RAYMOND B. MANNING
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Shrimps of the Family Processidae from the Northwestern Atlantic Ocean (Crustacea: Decapoda: Caridea)

SMITHSONIAN CONTRIBUTIONS TO ZOOLOGY NUMBER 89

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ABSTRACT

Manning, Raymond B., and Fenner A. Chace, Jr. Shrimps of the Family Processidae from the Northwestern Atlantic Ocean. (Crustacea: Decapoda: Caridea) *Smithsonian Contributions to Zoology*, number 89, 41 pages, 1971.—The processid shrimp fauna of the northwestern Atlantic Ocean is reviewed for the first time. Eleven species are recorded, of which eight are newly described. *Ambidexter symmetricus*, new genus, new species; *Nikoides schmitti*, new species; and six new species of *Processa* are described. *Ambidexter* is the only genus of the family in which both first pereiopods are chelate. *Nikoides* has not been recorded previously from outside of the Indo-West Pacific region. Keys to the species of *Nikoides* and to the Atlantic species of *Processa* are presented, and the Indo-West Pacific species of *Processa* are listed.

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Introduction

Shrimps of the family Processidae are small, nocturnal animals which are abundant in shallow-water habitats, primarily on grass flats. In the western Atlantic, at least, most of the species are found in the tropics or subtropics. We have seen no material from the American mainland north of North Carolina.

The western Atlantic processids have never been studied in detail. Prior to our study, the only representatives of the family known with certainty from the western Atlantic were three species of *Processa*. *Processa bermudensis* (Rankin, 1900), the first to be described, was redescribed by Gurney (1936), who also gave an account of its larvae; it was known only from Bermuda until Williams (1965) recorded it from North Carolina. In 1941 Lebour described *P. wheeleri* and its larvae from Bermuda; it is still known only from her material. Holthuis (1959) described *P. guyanae* from the coast of Surinam; we have seen no further specimens of this species.

Numerous lots of unidentified processids from various localities in the western Atlantic, which had accumulated in the collection of the Division of Crustacea, National Museum of Natural History (USNM), supplemented by collections made by one of us (RBM) in Florida and Puerto Rico, formed the basis of this report. Additional collections from Bermuda were made by one of us (RBM) in April 1970, because available study material from Bermuda, the type locality for two of the western Atlantic species, was apparently limited to one damaged specimen of *P. bermudensis* collected by G. Brown Goode in 1876–1877.

We describe below a new genus and species, a new species of *Nikoides*, a genus previously known only from the Indo-West Pacific region, and six new species of *Processa*. The eight new species, the presence of inadequate material of an additional new *Processa*, the occurrence of two unknown processid larvae at Bermuda (Lebour 1941), and the fact that we did not encounter two of the three previously known species from the study area suggest that not only was this review needed but that more is yet to be learned about the western Atlantic processids. We hope that this contribution to our knowledge of American processids will aid future work on members of this family.

Until 1936 when Miss Lebour showed that the British species then called *P. canaliculata* actually comprised two species, that species was thought to have a cosmopolitan distribution. Thus, most records of processids from the western Atlantic were identified as *P. canaliculata*, a species which does not occur outside of the eastern Atlantic region (Nouvel and Holthuis 1957). Fortunately, we have been able to examine and reidentify most of the western Atlantic specimens recorded in the literature as *P. canaliculata*, and the synonymies given herein reflect these identifications. Only two literature records could not be verified with certainty: Schmitt (1924) recorded a specimen of "*P. canaliculata*" from Caracas Bay, Curaçao, and Hudson, Allen, and Costello (1970) listed *Processa* sp. from Florida Bay. We have examined none of the material reported in these two papers.

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In addition to our descriptive accounts of the western Atlantic processids, we have included a key to the known species of *Nikoides*, constructed from data in the literature, a list of the nominal Indo-West Pacific species of *Processa*, and a provisional key to the Atlantic species of *Processa*. Some of the species recorded from the eastern Atlantic may conceivably be found in the western Atlantic also, although no species is now known to occur in both.

The descriptive accounts include a brief diagnosis designed to distinguish each species from other processids in the western Atlantic. Complete descriptions and illustrations are given for all species except *P. guyanae* Holthuis and *P. wheeleri* Lebour. Holthuis (1959) gave a complete account for *P. guyanae*; we have seen no additional material of that species. We were unable to locate the type or any additional material of *P. wheeleri*. Measurements in all cases are carapace lengths in millimeters. The descriptions are composites, and include observed variations in the material examined.

Acknowledgments

We are pleased to acknowledge the aid of the following individuals: Dorothy Bliss, American Museum of Natural History, and Willard Hartman, Peabody Museum, Yale University, for tracking down specimens previously recorded from Bermuda; H. Levi, Museum of Comparative Zoology, Harvard University (MCZ), for the loan of a specimen from the Bahamas; R. Ingle and A. L. Rice, British Museum (Natural History), for looking up the material from Bermuda reported by R. Gurney and M. Lebour; Carl Saloman, United States Fish and Wildlife Service, Saint Petersburg, Florida, and Larry Abele, Florida State University, for generously sharing collections; J. Rivero, University of Puerto Rico, Mayaguez, for making possible the visit by one of us (RBM) to Puerto Rico in 1961; Wolfgang Sterrer, director, Bermuda Biological Station, for making facilities available at the station in April 1970; and L. B. Holthuis, for funishing notes and illustrations made by H. Nouvel of the specimen reported from Guadeloupe as *P. canaliculata* by Monod (1939).

Family PROCESSIDAE Ortmann, 1896

Processidae Ortmann, 1896: 415, 424.—Holthuis, 1955: 116 [and synonymy].

DEFINITION.—Body smooth. Rostrum short, apex bifid or simple, ventral border never armed. Carapace armed at most with antennal spines. Postorbital groove present or absent. First abdominal somite neither armed nor denticulate. Fifth abdominal somite occasionally with posterolateral spine or spines on pleuron. Telson with 2 pairs of dorsal and 2 pairs of posterior spines, with pair of stout plumose setae between inner pair of posterior spines. Eyes relatively large, with well-developed cornea. Antennular peduncle with well-developed stylocerite; antennular flagella simple, ventromesial shorter than dorsolateral, with thickened setigerous portion proximally. Antennal scale well developed. Mandible lacking distinct incisor process and palp. First maxilla with 1 endite and palp. Second maxilla with endites reduced, palp and scaphognathite well developed. First maxilliped with palp, caridean lobe, epipod, and exopod. Second maxilliped with endite of 5 articles, exopod, and epipod. Third maxilliped with well-developed exopod. All pereiopods with pleurobranch; arthrobranch present or absent at base of first pereiopod; first pereiopod with (*Nikoides*) or without (*Ambidexter*, *Processa*) exopod. Both pereiopods of first pair chelate (*Ambidexter*) or with only 1 chelate (*Nikoides*, *Processa*), usually right, left with unopposed simple dactyl. Second pair of pereiopods chelate, slenderer than first; carpus always, merus usually, and ischium occasionally subdivided; ischium with inner basal enlargement; right second pereiopod usually stronger than left, sometimes equal. Third, fourth, and fifth pereiopods slender, terminating in simple dactyl. First pair of pleopods in male with foliaceous endopod sometimes bearing coupling lobe. Endopod of second pleopod in male with appendix interna and appendix masculina. Uropods elongate, exopods with transverse suture extending from lateral spine (adapted from Nouvel and Holthuis 1957.)

DISCUSSION.—Discovery of a processid shrimp with both first pereiopods chelate has necessitated a redefinition of the family—previously defined by the presence of a simple dactyl on one of the first pereiopods in all known species. The family can best be recognized by the form of the rostrum, which in most species is a simple projection of the carapace, terminating in an apical and a subapical tooth, in combination with usually asymmetrical first pereiopods. The subapical tooth may be set some distance posterior to the apex of the rostrum (as in *Nikoides maldivensis* Borradaile and *Processa jacobsoni* De Man), or it may be absent (as in *P. acutirostris* Nouvel and Holthuis and *Nikoides nanus* Chace).

In the key to families and superfamilies of caridean shrimp given by Holthuis (1955, couplet 16), in which the Processidae are separated from the other families in the superfamily Alpheoida (Hippolytidae, Ogyrididae, and Alpheidae), the following modification could be made:

16. First pair of pereiopods both chelate. Rostrum dentate or unarmed, not with single subdistal dorsal tooth . . 17
 Usually right first pereiopod chelate, left ending in simple clawlike dactylus. If both chelate, rostrum with distal setose notch formed by subdistal dorsal tooth . . . . Processidae

Although the processids exhibit some superficial resemblance to the Hippolytidae, we believe that the form of the rostrum and the structure of the mouthparts in the processids support the continued recognition of these two groups of species as distinct families.

All of the Atlantic processids are similar in basic facies; indeed, the western Atlantic species examined by us apparently have essentially identical mouthparts—with the exception of the number of spinules on the posterior margin of the molar process of the mandible—and uropods. We have figured the mouthparts of all but two of the western Atlantic species; they appear to be subsimilar to the mouthparts of *Processa canaliculata* Leach and *P. edulis* (Risso) as described by Lebour (1936).

In view of these close similarities, it is not surprising that the genera are very similar, differing only in characters of the first pereiopods. Gurney (1937) pointed out the similarities of the larvae of *Nikoides* and *Processa*, noting that there is more difference between the larvae of *Processa aequimana* and those of other species of *Processa* than there is between the larvae of *Nikoides* and *Processa*. He also pointed out the similarities between the rostrums of *Processa jacobsoni* De Man and *Nikoides maldivensis* Borradaile, in which the dorsal tooth is widely separated from the apex; De Man (1921) did not mention the exopods on the first pereiopods, but his species could prove to be conspecific with *N. maldivensis*. Chace (1955: 10), in his discussion of *Nikoides nanus*, a small species with short exopods on the first pereiopods, pointed out that the occurrence of short exopods in his species possibly strengthened Gurney's suggestion that *Nikoides* could be maintained as a distinct genus if only for convenience. It seems likely that the genera recognized here are closely related natural units.

It is also possible that additional study of Indo–West Pacific species will result in the recognition of additional genera. *Processa molaris* Chace has an unusually enlarged mandible, and *P. paucirostris* and *P. steinii*, two species described by Edmondson, each have an unusually short, unarmed rostrum, not extending much beyond the antennal spine.

Key to the Genera of the Processidae

1. First pereiopods both chelate [first pereiopods lacking exopods; second pereiopods symmetrical] . . . . ***Ambidexter***
 Only one of first pair of pereiopods (usually right) chelate, other pereiopod with simple dactyl 2

2(1). First pereiopods with exopods . . . . ***Nikoides***
 First pereiopods without exopods . . . . ***Processa***

Ambidexter, new genus

DEFINITION.—Processid shrimp with both first pereiopods chelate and lacking exopods.

TYPE-SPECIES.—*Ambidexter symmetricus*, new species (see below).

GENDER.—Masculine.

NUMBER OF SPECIES.—One, described below.

Ambidexter symmetricus, new species

FIGURES 1, 2

Processa sp. Tabb and Manning, 1961: 598 [listed; specimen from Flamingo].—Rouse, 1970: 140 [listed; part].

HOLOTYPE.—♂, 4.7 mm; Florida, Dade County, Miami, Biscayne Bay, Matheson Hammock Wading Beach; push net on grass flats, evening; C. F. E. Roper and R. B. Manning, col.; 7 July 1962; USNM 134097.

PARATYPES.—19♂, 17♀ (16 ovigerous); data as in holotype; USNM.—1♀; same locality; R. B. Manming, col.; 21 February 1960; USNM.—1 ovigerous ♀; same locality; sand, in sparse *Diplanthera*; R. B. Manning, col.; 10 May 1962; USNM.—4♂, 3♀ (1 ovigerous); same locality; L. P. Thomas, S. Dobkin, and R. B. Manning, col.; 28 June 1962; USNM.—6♂, 5♀ (3 ovigerous); same locality; D. R. Moore and R. B. Manning, col.; 13 July 1962;

USNM.—1 ovigerous ♀; Florida, Dade County, Biscayne Bay, Soldier Key; L. P. Thomas, col.; 3 July 1959; USNM.—1♂; Florida, Monroe County, Everglades National Park, Florida Bay, off Flamingo, Sandy Key Basin; D. Tabb and R. B. Manning, col.; 16 April 1959; USNM.—1♂, 1♀; Florida, Pinellas County, Boca Ciega Bay; BCG shovel; Carl H. Saloman, col.; 14 November 1963; USNM.—5♂, 10♀; Florida, Pinellas County, Point Pinellas, Tampa Bay; fine net, night; Carl H. Saloman, col.; 4 December 1965; USNM.—3 ovigerous ♀; Florida, Levy County, Seahorse Key, in channel near marker 14; H. B. Herrick, col.; 28 May 1964; USNM.—3♂, 4♀; Florida, Levy County, Cedar Keys; found among grass between tides; H. Hemphill, col.; 1883; USNM.—1♂; Florida, Franklin County, Bald Point; dug from sand-mud grass flat at low tide; M. Wass, col.; 31 January 1957; USNM.—1♀; Florida, Franklin County, Alligator Harbor, grass flats at mouth; L. Abele, col.; 29 January 1968; USNM.—1♀; Florida, Franklin County, Alligator Harbor; on bar, at mouth, in sand; may have come from *Diopatra* hole; L. Abele, col.; 18 November 1969; USNM.—5♂, 1♀; Louisiana, Chandeleur Island, Smack Channel; 29°51′N, 88°51′W; 17–18 feet; R. M. Darnell, col.; 28 March 1954; USNM.—2♂, 10♀ (8 ovigerous); Mexico, Tamaulipas, Punta Piedras (South), Laguna Madre del San Antonio; push net, night; 0–3 feet; H. Hildebrand, col.; 24 October 1953; USNM.—8♂, 11♀ (9 ovigerous); Puerto Rico, Lajas, La Parguera, east side of Maguey Island; evening, after dark, with push net on shallow *Thalassia* flats; R. B. Manning station PR 6–61; 24 June 1961; USNM.—1 ovigerous ♀; Trinidad; shore; *Albatross*, col.; 30 January–2 February 1884; USNM.

OTHER MATERIAL.—1 juvenile; Trinidad, Cocorite Swamp, northwest of Port of Spain; seaward mud flats; P. R. Bacon, col.; 31 August 1966; USNM.

DIAGNOSIS.—Antennal spine present. Stylocerite rounded laterally, unarmed. (Both first pereiopods chelate, lacking exopods.) Second pereiopods symmetrical, with 4 meral and 9–10 carpal articles. Carpus of fifth pereiopod longer than propodus. Fifth abdominal somite unarmed posterolaterally. Abdominal sternites unarmed.

DESCRIPTION.—Rostrum (Figure 1*b*) slightly deflexed, not extending beyond anterior margin of eye, upper margin slightly convex; apex (Figure 1*c*) bifid, lower tooth longer, short setae implanted in bifurcation; distal portion of lower margin of rostrum straight, lined with setae. Lower orbital angle obtusely rounded, inconspicuous. Antennal spine present. Lower anterior angle of carapace broadly rounded (Figure 1*a*).

Abdomen (Figure 1*d*) smooth, bare, ventral margins of pleura lined with fine setae. Fifth abdominal somite rounded or bluntly angled but unarmed posterolaterally. Sixth abdominal somite less than 1½ times as long as fifth, with acute posterolateral spine, lobe above articulation of uropod unarmed. Telson (Figure 1*e*) about 1¾ times as long as sixth abdominal somite, length 3½ times greatest width, with 2 pairs of dorsal and 2 pairs of distal spines; transverse line of setae present between anterior margin and anterior dorsal spines; anterior pair of dorsal spines of telson set in proximal fourth, posterior spines near midlength; distance between anterior margin of telson and anterior pair of dorsal spines about ⅓ distance between pairs of spines; outer of distal spines (Figure 1*f*) stronger, ventromesial flanked mesially by strong plumose seta; apex of telson rounded or produced into sharp median point.

Eyes (Figure 1*a*) moderately large, cornea width greater than length of stalk and cornea combined, about twice greatest width of antennal scale.

Antennular peduncle (Figure 1*g*) extending by distal 2 segments and ½ of proximal segment beyond rostrum, penultimate segment longer than distal, proximal segment subequal in length or longer than distal segments combined; proximal segment of antennular peduncle with ventral spine, set slightly beyond midlength. Stylocerite rounded laterally, unarmed. Dorsolateral flagellum of antennule nearly as long as carapace, thickened setigerous portion consisting of 11–19 articles and amounting to ½–⅔ of length in both sexes, slender distal portion consisting of 7–15 segments. Ventromesial flagellum twice as long as carapace.

Antennal scale (Figure 1*h*) extending to about midlength of distal segment of antennular peduncle, length of scale about 4⅓ times greatest breadth; distal spine of scale not overreaching blade. Antennal peduncle extending to about midlength of penultimate segment of antennular peduncle. Basal segment of antenna lacking ventrolateral spine. Antennal flagellum slightly longer than body.

Third maxilliped (Figure 1*o*) overreaching antennal scale by distal and ½ of penultimate segments; ultimate segment with short spines and numerous setae on surface, apex sharp; penultimate segment subequal to ultimate, less than half as long as proxi-

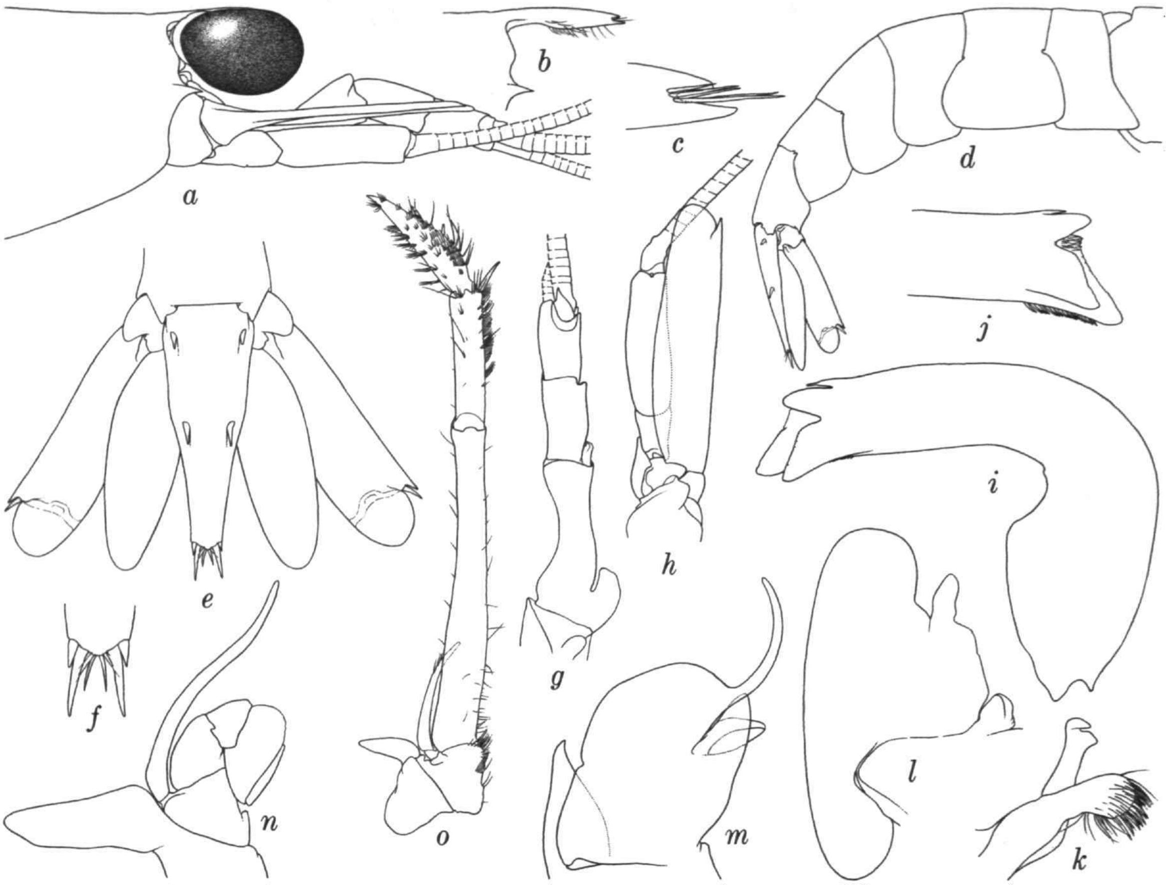

FIGURE 1.—*Ambidexter symmetricus*, new genus, new species, holotype, male, carapace length 4.7 mm: *a*, anterior region; *b*, rostrum; *c*, same, distal end; *d*, abdomen; *e*, telson and uropods; *f*, end of telson; *g*, right antennule; *h*, right antenna; *i*, right mandible; *j*, left mandible; *k*, right first maxilla; *l*, right second maxilla; *m*, right first maxilliped; *n*, right second maxilliped; *o*, right third maxilliped. Magnifications: *d*, ×6; *a*, *b*, *e*, *g*, *h*, *o*, ×12.5; *f*, *k–n*, ×25; *c*, *i*, *j*, ×63.

mal segment, with distal spines on mesial surface. Exopod well developed. Posterior margin of molar process of mandible (Figures 1*i*, *j*) with 16 spines; other mouthparts shown in Figures 1*k–n*.

Both pereiopods of first pair (Figures 2*a–b*) chelate, symmetrical, overreaching antennal scale by ½ the length of fingers; fingers slightly more than ½ the length of palm; carpus subequal to palm; merus slightly longer than carpus and chela combined. First pereiopods lacking arthrobranchs. Second pereiopods (Figures 2*c–d*) symmetrical, overreaching antennal scale by chela and 2 distal articles of carpus; ischium undivided, merus with 4 and carpus with 9–10 articles; fingers about ¾ the length of palm; carpus 4 times as long as chela; merus about 2½ times as long as chela; ischium slightly shorter than merus. Third pereiopod (Figure 2*e*) overreaching antennal scale by dactyl, propodus, and ⅛ of carpus; dactyl (Figure 2*f*) slender, simple, with subapical setae; propodus 3⅓ times as long as dactyl, unarmed, with short setae on surface, longer setae near midlength and subapically; carpus about twice the length of propodus, unarmed; merus 1¾ times as long as propodus, with 4–5 movable spines on lateral surface; ischium as long as propodus, with 2 movable spines on lateral surface; combined length of propodus and carpus of third pereiopod subequal to that of ischium and merus. Fourth pereiopod (Figure 2*g*) overreaching antennal scale by dactyl, propodus, and nearly ½ of carpus; dactyl (Figure 2*h*) slender, simple, with subapical tufts of setae; propodus slightly more than 3 times as long as dactyl, unarmed, ornamented with

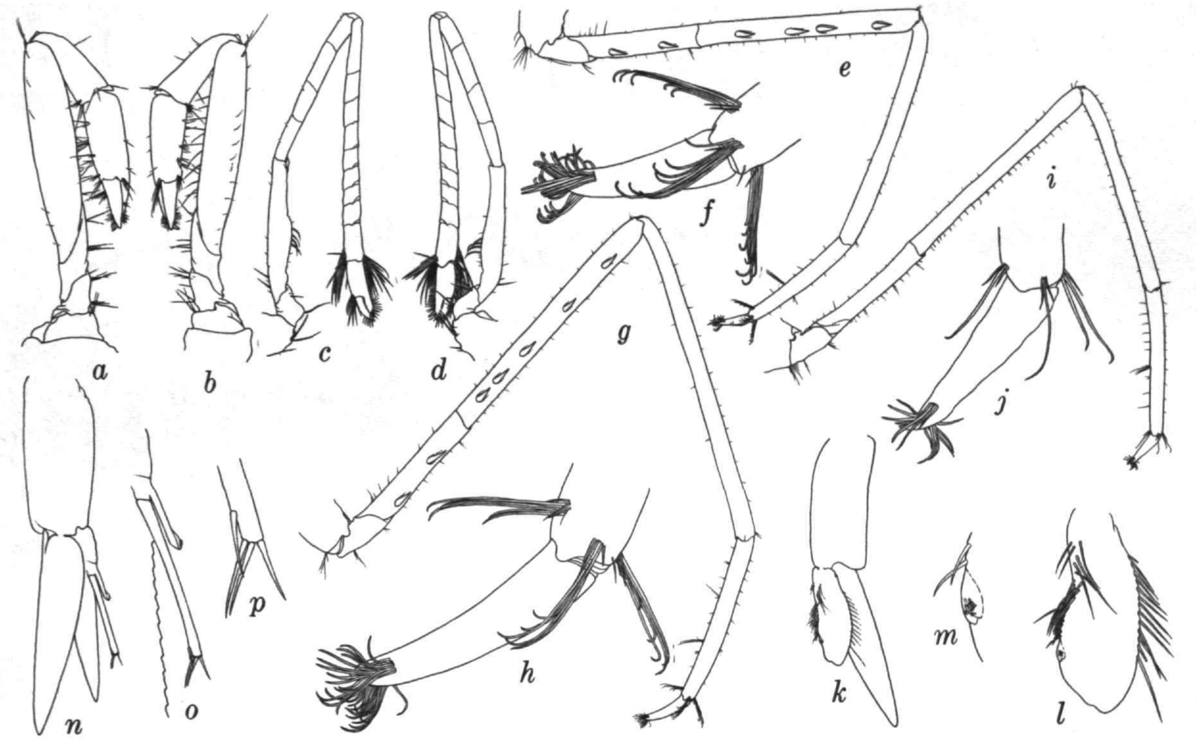

FIGURE 2.—*Ambidexter symmetricus*, new genus, new species, holotype, male, carapace length 4.7 mm: *a*, right first pereiopod; *b*, left first pereiopod; *c*, right second pereiopod; *d*, left second pereiopod; *e*, right third pereiopod; *f*, same, dactyl; *g*, right fourth pereiopod; *h*, same, dactyl; *i*, right fifth pereiopod; *j*, same, dactyl; *k*, right first pleopod; *l*, same, endopod; *m*, same, coupling-hook area at distomesial angle; *n*, right second pleopod; *o*, same, appendix masculina and appendix interna; *p*, end of appendix masculina. Magnifications: *a–e*, *g*, *i*, *k*, *n*, ×12.5; *l*, *o*, ×25; *f*, *h*, *j*, *m*, *p*, ×63.

short setae on surface and longer subapical tufts of of setae; propodus not markedly more setose in males than in females; carpus about 2 times the length of propodus, unarmed, ornamented with short setae on surface; merus about 1½ times as long as propodus, with 4–5 movable spines on lateral surface; ischium more than half as long as merus, with 2 movable spines on lateral surface; combined lengths of carpus and propodus of fourth pereiopod greater than that of ischium and merus. Fifth pereiopod (Figure 2*i*) overreaching antennal scale by dactyl and ½ of propodus; dactyl (Figure 2*j*) short, triangular, apex simple, obscured by setae; propodus 3⅔ times as long as dactyl, with 1 spine beyond midlength on flexor margin and scattered short setae on surface; propodus not markedly more setose in males than in females; carpus about 1½ times as long as propodus, unarmed; merus slightly more than 1½ times as long as carpus, unarmed; ischium about half as long merus, unarmed; combined lengths of carpus and propodus of fifth pereiopod subequal to that of ischium and merus.

Endopod (Figures 2*k–m*) of first pleopod of male about ½ as long as exopod, apex obliquely truncated, nonsetose; appendix interna completely fused with endopod, retinacular lobe present. Appendix masculina (Figures 2*n–p*) of second pleopod of male with 4 apical spinules, unarmed except near apex. Abdominal sternites unarmed. Outer margin of uropodal exopod (Figure 1*e*) terminating in blunt, triangular projection, with stronger mesial movable spine; exopod with suture at level of outer tooth, dorsal surface marked with blunt, triangular tooth or lobe on each side anterior to suture. Eggs small and numerous, 0.3–0.4 mm in diameter.

SIZE.—Carapace lengths of males, 2.1–4.5 mm; of females, 2.4–6.7 mm; of ovigerous females, 3.8–6.7 mm.

COLOR.—Body covered with scattered red chromatophores on light-cream, white, or colorless background. Chromatophores arranged in band across anterior portion of abdomen; color also concentrated on pleura and on appendages. Dactyls of first pereiopods and distal 2 segments of third maxillipeds darker than body. Smaller specimens with fewer chromatophores on body. Eggs orange.

DISCUSSION.—Among the western Atlantic processids, *A. symmetricus* shows some slight resemblance to *Processa hemphilli*, new species; a specimen of *Ambidexter* lacking the first pereiopods could be confused with *P. hemphilli*, for in both species the second pereiopods are symmetrical and have the same number of articles in the merus (four) and carpus (ten). In *P. hemphilli*, however, the stylocerite is armed laterally and the proportions of the segments of the pereiopods are different in the two species. In *A. symmetricus* the propodus of the third pereiopod is half as long as the carpus, and the propodus of the fifth pereiopod is two thirds the length of the carpus; in *P. hemphilli* the propodus of the third pereiopod is three fifths the length of the carpus, and the propodus of the fifth pereiopod is four fifths the length of the carpus. Both species are recorded herein from the west coast of Florida, where they may occur together.

Specimens of *A. symmetricus* are uniform and exhibit little variation. The relative size and number of articles in the thickened portion of the antennular flagellum appears to be the same in both males and females. The number of articles in the carpus and merus of the second pereiopods was not observed to vary widely; all specimens have four meral and nine or ten carpal articles. The merocarpal articulation of the second pereiopods does not extend beyond the eye, and falls well short of the eye in smaller specimens. The apex of the telson is rounded, as figured, or ends in an acute point.

The specimens collected by one of us (RBM) in Florida and Puerto Rico were obtained by using a push net in shallow water, one meter or less, on grass flats, after dark. Specimens were found on both *Diplanthera* and *Thalassia* flats with sand or mud substratum.

We have reexamined the material reported by Tabb and Manning (1961). Rouse (1970) noted that two species were taken in collections from Florida Bay studied by him; one of those had symmetrical first pereiopods.

NAME.—The generic name is from the Latin, *ambo*, both, and *dexter*, right, referring to the symmetrical chelae of the first pereiopods. The specific name is from the Greek, *symmetros*, referring to the symmetrical second pereiopods.

TYPE-LOCALITY.—Biscayne Bay, Miami, Dade County, Florida.

RANGE.—Western Atlantic region, from scattered localities in the northern and western Gulf of Mexico, southern Florida to Tamaulipas, Puerto Rico, and Trinidad; sublittoral to 6 m. It has been recorded from Everglades National Park, Florida, by Tabb and Manning (1961) and Rouse (1970).

Nikoides Paulson, 1875

Nikoides Paulson, 1875: 98.—De Man, 1920: 192 [list of species then known].—Gurney, 1937: 88 [review of species].—Holthuis, 1955: 117 [synonymy].

DEFINITION.—Processid shrimp with only 1 of first pereiopods chelate, the other (usually left) with simple dactyl; both first pereiopods with exopods.

TYPE-SPECIES.—*Nikoides danae* Paulson, 1875, by monotypy.

GENDER.—Masculine.

NUMBER OF SPECIES.—5, of which 1 is described below. The 5 known species may be distinguished by means of the following key:

Key to the Species of *Nikoides*

1. Rostrum simple, without dorsal subapical tooth [right second pereiopod with 15 meral and 43 carpal articles, left second pereiopod with 6 meral and 19 carpal articles; stylocerite unarmed laterally] . . . .
Nikoides nanus Chace, 1955; Eniwetok Atoll and Bikini Atoll, Marshall Islands, Pacific Ocean

Rostrum with dorsal subapical tooth 2

2(1). Dorsal rostral tooth widely separated from apical tooth, interval between teeth more than 3 times length of dorsal tooth [right second pereiopod unknown; left second pereiopod with 7 meral and 24 carpal articles; stylocerite not described] ....
Nikoides maldivensis Borradaile, 1915; Maldive Islands and Amirante Islands, Indian Ocean

Dorsal rostral tooth not widely separated from apical tooth, interval between teeth subequal to length of dorsal tooth 3

3(2). Posterolateral angle of fifth abdominal somite unarmed [right second pereiopod with 23–24 meral and 43–49 carpal articles, left second pereiopod with 5 meral and 17–18 carpal articles; stylocerite with lateral spine in adults] ..... ***Nikoides schmitti***, new species

Posterolateral angle of fifth abdominal somite with spine 4

4(3). Third maxilliped exceeding antennal scale by most or all of 2 distal segments; nonchelate first pereiopod exceeding antennal scale by dactyl and most of propodus; fourth pereiopod extending beyond antennal scale by dactyl, propodus, and nearly all of carpus [right second pereiopod with 23 meral and 50 carpal articles, left second pereiopod with 7 meral and 22 carpal articles; stylocerite unarmed (?)] ....
Nikoides sibogae De Man, 1918; Bikini Atoll, Marshall Islands, Pacific Ocean; Timor, Kei Islands, Aru Islands, Indonesia

Third maxilliped exceeding antennal scale by slightly more than terminal segment; nonchelate first pereiopod exceeding antennal scale by dactyl only; fourth pereiopod extending beyond antennal scale by dactyl and slightly more than half of propodus [right second pereiopod with 28 meral and 60 carpal articles, left second pereiopod with 7–8 meral and 28 carpal articles; stylocerite with lateral spine] ....
Nikoides danae Paulson, 1875; Red Sea

Nikoides schmitti, new species

FIGURES 3–5

Processa sp. Bullis and Thompson, 1965: 8 [listed; specimen from *Oregon* 2249].

HOLOTYPE.—♂, 4.4 mm; Florida, Monroe County, Tortugas, near black buoy, 1.25 km south of Garden Key; boat dredge, northeast haul, 26 m; W. L. Schmitt station 42–32; 8 July 1932; USNM 134109.

PARATYPES.—1 ♂; data as for holotype; USNM.—1 ovigerous ♀; Florida, Dade County, Biscayne Bay; Bill Retskin, col.; 7 July 1960; USNM.—1 ovigerous ♀; same, 1.25 km east of Matheson Hammock; shrimp trawl; D. Tabb, col.; 21–22 April 1961; USNM.—1 ♀; same, between markers 22 and 23, near west end of Biscayne Channel, approximately 1.1 km west-southwest of Cape Florida; 5 m; K. McNulty and R. Work, col.; Institute of Marine Sciences Bottom Community Survey station 22; 11 July 1957; USNM.

OTHER MATERIAL.—1 ♂, 1 ovigerous ♀; between British and Dutch Guiana; 33°11.5′N, 79°07′W; 7–9 m; *Oregon* station 2249; 27 July 1960; USNM.

DIAGNOSIS.—Antennal spine present. Stylocerite with lateral spine in adults. (Right pereiopod of first pair chelate, left with simple dactyl; first pereiopods with exopods.) Second pereiopods asymmetrical, right longer. Right second pereiopod with 23–24 meral and 43–49 carpal articles, left second pereiopod with 5 meral and 17–18 carpal articles. Carpus of fifth pereiopod longer than propodus. Fifth abdominal somite unarmed posterolaterally. Abdominal sternites unarmed.

DESCRIPTION.—Rostrum (Figure 3*b*) slightly deflexed, slender, extending to cornea or slightly beyond anterior margin of eye. Apex (Figure 3*c*) bifid, lower tooth longer, apex obscured by numerous long setae. Lower margin of rostrum sinuous, convex proximally, slightly concave distally. Lower orbital angle inconspicuous, broadly rounded. Antennal spine well developed. Lower anterior angle of carapace broadly rounded (Figure 3*a*).

Abdomen (Figure 3*d*) smooth, surface sparsely setose, ventral margins of pleura lined with fine setae. Fifth abdominal somite rounded posterolaterally. Sixth abdominal somite less than twice as long as fifth, angled or bluntly spined posterolaterally; lobe above articulation of uropod usually unarmed. Telson (Figure 3*e*) about or slightly more than 1½ times as long as sixth abdominal somite, length more than 3 times greatest width, with 2 pairs of dorsal and 2 pairs of distal spines; anterior pair of dorsal spines of telson set in proximal fourth, distal pair at midlength; distance from anterior margin to anterior pair of spines less than half the distance between pairs of

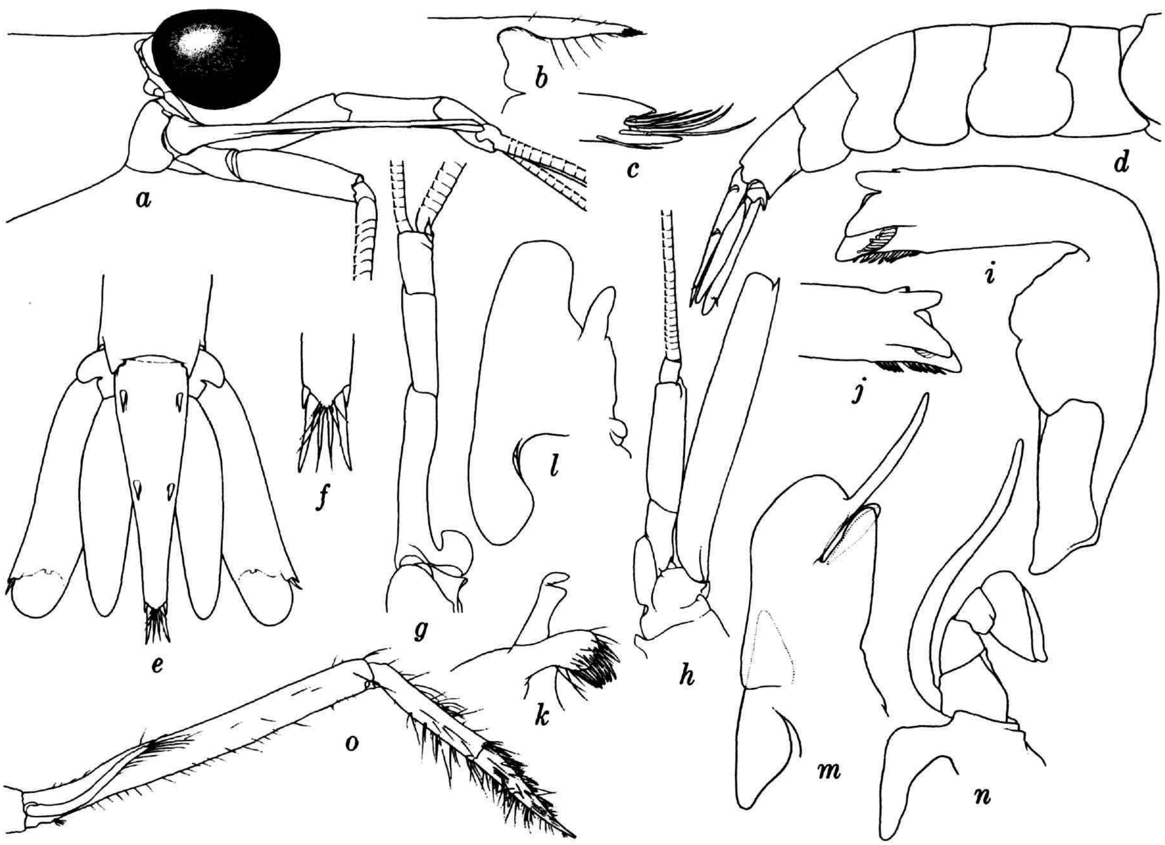

FIGURE 3.—*Nikoides schmitti*, new species, holotype, male, carapace length 4.4 mm: *a*, anterior region; *b*, rostrum; *c*, same, distal end; *d*, abdomen; *e*, telson and uropods; *f*, end of telson; *g*, right antennule; *h*, right antenna; *i*, right mandible; *j*, left mandible; *k*, right first maxilla; *l*, right second maxilla; *m*, right first maxilliped; *n*, right second maxilliped; *o*, right third maxilliped. Magnifications: *d*, ×6; *a*, *b*, *e*, *g*, *h*, *o*, ×12.5; *f*, *k–n*, ×25; *c*, *i*, *j*, ×63.

spines; outer of distal spines (Figure 3*f*) stronger, ventromesial flanked mesially by strong plumose seta; apex of telson rounded.

Eyes (Figure 3*a*) moderately large, cornea width less than length of stalk and cornea combined, twice or more greatest width of antennal scale.

Antennular peduncle (Figure 3*g*) extending beyond rostrum by distal segments and distalmost third of proximal segment, proximal segment longer than distal segments combined, penultimate segment 1½ times as long as ultimate. Proximal segment of antennular peduncle with ventral spine, set slightly beyond midlength. Stylocerite broadly rounded, with small lateral tooth in largest specimens (Figure 5*c*). Dorsolateral flagellum of antennule at least as long as carapace, thickened setigerous portion consisting of 20–21 articles and amounting to ⅔ of length in males, of 21–25 articles and amounting to ¾ of length in females, slender distal portion with 9–14 segments in both sexes. Ventromesial flagellum of antennule at least three times as long as carapace.

Antennal scale (Figure 3*h*) extending to end of or beyond antennular peduncle by less than length of distalmost segment, length of scale about 4 times greatest breadth; distal spine of scale overreaching anterior margin of blade in males, falling short of anterior margin in females. Antennal peduncle extending slightly beyond proximal segment of anten-

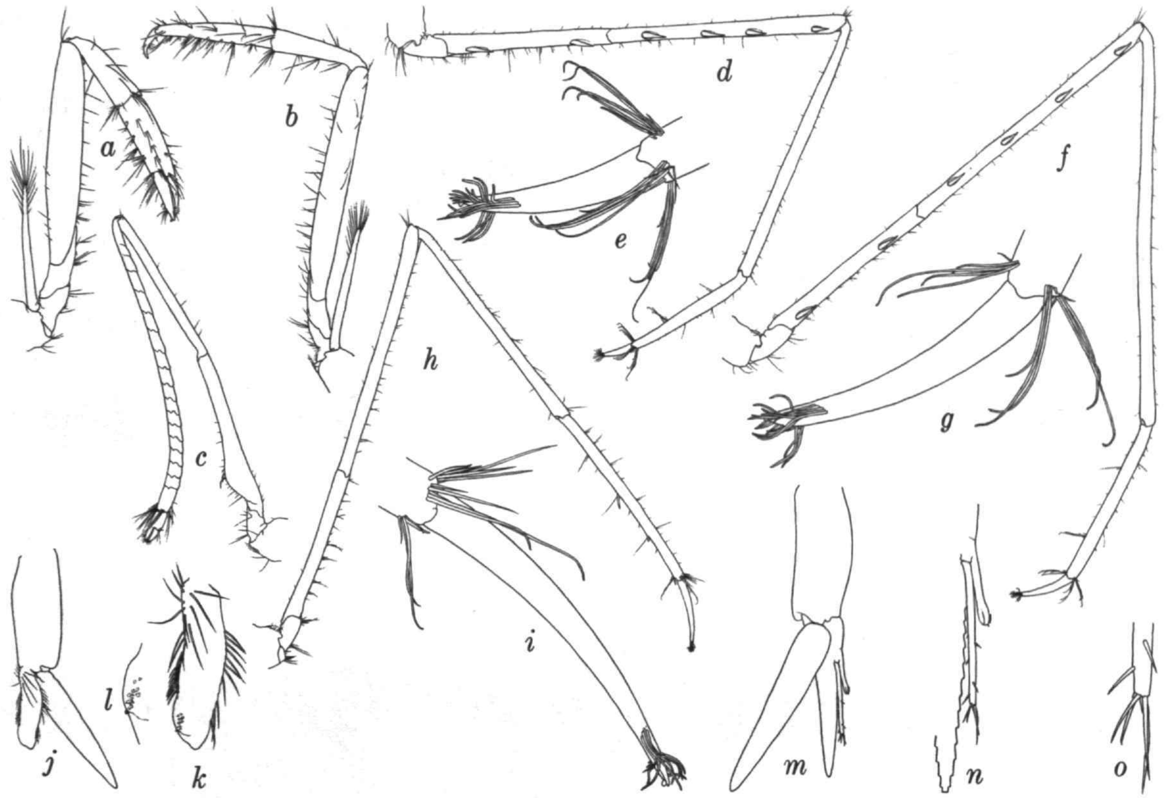

FIGURE 4.—*Nikoides schmitti*, new species, holotype, male, carapace length 4.4 mm: *a*, right first pereiopod; *b*, left first pereiopod; *c*, left second pereiopod; *d*, right third pereiopod; *e*, same, dactyl; *f*, right fourth pereiopod; *g*, same, dactyl; *h*, right fifth pereiopod; *i*, same, dactyl; *j*, right first pleopod; *k*, same, endopod; *l*, same, coupling-hook area at distomesial angle; *m*, right second pleopod; *n*, same, appendix masculina and appendix interna; *o*, end of appendix masculina. Magnifications: *a–d*, *f*, *h*, *j*, *m*, × 12.5; *k*, *n*, ×25; *e*, *g*, *i*, *l*, *o*, ×63.

nular peduncle. Basal segment of antenna lacking ventrolateral spine. Antennal flagellum more than 6½ times carapace length.

Third maxilliped (Figure 3*o*) overreaching antennal scale by slightly more than length of distal segment in males, by most of penultimate segment in females; ultimate segment with dorsal spines, apex sharp, about as long as penultimate segment but slightly less than ⅓ as long as proximal segment. Exopod well developed. Posterior margin of mandible (Figures 3*i*, *j*) with 13 small spines. Remainder of mouthparts shown in Figures 3*k–n*.

Right pereiopod of first pair (Figure 4*a*) chelate, falling short of tip of antennal scale, slightly overreaching penultimate segment of antennular peduncle; fingers about ½ length of the palm in males, about ¾ the length of palm in females; carpus subequal to or slightly shorter than palm; merus longer than carpus and chela combined. Left pereiopod of first pair (Figure 3*b*) with dactyl simple, extending about to end of antennal scale; dactyl less than ⅓ the length of propodus; carpus shorter than propodus; merus about as long as carpus, propodus, and dactyl combined. Exopods of first pereiopods not extending beyond midlength of merus. First pereiopods with arthrobranch. Second pereiopods (Figure 5) strongly asymmetrical. Right larger, overreaching antennal scale by chela, carpus, and ½ of merus; ischium divided into 3, merus into 23–24, and carpus into 43–49 articles; fingers subequal to palm in males, slightly shorter than palm in females; carpus about 13 times as long as chela in males, about 10 times as long as chela in females; merus more than 7 times as long as chela in males, 5–7 times as long as chela in females; ischium shorter than merus. Left pereiopod of second pair (Figures 4*c*, 5*b*) overreaching antennal scale by chela and about ⅓ of carpus; ischium not noticeably segmented, merus with 5 and carpus with 17–18 articles; fingers subequal to palm; carpus more than 8 times as long as chela; merus about 5 times as long as chela; ischium subequal to merus. Third pereiopod (Figure 4*d*) overreaching antennal scale by dactyl, propodus, and ⅓ of carpus; dactyl (Figure 4*e*) slender, simple, with numerous apical setae; propodus more than 3 times as long as dactyl, unarmed, ornamented with few scattered setae; carpus about 2 times as long as propodus in males, about 2–3 times as long in females, unarmed; merus less than twice as long as propodus, with 4 movable spines on lateral surface; ischium shorter than merus, with 2 movable spines on lateral surface; combined length of propodus and carpus of third pereiopod about as long as that of ischium and merus in males, combined length of propodus and carpus slightly longer in large females. Fourth pereiopod (Figure 4*f*) overreaching antennal scale by dactyl, propodus, and ⅔ of carpus; dactyl (Figure 4*g*) slender, simple, with numerous apical setae; propodus less than 3 times as long as dactyl, unarmed, with few scattered setae on surface and several long, distal tufts of setae; outer margin of propodus not lined with short setae in males; carpus slightly more than twice as long as propodus, unarmed, with few scattered setae; merus slightly less than twice the length of propodus, with 2–8 movable spines on lateral surface; ischium shorter than merus, with 1–2 movable spines on lateral surface; combined length of propodus and carpus of fourth pereiopod greater than that of ischium and merus. Fifth pereiopod (Figure 4*h*) overreaching antennal scale by dactyl and 9/10 of propodus in males, by dactyl and all of propodus in large females; dactyl (Figure 4*i*) slender, with rounded ventral tubercle distally and numerous long apical setae; propodus less than 3 times as long as dactyl, with scattered tufts of setae and 2 slender spines on flexor margin; upper margin of propodus not lined with short setae in males; carpus less than 1½ times as long as propodus in males, 1¼ times as long in females, unarmed, with few scattered setae; merus about 1½ times as long as propodus in males, 1¼ times in females, unarmed; combined length of propodus and carpus of fifth pereiopod subequal to that of ischium and merus.

Endopod of first male pleopod (Figures 4*j–k*) about ½ as long as exopod, apex obliquely truncate, with coupling hooks mesially; margins sparsely setose. Appendix masculina on endopod of second male pleopod (Figures 4*m–o*) with short lateral spinules and several longer distal spinules. Abdominal sternites unarmed. Basal segment of uropod (Figure 3*e*) terminating in rounded outer lobe; outer margin of exopods with 2 teeth at diaresis, inner slender, movable, outer blunter, fixed; diaresis with 2 blunt triangular lobes projecting posteriorly. Eggs small and numerous, 0.4–0.5 mm in diameter.

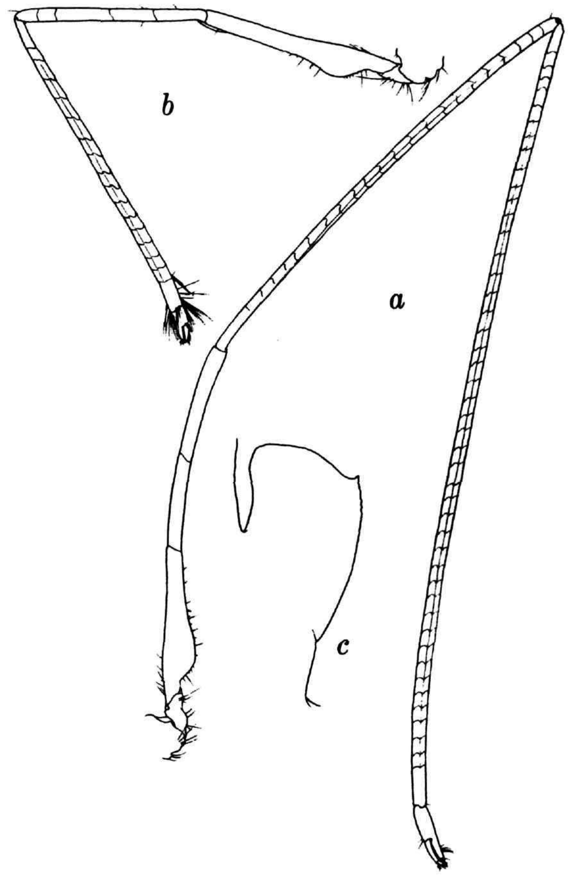

FIGURE 5.—*Nikoides schmitti*, new species. Paratype, male, from same lot as holotype, carapace length 5.0 mm: *a*, right second pereiopod; *b*, left second pereiopod. Paratype, ovigerous female, from Biscayne Bay, 7 July 1960, carapace length 8.8 mm: *c*, stylocerite of right antennule. Magnifications: *a*, *b*, ×12.5; *c*, ×25.

SIZE.—Carapace lengths of males, 4.4–5.3 mm; of females, 4.2–8.6 mm; of ovigerous females, 7.0–8.8 mm.

COLOR.—Not recorded.

DISCUSSION.—Four species of *Nikoides* have been described from localities in the Indo–West Pacific region; until now, the genus was believed to be restricted to that region. The four previously known species are *Nikoides danae* Paulson, 1875, from the Red Sea; *Nikoides maldivensis* Borradaile, 1915, from the Maldive Islands and Amirante Islands, Indian Ocean; *Nikoides sibogae* De Man, 1918, from Indonesia and Bikini Atoll, Pacific Ocean; and *Nikoides nanus* Chace, 1955, from the Marshall Islands. Gurney (1937) suggested that *N. sibogae* and *N. danae* should be synonymized, but Chace (1955) recognized both species. *Nikoides schmitti* differs from *N. danae*, *N. sibogae*, and *N. nanus* in lacking a posterolateral spine on the pleuron of the fifth abdominal somite; it further differs from *N. nanus* in having a bifid rostrum. The new species differs from *N. maldivensis* in having the rostral tooth situated subapically, not at the middle of the rostrum as in Borradaile's species.

The two specimens from the Guianas lack most pereiopods but appear to be conspecific with those from Florida; they were reported by Bullis and Thompson (1965) as *Processa* sp.

NAME.—We take great pleasure in dedicating this species to Waldo L. Schmitt, the dean of American carcinologists, who collected the holotype, and whose collections from the Americas have laid the foundation for much of our present knowledge of American decapods.

TYPE-LOCALITY.—1.25 km south of Garden Key, Tortugas, Monroe County, Florida.

DISTRIBUTION.—Western Atlantic, where it is known only from two localities off Florida, Biscayne Bay and Dry Tortugas, and from off the Guianas; shallow water to 26 m.

Processa Leach, 1815

Processa Leach, 1815, explanation of plate 41.—De Man, 1920: 197 [species listed].—Holthuis, 1955: 116 [synonymy].—Nouvel and Holthuis, 1957: 7 [synonymy, account of eastern Atlantic species].

DEFINITION.—Processid shrimps with only 1 of first pereiopods chelate, the other (usually left) with simple dactyl, and with first pereiopods lacking exopods.

TYPE-SPECIES.—*Processa canaliculata* Leach, 1815, by monotypy.

GENDER.—Feminine.

NUMBER OF SPECIES.—35, of which 14 occur in the Indo–West Pacific area (Table 1) and 21 occur in the Atlantic.

DISCUSSION.—Four groups can be distinguished among the nine species recorded below. In the two new species, *P. fimbriata* and *P. riveroi*, the stylocerite is armed, the pleuron of the fifth abdominal somite is armed posterolaterally, and the sternal spines are present on the abdomen. So far as we can determine, the only other species in which sternal spines have been recorded is *P. elegantula* Nouvel and Holthuis, which lacks the spine on the fifth pleuron, but has a well-developed spine on the stylocerite. *Processa elegantula* apparently is distantly related to *P. fimbriata* and *P. riveroi*; the sternal spines probably have arisen independently in the latter two species. The second group of species comprises *P. bermudensis* (Rankin) and *P. vicina*, new species, which differ from all other Atlantic processids in lacking antennal spines on the carapace; *P. vicina* differs from *P. bermudensis* in having symmetrical second pereiopods. *P. hemphilli*, new species, which also has symmetrical second pereiopods but has well-developed antennal spines, has two counterparts—*P. parva* Holthuis in the eastern Atlantic and *P. aequimana* (Paulson) in the Red Sea. The three species are so similar that they may prove to represent subspecies or populations of the same species. The remaining four species have asymmetrical second pereiopods, an unarmed pleuron on the fifth abdominal somite, and well-developed antennal spines. Two of the species, *P. guyanae* Holthuis and *P. tenuipes*, new species, are similar to *P. canaliculata* Leach and appear to be its counterparts in the western Atlantic.

The specimens of each species examined by us have proved to be very uniform, varying little if at all in major features; there were some observed differences between males and females and other differences between young specimens and adults. We observed no variation comparable to that reported by Allen (1961) for *P. canaliculata* from England. He observed variation in the spination of the stylocerite, the pleuron of the fifth abdominal somite, and the lobe on the sixth somite above the articulation of the uropod, as well as in the occurrence of arthrobranchs on the first pereiopods, the shape of the male pleopods, and the

TABLE 1.—*Nominal Species of* Processa *Described from the Indo-West Pacific Region*

Species	*Region*
P. aequimana (Paulson, 1875) (Gurney, 1937)	Red Sea
P. australiensis (Baker, 1907) (De Man, 1920)	Australia, Philippine Islands, Indonesia, and South Arabian coast
P. austroafricana Barnard, 1947 (Barnard, 1950, 1955)	South Africa
P. coutiere Nobili, 1904 (Nouvel, 1945)	Gulf of Aden
P. gracilis Baker, 1907	South Australia
P. hawaiiensis (Dana, 1852)	Hawaiian Islands
P. jacobsoni De Man, 1921 (De Man, 1924)	Savaii, Samoa, and Sumatra
P. japonica (De Haan, 1849) (Gurney, 1937)	Japan, Indonesia, Hawaiian Islands
P. kotiensis (Yokoya, 1933)	Japan
P. macrognatha (Stimpson, 1860)	Hong Kong
P. molaris Chace, 1955	Rongelap Atoll and Bikini Atoll, Marshall Islands
P. paucirostris Edmondson, 1930	Hawaiian Islands
P. processa (Bate, 1888)	Japan, Hawaiian Islands, Amboina, Singapore, and Gulf of Martaban
P. steinii Edmondson, 1935	Hawaiian Islands

terminal spination of the telson. These features appear to be more stable in the western Atlantic species of *Processa*.

There is a species of *Processa* from the Caribbean which we have not described herein. It differs from all the western Atlantic species in having the rostrum extending beyond the eyes, almost to the end of the first segment of the antennular peduncle. Both specimens in our collections lack all of the pereiopods. One of the specimens from Old Providence Island, West Indies, was recorded by Rathbun (1901) as *P. canaliculata*.

The Indo-West Pacific species of *Processa* described to date are listed in Table 1. All of the species listed in that table appear to be distinct from their Atlantic counterparts, with the possible exception of *P. aequimana* (Paulson), which we have not seen and which is similar to *P. parva* and *P. hemphilli* from the eastern and western Atlantic.

A provisional key to the Atlantic species of *Processa* follows. We have included *P. pontica* (Sowinsky) in the key on the basis of its redescription by Bacescu (1967)—Nouvel and Holthuis (1957) had synonymized the species with *P. edulis* (Risso).

Provisional Key to Atlantic Species of *Processa*

1. Pleuron of fifth abdominal somite with posterolateral spine 2
   Pleuron of fifth abdominal somite rounded or angled posterolaterally, lacking distinct posterolateral spine 10

2(1). Stylocerite unarmed 3
   Stylocerite with spine or spines on anterior margin 5

3(2). Apex of rostrum simple, not bifid [right second pereiopod with 18–31 meral and 47–65 carpal articles, left second pereiopod with 6–7 (13) meral and 23–28 carpal articles] . . . .
   Processa acutirostris Nouvel and Holthuis, 1957; eastern Atlantic, from France, Spain, and the Mediterranean Sea
   Apex of rostrum bifid 4

4(3). Merocarpal articulation of right second pereiopod not extending beyond antennal scale; second pereiopods almost symmetrical [right second pereiopod with 6–9 (11) meral and 18–24 carpal articles, left second pereiopod with 5 meral and 14–15 (17) carpal articles] . .
   Processa robusta Nouvel and Holthuis, 1957; eastern Atlantic and Mediterranean Sea
   Merocarpal articulation of right second pereiopod extending beyond antennal scale; second pereiopods very asymmetrical, right stronger [right second pereiopod with 12–18 (21) meral and 31–45 (49) carpal articles, left second pereiopod with 5–7 meral and 17–24 carpal articles] . . . .
   Processa edulis (Risso, 1816); eastern Atlantic, from the Netherlands to the western Mediterranean Sea; Nouvel and Holthuis (1957) recognize 3 subspecies

5(2). Merus of left second pereiopod undivided [right second pereiopod with 12–18 meral and 36–43 carpal articles, left second pereiopod with 1 meral and 16–19 carpal articles] ...... ***Processa macrodactyla*** Holthuis, 1952; Rio de Oro, West Africa

Merus of left second pereiopod subdivided into at least 5 articles 6

6(5). Lobe on sixth abdominal somite above articulation of uropod unarmed [right second pereiopod with 14–20 (22) meral and 38–49 carpal articles, left second pereiopod with 5–6 (8) meral and 17–18 (20) carpal articles] .... ***Processa macrophthalma*** Nouvel and Holthuis, 1957; western Mediterranean and Gulf of Guinea

Lobe on sixth abdominal somite above articulation of uropod produced into posterior spine 7

7(6). Stylocerite with row of spinules across anterior margin; pleuron of fifth abdominal somite with spinule above posterolateral spine [right second pereiopod with 15–18 meral and 28–40 carpal articles, left second pereiopod with 5 meral and 20–24 carpal articles] ..... ***Processa pontica*** (Sowinsky, 1882) (Bacescu, 1967); Black Sea

Stylocerite with spinule at inner or outer angle but not across anterior margin; pleuron of fifth abdominal somite lacking supplementary spinule above posterolateral spine 8

8(7). Basal segment of antenna unarmed; first pereiopods with arthrobranch; sternal spines absent [right second pereiopod with 10–20 meral and 28–65 carpal articles, left second pereiopod with 5–7 meral and 14–20 carpal articles] .... ***Processa intermedia*** Holthuis, 1951; West Africa, from the Cape Verde Islands, Liberia, Gold Coast, and Rio de Oro

Basal segment of antenna with spine; no arthrobranch on first pereiopods; spines present on sternum of anterior 5 abdominal somites 9

9(8). Cornea width 2 times greatest width of antennal scale; stylocerite armed at outer angle only; third pereiopod overreaching antennal scale by propodus and dactyl only [right second pereiopod with 13–16 meral and 31–40 carpal articles, left second pereiopod with 4–6 meral and 15–18 carpal articles] .... ***Processa fimbriata***, new species

Cornea width less than 1½ times greatest width of antennal scale; stylocerite with spine at inner and outer angles; third pereiopod overreaching antennal scale by most of carpus [right second pereiopod with 17 meral and 39–43 carpal articles, left second pereiopod with 5–6 meral and 16–20 carpal articles] .... ***Processa riveroi***, new species

10(1). Antennal spine absent 11

Antennal spine present 12

11(10). Second pereiopods asymmetrical; rostrum not markedly deflexed anteriorly [right second pereiopod with 10–15 meral and 19–29 carpal articles, left second pereiopod with 3–4 meral and 13–15 carpal articles] .... ***Processa bermudensis*** (Rankin, 1900)

Second pereiopods symmetrical; rostrum deflexed anteriorly [second pereiopods with 5 meral and 10–14 carpal articles .... ***Processa vicina***, new species

12(11). Second pereiopods symmetrical 13

Second pereiopods asymmetrical 14

13(12). Rostrum anteriorly deflexed; apex of telson acute but not produced into sharp point [second pereiopods with 4–6 (usually 6) meral and 10–15 (usually 11) carpal articles] .... ***Processa parva*** Holthuis, 1951; eastern Atlantic, from the North Sea to the western Mediterranean; West Africa

Rostrum not markedly deflexed; apex of telson produced into sharp point [second pereiopods with 4 meral and 10 carpal articles] .... ***Processa hemphilli***, new species

14(12). Second pereiopods slightly asymmetrical, merocarpal articulation of right pereiopod not extending beyond antennal scale 15

Second pereiopods very asymmetrical, merocarpal articulation of right pereiopod overreaching antennal scale 16

15(14). Rostrum extending beyond eyes; endopod of first male pleopod with angular apex [first, second, and third abdominal somites with sternal spines in males and young females; right second pereiopods with 6–8 (11) meral and 17–21 (30) carpal articles, left second pereiopod with 5–6 meral and 14–17 carpal articles] .... ***Processa elegantula*** Nouvel and Holthuis, 1957; eastern Atlantic, from France and the western Mediterranean

Rostrum not extending beyond eyes; endopod of first male pleopod broadly rounded apically [abdominal sternites not described; right second pereiopod with 7 meral and 23 carpal articles, left second pereiopod with 5 meral and 15 carpal articles] .... ***Processa wheeleri*** Lebour, 1941

16(14). Lobe on sixth abdominal somite above articulation of uropod produced into posterior spine 17
Lobe on sixth abdominal somite above articulation of uropod unarmed[1] 18

17(16). Stylocerite with strong lateral spine, anterior margin evenly convex from inner angle to lateral spine; antennal scale scarcely overreaching antennular peduncle [right second pereiopod with 21–22 meral and 45–46 carpal articles, left second pereiopod with 5 meral and 18–21 carpal articles] . . . . ***Processa profunda***, new species
Stylocerite with lateral spine, anterior margin straight or slightly sinuous, not curving outward from inner angle to lateral spine; antennal scale overreaching antennular peduncle by length of distal article [right second pereiopod with 16–24 (27) meral and 40–62 carpal articles, left second pereiopod with 4–8 (11) meral and 18–22 (28) carpal articles] . . . . . ***Processa mediterranea*** (Parisi, 1915); eastern Atlantic from France to western Mediterranean

18(16). Basal segment of antenna lacking lateral spine; anterior margin of stylocerite strongly sloping laterally; first pereiopod with arthrobranch [right second pereiopod with 9 meral and (20) 33–36 carpal articles, left second pereiopod with 4 meral and 17 carpal articles] . . . . ***Processa borboronica*** Holthuis, 1952; Gulf of Guinea
Basal segment of antenna with lateral spine; anterior margin of stylocerite straight or sinuous, not markedly sloping laterally; first pereiopod without arthrobranch 19

19(18). Stylocerite with strong lateral spine; carpus of right second pereiopod with fewer than 40 articles [right second pereiopod with 14–18 meral and 30–35 carpal articles, left second pereiopod with 5 meral and 15–19 carpal articles] . . . . ***Processa canaliculata*** Leach, 1815; eastern Atlantic, from the North Sea to the eastern Mediterranean
Stylocerite with lateral tubercle; carpus of right second pereiopod with more than 40 articles 20

20(19). Fifth pereiopod with propodus 4 times as long as dactyl and merus longer than carpus; rostrum straight dorsally [right second pereiopod with 18–20 meral and 44–47 carpal articles, left second pereiopod with 3–5+ meral and 17–18 carpal articles] . . . . ***Processa guyanae*** Holthuis, 1959
Fifth pereiopod with propodus 6–7 times as long as dactyl and merus shorter than carpus; rostrum convex dorsally [right second pereiopod with 18–28 meral and 48–69 carpal articles, left second pereiopod with 5–9 meral and 17–26 carpal articles] . . . . ***Processa tenuipes***, new species

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[1] Allen (1961) points out that this lobe may be armed in specimens of *P. canaliculata* from Northumberland, England.

Processa bermudensis (Rankin, 1900)

FIGURES 6, 7

Nika bermudensis Rankin, 1900: 536, pl. 17: figs. 2, 2*a*, 2*b*.
Processa canaliculata.—Rathbun, 1901: 104 [part, records for Bermuda and Key West only; listed].—Schmitt, 1935: 169, fig. 32 [part; Bermuda record only].—Chace, 1937: 56 [listed; ? part].—Monod, 1939: 557.
Processa canaliculata var. *bermudensis*.—Verrill, 1922: 138, pl. 16: figs. 6–6*b*, pl. 35: figs. 1–1*g*, pl. 41: fig. 4, pl. 47: figs. 8, 8*a*, 8*b* [? part; some figures possibly of *P. processa*, from Bate, 1888].
Processa bermudensis.—Gurney, 1936: 624, pl. 5: figs. 44–52, pl. 6: figs. 53–62 [larvae], pl. 7: figs. 63–68 [larvae]; 1937: 87 [listed].—Lebour, 1941: 401, 410, figs. 28–33.—Holthuis, 1959: 120 [discussion].—Williams, 1965: 86, fig. 70.
Processa ?bermudensis.—O'Gower and Wacasey, 1967: 209 [listed].
Processa sp. Rouse, 1970: 140 [part].

MATERIAL.—1 ♂; Bermuda; G. Brown Goode; 1876–1877; USNM.—1 ovigerous ♀; Bermuda, Saint George's Island, Ferry Point, grass flats on eastern side of point; push net; afternoon; L. K. and R. B. Manning, col.; 18 April 1970; USNM.—5 ♂; same; night collection; L. K. and R. B. Manning, col.; 18 April 1970; USNM.—1 ♂, 2 ♀ (1 ovigerous); same; grass flats on western side of point; push net; at night; L. K. and R. B. Manning, col.; 18 April 1970; USNM.—3 ♀ (2 ovigerous); Florida, Dade County, Miami, Virginia Key, Bear Cut; sewage beach, north of causeway; pushnet; R. B. Manning, col.; 4 May 1961; USNM.—7 ovigerous ♀; Florida, Dade County, Miami, Biscayne Bay; bait shrimp trawl; M. McBean, col.; 29 July 1959; USNM.—11 ovigerous ♀; same; 4 August 1959; USNM.—1 ♂, 2 ovigerous ♀; same; shrimp trawl; B. Retskin, col.; 7 July 1960; USNM.—1 ovigerous ♀; Florida, Monroe County, Key West; H. Hemphill, col.; 1885; USNM. —1 ovigerous ♀; Florida, Monroe County, Dry Tortugas, off west side of Bush Key Reef; from *Halimeda*; 20 August 1924; USNM.—1 ♀; Florida, Monroe County, Everglades National Park, Buttonwood Canal; D. Dubrow, A. Jones, col.; 4–5 April 1962; USNM.—5 ♀ (1 ovigerous); Florida, mouth of Tampa Bay, Egmont Key; trawl; Carl H. Saloman, col., station K-3; 21 December 1962; USNM.—6 ♀; same; 13 December 1963; USNM.—9 damaged specimens; Florida, Levy County, Cedar Key; H. Hemphill, col.; December 1883; USNM.—1 ♀; same; *Amphioxus* dredge; M. Wass, col.; 10 March 1956; USNM.—1 ovigerous ♀; Cuba, Cabanas; on mud, shell, and grass bottom; poisoned with copper sulphate; *Tomas Barrera* Expedition station 16; 8 June 1914; USNM.—1 ovigerous ♀; Cuba, Matanzas Province, Varadero, Cardenas Bay, off 61st Street; W. L. Schmitt, col.; 19 January 1957; USNM.—8 ♂, 7 ovigerous ♀; Puerto Rico, Lajas, La Parguera, east side of Maguey Island; evening, after dark, with push net on shallow *Thalassia* flats; R. B. Manning station PR 6-61; 24 June 1961; USNM.

DIAGNOSIS.—Antennal spine absent. Stylocerite rounded laterally, unarmed. (Right pereiopod of first pair chelate, left with simple dactyl; first pereiopods lacking exopods.) Second legs asymmetrical, right longer. Right second pereiopod with 10–15 meral and 19–29 carpal articles, left second pereiopod with 3–4 meral and 13–15 carpal articles. Carpus of fifth pereiopod longer than propodus. Fifth abdominal somite unarmed posterolaterally. Abdominal sternites unarmed.

DESCRIPTION.—Rostrum (Figures 6*b*, *c*) almost straight, not extending beyond eye; apex slightly deflexed, bifid, lower tooth longer, bifurcation obscured by several long setae; lower margin of rostrum convex proximally, concave distally. Lower orbital angle inconspicuous, rounded. Antennal spine absent. Lower anterior angle of carapace broadly rounded (Figure 6*a*).

Abdomen (Figure 6*d*) smooth, surface sparsely setose, ventral margins of pleura lined with fine setae. Fifth abdominal somite rounded posterolaterally. Sixth abdominal somite less than twice as long as fifth, bluntly angled posterolaterally; lobe above articulation of uropod rounded, unarmed. Telson (Figure 6*e*) about 1½ times as long as sixth abdominal somite, length 2½ to 3 times greatest width, with 2 pairs of dorsal and 2 pairs of distal spines; anterior pair of dorsal spines of telson set in proximal fourth, posterior spines at midlength; distance between anterior margin and anterior pair of dorsal spines less than ½ the distance between pairs of dorsal spines; outer of distal spines (Figure 6*f*) stronger, ventromesial flanked mesially by strong plumose seta; apex of telson produced into sharp median point.

Eye (Figure 6*a*) moderately large; cornea width

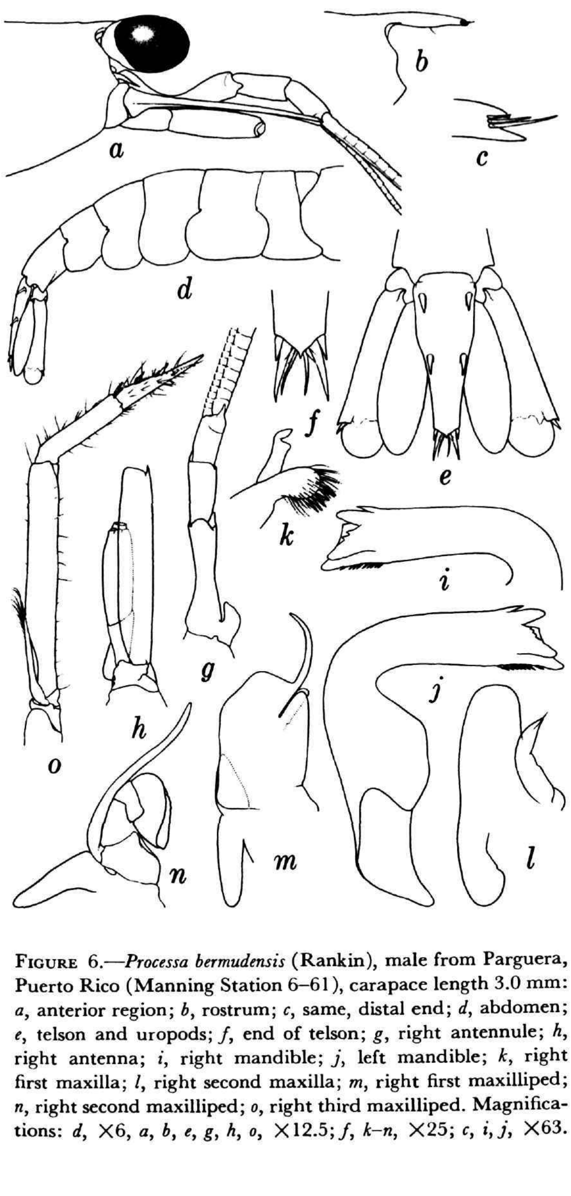

FIGURE 6.—*Processa bermudensis* (Rankin), male from Parguera, Puerto Rico (Manning Station 6–61), carapace length 3.0 mm: *a*, anterior region; *b*, rostrum; *c*, same, distal end; *d*, abdomen; *e*, telson and uropods; *f*, end of telson; *g*, right antennule; *h*, right antenna; *i*, right mandible; *j*, left mandible; *k*, right first maxilla; *l*, right second maxilla; *m*, right first maxilliped; *n*, right second maxilliped; *o*, right third maxilliped. Magnifications: *d*, ×6, *a*, *b*, *e*, *g*, *h*, *o*, ×12.5; *f*, *k*–*n*, ×25; *c*, *i*, *j*, ×63.

less than length of stalk and cornea combined, slightly more than twice greatest width of antennal scale.

Antennular peduncle (Figure 6*g*) extending beyond rostrum by distal 2 segments and ½ of proximal segment, proximal segment longer than distal segments combined, ultimate segment 9⁄10 the length of penultimate segment; proximal segment of antennular peduncle with ventral spine, set slightly beyond midlength. Stylocerite obtusely rounded laterally, inner margin projecting farther than outer, unarmed. Dorsolateral flagellum of antennule ⅔ as long as carapace, thickened setigerous portion consisting of 12–17 articles and amounting to ⅔–⅘ of length, slender distal portion consisting of 5–11 articles; ventromesial flagellum 2–3 times as long as carapace.

Antennal scale (Figure 6*h*) extending to or almost to end of antennular peduncle, length of scale about 5⅔ times greatest breadth; distal spine of scale overreaching blade. Antennal peduncle extending about to midlength of second segment of antennular peduncle. Basal segment of antenna lacking ventrolateral spine. Antennal flagellum about 4 times carapace length.

Third maxilliped (Figure 6*o*) overreaching antennal scale by distal and ½ of penultimate segments; ultimate segment with some short spines on surface, apex acute; ultimate segment equal to or shorter than penultimate, less than ½ as long as proximal segment; exopod well developed. Posterior margin of molar process of mandible with row of 9 spines. Other mouthparts (Figures 6*i–n*) as figured.

Right pereiopod of first pair (Figure 7*a*) chelate, overreaching antennal scale by about ½ the length of fingers; fingers about ⅔ the length of palm; carpus subequal to palm; merus as long as carpus and chela combined. Left pereiopod of first pair (Figure 7*b*) with simple dactyl, overreaching antennal scale by nearly entire dactyl; dactyl about ⅓ the length of propodus; carpus about ⅔ the length of propodus; merus as long as carpus and propodus combined. Arthrobranchs not visible at base of first pereiopods. Second pereiopods (Figures 7*c*, *d*) unequal, right longer, overreaching antennal scale by chela and nearly all of carpus; merocarpal articulation of right pereiopod extending beyond eye; ischium with 5 indistinct, merus with 10–15, and carpus with 19–29 articles; fingers about ⅘ as long as palm; carpus almost 6 times as long as chela; merus slightly more than 3 times as long as chela; ischium slightly longer than merus. Left pereiopod of second pair overreaching antennal scale by chela and slightly less than ½ of carpus; ischium undivided, merus with 3–4 and carpus with 13–15 articles; fingers subequal to palm; carpus slightly more than 6 times as long as chela; merus about 4 times as long as chela; ischium slightly shorter than merus. Third pereiopod (Figure 7*e*) overreaching antennal scale by dactyl, propodus, and ½ of carpus; dactyl (Figure 7*f*) slender, simple, with subapical setae; propodus about 3⅔ times as long as dactyl, unarmed, surface ornamented with scattered short setae, longer tufts at apex; carpus 1⅔ times as long as propodus, unarmed, with scattered short setae on surface; merus about 1½ times as long as propodus, with 4–5 movable spines on lateral surface; ischium about ⅔ as long as merus, with 2 movable spines on lateral surface; combined length of propodus and carpus of third pereiopod slightly greater than that of ischium and merus. Fourth pereiopod (Figure 7*g*) overreaching antennal scale by dactyl, propodus, and ½ of carpus; dactyl (Figure 7*h*) slender, simple, with subapical tufts of setae; propodus slightly more than 4 times as long as dactyl, unarmed, ornamented with few short setae on surface and longer distal tufts; outer margin of propodus not markedly more setose in males than females; carpus about 1½ times as long as propodus, unarmed, ornamented with few surface setae; merus about 1¼ times as long as propodus, with 4–8 movable spines on lateral surface; ischium shorter than merus, with 2 movable spines on lateral surface; combined length of carpus and propodus of fourth pereiopod greater than that of ischium and merus. Fifth pereiopod (Figure 7*i*) overreaching antennal scale by dactyl and propodus; dactyl (Figure 7*j*) slender, simple, apex obscured by long setae; propodus more than 3½ times as long as dactyl, ornamented with scattered short setae on surface and 3 spines on flexor margin; outer margin of propodus not markedly more setose in males than in females; carpus slightly longer than propodus, unarmed; merus about 1¼ times as long as propodus, unarmed; ischium shorter than merus, unarmed; combined length of propodus and carpus of fifth pereiopod greater than that of ischium and merus.

Endopod of first male pleopod (Figures 7*k*, *l*) about half as long as exopod, tapering distally, apex acute, setose, retinacular lobe well developed. Appendix masculina of second male pleopod (Figures 7*n*, *o*) with row of spinules on lateral margin, and with 4 distal and 2 subdistal spinules. Abdominal sternites unarmed. Outer margin of uropodal exopod (Figure 6*e*)

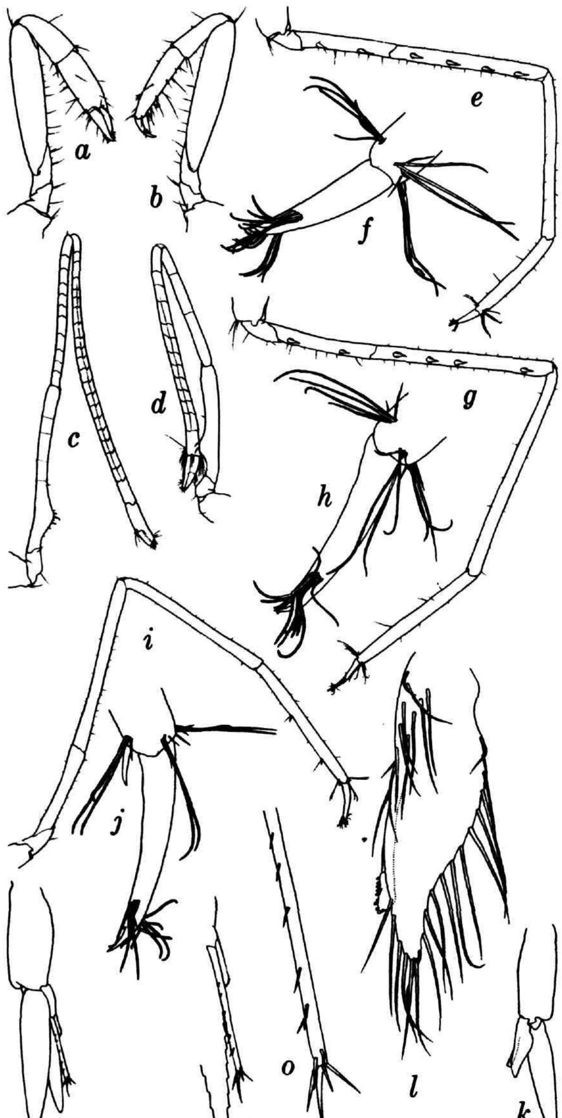

FIGURE 7.—*Processa bermudensis* (Rankin), male from Parguera, Puerto Rico (Manning Station 6–61), carapace length 3.0 mm: *a*, right first pereiopod; *b*, left first pereiopod; *c*, right second pereiopod; *d*, left second pereiopod; *e*, right third pereiopod; *f*, same, dactyl; *g*, right fourth pereiopod; *h*, same, dactyl; *i*, right fifth pereiopod; *j*, same, dactyl; *k*, right first pleopod; *l*, same, endopod; *m*, right second pleopod; *n*, same, appendix masculina and appendix interna; *o*, end of appendix masculina. Magnifications: *a–e*, *g*, *i*, *k*, *m*, ×12.5; *n*, ×25; *f*, *h*, *j*, *l*, *o*, ×63.

terminating in blunt, triangular projection, with stronger mesial movable spine; exopod with suture at level of outer tooth, dorsal surface marked with blunt, triangular tooth or lobe on each side anterior to suture. Eggs small and numerous, 0.4–0.5 mm in diameter.

SIZE.—Carapace lengths of males, 2.4–3.4 mm; of females, 3.3–5.8 mm; of ovigerous females, 3.3–5.7 mm.

COLOR.—Background light with many small, red chromatophores and fewer, larger white ones scattered over body; eyes light green; distal segment of third maxilliped and bases of third, fourth, and fifth pereiopods and pleopods red; abdomen with transverse red bar across third somite; eggs yellowish.

DISCUSSION.—*Processa bermudensis* resembles *P. vicina*, described below, but differs from all other Atlantic species of *Processa* in lacking the antennal spines on the carapace; it differs from *P. vicina* in having asymmetrical second pereiopods and in certain other features. *Processa bermudensis* has 10–15 meral and 19–29 carpal articles in the right second pereiopod and 3–4 meral and 13–15 carpal articles in the left second pereiopod, whereas in *P. vicina* there are 5 meral and 10–14 carpal articles in both second pereiopods. The rostrum of *P. bermudensis* is less deflexed apically, the eyes of that species are slightly smaller, and the pereiopod lengths and proportions of pereiopod segments differ in the two species.

The three females from the open beach on Virginia Key, Miami, are larger than most of the other specimens examined, and appear to have slightly smaller eyes; inasmuch as they resemble in most respects other available material (although the posterior pereiopods are missing), we tentatively assign them to this species.

We were unable to trace Rankin's types, which could not be found at the American Museum of Natural History or the Peabody Museum at Yale University; also, the material from Bermuda, reported by Gurney (1936) or Lebour (1941), apparently had not been deposited in the British Museum (Natural History). Two specimens collected by one of us (FACJr.) in Bermuda in 1936 (Chace 1937) could not be located in the Museum of Comparative Zoology at Harvard; apparently they were loaned to Miss Lebour, who noted (1941:411) that one of the specimens was *P. bermudensis* but that the other was a new species.

Processa bermudensis was collected together with *Ambidexter symmetricus* and *P. riveroi* on shallow *Thalassia* flats at Maguey Island, La Parguera, Puerto Rico; the three species apparently lived together and had the same or similar color patterns; of the three species taken at that station, *A. symmetricus* was the most abundant, *P. bermudensis* was second most abundant, and *P. riveroi*, of which only three specimens were taken, was the rarest.

TYPE-LOCALITY.—Harrington Sound, Bermuda.

DISTRIBUTION.—Western Atlantic, from Bermuda and the southeastern United States from North Carolina to northwest Florida, Cuba, and Puerto Rico, in shallow water.

Processa fimbriata, new species

FIGURES 8–10

Processa canaliculata.—Rathbun, 1901: 104 [part; records from Boqueron Bay and Vieques, only; listed].—Richardson, 1904: 87 [listed].—Pearse, 1932: 119 [listed].—Schmitt, 1935: 169 [part; records from Brazil, Puerto Rico, and Vieques only].

Processa sp. Pearse, 1950: 150 [listed].

HOLOTYPE.—♂, 2.5 mm; Florida, Monroe County, Tortugas, off East Key; 3 m; W. L. Schmitt, col.; 7 August 1924; USNM 134113.

PARATYPES.—2 ♀ (1 ovigerous); Bahama Islands, Bimini; from loggerhead sponge; A. S. Pearse, col.; 13 October 1948; USNM.—1 ovigerous ♀; Bahama Islands, Bimini; from sponge; A. S. Pearse, col.; 20 October 1948; USNM.—1 ♀; same; from *Spheciospongia vespara*; A. S. Pearse, col.; 31 October 1948; USNM.—1 ♀; Bahama Islands, Great Inagua Island, off Matthew Town; R. A. McLean and B. Shreve, col.; 1 August 1938; MCZ.—1 ovigerous ♀; Bahama Islands, Cat Cay; 11 meters; *Oregon*, col.; 10 November 1954; USNM.—1 ♂; North Carolina, off New River, Black Rocks; A. S. Pearse, col.; 8 August 1949; USNM.—1 ovigerous ♀; Florida, Monroe County, Tortugas, below lighthouse pier, east side Loggerhead Key; from weeds and rocks; W. L. Schmitt, col.; 18 August 1924; USNM.—1 ovigerous ♀; Florida, Monroe County, Tortugas, Loggerhead Key; from loggerhead sponge; A. S. Pearse, col., no. 119; 8 July 1931; USNM.—1 ♀, 1 juvenile; Florida, Monroe County, Tortugas, off north end of Loggerhead Key; 1+ meters; old coral rock with algae; C. R. Shoemaker station 1; 14 July 1926; USNM.—1 juvenile; Florida, Monroe County, Tortugas, Loggerhead Key, west of lighthouse; dredged from 6–9 meters; W. L. Schmitt, col.; 6 August 1924; USNM.—1 ♀; Florida, Monroe County, Tortugas, Bush Key reef, fort side; W. L. Schmitt station 29–30; 23 July 1930; USNM.—1 ♀; Florida, Monroe County, Tortugas, haul along east side of White Shoal off C3 buoy; W. L. Schmitt station 49–30; 9 August 1930; USNM.—1 ovigerous ♀; Florida, Monroe County, Tortugas; from stomach of *Lutjanus apodus*, Manter no. 1006, caught in trap; 31 July 1931; USNM.—1 ♂; Puerto Rico, Boqueron Bay; *Fish Hawk*, col.; 25 January 1899; USNM.—1 ♀; Puerto Rico, off Vieques; 23 m; coral; *Fish Hawk* station 6095 (Puerto Rico station 167); 8 February 1899; USNM.—1 ♀; Brazil, off Recife; 06°59′30″S, 34°47′W; 37 m; broken shells; *Albatross* station 2758; 16 December 1887; USNM.

DIAGNOSIS.—Antennal spine present. Stylocerite with lateral spinule. (Right pereiopod of first pair chelate, left with simple dactyl; first pereiopods lacking exopods.) Second pereiopods asymmetrical, right stronger. Right second pereiopod with 13–16 meral and 31–40 carpal articles, left second pereiopod with 4–6 meral and 15–18 carpal articles. Carpus of fifth pereiopod shorter than propodus. Fifth abdominal somite with posterolateral spine. Abdominal sternites 1–5 with median ventral spine.

DESCRIPTION.—Rostrum (Figure 8*b*) straight, not extending to anterior margin of eye; apex (Figure 8*c*) bifid, lower tooth longer, apex obscured by few short setae; lower margin of rostrum evenly convex. Lower orbital angle rounded, inconspicuous. Antennal spine present. Lower anterior angle of carapace broadly rounded (Figure 8*a*).

Abdomen (Figure 8*d*) smooth, bare, ventral margins of pleura lined with fine setae. Fifth abdominal somite with posterolateral spine (Figure 8*e*). Sixth abdominal somite less than twice as long as fifth, with blunt posterolateral spine; lobe above articulation of uropod produced into blunt triangular projection. Telson (Figure 8*f*) almost twice as long as fifth abdominal somite, length 3 times greatest width, with 2 pairs of dorsal and 2 pairs of distal spines; anterior pair of dorsal spines of telson set at end of proximal third, posterior spines beyond midlength; distance between anterior margin and anterior pair of spines slightly less than distance between pairs of spines; distal spines of telson (Figure 8*g*) as in *P. bermudensis*; apex of telson produced into sharp point.

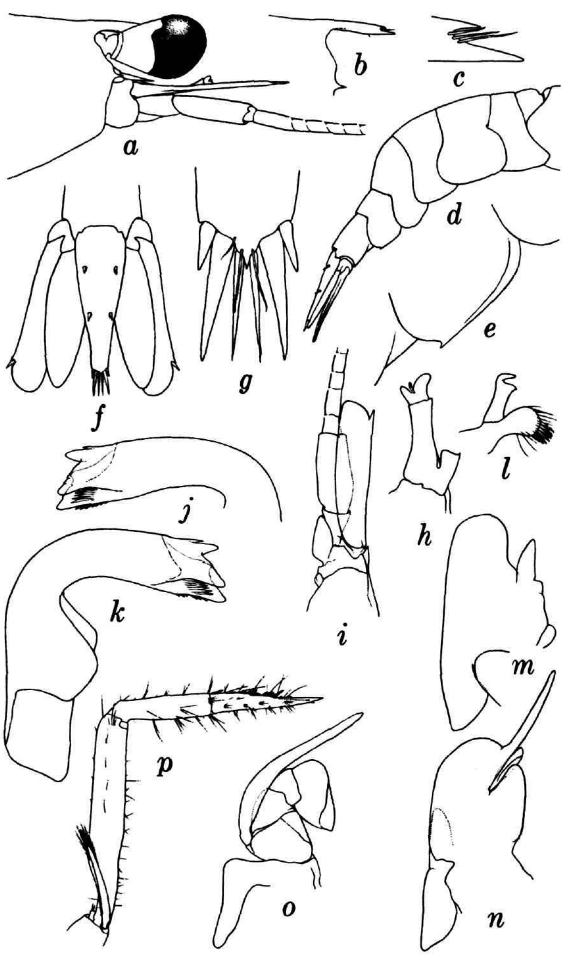

FIGURE 8.—*Processa fimbriata*, new species, holotype, male, carapace length 2.5 mm: *a*, anterior region; *b*, rostrum; *c*, same, distal end; *d*, abdomen; *e*, margin of fifth abdominal pleuron; *f*, telson and uropods; *g*, end of telson; *h*, right antennule (regenerating); *i*, right antenna; *j*, right mandible; *k*, left mandible; *l*, right first maxilla; *m*, right second maxilla; *n*, right first maxilliped; *o*, right second maxilliped; *p*, right third maxilliped. Magnifications: *d*, ×6; *a*, *b*, *f*, *h*, *i*, *p*, ×12.5; *e*, *l–o*, ×25; *c*, *g*, *j*, *k*, ×63.

Eyes (Figure 8*a*) moderately large; cornea width slightly less than length of stalk and cornea combined, about 1⅔ times greatest width of antennal scale.

Antennular peduncle (Figures 8*h*, 10*b*) extending by distal 2 segments and ⅓ of proximal segment beyond rostrum; basal segment of antennular peduncle almost twice as long as distal segments, ultimate segment about 9⁄10 as long as penultimate segment; proximal segment of antennular peduncle with ventral spine, set slightly beyond midlength. Stylocerite truncated anteriorly, with outer spine. Dorsolateral flagellum of antennule shorter than carapace, thickened setigerous portion consisting of 10–19 articles and amounting to ⅖–⅔ of length, slender distal portion consisting of at least 10–19 articles. Ventromesial flagellum at least 10 times as long as carapace.

Antennal scale (Figure 8*i*) slightly overreaching antennular peduncle, length of scale about 4 times greatest breadth; distal spine of scale not overreaching blade. Antennal peduncle extending to end of second segment of antennular peduncle. Basal segment of antenna with outer spine. Antennal flagellum damaged.

Third maxilliped (Figure 8*p*) overreaching antennal scale by length of ultimate and ⅔ of penultimate segments; ultimate segment with some short spines on outer surface, apex sharp; ultimate segment slightly longer than penultimate, slightly more than half as long as proximal segment. Exopod well developed. Mandible (Figures 8*j*, *k*) with 6–7 spines on posterior margin of molar process. Remainder of mouthparts (Figures 8*l–o*) as in *P. bermudensis*.

Right pereiopod of first pair (Figure 9*a*) chelate, barely overreaching antennal scale; fingers about ⅔ length of palm; merus slightly shorter than carpus and chela combined. Left pereiopod of first pair (Figure 9*b*) with simple dactyl, overreaching antennal scale by dactyl and ¼ of propodus; dactyl about ⅓ length of propodus; carpus slightly more than ½ as long as propodus; merus about as long as carpus and propodus combined. Arthrobranch not visible at base of first pereiopods. Second pereiopods asymmetrical, right (Figure 9*c*) stronger, overreaching antennal scale by chela and all but 1 or 2 proximal articles of carpus; merocarpal articulation extending to end of scale; ischium undivided, merus with 13–16, and carpus with 31–40 articles; fingers slightly shorter than palm; carpus slightly more than 7 times as long as chela; merus 4⅓ times as long as chela; ischium longer than merus. Left pereiopod of second pair (Figure 9*d*) overreaching antennal scale by chela and less than ⅔ of carpus; ischium undivided, merus with 4–6 and carpus with 15–18 articles; fingers about ⅔ length of palm; carpus 4 times as long as chela; merus 2⅔ times as long as chela; ischium slightly longer than merus. Third pereiopod (Figure 9*e*) overreaching antennal scale by dactyl and propodus; dactyl (Figure 9*f*) slender, simple, with apical setae;

propodus $3\frac{2}{3}$ times as long as dactyl, unarmed, ornamented with scattered tufts of setae along surface, longer tufts at apex; carpus $1\frac{1}{2}$ times as long as propodus, unarmed; merus less than $1\frac{1}{2}$ times as long as

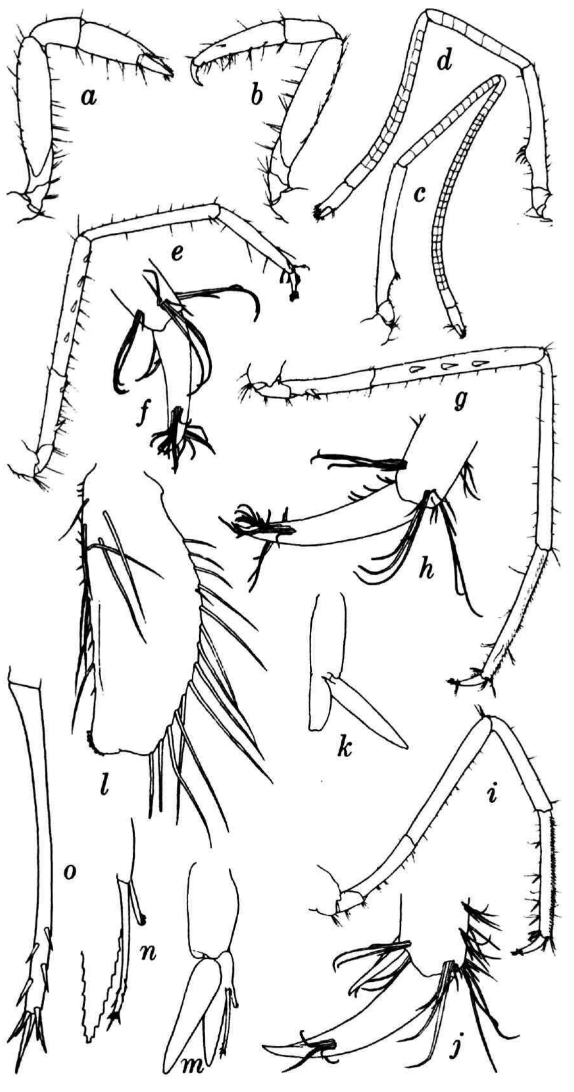

FIGURE 9.—*Processa fimbriata*, new species, holotype, male, carapace length 2.5 mm: *a*, right first pereiopod; *b*, left first pereiopod; *c*, right second pereiopod; *d*, left second pereiopod; *e*, right third pereiopod; *f*, same, dactyl; *g*, right fourth pereiopod; *h*, same, dactyl; *i*, right fifth pereiopod; *j*, same, dactyl; *k*, right first pleopod; *l*, same, endopod; *m*, right second pleopod; *n*, same, appendix masculina and appendix interna; *o*, appendix masculina. Magnifications: *a–e*, *g*, *i*, *k*, *m*, ×12.5; *n*, ×25; *f*, *h*, *j*, *l*, *o*, ×63.

propodus, with 3–4 movable spines on lateral surface; ischium shorter than merus, with 2 movable spines on lateral surface; combined lengths of propodus and carpus of third pereiopod slightly greater than that of ischium and merus. Fourth pereiopod (Figure 9*g*) overreaching antennal scale by dactyl, propodus, and about $\frac{1}{2}$ of carpus; dactyl (Figure 9*h*) slender, simple, apex obscured by long setae; propodus slightly more than 4 times as long as dactyl, unarmed, with some scattered tufts of setae on surface, as well as longer subapical tufts in females; outer surface of propodus in males completely covered by short setae; carpus about $1\frac{1}{3}$ times as long as propodus, unarmed, with scattered setae on surface; merus about $1\frac{1}{5}$ times as long as propodus, with 3–4 movable spines on lateral surface; ischium shorter than merus, with 1–2 movable spines on lateral surface; combined length of propodus and carpus of fourth pereiopod greater than that of ischium and merus. Fifth pereiopod (Figure 9*i*) overreaching antennal scale by dactyl and slightly less to slightly more than $\frac{1}{2}$ of propodus; dactyl (Figure 9*j*) slender, simple, with subapical tuft of setae; propodus slightly more than 3 times length of dactyl in males, slightly less than 3 times the length of dactyl in females, ornamented with 4–5 spines on flexor margin; outer surface of propodus with scattered tufts of setae in females, completely obscured by short setae in males; carpus shorter than propodus, unarmed; merus longer than propodus, unarmed; ischium shorter than merus, unarmed; combined lengths of propodus and carpus of fifth pereiopod slightly greater than or subequal to that of ischium and merus.

Endopod of first male pleopod (Figures 9*k*, *l*) about $\frac{1}{2}$ as long as exopod, apex truncate, with mesial retinacular surface; margins sparsely setose. Appendix masculina on endopod of second male pleopod (Figures 9*m–o*) with 4 subdistal and 6 distal spinules. Abdominal sternites 1–5 with median ventral spine. Uropods (Figure 8*f*) as in *P. bermudensis*. Eggs small and numerous, 0.3–0.4 mm in diameter.

SIZE.—Carapace lengths of males, 1.9–3.1 mm; of females, 1.9–6.3 mm; of ovigerous females, 3.3–6.3 mm.

COLOR.—Waldo L. Schmitt noted that a female from Tortugas has "no color markings of consequence; transparent; eyes black." No other information is available on color.

DISCUSSION.—This small species resembles *P. riveroi*, described below, and differs from all other Atlantic

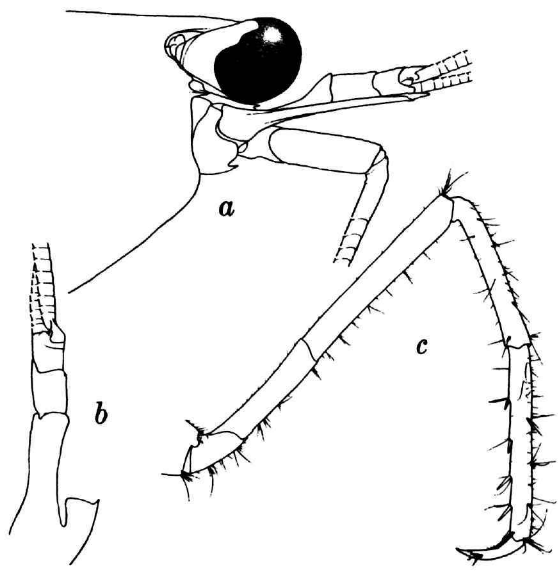

FIGURE 10.—*Processa fimbriata*, new species, paratype, ovigerous female from Loggerhead Key, Dry Tortugas, carapace length 3.8 mm: *a*, anterior region; *b*, right antennule; *c*, right fifth pereiopod. Magnifications: *a–c*, ×12.5.

species in several features. Both the stylocerite and the pleuron of the fifth abdominal somite are provided with spines, there is a ventral spine on each of the anterior five abdominal sternites between the pleopods, and the propodus of the fifth pereiopod is longer than the carpus. Sternal spines on the abdomen have been described previously only in *P. elegantula* Nouvel and Holthuis from the eastern Atlantic; in that species they were not observed on mature females—in contrast the sternal spines occur on adult females of both *P. fimbriata* and *P. riveroi*. *Processa elegantula* further differs from both *P. fimbriata* and *P. riveroi* in lacking a posterolateral spine on the pleuron of the fifth abdominal somite.

Processa fimbriata differs from the closely related *P. riveroi* in several features. The eyes of *P. fimbriata* are larger, the stylocerite is armed with one spine rather than two, and there are fewer spines (6–7 rather than 21) on the posterior margin of the molar process of the mandible; other differences are pointed out under the discussion of *P. riveroi*.

It seems likely that there is a habitat difference between *P. fimbriata* and *P. riveroi*. Many of our specimens of the former species were taken from sponges, and Pearse (1932, 1950) found *P. fimbriata* in *Speciospongia vespara*, *Hircinia strobilina*, and *Aulospongus schoemus*. In contrast, our material of *P. riveroi* was found free-living on shallow grass flats in association with two other species of processids.

Males of *P. fimbriata* differ from adult males of other western Atlantic processids (males of *P. hemphilli* and *P. riveroi* not examined) in having the lateral margin of the carpus and propodus of the fourth and fifth pereiopods ornamented with a dense coat of short setae, as shown in Figures 9*g*, *i*; the setae are not so well marked in smaller males as they are in large ones, in which the outline of the pereiopod is obscured. The only other species in which such setae have been reported, so far as we are aware, is *Nikoides danae* (Paulson) from the Red Sea; Gurney (1937:89) reported that males of *N. danae* could readily be distinguished from females "by having a series of bundles of stiff hairs along anterior margin of propodus of pereiopods 3–5."

The specimen from off Brazil was host for the type of a bopyrid isopod, *Urobopyrus processae* Richardson, 1905.

NAME.—The name is from the Latin, *fimbriatus*, fringed, alluding to the appearance of the fourth and fifth pereiopods.

TYPE-LOCALITY.—Off East Key, Tortugas, Monroe County, Florida.

DISTRIBUTION.—Western Atlantic, from North Carolina, southern Florida, the Bahamas, Puerto Rico, and off Brazil; shallow water to 37 m, on broken shell, coral, and in sponges.

Processa guyanae Holthuis, 1959

Processa guyanae Holthuis, 1959: 115, figs. 18, 19.

DIAGNOSIS.—Antennal spine present. Stylocerite with, at most, trace of lateral spinule. (Right pereiopod of first pair chelate, left with simple dactyl; first pereiopods lacking exopods.) Second pereiopods asymmetrical, right stronger. Right second pereiopod with 18–20 meral and 44–47 carpal articles, left second pereiopod with 3–5+ meral and 17–18 carpal articles. Carpus of fifth pereiopod longer than propodus. Fifth abdominal somite unarmed posterolaterally. Abdominal sternites unarmed.

DISCUSSION.—We have seen no material of this species other than some of the specimens on which Holthuis (1959) based his original description.

TYPE-LOCALITY.—Off the coast of Surinam.

DISTRIBUTION.—Western Atlantic, from off the coast of Surinam in depths between 44 and 49 m.

Processa hemphilli, new species

FIGURES 11, 12

Processa canaliculata.—Rathbun, 1901: 104 [listed; specimens from *Grampus* 5066 and Marco].

HOLOTYPE.—♀, 3.9 mm; Florida, Collier County, Marco; 2–6 m; H. Hemphill, col.; USNM 23386.

PARATYPES.—1 ♀; data as for holotype; USNM.—1 ovigerous ♀; Gulf of Mexico, off southwestern Florida; 25°13′N, 82°28′W; 31 m; broken shell; *Grampus* station 5066; 19 February 1889; USNM.

DIAGNOSIS.—Antennal spine present. Stylocerite with small lateral spine. (Right pereiopod of first pair chelate, left with simple dactyl; first pereiopods lacking exopods.) Second pereiopods symmetrical, with 4 meral and 10 carpal articles. Carpus of fifth pereiopod longer than propodus. Fifth abdominal somite unarmed posterolaterally. Abdominal sternites unarmed.

DESCRIPTION.—Rostrum (Figure 11*b*) slightly deflexed, tapering distally, not extending to anterior margin of eye. Apex (Figure 11*c*) bifid, lower tooth longer, apex obscured by numerous setae. Lower orbital angle broadly rounded. Antennal spine well developed. Lower anterior angle of carapace rounded (Figure 11*a*).

Abdomen (Figure 11*d*) smooth, bare, ventral margins of pleura lined with fine setae. Fifth abdominal somite obtusely angled posterolaterally, unarmed. Sixth abdominal somite subequal in length to fifth, with acute posterolateral angle; lobe above articulation of uropod angled but unarmed. Telson (Figure 11*e*) slightly more than 1½ times as long as fifth abdominal somite, length slightly more than 3 times greatest width, with 2 pairs of dorsal and 2 pairs of distal spines; anterior pair of dorsal spines of telson set in proximal fourth, posterior pair set beyond midlength; distance between anterior margin and anterior pair of dorsal spines about ¼ distance between pairs of dorsal spines; distal spines (Figure 11*f*) as in *P. bermudensis*; apex of telson produced into acute point.

Eye (Figure 11*a*) large, cornea width less than length of stalk and cornea combined, 1⅔ greatest width of antennal scale.

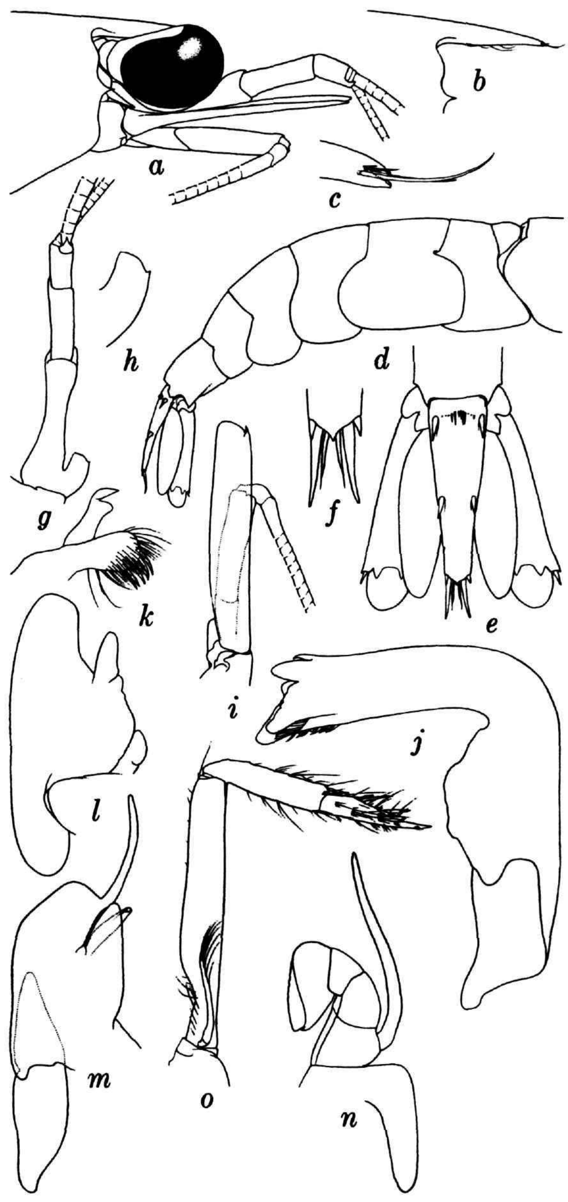

FIGURE 11.—*Processa hemphilli*, new species, holotype, female, carapace length 3.9 mm: *a*, anterior region; *b*, rostrum; *c*, same, distal end; *d*, abdomen; *e*, telson and uropods; *f*, end of telson; *g*, right antennule; *h*, same, stylocerite; *i*, right antenna; *j*, right mandible; *k*, right first maxilla; *l*, right second maxilla; *m*, right first maxilliped; *n*, left second maxilliped; *o*, right third maxilliped. Magnifications: *d*, ×6; *a, b, e, g, i, o*, ×12.5; *f, h, k–n*, ×25; *c, j*, ×63.

Antennular peduncle (Figure 11*g*) extending by 2 distal segments and 1/3 of proximal segment beyond rostrum, basal segment longer than distal segments combined; ultimate segment 3/5 the length of penultimate segment; proximal segment of peduncle with ventral spine, set slightly beyond midlength. Stylocerite (Figure 11*h*) subtruncated anteriorly, anterior margin sinuous, with small outer spine. Dorsolateral flagellum of antennule about 1/2 as long as carapace, thickened setigerous portion consisting of 10 articles and amounting to 9/10 of length, slender distal portion with 5 articles. Ventromesial flagellum as long as carapace.

Antennal scale (Figure 11*i*) extending to end of antennular peduncle, length of scale almost 6 times its greatest width; distal spine of scale falling short of rounded anterior margin of blade. Basal segment of antenna unarmed. Antennal peduncle extending slightly beyond proximal segment of antennular peduncle. Antennal flagellum broken in all specimens.

Third maxilliped (Figure 11*o*) overreaching antennal scale by slightly more than length of ultimate segment; ultimate segment ornamented with spines, apex sharp, segment slightly shorter than penultimate segment but 1/3 as long as proximal segment. Exopod well developed. Mandible (Figure 11*j*) with row of 9 spines on posterior margin of molar process. Remainder of mouthparts (Figures 11*k–n*) as in *P. bermudensis*.

Right pereiopod of first pair (Figure 12*a*) chelate, falling short of antennal scale by length of distal segment, reaching distal end of second antennular segment; fingers about 3/4 the length of palm; carpus slightly shorter than palm; merus about as long as carpus and chela combined. Left pereiopod of first pair (Figure 12*b*) with simple dactyl, falling short of antennal scale, extending barely to distal end of second antennular segment; dactyl slightly more than 1/3 the length of propodus; carpus shorter than propodus; merus about as long as carpus, propodus, and dactyl combined. No arthrobranch visible at bases of first pereiopods. Second pereiopods (Figures 12*c*, *d*) symmetrical, overreaching antennal scale by slightly more than length of chela; merocarpal articulation of second pereiopod not extending beyond eye; ischium not segmented, merus with 4 and carpus with 10 articles; fingers subequal to or slightly shorter than palm; carpus less than 5 times as long as chela; merus 3 times as long as chela; ischium subequal to or slightly shorter than merus. Third pereiopod (Figure 12*e*)

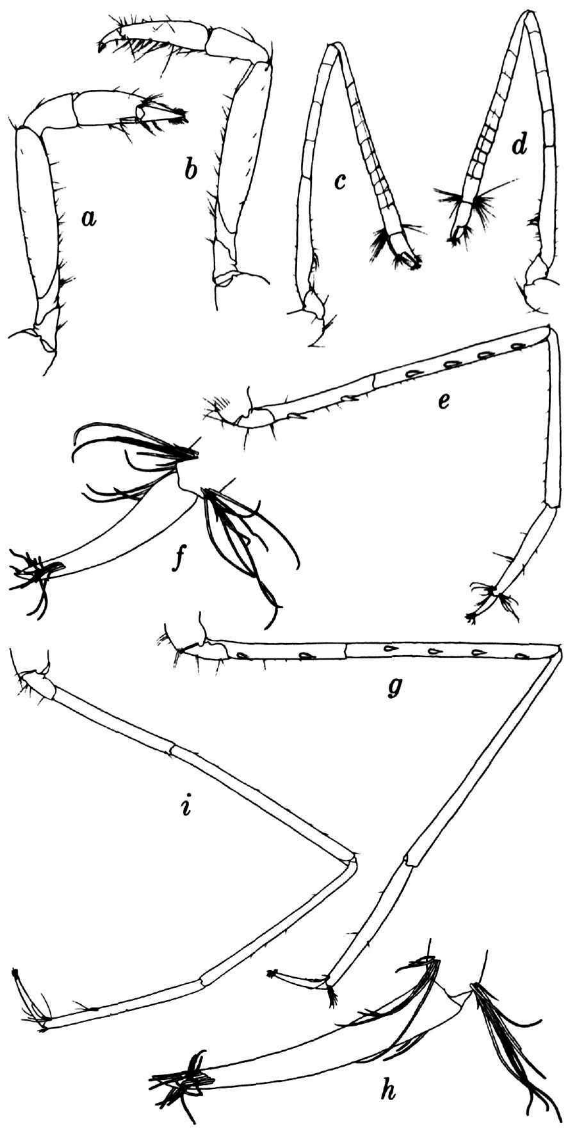

FIGURE 12.—*Processa hemphilli*, new species, holotype, female, carapace length 3.9 mm: *a*, right first pereiopod; *b*, left first pereiopod; *c*, right second pereiopod; *d*, left second pereiopod; *e*, right third pereiopod; *f*, same, dactyl; *g*, right fourth pereiopod; *h*, same, dactyl. Paratype, ovigerous female from off West Florida (*Grampus* Station 5066), carapace length 3.75 mm: *i*, right fifth pereiopod (extreme tip of dactyl missing). Magnifications: *a–e*, *g*, *i*, ×12.5; *f*, *h*, ×63.

overreaching antennal scale by dactyl and propodus; dactyl (Figure 12*f*) slender, simple, with apical setae; propodus 3 times as long as dactyl, unarmed, with scattered setae on surface and longer distal tufts of setae; carpus less than twice as long as propodus, unarmed; merus less than twice as long as propodus, subequal with carpus, with 4 movable spines on lateral surface; ischium shorter than merus, with 2 spines on outer surface; combined length of propodus and carpus of third pereiopod less than that of ischium and merus. Fourth pereiopod (Figure 12*g*) overreaching antennal scale by dactyl, propodus, and nearly ½ of carpus; dactyl (Figure 12*h*) slender, simple, apex obscured by tuft of setae; propodus about 2½ times as long as dactyl, unarmed, with some short setae on surface and longer distal tuft of setae; carpus less than twice as long as propodus, unarmed; merus about 1½ times as long as propodus, shorter than carpus, with 4 movable spines on lateral surface; ischium shorter than merus, with 2 spines on lateral surface; combined length of propodus and carpus of fourth pereiopod greater than that of ischium and merus. Fifth pereiopod (Figure 12*i*) overreaching antennal scale by dactyl, propodus, and nearly ⅕ of carpus; dactyl slender, simple, apex obscured by tufts of setae; propodus less than 3 times as long as dactyl, with tufts of setae on surface and longer distal setae, 1 spine present on flexor margin; carpus slightly longer than propodus, unarmed; merus less than 1½ times as long as propodus, slightly longer than carpus, unarmed; ischium shorter than merus, unarmed; combined lengths of propodus and carpus of fifth pereiopod slightly greater than that of ischium and merus.

Abdominal sternites unarmed. Uropods (Figure 11*e*) as in *P. bermudensis*. Eggs small and numerous, maximum diameter 0.3 mm.

SIZE.—Carapace lengths of females, 3.7–3.9 mm; of ovigerous female, 3.75 mm.

COLOR.—Not recorded.

DISCUSSION.—This new species closely resembles *P. parva* Holthuis, but differs in the following features: the rostrum is more tapered distally, less deflexed apically, and the interval between the rostral teeth is smaller; the antennular peduncle is slenderer; the tooth of the antennal scale falls short of the distal margin of the blade; the first pereiopod fails to reach the end of the antennal scale by the length of the distal segment, rather than extending to the end of the blade, and the merus is comparatively longer; in the second pereiopods there are 4 meral and 10 carpal segments, rather than 4–6 meral and 11–15 carpal segments; on the fourth pereiopod the carpus is longer than the merus, rather than subequal in length; the propodus of the fifth pereiopod has 2 spines on the flexor margin, whereas in *P. parva* there are 3 spines on the flexor margin; and the apex of the telson is produced into a sharp point, rather than being rounded or subacute apically.

In view of these differences, we prefer to call attention to the occurrence of this species by naming it, rather than by identifying it with the eastern Atlantic *P. parva*. The differences between *P. parva*, *P. aequimana* (Paulson) from the Red Sea, and *P. hemphilli* are so slight that additional material might very well show that they are the same.

Two other western Atlantic processids agree with *P. hemphilli* in having symmetrical second pereiopods, *Ambidexter symmetricus* and *Processa vicina*, which are described herein. An *Ambidexter* with both first pereiopods can be distinguished from *P. hemphilli* by the two being chelate; one lacking first pereiopods or the left first pereiopod can be distinguished by the absence of a spine on the stylocerite; the species also differ in the proportions of the segments of the pereiopods. *Processa vicina* differs from *P. hemphilli* in lacking an antennal spine.

NAME.—The species is named for the collector, Henry Hemphill.

TYPE-LOCALITY.—Marco, Collier County, Florida.

DISTRIBUTION.—Known only from the west coast of Florida, in 2–31 m.

Processa profunda, new species

FIGURES 13–15

Processa canaliculata.—Rathbun, 1901: 104 [listed; part, specimens from *Albatross* station 2402 only].

HOLOTYPE.—♂, 7.2 mm; Gulf of Mexico, off west coast of Florida; 28°36′N, 85°33′30″W; 202 m; grey mud; *Albatross* station 2402; 14 March 1885; USNM 23382.

PARATYPES.—1♂, 2♀ (1 ovigerous); data as for holotype; USNM.—2♀ (1 ovigerous); Gulf of Mexico, Florida, southwest of Dry Tortugas; 24°20′N, 83°20′W; 346 m; *Oregon* station 1005; 13 April 1954; USNM.

DIAGNOSIS.—Antennal spine present. Stylocerite with large lateral spine. (Right pereiopod of first pair chelate, left with simple dactyl; first pereiopods lack-