# A review of the bopyrid isopods infesting caridean shrimps in the northwestern Atlantic Ocean, with special reference to those collected during the Hourglass Cruises in the Gulf of Mexico

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# MEMOIRS OF THE HOURGLASS CRUISES

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## A REVIEW OF THE BOPYRID ISOPODS INFESTING CARIDEAN SHRIMPS IN THE NORTHWESTERN ATLANTIC OCEAN, WITH SPECIAL REFERENCE TO THOSE COLLECTED DURING THE HOURGLASS CRUISES IN THE GULF OF MEXICO

By

JOHN C. MARKHAM[1]

## ABSTRACT

Systematic accounts of the species of bopyrid isopods infesting caridean shrimps in the northwestern Atlantic region are presented; for nearly all of the species of bopyrids, synonymies are provided, and 23 species are illustrated. The total number of species known is 37, belonging to 27 genera of four subfamilies, including both branchial and abdominal parasites. Of these, 23 species are recorded from Florida, including 15 collected during the Hourglass Cruises. Included are descriptions of five new species and seven new genera, and the generic reassignment of eleven previously described species. The report includes extensive revisions of the two subfamilies whose members infest caridean shrimps exclusively, the Bopyrinae (branchial parasites) and the Hemiarthrinae (abdominal parasites). A list of all the carideans of the northwestern Atlantic known to harbor bopyrid parasites is composed of 73 species belonging to ten families, of which eight species are reported as hosts for the first time.

[1]Arch Cape Marine Laboratory, Arch Cape, Oregon 97102, U.S.A.
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## INTRODUCTION

The isopod suborder Epicaridea contains several families, the number of which is put variously at four (Sars, 1898), five (Caullery, 1950), ten (Codreanu, 1967) or eleven (Bonnier, 1900; Nielsen and Strömberg, 1965). All species in the suborder are holoparasites of crustaceans. For a diagnosis of the suborder, refer to Sars (1898) or Richardson (1905a).

The largest and best-defined epicaridean family, the Bopyridae, contains about 90% of the described species. All bopyrids infest decapods as definitive hosts, while their larvae, in the few cases known, are ectoparasites of calanoid copepods. The family Bopyridae is divided into ten subfamilies, of which six occur in the northwestern Atlantic, including the Gulf of Mexico. Four subfamilies contain species which are branchial parasites, while members of the other two subfamilies are abdominal parasites. Despite some exceptions, members of a particular subfamily are largely restricted to hosts belonging to a single decapodan infraorder. Adults belonging to the Bopyrinae (branchial parasites) and Hemiarthrinae (abdominal parasites) are known to infest only caridean shrimps. In the western Atlantic, both of these subfamilies have been seriously in need of revision. For this reason and because the parasites of caridean shrimps collected during the Hourglass Cruises of the Florida Department of Natural Resources became available for study, this report is devoted to bopyrid parasites of caridean shrimps of the northwestern Atlantic, including all species of Bopyrinae, Hemiarthrinae, and Argeiinae, and the three caridean-infesting species of Pseudioninae.

The Hourglass material, the core of that examined for this report, has been supplemented by material from many other sources (see Acknowledgments) to facilitate the preparation of a complete review of the species under consideration. The Hourglass collections almost certainly contain parasites belonging to other bopyrid subfamilies, but they will not be available until their hosts, mainly anomurans and brachyurans, are examined in detail.

## ACKNOWLEDGMENTS

Special thanks are extended to the staff of the Bureau of Marine Research, Florida Department of Natural Resources, especially David K. Camp and William G. Lyons, for sorting and providing material from the Hourglass and other collections (designated FSBC I) and for providing essential technical and editorial assistance. Other material, including type-specimens, was made available by Roland Bourdon, Station Biologique de Roscoff, France; Thomas E. Bowman, National Museum of Natural History, Smithsonian Institution (USNM); N. A. Chamberlain, Grice Marine Biological Laboratory, Charleston, South Carolina (GMBL); Robert H. Gore, Smithsonian Institution, Fort Pierce Bureau, Fort Pierce, Florida (IRCZM); Gordon Hendler, Smithsonian Oceanographic Sorting Center, Washington, D.C.; Lipke B. Holthuis, Rijksmuseum van Natuurlijke Historie, Leiden (RMNHL); William L. Kruczynski, Florida A & M University, Tallahassee, Florida; Alceu Lemos de Castro, Museu Nacional, Rio de Janiero; Herbert W. Levi, Museum of Comparative Zoology, Harvard University (MCZ); Patsy A. McLaughlin, Florida International University, Miami, Florida; S. Pinkster, Zoölogisch Museum, Amsterdam (ZMA); Bruce Stender and Elizabeth L. Wenner, South Carolina Marine Resources Division, Charleston, South Carolina (SCMRD); Lowell P. Thomas, Rosenstiel School of Marine and Atmospheric Science, University of Miami, Florida (UMML); Frank M. Truesdale, Louisiana State University, Baton Rouge, Louisiana; and Torben Wolff, Universitetets Zoologiske Museum, Copenhagen (ZMC). Thanks

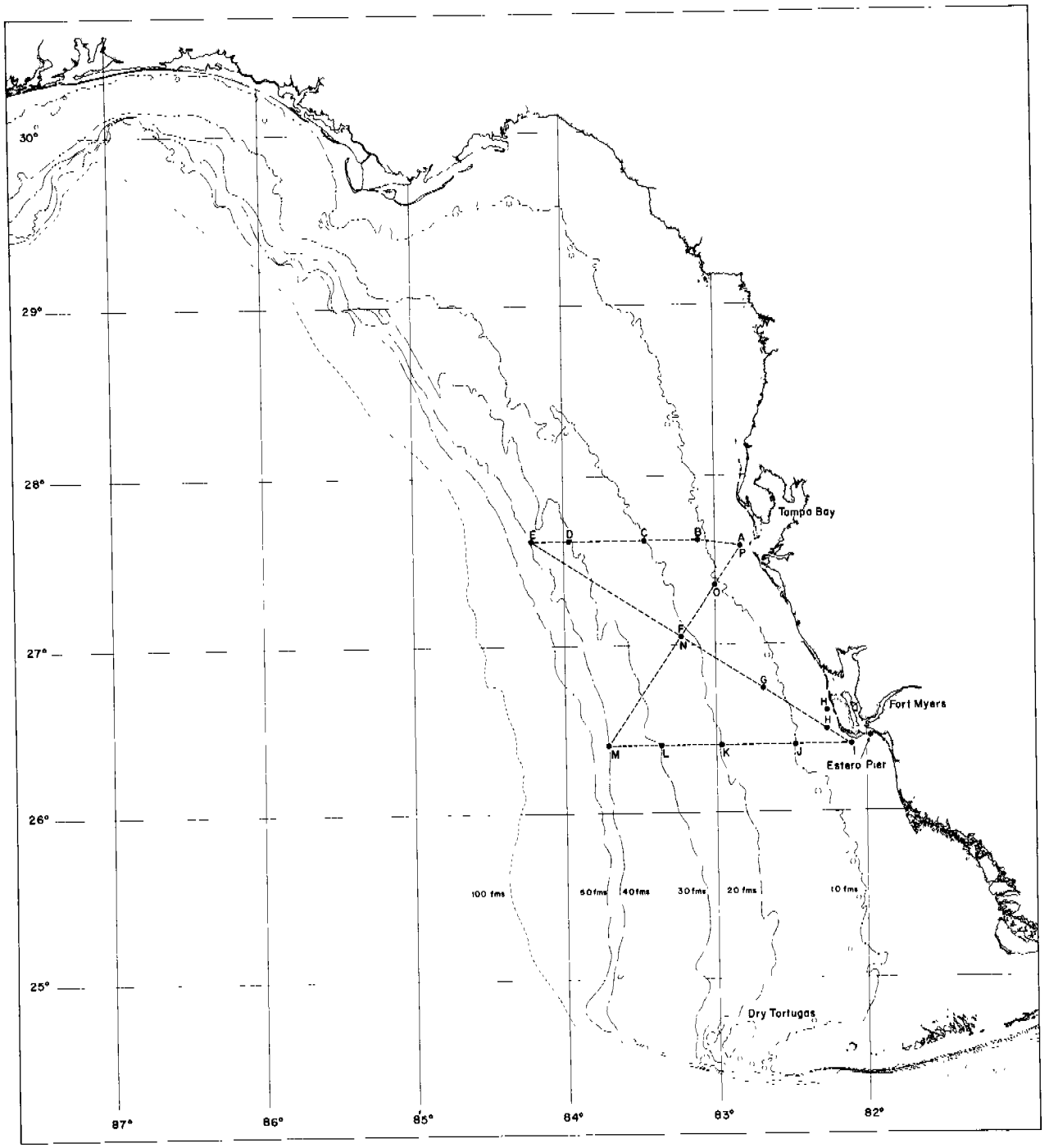


Figure 1. Hourglass cruise pattern and station locations.

for identifications of host shrimps are extended to L. G. Abele, Florida State University, Tallahassee, Florida, who identified many from the Hourglass collections (including those listed without attribution), Fenner A. Chace, Jr., National Museum of Natural History, Smithsonian Institution, who identified shrimps from Haiti and much of the material borrowed from USNM collections; M. R. Dardeau, Dauphin Island Sea Lab, Dauphin Island, Alabama, who identified several specimens of *Synalpheus*, corrected other identifications, and isolated some previously overlooked parasites; Julio García-Gómez, University of Miami, Florida, who identified many hosts in UMML collections including those taken by the University of Miami's vessels R/V *John*

TABLE 1. LOCATIONS AND DEPTHS OF BENTHIC HOURGLASS STATIONS.

| Station | Latitude* | Longitude* | Established Depth (meters) | Approximate Nautical Miles Offshore* |
|---|---|---|---|---|
| A | 27°35'N | 82°50'W | 6.1 | 4, due W of Egmont Key |
| B | 27°37'N | 83°07'W | 18.3 | 19, due W of Egmont Key |
| C | 27°37'N | 83°28'W | 36.6 | 38, due W of Egmont Key |
| D | 27°37'N | 83°58'W | 54.9 | 65, due W of Egmont Key |
| E | 27°37'N | 84°13'W | 73.2 | 78, due W of Egmont Key |
| I | 26°24'N | 82°06'W | 6.1 | 4, due W of Sanibel Island Light |
| J | 26°24'N | 82°28'W | 18.3 | 24, due W of Sanibel Island Light |
| K | 26°24'N | 82°58'W | 36.6 | 51, due W of Sanibel Island Light |
| L | 26°24'N | 83°22'W | 54.9 | 73, due W of Sanibel Island Light |
| M | 26°24'N | 83°43'W | 73.2 | 92, due W of Sanibel Island Light |

*U.S. Coast and Geodetic Chart No. 1003, dated June 1966.

*Elliot Pillsbury* and R/V *James M. Gilliss*. Daniel L. Adkison, Department of Biology, Tulane University, reported on material which he has collected in the Gulf of Mexico and will be describing. A. Veillet provided data on collections of P. Cornet in Haiti. L. B. Holthuis furnished a list of the currently accepted names of many caridean host species and made available numerous essential references. John A. Musick arranged for participation in a cruise of the University of Miami's R/V *Columbus Iselin*. Librarians at the University of Miami and the Bermuda Biological Station secured needed literature through interlibrary loans. Laboratory facilities were made available by Wolfgang E. Sterrer, Bermuda Biological Station for Research, Inc., where financial support from National Science Foundation Grant DEB-67-20102 was administered; the late Wilbur A. Markham, Arch Cape Marine Laboratory, Arch Cape, Oregon; Andrew G. Carey, Jr., School of Oceanography, Oregon State University, Corvallis, Oregon; and at their respective institutions (listed above) by David K. Camp, Robert H. Gore, and Thomas E. Bowman. Roland Bourdon and the late Sueo M. Shiino provided much helpful advice on systematic questions. Thomas E. Bowman made useful comments on a portion of the manuscript.

This report was made far easier to prepare by the invaluable identification, illustrations, and preliminary manuscript of the Hourglass material prepared by Robert J. Menzies and William L. Kruczynski. I wish to extend my sincerest thanks to Dr. Kruczynski for making the portion of that work treating the bopyrids available to me and allowing me to expand upon it. This report is dedicated to the memory of Dr. Menzies, whose death prevented his seeing it through to completion.

## METHODS AND MATERIALS

The Hourglass Cruises, described in detail by Joyce and Williams (1969), lasted 28 months (August 1965-November 1967) and included repeated, monthly trawl and dredge samples taken at night, at 10 locations on the central western Florida shelf in the Gulf of Mexico, at depths of 6-73 meters (Figure 1, Table 1). Stations B, C, and D were resampled each month during daylight. Although the Hourglass material forms the core of that examined for this report, supplemental material from many other sources was included to facilitate the preparation of a more complete review of the species under consideration. The second largest amount of material was collected by the author and colleagues at the University of Miami; it came mostly from southern Florida (including the Florida Keys), but also includes many samples from throughout the western

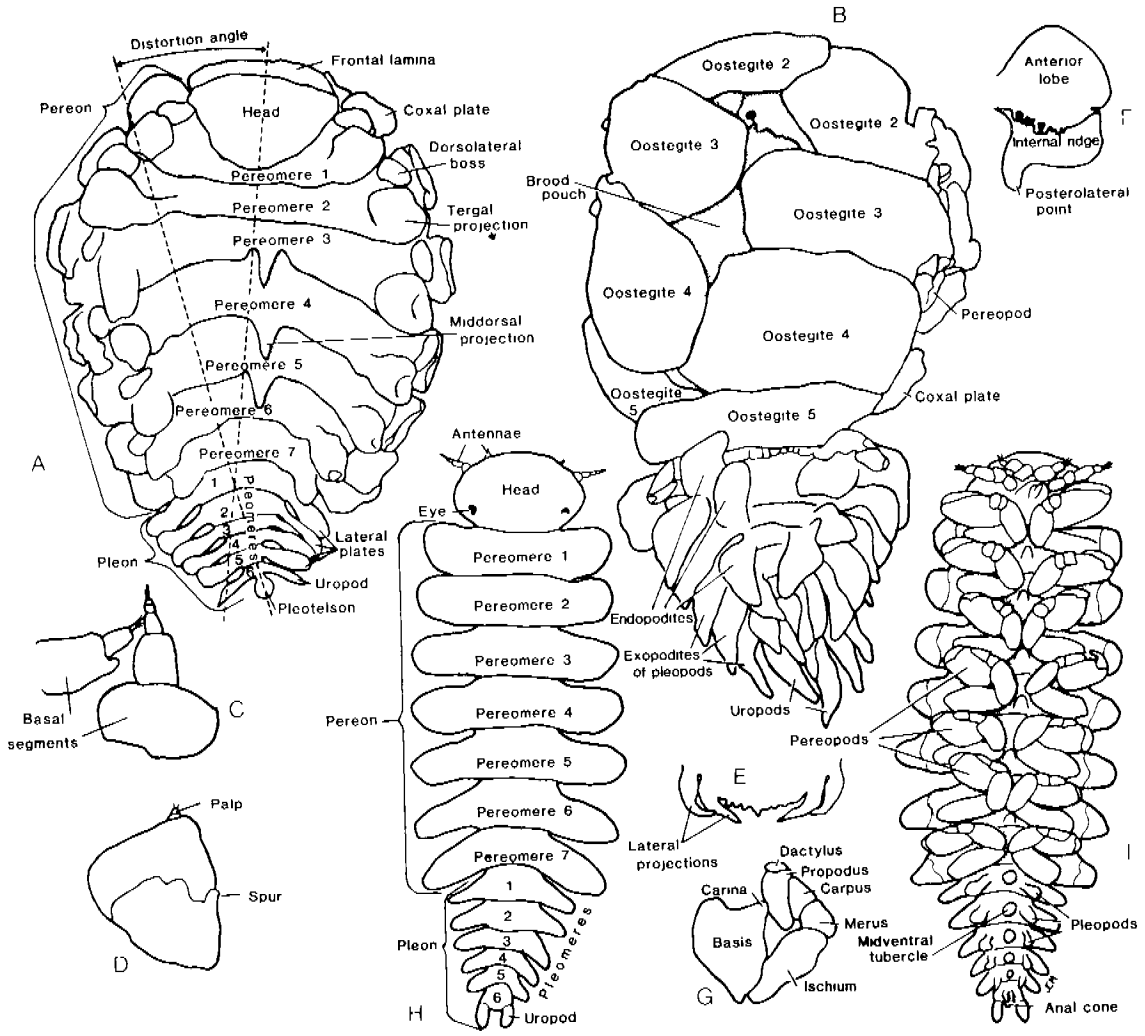


Figure 2. Composite bopyrid isopods illustrating morphological characters. A-G, female; H-I, male. A. Dorsal view. B. Ventral view. C. Antennae. D. Maxilliped. E. Posteroventral border of head. F. Oostegite 1, internal view. G. Pereopod. H. Dorsal view. I. Ventral view.

Atlantic. Other specimens came from numerous lots in the collections of ships' cruises, institutional museums, and private individuals. See credits in the Acknowledgments for details of these lots.

## MORPHOLOGICAL TERMS USED IN DESCRIBING BOPYRID ISOPODS

Morphological terms are still less standardized than desirable for isopods, including the Bopyridae. The accompanying labeled views of a hypothetical female and male (Figure 2) present the terminology used in this report. Although there is not always one word preferable over all others for a particular structure, I have tried to select terms which at least some authorities have used previously and to avoid any terms against which there are valid objections. I have followed the reasoning of Wolff (1956) for tanaidacean body regions in selecting the terms "pereon" and

"pleon". In the following glossary, a few definitions are modified from those of Moore and McCormick (1969). One must remember that the definitions presented here are intended to apply specifically to bopyrid isopods, so several of them are different from the definitions the same terms would have if applied to crustaceans in general.

ANAL CONE — Tapered projection beyond body surface, extending dorsally in females, ventrally to posteriorly in males, bearing anus.

ANTENNAE — Anterior paired appendages of head; both uniramous in adults; first reduced and often of three articles; second larger and often of five articles.

BROOD POUCH — Ventral region of pereon more or less enclosed by oostegites and containing eggs and developing larvae. Synonym, marsupium.

CONCAVE SIDE — Shorter side of female.

CONVEX SIDE — Longer side of female.

COXAL PLATE — Lateral expansion of pereopodal coxa partly or completely covering lateral edge of pereomere.

CRYPTONISCAN — Late larval stage.

DEXTRAL — With body axis distorted so right side longer and head displaced to left; among branchially infesting bopyrids, dextral females found in right gill chambers of hosts.

DISTORTION — Angle formed by intersection of lines drawn along longitudinal axes of head and pleon of female.

DORSOLATERAL BOSS — Rounded, knoblike process on anterolateral dorsal surface of pereomere of female.

ENDOPODITE — Inner (or ventral) ramus of pleopod or uropod.

EXOPODITE — Outer (or dorsal) ramus of pleopod or uropod.

FRONTAL LAMINA — Flaplike outgrowth of head, extending anteriorly and sometimes anterolaterally from head of female.

HEAD — Most anterior body region, unsegmented and bearing eyes, mouth, antennae, and maxillipeds. [In isopods, as well as other peracaridans, it is composed of the protomalacostracan head plus the first thoracic segment.] Synonym, cephalon.

LATERAL PLATE — Lateral extension of pleomere, often closely resembling pleopodal ramus.

MAXILLIPED — Paired mouth appendage, usually covering ventral surface of head in females, reduced to tiny flap in males.

MICRONISCAN — Earliest larva; form released from female's brood pouch.

MIDDORSAL BOSS — Rounded to pointed process arising from central dorsal region of pereomere of female.

MIDVENTRAL TUBERCLE — Conical projection arising from midventral region of pereomere and occasionally from pleomere or anterior region of pleon of male.

OOSTEGITE — Medially directed lamella arising from pereopodal coxa of female, enclosing brood pouch ventrally.

PALP — Anteromedial projection of maxilliped of female, often distinctly articulated.

PEREOMERE — One of seven somites or segments of pereon.

PEREON — Middle body region divided into seven pereomeres (first one often fused with head), each originally bearing pair of isomorphic grasping pereopods and, in female, bearing brood pouch ventrally.

PEREOPOD — Appendage of pereomere, originally of seven pairs, although one or more often missing in females of Hemiarthrinae; primitively of seven articles, some of which are occasionally lost through fusion.

PLEOMERE — Somite or segment of pleon; primitively six in number, often several are lost through fusion.

PLEON — Most posterior body region, consisting of up to six pleomeres (often fused into single piece in males), generally bearing paired pleopods and uropods. Synonym, abdomen.

PLEOPOD — Paired appendage of one of first five pleomeres; form ranging from flaplike and reduced to elongate and digitate, occasionally modified for respiration.

PLEOTELSON — Structure formed by fusion of one or more pleomeres with telson; that portion of terminal pleomere extending beyond bases of uropods.

SINISTRAL — Opposite in all respects to dextral, above.

SPUR - Projection of anteromedial corner of posterior segment of maxilliped.

TERGAL PROJECTION — Extended process on lateral posterodorsal surface of pereomere of female.

UROPOD — Paired appendage of terminal pleomere, often similar to rami of pleopods or lateral plates.

## SYSTEMATICS

### *HISTORICAL RÉSUMÉ*

The first record of a bopyrid isopod is apparently that of Deslandes (1724), who noted a parasite infesting a shrimp in France and considered it to be a larval fish. The next record was that of Fourgeroux de Bondaroy (1772), who identified the same parasite more accurately as an "insecte" and presented an acceptable description and drawings, which André (1940) reproduced for their historical interest. This same species was finally named *Monoculus crangorum* by Fabricius (1798). Latreille (1802) subsequently made it the type-species of *Bopyrus*, but considered the specific name inappropriate because it was based on the wrong host name, so he changed the name to *squillarum*.

Following the descriptions of a few new species, mostly in European waters, Leidy (1855) described the first species known from eastern North America, *Cepon* (now *Leidya*) *distortus*, a parasite of the fiddler crab *Uca pugilator* (Bosc, 1802) in New Jersey. Nonetheless, the papers which laid the basis of our knowledge of bopyrids in the northwestern Atlantic belong almost entirely to the present century. The first of Richardson's several carefully written papers treating bopyrids, especially of North America, was published in 1899, and her last in 1912. Most notable

was her monograph on the isopods of North America (Richardson, 1905a). From 1911 to 1953, Pearse wrote several papers including accounts of bopyrids from this region, but his work was much less careful, often suffering from misidentification, inadequate descriptions, and poor drawings. Some of his species remain unidentifiable because of improper preservation of his type-specimens. Nierstrasz and Brender à Brandis (1925, 1929, 1931) described many of the species of this region; their work was accurate, but their descriptions often were excessively brief. Schultz (1969) has recently published a semipopular update of Richardson's monograph, including coverage of the Bopyridae. Papers by Markham since 1972 have dealt with a few species at a time, mostly from the region considered here.

Heretofore, 28 species of bopyrid isopods infesting caridean shrimps in the northwestern Atlantic had been recorded, but several were inadequately described and assigned to the wrong genera. This report raises the number to 37 and reconsiders the systematic placement of all of them. The report draws on material collected throughout the northwestern Atlantic and considers all known published accounts of such species from that region, from the North Pole to the Equator and from the Midatlantic Ridge to North America, the Gulf of Mexico, and the Caribbean Sea, in marine and fresh waters.

The bulk of the material came from Florida, with material from the Hourglass Cruises forming the core of the collection, and specimens from Dade and Monroe Counties adding a major supplement. Because 23 of the 37 species known from the entire region occur in the waters of Florida, this emphasis seems justifiable.

For all species, complete synonymies based on all references known to the author are presented except where noted; for the exceptions, a note of explanation is in order. Where the species was either not examined or only recently reviewed, or there exist many secondary citations, as in textbooks, one of two types of shortened synonymy is used: "restricted synonymy" including only those citations of actual material examined or the introduction of new synonyms; or an "abreviated synonymy" containing only those citations of collections representing new hosts and/or localities.

## Family Bopyridae Rafinesque, 1815

*Diagnosis*: Female: Distinctly segmented, slightly to greatly asymmetrical, depressed. Head occasionally fused with first pereomere, sometimes enclosed by frontal lamina; antenna rudimentary; maxilliped of two segments, often with anteromedial palp; posteroventral border of head usually with one or two lateral projections on each side. All seven pereomeres usually distinct; pereopods reduced, usually of seven pairs, although up to six occasionally absent from one side; pereopods prehensile, dorsal to lateral, isomorphic; oostegites of five (rarely seven) pairs loosely fringing to completely concealing ventral surface. Pleon of three to six pleomeres with sides often produced into lateral plates resembling pleopodal rami; pleopods generally present on all but final pleomere; pleopods rudimentary or modified for respiration, uniramous or biramous, isomorphic; uropods, when present, terminal, uniramous or biramous, often of same form as pleopods or lateral plates. Male: Much smaller than female, at least twice as long as wide, symmetrical, distinctly segmented. Head rounded anteriorly, occasionally fused with first pereomere; antennae often prominent. Pereon of seven distinct pereomeres; pair of ventral, prehensile pereopods on each pereomere, usually isomorphic except first and sometimes second rarely conspicuously larger than others. Pleon of one to six pleomeres; if unisegmented, usually lacking appendages; if multisegmented, often with sessile to flaplike uniramous or biramous

pleopods on each pleomere but last; uropods, if present, uniramous or biramous and terminal. Ectoparasites of decapod crustaceans. (Modified after Sars, 1898, and Richardson, 1905a).

## KEY TO SIX SUBFAMILIES OF BOPYRIDAE OF WESTERN ATLANTIC, BASED ON MATURE FEMALES

(Those subfamilies not considered in this report indicated*)

1. Brood pouch not extending far beyond sides of pereon, at least partly formed by five pairs of loosely overlapping, stiff oostegites of nearly equal size; pleopods, when present, not pedunculate; infesting hosts branchially ..... 2

1. Brood pouch large, flaccid sac extending slightly to far beyond at least one side of pereon, tightly enclosed by flexible oostegites, usually fewer than five pairs and of unequal sizes; pleopods and lateral plates, when present, pedunculate; infesting hosts abdominally .... 5

2. Brood pouch completely enclosed by oostegites; usually infesting brachyurans or anomurans...3

2. Brood pouch usually completely open, most or all of ventral surface of pereon exposed (if brood pouch nearly closed, pleon almost fused or sharply twisted); infesting carideans ..... 4

3. Lateral plates sometimes absent, at most ovate, none directed forward; pleopodal rami ovate to lanceolate, both with smooth margins; infesting anomurans or, rarely, carideans..... ..... Pseudioninae (p. 9)

3. Lateral plates and pleopodal rami always present, elongate, with tuberculate to digitate margins; at least first lateral plates directed forward; infesting brachyurans..... Ioninae*

4. Head oval or fusiform, never fused with pereon; lateral plates pedunculate; pleopods knob-like, uniramous ..... Argeiinae (p. 16)

4. Head subrectangular or subtriangular or more or less fused with pereon; lateral plates, if present, not pedunculate; pleopods flaplike, usually biramous ..... Bopyrinae (p. 17)

5. Body often nearly symmetrical; brood pouch formed by oostegites on both sides of body and extending equally to both sides of pereon; infesting paguroids dorsoabdominally...Athelginae*

5. Body highly asymmetrical; brood pouch formed by oostegites on one side of body only and extending far to opposite side; infesting carideans ventroabdominally .... Hemiarthrinae (p. 94)

### Subfamily Pseudioninae R. Codreanu, 1967

*Diagnosis*: Female: Of rather primitive structure; all body segments separate; frontal lamina, coxal plates, and tergal projections usually moderately developed; oostegites completely enclosing brood pouch; usually some or all pleopods biramous; uropods usually present, either uniramous or biramous. Male: Head separated from pereon or lateral indentations indicating trace of separation. All pereomeres distinct, often with midventral tubercles. Pleon of one to six pleomeres, some often with midventral tubercles; if multisegmented, pleon usually bearing tuberculiform to flaplike pleopods on all but final pleomere; uropods present only in most primitive genera. Branchial parasites of anomurans and rarely of carideans and brachyurans. (Adapted from Codreanu, 1967.)

*Type-genus*: *Pseudione* Kossmann, 1881.

## KEY TO SPECIES OF *PSEUDIONE* INFESTING CARIDEAN SHRIMPS IN THE WESTERN ATLANTIC, BASED ON MATURE FEMALES

1. Head nearly centered at front of pereon; pleopods biramous..... *Pseudione*

1. Head displaced to anterolateral angle of pereon; pleopods uniramous ..... *Pontobopyrus*

### *Pseudione* Kossman, 1881

*Diagnosis*: Female: Body oval or pyriform; all segments distinct. Frontal lamina moderately developed. Coxal plates reduced; first oostegites with rounded posterolateral point. Six pleomeres, first five produced into moderately to greatly developed lateral plates; pleopods biramous, lanceolate; uropods usually uniramous, lanceolate. Male: Body generally smoothly tapered anteriorly and posteriorly from midpoint, although pleon occasionally abruptly wider or narrower than final pereomere; all body regions distinct. Anterior pereopods not markedly larger than others. Pleon of typical male 1/5 to 1/3 of total body length and of six pleomeres (occasionally aberrant specimens of some species with pleomeres variously fused and pleons proportionately shorter); pleopods uniramous, tuberculiform to flaplike; no uropods, but posterior border of terminal pleomere slightly to greatly produced into posterolateral points. Of worldwide distribution, infesting many kinds of anomurans, also some crangonids, pandalids, and nephropids.

*Type-species*: By monotypy and original designation, *Pseudione callianassae* Kossmann, 1881. Gender feminine.

## KEY TO SPECIES OF *PSEUDIONE* INFESTING CARIDEAN SHRIMPS IN THE WESTERN ATLANTIC, BASED ON MATURE FEMALES

1. Lateral plates greatly overlapping succeeding pleomeres ..... *Pseudione* species A

1. Lateral plates extending only to sides ..... 2

2. Frontal lamina large; some dorsolateral bosses well developed; pleopodal rami sharply tapered ..... *Pseudione affinis* (G. O. Sars)

2. Frontal lamina absent; no dorsolateral bosses; pleopodal rami rounded at ends..... ..... *Pseudione cognata*, n. sp.

### *Pseudione affinis* (G. O. Sars, 1882)

Abbreviated synonymy:

*Pleurocrypta affinis* Sars, 1882, pp. 68, 69, pl. 2, figs. 7, 8 [type-locality west coast of Norway; infesting *Pandalus leptorhynchus* Kinahan].

*Pseudione affinis*: Sars, 1898, pp. 201, 202, pl. 85, fig. 1 [Norwegian records; infesting pandalids]; Bourdon, 1968, pp. 188-194, figs. 55-59 [European records from Norway to Mediterranean; infesting pandalids]; 1972, pp. 107, 108, fig. 2 [Java Sea; infesting *Plesionika martia* (A. Milne Edwards)]; Al-Adhub and Bowers, 1977, pp. 229, 235 [Isle of Man; infesting *Dichelopandalus bonnieri* Caullery]; Markham, 1979a, pp. 523, 527 [Bermuda; infesting *Plesionika edwardsii* (Brandt)]; Bourdon, 1979b, p. 510 [Azores; infesting *P. antiguai* Zariquiey].

*Palaegyge plesionikae* Barnard, 1920, pp. 425, 426, pl. XVII, figs. 24, 25 [off Cape Point and Table Mountain, South Africa; infesting *Plesionika martia*]; Bourdon, 1972, pp. 105, 108 [synonymized with *Pseudione affinis*].

*Material examined*: None.

*Diagnosis*: Female: Nearly symmetrical, broadest near middle of pereon. Head bearing large frontal lamina extending slightly beyond pereonal margin. All pereomeres distinct, produced into tergal projections posteriorly to sides; first pereomere broader than final one. Rami of pleopods and uniramous uropods ending in sharply tapered points. Male: Body less than three times as long as broad, smoothly rounded, gently tapering toward each end. Head fusiform, much wider than long, only slightly extended. All pereomeres and pleomeres laterally separated and concave posteriorly. Pleopods slightly extended from pleomeral surfaces [derived from descriptions by Sars (1898) and Bourdon (1968)].

*Description*: See Sars (1898) or Bourdon (1968).

*Distribution*: Norway to France; southern Africa; Java Sea; Bermuda; Azores.

*Remarks*: Despite its remarkable and very disjunct geographical range, all known hosts of *Pseudione affinis* are closely related pandalid shrimps. Although the only published record of its occurrence in the western Atlantic is that from Bermuda (Markham, 1979a), D. L. Adkison (personal communication) has found a specimen tentatively identified as *P. affinis* off the coast of Virginia, where its host was *Plesionika tenuipes* (Smith).

## *Pseudione cognata*, new species

Figures 3, 4

*Material examined*: Infesting *Pontophilus gorei* Dardeau: HOURGLASS STATION E: 1 ♀ (HOLOTYPE, USNM 172351), 1 ♂ (ALLOTYPE, USNM 181841); 2 August 1966; dredge. — 3 ♀ (PARATYPES); 2 August 1966; trawl; USNM 181546. — OTHER MATERIAL: 1 ♀; R/V *Aquarius* Station 08, off Atlantic coast of Florida, 27°28'N, 79°56.5'W, 120 m; R. M. Avent, coll.; R. H. Gore, det. of host; 9 August 1974; 10 ft otter trawl; IRCZM 89: 3918.

*Description*: Holotype female (Figure 3): Length 2.02 mm, maximal width 1.17 mm, head length 0.44 mm, pleon length 0.57 mm, distortion of body axis 54°. All body segments and regions clearly set apart; body more or less evenly tapered, although first pleomere markedly wider than final pereomere (Figure 3A, B).

Head suboval, wider than long. No frontal lamina. Eyes near center, small but distinct. Antenna 1 (Figure 3C) of three articles, with setae distally; antenna 2 (Figure 3D) of five articles, each setose distally. Maxilliped (Figure 3E, F) with prominent, nonarticulate, setose palp and conspicuously separated posterior segment. Posteroventral border (Figure 3G) slightly undulate, entire, lacking lateral projections.

Pereon slightly broadest across pereomere 3. Sides of pereon somewhat irregular, with marked indentations between pereomeres; some pereomeres with mediolateral indentations. Dorsolateral bosses distinct on short sides of first two pereomeres, indistinct on long sides of pereomeres 2-5. No coxal plates. Oostegites almost completely enclosing brood pouch; oostegite 1 (Figure 3H, I) slightly pointed posteromedially, with unadorned internal ridge. Pereopods (Figure 3J-L) all about same size and proportions, long and slender, with all articles defined.

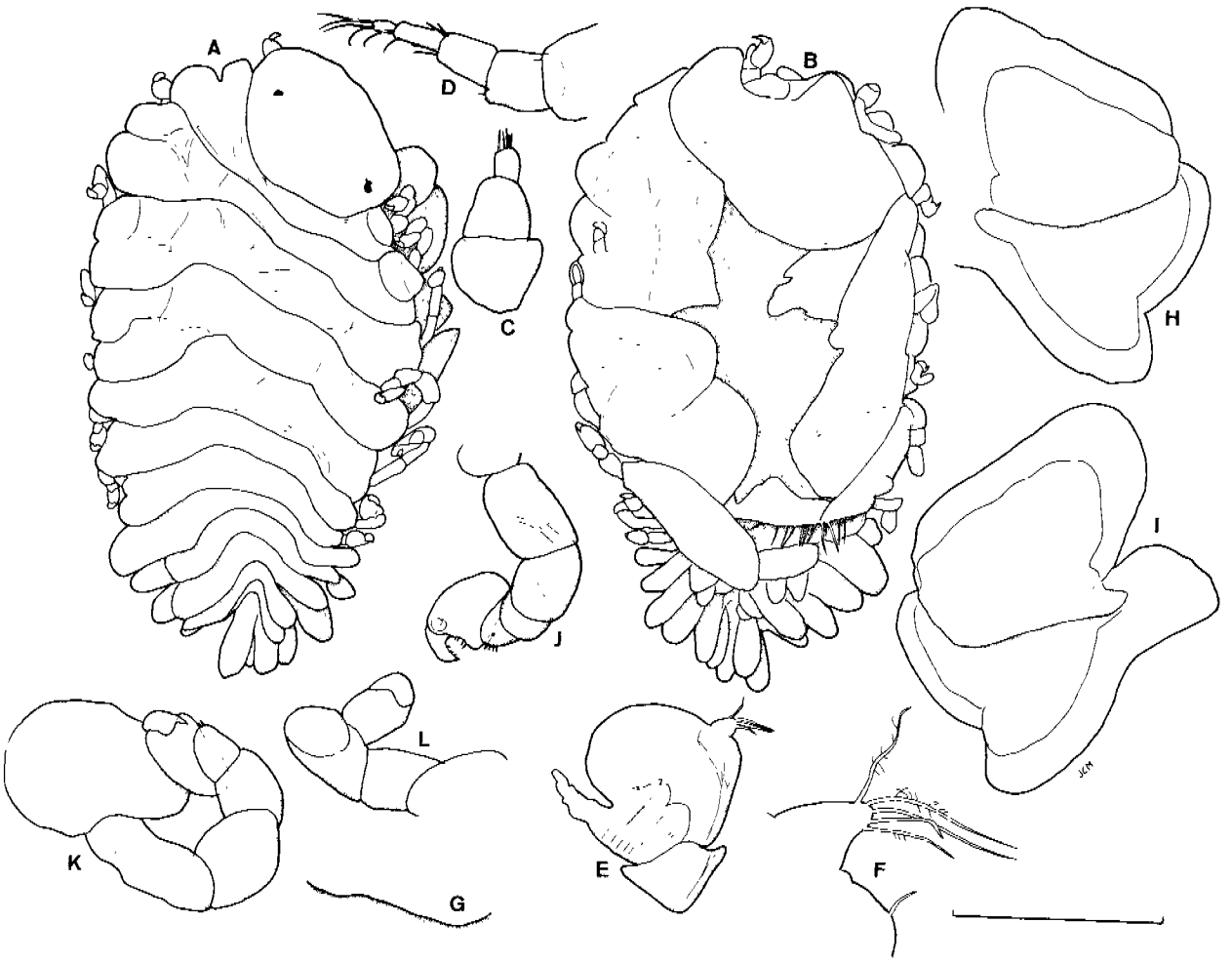


Figure 3. *Pseudione cognata*, n. sp., holotype ♀, USNM 172351. A. Dorsal view. B. Ventral view. C. Right antenna 1. D. Right antenna 2. E. Right maxilliped, internal view. F. Palp of same. G. Left posteroventral border of head. H. Left oostegite 1, external view. I. Same, internal view. J. Left pereopod 1. K. Right pereopod 4. L. Left pereopod 7. Scale 0.1 mm for C, D, F; 0.2 mm for J-L; 0.4 mm for E, G, H, I; 0.8 mm for A, B.

Pleon of six pleomeres, first five produced into tapered lateral plates; lateral plates on pleomere 1 exceeding width of others and of final pereomere. Pleopods of five pairs, all biramous, lanceolate. Uropods uniramous, of same shape and approximate size as pleopodal rami.

Allotype male (Figure 4): Length 0.72 mm, maximal width 0.28 mm, head length 0.15 mm, pleon length 0.24 mm. All body regions and segments distinctly separated, body nowhere abruptly narrowing (Figure 4A, B). Scattered pigment spots on dorsal surface.

Head suboval, wider than long, but somewhat narrower than any pereomere. Eyes near posterolateral corners, large, prominent. Antenna 1 (Figure 4C) of three articles, distal two bearing terminal setae. Antenna 2 (Figure 4D) of four or five articles, with distal tuft of setae on terminal article and scattered solitary setae elsewhere.

Pereon with nearly parallel sides. Pereomeres of nearly same length, separated only by shallow indentations. Pereopods (Figure 4E, F) of nearly same size but with dactyli progressively smaller posteriorly; all meri and carpi indistinctly separated.

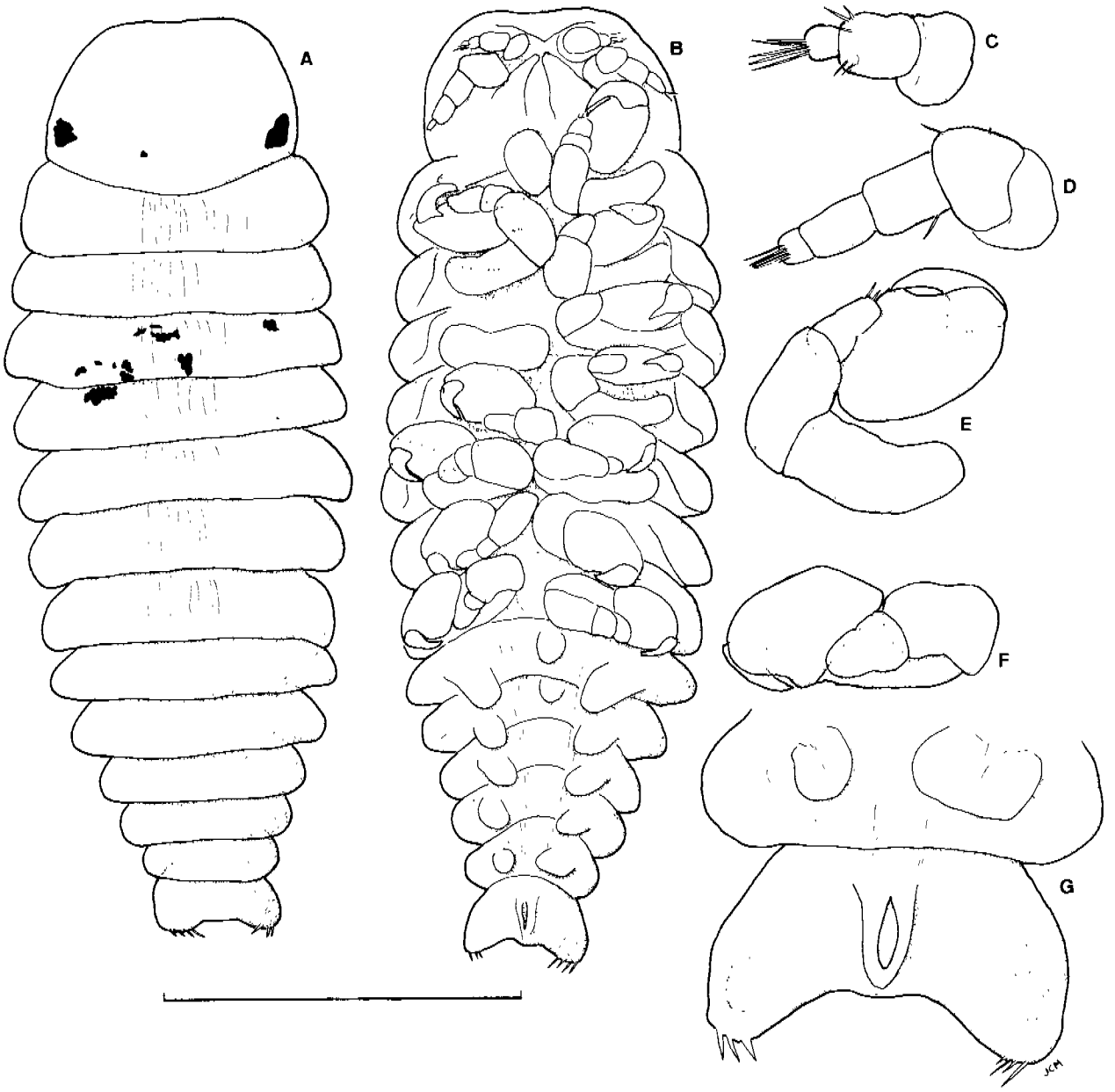


Figure 4. *Pseudione cognata*, n. sp., allotype ♂, USNM 181841. A. Dorsal view. B. Ventral view. C. Right antenna 1. D. Right antenna 2. E. Left pereopod 1. F. Right pereopod 7. G. End of pleon, ventral view. Scale 0.3 mm for A, B; 0.1 mm for C, D, G; 0.15 mm for E, F.

Pleon of six pleomeres, tapering evenly from width of pereon to somewhat less than half that width. All pleomeres of nearly same length, shorter than pereomeres. Midventral tubercles rounded, low, on first two pleomeres. Pleopods as extended flaps, mostly reaching well beyond posterior margins of pleomeres of origin, progressively shorter posteriorly. Terminal pleomere (Figure 4G) lacking uropods but produced into two setose lobes and marked ventrally by pair of indistinct sessile disks; prominent anal cone extending down from ventral surface and distending posterior margin slightly.

*Variations*: The Atlantic female has the pleopodal exopodites and uropods somewhat more extended than the holotype, while its endopodites are rather button-shaped.

*Type-locality*: Hourglass Station E, Gulf of Mexico, 27°37'N, 84°13'W; 73 m depth; 144 km west of Egmont Key, Florida.

*Host*: Presently known to infest only *Pontophilus gorei* Dardeau, 1980 (Crangonidae).

*Distribution*: Off both Atlantic and Gulf coasts of peninsular Florida.

*Etymology*: The specific name *cognata*, meaning "kindred" or "related," has been selected to emphasize the similarity of this species with *P. affinis* (G. O. Sars), whose specific name means "related to."

*Remarks*: The large subfamily Pseudioninae is composed of species which are almost all parasites of anomurans. Five previously known exceptions to this rule, parasites of carideans, are in the genus *Pseudione* (most of whose numerous species also infest anomurans). They are *P. affinis*, infesting pandalids of the genera *Pandalus*, *Dichelopandalus*, and *Plesionika* in northwestern Europe (Sars, 1898; Bonnier, 1900; Bourdon, 1968), the Java Sea (Carton, 1970; Bourdon, 1972) the Azores (Bourdon, 1979b), Bermuda (Markham, 1979a), and probably the Atlantic Ocean off Virginia (D. L. Adkison, personal communcation); *Pseudione indica* Chopra, infesting the crangonid *Pontophilus plebs* Kemp in the Bay of Bengal (Chopra, 1930); *Pseudione magna* Shiino, infesting the pandalid *Heterocarpus sibogae* de Man in Japan (Shiino, 1951); *Pseudione tattersalli* Nierstrasz and Brender à Brandis, infesting the pandalid *Plesionika ensis* (A. Milne Edwards) (Bourdon, 1972); and *Pseudione elongata* Hansen, represented by three subspecies infesting three different species of the nematocarcinid shrimp genus *Nematocarcinus* in the Galápagos (Hansen, 1897), the Philippines (Nierstrasz and Brender à Brandis, 1931), and off South Africa (Kensley, 1968). *Pseudione cognata* is similar to *P. affinis* and *P. indica*. Females of these three species have nonarticulating, setose maxillipedal palps, reduced coxal plates, and prominent pleonal lateral plates. The female of *P. cognata* differs from that of *P. affinis* by lacking a frontal lamina, in having a first oostegite with an entire internal ridge and the posterior extension central and blunt (rather than lateral and pointed), almost no development of dorsolateral bosses, and pleopodal rami bluntly rounded rather than sharply tapered; the female of *P. cognata*, in all of these respects, closely resembles the female of *P. indica*. It differs from *P. indica* by only a few minor points: in the female of *P. indica* the body is proportionately narrower, segmentation of pereomeres and pleomeres is less distinct, the pereopods have scales on the outer margins of several articles and relatively smaller bases, the terminal pleomere is conspicuous in dorsal view, and the pleopods are more widely separated. The male of *P. cognata* is similar to that of *P. affinis* in having sides of the pereon subparallel, similarly proportioned pereopods, midventral tubercles on the first two pleomeres, extended flaplike pleopods, and a posteriorly bilobate final pleomere. The male of *P. affinis* differs from that of *P. cognata* in having a proportionately much shorter head and narrower final pleomere; further, it lacks setae on the final pleomere. The male of *P. indica* is unknown.

*Pseudione* species A

*Material examined*: HOURGLASS MATERIAL: None. — OTHER MATERIAL: Infesting *Heterocarpus ensifer* A. Milne Edwards: 1 ♀, 1 ♂; U. S. Bureau of Commercial Fisheries R/V *Oregon* Station 1324, Gulf of Mexico, 23°24'N, 83°22'W; 360 m; July 1955; trawl; USNM 98677.

Infesting *Heterocarpus* sp. (? = *H. ensifer*): 2 ♀, 2 ♂; University of Miami R/V *John Elliott Pillsbury* Station P-1171, Cay Sal Bank, 23°45'N, 79°24'W; 512 m; 27 June 1970; 41 ft otter trawl; fine mud with shell and coral rubble; UMML.

*Diagnosis*: Female: Large (up to 20 mm long), only slightly distorted, outline smoothly oval. Head extending slightly beyond pereonal margin. Separation of pereomeres distinct; sides of pereomeres 1-4 bearing dorsolateral bosses. Lateral plates broad, triangular, all extending medioposteriorly, each greatly overlapping that behind it. Pleopodal exopodites and uropods slender, falcate, extended laterally; endopodites subtriangular, each overlapping that behind it. Male: Long, slender; sides nearly parallel. All body segments deeply separated laterally; head nearly as wide as first pereomere. Midventral tubercles on some pereomeres and pleomeres. Five pairs of tubiculiform pleopods.

*Description*: To be prepared.

*Remarks*: These specimens were unfortunately overlooked during preparation of this report and thus can be no more than mentioned. Thomas E. Bowman, who originally examined them, remarked on the close resemblance of both sexes to *Pseudione magna* Shiino, 1951, recorded as a parasite of *Heterocarpus sibogae* de Man, 1917, in Japan. Danforth (1976) reported it infesting *H. ensifer* in Guam. Despite having seen the specimens and concurring with that conclusion, I have not examined them adequately to determine whether they are actually conspecific with *P. magna*, a new subspecies of that species, or a closely related but distinct new species.

### *Pseudione* species B

*Material examined*: None.

*Remarks*: This species, probably new, has been recorded as a parasite of *Parapandalus* sp. in the Gulf of Mexico by D. L. Adkison (personal communication), who plans to prepare an account of it. For the present, its characters remain unknown, so it is impossible to key or diagnose it.

## *Pontobopyrus* Markham, 1979

*Diagnosis*: Female: Body axis describing nearly circular arc; all body segments set apart. Head deeply set into pereon and completely bordered anteriorly by large frontal lamina; maxilliped with articulating palp; posteroventral border of head bearing two pairs of lateral projections. Oostegites completely enclosing brood pouch. Six pleomeres deeply separated laterally, first five produced into elongate lateral plates and bearing small uniramous pleopods; final pleomere extending into long uniramous uropods. Male: Unknown. Host: Crangonid shrimp *Pontophilus*.

*Type-species*: By original designation, *Pontobopyrus abyssorum* Markham, 1979. Gender masculine.

*Remarks*: Only one species is known, *Pontobopyrus abyssorum* Markham.

### *Pontobopyrus abyssorum* Markham, 1979

*Pontobopyrus abyssorum* Markham, 1979b, pp. 769-772, fig. 1 [type-locality northwestern Atlantic Ocean, 38°04'N to 38°09'N, 70°22'W to 70°26'W, 3850 m; infesting *Pontophilus abyssi* S. I. Smith].

*Material examined*: None.

*Diagnosis*: As for genus.

*Description*: See Markham, 1979b.

*Distribution*: Known only from the type-locality, off Maryland.

## Subfamily Argeiinae Markham, 1977

*Diagnosis*: Female: Body rounded, from triangular to nearly circular; distortion to only 20°, either dextral or sinistral within species; all body regions and usually all segments distinct, none abruptly narrowing or extending out. Head much broader than long, oval to fusiform (exclusive of rare frontal laminae), posteroventral border with two or three lateral projections on each side, otherwise unornamented; maxilliped with articulated palp or at least tuft of setae indicating palp. Pereopods generally reduced; brood pouch usually wide open. Pleon of six pleomeres, first five bearing prominent lateral plates, pleomere six with uniramous uropods of essentially same size and shape as lateral plates; pleopods uniramous, usually five pairs, decreasing in size posteriorly, occasionally only first three or four pairs present, tuberculiform to shape of small oval flaps. Male: All body regions and pereomeres distinct. Head only about 1/10 of total body length, much shorter than broad, markedly narrower than pereon. Sides of pereon nearly parallel or diverging posteriorly. Pleon fused, as broad anteriorly as final pleomere, semicircular to subtriangular, with no indication of lost segmentation; all pleonal appendages completely absent. Branchial parasites of natantian shrimps of family Crangonidae and genera *Alpheus*, *Eualus*, and *Stenopus*. (From Markham, 1977a).

*Type-genus*: *Argeia* Dana, 1852.

*Remarks*: Only one genus, *Argeia*, is known from the western Atlantic.

### *Argeia* Dana, 1852

*Diagnosis*: Female: Body ovoid, about 3/4 as wide as long, only slightly distorted; all body regions and segments distinct. Head subrectangular, wider than long; maxilliped palp articulated or not, always setose; posteroventral border of head with two or three short lateral projections on each side. Pereomeres either bearing coxal plates or prominently divided laterally; oostegites surrounding but not covering brood pouch, first oostegite usually with large, rounded postero-lateral point. Pleon of six pleomeres, first five produced into prominent oval to lanceolate lateral plates; pleopods all uniramous and often reduced to knobs on ventral surface, especially posteriorly; uropods uniramous, of same size and shape as lateral plates. Male: Body about three times as long as wide. Head generally much narrower than pereon. Pereomeres distinctly separate, all of nearly same width. Pleon triangular, ending in broadly to sharply rounded point. Branchial parasites of crangonid shrimps (except one species infesting *Alpheus* spp.).

*Type-species*: By monotypy, *Argeia pugettensis* Dana, 1852. Gender feminine.

*Remarks*: Only one species is known from the western Atlantic, *Argeia atlantica* Markham.

### *Argeia atlantica* Markham, 1977

"Bopyrid Isopod": Sivertsen and Holthuis, 1956, p. 40 [southeast of Newfoundland, 42°59'N, 51°15'W, 1100 m; infesting *Sclerocrangon jacqueti* (A. Milne Edwards)].

*Argeia atlantica* Markham, 1977a, pp. 110, 115-118, figs. 1, 2 [type-locality Tongue of the Ocean, Bahamas, 1298-1342 m; infesting *S. jacqueti*].

"A new species of *Argeia*": Wenner, 1978, p. 1061 [Middle Atlantic Bight off east coast of United States; infesting *S. jacqueti*].

*Material examined*: HOURGLASS MATERIAL: None. — OTHER MATERIAL: Infesting *Sclerocrangon jacqueti* (A. Milne Edwards) (all hosts det. by E. L. Wenner): 2♀; University of Miami R/V *James M. Gilliss* Station 90, off North Carolina, 36°29.5'N, 74°40.4'W; 630-730 m; November 1974; 13.7 m semi-balloon otter trawl; USNM. — 1 ♀; Duke University R/V *Eastward* Station 30, off Delaware, 38°52.8'N, 72°45.7'W; 975-1090 m; April 1973; 9.1 m semi-balloon otter trawl; USNM.

*Diagnosis*: Female: Maxilliped with small, setose, articulating palp; posteroventral border of head with two small, pointed lateral projections on each side. Coxal plates on first three pereomeres; first oostegite truncate posteriorly; no carinae on pereopodal bases. Slight middorsal ridge along pleomeres 2-4; small midventral tubercles on pleomeres 4 and 5. Male: Head slightly narrower than first pereomere; second antenna of five articles. Pleon only about 1/4 total body length, as broad anteriorly as final pereomere, ending in broadly rounded point.

*Description*: See Markham, 1977a.

*Distribution*: Deep water of western Atlantic from off Newfoundland, Delaware, Virginia, North Carolina, and Bahamas.

*Remarks*: These specimens agree well with the published description, so further details are not given here. *Argeia atlantica* is known only from deep water (630-1342 m), on a single host species, over a large range in the northwestern Atlantic. It is the only representative of its subfamily known from any part of the Atlantic Ocean.

## Subfamily Bopyrinae Rafinesque, 1815, emend. R. Codreanu, 1967

*Diagnosis*: Female: Frontal lamina usually absent. Pereomeres usually distinct, although first occasionally fused with head and/or second pereomere; coxal plates and dorsolateral bosses reduced; oostegites surrounding but usually not covering brood pouch; all pereopods present but greatly reduced. Pleomeres separate or variously fused, often defined on only one side; lateral plates and uropods absent; pleopods reduced, posterior ones often absent. Male: Pleon partly to completely fused, pleomeres not widely separated, although often distinguishable at least laterally; pleopods sessile if present; no uropods. Branchial parasites of caridean shrimps. (Adapted from Codreanu, 1967).

*Type-genus*: *Bopyrus* Latreille, 1802.

## KEY TO GENERA OF BOPYRINAE IN WESTERN NORTH ATLANTIC, BASED ON MATURE FEMALES

1. Pleon sharply rotated, with posterior edge pointing forward ..... *Bathygyge*
1. Pleon extending straight back or nearly so ..... 2
2. Head and pereon separate ..... 3
2. Head and pereon fused at least medially ..... 11
3. Pleomeres (five to six in number) separate and laterally distinct ..... 4
3. Pleomeres fused at least medially or on short side or not laterally distinct ..... 10
4. Five pairs of biramous pleopods ..... 5
4. Three or four pairs of uniramous or biramous pleopods ..... 8
5. Maxilliped palp distally setose, articulating with maxilliped ..... *Probopyrinella*
5. Maxilliped palp differing from above or absent ..... 6
6. Maxilliped palp absent, corner of maxilliped with only tuft of setae ..... *Urobopyrus*
6. Maxilliped palp present ..... 7
7. Two lateral projections on each side of posteroventral border of head; first oostegite extended into prominent posterolateral point ..... *Probopyrus*
7. One lateral projection on each side of posteroventral border of head; first oostegite lacking posterolateral point ..... *Parabopyriscus*
8. Pleopods biramous ..... *Probopyria*
8. Pleopods uniramous ..... 9
9. Pleopods as distinct flaps; maxilliped palp articulating with maxilliped ..... *Schizobopyrina*
9. Pleopods as obscure ridges; maxilliped palp not articulating with maxilliped ..... *Bopyroides*
10. Pleomeres distinctly separated on long side but completely fused on short side ..... *Bopyrina*
10. Pleomeres not distinctly separated nor completely fused on either side, although separations very obscure ..... *Bopyrione*
11. Pleopods biramous ..... 12
11. Pleopods uniramous ..... 14
12. Head fused with first pereomere only medially; body oval ..... *Ovobopyrus*
12. Head completely fused with first pereomere; body elongate ..... 13
13. Pleomeres fused, sutures not indicated laterally ..... *Bopyrella*
13. Pleomeres separate, sutures deeply incised laterally ..... *Parabopyrella*
14. Five pairs of pleopods ..... *Bopyrinella*
14. Four pairs of pleopods ..... *Synsynella*

## *Bathygyge* Hansen, 1897

*Diagnosis*: Female: Body almost circular. Coxal plates large; oostegites about half closing brood pouch. Small pleon sharply rotated on itself, of six clearly separated pleomeres lacking lateral plates; pleopods and uropods biramous. Male: All body regions and pereomeres distinct. Propodus of each pereopod produced into ventrodistal projection receiving tip of dactylus. Pleon fused, ovate, bulbous, about 1/4 total body length, lacking appendages and most traces of segmentation.

*Type-species*: By monotypy and original designation, *Bathygyge grandis* Hansen, 1897. Gender feminine.

*Remarks*: Only one species is known, *Bathygyge grandis* Hansen.

## *Bathygyge grandis* Hansen, 1897

Restricted synonymy:

*Bopyrus* [sp.]: Faxon, 1895, p. 140.

*Bathygyge grandis* Hansen, 1897, pp. 122-124, pl. V, figs. 2-2c [type-locality off Acapulco, Pacific coast of Mexico, 16°33'N, 99°52'32"W; infesting *Glyphocrangon spinulosa* Faxon]; Stebbing, 1908, pp. 57-59, pl. XXXIII [off Cape Point, South Africa, 800-900 fm (=1460-1650 m); infesting *Glyphocrangon sculpta* (S. I. Smith)]; Wenner, 1978, pp. 1058-1061 [continental slope of Middle Atlantic Bight, off eastern United States; infesting *G. sculpta* and *G. longirostris* (S. I. Smith)].

?*Bathygyge* [sp.]: Bourdon, 1967c, p. 857 [Canary Islands; infesting *Glyphocrangon* sp. (probably *G. sculpta* or *G. longirostris*)]; 1979b, p. 510 [ Azores; infesting *G. longirostris*].

*Material examined*: HOURGLASS MATERIAL: None. — OTHER MATERIAL: Infesting *Glyphocrangon sculpta* (S. I. Smith): 1 ♀, 1 ♂; University of Miami R/V *James M. Gilliss* Station 96, off coast of Virginia, 37°08.6'N, 75°57.6'W, 2088-2170 m; November 1974; E. L. Wenner, det. of host; USNM.

Infesting *Glyphocrangon longirostris* (S. I. Smith): 1 ♀, 1 ♂; R/V *James M. Gilliss* Station 25, off coast of Virginia, 37°07.9'N, 73°53.2'W, 2250-2375 m; January 1976; E. L. Wenner, det. of host; in collection of D. L. Adkison.

*Diagnosis*: As for genus.

*Description*: See Hansen, 1897, or Richardson, 1905a.

*Distribution*: See *Remarks*.

*Remarks*: Because D. L. Adkison (personal communication) intends to redescribe this species and reconsider its systematic position in detail, it is not described or figured here. Preliminary examination indicates that despite its great geographical range (in rather deep water off western Mexico, South Africa, and both sides of the North Atlantic), all specimens so far assigned to *Bathygyge grandis* do properly represent a single species. Throughout that range, though, it is

known to infest only three species of the deep-water genus *Glyphocrangon* and is the only bopyrid known to infest any species of that genus. In these patterns of geographical, bathymetric, and host distribution, *B. grandis* closely resembles *Pseudione affinis*, discussed above. Although *Bathygyge grandis*, the only species of its genus, is here treated as a member of the Bopyrinae, it also exhibits close affinities to some other bopyrid subfamilies. The peculiar torsion of the female pleon, as well as some other characters, indicates that it probably should be reassigned to a subfamily of its own.

### *Probopyrinella* Nierstrasz and Brender à Brandis, 1929

*Diagnosis*: Female: Head distinctly separated from pereon, bearing large frontal lamina and single posterolateral extension on each side of posteroventral margin; maxilliped with articulating sentose palp but no spur. First two or three pereomeres notched on lateral margins of longer side; all pereomeres distinctly separated by lateral indentations; oostegite 1 very broad posteriorly, other oostegites leaving brood pouch wide open; pereopods isomorphic. Pleon of six distinct pleomeres separated by lateral indentations on long side only; five pairs of biramous pleopods, rami in form of extended oblong to sublanceolate flaps; no uropods. Male: At least three times as long as broad. Head distinct from pereon, trapeziodal in outline, with anterior margin truncate; antennae both of three articles. Pereomeres deeply separated laterally; each pereopod with ischium and merus more or less fused. Pleon of six pleomeres, distinct dorsally and laterally but not ventrally; usually five pairs of indistinct pleopods represented by sessile, chitinous rings; final pleomere extended and lacking appendages. Host in hippolytid genus *Latreutes*.

*Type-species*: By original designation, *Bopyroides latreuticola* Gissler, 1882. Gender feminine.

*Remarks*: Only one species is known, *Probopyrinella latreuticola* (Gissler).

### *Probopyrinella latreuticola* (Gissler, 1882)

Restricted synonymy:

*Bopyroides latreuticola* Gissler, 1882b, pp. 591-594, figs. 1-3 [type-locality Beaufort, North Carolina; infesting *Latreutes fucorum* (Fabricius)].

*Bopyrus latreutis* Bate, 1888, p. 584 [type-locality near Azores; infesting *L. fucorum*].

*Bopyrina latreuticola*: Bonnier, 1900, pp. 370-373; Schultz, 1969, p. 335, fig. 540.

*Probopyrus latreuticola*: Richardson, 1905a, pp. 560, 561, figs. 614-616; Fine, 1970, pp. 118, 119 [several localities in Sargasso Sea; infesting *L. fucorum*].

*Probopyrinella latreuticola*: Nierstrasz and Brender à Brandis, 1929, p. 26 [Sargasso Sea; infesting *L. fucorum*]; Markham, 1977b, pp. 189-196, figs. 1-3 [localities in western Atlantic; infesting *L. fucorum*; synonymy, summary of records, systematic history, diagnostic characters].

*Bopyrella asymmetrica* Nierstrasz and Brender à Brandis, 1929, pp. 35, 36, figs. 44, 45 [type-localities Sargasso Sea and Virgin Islands; infesting *L. fucorum*].

*Material examined*: HOURGLASS MATERIAL: None. — OTHER MATERIAL: Infesting *Latreutes fucorum* (Fabricius): 1 ♀; 10 m offshore, Haulover Canal, Indian River, Brevard County, Florida, intertidal; 14 November 1974; posthole digger; D. K. Young et al., coll.; M. A.

Capone, det. of host; IRCZM 89: 3907. — 1 ♀, 1 ♂; in floating *Sargassum* at surface, 20 miles east of sea buoy at Fort Pierce Inlet, Florida; 21 April 1972; dip net; V.C. Goldezen et al., coll.; R. H. Gore, det. of host; IRCZM 89: 3910. — 1 ♀, 1 ♂; Atlantic Ocean north of Marsh Harbor, Virgin Gorda, Virgin Islands; 5 April 1978; K. Rodman, coll.; IRCZM 89: 3908. — 3 ♀, 3 ♂; University of Miami R/V *Columbus Iselin* Station, Sargasso Sea, 28°30.4'N, 76°31.7'W; 12 February 1978; 505 $\mu$ neuston net, in 27.3 kg *Sargassum* at surface; J. C. Markham, coll. and det. of hosts; unassigned.

*Diagnosis*: As for genus.

*Description*: See Richardson, 1905a, and supplementary notes by Markham, 1977b.

*Distribution*: From the Gulf of Mexico and the Caribbean Sea to North Carolina and through the Sargasso Sea region to the Azores.

*Remarks*: *Probopyrinella latreuticola* is a common and widespread parasite of the hippolytid shrimp *Latreutes fucorum* (Fabricius). This shrimp, earlier often recorded under the synonym *L. ensiferus* Stimpson, is the most abundant decapod species found on *Sargassum*. *Probopyrinella latreuticola* is its only known branchial parasite.

## *Urobopyrus* Richardson, 1904

*Diagnosis*: Female: Broader than long, oval. Head distinctly separated from pereon and extending beyond it; anterior margin covered by reflexed frontal lamina; maxilliped without palp but with setae on anteromedial corner; posteroventral margin with two pairs of curved lateral projections. Large dorsolateral bosses on both sides of pereomeres 1-4; pereopods elongate. Pleon of six distinct pleomeres; five pairs of large, biramous, foliaceous pleopods; uropods biramous with linear rami. Male: Nearly three times as long as broad; sides of body smoothly tapered. Head separate from pereon. All pereomeres separated by lateral indentations; merus and carpus of each pereopod more or less fused; dactyli of pereopods 1 and 2 much larger than others. Six distinct pleomeres separated laterally; five pairs of small, obscure, tuberculiform pleopods; no uropods. Hosts in family Processidae.

*Type-species*: By monotypy, *Urobopyrus processae* Richardson, 1904. Gender masculine.

*Remarks*: Only one species is known, *Urobopyrus processae*.

## *Urobopyrus processae* Richardson, 1904

Figures 5, 6

Bopyride?: Bonnier, 1900, p. 381 [Golfe de Marseille; infesting *Processa edulis* (Risso)].

*Urobopyrus processae* Richardson, 1904, pp. 86, 87, fig. 92 [type-locality Mid-Atlantic Ridge off South America, 06°59'30"N, 34°47'W; infesting *Processa fimbriata* Manning and Chace]; Monod, 1923, p. 22 [Monaco; infesting *P. canaliculata* Leach]; Caroli, 1934, p. 235 [Golfo di Napoli; infesting *P. canaliculata*]; Rouch and Taberly, 1961, pp. 3-6, 8-14; 1962, p. 3; Bourdon, 1968, pp. 133, 334-339, 363, 383, 409, figs. 151-157, tabs. 52-57, graphs 22, 23 [Mediterranean coast of France, infesting *P. edulis*; France and Napoli, infesting *P. acutirostris* Nouvel and Holthuis]; 1971, p. 371 [Pointe Noire, Congo; infesting *Processa* n. sp.]; Abele, 1972, p. 366; Bourdon and Pike, 1972, p. 154; Coelho and Koenig, 1972, p. 256, tab. I; Nöel, 1976, pp. 82-84 [Banyuls, France; infesting *P. acutirostris*].

*Urobopyrus processi* [sic]: Richardson, 1904, p. 87.

*Urobopyrus* sp.: Hutton and Sogandares-Bernal, 1960, p. 288 [Boca Ciega Bay, Florida; infesting *Ambidexter symmetricus* Manning and Chace]; Bourdon, 1963, p. 428 [Roscoff, France; infesting *P. edulis*]; Hutton, 1964, p. 447.

*Urobopyrus provisorius* Rouch and Taberly, 1961, pp. 4-23, pls. I-IV [type-localities Mediterranean coast of France; infesting *P. acutirostris*]; 1962, pp. 3-15, pls. I-III.

?"Bopyrid isopod": Coen and Heck, 1983, pp. 207, 221, tab. 2 [near Caribbean entrance to Panama Canal; infesting *Ambidexter symmetricus*].

*Material examined*: Infesting *Processa tenuipes* Manning and Chace: HOURGLASS STATION E: 1 ♀; 4 March 1966; trawl; FSBC I 23853. — 1 ♀ (damaged); 2 August 1966; dredge; FSBC I 23854. — 1 ♀ (reference ♀) hyperparasitized by cabiropsid isopod; 6 October 1967; dredge; USNM 181547.

Infesting *Processa fimbriata* Manning and Chace: HOURGLASS MATERIAL: None. — OTHER MATERIAL: 1 ♀ (HOLOTYPE); United States Fisheries steamer *Albatross* Station 2758, off Cabo de São Roque, Brazil, 06°59'30"S, 34°47'W, 37 m; broken shell bottom; 16 December 1887; bag dredge; USNM 29098.

Infesting *Ambidexter symmetricus* Manning and Chace: HOURGLASS MATERIAL: None. — OTHER MATERIAL: 2 ♀ (1 damaged), 1 ♂ (reference ♂); east of Cabbage Key, Boca Ciega Bay, Gulf coast of Florida; 5 May 1958; USNM 101765.

Infesting *Ambidexter* n. sp.: HOURGLASS MATERIAL: None. — OTHER MATERIAL: 1 ♀, 1 ♂; Tarpon Springs, Florida; 28-29 September 1976; Florida Power Corporation Survey; USNM 181838.

*Description*: Reference female (Figure 5A-H): Body oval, smoothly rounded. Length 3.00 mm, maximal width 3.80 mm, head length 0.55 mm, head width 1.19 mm, pleon length 1.05 mm. Body axis doubly distorted, but only slightly so, 12° anteriorly, 8° posteriorly (Figure 5A, B).

Head distinctly set off from pereon and extending somewhat beyond its outline. Reflexed frontal lamina along anterior margin but not reaching laterally. Antennae obscure. Antennae of other female (Figure 5J, K) of three and two articles, respectively; both rather unusually proportioned. Posteroventral border (Figure 5C) with two subequal posterolateral projections on each side, outer one overlapping inner one; middle region produced into two obtusely angled convexities. Maxilliped (Figure 5D) without palp but with setose anteromedial corner, notched (abnormally) adjacent to that.

Pereomeres all distinct, separated by rather deep dorsal depressions. Most pereomeres bearing dorsolateral bosses and coxal plates; posterior margins of several produced into flaps extending over succeeding pereomeres. Oostegite 1 (Figure 5E, F) produced into centrally placed, triangular, posterolateral point; internal ridge unornamented. Other oostegites irregularly placed around brood pouch without enclosing it; all with some setae along posterior margins. Pereopods (Figure 5G, H) small, slender, of about same size.

Pleon of six distinct pleomeres somewhat separated laterally but not produced into lateral plates; terminal pleomere triangular, nearly surrounded by preceding one. Five pairs of biramous pleopods with large flaplike rami; endopodites suborbicular and completely covering ventral surface of pleon; exopodites obovate and extending far beyond margins of pleon. Uropods biramous, lanceolate rami extending far posteriorly.

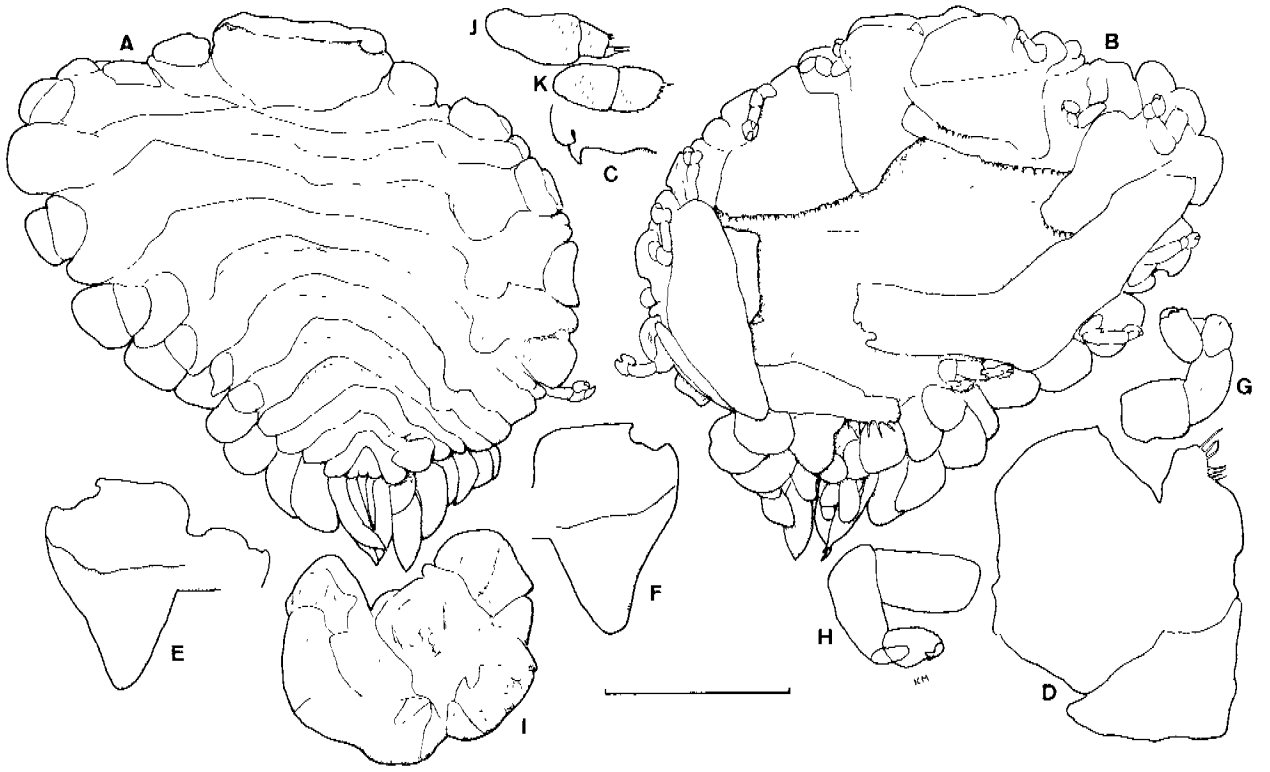


Figure 5. *Urobopyrus processae* Richardson, reference ♀, USNM 181547. A. Dorsal view. B. Ventral view. C. Posteroventral border of head. D. Right maxilliped. E. Right oostegite 1, internal view. F. Same, external view. G. Right pereopod 1. H. Left pereopod 7. I. Hyperparasite. J. Left antenna 1. K. Left antenna 2. Scale 1.2 mm for A-C, I; 1.0 mm for E, F; 0.2 mm for D, G, H; 0.1 mm for J, K.

Reference male (Figure 6): Length 1.79 mm, maximal width 0.50 mm, head length 0.20 mm, head width 0.36 mm, pleon length 0.49 mm. Sides of body subparallel, narrowing greatly toward each end (Figure 6A, B).

Head oval, nearly twice as wide as long, conspicuously set off from pereon and separated from it by deep lateral notches. Antenna 1 (Figure 6C) of three articles, all bearing long setae; antenna 2 (Figure 6D) of two articles, only distal one setose.

All pereomeres sharply separated by deep lateral notches. Indistinct middorsal ridges along pereon. No midventral tubercles. Pereopods (Figure 6E, F) diminishing in size posteriorly; first two pairs with dactyli far larger than those of other five pairs and with setae on distal articles; most meri and carpi fused but some obscurely separated.

Pleon of six distinct pleomeres, all separated laterally. Pleomere 1 (Figure 6G) with many setae extending into posterior concave region. Tuberculiform pleopods on pleomere 1 only (Figure 6G). Final pleomere (Figure 6H, I) subcordate, prominently extended, with long, low anal cone; no uropods, but tuft of setae on each corner.

Hyperparasitic female cabiropsid isopod (Figure 5I), probably *Cabirops* n. sp., removed from brood pouch, showing too little morphology to allow identification or description.

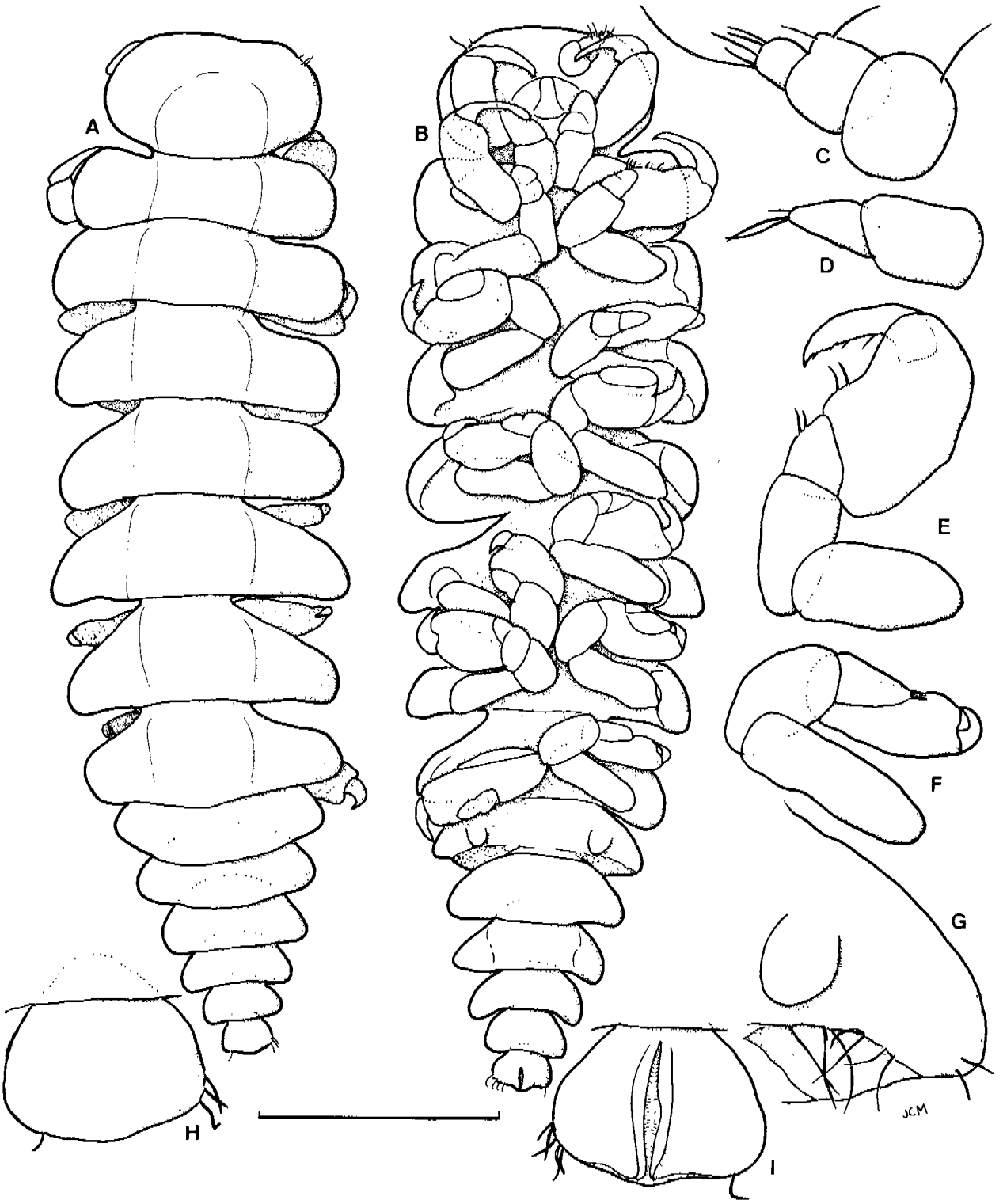


Figure 6. *Urobopyrus processae* Richardson, reference ♂, USNM 101765. A. Dorsal view. B. Ventral view. C. Right antenna 1. D. Right antenna 2. E. Right pereopod 1. F. Left pereopod 7. G. Left side pleomere 1, ventral view. H. Final pleomere, dorsal view. I. Same, ventral view. Scale 0.4 mm for A, B; 0.2 mm for E, F; 0.1 mm for C, D, G-I.

*Distribution*: Mediterranean Sea; off the Congo River mouth; Gulf of Mexico; southwestern Caribbean Sea (?); Brazil.

*Remarks*: Despite its great and highly disjunct range, *Urobopyrus processae* displays a rather restricted selection of hosts, all those known belonging to the processid genera *Processa* and *Ambidexter*. Bourdon (1968) considered all European citations of a *Urobopyrus* to refer to this species, which thus remains the sole member of the genus.

The parasites of *Ambidexter symmetricus* collected near the Caribbean entrance to the Panama Canal (Coen and Heck, 1983) probably belong to *U. processae*. Unfortunately, the specimens could not be located (L. D. Coen, personal communication), so I was unable to examine them.

The other females examined differ only slightly from the reference specimen. The maxilliped pictured (Figure 5D) is evidently abnormal, all others lacking the notch on the anterior margin and extending straight from the setose corner. In some cases the middle region of the anteroventral border of the head is more conspicuously produced, and one has more curved first oostegites. Bourdon (1968), without providing illustrations, reported that each of the antennae consists of three articles, in contrast with the peculiar appearing two-articled second antenna (Figure 5K) found here; in most females the antennae were not visible. Lengths of the females examined range from 1.70 to 4.40 mm, and ratios of lengths to widths of four undamaged females examined vary from 0.79 to 0.84. Of the seven females examined, five were dextral and two sinistral.

The male of *U. processae* depicted by Bourdon (1968) is proportionately shorter and has more rounded sides. Bourdon reported three articles on the antennae. He failed to mention that the dactyli of the first two pereopods are much larger than the others, although he examined the same male from Boca Ciega Bay described herein. He referred to indistinct pleopods on some more posterior pleomeres that became barely visible only after an unspecified treatment, but there was no evidence of them in the material I examined.

### *Probopyrus* Giard and Bonnier, 1888

*Diagnosis*: Female: Body subcordate in outline, with anterior margin nearly straight and distortion slight. Head distinct from pereon but deeply set into it and often completely bisecting first pereomere dorsally; frontal lamina small or absent; maxilliped palp present but not articulating with maxilliped, variously extended and distally setose; two lateral projections on each side of posteroventral border. Pereomeres distinct, some or all bearing coxal plates and dorsolateral bosses; pereopods small and all about equally developed; oostegites fringing but not enclosing brood pouch; oostegite 1 produced into prominent posterolateral point, variously shaped and with internal ridge entire to moderately digitate. Pleon of six distinct pleomeres fused only medially in some species; five pairs of flaplike biramous pleopods; uropods tiny or absent. Male: Body two to three times as long as broad. Head generally distinct from first pereomere though occasionally fused medially with it. All pereomeres distinct dorsally and separated by notches laterally, their margins generally rounded, occasionally square; no midventral tubercles; pereopods nearly equal in size, usually with all articles distinct. Pleomeres distinct but occasionally only five present; three to five pairs of tuberculiform to globose pleopods; terminal pleomere variously extended, semicircular to triangular, lacking uropods. Hosts in family Palaemonidae.

*Type-species*: By original designation, *Bopyrus ascendens* Semper, 1881. Gender masculine.

*Remarks*: The genus *Probopyrus* was established by Giard and Bonnier (1888a), who designated as type-species *Bopyrus ascendens* Semper, a parasite of *Palaemon lar* Fabricius in fresh water of the Philippines. Those authors simultaneously created the genus *Palegyge* (subsequently usually emended to *Palaegyge*) for *Palegyge borrei* Giard and Bonnier, a parasite of *Palaemon dispar* von Martens in Amboina, also in fresh water. Unfortunately, they failed to characterize either genus well, and there ensued considerable confusion regarding the proper placement of species subsequently described in one genus or the other. Chopra (1923, 1930) tried to distinguish the two genera by the presence or absence of a notch in the terminal pleomere of the female. On this basis, he transferred several previously described species from one genus to the other. The resultant generic placements seemed no more satisfactory, because other characters of the females did not correspond, nor were the males consistently separable. Thus, Nierstrasz and Brender à Brandis (1929) and Van Name (1936) reasonably concluded that the two genera are really the same, and *Probopyrus* was selected as the senior synonym.

Altogether, 46 species have been assigned to *Probopyrus* (including *Palegyge*). Most of these occur in brackish to fresh waters of Indo-West Pacific and western tropical and subtropical Atlantic regions. Twelve of the species previously have been reassigned elsewhere. Of the remaining 34 species, several are definitely or probably synonyms of others, so it is likely that far fewer than 30 are valid. Three of the species remaining in *Probopyrus*, including two from the western Atlantic, do not belong in the genus. One of the Atlantic species, *P. alphei* (Richardson), is reassigned as type-species of the new genus *Probopyria* below. The other, *P. palaemoni* Lemos de Castro and Brasil Lima, 1974, is not considered here because it is known only from Brazil, beyond the range of this report.

Richardson (1905a) presented a key to those species of *Probopyrus* found in the western Atlantic which has proven to be unusable for most specimens. Schultz (1969), acknowledging the difficulty of reliably distinguishing the western Atlantic species of *Probopyrus* if not considering some of them invalid, presented no key to the species of the genus, even though he otherwise presented keys to nearly all other species discussed. Van Name (1936) is so far the only author who has synonymized any local species. He placed several other nominal species in synonymy with *P. bithynis* Richardson, although he did not say what material he had examined. Lemos de Castro and Brasil Lima (1974) reported that synonymy without comment. Additional evidence, discussed below, indicates that all of those species, as well as most of the other species of *Probopyrus* in the western Atlantic, are in turn synonyms of *P. pandalicola* (Packard).

It must be noted that in her key to genera of the Bopyridae, Richardson (1905a) stated that the males of *Probopyrus* have fused pleons, but in all of the specimens examined for this report, including the types of Richardson's species, the pleons of the males are distinctly segmented. The only exception is *P. alphei*, which, for several reasons discussed below, is being made the type of a monotypic new genus.

In my opinion, only one northwestern Atlantic species, *Probopyrus pandalicola* (Packard), is definitely assignable to this genus, based on a study of the adults. Dale and Anderson (1982), in the type of study which should be performed more often, reared and carefully described the larvae of species of *Probopyrus* from the northwestern Atlantic. They concluded it was possible to distinguish three species, which they assigned to *P. pandalicola* (Packard), *P. floridensis* Richardson, and *P. bithynis* Richardson. They recorded *P. pandalicola* as a parasite of *Palaemonetes pugio* Holthuis in the Carolinas and Mississippi, *P. bithynis* as a parasite of

*Macrobrachium ohione* (Smith), and *P. floridensis* as a parasite of *Palaemonetes paludosus* (Gibbes) in northwestern Florida. If the species are distinguishable at any stage, they should clearly be regarded as separate entities. If they are distinct only as larvae, however, the separation into different species (or subspecies, or whatever) remains impossible and of little practical value for anyone working only with adults. It is hoped that further experimental work on living material will ultimately solve the problems involved. The only certainty is that this report will not be the final say in the matter.

## *Probopyrus pandalicola* (Packard, 1879)

Figures 7-10

*Bopyrus* sp.: Smith, 1878, p. 37 [Arlington Bluffs, St. Johns River, Florida; infesting *Palaemonetes vulgaris* (Say)]; Harger, 1880, pp. 312, 433.

*Bopyrus* [sp.]: Leidy, 1879, pp. 198, 199 [coast of New Jersey; infesting *P. vulgaris*].

*Bopyrus pandalicola* Packard, 1879, pp. 308-310, fig. 262 [type-locality unspecified, evidently somewhere on Atlantic coast of United States]; 1881, pp. 308-310, fig. 262.

*Bopyrus manhattensis* Gissler, 1881, p. 151, figs. 1, 2 [type-locality Atlantic coast of United States].

*Bopyrus palaemoneticola* Gissler, 1882a, pp. 6-12, text-figs. 1, 2, pls. I, II [type-locality Atlantic coast of United States]; 1882b, pp. 591, 592, 594; Richardson, 1901, p. 578.

*Probopyrus palaemoneticola*: Giard and Bonnier, 1888a, p. 305; 1888b, p. 235; 1888c, pp. 56, 74; Stebbing, 1893, p. 416; Bonnier, 1900, pp. 48, 62, 110, 111, 169, 222, 342-346, 382, fig. 57, pl. XXXI; Richardson, 1904, pp. 66, 67, figs. 41-43 [New Hampshire to Florida; infesting *P. vulgaris*]; Paulmier, 1905, pp. 185, 186, fig. 59; Chopra, 1923, p. 508; Pearse, 1947, p. 326 [Beaufort, North Carolina; infesting *P. vulgaris*]; Rioja, 1949, p. 172.

*Probopyrus bithynis* Richardson, 1904, pp. 68-70, figs. 46-51 [type-locality New Orleans, Louisiana; infesting *Macrobrachium ohione* (Smith)]; 1905a, pp. 555, 557-559, figs. 606-611 [Escondido River, Nicaragua; infesting *M. acanthurus* (Wiegmann)]; Pearse, 1911, p. 109 [Estado de Vera Cruz, Mexico; infesting *M. olfersii* (Wiegmann)]; 1915, p. 550 [La Rosa, Colombia; infesting *M. olfersii*]; Chopra, 1923, pp. 508, 510; Nierstrasz and Brender à Brandis, 1923, p. 94; Van Name, 1925, pp. 481-484 [Kartabo, Guyana; infesting *M. amazonicum* (Heller)]; 1936, pp. 32, 38, 485-489, figs. 309-311; Cordero, 1937, pp. 10, 11 [Belèm, Brazil; infesting *Macrobrachium* sp.]; Mackin and Hubricht, 1938, p. 634 [Hillcrest, St. Louis County, Missouri; infesting *M. ohione*]; Carvalho, 1942, pp. 129, 131; Rioja, 1949, pp. 172, 173; Holthuis, 1950a, p. 120 [unknown specific locality, West Indies; infesting *M. amazonicum*]; Pennak, 1953, p. 430, fig. 269; Chace et al., 1959, p. 873, fig. 31.2; Green, 1961, p. 143; Schultz, 1969, p. 331, fig. 534(a); Kaestner, 1970, p. 463; Coelho and Koenig, 1972, p. 256, tab. I [Rio Grande do Norte and Paraíba, Brazil]; Lemos de Castro and Brasil Lima, 1974, pp. 209, 214-216, figs. 16-26; [Parà, Brazil; infesting *M. amazonicum*; and Buenos Aires, Argentina; infesting *M. bonelli* (Nobili)]; Huner, 1977, p. 385 [Port Allen, Louisiana; infesting *M. ohione*]; Truesdale and Mermiliod, 1977, pp. 217-219, fig. 1, tab. 1 [Louisiana; infesting *M. ohione*]; Bourdon, 1979a, p. 501; Anderson and Dale, 1981, p. 156; Dale and Anderson, 1982, pp. 392-396, 402-404, 406, 407, figs. 1-4, tabs. 1, 2, 4 [Jackson County, Mississippi; infesting *M. ohione*; description of larvae].

*Probopyrus floridensis* Richardson, 1904, pp. 70, 71, figs. 52-55 [type-locality St. Johns River, Florida, and Little River, Miami, Florida; infesting *Palaemonetes exilipes* Stimpson]; 1905a, pp. 555, 556, figs. 602-605; 1912, p. 524; Chopra, 1923, pp. 508-510; Nierstrasz and Brender à Brandis, 1925, p. 7; Van Name, 1925, p. 483; Nierstrasz and Brender à Brandis, 1929, pp. 23, 24; Chopra, 1930, p. 128;Carvalho, 1942, pp. 125-133, text-figs. 1, 2, pl. I [São Vicente District, Estado do São Paulo, Brazil; infesting unspecified palaemonid]; Morris, 1948, p. 1; Rioja, 1949, pp. 172, 173; Hutton and Sogandares-Bernal, 1960, p. 287 [Cross Bayou, Pinellas County, Florida; infesting *Palaemonetes paludosus* (Gibbes)]; Hutton, 1964, p. 447 [Boca Ciega Bay, Florida; infesting *P. paludosus*]; Moore and McCormick, 1969,p. R88, fig. 33(2a, b, c); Schultz, 1969, p. 331, fig. 533; Lemos de Castro and Brasil Lima, 1974, pp. 209, 212-214, figs. 1-15 [Guarapuri, Espirito Santo, Brazil; infesting *P. paludosus*; and: Georgia; infesting *P. paludosus*]; Dale and Anderson, 1982, pp. 392-395, 397, 398, 400, 402-407, figs. 2, 7, tabs. 1-4 [Wakulla County, Florida; infesting *P. paludosus*; description of larvae].

*Probopyrus pandalicola*: Richardson, 1905a, pp. 553-555, figs. 599-601 [New Hampshire to Florida; infesting *Palaemonetes vulgaris* (Say); Baldwin Lodge, Mississippi; infesting *Palaemonetes* sp.; and: Lantana, Florida; infesting *Palaemonetes* sp.]; Rathbun, 1905b, p. 49; Fowler, 1912, pp. 244-246, 522, pls. 73-75 [Cape May, Ocean City, and Elk River, New Jersey; infesting unspecified host]; Summer et al., 1913, p. 661 [Acushnet River, Massachusetts; infesting *P. vulgaris*]; Pratt, 1916, p. 381; Kunkel, 1918, pp. 236, 237; Ortmann, 1918, p.842, fig. 1306; Nierstrasz and Brender à Brandis, 1925, p. 7; Van Name, 1925,

p. 483; Pratt, 1935, p. 444; Van Name, 1936, p. 489; Pearse, 1942, p. 248; Morris, 1948, pp. 1-19 [South River, Maryland; infesting *P. vulgaris*]; Miner, 1950, p. 451, pl. 145; Pearse, 1952, p. 41 [Texas coast; infesting *P. pugio* Holthuis]; Reinhard, 1956, p. 89; Hutton and Sogandares-Bernal, 1960, p. 287 [Mullet Key, Boca Ciega Bay, Florida; infesting *P. intermedius* Holthuis]; Hutton, 1964, p. 447 [St. Augustine, Florida; infesting *P. pugio* Holthuis]; Smith, 1964, pp. 105, 107; Williams, 1965, p. 61; Hegner and Engemann, 1968, p. 433; Şadoğlu, 1969, p. 197; Schultz, 1969, p. 330; Kaestner, 1970, p. 463; Gosner, 1971, pp. 476, 485, fig. 21.28; Wass, 1972, p. 147 [coast of Virginia; infesting *Palaemonetes* spp.]; Lemos de Castro and Brasil Lima, 1974, p. 209; Anderson, 1975a, pp. 747-751 [North Inlet, Georgetown, South Carolina; infesting *P. pugio*]; 1975b, pp. 201-206 [same locality and host]; 1977, pp. 239-250, tabs. 3-5 [same locality and host]; Truesdale and Mermilliod, 1977, p. 217; Walker, 1977a, pp. 198-205 [Aurora, North Carolina; infesting *P. pugio*]; 1977b, p. 967 [same locality and host]; Kelley, 1978, p. 169 [South Carolina; infesting *P. vulgaris*]; Lawler, 1978, p. 310; Overstreet, 1978, pp. 41-45, 107, figs. 78, 82, 83; Walker, 1978, p. 609 [unspecified locality; infesting *P. pugio*]; Beck, 1979, pp. 431-446 [rivers of northwest Florida; infesting *P. paludosus* and *P. kadiakensis* Rathbun]; Gosner, 1979, pp. 224, 225, pl. 49; Beck, 1980, pp. 265-268 [Wakulla River drainage, Florida; infesting *P. paludosus*]; Anderson and Dale, 1981, pp. 143, 144-147, figs. 1-4, tab. I [Carolinas and Mississippi; infesting *P. pugio*; description of larvae]; Dale and Anderson, 1982, pp. 392-395, 398, 401-407, figs. 3, 6, 7A, tabs. 1-4 [Georgetown County, South Carolina; Beaufort County, North Carolina; Hancock County, Mississippi; infesting *P. pugio*; description of larvae]; Van Wyk, 1982, p. 471; Anderson, 1983, p. 942 [unrecorded locality; infesting *Palaemonetes pugio*].

*Palaegyge meeki* Richardson, 1912, pp. 521, 522, figs. 1-4 [type-localities Panamá and Canal Zone; infesting *Macrobrachium carcinus* (Linnaeus)]; Chopra, 1923, pp. 486, 509; Nierstrasz and Brender à Brandis, 1923, pp. 91, 93; 1925, p. 7; Van Name, 1926, p. 2; Schultz, 1969, p. 328, fig. 526.

*Probopyrus panamensis* Richardson, 1912, pp. 523, 524, figs. 5-8 [type-locality Pariso, Canal Zone, Panamá; infesting *M. acanthurus* (Wiegmann)]; Rathbun, 1912, pp. 454, 460 [near Guaos, Provincia de Santa Clara,Cuba; infesting *M. olfersii*]; Chopra, 1923, pp. 508-510, 541; Nierstrasz and Brender à Brandis, 1923, p. 95; 1925, p. 7; Van Name, 1925, pp. 483, 484; 1926, p. 2; Nierstrasz and Brender à Brandis, 1929, p. 20; Chopra, 1930, p. 128 (footnote); Rioja, 1949, pp. 172, 173; Schultz, 1969, p. 331, fig. 532; Lemos de Castro and Brasil Lima, 1974, p. 211.

*Probopyrus* sp.: Beebe, 1925, p. 59 [Kartabo, Guyana; infesting *M. amazonicum* (Heller)]; Lemos de Castro, 1970, pp. 4, 5, pl. IV, figs. 18, 19 [Atafona, Estado do Rio de Janiero, Brazil; infesting *Palaemon pandaliformis* (Stimpson)].

*Probopyrus floridensis* var. *gigas* Nierstrasz and Brender à Brandis, 1925, pp. 5-7 [type-locality Curacao; infesting *Macrobracium amazonicum*]; Sumer, 1925, p. CXVI; Nierstrasz and Brender à Brandis, 1929, pp. 20, 21.

*Probopyrus bithynis* var. *gigas* Nierstrasz and Brender à Brandis, 1929, pp. 20, 21 [Essiquibo, Guyana; infesting *M. amazonicum*]; Chopra, 1930, p. 128.

*Probopyrus oviformis* Nierstrasz and Brender à Brandis, 1929, pp. 22-25, fig. 24 [type-locality Jolly Hill, St. Croix, Virgin Islands; infesting *Macrobrachium* sp.]; Van Name, 1936, pp. 32, 35, 489, fig. 312; Schultz, 1969, p. 330, fig. 531; Lemos de Csatro and Brasil Lima, 1974, p. 211.

*Probopyrus meeki*: Nierstrasz and Brender à Brandis, 1929, p. 23.

*Palaegyge oviformis*: Chopra, 1930, p. 128.

*Probopyrus creaseri* Pearse, 1936, p. 51, 52, figs. 16-21 [type-localities Cerro Isla and Cienaga, Progresso, Yucatán, Mexico; infesting *Palaemonetes vulgaris*]; Van Name, 1940, p. 138; Rioja, 1949, p. 173; Lemos de Castro and Brasil Lima, 1974, p. 212.

?"Bopyrid": Holthuis, 1948, p. 1112 [North of Paramaribo, Surinam; infesting type-specimens of *Macrobrachium surinamicum* Holthuis]; 1959, p. 91 [same material].

*Probopyrus papaloapanensis* Rioja, 1949, pp. 169-174, figs. 1-5 [type-locality Papaloapan River, Tuxtepec, Mexico; infesting *Macrobrachium* sp.]; Lemos de Castro and Brasil Lima, 1974, p. 212.

*Probopyrus* [sic] *floridensis* var. *gigas*: Holthuis, 1952, p. 23.

*Probopyrus thompsoni*: Smith, 1964, pp. 108, 109, pl. 14, fig. 21 [evidently in error].

*Probopyrus pandicola* [sic]: Schultz, 1969, figs. 529, 530.

*Probopyrus species*: Kaestner, 1970, p. 463.

"Branchial bopyrid parasite": Chace, 1972, p. 21 [Bahía de la Ascensión, Yucatán, Mexico; infesting *Palaemon* (*Palaeander*) *northropi* (Rankin)]; Holthuis, 1977, p. 273 [Rio Miel, near Baracoa, Oriente Province, Cuba; infesting *Macrobrachium faustinum* (de Saussure)].

*Probopyrus*: Meglitsch, 1972, p. 558, fig. 15.21.D.

*Probopyrus bythinis* [sic]: Lemos de Castro and Brasil Lima, 1974, pp. 214, 215.

*Probopyrus papaloanensis*[sic]: Lemos de Castro and Brasil Lima, 1974, p. 216.

?"Bopyrid parasite": Holthuis, 1977, p. 273 [Rio Cacoyugüin, Oriente Province, Cuba; infesting *M. acanthurus*].

?"Bopyrids": Holthuis, 1977, p. 273 [Rio Miel, near Baracoa, Oriente Province, Cuba; infesting *M. faustinum*].

?"Branchial bopyrid parasite": Holthuis, 1977, p. 273 [Pozo Azul, Yateritas, Oriente Province, Cuba; infesting *M. faustinum*].

Not "cf. *Probopyrus pandalicola*": Westinga and Hoetjes, 1981, p. 141, tab. 1 [= *Bopyrione synalphei* Bourdon and Markham, 1980].

*Material examined*: HOURGLASS MATERIAL: None. — OTHER MATERIAL: Infesting *Macrobrachium acanthurus* (Wiegmann): 1 ♀, 1 ♂; River at El Carmen, Campeche, Mexico; R. Román Contreras, coll.; 1980; J. C. Markham, det. of host; unassigned. — 1 ♀, 1 ♂; Cuba; J. H. Walsh, Jr., coll.; J.O. Maloney, det. of host; USNM 63309. — 1 ♀, 1 ♂; Petit Bourg, Martinique; 3 March 1968; USNM. — 1 ♀; Rio Palacio, Tortuguero, Costa Rica; 23 August 1963; H. H. Hobbs, Jr., det. of host; USNM 151965. — 1 ♀ (immature); from roots of water hyacinths in Tortuguero River, Costa Rica; 22 August 1955; L. Giovannoli, coll.; F. A. Chace, Jr., det. of host; USNM 151964. — 2 ♀, 2 ♂ (SYNTYPES of *Probopyrus panamensis* Richardson); Paraíso, Canal Zone, in small creek; 1911; S. E. Meek and S. F. Hildebrand, colls.; USNM 43503.

Infesting *Macrobrachium amazonicum* (Heller): 1 ♀, 1 ♂; Belém-Pará, Brazil; February 1964; A. Lemos de Castro, coll.; USNM 172349. — 1 ♀, 1 ♂ (SYNTYPES of *Probopyrus bithynis* var. *gigas* Nierstrasz and Brender à Brandis); unspecified locality, Venezuela; ZMC. — 1 ♀ (SYNTYPE of *Probopyrus bithynis* var. *gigas*); Essiquibo, Guyana; RMNHL 1378. — 1 ♀; Kartabo, Guyana; W. Beebe, coll.; RMNHL 1378. — 1 ♀; unspecified locality, Surinam; C. F. Kraepelin and H. Holm, colls.; RMNHL 349. — 1 ♀, 1 ♂; unknown locality; RMNHL 351. — 2 ♀, 2 ♂; Rio Orinoco, Venezuela (no other data); USNM.

Infesting *Macrobrachium ohione* (Smith): 2 ♀, 2 ♂; Mississippi River at mile 263, Pointe Coupée Parish, Louisiana; 7 July 1978; 10 ft seine; F. M. Truesdale, coll. and det. of hosts; USNM 172347. — 8 ♀, 8 ♂; Atchafalaya River at Wax Lake, St. Mary Parish, Louisiana; 7 June 1975; 30 ft bag seine; F. M. Truesdale, coll. and det. of hosts; USNM 172346. — 41 ♀, 38 ♂; same locality; 21 June 1975; F. M. Truesdale, coll. and det. of hosts; USNM 172348. — 5 ♀, 3 ♂ (SYNTYPES of *Probopyrus bithynis* Richardson); U.S. Bureau of Fisheries steamer *Albatross* station, Mississippi River near Exposition Grounds, New Orleans, Louisiana; USNM 29089.

Infesting *Macrobrachium olfersii* (Wiegmann): 1 ♀, 1 cryptoniscan larva; Rio Niqua, near San Cristóbal, Dominican Republic; prior to 1941; P. J. Bermudez, coll.; F. A. Chace, Jr., det. of host; MCZ 11656. — 1 ♀; Hermanskondre, Surinam; 13 May 1964; M. Boeseman, coll.; RMNHL 2055.

Infesting *Macrobrachium* sp. [? = *M. digueti* (Bouvier)]: 3 ♀, 2 ♂; Pacific slope, coastal streams of Burica Peninsula, south of Rio Chiriquí Basin, Panamá; elevation 30 m; 15 April 1962; H. Loften and E. Tyson, colls.; UMML.

Infesting *Macrobrachium* sp.: 1 ♀, immature (TYPE of *Probopyrus oviformis* Nierstrasz and Brender à Brandis); in brook, Mt. Steward Cut near Jolly Hill, St. Croix, U.S. Virgin Islands; 25 January 1906; Th. Mortensen, coll.; ZMC.

Infesting *Palaemon* (*Palaeander*) *northropi* (Rankin): 1 ♀, 1 ♂; Smithsonian-Bredin Expedition Station 65-60, near Punta Niccehabin Light, Bahía de la Ascensión, Quintana Roo, Mexico; 13 April 1960; F. C. Daiber, coll.; F. A. Chace, Jr., det. of host; USNM 128466. — 2 ♀, 2 ♂; around mangrove roots, Laguna Grande, Golfo de Cariaco, Sucre, Venezuela; 12 December 1960; R. Martinez, coll.; USNM 107049. — 2 ♀, 2 ♂, Vila Velha, Pernambuco, Brazil; 28 November 1970; A. Lemos de Castro, coll. and det. of hosts; USNM 172349.

Infesting *Palaemon* sp.: 4 ♀, 4 ♂; New Orleans, Louisiana; probably prior to 1850; ZMC.

Infesting *Palaemonetes* (*Palaemontes*) *intermedius* Holthuis: 1 ♀, 1 ♂; Indian River, Fort Pierce, St. Lucie County, Florida; 1.0 m; 16 November 1978; seine in grass bed; D. DeFreese, coll. and det. of host; IRCZM 89: 3911. — 3 ♀, 3 ♂; north of nuclear power plant on Hutchinson Island, Indian River, St. Lucie County, Florida; 1-2 m; 7 June 1972; 20-foot seine net; IRCZM 89: 3912. —2 ♀, 1 ♂; in grass bed in Indian River, Sebastian Inlet, Brevard County, Florida; 20 October 1978; seine; D. DeFreese, coll. and det. of host; IRCZM 89: 3410. — 1 ♀; offshore from power generating plant at Crystal River, Citrus County, Florida; 15 July 1971; seine; C. Grimes and J. Mountain, coll.; W. L. Kruczynski, det. of host; FSBC I 16582. — 1 ♀, 1 ♂; in *Thalassia* bed, Matheson Hammock, Miami, Florida; June 1961; C. R. Child, coll.; J. García-Gómez, det. of host; UMML 32: 5346. — 1 ♀, 1 ♂; same locality; 15 December 1972; J. C. Markham, coll.; J. García-Gómez, det. of host; UMML 32: 5347. — 1 ♀, 1 ♂; West Lake, Everglades National Park, Florida; 16 January 1959; D. C. Tabb and R. B. Manning, colls.; R. Rehrer, det. of host; UMML 32: 5349. — 1 ♀, 1 ♂; Bear Lake, Everglades National Park, Florida; 27 January 1959; D. C. Tabb and R. B. Manning, colls.; R. B. Manning, det. of host; UMML 32: 5330. — 1 ♀, 1 ♂; East Whitewater Bay, Everglades National Park, Florida; 16 April 1959; D. C. Tabb and R. B. Manning, colls.; R. B. Manning, det. of host; UMML 32: 5351.

Infesting *Palaemonetes* (*Palaemonetes*) *paludosus* (Gibbes): 1 ♀, 1 ♂ (SYNTYPES of *Probopyrus floridensis* Richardson); Satsuma Island, near St. Johns River, Florida; USNM 29090. — 1 ♀, 1 ♂; North Rim Ditch, 10.5 km northwest of Jensen, Florida; 4 July 1954; J. D. Kilby et al., colls.; H. H. Hobbs, Jr., det. of host; USNM 99874. — 2 ♀ (immature); 13.0 km north of Coot Bay Pond, Everglades National Park, Florida; 11 March 1959; D. C. Tabb and R. B. Manning, colls.; R. B. Manning, det. of hosts; UMML 32: 5352. — 30 ♀, 29 ♂; Turnbull Creek at Highway 1, north end Indian River, Volusia County, Florida, 28°49.2′N, 80°51.6′W; 13 February 1979; dip net; intertidal; P. S. Mikkelsen, coll. and det. of host; IRCZM 89: 4806.

Infesting *Palaemonetes* (*Palaemonetes*) *pugio* Holthuis: 11 ♀, 10 ♂; North Inlet, Georgetown, South Carolina, 33°18.5′N, 79°10.3′W; 20 July 1970; dipnet on shell and sponge; N. A. Chamberlain, coll. and det. of hosts; GMBL 70-124. — 12 ♀, 11 ♂; Toogoodoo Creek, near Edisto, South Carolina, 32°41.3′N, 80°17.3′W; 25 May 1972; J. Miglarese, C. Farmer, L. Oswald, colls.; SCMRD. — 1 ♀; La Quinta Channel, SSW of Ingleside, San Patricio County, Texas; 16-24 October 1972; S. L. H. Fuller and R. R. Grant, Jr., colls. and dets. of host; UMML 32: 5354. — 6 ♀, 2 ♂ (including reference specimens); St. Marks, Florida; 23 July 1974; W. L. Kruczynski, coll. and det. of hosts; USNM 172345 and 181548. — 2 ♀; seven miles south of Cape Romano Shoals bell buoy, Florida, 25°30′N, 81°35′W; 6.7 m; 26 August 1976; J. R. Sullivan, coll.; W. G. Lyons, det. of hosts; FSBC I 16614.

Infesting *Palaemonetes* (*Palaemonetes*) *vulgaris* (Say): 1 ♀, 1 ♂ (SYNTYPES of *Probopyrus creaseri* Pearse); Isla Cerro, near Progreso, Yucatàn, Mexico; 1 August 1932; A. S. Pearse, coll.; E. P. Creaser, det. of host; USNM 98375.

Infesting *Palaemonetes* sp.: 3 ♀ (of which 2 immature), 1 ♂; Sapelo Island, Georgia; 2, 16, 30 August 1971; E. Rasmussen, coll. and det. of hosts; in collection of E. Rasmussen, Copenhagen.

Infesting *Periclimenes americanus* (Kingsley): 2 ♀, 1 ♂, 1 cryptoniscan larva; in shallow water, Card Sound, Florida; 31 May 1970; J. García-Gómez, coll. and det. of hosts; UMML 32: 5353.

Separated from hosts: 1 ♀, 1 ♂; Banana River, Brevard County, Florida, 28°22'N, 80°39'W; 0.1-0.4 m; 27 February 1975; in *Halodule wrightii*, posthole digger; R. W. Virnstein et al., colls.; IRCZM 89: 3895. — 3 ♀ (including 2 immature), 1 ♂; Link Port, Indian River, St. Lucie County, Florida, 27°32.2'N, 80°20.9'W; 3 October 1975; R. W. Virnstein et al., colls.; IRCZM 89: 3893. — 1 ♀; same collections; IRCZM 89: 3896. — 1 ♀, 1 ♂; same location and collectors; 14 June 1976; IRCZM 89: 3901.

*Description*: Reference female (Figure 7): Length 6.36 mm, maximal width 5.08 mm, head length 1.56 mm, pleon length 1.92 mm, body axis distortion 30°. Outline ovate. Dark brown pigmentation over oostegites and elsewhere (Figure 7A, B).

Head broadly cuneate and deeply set into pereon; anterior margin extending only slightly beyond pereon and lacking frontal lamina. Antennae (Figure 7C, D) each of three articles, both distal ones small on second antenna; terminal tuft or other setae possibly present but not discernible. Maxilliped (Figure 7E) distinctly segmented, with short, nonarticulated setose palp (Figure 7F) and prominent spur (Figure 7G). Posteroventral border of head (Figure 7H) with two lateral projections on each side, outer one broad and blunt, inner one long and slender, middle region produced into two obtuse points.

Pereomeres distinctly separated dorsally and laterally. Dorsolateral bosses on both sides of pereomeres 1-4, coxal plates on short sides of pereomeres 1-4 and on long sides of pereomeres 1-5. Oostegites completely surrounding but not enclosing brood pouch; oostegite 1 (Figure 7I, J) with prominent, slender, subfalcate, posterolateral point and dentate internal ridge. All articles of all pereopods (Figure 7K, L) distinct; size of pereopods increasing posteriorly; bases proportionately larger and more carinate posteriorly; all dactyli deeply set into propodi.

Pleon overlapped by final pereomere, of six distinct pleomeres only slightly separated laterally; first five of nearly same length, about half that of posterior pereomeres; terminal pleomere triangular, posteriorly truncate. Anterolateral margins of long sides of first four pleomeres reflexed. Five pairs of biramous, foliate pleopods; endopodites of first pair much larger than others and concealing nearly all other pleopods.

Reference male (Figure 8): Length 0.80 mm, maximal width 0.36 mm, head length 0.15 mm, pleon length 0.22 mm. All body regions and segments distinct dorsally and separated laterally. Sides of pereon subparallel but pleon abruptly broader than pereon (Figure 8A, B). Most of dorsal surface with dark brown pigment.

Head prominently extended anteriorly, semicircular, with slight concavity in front; posterolateral corners produced into slight points. Large, irregularly shaped eyespots near edges. Antennae (Figure 8C, D) each of three articles, smaller distally; antenna 1 with setae on distal margin of each article; setae possibly on antenna 2 but not discernible.

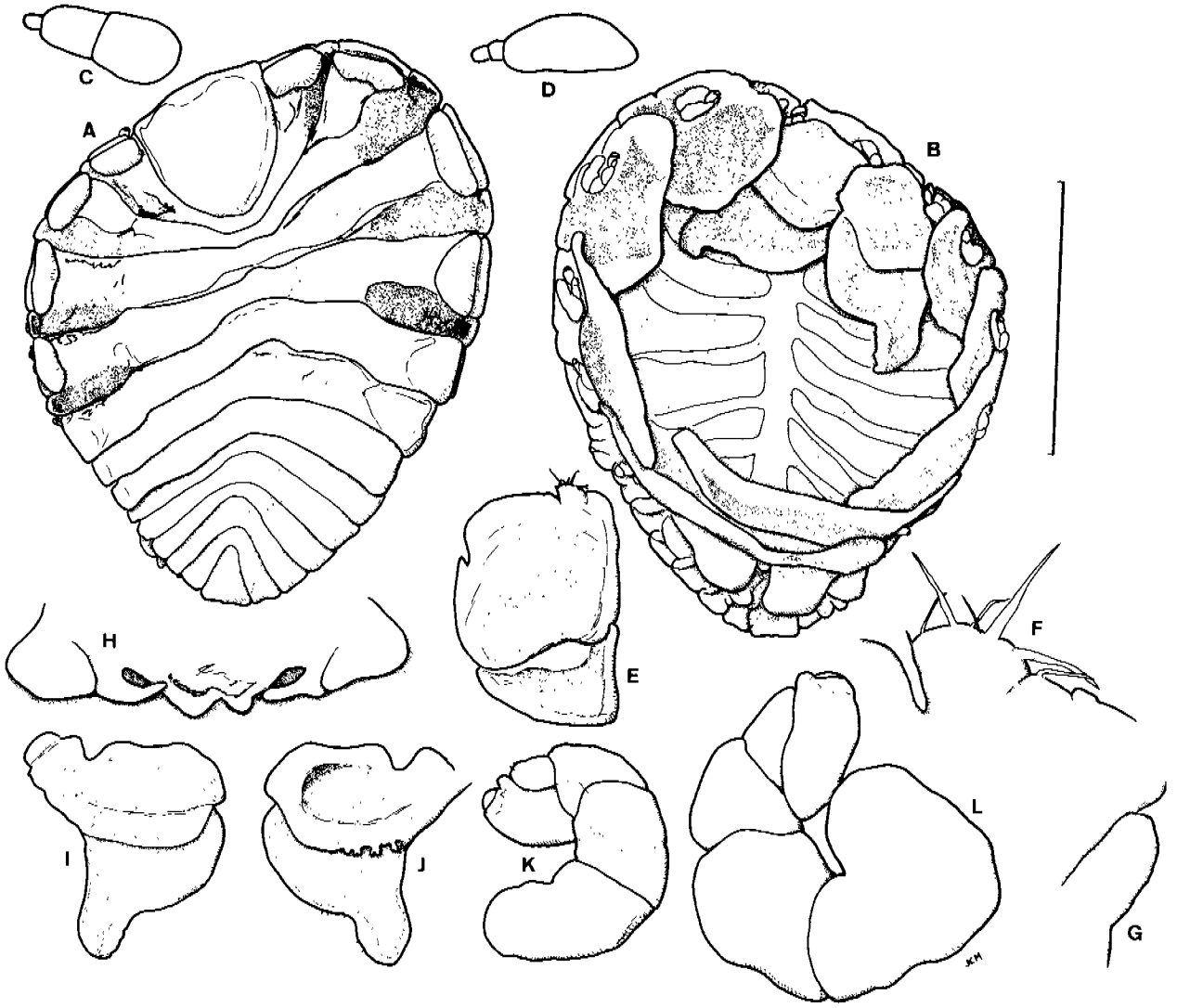


Figure 7. *Probopyrus pandalicola* (Packard), reference ♀, USNM 172345 or 181548. A. Dorsal view. B. Ventral view. C. Right antenna 1. D. Right antenna 2. E. Right maxilliped. F. Palp of same. G. Maxilliped spur. H. Posteroventral border of head. I. Right oostegite 1, external view. J. Same, internal view. K. Right pereopod 1. L. Right pereopod 7. Scale 3.0 mm for A, B, I, J; 1.5 mm for E, H; 0.25 mm for C, D, F, G; 0.5 mm for K, L.

Pereomeres distinct dorsally and separated by notches laterally; lateral margins of all pereomeres greatly reflexed ventrally; no midventral tubercles. Pereopods (Figure 8E, F) small but slightly increasing in size posteriorly; evidently all articles of all pereopds defined, but difficult to see in some cases; some sparse setation present.

Pleon of six distinct pleomeres deeply separated laterally, overall outline semicircular. Terminal pleomere deeply set into preceding one, its posterior margin truncate except for posteriorly extended central anal cone, latter reaching just as far back as margins of pleomere 5. Pleopods on pleomeres 1-4 rather ill-defined and extending posteriorly. No uropods.

*Variations*: Females (Figure 9): Some of the type-specimens of various nominal species of *Probopyrus* are distinctly different in a few characters, but examination of a large series

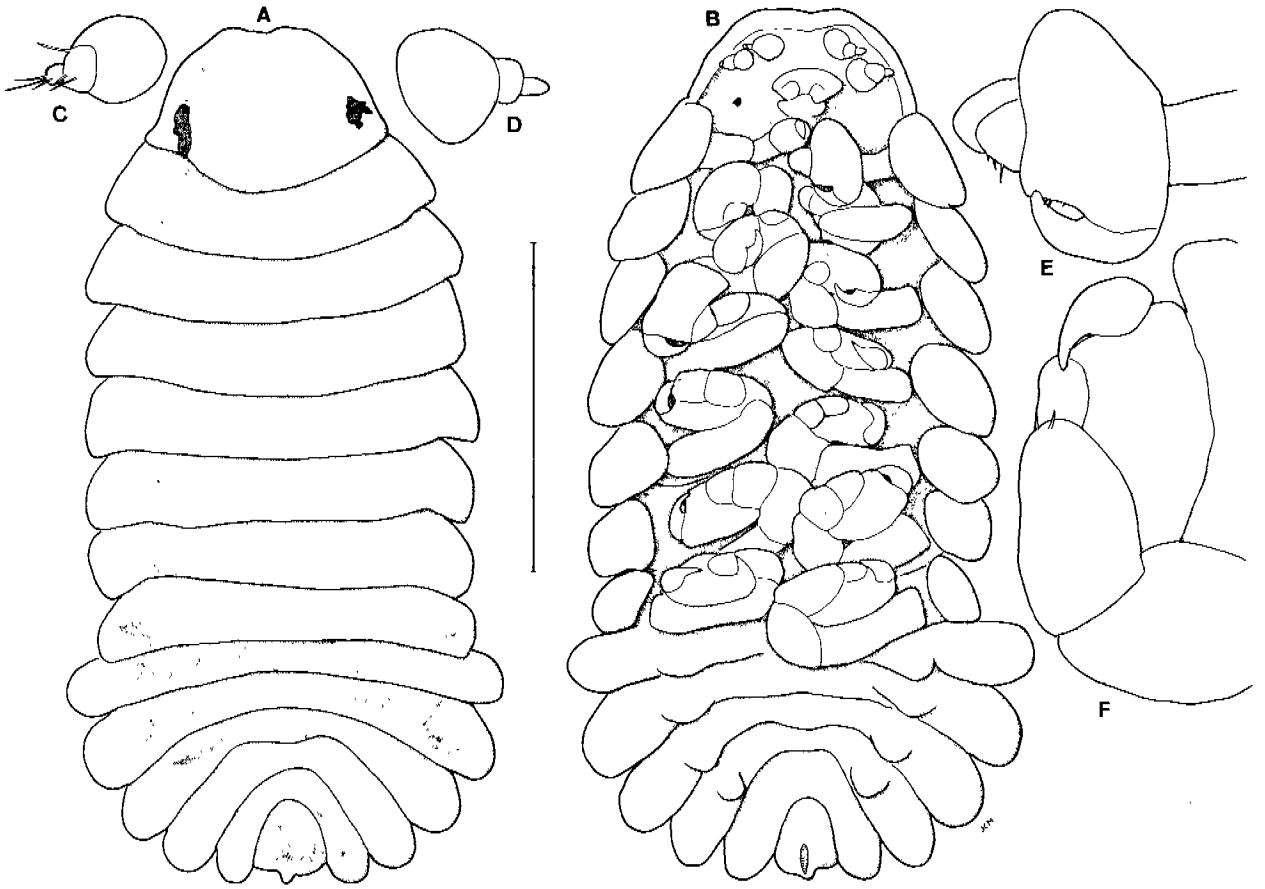


Figure 8. *Probopyrus pandalicola* (Packard), reference ♂, USNM 172345 or 181548. A. Dorsal view. B. Ventral view. C. Right antenna 1. D. Left antenna 2. E. Left pereopod 1. F. Left pereopod 7. Scale 0.3 mm for A, B; 0.1 mm for C-F.

(including paratypes) has revealed almost continuous intergradations which show no correlation with size, species of host, geographical location, or variations in accompanying males. In some females, the second pereomere is bisected by the head (Figure 9A); the first oostegite is proportioned slightly differently (Figure 9E, K); the head is more or less extended and produced into anterolateral "horns" (Figure 9D); the pleomeres are separated laterally to varying degrees (Figure 9A, D, J, M); the pleopods, especially of immature specimens, are more prominent (Figure 9B, I); and the terminal pleomere is posteriorly convex (Figure 9L), nearly straight (Figure 9H), or slightly to deeply bilobed (Figure 9A, C, F, G, I, J, M). Immature females (Figure 9I), as is typical in most bopyrids, have relatively smaller oostegites, revealing the pereopods, and proportionately longer pleons.

Males (Figure 10): The type-specimens exhibit some of the greatest variation seen in this species. Some (Figure 10A, F) are proportionately longer than the reference specimen or more irregular in shape (Figure 10E). Antennae (Figure 10B, C) of some have articles of more nearly the same size, and pereopods (Figure 10D) show some differences in proportions. The greatest variations occur in the pleons. Some lack all pleopods (Figure 10G), while others have up to five

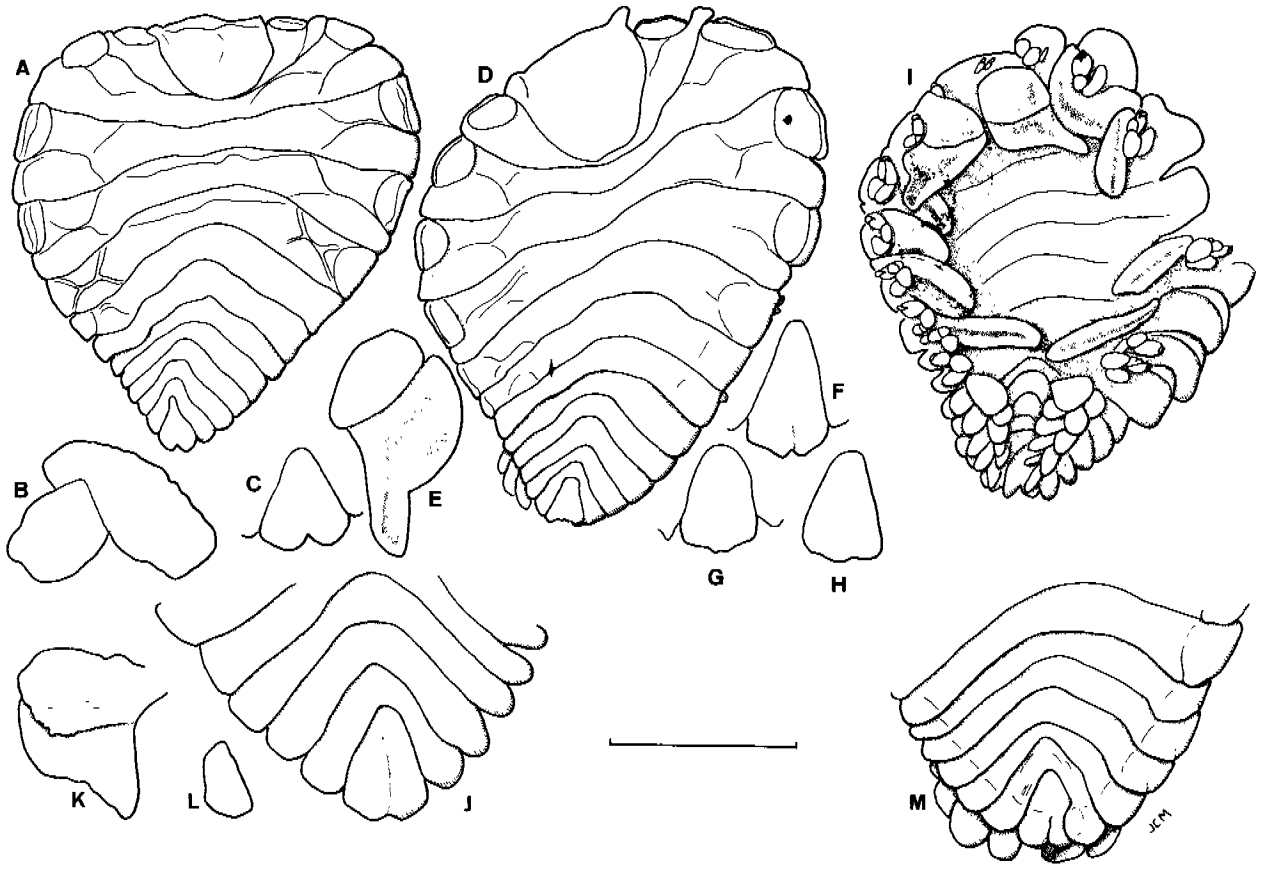


Figure 9. *Probopyrus pandalicola* (Packard), other ♀ specimens. A, B, holotype ♀ of *Probopyrus panamensis* Richardson, USNM 43503; C, paratype ♀ of *P. panamensis*, USNM 43503; D, E, holotype ♀ of *P. floridensis* Richardson, USNM 29090; F-H, ♀ paratypes of *P. floridensis*, USNM 29090; I, holotype ♀ of *P. oviformis* Nierstrasz and Brender à Brandis, ZMC; J, K, holotype ♀ of *P. bithynis* Richardson, USNM 29089; L, paratype ♀ of *P. bithynis*, USNM 29089; M, specimen from Pointe Coupée Parish, Louisiana, USNM 172347. A. Dorsal view. B. Left pleopod 1. C. Final pleomere. D. Dorsal view. E. Left oostegite 1, external view. F. Final pleomere. G. Same. H. Same. I. Ventral view. J. Dorsal view. K. Oostegite 1, internal view. L. Final pleomere. M. Pleon. Scale 1.0 mm for D, F-J; 2.0 mm for B, C, E, K-M; 4.0 mm for A.

pairs of rather prominent pleopods (Figure 8B); and the terminal pleomere may be an extended button (Figure 10A, E) to a deeply embedded bilobed structure (Figure 10F, G), or ventrally fused with the preceding pleomere (Figure 10H).

*Distribution*: New Hampshire to Brazil; Pacific drainage of Panamá; in fresh and marine waters.

*Remarks*: The synonymy of all western Atlantic species of *Probopyrus* is justifiable despite a large amount of variation among specimens, a great geographical range, the complete lack of consistent correlation between the variation of opposite sexes, their sizes, their locations, and species of their hosts. The oldest available name is *P. pandalicola*. It is the only known branchial parasite of *Macrobrachium*, *Palaemon*, and *Palaemonetes* in the northwestern Atlantic, where it infests at least ten different host species.

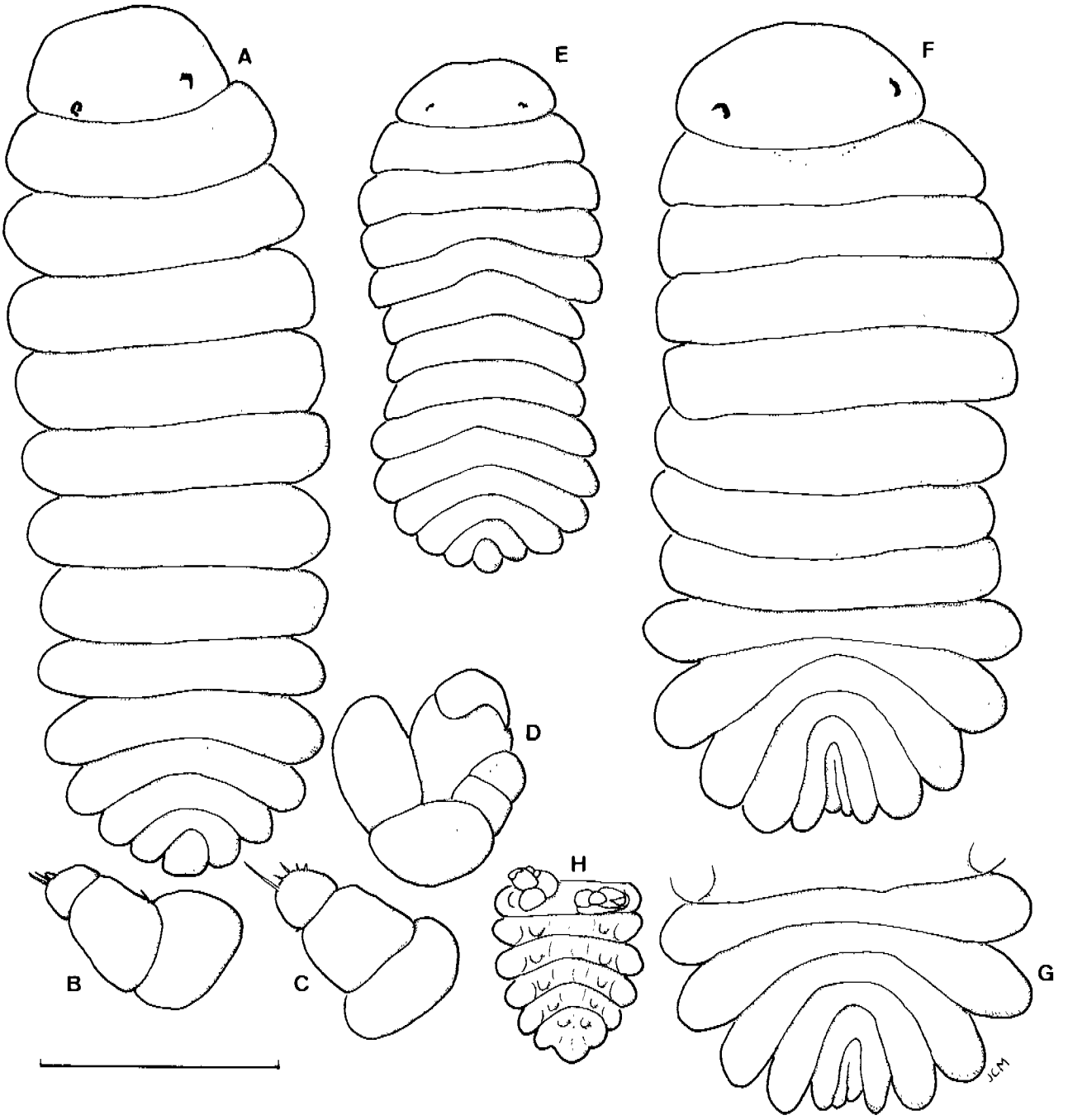


Figure 10. *Probopyrus pandalicola* (Packard), other ♂ specimens. A-D, allotype ♂, *Probopyrus floridensis* Richardson, USNM 29090; E, allotype ♂, *P. panamensis* Richardson, USNM 43503; F, G, allotype ♂, *P. bithynis*, USNM 29089; H, specimen from Pointe Coupée Parish, Louisiana, USNM 172347. A. Dorsal view. B. Right antenna 1. C. Right antenna 2. D. Right pereopod 1. E. Dorsal view. F. Dorsal view. G. Pleon, ventral view. H. Pleon, ventral view. Scale 1.2 mm for H; 1.0 mm for E; 0.4 mm for A, F, G; 0.2 mm for D; 0.1 mm for B, C.

## *Parabopyriscus*, new genus

*Diagnosis*: Female: Body ovate, slightly distorted, with no abrupt change in width; all body regions and segments distinct. Maxilliped with prominent setose but nonarticulated palp; posteroventral border of head with single pair of slender lateral projections. First oostegite without posterolateral point. Pleon of six pleomeres markedly separated laterally, first five bearing biramous, flaplike pleopods; no uropods. Male: Body much longer than broad. Head and first pereomere fused but juncture indicated laterally. Pereopods all about equally developed; no midventral pereonal tubercles. Six pleomeres more or less defined laterally, but some or all fused; five pairs of tuberculiform pleopods present, although posterior ones often obscure. Parasites of alpheids.

*Type-species*: By present designation, *Parabopyriscus stellatus*, new species.

*Etymology*: *Para-*, meaning "beside" or "close to" + generic name *Bopyriscus*, selected to stress close resemblance to *Bopyriscus* Richardson, 1905. Gender masculine.

*Remarks*: See below.

## *Parabopyriscus stellatus*, new species

Figures 11-14

*Material examined*: Infesting *Synalpheus hemphilli* Coutière: HOURGLASS STATION K: 1 ♀, slightly immature (HOLOTYPE, USNM 181549), 1 ♂ (ALLOTYPE, USNM 181550); 15 February 1967; trawl.

Infesting *Alpheus normanni* Kingsley: HOURGLASS STATION B: 1 ♀, 1 ♂, both immature (PARATYPES); 11 August 1967; dredge; FSBC I 23893.

*Description*: Holotype female (Figure 11): Length 3.37 mm, maximal width 3.01 mm, head length 0.83 mm, pleon length 1.15 mm, body axis distortion 15°, body outline without abrupt changes in width (Figure 11A, B).

Head subtriangular, extending slightly beyond pereonal margin and produced into ill-defined frontal lamina. Antennae of three and two articles respectively (Figure 11C); each antenna setose distally. Maxilliped (Figure 11D) of indiscernible segmentation, produced into prominent, setose, nonarticulated palp. Posteroventral border of head (Figure 11E) with slightly convex midregion and one slender, short, curved, lateral projection on each side.

Pereomeres well defined; all bearing large but rather indistinct coxal plates, lacking dorsolateral bosses and tergal projections. Oostegites reduced, first one (Figure 11F, G) nearly square, without posterolateral point, with unornamented internal ridge. Pereopods (Figure 11H, I) all similar, increasing slightly in size posteriorly; all carpi distally setose.

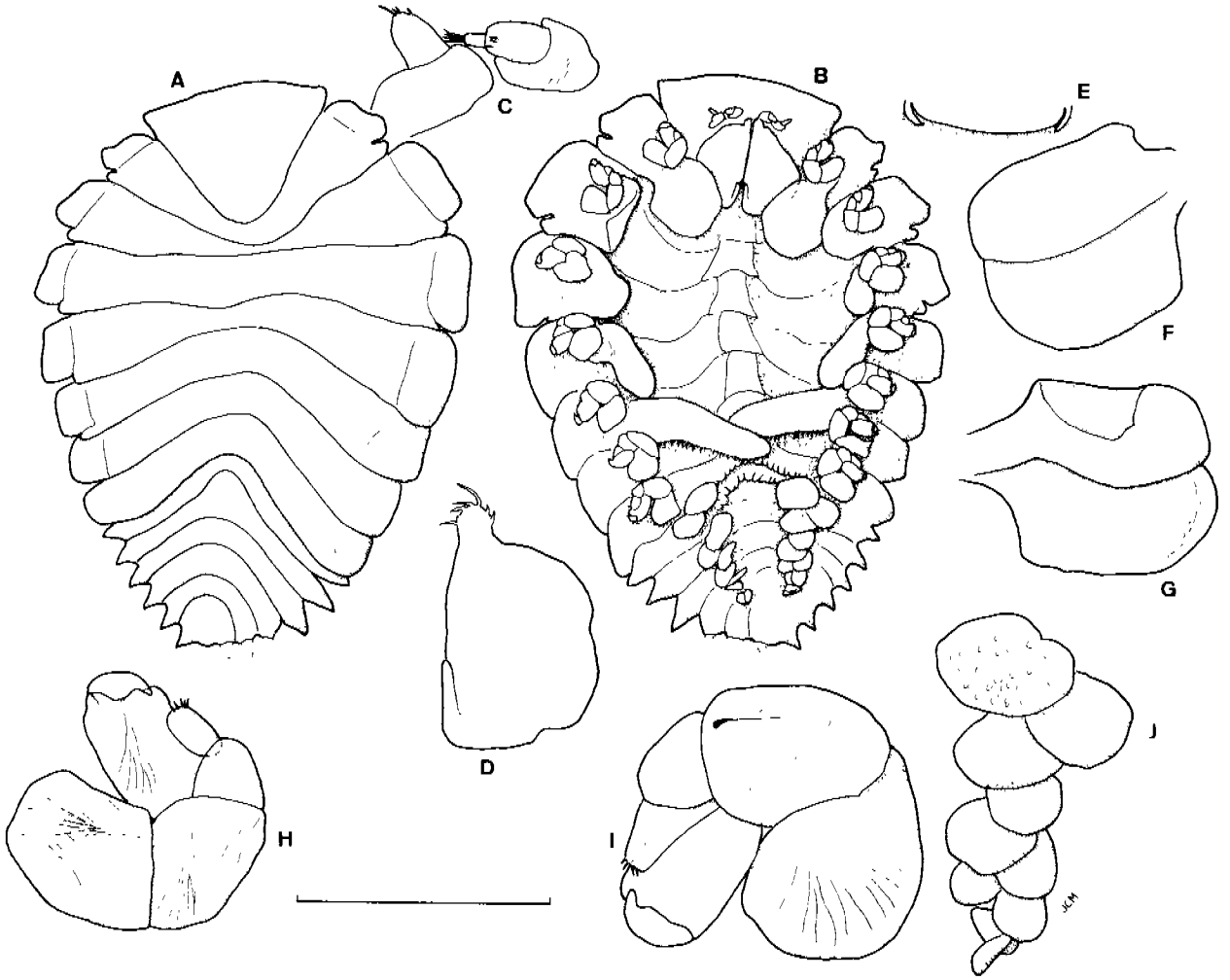


Figure 11. *Parabopyriscus stellatus*, n. gen., n. sp., holotype ♀, USNM 181549. A. Dorsal view. B. Ventral view. C. Right antennae. D. Left maxilliped. E. Posteroventral border of head. F. Left oostegite 1, external view. G. Same, internal view. H. Right pereopod 1. I. Right pereopod 7. J. Left pleopods. Scale 1.5 mm for A, B; 1.25 mm for E; 0.5 mm for D, F, G, J; 0.25 mm for C, H, I.

Pleon, overlapped anteriorly by final pereomere, of six well-defined pleomeres, each produced into slender, acutely angled point at each side. Five pairs of small, biramous, flaplike pleopods (Figure 11J). No uropods.

Allotype male (Figure 12): Length 1.21 mm, maximal width 0.54 mm, pleonal length 0.34 mm; outline fusiform (Figure 12A, B).

Head fused with first pereomere, but juncture defined laterally; anterior margin truncate. Pair of small, distinct eyes near posterior region of head. Antennae (Figure 12C) of four and three articles respectively, although articulation of antenna 2 obscure; both antennae setose distally, and antenna 1 with scattered setae elsewhere.

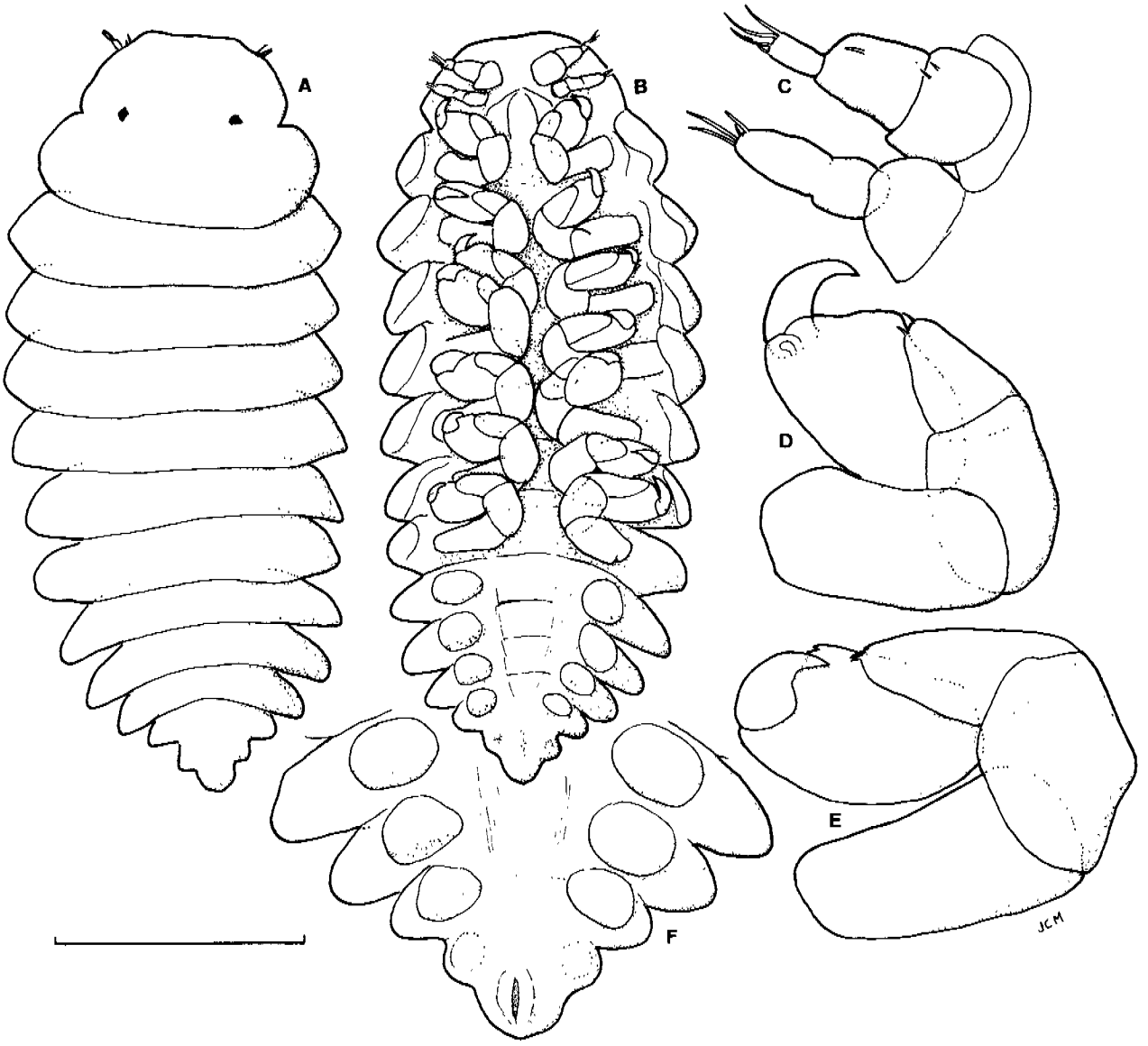


Figure 12. *Parabopyriscus stellatus*, n. gen., n. sp., allotype ♂, USNM 181550. A. Dorsal view. B. Ventral view. C. Right antennae. D. Right pereopod 1. E. Right pereopod 7. F. Pleon, ventral view. Scale 0.4 mm for A, B; 0.2 mm for F; 0.1 mm for C-E.

Pereomeres all set apart and pointed laterally; no midventral tubercles. Pereopods (Figure 12D, E) all very similar in structure and increasing slightly in size posteriorly; each with carpus sparsely setose distally.

Pleon with six pleomeres indicated laterally, first three deeply separated, but pleomeres 4 to 6 fused dorsally; all only obscurely separated ventrally (Figure 12F). Four pairs of raised, tuberculiform pleopods (Figure 12F) with indication of fifth pair present. No uropods.

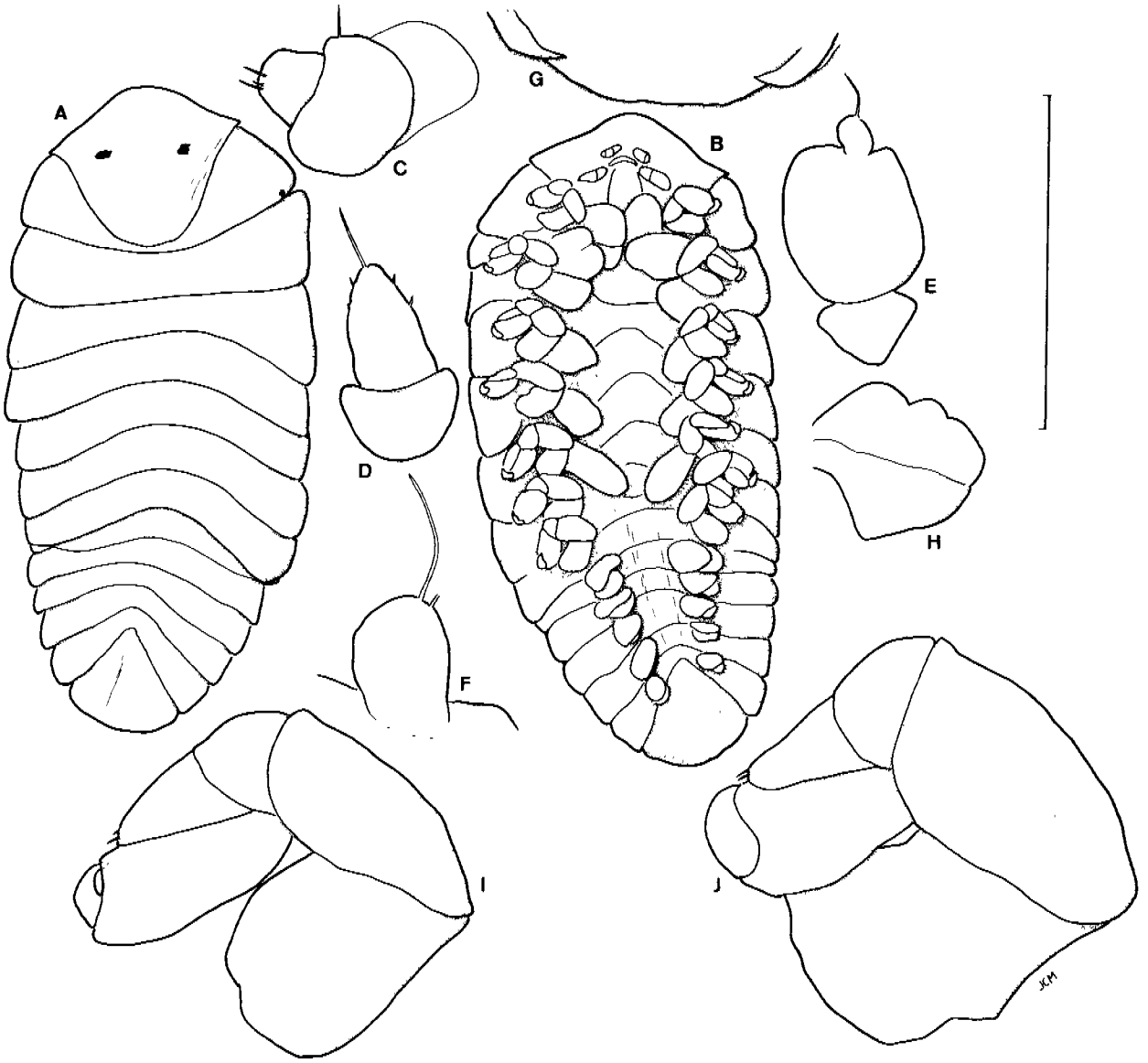


Figure 13. *Parabopyriscus stellatus*, n. gen., n. sp., immature ♀, FSBC I 23893. A. Dorsal view. B. Ventral view. C. Right antenna 1. D. Right antenna 2. E. Right maxilliped. F. Palp of same. G. Posteroventral border of head. H. Right oostegite 1, external view. I. Right pereopod 1. J. Right pereopod 7. Scale 1.0 mm for A, B; 0.3 mm for E, G, H; 0.15 mm for I, J; 0.1 mm for C, D, F.

*Remarks on immature female* (Figure 13): Proportionately much narrower, with body segments less distinctly separated. Eyes present. Antennae differently proportioned. Maxilliped sharply constricted. Oostegites very rudimentary.

*Remarks on immature male* (Figure 14): Body outline more irregular. Antennae of slightly different segmentation. Some pereopods with more segments distinct. Pleon fused, pleomeres much less distinctly indicated laterally; all five pairs of tuberculiform pleopods well developed.

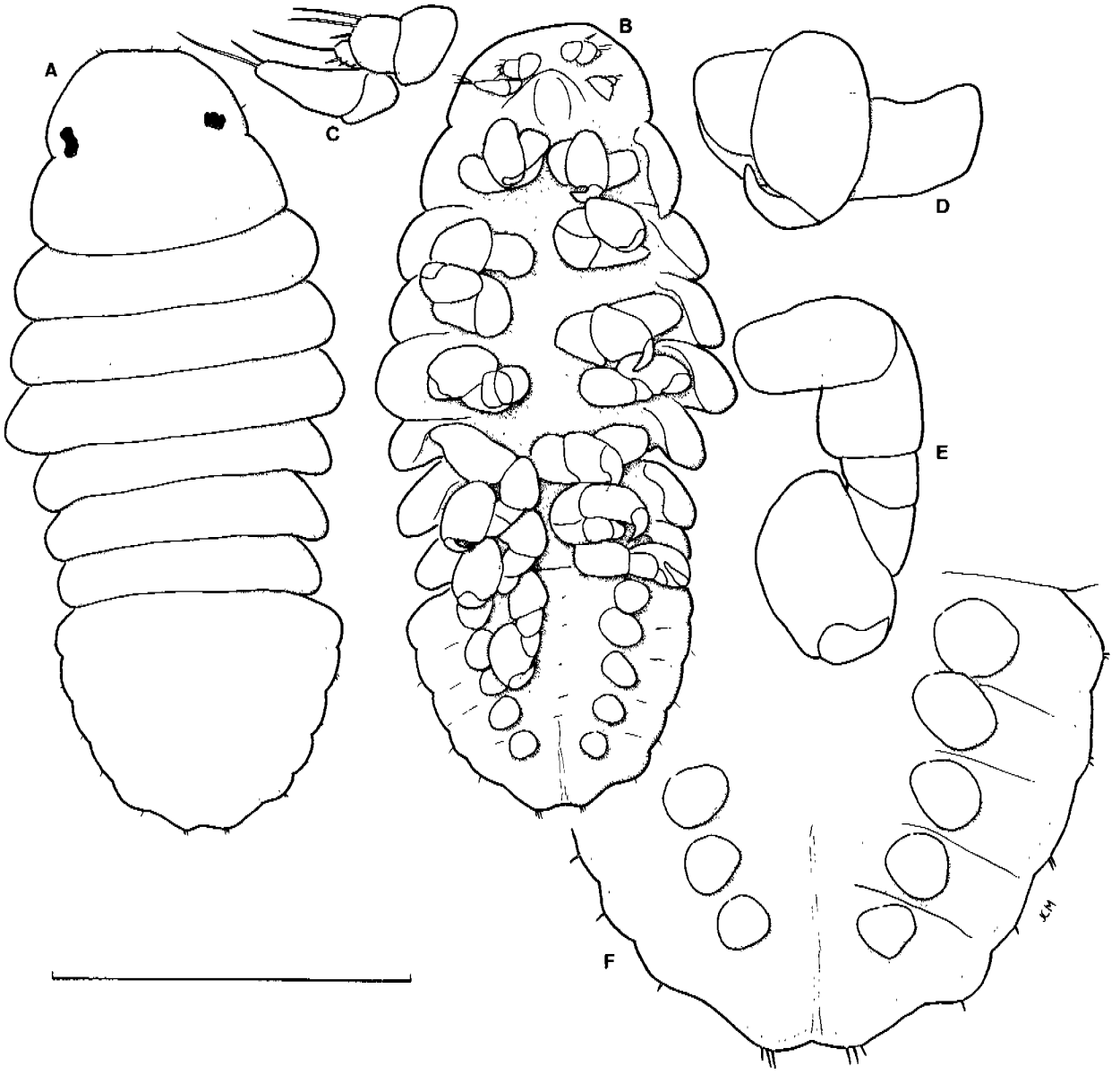


Figure 14. *Parabopyriscus stellatus*, n. gen., n. sp., immature ♂, FSBC I 23893. A. Dorsal view. B. Ventral view. C. Right antennae. D. Left pereopod 1. E. Left pereopod 7. F. Pleon, ventral view. Scale 0.3 mm for A, B; 0.15 mm for F; 0.1 mm for C-E.

*Type-locality*: Hourglass Station K, 94 km west of Sanibel Island, Florida, in Gulf of Mexico, 26°24′N, 82°58′W, 36.6 m.

*Distribution*: Presently known only from type-locality and from Hourglass Station B, also in Gulf of Mexico, 35 km west of Egmont Key, Florida, 27°37′N, 83°07′W, 18.3 m.

*Etymology*: The specific name *stellatus* is a Latin adjective meaning "starred," selected in reference to the starlike shape of the pleon of the holotype female.

*Remarks*: The new genus, *Parabopyriscus*, is closely similar to *Bopyriscus* Richardson, known only from the type-specimens of its type-species, *B. calmani* Richardson (1905a) from California. Re-examination of those types has clarified some details not mentioned in the original description, and the following remarks are based on that re-examination. The most important difference between females of *B. calmani* and *Parabopyriscus stellatus* is that the first oostegite of *B. calmani* is produced into a prominent posterolateral point. This is the main reason for the creation of a new genus for the latter species. Another significant difference is that *B. calmani* has only rudimentary second antennae; it also lacks coxal plates, but some small tergal projections are present. Other details of body segment separation and pereopod proportions would be important at least at the specific level. Males of these two species are rather more different from one another. Males of *B. calmani* completely lack pleopods, and their heads and pereons are not fused. Like males of *Parabopyriscus stellatus*, the first three pleomeres are free, but the terminal piece has lateral indications of only two pleomeres rather than three. Bourdon (1980) incorporated *Bopyriscus* into *Bopyrella* (discussed below), but I am using a more restricted definition of *Bopyrella*, thereby retaining *Bopyriscus* and necessitating the erection of *Parabopyriscus*.

Although it was not mentioned in the description (Richardson, 1905a), the host of *Bopyriscus calmani*, according to the label with the types, was "*Alpheus*," a member of the same family and possibly genus as the host of the new species.

## *Probopyria*, new genus

*Diagnosis*: Female: All body segments set apart. Head distinctly extended and produced into anterolateral "horns;" posteroventral border of head with two pairs of lateral projections, both longer than wide; maxilliped lacking palp but with setose anteromedial corner. Oostegite 1 about as wide as long, extended into posterolateral projection at least 1/5 of its total length; coxal plates absent. Pleon of six pleomeres divided by deep notches along both sides; four pairs of flaplike biramous pleopods; no uropods. Male: Body less than three times as long as broad, sides subparallel. Head, pereomeres and pleon separate. No midventral tubercles. Pleon fused, although margins undulate, wider than adjacent pereomeres and much shorter than wide; five pairs of uniramous, sessile, flaplike pleopods; no uropods. Hosts in family Alpheidae.

*Type-species*: By present designation, *Bopyrus alphei* Richardson, 1900.

*Etymology*: Name *Probopyria* selected to emphasize close similarity to *Probopyrus* Giard and Bonnier. Gender feminine.

*Remarks*: *Probopyria* occupies a rather advanced position in the Bopyrinae, as indicated by the lack of maxilliped palp and the fifth pleopods in the female and by the fusion of the pleon in the male. It is closely related to *Bopyrella* Bonnier (below) and *Probopyrus* Giard and Bonnier (above), to both of which its type-species previously had been assigned. The female differs from that of *Bopyrella* mainly in having the head distinct from the pereon and in having the pleon only about 2/3 as long as broad; further, in most species of *Bopyrella*, the males' pleons are segmented. In contrast with *Probopyria*, females of *Probopyrus* have less extended heads, relatively narrower first oostegites, and no deep notches separating pleomeres. Males of *Probopyrus* have six-segmented pleons lacking pleopods. In addition, all species properly assigned to *Probopyrus* infest only palaemonids, never alpheids.

At present, only one species is in the genus. Bourdon (1980) incorporated *Bopyrus alphei* Richardson into *Bopyrella*, but my definition of that genus (below) excludes it.

## *Probopyria alphei* (Richardson, 1900), new combination

Figures 15, 16

[*Bopyrus* sp.]: Muller, 1871, p. 68 [no description; Florinópolis, Brazil; infesting *Alpheus* sp.].

*Bopyrella* (?) *alphei*: Giard and Bonnier, 1890, p. 369; Bonnier, 1900, pp. 221, 352, 381; Nierstrasz and Brender à Brandis, 1923, p. 97.

*Bopyrus*? *alphei* Giard and Bonnier, 1890, p. 369 [nomen nudum]; Stebbing, 1893, p. 416.

*Bopyrus alphei* Richardson, 1900, pp. 158, 159, figs. 3, 4 [type-locality Rio Parahyba do Norte, Brazil; infesting *Alpheus heterochaelis* Say]; 1901, p. 578 [Beaufort, North Carolina; infesting *A. heterochaelis*].

*Gyge* sp.: Wilson, 1900, p. 353 [Beaufort, North Carolina; infesting *A. heterochaelis*].

*Probopyrus alphei*: Richardson, 1904, pp. 67, 68, figs. 44, 45; 1905a, pp. 553, 559-560, figs. 612, 613; Hay and Shore, 1918, p. 386 [Beaufort, North Carolina; infesting *A. heterochaelis*]; Chopra, 1923, p. 508; Nierstrasz and Brender à Brandis, 1925, p. 7; Carvalho, 1942, pp. 130, 131; Pearse, 1947, p. 326 [Beaufort, North Carolina; infesting *A. heterochaelis*]; Menzies and Glynn, 1968, p. 13, Sadoğlu, 1969, p. 197; Schultz, 1969, p. 329, fig. 528; Rouse, 1970, p. 135 [southwest Florida; infesting *Alpheus* sp.]; Lemos de Castro and Brasil Lima, 1974, p. 210; Kelley, 1978, p. 169 [coast of South Carolina; infesting *A. heterochaelis*]; Lawler, 1978, p. 309.

*Capitetragonia asperotibialis* Pearse, 1953a, pp. 234, 235, figs. 122-130 [type-locality Alligator Harbor, Florida; infesting *A. normanni* Kingsley].

*Bopyrella alphei*: Lemos de Castro, 1965, pp. 283, 287, figs. 14-23 [Barro do Arapiranga, Carutapera, Maranhao, Brazil; infesting *Alpheus* sp.; and: Ilha de São Sebastião, São Paulo, Brazil; infesting *Alpheus* sp.]; Bourdon, 1980, pp. 187, 201-204, fig. 7 [re-examination of types].

"Branchial bopyrid": Chace, 1972, p. 73 [Antigua Island, infesting *A. viridari* (Armstrong)].

*Material examined*: HOURGLASS MATERIAL: None. — OTHER MATERIAL: Infesting *Alpheus heterochaelis* Say: 1 ♀, 1 ♂ (originally called *Gyge* sp.); Beaufort, North Carolina; prior to 1900; H. V. Wilson, coll. and det. of host; USNM 25069. — 1 ♀, 1 ♂; same locality; 29 July 1946; A. S. Pearse, coll. and det. of host; USNM 20954. — 2 ♀ (1 hyperparasitized), 1 ♂; Card Sound, Florida; shallow water; 10 March and 8 April 1970; J. García-Gómez, coll. and det. of hosts; UMML. — 1 ♀, 1 ♂, Buttonwood Canal, Flamingo, Florida; 30 June 1965; D. C. Tabb, coll. and det. of host; USNM. — 1 ♀, 1 ♂ (SYNTYPES of *Bopyrus alphei* Richardson); Branner-Agassiz Expedition Station, Rio Parahyba do Norte, Brazil; on mangroves; 21 June 1899; A. W. Greely, coll.; USNM 23759.

Infesting *Alpheus normanni* Kingsley: 1 ♀, 1 ♂ (SYNTYPES of *Capitetragonia asperotibialis* Pearse); Alligator Harbor, Florida; A. S. Pearse, coll. and det. of host; USNM 93720. — 13 ♀, 14 ♂; Florida Power Corporation survey, Anclote Harbor, Tarpon Springs, Florida; March, April, May, June, September, November 1976; J. C. Markham, det. of hosts; USNM 181909. — 4 ♀ (1 hyperparasitized), 3 ♂; Card Sound, Florida; shallow water; 28 October 1970, 9 December 1970, 14 and 15 January 1971; J. García-Gómez, coll. and det. of hosts; UMML 32: 5343, 32: 5344, and 32: 5345.

Infesting *Alpheus viridari* (Armstrong): 1 ♀, 1 ♂; Indian River, St. Lucie County, Florida; north side Link Port Channel; 0.15 m, under rock; R. H. Gore, det. of host; IRCZM 89: 3909. —

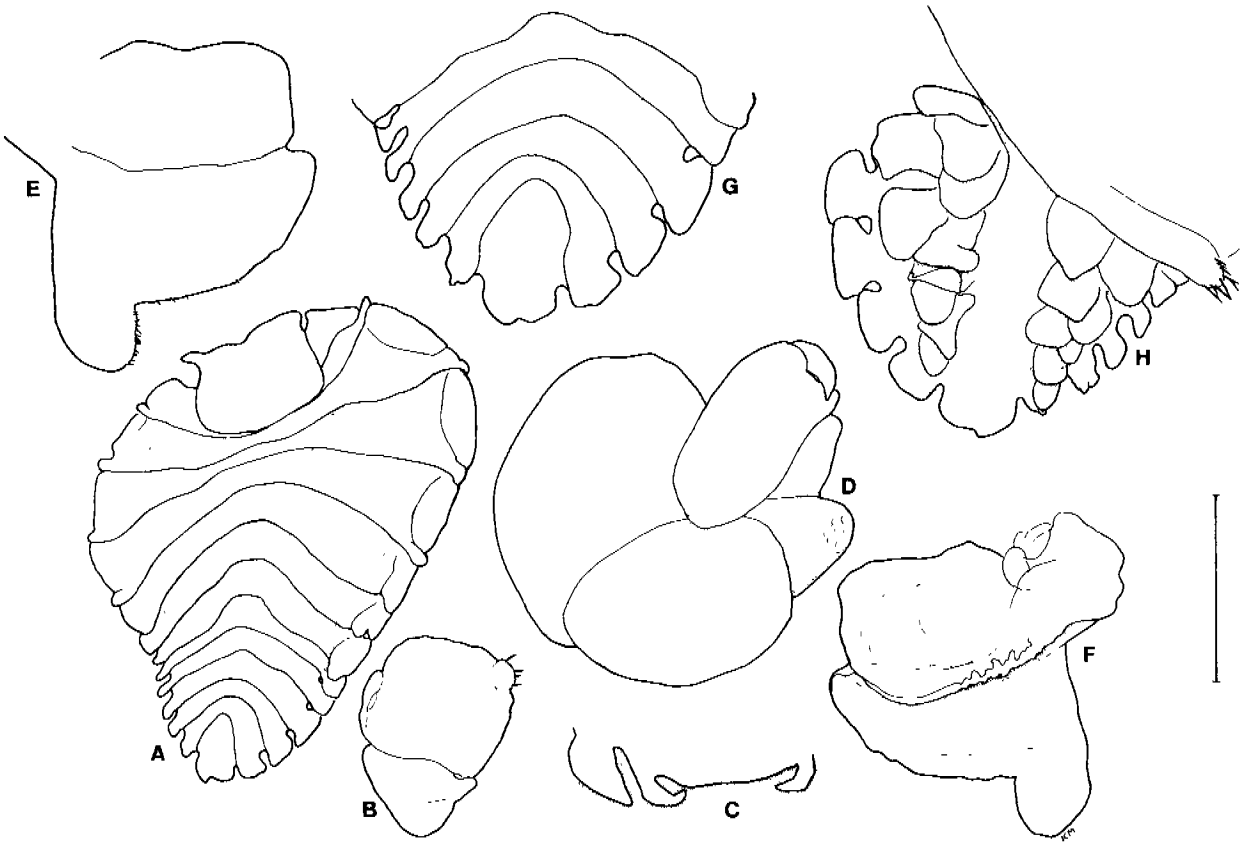


Figure 15. *Probopyria alphei* (Richardson), holotype ♀, USNM 23759. A. Dorsal view. B. Right maxilliped. C. Posteroventral border of head. D. Pereopod. E. Right oostegite 1, external view. F. Same, internal view. G. Pleon, dorsal view. H. Pleon, ventral view. Scale 2.0 mm for A; 1.0 mm for B, C, E-H; 0.2 mm for D.

3♀, 3 ♂; Smithsonian-Bredin Expedition Station 77-56, from ship fender along dockyard seawall, English Harbour, Antigua Island; 4 April 1956; USNM.

Infesting *Alpheus* sp.: 1 ♀, 1 ♂; south of Loggerhead Key, Dry Tortugas, Florida; 180 m; 10 April 1964 (collection data possibly erroneous); B. Benton, coll.; J. C. Markham, det. of host; UMML 32: 5355.

Separated from host: 2 ♀, 2 ♂; Haulover Canal, Indian River, Brevard County, Florida, 28°44.2'N, 80°45.8'W; 0.1-0.4 m, at low tide in bed of *Halodule wrightii*; R. W. Virnstein et al., colls.; 10 February 1976; posthole digger in sand; IRCZM 89: 3892.

*Description*: Holotype female (Figure 15): Length 5.1 mm, maximal width 4.2 mm, head length 1.0 mm, pleon length 2.0 mm. Body axis distortion 37°. Body shape nearly cordate. All body segments and regions distinct (Figure 15A).

Head subrectangular, wider than long, extending far from pereon and produced into prominent anterolateral "horns." Antennae obscure. Maxilliped (Figure 15B) nearly 4/5 as wide as long, lacking palp but with anteromedial corner setose. Posteroventral border (Figure 15C) with two pairs of lateral projections, outer ones very much broader.

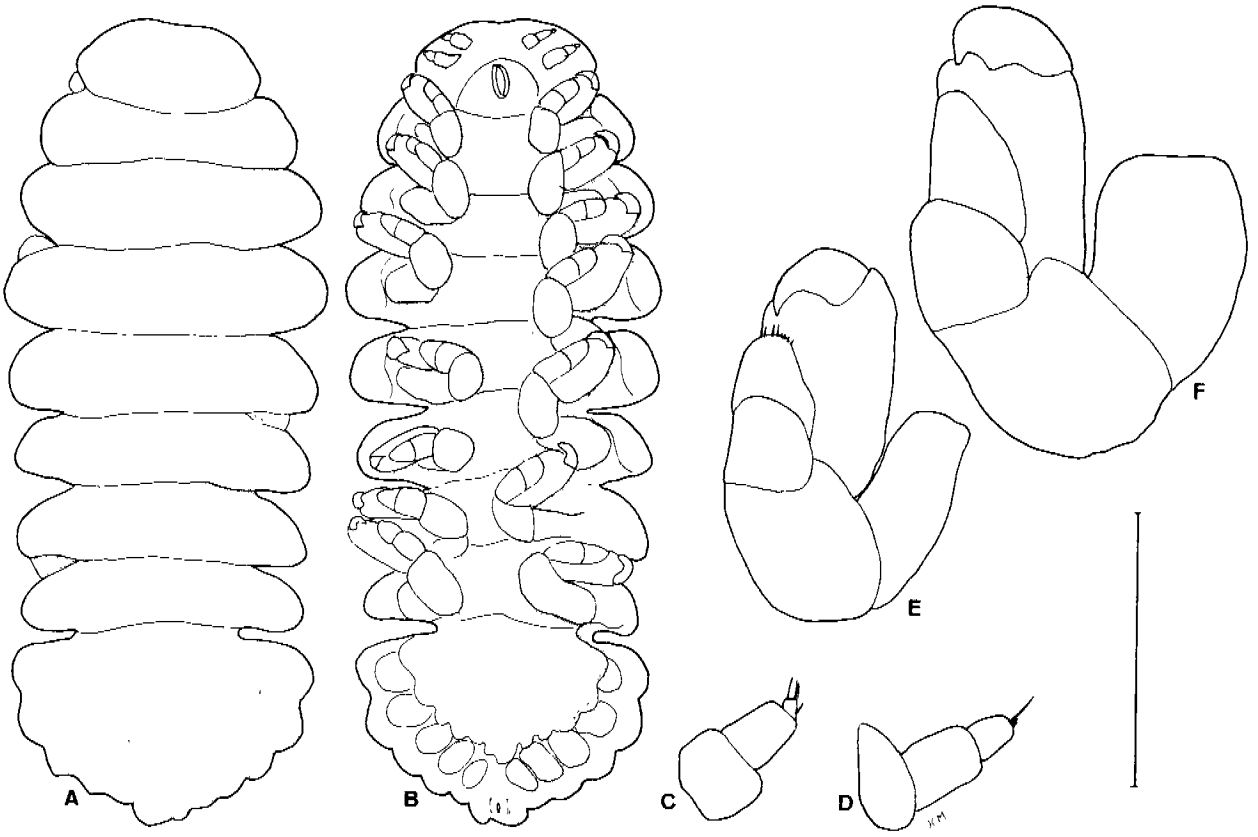


Figure 16. *Probopyria alphei* (Richardson), allotype ♂, USNM 23759. A. Dorsal view. B. Ventral view. C. Right antenna 1. D. Right antenna 2. E. Right pereopod 1. F. Right pereopod 7. Scale 0.5 mm for A, B; 0.125 mm for C-F.

Pereon smoothly rounded along both sides, widest across pereomere 3. First pereomere bisected by head dorsally. First four pereomeres bearing narrow tergal projections on both sides. All pereomeres with coxal plates on long side but none on other side. Pereopods (Figure 15D) all similar in size and proportions, with all articles distinct; basis larger than all other articles together, merus extending conspicuously in each pereopod. Oostegites surrounding but not covering brood pouch; oostegite 1 (Figure 15E, F) about as wide as long, both lobes of nearly same length, internal ridge irregularly crenulate, posterolateral point bluntly rounded and extending straight back from lateral margin.

Pleon (Figure 15G, H) tapering posteriorly, of six pleomeres, distinct dorsally but not ventrally. Deep lateral notches at anterior sides of each pleomere separating it from preceding segment. Biramous pleopods on first five pleomeres, in form of rather irregularly inserted flaps decreasing in size posteriorly. Final pleomere unevenly indented posteriorly, lacking uropods.

Allotype male (Figure 16): Length 1.46 mm, maximal width 0.58 mm, head length 0.16 mm, pleon length 0.52 mm. All body regions and pereomeres clearly set off (Figure 16A, B).

Head oval and more than twice as wide as long, but still much narrower than any pereomere. Antennae (Figure 16C, D) both three-articled with distal tufts of setae.

Pereon slightly broadest across pereomere 3, only slightly narrower behind. All pereomeres rather deeply divided laterally. Pereopods (Figure 16E, F) all of essentially same proportions but slightly increasing in size posteriorly.

Pleon almost semicircular, 2/3 as long as wide, slightly wider than final three pereomeres. Pleon fused into single piece, but lateral undulations indicating six pleomeres. Midventral regions produced into prominent swollen region with margin following margin of pleon. Five pairs of sessile, discoid, uniramous pleopods just lateral to edge of central swelling. Anal cone only slightly produced. No uropods.

*Distribution*: North Carolina through western Florida; Antigua; Brazil.

*Remarks*: For reasons discussed above for the new genus *Probopyria*, *Bopyrus alphei* Richardson cannot be assigned to either *Probopyrus* or *Bopyrella*, to which the species previously has been assigned. Superficially, the species is quite similar to *Parabopyrella richardsonae* (Nierstrasz and Brender à Brandis), redescribed below, another parasite of some of the same species of alpheids in the same localities. These two species differ in several important respects in both sexes. Females of *P. richardsonae* are narrower relative to their length, have articulated maxilliped palps, and lack deep anterolateral notches on most or all pleomeres. The male of *P. richardsonae* has the head and pereon fused and the pleon much wider than any pereomere.

The type-specimens of *Capitetragonia asperotibialis* were mounted on microscope slides, and the mounting medium dissolved them, so they were difficult to study. In light of what remains discernible of them, the drawings of Pearse (1953a), and the recorded host species, it appears that *C. asperotibialis* is a synonym of *Probopyria alphei*. Wilson's (1900) record of *Gyge* sp. was based on specimens clearly assignable to *P. alphei*. There is little variation among the other specimens examined.

## *Schizobopyrina*, new genus

*Diagnosis*: Female: All body regions and segments usually distinct, although head often variously fused with first pereomere; body axis moderately distorted. Frontal lamina large but poorly differentiated from head, usually with concave margin on shorter side; maxilliped palp extended, setose, and articulating, but sometimes only rather obscurely so; posteroventral border with two pairs of projections. Dorsolateral bosses on long sides of pereomeres 1-4; first oostegites produced into narrow to broad posterolateral points, right and left ones of slightly to greatly different structure; other oostegites elongate, each overlapping next behind it, surrounding brood pouch but not at all covering it. Pleon of six distinct pleomeres, final one bilobate and extending little if any beyond preceding pleomere; four pairs of uniramous, flap-like pleopods; no uropods. Male: Width about 1/3 to 1/2 length, body fusiform. Head fused with first pereomere and partly embedded in it. No midventral pereonal tubercles; pereopods all similar in size and structure. Pleon fused, but five pleomeres indicated laterally; usually three or four pairs of obscure tuberculiform pleopods; no uropods. Hosts in Palaemonidae, some in Hippolytidae.

*Type-species*: By present designation, *Bopyrina urocaridis* Richardson, 1904.

*Etymology*: Prefix "*schizo-*" (split) + generic name *Bopyrina* selected to emphasize close similarity to *Bopyrina* Kossmann, but with distinction of female's pleomeres being separated on both sides. Gender feminine.

*Remarks*: *Schizobopyrina* is similar to *Bopyrina* Kossmann (discussed below), to which its type-species, *S. urocaridis*, was heretofore assigned, but differs from *Bopyrina* in some important respects. Females of both genera have concave margins on one side of their frontal laminae and unequal formation of the first oostegites. The presence of a maxilliped palp, elongate oostegites 2-5, and at least lateral separation of the pleomeres in *Schizobopyrina* contrasts with the lack of a palp, tiny second through fifth oostegites, and pleomeral fusion on the short side of *Bopyrina* females. The males of *Schizobopyrina* differ from those of *Bopyrina* in being proportionately broader, having less extended heads, and often having at least rudimentary pleopods.

Nine other species of *Bopyrina* occurring in the warm waters of the Pacific and Indian Oceans are also reassignable to *Schizobopyrina*. These are *B. amakusaensis* Shiino, *B. andamanica* Chopra, *B. brachytelson* Nierstrasz and Brender à Brandis, *B. cochinensis* Chopra, *B. gracilis* Chopra, *B. kossmanni* Chopra, *B. lobata* Bourdon and Bruce, *B. miyakei* Shiino, and *B. striata* Nierstrasz and Brender à Brandis. The generic diagnosis above takes these species into account.

Only one western Atlantic species is assigned to the genus, *Schizobopyrina urocaridis* (Richardson).

### *Schizobopyrina urocaridis* (Richardson, 1904), new combination

Figures 17-21

*Bopyrina urocaridis* Richardson, 1904, pp. 73, 74, figs. 60-62 [type-locality Punta Rassa, Florida; infesting *Periclimenes longicaudatus* (Stimpson)]; 1905a, p. 565, figs. 624-626; Chopra, 1923, pp. 417, 418, 523, 525, 542; Nierstrasz and Brender à Brandis, 1923, p. 102; 1925, p. 7; 1929, pp. 40, 42; Pearse, 1953b, p. 619, fig. 1 [off Beaufort, North Carolina; infesting *P. longicaudatus*]; Hutton and Sogandares-Bernal, 1960, p. 287 [Maximo Point, Boca Ciega Bay, Florida; infesting *P. longicaudatus*]; Hutton, 1964, p. 447; Wells and Wells, 1966, pp. 59, 60; Menzies and Glynn, 1968, p. 13; Schultz, 1969, p. 336, fig. 542; Rouse, 1970, p. 135 [southwest Florida; infesting *P. longicaudatus*].

?*Bopyrina* sp.: Bullis and Thompson, 1965, p. 4 [Gulf of Mexico near Pensacola, Florida; host unrecorded].

*Bopyrina pontoniae* Wells and Wells, 1966, pp. 57-60, figs. 3, 4 [type-locality off Core Banks, North Carolina; infesting *Pontonia margarita* Smith commensal with *Argopecten gibbus* (Linnaeus)]; Schultz, 1969, pp. 335, 336, fig. 541; Kelley, 1978, p. 169.

*Material examined*: HOURGLASS MATERIAL: None. — OTHER MATERIAL: Infesting *Periclimenes longicaudatus* (Stimpson): 1 ♀ (HOLOTYPE), 2 ♀, 1 ♂ (PARATYPES); Punta Rassa, Florida; 2 m; H. Hemphill, coll.; USNM 29088, 29228, and 29229. — 1 ♀, 1 ♂; Shackleford Banks, Beaufort, North Carolina; 14 July 1952; S. Wainwright, coll.; USNM 95119 and 95118. — 1 ♀; Maximo Point, Boca Ciega Bay, Florida; R. F. Hutton and F. Sogandares-Bernal, colls.; USNM 101834. — 2 ♀, 1 ♂; one mile west of Marker No. 1, Cedar Key, Florida; 7 March 1955; E. L. Pierce, coll.; USNM 102022. — 1 ♀; offshore from Crystal River power generating plant, Citrus County, Florida, 28°56'06"N, 82°45'18"W; 1.5 m; 26 August 1971; C. Grimes and J. Mountain, colls.; FSBC I 16581. — 1 ♀; Florida Power Corporation survey, Anclote Harbor, Tarpon Springs, Florida; 28 September 1976; unassigned. — 17 ♀ (12 immature), 4 ♂, 6 cryptoniscan larvae; same locality; 4 November 1976; USNM 181839.

Infesting *Pontonia margarita* Smith: 1 ♀ (HOLOTYPE of *Bopyrina pontoniae* Wells and Wells); off Core Banks, North Carolina; 22 m in mantle cavity of *Argopecten gibbus* (Linnaeus); 3 April 1961; USNM 114440.

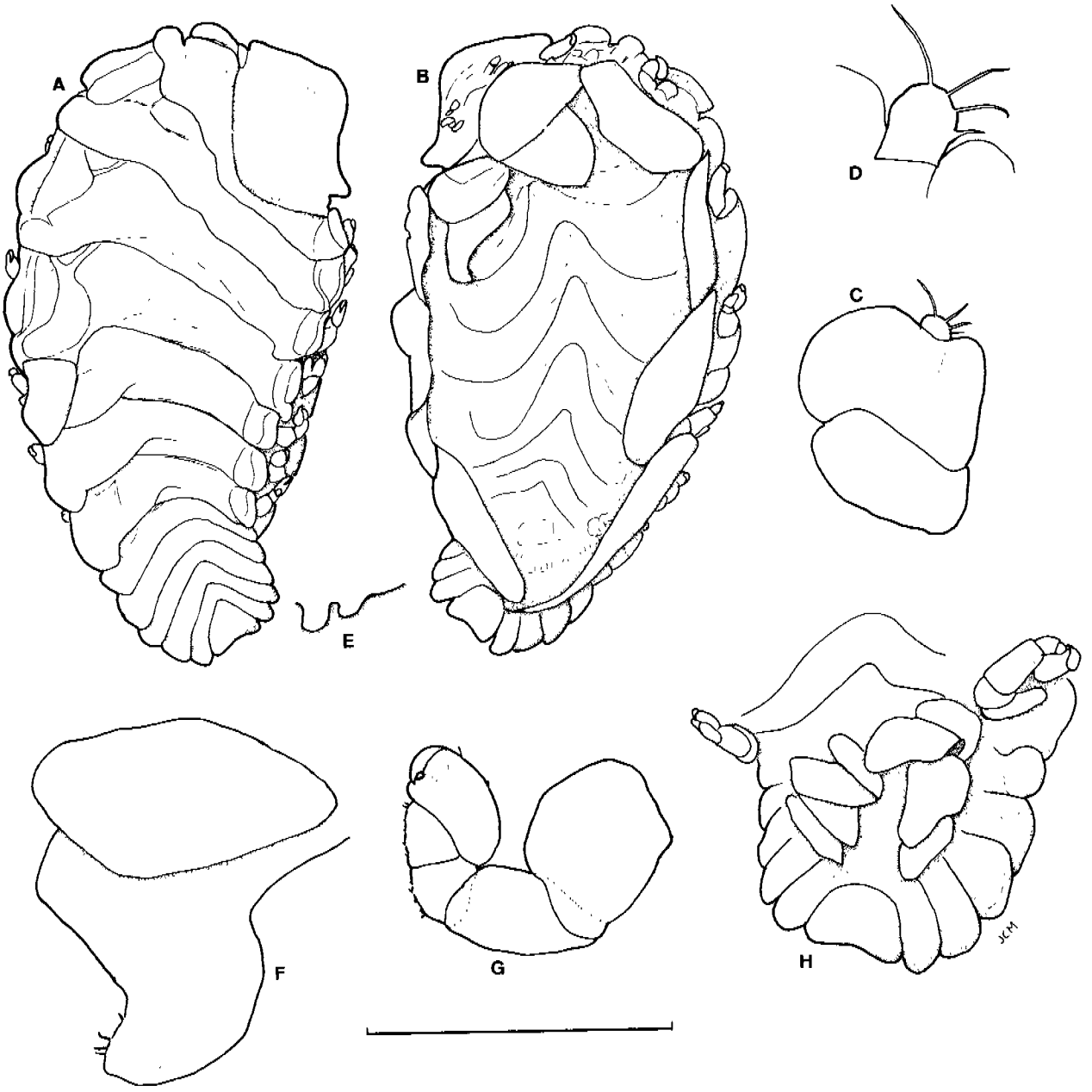


Figure 17. *Schizobopyrina urocaridis* (Richardson), paratype ♀, USNM 29229. A. Dorsal view. B. Ventral view. C. Right maxilliped, external view. D. Palp of same. E. Right posteroventral border of head. F. Right oostegite 1, internal view. G. Right pereopod 1. H. Pleon, ventral view. Scale 1.5 mm for A, B; 0.5 mm for C, F; 0.9 mm for E, H; 0.25 mm for D, G.

Separated from host: 1 ♀; *Alpha Helix* cruise PD-69-500, south of Belize City, Belize, 17°13.2'N, 88°16.5'W; 25 m; 17 July 1977; dredge; USNM.

*Description*: Paratype female (Figure 17): Length 3.31 mm, maximal width 1.64 mm, head length 0.73 mm, pleon length 0.79 mm, body axis distortion 72°. All body regions and segments distinct (Figure 17A, B).

Head roughly quadrangular, separated from pereon by deep dorsal groove. Large, indistinctly set-off frontal lamina extended into triangular lateral points and prominently notched on shorter side of body. Antennae tiny, obscure, each of three articles. Maxilliped

(Figure 17C) relatively broad, with sparsely setose palp (Figure 17D) deeply set into margin and articulating with it. Posteroventral border (Figure 17E) with two short, blunt lateral projections on each side.

Pereomeres distinctly separate dorsally and laterally, much less so ventrally. Coxal plates on both sides of pereomeres 1-4, dorsolateral bosses on long sides of same pereomeres. Oostegites surrounding but not at all enclosing brood pouch; first oostegites of different shapes, right one (Figure 17F) with falcate posterolateral point, left one with semioval posterolateral point; internal ridges of both unadorned. Pereopods (Figure 17G) all of nearly same size, with all articles distinct; several tiny setae along margins.

All six pleomeres distinct, but final one deeply embedded in fifth one and making posterior margin appear truncate. Four pairs of irregularly shaped, leaf-like, uniramous pleopods. No uropods.

Allotype male (Figure 18): Length 0.64 mm, maximal width 0.29 mm, pleon length 0.14 mm. Outline roughly fusiform (Figure 18A, B).

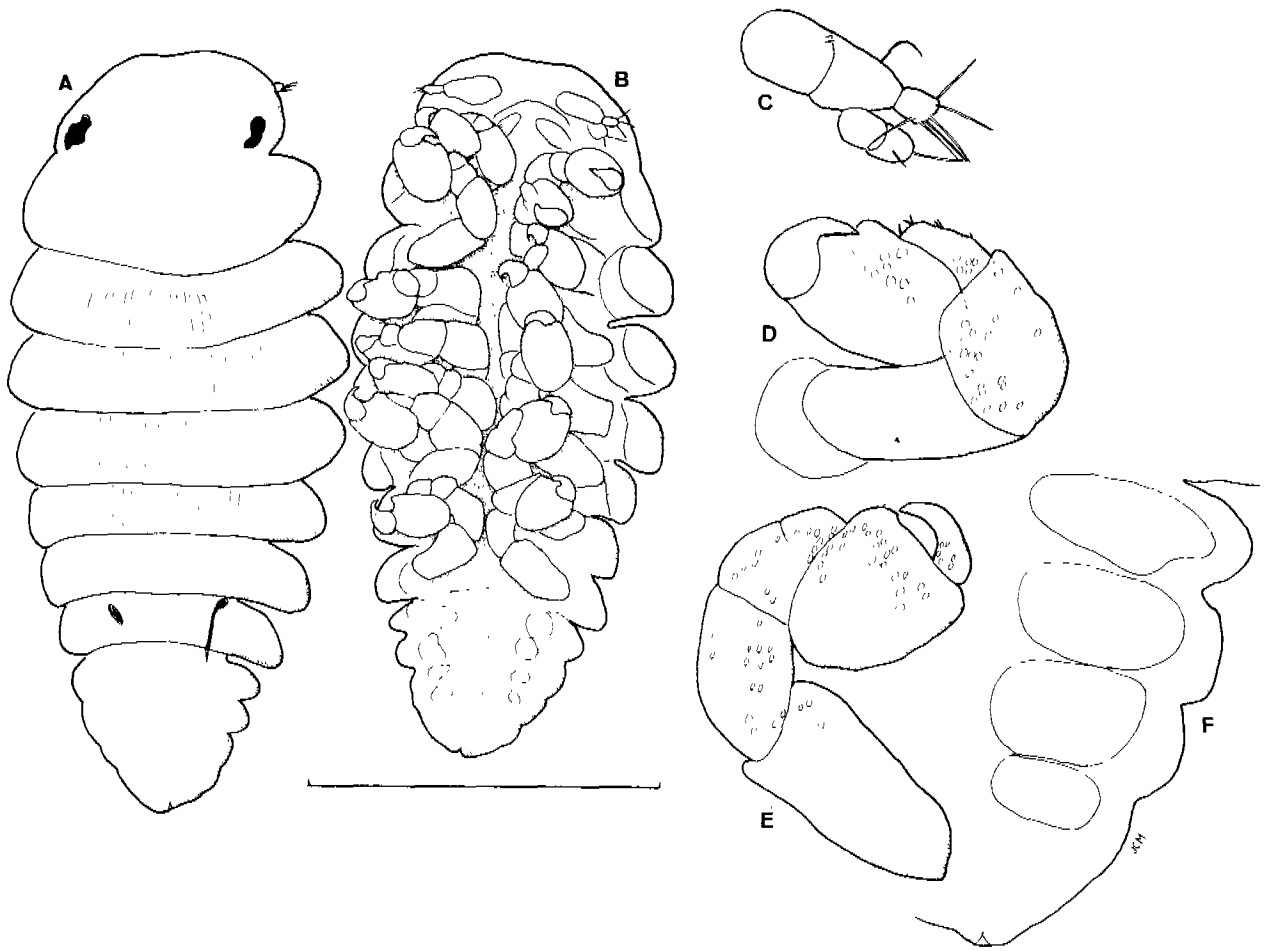


Figure 18. *Schizobopyrina urocaridis* (Richardson), allotype ♂, USNM 29228. A. Dorsal view. B. Ventral view. C. Left antennae. D. Right pereopod 1. E. Left pereopod 7. F. Left side of pleon, ventral view. Scale 0.3 mm for A, B; 0.1 mm for C-F.

Head much broader than long, fused with first pereomere, but juncture present laterally. Large eyespots near posterolateral corners. Antennae (Figure 18C) of three and two articles respectively, each sparsely setose.

Pereomeres distinctly separated laterally. No midventral tubercles. Irregular pigment spots on dorsal surface of final pereomere. Pereopods (Figure 18D, E) of nearly same size, although dactyli somewhat smaller posteriorly; carpi and meri of all at least partly fused.

Pleon fused into single piece, but rudiments of five pleomeres indicated laterally; posterior border slightly notched medially. Four pairs of rudimentary, flat, sessile pleopods (Figure 18F). No uropods.

*Variations*: Females (Figures 19, 20): The other females examined agree in all important respects. The female illustrated (FSBC I 16581) has a proportionately broader pleon (Figure 19A) and much more rudimentary pleopods (Figure 19B), and, being fresher, still retains eye coloration and some other pigmentation. Its broadly pointed first oostegite (Figure 19C) is

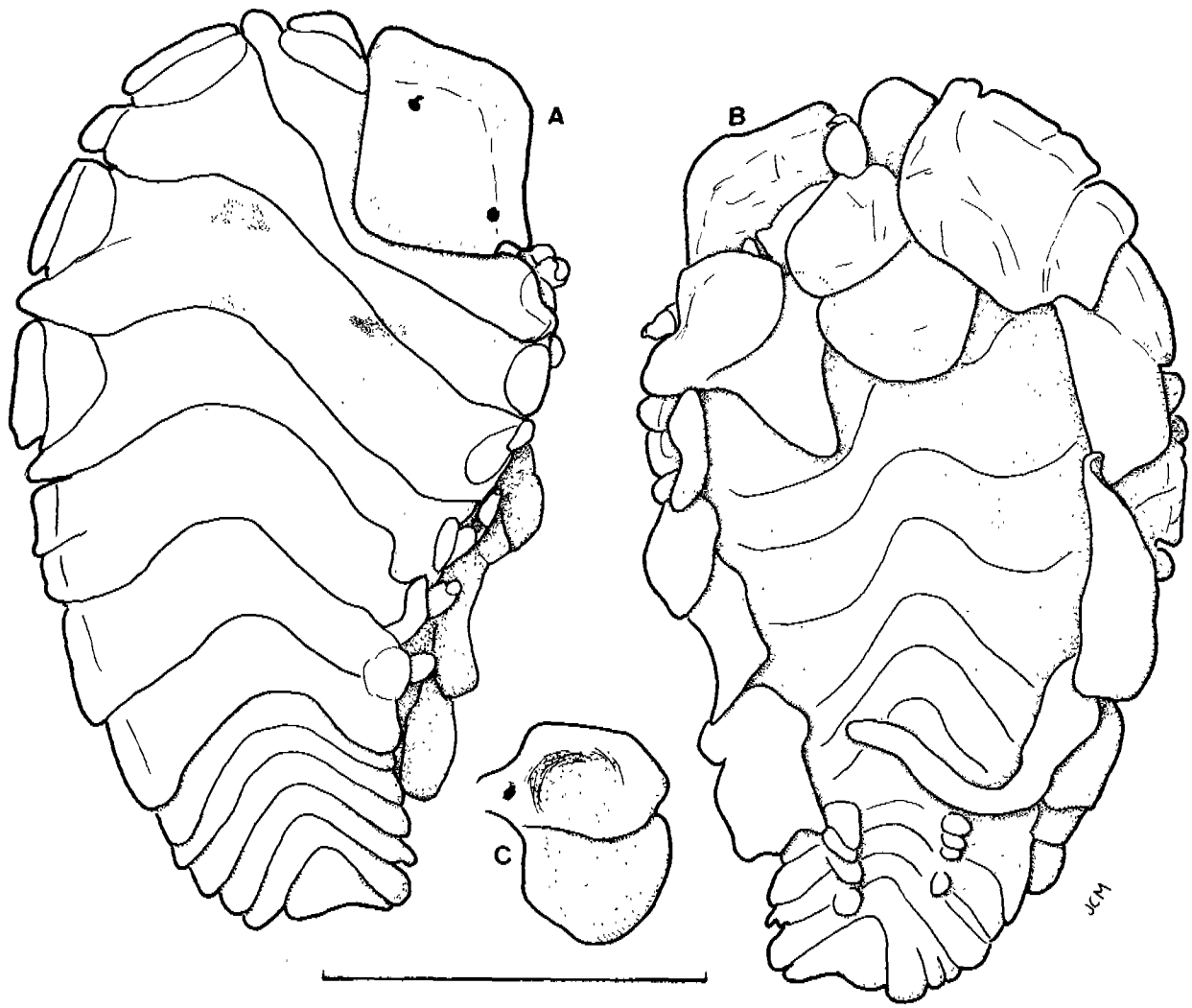


Figure 19. *Schizobopyrina urocaridis* (Richardson), ♀ from Crystal River, Florida, FSBC I 16581. A. Dorsal view. B. Ventral view. C. Left oostegite 1, internal view. Scale 1.0 mm.

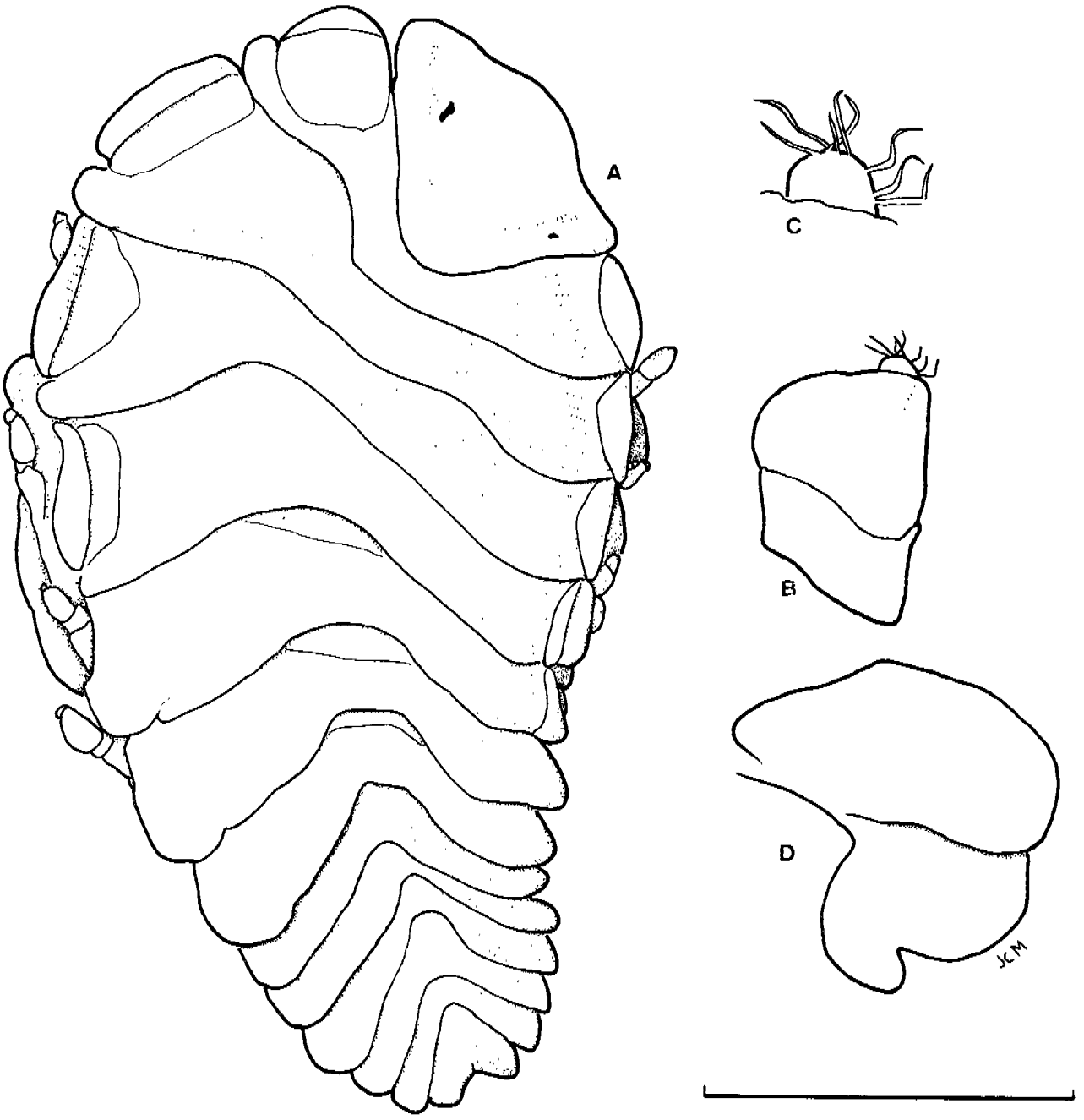


Figure 20. *Schizobopyrina urocaridis* (Richardson), holotype ♀ of *Bopyrina pontoniae* Wells and Wells, USNM 114440. A. Dorsal view. B. Right maxilliped. C. Palp of same. D. Left oostegite 1, internal view. Scale 1.25 mm for A; 1.0 mm for B, D; 0.4 mm for C.

illustrated for contrast. The holotype female of *Bopyrina pontoniae* (Figure 20) has a slightly more slender body and concave pleotelson (Figure 20A), a narrower maxilliped (Figure 20B) with a more setose palp (Figure 20C), and a more falcate point on the narrow-pointed first oostegite (Figure 20D).

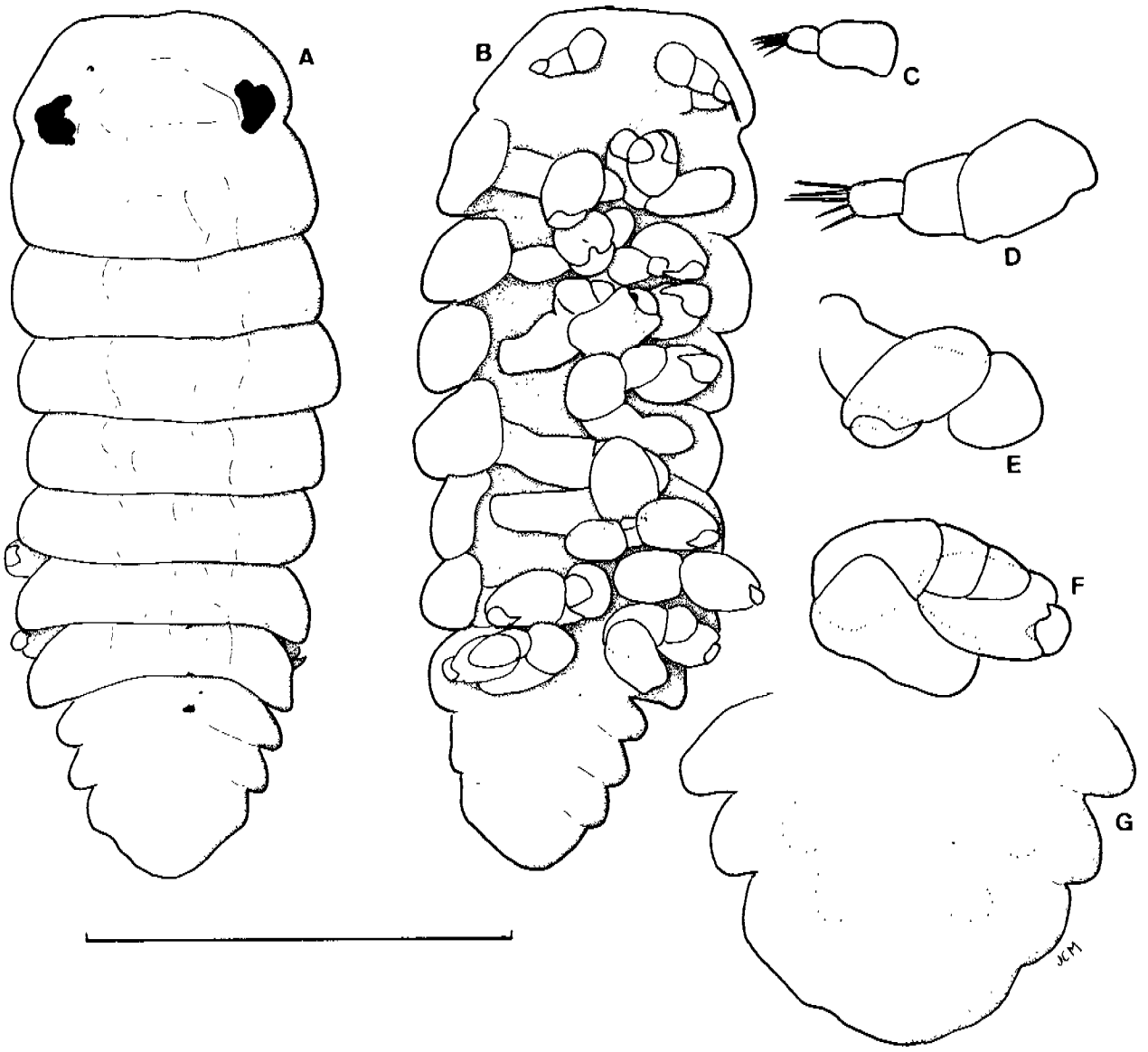


Figure 21. *Schizobopyrina urocaridis* (Richardson), ♂ from Cedar Key, Florida, USNM 102022. A. Dorsal view. B. Ventral view. C. Right antenna 2. D. Right antenna 1. E. Right pereopod 1. F. Left pereopod 7. G. Pleon, ventral view. Scale 0.3 mm for A, B; 0.1 mm for C, D; 0.15 mm for E-G.

Males (Figure 21): In the male illustrated (USNM 102022), from Cedar Key, Florida, the sides are more nearly parallel; the head is relatively broader; the second antennae are more setose; the meri and carpi of some pereopods, especially the more posterior ones, are distinct; and the pleopods are extremely faint, only three being barely discernible. In another male, not illustrated, the juncture between the head and pereon is not visible laterally; the pereopods have dactyli all the same size, not smaller posteriorly, and some carpal-meral separations.

*Distribution*: North Carolina; western Florida; and Belize.

*Remarks*: Wells and Wells (1966) described *Bopyrina pontoniae* based on a single female. The characters cited by Wells and Wells to distinguish *B. pontoniae* from *B. urocaridis*, which they

considered its closest relative, appear too minor for *B. pontoniae* to be retained as a separate species, especially in light of re-examination of the holotype. Nonetheless, that female is the only specimen of *B. urocaridis* known to infest a host other than *Periclimenes longicaudatus*. Bullis and Thompson (1965) reported a "*Bopyrina* sp." from off Pensacola, Florida, which may belong to *B. urocaridis*. Although the host was not mentioned, those authors also reported *Pontonia margarita* Smith, the host of *B. pontoniae*, at the same station.

The male described by Pearse (1953b) and erroneously called the "allotype" (USNM 95118) had been mounted on a microscope slide, and almost completely dissolved by the mounting medium. This fact probably accounts for the peculiar drawing by Pearse (1953b: Figure 1), in which the pleopods appear to be dorsally placed.

## *Bopyroides* Stimpson, 1864

*Diagnosis*: Female: Body oval, more than half as wide as long, only moderately distorted. Head separate from pereon, with distinct frontal lamina; maxilliped with setose, nonarticulating palp; posteroventral border with two pairs of lateral projections. Dorsolateral bosses and coxal plates on both sides of pereomeres 1-4, but no tergal projections; oostegite 1 not pointed posterolaterally. Six pleomeres either separated dorsally or at least indicated by minute lateral notches; four or five pairs of rudimentary, uniramous pleopods represented by ill-defined tubercles; no uropods. Male: Body to four times as long as wide with nearly parallel sides. Head separate from pereon. No midventral pereonal tubercles. Pleon completely fused, subtriangular; lacking all appendages. Parasites of hippolytid and pandalid shrimps.

*Type-species*: By original designation, *Bopyroides acutimarginatus* Stimpson, 1864 [= *Bopyrus hippolytes* Krøyer, 1838]. Gender masculine.

*Remarks*: Of several species which have been assigned to *Bopyroides*, most are synonyms of *B. hippolytes* (Krøyer), a circumboreal species found infesting many different species throughout its great range in the Atlantic, Pacific, and Arctic Oceans. The only other species properly placed in *Bopyroides* is *B. cluthae* (Scott), reported from Britain and northwestern France (Bourdon, 1968). Both species infest members of both host families, Pandalidae and Hippolytidae. Only one species, *Bopyroides hippolytes* (Krøyer), is known in the western Atlantic.

## *Bopyroides hippolytes* (Krøyer, 1838)

Restricted synonymy, lacking all secondary citations. (All host names updated according to information provided in personal communications from L. B. Holthuis.):

*Bopyrus hippolytes* Krøyer, 1838, pp. 306-310, pl. IV, fig. 22a, b, bx, c, d [type-locality Greenland; infesting *Lebbeus polaris* (Sabine)]; Thompson, 1848, p. 65 [Galway, Ireland; infesting *Hippolyte varians* Leach]; Stimpson, 1862, p. 140 [Port Foulke, Greenland].

*Bopyroides acutimarginatus* Stimpson, 1864, p. 156 [type-locality Puget Sound, Washington; infesting *Heptacarpus brevirostris* (Dana)].

*Bopyroides hippolytes*: Stimpson, 1864, p. 156; Sars, 1898, pp. 198-200, pl. 84, fig. 2 [Norway; infesting *Spirontocaris* spp.]; Bonnier, 1900, pp. 162, 221, 373-375, 377, 381 [Arctic Ocean and Norway; infesting *Lebbeus polaris*]; Norman, 1902, p. 479 [East

Finmark, Norway]; Richardson, 1905a, pp. 567-572, figs. 628-637 [both coasts of North America; infesting many species of shrimps]; 1905b, pp. 218-220, figs. 6, 7 [Nanaimo, British Columbia, to Kodiak, Alaska; infesting *Spirontocaris* spp. and *Pandalus jordani* Rathbun]; 1909, pp. 122, 123 [Alaska, Bering Sea, and Japan; infesting *Spirontocaris* spp.]; Grieg, 1909, p. 553 [east Greenland; infesting *Lebbeus polaris*]; Hansen, 1909, p. 219 [Skagerak, Denmark; infesting *Spirontocaris lilljeborgii* (Danielssen)]; Deriugin, 1915, p. 438, pl. 12, fig. 12 [Gulf of Kola; infesting *Lebbeus polaris*]; Hansen, 1916, pp. 203-205, pl. 15, fig. 11a-d [Davis Strait; north of Iceland; infesting *Spirontocaris* spp.]; Stephensen, 1916, p. 239 [Greenland; infesting *S. lilljeborgii*]; Fee, 1926, p. 41 [British Columbia; infesting *Heptacarpus brevirostris*]; Sparre-Schneider, 1926, p. 66 [Tromsøsundet, Norway; infesting *Spirontocaris* sp.]; Nierstrasz and Brender à Brandis, 1929, p. 17 [3 localities, Greenland; infesting *Lebbeus polaris*]; Gurjanova, 1933, p. 451 [west Spitzbergen and Barents Sea; infesting *Spironotocaris spinus* (Sowerby)]; Procter, 1933, p. 247 [Mount Desert, Maine; infesting *Eualus fabricii* (Krøyer)]; Gurjanova, 1936, pp. 221, 222 [White Sea and Norway Sea]; Shino, 1937, pp. 293-296, fig. 1 [4 localities, Japan; infesting *Spirontocaris* spp.]; Stephensen, 1937, pp. 12, 18, 21, tabs. I, III [synopsis of distribution, Iceland; infesting *S. spinus*]; 1943, pp. 52, 53 [east Greenland localites; infesting *Lebbeus polaris*]; Dahl, 1949, pp. 14, 15 [Norway localities; infesting *Spirontocaris* spp.]; LeSueur, 1954, p. 216 [Jersey; infesting *Hippolyte* spp.]; Marine Biological Association, 1957, p. 206 [Plymouth Sound, England; infesting *Hippolyte varians* Leach]; Ouspenskaia, 1960, pp. 235, 240, fig. 42 [western Barents Sea; infesting *Pandalus borealis* Krøyer, *P. montagui* Leach, and *Lebbeus polaris*]; Bruce et al., 1963, p. 148 [Isle of Man; infesting *Spirontocaris spinus*]; Bourdon, 1968, pp. 350-359, figs. 158-163 [many localities in Europe and many hosts]; George and Strömberg, 1968, p. 253 [San Juan Islands, Washington; infesting *Spirontocaris* spp. and *Eualus* spp.]; Stromberg, 1971, pp. 1-42, figs. 1, 2, 10-15, 18 [Norway and Washington; infesting several hosts].

*Gyge hippolytes*: Bate and Westwood, 1868, pp. 230, 231, unnumbered fig. [Galway, Ireland; Polperro, England; infesting *Lebbeus polaris*]; Miers, 1877, pp. 64, 65 [Ellsmere Island; infesting *L. polaris*]; Harger, 1880, p. 311 [Cape Cod Bay, Massachusetts; infesting *Spirontocaris spinus*, *S. lilljeborgii*, *Eualus fabricii*; Casco Bay, Maine; infesting *Lebbeus polaris*, *Eualus pusiolus* (Krøyer); Halifax, Nova Scotia; Gulf of Maine; infesting *S. lilljeborgii*; Cash's Ledge, Maine; infesting *S. spinus*]; Hoek, 1882, pp. 35-37, 74, 75, pl. I, fig. 6, pl. II, figs. 20-22 [Barents Sea; infesting *S. spinus*]; Weber, 1884, p. 35 [Arctic Ocean; infesting *S. spinus* and *Eualus gaimardii* (H. Milne Edwards)]; Sars, 1886, p. 35 [Vestfjord, Norway; infesting *S. lilljeborgii*]; Hansen, 1887, p. 197 [west Greenland; infesting *Eualus fabricii* and *Lebbeus polaris*]; Ohlin, 1895, p. 19 [Baffin Bay and Smith Sound; infesting *L. polaris*]; Whiteaves, 1901, p. 236 [Gulf of St. Lawrence; infesting *S. spinus* and *Pandulus montagui*]; Kingsley, 1901, p. 174 [Casco Bay, Maine; infesting "*Hippolyte*"].

*Pleurocrypta hippolytes*: Norman, 1886, p. 13.

*Bopyroides* spp.: Bonnier, 1900, p. 378.

*Bobyroides* [sic] *hippolytes*: Greve, 1963, p. 39 [9 Norwegian localities; infesting *Spirontocaris lilljeborgii*, *S. spinus*, and *Lebbeus polaris*].

*Material examined*: None.

*Diagnosis*: Female: Body more than 3/4 as wide as long, with smoothly rounded sides. Head much wider than long. Ventral segmentation of pleon indicated only by faint lines in chitin; pleopods very indistinct, in four pairs; final pleomere not extended. Male: Sides of body nearly parallel. At regions of contact, head and pleon only slightly narrower than adjacent pereomeres; pereomeres not deeply separated from one another. Maximal width of pleon only about 2/3 its length. (Adapted from Bourdon, 1968.)

*Description*: See Sars (1898), Bonnier (1900), Richardson (1905a), or Bourdon (1968).

*Distribution*: Arctic Ocean and boreal regions of Atlantic and Pacific Oceans; along coast of North America, northeastern Asia, and northwestern Europe.

*Remarks*: *Bopyroides hippolytes* has been well redescribed and illustrated in thorough detail elsewhere, and so need not be considered in detail here. In extending no farther south than Cape Cod in the western Atlantic, *B. hippolytes* is the only bopyrine in the region not found in the tropics or subtropics, and the only one found in boreal or Arctic waters. Except for *Hemiarthrus abdominalis* (Krøyer) (discussed below), it infests more different host species than any other known bopyrid isopod. All of the host species belong to the caridean families Hippolytidae and Pandalidae.

## *Bopyrina* Kossmann, 1881

*Diagnosis*: Female: Body only moderately distorted. Head separated from pereon at least laterally, either fused or free posteriorly; frontal lamina long, rather obscurely separated from head, extending in points to both sides; maxilliped lacking palp; posteroventral border with single projection on each side. Posterior pereomeres produced into swollen ventral lobes; coxal plates obscure or absent; first oostegites more or less shaped differently from each other, both with unadorned internal ridges; other oostegites very reduced and difficult to observe; pereopods with anteriorly enlarged bases. Pleon completely fused on short side but with four or five pleomeres indicated on long side; three or four pairs of uniramous pleopods, first quite prominent flaps, other pleopods reduced and often very indistinct; no uropods. Male: Body usually at least three times as long as broad. Head fused with pereon, but juncture indicated laterally (occasionally, head distinct as intraspecific variation); antenna 1 of three articles, antenna 2 of one or two. Pereomeres lacking midventral tubercles; pereopods all of normal size. Pleon variously fused, with at least two free pleomeres and up to five pleomeres distinct or indicated laterally; no pleopods; no true uropods, but posterolateral corners often bearing long, slender, cuticular extensions. Hosts in genus *Hippolyte*.

*Type-species*: By monotypy, *Bopyrus ocellatus* Czerniavsky, 1869. Gender feminine.

*Remarks*: The generic diagnosis above is much more restrictive than those previously used (mostly implicitly) for *Bopyrina*. This diagnosis is based mainly on the type-species, *B. ocellata* (Czerniavsky) of Europe (Bourdon, 1968) and Australia (Bourdon and Bruce, 1983) and the sole western Atlantic species retained in the genus, *B. abbreviata* Richardson, which are both very similar. *Bopyrina gigas* Nierstrasz and Brender à Brandis from Indonesia and *B. sewelli* Chopra from India are retained in the genus. Ten other species have been removed to *Schizobopyrina* (above). *Bopyrina choprae* Nierstrasz and Brender à Brandis and *B.* (?) *pleurocephala* Monod, both in need of redescription, belong to different (and probably still undescribed) genera.

One western Atlantic species is known, *Bopyrina abbreviata* Richardson.

### *Bopyrina abbreviata* Richardson, 1904

Figures 22-24

*Bopyrina abbreviata* Richardson, 1904, pp. 71-73, figs. 56-59 [type-locality Punta Rassa, Florida; infesting *Hippolyte zostericola* (Smith)]; 1905a, pp. 563, 564, figs. 620-623; Chopra, 1923, pp. 419, 523, 525, 534, 542; Nierstrasz and Brender à Brandis, 1923, pp. 98, 100, 102; 1925, p. 7; 1929, p. 40; Chopra, 1930, pp. 145, 146; Shino, 1934, p. 270; 1939c, pp. 95, 96; Pearse, 1953b, p. 619 [ off Beaufort, North Carolina; infesting *H. pleuracanthus* (Stimpson)]; Hutton and Sogandares-Bernal, 1960, p. 287 [Maximo Point, Boca Ceiga Bay, Florida; infesting *Hippolyte* sp.]; Hutton, 1964, p. 447; Menzies and Glynn, 1968, p. 13; Schultz, 1969, p. 334, fig. 538; Rouse, 1970, p. 135 [southwest Florida; infesting *H. pleuracanthus*]; Bourdon and Markham, 1980, p. 229.

?*Probopyrinella latreuticola*: Nierstrasz and Brender à Brandis, 1929, p. 26 [in part, Coral Bay, St. John, Virgin Islands; infesting *H. pleuracanthus*].

"Branchial bopyrid": Chace, 1972, p. 111 [Tobago,West Indies; infesting *H. curacaoensis* Schmitt].

*Material examined*: Infesting *Hippolyte pleuracanthus* (Stimpson): HOURGLASS MATERIAL: None. — OTHER MATERIAL: 2 ♀, 2 ♂; adjacent to Duke University Laboratory Pier, Beaufort, North Carolina; about 1930; A. S. Pearse, coll. and det. of hosts; USNM 95119. — 1 ♀, 1 ♂; in grass beds, Beaufort, North Carolina; 25 July 1970; R. W. Heard, coll. and det. of

hosts; USNM 150727. — 3 ♀, 3 ♂; Florida Power Corporation survey, Anclote Harbor, Tarpon Springs, Florida; 4 November 1976; USNM 173482. — 12 ♀, 12 ♂ (PARATYPES); Punta Rassa, Florida; 1.8 m; prior to 1904; H. Hemphill, coll.; USNM 29097. — 4 ♀, 2 ♂; Virginia Key, Miami, Florida; 6 September 1975; P. Van Arman, coll. and det. of hosts; USNM. — 5 ♀, 5 ♂ (including reference specimens); Dinner Key, Miami, Florida; shallow water; 1 December 1971; J. García-Gómez, coll. and det. of hosts; UMML 32: 5329. — 14 ♀, 10 ♂; Card Sound, Florida; in shallow water; March to December 1970; J. García-Gómez, coll. and det. of hosts; UMML 32: 5330. — 1 ♀, 1 ♂; from unknown locality (probably southeast Florida); UMML 32: 5365.

Infesting *Hippolyte* sp. [probably *H. pleuracanthus*]: HOURGLASS MATERIAL: None. — OTHER MATERIAL: 1 ♀, 1 ♂; Maximo Point, Boca Ciega Bay, Florida; 17 April 1958; Springer and Sogandares-Bernal, colls.; T. E. Bowman, det. of host; USNM 01836.

Infesting *Hippolyte curacaoensis* Schmitt: HOURGLASS MATERIAL: None. — OTHER MATERIAL: 1 ♀; Smithsonian-Bredin Expedition Station 4-59, west of Pigeon Point, Tobago, West Indies; 4 April 1959; F. A. Chace, Jr., det. of host; USNM.

Separated from hosts: HOURGLASS STATION C: 1 ♀ (damaged); 8 September 1966; trawl; FSBC I 23858. — OTHER MATERIAL: 8 ♀ (including 2 immature); drop net site, near Round Island, Indian River, St. Lucie County, Florida, 27°33.4'N, 80°20.6'W; 0.1-0.4 m, on sandy bottom in bed of *Halodule wrightii*; 22 May and 27 June 1978; R. W. Virnstein et al., colls.; IRCZM 89: 3894, 3898-3900, 3902, 3903, 3904, and 3906. — 1 ♀; Link Port, Indian River, St. Lucie County, Florida, 27°32.2'N, 80°20.9'W; on sandy bottom in bed of *Halodule wrightii*; 20 April 1976; R. W. Virnstein et al., colls.; IRCZM 89: 3905. — 1 ♀; Belize-80, diving station 32, offshore from Belize, 16°48.2'N, 88°04.5'W; 15 m; 2 April 1980; G. Hendler, coll.; USNM.

*Diagnosis*: As for genus except: Female: Head and pereon distinct; some coxal plates slightly developed; first oostegites markedly different from each other; only three pairs of pleopods definitely present. Male: Antenna 2 of single article; at least some pereopods with meri and carpi fused; at least three pleomeres present or indicated.

*Description*: Reference female (Figure 22): Length 1.44 mm, maximal width 0.79 mm, head length 0.41 mm, pleon length 0.41 mm, body distortion 34°. Body oval, without abrupt disruption of margins (Figure 22A, B).

Head separate from pereon, irregularly polygonal, width exceeded anteriorly by large frontal lamina only indistinctly separated from rest of head; frontal lamina asymmetrically produced into rounded lateral points and slightly undulating anteriorly. Antennae not discernible, presumably very reduced. Maxilliped (Figure 22C) truncate anteriorly, lacking any trace of palp. Posteroventral border of head (Figure 22D) with single, slender, sharply pointed projection on each side.

Pereomeres distinctly separated dorsally and laterally. Coxal plates absent except on long sides of pereomeres 1-3. Dorsolateral bosses absent. Final two pereomeres with dorsolateral swellings on long sides extending far enough to be visible dorsally. First oostegites (Figure 23E) both large and extending back more than 1/3 length of pereon, but markedly truncate anteriorly and unadorned internally; posterior segment of right first oostegite tapering to blunt point, that of left first oostegite semioblong. Other oostegites very reduced and difficult to discern.

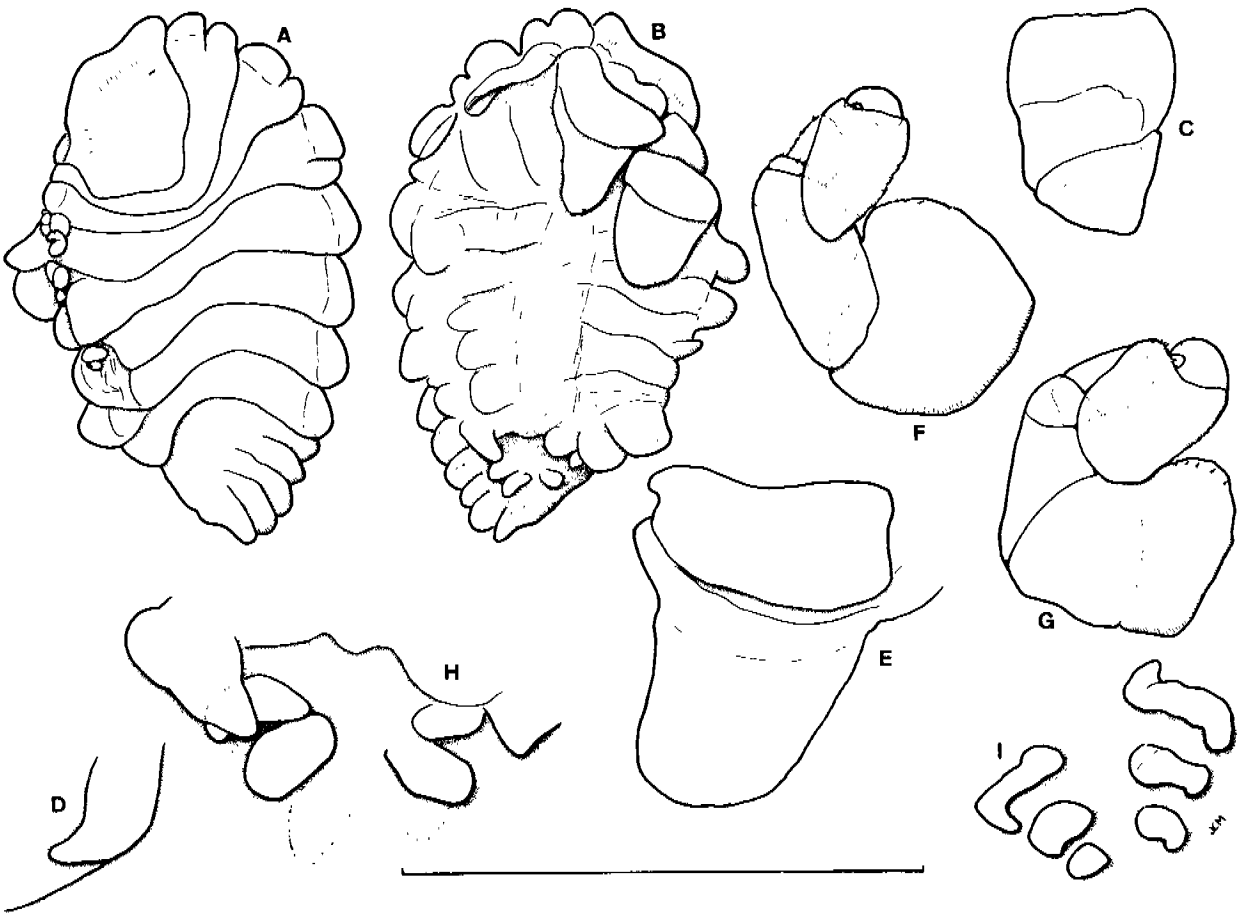


Figure 22. *Bopyrina abbreviata* Richardson, reference females, UMML 32: 5329. A. Dorsal view. B. Ventral view. C. Right maxilliped, external view. D. Left posteroventral border of head. E. Right oostegite 1, internal view. F. Right pereopod 1. G. Left pereopod 7. H. Pleopods of ♀ 1. I. Pleopods of ♀ 2. Scale 1.5 mm for A, B; 1.0 mm for C, I; 0.5 mm for D, E, H; 0.25 mm for F, G.

Pereopods (Figure 22F, G) tiny, all of about same size and proportions, basal segments relatively enlarged, all articles separate; scattered setae on several margins.

Pleon distinctly divided into five pleomeres on long side and about halfway across dorsal surface, but no trace of segmentation on opposite side. Pleopods (Figure 22H, I) as irregularly shaped uniramous flaps, at least three pairs present and indication of fourth pair occasionally discernible. No uropods.

Paratype male (Figure 23): Length 0.78 mm, maximal width 0.21 mm, pleon length 0.21 mm. Body outline lanceolate, rounded anteriorly, and tapered posteriorly (Figure 23A, B).

Head completely fused with pereon posteriorly, but juncture indicated laterally; head semicircular. Large, irregularly shaped, dark eyespots. Antenna 1 (Figure 23C) of three articles and tipped with sparse setae; antenna 2 (Figure 23D) of single article.

Pereon with sides nearly parallel, all pereomeres well separated laterally. No midventral tubercles. Pereopods (Figure 23B, E, F) quite small, all about same size and proportions; meri

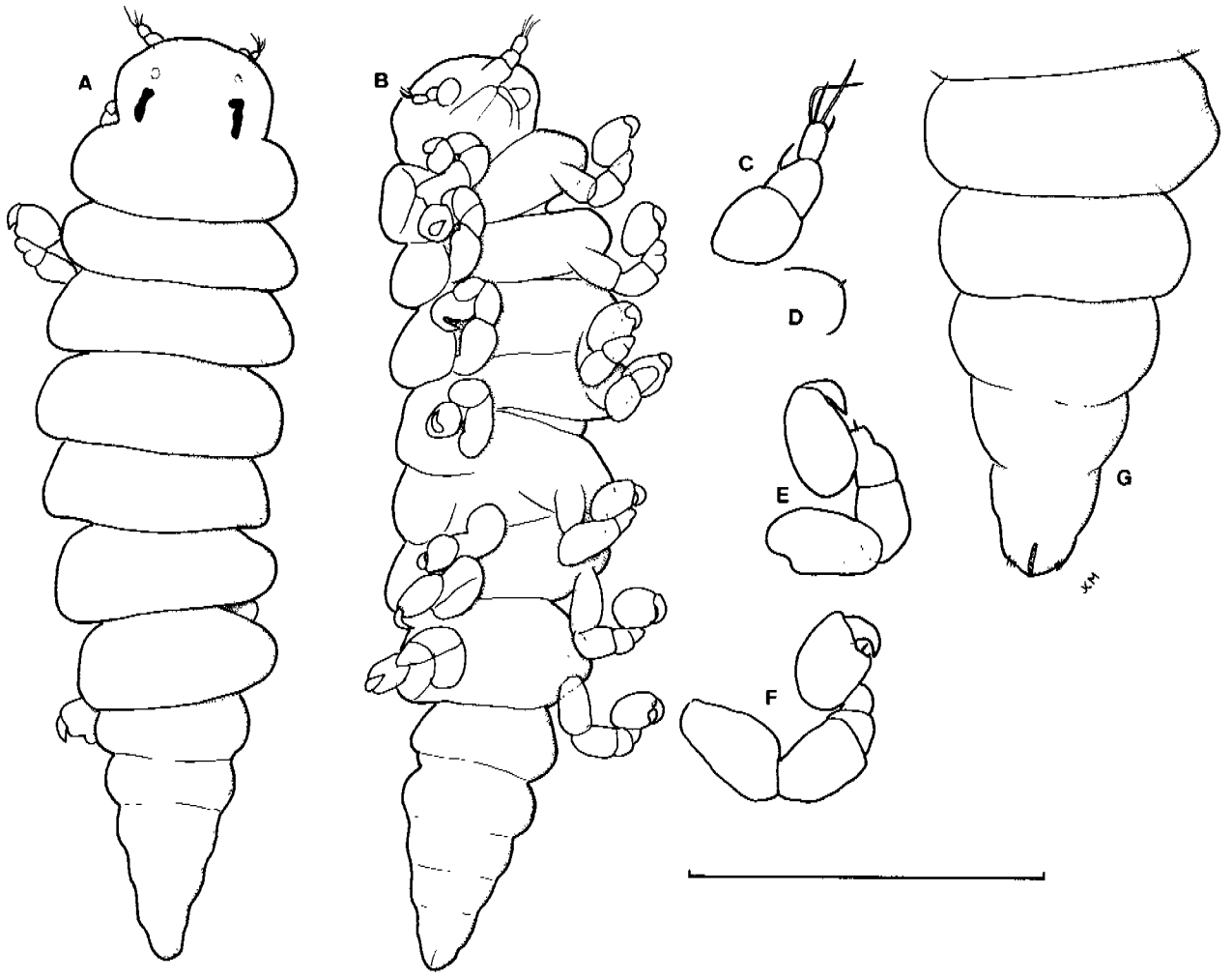


Figure 23. *Bopyrina abbreviata* Richardson, paratype ♂, USNM 29097. A. Dorsal view. B. Ventral view. C. Left antenna 1. D. Left antenna 2. E. Left pereopod 1. F. Left pereopod 7. G. Pleon, ventral view. Scale 0.3 mm for A, B; 0.15 mm for E-G; 0.1 mm for C, D.

and carpi of anterior pereopods fused, those of posterior pereopods separated but somewhat obscurely so.

Pleon (Figure 23G) triangular, tapering to sharp point. At least three pleomeres obscurely separated dorsally and ventrally; faintly undulate margins indicating remnants of six pleomeres laterally. No pleopods or uropods, but two small tufts of very short setae on posterolateral borders.

*Variations*: Females: In some cases pereomeres quite distinctly separated ventrally; in one, coalesced pleomeres indicated slightly by shallow indentations on short side of pleon. Male (Figure 24): In some cases relatively shorter; propodus and dactylus of anterior pereopods larger than those of others; posterior edge of pleon produced into two cuticular extensions but probably not true uropods; occasionally head distinctly separated from pereon.

*Distribution*: North Carolina; both coasts of Florida; Belize; and West Indies.

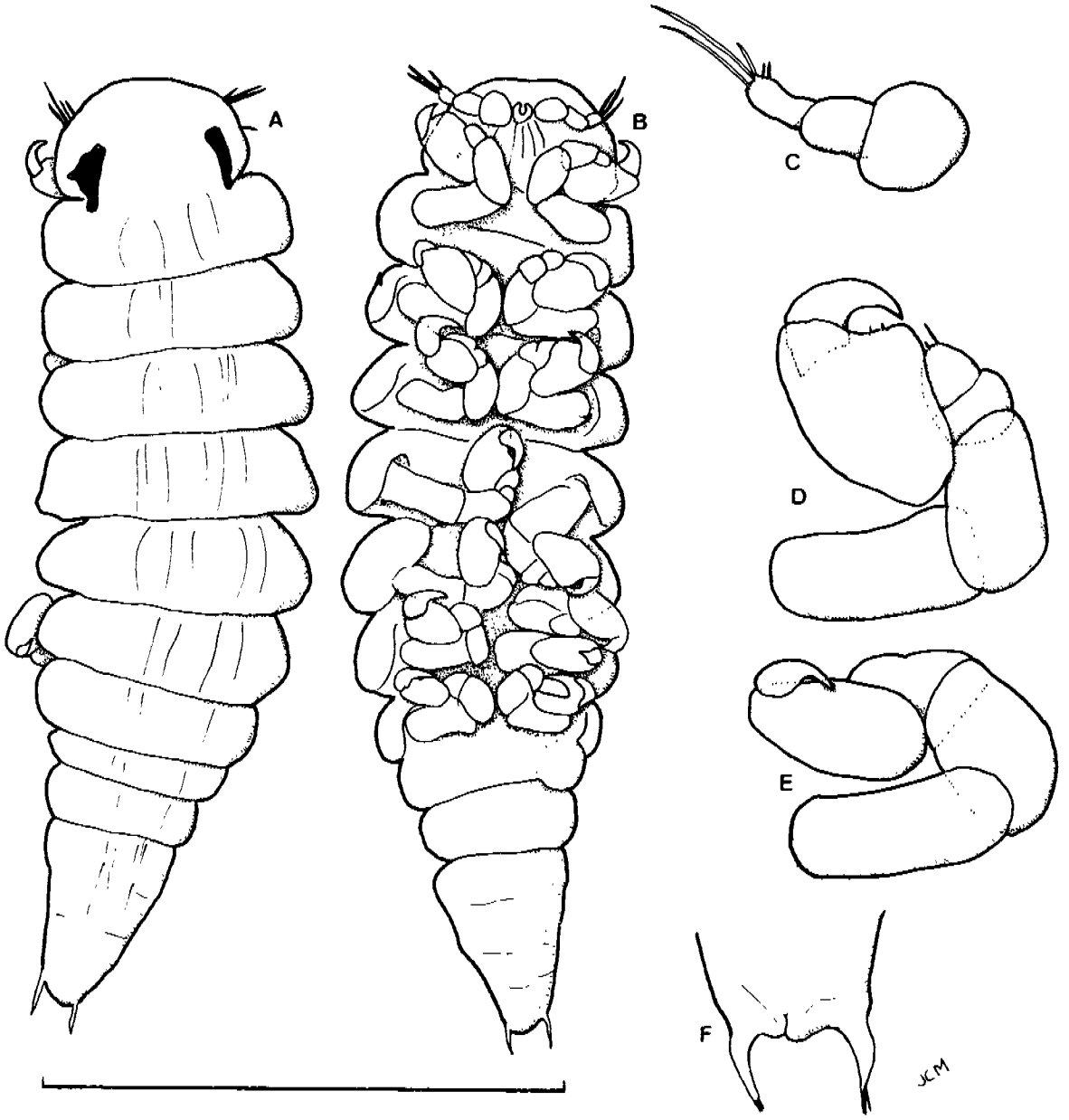


Figure 24. *Bopyrina abbreviata* Richardson, ♂ from Biscayne Bay, Florida, UMML 32: 5329. A. Dorsal view. B. Ventral view. C. Right antenna 1. D. Right pereopod 1. E. Right pereopod 7. F. End of pleon, ventral view. Scale 0.3 mm for A, B; 0.1 mm for C-F.

*Remarks*: *Bopyrina abbreviata* is clearly very similar to the European species *B. ocellata* (Czerniavsky). It satisfies all of the criteria listed by Bourdon (1968: 397) for recognition of females of *B. ocellata* except that in females of *B. abbreviata* the head is distinct from the pereon, and some coxal plates are present. The males of the two species are still more similar,

even in the detail of frequently having peculiar "tail-like" extensions. Both Chopra (1923) and Shiino (1934) considered *B. abbreviata* a possible synonym of *B. giardi* Bonnier. However, when Bourdon (1968) included *B. giardi* in the synonymy of *B. ocellata*, he did not regard *B. abbreviata* as a synonym. The evidence presented here substantiates that conclusion.

*Bopyrina abbreviata* has been collected frequently, nearly always from the same host species, *Hippolyte pleuracanthus*. Chace (1972) has discussed the possibility that *H. zostericola* (Smith, 1873), also often recorded as the host of *Bopyrina abbreviata*, may be a synonym of *H. pleuracanthus* (Stimpson, 1871). Julio García-Gómez, who identified several of the host specimens mentioned in this report, has concluded (personal communication) that the distinctions cited by Chace (1972) to separate those species reflect different growth stages of a single species. Peggy Van Arman, who collected and provided some of the material, identified those hosts as *H. zostericola* and reported (personal communication) that she had found characters of the larvae which served to distinguish the species; Shield (1978) agrees with this. Finally, Patsy McLaughlin, after examining a large series of specimens from Anclote Harbor, Florida, including those reported herein as hosts, has reported (personal communication) that only one species is valid. For purposes of this report, they are being considered a single species under the older name *H. pleuracanthus*, but this should not be considered a definitive opinion.

This is the first report of infestation of *H. curacoaensis* by *Bopyrina abbreviata*; Chace (1972) mentioned this specimen without identifying the parasite. The specimens infesting *H. pleuracanthus* in St. John, Virgin Islands, reported by Nierstrasz and Brender à Brandis (1929) as *Probopyrinella latreuticola*, probably belong to *Bopyrina abbreviata*. The reasons for this conclusion are that *B. abbreviata* is the only known branchial parasite of *H. pleuracanthus* and that *Probopyrinella latreuticola* (see above) has never otherwise been recorded from any host but *Latreutes fucorum* (Fabricius). Unfortunately, the specimens in question were not available for examination.

## *Bopyrione* Bourdon and Markham, 1980

*Diagnosis*: Female: Subovate in outline, only moderately distorted. Head distinct, deeply set into pereon; pair of pointed projections on each side of posteroventral border; maxilliped with palp absent or lacking setae and articulation. Oostegites nearly or completely covering brood pouch; first oostegite with long posterolateral point and nearly unadorned internal ridge; pereopods with blunt dactyli and large bases. Pleon of five or six obscurely separated pleomeres, their separations not indicated by lateral indentations; pleopods uniramous, slightly extended, tapering flaps, usually in four pairs; no lateral plates or uropods. Male: Body about twice as long as broad, fusiform in outline. Head variably set off from pereon, with prominent eyes. Final pereomere fused with pleon in two species. Pleon of one to five pleomeres, margins undulate when pleomeres fused. Hosts in genera *Alpheus* and *Synalpheus*.

*Type-species*: By original designation, *Bopyrione synalphei* Bourdon and Markham, 1980. Gender feminine.

*Remarks*: The genus *Bopyrione* contains four known species, all quite similar. The single western Atlantic species, *B. synalphei* Bourdon and Markham, and an Indian species, *B. woodmasoni* (Chopra, 1923), infest species of *Synalpheus*. The other two species, *B. longicapitata* Markham, 1982, and *B. toloensis* Markham, 1982, both from Hong Kong, are parasites of *Alpheus* spp.

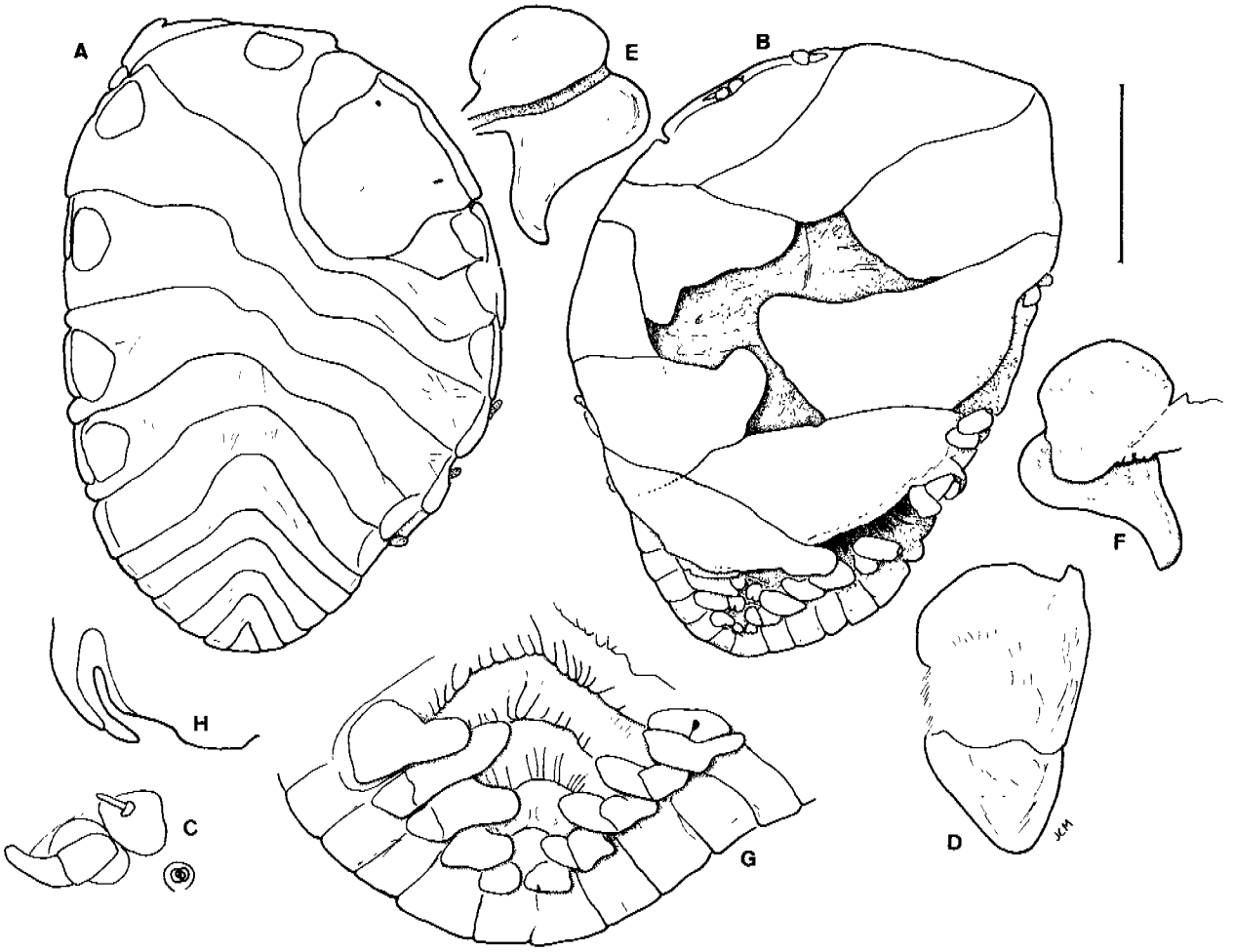


Figure 25. *Bopyrione synalphei* Bourdon and Markham, reference ♀, UMML 32: 5332. A. Dorsal view. B. Ventral view. C. Right antennae and maxillules. D. Right maxilliped. E. Right oostegite 1, external view. F. Same, internal view. G. Pleon, ventral view. H. Right posteroventral border of head. Scale 2.0 mm for A, B, E, F; 1.0 mm for D, G, H; 0.5 mm for C.

## *Bopyrione synalphei* Bourdon and Markham, 1980

Figures 25, 26

?Bopyrid: Coutiere, 1909, p. 52 [no locality listed; infesting *Synalpheus brevicarpus* (Herrick)].

"Branchial bopyrid": Chace, 1972, pp. 95, 104 [Tobago; infesting *Synalpheus minus* (Say); and: Bahía de la Ascensión, Yucatán, Mexico; infesting *Synalpheus townsendi* Coutière].

"Bopyrid isopods": Hoetjes et al., 1976, p. 33 [in part, Curaçao; infesting "snapping shrimp"].

*Bopyrione synalphei* Bourdon and Markham, 1980, pp. 222-228, figs. 1-3 [type-locality Golfe de Gonâve, Haiti; infesting *Synalpheus* sp. (near *S. longicarpus* (Herrick)); same locality, infesting *S. bousfieldi* Chace, *S. pectiniger* Coutière, and *Synalpheus* sp. (near *S. goodei* Coutière); also: eastern Gulf of Mexico; infesting *S. goodei*; and Curaçao; infesting *Synalpheus* sp.]; Markham 1982, pp. 351, 354.

"cf. *Probopyrus pandalicola*": Westinga and Hoetjes, 1981, p. 141, tab. 1 [not *Probopyrus pandalicola* (Packard)].

*Material examined*: Infesting *Synalpheus longicarpus* (Herrick): HOURGLASS STATION C: 1 ♀ (damaged; PARATYPE); 8 September 1966; trawl; FSBC I 23859.

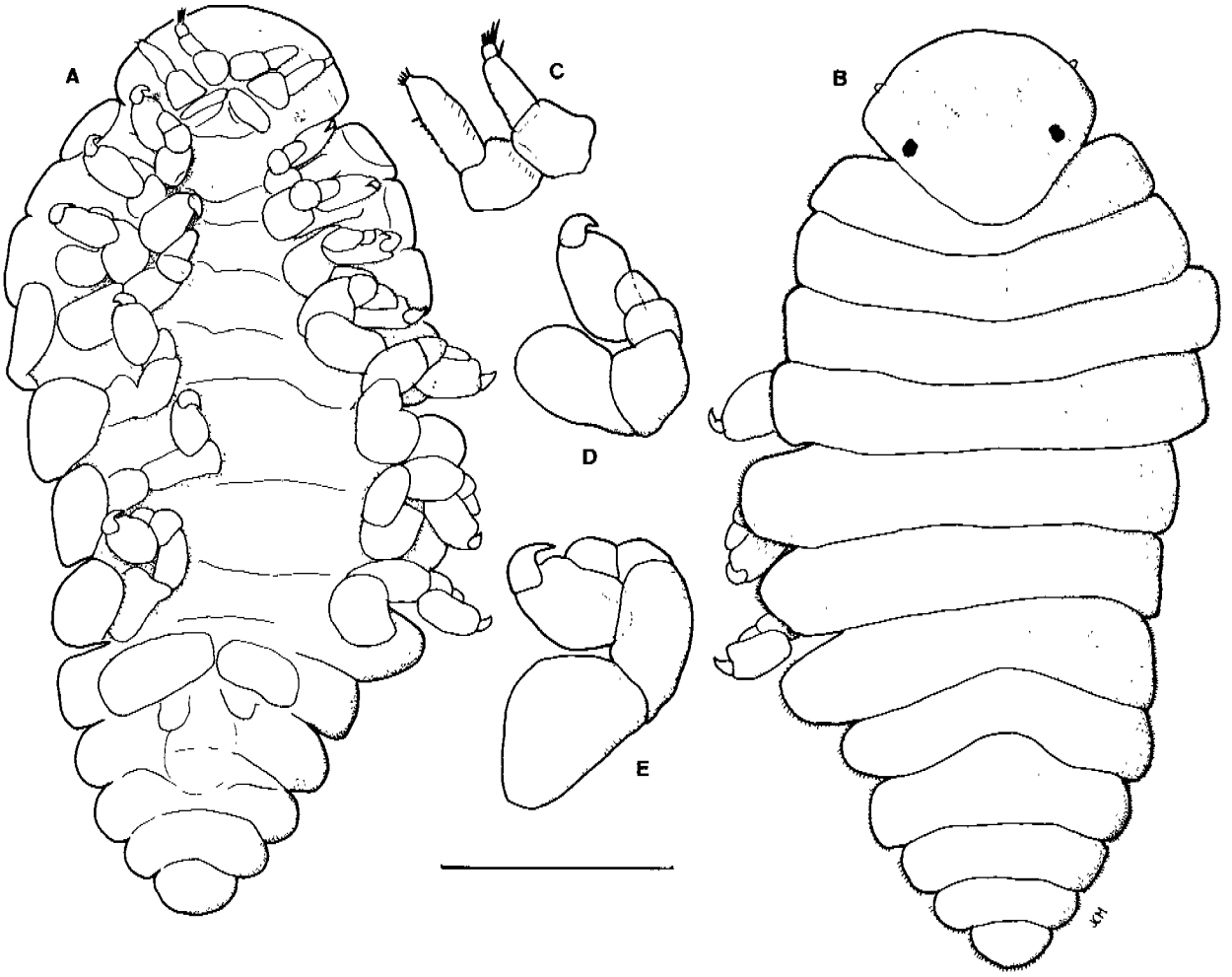


Figure 26. *Bopyrione synalphei* Bourdon and Markham, reference ♂, UMML 32: 5332. A. Ventral view. B. Dorsal view. C. Right antennae. D. Right pereopod 1. E. Right pereopod 7. Scale 0.4 mm for A, B; 0.2 mm for C-E.

Infesting *Synalpheus minus* (Say), (hosts det. by J. García-Gómez, except as noted): HOURGLASS MATERIAL: None. — OTHER MATERIAL: 1 ♀, 1 ♂; among fouling material on corrosion dock, Rosenstiel School of Marine and Atmospheric Science, Virginia Key, Bear Cut, Miami, Florida; 11 January 1971; H. B. Moore et al., colls.; UMML. — 1 ♀; Biscayne Bay, Florida; 12 June 1948; dredge; H. D. Doochin, coll.; UMML 32: 806. — 2 ♀, 2 ♂ (both from single bilaterally infested host specimen); Card Sound, Florida; shallow water; 12 March 1971; J. García-Gómez, coll.; UMML 32: 5332. — 1 ♀, 1 ♂; same locality and collector; 15 March 1972; UMML. — 1 ♀, 1 ♂ (reference specimens); same locality and collector; 29 May 1972; UMML 32: 5332. — 1 ♀, 1 ♂; Smithsonian-Bredin Expedition Station 31-59, on sand flats off beach, west of Pigeon Point, Tobago; 10 April 1959; F. A. Chace, Jr., det. of host; USNM. — 1 ♀; Smithsonian-Bredin Expedition Station 8-59, Buccoo Reef, Tobago; 5 April 1959; F. A. Chace, Jr., det. of host; USNM.

Infesting *Synalpheus pectiniger* Coutière (hosts det. by G. Y. Hendrix, all from sponges): HOURGLASS MATERIAL: None. — OTHER MATERIAL: 1 ♀ (hyperparasitized by cabiropsid isopod), 1 ♂; University of Miami R/V *John Elliott Pillsbury* Station P-1283, off Enriquillo, Dominican Repbulic, 17°35'N, 71°25'W; 18-27 m; 19 July 1970; UMML 32: 5333.

— 1 ♀, 1 ♂; R/V *John Elliott Pillsbury* Station P-1249, southwest of Jamaica, 17°23'N, 78°39'W; 25 m; 13 July 1970; UMML 32: 5334.

Infesting *Synalpheus townsendii* Coutière: HOURGLASS MATERIAL: None. — OTHER MATERIAL: 1 ♀; Smithsonian-Bredin Expedition Station 82-60, Bahía de la Ascensión, Quintana Roo, Mexico; 0.5-1.0 m; 16 April 1960; F. A. Chace, Jr., det. of host; USNM.

*Diagnosis*: As for genus, except: Female: Head nearly or completely bisecting pereomere 1 dorsally. Maxilliped palp absent to slightly extended. Small dorsolateral bosses sometimes present on some pereomeres. Oostegites usually not completely enclosing brood pouch. Pleomeres with separations almost completely invisible or inconspicuous; pleopods always uniramous, although occasionally wrinkled so as to look nearly biramous, in four or five pairs. Male: Body outline often irregular. Pereomeres frequently bearing midventral tubercles. Pleon separate from final pereomere, of three to five pleomeres. Hosts in genus *Synalpheus*.

*Description*: See Bourdon and Markham, 1980.

*Distribution*: Both coasts of Florida; Yucatán through West Indies to Curaçao.

*Remarks*: The single female of *Bopyrione synalphei* taken in the Hourglass collections has a badly damaged anterior region, so it is not illustrated. Nonetheless, it serves to establish the occurrence of the species in the Gulf of Mexico. The drawings presented are those of the reference female (Figure 25) and male (Figure 26) from Card Sound, Florida.

## *Ovobopyrus*, new genus

*Diagnosis*: Body outline smoothly oval, nowhere abruptly narrowing; length about 1 1/2 times greatest width. Head separated from pereon laterally but fused posteriorly; maxilliped with irregularly shaped, non-setose, non-articulating palp. Long sides of pereomeres 1-4 with prominent coxal plates, dorsolateral bosses, and tergal projections; short sides of same pereomeres with only inconspicuous coxal plates and tergal projections. Pleon of six distinct pleomeres, all separated by large lateral notches; five pairs of biramous pleopods; no uropods. Male: About twice as long as wide, with irregularly subparallel sides. Head abruptly narrower than pereon, fused midposteriorly with first pereomere. Pereopods large relative to body size. Pleon as single fused piece; five pairs of discoid sessile pleopods and similar anal cone. Host in genus *Alpheus*.

*Type-species*: By present designation, *Ovobopyrus alphezemiotes*, new species.

*Etymology*: Prefix *Ovo-*, meaning "oval," to emphasize shape of female + generic name *Bopyrus*. Gender masculine.

*Remarks*: See the remarks below for characters distinguishing this genus. Only one species is known, *Ovobopyrus alphezemiotes*, new species.

## *Ovobopyrus alphezemiotes*, new species

Figures 27, 28

*Material examined*: Infesting *Alpheus armillatus* H. Milne Edwards: HOURGLASS STATION C: 1 July 1967; dredge; 1 ♀ (HOLOTYPE, USNM 181551), 1 ♂ (ALLOTYPE, USNM 181552).

*Description*: Holotype female (Figure 27): Length 4.90 mm, maximal width 3.48 mm, head length 0.80 mm, pleon length 1.68 mm. Distortion 30°. Outline oval, no part abruptly narrowing or extending (Figure 27A, B).

Head deeply set into first pereomere, fused with it posteriorly but not laterally. Reflexed frontal lamina completely across front but not extending to sides. Two large lobes on posterior half of dorsal surface. Antenna 1 (Figure 27C) of two articles, distal one very small and bearing terminal tuft of setae. Antenna 2 (Figure 27D) of two articles of about same size, distal one with single terminal seta. Maxilliped (Figure 27E) produced into nonarticulating palp lacking setae;

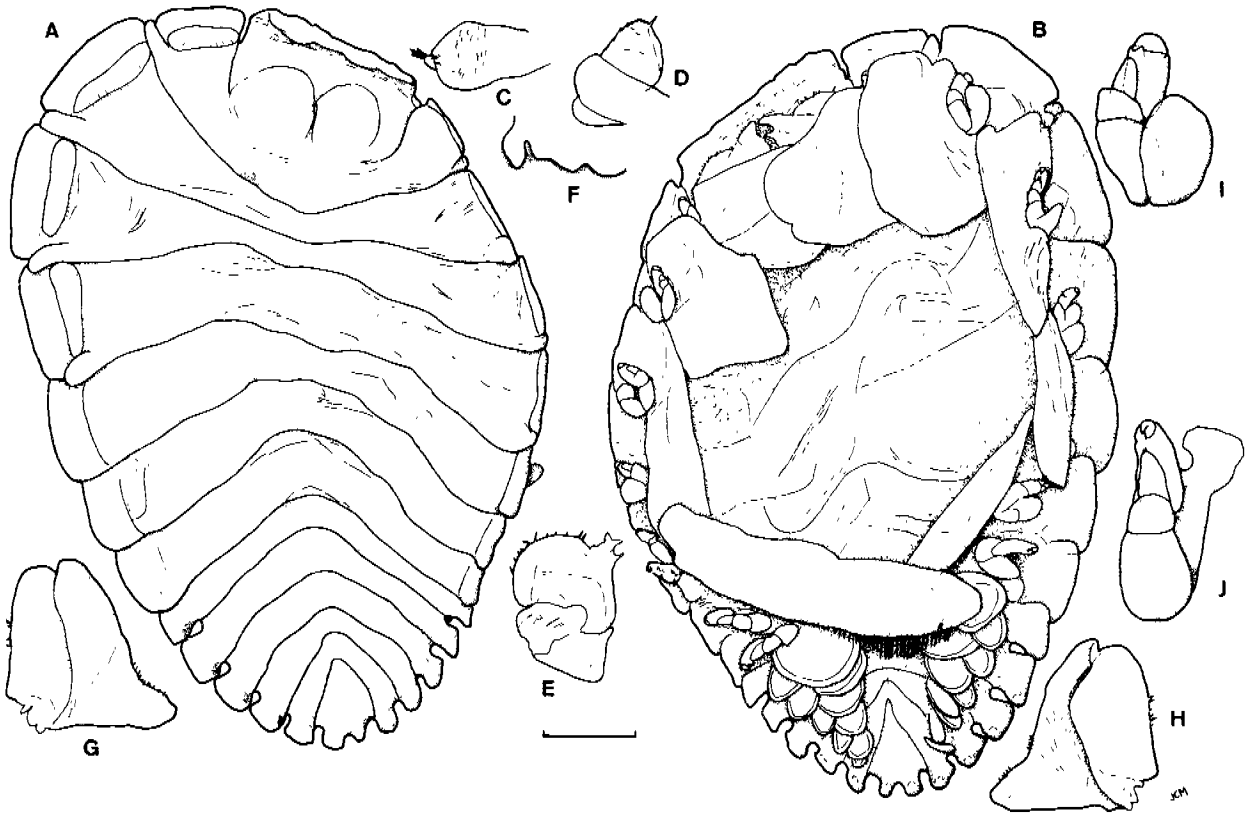


Figure 27. *Ovobopyrus alphezemiotes*, n. gen., n. sp., holotype ♀, USNM 181551. A. Dorsal view. B. Ventral view. C. Right antenna 1. D. Left antenna 2. E. Maxilliped. F. Posteroventral border of head. G. Right oostegite 1, external view. H. Same, internal view. I. Left pereopod 1. J. Right pereopod 7. Scale 0.6 mm for A, B, E-H; 0.2 mm for I, J; 0.1 mm for C, D.

fringe of setae along anterior margin; spur moderately extended. Posteroventral border of head (Figure 27F) with single, short, unornamented, flaplike lateral projection at each side, sinuate margin medially.

All pereomeres distinctly separated, pereomere 3 broadest. Prominent, broad coxal plates, slender dorsolateral bosses, and moderately extended tergal projections on long sides of first four pereomeres. On short side, no dorsolateral bosses but reduced coxal plates on all pereomeres; short tergal projections on first four pereomeres. Oostegites surrounding but not at all enclosing brood pouch; first oostegite (Figure 27G, H) as wide as long, subtriangular in outline with posterolateral point extending straight back, no ornamentation on internal ridge; succeeding oostegites progressively longer until oostegite 5 over four times as long as wide and fringed with setae posteriorly. Pereopods (Figure 27I, J) relatively small, although posterior ones slightly larger and with smaller dactyli.

Pleon of six distinct pleomeres not produced into lateral plates but deeply separated by lateral notches. Five pairs of flaplike, biramous pleopods extending out from pleonal surface and only partly covering it; endopodites larger than respective exopodites, former subcircular and latter oval. No uropods, but terminal pleomere with midposterior notch like those separating pleomeres and making it posteriorly bilobed.

Allotype male (Figure 28): Length 0.87 mm, maximal width 0.44 mm, head length about 0.12 mm, head width 0.24 mm, pleon length 0.24 mm. Sides of body irregularly subparallel, tapering more or less toward both ends but head abruptly narrower than pereon (Figure 28A, B).

Head nearly rectangular, truncate anteriorly, separated from much broader first pereomere at posterolateral corners, fused midposteriorly. Irregularly shaped, dark eyes extending onto pereomere 1. Antenna 1 (Figure 28C) of three articles, each much smaller than that proximal to it, distal and middle articles with some setae; antenna 2 (Figure 28D) of two articles, distal one longer and narrower than proximal one and tipped by sparse setae.

Pereomere distinct dorsally and laterally but only obscurely separated ventrally, of various widths, though middle ones somewhat wider. Pereopods (Figure 28E, F) large, clustered along midline, and covering more than half of ventral surface; increasing slightly in size posteriorly; all with some setae on carpi and propodi.

Pleon completely fused, with sinuate margins vaguely indicating remnants of six pleomeres. Five pairs of uniramous, discoid, suboval pleopods decreasing in size posteriorly. End of pleon extending beyond general margin into point and bearing conspicuous anal cone midventrally (Figure 28G).

*Distribution*: Known only from the type-locality, Hourglass Station C, 70 km west of Egmont Key, Florida, 27°37'N, 83°28'W, 36.6 m.

*Etymology*: Greek stem, "*alphe-*", from host's name, + "*zemiotes*," one who punishes or damages.

*Remarks*: The combination of oval body shape, an incompletely separated head, dorsolateral bosses on one side, deeply separated pleomeres, and prominent biramous pleopods in the

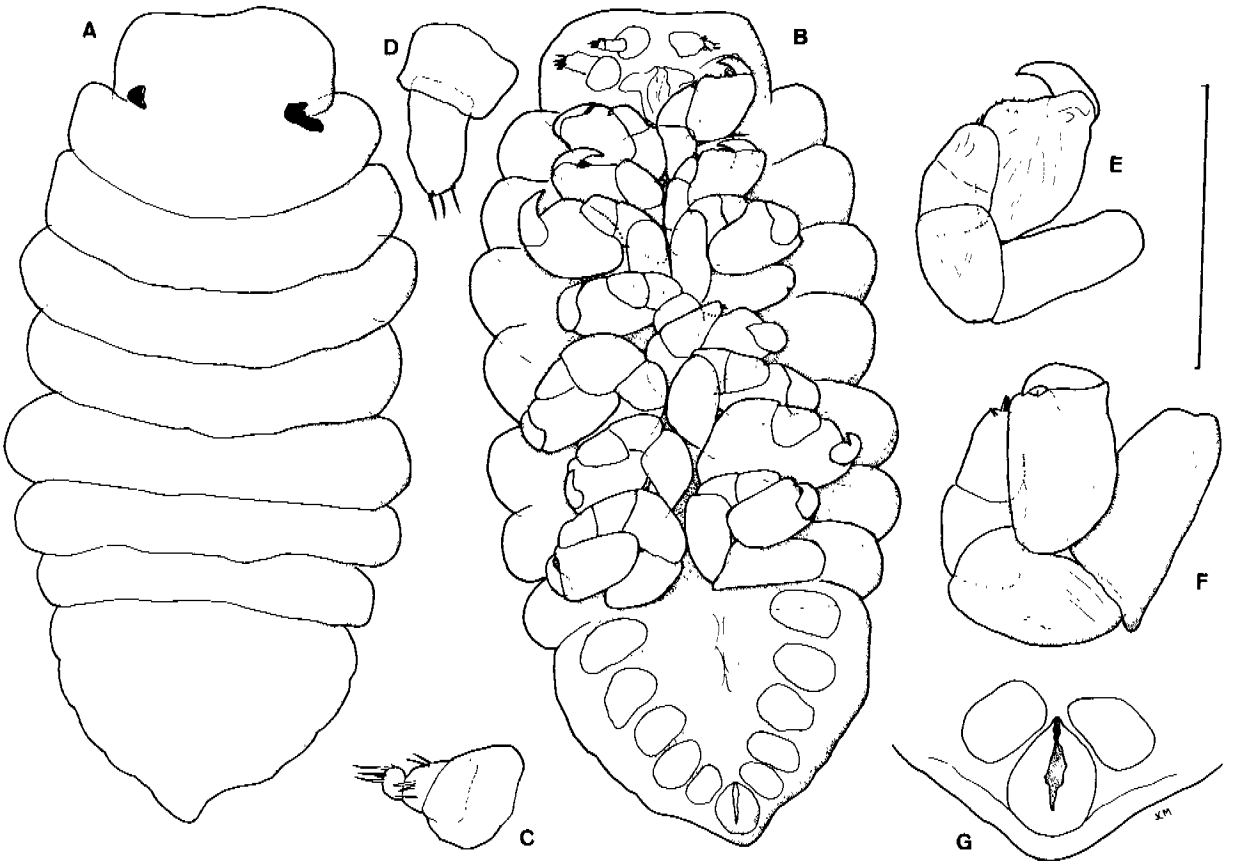


Figure 28. *Ovobopyrus alphezemiotes*, n. gen., n. sp., allotype ♂, USNM 181552. A. Dorsal view. B. Ventral view. C. Right antenna 1. D. Right antenna 2. E. Left pereopod 1. F. Left pereopod 7. G. Posterior region of pleon, ventral view. Scale 0.3 mm for A, B; 0.15 mm for E-G; 0.1 mm for C, D.

female makes this species highly distinctive and warrants the creation of the new genus, *Ovobopyrus*, for it. Its affinities are rather obscure in that some of the female's characters, especially pleonal ones, are more typical of the Pseudioninae, while such characters as the head-pereon fusion, the gaping brood pouch, the simple posteroventral border of the head, and the unadorned internal ridge of the first oostegite place it in the Bopyrinae, where it is assigned here. The characters of the male are also ambiguous in that they could place it either in an advanced position in the Pseudioninae or in the Bopyrinae.

As a parasite of *Alpheus armillatus*, *Ovobopyrus alphezemiotes* represents the fifth known genus of branchial parasites of *Alpheus* species. Whether or not the parasite of *Alpheus armillatus* reported by Chace (1972) from Antigua belongs to *Ovobopyrus alphezemiotes* is unknown.

## *Bopyrella* Bonnier, 1900

*Diagnosis*: Female: Body cuneate, broadest near anterior end and tapering regularly through pleon. Head fused completely or at least medially with first pereomere. Maxilliped with setose, usually nonarticulating palp. Coxal plates very reduced; dorsolateral bosses absent; first

oostegites and interior of brood pouch completely exposed by other oostegites. All pleomeres fused but faintly indicated dorsally, variously separated on long side, not at all separated on short side; five pairs of extended, biramous pleopods, their rami oblong and clearly standing above pleonal surface. Male: Body usually more than twice as long as broad. Head and first pereomere completely fused but juncture indicated by lateral indentations. Pleon much broader than long, of three to six free pleomeres, of which first one broader than final pereomere; pleopods tiny or absent. Hosts in family Alpheidae, mostly *Alpheus* but rarely *Synalpheus*. Distribution pantropical.

*Type-species*: By original designation, *Bopyrella thomsoni* Bonnier, 1900. Gender feminine.

*Remarks*: Bourdon (1980) recently reviewed the genus *Bopyrella* and solved several of the systematic problems in it. His key to species (1980: 186, 187) indicates the major divisions within the genus, and I consider one of them, the degree of fusion of the females' pleons, to be important at the generic level. Thus, of the 35 nominal species previously assigned to *Bopyrella*, I am retaining in the genus only those five species keyed out in Bourdon's couplets B and C. They are *B. thomsoni* Bonnier, *B. malensis* Bourdon, *B. macginitiei* Shiino, *B. harmopleon* Bowman, and, by suppression of the genus *Bopyriscus* Richardson, its type-species, *B. calmani* (Richardson). *Bopyrella* remains pantropical except in the eastern Atlantic.

There is only one western Atlantic species, *Bopyrella harmopleon* Bowman.

### *Bopyrella harmopleon* Bowman, 1956

*Bopyrella harmopleon* Bowman, 1956, pp. 1-3, fig. 1 [type-locality Gran Roque, Venezuela; infesting *Synalpheus brevicarpus* (Herrick); also: Los Roques, Venezuela; infesting *S. fritzmuelleri* Coutière; and La Salle and Gran Roque, Venezuela; infesting *S. hemphilli* Coutière]; Lemos de Castro, 1965, p. 283, figs. 1-5 [Ilha de São Sebatião, São Paulo, Brazil; infesting *Synalpheus* sp.]; Şadoğlu, 1969, p. 197; Schultz, 1969, p. 332, fig. 534(b); Bourdon, 1980, pp. 187, 227, 229, 230, tab. V.

*Material examined*: None.

*Diagnosis*: As for genus with specific details: Female with head bearing frontal lamina clear across anterior margin and extending slightly beyond general margin but not reflexed; maxilliped palp articulated; first oostegite 1 1/2 times as long as broad, with laterally convex posterolateral point 1/3 as wide as greatest width of that appendage; end of pleon faintly notched. Male with all pereomeres and all three to six pleomeres distinctly separated laterally; pleopods usually absent but occasionally in form of minute vestiges. (Derived from description by Bowman, 1956).

*Description*: See Bowman, 1956.

*Distribution*: Atlantic coasts of Venezuela and Brazil.

### *Parabopyrella*, new genus

*Parabopyrella* Markham, 1982, p. 345 [nomen nudum].

*Diagnosis*: Female: Head completely fused with pereomere 1 except for short extent along anterolateral margins; frontal lamina present but very short; maxilliped with extended, setose, usually articulating palp; posteroventral border with two pairs of blunt projections on each side.

Oostegite 1 with blunt to sharp posterolateral point and unadorned or, at most, partly toothed, internal ridge; fifth oostegites very long and slender; often prominent lateral bosses on both sides of first four pereomeres. Six very distinct pleomeres separated by rather deep lateral incisions; five pairs of overlapping, flaplike, biramous pleopods; terminal pleomere either smoothly rounded or produced into two points but lacking uropods. Male: Head fused with first pereomere. Pereopods relatively large; no midventral tubercles on pereon. Pleon partly to completely fused, its anterior edge at least as broad as last pleomere and sometimes much broader; five pairs of sessile pleopods; no uropods. Hosts in families Alpheidae and Hippolytidae.

*Type-species*: By present designation, *Bopyrella mortenseni* Nierstrasz and Brender à Brandis, 1929.

*Etymology*: Prefix *Para-*, meaning "beside" + generic name *Bopyrella*, selected to emphasize close resemblance to the genus *Bopyrella* Bonnier. Gender feminine.

*Remarks*: Most of the western Atlantic species previously assigned to *Bopyrella* Bonnier (discussed above) do not properly belong in that genus on the basis of the redefinition given above. I am thus handling these species differently from Bourdon (1980), who used a much broader definition of *Bopyrella* and included them in it. In *Bopyrella* (sensu stricto), the females have fused pleons, and the males have multisegmented pleons and lateral indentations at the head-pereon juncture. Four western Atlantic species are herein transferred to the new genus *Parabopyrella*, of which *Bopyrella mortenseni* is designated the type-species. Elsewhere, mostly in the Indo-West Pacific, 20 species previously assigned to *Bopyrella* are also incorporated into *Parabopyrella*. This includes all of the species included in couplet A of the key to species of *Bopyrella* by Bourdon (1980), except *B. alphei* (Richardson), made the type-species of *Probopyria* above, and *B. inoi* Shiino, 1949, which evidently belongs in *Synsynella* or another genus. Also among these 20 species are three more recently described in *Bopyrella*, namely *B. delagoae* Bourdon, 1982, *B. incisa* Bourdon, 1982, and *B. saronae* Bourdon and Bruce, 1979.

## KEY TO WESTERN ATLANTIC SPECIES OF *PARABOPYRELLA*, BASED ON MATURE FEMALES

1. Terminal pleomere produced into two points ..... 2
1. Terminal pleomere smoothly rounded ..... 3
2. Body nearly as broad as long ..... *Parabopyrella lata* (Nierstrasz and Brender à Brandis)
2. Body nearly twice as long as broad ..... *Parabopyrella thomasi* (Nierstrasz and Brender à Brandis)
3. Pleomeres separated laterally by broad notches ..... *Parabopyrella mortenseni* (Nierstrasz and Brender à Brandis)
3. Pleomeres separated laterally by narrow slits ..... *Parabopyrella richardsonae* (Nierstrasz and Brender à Brandis)

## *Parabopyrella lata* (Nierstrasz and Brender à Brandis, 1929), new combination

Figures 29, 30

*Bopyrella lata* Nierstrasz and Brender à Brandis, 1929, pp. 34, 35, fig. 43 [type-locality between St. Thomas, Virgin Islands, and Saba, Netherlands Antilles, infesting unidentified alpheid]; Chopra, 1930, pp. 137, 138; Lemos de Castro, 1965, pp. 283-286, figs. 6-13 [Bahía de Guanabara, Brazil; infesting *Alpheus* sp.; and: Ilha de São Sebastião, São Paulo, Brazil; infesting *Upogebia affinis* (Say) (very questionable host record)]; Bourdon, 1980, pp. 187, 199-201, fig. 6 [re-examination of holotype].

*Material examined*: HOURGLASS MATERIAL: None. — OTHER MATERIAL: Infesting *Alpheus normanni* Kingsley (hosts det. by J. García-Gómez): 1 ♀, 1 ♂ (reference ♂); Card Sound, Florida; shallow water; 16 October 1970; J. García-Gómez, coll.; UMML 32: 5326. — 1 ♀, 1 ♂; same locality and collector; 29 March 1972; UMML 32: 5327. — 1 ♀; Looe Key Reef, Florida; 1.5 to 2.0 m; 11 October 1969; UMML 32: 5328.

Infesting unidentified alpheid: 1 ♀ (HOLOTYPE); between Saba Island and St. Thomas, Virgin Islands; 27 m; 7 March 1906; Th. Mortensen, coll.; ZMC.

*Description*: Holotype female (Figure 29): Length 2.96 mm, maximal width 3.13 mm, head length 0.64 mm, pleon length 0.87 mm. Axis distortion 23°. Body rather evenly rounded, nearly ovate (Figure 29A, B).

Head completely fused with first pereomere posterodorsally but distinct anterolaterally. Short frontal lamina. Antenna 1 of three articles, antenna 2 of two articles (Figure 29C), both sparsely setose distally. Maxilliped (Figure 29D) moderately broad, distinctly segmented, with posterior segment produced into prominent anteromedial spur; palp (Figure 29E) extending slightly beyond margin, nonarticulating, bearing six long setae; two similar setae on adjacent corner of maxilliped. Posteroventral margin of head (Figure 29F) with slight medial notch, two lateral projections on each side, outer ones broader and longer than inner ones.

Pereon broadest across second pereomere, all pereomeres clearly demarcated; variously developed tergal projections on pereomeres 1-4; dorsolateral bosses and coxal plates on pereomeres 2-4. Oostegites only fringing brood pouch and leaving it almost completely open; oostegite 1 (Figure 29G, H) with only slightly ornamented internal ridge and broad, blunt, posterolateral point; other oostegites long and slender, setose posteriorly. Pereopods (Figure 29I, J) all of about same size and proportions, with all articles demarcated; tuft of setae on carpus of each.

Pleon of six distinct pleomeres, all strongly convex anteriorly; broad notches separating all pleomeres on longer side of body; no true lateral plates, but some pleomeres slightly extended; pleomeres 1-5 quite short, terminal pleomere much longer than broad and produced into two triangular posterior projections and bearing tuberculiform anal cone (Figure 29K) in center of dorsal surface. Five pairs of flaplike, biramous pleopods, generally smaller posteriorly (Figure 29L). No uropods.

Reference male (Figure 30): Length 3.20 mm, head length 1.55 mm, head width 1.98 mm, pleon length 2.83 mm. All body regions distinct. Head markedly narrower than pereon, sides of pereon irregularly divergent posteriorly but final pereomere narrower than preceding one (Figure 30A, B).

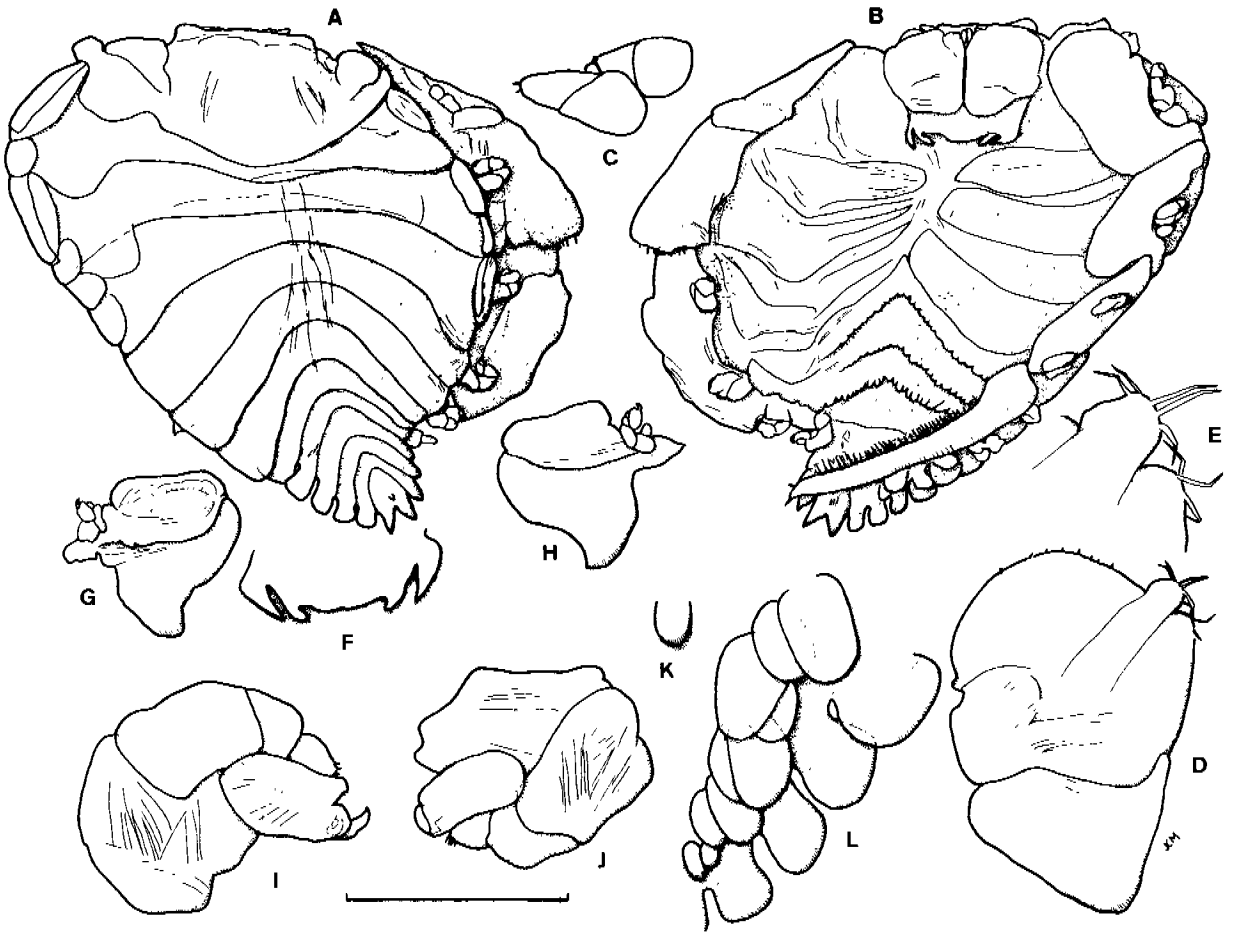


Figure 29. *Parabopyrella lata* (Nierstrasz and Brender à Brandis), holotype ♀, ZMC. A. Dorsal view. B. Ventral view, first oostegites removed. C. Right antennae. D. Left maxilliped. E. Palp of same. F. Posteroventral border of head. G. Left pereopod 1 with oostegite, external view. H. Same, internal view. I. Left pereopod 1. J. Right pereopod 7. K. Anal cone. L. Left pleopods. Scale 1.3 mm for A, B, G, H; 1.0 mm for F; 0.4 mm for D, L; 0.2 mm for C, E, I-K.

Head nearly ovate, widest somewhat before truncate posterior border. Eyes irregularly shaped and prominent. Antenna 1 (Figure 30C) of three articles, distal two quite setose, basal one less so; antenna 2 (Figure 30D) of two articles, distal one sparsely setose.

Pereomeres markedly separated laterally, fifth and sixth broadest. Pereopods (Figure 30E, F) all of similar structure, slightly larger posteriorly, some with meri and carpi fused to various degrees.

Pleon subovate, anterior region broader than final pereomere. Pleomeres completely fused, but traces of all six indicated by marginal undulations. Five pairs of rather large, vaguely defined, sessile pleopods. Anal cone (Figure 30G) large and of structure similar to that of pleopods.

*Distribution*: Southeast Florida; Virgin Islands; southern Brazil.

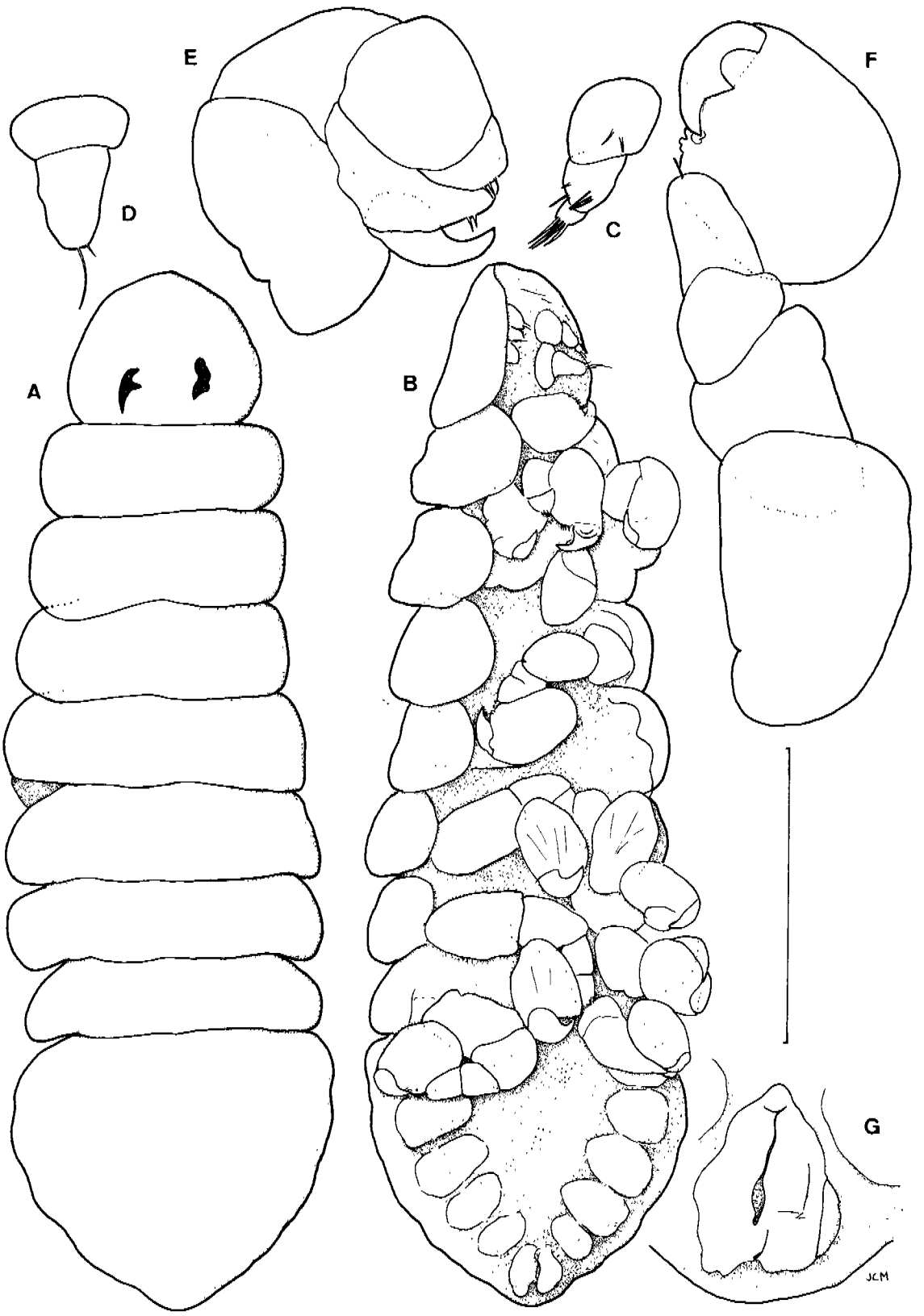


Figure 30. *Parabopyrella lata* (Nierstrasz and Brender à Brandis), reference (distorted) ♂, UMML 32: 5326. A. Dorsal view. B. Ventral view. C. Left antenna 1. D. Left antenna 2. E. Left pereopod 1. F. Left pereopod 7. G. Anal cone. Scale 0.3 mm for A, B; 0.1 mm for C-G.

*Remarks*: The anterior half of the reference male was distorted, with the right side sharply reflexed beneath the body; efforts to straighten it proved unsuccessful. The dorsal view (Figure 30A) shows the probable appearance of the male if it were not distorted, while the ventral view (Figure 30B) shows the distortion. The other male examined was not suitable for illustration. This is the first description of the male of *Parabopyrella lata*. The distinct separation of the head from the pereon, contrary to the generic diagnoses of *Parabopyrella* and *Bopyrella*, is difficult to interpret. Since the condition was not determinable in the other male, it is unclear whether this condition is characteristic of this species or an abnormality of this individual. Lemos de Castro (1965) pictured, but did not describe, two males of *P. lata*. Although his drawings are ambiguous, it appears that one has the head separate from the pereon, and the other has its head fused with the pereon.

The female of *Parabopyrella lata* illustrated by Lemos de Castro (1965) differs from the holotype in having a more setose, articulated maxilliped palp, better defined tergal projections, and evidently no anal cone. None of these differences seems adequate to exclude his specimen from this species, especially since the other characters correspond well with those of the holotype. The report by Lemos de Castro (1965) of infestation of *Upogebia affinis* (Say), a thalassinidacean, seems highly questionable. No species of the Bopyrinae is otherwise known to infest a host species not in the section Caridea.

## *Parabopyrella thomasi* (Nierstrasz and Brender à Brandis, 1929), new combination

Figure 31

*Bopyrella thomasi* Nierstrasz and Brender à Brandis, 1929, pp. 32, 33, figs. 39, 40 [type-locality St. Thomas, Virgin Islands; infesting *Tozeuma carolinense* Kingsley]; Shiino, 1936b, p. 159; 1939a, p. 12; Bourdon, 1980, pp. 187, 210-212, fig. 11 [re-examination of holotype].

*Material examined*: HOURGLASS MATERIAL: None. — OTHER MATERIAL: Infesting *Tozeuma carolinense* Kingsley: 1 ♀ (HOLOTYPE) (ALLOTYPE male missing); Danish West Indies (= U. S. Virgin Islands; St. Thomas?); 10 June 1911; H. Blegvad, coll.; J. G. de Man, det. of host; ZMC.

*Description*: Holotype female (Figure 31): Length 3.31 mm, maximal width 1.61 mm, pleon length 1.03 mm. Head-pereon axis distortion 24°, pereon-pleon distortion 10°. Sides of body regularly tapered (Figure 31A, B).

Head fused posteriorly with pereon but distinct laterally; head produced into frontal lamina extending to both sides. Antennae (Figure 31C, D) reduced and obscure, each of two articles with distal setae. Maxilliped (Figure 31E) suboval, bearing long, articulated, setose palp. Posteroventral border difficult to discern.

Pereon broadest across pereomeres 3 and 4. Pereomeres all distinct and separated laterally by indentations. Traces of tergal projections on some pereomeres. No coxal plates or dorsolateral bosses. Pereopods (Figure 31H) equally developed. Oostegite 1 (Figure 31F, G) short relative to width, produced into broad, bluntly rounded, posterolateral projection directed medially and only slightly posteriorly; internal ridge curved but unornamented. Other oostegites very slender, surrounding but not at all enclosing brood pouch.

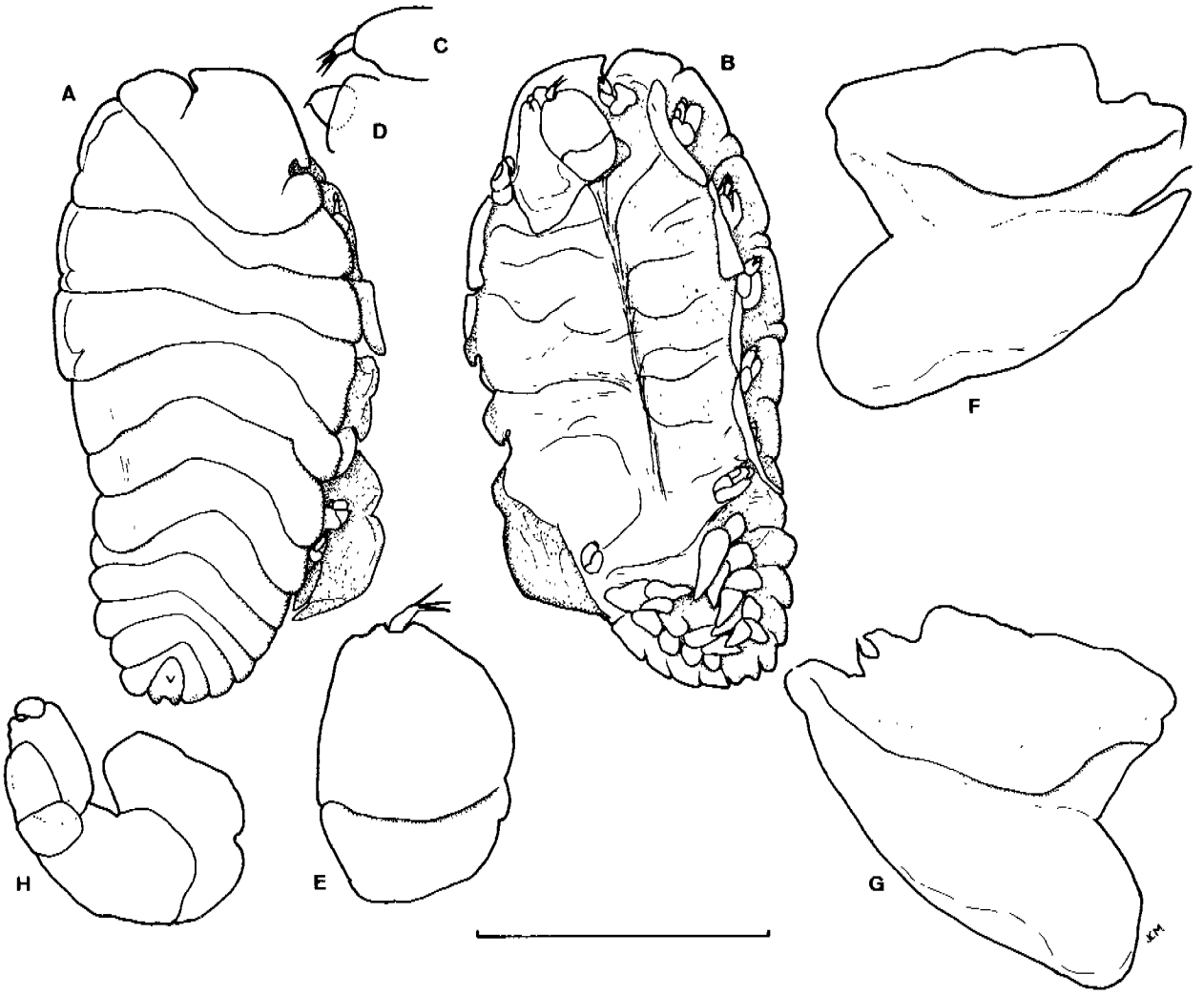


Figure 31. *Parabopyrella thomasi* (Nierstrasz and Brender à Brandis), holotype ♀, ZMC. A. Dorsal view. B. Ventral view. C. Right antenna 1. D. Right antenna 2. E. Right maxilliped. F. Left oostegite 1, external view. G. Same, internal view. H. Left pereopod 1. Scale 1.5 mm for A, B; 0.5 mm for F, G; 0.25 mm for C, D, E, H.

Pleon of six well-defined pleomeres lacking lateral plates. First five pleomeres each with pair of leaf-like, biramous pleopods, their endopodites pointed and exopodites broadly rounded; endopodites larger than exopodites, especially anteriorly. Pleomere 6 produced into two short posterior points with middorsal anal cone. No uropods.

Allotype male (according to description and illustration of Nierstrasz and Brender à Brandis, 1929): Length about 1.00 mm, maximal width about 0.21 mm, pleon length about 0.23 mm. Sides of body nearly parallel, tapering only slightly in head and pleon.

Head fused with first pereomere, sharply truncate anteriorly and almost square-cornered, just slightly narrower than pereon. Eyes distinct, near posterolateral corners. Slight indentation indicating juncture between head and pereomere 1.

All pereomeres distinctly separated by deep notches. Structure of pereopods uncertain.

Pleon completely fused but with faintly undulate margin indicating remnants of six pleomeres. Anterior region as broad as pereon, sides tapering gradually from there through 5/6 of length, then narrowing rather abruptly to posterior point.

*Distribution*: Known only from the type-locality, St. Thomas, Virgin Islands.

*Remarks*: Regrettably, the allotype male has been lost, and no other male of *Parabopyrella thomasi* is known. Several important details of its structure are uncertain. The species appears to belong to *Parabopyrella* despite some differences in the female from those of other species: antennae with only two articles apiece and body axis doubly distorted. The male, despite its peculiar rod-like shape, conforms to the generic diagnosis in those characters known.

It is remarkable that *Parabopyrella thomasi* is known only from the type-specimens, collected in the Virgin Islands, because its host, *T. carolinense*, occurs along much of the western Atlantic coast, from Massachusetts to Curaçao (Chace, 1972).

## *Parabopyrella mortenseni* (Nierstrasz and Brender à Brandis, 1929), new combination

Figures 32-35

*Bopyrella mortenseni* Nierstrasz and Brender à Brandis, 1929, pp. 30, 31, figs. 34-37 [St. Thomas, Virgin Islands; infesting *Lysmata wurdemanni* (Gibbes)]; Chopra, 1930, pp. 137, 138; Shiino, 1933, p. 282; Chace, 1970, p. 60 [Bahia de Turiamo, Estado Aragua, Venezuela; infesting *Lysmata rathbunae* Chace]; Bourdon, 1980, pp. 187, 218, 220, 221, 224, 225, fig. 15, tab. IV [re-examination of types].

*Bopyrella Mortenseni*: Monod, 1933, p. 235.

not *Bopyrella Mortensni* [sic]: Qazi, 1959, pp. 60, 61, figs. 7, 8 [see *Remarks*].

*Probopyrus* sp.: Van Arman and Smith, 1970, pp. 133-135, figs. 1, 2 [Biscayne Bay, Florida; infesting *Lysmata wurdemanni*]; Anderson, 1977, p. 248; Bursey, 1978; p. 569.

*Material examined*: Infesting *Lysmata rathbunae* Chace: HOURGLASS STATION C: 1 ♀ (immature), 1 ♂; 1 July 1967; dredge; J. C. Markham, det. of host (ovigerous ♀); FSBC I 23894. — OTHER MATERIAL: 1 ♀; Bahía de Turiamo, Aragua, Venezuela, in sponges; 9 m; October 1960; P. R. Morales, coll.: F. A. Chace, Jr., det. of host; USNM 107092.

Infesting *Lysmata wurdemanni* (Gibbes): HOURGLASS MATERIAL: None. — OTHER MATERIAL: 1 ♀, 1 ♂; off Marco Island, Florida; 5.4 m; 14 July 1976; J. R. Sullivan et al., colls.; W. L. Kruczynski, det. of host; FSBC I 16596. — 1 ♀, 1 ♂; off Ten Thousand Islands, Monroe County, Florida; 5.4 m; 18 July 1976; J. R. Sullivan et al., colls.; W. L. Kruczynski, det. of host; FSBC I 16613. — 1 ♀, 1 ♂, Biscayne Bay, Florida; 1969; J. A. Van Arman, coll.; S. Dobkin, det. of host; UMML 32: 5376. — 1 ♀, 1 ♂; south of Alligator Light, Monroe County, Florida; 11 m; 4 August 1965; E. Maynard, coll.; R. B. Manning, det. of host; USNM 120094. — 1 ♀ (HOLOTYPE), 1 ♂ (ALLOTYPE); outside Currents Hole, east of St. Thomas, U. S. Virgin Islands; 26 m; 16 March 1906; Th. Mortensen, coll.; J. G. de Man, det. of host; ZMC.

*Description*: Holotype female (Figure 32): Length 8.12 mm, maximal width 5.08 mm, head length 1.44 mm, pleon length 2.86 mm. Body axis distortion 47°. Body outline broadly falcate, evenly tapered toward posterior (Figure 32A, B).

Head completely fused with first pereomere laterally and posteriorly, except for separation by anterolateral notches. Short frontal lamina along all of anterior margin. Antenna 1 (Figure

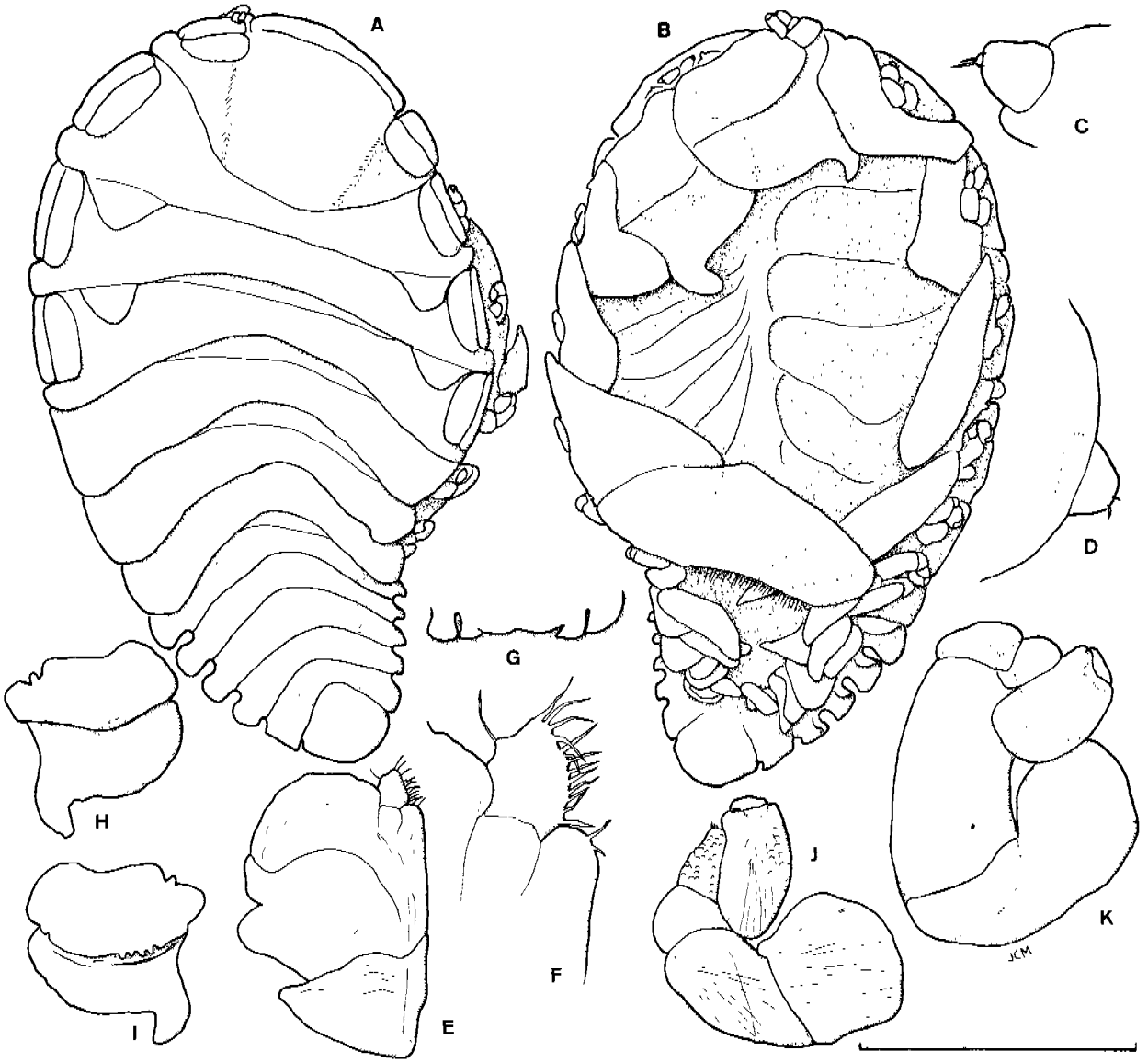


Figure 32. *Parabopyrella mortenseni* (Nierstrasz and Brender à Brandis), holotype ♀, ZMC. A. Dorsal view. B. Ventral view. C. Right antenna 1. D. Right antenna 2. E. Right maxilliped. F. Palp of same. G. Posteroventral border of head. H. Right oostegite 1, external view. I. Same, internal view. J. Right pereopod 1. K. Right pereopod 7. Scale 3.0 mm for A, B, G-I; 1.5 mm for E; 0.5 mm for F, J, K; 0.25 mm for C, D.

32C) of three articles, distal one very tiny; antenna 2 (Figure 32D) of two articles, basal one very broad; both antennae tipped by sparse tufts of setae. Maxilliped (Figure 32E) with rather irregular margins, developed into prominent, articulated, setose palp (Figure 32F) and moderately extended spur. Posteroventral border of head (Figure 32G) with two pairs of rather blunt lateral projections, middle region concave.

First four pereomeres bearing dorsolateral bosses and coxal plates on both sides. Final pereomere distinctly overlapping pleon. Brood pouch gaping widely, surrounded but not enclosed by oostegites. Oostegite 1 (Figure 32H, I) with irregular margin, produced into rather narrow, curved, posterolateral point, bearing some teeth on internal ridge, with very deep transverse external groove. Pereopods (Figure 32J, K) all similar, with segmentation distinct but with bases and ischia larger posteriorly.

Pleon of six distinct pleomeres separated by deep lateral notches and produced into low, broad, middorsal ridge; segmentation obscure ventrally. Pleomeres 1-4 with ventrally reflexed anterolateral margins on longer side. Five pairs of biramous pleopods of foliate rami long and slender, smaller posteriorly. No uropods.

Allotype male (Figure 33): Length 2.17 mm, maximal width 0.74 mm, pleon length 0.48 mm. Sides of body nearly parallel (Figure 33A, B).

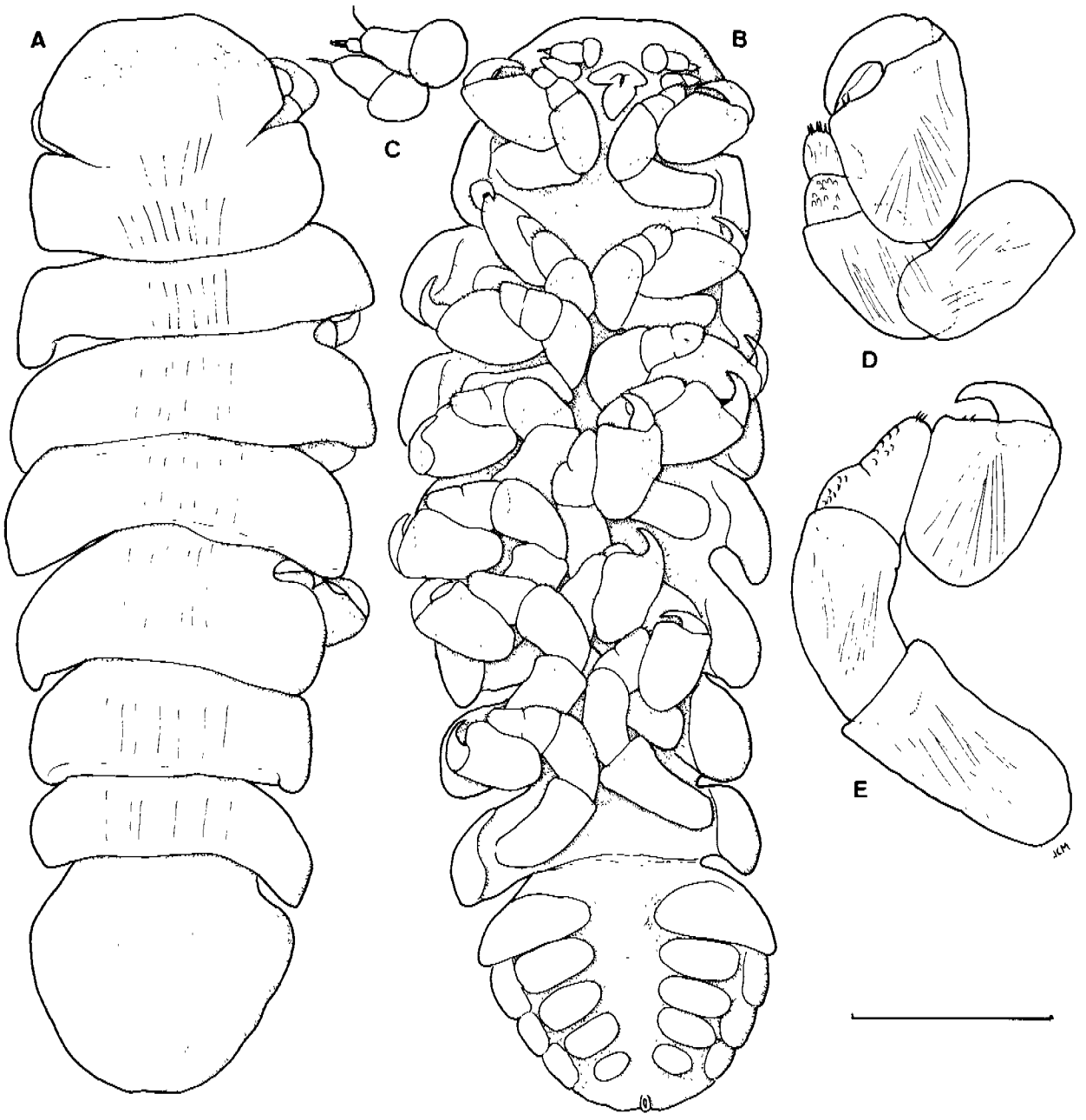


Figure 33. *Parabopyrella mortenseni* (Nierstrasz and Brender à Brandis), allotype ♂, ZMC. A. Dorsal view. B. Ventral view. C. Right antennae. D. Left pereopod 1. E. Left pereopod 7. Scale 0.4 mm for A, B; 0.2 mm for C-E.

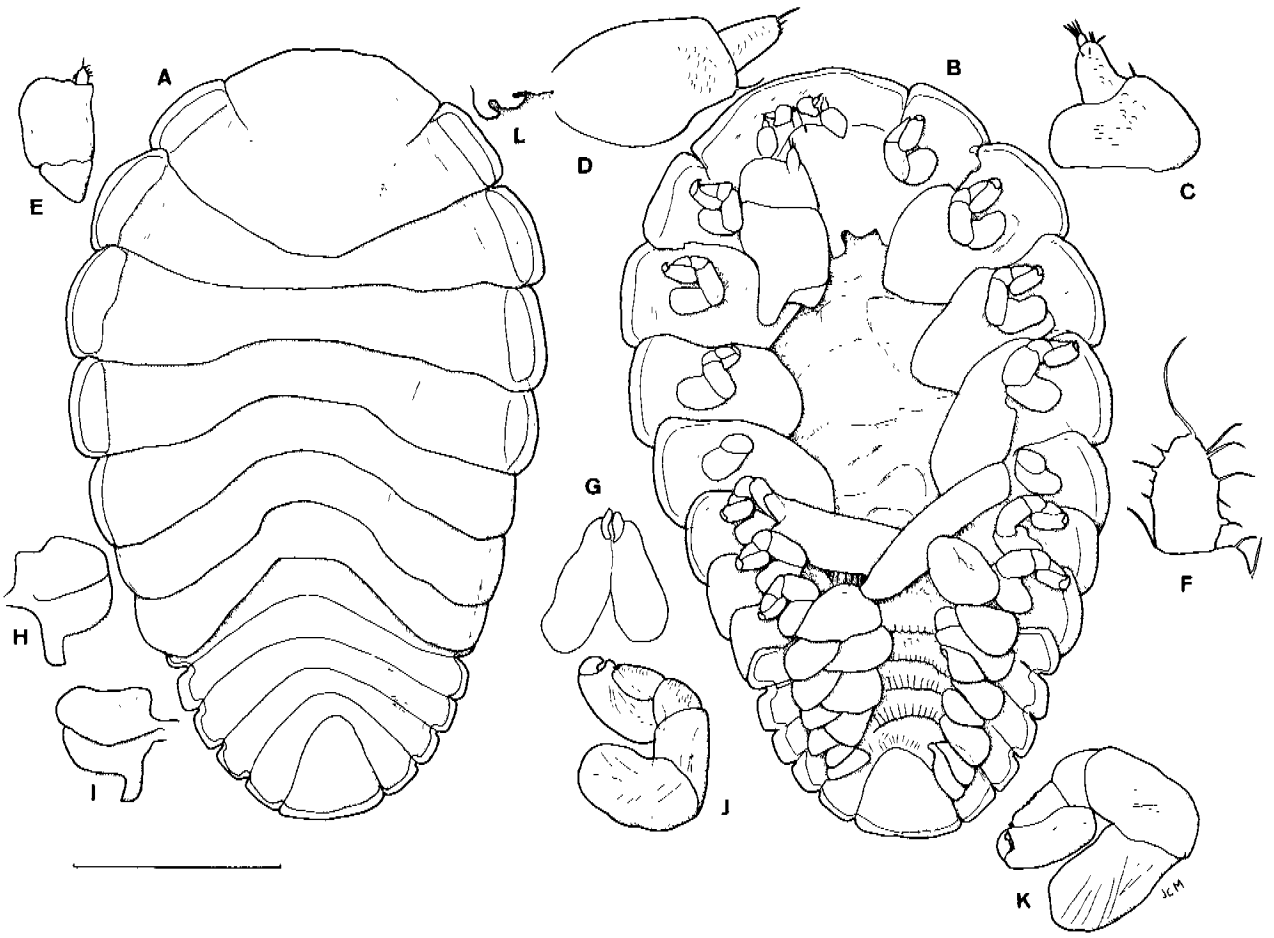


Figure 34. *Parabopyrella mortenseni* (Nierstrasz and Brender à Brandis), immature ♀ from Hourglass Station C, FSBC I 23894. A. Dorsal view. B. Ventral view, left oostegite 1 removed. C. Right antenna 1. D. Right antenna 2. E. Right maxilliped. F. Palp of same. G. Maxillae. H. Right oostegite 1, external view. I. Same, internal view. J. Right pereopod 1. K. Right pereopod 7. L. Right posteroventral border of head. Scale 1.5 mm for A, B, E, H, I, L; 0.5 mm for J, K; 0.25 mm for C, D, F, G.

Head fused with first pereomere, but juncture indicated by lateral indentations. Antennae of three and two articles respectively (Figure 33C), both bearing some setae distally; antenna 1 also with scattered setae elsewhere.

Pereomeres deeply separated by anterolateral notches. No midventral tubercles. Pereopods (Figure 33D, E) more elongate posteriorly, with smaller dactyli and less distinctly articulated meri and carpi; carpi and propodi setose distally.

Pleon fused into single piece, broadest somewhat behind anterior margin; ventrolateral margins indicating traces of segmentation. Five pairs of flat pleopods just barely rising above pleonal surface. No uropods.

*Distribution*: Southern Florida; Virgin Islands; Venezuela; infesting *Lysmata* spp.

*Remarks*: The immature female (Figure 34) taken during the Hourglass Cruises (FSBC I 23894) differs from the holotype in several minor respects, most of them attributable to its immaturity: the oostegites are proportionately smaller and tightly pressed against the pereonal surface, the

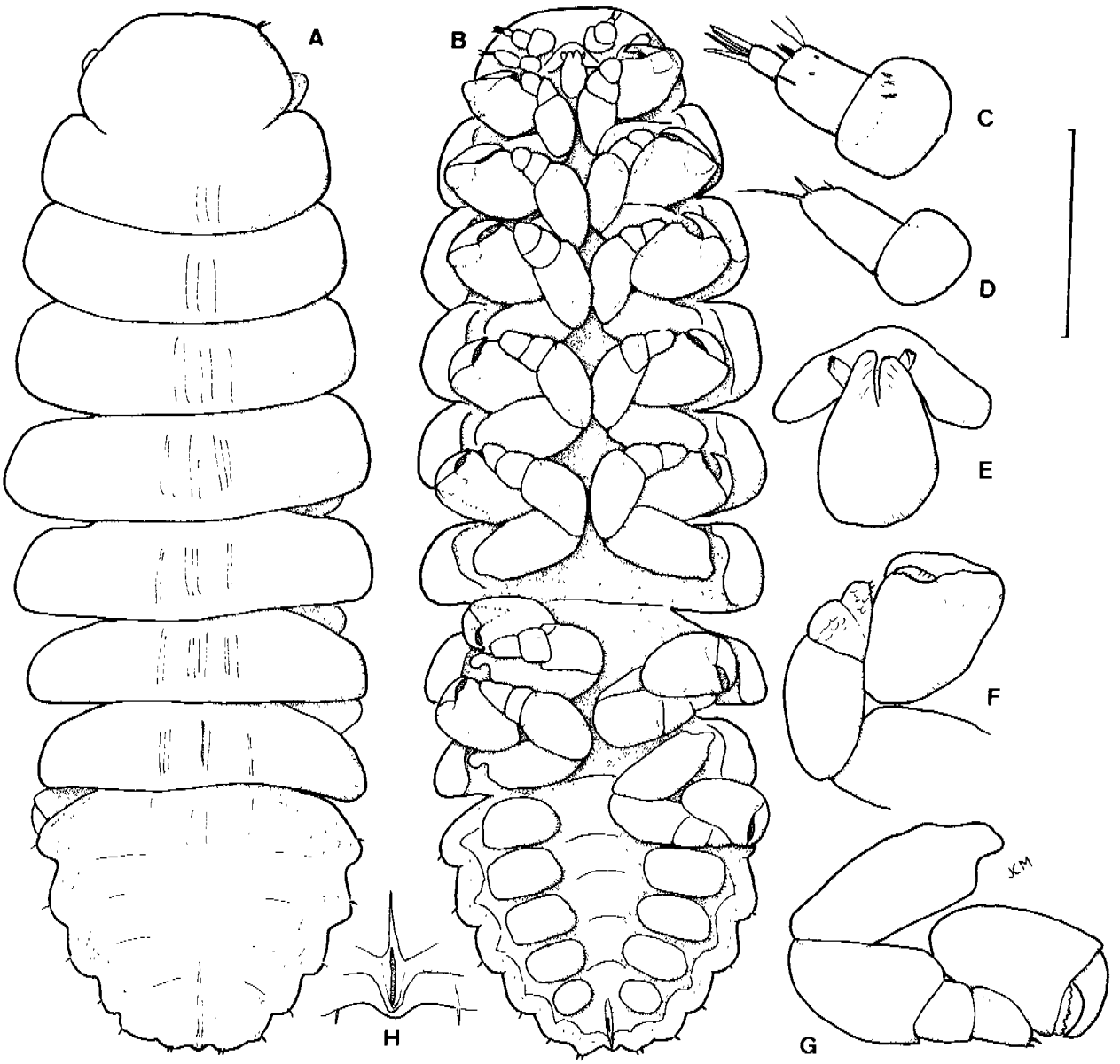


Figure 35. *Parabopyrella mortenseni* (Nierstrasz and Brender à Brandis), ♂ from Hourglass Station C, FSBC I 23894. A. Dorsal view. B. Ventral view. C. Right antenna 1. D. Right antenna 2. E. Mouth parts. F. Right pereopod 1. G. Right pereopod 7. H. End of pleon, ventral view. Scale 0.4 mm for A, B; 0.2 mm for F, G; 0.1 mm for C-E, H.

body is less distorted, the pleon is proportionately larger, the internal ridge of the first oostegite lacks teeth, and the notches between the pleomeres are less pronounced. The male accompanying that female (Figure 35) is very similar to the allotype. The sides of the body are more regular, and the sides of the pleon are undulate, defining the six coalesced pleomeres, while the ventrolateral margins of the pleon are not reflexed. The other specimens examined do not differ appreciably from the types. All of them have been mentioned previously by Chace (1970) and Van Arman and Smith (1970).

Qazi (1959) identified a parasite of a Pakistani alpheid as *Bopyrella nierstraszi* Chopra, and concluded that the latter species was really a junior synonym of *B. mortenseni*. Several details of

his specimens make it doubtful that Qazi's identification as *B. nierstraszi* was correct. In any event, the distinctions pointed out by Chopra (1930) to separate *B. nierstraszi* from *B. mortenseni* are adequate to retain the specific distinctness of these two species. Thus, Qazi's (1959) synonymy and extended host and geographic range for *Bopyrella* (now *Parabopyrella*) *mortenseni* are not here accepted.

## *Parabopyrella richardsonae* (Nierstrasz and Brender à Brandis, 1929), new combination

Figure 36

*Bopyrella richardsonae* Nierstrasz and Brender à Brandis, 1929, pp. 33, 34, figs. 41, 42 [type-locality U. S. Virgin Islands; infesting *Alpheus formosus* Gibbes]; Shiino, 1933, p. 282, Hutton and Sogandares-Bernal, 1960, p. 287 [Boca Ciega Bay, Florida; infesting *Alpheus heterochaelis* (Say)]; Hutton, 1964, p. 447; Bourdon, 1980, pp. 187, 221-223, 224, fig. 16, tab. IV [re-examination of types].

*Material examined*: Infesting *Alpheus formosus* Gibbes: HOURGLASS MATERIAL: None. — OTHER MATERIAL: 1 ♀ (HOLOTYPE) (ALLOTYPE male missing); Danish West Indies (= U. S. Virgin Islands); 15 December 1911; Meng, coll.; J. G. de Man, det. of host; ZMC.

Infesting *Alpheus normanni* Kingsley: HOURGLASS STATION B: 1 ♀; 1 July 1967; dredge; FSBC I 23862. — 1 ♀; 2 November 1967; dredge; FSBC I 23863.

*Description*: Holotype female (Figure 36): Length 2.83 mm, maximal width 1.45 mm, pleon length 0.93 mm. Distortion of body axis 28°. Body outline broadly falcate, smoothly tapered (Figure 36A, B).

Head fused with first pereomere except for anterolateral separations. Rather long frontal lamina along whole anterior margin, juncture between it and head moderately defined. Antennae (Figure 36C, D) each of two articles, both articles tipped with sparse setae, basal article of antenna 2 much enlarged. Maxilliped (Figure 36E) with extended, setose palp (Figure 36F) not fully articulated. Posteroventral border of head (Figure 36G) concave medially, with two pairs of bluntly pointed lateral projections.

Pereon broadest across pereomere 3; all pereomeres distinct. Prominent coxal plates on both sides of first four pereomeres; large dorsolateral bosses on both sides of pereomeres 1-3 and longer side of pereomere 4. Oostegite 1 (Figure 36H, I) about as long as wide, with unadorned internal ridge and rather broad, blunt, posterolateral point extending well beyond posterior margin; other oostegites leaving brood pouch gaping broadly. Pereopods (Figure 36J, K) all very similar but with bases and ischia somewhat larger posteriorly; tuft of several setae on distal margin of each carpus.

Pleon of six pleomeres distinctly delineated dorsally and separated laterally by shallow notches, more marked on short side; ventral segmentation obscure. Five pairs of small, flap-like, biramous, suboval pleopods (Figure 36L) not all in contact with each other, better developed on long side, progressively smaller posteriorly. Terminal pleomere somewhat enlarged.

Allotype male (according to description and illustration of Nierstrasz and Brender à Brandis, 1929, and Bourdon, 1980): Length 1.25 mm, maximal pereonal width 0.40 mm, maximal pleonal width 0.47 mm, pleon length 0.37 mm. Head markedly narrower than any pereomeres; sides of pereon subparallel; pleon abruptly narrower than pereon.

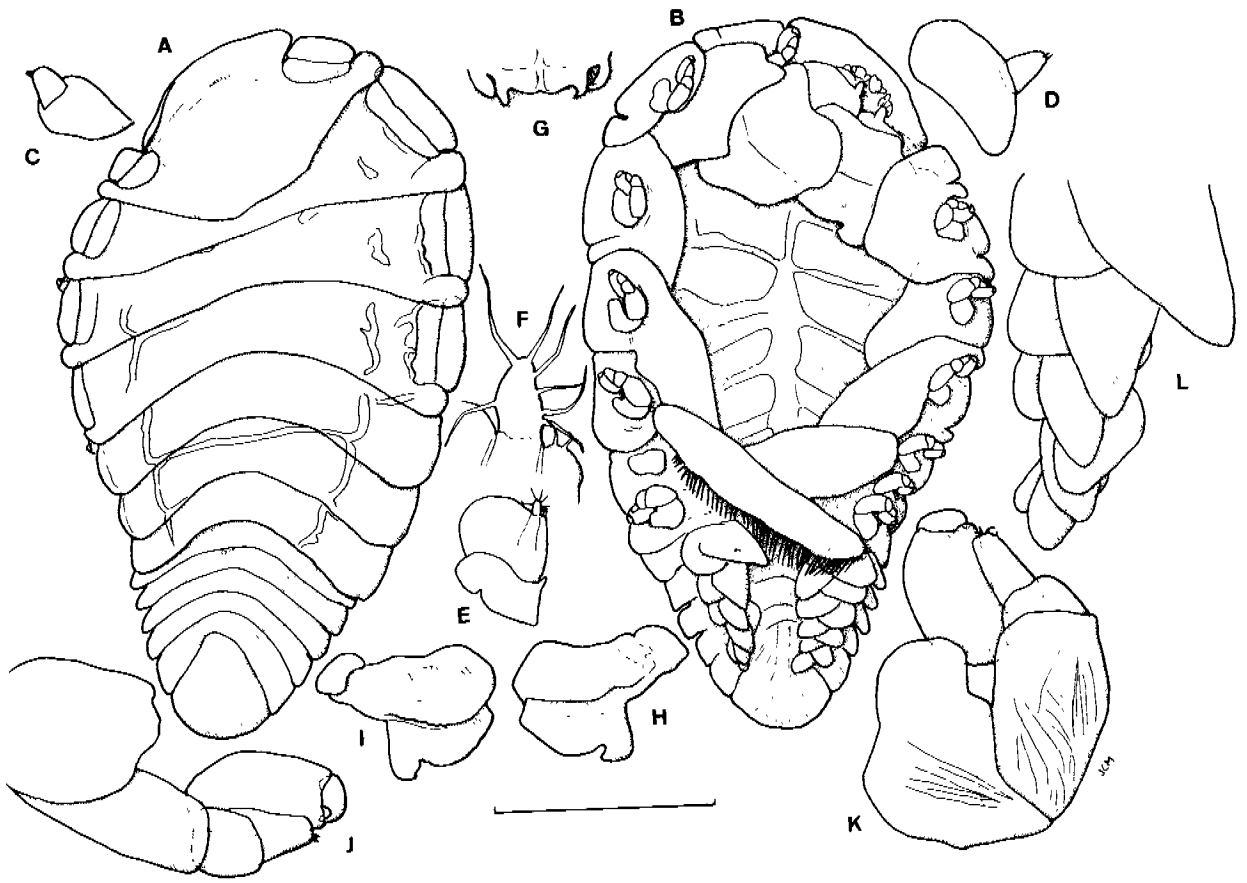


Figure 36. *Parabopyrella richardsonae* (Nierstrasz and Brender à Brandis), holotype ♀, ZMC. A. Dorsal view. B. Ventral view. C. Right antenna 1. D. Right antenna 2. E. Right maxilliped. F. Palp of same. G. Postero-ventral border of head. H. Left oostegite 1, external view. I. Same, internal view. J. Right pereopod 1. K. Right percopod 7. L. Right pleopods. Scale 1.5 mm for A, B, E, G-I; 0.5 mm for L; 0.25 mm for C, D, F, J, K.

Head completely fused with first pereomere, but juncture indicated laterally by slight indentations. Eyes prominent. First antenna of three articles, each much narrower than that proximal to it; distal one tipped with long setae, middle one bearing cluster of short setae, and basal article with one seta. Second antenna as long as first but of only two articles, both about same size, only distal one setose.

Pereon broadest across pereomere 3. All pereomeres separated laterally by indentations. Pereopods all about same size, with meri and carpi fused.

Pleon fused and almost semicircular, very broad across anterior edge and rounded posteriorly but with slight undulations indicating coalesced pleomeres and minute, central posterior point. Two small, conical midventral tubercles on first two fused pleomeres, anterior one much larger. Incomplete, faint curved lines indicating six coalesced pleomeres dorsally. Five pairs of faintly defined, oval, sessile pleopods. No anal cone.

*Distribution*: Central west coast of Florida; U. S. Virgin Islands.

*Remarks*: Unfortunately, no male of *Parabopyrella richardsonae* was available for examination. The specimens from Boca Ciega Bay reported by Hutton and Sogandares-Bernal (1960) were not found, so it remains unconfirmed whether those authors were indeed dealing with this species. The present material from Hourglass Station B reconfirms occurrence of the species in the Gulf of Mexico. The broad pleon of the male is very distinctive, immediately setting this species off from any other in the western Atlantic.

## *Parabopyrella* species

Figure 37

*Material examined*: Separated from host: HOURGLASS STATION J: 1 ♀ (very immature); 5 July 1967; dredge; FSBC I 23864.

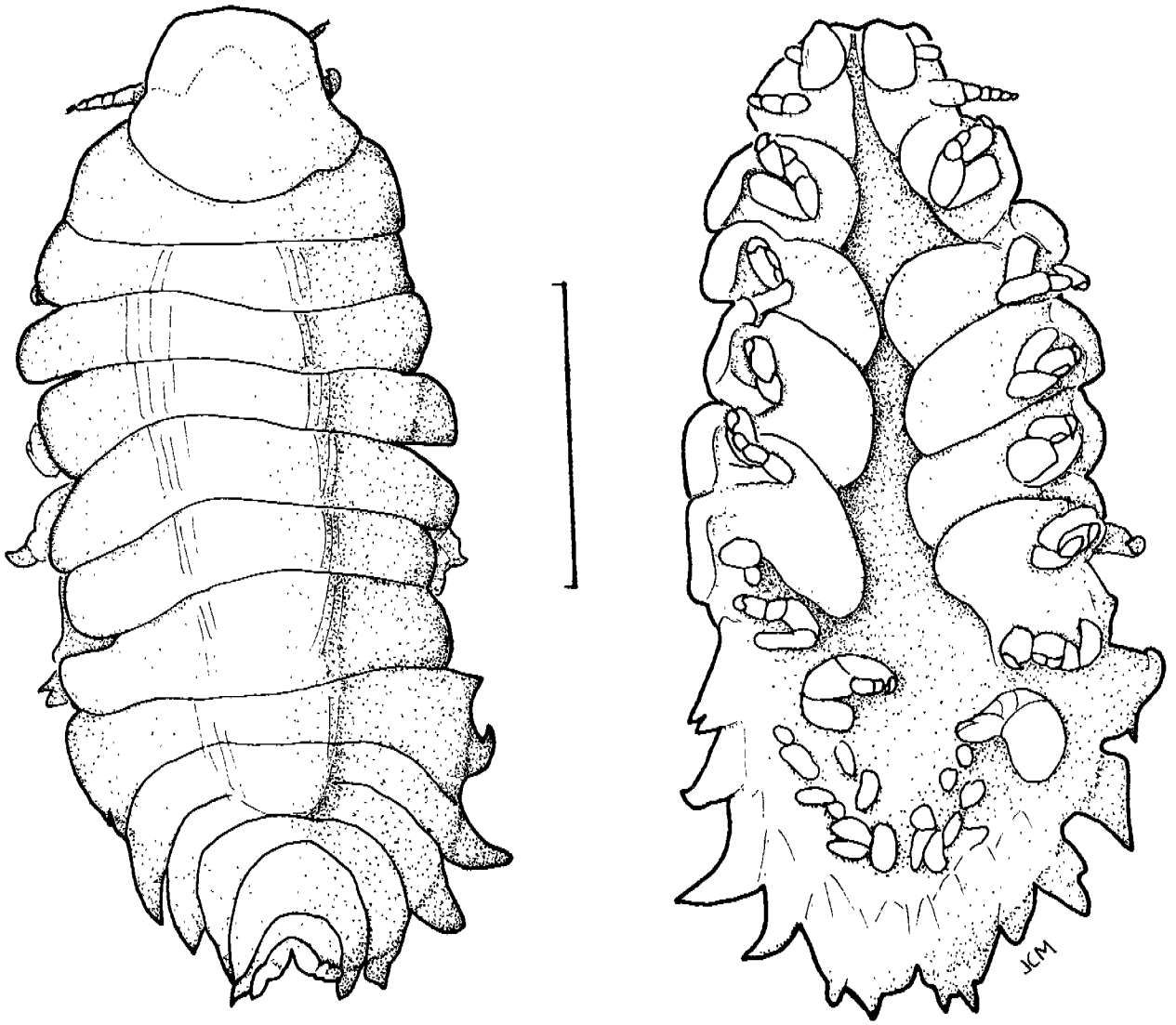


Figure 37. *Parabopyrella* sp., immature ♀ from Hourglass Station J. FSBC I 23864. Dorsal and ventral views. Scale 1.0 mm.

*Remarks:* This specimen is probably a member of the genus *Parabopyrella*, most likely a representative of one of the species discussed above. Unfortunately, it is so immature that many of the characters which would otherwise be diagnostic are not yet developed. Because the single specimen was separated from its host (and would have been too small to produce the branchial swelling typical for bopyrids), that clue to its identity cannot be used. It is illustrated, but it does not seem practical to present any further description.

*Bopyrinella* Nierstrasz and Brender à Brandis, 1925

*Diagnosis*: Female: Body relatively long and moderately distorted. Head extended but fused posteriorly with pereon; maxilliped with articulated, setose palp. Pereomeres variously fused dorsally; small coxal plates and tergal projections, and obscure dorsolateral bosses on long sides of some pereomeres; only first pair of oostegites well developed, those differently shaped on right and left sides. Pleon of six pleomeres distinct laterally but variously fused dorsally; final pleomere extended and bluntly rounded; five pairs of uniramous, flap-like pleopods; no uropods. Male: Body more than twice as long as wide. Head fused with first pereomere, but juncture indicated laterally. Pereomeres well separated laterally and dorsally; no midventral tubercles. Pleon fused, but six pleomeres defined laterally; five pairs of often very obscure, sessile, discoid pleopods; no uropods. Parasites of shrimps in family Hippolytidae.

*Type-species*: By monotypy, *Bopyrinella antillensis* Nierstrasz and Brender à Brandis, 1925 [=*Bopyrina thorii* Richardson, 1904]. Gender feminine.

*Remarks*: Nierstrasz and Brender à Brandis (1925) erected the genus *Bopyrinella* for the new species *B. antillensis* from Curaçao, which is herein regarded as a junior synonym of *Bopyrina thorii* Richardson, 1904. Regrettably, the type-specimens of *Bopyrinella antillensis* could not be located. Circumstantial evidence indicates that they should be in the collection of the Zoölogisch Museum, Amsterdam, but inquiries and searches kindly conducted by Drs. S. Pinkster and L. B. Holthuis failed to locate them there or at any other Dutch museum; there is no record of their ever having been registered anywhere. Published accounts of *B. antillensis* and examination of several specimens intermediate between it and *Bopyrina thorii* indicate the two species are synonymous. The species with the older name, *Bopyrina thorii*, cannot be retained in the genus *Bopyrina* as redefined above. Thus, the generic name available for this species is *Bopyrinella* Nierstrasz and Brender à Brandis, with the specific name *thorii* (Richardson) claiming priority. The only character cited by Nierstrasz and Brender à Brandis (1925) to distinguish *Bopyrinella* from *Bopyrina* is the presence of fifth pleopods on females of the former. The lack of a maxilliped palp on females of *Bopyrina*, the shapes of the pleons, variations in segmentation, and several other characters also serve to separate *Bopyrinella* from *Bopyrina*.

Monod (1933) described a parasite of an alpheid from the Gulf of Suez as "*Bopyrinella* (?) *stricticauda*". It is certain that the species does not belong in *Bopyrinella*, but it is beyond the scope of this report to reassign it. Shiino (1936a) described a parasite of *Spirontocaris rectirostris* (Stimpson) in Japanese waters as *Bopyrinella antilensis* [sic] var. *nipponica*. On the basis of Shiino's description, it is clear that the variety, while properly placed in *Bopyrinella*, is not conspecific with the Antillean species, so it is hereby raised to specific rank as *Bopyrinella nipponica* Shiino, 1936. The only other species in the genus, also in Japan, is *Bopyrinella albida* Shiino, 1958, a parasite of *Athanas kominatoensis* Kubo.

Only one species is known in the western Atlantic, *Bopyrinella thorii* (Richardson).

## *Bopyrinella thorii* (Richardson, 1904), new combination

Figures 38, 39

*Bopyrina thorii* Richardson, 1904, p. 74, fig. 63 [type-locality Key West, Florida; infesting *Thor floridanus* Kingsley]; 1905a, p. 566, fig. 627; Chopra, 1923, pp. 523, 525, 542; 1930, p. 143; Menzies and Glynn, 1968, p. 13; Schultz, 1969, p. 335, fig. 539; Markham, 1972, pp. 39, 42 [southern Florida; infesting *Thor floridanus*].

*Bopyrina thoris*: Nierstrasz and Brender à Brandis, 1923, pp. 98, 100, 102; 1925, p. 7; 1929, p. 40.

*Bopyrinella antillensis* Nierstrasz and Brender à Brandis, 1925, pp. 6, 7, figs. 22-25 [type-locality Spaanische Baai, Curaçao; infesting *Thor floridanus*]; Chopra, 1930, p. 143; Monod, 1933, pp. 238, 240.

not *Bopyrinella antilensis* [sic] var. *nipponica* Shiino, 1936b, pp. 159-161; 1939c, p. 185; 1958, pp. 62, 63; 1972, p. 8 [= *Bopyrinella nipponica* Shiino, 1936, herein designated].

*Bopyrinella antilensis* [sic]: Shiino, 1936b, p. 161.

"Branchial bopyrid": Chace, 1972, p. 136 [Bahía de la Ascensión, Yucatán, Mexico; infesting *Thor floridanus*].

*Material examined*: HOURGLASS MATERIAL: None. — OTHER MATERIAL: Infesting *Thor floridanus* Kingsley: Many ♀ and ♂ (including reference specimens); Card Sound, Monroe

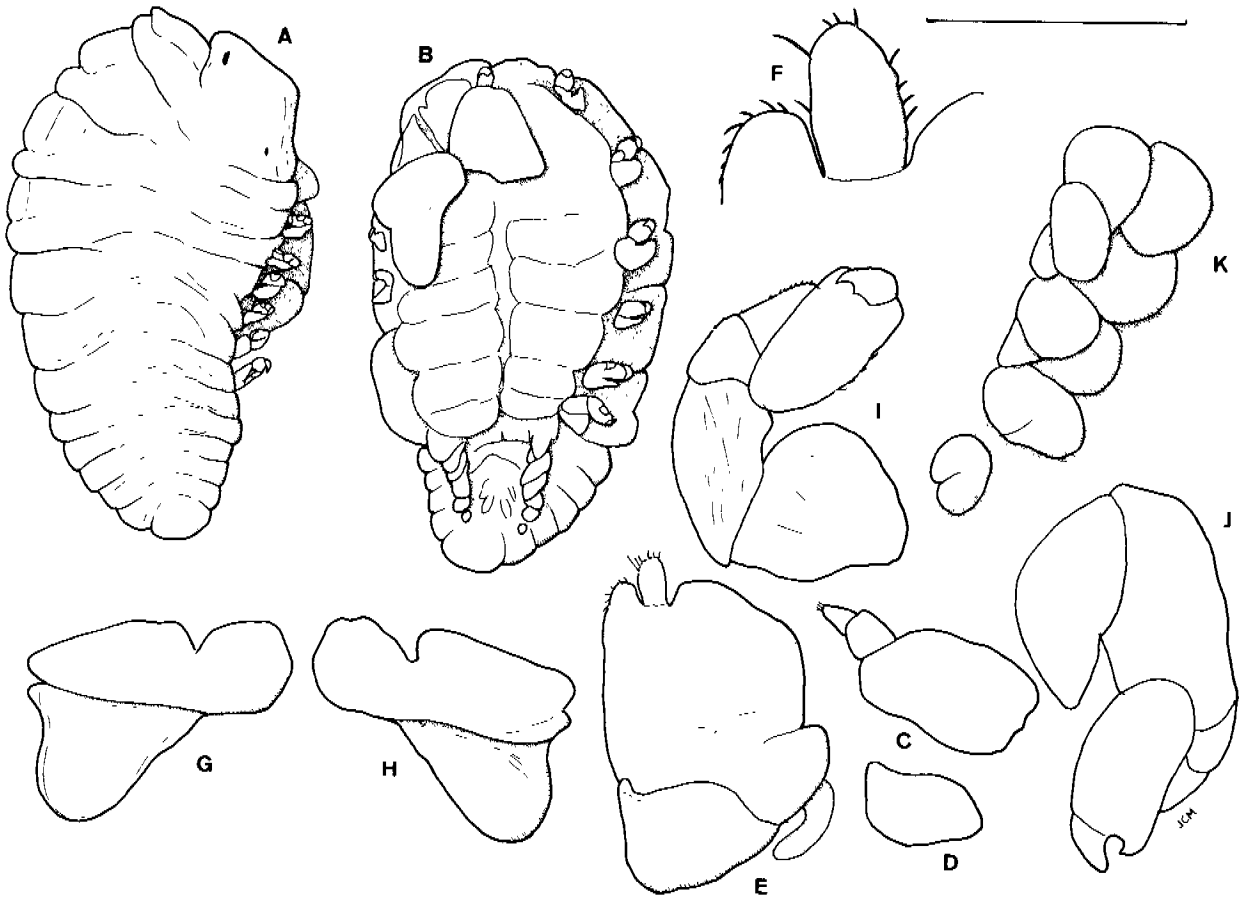


Figure 38. *Bopyrinella thorii* (Richardson), reference ♀, UMML uncatalogued. A. Dorsal view. B. Ventral view. C. Right antenna 1. D. Right antenna 2. E. Left maxilliped, external view, and posteroventral border of head. F. Palp of maxilliped. G. Left oostegite 1, external view. H. Same, internal view. I. Left pereopod 1. J. Left pereopod 7. K. Left pleopods. Scale 0.9 mm for A, B; 0.5 mm for G, H; 0.25 mm for E, K; 0.125 mm for C, D, I, J; 0.08 mm for F.

County, Florida; shallow water; 1970 and 1971; J. García-Gómez, coll. and det. of hosts; UMML. — 1 ♀ (HOLOTYPE); U.S. Fisheries Commission steamer *Albatross* Station, Key West, Florida; 15-27 April 1884; USNM 29099. — 1 ♀; Smithsonian-Bredin Expedition Station 77-60, north end of Bahía de la Ascensión, Quintana Roo, Mexico; 15 April 1960; F. A. Chace, Jr., det. of host; USNM.

*Description*: Reference female (Figure 38): Body outline broadly falcate. Length 1.82 mm, maximal width 0.94 mm, head width 0.56 mm, pleon length 0.58 mm. Body axis distortion 77°. Margins smoothly tapered (Figure 38A, B).

Head extending somewhat beyond body outline and produced anteriorly into large, reflexed lamina. Head laterally separate from pereon but posteriorly fused with it. Eyes small, laterally placed. Antennae (Figure 38C, D) of three and one articles, respectively, with setation difficult to discern. Maxilliped (Figure 38E) with much larger anterior segment, bearing extended, setose, articulating palp (Figure 38F) and slender, extended spur. Posteroventral border of head with single, tapered lateral projection on each side (Figure 38E).

Pereon with distinct separations along margins but some rather uncertain segmentation dorsally. Small coxal plates, short tergal projections, and obscure dorsolateral projections on long sides of peromeres 1-4. First oostegites (Figure 38G, H) quite large, that on shorter side markedly larger; both with unadorned internal ridges and extended posterolateral regions, that on shorter side longer and curved. Other oostegites very reduced except fifth one on short side slender, elongate, and extending clear across gaping brood pouch. Pereopods (Figure 38I, J) all similar but somewhat larger posteriorly.

Six pleomeres clearly demarcated laterally, but some of dorsal segmentation obscure and possibly absent. Ventrally, pleomeres separated only laterally. Final pleomere more sharply tapered than preceding one and extending deeply into it, broadly rounded and extended posteriorly. Five pairs of uniramous pleopods, most deeply divided so as to appear nearly biramous. No uropods.

Reference male (Figure 39): Length 0.67 mm, maximal width 0.28 mm, pleon length 0.17 mm. Body narrowly elliptical and smoothly tapered (Figure 39A, B).

Head short and posteriorly fused with pereon, but juncture indicated by lateral indentations and slight posterolateral separations. Large, dark eyes near posterolateral corners of head. Antennae (Figure 39C, D) of three and two articles, respectively; first antenna densely setose.

Pereomeres all distinctly separated laterally and dorsally, with lateral margins reflexed ventrally. No midventral tubercles. Pereopods (Figure 39E, F) all similar but with dactyli somewhat smaller and other articles rather more elongate posteriorly; sparse, small setae on all carpi.

Pleon fused but with six pleomeres indicated laterally. Five pairs of flat, sessile, discoidal pleopods. No uropods, but terminal pleomere with anal cone extending slightly posteriorly and small tuft of setae at each side (Figure 39G).

*Variations*: Females: Separation of the head and segmentation of both the pereon and pleon are quite variable and often very difficult to assess; some specimens have no evident dorsomedial

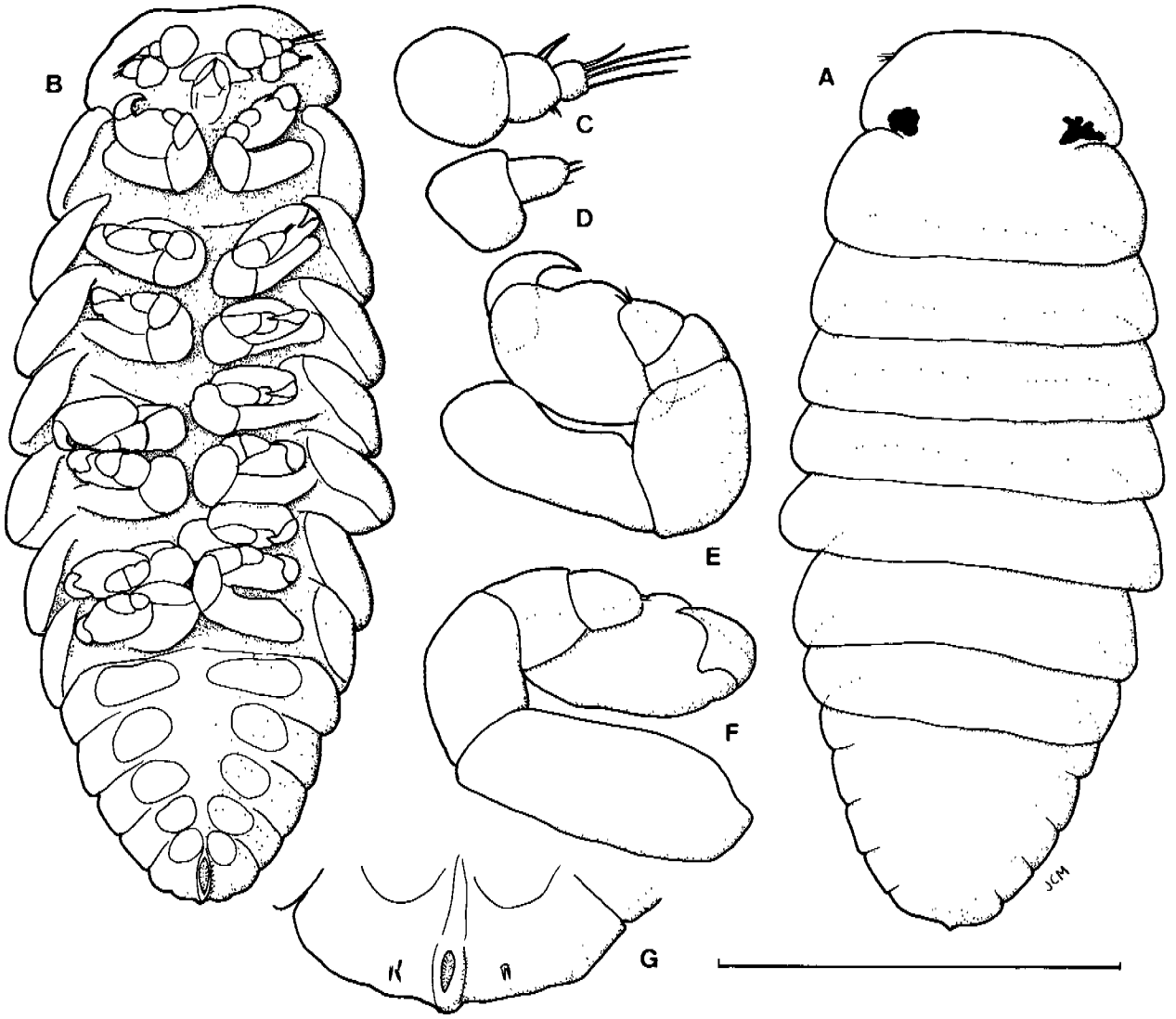


Figure 39. *Bopyrinella thorii* (Richardson), reference ♂, UMML uncatalogued. A. Dorsal view. B. Ventral view. C. Left antenna 1. D. Left antenna 2. E. Right pereopod 1. F. Right pereopod 7. G. End of pleon, ventral view. Scale 0.3 mm for A, B; 0.1 mm for C-G.

separation of any segments. In some specimens the anterolateral margins of the pleomeres on the long side are markedly reflexed. Whereas, in the reference female the pleopods are so deeply divided as to appear biramous, in other cases they are unquestionably uniramous. The most consistent features seem to be the general body shape, the extended head, the narrow coxal plates, the structure of the oostegites, and the broadly rounded final pleomere. All of these characters were well illustrated by Richardson (1904, 1905a) for the holotype of *Bopyrina thorii* and by Nierstrasz and Brender à Brandis (1925) for the holotype of *Bopyrinella antillensis*, leaving little doubt that those species are synonymous. Richardson (1904, 1905a) indicated a separate but strangely proportioned head, which re-examination of the holotype indicated to be incorrect. It is possible that what she considered to be the posterior border of the head was really a crease in the cuticle.

Males: In some males the carpi and meri of a few pereopods are fused. Occasionally, the pleon is abruptly narrower than the final pereomere, and its margins are reflexed ventrally, although the pleonal margin is still shaped the same. In a few cases the pleons are marginally setose. The pleopods of some males are very difficult to see. Richardson (1904) had no male available, but that of Nierstrasz and Brender à Brandis (1925) corresponds with the present material in all respects, except that those authors said there were no pleopods. In the case of some of the males examined, this is very nearly true, so their interpretation of a similar specimen is understandable.

*Distribution*: Southern Florida; Yucatán; Curaçao.

## *Synsynella* Hay, 1917

*Diagnosis*: Female: Body ovate, only moderately distorted. Head extended and with broad frontal lamina, fused with pereon posteriorly but separated at least slightly along lateral margin; maxilliped palp setose, articulating only in *S. deformans*; two pairs of lateral projections on posteroventral border. Dorsolateral bosses and coxal plates on both sides of pereomeres 1-4; brood pouch open or nearly closed. Pleon typically of six pleomeres often variously fused; four pairs of flaplike, uniramous pleopods (occasionally some appearing biramous because of folding and, rarely, one pair absent); no uropods. Male: Body more than twice as long as wide, sides nearly parallel. Head usually fused midposteriorly but occasionally separate. No midventral tubercles. Five pleomeres, of which first at least as wide as last pereomere and final two fused dorsally; pleopods obscure sessile discs or absent. Hosts in genus *Synalpheus*.

*Type-species*: By original designation, *Synsynella deformans* Hay, 1917. Gender feminine.

*Remarks*: *Synsynella* is definitely known only from the temperate and tropical coasts of the western Atlantic, although the Japanese species described as *Bopyrella inoi* by Shiino (1949) may properly belong to *Synsynella* (Bourdon, 1980). Kruczynski and Menzies (1977) reviewed the genus and considered the sympatric species *Bopyro choprae* Pearse, 1932, the type-species of *Bopyro* Pearse, and *Synsynella deformans* to be synonymous. Bourdon (1981b), in a revision of *Synsynella*, agreed that *Bopyro* is a synonym of *Synsynella*, but he considered *B. choprae* to be a distinct species, hence to be redesignated *Synsynella choprae* (Pearse). He also described a third species, *Synsynella integra* Bourdon, from the same hosts and localities; specimens were even present among the type-specimens of *S. deformans*. Yet another nominal species is *Prosynsynella hayi* Niestrasz and Brender à Brandis (1929), which I am calling a synonym of *S. choprae*. This action would suppress the genus *Prosynsynella* Nierstrasz and Brender à Brandis, of which *P. hayi* is the type-species. The Hourglass collections contained all three of these species, and other material has also been examined. Finally, one other undescribed species from Haiti, of which R. Bourdon is preparing a description, is assignable to *Synsynella*. A key to species, expanded from one graciously made available by R. Bourdon (personal communication), is included, but because of his study, the species are not considered in detail. Two of the species are illustrated and diagnosed, while the others are only mentioned.

## KEY TO WESTERN ATLANTIC SPECIES OF *SYNSYNELLA*, BASED ON MATURE FEMALES

1. Brood pouch half closed; oostegites 4 and 5 nearly or fully as broad as long..... ..... *Synsynella deformans* Hay

1. Brood pouch wide open; oostegites 4 and 5 nearly three times as long as broad ... 2

2. Sides of pleomeres on short side of body rounded or indicated only by undulations ..... ..... *Synsynella choprae* (Pearse)

2. Both sides of pleomeres well separated and some pointed..... 3

3. Final pleomere entire..... *Synsynella integra* Bourdon

3. Final pleomere deeply notched ..... *Synsynella* n. sp.

### *Synsynella deformans* Hay, 1917

Figures 40, 41

*Synsynella deformans* Hay, 1917, pp. 570-572, pl. 99, figs. 13-18 [type-locality Onslow Bay, off Beaufort Inlet, North Carolina; infesting *Synalpheus longicarpus* (Herrick)]; Hay and Shore, 1918, p. 383; Nierstrasz and Brender à Brandis, 1929, pp. 4, 36-38 [West Indies; host not reported]; Williams, 1965, p. 74 [Carolinas; infesting *S. longicarpus*]; Shultz, 1969, pp. 313, 333, fig. 535, Kruczynski and Menzies, 1977, pp. 551-556, fig. 1A-C [re-examination of type-material]; Kelley, 1978, p. 169; Bourdon, 1981b, pp. 1143-1154, 1157 [re-examination of type-material; and Haiti; infesting *Synalpheus* sp.; and unspecified West Indian locality; infesting unknown host].

*Bopyrella deformans*: Chopra, 1922, p. 70; 1923, pp. 414, 418, 468; 1927, p. 119; 1930, pp. 132-134.

*Material examined*: Infesting *Synalpheus longicarpus* (Herrick): HOURGLASS STATION D: 1 ♀, 1 ♂ (damaged); 26 January 1967; trawl; FSBC I 23865. — OTHER MATERIAL: 4 ♀ (HOLOTYPE and PARATYPES); U. S. Fisheries steamer *Fish Hawk* Station 8293, Onslow Bay, about 32 km from Beaufort Inlet, North Carolina; 18 m; August 1915; USNM 48371, 48372.

Infesting *Synalpheus brooksi* Coutière: HOURGLASS STATION K: 1 ♀; 4 September 1966; trawl; FSBC I 23868. — OTHER MATERIAL: 1 ♀, 1 ♂ (reference ♂); east of main span of Skyway Bridge, Tampa Bay, Florida; 4.2-7.3 m; 12 October 1976; W. G. Lyons and D. K. Camp, colls.; W. L. Kruczynski, det. of host; FSBC I 16612.

Infesting *Synalpheus pectiniger* Coutière: HOURGLASS STATION K: 1 ♀; 7 April 1967; trawl; FSBC I 18897. — OTHER MATERIAL: 1 ♀, 1 ♂; University of Miami R/V *John Elliott Pillsbury* Station P-1249, southwest of Jamaica, 17°23'N, 78°39'W; 25 m, in sponge; 13 July 1970; J. García-Gómez, det. of host; UMML 32: 5334.

Separated from host: HOURGLASS STATION C: 1 ♀; 7 February 1966; dredge; FSBC I 23866. — HOURGLASS STATION K: 1 ♀ (reference ♀); 22 July 1966; trawl; FSBC I 23867.

*Diagnosis*: Female (Figure 40): Body broadly ovate, distorted about 20°. Head usually fused posteriorly but separated laterally; frontal lamina produced into slight points but not separated from head; maxilliped palp articulate and setose; posterolateral projections, if discernible, usually two on each side of posteroventral border. Oostegites covering at least half of brood pouch; first one extending straight back into short, lateral point; fourth and fifth ones nearly as broad as long. Pleon of six pleomeres, distinct on both sides and more or less pointed; terminal

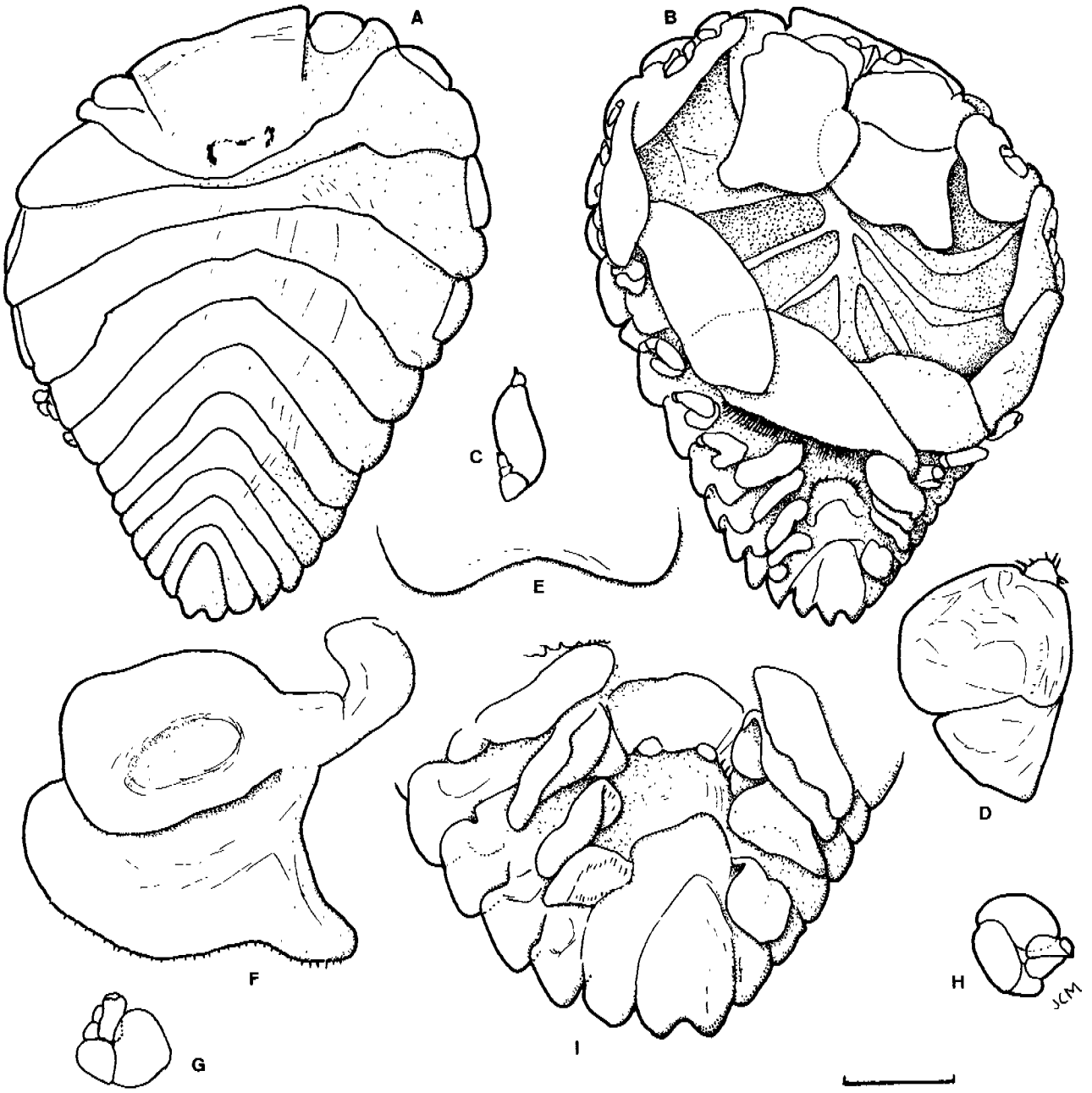


Figure 40. *Synsynella deformans* Hay, reference ♀, FSBC I 23867. A. Dorsal view. B. Ventral view. C. Left antennae. D. Right maxilliped, external view. E. Posteroventral border of head. F. Right oostegite 1, internal view. G. Right pereopod 1. H. Right pereopod 7. I. Pleon, ventral view. Scale 1.0 mm for A, B; 0.5 mm for D-I; 0.3 mm for C.

pleomere extended and bifurcate; two to four pleopods on each side; anterior ones much wider than long and occasionally appearing biramous. Male (Figure 41): Body about three times as long as wide. Juncture between head and first pereomere indicated by rounded lateral notches. Pereopods nearly equal in size, all meri and carpi partly to completely fused. First pleomere of same breadth as final pereomere.

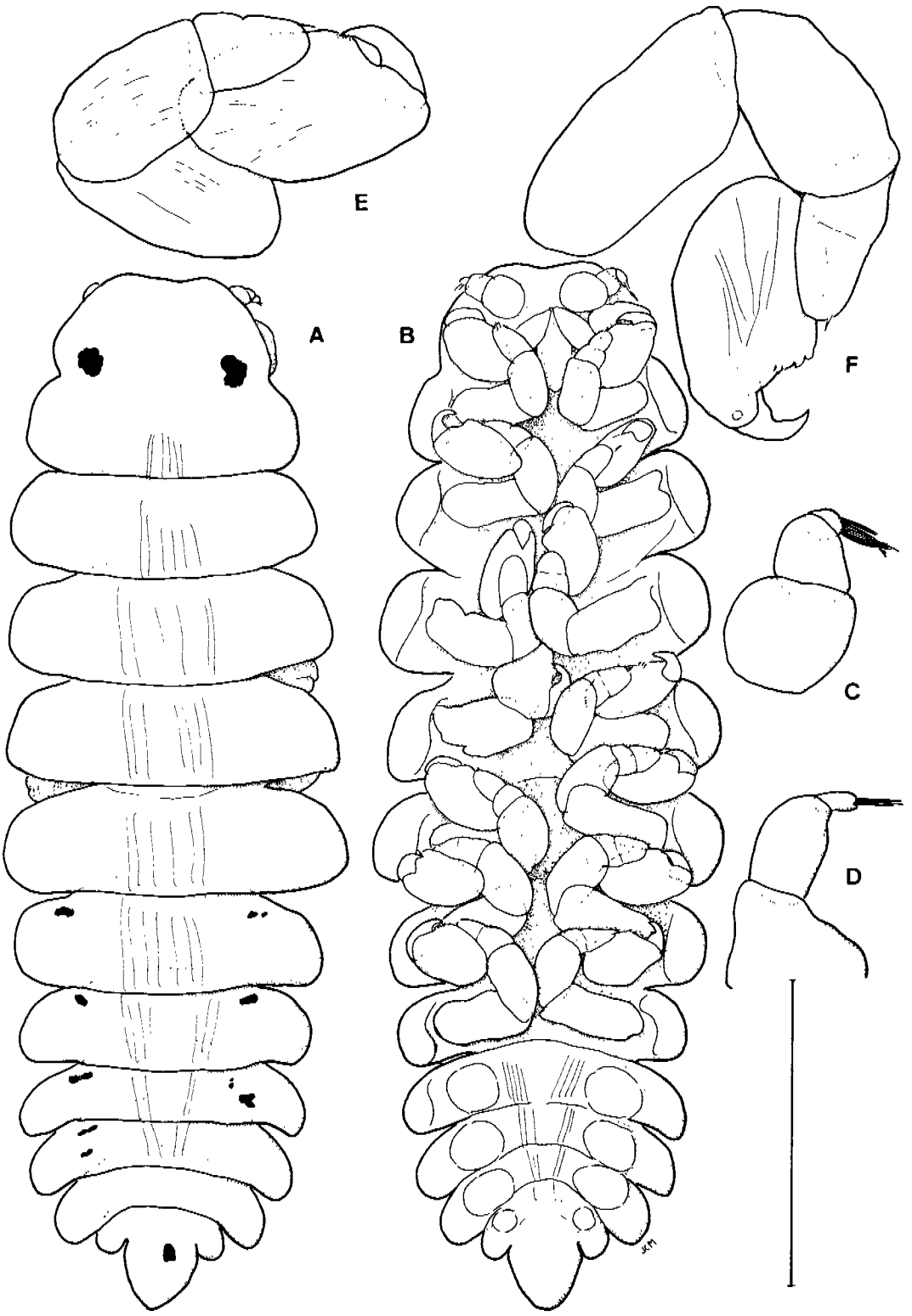


Figure 41. *Synsynella deformans* Hay, reference ♂, FSBC I 16612. A. Dorsal view. B. Ventral view. C. Left antenna 1. D. Left antenna 2. E. Left pereopod 1. F. Left pereopod 7. Scale 0.3 mm for A, B; 0.1 mm for C-F.

*Description*: See Hay (1917) and Kruczynski and Menzies (1977).

*Distribution*: North Carolina; western Florida; Jamaica.

## *Synsynella choprae* (Pearse, 1932)

Figures 42-44

?"Bopyrid": Coutière, 1909, p. 52 [unlisted locality; infesting *Synalpheus minus* (Say)].

?*Prosynsynella hayi* Nierstrasz and Brender à Brandis, 1929, pp. 36, 37, figs. 46, 47 [type-locality Virgin Islands; infesting *Synalpheus* sp., subsequently identified as *S. minus*]; Chopra, 1930, pp. 137, 138; Shiino, 1949, p. 49; Bourdon, 1981b, p. 1161.

*Bopyro choprae* Pearse, 1932a, pp. 1-3, figs. 1-14 [type-locality Dry Tortugas, Florida; infesting *Synalpheus brooksi* Coutière]; 1932b, p. 107; 1932c, pp. 119-122, tab. 1; Shiino, 1949, p. 49; Pearse, 1950, p. 41, figs. 1, 2 [offshore from Black Rocks, North Carolina; infesting *S. longicarpus* (Herrick) and *S. minus* (Say)]; 1951, p. 368 [Bimini, Bahamas; infesting *S. brooksi*]; Schultz, 1969, p. 337, fig. 544; Kruczynski and Menzies, 1977, pp. 552-556 in part, figs. 1D, 2 [re-examination of type-material].

?*Prosynsynella Hayi*: Monod, 1933, pp. 236, 238.

*Bopyrus chopre* [sic]: Carvalho, 1942, p. 128.

*Pseudione*? sp.: Menzies and Frankenberg, 1966, pp. 26, 27, 73, fig. 7 [Georgia; infesting *Synalpheus* sp.].

?*Prosynsynella*: Kruczynski and Menzies, 1977, p. 551.

*Synsynella deformans*: Kruczynski and Menzies, 1977, pp. 551-556 [in part]; Markham, 1979a, pp. 523, 525, 526, fig. 1 [Bermuda; infesting *Synalpheus gooderi* Coutière]. [not *Synsynella deformans* Hay, 1917.]

*Bopyrina choprae*: Kelley, 1978, p. 169 [not *Bopyrina choprae* Nierstrasz and Brender à Brandis, 1929].

*Synsynella choprai*: Bourdon, 1981b, pp. 1143, 1149, 1150, 1154-1157, figs. 4, 5 [re-examination of types; and Haiti; infesting *Synalpheus* sp.].

*Material examined*: Infesting *Synalpheus brooksi* Coutère: HOURGLASS STATION C: 1 ♀, 1 ♂; 18 June 1966; trawl; FSBC I 23869. — 3 ♀, 3 ♂; 8 September 1966; trawl; FSBC I 23895, 23872. — HOURGLASS STATION K: 1 ♀, 1 ♂; 21 March 1966; trawl; FSBC I 23878. — 1 ♀; 4 September 1966; trawl; FSBC I 23870. — OTHER MATERIAL: 20 ♀ (including reference ♀), 7 ♂; east of main span of Skyway Bridge, Tampa Bay, Florida; 4.2-7.3 m; 12 October 1976; W. G. Lyons and D. K. Camp, colls.; W. L. Kruczynski, det. of hosts; FSBC I 23871.

Infesting *Synalpheus minus* (Say) (J. García-Gómez, det. of host): HOURGLASS MATERIAL: None. — OTHER MATERIAL: 1 ♂ (ALLOTYPE of *Prosynsynella hayi* Nierstrasz and Brender à Brandis); Danish West Indies (= U. S. Virgin Islands); 1911; Meng, coll.; ZMC. — 1 ♀, 1 ♂ (material of Menzies and Frankenberg, 1966); Sapelo Island, Georgia; in collection of R. W. Heard.

Infesting *Synalpheus pandionis* Coutière: HOURGLASS STATION L: 1 ♀, 1 ♂; 13 November 1966; dredge; FSBC I 23873. — 1 ♀; 13 January 1967; trawl; FSBC I 23874. — HOURGLASS STATION M: 1 ♀; 12 April 1966; trawl; FSBC I 23875. — 1 ♀, 1 ♂ (reference ♂); 12 October 1967; trawl; FSBC I 23876.

Infesting *Synalpheus* spp. indet.: HOURGLASS STATION C: 1 ♀; 25 January 1967; trawl; FSBC I 18896. — HOURGLASS STATION D: 1 ♀; 26 January 1967; trawl; FSBC I 23877. — OTHER MATERIAL: 1 ♀, 1 ♂; Trou-Forban, Haiti; July 1962; R. Cornet, coll.; USNM 181527. — 3 ♀; Cayes Pélican, Haiti; March 1961; R. Cornet, coll.; USNM 181528. — 1 ♀; Mer Frapée, Golfe de la Gonâve, Haiti; March 1961; R. Cornet, coll.; USNM 181529.

*Diagnosis*: Female (Figure 42): Body broadly ovate, only moderately distorted (about 30°). Head completely fused with pereomere 1; frontal lamina extending markedly to at least one side and often articulating with head; maxilliped with setae on anteromedial corner and on end of nonarticulating palp. Pereon with some distinct coxal plates and dorsolateral bosses; oostegites leaving brood pouch wide open, first one concave at base of dorsolateral projection, fourth and fifth ones much longer than broad. Pleon of six pleomeres, deeply separated and reflexed on long side but nearly to completely fused on short side; terminal pleomere sharply indented; four pairs of pleopods, oval (anteriorly) to lanceolate, those on short side of body much reduced; no uropod. Male (Figure 43): Length less than three times width. Juncture between head and pereon indicated by acutely angled lateral notches. Pereopods with variously fused or separated meri and carpi. Pleon of five pleomeres, but final two fused; first pleomere broader than final pereomere; four pairs of oval, discoid, sessile pleopods.

*Description*: See Bourdon (1981b).

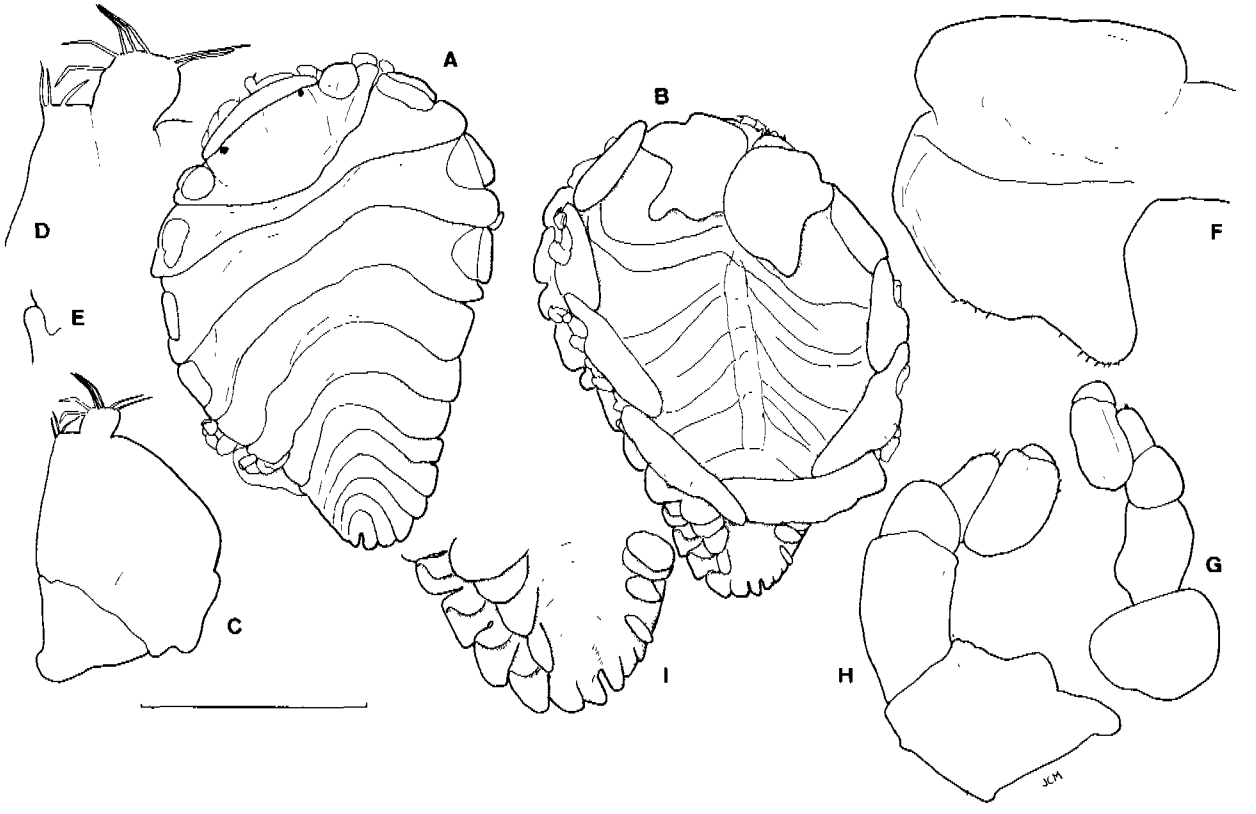


Figure 42. *Synsynella choprae* (Pearse), reference ♀, FSBC I 23871. A. Dorsal view. B. Ventral view. C. Right maxilliped, internal view. D. Palp of same. E. Spur of same. F. Right oostegite 1, internal view. G. Right pereopod 1. H. Right pereopod 7. I. Pleon, ventral view. Scale 1.5 mm for A, B; 0.8 mm for I; 0.5 mm for C, F; 0.25 mm for D, E, G, H.

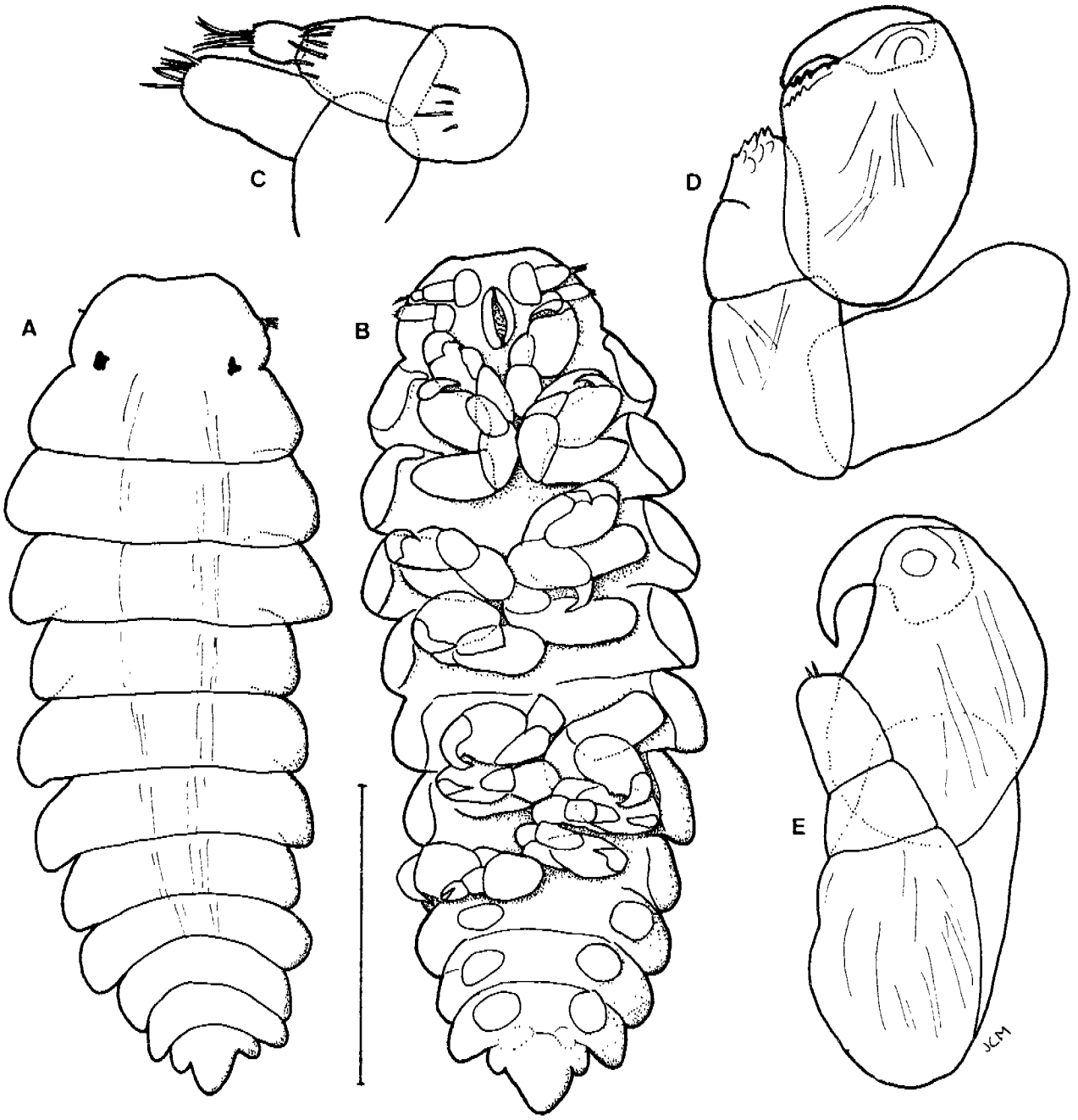


Figure 43. *Synsynella choprae* (Pearse), reference ♂, FSBC I 23876. A. Dorsal view. B. Ventral view. C. Right antennae. D. Left pereopod 1. E. Right percopod 7. Scale 0.4 mm for A, B; 0.1 mm for C-E.

*Distribution*: Bermuda; North Carolina; Georgia; southern and western Florida; Bahamas; Haiti; Virgin Islands.

*Remarks*: The holotype female of *Prosynsynella hayi* has been lost, but on the basis of the single drawing and the very brief description by Nierstrasz and Brender à Brandis (1929), the species seems possibly assignable to *Synsynella choprae* and would become the senior synonym. The

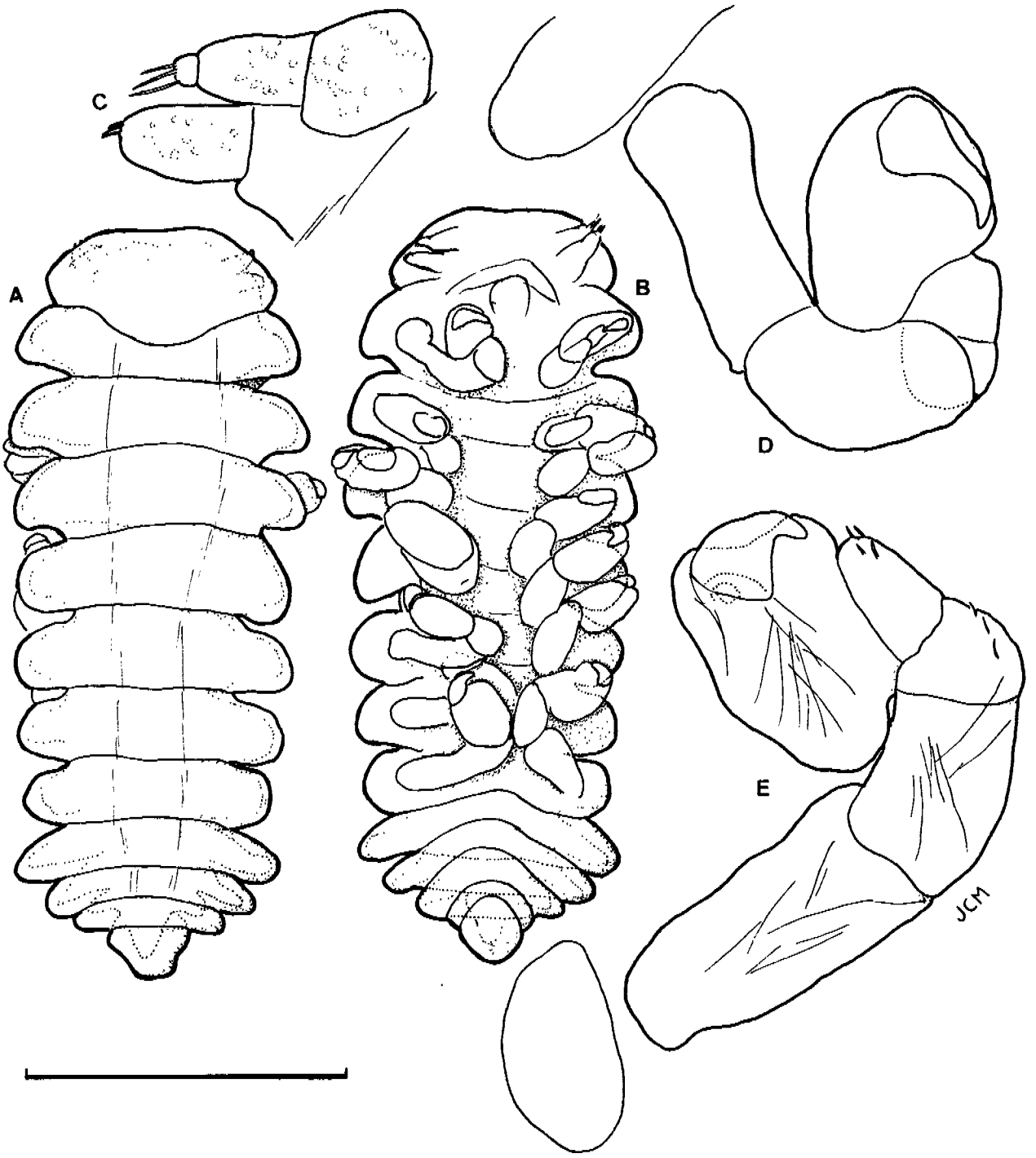


Figure 44. *Synsynella choprae* (Pearse), allotype ♂ of *Prosynsynella hayi* Nierstrasz and Brender à Brandis, ZMC. A. Dorsal view. B. Ventral view. C. Right antennae. D. Right pereopod 1. E. Right pereopod 7. Scale 0.4 mm for A, B; 0.1 mm for C-E.

allotype male of *P. hayi* (Figure 44), whose characters alone persuaded Nierstrasz and Brender à Brandis to describe a new species in a new genus, is very different from typical *Synsynella* males: the head and pereon are separate, the fourth and fifth pleomeres are distinct ventrally, and there are no pleopods. Because of the incomplete knowledge of the female and the

peculiarities of the male, the synonymy of *Prosynsynella hayi* and *Synsynella choprae* must remain somewhat questionable.

It is possible that some of the citations of *Synsynella choprae* by Pearse in the synonymy above actually refer to *S. deformans*.

### *Synsynella integra* Bourdon, 1981

*Synsynella deformans*: Hay, 1917, pp. 571, 572 [in part; among type-material of *S. deformans* Hay, Onslow Bay, North Carolina; infesting *Synalpheus longicarpus* (Herrick)]; Kruczynski and Menzies, 1977, pp. 551-556 [in part; re-examination of type-material of *S. deformans*].

?*Bopyro choprae*: Pearse, 1950, p. 41, figs. 1, 2 [offshore from Black Rocks, North Carolina; infesting *S. longicarpus* (Herrick) and *S. minus* (Say)]; Bourdon, 1981b, p. 1161. [possible misidentification].

*Synsynella integra* Bourdon, 1981b, pp. 1143, 1150-1151, 1158-1161, figs. 6-8 [Onslow Bay, about 20 miles from Beaufort, North Carolina; infesting *S. longicarpus*].

*Material examined*: Infesting *Synalpheus pandionis* Coutière: HOURGLASS STATION D: 1 ♀; 14 December 1966; trawl; FSBC I 23879.

*Diagnosis*: According to key above.

*Description*: See Bourdon (1981b).

*Remarks*: Despite its collection by the Hourglass Cruises, the single specimen examined has not been considered in any detail.

### *Synsynella*, new species

*Material examined*: None

*Diagnosis*: According to key above.

*Description*: In preparation by R. Bourdon (personal communication).

*Remarks*: The new species is being described by R. Bourdon (personal communication) on the basis of material found infesting *Synalpheus* spp. at Haiti, the only known locality.

## *PROBABLE BOPYRINAE RECORDED BUT NOT IDENTIFIED*

Chace (1972) recorded several unidentified branchial parasites of caridean shrimps collected during the Smithsonian-Bredin Expeditions in the Caribbean. Some of those parasites are discussed above; others remain unobtainable, so one can only surmise that they belong to the Bopyrinae. The host species and their localities are: *Alpheus armillatus* H. Milne Edwards, Antigua; *Alpheus viridari* (Armstrong), Antigua; and *Synalpheus longicarpus* (Herrick), Mustique.

Four additional records of caridean-infesting branchial parasites, probably bopyrines, in the northwestern Atlantic have also become available. They are of probably undescribed species whose hosts have never before been known to harbor bopyrid parasites. The parasites were unavailable during preparation of this report. The host species, the sources of the records, and their localities are as follows: *Lipkebe holthuisi* Chace: Shaw et al. (1977), eastern Gulf of Mexico, 26°25'N, 83°50'W, 150 m; *Gnathophyllum modestum* Hay: Dardeau et al. (1980), northeastern Gulf of Mexico; *Latreutes parvulus* (Fabricius): D. L. Adkison (personal communication), Gulf of Mexico (considered to be new species of *Probopyrinella*), and Camp et al. (1977), Hutchinson Island, Florida.

## Subfamily Hemiarthrinae Markham, 1972

(= Phrixinae Caroli, 1949, and Phryxinae Codreanu and Codreanu, 1956)

*Diagnosis*: Female: Body generally distorted, sometimes more than 90°. Head deeply set into pereon, occasionally bisecting first pereomere. Pereomeres distinct on short side, their borders obscured on long side; brood pouch greatly expanded on long side, completely closed, covering entire ventral and lateral surfaces of head, pereon, and part of pleon as well as part of dorsal surface of pereon; only first 4 oostegites of long side contributing to brood pouch, other oostegites reduced or absent; usually all pereopods present on short side, 1 (most anterior) to 7 present on opposite side. Usually 5 pleomeres, first four usually bearing prominent lateral plates; pleopods usually on all but terminal pleomere, variously uniramous or biramous; uropods absent or variously developed. Male: Body at least twice as long as broad. Head and first pereomere separate to fully fused, all other pereomeres separate; no midventral tubercles. Pleon fused, lacking appendages. Ventral abdominal parasites (with 3 known exceptions) of caridean shrimps.

*Type-genus*: *Hemiarthrus* Giard and Bonnier, 1887.

*Remarks*: This subfamily was originally designated Phrixinae by Caroli (1949), then Phryxinae by Codreanu and Codreanu (1956), both of which were based on invalid generic names, *Phrixus* (a junior synonym) and *Phryxus* (a junior homonym). Markham (1972) subsequently renamed it Hemiarthrinae, presented a synonymy, and discussed the systematic history of its name.

In the western Atlantic, ten species are presently known, only two of which belong to the same genus. Because there is frequently intraspecific variation even among key characters, the key presented will often prove unreliable. Thus, one should use the diagnoses and illustrations presented in correlation with the key to achieve reliable identifications.

## KEY TO GENERA OF HEMIARTHRINAE IN THE NORTHWESTERN ATLANTIC, BASED ON MATURE FEMALES

1. Some or all lateral plates biramous ..... 2

1. Lateral plates uniramous or absent ..... 3

2. Oostegite 2 reflexed over head; one complete pereopod on convex side, seven on concave side ..... *Diplophryxus*

2. Oostegite 2 not reflexed over head; two complete pereopods on convex side, five on concave side ..... *Allodiplophryxus*

3. Convex side bearing all seven pereopods ..... 4

3. Convex side bearing only one to three pereopods ..... 5

4. All four or first three pleopods biramous; all four lateral plates well developed ... *Eophrixus*

4. Pleopods uniramous; fourth lateral plates reduced or absent ..... *Loki*

5. Convex side with three pereopods; body distorted 35° or less ..... *Dicropleon*

5. Convex side with one or two pereopods; body distorted 80° or more ..... 6

6. Pleopods biramous ..... *Hyperphrixus*

6. Pleopods uniramous ..... 7

7. Usually only four pleomeres, first three lacking appendages or having only tiny rudiments on short side (= side of pereonal convexity) ..... *Azygopleon*

7. Five pleomeres, first four and rarely fifth having appendages on both sides ..... 8

8. Convex side with one pereopod; antennae reduced ..... *Hemiarthrus*

8. Convex side with two pereopods; antennae as prominent, unsegmented flaps ... *Metaphrixus*

## *Diplophryxus* Richardson, 1904

*Diagnosis*: Female: Body axis slightly (30°) to greatly (100°) distorted. Convex side with only first pereopod complete, though bases of second and third often present on brood pouch; concave side with three to seven pereopods; all pereopods reduced; pereomere 1 usually complete dorsally. Pleon of five pleomeres; four pairs of biramous lateral plates with ovate to lanceolate rami; four pairs of biramous pleopods; uropods various. Male: Head and pereon separate; pereopods small, not extending beyond pereomeral margins at all. End of pleon rounded. Distribution: Japan, Andaman Islands, Mozambique, Georgia to Yucatán; infesting *Alpheus* spp., *Palaemon* spp., *Leander* sp., and *Gnathophyllum* sp.

*Type-species*: By monotypy, *Diplophryxus jordani* Richardson, 1904. Gender masculine.

*Remarks*: So far, five species have been assigned to *Diplophryxus*. Two of these, *D. richardsoni* Chopra, 1930, and *D. synalphei* Pearse, 1950, are excluded on the basis of the diagnosis above. Those remaining are *D. jordani* Richardson, 1904, the type-species, infesting *Leander* spp. around Japan and near India; *D. alphei* Shiino, 1934, infesting *Alpheus* spp. in Japan and Mozambique; and *D. kempi* Chopra, 1930, infesting *Gnathophyllum fasciolatum* Stimpson in the Andaman Islands. The single species previously reported from the western Atlantic, *D. synalphei*, is being reassigned to *Hemiarthrus*, below. Despite the removal of three species from the genus, *Diplophryxus* remains somewhat heterogeneous in several characters of the females and in the selection of hosts. Still, the presence of a single pereopod on the convex side and,

especially, of biramous lateral plates in the females seems to justify the inclusion of all four species in a single genus.

Only one species is known in the western Atlantic, *Diplophryxus* n. sp. This undescribed species is briefly treated here but subsequently will be described elsewhere.

### *Diplophryxus*, new species

"Abdominal Bopyrid": Chace, 1972, p. 67 [Bahía de la Ascensión, Quintana Roo, Yucatán, Mexico; infesting *Alpheus formosus* Gibbes].

*Material examined*: HOURGLASS MATERIAL: None. — OTHER MATERIAL: Infesting *Alpheus formosus* Gibbes: 1 ♀; Smithsonian-Bredin Expedition Station 85-60, along shore near Suliman Point, Bahía de la Ascensión, Quintana Roo, Yucatán, Mexico; 17 August 1960; W. L. Schmitt et al., colls.; F. A. Chace, Jr., det. of host; USNM 154607.

Infesting *Alpheus* sp. indet.: 1 ♀, 1 ♂; on shelly mud bottom, Warsaw Sound, Chatham County, Georgia; 4.5 m; 24 June 1972; R. W. Heard, coll.; unassigned. — 1 ♂; Haulover Canal, Indian River, Brevard County, Florida, 28°44.2'N, 80°45.8'W; posthole digger in bed of *Halodule wrightii*, 0.1-0.4 m; 10 February 1976; R. W. Virnstein et al., colls.; IRCZM 89: 3890. — 1 ♀; same data; 10 February 1976; R. W. Virnstein et al., colls.; IRCZM 89: 3891.

*Diagnosis*: Female: Body distorted about 80°. All pereomeres obscure dorsally; digitate projections on ventral surface of pereomere 2; first pereopod on concave side prominent, all others tiny and hidden; bases of second and third pereopods of convex side represented by scars on brood pouch; first oostegites on both sides extending over to dorsal surface; brood pouch very large and distended. Rami of pleopods and lateral plates very long and slender. Male: Head subcircular, markedly narrower than first pereomere and extending far from it. Pereopods all nearly of same size, but first two pairs with much larger and sharper dactyli. Pleon more than 1/3 total body length, with slightly undulate lateral margins and rounded posterior point.

*Description*: To be prepared by R. W. Heard, Gulf Coast Research Laboratory, Ocean Springs, Mississippi.

*Distribution*: Georgia; eastern Florida; Yucatán.

### *Allodiplophryxus*, new genus

*Diagnosis*: Female: Body distorted about 90°. Most pereomeres obscurely separated; brood pouch extending far forward but rather little laterally; no oostegite overlapping dorsal surface of body; two pereopods on convex side (basis only of third on oostegite), five pereopods on concave side, first two much larger than others. Pleon of five pleomeres, first four produced into stubby, biramous lateral plates and bearing similar biramous pleopods; terminal pleomere as subrectangular pleotelson lacking appendages. Male: Sides of body subparallel, with head nearly as broad as pereon. Head distinctly set off from pereon and bearing prominent eyes. Pereopods of same size, but those of first two pairs with carpi and meri fused. Pleon about 1/3

of total body length and evenly tapering to rather sharp point. Distribution: Western Florida; infesting *Periclimenes*.

*Type-species*: By present designation, *Allodiplophryxus floridanus*, new species.

*Etymology*: Greek prefix "allo-", meaning "other", and generic name *Diplophryxus* selected to emphasize the close similarity of the females of these two genera. Gender masculine.

*Remarks*: The female of *Allodiplophryxus* differs from all other genera of the Hemiarthrinae in having the combination of two and five pereopods on opposite sides and biramous lateral plates and pleopods. It is highly unusual for fewer than seven pereopods to be present on the concave side; the reduction in their numbers on both sides seems to place *Allodiplophryxus* in a rather advanced place in the subfamily. However, the biramous condition of the pleopodal appendages, a characteristic shared only with *Diplophryxus*, seems rather primitive. The male is almost indistinguishable from those of some species of *Hemiarthrus*. Its large eyes and fully separated head are primitive, but its reduction in numbers of articles of some pereopods appears rather advanced.

Only one species is known, *Allodiplophryxus floridanus*, new species.

### *Allodiplophryxus floridanus*, new species

Figures 45, 46

*Material examined*: HOURGLASS MATERIAL: None. — OTHER MATERIAL: Infesting *Periclimenes longicaudatus* (Stimpson): 1 ♀ (HOLOTYPE, USNM 181666), 1 ♂ (ALLOTYPE, USNM 181667); Florida Power Corporation Survey Station T-30-3, Anclote Harbor, Pasco County, Florida; about 3 m; 4 November 1976; dredge; G. Beardsley et al., colls.; J. C. Markham, det. of host.

*Description*: Holotype female (Figure 45): Length 3.72 mm, maximal width 2.00 mm, head length 0.64 mm, pleon length 0.75 mm. Distortion of body axis 85°. Body greatly elongated, with head closest to posterior end. Both head and pleon distinct (Figure 45A, B).

Head subovate, much longer than wide, deeply embedded in pereon. Small dark eyes near lateral margins. First antennae (Figure 45C) very reduced and of only one segment; second antennae indiscernible. Mouth produced into large oral cone. Maxilliped (Figure 45D) long and narrow, of large anterior segment and small posterior one; no palp or spur present. Posteroventral border (Figure 45E) slightly notched medially and produced into two bluntly pointed lateral projections on each side.

Pereon clearly segmented on concave side, but only posterior margin of pereomere 2 extending beyond midline on dorsal surface. Ventrally, pereomere 2 produced into several fleshy extensions (Figure 45E). First oostegite (Figure 45F) with deeply excavate anterior lobe, simple internal ridge and reduced posterolateral point. First two pereopods (Figure 45G, H) of each side rather well developed; on convex side, third pereopod (Figure 45I) represented by only scarlike basis at farthest extension of brood pouch, other pereopods absent; on concave side, pereopods 3-5 tiny and clustered together, pereopods 6 and 7 absent.


Figure 45. *Allodiplophryxus floridanus*, n. gen., n. sp., holotype ♀, USNM 181666. A. Dorsal view. B. Ventral view. C. First antennae. D. Right maxilliped, internal view. E. Left posteroventral border of head and adjacent perconal region. F. Right oostegite 1, internal view. G. Right pereopod 1. H. Right pereopod 2. I. Basis of left pereopod 3. J. Pleotelson, dorsal view. Scale 1.1 mm for A, B; 0.6 mm for E, I; 0.4 mm for D, F; 0.2 mm for C, G, H, J.

Pleon of five pleomeres and extending somewhat out from pereon. First four pleomeres developed into stubby, biramous lateral plates and bearing similar biramous pleopods almost completely obscuring ventral surface. Final pleomere (Figure 45J) subrectangular, broadest somewhat behind anterior margin, slightly indented posteriorly, lacking appendages.

Allotype male (Figure 46): Length 0.65 mm, maximal width 0.17 mm, head length 0.11 mm, pleon length 0.21 mm. All body regions and segments clearly separated (Figure 46A, B).

Head nearly oval, much wider than long, extending far out, nearly as broad as pereon. Prominent, irregularly shaped eyes in posterior half. First antenna of three articles, second of two, both sparsely setose (Figure 46C, D).

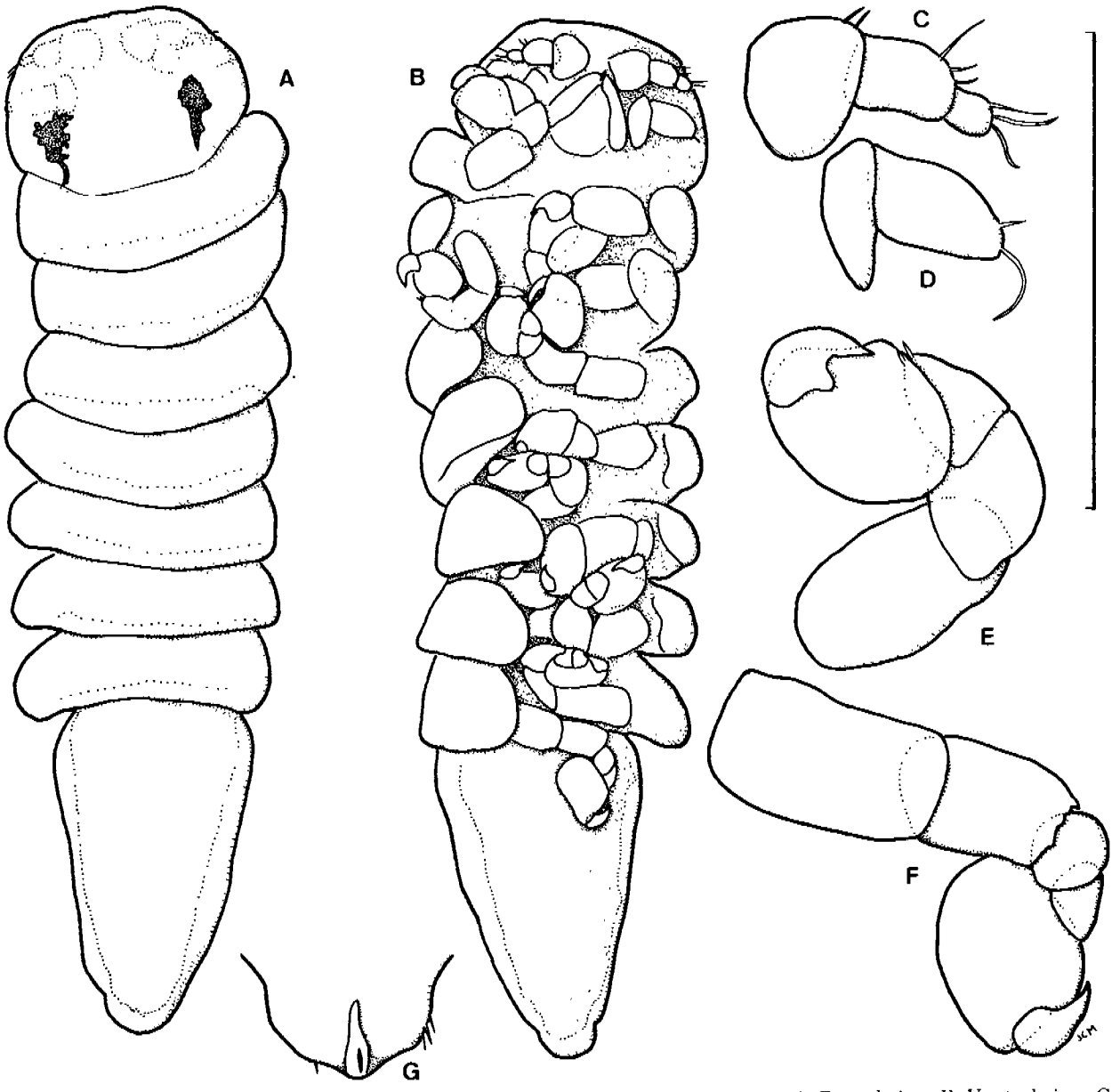


Figure 46. *Allodiplophryxus floridanus*, n. gen., n. sp., allotype ♂, USNM 181667. A. Dorsal view. B. Ventral view. C. Left antenna 1. D. Left antenna 2. E. Right pereopod 1. F. Right pereopod 7. G. End of pleon, ventral view. Scale 0.3 mm for A, B; 0.1 mm for C-G.

Pereon with some pereomeral margins curled ventrally, leaving sides with irregular outlines but roughly parallel. Pereopods (Figure 46E, F) all small and about equally developed; those of first two pairs with meri and carpi fused; other pereopods with all articles separate.

Pleon slightly narrower than last pereomere, nearly in shape of isoceles triangle, tapering toward rather sharp point. Distal end (Figure 46G) with sparse setae on each side and small medial anal cone.

*Distribution*: Presently known only from the type-locality, Anclote Harbor, Florida.

*Etymology*: The specific name, *floridanus*, refers to the type-locality on the west coast of Florida.

*Remarks*: The characters which distinguish *Allodiplophryxus floridanus* are those cited under the discussion of the genus *Allodiplophryxus*. Although *Periclimenes longicaudatus* has been previously recorded as the host of *Schizobopyrina urocaridis* (discussed above), this is the first record of its infestation by an abdominal parasite.

## *Eophrixus* Caroli, 1930

*Diagnosis*: Female: Body slightly to greatly distorted (20° to 80°). First oostegite on concave side produced into prominent posterolateral point; all seven pairs of pereopods fully developed and of nearly same size. Pleon well extended, of five pleomeres; first four pleomeres each bearing prominent oval lateral plates on each side. Four pairs of biramous pleopods (fourth pleopods uniramous in *E. subcaudalis*); endopodites smaller than exopodites; uropods usually present, never large. Male: Considerably longer than wide. Head fused with first pereomere; antennae often extending prominently; pleon usually pointed. Infesting alpheids, palaemonids, and hippolytids.

*Type-species*: By monotypy, *Phrixus* (*Eophrixus*) *lysmatae* Caroli, 1930. Gender masculine.

*Remarks*: Caroli (1930) established *Eophrixus* as a subgenus of *Phryxus* (which he emended to *Phrixus*), to include those species whose females bear seven pereopods on the convex side. He did not designate a type-species but listed three new species as examples. Only one of those, *Phrixus lysmatae*, was described, the others remaining nomina nuda; *P. lysmatae* becomes the type-species by monotypy. Nierstrasz and Brender à Brandis (1931) quickly raised *Eophrixus* to generic status. Later, Caroli (1949) incorporated *Hypophryxus* Shiino, 1934, into *Eophrixus*. Although Codreanu and Codreanu (1956) in turn incorporated *Eophrixus*, including *Hypophryxus*, into *Anisarthrus* Giard, 1907, that synonymy seems unacceptable. *Phryxus subcaudalis* Hay, 1917, which Caroli (1930) assigned to the subgenus *Paraphrixus* on the basis of an erroneous original description, is herein reassigned to *Eophrixus*.

The seven species of *Eophrixus* now known are distributed from North Carolina to Venezuela (including the Gulf of Mexico), Japan, and Italy. Only one species is known in the western Atlantic, *Eophrixus subcaudalis* (Hay).

## *Eophrixus subcaudalis* (Hay, 1917), new combination

Figures 47-51

*Phryxus subcaudalis* Hay, 1917, pp. 569, 570, 572, pl. 98, figs. 1-6 [in part; type-locality off coast of North Carolina; infesting *Synalpheus longicarpus* (Herrick)]; Hay and Shore, 1918, p. 383; Pearse, 1950, p. 43; Williams, 1965, p. 64 [considered common in Carolinas; infesting *S. longicarpus*].

*Hemiarthrus subcaudalis*: Chopra, 1923, pp. 419, 429, 433, 435, 436, 439, 440; Schultz, 1969, p. 313, fig. 497; Kelley, 1978, p. 169.

*Phrixus* (*Paraphrixus*) *subcaudalis*: Caroli, 1930, pp. 259-263.

*Paraphrixus subcaudalis*: Nierstrasz and Brender à Brandis, 1931, p. 205; Westinga and Hoetjes, 1981, p. 141, tab. 1 [Bonaire and Curaçao; infesting unspecified alpheids].

?*Hemiarthrus schmitti* Pearse, 1932a, p. 4, figs. 16, 17, 19-21 [in part; among type-material of *Hemiarthrus schmitti* Pearse; Tortugas, Florida; infesting *Synalpheus brooksi* Coutière]; Schultz, 1969, fig. 499b.

"Abdominal bopyrid": Chace, 1972, p. 92 [Mujeres Island, Quintana Roo, Mexico, infesting *Synalpheus brooksi* Coutière].

"Bopyrid isopods": Hoetjes et al., 1976, p. 33 [in part; Curaçao; infesting unidentified alpheid].

*Material examined*: Infesting *Synalpheus brooksi* Coutière: HOURGLASS STATION K: 1 ♀; 13 January 1966; trawl; FSBC I 28353. — OTHER MATERIAL: 1 ♀, 1 ♂; in *Spheciospongia vesparia* (Lamarck), in shallow water, Soldier Key, Biscayne Bay, Florida; 25 April 1970; J. C. Markham, coll; UMML. — 1 ♀ (called PARATYPE of *Hemiarthrus schmitti* Pearse); in *S. vesparia*, Dry Tortugas, Florida; 27 June 1931; A. S. Pearse, coll. and det. of host; USNM 149399. — 1 ♀; Smithsonian-Bredin Expedition Station 28-60, Mujeres Island, Quintana Roo, Mexico; 31 March 1960; F. A. Chace, Jr., det. of host; USNM 128462. — 3 ♀; Smithsonian-Bredin Expedition Stations 47-60 and 48-60, north end of Cozumel Island, Quintana Roo, Mexico; 8 April 1960; F. A. Chace, Jr., det. of host; USNM 128463 to 128465.

Infesting *Synalpheus goodei* Coutière: HOURGLASS STATION M: 1 ♀, 1 ♂; 5 September 1966; dredge; FSBC I 23886.

Infesting *Synalpheus hemphilli* Coutière: HOURGLASS MATERIAL: None. — OTHER MATERIAL: 1 ♀; Trou Baquente, Golfe de la Gonâve, Haiti; September 1961; R. Cornet, coll.; F. A. Chace, Jr., det. of host; USNM.

Infesting *Synalpheus longicarpus* (Herrick): HOURGLASS STATION C: 1 ♀, 1 ♂ (variant ♂); 18 June 1966; trawl; FSBC I 23882. — 4 ♀, 4 ♂; 8 September 1966; trawl; FSBC I 23883. — HOURGLASS STATION K: 1 ♀, 1 ♂; 13 January 1966; trawl; FSBC I 23880. — 1 ♀, 1 ♂; 22 July 1966; trawl; FSBC I 23884. — OTHER MATERIAL: 1 ♀ (HOLOTYPE of *Phryxus subcaudalis* Hay), 9 ♀, 4 ♂ (PARATYPES); U. S. Fisheries steamer *Fish Hawk* Station 8293, in unnamed sponge 20 miles off Beaufort Inlet, Onslow Bay, North Carolina; August 1915; W. P. Hay, coll. and det. of hosts; USNM 48371 and 48368. — 1 ♀; Los Roques, Venezuela; November 1950; F. A. Chace, Jr., det. of host; USNM 149305.

Infesting *Synalpheus mcclendoni* Coutière: HOURGLASS MATERIAL: None. — OTHER MATERIAL: 3 ♀, 2 ♂ (including variants illustrated); in unidentified sponge, Tortugas shrimp grounds, about 80 km west of Key West, Florida; 24-30 m; 14-15 April 1971; J. C. Markham, coll.; J. García-Gómez, det. of hosts; USNM.

Infesting *Synalpheus pandionis* Coutière: HOURGLASS STATION B: 1 ♀; 20 May 1967; dredge; FSBC I 23881. — HOURGLASS STATION L: 2 ♀; 5 September 1966; dredge; FSBC I 23885, 28606.

Infesting *Synalpheus pectiniger* Coutière: HOURGLASS MATERIAL: None. — OTHER MATERIAL: 1 ♀, 1 ♂ (reference specimens); University of Miami R/V *John Elliott Pillsbury* Station P-1283, off Enriquillo, Dominican Republic, 17°35'N, 71°25'W; 18-25 m; 19 July 1970; UMML.

Infesting *Synalpheus* spp. indet.: HOURGLASS MATERIAL: None. — OTHER MATERIAL: 3 ♀, 2 ♂; in *Spheciospongia*, Pelican Cay, Haiti; March 1961; R. Cornet, coll.; USNM. —3 ♀, 1 ♂; in *Spheciospongia*, Mer Frapée, Golfe de la Gonâve, Haiti; May 1960; R. Cornet, coll.; USNM 181668. — 6 ♀, 2 ♂; same locality; March 1961; R. Cornet, coll.; USNM 181668. — 1 ♀; among oysters, same locality; R. Cornet, coll.; May 1964; USNM. — 6 ♀, 3 ♂; from unrecorded specific locality, Haiti; R. Cornet, coll.; unassigned. — 21 ♀, 21 ♂; in *S. vesparia*, St. Michielsbaai, Curaçao; 3 m; 13 April 1976; E. Westinga and P. Hoetjes, colls. and dets. of hosts; ZMA. — 1 ♀, 1 ♂; Belize-80, diving station 32, offshore from Belize, 16°48.2'N, 88°04.5'W; 15 m; 2 April 1980; G. Hendler, coll.; USNM.

Separated from hosts: HOURGLASS STATION C: 1 ♀, 1 ♂; 8 September 1966; trawl; FSBC I 23887. HOURGLASS STATION M: 1 ♂; 13 November 1966; dredge; FSBC I 23888. — OTHER MATERIAL: 3 ♀, 4 ♂; from unrecorded specific locality, Haiti; R. Cornet, coll.; unassigned.

*Description*: Reference female (Figure 47): Length 5.8 mm, maximal width 4.0 mm, head length 1.0 mm, pleon length 1.3 mm, distortion of body axis 80° (Figure 47A, B).

Head deeply set into pereon. Antennae (Figure 47C) prominent, first one of three articles, second of five articles, both antennae bearing some setae distally. No eyes. Posteroventral border of head with single, rather short, lateral projection on each side.

Pereon greatly distended, with most pereomeres defined only on concave side. Oostegite 1 (Figure 47D) rather elongate and truncate anteriorly, with unadorned internal ridge, narrow posterolateral point. All seven pairs of pereopods nearly alike in size and shape (Figure 47E, F); on concave side, pereopods 1 and 2 near head, pereopod 3 on opposite side of brood pouch, pereopods 4, 5 near posterolateral border of brood pouch, pereopods 6, 7 at posterior edge of brood pouch and extending over to other side of body.

Pleon elongate and prominent, of five pleomeres. First four pleomeres produced into conspicuous suboval lateral plates extending far to sides and progressively smaller posteriorly.

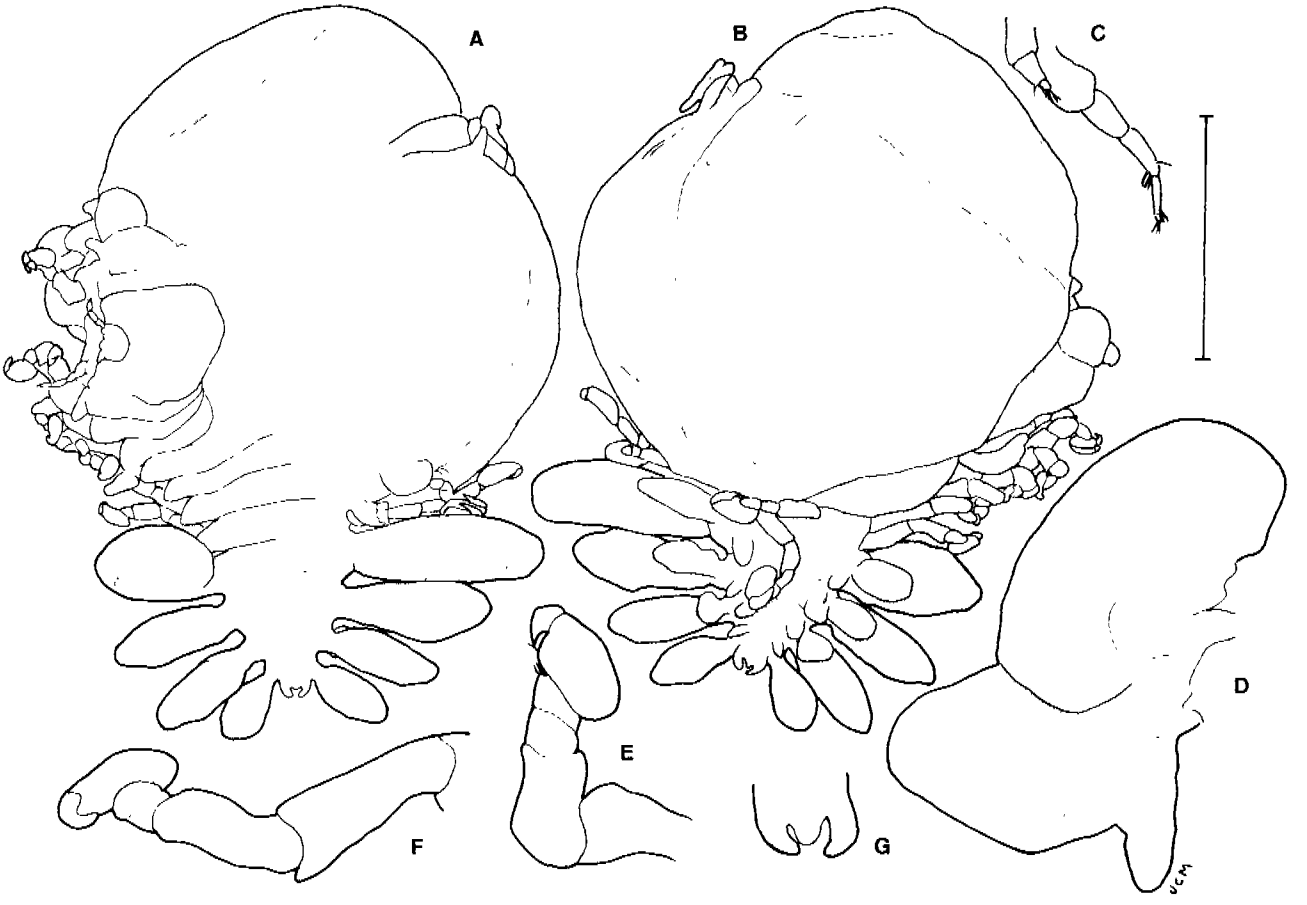


Figure 47. *Eophrixus subcaudalis* (Hay), reference ♀, UMML uncatalogued. A. Dorsal view. B. Ventral view. C. Left antennae. D. Left oostegite 1, internal view. E. Right pereopod 1. F. Left pereopod 7. G. Fifth pleomere. Scale 2.0 mm for A, B; 0.5 mm for C, E-G; 1.0 mm for D.

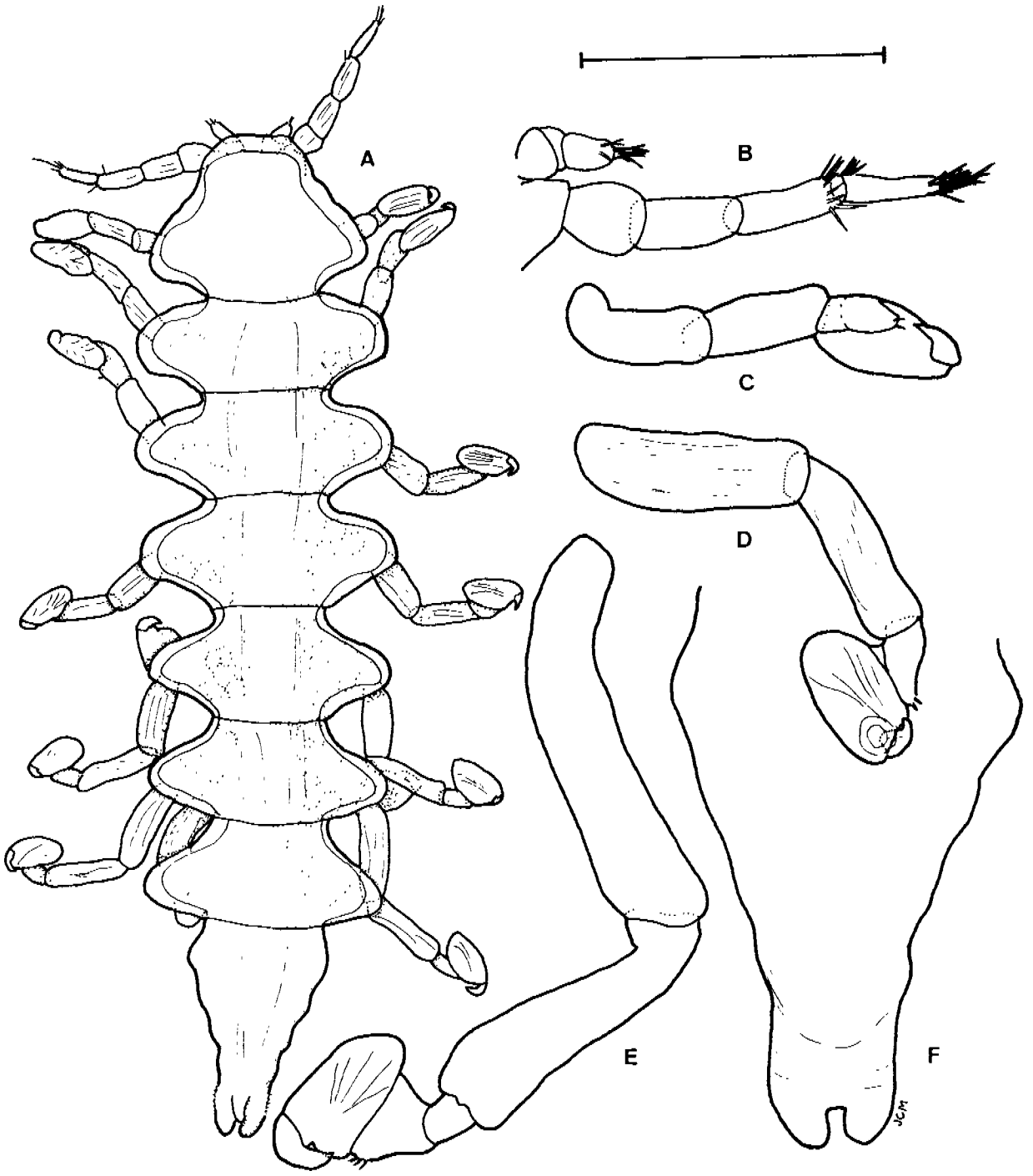


Figure 48. *Eophrixus subcaudalis* (Hay), reference ♂, UMML uncatalogued. A. Dorsal view. B. Right antennae. C. Right pereopod 1. D. Left pereopod 5. E. Left pereopod 7. F. Pleon, ventral view. Scale 1.0 mm for A; 0.5 mm for B-F.

First three pleopods biramous, fourth uniramous, evidently lacking exopodites; exopodites resembling lateral plates but much smaller, endopodites in form of small bumps. Terminal pleomere bearing pair of reduced, flaplike uropods surrounding central anal cone (Figure 47G).

Reference male (Figure 48): Length 3.3 mm, maximal width 0.8 mm, pleon length 0.7 mm. Sides of body nearly parallel (Figure 48A).


Figure 49. *Eophrixus subcaudalis* (Hay), variant ♀, USNM uncatalogued. A. Dorsal view. B. Maxillipeds and ventral surface of pereomere 2. C. Left posteroventral border of head. D. Right oostegite 1, internal view. E. Left oostegite 1, internal view. F. Pereopods and pleon. Scale 1.0 mm.

Head completely fused with first pereomere. Antennae (Figure 48B) very prominent, first of four articles, second of six articles, both antennae bearing several setae distally. No eyes.

Pereomeres deeply separated laterally. Pereopods (Figure 48C-E), especially posterior ones, extremely elongate and extending far to sides.

Pleon narrow and extended (Figure 48A, E), showing slight lateral and dorsal indications of five former pleomeres; posterior border produced into two points separated dorsally by anal cone.

*Variations*: Some of the females diverge considerably from the above description, even among some key characters. At the extreme, they are proportionately much broader and less distorted,

thus approaching *Dicropleon*, discussed below. Their heads are proportionately larger. Some of the pereopods on the convex side are often clustered far posteriorly. The fourth pleomere is occasionally reduced, and all pleopods may be uniramous and oval (Figure 49). Among males, there is also considerable variation. An extreme case has the pereopods reduced, with all meri and carpi fused, at least in part, and the pleon nearly square except for two terminal lobes slightly extending posteriorly and divided by a deep cleft (Figure 50); another male (Figure 51) has the head and first pereomere nearly semielliptical in outline, very setose antennae, undulate pleonal margins and posterior extensions which may be construed as uropods, an anomaly contrary to the subfamilial diagnosis.

At first these variations seemed unquestionable grounds for establishing a new genus to contain a new species. Examination of the material from Haiti, however, revealed that between the extremes there is a nearly continuous gradation in almost all characters. Because it occasionally proved difficult to assign specimens to one species or the other, it finally became evident that only one highly variable species was present.

*Distribution*: North Carolina; southern and western Florida; Yucatán; Belize; Hispaniola; and Curaçao.

*Remarks*: In his original description of this species, Hay (1917) stated that the female had only five pereopods on the convex side. On the basis of that report, Caroli (1930) assigned the species to his new subgenus *Paraphrixus*, which Nierstrasz and Brender à Brandis (1931) then raised to generic rank. Nearly all the females examined, including the holotype, have seven pereopods on the convex side, while a single female has six such pereopods. On the basis of the pereopod number and the pleonal appendages, this species clearly belongs to *Eophrixus*, to which it is being reassigned. The head of the male is fused with the first pereomere, as with all other *Eophrixus* males. The frequently elongate pereopods and strangely split pleon are distinctive, but they do not necessarily exclude the male from *Eophrixus*.

Hay (1917) did not designate an allotype male, but he examined four males which he included among his paratypes. His description of the males was extremely brief, including mention of the long pereopods and the split pleon; the only illustration was a photograph of three males. In his discussion, he mentioned a fourth male which, because of its very different characters, he considered as possibly being immature or "accessary." In reality, that male belongs to *Azygopleon schmitti* (Pearse), discussed below, eight females of which were also among Hay's paratypes. Also among those paratypes were two females of *Hemiarthrus synalphei* (Pearse), discussed below.

Even though Hay (1917) had a rather large sample for the original description of this species, no further specimens had been reported until now. All of the geographical records outside of North Carolina and the other six host records are new.

There appears to be no predominance of either dextral or sinistral forms in *Eophrixus subcaudalis*.

A regression plot of the lengths of 17 females (from 2.10 to 5.50 mm) on the carapace lengths of their respective hosts (from 3.68 to 7.33 mm) produced the equation, female length = 0.88 × host length + 2.46 mm. The correlation coefficient is 0.81.

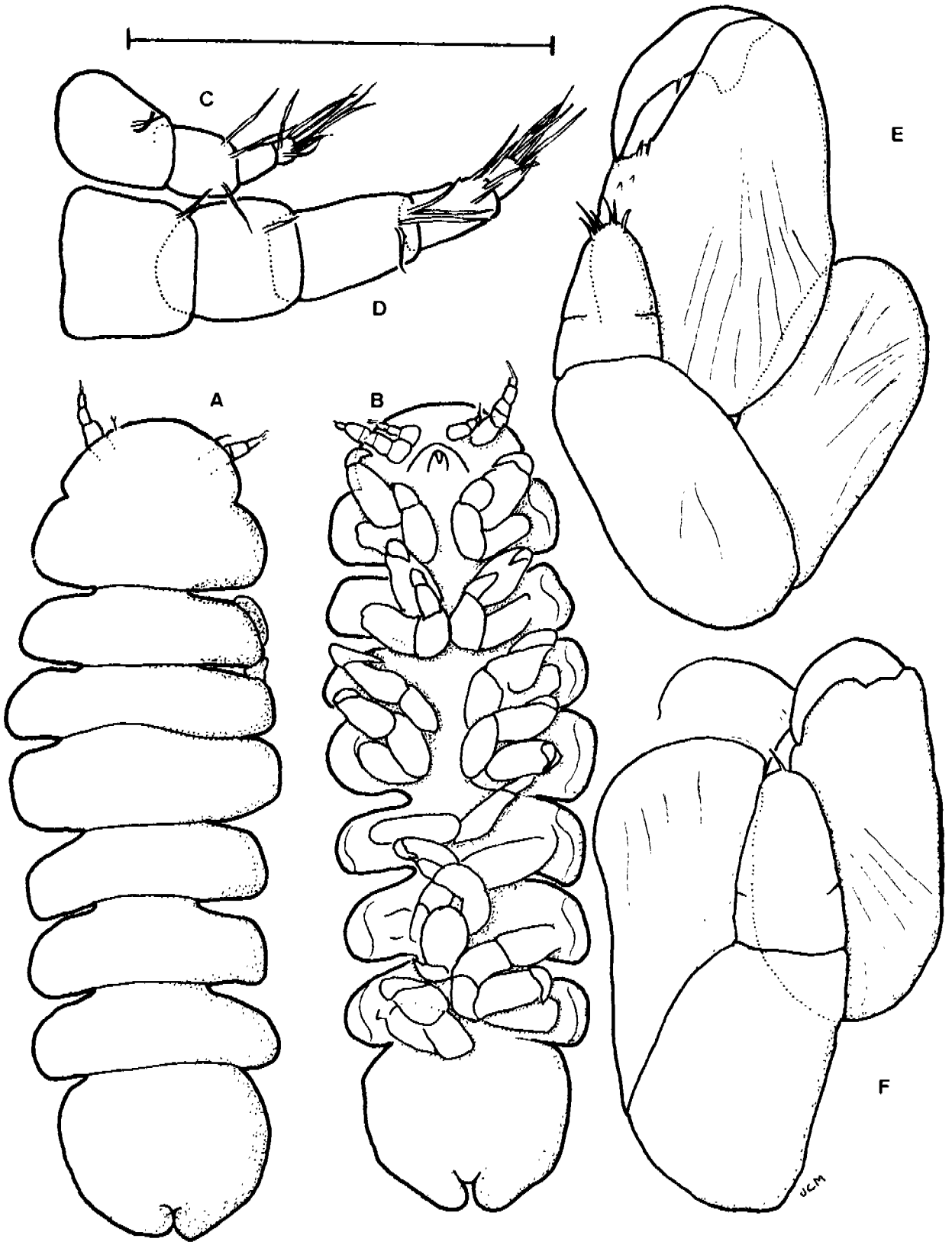


Figure 50. *Eophrixus subcaudalis* (Hay), variant ♂, USNM uncatalogued. A. Dorsal view. B. Ventral view. C. Left antenna 1. D. Left antenna 2. E. Left pereopod 1. F. Right pereopod 7. Scale 1.0 mm for A, B; 0.2 mm for C-F.

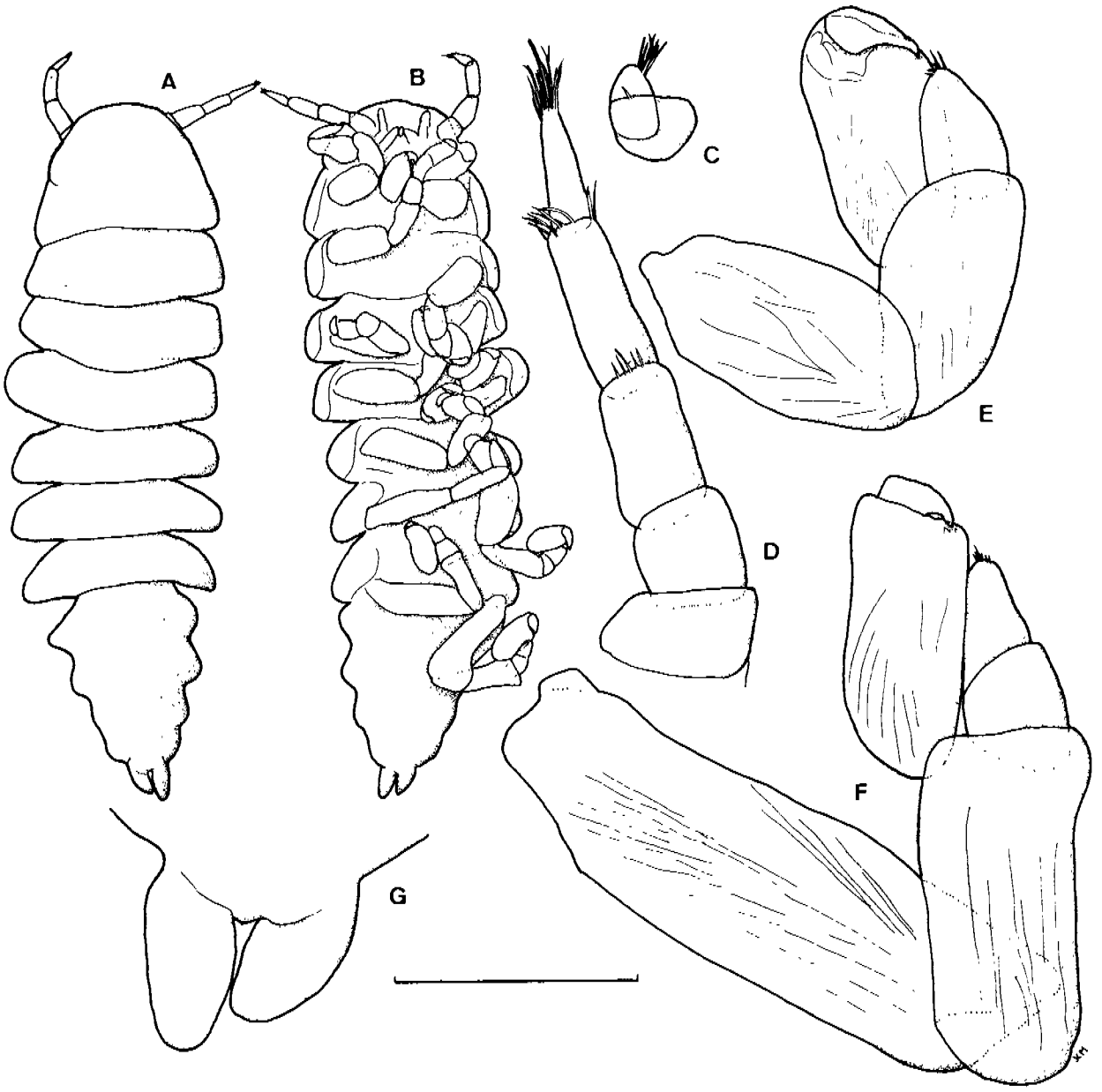


Figure 51. *Eophrixus subcaudalis* (Hay), variant ♂, FSBC I 23882. A. Dorsal view. B. Ventral view. C. Right antenna 1. D. Right antenna 2. E. Right pereopod 1. F. Right pereopod 7. G. End of pleon, ventral view. Scale 1.0 mm for A, B; 0.2 mm for C-G.

## *Loki* Markham, 1972

*Diagnosis*: Female: Body only moderately distorted (about 45°). Head deeply embedded in pereon. Pereomeres poorly defined; all seven pairs of pereopods present and well developed; first two pereopods on both sides extending beyond head, and final four clustered near pleon; third pereopod on convex side opposite head, that on concave side adjacent to head. Five pleomeres; lateral plates prominent on pleomeres 1-3, greatly reduced or absent on fourth pleomere; uniramous pleopods on pleomeres 1-3 only; uropods prominent and often divergent. Male: Body less than three times as long as wide; head partly fused with pereon; pleon also

partly fused with pereon and rounded except for anal cone posteriorly. Infesting shrimps in hippolytid genus *Thor*.

*Type-species*: By original designation, *Loki circumsaltanus* Markham, 1972. Gender masculine.

*Remarks*: Only one species is known, *Loki circumsaltanus* Markham.

## *Loki circumsaltanus* Markham, 1972

*Metaphixus carolii*: Rouse, 1970, p. 135 [not *Metaphixus carolii* Nierstrasz and Brender à Brandis; southwest Florida, infesting *Thor* spp.]

"Abdominal bopyrid": Chace, 1972, p. 137 [Tortola; infesting *Thor manningi* Chace].

*Loki circumsaltanus* Markham, 1972, pp. 42-49, 55, figs. 1-7, tab. 1 [type-locality Biscayne Bay to Card Sound, Florida; infesting *Thor floridanus* Kingsley].

*Material examined*: HOURGLASS MATERIAL: None. — OTHER MATERIAL: Infesting *Thor floridanus* Kingsley: 28 ♀; Everglades National Park, near Murray Key, Florida Bay, Florida; 17 May 1964; D. C. Tabb, coll. and det. of hosts; USNM 150535. — 45 ♀, 2 ♂; same locality; 17 June 1964; W. L. Rouse, coll. and det. of hosts; UMML 32: 5377. — 2 ♀; same locality; 2 July 1964; W. L. Rouse, coll. and det. of hosts; UMML. — 7 ♀, 1 ♂; same locality; dates unknown (probably 1964); UMML. — 1 ♀, 1 ♂; Joe Kemp Channel, southeast of Flamingo, Florida; 17 June 1964; W. L. Rouse, coll. and det. of host; UMML.

Infesting *Thor manningi* Chace: 1 ♀; Smithsonian-Bredin Expedition Station 23-58, on flats near mangroves at head of bay, Sopers Hole, West End, Tortola, Virgin Islands; 0.5 m; 31 March 1958; F. A. Chace, Jr., det. of host; USNM 143679.

Separated from host: 1 ♀, 1 ♂; *Alpha Helix* cruise MS-60-500, south of Turneffe Island, Belize, 17°10.0'N, 87°56.1'W; 20 m; epibenthic sled; 15 July 1977; USNM.

*Diagnosis*: As for genus.

*Description*: See Markham, 1972.

*Distribution*: Southern Florida; Belize; and Tortola, Virgin Islands.

*Remarks*: Of 132 females examined (84 listed above plus 48 from the type-series), 58 were dextral and 74 sinistral, a deviation from an expected 1:1 ratio which is not statistically significant. Lateral plates are absent from both sides of the fourth pleomere in 51 females, present but reduced on both sides in 60 females, and present on only one side (as in the holotype) in 19 females. The condition in the two females with damaged pleons is uncertain. Among males examined, most lack the pleonal setae present in the allotype but otherwise conform with it well.

Rouse (1970) reported a parasite of *Thor* spp. from southern Florida, which he identified as *Metaphrixus carolii* Nierstrasz and Brender à Brandis, discussed below. Examination of his material shows that he had a mixture of *M. carolii*, evidently from *Hippolyte pleuracanthus*, and

*Loki circumsaltanus*, evidently from *Thor floridanus*. Chace (1972) reported an unidentified abdominal parasite of *Thor manningi* at Tortola, which proved to belong to *L. circumsaltanus*. The hosts collected in Florida are all definitely or probably assignable to *Thor floridanus*, although Chace (1972) also reports three other species of *Thor* from there.

The allotype male was attached to a pleopod of the host rather than to the female, an unusual condition for bopyrids. This was the only male found so attached. However, because only 16 of the 132 females examined were accompanied by males, this may be a common situation for this species, with the result that males are frequently lost in collecting.

## *Dicropleon* Markham, 1972

*Diagnosis*: Female: Body axis only moderately distorted. First two pairs of pereopods anterior to head, those of convex side slightly larger than pereopods 1 and 2 of concave side; pereopod 3 of convex side on margin of brood pouch opposite head, very reduced but complete; pereopods 4-7 of convex side absent; pereopods 3-7 of concave side fully developed but smaller than anterior two and lined up close together. Pleon of five pleomeres, first four with large, uniramous lateral plates, terminal one cleft posteriorly; four pairs of pleopods, first three with minute endopodites or none. Uropods absent. Male: Head and pleon partly fused medially with pereon. Pleon triangular, with slit end.

*Type-species*: By original designation, *Dicropleon periclimenis* Markham, 1972. Gender masculine.

*Remarks*: The genus *Dicropleon* has recently been enlarged to four species with the description of a new species and the reassignment of a previously described species, both of which occur in the Indian Ocean (Markham, 1980), and the description of a new species from Hong Kong (Markham, 1982). Because the four species are known from a total of only eight specimens (the only males known being the allotypes of *D. periclimenis* and *D. morator* Markham, 1982), some of the characters cited for *Dicropleon* may be more variable than they so far appear. The known distribution of *Dicropleon* is St. Lucia, West Indies; Kilihari, Gulf of Manaar; Malé Atoll, Maldives; and Hong Kong. Three of the hosts are in the palaemonid genus *Periclimenes*, the fourth in the processid genus *Processa*.

Only one species is known from the western Atlantic, *Dicropleon periclimenis* Markham.

## *Dicropleon periclimenis* Markham, 1972

"Abdominal bopyrid parasite": Chace, 1972, p. 31 [St. Lucia; infesting *Periclimenes americanus* (Kingsley)].

*Dicropleon periclimenis* Markham, 1972, pp. 49-55, tab. II, figs. 8-10 [type-locality St. Lucia; infesting *Periclimenes americanus* (Kingsley)]; 1980, p. 632 [discussion]; 1982, pp. 381-384.

*Material examined*: None.

*Diagnosis*: Female: As for genus except: each tiny first antenna extending over large basal segment of adjacent second antenna; endopodites of pleopods present but very reduced; uropods absent. Male: As for genus.

*Description*: See Markham, 1972.

*Distribution*: Known only from the type-locality, St. Lucia.

*Remarks*: Chace (1972) originally recorded the type-specimens of *Dicropleon periclimenis*. He also listed another parasitized individual of the host species, *Periclimenes americanus*, collected during the Smithsonian-Bredin Expeditions at Antigua, but a search at the Smithsonian Institution failed to turn up that individual, so its parasite remains unknown. The type-specimens thus remain the only ones recorded for *Dicropleon periclimenis*.

## *Hyperphrixus* Nierstrasz and Brender à Brandis, 1931

*Diagnosis*: Female: Body axis distorted more than 90°, outline subcircular. Head deeply set into pereon but not bisecting any pereomeres; seven pereopods on concave side, either clustered near head or evenly spaced between head and pleon; one or two pereopods on convex side. Five pleomeres, first four bearing well-developed, lanceolate, uniramous lateral plates and biramous pleopods; no uropods. Male: Body more than three times as long as broad. Head and pereon completely separate. Sides of pereon subparallel; all pereomeres distinct but not deeply separated laterally. Pleon swollen, without traces of segmentation or appendages. Parasites of shrimps in palaemonid subfamily Pontoniinae.

*Type-species*: By monotypy, *Hyperphrixus tattersalli* Nierstrasz and Brender à Brandis, 1931. Gender masculine.

*Remarks*: Only one species is known in the western Atlantic, *Hyperphrixus castrensis*, new species.

## *Hyperphrixus castrensis*, new species

Figures 52, 53

*Material examined*: Infesting *Periclimenes perryae* Chace: HOURGLASS STATION C: 1 ♀ (HOLOTYPE, USNM 181553), 1 ♂ (ALLOTYPE, USNM 181554); 8 October 1966; trawl.

*Description*: Holotype female (Figure 52): Length 2.58 mm, maximal width 2.20 mm, head length 0.47 mm, pleon length 0.33 mm; body axis distortion 110°. Body outline rather evenly rounded, only pleon extending beyond it (Figure 52A, B).

Head oblong, much longer than wide, deeply set into pereon. Antennae very reduced and difficult to discern. Structure of maxilliped also indiscernible. Posteroventral border (Figure 52C) produced into two tapering points on each side.

Segmentation of pereon very incomplete, only first pereomere fully defined and nearly surrounding head. Pereopods (Figure 52D) of concave side clustered together in line from head to pleon, first six regularly diminishing in size posteriorly, seventh one markedly smaller than others; on convex side, only two pereopods, of which second possibly incomplete. Brood pouch extending beyond head. First oostegite (Figure 52E, F) concealed by others, somewhat concave internally, with short, recurved internal ridge and slender, spatulate posterolateral projection.

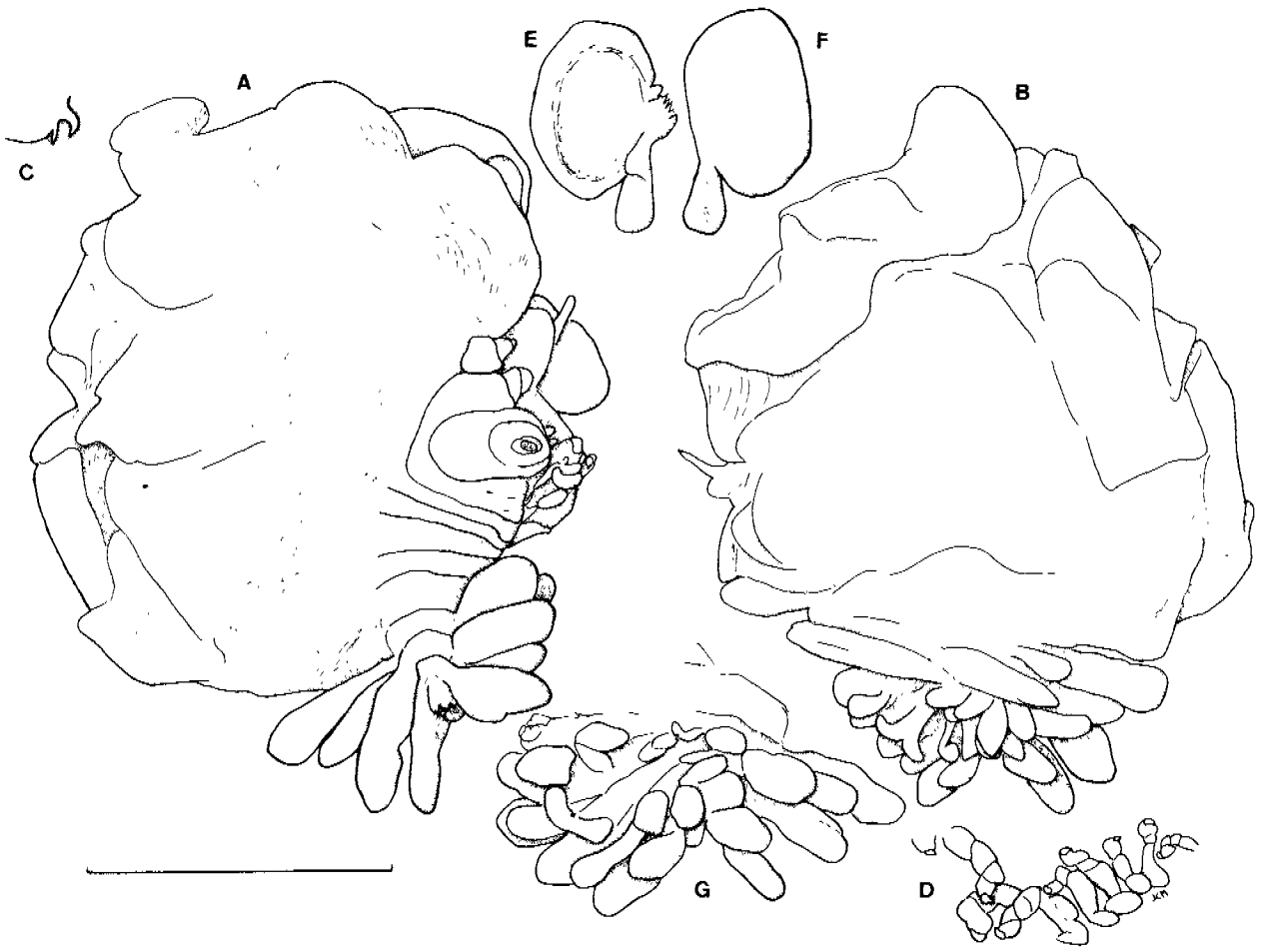


Figure 52. *Hyperphrixus castrensis*, n. sp., holotype ♀, USNM 181553. A. Dorsal view. B. Ventral view. C. Left posteroventral border of head. D. Pereopods. E. Left oostegite 1, internal view. F. Same, external view. G. Pleon, ventral view. Scale 1.2 mm for A-C; 1.0 mm for D-G.

Pleon of five pleomeres, of which some not completely separated. First four pleomeres produced into lanceolate lateral plates, those on convex side extending somewhat farther from body. First four pleomeres (Figure 52G) bearing biramous pleopods, their rami also mostly lanceolate and similar to but smaller than lateral plates. Terminal pleomere small, almost completely surrounded by preceding one, lacking uropods but with posterior margin three-pointed.

Allotype male (Figure 53): Length 0.75 mm, maximal width 0.24 mm, head length 0.10 mm, pleon length 0.24 mm. All body regions clearly set apart (Figure 53A).

Head suboval, much wider than long. Pale eyes near posterolateral corners. First antenna of three articles, second of two articles (Figure 53B); only sparse setae on both. Head only slightly narrower than first pereomere.

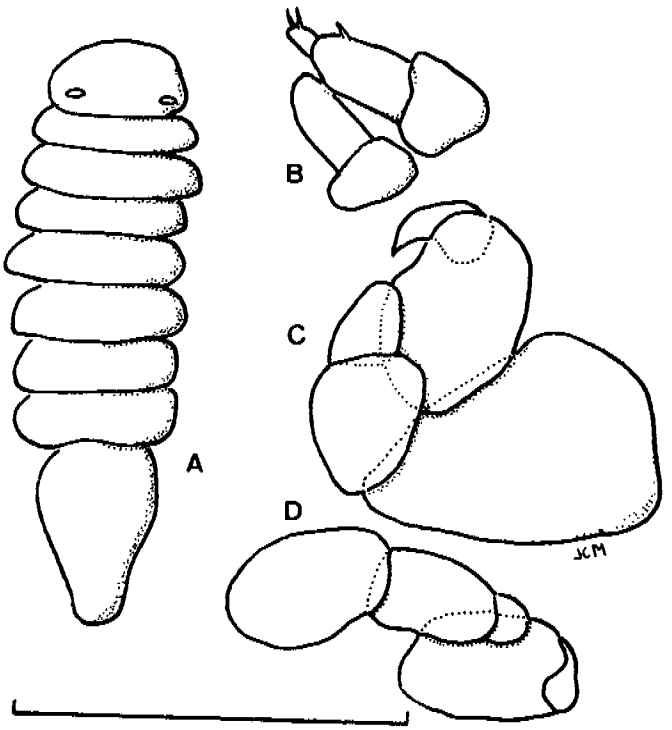


Figure 53. *Hyperphrixus castrensis*, n. sp., allotype ♂, USNM 181554. A. Dorsal view. B. Right antennae. C. Right pereopod 1. D. Left pereopod 7. Scale 0.5 mm for A; 0.1 mm for B-D.

Pereomeres separated laterally but not deeply so; all of nearly same width, so sides of pleon almost parallel. Pereopods (Figure 53C, D) decreasing in size posteriorly; all carpi and meri fused, but other articles distinct.

Pleon fused and without any segmentation indicated. Outline pyriform, nearly truncate posteriorly. No indication of pleopods or uropods.

*Distribution*: Known only from type-locality, Hourglass Station C, Gulf of Mexico, 70 km due west of Egmont Key, Florida, 27°37'N, 83°28'W, 36.6 m on sandy bottom.

*Etymology*: The specific name *castrensis* has been selected to honor David K. Camp, who supervised the curation and dispersal of the material collected by the Hourglass Cruises.

*Remarks*: *Hyperphrixus castrensis* shares many of the characters of the type-species, *H. tattersalli* Nierstrasz and Brender à Brandis, 1931, heretofore the only species known. The female of *H. tattersalli* differs in having only one pereopod on the convex side, the pereopods on the concave side bunched far forward, slightly more complete pereomeres, relatively more slender lateral plates and pleopodal rami, and a broader, more extended final pleomere. The male of *H. tattersalli* has a proportionately longer and more bulbous pleon. Since each species is known from but a single pair, intraspecific variation is unknown.

*Hyperphrixus tattersalli*, collected at Jolo, Sulu Archipelago, Philippines, infested a host identified only as "Pontoniide." On my behalf, Dr. Torben Wolff submitted that host specimen to Dr. A. J. Bruce, who has identified it as *Periclimenaeus* sp., specific identification being impossible because of loss of appendages. It is thus in the same family as the host of *Hyperphrixus castrensis*.

## *Metaphrixus* Nierstrasz and Brender à Brandis, 1931

*Diagnosis*: Female: Body axis greatly distorted, often more than 90°; body outline nearly circular. Eyes present. All seven pereopods on concave side, in orderly row; only first two pereopods on convex side. Five pleomeres; prominent lateral plates and uniramous pleopods on pleomeres 1-4; fifth pleomere conspicuously extended, with or without uropods. Male: Body at least twice as long as wide, posteriorly tapering to rather sharp or rounded point. Antennae conspicuous; eyes large. Sides of pereon nearly parallel; pereopods small and concealed beneath body. Distribution: Florida and Virgin Islands; Zanzibar; Singapore; infesting shrimps of the families Hippolytidae and Palaemonidae.

*Type-species*: By monotypy, *Metaphrixus carolii* Nierstrasz and Brender à Brandis. Gender masculine.

*Remarks*: Three species have been assigned to *Metaphrixus*, but one, *M. bifidus* Bourdon, 1967a, was reassigned to *Dicropleon* by Markham (1980). The two species remaining in *Metaphrixus* are *Metaphrixus carolii* and *M. intutus* Bruce, 1965. *Metaphrixus intutus* is a parasite of two species of the palaemonid genus *Palaemonella* in Zanzibar (Bruce, 1965) and Singapore (Bruce, 1979). It is highly unusual in occurring on the dorsal surface of its host (Bruce, 1965) rather than among its pleopods; morphologically, its placement in *Metaphrixus* is correct.

Only one species is known from the western Atlantic, *Metaphrixus carolii* Nierstrasz and Brender à Brandis.

## *Metaphrixus carolii* Nierstrasz and Brender à Brandis, 1931

Figure 54

*Metaphrixus carolii* Nierstrasz and Brender à Brandis, 1931, pp. 206, 207, figs. 100-102 [type-locality Christiansted, St.Croix, Virgin Islands; host unrecorded]; Bruce, 1965, pp. 385, 389, 390; Rouse, 1970, p. 135 [in part; southwestern Florida; host erroneously reported as *Thor* sp.]; Stromberg, 1971, pp. 2, 7 [near Flamingo, Florida; host not recorded; remarks on development]; Bruce, 1972, p. 450; Markham, 1972, pp. 42, 47, 48, 54, tab. II [southern Florida; infesting *Hippolyte pleuracanthus* (Stimpson)].

*Metaphryxus carolii*: Bourdon, 1967a, pp. 173, 174.

*Metaphryxus*: Bruce, 1973, p. 523.

*Material examined*: HOURGLASS MATERIAL: None. — OTHER MATERIAL: Infesting *Hippolyte pleuracanthus* (Stimpson): 1 ♀, 1 ♂ (reference specimens); Card Sound, Monroe County, Florida; shallow water; 1970?; J. García-Gómez, coll. and det. of host; UMML 32: 5362. — 1 ♀, 1 ♂; same locality; 2 June 1970; J. García-Gómez, coll. and det. of host; UMML 32: 5371. — 1 ♀; near Murray Key, Everglades National Park, Florida; 17 May 1964; D. C. Tabb, coll. and det. of hosts; USNM 150536. — 4 ♀, 2 ♂; same locality; 17 June 1964; W. L. Rouse, coll. and det. of hosts; USNM. — 19 ♀ (4 immature), 10 ♂; Joe Kemp Channel, southeast of Flamingo, Florida; 17 June 1964; W. L. Rouse, coll. and det. of hosts; UMML.

*Description*: Reference female (Figure 54A-H): Length 2.0 mm, maximal width 1.9 mm, head length 0.5 mm, pleon length 0.6 mm. Distortion 92°. Body nearly circular in outline (Figure 54A, B).

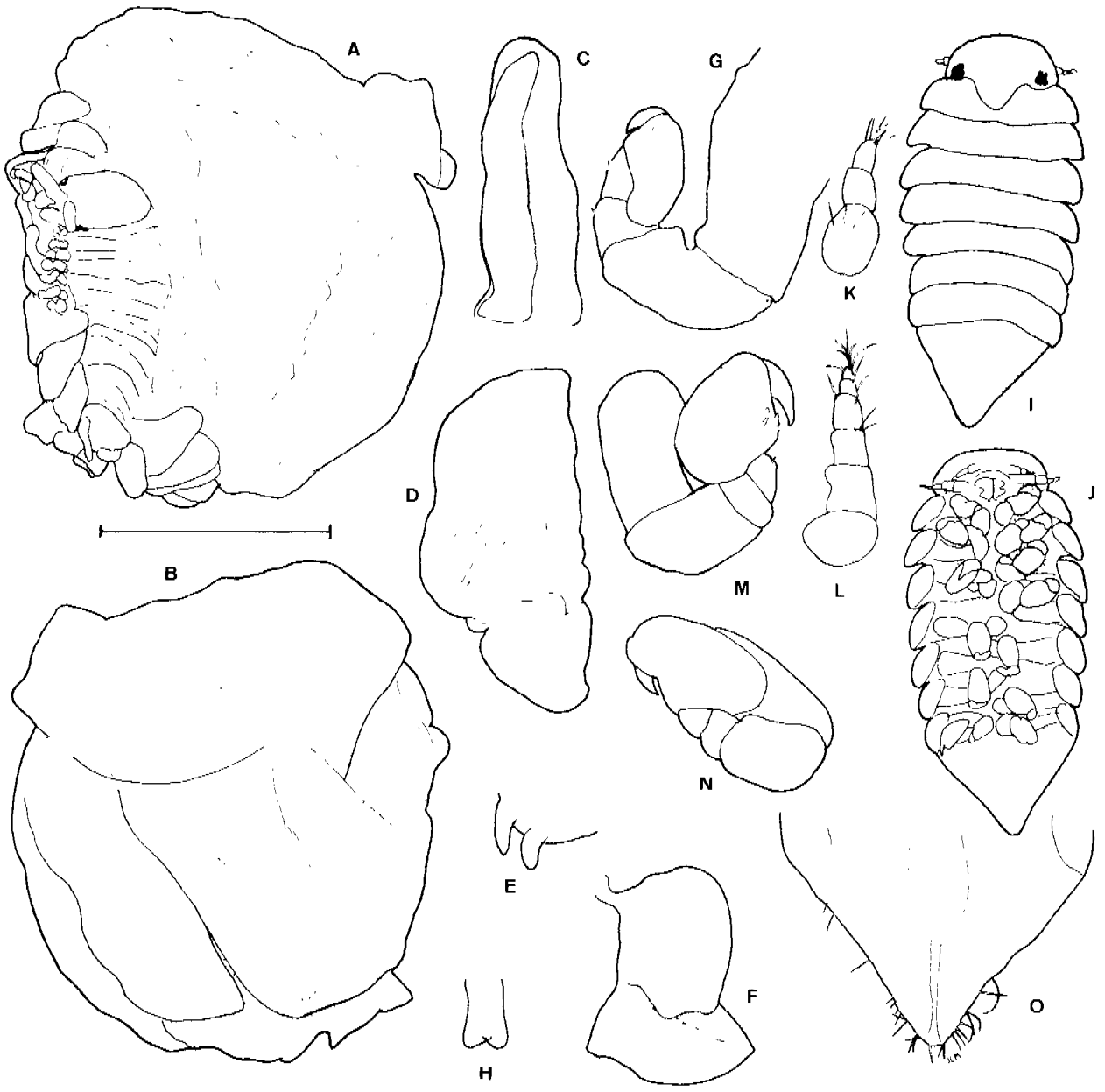


Figure 54. *Metaphrixus carolii* Nierstrasz and Brender à Brandis. A-H, reference ♀; I-O, reference ♂, UMML 32: 5362. A. Dorsal view. B. Ventral view. C. Right antennae. D. Right maxilliped. E. Right posteroventral border of head. F. Right oostegite 1, internal view. G. Right pereopod 1. H. Pleotelson. I. Dorsal view. J. Ventral view. K. Left antenna 1. L. Left antenna 2. M. Right pereopod 1. N. Right pereopod 7. O. Pleon, ventral view. Scale 1.0 mm for A, B, F; 0.2 mm for C, G, O; 0.4 mm for D, E, H-J; 0.1 mm for K-N.

Head nearly rectangular, longer than broad. Antennae (Figure 54C) both extended, unsegmented flaps, first lying on top of second. Prominent eyes on anterolateral corners of head. Maxilliped (Figure 54D) lacking palp. Posteroventral border of head (Figure 54E) with two moderately long, pointed lateral projections on each side.

All pereomeres distinct on concave side and medially but not on convex side. Oostegite 1 (Figure 54F) bearing rather smooth internal ridge and reduced posterolateral point. All seven

pereopods present on concave side but reduced and grouped closely together in comblike row along side of pereon. Convex side bearing pereopods only on first two pereomeres. Pereopods of convex side (Figure 54G) nearly four times as large as those on concave side.

Pleon of five pleomeres, first four bearing uniramous, lanceolate to oval lateral plates and similar uniramous pleopods. Terminal pleomere (Figure 54H) prominently extended, slightly bilobate posteriorly. Uropods absent.

Reference male (Figure 54I-O): Length 0.7 mm, maximal width 0.3 mm, head length 0.1 mm, pleon length 0.2 mm. All body regions distinct dorsally, but last pereomere ventrally fused with pleon; sides of body nearly parallel (Figure 54I, J).

Head abruptly narrower than pereon, extending deeply into pereomere 1 centrally. Conspicuous black eyes near posterior corners. Antennae (Figure 54K, L) prominent, first of three articles, second of six, both antennae bearing numerous setae, especially distally.

Pereon slightly widest across third and fourth pereomeres. All pereomeres widest at posterior borders, lateral margins rounded inward anteriorly. Pereopods (Figure 54M, N) of nearly same size and structure, though dactyli progressively smaller posteriorly.

Pleon (Figure 54O) triangular, lateral and anterior margins of nearly same length. Lateral margins bearing scattered setae.

*Variations*: Of the 26 females examined, 19 lack uropods, as in the reference female, while seven bear uniramous uropods. Eleven of the females are dextral and 15 sinistral, a nonsignificant variation from an expected 1:1 ratio. Among the 14 males, nine match the reference male, while four have the pleon more rounded posteriorly. A single male has the posterior margin of the head straight rather than extended into the first pereomere.

*Distribution*: Southern Florida; St.Croix, Virgin Islands.

*Remarks*: *Metaphrixus carolii* has been reported to infest *Thor* sp. (Rouse, 1970) and *Hippolyte pleuracanthus* (Markham, 1972). The citation of *Thor* sp. by Rouse (1970) evidently arose from confusion with *Loki circumsaltanus* in the same samples. Based on the material examined for the present study, *H. pleuracanthus* may be the only host of *M. carolii*.

### *Hemiarthrus* Giard and Bonnier, 1887

*Diagnosis*: Female: Body axis moderately distorted (about 35° to 60°). Anterior edge of head more or less concave; antennae reduced. First pereomere complete but occasionally covered medially by head; concave side of pereon with seven pereopods, all nearly same size; convex side with only first pereopod. Five pleomeres; lateral plates prominent, lanceolate to oval, on pleomeres 1-4; pleopods uniramous, in four pairs; terminal pleomere tapering to narrow point, lacking uropods. Male: Nearly three times as long as broad. Eyes tiny; head clearly separated from pereon. Sides of pereon nearly parallel; regions between pereomeres deeply indented. Pleon tapering to rounded to acute point. Circumboreal, along all northern coasts; North Carolina to Gulf of Mexico. Infesting hippolytids, pandalids, and *Synalpheus* spp.

*Type-species*: By monotypy, *Bopyrus abdominalis* Krøyer. Gender masculine.

*Remarks*: Giard and Bonnier (1887b: 36, footnote) established the genus *Hemiarthrus* quite incidentally, stating that they were including in it those species of *Phryxus* Rathke which "...différent beaucoup du type *Phryxus*, soit dans le sexe femelle, soit dans le sexe mâle qui a tous les anneaux du pléon libres et munis de membres rudimentaires." The only species which they explicitly included in their new genus was *Phryxus abdominalis* Krøyer, which is the type-species of *Phryxus*. Their action was highly confusing because Giard and Bonnier (1887b) clearly did not regard *Phryxus* Rathke as an unavailable name, even though Agassiz (1848) had presented evidence that it was a junior homonym, as discussed by Markham (1972). Bonnier (1900) later disregarded *Hemiarthrus* and listed several species in *Phryxus*. Giard (1907: 322), acknowledging the preoccupation of *Phryxus*, referred to "...*Phryxus abdominalis* Kröyer dont nous avon fait le type de notre genre *Hemiarthrus*."

Numerous names have been included in *Phryxus* Rathke and several in *Hemiarthrus*. Several of these are nomina nuda or synonyms of others. Many others were removed when the scope of the genus was restricted as Caroli (1930) divided it into several subgenera, which Nierstrasz and Brender à Brandis (1931) promptly raised to generic rank. Of the three species remaining, *Hemiarthrus schmitti* Pearse clearly belongs in a separate genus, created below, and *H. nematocarcini* Stebbing, 1914, which was very poorly described, has proven upon re-examination of the types to belong to yet another new genus; because *H. nematocarcini* occurs only in South Africa, outside the scope of this report, it is not included here. Removal of those two species from *Hemiarthrus* (sensu stricto) leaves only the type-species, *H. abdominalis* (Krøyer) in the genus. However, re-examination of the types of *Diplophryxus synalphei* Pearse indicates that it should properly be transferred to *Hemiarthrus*. *Hemiarthrus* thus contains two species, both found in the western Atlantic.

## KEY TO WESTERN ATLANTIC SPECIES OF *HEMIARTHRUS*, BASED ON MATURE FEMALES

1. Antennae anteriorly placed; pereopods of nearly same size; pleon ending in double point... ..... *Hemiarthrus abdominalis* (Krøyer)

1. Antennae dorsally placed; pereopods smaller posteriorly; pleon ending in single point ..... ..... *Hemiarthrus synalphei* (Pearse)

### *Hemiarthrus abdominalis* (Krøyer, 1840-1841)

Restricted synonymy; only Atlantic records cited. (All host names updated according to information provided in personal communication from L. B. Holthuis):

*Bopyrus abdominalis* (Krøyer, 1840-1841, pp. 102-112, 289-299, pls. I, II [type-locality Greenland (?); infesting *Eualus gaimardii* (Krøyer)]; 1842, p. 263 [Scandinavia; infesting *E. pusiolus* (Krøyer), *Spirontocaris phippsii* (Krøyer)]; Gaimard, 1846, pl. 29, figs. 1a-u; Norman, 1876, p. 209 [west Greenland; infesting *Spirontocaris spinus* (Sowerby)].

*Phryxus Hippolytes* Rathke, 1843, pp. 40-60, pl. II, figs. 1-10 [type-locality coast of Norway; infesting *Hippolyte* sp.]; White, 1857, p. 257 [Sussex, England; infesting *Hippolyte* sp. and "white shrimp"].

*Phryxus abdominalis*: Lilljeborg, 1852, p. 11 [Sweden]; Cornalia and Panceri, 1861, pp. 113, 114; Steenstrup and Lütken, 1862, p. 275 [Denmark]; Bate and Westwood, 1868, pp. 234-237, unnumbered figs. [Sussex; infesting *Pandalus montagui* Leach; Northumberland; infesting *Eualus pusiolus*]; Norman, 1869, p. 288 [Shetlands; infesting *E. pusiolus*]; 1886, p. 13 [North Atlantic]; Meinert, 1877, p. 86 [Øresund, Storebaelt, Lillebaelt; infesting *Crangon allmanni* Kinahan, *Eualus gaimardii*]; Miers, 1877, pp. 56, 65 [east coast Ellsmere Island; infesting *Lebbeus polaris* (Sabine)]; Harger, 1879, pp. 158, 164, 165 [New England north of Cape Cod Bay; infesting *Pandalus* spp., *Hippolyte* spp.]; 1880, pp. 312, 433 [Cape Cod Bay; infesting *Pandalus borealis* Krøyer, *P. montagui*, *Spirontocaris spinus*, *S. lilljeborgii* (Danielssen); Gulf of Maine; infesting *Eualus pusiolus*; Halifax; infesting *E. pusiolus*, *Spirontocaris spinus*, *S. lilljeborgii*]; Smith, 1884a, p. 222 [ Labrador; infesting *Eualus gaimardii*]; 1884b, p. 230; Verrill, 1885, p. 560 [off New England, 177-642 m; infesting *Dichelopandalus leptocerus* (Smith)]; Hansen, 1887, pp. 196, 197 [west Greenland; infesting *Hippolyte* spp., *Pandalus montagui*]; Ohlin, 1895, pp. 18, 19 [Baffin Bay and Smith Sound; infesting *Spirontocaris phippsii*, *Lebbeus polaris*]; Sars, 1898, pp. 212, 215-217, 219, 220, pls. 90, 91 [coast of Norway; infesting *Spirontocaris* spp. and *Pandalus* spp.]; Scott, 1901, pp. 336, 337 [Clyde Sea; infesting *Spirontocaris spinus*]; Whiteaves, 1901, p. 236 [Belle Island Strait, Nova Scotia; infesting *Lebbeus polaris*]; Rathbun, 1905, p. 48 [Maine and Massachusetts]; Richardson, 1905a, pp. 500-503, figs. 550-552 [summary of accounts]; Grieg, 1909, p. 553 [east coast of Greenland; infesting *Lebbeus polaris*]; Hansen, 1909, p. 221 [Denmark; infesting many different hosts]; Zirwas, 1910, pp. 99, 100 [North Sea; infesting *Leander* sp.]; Hansen, 1916, pp. 206-208, pl. XV, fig. 13a [Davis Strait; infesting *P. montagui*, *Lebbeus polaris*, *Spirontocaris* sp., *S. spinus*]; Stephenson, 1916, pp. 239, 250, 251, 299, 327, 330, 331, 335, 350, 371 [Greenland, many localities; infesting *Lebbeus groenlandicus* (Fabricius), *L. polaris*]; Wallace, 1919, pp. 5, 40 [ Bay of Fundy; infesting *Eualus pusiolus*]; Nierstrasz and Brender à Brandis, 1926, pp. 35, 36, figs. 118-124 [Danish localities; infesting several hosts]; Sparre-Schneider, 1926, p. 66 [Tromsøsundet, Norway; infesting *Spirontocaris phippsii*, *S. spinus*, *Eualus gaimardii*, *E. pusiolus*, *Pandalus montagui*]; M'Intosh, 1927, p. 116 [St. Andrews, Scotland; infesting *Hippolyte* sp.]; Stephenson, 1936, pp. 15, 16, fig. 16 [Greenland localities; infesting *Spirontocaris* sp., *Pandalus* sp.]; Hult, 1941, p. 125 [Skagerrak; infesting *Pandalus propinquus* Sars, *P. borealis* Krøyer, *Spirontocaris lilljeborgii*]; Stephensen, 1943, pp. 4, 53, 54 [east Greenland; infesting *Spirontocaris phippsii*, *Eualus gaimardii*, *Lebbeus polaris*]; Gaevsknoi, 1948, p. 252, pl. LXVII, fig. 7; Holthuis, 1950b, p. 15 [Kentish Knock, Belgium; Tréport and Pas-de-Calais, France; infesting *Eualus pusiolus*]; Pike, 1954, pp. 20, 21 [Clyde Sea; infesting *Pandalus* spp. and *Spirontocaris* spp.]; Horsted, 1956, pp. 104, 105, 108, 109, 113, tab. 38 [west coast of Greenland; infesting *Pandalus borealis*, *Eualus macilentus* (Krøyer)]; Smidt, 1956, p. 46 [west coast of Greenland; infesting *Pandalus borealis*]; Allen, 1959, p. 214 [Northumberland, England; infesting *Pandalus montagui*, *Spirontocaris lilljeborgu*]; Bruce et al., 1963, p. 149 [Isle of Man; infesting *Pandalus montagui*]; Greve, 1963, pp. 39, 40, tab. 2 [along Norwegian coast at 44 localities, 5-810 m; infesting *Spirontocaris spinus*, *S. lilljeborgii*, *S. phippsii*, *Lebbeus polaris*, *Eualus pusiolus*, *E. gaimardii*].

*Phryxus*. Henderson, 1886, p. 344 [Firth of Clyde; infesting *Thoralus cranchii* (Leach)].

*Hemiarthrus abdominalis*: Giard and Bonnier, 1887b, p. 36, footnote; Proctor, 1933, p. 247 [Mount Desert Island, Maine; infesting *Eualus pusiolus*]; Mistakidis, 1957, pp. 41, 42, 46 [Thames estuary; infesting *Pandalus montagui*]; Pike, 1960, pp. 239-250, figs. 1, 2B, 5, tab. I [Firth of Clyde; infesting several pandalids and hippolytids]; Allen, 1963, p. 678 [English coasts; infesting *P. montagui*]; Bourdon, 1963, p. 425 [Roscoff; infesting *Thoralus cranchu*, *Eualus occultatus* (Lebour), *Hippolyte varians* Leach]; Allen, 1966, pp. 1-6 [ Northumberland; infesting *Eualus pusiolus*]; Bourdon, 1967a, pp. 281, 284, tab. 1 [Roscoff; infesting *H. longirostris* f. *amoricana* Sollaud]; 1968, p. 405 [Roscoff; infesting *H. varians*]; Squires, 1970, p. 41 [northeast Canada; infesting *Eualus pusiolus*]; Strömberg, 1971, pp. 1, 2, 7, 8, 10, 14, 19, 20, 21, 34, 35, 42, figs. 5, 6 [Raunefjorden, Norway; infesting *Pandalus borealis*, *Lebbeus polaris*]; Hamond, 1974, pp. 201, 209, tab. 1 [Norfolk, England; infesting *Pandalus montagui*; Yarmouth, England; infesting *Thoralus cranchii*]; Jones, 1974, pp. 193-196, figs. 1-10 [Isle of Man; infesting *Dichelopandalus bonnieri* (Caullery)]; Warren, 1974, pp. 21-26, tab. I, figs. 1-3 [east coast of England; infesting *Pandalus montagui*, Cape Canso, Nova Scotia; infesting *P. borealis*]; Al-Adhub and Bowers, 1977, pp. 229, 235 [Isle of Man; infesting *Dichelopandalus bonnieri*].

*Phryxus* abdominal, Giard, 1888, pp. 35, 36 [New England?; infesting *Eualus gaimardii*].

*Phrixus* (*Phrixus*) *abdominalis*: Caroli, 1930, pp. 259-263.

*Phrixus abdominalis*: Nierstrasz and Brender à Brandis, 1931, pp. 201, 202, 208, fig. 93 [Ingolfs Fjord, Iceland].

"Isopode": Leloup, 1936, pp. 9, 10, 12, 20 [southern North Sea; infesting *Pandalus montagui*].

*Hemiarthrus* (*Phryxus*) *abdominalis*: Haynes and Wigley, 1969, p. 72 [Nova Scotia to Long Island, New York].

*Material examined*: None.

*Diagnosis*: As for genus except: in female, antennae anteriorly placed, pereopods all of nearly same size, pleon ending in double point; in male, body only about twice as long as wide, end of pleon rather sharply pointed.

*Description*: See Sars, 1898; Richardson, 1905a; Stephensen, 1943.

*Distribution*: See *Remarks*.

*Remarks*: *Hemiarthrus abdominalis* has a distributional pattern extremely similar to that of *Bopyroides hippolytes,* discussed above. Both are circumboreal, extending throughout the Arctic regions, down the Atlantic to France and Cape Cod and down the Pacific to northern Washington and central Japan. Further, all of the species infested by *B. hippolytes,* both pandalids and hippolytids, also serve as hosts for *H. abdominalis,* aften in the same localities, although the total number of known host species for *H. abdominalis* is larger. In the Atlantic Ocean, *H. abdominalis* has been recorded from 18 host species. In the rest of its range, the Arctic and Pacific Oceans, it is known to infest 24 host species. Of the latter group, ten species also serve as hosts in the Atlantic, so the total number recorded worldwide is 32 species, the greatest number of host species known for any bopyrid species. As with *B. hippolytes, H. abdominalis* is the only western Atlantic member of its subfamily not found in tropical or subtropical waters. Two records of its southern limits must be considered dubious. Light (1954) cited it from central California without documentation, although it may actually occur there. Far more questionable is the unsubstantiated record of Riedl (1963) from the Adriatic as a parasite of alpheids and hippolytids. There is otherwise no account of its occurrence anywhere in the Mediterranean or as a parasite of any alpheid.

## *Hemiarthrus synalphei* (Pearse, 1950), new combination

Figures 55-57

*Phryxus subcaudalis* Hay, 1917, p. 570 [in part; among type-material of *Phryxus* (now *Eophrixus*) *subcaudalis;* off coast of North Carolina; infesting *Synalpheus longicarpus* (Herrick)].

*Diplophryxus synalphei* Pearse, 1950, pp. 41-43, figs. 3-7 [type-locality New River, North Carolina; infesting *Synalpheus fritzmuelleri* Coutiere]; Schultz, 1969, p. 314, fig. 500(a); Kelly, 1978, p. 169; Bourdon, 1981a, p. 632, footnote.

*Material examined*: Infesting *Synalpheus fritzmuelleri* Coutière: HOURGLASS MATERIAL: None. — OTHER MATERIAL: 1 ♀ (HOLOTYPE); Black Rocks, off New River, North Carolina; 3m; 10 August 1949; A. S. Pearse, coll. and det. of hosts; USNM 90103. — 1 ♂ (ALLOTYPE), same locality and collector; 7 July 1949; USNM 90104.

Infesting *Synalpheus hemphilli* Coutière: HOURGLASS MATERIAL: None. — OTHER MATERIAL: 1 ♀, 1 ♂; Mer Frapée, Golfe de la Gonâve, Haiti; March 1972; R. Cornet, coll.; USNM.

Infesting *Synalpheus longicarpus* (Herrick): HOURGLASS STATION C: 1 ♀; 8 September 1966; trawl; FSBC I 28482. — 1 ♀ (first reference ♀), 1 ♂; 25 January 1967; trawl; FSBC I 23889. — HOURGLASS STATION D: 1 ♀; 26 January 1967; trawl; FSBC I 23890. — HOURGLASS STATION K: 1 ♀; 22 July 1966; trawl; FSBC I 23891. — OTHER MATERIAL: 2 ♀ (including second reference ♀), among PARATYPES of *Phryxus subcaudalis* Hay; U. S. Bureau of Fisheries steamer *Fish Hawk* Station 8293, in unspecified sponge, 20 miles off Beaufort Inlet, Onslow Bay, North Carolina; August 1915; W. P. Hay, coll. and det. of hosts; USNM 149400.

Infesting *Synalpheus* sp. (or spp.) indet.: HOURGLASS MATERIAL: None. — OTHER MATERIAL: 6 ♀; Mer Frapée, Golfe de la Gonâve, Haiti; dates uncertain; R. Cornet, coll.; USNM.

*Diagnosis*: As for genus except: in female, antennae dorsally placed, posterior pereopods markedly smaller than anterior ones, and pleon ending in single point; in male, length up to four times width, pleon ending in more or less rounded point.

*Description*: Reference females (Figures 55, 56): Lengths 5.9, 3.5 mm, maximal widths 5.2, 3.6 mm, head lengths 1.3, 0.9 mm, pleon lengths 2.0, 1.4 mm. Body axis distortion 45°. Body subcircular in outline (Figures 55, 56A).

Head proportionately quite large, overlapping much of anterior region of pereon. Deep, V-shaped groove in dorsal surface of head extending more than half of distance to posterior edge and containing displaced, flaplike, unsegmented antennae (Figure 56B). Antenna 1 slender, arising from middle of head, antenna 2 broader, arising near anterior margin. Posteroventral border of head (Figure 56C) slightly concave medially, produced into two pairs of bluntly pointed projections laterally.

All pereomeres distinct on concave side and medially. Oostegite 1 of concave side (Figure 56D) oval except for long, narrow posterolateral point. Oostegite 2 of convex side (Figure 56E) sharply reflexed over head, tuberculate externally, consisting of two suboval segments meeting at marked angle (about 45°) to their long axes; internal ridge entire, posterior segment bearing blunt, hooked projection. Second pereomere with several small, projecting, fleshy flaps on ventral surface (Figure 56C). All seven pereopods (Figure 56F-I) decreasing in size posteriorly on concave side. On convex side, only first pereopod developed, third pereopod represented by scarlike plate on margin of brood pouch (Figure 56H) indicating basal segment.

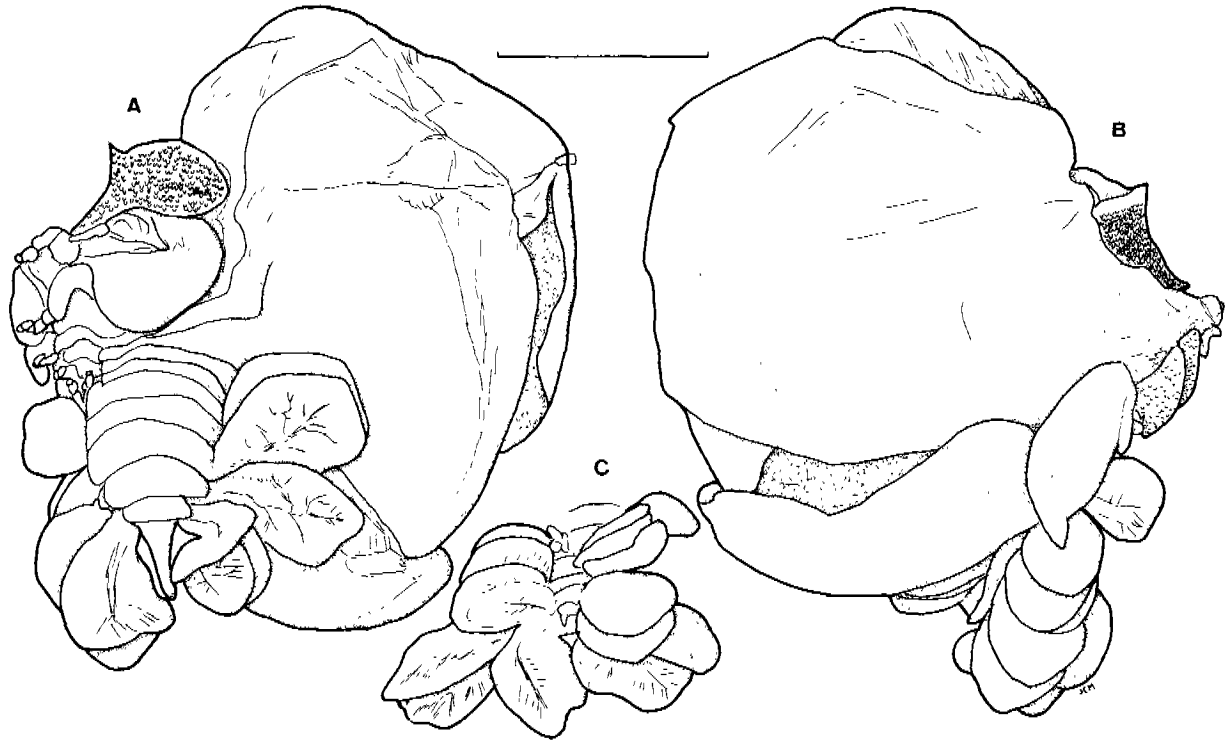


Figure 55. *Hemiarthrus synalphei* (Pearse), first reference ♀, FSBC I 23889. A. Dorsal view. B. Ventral view. C. Pleon, ventral view. Scale 2.0 mm.


Figure 56. *Hemiarthrus synalphei* (Pearse), second reference ♀, USNM 149400. A. Dorsal view. B. Ventral view. C. Posterior part of head and pereomere 2, ventral view. D. Left oostegite 1, internal view. E. Right oostegite 1, internal view. F. Right pereopod 1. G. Left pereopods 1 and 2. H. Basis of left pereopod 3. I. Left pereopods 6 and 7 Scale 2.0 mm for A; 0.5 mm for B, F, I; 1.0 mm for C-E, G, H.

Pleon extending dorsally well away from pereon, of five pleomeres. Each of first four pleomeres with pair of uniramous, pedunculate, nearly circular lateral plates and pair of similar uniramous pleopods. Terminal pleomere produced into extended pleotelson. Uropods absent.

Allotype male (Figure 57): Length 1.6 mm, maximal width 0.4 mm, head length 0.2 mm, pleon length 0.5 mm. Body slender, with nearly parallel sides (Figure 57A, B).

Head subquadrate, distinctly extended. Eyes small, irregular, eccentrically placed. Antenna 1 (Figure 57C) of three articles; antenna 2 (Figure 57D) of four articles, basal one perpendicular to others.

Pereomeres separated by lateral indentations, third and fourth broadest. Pereopods Figure 57E, F) of nearly same size and structure, though dactyli smaller posteriorly; nearly all meri and carpi fused.

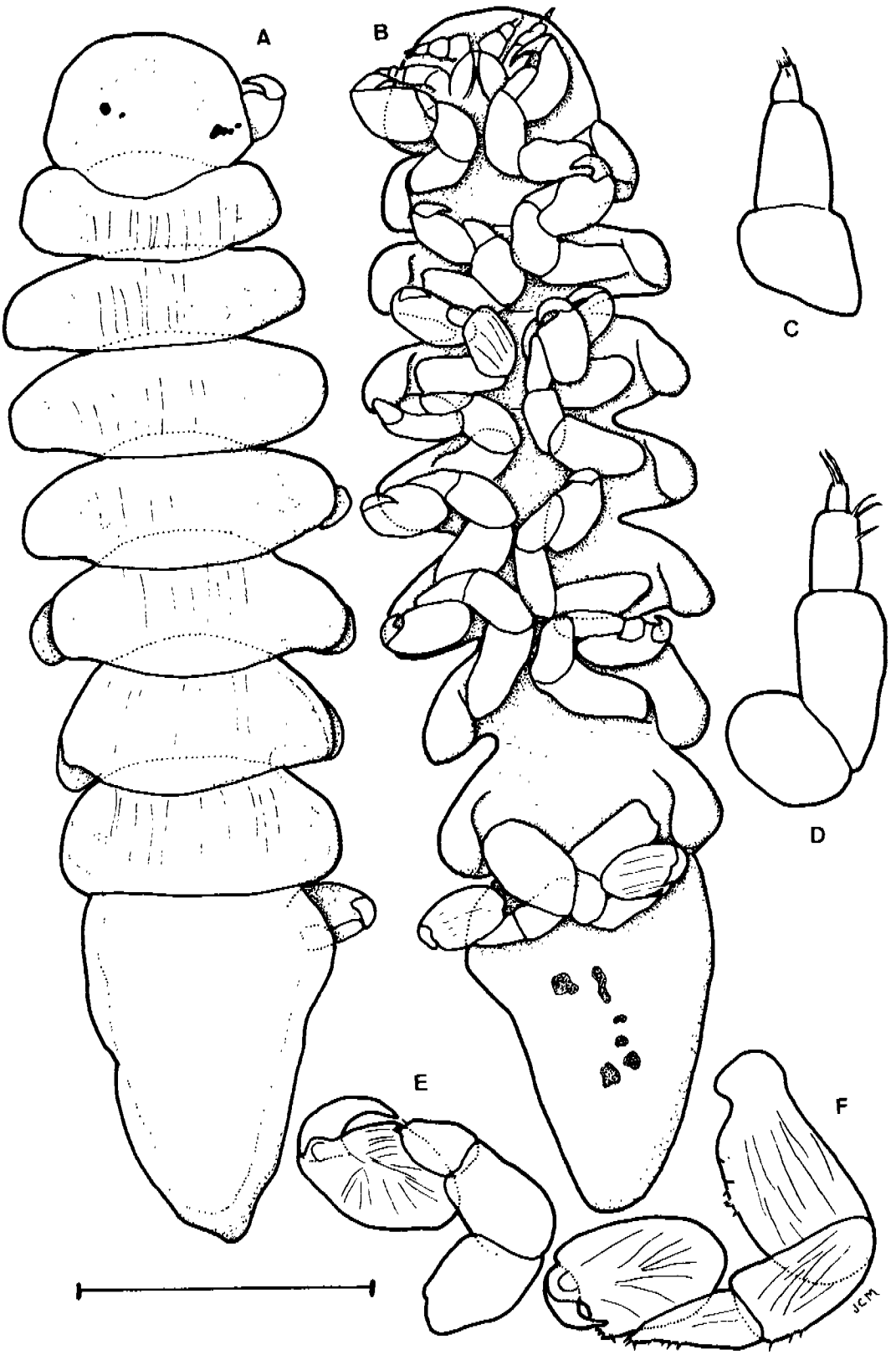


Figure 57. *Hemiarthrus synalphei* (Pearse), allotype ♂, USNM 90104. A. Dorsal view. B. Ventral view. C. Right antenna 1. D. Right antenna 2. E. Right pereopod 1. F. Right pereopod 7. Scale 0.4 mm for A, B; 0.1 mm for C, D; 0.2 mm for E, F.

Pleon fused, subtriangular, with irregular posterior point. Dorsal surface slightly creased. No pleonal appendages.

*Distribution*: North Carolina; western Florida; Haiti.

*Remarks*: Although Pearse (1950) described this species as *Diplophryxus synalphei*, it does not belong in *Diplophryxus* because females have no pleopodal endopodites, in contrast with other females of that genus. In being reassigned to *Hemiarthrus*, it becomes the only species besides *H. abdominalis* to belong in that genus. *Hemiarthrus synalphei* contrasts markedly with *H. abdominalis* in both range and host selection. There is very little variation among the specimens of *H. synalphei* examined. The other males lack the pleonal creases of the allotype, which Pearse (1950) evidently interpreted as segmental margins to conclude that three pleomeres were present.

## *Azygopleon*, new genus

*Diagnosis*: Female: Body greatly distorted (often more than 90°), with pleon considerably distorted in opposite direction. Convex side bearing only one pereopod, that much longer and more slender than seven pereopods on concave side. Usually only four pleomeres, occasionally minute fifth one present; long side of pleon (that on concave side of body) bearing reduced, uniramous lateral plates and uniramous pleopods on pleomeres 1-3, short side with no more than two minute lateral plates on one or two of first three pleomeres; pleomere 4 with large, uniramous lateral plate and similar uniramous pleopod on each side. Uropods absent. Male: Body long and slender. Head distinct from pereon; pereopods reduced; pleon smoothly rounded posteriorly. Infesting *Synalpheus* spp.

*Type-species*: By present designation, *Hemiarthrus schmitti* Pearse, 1932.

*Etymology*: Greek prefix, "*Azygo-*", meaning "irregular" or "asymmetrical" + pleon, in reference to unequal numbers of appendages on opposite sides of pleomeres. Gender masculine.

*Remarks*: The peculiar pleonal asymmetry and reverse distortion of the female of *Hemiarthrus schmitti* clearly exclude it from any heretofore described hemiarthrine genus and serve to justify the creation of a new genus for it. Only one species is known in the western Atlantic, *Azygopleon schmitti* (Pearse).

## *Azygopleon schmitti* (Pearse, 1932), new combination

Figures 58, 59

*Phryxus subcaudalis* Hay, 1917, p. 570 [in part; among type-material of *Phryxus* (now *Eophrixus*) *subcaudalis*; off coast of North Carolina; infesting *Synalpheus longicarpus* (Herrick)].

*Hemiarthrus schmitti* Pearse, 1932a, pp. 3, 4, figs. 15-21 [type-locality Dry Tortugas, Florida; infesting *Synalpheus brooksi* Coutière]; 1932b, p. 107 [same locality and host]; 1932c, p. 119-122, tab. 1 [same locality and host]; 1951, pp. 367, 368 [Bimini, Bahamas; infesting *S. brooksi*]; Schultz, 1969, p. 314, fig. 499; Kelley, 1978, p. 169; Westinga and Hoetjes, 1981, pp. 141, 149, tab. 1 [Bonaire and Curaçao; infesting unspecified alpheid].

*Material examined*: Infesting *Synalpheus brooksi* Coutière: HOURGLASS STATION K: 1 ♀, 1 ♂; 4 September 1966; trawl; FSBC I 28361. — OTHER MATERIAL: 2 ♀, 1 ♂; in *Spheciospongia vesparia* (Lamarck), Soldier Key, Biscayne Bay, Florida; shallow water; 25 April 1970; J. C. Markham, coll.; UMML 32: 5358. — 28 ♀, 10 ♂ (SYNTYPES); in *S. vesparia*, Dry Tortugas, Florida; 27 June 1931; A. S. Pearse, coll.; USNM 65144. — 1 ♀, 1 ♂; east of main span of Skyway Bridge, Tampa Bay, Florida; 4.2-7.3 m; 12 October 1975; W. G. Lyons and D. K. Camp, colls.; FSBC I 16611.

Infesting *Synalpheus hemphilli* Coutière: 1 ♀, 1 ♂; Golfe de la Gonâve, Haiti; March 1962; R. Cornet, coll.; USNM.

Infesting *Synalpheus longicarpus* (Herrick): 8 ♀, 8 ♂; among PARATYPES of *Phryxus subcaudalis* Hay; U. S. Bureau of Fisheries steamer *Fish Hawk* Station 8293, in unspecified sponge, 20 miles off Beaufort Inlet, Onslow Bay, North Carolina; August 1915; W. P. Hay, coll. and det. of hosts; USNM 149397.

Infesting *Synalpheus mcclendoni* Coutière: 1 ♀, 1 ♂; in unidentified sponge, Tortugas shrimp grounds, about 80 km west of Key West, Florida; 24-30 m; 14-15 April 1971; J. C. Markham, coll.; J. García-Gómez, det. of host; UMML.

Infesting *Synalpheus pectiniger* Coutière: 2 ♀, 2 ♂ (including reference specimens); R/V *John Elliott Pillsbury* Station P-1283, off Enriquillo, Dominican Republic, 17°35'N, 71°25'W; 18-27 m; 19 July 1970; J. García-Gómez, det. of hosts; UMML 32: 5359. — 1 ♀, 1 ♂; R/V *John Elliott Pillsbury* Station P-1249, in unidentified sponge, Pedro Bank, southwest of Jamaica, 17°23'N, 78°39'W; 26 m; 13 July 1970; J. García-Gómez, det. of host; UMML 32: 5360.

Infesting *Synalpheus* sp. (or spp.) indet.: 15 ♀, 11 ♂; in *Spheciospongia* sp., Golfe de la Gonâve, Haiti; May 1960, March 1961, May 1964; R. Cornet, coll.; USNM. — 3 ♀; Belize-80, diving station 32, offshore from Belize, 16°48.2'N, 88°04.5'W; 15 m; 2 April 1980; G. Hendler, coll.; USNM.

Separated from hosts: 3 ♀, 1 ♂; Belize-80, diving station 11, forereef slope, offshore from Belize, 16°48.2'N, 88°04.5'W; 27.4 m; 26 March 1980; USNM. — 1 ♀; Belize-80, diving station 16, forereef crest, offshore from Belize, 16°48.2'N, 88°04.5'W; 15.2 m; 27 March 1980; USNM.

*Diagnosis*: As for genus.

*Description*: Reference female (Figure 58): Length 2.5 mm, maximal width 3.4 mm, head length 0.9 mm, pleon length 0.9 mm. Distortion 42°. Body nearly square in outline (Figure 58A).

Head nearly circular, deeply set into pereon. Dorsal surface of head with anteriorly deeply indented plate bearing displaced first antennae; second antennae displaced to anterior edge of head; both pairs of antennae (Figure 58B, C) flaplike and unsegmented. Maxilliped (Figure 58D) long and slender, without palp. Posteroventral border of head (Figure 58E) slightly concave medially, with two short, laterally directed projections on each side.

Pereomeres distinct only on concave side and medially, bunched together tightly. Oostegite 1 of concave side (Figure 58F) suboval, with rounded triangular internal ridge and similarly shaped posterolateral point. Oostegite 2 of convex side (Figure 58G) reflexed over


Figure 58. *Azygopleon schmitti* (Pearse), reference ♀, UMML 32: 5359. A. Dorsal view. B. First antennae. C. Second antennae. D. Maxillipeds. E. Posteroventral border of head. F. Left oostegites, internal view. G. Right oostegite 1, internal view. H. Left pereopod 1. I. Right pereopod 1. Scale 2.0 mm for A; 1.0 mm for D-G; 0.4 mm for B, H, I; 0.2 mm for C.

head, separated into two segments of nearly equal size, separated by prominent internal ridges. All seven pereopods on concave side, first one (Figure 58H) much larger than others. Convex side bearing only first pereopod, that very long and slender (Figure 58I).

Pleon of four pleomeres, each of first three bearing uniramous, lanceolate lateral plate and pleopodal exopodite only on side corresponding with concave side of pereon, none on other side. Each lateral plate larger than accompanying pleopod and each appendage somewhat larger than corresponding one on preceding pleomeres. Terminal pleomere bearing lateral plate and pleopodal exopodite on each side, all four of these appendages lanceolate, of same size, and much larger than any preceding appendages. No uropods.

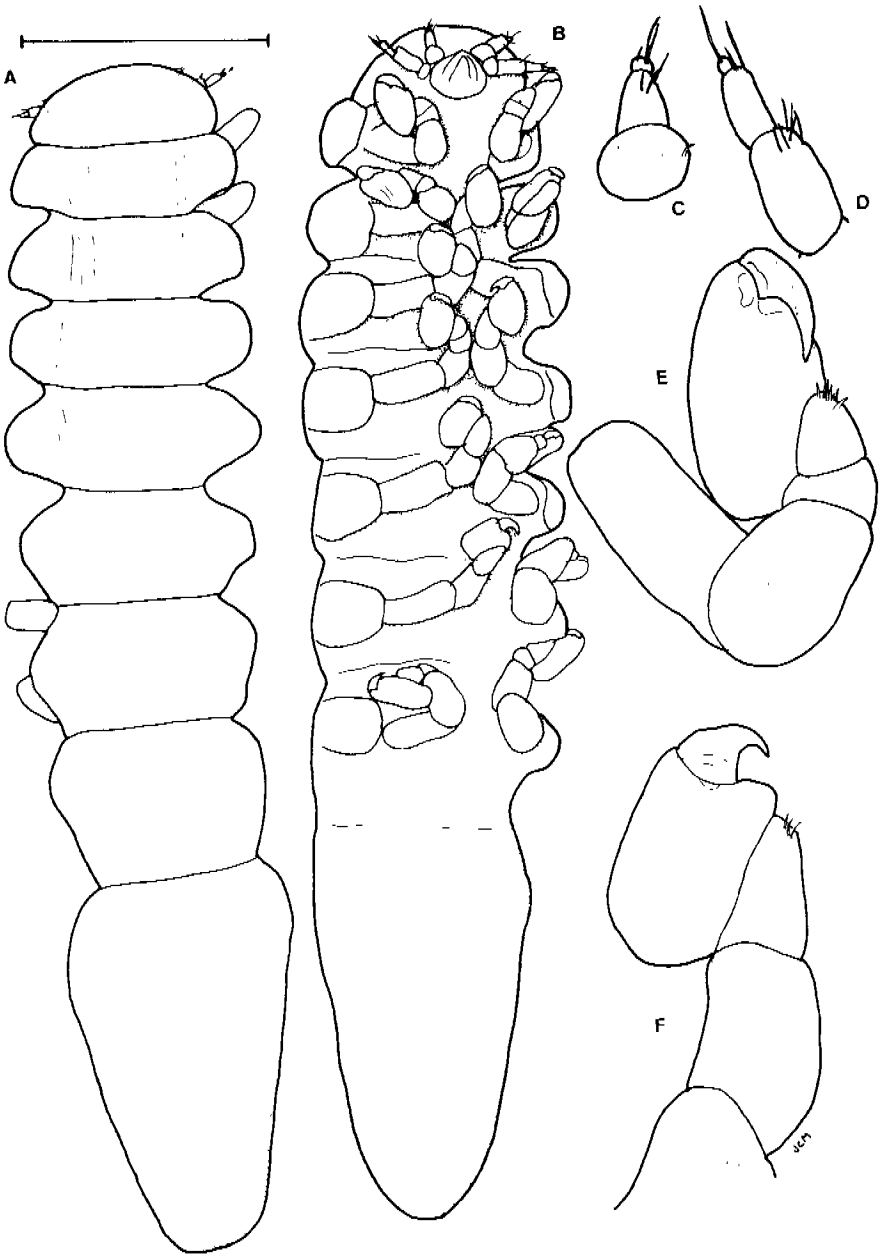


Figure 59. *Azygopleon schmitti* (Pearse), reference ♂, UMML 32: 5359. A. Dorsal view. B. Ventral view. C. Right antenna 1. D. Right antenna 2. E. Right pereopod 1. F. Right pereopod 6. Scale 0.4 mm for A, B; 0.1 mm for C-F.

Reference male (Figure 59): Length 1.9 mm, maximal width 0.4 mm, head length 0.1 mm, pleon length 0.6 mm. Body very long and slender, all body regions and pereomeres distinct dorsally but not ventrally (Figure 59A, B).

Head semicircular, narrower than first pereomere. No eyes. Antenna 1 (Figure 59C) of three articles greatly decreasing in size distally, all bearing some terminal setae. Antenna 2 (Figure 59D) of four articles, distal three terminally setose.

Pereon broadest across fourth pereomere. All pereomeres separated by lateral indentations; pereomeres increasing in length posteriorly, pereomere 7 more than twice as long as pereomere 1. Pereopods (Figure 59E, F) tiny, all of nearly same size but dactyli smaller posteriorly; meri and carpi of some pereopods fused, all carpi with tufts of setae distally.

Pleon broadest slightly behind anterior edge, tapering posteriorly, much longer than broad, terminating in bluntly rounded point.

*Distribution*: North Carolina; both coasts of Florida; Belize; Bimini, Bahama Islands; Hispaniola; Pedro Bank southwest of Jamaica; Bonaire and Curaçao.

*Remarks*: Of 58 females examined, 24 are dextral and 34 sinistral; this variation from the expected ratio of 1:1 has a probability slightly greater than 0.05 (chi-square test). There seems to be little variation from the reference specimen in either sex. One female has tiny eyes. Two females have minute exopodites on the convex side of pleomere 3, and one of these also has a tiny lateral plate there; one female lacks both appendages from the concave side of the terminal pleomere, while another has an extra ramus on that segment. Finally, one female bears a tiny projection between the exopodites of pleomere 4, which may be a rudimentary fifth pleomere. There is some slight pleonal variation among males, the sides rarely being nearly parallel, and occasionally the bodies proportionately shorter.

As discussed above under *Eophrixus subcaudalis*, the male which Hay (1917) considered an immature or "accessory" male of that species really belongs to *Azygopleon schmitti*, as do eight females which Hay considered to be paratypes of the former species. *Azygopleon schmitti* was previously known only as a parasite of *Synalpheus brooksi*, so all other host records reported herein are new.

### Hemiarthrinae species

*Material examined*: Infesting *Pontophilus gorei* Dardeau: HOURGLASS STATION D: 1 ♀ (immature); 3 June 1967; trawl; FSBC I 23892.

*Remarks*: The single specimen does not seem to be assignable to any species or even genus previously described. Unfortunately, however, because of the female's immaturity and the lack of a male as well as the known high degree of variability among most other hemiarthrines, it is extremely difficult to reach conclusions about its placement, so it has not been considered in detail. This is the first record of the infestation of any crangonid in the western Atlantic by a hemiarthrine. In the Bay of Bengal, *Diplophryxus richardsoni* Chopra, 1930, infests *Pontophilus lowisi* Kemp, and in Norway *Hemiarthrus abdominalis* (Krøyer) has been recorded (Meinert, 1877) as a parasite of *Crangon allmanni* Kinahan.

## *PROBABLE HEMIARTHRINAE RECORDED BUT NOT IDENTIFIED*

Eight published and unpublished records of abdominal parasites of caridean shrimps in the northwestern Atlantic Ocean have become available. Some of them refer to species known to be undescribed, while others are of specimens which could not be located for subsequent examination. Although some of the host species cited are otherwise known to bear species of

parasites discussed above, the host-species specificity among the Hemiarthrinae is so low that it is impossible to guess the identities of unseen specimens. It is possible that some of the cited parasites belong to other epicaridean families, but far more likely that they really are hemiarthrine bopyrids. The host species, the sources of the records, and the localities are as follows: *Acanthephyra purpurea* A. Milne Edwards: Chace, 1947, p. 11, off Bermuda (discussed by Markham, 1979a); *Nematocarcinus ensifer* (Smith): R. W. Heard, personal communication, Atlantic Ocean off Virginia; *Periclimenes americanus* (Kingsley): Chace, 1972, p. 31, Antigua and Tobago Keys; *Salmoneus ortmanni* (Rankin): Chace, 1972, p. 79, Bahía de la Ascensión, Yucatán; *Synalpheus fritzmuelleri* Coutière: Chace, 1972, p. 93, Antigua and Carriacou Islands; *Synalpheus longicarpus* (Herrick): Chace, 1972, p. 94, Mustique and Tobago Cays; *Synalpheus pectiniger* Coutière: Chace, 1972, p. 103, Bahía de la Ascensión, Yucatán; *Dichelopandalus leptocerus* (Smith): D. L. Adkison, personal communication, Atlantic Ocean off Virginia.

## DISCUSSION

The number of bopyrid species known to infest caridean shrimps in the northwestern Atlantic now stands at 37, in 27 genera of four subfamilies. This report includes the descriptions of seven new genera and five new species and the generic reassignment of 11 species previously described. Representatives of five new species yet to be described are also mentioned. Of the total of 37 species, 23 occur in Florida, and, of these, 15 species were taken by the Hourglass Cruises along a small portion of the Gulf coast of Florida.

The known caridean hosts for northwestern Atlantic bopyrid isopods belong to 73 species in 30 genera in ten families of five superfamilies. These are listed in Table 2 and arranged according to Holthuis (1955). Most of the species of parasites infest only a few host species, but there are three marked exceptions to this rule, all of which may reflect lack of competition. *Probopyrus pandalicola*, the only species found in fresh water over a very large range, infests at least 17 species in four palaemonid genera. Similarly, *Bopyroides hippolytes* and *Hemiarthrus abdominalis*, the sole representatives of their respective subfamilies in northern cold waters, each infest five hippolytid species and one pandalid species in the northwestern Atlantic.

TABLE 2. CARIDEAN SPECIES SERVING AS HOSTS FOR BOPYRID ISOPODS IN THE NORTHWESTERN ATLANTIC OCEAN. NEW HOST, PARASITE, OR LOCALITY RECORDS INDICATED §.

| Host species | Parasite species | Localities |
|---|---|---|
| Section Caridea | | |
| Superfamily Oplophoroidea | | |
| Family Oplophoridae | | |
| *Acanthephyra purpurea* A. Milne Edwards | Unidentified hemiarthrine? | Bermuda |
| Family Nematocarcinidae | | |
| *Nematocarcinus ensifer* (Smith) § | Unidentified hemiarthrine | Off Virginia |
| Superfamily Palaemonoidea | | |
| Family Palaemonidae | | |
| Subfamily Palaemoninae | | |
| *Palaemon northropi* (Rankin) | *Probopyrus pandalicola* (Packard) | Yucatán; Venezuela; Brazil |

TABLE 2. CARIDEAN SPECIES SERVING AS HOSTS FOR BOPYRID ISOPODS IN THE NORTHWESTERN ATLANTIC OCEAN. NEW HOST, PARASITE, OR LOCALITY RECORDS INDICATED §. (CONT.)

| | | |
|---|---|---|
| *P. pandaliformis* (Stimpson) | P. *pandalicola* | Brazil |
| *Palemonetes exilipes* Stimpson | P. *pandalicola* | E Florida |
| *P. intermedius* Holthuis | *P. pandalicola* | W, SW, SE, NW Florida |
| *P. kadiakensis* Rathbun | *P. pandalicola* | NW Florida |
| *P. paludosus* (Gibbes) | *P. pandalicola* | E, SW, NW Florida |
| *P. pugio* Holthuis | *P. pandalicola* | North Carolina; South Carolina; E, NW Florida; Mississippi; Texas § |
| *P. vulgaris* (Say) | *P. pandalicola* | New Hampshire to Florida; Yucatán |
| *Palaemonetes* sp. or spp. indet. | *P. pandalicola* | Georgia; Mississippi |
| *Macrobrachium acanthurus* (Wiegmann) | *P. pandalicola* | Central America; Cuba(?); Martinique; Surinam |
| *M. amazonicum* (Heller) | *P. pandalicola* | West Indies; NE South America |
| *M. carcinus* (Linnaeus) | *P. pandalicola* | Panama |
| *M. faustinum* (de Saussure) | Unidentified | Cuba |
| *M. ohione* (Smith) | *P. pandalicola* | Missouri; Mississippi; Louisiana |
| *M. olfersii* (Wiegmann) | *P. pandalicola* | Mexico to Surinam; Cuba; Hispaniola § |
| *M. surinamicum* Holthuis | Unidentified | Surinam |
| *Macrobrachium* spp. indet. | *P. pandalicola* | Mexico; St. Croix; Brazil |
| Subfamily Pontoniinae | | |
| *Periclimenes americanus* (Kingsley) | *P. pandalicola* § | SE Florida |
| | *Dicropleon periclimenes* Markham | St. Lucia |
| | Unidentified hemiarthrine | Antigua; Tobago |
| *P. longicaudatus* (Stimpson) | *Schizobopyrina urocaridis* (Richardson) | North Carolina; W, NW Florida |
| | *Allodiplophryxus floridanus* n. gen., n. sp. § | W Florida § |
| *Periclimenes perryae* Chace § | *Hyperphrixus castrensis* n. sp. § | W Florida § |
| *Pontonia margarita* Smith | Schizobopyrina urocaridis (Richardson) | North Carolina |
| *Lipkebe holthuisi* Chace | Unidentified bopyrine | Gulf of Mexico |
| Family Gnathophyllidae | | |
| *Gnathophyllum modestum* Hay | Unidentified bopyrine | Gulf of Mexico |

TABLE 2. CARIDEAN SPECIES SERVING AS HOSTS FOR BOPYRID ISOPODS IN THE NORTHWESTERN ATLANTIC OCEAN. NEW HOST, PARASITE, OR LOCALITY RECORDS INDICATED §. (CONT.)

| | | |
|---|---|---|
| Superfamily Alpheoidea | | |
| Family Alpheidae | | |
| *Salmoneus ortmanni* (Rankin) | Unidentified hemiarthrine | Yucatán |
| *Alpheus armillatus* H. Milne Edwards | *Ovobopyrus alphezemiotes* n. sp. § | W Florida § |
| | Unidentified bopyrine | Antigua |
| *A. formosus* Gibbes | *Parabopyrella richardsonae* (N. & B. à B.)* | Virgin Islands |
| | *Diplophyrxus* n. sp. § | Yucatán § |
| *A. heterochaelis* (Say) | *Probopyria alphei* (Richardson) | North Carolina; SE Florida §; Brazil |
| | *Parabopyrella richardsonae* | W Florida |
| *A. normanni* (Kingsley) | *Parabopyriscus stellatus* n. sp. § | W Florida § |
| | *Probopyria alphei* | NW, SE Florida § |
| | *Parabopyrella lata* (N. & B. à B.)* | SE Florida |
| | *Parabopyrella richardsonae* (N. & B. à B.)*§ | W Florida § |
| *A. viridari* (Armstrong) | *Probopyria alphei* § | Antigua |
| *Alpheus* spp. indet. | *P. alphei* | SW Florida; Brazil |
| | *Diplophyrxus* n. sp. § | Georgia §; E Florida § |
| *Synalpheus bousfieldi* Chace | *Bopyrione synalphei* Bourdon and Markham | Haiti |
| *S. brevicarpus* (Herrick) | *Bopyrella harmopleon* Bowman | Venezuela |
| *S. brooksi* Coutière | *Synsynella deformans* Hay § | W Florida § |
| | *S. choprae* (Pearse) | SW Florida; Bimini |
| | *Eophrixus subcaudalis* (Hay) § | SE, SW, W Florida §; Yucatán |
| | *Azygopleon schmitti* (Pearse) | SE §, SW, W § Florida; Bimini |
| *S. fritzmuelleri* Coutière | *Bopyrella harmopleon* | Venezuela |
| | *Hemiarthrus synalphei* (Pearse) | North Carolina |
| *S. goodei* Coutière | *Bopyrione synalphei* | W Florida |
| | *Eophrixus subcaudalis* § | W Florida |
| | *Synsynella choprae* § | Bermuda § |
| *S. hemphilli* Coutière | *Parabopyriscus stellatus* § | W Florida § |
| | *Bopyrella harmopleon* | Venezuela |
| | *Eophrixus subcaudalis* § | Haiti § |
| | *Hemiarthrus synalphei* § | Haiti § |
| | *Azygopleon schmitti* § | Haiti § |

TABLE 2. CARIDEAN SPECIES SERVING AS HOSTS FOR BOPYRID ISOPODS IN THE NORTHWESTERN ATLANTIC OCEAN. NEW HOST, PARASITE, OR LOCALITY RECORDS INDICATED §. (CONT.)

| | | |
|---|---|---|
| *S. longicarpus* (Herrick) | *Synsynella deformans* | North Carolina; W Florida |
| | *S. choprae* § | North Carolina § |
| | *Synsynella integra* § | North Carolina; W Florida §; Haiti |
| | *Bopyrione synalphei* § | W Florida |
| | Unidentified bopyrine | Mustique |
| | *Eophrixus subcaudalis* | North Carolina; W Florida §; Venezuela § |
| | *Hemiarthrus synalphei* | North Carolina; W Florida § |
| | *Azygopleon schmitti* § | North Carolina § |
| | Unidentified hemiarthrine | Mustique; Tobago |
| *S. mcclendoni* Coutière § | *Eophrixus subcaudalis* § | SW Florida |
| *S. minus* (Say) | *Bopyrione synalphei* § | SE Florida §; Tobago |
| | *Synsynella choprae* | North Carolina; Georgia; Virgin Islands |
| *S. pandionis* Coutière § | *Eophryxus subcaudalis* § | W Florida |
| | *Synsynella choprae* § | W Florida |
| | *Synsynela integra* § | W Florida |
| *S. pectiniger* Coutière | *Bopyrione synalphei* | Hispaniola; Jamaica § |
| | *Synsynella deformans* § | Jamaica; W Florida § |
| | *Eophrixus subcaudalis* § | Dominican Republic § |
| | *Azygopleon schmitti* § | Dominican Republic §; Jamaica § |
| | Unidentified hemiarthrine | Yucatán |
| *S. townsendi* Coutière | *Bopyrione synalphei* § | Yucatán § |
| *Synalpheus* spp. indet. | *B. synalphei* | Curaçao |
| | *Bopyrella harmopleon* | Brazil |
| | *Synsynella deformans* | W Florida |
| | *S. choprae* | W Florida; Haiti § |
| | *Synsynella* n. sp. B § | Haiti § |
| | *Eophrixus subcaudalis* § | Haiti §; Curaçao §; Belize § |
| | *Hemiarthrus synalphei* | Haiti § |
| | *Azygopleon schmitti* | Haiti §; Belize § |
| Alpheid, indet. | *Parabopyrella lata* | Haiti § |
| Family Hippolytidae | | |
| *Eualus fabricii* (Krøyer) | *Bopyroides hippolytes* (Krøyer) | Greenland; Maine; Massachusetts |
| *E. gaimardii* (Krøyer) | *Hemiarthrus abdominalis* (Krøyer) | E Greenland; New England? |
| E. *pusiolus* (Krøyer) | B. *hippolytes* | Maine |
| | *H. abdominalis* | Maine |
| *Spirontocaris lilljeborgii* (Danielssen) | *B. hippolytes* | Greenland; Baffin Bay; Massachusetts |
| *S. phippsi* (Krøyer) | *H. abdominalis* | E Greenland |
| *S. spinus* (Sowerby) | *B. hippolytes* | Gulf of St. Lawrence; Massachusetts |

TABLE 2. CARIDEAN SPECIES SERVING AS HOSTS FOR BOPYRID ISOPODS IN THE NORTHWESTERN ATLANTIC OCEAN. NEW HOST, PARASITE, OR LOCALITY RECORDS INDICATED §. (CONT.)

| | | |
|---|---|---|
| Family Processidae | | |
| *Processa fimbriata* Manning and Chace | *Urobopyrus processae* Richardson | Middle Atlantic off Brazil |
| *P. tenuipes* Manning and Chace | *U. processae* § | W Florida |
| *Ambidexter symmetricus* Manning and Chace | *U. processae* | W Florida |
| *Ambidexter* n. sp. § | *U. processae* § | W Florida |
| Superfamily Pandaloidea | | |
| Family Pandalidae | | |
| *Parapandalus* sp. § | *Pseudione* sp. § | Gulf of Mexico § |
| *Plesionika edwardsii* (Brandt) | *P. affinis* (G. O. Sars) | Bermuda |
| *P. tenuipes* (Smith) § | *P. affinis*? § | Off Virginia |
| *Dichelopandalus leptocerus* (Smith) | *H. abdominalis* | New England |
| | Unidentified hemiarthrine | Off Virginia |
| *Pandalus borealis* Krøyer | *Hemiarthrus abdominalis* | W Greenland; Nova Scotia; Massachusetts |
| *P. montagui* Leach | *Bopyroides hippolytes* | Gulf of St. Lawrence |
| *Heterocarpus ensifer* A. Milne Edwards | *Pseudione* n. sp. § | Cay Sal §; Gulf of Mexico § |
| Superfamily Crangonoidea | | |
| Family Glyphocrangonidae | | |
| *Glyphocrangon longirostris* (Smith) | *Bathygyge grandis* Hansen | Off Virginia § |
| *G. sculpta* (Smith) | *B. grandis* | Off Virginia § |
| Family Crangonidae | | |
| *Sclerocrangon jaqueti* (A. Milne Edwards) | *Argeia atlantica* Markham | Newfoundland; North Carolina §; Bahamas |
| *Pontophilus abyssi* Smith | *Pontobopyrus abyssorum* Markham | Off Virginia |
| *P. gorei* Dardeau | *Pseudione cognata* n. sp. § | E, W Florida § |
| | Unidentified hemiarthrine § | W Florida § |

* N. & B. à B. = Nierstrasz and Brender à Brandis.

The collections of caridean-infesting bopyrid isopods from the Hourglass Cruises produced a total of 15 species, of which six proved to be new to science (four of these being described in this report). In addition, several of the other species, although already described, were but poorly known, and the Hourglass material has made possible redescriptions of them and reassessments of their systematic positions. Twelve caridean species with parasites were collected during the Hourglass Cruises; of those, nine species had not previously been recorded as hosts in the Gulf of Mexico, and, of that group, four species had never been known to be infested anywhere.

Of the 739 samples taken by the Hourglass Cruises, only 30 (or 4%) produced bopyrid-infested carideans, but these were spread quite evenly over the sampling program in both time

TABLE 3. OCCURRENCES OF CARIDEAN-INFESTING BOPYRID ISOPODS AT HOURGLASS STATIONS EACH MONTH, DREDGE AND TRAWL SAMPLES COMBINED. SUBSCRIPTS 1, 2, AND SP DESIGNATE NIGHT, DAY, AND 13.7 M TRAWL SAMPLES, RESPECTIVELY.

| STA | 1965 | | | | | 1966 | | | | | | | | | | | | | 1967 | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | A | S | O | N | D | J | F | M | A | M | J | J | J sp | A | S | O | N | D | J | J sp | F | M | A | M | J | J | A | S | O | N |
| A | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| $B_1$ | | | | | | | | | | | | | | | | | | | | | | | | | | I | | | | |
| $B_2$ | | | | | | | | | | | | | | | B | | | | | | | | | D | | | J | | | |
| $C_1$ | | | | | | | M | | | | | | | | | F | | | | E,L | | | | | | G,H | | | | I |
| $C_2$ | | | | | | | | | | | D,L | | | | C,D,E | | | | | | | | | | | | | | | |
| $D_1$ | | | | | | | | | | | | | | | | | | | | E,L,M | | | | | | | | | | |
| $D_2$ | | | | | | | | | | | | | | | | | | N | | | | | | | | | | | | |
| E | | | | | | | | O | | | | | | K,O | | | | | | | | | | | | | | | O | |
| I | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| J | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| K | | | | | | D | | L | | | | | E,M | | A,D, L,M | | | | | | J | | M | | | | | | | |
| L | | | | | | | | | | | | | | | D | | L | | L | | | | | | | | | | | |
| M | | | | | | | | | L | | | | | | D | | D | | | | | | | | | | | | L | |

A: *Azygopleon schmitti*
B: *Bopyrina abbreviata*
C: *Bopyrione synalphei*
D: *Eophrixus subcaudalis*
E: *Hemiarthrus synalphei*
F: *Hyperphrixus castrensis*
G: *Ovobopyrus alphezemiotes*
H *Parabopyrella mortenseni*
I: *Parabopyrella richardsonae*
J: *Parabopyriscus stellatus*
K *Pseudione cognata*
L: *Synsynella choprae*
M: *Synsynella deformans*
N: *Synsynella integra*
O: *Urobopyrus processae*

and space (Table 3): at seven of the ten benthic sampling stations (Stations A, I, and J producing none) and in 20 of the 28 months (between January 1966 and November 1967). There was no seasonal predominance. The greatest number of productive stations was occupied in September 1966, when Stations B, C, K, L, and M yielded parasites; the second most successful month was January 1967 (Stations C, D, and L producing bopyrids). Parasites were collected at two stations during March 1966 (with material from Stations E and K), November 1966 (Stations L and M), July 1967 (Stations B and C), and October 1967 (Stations E and M). Only one station provided parasites in each of the other 14 months.

There seems to have been a marked preponderance of parasites at particular depths. Stations C and K, both at a depth of 37 m, were productive during seven and six of the months sampled, respectively. Next most productive were Stations B (18 m depth) and M (73 m), with four productive months apiece. The other three stations providing material, Stations D, E, and L, each had three (E and L) or two (D) productive months, respectively, while the shallowest stations, A and I, along with the moderately shallow Station J, produced nothing. Eight species of bopyrids came from Station C (including three in September 1966 alone), five species came from Station K (including three in September 1966 alone), four came from Station D (of which three were collected in January 1967 alone), and four came from Station B, while the other stations yielded only one or two species each. These results are biased, however, because Stations B, C, and D were sampled twice as often as the others; although all stations were sampled at night, Stations B, C, and D were resampled each month during the day (Joyce and Williams, 1969: 5).

Regrettably, information on all caridean shrimps collected during the Hourglass Cruises is not yet available, so it is impossible to make a thorough assessment of the occurrence of their parasites. Thus, it remains unreported how many specimens of those species known to be infested elsewhere were collected uninfested during the Hourglass Cruises.

It is noteworthy that the Hourglass collections, over slightly more than one degree of latitude, turned up 15 species of caridean-infesting bopyrids, or 41% of the 37 species known from the whole 90° of latitude of the northwestern Atlantic. Any explanation of this richness must still be conjectural, but some possibilities may be mentioned. First, most such species are known from the intertidal or immediately subtidal regions, while the Hourglass samples came from deeper water, where perhaps more host species occur. Second, the repeated sampling was obviously beneficial: no bopyrids were collected during the first five months of sampling; it took 14 months to obtain 50% of the species eventually found; and it took 25 months (of the total 28 months of the program) before representatives of all 15 species herein reported were found. Finally, of course, it is entirely possible that the region sampled, as a transitional region between the tropical and temperate faunas, is much richer in species than regions either to the north or south of it. Comparable sampling programs elsewhere would be needed to confirm or refute this.

## *ZOOGEOGRAPHICAL DISTRIBUTION AND EVOLUTION*

It is too early to draw many conclusions about the zoogeography of the Bopyridae of the northwestern Atlantic. First, the facts that the Hourglass collections produced five new species from a small area and that at least five more new species remain to be described indicate that even the bopyrids infesting carideans in the region are far from fully known. Second, other regions of the world with which the northwestern Atlantic caridean-infesting bopyrid fauna may be compared are at best no better surveyed, and many known species from them require additional description and generic reassignment.

Because zoogeography is largely a function of a group's evolutionary history, some remarks on the conjectured evolution of the Bopyridae are in order here. Being noncalcified, the bopyrids have left no direct fossil record (Bachmayer, 1948), but morphological characters and circumstantial evidence related to their parasitic mode of life have shed some light on their probable past. Giard and Bonnier (1887a) presented the first notion of a possible phylogeny, based on larvae alone. Considering the morphology of the adults of both sexes, Nierstrasz (1931) pointed out the probable lines which evolution has taken among the epicarideans, starting with the bopyrids, which are the least specialized. Shiino (1952, 1965, 1966), dealing with the Bopyridae alone, pointed out that the genus *Pseudione*, on the basis of its generalized morphology, variability, and wide host selection, represents the ancestral form from which all other bopyrids are monophyletically derivable. He stressed that evolution from *Pseudione*, or, more properly, the primitive pseudionine stem, has mostly involved selective reduction of appendages and fusion of body parts; it is this principle which has dictated the sequence of genera in this report. Shiino's evolutionary scheme for the various subfamilies seems quite acceptable except that he hypothesized a common derivation for the two large subfamilies of abdominal parasites, Hemiarthrinae and Anthelginae. It now appears more likely that each is separately derivable from the Pseudioninae, the Hemiarthrinae through the Bopyrophryxinae, and the Athelginae from a different pseudionine ancestor through the Ioninae and Phyllodurinae. The Bopyrinae are evidently derived from yet another primitive pseudionine by way of the Argeiinae, although the opposite sequence is also possible. The changes of host groups and modes of infestation accompanying these morphological changes remain to be explained.

Eichler (1949) has propounded several rules of ectoparasitism which are applicable to the Bopyridae. The most important is that the ancestors of extant parasites infested the ancestors of their hosts. Although in some fossil decapods, especially galatheid anomurans (Glaessner,

1969), the branchial swellings indicative of bopyrid infestations are fairly common, the rather thin calcification of carideans both restricts their fossil record and leaves evidence of fossil infestation unknown.

Of the northwestern Atlantic species, ten belong to monotypic genera, and twelve others are the sole representatives of their genera in the region. Two genera are represented by two species apiece, one genus by three species, and two genera by four species apiece. Eleven genera are endemic to the region. All but seven of the species are also endemic. Of the nonendemic species, *Pseudione affinis* and *Bathygyge grandis* are disjunctly distributed, deep-water cosmopolites; *Probopyrus pandalicola* extends from New Hampshire to Argentina; *Probopyrinella latreuticola* accompanies its single host clear across the North Atlantic; *Urobopyrus processae* occurs sparsely on both sides of the Atlantic; and *Bopyroides hippolytes* and *Hemiarthrus abdominalis* are distributed continuously throughout the boreal region.

For comparison, Table 4 presents a numerical summary of the occurrence of caridean-infesting bopyrids in four regions of the northern hemisphere. Data for the western Atlantic are from this report, for the eastern Atlantic (Europe and Iceland to Africa, the Azores, and Canaries, including the Mediterranean and Black Seas) from Caroli (1930), Bourdon (1968), and other sources, for the eastern Pacific (from Alaska to the Galápagos) from Hansen (1897), Richardson (1905a), and other sources, and for the Indo-Northwest Pacific (from Siberia and the Red Sea to the Equator) from the papers of Chopra, Nierstrasz and Brender à Brandis, and Shiino, and other sources. Although the Indo-Northwest Pacific has by far the largest number of caridean-infesting bopyrids (103 species), the number of host species is only slightly larger than that of the northwestern Atlantic, and the numbers of parasite and host genera are smaller in the Indo-Northwest Pacific than in the northwestern Atlantic. All numbers from other regions are considerably lower than these. The strongest affinities, on the generic level, of both hosts and parasites of the northwestern Atlantic are with the northeastern Atlantic.

TABLE 4. COMPARATIVE STATISTICS FOR CARIDEAN-INFESTING BOPYRID ISOPODS FROM FOUR REGIONS OF NORTHERN HEMISPHERE. (SEE TEXT FOR EXPLANATION).

| Region | Parasite numbers | | | Genera also in | Host numbers | | | Genera also hosts |
|---|---|---|---|---|---|---|---|---|
| | Spp. | Gen. | Subfam. | NW Atlantic | Spp. | Gen. | Fam. | in NW Atlantic |
| NW Atlantic | 37 | 27 | 4 | — | 73 | 30 | 10 | — |
| NE Atlantic | 16 | 13 | 3 | 8 | 38 | 19 | 7 | 13 |
| NE Pacific | 9 | 9 | 4 | 6 | 46 | 17 | 6 | 8 |
| Indo-NW Pacific | 103 | 25 | 4 | 10 | 75 | 24 | 9 | 12 |

A list of the 18 genera treated in this report which are also represented elsewhere in the world (Table 5) shows that there is a very good coincidence of host and parasite genera. Additional knowledge of the respective faunas will probably further enhance this correspondence. This almost certainly reflects coevolution of the hosts and their parasites after geographical isolation of a common ancestral stock for each.

TABLE 5. GENERA OF CARIDEAN-INFESTING BOPYRIDAE OF THE NORTHWESTERN ATLANTIC ALSO FOUND ELSEWHERE AND OF THEIR HOSTS THERE AND ELSEWHERE.

| Genus | Species numbers | | Other localities | Host genus or genera | |
|---|---|---|---|---|---|
| | NW Atlantic | Elsewhere | | NW Atlantic | Elsewhere |
| *Pseudione* | 3 | 3 | NW Europe; Java Sea; Bay of Bengal; Japan | *Plesionika*<br>*Heterocarpus*<br>*Parapandalus*<br>*Pontophilus* | *Plesionika*<br>*Heterocarpus*<br>*Pandalus*<br>*Dichelopandalus* |
| *Argeia* | 1 | 3 | NW North America; Japan; Korea; Bay of Bengal; Philippines | *Sclerocrangon* | *Alpheus*<br>*Eualus*<br>*Argis*<br>*Crangon*<br>*Mesocrangon*<br>*Metacrangon* |
| *Bathygyge* | 1 | 1 | W Mexico; South Africa; Canaries | *Glyphocrangon* | *Glyphocrangon* |
| *Urobopyrus* | 1 | 1 | Mediterranean; Zaire | *Processa*<br>*Ambidexter* | *Processa* |
| *Probopyrus* | 1 | 32 | India through Indonesia to Japan; Pacific Panamá | *Macrobrachium*<br>*Palaemon*<br>*Palaemonetes*<br>*Periclimenes* | *Macrobrachium*<br>*Palaemon* |
| *Schizobopyrina* | 1 | 9 | Andamans to Japan and Australia; California | *Periclimenes* | *Periclimenes*<br>*Anchistus*<br>*Leander*<br>*Conchodytes*<br>*Hippolyte*<br>*Tozeuma* |
| *Bopyroides* | 1 | 2 | All Arctic and boreal coasts | *Eualus*<br>*Spirontocaris*<br>*Lebbeus*<br>*Pandalus* | *Eualus*<br>*Spirontocaris*<br>*Lebbeus*<br>*Pandalus*<br>*Caridion*<br>*Heptacarpus* |
| *Bopyrina* | 1 | 3 | Britain to Black Sea; Indonesia; Nicobars | *Hippolyte* | *Hippolyte*<br>*Chlorotocella*<br>*Gelastocaris* |
| *Bopyrione* | 1 | 3 | Andamans; Hong Kong | *Synalpheus* | *Synalpheus*<br>*Alpheus* |
| *Bopyrella* | 1 | 4 | India to South Pacific; California | *Synalpheus* | *Synalpheus*<br>*Alpheus* |

TABLE 5. GENERA OF CARIDEAN-INFESTING BOPYRIDAE OF THE NORTHWESTERN ATLANTIC ALSO FOUND ELSEWHERE AND OF THEIR HOSTS THERE AND ELSEWHERE. (CONT.)

| | | | | | |
|---|---|---|---|---|---|
| *Parabopyrella* | 4 | 20 | Red Sea to Japan and Australia | *Alpheus*<br>*Lysmata*<br>*Tozeuma* | *Alpheus*<br>*Lysmata*<br>*Synalpheus*<br>*Saron* |
| *Bopyrinella* | 1 | 2 | Japan | *Thor* | *Athanas*<br>*Spirontocaris* |
| *Diplophryxus* | 1 | 3 | Japan; Mozambique; India; Andamans | *Alpheus* | *Alpheus*<br>*Leander*<br>*Gnathophyllum* |
| *Eophrixus* | 1 | 6 | Italy; Japan | *Synalpheus* | *Synalpheus*<br>*Alpheus*<br>*Periclimenes*<br>*Lysmata* |
| *Dicropleon* | 1 | 3 | Maldives; Gulf of Manaar; Hong Kong | *Periclimenes* | *Periclimenes*<br>*Processa* |
| *Hyperphrixus* | 1 | 1 | Philippines | *Periclimenes* | *Periclimenaeus* |
| *Metaphrixus* | 1 | 1 | Zanzibar; Singapore | *Hippolyte* | *Palaemonella* |
| *Hemiarthrus* | 2 | 1 | NW Europe; NE Asia; NW North America | *Dichelopandalus*<br>*Eualus*<br>*Hippolyte*<br>*Lebbeus*<br>*Pandalus*<br>*Spirontocaris*<br>*Synalpheus* | *Dichelopandalus*<br>*Eualus*<br>*Hippolyte*<br>*Lebbeus*<br>*Pandalus*<br>*Spirontocaris*<br>*Crangon*<br>*Heptacarpus*<br>*Leander*<br>*Thoralus* |

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