

ISABEL PÉREZ FARFANTE

*Western Atlantic
Shrimps of the
Genus *Metapenaeopsis*
(Crustacea, Decapoda,
Penaeidae), with
Descriptions of
Three New Species*

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ABSTRACT

Pérez Farfante, Isabel. Western Atlantic Shrimps of the Genus *Metapenaeopsis* (Crustacea, Decapoda, Penaeidae), with Descriptions of Three New Species. *Smithsonian Contributions to Zoology*, 79: 1-37. 1971. Five species of the genus *Metapenaeopsis* occur in the western Atlantic, three of which are described as new. A key for their separation, synonymies, disposition of the types, diagnoses, detailed descriptions, and illustrations are presented for each species, and their affinities are discussed. Their geographic and bathymetric ranges together with data on habits and habitats are also included. The morphology and development of the peculiar asymmetrical petasma of *Metapenaeopsis* have been investigated, and correlations made with previous significant works.

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Isabel Pérez Farfante

Western Atlantic Shrimps of the Genus *Metapenaeopsis* (Crustacea, Decapoda, Penaeidae), with Descriptions of Three New Species

Introduction

The American species of the genus *Metapenaeopsis* were investigated by Burkenroad (1934) who re-defined the taxon and reduced it to a subgenus of the genus *Penaeopsis*. Not only did he present a critical review of the earlier literature, but he also contributed greatly to our understanding of the genus as a whole. In the last three decades additions to our knowledge of the New World species have been limited essentially to records of their presence in various areas. One exception is the description of the general morphology of "*Penaeopsis goodei* (Smith)" by Williams (1965).

Until a large collection of these shrimps from the western Atlantic recently became available to me, the abundance of the *Metapenaeopsis* fauna, and its wide distribution along the east coast of America had not been realized. This material has allowed me to present a more detailed account of the morphology—particularly of the external genitalia—of the various species, to follow the development of the petasma through the juvenile stage, and to investigate the ranges of morphological variation in two species. Three new species are added to the genus, and the known distributions of those previously described are extended. Included also is a review

of earlier works on the genus and an evaluation of the petasmal characteristics in diagnosing super-specific taxa. Carapace length (c.l.) was measured from the orbital margin to the midposterior margin of the carapace, and total length (t.l.) from the apex of the rostrum to the posterior end of the telson.

Metapenaeopsis is treated as a separate genus, rather than as a subgenus of *Penaeopsis*; I thus follow Kubo (1949) who concluded that these shrimps possess a number of characters of generic rank. The asymmetrical petasma is unique and undoubtedly the most outstanding generic feature. Burkenroad (1959) indicated that a generic status for *Metapenaeopsis* "will probably prove acceptable as a convenience, after these groups have become better understood."

Acknowledgments

I thank Harvey R. Bullis, Jr., for making available to me the extensive material collected during the *Oregon* and *Silver Bay* cruises; Jacques Forest for the loan of the specimens taken from the *Calypso*; Gilbert L. Voss and Frederick M. Bayer for permitting me to study the collections made during the *Gerda* and *Pillsbury* expeditions; Willard D. Hartman and Herbert W. Levi for lending me the *Metapenaeopsis* of the Peabody Museum of Natural History and the Museum of Comparative Zoology, respectively; Waldo L. Schmitt and Lipke B.

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Holthuis for their help in locating the types of *Metapenaeopsis smithi* (Schmitt), and Thomas E. Bowman, Fenner A. Chace, Jr., and Horton H. Hobbs, Jr., for their constructive criticisms of the manuscript. Finally, special thanks go to Maria M. Diéguez for preparing the illustrations, without which this work would be far less useful to future students of the genus *Metapenaeopsis*.

The material examined in this study is located in the following institutions, cited by their abbreviations: American Museum of Natural History (AMNH); Muséum National d'Histoire Naturelle, Paris (MNHN); Museum of Comparative Zoology, Harvard University (MCZ); Peabody Museum of Natural History, Yale University (YPM); Rosenstiel School of Marine and Atmospheric Sciences, University of Miami (RSMAS); and the United States National Museum, Smithsonian Institution (USNM).

The asymmetrical petasma

The major studies of the structure and probable homologies of the asymmetrical petasma are rather difficult to comprehend because of the various terminologies employed and the lack of precision in delimiting certain structures. Below, I have discussed these contributions in an attempt to assist others in comparing and interpreting previous descriptions.

The generalized pattern of the asymmetrical petasma was first described by Kishinouye (1929), who presented a nomenclature for designating the most conspicuous parts. He recognized that each petasomal endopod is divided into anterior [distal] and posterior [proximal] halves, and that the distal half is subdivided longitudinally into "external and internal pieces." Further, he stated that the left "internal piece" is subdivided transversely, or transversely and longitudinally. Burkenroad (1934) discussed Kishi-

TABLE 1.—Nomenclature used by different authors in descriptions of the peculiar distal structures of the petasma of *Metapenaeopsis*

	<i>Kishinouye (1929)</i>	<i>Burkenroad (1934)</i>	<i>Kubo (1949)</i>	<i>Present study</i>
Left external piece		Left distoventral projection	Left distoventral projection	Left distoventral projection
Right external piece		Right distoventral projection	Right distoventral projection	Right distoventral projection
Left internal piece		Distal portion of left endopod divided	Left distodorsal lobule and inner and outer intermediate strips (Indo-Pacific species)	Left distodorsal element and left distodorsal projection (American species)
		Distal portion of left endopod simple	Left dorsal piece: "distodorsal lobule and inner and outer intermediate strips . . . united" (Indo-Pacific species)	
Right internal piece	proximal part	Distomedian lobe	Right distodorsal lobule	Right distodorsal element, and right distodorsal and subapical projections
	first distal part or convoluted distal part	Distoventral flap	Distoventral flap	Distoventral flap
	second distal part	Distolateral lobe	Distomedian lobule	Distoventral element

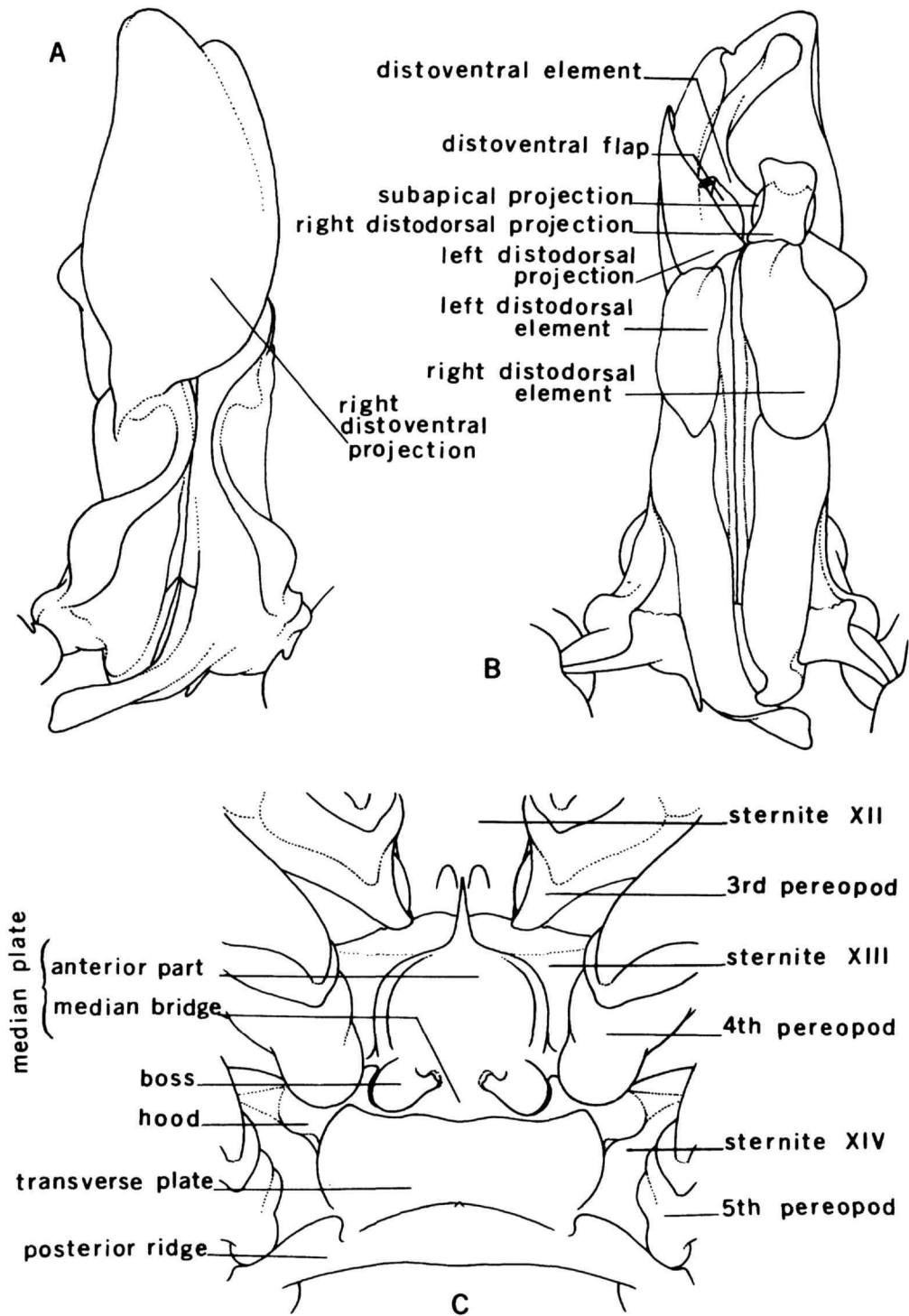


FIGURE 1.—Features of the external genitalia used in *Metapenaeopsis* taxonomy. A, Ventral view of petasma. B, Dorsal view of petasma. C, Thelycum.

nouye's work, and indicated the homologies between the parts of the asymmetrical petasma with those of the simple, symmetrical petasmata of *Penaeus* and *Penaeopsis megalops*. He believed that each petasmatid endopod is distally divided into three main lobes, which he termed distomedian, distolateral, and distoventral, and gave certain of the distal structures of the asymmetrical petasma the names of the assumed corresponding homologous parts of the symmetrical petasma. He stated that "Kishinouye's 'second distal part' is a much thickened and divided distolateral lobe," and, as explanation, added "as in many forms with open petasma, a portion of this lobe in *Metapenaeopsis* is spinose."

Burkenroad made two additional statements which are not entirely clear. He wrote that Kishinouye's "'internal piece' of the left endopod of the petasma may be simple or may be divided into more than one lobe; in the American species it is a simple flexible flap." However, Kishinouye's "internal piece" of the left endopod in the American species of *Metapenaeopsis* consists of two parts: a rigid proximal element and a distal projection, of which only the latter may be described as a "flexible flap." Burkenroad also stated that "Kishinouye's 'proximal part' surmounting the cincinnulated median margin of the endopod, is a fleshy, subdivided distomedian lobe," but he did not identify the subdivisions, none of which seem fleshy to me, but membranous or highly sclerotized.

Kubo (1949) reviewed Burkenroad's terminology and prepared a table showing equivalent names used by Kishinouye and Burkenroad and those proposed by him. Unfortunately, in this table the first two names (a., right distoventral projection and b., right distodorsal lobule) are transposed. In his figure 18, which illustrates his description and terminology of the asymmetrical petasma, as well as in other figures and descriptions in the text, he uses "right distoventral projection" for the same structure that Burkenroad termed the "right distoventral projection" and Kishinouye, the "right external piece." Furthermore, Kubo applied "right distodorsal lobule" in his figures and text to the dorsal portion that Burkenroad termed the "distomedian lobe" and Kishinouye the "proximal part."

Presented in Table 1 are the equivalents of the nomenclature proposed by the three authors mentioned above and by me. Some of the terms used in

the present study have been used by one or more of the other authors, but a few have been introduced to substitute for those that seem misleading to me. In Figure 1 are illustrated the various structures of the petasma (A, B), as well as the external (ventral) parts of the thelycum (C). Kubo considered the petasma as consisting of median and lateral lobes, each folded longitudinally in two lobules, which Pérez Farfante (1969) designated the dorsomedian and ventromedian lobules and the dorsolateral and ventrolateral lobules. Kubo termed the rigid distal portion of the dorsolateral lobule "distodorsal lobule," which does not seem appropriate, since it applies to only a part of the lobule; consequently I refer to it as the "distodorsal element." The "distolateral lobe" of Burkenroad and "distomedian lobule" of Kubo is a structure formed by Kubo's "ventrolateral lobule." Burkenroad's designation is too broad, and since the structure is neither derived from Kubo's median lobe nor located in a truly median position, I have termed it the "distoventral element." This designation was chosen because this element bears a relation to the ventrolateral lobule (of which it is a part) that is similar to the relation of the distodorsal element to the dorsolateral lobule. In the American species, the right half of the petasma possesses two distal projections, which I have termed the right distodorsal and subapical projections.

Kubo described the development of the petasma in three species of *Metapenaeopsis*, and concluded that all the distal structures (except the median lobes) arise from the lateral lobe. He also indicated their positions in relation to the dorsolateral and ventrolateral lobules of the proximal half of the petasma.

My observations on several stages of development of the juvenile petasma, and comparisons with fully developed ones, indicate that the distodorsal elements are part of the dorsolateral lobules (as Kubo concluded), as are the projections at their distal margins. My studies also show that the distoventral element is part of the ventrolateral lobule, expanded by the separation of the external and internal walls, and produced distally into one or more processes, widely variable in shape. The distoventral flap is a long, median extension of the proximomedian portion of the distoventral element, and the distoventral projection is a protrusion of the ventrolateral

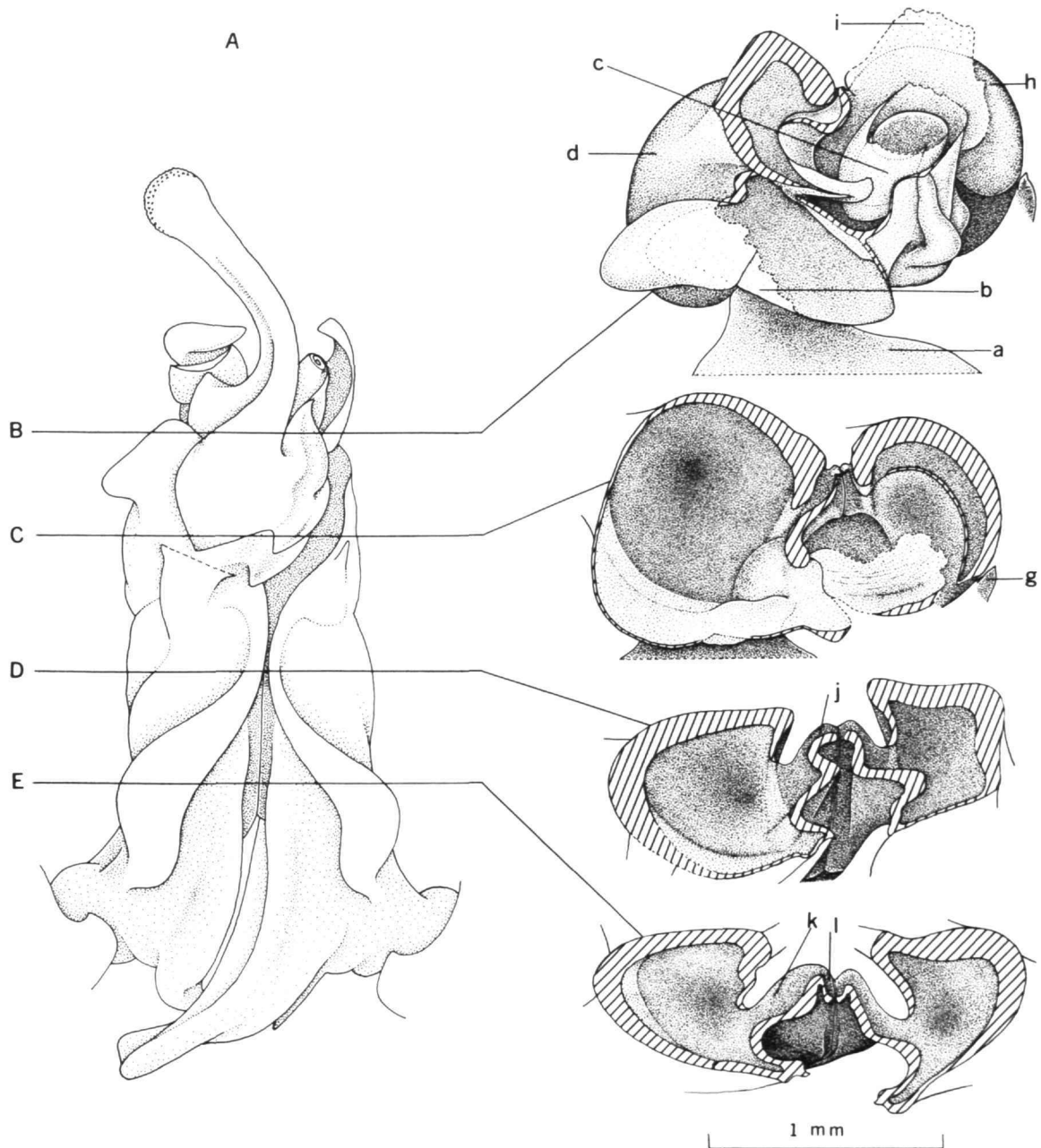


FIGURE 2.—A, Petasma of *Metapenaeopsis goodei* showing levels at which cross sections were made. b, c, d, e, Cross sections of petasma from ♂ 9.25 mm c.l., off Sanibel Island, Florida, a-d, g-l as in Figure 3.

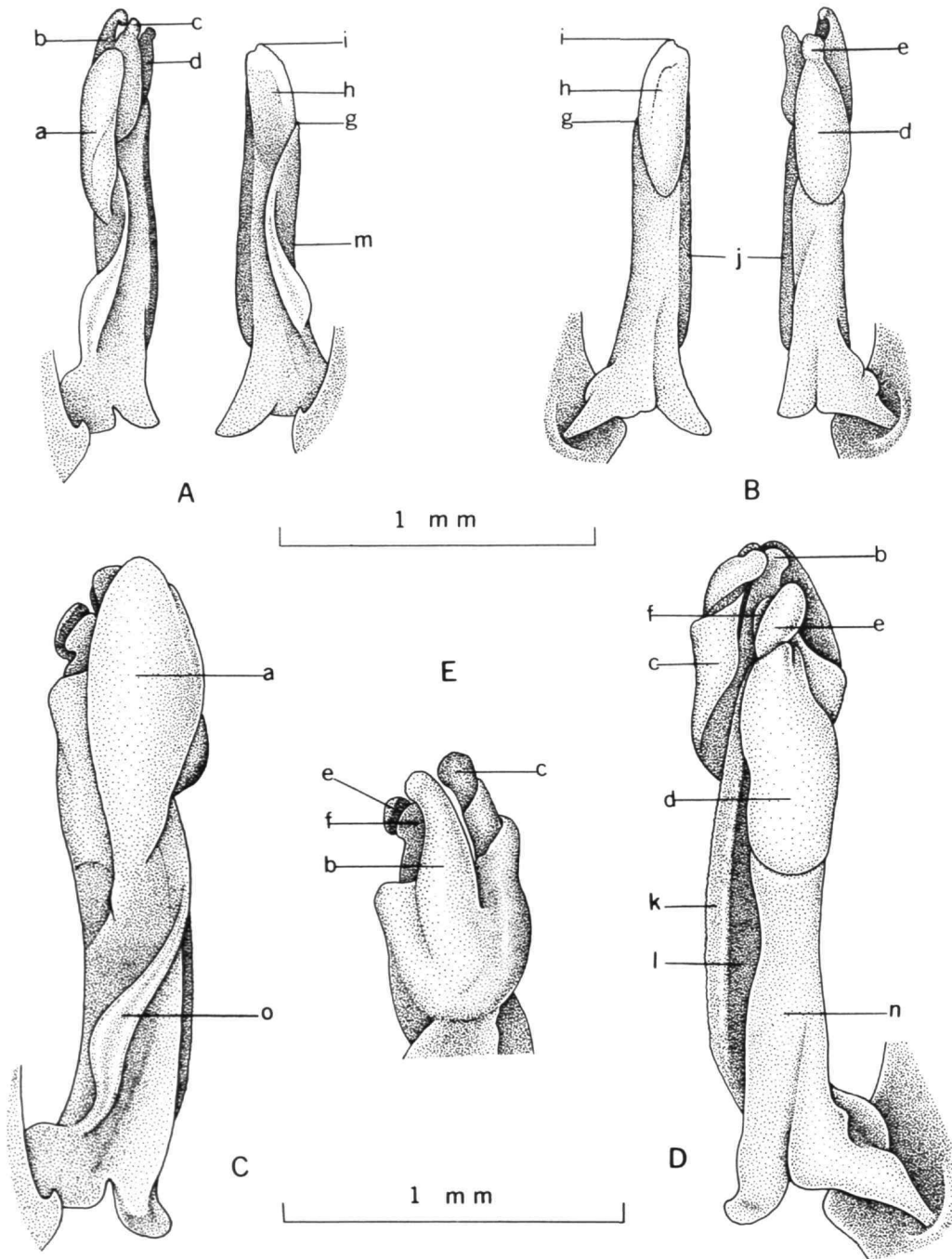


FIGURE 3.—*Metapenaeopsis goodei* (Smith). Juvenile petasmata. A, Ventral view, ♂ 3.6 mm c.l., off Islamorada, Florida Keys. B, Dorsal view of same petasma. C, Ventral view of right half of petasma, ♂ 5.2 mm c.l., south of St. George Island, Florida. D, Dorsal view of same half of petasma. E, Distal part of same, ventral view with distoventral projection bent ventrally. a, Right distoventral projection. b, Distoventral element. c, Distoventral flap. d, Right distodorsal element. e, Right distodorsal projection. f, Subapical projection. g, Left distoventral projection. h, Left distodorsal element. i, Left distodorsal projection. j, Median lobe. k, Dorsomedian lobule. l, Ventromedian lobule. m, Lateral lobe. n, Dorsolateral lobule. o, Ventrolateral lobule.

lobule. The development and relationships of the distal structures at two stages during the juvenile period are shown in Figure 3A-E.

The four cross sections in Figure 2A-E along the length of the adult petasma clearly indicate the pattern of arrangement of its various parts. They show that the median lobes are outwardly folded longitudinally, forming the dorsomedian and ventromedian lobules, and, although narrow distally, increase progressively in width proximally and become very conspicuous. The cross sections also show that the internal and external walls of the petasma are close together throughout the length of the median lobes. For the most part, however, these walls are widely separated in the lateral lobes; the external wall is expanded, whereas the internal wall is narrow. The separation of the walls gives rise to a hollow tube, roughly semicircular in cross section. Along the proximal third of the petasma, the ventromedian margin of the lateral lobes is produced into a thick and rigid shelf-like extension, formed by the internal and external walls becoming almost contiguous. With the formation of this shelf, the cavity of the petasma communicating with the outside becomes larger and there is a concomitant reduction in the cross-sectional area of the lateral lobes. This area reaches its minimum size along the proximomedian spurs.

The examination of large series of juvenile males has demonstrated that the petasma develops rapidly. For instance, in *Metapenaeopsis goodei* (Smith) of 3 mm c.l., about 16 mm t.l., both petasmas endopods are of the same length; the right one, however, already possesses a rudiment of the distoventral projection in the form of a small, thumblike lobe at the lateral part of the articulation (visible as a weak line) between the proximal and distal portions of the endopod, and three minute lobes at the distal margin of the endopod. These lobes represent the distoventral flap, the distoventral element, and the distodorsal projection. In males of 3.6 mm c.l., about 18 mm t.l., the distal structures are distinct, but their specific characters have not become differentiated (Figure 3A, B). The structures are clearly distinct in males of 4 mm c.l., 22 mm t.l.; e.g., the right distoventral projection exhibits a small sinus near its median margin, and the distoventral element is produced into a relatively long, narrow process bearing minute distal spinules. At 5 mm c.l., 27 mm

t.l. the distal structures are well developed (Figure 3C-E).

The function of the various structures of the distal half of the petasma of *Metapenaeopsis* cannot be explained on the basis of our present knowledge. This extremely complex apparatus serves the purpose of transferring the spermatophores during copulation to a pair of symmetrical seminal receptacles, consisting of more or less expanded capsules joining simple tubular ducts. Burkenroad (1938) suggested that in females, the spermatophores enter the seminal receptacles by an opening at the median extremity of each duct (e.g., *Metapenaeopsis goodei*) or, more often, along the length of the duct, far from its median extremity (e.g., *Metapenaeopsis smithi*). I have observed many impregnated females with the openings of the ducts plugged by platelets, which are formed by a hardened mass of material attached to the spermatophores. In recently impregnated females this material, glutinous in appearance, protrudes from each opening; it is similar to that accompanying the spermatophores recently attached to females of other genera of penaeid shrimps. Impregnation thus may occur through those small openings instead of along the rather long grooves between sternites XIII and XIV, which open into the seminal receptacles. Burkenroad (1934) had previously stated that the sperm is extruded at the anterolateral ends of these grooves; however, I have gathered no evidence to confirm this conclusion.

Genus *Metapenaeopsis* Bouvier

- Parapenaeus* Smith, 1885 [part], p. 170.
Metapenaeus Wood-Mason, 1891 [part], p. 271.
Metapenaeopsis Bouvier, 1905a, p. 981.—Kubo, 1949, p. 408.—Dall, 1957, p. 166.
Archipenaeopsis Bouvier, 1905b, p. 747.
Parapenaeopsis Bouvier, 1905b, p. 748 [not *Parapenaeopsis* Alcock, 1901].
Metapeneus Alcock, 1905 [part], p. 519.—Alcock, 1906 [part], p. 16.
Penaeopsis: Bouvier, 1908 [part], p. 3.—A. Milne Edwards and Bouvier, 1909 [part], p. 220.—de Man, 1911 [part], p. 8.—Verrill, 1922 [part], p. 43.—Schmitt, 1924a, p. 61.—Holthuis, 1952, p. 80.—Williams, 1965, p. 29.
Leptopenaeus Kishinouye, 1929, p. 282.
Ceratopenaeus Kishinouye, 1929, p. 282.
Erythropenaeus Kishinouye, 1929, p. 283.
Penaeopsis (*Metapenaeopsis*): Burkenroad, 1934, p. 4.
Type-species by original designation, *Metapenaeopsis pubescens* Bouvier, 1905a [not *Penaeus pubes-*

cens Stimpson, 1871] — *Penaeopsis miersi* Holthuis, 1952.

Diagnosis

Rostrum with dorsal teeth only. Carapace without longitudinal or transverse sutures. Cervical, hepatic, and orbito-antennal sulci usually feeble. Antennal, pterygostomial, and hepatic spines well developed; orbital spine small. Abdomen with mid-dorsal carina variable in length. Telson with tip appearing trifid, bearing pair of fixed, lateral, sub-apical spines, and with several (three) pairs of movable, lateral, relatively large spines anterior to fixed pair. Integument pubescent. First antennular segment with spine, "parapeneid spine," on distal half of ventromedian margin. Antennular flagella variable in length, usually shorter but sometimes longer than carapace. Palp of first maxilla short, unsegmented. Basial spines on third maxilliped and first and second pereopods, always lacking on third. Exopods on all maxillipeds and pereopods. Petasma asymmetrical, divided transversely at about mid-length, distal half complex and divided into various elements and projections; proximal half with dorso-lateral lobules produced proximally into spurlike projections, left one oblique, directed medially and longer than right. Appendix masculina usually consisting of small, flexible, distal lobe, projecting from broadened distal extremity of thickened rib on dorso-median margin of endopod. Thelycum consisting of well-developed median plate on sternite XIII and certain structures on sternite XIV, including pair of transverse, invaginated seminal receptacles on anterior margin. Pleurobranchiae on somites IX to XIII; rudimentary arthrobranchia on VII, anterior and posterior arthrobranchiae on VIII to XII, and rudimentary anterior arthrobranchia and posterior arthrobranchia on XIII. Mastigobranchiae on

first and second maxillipeds and first three pairs of pereopods. Zygocardiac ossicle consisting of two large teeth, sometimes with smaller teeth and patch of minute teeth. [Modified from Burkenroad (1934), Kubo (1949), and Dall (1957)].

Holthuis' proposal of a new name for the type-species was preceded by a misidentification and a questionable deduction. Bouvier, believing that his specimens from west Africa were perhaps conspecific with *Penaeus pubescens* Stimpson, 1871, from Saint Thomas, Virgin Islands, identified them under that name, and assigned the species as the type of his new genus *Metapenaeopsis*. Unfortunately, Stimpson's type was destroyed in the Chicago fire of 1871, and no subsequent specimens assignable to it have been discovered. Burkenroad (1934) recognized that Bouvier's *pubescens* differs from Stimpson's description—which included characters that he thought might make it referable to the genus *Parapenaeopsis*—and recommended that the name *pubescens* be provisionally applied to Bouvier's types. Holthuis (1952) also concluded that Bouvier's *pubescens* is based on a misidentification, and is distinct from *Penaeus pubescens* Stimpson; therefore, he proposed the substitute name *Penaeopsis miersi* [not recognizing the genus *Metapenaeopsis*].

Burkenroad (1934) recognized two sections in *Metapenaeopsis*, which were based solely on the size of the left distoventral projection:

Section I. Left distoventral projection rudimentary. Atlantic and American Pacific species.

Section II. Left distoventral projection large—as large as or larger than right one. All Indo-Pacific species.

The following petasmal character may now be added in the diagnoses of the two sections: the species of Section II lack a right distodorsal projection, whereas the species of Section I possess one.

Key to the western Atlantic species of *Metapenaeopsis*

1. Thelycum with median plate bearing horseshoe-shaped marginal strip and coiled lateral strips. Petasma with distoventral projection cleft by deep sinus into two long, subequal lobes *M. smithi*
Thelycum with median plate lacking marginal and coiled strips. Petasma with distoventral projection simple, forming one single lobe or cleft by shallow sinus into two short, subequal lobes, or into two unequal lobes 2
2. Thelycum with anteromedian portion of transverse plate strongly depressed; median plate bearing prominent bosses with posterolateral corners produced. Petasma with distoventral projection forming single lobe *M. hobbsi*

- Thelycum with anteromedian portion of transverse plate elevated; median plate bearing bosses with posterolateral corners not produced. Petasma with distoventral projection cleft by shallow sinus forming two lobes 3
3. Thelycum with anterior part of median plate convex, bearing two large pits. Petasma with distoventral projection mittenlike in outline, large left lobe extending distally far beyond small right lobule *M. gerardoii*
- Thelycum with anterior part of median plate concave, bearing two small pits. Petasma with distoventral projection distally cleft into two subequal or unequal lobes; if unequal, larger lobe not extending distally much beyond smaller lobe 4
4. Thelycum with anterior part of median plate long, at least half as long as median plate. Petasma with distoventral projection cleft into two unequal lobes, right lobe noticeably larger than left *M. goodei*
- Thelycum with anterior part of median plate short, less than half as long as median plate. Petasma with distoventral projection cleft into two subequal lobes or left lobe slightly larger than right *M. martinella*

Metapenaeopsis goodei (Smith)

FIGURES 2, 3, 4, 5, 6, 7, 8, 13A

Parapenaeus goodei Smith, 1885, p. 176. Type-locality: Bermudas. Lectotype: YPM 4714.—Rathbun, 1900, p. 152.

Archipenaeopsis vestitus Bouvier, 1905b, p. 747. Type-locality: west of Dry Tortugas, 37 fm [68 m], 1877, *Blake* Station 11. Holotype: MCZ 7204.—Schmitt, 1924a, p. 63.

Parapenaeopsis rathbuni Bouvier, 1905b, 748. Type-locality: west Florida, 19 fm [35 m], 24 April 1872, *Bache*. Holotype: MCZ 7203.

Metapenaeus goodei.—Alcock, 1905, p. 519.—Alcock, 1906, p. 51.

Penaeopsis goodei.—Bouvier, 1908, p. 6.—A. Milne Edwards and Bouvier, 1909, p. 226, fig. 55, pl. 4: figs. 6–10.—de Man, 1911, p. 53.—Verrill, 1922, p. 44, pl. 15: figs. 1A–1AIV, 1a, pl. 16: fig. 3.—Schmitt, 1924a, p. 61, figs. 1a, 2b, d.—Boone, 1927 [part], p. 80.—Boone, 1930 [part], p. 110, pl. 34 (not text-figures 4A, B).—Wheeler, 1937, p. 325.—Voss, 1955, p. 11, fig. 20.—Tabb and Manning, 1961, p. 595.—Bullis and Thompson, 1965, p. 5.—Williams, 1965, p. 29, figs. 16, 17A, B.

Metapenaeus goodei.—Rathbun, 1920, p. 320.

Penaeopsis [by implication] *vestitus*.—Schmitt, 1924a, p. 63.

Penaeopsis [by implication] *rathbuni*.—Schmitt, 1924a, p. 63.

Penaeopsis (*Metapenaeopsis*) *goodei*.—Burkenroad, 1934 [part], p. 15, figs. 2, 3.—Burkenroad, 1938, p. 76.—Springer and Bullis, 1956, p. 9.

Metapenaeopsis? *goodei*.—Fausto Filho, 1968, p. 70.

Material

BERMUDA ISLANDS

1 ♂, YPM 4714, Bermudas, G. B. Goode. 5 ♀, YPM, St. George's Island, jetty at Bermuda Biological Station, 6 June 1936, M. D. Burkenroad. 5 ♂ 8 ♀, YPM, St. George's Island, jetty at Bermuda Biological Station, 20 June 1936, M. D. Burkenroad. 6 ♂ 2 ♀, YPM, St. George's Island, jetty at Bermuda

Biological Station, 25 July 1935. 3 ♂, YPM, St. George's Island, Murray's Anchorage, 13 July 1936, M. D. Burkenroad. 1 ♀, AMNH, Nonsuch Island wharf, 31 August 1935. 2 ♀, YPM, North lagoon, 17 June 1936, M. D. Burkenroad. 1 ♀, YPM, North lagoon, 22 June 1936, M. D. Burkenroad. 5 ♂ 4 ♀, YPM, 1936, M. D. Burkenroad. 4 ♂ 9 ♀, YPM, 25 August 1935.

UNITED STATES

North Carolina: 32 ♂ 30 ♀, USNM, NE of Cape Lookout, 59 m, 18 October 1885, *Albatross* Station 2605.

Georgia: 1 ♀, USNM, off Jekyll Island, 73 m, 15 March 1940, *Pelican* Station 198–1.

Florida: 3 ♀, USNM, off Fernandina, 42–45 m, 9 October 1962, *Silver Bay* Station 4497. 1 ♀, USNM, off Jacksonville, 55 m, 9 March 1955, *George M. Bowers* Station 31. 2 ♂ 5 ♀, USNM, off Saint Augustine, 46–49 m, 8 October 1962, *Silver Bay* Station 4465. 1 ♂ 2 ♀, USNM, off Saint Augustine, 329 m, 16 September 1956, *Combat* Station 119. 2 ♀, USNM, off Sebastian, 72 m, 28 September 1963, *Silver Bay* Station 5107. 4 ♂ 2 ♀, RSMAS, Virginia Key, S side of bridge, 9 March 1963, staff RSMAS. 5 ♂ 6 ♀, USNM, off Old Rhodes Key, Straits of Florida, 49 m, 24 October 1960, *Silver Bay* Station 2354. 46 ♂ 48 ♀, USNM, off Islamorada, 40–44 m, 26 February 1969, *Gerda* Station 1038. 14 ♂ 29 ♀, RSMAS, off Islamorada, 36.3–42 m, 26 February 1969, *Gerda* Station 1037. 1 ♂ 3 ♀, USNM, Key West, 1884, *Albatross* in port. 1 ♀, MCZ 7204, west of Dry Tortugas, 68 m, 1877, *Blake* Station 11. 2 ♀, USNM, NE of Loggerhead Key, Dry Tortugas, 35 m, 3 December 1954, G. H. Eubank. 1 ♀, MCZ

7203, west Florida, 35 m, 24 April 1872, *Bache*, W. Stimpson. 45 ♂ 50 ♀, USNM, off Sanibel Island, 49 m, 18 March 1885, *Albatross Station* 2411. 6 ♀, USNM, off Anclote Keys, 37 m, 16 July 1957, *Silver Bay Station* 54. 1 ♂, USNM, off Dog Island, 40–37 m, 16 July 1957, *Silver Bay Station* 53. 2 ♂ 1 ♀, USNM, off George Island, 55 m, 15 March 1885, *Albatross Station* 2405. 1 ♂ 1 ♀, USNM, off Saint Vincent Island, 64 m, 7 March 1954, *Oregon Station* 896. 4 ♂ 3 ♀, USNM, off Cape San Blas, 46 m, 7 February 1885, *Albatross Station* 2370. 1 ♂, USNM, Pensacola, S. Stearns.

MEXICO

Campeche: 1 ♀, USNM, Cayos Arcas reef, 9 m (stomach of bonefish).

Quintana Roo: 1 ♀, USNM, off Isla Mujeres, 29 m, 11 June 1962, *Oregon Station* 3638.

BAHAMA ISLANDS

1 ♀, YPM, Royal Island, Eleuthera, 14 March 1925, *Pawnee I.* 1 ♀, YPM, Saddle Rock Islands, 23 March 1925, *Pawnee I.* 27 ♂ 14 ♀, USNM, off Cat Cays. "surface," 26–318 m, 21 May 1966, *Oregon Station* 6096.

CUBA

1 ♀, USNM, Bahía Honda, 22 m, 4 June 1914, *Tomás Barrera Station* 15. 1 ♀, USNM, Cayo Levisa Reef, 5 m, 2 June 1914, *Tomás Barrera Station* 14. 1 ♂, USNM, Cabo San Antonio, 25 May 1914, *Tomás Barrera*. 1 ♂, YPM, Bahía de Guantánamo, 22 April 1933. 1 ♀, YPM, Bahía de Guantánamo, 22 April 1933, M. B. Bishop and party.

PUERTO RICO

1 ♂ 3 ♀, USNM, off Mayagüez, 22 m, 3 June 1965, *Oregon Station* 5450. 1 ♂, USNM, off Humacao, 17 m, 8 February 1899, *Fish Hawk Station* 171. 1 ♀, USNM, off Humacao, 18 m, 8 February 1899, *Fish Hawk Station* 169. 2 ♂ 1 ♀, USNM, off Isla de Vieques, 29 m, 8 February 1899, *Fish Hawk Station* 164.

VIRGIN ISLANDS

Peter Island: 2 ♀, USNM, 26 m, 16 May 1967, *Oregon Station* 6691.

WESTERN CARIBBEAN

Swan Island: 1 ♂, YPM, 12 April 1925, *Pawnee I.*

HONDURAS

1 ♀, RSMAS, off Punta Patuca, 43.89 m, 1952, *Antilles*.

COLOMBIA

5 ♀, USNM, NE Cartagena, 44–42 m, 1 August 1968, *Pillsbury Station* 791. 12 ♂ 32 ♀, USNM, W of Tucuracas, 9 m, 30 July 1968, *Pillsbury Station* 778.

SURINAM

1 ♂, USNM, 55–59 m, 14 July 1968, *Pillsbury Station* 648.

BRAZIL

Paraíba: 1 ♂ 1 ♀, MNHNP, S of João Pessoa, 45 m, 16 November 1961, *Calypto Station* 1. Alagoas: 1 ♀, USNM, Maceió coral reef, 22 July 1899, A. W. Greeley, Branner-Agassiz Expedition. Bahia: 1 ♀, MNHNP, off Salvador, 60–44 m, 24 November 1961, *Calypto Station* 58.

Diagnosis

Body almost entirely covered by plumose, densely set setae. Stylocerite long, extending as far as base of distal third of first antennular segment. Third pereopod short, reaching at most to distal end of second antennular segment. Abdomen with middorsal carina long, extending at least from anterior end of third somite to posterior margin of sixth somite. Telson with terminal portion long, slender, length four to six and one-half times width at base. Petasma with right distoventral projection shallowly cleft into two unequal lobes, right lobe larger than left. Thelycum with median plate densely covered by setae, anterior part long, strongly concave, bosses short and produced anteromedially to small pits; transverse plate tilted anteroventrally.

Description

PUBESCENCE (Figures 4 and 5A–C).—Body densely covered with stout setae of various sizes, provided

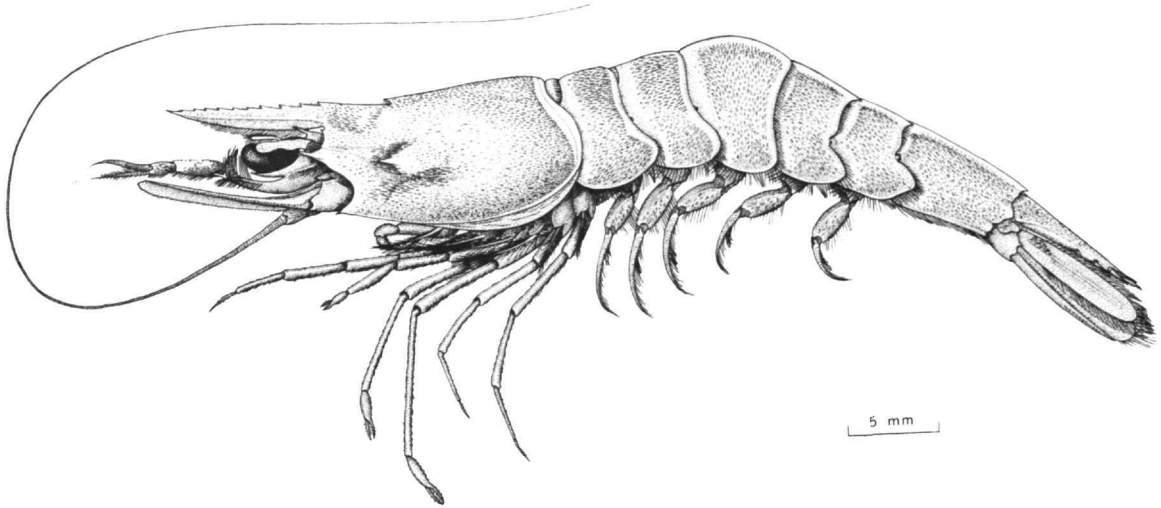


FIGURE 4.—*Metapenaeopsis goodei* (Smith). Lateral view, ♀ 12.5 mm c.l., off Jacksonville, Florida.

with pinnulae arranged like barbs of feather. Most setae long or moderately long, with numerous pinnulae, pinnulae longer and flexible along middle, shorter and flexible distally, and short and rigid proximally (Figure 5A, C). Other setae short, slightly curved, with short, sparse, rather rigid pinnulae (Figure 5B). Longer setae on dorsum of carapace, along margins of cervical and hepatic sulci, anterior to hepatic spine, and over most of branchial region. Short setae sparsely covering rostrum (adrostral carina bare) and hepatic region, denser on anterior and posterolateral portions of carapace. Abdomen almost entirely covered by setae, most of them long.

ROSTRUM.—Teeth 9 to 13, mode 10 (percentage distribution: 8—5.2, 9—24, 10—52, 11—16.8, 12—1.6, 13—0.4; N=250) + epigastric; first tooth slightly anterior to orbital margin, epigastric almost at one-third carapace length from orbital margin. Rostrum slightly to moderately tilted upward from base, with extreme posteroventral margin concave, maximum height immediately anterior to concavity, decreasing progressively to apex; rostrum in adult reaching as far as distal end of antennular peduncle, shorter in young.

CARAPACE.—Orbital angle about 90°, apex with minute orbital spine, directed anterodorsally. Antennal spine long and pointed; antennal carina short and rounded; hepatic spine slender and sharp, extending anteriorly slightly beyond epigastric tooth;

pterygostomial spine slender and long, more than half length of curved anterior portion of margin below spine. Orbits-antennal sulcus feeble; cervical sulcus distinct, almost hidden by long setae; hepatic sulcus rather well marked, but almost hidden by long setae, nearly horizontal to level of base of hepatic spine, there turning anteroventrally.

ANTENNALES.—Length of antennular peduncle almost nine-tenths that of carapace; dorsal flagellum slightly shorter than ventral, length of ventral about two-fifths that of antennular peduncle. Prosartema extending approximately to base of distal fifth of first antennular segment; stylocerite projected distally in sharp, long, spine, reaching as far as base of distal third of first antennular segment; anterolateral spine long, slender, and sharp.

ANTENNAE.—Scaphocerite reaching as far as end of proximal fourth of dorsal antennular flagellum, armed with series of stout spines along dorsal surface of distolateral margin. Antennal flagellum as long as total length of shrimp.

THORACIC APPENDAGES.—Third maxilliped reaching to between proximal fourth and distal end of second antennular segment; first pereopod extending at least to midlength of carapocerate and, at most, exceeding it by entire length of dactyl; second pereopod surpassing carapocerate by two-thirds length of propodus or by as much as propodus and one-fifth length of carpus; third pereopod reaching at least

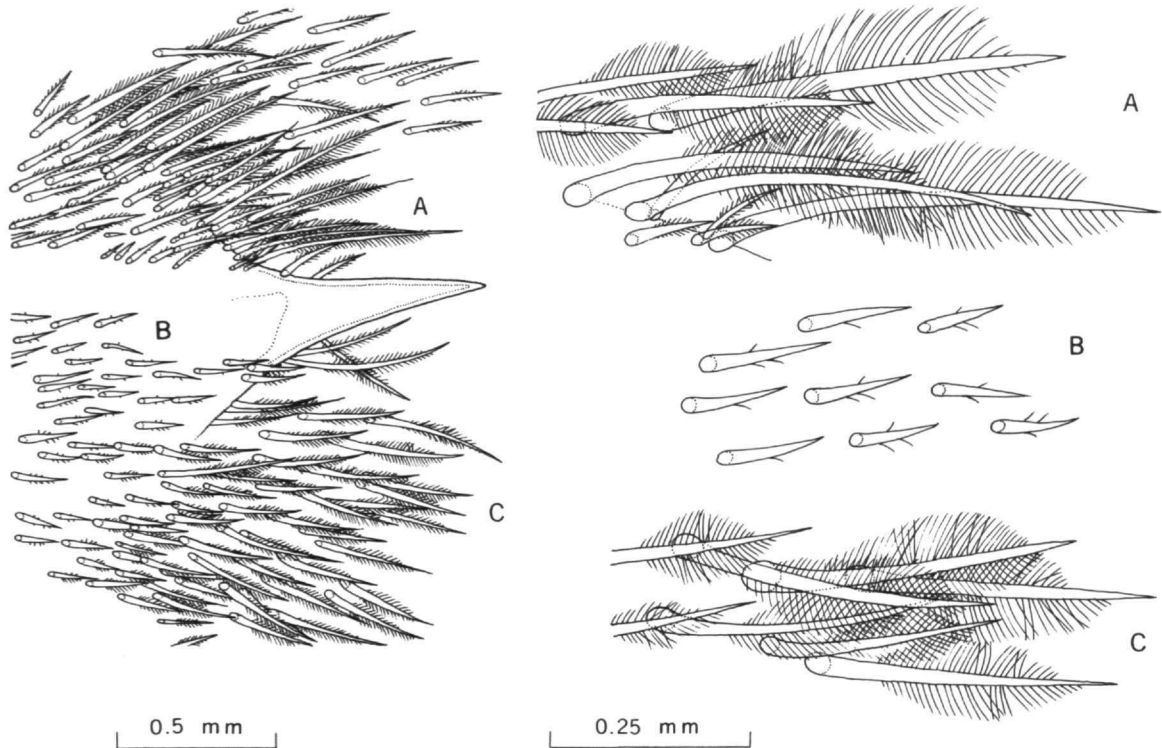


FIGURE 5.—*Metapenaeopsis goodei* (Smith). Pubescence on hepatic region and adjacent portion of antennal region, ♀ 9.8 mm c.l., Cat Cays, Great Bahama Bank.

end of proximal fourth and, at most, distal end of second antennular segment; fourth pereopod extending as far as distal fourth of carapocrite; fifth pereopod exceeding fourth by half or by entire length of dactyl. Coxal plate of fourth pereopod in females broad and slightly convex. Ischial spine present on first pereopod.

ABDOMEN.—Median carina extending from third somite (occasionally from posterior half of second) to sixth somite, carina rounded but prominent anteriorly, forming blunt keel and increasing in height from fourth to sixth somites, bearing V-shaped incision on posterior margin of fourth and fifth, and ending on posterior margin of sixth in small spine. Abdomen forming hump from second to fourth somites; length of sixth somite one and one-half times maximum height. Telson slightly surpassing base of distal fifth of inner ramus of uropod with terminal portion slender, and long, four to six and one-half times width at base; lateral fixed spines of

telson reaching end of proximal two-fifths or as far as midlength of terminal portion; posterior of three pairs of movable spines almost reaching, occasionally slightly surpassing, fixed spines, second pair slightly surpassing base of posterior pair, and anterior pair very small. Outer ramus of uropod slightly longer than inner.

PETASMA (Figures 2A–E and 6A–C).—Right distoventral projection cleft by shallow sinus into two unequal lobes; right lobe larger than left, and folded at level of sinus partially obscuring left lobe. Distoventral flap tightly wound in subconical roll, strongly inclined dorsally. Distoventral element moderately convex proximally, and extending distally in long, narrow, clavate, dextrally directed process, considerably surpassing right distodorsal projection; process with distal surface studded with spinules, and bearing basal subtriangular scale. Rigid component contiguous with distoventral element (ventral extension of right distodorsal ele-

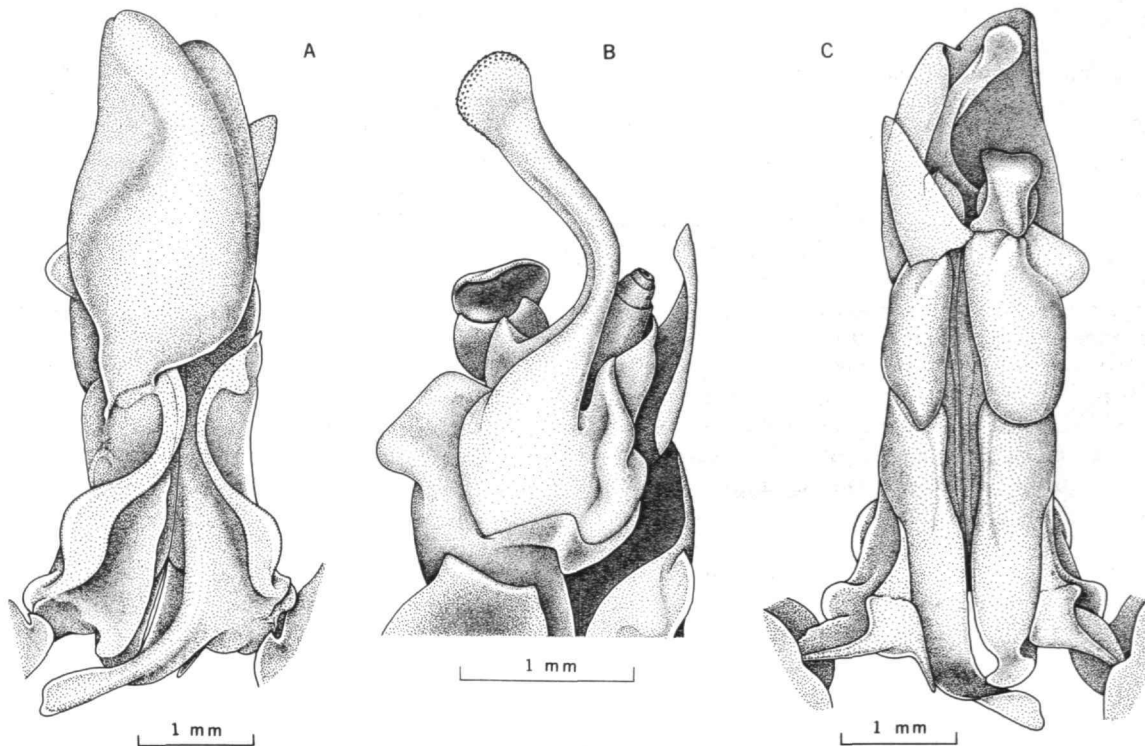


FIGURE 6.—*Metapenaeopsis goodei* (Smith). A, Petasma, ventral view, ♂ 7.7 mm c.l., Cat Cays, Great Bahama Bank. B, Distal part of petasma, ventral view with distoventral projection bent ventrally, ♂ 10 mm c.l., Jetty at Bermuda Biological Station, Bermuda Islands. C, Dorsal view of A.

ment), bearing lateral, subrectangular prominence. Right distodorsal projection thick, stiff, and bent ventrally at about right angle; subapical projection stiff, roughly crescent shaped, bearing two subequal horns. Left distodorsal projection long, thin, flexible, broad at base, gently narrowing and produced distally in subrectangular process, considerably surpassing distoventral flap. Proximal portion of left half of petasma with long spine at dorsolateral base of long, oblique, median spur.

For development of petasma see page 7 and Figure 3A-E.

APPENDIX MASCULINA (Figure 7A, B).—Consisting of small, subtriangular, laterally directed, flexible lobe, projecting from distal rim of strong, arcuate rib running along dorsomedian margin of endopod.

THELYCUM (Figure 8A, B).—Posterior ridge with sharp anterior margin forming two lateral lobes, and pointed median lobe. Transverse plate long,

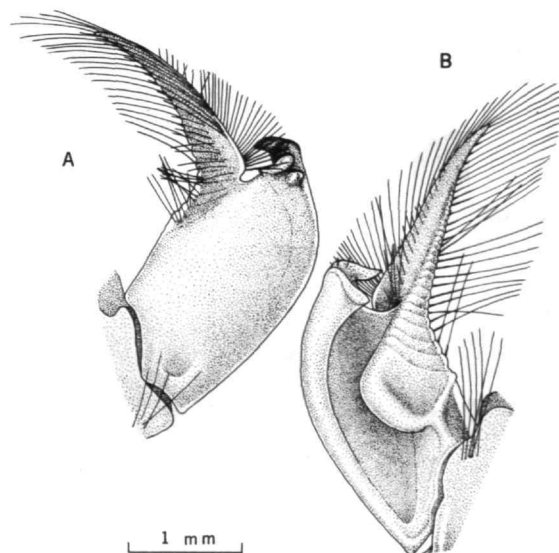


FIGURE 7.—*Metapenaeopsis goodei* (Smith). A, Appendix masculina, right, ventral surface, ♂ 10 mm c.l., Jetty at Bermuda Biological Station, Bermuda Islands. B, Dorsal surface of same appendix.

tilted anteroventrally, almost uniform in length, with anterior margin almost straight or produced on each side into small, sharp-edged, rounded or slightly pointed projection, and with posterior portion strongly depressed and overhung by posterior ridge. Hoods extending anterodorsally and laterally, but not produced posteriorly. Median plate densely setose, bearing long, slender, anteromedian spine. Median bridge short, trapezoidal, widest posteriorly. Anterior part of median plate concave, with anterolateral corners gently rounded and turned ventrally, proportionately long, length (measured from base of spine to pits) constituting 56 percent to 75 percent of total length of median plate (measured from base of spine to midposterior margin); posterolateral portions of median plate forming short bosses, their length constituting 25 percent to 44 percent of the total length of median plate, bosses produced anteromedially, partially covering small pits; in impregnated females, pits usually plugged

by minute plate on median extremity of spermatophores. Grooves between sternites XIII and XIV extending along anterior and median margins of hoods, continuing along anterior margin of transverse plate to median bridge, there turning anteromedially, and ending in pits. Sternite XII with two blunt, submedian protuberances.

Sternite XI in females, as well as in males, bearing paired long, spinuous processes broad basally.

SEMINAL RECEPTACLES (Figure 8b).—Paired trapezoidal capsules, widest anteriorly (located dorsal to hoods), joining almost horizontal narrow ducts, that parallel grooves between sternites XIII and XIV, and opening in pits. (There is some evidence that the spermatophores penetrate into the seminal receptacles via the pits—see earlier section on "the asymmetrical petasma.")

COLOR.—According to Boone (1927) *M. goodei* [? and *M. smithi*] is pink.

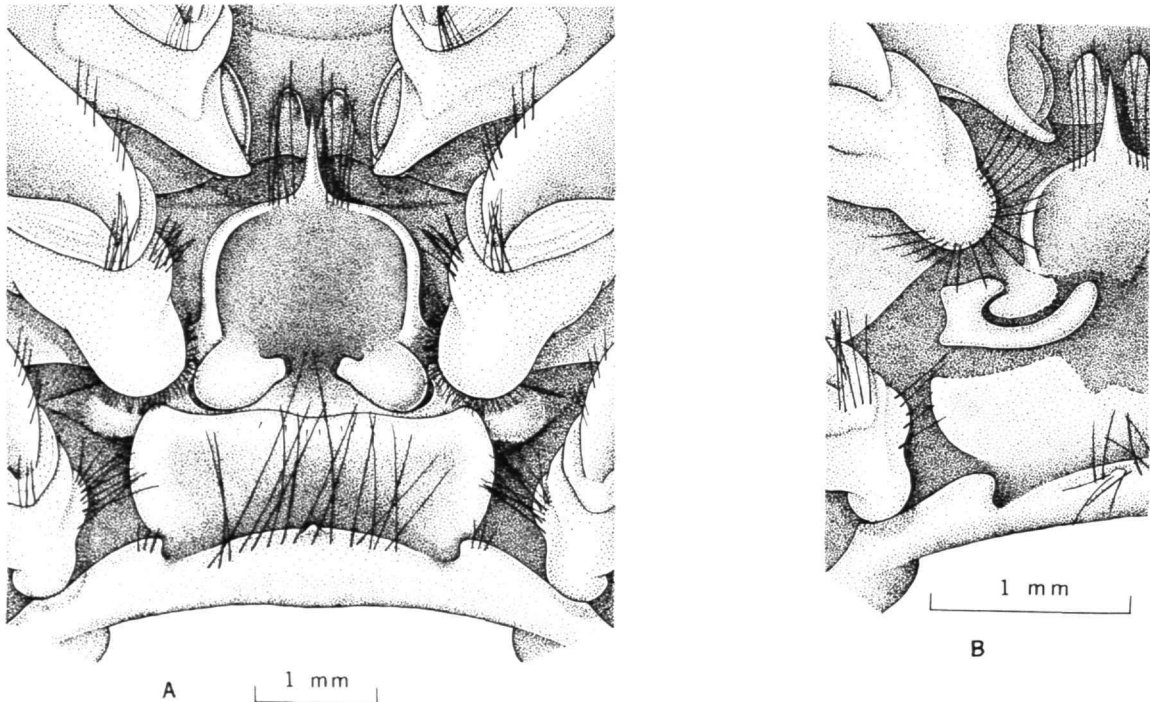


FIGURE 8.—*Metapenaecopsis goodei* (Smith). A, Thelycum, ♀ 15.25 mm c.l., off Jacksonville, Florida. B, Seminal receptacle, ♀ 10 mm c.l., Bermuda Islands. (Median plates denuded.)

Size

Maximum length observed, 1 ♀, 16 mm carapace length, 75 mm total length, off Isla Mujeres, Quintana Roo, Mexico; males smaller than females, maximum length observed 10.9 mm carapace length, 57 mm total length, holotype, Bermuda Islands.

Williams (1965) recorded a male 19 mm carapace length including the rostrum. This specimen is slightly smaller than the holotype, which measures 19.4 mm from the apex of the rostrum to the mid-posterior margin of the carapace.

Distribution

The range of *Metapenaeopsis goodei* extends from North Carolina, between Cape Hatteras and Cape Lookout, and the Bermudas to the Florida Keys, and along the Gulf coast of Florida to Pensacola. It is also found around the coast of Yucatán (Cayos Arcas to Isla Mujeres), Mexico, throughout the Caribbean, and along the Atlantic coast of South America to Brazil.

The occurrence of *Metapenaeopsis goodei* south of the Antilles was previously based on the collection of a single female from Maceió, Alagoas, Brazil (Rathbun, 1900). The material available for the present study confirms the presence of this species on the Brazilian coast, at least as far south as Salvador, Bahia, and demonstrates that it also lives along the coast from Colombia to the Guianas.

Metapenaeopsis goodei is mostly a shallow water species; by far the majority of the specimens recorded were collected at less than 60 m. A few, however, were caught at 329 m, off Saint Augustine, Florida, *Combat* Station 119.

Habitat and habits

Metapenaeopsis goodei lives on a great variety of bottom types. Rathbun (1900) and Boone (1927) recorded it on coral reefs, and Rathbun (1927), on mud and sand. Some of the specimens collected during the cruises of the *Albatross*, *Calypto*, *Silver Bay*, and *Tomás Barrera* were on those same kinds of substrata, and others were on gravel, broken shells or rocks. In some localities the bottom was covered by algae.

Metapenaeopsis goodei, as well as its close relative *M. smithi*, is more active at night than during the

day. The few data available on the time of collection indicate that by far the majority of the specimens were caught at sunset or after. The observations by Wheeler (1937) in the Bermudas showed that the animals come to the surface about an hour after sunset at the time of the new moon, but their numbers reach a maximum on the 2nd and the 26th nights of the lunar months. This pattern of behavior indicates that there is some correlation between the periodic appearances of the shrimps and the phases of the moon. He concluded that light is the most probable factor controlling periodicity (by inhibiting the activity of the shrimp), but that its effect is occasionally modified by the opacity of the water. Wheeler also found that both species exhibit a seasonal fluctuation, the number of individuals being greatest in the summer.

Remarks

Metapenaeopsis goodei is closely allied to the following species, but can be separated from it by the features of its petasomal components and the structure of the thelycum. The distoventral projection of the petasma is shallowly cleft into two unequal lobes, the right one of which is larger and extends further distally than the left; the process of the distoventral element is long, directed dextrally in a broad arc, and extends distally considerably beyond the right distodorsal projection; and, finally, the left distodorsal projection is produced into a narrow process, surpassing considerably both the distoventral flap and the right distodorsal projection. The anterior part of the median plate of the thelycum is proportionately long, its length 56 percent to 75 percent of the total length of the median plate; correspondingly, the posterior part of the median plate—bosses and median bridge—are proportionately short, constituting 25 percent to 44 percent of the total length of the median plate; in addition, the bosses are convex, but not so prominent as are those of the new species described below, and the median bridge is broad. Furthermore, in *M. goodei* the rostral teeth vary in number from 9 to 13, modally 10, rather than 6 to 11, modally 9.

Smith (1885) described *Parapenaeus goodei* on the basis of a single male from the Bermudas, and "several smaller specimens, both male and female, in the museum of Yale College, collected in the

Bay of Panama by Prof. F. H. Bradley." The specimens from Panama have not been located in the Peabody Museum of Natural History, Yale University, and, as Burkenroad (1934) suggested, they most probably belong to a different species since no species of *Metapenaeopsis* has been found common to both coasts of the American Continent. Verrill (1922) designated the male from the Bermudas as the lectotype of *Parapenaeus goodei* Smith, the only specimen in the type-series for which the author gave detailed measurements.

There is a contradiction in Bouvier's references to the type-localities of *Archipenaeopsis vestitus* and *Parapenaeopsis rathbuni*. Bouvier (1905b) proposed the name *Archipenaeopsis vestitus* on the basis of a single specimen, said to have been taken in the Antillean Sea, at 37 fm, during an expedition by the *Blake*. A few years later, Bouvier (1908) indicated that his specimen, a female, came from Sombrero, and repeated that it had been caught by the *Blake*. Soon after, A. Milne Edwards and Bouvier (1909) again pointed out that this specimen had been collected in the vicinity of Sombrero, by the *Blake* in 37 fm, and added: station 11, 24°43'N, 83°25'W. This locality, which is west of Dry Tortugas, not in the Antillean Sea, is certainly the type-locality of *A. vestitus*, because the type-specimen is accompanied by an old label on which is printed "*Blake*," and in handwriting "sta. 11, 1877, 37 fm."

The name *Parapenaeopsis rathbuni* was proposed by Bouvier (1905b) also on the basis of a single specimen which he stated had been captured by Stimpson in the Antillean Sea, at 17 fm. Later, however, Bouvier (1908) stated that his specimen of *P. rathbuni* had been caught by Stimpson west of Florida. The following year, A. Milne Edwards and Bouvier (1909) again pointed out that the holotype of the species had been taken during Stimpson's expedition [aboard the *Bache*] west of Florida, at a depth of 19 fm. Fortunately, Sanderson Smith (1888:962) published the list of stations established by the *Bache*, only one of them is at 19 fm—serial number 52S, 24 April 1872, at 26°16'25"N, 82°50'10"W, west of Florida. Undoubtedly, this position is the type-locality because the holotype is accompanied by a label on which is written "west Florida—19 fm."

I have examined the types of *Parapenaeus goodei* Smith, *Archipenaeopsis vestitus* Bouvier, and *Para-*

penaeopsis rathbuni Bouvier. The three specimens are essentially identical and represent the species *Metapenaeopsis goodei* (Smith), as had been recognized previously by Bouvier (1908), A. Milne Edwards and Bouvier (1909), and Burkenroad (1934). Thus, Schmitt's (1924a) belief that *A. vestitus* is different from *M. goodei* and that *P. rathbuni* might belong to yet another species has not been substantiated.

Metapenaeopsis martinella, new species

FIGURES 9, 10, 13b

Penaeopsis goodei.—Boone, 1927 [part], p. 80.

Penaeopsis (Metapenaeopsis) goodei—Burkenroad, 1934 [part], p. 15.

Material

Holotype: ♀, 9.7 mm carapace length, 43 mm total length. Type-locality: off Acaraú, Ceará, Brazil, 2°10'S, 39°52'W. 137 m, Oregon Station 4252, 12 March 1963, USNM 128034. Allotype: ♂, 8.5 mm carapace length, 38.5 mm total length, data as in holotype, USNM 128035. Paratypes: 3 ♂ 4 ♀, collected with the holotype, USNM 128593.

CUBA

1 ♂, USNM, Ensenada de Cajón, 22 May 1914, Tomás Barrera Station 11. 5 ♀, MCZ, Cayo Piedras, Bahía de Cochinos, 5 m, 11 August 1939, L. Howell Rivero.

HAITI

1 ♀, AMNH, Port au Prince, W. Beebe. 1 ♂, AMNH, Port au Prince, W. Beebe. 2 ♀, AMNH, Port au Prince, W. Beebe. 2 ♀, USNM, Anse-a-Galet, La Gonave, 22 March 1930, Parish-Smithsonian Expedition.

VIRGIN ISLANDS

Saint Thomas: 2 ♂, USNM, Brewers Bay, 1 March 1933, Johnson-Smithsonian Deep Sea Expedition.

LESSER ANTILLES

Saba Bank: 71 ♂ 116 ♀, USNM, 16-18 m, 19 July 1969, Pillsbury Station 963. Dominica: 1 ♂ 1 ♀, USNM, Woodbridge Bay, 4 m, 25 March 1956,

Smithsonian-Bredin Expedition Station 52-56. Saint Lucia: 2 ♀, USNM, 16-24 m, 29 September 1964, *Oregon* Station 5058. The Grenadines: 1 ♂ 1 ♀, USNM, off Carriacou Island, 18 m, 27 September 1964, *Oregon* Station 5050.

BRITISH HONDURAS

2 ♀, YPM, Glover Reef, 16 April 1925, *Pawnee* I.

WESTERN CARIBBEAN

Rosalind Bank: 1 ♂ 2 ♀, USNM, 27 m, 6 June 1962, *Oregon* Station 3618.

PANAMA

2 ♀, USNM, Bocas del Toro, 27 m, April 1963, *Pelican* Station 800.

VENEZUELA

1 ♂ 2 ♀, RSMAS, E of Isla de Margarita, 27-24 m, 19 July 1968, *Pillsbury* Station 712.

SURINAM

1 ♀, USNM, 55-59 m, 14 July 1968, *Pillsbury* Station 648.

BRAZIL

Maranhão: 2 ♀, USNM, off Lençóis Pequenos, 66 m, 10 March 1963, *Oregon* Station 4231. Ceará: 2 ♂ 3 ♀, USNM, off Mundaú, 40 m, 13 March 1963, *Oregon* Station 4855. Rio Grande do Norte: 1 ♀, MNHNP, NE of Rio Grande do Norte, 18 m, 17 November 1961, *Calypso* Station 10. Paraíba: 1 ♂ 4 ♀, S of João Pessoa, 45 m, 16 November 1961, *Calypso* Station 1. Pernambuco: 1 ♂ 2 ♀, MNHNP, off Cabo Escada, 33 m, 21 November 1961, *Calypso* Station 27.

Diagnosis

Body almost entirely covered by plumose, densely set setae. Stylocerite long, extending as far as base of distal third of first antennular segment. Third pereopod short, reaching at most to distal end of second antennular segment. Abdomen with mid-dorsal carina long, extending at least from anterior end of third to posterior margin of sixth somites. Telson with terminal portion long, slender, four to six times width at base. Petasma with right distoven-

tral projection shallowly cleft into two subequal lobes or left lobe slightly larger than right. Thelycum with median plate densely covered by setae, anterior part short, strongly concave, bosses long, very prominent, and produced anteromedially to small pits; transverse plate tilted anteroventrally.

Description

PUBESCENCE.—Body densely covered with stout setae of various sizes, structure and arrangement similar to those of *Metapenaeopsis goodei*.

ROSTRUM.—Teeth 6 to 11, mode 9 (percentage distribution: 6—0.5, 7—2, 8—16.5, 9—55, 10—25, 11—1; N=200) + epigastric; first tooth at level of orbital margin, epigastric slightly anterior to one-third carapace length from orbital margin. Rostrum moderately to pronouncedly tilted upward from base, with extreme posteroventral margin concave, distally gently rounded to sigmoidal; maximum height immediately anterior to concavity and decreasing progressively to apex; rostrum in adult reaching base of distal third of third antennular segment, shorter in young.

CARAPACE.—Orbital angle about 90°, apex with minute orbital spine, directed anterodorsally. Antennal spine long and pointed; antennal carina short and rounded; hepatic spine long, slender, and sharp, extending anteriorly slightly beyond epigastric tooth; pterygostomial spine two-fifths to three-fifths length of curved anterior portion of margin below spine. Orbito-antennal sulcus indistinct, cervical sulcus feeble, almost hidden by long setae; hepatic sulcus with posterior portion nearly horizontal and shallow to level of base of hepatic spine, there turning rather abruptly anteroventrally, becoming deeper along inclined portion, entire sulcus covered by long setae.

ANTENNULES.—Length of antennular peduncle almost nine-tenths that of carapace; dorsal flagellum slightly shorter than ventral, length of latter about two-fifths that of antennular peduncle. Prosartema extending approximately to base of distal fifth of first antennular segment; stylocerite projecting distally in sharp, long spine, reaching as far as base of distal third of first antennular segment; anterolateral spine long, slender and sharp.

ANTENNAE.—Scaphocerite reaching as far as proximal fourth of dorsal antennular flagellum, and armed with series of stout spines along dorsal sur-

face of distolateral margin. Antennal flagellum as long as total length of shrimp.

THORACIC APPENDAGES.—Third maxilliped reaching at least to distal end of first antennular segment but not beyond proximal fourth of second segment; first pereopod extending as far as distal end of carapocerite; second pereopod surpassing carapocerite by as much as whole length of propodus; third pereopod extending at least to midlength and, at most, to distal end of second antennular segment; fourth pereopod reaching to distal fourth of carapocerite; fifth pereopod exceeding fourth by half or by entire length of dactyl. Coxal plate of fourth pereopod in females broad and slightly convex. Ischial spine present on first pereopod.

ABDOMEN.—Median carina extending from third (occasionally from posterior half of second) to sixth somites, carina rounded and prominent on third, forming blunt keel, and increasing in height posteriorly, bearing V-shaped incision on posterior margin of fourth and fifth somites and ending on posterior margin of sixth somite in small spine.

Abdomen forming hump from second to fourth somites; length of sixth somite one and one-half times maximum height. Telson slightly surpassing base of distal fifth of inner ramus of uropod, with terminal portion slender, and long, four to six times width at base; lateral fixed spines of telson reaching end of proximal two-fifths or as far as midlength of terminal portion; posterior of three pairs of movable spines almost reaching, occasionally slightly surpassing, fixed spines, second pair slightly surpassing bases of posterior pair, anterior pair very small. Outer ramus of uropod slightly longer than inner.

PETASMA (Figure 9 A-C).—Right distoventral projection cleft by shallow sinus into two subequal lobes or into slightly unequal lobes, left lobe slightly larger than right. Distoventral flap tightly wound in subconical roll, strongly inclined dorsally. Distoventral element moderately convex proximally, and extending distally in short or moderately long, narrow process, strongly turned dextrally immediately beyond right distodorsal projection; process with distal surface studded with spinules, and bearing basal subtri-

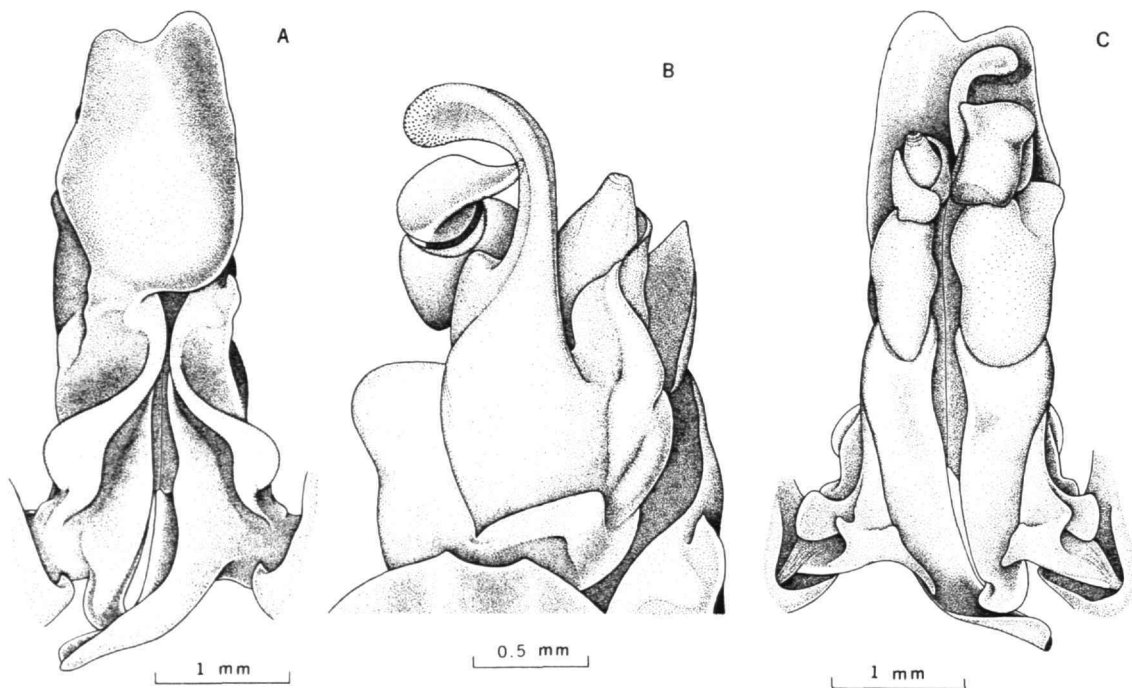


FIGURE 9.—*Metapenaeopsis martinella*, new species. A, Petasma, ventral view, ♂ 8.5 mm c.l., off Acaraú, Ceará, Brazil. B, Distal part of same petasma, ventral view with distoventral projection bent ventrally. C, Dorsal view of A.

angular scale. Rigid component contiguous with distoventral element (ventral extension of right distodorsal element), bearing lateral, subsemicircular prominence. Right distodorsal projection thick, stiff, and strongly bent ventromedially; subapical projection stiff, roughly crescent shaped, bearing two subequal horns. Left distodorsal projection thin, flexible, subtriangular and short, extending to midlength or slightly beyond distoventral flap. Proximal portion of left half of petasma with long spine at dorsolateral base of long, oblique, median spur.

APPENDIX MASCULINA.—Essentially identical to that described for *Metapenaeopsis goodei* (Smith).

THELYCUM (Figure 10). Posterior ridge with sharp anterior margin forming two lateral lobes, and pointed median lobe. Transverse plate long, tilted anteroventrally, almost uniform in length, with anterior margin almost straight to distinctly convex, often slightly produced anteriorly on each side into small projection, and with posterior portion strongly depressed and overhung by posterior ridge. Hoods extending anterodorsally and laterally, but not produced posteriorly. Median plate densely setose, bearing long, slender, anteromedian spine. Median bridge elongate, trapezoidal, widest posteriorly. Anterior part of median plate concave, with antero-

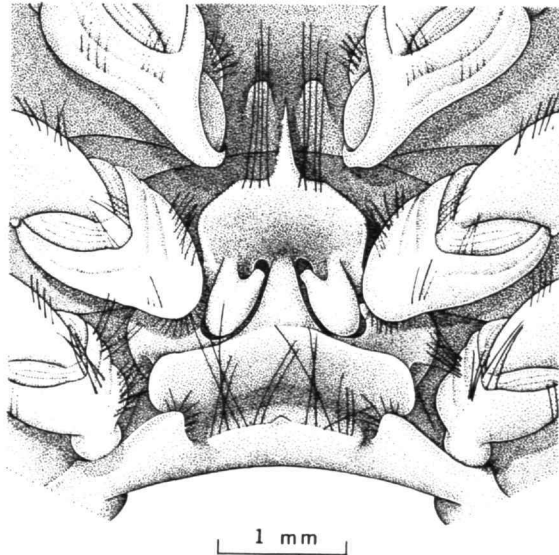


FIGURE 10.—*Metapenaeopsis martinella*, new species. Thelycum, holotype ♀ 9 mm c.l., off Acaraú, Ceará, Brazil. (Median plate denuded.)

lateral corners usually truncated, proportionately short, length (measured from base of spine to pits) constituting 30 percent to 55 percent of the total length of median plate (measured from base of spine to midposterior margin); posterolateral portions of median plate forming strongly prominent and elongate bosses, their length constituting 45 percent to 70 percent of the total length of the median plate, bosses produced anteromedially, partially covering small pits; in impregnated females, pits plugged by minute plate on median extremity of spermatophores. Grooves between sternites XIII and XIV extending along anterior and median margins of hoods, continuing along anterior margin of transverse plate to median bridge, there turning and extending anteromedially, ending in pits. Sternite XII with two blunt, submedian protuberances.

Sternite XI in females, as well as in males, bearing paired, long, spinous processes, broad basally.

SEMINAL RECEPTACLES.—Paired trapezoidal capsules, widest anteriorly, joining long narrow ducts that make gentle arcs paralleling grooves between sternites XIII and XIV, and open in pits.

Size

Maximum carapace length recorded, 1 ♀, 14.5 mm, total length undetermined because the telson is broken; 1 ♂, 11 mm c.l., 57 mm t.l., both from Saba Bank, Lesser Antilles, Pillsbury Station 963.

Name

This species is named for Martin D. Burkenroad.

Distribution

Metapenaeopsis martinella ranges throughout the Antilles, and the western Caribbean and southward at least to Cabo Escada, Pernambuco, Brazil. This species has been found mostly at shallow depth, but several specimens were taken at 137 m, off Acaraú, Ceará, Brazil, at Oregon Station 4252.

Habitat and habits

The only information available as to the substrata it occupies is from the cruise of the *Calypso*; the specimens were taken on coral reefs, broken shells,

and calcareous algae. According to Boone (1927) and my own data, this species is mostly nocturnal.

Remarks

Metapenaeopsis martinella is closely related to *M. goodei* but can be distinguished by the structure of the petasma and thelycum. The distoventral projection of the petasma is shallowly cleft into two subequal lobes slightly unequal in some specimens but the left lobe is slightly longer than the right; the process of the distoventral element is relatively short and strongly curved dextrally, its apical portion lying immediately beyond the right distodorsal projection which, in turn, is pronouncedly bent ventromedially; and, finally, the left distodorsal projection is subtriangular and short, not or barely surpassing the distoventral flap. The anterior part of the median plate of the thelycum is proportionately short, its length less or barely more than half the total length of the median plate; correspondingly, the posterior part—bosses and median bridge—are proportionately long; in addition, the bosses are strongly prominent and the median bridge is narrow. Furthermore, in *M. martinella* the rostral teeth vary in number from 6 to 10, modally 9; whereas in *M. goodei* the teeth tend to be more numerous, varying from 9 to 13, modally 10.

Metapenaeopsis martinella is restricted to the Caribbean and the Atlantic coast of South America, whereas *M. goodei* extends much farther north, as far as North Carolina, and seems to have the center of abundance along the southeastern coast of the United States, beyond the range of *M. martinella*.

Metapenaeopsis gerardoii, new species

FIGURES 11, 12, 13c

Penaeopsis goodei.—Boone, 1927 [part], p. 80.

Penaeopsis (Metapenaeopsis) goodei.—Burkenroad, 1934 [part], p. 15.

Material

Holotype: ♀, 6.8 mm carapace length, 32.5 mm total length. Type-locality: off Mayagüez, Puerto Rico, 18°08.5'N, 67°23'W, 22 m, Oregon Station 5440, 3 June 1965, USNM 127515. Allotype: ♂, 7 mm carapace length, about 35 mm total length, data as

in holotype, USNM 108033. Paratypes: 1 ♂ 3 ♀, collected with the holotype, USNM 128584.

FLORIDA

2 ♂, RSMAS, off Islamorada, 40-44 m, 26 February 1969, Gerda Station 1038.

BAHAMA ISLANDS

2 ♂, USNM, Cat Cays, Great Bahama Bank, "surface," 21 May 1966, Oregon Station 6096. 1 ♀, YPM, Royal Island, Eleuthera, 14 March 1925, Pawnee I. 1 ♀, USNM, SW of Andros, Great Bahama Bank, 229-275 m, 5 November 1960, Silver Bay Station 2452.

CUBA

1 ♂, USNM, Cabo San Antonio, Pinar del Río, 9 m, W. Nye, Albatross. 2 ♀, USNM, Cayo Levisa, Pinar del Río, May-June, 1914, Tomás Barrera Station 14. 1 ♂, YPM, Bahía de Guantánamo, 22 April 1933, M. B. Bishop and party.

LESSER ANTILLES

Martinique: 1 ♀, USNM, 73 m, 10 September 1964, Oregon Station 5000. Saint Lucia: 1 ♀, USNM, 29 m, 8 March 1966, Oregon Station 5956. 2 ♀, USNM, 24-29 m, 29 September 1964, Oregon Station 5059. 2 ♂ 3 ♀, USNM, 16-24 m, 29 September 1964, Oregon Station 5058. Barbados: 1 ♀, USNM. 91-366 m, J. B. Lewis. The Grenadines: 1 ♀, USNM, off Carriacou, 18 m, 27 September 1964, Oregon Station 5050. 1 ♀, USNM, 40-37 m, 27 September 1964, Oregon Station 5047.

BRITISH HONDURAS

1 ♂ 1 ♀, YPM, Glover Reef, surface, 16 April 1925, Pawnee I.

NICARAGUA

9 ♂ 8 ♀, USNM, off NE Nicaragua, 55 m, 8 June 1964, Oregon Station 4930.

VENEZUELA

1 ♀, USNM, Cabo de la Vela, Península de Paraguaná, 48 m, 12 October 1965, Oregon Station 5697.

Diagnosis

Body almost entirely covered by plumose, densely set setae. Stylocerite relatively short, extending to mid-

length of first antennular segment. Third pereopod long, surpassing distal end of antennular peduncle by as much as four-fifths length of propodus. Abdomen with middorsal carina long, extending at least from anterior end of third to posterior margin of sixth somites. Telson with terminal portion long, slender, length five times width at base. Petasma with right distoventral projection mittenlike in outline; distoventral element produced in sinistrally directed tonguelike process. Thelycum with median plate densely covered by setae, anterior part short, convex, bosses long, with internal margin surrounding large pits; transverse plate tilted anteroventrally.

Description

PUBESCENCE.—Body densely covered with stout, plumose setae of various sizes (see description of *Metapenaeopsis goodiei*). Longest setae along margin of cervical sulcus, hepatic sulcus, anterior to hepatic spine, on pterygostomial region and on posteroventral portion of branchial region; most of branchial region covered by long, but more slender setae. Rostrum, anterior portion of carapace and hepatic region with short setae, some lacking pinnulae. Abdomen almost entirely covered by setae, most of which are long.

ROSTRUM.—Teeth 8 to 10 (mode 9) + epigastric; first tooth at level of orbital margin, epigastric almost at one-third carapace length from orbital margin. Rostrum moderately to pronouncedly tilted upward from base, with extreme posterior portion of ventral margin concave, distally sigmoidal; maximum height immediately anterior to concavity, decreasing progressively to apex; rostrum shorter than carapace, in adult reaching as far as base of distal third of third antennular segment, shorter in young.

CARAPACE.—Orbital angle about 90°, apex with minute orbital spine directed anterodorsally. Antennal spine long, pointed, with short, rounded carina; hepatic spine long, slender, and sharp, apex slightly anterior to epigastric tooth; pterygostomial spine relatively small, one-third to two-fifths length of curved anterior portion of margin below spine. Orbito-antennal sulcus indistinct; cervical sulcus shallow, almost hidden by long setae; hepatic sulcus well marked, nearly horizontal to level of hepatic spine, there turning rather abruptly anteroventrally.

ANTENNULES.—Length of antennular peduncle almost nine-tenths that of carapace; dorsal flagellum slightly shorter than ventral, length of ventral about two-fifths that of antennular peduncle. Prosartema extending approximately to base of distal fifth of first antennular segment; stylocerite projected distally in pointed spine reaching almost midlength of first antennular segment; anterolateral spine long, slender, and sharp.

ANTENNAE.—Scaphocerite reaching as far as base of dorsal antennular flagellum, armed with series of stout spines along dorsal surface of distolateral margin. Antennal flagellum as long as total length of shrimp.

THORACIC APPENDAGES.—Third maxilliped ranging in extent from base of distal third of second antennular segment to end of third segment; first pereopod extending to distal end of carapace or surpassing it by as much as entire length of propodus; second pereopod surpassing carapace by at least half length of propodus or by as much as propodus and one-third length of carpus; third pereopod reaching, at least, midlength of third antennular segment and, at most, surpassing it by four-fifths length of propodus; fourth pereopod extending as far as distal end of carapace; fifth pereopod exceeding fourth by half length of dactyl. Coxal plate of fourth pereopod in females slightly narrowing medially. Ischial spine present on first pereopod.

ABDOMEN.—Median carina extending from third somite (occasionally from posterior half of second) to sixth somite, rounded anteriorly, forming blunt keel and increasing in height from fourth to sixth somites, bearing V-shaped incision on posterior margin of fourth and fifth somites, and ending on posterior margin of sixth in small spine. Abdomen forming hump from second to fourth somites; length of sixth somite about one and one-half times maximum height. Telson reaching base of distal tenth of inner ramus of uropod, with terminal portion slender, and long, about five times width at base; lateral fixed spines of telson reaching five-fifteenths, or as far as six-fifteenths of terminal portion; posterior pair of movable spines reaching as far as fixed spines, second pair slightly surpassing bases of posterior pair, anterior pair very small. Outer ramus of uropod slightly longer than inner.

PETASMA (Figure 11A-C).—Right distoventral projection mittenlike in outline, cleft by shallow, proximolateral sinus into small right lobe, and large, much distally extended, left lobe. Distoventral flap wound in broad roll, strongly inclined dorsolaterally. Distoventral element pronouncedly convex proximally, and extending distally in broad, sinistrally directed, tonguelike process, with lateral margin turned ventrally and covered with minute granules; distoventral element dorsally bearing small, dextrally directed, sinuous membrane. Rigid component contiguous with distoventral element (ventral extension of right distodorsal element) produced distally into stiff process, bearing three small, longitudinal ribs. Right distodorsal projection thick, stiff, much elongate, and overhanging tonguelike process; subapical projection stiff, bearing two unequal horns, the right one considerably longer than left. Left distodorsal projection thin, flexible, subtriangular and short, extending only to about four-fifths of distoventral flap. Proximal por-

tion of left half of petasma with long, relatively broad spine at dorsolateral base of long, oblique, median spur.

APPENDIX MASCULINA.—Essentially identical to that described for *M. goodei* (Smith).

THELYCUM (Figure 12A, B).—Posterior ridge (with sharp edged anterior margin) forming two lateral lobes, and pointed, narrower median lobe. Transverse plate long, tilted anteroventrally, almost uniform in length, with anterior margin almost straight or with three low scallops, and with posterior portion strongly depressed and overhung by posterior ridge. Hoods subrhomboid in outline, extending anterodorsally and laterally, but not produced posteriorly. Median plate densely setose, bearing long, slender anteromedian spine. Median bridge elongate, trapezoidal, widest posteriorly, and produced near anterior extremity in small lateral shoulders. Anterior part of median plate short, convex, with anterolateral margins abruptly rounded, and prolonged caudally on each side in

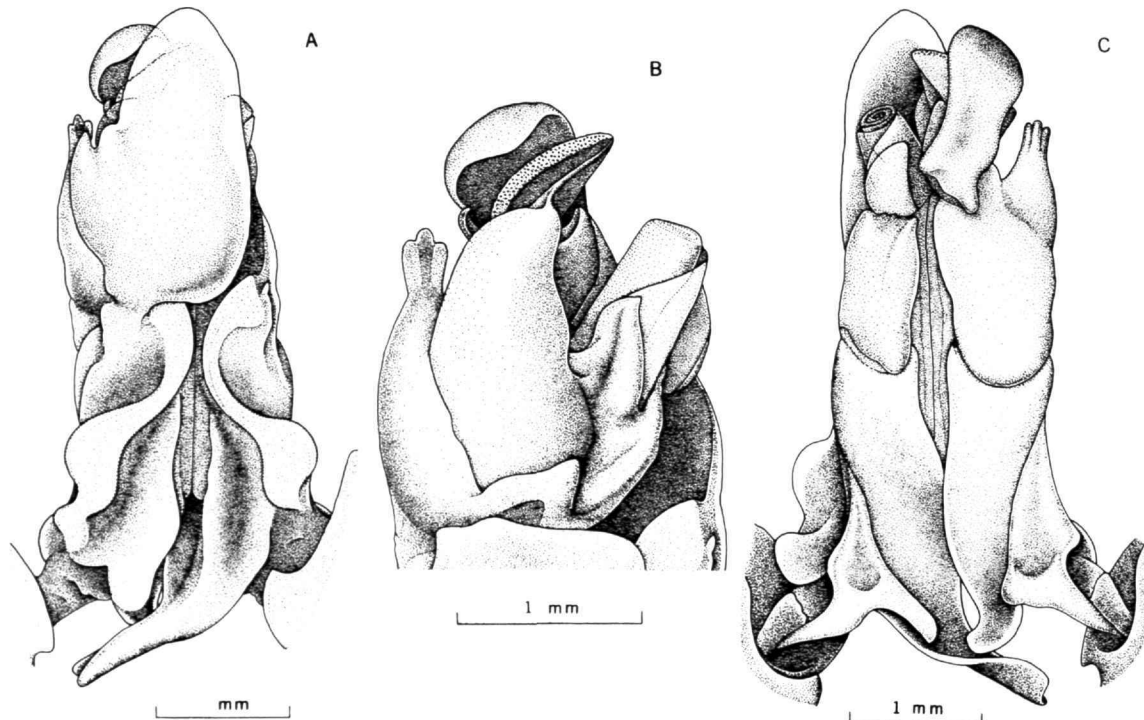


FIGURE 11.—*Metapenaopsis gerardoi*, new species. A, Petasma, ventral view, allotype ♂ 7.25 mm c.l., off Mayagüez, Puerto Rico. B, Distal part of same petasma, ventral view with distoventral projection bent ventrally. C, Dorsal view of A.

narrow arms; arms posteriorly expanded in moderately convex bosses, slightly turned anteromedially, and forming posterior margin of large pits. In impregnated females each pit plugged by minute plate of hardened material accompanying spermatophores. Grooves between sternites XIII and XIV extending along anterior and median margins of hoods reaching anterior margin of transverse plate, there turning anteriorly along lateral margins of median bridge, and ending in pits. Sternite XII with paired blunt, rather closely set submedian protuberances.

Sternite XI in females, as well as in males, bearing two spinous processes broad basally (Figure 12A).

SEMINAL RECEPTACLES (Figure 12B, C).—Paired capsules, somewhat flattened and subrectangular in outline, produced and tapering posterolaterally, and located dorsal to hoods. Capsules continuous with broad ducts extending along groove between sternites XIII and XIV and reaching median bridge, there turning sharply anteriorly making arc of approximately 270° , ducts broadening anteriorly forming ventrally directed funnel opening to exterior by pits.

Size

Maximum carapace length recorded, 1 ♀, 10.2 mm,

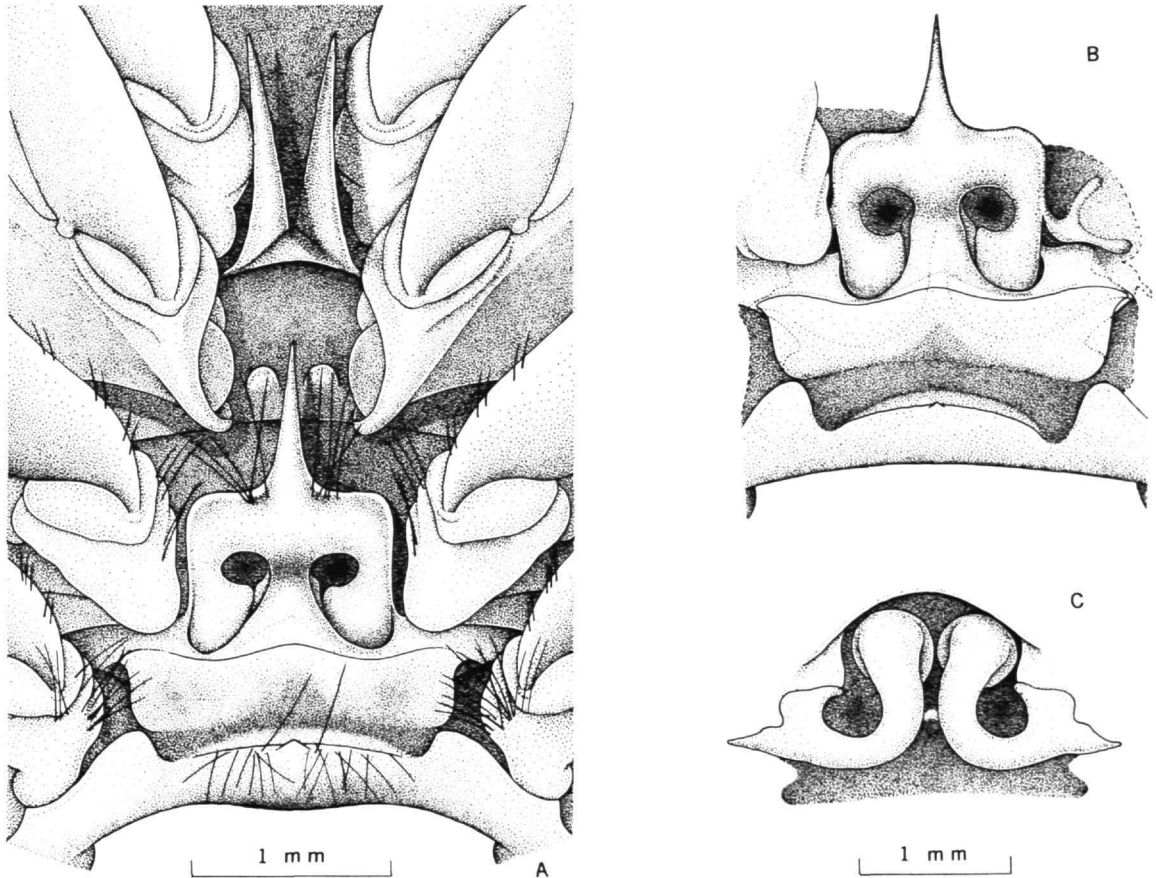


FIGURE 12.—*Metapenaeopsis gerardoi*, new species. A, Thelycum, holotype ♀ 6.8 mm c.l., off Mayagüez, Puerto Rico. B, Ventral view of the thelycum showing seminal receptacles through median bridge and transverse plate, ♀ 10.2 mm c.l., off northeastern Nicaragua. C, Dorsal view of same seminal receptacles. (Median plates denuded.)

from SW of Andros, Great Bahama Bank, Bahamas, *Silver Bay* Station 2452; males smaller than females, largest observed, 1 ♂, 7.9 mm c.l., from off NE Nicaragua, *Oregon* Station 4930. Total lengths undetermined because in both specimens the telson is broken.

Name

This species is named for my husband, Gerardo A. Canet.

Distribution

This species is known from the Florida Keys, the West Indies, and the Caribbean coast of Central and South America. All of the specimens available were collected in shallow water except one female from 229–275 m, off Andros, Bahamas, and another female from 91–366 m, off Barbados.

Habitat and habits

The data at my disposal are too limited to allow conclusions.

Remarks

The thelycum of this species is rather similar to that of *Metapenaeopsis martinella*, but differs from it in possessing a distinctly convex, instead of depressed, anterior part of the median plate, and in having large pits. The males of the two species differ strikingly in the structure of the petasmas. In *M. gerardoi* the distoventral projection is mittenlike in outline, and the distal process of the distoventral element is broad, tonguelike, and directed to the left. Furthermore, in *M. gerardoi* the ventral extension of the right distolateral lobe is distally produced into a small projection. In *M. gerardoi* the petasma develops rapidly: in males of 4.5 mm c.l., about 23 mm t.l., the petasmas endopods are already joined, and the distal structures exhibit the adult form.

In this species the third maxilliped and the pereopods are proportionately longer than in the other *Metapenaeopsis* of eastern American waters. For example, the third pereopods extend forward, at most, to midlength of the second antennular seg-

ment in *M. smithi*, to the distal end of same segment in *M. goodei* and *M. martinella*, and to midlength of the third segment in *M. hobbsi*; in *M. gerardoi*, however, the third pereopod surpasses the antennular peduncle by as much as four-fifths the length of the propodus. In Figure 13 the third pereopods of the five species are depicted; that of *M. gerardoi* (13c) is the longest even though it was taken from the smallest specimen of the species represented.

Metapenaeopsis hobbsi, new species

FIGURES 13d, 14, 15, 16, 17

Material

Holotype: ♀, 10 mm carapace length, 64 mm total length. Type-locality: NW of Cabo Cordera, Venezuela, 10°44'N, 66°07'W to 10°45'N, 66°08'W, 60–73 m, *Pillsbury* Station 737, 22 July 1968, USNM 128416. Allotype: ♂, 7 mm carapace length, 36 mm total length, data as in holotype, USNM 128417. Paratypes: 9 ♂ 8 ♀, collected with the holotype, USNM 128418. 1 ♀, off Guyana, 55–40 m, 31 August 1958, *Oregon* Station 2249, USNM 103508.

BAHAMA ISLANDS

1 ♀, USNM, off Great Inagua, 183–137 m, 5 November 1961, *Silver Bay* Station 3502.

LESSER ANTILLES

Martinique: 2 ♀, USNM, 46–48 m, 10 July 1969, *Pillsbury* Station 913. Saint Lucia: 1 ♀, USNM, 79 m, 29 September 1964, *Oregon* Station 5062.

TRINIDAD-TOBAGO

1 ♀, USNM, W of Tobago, 62 m, 14 March 1966, *Oregon* Station 5970.

WESTERN CARIBBEAN

1 ♀, USNM, off Isla de San Andrés, 139 m, 6 February 1967, *Oregon* Station 6434.

COLOMBIA

1 ♀, USNM, off Bahía de Barbacoas, 110–73 m, 28 May 1964, *Oregon* Station 4906. 1 ♀, USNM, NE of Cartagena, 44–42 m, 1 August 1968, *Pillsbury* Station 791. 1 ♂ 3 ♀, RSMAS, NW of Bar-

ranquilla, 29–26 m, 1 August 1968, Pillsbury Station 793.

FRENCH GUIANA

9 ♂ 11 ♀, USNM, 42 m, 8 July 1968, Pillsbury Station 648.

BRAZIL

Pernambuco: 1 ♀, MNHNP, off Recife, 75 m, 21 November 1961, Calypso Station 23. Espírito Santo: 1 ♀, MNHNP, off Guriri, 12 m, 1 December 1961, Calypso Station 97.

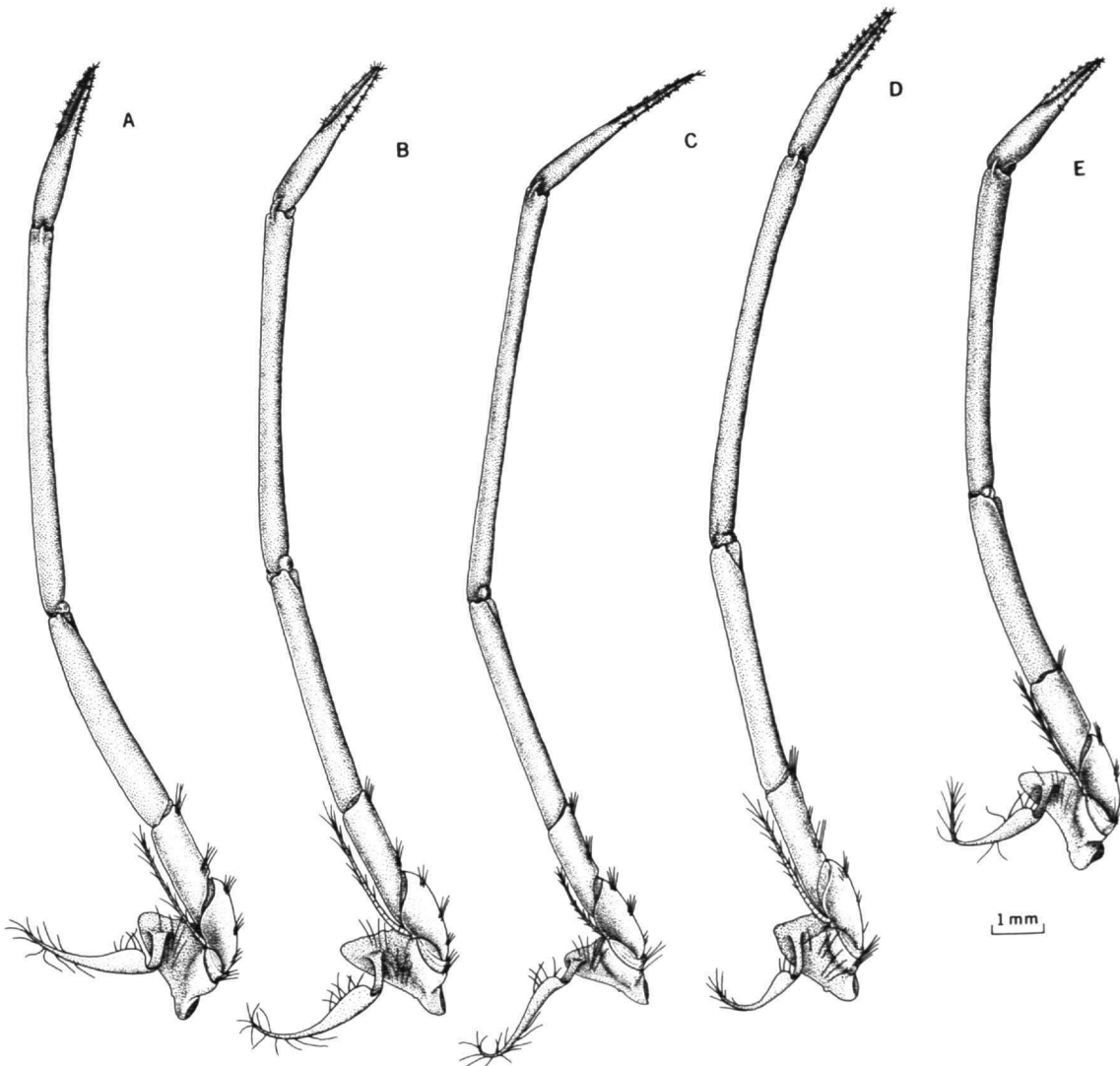


FIGURE 13.—Third right pereopod. A, *Metapenaeopsis goodei* (Smith), ♀ 10.5 mm c.l., southwest of Cape San Blas, Florida. B, *Metapenaeopsis martinella*, new species, ♀ 10.5 mm c.l., La Gonave, Haiti. C, *Metapenaeopsis gerardoi*, new species, ♀ 8.75 mm c.l., off Barbados, Lesser Antilles. D, *Metapenaeopsis hobbsi*, new species, ♀ 10.5 mm c.l., off Recife, Pernambuco, Brazil. E, *Metapenaeopsis smithi* (Schmitt), ♀ 10.5 mm c.l., Serrana Bank, western Caribbean.

Diagnosis

Body covered by simple, moderately dense setae. Stylocerite short, reaching only to about midlength of first antennular segment. Third pereopod rather short, extending to midlength of third antennular segment. Abdomen with middorsal carina short, extending from fourth to sixth somites. Telson with terminal portion slender, and long, length about five times width at base. Petasma with right distoventral projection consisting of single, undivided lobe; distoventral element produced distally into two parts, a lobe and a process ending in bulb. Thelycum with median plate strongly concave, bosses with rather sparse setae and with posterolateral corners produced in small projections, flanking pits; pits caudal to posterior margin of bosses; transverse plate strongly depressed.

Description

PUBESCENCE (Figure 14A-C).—Body covered by moderately dense, simple setae of various sizes, most moderately long. Longer setae limited to margins of cervical and hepatic sulci, and immediately anterior to hepatic spine; moderately long setae largely covering dorsum and extending into dorsal portion of rostrum; short setae sparse on hepatic region and denser over most of branchial region. Abdomen

almost entirely covered (margins of somites and midanterior portion of pleura bare) by setae, mostly short; telson, except for margins and terminal portion, studded with setae of various lengths.

ROSTRUM.—Teeth 6 to 9, mode 7 (percentage distribution: 6—12, 7—44, 8—36, 9—8; N=25) + epigastric; first tooth distinctly anterior to orbital margin; epigastric at about one-fourth carapace length from orbital margin. Rostrum moderately tilted upward from base, with extreme posteroventral margin concave; maximum height immediately anterior to concavity, decreasing progressively to apex; rostrum in adult reaching as far as midlength of third antennular segment, shorter in young.

CARAPACE.—Orbital angle almost 90°, apex with minute orbital spine directed anterodorsally; antennal spine prominent, pointed, with low, round carina; hepatic spine long, slender, and sharp, its apex almost at level of that of epigastric tooth; pterygostomial spine relatively small, about one-third length of curved anterior portion of margin below spine. Orbits-antennal sulcus indistinct; cervical sulcus feeble, almost hidden by long setae; hepatic sulcus distinct, nearly horizontal to level of hepatic spine, there turning anteroventrally.

ANTENNULES.—Length of antennular peduncle about four-fifths that of carapace. Dorsal flagellum slightly shorter than ventral, length of ventral about

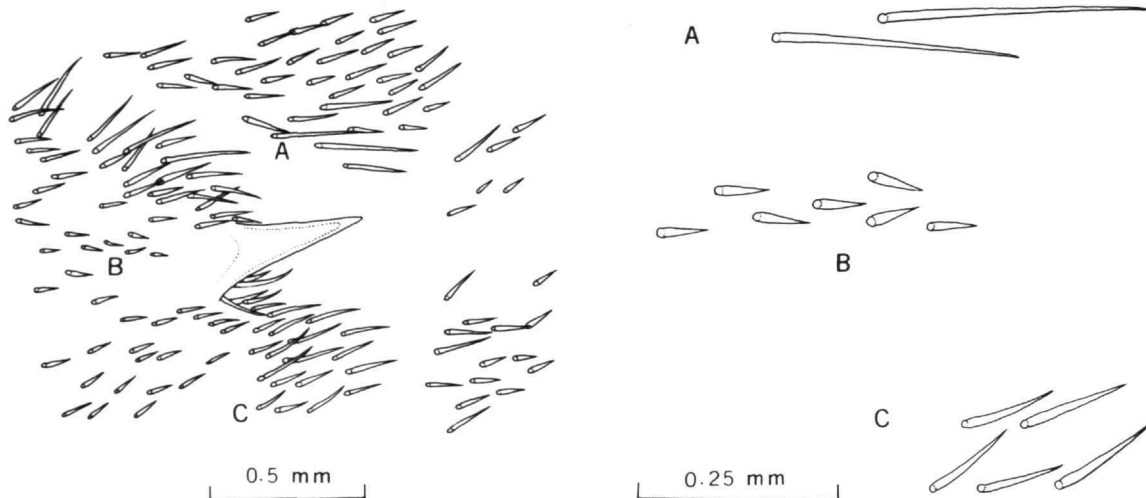


FIGURE 14.—*Metapenaeopsis hobbsi*, new species. Pubescence on hepatic region and adjacent portion of antennal region, ♀ 8.6 mm c.l., Bahía de Barbacoas, Colombia.

two-fifths that of antennular peduncle. Prosartema extending to about base of distal fifth of first antennular segment; stylocerite projected distally in sharp, relatively short spine, reaching to midlength of first antennular segment; anterolateral spine long, slender, and sharp.

ANTENNAE.—Scaphocerite extending to base of dorsal antennular flagellum, and armed with series of stout spines along dorsal surface of distolateral margin. Length of antennal flagellum same as shrimp total length.

THORACIC APPENDAGES.—Third maxilliped surpassing antennular peduncle by half length of dactyl; first pereopod extending at least to midlength of carpuce and, at most, exceeding it by half length of dactyl; second pereopod surpassing carpuce by as much as entire length of propodus; third pereopod reaching as far as midlength of third antennular segment; fourth pereopod extending to midlength of carpuce; fifth pereopod exceeding fourth by half length of dactyl; coxal plate of fourth pereopod in females rather broad and slightly convex. Ischial spine on first pereopod.

ABDOMEN.—Median carina extending from fourth to sixth somites, forming blunt keel and increasing in height posteriorly, bearing V-shaped incision on posterior margin of fourth and fifth somites, and ending on posterior margin of sixth in small spine. Abdomen forming hump on third and fourth somites; length of sixth somite one and one-half times maximum height. Telson slightly surpassing base of distal fifth of inner ramus of uropod, with terminal portion slender, and long, four and one-half to five times width at base; lateral fixed spines of telson reaching end of proximal third of terminal portion; posterior of three pairs of movable spines surpassing fixed spines, extending to midlength of terminal portion, second pair slightly surpassing bases of posterior pair, and anterior pair very small. Outer ramus of uropod slightly longer than inner.

PETASMA (Figures 15A-C and 16A, B).—Right distoventral projection with lateral margin making right angle turn mesially at end of basal one-third, and then turning abruptly distally to form an elongate, subelliptical lobe. Distoventral flap striated and wound in subconical roll, strongly inclined

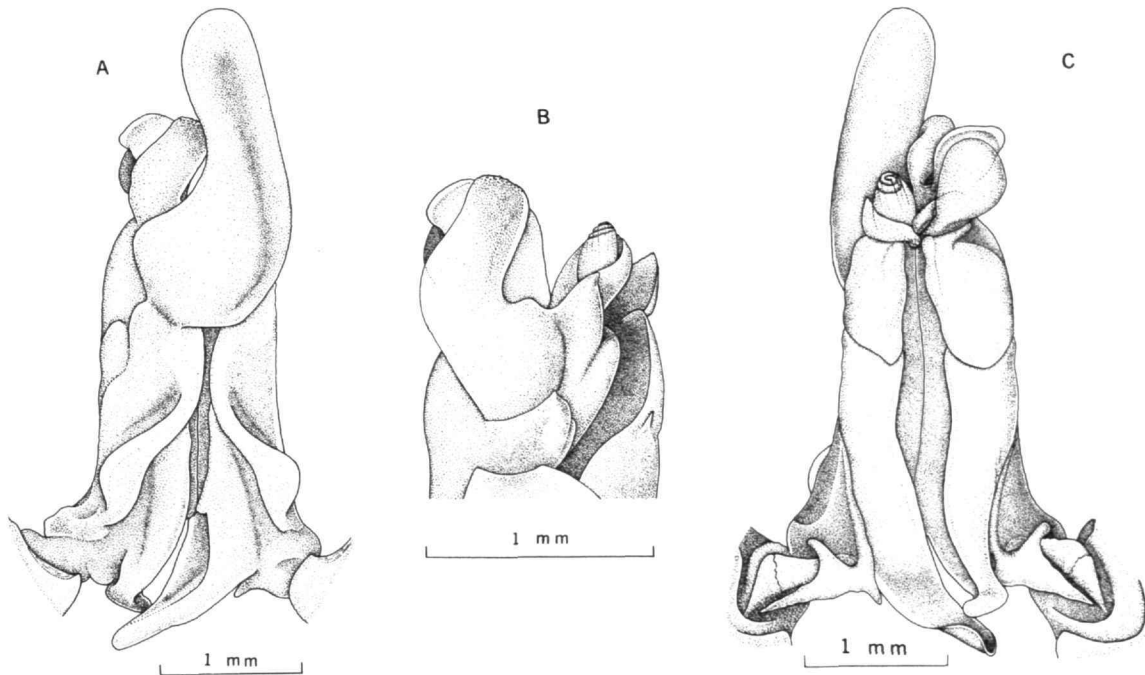


FIGURE 15.—*Metapenaeopsis hobbsi*, new species. A, Petasma, ventral view, ♂ 6.8 mm c.l., off French Guiana. B, Distal part of petasma, ventral view with distoventral projection bent ventrally, ♂ 6.4 mm c.l., off French Guiana. C, Dorsal view of A.

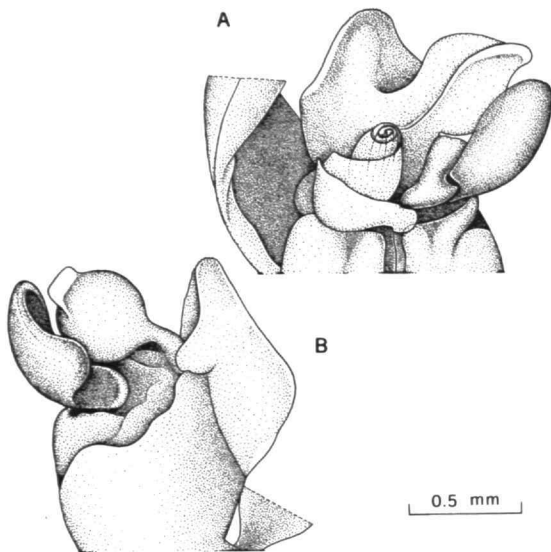


FIGURE 16.—*Metapenaeopsis hobbsi*, new species. A, Lateral view of distal part of petasma, ♂ 6.4 mm c.l., off French Guiana. B, Dorsal view.

dorsally. Distoventral element with proximal portion produced distomedially into convex, elongate lobe, bearing minute spinules on distal margin, and extending distodorsally in thick process ending in bulb. Rigid component contiguous with distoventral element (ventral extension of right distodorsal element), plain. Right distodorsal projection fleshy, petaloid, and with proximolateral portion turned ventrally; subapical projection short (narrow), stiff, extending medially beyond and embracing basal portion of right distodorsal projection. Left distodorsal projection subtriangular, thin, flexible, and short, extending at most to distal end of distoventral flap. Proximal portion of left half of petasma with short spine at dorsolateral base of long, oblique, median spur.

APPENDIX MASCULINA.—Essentially identical to that described for *M. goodei* (Smith).

THELYCUM (Figure 17A, B).—Posterior ridge with sharp anterior margin forming two rounded lateral lobes, and pointed, broadly subtriangular median lobe. Transverse plate with anteromedian

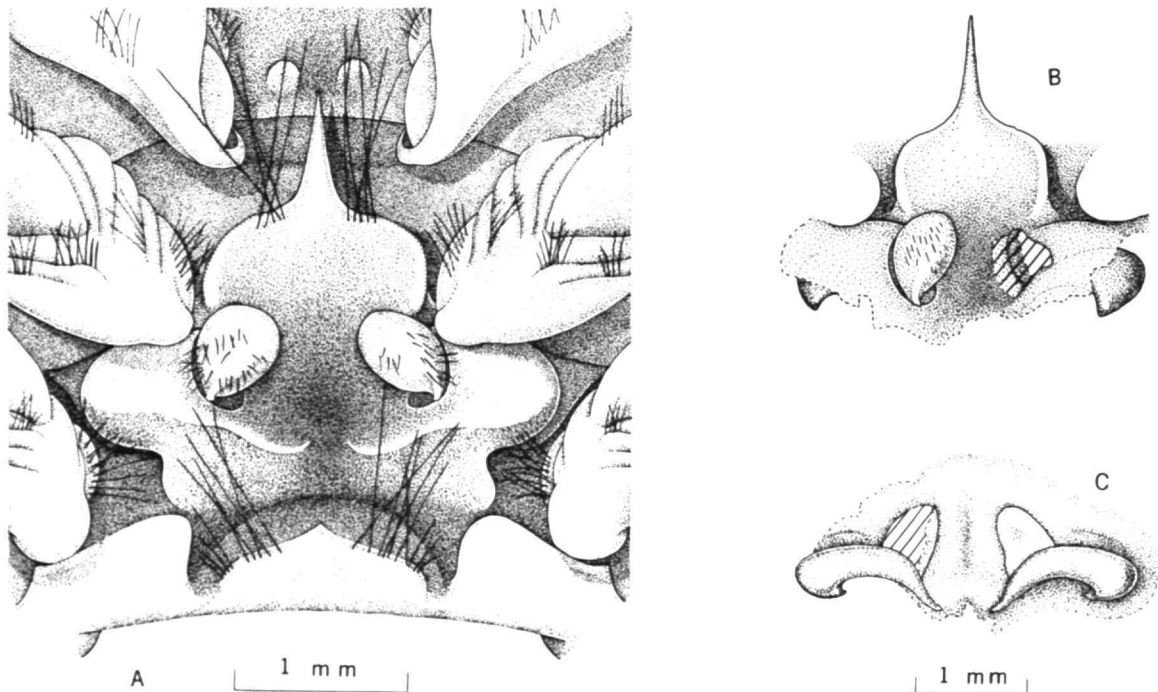


FIGURE 17.—*Metapenaeopsis hobbsi*, new species. A, Thelycum, ♀ 9.5 mm c.l., off Guyana. B, Seminal receptacles, ventral view, ♀ 9.75 mm c.l., off Bahía de Barbacoas, Colombia. C, Dorsal view of same seminal receptacles.

portion strongly depressed, its anterolateral portions produced in elongate, anteroventrally produced projections; anterior border of projections thickened and lateral borders markedly sinuous. Hoods extending gently anterodorsally and laterally, forming subelliptical prominences. Median bridge broadly trapezoidal, widest posteriorly, and strongly depressed. Median plate bearing long, slender, antero-medial spine. Anterior part of median plate strongly concave, inclined anteroventrally, with anterolateral margins gently rounded; posterolateral portions of median plate forming prominent, ovoid bosses, armed with sparse and rigid setae, their posterolateral corners produced in short, narrow projections, delimiting relatively large pits, located caudal to bosses. Grooves between sternites XIII and XIV extending along anterior and median margins of hoods, reaching anterior margin of transverse plate, there ending in pits. Sternite XII with paired blunt, rather closely set, submedian protuberances.

Sternite XI in females, as well as in males, bearing two long, spinous processes broad basally.

SEMINAL RECEPTACLES (Figure 17B, c).—Paired, subovoid, posteromedially pointed capsules, located dorsal to hoods, continuous with broad ducts tapering medially and ending in pits.

Size

Maximum length recorded, 1 ♀, 10.5 mm carapace length, 46 mm total length, from off Recife, Pernambuco, Brazil, *Calypso* Station 23; males smaller than females, maximum length recorded that of ♂ allotype.

Name

I have named this species for Horton H. Hobbs, Jr., whose suggestions throughout the course of this study have been very valuable to me.

Distribution

The material available, although limited, indicates that this species is rather widely distributed in the western Atlantic, ranging from the Bahamas throughout the Antilles, the Caribbean coast of Central and South America, and from Trinidad to Guriri, Espírito Santo, Brazil. *M. hobbsi* lives

mainly in shallow water, but also occurs at depths of, at least, 137–183 m.

Habitat and habits

Information is too meager to allow conclusions.

Remarks

The males of this species are unique among the western Atlantic forms in this genus in having a distoventral projection consisting of a simple, undivided lobe; a distoventral element which is produced distally into two parts, a lobe and a process ending in a bulb; and a subapical projection which is narrow and elongate, its median extremity curved to embrace the basal portion of the right distodorsal projection. Males as small as 4 mm c.l. can be separated by the distal structures of the petasma, which are sufficiently developed to make various specific features readily identifiable. The females can be distinguished from other females of the genus by the following characteristics: the posterolaterally produced bosses, the position of the pits caudal to the bosses, the subelliptical, much laterally extended hoods, and the strongly depressed anteromedian portion of the transverse plate.

Metapenaeopsis smithi (Schmitt)

FIGURES 13E, 18, 19, 20, 21, 22

Penaeopsis smithi Schmitt, 1924a, p. 62, fig. 1 b, c, fig. 2 a, c. Type-locality: Caracas Baai, Curaçao. Syntypes: 1 ♂ 1 ♀, Zoological Museum, Amsterdam, 10 April 1920. 2 "immature," Zoological Museum, Amsterdam, 19 April 1920. 2 ♂ 1 ♀ 1 juvenile, Zoological Museum, Amsterdam, 13 May 1920. 2 ♂ 1 ♀, USNM 57537, 13 May 1920. All collected by C. J. van der Horst.—Schmitt, 1924b, p. 65.—Schmitt, 1936, p. 364.—Wheeler, 1937, p. 325.

Penaeopsis goodei.—Boone, 1930 [?part], p. 110, possibly fig. 4A.

Penaeopsis (Metapenaeopsis) smithi.—Burkenroad, 1934, p. 17, figs. 4–7.—Burkenroad, 1938, p. 78.—Bullis and Thompson, 1965, p. 6.

Material

BERMUDA ISLANDS

1 ♀, YPM. St. George's Island, 25 January 1935, *Atlantis* (in port). 2 ♀, YPM, St. George's Island,

26 and 29 January 1935, M. D. Burkenroad (?). 1 ♀, YPM, Wingay Bay, 20 (25?) November 1915, staff Bermuda Biological Station. 1 ♀, YPM, "Jetty," 25 July 1935, M. D. Burkenroad. 1 ♀, YPM, "Jetty," 24 August 1935, M. D. Burkenroad. 1 ♀, YPM, 19 June 1936, M. D. Burkenroad.

FLORIDA

3 ♂ 5 ♀, USNM, Bear Cut, E of Virginia Key, 28 May 1956, D. De Sylva et al., Station 22. 2 ♂ 2 ♀, USNM, Virginia Key, S side of bridge, 9 March 1963, staff RSMAS. 6 ♀, USNM, Straits of Florida, 366-384 m, July 1955, *Oregon* Station 1350. 2 ♀, RSMAS, SW Dry Tortugas.

MEXICO

1 ♀, USNM, E of Arrecife Alacrán, 27 m, 11 and 12 May 1958, *Oregon* Station 2174.

BAHAMA ISLANDS

4 ♀, YPM, Green Cay, 27 February 1927, *Pawnee* I. 1 ♀, YPM, Green Cay, 13 March 1927, *Pawnee* I. 1 ♀, YPM, Green Cay, 17 March 1925, *Pawnee* I. 2 ♀, YPM, Saddle Rock Islands, 23 March 1925, *Pawnee* I. 1 ♀, USNM, S of Great Inagua, 11 m, 25 May 1965, *Oregon* Station 5422. 4 ♀, USNM, Samana Cay, ¼ mile off Atwood, 24 m, 26 January 1968, K. L. Gosner. 1 ♂ 11 ♀, USNM, 1 mile W of Bimini Bay, 18 m, 1966, *Oregon* Cruise 109. 3 ♀, RSMAS, Bimini Harbor, 27 November 1953, G. L. Voss. 4 ♂ 5 ♀, USNM, Cat Cays, "surface," 21 May 1966, *Oregon* Station 6096. 1 ♂ 5 ♀, RSMAS, Cay Sal, 2 May 1960, staff Bureau of Commercial Fisheries Florida Project.

CUBA

6 ♂ 4 ♀, USNM, Cayo Levisa, May to June 1914, *Tomás Barrera* Station 14. 1 ♂, USNM, between Cabo San Antonio and Cabo Cajón, 24 May 1914, *Tomás Barrera* Station 12. 1 ♀, USNM, Ensenada de Cajón, 22 May 1914, *Tomás Barrera* Station 11. 1 ♀, YPM, Bahía de Guantánamo, 22 April 1933, (?) M. D. Burkenroad.

HAITI

1 ♂, AMNH, Port au Prince, W. Beebe. 1 ♀, AMNH, Port au Prince, W. Beebe. 1 ♂ 1 ♀, AMNH, Port au Prince, W. Beebe. 2 ♂, AMNH, Port au Prince, W. Beebe.

PUERTO RICO

1 ♀, USNM, Playa de Fajardo, 23 February 1933, Johnson-Smithsonian Deep Sea Expedition.

VIRGIN ISLANDS

Saint Thomas: 2 ♀, USNM, Brewers Bay, 1 March 1933, Johnson-Smithsonian Deep Sea Expedition. Saint John: 3 ♂ 1 ♀, RSMAS, E Europa Bay, 16 February 1959, H. Kumpf et al. 6 ♂ 11 ♀, RSMAS, shore at Greater Lameshur Bay, 28 April 1959, C. R. Robins, T. McKenny, and J. Randall, Station 46. Peter Island: 1 ♀, USNM, 26 m, 16 May 1967, *Oregon* Station 6691. Saint Croix: 1 ♂, USNM, Christiansted, H. A. Beatty.

LESSER ANTILLES

Saint Christopher: 2 ♀, AMNH, Basseterre, 21 July 1932, *Antares* Expedition. Sint Maarten: 3 ♂ 1 ♀, RSMAS, Little Bay, 7 July 1959, John E. Randall and C. P. Idyll. The Grenadines: 4 ♀, USNM, 33 m, 18 March 1966, *Oregon* Station 5981. *Islas Los Roques*: 2 ♂ 2 ♀, USNM, Isla El Carenero, 3 August 1963. Curaçao: 1 ♂ 2 ♀, syntypes, USNM 57537, Caracas Baai, 13 May 1920, C. J. Van der Horst.

WESTERN CARIBBEAN

Swan Island: 1 ♂ 9 ♀, YPM, 12 April 1925, *Pawnee* I, Station 29. Rosalind Bank: 1 ♀, USNM, 27 m, 6 June 1962, *Oregon* Station 3618. Serrana Bank: 4 ♂ 8 ♀, USNM, 0 to 2 m, 12 May 1964, *Oregon* Station 4836. Isla de Providencia: 1 ♀, USNM, 1884, *Albatross*.

Diagnosis

Body covered by plumose, rather densely set setae, arranged in two patches on each side of carapace and bands and patches on pleonic somites. Stylocerite usually short, reaching to midlength of first antennular segment. Third pereopod short, extending at most to midlength of second antennular segment. Abdominal carina short, extending from posterior half of third to sixth somites. Telson with terminal portion short and broad, length of latter three to three and one-half times width at base. Petasma with right distoventral projection deeply cleft into two subequal, elongate lobes. Distoventral

element distally produced in dextrally directed broad process. Thelycum with median plate bearing horseshoe-shaped marginal strip and coiled lateral strips.

Description

PUBESCENCE (Figure 18A-D).—Carapace covered with setae of two types: one stiff, with stout shaft, other with flexible, slender shaft. First type either relatively long, bearing rather firmly attached pinnulae, latter long along middle portion, decreasing in length toward both extremities (Figure 18A, c) or short, unarmed (Figure 18B). Longer setae on parts of dorsum of carapace, and laterally anterior to hepatic spine, bordering cervical sulcus and hepatic sulcus (there forming elongate, curved patch); two patches of longer setae also present on branchial region, one posterodorsally and other posteroventrally. Short setae sparse on rostrum, more abun-

dant on anteroventral portion of carapace, on parts of dorsum, at base of hepatic spine, and sparsely covering branchial region. Stiff setae, most long, also arranged in bands and patches on pleonic somites, and covering telson. Second type, that with flexible, slender shaft and bearing pinnulae (Figure 18D) rather sparsely distributed on various areas of carapace.

ROSTRUM.—Teeth 7 to 10, mode 8 (percentage distribution: 7—2, 8—55, 9—38, 10—5; N = 60) + epigastric; first tooth slightly anterior to orbital margin, last tooth minute, epigastric almost constantly at one-fourth carapace length from orbital margin. Rostrum slightly to moderately tilted upward from base, with extreme posteroventral margin concave, maximum height immediately anterior to base, decreasing progressively to apex; rostrum shorter than carapace, in adult reaching as far as midlength of third antennular segment, shorter in young.

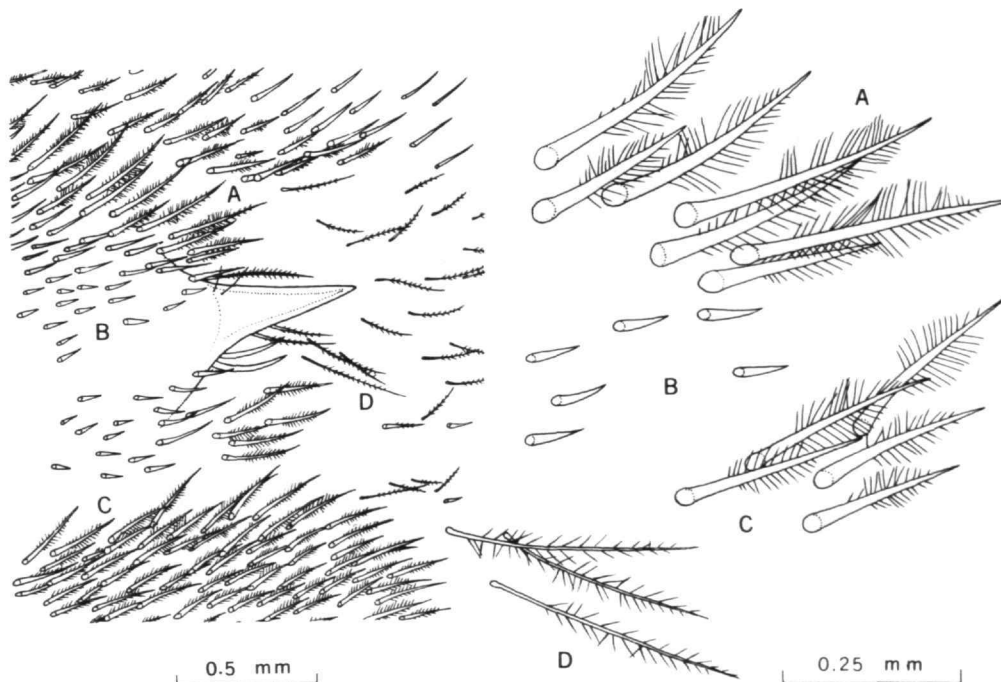


FIGURE 18.—*Metapenaeopsis smithi* (Schmitt). Pubescence on hepatic region and adjacent portion of antennal region, ♀ 9.2 mm c.l., Swan Island, Caribbean Sea.

CARAPACE.—Orbital angle almost 90° , apex with minute orbital spine directed anterodorsally; antennal spine prominent, pointed, with low round carina; hepatic spine long, slender, and sharp, apex slightly anterior to that of epigastric tooth; pterygostomian spine relatively small, about one-third length of curved anterior portion of margin below spine. Orbito-antennal sulcus indistinct; cervical sulcus feeble, almost hidden by long setae; hepatic sulcus nearly horizontal to level of hepatic spine, there turning anteroventrally.

ANTENNULES.—Length of antennular peduncle about four-fifths that of carapace. Dorsal flagellum slightly shorter than ventral, length of ventral about two-fifths that of antennular peduncle. Prosartema extending to about base of distal fifth of first antennular segment; stylocerite projected distally in sharp, relatively short spine, usually extending only to midlength (but occasionally as far as two-thirds) of first antennular segment; anterolateral spine, long, slender, and sharp.

ANTENNAE.—Scaphocerite with series of stout spines along dorsal surface of distolateral margin, its distal end reaching about proximal fourth of thickened portion of dorsal antennular flagellum. Length of antennal flagellum same as shrimp total length.

THORACIC APPENDAGES.—Third maxilliped ranging in extent from distal end of first antennular segment to end of proximal third of second; first pereopod extending at least to midlength of carapace and, at most, exceeding it by half dactyl; second pereopod exceeding carapace by as much as four-fifths length of propodus; third pereopod reaching at least end of proximal fourth and, at most, midlength of second antennular segment; fourth pereopod reaching to midlength of carapace; fifth pereopod exceeding fourth by half to entire length of dactyl. Coxal plate of fourth pereopod in females broad and slightly convex. Ischial spine on first pereopod.

ABDOMEN.—Median carina extending from fourth

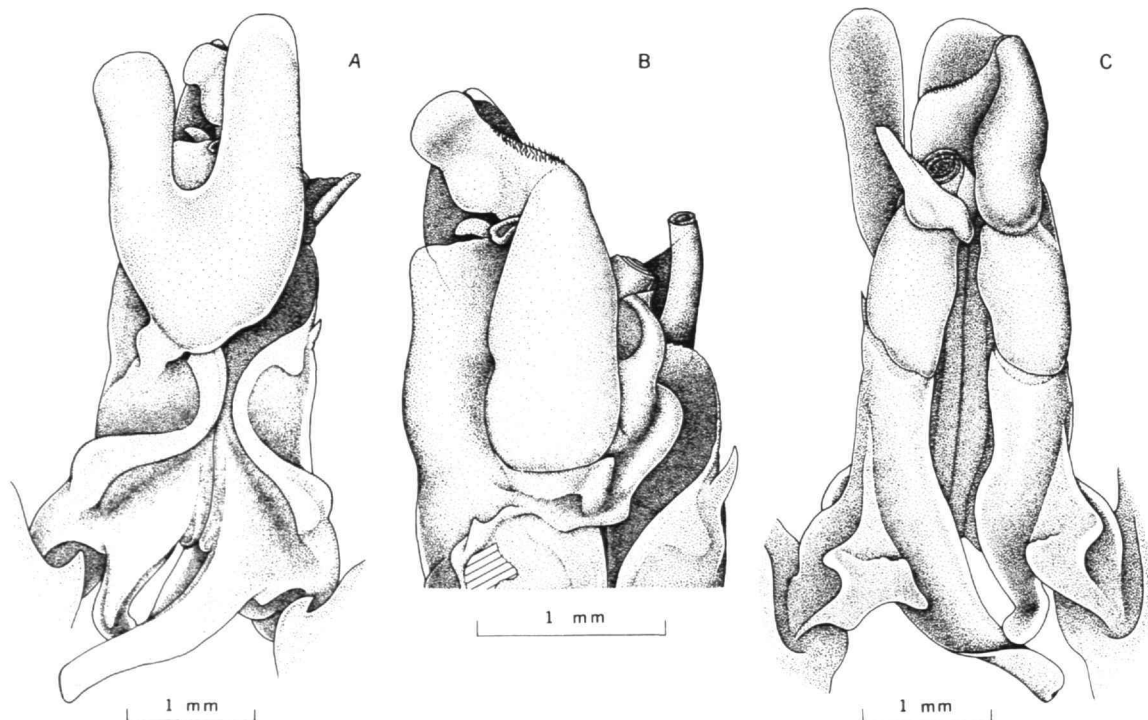


FIGURE 19.—*Metapenaeopsis smithi* (Schmitt). A, Petasma, ventral view, ♂ 7.7 mm c.l., Serrana Bank, western Caribbean. B, Distal part of petasma, ventral view with distoventral projection removed, ♂ 6.75 mm c.l., Cat Cays, Great Bahama Bank. C, Dorsal view of A.

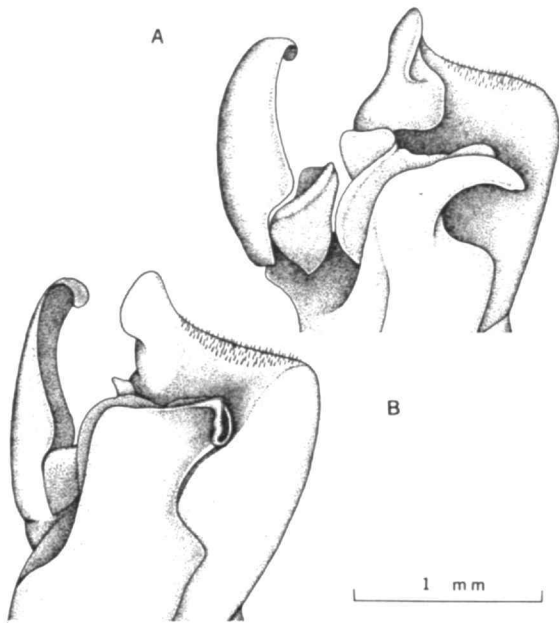


FIGURE 20.—*Metapenaeopsis smithi* (Schmitt). A, Ventro-lateral view of distal part of petasma, ♂ 7.7 mm c.l., Serrana Bank, western Caribbean. B, Lateral view of same part.

somite, occasionally from posterior half of third (if present there, low and rounded), to sixth somite, forming blunt keel and increasing in height posteriorly, bearing V-shaped incision on posterior margin of fourth and fifth somites, and ending on posterior margin of sixth in small spine. Abdomen forming hump from second to fourth somites; length of sixth somite one and one-half times maximum height. Telson slightly surpassing base of distal fifth of inner ramus of uropod, with terminal portion short and broad, three to three and one-half times width at base; lateral fixed spines of telson reaching end of proximal third of terminal portion, posterior of three pairs of lateral movable spines reaching as far as, or slightly surpassing, fixed spines, second pair extending to bases of posterior pair, anterior pair very small. Outer ramus of uropod slightly longer than inner.

PETASMA (Figures 19A-C and 20A, B).—Right distoventral projection cleft by deep sinus into two subequal, elongate lobes. Distoventral flap wound in large roll, strongly inclined dorsally. Distoventral element consisting of proximal, blunt demicone,

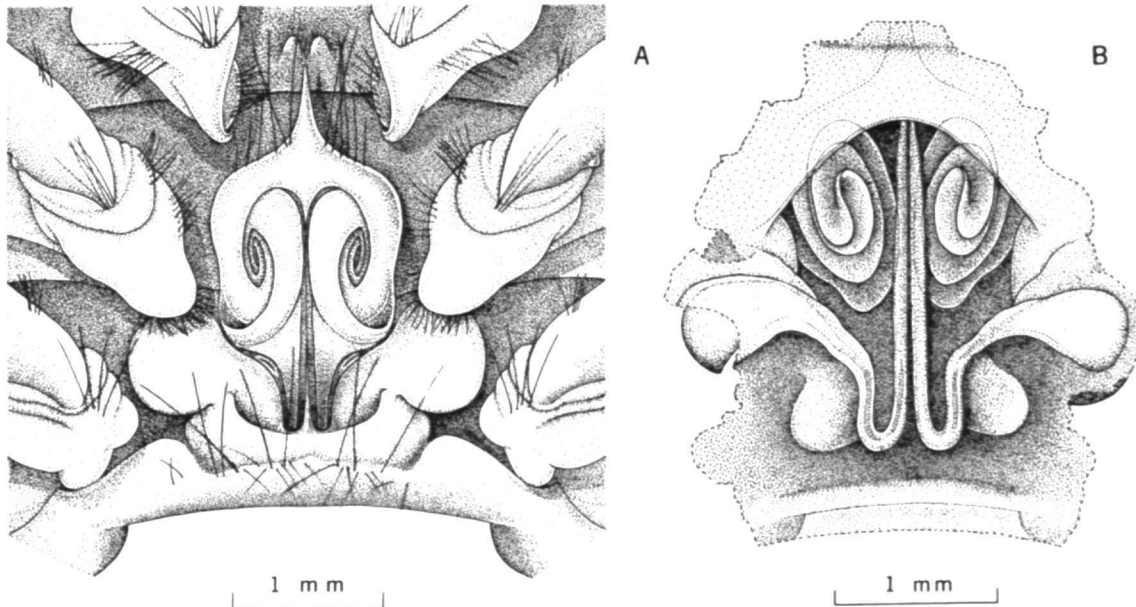


FIGURE 21.—*Metapenaeopsis smithi* (Schmitt). A, Thelycum, ♀ 10 mm c.l., Saint Christopher, Lesser Antilles. B, Dorsal view of thelycum showing seminal receptacles, ♀ 10 mm c.l., Swan Island, Caribbean Sea.

produced distally in dextrally directed, broad process, with distomedian border densely covered by spinules; demicone bearing dorsal, strongly recurved fold. Rigid component contiguous with distoventral element (ventral extension of right distodorsal element), produced distally, and bearing subterminal, ventrally projecting horn, lying against demicone. Right distodorsal projection fleshy and roughly lanceolate; subapical projection subtrapezoidal and stiff. Left distodorsal projection thin, flexible, elongate, tightly wound, and ventrally inclined. Proximal portion of left half of petasma with short, blunt spine at dorsolateral base of long, oblique, median spur.

APPENDIX MASCULINA.—Essentially identical to that described for *M. goodei* (Smith).

THELYCUM (Figures 21A, B and 22).—Posterior ridge forming two lateral rounded lobes, with median portion short and almost uniform in length, barely produced anteriorly along midline. Transverse plate with median portion short, anterolaterally produced in conspicuous extensions connecting with hoods; latter subsemicircular in outline, extending anterodorsally, flanking posterolateral portions of median plate, and continuing posteromedially forming paired pouches dorsal to transverse plate. Median bridge slender, long, and deeply set,

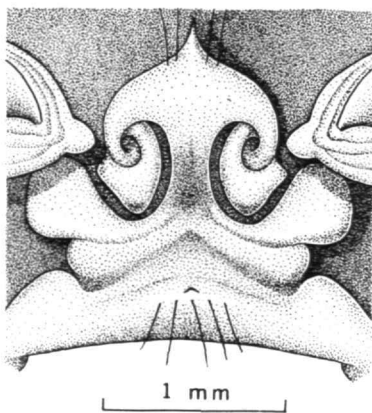


FIGURE 22.—*Metapanaeopsis smithi* (Schmitt). Juvenile thelycum, ♀ 4.6 mm c.l., no data (Bingham Oceanographic Collection 129, YPM).

and hidden anteriorly by median strips. Median plate much elongated, armed with long, antero-medial spine, and with ventral surface bearing paired external spiral grooves (originating posteriorly and running on each side of median line) delimiting horseshoe-shaped marginal strip, and, near end of arm of shoe, turning anteriorly and finally posteriorly, ending in pit, located at center of lateral half of median plate; paired internal spiral grooves (originating on excavated, posterolateral portions of median plate) extending anteriorly subparallel to corresponding external groove, continuing posteriorly and finally anteriorly, ending in pit; median longitudinal segments of external and internal grooves delimiting broad median strip, latter suddenly narrowing and continuing between grooves to central pit; strips formed by grooves on each side giving impression of single strip wound in spiral; median plate extending caudally into two elongate, subtriangular processes. Narrow, ribbonlike folds on dorsal surface of median plate (Figure 21B), underlying coiled grooves on ventral surface, innermost portions of folds forming funnel corresponding to ventral pit. Paired grooves between sternites XIII and XIV extending along anterior and median margins of hoods dipping beneath transverse plate, there making U turn and running anteriorly on each side of slender median bridge. Sternite XII with paired, small protuberances.

Sternite XI in females, as well as in males, bearing two spinous processes broad at their bases.

SEMINAL RECEPTACLES (Figure 21B).—Paired, roughly ovoid capsules, somewhat flattened, slightly produced posterolaterally, and located dorsal to hoods. Capsules continuous with narrow ducts running posteromedially and then turning anteriorly in U, median arm of U extending anteriorly on dorsal surface of median plate to marginal strip; ducts (underlying grooves between sternites XIII and XIV) opening in almost imperceptible slits, located between subtriangular processes of median plate and posteromedian extensions of hoods. In impregnated females, spermatophores restricted to capsules and proximal portions of ducts, not occupying median arm of U on either side; impregnation often detectable by hardened secretion from spermatophores protruding from slits.

Size

Maximum length recorded, 1 ♀, 12.4 mm c.l., 49 mm t.l., from Bermuda Islands; males smaller than females, maximum length recorded 7.7 mm c.l., 40 mm t.l., from Serrana Bank, Oregon Station 4936 (petasma figured).

Distribution

Metapenaeopsis smithi is found in the Bermuda Islands, southeast coast of Florida to the Tortugas Islands, throughout the West Indies—from Bahamas to Curaçao—and from Arrecife Alacrán, Mexico, southward along the Caribbean coast of Central America and South America. The occurrence of this species on the coast of Florida and the Tortugas Islands has not been recorded previously.

Metapenaeopsis smithi lives in shallow water, but some specimens were captured at depths as great as 366-384 m, in the Straits of Florida, at Oregon Station 1350. Most *Metapenaeopsis* of the western Atlantic show this same curious pattern of bathymetric distribution, occurring mainly in shallow water but, apparently, invading greater depths, close to the continental or island platforms.

Habitat and habits

Schmitt (1924a) recorded *Metapenaeopsis smithi* on sand, and Boone (1927) in coral reefs. During the cruise of the *Tomás Barrera* collections were made on coral, sand, rock, and "weedy" bottoms, and the Johnson-Smithsonian Deep Sea Expedition caught one specimen in floating sargassum on Playa Fajardo, Puerto Rico (see also discussion of habitat and habits of *M. goodei*).

Remarks

The unique structure of the thelycum of *Metapenaeopsis smithi* enables the ready recognition of the females of this species. Males, in turn, can be identified by the deeply cleft distoventral projection, the relatively short, broad, and dextrally directed process of the distoventral element, the presence of an elongate patch of spinules on the distomedian border of that process, and by the prominent horn of the ventral extension of the right distodorsal element. *M. smithi* may be distinguished from its congeners

in the western Atlantic also by the short, broad terminal portion of the telson, and the pubescence.

Burkenroad (1934) stated that "there are no qualitative differences in the nature of the tomentum between *P. smithi* and *P. goodei*, although there appear to be quantitative ones." According to my observations, however, the structure, density and pattern of arrangement of the setae differ in the two species. The setae of *Metapenaeopsis smithi* are relatively shorter, and some of the shortest ones are bare, not only lacking pinnulae, but showing no trace of those which might have been detached, whereas in *Metapenaeopsis goodei* the shortest setae usually exhibit pinnulae or, often, the points of attachment, even if feeble, of lost ones. In addition, *M. smithi* possesses setae with flexible shaft, which are lacking in *M. goodei*. The quantitative differences between the two in pubescence are even more obvious; in *M. goodei* the carapace and abdomen are almost uniformly covered by closely set setae, except for a bare marginal strip around the pleonic somites, whereas in *M. smithi* the branchial region is rather sparsely covered by short setae, among which two elongate patches of long setae stand out, and the setae of the pleonic somites are arranged in well-defined bands and patches.

In this species the third pereopods are shorter than in the other members of the genus in the western Atlantic, extending forward, at most, to midlength of the second antennular segment. The relationship of the length of the third pereopods to that of the carapace in the five species may be obtained by comparing the illustrations in Figure 13. Obviously, the third pereopod of *M. smithi* (13E) is proportionately the shortest.

The detailed study of the thelycum of *M. smithi* has demonstrated that it is even more complex than has been previously realized. The anterior part of the median plate is reduced in area by the anterior elongation of the median bridge and posterolateral portions of the median plate. The posterolateral portions are equivalent to the bosses of other species, and in their elongation form the median strips. The median bridge and the posterolateral portions are also produced posteriorly (the latter in subtriangular processes); the elongation of these structures in both directions, in turn, are responsible for the long seminal receptacles (Figure 21B) underlying the grooves along the margins of the subtriangular processes and median bridge. The median limbs of these

grooves terminate near the anterior extremity of the median strips and do not continue laterally as Burkenroad (1934) suggested. The wound dorsal folds, underlying the grooves on each side of the ventral surface of the median plate, are independent of the seminal receptacles, and their function is not only unknown, but puzzling, since they do not serve the purpose of storing the spermatophores. Another structure, the function of which is unknown, is the pair of pouches formed by the posterolateral portions of the hoods, dorsal to the transverse plate.

Even in a female 4.6 mm in carapace length (Figure 22) the early stages in the modification of the basic pattern of the thelycum can be observed. The elongation of the median bridge, and the anterior and posterior expansions of the posterolateral portions of the median plate are already initiated; the posterior coiling of the marginal strip has also begun.

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Simple *tabulations* in the text (e.g., columns of data) may carry headings or not, but they should not contain rules. Formal *tables* must be submitted as pages separate from the text, and each table, no matter how large, should be pasted up as a single sheet of copy.

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In the *bibliography* (usually called "Literature Cited"), spell out book, journal, and article titles, using initial caps with all words except minor terms such as "and, of, the." (For capitalization of titles in foreign languages, follow the national practice of each language.) Underscore (for italics) book and journal titles. Use the colon-parentheses system for volume, number, and page citations: "10(2):5-9." Spell out such words as "figures" and "plates" (or "pages" when used alone).

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