The propodus bears 3 "serrate" spines of varying length, opposing 5 similar spines on the dactyl. The shortest and most medial of the 3 propodal spines has a distinct 90° bend at its tip in all 4 species under consideration, a feature also evident in *S. insulare* (see Hansen 1910). (In *S. elongatum* (personal observation) and *S. indicus* (see Silas

and Mathew 1967), the spine is only slightly curved.) Although the serrations of these spines appear as small denticles under the light microscope, SEM showed them to be composed of imbricated cuticular plates. Boden *et al.* (1955) stated the serrations to be finer in *S. suhmii* than in *S. affine* or *S. longicorne*; this was the only distinction among the chelae of these species reported in the literature.

Larval Development

Morphological data from larval studies of all 4 species (Table 3) are both incomplete and unreliable, being based on collected, rather than laboratory-cultured, larvae. Identifications therefore rely on similarity to whatever adult species were collected in the same area, often including more than one of the 4 species in question. However, assuming the larvae belong to the 4 species as a group, the data provided by these studies suggest similar developmental sequences among those "species" in which larvae have been described. Considerable variation is also evident, especially in pleopodal setational sequences in furcilia larvae. Mauchline (1959) suggested that changes in these appendages in euphausiids are a result of environmental influences, resulting in a series of dominant stages plus a number of less-frequently encountered variants. If so, other structures, such as the eye, might also be altered by environment during larval or post-larval development.

Depth Distribution

All 4 species are generally considered to be epi- to mesopelagic, and non-migratory. Collections made with opening-closing nets to sample discrete depth intervals (Brinton 1967; Baker 1970; Schroeder 1971) revealed populations of *S. suhmii, S. affine,* and *S. longicorne* to be centered at overlapping, but respectively deeper, levels (Table 2), thus paralleling the increasing number of facets in the upper eye lobe. Although *S. microphthalma* was not found in these 3 investigations, data from other collections indicate this species occurs, as expected, at generally shallower depths than the other 3 species (Ponomareva 1963; Roger 1974).

Discussion

These data suggest 2 alternatives. The 4 species are either (1) sibling species (as held traditionally) in which genetically-induced eye morphology determines habitat depth, which in turn acts to isolate allopatrically the various phena, or (2) a single species, the life history of which includes a series of sequentially-varying eye morphologies, which in turn dictate habitat depth. Accordingly, shallow-living small individuals with few eye facets

Table 3.—Comparative larval characteristics of *Stylocheiron microphthalma*, *S. suhmii*, *S. affine*, and *S. longicorne*.

	S. microphthalma[1]	*S. suhmii*[2]	*S. affine*[3]	*S. longicorne*[4]
Calyptopsis:				
Body length (mm)	ND[5]	1.2–2.5	ND	1.3–2.4
Number of abdominal segments	ND	0→5→6	ND	ND
Number of terminal telson spines	ND	5→6 or 6	ND	6→7
Eye structure	ND	pyriform	ND	ND
Furcilia:				
Body length (mm)	ND	2.2–3.3	ND	1.9–4.0
Pleopod setation sequence:[6]				
Dominant stages	ND	(0″0′)→ (0″1′)→ (1″2′)→ (3″2′)→ (5″)	(0″0′)→ (0″2′)→ (1″2′)→ (3″2′)→ (5″)	(0″0′)→ (0″1′)→ (1″2′)→ (3″2′)→ (5″)
Variant stages	ND	(0″2′);(2″3′); (4″1′);(1″0′)	(0″1′);(4″1′)	ND
Number of terminal telson spines	ND	6→4→1 or 6→4	5→3→1 variant of 3	7→5→1 or 7
Number of facet rows in upper eye lobe	2	2–3 or 2	3	3–5 or cylindrical, and 3–4
"Cyrtopia" (now considered late furcilia stages):				
Body length (mm)	ND	3.0–4.0	ND	3.6–4.9
Number of terminal telson spines	ND	1	ND	7→1 or 5→1
Number of pairs of long lateral telson spines	ND	2→1	ND	2→1

Data from: [1] Brinton 1962a. [2] Brinton 1975; B. Casanova 1972, 1974; Gurney 1942; Lebour 1926 (a–c). [3] Brinton 1975; Silas and Mathew 1977. [4] B. Casanova 1972, 1974; Frost 1935; Mauchline 1971. [5] ND = no data. [6] Pleopod designations: (stage and setation) ″ = setose; ′ = nonsetose.

should develop into larger individuals with larger eyes, capable of inhabiting greater depths. Current taxonomy in these 4 species advocates the first choice. However, morphological, ontogenetic, and ecological information now available, although admittedly incomplete, equally (and in some cases, better) supports the second hypothesis.

Morphology.—The similar reproductive morphologies show that *S. microphthalma*, *S. suhmii*, *S. affine*, and *S. longicorne* possess greater affinities to one another than to other members of the *S. longicorne* species group. Other data indicate that the current taxonomic practice of relying almost exclusively on the upper lobe of the eye for separation of these species is of questionable value. This upper lobe has been shown to increase in both size and number of ommatidia with increasing habitat depth, probably as a function of light penetration levels. J. P. Casanova (1977) found this same relationship in the spherical-eyed *Meganyctiphanes norvegica*; specimens from Atlantic surface waters had eyes of smaller overall diameter, ommatidial diameter, and number of ommatidia, than deeper-living Mediterranean specimens. The specialized upper lobe in euphausiids with bilobed eyes is known to function in distance perception (Mauchline and Fisher 1969), vital to predatory animals, so that a greater number of ommatidia would presumably be required at the lower light levels occurring at greater depths. Although Brinton (1967, 1975) recognized this relationship as adaptation related to visual recognition of prey, potential mates, and predators, he did not consider the alternative that only one instead of 4 species might be involved.

Other morphological differences between the 4 forms are also compatible with the single-species hypothesis. Observed size differences in thoracic compound sensilla, believed to be involved in light perception, indicate that these structures also contribute to attainment of appropriate light intensity levels and depths. Furthermore, the existence of sexually mature and ovigerous members of all 4 forms of the species is explained if an individual becomes sexually mature at a small size, remains reproductively active as it becomes larger and the number of eye facets concomitantly increases.

Ontogeny.—Larvae described in the literature, although questionably labelled with 4 different species names, can also provide additional support for the single-species contention. Assuming adequate sampling, and because no larvae have been observed with more than 5 rows of facets in the upper eye lobe, some change in eye morphology must occur, at least in those adults having eyes with 6 or more rows. Indeed, a series of steps must be involved in the acquisition of an eye with 19 facet rows. As is apparently true from existing larval descriptions, each individual does not pass through all increments of eye structure, i.e., always beginning with 2 rows of facets, progressing to 3, then to 4, etc., with increasing size. The single-species hypothesis need not address the latter because varying larval environments may induce different larval morphologies, as is evident in the development of other structures.

A number of subadult specimens encountered in the R/V *Gosnold* collections also support this hypothesis. These specimens each displayed oblong eyes (lower lobe width/upper lobe width $\simeq$ 1.0) and a ratio of eye length to lower lobe width which would indicate *S. longicorne*. However, they possessed 6 facet rows in the upper eye in lateral view, and measurements of eye length, as well as the sixth abdominal segment, either definitely indicating *S. affine* or within the range of overlap of *S. affine* and *S. longicorne*. No sexually mature individuals were encountered having this intermediate morphology, suggesting that the characters involved may be ontogenetic. The holotype of *S. longicorne* (7.3 mm female, BMNH 1940.7.10.1) is also of this intermediate form (Fig. 7), thus corresponding more closely to the current taxonomic conception of *S. affine.* Although the holotype was larger in size than the *Gosnold* subadults, determining the maturity of the specimen would have required dissection, and was not done.

Ecology.—The absence of one or more of the various forms from any one area further supports the hypothesis of environmentally influenced morphologies. For example, adults of the 2-faceted form (in lateral view = "*S. microphthalma*") were not found in the eastern Floridan collections perhaps because environmental conditions were unfavorable in that area for maintenance of such an animal. Likewise, larger forms ("*S. longicorne*"), capable of existing in colder, deeper waters, have been collected from higher (=cooler) latitudes than the shallow-living (=warmer water) forms. However, the existence of discontinuous distributions does not preclude the conspecific nature of these 4 forms. Rather, it indicates that each morphology is best suited to a limited set of environmental conditions, including ambient temperature, pressure, and light intensity level.

Taxonomy.—*Stylocheiron microphthalma, S. suhmii, S. affine,* and *S. longicorne* are therefore best considered as interpopulational variants of a single polymorphic species, in which morphology is environmentally or ontogenetically influenced. The name *S. suhmii* has page priority and with strict adherence to Articles 23–24 of the International Code of Zoological Nomenclature (ICZN), the remaining 3 names become junior subjective synonyms. Article 15 of the ICZN furthermore prevents the use of *forma* designations.

As senior synonym, *Stylocheiron longicorne* might be preferable over the simultaneously published *S. suhmii.* As first revisor, I need not strictly adhere to page priority in designating the name best serving nomenclatural stability (see Recom. 24A of the ICZN). When factors including adequacy of description, condition of holotype, and familiarity of the species to the scientific community are considered, both names are of equal value. The only advantage in establishing priority of the name *S. longicorne* would be to allow continued use of the terminology "*S. longicorne* species group." However, Hansen (1910) appears to have arbitrarily chosen *S. longicorne* to represent this group, without giving any explanation. Furthermore, the

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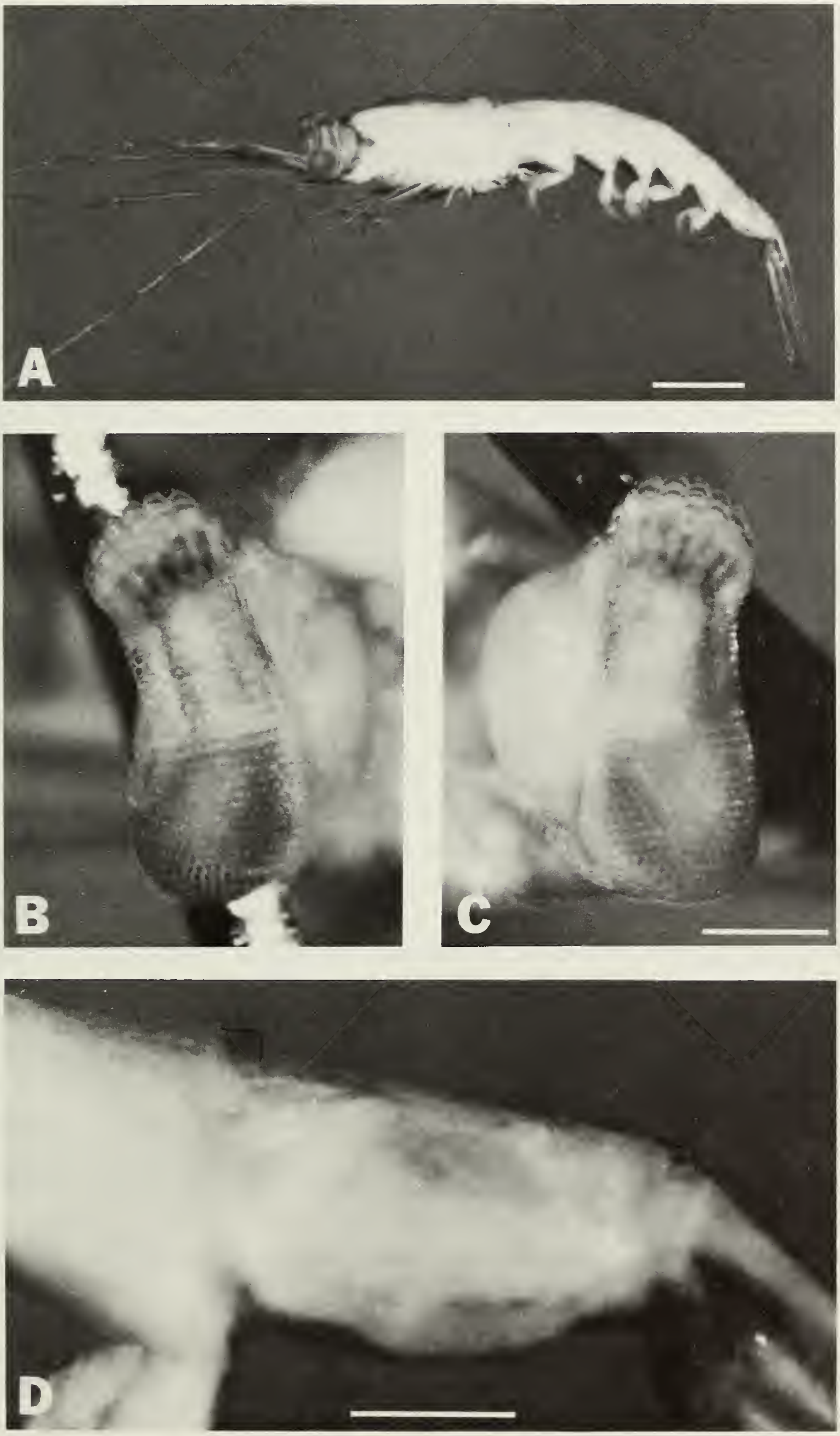
Fig. 7. *Stylocheiron longicorne,* holotype, 7.3 mm female, BMNH 1940.7.10.1: A, Entire specimen, left lateral view; B. Left eye, scale as in C; C, Right eye. In B and C, eyes are adjusted to direct lateral view with pins, to show 6 aligned rows of facets in each upper lobe; D, Sixth abdominal segment, left lateral view, retouched to show posterior margins of fifth and sixth segments. Scale = 1.0 mm (A), 0.25 mm (B–D).


A
B
C
D

species group category has no taxonomic status and seems primarily a grouping of convenience. Consequently, I designate *Stylocheiron suhmii* as senior synonym by page priority over *S. longicorne*. An emended description of *S. suhmii* reflecting this treatment is provided below. If a species group name is used at all, it should be termed the "*S. suhmii* species group" to avoid use of an invalid name.

Emended Description of
Stylocheiron suhmii G. O. Sars, 1883

Stylocheiron suhmii G. O. Sars, 1883:31–32; 1885:142–144, pl. XXVII, figs. 1–4.—Hansen, 1905:30–31; 1910:119–120; 1912:277–278, pl. 11, fig. 3(a–b).—Lebour, 1926a:203–211, fig. 1(a–l), fig. 2(a–d); 1926b:773–774, fig. 4(p–s); 1926c:520–521, 524.—Ruud, 1936:16–17, 49–53, figs. 5, 17, Table 17.—Sheard, 1953:20, Tables 1, 2, 9.—Boden, 1954: 234, fig. 20(d–e).—Boden *et al.*, 1955:383–385, fig. 50(a–c).—Pillai, 1957:24.—Brinton, 1962a: 175, figs. 87–88, Table 12; 1975:206, 256, figs. 109, 123b, Table 5.—Schroeder, 1971:116–122, fig. 30(a–c), Tables 2, 5–7, 10–12.—B. Casanova, 1972:180; 1974:111–118, figs. 28–30.—Costanzo and Guglielmo, 1976b:180, text-fig. 3, pl. 2, fig. 1.—Roger, 1976:104, Table 1.—Mauchline and Nemoto, 1977:287, fig. 4.—Lomakina, 1978:207–208, figs. 14(2), 125(1–2).

S. suhmi.—Ortmann, 1893:17–18.—Gurney, 1942:173, Table.—Brinton, 1967:475–477, 482, fig. 21.—Mauchline, 1967:34–36, fig. 18e.

S. longicorne G. O. Sars, 1883:32; 1885:144–145, pl. XXVII, fig. 5.—Hansen, 1908:92–93; 1910:120–121, pl. XVI, fig. 5(a–b); 1912:279–280, pl. 11, fig. 4(a–b).—Frost, 1935:447–451, pl. XIV(A–J), pl. XV(A–H), Table.—Ruud, 1936:15–16, 47–49, figs. 5, 17, 20, Table 16.—Banner, 1950:37–38, pl. IV, fig. 25a, Table 1.—Sheard, 1953:20, Tables 1–2, 9.—Boden, 1954:234–36, fig. 21(a–c).—Boden *et al.*, 1955:388–389, fig. 53(a–c).—Brinton, 1962a:190–193, figs. 93b, 98–100, Table 12; 1975:215–216, 258, figs. 115, 124(a–c), Table 5.—Mauchline, 1967:34–36, fig. 18g; 1971:13, pl. IV(14a–14g), Tables 1–4.—Schroeder, 1971:112–116, fig. 29(a–c), Tables 2, 5–7, 10–12.—B. Casanova, 1974:105–109, figs. 26–27.—Costanzo and Guglielmo, 1976b:180, text-fig. 4, pl. 2, fig. 2.—Roger, 1976:104, Table 1.—Mauchline and Nemoto, 1977:287, fig. 4.—Lomakina, 1978:211–212, figs. 7(12), 8(10), 11(3), 16, 128(1–4).

S. mastigophorum Chun, 1887:30–32, pl. IV, fig. 1–1a; 1896a:144–152, pl. IX, figs. 1–27, pl. X, figs. 1–19; 1896b:200–209, 215–228, text-fig. 4, pl. XVI, figs. 3, 7, pl. XIX, figs. 1–13.—Hansen, 1905:30–31.

S. microphthalma Hansen, 1910:117–118, pl. XVI, fig. 3(a–d).—Sheard, 1953:20, Tables 1–2.—Boden *et al.*, 1955:385–386, fig. 51(a–c).—Brinton, 1962a:172–175, figs. 85–86, Table 12; 1967:482; 1975:210–212, figs. 112(a–

b), 123g, Table 5.—Roger, 1976:104, Table 1.—Lomakina, 1978:208–209, figs. 4(4), 14(4), 126(1–4).

S. microphthalmum.—Zimmer and Gruner, 1956:253.

S. affine Hansen, 1910:118–120, pl. XVI, fig. 4(a–d); 1912:278–279.—Sheard, 1953:20, Tables 1, 2, 9.—Boden, 1954:232–234, fig. 20(a–c).—Boden *et al.*, 1955:382–383, fig. 49(a–c).—Pillai, 1957:22–24, fig. XI(1–3).—Brinton, 1962a:178–190, figs. 92–97, Table 12; 1967:475–477, fig. 19; 1975:208–210, 256, figs. 111, 123(d–f), 137, Table 5.—Mauchline, 1967:34–36, fig. 18C.—Schroeder, 1971:97–101, fig. 26(a–c), Tables 2, 5–7, 10–12.—Roger, 1976:104, Table 1.—Mauchline and Nemoto, 1977:287, fig. 4.—Silas and Mathew, 1977:578, fig. 5.—Lomakina, 1978:205–207, figs. 3(5), 124(1–3).

S. affini.—Wiebe, 1976:75, fig. 7 [lapsus].

Description.—Generic characters: Rostrum acute; sexually dimorphic, longer in female. Carapace lacking lateral denticles at ventral edge. Antennular peduncle without species-specific lobes or processes; segments sexually dimorphic, longer and thinner in female. Eyes bilobate. Mandible without palp. Maxillule without pseudoexopodite. Maxilla with reduced endopodite; endite of the protopodite not divided into 2 lobes. Third thoracic endopod greatly elongate, with strong terminal bristles. Seventh and eighth thoracic appendages reduced. Five photophores: one each on eyestalks, on bases of seventh thoracic appendages, and on ventral surface of first abdominal segment. Petasma with inner and medial lobes fused; secondary spinous process may be present; additional process absent. Thelycum formed solely by united plates from coxae of sixth thoracic appendages, with series of setae on anterior edge. Ova carried by female in ovisac.

Specific characters: Carapace weakly keeled in gastric region. Lower lobe of eye with numerous radiating ommatidia; upper lobe with 4 to over 200 enlarged parallel ommatidia, increasing in number with habitat depth or body size; ommatidia of lateral areas of eye rudimentary, transparent. Maxillae lacking suture line between lobe of third joint and endopod. Elongate third thoracic endopod terminating in "false chela" of 3 propodal spines opposing 5 dactylar spines; most medial propodal spine with 90° bend at tip. Abdominal segments unarmed.

Petasma with terminal and proximal processes blade-like distally, subequal in size; distal end of terminal process dentate in larger (? more mature) specimens; lateral process slightly smaller than preceding, distally rounded.

Thelycum with plates fused in anterior third of midventral line, widely diverging posteriorly; anterior edge bearing 2–5 primary, 2–4 secondary setae, increasing in number in larger (? more mature) specimens.

Adult body length.—5.5–15.3 mm.

Distribution.—Panoceanic from approximately 40°N to 40°S, and as far as 63°N in the Atlantic (Dahl 1961). Epi- to mesopelagic, ranging primarily from 0–500 m in depth. In general, forms with larger eyes inhabit greater depths than those with smaller eyes. Does not undergo diel vertical migrations, but may be capable of daytime avoidance of collecting devices (Brinton 1967).

Remarks.—Stylocheiron suhmii was originally described from a single female specimen having eyes "much narrowed in the upper part" (G. O. Sars 1883:31), but without reference to the exact number of ommatidia. Hansen (1910:119–120) re-examined Sars' holotype, stating that it displayed "three well developed crystal cones in a transverse row," thus apparently (and as will be seen, erroneously) emending the description of *S. suhmii.* In the same work, Hansen also named 2 new species, distinguished from *S. suhmii* by number of ommatidia visible in lateral view: *S. microphthalma* with 2, and *S. affine* with 4–6.

My re-examination of the holotype of *S. suhmii* (6.1 mm* female, BMNH 1981.87) revealed a lateral count of 2 rows in the upper eye lobe (Fig. 8C–F), rather than 3 as described by Hansen (1910). The specimen (Fig. 8A), permanently mounted on a microslide, has a slightly damaged right eye (Fig. 8E–F), resulting in distortion which brought the "incorrect" anterolateral viewing angle (previously discussed) into view, and apparently caused Hansen's erroneous emendation. Moreover, proportions of the sixth abdominal segment (L/D = 1.5; Fig. 8B) and the eye structure of the holotype of *S. suhmii* agree with the currently accepted characteristics (Table 2) and with the syntypes (see Appendix) of *S. microphthalma.* It is thus apparent that Hansen's misinterpretation of the eye of Sars' holotype was the primary error leading him to establish *S. microphthalma.* The latter species, supposedly distinguished from *S. suhmii* by having only 2 rows of facets, is identical to the holotype, and becomes a junior subjective synonym, of *S. suhmii,* regardless of any other conclusion reached by this study.

Although never carried to such an extent, the synonymizing of *S. longicorne* with *S. suhmii* is not entirely new. Both species were described by G. O. Sars (1883) and have been synonymized several times. Hansen (1905) considered them to be immature (*S. suhmii*) and adult (*S. longicorne*) individuals of the same species, and designated *S. suhmii* as the valid name. Ortmann (1905) also followed this practice. In addition, Hansen (1905) synonymized *S. mastigophorum* Chun, 1887, with *S. suhmii,* based on identical structures of the first 2 pairs of thoracic legs. This was done on the advice of Calman (in Hansen 1905), who, in comparing the holotype of *S. longi-*

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* The value of 8 mm usually cited as the maximum size of *S. suhmii* is attributable to this specimen, as originally cited by Sars (1883). Personal examination revealed that this length included the antennae and that the body length is actually 6.1 mm.

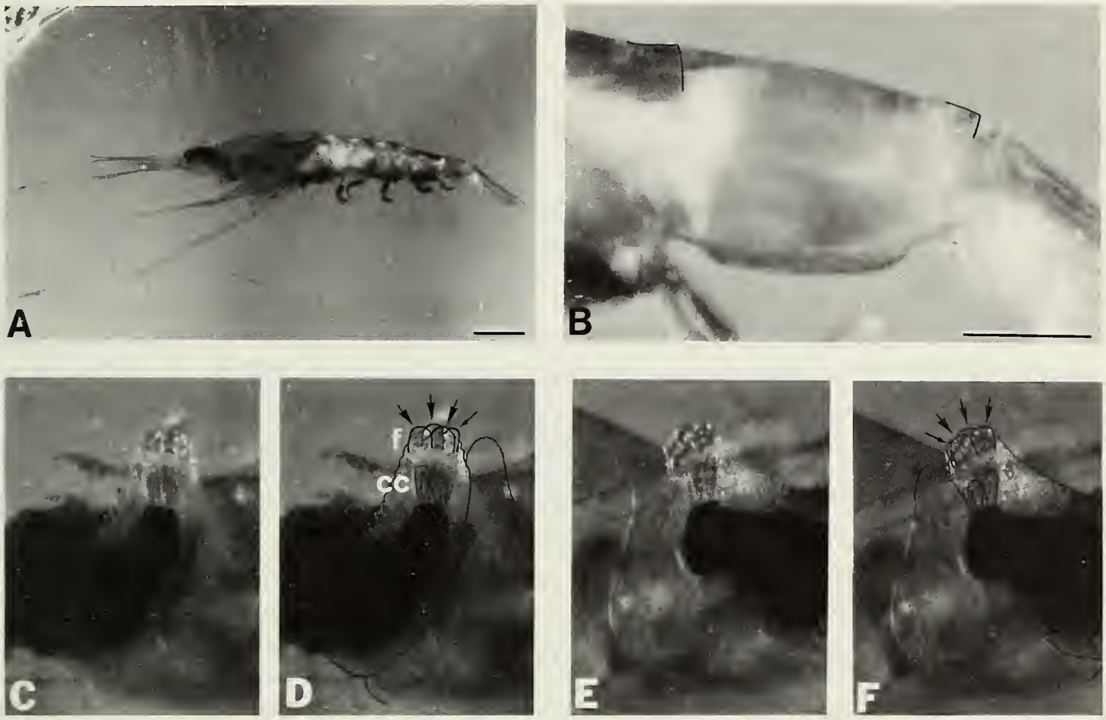

Fig. 8. *Stylocheiron suhmii,* holotype, 6.1 mm female, BMNH 1981.87: A. Entire specimen, left lateral view; B, Sixth abdominal segment, left lateral view, retouched to show posterior margins of fifth and sixth segments; C, Left eye; D, Same, retouched to emphasize enlarged ommatidia; E, Right eye; F, Same, retouched as in D. Lower portion of right eye is slightly damaged. Arrows indicate the enlarged facets; smaller arrow points to fourth and smallest facet in each upper lobe. cc, crystalline cones; f, corneal facets. Magnification in C–F as in B. Scale = 1.0 mm (A), 0.25 mm (B–F).

corne with the description and figures of *S. mastigophorum,* found Chun's distinctions between the 2 species in the thoracic legs to be without value. Hansen (1908) later resurrected *S. longicorne,* and cancelled his "first revisor" status, when additional material prompted the descriptions of *S. microphthalma* and *S. affine,* published in 1910. *S. mastigophorum* then became synonymous in part (Hansen 1910) with both *S. suhmii* and *S. longicorne,* according to Chun's (1896b) illustrations of their respective eye structures. Finally, in a catalog from the National Museum of Ireland, the 2 names appeared again in synonymy: "*Stylocheiron longicorne* G. O. Sars = *Stylocheiron suhmi* [sic] G. O. Sars" (O'Riordan [1969]:52), although with the name *S. longicorne* having apparent priority.

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Appendix

Material examined, *Stylocheiron longicorne* species group.

I. *Stylocheiron suhmii* G. O. Sars, 1883.

A. Specimens with 2 rows of facets visible in lateral view, formerly referable to *S. microphthalma*: INDO-PACIFIC: North of New Guinea: 1 ♀ (holotype of *S. suhmii*), BMNH 1981.87.—Indonesia: 3 ♀♀ (syntypes of *S. microphthalma*), *Siboga* Sta. 104–108, ZMA Sch. 150.143; 3 ♂♂, 12 ♀♀ (illustrated syntypes (Hansen 1910) of *S. microphthalma)*, *Siboga* Sta. 128, ZMUC; 2 ♀♀ (syntypes of *S. microphthalma*), *Siboga* Sta. 129, ZMA Sch. 150.144; 1 ♀ with empty ovisac (syntype of *S. microphthalma*), *Siboga* Sta. 184, ZMA Sch. 150.145; 2 ♀♀ (syntypes of *S. microphthalma*), *Siboga* Sta. 276, ZMA Sch. 150.146; 1 ♂, 1 ♀, *Albatross* Sta. 5616, ZMUC.—Fiji Islands: 1 ♀, ZMUC.—China Sea: 2 ♂♂, 1 ♀, *Albatross* Sta. 5320, USNM 49355.—ATLANTIC: Tropical Atlantic: 2 subadults, BMNH 1886.37 (in part).—Bermuda: 2 ♂♂, 10 ♀♀, 29 subadults, BMNH 1965.8.23.346–358 (in part).

B. Specimens with 3 rows of facets visible in lateral view, formerly referable to *S. suhmii* (sensu Hansen): INDO-PACIFIC: Philippine Islands: 1 ♂, 1 subadult, BMNH 1886.37 (in part).—China Sea: 1 specimen, BMNH 1886.37 (in part).—Fiji Islands: 1 ♂, 2 ♀♀, ZMUC.—ATLANTIC: Western Atlantic: 10 ♂♂, 41 ♀♀, *Bache* Sta., USNM 62294 (in part); 1 ♀, *Bache* Sta., USNM 62295 (in part).—Tropical Atlantic: 1 ♂, BMNH 1886.37 (in part).—eastern Florida: 6 ♂♂, 7 ♀♀, *Gosnold* Sta. 130; 1 ♂, *Gosnold* Sta. 131; 13 ♂♂, 21 ♀♀, 1 other specimen, *Gosnold* Sta. 144; 14 ♂♂, 24 ♀♀, *Gosnold* Sta. 159; 54 ♂♂, 55 ♀♀ (3 ovigerous), *Gosnold* Sta. 160; 2 ♂♂, 3 ♀♀, *Gosnold* Sta. 172; 7 ♂♂, 7 ♀♀, *Gosnold* Sta. 173.—Bermuda: 2 ♂♂, 14 ♀♀, 5 subadults, BMNH 1965.8.23.346–358 (in part).

C. Specimens with 4–8 rows of facets visible in lateral view, formerly referable to *S. affine*: INDO-PACIFIC: Indonesia: 6 ♀♀, 19 other specimens (syntypes of *S. affine*), *Siboga* Sta. 66, ZMUC; 1 ♀ (syntype of *S. affine*), *Siboga* Sta. 118, ZMA Sch. 150.150; 3 ♀♀ (syntypes of *S. affine*), *Siboga* Sta. 129, ZMA Sch. 150.151; 1 ♀, 7 other specimens (syntypes of *S. affine*), *Siboga* Sta. 141, ZMA Sch. 150.152; 4 ♀♀ (one ovigerous) (syntypes of *S. affine*), *Siboga* Sta. 143, ZMA Sch. 150.153; 5 ♀♀ (syntypes of *S. affine*), *Siboga* Sta. 148, ZMA Sch. 150.154; 1 ♀ (syntype of *S. affine*), *Siboga* Sta. 157, ZMA Sch. 150.147; 2 ♂♂, 6 ♀♀, 4 other specimens (syntypes of *S. affine*), *Siboga* Sta. 185, ZMA Sch. 150.148; 6 ♂♂, 20 ♀♀, 9 other specimens (illustrated syntypes (Hansen 1910) of *S. affine*), *Siboga* Sta. 203, ZMUC; 1 ♀, 29 subadults (syntypes of *S. affine*), *Siboga* Sta. 220, ZMUC; 5 ♂♂, 11 ♀♀, 3 other specimens (syntypes of *S. affine*), *Siboga* Sta. 276, ZMA Sch. 150.149.—Philippine Islands: 3 ♂♂, 7 ♀♀, *Albatross* Sta. 5456, ZMUC; 7 ♂♂, 37 ♀♀, 10 other specimens, *Albatross* Sta. 5456, USNM 49378.—Tropical eastern PACIFIC: 1 ♀, ZMUC; 3 ♀♀, *Albatross* Sta. 4634, ZMUC.—AT-

LANTIC: Western Atlantic: 24 ♂♂, 50 ♀♀, Bache Sta., USNM 62295 (in part).—Bermuda: 1 ♀, BMNH 1965.8.23.346–358 (in part).—eastern Florida: 19 ♂♂, 17 ♀♀, *Gosnold* Sta. 144; 5 ♂♂, 6 ♀♀, *Gosnold* Sta. 159; 2 ♂♂, 14 ♀♀, *Gosnold* Sta. 160; 1 ♂, 2 ♀♀, *Gosnold* Sta. 172; 2 ♂♂, 6 ♀♀, *Gosnold* Sta. 173.

D. Subadult specimens with 6 rows of facets visible in lateral view, intermediate in morphology to *S. affine* and *S. longicorne* (sensu Brinton): ATLANTIC: south of Cape of Good Hope: 1 ♀ (holotype of *S. longicorne*), BMNH 1940.7.10.1.—eastern Florida: 2 ♂♂, 2 ♀♀, *Gosnold* Sta. 144; 1 ♂, 1 ♀, *Gosnold* Sta. 159; 1 ♀, *Gosnold* Sta. 160; 2 ♀♀, *Gosnold* Sta. 172.

E. Specimens with 7–19 rows of facets visible in lateral view, formerly referable to *S. longicorne*: ATLANTIC: Western Atlantic: 21 ♂♂, 65 ♀♀, 9 other specimens, *Bache* Sta., USNM 62295 (in part); 1 ♀, *Bache* Sta., USNM 92294 (in part).—Gulf of Mexico: 2 ♂♂, 4 ♀♀, *Alaminos* Sta. 66.A.5.3, USNM 135313.—eastern Florida: 23 ♂♂, 41 ♀♀, *Gosnold* Sta. 144; 2 ♂♂, 4 ♀♀, *Gosnold* Sta. 159; 1 ♀, *Gosnold* Sta. 160; 5 ♀♀, *Gosnold* Sta. 172.

F. Other specimens previously misidentified as one of the forms of this species: *S. affine*: 1 specimen, off western Africa, *Atlantide* Sta. 91, ZMUC [not genus *Stylocheiron,* according to photophore arrangement]; 1 specimen, off western Africa, *Atlantide* Sta. 52, ZMUC [mysid, according to statocyst in uropod].—*S. suhmii*: 1 specimen, tropical Atlantic, BMNH 1886.37 (in part) [=*S. carinatum*].

II. Other members of the *Stylocheiron longicorne* species group:

A. *Stylocheiron elongatum* G. O. Sars, 1883: ATLANTIC: Western Atlantic: 18 ♂♂, 21 ♀♀ (7 ovigerous), 6 subadults, *Bache* Sta., USNM 62293.—eastern Florida: 10 ♂♂, 31 ♀♀ (4 ovigerous), *Gosnold* Sta. 144; 3 ♂♂, *Gosnold* Sta. 159; 1 ♀, *Gosnold* Sta. 160; 4 ♂♂, 15 ♀♀ (2 ovigerous), 5 other specimens, *Gosnold* Sta. 172.

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94(4), 1981, pp. 1205–1210

POTAMOTRYGONOCOTYLE TSALICKISI, NEW GENUS AND SPECIES (MONOGENEA: MONOCOTYLIDAE) AND *PARAHETERONCHOCOTYLE AMAZONENSIS,* NEW GENUS AND SPECIES (MONOGENEA: HEXABOTHRIIDAE) FROM *POTAMOTRYGON CIRCULARIS* GARMAN (CHONDRICHTHYES: POTAMOTRYGONIDAE) IN NORTHWESTERN BRAZIL

Monte A. Mayes, Daniel R. Brooks, and Thomas B. Thorson

Abstract.—Two new monogeneans are described from *Potamotrygon circularis* in northwestern Brazil. The first species, a monocotylid, most closely resembles members of *Heterocotyle* but differs by possessing oral glands and by lacking sclerites in the septa dividing the opisthaptor into loculi. The new species further possesses dorsal muscular papillae on the opisthaptor, a trait which members of *Neoheterocotyle* exhibit, but resembles *Neoheterocotyle* in no other diagnostic traits. The new genus *Potamotrygonocotyle* is proposed to accommodate the new species. The second new species, for which the new genus *Paraheteronchocotyle* is proposed, is a member of the Hexabothriidae. It differs from all other known hexabothriids by lacking anchors on the haptoral appendix. The new species exhibits sucker and hook morphology intermediate between two currently-recognized groups of hexabothriids. One group exhibits suckers and hooks of subequal size and the other exhibits suckers and hooks each comprising two different size classes. The new species possesses uniform-sized suckers and unequal-sized hooks.

Introduction

From 1975 to 1979, we conducted field studies collecting helminth parasites inhabiting freshwater stingrays (Potamotrygonidae) from northern and eastern South America. Among the helminths collected were specimens of two new species of monogeneans described herein. This report is the first record of any monogeneans inhabiting freshwater stingrays. Based on their morphological traits, we propose a new genus for each species.

Materials and Methods

Hosts were harpooned by local fishermen and were examined alive or shortly after death. Gills were removed, placed in fresh water and examined for living monogeneans, or were preserved in 10% formalin for future examination. Living specimens were fixed with AFA and stored in 70% ethanol. Most specimens were stained with Mayer's hematoxylin, dehydrated, cleared with methyl benzoate, and mounted in Canada balsam. One specimen was prepared for histological examination using standard histological procedures, sectioned at 8 μm, stained with hematoxylin-eosin, cleared with xylene, and mounted in a commercial resin. Measurements were made using an optical micrometer, according to the protocol described by Dillon and Hargis (1968); measurements are expressed in μm with the range followed by the mean in parentheses. Suckers of one of the species, a hexabothriid, were numbered by denoting as #1 the sucker nearest the haptoral appendix and counting counterclockwise. Curved structures were measured in a straight line from one extreme to another; hook points were measured from the outside of the distal end to the outside of the proximal end. Figures were prepared with the aid of a drawing tube.

Potamotrygonocotyle, new genus

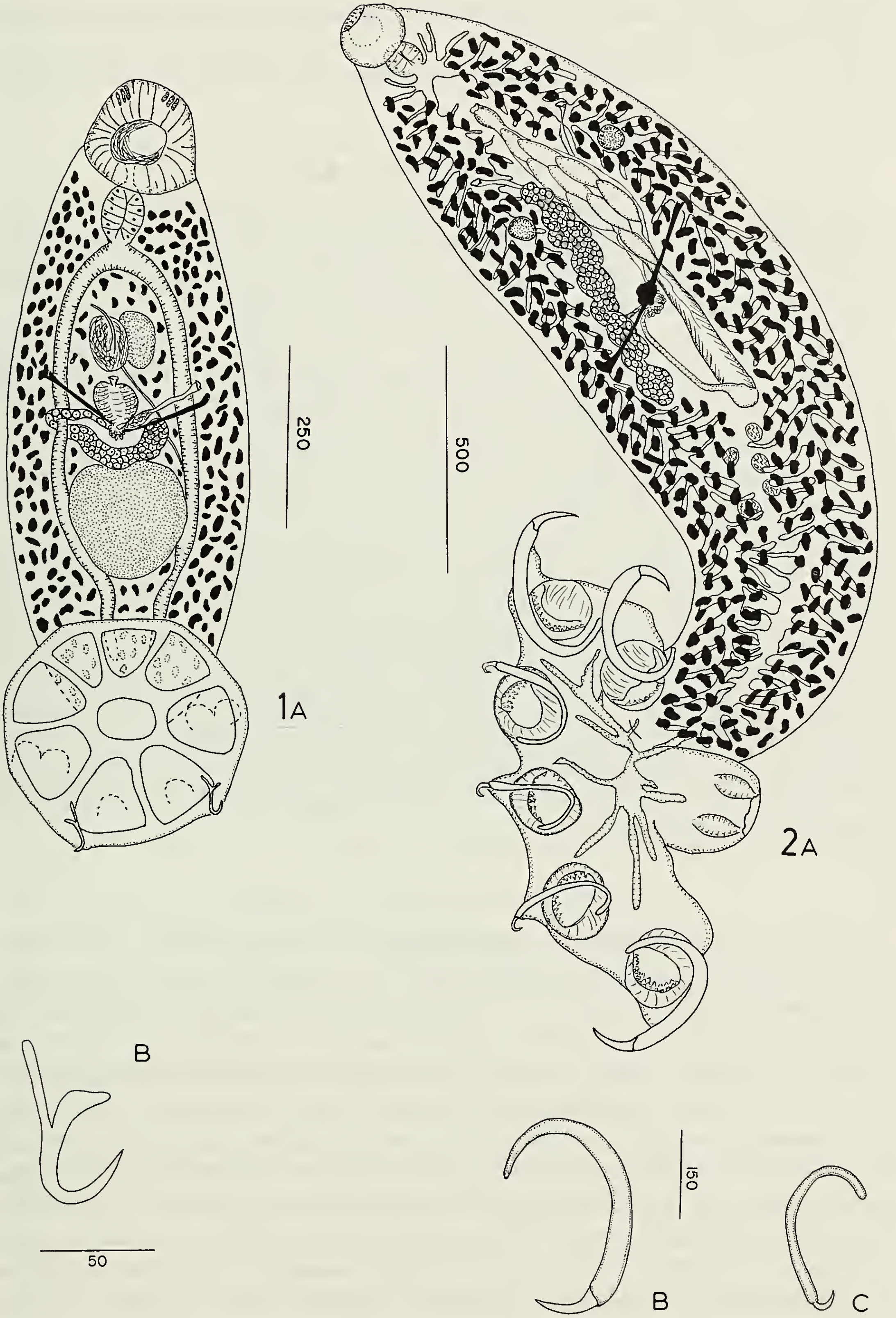
Diagnosis.—Monogenea, Monocotylidae. Prohaptor composed of sucker, esophagus leading to muscular pharynx. Intestinal crura bifurcate, terminating blindly near posterior end of body. Cirrus simple, tubular, cuticularized; prostatic bulb large. Ovary median, tubular, looping around right intestinal crurus. Uterus leading to muscular metraterm. Vitellaria extending from prohaptor to opisthaptor. Opisthaptor divided ventrally into 8 lateral loculi and single central loculus; septa lacking sinuous ridge or sclerites; 2 anchors and 14 hooks present; dorsal surface with 6 muscular papillae. Parasites of freshwater stingrays. South America.

Type-species.—Potamotrygonocotyle tsalickisi.

Potamotrygonocotyle tsalickisi, new species

Fig. 1

Description. (based on 10 specimens).—Body 703–923 (848) long by 235–300 (275) wide. Opisthaptor octagonal, 210–265 (243) long by 235–255 (248) wide, armed with pair of sickle-shaped anchors each 53–69 (61) long with short deep root and elongate superficial root. Marginal membrane of opisthaptor armed with 14 hooks each 5–7 (6) long. Dorsal surface of posterior pair of peripheral loculi each with single papilla; dorsal surface of next most posterior pair of loculi each with 2 papillae; papillae 33–42 (37) wide. Oral sucker subterminal, 112–130 (124) in diameter, with 3 paired small head organs on antero-lateral margins. Eyespots lacking. Mouth leading to muscular pharynx 62–92 (74) long by 53–60 (57) wide. Testis in posterior half of body 117–195 (158) long by 117–163 (139) wide. Copulatory complex composed of simple cuticularized cirrus, pyriform ejaculatory bulb, conspicuous prostatic reservoir. Vagina single, with ventro-sinistral opening.



Figs. 1, 2. Monogeneans from *Potamotrygon circularis*. 1, *Potamotrygonocotyle tsalickisi:* A, Ventral view of holotype; B, Close-up of anchor. 2, *Paraheteronchocotyle amazonensis:* A, Ventral view of holotype; B, Close-up of large anchor; C, Close-up of small anchor.

Vitellaria follicular, extending from pharynx to opisthaptor levels, confluent posttesticularly. Eggs not observed.

Host.—Potamotrygon circularis Garman (Chondrichthyes: Potamotrygonidae).

Site of infection.—Gills.

Locality.—Itacuai River, 5 km SE Atalaia do Norte, Brazil.

Holotype.—USNM Helm. Coll. Paratypes: USNM Helm. Coll.

Etymology.—This species is named in honor of Mr. Mike Tsalickis, Leticia, Colombia who aided us greatly in our collections. The genus is named for the family of stingrays which it is known to inhabit.

Remarks.—Potamotrygonocotyle tsalickisi most closely resembles members of *Heterocotyle* Scott, 1904 by possessing vitelline follicles extending from the level of the pharynx to near the opisthaptor, an opisthaptor with one central and eight peripheral loculi and armed with a pair of anchors as well as a prohaptor which is an oral sucker. The new species possesses preoral glands which *Heterocotyle* species lack and lacks sclerites in the septa, which *Heterocotyle* species possess. By having dorsal muscular papillae on the opisthaptor, *P. tsalickisi* resembles *Neoheterocotyle inpristi* Hargis, 1955. However, the holotype of *N. inpristi* (USNM Helm. Coll. No. 38139) possesses sclerotized papillae (those of the new species are not sclerotized), lacks an oral sucker, exhibits vitelline follicles extending only to the anterior margin of the posterior one-third of the body, and possesses anchors which are more dactylogyroid-like than monocotylid in shape. Based on the characters discussed above, the new species cannot be accomodated within *Heterocotyle* or *Neoheterocotyle* and we therefore propose the new genus for it.

Paraheteronchocotyle, new genus

Diagnosis.—Monogenea, Hexabothriidae, Hexabothriinae. Opisthaptor with 6 subequal suckers in semicircular arrangement on posterior margin, each armed with single hook. Hooks divided into 2 groups; first group large and robust, with point forming continuous arc with shaft; second group small and slender, with recurved points and shaft and narrowing juncture of point and shaft. Opisthaptoral appendix lacking hooks; 2 muscular suckers present at posterior end. Prohaptor an oral sucker. Large muscular pharynx present, esophagus lacking. Intestinal crura with diverticula; joined posteriorly; with confluent branch extending into opisthaptor. Testes few, preovarian. Cirrus unarmed. Common genital pore present. Ovary tubular-elongate, in middle third of body. Uterus enlarged distally into egg sac. Vaginal opening ventro-lateral, posterior to genital pore. Vitellaria follicular, extending from level of pharynx to posterior end of body, not extending into opisthaptor. Eggs with single filament at one pole. Parasites of freshwater stingrays. South America.

Type-species.—*Paraheteronchocotyle amazonensis.*

Paraheteronchocotyle amazonensis, new species

Fig. 2

Description (based on 5 specimens).—Body 1.92–2.70 mm (2.20 mm) long by 463–515 (496) wide. Opisthaptor wedge-shaped, 346–475 (435) long by 718–1030 (925) wide; armed with 6 subequal suckers 117–169 (143) long by 130–183 (156) wide. Sucker hooks dissimilar in size and morphology; larger hooks in positions 1,2,6 240–300 (276) long with point 98–110 (100) long, point joining shaft in continuous arc; smaller hooks in positions 3,4,5 192–240 (217) long with point 53–70 (61) long; point joining shaft at narrowing of hook, recurved. Haptoral appendix lacking hooks, 187–228 (214) long, with paired terminal suckers. Prohaptor with terminal oral sucker 122–147 (136) long by 146–176 (168) wide. Pharynx 60–98 (78) in diameter. Testes few, located in anterior ½ of body, preovarian, 53–57 in diameter in section. Ejaculatory bulb muscular, unarmed. Ovary dextral, elongate, coiling into posterior ½ of body, anterior extremity within testicular field. Proximal portion of uterus muscular, expanding anteriorly into egg sac opening at common genital pore; genital pore median, ventral, in anterior $^1/_5$ of body. Vitellaria follicular, extending from level of pharynx to opisthaptor. Vaginae bilateral, opening ventro-laterally, posterior to genital pore; seminal receptacle not observed. Eggs with filament at one end 130–138 (134) long by 44–52 (49) wide excluding filament.

Host.—*Potamotrygon circularis* Garman (Chondrichthyes: Potamotrygonidae)

Site of infection.—Gills.

Locality.—Itacuai River, 5 km SE Atalaia do Norte, Brazil.

Holotype.—USNM Helm. Coll. Paratypes: USNM Helm. Coll.

Etymology.—The specific names refers to the general area in which the species occurs, whereas the generic name refers to the close relationship between the new species and members of *Heteronchocotyle.*

Remarks.—Members of the Hexabothriidae Price, 1942, possess opisthaptors comprising six suckers each armed with a hook (sometimes called a sclerite) and a haptoral appendix with two suckers. With the exception of *Paraheteronchocotyle amazonensis,* all hexabothriids possess a pair of anchors associated with the haptoral appendix. Previously described hexabothriids comprise two groups based on relative sizes of suckers and hooks: (1) those with suckers and hooks of subequal size and (2) those with suckers and hooks comprising two different size classes each. The new species thus differs from all other members of the family by possessing uniform-sized suckers but unequal-sized hooks. *Paraheteronchocotyle amazonensis* appears to be most closely related to members of *Heteronchocotyle* Brooks, 1934, by possessing unequal-sized hooks and an unarmed rather than spinose cirrus.

We observed testes in only one of our five specimens, and that one was non-ovigerous. Brinkmann (1952) reported other observations of protandry among hexabothriids and we ascribe the lack of testes in four of our specimens to that phenomenon.

Acknowledgments

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94(4), 1981, pp. 1211–1218

REDESCRIPTION OF *IPHIPLATEIA WHITELEGGEI*, A NEW GUINEA MARINE AMPHIPOD (CRUSTACEA)

J. Laurens Barnard

Abstract.—*Iphiplateia whiteleggei* is redescribed and its range extended from southeastern Australia to northern New Guinea. As a result of new information, a new key to the genera of the family Phliantidae is presented.

Introduction

This is the last known genus of Phliantidae to be treated in modern time. It has not been seen since the 1890's and is here redescribed from new specimens caught along the shores of New Guinea. The original material came from New South Wales, Australia.

The Phliantidae have been heavily revised in the past decade. In 1969 (see Barnard 1969) the family comprised *Ceina, Heterophlias, Iphinotus, Iphiplateia, Palinnotus, Pariphinotus, Pereionotus, Phlias, Plioplateia, Quasimodia,* and *Temnophlias*. *Ceina* was removed to its own family by J. L. Barnard (1972b); *Palinnotus* was found to be a synonym of *Pereionotus* by Ledoyer (1978); *Plioplateia* was removed to its own family by Barnard (1978a), and *Temnophlias* was removed to its own family by Griffiths (1975). *Gabophlias* was described by Barnard (1972a). *Phlias* has been obscure since its inception, an unfortunate circumstance because it is the type-genus of the family. It and some other genus are probably synonymous. *Pariphinotus* is probably a synonym of *Heterophlias*, thereby leaving only *Gabophlias, Heterophlias, Iphinotus, Iphiplateia, Pereionotus,* and *Quasimodia* as valid genera, one of these possibly being junior to *Phlias*.

Heterophlias has been well described by Shoemaker (1933), *Iphinotus* by J. L. Barnard (1972b), and *Quasimodia* by J. L. Barnard (1972a).

A better key to the genera is possible now that *Iphiplateia* is redescribed here. The old application of ramus-peduncle distinctions on uropod 3 seems difficult to use in identification so that the following two keys are based on other characters. Generally the pleon on phliantids is sufficiently transparent that it can be unrolled while mounting the animal dorsal or ventral side down on a slide in mounting medium, and the pleopods can be seen with the high power of a compound microscope, at least sufficiently well to identify the genus without major dissections.

The use of the maxillipedal palp is now poor as certain taxa (*Iphinotus*)

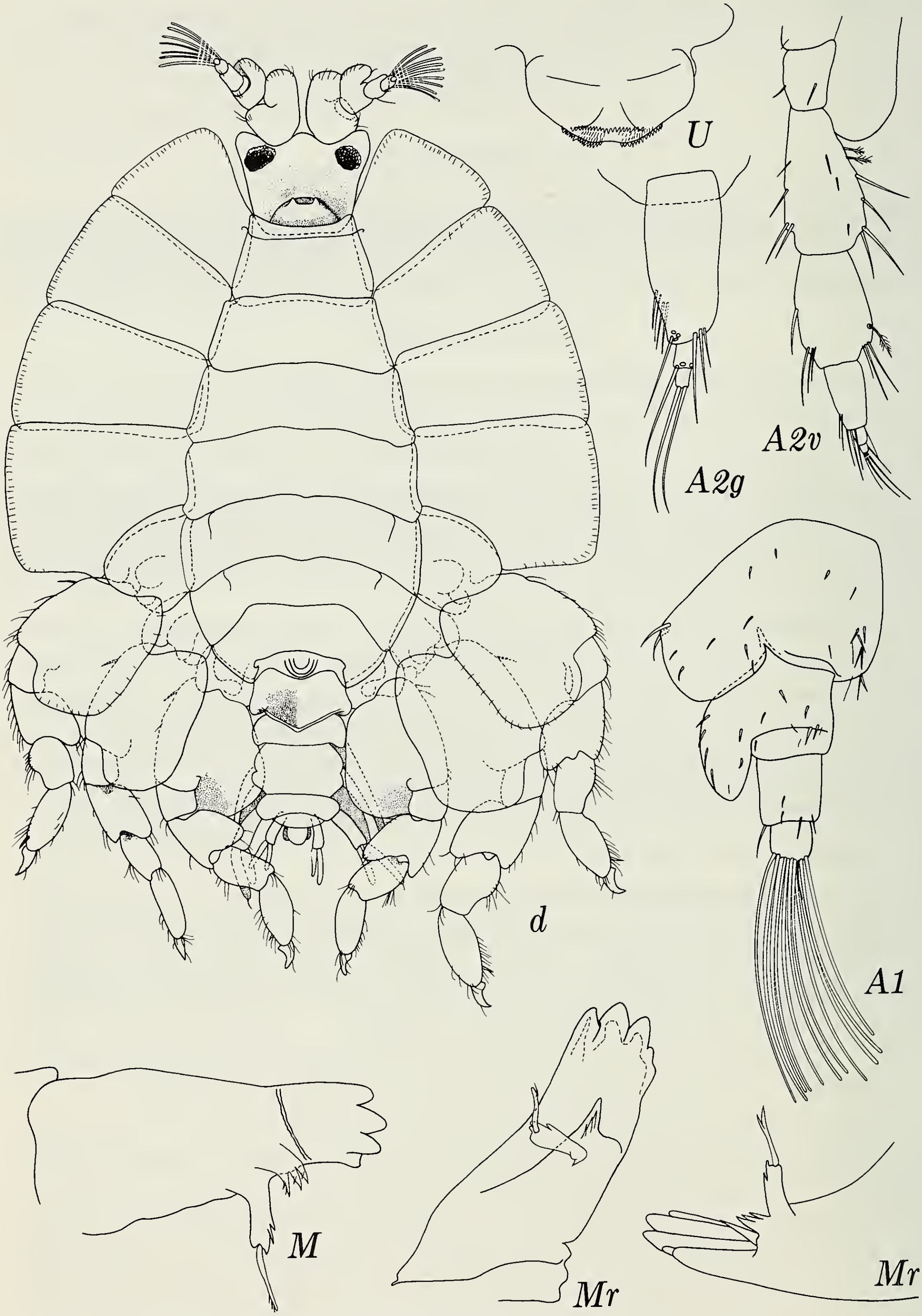

Fig. 1. *Iphiplateia whiteleggei* Stebbing, male "c."

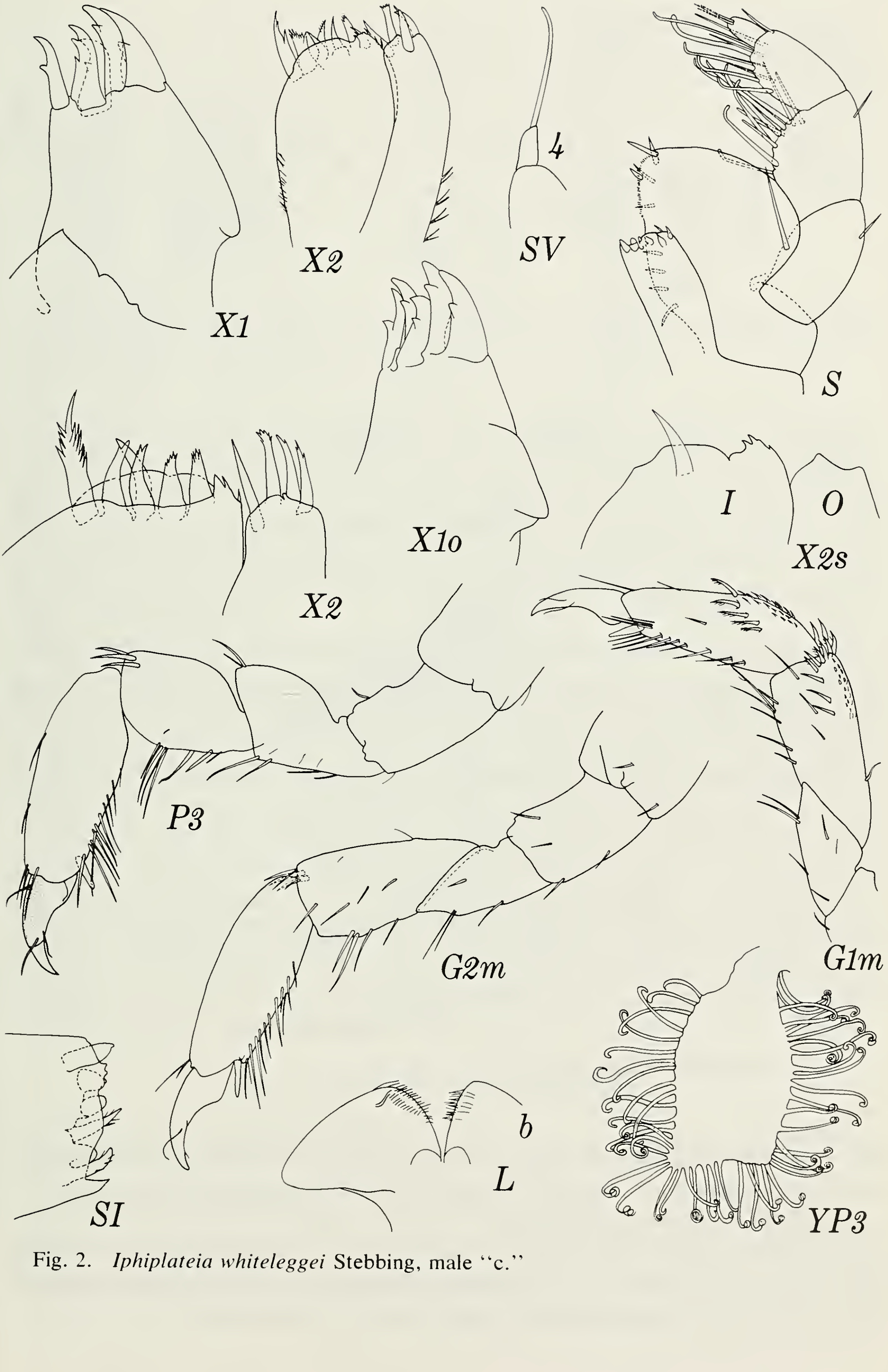

Fig. 2. *Iphiplateia whiteleggei* Stebbing, male "c."

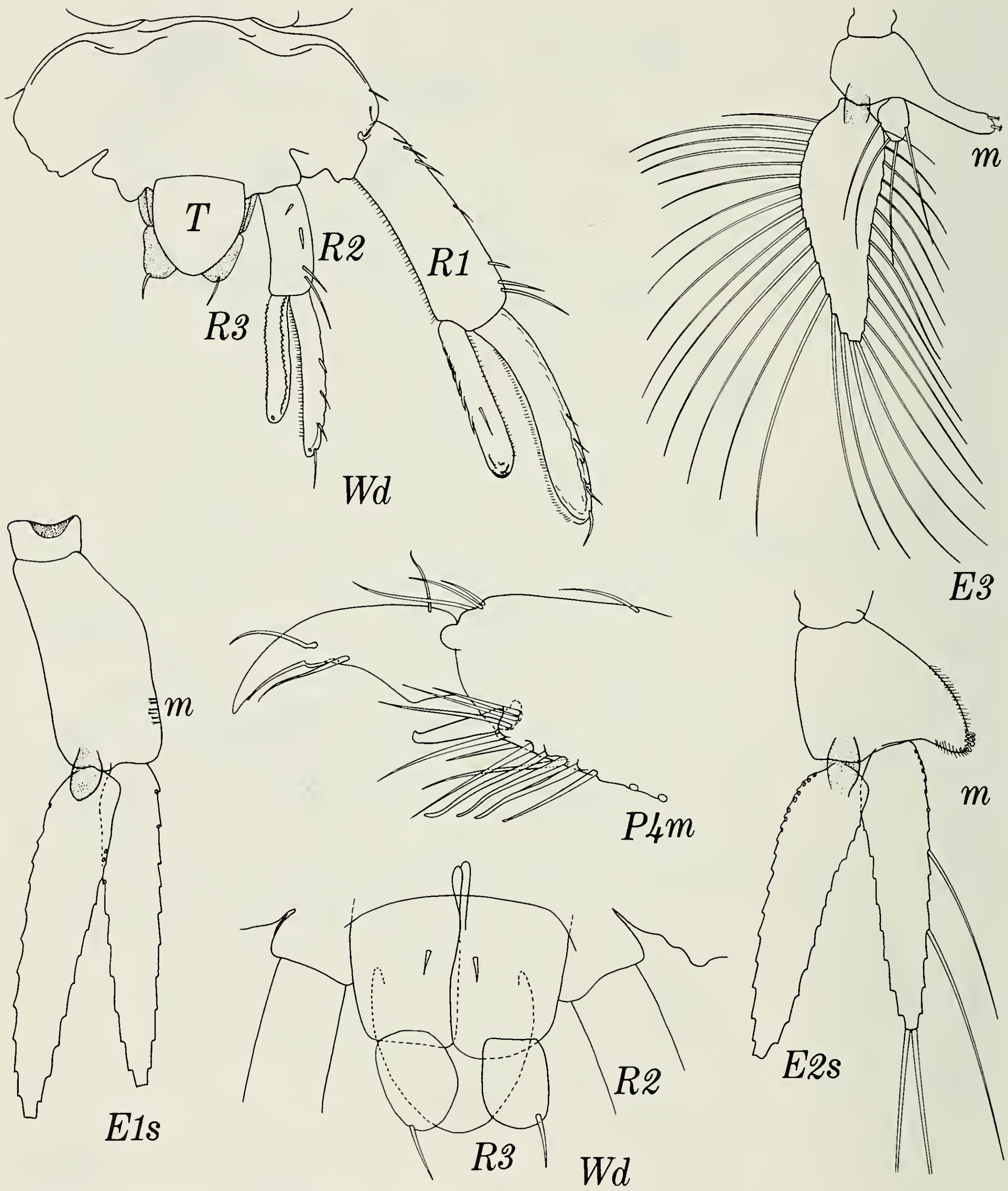

Fig. 3. *Iphiplateia whiteleggei*, male "c."

have variable numbers of palpar articles. Only the female of *Pereionotus* lacks one ramus on uropod 2 so that the keys have avoided that pitfall.

Drawings of the obscure *Phlias serratus* Guérin (1836) are here represented in Fig. 4; they have been photographed and reinked from the original; the taxon was collected on a voyage between New South Wales and the Falkland Islands so the origin of the species remains obscure.

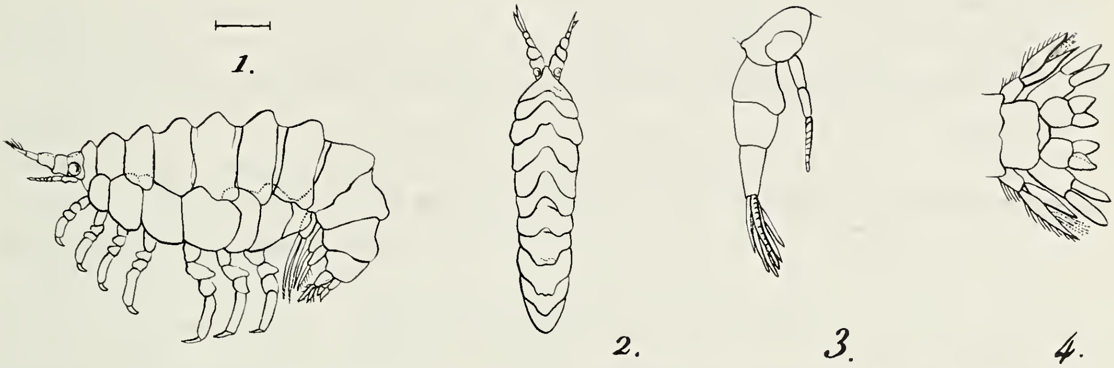

Fig. 4. *Phlias serratus* Guérin; enlargement, rearrangement, and reinking of Guérin's (1836) original drawings including his figure numbers.

One may run it through the key presented herein but find no place for its characteristics; Guérin drew the third pleopod thinking it to be uropod 1, not noticing that uropod 3 was vestigial and hidden under the telson. If he used simply a representational pleopod then the drawing is erroneous; if, indeed it lacks a medial extension of the peduncle and elongate inner ramus as shown then it is quite unique within Phliantidae in combination with its other characteristics.

The dorsal body outline appears much too lumpy to be *Iphiplateia*; *Heterophlias* has bever been recorded from the southern hemisphere; pleopod 3 is wrong for all the remaining genera but the body generally looks like *Palinnotus*(=*Pereionotus*). The species therefore may be *Pereionotus thomsoni* (Stebbing) but comparison of Guérin's drawings and those in Barnard (1972a, figures 176–179) leaves many questions unanswered.

Legends: Capital letters describe morphological parts; lower case letters to right of capital letters describe modifications, as follows: A, antenna; B, brood plates of female "h"; G, gnathopod; E, pleopod; I, inner plate or ramus; L, lower lip; M, mandible; O, outer plate or ramus; P, pereopod; R, uropod; S, maxilliped; T, telson; U, upper lip; V, palp; W, urosome; X, maxilla; Y, gill; b, broken; d, dorsal; g, enlarged; m, medial; o, opposite; r, right; s, setae removed; v, ventral.

Key I to the Genera of Phliantidae

1. Article 2 of pereopod 7 ovate .... *Iphiplateia*
– Article 2 of pereopod 7 quadrate 2
2. Article 2 of pereopod 6 quadrate .... *Heterophlias* (=*Pariphinotus*)
– Article 2 of pereopod 6 ovate 3
3. Inner ramus of pleopod 3 greatly shortened 4
– Inner ramus of pleopod 3 about as long as outer ramus. 5

4. Pereopods prehensile, body very tall .... *Quasimodia*
– Pereopods simple, body very flat .... *Gabophlias*
5. Peduncles of all pleopods strongly produced medially, molar stubby, with nail .... *Iphinotus*
– Peduncle of pleopod 1 unproduced, of pleopod 2 weakly produced, of pleopod 3 strongly produced, molar spike-like .... *Pereionotus* (=*Palinnotus*)

Key II Genera of Phliantidae

1. Inner ramus of pleopod 3 unshortened .... Key I, couplet 5
– Inner ramus of pleopod 3 shortened 2
2. Article 2 of pereopod 6 quadrate .... *Heterophlias* (=*Pariphinotus*)
– Article 2 of pereopod 6 ovate 3
3. Article 2 of pereopod 7 ovate .... *Iphiplateia*
– Article 2 of pereopod 7 quadrate .... Key I, couplet 4

Iphiplateia Stebbing

Iphiplateia Stebbing, 1899:414 (*Iphiplateia whiteleggei* Stebbing, 1899, monotypy).—Stebbing, 1906:203.

Molar cylindrical or box-like, with apical nail. Article 2 of pereopods 5–7 all ovate, alike; pereopods simple. Peduncles of pleopods diverse, pleopod 1 with rectangular peduncle, pleopod 3 with immensely produced peduncle, pleopod 2 transitional; rami of pleopods 1–2 elongate, inner ramus of pleopod 3 very short.

Iphiplateia whiteleggei Stebbing
Figs. 1–3

Iphiplateia whiteleggei Stebbing, 1899:415–416, plate 34; 1906:203–204, figs. 52, 53.

Original description and illustrations excellent; reillustrated herein, figures self-explanatory; following remarks concern only figure problems or unillustrated aspects:

Body extremely flat, coxae pointing almost completely laterad, segments with only 3 dorsal humps, one each on pereonites 1, 7 and pleonite 1, the last forming keel, humps diminished or absent in juveniles, but hump near back of head part of pereonite 1 in male "c" with 2 anterodorsal nipples, these absent in other specimens; urosomites 2–3 and base of telson all fused together or very dimly partitioned. Epistome flat in front. Right mandible with spine like lacinia mobilis distinct from 3 fused spines of spine row but left lacinia mobilis absent.

Gnathopod 2 and pereopods 3–7 with article 6 alike medially, only gnathopod 1 with extra subapical row of prickled spines.

Gills sausage shaped, on coxae 2–6, becoming smaller posteriorly, that on coxa 6 scarcely larger than male penial process of sternite 7; brood plates broad, very small, perhaps no mature females present.

Inner ramus of pleopod 3 setose; pleopod 1 with multiple coupling hooks, pleopod 2 with 4–5, pleopod 3 with 2–3.

Material.—Madang, New Guinea, 31 July 1980, scrapings from reef rubble in shallow water, coll. C. A. Child, Jr., J. L. Barnard, and C. M. Barnard; male "c" 3.23 mm (illustrated), female "h" 2.92 mm (brood plate illustrated), juvenile "r" 1.88 mm, juvenile "z" 1.86 mm, and 4 other adults; USNM 184222.

Remarks.—Differing from *I. orientalis* Tzvetkova (1976, Japan Sea) in the presence of 5 or 6 elements (versus 2) on the outer plate of maxilla 2 and the distinctly larger and setose inner ramus of pleopod 3; one assumes Stebbing might have missed these setae in the original Australian material of *I. whiteleggei.*

Distribution.—Sydney, New South Wales, to northern New Guinea, intertidal or shallow water.

Acknowledgments

I thank C. Allen Child, Jr., Deborah R. Feher (illustrator), Janice Clark, Margaret S. Cairns, Deborah Bernsdorf, and Elizabeth B. Harrison for assistance. S. Dillon Ripley, Secretary of the Smithsonian Institution, provided the funds for our field work in New Guinea, for which we are most grateful.

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CLIONA RHODENSIS, NEW SPECIES (PORIFERA: HADROMERIDA) FROM THE MEDITERRANEAN

Klaus Rützler and Richard G. Bromley

Abstract.—A new species of the limestone-excavating sponge family Clionidae, *Cliona rhodensis,* is described from the Mediterranean. The sponge is vivid orange-red in color, makes small papillar and large chamber excavations, and has microscleres with an unusually great range of shape and size. Mean length and width of spicules is 365.4 × 10.4 μm for tylostyles, 11.4 × 4.7 μm for small papillar microscleres, and 43.4 × 5.7 μm for large choanosomal spirasters. At Rhodes (Greece) *C. rhodensis* is among the three most abundant clionids in shallow water. The species has also been found elsewhere in the Mediterranean where it has been reported previously as *C. carteri* (Ridley).

Introduction

Three species of distinctive red clionid sponges are known to be common in the Mediterranean (Volz 1939). *Cliona schmidti* (Ridley) is purplish red, *C. vastifica* Hancock is orange yellow to orange-red, and *C. vermifera* Hancock is vermilion. During a recent survey of the limestone coast of Rhódos (Rhodes), Greece, one of us (RGB) noted a very common bright orange-red *Cliona* whose spiculation was very different from that of any of the aforementioned species. Further study showed the identity of the Rhodes sponge to be the same as a species described from Tunisia as *C. carteri* (Ridley) (Rützler 1973). The type of *C. carteri,* however, was since examined (by KR) at the British Museum (Natural History) (No. 1876.12.27.14) and found to be distinct from any of the Mediterranean material studied. We have now come to the conclusion that the common red *Cliona* from Rhodes represents an undescribed species.

Family Clionidae

Cliona rhodensis, new species
Figs. 1, 2

Description.—Color: The papillae are vivid orange-red (cf. no. 33A, color chart, Royal Horticultural Society, London), the choanosome is orange-red, too, but less brilliant. Color fades to orange-brown or yellow-brown on drying and becomes grey in alcohol.

Shape and size: Papillae are circular and discrete, fusion is very uncom-

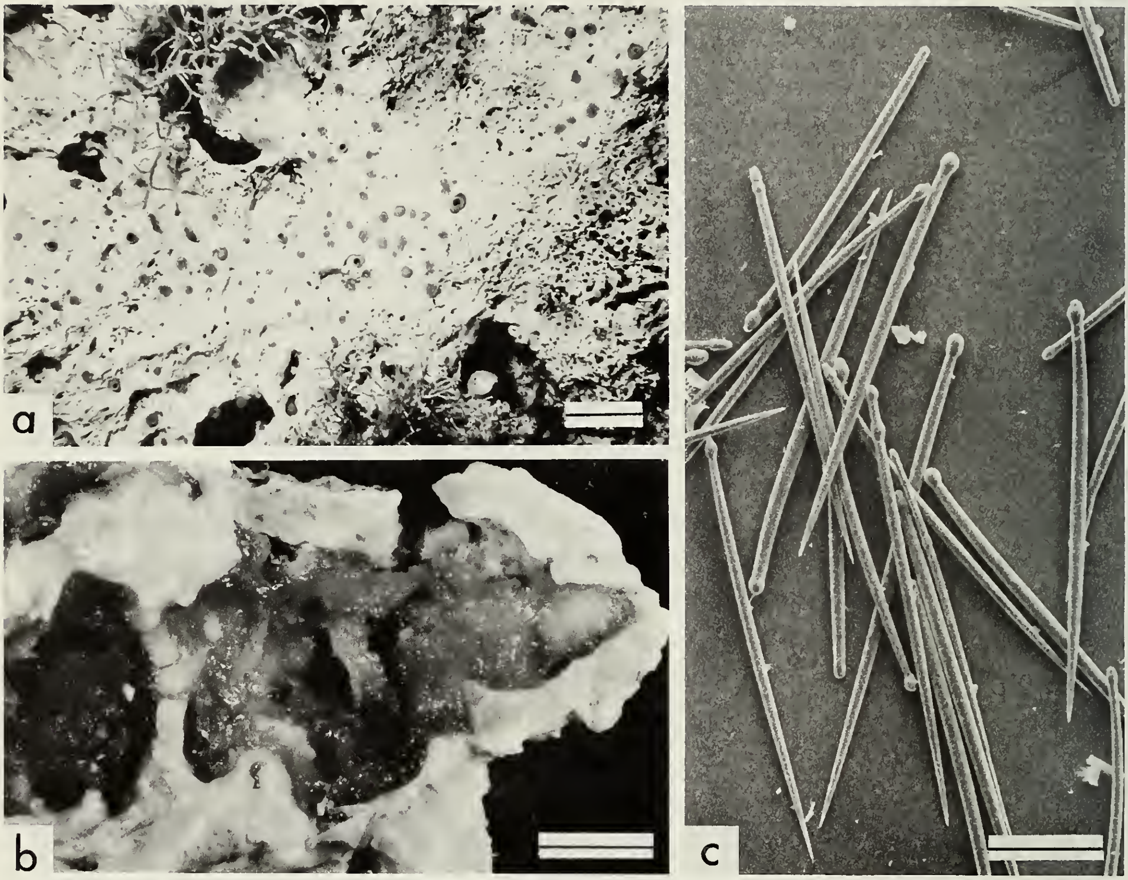

Fig. 1. *Cliona rhodensis:* a, Underwater view of papillae of a live specimen, scale bar = 2 cm; b, Two chambers of a preserved specimen exposed by breaking up substrate rock, scale bar = 5 mm; c, Tylostyles of holotype, USNM 31371, scale bar = 100 μm.

mon, and there is no growth above the substrate (Fig. 1a). Inhalant papillae range 0.5–3.0 mm (average 2 mm), exhalant papillae 2.0–4.8 mm (average 3 mm). Excavations are large and camerate (Fig. 1b). New chambers are initiated at a distance from the next and grow subspherically until the shape is compromised by adjacent chambers. Intervening walls of substrate become increasingly thin and are eliminated here and there causing fusion of chambers. Unfused chambers measure 10 × 10 mm to 12 × 20 mm in cross-section but fusion can create crypts over 3 cm long. The largest crypt measured was about 2 × 4 cm and considerably larger but empty ones—believed to have been bored by this species—are commonly encountered. Interchamber canals are numerous and fine, rarely exceeding 0.5 mm in diameter. Excavations resemble those of *Cliona celata* Grant (cf. Volz 1939:pl. 2, fig. 3, lower). Chambers of fresh material are filled by fairly tough tissue. The largest sponge observed measured 55 cm in diameter.

Spicules: Tylostyles are fusiform with a distinct head (Fig. 1c). Mucronate and subterminal modifications of the head are common. Microscleres are of two types and size classes. Short, stout spirasters (Fig. 2b) and amphiasters (Fig. 2a) with many heavy-set compound spines (category I) prevail in the papillar tissue, long thin spirasters and some straight rods with few slender spines (category II) (Fig. 2c) are most common in the chamber tissue. Spicule dimensions for individual specimens are given in Table 1. Mean of means of all specimens measured (length × width) is 365.4 × 10.4 μm for tylostyles, 11.4 × 4.7 μm for microscleres I (spirasters, amphiasters), and 43.4 × 5.7 μm for microscleres II (spirasters).

Ecology.—Depth: At Rhodes *Cliona rhodensis* is very abundant between sea level and 3 m depth. It is common to 9 m depth but it was not seen between 9 m and 15 m, despite numerous dives to that depth. However, the sponge looks drab at 8 m and could have been overlooked because no artificial light was available. In southern France this species may occur as deep as 40 m (Topsent 1900:98).

Habitat: The new species is estimated to be second in abundance among clionids on all limestone coasts of Rhodes; *Cliona viridis* (Schmidt) is most common, *Cliothosa hancocki* Topsent ranks third. *Cliona rhodensis* is most obvious on well-lit upper surfaces of limestone where echinoid grazing has removed fleshy algal cover. However, the sponge is equally abundant under overhangs in deeply shaded locations in shallow water. It appears less common under thick algal turf but this observation may merely reflect the greater difficulty of discovery there.

Substrate: The Rhodes localities abound in Mesozoic limestone thinly coated by lithothamnioid algae which is the normal substrate for *Cliona rhodensis*. The sponge occurs in large boulders but was never seen in rocks less than 8 cm in diameter, or in loose mollusk shells. It is also found in beachrock composed of limestone pebbles cemented by magnesium calcite. In such cases the sponge is commonly restricted to the cement between the grains producing malformed excavations.

Distribution.—Mediterranean: Rhodes, Greece (identically colored sponges with the same excavation pattern were seen at Crete, Monemvasia, and Corfu but no specimens were collected); Korbous, Tunisia (as *Cliona carteri,* Rützler 1973:629); S. Vito, near Bari, Italy; and Capo Caccia, Sardinia, Italy (A. Schwarz, Bochum, pers. comm.). Specimens reported from the Dalmatian Adriatic, Yugoslavia (as *Vioa viridis* var. *carteri,* Lendenfeld 1897:59), from the Gulf of Taranto and the Channel of Otranto, Italy (as *C. carteri*: Sarà 1964:306), and from the south coast of France (as *C. viridis* var. *carteri*: Topsent 1900:98) are presumed to belong to this species.

Etymology.—Named after Rhódos, the type-locality.

Material examined.—Holotype and 7 paratypes are deposited in the collection of the National Museum of Natural History, Smithsonian Institution (USNM), one paratype at the British Museum (Natural History) (BM). Holotype—8 m depth, St. Paul's Bay, Lindos, Rhodes, Greece, R. Bromley,

Table 1.—Spicule dimensions for *Cliona rhodensis*. Measurements (in μm) are ranges of 10 or more spicules chosen at random, with means ± SE in parentheses (— = no data).

	Tylostyles				
	Length	×	Width	Neck diameter	Head diameter
Holotype					
Rhodes, USNM 31371[a]	320–425 (402 ± 12)	×	7.5–13.8 (11.0 ± 0.7)	5.0–10.0 (7.9 ± 0.6)	7.5–16.3 (12.4 ± 1.0)
Paratypes					
Rhodes, USNM 31368	300–485 (394 ± 16)	×	7.5–12.5 (11.0 ± 0.6)	5.0–11.3 (8.1 ± 0.6)	10.0–16.3 (13.8 ± 0.7)
USNM 31369	360–490 (420 ± 7)	×	7.5–16.3 (12.4 ± 0.5)	5.0–11.3 (9.1 ± 0.4)	8.8–18.8 (14.0 ± 0.5)
USNM 31370	300–420 (380 ± 12)	×	5.0–12.5 (9.9 ± 0.8)	3.8– 8.8 (6.6 ± 0.7)	10.0–15.0 (12.6 ± 0.6)
BM 1981:4:9:1	250–370 (318 ± 12)	×	2.5–12.5 (9.3 ± 1.0)	2.5– 8.8 (7.0 ± 0.7)	5.0–15.0 (12.3 ± 1.0)
Bari, USNM 31372	270–470 (342 ± 19)	×	7.5–10.0 (9.8 ± 0.3)	5.0– 7.5 (6.8 ± 0.3)	7.5–13.8 (12.1 ± 0.8)
Korbous, USNM 31373[b]	250–370 (302)	×	6.3–12.0 (9.3)	—	11.3–15.0 (13.0)

	Microscleres I			Microscleres II		
	Length	×	Width	Length	×	Width
Holotype						
Rhodes, USNM 31371[a]	7.3–12.9 (10.0 ± 0.5)	×	2.8–5.9 (4.9 ± 0.2)	38.7–53.5 (45.5 ± 1.8)	×	5.0–11.2 (7.5 ± 0.8)
Paratypes						
Rhodes, USNM 31368	7.5–15.0 (10.8 ± 0.5)		—	32.5–52.5 (43.9 ± 1.9)		—
USNM 31369	—		—	—		—
USNM 31370	5.0–13.8 (9.0 ± 0.5)		—	27.5–57.5 (47.9 ± 3.4)		—
BM 1981:4:9:1	—		—	—		—
Bari, USNM 31372	6.3–20.0 (12.1 ± 0.9)		—	35.0–65.0 (42.8 ± 2.8)		—
Korobous, USNM 31373[b]	7.5–30.0 (15.3)	×	3.8–6.4 (4.5)	27.5–45.5 (36.8)	×	2.5– 5.0 (3.8)

[a] Measurements of microscleres from scanning electron micrographs.

[b] Values from Rützler 1973.

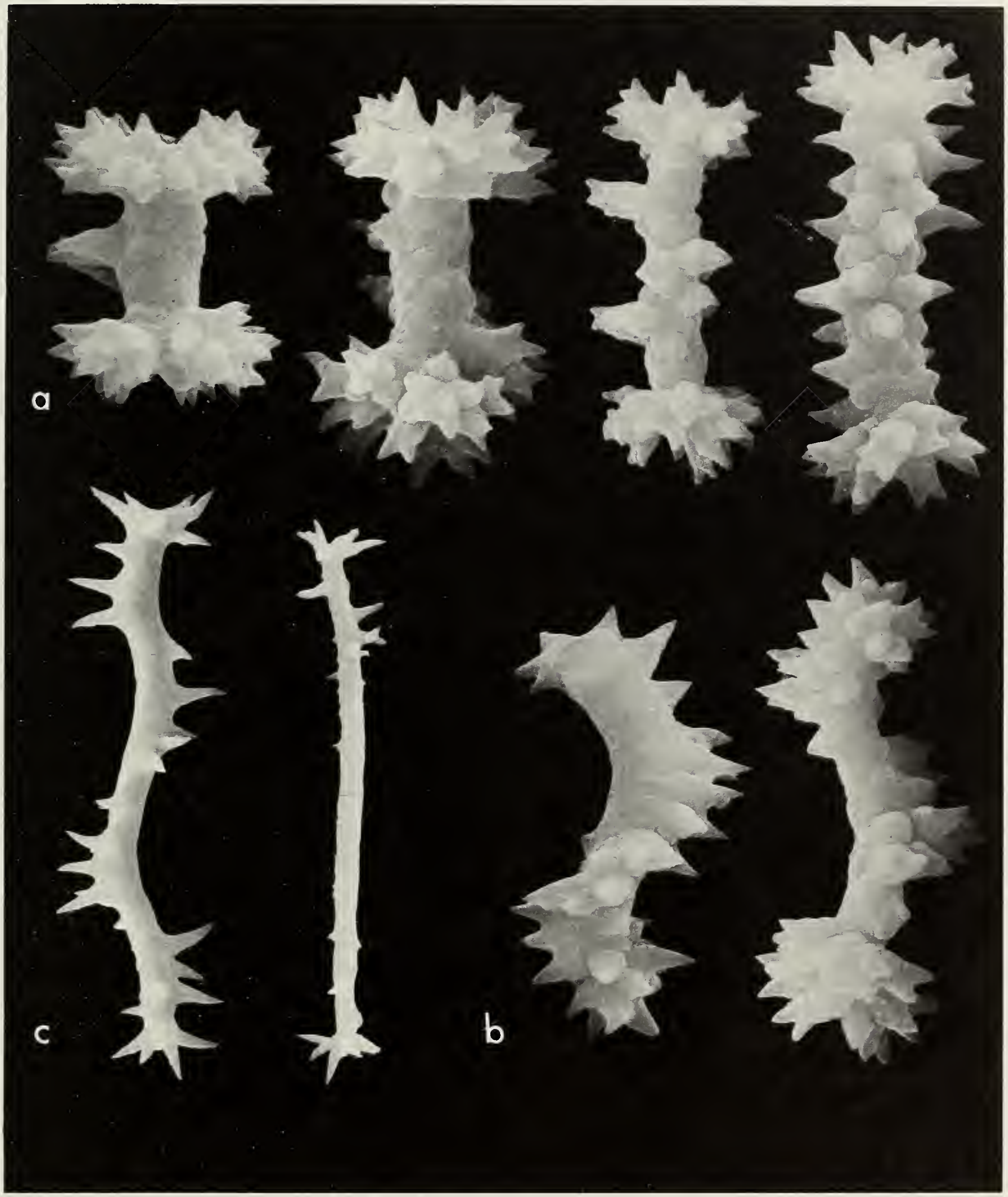

Fig. 2. *Cliona rhodensis:* Holotype, USNM 31371: a, Papillar amphiasters, ×4600; b, Papillar spirasters, ×4600; c, Choanosomal spirasters, ×1500.

coll. 3 June 1979, USNM 31371 (dry). Paratypes—4 m depth, Porto Piccolo, St. Paul's Bay, Lindos, Rhodes, Greece, R. Bromley, coll. 27 Sept. 1977, USNM 31366 (dry); 3 m depth, St. Paul's Bay, Lindos, Rhodes, Greece, R. Bromley, coll. 3 May 1978, USNM 31367 (dry); 2–4 m depth, St. Paul's Bay, Lindos, Rhodes, Greece, R. Bromley, coll. 3 June 1979, USNM 31368 (alcohol); 0.5 m depth, north point of Ladiko south, Rhodes, Greece, R. Bromley, coll. 4 June 1979, USNM 31369 (alcohol); 3 m depth, Ladiko, Rhodes, Greece, R. Bromley, coll. 4 June 1979, USNM 31370 (dry); 1 m depth, S. Vito, South of Bari, Italy, K. Rützler, coll. 25 May 1968, USNM 31372 (alcohol); 4 m depth, Korbous, Tunisia, K. Rützler, coll. 24 June 1970, USNM 31373 (alcohol); 2 m depth, St. Paul's Bay, Rhodes, Greece, R. Bromley, coll. 9 May 1978, BM 1981:4:9:1 (dry).

Discussion.—Topsent (1900:98) assigned specimens of a red clionid from the Mediterranean coast of France (Banyuls, Cap l'Abeille) to *Cliona carteri* (Ridley) and agreed with Lendenfeld (1897:59) who considered this sponge to be only a variety of *C. viridis* (Schmidt). Neither author had examined type-material.

The holotype of *Vioa carteri* Ridley (BM 1876.12.27.14) is still of vivid red-purple (R. H. S. color chart 66A) color, in spite of the long storage time in alcohol. The pigment resembles that of *Cliona schmidti* (Ridley) which is purple (R. H. S. color chart 78B) and of similar stability in many organic solvents (Christomanos and Norton 1974:19). The few papillae visible on the coralline encrusted rock fragment are under 1 mm in diameter. The only visible excavation is a 12 × 2 mm gallery of confluent chambers lined with red-purple tissue. Tylostyles and spirasters (1 category only) are of the size and shape described and figured by the author of the species (Ridley 1881:129, pl. XI, fig. 2).

In spite of spicular similarities between *Cliona carteri* and *C. viridis* the distinctive pigment of the former should be sufficient to keep the two species separate, at least until more material is available. Topsent (1900:100), however, presumed the original color designation as incorrect and ignored the significance of two spiraster categories that he pointed out in his description and illustration (p. 99, pl. III, fig. 4); his sponge clearly belongs to our new species, *C. rhodensis*. Rützler (1973:629, fig. 4) followed Topsent's (1900) interpretation and described a red sponge from Tunisia as *C. carteri*. This specimen (USNM 31373) is now part of the type-series of *C. rhodensis*.

Only two clionids—*C. lobata* Hancock and *Cliona schmidti* (Ridley)—have a spicule complement comparable to that of *C. rhodensis*. Both lack amphiasters, make much smaller excavations, and are distinct in several other aspects: *C. lobata* is yellow and has much smaller and thinner tylostyles (200 × 4 μm) (Topsent 1900:70); *C. schmidti* is purple (with alcohol-insoluble pigment), has smaller tylostyles (260 × 6 μm), and much larger, thicker, and coarser spined spirasters I (43 × 14 μm) (Rützler 1973).

Acknowledgments

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THE PUERULUS AND POST-PUERULUS OF THE HAWAIIAN SPINY LOBSTER *PANULIRUS MARGINATUS*

William J. Cooke and Craig D. MacDonald

Abstract.—Collections of pueruli and post-pueruli at Kure Atoll, Hawaii, provide material for a description of these stages of the Hawaiian endemic spiny lobster, *Panulirus marginatus*. This description allows reliable identification of the two local species of spiny lobsters at the time of settlement. Pueruli of *P. marginatus* are best separated from the other local species, *P. penicillatus* by the shorter forward projection of the supra-orbital spines, the absence of a caudally directed spine on the fifth thoracic sternite, and slightly greater exopod development on the second and third maxillipeds in *P. marginatus*. The diagnostic features of adults have been found to be valid for the post-puerulus stage of both species.

Introduction

The Hawaiian spiny lobster, *Panulirus marginatus* (Quoy and Gaimard, 1825) is restricted to the Hawaiian faunal area (George and Holthuis 1965) including Johnston Atoll (Brock 1973). *Panulirus penicillatus* (Oliver, 1791), a more widely distributed Indo-Pacific spiny lobster (George 1968), is also found in Hawaii. The puerulus stage of *P. penicillatus* was described by Michel (1971). As part of a fishery management investigation by one author (CDM), settling pueruli and post-pueruli were collected on Witham habitats (Witham *et al.* 1968) beginning in May 1979 at Kure Atoll (178°18′W, 28°24′N). The ability to differentiate between these two species at the time of settlement is required to determine the geographic and temporal pattern of larval recruitment of each lobster species, information needed for a sound fisheries management plan. The collection of many *P. marginatus* specimens provided the opportunity to describe the diagnostic features for this previously uncollected stage.

Materials and methods.—These specimens were compared with literature descriptions of known *Panulirus* pueruli and with pueruli of *P. penicillatus* from Hawaii and elsewhere in the Pacific. Specimens that were not *P. penicillatus* were treated initially as presumptive *P. marginatus*. Electrophoretic studies of these specimens (with the exoskeletons retained for morphological examination) revealed in all the presence of the same suite of diagnostic isozymes which separate adult specimens of *P. marginatus* from *P. penicillatus* (J. Shaklee pers. comm.) confirming their identity.

Table 1.—Characters separating pueruli from post-pueruli in *Panulirus*.

Character	Puerulus	Post-puerulus
Body shape	Dorsoventrally flattened	Generally cylindrical
Body spination	6 on dorsal carapace	Many dorsally and laterally on carapace
Exoskeleton	Non-calcified	Calcified
Color	Initially clear, pre-molt pigmented	Brownish green to reddish brown, never clear
Fifth thoracic sternite	With tooth, spine or nub	Evenly rounded
Second pleopod	Endopodite as long as exopodite	Endopodite ½ or less exopodite

Panulirus marginatus material: 30 pueruli collected; 16 May 1979 (#1), 23 June 1979 (#'s 6–18), 1 July 1979 (#'s 26, 27, 29–36), 6 July 1979 (#19–20, 22–25); 6 post-pueruli collected; 26 May 1979 (#'s 2–5), 23 June 1979 (#21), and 28 July 1979 (#28).

Panulirus penicillatus material: 3 pueruli collected Oahu, Hawaii (UH Zool. Dept. ref. coll.), 1 puerulus collected Enewetak Atoll, Marshall Islands, 12 March 1979; 13 post-pueruli collected Enewetak, 12 March 1979.

All material is deposited under Accession No. 810002HA in the collections of the Processing Center, Naval Ocean Systems Center, Hawaii Laboratory, Kailua, Hawaii.

Results.—The characters used to separate pueruli from post-pueruli are listed in Table 1 (also compare Figs. 1a and 2a). The puerulus stage is recognized by its dorsoventral compression, sparse carapace spination, lack of calcification and the presence of well developed pleopods. Color is not particularly useful, as older pueruli approaching the molt become considerably darker. Indeed, at this stage many of the features of the next stage such as carapace spination are visible beneath the cuticle.

The general morphology of *P. marginatus* pueruli conforms to previously published descriptions of *Panulirus* (Bonde 1932; Gordon 1953; Deshmukh 1966; Michel 1971) so only those features which separate it from others in the genus will be described. Like other pueruli these are dorsoventrally compressed with a thin exoskeleton. Early pueruli are transparent (turning white in formalin) except for a distal band and several more proximal transverse reddish brown bands on the antennal flagella. Later pueruli are considerably darker, and on gross examination may be taken for post-pueruli.

The dorsal carapace of *P. marginatus* bears only 6 spines, one pair at the anterior ends of the weak dorsal carinae, one pair behind the orbits, and one pair behind the supra-orbital spines or "horns." These supra-orbital

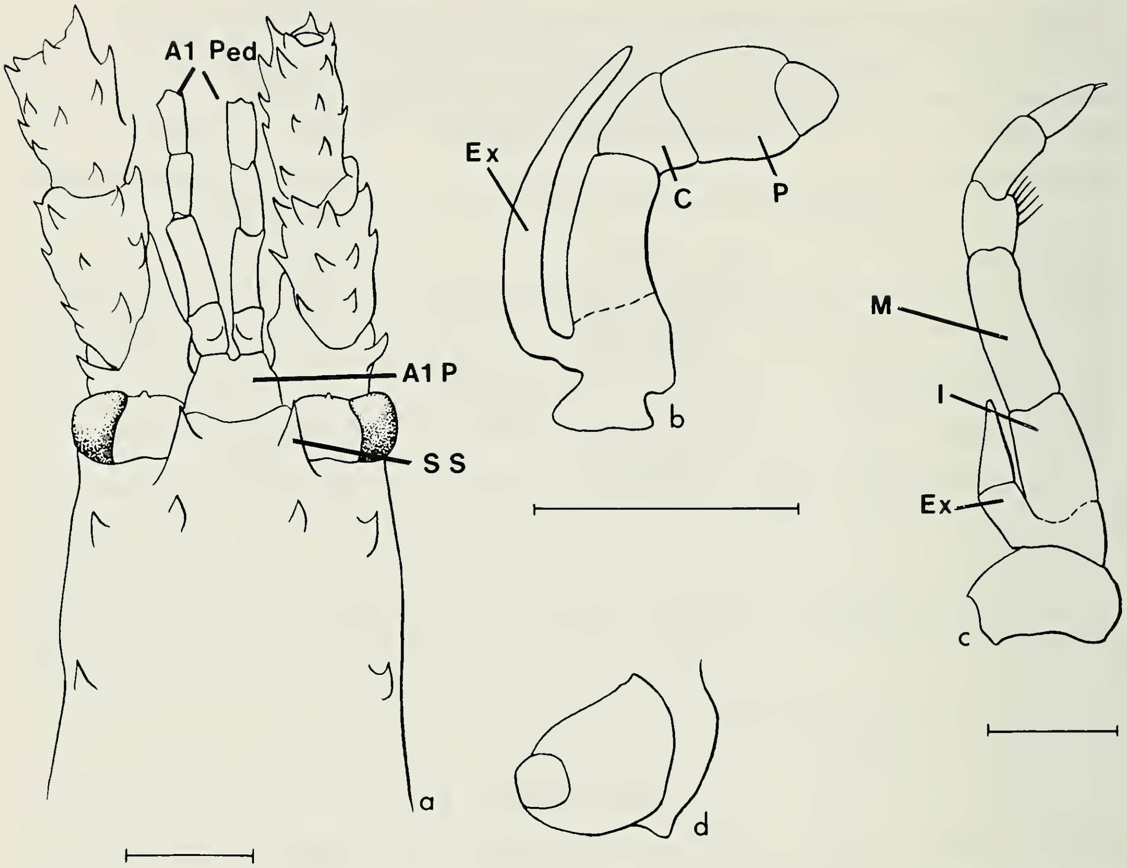

Fig. 1. Puerulus of *P. marginatus:* a, Dorsal view of anterior portion; b, Second maxilliped; c, Third maxilliped; d, Fifth thoracic sternite lateral view. Scale bars: a, 2 mm; b, 1 mm; c and d, 1 mm. Abbr. A1 P, Antennular Plate; A1 Ped, Antennular Peduncle; C, Carpus; Ex, Exopod; I, Ischium; M, Merus; P, Propodus; SS, Supra-orbital Spines.

spines vary in length between 0.3 and 0.7 the distance to the anterior margin of the antennular plate and reach just to the anterior margin of the eyestalks (Fig 1a). In *P. penicillatus* these supra-orbital spines extend past the anterior margin of the eyestalks to or beyond the anterior margin of the antennular plate. The antennular peduncle is relatively long and slender in *P. marginatus* with a width/length ratio of approximately 1:8.4. The antennal flagella tapers distally and is not spatulate. The antennal peduncle is robust and heavily spined with 5–6 spines on the dorsal segment of the second segment.

The exopod of the second maxilliped in *P. marginatus* extends to at least the carpal/propodal articulation and can reach mid-propodus (Fig. 1b). Its greatest length in *P. penicillatus* is mid-carpus. The exopod of the third maxilliped in *P. marginatus* extends well past the ischial/meral articulation with its tip at 0.1 to 0.3 the length of the merus (Fig. 1c). In *P. penicillatus,* the exopod tip is below the ischial/meral articulation.

The fifth thoracic sternite in *P. marginatus* has a ventrally directed non-

Table 2.—Distinguishing characters of *P. marginatus* and *P. penicillatus* at the puerulus stage.

Character	*P. marginatus* (n = 30)	*P. penicillatus* (n = 4)
Supra-orbital spines, apex of	0.3–0.75 length antennular plate	≥ length antennular plate
Antennular peduncle, W/L ratio ($\bar{x}$)	1:8.4	1:6.1
Second maxilliped, apex of	Carpal/propodal articulation to mid-propodus	Mid-carpus
Third maxilliped, apex of	0.1 length merus to 0.3 length merus	0.95 length ischium
Fifth thoracic sternite	Ventrally directed weak nub	Posteriorly directed strong spine

acute nub (Fig. 1d) in lateral view in contrast to *P. penicillatus* which has a posteriorly directed acute spine here. Table 2 summarizes the features which separate the two Hawaiian *Panulirus*. Comparisons with other species are discussed later.

The post-pueruli bear all the distinguishing features of the adults, although usually in a less developed state. In *P. marginatus* this includes the presence of only 2 instead of 4 large spines on the antennular plate (Fig. 2a vis. 2b), and the presence of an uninterrupted dorsal transverse groove on the abdominal somites in contrast to *P. penicillatus* where the groove is medially interrupted. A summary of diagnostic features in the post-puerulus is given in Table 3.

Discussion

Information is available on pueruli of the *P. japonicus* group for *P. japonicus* (Ortmann 1891; Nakazawa 1917; Kinoshita 1934), *P. longipes femoristriga* (Michel 1971), and *P. cygnus* (George 1962). *Panulirus japonicus* is reported to have a vestigial exopod on the third maxilliped (key in Deshmukh 1966) and no spine on the fifth thoracic sternum. Ortmann's (1891) figure 3 shows the supra-orbital spines extending beyond the eyestalks, but not to the anterior margin of the antennular plate; however, Nakazawa's (1917) figure 3 shows the supra-orbital spines extending beyond the eyestalks to the anterior margin of the antennular plate. This figure also shows 5 or 6 spines on the dorsal surface of the second segment of the antennal peduncle. *Panulirus longipes femoristriga* has supra-orbital spines not reaching the anterior margin of the antennular plate, a long slender antennular peduncle with a W/L ratio of 1:8.8, and a more lightly spined (3–4

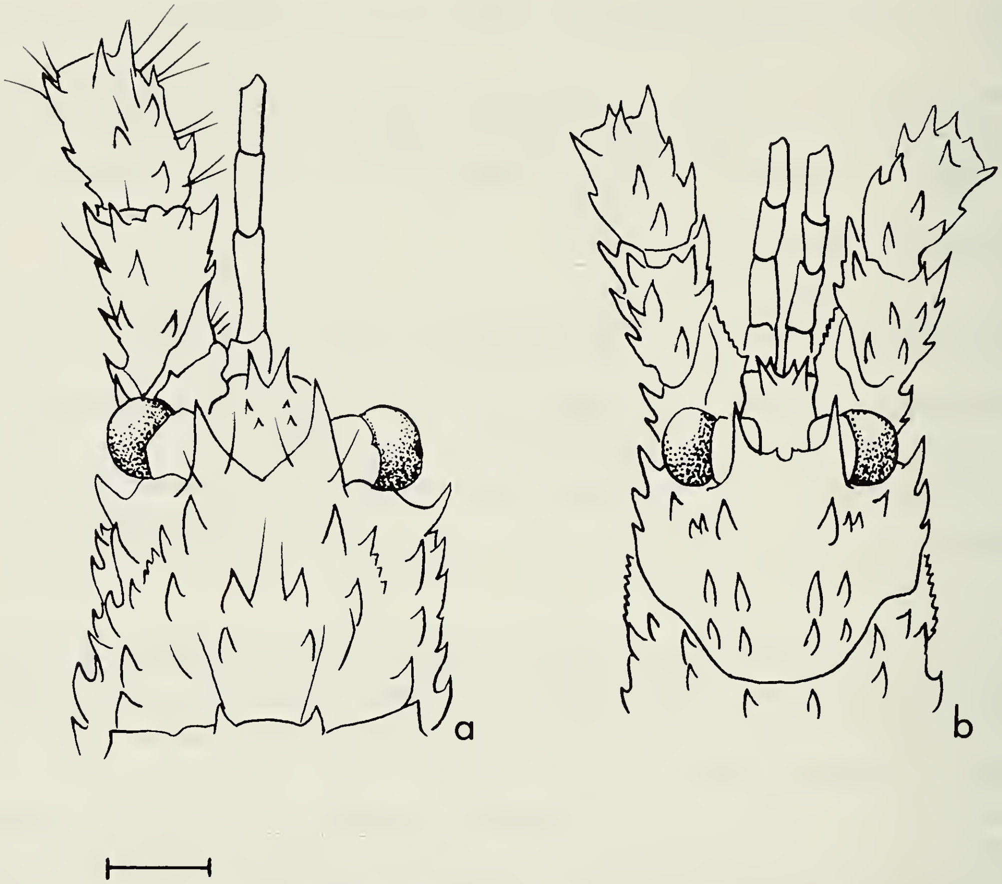

Fig. 2. Post-puerulus of: a, *P. marginatus*; b, *P. penicillatus*. Scale bar: 2 mm.

spines) dorsal surface for the second segment of the antennal peduncle. The exopods of the second and third maxillipeds are well developed, reaching almost to the propodal/dactyl articulation on the second, and well past the ischial/meral articulation on the third. The fifth thoracic sternite has an acute spine directed ventrally. *Panulirus cygnus* has a second maxilliped exopod reaching to the carpal/propodal articulation, a third maxilliped exopod reaching to at least the base of the merus, and no tooth on the posterior margin of the Thoracic sternite. Data on the other features were not given by George (1962).

Panulirus japonicus group adults are characterized by flagellate exopods on the second and third maxillipeds, an antennular plate with only two large spines, and uninterrupted dorsal transverse grooves on the five abdominal somites according to George and Holthuis (1965). *Panulirus penicillatus* is considered by them to be the most closely related Indo-Pacific species outside the group. Since *P. marginatus, P. longipes femoristriga, P. cygnus,* and the related *P. penicillatus* all have well developed third maxilliped exopods, the "vestigial" exopod of *P. japonicus* is difficult to explain, and should be confirmed by reexamination. If indeed it is vestigial

Table 3.—Distinguishing characters of *P. marginatus* and *P. penicillatus* at the post-puerulus stage.

Character	*P. marginatus* (n = 6)	*P. penicillatus* (n = 13)
Supra-orbital spines, apex of	0.5–1.0 length antennular plate	≥ length antennular plate
Supra-orbital spines, medial region	Smoothly concave	Notched, with small teeth laterally
Antennular plate, number of spines	2 (plus spinules)	4 (plus spinules)
Antennular peduncle, W/L ratio ($\bar{x}$)	1:10.6	1:8.2
Antennal peduncle, W/L 2nd seg. ($\bar{x}$)	1:1.85	1:1.48
Second maxilliped, apex of	Mid-propodus	Mid-carpus to carpal/propodal articulation
Third maxilliped, apex of	0.1 length merus to 0.3 length	0.2 length ischium to 0.6 length
Abdominal somites	Dorsal transverse groove uninterrupted	Groove interrupted medially

as described, it would provide a link from the *P. japonicus* group to other *Panulirus* species which have vestigial exopods in the puerulus stage, and indistinct non-flagellate exopods in the adult stage.

Differentiation of pueruli of the two local species is decisive. However, some confusion may be encountered in separating *P. marginatus* pueruli from others in the *P. japonicus* group. If *P. japonicus* really has a vestigial third maxilliped exopod this would be the clearest separation; otherwise, the greater relative length of the supra-orbital spines in *P. japonicus* might separate the two. *Panulirus longipes femoristriga* can be separated by its less spinose antennal peduncle and the acute tooth on the fifth thoracic sternite. For *P. cygnus,* the only good features for separation are apparently the slightly greater development of the maxilliped exopods in *P. marginatus*. In the *P. japonicus* group, only the puerulus of *P. pascuensis* has not been described. Clearly, the known pueruli of this species group show a homogeneity of most features, which in our opinion, validates George and Holthuis's (1965) recognition of these species as more closely related to each other than to other *Panulirus* species.

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RECTIFICATIONS IN THE NOMENCLATURE OF SOME INDO-PACIFIC LITTORINIDAE—II[1]

Joseph Rosewater and Dietrich Kadolsky

Abstract.—*Trochus quadricinctus* Mühlfeld, 1824, a previously overlooked senior synonym, has priority over *Littorina leucosticta* Philippi, 1847. *Nodilittorina* (*Granulilittorina*) *hawaiiensis,* nomen novum, replaces the junior primary homonym, *Littorina picta* Philippi, 1846, *non Litorina obtusata picta* Menke, 1845. *Litorina rubra* Anton, 1838, formerly considered unrecognizable, is placed in synonymy with *Nodilittorina* (*Nodilittorina*) *pyramidalis* Quoy and Gaimard, 1833.

Introduction

Need for the following nomenclatorial changes has come to light subsequent to the classification of Indo-Pacific Littorinidae, subfamily Littorininae, proposed by Rosewater (1970).

I. *Nodilittorina* (*Granulilittorina*) *quadricincta* (Mühlfeld, 1824)

Trochus quadricinctus Mühlfeld, 1824:210, pl. 7, fig. 6a, b [lectotype figure; original locality, East Indies Sea, here restricted to Bombay, India]; not *Trochus quadricinctus* S. V. Wood, 1842:531 [nomen nudum].

Litorina leucosticta Philippi, 1847:162, pl. 3, fig. 11 [lectotype figure; Bombay, India]; Rosewater, 1970:497, pl. 384, figs. 1–5; pl. 385.

Melaraphe subgranosa Dunker, 1866:913 [type in Berlin Museum?; Madras [India]]; Frauenfeld, 1867:9, pl. 1, figs. 10a, b [not fig. 10c which = *G. millegrana* (Philippi, 1846)].

Littorina leucostica 'Philippi', Tryon, 1887:299 [error for *L. leucosticta* Philippi, 1847].

Original description.—One of us (Kadolsky) has translated into English Mühlfeld's description of *Trochus quadricinctus* which, together with his illustrations, gives an excellent impression of the species identity:

> *Trochus quadricinctus.* The four-ridged top snail. The egg-shaped, bulgy, weakly wrinkled, transversely keeled, brown-greenish, at the base white shell has a very wide, almost round aperture.

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[1] The first paper by this title appeared in Proceedings of the Biological Society of Washington 92(4), 1979, pp. 773–782.

> The 4.5 lines [9.8 mm] long and 3–3.5 lines [6.5–7.6 mm] wide snail is longitudinally delicately wrinkled and transversely fairly narrowly striated and studded with elevated ridges or edges. Of the 4 whorls with which the shell is provided, the first and largest, at the base white one, has 4; the second has only two; and the third has only one edge which appears to be embellished by white and brown alternating elongate spots, like the other (edges). The wide aperture is entire; it has a slightly sickle-shaped, widely reflected and grown-on brown colored columella lip and a toothed, white and brown spotted shell lip. The throat and the interior is brown. The whereabouts are the East Indian Sea.

Remarks.—Rosewater (1970) overlooked the earlier name, *Trochus quadricinctus* Mühlfeld, when constructing the synonymy of this species. So far as we can determine the name *quadricinctus* has not been used by malacologists in primary zoological literature since it was introduced. The name it supercedes, *Litorina leucosticta* Philippi, is nearly as obscure, having been recognized only since Rosewater (ibid.) used it; consequently, in our opinion *T. quadricinctus* should be allowed priority.

Trochus quadricinctus is the nominate subspecies of a group of three inhabiting southeast Asia and the western Pacific and some south Pacific islands: *Nodilittorina* (*Granulilittorina*) *quadricincta quadricincta* (Mühlfeld, 1824). This change will also affect the nomenclature of two other nominal species, which are subspecies of the *Nodilittorina quadricincta* species group, as follows: *Nodilittorina leucosticta biangulata* (von Martens, 1897) becomes *Nodilittorina quadricincta biangulata* (von Martens, 1897) (see Rosewater ibid., p. 499); and *Nodilittorina leucosticta feejeensis* (Reeve, 1857) becomes *Nodilittorina quadricincta feejeensis* (Reeve, 1857) (see Rosewater ibid., p. 500).

II. *Nodilittorina* (*Granulilittorina*) *hawaiiensis,* nomen novum

Littorina picta Philippi, 1846:139 (lectotype in British Museum (N.H.); ad insulas Sandwich); as *Litorina picta* Philippi, 1847:166 [not *L. picta marmorata,* ibid., p. 167, pl. 3, fig. 26, from Luzon, Philippines = *G. millegrana* Philippi]; Rosewater, 1970:503; not *Litorina obtusata picta* Menke, 1845:57 (Helgoland); Dautzenberg and Fischer 1915, p. 91.

The new name, *Nodilittorina* (*Granulilittorina*) *hawaiiensis,* is proposed here as a replacement name for the endemic Hawaiian *Nodilittorina, Littorina picta* Philippi, 1846, because as a junior primary homonym of *L. obtusata picta* Menke, 1845, it must be rejected permanently. Nearly all authors subsequent to Menke either have overlooked his ''*picta*'' or ignored it, including Küster and Weinkauff (1853–1882), Weinkauff (1883), Tryon (1887), and Sherborn (1902–1933). Both Whipple (1965) and Rosewater

(1970) overlooked the name in their monographs. The type-specimen of *Nodilittorina hawaiiensis* is the lectotype of *Littorina picta* Philippi selected by Rosewater (1970:504).

III. *Nodilittorina* (*Nodilittorina*) *pyramidalis* (Quoy and Gaimard, 1833)

Litorina rubra Anton, 1838:53, no. 1923 (no locality); not *Litorina scabra rubra* Philippi, 1847:222, nor *Litorina angulifera rubra,* ibid.: 224.

Original description.—One of us (Kadolsky) has translated into English Anton's brief description:

> *Litorina rubra.* Acutely oval, four flattened whorls, the lowermost with two rows of completely separated little pearls, the 2nd and 3rd whorl with one row (each); brown-red, tubercles white; non-umbilicate; columella very broad; aperture ovate. Width 1.5‴ [3.3 mm], height 2‴ [4.4 mm].

Remarks.—This species name either has been ignored or listed as a questionable entity because it was not figured originally and there is no known type-specimen (see Tryon 1887:260). Anton's reference to an acutely oval shell with two rows of white nodules ("pearls") on the body whorl, and one row each on spiral whorls, clearly narrows the identity to *Nodilittorina pyramidalis* under which *Litorina rubra* Anton, 1838, should be listed as a junior synonym.

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RANGE EXTENSION AND SUPPLEMENTARY DESCRIPTION OF *BATHYCONCHOECIA DEEVEYAE* (OSTRACODA: HALOCYPRIDIDAE)

Louis S. Kornicker

Abstract.—The halocyprid ostracode species *Bathyconchoecia deeveyae* Kornicker, 1969 is reported from the western Atlantic off Surinam. Previously it was known only from the eastern Pacific and Indian oceans. Because the single specimen from the western Atlantic is a female more mature than the unique holotype, it is described and illustrated.

Introduction

The R/V *Knorr,* operated by the Woods Hole Oceanographic Institution, collected in 1972 at a depth of 508–523 m in the western Atlantic off Surinam a bottom sample containing a single specimen of *Bathyconchoecia deeveyae* Kornicker, 1969. This species had previously been known from single specimens collected in the eastern Pacific off Peru at a depth of 520 m (Kornicker 1969:403), and off the southwest coast of India in a vertical plankton haul from 200 to 0 m (George 1971:141). The Indian specimen is an adult male. The holotype of *B. deeveyae* from off Peru is a female at the A-1 or A-2 stage of development. The specimen from off Surinam is more mature (A-1 or adult female) than the holotype, and is therefore, described and illustrated here.

Bathyconchoecia deeveyae Kornicker, 1969
Figs. 1–4

Bathyconchoecia deeveyae Kornicker, 1969:403, pl. 1, figs. 1, 2.—Kornicker and Angel, 1975:3.

Holotype.—USNM 123335, juvenile female, carapace preserved in alcohol; slide of appendages lost.

Type-locality.—Pacific Ocean, 07°53′S, 80°30′W, depth 520 m, benthic trawl.

Material.—USNM 157494, female (A-1 instar or adult), western Atlantic, off Surinam, 07°45′18″N, 54°24′00″W, depth 508–523 m, R/V *Knorr,* cruise 25 (Surinam transect), sta 297, 28 Feb 1972, epibenthic sled.

Description of female (A-1 instar or adult) (Figs. 1–4).—Carapace with linear dorsal margin except for slight bulge near middle, and also at posterior corner of each valve in vicinity of glands (Fig. 1a, b); anterodorsal corner

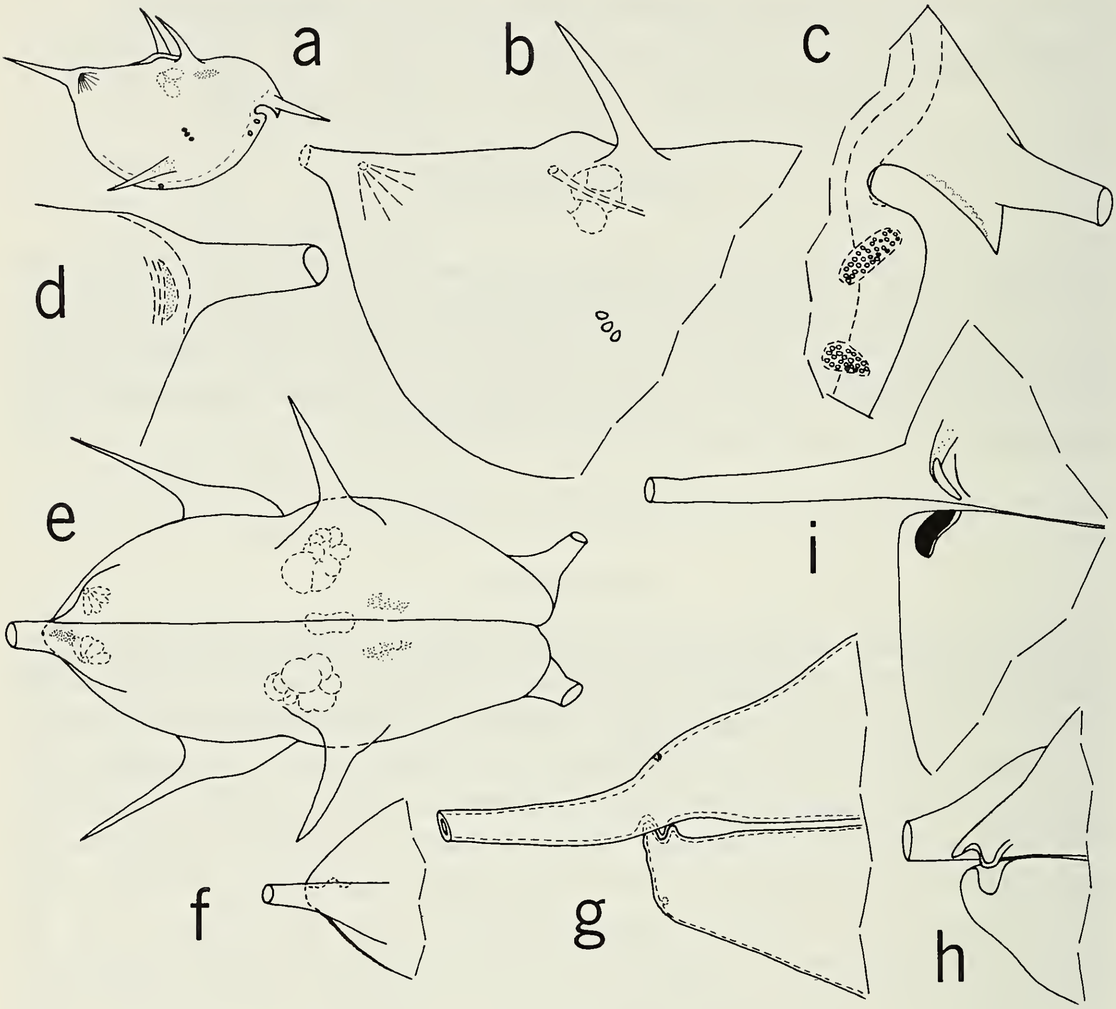

Fig. 1. *Bathyconchoecia deeveyae,* USNM 157494: a, Lateral view of complete specimen; b, c, Details from "a"; d, Left lateral view of posterodorsal part of complete specimen showing main tooth of right valve (stippled) seen through translucent left valve; e, Dorsal view of complete specimen excluding tips of anterior and posterior spines; f, Detail of dorsal end of "e" showing configuration of posterior hingement; g–i, Ventral views of posterior end of valves showing posterior hinge structures; g, With valves closed; h, With valves partly open; i, With valves flattened under cover slip (socket of left valve filled-in, tooth of right valve not filled-in).

evenly rounded except for long spine on right valve; rostrum with pointed tip and long spine pointing forward and outward (Fig. 1a–d).

Ornamentation (Fig. 1a, e): Right and left valves with 2 anterior spines, 2 dorsal spines near middle, and 2 lateral spines below valve middle; right valve with additional posterior spine. Surface with abundant shallow punctae but without frills between punctae.

Central adductor muscle attachments (Fig. 1a, b): Consisting of 3 small oval scars.

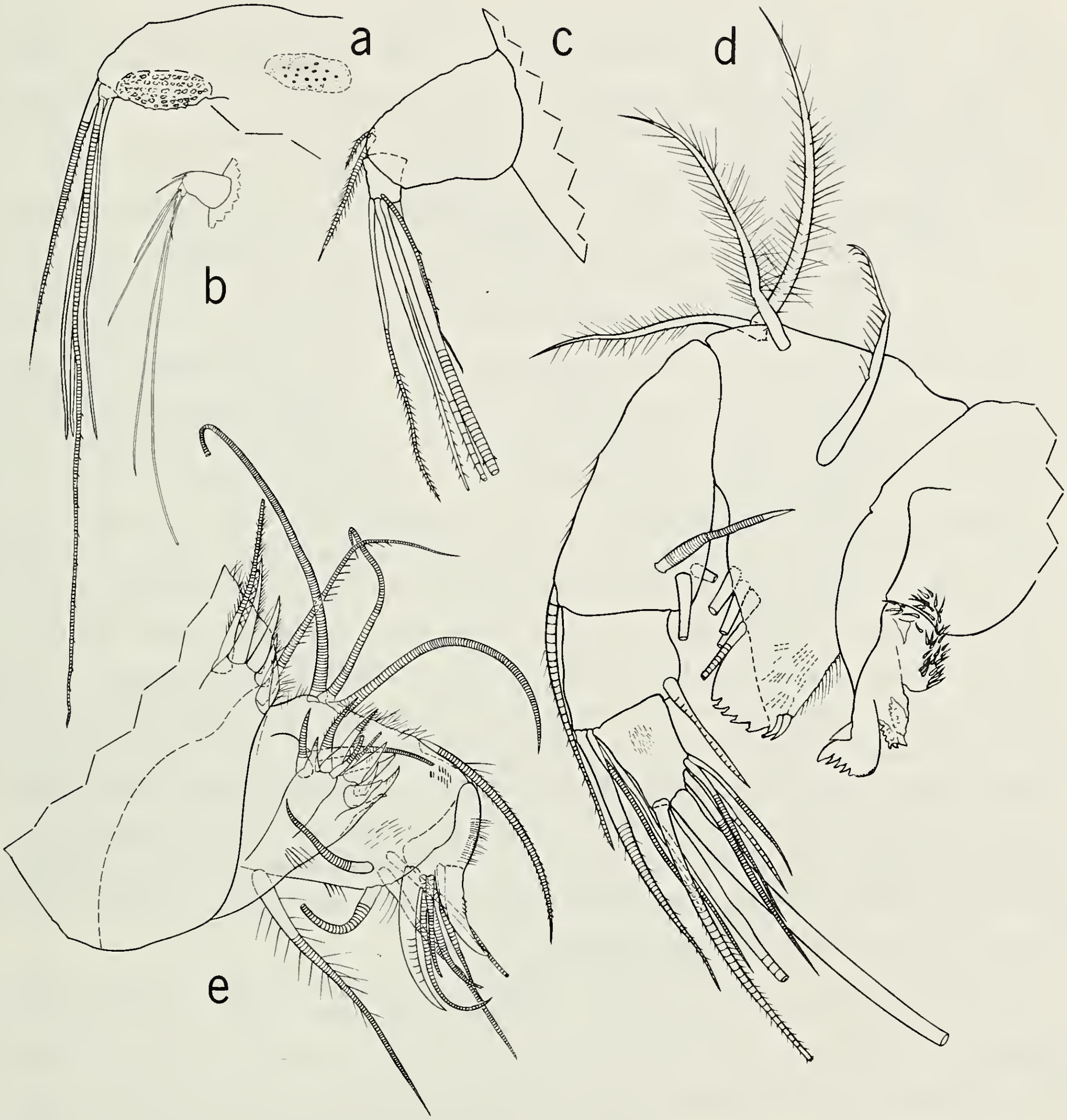

Fig. 2. *Bathyconchoecia deeveyae,* USNM 157494: a, 1st antenna; b, Endopodite of 2nd antenna; c, Detail of "b"; d, Mandible; e, Maxilla.

Glands (Fig. 1a–c, e): Symmetrically located in posterodorsal corner of each valve, opening at apex of small mound. 3 additional glandular openings on infold: 2 just ventral to incisur, 1 near middle of ventral margin (Fig. 1a, c).

Hingement (Fig. 1d, f–i): Posterodorsal corner of right valve with elongate tooth fitting into socket of left valve; elongate tooth anterior to socket of left valve fitting into poorly defined socket anterior to tooth of right valve; edge of valve posterior to socket of left valve fitting into depression posterior to tooth of right valve (Fig. 1h).

Size: USNM 157494: length excluding spines 1.49 mm; length including spines 2.31 mm; height excluding spines 1.10 mm; height including spines 1.42 mm; width including spines 1.35 mm; maximum width of carapace (excluding spines) anterior to lateral spines 0.75 mm; maximum width of carapace (excluding spines) posterior to lateral spines 0.68 mm.

First antenna (Fig. 2a): Shaft short with indistinct segmentation. Oval brown pigmented area present at proximal end; darker pigment cells clustered near middle of oval. Brushlike structure with about 207 filaments in about 9 rows, each with about 23 filaments. Dorsal bristle on segment following brushlike structure stout, spinous, about two-thirds length of brushlike filaments. Terminal segment with 4 bristles (3 slightly longer than bristle on previous joint, 1 much longer, reaching well past brushlike filaments and with widely scattered marginal spines).

Second antenna: Protopodite bare. Exopodite with 9 joints: joint 1 with short medial bristle extending past distal end of 2nd joint; joints 2–8 with long bristles with natatory hairs; 9th joint with 4 bristles (1 small, bare; 1 slender, about same length as joints 2–9, with scattered small spines; 1 slender, about same length as joint 1, with scattered small spines; 1 long with natatory hairs); joints 2–7 with minute spines forming row along part of distal margin. Endopodite 2-jointed (Fig. 2b, c): 1st joint with 2 spinous bristles (proximal of these less than one-half length of other); 2nd segment with 3 distal bristles (middle bristle longer than others; all with widely scattered faint spines on proximal part), and 2 longer bristles on small pedestal, both with widely scattered small spines (shorter of latter 2 bristles about three-fourths length of other bristle).

Mandible (Figs. 2d, 3a, b): Coxa: proximal list with about 11 minute teeth; distal list obscure but with about 12 teeth (Fig. 3b); short stout bristle on anterior ventral corner of spinous anterior part of coxa missing on both limbs. Basis with 1 distal anterior bristle, 3 distal lateral bristles near anterior margin, 1 hirsute medial bristle near middle and 3 hirsute dorsal bristles near anterodorsal corner; ventral incisor edge with 5 teeth followed by single tooth, a short tubelike bristle and a short clawlike bristle (Fig. 3a). Endopodite: 1st joint with 1 distal dorsal bristle and 3 bristles near distal ventral corner (2 medial, 1 lateral); 2nd endopodial joint with 1 distal ventral bristle and 3 distal dorsal bristles; 3rd joint with 4 ventral bristles (1 on lateral side) and 3 terminal bristles (ventral of these very long, clawlike).

Maxilla (Fig. 2e): Precoxale endite with 2 long, slender, ringed bristles (distal of these could be on basis) and 5 short, stout, hirsute unringed bristles; coxale endites each with 6 short bristles. Basis with 1 short lateral bristle. Endopodite: 1st joint with 4 anterior bristles (3 proximal, 1 distal), 5 posterior bristles (1 proximal and 4 near distal ventral corner); end joint with 2 stout claws and 4 slender bristles.

Fifth limb (Fig. 3c, d): Endopodite with 2 stout claws; endopodite plus

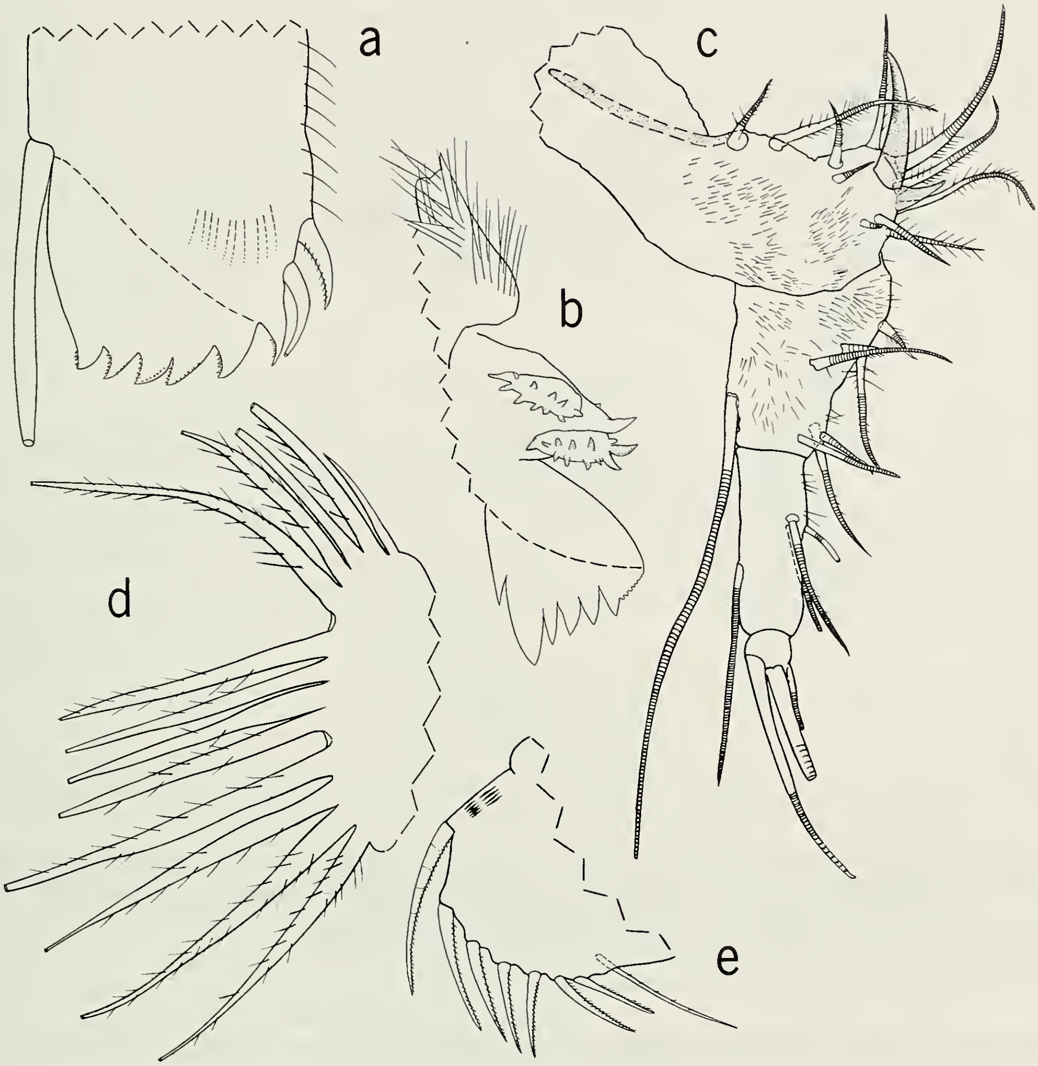

Fig. 3. *Bathyconchoecia deeveyae,* USNM 157494: a, b, Details from Fig. 2d; c, d, 5th limb; e, Left lamella of furca and single posterior bristle.

protopodite with total of about 11 slender ringed bristles. Exopodite: 1st joint with 1 very long, subterminal, dorsal bristle, and 7 short, slender, ringed bristles on or near ventral margin; 2nd joint with 1 subterminal dorsal bristle and 3 bristles near middle of ventral margin; end joint with 3 bristles (2 clawlike). Epipodial appendage with bristles forming 3 groups, each with 4 hirsute bristles (proximal group with 1 smaller additional bare bristle proximal to the 4 hirsute bristles).

Sixth limb (Fig. 4a, b): Protopodite with 1 spinous ventral bristle. Exopodite: 1st joint with 3 spinous ventral bristles (1 near middle, 2 terminal), 1 long terminal dorsal bristle, and 1 lateral bristle; 2nd joint with 4 bristles near ventral margin (2 medial, 2 lateral); 3rd joint with 1 ventral and 1 dorsal

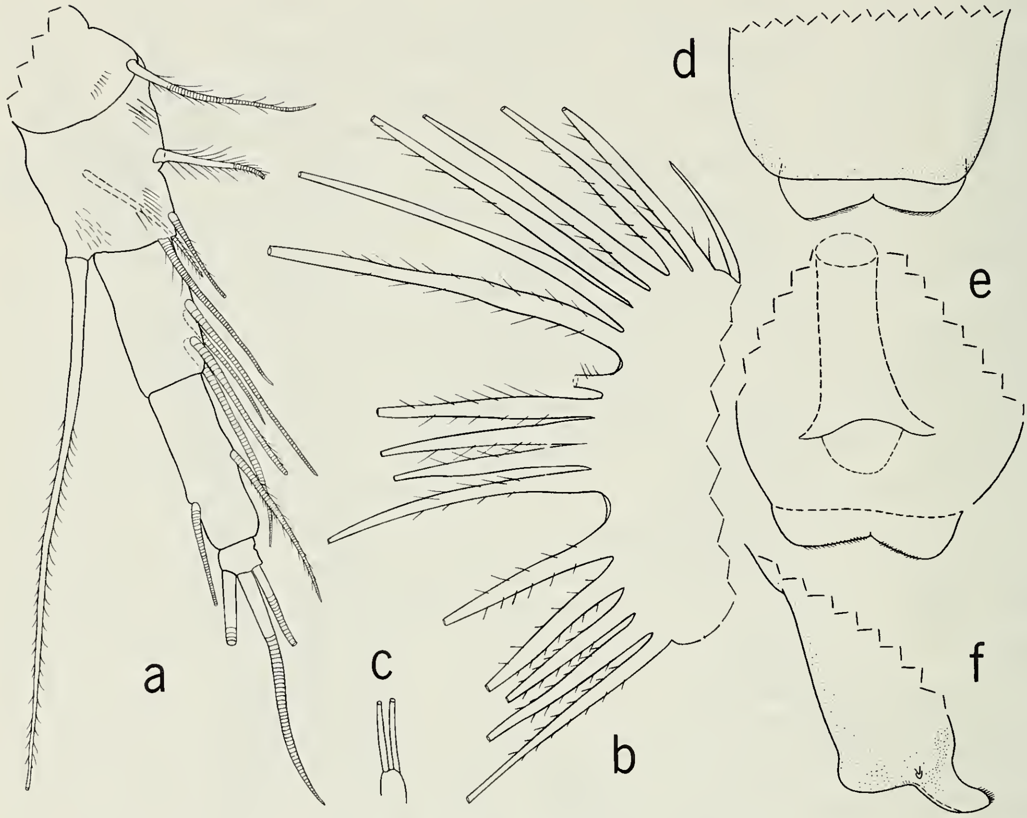

Fig. 4. *Bathyconchoecia deeveyae,* USNM 157494: a, b, 6th limb; c, 7th limb (distal part of bristles broken off on both limbs); d–f, Upper lip: d, Anterior view; e, Posterior view showing semicircular mouth and tubular esophagus (both dashed).

bristle; end joint with 3 bristles. Epipodial appendage consisting of hirsute bristles forming 3 groups of 6, 6, and 5 bristles (the former proximal group with additional smaller proximal bristle with small marginal spines or bare).

Seventh limb (Fig. 4c): Consisting of 2 bristles on small lobe (bristles broken on both appendages of specimen).

Furca (Fig. 3e): Each lamella with 7 claws with teeth along posterior margins; long unpaired, spinous bristle present following claws; claw 1 with 4 faint sutures.

Upper lip (Fig. 4d–f): Projecting posteriorly, terminating in thin divided lamina with posteriorly pointed spines along edge.

Bellonci organ: None observed.

Remarks.—The specimen from off Surinam is referred to *B. deeveyae* rather than to *B. septemspinosa* Angel, 1970, because of not having frills between punctae on the carapace surface (for illustration of frills see Kornicker and Angel 1975: fig. 9c, d). *Bathyconchoecia septemspinosa* has been collected only along the west coast of Africa. It is very closely related to *B. deeveyae,* and could be conspecific with it.

On the basis of the number of furcal claws, the specimen of *B. deeveyae* from Surinam is 1 stage older than the holotype of the species from the eastern Pacific. The adult male of *B. deeveyae* described by George (1971:143) bears 7 furcal claws, the same number on the specimen described herein. This suggests that the Surinam specimen is an adult. However, additional specimens and work are required before problems concerning taxonomic relationships of the widely separated specimens thus far collected can be resolved.

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OITHONA WELLERSHAUSI, NEW SPECIES, AND *O. SPINULOSA* LINDBERG, 1950 (COPEPODA: CYCLOPOIDA: OITHONIDAE) FROM THE MOUTH OF THE PEARL RIVER, CHINA

Frank D. Ferrari

Abstract.—Two tropical, inshore, rostrate, species of the genus *Oithona, O. wellershausi,* n. sp. and *O. spinulosa* Lindberg, 1950, are described from the mouth of the Pearl River, China. The relation of these two Indo-Pacific species to *O. brevicornis* Giesbrecht, 1891, is discussed.

Introduction

From 1954 to 1959 the Fisheries Research Unit of the University of Hong Kong conducted an investigation of the outflow of the Pearl River, from its mouth to the edge of the continental shelf. The study was directed by Dr. F. D. Onmanney. Plankton samples collected during the survey were later transferred to the Fisheries Research Station in Aberdeen, Hong Kong. In 1963 about 1500 of these samples were donated to the Smithsonian Oceanographic Sorting Center by Dr. A. J. Bruce, Research Officer at the Station.

During an examination of the copepods from about 50 surface samples, a number of oithonids of the genus *Oithona* were found in 15. The samples were collected between 22°13′ to 22°15′N and 113°52′ to 115°05′E. Most specimens could be assigned tentatively to common neritic species, *Oithona simplex, O. nana,* and *O. plumifera.* A separate study of these animals is to be published. A few specimens of two rostrate, inshore species, *Oithona wellershausi,* n. sp. and *O. spinulosa* Lindberg, 1950, were also found. Descriptions of these specimens are followed by a discussion of their relations to *O. brevicornis* Giesbrecht, 1891.

Oithona wellershausi, new species
Figs. 1D–F, 2E–H, 3E–H, 4D–F, 5G–L, 6E–H, 7E–H

? *Oithona brevicornis* forma *aruensis* (females only) Früchtl, 1924:88, fig. 44.

? *Oithona brevicornis* smaller form Wellershaus, 1969:282, figs. 107–108.

? *Oithona brevicornis* forma *minor* Nishida *et al.,* 1977:131, figs. 4a, b, 5a–c; Ushima, 1979:59, figs. 1–5.

Female.—Length range 0.45–0.50 mm (30 specimens); Pr/Ur ~ 1.3. Anterior Pr smoothly rounded dorsally, produced as a rostrum laterally (Figs.

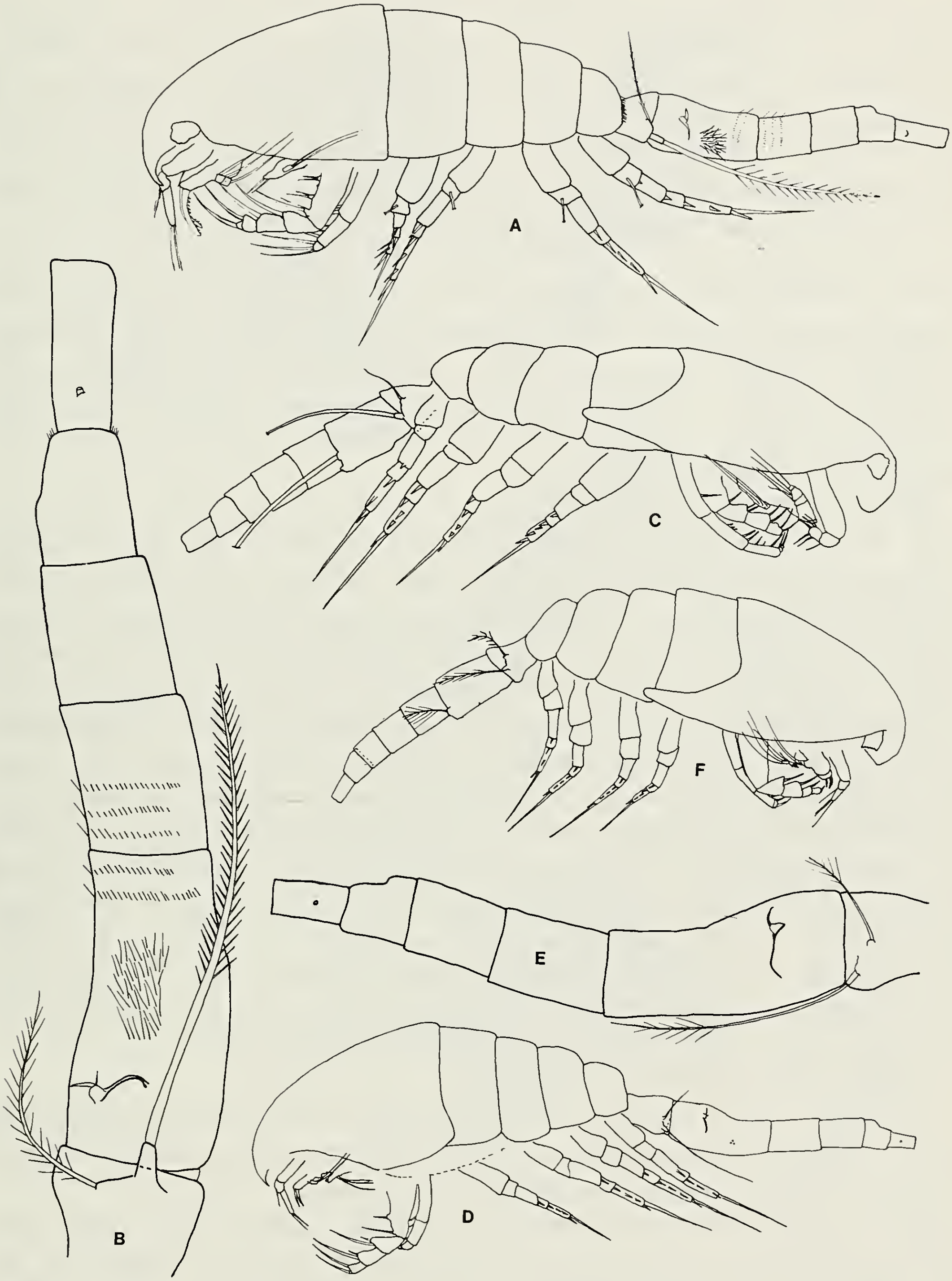

Fig. 1. *Oithona spinulosa*. Female: A, Habitus lateral; B, Ur lateral; Male: C, Habitus lateral. *Oithona wellershausi*. Female: D, Habitus lateral; E, Ur lateral; Male: F, Habitus lateral.

3F, G). Percentages of Ur segments & CR—14:36:16:14:9:11; CR (length/width) ~ 2.2/1. Bsp2Mn (Fig. 3E) 2 thick, slightly curved spines with spinules denser on lateral spine than medial; Re incompletely articulated with 5 setae, apical 2 broken on these specimens; Ri 4 setae, proximal with setules. Bsp1Mx1 (Fig. 4D) with usual armature of strong spines but ventralmost unusually long, more than 2× length of any other; Bsp2 3 thin spines, 2 with spinules; Re 1 segment, 3 setae; Ri 3 setae. ReP1–4 with 1-1-3, 1-1-3, 1-1-3, 1-1-2 Se (Figs. 6E, F, 7E, F). Bsp1–2P4 with hairs in rows or patches; SeRe1 minute; remaining Se increasing in length distally; Ri1 with hairs on posterior surface; Si1Ri2 unmodified Si2 slightly curved with flange on distal ¼; Si1Ri3 longer and thicker, slightly curved with flange on distal ½. P5 as in Fig. 1E. Armature near genital opening a single curved spine. CR (Fig. 5I) dorsal seta with setules; Se, inserted ⅓ distance from anterior margin, 0.9× length of CR.

Male.—Length range 0.43–0.46 mm (18 specimens); Pr/Ur ~ 1.6/1. Anterior Pr rounded dorsally, rostrum absent. Cph flap (Fig. 1C) extending beyond posterior articulation of Pg1. Pore signature (Fig. 4F) of 'hebes' type; anterodorsal cluster 2 slightly sinuous, parallel lines of organs oriented almost dorsoventrally; anterior line 11–13 organs, posterior 10–12; horizontal row essentially a single line of organs terminating posteriorly between 11th and 12th column; 12 columns, 1st immediately ventral to anterodorsal cluster; horizontal series, generally as a double row of organs along ventral edge of Cph and flap, except between 4th and 5th column as a single row. A2 segment 3 (Fig. 5J) longer than in female. Bsp2Mn (Fig. 3H) 2 thin spines with long spinules; Re 5 setae, apical brush-like; Ri 4 setae, proximal with setules. Bsp1Mx1 (Fig. 4E) with elongate ventral spine; Bsp2 3 thin spines; Re 1 segment, 3 setae; Ri 3 setae. ReP1–4 with 1-1-3, 1-1-3, 1-1-3, 1-1-2 Se (Figs. 6G, H, 7G, H). P4 lacking hairs and modified setae. P5 simple (Fig. 1F). Genital flap with 1 seta. CR (length/width) 1.6/1; all setae (Fig. 5L) relatively smaller than in female; dorsal apparently naked.

Remarks.—see Discussion section.

Etymology.—This species is named in honor of Dr. Stefen Wellershaus for his exemplary descriptions of the Cochin specimens and his valuable compilation of information on oithonid morphology.

Type-material.—Female holotype (USNM 184587) from Pearl River Plankton Collection; Cr. 0; St. 23; 22°13.2′N, 114°09.8′E, 3 Aug 1954, surface. 46 female and 13 male paratypes (USNM 184588) various stations from 22°13′ to 22°15′N and 113°52′ to 115°05′E, 1955–1959, surface.

Oithona spinulosa Lindberg, 1950

Figs. 1A–C, 2A–D, 3A–D, 4A–C, 5A–F, 6A–D, 7A–D

Oithona spinulosa Lindberg, 1950:259, figs. 1–2.

Oithona brevicornis typical form Wellershaus, 1969:279, figs. 103–106, 109–119.

Fig. 2. *Oithona spinulosa*. Female: A, A1; B, Mx2; Male: C, A1; D, Mx2. *Oithona wellershausi*. Female: E, A1; F, Mx2; Male: G, A1; H, Mx2.

? *Oithona brevicornis* forma *typica* Nishida *et al.*, 1977:53, figs. 1c–h, 2b.

Female.—Length range 0.57–0.64 mm (30 specimens); Pr/Ur ~ 1.3. Anterior Pr (Fig. 3C) dorsally tapering toward a distinctly rounded projection; laterally produced as a rostrum. Pg4 with tiny hairs on posterior edge. Per-

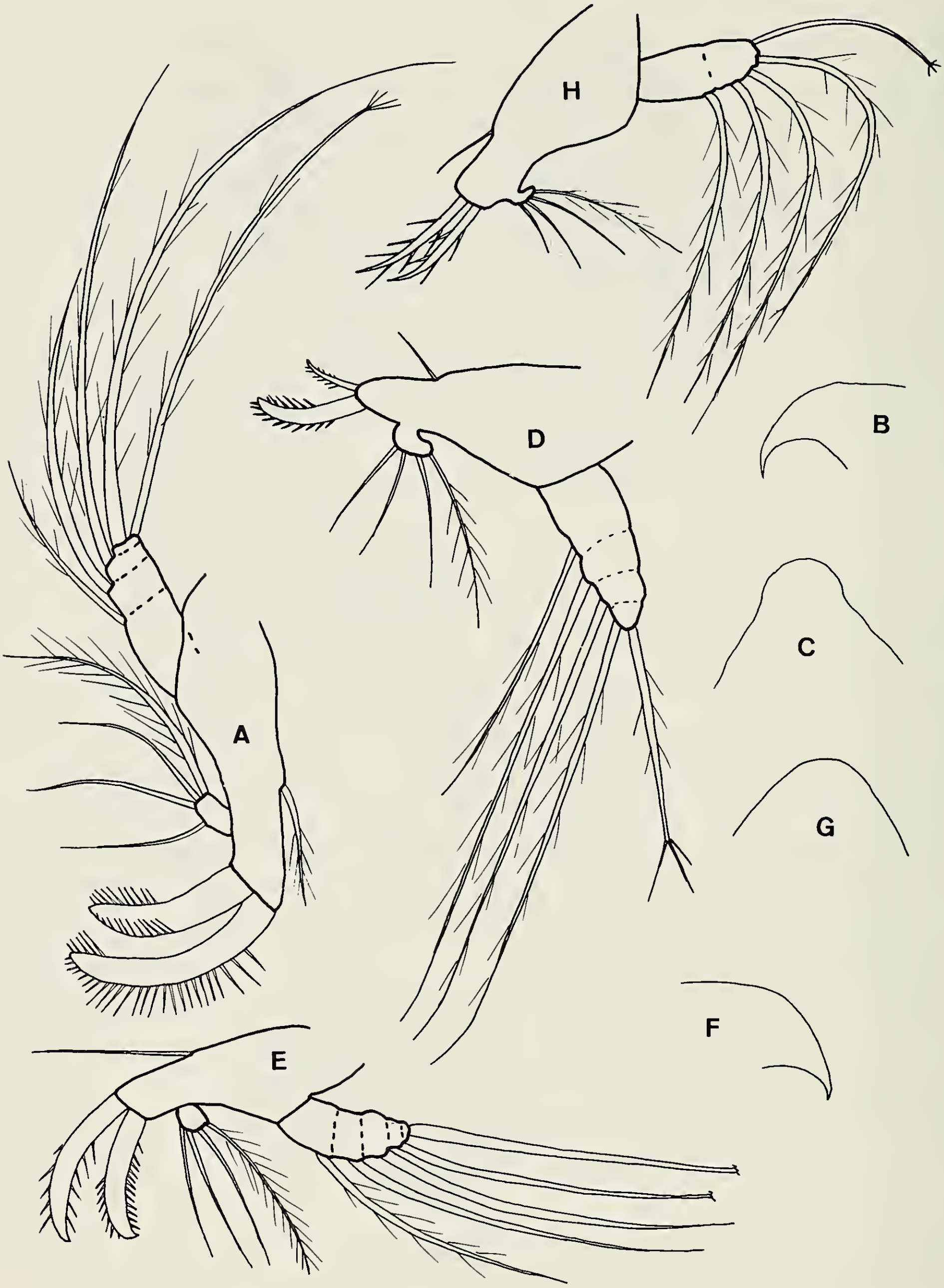

Fig. 3. *Oithona spinulosa*. Female: A, Mn; B, Forehead lateral; C, Forehead dorsal; Male: D, Mn. *Oithona wellershausi*. Female: E, Mn; F, Forehead lateral; G, Forehead dorsal; Male: H, Mn.

centages of Ur segments and CR—13:29:15:14:13:16. Genital segment (Fig. 1B) with a distinct patch of long hairs, midlaterally, both sides; beyond these, 2 rows of small hairs dorsolaterally, terminating ventrolaterally. Ur3 3 or 4 similar rows of small hairs, first row obscured if Ur3 is drawn into genital segment; 4th row present in 9 of 30 specimens. CR (length/

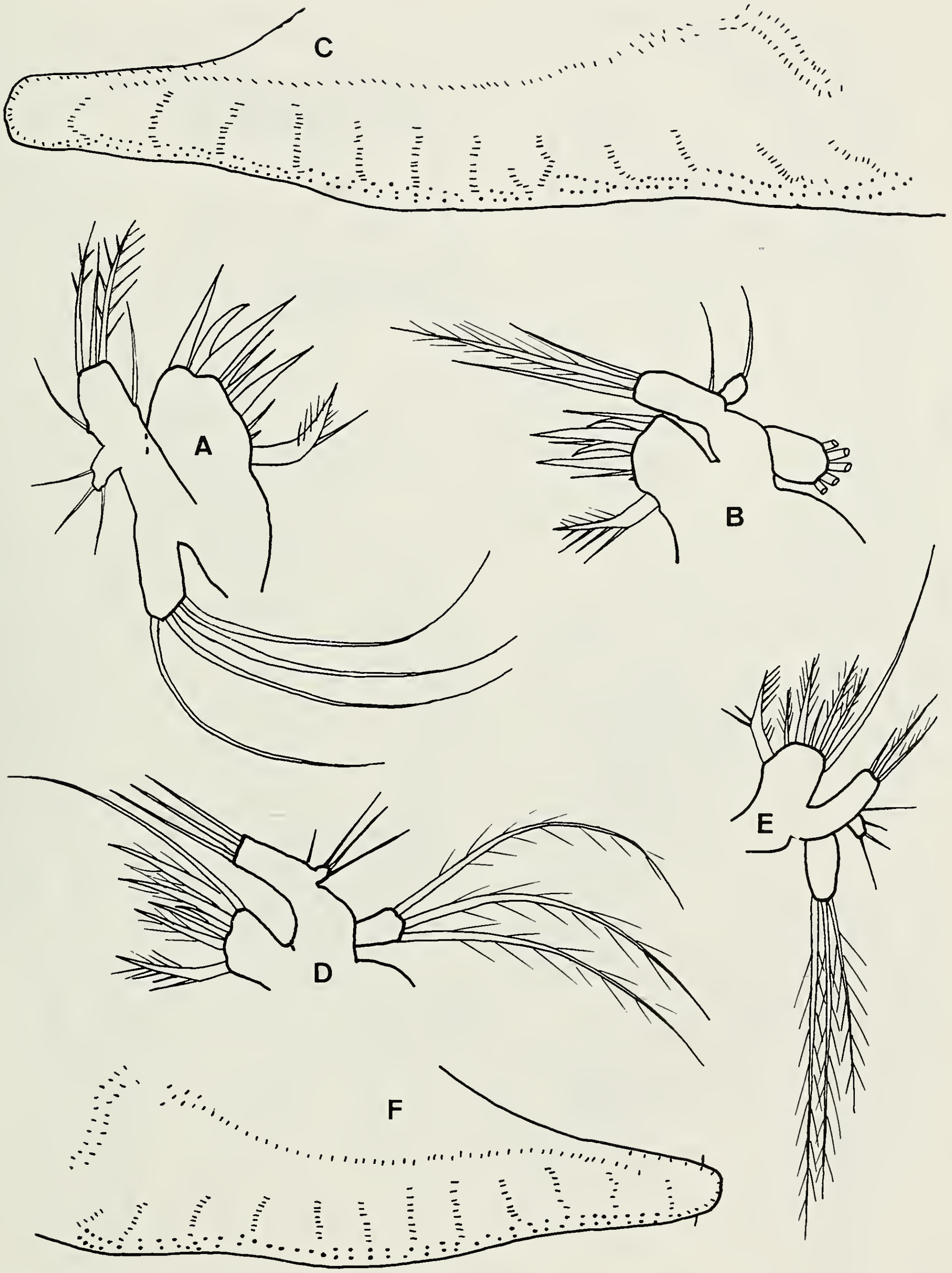

Fig. 4. *Oithona spinulosa*. Female: A, Mx1; Male: B, Mx1; C, Pore signature (right). *Oithona wellershausi*. Female: D, Mx1; Male: E, Mx1; F, Pore signature (left).

width) – 3.0/1. Bsp2Mn (Fig. 3A) 2 thick, curved spines, with spinules; Re 4 poorly articulated segments, 5 setae, apical brush-like; Ri 4 setae, proximal with setules. Bsp2Mx1 (Fig. 4A) 3 distal spines, 2 with spinules; Re 1 segment, 4 naked setae; Ri 3 setae. ReP1–4 (Figs. 6A, B, 7A, B) with 1-1-3,

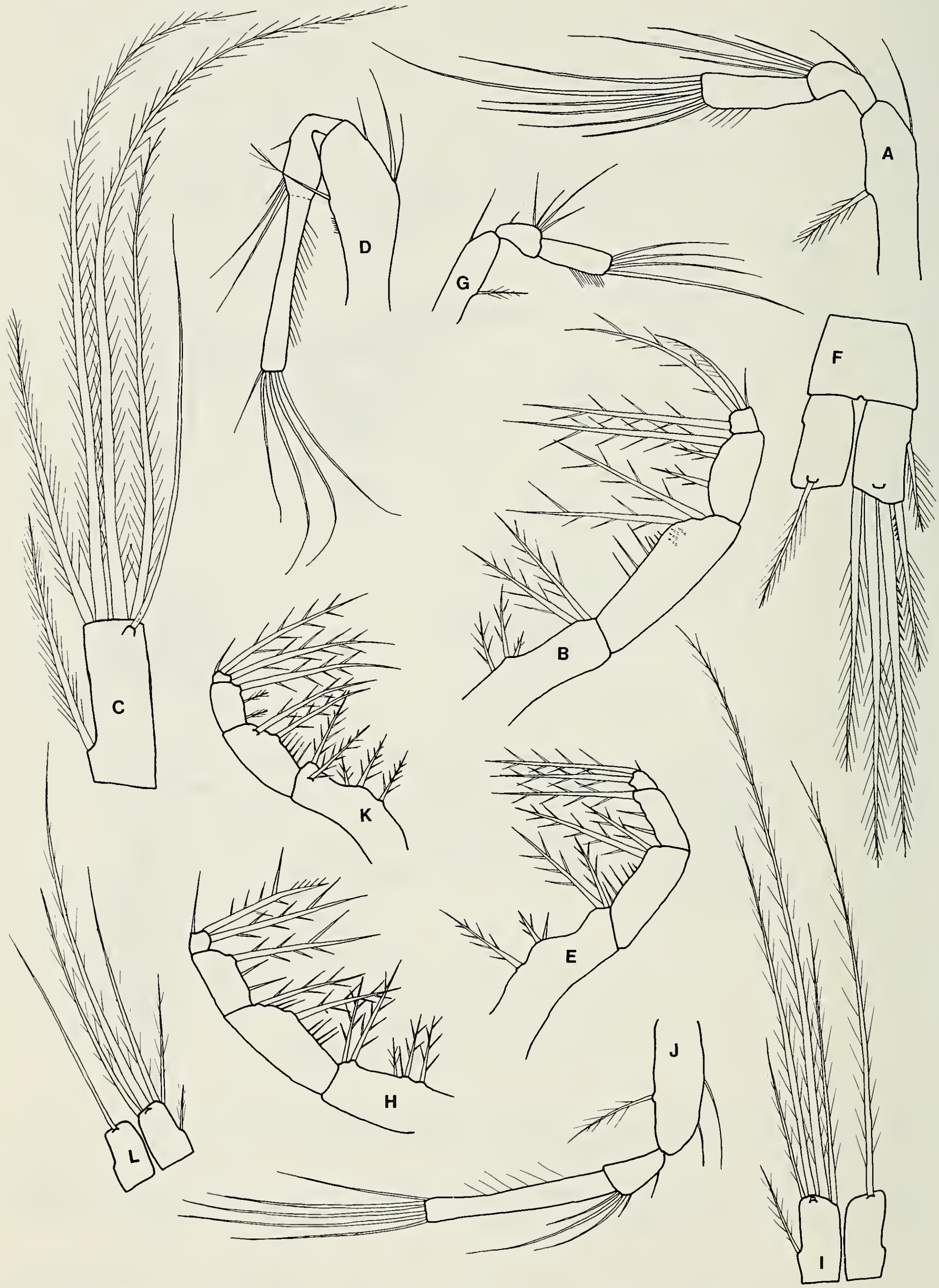

Fig. 5. *Oithona spinulosa*. Female: A, A2; B, Mxp; C, CR dorsal; Male: D, A2; E, Mxp; F, CR dorsal. *Oithona wellershausi*. Female: G, A2; H, Mxp; I, CR dorsal; Male: J, A2; K, Mxp; L, CR dorsal.

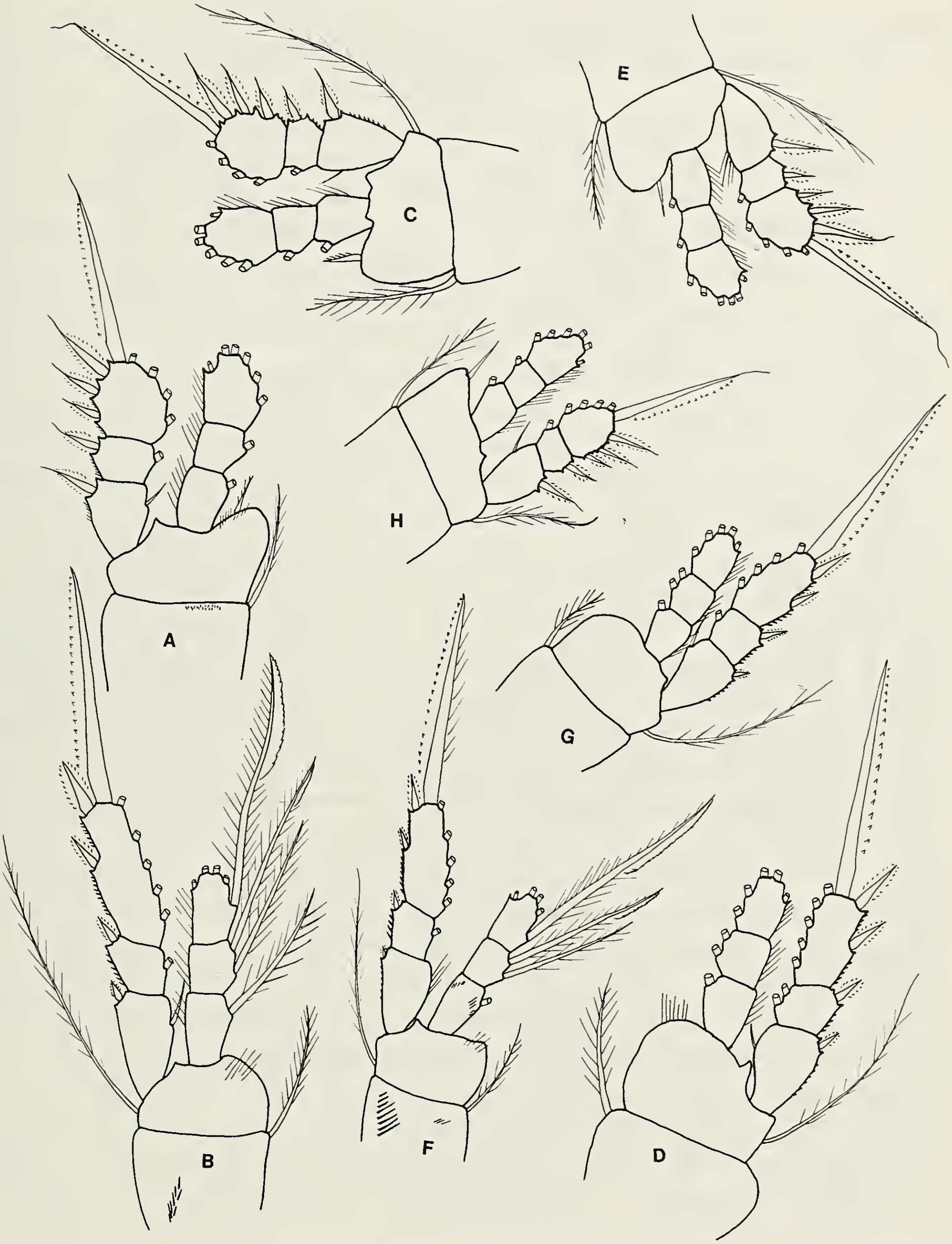

Fig. 6. *Oithona spinulosa*. Female: A, P1; B, P4; Male: C, P1; D, P4. *Oithona wellershausi*. Female: E, P1; F, P4; Male: G, P1; H, P4.

1-1-3, 1-1-3, 1-1-2 Se. Bsp1P4 with row of spinules; Bsp2 few hairs; Re1 Se smallest, remaining Se increasing in length distally; Si1Ri2 unmodified; Si2 straight, small flange on distal $^1/_5$; Si1Ri3 thicker, curved, with well-developed flange on distal ½. P5 (Fig. 1B) ventral seta thick, extending beyond pos-

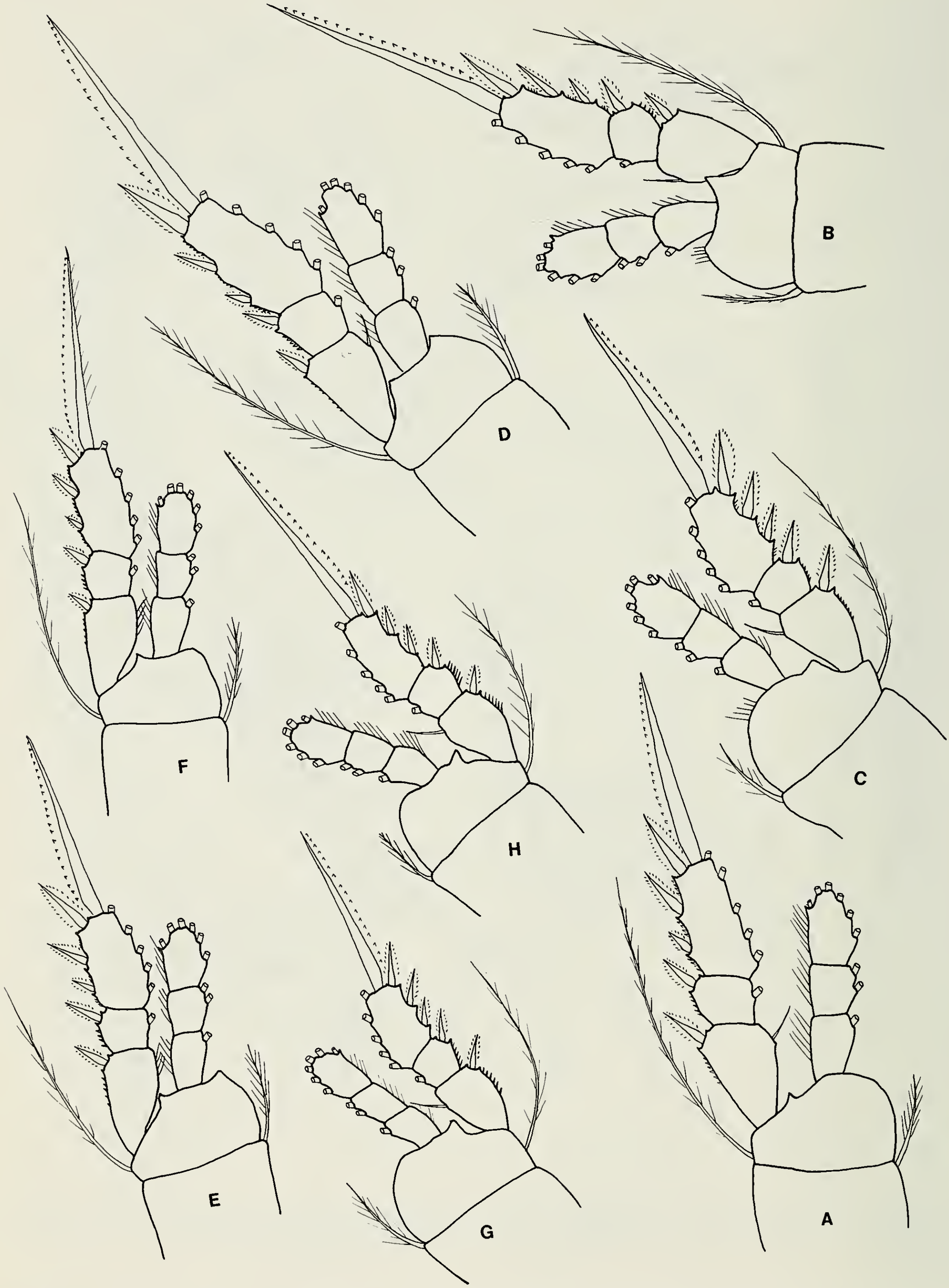

Fig. 7. *Oithona spinulosa*. Female: A, P2; B, P3; Male: C, P2; D, P3. *Oithona wellershausi*. Female: E, P2; F, P3; Male: G, P2; H, P3.

terior margin of Ur3, with thick hairs on distal ⅔. SeCR (Fig. 5C) inserted $^1/_5$ distance from anterior margin of CR; Se 1.5× length of CR; dorsal seta naked.

Male.—Length range 0.53–0.57 mm (30 specimens); Pr/Ur ~ 1.6. Anterior Pr rounded dorsally, rostrum absent. Cph flap (Fig. 1C) extending beyond posterior margin of Pg1. Pore signature (Fig. 4C) of 'hebes' type; anterodorsal cluster 2 lines of organs placed dorsolaterally, anterior line 16–17 organs, posterior 15–16; horizontal row anteriorly as double line of 8–9 organs and single line thereafter, terminating near dorsal end of 12th column; 12 columns, 1st ventral to anterodorsal cluster, 5th J-shaped; horizontal series a double row of organs along ventral edge of Cph and flap. A2 (Fig. 5D) indistinct articulation between segments 2–3; segment 3 elongate. Bsp2Mn (Fig. 3D) 2 dissimilar spines; ventral thick, slightly curved, with spinules, like those of female; dorsal smaller, thinner, slightly curved; Re 4 indistinctly articulated segments, with 5 setae, apical brush-like; Ri 4 setae, proximal with setules. Bsp2Mx1 (Fig. 4B) 3 long thin spines, middle armed; Re 1 segment, 5 setae; Ri with 1 seta. ReP1–4 (Figs. 6C, D, 7C, D) with 1-1-3, 1-1-3, 1-1-3, 1-1-2 Se. P4 lacks modified setae. P5 (Fig. 1C) ventral seta thick but broken on all specimens. Genital flap with 1 thick seta, broken on all specimens. CR (length/width) 2.0/1 (Fig. 5F); all setae reduced compared to female; Se inserted ⅓ distance from anterior border of CR, equal to length of CR; St4 (lateral-most) with spinules on proximal medial margin; St3 spinules on lateral margin; dorsal seta with setules.

Remarks.—(also see Discussion section) 8 females were found with 2 spermatophores (1 on each side) attached to an irregular plate at the ventral edge of each genital groove below the genital armature. An additional female had 3 spermatophores on the left side and 2 on the right. No fertilization tubules were apparent but all structures were in poor condition. Ushima (1979) noted sexual dimorphism in copepodid V of his *O. brevicornis* forma *minor.* A pair of setae are found on the first abdominal segment (Ur2 of that stage) in the males; these setae are absent on the females. I found several copepodid V's of *O. spinulosa.* Those that possessed extra setae on Ur2 also had a tiny cephalosome flap extending just beyond the articulation of the cephalosome and pediger 1. No integumental organs were present on the cephalosome or flap.

Discussion

Difficulties with small, inshore, rostrate, Indo-Pacific species of *Oithona* date from Giesbrecht's (1892) incomplete description of a new female from Hong Kong harbor, *O. brevicornis.* Giesbrecht found no males. His description notes a rostrum similar but not identical to *O. plumifera* and *O. similis,* relative proportions of various prosome and urosome segments, caudal rami considerably longer than the anal segment and 3 times as long as wide. Outer spines of the swimming leg exopods are identical to *O. nana,* 1-1-3, 1-1-3, 1-1-3, 1-1-2. Giesbrecht's illustrations (Table 34, figs. 6, 7) of a dorsal view of the whole animal and lateral view of the forehead, are generally uninstructive other than to confirm various body proportions. The setae of leg 5 and caudal ramus are not shown.

Rosendorn (1917) ascribes specimens of rostrate females with males from the mouth of the Congo River to *O. brevicornis.* Ferrari and Bowman (1980) note unique oithonids apparently found only in a large, western, tropical Atlantic river, the Amazon. Based on present distributional knowledge of estuarine and coastal copepods, it seems unlikely, as both Früchtl (1924) and Herbst (1964) suggest, that Rosendorn's specimens are identical to those Giesbrecht studied.

Früchtl (1924) attributes small (0.41–0.43 mm), inshore, rostrate females from his Sample 1, east exit of Sangi Manumbai, a marine channel between Wokam and Kobroör Islands of Kepulauan Aru, Indonesia, to a local race of *Oithona brevicornis,* which he named *O. brevicornis* forma *aruensis.* In his Table VII (p. 90) he compares these specimens to his designation of the typical form of *O. brevicornis,* Rosendorn's specimens. From that table, the basipod spines on the mandible are described as sharply tapered with strong spinules, not thick and blunt toward the ends. In the text Früchtl does not mention these spines in his discussion of the females but notes them with the males. Früchtl does mention that his specimens differ from Giesbrecht's in their remarkably small size, caudal ramus twice as long as wide, the external seta not twice the length of the caudal ramus, and differences in abdominal length ratios. These females seem similar to the new species, *O. wellershausi.* Früchtl's males of this form are larger (0.58 mm) than his females. Ferrari and Bowman (1980) note that sexual dimorphism in size for small species of *Oithona* is not pronounced. All males I have examined, which can be attributed to females by isolated co-occurrences in samples, are equal to or more often smaller than their conspecific females. Only 1 of Früchtl's 26 males occurred with his *O. brevicornis* forma *aruensis* in Sample 1. The remainder were found with 25 females of his second local race, *O. brevicornis,* forma *arostrata* (0.62 mm) in Sample 2 from the west exit of Sangi Barkai (now Sangi Workai), a marine channel between Kobroör and Maikoor Islands, Kepulauan Aru. The males are probably conspecifics of the latter form. Concerning the identity of this form, well-documented instances of arostrate populations of rostrate, free-swimming copepods are not numerous. A well-known case is the arostrate population of the calanoid *Acartia lilljeborgii* from Saint Lucia, West Indies (Bowman 1965). No arostrate population of a rostrate oithonid has been reported since Früchtl's. It seems more likely that Früchtl's arostrate form (including most males assigned to *O. brevicornis* forma *aruensis*) is identical or closely related to *O. dissimilis* Lindberg, 1940, an arostrate inshore species (see Ferrari 1977).

Herbst (1964) first introduces Lindberg's (1950) *O. spinulosa* to his discussion of the *O. brevicornis* problem. He compares descriptions of *O. spinulosa* with *O. brevicornis* by Giesbrecht, Rosendorn, and Früchtl to his specimens from Al Ghardaga on the Red Sea. Herbst agrees with Früchtl that Rosendorn's Congo River specimens may not be identical to Giesbrecht's. He also notes that Früchtl's small *O. brevicornis* forma *aruensis* possesses a relatively long genital segment, short caudal ramus, and differences in basipodal spines of the mandible. He mentions that the relative length of the prosome distinguishes *O. spinulosa* but dismisses the hairs on the genital and following segments as easily overlooked or considered insignificant by earlier authors. He does not discuss the long, thick, densely plumed seta of leg 5. Herbst's female specimens from the Red Sea (0.53–0.57 mm) have caudal rami about 3 times as long as wide, with their outer edge seta, inserted near the anterior end of the ramus, only as long as the ramus. Two thick, blunt spines with strong spinules adorn the basipod of a mandible whose endopod has 4 weak setae. Herbst places his specimens in *O. brevicornis* s.l. because the armature of maxilla 1 and absence of hairs on the genital segment of his specimens separate them from *O. spinulosa*. His specimens seem very similar to those originally described by Giesbrecht.

Wellershaus (1969) describes and illustrates two forms of *O. brevicornis* from the Cochin Backwaters, India, and further describes specimens from Hong Kong harbor. Females of the typical form from Cochin seem to me identical to *O. spinulosa,* a fact Wellershaus admits. But he maintains that Lindberg's species is similar to Giesbrecht's. He suggests that "main characters" used by Lindberg to differentiate *O. spinulosa* are not reported by Giesbrecht. Aside from the fact that Wellershaus has been very conservative in recognizing Lindberg's species (see Ferrari 1977, for a redescription of *O. dissimilis*), it is difficult to believe that Giesbrecht would have overlooked an unusually armed, long, thick seta on leg 5 or hairs on the genital segment of his Hong Kong specimens. Wellershaus' specimens also agree closely with those of *O. spinulosa* from the Pearl River area with respect to most details, especially the armature and degree of sexual dimorphism of the mandible. My specimens are slightly smaller (0.57–0.64 mm) and have a small flange on the distal tip of 2 endopodal setae on leg 4.

Wellershaus' smaller form of *O. brevicornis* from Cochin agrees with the new species in such details as he mentions: relative proportions of the anal segment and caudal ramus; ornamentation of the setae of leg 5 and caudal ramus; position of external seta on caudal ramus; absence of hairs on genital and following segments; armature of mandible.

Wellershaus' specimens of *O. brevicornis* from Hong Kong are noteworthy in several respects. They are collected from the harbor; it is not unreasonable to assume that this was the source of Giesbrecht's specimens. They are similar to Giesbrecht's in those characters available for comparison: size; ratios of prosome to urosome, length to width of anal segment and caudal ramus; absence of hairs on genital and following segments; undistinguished seta on leg 5. Wellershaus notes that the mandible of these males is similar to the Cochin large form. Thus males of *O. brevicornis,* like *O. spinulosa,* have on the large basipod one spine like the female and a second, reduced in size, with longer spinules. Specimens of *O. brevicornis* from the Yellow and East China Seas reported by Chen *et al.* (1974) cannot be distinguished from *O. spinulosa* based on descriptions and illustrations given.

In 1975 Bowman correctly separated the temperate, rostrate, inshore species, *Oithona colcarva,* of the east and gulf coasts of the United States from the tropical, Indo-Pacific, rostrate *O. brevicornis.* Specimens of *O. brevicornis* forma *major,* reported by Nishida *et al.* (1977) from Suruga and Tokyo Bays, are similar to *O. spinulosa* in position of external seta of the caudal ramus. The authors consider these animals identical to Wellershaus' typical form. The seta of leg 5 is described "with abundant hair" but not unusually thick; hairs are not reported on any urosome segment. Nisheda *et al.* note that their *O. brevicornis* forma *minor* is similar to the small form of Wellershaus and *O. brevicornis* forma *aruensis* of Früchtl. The male mandible is similar to *O. wellershausi* with its identical but sexually dimorphic basipod spines. However, their female (Fig. 4a, p. 54) has a caudal ramus whose length appears greater than twice its width. Ushima (1979) reports on the ontogenetic development of *O. brevicornis* from a brackish water harbor in Tokyo Bay. Ushima identifies his specimens as *O. brevicornis* forma *minor* of Nishida *et al.* and again the caudal ramus length appears more than twice its width (Fig. 3k). One interesting feature of Ushima's study is the position and armature of the nauplius mandible (Fig. 1a). It appears that the basipod spines, which exhibit so much diversity in adult animals, may act as the primary food-grinding structures of the nauplius.

Despite the apparent orderliness of the above account much remains to be done with tropical, inshore, Indo-Pacific species of *Oithona.* A complete description of male specimens of *O. brevicornis* from its probable type-locality, Hong Kong harbor, is of primary concern. Future investigators should attempt to describe and illustrate accurately such features as: male and female mandible and maxilla 1, noting the degree of sexual dimorphism; female leg 4 with modified setae; leg 5 of male and female; armature of genital openings; male pore signature. The pore signature, already described for 3 Indo-Pacific, inshore species, *Oithona dissimilis* (see Ferrari 1977), *O. wellershausi,* and *O. spinulosa,* has proven useful in separating males of these easily-differentiated species. However, the inshore areas of the Indo-Pacific are represented by a diverse number of environments, presenting these tiny cyclopoids singular opportunities for speciation. There is no reason to believe all species have been encountered. As sampling of coastal environments increases, the picture of *Oithona* diversity will only become more complex but with careful descriptive work, it is hoped, not more confusing.

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SCALPELLONISCUS, A NEW GENUS FOR TWO SPECIES OF CRYPTONISCID ISOPODS (EPICARIDEA) PARASITIC ON ABYSSAL STALKED BARNACLES

Mark J. Grygier

Abstract.—The genus *Scalpelloniscus* is proposed for 2 species of ectoparasitic cryptoniscid isopods from scalpellid barnacles. *S. penicillatus,* n. sp. infests various barnacles at about 4500 m near the Walvis Ridge in the South Atlantic. The male and immature female stages are described. The cryptoniscus larva of *Cyproniscus binoculis* Menzies and George, living on *Catherinum perlongum* in the Peru-Chile Trench, is redescribed and the species transferred to *Scalpelloniscus.* Attention is drawn to possible sequential sexual dimorphism in the "cryptoniscus larva" stage of cryptoniscid isopods, and it is suggested that future generic diagnoses in this family rely less upon host organisms, and more upon morphological details shared among species.

Introduction

Epicaridean isopods of the family Cryptoniscidae are parasitic upon a wide variety of marine crustaceans. They comprise 6 primarily host-defined subfamilies (sometimes considered families) and a large number of unassigned monotypic genera. The most recent reviews are those of Nielsen and Strömberg (1965, 1973, the former with an extensive bibliography), and many new species have been described since (e.g., Bourdon 1972; Grygier 1981; Menzies and George 1972; Schultz 1977).

These sequentially hermaphroditic isopods have complex life cycles involving up to 3 planktonic larval stages (Caullery 1908); the last of these, the cryptoniscus, seeks out the definitive host. With little or no morphological change, it matures to a protandric male. Internal organization may reflect a sex change soon thereafter, but, in any case, a catastrophic metamorphosis occurs in the molt to the adult female (e.g., Bocquet-Védrine and Bocquet 1972; Goudeau 1967, 1972a).

This paper presents, firstly, the description of a new cryptoniscid isopod parasitic on abyssal scalpellid barnacles from the South Atlantic. One specimen is a protandric male; 3 others appear to be transitional stages in the metamorphosis to the female and will be referred to as immature females throughout. Next is a redescription and reevaluation of *Cyproniscus binoculis* Menzies and George, discovered on a scalpellid barnacle in the Peru-

Chile Trench (Menzies and George 1972). Lastly, the affinities of these 2 species are discussed, and criteria for generic diagnoses in Cryptoniscidae are proposed.

Scalpelloniscus, new genus

Diagnosis.—Protandric males and immature females with body about 3 times longer than wide, widest at fifth pereonite. Basal article of first antenna with 8 posterior teeth. Eyes absent. Oral cone pointing anteriorly. Dactyli of first and second pereopods (gnathopods) not overextending palms of propodi. Third through seventh pairs of pereopods ambulatory; quadrate, distal end of propodus in third through fifth pairs with terminal lobe in notch toward medial side; propodi of sixth and seventh pairs tapering distally, dactyli relatively longer than in preceding pairs. Ambulopod ischia and pleopod protopodi with flanges. Uropod exopod cylindrical, at least half as long as conical endopod; endopod medial setation profuse, 6 dorsal setae proximally. Posterior pleotelson margin entire with rounded medial protrusion. Anal tube absent. Cuticular sculpturing pronounced. Mature females unknown.

Etymology.—From Scalpellidae, the family of barnacles these isopods infest, and Latin *oniscus*, woodlouse. Gender masculine.

Type-species.—Scalpelloniscus penicillatus.

Scalpelloniscus penicillatus, new species

Figs. 1–16

Methods and materials.—Host barnacles collected near Walvis Ridge in South Atlantic by the *Jean Charcot* during Campagne Walvis 1. Male and 1 immature female attached to same specimen of scalpellid barnacle (cf. *Arcoscalpellum* n. sp.) from St. CP06 (33°22.5′S, 2°35.9′E; 4550 m; 30 Dec. 1978). Two more immature females free in jar of preserved scalpellid barnacles (*Neoscalpellum, Mesoscalpellum,* and *Arcoscalpellum*; last not same species as above) from St. CP05 (33°22.8′S, 2°36.0′E or 33°26.2′S, 2°34.6′E; 4500 m; 30 Dec. 1978).

All specimens examined whole in lactic acid and measured (Table 1). One free immature female completely dissected, male partly dissected, parts mounted in Turtox CMC-10 with acid fuchsin or in glycerine jelly. Drawings done with aid of camera lucida.

Holotype.—Undissected immature female from CP05; allotype: male; paratypes: other 2 immature females. Holotype, allotype, 1 paratype (dissected) deposited in Muséum National d'Histoire Naturelle, Paris; other paratype in National Museum of Natural History, Washington, D.C. (USNM 184576).

Diagnosis.—Males and immature females 2.5–4 mm long, with unequal

Table 1.—*Scalpelloniscus penicillatus*, n. sp., sizes of specimens and relations to hosts.

Specimen—station	Length	Width	Relation to host
Immature ♀, holotype—CP05	4.00 mm	1.33 mm	Broken cirral setae in gnathopods
Immature ♀, paratype—CP05	4.2 mm*	1.45 mm*	Broken cirral setae in gnathopods
Immature ♀, paratype—CP06	2.83 mm	1.03 mm	Grasping cirral setae in gnathopods
♂, allotype—CP06	2.34 mm	0.90 mm	Attached to side of body by first antennae, oral cone, and gnathopods

* Extrapolated after dissection from sizes of large trunk pieces.

first antennal rami, nearly equally wide anterior and posterior ischial flanges on ambulopods, toothed coxal plates, no dorsal pores. Posterior genal flaps well developed in immature female, extending to middle of second pereonite; undeveloped in male. Sixth and seventh pereopods with distinctly shorter ischia and propodi than preceding pairs in immature female, but not male. Mature female unknown.

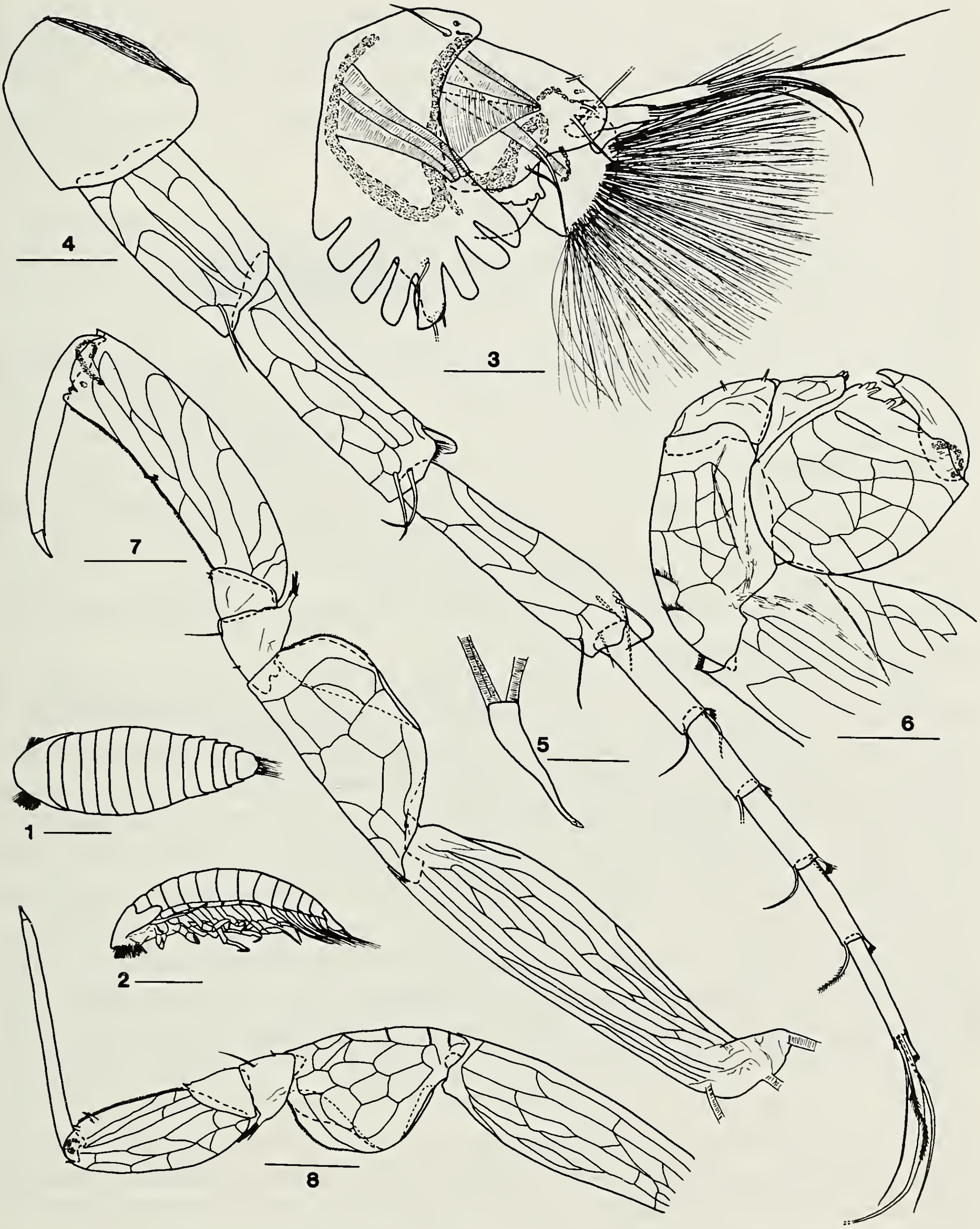
Etymology.—Specific name from Latin *penicillus,* a brush, referring to bundle of aesthetascs on first antennae of immature females.

Description of immature females.—Body fusiform, divided into cephalon (head and 1 fused thoracomere), 7 pereonites (T1–7), 5 pleonites, and pleotelson (Fig. 1); widest at T5. Body convexly lenticular in cross section, dorsal side more strongly curved; dorsum convex in side view, ventral side straight (Fig. 2). Anterior end of cephalon rounded, genal regions produced into pair of flaps reaching posteriorly to middle of T2. Eyes absent.

First antennae (Fig. 3) with 3-merous peduncle. First article plate-like, about twice as long as wide, concave laterally; posterior edge bluntly pointed, deeply incised forming 8 teeth; apical tooth (fifth from midline) bifid, longer, narrower part in plane of other teeth, other part dorsal to this plane; 2 setae arising in gap between parts of this tooth; 1 or 2 setae at its base on exposed face of article; 3 setae at anterolateral corner of exposed face, 1 long, 2 of medium length. Second article triangular, fitting into lateral concavity of first; 2 posterior setae on exposed face, 4 more near lateral apex. Third article short, bearing pair of 1-merous rami and large, ventrolateral bulb completely covered with brush-like bundle of capillary aesthetascs, lateralmost ones thicker than rest; single lateral seta on bulb; dorsal ramus twice as long as ventral, both tapering with terminal setae, 4 and 3 respectively.

First and second articles possibly articulating separately to cephalon (cf. Goudeau 1972b). Muscle in first article extending from articulation to lateral side; large muscle occupying much of second article attached to own articulation with cephalon, second muscle extending into aesthetasc bulb.

Second antennae (Fig. 4) with 4-merous peduncle and 5-merous flagellum



Figs. 1–8. *Scalpelloniscus penicillatus,* n. sp., immature females; 1–2, holotype; 3–8, dissected paratype. 1, Dorsal view of body; 2, Lateral view of body; 3, First antenna, exposed face; 4, Second antenna; 5, Mandible; 6, Second pereopod; 7, Fourth pereopod; 8, Seventh pereopod. Cuticular sculpturing indicated in 4, 6–8; representative ctenae in 6. Scale bars 10 mm in 1, 2; otherwise 0.1 mm.

reaching to rear of T5. First peduncular article very short, next 3 articles progressively longer and narrower; second article with fringe of mediodistal spinules; setation formula for peduncle: 0-1-3-5. Flagellar articles narrow, cylindrical; membranous medial fringe with finely dissected margin on each; setation formula variable (e.g., 2-1-2-1-3, 2-1-2-1-5, 1-1-2-1-5); terminal setae of unequal length, 1 very long.

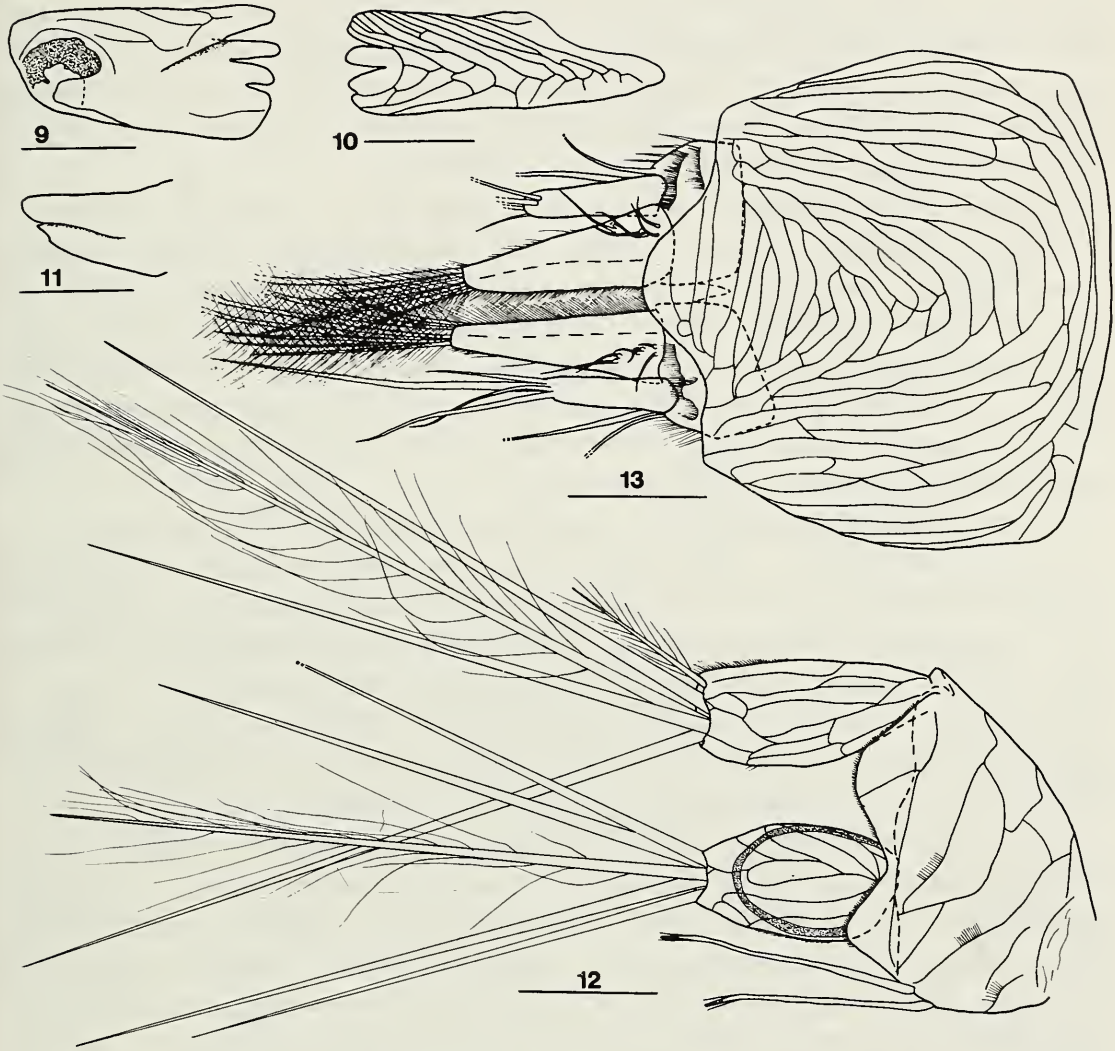
Oral cone pointing anteriorly, partly covered by toothed plates of first antennae. Pair of oval sclerites at posterior base. Mandibles styliform, tips with multiple weak barbs (Fig. 5). Pair of small, posteriorly directed spines just posterior to cone.

First and second pereopods gnathopodial (Fig. 6). Basis and ischium short, broad. Merus and carpus triangular; 2 setae on inner face of merus; 4-dentate spine on inner distal angle of carpus; all gnathopods flexed, obscuring external side of merus, so expected large seta there (cf. male below) not seen. Propodus round in side view with very powerful muscles; series of heavy spines on inner side facing dactylus, details obscured in all but second pereopod of 1 specimen: 1 simple spine, 1 3-dentate, 1 4-dentate. Dactylus not longer than palm of propodus, forming subchela; massive terminal claw with small seta at base.

Third through seventh pereopods ambulatory (Figs. 7, 8). Basis elongate, somewhat broader distally than proximally. Ischium half as long as basis (even shorter in sixth and seventh pairs), external side expanded into pair of equally wide flanges with fringed margins. Merus and carpus triangular with longer faces internal; internal face of merus with very short proximal seta, longer distal one, external angle bearing short, very thick seta with numerous setules; 3- or 4-dentate spine at distal angle of carpus. Propodus as long as ischium (i.e., shorter in sixth and seventh pairs); inner margin fringed with fine hairs; distal end quadrate in third through fifth pairs with lobe in notch near inner corner and subterminal spine with 2 or more teeth on posterior face, second such spine halfway along inner margin; distal end tapering in last 2 pairs, lacking lobe, but with 2 spines on inner margin, 1 terminal, 1 subterminal. Dactylus ⅔ length of propodus in third through fifth pairs, terminating in slightly decurved claw with basal spinule; dactylus longer and narrower relative to rest of limb in last 2 pairs (moderately longer than propodus), claw straight in sixth pair, recurved in seventh; claw of seventh lacking basal spinule.

Coxal plates of all 7 pereonites with rounded posterior teeth (Figs. 9–11); distalmost tooth widest, often with shoulder; tooth formula: 4-4-4-3-3-3-2.

Five pairs of almost identical pleopods (Fig. 12), second pair slightly larger than others, fifth markedly smaller. Protopod attached near midline of body, expanded laterally, almost twice as wide as long; 2 medial setae, distal one slightly longer than proximal, subterminal pair of fine, sharp setules on each, distal part of seta roughened; distal edge of protopod ex-



Figs. 9–13. *Scalpelloniscus penicillatus,* n. sp., immature female; dissected paratype. 9, Representative anterior coxal plate, medial view; 10, Representative middle coxal plate, lateral view; 11, Seventh coxal plate, lateral view; 12, Third pleopod; 13, Pleotelson and uropods, dorsal view. Cuticular sculpturing indicated in 9, 10, 12, 13; representative ctenae in 12, 13. Scale bars 0.1 mm.

panded into 2 flanges with fringed margins overlying bases of rami. Endopod oval with internal chitinous ring, fine hairs on margins; 5 very long terminal setae (3 in fifth pair), each with 2 rows of oppositely placed setules up to ¼ as long as seta. Exopods narrow basally, blade-like distally, lined with fine hairs; 5 terminal setae, medial 4 similar to those of endopod, lateralmost short, more densely setulose.

Pleotelson quadrate (Fig. 13); posterior margin entire, rounded with concave sides. Anal tube (Schultz 1980) absent.

Uropod (Fig. 13) protopod short, lined with fine hairs laterally and medially; 2 setae on laterodistal corner, medial one longer than lateral. Rami

1-merous; conical endopod twice as wide, 50% longer than cylindrical exopod. Exopod with fine lateral hairs, 4–7 terminal setae (difficult to count due to dense setulation), 3 longer than rest. Endopod with profuse medial setation, sparse lateral hairs; 6 proximal dorsal setae; apparently 6–10 terminal setae, again obscured by dense setulation.

Network of fine ridges over most of body (Figs. 4, 6–10, 12, 13), transverse across dorsum, arcuate on pleotelson, longitudinal on longer articles of appendages, tesselate on shorter articles. Ridges generally formed by rows of minute spinules, barely distinguishable by light microscopy; spinules much longer on thoracic and abdominal appendages, forming ctenae (Figs. 6, 8, 12, 13). Body surface densely dotted with small pits, seemingly of equal density everywhere. Many fine canals penetrating cuticle along anterior rim of cephalon, absent dorsally.

Pair of reniform ovaries with oocytes occupying T3–7 in holotype.

Description of male.—Body form similar to immature females except for smaller size (Table 1), undeveloped genal flaps overlapping only small part of T1, less well developed cuticular sculpturing, strong concavity of ventral body surface in cross-section, and paired sperm masses in T7.

First antennae as in immature females but with few weak teeth on second article and fewer aesthetascs on third. Second antenna setation formula: 0-1-3-5-1-0-2-1-(4?). Oral cone as in immature females.

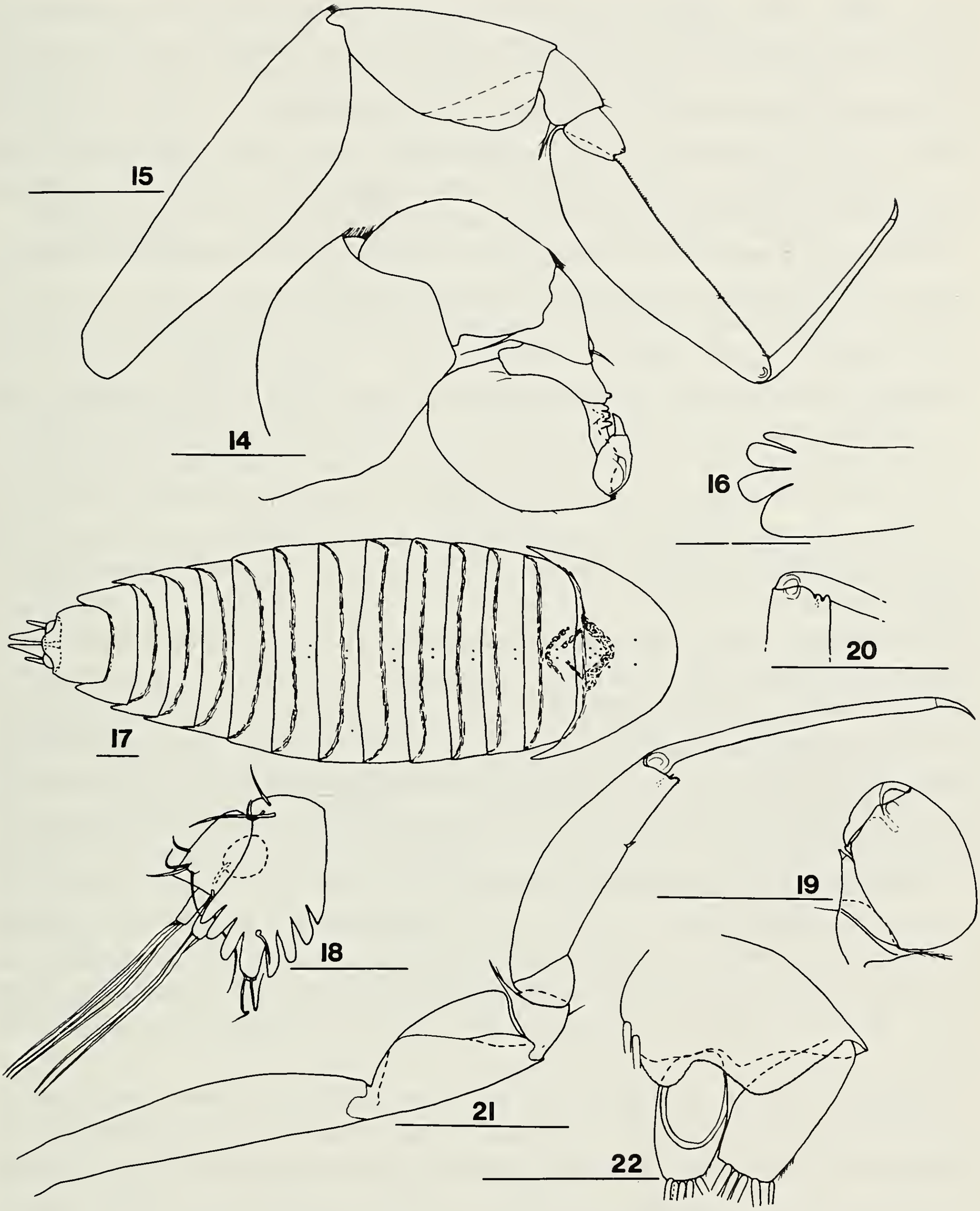
Gnathopods very strong (Fig. 14); large seta at external apex of merus (hidden from view in immature females); carpus short; propodus very large, egg-shaped, with 4 heavy spines facing dactylus; dactylus comparatively shorter than in immature females, otherwise similar. Third through fifth pereopods as in immature females except large meral seta not as elaborate. Sixth and seventh pairs differing from immature females (Fig. 15); ischium and propodus not shortened; propodus narrow distally, but relative positions of 2 spines not changed from other 3 pairs. Coxal plate tooth formula: 5-4-4-4-4-4-(2 or 3); teeth generally spatulate (Fig. 16).

Distal fringe on pleopod protopod clearly denticulate; short seta on exopod even shorter than in immature females. Pleotelson rear margin entire. Uropod endopod only 20% longer than exopod; terminal setal count of endopod and exopod 12 and 6 respectively; lateral setae on protopod lacking in mounted uropod, probably due to rough dissection.

Scalpelloniscus binoculis (Menzies and George), new combination
Figs. 17–22

Cypronisсus binoculis Menzies and George, 1972:36, fig. 23.

Notes.—The single known specimen of *C. binoculis* is a cryptoniscus larva attached externally to the capitulum of a scalpellid barnacle from the Peru-Chile Trench (*Anton Bruun* St. 169: 8°46′S, 80°44′W; 3909–3970 m; 2



Figs. 14–16. *Scalpelloniscus penicillatus,* n. sp., male; allotype. 14, Second pereopod; 15, Seventh pereopod; 16, Third coxal plate. Scale bars 0.1 mm.

Figs. 17–22. *Scalpelloniscus binoculis* (Menzies and George), cryptoniscus larva; holotype. 17, Dorsal view of body showing pores on cephalon and pereonites; 18, First antenna, exposed face; 19, Distal part of second pereopod; 20, Detail of propodus-dactylus articulation in fifth pereopod; 21, Seventh pereopod; 22, Third pleopod. Scale bars 0.1 mm.

Nov. 1965). The original description consisted of only a few sentences, omitting the majority of characters necessary to discriminate between species (Nielsen and Strömberg 1965, 1973). In addition, parts of the description are confusing (e.g., ''Second antenna biramous . . . ,'' (p. 36) must refer to the first antenna), and the illustrations are overly schematic. The redescription of this species which follows shows that *C. binoculis* is closely related to *S. penicillatus*; therefore, I am transferring it to the new genus.

Methods and materials.—Holotype (USNM 121741) examined whole in lactic acid; drawings done with aid of camera lucida.

Host.—Catherinum (=*Arcoscalpellum*) *perlongum* (Pilsbry); det. Miss Nancy Freres and Dr. William A. Newman.

Diagnosis.—Cryptoniscus larva about 1.5 mm long, with equal first antennal rami, well developed genal flap extending to end of first pereonite, anterior ischial flange of ambulopods much narrower than posterior flange, coxal plates untoothed. Ischia and propodi of sixth and seventh pereopods not shortened, but propodi tapered distally and dactyli relatively longer than in other pairs. Nine dorsal pores in cephalon, pair on each pereonite. Mature female unknown.

Description.—Characters may be assumed to be similar to *S. penicillatus* immature females unless specified otherwise.

Body fusiform, 1.55 mm long, 0.5 mm wide, widest at T5 (Fig. 17). Genal flaps of cephalon extending to end of T1. First antenna (Fig. 18) differing from *S. penicillatus* only in third article rami being of equal length, dorsal one with 3 setae, ventral with 2 or 3, and aesthetascs from bulb all parallel, extending posteriorly. (Menzies and George (1972, fig. 23C) omit several features, including the shortest anterior seta of the first article, a seta at the base of the middle tooth, 2 lateral setae on the second article, and, though it is mentioned in the text, the aesthetasc bulb with its single seta. Many of the setae shown in their figure are much too short, especially those of the rami.) Second antennae reaching to T6; setation formula: 0-1-3-4-2-1-1-1-(2 or 3).

Gnathopod (Fig. 19) ischium with anterior flange; carpus compressed, with robust bifid or trifid distal spine (stronger than shown by Menzies and George (1972, fig. 23D)); dactylus aquiline, opposing large teeth on propodus (details obscured), no seta seen at base of claw. Ambulopod (Figs. 20, 21) ischia with posterior flange wider than anterior. Merus with single long seta medially, simple large seta on lateral angle. Carpus rounded with simple distal spine. Ischium and propodus not shortened in sixth and seventh pereopods. Propodus quadrate distally (Fig. 20), but more tapered and inner corner denticulate in sixth and seventh pairs; lobe present within notch as in *S. penicillatus*; 2 simple spines, 1 subterminal posteriorly, other slightly more than halfway distally along medial edge. Dactylus longer in last 2 pairs than in others (slightly longer than propodus), claw still decurved. Coxal plates not toothed. Tips of pleopod protopod medial setae trifid, lateral setules simple, middle tip lanceolate with 5 pairs of minute knobs; distal flange over base of endopod small, rounded (Fig. 22). Uropod exopods tapering slightly, endopods conical, both with about 5 terminal setae (obscured by dense setulation); 4 fine, lateral setae on endopods. Pleotelson posterior margin rounded with concave sides, slightly asymmetrical.

Widely spaced pores along anterior rim of cephalon; dorsum of cephalon with 9 additional pores, 4 forming large, central trapezoid, rest posterior to these in smaller trapezoid with 1 in middle; each pereonite with pair of pores flanking midline (Fig. 17). Eyes absent, making the specific name *binoculis*—2 eyes—inappropriate. Those structures identified as eyes by Menzies and George (1972, fig. 23A) seem to be attachments of second antennal extrinsic muscles and/or "fentes céphaliques" (Bourdon *et al.* 1980).

Discussion

Dimorphism.—An unanticipated difficulty in specific identification is presented by the significant sequential sexual dimorphism in the "cryptoniscus larva" stage of development in *S. penicillatus.* When I first examined these specimens, I thought the 2 morphs (male and immature female) represented distinct species, but after noting the similarities of their appendages and considering that a specimen of each morph was removed from a single host barnacle, I suspected that they were ontogenetic stages. This interpretation was strengthened by the discovery of testes in the smallest specimen and ovaries in the largest. The ontogenetic changes in *S. penicillatus* should caution workers to specify a specimen's position in the metamorphic sequence as precisely as possible.

Affinities.—Scalpelloniscus is closely related to *Hemioniscus balani* Buchholz and also to at least one species in the inhomogenous genus *Cyproniscus* Kossmann.

H. balani, the type and only well known species of its genus, is a very widely distributed parasite of balanomorph barnacles (Crisp 1968; Goudeau 1970), though it may actually comprise more than 1 species (E. Gomez, pers. comm.). The recently redescribed European variety (Goudeau 1970) agrees with *S. penicillatus* and *S. binoculis* in having posterior teeth on the basal first antennal article, an anteriorly pointing oral cone, a characteristic pereopod facies, and an untoothed pleotelson margin. Many differences exist between the 2 genera, though. In *H. balani* the basal article of the first antenna has 7 sharp teeth. The second article is dentate, and the longer ramus has 2 aesthetascs not seen in *Scalpelloniscus.* Goudeau's description of a basal seta on one of the rami may be mistaken; this seta probably arises from the aesthetasc bulb as in *Scalpelloniscus.* The second antenna reaches only to T4 in *H. balani* and has more setae on the fourth article. The gnathopod dactyli are armed with a scale not found in *Scalpelloniscus*. In the ambulopods the subterminal propodal spine is palmate, and the dactyli are fringed. The sharp teeth of the coxal plates agree in number with the male of *S. penicillatus* except for T1, which has 7. The pleotelson margin in *H. balani* is triangular, not rounded. This species also differs from *Scalpelloniscus* in having eyes and in not showing a marked sequential sexual dimorphism before metamorphosis.

Species of *Cyproniscus* also have posterior teeth on the first antennal basal articles and the coxal plates, but in other characters they differ considerably among themselves. The type-species, *C. cypridinae* (Sars), parasitic on an ostracod, is the most reminiscent of *Scalpelloniscus*. Close affinites of many of the other *Cyproniscus* species to *C. cypridinae* are doubtful, and they will not be considered here.

C. cypridinae resembles *Scalpelloniscus* in its oral cone, pereopods, coxal plates, and pleotelson (Sars 1899; Nielsen and Strömberg 1973). Significant differences include the first antennal basal article with its 6 teeth in one plane, the tips forming a straight line, and the coxal plate tooth formula: 4-4-5-5-5-4-4. *C. cypridinae* also has flanged bases on at least some pereopods and a squared-off cephalic margin with rounded corners.

Hemioniscus and *Cyproniscus* have been considered disparate enough to serve as type-genera for different families (Bonnier 1900), and are still placed in different subfamilies. That *Scalpelloniscus* seems fairly closely related to the type-species of these genera suggests that there is no strong morphological basis for such a distinction above the generic level.

Guidelines on generic diagnoses.—Modern systematic work on Cryptoniscidae has been hindered by the tendency of some early authors to establish new taxa based solely upon host organisms. This procedure resulted in numerous artificial groupings and discriminations. Even when morphological criteria alone have been employed, as has been the case for planktonic specimens with unknown hosts, generic assignments have been made either on the basis of a few general characters (e.g., Sars 1899; Hansen 1895, 1916; Menzies and George 1972) or by the establishment of numerous new genera (e.g., Schultz 1977).

The genus *Scalpelloniscus* deserves note because its 2 species are linked by very specific characters besides their common scalpellid hosts. The first antennae are almost identical in *S. penicillatus* and *S. binoculis*. Since the morphology of this appendage, particularly of its first article, is extremely diversified throughout the family (cf. examples in Schultz 1977), the identity of its structure in the present two species should offset doubts of their affinity engendered by the presence of toothed coxal plates in one species but not the other, or by differences in the setation of other appendages. The ambulopod propodi are also isomorphic in the two *Scalpelloniscus* species; however, pereopods have not generally been described in sufficient detail to evaluate this identity as an indication of affiliation. Future revisions of Cryptoniscidae should include generic diagnoses incorporating a set of very precise characters, as has been possible for *Scalpelloniscus*. Such a procedure might upset classifications throughout the family, but would result in a more natural arrangement than the primarily host-based system now employed.

Acknowledgments

The scalpellid barnacles from which *Scalpelloniscus penicillatus* were removed had been sorted initially by the Centre National de Tri d'Océanographie Biologique and sent to Dr. William Newman (Scripps Institution of Oceanography) in whose laboratory I conducted this study. Dr. Thomas E. Bowman (USNM) lent me the holotype of *Cyproniscus binoculis*. Dr. Newman and Mr. George Wilson (S.I.O.) offered helpful suggestions during the course of the study and criticized the manuscript. This work, a Contribution of Scripps Institution of Oceanography, new series, was done during the tenure of an NSF Graduate Fellowship and partly supported by NSF Grant DEB78-15052.

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A NEW SPECIES OF THE GENUS *PARATANAIS* (CRUSTACEA: TANAIDACEA), *P. SPINANOTANDUS*, FROM SEAMOUNT VEMA

Jürgen Sieg

Abstract.—A new species, *Paratanais spinanotandus* n. sp., is described from South African waters. Relationship to other species of the genus is discussed briefly.

Introduction

While working on a revision of the family Paratanaidae, it was necessary to get as much material as possible of each taxon in the family. In this way I also received material of a species belonging to the genus *Paratanais*. Because this species is so easily recognized it is described here. The phylogenetic relationship of this species as well as that of the other members of the genus will be discussed in a separate paper.

Paratanais spinanotandus, new species

Material.—2 ♀♀, Sta. VEM 34 H, University of Cape Town Ecological Survey, 1978. Seamount Vema, South Atlantic Ocean, 31°38′S, 8°02′E, 39 m, holotype ♀ USNM 184553, paratype (dissected) ♀ USNM 184554.

Etymology.—From the Latin "spina" (spine) + "notandus" (remarkable).

Description.—(paratype):

Body: Robust, nearly 5 times longer than broad, length about 3 mm (Fig. 1).

Cephalothorax: Broader than long, narrowing from posterior to anterior, with 2 well separated eye-lobes; large zones of the cephalothorax less calcified, forming 4 "plates," one "frontal plate" reaching rostrum from one eye-lobe to the other and going backwards to the middle of cephalothorax, 2 "lateral plates" covering the respiratory chamber and one "caudal plate" lying between the "lateral plates."

Peraeonites: All peraeonites laterally rounded in dorsal view; first 3.6 times broader than long, rostral border near each side with indenture (for respiratory current?); second peraeonite 2.7 times, third 2.3 times, fourth and fifth 2.2 times broader than long; sixth peraeonite of same size as third.

Pleon: Consisting of 5 separate pleonites and pleotelson; all pleonites small, 6.8 times broader than long; pleotelson normally developed, without any distinctive character.

Antenna 1 (Fig. 1): Four-jointed; first joint stout, only 1.7 times longer than broad, outer border with only one small distal seta, inner border with 2 feathered hairs at the middle and 3 feathered hairs and one seta at distal third; second joint as long as broad, with 3 feathered hairs and 2 setae distally; third also as long as broad, inner and outer border each with one seta distally; fourth joint elongate, 4.4 times longer than broad, longer than second and third joint combined, with 2 feathered hairs, 2 smaller and 4 longer setae, and one aesthetasc.

Antenna 2 (Fig. 1): Six-jointed; first joint triangular in cross-section, fused with cephalothorax; second large, also triangular in cross-section, 1.4 times longer than broad, outer border with one seta distally, inner border with one small seta at the middle; third joint triangular in cross-section, little broader than long, outer border with one large distal spine; fourth joint rounded in cross-section, 3.2 times longer than broad, with 2 feathered hairs and 2 small seta distally; fifth 2.5 times longer than broad, with one long distal seta; sixth joint small, conical, with 4 long and 2 shorter setae.

Labrum (Fig. 2): Hood-shaped, covered with fine hairs.

Mandibles (Fig. 2): Robust, pars molaris well developed, having crushing area surrounded with strong wall of which one third is notched; left mandible with strong crenulate lacinia mobilis and well developed pars incisiva; right mandible without lacinia mobilis, but strong crenulate pars incisiva.

Labium (Fig. 2): With inner and reduced outer lobe; inner lobe deeply incised in the middle, distal third covered with groups of tiny hairs.

Maxilla 1 (Fig. 2): With endite and uniarticulate palp; endite normal, with 9 terminal spines; palp as long as endite, with 2 setae.

Maxilla 2 (Fig. 2): Large, oval, lacking seta.

Maxilliped (Fig. 2): Without coxae, well developed; basis fused medially in proximal third, with one long seta near articulation of palpus; inner lobe large, broader than basis, with one seta and two membranous spinelike structures, border covered with some short seta as well as some groups of tiny hairs; palpus four-jointed; first only little longer than broad, no seta; second triangular, outer border with one seta, inner border with one long seta, one biciliate and one strong, serrate spine; third as long as broad, inner border with 3 strong, biciliate spines; fourth joint nearly twice as long as broad, with one seta at outer border and 5 biciliate spines at inner border.

Epignath (Fig. 2): Falciform, with tiny hairs at tip.

Cheliped (Fig. 2): Strong; coxa large, behind a proximal conjunction of the basis; latter 1.6 times longer than broad, no seta; merus triangular, elongate and reaching nearly to distal border of carpus, with one rostral seta; carpus also 1.6 times longer than broad, tergal border with one proximal and one distal seta, sternal border with one rostral seta distally; propodus of normal size, fixed finger with strong spine at end, colored brown-red, tergal border with 3 rostral setae, sternal border with one rostral seta,

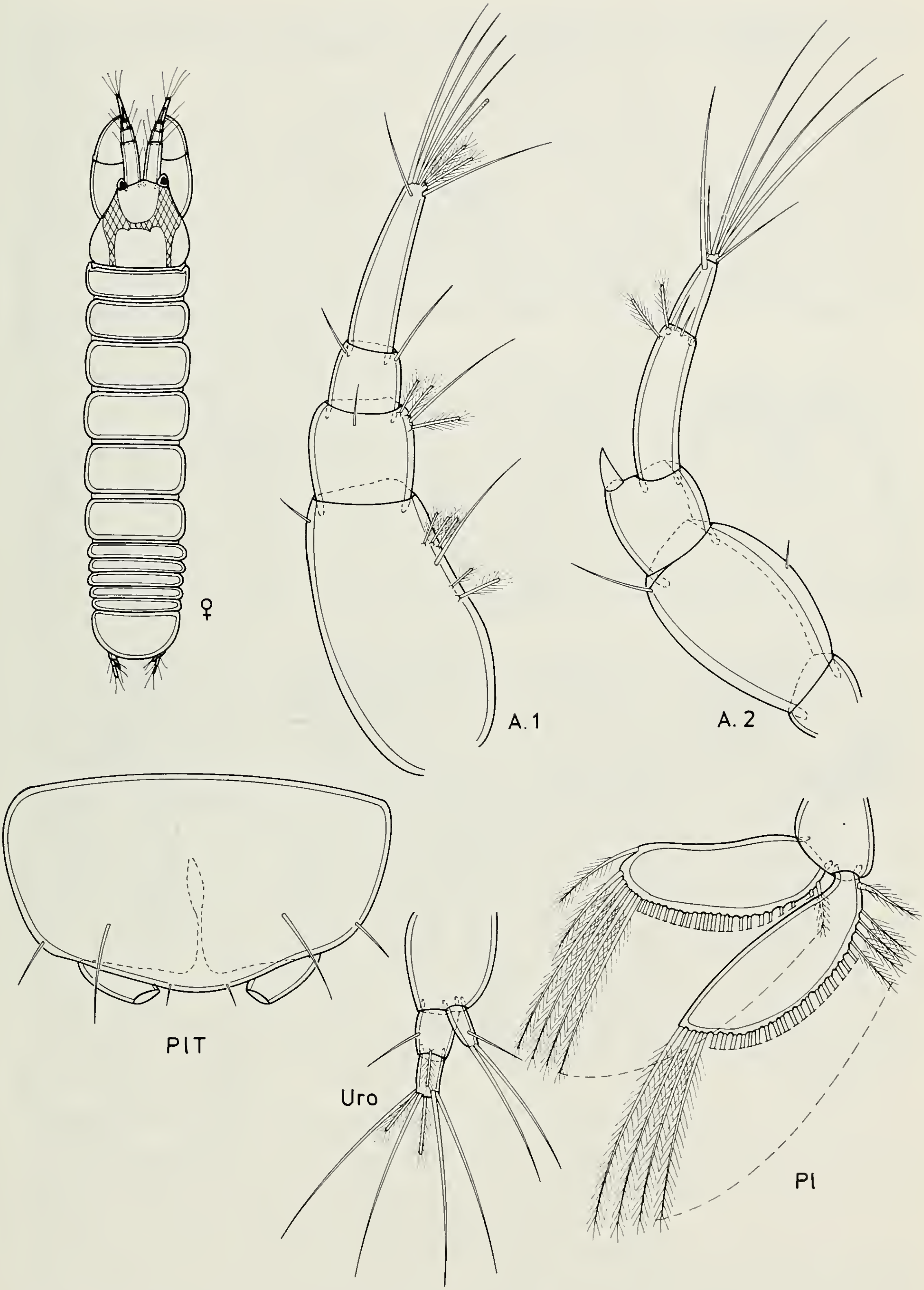

Fig. 1. *Paratanais spinanotandus*, female, paratype.

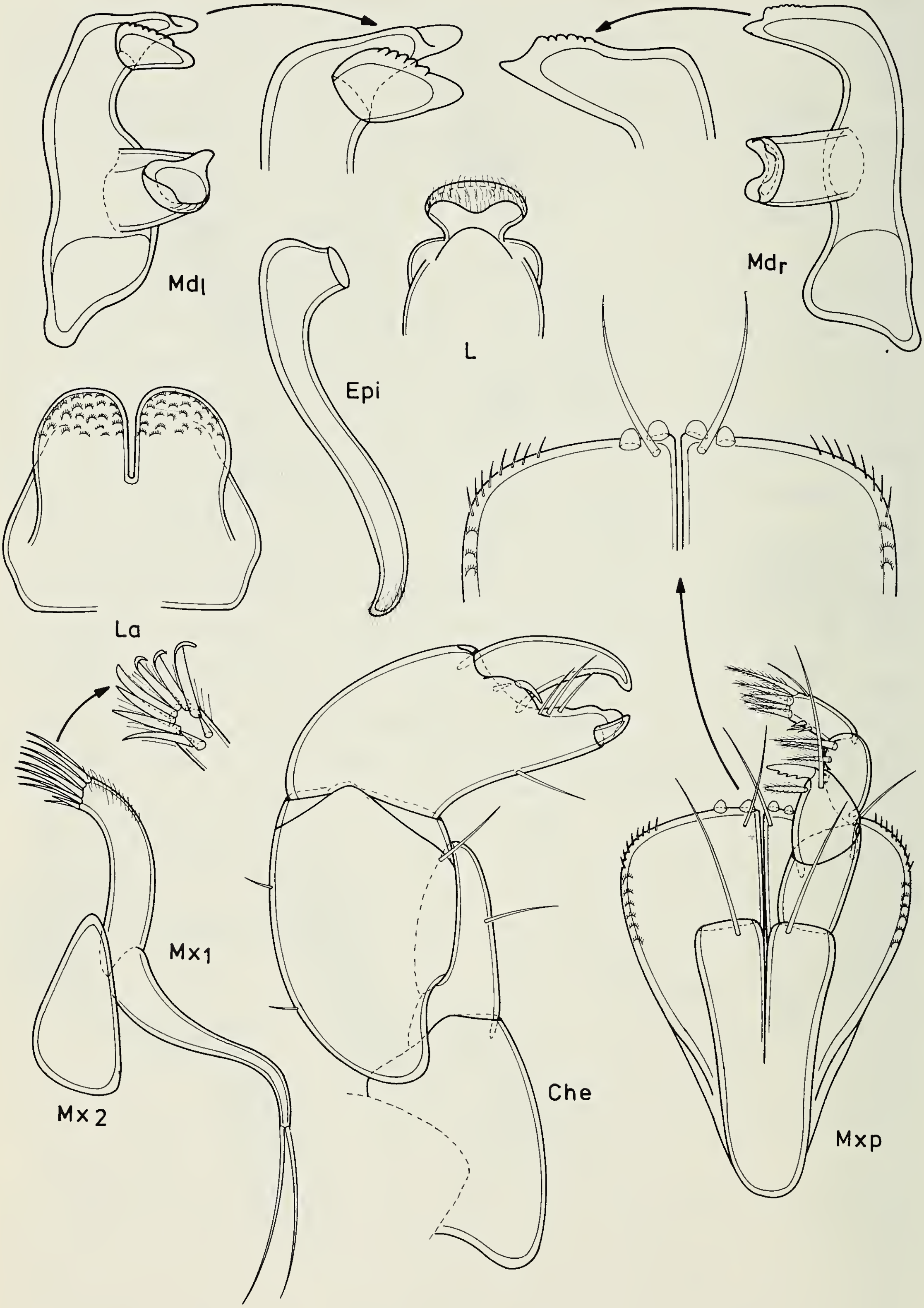

Fig. 2. *Paratanais spinanotandus*, female, paratype.

with one feathered, tiny caudal spine near articulation of dactylus representing the "comb"; dactylus strong, curved, tip colored brown-red, no seta.

Peraeopod 1 (Fig. 3): Slender, coxa more or less fused with peraeonite, with one seta; basis slender, 6.2 times longer than broad, no seta; ischium small, with one tergal seta; merus elongate, 4 times longer than broad and longer than propodus, no seta; carpus 2.2 times longer than broad, sternal border with one distal seta; propodus 5.5 times longer than broad, tergal border with one distal seta and sternal border with two small and one longer distal seta; dactylus with spine, reaching nearly the length of propodus, with one small seta proximally.

Peraeopod 2 (Fig. 3): Developed normally; coxa fused with peraeonite, with one seta; basis 3 times longer than broad, sternal border with one proximal seta; ischium small, with one tergal seta; merus nearly twice as long as broad, tergal border with one caudal seta and one rostral spine distally; carpus 1.7 times longer than broad, tergal border with one small rostral and caudal spine distally, sternal border with one small seta; propodus 3.8 times longer than broad, tergal border with one distal seta; dactylus and spine together reaching two-thirds of length of propodus, dactylus with proximal seta.

Peraeopod 3 (Fig. 3): Proportions and armament (except carpus) as in P.2; sternal border of carpus with one strong distal spine, tergal border with small rostral and caudal spine distally; propodus 4.6 times longer than broad.

Peraeopod 4 (Fig. 3): Stout; coxa fused with peraeonite, no seta; basis 2.2 times longer than broad, tergal border at distal third with one feathered hair and one seta; ischium small, with 2 tergal setae; merus curved sternally, 1.7 times longer than broad, tergal border with one rostral and caudal spine distally with some small rows of tiny spines nearby; carpus 1.3 times longer than broad, tergal and sternal border each with one rostral and caudal spine, sternal border with additional seta, tergal border covered with row of tiny spines; propodus twice longer than broad, tergal border covered with row of tiny spines and with rostral and caudal spine distally, sternal border with one strong feathered hair and one strong distal seta; dactylus and spine fused to claw, short.

Peraeopod 5 (Fig. 3): Proportions and armament as in P.4.

Peraeopod 6 (Fig. 3): Proportions and armament as in P.4/P.5; but proximal feathered hair at sternal border of propodus lacking; sternal border bearing 3 strong biciliate setae distally instead of one.

Pleopods (Fig. 1): All 5 pairs of pleopods similarly developed; basis as long as broad, no seta; exopod of one article, without setae on inner border, with many setae on outer border, most proximal one strongest, irregularly ciliated and separated by gap from the next one; endopod of one article,

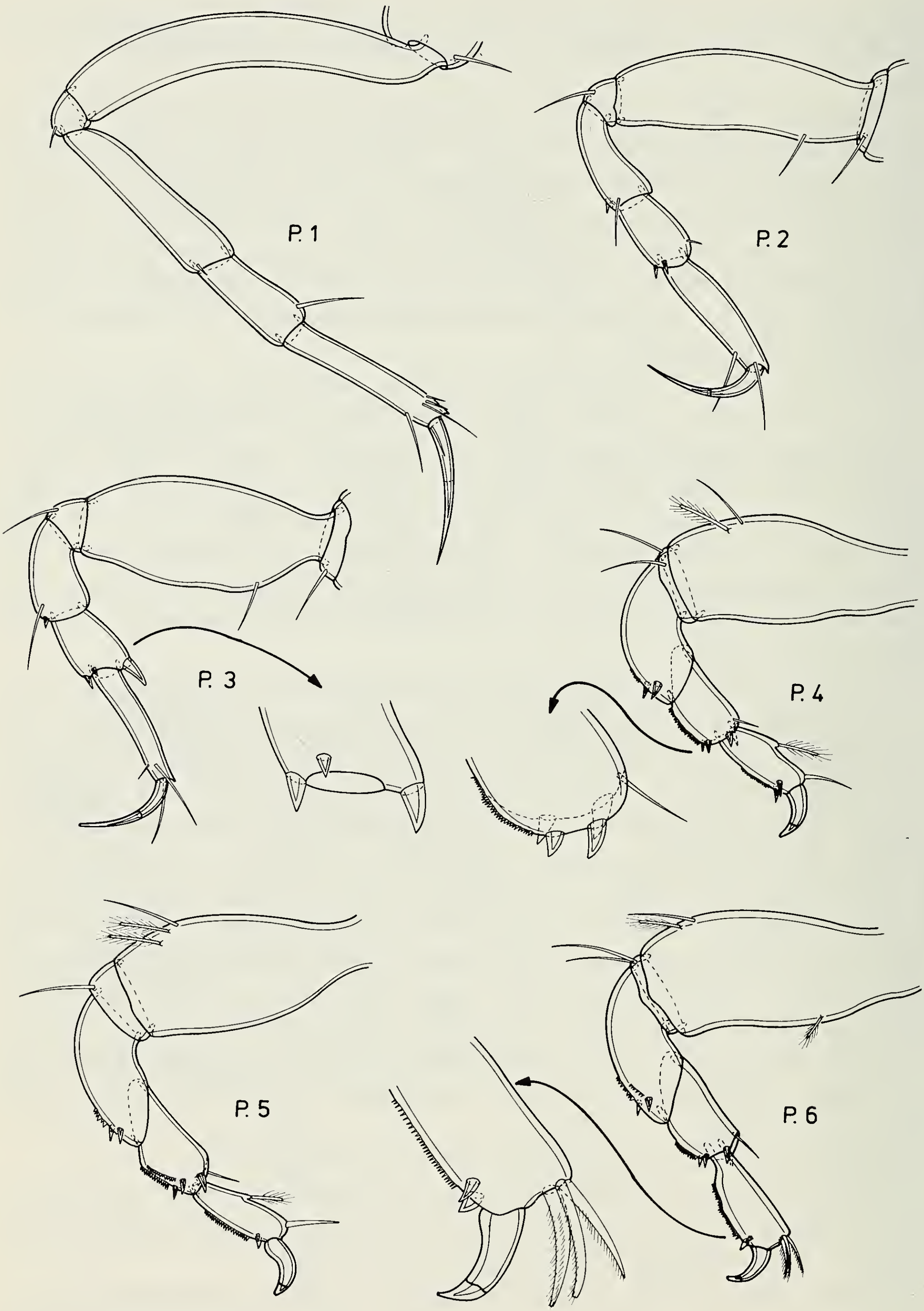

Fig. 3. *Paratanais spinanotandus,* female, paratype.

with one seta at distal inner border and many setae at outer border, distal seta shorter than following one and irregularly ciliated, most proximal one close to basis and separated by gap from next one.

Pleotelson (Fig. 1): Developed normally, 1.8 times broader than long, caudal point not prominent, with 2 small setae; with one long seta near articulation of uropods, additional seta at caudal corner.

Uropods (Fig. 1): Small and biramous; basis strong, but only 1.1 times longer than broad, no seta; endopodite short; 2-jointed, first joint 1.2 times longer than broad with one feathered hair and one seta, second 1.7 times longer than broad with 2 feathered hairs and 4 long setae distally; endopodite small, one-jointed, nearly 2.5 times longer than broad, but only reaching end of first joint of endopodite, with one seta at distal third (marking fusion of 2 former joints?) and with 2 distal setae.

Remarks.—This species is easily separated from all others of the genus by the serrate spine on the second joint of palpus of the maxilliped, which is unique. It also can be distinguished from *P. euelpis,* which has been described from South Africa (Cape Town; Cape St. Blaize N by E, 73 miles; Lion's Head/Table Bay) and refigured by Lang (1973: figs 18a–k, 19a–k), by the proportion of merus to propodus in the peraeopods and by the uropods. In *P. euelpis* the merus is shorter than the propodus, not longer as in *P. spinanotandus.* The uropods are more elongate in *P. euelpis* than in *P. spinanotandus.* It also should be mentioned that *P. elongatus, P. impressus* and *P. euelpis* appear to me to be identical. The distinctions mentioned by Kussakin and Tzareva (1972:242) are based on information given by Barnard (1920:330). But comparing *P. impressus* with the figures of a paratype of *P. euelpis* given by Lang (1973) these differences are not apparent. This synonymy with *P. elongatus* only can be verified by examination of new material from the type-locality, since the *Dana* material has been lost (Lang 1973:201).

Acknowledgments

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A NEW AMERICAN GENUS OF PREDACEOUS MIDGES RELATED TO *PALPOMYIA* AND *BEZZIA* (DIPTERA: CERATOPOGONIDAE)

William L. Grogan, Jr. and Willis W. Wirth

Abstract.—*Amerohelea,* a new American genus of predaceous midges, is described and illustrated. Included in this new genus are *Palpomyia sordidipes* Macfie and *Bezzia frontispina* Dow and Turner (New Combinations), and the following eight New Species: *dalcyi, fasciata, galindoi* (type-species), *nelsoni, pseudofasciata, ronderosi, spinellii,* and *vargasi. Amerohelea* is distinguished from *Palpomyia* and *Bezzia* by its single spermatheca and a single pair of gland rods arising near the lateral margins of the seventh abdominal segment.

Introduction

While involved in revisionary studies on nearctic *Palpomyia* (Grogan and Wirth 1975, 1979), we encountered specimens that differed from other members of that genus in possessing only a single spermatheca. A search of the collections at the National Museum of Natural History (USNM) in Washington, D.C., yielded many similar specimens. Further examination of these specimens revealed that they possessed several other characters that distinguished them from *Palpomyia.* A formal description of these individuals in a new genus was postponed to a later date, as nearly all of the species are neotropical, and our studies on *Palpomyia* were on the nearctic fauna. The name of the new genus is based on its apparent restriction in distribution to the Americas.

Apparently only two species of this new genus have previously been described, *Palpomyia sordidipes* Macfie (1939) and *Bezzia frontispina* Dow and Turner (1976). This is the case despite many species of *Palpomyia* having been described from the Neotropical Region by Lane (1947, 1960), Lane *et al.* (1955), and Macfie (1939). This is also true for *Bezzia* (Lane 1958), but to a lesser extent, as it appears that this genus is less well represented in the Neotropics.

The specimens examined in this study were mounted on slides in the manner of Wirth and Marston (1968). When possible, ten females of each new species were measured and the data presented in the variation section as follows: mean value (minimum value–maximum value, n = number of measurements). For general terminology of the Ceratopogonidae see Wirth (1952) and Wirth *et al.* (1978); terms dealing with antennal sensilla are those of Wirth and Navai (1978); terms dealing with male genitalia are those of Snodgrass (1957). We are indebted to Niphan C. Ratanaworabhan for Figures 5, 6, and 9, and to Mary McNally for Figure 2. We would also like to thank Karen Lezon for analysis of the statistical data.

Holotypes and allotypes of our new species are deposited in the National Museum of Natural History in Washington, D.C. Paratypes, as available, will be deposited in the British Museum (Natural History), London; Muséum National d'Histoire Naturelle, Paris; and the Museu de Zoologia da Universidade de São Paulo, Brazil.

Amerohelea, new genus

Type-species.—Amerohelea galindoi, n. sp., by present designation.

Diagnosis.—A genus of small to medium sized predaceous midges of the tribe Palpomyiini distinguished from all other ceratopogonid genera by the following combination of characters: Abdomen of female with a single pair of eversible glands and usually sclerotized gland rods arising near the lateral margins of the seventh segment, and a single spermatheca; fifth tarsomeres rather short and stout and usually bearing one or more pairs of short, straight, stout, ventral setae; claws small, equal sized with basal inner teeth; fourth tarsomeres deeply cordate; fore femur usually armed ventrally with one or more stout spines.

Description.—Small to medium sized predaceous midges, wing length 1.0–2.2 mm; body moderately robust to slender, nearly bare.

Head: Eyes bare, narrowly separated. Antennal flagellum moderately stout to slender; all flagellomeres with sensilla chaetica and sensilla trichodea; distal five flagellomeres elongate in female and bearing sensilla basiconica; distal three flagellomeres elongate in male with sensilla basiconica; flagellar plume sparse in male. Palpus moderately slender, five-segmented; third segment without a defined pit, with scattered capitate sensilla mesally. Mandibular teeth large and coarse.

Thorax: Robust; scutum with uniform fine pubescence and with a small anterior spine or tubercle. Legs slender to moderately stout; fore femur slender to moderately swollen, with 0–7 ventral spines; mid- and hindfemora non-spinose; fourth tarsomeres deeply cordate; fifth tarsomeres rather short and stout, usually bearing one or more pairs of short, straight, stout, ventral setae; claws of female small, equal sized with basal inner teeth and bifid tips. Wing narrow to moderately broad; hyaline to infuscated; surface covered with microtrichia only, macrotrichia absent; usually two radial cells present, rarely one; costa extending ¾ of wing length; no intercalary fork; medial fork broadly sessile; anal veins with downward bend near middle of second and sometimes first vein; anal lobe poorly to moderately well developed.

Abdomen: Female with a single pair of eversible glands and gland rods (usually sclerotized) arising near lateral margins of eighth segment; only one spermatheca and no evidence of vestigial one; eighth sternum large and cleft posteriorly; ninth sternum with single pair of anteriorly directed arms; tenth sternum with three or more pairs of large setae. Genitalia of male with well-developed cerci; basimere simple, telomere articulated; aedeagus usually triangular, ventral surface usually spiculate; claspettes fused basally a short distance, divided distally, basal arms usually elongate.

Immature stages.—Eggs dissected from gravid females are of the usual narrow, elongate oval shape characteristic of *Palpomyia* and *Bezzia,* without the subapical frilled collar found in the Stenoxenini. The pupa is known only for *Amerohelea sordidipes* (Macfie), which Lane *et al.* (1955) described from Brazil. The description is too short and the figures too sketchy to show diagnostic characters, except that the respiratory horn is figured as slightly swollen in midportion, spindle-shaped, with the apex narrowed and bearing apically apparently only one spiracular opening. The operculum is of an unusual shape, much broader than long, without distinct sublateral tubercles, but with the lateral margins forming broad lobes and the anterior margin somewhat scalloped.

Relationships.—The short, stout setae on the fifth tarsomeres of female *Amerohelea* are reminiscent of the batonnets found in the Sphaeromiini, and indeed individuals could mistakenly be keyed to that tribe (couplet 8) in Wirth *et al.* (1974). Females, however, lack the dense setae on the eighth sternum that characterize sphaeromiine genera. The presence of abdominal gland rods further distinguishes female *Amerohelea* from that tribe and indicates that the genus belongs in either the tribe Palpomyiini or Stenoxenini. We conclude that it is a member of the Palpomyiini because it lacks the following three apotypic character states that distinguish the Stenoxenini: (1) female with eighth segment narrowed distally, (2) egg with frilled subapical collar, (3) body unusually slender and flattened dorsoventrally (Grogan and Wirth 1979).

Because most members of *Amerohelea* possess two radial cells, this new genus is apparently most closely related to *Palpomyia.* In addition, their male genitalia also resemble those of *Palpomyia,* more so than *Bezzia,* but do not readily fit exactly into any of the species groups of *Palpomyia* as defined by Grogan and Wirth (1975, 1979). It appears that species of *Amerohelea* are more specialized than either *Palpomyia* or *Bezzia* for two reasons: (1) they possess only a single spermatheca with no evidence of a vestigial one, and (2) they have only a single pair of gland rods that arise near the lateral margins of the abdominal segment. The short, stout setae on the fifth tarsomeres of *Amerohelea* are similar to those present on members of the *tibialis* and *lineata* groups of *Palpomyia* (Grogan and Wirth 1979) and in some of the subgenera or groups of *Bezzia.* However, the setae on the fifth tarsomeres of *Palpomyia* and *Bezzia* differ from those of *Amerohelea* in being longer, with more slender, curved tips. The presence of these setae may indicate that *Amerohelea* may have evolved from an ancestor similar to members of the *tibialis* group of *Palpomyia.*

Biology.—Although nothing is presently known of the natural history of this new genus, by comparing them with another better known group we may speculate on their feeding behavior. The small female claws are similar to those of the *flavipes* group of *Palpomyia* (Grogan and Wirth 1979) except that they have small basal inner teeth. Members of the *flavipes* group possess small, broad mandibles with 5–6 large teeth that are indistinguishable from those of *Amerohelea.* These *Palpomyia* species with reduced, small claws and a mandible of this configuration have been recorded feeding only on Ephemeroptera, not Chironomidae or other Ceratopogonidae, which are the usual prey of other *Palpomyia* and other genera of predaceous ceratopogonids (Downes 1978; Grogan and Wirth 1979). The morphological similarities between *Amerohelea* and the *flavipes* group of *Palpomyia* indicate that the former may also utilize mayflies as prey.

Key to the Species of *Amerohelea*

1. Wing with one radial cell; frontoclypeus with numerous stout spines .... 10. *frontispina* (Dow and Turner)
– Wing with two radial cells; frontoclypeus with slender hairlike setae 2
2. Hind femur with distinct subapical yellowish band 3
– Hind femur brown, without subapical yellowish band 4
3. Wing hyaline; palpal ratio 2.0–2.5; ratio of flagellum length to wing length 0.72–0.84 .... 1. *fasciata,* n. sp.
– Wing infuscated; palpal ratio 2.7–3.3; ratio of flagellum length to wing length 0.60–0.66 .... 2. *pseudofasciata,* n. sp.
4. Fifth tarsomeres without ventral setae 5
– Fifth tarsomeres with one or more pairs of ventral setae 6
5. Spermatheca with distinct long neck; wing length less than 1.1 mm .... 3. *dalcyi,* n. sp.
– Spermatheca without a neck; wing length 1.5 mm or greater .... 4. *nelsoni,* n. sp.
6. Fore femur unarmed; fifth tarsomeres with only a single pair of setae .... 5. *spinellii,* n. sp.
– Fore femur with one or more ventral spines; fifth tarsomeres with two or more pairs of setae 7
7. Fore femur with 1–2 spines 8
– Fore femur with 3–6 spines 9
8. Fore femur with one spine (rarely 0–2); claspettes of male genitalia with slender distal portions curving inward .... 6. *galindoi,* n. sp.

– Fore femur with two spines (rarely 1–3); claspettes of male genitalia with broad distal portions straight .... 7. *vargasi,* n. sp.

9. Legs uniformly brownish; fore femur swollen; antennal ratio 1.35 .... 8. *ronderosi,* n. sp.

– Legs with hind leg darkest, fore and mid legs lighter in shade; fore femur slender; antennal ratio 1.39–1.49 .... 9. *sordidipes* (Macfie)

1. *Amerohelea fasciata,* new species

Figs. 1a–d, 3a

Diagnosis.—Distinguished from all other species in the genus except *A. pseudofasciata* n. sp. by its yellowish legs with a distinct subapical yellow band on the dark hind femur. From *pseudofasciata* it is distinguished by its hyaline wing with narrow anal angle (wing infuscated with broader anal angle in *A. pseudofasciata*), palpal ratio 2.0–2.5 (2.7–3.3 in *A. pseudofasciata*), and ratio of flagellum length to wing length 0.72–0.84 (0.60–0.66 in *A. pseudofasciata*).

Holotype female.—Wing length 1.82 mm; breadth 0.54 mm.

Head: Dark brown; eyes very narrowly separated (a distance of 0.019 mm). Antennal flagellum (Fig. 1a) light brown on basal halves of proximal four flagellomeres, remainder brown; flagellomeres with lengths in proportion of 29-17-17-17-17-18-18-22-45-45-47-47-57; antennal ratio 1.55; flagellum very long and slender, total length 1.47 mm; ratio of flagellum length to wing length 0.81. Palpus light brown; segments with lengths in proportion of 7-10-14-10-12; third segment with 5–6 mesal capitate sensilla; palpal ratio 2.00. Mandible with five large coarse teeth.

Thorax: Dark brown; anterior scutal spine well developed. Legs (Fig. 1c) yellow, hind femur except for subapical band, and hind tibia dark brown, proximal third of mid femur light brown, fore femur with four spines; tarsi brown except yellowish on proximal two tarsomeres of fore and mid legs; fifth tarsomeres similar to those of *A. galindoi,* n. sp. (Fig. 6j) with two pairs of stout setae. Wing (Fig. 1b) hyaline with narrow anal angle; anterior veins brown, posterior veins pale; costal ratio 0.78. Halter dark brown.

Abdomen: Brown; gland rods extending the length of 2½ segments; spermatheca not visible due to improper mounting, that of a paratype (Fig. 1d) is spheroid with stout, short neck, measuring 0.074 by 0.055 mm.

Allotype male.—Similar to female except smaller, legs brownish, hind femur without yellowish subapical band and with the usual other sexual differences. Genitalia as in Fig. 3a. Ninth sternum with curved base, four times broader than long; ninth tergum tapering gradually distad to a broad rounded tip, cerci extending well beyond basimeres with single large subapical and single large apical setae. Basimere nearly straight, about twice as long as broad; telomere about ⅔ length of basimere, tapering slightly distally to a greatly curved, broadly pointed tip. Aedeagus slightly broader

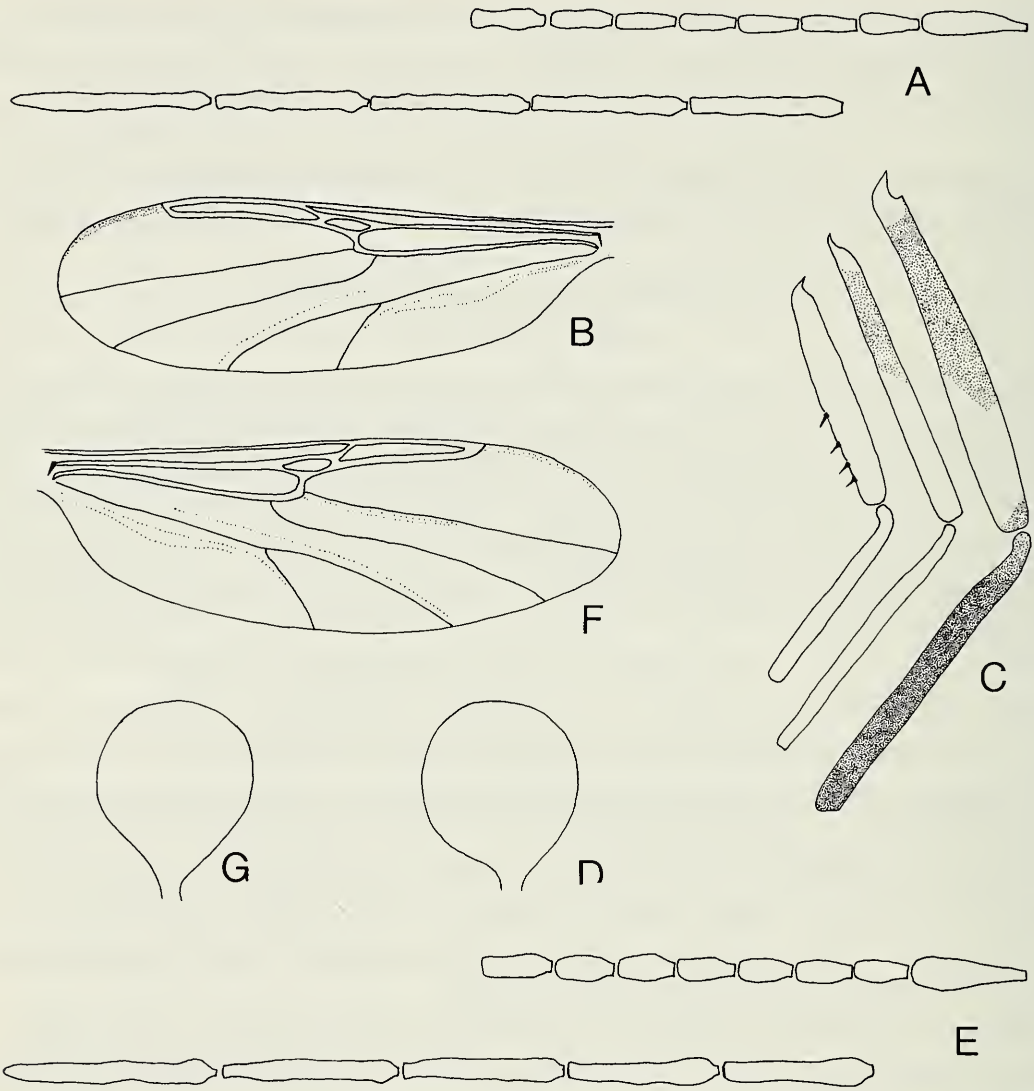

Fig. 1. *Amerohelea fasciata* (A–D) and *A. pseudofasciata* (E–G): A, E, antennal flagella; B, F, wings; C, legs; D, G, spermatheca.

than long, shape quite different from other species in the genus, membrane but not ventral surface spiculate, basal arch ½ of total length; basal arm heavily sclerotized, curved slightly to a pointed tip; distal portion with broad rounded lateral projections, mesal portion slender proximally, then expanding abruptly distad into a nearly round process with small, pointed, heavily sclerotized, anteriorly projecting points. Claspettes fused on basal portion; basal arm recurved angularly at about 120°, tip broad and paddle-shaped; distal portion divided into broad halves each curving outward away from each other, then inward to where the rounded tips face each other.

Variation.—Wing length 1.81 (1.64–2.07, n = 10) mm; breadth 0.54 (0.56–0.64, n = 10) mm. Antennal ratio 1.55 (1.44–1.66, n = 9); flagelium length 1.40 (1.23–1.58, n = 9) mm; ratio of flagellum length to wing length 0.78

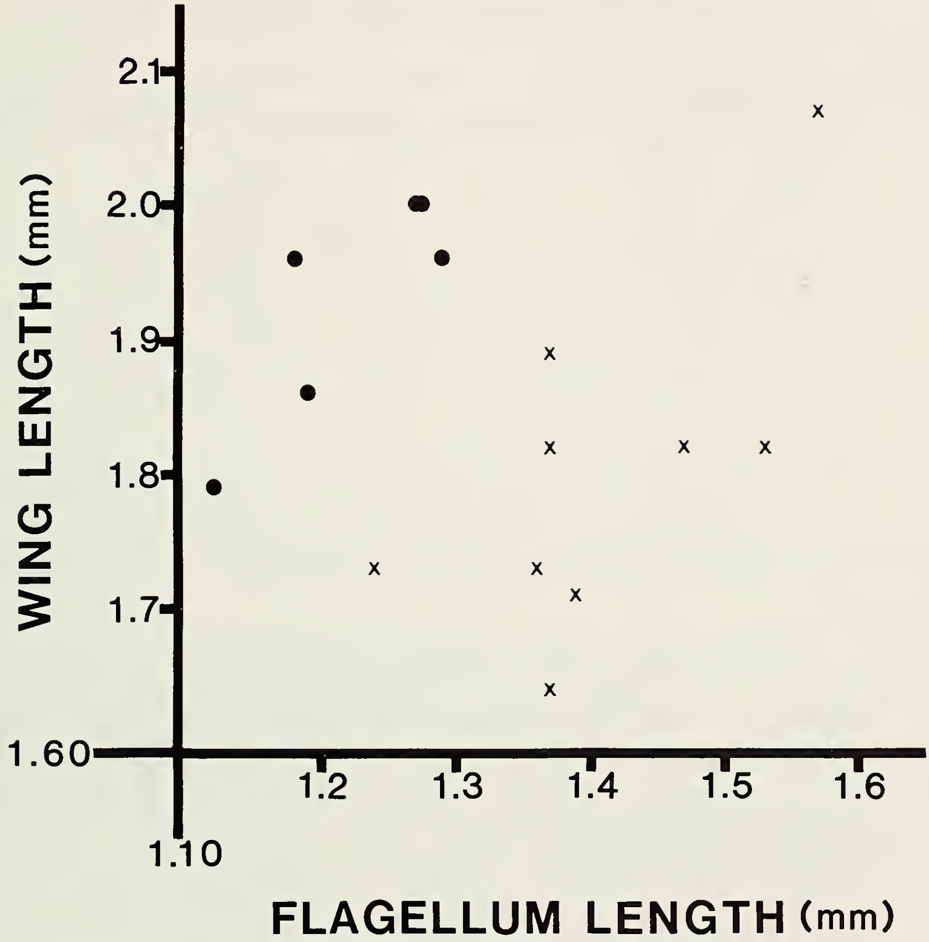

Fig. 2. Scatter diagram showing correlation between wing length and flagellum length in *A. fasciata* (X) and *A. pseudofasciata* (solid circles). Significant at 5% level.

(0.72–0.84, n = 9). Palpal ratio 2.27 (2.00–2.50, n = 10). Costal ratio 0.79 (0.77–0.81, n = 10). Fore femoral spines 3–5.

Distribution.—Mexico south to Colombia.

Types.—Holotype female, Belize, Augustine, 1.viii.1968, W. L. Haase, black light (Type no. USNM 76569). Allotype male, Belize, Cayo Dist., Western Highway MP66, vi.1969, W. & D. Haase, light trap. Paratypes, 62 females, as follows:

BELIZE: Same data as holotype, 27 females. Same data as allotype, 14 females. Cayo Dist., Central Farm, MP67, 15.vii.1968, W. L. Haase, black light, 1 female. Columbia Forest Station, vii.1968, W. L. Haase, black light, 1 female.

COLOMBIA: Valle, Rio Raposo, xii.1963, V. H. Lee, light trap, 1 female.

COSTA RICA: Limon Prov., La Lola near Matina, 11.iii.1965, W. D. Duckworth, 1 female.

HONDURAS: Comayagua, Comayagua, 4.vii.1966, J. F. Matta, 1 female;

Table 1.—Comparison of the ratios of flagellum length to wing length in *A. fasciata* and *A. pseudofasciata*, significant at 0.5% level.

A. fasciata	*A. pseudofasciata*
0.81	0.66
0.84	0.64
0.72	0.63
0.79	0.64
0.84	0.60
0.81	0.64
0.75	$\bar{x}$ = 0.63 (n = 6)
0.76	
0.72	
$\bar{x}$ = 0.78 (n = 9)	

F. S. Blanton, 1 female. Francisco Morazan, Zamorano, iv.1965, F. S. Blanton, 1 female.

MEXICO: Morelos, San Luis Potosi, El Salto Falls, iv.1965, H. V. Weems, 1 female; 17.vi.1969, W. & D. Haase, light trap, 3 females. Sonora, 10 mi E Navajoa, 13.viii.1959, Werner & Nutting, light trap, 2 females. Tabasco, Rio Puyacatengo, E Teapa, 28.vii.1966, Flint & Ortiz, 5 females.

PANAMA: Canal Zone, Loma Borracho, 23.x.1951, F. S. Blanton, light trap, 1 female; Mojinga Swamp, i.1952, 1953, F. S. Blanton, light trap, 3 females. Chiriqui Prov., David, vii.1964, A. Broce, 1 female; Dolega, 25.vi.1964, A. Broce, 1 female. Cocle Prov., Anton, 11.xi.1952, F. S. Blanton, light trap, 1 female. Colon Prov., Cativa, 27.viii.1952, F. S. Blanton, light trap, 1 female. Darien Prov., Santa Fe, 11.ix.1964, A. Broce, 1 female. Panama Prov., La Jolla, 21.x.1953, F. S. Blanton, light trap, 1 female; Tocumen, i.1953, F. S. Blanton, light trap, 3 females.

Discussion.—This species is named after the distinct subapical yellowish band on the hind femur. We first sorted out this species from its sibling *A. pseudofasciata* on the basis of the darker wing with broader anal angle in the latter species. Examination of other characters led us to believe that two nearly identical species were present, separated from one another by a large geographical area. In addition to the wing characters, the palpal ratio of *A. pseudofasciata* is greater than that of *A. fasciata* (2.67–3.33 versus 2.00–2.50). These differences should be sufficient to separate the two species, but we also discovered that there was a definite correlation between the wing length and flagellum length that further differentiates these two siblings (Fig. 2). This correlation is statistically significant at the 5% level.

2. *Amerohelea pseudofasciata*, new species
Fig. 1e–g

Diagnosis.—Distinguished from all other species in the genus except *A. fasciata*, n. sp. by its yellowish legs with a distinct subapical yellow band

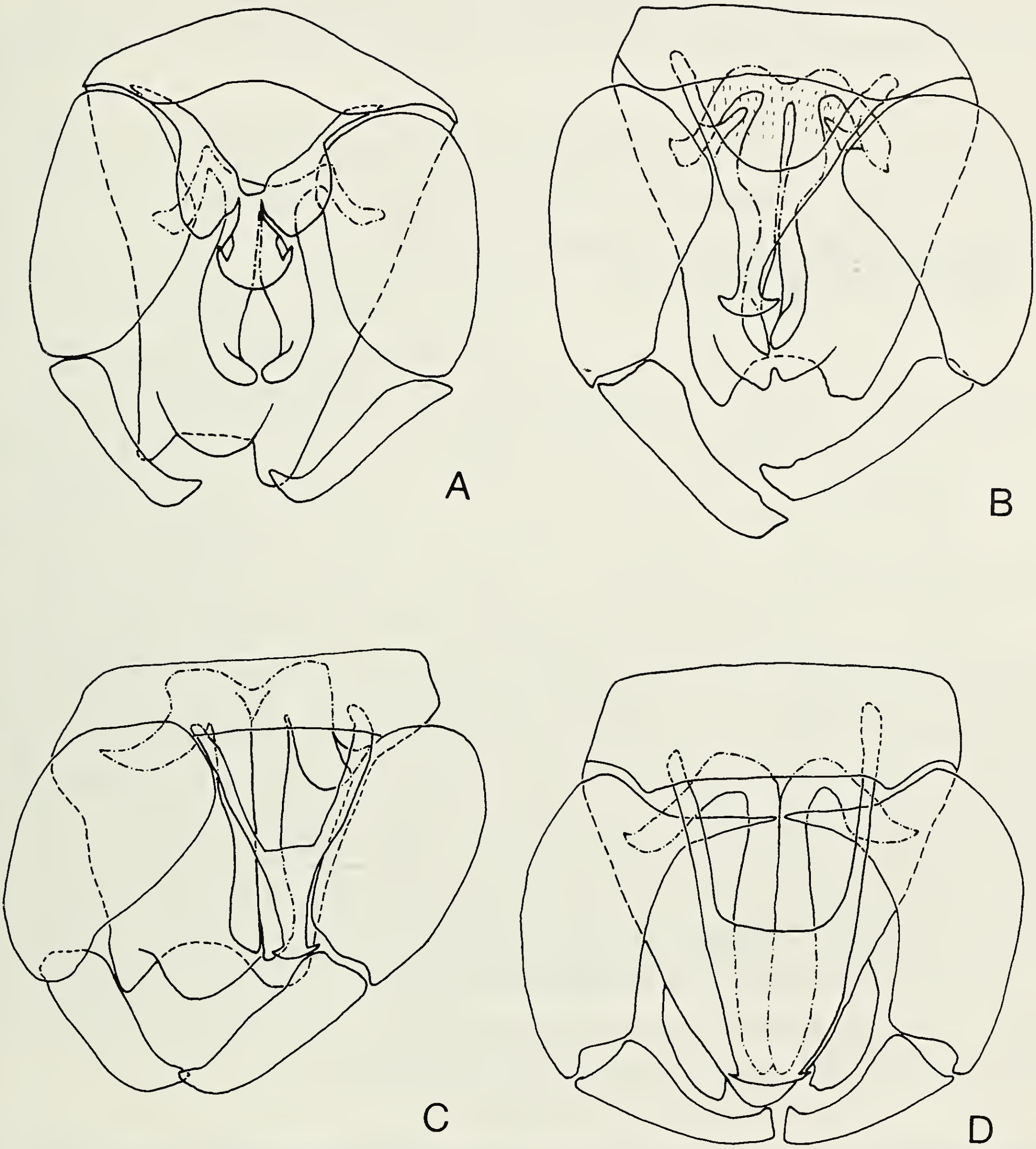

Fig. 3. Male genitalia of *Amerohelea* spp.: A, *A. fasciata*; B, *A. galindoi*; C, *A. vargasi*; D, *A. ronderosi*.

on the dark brown hind femur. From *A. fasciata* it is distinguished by its infuscated wing, palpal ratio 2.67–3.33, and flagellum length to wing length ratio 0.60–0.66.

Holotype female.—Wing length 2.00 mm; breadth 0.68 mm.

Head: Dark brown; eyes narrowly separated (a distance of 0.022 mm). Antennal flagellum (Fig. 1e) brown on proximal eight flagellomeres, darker brown on distal five flagellomeres; flagellomeres with lengths in proportion of 27-14-14-15-15-15-15-18-39-40-41-44-47; antennal ratio 1.59; flagellum long and slender, total length 1.27 mm; ratio of flagellum length to wing length

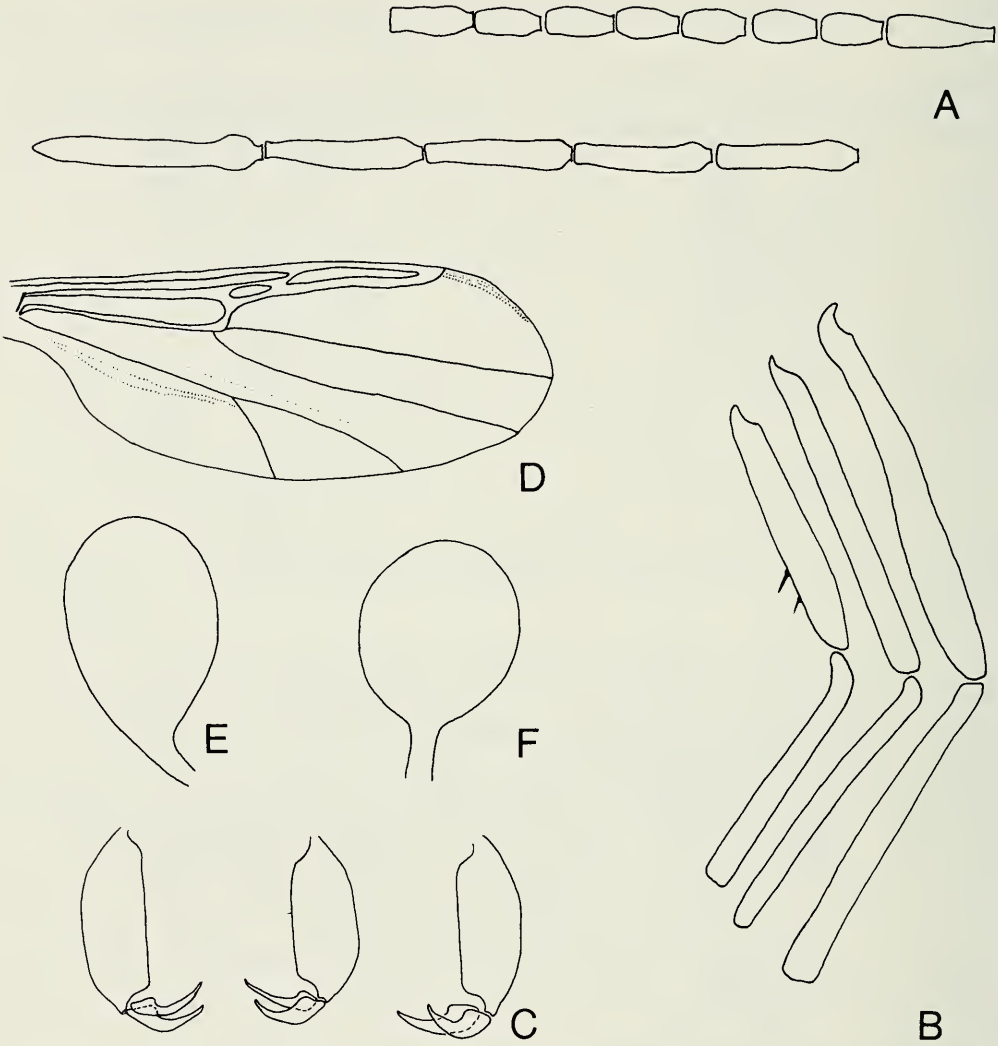

Fig. 4. *Amerohelea dalcyi:* A, antennal flagellum; B, legs; C, 5th tarsomeres and claws; D, wing; E, F, spermathecae.

0.64. Palpus light brown; segments with lengths in proportion of 6-12-18-11-12; third segment with 3–4 capitate sensilla on mesal side; palpal ratio 3.00. Mandible with five large coarse teeth.

Thorax: Dark brown; anterior scutal spine not visible due to distortion but it is small and poorly developed in paratypes. Legs yellowish, similar to those of *A. fasciata,* n. sp. (Fig. 1c) with distinct subapical yellowish band on dark hind femur, hind tibia also dark brown, mid femur paler than that of *A. fasciata* without a definite proximal dark band; fore femur with four spines; tarsi yellowish on proximal three tarsomeres, brown on distal two; fifth tarsomeres similar to those of *A. galindoi* (Fig. 6j) with 2–3 pairs of stout setae. Wing (Fig. 1f) infuscated, anterior veins brown, posterior veins paler; costal ratio 0.75; ratio of flagellum length to wing length 0.64. Halter dark brown.

Abdomen: Brown; gland rods extending the length of two segments; spermatheca (Fig. 1g) spheroid with distinct neck, measuring 0.078 by 0.059 mm.

Male.—Unknown.

Variation.—Wing length 1.94 (1.79–2.00, n = 7); breadth 0.65 (0.61–0.68, n = 7). Antennal ratio 1.62 (1.48–1.70, n = 6); flagellum length 1.22 (1.12–1.29, n = 6) mm. Ratio of flagellum length to wing length 0.63 (0.60–0.66, n = 6). Palpal ratio 3.07 (2.67–3.33, n = 7). Costal ratio 0.76 (0.74–0.77, n = 7). Fore femoral spines 4–7.

Distribution.—Argentina, Brazil.

Types.—Holotype female, 7 female paratypes, Brazil, Santa Catarina, Nova Teutonia, i.1971, F. Plaumann (Type no. USNM 76570). Additional paratypes:

ARGENTINA: Misiones, R. Piray, N of San Pedro, 22.xi.1973, O. S. Flint, Jr., 1 female.

BRAZIL: Nova Teutonia, xii.1962, F. Plaumann, 1 female (Canad. Nat. Coll.). Goias, Corumba, xi.1945, M. Barretto, 1 female.

Discussion.—*Palpomyia conifera* Macfie (1939), described from a male from Nova Teutonia, Brazil, has leg markings very similar to those of *A. pseudofasciata,* and we made a close comparision of descriptions to be sure our females were not conspecific with Macfie's male of *conifera.* In our opinion, Macfie had a different species, a true *Palpomyia,* with leg markings as in *pseudofasciata* but with a darkened area at the bases of the fore and mid tibiae; fore femur armed with 8–9 spines; wing hyaline, veins almost colorless. Macfie's figure of the male genitalia shows the parameres fused a considerable distance in midportion, placing the species in *Palpomyia.*

3. *Amerohelea dalcyi,* new species

Fig. 4

Diagnosis.—Distinguished from all other species in the genus by its small size (wing length less than 1.10 mm), fifth tarsomeres without stout setae, and brown legs with 0–2 fore femoral spines.

Holotype female.—Wing length 1.02 mm; breadth 0.41 mm.

Head: Brown; eyes barely separated (a distance of 0.01 mm). Antennal flagellum (Fig. 4a) light brown; flagellomeres with lengths in proportion of 15-10-10-9-10-10-10-12-20-21-21-22-35; antennal ratio 1.38. Palpus light brown; segments with lengths in proportion of 5-8-9-6-8; third segment with two ventromesal capitate sensilla; palpal ratio 1.80. Mandible with five large coarse teeth.

Thorax: Dark brown; anterior scutal spine not evident due to folding. Legs (Fig. 4b) brown with two small fore femoral spines; tarsi same color as femora and tibiae; fifth tarsomeres (Fig. 4c) short, stout, without ventral stout setae present as in other members of the genus. Wing (Fig. 4d) hyaline, broad, with well developed anal angle; anterior veins light brown, posterior veins paler; costal ratio 0.79. Halter dark brown.

Abdomen: Brown; gland rods extending the length of 1½ segments; spermatheca (Fig. 4e) ovoid with long neck, measuring 0.067 by 0.039 mm; spermatheca of paratype (Fig. 4f) spheroid.

Male.—Unknown.

Variation.—The following values were recorded for the single female paratype: Wing length 1.07 mm; breadth 0.43 mm. Antennal ratio 1.49. Palpal ratio 2.00. Fore femur without ventral spines. Costal ratio 0.86.

Distribution.—Brazil; known only from the type locality.

Types.—Holotype female, Brazil, Amazonas, Rio Solimões, 1.viii.1961, E. J. Fittkau, at light (Type no. USNM 76571). One female paratype with same data except taken 15.ix.1961.

Discussion.—This species is named for Dalcy de O. Albuquerque, Museu Nacional, Rio de Janeiro, Brazil.

Amerohelea dalcyi most closely resembles *A. nelsoni,* n. sp., which differs by having a spermatheca that lacks a neck and by its larger size (wing length 1.50–1.61 mm). *Amerohelea spinellii,* n. sp. also resembles *A. dalcyi,* but differs by having a single pair of setae on its fifth tarsomeres and its larger size (wing length 1.11–1.50 mm).

4. *Amerohelea nelsoni,* new species
Fig. 5e–h

Diagnosis.—Distinguished from all other species by its oval spermatheca without neck, fifth tarsomeres without ventral setae, and brownish legs with fore femur armed with two spines.

Holotype female.—Wing length 1.50 mm; breadth 0.54 mm.

Head: Brown; eyes narrowly separated (a distance of 0.022 mm). Antennal flagellum (Fig. 5e) light brown; lengths of flagellomeres in proportion of 21-12-12-12-12-13-13-15-32-32-35-33-39; antennal ratio 1.55. Palpus light brown; segments with lengths in proportion of 7-9-13-9-10; third segment with 3–4 capitate sensilla on mesal surface; palpal ratio 2.60. Mandible with five large coarse teeth.

Thorax: Dark brown; anterior scutal spine well developed. Legs (Fig. 5g) brown, hind leg darkest, fore leg lightest in shade; fore femur armed with two ventral spines; tarsi brown, hind darkest, mid and fore lighter in shade; fifth tarsomeres rather short and stout, similar to those of *A. dalcyi* (Fig. 4c) and like that species lacking ventral setae. Wing (Fig. 5f) slightly infuscated with moderately broad anal angle; anterior veins brown, posterior veins paler; costal ratio 0.81. Halter brown.

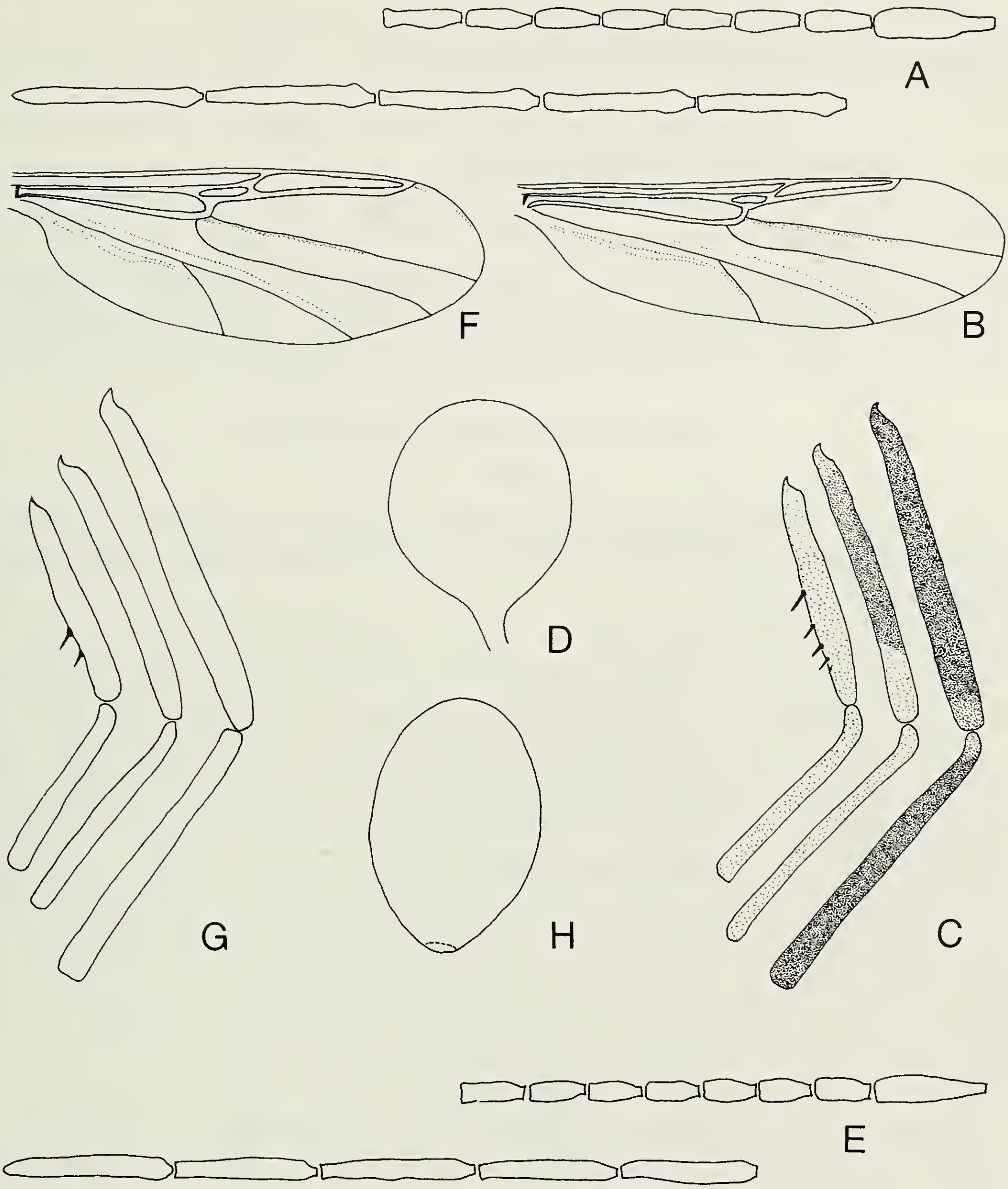

Fig. 5. *Amerohelea sordidipes* (A–D) and *A. nelsoni* (E–H): A, E, antennal flagella; B, F, wings; C, G, legs; D, H, spermathecae.

Abdomen: Golden brown; gland rods not sclerotized, invisible; spermatheca (Fig. 5h) ovoid without a neck, measuring 0.110 by 0.090 mm.

Male.—Unknown.

Variation.—Wing length 1.55 (1.50–1.61, n = 3) mm; breadth 0.57 (0.54–0.59, n = 3) mm. Antennal ratio 1.55 (1.50–1.59, n = 3). Palpal ratio 2.58 (2.33–2.60, n = 3). Costal ratio 0.81 (0.80–0.81, n = 3).

Distribution.—Brazil; known only from the type locality.

Types.—Holotype female, 2 female paratypes, Brazil, Amazonas, Rio Solimões, 15.ix.1961, E. J. Fittkau, at light (Type no. USNM 76572).

Discussion.—This species is named for Nelson Papavero, Museu de Zoologia, Universidade de São Paulo, Brazil.

A. nelsoni most closely resembles *A. dalcyi,* n. sp., which differs by its spheroid to pyriform spermatheca with a long neck and by its smaller size (wing length less than 1.10 mm). *A. spinellii,* n. sp. also resembles *A. nelsoni* but differs obviously by its pyriform spermatheca with a long neck, nonspinose fore femur, and fifth tarsomeres with a single pair of ventral setae.

5. *Amerohelea spinellii,* new species
Fig. 6

Diagnosis.—Distinguished from all other species in the genus by its brown legs with unarmed fore femur and its fifth tarsomeres armed with only a single pair of setae.

Holotype female.—Wing length 1.46 mm; breadth 0.52 mm.

Head: Brown; eyes slightly separated (a distance of 0.03 mm). Antennal flagellum (Fig. 6a) brown; lengths of flagellomeres in proportion of 20-12-12-12-12-13-14-17-28-26-26-26-29; antennal ratio 1.21. Palpus (Fig. 6b) brown; segments with lengths in proportion of 5-7-10-8-8; third segment with numerous capitate sensilla on ventromesal surface; palpal ratio 2.00. Mandible (Fig. 6d) with 5 large coarse teeth.

Thorax: Dark brown; anterior scutal spine (Fig. 6e) well developed. Legs (Fig. 6f) brown; fore femur unarmed; hind tibial comb (Fig. 6g) with six large setae; tarsi (Fig. 6h) brown; fifth tarsomeres (Fig. 6i) moderately short and stout with a single pair of ventral setae. Wing (Fig. 6c) slightly infuscated with moderately broad anal angle; anterior veins brown, posterior veins paler; costal ratio 0.80. Halter stem light brown; knob dark brown.

Abdomen (Fig. 6k): Brown; gland rods not sclerotized, invisible; spermatheca (Fig. 6j) pyriform with long neck; measuring 0.100 by 0.059 mm.

Male.—Unknown.

Variation.—Wing length 1.27 (1.11–1.50, n = 8) mm; breadth 0.49 (0.46–0.52, n = 8) mm. Antennal ratio 1.36 (1.21–1.44, n = 6). Palpal ratio 1.62 (1.42–2.00, n = 5). Costal ratio 0.79 (0.77–0.81, n = 8).

Distribution.—Colombia.

Types.—Holotype female, Colombia, Valle, Rio Micay, Casa de Suarez, 24.ix.1965, V. H. Lee, at Light (Type no. USNM 76573). Paratypes: same data as holotype, 1 female. Valle, Rio Raposo, i–x.1964, V. H. Lee, light trap, 8 females.

Discussion.—This species is named for Gustavo R. Spinelli, Insituto de Limnologia, Universidad Nacional de la Plata, Republica da Argentina.

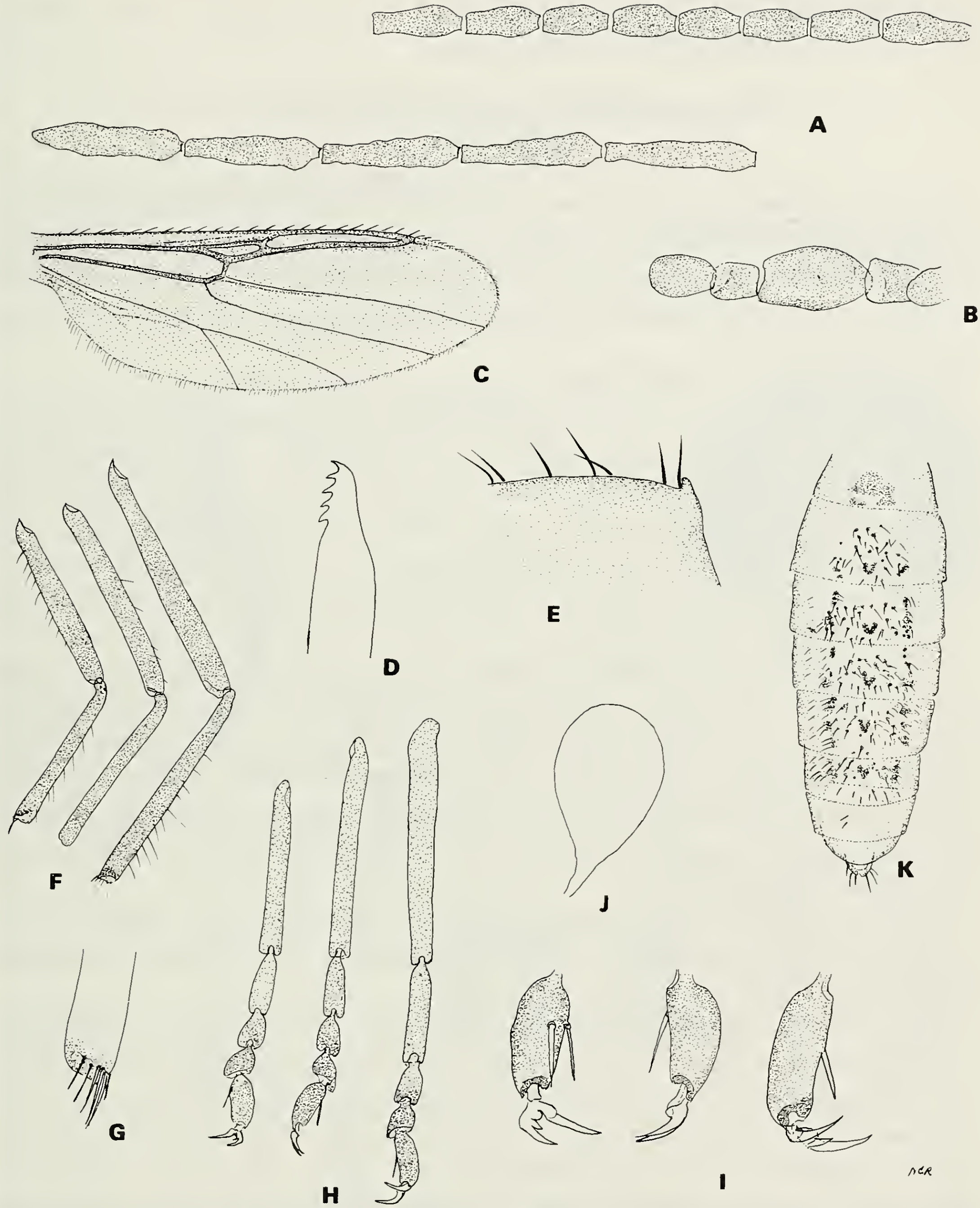

Fig. 6. *Amerohelea spinellii:* A, antennal flagellum; B, palpus; C, wing; D, mandible; E, anterior scutal spine; F, legs; G, hind tibial comb; H, tarsi; I, 5th tarsomeres and claws; J, spermatheca; K, abdomen.

Amerohelea spinellii most closely resembles *A. dalcyi,* n. sp., which differs in its smaller size (wing length less than 1.10 mm), ventral setae lacking on the fifth tarsomeres, and fore femur with one or two ventral spines. *Amerohelea nelsoni* is also closely related to *A. spinellii,* but differs in its ovoid spermatheca with neck lacking, fore femur with two ventral spines, and fifth tarsomeres without ventral setae.

6. *Amerohelea galindoi,* new species

Figs. 3b, 7

Diagnosis.—Distinguished from all other species in the genus by its brown legs with fore femur bearing a single spine (rarely 0–2 spines), retort-shaped spermatheca, fifth tarsomeres with 1–2 pairs of stout ventral setae, and male genitalia with slender triangular aedeagus and claspettes with recurved, slender, distal portions.

Holotype female.—Wing length 1.61 mm; breadth 0.50 mm.

Head (Fig. 7d): Dark brown; eyes very narrowly separated (a distance of 0.01 mm). Antennal flagellum (Fig. 7a) brown; lengths of flagellomeres in proportion of 23-15-14-16-16-16-17-20-42-41-43-43-45; antennal ratio 1.64; flagellum very long and slender, total length 1.36 mm. Palpus (Fig. 7b) brown; segments with lengths in proportion of 7-11-13-9-13; third segment with 4–5 capitate sensilla on mesal surface; palpal ratio 2.33. Mandible (Fig. 7e) with 5–6 large coarse teeth.

Thorax: Dark brown; anterior scutal spine (Fig. 7f) well developed. Legs (Fig. 7g) brown, hind leg darkest, fore leg lightest in shade; fore femur bearing a single ventral spine; hind tibial comb (Fig 7h) with 7–8 large setae; tarsi (Fig. 7i) brown, hind darkest, fore lightest in shade; fifth tarsomeres (Fig. 7j) with two pairs of stout setae. Wing (Fig. 7c) very slightly infuscated, anal angle narrow; anterior veins brown, posterior veins paler; costal ratio 0.80. Halter dark brown.

Abdomen (Fig. 7l): Dark brown; gland rods extending the length of 1½ segments; spermatheca (Fig. 7k) retort-shaped with well-defined neck, measuring 0.07 by 0.05 mm.

Allotype male.—Similar to female but smaller, with the usual sexual differences. Genitalia as in Fig. 3b. Ninth sternum with straight base, about 4 times broader than long; ninth tergum tapering slightly on proximal half, then more abruptly on distal half to broadly rounded tip, cerci extending the length of basimeres and each bearing a single large apical seta. Basimere slightly curved, about twice as long as broad with broad base and tapering gradually distally; telomere ⅔ length of basimere, tapering slightly distally to broad, slightly hooked tip. Aedeagus slightly longer than broad, membrane and ventral surface spiculate, basal arch over ⅓ of total length; basal arm straight, very heavily sclerotized; distal portion tapering abruptly and becoming very slender, the tip of the underlying membrane crescent-shaped. Claspettes fused basally; basal arm very heavily sclerotized, recurved nearly 180°, tip paddle-shaped with slender mesally directed portion; distal portion divided, each part broad proximad, then tapering distally with recurved tips curving towards each other.

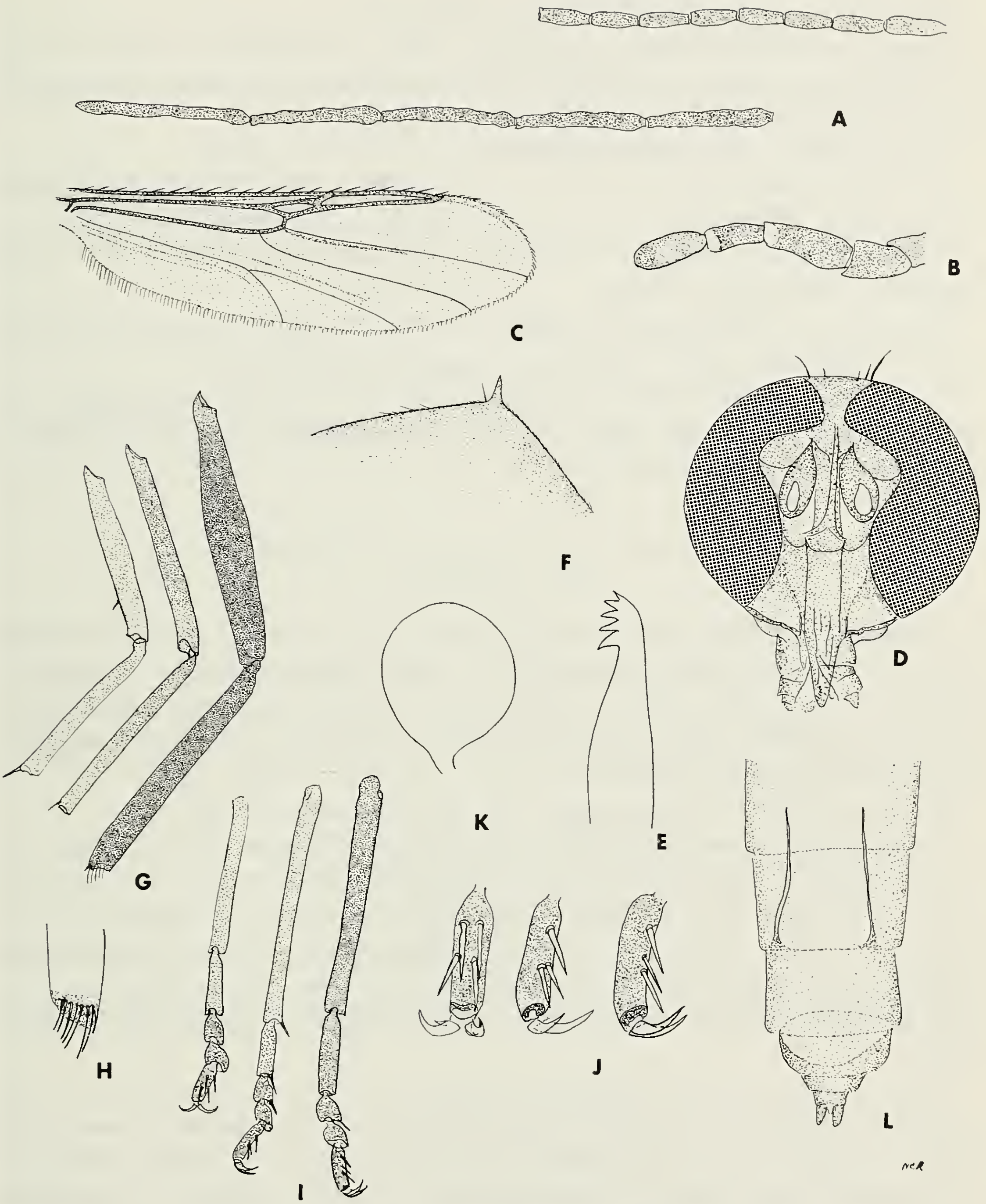

Fig. 7. *Amerohelea galindoi:* A, antennal flagellum; B, palpus; C, wing; D, head; E, mandible; F, anterior scutal spine; G, legs; H, hind tibial comb; I, tarsi; J, 5th tarsomeres and claws; K, spermatheca; L, abdomen.

Variation.—Wing length 1.63 (1.46–1.96, n = 10) mm; breadth 0.50 (0.46–0.54, n = 10) mm. Antennal ratio 1.59 (1.53–1.65, n = 9). Palpal ratio 2.32 (1.83–2.83, n = 10). Costal ratio 0.80 (0.78–0.82, n = 10). Fore femoral spines usually one, rarely 0–2.

Distribution.—Colombia, Panama, Venezuela.

Types.—Holotype female, Colombia, Valle, Rio Raposo, ii.1964, V. H. Lee, light trap (Type no. USNM 76574). Allotype male, same data except ii.1965. Paratypes, 9 males, 60 females, as follows:

COLOMBIA: Same data as allotype, 8 males, 57 females.

PANAMA: Bocas del Toro Prov., Almirante, iii.1953, F. S. Blanton, light trap, 1 male, 2 females.

VENEZUELA: Zulia, El Tucuco, Sierra de Perija, 28.i.1978, J. B. Heppner, light trap, 1 female.

Discussion.—This species is named for Pedro Galindo, formerly director of the Gorgas Memorial Laboratory, Republica de Panama.

A. galindoi most closely resembles *A. vargasi,* n. sp., which differs in having two fore femoral spines and the male genitalia with broad, straight, distal portions on the claspettes.

7. *Amerohelea vargasi,* new species
Figs. 3c, 8a–c

Diagnosis.—Distinguished from all other species in the genus by its brown legs with the fore femur bearing two ventral spines (rarely 1–3 spines), spherical spermatheca, fifth tarsomeres with two pairs of stout ventral setae, and male genitalia with slender triangular aedeagus and broad, straight, distal portions on the claspettes.

Holotype female.—Wing length 1.96 mm; breadth 0.59 mm.

Head: Dark brown; eyes barely separated (a distance of 0.01 mm). Antennal flagellum (Fig. 8a) dark brown; lengths of flagellomeres in proportion of 25-17-17-17-18-18-20-24-46-46-49-52-64; antennal ratio 1.65; flagellum very long and slender, total length 1.53 mm. Palpus dark brown; segments with lengths in proportion of 8-10-14-12-14; third segment with 3–4 capitate sensilla on mesal surface; palpal ratio 2.80. Mandible with five large coarse teeth.

Thorax: Dark brown; anterior scutal spine small, poorly developed. Legs similar to those of *A. galindoi,* n. sp. (Fig. 7g), dark brown, fore femur lighter brown, bearing two ventral spines; tarsi brown, similar to those of *A. galindoi,* n. sp. (Fig. 7i); fifth tarsomeres similar to those of *A. galindoi* (Fig. 7j) with two pairs of stout setae. Wing (Fig. 8b) very slightly infuscated with narrow anal angle; anterior veins brown, posterior veins paler; costal ratio 0.78. Halter dark brown.

Abdomen: Brown; gland rods extending length of 2½ segments; spermatheca (Fig. 8c) spherical with rather short neck, measuring 0.08 by 0.07 mm.

Allotype male.—Similar to female but smaller, with the usual sexual differences. Genitalia as in Fig. 3c. Ninth sternum with straight base, about

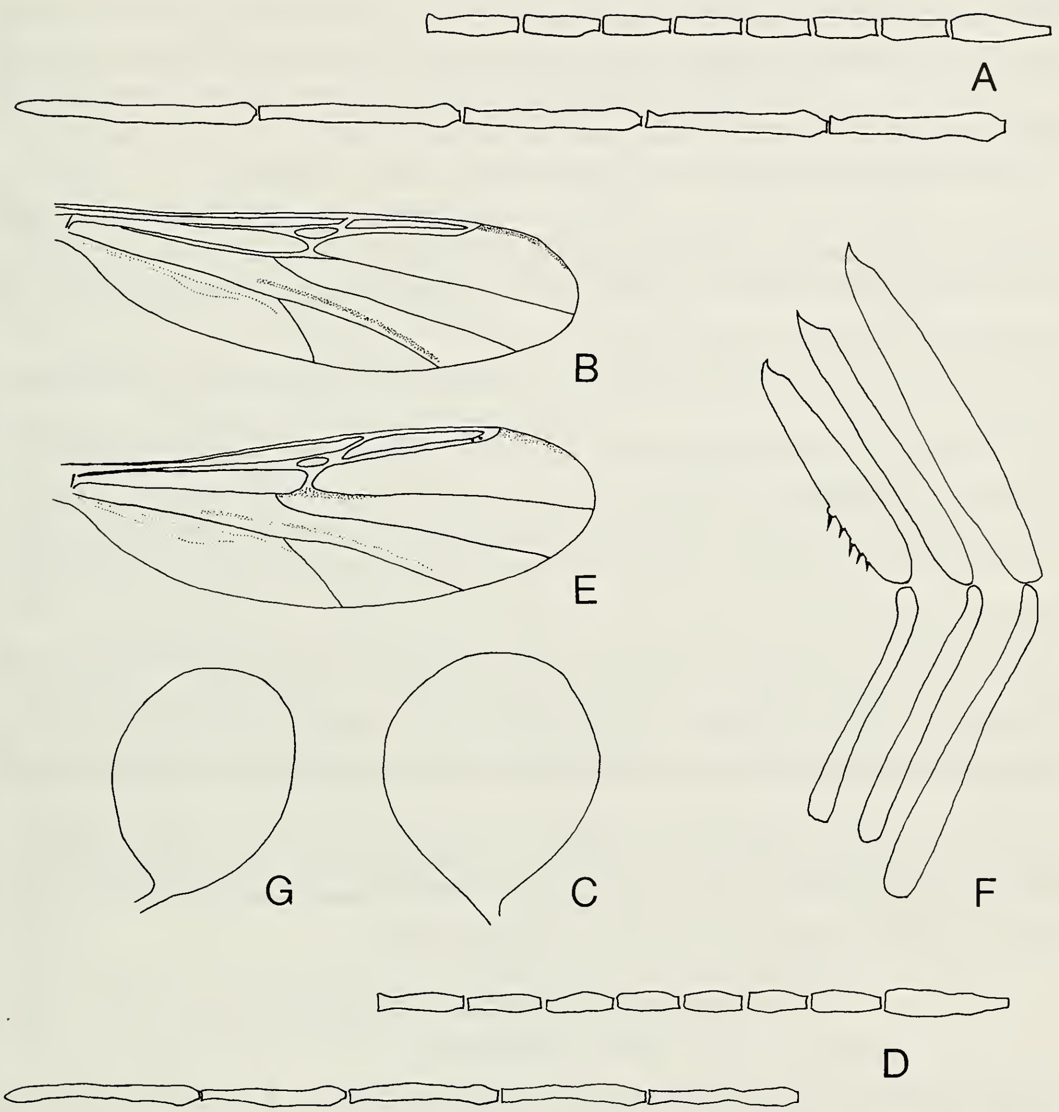

Fig. 8. *Amerohelea vargasi* (A–C) and *A. ronderosi* (D–G): A, D, antennal flagella; B, E, wings; C, G, spermathecae; F, legs.

four times broader than long; ninth tergum tapering slightly on proximal fifth, then more abruptly distally to rounded tip. Basimere slightly curved, about twice as long as broad with broad base tapering slightly distad; telomere nearly as long as basimere, tapering very slightly distad to curved tip. Aedeagus almost 1½ times longer than broad, membrane and ventral surface spiculate, basal arch over ½ of total length; basal arm slightly curved, very heavily sclerotized; distal portion tapering abruptly and becoming very slender, the tip of the underlying membrane crescent-shaped. Claspettes fused on basal portion; basal arm heavily sclerotized, doubly recurved, tip broad and pointed; distal portion divided, each part nearly parallel sided, tip broadly rounded.

Variation.—Wing length 1.87 (1.71–2.20, n = 10) mm; breadth 0.58 (0.54–0.66, n = 10) mm. Antennal ratio 1.61 (1.48–1.74, n = 10). Palpal ratio 2.82 (2.43–3.40, n = 10). Costal ratio 0.79 (0.77–0.82, n = 10). Fore femoral spines usually two, rarely 1–3.

Distribution.—Belize, Costa Rica, El Salvador, Mexico.

Types.—Holotype female, Belize, Augustine, 1.vii.1968, W. L. Haase, black light (Type no. USNM 76575). Allotype male, Belize, Cayo Dist., Western Highway MP66, vi.1968, W. L. Haase, light trap. Paratypes, 16 females, as follows:

BELIZE: Same data as holotype, 6 females; same data as allotype, 2 females.

COSTA RICA: San Jose, San Isidro, Perez Zeledon, 2175 ft, vii.1962, F. S. Blanton, light trap, 1 female.

EL SALVADOR: San Vicente, Santo Domingo, 22.xi.1966, F. S. Blanton, 1 female. Sonsonate, Armenia, 1.viii.1966, F. S. Blanton, light trap, 1 female.

MEXICO: Oaxaca, Palomares, 5–21.ix.1961, R. and K. Dreisbach, 1 female. Vera Cruz, Acayucan, 23.x.1957, R. and K. Dreisbach, 1 female.

Discussion.—This species is named for Luis Vargas, Consejo Tecnico de la Campaña Nacional para la Erradicacion del Paludisma, Mexico, D. F., Mexico.

A. vargasi most closely resembles *A. galindoi,* n. sp., which differs in having the fore femur usually bearing a single ventral spine and the male claspettes with recurved, slender, distal portions.

8. *Amerohelea ronderosi,* new species
Figs. 3d, 8d–g

Diagnosis.—Distinguished from all other species in the genus by its uniformly brownish legs, the fore femur swollen and bearing 3–5 spines, antennal ratio 1.35, male genitalia with broad triangular aedeagus, and claspettes with broad, straight, distal portions.

Holotype female.—Wing length 1.86 mm; breadth 0.61 mm.

Head: Dark brown; eyes very narrowly separated (a distance of 0.01 mm). Antennal flagellum (Fig. 8d) brown; flagellomeres with lengths in proportion of 27-19-17-17-18-19-21-24-42-40-42-40-54; antennal ratio 1.35; flagellum long and slender, total length 1.40 mm. Palpus brown; segments with lengths in proportion of 8-13-14-12-9; third segment with 2–3 capitate sensilla on mesal surface; palpal ratio 2.33. Mandible with 5–6 large coarse teeth.

Thorax: Dark brown; anterior scutal spine small, poorly developed. Legs (Fig. 8f) uniformly brown; fore femur swollen, bearing 3–5 spines; tarsi brown, lightest on fore leg, mid basitarsus with palisade setae as on hind leg; fifth tarsomeres similar to those of *A. galindoi,* n. sp. (Fig. 7j) with two pairs of stout setae on fore leg, one pair each on mid and hind legs. Wing (Fig. 8e) slightly infuscated with narrow anal angle; anterior veins brown, posterior veins paler; costal ratio 0.83. Halter dark brown.

Abdomen: Brown; gland rods not sclerotized, invisible; spermatheca (Fig. 8g) slightly retort shaped with long slender neck, measuring 0.090 by 0.060 mm.

Allotype male.—Similar to female but smaller, with the usual sexual differences. Genitalia as in Fig. 3d. Ninth sternum with straight base, over twice as broad as long; ninth tergum tapering rather abruptly to a narrow rounded tip, cerci extending slightly beyond basimeres, tip with a single long seta. Basimere distinctly curved, about twice as long as broad, base with slender mesal extension; telomere more than half the length of basimere, tapering slightly distad to broad truncate tip. Aedeagus nearly twice as long as broad, membrane and ventral surface spiculate, basal arch over half of total length; basal arm nearly straight, very heavily sclerotized; distal portion tapering very slightly to broadly rounded tip, underlying membrane extending beyond tip, broadly crescent shaped. Claspettes apparently divided but perhaps fused on extreme basal portion; basal arm heavily sclerotized, recurved about 120°, tip paddle-shaped; distal portion divided, each portion straight and nearly parallel sided, tapering to narrow rounded tip.

Distribution.—Colombia; known only from the type locality.

Types.—Holotype female, allotype male, two male paratypes, Colombia, Valle, Rio Raposo, 15.vi.1964, V. H. Lee, light trap (Type no. USNM 76576).

Discussion.—This species is named for Ricardo Ronderos, Museo de La Plata, Universidad Nacional de la Plata, Argentina.

A. ronderosi most closely resembles *A. sordidipes,* which has a slender fore femur bearing 4–5 spines, brownish legs with hind leg darkest, mid and fore legs lighter in shade, and antennal ratio 1.39–1.49. The male of *A. sordidipes* is unknown. The male genitalia of *A. vargasi* are similar to those of *A. ronderosi,* but its aedeagus is very narrow distally. Females of *A. vargasi* differ by having the fore femur slender and bearing two, rarely three, ventral spines.

9. *Amerohelea sordidipes* (Macfie), new combination
Fig. 5a–d

Palpomyia sordidipes Macfie, 1939:209 (female; Brazil; Lane, 1947:440 (male; fig. genitalia; Brazil); Lane, Forattini and Rabello, 1955:81 (pupa; figs.; Brazil); Lane, 1960:388 (in key; recorded Para, Brazil).

Diagnosis.—Distinguished from all other species in the genus by its brown legs, hind leg darkest, distal fourth of mid femur, mid tibia and fore leg light brown; fore femur slender and bearing 3–5 spines; spermatheca spherical; antennal ratio 1.39–1.49.

Female.—Wing length 1.84 mm; breadth 0.55 mm.

Head: Dark brown; eyes narrowly separated (a distance of 0.03 mm). Antennal flagellum (Fig. 5a) brown; flagellomeres with lengths in proportion of 25-15-15-15-15-15-16-20-37-39-39-41-47; antennal ratio 1.49; flagellum long and slender, total length 1.25 mm. Palpus light brown; segments with lengths in proportion of 6-10-19-11-12; third segment with 4–5 capitate sensilla; palpal ratio 3.80. Mandible with five large coarse teeth.

Thorax: Dark brown; anterior scutal spine well developed. Legs (Fig. 5c) dark brown, proximal ¾ and distal fourth of mid femur, mid tibia and fore leg light brown; fore femur slender with 3–4 spines; tarsi brown, hind tarsus darkest, mid and fore tarsi lighter in shade; fifth tarsomeres similar to those of *A. galindoi* (Fig. 7j) with two pairs of stout setae. Wing (Fig. 5b) very slightly infuscated, anal angle narrow; anterior veins brown, posterior veins paler; costal ratio 0.78. Halter dark brown.

Abdomen: Brown; gland rods extending the length of 2½ segments; spermatheca (Fig. 5d) spheroid with long neck, measuring 0.078 by 0.052 mm.

Male (after Lane 1947).—Ninth sternum with deep, caudomedian excavation. Basimere nearly straight, about three times as long as broad; distomere slightly curved, slender, tapering to tip. Aedeagus narrow at base, basal arch high and narrow, extending to more than half of total length, tip broad and bluntly rounded. Claspettes narrowly joined at bases, each with slender, sinuate, basal arm, distal free portions nearly straight, each only slightly tapered to moderately slender tip.

Variation.—Wing length 1.80 (1.62–1.89, n = 8) mm; breadth 0.56 (0.50–0.59, n = 7) mm. Antennal ratio 1.45 (1.39–1.49, n = 7). Palpal ratio 3.15 (2.50–3.80, n = 8). Costal ratio 0.79 (0.78–0.81, n = 8). Fore femoral spines 3–5.

Distribution.—Bolivia, Brazil.

Types.—Syntypes, 2 females, Brazil, Santa Catarina, Nova Teutonia, 20.xi.1937, F. Plaumann (in British Museum (Nat. Hist.), London).

Specimens examined.—BOLIVIA: Santa Cruz Prov., San Esteban Mayurina, 120 ft, 2–5.x.1959, Cummings, light trap, 8 females.

Discussion.—This species most closely resembles *A. ronderosi,* n. sp., which differs by its uniformly brownish legs, its swollen fore femur bearing 3–5 spines, and its antennal ratio 1.35. Females of *A. vargasi,* n. sp. also resemble *A. sordidipes,* but their fore femora usually have two spines, rarely three spines, and their legs are more uniformly brownish.

According to the original description, the Brazilian types of *A. sordidipes* differ from the Bolivian females described above as follows: Wing length "about 2 mm; greatest breadth 0.5 mm." Lengths of three distal palpal segments in proportion of 17-12-14; antennal ratio 1.25; costal ratio 0.8; fore femur with three spines; spermatheca 0.057 mm in diameter, duct sclerotized for 0.017 mm. We are confident that our material agrees closely enough with the original description to identify our species as *A. sordidipes.*

We must comment on Lane's (1960) treatment of *A. sordidipes* which he correctly identified and located in his key to Neotropical *Palpomyia.* His couplets 31 and 32 read as follows:

31. Femora of fore legs armed with 3 or 4 spines; segment V or tarsi armed; only one spermatheca 32
– Femora of fore legs armed with 6 to 10 spines; segment V of tarsi not armed; two or three spermathecae .... *subfuscula* I. & M., 1931
32. Abdomen with shining white pruinosity .... *tamoioi,* sp. n.
– Abdomen shining blackish .... *sordidipes* Macfie, 1939

Checking the description of *P. tamoioi,* sp. n. on page 388, we find a species keying out near *A. vargasi,* n. sp. in our key, but the species is larger, wing length 2.8 mm. It also differs in having the wing hyaline, halter with yellowish stem and black knob, tarsi with proximal three tarsomeres yellow on fore and mid legs, on proximal two tarsomeres on hind leg; abdomen with tergum I shining black, II shining black but white pruinose in middle; III–VII covered with white pruinosity except for round shining nude area at each side anteriorly, and segments iv to apex telescoping one into the other and thus forming a gradually narrowing structure. Lane stated that the holotype female had two long slender ventral spines on the fore femur. He also mentioned that his description was from a dry specimen, and we must conclude that the gland rods and spermathecae were not examined. Thus we cannot assume that *Palpomyia tamoioi* belongs in *Amerohelea,* and moreover the dorsal white pollinose pattern and distal telescoping of the abdomen, the hyaline wing, the pale halter stem, and yellowish bases of the tarsi make it seem more likely that the species is a true *Palpomyia.*

10. *Amerohelea frontispina* (Dow and Turner), new combination

Fig. 9

Bezzia frontispina Dow and Turner, 1976:138 (female; Texas; figs.).

Diagnosis.—Distinguished from all other species in the genus by its wing with one radial cell, and by the distinctive frontoclypeus with stout spines.

Female.—Wing length 1.35 (1.20–1.41, n = 10) mm; breadth 0.50 (0.44–0.52, n = 10) mm.

Head (Fig. 9d): Dark brown; frontoclypeus with numerous stout spines. Antennal flagellum (Fig. 9a) brown; basal halves of proximal eight flagellomeres and bases of 9–15 lighter brown; flagellomeres with length in proportion of 16-11-11-11-11-11-11-13-26-25-24-26-32; antennal ratio 1.33 (1.25–1.58, n = 10). Palpus (Fig. 9b) medium brown; segments with lengths in

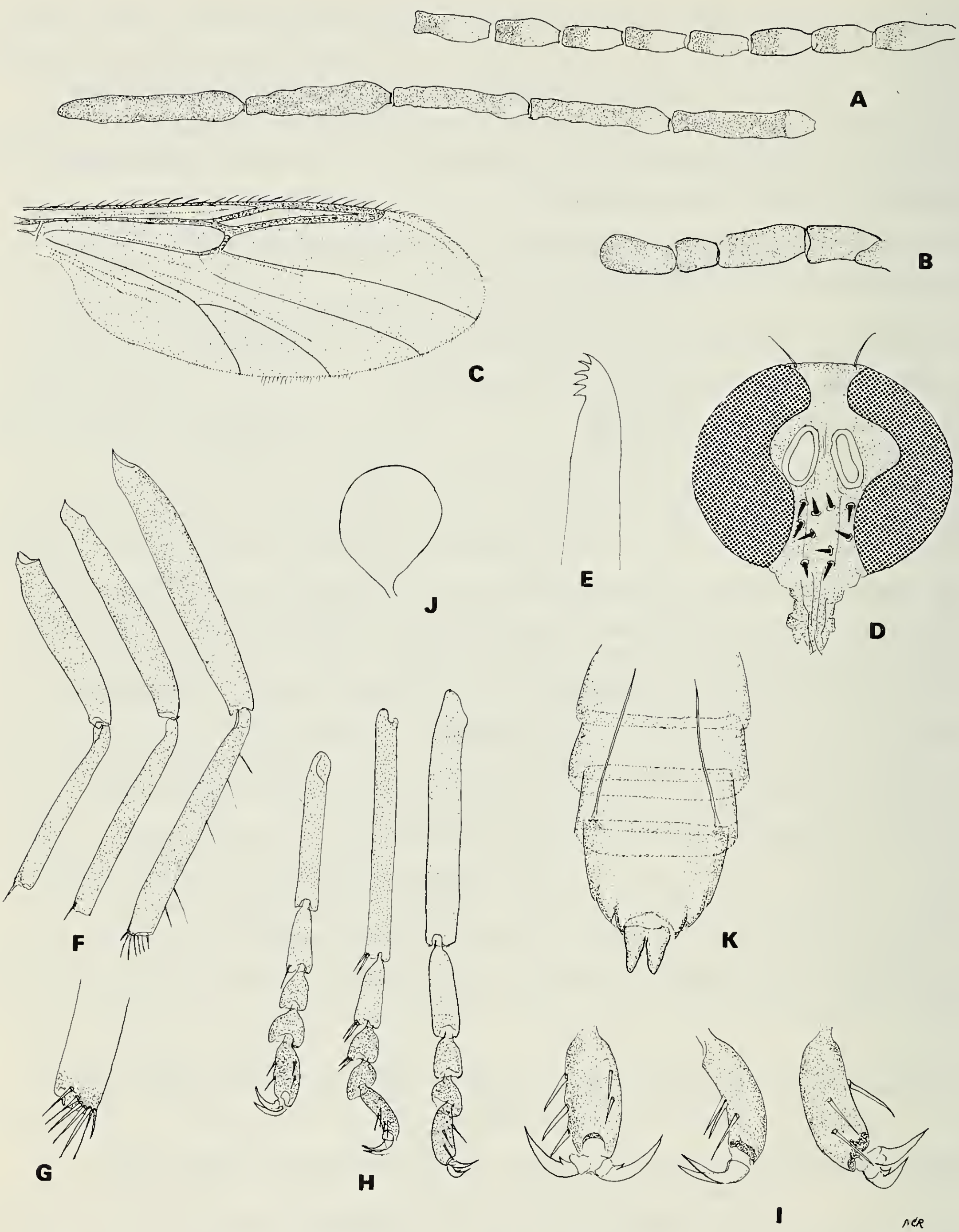

Fig. 9. *Amerohelea frontispina:* A, antennal flagellum; B, palpus; C, wing; D, head; E, mandible; F, legs; G, hind tibial comb; H, tarsi; I, 5th tarsomeres and claws; J, spermatheca; K, abdomen.

proportion of 5-8-11-7-9; third segment with 2–3 capitate sensilla on ventromesal surface; palpal ratio 2.04 (1.83–2.20, n = 6). Mandible (Fig. 9e) with five large coarse teeth.

Thorax: Dark brown with small anterior scutal spine. Legs (Fig. 9f) dark brown, fore femur unarmed, hind tibial comb (Fig. 9g) with seven large setae; tarsi (Fig. 9f) with proximal two tarsomeres paler, fifth tarsomeres (Fig. 9i) with 3–5 stout setae. Wing (Fig. 9c) hyaline, moderately broad with one radial cell and well developed anal angle; anterior veins brown, posterior veins paler; costal ratio 0.75 (0.73–0.78, n = 10). Halter dark brown.

Abdomen (Fig. 9k): Dark brown; pleura reddish purple; gland rods extending the length of three segments; spermatheca (Fig. 9j) pyriform with moderately long neck, measuring 0.074 by 0.052 mm.

Male.—Unknown; although we have examined a large number of females from many localities, we have been unable to identify males of this species; the species may be parthenogenic, but more likely we have overlooked the males as belonging to another species.

Distribution.—Widespread from California and Texas south to Colombia and Venezuela.

Type.—Holotype female, Texas, Gillespie Co., Fredericksburg, 2.vii.1967, Blanton and Borchers, light trap (Type no. USNM 76578).

Specimens examined.—

ARIZONA: Santa Cruz Co., Pena Blanca, 10 mi W Nogales, 1.viii.1961, Werner, Johnson and Nutting, light trap, 2 females. Yavapai Co., Oak Creek and Verde River, 9–10.vi.1977, M. W. Sanderson, light trap, 3 females.

BELIZE: Cayo Dist., Western Highway MP66, vi.1969, W. and D. Haase, light trap, 16 females.

CALIFORNIA: Trinity Co., Union Hill Lake, 1 mi NE Douglas, 28.vii.1970, S. Frommer and L. LaPre, 2 females.

COLOMBIA: Valle, Rio Raposo, iii.1963, V. H. Lee, light trap. 2 females.

GUATEMALA: Suchitepequez Prov., Rio Sis, 22 km S Finca La Maquina, vi.1966, O. S. Flint, 3 females; San Antonio Suchitepequez, 6.vii.1965, P. J. Spangler, malaise trap, 2 females.

HONDURAS: Comayagua Prov., Comayagua, x.1967, F. S. Blanton, light trap, 2 females. Francisco Morazan, Casa Viejas, v.1963, J. F. Matta, 4 females. Choluteca, Jicaro-Galán Jct. 5 mi W, 8.vii.1965, P. J. Spangler, light trap, 24 females. Valle, Nacaome, 28.v.1964, F. S. Blanton, light trap, 28 females.

MEXICO: Chiapas, Puenta Macalapa, 22.v.1964, F. S. Blanton, light trap, 1 female. Morelos, El Salto Falls, 17.vi.1969, W. & D. Haase, light trap, 1 female. Nayarit, Tepec, 21.viii.1964, F. S. Blanton, light trap, 1 female. Sonora, 5 mi W Alamos, 14.viii.1959, Werner & Nutting, light trap, 12 females; 10 mi E Navajoa, 13.viii.1959, Werner & Nutting, light trap, 6 females. Tabasco, Rio Puyacatengo, E of Teapa, 28.vii.1966, Flint & Ortiz, light trap, 1 female. Veracruz, Cuitlahuac, 10.viii.1964, P. J. Spangler, light trap, 3 females.

PANAMA: Canal Zone, Gamboa, Rio Agua Salud, vii.1967, W. W. Wirth, light trap, 1 female.

TEXAS: Gillespie Co., Fredericksburg, 2–30.vii.1967, Blanton & Borchers, light trap, 4 females. Kimble Co., Llano River, 23.v.1972, W. W. Wirth, malaise trap, 1 female. Real Co., Garner St. Park, 23.v.1972, W. W. Wirth, light trap, 6 females; Rio Frio, Leakey, 23.v.1972, W. W. Wirth, malaise trap, 1 female. Val Verde Co., Juno, Devil's River, 13.vi.1953, W. W. Wirth, 1 female.

VENEZUELA: Aragua Prov., Ocumare, 19.ii.1969, P. & P. Spangler, 1 female.

Discussion.—Although this species possesses only a single radial cell, we are assigning it to *Amerohelea* because of its single spermatheca, single pair of gland rods arising near the lateral margins of the eighth abdominal segment, and fifth tarsomeres with stout ventral setae, characters present in other members of the genus, and not typical of the genus *Bezzia*. We will not be overly confident of this assignment until we can examine the male for characters of the genitalia.

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