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(PLATES 1-38)

BY

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AMPHIPODA OF THE FAMILY AMPELISCIDAE COLLECTED IN THE EASTERN PACIFIC OCEAN BY THE *VELERO III* AND *VELERO IV*

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Plates 1-38

Amphipoda of the family Ampeliscidae form an important component of any littoral marine soft-bottom fauna. The amphipod collections of the Allan Hancock Foundation, assembled in part from numerous dredge hauls on soft-bottom areas, contain a large number of ampeliscids. For the most part, these materials were obtained by expeditions of the *Velero III* and *Velero IV,* motor cruisers of Captain Allan Hancock. In addition, several individuals have contributed small personal collections of Ampeliscidae to the Foundation.

The present paper deals with material collected in the Eastern Pacific Ocean: along the coast of the Americas from Puget Sound, Washington, to Peru, the Gulf of California, and the Galapagos Islands.

The writer is indebted to the following persons for aid in preparing this paper: to Captain Allan Hancock and the administration of the Foundation for the use of laboratory space and equipment; to Dr. John S. Garth for supervision of the study and critical counsel; to Dr. John L. Mohr for the use of reprints and the donation of material; and to Dr. James E. Lynch of the School of Fisheries, University of Washington, Seattle, for the donation of material from Puget Sound.

Systematic Discussion

Ampeliscidae from the Eastern Pacific Ocean have been reported upon by Stimpson (1864), Holmes (1908), Stout (1913), and Shoemaker (1916 and 1942). Stimpson in 1864 described *Ampelisca pugetica* from Puget Sound, Washington; Holmes (1908) described six new species of *Ampelisca* collected by the *Albatross* from Monterey, California, and the Channel Islands off southern California. His species were: *Ampelisca cristata, A. californica, A. coeca, A. plumosa, A. pacifica,* and *A. lobata. Ampelisca californica* is considered by this writer a synonym of A. *pugetica* Stimpson. Material of *A. plumosa* and *A. coeca* is not present in the available collections. In addition to the species of *Ampelisca,* Holmes reported upon the presence of *Byblis gaimardii* (Krøyer, 1846) and *Haploops tubicola* Lilljeborg (1855). No members of the genus *Haploops* are present in the collections at hand and *Byblis* is represented only by a single species, new to science. It is unknown whether Holmes' material of *"Byblis gaimardii"* is the same as this new species. Stout (1913) described the new species *Ampelisca articulata,* which was referred to *A. lobata* Holmes by Shoemaker (1941), with whom the writer agrees. Shoemaker (1916) described *A. venetiensis,* a valid species; in 1942 he reported *A. lobata* from the Galapagos Islands, and *A. schellenbergi* Shoemaker (1933) from Magdalena Bay, Lower California, the first record of this Caribbean species from the Pacific Coast of North America.

Ampelisca eschrichtii Krøyer (1842) has been placed in the key to the species of that genus because of Derjavin's (1930) record of it in the Bering or Okhotsk Sea. It is probable that this species will be found along the coast of Alaska.

Most of the dredge hauls made by the *Velero III* and *Velero IV* were in waters of less than 100 fms depth; the relative absence of forms lacking corneal lenses may be due to this fact, only a single blind species, new to science, being taken (at a depth of 230 to 280 fms). *Ampelisca coeca* Holmes and *A. plumosa* Holmes, both lacking corneal lenses, were taken by the Albatross in 302 to 638 fms and 618 to 667 fms respectively. The absence of forms of *Ampelisca* with the elongated third article of peraeopod 5 is peculiar, only a single species, *A. milleri,* new to science, being collected. The rather large number of new species of *Ampelisca* has caused the writer concern over the use of specific criteria in separating populations. However, each new species has been carefully scrutinized and compared with the descriptions and figures of other species in the literature. In the present collection, only two species, *A. macrocephala* Lilljeborg (1852) and *A. schellenbergi* Shoemaker, are known outside the Eastern Pacific region. As previously mentioned, one other species, *A. eschrichtii,* has been recorded from this region and was originally described from other areas. Because the writer has had considerable difficulty in separating some of the new species described herein from other species described since Stebbing's monograph (1906), a brief discussion of the principal taxonomic features of the genus *Ampelisca* has been included, to facilitate the work of other systematists in placing some of the more poorly described species on a firmer foundation.

Order AMPHIPODA

Suborder GAMMARIDEA

Family Ampeliscidae

Antenna 1 without accessory flagellum; eyes when present, externally simple, usually four in number; mandible with palp, cutting edge of molar ridged; article 3 of gnathopod 2 not elongate; telson cleft; pleon segments 5 and 6 coalesced; inner and outer lobes of lower lip well developed; peraeopod 5 structurally different from peraeopods 3 and 4.

Remarks: Stebbing (1906) states that the fourth article of peraeopod 1 is usually more setose than that of peraeopod 2. This is probably a typographical error; in the present materials, peraeopod 2 is always more setose than peraeopod 1.

Genus AMPELISCA Krøyer

Ampelisca Krøyer (1842), Naturh. Tidssk., vol. 4, pp. 154-155.

TYPE SPECIES.—*Ampelisca eschrichtii* Krøyer (1842).

Peraeopod 5: article 2, lower edge without setae between its expansion and the third article; article 6 foliaceous or rather slender, article 7 lanceolate.

Remarks: Characters which appear to be rather constant in the material at hand and which will not be discussed in the descriptions of the species are the following: Palp of mandible borne on a large process (Plate 11, figure D), accessory plate well developed and reaching as far as primary cutting plate. Inner plate of maxilla 1 conical or stout-lanceolate (Plate 11, figure C), armed apically with 2 setae, palp article 2 widened apically. Maxilla 2 generally showing the form of Plate 11, figure H, but occasionally modified as noted under the species concerned. Palp article 3 of maxilliped (Plate 11, figure J) produced distally, article 4 slender, armed with a spine and several echinulate setules. Coxae 1 to 4, lower edge with 1 to 2 rows of setae; coxa 4 large, posterior upper one third strongly incised. Inner edge of article 7 of gnathopods 1 and 2 (Plate 15, figure C) lined with several setules. Peraeopod 2 larger than 1, article 4 larger and more setose in peraeopod 2, and posterior edge of article 3 setose in peraeopod 2. Anterior edge of article 2 of peraeopod 3 rounded, setose; anterior edge of article 2 of peraeopod 4 subquadrate in outline, not as strongly setose as in peraeopod 3.

Taxonomic Features of the Genus *Ampelisca*

Of primary importance in separating species of the genus *Ampelisca* are the following characters:

1. The shape of pleon segment 3. The posterior edge of this segment takes many forms and, when combined with several other features, offers an excellent character for the separation of groups of species. It is not advisable to use the shape of this segment alone as a specific criterion because of its marked variability in some species, such as *Ampelisca cristata* Holmes.

2. Dorsal posterior process of pleon segment 4. Two main categories may be separated here: (a) those species in which a lamellar crest is elevated above the segment; (b) those species in which a hump or boss is produced and variously ornamented. A negative value is seen in species such as *Ampelisca lobata* Holmes, in which the dorsal surface of this segment is only slightly convex. The various shapes assumed by the crests and humps are better shown by accurate illustrations than by descriptive phrases.

3. Shape of head. The length of the head in relation to the body segments may have some systematic value, but the shape of the rostral area and the lower front margin are of greater importance. The lower front margin of the head may be subparallel to the upper margin, making the head appear elongated and produced. When the margin is oblique, the head appears blunt. The oblique margin may be convex, straight, or slightly concave.

4. Eyes. Some species lack corneal lenses entirely; other species possess 2 pairs of lenses, of which the lower pair shows the greatest variation in placement. In some cases, the lower pair may be covered by the lower front margin as in *Ampelisca hemicryptops* K. H. Barnard (1930). Other variations include the placement of the lower lenses either at the lateral angle of the head or below the lateral angle on the oblique margin.

5. Length of uropod 1. This appendage is of great value in quickly separating species which superficially appear to be similar (contrast *Ampelisca mexicana,* new species, and *A. gnathia,* new species). The shortening of uropod 1 and the presence of a stout peduncle may be accompanied by a foreshortening of the urosome.

6. Peraeopod 5. This appendage is quite variable in the genus *Ampelisca* and offers many excellent taxonomic features: the shape and length of the posterior lobe of article 2; the proportional lengths of

articles 3 and 4; the posterior lobe of article 4, its size and shape; the shape of article 5 (the presence or absence of anterior notches and its length relative to articles 4 and 6); and the length of article 6.

7. Shape of the rami of uropod 3. These are of particular importance in such species as *Ampelisca pacifica* Holmes and *A. lobata* Holmes, where one of the rami is greatly modified.

Of secondary importance in the genus *Ampelisca* are the following characters:

1. Length of article 7 of peraeopod 2.
2. Shape and armature of telson lobes.
3. Shape of article 6 of gnathopod 1. In some species, the posterior edge of this article is strongly inflated, forming a false palm which is usually strongly armed with spines and setae. Article 7 also may be enlarged.
4. Presence or absence of anterodistal process on article 5 of peraeopods 3 and 4 (see *Ampelisca milleri,* new species).
5. Presence or absence of a long spine at apex of outer ramus of uropod 2.
6. Lateral or medial ridges of dorsal surface of pleon segment 2 (also a secondary sexual character).
7. Size of dorsal processes of pleon segment 6 (also a secondary sexual character).
8. Relative lengths of antennae and their segments to each other and to the body length. Due to their fragility, a great many specimens of *Ampelisca* reach the laboratory with the flagella or entire antennae missing.

Secondary Sexual Characteristics of the Genus *Ampelisca*

In general, the adult male of a species of *Ampelisca* is rarely encountered. In exceptional cases an entire lot of material may contain only males. Sexual dimorphism is usually limited to the following characters found in the male:

1. A row of setal tufts on the inferior edge of the peduncle of antenna 1 and the superior edge of the peduncle of antenna 2 in the adult male.
2. The antennae may be longer than in the female.
3. The dorsal process of pleon segment 4 may be more strongly produced.
4. The lateral processes of pleon segment 6 are more strongly developed.

5. In species which develop ridges of pleon segment 2, it is found that the female develops 2 lateral ridges, the male one medial ridge.

6. Some species show striking differences in the morphology of uropod 3. This is well seen in *Ampelisca lobata* Holmes.

Artificial Key to the Species of *Ampelisca* Known From the Eastern Pacific Ocean

1. Eyes present 4
1. Eyes absent 2
  2. Posterolateral corner of pleon segment 3 rounded . *plumosa*
  2. Posterolateral corner of pleon segment 3 produced into a tooth 3
3. Coxae 1 and 2 with a tooth at posterolateral corner . . . . *catalinensis*
3. Coxae 1 and 2 without tooth . . . . *coeca*
    4. Peraeopod 5, article 3 much longer than 4 . . *milleri*
    4. Peraeopod 5, article 3 subequal to or shorter than 4 . 5
5. Pleon segment 3 strongly rounded 6
5. Pleon segment 3 quadrate or produced 12
  6. Pleon segment 4, dorsal surface strongly produced, posteriorly ending above segment 5 8
  6. Pleon segment 4 slightly convex, posterior end nearly flush with segment 5 7
7. Peraeopod 5 and uropod 3 stout . . . . . . *schellenbergi*
7. Peraeopod 5 and uropod 3 slender in structure . . . *lobata*
8. Dorsal process of pleon segment 4 strongly saddle shaped . . . . *venetiensis*
8. Dorsal process of pleon segment 4 not saddle shaped . . 9
9. Uropod 3, one ramus strikingly uncinate . . . . . *romigi*
9. Uropod 3, not appearing uncinate in undissected animal . 10
10. Uropod 3, peduncle short, stout, rami elongated 11
10. Uropod 3, peduncle subequal to rami . . . . . *isocornea*
    11. Pleon segment 4, process hood shaped in female . *cucullata*
    11. Pleon segment 4, process not hood shaped in female . *vera*
12. Carina of pleon segment 4 lamellar 13
12. Carina of pleon segment 4 not lamellar 14
    13. Dorsal edge of carina entire . . . . *cristata*
    13. Dorsal edge of carina incised . . . . . . *cristoides*
14. Uropod 3, rami broad . . . . *pacifica*
14. Uropod 3, rami slender, lanceolate 15

15. Lower front edge of head subparallel to upper margin . 16
15. Lower front edge of head oblique . . . *panamensis*
16. Post edge pleon 3 bisinuate . . . . . . *brevisimulata*
16. Post edge pleon 3 not bisinuate 17
17. Posterior edge of pleon segment 3 nearly straight . . 18
17. Posterior edge of pleon segment 3 strongly convex . . 19
18. Pleon segment 3 with a strong tooth . . . . . *hancocki*
18. Pleon segment 3 with a weak tooth . . . . . *shoemakeri*
19. Article 4 of peraeopod 5 strongly produced . . . 21
19. Article 4 of peraeopod 5 not strongly produced . . 20
20. Anterior edge of article 5 of peraeopod 5 notched, apex of outer ramus of uropod 2 without long spine . . . . . *eschrichtii*
20. Anterior edge of article 5 of peraeopod 5 smooth, apex of outer ramus of uropod 2 with long spine . . . . . *macrocephala*
21. Pleon segment 3 with a strong tooth 22
21. Pleon segment 3 weakly produced . . . . . *indentata*
22. Uropod 1 reaching to end of uropod 2 . . . . . *mexicana*
22. Uropod 1 reaching only slightly beyond end of peduncle of uropod 2 23
23. Gnathopod 1 strongly subchelate . . . . . . *gnathia*
23. Gnathopod 1 weakly subchelate . . . . . . *pugetica*

Ampelisca catalinensis, new species

Plates 1 and 2

Description of female: Head longer than first 2 body segments, anterior edge of head incised, lower front margin oblique, concave. Corneal lenses absent.

Antenna 1 reaching well beyond end of peduncle of antenna 2; article 2 of peduncle more than twice as long as 1, article 3 shorter than 1.

Antenna 2 about as long as body; article 5 of peduncle four fifths as long as 4.

Mandible: spine row with 10 spines; article 3 of palp about two thirds as long as 2.

Maxilla 1: outer plate armed with 11 spines; article 2 of palp wider than outer plate, armed with 5 spines, 4 cusp teeth, and 8 setae.

Maxilliped: inner plate reaching to end of palp article 1, armed with 3 chisel teeth; outer plate reaching almost to end of palp article 2, inner edge with 10 chisel teeth, rounded apex with 9 spines and setae, the outermost 5 plumose.

Lower posterior angle of coxa 1 with a tooth, of coxa 2 with a small tooth; coxa 3 lacking a tooth.

Gnathopod 1: article 6 two thirds as long as 5, both lined posteriorly with strong setal spines; article 7 strong, two thirds as long as article 6.

Gnathopod 2: article 6 slightly more than one half as long as article 5; article 7 about one half as long as 6.

Peraeopod 1: article 4 very slender, anterodistal angle not produced; article 7 longer than articles 5 and 6 combined.

Peraeopod 2: article 4 rather slender, more setose than in peraeopod 1; anterodistal edge of article 4 slightly produced.

Peraeopod 3: missing on both sides.

Peraeopod 4: article 6 almost as long as article 5; posterior edge of article 6 with 2 spines, posterior edge of article 5 with 2 sets of spines.

Peraeopod 5: posterior lobe of article 2 obliquely rounded below, reaching downward to junction between articles 4 and 5; article 3 slightly longer than 4; posterior edge of article 4 slightly produced, setose; articles 5 to 7 successively shorter, anterodistal edge of article 5 notched, article 6 rather narrow.

Uropod 1 not reaching to end of uropod 2, rami slightly longer than peduncle; outer edges of both rami weakly spinulate, inner edge of inner ramus strongly spinulate.

Uropod 2: outer ramus shorter than inner, apex of outer ramus with a long spine; both edges of rami strongly spinulate.

Uropod 3: rami slender, lanceolate, subequal in size; inner margin of inner ramus armed with spines, outer edge setose.

Telson: lobes rather slender, apices truncate, notched, each armed with 1 spine and 1 setule; dorsal surface of each lobe with 3 spinules.

Pleon segment 3: posterior edge slightly concave, posteroinferior angle produced into a strong tooth.

Pleon segment 4: raised dorsally into a slightly convex process which ends sharply above segment 5.

Pleon segment 6: lateral ridges low.

Male: Unknown.

Type: Holotype, AHF no. 405, ovigerous female, 15 mm.

Type locality: Station 1156-40, 6½ miles east of Long Point, Santa Catalina Island, California, 230 to 280 fms.

Material examined: The type.

Remarks: This species resembles *Ampelisca odontoplax* Sars (1879) but coxa 3 lacks a tooth, the head is not carinate, article 6 of gnathopod

1 is not produced, uropod 1 is shortened, article 6 of peraeopod 5 is shorter than article 5, and the lobe of article 2 of this appendage is shaped differently.

It is closely related to *Ampelisca abyssicola* Stebbing (1888) but differs in the presence of a tooth on the lower posterior angle of pleon segment 3, the longer first antennae, and the lack of a tooth on coxa 3.

Ampelisca catalinensis is also closely related to *A. coeca* Holmes but may be distinguished by the presence of teeth on the first two coxae, by a more strongly produced tooth on the posterior edge of pleon segment 3, and by the more evenly rounded lower edge of the posterior lobe of article 2 of peraeopod 5. It is possible that this species may be a variety of *Ampelisca coeca,* but the relationships will have to be confirmed by more materials dredged from the deeper bottoms (250 to 350 fms) where these two species may be more frequently encountered.

Distribution: The type locality.

Ampelisca milleri, new species

Plates 3 and 4

Description of female: Head not quite as long as first 3 body segments, anterior edge broadly incised, lower front margin oblique, concave. Eyes small, upper pair behind upper edge of antenna 1, lower pair below lateral angle of head.

Antenna 1 reaching well beyond end of peduncle of antenna 2; article 1 of peduncle stout, elongated; article 2 one and one-half times as long as 1; article 3 about one third as long as 1.

Antenna 2: flagellum broken, peduncle strongly setose, articles 4 and 5 of peduncle subequal in length.

Mandible: spine row with 10 spines, article 2 of palp broadly expanded, article 3 two thirds as long as 2.

Maxilla 1: outer plate armed with 10 spines; palp article 2 more slender than outer plate, armed apically with 4 spines, 3 cusp teeth, and 15 to 18 setae.

Maxilliped: inner plate reaching to end of palp article 1, armed with 1 or 2 chisel teeth; outer plate reaching to end of palp article 2, inner margin and apex armed with 11 or 12 spines, not chisel shaped, and 2 plumose setae.

Gnathopod 1 moderately stout, setae strongly developed; posterior edge of article 6 slightly convex; article 7 about two thirds as long as 6.

Gnathopod 2: articles 4 to 6 not greatly elongated; article 6 one half as long as 5; article 7 very short and stout.

Coxae 1 to 3: lower posterior angle slit.

Peraeopod 1: article 7 about as long as articles 5 and 6 combined; distal anterior angle of article 4 slightly produced.

Peraeopod 2: similar to 1 but with generic differences. Side plate 4 narrow in holotype, sides parallel, bottom edge rounded; in some of the other specimens at hand, the side plate is very wide with a rounded lower edge. The remaining specimens, intermediate in size between the two above-mentioned forms, have intergrading conditions.

Peraeopod 3 very short and stout; article 5 short, posterior distal edge strongly produced, posterior edge with 3 spines; article 6 longer than 5, posterior edge with 3 spines.

Peraeopod 4 shorter and stouter than 3; article 5 similar to peraeopod 3 but article 6 shorter than in the previous appendage and with 2 spines on posterior edge. Anterior edge of article 7 of both peraeopods 3 and 4 with a single large tooth.

Peraeopod 5: lower edge of posterior lobe of article 2 obliquely rounded, reaching only to end of article 3; article 4 much shorter than 3, article 5 slightly longer than 4, article 6 longer than 5, article 7 short, about as long as 5.

Uropod 1 reaching slightly beyond end of uropod 2; rami subequal in length, shorter than peduncle; inner edge of each ramus spinulate.

Uropod 2: rami shorter than peduncle, inner edge of inner ramus spinulate, inner edge of outer ramus with 1 spine.

Uropod 3: outer ramus slender, subequal in length to the inner ramus, which is moderately broad; distal inner edge of inner ramus armed with several very short, broken but evenly worn setae.

Telson: lobes tapering evenly, apices narrow, truncated, notched, each with 1 or 2 spinules; dorsal surface of each lobe with 3-4 spinules.

Pleon segment 3: posterior edge slightly convex, lower posterior corner produced into small tooth.

Pleon segment 4: dorsal posterior surface produced upward, forming a subacute mound, rising far above segment 5. In the figured paratype, this character is not quite so strongly developed.

Pleon segment 6: lateral ridges acutely produced.

Male: Unknown.

Type: Holotype, AHF no. 419, female, 6 mm.

Type locality: Station 1412-41, 2 miles south of Crook Point, San Miguel Island, California, 41 to 43 fms.

Material examined: Stations 209-34 (5), 250-34 (1), 259-34 (1), 272-34 (1), 461-35 (2), 468-35 (2), 556-36 (1), 563-36 (1), 632-37

(1), 1288-41 (1), 1289-41 (1), 1294-41 (1), 1412-41 (2). Albemarle Island, Galapagos Islands, off Cape Cristopher, dip-net, January 16, 1932.

Remarks: The second specimen from Station 1412-41 (8 mm) has the second antenna broken at the fourth article; the specimen from Station 1388-41 (7 mm) has a very short fourth article of antenna 2 while the fifth article remains as long as in the female. The antennae of these two specimens are much stouter than in the female but lack setal tufts; although in the specimen from Station 1388-41 (which was about to molt at the time of collecting) there is a series of striations under the outer cuticle which follows the same pattern as the setal tufts typical of the male of other species. In addition, the third uropods have longer setae.

This species is similar to *Ampelisca scabripes* Walker (1904) but differs in the blunt shape of the tooth on pleon segment 3, the lack of the scabrous condition of the lobe of article 3 of peraeopods 3 and 4, and the rather smooth edges of the rami of the third uropods. The lobe of article 2 of peraeopod 3 is also wider in *Ampelisca milleri.*

Ampelisca milleri resembles *A. tenuicornis* Lilljeborg (1855) but has a stronger process on pleon segment 4, longer antennae, and a strong process on article 5 of peraeopods 3 and 4. From *Ampelisca hupferi* Schellenberg (1925) it differs in the structure of peraeopods 3 and 4, the stouter third uropods, and the relative proportions of articles 5 and 6 of peraeopod 5. It is distinguished from *Ampelisca rubra* Chevreux (1925) by the shape of the head, the size of eyes, the shape of pleon segment 3, and the rami of uropod 3.

Distribution: Channel Islands, off the coast of southern California, 34 to 103 fms; Gulf of California at Isla Partida, Tiburon Island, Espiritu Santo Island, 10 to 55 fms; Tangola Tangola Bay and Tenacatita Bay, Mexico, 15 to 25 fms; Port Parker and Playa Blanca, Costa Rica, 5 to 15 fms; Secas Islands, Panama, 25 fms; off Santa Elena Bay, Ecuador, 8 to 10 fms; Albemarle Island, Galapagos Islands surface.

Ampelisca lobata Holmes

Plates 5 and 6

Ampelisca lobata Holmes (1908), Proc. U. S. Natl. Mus., vol. 35, no 1654, pp. 517-518, fig. 25; Shoemaker (1942), Smithsonian Misc. Coll., vol. 101, no. 11, p. 7.

Ampelisca articulata Stout (1913), Zool. Jahrb., Syst., vol. 34, pp. 639-640.

Description of male: Head not as long as first 3 body segments, with a conspicuous rostrum, lower edge of head oblique and convex. Eyes small, upper pair behind front incision of head, lower pair on lower oblique margin of head.

Antenna 1 more than one half as long as antenna 2; articles 1 and 2 of peduncle subequal in length; setal tufts typically developed on peduncles of both antennae.

Antenna 2 about as long as body (? broken); article 5 of peduncle about three fourths as long as 4.

Mandible: spine row with 10 spines; article 3 of palp more than three fourths as long as 2.

Maxilla 1: outer plate with 11 spines; article 2 of palp nearly as wide as outer plate, armed with 4 spines, 3 cusp teeth and 9 setae.

Maxilliped: inner plate reaching to end of palp article 1, apex with 2 chisel teeth; outer plate reaching to end of palp article 2, inner edge with 9 chisel teeth, rounded apex with 5 spines, the outer 2 plumose.

Coxae 1 to 3: lower posterior angle slit.

Gnathopod 1: article 6 about two thirds as long as 5, article 7 nearly two thirds as long as 6; posterior edge of article 6 slightly concave and with strongly developed setal spines.

Gnathopod 2: article 6 about half as long as 5, article 7 half as long as 6.

Peraeopod 1: anterodistal end of article 4 produced downward, anterior and posterior margins strongly setose; article 7 about as long as articles 5 and 6 combined.

Peraeopod 2: similar to 1 but with generic differences.

Peraeopod 3: posterior edge of article 5 with 3 sets of spines, posterior edge of article 6 with 2 spines.

Peraeopod 4: posterior edge of article 5 with 3 sets of spines, posterior edge of article 6 with 1 spine.

Peraeopod 5: lower edge of posterior lobe of article 2 rounded, above this oblique, reaching down slightly beyond end of article 3; article 4 longer than 3, its posterior edge with a narrow setose lobe; article 6 slightly longer than 5, the last 3 articles rather narrow.

Uropod 1: reaching to end of uropod 2; rami subequal to each other, about as long as peduncle; inner edge of both rami spinulate.

Uropod 2: outer ramus shorter and narrower than inner, inner ramus subequal to peduncle in length; both margins of both rami spinulate.

Uropod 3: rami subequal in length, lanceolate, outer ramus more slender than inner; both rami setose on both margins, inner margin of inner ramus with 6 short spines.

Telson: lobes broad; apices notched, each with a single spine; dorsal surface of each lobe with 3 spines and a seta.

Pleon segment 3: posterior margin slightly convex, lower posterior angle nearly quadrate. Dorsal surface of segment with a very low, medial ridge.

Pleon segment 4: posterior dorsal surface slightly convex, posterior end not raised above pleon segment 5.

Pleon segment 6: lateral ridges rather well developed.

Length of male 9 mm.

Description of female: Antennal peduncles rather slender, antenna 1 reaching only slightly beyond end of peduncle of antenna 2, article 2 of peduncle of antenna 1 longer than article 1; article 6 of gnathopods 1 and 2, setal spines not strongly developed, palm not concave; inner ramus of uropod 3 strikingly smaller than outer, with only a few terminal setae, inner edge of inner ramus strongly serrate, each serration enclosing a short spine, setae absent; peraeopods 1 and 2, not as strongly setose as in male; posterior margin of pleon segment 3 not quite as convex as in male; pleon segment 4 not as strongly convex as in male.

Material examined: Stations 16-33 (1), 82-33 (2), 111-33 (2), 114-33 (9), 157-34 (1), 170-34 (1), 171-34 (1), 173-34 (1), 183-34 (51), 185-34 (1), 190-34 (16), 201-34 (3), 264-34 (2), 279-34 (2), 283-34 (81), 287-34 (2), 306-34 (74), 317-34 (1), 392-35 (2), 394-35 (1), 423-35 (2), 433-35 (1), 448-35 (1), 450-35 (1), 466-35 (8), 562-36 (1), 696-37 (2), 734-37 (1), 874-38 (1), 1123-40 (1), 1155-40 (2), 1170-40 (2), 1232-41 (1), 1269-41 (2), 1280-41 (1), 1369-41 (3), 1405-41 (1), 1407-41 (31), 1418-41 (2), 1421-41 (4), 1426-41 (3), 1431-41 (5), 1619-48 (1), 1621-48 (2), 1790-49 (2), 1905-49 (6), 1944-50 (1), 2014-51 (19).

Remarks: Holmes' figures indicate that he described a young male, as the third uropods are subequal in length and not strongly setose. There is a considerable difference between the third uropods of the male and female.

This species closely resembles *Ampelisca schellenbergi* Shoemaker (1933) in the form of the peduncle of antenna 1, pleon segments 3 and 4, shape of head, and uropod 3. It differs from *Ampelisca lobata* in the anterodistal notch of article 5 of peraeopod 5, the more slender telson, the peculiar attachment of article 6 to article 5 on peraeopod 5, and the lack of spines on the third uropod inner ramus of the female.

The largest specimens of this species (11 mm) show a slight production of pleon segment 3 into a small point at the posterolateral corner. This variation appears to depend only on the size of the specimens.

Distribution: Widely distributed in the Channel Islands, off the coast of southern California, 12 to 100 fms; along the coast of Lower California at San Quentin Bay, Cedros Island, Santa Maria Bay, San Carlos Point, and Thurloe Head, 2.5 to 30 fms; Gulf of California at San Hipolito Bay, San Esteban Island, San Pedro Nolasco Island, and Tortuga Island, shore to 75 fms; south of White Friars Islands, Mexico, 25 fms; Port Parker, Costa Rica, shore; coast of Panama at Secas Islands and Bahia Honda, shore to 14 fms; off Port Utria and Octavia Bay, Colombia, shore to 20 fms; south of La Libertad, Ecuador, shore; North Bay, Lobos de Afueras Islands, Peru, 12 to 22 fms; Galapagos Islands, shore to 70 fms.

Ampelisca schellenbergi Shoemaker

Plates 7 and 8

Ampelisca schellenbergi Shoemaker (1933), Amer. Mus. Nov., no. 598, pp. 3-5, figs. 1, 2; Shoemaker (1942), Smithsonian Misc. Coll., vol. 101, no. 11, p. 9.

Description of female: Head about as long as first 3 body segments, anterior edge of head broadly incised, lower front edge oblique, convex. Upper pair of eyes behind upper margin of antenna 1, lower pair just below angle of lateral lobe of head.

Antenna 1 stout, slightly longer than peduncle of antenna 2; first and second articles of peduncle subequal, third slightly shorter.

Antenna 2 about three fourths as long as body; peduncle short, stout; article 5 three fourths as long as 4.

Mandible: spine row with 9 spines; article 3 of palp about as long as 2.

Maxilla 1: outer plate with 10 spines; apex of palp article 2 with 5 spines, 4 cusp teeth and 4 or 5 setae.

Maxilliped: inner plate reaching to end of palp article 1, apex with 2 chisel teeth; outer plate reaching to end of palp article 2, inner edge with 12 chisel teeth, rounded apex with 4 setal spines.

Coxae 1 to 3: lower posterior corner split.

Gnathopod 1: article 6 about as long as article 5, posterior margin nearly straight; article 7 rather strong, more than one half as long as 6.

Gnathopod 2 not much longer than 1, article 5 shortened, article 6 about two thirds as long as article 5, article 7 strong.

Peraeopod 1 rather stout, not greatly setose; article 4 produced slightly at anterodistal angle, more strongly at posterodistal angle; article 7 not much longer than articles 5 and 6 combined, nearly straight.

Peraeopod 2: similar to 1 but with generic differences.

Peraeopod 3 rather stout and short; articles 5 and 6 subequal in length, article 5 with 2 sets of spines on posterior edge, article 6 with 2 spines on posterior edge.

Peraeopod 4: similar to 3 but with generic differences.

Peraeopod 5 very stout; lower posterior edge of lobe of article 2 oblique, lobe reaching downward to middle of article 4; article 4 much longer than 3, very massive, posterior edge produced, setose; article 5, anterior edge strongly notched; article 6 attached to posterior proximal portion of 5; article 7 short, stout.

Uropod 1 extending as far as uropod 2, rami as long as peduncle, inner ramus with 2 spinules on upper margin, outer margin of outer ramus spinulate.

Uropod 2: rami slightly shorter than peduncle, subequal in size, upper edge of inner ramus and both edges of outer ramus spinulate.

Uropod 3 short, stout; rami very short, broad; inner ramus slightly larger than outer, apex with a few spinules and short setae; apex of outer ramus notched.

Telson: lobes rather narrow, apices blunt, notched, each notch containing a blunt spine; dorsal surface of each lobe with 2 blunt spines.

Pleon segment 3: posterior edge convex, posterior inferior angle nearly quadrate.

Pleon segment 4: posterior dorsal surface weakly convex, not produced above segment 5 at posterior end.

Pleon segment 6: lateral processes small.

Male: Differing from the female by the setal tufts on the antennae; antenna 2 longer than body; pleon segment 4 strongly rounded; crests of pleon segment 6 strongly developed; rami of uropod 3 stout, lanceolate, inner ramus wider than outer, both rami strongly setose, apices slightly recurved. Found only at Station 478-35.

Material examined: Stations 12-33 (2), 113-33 (152), 244-34 (1), 257-34 (1), 264-34 (2), 287-34 (6), 364-35 (15), 374-35 (1), 398-35 (1), 448-35 (3), 459-35 (24), 478-35 (44), 487-35 (3), 555-36 (1), 556-36 (9), 562-36 (679). Laguna Beach, California, intertidal, collected by John L. Mohr, April 17, 1947.

Remarks: This species differs from *Ampelisca lobata* Holmes in the shape of peraeopod 5 and in the form of uropod 3.

Distribution: Laguna Beach, California, shore; Cedros Island, 10 to 15 fms; Gulf of California at Isla Partida and San Esteban Island, 10 to 70 fms; south of White Friars Islands and Tenacatita Bay, Mexico, 25 fms; Costa Rica at Salinas Bay, Viradores Islands and Playa Blanca, 1.5 to 3 fms; Panama at Secas Islands and Bahia Honda, 5 to 35 fms; Ecuador at La Libertad and Salango Island, 3 to 4 fms; Peru at Lorenzo Island and Viejas Island, shore to 12 fms.

Ampelisca venetiensis Shoemaker

Plate 9

Ampelisca venetiensis Shoemaker (1916), Proc. Biol. Soc. Washington, vol. 29, pp. 158-159.

Description of female: Head projecting, as long as first 3 body segments, lower front margin parallel to upper margin. Upper pair of eyes above and behind incised portion of front margin, lower pair of eyes at lateral angle of head.

Antenna 1 reaching about half way along fifth article of peduncle of antenna 2; article 1 tumid, article 2 about one half again as long as article 1, article 3 shorter than article 1.

Antenna 2 about the length of the body; article 5 of peduncle about three fourths as long as article 4.

Mandible: spine row with 16 to 20 spines; article 3 of palp slightly shorter than article 2.

Maxilla 1: outer plate armed with 11 spines; article 2 of palp more slender than outer plate, apex armed with 5 spines, 4 cusp teeth and 8 or 9 setae.

Maxilliped: inner plate reaching slightly beyond end of palp article 1, apex armed with 2 chisel teeth; outer plate reaching to end of palp article 2, inner edge armed with 11 chisel teeth, rounded apex with 6 or 7 setal spines and setae, the outer 3 or 4 plumose.

Coxa 1: lower posterior angle with a blunt tooth, coxae 2 and 3 without tooth or slit.

Gnathopod 1: article 6 about two thirds as long as 5, article 7 one half as long as 6.

Gnathopod 2: article 6 slightly more than one half as long as article 5, article 7 one half as long as 6.

Peraeopod 1: anterior distal angle of article 4 produced; article 7 not longer than articles 5 and 6 combined.

Peraeopod 2: similar to 1 but with generic differences.

Peraeopod 3: posterior edge of article 5 with 2 or 3 groups of spines, posterior edge of article 6 with 5 to 7 spines.

Peraeopod 4: posterior edge of article 5 with 2 or 3 groups of spines, posterior edge of article 6 with 4 or 5 spines.

Peraeopod 5: posterior lobe of article 2, lower posterior margin obliquely rounded, reaching down to junction between articles 4 and 5; article 4 longer than 3, with a moderately strong posterior, setose lobe; article 5, anterior distal edge notched; article 6 longer than 5; article 7 about three fourths as long as 6. Lower edge of lobe of article 2 minutely crenulate.

Uropod 1 reaching as far as uropod 2, rami subequal to each other and to peduncle; both edges of inner ramus and outer edge of outer ramus spinulate.

Uropod 2: rami shorter than peduncle, both margins of inner ramus and outer margin of outer ramus spinulate, outer ramus tipped with a long spine.

Uropod 3: rami broad, subequal in length, outer ramus narrower than inner, both rami strongly setose, apex of outer ramus hooked.

Telson: lobes evenly tapering, apices unnotched, armed with 1 to 7 spinules, middle dorsal surface of each lobe armed with a diagonal row of 5 to 9 setae or 2 successive rows with 3 to 5 setae each. The spinules at the apices may be strongly asymmetrical in number, such as 1 and 7, or be more symmetrical, such as 5 and 5 or 4 and 3.

Pleon segment 3: posterior margin slightly convex, lower posterior angle broadly rounded. Dorsal surface of segment with 3 longitudinal ridges which run forward on the body of the animal to include peraeon segment 7, the middle carina continuing on to peraeon segment 6. The integument lateral to the carinae may be folded or deeply pitted.

Pleon segment 4: posterior dorsal surface raised into a strong, saddle-shaped carina, the 2 apices of which are acute.

Pleon segment 6: lateral ridges strongly developed.

Material examined: Stations 209-34 (7), 468-35 (5), 580-36 (1), 934-39 (1), 936-39 (1), 1037-40 (1), 1965-50 (15), 2026-51 (4).

Remarks: The armature of the telson of this species is very distinctive, as is the shortness of the seventh article of peraeopods 1 and 2. Although no males were found in the present collections, Shoemaker (1916) has described them.

The largest specimen at hand measured 18 mm in length (Station 1965-50). The smallest specimen exhibiting carinae on the dorsal surface of pleon segment 3 was 9.5 mm in length.

Distribution: South Bay, Cedros Island, 16 to 19 fms; off Entrada Point, Magdalena Bay, 28 to 34 fms; Gulf of California at Boca de la Trinidad and San Marcos Island, 20 to 150 fms; Port Parker, Costa Rica, 3 to 10 fms; off Santa Elena Bay, Ecuador, 8 to 10 fms.

Ampelisca romigi, new species

Plates 10 and 11

Description of female: Head not as long as first 3 body segments, front margin broadly incised, lower front margin oblique, convex. Upper pair of eyes behind upper edge of antenna 1, lower pair on front oblique margin.

Antenna 1 reaching beyond middle of article 5 of peduncle of antenna 2, or longer than peduncle; article 2 about one and one-half times as long as 1; article 3 shorter than 1.

Antenna 2 three fourths to longer than body; article 4 of peduncle slightly longer than article 5.

Mandible: spine row with 10 spines; palp article 3 about two thirds as long as second article.

Maxilla 1: outer plate armed with 11 spines; article 2 of palp rather slender, apically armed with 4 spines, 4 cusp teeth, and 8 or 9 setae.

Maxilliped: inner plate reaching beyond palp article 1, apex armed with 2 chisel teeth; outer plate reaching to end of palp article 2, inner margin with 7 chisel teeth, rounded apex with 6 setal spines, the outer 3 plumose.

Coxae 1 to 3: lower posterior corner with a slit.

Gnathopod 1: article 6 three fourths as long as 5, palm convex, lined with slightly pectinate setae; article 7 slightly more than half as long as 6.

Gnathopod 2: article 6 slightly more than half as long as 5, article 7 two thirds as long as 6.

Peraeopod 1: article 7 slightly longer than articles 5 and 6 combined; anterodistal angle of article 4 slightly produced; article 2 greatly inflated.

Peraeopod 2: similar to 1 but with generic differences.

Peraeopod 3: posterior edge of article 5 with 2 or 3 sets of spines, posterior edge of article 6 with 2 spines.

Peraeopod 4: similar to 3 but with generic differences.

Peraeopod 5: lower edge of lobe of article 2 reaching joint between articles 4 and 5, lower posterior edge oblique; article 4 with a posterior setose lobe; article 5, distal anterior edge notched; article 6 longer than 5, expanded; article 7 shorter than 5.

Uropod 1 nearly reaching the end of uropod 2, rami subequal to each other, equal in length to peduncle, both margins of inner ramus spinulate, outer ramus unarmed.

Uropod 2: outer ramus slightly shorter and more slender than inner, both margins of inner ramus and outer margin of outer ramus spinulate.

Uropod 3: rami moderately slender, outer ramus slightly shorter and narrower than inner, its end notched; apex of inner ramus slightly uncinate, inner apical margin setose.

Telson: lobes rather broad, apices blunt, each with a spinule and a setule; dorsal surface of each lobe with 2 to 4 spinules.

Pleon segment 3: posterior edge convex, lower posterior corner quadrate in outline.

Pleon segment 4: posterior dorsal surface raised into a weakly saddle-shaped process, the posterior dorsal edge keel-like.

Pleon segment 6: lateral ridges weakly developed.

Male: Only 2 underdeveloped males from Station 1390-41 were found in the collections. They differ from the female only in the presence of slightly developed setal tufts on the peduncles of both antennae.

Types: Holotype, AHF no. 414, female, 11 mm; paratypes, 4 females.

Type locality: Station 1294-41, one half mile south of Gull Island, Santa Cruz Island, California, 34 to 41 fms.

Material examined: Stations 209-34 (5), 277-34 (11), 457-35 (1), 478-35 (18), 481-35 (8), 555-36 (1), 556-36 (1), 561-36 (2), 564-36 (16), 576-36 (1), 581-36 (1), 582-36 (1), 702-37 (2), 704-37 (1), 706-37 (1), 745-37 (1), 908-39 (1), 911-39 (1), 981-39 (1), 985-39 (1), 1150-40 (4), 1173-40 (1), 1192-40 (2), 1194-40 (2), 1202-40 (48), 1220-40 (2), 1229-41 (2), 1267-41 (1), 1280-41 (1), 1294-41 (10), 1298-41 (5), 1318-41 (1), 1321-41 (3), 1353-41 (1), 1359-41 (7), 1373-41 (1), 1386-41 (3), 1387-41 (1), 1388-41 (21), 1390-41 (17), 1411-41 (1), 1412-41 (2), 1418-41 (16).

Remarks: The paratype selected for figuring (10 mm) did not show as well developed characters of the third uropods as did other specimens, one of which, from Station 1220-40, is also figured. The shape of uropod 3 and the heavily developed second article of the first 4 appendages make this species striking.

It is related to *Ampelisca fusca* Stebbing (1888), but differs in the short antenna 1, the shape of the third uropods and telson, and the lack of teeth on the first three coxae.

In very large specimens of this species (16 mm, from Stations 576-36 and 704-37), the lower posterior corner of pleon segment 3 is very minutely produced. This same phenomonon is also exhibited in large specimens of *Ampelisca lobata* Holmes.

Distribution: Along the coast of southern California and in the Channel Islands, 15 to 275 fms; Gulf of California at Angel de la Guardia Island, Isla Partida, Angeles Bay, San Marcos Island, Tortuga Island, and Tiburon Island, 8 to 70 fms; Isabel Island, Mexico, 10 to 25 fms; Salinas Bay, Costa Rica, 1.5 to 6 fms; Secas Islands, Panama, 12 fms; Santa Elena Bay, Ecuador, 8 to 10 fms.

Ampelisca isocornea, new species

Plate 12

Description of male: Head not quite as long as first 3 body segments, anterior edge broadly incised, lower front edge oblique, concave. Upper pair of eyes suboval in outline, equal in size to lower pair of eyes; lower pair on lower front edge of head below lateral angle.

Antenna 1 reaching beyond the peduncle of antenna 2; peduncle stout; article 2 about one and one-half times as long as article 1, article 3 shorter than 1.

Antenna 2 longer than body; article 5 of peduncle seven eighths as long as 4.

Mandible: spine row with 10 spines; palp article 3 two thirds as long as article 2.

Maxilla 1: outer plate with 10 spines; palp article 2 about as wide as outer plate, apex with 4 spines, 3 cusp teeth, and 11 or 12 setae.

Maxilliped: apex of inner plate with 2 chisel teeth; inner edge of outer plate with 8 chisel teeth; rounded apex with 7 setal spines, the outer 4 of which are plumose. Palp normal.

Gnathopod 1: article 6 almost as long as 5, posterior edge slightly convex; article 7 large, about two thirds as long as article 6.

Gnathopod 2 very slender; article 6 more than one half as long as 5; article 7 slightly more than one half as long as article 6.

Coxal plates 1 to 3: lower posterior angle with a small slit.

Peraeopod 1 rather stout; distal ends of article 4 very slightly produced; article 7 longer than 5 and 6 combined.

Peraeopod 2 very stout, very strongly setose.

Peraeopod 3: anterior edge of article 2 setose; article 6 shorter than 5, posterior edge with 2 spines; posterior edge of article 5 with 3 sets of spines.

Peraeopod 4: posterior edge of article 5 with 2 sets of spines, posterior edge of article 6 with 3 spines.

Peraeopod 5 rather slender, posterior lobe of article 2 rather narrow; lower hind edge very oblique, lobe reaching downward to middle of article 4; article 4 slightly longer than 3, with a narrow, posterior, setose lobe; article 5 shorter than 6, anterior edge with 1 or 2 notches; article 6 moderately stout; article 7 shorter than 5, slender.

Uropod 1 reaching to end of uropod 2, rami almost as long as peduncle; both edges of inner ramus spinulose, outer ramus unarmed.

Uropod 2: outer ramus shorter than inner, the inner ramus as long as peduncle; inner edges of both rami spinulose, outer edge of inner ramus with several small spinules.

Uropod 3: outer ramus slender, lanceolate; inner ramus broad, lanceolate; both rami strongly setose.

Telson: lobes rather inflated, apices blunt, notched, each with a small blunt spine and a setule; upper surface of each lobe with 2 or 3 small, blunt spines.

Pleon segment 3: posterior edge convex, lower posterior corner rounded, subquadrate.

Pleon segment 4 raised dorsally into a massive, nearly acute process, the posterior edge of which is vertical.

Pleon segment 6: lateral ridges well developed.

Female: Unknown.

Types: Holotype, AHF No. 418, male, 10 mm; paratype, male, 10 mm.

Type locality: Station 1388-41, 3.6 miles off east point, Santa Rosa Island, California, 52 to 55 fms.

Material examined: Stations 939-39 (1 male), 1388-41 (2 males).

Remarks: This species resembles *Ampelisca birulai* Brüggen (1909), but differs in the shape of the rami of uropod 3, the armature and shape of the telson, and the shape of articles 3 and 4 of peraeopod 5.

Distribution: The type locality and a single record from Port Parker, Costa Rica, 5 to 10 fms.

Ampelisca cucullata, new species

Plate 13

Description of female: Head longer than first 2 body segments, anterior edge slightly incised, lower front edge oblique, convex. Upper pair of eyes behind upper margin of antenna 1, lower pair at lateral angle of head.

Antenna 1 reaching almost to end of peduncle of antenna 2; article 2 of peduncle half again as long as 1; article 3 one half as long as 1.

Antenna 2 more than half as long as body; article 5 of peduncle about four fifths as long as 4.

Mandible: spine row with 7 or 8 spines; article 3 of palp about as long as 2.

Maxilla 1: outer plate armed with 10 to 13 spines; article 2 of palp nearly as wide as apex of outer plate, armed with 4 spines, 3 cusp teeth and 8 setae.

Maxilla 2 rather stout, apex of outer plate not expanded, almost tapering.

Maxilliped: inner plate reaching to end of palp article 1, apex with 1 chisel tooth; outer plate reaching to end of palp article 2, inner edge with 6 chisel teeth, rounded apex with 4 setal spines, the outermost plumose.

Coxae without slit at lower posterior corner.

Gnathopod 1 rather slender; article 6 two thirds as long as 5; article 7 more than one half as long as 6; posterior edge of article 6 nearly straight.

Gnathopod 2: article 6 about one half as long as 5, article 7 about two thirds as long as 6.

Peraeopod 1: article 4 produced slightly at anterodistal angle; article 7 slightly longer than articles 5 and 6 combined.

Peraeopod 2 similar to 1 but with generic differences.

Peraeopod 3 rather stout; article 6 shorter than 5, with 1 spine on posterior edge; article 5 with 3 sets of spines on posterior edge.

Peraeopod 4: posterior edge of article 5 with 2 sets of spines, of article 6 with 2 spines.

Peraeopod 5: posterior lobe of article 2 large, lower edge oblique, nearly truncate, reaching down nearly to middle of article 4; articles 3 and 4 subequal in length; article 5 shorter than 6; article 7 about as long as 5; anterodistal edge of article 5 notched.

Urosome reduced in size.

Uropod 1 reaching to end of uropod 2; peduncle short, stout; rami longer than peduncle, outer ramus longer than inner; inner edge of inner ramus with a few spines.

Uropod 2: rami shorter than peduncle; upper edges of both rami spinulate.

Uropod 3: rami moderately broad, lanceolate, not much longer than peduncle; inner ramus wider than outer.

Telson: lobes apically rounded, each armed with a seta; dorsal surface of each lobe armed with 2 or 3 setae along inner edge.

Pleon segment 3: posterior edge slightly convex, lower posterior angle rounded.

Pleon segment 4: dorsal posterior surface raised into a large hood-shaped hump which is nearly cristate at its apex.

Pleon segment 6: lateral ridges very small.

Male: Unknown.

Types: Holotype, AHF no. 3912, ovigerous female, 5.5 mm; paratypes, 4 ovigerous females.

Type locality: Station 964-39, Tenacatita Bay, Mexico, 2 to 8 fms.

Material examined: Five ovigerous females and 3 females from the type locality.

Remarks: See *Ampelisca vera,* new species, below, for a discussion of this species.

Distribution: Known only from the type locality.

Ampelisca vera, new species

Plates 14, 15 and 16

Description of male: Head nearly as long as first 3 body segments, anterior edge moderately incised, rostrum not strongly developed; lower front edge of head convex, oblique. Upper pair of eyes rather small, behind upper edge of antenna 1; lower pair at lateral angles of head, larger than upper pair.

Antenna 1 longer than peduncle of antenna 2, stout; article 2 of peduncle slightly longer than 1; article 3 short.

Antenna 2 about as long as body; articles 4 and 5 of peduncle subequal in length.

Mandible: spine row with 11 spines; article 3 of palp nearly as long as article 2.

Maxilla 1: outer plate armed with 11 spines; article 2 of palp nearly as wide as outer plate, apex with 4 spines, 3 cusp teeth and 8 to 10 setae; inner plate rather long, conical.

Maxilliped: inner plate reaching to end of palp article 1, apex with 2 chisel teeth; outer plate reaching to end of palp article 2, inner edge with 8 chisel teeth, rounded apex with 4 or 5 setal spines.

Coxae 1 to 3 without a slit at lower posterior angles, although a single seta is set in a notch.

Gnathopod 1: article 6 shorter than article 5; article 7 two thirds as long as 6; posterior edge of article 6 nearly straight.

Gnathopod 2: article 6 one half as long as 5, article 7 nearly two thirds as long as 6.

Peraeopod 1 rather stout; article 7 slightly longer than articles 5 and 6 combined; article 4, distal anterior angle slightly produced.

Peraeopod 2 similar to 1, but with generic differences.

Peraeopod 3: article 2 rather wide; posterior edge of article 5 with 2 sets of spines; posterior edge of article 6 with 2 spines.

Peraeopod 4: article 2 rather narrow, appendage otherwise similar to peraeopod 3 but with generic differences and posterior edge of article 6 with 3 spines.

Peraeopod 5: article 2 wide, lower edge of lobe asymmetrically rounded, reaching downward to joint between articles 4 and 5; articles 3 and 4 subequal in length, article 4 with a long, slender posterior setose lobe; article 6 longer than 5, article 7 subequal to 5 in length.

Uropod 1 reaching to end of uropod 2; peduncle short, stout; rami much longer than peduncle; inner edge of inner ramus armed with spinules, outer ramus unarmed.

Uropod 2: rami shorter than peduncle, outer ramus slightly shorter than inner, armed apically with a small spine; upper edges of both rami spinulate, inner edge of inner ramus spinulate.

Uropod 3: rami lanceolate, outer somewhat narrower than inner, both margins of both rami strongly setose.

Telson cleft nearly three fourths of its length; lobes broad, apices blunt, incised, each armed with 5 setules; dorsal surface of each lobe with 2 or 3 setules.

Pleon segment 3: posterior edge strongly convex, lower posterior corner rounded; dorsal surface of segment with a single, small ridge.

Pleon segment 4: dorsal posterior surface with a strong, massive carina; posterior angle subacute.

Pleon segment 6: lateral ridges strongly developed.

The urosome segments are considerably shortened, the urosome being rather small in size.

Description of female: Antenna 1, article 2 of peduncle almost twice as long as article 1; article 5 of peduncle almost three fourths the length of article 4; article 3 of mandibular palp almost two thirds as long as article 2; inner edge of outer plate of maxilliped with 6 chisel teeth, rounded apex with 5-6 setal spines, the 2 outermost plumose; article 5 of peraeopod 5, anterior distal edge notched; uropod 3, outer margin of inner ramus with several groups of setules, outer margin of outer ramus setose; pleon segment 4 raised to a subacute process much smaller than in the male; pleon segment 6, lateral ridges small.

Types: Holotype, AHF no. 345, male, 9 mm; paratype, male, 9 mm; allotype, female, 10 mm.

Type locality: Cultus Bay, Whidbey Island, State of Washington, May 30, 1934, collected by J. E. Lynch and W. Mcl. Chapman, muddy bottom of intertidal.

Material examined: Stations 113-33 (1), 116-33 (44), 214-34 (1), 236-34 (1), 259-39 (2), 264-34 (1), 396-35 (2), 421-35 (2), 429-35 (4), 431-35 (1), 432-35 (1), 443-35 (12), 468-35 (14), 470-35 (3), 475-35 (15), 476-35 (52), 477-35 (3), 480-35 (2), 481-35 (30), 555-36 (1), 556-36 (1), 558-36 (5), 562-36 (1), 564-36 (27), 572-36 (1), 702-37 (3), 734-37 (8), 769-38 (1), 1055-40 (2), 1131-40 (1), 1140-40 (1), 1168-40 (1), 1169-40 (1), 1191-40 (1), 1202-40 (1), 1229-41 (2), 1245-41 (1), 1294-41 (1), 1328-41 (1), 1359-41 (3), 1373-41 (1), 1384-41 (7), 1390-41 (1), 1418-41 (9), 1965-50 (7), 2026-51 (39), and 27 specimens from type locality.

San Quintin Bay, Lower California, dredged in shallow water, April 6, 1950, collected by R. J. Menzies (14).

Remarks: In young females the head is not produced so far forward as in the figured specimen. The female differs from the male in the shape of the head, the weaker process of pleon segment 4, and the shorter antennae and armature of uropod 3.

The male of this species might easily have been described as the unknown male of *Ampelisca cucullata,* new species, but is placed with the herein described females on the basis of the rostral portion of the head and by the association of males and females in the Whidbey Island material. The females of *Ampelisca vera* and *A. cucullata,* new species, are distinguished by the shape of pleon segment 4.

I am unable to separate this species from *Ampelisca compressa* Holmes (1905, pp. 480-481) which exists on the basis of a very poor description and figures.

Ampelisca vera is easily confused with *A. romigi,* new species, but may be distinguished by the slightly shorter, broad peduncle of uropod 1 and by the non-uncinate rami of the third uropods.

Considerable variation is seen in the dorsal process of pleon segment 4 of the female, the extremes of which can be seen in the figures. Other specimens show intergradations between these extremes.

Distribution: Along the coast of southern California and in the Channel Islands, 10 to 109 fms; along the coast of Lower California at San Quintin Bay, Todos Santos Island, Cedros Island, and Magdalena Bay, shallow to 41 fms; Gulf of California at San Pedro Nolasco Island, Isla Partida, Angel de la Guardia Island, San Esteban Island, Tiburon Island, and Angeles Bay, 8 to 75 fms; south of White Friars Islands and Tangola Tangola Bay, 25 fms; off San Jose Point, Guatemala, 20 fms; Costa Rica at Salinas Bay, Port Parker, and Cocos Bay (south of Port Culebra), 2 to 20 fms; Panama at Bahia Honda and Piñas Bay, 5 to 20 fms; Octavia Bay and Port Utria, Colombia, 30 to 50 fms; Salango Island and Cape San Francisco, Ecuador, 2 to 12 fms.

Ampelisca cristata Holmes

Plates 17 and 18

Ampelisca cristata Holmes (1908), Proc. U.S. Natl. Mus., vol. 35, pp. 507-508, figs. 16, 17.

Description of female: Head as long as first 3 segments, front margin of head slightly incised, lower front margin parallel to upper margin of head. Upper pair of eyes near anterior margin of head, lower pair at lateral angle of head.

Antenna 1 short, reaching almost to end of peduncle of antenna 2; article 1 tumid, not as long as article 2; article 3 about half as long as 2.

Antenna 2 about the length of the body; article 5 of peduncle two thirds as long as 4.

Mandible: spine row with 13 to 15 spines, article 3 of palp shorter than second.

Maxilla 1: outer plate armed with 10 spines; article 2 of palp nearly as large as outer plate, apex with 5 spines, 5 cusp teeth and 15 to 17 setae.

Maxilliped: inner plate not quite reaching to middle of palp article 2, apex with 3 chisel teeth; outer plate reaching to end of palp article 2, inner margin with 12 chisel teeth, rounded apex with 7 to 9 spines and setae, the outer three of which are plumose.

Coxa 1: lower posterior angle with a tooth, coxae 2 and 3 without tooth or slit.

Gnathopod 1: article 6 about two thirds as long as 5, article 7 about one half as long as 6. Posterior margin of article 2 lined with small spinules.

Gnathopod 2: article 6 less than half as long as 5, article 7 half as long as 6; article 2 as in gnathopod 1.

Peraeopod 1: coxal plate not narrow at distal end as figured by Holmes (1908, fig. 16); article 2 lined with spinules as in gnathopods 1 and 2; article 7 nearly twice as long as articles 5 and 6 combined; anterodistal angle of article 4 produced.

Peraeopod 2 similar to 1 but with generic differences.

Peraeopod 3: posterior margin of article 6 with 6 or 7 strong setal spines.

Peraeopod 4: posterior margin of article 5 with 4 sets of spines, posterior margin of article 6 with 4 spines.

Peraeopod 5: inferior edge of posterior lobe of article 2 nearly truncate below, extending down to junction between articles 4 and 5; article 2 rather short; article 4 longer than 3; articles 5 and 7 of equal length, about two thirds as long as article 6.

Uropod 1 reaching to end of uropod 2; rami equal in size, as long as peduncle; both margins of inner ramus and outer margin of outer ramus lined with spinules.

Uropod 2: rami shorter than peduncle, equal in size; inner margins of both rami spinulate; apex of outer ramus with a long spine.

Uropod 3: rami equal in length, broad, lanceolate.

Telson: apices pointed, notched laterally, each notch with 3 or 4 spinules and 1 setule; dorsal surface of each lobe with 2 to 4 spinules.

Pleon segment 3: posterior edge strongly convex, lower posterior angle strongly produced into a tooth; dorsal surface of segment with 2 low, lateral, longitudinal crests.

Pleon segment 4 with a strong dorsal laminar crest, the posterior dorsal edge of which inclines upwards, rounds off, and then descends obliquely to base. In the largest female in the collections (18 mm long), the front portion of pleon segment 4 has 2 low, lateral ridges.

Pleon segment 6: lateral ridges sharp, prominent.

Male: Unknown.

Material examined: Stations 470-35 (1), 538-36 (1), 701-37 (1), 722-37 (1), 887-38 (6), 889-38 (6), 898-38 (1), 913-39 (1), 975-39 (1), 1074-40 (1), 1122-40 (1), 1123-40 (2), 1153-40 (2), 1205-40 (1), 1219-40 (1), 1232-41 (1), 1274-41 (4), 1278-41 (1), 1295-41 (3), 1321-41 (2), 1340-41 (1), 1348-41 (1), 1372-41 (1), 1678-49 (1), 1905-49 (2), 2030-51 (4). Hubbs Station No. 49-166 (1 specimen).

Remarks: The lower edge of the posterior lobe of article 2 of peraeopod 5 is transverse in young specimens (7 mm) ; in older specimens it is asymmetrically rounded.

As is seen in Holmes' figures of this species and the figures in this paper, the dorsal crest of pleon segment 4 is rather variable in shape.

Some specimens reaching a size of 12-13 mm may lack brood plates, yet not possess the setal tufts typical of the male antennae of this genus. However, the peduncles of the antennae are somewhat stouter and the antennae appear to be slightly longer than normal. The notch between segment 3 and the dorsal crest of pleon segment 4 is not as deep as in males of *Ampelisca cristata* forma *microdentata,* new form, and there are 2 lateral crests on pleon segment 2. These forms resemble the "intersexes" described by Sexton (1924).

Distribution: Widely distributed in the Channel Islands and surrounding banks, along the coast of southern California, 14 to 57 fms; also found at Farallon Islands, off the coast of central California, 37 fms; off Point Pinos, Monterey Bay, 36 fms; Cedros Island, 40 to 41 fms; Gulf of California at Angeles Bay and Georges Island, 10 to 32 fms; off Rocky Point, Sonora, Mexico, 11 fms; Port Parker, Costa Rica, 5 fms.

Ampelisca cristata forma **microdentata,** new form

Plates 17 and 18

Description of female: Differing from the typical form by the reduction in size of the tooth at the lower posterior angle of pleon segment 3.

Male: Probably not fully developed. Antenna 1 reaching well beyond the end of the peduncle of antenna 2, flagellum broken; peduncle of antenna 2 somewhat stouter than in female; setal tufts of peduncles of antenna typically developed: depression between pleon segment 3 and dorsal crest of pleon segment 4 deeper than in female; dorsal crest of segment 4 with a more massive base, becoming laminar only near apex; pleon segments 2 and 3 with a single, weak, dorsal ridge.

Types: Holotype, AHF no. 408, female, 14 mm; paratypes, 3 females; allotype, male, 9.5 mm.

Type locality: Station 1169-40, 3½ miles west of Huntington Beach, California, 17 to 18 fms.

Material examined: Stations 212-34 (1), 218-34 (1), 249-34 (1), 259-34 (1), 277-34 (3), 280-34 (1), 281-34 (1), 283-34 (1), 451-35 (2), 456-35 (2), 468-35 (1), 472-35 (1), 475-35 (11), 478-35 (1), 481-35 (5), 493-36 (1), 506-36 (2), 524-36 (1), 526-36 (1), 555-36 (1), 561-36 (1), 562-36 (2), 564-36 (1), 576-36 (1), 607-36 (1), 639-37 (2), 643-37 (1), 673-37 (1), 697-37 (3), 701-37 (4), 706-37 (4), 732-37 (1), 747-37 (1), 769-38 (18), 770-38 (12), 893-38 (3), 930-39 (1), 936-39 (6), 941-39 (2), 964-39 (2), 1003-38 (3), 1031-40 (1), 1078-40 (1), 1087-40 (2), 1096-40 (1), 1123-40 (1), 1142-40 (6), 1143-40 (3), 1160-40 (4), 1168-40 (7), 1169-40 (24), 1190-40 (4), 1197-40 (4), 1238-41 (1), 1274-41 (1), 1280-41 (2), 1283-41 (1), 1662-48 (2), 1703-49 (1), 1925-49 (12), 2018-51 (5).

Remarks: There appear to be no intergrades in the material at hand between the form of pleon segment 3 of typical *Ampelisca cristata* and the new form. However, the specimens which I have separated from *A. cristata* for the sake of convenience and given a new "subspecific" designation, show considerable variation in the above mentioned character. As illustrated in the accompanying figures, it is seen that the tooth may vary from the intermediate type seen in the holotype to the form in figure G of plate 17, in which the angle of pleon segment 3 is nearly quadrate. The most frequently occurring type is that similar to the holotype and only the materials from Stations 1703-49 and 1925-49 have the completely reduced form.

Distribution: Along the coast of southern California and in the Channel Islands, 6 to 52 fms; along the coast of Lower California, 3 to 40 fms; Guadelupe Island, 35 to 40 fms; Gulf of California, 1 to 75 fms; Tenacatita Bay, Tangola Tangola Bay, and Isabel Island, Mexico, 2 to 25 fms; off San Jose Point, Guatemala, 7 to 20 fms; along the coast of Costa Rica, shore to 48 fms; Bahia Honda and Secas Islands, Panama, 12 to 20 fms; off Gorgona Island, Colombia, shore; off La Plata Island, Ecuador, 45 to 55 fms.

Ampelisca cristoides, new species

Plates 19 and 20

Description of female: Head nearly as long as first 3 body segments, anterior margin slightly incised, lower front margin parallel to upper margin of head. Upper pair of eyes behind upper margin of antenna 1, lower pair projecting from lower lateral angle of head.

Antenna 1 reaching almost to end of peduncle of antenna 2; article 1 of peduncle tumid; second article about half again as long as first, third shorter than first.

Antenna 2 about three fourths as long as body; article 5 of peduncle three fifths as long as 4.

Mandible: spine row with 14 spines; article 3 of palp as long as article 2.

Maxilla 1: outer plate armed with 11 spines; article 2 of palp much more slender than outer plate, apex with 4 spines, 3 cusp teeth, and 8 to 10 setae, and lined on outer edge with 4 long, simple setae.

Maxilliped: inner plate reaching slightly beyond end of palp article 1, apex armed with 3 chisel teeth; outer plate reaching to end of palp article 2, inner edge with 10 chisel teeth, rounded apex with 6 setal spines, the outer 4 plumose.

Coxa 1: lower posterior corner with a strong tooth, coxae 2 and 3 without tooth.

Gnathopod 1 moderately slender; article 6 about two thirds as long as 5, article 7 about one half as long as 6.

Gnathopod 2: article 6 about one half as long as 5, article 7 one half as long as 6.

Peraeopod 1: article 4, anterior distal angle produced; article 7 longer than 5 and 6 combined.

Peraeopod 2 similar to 1 but with generic differences.

Peraeopod 3: posterior edge of article 5 with 4 sets of spines, anterior edge lined with moderately strong setae; article 6, posterior edge with 6 setal spines.

Peraeopod 4: posterior edge of article 5 with 3 sets of spines, posterior edge of article 6 with 3 setal spines.

Peraeopod 5: posterior lobe of article 2 nearly truncate below, reaching almost to junction between articles 4 and 5; article 4 with a small, posterior, setose lobe; article 4 longer than 3; article 6 broadly expanded; article 7 as long as article 5.

Uropod 1 reaching to end of uropod 2; peduncle slightly longer than rami; both edges of inner ramus and outer edge of outer ramus spinulate.

Uropod 2: peduncle slightly longer than rami; both edges of inner ramus and upper edge of outer ramus spinulate; outer ramus with a strong spine at apex.

Uropod 3: rami broad, lanceolate, subequal, both edges of outer ramus and outer edge of inner ramus setose.

Telson: lobes moderately slender; apex of lobe notched laterally, containing 3 or 4 setae; upper surface of each lobe with 3 to 5 setae.

Pleon segment 3: posterior edge convex, lower posterior angle with a small tooth, dorsal surface of segment raised into 2 very strong lateral ridges.

Pleon segment 4: dorsal surface with a thin keel, the dorsal surface of which is strongly incised.

Pleon segment 6: lateral ridges strongly developed.

Male: Unknown.

Types: Holotype, AHF no. 4914, female, 14.5 mm; paratype, female, 14 mm.

Type locality: Station 1714-49, 2 miles east of Entrada Point, Magdalena Bay, Lower California, 17 to 18 fms.

Material examined: Stations 221-34 (3), 259-34 (4), 268-34 (2), 280-34 (2), 284-34 (2), 285-34 (2), 456-35 (2), 458-35 (1), 478-35

(1), 481-35 (4), 564-36 (5), 576-36 (1), 706-37 (2), 726-37 (1), 745-37 (5), 856-38 (1), 1075-40 (4), 1714-49 (2), 1757-49 (1), 1965-50 (2).

Remarks: This species is very closely related to *Ampelisca cristata* forma *microdentata,* new form, differing essentially only in the shape of the dorsal crest of pleon segment 4. Slight intergradations between the two species have been found in the material at hand, but in all cases *A. cristoides* is easily separated from *A. cristata* forma *microdentata* (see remarks under latter). Whether *A. cristoides* is only a form of *A. cristata* or whether it is indeed a reproductively isolated population cannot be decided at this time. It has been given specific status to facilitate the future work of taxonomists.

Distribution: Along the coast of Lower California at Thurloe Head, Santa Maria Bay, and Magdalena Bay, 17 to 40 fms; Gulf of California at Carmen Island, Georges Island, Lobos Point, Tortuga Island, Angel de la Guardia Island, and Tiburon Island, shore to 25 fms; Isabel Island, north of White Friars Islands, and Tangola Tangola Bay, Mexico, 10 to 25 fms; Salinas Bay, Costa Rica, 1.5 to 6 fms; Secas Islands, Panama, 5 to 20 fms; Port Utria and off Gorgona Island, Colombia, 15 to 30 fms.

Ampelisca pacifica Holmes

Plates 21 and 22

Ampelisca pacifica Holmes (1908), Proc. U.S. Natl. Mus., vol. 35, no. 1654, pp. 511-513, figs. 20-22.

Description of female: Head nearly as long as first 3 body segments, anterior margin incised, lower front margin subparallel to upper margin. Upper pair of eyes near front margin of head, lower pair at inferoanterior angle of head.

Antenna 1 reaching middle of fifth article of antenna 2 peduncle; article 1 tumid, article 2 slightly more than twice as long as first, article 3 subequal to 1 in length.

Antenna 2 more than three fourths as long as body; article 5 of peduncle about two thirds as long as article 4.

Mandible: spine row with 9 spines; article 3 of palp more than two thirds as long as article 2.

Maxilla 1: outer plate with 11 spines; article 2 of palp large, apex with 5 spines, 4 cusp teeth, and 15 setae.

Maxilliped: inner plate not extending to middle of palp article 2, apex with 2 chisel teeth and a smaller medial one; outer plate reaching to end of palp article 2, inner margin with 10 chisel teeth, rounded apex with 6 spines, the outer 3 plumose.

Coxae 1 to 3: lower posterior angle slit.

Gnathopod 1: article 6 about three fourths as long as 5, article 7 two thirds as long as 6.

Gnathopod 2: article 6 about one half as long as 5, article 7 about one half as long as 6.

Peraeopod 1: anterodistal margin of article 4 produced; article 7 half again as long as articles 5 and 6 combined.

Peraeopod 2 similar to 1 but with generic differences.

Peraepod 3: posterior margin of article 5 with 2 sets of spines; posterior margin of article 6 with 1 or 2 spines.

Peraeopod 4: posterior margin of article 5 with 3 sets of spines; posterior margin of article 6 with 2 spines.

Peraeopod 5: inferior margin of lobe of article 2 rounded, extending downward to junction of articles 4 and 5; article 3 subequal in length to article 4, the latter with a posterior, setose lobe; articles 5 and 7 subequal in length; article 6 longer than 5, anterodistal edge of the latter notched slightly.

Uropod 1 extending backward to end of uropod 2; rami equal in size, longer than peduncle; inner margin of inner ramus spinulate.

Uropod 2: rami subequal in length to peduncle; upper margins of both rami spinulate, apex of outer ramus with a long spine.

Uropod 3: rami inflated; outer ramus broader than inner, apex more rounded, apical inner and outer margins setose; apex of inner ramus slightly rounded, with a cusp at inner edge, outer and apical margins setose.

Telson: lobes tapering evenly to apex, apex notched, with 4 to 6 setules; dorsal surface of each lobe with 7 or 8 bifid spinules.

Pleon segment 3: posterior margin convex, lower posterior angle strongly produced into a tooth; dorsal surface of segment with 2 low, lateral ridges which may extend anteriorly to pleon segment 1.

Pleon segment 4: posterior dorsal surface raised into a slightly saddle-shaped process.

Pleon segment 6 with small lateral ridges.

Length of female 13 mm.

Male: Antenna 2 about as long as body; pleon segment 3, dorsal surface with a single medial ridge; pleon segment 4 more strongly produced; pleon segment 6, lateral ridges strongly developed; setal tufts of antennal peduncles typically developed. Length of male, 10 mm.

Material examined: Stations 250-34 (3), 496-36 (8), 985-39 (1), 1026-39 (1), 1140-40 (1), 1131-40 (1), 1160-40 (1), 1168-40 (2), 1194-40 (2), 1202-40 (5), 1220-40 (9), 1229-41 (1), 1319-41 (2), 1343-41 (1), 1379-41 (1), 1384-41 (3), 1388-41 (5), 1392-41 (1), 1396-41 (1).

Remarks: Holmes failed to mention the presence and the location of the eyes in describing this species. The rami of the third uropods are rather distinctive and easily identify this species in the Eastern Pacific fauna. *Ampelisca statenensis* K. H. Barnard (1932) appears to resemble it closely but varies in the wider lobe of article 2 of peraeopod 5, the less well developed tooth on pleon segment 3, and the even more greatly inflated rami of uropod 3.

Distribution: Widely distributed in the Channel Islands off the coast of southern California from Point Fermin south to Laguna Beach, 10 to 275 fms; Fraile Bay, Gulf of California, 80 fms; Secas Islands, Panama, 25 fms.

Ampelisca brevisimulata, new species
Plates 23 and 24

Description of female: Head almost as long as first 3 segments of body, lower front margin subparallel to upper margin, anterior margin nearly straight. Upper pair of eyes near anterior margin of head, above insertion of first antennae; lower pair of eyes at inferoanterior angle of head.

Antenna 1 reaching beyond end of fourth peduncle article of antenna 2; article 1 of peduncle tumid; article 2 slender, almost twice as long as article 1; article 3 slightly less than half as long as article 2.

Antenna 2 more than three fourths the length of the body; article 5 of peduncle three fourths as long as article 4.

Mandible: spine row with 10 or 11 spines; article 3 of palp two thirds as long as 2.

Maxilla 1: outer plate with 10 or 11 spines; article 2 of palp almost as large as outer plate, apex armed with 4 spines, 4 cusp teeth and 9 setae.

Maxilliped: inner plate reaching beyond end of palp article 2, apex armed with 2 strong chisel teeth, and a single medial, small tooth; inner margin of outer plate with 8 chisel teeth, rounded apex with 5 setal spines, the outer 3 of which are plumose.

Coxa 1 with a small tooth; coxae 2 and 3 without tooth or slit.

Gnathopod 1: article 6 shorter than article 5, palm nearly straight; article 7 almost half as long as article 6.

Gnathopod 2: article 6 less than half as long as article 5; article 7 about half as long as 6.

Peraeopod 1: seventh article more than half again as long as articles 5 and 6 combined; distal anterior margin of article 4 slightly produced.

Peraeopod 2 similar to 1 but with generic differences.

Peraeopod 3: posterior margin of article 5 with 6 sets of spines, article 6 with 5 spines.

Peraeopod 4: posterior margin of article 5 with 5 or 6 sets of spines, article 6 with 4 spines.

Peraeopod 5: inferior margin of lobe of article 2 rounded, extending downward to end of article 4; article 4 slightly longer than article 3, with a small, setose, posterior lobe; articles 5 to 7 inflated, 5 and 7 subequal in length, shorter than article 6.

Uropod 1 extending to end of uropod 2; rami subequal in length to peduncle; both margins of both rami spinulate.

Uropod 2: rami equal in size, subequal to peduncle; inner margins of both rami lined with spinules, outer margin of inner ramus lined with smaller spinules; apex of outer ramus with a long spine.

Uropod 3: rami broadly lanceolate, outer ramus narrower than inner; inner margins of both rami lined with setae about halfway to base, outer margin of outer ramus lined with spinules; upper and lower surface of inner ramus sparsely covered with setae.

Telson: lobes not tapering evenly to apex, apices very slender, only slightly notched, containing 1 or 2 setae; dorsal surface of each lobe with 12 to 18 setae.

Pleon segment 3: posterior margin strongly bisinuate; lower posterior angle produced into a strong tooth, the prominence above being large, rounded, produced about the same length as the tooth.

Pleon segment 4: posterior dorsal surface slightly raised, ending posteriorly in a right angle above segment 5.

Male: Differing from the female by the production of pleon segment 4 into a tall, rounded boss; pleon segment 6 strongly produced; uropod 3, rami slightly stouter than in female; antennal armature typical of the male ampeliscid.

Types: Holotype, AHF no. 415, ovigerous female, 8 mm; paratype, female, 9 mm.

Type locality: Station 1321-41, 2 miles west of Church Rock, Santa Catalina Island, 45 to 53 fms.

Material examined: Stations 281-34 (1), 439-35 (2), 468-35 (1), 769-38 (6), 770-38 (3), 1168-40 (3), 1169-40 (6), 1191-40 (1), 1194-40 (6), 1202-40 (1), 1220-40 (1), 1321-41 (17), 1388-41 (2), 1390-41 (6), 1780-49 (8), 2018-51 (3), 2026-51 (4), Burch 3837 (1).

Remarks: This species is closely related to *Ampelisca brevicornis* (Costa, 1853) but is distinguished by the lack of a strongly produced article 4 of peraeopod 1, by the smaller posterior lobe of peraeopod 5, by the long article 2 of peduncle of antenna 1, and by the straightness of the posterior edge of article 2 of peraeopod 4. In some of these characters it is more closely related to *A. subbrevicornis* Pirlot (1936) ; but it differs from that species in the shorter length of article 5 of the peduncle of antenna 2, the longer, more slender article 2 of the peduncle of antenna 1, the lack of a strongly developed posterior lobe of article 4 of peraeopod 5, and the subequal rami of uropod 3.

Distribution: Along the coast of southern California and in the Channel Islands, 16 to 83 fms; along the coast of Lower California at Cedros Island, Santa Maria Bay, and Blanca Bay, 8 to 30 fms; Gulf of California off San Gabriel Bay, Espiritu Santo Island, 21 fms; off San Jose Point, Guatemala, 7 to 20 fms; Port Parker, Costa Rica, 5 fms; Piñas Bay, Panama, 20 fms.

Ampelisca panamensis, new species

Plate 25

Description of female: Head similar to *Ampelisca cristata* Holmes, nearly as long as first 3 body segments, lower front margin parallel to upper margin; lower pair of eyes at inferior angle, upper pair smaller than lower pair, behind upper margin of antenna 1.

Antenna 1 reaching end of peduncle of antenna 2; article 1 stout, tumid; article 2 nearly twice as long as article 1; article 3 shorter than 1.

Antenna 2 about two thirds as long as body; article 5 of peduncle three fourths as long as article 4.

Mandible with 8 to 10 spines in spine row; article 3 of palp two thirds as long as article 2.

Maxilla 1: outer plate with 11 spine teeth; palp narrower than outer plate, apex with 7 spines and 8 to 10 setae.

Maxilliped: inner plate very broad, reaching slightly beyond palp article 1, apex strongly setose, with a single, chisel-shaped spine; outer plate reaching to end of palp article 2, inner edge with 8 chisel-shaped teeth, apex with 4 setal spines, outermost one plumose.

Coxa 1 with a tooth at lower posterior corner. Other coxae without tooth or slit.

Gnathopod 1: article 6 slender, two thirds as long as 5; article 7 two thirds as long as 6.

Gnathopod 2: article 6 slightly more than half as long as 5; article 7 half as long as 6.

Peraeopod 1: anterodistal angle of article 4 slightly produced, article 4 sparsely setose; article 7 longer than 5 and 6 combined.

Peraeopod 2 similar to 1 but larger, with articles 3 and 4 strongly setose on posterior edges.

Peraeopod 3: posterior edge of article 5 with 3 sets of spines; article 6 shorter than 5, posterior edge with 3 spines.

Peraeopod 4 similar to 3 but with generic differences; posterior edge of article 6 with 2 spines.

Peraeopod 5: lower posterior edge of article 2 oblique, lobe reaching down to joint between articles 4 and 5; article 4 subequal to 3 in length, with a moderate large, setose posterior lobe; article 5 notched on lower anterior edge; article 6 as long as articles 4 and 5 combined; article 7 longer than 4, shorter than 6.

Uropod 1 reaching to end of uropod 2; rami as long as peduncle; outer ramus unarmed, inner edge of inner ramus spinulate.

Uropod 2: upper outer edge of peduncle spinulate; rami as long as peduncle; outer ramus with upper and inner margins spinulate, with a long subapical spine; inner ramus with both margins spinulate, the outer edge sparsely.

Uropod 3: rami moderately broad, lanceolate, inner ramus broader than outer; apices acute, inner apical edge of outer ramus setose, outer apical edge of inner ramus setose.

Telson: apices truncate, somewhat recessed, each armed with a spine and a setule; upper edge of each lobe with 2 stout spines.

Pleon segment 3: posterior edge slightly convex, lower posterior corner produced into a very small tooth.

Pleon segment 4 raised into a subcristate process which is acute at the posterior end.

Pleon segment 6: lateral crests not strongly developed.

Male: Unknown.

Types: Holotype, U.S. National Museum No. 93273, ovigerous female, 11 mm; paratypes, 2 deposited at USNM, 2 at AHF.

Type locality: Station 113-33, Bahia Honda, Panama, 5 to 8 fms.

Material examined: The types.

Remarks: This species is closely related to *Ampelisca brevisimulata,* new species, but differs in the shape of pleon segment 3, the presence of a notch on article 5 of peraeopod 5, and the shape and armature of the telson.

It is also closely related to *A. pacifica* Holmes, but may be distinguished by the shape of uropod 3, by the notch on article 5 of peraeopod 5, by the shape of uropod 1, and by the armature of the telson.

Ampelisca hancocki, new species

Plate 26

Description of female: Head not as long as first 3 body segments, anterior edge moderately incised, lower front edge oblique, nearly straight. Eyes large, upper pair situated rather far behind the anterior edge of the head, lower pair slightly below lateral angle of head.

Antenna 1 not reaching end of peduncle of antenna 2; article 2 of peduncle almost twice as long as article 1; article 3 as long as article 1.

Antenna 2 about three fourths the length of the animal; article 5 of peduncle subequal in length to article 4.

Mandible: spine row with 7 or 8 spines; article 3 of palp about three fourths as long as article 2.

Maxilla 1: outer plate with 10 spines; palp article 2 broader than outer plate, armed with 4 spines, 3 cusp teeth, and 8 setae.

Maxilliped: inner plate slender, truncate, armed with a single chisel-like tooth; inner margin of outer plate with 6 chisel teeth, rounded apex with 4 spines and 2 plumose setal spines; inner setal row with 5 setae. Palp normal.

Coxae 1 and 2 with a small slit at the lower posterior corners.

Gnathopod 1 moderately stout; article 6 nearly as long as article 5; article 7 strong, two thirds as long as article 6.

Gnathopod 2 slender; article 6 about two thirds as long as 5; posterior edge of article 6 very slightly convex; article 7 short.

Peraeopod 1: article 2 stouter than article 4; article 7 slightly longer than articles 5 and 6 combined; article 4, distal anterior edge produced slightly.

Peraeopod 2 similar to peraeopod 1 but with generic differences.

Peraeopod 3 moderately stout; anterior edge of article 2 heavily setose, with 2 spines on posterior edge; article 5 with 1 spine on posterior edge.

Peraeopod 4: article 5 with a single spine on posterior edge, article 6 with 3 spines on posterior edge.

Peraeopod 5 very stout; posterior lobe of article 2 large, inferior edge obliquely rounded, extending downward to middle of article 4; articles 3 and 4 subequal in length, article 4 with a massive, posterior, setose lobe; article 5 subequal in length to 4; article 6 broadly expanded, longer than article 5; article 7 rather slender, short.

Uropod 1 almost extending to end of uropod 2; rami almost as long as the rather stout peduncle; outer ramus unarmed, inner ramus with a few spinules on both edges.

Uropod 2: outer ramus a little shorter than inner, both much shorter than peduncle; upper edge of outer ramus lined with spinules; both edges of inner ramus spinulose; upper outer edge of peduncle with several spinules.

Uropod 3: rami slender, lanceolate, sparsely setose; see figure.

Telson rather slender, apices rounded, each armed medially with a stout spine and a setule; dorsal surface of each lobe with 2 stout spines.

Urosome reduced in size.

Pleon segment 3: posterior edge nearly straight, posterolateral corner produced into a very large, massive tooth.

Pleon segment 4: dorsal surface raised into a weakly saddle-shaped process, the posterior edge of which is vertical.

Pleon segment 6: lateral ridges weak.

Description of male: A single male, 6.5 mm in length, from Station 1390-41, was found. The setal tufts on the antennae very slightly developed, antenna 2 as long as body, antenna 1 reaching to end of peduncle of antenna 2, article 1 of peduncle of antenna 1 very stout, large; carina of pleon segment 4 slightly more produced than in female.

Type: Holotype, AHF no. 3910, ovigerous female, 5.6 mm.

Type locality: Station 936-39, Port Parker, Costa Rica, 5 to 10 fms.

Material examined: Stations 476-35 (4), 541-36 (1), 701-37 (1), 936-39 (1), 1390-41 (1), 1412-41 (1), 1418-41 (1).

Remarks: This species shows some resemblance to *Ampelisca bouvieri* Chevreux (1913) but differs in the shape of peraeopod 5, the shorter first antenna, the less strongly produced tooth of pleon segment 3, and the shape of pleon segment 4.

Distribution: Known from Salinas Bay and Port Parker, Costa Rica, 5 to 10 fms; Gulf of California at Puerto Refugio, Angel de la Guardia Island and Angeles Bay, 32 to 60 fms; Channel Islands, off the coast of southern California, 41 to 47 fms.

Ampelisca shoemakeri, new species

Plates 27 and 28

Description of female: Head not as long as first 3 body segments, anterior edge moderately incised, lower front edge oblique, convex. Upper portion of head rather compressed laterally. Upper pair of eyes behind upper antennae, lower pair slightly below lateral angle of head.

Antenna 1 not reaching to end of peduncle of antenna 2; article 2 of peduncle slightly longer than 1; article 3 about half as long as article 1.

Antenna 2: in the material available, the flagella of this antenna are broken; article 5 of peduncle longer than 4.

Mandible: spine row with 10 spines; article 3 of palp as long as or longer than 2.

Maxilla 1: outer plate armed with 11 spines; article 2 of palp about as wide as outer plate, armed with 4 spines, 3 cusp teeth and 10 setae.

Maxilliped: inner plate reaching to end of palp article 1, apex armed with 2 chisel teeth; outer plate reaching to end of palp article 2, inner edge lined with 7 chisel teeth, rounded apex with 5 setal spines, the outermost plumose.

Coxae 1 to 3: lower posterior angle slit.

Gnathopod 1: article 6 about three fourths as long as 5; article 7 more than half as long as 6; posterior edge of article 6 slightly convex.

Gnathopod 2: article 6 almost two thirds as long as 5; article 7 about one half as long as 6.

Peraeopod 1: article 4 greatly wider than article 5; article 7 about as long as articles 5 and 6 combined.

Peraeopod 2 similar to 1 but with generic differences.

Peraeopod 3: rather stout, article 2 very wide; posterior edge of article 6 with 2 spines, posterior edge of article 5 with 1 spine.

Peraeopod 4 stout; posterior edge of article 5 with 1 spine, posterior edge of article 6 with 3 spines.

Peraeopod 5: posterior lobe of article 2, lower edge rounded, extending downward only slightly past end of article 3; article 4 subequal to 3 in length, posterior edge with a narrow setose lobe; article 6 slightly longer than 5; article 7 about as long as 5, slender.

Uropod 1: reaching to end of 2; peduncle moderately stout; rami longer than peduncle, outer unarmed, inner ramus with both edges spinulate.

Uropod 2: rami shorter than peduncle, subequal in length; inner edge of inner ramus and upper edge of outer ramus spinulate.

Uropod 3: rami slender, lanceolate, outer more slender than inner; both rami slightly setose.

Telson moderately slender, apices medially notched, each notch with a stout spine; dorsal surface of each lobe with 5 stout spines.

Pleon segment 3: posterior edge nearly straight, lower posterior angle produced into a small tooth.

Pleon segment 4 slightly raised dorsally, slightly concave, posterior edge rounded.

Pleon segment 6: lateral ridges slightly developed.

Description of male: Anterior dorsal portion of head slightly more produced than in female; antenna 1 reaching beyond peduncle of antenna 2; antenna 2 longer than body, article 3 of peduncle stouter than in female; peduncles of antennae with setal tufts; pleon segment 3, dorsal posterior surface produced into a moderately strong carina; pleon segment 4 strongly produced; lateral ridges of pleon segment 6 strong. The third uropods are strikingly different from those of the female and open the question whether this is actually the male of the species as based on the female holotype, although other species, such as *A. lobata* Holmes, also show this sexual dimorphism. All other characteristics of the male appear to be within the range of variation encountered in the female material.

Types: Holotype, AHF no. 3913, female, 6 mm; paratypes, 5 females; allotype, male, 5.5 mm.

Type locality: Station 964-39, Tenacatita Bay, Mexico, 2 to 8 fms.

Material examined: Stations 122-33 (2), 264-34 (1), 475-35 (266), 480-35 (6), 770-38 (1), 964-39 (12), 2026-51 (4).

Remarks: The length of the fifth article of the peduncle of antenna 2 varies considerably. In the holotype and the figured paratype it is longer than article 4; in the other specimens it may be subequal to or shorter than article 4.

In young specimens the head is narrower vertically than in the type material, not as laterally compressed, and the lower pair of eyes may be situated at the lower anterior angle of the head. The range of variation in these characters seems to indicate that they have no specific value.

This species appears to be closely related to *Ampelisca hancocki,* new species, but differs essentially in the weak tooth of pleon segment 3 and the relative proportions of the rami and peduncle of uropod 1.

Distribution: South Bay, Cedros Island, 16 to 19 fms; Tenacatita Bay, and south of White Friars Islands, Mexico, 4 to 25 fms; off San Jose Point, Guatemala, 7 to 11 fms; Salinas Bay, Costa Rica, 12 to 20 fms.

Ampelisca macrocephala (Lilljeborg)

Plate 29

Ampelisca macrocephala Lilljeborg (1842), Öfv. Ak. Förh., vol. 9, p. 7; Sars (1895), Crust. Norway, vol. 1, pp. 172-173, pl. 60, fig. 1; Stebbing (1906), Das Tierreich, pt. 21, p. 101; Holmes (1908), Proc. U.S. Natl. Mus., vol. 35, no. 1654, p. 510.

Description of female: Head nearly as long as first 3 body segments, anterior margin slightly incised, lower margin oblique, nearly straight. Upper pair of eyes near anterior margin of head, lower pair at infero-anterior angle of head.

Antenna 1 reaching to the middle of or to the end of article 5 of antenna 2; article 2 of peduncle twice as long as article 1, article 3 slightly shorter than 1.

Antenna 2 more than half the length of the body; article 5 of peduncle three fourths as long as 4.

Mandible: spine row with 8 spines; article 3 of palp two thirds as long as article 2.

Maxilla 1: outer plate armed with 10 spines; article 2 of palp nearly as large as outer plate, apex armed with 5 spines, 4 cusp teeth and 7 to 9 setae.

Maxilliped: inner plate not quite reaching to middle of palp article 2, apex with 2 chisel teeth; outer plate reaching to middle of palp article 3, inner edge with 8 chisel teeth, rounded apex with 5 spines, the outer 3 plumose.

Coxae 1 to 3: lower posterior angle slit.

Gnathopod 1: article 6 two thirds as long as 5, article 7 about two thirds as long as 6; palm slightly convex.

Gnathopod 2: article 6 less than half as long as article 5, article 7 half as long as 6.

Peraeopod 1: anterodistal margin of article 4 very slightly produced; article 7 half again as long as articles 5 and 6.

Peraeopod 2 similar to 1 but with generic differences.

Peraeopod 3: posterior margin of article 5 with 2 or 3 sets of spines, posterior edge of article 6 with 1 spine.

Peraeopod 4: posterior margin of article 5 with 2 or 3 sets of spines, posterior margin of article 6 with 1 spine.

Peraeopod 5: inferior margin of posterior lobe of article 2 nearly truncate, extending downward almost to end of article 4; article 4 as long as article 3, with a small posterior, setose lobe; articles 5 and 7 subequal in length, shorter than article 6.

Uropod 1 extending backward to end of uropod 2; rami equal in length, subequal to peduncle; upper margins of both rami spinulate.

Uropod 2: rami subequal in length, subequal to peduncle; inner margin of inner ramus and outer margin of outer ramus spinulate, apex of outer ramus with a long spine.

Uropod 3: rami subequal in length; broadly lanceolate, outer ramus narrower than inner; apical outer margin of inner ramus and inner margin of outer ramus strongly setose.

Telson: lobes tapering evenly to apex; apex strongly notched, with 2 setae; dorsal surface of each lobe with 2 setae.

Pleon segment 3: posterior edge convex, lower posterior corner strongly produced into a tooth.

Pleon segment 4: slightly raised posteriorly, ending acutely above segment 5.

Pleon segment 6 with low lateral ridges.

Length of female, 9 mm.

Description of male: Antenna 1 reaching to end of peduncle of antenna 2; antenna 2 as long as body, peduncles typically setose; pleon segment 4 with a deep notch, followed by a large, hood-like process, the posterior edge vertical.

Material examined: Stations 887-38 (1), 1160-40 (1), 1168-40 (2), 1169-40 (2), 1194-40 (2), 1202-40 (1), 1229-41 (13), 1245-41 (1), 1319-41 (1), 1379-41 (6), 1384-41 (8), 1386-41 (4), 1388-41 (6), 1390-41 (4), 1418-41 (11), 1471-42 (8). Burch Station 3837 (1).

Remarks: There has been considerable discussion in the literature regarding this species' relationship to *Ampelisca eschrichtii* Krφyer and the problem of bipolarity. All the specimens at hand correspond to the diagnosis of *A. macrocephala* by Stappers (1911); the most important characters in separating these two species appear to be (1) the lack of a small tooth at the lower posterior angle of coxae 1 and 2, although the corner is slit in the present material; (2) the smooth anterior margin of article 5 of peraeopod 5; (3) the long spine on the outer ramus of uropod 2; (4) the nearly straight lower edge of the posterior lobe of article 2 of peraeopod 5. All of these are characteristic of *Ampelisca macrocephala.* Stappers also mentions that the outer ramus of uropod 2 is somewhat shorter than the inner; this is true in the present material only in the older specimens. Stephensen (1925) questions Holmes' determination of *A. macrocephala* at Monterey as being acceptable only with "due caution." A large series of comparative materials from both the Atlantic and Pacific Oceans, is needed to solve the several problems concerning this species. The materials at hand differ from the figures of this species in Sars (1895) by the longer article 7 of peraeopods 1 and 2. Holmes (1905) has noticed a variability in this feature, but it appears to be rather constant in the present specimens.

Distribution: Widely distributed in the Channel Islands and along the coast of southern California, 16 to 115 fms; off 10 Mile Creek, south of Winchester Bay, Oregon, 20 to 40 fms; northeast of Middle Farallon Island, 37 fms; 4 miles north of Todos Santos Island, Lower California, 41 fms.

Ampelisca indentata, new species

Plate 30

Descripton of female: Head about as long as first 2 body segments, front margin slightly concave, lower front margin deeply incised and containing lower pair of eyes. Upper pair of eyes behind upper edge of antenna 1.

Antenna 1 reaching end of peduncle of antenna 2; article 1 of peduncle almost as long as article 2, article 3 about half as long as 1.

Antenna 2 nearly as long as body or somewhat shorter; article 5 of peduncle four fifths as long as 4.

Mandible: spine row with 8 spines; article 3 of palp two thirds as long as article 2; the latter article rather stout.

Maxilla 1: outer plate with 9 to 10 spines; palp article 2 narrower than outer plate, apex armed with 4 spines and 3 cusp teeth.

Maxilliped: inner plate rather slender, reaching to end of palp article 1, apex with a single chisel tooth; outer plate reaching to end of palp article 2, inner edge lined with 7 chisel teeth, rounded apex with 5 setal spines, the outer 2 plumose.

Coxae 1 and 2: lower posterior angle slit; coxa 3 without slit.

Gnathopod 1: article 6 about as long as 5, posterior edge strongly inflated and armed with spines and setae; article 7 short, stout.

Gnathopod 2: article 6 about half as long as 5, article 7 about half as long as 5.

Peraeopod 1 similar to that of *Ampelisca pugetica* Stimpson.

Peraeopod 2: articles 2 and 4 very turgid, article 4 about as long as in peraeopod 1.

Peraeopod 3: posterior edge of article 5 with 3 sets of spines, posterior edge of article 6 with 1 spine.

Peraeopod 4 similar to 3 but with generic differences.

Peraopod 5 similar to that of *A. pugetica* but stouter; article 6 and the large posterior lobe of article 4 much stouter; articles 5 and 7 noticeably shorter than in *A. pugetica.* Anterior edge of article 5 notched.

Uropod 1 reaching almost to end of uropod 2; rami shorter than peduncle; both edges of inner ramus and outer edge of outer ramus spinulate.

Uropod 2: rami shorter than peduncle; both edges of both rami spinulate, apex of outer ramus with a long spine.

Uropod 3: rami slender, lanceolate, outer more slender than inner; both edges of outer ramus and outer edge of inner ramus setose.

Telson moderately broad, apices almost truncate, very slightly incised, each armed with 3 setules; upper surface of each lobe with 4 or 5 setules.

Pleon segment 3: posterior edge strongly convex, lower posterior angle produced into small tooth.

Pleon segment 4: posterior dorsal process saddle-shaped, posterior edge vertical.

Pleon segment 6: lateral processes small.

Male: Unknown.

Types: Holotype, AHF no. 406, female, 8 mm; paratypes, 3 females.

Type locality: Station 1168-40, 3½ miles off Newport Beach, California, 34 to 37 fms.

Material examined: Stations 1160-40 (1), 1168-40 (6), 1194-40 (2), 1321-41 (1), 1362-41 (2), 1388-41 (1), 1390-41 (12), 1780-49 (5). Cedros Island, Lower California, May 13, 1946, Kenyon-Williams Expedition (2).

Remarks: This species is closely related to *A. pugetica* Stimpson but differs in the longer first uropod, the smaller tooth on pleon segment 3, and the shape of the head. The dorsal process of pleon segment 4 is rather shallow, but the specimens at hand are small, corresponding to the small specimens of *A. pugetica* which also have a shallow process.

In the figured paratype, the indentation on the lower front edge of the head appears to be exaggerated somewhat. Smaller specimens show the incision to be much shallower.

This species resembles *A. composita* Schellenberg (1931) in the form of pleon segment 4 and peraeopod 5, but differs in the presence of eyes, the less strongly produced tooth of pleon segment 3, the more slender rami of uropod 3, the shape of the head, and the apices of the telson.

It bears some resemblance to *A. senegalensis* Chevreux (1925), but is distinguishable by the shape of the head, the rami of uropod 3, and the length of uropod 1.

Distribution: Channel Islands and along the coast of southern California, 15 to 55 fms; Gulf of California, off San Gabriel Bay, Espiritu Santo Island, 21 fms.

Ampelisca mexicana, new species

Plates 31 and 32

Description of female: Head not as long as first 3 body segments, anterior edge slightly incised, lower front edge oblique, margin nearly straight. Upper pair of eyes behind upper edge of antenna 1, lower pair at lateral angle of head.

Antenna 1 reaching nearly to end of peduncle of antenna 2; article 2 of peduncle longer than 1; article 1 rather slender; article 3 shorter than 1.

Antenna 2: flagellum broken; article 5 of peduncle about three fourths as long as article 4.

Mandible: spine row with 7 spines; article 3 of palp as long as article 2.

Maxilla 1: inner plate slender, conical, apex with 2 setae; outer plate with 9 spines; apex of palp with 4 spines, 3 cusp teeth and 6 setae.

Maxilliped: inner plate reaching to end of palp article 1, apex with a single large chisel tooth; outer plate reaching to end of palp article 2, inner margin lined with 8 chisel teeth, rounded apex with 3 setal spines, the outermost one plumose. Palp normal.

Coxal plates 1 and 2: lower posterior angle with a small slit. Coxal plate 3 without slit.

Gnathopod 1: article 5 longer than article 6; posterior edge of article 6 strongly inflated and heavily armed with spines and setae; article 7 moderately strong.

Gnathopod 2 very slender; article 6 slightly more than half as long as article 5; article 7 two thirds as long as 6.

Peraeopod 1: article 7 about as long as articles 5 and 6 combined; distal anterior edge of article 4 not produced.

Peraeopod 2 similar to 1 but with generic differences.

Peraeopod 3: anterior edge of article 2 setose; posterior edge of article 5 with 2 sets of spines (1 each); posterior edge of article 6 with 1 spine.

Peraeopod 4 similar to 3 but with generic differences.

Peraeopod 5: lower edge of posterior lobe of article 2 broadly truncate, reaching down almost to middle of article 4; article 4 slightly longer than 3, produced behind into a large, setose, tumid lobe; article 5 very short; article 6 long, expanded; article 7 rather slender.

Uropod 1 reaching as far back as uropod 2; rami as long as peduncle; base of inner ramus with a single spine.

Uropod 2: rami equal in length to peduncle; apices of both rami armed with a single long spine, inner edge of inner ramus and outer edge of outer ramus lined with spines.

Uropod 3: rami slender, lanceolate, outer ramus much more slender than inner.

Telson rather narrow, apices laterally notched, surface of each lobe with 3 setae.

Pleon segment 3: posterior edge convex, lower posterior corner strongly produced into a tooth, above which there is a sinus.

Pleon segment 4 slightly elevated and weakly saddle-shaped.

Pleon segment 6: lateral ridges strongly developed.

Male: Unknown.

Types: Holotype, AHF no. 3911, ovigerous female, 4.5 mm; paratype, female, 5.0 mm.

Type locality: Station 964-39, Tenacatita Bay, Mexico, 2 to 8 fms.

Material examined: Stations 259-34 (3), 281-34 (5), 373-35 (1), 475-35 (6), 481-35 (1), 964-39 (6), 2026-51 (3).

Remarks: This species appears closely related to *A. gnathia,* new species, of which only the male is known. However, *A. mexicana* differs in the shape of the head, in the larger lobe of article 4 of peraeopod 5, in the unnotched anterior edge of article 5, and in a number of other characters which may be seen from examination of the figures. It resembles *A. gnathia,* particularly in the shape of gnathopod 1, pleon segments 3 and 6, and the telson.

Distribution: Lower California at Cedros Island, and Santa Maria Bay, 16 to 30 fms; Tangola Tangola Bay and Tenacatita Bay, Mexico, 2 to 20 fms; Salinas Bay, Costa Rica, 6 to 20 fms; off Viejas Islands, Independicia Bay, Peru, 12 fms.

Ampelisca gnathia, new species

Plates 33 and 34

Description of male: Head about as long as first 3 body segments, superior edge prolonged anteriorly to form a blunt rostrum, anterior edge strongly incised, lower front edge oblique. Upper pair of eyes behind upper margin of first antennal article, lower pair below lateral angle of head.

Antenna 1 reaching to end of peduncle of antenna 2; first and second article of peduncle subequal in length, armed on lower margin with setal tufts; article 3 less than half as long as article 2, unarmed.

Antenna 2 longer than body; article 5 of peduncle about three fourths as long as article 4, both lined on superior margins with minute setal tufts.

Mandible: spine row with 10 spines; article 3 of palp as long as second.

Maxilla 1: apex of outer plate with 10 spines; palp article 2 narrower than outer plate, apex armed with 4 spines, 3 cusp teeth, and 10 to 12 setae.

Maxilliped: inner plates reaching slightly beyond end of palp article 1, apex armed with 1 chisel tooth; outer plate reaching to end of palp article 2, inner edge lined with 8 chisel teeth, rounded apex with 4 setal spines, the outer 2 plumose.

Coxae 1 and 2 with strong slit, 3 without.

Gnathopod 1 stout; article 6 as long as article 5, posterior proximal edge produced into a massive, rounded lobe, the palmar portion armed with heavy spines and setae; distal end of article 6 narrow; article 7 about two thirds as long as article 6, strong, arched, inner edge with several simple setae.

Gnathopod 2 slender; article 6 more than half as long as article 5, posterior edge nearly straight; article 7 half as long as article 6, slightly curved, with a single simple seta on inner margin.

Peraeopod 1: posterior edge of article 4 lined with setae nearly its entire length, anterodistal angle slightly produced; article 7 about half again as long as articles 5 and 6 combined.

Peraeopod 2 similar to 1 but with generic differences.

Peraeopod 3: posterior edge of article 5 with 2 or 3 sets of spines, posterior edge of article 6 with 1 to 3 spines.

Peraeopod 4 similar to 3 but with generic differences.

Peraeopod 5: posterior lobe of article 2 evenly rounded, extending downward to end of article 3; articles 3 and 4 subequal in length, article 4 with a large, posterior setose lobe; distal anterior edge of article 5 notched; article 6 rather narrow; article 7 slender, attenuated, about as long as article 5.

Uropod 1 short, reaching only slightly beyond end of peduncle of uropod 2; rami equal to peduncle in length; both edges of inner ramus spinulate, outer ramus unarmed.

Uropod 2: peduncle not larger than rami; both edges of inner ramus and inner edge of outer ramus spinulate, apex of outer ramus with a long spine.

Uropod 3: rami rather slender, lanceolate, not heavily setose (many setae broken off).

Telson rather broad, lobes notched apically, each notch with 2 or 3 setules; upper surface of each lobe with 3 setules.

Pleon segment 3: posterior edge convex, lower posterior angle strongly produced into a large tooth.

Pleon segment 4: dorsal posterior surface raised into a large, straight-margined process which almost becomes keel-shaped posteriorly and ends vertically above segment 5.

Pleon segment 6 with well developed lateral ridges.

Female: A single female from Station 1321-41 is referred provisionally here. The specimen resembles the male holotype in the shape of the head, the antennae, peraeopods 1 to 5, the uropods and the telson. It differs from the holotype by the less sharply delimited palm of gnathopod 1, and the process of pleon segment 4, which is a low, weakly saddle-shaped structure. These differences fall in the class of secondary sexual characteristics. In addition, the female differs by the shape of pleon segment 3, which has a broadly convex posterior edge and a weak tooth at the posterior lateral corner. It is possible that this female represents a form of this new species similar to that found in *Ampelisca cristata* Holmes. Until further materials of both sexes are available, it is impossible to justify this solution.

Types: Holotype, AHF no. 416, male, 8 mm; paratypes, 3 males.

Type locality: Station 1321-41, 2 miles west of Church Rock, Santa Catalina Island, 45 to 53 fms.

Material examined: Stations 1055-40 (1), 1321-41 (5).

Remarks: The male from Station 1055-40 has the dorsal process of pleon segment 4 slightly concave; otherwise it corresponds to the type material.

This species is closely related to *A. pugetica* Stimpson but may be distinguished by the shape of gnathopod 1, by the head, and by the dorsal process of pleon segment 4.

It bears some resemblance to *A. macrocephala* but differs in the short uropod 1, the large posterior lobe of article 4 of peraeopod 5, and the shape of the head.

Distribution: Known only from the type locality and north of Granite Island, Angel de la Guardia Island, Gulf of California, 57 fms.

Ampelisca pugetica Stimpson

Plates 35 and 36

Ampelisca pugetica Stimpson (1864), Proc. Acad. Nat. Sci. Philadelphia, vol. 16, pp. 158-159.

Ampelisca californica Holmes (1908), Proc. U.S. Natl. Mus., vol. 35, no. 1654, pp. 513-515, fig. 23.

Description of female: Head not as long as first 3 body segments, anterior edge of head incised, lower front margin of head oblique, nearly straight. Upper pair of eyes behind first antennae, lower pair on oblique margin.

Antenna 1 variable in length, reaching to middle of peduncle article 5 of antenna 2 or beyond end of peduncle of antenna 2, depending on the age of the specimens; first article of peduncle tumid, more than half as long as article 2; article 3 half as long as article 2.

Antenna 2 about the length of the body; article 4 of peduncle longer than article 5, or nearly subequal to it in some adults (14 mm).

Mandible: spine row with 11 or 12 spines; article 3 of palp slightly more than half as long as article 2.

Maxilla 1: outer plate with 11 spines; article 2 of palp almost as large as outer plate, armed with 4 spines, 4 cusp teeth and 9 to 12 setae.

Maxilliped: inner plate not quite reaching to middle of palp article 2, apex with 2 chisel teeth; outer plate reaching to end of palp article 2, inner margin with 11 chisel teeth, rounded apex with 6 spines and setae, the outer 2 of which are plumose.

Coxae 1 and 2: lower posterior angle slit, coxa 3 without a slit.

Gnathopod 1: article 6 about two thirds as long as 5, article 7 about one half as long as 6.

Gnathopod 2: article 6 about half as long as 5, article 7 less than half as long as 6.

Peraeopod 1: article 7 half again as long as articles 5 and 6 combined; anterodistal angle of article 4 produced.

Peraeopod 2 similar to 1 but with generic differences.

Peraeopod 3: posterior margin of article 5 with 3 sets of spines, posterior margin of article 6 with 4 spines.

Peraeopod 4: posterior margin of article 5 with 3 sets of spines, posterior margin of article 6 with 1 or 2 spines.

Peraeopod 5: inferior margin of posterior lobe of article 2 rounded, extending down beyond end of article 3; article 2 rather short, articles 3 and 4 subequal in length, article 4 with a large, posterior, setose lobe; articles 5 and 7 subequal in length, shorter than article 6; distal anterior margin of article 6 notched.

Uropod 1 reaching to end of or slightly beyond peduncle of uropod 2; rami equal in size, slightly shorter than peduncle; both margins of inner ramus and outer margin of outer ramus spinulate.

Uropod 2: rami equal in size, slightly shorter than peduncle; both margins of inner ramus and outer margin of outer ramus spinulate, apex of outer ramus with a long spine.

Uropod 3: rami equal in size, long, slender, lanceolate; apex of inner ramus setose, inner margin of outer ramus setose.

Telson: apices of lobes pointed, notched on outer edge, apices with 2 to 5 setae; dorsal surface of each lobe with 4 to 6 setae.

Pleon segment 3: posterior margin slightly convex, lower posterior angle produced into a large tooth. Dorsal surface of segment may be slightly cristate.

Pleon segment 4: posterior dorsal surface with a saddle-shaped carina, posterior margin vertical.

Pleon segment 6 with low lateral crests.

Length of female, 16 mm.

Male: Differing from the female by the deeper notch of segment 4 between segment 3 and the dorsal carina, by the more shallow saddle-shape of the carina; rami of uropod 3 broader than in female; antennal peduncles with setal tufts; telson slightly broader than in female; and rostral area of head slightly more produced. Length of male, 11 mm.

Material examined: Stations 696-37 (14), 706-37 (1), 711-37 (2), 713-37 (1), 893-38 (6), 981-39 (6), 985-39 (1), 1022-39 (2), 1026-39 (1), 1031-40 (1), 1140-40 (1), 1150-40 (5), 1151-40 (1), 1168-40 (4), 1169-40 (8), 1173-40 (3), 1191-40 (2), 1194-40 (7), 1202-40 (3), 1245-41 (1), 1260-41 (1), 1295-41 (8), 1316-41 (1), 1328-41 (1), 1353-41 (1), 1359-41 (2), 1384-41 (16), 1387-41 (10), 1388-41 (2), 1390-41 (16), 1402-41 (1), 1418-41 (9), 1938-50 (1).

Remarks: In young material (7-9 mm), the apical notches of the telson lobes possess only 3 to 4 setae, and the dorsal surface of each lobe has only 2 setae; the depression on the carina of pleon segment 4 is very shallow.

Stimpson probably described this species on the basis of male specimens, for he notes the presence of a deep notch between pleon segment 3 and the dorsal carina of pleon segment 4. Holmes described a new species, *Ampelisca californica,* which he differentiated from *A. pugetica* by the shallow notch between segment 3 and the carina of segment 4 of the pleon. Holmes also described a male of the species, but he probably had several specimens similiar to those in the present collections, which differ from typical females in the longer antennae and the lack of brood plates. It is possible that these forms represent "intersexes."

Distribution: Widely distributed in the Channel Islands and along the coast of southern California, 10 to 275 fms; coast of Lower California at Dewey Channel and north of Todos Santos Island, 21 to 41 fms; Gulf of California at Tortuga Island and Puerto Refugio, Angel de la Guardia Island, shore to 45 fms.

Ampelisca pugetica forma **macrodentata,** new form

Plate 36, fig. B

Description of female: Differing from the typical form only by the greater development of the tooth at the inferoposterior angle of pleon segment 3. In all other respects the material at hand shows characteristics within the range of variability of typical *A. pugetica.* Male unknown.

Types: Holotype, AHF no. 417, ovigerous female, 8.5 mm; paratypes, 4 females.

Type locality: Station 1321-41, 2 miles west of Church Rock, Santa Catalina Island, California, 45 to 53 fms.

Material examined: Stations 116-33 (3), 264-34 (11), 281-34 (98), 373-35 (8), 384-35 (4), 385-35 (12), 392-35 (18), 395-35 (1), 434-35 (3), 460-35 (1), 468-35 (1), 475-35 (22), 476-35 (1), 541-36 (1), 544-36 (1), 563-36 (2), 566-36 (1), 677-37 (2), 701-37 (9), 702-37 (15), 706-37 (5), 823-38 (5), 829-38 (1), 833-38 (1), 845-38 (1), 1055-40 (1), 1202-40 (1), 1321-41 (18), 1780-49 (3), 2018-51 (12), 2026-51 (3). Cedros Island, Kenyon-Williams Expedition, May 18, 1946 (1). Albemarle Island, Galapagos Islands, dipnet, Jan. 16, 1932 (1).

Distribution: Point Fermin and Santa Catalina Island, 16 to 53 fms; along the coast of Lower California at Cedros Island, Blanca Bay, and Santa Maria Bay, 8 to 30 fms; Gulf of California at Angel de la Guardia Island, Tiburon Island, Ildefonso Island, Angeles Bay, 8 to 65 fms; south of White Friars Islands, Mexico, 25 fms; Costa Rica at Salinas Bay, Playa Blanca, Port Parker, and Port Culebra, shore to 20 fms; Octavia Bay, Colombia, 2 fms; Peru at Sechura Bay, San Juan Bay, Independencia Bay, and Lobos de Afuera Islands, 5 to 40 fms; Albemarle Island, Galapagos Islands, surface.

Byblis veleronis n. sp.

Plates 37 and 38

Description of female: Anterior margin of head produced in the middle to a small obtuse point, anteroinferior margin straight, parallel to upper margin. Eyes large, dorsal pair near front margin of head, lower pair at inferoanterior angle of head.

Antenna 1 longer than peduncle of antenna 2 by about the length of article 5 of antenna 2; article 1 of peduncle tumid; article 2 slender, ranging from one and one-half to three times as long as article 1 (longer in older specimens) ; article 3 slightly shorter than 1.

Antenna 2 about two thirds as long as body; article 5 of peduncle about seven eighths as long as article 4.

Mandible: spine row with 7 to 12 spines; article 3 of palp more than half as long as 2.

Maxilla 1: inner plate elongated, triangular, apex with 1 seta; outer plate with 11 serrated spines; article 2 of palp half again as wide as outer plate, apex armed with 4 spines, 3 cusps and 10 setae.

Maxilla 2: about as figured by Sars (1895, plate 64) for *B. gaimardi* (Krφyer), but inner plate smaller.

Maxilliped: inner plate reaching beyond end of palp article 1, apex with 2 chisel teeth; outer plate extending to end of palp article 2, inner edge with 11 to 13 chisel teeth, rounded apex with 6 to 9 spines; article 3 of palp rather slender at base.

Anterior and lower edge of coxae slightly serrate and closely setose.

Gnathopod 1: article 2 slender; article 6 two thirds as long as 5; article 7 two thirds as long as 6, lined on inner edge with setules.

Gnathopod 2: article 6 about two thirds as long as 5; article 7 two thirds as long as 6, similar to but more slender and longer than in gnathopod 1.

Peraeopod 1: article 4 rather slender, article 6 about half again as long as 5, article 7 shorter than 6.

Peraeopod 2: article 7 nearly subequal to 6, appendage longer and more setose than peraeopod 1.

Peraeopod 3: article 2 with a rather slender posterior lobe, anterior margin armed with spines and setae; posterior margin of article 5 with 6 sets of spines, posterior margin of article 6 with 8 spines.

Peraeopod 4: posterior lobe of article 2 not developed; posterior edge of article 5 with 5 sets of spines, posterior edge of article 6 with 6 spines.

Peraeopod 5: posterior lobe of article 2 reaching downward to end of article 5; article 4 nearly twice as long as article 3; article 5 longer than 4, about as long as 6; article 7 styliform, one half as long as 6.

Uropod 1 reaching to end of uropod 2; outer ramus longer than peduncle, inner ramus shorter and more slender than outer, inner and outer edges spinulate; outer edge of outer ramus spinulate.

Uropod 2: rami slightly shorter than peduncle; upper and outer edges of both rami spinulate.

Uropod 3: rami subequal to each other; opposing margins strongly serrate, inner margin of inner ramus lined with stout spines, outer edge of outer ramus with a row of setae.

Telson extremely variable in length and shape of apices, cleft more than one half its length, about as long as broad, apices of lobes rounded, scalloped, armed with 1 or 2 setae.

Pleon segment 3: posterior edge broadly rounded.

Pleon segment 4: dorsal surface gently upraised.

Pleon segment 6: tricarinate.

Male: Differing from the female by the stouter article 2 of antenna 1 and article 4 of antenna 2 and the typical setal tuft development on the antennal peduncles. The dorsal surface of pleon segment 4 is more strongly produced; inner edge of inner ramus of uropod 3, spines not as stout, and edge closely beset with plumose setae along its entire length.

Types: Holotype, AHF no. 3914, ovigerous female, 14 mm; paratype, female.

Type locality: Station 915-39, Sulphur Bay, Clarion Island, 5 fms.

Material examined: Station 913-39 (1), 915-39 (2), 981-39 (1), 998-39 (1), 1130-40 (1), 1160-40 (1), 1168-40 (2), 1190-40 (1), 1194-40 (4), 1202-40 (1), 1229-41 (1), 1269-41 (1), 1328-41 (1), 1359-41 (1), 1380-41 (1), 1384-41 (1), 1386-41 (1), 1387-41 (15), 1388-41 (7), 1390-41 (19), 1411-41 (1), 1418-41 (2), 1780-49 (2).

Remarks: This species is closely related to *Byblis affinis* Sars (1895), but is distinguishable by the larger eyes, the longer article 4 of antenna 2, and the more acute apices of the telson. It differs from *Byblis gaimardii* (Krøyer) essentially only in the deeper cleft of the telson. It is not known whether the "*Byblis gaimardii*" cited by Holmes in 1908 from Monterey, California, is the same as this species.

The writer is not certain that this species is distinct from *Byblis japonicus* Dahl (1944), and specimens from both areas should be compared before a decision is made. Several small differences between the figures and description of Dahl and the present material may be enumerated: (1) antenna 1 is almost as long as 2 in the male of *B. japonicus;* (2) coxae 1 and 2 are different in shape; (3) the posterior edge of pleon segment 3 is somewhat different in shape; (4) the spinulation of the inner ramus is stronger than in *Byblis japonicus.*

Distribution: Widely distributed in the Channel Islands and along the coast of southern California, 15 to 228 fms. Also known from Sulphur Bay, Clarion Island, 5 fms, and in the Gulf of California, off San Gabriel Bay, Espiritu Santo Island, 21 fms.

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PLATE 1

Ampelisca catalinensis, new species

Holotype, female, 15 mm, Station 1156-40.
Figure A. Head.
B. Peraeopod 5, right.
C. Telson.
D. Uropod 3, right.

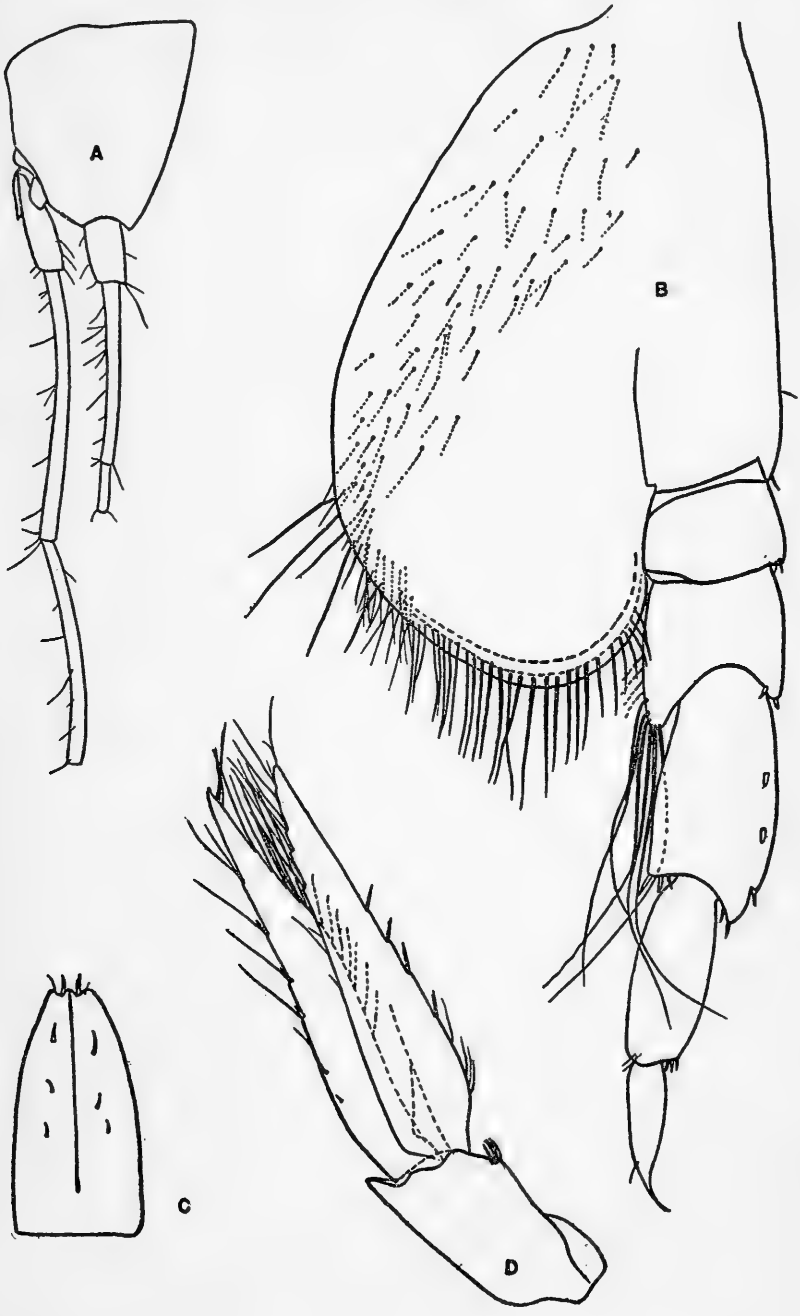
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PLATE 2

Ampelisca catalinensis, new species

Holotype, female, 15 mm, Station 1156-40.

Figure A. Peraeopod 1, right.
B. Peraeopod 4, left.
C. Coxa 1, right.
D. Urosome and pleon segment 3.

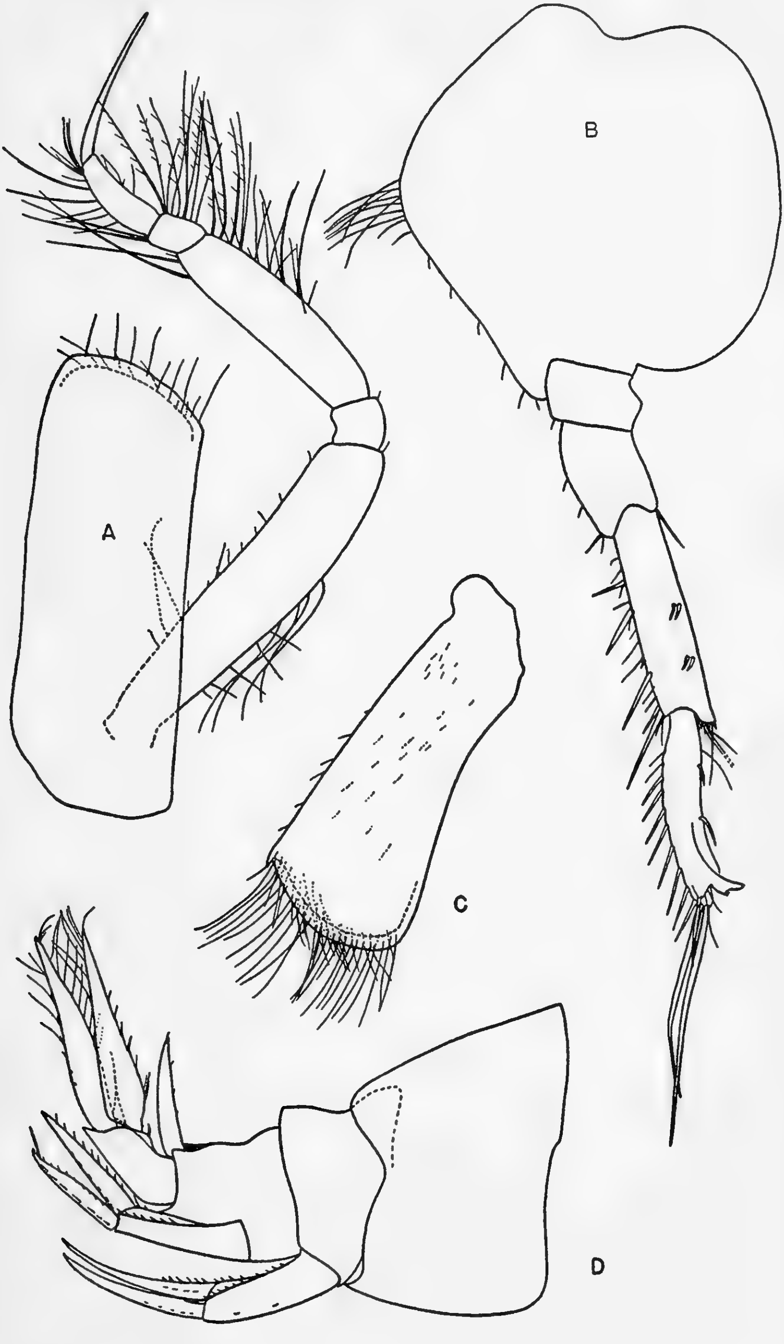
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PLATE 3

Ampelisca milleri, new species

Female, 8 mm, Station 1288-41.

Figure A. Peraeopod 3, right.
B. Peraeopod 1, right.
D. Uropod 3, right.
E. Head.
C. Peraeopod 5, left.

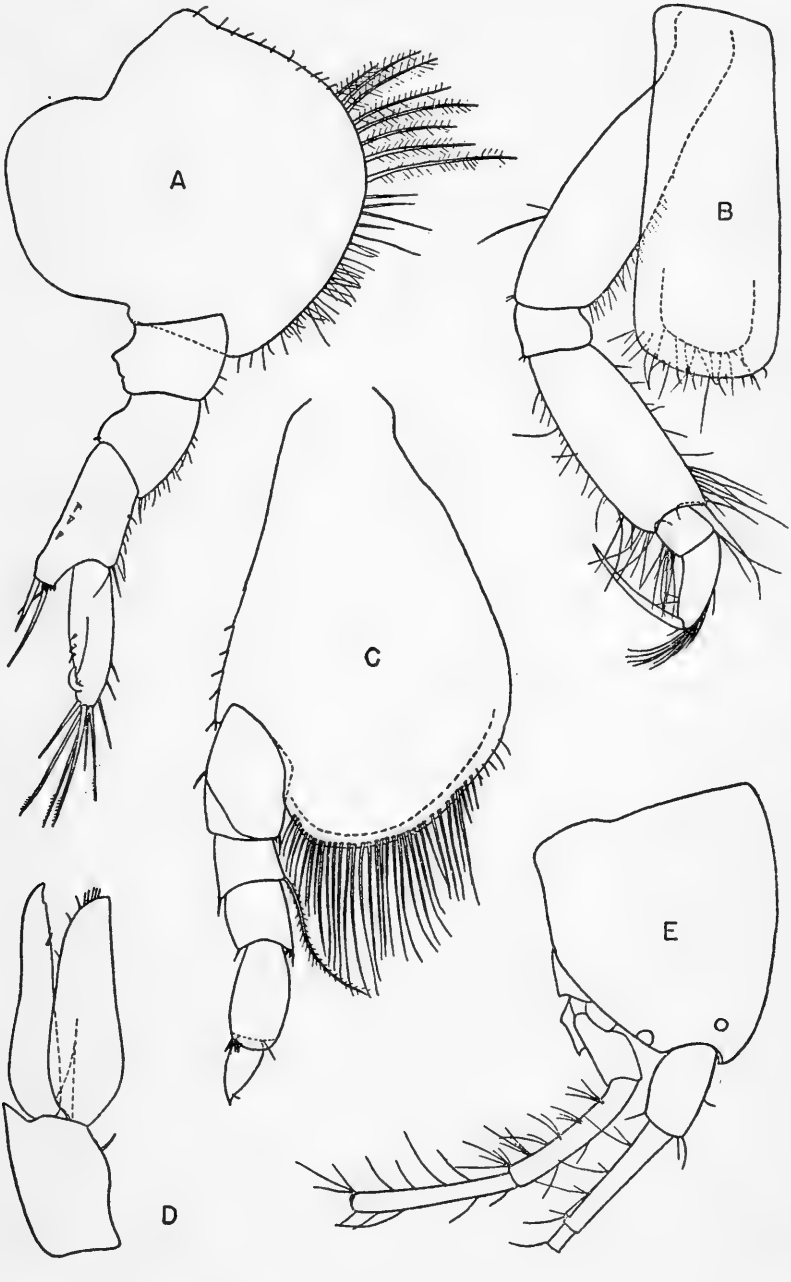
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PLATE 4

Ampelisca milleri, new species

Young male?, 7 mm, Station 1288-41.

Figure A. Telson.

B. Head.

D. Uropod 3, left.

Female, 8 mm, Station 1288-41.

Figure C. Urosome and pleon segment 3.

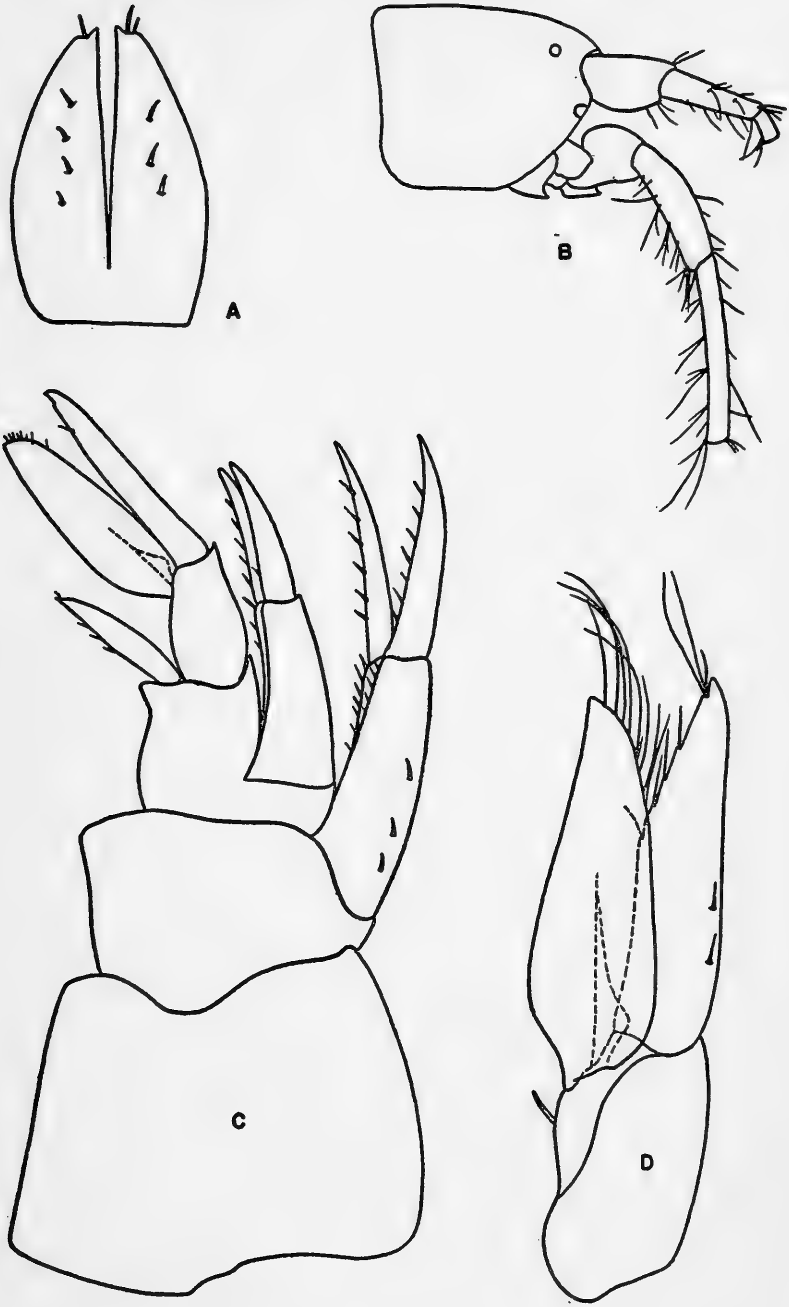
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PLATE 5

Ampelisca lobata Holmes

Male, 9 mm, Station 696-37.
Figure A. Head.
B. Peraeopod 5, right.
C. Telson.
D. Peraeopod 1, right.
F. Urosome and pleon segment 3.
Female, 10 mm, Station 1407-41.
Figure E. Uropod 3, right.

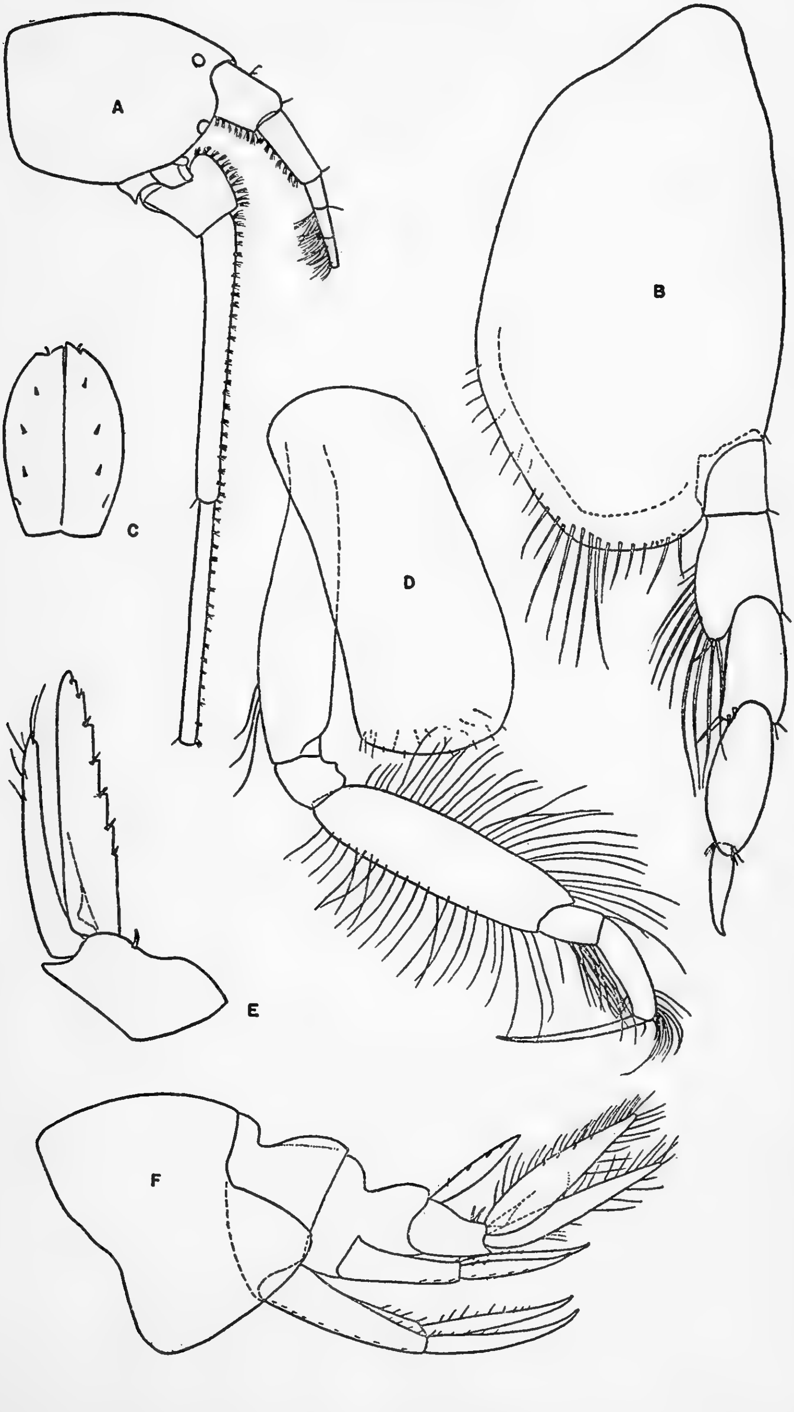
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PLATE 6

Ampelisca lobata Holmes

Male, 9 mm, Station 696-37.
Figure A. Uropod 3, right.
B. Peraeopod 3, right.
C. Article 6 of gnathopod 1, left.
Female, 10 mm, Station 1407-41.
Figure D. Pleon segments 3 and 4.
Female, 11 mm, Station 283-34.
Figure E. Pleon segment 3.

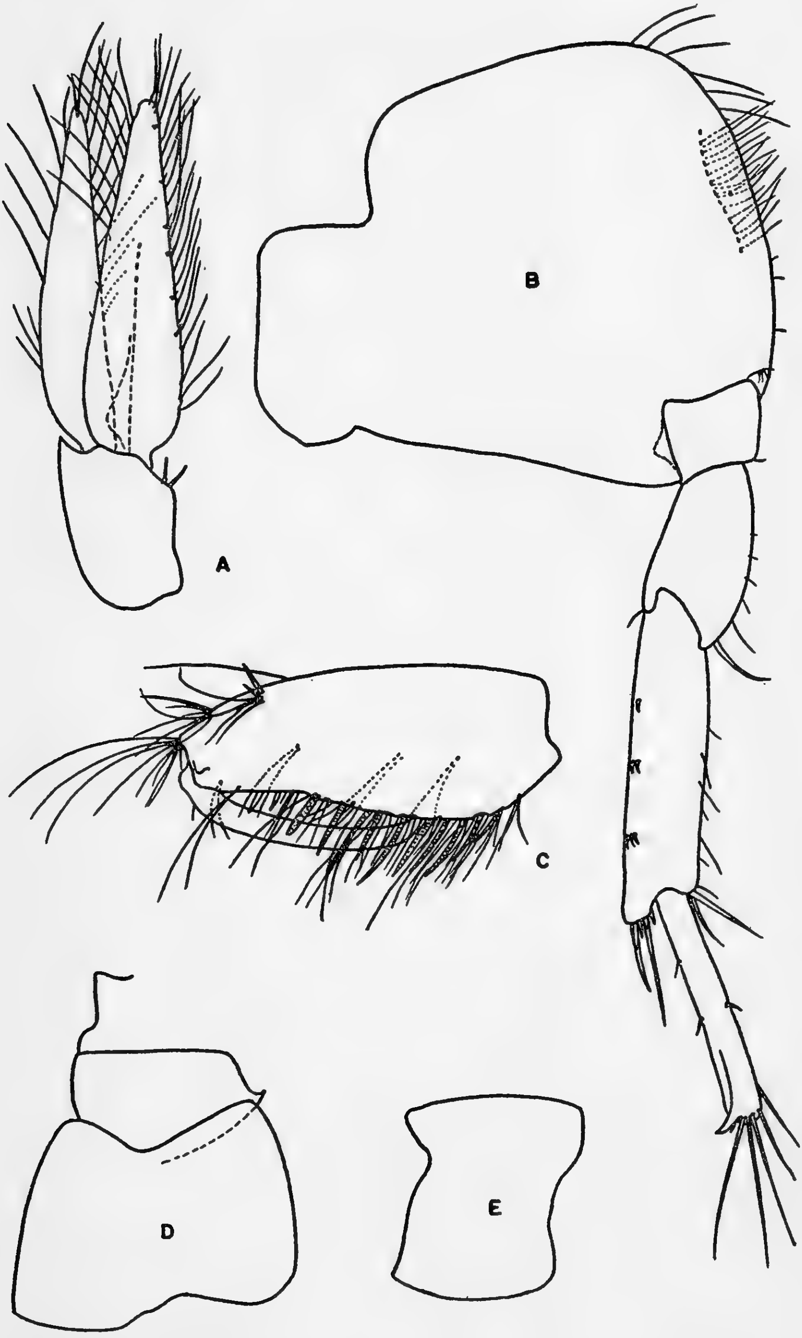
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PLATE 7

Ampelisca schellenbergi Shoemaker

Female, 5.5 mm, Laguna Beach, California, shore.
Figure A. Head.
C. Peraeopod 5, right.
Female, 2.5 mm, Station 478-35.
Figure B. Uropod 3, right.
Male, 5.8 mm, Station 478-35.
Figure D. Uropod 3, right.
E. Pleon segments 3 and 4.


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PLATE 8

Ampelisca schellenbergi Shoemaker

Female, 5.5 mm, Laguna Beach, California, shore.
Figure A. Peraeopod 3, right.
B. Urosome and pleon segment 3.
D. Peraeopod 1, right (showing molt onset).
E. Telson.
G. Uropod 3, right.
Male, 5.8 mm, Station 478-35.
Figure C. Telson.
Female, 10 mm, Station 562-36.
Figure F. Uropod 3, right.

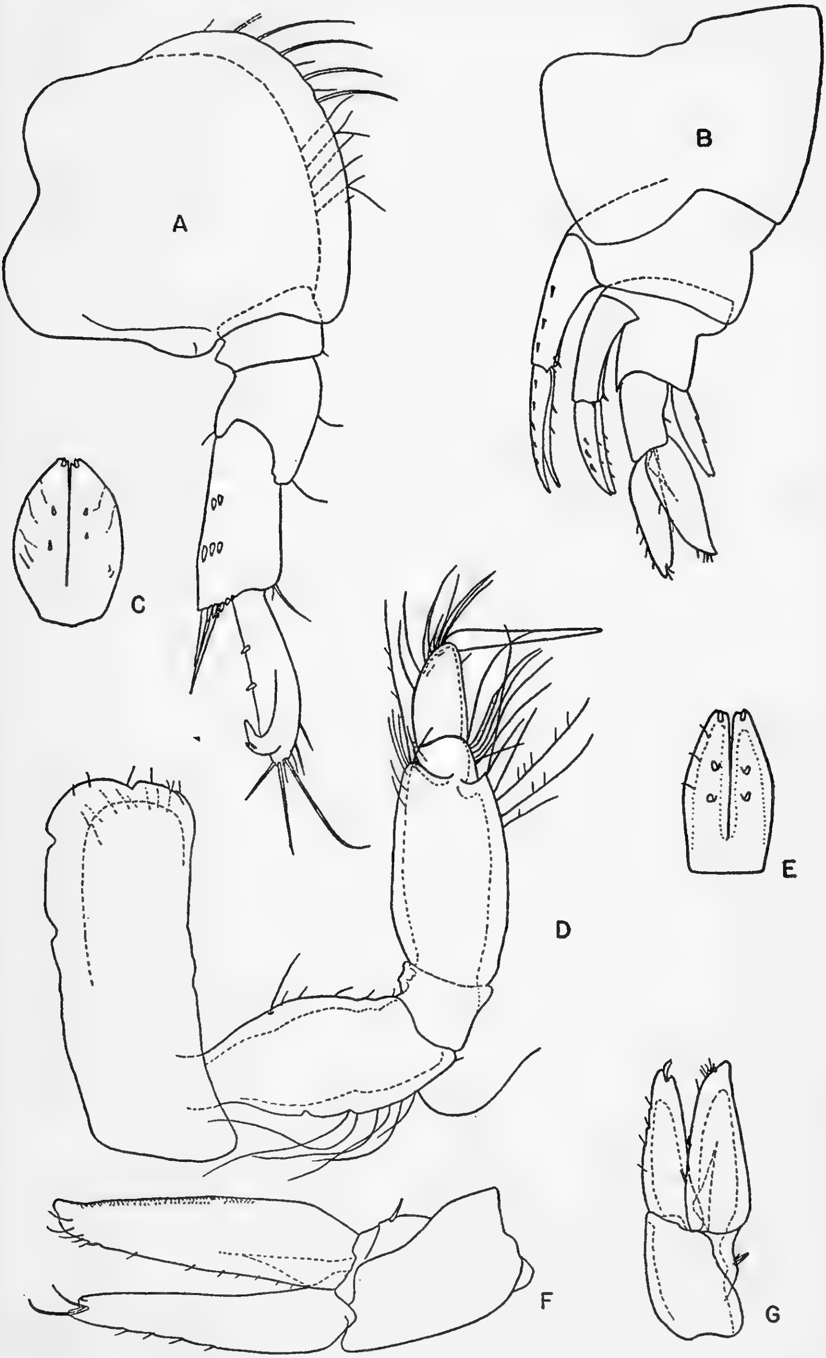
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PLATE 9

Ampelisca venetiensis Shoemaker

Female, 16 mm, Station 1965-50.
Figure A. Peraeopod 3, left.
C. Head.
D. Telson.
E. Peraeopod 5, left.
F. Peraeopod 1, left.
G. Lower posterior corner of coxa 1, greatly magnified.
H. Lower edge of article 2, peraeopod 5, greatly magnified.
I. Urosome and pleon segment 3.
J. Uropod 3, left.

Female, 12 mm, Station 1965-50.
Figure B. Telson.

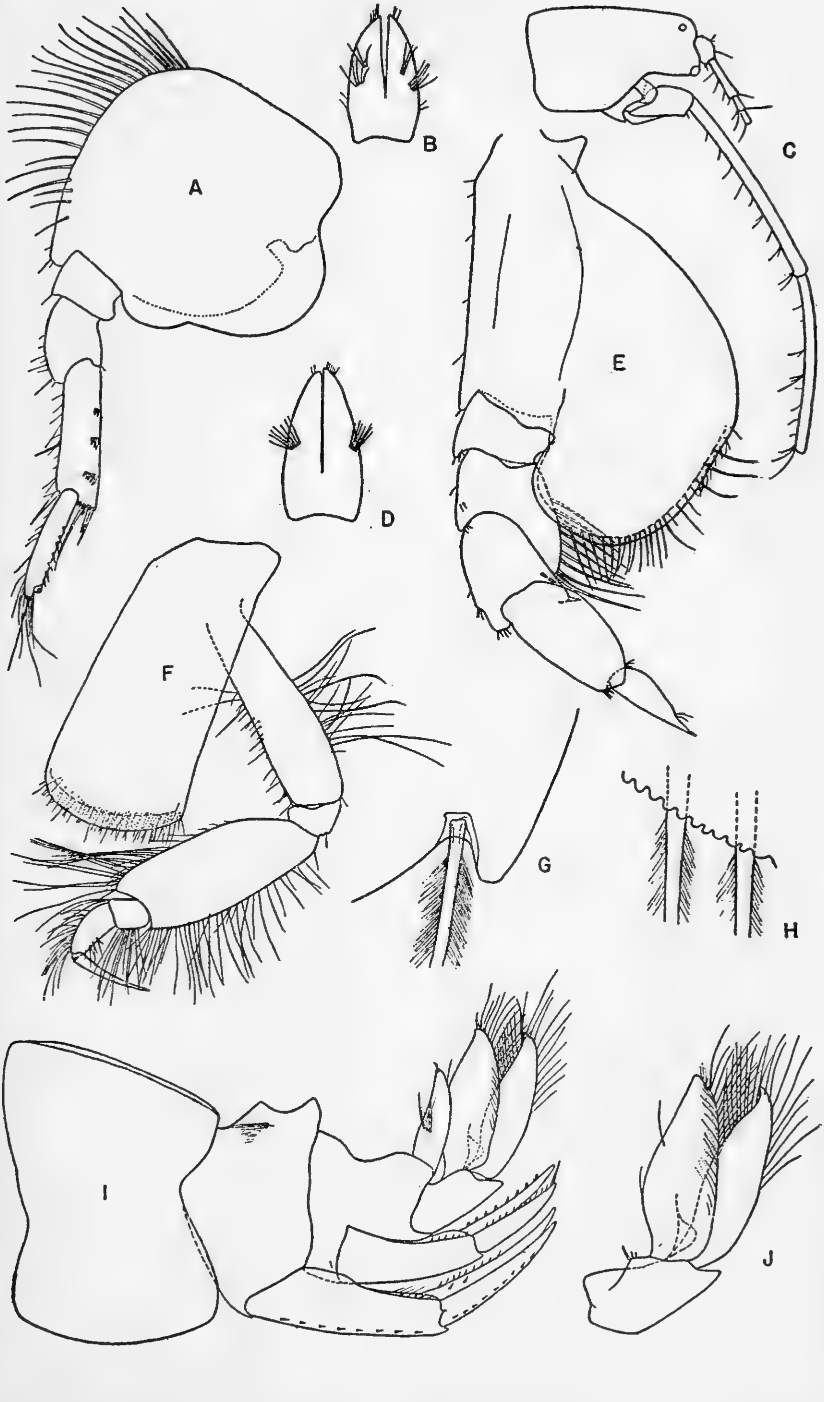
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PLATE 10

Ampelisca romigi, new species

Paratype, female, 10 mm, Station 1294-41.
Figure A. Head.
D. Peraeopod 5, right.
Female, 10 mm, Station 1220-40.
Figure B. Uropod 3, right.
C. Urosome and pleon segment 3.

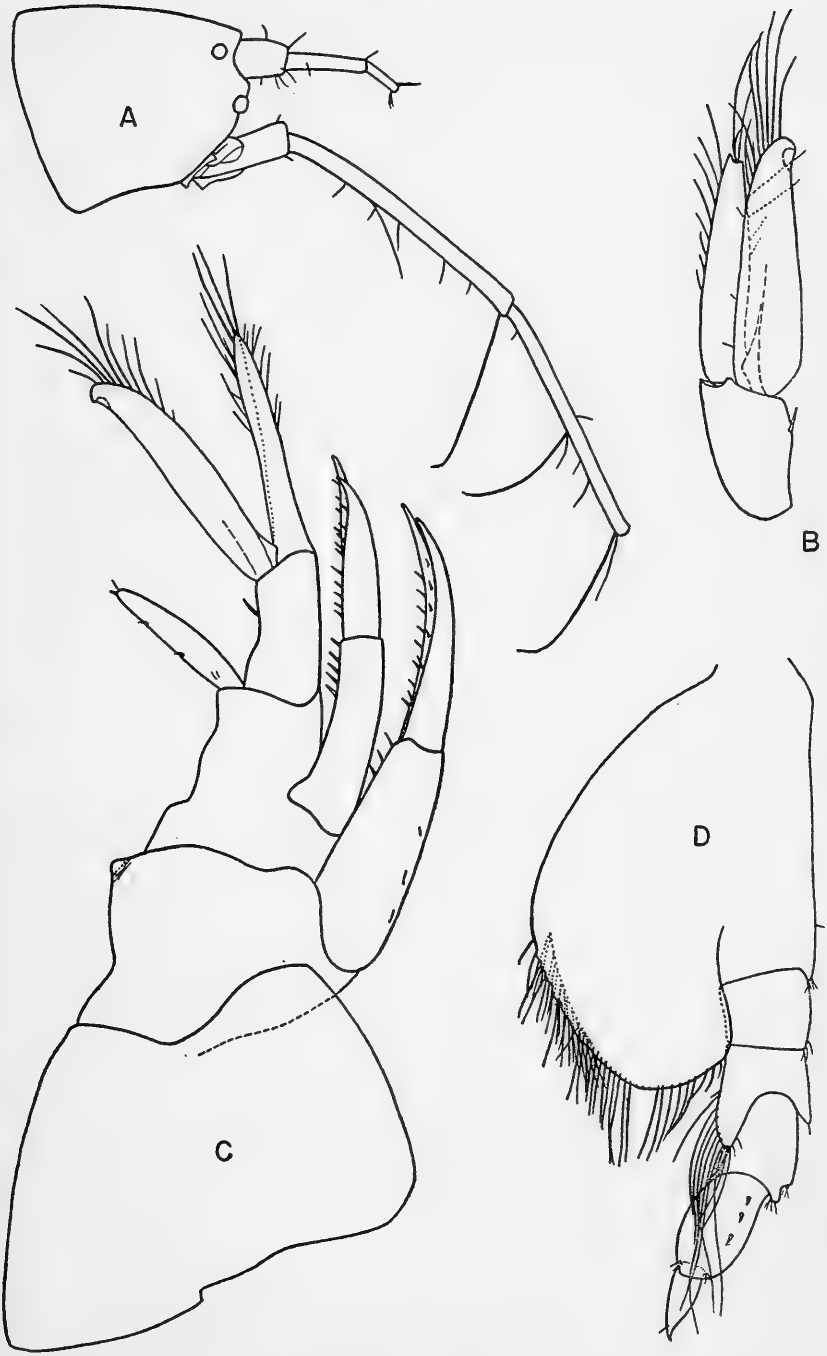
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PLATE 11

Ampelisca romigi, new species

Paratype, female, 10 mm, Station 1294-41.
Figure A. Peraeopod 1, right.
B. Peraeopod 3, right.
Female, 10 mm, Station 1220-40.
Figure C. Maxilla 1, right.
D. Mandible, right.
G. Telson.
H. Maxilla 2, right.
J. Maxilliped, left.
Female?, 8 mm, Station 1202-40.
Figure E. Pleon segment 4.
Female, 16 mm, Station 704-37.
Figure F. Pleon segment 3.

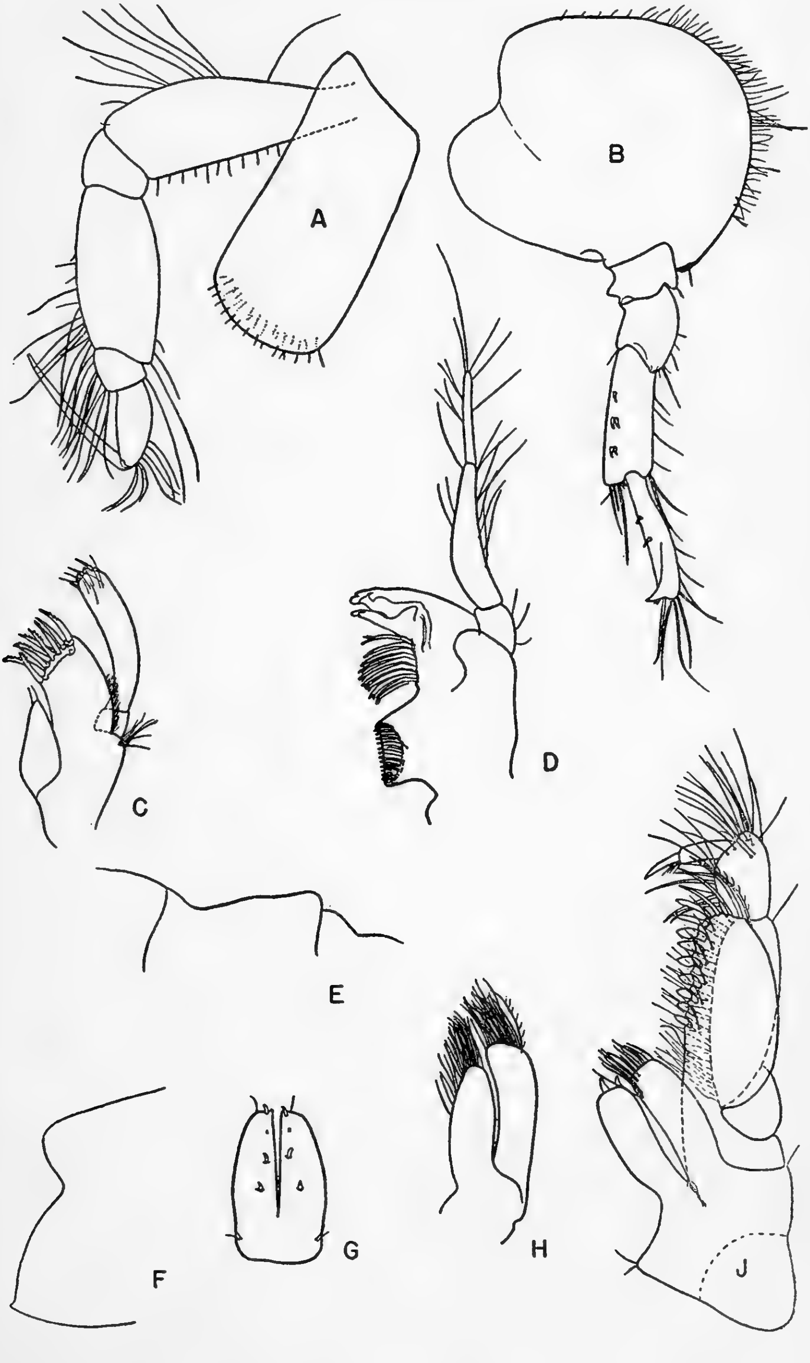
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PLATE 12

Ampelisca isocornea, new species

Paratype, male, 10 mm, Station 1388-41.

Figure A. Head.
B. Article 5, antenna 2.
C. Uropod 3, right.
D. Telson.
E. Peraeopod 4, right.
F. Peraeopod 5, right.
G. Peraeopod 1, right.
H. Urosome and pleon segment 3.

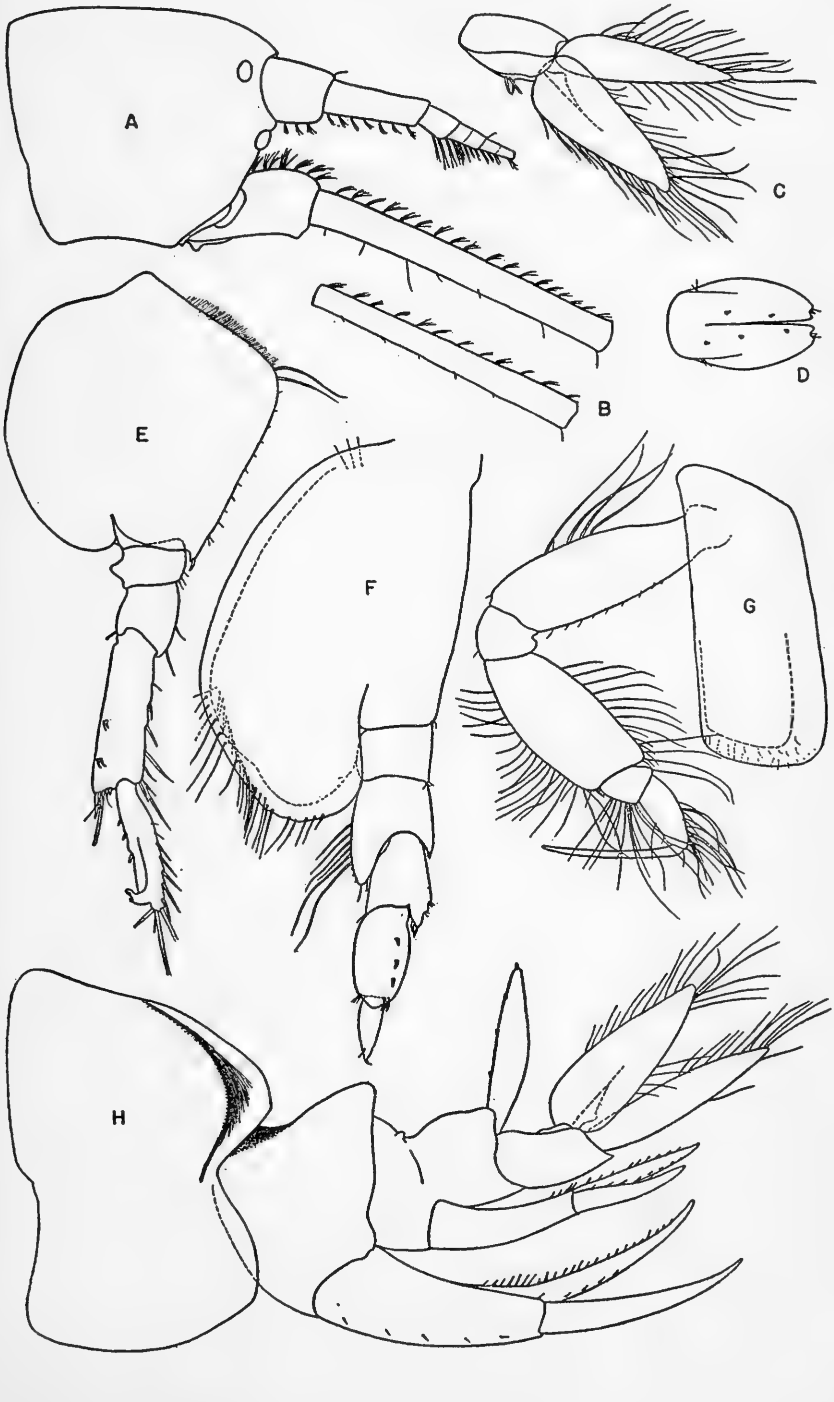
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PLATE 13

Ampelisca cucullata, new species

Paratype, ovigerous female, 6 mm, Station 964-39.

Figure A. Peraeopod 4, right.
B. Peraeopod 1, right.
C. Peraeopod 5, right.
D. Uropod 3, right.
E. Telson.
F. Urosome and pleon segment 3.
G. Head.

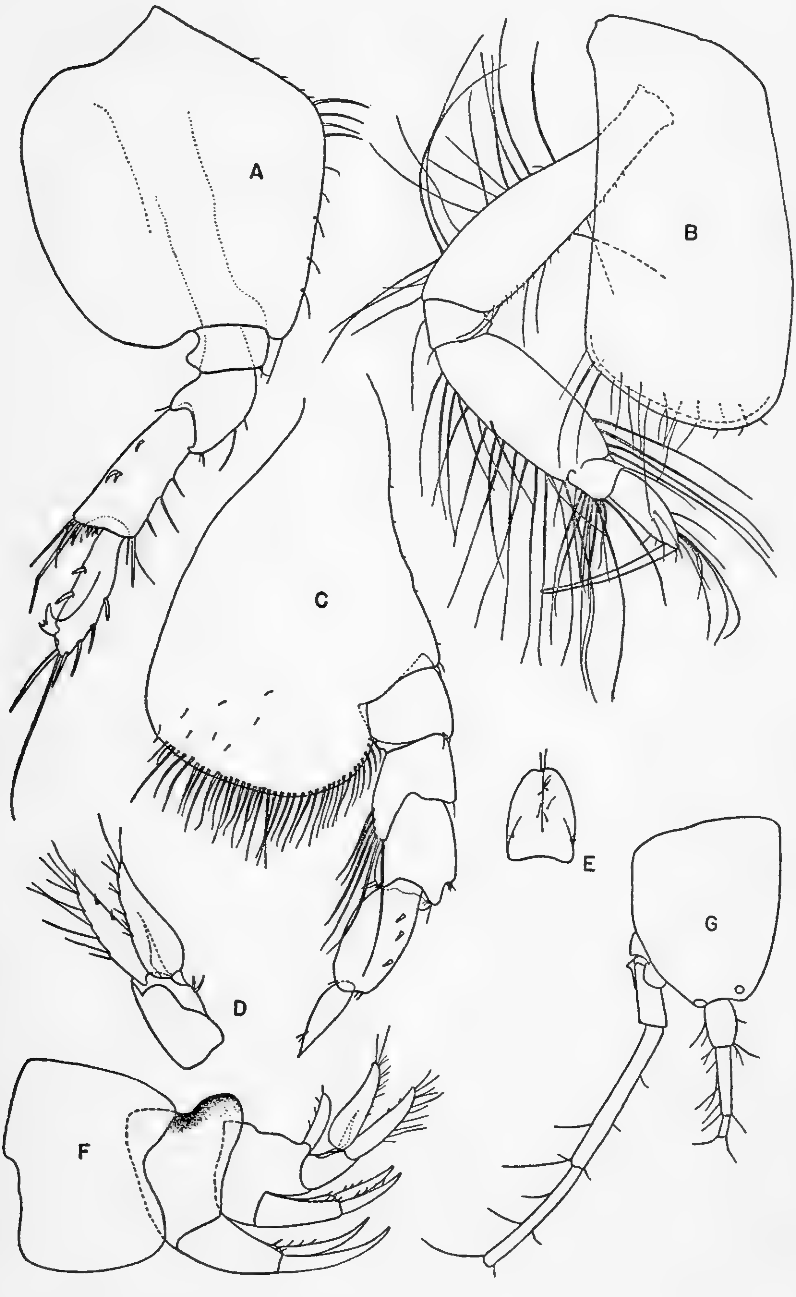
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PLATE 14

Ampelisca vera, new species

Female, 8 mm, Station 1384-41.
Figure A. Head.
B. Peraeopod 4, right.
C. Peraeopod 5, right.
D. Uropod 3, right.
F. Telson.
H. Urosome and pleon segment 3.
Another female, 8 mm, Station 1384-41.
Figure G. Pleon segment 4.
Female, 9.5 mm, Station 702-37.
Figure E. Pleon segment 4.

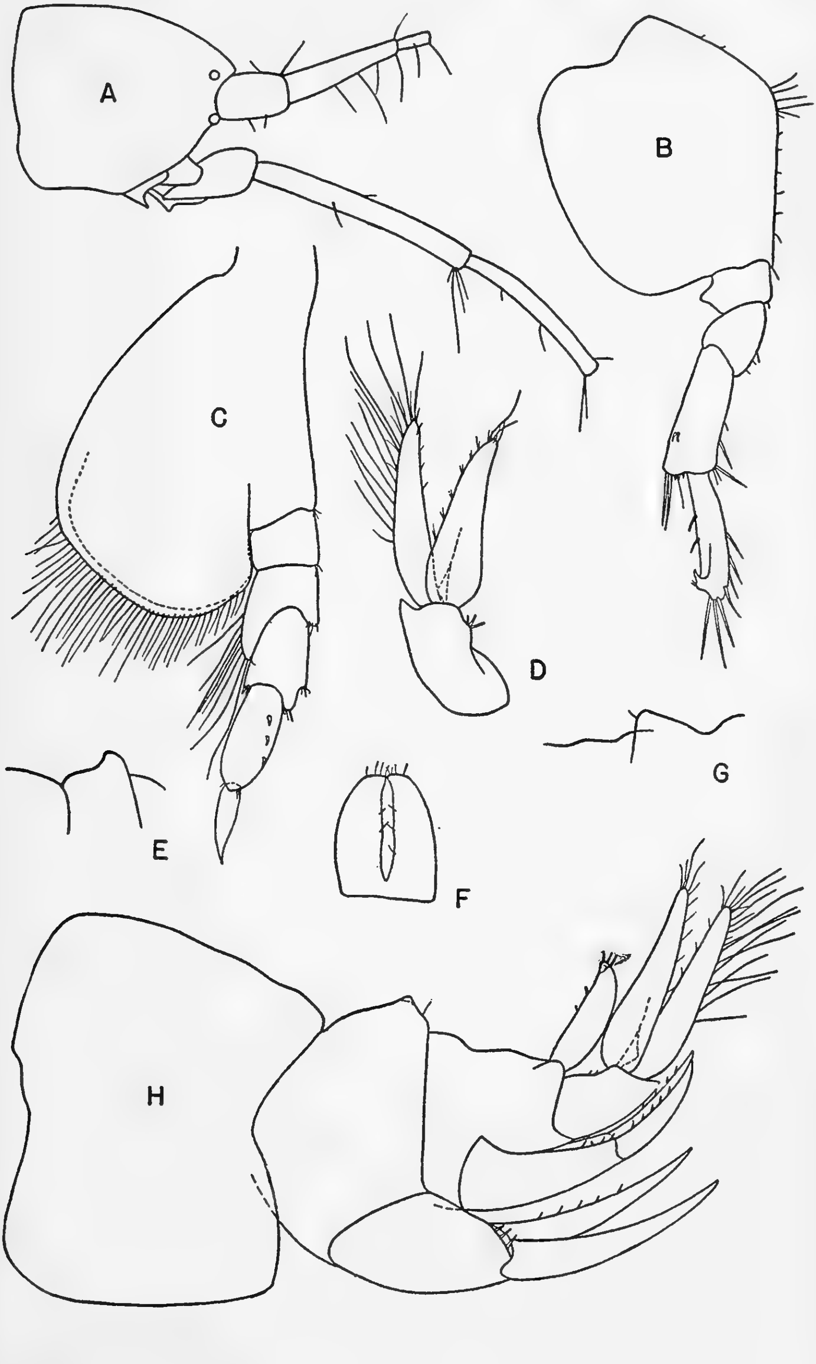
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PLATE 15

Ampelisca vera, new species

Paratype, male, 9 mm, Whidbey Island, Washington.
Figure A. Telson.
B. Peraeopod 5, right.
C. Gnathopod 2, right.
D. Head.
E. Urosome and pleon segment 3.
Male, 8 mm, Whidbey Island, Washington.
Figure F. Pleon segment 4.

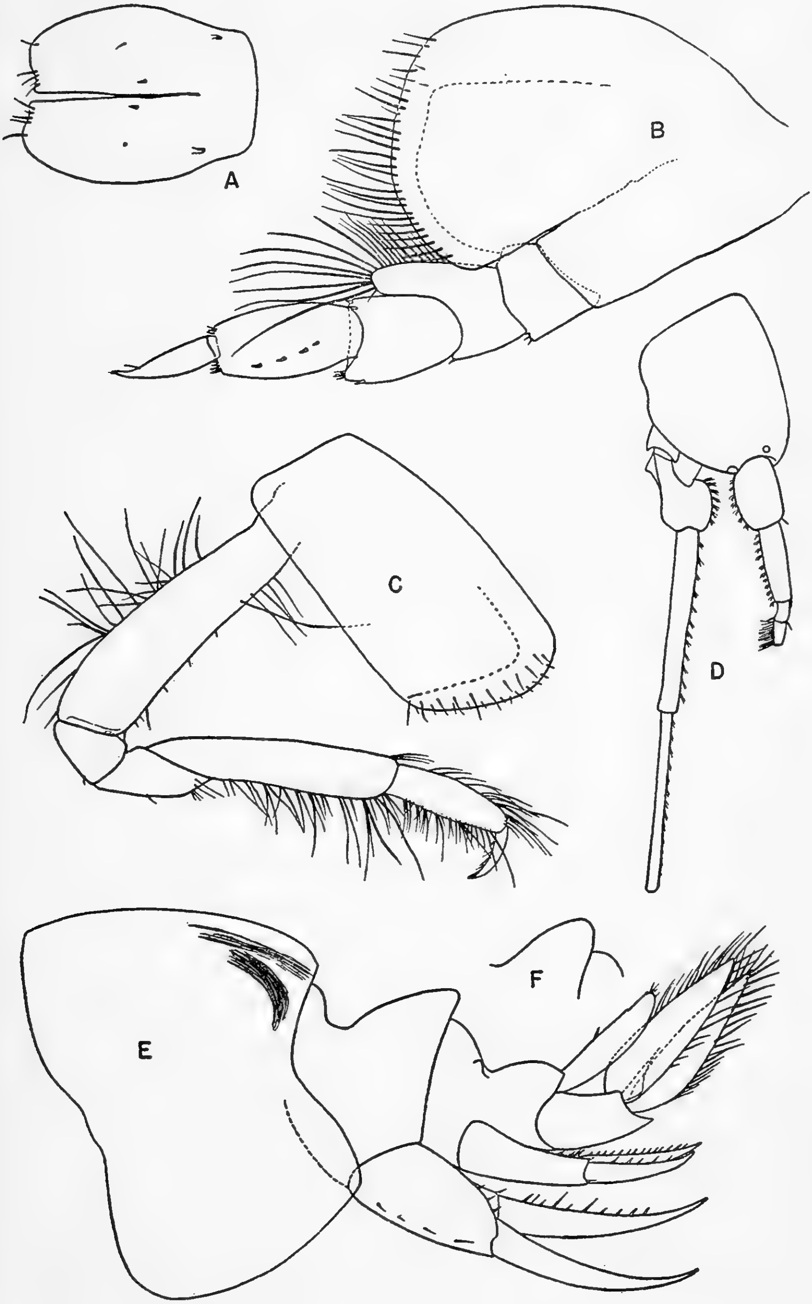
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PLATE 16

Ampelisca vera, new species

Paratype, male, 9 mm, Whidbey Island, Washington.

Figure A. Peraeopod 3, right.
B. Uropod 3, right.
C. Gnathopod 1, right.
D. Peraeopod 1, right.

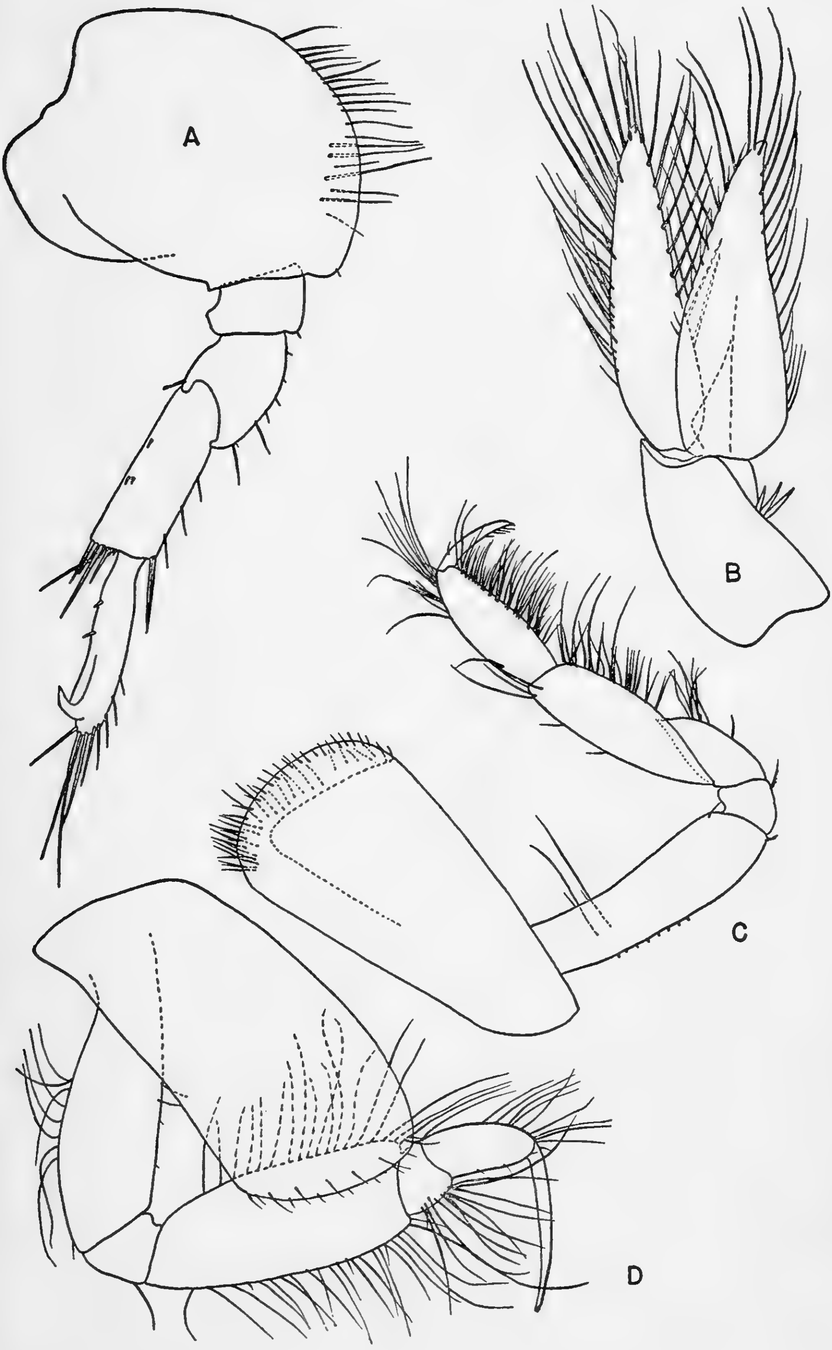
A
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PLATE 17

Ampelisca cristata Holmes

Ovigerous female, 16 mm, Station 889-38.
Figure A. Peraeopod 3, right.
B. Peraeopod 5, right.
C. Head.
Female, 14 mm, Station 1372-41.
Figure D. Pleon segment 4.

Ampelisca cristata forma *microdentata,* new form

Paratype, female, 13 mm, Station 1169-40.
Figure E. Telson.
Male, 9 mm, Station 936-39.
Figure F. Pleon segment 4.
Female, 11 mm, Station 1925-49.
Figure G. Pleon segment 3.
Allotype, male, 9.5 mm, Station 1169-40.
Figure H. Pleon segments 3 and 4.

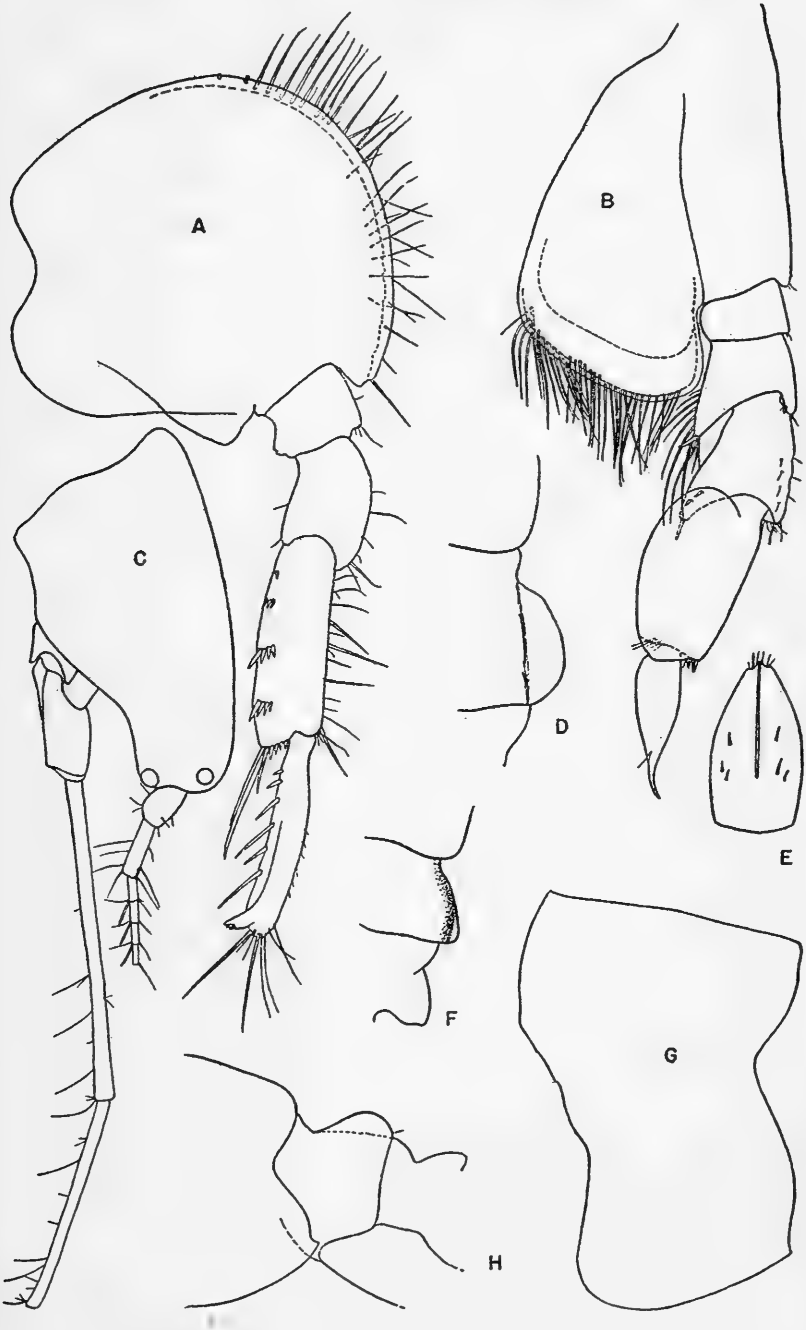
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PLATE 18

Ampelisca cristata Holmes

Ovigerous female, 16 mm, Station 889-38.
Figure A. Peraeopod 1, right.
C. Telson.
D. Uropod 3, right.
G. Urosome and pleon segment 3.

Female, 17 mm, Station 1372-41.
Figure F. Telson.

Ampelisca cristata forma *microdentata,* new form

Holotype, female, 13 mm, Station 1169-40.
Figure B. Pleon segments 3 and 4.

Male, 8.5 mm, Station 697-37.
Figure E. Pleon segment 4.

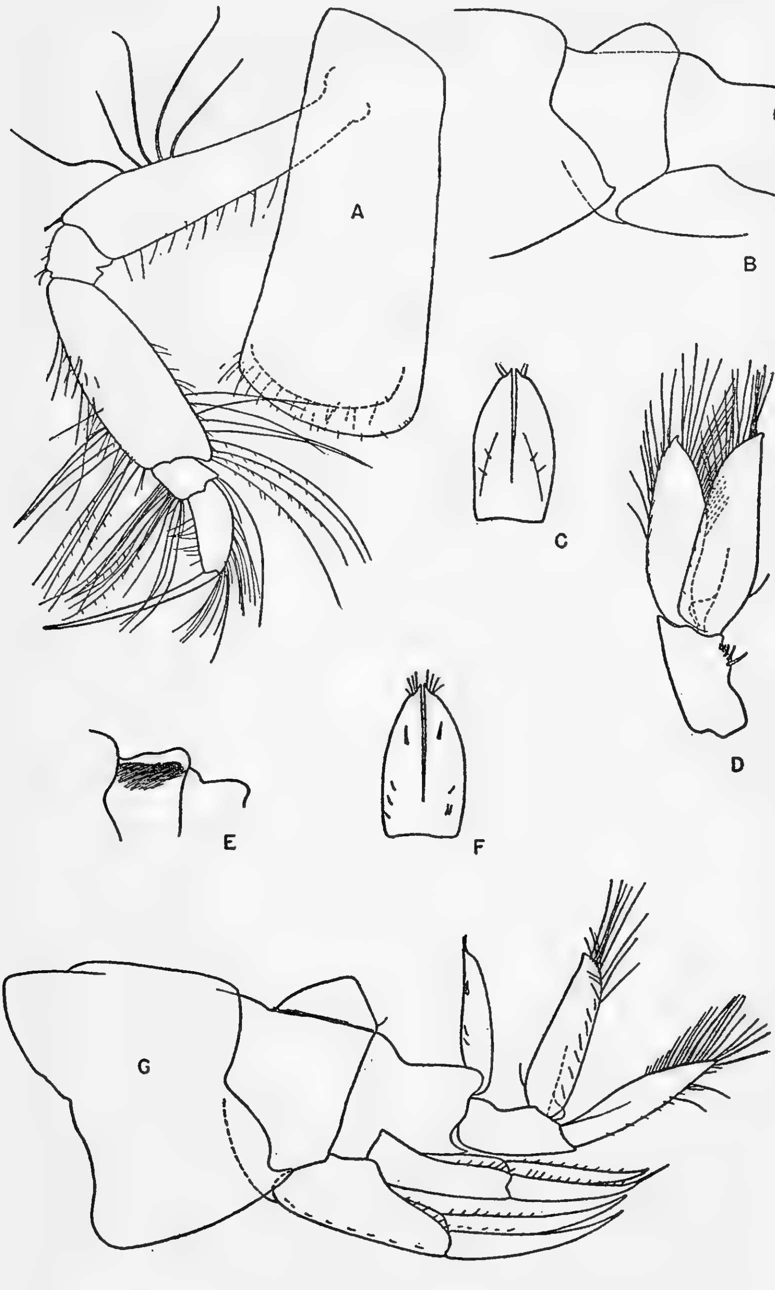
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PLATE 19

Ampelisca cristoides, new species

Paratype, female, 14 mm, Station 1714-49.

Figure A. Head.

B. Telson.

C. Peraeopod 1, right.

D. Urosome and pleon segment 3.

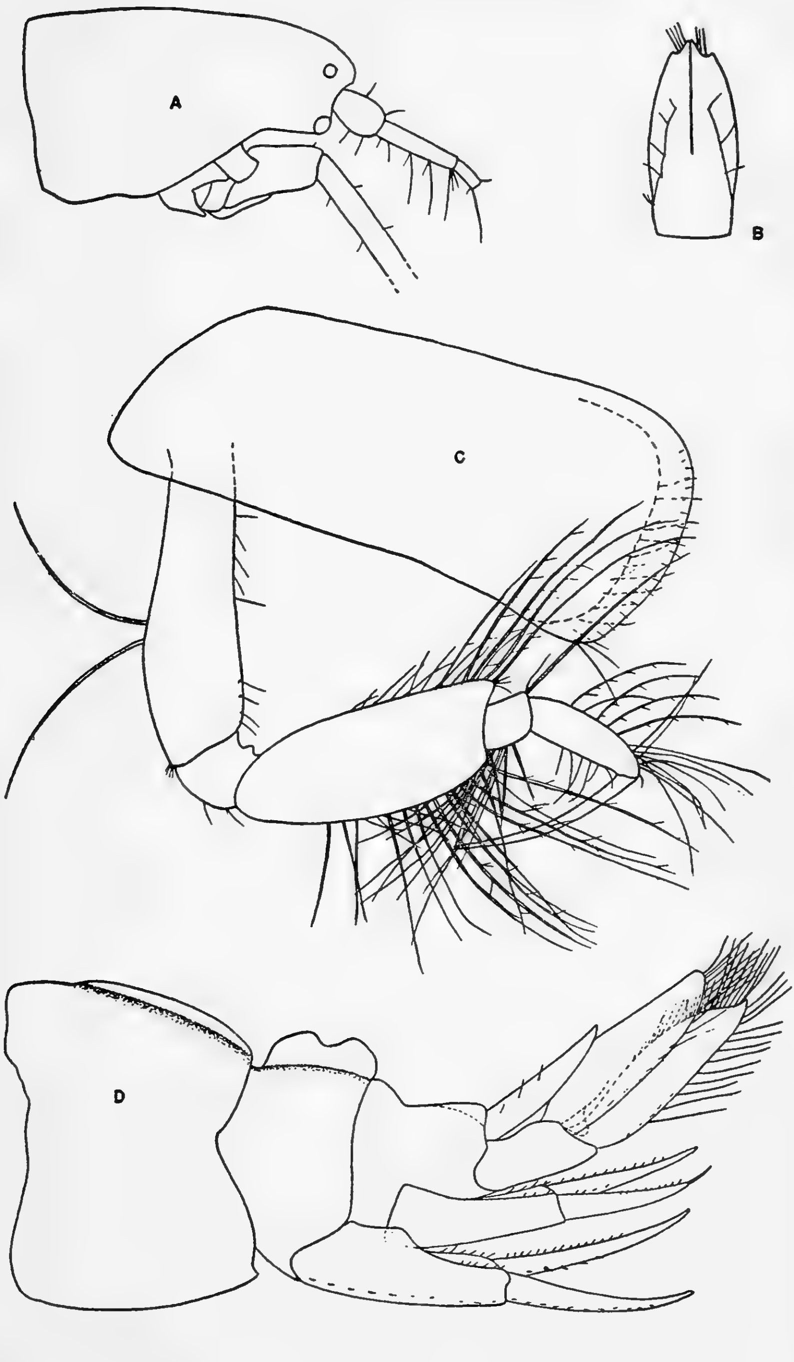
A
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PLATE 20

Ampelisca cristoides, new species

Paratype, female, 14 mm, Station 1714-49.

Figure A. Peraeopod 4, right.
B. Peraeopod 5, right.
C. Coxa 1, right.
D. Uropod 3, right.

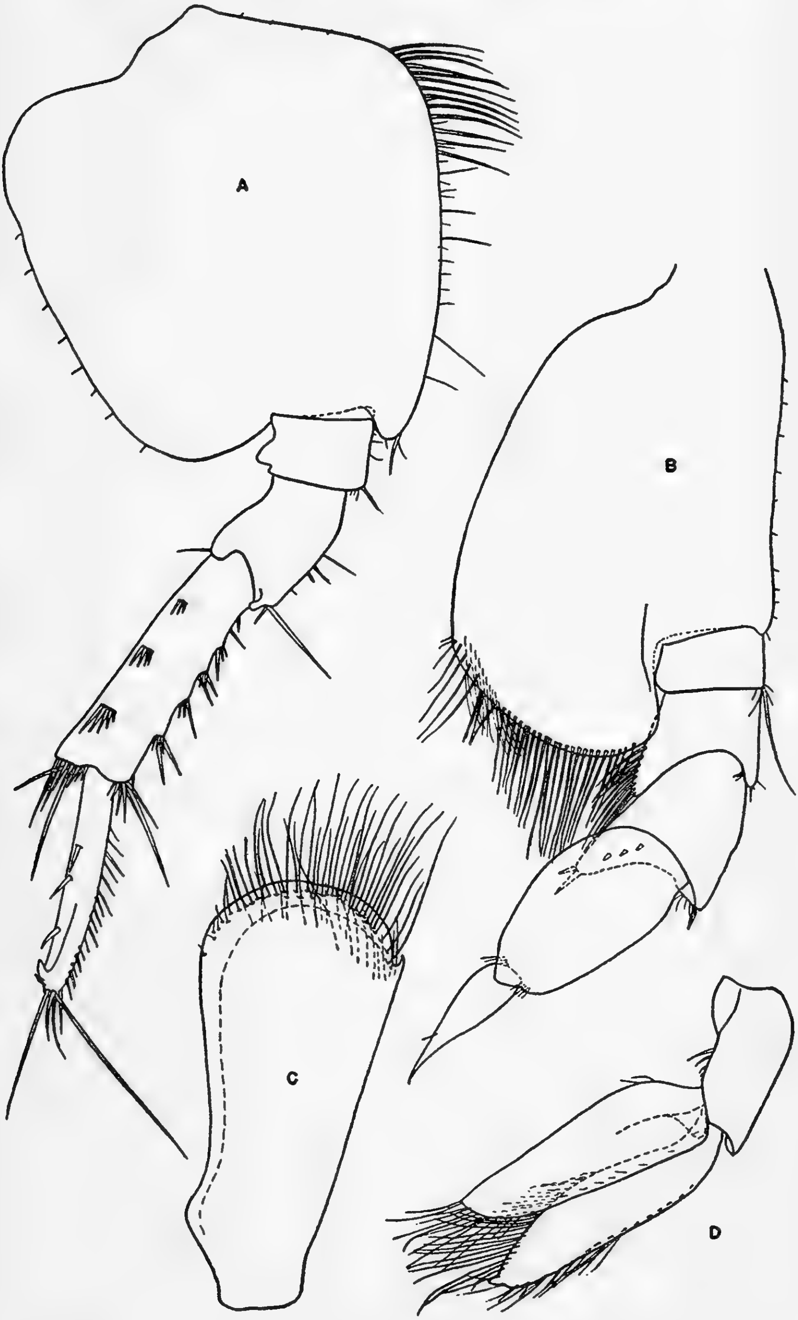
A
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PLATE 21

Ampelisca pacifica Holmes

Male, 10 mm, Station 1388-41.
Figure A. Head.
B. Telson.
C. Peraeopod 1, right.
Female, 9 mm, Station 1388-41.
Figure D. Urosome and pleon segment 3.

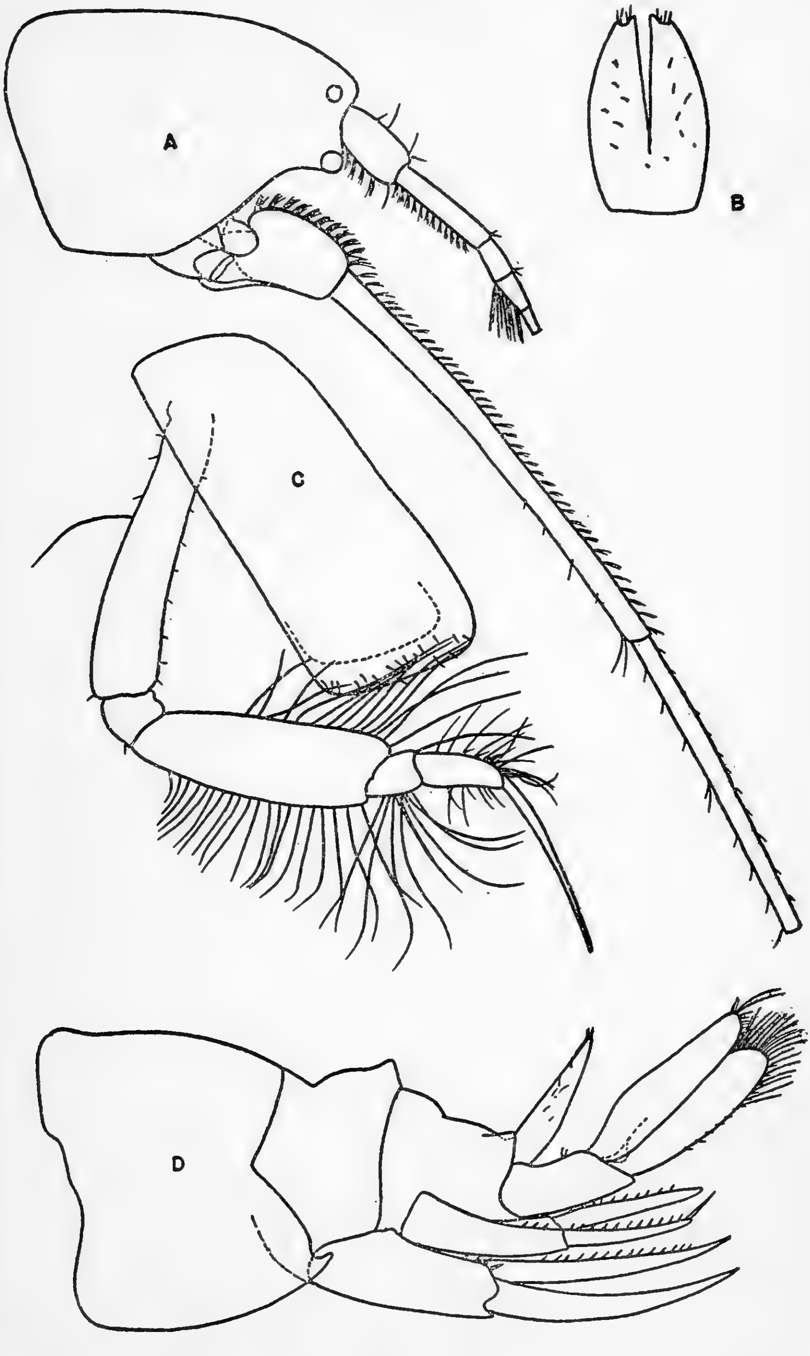
A
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PLATE 22

Ampelisca pacifica Holmes

Male, 10 mm, Station 1388-41.

Figure A. Peraeopod 3, right.

B. Peraeopod 5, right.

C. Uropod 3, right.

D. Urosome and pleon segment 3.

E. Seta of lower edge of article 2 of peraeopod 5, greatly magnified.

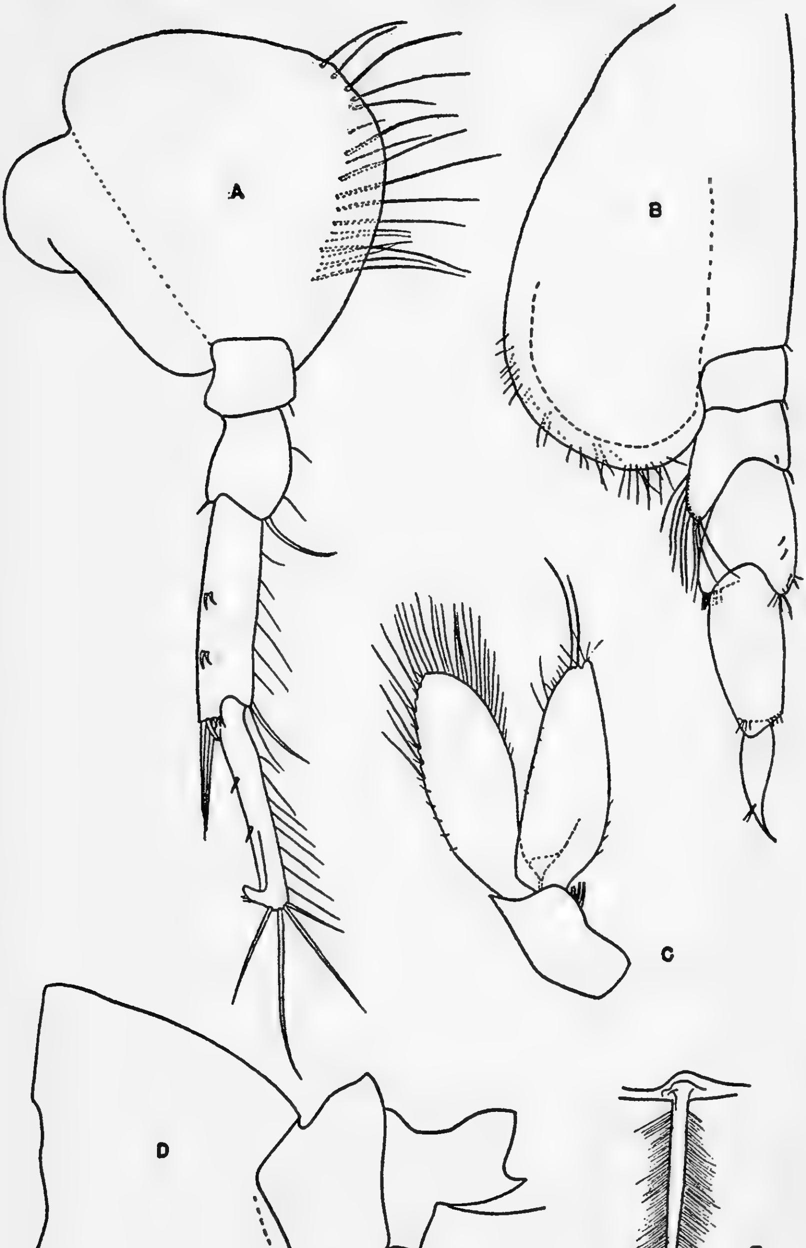
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PLATE 23

Ampelisca brevisimulata, new species

Paratype, female, 9 mm, Station 1321-41.

Figure A. Head.

B. Peraeopod 5, right.

D. Telson.

E. Peraeopod 1, right.

Male, 7 mm, Station 769-38.

Figure C. Uropod 3, left.

F. Pleon segments 3 and 4. (Note: tooth on segment 3 is much shorter than in the female. This may need separate designation as a new form when more materials are available for comparison.)

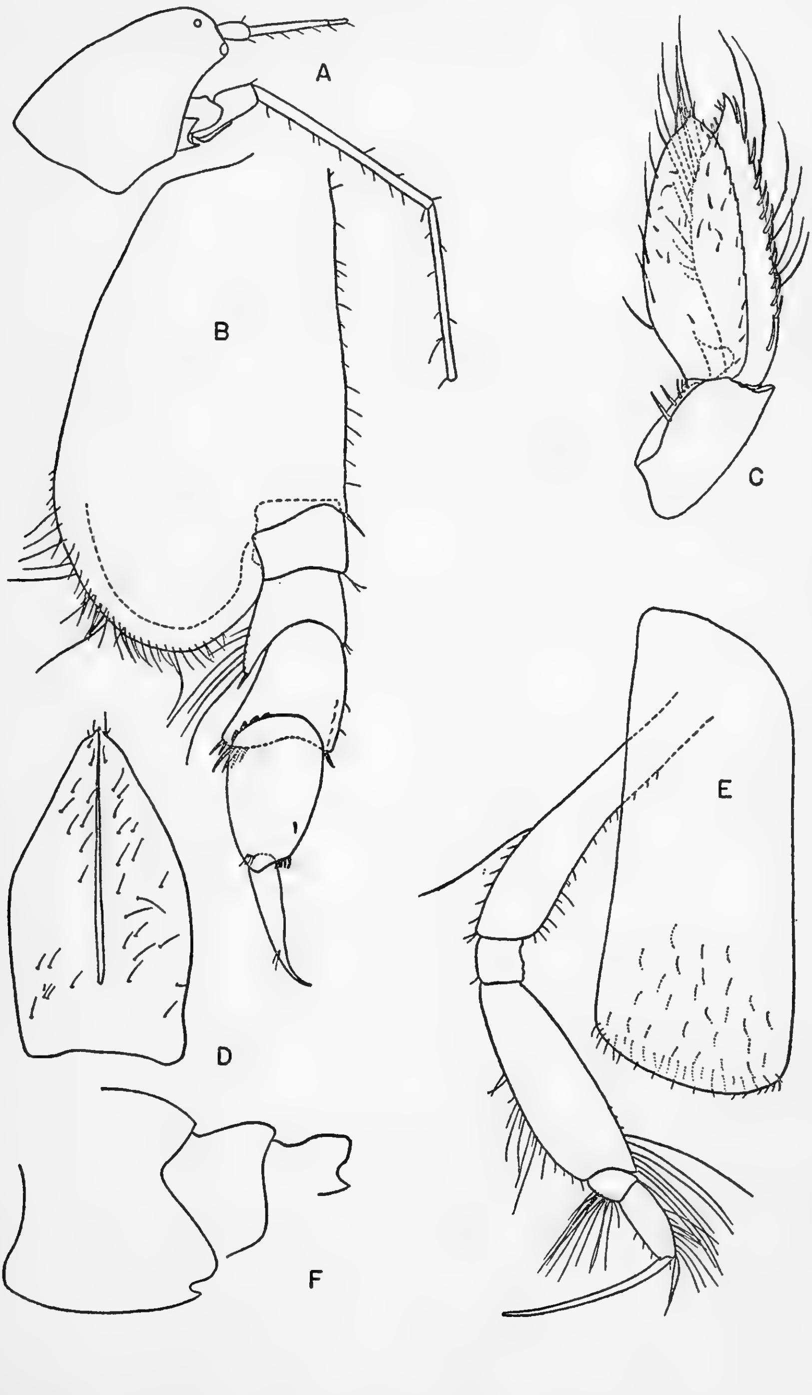
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PLATE 24

Ampelisca brevisimulata, new species

Paratype, female, 9 mm, Station 1321-41.

Figure A. Peraeopod 4, right.
B. Urosome and pleon segment 3.
C. Uropod 3, left.
D. Lower posterior corner of coxa 1, greatly magnified.

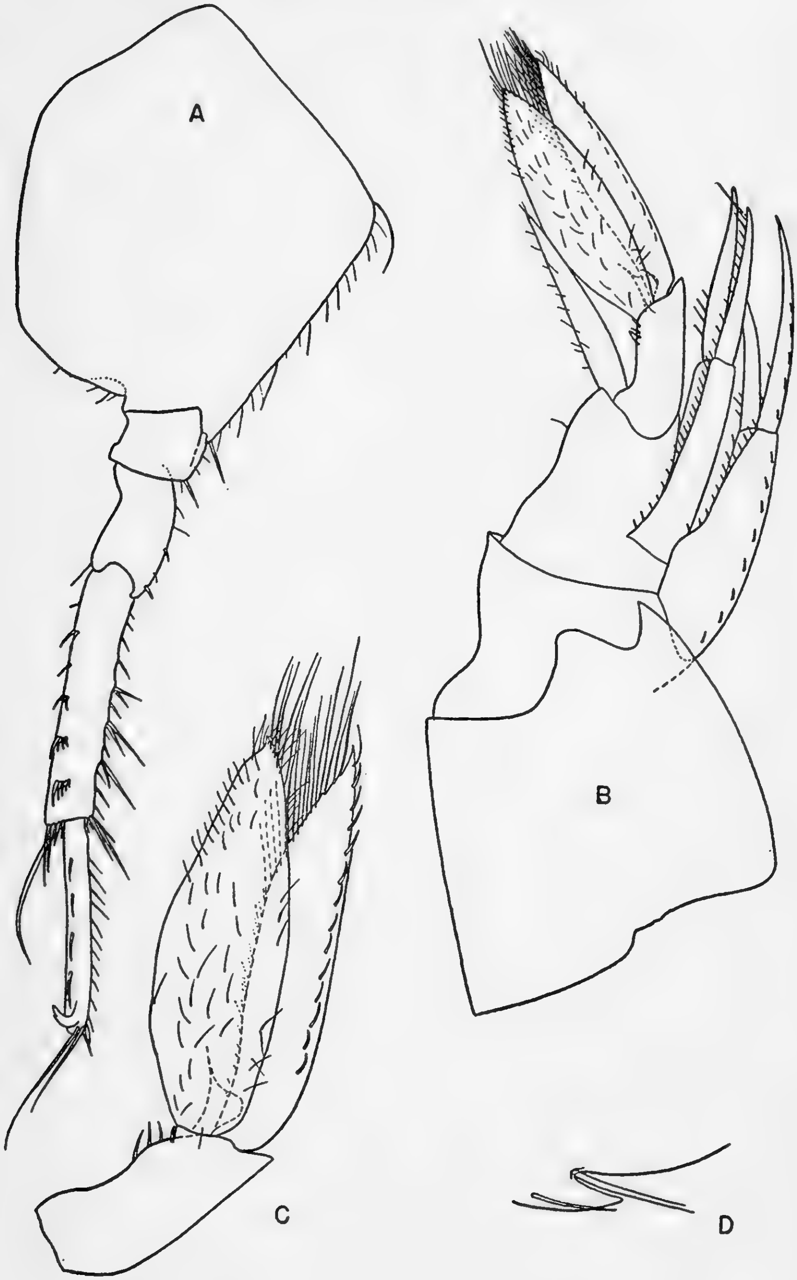
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PLATE 25

Ampelisca panamensis, new species

Paratype, female, 7.5 mm, Station 113-33.

Figure A. Peraeopod 3, left.
B. Peraeopod 1, left.
C. Peraeopod 5, left.
D. Telson.
E. Urosome and pleon segment 3.
F. Lower posterior corner of coxa 1, left.
G. Uropod 3, left.

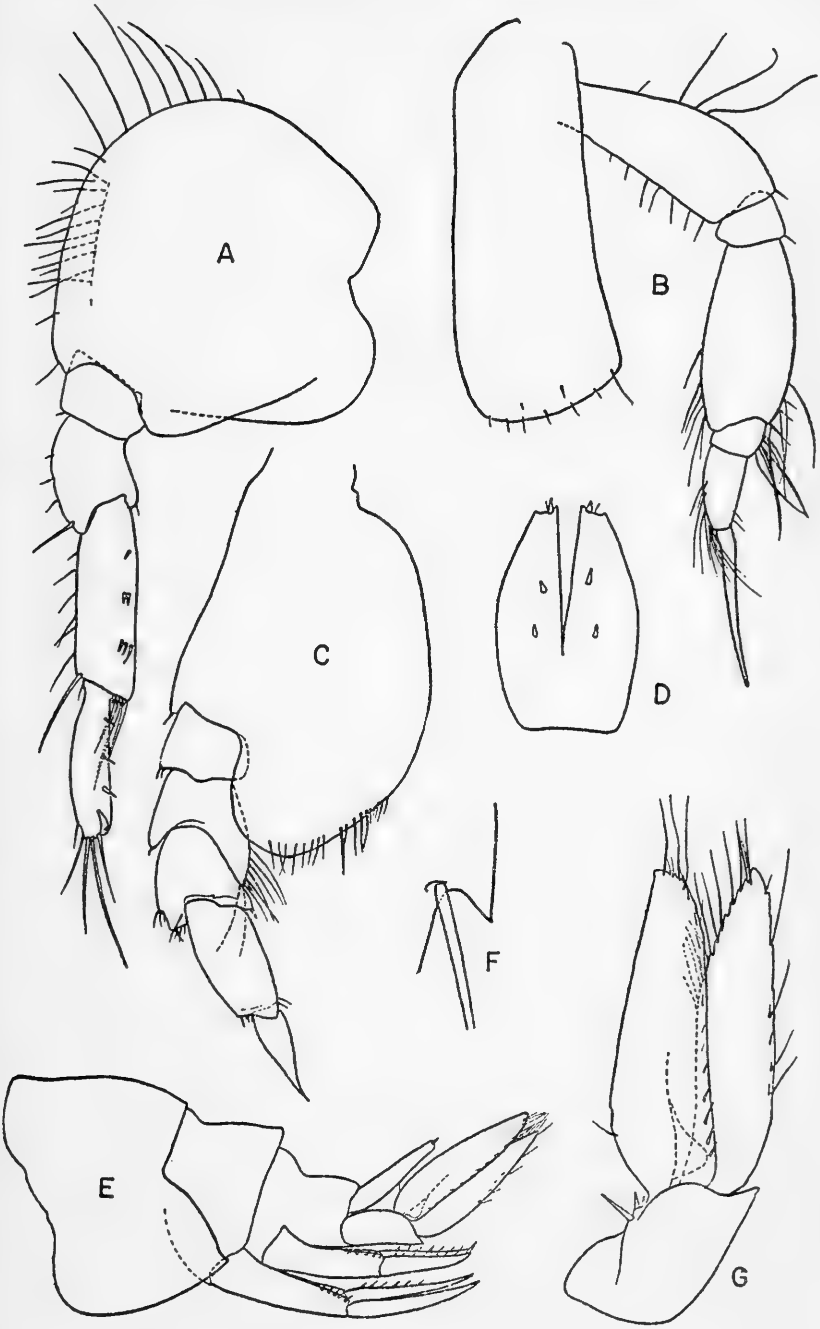
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PLATE 26

Ampelisca hancocki, new species

Ovigerous female, 6 mm, Station 1418-41.

Figure A. Head.
B. Peraeopod 3, right.
C. Peraeopod 5, right, enlarged.
D. Uropod 3, left.
E. Telson.
F. Peraeopod 1, right.
G. Urosome and pleon segment 3.

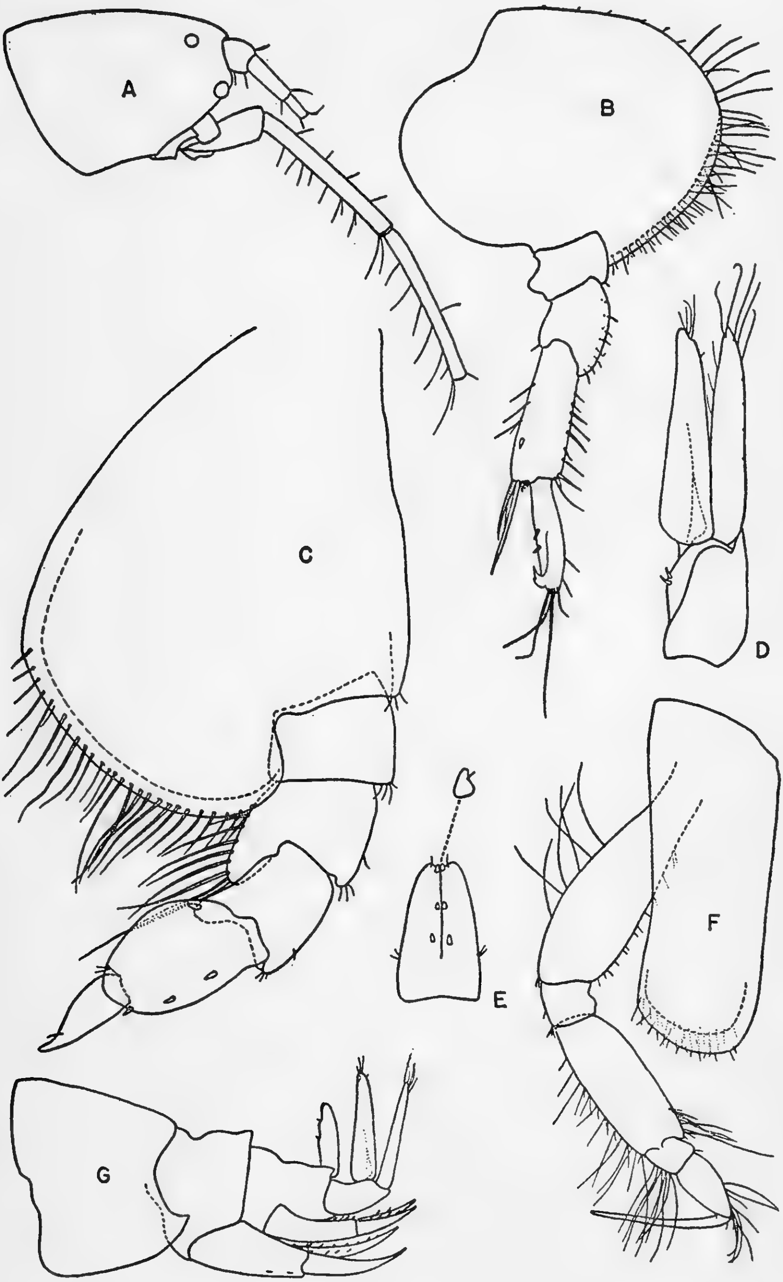
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PLATE 27

Ampelisca shoemakeri, new species

Paratype, female, 6 mm, Station 964-39.
Figure A. Head.
C. Peraeopod 1, right.
D. Uropod 3, right.
E. Urosome and pleon segment 3.
Allotype, male, 5.5 mm, Station 964-39.
Figure B. Telson.

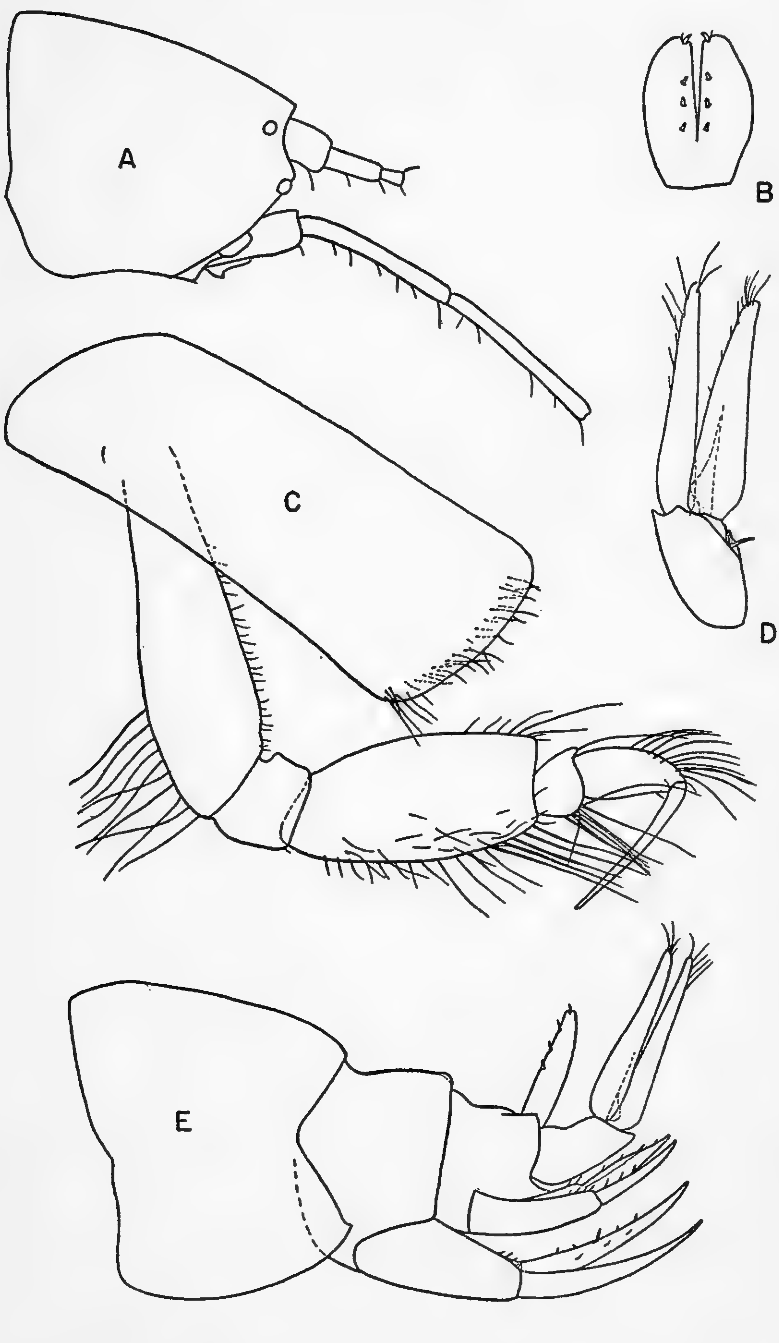
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PLATE 28

Ampelisca shoemakeri, new species

Paratype, female, 6 mm, Station 964-39.
Figure A. Peraeopod 3, right.
C. Peraeopod 5, right.
D. Telson.
Allotype, male, 5.5 mm, Station 964-39.
Figure B. Uropod 3, right.
E. Pleon segments 3 and 4.

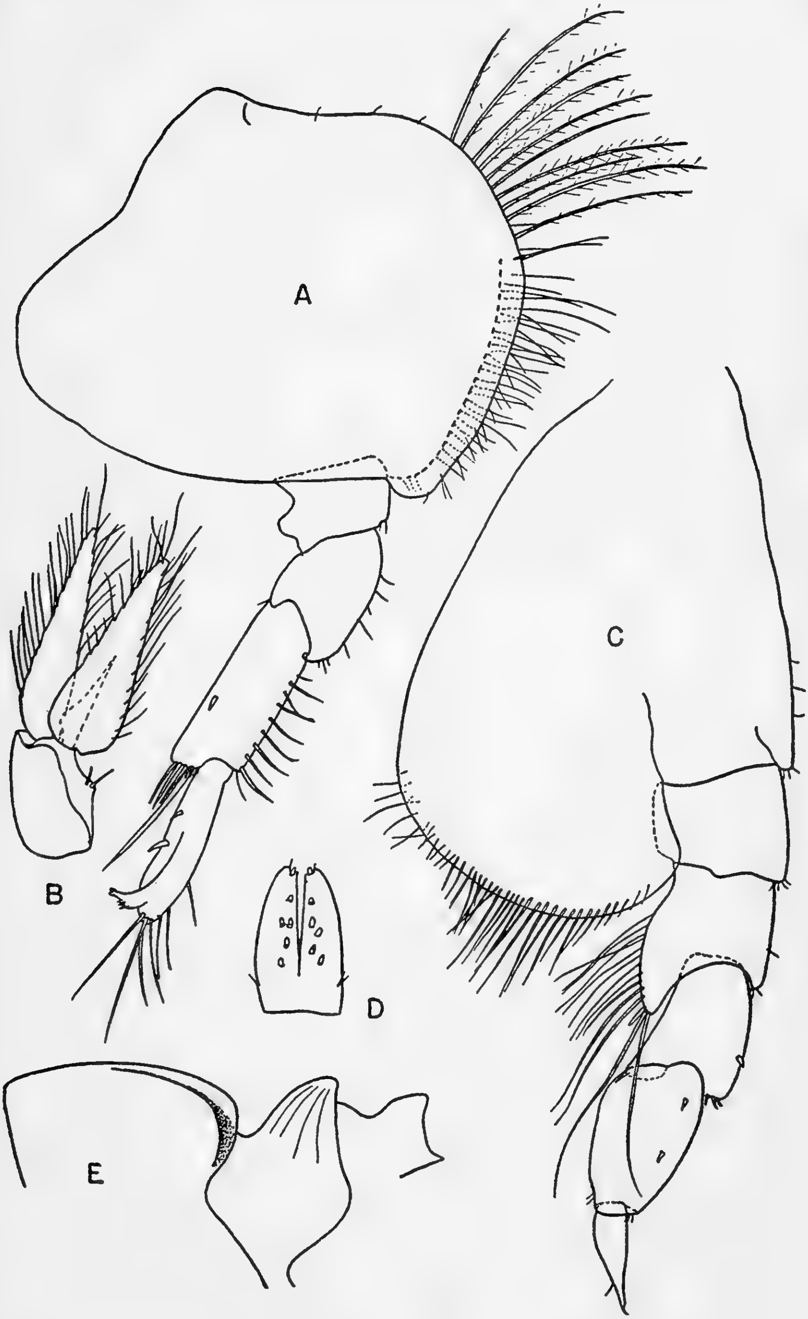
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PLATE 29

Ampelisca macrocephala Lilljeborg

Female, 7 mm, Station 1390-41.

Figure A. Head.
B. Peraeopod 3, right.
C. Peraeopod 5, right, enlarged.
D. Uropod 3, right.
E. Telson.
F. Lower posterior corner of coxa 1, greatly magnified.
G. Peraeopod 1, right.
H. Urosome and pleon segment 3.

Male, 7 mm, Station 1229-41.

Figure J. Pleon segment 4.

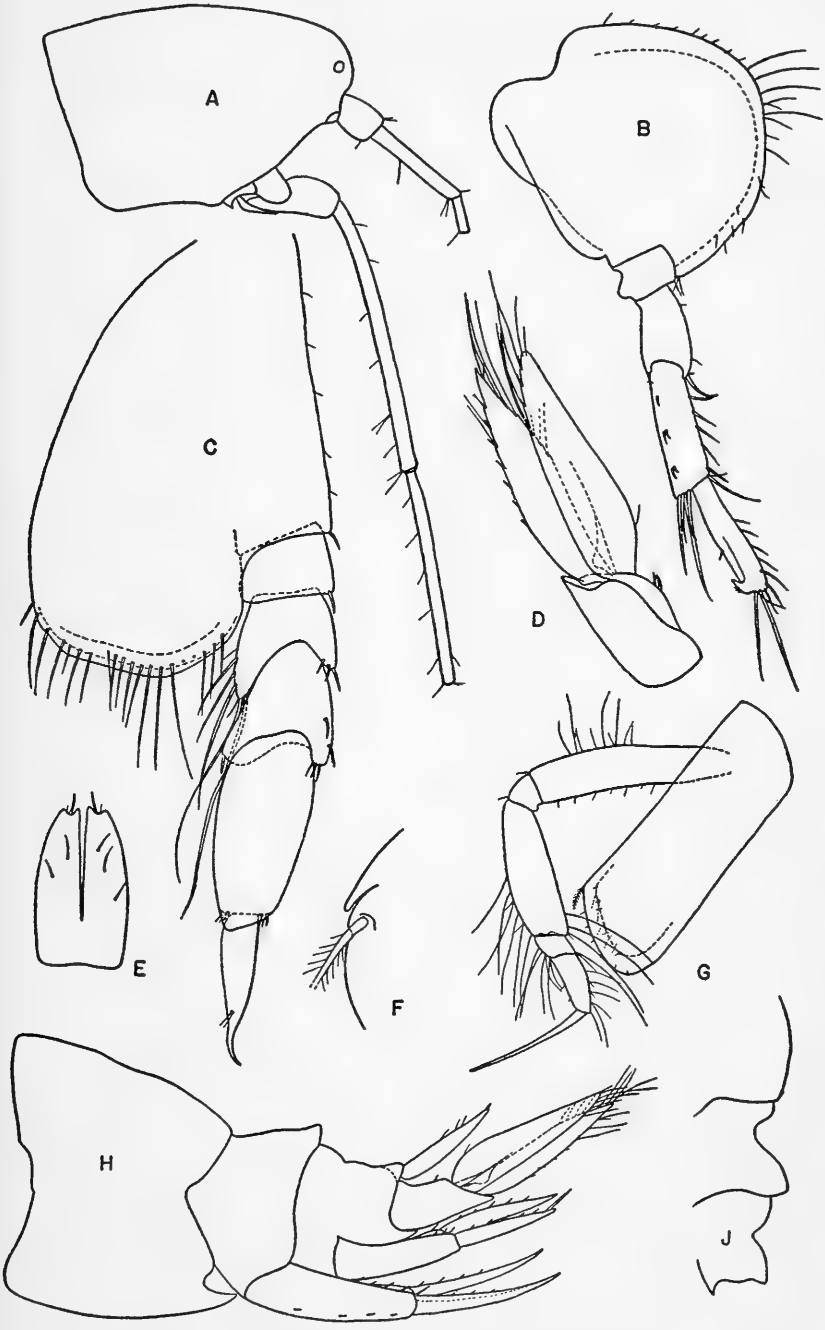
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PLATE 30

Ampelisca indentata, new species

Paratype, female, 7.5 mm, Station 1168-40.

Figure A. Head.
B. Lower posterior corner of coxa 1, greatly magnified.
C. Peraeopod 5, right.
D. Telson.
E. Article 6 of gnathopod 1, right.
F. Uropod 3, right.
G. End of palp of maxilla 1, greatly magnified.
H. Urosome and pleon segment 3.

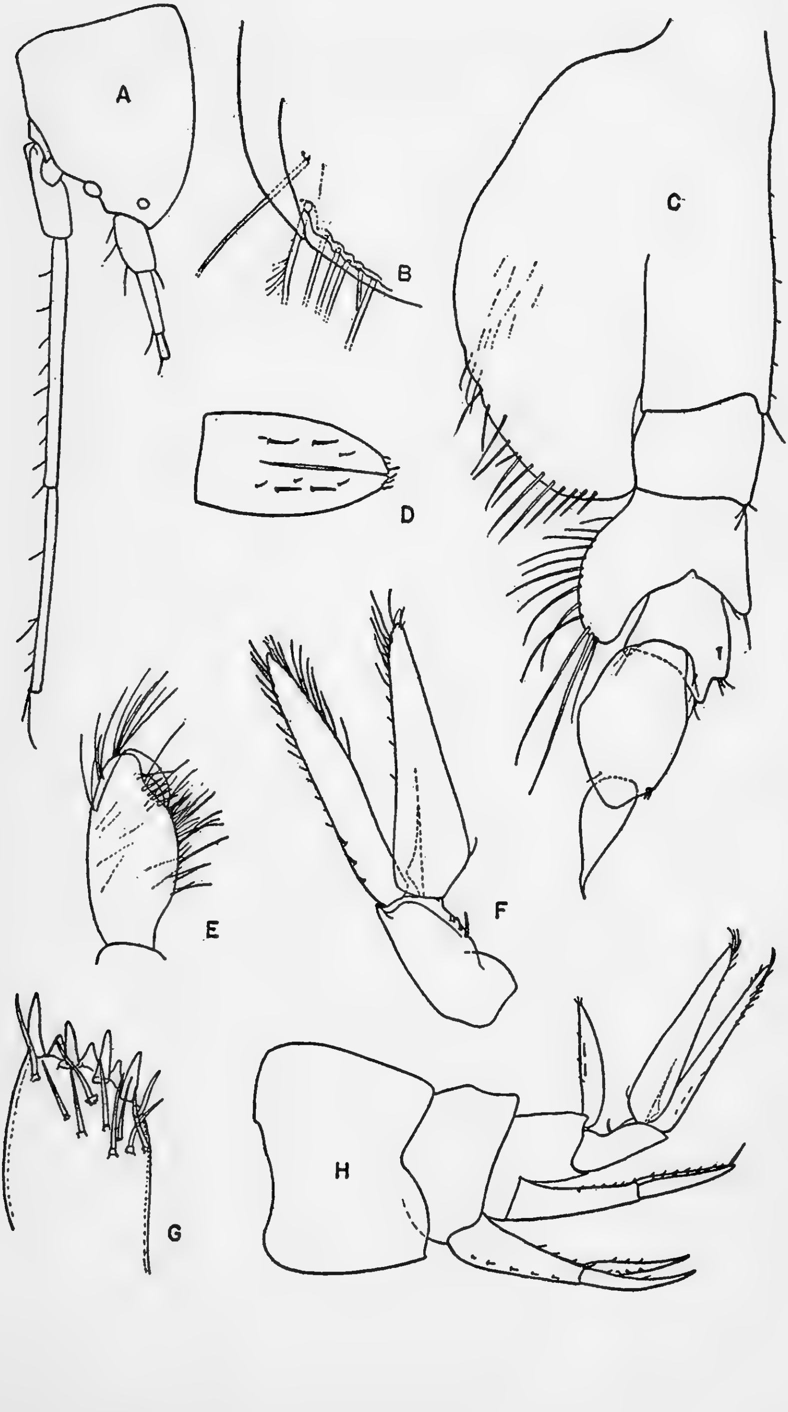
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PLATE 31

Ampelisca mexicana, new species

Paratype, female, 5 mm, Station 964-39.

Figure A. Head.
B. Uropod 2, right.
C. Telson.
D. Urosome and pleon segment 3.
E. Peraeopod 5, right.

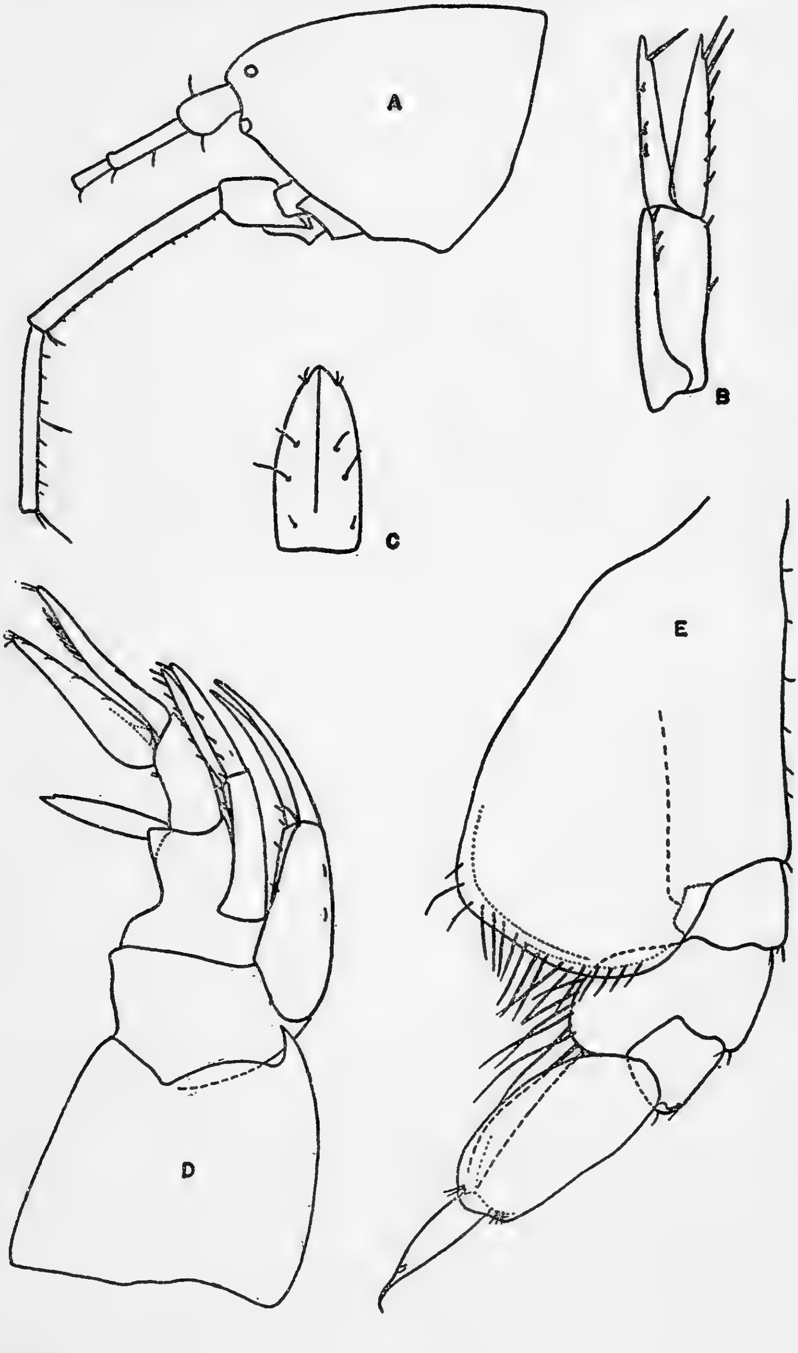
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PLATE 32

Ampelisca mexicana, new species

Paratype, female, 5 mm, Station 964-39.

Figure A. Uropod 3.
B. Peraeopod 3, right.
C. Peraeopod 1, right.
D. Article 6 of gnathopod 1, right, greatly magnified.

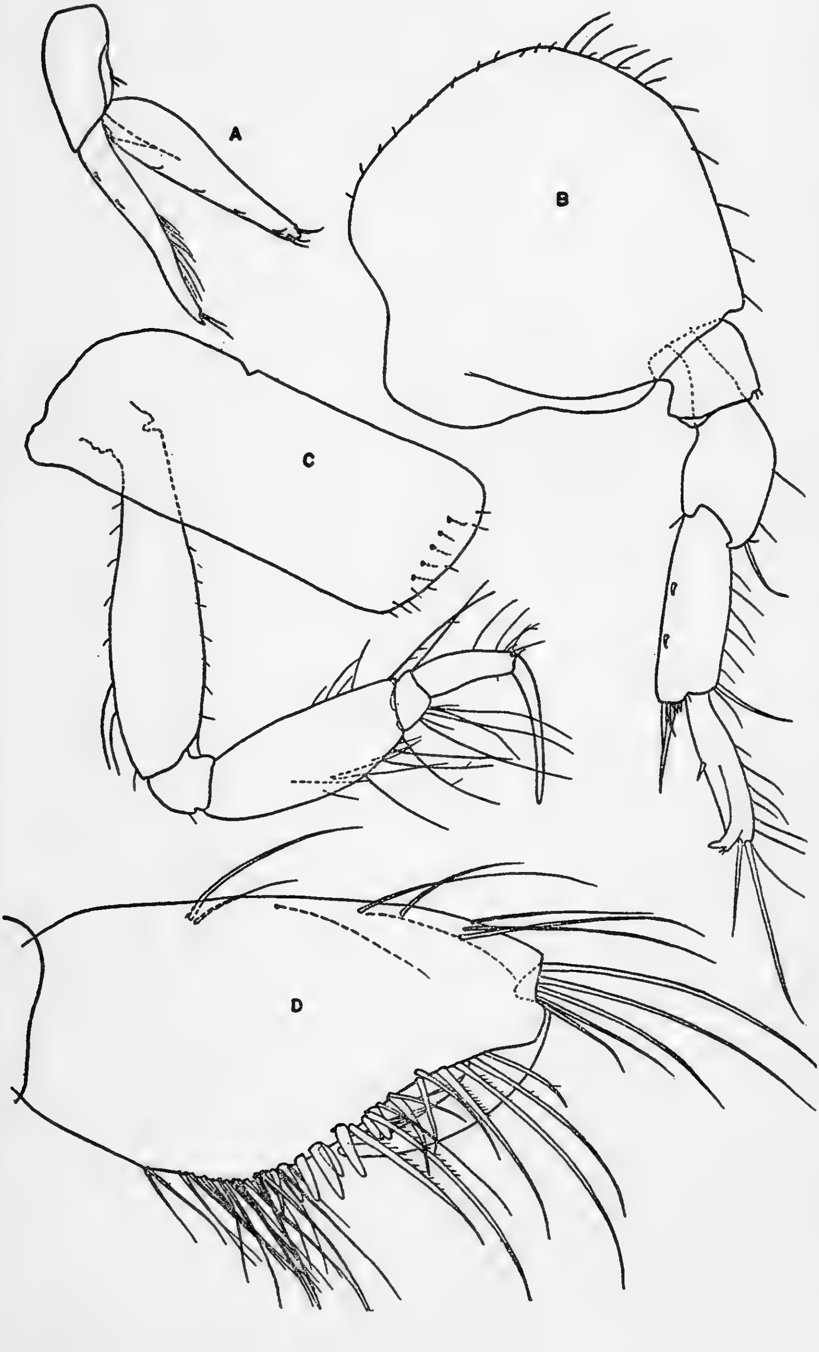
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PLATE 33

Ampelisca gnathia, new species

Paratype, male, 7.5 mm, Station 1321-41.

Figure A. Head.

B. Peraeopod 5, right.

C. Peraeopod 1, right.

D. Gnathopod 1, right, enlarged.

E. Telson.

F. Uropod 3, left.

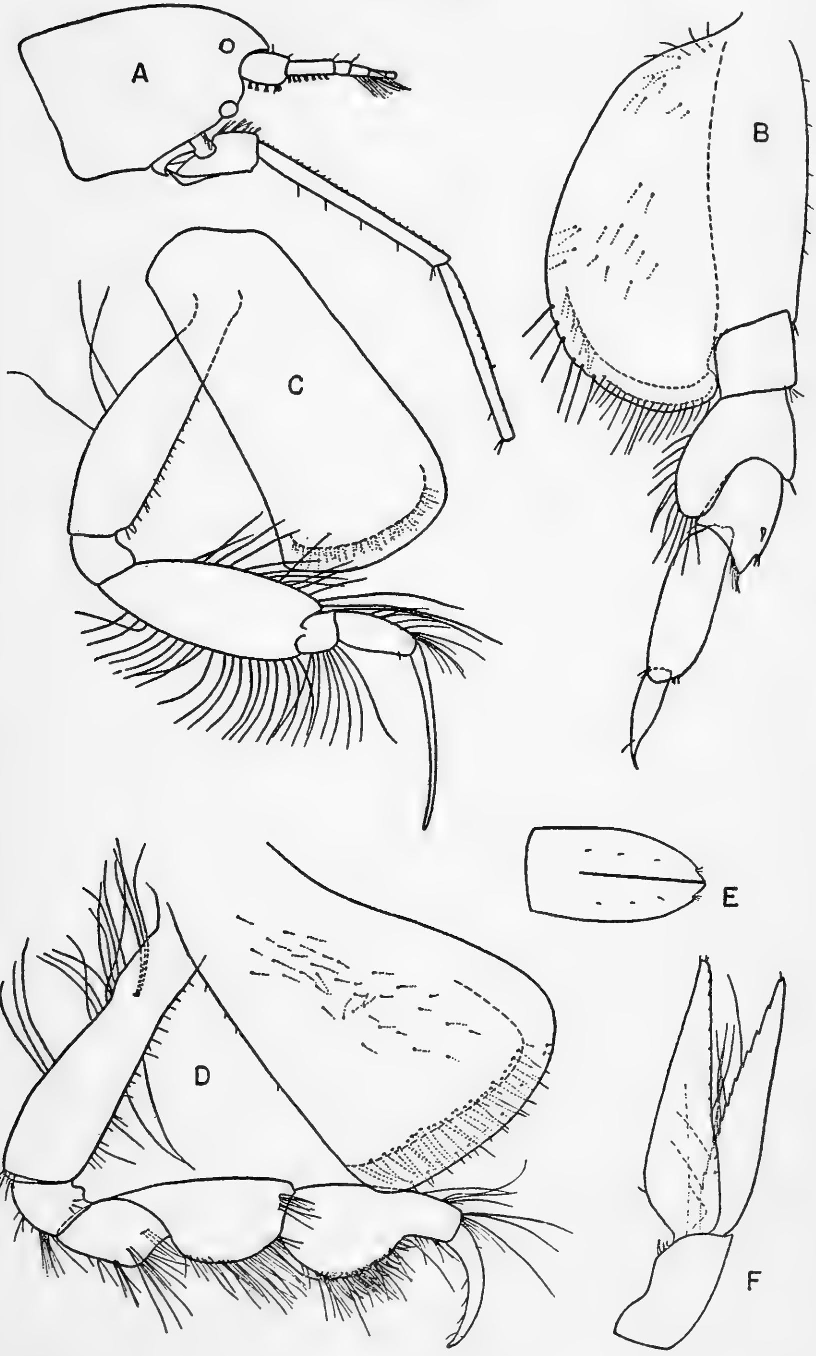
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PLATE 34

Ampelisca gnathia, new species

Paratype, male, 7.5 mm, Station 1321-41.

Figure A. Pleon segment 4.

B. Peraeopod 3, right.

C. Urosome and pleon segment 3.

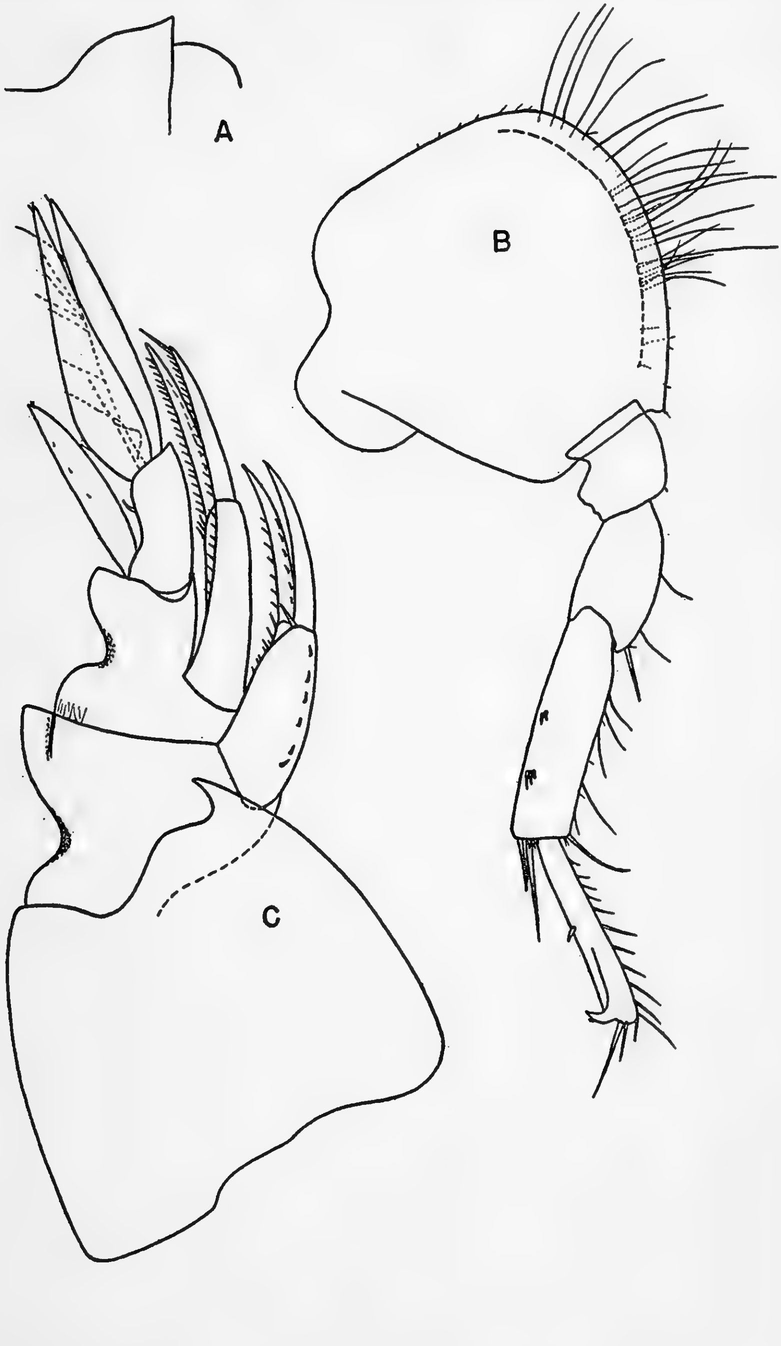

A
B
C

PLATE 35

Ampelisca pugetica Stimpson

Ovigerous female, 12 mm, Station 1418-41.
Figure A. Head.
B. Uropod 3, right.
C. Peraeopod 5, right.
F. Urosome and pleon segment 3.
Male, 10.5 mm, Station 1418-41.
Figure D. Uropod 3, right.
E. Pleon segments 3 and 4.

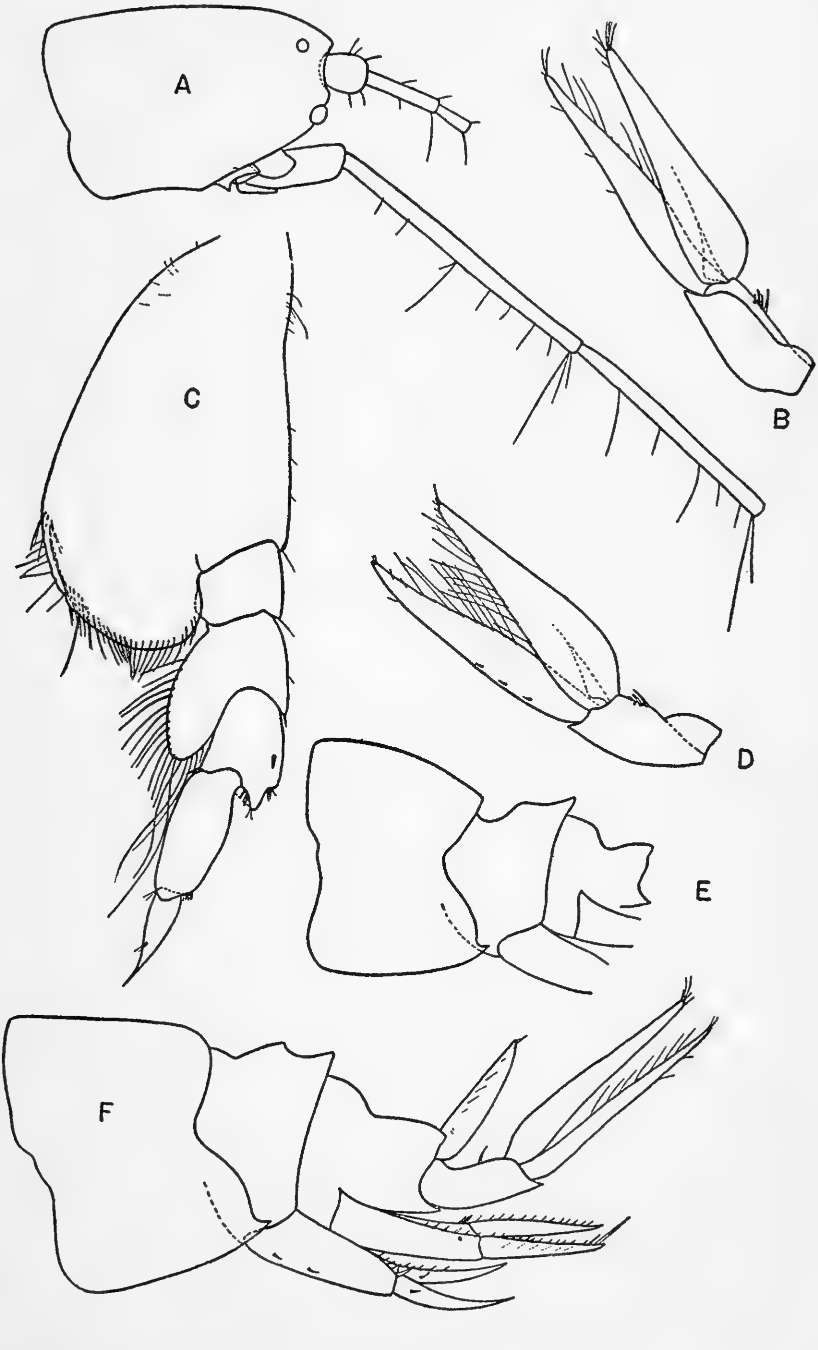

A
B
C
D
E
F

PLATE 36

Ampelisca pugetica Stimpson

Ovigerous female, 12 mm, Station 1418-41.
Figure A. Peraeopod 4, right.
C. Peraeopod 1, right.
E. Telson.
Male, 10.5 mm, Station 1418-41.
Figure D. Telson.

Ampelisca pugetica forma *macrodentata,* new form
Female, 9 mm, Station 1055-40.
Figure B. Pleon segments 3 and 4.

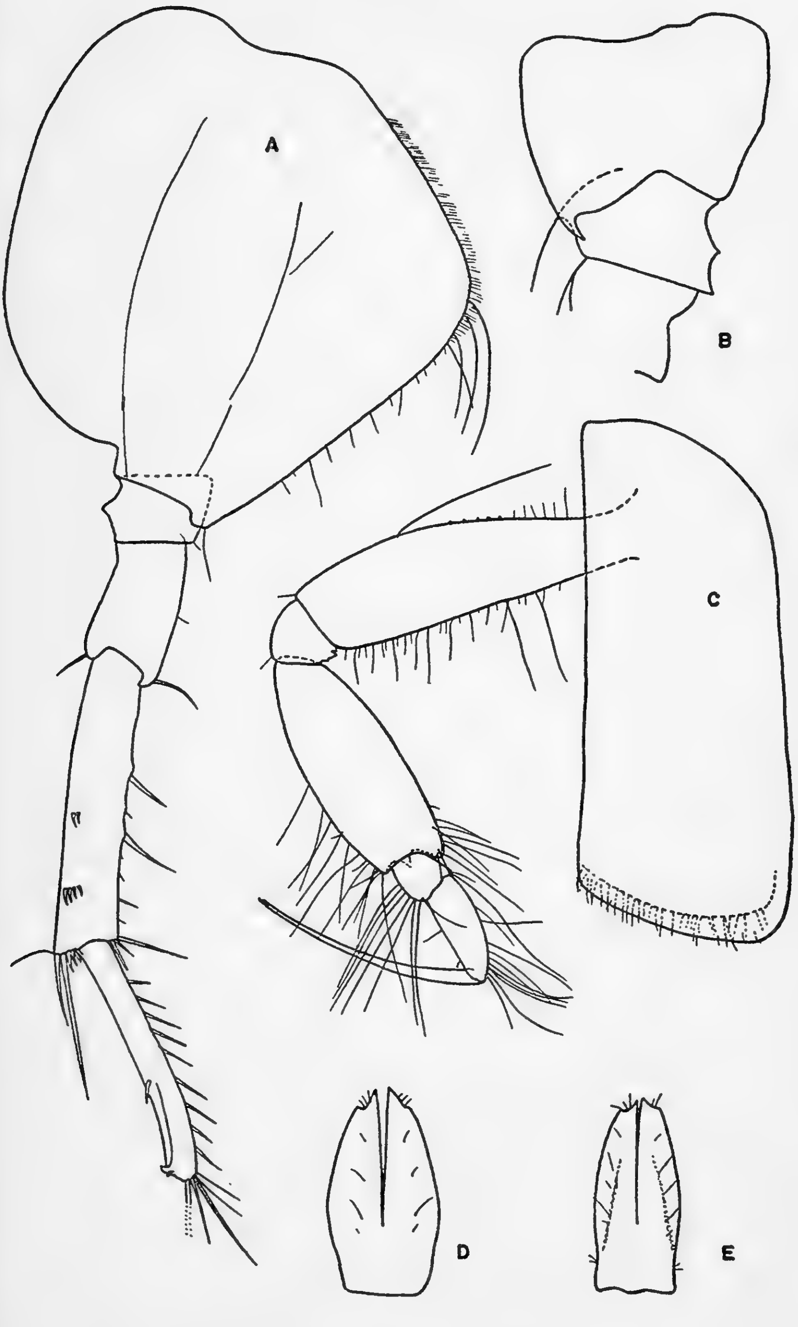

A
B
C
D
E

PLATE 37

Byblis veleronis, new species

Paratype, female, 16 mm, Station 915-39.

Figure A. Head.
B. Peraeopod 1, left.
C. Peraeopod 5, left.
D. Article 5 of antenna 2.
E. Urosome and pleon segment 3.
F. Uropod 3, right.

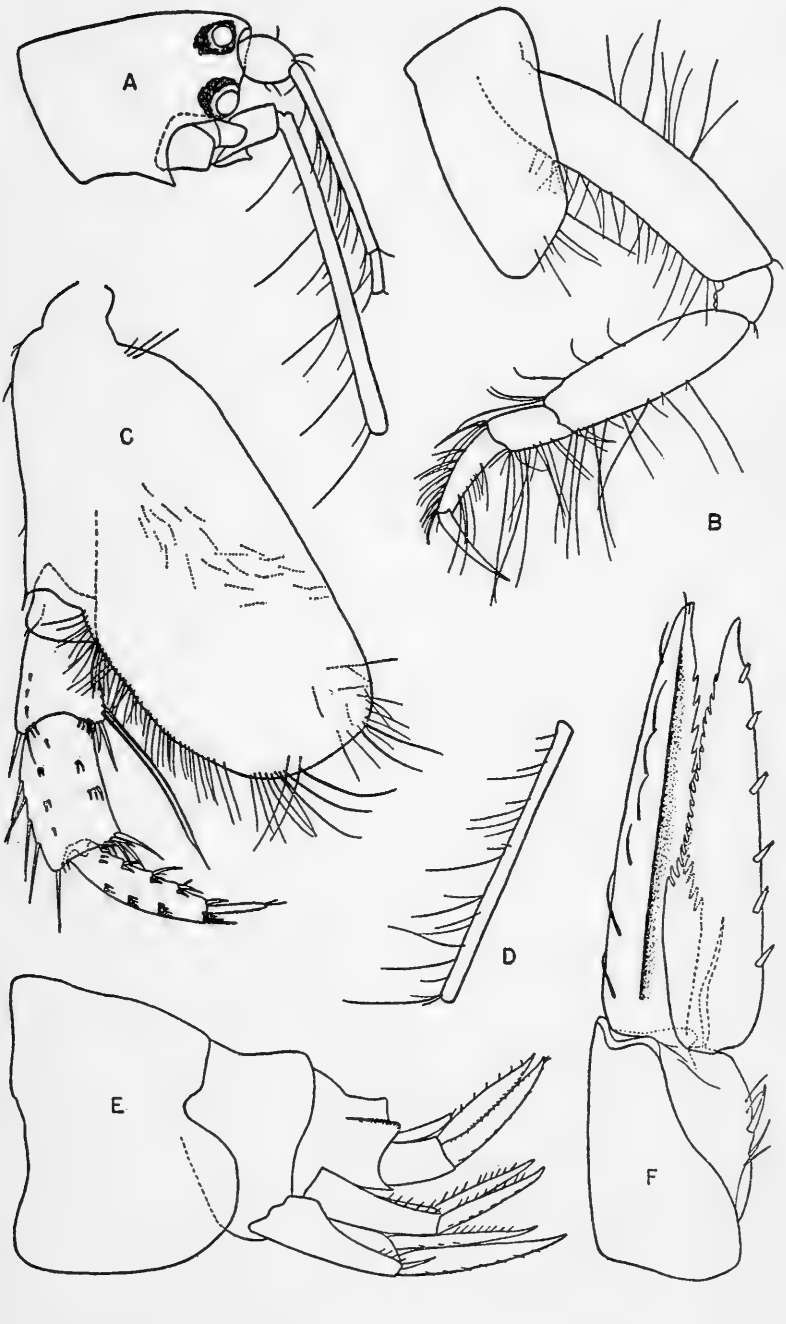
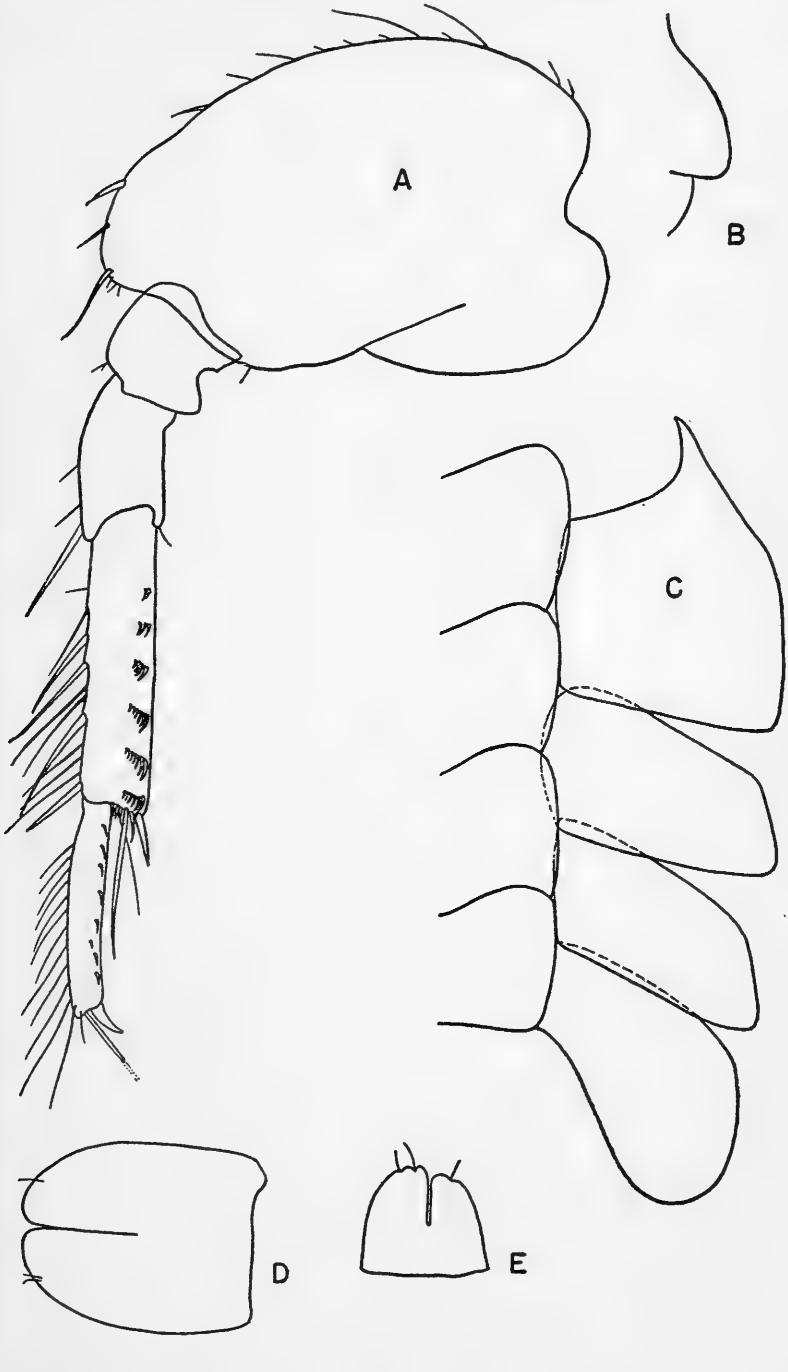

A
B
C
D
E
F

PLATE 38

Byblis veleronis, new species

Paratype, female, 16 mm, Station 915-39.
Figure A. Peraeopod 3, left.
C. Coxae 1-4, left
E. Telson.
Male, 17mm, Station 1384-41
Figure B. Pleon segment 4.
D. Telson, enlarged


A
B
C
D
E

ALLAN HANCOCK PACIFIC EXPEDITIONS

VOLUME 18 NUMBER 2

THE GENUS *PYLOPAGURUS* (CRUSTACEA: ANOMURA) IN THE PACIFIC WITH DESCRIPTIONS OF TWO NEW SPECIES

(PLATES 39-43)

BY

BRYCE C. WALTON

THE UNIVERSITY OF SOUTHERN CALIFORNIA PRESS
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REPORTS ON THE COLLECTIONS OBTAINED BY ALLAN HANCOCK PACIFIC EXPEDITIONS OF VELERO III IN 1931-1941 AND VELERO IV IN 1949-1950.

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THE GENUS *PYLOPAGURUS* (CRUSTACEA: ANOMURA) IN THE PACIFIC WITH DESCRIPTIONS OF TWO NEW SPECIES

By
BRYCE C. WALTON[1]

Among the crustaceans popularly known as the "hermit crabs" is the small genus *Pylopagurus*. Relatively little known from the Pacific, these animals are unique in choosing as a carcinoecium or "dwelling" those structures having an aperture of circular outline and rather uniform size, such as tooth-shells (*Dentalium spp.*) or the tubes of annelids and mollusks. Adaptation to this means of protecting their soft and unarmored abdomens has been accomplished by the development of a broad, flattened, large pincer which forms a perfectly fitted trap-door, sealing off the entrance when the hermit retreats into his refuge. As a further refinement, at least two species of pylopagurids have developed a unique symbiosis with a colonial hydrocoral, which completely overgrows the gastropod shell except for the aperture, where it is neatly trimmed back by the crab's large pincer. The pylopagurid is thus provided with a "custom-made" aperture which exactly fits the chelate operculum with which it is closed.

Nine species of *Pylopagurus* have been described from Pacific waters to date. However, only a small number of specimens have been collected and references to the group have been limited to descriptions of new species and a very few records of collections made. Descriptions available at present are not satisfactory, since they were written at different times by different authors and are not parallel in the diagnostic features used. Furthermore, most of the species have not been illustrated. Consequently, identification is difficult, if not impossible, without access to type material.

The collections of the Allan Hancock Foundation at the University of Southern California include probably the greatest aggregation of Pacific forms of *Pylopagurus* available in any one place. These collections from the Eastern Pacific between Oregon and Ecuador, made in the period from 1931 to 1950, are the basis for the present study. Over 500 specimens of this genus were examined. The purpose of this paper is to report the knowledge of the geographic and bathymetric distribution of *Pylopagurus* afforded by these collections, and to facilitate the easy and accurate identification of these hermits.

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The writer did not have an opportunity to examine the types of Faxon's species, but fortunately they were well figured and specimens were available from the type locality which agreed in every particular with the original descriptions.

The writer wishes to express his appreciation to Captain Allan Hancock for the great privilege of using the collections and facilities of the Foundation; to Dr. John S. Garth for his help and guidance; and to Dr. Waldo L. Schmitt and Dr. Fenner A. Chace for their assistance and for permission to examine the type specimens in the United States National Museum.

PYLOPAGURUS Milne-Edwards & Bouvier 1893

Chelipeds dissimilar and unequal, the right much larger, highly developed as a more or less discoidal operculum. Fourth pair of thoracic legs subchelate. External maxillipeds widely separated at base, exopodite of all three pairs flagellate. Abdomen not spirally coiled, straight or merely flexed; paired abdominal appendages present on first somite of female only; vasa deferentia of male not extruded.

Genotype: Not designated. The genus was erected by Milne-Edwards and Bouvier to accommodate only forms found in the Caribbean. Since the writer has not had an opportunity to examine these genosyntypes, the designation of a genotype is not possible in this paper.

Key to the Eastern Pacific Species of *Pylopagurus*

I. Carpus of major cheliped with three or less teeth on inner margin of dorsal surface.
   A. Telson with "V" shaped notch in terminal margin, strong curved teeth at each edge of notch; margins of opercular face of hand a low subserrate ridge.
      1. Major cheliped discoidal, widest portion at level of base of dactyl; carpus length less than twice its width . . . . *holmesi*
      2. Major cheliped spatulate, widest at point distal to base of dactyl; carpus length more than twice its width . . . . *longicarpus*
   B. Telson a simple semioval plate with entire margins; margins of opercular face of large hand with distinct denticulations.

1. Carpus of major cheliped with three teeth on inner margin of dorsal surface.
    a. Outer margin of major hand a low granulate ridge . . . . *spinicarpus*
    b. Outer margin of major hand with large evenly spaced teeth tipped with inwardly directed corneous spinules . . . . *hancocki*
2. Carpus of major cheliped with two teeth on inner margin of dorsal surface.
    a. Lateral points of front rounded, inner margin of minor hand unarmed . . . . *guatemoci*
    b. Lateral points of front acute, inner margin of minor hand with row of sharp spines . . . . *coronatus*

II. Carpus of major cheliped with more than three teeth on inner margin of dorsal surface.
  A. Telson grossly asymmetrical, palm of hands ornamented with large conical tubercles with radiating peripheral processes . . . . *hirtimanus*
  B. Telson essentially symmetrical, palm set with microscopic granules.
    1. Denticulations on terminal margin of telson restricted to sides of notch . . . . . . *cervicornis*
    2. Denticulations of telson not restricted to notch, but extending across terminal margin of entire telson.
        a. Major cheliped longer than rest of body, granules of palm tipped with vertical corneous spinules . . . . *longimanus*
        b. Major cheliped shorter than rest of body, granules of palm tipped by anteriorly directed corneous spinules . . . . . . *varians*

Pylopagurus holmesi Schmitt

1921 *Pylopagurus holmesi* Schmitt. U. Cal. Publ. Zool. 23, pp. 144-145, figs. 94 a, b.

Type: Male holotype, U. S. N. M. catalogue number 53330, from Santa Catalina Island, California.

Description: Chelipeds dissimilar and unequal, the right much larger; discoidal upper surface of manus completely margined by finely incised denticulate ridge, separating discoidal surface posteriorly from short, transversely and longitudinally convex proximal portion; widest portion at base of broad, flattened fingers; carpus trigonal with stout acute spine at anteromedial corner, surface covered with distinct, pointed, forward curved granules; merus trigonal, only slightly overreaching eyes, lower anterolateral corner with stout spine.

Minor cheliped very small, less than one-half width of right; lateral margin of palm a slight, finely denticulate ridge; fingers gaping at base, with fascicles of setae on outer edges; carpus crested with many sharp spines.

Precervical portion of carapace smooth, polished, slightly longer than wide, median point narrow, acute, twice as long as width of base; lateral projections rounded, reaching only slightly beyond base of median point; postcervical portion not calcified, posterior border with slight rounded indentation.

Eyestalks short, stout, compressed; corneas dilated; eye scales triangular, longitudinally convex, apices slightly rounded, furnished with stout, acute, subterminal spines which extend beyond apices.

Antennal acicle slender, smooth-margined, acute, curving outward, slightly shorter than eyes; antennal peduncles when extended approximating length of eyes, flagella slightly setose and not overreaching major cheliped; antennular peduncles exceeding length of eyes by one half length of terminal article, ventral flagellum three fourths as long as dorsal flagellum.

Pereiopods of left side as long as right, reaching base of fingers of major hand; carpus and propodus crested with forward-hooked, pointed spines; dactyl spinulose, slightly longer than propodus, and tipped with sharp corneous claw.

Fourth pair of thoracic legs subchelate, rasp restricted to distal margin, not developed on outer face of hand; fifth pair minutely chelate, rasp developed on outer surface of propodus and fingers.

Abdomen straight, membranous, slightly longer than thorax, terga not present except in poorly calcified caudal shield.

Telson symmetrical, rather poorly calcified, smooth, outline almost a half-circle except for prominent notch in terminal margin, a strong, downward curving, flattened tooth at each end of notch, setae and smaller denticles along sides toward apex; uropodal peduncles short, heavy, anterior pair of blades over twice length of posterior pair, both sparsely setose along anterior and posterior margins.

Distribution: From Santa Catalina Island and San Pedro to San Diego, California, 10 to 30 fathoms. (Schmitt 1921).

Specimens in the Hancock collection are from San Miguel Island, Santa Cruz Island, Santa Barbara Island, Santa Catalina Island, San Clemente Island, California, and Baja California, Mexico; and from Inner Gorda Bank, Coronados Island, Natividad Island, Angeles Bay, San Pedro Nolasco Island, and Lobos Point, Gulf of California, Mexico.

This species was taken at the following Hancock stations. The number of specimens is indicated after each station number:

523-36	1	1012-39	11	1251-41	1	1341-41	1
539-36	2	1023-39	2	1253-41	1	1348-41	3
546-36	2	1024-39	1	1258-41	1	1418-41	1
725-37	2	1035-40	1	1278-41	5	1419-41	1
735-37	7	1054-40	1	1298-41	3	1422-41	36
882-38	9	1080-40	30	1330-41	1	1919-49	2
975-39	3	1084-40	6	1332-41	4	1920-49	40
979-38	3	1119-40	2	1336-41	2	1922-49	1
1009-39	2	1147-40	3	1338-41	1	1927-49	10
1010-39	17						

The San Miguel Island record at 34°05′20″ N. Latitude and 120° 20′40″ W. Longitude represents a slight northward extension of the known range of the species. The southward records to the tip of Baja California and thence northward into the Gulf of California constitute a very considerable extension of the known range and indicate a unique geographic distribution. The bathymetric range is quite wide, from one fathom to 250 fathoms.

Discussion: A considerable degree of sexual dimorphism is exhibited in this species. The females tend to be more slender and have the major hand longer in proportion to its width; this results in the opercular face of the manus approaching an ovoid rather than a discoidal outline, with the terminal end slightly flattened. The difference is further heightened in old males, apparently as a result of isogonic growth. After maximum size is attained, further laying down of calcium carbonate builds up the margins of the hand, the resultant high ridge imparting a very concave surface to the hand, although otherwise the relative proportions remain unchanged.

Remarks: The favored carcinoecium seemed to be shells of *Dentalium sp.* although some were found in a tubular bryozoan colony, *Antropora tincta* (Hastings).

Pylopagurus longicarpus n. sp.

Type: Male holotype, AHF no. 407, five male and five female paratypes, from station number 1057-40 off Puerto Refugio, Angel de la Guardia Island, Gulf of California, dredged on 29 January 1940 by the *Velero III* in 51 to 56 fathoms.

Diagnosis: Major part of upper surface of large hand spatulate, over twice as long as wide, widest portion distal to base of fingers; carpus greatly elongate, over twice as long as wide.

Description: Chelipeds dissimilar, unequal, the right much larger; spatulate upper surface of manus margined by ridge of minute pointed granules, widest portion distal to base of fingers, anterior one-third so strongly longitudinally convex that it appears to be bent downward when viewed from lateral aspect, proximal portion longitudinally and transversely convex, covered with minute pointed granules; carpus elongate, over twice as long as wide, surface covered with pointed, forward-curved granules, broad-based acute spine on anteromedial corner; merus also elongate, extending beyond tips of eyes for over two thirds of its length, lower anterolateral corner with acute spine.

Minor cheliped quite small, manus approximately one half the greatest width of the major; carpus crested with sharp forward curved spines, several forward directed spines on dorsal surface of anterior margin.

Percervical portion of carapace smooth, longer than wide, median point narrow, extremely acute, over twice as long as width of base; lateral projections rounded, barely reaching beyond base of median point; postcervical portion not calcified, glabrous, posterior border with slight rounded indentation.

Eyestalks short, stout, somewhat dorso-ventrally compressed; corneas dilated; eye-scales triangular, longitudinally convex, furnished with stout acute, subterminal spines which project beyond apices.

Antennal acicle slender, smooth-margined, acute, curving outward, slightly shorter than eyes; antennal peduncles when extended approximating length of eyes, flagella slightly setose, reaching to middle of major carpus; antennular peduncles longer than eyes by one half the length of terminal article.

Pereiopods on left side as long as on right, not reaching base of fingers of major hand; carpus and propodus crested with forward curved pointed granules; dactyls spinulose, slightly longer than propodus and tipped with a corneous claw.

Fourth pair of thoracic legs subchelate, rasp restricted to distal margin, not developed on outer face of hand; fifth pair minutely chelate, rasp developed on outer surface of propodus and fingers.

Abdomen straight, membranous, over twice as long as thorax, terga not present except in poorly calcified caudal chield.

Telson symmetrical, rather poorly calcified, smooth, outline almost a half-circle except for prominent notch in terminal margin, a strong, downward curving, flattened tooth at each end of notch, with setae and smaller denticles along sides toward apex; uropodal peduncles short, heavy, anterior pair of blades over twice length of posterior pair, both sparsely setose along anterior and posterior margins.

Measurements: Total length (rostral point to tip of abdomen) 33 mm; length of carapace 4.3 mm; length of precervical portion 2 mm; length of major manus 5.9 mm; width of major manus 2.3 mm; length of carpus 4.2 mm; width of carpus 1.7 mm; length of minor manus 2.4 mm; width of minor manus 1 mm; length of dactyl second thoracic leg 3.6 mm; length of propodus second thoracic leg 2.9 mm.

Distribution: Known only from the Gulf of California at Angel de la Guardia Island and Consag Rock at the following stations.

541-36	5
1057-40	66
1068-40	1

The bathymetric range was from 24 to 60 fathoms.

Discussion: This species is very closely related to *P. holmesi,* and, as in that species, there is a considerable variation in the ratio of length to width, especially of the major cheliped. The extremely long narrow form of the cheliped is typical of adult males, apparently the result of heterogonic growth. Each growth stage results in the addition of a considerable increment at the terminal margin with only a slight addition to the width. This is apparent to a lesser degree in other appendages and in the body itself. The younger forms tend toward an ovoid rather than a spatulate hand and in the females the over-all proportions and appearance are often practically identical with the females of *P. holmesi;* in fact, they are often distinguishable only with considerable difficulty.

Remarks: With the exception of a few juveniles, this species was taken only in the chitinous tubes of the polychaete *Hyalinoecia juvenalis* Moore.

Pylopagurus guatemoci Glassell

1937 *Pylopagurus guatemoci* Glassell, Zoologica 22, (3) p. 254.

Type: Male holotype, New York Zoological Society, Department of Tropical Research, catalogue number 36801, from five miles west of San Jose Point, Pacific side of Baja California, in 45 fathoms.

Description: Chelipeds dissimilar and unequal, the right much larger; merus smooth, trigonal, as deep as wide, inferomedial margin with deep narrow indentation to receive ischium; carpus greatly widened distally, superomedial border armed with two prominent, forward-curving spines, one overhanging anterior margin, the other medial; upper surface smooth, lightly setose, rounding gradually to the inferolateral margin; manus discoidal, face four-fifths as wide as long, almost completely surrounded by upturned denticulate margin, proximal margin prominent, teeth irregular in size, tipped with corneous spines, some teeth double, some turned inward; teeth on fingers a continuation of those on palm but diminishing in size, and inclined outward instead of vertical, face of hand set with microscopic low, rounded granules bearing long, slender, corneous spines.

Minor cheliped extending to base of fingers of major hand; carpus bicristate, medial row of spines smaller, hand depressed, outer margin of row of spines extending onto pollex, palm with medial row of small spines, medial margin unarmed and slightly setose.

Precervical portion of carapace as broad as long, strongly transversely convex, smooth-polished; medial projection a broad based triangle, three times as wide at base as high, tipped with minute spinule; lateral projections rounded but tipped with minute subterminal spinule; postcervical portion naked, membranous.

Eyestalks cylindrical, slightly constricted in middle, equal in length to width of front; cornea very slightly dilated; ophthalmic scales longitudinally convex, bluntly rounded with very prominent, wide based, acute, subterminal spine.

Antennal acicle slender, curving, acute, reaching just beyond corneal base, margins entire, medial margin setose; peduncle when extended exceeds eyes by one-third length of terminal article; flagellum with scattered setae.

Antennular peduncle when extended exceeds corneal base by full length of terminal article; dorsal flagellum densely setose beneath; ventral flagellum small, of five articles with single terminal seta.

Pereiopods equally developed on both sides; merus smooth, compressed, superior and inferior margins with line of tufted setae; carpus has single, small, hooked spine medially on superior surface; propodus almost one-fourth longer than dactyl; dactyl spinulose on superior and inferior margins, setose, tipped with sharp curved, horny claw.

Fourth pair of thoracic legs subchelate, rasp restricted to small area on face of propodus; fifth pair longer than fourth, rasp covering one-half of propodus and the minute dactyl and pollex.

Abdomen short, obese, terga not present except in caudal shield; anterior tergum in shield separate, larger, smooth, anterolateral corners rounded; posterior tergum with posterolateral corners produced into bluntly triangular lobes equipped with long setae.

Telson symmetrical, semioval, smooth, margins entire; uropodal blades equally developed on both sides, rasp covering narrow crescentic area on upper distal face, posterior blade reduced, barely exceeding base of anterior blade, rasp covering almost all upper surface.

Distribution: Previously known only from the type locality near San Jose Point, Baja California, in 45 fathoms (Glassell 1937).

Specimens in the Hancock collections are from Point Hueneme, Santa Cruz Island, Santa Rosa Island, Seal Beach, Santa Barbara Island, Santa Catalina Island, San Clemente Island, and San Diego, California; Cortes Bank, Guadalupe Island, and Cedros Island, Baja California, and east of Angel de la Guardia Island, Gulf of California, Mexico.

534-36	1	1240-41	1	1354-41	1	1920-49	3
984-39	1	1253-41	6	1374-41	1	1922-49	1
1012-39	5	1264-41	2	1391-41	1	1927-49	1
1018-39	2	1274-41	1	1392-41	1		
1023-39	1	1298-41	1	1418-41	3		
1158-40	3	1342-41	1	1624-48	1		

The bathymetric range was from 11 to 150 fathoms.

The Hueneme locality at 34°05′30″ N. Latitude, 119°02′40″ W. Longitude now represents the northernmost report of the occurrence of the species and the Cedros Island station at 28°05′50″ N. Latitude, 115°31′00″ W. Longitude the southernmost report. The Angel de la Guardia Island locality is the only report of the species from the Gulf of California.

Remarks: Two female specimens were without the paired abdominal appendages characteristic of the genus. Both were infected with (what the writer believes to be) rhizocephalan parasites and the lack of these appendages is therefore presumed to be the result of parasitic castration with suppression of secondary sexual characteristics.

Pylopagurus hancocki n. sp.

Type: Male holotype AHF no. 362, dredged by the *Velero III* 2 March 1936 at the station 534-36 off San Francisquito Bay, Gulf of California, in 125 fathoms.

Diagnosis: Merus of major cheliped trigonal, inner margin of carpus with three spines, two medial and one distal; opercular surface of hand entirely margined by regularly spaced, inward-curving spines with sharp corneous tips; median projection angular, apex sharply truncate, lateral points rounded, almost obsolete.

Description: Chelipeds dissimilar and unequal, the right much larger; merus trigonal, upper surface setose; carpus narrow proximally, widening evenly to manus, medial margin bearing three distinct, forward-curving spines, two medially and one distally, superior surface lightly setose; opercular surface three fifths as wide as long, widest point just distal to base of fingers, completely margined by evenly spaced spines with sharp corneous tips directed inward, separated by rounded sinuses; fingers broad, having line of tufted setae bordering cutting edges.

Minor cheliped reaching base of fingers of major hand; carpus rugose, with coarse setae, inner margin armed with two minute spines medially and large distal spine which is partially cleft, leaving two points on single base; outer margin of hand marked by row of small spines reaching to base of pollex, large spine supported by a ridge on medio-proximal margin; dactyl longer than palm, setose.

Anterior portion of carapace not quite as broad as long, transversely convex, slightly rugose, and bearing a few tufts of setae, median point angular, apex sharply truncate, lateral points rounded, almost obsolete; posterior portion membranous, slightly setose on branchial regions.

Eyestalks stout, terete, constricted in middle, slightly setose on superior surface; cornea dilated; ophthalmic scales longitudinally convex, triangular, margins entire, with prominent subterminal spine.

Antennal acicle slender, outward-curving, pointed, reaching middle of cornea; peduncle when extended exceeding eyes by two thirds the length of the cylindrical terminal article; flagellum setose.

Antennular peduncle when extended exceeding length of eyes by full length of terminal articles; superior flagellum of about eighteen annulations, densely setose beneath, inferior flagellum almost equal in length to superior.

Pereiopods slightly longer on right side, slightly compressed, setose, with margins unarmed except for spinules on lower margins of dactyli; propodus equal in length to the related dactyl.

Fourth pair of thoracic legs subchelate, rasp on propodus only; fifth pair minutely chelate.

Abdomen short, membranous, terga not present except in well calcified caudal shield; anterior tergum transversely and longitudinally convex, slightly setose, rough, anterolateral corners rounded off, sulcus deep and flexible; posterior tergum smaller, with tufted setae on posterolateral corners and two tufts on terminal margin.

Telson symmetrical, simple, calcareous plate, semioval in outline with margins entire; uropods slightly larger on left side.

Measurements: Total length (rostral point to tip of abdomen) 7 mm; length of carapace 2.75 mm; length of precervical region 1.75 mm; width of precervical portion 1.50 mm; length of major manus 3 mm; width of major manus 1.75 mm; length of dactyl 1 mm; length of carpus 2 mm; length of minor manus 1.25 mm; width of minor manus 0.75 mm; length of propodus first ambulatory leg 8.5 mm; length of dactyl first ambulatory leg 8.5 mm; length of caudal shield 1 mm; width of caudal shield 0.75 mm.

Distribution: Known only from the type locality, off San Francisquito Bay, Gulf of California.

Discussion: This species is closely related to *P. guatemoci,* but may be distinguished from it by the three large spines on the superior surface of the major carpus (*P. guatemoci* having but two), the truncate rostral point, and the partially cleft spine on the distal end of the carpus of the minor cheliped.

Remarks: The carcinoecium was a gastropod shell completely overgrown with cheilostomatous Bryozoa.

The species is named for Captain Allan Hancock in recognition of his contributions to the zoological knowledge of the Pacific regions.

Pylopagurus coronatus (Benedict)

1892 *Eupagurus coronatus* Benedict, Proc. USNM 15 (887) p. 24.
1937 *Pylopagurus coronatus,* Glassell, Zoologica 22 (3) p. 254.

Type: Holotype, U.S.N.M. Catalogue number 16699. From *Albatross* station number 2829, off Cape San Lucas, Gulf of California, in 31 fathoms.

Description: Chelipeds dissimilar and unequal, the right much larger; merus short, compressed, with narrow longitudinal ridge on superior surface; carpus short, also crested with narrow ridge ending in sharp projection just short of distal margin, inner margin bearing forward hooked spine medially and similar larger spine at anterior end, overhanging distal margin; hand suboval, twice as long as carpus, opercular face completely bordered by sharp teeth separated by rounded sinuses and with unevenly spaced angular elevations.

Minor cheliped very small, less than one third the width of major hand; carpus with forward hooked spine medially on inner margin and two prominent spines side by side at anteromedial corner; hand with inner margin marked by minute sharp, forward inclined spines; fingers about as long as palm, setose, not gaping at base.

Precervical portion of carapace about as broad as long, rugose, slightly setose; median point triangular, acute, much in advance of very acute lateral points; postcervical portion membranous, slightly setose on cardiac and intestinal areas.

Eyestalks cylindrical, long, slender, much constricted in middle, cornea elongate, only slightly dilated; ophthalmic scales short, with rounded margins and prominent, acute, subterminal spine.

Antennal acicle slender, outward-curving, acute, falling short of corneal base; peduncle when extended slightly longer than eye; flagellum with long scattered setae.

Ambulatory legs about equally developed on both sides, superior and inferior margins hairy, unarmed except for claw-tipped dactyli which are spinulose on inferior margins.

Fourth pair of thoracic legs extremely short, subchelate, rasp restricted to terminal margin of propodus; fifth pair minutely chelate, rasp covering both fingers and laterally swollen propodus.

Abdomen longer than thorax, membranous, caudal shield well calcified; anterior tergum transversely convex, bearing tufts of setae, anterolateral corners rounded off, posterolateral corners produced slightly into small triangular points, suture deep and flexible; posterior tergum smaller, bearing tufts of long setae on posterolateral corners and two smaller tufts on terminal margin.

Telson symmetrical, a simple calcareous plate, with smoothly rounded corners and entire margins; uropods symmetrical, heavily calcified.

Distribution: Previously recorded from Cape San Lucas in the Gulf of California (Benedict), and a single specimen from Arena Bank, Gulf of California, in 50 fathoms (Glassell).

Specimens were taken by Hancock Expeditions at Isla Partida at station 559-36 and at San Francisquito Bay at station 634-36, both in the Gulf of California. The depths were 45 and 125 fathoms, respectively.

Remarks: One specimen was taken in a coiled gastropod shell.

Pylopagurus spinicarpus Glassell

1938 *Pylopagurus spinicarpus* Glassell, Allan Hancock Pac. Exped. 5 (1) p. 1.

Type: Male holotype, U.S.N.M. catalogue number 75432, and female paratype, from Puerto Refugio, Angel de la Guardia Island, Gulf of California, collected 4 March 1936 in 65 fathoms.

Description: Chelipeds dissimilar and unequal, the right much larger; merus trigonal, upper distal portion rounded, slightly setose, medial and inferior margins entire; carpus widening distally, medial margin with two forward-curving medial teeth separated from larger, distal tooth by deep rounded sinus, superior surface smooth with few large scattered setae, medial surface greatly contorted; manus longitudinally and transversely convex, medial margin of palm a serrate ridge, lateral margin a low granulate ridge; both margins continued on to fingers; fingers and palm equal in length.

Minor cheliped reaching nearly to middle of palm of major cheliped, merus compressed, smooth, lightly setose; carpus slightly shorter, widening distally with scattered coarse setae, outer margin with one medial spine, anterior margin with two spines; hand long, outer margin a low-toothed ridge, inner margin obsolete, surface smooth except for median ridge on palm extending some distance onto pollex.

Precervical portion of carapace as long as wide, transversely convex, naked, polished; median point obtuse, armed with sharp, depressed spinule, lateral points as long as median, armed with spinules; post-cervical portion naked, membranous.

Eyestalks long, equal to width of carapace, cylindrical, constricted in middle, with several tufts of coarse setae on dorsal and medial surfaces, cornea dilated; ophthalmic scales bluntly pointed, margins entire with fringe of radiating setae, subterminal spines prominent and sharp.

Antennal acicle slender, outward-curving, acute, reaching base of cornea; peduncle when extended exceeds length of eyes by one third the length of cylindrical terminal article; flagellum setose.

Antennular peduncle exceeding eyes by length of terminal article; superior flagellum of about 17 annulations, densely setose beneath; inferior flagellum about one half the length of superior flagellum.

Ambulatory legs equally developed on both sides, slightly setose, upper margins unarmed, propodus with spinule on distal end of medial surface, dactyl spinulose beneath.

Fourth pair of thoracic legs subchelate, short, rasp restricted to terminal margin of propodus; fifth pair minutely chelate, rasp on both fingers and on swollen outer surface of propodus.

Abdomen slightly longer than carapace, uncoiled, membranous; no terga present except those of caudal shield, of which anterior is convex, with tufted setae, rounded anteriorly, posterior corners produced slightly, suture flexible, posterior smaller, posterior corners acute triangular lobes.

Telson a smooth, symmetrical, semioval plate with entire margins; uropodal blades larger on left side, posterior blades much reduced on both sides.

Distribution: Santa Inez Bay and Gorda Bank, Gulf of California, at depths from 40 to 80 fathoms (Glassell 1938).

Specimens in the Hancock collections are from Angel de la Guardia Island, Gulf of California, Ladrones Island, Panama, and Gorgona Island, Colombia.

The station numbers are:

541-36	2	943-39	1
546-36	1	1057-40	2
851-38	1	1058-40	1

The depth range was 10 to 70 fathoms.

Pylopagurus varians (Benedict)

1892 *Eupagurus varians* Benedict, Proc. USNM 15 (887) p. 24.
1898 *Eupagurus varians,* Bouvier, Bull. Mus. Hist. Nat. 4 (8) p. 382.
1937 *Pylopagurus varians,* Glassell, Zoologica 22 (3) p. 253.

Type: Syntypes, U.S.N.M. catalogue number 16734, from near Espiritu Santo Island, Gulf of California, in 39 fathoms.

Description: Chelipeds dissimilar and unequal, the right much larger; merus compressed, slightly crested, produced down to angle or tubercle on inferior surface; carpus long, narrow proximally, widening toward manus, sides and lower surface rounded, upper surface covered with spines; hand roughly discoidal, face covered with granules constricted at base and bearing an anteriorly directed spine.

Minor cheliped with carpus compressed, bicristate, inner row reduced, hand reaching past base of fingers of major hand, depressed, wide, covered with pointed granules, fingers longer than palm, widely gaping at base.

Precervical portion of carapace about as broad as long, transversely convex, glabrous; median projection broadly triangular, apex produced slightly into a more acute point; lateral projections of cardiac region distinctly marked off as a pentagonal plate.

Eyestalks stout, terete, constricted in middle, cornea dilated; ophthalmic scales bluntly triangular, longitudinally convex, with prominent, acute, subterminal spine.

Antennal acicle slender, outward-curving, pointed, slightly setose, and approximating length of eyes; peduncles when extended exceeding eyes by over one half length of slightly compressed terminal article; flagella slender, slightly setose.

Antennular peduncles when extended exceeding eyes by full length of long slender terminal article; inferior flagellum slender, evenly tapering, about two thirds length of superior flagellum.

Ambulatory legs wide, compressed, slightly longer on right side; merus much compressed, smooth except for slight scales and setae on superior and inferior margins; carpus rounded laterally, crested with small sharp spines; propodus of second pair sometimes similar but often with spines reduced to mere scales; dactyls spinulose, with only sparse setae.

Fourth pair of thoracic legs subchelate, minute dactyl not bearing rasp as does pollex and small distal portion of propodus; fifth pair minutely chelate, with tuft of very long setae on distal end of laterally swollen propodus.

Membranous abdomen as long as carapace, membranous terga not in contact, caudal shield calcified, suture flexible; anterior tergum transversely and longitudinally convex, smooth, posterolateral corners produced slightly; posterior tergum similar in shape, slightly smaller with few tufted setae on lateral and terminal borders.

Telson symmetrical, fringed laterally by setae, posterolateral corners with prominent, flat, downward curving tooth, entire terminal margin between teeth occupied by denticulations of varying size; uropods larger on left side, anterior blade with rasp over most of outer surface, posterior blade much reduced, completely covered by rasp on outer surface.

Distribution: Arena Bank and Santa Inez Bay in the Gulf of California (Glassell); near Espiritu Santo Island, Gulf of California (Benedict).

Specimens in the Hancock collections are from Ensenada de San Francisco, Sonora, San Pedro Nolasco Island, Tiburon Island, Isla

Partida, Angel de la Guardia Island, Angeles Bay, Los Coronados Islands, all in the Gulf of California, and from Secas Island, Panama. The complete list of station numbers is:

449-35	6	556-36	1	701-37	3	738-37	1
524-36	1	559-36	6	711-37	1	1051-40	1
538-36	2	566-36	1	712-37	3	1056-40	11
546-36	2	575-36	2	734-37	8	1725-49	2
549-36	5	699-36	1	737-37	1	1726-49	2

The bathymetric range was from 10 to 100 fathoms.

The report from Secas Island, Panama, at 7°57′35″ N. Latitude 82°01′35″ W. Longitude constitutes the first record of the species outside the Gulf of California.

Discussion: This species is very closely allied with *P. cervicornis.* Glassel (1937) stated, "These two species, *P. varians,* and *P. cervicornis,* may prove to be one and the same species, one a variety of the other, when it is possible to get a large series of adult forms from both ends of the Gulf of California together for comparison. There seems to be an intergradation which is difficult otherwise to explain."

There exists, indeed, a high degree of intergradation, largely due to the great amount of individual variation in the appropriately named *P. varians.* Of the characters used in Benedict's description (Glassell did not redescribe the species), only one, the type of granules on the major cheliped, was found to be constant for the differentiation of the two forms.

These unique granules, along with the distinctive shapes of the telson, which also proved to be unvarying, provide characters clearly indicating that these are distinct species and afford a quick method of identifying each.

Remarks: The common carcinoecium of this form is a gastropod shell completely overgrown with a hydrocoral which forms several medial and long upswept lateral spines described by Benedict as "branches not unlike the horns of a deer." This is probably the "Bryozoan"-encrusted shell mentioned by Bouvier (1898) and Glassell (1937) as the habitat of this species.

Pylopagurus cervicornis (Benedict)

1892 *Eupagurus cervicornis* Benedict, Proc. USNM 15 (887) p. 25.
1937 *Pylopagurus cervicornis,* Glassell, Zoologica 22 (3) p. 253.

Type: Syntypes, U.S.N.M. catalogue number 16700, off Cape San Lucas, Gulf of California.

Description: Chelipeds dissimilar and unequal, the right much larger; merus compressed, almost as deep as long; carpus long, widening proximally to manus, inner margin marked by row of pointed, forward-hooked spines, upper surface covered with similar smaller spines, outer margin marked by row of more closely spaced spines, granular inferior surface produced to a prominence which often, but not invariably, bears a spine surrounded by a circle of seven or eight smaller spines; hand roughly discoidal, opercular face completely margined by corneous-tipped spines, and covered by widely spaced pointed granules tipped with vertically directed slender spines.

Minor cheliped reaching beyond base of fingers of major hand, carpus bicristate, outer row of spines much the larger; palm depressed, oval, covered with sharp-pointed granules; fingers longer than palm, gaping at base.

Precervical portion of carapace as broad as long, transversely convex, glabrous; median point broadly triangular, slightly in advance of angular laterals; postcervical portion membranous, cardiac region distinctly marked off.

Eyestalks stout, terete, constricted in middle; cornea dilated; ophthalmic scales generally acutely triangular, with prominent, acute, subterminal spine.

Antennal acicle slender, outward-curving, acute, slightly setose, slightly exceeding length of eyes; peduncle when extended exceeding eyes one half length of compressed terminal article; flagellum setose.

Antennular peduncle when extended exceeding eyes by length of long terminal article; superior flagellum of about twenty annulations, setose beneath; inferior flagellum slender, evenly tapering, about two thirds as long as superior.

Ambulatory legs wide, compressed, slightly longer on right side; merus much compressed, smooth but for slight scales and setae on superior and inferior margins; carpus rounded laterally, crested with sharp spines; propodus of first pair similarly crested, second pair with spines often reduced to mere scales; dactyls spinulose with only sparse setae.

Fourth pair of thoracic appendages chelate, minute dactyl not bearing rasp as does pollex and anterior portion of propodus; fifth pair minutely chelate, with tuft of very long setae on distal end of laterally swollen propodus.

Abdomen as long as carapace, membranous, terga membranous, not in contact with one another; caudal shield calcified, suture flexible, anterior tergum longitudinally and transversely convex, smooth, polished, posterolateral corners produced slightly, posterior tergum slightly smaller.

Telson symmetrical, posterior margin with wide, shallow "V"-shaped notch, with flattened, acute, downward-curving teeth of varying size, restricted to notch area; uropods larger on left side, anterior blade with rasp over most of outer surface, posterior blade much reduced, completely covered by rasp.

Distribution: Off Cape San Lucas, Gulf of California (Benedict), Arena Bank, Gulf of California, 30 to 50 fathoms (Glassell).

Specimens in the Hancock collections are from San Pedro Nolasco Island, Angel de la Guardia Island, and San Ignacio Bay, Sinaloa, Gulf of California, Mexico. The list of stations is as follows:

544-36	4	708-37	1	1054-40	1	1084-40	1
546-36	2	735-37	1	1055-40	3	1725-49	1
549-36	1	742-37	14	1080-40	5	1726-49	16

The bathymetric range was from 30 to 110 fathoms.

Remarks: The carcinoecium is usually a gastropod shell completely overgrown with hydrocoral as in *P. varians*.

Pylopagurus longimanus Faxon

1893 *Pylopagurus longimanus* Faxon, Bull. Mus. Comp. Zool. 24 p. 168.

1895 *Pylopagurus longimanus* Faxon, Mem. Mus. Comp. Zool. 18 p. 61, Pl. 12, figs. 1-1e.

Type: Five male syntypes in the Museum of Comparative Zoology, Harvard University, from Cocos Island, Costa Rica, *Albatross* station number 3368, in 66 fathoms (Faxon 1895).

Description: Chelipeds dissimilar and unequal, the right much larger, longer than entire body in older specimens; merus compressed, lateral surface smooth, polished, lower and medial surfaces granulate, dorsal surface with slightly larger granules; carpus equaling combined length of all three preceding segments, longitudinally convex dorsal surface with pointed granules between well defined lateral margins of larger teeth; hand slightly longer than carpus, irregularly oval, small denticles along entire margin of opercular surface, posterior margin falling just short of carpus, basal angle quite small; entire surface of hand covered quite uniformly with upright, pointed granules, those on opercular surface slightly larger; fingers elongate, crossed at tips, dactyl five eighths total length of hand, longitudinally contorted, pollex one half total length of hand, with prominent tubercle on cutting edge.

Minor cheliped much reduced, reaching to about the middle of carpus of major cheliped; merus and carpus slightly setose and hardly more expanded than corresponding articles of ambulatory legs; carpus armed on superolateral margin with row of strong forward-curving spines; propodus quite narrow, flaring abruptly to widest portion at base of fingers; dactyl almost twice the length of propodus, strongly convex in outline; both fingers armed with regular chitinous denticles on cutting edge, gaping at base, and furnished with many tufted setae on under surface.

Precervical portion of carapace broader than long, very convex, smooth, polished, median projection quite long and acute, extending beyond bases of eye scales, lateral points angular, shorter than median; postcervical portion naked, membranous.

Eyestalks short, cylindrical, constricted in middle and then widening, diameter at base of cornea greater than at basal portion, cornea large, dilated; ophthalmic scales convex, acute, with prominent, sharp, subterminal spine.

Antennal acicles slender, pointed, outward-curving, slightly setose, equaling or slightly exceeding length of eyes; peduncles when extended with proximal portion of terminal article even with base of cornea; flagellum setose.

Antennular peduncles very long, exceeding eyestalks by more than one half length of terminal segment, dorsal flagellum of about twenty-four annulations, densely setose beneath, inferior flagellum evenly tapering, about two thirds length of superior.

Ambulatory legs longer on right side, very slightly setose, merus unarmed on dorsal surface; carpus slightly shorter, with row of sharp spines on dorsal surface; propodus of first pair armed with similar spines, but propodus of second pair unarmed; dactyli of both pairs flattened, spinulose, and longer than related propodus.

Fourth pair of thoracic legs subchelate, minute dactyl not bearing rasp as does pollex and distal portion of palm; fifth pair minutely chelate, rasp covering both fingers and propodus.

Abdomen as long as carapace, membranous; terga membranous, not in contact; caudal shield calcified, suture flexible, anterior tergum smooth, posterior corners produced slightly, posterior tergum similar in shape, slightly smaller, with a few tufts of setae on lateral and terminal borders.

Telson symmetrical, incompletely divided by transverse suture, terminal margin armed with denticulations, the most lateral pair of teeth on each side largest, then two or three minute teeth, one larger, and then a series of rather uniform minute teeth in the center; uropods larger on left side, anterior blade with rasp over most of outer surface, posterior blade much reduced, completely covered by rasp on outer surface.

Distribution: Cocos Island, Costa Rica, in 66 fathoms (Faxon 1893).

Specimens in the Hancock collections are from off Nuez Island and Chatham Bay, Cocos Island. The station numbers are as follows:

772-38	1	779-38	1
773-38	1	780-38	3

The depth range was from 30 to 60 fathoms.

Pylopagurus hirtimanus Faxon

1893*Pylopagurus hirtimanus* Faxon, Bull. Mus. Comp. Zool. 24 p. 170.
1895 *Pylopagurus hirtimanus* Faxon, Mem. Mus. Comp. Zool. 18 p. 65, Pl. 13, figs. 1-1e.

Type: Syntypes, Museum of Comparative Zoology, Harvard University, from off Cocos Island, Costa Rica, dredged by the *Albatross* in 66 fathoms 28 February 1891 (Faxon 1895).

Description: Chelipeds dissimilar and unequal, the right much larger; merus short, naked, almost as deep as long, lower lateral margin with series of sharp spines; carpus with dorsal surface very hirsute and with scattered small, pointed granules, medial margin marked by row of sharp, anteriorly curved spines; hand margined by row of even, sharp teeth except for ill-defined posterior margin, proximal one third of dorsal surface setose, hairy area ending abruptly to expose low dome-shaped granules with flat, circular bases cut into radiating peripheral processes covering entire opercular surface.

Minor cheliped reaching beyond base of dactyl, over one half as wide as major hand, merus similar to that of major hand but smaller; carpus very hairy on dorsal surface, bearing median row of sharp curved spines; hand covered with tubercles similar to those of larger hand, lateral border likewise margined as the larger hand, but medial margin lacking teeth, inferior surface hairy and tuberculose.

Precervical portion of carapace wider than long, posterior border extending into rounded lobe, median projection in advance of laterals, obtuse, slightly depressed and obscured by tuft of setae near apex; lateral points obtuse but tipped with sharp spinule; postcervical portion membranous, becoming hairy on branchial regions, cardiac region defined as a quadrangular plate.

Eyestalks terete, constricted in middle with median line of tufted setae on dorsal surface, cornea dilated; ophthalmic scales convex, pointed, margins entire with subterminal spine slightly protruding.

Antennal acicles slender, outward-curving, very hairy on medial margin, reaching corneal base; peduncles when extended slightly exceeding reach of eyes; flagellum very slender, greatly exceeding reach of major hand, with short, very fine setae.

Antennular peduncles when extended exceed eyes by one half the length of the distally flaring third article.

Ambulatory legs of equal length on both sides, only slightly compressed, very hairy on dorsal surface, unarmed but for single tooth medially placed on distal end of dorsal surface of carpus and spinules above and below on the dactyli.

Fourth pair of thoracic legs very short, subchelate, rasp restricted to terminal margins; fifth pair minutely chelate, outer surface of swollen propodus covered by rasp, lower margin with line of long, silky setae.

Abdomen obese, terga not distinct except in caudal shield; anterior tergum larger, tufted, convex, front corners rounded, posterior corners produced, suture only slightly flexible; posterior tergum with setal tufts on terminal margin.

Telson divided into two lobes, both asymmetrical, the posterior greatly so, left side much larger; posterior margin medially notched and bearing several strong, downward-curving teeth; uropods larger on left side, posterior blade much reduced on both sides.

Distribution: Off Cocos Island, Costa Rica, in 66-100 fathoms (Faxon 1895).

Specimens in the Hancock collections are from Nuez Island and Chatham Bay, Cocos Island, and north of Hood Island, Galapagos Islands. The station numbers are as follows:

773-38	2
780-38	6
814-38	2

The depths ranged from 20 to 50 fathoms.

Pylopagurus (?) affinis Faxon

1893 *Pylopagurus affinis* Faxon, Bull. Mus. Comp. Zool. 24 p. 169.
1895 *Pylopagurus affinis* Faxon, Mem. Mus. Comp. Zool. 18 p. 64, Pl. 12, figs. 2-2d.

Type: Male holotype, dredged in 85 fathoms by the *Albatross* in the Gulf of Panama, *Albatross* station number 3397, in the Museum of Comparative Zoology, Harvard University.

Description: Chelipeds dissimilar, unequal, the right much larger; upper margin of carpus armed with two or three spines, the anterior spine largest, outer face of carpus smooth except for a light tubercular ridge along the middle; external (opercular) face flat, covered with minute, spinulous granules, and surrounded by border of sharp spines, the proximal border not sharply defined by spines from basal portion; lower surface of chela smooth.

Minor cheliped very hirsute; inferior border of chela conspicuously toothed.

Ambulatory legs hairy; the vasa deferentia are extruded from the base of the fifth leg on each side, appearing as slender threads, the right much longer and twisted.

Telson symmetrical, subcircular in outline, its posterior border convex and entire.

Discussion: The preceeding description was adapted from the original description by Faxon (1895). From this, and the very clear figure (pl. XII, fig. 2 C), it is apparent that the extruded vas deferens precludes the assignment of this species to *Pylopagurus,* or indeed, to any existing genus. The formation of any opinion regarding the placement of this form is probably best reserved until more specimens are examined, since the single male obtained in 1891 is the only report of this form.

Discussion

The results of this study indicate that *Pylopagurus* is predominately a tropical form in the Eastern Pacific as it is in other waters. *P. longimanus* and *hirtimanus* are obviously Panamic species and the information now at hand clearly confirms this assignment for *varians* and *cervicornis.* It is also the writer's belief that *coronatus, spinicarpus, hancocki,* and *longicarpus* should definitely be considered as belonging to the Panamic fauna, in spite of the small number of existing records many of which are near the northern limits of this region, since additional evidence for their southern affinities is afforded by their absence in the extensive collections to the North. It seems quite improbable that they would not have been discovered by the widespread collecting of the *Velero III* and *Velero IV* off the coast of Northern Mexico or Southern California if they did occur in the North Temperate Zone.

P. guatemoci alone appears clearly to fit the distributional pattern of the North Temperate Fauna, with no records of its occurrence south of the 28th parallel. Previously, *holmesi* was considered to be North Temperate also, but the records here given show its distribution to be something of a puzzle. The northern segment of its range corresponds rather closely to that of *guatemoci,* with a sharp break around the Punta Eugenia area. However, its occurrence in the Gulf of California, and in the presumably tropical southern portion, does not coincide with any expected pattern. Moreover, these southern records are the more anomalous in that they also represent some of the shallowest records for the species. This is the direct opposite to normal expectation, in that northern forms usually occur in progressively deeper (colder) water as they range southward. For the present, this anomaly must remain without an explanation. Possibly it may serve as a useful reminder of the need for more information and spur on the search that will bring a fuller understanding of this interesting group of crustaceans.

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EXPLANATION OF PLATES

PLATE 39

Pylopagurus holmesi Schmitt ♂

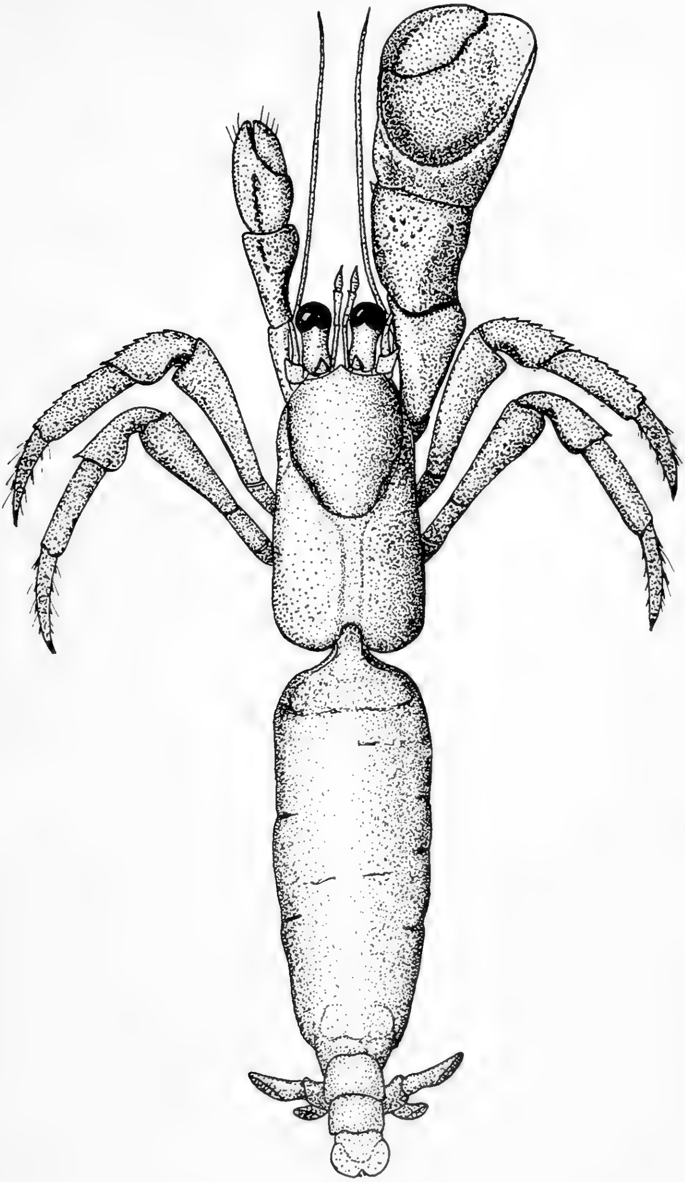


PLATE 40

Pylopagurus longicarpus n. sp.

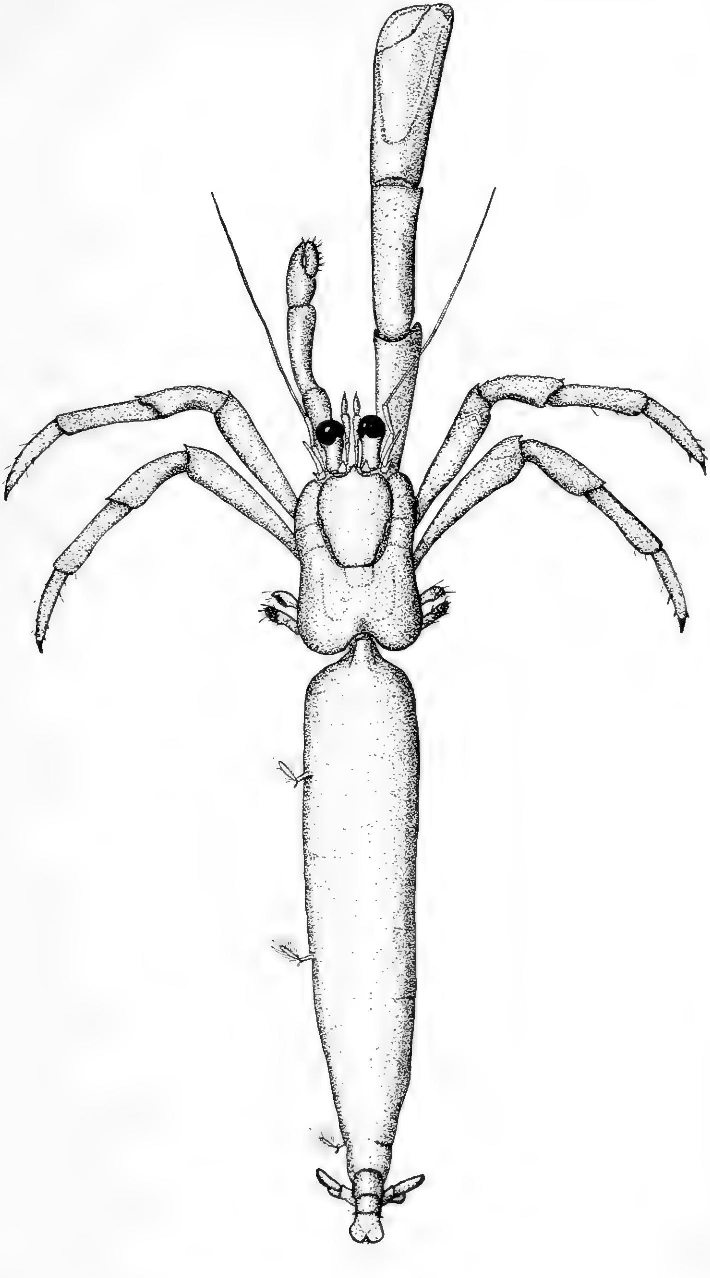


PLATE 41

Pylopagurus hancocki n. sp.

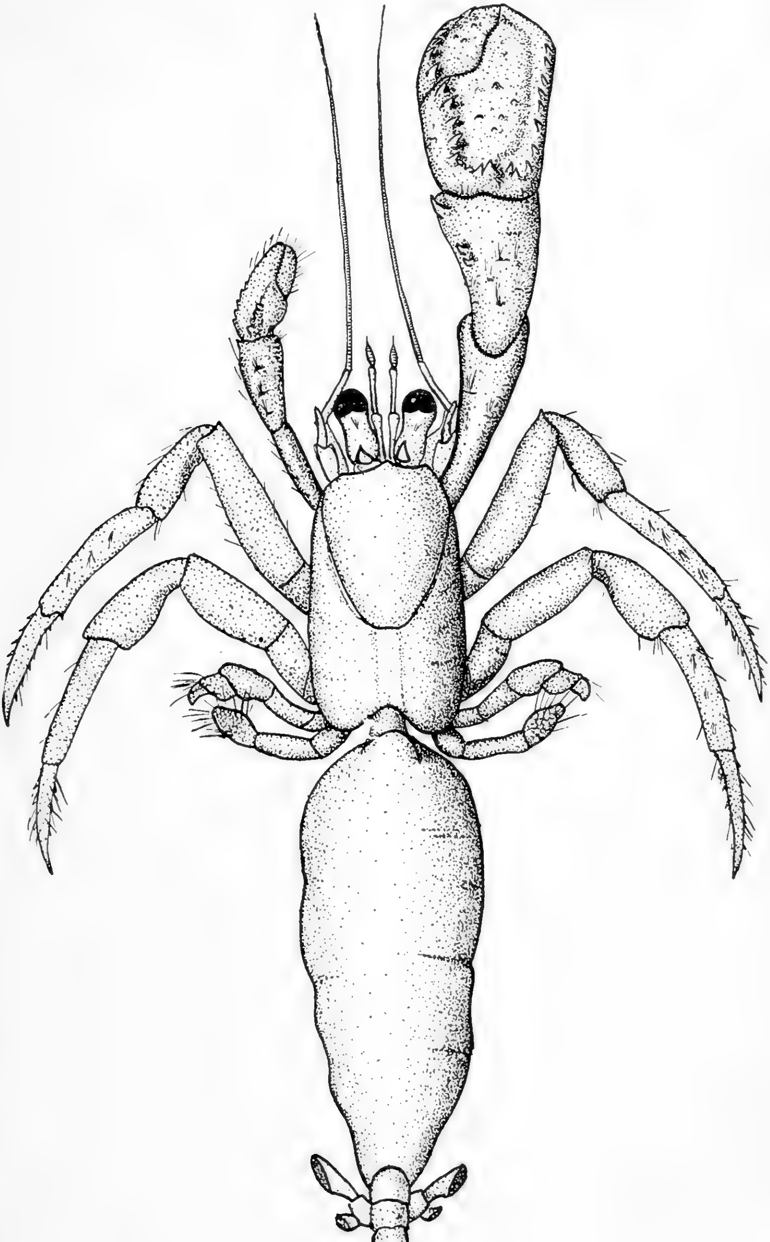


PLATE 42

A-D *Pylopagurus cervicornis*

A. Telson
B. Microscopic granules of palm
C. Major manus
D. Carapace

E-H *Pylopagurus varians*

E. Telson
F. Microscopic granules of palm
G. Major manus
H. Carapace

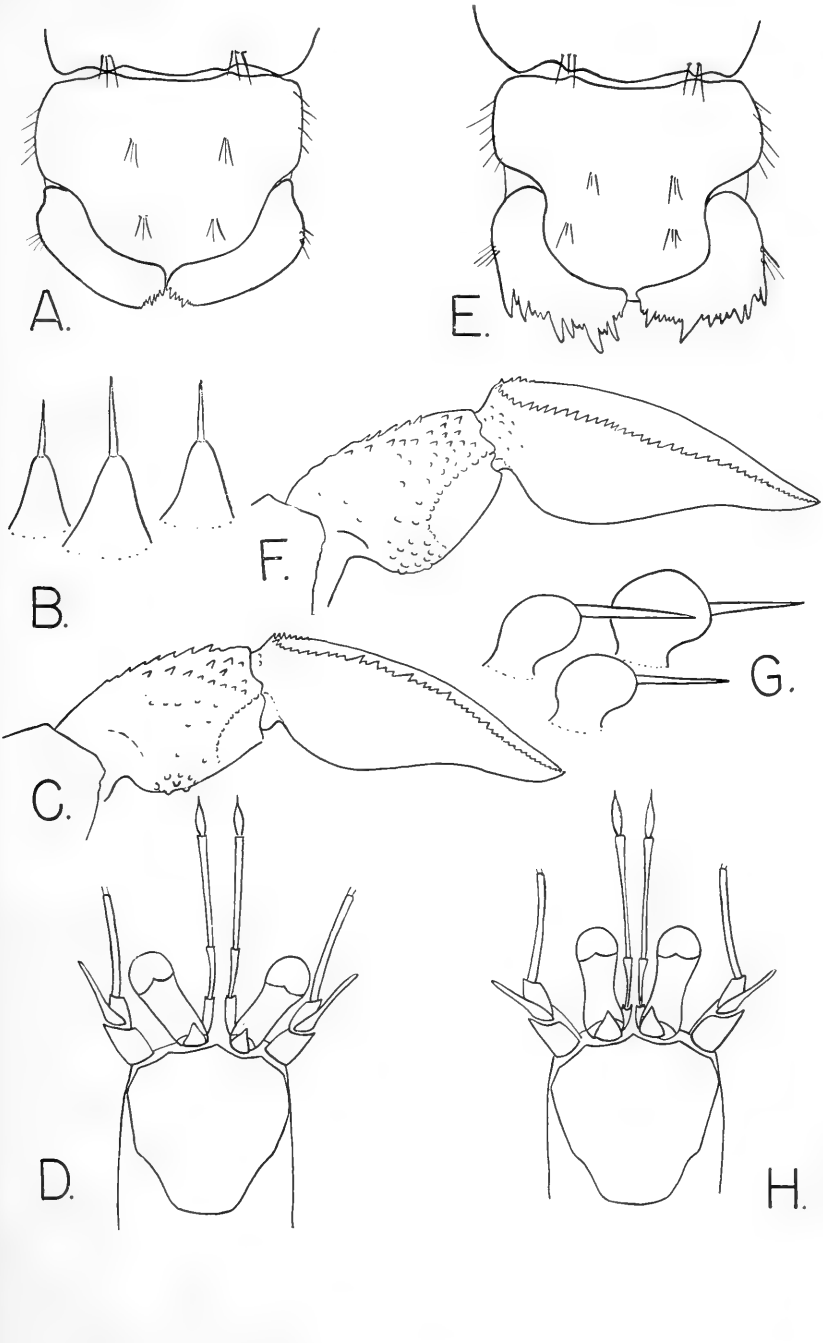
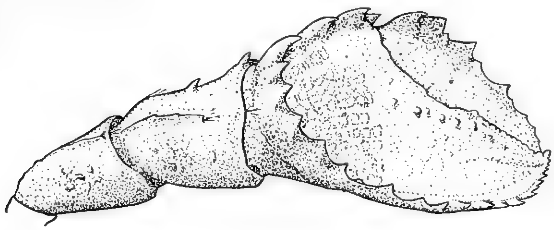

A.
E.
B.
F.
G.
C.
D.
H.

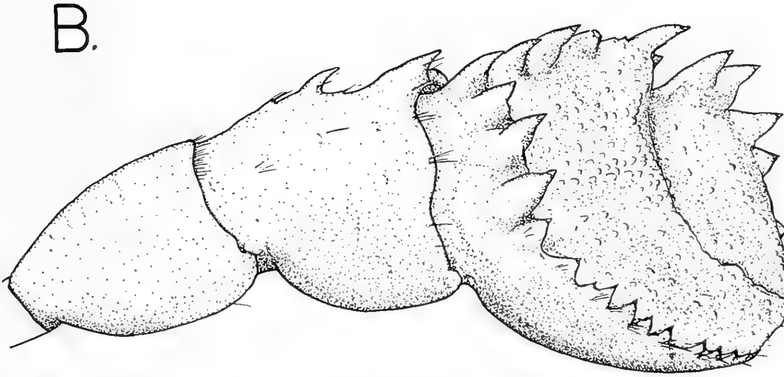
PLATE 43

A. *Pylopagurus coronatus* - Major manus
B. *Pylopagurus guatemoci* - Major manus
C. *Pylopagurus spinicarpus* - Major manus

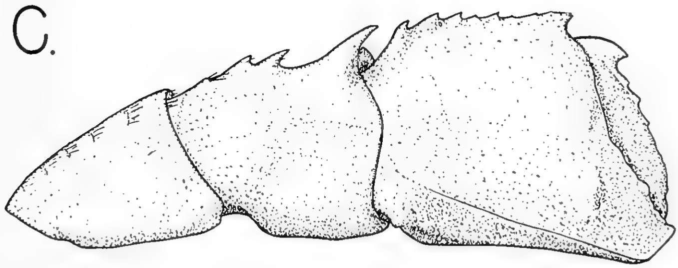
A.



B.



C.



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THE AMPHIPOD FAMILY PHOXOCEPHALIDAE IN THE EASTERN PACIFIC OCEAN, WITH ANALYSES OF OTHER SPECIES AND NOTES FOR A REVISION OF THE FAMILY

(PLATES 1-75, CHART 1)

BY

J. LAURENS BARNARD

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J. LAURENS BARNARD

INTRODUCTION

Since 1931 the motor cruisers *Velero III* and *Velero IV* have been dredging on marine soft bottoms from California to Peru. In this vast, rich and practically virgin zoological area, the overwhelming abundance and variety of large animals that came on board ship left little time for collections of smaller animals in the size class one to ten millimeters. Nevertheless, thousands of lots of these materials were returned to the laboratory and sorted. As the explorations continued, collecting techniques were improved continually so that small animals now constitute the greater number of specimens accessioned.

In 1952, under the direction of Dr. Olga Hartman, a quantitative survey of San Pedro Basin, including coastal shelves and slopes, was commenced (Hartman 1955). This was extended to Santa Monica Basin and environs in 1955 (Hartman 1956) and to the coastal shelf between Point Conception and the Mexican Border in 1956 (Hartman and Barnard 1957).

Prior to 1952 the *Velero III* and *Velero IV* sampled the benthos with several types of dredges and drags, none of which provided a quantitative sample. Since that time the Hayward orange-peel-bucket (Hartman 1955) has been the main sampler used. The bucket collects a large quantitative benthic sample in a manner similar to the Petersen grab. The samples are washed through a fine screen (24 meshes/inch, see Reish 1958 for discussion) and shaker device; all residual materials are preserved and sorted completely in the laboratory. These techniques have resulted in a vast amount of small crustacean material, most of which represents new species and new records.

It was discovered that the most abundant group of crustaceans, apart from the ostracods, was the Phoxocephalidae, a family of amphipods poorly known in the eastern Pacific Ocean. A study of these was started in 1951 which indicated the need for the examination of species and genera described in the literature. A number of collections were borrowed with the hope of monographing the family but the press of other duties interrupted this ambition. However, the writer was privileged to see enough material from other seas that he was able to outline a revision of the family (J. L. Barnard 1958) and was able to clarify a number of problems at the specific level, presented herein.

ACKNOWLEDGMENTS

To Dr. Olga Hartman I owe a debt of gratitude for her constant attention and interest in this study, for supplying most of the materials, and for her encouragement.

To the following I am indebted for the donation of specimens: Dr. John L. Mohr, Dr. Donald J. Reish, Dr. Thomas E. Bowman and Dr. Francis P. Filice. In addition, Dr. Reish, Dr. Keith H. Woodwick and Mr. Richard H. Linsley helped in collecting specimens at Newport Bay and elsewhere.

The following aided me in securing loans of material in other museums: Dr. Fenner A. Chace, Jr., U.S. National Museum; Prof. Dr. Karl Lang of the Swedish State Museum; Dr. E. L. Bousfield of the Canadian Museum of Natural History; and Prof. E. Percival, Canterbury College, Christchurch, New Zealand.

Dr. Isabella Gordon of the British Museum of Natural History examined and made notes for me on two species deposited in that museum, for which I am most grateful. Dr. Keith Sheard, CSIRO Division of Fisheries, Western Australia, very generously devoted a considerable amount of time to examining type materials of three Australian species. The following aided in other ways: Dr. D. E. Hurley, while a Fulbright scholar at the Hancock Foundation in 1955, gave much encouragement and advice to me; Mrs. Dorothy Halmos, Hancock Librarian and Editor, helped me in many ways to delve into the literature of this group.

During the first year of this study I was a Fellow at the Hancock Foundation; for the remaining six years it was a spare-time project while I was an instructor at California State Polytechnic College, a research scientist for the Department of Biology, University of Southern California, a research investigator at the Hancock Foundation and in private business.

I am most indebted to Captain Allan Hancock for the use of space and equipment in the Foundation.

THE PROBLEM OF THE SYSTEMATIST IN RELATION TO PHENOTYPES, HYBRIDIZATION AND ECOLOGY

It is commonly the case that the more material a systematist examines the less clearly distinct many closely related species seem. Species cannot be defined on the basis of single holotypes because each of them is a complex of alleles responding in different ways to several environments. This is eminently characteristic of the species in the genus *Paraphoxus*, members of which are monotonously plain and similar, and so numerous and common as to be present, with rare exception, in all samples collected on muddy bottoms from the intertidal to 100 fathoms.

In systematics there have been trends to "lumping" and trends to "splitting", the latter being preferable from a nomenclatural viewpoint. The "New Systematics" (Huxley 1940 and Mayr 1942)* is an attempt to stimulate a realistic approach to speciation, by segregating micro- and macropopulations of animals where genetic factors, isolation

*The New Systematics is a fresh approach which answers those critics who consider systematics a dead science and who consider systematists as little more than file clerks. The refusal of a large body of biological scientists (especially physiologists, both chemical and electronic) to recognize, support or encourage the systematist has reduced the number of these scientists in many groups to dangerously low levels. In one way, this anathema has brought considerable benefits, for the postwar graduate, trained in other fields, who becomes a working systematist, often is better and more broadly educated than are narrowly specialized members in other fields. The systematist (especially in marine biology) no longer writes a dissertation in systematics; he writes one in physiology, genetics, embryology, ecology, or a combination of these fields; thus, he often becomes better acquainted with general living systems than do other graduates.

The need for more systematists is only too evident to anyone who would take time to peruse recent works such as Hartman (1955 and 1956) and Hartman and Barnard (1957) and see how many new or poorly known species of animals have been collected in two small off-shore areas of California.

One might also use the previous references as a base on which to compare nearly all marine surveys of the last decade to see how they have failed, in some cases conveniently, in others through sampling failures, to consider polychaete and crustacean faunas. Dr. Hartman and her coworkers have found that polychaetes comprise most of the biomass in many marine communities and that polychaetes and crustaceans together comprise more than 75% of the species in marine level bottoms. Surveys which fail to consider these animals have little value to descriptive ecology and are misleading to experimental ecologists, who, as a result, often work with animals of minor importance to the dynamics of marine ecosystems.

This state of affairs will continue until it is realized that systematists are valuable basic research scientists and of practical value to ecology.

and ecology are taken into account. In this way, systematics would cease to be a "pigeon-holing" science.

One problem emerging from the New Systematics is that the worker must use an insight and intuition, based on a broad education and experience in several disciplines, in order to compensate for his inability to study the life-history, genetics, zoogeography and other properties of *each* species he attempts to classify. Micro-ecological isolation is difficult to study and marine faunas are too poorly known to be able to distinguish geographic races from ecophenotypes. Thus, the differences between two closely related populations cannot always be accurately denoted species, subspecies, phenotypes, hybrids, or ecophenotypes.

The writer has made every effort to segregate entities at the specific level, so that each category is more or less of the same rank. Whatever success he has had in this undertaking has been due largely to the vast amount of material examined over a long period of time. Many aberrations, often described by zoologists as distinct species, have been clearly discerned as phenotypes, hybrids or ecophenotypes. Doubtless, there remains room for discussion of some of the species complexes, particularly the EPISTOMUS-LUCUBRANS-ABRONIUS-DABOIUS-STENODES complex of the genus *Paraphoxus*. However, the separation of this complex into species units has been done repeatedly by me with less than 5% occurrence of intergradation in more than 700 samples, thus suggesting that these populations have distinct genetic (physiological) barriers. There is the possibility that these populations are phenotypes or ecophenotypes. If this approach is considered it would be one of the most entertaining and significant studies which could be undertaken by a genetical ecologist.

STATION RECORDS

None of the species is provided with a list of the stations at which it occurs, for such lists would consume a large number of printed pages, unnecessarily. A card file of these has been deposited at the Allan Hancock Foundation, and a brief summary of such records printed herein. A more detailed account of the quantitative ecology of all benthic amphipods in southern California is in preparation, wherein will be found more precise distributional data.

In reference to data for type localities, the original information may be found in the following publications: Fraser 1943, Hartman

1955, Hartman 1956, Hartman and Barnard 1957, and Hartman and Barnard 1958.

Family PHOXOCEPHALIDAE

Diagnosis.—Gammaridean Amphipoda with head produced into a hood-like rostrum overhanging the antennae; antenna 1 bearing a well developed accessory flagellum; peraeopod 5 shorter than peraeopod 4 and dissimilar to it in structure; peraeopods usually well armed with spines and setae for burrowing into soft bottom sediments.

Key To PHOXOCEPHALIDAE

1. Peraeopod 3, article 2 more than twice as wide as article 3........ 2
1. Peraeopod 3, article 2 about as wide as article 3........................ 8
2. Maxilla 1, palp biarticulate.. 3
2. Maxilla 1, palp uniarticulate.. 6
3. Antenna 2, flagellum multiarticulate, gnathopods 1-2 similar...... in size 4
3. Antenna 2, flagellum biarticulate, gnathopod 1 much larger........ than gnathopod 2.. *Joubinella*
4. Palp article 4 of maxilliped bears two large distal setae,............... rostrum minute .... *Microphoxus n.g.*
4. Palp article 4 of maxilliped bears no large distal setae, rostrum well developed 5
5. Mandibular palp borne on a large process, sickle-shaped............... .... *Mandibulophoxus*
5. Mandibular palp not borne on a large process, not........................ sickle-shaped .... *Paraphoxus*
6. Mandible, molar bearing ridges and cusps................ *Phoxocephalus*
6. Mandible, molar smooth or bearing a few spines......................... 7
7. Eyes present, maxillipedal palp article 3 not produced.... *Metaphoxus*
7. Eyes absent, maxillipedal palp article 3 produced.......... *Leptophoxus*
8. Eyes absent.. 9
8. Eyes present.. 11
9. Head with dorsal crest, uropod 2 with apical ramal spines.......... .... *Pseudharpinia*

9. Head lacks dorsal crest, uropod 2 usually lacks apical ramal spines 10
10. Antenna 2 in male very short .... *Harpinia*
10. Antenna 2 in male as long as body .... *Harpiniopsis*
11. Antenna 2 with basal ensiform process .... *Heterophoxus*
11. Antenna 2 lacks basal ensiform process .... *Proharpinia*

Relationships of Phoxocephalid Genera

It is possible to determine the structure of a primitive phoxocephalid from an approximate analysis of the conservative features of other gammaridean amphipods and then to hypothesize an approximate tree of successive relationships between the living genera. This tree is diagrammed below.

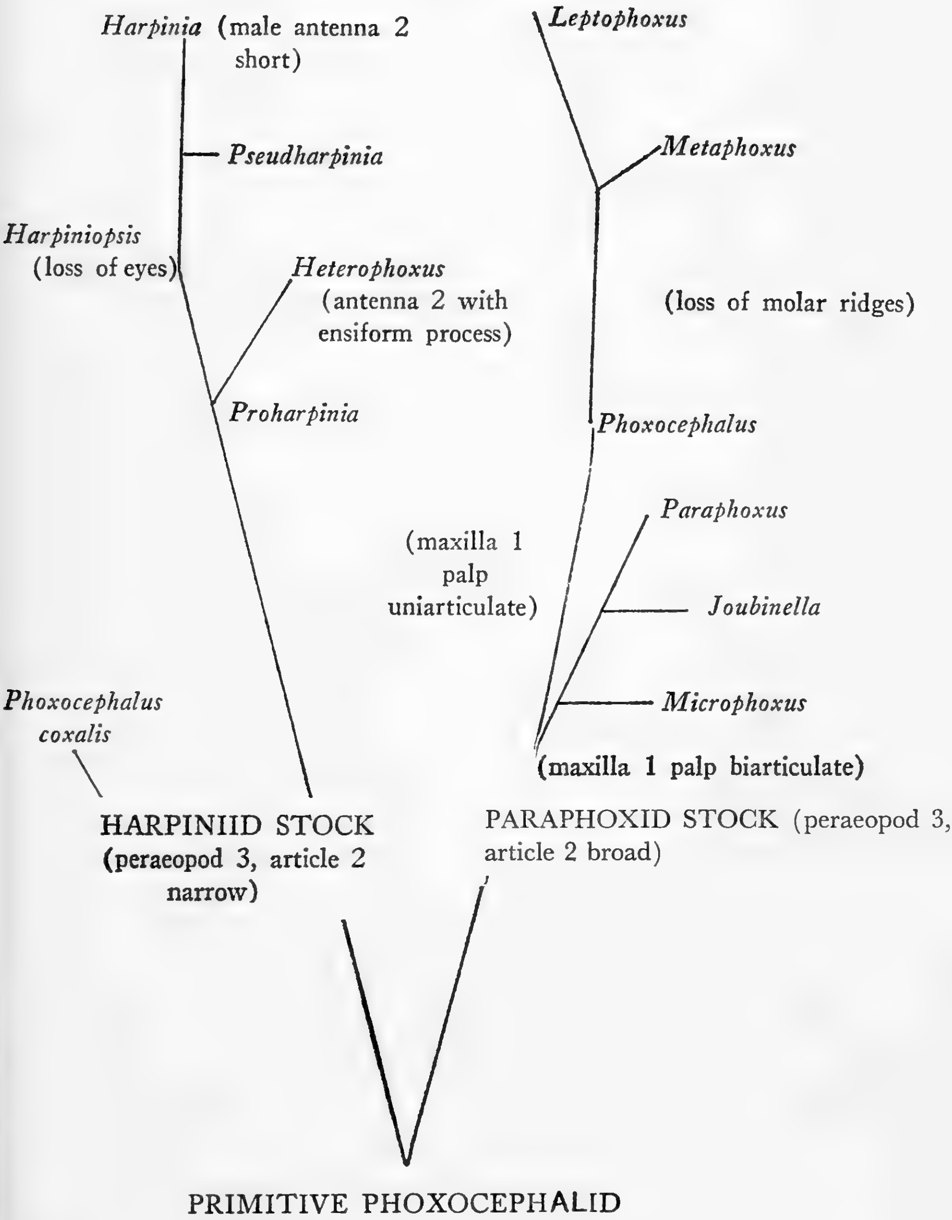
None of the existing genera bears all of the features which must be hypothesized for the primitive phoxocephalid: animals with ridged triturating mandibles; eyes; biarticulate palps of the first maxillae; long male second antennae; distally setose fourth article of the maxillipedal palp.

The basic division between the existing groups seems to be the difference between steno- and eurypodous second articles of the third peraeopods, resulting in harpiniid and paraphoxid stocks. This contrast seems to be more basic than the loss of eyes in certain groups, or the fusion of the two articles of the first maxillary palp in others, as well as other minor characters which might be used. It is interesting that one species assigned now to the genus *Phoxocephalus* bears a stenopodous third peraeopod. It differs from all other species in the harpiniid stock in the ridged molar processes of the mandible.

The harpiniid stock has been characterized by a progressive loss of eyes and reduction of the male second antennae.

The paraphoxid stock has two branches, characterized by the palp of the first maxilla. *Phoxocephalus* stands at the base of this branch, while *Metaphoxus* and *Leptophoxus* have lost the molar ridges of the mandible. The other branch is composed mainly of the genus *Paraphoxus*, with *Microphoxus* a primitive limb due to the setosity of the maxillipedal palp article 4. The genus *Joubinella* is a pelagic genus, similar to *Paraphoxus*, except for its eusirid gnathopods, typical of other pelagic amphipod genera.

RELATIONSHIPS OF PHOXOCEPHALID GENERA



Genus **Paraphoxus** Sars

Paraphoxus Sars 1895: 148-149; J. L. Barnard 1958: 146.
Pontharpinia Stebbing 1897: 32-33.
Parharpinia Stebbing 1899: 207.
Protophoxus K. H. Barnard 1930: 335.
Trichophoxus K. H. Barnard 1930: 336.
Metharpinia Schellenberg 1931: 65.

Type species.—Phoxus oculatus Sars.

Diagnosis.—Peraeopod 3, article 2 broad; eyes present; fourth palp article of maxilliped long, slender; gnathopods similar in size; molar of mandible smooth, bearing a few spines; maxilla 1 with biarticulate palp; ramal apices of uropods 1 and 2 not spinose.

Remarks.—As can be seen from the synonymy, several attempts have been made to segregate species of this group from each other. Most of these attempts have been based on the erroneous conclusion that the type species of the genus had an uniarticulate maxillary palp and that certain quantitative values of appendages had qualitative meaning. The following discussion will explain some of the reasons for this consolidation, which at first sight appears quite radical.

When Sars 1895 described the genus *Paraphoxus* he wrote that the first maxillary palp was uniarticulate. Reexamination of the type species *P. oculatus* by the writer revealed that the palp is biarticulate so that subsequent genera such as *Pontharpinia* are not distinguishable from *Paraphoxus* by this character. Stebbing 1897 based *Pontharpinia* mainly on this difference, which is considered invalid herein.

The genus *Parharpinia* was distinguished by Stebbing 1899 from *Pontharpinia* by the slender third to fifth peraeopods, but subsequent authors have pointed out the variety and intergradation of these peraeopods between the two extremes of slenderness and stoutness (Plate 1).

Protophoxus K. H. Barnard 1930 was submerged in *Pontharpinia* by Pirlot 1932. The reexamination of this genus by Hurley 1954 showed that it was indistinguishable from *Pontharpinia* and is considered a *Paraphoxus* herein.

Trichophoxus K. H. Barnard 1930 was based on elongated fifth articles of the gnathopods; the present research shows this to be variable and intergrading interspecifically (Plate 1).

Metharpinia Schellenberg 1931 poses a singular problem. The main difference of this genus is in the abruptly narrowed or styliform rostrum. The present research has revealed several species which are intergradations between those with a very narrow rostrum and those with a normally tapering rostrum (Plate 1). However, the use of this criterial pair is a valuable point of dichotomy with which to identify species of the genus and indicates a need to retain an appropriate appellation to denote an artificial subgenus. The writer considers that the narrowing of the rostrum had no single evolutionary beginning and is a polyphyletic mutation(s) occurring repeatedly. The genus *Metharpinia* is superseded subgenerically by the name *Trichophoxus*, so that the writer retains the subgenus *Trichophoxus ss* for species with narrowed or "trichophoxid" rostrums.

The genus *Paraphoxus*, as defined by the writer, is a widespread, abundant and variable genus. It offers the zoologist a valuable opportunity to study distribution, variation, evolution and the correspondence of morphology to specific environments. One may ask the questions: Are the same morphological types correlated with the properties of their environment such as temperature and type of substratum? In distantly segregated zoogeographic communities of similar physical properties such as western Australia and southern California, do the same morphological types occur in each community? Are they in the same ratio of abundance? Is their behavior in relation to other community members the same? Is their position in the food chain the same? etc. Finding differences in communities on this zoogeographic basis may well answer a perplexing evolutionary problem as to whether centers of origin occur from which highly successful groups have originated and spread throughout the marine environment.

Since discriminating systematics is the first step in studying zoogeography and regional evolution, the following systematic discussion of *Paraphoxus* may be useful to systematists identifying the many forms of the genus.

Important Systematic Features in the Genus **Paraphoxus***

While the present study was in progress a chart of the species of the genus was compiled and the criteria of each checked off in appropriate squares (Tables 1 & 2). It was seen from the

*See J. L. Barnard 1958 for condensed version of this section.

blank spaces of this chart that many of the species were poorly known. It is hoped that zoologists having access to the species concerned will examine them and determine the unknown criteria. Only then, can an attempt be made to construct a zoogeographic flow-chart of criteria.

The differentiating characters used in this study represent those deemed to vary the least intraspecifically but to vary the most interspecifically. The following characters are important not only from this viewpoint but because they are easiest to observe in undissected specimens.

In the diagnoses of the species in the systematic section uniform generic criteria are not mentioned.

A section on minor criteria will follow this discussion.

Head.—Little attention has been paid to the dorsal view of the rostrum in the past and it is entirely unknown in many species. Since a narrowed rostrum can scarcely be overlooked, it has been assumed in Table 1 that the rostrum is broad for those species in which it has not been described.

Two major rostral types occur, the broadened one with straight or slightly convex lateral edges, tapering evenly to the apex (*Paraphoxus ss.*); and the abruptly narrowed one which is called the modified or trichophoxid rostrum (*Trichophoxus ss.*). In the modified type the styliform section may be broad (*P. epistomus*) or quite narrow (*P. abronius*). Species with a normal rostrum may be distinguished from each other by the difference in total head length. For example, *P. obtusidens* and *P. spinosus* are scarcely distinguishable except for the longer head, smaller eyes and larger body size of the former species.

Body.—The body proportions of paraphoxids vary so much that it is possible to isolate species superficially on the basis of their general appearance. This is best illustrated when the two species *P. obtusidens* (Plate 33, fig. A) and *P. tricuspidatus pallidus* (Plate 38, fig. B) are compared. Gross inspection would certainly indicate that they belong to separate genera but detailed analysis reveals no basic generic differences. *Paraphoxus bicuspidatus* has a very broad, dorsally flattened and laterally expanded body, with the urosome disproportionately small, whereas *P. obtusidens* has a rather slender, uniformly tapered body.

Epistome.—Until Shoemaker 1938 discovered the presence of an acutely produced epistome in *P. epistomus*, it was generally known that the Phoxocephalidae lacked a cuspidate epistome. Other species described below have this character, while many do not. It remains to reexamine many other phoxocephalids for this character which is rarely mentioned in the literature (Table 1).

The length and degree of acuteness of the epistomal process or the lack of it vary so much interspecifically that groups of otherwise unidentified specimens may be segregated by its shape. Since it is difficult to see, the following technique is described for its rapid discernment: The writer, who is right-handed, holds the animal under the stereomicroscope, on its right side with the head to the right, the ventral side away from him; the left hand holds the specimen in a forceps in this position; the right hand holds a needle which is used to press the antennae and mandibular palps dorsally or toward the observer, thus revealing the epistome for quick observation.

In any one species the shape of the epistome is sufficiently uniform that specific differences are evident. Four basic types of epistome have been noted by the writer: (1) unproduced and anteriorly rounded, sometimes with a minute apical cone, the epistome small or massive (*P. oculatus*, Plate 28, fig. B; *P. obtusidens*, Plate 32, fig. D); (2) slightly produced, bearing a small, acute anterior tubercle (*P. lucubrans*, Plate 12, fig. D); (3) a short tooth-like process, often quite massive as on *P. similis* (Plate 22, fig. E); (4) a long, acute, almost needle-like, occasionally slightly curved process (*P. epistomus*, Plate 6, fig. D).

Juvenile specimens may have the epistome slightly less pronounced than in adults.

Gnathopods.—Unlike most other amphipods the gnathopods of *Paraphoxus* show no sexual dimorphism. In any one species they are rather uniform in both juveniles and adults, although in a few cases, such as *P. epistomus*, the juveniles will have fifth articles shorter than in adults. It is imperative that adequate figures of both gnathopods be given to facilitate systematic distinction. Often such specific differences occur which have been used by the writer as a final confirmation in a specific identification.

Usually, the fifth article of the second gnathopod is shorter than the corresponding article of gnathopod 1 but the degree of shortness varies in different species. Frequently the sixth article is broader in the second gnathopod than in the first.

The lengths of articles 5 and 6 are useful systematic characters. The fifth article may range from much shorter to much longer than article 6. Two species closely related in other characters, such as *P.*

Check-list of morphological criteria of species of *Paraphoxus* described in the literature, not found in southern California. In some cases clarification of criteria has been made in the present paper and indicated by an asterisk.

X=positive, O=negative, XO=intermediate, blank areas=unknown, S=spurs

	Rostrum wide	Epistome produced	Prpd. 5 teeth large	3rd epimeron unique	Gn. 1-2, art. 6 wide	Gn. 1, art. 5 shorter than 6	Female urpd. 3 inner ramus ½ or more as long as outer	Urpd. 2, many long spines on peduncle	Prpd. 3 stout	Prpd. 4 stout	Prpd. 4, art. 5 stout	Prpd. 3, art. 4 stouter than 5	Maxpd. plp. art. 4 with spine
AUSTRALIS	x		o	x	x	x	o	o	o	o	o	o	x
BARNARDI	o		o		x	o			x	x	o	o	
CAPILLATUS	o	o*	o	o	o	x			x	x	x	x	o*
CENTRALIS	o		o	o	x	o		o	o	o	o	o	x
CORNUTUS	o	o*	o	o	x	x	x	o	x	x	x	o	x
FUEGIENSIS	x	o*	o	o	x	o	x	xo	o	o	o	o	x*
LONGIROSTRIS	o	o*	o	o	xo	x	x		x	x	o	x	x
MAXIMUS	x		o	x	x		x	x	o	o	o	x	
MILLERI	o	o*	o	o	xo	x	x	o	x	x	x	o	o*
NASUTUS	o		o		x?	o			x	x	x	x	
OBLIQUUS	x		o	x	x	x	x	x	o	o	o	o	
OCHOTICUS	x		o	x	x	o	x		o	o	o	x	o
PINGUIS	x		o	x*	x	o	x*	o*	x	x	o	x	
PYRIPES=MAXIMUS	x		o	x	x			x	o	o	o		x
ROSTRATUS (Pirlot)	o		o	o	x	x	x	o	x	x	x	x	x
ROTUNDIFRONS	x		o	o	x	o	x		o	o	o	o	
SIMPLEX	x		o	o	x	o	o		o	o	o	x	
SINUATUS	x	o*	o	o	x	x	x	o	o	o	o	o	o
STEBBINGI	x		o	o	o	x			x	x	x	x	o
TATTERSALLI	x		o	o	x	o		x?	o	o	o	x	
TRIDENTATUS	o	o	xo	o	o	x	o	o	x	x	x	o	o
UNCIGERUS	x		s		x	x	x	o	o	o	o	o	
UNCINATUS	x		o	x	x	o	x	x	o	o	o	x	o
VILLOSUS	x	o*	o	o	x	o	x	x	x	o	x	o	

TABLE 1

floridanus and *P. epistomus* (Plate 21, fig. H and Plate 6, fig. K), may be separated on the basis of this length ratio.

Some species, such as *P. variatus*, have the sixth articles of the gnathopods quite narrowed and rather slender (Plate 3, fig. G), in contrast to the usually broad, slightly inflated sixth articles of most species. In these cases of narrowed propodi (sixth articles), the palm is usually transverse compared to slightly oblique in the broader propodi.

Peraeopod 3.—Considerable variation occurs in the width of the fourth and fifth articles of this appendage. At one time *Pontharpinia* Stebbing 1897 and *Parharpinia* Stebbing 1899 were distinguished by the stoutness or slenderness of peraeopods 3 and 4. These appendages vary so much from species to species that no qualitative break can now be recognized (Plate 2).

It is conventional to compare the widths of articles 4 and 5 to the width of article 2, the latter being rather uniformly expanded throughout the genus. Articles 4 and 5 range in breadth from broader than to less than one third as wide as article 2.

In general, the stouter the appendage the more heavily it is armed with spines and setae, which may indicate that such species are better diggers or burrow in coarser sediments.

Differences in width between articles 4 and 5 occur from species to species and occasionally may occur intraspecifically, possibly indicating phenotypy (see *P. epistomus*, Plate 6, fig. P and Plate 8, fig. C).

The length of article 6 in relation to the lengths of articles 4 or 5 is an important factor to be described, this article varying from shorter than to much longer than article 5.

Peraeopod 4.—In most of the species studied by the writer, the fourth and fifth articles of peraeopod 4 are narrower than those of peraeopod 3. In addition, article 2 is usually broader than in peraeopod 3 so that the disproportion between article 2 and the rest of the appendage is greater than in peraeopod 3.

In most species there is little difference in width of articles 4 and 5 but in *P. longirostris* article 4 is quite inflated and much broader than 5.

The length of article 6 in relation to either articles 4 or 5 must also be taken into account.

Peraeopod 5.—The structure of this appendage is quite useful in differentiating between species.

Some differences of note may be seen in articles 3 to 7, such as slenderness, stoutness and proportionate length of the several articles. Stoutness of articles 4 and 5 in *P. obtusidens major* (Plate 32, fig. Q)

Check-list of morphological criteria of species of *Paraphoxus* from southern California. X=positive, O=negative, XO=intermediate, S=spurs or short, L=long

Species are listed in order of their morphology, not alphabetically.

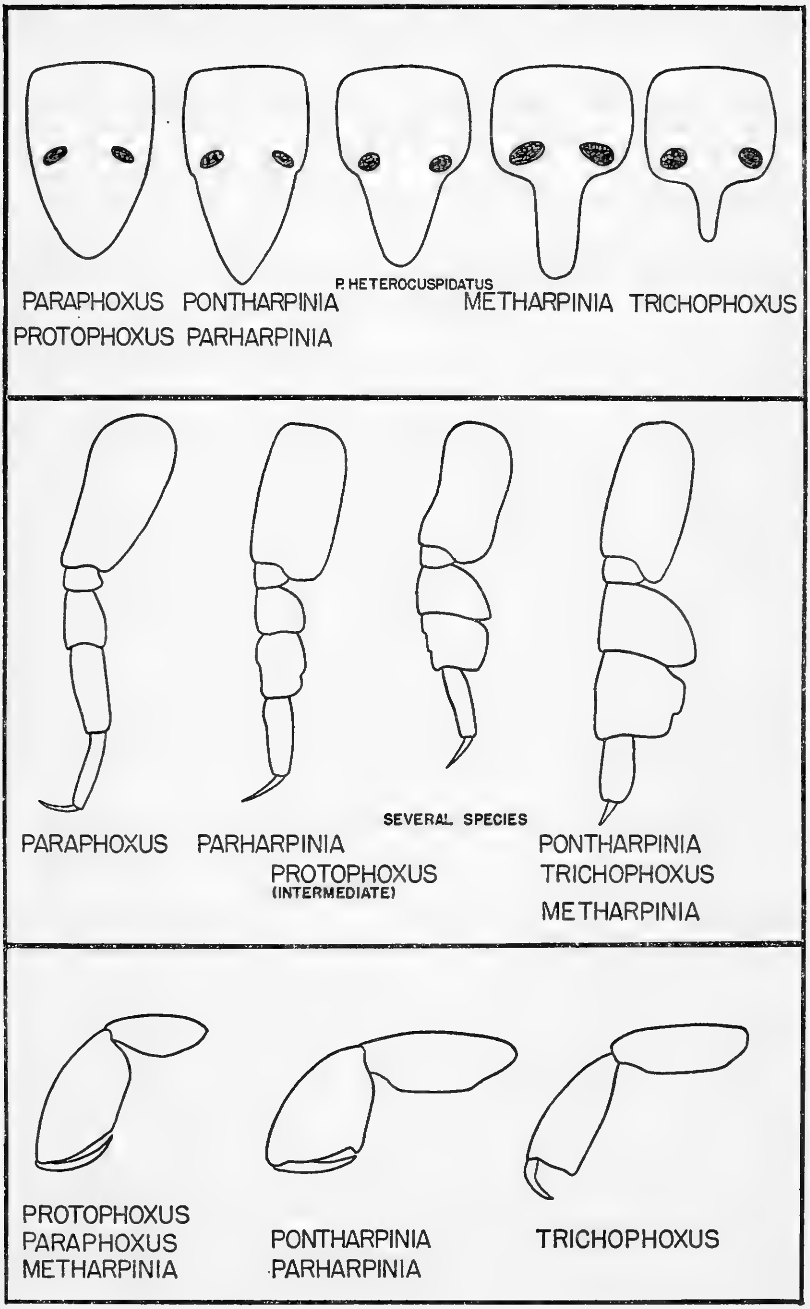
Species		Rostrum wide	Epistome produced	Prpd. 5 teeth large	3rd epimeron unique	Gn. 1-2, art. 6 wide	Gn. 1, art. 5 shorter than 6	Female urpd. 3 inner ramus ½ or more as long as outer	Urpd. 2, many long spines on peduncle	Prpd. 3 stout	Prpd. 4 stout	Prpd. 4, art. 5 stout	Prpd. 3, art. 4 stouter than 5	Maxpd. plp. art. 4 with spine
SIMILIS		x	xL	o	o	x	o	o	x	o	o	o	x	x
COGNATUS	(*Paraphoxus ss*)	x	xs	o	o	x	o		o	o	o	o	o	x
OBTUSIDENS		x	ox	o	o	x	ox	x	ox	o	o	o	o	o
SPINOSUS		x	o	o	o	x	o	o	o	x	o	o	o	o
ROBUSTUS		x	o	o	x	x	o	o	x	o	o	o	o	x
CALCARATUS		x	o	o	x	x	x	x	x	o	o	o	o	x
OCULATUS		x	o	o	o	x	o	o	o	o	o	o	o	x
EPISTOMUS		o	xL	o	o	x	x	x	o	x	o	x	x	ox
ABRONIUS	(*Trichophoxus*)	o	xL	o	o	x	x	x	o	x	o	x	o	o
FATIGANS		o	xs	o	o	o	x	o	o	x	x	x	o	o
DABOIUS		o	xs	o	o	x	x	o	o	x	x	x	o	o
LUCUBRANS		o	xs	o	o	x	x	x	o	x	o	x	x	o
VARIATUS		o	xL	x	o	o	x	o	o	x	x	x	o	o
STENODES		o	o	o	o	x	x	x	o	x	x	x	x	x
HETEROCUSPIDATUS		o	o	x	o	xo	x	x	o	x	x	x	o	x
BICUSPIDATUS		o	o	s	o	o	x	o	o	x	x	x	o	o
FLORIDANUS		o	o	o	o	x	o	o	o	x	x	o	x	o?

TABLE 2

PLATE 1

Scheme to show intergradation of several characters in genera now considered to belong to *Paraphoxus*.

Top row, heads; middle row, third peraeopods; bottom row, ends of gnathopod 1.


PARAPHOXUS
PROTOPHOXUS
PONTHARPINIA
PARHARPINIA
P. HETEROCUSPIDATUS
METHARPINIA
TRICHOPHOXUS
PARAPHOXUS
PARHARPINIA
SEVERAL SPECIES
PROTOPHOXUS
(INTERMEDIATE)
PONTHARPINIA
TRICHOPHOXUS
METHARPINIA
PROTOPHOXUS
PARAPHOXUS
METHARPINIA
PONTHARPINIA
PARHARPINIA
TRICHOPHOXUS

differentiates it from *P. o. obtusidens* (Plate 34, fig. H) but in general, species may be differentiated by other criteria.

The important features of peraeopod 5 are the shape and armature of article 2. The expansive posterior lobe of this article varies in its downward extension to articles 3, 4, or 5. More important than this is the sculpturing of its posterior edge. It may be nearly smooth as in *P. obtusidens* (Plate 32, fig. Q) with the teeth very shallow and scarcely evident; it may bear 3 to 9, small to large teeth as in most species (Plate 6, fig. R); or it may be produced into one or two large spurs as in *P. bicuspidatus* (Plate 15, fig. P). Little variation in spurs of species such as *P. bicuspidatus* has been seen but in species such as *P. variatus* (Plate 3, fig. M and Plate 4, figs. D, M, V) and others bearing small teeth, a variation of one to four in the total number has been observed. Tooth size generally remains stable except in *P. variatus*, where the extremes are great.

The *sweep point* is defined as the point where the posterior and lower margins of article 2 meet. It varies considerably but its usefulness has not been emphasized prior to the present study.

Uropod 2.—The spinal armature on the peduncle of this appendage varies remarkably from species to species. Two extremes of this are seen in *P. heterocuspidatus* (Plate 19, fig. V) and *P. epistomus* (Plate 6, fig. T). In the former species the upper edge of the peduncle is armed with very short, stout spines, few in number, whereas in the latter species it is armed with long, slender, numerous setae. These differences can be seen readily in an undissected specimen.

Other differences in second uropods are minor in nature.

Third pleonal epimera.—In 1930 K. H. Barnard noted the need for more attention to the configuration and setal armature of the third pleonal epimera in the Phoxocephalidae. Differences between species in most known species are quite minor, variable between sexes and ages, but a few species such as *P. robustus* (Plate 25, fig. T) and *P. pinguis* (Plate 44, fig. A) have a large tooth at the lower corner, which distinguishes them from other species having a rounded lower posterior corner.

The simplest expression of shape occurs in *P. oculatus* (Plate 28, fig. F) with an unarmed and rounded corner. However, the posterior part of the epimeron is somewhat prolonged, unlike other known paraphoxids. In most species the lower corner bears a small cusp and one or more setae, the posterior edge being slightly convex and not prolonged posteriorly. In males, the posterior edge may become quite convex and distorted (Plate 11, fig. F).

In one facies of *P. obtusidens* the posterior edge is concave and slightly prolonged so that the lower corner is slightly produced in both sexes and quite heavily setose along the posterior edge.

One group of species, represented by *P. calcaratus* has few setae on the posterior edge of the epimeron but bears a diagonal row of setae along the lateral face of the segment (Plate 26, fig. U). This feature is easily overlooked and several species need reexamination on this point.

Minor Systematic Differences in Paraphoxus

In general, the following criteria are not used by the writer for basic diagnoses of species. Occasionally they may be useful as peculiarities not generally found in the group. Some of these characters may have important future use for helping to distinguish lines of evolution in the genus.

Mouthparts.—Generally these are uniform in the group but two points of interest should be noted.

The molar of the mandible in some species such as *P. lucubrans* (Plate 12, fig. F) is more bulbous than in others. This difference is difficult to observe without careful preparation of the mandible and is subject to artifacts according to the tonicity of the mounting media used and the kind of preservation.

The fourth article of the maxillipedal palp varies from species to species depending on the appearance or absence of an apical spine. Various states of fusion of this spine occur so that its use as a subgeneric character was abandoned by the writer. This character may help in determining lines of evolution and it should be checked in many of the poorly known species.

Coxae.—The number of setae on the coxae may be useful on a minor scale to differentiate species but care must be used, as in so many of the criteria discussed, that ecological conditions do not play a part in the expression of them. In *P. milleri*, cusps on the coxae are a distinctive feature (Plate 40, fig. H).

Peraeopods 1 and 2.—The spines of the posterodistal end of article 5 may be quite slender as in *P. milleri* or quite stout as in most of the other species.

Second pleonal epimera.—Most of the species have the lower posterior corner rounded and the posterior edge smooth. However in one larger species, *P. obtusidens major*, the lower corner is produced and the posterior edge heavily setose. These setae appear only in large adults.

Telson.—The shape may be long and slender, with acute apices, or short and stout with rounded apices. The apical armature of each lobe may consist of 3 long setae or 1-2 short spines, with or without a feathered seta. In a few species such as *P. milleri* the dorsal proximal armature may consist of stout spines on each lobe, while in the remaining species it consists of 1 or 2 feathered setae.

Sexual Characters in **Paraphoxus**

Unlike most amphipods, sexual dimorphism does not affect the gnathopods; rather it involves the eyes, second antennae and third uropods. Most specimens of the genus which are encountered are females, the ratio running in an order of magnitude of 10:1 or greater.

Eyes.—The compound eyes of females are small but this smallness may vary in its degree in different species, so that the size may be useful as a systematic character. For instance it is most useful when comparing the very diminutive eyes of *P. daboius* (Plate 10, fig. A) and the medium sized ones of *P. lucubrans* (Plate 12, fig. A), two species otherwise similar.

The eyes of adult males are so large and occupy so much of the breadth of the dorsal surface of the head that it is difficult to see relative differences in size in various species, although drawings often show them. The eyes of young males are scarcely larger than in their females, but the increase to adult size apparently occurs in a few instars. In some way, the large eyes of adult males must be associated with their positive phototropism at night, when they are attracted to a night-light, while females are not (Fage 1932).

Second antennae.—The flagellum of the second antenna in female paraphoxids is shorter than the peduncle and composed of rather slender, moderately long articles lacking sensory appendages. Young males bear second antennae with flagella slightly longer than the peduncle, the articles being short and stout and much more numerous than in females. It is apparent that at the outset of sexual maturation, flagellar segments undergo rapid proliferation, and increase in length at later instars. Male animals bear second antennae which are as long as or longer than the body and composed of long, slender articles. Some of the proximal articles may have sensory clubs and the distal dorsal side of peduncular article 5 may also have sensory clubs. Articles 3 and 4 of the peduncle often have thick tufts of dorsal hairs.

Third pleonal epimera.—Differences in convexity and distortion of the posterior edges of the third epimera in males have been discussed previously.

Third uropods.—In general the third uropods of males are more setose and the inner rami longer than in females. In species such as *P. calcaratus* (Plate 26, fig. P) the female inner ramus is short and scale-like while in *P. obtusidens* (Plate 34, fig. L) it is as long as article 1 of the outer ramus, thus quite masculine. In most species examined there appears to be little difference between juvenile and adult females regarding the third uropods but in *P. obtusidens* the inner ramus is short in juveniles and long in adult females.

In the process of maturing, males show a progressive change in length of the inner ramus, until it approximates the outer ramus in length. Increase in setation of both rami takes places so that both bear long plumose setae in adult males.

Urosome.—In males the proximal part of pleonal segment 4 is strongly depressed while in females it is nearly flush with segment 3.

The several dimorphic sexual conditions and their variability in paraphoxids must be kept in mind when identifying these animals, so that erection of erroneous new species does not occur.

Key to the Genus **Paraphoxus**

1. Rostrum abruptly narrowed in front of eyes *(Trichophoxus)* 2
1. Rostrum tapering evenly in front of eyes *(Paraphoxus)*............... 21
2. Article 5 of gnathopod 1 shorter than article 6............................ 3
2. Article 5 of gnathopod 1 longer than or equal to article 6......... 5
3. Article 2 of peraeopod 5 extends down to end of article 5 ....*barnardi*
3. Article 2 of peraeopod 5 extends down to end of article 4 or less 4
4. Articles 4-5 of peraeopod 4 equally expanded............................*nasutus*
4. Article 5 of peraeopod 4 much narrower than article 4 ....*floridanus*
5. Peraeopod 5 with 2 large spurs...*bicuspidatus*
5. Peraeopod 5 lacks spurs.. 6
6. Article 2 of peraeopod 5 with large teeth.. 7
6. Article 2 of peraeopod 5 with small teeth.. 9
7. Epistome unproduced.. 8
7. Epistome produced and very long...*variatus*
8. Peraeopod 5 with 3 large teeth..*tridentatus*
8. Peraeopod 5 with 4-5 medium, uneven teeth........*heterocuspidatus*

9. Gnathopod 1, article 6 narrow.. 10
9. Gnathopod 1, article 6 broad.. 12
10. Epistome unproduced.. 11
10. Epistome with a short cusp..*fatigans*
11. Peraeopod 5, article 2 reaching to end of article 5............*capillatus*
11. Peraeopod 5, article 2 reaching to end of article 4...............*milleri*
12. Rostrum very narrow.. 13
12. Rostrum not very narrow.. 16
13. Pleon segment 6 with a large, retruse, acute cusp................*cornutus*
13. Pleon segment 6 plain.. 14
14. Epistome with a long anterior cusp..*abronius*
14. Epistome unproduced.. 15
15. Rostrum short ....*stenodes*
15. Rostrum long ....*longirostris*
16. Peraeopod 3, article 4 short, wide, posterior expansion................
narrow distally ....*rostratus*
16. Peraeopod 3, article 4 broad, long, posterior expansion................
broad distally.. 17
17. Epistome produced.. 18
17. Epistome not produced.. 20
18. Epistomal cusp long..*epistomus*
18. Epistomal cusp short.. 19
19. Female eyes medium in size, uropod 3 inner ramus....................
more than half as long as outer ramus..............................*lucubrans*
19. Female eyes small, uropod 3 inner ramus less..............................
than half as long as outer ramus..*daboius*
20. Peraeopod 5, article 2 teeth dissimilar in size..............................
and large..*heterocuspidatus**
20. Peraeopod 5, article 2 teeth small and similar.....................*floridanus*
21. Third epimeron produced into a large tooth................................ 22
21. Third epimeron not produced into a large tooth........................... 25
22. Peraeopods 3-4 very stout..*pinguis*
22. Peraeopods 3-4 not very stout.. 23
23. Female uropod 3, inner ramus less than half as long as outer,......
maxillipedal palp article 4 with apical spine.....................*robustus*
23. Female uropod 3, inner ramus more than half as long as outer,....
maxillipedal palp article 4 lacks spine.. 24
24. Third pleonal epimeron with oblique lateral setal row........*ochoticus*

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*This species has 2 positions in the key.

24. Third pleonal epimeron lacks setal row .... *uncinatus*
25. Third pleonal epimeron with oblique lateral setal row 26
25. Third pleonal epimeron lacks setal row 29
26. Epimeral setal row short .... *australis*
26. Epimeral setal row long 27
27. Peraeopod 5, article 2 narrowing distally .... *obliquus*
27. Peraeopod 5, article 2 widening distally 28
28. Telson, each lobe with 2 setae .... *calcaratus*
28. Telson, each lobe with one seta .... *pyripes* (=*maximus*)
29. Peraeopod 5 with large spur on article 2 .... *uncigerus*
29. Peraeopod 5 lacks large spur on article 2 30
30. Gnathopod 1, article 6 very slender .... *stebbingi*
30. Gnathopod 1, article 6 broad 31
31. Gnathopods 1-2, sixth articles differ in size .... *tattersalli*
31. Gnathopods 1-2, sixth articles alike in size 32
32. Epistome produced 33
32. Epistome not produced 34
33. Epistome large .... *similis*
33. Epistome small .... *cognatus*
34. Uropods 1-2, inner and outer ramal spines dissimilar .... *sinuatus*
34. Uropods 1-2, inner and outer ramal spines similar 35
35. Female uropod 3, inner ramus half the length of outer ramus, or less 36
35. Female uropod 3, inner ramus more than half the length of outer ramus 38
36. Peraeopods lack stout spines .... *oculatus* (=*maculatus*)
36. Peraeopods armed with stout spines 37
37. Gnathopods 1-2, article 4 produced .... *simplex*
37. Gnathopods 1-2, article 4 not produced .... *spinosus*
38. Third epimeron poorly setose, broadly attenuated behind .... *rotundifrons*
38. These characters not combined 39
39. Peraeopod 3 very stout .... *villosus*
39. Peraeopod 3 slender 40
40. Third epimeron, posterior edge usually concave or straight, setose, head long .... *obtusidens*
40. Third epimeron, posterior edge convex, poorly setose, head short .... *fuegiensis*

Not included is *P. centralis* Schellenberg 1938, which is indistinguishable as a specific entity

Key to *Paraphoxus* from Southern California

1. Head with rostrum abruptly narrowed in front of eyes 2
1. Head with rostrum tapering evenly in front of eyes 11
2. Epistome with an anterior cusp 3
2. Epistome unproduced 8
3. Epistomal cusp long 4
3. Epistomal cusp short 6
4. Teeth of peraeopod 5 very large, few in number .... *variatus*
4. Teeth of peraeopod 5 small, numerous 5
5. Rostrum very narrow, short, teeth of peraeopod 5 slightly enlarged .... *abronius*
5. Rostrum spatulate, long, teeth of peraeopod 5 small .... *epistomus*
6. Gnathopod 1, article 6 narrow .... *fatigans*
6. Gnathopod 1, article 6 broad 7
7. Female eyes very small; uropod 3, inner ramus short .... *daboius*
7. Female eyes large; uropod 3, inner ramus long .... *lucubrans*
8. Peraeopod 5 with 2 large spurs .... *biscuspidatus*
8. Peraeopod 5 with medium sized or small teeth 9
9. Head with very narrow, short rostrum .... *stenodes*
9. Head with long, spatulate or broad rostrum 10
10. Peraeopod 5 with 4-5 medium sized teeth .... *heterocuspidatus*
10. Peraeopod 5 with many small teeth .... *floridanus*
11. Epistome with an anterior cusp 12
11. Epistome unproduced 13
12. Epistomal cusp large, massive, long .... *similis*
12. Epistomal cusp short, small .... *cognatus*
13. Third pleonal epimeron with large tooth .... *robustus*
13. Third pleonal epimeron lacks tooth 14
14. Third pleonal epimeron with oblique lateral setal row .... *calcaratus*
14. Third pleonal epimeron lacks setal row 15
15. Third pleonal epimeron asetose, slightly prolonged, maxillipedal palp bears apical spine .... *oculatus*
15. Third pleonal epimeron setose on hind edge, maxillipedal palp lacks apical spine 16
16. Female uropod 3 with short inner ramus, head short .... *spinosus*
16. Female uropod 3 with long inner ramus, head long 17
17. Peraeopod 3 stout, article 5 of peraeopod 5 stout .... *obtusidens major*
17. Peraeopod 3 slender, article 5 of peraeopod 5 slender .... *obtusidens*

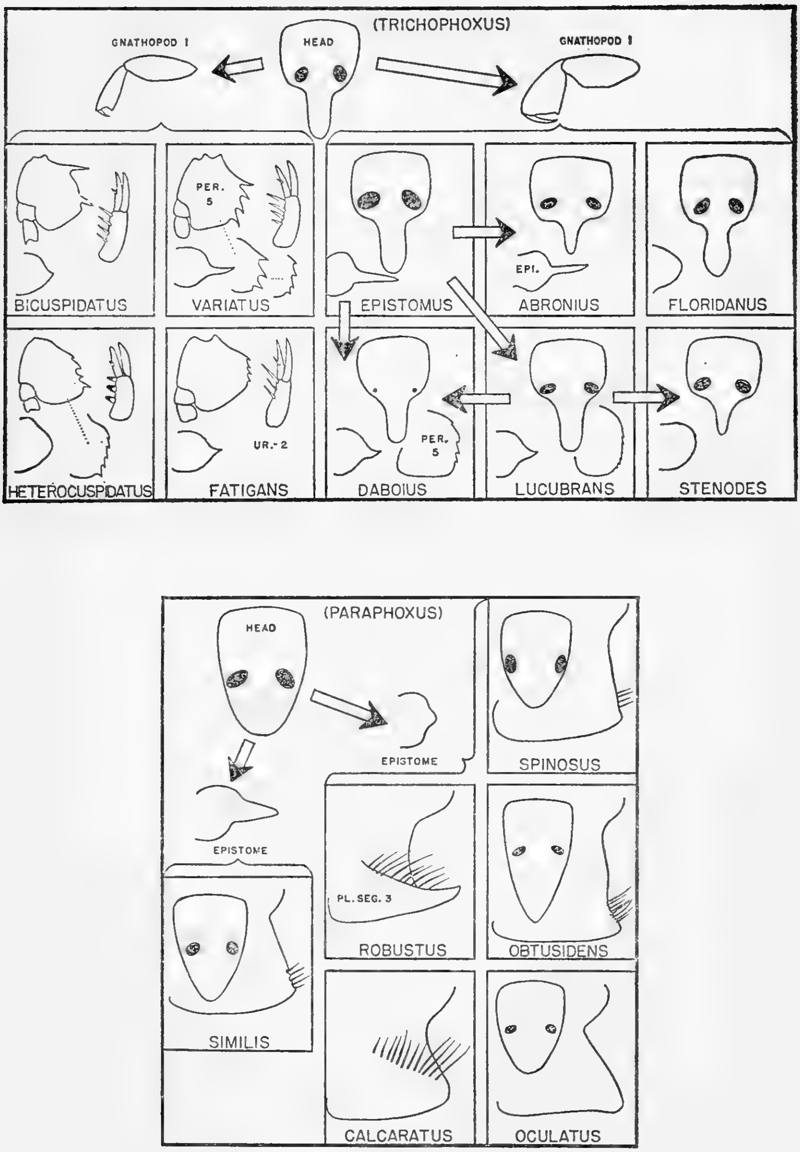


PLATE 2

Illustrated key to *Paraphoxus* from southern California. Arrows show dichotomy and close relationship.

Names for Unknown Species in Hartman (1955)

The writer prepared a list of phoxocephalid amphipods which was published in Hartman 1955 (pp. 159-165). The species were designated with letter suffices, which, for the genus *Paraphoxus,* are redesignated below:

Paraphoxus sp.	A =	*P.*	*oculatus* (Sars)
Pontharpinia sp.	B =	*Paraphoxus*	*obtusidens* (Alderman)
	E =		*bicuspidatus,* n. sp.
	F =		*calcaratus* (Gurjanova)
	G =		*epistomus* (Shoemaker)
	J =		*similis,* n. sp.
	K =		*variatus,* n. sp.
	L =		*lucubrans,* n. sp., juveniles
	M =		*heterocuspidatus,* n. sp.
	N =		*cognatus,* n. sp.
	P =		*lucubrans,* n. sp., adults
	Q =		*stenodes,* n. sp.
	R =		*epistomus* (Shoemaker), variant
	S =		*epistomus* (Shoemaker), variant
	T =		*abronius,* n. sp.
	U =		*daboius,* n. sp.
	V =		*fatigans,* n. sp.

EASTERN PACIFIC OCEAN SPECIES

Paraphoxus variatus, new species

(Plates 3, 4)

Diagnosis of female.—Head broad, rostrum slightly to moderately tenuous but bluntly rounded at apex, eyes medium in size.

Epistome acutely produced, very long and acute or rather stouter and more blunt.

Maxilliped palp article 4 lacks apical spine.

Variation in criteria of *Paraphoxus variatus*, n. sp.
X=positive, O=negative, XO and OX are intermediates.

Station	Specs. Checked	Epi. Long	No. of Teeth Perpd. 5	Ur. 1 Rami With Spines	Ur. 2 Rami With Spines	Perpd. 5 Teeth Long	Perpd. 4 Like *fatigans*	*fatigans* Also Present
2126	1	O	4	X	X	OX	O	O
2214	1	O	4	X	X	O	O	O
2232	2	O	4+1	X	X	O	O	O
2291	1	X	4	X	X	OX	O	O
2310	5	X	3	O	O	X	O	X
2311	4	X	3	O	O	X	O	X
2444	2	O	4	X	X	O	O	O
2496	2	O	4	X	X	O	O	X
2497	1	O	4	X	O	OX	O	X
2501	1	O	4	O	O	OX	O	X
2505	2	X	3	O	O	X	OX	O
2607	1	X	3	O	O	X	X	O
2608	1	X	3	O	O	X	O	O
2610	2	X	3	X	X	XO	O	O
2611	2	O	4	X	X	OX	O	O
2618	1	X	4+1	X	X	OX	O	O
2646	2	X	3	O	O	X	OX	O

TABLE 3

Gnathopods 1-2: article 5 longer than 6, the latter narrow, palm transverse. Ratio of lengths of articles 5-6: Gnathopod 1 = 28:21, Gnathopod 2 = 27:20.

Peraeopod 3: articles 4 and 5 of similar width, nearly as wide as article 2, article 6 slender but shorter than 5. Ratio of widths of articles 2, 4, 5, 6 = 25:22:22:7.

Peraeopod 4: article 4 as wide as article 4 of peraeopod 3, article 5 more slender. Ratio of widths of articles 2, 4, 5, 6 = 35:22:14:6.

Peraeopod 5 quite variable; expansion of article 2 as broad as long; its lower edge reaches nearly to the end of article 4, is truncated and dips anteriorly; sweep point at end of article 3; the teeth on the posterior edge usually are quite large and number 3 or 4; occasionally a small dorsal fifth tooth is present; in some specimens (see Table 3) the teeth are medium in size, these usually being specimens having four teeth.

Uropod 1: upper edge of peduncle with 1-4 spines, in some specimens these are stout, in others some of the proximal ones are slender; rami each bearing a small apical submerged spine and marginal spines on each ramus are one in number or absent.

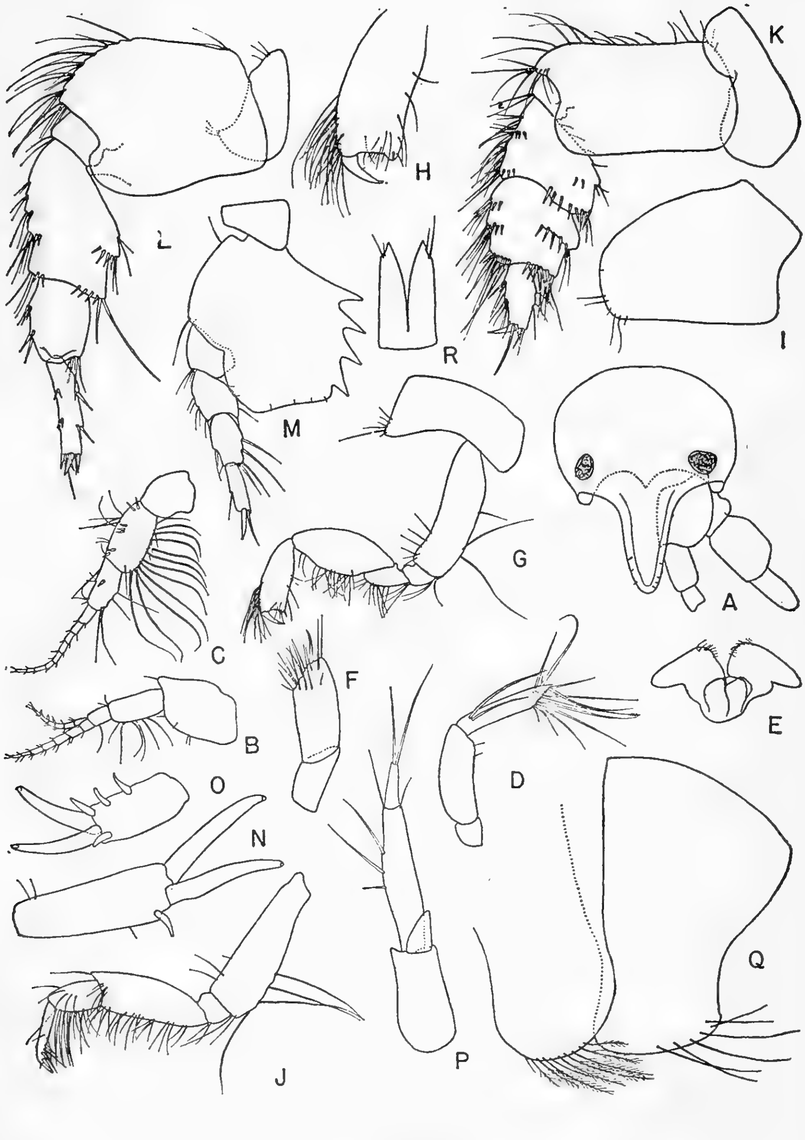


PLATE 3

Paraphoxus variatus n. sp., female, 4 mm, Sta. 2310-53.

Figs. A, head; B,C, antennae 1, 2; D, mandibular palp; E, lower lip; F, maxilla 1, palp; G,H, gnathopod 2; I, coxa 4; J,K,L,M, peraeopods 1, 3, 4, 5; N,O,P, uropods 1, 2, 3; Q, pleon segments 2-3; R, telson.

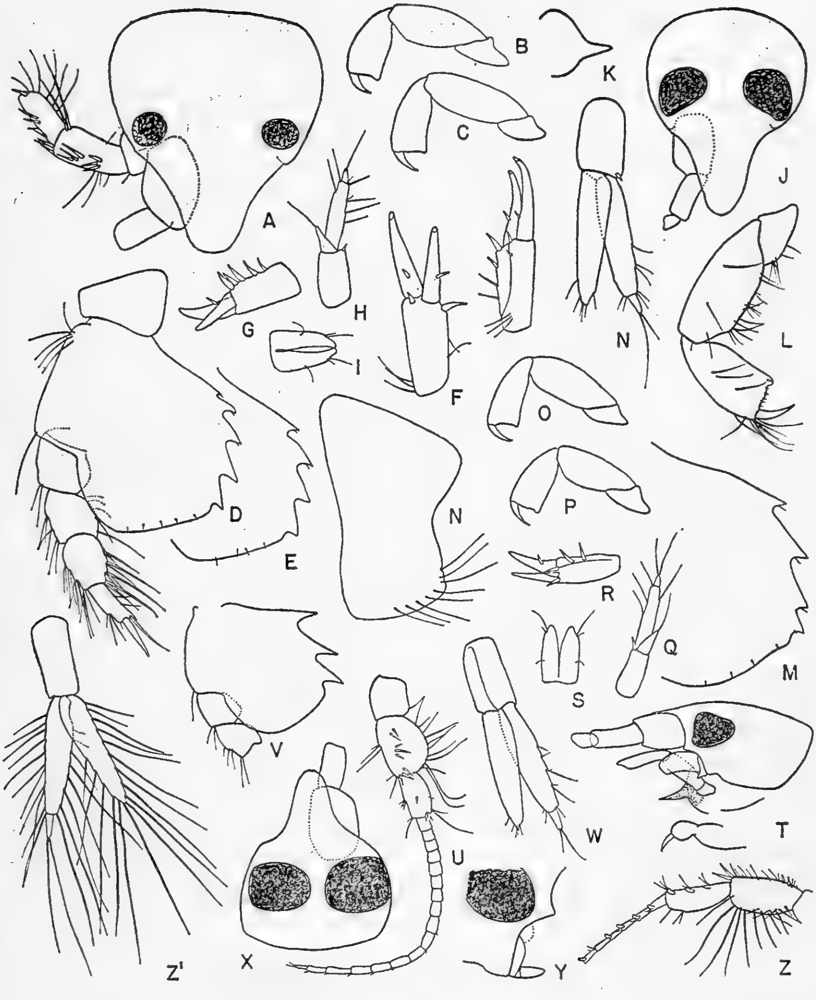


PLATE 4

Paraphoxus variatus n. sp., female, 4.75 mm, Sta. 2618-54.
Figs. A, head; B,C, gnathopods 2, 1; D,E, peraeopods 5, left and right; F,G,H, uropods 1, 2, 3; I, telson.

Male, young, 3.5 mm, Sta. 2496-53. Figs. J, head; K, epistome; L, gnathopod 1; M, peraeopod 5, article 2; N, uropod 3.

Female, 3.75 mm, Sta. 2444-53. Figs. O,P, gnathopods 1, 2; Q,R,R', uropods 3, 2, 1; S, telson.

Male, young, 3 mm, Sta. 2310-53. Figs. T, head; U, antenna 2; V, peraeopod 5; W, uropod 3.

Uropod 2: upper edge of peduncle with 3-5 stout spines, inner ramus with or without a marginal spine; apices of rami with small, often difficult to see, submerged spines.

Uropod 3: inner ramus about one fourth as long as outer or as much as one third long; article 2 of outer ramus about one third as long as article 1 or as little as one sixth as long.

Telson slender, apices acute or slightly rounded, each lateral notch with 2 setae.

Third epimeron: posterior edge straight, lower corner scarcely produced, setae sparse or absent on posterior edge.

Male.—Sexual dimorphism typical.

Holotype.—AHF No. 534, female, 3.2 mm.

Type locality.—Station 2310-53, near Long Beach Breakwater, California, 33-40-00 N, 118-10-00 W, 15 fms, sandy mud, May 16, 1953.

Remarks.—Small specimens from Station 2311-53 measuring about 2 mm in length have only 2 teeth on article 2 of peraeopod 5.

This species bears the name *variatus* due to the rather pronounced variations encountered. Thus, the epistome may vary from long to of medium length; peraeopod 5 may have three, four, or five teeth on the posterior edge of article 2; the teeth may be short, medium sized, or long; the presence or absence of spines on the first two uropodal rami occurs but the variation apparently bears no relationship to sexual maturity, although some correlation with size occurs. Specimens appearing to be in the same stage of development regarding setosity and spinosity occur at different stations but are different in size, indicating possible effects of available food or crowding, thus resulting in different rates of maturation. Since most of the stations examined are in shallow waters, there is no correlation of size to depth of habitat.

Table 3 is a compilation of some variable features in the species. It must be noticed that specimens from Stations 2505-53, 2607-54, and 2646-54 have fourth peraeopods which are similar to those of *P. fatigans*, n. sp. The similarity is based on stoutness of article 5 in *P. fatigans*. See the latter species for a discussion of the close relationships of the two animals.

Material examined.—429 specimens at 72 stations.

Distribution.—Southern California coastal and insular shelves, 5 to 60 fms. Eighty percent of the records are shallower than 20 fms.

Paraphoxus abronius, new species
(Plate 5)

Diagnosis of female.—Head broad, rostrum very narrow and rather short; eyes medium in size.

Epistome produced anteriorly into a very long, sharp process.

Maxilliped palp article 4 apically simple.

Gnathopods 1-2: article 5 much longer than 6, the latter moderately broad, palm nearly transverse. Ratio of lengths of articles 5-6: Gnathopod 1 = 26:20, Gnathopod 2 = 24:18.

Peraeopod 3: article 4 nearly as wide as 2, article 6 slightly longer than 5. Ratio of widths of articles 2, 4, 5, 6 = 28:26:24:10.

Peraeopod 4: ratio of widths of articles 2, 4, 5, 6 = 43:24:17:8.

Peraeopod 5: article 2 slightly longer than broad, the ratio of width to length being 53:58; lower edge slightly convex and reaching nearly to end of article 4, sweep point near middle of article 4; posterior edge bearing about 6 medium sized teeth, larger than in *P. epistomus.*

Uropods 1-2: margins of peduncles and rami armed with thin spines.

Uropod 3: inner ramus nearly three-fourths as long as outer, article 2 of outer ramus about one-third as long as article 1.

Telson slender, apices narrow, lateral notches with 2-3 slender spines.

Third epimeron: posterior edge moderately convex, lower corner slightly produced, rounded, and bearing 2 setae.

Male.—Sexual dimorphism typical.

Holotype.—AHF No. 546, male, 3 mm.

Type locality.—Station 2607-54, off Huntington Beach, California, 33-39-59 N, 118-01-59 W, 5 fms, compact black sand, Mar. 3, 1954.

Remarks.—This species differs from *P. epistomus* (Shoemaker) in the following ways: (1) the larger teeth of peraeopod 5; (2) the very narrow rostrum; (3) the lack of a large apical peduncular spine on uropod 1; (4) the longer hind edge on the third epimeron in the female.

Similar to the case in *P. lucubrans* n. sp. a collection of typical *P. epistomus* near Pt. Conception contained a single, rather large specimen which by definition should be placed in *P. abronius* but which, except for the very narrow rostrum, would be considered a mutant of *P. epistomus.* As with *P. lucubrans* it is possible that *P. abronius* is a northern species having a sporadic occurrence in southern California where it meets its closely related neighbor *P. epistomus* and where infrequent hybridization might occur to confuse the discreteness of these populations.

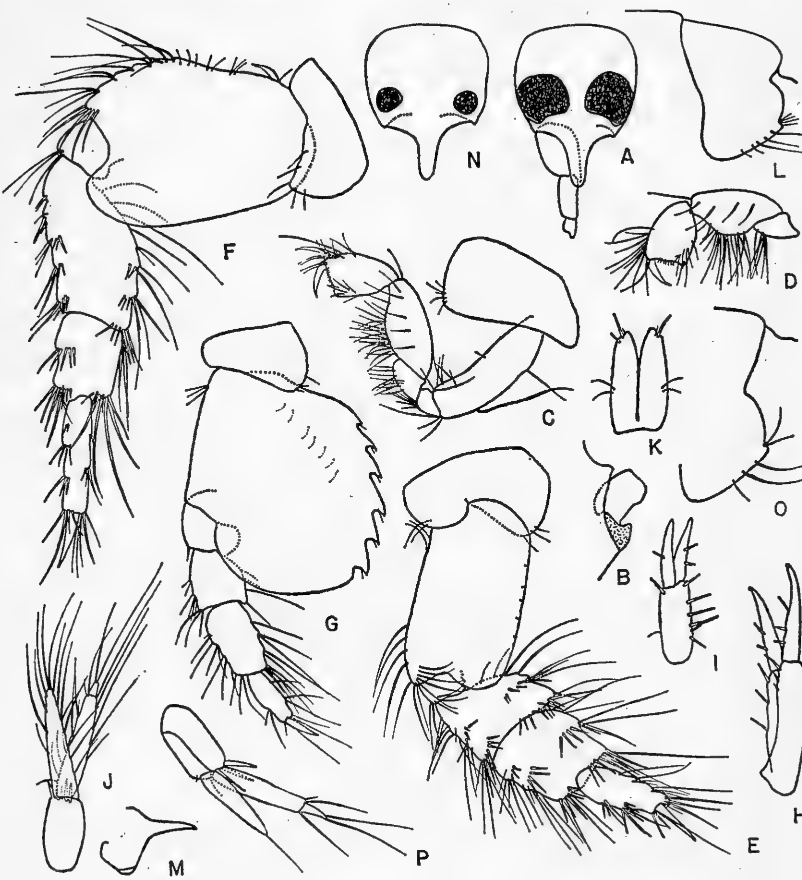


PLATE 5

Paraphoxus abronius n. sp., male, 3 mm, Sta. 2607-54.
Figs. A, head; B, head, lower corner; C,D, gnathopods 1, 2; E,F,G, peraeopods 3, 4, 5; H,I,J, uropods 1, 2, 3; K, telson; L, pleon segment 3; M, epistome.
Female 2.5 mm, Sta. 2607-54. Figs. N, head; O, pleon segment 3; P, uropod 3.

Despite these possibilities of close relationship the several populations, *P. abronius*, *P. epistomus* and *P. lucubrans*, are distinct and numerous enough to warrant nomenclatural segregation at this time.

Material examined.—1596 specimens at 22 stations.

Distribution.—Southern California coastal shelf, 5 to 50 fms. Although the species occurs infrequently, the number of specimens at a single station is high; the four highest stations had 873, 226, 120, and 104 specimens respectively.

Paraphoxus epistomus (Shoemaker), new combination
(Plates 6, 7, 8)

Pontharpinia epistoma Shoemaker 1938: 326-329, fig. 1.

Diagnosis of typical female.—Head with constricted rostrum which is long and broad; eyes intermediate in size. Body narrow.

Epistome produced into a long thin acute anterior process.

Maxillipedal palp article 4 with an indistinct apical spine.

Gnathopod 1: article 5 longer than 6, its posterior edge nearly straight, varying to moderately convex, article 6 broad distally, palm only slightly oblique. Gnathopod 2 similar to 1 but article 5 slightly shorter than in gnathopod 1, still longer than article 6. Ratio of lengths of articles 5 and 6; Gnathopod 1 = 28:24, Gnathopod 2 = 26:23.

Peraeopod 3: article 4 slightly narrower than 2, article 5 slightly longer and slightly narrower than 4, article 6 slender, as long as 5, article 7 slightly more than half as long as 6. Ratio of widths of articles 2, 4, 5, 6 = 27:24:19:8.

Peraeopod 4 quite slender below article 2, article 5 shorter and slightly narrower than 4, article 6 as long as 4, article 7 a little less than half as long as 6. Ratio of widths of articles 2, 4, 5, 6 = 32:16:12:6.

Peraeopod 5: article 2 broadly expanded, extending almost to the end of article 4, ratio of width to length is 16:13, posterior edge rather straight, with about 7 small teeth; article 6 nearly half again as long as either 4 or 5, article 7 more than half as long as 6.

Uropod 1: upper edge of peduncle with several long spines, distally with a stout one; rami longer than peduncle, each with about 4-6 marginal spines, each apex with an articulating spine.

Uropod 2: peduncular margin with about 5 long, upstanding spines, rami as long as peduncle, margins of each with 3-5 slender spines, apices each with an articulating spine.

Uropod 3: inner ramus about five-sixths as long as outer, article 2 of outer one-fifth as long as article 1, slender.

Telson rather slender, lateral apices oblique, notched, each with 2 spines and a feathered seta.

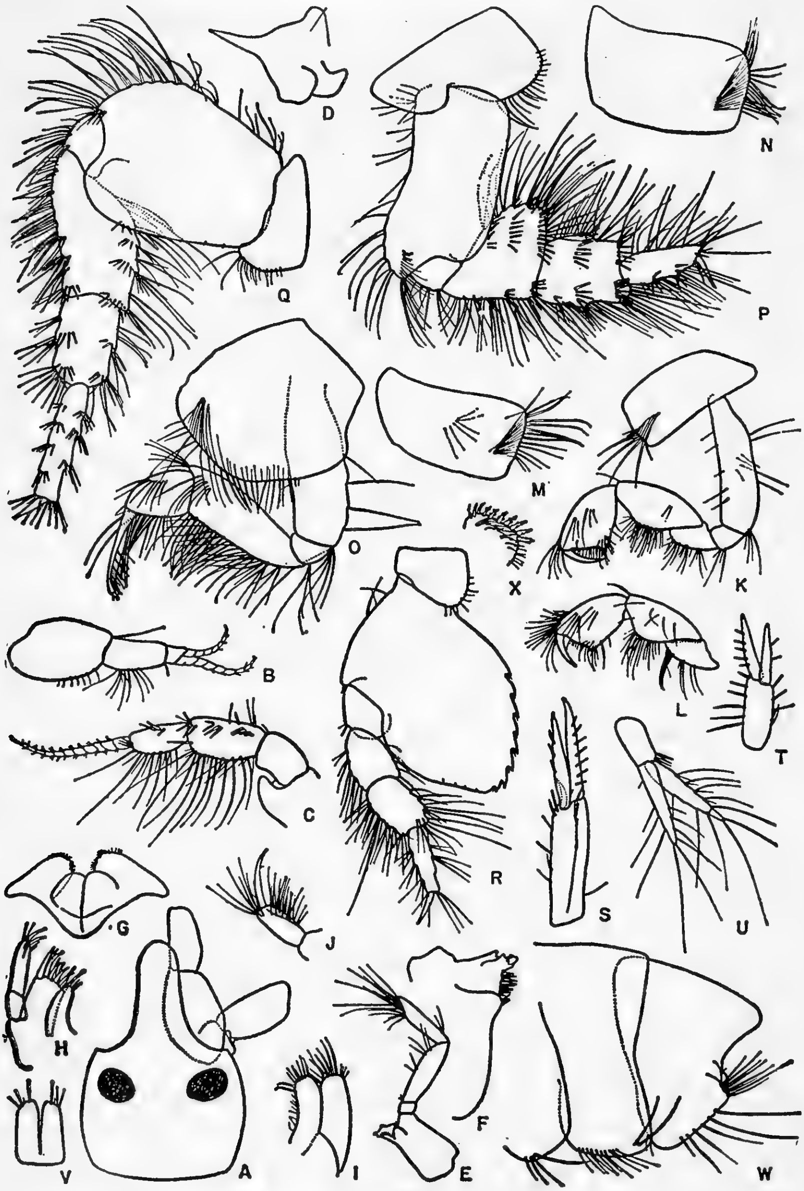


PLATE 6

Paraphoxus epistomus (Shoemaker), female, 5.5 mm, Sta. 2607-54.

Figs. A, head; B,C, antennae 1, 2; D, epistome; E,F, mandibles; G, lower lip; H,I, maxillae 1, 2; J, maxillipedal palp; K,L, gnathopods 1, 2; M,N, coxae 2, 3; O,P,Q,R, peraeopods 2, 3, 4, 5; S,T,U, uropods 1, 2, 3; V, telson; W, pleon segments 1-3; X, grinding plate of gastric mill.

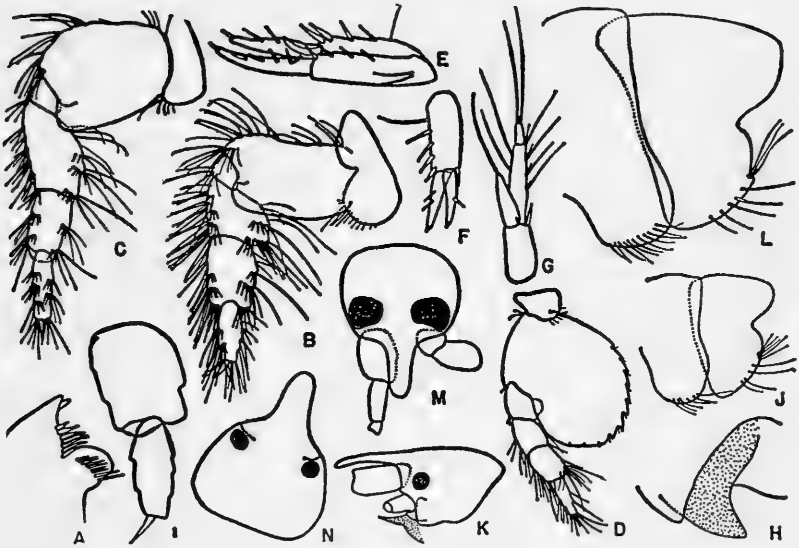


PLATE 7

Paraphoxus epistomus **(Shoemaker), female, 3 mm, Sta. 2214-52.**
Figs. A, mandible; B,C,D, peraeopods 3, 4, 5; E,F,G, uropods 1, 2, 3; H, gland cone, antenna 2, stippled.
Female, 3.5 mm, Sta. 2214-52. Figs. I, peraeopod 3, end; K, head; L, pleon segments 2, 3.
Male, young, Sta. 2214-52. Figs. J, pleon segments 2-3; M, head.
Female, 4 mm, Sta. 2214-52. Fig. N, head.

Third epimeron: posterior edge sweepingly convex, lower corner not produced, setal row increasingly admarginal along lower half of posterior edge.

Male.—Sexual dimorphism typical. Sizes 6-7 mm.

Remarks on young animals

The female stage described above was at first thought to be intersexual due to the moderately large eyes and long inner ramus of the third uropod but apparently the elder females develop these conditions normally. In young females and juveniles the eyes are small though black and distinct in alcohol. Specimens at a size of 3.5 mm which bear brood plates are shown in Plate 7. They have a much shorter inner ramus of the third uropod, the posterior edge of peraeopod 5, article 2, is more convex and the fifth articles of gnathopods 1-2 are slightly shorter than the sixth articles. The last two articles (6-7) of the last 3 peraeopods

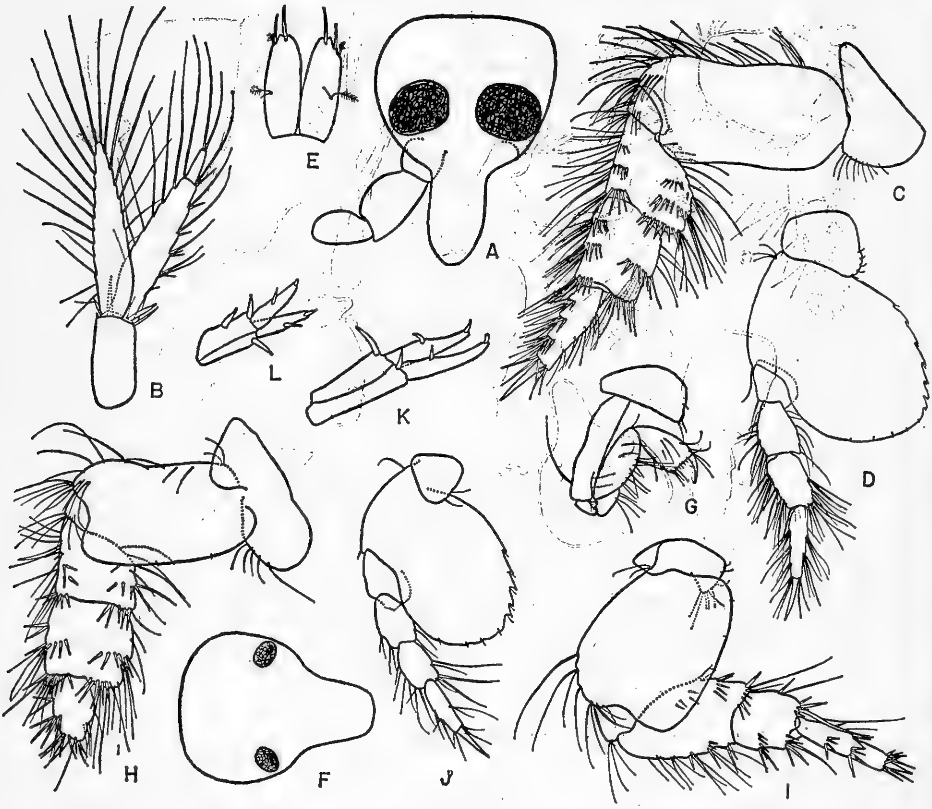


PLATE 8

Paraphoxus epistomus (Shoemaker), male, 4 mm, Sta. 2607-54.
Figs. A, head; B, uropod 3.
Female, 7 mm, Sta. M-79-49. Figs. C,D, peraeopods 3, 5; E, telson.
Female, 3 mm, Venado Beach, Panama. Figs. F, head; G, gnathopod 1; H,I,J, peraeopods 3, 4, 5; K,L, uropods 1, 2.

are distinctly shorter than in larger specimens. Thus, terminal differentiation does not necessarily accompany sexual maturity.

Other variation in adults

Another facies of this species is seen in occasional lots of material which have article 4 of peraeopod 3 half again as wide as article 5, the teeth on peraeopod 5 being slightly larger (Plate 8, fig. C and Plate 6, fig. R). Intergradations occur between this extreme and the typical one described above.

The minute panamic facies

Small specimens about 3 mm in length were collected intertidally on sand flats at Venado Island, Pacific Panama, by the writer. These proved to be elder females of the species due to the long rami on uropod 3. However, they differ from the warm temperate representatives by the stouter third and fourth peraeopods, and the first two pairs of uropods, each peduncle and ramus of which bear only one spine.

Material examined.—1499 specimens at 128 stations.

Distribution.—Western Atlantic from New Hampshire to South Carolina. Eastern Pacific from Mendocino County, California, to Panama, 0 to 60 fms. At Venado Island, Panama, the minute facies was collected by the writer on exposed tidal flats in small depressions filled with silt and fine sand. On the southern California coastal shelf the species rarely occurs below 20 fms depth, and specimens from those greater depths often are aberrant and easily confused with *P. lucubrans* n. sp. Near Pt. Conception *P. epistomus* occurs at stations where it appears to intergrade with *P. abronius* n. sp.

Paraphoxus fatigans, new species

(Plate 9)

Diagnosis of female.—Differs from *P. variatus* n. sp. in the following criteria: (1) acute cusp of epistome shorter; (2) article 5 of peraeopod 4 shorter and much stouter; (3) the teeth on the posterior edge of article 2 of peraeopod 5 are much smaller and quite closely compressed together, the lower edge of the article being more oblique.

Holotype.—AHF No. 535, female, 3 mm.

Type locality.—Station 2496-53, off Long Beach, California, 33-38-00 N, 118-10-00 W, 18 fms, dark sandy mud, Nov. 27, 1953.

Remarks.—The holotype of this species and that of *P. variatus* are quite different in respect to the epistome, peraeopod 4 and peraeopod 5. In all other features the species are quite similar.

If one inspects the figures for *P. variatus* one will see a trend in variation which brings that species close to *P. fatigans*, especially in the decrease in the size of teeth of peraeopod 5, the shortening of the epistome and, in a few specimens (Table 3), the similarity of peraeopod 4.

The species *fatigans* may deserve no specific status and the possibility that it is a phenotype of *variatus* should be studied.

Material examined.—435 specimens at 41 stations.

Distribution.—Southern California coastal shelf, generally 10 to 24 fms, occasionally at 50 fms, and aberrant specimens at 210 fms.

Paraphoxus daboius, new species

(Plates 10, 11)

Diagnosis of female.—Head with tenuous but rather broad rostrum; eyes very small, in some specimens not visible.

Epistome produced into a small, acute cusp.

Maxillipedal palp article 4 apically simple.

Gnathopod 1: article 5 much longer than 6, the latter broad, with a transverse palm. Ratios of lengths of articles 5 and 6: Gnathopod 1 = 30:23, Gnathopod 2 = 27:22.

Peraeopod 3: articles 4-5 nearly as wide as article 2, article 6 shorter than 5. Ratio of widths of articles 2, 4, 5, 6 = 30:28:28:12.

Peraeopod 4: ratio of widths of articles 2, 4, 5, 6 = 42:28:19:7.

Peraeopod 5: article 2 nearly as wide as long, the ratio of width to length being 53:56; article 2 extends down nearly to the end of article 4, sweep point at middle of article 4, lower edge truncated; posterior edge with 3 small teeth and an occasional minute one proximally; articles 4 and 5 rather stout.

Uropods 1-2: spines rather stout, each ramus of each uropod with one spine, peduncle of uropod 1 with one marginal spine, of uropod 2 with 2 spines.

Uropod 3: inner ramus less than one third as long as outer; article 2 of outer less than one third as long as article 1.

Telson rather slender, apices rounded, lateral notches each with 3 long setae.

Third epimeron: posterior edge convex, lower corner slightly produced, bearing one seta.

Male.—Eyes not as large as in most species of *Paraphoxus,* otherwise with typical sexual dimorphism.

Holotype.—AHF No. 536, female, 3.75 mm.

Type locality.—Station 2227-53, east of Santa Catalina Island, 33-24-12 N, 118-20-01 W, 128 fms, fine dark green mud, Feb. 28, 1953.

Remarks.—This species is related closely to *P. lucubrans* n. sp. but differs in the following ways: (1) the eyes of the female are much smaller; (2) the spination on uropods 1-2 is less abundant; (3) the

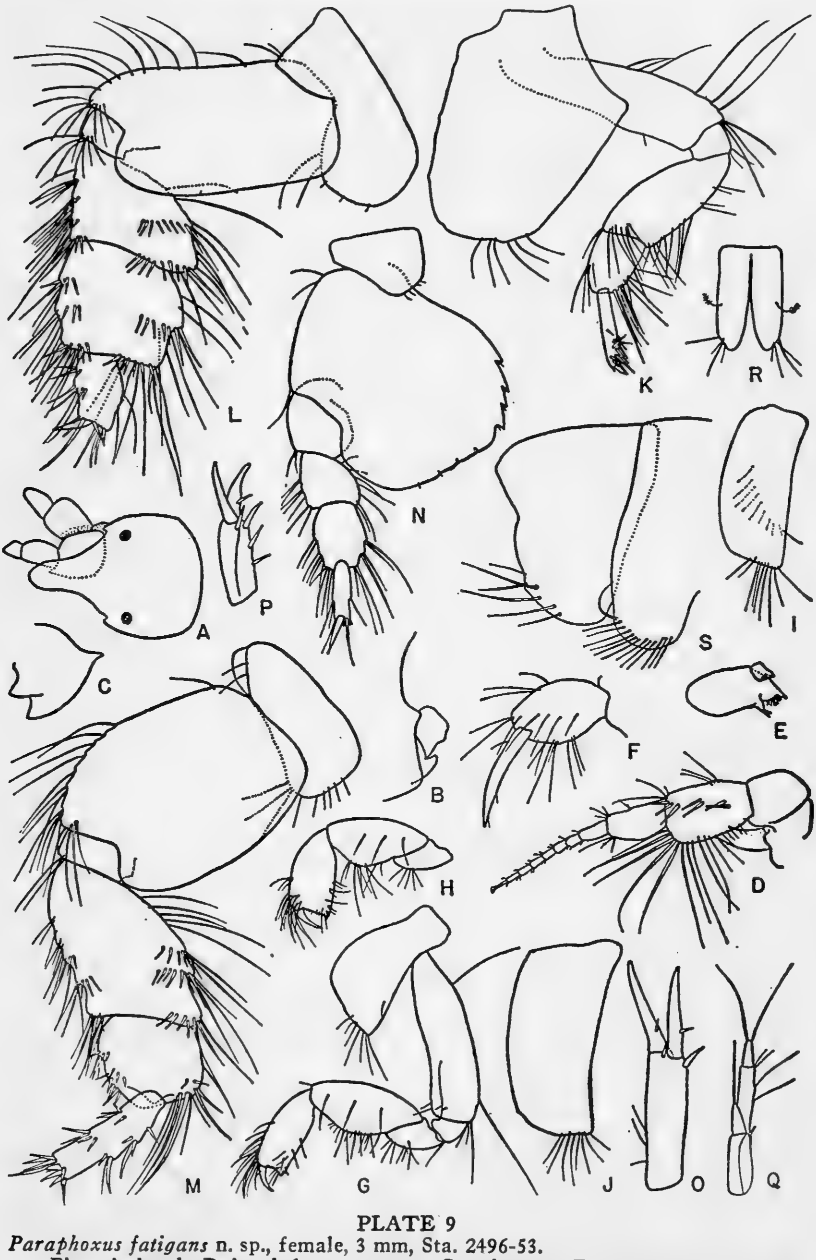


PLATE 9

Paraphoxus fatigans n. sp., female, 3 mm, Sta. 2496-53.

Figs. A, head; B, head, lower corner; C, epistome; D, antenna 2; E, mandible; F, maxillipedal palp; G, H, gnathopods 1, 2; I,J, coxae 2, 3; K, L,M,N, peraeopods 2, 3, 4, 5; O,P,Q, uropods 1, 2, 3; R, telson; S, pleon segments 2, 3.

telsonic apices are armed with long setae and not short spines; (4) the inner ramus of uropod 3 is quite short while in *P. lucubrans* it is nearly as long as the outer ramus; (5) article 2 of peraeopod 5 is broad distally and truncated while in *P. lucubrans* it is narrowed and convex distally; (6) the posterior edge of article 2 of peraeopod 5 has only 3 teeth and these are larger than the 6-7 teeth on *P. lucubrans*; (7) article 5 of gnathopod 1 is very long and slender while in *P. lucubrans* it is somewhat stouter.

Atypical Specimens (Station 3045-55)

A female 3 mm in length and bearing brood plates has eyes larger than typical females, more like *P. lucubrans*, and the uropods are more spinose. However, the specimen is like *P. daboius* in the third uropods, the telson and the gnathopods, while article 2 of peraeopod 5 is like *P. daboius* in that the teeth are smaller. Two juvenile males of this type are present also at the same station and bear eyes with better developed pigment than normally seen in the species. These specimens may be hybrids or mutants.

Material examined.—121 specimens at 25 stations.

Distribution.—Southern California coastal slopes, 42 to 230 fms. A deep water species which may be an ecophenotype to *Paraphoxus epistomus*, having reduced eyes.

Paraphoxus lucubrans, new species

(Plates 12, 13, 14)

Diagnosis of female.—Head with rostrum narrowed anterior to eyes but rather short and broad; eyes medium in size.

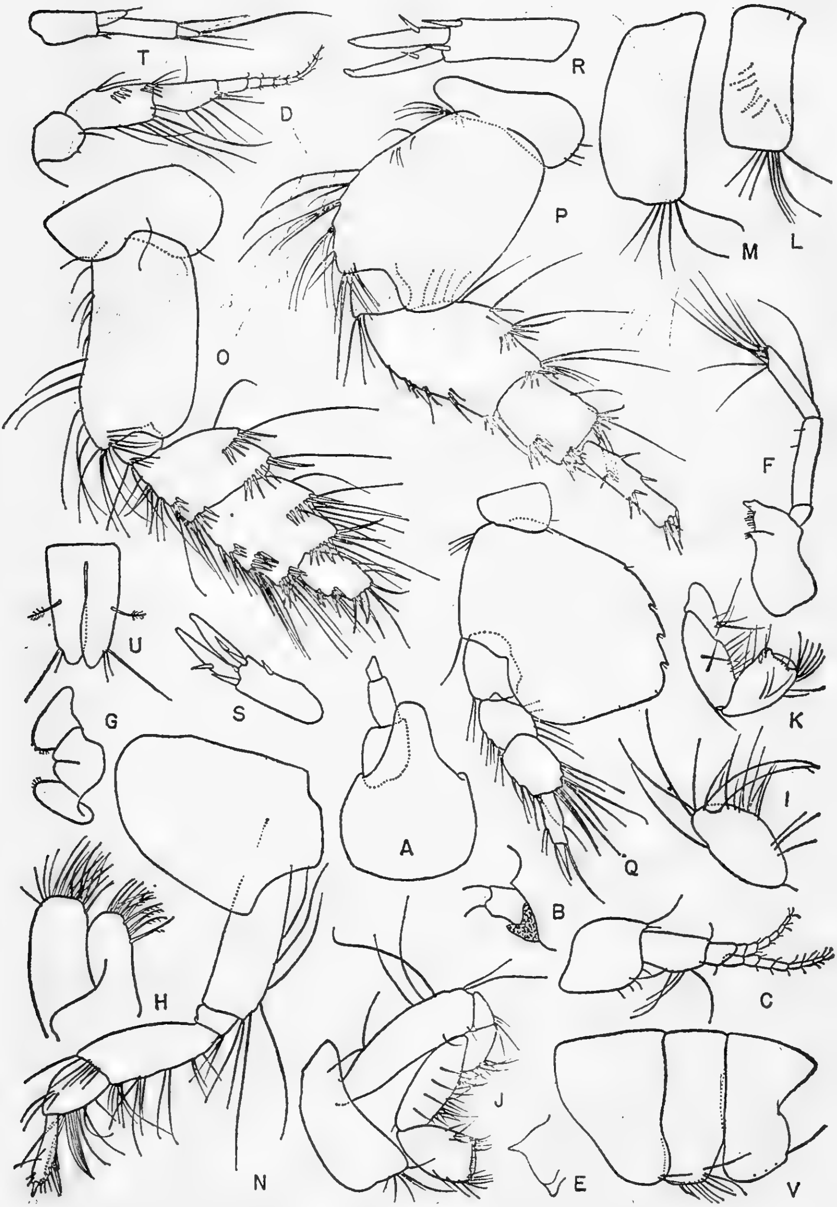
Epistome variable, produced into a small acute cusp or scarcely produced and blunt.

Maxilliped palp article 4 apex unmodified.

PLATE 10

Paraphoxus daboius **n. sp., female, Sta. 2423-53.**

Figs. A, head; B, gland cone, stippled; C,D, antennae 1, 2; E, epistome; F, mandible; G, lower lip; H, maxilla 2; I, maxillipedal palp; J,K, gnathopods 1, 2; L,M, coxae 2, 3; N,O,P,Q, peraeopods 2, 3, 4, 5; R,S,T, uropods 1, 2, 3; U, telson; V, pleon segments 1-3.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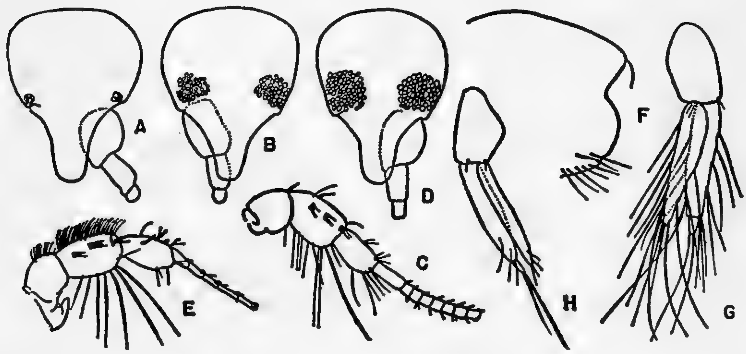


PLATE 11

Paraphoxus daboius n. sp., female, 3.5 mm, Sta. 2443-53.
Fig. A, head.
Male, young, 3 mm, Sta. 2443-53. Figs. B, head; C, antenna 2; H, uropod 3.
Male, 3 mm, Sta. 2443-53. Figs. D, head; E, antenna 2; F, pleon segment 3; G, uropod 3.

Gnathopod 1: article 5 slightly longer than 6, rather stout; article 6 not broad, palm nearly transverse. Ratios of lengths of articles 5 and 6: Gnathopod 1 = 26:22, Gnathopod 2 = 1:1.

Peraeopod 3: article 4 nearly as wide as 2, article 6 shorter than 5. Ratio of widths of articles 2, 4, 5, 6 = 32:29:26:15.

Peraeopod 4: ratio of widths of articles 2, 4, 5, 6 = 47:29:24:12.

Peraeopod 5: article 2 rather slender, its ratio of width to length being 50:62; it reaches down to the end of article 4 and narrows distally, with a convex lower edge; the posterior edge bears about 7 small teeth; rest of appendage rather stout.

Uropods 1-2: spines on marginal edges slender and moderately numerous. Apices of rami bear articulated spines.

Uropod 3: inner ramus longer than article 1 of outer ramus; article 2 of outer ramus a little more than one fifth as long as article 1.

Telson moderately broad, apices blunt, the beveled lateral edges bearing 3 short spines each.

Third epimeron: posterior edge rather short, bulging, lower corner rounded, bearing several long setae.

Male.—Sexual dimorphism typical.

Holotype.—AHF No. 537, female, 4.3 mm.

Type locality.—Station 2498-53, middle of Santa Catalina Channel, 33-34-01 N, 118-09-58 W, 50 fms, sandy mud, Nov. 27, 1953.

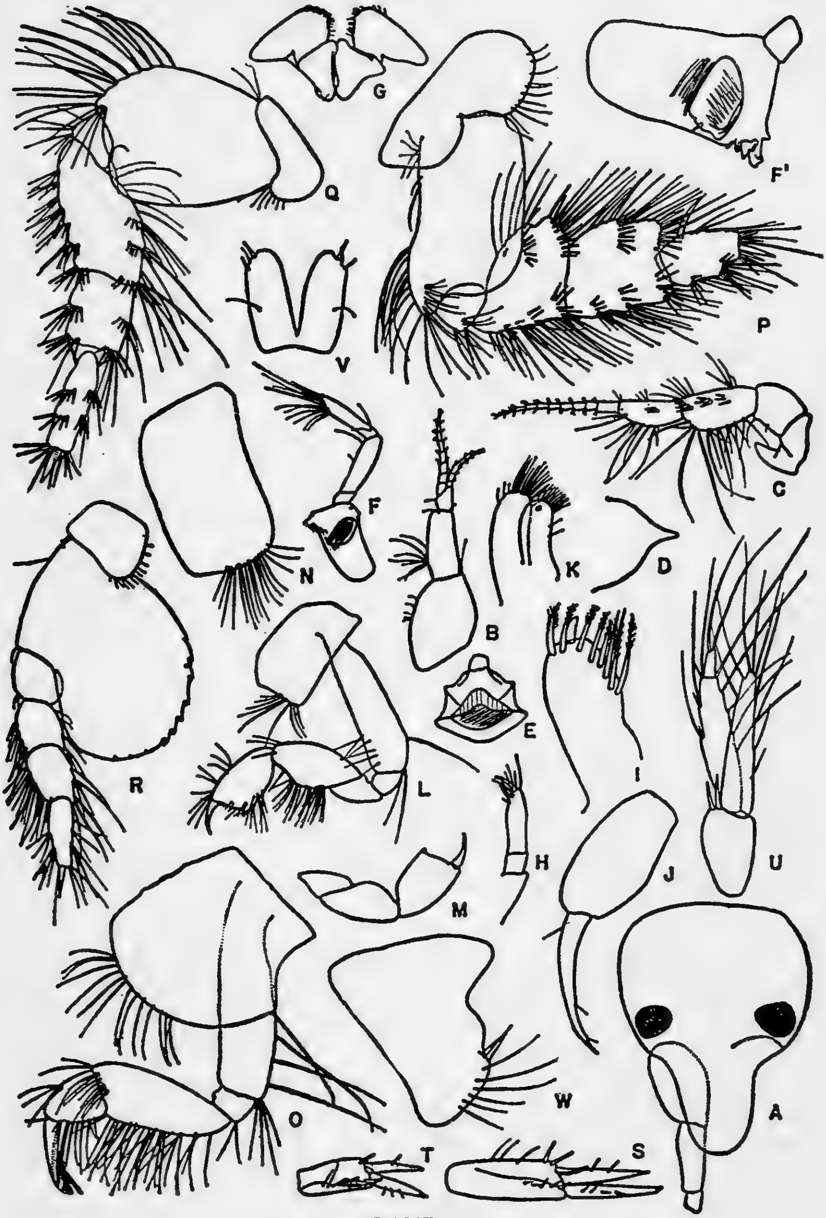


PLATE 12

Paraphoxus lucubrans n. sp., female, 4.4 mm, Sta. 2498-53.

Figs. A, head; B,C, antennae 1, 2; D, epistome; E, upper lip, dorsal view; F,F' mandibles; G, lower lip; H, maxilla 1, palp; I,J, maxilliped, inner plate and palp; K, maxilla 2; L,M, gnathopods 1, 2; N, coxa 3; O,P,Q,R, peraeopods 2, 3, 4 (reduced), 5; S,T,U, uropods 1, 2, 3; V, telson; W, pleon segment 3.

Remarks.—The relationship of this species to *P. daboius* is discussed under the remarks of that species.

Paraphoxus lucubrans appears related to *P. nasutus* (Gurjanova 1936: 249) but several important characters were not described for *P. nasutus*, such as the epistome and the first 2 pairs of uropods. A dorsal drawing of the head of *P. nasutus* is needed for final comparison in order to determine the extent of the rostral incision anterior to the eyes in that species.

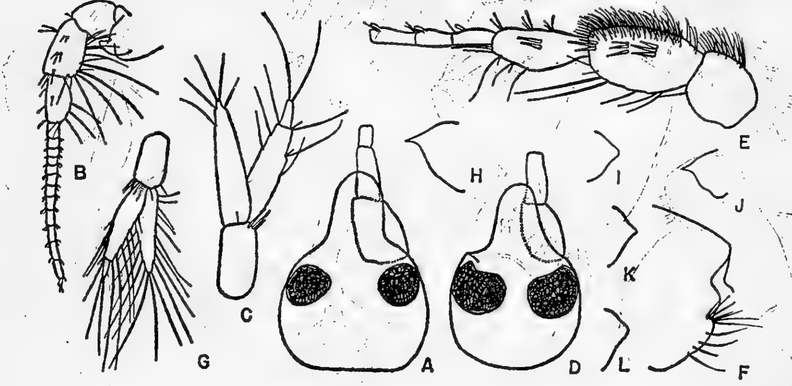


PLATE 13
Paraphoxus lucubrans n. sp., male, young, 4 mm, Sta. 2498-53.
Figs. A, head; B, antenna 2; C, uropod 3.
Male, 3.25 mm, Sta. 2394-53. Figs. D, head; E, antenna 2; F, pleon segment 3; G, uropod 3.
Epistomes of several specimens, Figs. H,I,J,K,L.

Juvenile animals have the inner ramus of uropod 3 much shorter than in the adult female, although some small specimens have a rather long inner ramus of uropod 3 (see Plate 14, fig. V). These specimens are small, 2-3.5 mm, and have fewer teeth on peraeopod 5, poorly spinose uropods 1-2 and article 5 of gnathopods 1-2 is slightly shorter.

This species is very closely related to *P. epistomus*, differing mainly in the shorter epistomal process. One of the most distinctive collections of this species occurred near Pt. Conception, a theoretical faunal boundary line. Here the specimens were large and well developed, with a rostrum of the flaring kind usually associated with *P. epistomus*. Study of materials north of Pt. Conception may show that *P. lucubrans* is mainly

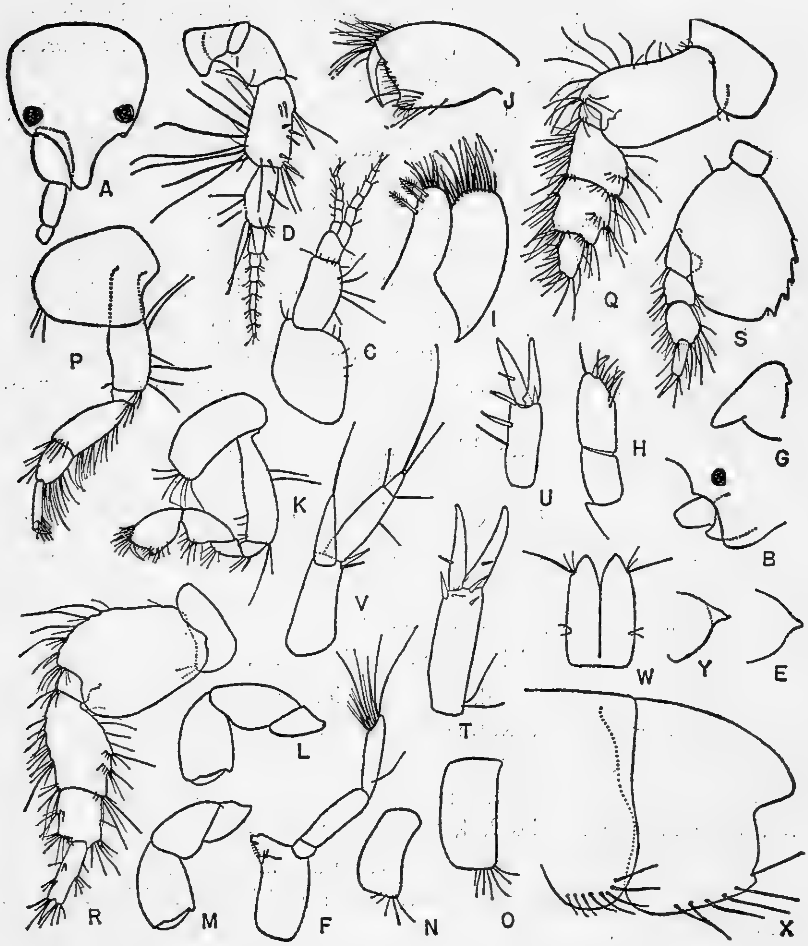


PLATE 14

Paraphoxus lucubrans n. sp. var., female, 3 mm, Sta. 2232-52.

Figs. A, head; B, head, lower corner; C,D, antennae 1, 2; E, epistome; F, mandible; G, lower lip; H, maxilla 1, palp; I, maxilla 2; J,K, gnathopods 1, 2; L,M, gnathopods 1, 2, ends; O, coxa 3; P,Q,R,S, peraeopods 2, 3, 4, 5; T,U,V, uropods 1, 2, 3; W, telson; X, pleon segments 2-3.

Female, 2.75 mm, Sta. 2232-52. Fig. Y, epistome.

a northern species which occurs sporadically in the southern California area, meeting its southern neighbor *P. epistomus* and perhaps interbreeding with it to provide the variety of phenotypes seen in *P. epistomus.* If so, then the two species should become subspecies.

Another possibility is that *P. lucubrans* is a simple phenotype of *P. epistomus.* If so, then its presence might also be demonstrable in specimens collected in Atlantic waters.

Material examined.—264 specimens at 34 stations.

Distribution.—Southern California coastal shelf, 5 to 50 fms. More than 60% of the records are deeper than 20 fms. It is possible that this is a transitional stage between *P. epistomus* and *P. daboius* living in depths intermediate between the two. Most of the shallow records concern specimens of juvenile size, which may be aberrant small *P. epistomus.*

Paraphoxus bicuspidatus, new species

(Plates 15, 16)

Diagnosis of female.—Rostrum constricted anterior to the eyes, varying from medium length to long, apex broad. Eyes very small. Body broad.

Epistome minutely produced anteriorly.

Maxillipedal palp article 4 unmodified apically.

Gnathopods 1 and 2 similar, article 5 longer than 6, the latter rather narrow, palm transverse. Ratio of article 5 to 6 in gnathopod 1 = 23:17.

Peraeopod 3: article 4 nearly as wide as 2, article 5 scarcely more slender, article 6 narrow, shorter than 5; article 7 medium in length. Ratio of widths of articles 2, 4, 5, 6 = 26:24:22:9.

Peraeopod 4: articles 4-5 narrower than in peraeopod 3, but the appendage is stout, nevertheless. Ratio of widths of articles 2, 4, 5, 6 = 36:20:15:6.

Peraeopod 5: article 2 not broadly expanded, the ratio of width to length is 38:45, extending downward nearly to the end of article 4, sweep point near distal end of article 3, lower edge truncated and dipping anteriorly; posterior edge with two large spurs, one each near the dorsal and ventral edges, the dorsal one varying from as long to much longer than the ventral spur. Rest of appendage slender.

Uropods 1 and 2 with rami shorter than peduncles. Uropod 1 with peduncle armed with about 4 medium-sized spines becoming slender proximally; each ramus has a short marginal spine and a terminal claw.

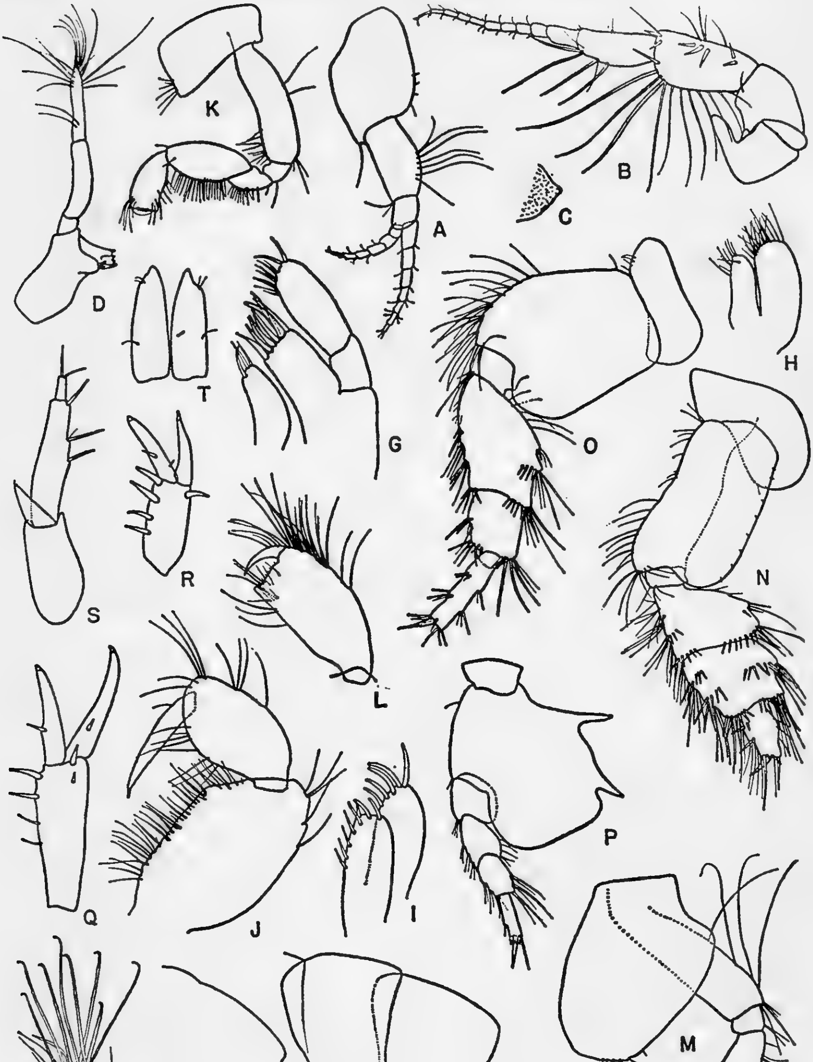


PLATE 15

Paraphoxus bicuspidatus n. sp., female, 4 mm, Sta. 2610-54.

Figs. A,B, antennae 1, 2; C, epistome; D, mandible; E, mandible, palp article 3; F, lower lip; G,H, maxillae 1, 2; I,J, maxilliped; K, L, gnathopods 1, 2; M,N,O,P, peraeopods 2, 3, 4, 5; Q,R,S, uropods 1, 2, 3; T, telson; U, pleon segments 2, 3; V, pleon segment 3, another view.

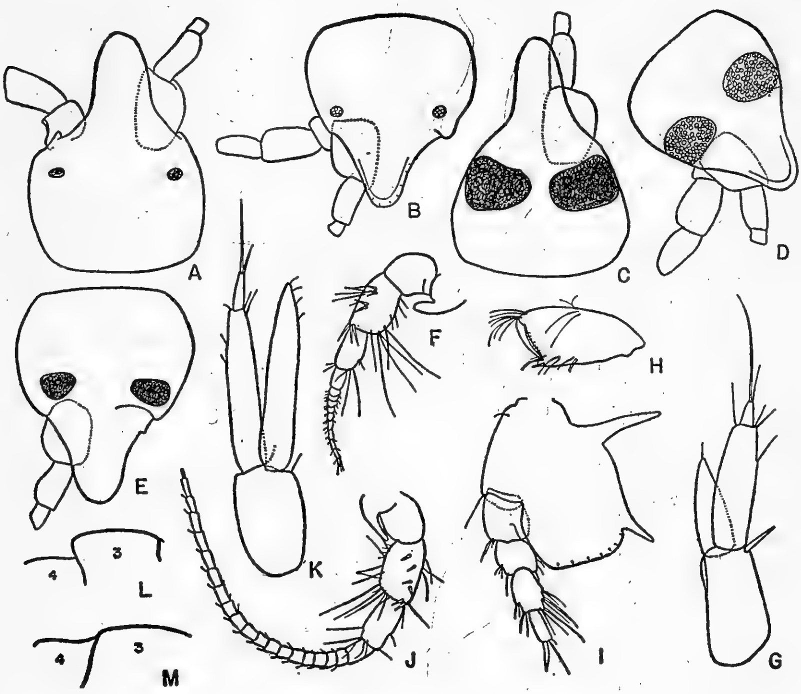


PLATE 16

Paraphoxus bicuspidatus n. sp.

Figs. A, head, female, 4.5 mm, Sta. 1274-41; B, head, female, 3-5 mm, Sta. 126-33; C,J,K,L, head, antenna 2, uropod 3, pleon segments 3-4, male, 5 mm, Sta. 2448-53; D, head, male, 3 mm; E,F,G, head, antenna 2, uropod 3, young male, 4.5 mm, Sta. 2448-53; H,I,M, end of gnathopod 1, peraeopod 5, pleon segments 3-4, female, 3.3 mm, Sta. 2034-51.

Uropod 2: peduncular margin with 4 stout, prominent spines, outer ramus with a marginal spine, inner ramus bare, both rami with terminal claws.

Uropod 3: inner ramus about one third as long as outer, article 2 of outer ramus about one sixth as long as article 1.

Telson slender, apices conical and pronounced, lateral bevelments with 2 setae each.

Gland cone of antenna 2 rather prominent as in the genus *Heterophoxus*.

Third epimeron: posterior edge slightly convex (appearing concave from unflattened view), lower corner scarcely produced and bearing one seta.

Male.—Sexual dimorphism typical. The rostrum of the head is usually less constricted.

Holotype.—USNM Cat. No. 97307, female, 3.3 mm.

Type locality.—Station 126-33, Santa Maria Bay, Lower California, 24-45-00 N, 112-13-30 W, 5-25 fms, gray sand, March 21, 1933, collected by the *Velero III.*

Remarks.—This species is recognized easily by the very broad body, the narrowed rostrum and the 2 large spurs on peraeopod 5.

An interesting specimen, apparently a mutant, is a male (3 mm) from Sta. 2607-54 which bears a long epistome similar to that seen in *P. epistomus* but which is otherwise like typical specimens.

Material examined.—3027 specimens at 153 stations.

Distribution.—Southern California to Santa Maria Bay, Lower California, 15 to 115 fms. The species is concentrated mainly in depths between 30 and 50 fms where it is associated with dense populations of the brittle star, *Amphiodia urtica.*

Paraphoxus stenodes, new species

(Plates 17, 18)

Diagnosis of female.—Head with rather short, very narrow rostrum constricted in front of the eyes; eyes medium in size. Body narrow.

Epistome massive, rounded in front.

Maxilliped palp article 4 with small apical spine and subapical seta.

Gnathopod 1: article 6 slightly shorter than 5, moderately expanded, palm slightly oblique, less so in gnathopod 2. Ratio of lengths of articles 5-6: Gnathopod 1 = 20:18, Gnathopod 2 = 1:1.

Peraeopod 3: articles 4-5 broadly expanded but not as wide as article 2, article 6 shorter than 5, article 7 moderately long. Ratio of widths of articles 2,4,5,6 = 27:22:20:9.

Peraeopod 4: article 4 as broadly expanded as article 4 of peraeopod 3, but rather narrow in relation to article 2 of peraeopod 4; article 6 longer than 5. Ratio of widths of articles 2, 4, 5, 6 = 35:21:14:7.

Peraeopod 5: article 2 broadly expanded, its ratio of width to length is 41:44, extending down to middle of article 4, lower edge truncate but dipping anteriorly, sweep point near distal end of article 3, posterior edge rather convex and armed with 4 moderately large sharp teeth, above

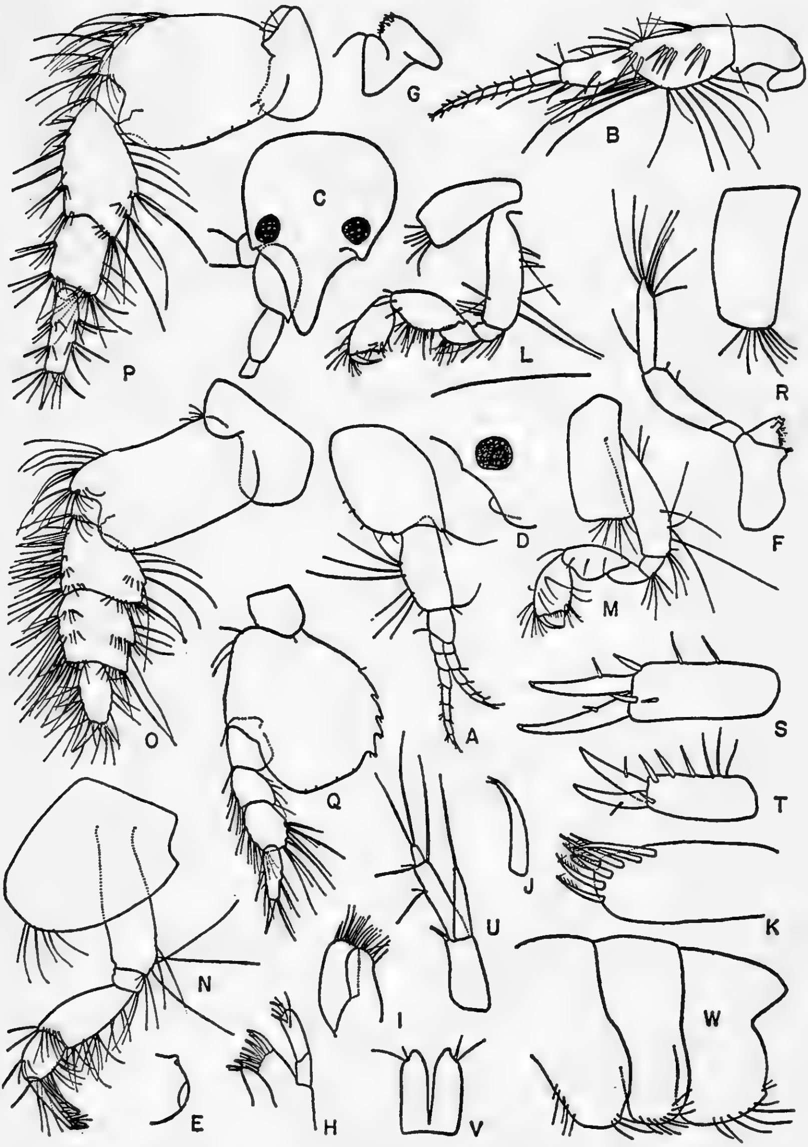


PLATE 17

Paraphoxus stenodes n. sp., female, 4 mm, Sta. 2311-52.

Figs. A,B, antennae 1, 2; C, head; D, head, side view; E, epistome; F, mandible; G, lower lip; H,I, maxillae 1, 2; J, maxillipedal palp article 4; K, maxilliped, inner plate; L,M, gnathopods 1, 2; N,O,P,Q, peraeopods 2, 3, 4, 5; R, coxa 3; S,T,U, uropods 1, 2, 3; V, telson; W, pleon segments 1-3.

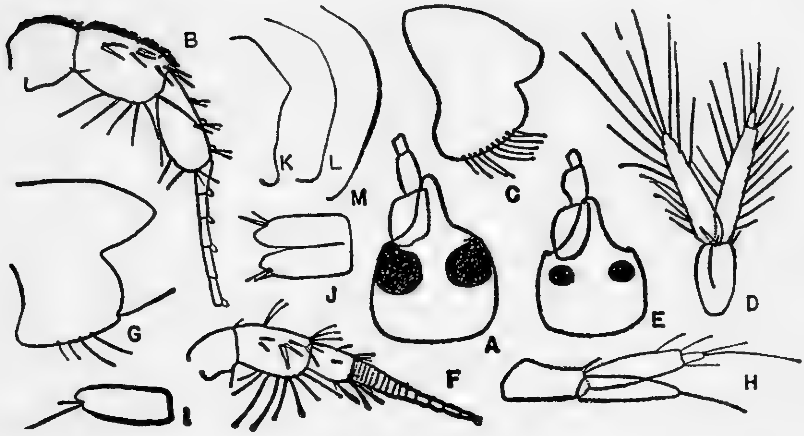


PLATE 18

Paraphoxus stenodes n. sp., male, 2.75 mm, Sta. 2608-54.
Figs. A, head; B, antenna 2; C, pleon segment 3; D, uropod 3; J, telson.
Male, young, 2.75 mm, Sta. 2608-45. Figs. E, head; F, antenna 2; G, pleon segment 3; H, uropod 3; I, telson.
Females, Sta. 2606-54, epistomes.
Figs. K, 3 mm; L, 3.5 mm; M, 4 mm.

which is a poorly developed serration; rest of appendage slender, articles 5-6 subequal in length.

Uropod 1: rami shorter than peduncle, the latter with outer margin bearing 2 slender setae and a terminal stout spine, each ramus with a marginal slender spine and an apical spinule.

Uropod 2: rami shorter than peduncle, peduncular margin bearing about 6 slender spines, each ramus with a slender marginal and a stout terminal spine.

Uropod 3: inner ramus two thirds as long as outer, article 2 of outer ramus slightly less than one fourth as long as article 1.

Telson moderately narrow, apices subacute, armed laterally with 3 slender spines or setae each.

Third epimeron posterior edge convex, sweeping into a small point at lower corner where 2 short setae are borne.

Male.—With typical sexual dimorphism.

Holotype.—AHF No. 538, female, 3 mm.

Type locality.—Station 2311-53, off Huntington Beach, California, 33-40-00 N, 118-05-08 W, 12 fms, sandy mud, May 16, 1953.

Remarks.—This species looks much like *Paraphoxus abronius* n. sp. but differs in lacking a long epistomal cusp, in the slightly broader rostrum, in the fewer teeth on peraeopod 5 and other minor differences.

It is also related to *P. nasutus* (Gurjanova 1936: 249) but differs in the shape of the head and the shape and location of the teeth on peraeopod 5.

It is related to *P. cornutus* (Schellenberg 1931) but differs mainly in the lack of a process on the third urosome segment.

Material examined.—833 specimens at 86 stations.

Distribution.—Southern California coastal and insular shelves, 5 to 24 fms.

Paraphoxus heterocuspidatus, new species

(Plates 19, 20)

Diagnosis of female.—Head with broad rostrum but constricted in front of eyes; eyes small. Body rather broad and dorsally flattened.

Epistome not produced, rounded in front.

Maxillipedal palp article 4 with small apical spine and subterminal seta.

Gnathopods 1-2: article 5 longer than 6, the latter moderately to very broad and expanding distally, palm scarcely oblique. Ratio of articles 5 to 6: Gnathopod 1 = 36:29, Gnathopod 2 = 32:38.

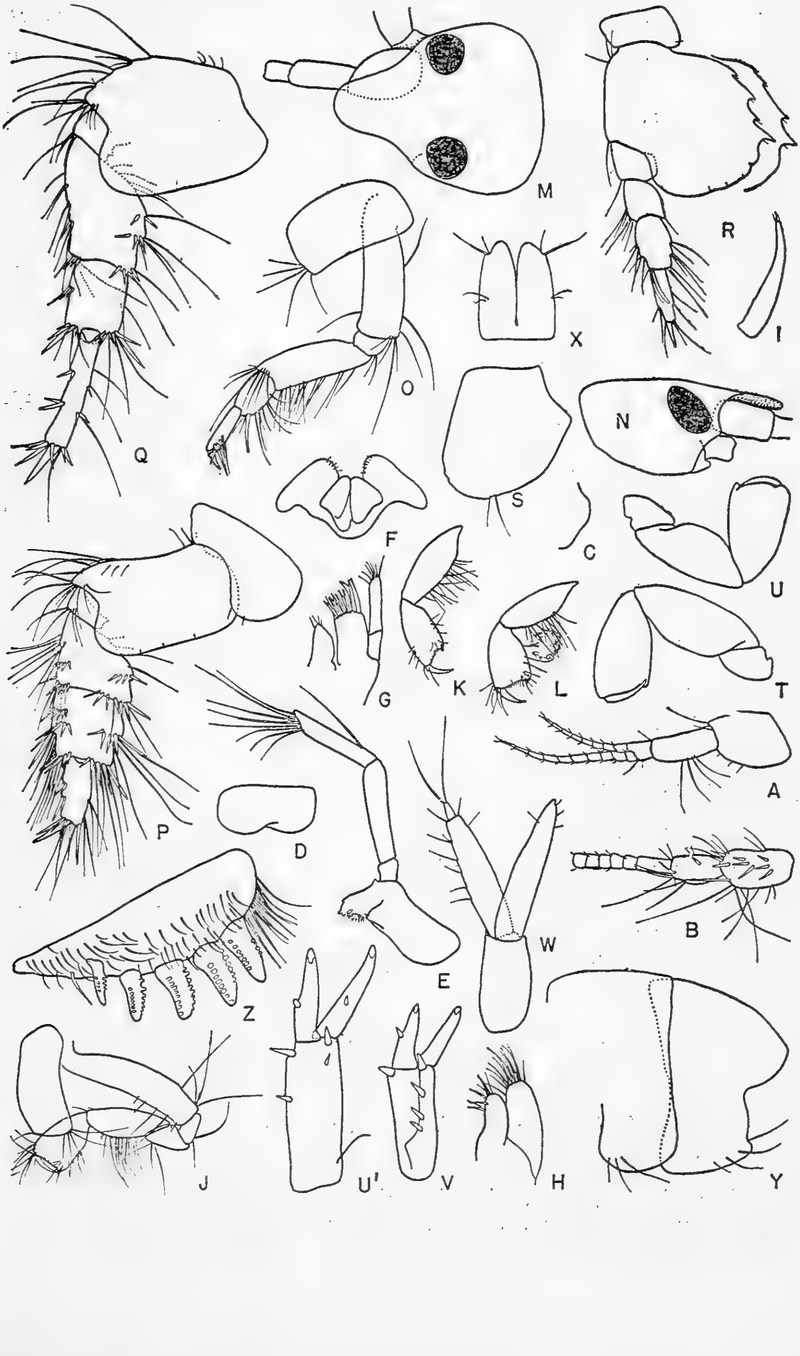
Peraeopod 3: articles 4-5 moderately expanded, narrower than article 2, article 6 as long as 5. Ratio of widths of articles 2, 4, 5, 6 = 26:20:19:8.

Peraeopod 4: article 4 as broad as in peraeopod 3, article 2 much broader, article 6 much longer than 5. Ratio of widths of articles 2, 4, 5, 6 = 36:20:15:6.

Peraeopod 5: article 2 generally rather broad, in typical specimens the ratio of width to length is about 43:42 or 1:1. Posterior edge of article 2 with 4-5 teeth; generally the teeth are variable in size and not uniformly larger ventrally; one or more of the teeth may be much smaller than its dorsal neighbor, or the dorsal pair of teeth may be much smaller than the ventral pair. Sweep point near distal edge of article 3, lower edge broad, scarcely dipping anteriorly and slightly convex; rest of appendage moderately stout, article 6 as long as 5.

PLATE 19

Paraphoxus heterocuspidatus, n. sp., male, young, 2.75 mm, Sta. 2113-52.
Figs. A,B, antennae 1, 2; C, epistome; D, upper lip; E, mandible; F, lower lip; G,H, maxillae 1, 2; I, maxillipedal palp article 4; J, gnathopod 1; K,L, gnathopods 2, both sides; M,N, head; O,P,Q,R, peraeopods 1, 3, 4, 5 (including right posterior edge); S, coxa 4; U',V,W, uropods 1, 2, 3; X, telson; Y, pleon segments 2-3; Z, chewing plate of gastric mill.
Female, Sta. 2153-52. Figs. T,U, gnathopods 1, 2.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Uropods stout. Uropod 1: rami sh[...]an peduncle, each with a marginal and a terminal stout spine, ped[...]ith 2 pairs of stout spines.

Uropod 2: margin of peduncle with [...]t spines, only inner ramus with a stout marginal spine, ends of both rami each with a stout spine.

Uropod 3: inner ramus about five sixths as long as outer, article 2 of outer short, about one sixth as long as article 1.

Telson moderately broad, apices subacute, each with a long and a short lateral, subapical seta.

Third epimeron: posterior edge nearly straight, scarcely convex, armed with one seta above the slightly produced lower corner.

Male.—Sexual dimorphism typical.

Holotype.—AHF No. 539, ovigerous female, 4.2 mm.

Type locality.—Station 2312-53, off Seal Beach, California, 33-42-06 N, 118-05-22 W, 7.5 fms, brown sandy mud, gravel, May 16, 1953.

Remarks.—Specimens of this species have been collected in a bay environment at San Quintin Bay, Lower California. They differ from most open ocean members of the species in the evenness of the teeth on peraeopod 5, the slightly narrower hands of the gnathopods and the longer spines of the uropods. Uropod 2 lacks marginal ramal spines. Similar but larger male specimens were collected in plankton off Coronados Islands in which the fifth articles of the gnathopods were longer and narrower than typical. All other criteria of these specimens fit the typical members, including the broad rostrum, the unproduced epistome and the long inner ramus of the female third uropod (in the San Quintin specimens).

Material examined.—224 specimens at 39 stations.

Distribution.—Southern California coastal and insular shelves, 7 to 60 fms. Collected once on the west slope of the Santa Cruz Basin at 80 fms. A bay form occurs in San Quintin Bay, Lower California. Occasionally caught in dipnets and larvae traps.

Paraphoxus floridanus (Shoemaker), new combination

(Plate 21)

Pontharpinia floridana Shoemaker 1933: 5-8, figs. 3, 4; Shoemaker 1948: 2.

Diagnosis of female.—Head with a strongly constricted rostrum which is distally spatulate; eyes moderately large, oval.

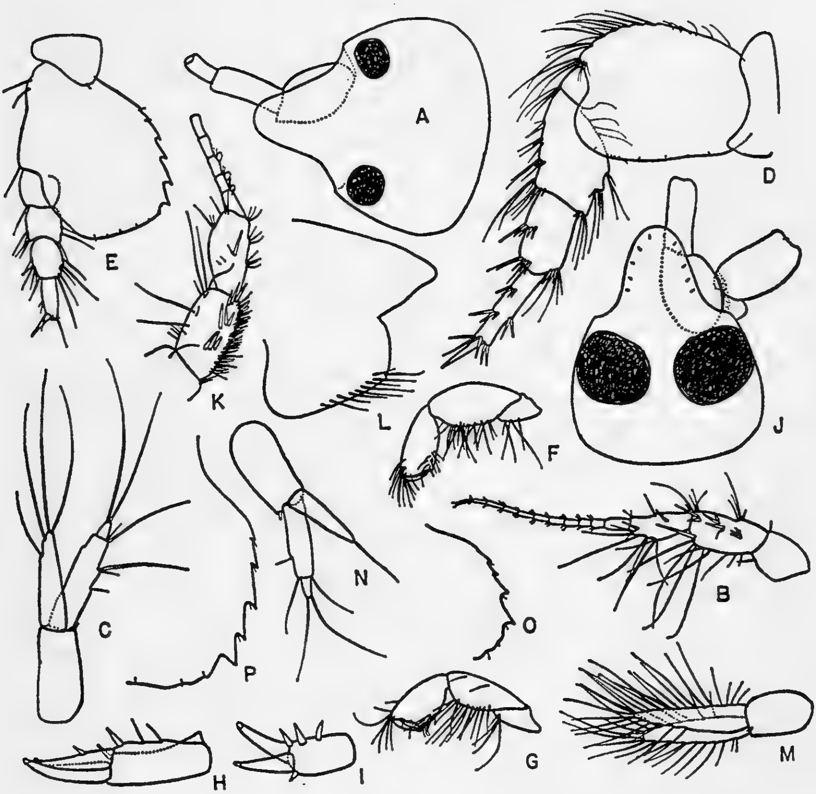


PLATE 20

Paraphoxus heterocuspidatus, n. sp., female, 4 mm, Sta. 2312-53.
Figs. A, head; B, antenna 2; C, uropod 3.

Female, 3.75 mm, San Quintin Bay, L.C. Figs. D,E, peraeopods 4, 5; F,G, gnathopods 1, 2; H,I, uropods 1, 2.

Male, 4.75 mm, Coronados Islands. L.C. Figs. J, head; K, antenna 2; L, pleon segment 3; M, uropod 3.

Male, young, 3.5 mm, Sta. 2113-52. Figs. N, uropod 3; O, article 2, peraeopod 5, posterior edge.

Male, young, 3 mm, Sta. 2153-52. Fig. P, article 2, peraeopod 5, posterior edge.

Epistome unproduced.

Maxillipedal palp article 4 simple.

Gnathopods 1 and 2 similar, articles 5 and 6 subequal in length, article 6 moderately broad, palm slightly oblique.

Peraeopod 3: article 4 nearly as stout as article 2, article 5 noticeably narrower than 4, article 6 shorter than 5. Ratio of widths of articles 2, 4, 5, 6 = 32:30:23:11.

Peraeopod 4: articles 2 and 4 quite tumid, article 5 rather slender. Ratio of widths of articles 2, 4, 5, 6 = 46:30:17:8.

Peraeopod 5: article 2 rather narrow, the ratio of width to length is 7:8; article 2 extends down nearly to the end of article 4, its lower edge is slightly convex, sweep point at distal end of article 3; posterior edge with 9-10 small teeth; article 6 much longer than 5, article 7 long.

Uropod 1: upper edge of peduncle armed with slender spines, apical one very large; rami as long as peduncle, outer armed with 4 short spines, inner with 2, each apex with an articulated spine.

Uropod 2: peduncle with about 7 slender marginal spines, outer ramus with about 5 short spines, inner bare, apex of outer with 2 slender spines besides an imbedded spine, inner with one apical spine and an imbedded one.

Uropod 3: inner ramus about three fourths as long as outer, article 2 of outer ramus long, about four tenths as long as article 1.

Telson: apices subacute, lateral notches each with a spine and a feathered setule, lateral edges each with a fascicle of setae about two thirds the distance from the base.

Third epimeron: posterior edge straight, setose its full length, lower posterior corner broadly rounded and sweeping down to the lower edge.

Male.—See Shoemaker 1933.

Remarks.—The adult female is about 7 mm in length. A juvenile specimen 4 mm in length from Station 461-35 has the inner ramus of uropod 3 much shorter and the eyes relatively smaller than in adult females.

Although the uropodal armature of the present specimens does not quite tally with the descriptions of Shoemaker 1933, and the second article of peraeopod 5 is slightly broader with smaller teeth, there is no hesitation in allying the Pacific specimens with the Atlantic ones. Future close comparison of specimens from both oceans may show subspeciation.

Material examined.—11 specimens at 5 stations.

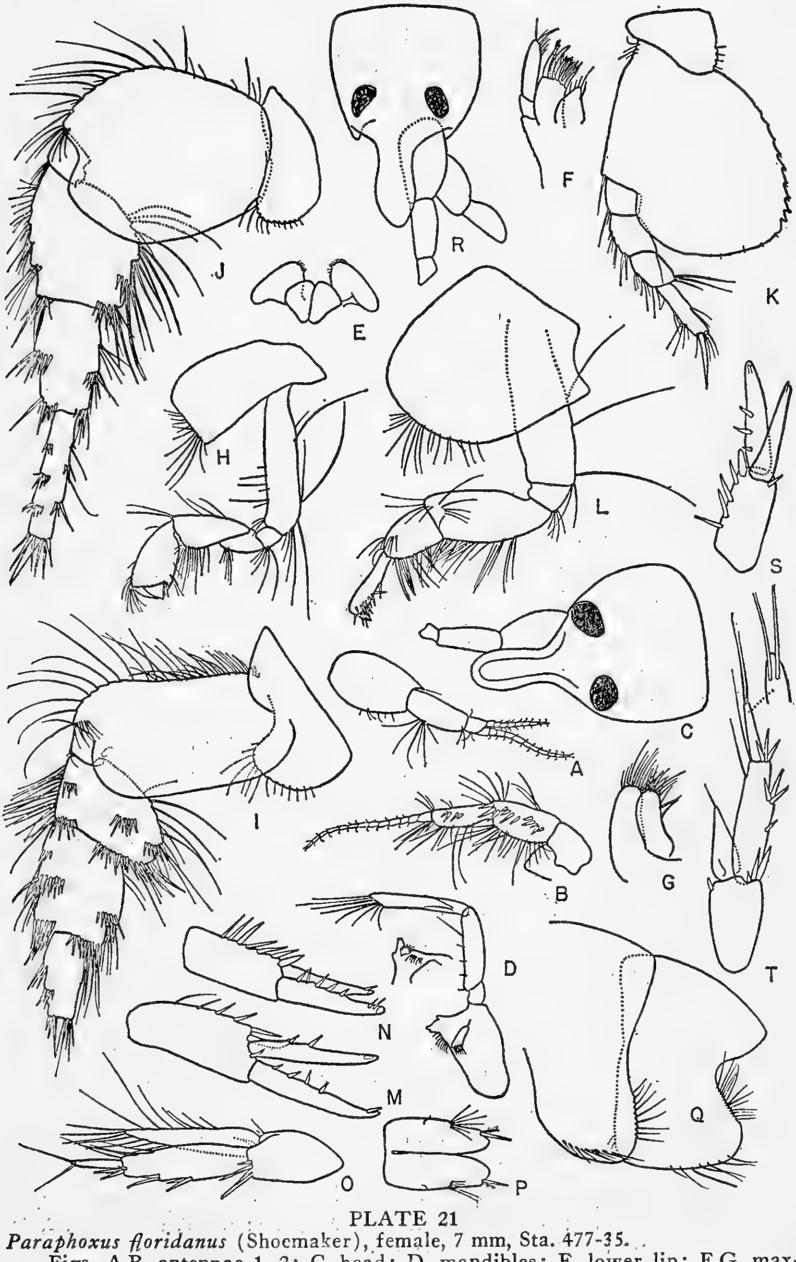


PLATE 21

Paraphoxus floridanus (Shoemaker), female, 7 mm, Sta. 477-35.

Figs. A,B, antennae 1, 2; C, head; D, mandibles; E, lower lip; F,G, maxillae 1, 2; H, gnathopod 1; L,I,J,K, peraeopods 2, 3, 4, 5; M, N,O, uropods 1, 2, 3; P, telson; Q, pleon segments 2-3.

Female, 4 mm, Sta. 461-35. Figs. R, head; S,T, uropods 2, 3.

Distribution.—South Carolina to Florida. Eastern tropical Pacific from Panama to the California-Mexico borderline, 2 to 24 fms. The species does not occur on the coastal shelf of southern California, north of the Mexican border.

Paraphoxus similis, new species
(Plates 22, 23)

Diagnosis of female.—Head rather broad and short, rostrum tapering evenly anteriorly to a blunt apex, eyes medium in size, oval. Body moderately slender.

Epistome grossly produced in a massive, finger-like projection.

Maxillipedal palp article 4 with an apical spine.

Gnathopod 1: article 5 much shorter than 6, the latter rather slender and with an oblique palm; article 6 of gnathopod 2 somewhat stouter than in gnathopod 1. Ratio of lengths of articles 5 and 6: Gnathopod 1 = 19:30, Gnathopod 2 = 15:28.

Peraeopod 3 rather slender, articles 4-6 successively more slender and longer. Ratio of widths of articles 2, 4, 5, 6 = 24:13:11:6.

Peraeopod 4 slender, article 2 with posterior ventral corner produced downward strongly and subconically. Ratio of widths of articles 2, 4, 5, 6 = 30:12:8:5.

Peraeopod 5: article 2 moderately broad, its ratio of width to length is 42: 47; article 2 extends down nearly to the end of article 4, its sweep point being at the middle of article 4; lower edge scarcely rounded, posterior edge armed with about 7 small teeth; rest of appendage slender, article 6 longer than 5, article 7 moderately long.

Uropods 1-2: apices of rami each bear a short, articulated spine; uropod 1 with long spines on peduncle, the distal one stout; both rami with slender spines; uropod 2 with long peduncular spines, outer ramus with 3 long spines, inner with one.

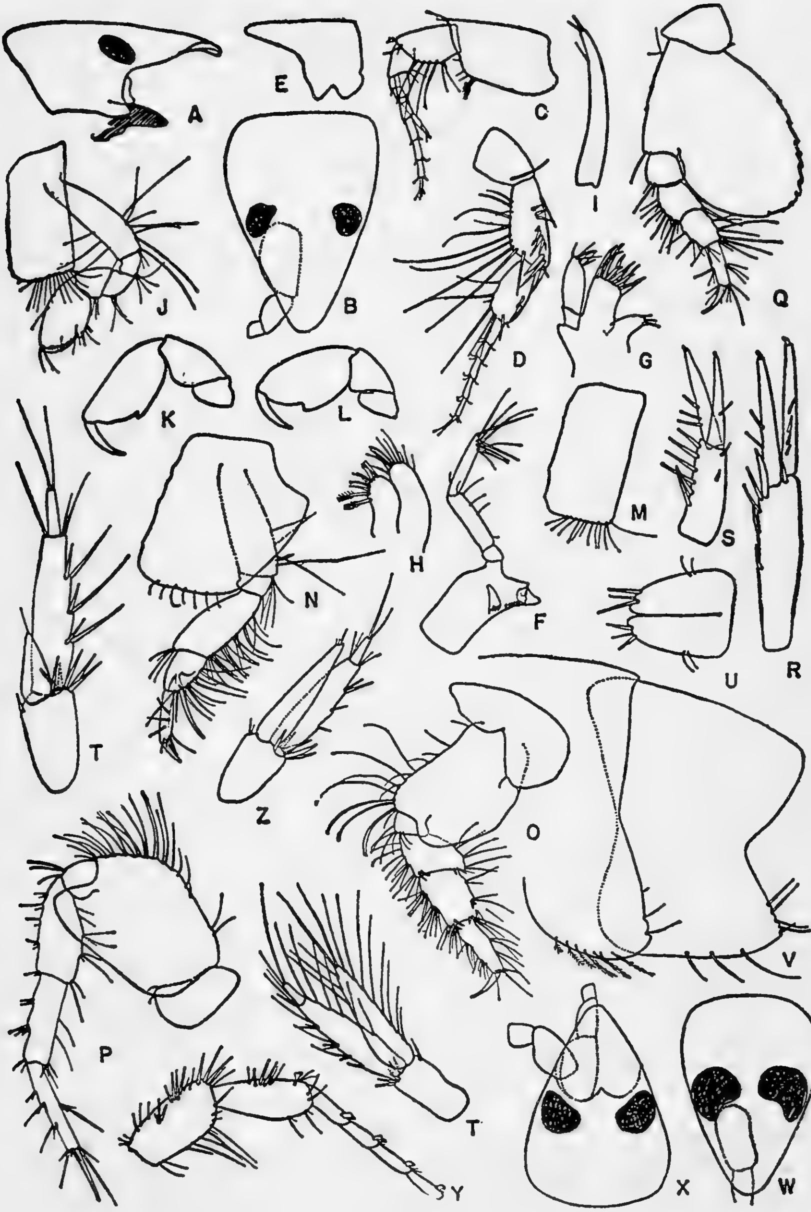
Uropod 3: inner ramus one third as long as outer ramus; article 2 of outer ramus slender, about one third as long as article 1.

PLATE 22

Paraphoxus similis n. sp., female, 3.5 mm, Sta. 2448-53.

Figs. A,B, head; C,D, antenna 1, 2; E, epistome; F, mandible; G,H, maxillae 1, 2; I, maxillipedal palp article 4; J,K,L, gnathopods 2, 1, 2; M, coxa 3; N,O,P,Q, peraeopods 2, 3, 4, 5; R,S,T, uropods 1, 2, 3; U, telson; V, pleon segments 2-3.

Male, 3.5 mm, Sta. 2448-53. Figs. W, head; T', uropod 3; Y, antenna 2.
Male, young, 3.3 mm, Sta. 2292-53. Figs. X, head; Z, uropod 3.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Telson broad, the broad apices each with 3 long spines.

Third epimeron: posterior edge straight, lower corner quadrate, the posterior edge with about 5 stiff setae.

Male.—Sexual dimorphism typical.

Holotype.—AHF No. 5310, female, ovigerous, 3.75 mm.

Type locality.—Station 2292-53, off Huntington Beach, California, 33-35-30 N, 118-05-30 W, 60 fms, fine mud, Apr. 24, 1953.

Remarks.—This species cannot be distinguished clearly from *P. simplex* (Gurjanova 1938: 272) due to the fact that the epistome and third epimera have not been described.

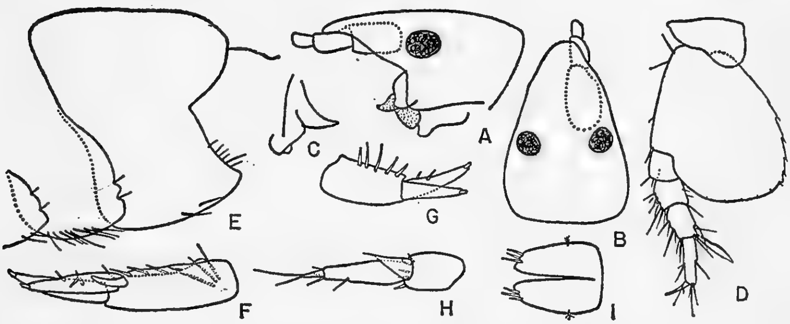


PLATE 23

Paraphoxus similis, **n. sp., female, 4 mm, Friday Harbor, Washington.**
Figs. A,B, head; C, epistome; D, peraeopod 5; E, pleon segments 1-3; F,G,H, uropods 1, 2, 3; I, telson.

Some small differences applicable to the new species and of subspecific value are:

(1) article 4 of gnathopod 2 is not produced.

(2) The posterior edge of article 2 of peraeopod 5 is more oblique and the whole article less quadrangular.

(3) the inner ramus of the feminine third uropod is somewhat shorter.

(4) the telson has more apical spines.

(5) the third peraeopod appears slightly shorter and stouter.

This species is closely related to *P. cognatus* n. sp., differing principally from it in the massive epistome. In *P. cognatus* the epistome is produced but is smaller and more sharply pointed. Other minor differences of *P. cognatus* include: (1) the rounded lower posterior corner of the third epimeron; (2) the shorter, denser spines on the peduncle of uropod 2; (3) the more broadly rounded apices of the telson and shorter spines. It is possible that *P. cognatus* fits Gurjanova's description of *P. simplex* more closely and is a subspecies of it. Until the epistome and third epimera of *P. simplex* are described, these problems remain unsolved.

A male *P. similis* (3.5 mm, Station 2233-53) bearing the typical epistome, third epimeron and second uropods, has the third and fourth peraeopods and telson more like *P. cognatus*, indicating a variability or unreliability of the latter criteria for diagnosis.

A specimen from Friday Harbor (figured in Plate 23) illustrates minor differences of the species in the northern part of its range, which complicate its relationship to *P. simplex*. The teeth on peraeopod 5 are smaller as in *P. simplex* but the telson still bears 3 apical spines on each lobe. The epistome of the figured specimen is the largest of the 8 specimens in the lot, the others bearing epistomes smaller and more like *P. cognatus*. The third epimera are slightly sinuate, unlike the southern counterpart.

Material examined.—1254 specimens at 148 stations.

Distribution.—Puget Sound to Southern California. On the southern California coastal shelf and slope, 17 to 177 fms, but concentrated mainly in depths of 30 to 60 fms where it is associated with *Paraphoxus bicuspidatus* and the brittle star *Amphiodia urtica*. In Hueneme submarine canyon, 90 fms.

Paraphoxus cognatus, new species
(Plate 24)

Diagnosis of male.—Head rather broad and short, rostrum tapering evenly anteriorly, eyes large, oval.

Epistome produced, acute but rather short, variable.

Maxillipedal palp article 4 with an apical spine.

Gnathopods: article 5 much shorter than 6, the latter rather slender in gnathopod 1, stouter in gnathopod 2: palm oblique. Ratios of lengths of articles 5 and 6: Gnathopod 1 = 10:13. Gnathopod 2 = 8:12.

Peraeopod 3 moderately slender, articles 4-6 successively more slender and longer. Ratio of widths of articles 2, 4, 5, 6 = 10:8:7:3.

Peraeopod 4 slender, article 2 with posterior ventral corner slightly produced and rounded broadly. Ratio of widths of articles 2, 4, 5, 6 = 29:13:10:5.

Peraeopod 5: article 2 rather narrow, its ratio of width to length is 38:51; article 2 extends downward more than midway along article 4,

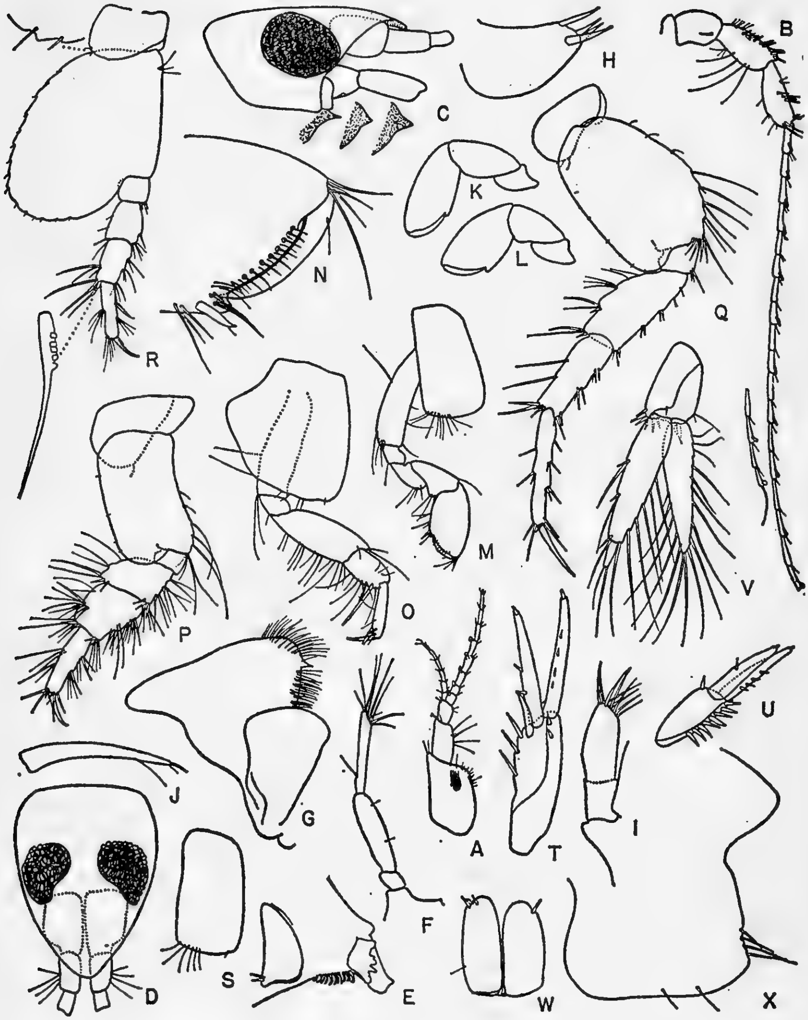


PLATE 24

Paraphoxus cognatus, n. sp., male, 4 mm, Sta. 2047-51.

Figs. A,B, antennae 1, 2; C,D, head and other epistomes: E,F, mandible; G, lower lip; H, inner plate, maxilla 1; I, palp, maxilla 1; J, maxillipedal palp article 4; K,L,M,N, gnathopods 1, 2, 2, 2; O,P,Q, R, peraeopods 2, 3, 4, 5; S, coxa 3; T,U,V, uropods 1, 2, 3; W, telson; X, pleon segment 3.

its lower edge rounded; sweep point near distal end of article 3; posterior edge with about 9 minute teeth; rest of appendage slender, article 6 longer than 5, article 7 moderately long.

Uropods 1-2: apices of rami each bear a short, articulated spine; uropod 1 with a few long peduncular spines, the distalmost being the stoutest; rami with small spines.

Uropod 2 with short, crowded spines on peduncle, outer ramus with 4 small spines, inner ramus with one.

Uropod 3: inner ramus as long as article 1 of outer ramus; article 2 of outer ramus about one fifth as long as article 1.

Telson broad, apices broadly rounded, notched laterally, each notch with 1 to 3 short spines, less than three indicating that they are broken off.

Third epimeron: posterior edge nearly straight, lower corner softly quadrate, lower posterior edge with 4 stiff setae.

Female.—Unknown.

Holotype.—AHF No. 5114, male, 4 mm.

Type locality.—Station 2047-51, Emerald Cove, Santa Catalina Island, 33-28-04 N, 118-31-21 W, dip net, July 27, 1951.

Remarks.—Unfortunately no female animals have been discovered. It is essential that they be described in order to indicate the relationship of this species to *P. simplex* (Gurjanova 1938: 272). Any differences between the two species might lie in the length of the inner ramus of the third uropod, in the size of the eyes, in the epistome and the third epimera, but the latter two criteria are unknown in *P. simplex* so that the two species cannot be differentiated at this time.

The close relationship of *P. cognatus* to *P. similis* n. sp. is discussed under the latter heading.

Material examined.—78 specimens at 2 stations.

Distribution.—Dipnetted at night near Santa Catalina Island and identified from a station on the east slope of San Pedro Basin, 177 fms.

Paraphoxus robustus Holmes

(Plate 25)

Paraphoxus robustus Holmes 1908: 518-521, fig. 27.

Diagnosis of female.—Head broad, rostrum not tenuous, eyes small; body narrow.

Epistome not produced.

Maxilliped palp article 4 with apical spine.

Gnathopods 1-2, article 5 shorter than 6, article 6 rather slender, palm oblique. Ratio of lengths of articles 5-6: Gnathopod 1 = 31:36; Gnathopod 2 = 26:36.

Peraeopod 3 slender, article 6 longer than 5. Ratio of widths of articles 2,4,5, 6 = 17:10:9:5.

Peraeopod 4 slender, article 2 prolonged conically at distal posterior corner. Ratio of widths of articles 2,4,5, 6 = 31:11:8:5.

Peraeopod 5: article 2 moderately slender, its ratio of width to length being 4:5; article 2 extends down to the middle of article 4, strongly convex on lower edge, sweep point at lower end of article 3; posterior edge with about 9 minute teeth.

Uropod 1: upper edge of peduncle with slender, long setae, outer ramus with 2, inner ramus with one stout spine.

Uropod 2: upper edge of peduncle with crowded, long stiff setae, outer ramus bare, inner with 3 stout spines.

Uropod 3: inner ramus about one half as long as outer ramus, article 2 of outer ramus very slender and about one sixth as long as article 1; otherwise the entire appendage is stout.

Telson: broad, apices blunt, each armed with 3 long spines.

Third epimeron: posterior edge slightly concave, lower corner armed with a large, blunt tooth, the upper edge of which continues as a setose flange onto the lateral surface of the epimeral plate.

Male.—Sexual dimorphism typical. Article 2 of the outer ramus of uropod 3 is about one twelfth as long as article 1.

Remarks.—The writer has not examined the holotype of this species but believes he has identified it correctly from Holmes' description and figures. Only a minor addition is needed to the original work on this species, which is the setose flange on the lateral face of the third epimeron.

Paraphoxus ochoticus (Gurjanova 1953: 225) may be a subspecies of *P. robustus*. See *P. ochoticus* for a discussion.

Material examined.—252 specimens from 62 stations.

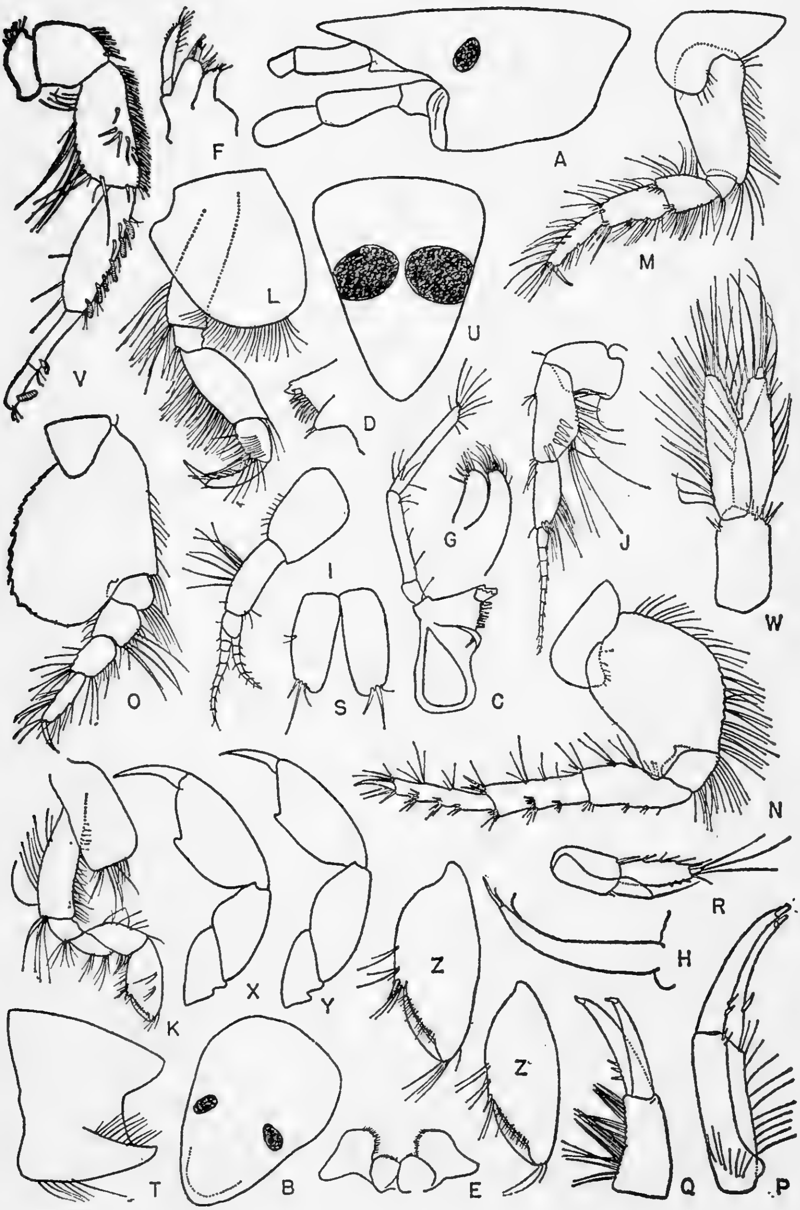
Distribution.—Puget Sound to southern California. Southern California coastal shelf and slopes, 30 to 115 fms, mainly concentrated in 30 to 60 fms and associated with the brittle star *Amphiodia urtica.*

PLATE 25

Paraphoxus robustus Holmes, female, 10 mm, Sta. 1390-41.

Figs. A,B, head; C, mandible; D, mandible; E, lower lip; F,G, maxillae 1, 2; H, maxillipedal palp article 4; I,J, antennae 1, 2; K, gnathopod 2; L,M,N,O, peraeopods 2, 3, 4, 5; P,Q,R, uropods 1, 2, 3; S, telson; T, pleon segment 3; Z,Z' gnathopods 2, 1.

Male, 6.5 mm, Sta. 1390-41. Figs. U, head; V, antenna 2; W, uropod 3; X,Y, gnathopods 1, 2.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Paraphoxus calcaratus (Gurjanova), new combination
(Plate 26)

Parharpinia calcarata Gurjanova 1938: 271-272, 385, figs. 9, 9a, 9b.
Pararpinia (sic) calcarata, Gurjanova 1951: 388-392, figs. 237 A,V,B.

Diagnosis of female.—Head short and broad, rostrum broad anteriorly, bluntly rounded in front, eyes medium in size, oval.

Epistome not produced.

Maxillipedal palp article 4 with well developed articulated apical spine.

Gnathopod 1: article 6 longer than 5, rather slender, palm oblique. Ratio of lengths of articles 5 and 6: Gnathopod 1 = 4:5, Gnathopod 2 = 6:11.

Peraeopod 3 slender, articles 4-6 successively slightly narrower and longer. Ratio of widths of articles 2, 4, 5, 6 = 18:10:9:5.

Peraeopod 4 slender, articles 4-6 increasingly narrower, article 6 as long as 5. Ratio of widths of articles, 2, 4, 5, 6 = 28:9:6:3.

Peraeopod 5: article 2 rather narrowly expanded, the ratio of width to length is 4:5; article 2 extends down to the middle of article 4, its sweep point is at distal end article 3, lower edge rounded; posterior edge with about 6 shallow teeth; rest of appendage slender, article 6 longer than 5, article 7 rather long.

Uropod 1: margin of peduncle with about 6 slender spines, rami shorter than peduncle, each with a few short marginal spines, apices each with a small blunt spine.

Uropod 2: margin of peduncle with numerous long setae, rami as long as peduncle, apices unarmed, outer ramus with a few short marginal spines.

Uropod 3: inner ramus about seven eighths as long as outer ramus, article 2 of the latter is about one eighth the length of article 1.

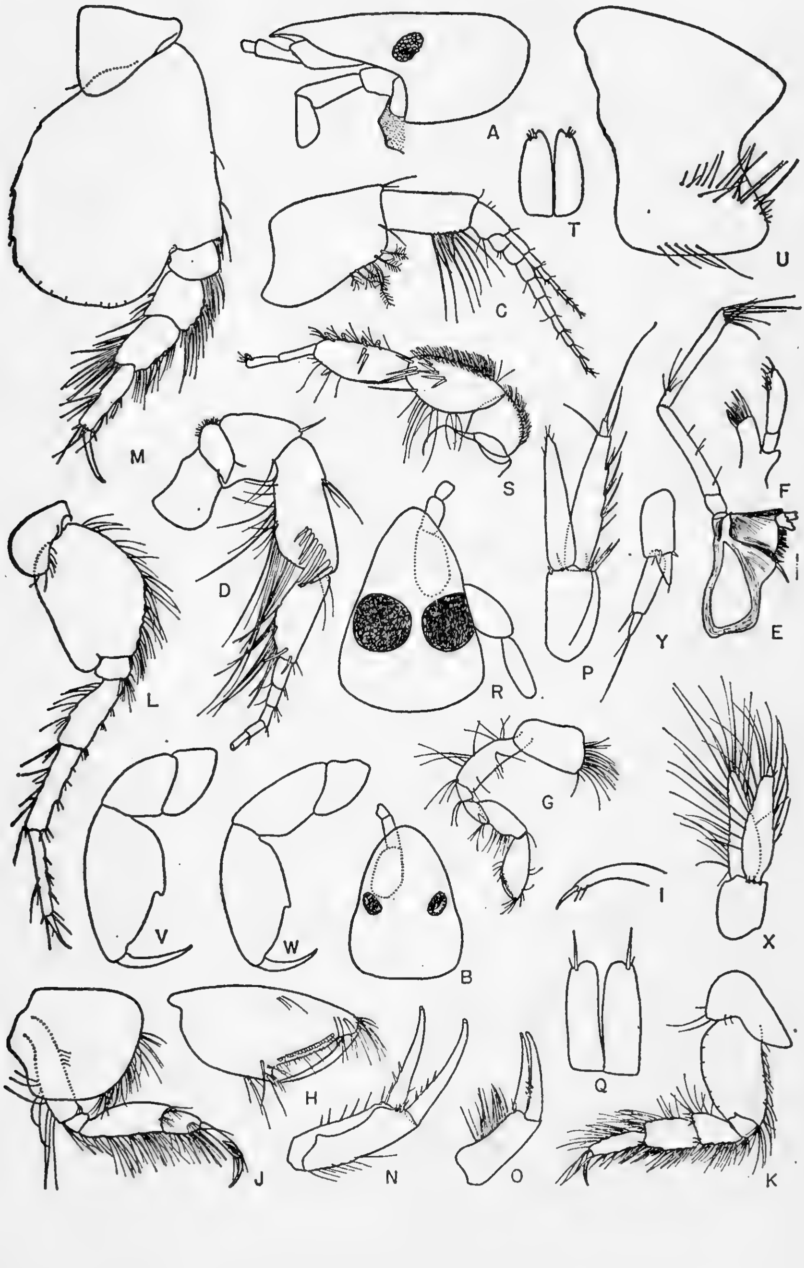
Telson rather slender, apices broadly rounded, each lateral notch with a long and a short spine.

PLATE 26

Paraphoxus calcaratus (Gurjanova), female, 9 mm, Sta. 1156-40.

Figs. A,B, head; C,D, antennae 1, 2; E, mandible; F, maxilla 1; G,H, gnathopods 1, 2; I, maxillipedal palp article 4; J,K,L,M, peraeopods 2, 3, 4, 5; N,O,P, uropods 1, 2, 3; Q, telson; U, pleon segment 3.

Male, 6 mm, Sta. 201-34. Figs. R. head; S, antenna 2; T, telson; X, uropod 3,
Female, 7.5 mm, Sta. 2414-53. Figs. V,W, gnathopods 2, 1.
Juvenile, Sta. 2414-53. Fig. Y, uropod 3.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Third epimeron: posterior edge nearly straight, lower corner rounded, lateral face bearing an oblique but ragged row of setae.

Male.—Sexual dimorphism typical. Telsonic apices more acute and both spines of each are short.

Remarks.—The specimens at hand are quite close to *P. calcaratus*, the only clear difference being the lack of the peculiar process on article 5 of peraeopod 5, which, in northern specimens, should be examined in more detail. It is probably the result of an accident to the figured specimen.

Material examined.—18 specimens at 8 stations.

Distribution.—Japan Sea, 75 m. Southern California on the east slope of San Pedro Basin and the west slope of Santa Monica Basin, 177 to 380 fms. Galapagos Islands, 25 to 40 fms.

Paraphoxus oculatus (Sars) (*maculatus* Chevreux)

(Plates 27, 28)

Phoxus Holbölli, Norman 1869: 278 (in part, *fide* Norman 1900, not Krøyer).

Phoxus oculatus Sars 1879: 441 (*fide* Stebbing 1906, not seen); Sars 1883: 84; Sars 1885: 154-156, pl. 13, figs. 4, 4a-e; Sars 1886: 45; Hansen 1888: 86.

Phoxocephalus oculatus, Norman 1900: 334-335; Patience 1909: 130-131.

Paraphoxus oculatus, Sars 1895: 149-150, pl. 51; Hansen 1895: 127; Walker 1895: 296; Stebbing 1906: 137-138; Stephensen 1913: 130-131; Stephensen 1925: 162; Stephensen 1926: 60; Schneider 1926: 17; Stephensen 1928: 138-139, fig. 26, *16-18*; Stephensen 1929: 84, fig. 21, *98*; Derjavin 1930: 327; Gurjanova 1936: 150; Moore 1937: 119; Stephensen 1938: 150-151; Stephensen 1940: 20; K. H. Barnard 1951: 704; Gurjanova 1951: 364-365, fig. 215.

Phoxus maculatus Chevreux 1888: 40-41.

Paraphoxus maculatus, Chevreux 1898: 477; Chevreux 1900: 34-36, pl. 5, fig. 5; Stebbing 1906: 138; Chevreux 1911: 187, pl. 10, figs. 12-13; Chevreux and Fage 1925: 103-104, fig. 97.

Paraphoxus sp., Stephensen 1925: 163.

PLATE 27

Paraphoxus oculatus (Sars), female, 4.75 mm, Sta. 2293-53.

Figs. A,B, antennae 1, 2; C,D, head; E, mandible; F, lower lip; G,H, maxilla 1; I, maxilla 2; J, maxillipedal palp; K, maxilliped, inner plate; L,M, gnathopods 1, 2; N, coxa 1; O,P,Q,R, peraeopods 2, 3, 4, 5; S,T, uropods 1, 2; U, telson.


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Special material examined.—Vannø, Norway, 14-8-25, 70-100, and 140-150 m, 8 specimens, courtesy Dr. T. Soot-Ryen, Tromsø Museum.

Remarks.—The specimens compared favorably with the drawings by Sars 1895. The palp of the first maxilla was found to be biarticulate, not uniarticulate. This error, promulgated for more than a half century, has been the partial cause for the host of genera erected for paraphoxids

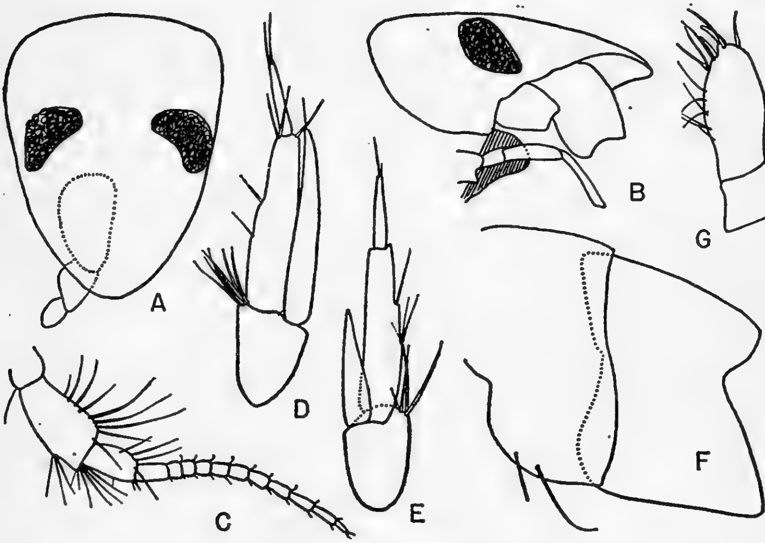


PLATE 28

Paraphoxus oculatus **(Sars), male, young, 4.5 mm, Sta. 2293-53.**
Figs. A,B, head; C, antenna 2; D, uropod 3.
Female, 4.75 mm, Sta. 2293-53. Figs. E, uropod 3; F, pleon segments 2-3.
Female, 3.75 mm, Vannø, Norway. Fig. G, maxilla 1, palp.

having two-jointed maxillary palps. Sars' figure of the fourth article of the maxillipedal palp is unclear but specimens from both Norway and southern California demonstrate the presence of the apical spine.

In other respects, the southern California specimens fit Sars' figures, although they are less than half the size of Norwegian specimens.

The epistome of the species is quite large and bulbous but rounded in front.

I am unable to recognize any marked qualitative differences of *P. maculatus* (Chevreux) and believe that the slight quantitative differences of more slender appendages are simply the result of the species living in warmer waters. Based on a survey of the differences which are used to segregate other species of the genus, the differences between *P. oculatus* and *P. maculatus* are inconsiderable. One may see more variation in some of the species I have described herein, from single populations. Thus, it is my opinion that the above two species should be fused.

Distribution.— West of Greenland to 71° N, the Kara Sea (79° N), along the Norwegian Coast, Iceland, East Greenland, around the British Isles, into the Mediterranean eastward to Tunisia, at South Africa, Japan, and in the eastern Pacific. The deepest collection was 470 fv at East Greenland. The species lives in waters as cold as 0.6° C and thus is capable of a wide bathymetric range based on temperature.

Material examined.—34 specimens at 16 stations.

New records.—Eastern Pacific Ocean: Galapagos Islands, 58-60 fms; Southern California coastal slopes and basins as follows: San Pedro Basin, 205-277 fms; Santa Catalina Basin, 620 fms; Redondo submarine canyon, 129-196 fms; Santa Barbara Basin, 150 fms; recorded once each at Oceanside and Santa Monica Bay at 15 and 50 fms, perhaps in areas of upwelling.

Paraphoxus spinosus (Holmes) = Eobrolgus spinosus

(Plates 29, 30, 31)

Barnard 1979

Paraphoxus spinosus Holmes 1903: 276 (key only); Holmes 1905: 477-478, fig. 12; Kunkel 1918: 76-78, fig. 13; Shoemaker 1925: 26-27; J. L. Barnard 1959: 18.

Identification.—I have examined specimens of *P. spinosus* from Woods Hole, Massachusetts (courtesy Dr. T. E. Bowman, USNM) and found them comparable to the cold water Puget Sound specimens of the Pacific Coast. Although well known from the Atlantic Coast of North America and considered an Atlantic species it is likely that the species is a Pacific autochthon, for it would appear that the genus *Paraphoxus* had its origin in the Pacific Ocean.

Diagnosis of Puget Sound female.—Head rather short, with unconstricted, broad rostrum, eyes medium in size, round. Body narrow. Epistome unproduced, rounded in front.

Gnathopod 1: article 6 slightly longer than 5, not very broadly expanded, palm oblique. Ratio of lengths of articles 5-6; Gnathopod 1 = 17:18, Gnathopod 2 = 14:18.

Peraeopod 3: articles 4-5 narrower than 2 but rather broadly expanded, article 6 narrow, as long as article 5; article 7 moderately long. Ratio of widths of articles 2, 4, 5, 6 = 9:7:6:2.

Peraeopod 4 slender distally, article 5 only three fourths as long as 4 and slightly shorter than article 6. Ratio of widths of articles 2, 4, 5, 6 = 16:7:5:2.

Peraeopod 5: article 2 rather broadly expanded, its ratio of width to length is 41:46, extending down slightly beyond end of article 3, lower edge quite convex, its sweep point at level of base of article 3, posterior edge with 7-8 small serrations at and above sweep point. Remainder of appendage slender, article 6 slightly longer than either 4 or 5.

Uropod 1: peduncular margin with 2 short spines, each ramus with one marginal and one terminal spine; rami shorter than peduncle.

Uropod 2: peduncular margin with 4 short spines, rami shorter than peduncle, each with a terminal spine, no marginal spines.

Uropod 3: inner ramus half as long as outer, article 2 of outer ramus little more than one third as long as article 1, slender.

Telson rather broad, apices slightly oblique, broad, each armed with a spine and setule.

Third epimeron: posterior edge slightly convex, armed with 3-4 setae near lower corner, the latter being subquadrate. Length 4.5 mm.

Male.—Specimens of a size similar to the female appear to be more differentiated, the spines on the uropods being more numerous, especially on the peduncle of the second uropod. The eyes are scarcely larger than those of the female. Other sexual differences are normal.

Southern Representatives of *Paraphoxus spinosus*

Surface collections of males resembling this species were collected near Coronados Islands. The specimens approximated 3 mm in length and differed from Puget Sound material mainly in the longer fifth

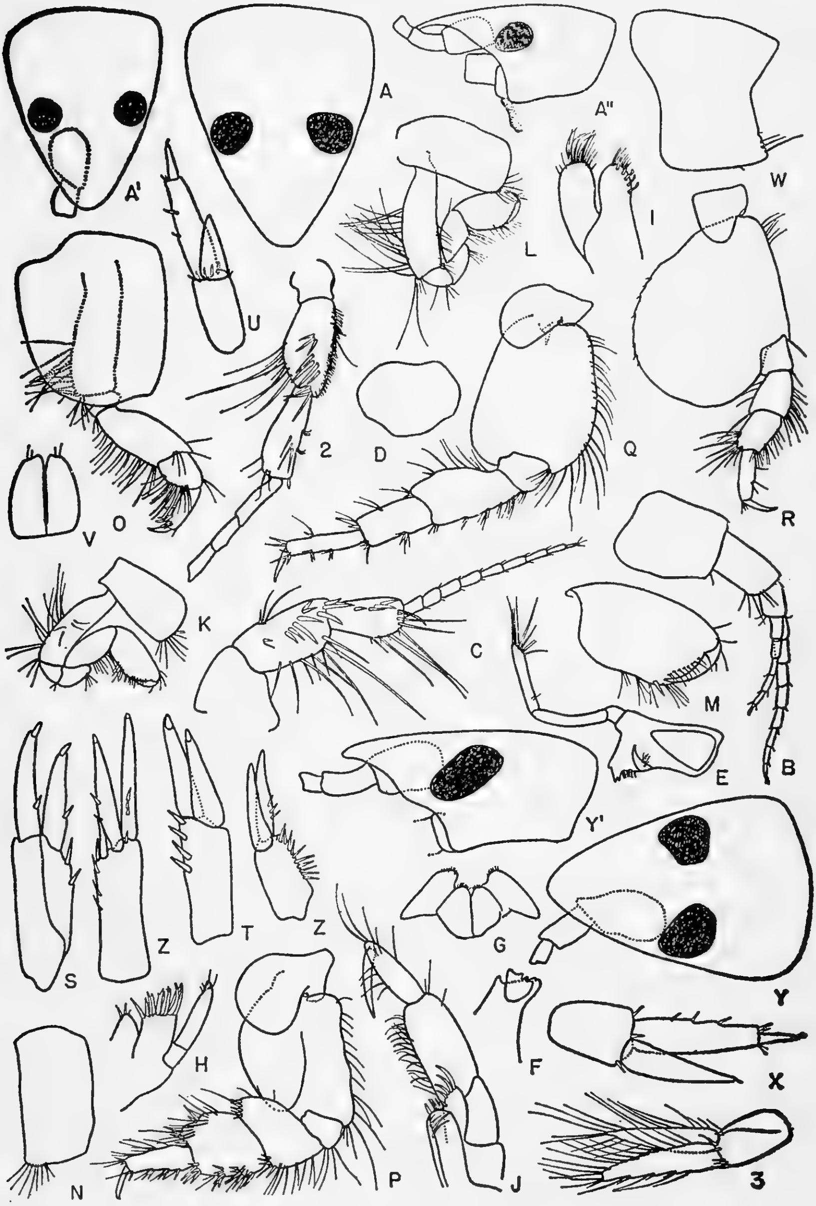
PLATE 29

Paraphoxus spinosus Holmes, female, 4.5 mm, False Bay, San Juan Island, Washington.

Figs. A,A", head; B,C, antennae 1, 2; D, upper lip; E,F, mandibles; G, lower lip; H,I, maxillae 1, 2; J, maxilliped; K,L,M, gnathopods 1, 2, 1; N, coxa 3; O,P,Q,R, peraeopods 2, 3, 4, 5; S,T,U, uropods 1, 2, 3; V, telson; W, pleon segment 3.

Male, young, 5 mm. Fig. X, uropod 3.

Male, 4.5 mm. Figs. Y,Y', head; Z,Z',3, uropods 1, 2, 3; 2, antenna 2.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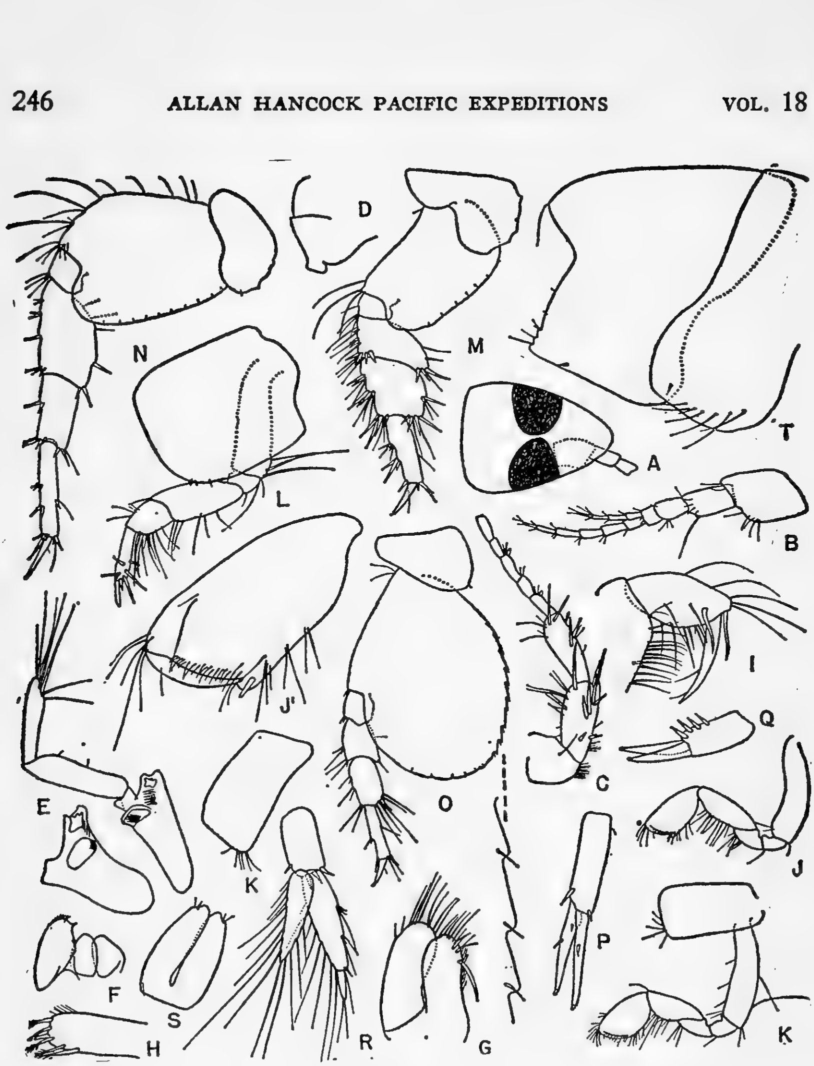


PLATE 30

Paraphoxus spinosus Holmes, male, 3 mm, Coronados Islands, L.C. Figs. A, head; B,C, antennae 1, 2; D, epistome; E, mandibles; F, lower lip; G, maxilla 2; H, maxilliped, inner plate; I, maxillipedal palp; J,J',K, gnathopods 1, 1, 2; L,M,N,O, peraeopods 2, 3, 4, 5; P,Q,R, uropods 1, 2, 3; S, telson; T, pleon segments 3-2.

articles of the gnathopods, the ratios of articles 5 and 6 in gnathopod 1 being 18:17 and in gnathopod 2 being 1:1. The second article of peraeopod 5 is less broad in the southern material, the ratio of width to length being 42:51, compared with 41:46 in Puget Sound material. The sweep point of article 2 is below the base of article 3; article 2

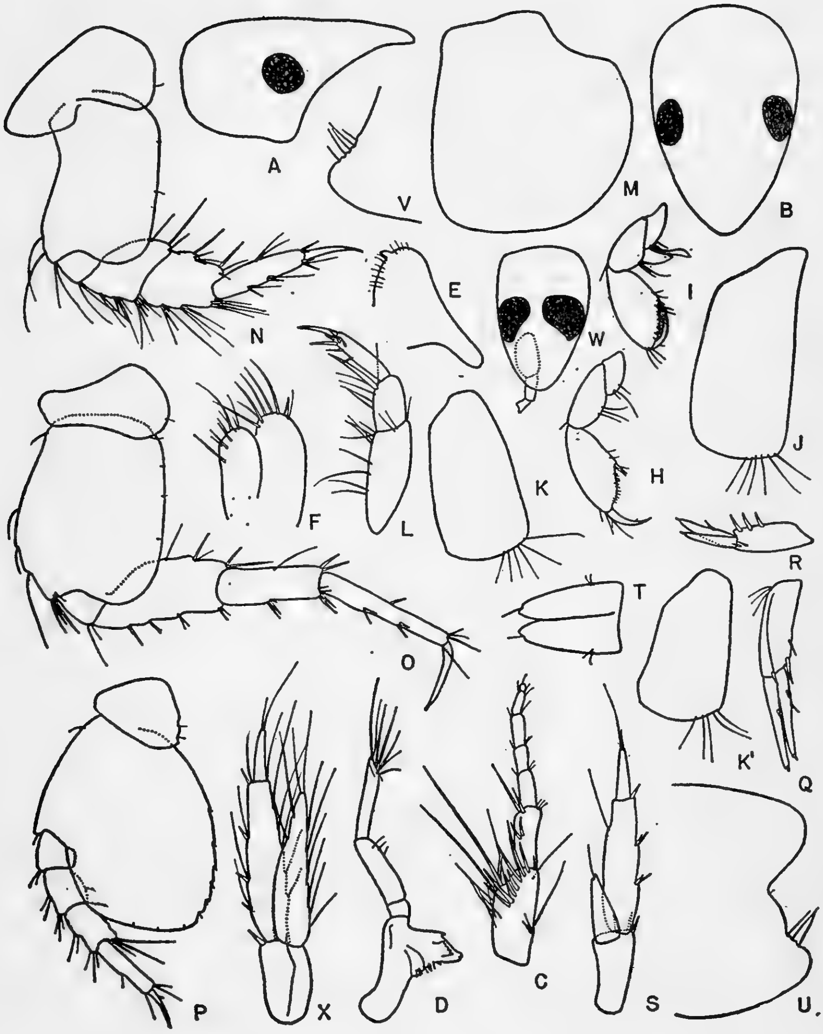


PLATE 31

Paraphoxus spinosus Holmes, female, 2.5 mm, Newport Bay, California.

Figs. A,B, head; C, antenna 2; D, mandible; E, lower lip; F, maxilla 2; H, I, gnathopods 1, 2; J, K, K', M, coxae 3, 2, 1, 4; L, N, O, P, peraeopods 2, 3, 4, 5; Q, R, S, uropods 1, 2, 3; T, telson; U, pleon segment 3.

Female, 2.5 mm (another specimen), Newport Bay. Fig. V, pleon segment 3.

Male, 2.5 mm, Newport Bay. Figs. W, head; X, uropod 3.

extends down almost to the end of article 4 and has up to 10 serrations. The eyes of the males are larger in southern specimens.

These and other differences might be explained on the basis that warmer temperatures allow maturation of postliminious secondary sexual features.

Specimens from Newport Bay, California

Diagnosis.—Differing from the typical in (1) the longer distal portion of peraeopod 4, the ratio of the combined lengths of articles 3 to 7 compared with the length of article 2 being 15:6 while normally it is 13:6; (2) the ratio of width to length of peraeopod 5, article 2 is 47:52, thus being broader than in typical specimens; (3) article 2 of peraeopod 5 extends down a little beyond the end of article 4, more than in the typical; (4) the ventral edge of article 2 is truncated while commonly it is strongly convex, thus accounting for the broader appearance of the fifth peraeopods in this form; (5) in gnathopods 1 and 2 the ratios of articles 5 and 6 are respectively; 3:4 and 2:3, thus much less than in the normal form; (6) the posterior edge of the third epimeron is more concave than typically, the lower corner being more produced and rounded; (7) the telson is more slender; (8) articles 2, 4, 5, 6 of peraeopod 3 have a ratio of width which is 9:6:5:2 compared with 9:7:6:2 in typical specimens; (9) articles 5 and 6 of peraeopod 3 have a ratio of length which is 3:4 compared with 1:1 in the typical form.

Remarks.—This minute facies is a bay form, being restricted as presently known to Newport Bay, California (J. L. Barnard 1959). Apparently it is a reflection of special environmental conditions, perhaps warmer temperatures. However, the phenotypic expressions of the bay form tend away from the trends noted in warm southern oceanic representatives as compared to northern cold water animals (which in a sense are bay forms also). This trend is noted particularly in the fifth articles of the gnathopods which increase from short to long in the following progression: Newport Bay—Puget Sound—southern oceanic.

The fourth peraeopods of the Newport Bay form are longer than in the other forms, while the third epimera are different. The fifth peraeopods represent the extreme of the tendency of southern animals to have a longer and more truncated second article, but strangely the number of serrations on the posterior edges is fewer than either of the other forms. Thus, the Newport facies does not carry the warm southern trend to its extreme and may be evidence that it is a population with a somewhat different genetic constitution.

The complex of forms in *P. spinosus* is similar to the complex in *P. obtusidens* and at times it is difficult to separate the two complexes, particularly young *P. obtusidens*. The larger eyes, shorter head and shorter inner ramus of uropod 3 serve to distinguish *P. spinosus.*

Perplexing specimens are found occasionally such as a 6.5 mm animal from M-10-48 (middle California) which in size resembles *P. obtusidens* but which has the short head of *P. spinosus*; it has been placed with *P. obtusidens* as a mutant.

Material examined.—341 specimens at 36 stations.

Distribution.—Widely distributed in the western Atlantic Ocean. Eastern Pacific Ocean from Puget Sound to the Gulf of California. Southern California coastal shelf, 5 to 40 fms, all but 2 samples shallower than 20 fms; not usually abundant in comparison with its close relative, *P. obtusidens*; in Newport Bay, California (Barnard 1959) it is widely scattered and abundant; occasionally caught in plankton tows, for instance at Coronados Islands.

Paraphoxus obtusidens (Alderman)

(Plates 33, 34, 35, 36, 37)

Pontharpinia obtusidens Alderman 1936: 54-56, figs. 1-13, 19; Hewatt 1946: 199; J. L. Barnard 1954: 4.

Pararpinia (sic) pontarpioides Gurjanova 1953: 229-230, figs. 11-12.

Paraphoxus obtusidens, J. L. Barnard 1958: 147.

Diagnosis of female.—Head rather large, broad basally, the long rostrum tapering evenly anteriorly; eyes medium in size, round. Body narrow.

Epistome variable, unproduced or with a small conical anterior cusp.

Maxillipedal palp article 4 simple apically.

Gnathopod 1: article 6 longer than 5, not very broadly expanded, palm moderately oblique. Ratio of lengths of articles 5-6; Gnathopod 1= 17:21, Gnathopod 2 = 14:20.

Peraeopod 3: articles 4-5 about three fourths as wide as article 2, article 6 narrow, as long as or longer than article 5, article 7 moderately long. Ratio of widths of articles 2, 4, 5, 6 = 28:20:20:9. Ratio of length of article 5 to 6 ranges from 22:30 to 22:23.

Peraeopod 4 slender distally, article 5 about two thirds as long as 4, article 6 ranging from three fourths to as long as articles 4 and 5 combined. Ratio of widths of articles 2, 4, 5, 6 = 23:11:7:3.

Peraeopod 5: article 2 broadly expanded, in one form the ratio of width to length being as much as 61:56 while in the other major form it is as little as 47:56. Article 2 varies in its downward extension from about midway almost to the end of article 4. The sweep point varies in position from above the base of article 3 down to its distal end; in the former extreme, the lower edge of article 2 is much more rounded. The teeth on the posterior edge are very small, generally 9 in number, in some specimens being nearly obliterated. Article 6 is slightly longer than either 4 or 5.

Uropod 1: lateral peduncular margin with moderately stout spines, rami shorter than peduncle, each armed with a variable number of marginal spines, those on the inner ramus being smaller than those on the outer ramus. Each ramus has a terminal spine.

Uropod 2: peduncle bears spines, ranging from very slender to very stout in the extremes; outer ramus about as long as peduncle, bearing several stout or slender spines; inner ramus unarmed. Each ramus has a terminal spine (see Table 5).

Uropod 3: inner ramus longer than half the length of the outer, in its maximum development as long as article 1 of outer ramus; article 2 of outer ramus stout, one fifth to one seventh as long as article 1.

Telson broad, apices blunt, slightly oblique, armed with 3 spines, lateral margins with spines at distal third.

Third epimeron varying from a form having a concave posterior edge and a slightly upturned lower corner to one having the posterior edge straight and the lower corner evenly rounded. The setae on the posterior edge vary from few to numerous (See Table 5).

Male.—Sexual dimorphism typical.

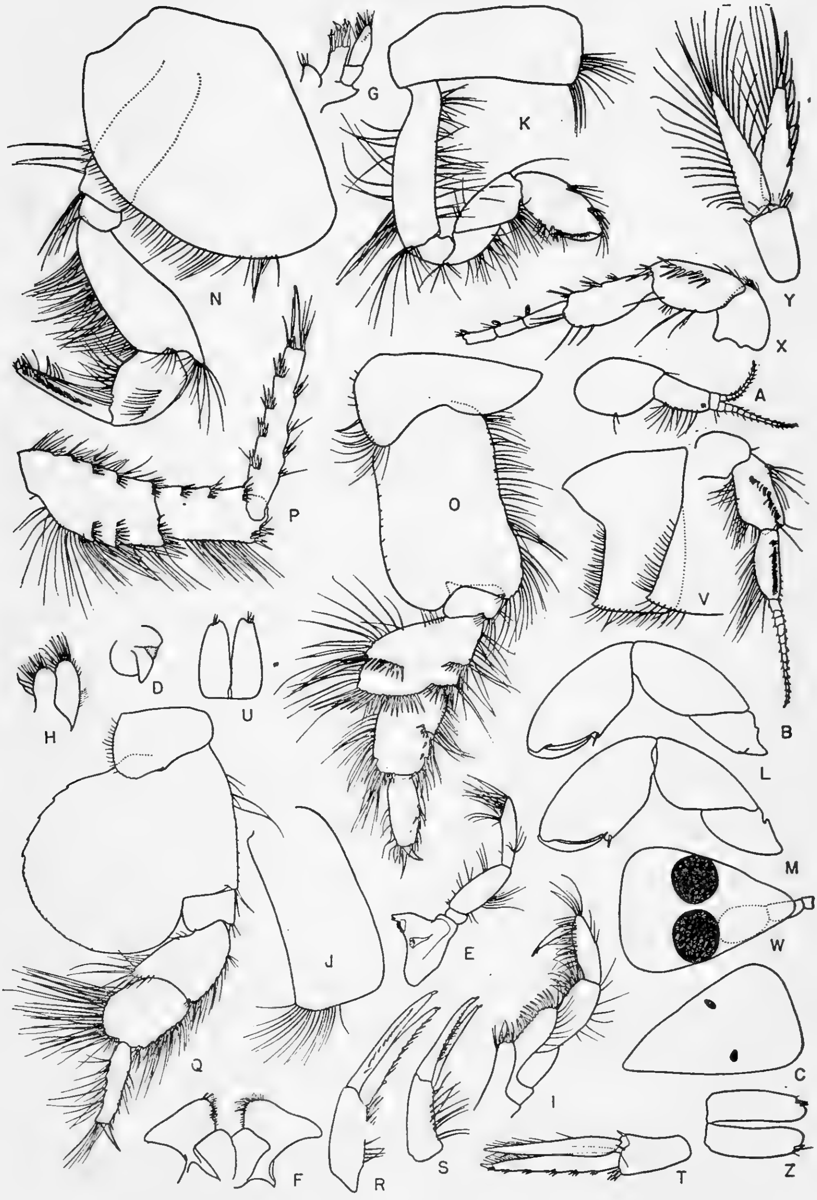
Discussion.—This species is quite abundant and widely distributed in the eastern Pacific Ocean; it is quite variable so that a limited diagnosis is difficult. For this reason I have employed a large number of figures in order to record the variations encountered.

PLATE 32

Paraphoxus obtusidens (Alderman) *major* n. subsp., female, 12 mm, Sta. 888-38.

Figs. A,B, antenna 1, 2; C, head; D, epistome; E, mandible; F, lower lip; G,H, maxillae 1, 2; I, maxilliped; J, coxa 1; K, gnathopod 2; L,M, gnathopods 1, 2; N,O,P,Q, peraeopods 2, 3, 4, 5; R,S,T, uropods 1, 2, 3; U, telson; V, pleon segments 3-2.

Male, 7 mm, Sta. 2018-51. Figs. W, head; X, antenna 2; Y, uropod 3; Z, telson.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At first, in my researches, it was believed that this species comprised two distinct forms, employing the extremes in the following table:

	Type A	*Type B*
Uropods 1-2	Spines slender	Spines stout, short
Peraeopod 5, article 2	Very broad Lower margin well rounded Teeth nearly obliterated Lower margin serrate Lower margin setose	Narrower Lower margin truncated Teeth distinct Lower margin smooth Lower margin setulate
Third epimeron	Posterior edge concave Numerous setae	Posterior edge straight Few setae

TABLE 4

It was considered that these forms either represented ecological subspecies or were determined by larger size and greater age of type A. Intergradations between the two types have been encountered quite frequently. These are specimens in which the differentiating criteria are blended between the extremes or have one or more characters of the second type associated with the rest of the criteria of the first type. Size does appear to play a limited role; the greatly expanded second article of peraeopod 5 and the concave third epimera generally are associated with large specimens, although exceptions occur.

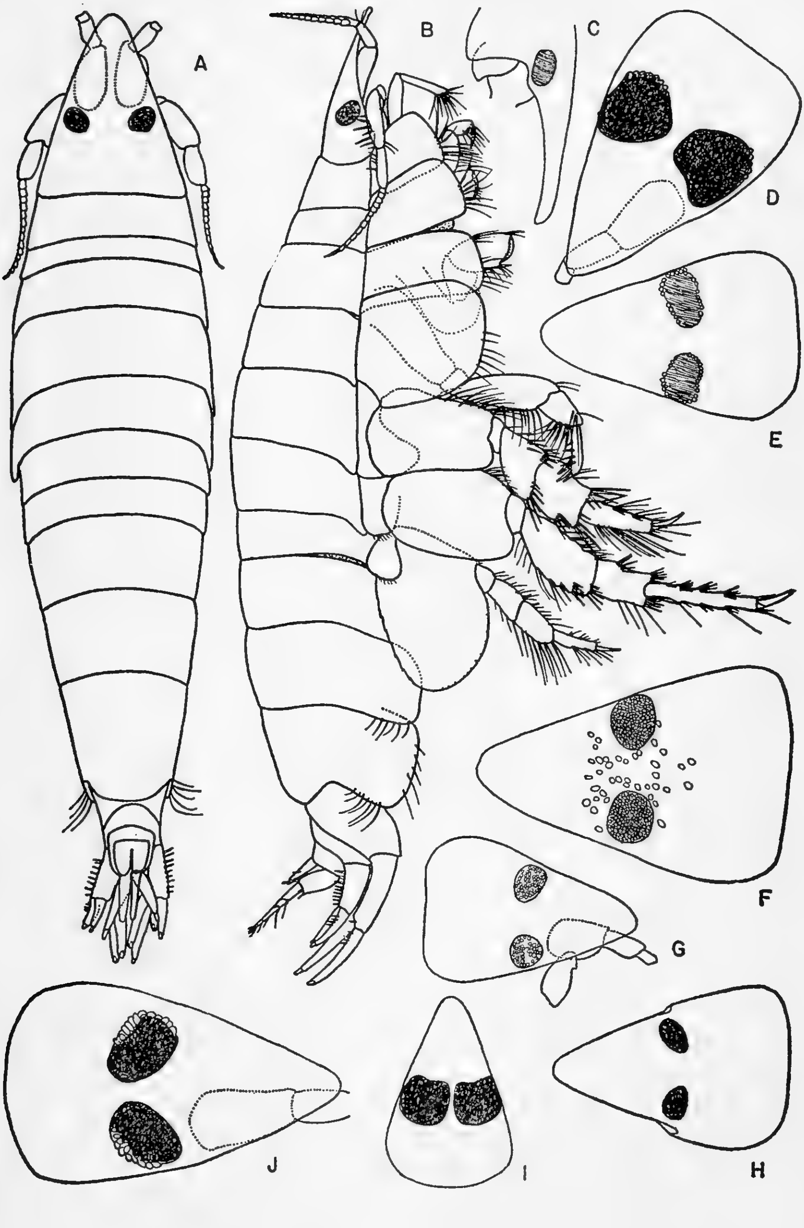
Analyzing hundreds of specimens left the writer with the impression that ecological conditions, perhaps the abundance of food, or the kind of major community in which the animals exist, determine the size of the oldest adults in a population. Attempts were made to correlate large populations with some observable physical factor which had been recorded at the time of collection but the data are too complex to be of use at this time. It is hoped that correlations can be made when we understand the community relationships and distributions better.

PLATE 33

Paraphoxus obtusidens (Alderman), female, 13 mm, Sta. 2091-52.

Figs. A,B, entire animal, dorsal and lateral.
Heads:

Figs. C, female, 10 mm, Sta. 2348-53.
D, male, 5 mm, San Quintin Bay, L. C.
E, male, young, 6 mm, Sta. 1372-41.
F, female, 8 mm, Sta. 478-35.
G, female, 6 mm, Sta. 677-37.
H, female, 15 mm, Sta. 1140-40.
I, male, 7 mm Sta. 279-34.
J, male, young, 5.5 mm, Sta. 1169-40.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J

The present species would be of great value in studying post-ephebic differentiation and ecological influences on size and maturation. The distinct differences between sizes of spines on the first two uropods would be an interesting problem for the genetical ecologist.

Variability in features of *Paraphoxus obtusidens* (Alderman)

Sta.	mm	3rd pleon seg. posterior edge		uropod 2 peduncle spine length	
		CONCAVE	STRAIGHT	LONG	SHORT
2394	4	half		half	
2312	4	half		half	
2214	4		x	x	
1390	5		x		x
2348	5	half		half	
San Quint.	5	x		x	
San Quint.	6	x			
1295	6	half		x	
2291	6	x		x	
2496	6	half		x	
1598	7		x		x
1169	7	x		x	x
1205	8	half			
2024	8		x		x
1241	10	half		x	
889	11	x			x
1232	15	half		half	

TABLE 5

Specimens from San Quintin Bay

Some evidence for the influence of environment on the expression of morphology is seen in the specimens collected at San Quintin Bay, Lower California (Plate 35, figs. S-Y). The adult animals ranged in length from 5 to 6 mm. The lower posterior corners of the third epimera are quite prolonged and upturned, exaggerating the extreme found in larger adults of the open sea, but the second article of the fifth peraeopod is not broadly expanded and the teeth are quite distinct.

Juvenile animals

The juveniles of this species are quite similar to adults of *P. spinosus* and difficult to distinguish, for the head is not prolonged and the armature of the first two uropods is quite similar in both species. It is interesting to note that the apical spine of the fourth maxillipedal palp article, seen in the adults of other species, is present in juveniles of *P. obtusidens*, although it is rather indistinct. Because of its loss or fusion in maturation it would appear that species which retain it as adults are more primitive.

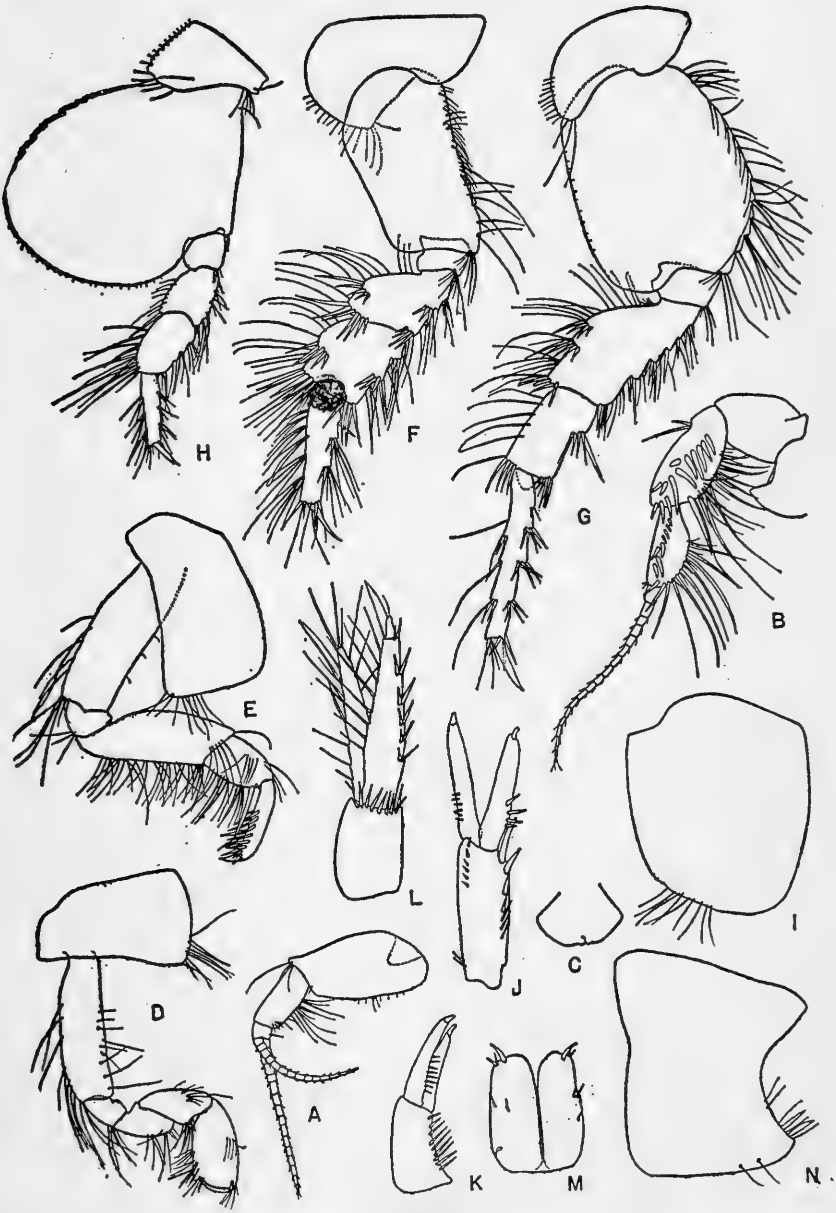


PLATE 34

Paraphoxus obtusidens (Alderman), female, 15 mm, Sta. 1140-40.

Figs. A,B, antennae 1, 2; C, upper lip; D, gnathopod 2; E,F,G,H, peraeopods 1, 3, 4, 5; I, coxa 4; J,K,L, uropods 1, 2, 3; M, telson; N, pleon segment 3.

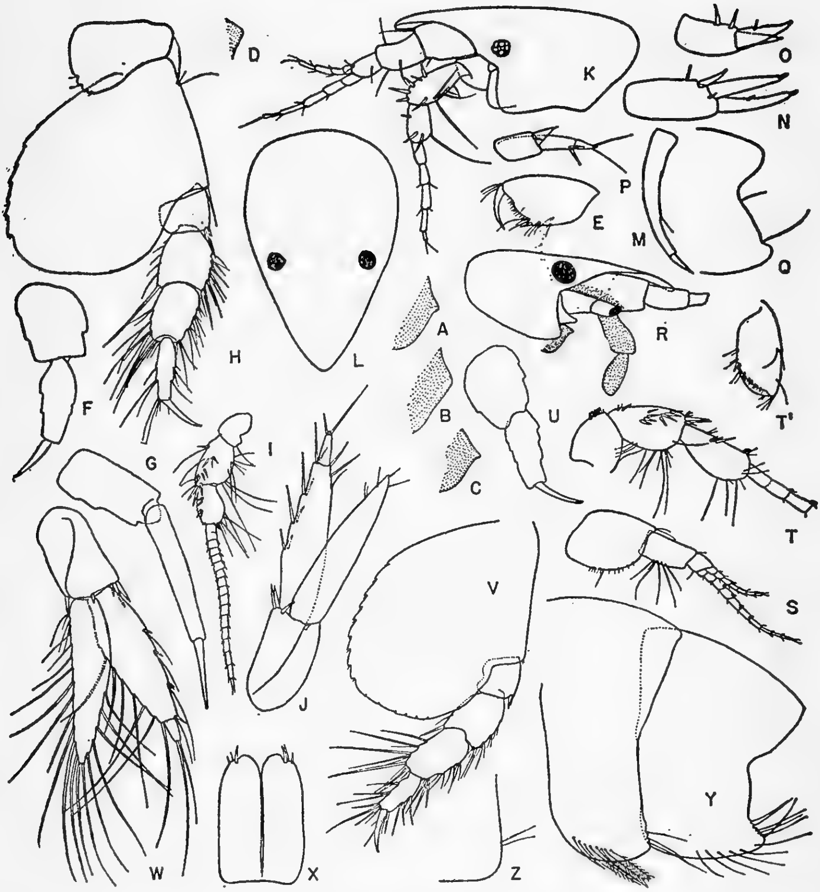


PLATE 35

Paraphoxus obtusidens (Alderman).

Epistomes:

Figs. A, female, 8 mm, Sta. 478-35.
B, female, 10.5 mm, Sta. 285-34.
C, female, 6 mm, Sta. 564-36.
D, male, 6 mm, Sta. 2312-53.

Female, Sta. 1169-40. Figs. E, gnathopod 1; F,G,H, peraeopods 3, 4, 5; I, antenna 2; J, uropod 3.

Juvenile, 3 mm, Sta. 2348-53. Figs. K,L, head; M, maxillipedal palp article 4; N,O,P, uropods 1, 2, 3; Q, pleon segment 3.

Male, young, 6 mm, Sta. 2291-53. Fig. R, head.

Male, 5 mm, San Quintin Bay, L.C. Figs. S,T, antennae 1, 2; U, peraeopod 3; V, peraeopod 5; W, uropod 3; X, telson.

Female, 6 mm, San Quintin Bay, L.C. Fig. Y, pleon segment 2-3.

Female, 10 mm, Sta. 285-34. Fig. Z, pleon segment 3.

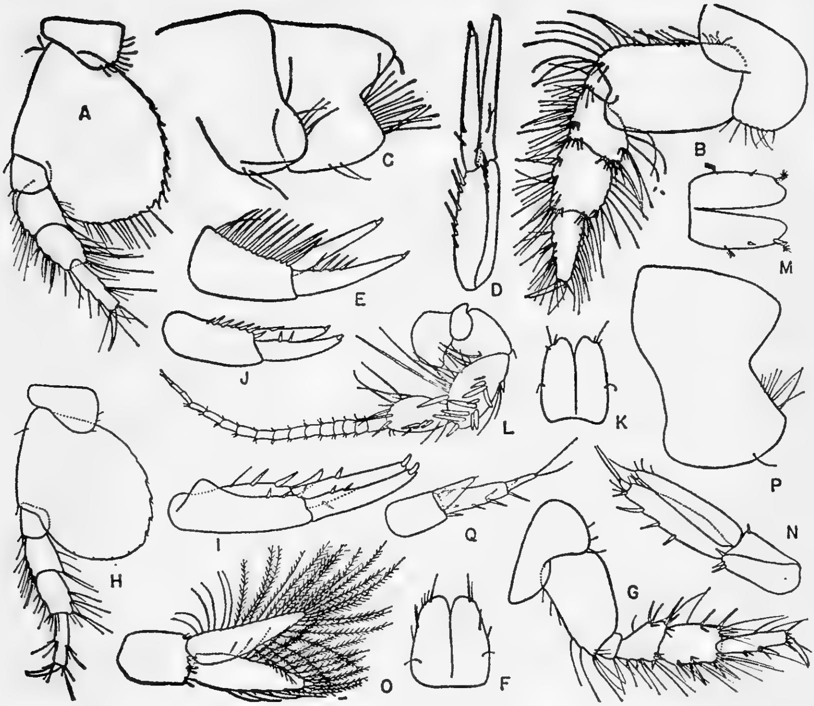


PLATE 36

Paraphoxus obtusidens (Alderman), female, 7 mm, Sta. 2214-52.
Figs. A,B, peraeopods 5, 3; C, pleon segments 2-3; D,E, uropods 1, 2; F, telson.
Juvenile, 4 mm, Sta. 442-35. Figs. G,H, peraeopods 3, 5; I,J, uropods 1, 2; K, telson.
Male, young, 7 mm, Sta. 1372-41. Figs. L, antenna 2; M, telson; N, uropod 3.
Male, 9 mm, Sta. 279-34. Fig. O, uropod 3.
Female, 9 mm, Sta. 456-35. Fig. P, pleon segment 3.
Juvenile, 3.25 mm, Sta. 2611-54. Fig. Q, uropod 3.

The inner ramus of the third uropod in juveniles is half or less as long as the outer ramus; its elongation in adult females is unusual in the Phoxocephalidae.

Synonymy

"Pararpinia" pontarpioides appears to belong with *P. obtusidens.* The latter species is quite variable and Gurjanova's species fits the facies which has stout spines on uropod 2 and a third pleonal segment with straight and setose hind edge. The figure of the head given by Gurjanova indicates a shorter rostral area than in Californian specimens but I do not believe

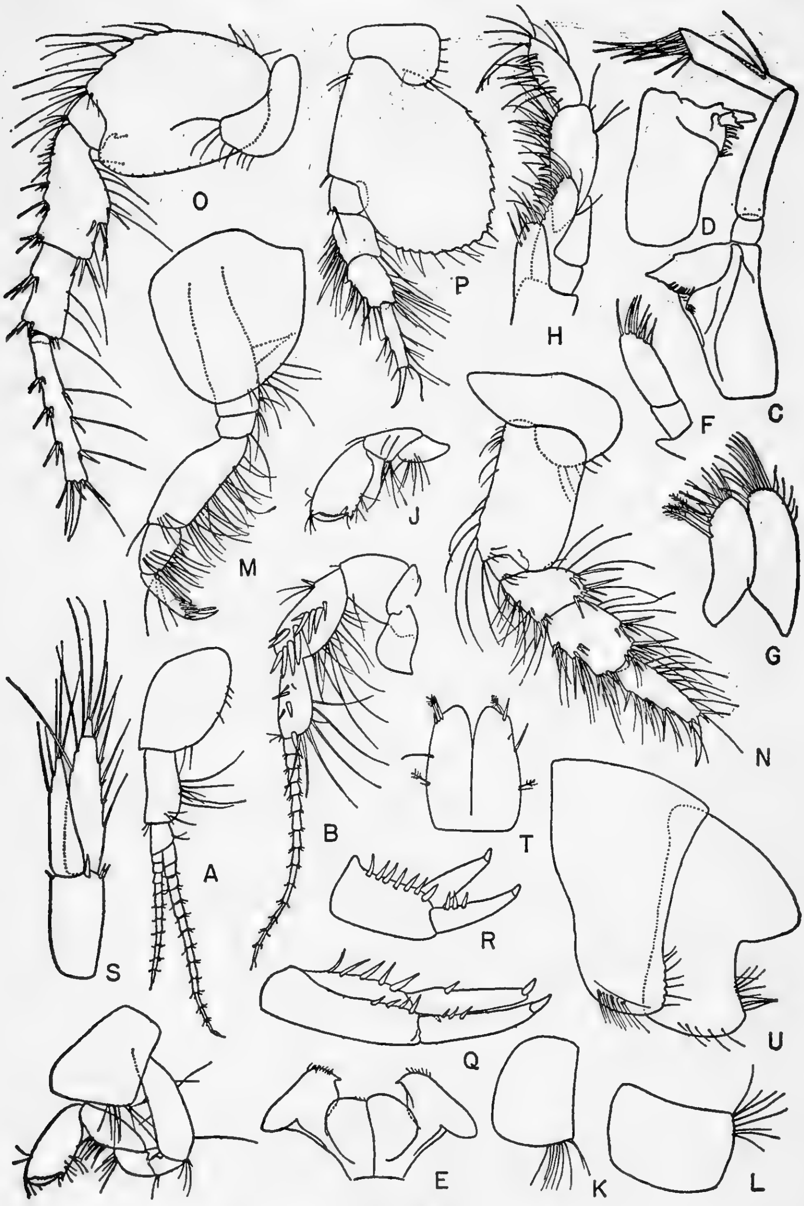


PLATE 37

Paraphoxus obtusidens (Alderman), female, 8.5 mm, Sta. 677-37.

Figs. A,B, antennae 1, 2; C,D, mandibles; E, lower lip; F, maxilla 1, palp; G, maxilla 2; H, maxilliped; I,J, gnathopods 1, 2; K,L, coxae 2, 3; M,N,O,P, peraeopods 2, 3, 4, 5; Q,R,S, uropods 1, 2, 3; T, telson; U, pleon segments 2-3.

that this is of serous concern, in light of occasional short-headed specimens found in California (see above).

Material examined.—1125 specimens at 186 stations.

Distribution.—Kurile Islands to Colombia, South America, and the Gulf of California, 0 to 80 fms, generally shallower than 20 fms. This species is large and was frequently collected by *Velero III* expeditions in the tropical eastern Pacific at Colombia, Panama, Costa Rica, Gulf of California and Lower California. It occurs intertidally at La Jolla and Pt. Fermin, California, and has been collected at the mouth of the Salinas River in Monterey County, California. It lives in medium and coarse sands.

Paraphoxus obtusidens major, new subspecies

(Plate 32)

Diagnosis of female.—Head rather large, broad basally, the long rostrum tapering evenly anteriorly, eyes small in size, oval. Body narrow.

Epistome unproduced.

Maxilliped with unmodified apex of palp article 4.

Gnathopod 1: article 6 longer than 5, not very broadly expanded, palm oblique. Ratio of lengths of articles 5 and 6; Gnathopod 1 = 13:15, Gnathopod 2 = 12:15.

Peraeopod 3: article 4 nearly as broad as 2, but much broader than article 5, article 6 shorter than 5, article 7 short. Ratio of widths of articles 2, 4, 5, 6 = 38:32:18:9.

Peraeopod 4: articles 4 and 5 much more slender than in peraeopod 3, the widths of articles 4 and 5 are 23 and 15 while in peraeopod 3 they are 32 and 18.

Peraeopod 5: article 2 broadly expanded, about as long as wide, posterior edge with about 5 minute teeth, sweep point above base of article 3, lower edge of article 2 quite convex, semi-circular; article 2 extends down only slightly beyond end of article 3: articles 4 and 5 quite broad, being nearly as broad as article 4 of peraeopod 4; article 6 slender, longer than 5; article 6 very setose.

Uropods 1 and 2; rami longer than peduncle. Uropod 1: peduncle armed with slender, moderately long setae, rami with numerous short spines, apices each with a movable spine as on uropod 2.

Uropod 2: peduncle with long setae, inner ramus bare, outer ramus with numerous slender, but short spines.

Uropod 3: rami subequal in length, quite slender, outer ramus with article 2 less than one ninth as long as article 1.

Telson moderately broad, each set of 3 short apical spines inset laterally to the rounded end.

Second and third epimera similar, unlike most other paraphoxids, lower posterior corners produced into a small tooth, posterior edges nearly straight and setose for most of their lengths.

Male.—Sexual dimorphism typical. Rami of third uropods much broader than in female.

Holotype.—AHF No. 3816, female, 17.5 mm.

Type locality.—Station 888-38, near the mouth of Salinas River, Monterey Bay, California, 36-44-30 N, 121-49-30 W, 10-13 fms, sand bottom, Aug. 8, 1938.

Remarks.—At first glance this subspecies is remarkably like *P. obtusidens* and in the Santa Barbara to Point Conception region is difficult to separate from the typical species. The following points are useful in distinguishing large adults from *P. obtusidens:*

(1) broad fourth and fifth articles of peraeopod 5; (2) the more hemispherical lower edge of article 2, peraeopod 5; (3) broader peraeopod 3, article 4 being much broader than 5; (4) similarity of second and third epimera, and more dense setation; (5) a somewhat stouter fifth article of peraeopods 1-2; (6) more numerous and different forms of spines and setae on uropods 1-2.

The species bears a resemblance to *P. villosus* (Haswell) but the former differs in the following points: (1) article 6 of gnathopod 1 is more slender; (2) article 4 of peraeopod 3 is much wider than 5; (3) articles 4 and 5 of peraeopod 5 are broadly expanded.

The distribution of this species lies mainly north of Point Conception while *P. obtusidens* is mainly south of that point. However, *P. obtusidens* is found at intertidal localities north of Point Conception and by my synonymy extends north to the Okhotsk Sea. It is probable that *P. o. major* represents a terminal growth condition of *P. obtusidens* in cold waters since it is distinguishable only as large adults. Otherwise the widely overlapping ranges would need explanation on an unlikely ecological subspeciation.

Material examined.— 108 specimens at 14 stations.

Distribution.—This subspecies appears to be correlated with colder shallow waters around promontories where upwelling might occur and may be a terminal growth stage on coarse sands or in rich feeding grounds. It has been collected at the following localities: Marin County, California, intertidal; mouth of Salinas River; Osoflacos, in coarse sand near surf zone; Pt. Conception and Pt. Arguello, 10 to 50 fms on coarse sands; Santa Cruz Island, 10 fms; Blanca Bay, Lower California, 8-12 fms.

The *heterocuspidatus, tridentatus, t. pallidus* Complex

The three species and subspecies in the complex to be described are difficult to identify separately and it has been the opinion of the writer at times to submerge all of them as subspecies. However, considerably more northern and bay specimens must be collected in order to clarify the relationships. The following table may be useful in distinguishing the species as they now stand:

	heterocuspidatus	*tridentatus*	*t. pallidus*
Rostrum	broad	narrower	broad
Uropod 3, length of inner ramus, female	5/6	1/3	1/2
Teeth, peraeopod 5	4-5 small or medium, even or uneven	3 medium	3 large
Pleon 3 epimera	quadrate, poorly setose	quadrate, moderately setose	quadrate well setose
Gastric mill, accessory grinding spines	flat, not oblique	?	acute, oblique

TABLE 6

Paraphoxus tridentatus (J. L. Barnard), new combination

Pontharpinia tridentata J. L. Barnard 1954: 4-6, pls. 4-5.

Diagnosis of female.—Head short, with rostrum constricted in front of eyes; eyes small in size, oval. Body very broad, flattened dorsally.

Epistome unproduced.

Maxillipedal palp article 4 with subapical seta only.

Gnathopods 1-2: article 5 slightly longer than 6, article 6 narrow but expanding distally, palm nearly transverse.

Peraeopod 3: articles 4-5 broadly expanded, slightly narrower than article 2, article 6 two thirds as long as 5. Ratio of widths of articles 2, 4, 5, 6 = 26:22:20:8.

Peraeopod 4: article 4 expanded as broadly as article 4 in peraeopod 3, but much narrower than article 2 which is very broad in peraeopod 4, article 6 longer than 5.

Peraeopod 5: article 2 not broadly expanded, ratio of width to length is 46:51, posterior edge with 3 large teeth increasing in size ventrally; sweep point near distal end of article 3, lower edge dipping slightly anteriorly but truncated; rest of appendage rather stout except for article 6 which is narrow and not longer than either article 4 or 5.

Uropods stout. Uropod 1: peduncle sparsely spinate, distal spines stout, rami shorter than peduncle, each with one stout marginal and one terminal spine.

Uropod 2: peduncle with about 4 stout marginal spines, rami as long as peduncle, inner ramus with 1 marginal and 1 terminal spine, outer ramus with a terminal spine only.

Uropod 3: inner ramus about one third as long as outer, article 2 of outer ramus short, about one fourth as long as article 1.

Telson slender, apices oblique and slightly notched, each with several long setae.

Third epimeron: posterior edge curving broadly into lower edge and sparsely setose.

Male.—Sexual dimorphism typical.

Remarks.—The figure of the third epimeron in J.L. Barnard 1954 is poor for it is an oblique view. The correct shape is very close to the figure of *P. tridentatus pallidus* n. subsp., herein.

Material examined.—6 specimens at 2 stations.

Distribution.—A northern species replaced by *P. heterocuspidatus* n. sp. in southern California. The southernmost records are at Goleta, 10 fms on the coastal shelf and Santa Cruz Island, 10 fms. The species was described from Oregon.

Paraphoxus tridentatus pallidus, new subspecies

(Plates 38, 39)

Diagnosis of female.—Head with broad rostrum constricted in front of eyes and rather short. Eyes small in size. Body very broad, dorsally flattened.

Epistome unproduced, with a small anterior cusp.

Maxillipedal palp article 4 with subapical seta only.

Gnathopods 1-2: article 5 much longer than 6, the latter quite narrow and not expanding distally, palm transverse. Ratio of articles 5-6; Gnathopod 1 = 35:24, Gnathopod 2 = 36:26. Coxae armed on medial surfaces with small setae on coxa 1 and large ones on coxa 2.

Peraeopod 3: articles 4 and 5 broadly expanded, but slightly narrower than article 2, article 6 more than three fourths as long as 5. Ratio of widths of articles 2, 4, 5, 6 = 30:26:26:10.

Peraeopod 4: article 4 as broad as in peraeopod 3, but much more slender than the broad article 2, article 6 longer than 5. Ratio of widths of articles 2, 4, 5, 6 = 41:26:18:7.

Peraeopod 5: article 2 not broadly expanded, ratio of width to length is 45:52, posterior edge with 3 large teeth increasing in size ventrally; sweep point near distal end of article 3, lower edge dipping strongly anteriorly, slightly convex; rest of appendage rather stout except for article 6 which is narrow and not longer than article 5.

Uropods stout. Uropod 1: distal edge of peduncle with 2 stout spines, rami shorter than peduncle, each with one stout marginal and one terminal spine.

Uropod 2: peduncle with 4 stout marginal spines, rami shorter than peduncle, inner ramus with a small marginal spine only, each ramus with a terminal spine.

Uropod 3: inner ramus about one half as long as outer, article 2 of outer ramus short, about one ninth as long as article 1.

Telson slender, apices rounded, each with a lateral subterminal spine.

Third epimeron: posterior edge nearly straight, lower corner quadrate and slightly cuspate, posterior edge with 3-4 setae.

Male.—With typical sexual dimorphism.

Holotype.—AHF No. 4918, female, 6.5 mm.

Type locality.—False Bay, San Juan Island, Aug. 13, 1949, coll. J. W. Bee.

Remarks.—This subspecies differs from the typical subspecies particularly in the narrower sixth articles of gnathopods 1-2 and in the other criteria of Table 6. It may be simply an ecophenotype responding to its bay environment in the same way that the San Quintin Bay forms of *P. heterocuspidatus* do, by the narrower hands of the gnathopods and other quantitative differences. The *P. t. pallidus* specimens also differ from *P. heterocuspidatus* in the spination on the gastric mill (compare Plate 38, fig. M and Plate 19, fig. Z). A study of this anatomy may prove interesting from both a systematic and ecologic point of view.

Material examined.—False Bay, San Juan Island, Puget Sound, Washington: August 1948, coll. Dr. J. L. Mohr (4); August 13, 1949, coll. J. W. Bee (33).

Distribution.—Known only from Puget Sound, Washington.

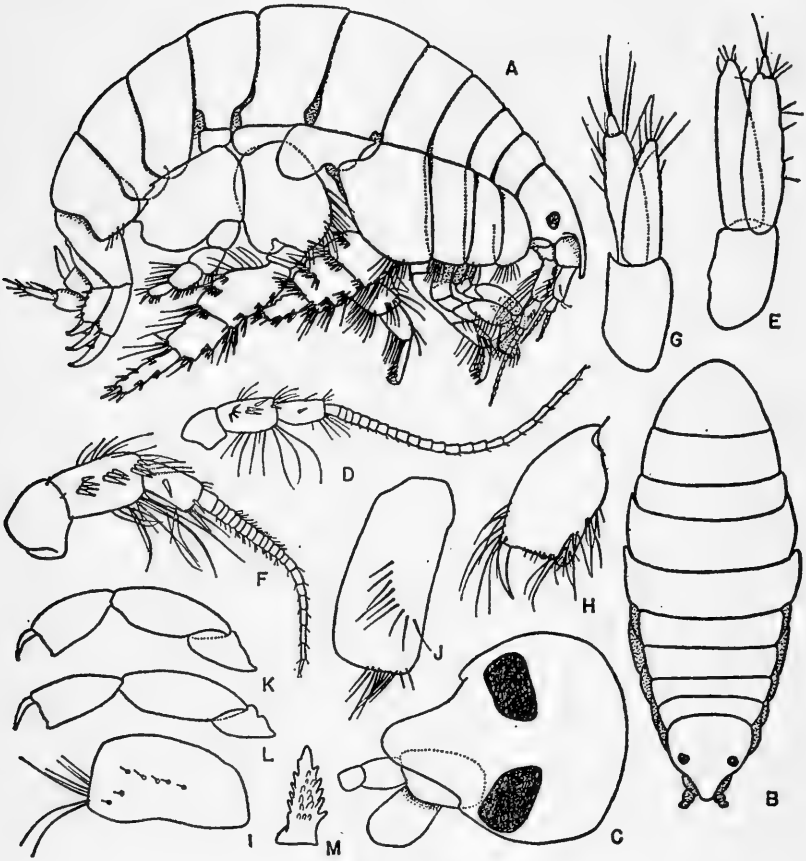


PLATE 38

Paraphoxus tridentatus pallidus, n. subsp., female, 8 mm, False Bay, San Juan Island, Washington.

Figs. A,B, lateral and dorsal views of body; I,J, coxae 1, 2; K,L, gnathopods 1, 2; M, tooth of gastric mill.

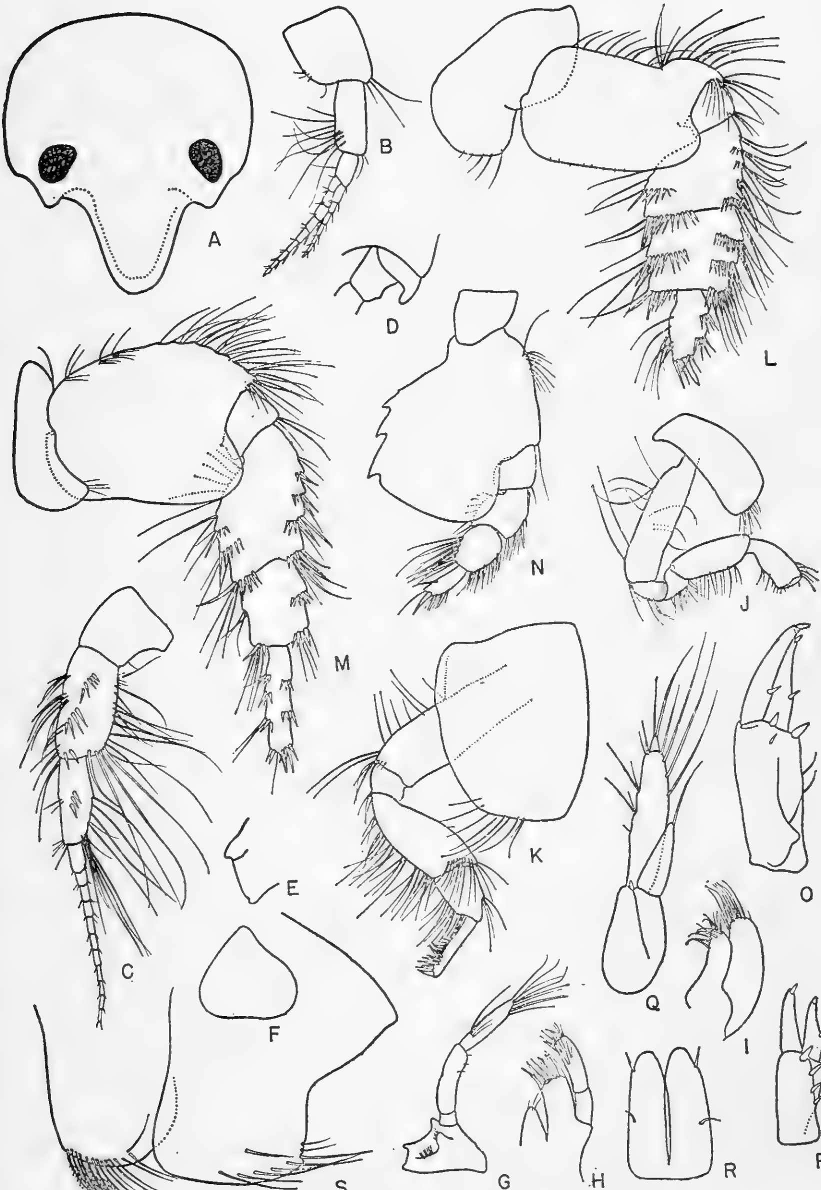
Male, young, 6 mm. Figs. C, head; F, antenna 2; G, uropod 3.

Male, young, 5.5 mm. Figs. D, antenna 2; E, uropod 3; H, gnathopod 2.

PLATE 39

Paraphoxus tridentatus pallidus, n. subsp., female, 8 mm, False Bay, San Juan Island, Washington.

Figs. A, head; B,C, antennae 1, 2; D, head, lower anterior corner; E, epistome; F, upper lip; G, mandible; H,I, maxillae 1, 2; J, gnathopod 2; K,L,M,N, peraeopods 2, 3, 4, 5; O,P,Q, uropods 1, 2, 3; R, telson; S, pleon segments 2-3.


A
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Paraphoxus milleri (Thorsteinson)

(Plate 40)

Pontharpinia milleri Thorsteinson 1941: 82, pl. 5, figs. 52-62.

Pontharpinia longirostris Gurjanova 1938: 263-267, 385, fig. 7 (homonym, not Schellenberg 1931); Gurjanova 1951: 385-387, fig. 235.

Pontharpinia robusta Gurjanova 1938: 262-263, figs. 6, 6a (homonym, not Holmes 1908); Gurjanova 1951: 384-385, figs. 233, 234.

Paraphoxus milleri, J. L. Barnard 1958: 147.

Composite diagnosis.—Head broad, rostrum narrowed anterior to the eyes, generally rather wide; eyes rather small in female.

Epistome unproduced.

Maxillipedal palp article 4 lacks apical spine.

Gnathopods 1-2: article 5 slightly longer than 6, anterior edge of article 6 curved, posterior edge straight, palms nearly transverse; lower posterior corners of first 3 pairs of coxae bear cusps; ratio of lengths of articles 5 and 6; Gnathopod 1 = 26:23; Gnathopod 2 = 24:21.

Peraeopod 3: articles 4 and 5 as wide or much wider than article 2, article 6 rather narrow, article 7 short, stout. Ratio of widths of articles 2, 4, 5, 6 in specimen at hand = 24:24:24:9; in Thorsteinson's figures the ratio is 22:28:24:8; in *Pontharpinia robusta* it is 26:26:22:10.

Peraeopod 4: in the American specimens article 2 is sub-circular but more oval in Asian specimens; article 4 is quite broad in American specimens while in Asian material it is scarcely broader than article 5; article 7 short, stout. Ratios of widths of articles 2, 4, 5, 6 listed in order of decreasing width: in Thorsteinson's specimen = 45:37:23:8, in the present specimen = 46:33:22:7; in *P. robusta* = 44:26:20:7.

Peraeopod 5: article 2 about as broad as long, lower edge convex and reaching about to middle of article 4; sweep point near lower end of article 3; posterior edge with 7-10 small teeth which increase in size distally and become less hooked; articles 4 and 5 rather stout; article 7 short.

Uropods known only from the present material.

Uropod 1 sparsely spinose.

Uropod 2 with about 4 peduncular spines, each ramus with a single marginal spine.

Uropod 3: in both male and female the inner ramus is nearly as long or longer than article 1 of the outer ramus; article 2 of the outer ramus is quite short, about one tenth as long as article 1.

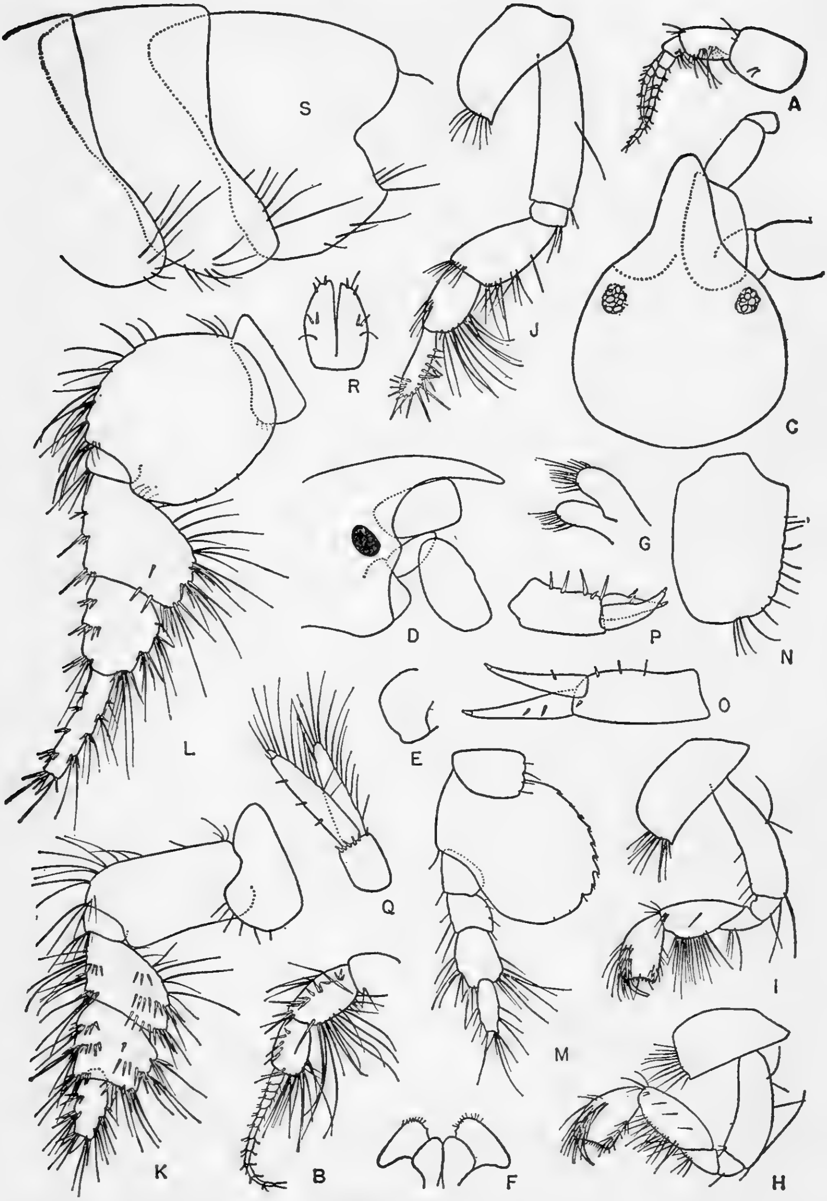


PLATE 40

Paraphoxus milleri (Thorsteinson), female, 10 mm, Savary Island, Strait of Georgia, British Columbia.

Figs. A,B, antenna 1, 2; C,D, head; E, epistome; F, lower lip; G, maxilla 2; H,I, gnathopods 1, 2; J,K,L,M, peraeopods 1, 3, 4, 5; N, coxa 4; O,P,Q, uropods 1, 2, 3; R, telson; S, pleon segments 1-3.

Telson moderately broad, apices rather narrow, notched, armed with a stout spine or spines; subterminal dorsolateral edges each armed with a spine or groups of spines.

Third epimeron: posterior edge nearly straight and distally setose, lower corner quadrate or slightly produced.

Remarks.—Despite the considerable differences in the figures concerning the three species which have been fused here, no consistent qualitative differences can be pointed out. The published figures of *P. robusta* and *P. milleri* are males, the former an immature one; *P. longirostris* is a female (being half as large as *P. robusta*) or possibly a juvenile, for the spines and setae on its peraeopods are not as richly developed as in the other two representatives. The material at hand comprises a number of specimens of all ages.

This species is characterized by the stoutness of the fifth article of the fifth peraeopod, occurring in all three representatives. The coxal cusps shown so well developed by Miss Thorsteinson are not quite as well represented in the material at hand but are evident in figures of *P. robusta* and only slightly in *P. longirostris*. The third uropods of the male representatives compare well, being characterized by the shortness of the second article of the outer ramus.

The general shape of peraeopod 5, article 2, and its teeth are similar in all but *P. longirostris*, which is probably an underdeveloped juvenile, although the shape of the appendage is similar. The telsons vary in shape and spination from animal to animal but no clear demarcation among them is apparent. All the telsons correspond to the extent of bearing short spines, no long setae.

The gnathopods show many agreements, particularly in the length of the fifth article, but Miss Gurjanova's drawings of her two species do not show the clear contrast between the convex anterior and straight posterior edges of the sixth article seen in *P. milleri* and the specimen at hand. This is also true of the transversity of the palms of the American specimens.

The dorsal shape of the heads corresponds less well than other characters, but this problem may be resolved in part by different aspects and mounting techniques used. The rostrum in *P. robusta* appears broader than in specimens at hand or *P. longirostris* but the difference is so small that it can be attributed to intraspecific variation. The process on the lower corner of the head in *P. robusta*, figured as a large cone, I attribute to the possible exaggeration of the gland cone on the second antenna, which appears more rounded in Thorsteinson's drawing of *P. milleri.*

The slight point at the lower corner of the third epimeron seen on the specimens at hand also appears in *P. robusta.*

All of these features in common have led me to conclude that the above synonymy is correct. No doubt, further examination of materials from both continents will reveal subspeciation, but I am convinced that the two groups represent the same species.

Both of the names proposed by Miss Gurjanova are homonyms so that the earliest available name for the species is *P. milleri.*

Material examined.—49 specimens from 2 stations.

Distribution.—Bering Sea and Japan Sea; Puget Sound; recorded here from Strait of Georgia, British Columbia, sand flats at low water, coll. E. W. Bousfield; San Francisco Bay, coll. F. Filice.

Paraphoxus milleri lindbergi (Gurjanova), new combination

Pontarpinia (*sic*) *robusta lindbergi* Gurjanova 1953: 224-225, figs. 7, 8.

Remarks.—Miss Gurjanova distinguishes this subspecies from the typical one by the lack of an antennal process on the head; and the sixth article of peraeopods 1 and 2 is shorter. I have already explained above that I believe the head process is an artifact, in part, and the variation of the peraeopods is of minor nature and possibly the response of the animal to a special environment. However, the remarkable thing about ssp. *lindbergi* is the short inner ramus on the male uropod 3, which is unique in the genus and contrary to the situation in typical *P. milleri* (=*P. robusta*). Indeed, if this is normal, then the systematic status of the subspecies must be conserved.

Distribution.—Eastern side of Iturup Island, Kurile Islands, 20-75 m.

OTHER SPECIES

Paraphoxus australis (K. H. Barnard), new combination

Phoxus batei, Thomson 1882:232-233, pl. 17, figs. 2a-e (*fide* Hurley 1954), not Haswell 1880.

Protophoxus australis Barnard 1930: 335-336, fig. 12

Pontharpinia australis, Hurley 1954: 581-587, figs. 1-28

Distribution.—New Zealand: North Cape, Three Kings Island, Spirits Bay, Queen Charlotte Sound, Port Chalmers, Stewart Island (Paterson Inlet) at the surface, surface at night, and dredged down to 30 fms.

Paraphoxus barnardi (Pirlot), new combination

Pontharpinia rostrata, K. H. Barnard 1931: 119, fig. 1 (not Dana 1853).

Pontharpinia barnardi Pirlot 1932: 62 (new name).

Distribution.—Low Isles, Great Barrier Reef, Australia.

Paraphoxus capillatus (K. H. Barnard), new combination
(Plate 41)

Trichophoxus capillatus Barnard 1930: 336-337, fig. 13,

Remarks.—The syntypes of this species were examined for me by Dr. Isabella Gordon in the British Museum of Natural History. Her notes indicate to me that *Trichophoxus* and *Metharpinia* are congeneric, the first name having priority and retained as a subgenus under *Paraphoxus,* serving to segregate those species with narrowed rostrums.

Additional descriptive details.—Epistome with a rounded cone shaped process in front; maxilliped palp article 4 long, slender, simple; uropods 1-2 typical of the genus, each ramus bearing a small distal claw and no

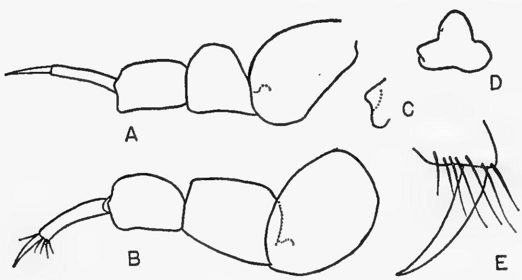


PLATE 41

Paraphoxus capillatus (K. H. Barnard), type.
Figs. A,B, peraeopods 3, 4; C, epistome; D, upper lip; E, maxillipedal palp article 4.

distal spines. Figures in Plate 41 are tracings of camera lucida sketches supplied by Dr. Gordon.

Distribution.—New Zealand, North Cape, 3 m, night.

Paraphoxus centralis (Schellenberg), new combination

Pontharpinia centralis Schellenberg 1938: 15-17, fig. 8.

Distribution.—Hawaii.

Paraphoxus cornutus (Schellenberg), new combination

Metharpinia cornuta Schellenberg 1931: 68-69, fig. 35.

Remarks.—One specimen of Schellenberg's original series was examined but not dissected. The epistome is rather large and bulbous like that of *P. longirostris* Schellenberg and *P. oculatus* (Sars). The fourth palp article of the maxilliped has a well developed apical spine, unlike *P. longirostris.*

The species is rather similar to *P. stenodes* n. sp. from the Northern Hemisphere, especially in its rostrum and uropods 1 and 2, but differs from all other known paraphoxids in the large erect terminal cusp on pleon segment 6. Peraeopod 3 is unlike that in *P. longirostris* in that articles 4 and 5 are of equal width.

Material examined.—One female, 6 mm, Swedish Museum Cat. No. 2699, 4.XII. 1895, Punta Arenas, Sandboden mit Algen, 7-8 Fd.

Distribution.—South America, southern tip at Punta Arenas and Ushuaia, Ebbestrand to 8 Fd.

Paraphoxus fuegiensis (Schellenberg)

(Plate 42)

Parharpinia fuegiensis Schellenberg 1931: 78-80, fig. 40; Stephensen 1949: 5-6.

Remarks.—I have reexamined many of Schellenberg's original specimens of this species and provide some fresh figures of a number of the morphological features, drawn mainly from one of the four syntypes.

This species finds its close relationship to such categories as *P. oculatus*, *P. spinosus*, *P. simplex* and *P. rotundifrons.* The relationships are explained in the key to the species of the genus. Because of its brief description *P. rotundifrons* appears nearly indistinct from *P. fuegiensis* but they may be segregated provisionally by the subtle differences in the shape of the third epimera.

Aberrant specimen.—A single female, 9 mm, from Swedish Museum Cat. No. 3631 is quite aberrant and may be a hybrid offspring with *P. sinuatus* (=*P.* "*villosa*," Schellenberg). The specimen is blind and its first antenna is very stout and modified to resemble the antennae of some Lysianassidae. (Plate 42, figs. S, T, U). The head shape, gnathopods, and peraeopod 5 are like those in *P. sinuatus* while the maxillipedal palp, uropods 1-2, and the third pleonal epimera are quite normal.

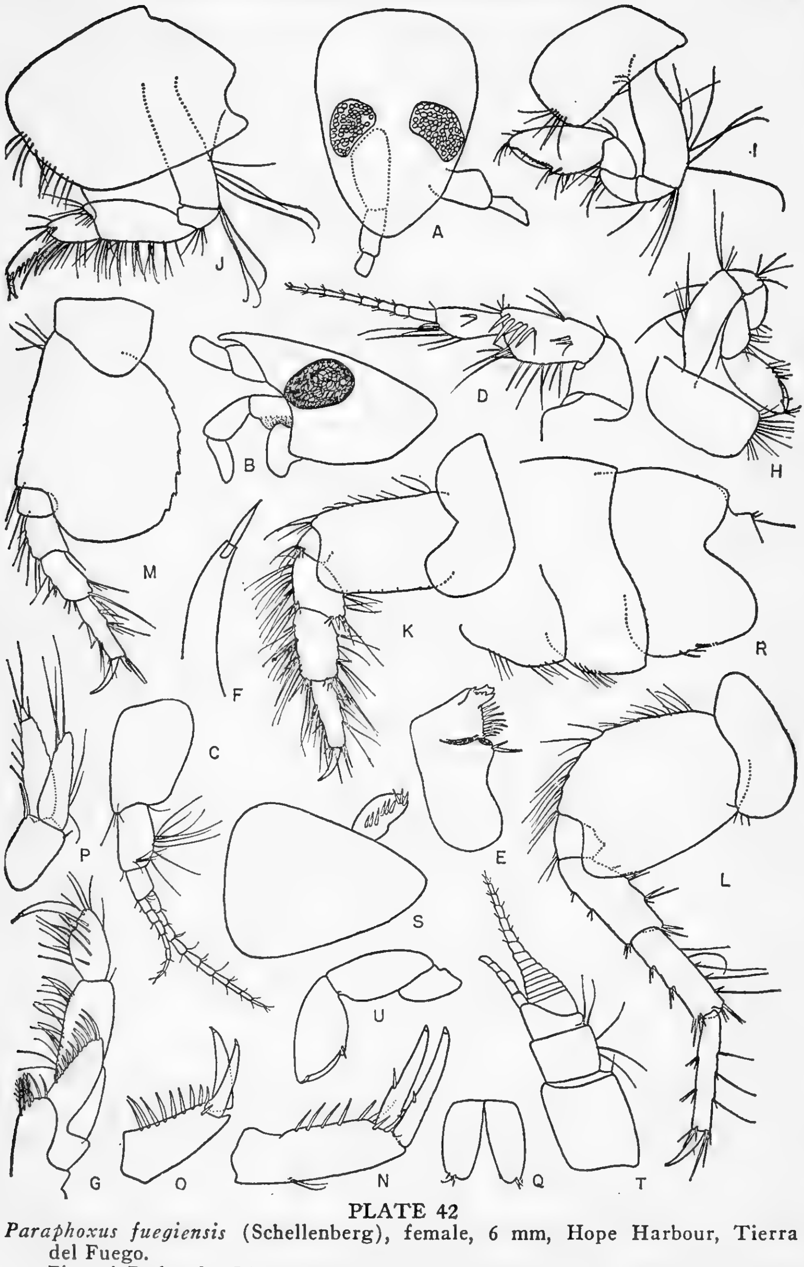


PLATE 42

Paraphoxus fuegiensis (Schellenberg), female, 6 mm, Hope Harbour, Tierra del Fuego.

Figs. A,B, head; C,D, antennae 1, 2; E, mandible; F, maxillipedal palp article 4; G, maxilliped; H,I, gnathopods 1, 2; J,K,L,M, peraeopods 2, 3, 4, 5; N,O,P, uropods 1, 2, 3; Q, telson; R, pleon segments 1-3. Female, 9.5 mm, Bahia Inutil. Figs. S, head; T, antenna 1; U, gnathopod 1.

Material examined.—Swedish Museum Cat.: No. 591, Valparaiso, 6-8 Fd (1) (other specimens are *P. "villosa"* and a new species); No. 3631, Bahia Inutil, 20-30 Fd, 23/1/96 (1) (one 4 mm juv.=*P. "villosa"*); No. 3633, Puerto Madryn, 2-5 Fd, 9/11/95 (1); No. 3634, Puerto Condor; 50 Fd, 26/2/96 (2); No. 3635, Punta Arenas, Ebbestrand, 1/12/95 (2); No. 3636, Sűd-Georgien, Cumberland Bay, 75 m, 14/5/02 (3); No. 3637, Sűd-Georgien, Grytviken, 22 m, 30/5/02 (2); No. 3638, Sűd-Georgien, Cumberland Bay, 252-310 m, 5/6/02 (1); No. 6632, Hope Harbour, 6-10 Fd, 30/4/96 (4).

Distribution.—Widely collected in the Magellanic-Fuegian archipelago at the tip of South America, shore to 50 fms; South Georgia, 40 to 170 fms; Tristan da Cunha, surface.

Paraphoxus longirostris (Schellenberg), new combination

(Plate 43)

Metharpinia longirostris Schellenberg 1931: 65-67, fig. 34; Schellenberg 1935: 232.

Remarks.—I have examined a single damaged specimen of Schellenberg's original series but have not refigured it. The specimen was abnormal in its lack of eyes and the fifth article of gnathopod 1 was much broader than Schellenberg's figure. The epistome was unproduced and the fourth palp article of the maxilliped simple; third pleonal epimeron nearly quadrate at lower posterior corner. The spines of the uropods were worn off.

The species resembles *P. stenodes* n. sp. but differs in its longer rostrum, stouter peraeopods 3 and 4, the smaller and more numerous teeth of article 2, peraeopod 5, and the straighter hind edge of peraeopod 5, article 2.

PLATE 43

Paraphoxus longirostris (Schellenberg), female, 6 mm, Valparaiso. Maxillipedal palp articles 3-4.

Material examined.—One damaged specimen, 6 mm, Swedish Museum Cat. No. 3642, Valparaiso, 7 Fd.

Distribution.—South America: Valparaiso, Corral, and south of mouth of La Plata River, 5-7 Fd.

Paraphoxus nasutus (Gurjanova), new combination

Pontarpinia (*sic*) *nasuta* Gurjanova 1936: 249-251, fig. 3; Gurjanova 1951: 382-384, fig. 232.

Distribution.—Chukchi Sea, Bering Sea, 12-15 m.

Paraphoxus obliquus (K. H. Barnard), new combination

Parharpinia obliqua K. H. Barnard 1932: 101-102, fig. 51.

Distribution.—South Georgia, horizontal net tow, 0-5 m; South Shetlands, Bransfield Strait, 200 m.

Paraphoxus ochoticus (Gurjanova), new combination

Pararpinia (*sic*) *ochotica* Gurjanova 1953: 225-229, figs. 9-10.

Discussion.—This species bears a remarkable resemblance to *P. robustus* (Holmes) and may be a subspecies of it. However, there are several significant features not described or figured by Gurjanova which may be found to be different (uropods 1-2, epistome). *P. ochoticus* differs from *P. robustus* in:

(1) the female third uropods have long inner rami.

(2) the lower antennal corner of the head is produced slightly.

(3) pleon segment 3 has a smaller and sharper tooth at the lower corner of the epimeron; the setal row appears more oblique and is not set on a ridge as in *robustus*. However, it is possible that this ridge may have been overlooked by Gurjanova, for it is scarcely apparent in juvenile animals.

Distribution.—Okhotsk Sea, eastern shore of Northern Sakhalin.

Paraphoxus pinguis (Haswell)

(Plate 44)

Urothoë pinguis Haswell 1879: 325-326, pl. 19, fig. 2; Haswell 1882: 240-241.

Pontharpinia pinguis, Stebbing 1906: 146 (in part).

not *Pontharpinia pinguis,* Stebbing 1897: 33-34, pl. 9B; Stebbing 1910: 635.

Material analyzed.—*Urothoë pinguis* Haswell 1879, type, Australian Museum, Sydney, G 5406, male?, examined by Dr. Keith Sheard, type locality Bondi Beach, length 10 mm.

Remarks.—Dr. Sheard made a very complete analysis of this type specimen and from his copious notes I have been able to distinguish the specimen which Stebbing 1897 had, as well as other similar species.

I have reorganized Dr. Sheard's notes to fit the present context but include all information supplied by him, for I believe these to be notes of utmost value, considering the importance of the species as the type of the genus *Pontharpinia,* as established by Stebbing. It should be remarked, that as far as this writer is concerned one need not be troubled by the fact that when Stebbing described the genus *Pontharpinia* using *Urothoë pinguis* as the type species he had another species of *Pontharpinia* at hand which was labeled *pinguis,* sent to him by Dr. Haswell. That species obviously was different from *P. pinguis* and I have renamed

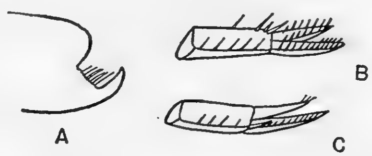


PLATE 44

Paraphoxus pinguis (Haswell), type, male?, 10 mm, Australian Museum, sketches copied from Dr. Keith Sheard's notes.
Figs. A, pleon segment 3; B,C, uropods 1, 2.

it *P. stebbingi.* Stebbing designated *U. pinguis* as the type of the genus *Pontharpinia* so that the genus must be based on the characters of *U. pinguis* regardless of what species Stebbing had at hand.

Notes on the type specimen.—Mandibles and maxillipeds missing, one first maxilla missing, the other with 2-jointed palp. Gnathopods 1 and 2 with segment 6 missing and fifth segments closely resembling Haswell's drawing (fig. 2f in Haswell 1879 shows gnathopod 1 with article 5 somewhat shorter than 6, the latter elongate-oval and rather broad).

Dr. Sheard notes that Haswell's figure of the peraeopods is "reasonably good." In Table 7 are given the relative lengths and widths of these articles as measured with an ocular micrometer by Dr. Sheard. He notes that on the type specimen the second article of peraeopod 5 is finely crenulate behind, with small, sparse setae from the crenulations. Summarizing from Sheard's notes and Table 7 we see the following important points of the last 3 peraeopods:

Relative Lengths and Widths of the articles of peraeopods 1-5 of type specimen *Urothoe pinguis* (from notes of Dr. Sheard)

	Per. 1		Per. 2		Per. 3		Per. 4		Per. 5	
Article	L	W	L	W	L	W	L	W	L	W
2	9	5	10	5	8	5	14	10	4	11
3	2	2	2	2	1	2	2	2	3	2
4	8	4.5	10	5	3	8	4	10	4	1.5
5	6	2.5	4.5	2.5	5	4	7	5.5	3	1.5
6	5	1	4	1	6	2	8.5	1.5	3	1.5
7	1	—	1	—	2		4	—	2	—

TABLE 7

Relative lengths of the articles of uropods 1-3 of type specimen *Urothoe pinguis* (from notes of Dr. Sheard)

	Uropod 1	Uropod 2	Uropod 3
Peduncle	6	3	2
Outer ramus	5.5	5	6
Inner ramus	5	4	6
Articles of outer ramus of uropod 3= 5:1.			

TABLE 8

Peraeopod 3: article 4 is more than half again as wide as article 2, article 5 is half as wide as article 4 and nearly as wide as article 2; article 6 is longer than 5 and very slender, while article 7 is very short.

Peraeopod 4: article 4 is as wide as 2 and wider than article 4 of peraeopod 3; article 5 is about half as wide as article 4 and article 6 is longer and much narrower than 5; article 7 is twice as long as in peraeopod 3.

Peraeopod 5: the expansion of article 2 is slightly wider than article 2 of peraeopod 4, the rest of the articles being very narrow, articles 5 and 6 being equal in length.

Uropods 1-3: all with each pair of rami subequal in length.

Uropod 1: peduncle with a row of setae along outer margin, inner margin with several setae; posterior edge of peduncle with a large spine, then a smaller one near it and then a small thin one; a small spine is in the middle of the inner margin; outer ramus with 6 setae along proximal outer margin, none on inner margin, each distal margin with 5 short spines each. Inner ramus with 7 thin spines along each margin.

Uropod 2: peduncle with 4 spines along dorsal surface, one large spine near end; outer ramus with possibly 10 small spines on dorsal surface; inner ramus with 3 spines at end on dorsal surface.

Uropod 3 with the rami subequal in length.

Relative lengths of the various articles on the uropods are seen in Table 8.

Telson missing.

The most remarkable part of Dr. Sheard's notes is the drawing of the third pleonal epimeron, which, as Sheard wrote, is quite different from the drawing of Haswell (pl. 19, fig. 2, whole animal). Haswell showed the lower posterior corner of the epimeron to be quadrate; actually the type specimen has a very long, slightly upturned tooth at this point, while the posterior edge has several long setae (see Plate 44, fig. A which is copied from Sheard's notes).

Sheard notes that the urosome of the type specimen is damaged.

Distribution.—Known only from the type locality, Bondi, New South Wales, Australia.

Paraphoxus pyripes K. H. Barnard

Paraphoxus pyripes K. H. Barnard 1930: 332-333, fig. 10.
Pontharpinia maxima Stephensen 1947: 42-44, fig. 15-16.

Remarks.—Dr. Isabella Gordon of the British Museum (Natural History) examined the holotype of this species for me (*P. pyripes*). The apex of maxillipedal palp article 4 has a defiinite distal spine.

The large size, small eyes, nearly exact correspondence of peraeopods 3-5 and especially the third pleonal epimeron and the geographic distribution indicate that *P. maxima* is a synonym of *P. pyripes.*

Distribution. — New Zealand, off Campbell Island; McMurdo Sound, Antartica; Bridgeman, Graham Region, Antartica. Surface to benthos of 750 meters.

Paraphoxus rostratus (Dana)

Urothoe rostratus Dana 1853: 921-922, pl. 62, fig. 5.
Urothoë rostratus, Bate 1862: 118, pl. 20, fig. 4.
Phoxus Batei Haswell 1879: 259-260, pl. 9, fig. 3; Haswell 1882: 237-238 (both reference *fide* Stebbing 1906).
Pontharpinia rostrata, Stebbing 1906: 146-147; Stebbing 1910: 635; Pirlot 1932: 62-68, figs. 12-14 (in part, not fig. 15 = *Paraphoxus sp.).*
?Pontharpinia rostratus, Stebbing 1914: 357 (Falkland Islands).
not *Phoxus batei,* Thomson 1882: 232-233 (=*P. australis,* fide Hurley, 1954).

not *Pontharpinia rostrata,* K. H. Barnard 1931: 119, fig. 1 (=*P. barnardi, fide* Pirlot 1932).

Remarks.—The figures by Pirlot 1932 correspond favorably with those of Dana 1853 and there is little doubt that Pirlot had Dana's species. Although the measured proportions of some of the articles of peraeopods 3, 4, 5 do not compare properly, this may be attributed to slight exaggerations on Dana's small figures.

It is most important to rediscover 'Phoxus Batei' of Haswell 1879 and determine that it is, indeed, *P. rostratus,* as it would appear to be from the literature. The types apparently are not in the Australian Museum and labeled specimens there belong to another species (see my *Paraphoxus* sp. Australia).

The occurrence of this species in the Falkland Islands as written by Stebbing 1914 is questionable, because of geography and temperature.

Distribution.—Sulu Sea; Port Jackson, Australia; coast south of Manipa Island.

Paraphoxus rotundifrons (K. H. Barnard), new combination

Parharpinia rotundifrons K. H. Barnard 1932: 104, fig. 53.
Pontharpinia (*rotundifrons*) ?, Stephensen 1947: 44-45, fig. 17.

Distribution.—South Georgia, 18-235 m; South Sandwish Islands; South Shetland Islands, Deception.

Paraphoxus simplex (Gurjanova), new combination

Parharpinia simplex Gurjanova 1938: 272-274, 385-386, fig. 10.
Pararpinia (*sic*) *simplex,* Gurjanova 1951: 392-394, fig. 238.

Distribution.—Japan Sea.

Paraphoxus sinuatus (K. H. Barnard)

(Plate 45)

Parharpinia sinuata K. H. Barnard 1932: 103-104, fig. 52.
Parharpinia villosa, Schellenberg 1931: 75-78, fig. 39; (not Haswell 1879); Schellenberg 1935: 232.
Paraphoxus sinuatus, J. L. Barnard 1958: 147-148.

Diagnosis of female.—Head rather large, broad basally, the rather long rostrum tapering anteriorly; eyes medium in size, roundish. Body somewhat slender.

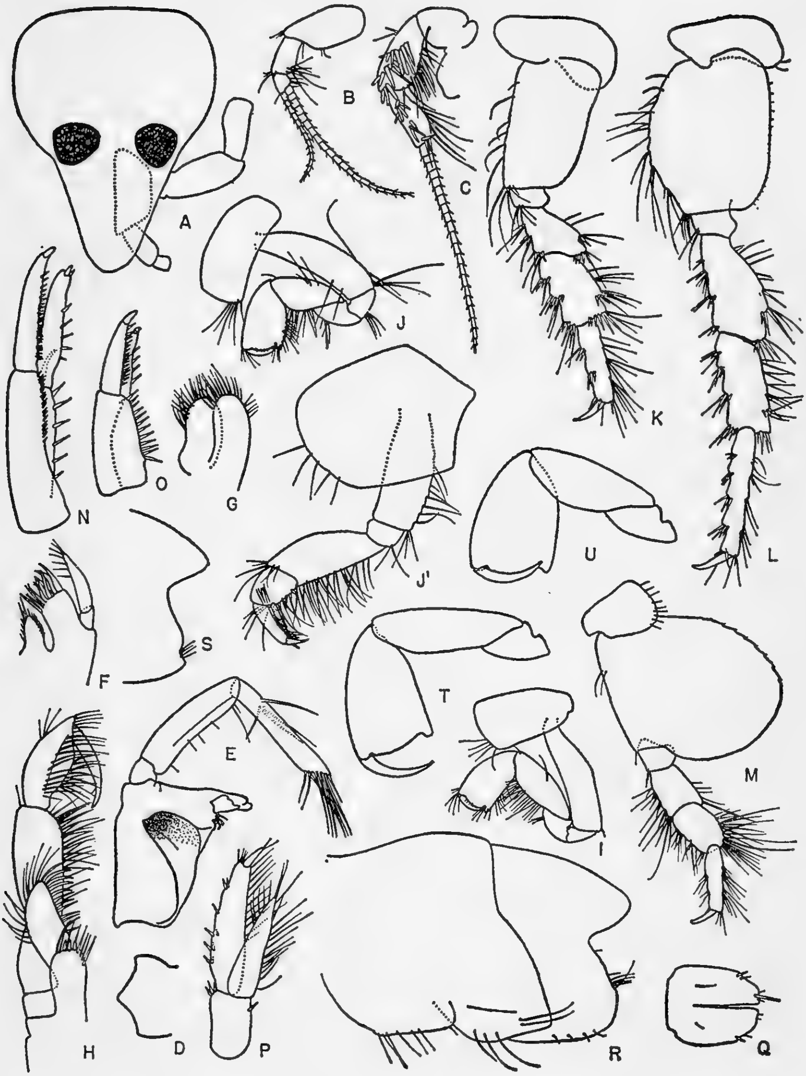


PLATE 45

Paraphoxus sinuatus (K. H. Barnard), female, 12.5 mm, Isla Nueva, Tierra del Fuego.

Figs. A, head; B,C, antennae 1, 2; D, epistome; E, mandible; F, G, maxillae 1, 2; H, maxilliped; I,J, gnathopods 1, 2; T,U, gnathopods 1, 2; J,K,L,M, peraeopods 2, 3, 4, 5; N,O,P, uropods 1, 2, 3; Q, telson; R, pleon segments 1-3.

Juvenile, 4.5 mm, Punta Arenas. Fig. S, pleon segment 3.

Epistome slightly conical anteriorly.

Maxillipedal palp article 4 simple apically.

Gnathopod 1: article 5 slender, longer than 6, the latter well expanded, palm nearly transverse. Ratio of lengths of articles 5 and 6: Gnathopod 1 = 25:22, Gnathopod 2 = 1:1 (23:23).

Peraeopod 3: articles 4-5 very slender, articles 5-6 subequal in length. Ratio of widths of articles 2, 4, 5, 6 = 23:17:17:7.

Peraeopod 4 slender, articles 4-5 equal in length, article 6 longer than either. Ratio of widths of articles 2, 4, 5, 6 = 36:18:16:7.

Peraeopod 5: article 2 broadly expanded, ratio of width to length is 49:51, sweep point at base of article 3, lower edge broadly convex, posterior edge with 9-10 minute teeth; article 6 much longer than either 4 or 5.

Uropods 1 and 2: rami shorter than peduncle, the outer rami of both uropods with numerous small spines, inner rami with a few large spines; the medial and lateral edges of the peduncle of uropod 1 also have dissimilar spine rows; peduncle of uropod 2 with large spines; apices of rami with movable spine. Note that the inner ramus of uropod 2 bears spines, unusual in the genus.

Uropod 3: inner ramus about two thirds as long as outer, article 2 of outer ramus about one fifth as long as article 1; inner ramus rather setose for a female.

Telson very broad, apices truncate, each with a larger and 2 minute spines, lateral edges with subapical notches about three-fourths the length from the base, each bearing 2 spines.

Third epimeron: posterior edge nearly straight, slightly produced at lower corner, but with a long, nearly parallel margin below the lower corner sweeping onto the lower edge; setae sparse.

Male.—See Schellenberg 1931.

Remarks.—Schellenberg identified his South American specimens with the Australian *P. villosa* (Haswell). I have been able to examine some of Schellenberg's specimens and have compared them with notes of the type of *P. villosa* supplied by Dr. Sheard. The comparison demonstrates that the South American *"villosa"* is a distinct species (see notes below).

In 1932 Dr. K. H. Barnard erected *P. sinuata*, the brief description and figures of which fit Schellenberg's *"villosa."* Thus, *P. sinuata* takes priority as the valid name.

Notes on identification.—The following differences are considered by me sufficient to warrant specific rank for South American *"villosa"*

(=*sinuata*). Undoubtedly direct comparison of specimens with the type of *P. villosus* would reveal additional differences.

(1) gnathopod 1: ratio of articles 5-6: *villosus* = 6:5; *P. sinuatus* = 7:8. Article 6 has parallel edges in *P. sinuatus* and expanded-convex edges in *P. villosus.*

(2) peraeopod 3: article 4 is as wide as article 2 in *P. villosus* but only two thirds as wide as article 2 in *P. sinuatus.*

(3) peraeopod 5, article 2: posterior edge in *P. sinuatus* has sparse serrations with short setae, while Dr. Sheard states that in *P. villosus* the posterior edge has fine crenulations and long setae.

(4) uropod 1 peduncle: the spines are of different sizes on the outer and inner edges in *P. sinuatus* while they are of similar size, and less numerous, in *P. villosus.*

(5) uropod 2, inner ramus: spines present on *P. sinuatus* and absent in *P. villosus.*

Other relationships.—*Paraphoxus sinuatus* is quite similar superficially to *P. obtusidens* from Pacific North America but differs in the following ways:

(1) uropod 1, outer ramus: the entire length is lined with small spines, while in *P. obtusidens* they occur only proximally.

(2) uropod 2: the inner ramus lacks spines in *P. obtusidens.* The spination of the rami of uropods 1-2 is distinctly different (see above remarks) than in *P. obtusidens.*

(3) the head is broader and flatter and somewhat demarcated in front of the eyes (in this way similar to *P. obtusidens major*).

(4) third epimeron: the sweeping edge below the lower corner is never as pronounced in *P. sinuatus* as in those forms of *P. obtusidens* which are similar.

(5) the telson is broader and armed differently in the two species.

Abnormal specimens.—The enlarged figures of the gnathopods shown herein are of another specimen (Swedish Museum Cat. No. 2741) and show somewhat broader hands than normal.

A presumed juvenile included in Cat. No. 3639 (SSM) had a rather convex posterior edge on the third epimeron above the lower corner and the lower edge curved up broadly to meet the lower corner. The outer rami of uropods 1 and 2 had 4-5 and 2-3 rather large spines respectively, instead of relatively numerous small spines in the adults. Development in this species should be studied more intensively to verify juvenile and adult differences.

Material examined.—Swedish Museum Cat.: No. 2722, Bahia Inutil, 20-30 Fd, 23/1/96 (11); No. 2728, Bahia Inutil, 11-5 Fd, 23/1/96 (1); No. 2741, Isla Nueva, 30 Fd, 7/2/96 (15); No. 3639, Punta Arenas, 7-8 Fd, 4/12/95 (1); No. 3640, 54-43 S, 64-08 W. Feuerland, 6/1/02, 36 m (2).

Changes in identification.—Swedish Museum Cat.: No. 591, Valparaiso, 6-8 Fd, 4 females, 3 juv. labeled as *P. fuegiensis* but are *"villosa"*, probable transcription error, for these specimens appear to be listed in combined groupings of Schellenberg 1931: 75; No. 3641, Puerto Madryn, 2-5 Fd, 9/11/95, 1 ovig. female, 6 mm, specimen appears to be a new species, not *"villosa"*; it has a long tooth at the lower corner of the third epimeron.

Distribution.—From Valparaiso, Chile, through the Magellanic-Fuegian archipelago at the tip of South America to South Georgia in the South Atlantic Ocean, 2 to 87 fms.

Paraphoxus stebbingi J. L. Barnard

Pontharpinia pinguis, Stebbing 1897: 33-34, pl. 9B; Stebbing 1906: 146 (in part); Stebbing 1910: 635 (in part).

Paraphoxus stebbingi J. L. Barnard 1958: 148.

Remarks.—This category was provided with a new name by me due to the considerable differences between the description and figures of Stebbing 1897 and the type of *P. pinguis* as examined by Dr. Keith Sheard. Further comments on this species are unnecessary until new collections can be made in Australia.

Distribution.—Jervis Bay, New South Wales, Australia.

Paraphoxus tattersalli J. L. Barnard

Parharpinia villosa, Tattersall 1922: 4-6, pl. 1, figs. 7-14 (not Haswell 1879).

Paraphoxus tattersalli J. L. Barnard 1958: 148.

Distribution.—Abrolhos Islands, Indian Ocean.

Paraphoxus uncigerus (Gurjanova), new combination

Parharpinia uncigera Gurjanova 1938: 267-269, 385, fig. 8.

Pararpinia (*sic*) *uncigera,* Gurjanova 1951: 388, fig. 236.

Distribution.—Japan Sea, Okhotsk Sea.

Paraphoxus uncinatus (Chevreux), new combination

Pontharpinia uncinata Chevreux 1912: 4; Chevreux 1912a: 100-104, figs. 10-12.

Distribution.—Port-Lockroy, chenal de Roosen, 60-70 m (Holland?).

Paraphoxus villosus (Haswell)

Phoxus villosus Haswell 1879: 258-259, pl. 9, fig. 2; Haswell 1882: 236-237.

Parharpinia villosa, Stebbing 1906: 147-148 (in part); Stebbing 1910: 638.

not *Parharpinia villosa,* Tattersall 1922: 4-6, pl. 1. figs. 7-14 (=*P. tattersalli*); Schellenberg 1926: 300-301 (=*P.* sp.); Schellenberg 1931: 75-78, fig. 39 (=*P. sinuata*); Schellenberg 1935: 232 (=*P. sinuata*).

not *Pontharpinia villosa*, K. H. Barnard 1940: 442-443 (=*P.* sp.).

not *Phoxus batei,* Thomson 1882: 232-233 (not Haswell 1879) (= *P. australis*).

Material analyzed.—Type specimen of *Phoxus villosus* Haswell, 1879, female, 11 mm, G 5413, Australian Museum, Sydney, examined by Dr. Keith Sheard.

Remarks.—The examination by Dr. Keith Sheard of this specimen has been valuable in showing that the *P. villosus* of many others, such as Tattersall 1922 and Schellenberg 1931, were other species.

From Dr. Sheard's notes it appears that Haswell's figures of this specimen are adequate (pl. 9, fig. 2).

Gnathopods 1 and 2 with article 6 broadly expanded, the palm nearly transverse. Dr. Sheard's measurements show that in gnathopod 1 the ratio of lengths of articles 6 to 5 is 6:5 while in gnathopod 2 it is 6:4, article 5 being a little shorter than 6 in the first gnathopod.

Table 9 gives the relative lengths and widths of the articles of the 5 pairs of peræopods as measured by Dr. Sheard. These show that peraeopods 3-5 were well figured by Haswell; salient features include the facts that peræopods 3 and 4 are rather slender (a point used by Stebbing 1899 to distinguish the genus *Parharpinia* for which this species is the type) and the second article of the fifth peræopod is very broadly expanded. The posterior edges of article 2 of peræopods 4 and 5 are finely crenulated and bear long setæ.

Uropod 1: the peduncle bears 7 spines on the inner margin and 3 on the outer margin near its distal end. The outer ramus has 10 small spines while the inner has 2 large ones in the middle of the margin.

Uropod 2: outer margin of peduncle with 10 spines, inner margin bare. Outer ramus with 7 spines along margin, inner ramus devoid of spines.

Relative Lengths and Widths of the articles of peraeopods 1-5 of the type specimen of *Phoxus villosus* (from notes of Dr. Sheard).

Article	Per. 1		Per. 2		Per. 3		Per. 4		Per. 5	
	L	W	L	W	L	W	L	W	L	W
2	7	2.5	8	3	12	4	14	8.5	9	12
3	1	2	1	2	2	3	2	3	1	2
4	8	4	9	4.5	4.5	4	7	4	3	3
5	4	3	4	3	4.5	4	6	3	3	2.5
6	5	1	5	1	7	2	11	1.8	5	1.3
7	1		1		2		4		3	

TABLE 9

Relative lengths of the articles of uropods 1 to 3 of the type specimen of *Phoxus villosus* (from notes of Dr. Sheard).

	Uropod 1	Uropod 2	Uropod 3
Peduncle	7	5.5	2.5
Outer ramus	8	5	5
Inner ramus	7	5.5	3.5
Articles of outer ramus of uropod 3= 9:1			

TABLE 10

Each ramus of first two uropods terminates in a stout, movable spine. Table 10 gives the relative lengths of the peduncles and rami of the first 3 pairs of uropods.

Epimeron of pleon segment 3 subquadrate, lower posterior corner rounded, rear margin crenulate, with a seta at each angle of the crenulations.

Telson with apices broadly truncated, at each side of each apex is a pair of setules, and 3 setules along each lateral margin of each lobe.

Maxilliped: palp article 4 long and attenuated but lacking a terminal spine.

Synonymy.—The *Parharpinia villosa* of Schellenberg 1931 differs from the type specimen in the more numerous spines of the first 2 uropods, the longer fifth articles of the first 2 pairs of gnathopods and the configuration of the telson. In addition, the posterior edges of the second articles of peræopods 4-5 are finely crenulated but not armed with long setæ. Despite the other features which show that these two species are closely related and may represent subspecies I feel it wise to keep the South American species under its available name of *P. sinuatus* (K. H. Barnard).

Distribution.—Know only from the type locality, Port Jackson, New South Wales, Australia.

Paraphoxus sp., Australia

Material analyzed.—Two specimens labeled *Phoxus Batei* Haswell 425, Pt. Jackson, P 3438 (type locality of the species), Australian Museum, Sydney, analyzed by Dr. Keith Sheard.

Identification.—It was thought that these specimens represented the types of *P. batei* Haswell but apparently they are not the types and possibly not even *P. batei*, for there is some difference in the fourth and fifth peræopods when compared with Haswell's drawings. Thus, it appears that the types have been lost, unless they are these specimens, unlabeled as such. The specimens are of interest, however, for they represent an additional Australian species, as differentiated below from Dr. Sheard's notes. They were not dissected.

Description of specimen A.—Length 4.7 mm.

Maxilliped, article 4 as long as 3, bearing a thin, terminal spine.

Gnathopod 2 slightly larger than 1 but similar in proportions, the fifth articles as long as the sixth, article 6 nearly square in outline, having a length to width ratio of 2.00:1.75, the palm nearly transverse, article 5 slender, having a ratio of 2:1. Haswell's figures show article 6 longer than broad.

Peraeopods: Table 11 gives the relative lengths and widths of the respective articles. Comparing these proportions with the illustrations of Haswell (1879 pl. 9, fig. 3) the most important differences involve peræopods 3 and 4, of which articles 4 and 5 in the present material are the same width respectively in each appendage, while in Haswell's drawings article 5 is narrower than article 4 in both appendages.

In peraeopod 4, article 6 is much longer than 5 in Haswell's drawings, while in the present material article 6 is much shorter than 5. Peræopod 5, article 2 has crenulations extending in a semicircle from the middle of the hind margin onto the entire lower edge.

Uropod 1: peduncle with 3 setæ on inner margin and a small spine at the end, outer margin with 2 small distal spines. Outer ramus

Lengths and widths of articles of last three peraeopods, by ratios, *Paraphoxus* sp., Australia.

Article	Perpd. 3		Perpd. 4		Perpd. 5	
	L	W	L	W	L	W
2	3	2.5	5	3	2.5	3
3	1	1	1	1	1	1
4	1.5	2	3	1.5	1.5	1
5	2	2	2.5	1.5	1.5	0.5
6	2	1	1.5	0.5	2	0.5
7	1	—	0.5	—	0.5	—

TABLE 11

Relative lengths of articles of uropods 1-3, by ratios, *Paraphoxus* sp., Australia

	Uropod 1	Uropod 2	Uropod 3
Peduncle	2.5	1.5	1
Outer ramus	2.0	1.25	1
Inner ramus	2.0	1.0	0.5

TABLE 12

with 4 small spines along middle of upper edge. Inner ramus with 2 small spines along middle of upper edge.

Uropod 2: peduncle with 2 small spines on dorsal edge and one at distal end. Outer ramus with one small spine in middle of upper edge. Inner ramus with 2 small spines in middle of upper edge.

Table 12 gives the relative lengths of the several articles of the three pairs of uropods. The apical tips of the rami are nonmovable chitin.

Third epimeron: rounded behind and minutely dentated, lower posterior corner bears a very small tooth.

Remarks.—The specimens obviously are different from other Australian species such as *P. villosus*, *P. pinguis*, *P. australis*, and *P. rostratus* and probably represent a new species. *Phoxus batei*, as a specific category, has been fused with *P. rostratus* (Dana).

Paraphoxus sp., Flores Sea

Pontharpinia rostrata, Pirlot 1932: 62, fig. 15 (in part) (not Dana 1853).

Remarks.—The parts of the male specimen figured by Pirlot in his fig. 15 appear not to correspond with his other material, both in the slender fourth peræopod and in the lack of a well defined spine on maxillipedal palp article 4. These characters are not represented as sexual differences in species which the writer has examined. It would be preferable to keep this material distinct from Pirlot's other specimens of *P. rostratus* until further examination can be made.

Distribution.—Flores Sea, plankton.

Paraphoxus sp., South Africa

Parharpinia villosa, Schellenberg 1926: 300-301 (not Haswell 1879).

Pontharpinia villosa, K. H. Barnard 1940: 442-443 (not Haswell 1879).

Remarks.—Schellenberg compared his 3.5 mm juvenile with the description of Tattersall 1922 (which is also not *P. villosa)* and noted a few minor differences. Barnard 1940 says that Schellenberg's material is probably *Pontharpinia stimpsoni* (which I removed to the new genus *Mandibulophoxus* J. L. Barnard 1957) but if this were the case Schellenberg undoubtedly would have noted the many distinctive characteristics of *stimpsoni* not possessed by even Tattersall's *villosa* and would have mentioned them.

The writer prefers to keep these records in a separate category until further exploration reveals what Schellenberg had.

Distribution.—Simons Bay, South Africa.

Dubious Species of Paraphoxus

Phoxus grandis Stimpson 1857: 521. San Francisco Bay, California. Possibly *P. milleri* or *P. obtusidens.*

Phoxus geniculatus Stimpson 1856: 382; Bate 1862: 100. Japan.

Phoxus obtusus Stimpson 1856: 382; Bate 1862: 100. Japan.

Phoxus erythrophthalmus Catta 1875: 163. Mediterranean.

General Zoogeography of the Genus Paraphoxus

Studies on the genus *Paraphoxus* have been concentrated in only a few widely scattered areas of the world (see Chart I and Table 13).

In the northern and eastern Atlantic, including the Mediterranean Sea, well studied areas, a single species of the genus is known (*P. oculatus* = *P. maculatus*) which is also known from the eastern Pacific, Japan Sea and South Africa. The species may be cosmopolitan in temperate and subarctic regions.

The western Atlantic Ocean, presumably a well studied area supports only three species of the genus, all of which are known from the eastern Pacific, as well.

The high latitudes of South America have four, possibly a fifth species, one of which is shared with the three species of Antarctic regions.

The Antarctic shares another of its three species with southwestern Pacific faunas.

The southwestern Pacific area, though poorly studied, has nine species, most of which are rather poorly described and not widely collected.

The central Pacific supports one known species, poorly described or indistinguishable as a specific entity.

The northeastern Pacific, especially southern California, is well known through the present study. Nineteen species of the genus are known in the area, of which three are shared with the northwestern Pacific and three with the western Atlantic.

The northwestern Pacific, including Japan Sea and Okhotsk Sea, has seven well known species of the genus and a single species has been described from subarctic Bering and Chukchi Seas.

From Chart 1 and Table 13 the relationships of the faunas, as known, can be seen. It is clear that the North Atlantic is impoverished of the genus *Paraphoxus* while the North Pacific has at least 23 distinct species. It would appear likely that the North Pacific was a center for the evolution of the genus and perhaps for the family, as well (J. L. Barnard 1958). It is strange that only one species of the many in the North Pacific has managed to reach European waters (*P. oculatus*); it is a species which, in southern California, is rarely collected and usually at depths greater than 300 ft, not being able to exist on the coastal shelves, where warmer temperatures or competition may exclude it. Like other cosmopolitan amphipods discussed by Barnard (1959) and Barnard and Reish (1959), it thrives in areas of little competition, such as the North and eastern Atlantic.

The three species of the western Atlantic, all of which are found also in the eastern Pacific, are relatively warm water animals and their pathway of migration is suggested as west to east through middle America.

With the exception of *P. oculatus*, no species is common to the northern and southern hemispheres, although a number of northeastern Pacific animals should be expected as far south as Peru.

The most important point to be gathered from Chart 1 is the large area of oceans which remains unstudied; the provisional conclusions regarding faunal relationships will be modified considerably when the unknown faunas have been examined.

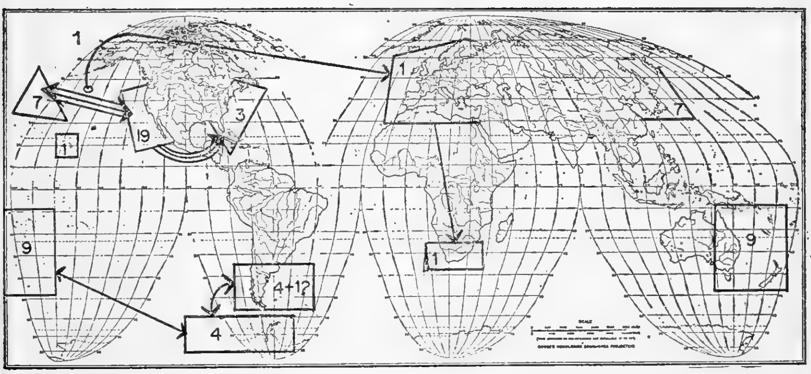


CHART 1

World map showing distribution of *Paraphoxus* by area.

Numbers in each area designate the number of known species. Arrows indicate the number of species shared between the areas. Direction of the arrows indicate migration of the species from its center of origin. Bidirectional arrows indicate no opinion or knowledge concerning the origin.

List of the members of the genus *Paraphoxus* by major world area, as plotted on Chart 1.

NORTHWESTERN PACIFIC OCEAN (Japan Sea, Okhotsk Sea)

P. calcaratus .... N.E. PAC.
P. milleri .... N.E. PAC.
P. obtusidens .... N.E. PAC.
P. ochoticus
P. oculatus .... N.E. PAC., ATLANTIC
P. simplex
P. uncigerus

SUBARCTIC (Bering and Chukchi Seas)

P. nasutus

CENTRAL PACIFIC OCEAN

P. centralis

NORTHEASTERN PACIFIC OCEAN (British Columbia to Guatemala)

P. abronius
P. bicuspidatus
P. calcaratus .... N.W. PAC.
P. cognatus
P. daboius
P. epistomus .... W. ATLANTIC
P. fatigans
P. floridanus .... W. ATLANTIC
P. heterocuspidatus
P. lucubrans
P. milleri .... N.W. PAC.
P. obtusidens .... N.W. PAC.
P. oculatus .... N.W. PAC.,ATLANTIC
P. robustus
P. similis
P. spinosus .... W. ATLANTIC
P. stenodes
P. tridentatus
P. variatus

WESTERN ATLANTIC OCEAN (Canada to Cuba)

P. epistomus .... E. PAC.
P. floridanus .... E. PAC.
P. spinosus .... E. PAC.

NORTHERN, EASTERN, SOUTHEASTERN ATLANTIC

P. oculatus .... N. PAC.

SOUTH AMERICA, HIGH LATITUDES (Chile, Magellan, Falklands)

P. cornutus
P. fuegiensis
P. longirostris
P. sinuatus .... ANTARCTIC
?P. rostratus (Falklands)

ANTARCTIC

P. pyripes (=maximus) .... S.W. PAC.
P. rotundifrons
P. sinuatus .... SOUTH AMERICA

SOUTHWESTERN PACIFIC (Australia, New Zealand)

P. australis
P. barnardi
P. capillatus
P. pinguis
P. pyripes .... ANTARCTIC
P. rostratus .... ?Falklands
P. stebbingi
P. tattersalli
P. villosus

TABLE 13

Genus **Microphoxus**, new genus

Diagnosis.—Maxillipedal palp article 4 bears two apical setæ; eyes present; article 2 of peræopod 3 broad; rami of uropods 1 and 2 with apical spines; head with very short, narrow rostrum; maxilla 1 with biarticulate palp; mandible with simple molar.

Type species.—*Microphoxus minimus,* n. sp.

Remarks.—This genus is related to *Paraphoxus* more than to any other phoxocephalid genus, but differs in the apical setæ on the fourth maxillipedal palp article. The very small rostrum and apical spines on the rami of uropod 2 also are characteristic.

Microphoxus minimus, new species

(Plate 46)

Descriptive features.—Eyes very small, each composed of 3-5 lenses; epistome not produced; peræopod 5 with posterior lobe of article 2 produced down to the middle of article 5, posterior edge bearing 3 medium sized teeth; third pleonal epimeron with posterior edge nearly straight, lower corner rounded and bearing a short submarginal oblique row of setæ.

Holotype.—USNM Cat. No. 97308, female, 2.25 mm.

Type locality.—Station 460-35, Playa Blanca, Costa Rica, 10-56-00 N, 85-52-50 W, 3-5 fms, sand, shell, Feb. 8, 1935.

Remarks.—A fragment of a male specimen also was collected at the type locality. The eyes are quite large and quadrangular, the second antenna about three fourths as long as the body. The urosome is missing.

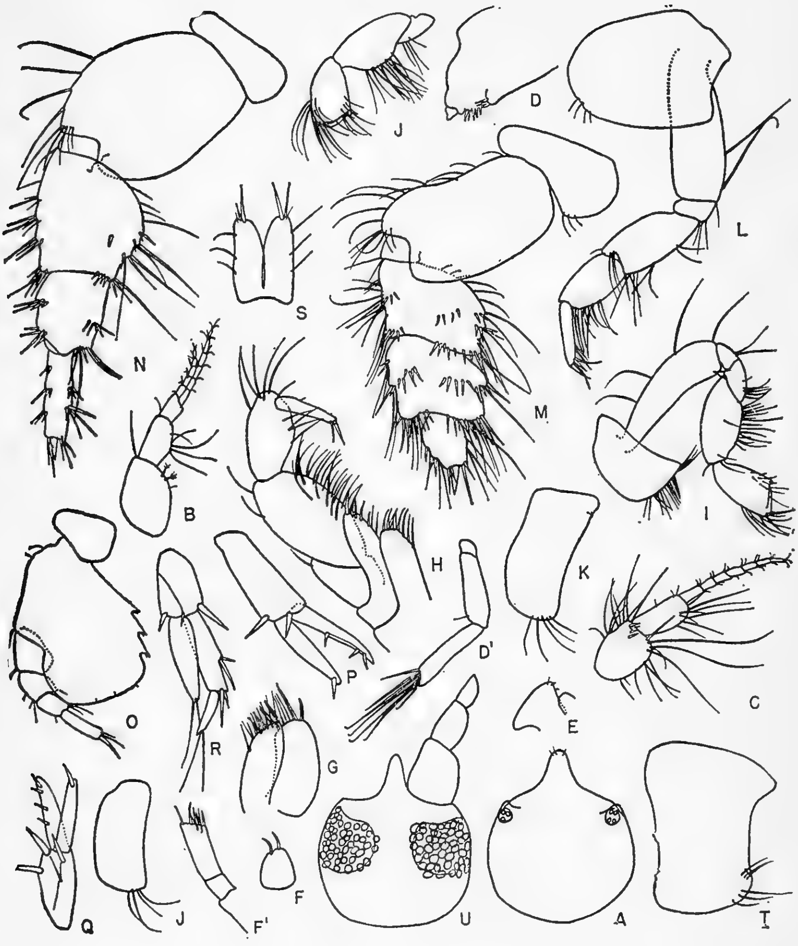


PLATE 46

Microphoxus minimus n. gen., n. sp. Female, holotype, 2.5 mm, Sta. 460.

Figs. A, head; B,C, antennae 1, 2; D,D', mandible; E. lower lip, half; F, maxilla 1, inner plate; F', maxilla 1, palp; G, maxilla 2; H, maxilliped; I,J, gnathopods 1,2; J',K, coxae 2, 3; L,M,N,O, peraeopods 2, 3, 4, 5; P,Q,R, uropods 1, 2, 3; S, telson; T, pleon segment 3.

Male, fragment, Sta. 460.

Fig. U, head.

Genus Phoxocephalus Stebbing

Phoxus Krøyer 1842: 150 (not Billberg 1820, Coleoptera).
Phoxocephalus Stebbing 1888: 810-811 (new name).

Diagnosis.—Molar process of mandible well developed, ridged and cuspate apically; third uropods with slender, elongated rami.

Type species.—*Phoxus holbölli* Kröyer 1842.

Remarks.—This group of species is the only assemblage in the family which is characterized by the ridged molar of the mandible, except for the genus *Joubinella.*

It is a genus which includes several different species-groups and therefore may be polyphyletic and quite artificial. The groups are as follows:

(1) The type species, *P. holbölli,* lacks eye lenses and has rather small gnathopods. Atlantic Ocean.

(2) Four species, *P. bassi*, *P. regium*, *P. kergueleni* and *P. homilis*, differ from the type species by the presence of lensed eys, and enlarged, eusirid-type gnathopods. Pacific, Indian and Antarctic Oceans.

(3) *P. tenuipes* lacks eye lenses but has enlarged gnathopods; it has an elongated fourth peraeopod, a minor difference. North Atlantic.

(4) *P. coxalis* is unusual in having a slender second article on the third peræopod, a character often used for generic separation; gnathopods enlarged. South Atlantic Ocean.

I believe that it is premature to stratify these groups with different names. However, there may be future zoogeographic evidence which will verify a more distant relationship between these groups than now shown by their morphologies. The two North Atlantic species show the stepwise loss of eye lenses *(tenuipes* and *holbölli)* and reduction of gnathopod size (*holbölli*) which may be evidence of long isolation from more primitive Pacific elements, bearing eye lenses and enlarged gnathopods.

Other generic features.—Palp of maxilla 1 uniarticulate, palp of maxilliped with long fourth article bearing a short terminal seta; second antenna of male as long as body; posterior edge of peraeopod 5, article 2, poorly sculptured.

Note on P. capuciatus.—Oliveira 1955 has described a new species *Phoxocephalus capuciatus,* which should be removed to *Platyischnopus gracilipes* Schellenberg 1931 in the Haustoriidæ.

Key to the Genus **Phoxocephalus**

1. Peraeopod 3, article 2 very slender..*coxalis*
1. Peraeopod 3, article 2 broad.. 2
2. Eyes absent or structurally deficient.. 3
2. Eyes usually well developed and bearing ommatidea..................... 4
3. Gnathopods 1-2, article 6 longer than broad,...............................
   peraeopod 4 rather short...*holbőlli*
3. Gnathopods 1-2, article 6 as broad as long,..................................
   peraeopod 4 quite long...*tenuipes*
4. Gnathopod 2, article 6 as broad as long..................................*bassi*
4. Gnathopod 2, article 6 longer than broad...................................... 5
5. Uropod 1, rami equal in length...*regium*
5. Uropod 1, rami unequal in length... 6
6. Uropod 2 with one stout peduncular spine, rami bare.....*kergueleni*
6. Uropod 2, peduncle and outer ramus with......................................
   several slender spines.......................................*homilis* n.sp.

Phoxocephalus coxalis K. H. Barnard

Phoxocephalus coxalis K. H. Barnard 1932: 97-99, fig. 48.

Diagnosis.—Eyes well developed and bearing lenses; gnathopod 2, article 6 longer than broad; peræopod 3, article 2 very slender; epimera of pleon segment 3 convex and smooth behind; rami of uropod 1 equal in length; posterior lobe of article 2 of peræopod 5 narrowing distally.

Remarks.—This species is unique for the slender second article of the third peræopod, similar to harpiniid-type phoxocephalids.

Distribution.—Near South Georgia, 53° 42′ S, 37° 12′ W, pelagic, 0-5 m.

Phoxocephalus holbölli (Kröyer)

(Plates 47, 48)

Phoxus Holbőlli Krøyer 1842: 151-152; Krøyer 1845: 551-563; Bate 1857: 140; Bate 1862: 98, pl. 16, fig. 2; Goës 1866: 528; Norman 1869: 278 (in part); Boeck 1876: 214, pl. 7, fig. 5; Jarzynsky 1885:168; Sars 1886: 44-45.

Phoxus Holbőllii, Boeck 1871: 134-135.

Phoxus Holbőlli, Hansen 1888: 85; Schneider 1891: 103-104; Meinert 1893: 159.

?Phoxus holbőlli, Robertson 1888: 28.

Phoxus Kröyeri Stimpson 1853: 58; Bate 1862: 101; Smith 1873: 556.
?Phoxus simplex Bate 1857: 525 (also see *Metaphoxus pectinatus*); ?Robertson 1888: 27-28.
Phoxocephalus Holbölli, Sars 1895: 144-145, pl. 49; Norman 1900; 334; Norman 1902: 480; Reibisch 1905: 166; Scott 1906: 148. Stephensen 1928: 135-137, fig. 26, 1-12.
Phoxocephalus hölbölli, Holmes 1905: 477, fig.
Phoxocephalus Holboellii Stephensen 1917: 130.
Phoxocephalus holboelli, Oldevig 1933: 81.
Phoxocephalus Holbölli, Dons 1935: 107.
Phoxocephalus holbölli, Patience 1909: 125-130, pl. 4, fig. 1 (in part); Bjorck 1915: 14-15; Derjugin 1915: 444; Kunkel 1918: 74-75, fig. 12; Stephensen 1925: 159-160; Stephensen 1926: 59; Schneider 1926: 16-17; Stephensen 1929: 85, fig. 21, 101; Stephensen 1929a: 4; Shoemaker 1930: 44-45; Schellenberg 1934: 131; Gurjanova 1935: 73; Stephensen 1940: 19-20; Schellenberg 1942: 173-174, fig. 143; Stephensen 1944: 52; Gurjanova 1951: 263-264, fig. 214; Bousfield 1956: 137.
Phoxocephalus holbölli Stephensen 1938: 148-149.

(Additional references to the species are to be found in Shoemaker 1930).

Diagnosis.—Eyes composed of a mass of whitish pigment cells, no lenses; peræopod 3, article 2 stout; epimera of pleon segment 3 only slightly convex behind, subquadrate, smooth except for tiny setules; rami of uropod 1 equal in length; posterior lobe of article 2 of peraeopod 5 expanding distally. Gnathopods rather small.

Remarks.—See the discussion under "Phoxocephalus" for the problems of classification posed by this, the type species of the genus.

In the material examined by me, large specimens of both sexes approaching 6 mm in length have the second gnathopod noticeably larger than the first but in smaller specimens and in Sars' figures they are nearly the same size. In immature animals of most other species of *Phoxocephalus* there are distinct differences in configuration or size of the gnathopods.

In male specimens the rostrum is very slightly downturned and the apex from the lateral view slightly broader than in the female. The eye appears to be a small mass of 10-20 poorly defined cells, no crystalline lenses. The first and second uropods add spines on the rami in animals approaching 5 mm in length. The epistome is rounded in front.

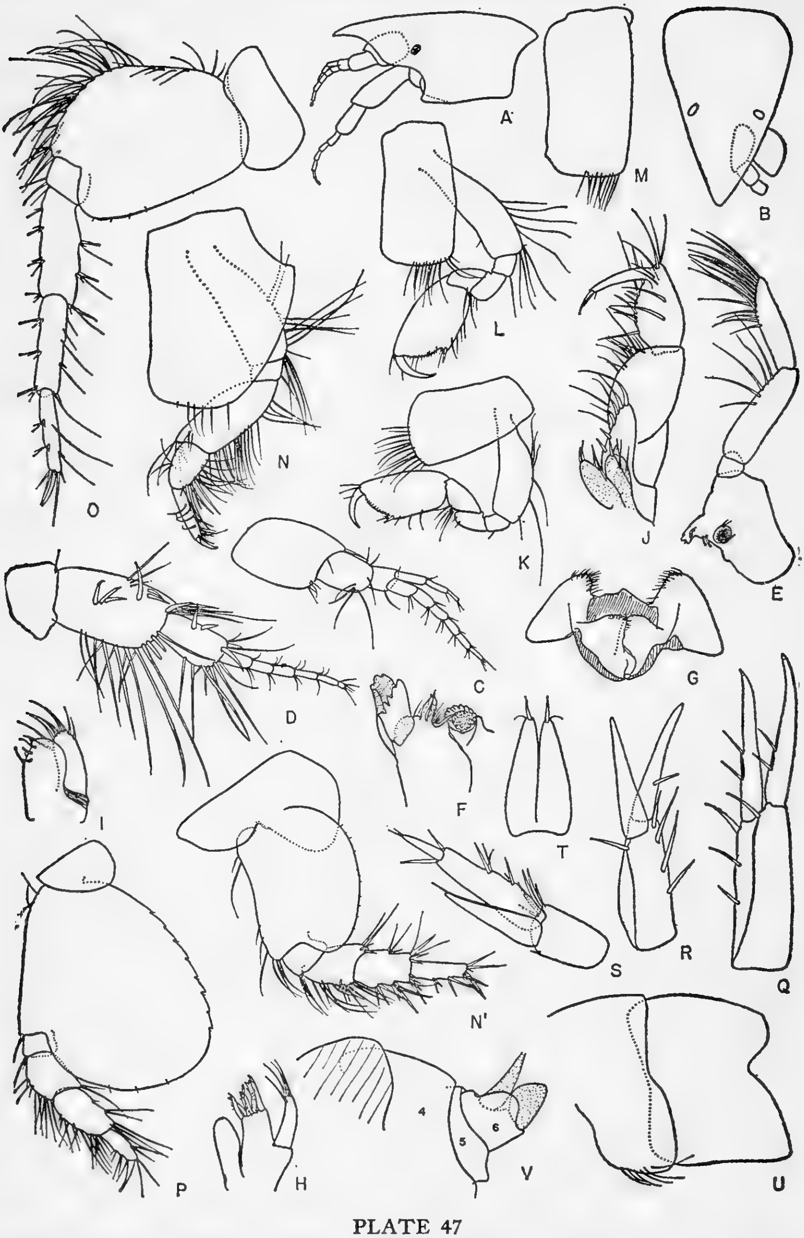


PLATE 47

Phoxocephalus holbölli (Krøyer). Female, 5 mm, Duck Pond, Bay of Fundy, Aug. 13, 1912.

Figs. A,B, head; C,D, antennae 1, 2; E,F, mandibles; G, lower lip; H,I, maxillae 1, 2; J, maxilliped; K,L, gnathopods 1, 2; M, coxa 3; N,N',O,P, peraeopods 2, 3, 4, 5; Q,R,S, uropods 1, 2, 3; T, telson; U, pleon segments 2-3; V, urosome.

Robertson 1888 mentions the presence of small white eyes in his identification of *Metaphoxus simplex* (as *Phoxus simplex*); similar to the present species. His inclusion of an identificiation of *P. holbölli* causes uncertainty to his identifications and his distributional localities have been omitted.

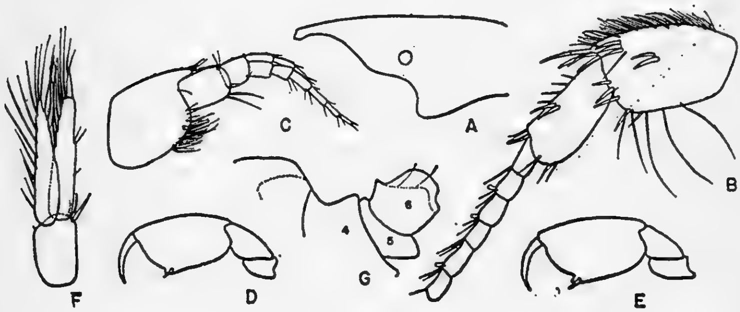


PLATE 48

Phoxocephalus holbölli **(Krøyer). Same as plate 47.**

Figs. A, head; B,C, antennae 1, 2; D,E, gnathopods, 1, 2; F, uropod 3; G, urosome.

Material examined.—Specimens deposited in the National Museum of Canada, Ottawa, and provided for examination through the courtesy of Dr. E. L. Bousfield. Woodwards Cove, June 19, 1912 (6); Newfoundland, Two Gut Cove, Port au Port Bay, Jul. 7, 1954, coll. Bousfield (4); Quebec, Pte. à John, north shore of St. Lawrence Estuary, Sept. 2, 1953, coll. Bousfield, low water (6); Quebec, Pt. St. Peter, Gaspé Bay, Jul. 29, 1953, coll. Bousfield (1); Nova Scotia, Cape Breton Island, Morien Bay, north shore, 3 miles NE of Port Morien, Jul. 3, 1954, coll. Bousfield (1); Nova Scotia, Cape Breton Island, Lingan, at old road bridge across bay, Jul. 2, 1954, coll. Bousfield (5); Nova Scotia, Annapolis Basin, Sept. 27, 1916, 7-9 m (8); the following stations are in the Bay of Fundy: south of Lubec, June 17, 1912, low tide (2); off Head Harbour, New Brunswick, Sept. 2, 1913, 70-80 fms (3); outside Petit Passage, July 31, 1913, 32 fms, sand and gravel (1); St. Andrews Harbour, Aug. 6, 1912, 1-5 fms, sand and mud (4); Campobello, Duckpond, Aug. 13, 1912, dredged, 10 ft, sand (30).

Distribution.—This has been the most frequently reported phoxocephalid. Western Atlantic as far south as Long Island Sound; Greenland, east and west coasts; Iceland; Spitsbergen; coastlines of Barents and Norwegian Seas; White Sea; Kara Sea; south into the Baltic Sea, east of Bornholm; through the British Isles where the southernmost locality of the species lies at Plymouth. It has not been reported south of Denmark on the continent. It has been reported from shoal water to a depth of 190 meters, but most of the records in European seas are less than 60 meters.

Phoxocephalus tenuipes Stephensen

Phoxocephalus tenuipes Stephensen 1925: 160-161, fig. 47.

Diagnosis.—Eyes absent; gnathopod 2, article 6 as broad as long; peraeopod 3, article 2 stout; epimera of pleon segment 3 convex and smooth behind; rami of uropod 1 equal in length; posterior lobe of article 2 of peraeopod 5 expanding distally.

Distribution.—West of Greenland, 66° 35′ N; North Atlantic Ocean, west and southwest of Iceland. Depth, 600 to 1505 meters.

Phoxocephalus bassi (Stebbing)

Phoxus bassi Stebbing 1888: 811-815, pl. 54.

Phoxocephalus bassi, Stebbing 1906: 135; Stebbing 1910: 577, 635; Thomson 1913: 242; K. H. Barnard 1930: 330-331, fig. 9b.

not *Phoxocephalus bassi,* Thomson 1902: 463 (→*P. regium, fide* Hurley 1954).

Diagnosis.—Eyes well developed, bearing lenses; gnathopod 2, article 6 as broad as long; peraeopod 3, article 2 broad; epimera of pleon segment 3 convex and smooth behind and bearing an oblique row of 3 setae near the posterior edge; rami of uropod 1 equal in length; posterior lobe of article 2 of peraeopod 5 expanding distally.

Distribution.—Australia: Bass Strait, 38 fms; Wata Mooli, 54-59 fms; New Zealand: off Three Kings Islands, surface.

Phoxocephalus regium K. H. Barnard

Phoxocephalus regium K. H. Barnard 1930: 331-332, fig. 9a; Hurley 1954: 594-598, figs. 68-91.

Phoxocephalus bassi, Thomson 1902: 463 (not Stebbing 1888, *fide* Hurley 1954).

Phoxocephalus kergueleni, Chilton 1909: 618-619 (not Stebbing 1888, *fide* Hurley 1954).

Diagnosis.—Eyes well developed, bearing lenses; gnathopod 2, article 6 longer than broad; peraeopod 3, article 2 broad; epimera of pleon segment 3 convex behind and scalloped; rami of uropod 1 equal in length; posterior lobe of article 2 of peraeopod 5 expanding ventrally.

Distribution.—New Zealand: off Three Kings Islands and Otago Harbour, surface; Snares Islands, dredged at 50 fms.

Remarks.—In attempting to formulate a key to the genus *Phoxocephalus* it came to my attention that *P. regium* was so closely related to *P. kergueleni* (Stebbing 1888: 816, pl. 55) that they could be separated, as now known, only on minor points.

When K. H. Barnard (1930: 331-332) described *P. regium* he noted that it was very closely related to another species *P. bassi* (Stebbing 1888: 811, pl. 54) in many respects but in the gnathopods it was quite distinct; however, he did not distinguish his species from *P. kergueleni.* In separating *P. kergueleni* and *P. regium* I have attempted to find differences other than the gnathopods between *P. kergueleni* and *P. bassi* which might, from K. H. Barnard's statements, be useful in distinguishing *P. kergueleni* and *P. regium.* Stebbing (1888) figured the *toto* male of *P. bassi* and the *toto* female of *P. kergueleni* so that eye, antennal and third uropod differences are sexual in nature. Other differences between the two include the following characters in *P. kergueleni,* the opposites being true for *P. bassi.*

1. Outer plate of maxilliped with 3 spines instead of 5.

2. Peraeopods 1-2 with the distal spine of the posterior edge of article 5 slender.

3. Peraeopod 3 with article 6 only slightly longer and narrower than article 5 while in *P. bassi* it is distinctly different from article 5.

4. Peraeopod 5, article 2 extending to the end of article 4, while in *P. bassi* it extends scarcely past article 3.

5. Uropod 1, outer ramus distinctly shorter and narrower than the inner ramus, whereas in *P. bassi* the two rami are subequal.

6. Telson with apical spines long, in *P. bassi* short.

All of these characters might be used also to distinguish *P. regium* from *P. kergueleni* and this is substantiated further by the excellent work of Hurley 1954 who figured and described *P. regium* completely. In discussing this problem with Dr. Hurley in person, we were able to arrive at the above differentiating characteristics, except that Hurley's figured material showed the outer plate of the maxilliped with 3 spines, not 5 as in *P. bassi,* so that this is not a valid difference. In addition, his work shows that the first gnathopod of *P. regium* is slightly but rather distinctly different from that of *P. kergueleni* in the shape of the sixth article, which is a bit longer and slightly more slender in *P. kergueleni.* In the examination of *P. homilis* n. sp., I have observed that the configuration of this appendage scarcely varies in subadults so that this slight difference in the two species from the southern Hemisphere may prove to be valid.

Although the two species *P. regium* and *P. kergueleni* are very similar and at first glance of the published figures appear identical, differences as stated above have been noted and should be used to distinguish these species until reexamination of true *P. kergueleni* can be accomplished. The microscopic structure of the epimera of the third pleonal segment is still unknown in *P. kergueleni* and might be useful in distinguishing the species.

The following table illustrates the differences between three species:

	bassi	*regium*	*kergueleni*
Gnathopod article 6 longer than broad	O	X	X
Uropod 1, rami equal	X	X	O
Peraeopods 1-2 with stout spine on article 2	X	X	O

Phoxocephalus kergueleni (Stebbing)

Phoxus kergueleni Stebbing 1888: 816-819, pl. 55.
Phoxocephalus kergueleni, Stebbing 1906: 135.
not *Phoxocephalus kergueleni*, Chilton 1909: 618-619 (→*P. regium*, *fide* Hurley 1954).

Diagnosis.—Eyes well developed and bearing lenses; gnathopod 2, article 6 longer than broad; peraeopod 3, article 2 broad; epimera of pleon segment 3 convex and apparently smooth behind; outer ramus of uropod 1 shorter than inner; posterior lobe of article 2 of peraeopod 5 expanding distally.

Distribution.—Off Cumberland Bay, Kerguelen, 120 fms.

Phoxocephalus homilis, new species

(Plates 49, 50)

Diagnosis.— Eyes with well developed lenses; gnathopods with enlarged terminal articles, article 6 of each longer than broad; peraeopod 3 with second article broadly expanded; uropod 1 with rami slightly unequal; uropod 2 with slender spines on peduncle and outer ramus; peraeopod 4 not elongated; epimera of pleon segment 3 nearly straight behind, smooth except for setules; peraeopod 5, lobe of article 2 expanding distally.

Descriptive features.—Epistome rounded in front; eyes small but distinct and composed of several lenses in female, but quite large in the young male; inner lobes of lower lip quite short, much as in *P. holbölli*; inner plate of maxilla 2 much broader than outer and sparsely setose, the setae being very short; the fifth article of the first and second peraeopods bears slender setae but no stout spine.

Holotype.—AHF No. 5311, female, 4 mm.

Type locality.—Station 2293-53, 6.9 mi SW of Newport west jetty light, California, 33-30-00 N, 117-57-57 W, 252 fms, April 23, 1953, mud collected with orange-peel bucket.

Remarks.—This species is quite closely related to *Phoxocephalus kergueleni* (Stebbing 1888) and but for a few minor features might be considered a geographic subspecies of it. One of the distinctive features separating *P. homilis* from *P. kergueleni* is the spination of the second uropods; in *P. homilis* both the peduncle and the outer ramus each bear at least 2 slender spines (smallest specimens available 2 mm) while Stebbing's figure shows only one stout peduncular spine and no spines on the outer ramus in *P. kergueleni.* The expansion of the second article of peraeopod 5 in *P. homilis* extends down only slightly beyond the middle of article 4 while in *P. kergueleni* it extends about to the middle of article 5 (if one rearranges Stebbing's figure to show the lower part of the appendage as straight). Stebbing's figures also show the third uropod with the inner ramus slightly longer and the first article of the outer ramus but he figured the third uropod of the juvenile male.

Phoxocephalus kergueleni and *P. homilis* are distinct from other members of the genus in the slightly atrophic outer ramus of the first uropod.

Material examined.—267 specimens at 74 stations.

Distribution.—Southern California slopes, 50 to 292 fms, rarely as shallow as 30 fms, generally 100 to 200 fms. Dipnetted at Cedros Island, Lower California.

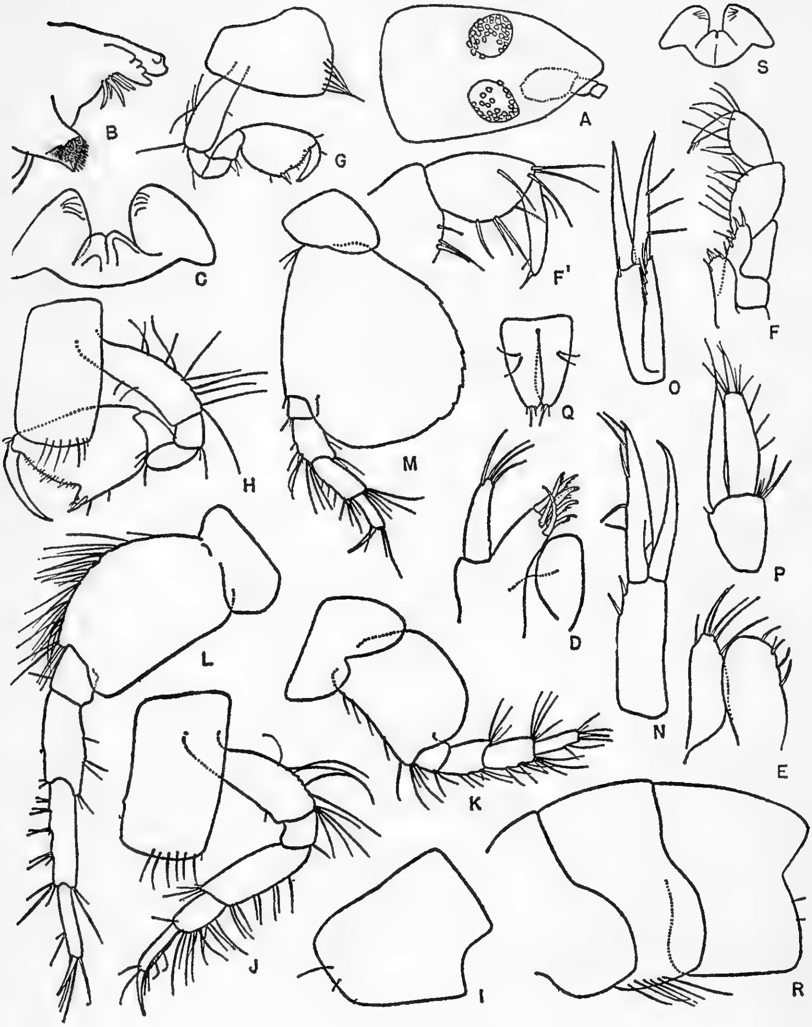


PLATE 49

Phoxocephalus homilis n. sp. Young male, 3 mm, Sta. 2293.

Figs. A, head; B, mandible; C,S, lower lip; D,E, maxillae 1, 2; F,F', maxilliped; G,H, gnathopods 1, 2; I, coxa 4; J,K,L,M, peraeopods 1, 3, 4, 5; N,O,P, uropods 1, 2, 3; Q, telson; R, pleon segments 1-3.

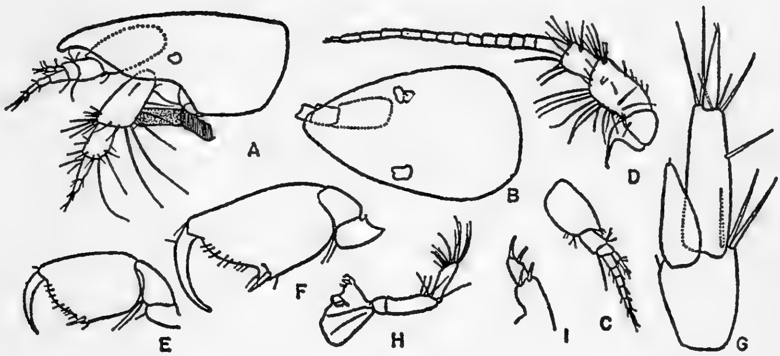


PLATE 50

Phoxocephalus homilis n. sp. Young male, 3 mm, Sta. 2293.
Figs. C,D, antennae 1, 2.

Female, 2.75 mm, Sta. 2293.
Figs. A,B, head; E,F, gnathopods 1, 2; uropod 3; H, mandible; I, plates of maxilliped.

Genus **Metaphoxus** Bonnier

Metaphoxus Bonnier 1896: 630.

Diagnosis.—Article 2 of peraeopod 3 expanded; eyes present; mandibular molar simple, bearing a few spines; maxilla 1 with uniarticulate palp; maxilliped with moderately long fourth article bearing a stout terminal spine; gnathopods enlarged or heteromorphous.

Type species.—*Metaphoxus typicus* Bonnier 1896 (=*Phoxocephalus pectinatus* Walker 1896).

Key to the Genus **Metaphoxus**

1. Gnathopods 1-2, palm transverse, hind margin prolonged so as to appear chelate........*fultoni*
1. Gnathopods 1-2, palm oblique, not cheliform........ 2
2. Gnathopod 1, article 6 twice as long as broad, slender, edges parallel; peraeopod 5, stenopodous part short........*frequens* n. sp.
2. Gnathopod 1, article 6 is 1.5 times as long as broad, edges parallel or diverging; peraeopod 5, stenopodous part long........*pectinatus*

Metaphoxus fultoni (Scott)

Phoxocephalus Fultoni Scott 1890: 327, pl. 12, figs. 10-12, pl. 13, figs. 13-19 (not seen); Robertson 1892: 207-208; Chevreux 1898: 477; Norman 1900: 336; Scott 1906: 148.

Phoxocephalus chelatus Della Valle 1893: 742-743, pl. 5, fig. 10, pl. 35, figs. 29-35.

Phoxocephalus fultoni, Walker 1895: 296; Calman 1896: 743-748, pl. 31, figs. 1-2; Scott 1907: 178; Patience 1909: 118-125, pls. 3, 4 (part).

Metaphoxus Fultoni, Walker 1901: 299; Norman and Brady 1909: 306; Chevreux 1911: 189, pl. 9, figs. 17, 18; Chevreux and Fage 1925: 106-107, figs. 96, 100; Fage 1933: 203-207; Candeias 1934: 2.

Metaphoxus fultoni, Stebbing 1906: 139; Tattersall 1913: 6-7; Stephensen 1929: 84, fig. 21, *99;* Moore 1937: 119; Plymouth Mar. Fauna 1931: 189.

Distribution.—Numerous localities in the British Isles as far north as Firth of Forth and west to Galway Bay; Biscay Bay, frequently; Mediterranean, French Coast and east to Naples; Tunisia; Portugal.

Metaphoxus frequens, new species
(Plates 51, 52)

Diagnosis.—Gnathopods 1-2 with palm oblique, not chelate in appearance; gnathopod 1, article 6 twice as long as broad, anterior and posterior edges parallel; peraeopod 5 with that part of the appendage distal to article 2 short in relation to article 2; maxilliped with inner plate rather narrow and armed apically with one long seta, the base of which is as wide as the plate.

Descriptive features.—Pleon segment 3 with epimeron convex behind, lower corner rounded but not broadly, lower corner of head with a slight point, eyes small in female, large in male, antenna 2 short in female, long in male.

Holotype.—AHF No. 5312, female, ovigerous, 3 mm.

Type locality.—Station 2294-53, 1.45 mi SSE of Newport west jetty light (California), 33-33-56 N, 117-52-00 W, 47 fms, fine mud and clay, April 24, 1953.

Remarks.—This species is closely related to *M. pectinatus,* differing in those criteria in the key and diagnosis above. Some variation occurs

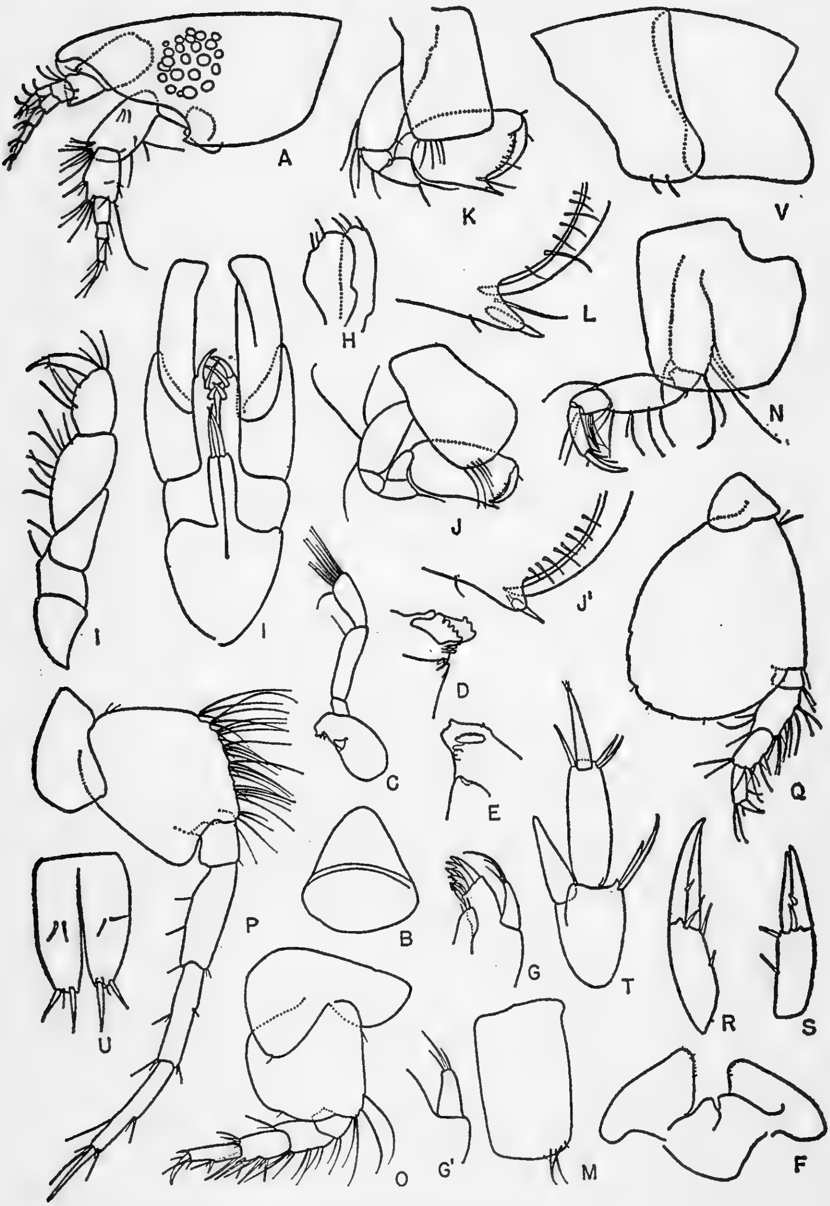


PLATE 51

Metaphoxus frequens, n. sp. Female, 3 mm, Sta. 125.

Figs. A, head; B, upper lip; C,D,E, mandibles; F, lower lip; G,G', maxilla 1; H, maxilla 2; I,I', maxilliped; J,J', gnathopod 1; K,L, gnathopod 2; M, coxa 3; N,O,P,Q, peraeopods 2, 3, 4, 5; R,S,T, uropods 1, 2, 3; U, telson; V, pleon segments 2-3.

in the second gnathopods, witness the drawings of an ovigerous female, 2.5 mm, on pl. 52 fig. B. The inner plate of the maxilliped of other metaphoxids has not been well figured but the condition in *M. frequens* appears to be unique: a very slender plate with a single stout seta.

This species and *Phoxocephalus homilis* n. sp., were confused by me for some time, but I have reexamined all of the materials and find that the gnathopod criteria are distinctive, the elongated sixth article of gnathopod 1 applying to all *M. frequens*, while in *P. homilis* it is short and stout. Otherwise, the two species are superficially alike and easily confused. They are separated generically by the condition of the mandibular molars.

Material examined.—1234 specimens at 157 stations.

Distribution.—Southern California coastal shelf and slopes, 12 to 115 fms. Collected on the east slope of Santa Cruz Basin, 218 to 250 fms. Collected at Isabel Island, Mexico. Dipnetted at Santa Barbara Island.

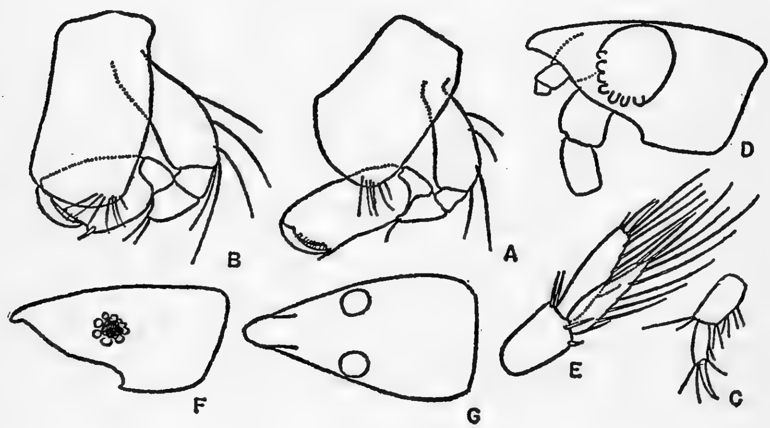


PLATE 52

Metaphoxus frequens, n. sp., ovigerous female, 2.5 mm, Sta. 2444.
Figs. A,B, gnathopods 1, 2; C, end of peraeopod 5.

Male, 3 mm, Sta. 2444.
Figs. D, head; E, uropod 3.

Female, 3.5 mm, Sta. 2444.
Fig. F, head.

Female, 3.0 mm, Sta. 2444.
Fig. G, head, dorsal.

Metaphoxus pectinatus (Walker), *nomen conservandum*

Phoxus simplex Bate 1857: 525 (*fide* Norman 1900, not Walker 1896a); Bate and Westwood 1863: 140-142, fig.; Bate 1862: 97-98, pl. 16, fig. 1; Boeck 1871: 135.

Phoxus Kröyerii Bate 1857: 140 (=homonym, not Stimpson 1853).

Phoxocephalus simplex, Calman 1896: 748-751, pl. 32, fig. 3; Norman 1900: 335-336.

Phoxocephalus pectinatus Walker 1896: 343-344, pl. 16, figs. 1-6; Walker 1896a: 156-157.

Metaphoxus pectinatus, Chevreux 1898: 577; Chevreux 1900: 33-34; Walker 1901: 299-300, pl. 27, fig. 22; Stebbing 1906: 139-140; Chevreux 1911: 187-188, pl. 9, figs. 19-20; Chevreux 1925: 295; Chevreux and Fage 1925: 105-106, figs. 98, 99; Fage 1933: 203-207, fig. 10; Chevreux 1935: 73; Ruffo 1938: 130; Ruffo 1947: 84; Plym. Mar. Fauna 1931: 189.

Metaphoxus typicus Bonnier 1896: 630-633, pl. 37, fig. 1; Chevreux 1927: 72.

Metaphoxus fultoni, Patience 1909: 125-130, pls. 3, 4, fig. 1 (in part, not Scott 1890).

Nomenclature.—The type specimen of *Phoxus simplex* Bate 1857 has not been identified with certainty. Both Norman 1900 and Walker 1896a have examined the specimen and each referred it to different species. Part of the difficulty appears to lie in the damaged condition of the type. Despite the differences between the figures of Bate 1857 and the specimen, as detailed by Walker 1896a, the gnathopods are remarkably like *M. pectinatus* more than they are to *Phoxocephalus holbölli,* although Bate's figures of head and antennae are like *P. holbölli.* Norman 1900 disputed Walker's conclusions and referred to *M. pectinatus* as a junior synonym of *P. simplex.* No European workers have discussed the point further and later synonymies have ignored the problem. Despite my belief that *P. simplex* is probably a senior synonym of *M. pectinatus* it is not my place to fix the name permanently. Considering the long history of the use of the name *M. simplex* it would be wise to conserve it.

I am unable to discern any qualitative differences between *M. pectinatus* and *M. typicus* from the literature. Bonnier 1896 in a footnote on p. 633 distinguishes his species from *M. pectinatus* by the broader second article of peraeopod 5. Comparison of various figures shows the apex of article 6 of gnathopod 1 to be slightly narrowed in *M. pectina-*

tus, while the dactyls of the peraeopods seem shorter and stouter; the third pleonal epimeron is less obtusely rounded in *M. pectinatus.* It is my belief that these characters are not enough to require distinct specific names. Norman 1900 has reached the same conclusion in his synonymy.

Distribution.—In the British Isles as far north as the Firth of Clyde; Atlantic Coast of France; north coast of the Mediterranean as far east as Corsica and Genova. Meropelagic and benthic to 80 m.

Genus **Leptophoxus** G. O. Sars

Leptophoxus G. O. Sars 1895: 146.

Diagnosis.—Peraeopod 3 with article 2 broad; palp of maxilla 1 uniarticulate; molar of mandible simple; eyes absent; palp article 3 of maxilliped produced conically; gnathopod 2 enlarged; palp article 3 of mandible broad, truncated.

Type species.—*Phoxus falcatus* G. O. Sars

Leptophoxus falcatus G. O. Sars

Phoxus simplex Boeck 1870: 135 (*fide* Sars 1883, Norman 1900, not Bate 1857).

Phoxus falcatus Sars 1883: 84.

Leptophoxus falcatus Sars 1895: 147-148, pl. 50; Norman 1895: 482; Stebbing 1906: 136-137; Stephensen 1925: 161-162; Stephensen 1926: 59-60; Stephensen 1928: 137-138, fig. 26, 13-15; Stephensen 1929: 84, fig. 21, *100;* Oldevig 1933: 83; Stephensen 1938: 150 (and references).

Distribution.—Greenland, east and west coasts; Norway; North Sea; Skagerrak. Depth: 56 to 2258 m.

Leptophoxus falcatus icelus, new subspecies

(Plates 53, 54)

Diagnosis.—This subspecies closely resembles *L. falcatus*, differing in a number of minor characters which appear to be of racial value. These points of difference in *L. f. icelus* are:

1. The last article of the maxillipedal palp is rather stout and scarcely longer than the projection of article 3.

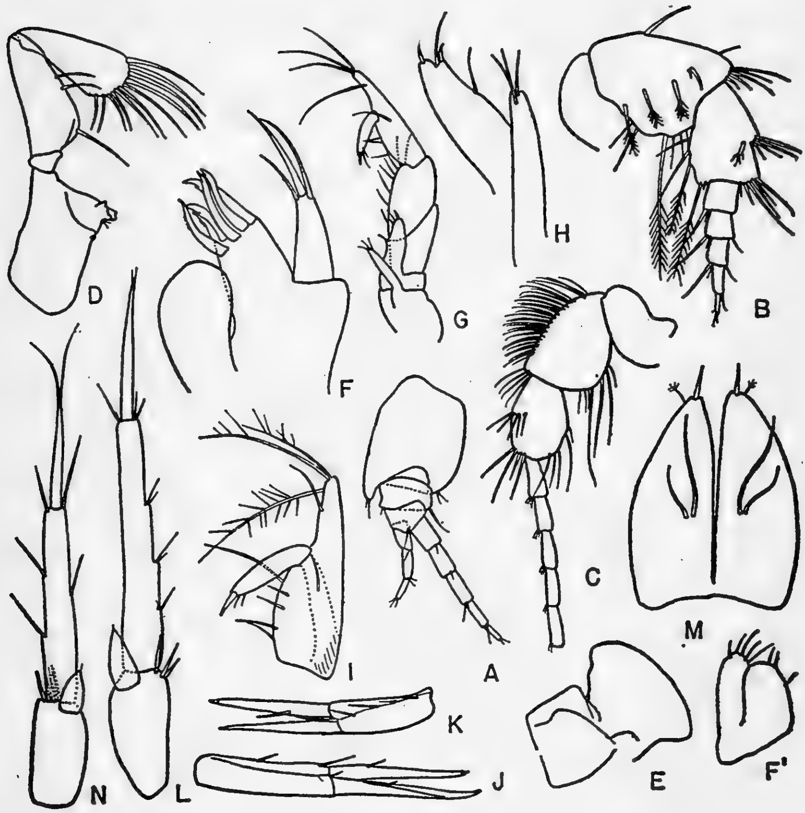


PLATE 53

Leptophoxus falcatus icelus, n. subsp., female, 3 mm, Sta. 2413.
Figs. A,B, antennae 1, 2; D, mandible; E, lower lip; F,F', maxillae 1, 2; G,H,I, maxilliped; J,K,L, uropods 1, 2, 3; M, telson.
Male, 3 mm, Sta. 2389.
Figs. C, antenna 2; N, uropod 3.

2. Both rami of uropod 1 and the outer ramus of uropod 2 each bear a spine.

3. The inner plate of the first maxilla is rather large and the palp small.

4. The expansion of peraeopod 3, article 2, is slightly attenuated posteriorly.

5. The expansion of peraeopod 5, article 2, has only two serrations compared with 6 in *L. falcatus.*

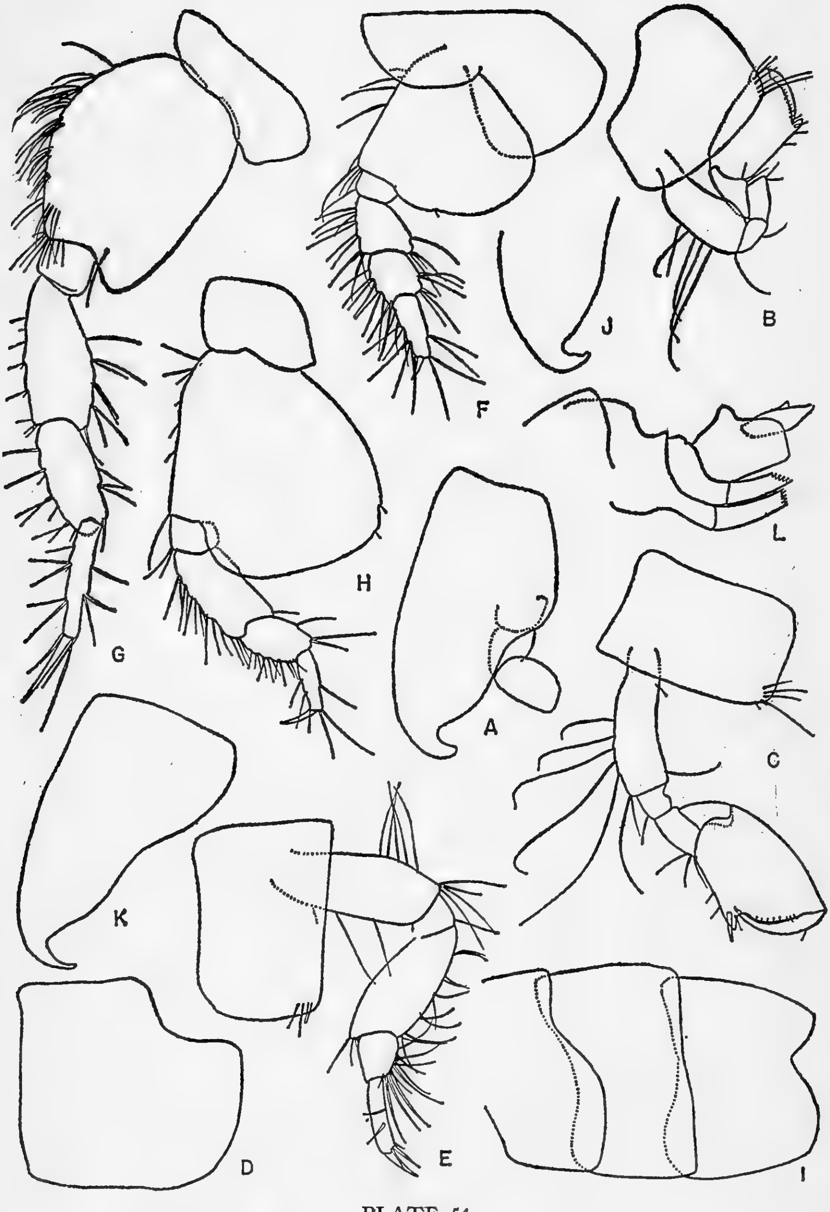


PLATE 54

Leptophoxus falcatus icelus, n. subsp., female, 3 mm, Sta. 2413.

Figs. A, head; B,C, gnathopods 1, 2; D, coxa 4; E,F,G,H, peraeopods 1, 3, 4, 5; I, pleon segments 1-3.

Another female, 2.5 mm, Sta. 2793.

Fig. J, head.

Male, 3 mm, Sta. 2389.

Figs. K, head; L, posterior end of pleon.

6. Article 4 of peraeopod 5 is almost as long as articles 5 and 6 combined, while in *L. falcatus* it is only slightly longer than articles 5 and 6 combined.

7. The inner plate of the maxilliped is not acuminate as drawn by Sars 1895, pl. 50.

Male.—Uropod 3 is the same as on the female; antenna 2 is nearly as long as the body, article 4 of the peduncle bearing thick clusters of dorsal hairs.

Holotype.—AHF No. 5313, female, 3.75 mm.

Type locality.—Station 2413-53, 11.5 mi ENE of Long Point, Catalina Island light, 33-30-00 N, 118-10-00 W, 205 fms, muddy clay bottom, Sept. 17, 1953.

Remarks.—The genus *Leptophoxus* is rarely collected in southern California and this may indicate that it is at the southern limits of its distribution in shallow water.

Material examined.—13 specimens at 8 stations.

Distribution.—Southern California slopes, 136 to 277 fms. Santa Catalina Basin, 612 fms; San Pedro Basin, 470 fms.

Genus **Proharpinia** Schellenberg

Proharpinia Schellenberg 1931: 80.

Diagnosis.—Article 2 of peraeopod 3 narrow; eyes present; article 2 of antenna 2 lacks an ensiform process; lower anterior corner of head produced.

Type species.—*P. antipoda* Schellenberg 1931.

Remarks.—This genus differs from *Heterophoxus* Shoemaker mainly in the lack of an ensiform process on the second article of antenna 1. However, all of the species I am assigning to this genus also have the lower corner of the head produced, which may prove to be a conservative generic character.

Key to the Genus **Proharpinia**

1. Third pleonal epimeron lacks tooth.................................*tropicana* n. sp.
1. Third pleonal epimeron bears medium to long teeth........................ 2
2. Peraeopod 5, article 2 with 7-8 large teeth.................................*antipoda*
2. Peraeopod 5, article 2 with a few minute serrations........................ 3
3. Uropod 1, outer ramus shortened, eyes rectangular....................*hurleyi*
3. Uropod 1, outer ramus of normal length, eyes round.........*stephenseni*

Proharpinia tropicana, new species
(Plate 55)

Diagnosis.—Third pleonal epimeron with a slight notch at the lower posterior corner; article 2 of peraeopod 5 with about 3 medium sized teeth; telson with blunt spinose apices; eyes medium in size, rectangular; uropod 1 with very short outer ramus.

Descriptive features.—Head tall, nearly carinate at top, lower head process small; maxilliped similar to *Heterophoxus oculatus*, inner plate, with one medial spine and 2 apical setae; gnathopods 1 and 2 similar; rami of uropods naked; last three peraeopods very slender.

Holotype.—USNM No. 97309, female, 2.5 mm.

Type locality—Station 169-34, Academy Bay, Indefatigable Island, Galapagos Islands, 00-46-18 S, 90-19-27 W, 15-25 fms, sand, rock, algae, Jan. 20, 1934, collected by the *Velero III.*

Remarks.—It is unfortunate that only one specimen of this species exists but the distinctive third pleonal epimeron and short outer ramus of uropod 1 render it easily recognizable.

Distribution.—Galapagos Islands.

Proharpinia antipoda Schellenberg
(Plate 56)

Proharpinia antipoda Schellenberg 1931: 80-81, fig. 41.

Diagnosis.—Tooth of third pleonal epimeron very long and curved upwards; article 2 of peraeopod 5 cut into about 5-7 large teeth, telson with apices acutely pointed, each with one slender seta; eyes rather small in female; uropod 1 with outer ramus of normal length; lower process of head large and diverging from axis of rostrum; rami of first 2 uropods bear many long spines, on uropod 2 the spines extending nearly to the ends of the rami.

Material examined.—Swedish State Museum Catalogue Nos.: 2760, Ultima Esperanza (11); 2789, Kap Valentyn (1); 2798, Ushuaia (8), type; 3466, Puerto Toro (1); 3467, Puerto Augusta (1 female, eyes not visible); 3468, Puerto Condor (1); 3469, Lagotowia (3); 3470, Port Louis, Falkland Islands (1).

Remarks.—The male specimen from Cat. No. 2760 has the teeth of peraeopod 5, article 2, nearly obliterated but is distinguishable from *P. stephenseni* by the spines of the second uropodal rami and other characters.

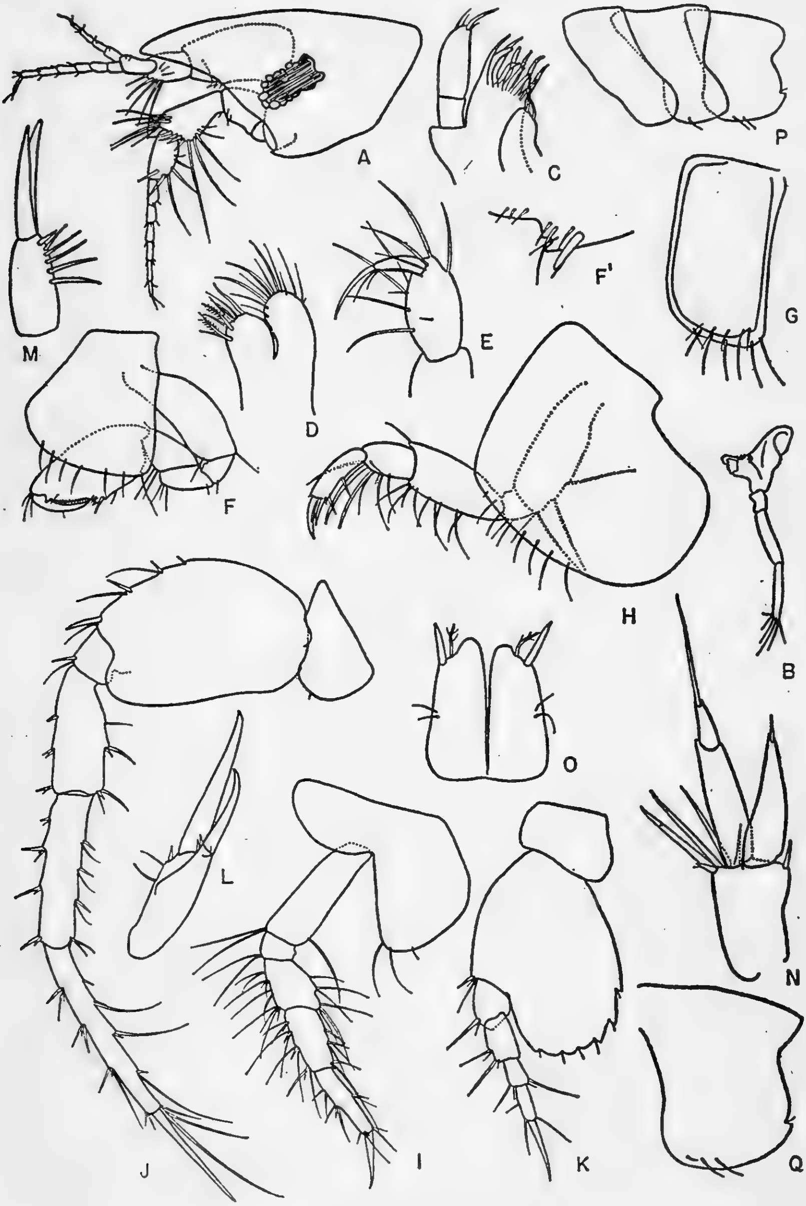


PLATE 55

Proharpinia tropicana, n. sp. Female, holotype, 2.5 mm, Sta. 169.

Figs. A, head; B, mandible; C,D, maxillae 1, 2; E, end of maxillipedal palp; F, gnathopod 1; G, coxa 2 inside, coxa 3 outside; H,I,J,K, peraeopods 2, 3, 4, 5; L,M,N, uropods 1, 2, 3; O, telson; P, pleon segments 1-3; Q, pleon segment 3.

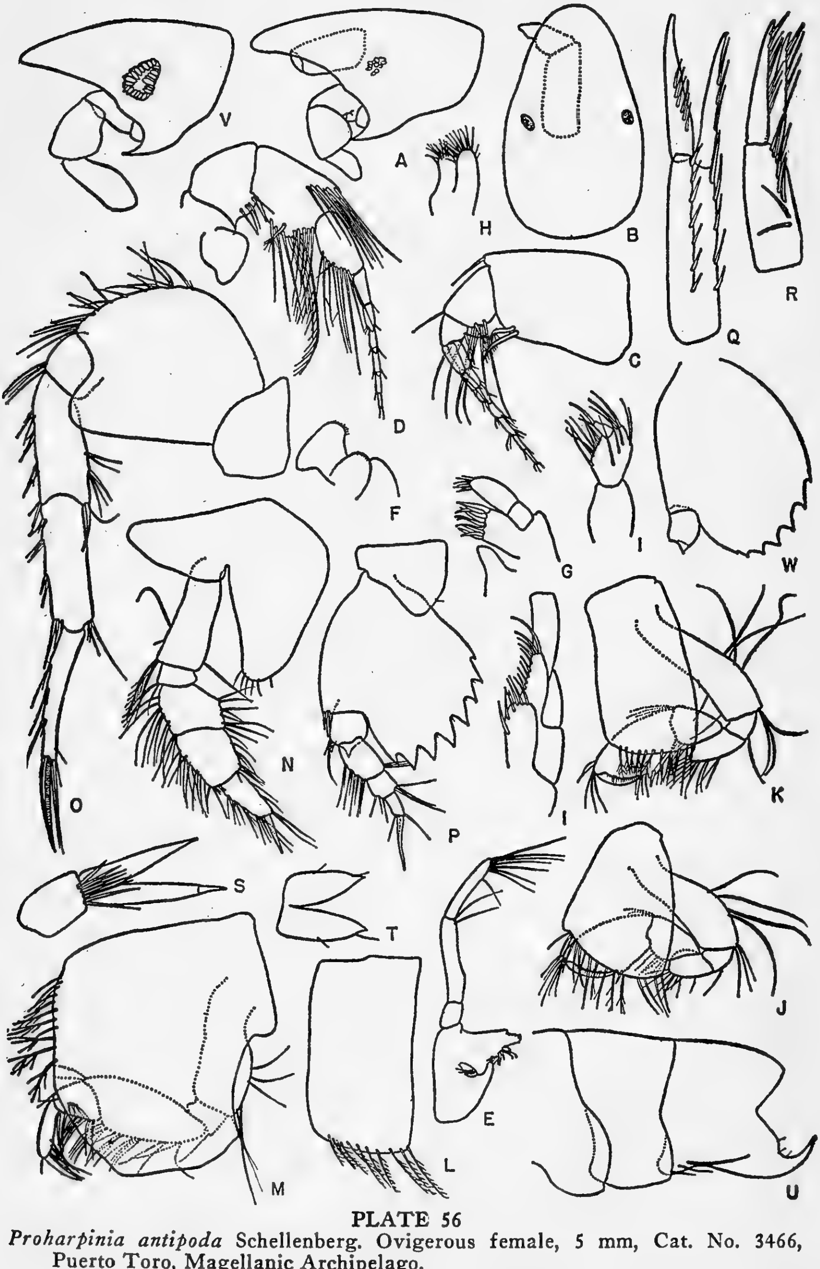


PLATE 56

Proharpinia antipoda Schellenberg. Ovigerous female, 5 mm, Cat. No. 3466, Puerto Toro, Magellanic Archipelago.

Figs. A,B, head; C,D, antennae 1, 2; E, mandible; F, lower lip; G,H, maxillae 1, 2; I,I', maxilliped; J,K, gnathopods 1, 2; L, coxa 3; M,N,O,P, peraeopods 2, 3, 4, 5; Q,R,S, uropods 1, 2, 3; T, telson; U, pleon segments 1-3.

Male, 5.5. mm, Cat. No. 3470, Falkland Islands.

Figs. V, head; W, peraeopod 5.

The 4.5 mm female of Cat. No. 3468 is quite aberrant, lacking eyes, having a shortened tooth of the third pleonal epimeron, lacking distal spines of the rami of uropods 1 and 2 and having small differences in the configuration of peraeopod 5.

Distribution.—Magellanic Archipelago; Falkland Islands. Depth, 3-150 fms.

Proharpinia hurleyi J. L. Barnard

(Plate 57)

Harpinia obtusifrons, Chilton 1909: 619 (in part); Stephensen 1927: 306-307, fig. 6 (not Stebbing 1888).

Heterophoxus stephenseni, Hurley 1954: 589-593, figs. 29-67 (not Schellenberg 1931).

Proharpinia hurleyi J. L. Barnard 1958: 149.

Diagnosis.—Tooth of third pleonal epimeron medium in length or short; article 2 of peraeopod 5 with small posterior serrations; telson with blunt spinose apices; eyes rectangular; uropod 1, outer ramus shortened.

Holotype.—Slide P. 31, female, from Hurley 1954: 593.

Type locality.—Sandbank, Quarantine Island, Otago Harbour, N.Z., 19/1/53, coll. D. E. Hurley, in his personal collections.

Material examined.—(1) Portobello Marine Biological Station, Otago Harbour, New Zealand, 24/5/54, in blackish sandy mud, 3 females, courtesy of Dr. D. E. Hurley; (2) through the courtesy of Prof. E. Percival, Canterbury University College, Christchurch, N.Z., I have examined some of Dr. Chilton's material of *"Harpinia obtusifrons."* The material was on stained slides, no wet material being extant. One series of three slides of one dissected specimen labeled as follows "female sign, A1, A2, A3, Harpinia obtusifrons Steb. Perseverance Hr. Campbell Is. xi. 07 Charles Chilton" and penciled 11-18, 11-19, 11-20, corresponds to the material figured by Hurley 1954. Another whole mount slide with the same labeling except penciled 11-17 corresponds also, except that it, a male, has a short third pleonal tooth similar to that figured by Stephensen 1927.

Remarks.—From Stephensen's figures, Hurley's figures and Chilton's slides it is apparent that all three belong to a species different from *H. stephenseni* Schellenberg, despite Schellenberg's inclusion of Chilton's and Stephensen's references with *H. stephenseni.* Detailed differences are noted by J. L. Barnard (1958).

However, *P. stephenseni* and *P. hurleyi* are very closely related species and the specimen figured by Stephensen partially bridges the gap between the South American and New Zealand species. The most critical features of difference appear to be the shortened ramus of uropod 1 and the rectangular eyes of *P. hurleyi.*

Distribution.—New Zealand; Campbell Island; Auckland Islands.

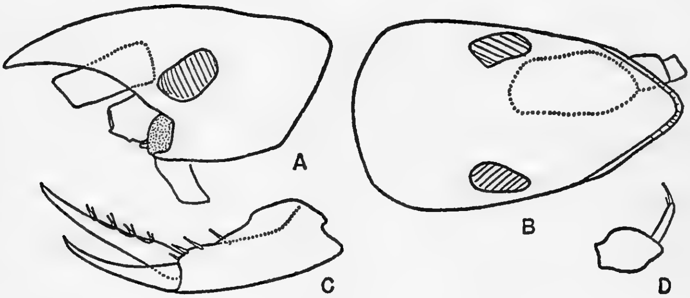


PLATE 57

Proharpinia hurleyi J. L. Barnard. Female 5 mm, Otago Harbour, New Zealand.
Figs. A,B, head; D, articles 3-4 of maxillipedal palp.

Female, Cat. A3, Perseverance Harbour, Campbell Island, New Zealand (Chilton).
Fig. C, uropod 1.

Proharpinia stephenseni (Schellenberg)
(Plate 58)

Heterophoxus stephenseni Schellenberg 1931: 73-74, fig. 37a.

Proharpinia stephenseni, J. L. Barnard 1958: 149.

not *Harpinia obtusifrons,* Chilton 1909: 619; Stephensen 1927: 306-307, fig. 6 (→*Proharpinia hurleyi*).

not *Heterophoxus stephenseni,* Hurley 1954: 589-593, figs. 29-67 (→*Proharpinia hurleyi*).

Diagnosis.—Tooth of third pleonal epimeron short, curved upward; article 2 of peraeopod 5 not serrated or toothed; telson with blunt apices, each armed with one setule; eyes large and round in female; uropod 1, outer ramus of normal length; lower process of head small and parallel to the axis of the rostrum; rami of first two uropods armed sparsely with spines.

Material examined.—Swedish State Museum Catalogue Nos.: 2850, Port Albemarle, Falkland Islands (2); 2851, Ushuaia (2); 2852, Port

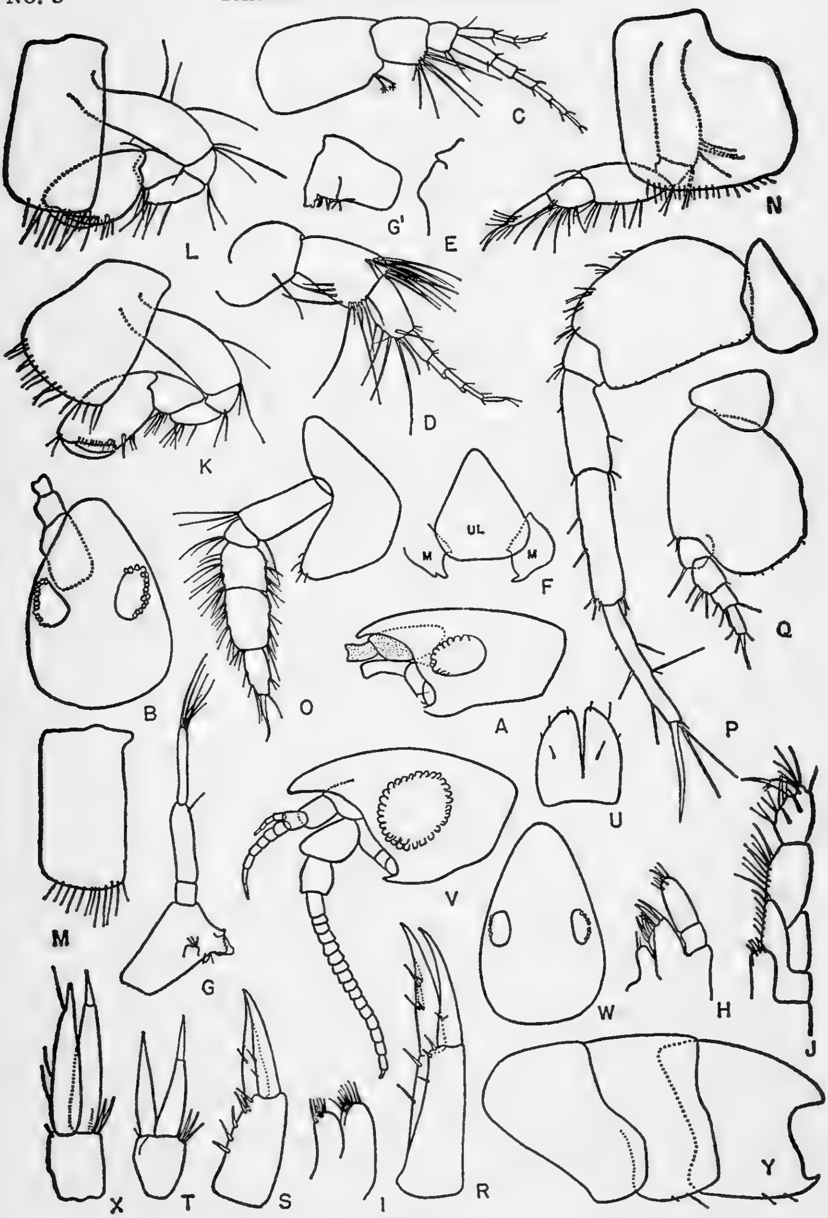


PLATE 58

Proharpinia stephenseni (Schellenberg). Female, 4 mm, Falkland Islands (Cat. No. 3097).

Figs. A,B, head; C,D, antennae 1, 2; E, epistome, lateral; F, upper lip and mandibles, anterior; G,G', mandibles; H,I, maxillae 1, 2; J, maxilliped; K,L, gnathopods 1, 2; M, coxa 3; N,O,P,Q, peraeopods 2, 3, 4, 5; R,S,T, uropods 1, 2, 3; U, telson; Y, pleon segments 1-3.

Male, 4 mm, same station.

Figs. V,W, head; X, uropod 3.

Louis, Falkland Islands (8); 3097, same locality (26); 3128, Ushuaia (6); all originally reported by Schellenberg 1931.

Remarks.—After examining Schellenberg's material of this species and that of *Proharpinia antipoda,* I reached the conclusion that the two species were congeneric, although Schellenberg had them separated into different genera in his 1931 paper. Before obtaining Schellenberg's species it was apparent to me that his genus *Proharpinia* was indistinct from *Heterophoxus* Shoemaker, because his generic diagnosis fitted that of *Heterophoxus.* Although he called attention to a feature of similarity he failed to distinguish the two genera. Especially confusing was the fact that Schellenberg described the species *Heterophoxus stephenseni* which appeared similar in all generic features to *Proharpinia antipoda.* By restricting to the genus *Proharpinia* those species lacking an antennal ensiform process the removal of *H. stephenseni* to *Proharpinia* was effected (J. L. Barnard 1958).

When Schellenberg described *H. stephenseni* he included *Harpinia obtusifrons* of Chilton 1909 and Stephensen 1927 (not Stebbing 1888) as references. However, these citations should be removed to *Proharpinia hurleyi* J. L. Barnard (1958).

Distribution.—South America at Ushuaia; Falkland Islands. Depth, 2-18 meters.

Genus **Heterophoxus** Shoemaker

Heterophoxus Shoemaker 1925: 22.

Diagnosis.—Article 2 of peraeopod 3 slender; eyes present; second article of second antenna bears ensiform process; fourth palp article of maxilliped short, with one or more long terminal setae; second article of third uropodal outer ramus minute; first maxillary palp with 2 articles.

Type species.—*Heterophoxus pennatus* Shoemaker 1925 (= *Harpinia oculata* Holmes 1908).

Remarks.—All of the species which I have assembled in this genus agree in not having a large process at the lower antennal corner of the head such as is seen in the genus *Proharpinia.* The ensiform process of the second antenna is also diagnostic of *Heterophoxus.* The smallness of the second article of the third uropodal outer ramus is rare for the family (see *Pseudharpinia*); K. H. Barnard 1932 mentions that in *H. videns* the second article is absent in the male.

Key to the Genus Heterophoxus

1. Third pleonal epimeron with long tooth.. 2
1. Third pleonal epimeron with short tooth..................................*videns*
2. Article 2 of peraeopod 5 reaches halfway along article 4................ 3
2. Article 2 of peraeopod 5 reaches to the end of article 4....*ophthalmicus*
3. Article 4 of peraeopod 5 stout, lobed on hind margin............*trichosus*
3. Article 4 of peraeopod 5 slender, not lobed...............................*oculatus*

Heterophoxus videns K. H. Barnard

Heterophoxus videns K. H. Barnard 1930: 334-335, fig. 11; Schellenberg 1931: 74-75, figs. 37b, 38; K. H. Barnard 1932: 100; Schellenberg 1935: 232; Nicholls 1938: 46, fig. 24.

Diagnosis.—Third pleonal epimeron with a short tooth; peraeopod 5, article 2 reaching to end of article 4, teeth on posterior edge rounded, not acute (but see below).

Remarks.—I have removed from the synonymy of this species the specimens identified as *Harpinia obtusifrons* by Walker 1907, Chilton 1909 and 1912, referred to by K. H. Barnard 1932, for they could be one of several other species, especially *Proharpinia hurleyi* J. L. Barnard. However, I have examined a series of 6 slides representing 2 dissected specimens identified by Dr. Chilton as *H. obtusifrons* and deposited in Canterbury University Museum (courtesy of Prof. E. Percival). The slides were labeled N-1 to N-3 and X-1 to X-3, penciled respectively 166-13-14-15 and 162-1-2-3, from McMurdo Bay, "Nimrod" Expedition. Pleon segment 3 was not extant but the ensiform process of antenna 2 and peraeopod 5 corresponded to *H. videns* except for the sharp teeth. Other specimens of Chilton were *P. hurleyi* (see J. L. Barnard 1958).

The *H. obtusifrons* of Stephensen 1927 has been referred by J. L. Barnard 1958 to *P. hurleyi.*

Distribution.—(restricted): *Antarctica* at McMurdo Sound; off Cape Adare; Commonwealth Bay. South Shetlands; South Georgia; Falkland Islands; South America, numerous localities throughout the Magellan-Fuego Archipelago and as far north as Valparaiso.

Heterophoxus ophthalmicus (Schellenberg)

Harpinia ophthalmica Schellenberg 1925: 136-138.

Heterophoxus ophthalmicus, J. L. Barnard 1958: 148.

Remarks.—In looking over Schellenberg's rather good description it is at once apparent that he had an heterophoxid. This is shown by the presence of eyes, the ensiform process on the second antenna and the short fourth palp article bearing a long seta on the maxilliped. Because figures were not given, it is quite difficult to distinguish this species either from *H. trichosus* or *H. oculatus.* Schellenberg distinguished his species from *Harpinia oculata* Holmes (=*Heterophoxus*) by the larger expanded second article of peraeopod 5, the broad posterior teeth of that appendage, and the paucity of setae on the antennae, coxae and third pleonal epimeron. The setation in Holmes' figures and description is not typical of the species in general, for it is a rather large and setose specimen, so that this difference would not be of great use in distinguishing the species. Only in the large and broad teeth of *H. ophthalmicus* can any difference be found.

Distribution.—Nigeria, Lagos.

Heterophoxus trichosus K. H. Barnard

Heterophoxus trichosus K. H. Barnard 1932: 100-101, fig. 50; Stephenensen 1947: 38.

Diagnosis.—Third pleonal epimeron with a very long tooth; peraeopod 5, article 2 reaching to middle of fourth article, posterior teeth acute, lower edge anteriorly concave, appearing subacute, whereas in other heterophoxids the lower edge is convex.

Remarks.—A number of important generic and specific points need to be described for this species in order to verify that it is an heterophoxid. Particularly needed is a description of the third uropods, whether the second article of the outer ramus is minute.

Distribution.—South Shetlands and Graham Region, 200 m.

Heterophoxus oculatus (Holmes)

(Plates 59, 60, 61)

Harpinia oculata Holmes 1908: 521-523, fig. 28.

Harpinia affinis Holmes 1908: 523-524, fig. 29.

Heterophoxus pennatus Shoemaker 1925: 22-26, figs. 1-3.

Heterophoxus oculatus, J. L. Barnard 1958: 148.

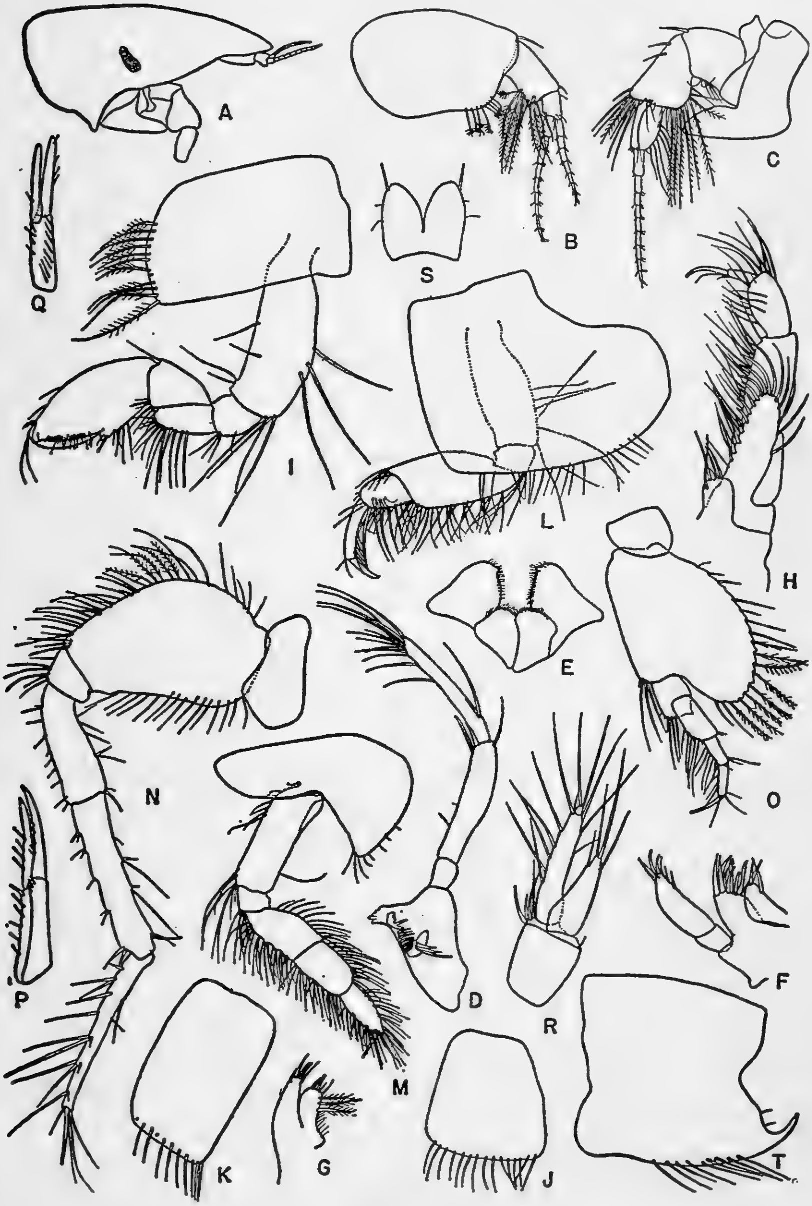


PLATE 59

Heterophoxus oculatus (Holmes), female, 7 mm, Sta. 2448.

Figs. A, head; B,C, antennae 1, 2; D, mandilbe; E, lower lip; F,G, maxillae 1, 2; H, maxilliped; I, gnathopod 2; J,K, coxae 1, 3; L, M, N,O, peraeopods 2, 3, 4, 5; P,Q,R, uropods 1, 2, 3; S, telson; T, pleon segment 3.

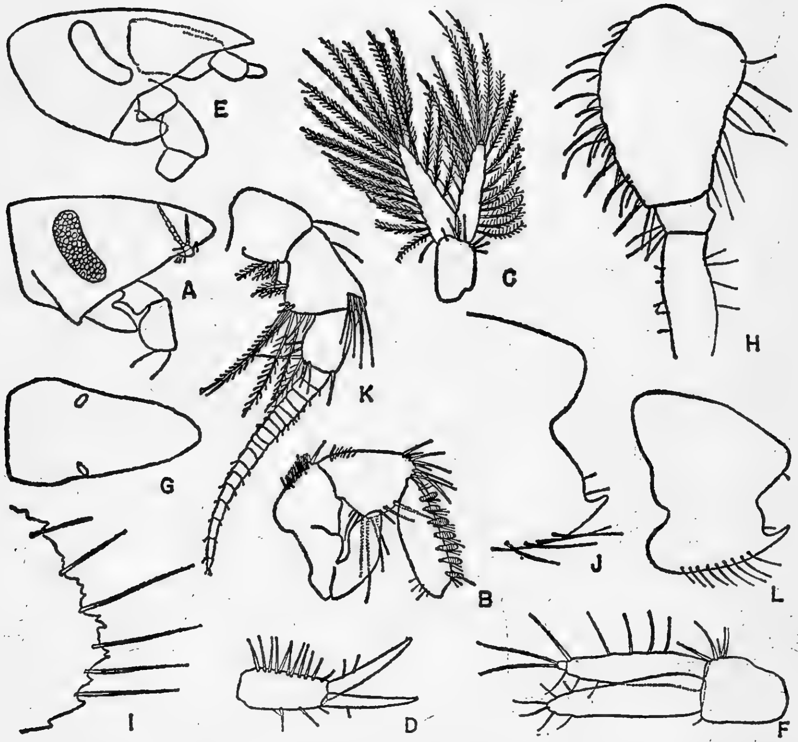


PLATE 60

Heterophoxus oculatus (Holmes), male, 7.5 mm, Friday Harbor, Washington.
Figs. A, head; B, antenna 2; C, uropod 3; D, uropod 2; L, pleon segment 3.
Young male, 5.5 mm, Sta. 2448.
Figs. E, head; F, uropod 3; K, antenna 2.
Female, 7 mm, Sta. 2142.
Figs. G, head; I, peraeopod 5, article 2; J, pleon segment 3.
Female, 4 mm, Sta. 2414.
Fig. H, part of peraeopod 4.

Diagnosis.—Third pleonal epimeron with a moderate to long tooth; peraeopod 5, article 2 not reaching to end of article 4; teeth of peraeopod 5, article 2, sharp pointed.

Descriptive features.—The eyes of the female are poorly pigmented and often are invisible; the eyes of the male are quite large and reniform; the fifth article of the second antenna in the female is shorter than the fourth but in the adult male it is longer than the fourth and bears large sac-like sensory bodies; in the female the flagellum of the

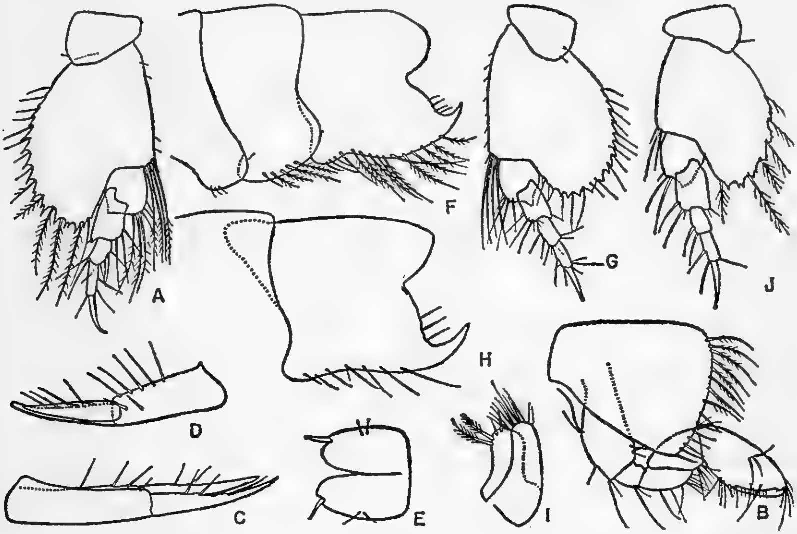


PLATE 61

Heterophoxus oculatus (Holmes), female, 5.2 mm, Sta. 253.
Figs. A, peraeopod 5; B, gnathopod 1; C,D, uropods 1, 2; E, telson; F, pleon segments 1-3.
Female, 6 mm, Sta. 2170.
Figs. G, peraeopod 5; H, pleon segment 3; I, maxilla 2.
Female, 4 mm, Sta. 2344.
Fig. J, peraeopod 5.

second antenna is short, having about 10 articles but in the fully developed male it consists of long articles and the antenna is as long as the body; young males exhibit stout but short flagellar articles.

Epistome not produced.

Gnathopods 1 and 2 similar in size and morphology.

The head has the lower antennal corner extended down acutely and in some specimens it is distinctly produced (see plate 59, fig. A), but not as much as in *Proharpinia*.

Peraeopod 5 has article 2 cut into a number of teeth which are short but acute; between each tooth is a seta; the number of setae range from 6 to 17; in some specimens each intersetal tooth may be double-pointed, especially near the ventral edge.

Uropod 1: rami with 3-6 moderately long setae, the outer ramus slightly longer than the inner. Uropod 2: outer ramus reaching farther than the inner, peduncle with long setae, rami undefined apically, inner ramus with 1-2 setae, outer with 3-4 setae.

Uropod 3: rami rather stout, article 2 of outer ramus minute.

Female: inner ramus about two thirds as long as outer, setae sparse.

Immature male: inner ramus slightly longer than outer, setae sparse.

Male: inner ramus slightly longer than outer, setae numerous.

Telson split about half its length, lobes diverging, bluntly rounded, each with an apical spine.

Epimera of pleon segment 3 with lower edge often undulating or sigmoid.

Holotypes examined.—*Harpinia affinis* Holmes 1908. USNM No. 38549, Sta. 4554, U. S. Fish Comm., Monterey Bay, Calif., 60-80 fms, June 9, 1904, female, 9 mm. This is a badly mutilated specimen in two parts in alcohol and 3 type slides. The head is extant but its internal anatomy has been disturbed so that the eyes apparently have been destroyed. The maxilliped is typical of *H. pennatus* as figured by Shoemaker 1925 but the other mouthparts are absent. Antenna 2 has the large ensiform process; all other charatcers fall within the range of *H. pennatus* except the fourth peraeopod which has a protrusion on the posterior edge of article 2 as was figured by Holmes. This minor difference has no taxonomic value.

Harpinia oculata Holmes 1908. USNM No. 38548, Sta. 4342, U. S. Fish Comm., off S. Coronado Island (Mexico), 53-66 fms, Mar. 11, 1904, female, 8 mm. This specimen is in good condition except that the mouthparts have been removed and placed on 3 type slides. It is a typical *H. pennatus* in all respects, except that the right first gnathopod has assumed a regenerating phase, having the dactylus quite thick and short and not reaching to the end of the transverse palm. I have chosen the name *oculatus* as the senior synonym, although *"affinis"* was also available, on the basis of page priority in Holmes 1908, the better condition of the holotype, and the appropriate name, *"oculatus."*

Material examined.—2428 specimens at 298 stations.

Distribution.—Puget Sound to Panama. At Bahia Honda, Panama, it was collected in 5-8 fms. On the southern California shelf and slopes it is rarely collected as shallow as 10 fms, but is abundant between 24 and 400 fms, with most of the records between 50 and 200 fms. It has also been collected in the following basins: San Pedro Basin, 230 to 440 fms; Santa Catalina Basin, 587 to 620 fms; Santa Cruz Basin, 250 to 1049 fms.

Heterophoxus oculatus, forma nitellus, new form

(Plate 61, figs. A-F)

Diagnosis.—Differentiated from the typical form by the much longer and more acute teeth on the second article of peraeopod 5.

Other features.—Only two specimens of this peculiar form have been collected. In the larger specimen figured, the palp of the mandible is quite slender and smaller than normal and the spines on the first two uropods much sparser, while the spines on the posterior edge of peraeopod 5, article 2, are stouter. The eyes were not visible.

The smaller specimen has a normal mandibular palp, only two slender spines are present on the posterior edge of article 2 of peraeopod 4 and the teeth on peraeopod 5, article 2, are few in number.

Remarks on distribution.—The larger specimen came from Costa Rica at 10 fms (Sta. 253) while the smaller came from the channel between Catalina Island and the mainland, California, at 700 fms (Sta. 2849). The wide geographic separation, broad bathymetric distribution, and rarity of this form suggest that it is a mutant.

Genus **Harpiniopsis** Stephensen

Harpiniopsis Stephensen 1925: 171.

Diagnosis.—Maxillipedal palp article 4 with long apical seta or setae; eyes absent; article 2 of peraeopod 3 narrow; male second antennae as long as body; both pairs of male antennae lack the enlarged setal brushes of male *Harpinia.*

Type species.—*Harpiniopsis similis* Stephensen.

Remarks.—A discussion of the reasons for the retention of this genus may be found under "*Harpinia*" in this paper and in Barnard (1958). All of the new species which are described from the eastern Pacific Ocean herein have been placed in *Harpiniopsis* despite the lack of males in some species. For the present, there is no evidence that true *Harpinias* occur south of Pt. Conception, California, where these species were collected. The key to the genus *Harpinia* should be checked for complete verification of specific identities, but the following key is useful for those species assigned to *Harpiniopsis.*

Key to the Genus **Harpiniopsis**

1. Epistome strongly produced..*epistomatus* n. sp.
1. Epistome not produced 2
2. Third pleonal epimeron with tooth at lower posterior corner....... 3
2. Third pleonal epimeron lacks tooth at lower posterior corner.... 8
3. Head with acute process at lower corner 4
3. Head lacks acute process at lower corner 7
4. Peraeopod 5, article 2 with expanded setose edge at........................ lower anterior corner ....*sanpedroensis* n. sp.
4. Peraeopod 5, article 2 with 2-5 short setae at lower........................ anterior corner.. 5
5. Peraeopod 5, article 2 with 2 large posterior teeth.....*profundis* n. sp.
5. Peraeopod 5, article 2 with small posterior teeth................................ 6
6. Third pleonal epimeron with definite posterior tooth.........*similis*
6. Third pleonal epimeron prolonged and acute..................*fulgens* n. sp.
7. Third pleonal epimeron, tooth long....................................*emeryi* n. sp.
7. Third pleonal epimeron, tooth short...............................*galerus* n. sp.
8. Third pleonal epimeron prolonged behind..........................*naiadis* n. sp.
8. Third pleonal epimeron straight behind...sp. D

Harpiniopsis epistomatus, new species
(Plates 62, 63)

Diagnosis.—Head with lower corner unproduced.

Epistome produced into a long, acute process.

Peraeopod 5, article 2 rounded below, produced down to the end of article 4, posterior edge with 1-2 small distal serrations. Rest of appendage normally setose.

Third pleonal epimeron linear, oblique, lower corner rounded.

Male.—Antenna 2 slightly longer than the body.

Holotype.—AHF No. 5314, female, 3.5 mm.

Type locality.—Station 2229-53, 6.9 mi ENE of Long Point, Santa Catalina Island, 33-36-00 N, 118-13-57 W, February 28, 1953, 440 fms, sandy clay, gravel, rocks.

Remarks.—This is the only harpiniid which is known to bear a produced epistome. Otherwise, it is closely related to *Harpinia laevis* G.O. Sars.

Material examined.—41 specimens at 18 stations.

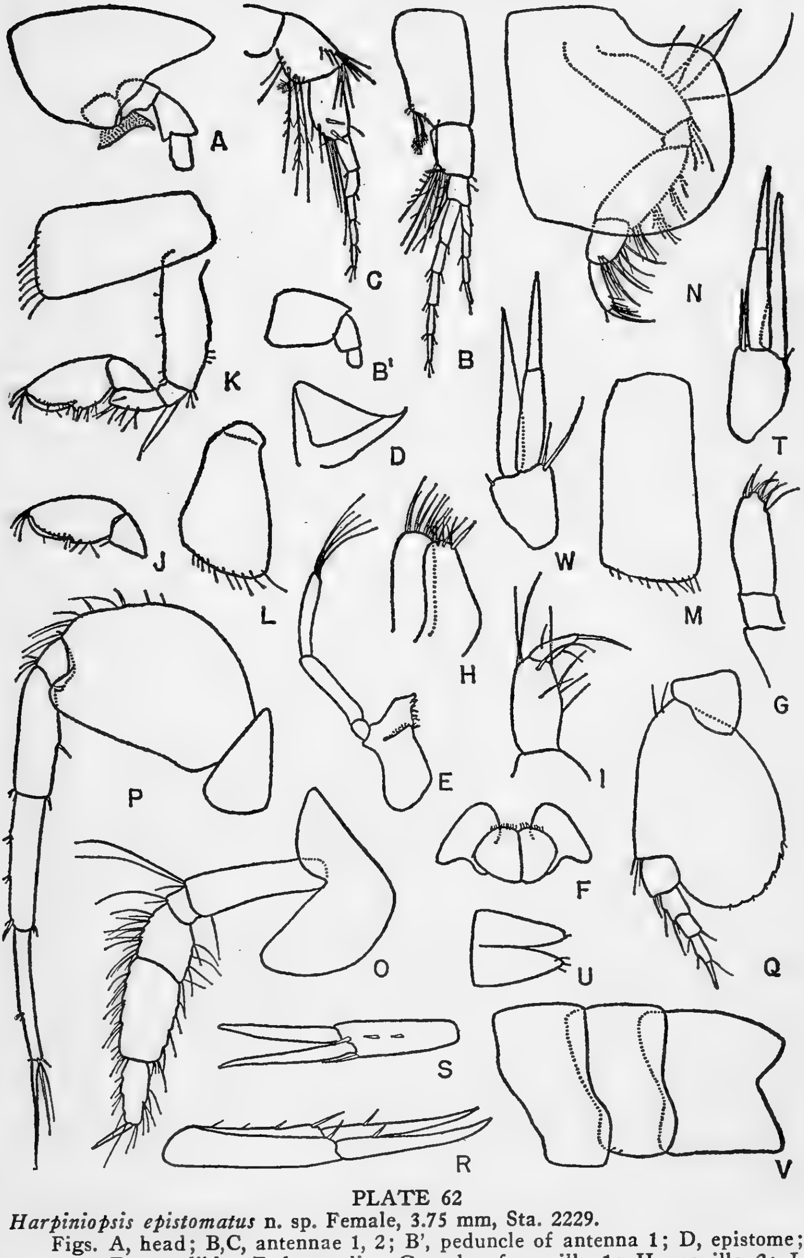


PLATE 62

Harpiniopsis epistomatus n. sp. Female, 3.75 mm, Sta. 2229.

Figs. A, head; B,C, antennae 1, 2; B', peduncle of antenna 1; D, epistome; E, mandible; F, lower lip; G, palp of maxilla 1; H, maxilla 2; I, maxilliped, end of palp; J,K, gnathopods 1, 2; L,M, coxae 1, 3; N,O,P,Q, peraeopods 2, 3, 4, 5; R,S,T, uropods 1, 2, 3; U, telson; V, pleon segments 1-3.

Distribution.—Southern California slopes, 230 to 400 fms. San Pedro Basin, 410 to 440 fms; Santa Cruz Basin, 829 fms; slope of Santa Catalina Basin, 504 fms.

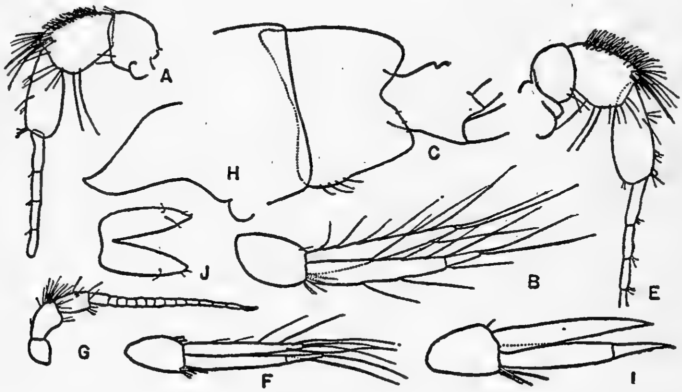


PLATE 63

Harpiniopsis epistomatus n. sp. Male, 3 mm, Sta. 2441.
Figs. A, antenna 2; B, uropod 3; C, pleon segment 3.
Male, 3 mm, Sta. 2230.
Figs. E, antenna 2; F, uropod 3.
Male, young, 3.25 mm, Sta. 2475.
Figs. G, antenna 2; H, epistome; I, uropod 3; J, telson.

Harpiniopsis sanpedroensis, new species
(Plates 64, 65)

Diagnosis.—Lower corner of head strongly produced into an acute process.

Epistome rounded in front.

Peraeopod 5, article 2 produced down to the end of article 4, posterior edge with numerous large and small irregular teeth; distal anterior edge of article 2 expanded and armed with 10 large, plumose setae.

Third pleonal epimeron with a long slightly upturned tooth at the lower posterior corner.

Male.—Unknown.

Holotype.—AHF No. 547, female, 4.5 mm.

Type locality.—Station 2850, west of Santa Catalina Island, 33-14-00 N, 118-18-04 W, June 23, 1954, 620 fms, bottom of green mud.

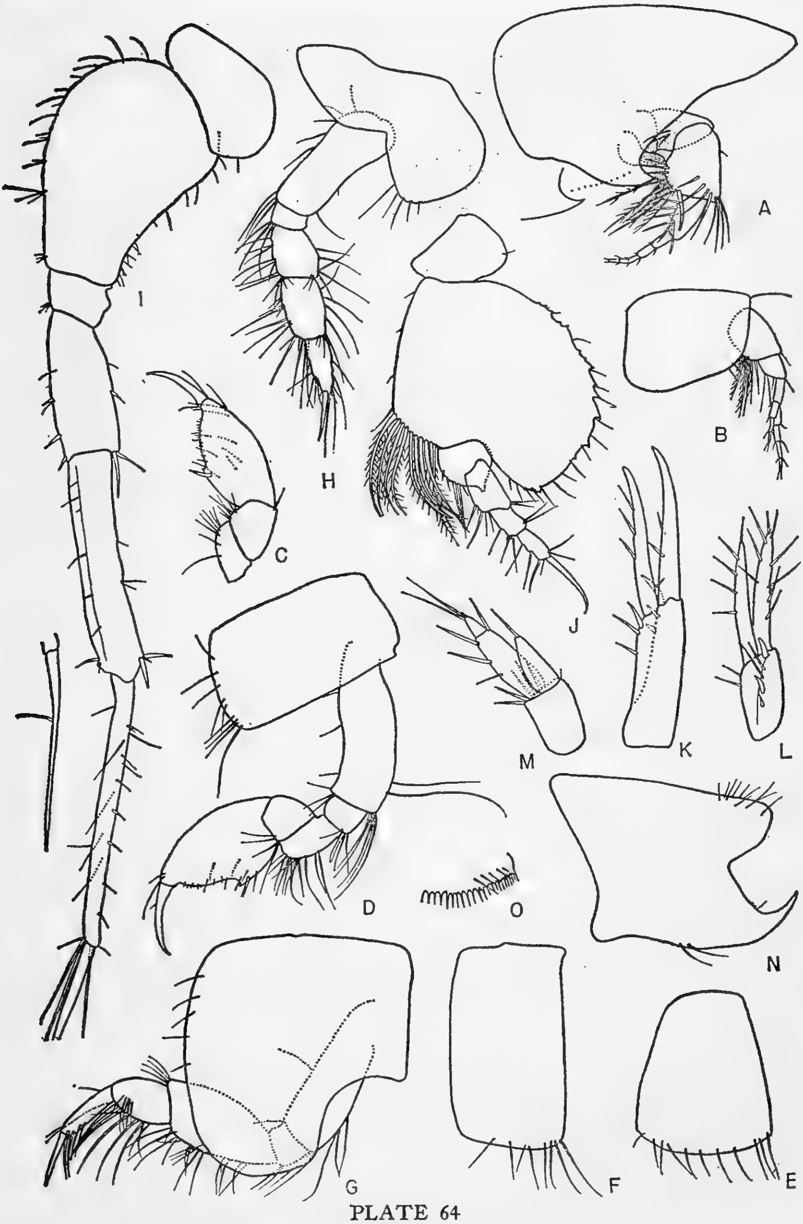


PLATE 64

Harpiniopsis sanpedroensis, n. sp. Female, 5 mm, Sta. 2850.

Figs. A, head; B, antenna 1; C,D, gnathopods 1, 2; E,F, coxae 1, 3; G,H,I,J, peraeopods 2, 3, 4, 5; K,L,M, uropods 1, 2, 3; N, pleon segment 3; O, marginal ornamentation of the posterior edge of pleon segment 3.

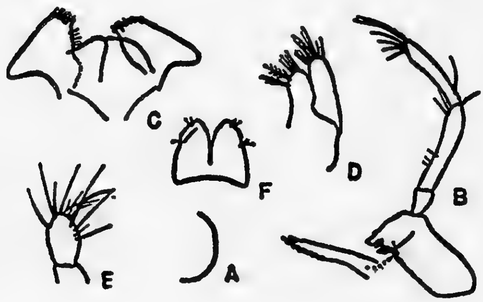


PLATE 65

Harpiniopsis sanpedroensis, n. sp. Female, 5 mm, Sta. 2850.
Figs. A, epistome; B, mandible; C, lower lip; D, maxilla 2; E, palp of maxilliped; F, telson.

Remarks.—This species is remarkable for the spinosity of the rami of uropods 1 and 2 and resembles *Pseudharpinia dentata* Schellenberg in this respect. If *Pseudharpinia* is to be considered a valid genus then *H. sanpedroensis* probably should be transferred to that genus.

Harpiniopsis sanpedroensis resembles *Harpinia excavata* but differs in the fewer and slightly larger posterior teeth of peraeopod 5, article 2.

Material examined.—The type locality, 2 specimens.

Harpiniopsis profundis, new species
(Plate 66)

Diagnosis.—Lower corner of head with a medium-sized process. Epistome not produced.

Peraeopod 5, article 2 produced down to the end of article 4, distal posterior edge oblique and armed with about 8 teeth, which increase in size distally.

Third pleonal epimera with lower posterior corner strongly produced.

Male.—Unknown.

Holotype.—AHF No. 548, female, 4.5 mm, unique.

Type locality.—Station 2850, west of Catalina Island, 33-14-00 N, 118-18-04 W, June 23, 1954, 620 fms, green mud.

Remarks.—This species appears related to *H. tarasovi* Bulycheva 1936 in the structure of the fifth peraeopod and third pleonal epimera but bears a large lower head process which apparently is not developed in *H. tarasovi.*

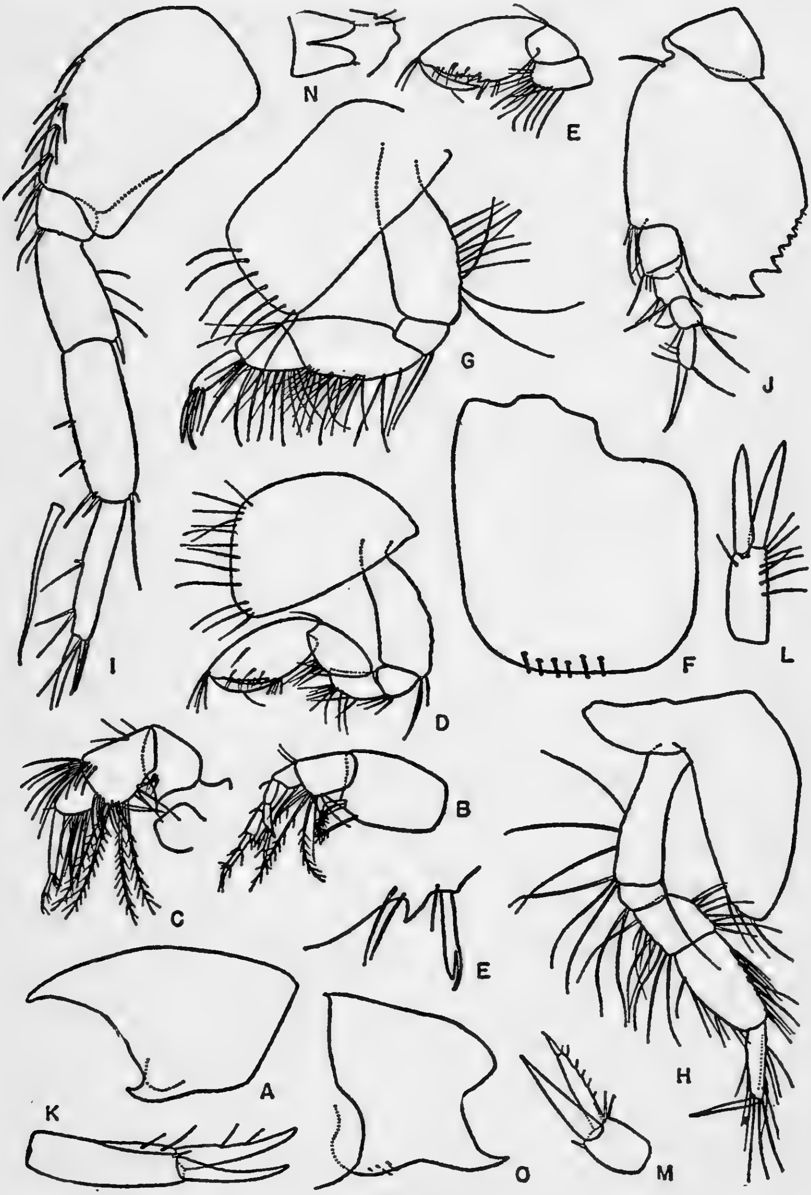


PLATE 66

Harpiniopsis profundis n. sp. Female, holotype, 4.5 mm, Sta. 2850.

Figs. A, head; B,C, antennae 1, 2; D,E, gnathopods 1, 2; E', palm of gnathopod 2; F, coxa 4; G,H,I,J, peraeopods 1, 3, 4, 5; K, L, M, uropods 1, 2, 3; N, telson; O, pleon segment 3.

Harpiniopsis similis Stephensen

Harpiniopsis similis Stephensen 1925: 171-172, fig. 51; Stephensen 1940: 27.

Harpinia (*Harpiniopsis*) *similis,* Gurjanova 1936a: 150; Gorbunov 1946: 43; Gurjanova 1951: 372-373, fig. 222.

Distribution.—Polar Basin; New Siberian Sea; Kara Sea; Norwegian Sea; west of Greenland. Depth, 57 to 1090 meters.

Harpiniopsis fulgens, new species

(Plates 67, 68)

Diagnosis.—Head rather short, strongly and acutely produced at lower corner.

Epistome not produced.

Peraeopod 5 with article 2 produced down to the end of article 3, posterior edge with 5-6 shallow teeth on the distal edge only. Rest of appendage normally setose.

Third pleonal epimeron: posterior edge straight, then prolonged into a large blunt process.

Male.—Antenna 2 as long as body.

Holotype.—AHF No. 5315, female, 3.75 mm.

Type locality.—Station 2306-53, 6.2 mi S. of Pt. Fermin Light, California, 33-36-07 N, 118-18-00 W, April 25, 1953, 215 fms, clay and mud.

Remarks.—The prolongation of the third pleonal epimera is greater in some specimens of the species, so that it approaches the condition of a definite tooth. In this respect these specimens approach the configuration of *H. similis* Stephensen (1925) and the species may not be specifically distinct from that one. However, variability studies and further morphologic description are needed for the Atlantic *H. similis.*

Some specimens bear a slight dorsal head crest.

Material examined.—90 specimens at 34 stations.

Distribution.—Southern California slopes, 70 to 277 fms. Ridge between San Nicolas Island and Santa Cruz Basin, 200 fms. Slope of Santa Catalina Basin, 517 fms. San Clemente Basin, 1092 fms.

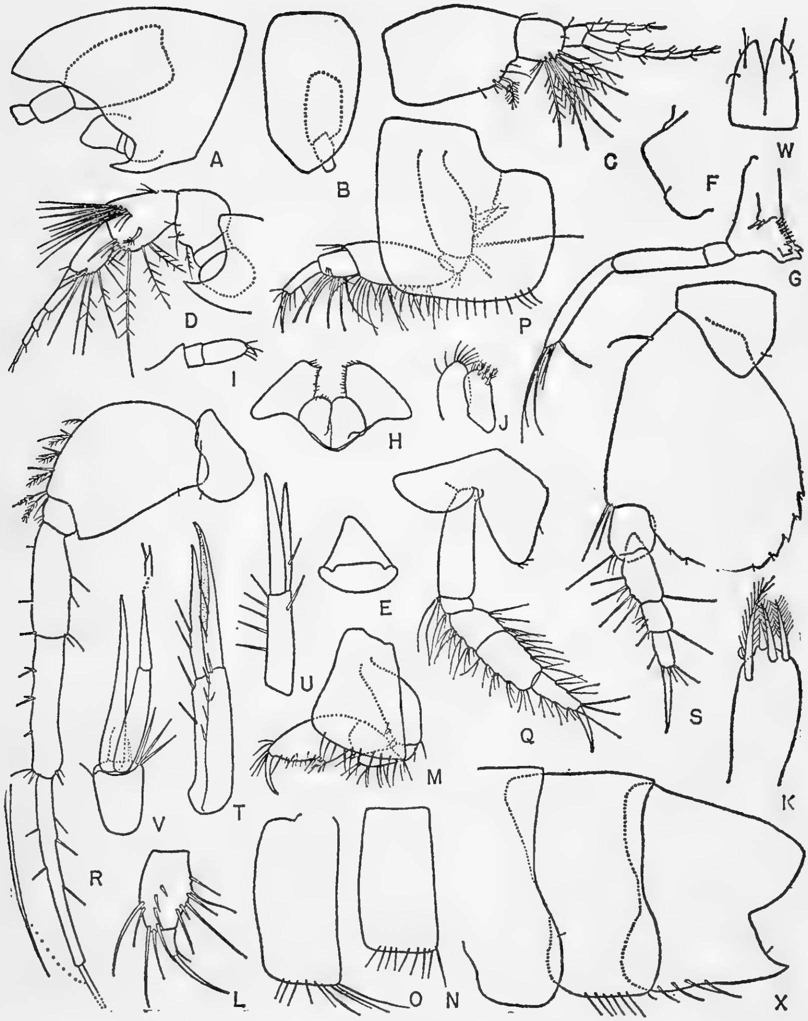


PLATE 67

Harpiniopsis fulgens n. sp. Female, 3.2 mm, Sta. 2306.

Figs. A,B, head; C,D, antennae 1, 2; E, upper lip; F, epistome; G, mandible; H, lower lip; I, palp of maxilla 1; J, maxilla 2; K, inner plate of maxilliped; L, palp articles 3-4 of maxilliped; M, gnathopod 1; N,O, coxae 2, 3; P,Q,R,S, peraeopods 2; 3, 4, 5; T,U,V, uropods 1, 2, 3; W, telson; X, pleon segments 1-3.

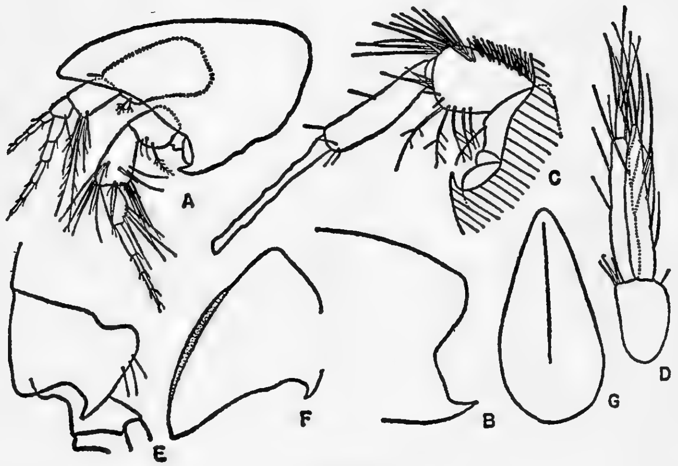


PLATE 68

Harpiniopsis fulgens n. sp. varieties.
Female, 3 mm, Sta. 2172.
Figs. A, head; B, pleon segment 3.
Female, 3.75 mm, Sta. 2430.
Figs. C, antenna 2; D, uropod 3; E, pleon segment 3.
Male, 4 mm, Sta. 3400.
Figs. F,G, head.

Harpiniopsis emeryi, new species
(Plate 69)

Diagnosis.—Lower corner of head very slightly produced.

Epistome not produced.

Peraeopod 5 small, article 2 not very broad, lower posterior edge with 2 small teeth; the lower corner is formed by 2 larger teeth.

Third pleonal epimeron with a very long upturned tooth at the lower posterior corner.

Male.—Unknown.

Holotype.—AHF No. 549, ovigerous female, 4.25 mm.

Type locality.—Station 2632, 4.4 mi S of end of Newport Beach Pier, 33-31-58 N, 117-55-57 W, April 24, 1954, 230 fms, sandy gray-green mud.

Remarks.—This species closely resembles *H. galerus,* n. sp. but differs in the very elongated tooth of the third pleonal epimera.

Material examined.—8 specimens at 7 stations.

Distribution.—Southern California slopes, 230 to 280 fms. Slope of Santa Cruz Basin, 400 fms. Santa Catalina Basin and slopes, 504 to 620 fms. Santa Cruz Basin, 1477 fms.

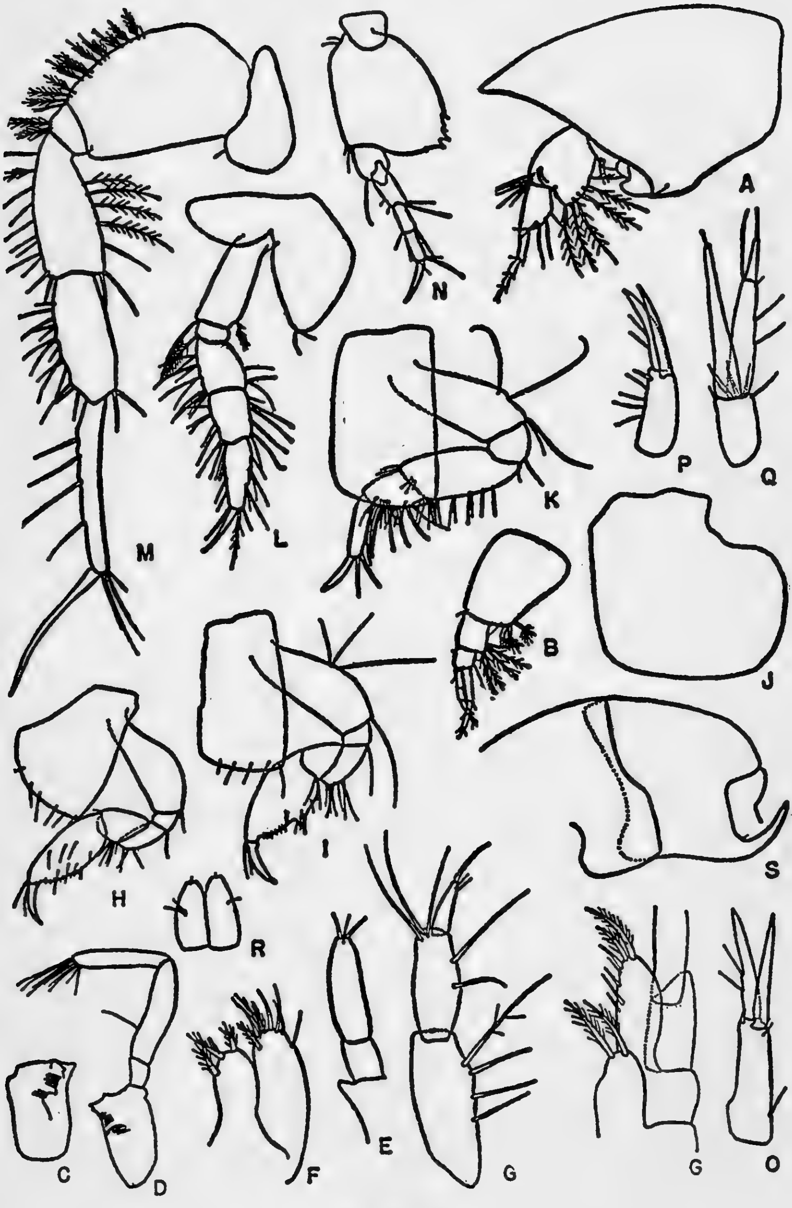


PLATE 69

Harpiniopsis emeryi, n. sp. Female, 4.5 mm, Sta. 2850.

Figs. A, head; B, antenna 1; C,D, mandibles; E, palp of maxilla 1; F, maxilla 2; G,G' maxilliped; H,I, gnathopods 1, 2; J, coxa 4; K,L,M,N, peraeopods 1, 3, 4, 5; O,P,Q, uropods 1, 2, 3; R, telson; S, pleon segments 2-3.

Harpiniopsis galerus, new species
(Plates 70, 71, 72)

Diagnosis.—Lower corner of head scarcely produced.

Epistome not produced.

Peraeopod 5, article 2 produced down to the end of article 3, posterior edge quite variable in configuration (see figures), with 4-8 shallow teeth. Rest of appendage slender and with normal setation.

Third pleonal epimeron with moderately large, slightly upturned tooth. Pleon segment 4 bears a posterolateral spine on each side.

Male.—Antenna 2 as long as body.

Holotype.—AHF No. 5316, female, 2.5 mm.

Type locality.—Station 2436-53, 5.5 mi SE of Long Point, Santa Catalina Island, California, 33-20-00 N, 118-18-00 W, 44 fms, sandy mud and clay.

Remarks.—This species is closely related to *H. emeryi* n. sp. from which it differs in the shorter tooth of pleon segment 3 and the more numerous and better developed posterior teeth of peraeopod 5.

Several slight changes occur from juvenile to adult specimens at the 2.5 to 3.0 mm length. The spines on uropods 1 and 2 become slightly longer, article 2 of peraeopod 5 becomes slightly broader and the tooth of pleon segment 3 becomes slightly longer.

At the position where other phoxocephalids bear eyes there is a small accumulation of cellular material beneath the chitin, which might be confused with true ommatideal bundles.

Material examined.—65 specimens at 17 stations.

Distribution.—Southern California slopes, 45 to 300 fms.

Harpiniopsis naiadis, new species
(Plate 73)

Diagnosis.—Lower corner of head with a short, pointed cusp.

Epistome not produced.

Peraeopod 5, article 2 produced down to the end of article 3, posterior edge with 4 small teeth.

Third pleonal epimeron with an oblique posterior edge, prolonged to form an acute process at the lower corner.

Male.—Unknown.

Holotype.—AHF No. 5317, female, 2.75 mm.

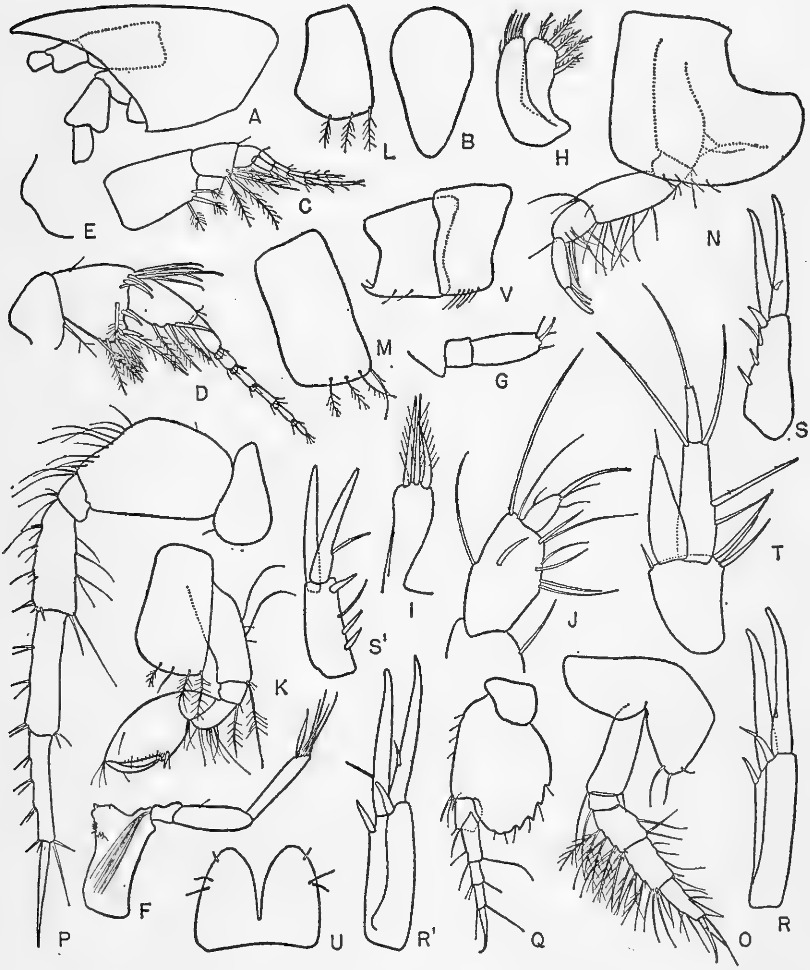


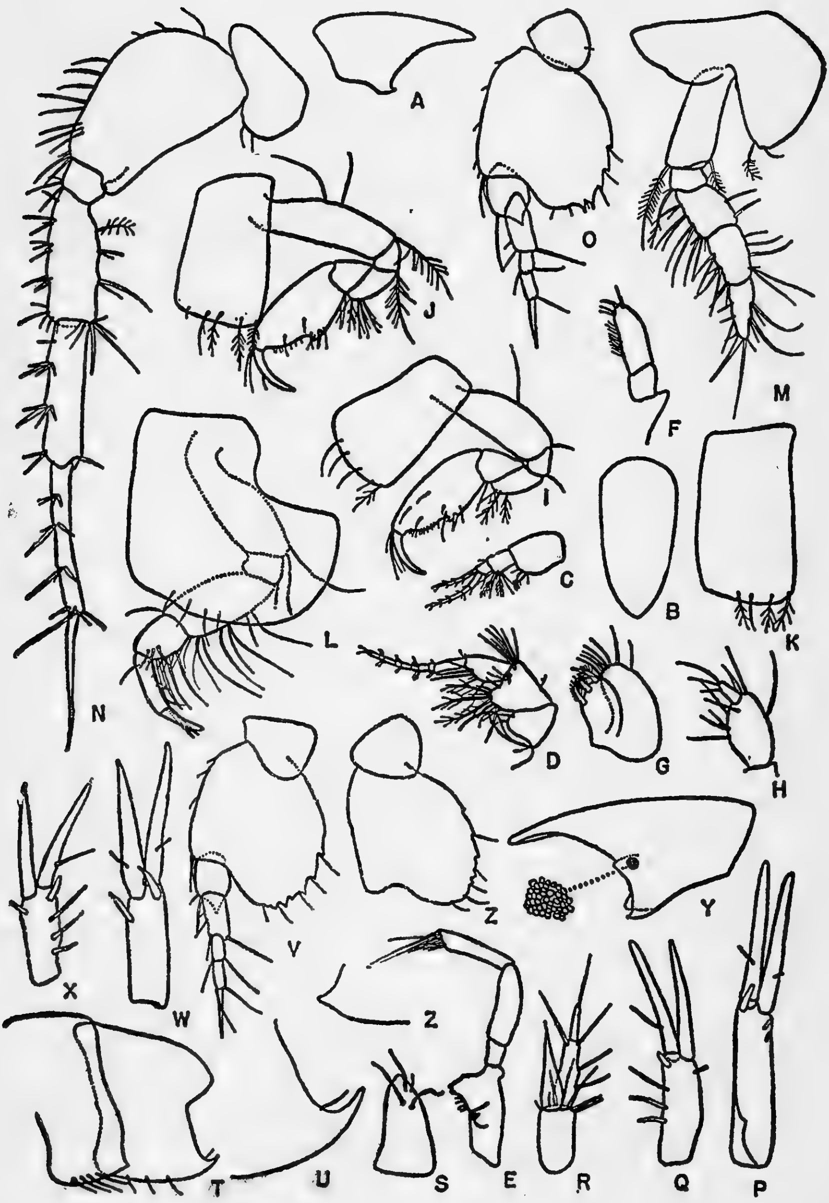
PLATE 70

Harpiniopsis galerus n. sp. Female, 3 mm, Sta. 2436.

Figs. A,B, head; C,D, antennae 1, 2; E, epistome; F, mandible; G, palp of maxilla 1; H, maxilla 2; I, inner plate of maxilliped; J, palp of maxilliped; K, gnathopod 2; L,M, coxae 1, 3; N,O,P,Q, peraeopods 2, 3, 4, 5; R,S,T, uropods 1, 2, 3; U, telson; V, pleon segments 3-2.

Another female, 3 mm, Sta. 2436.

Figs. R',S', uropods 1, 2.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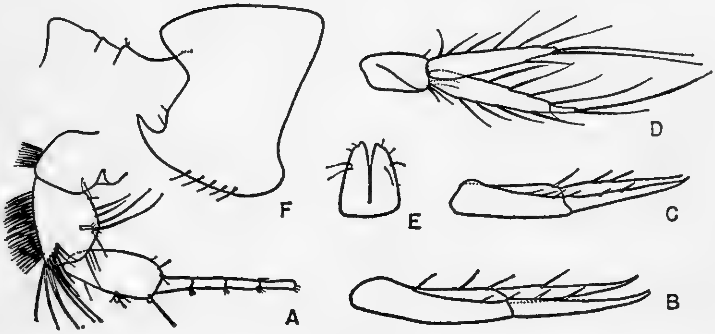

PLATE 72

Harpiniopsis galerus n. sp. Male, 3.5 mm, Sta. 2230.
Figs. A, antenna 2; B,C,D, uropods 1, 2, 3; E, telson; F, pleon segment 3 and top of urosome.

Type locality.—Station 2344, 5.3 mi ENE of E end, Santa Catalina Island light, 33-19-54 N, 118-14-20 W, 210 fms, bottom of sandy mud, gravel, rocks, July 1, 1953.

Remarks.—This species is similar to *H. epistomatus* n. sp. but differs in the lack of a produced epistome.

Material examined.—3 specimens at 2 stations.

Distribution.—Southern California slope, 185 to 210 fms.

Harpiniopsis sp. D
(Plate 74)

Diagnosis.—Head lacks process at lower corner.

Condition of epistome unknown.

Peraeopod 5, article 2 produced down to end of article 4, posterior edge with 2-3 shallow teeth.

PLATE 71

Harpiniopsis galerus n. sp. Female, 3 mm, Sta. 2414.
Figs. A,B, head; C,D, antennae 1, 2; E, mandible; F, palp of maxilla 1; G, maxilla 2; H, palp of maxilliped; I,J, gnathopods 1, 2; K, coxa 3; L,M,N,O, peraeopods 2, 3, 4, 5; P,Q,R, uropods 1, 2, 3; S, telson, half; T, pleon segments 2-3; U, pleon segment 3.

Juvenile, 2 mm, Sta. 2227.
Figs. V, peraeopod 5; W,X, uropods 1, 2.

Female, 2 mm, Sta. 2367.
Figs. Y, head with cellular ganglion?; Z, peraeopod 5.

Female, 2.5 mm, Sta. 2851.
Fig. Z', lower corner of pleon segment 3.

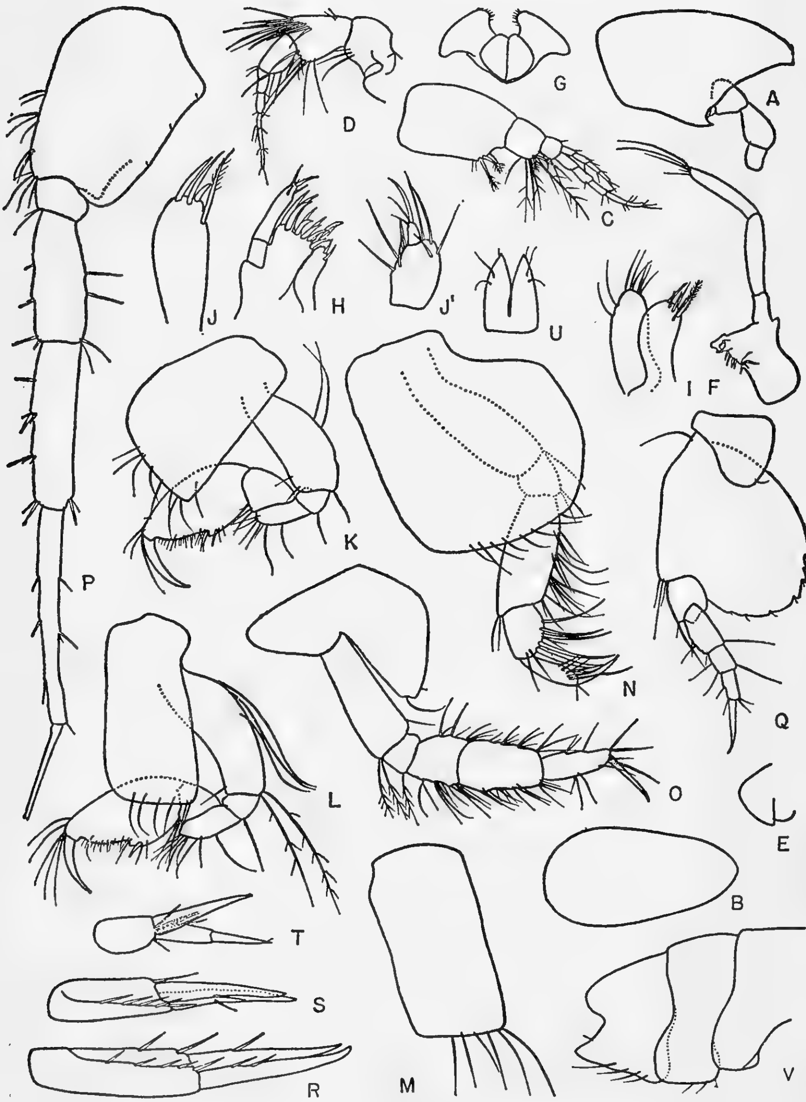

PLATE 73

Harpiniopsis naiadis, n. sp. Female, 3 mm, Sta. 2302.

Figs. A,B, head; C,D, antennae 1, 2; E, epistome; F, mandible; G, lower lip; H,I, maxillae 1, 2; J,J' maxilliped; K,L, gnathopods 1, 2; M, coxa 3; N,O,P,Q, peraeopods 2, 3, 4, 5; R,S,T, uropods 1, 2, 3; U, telson; V, pleon segments 3-1.

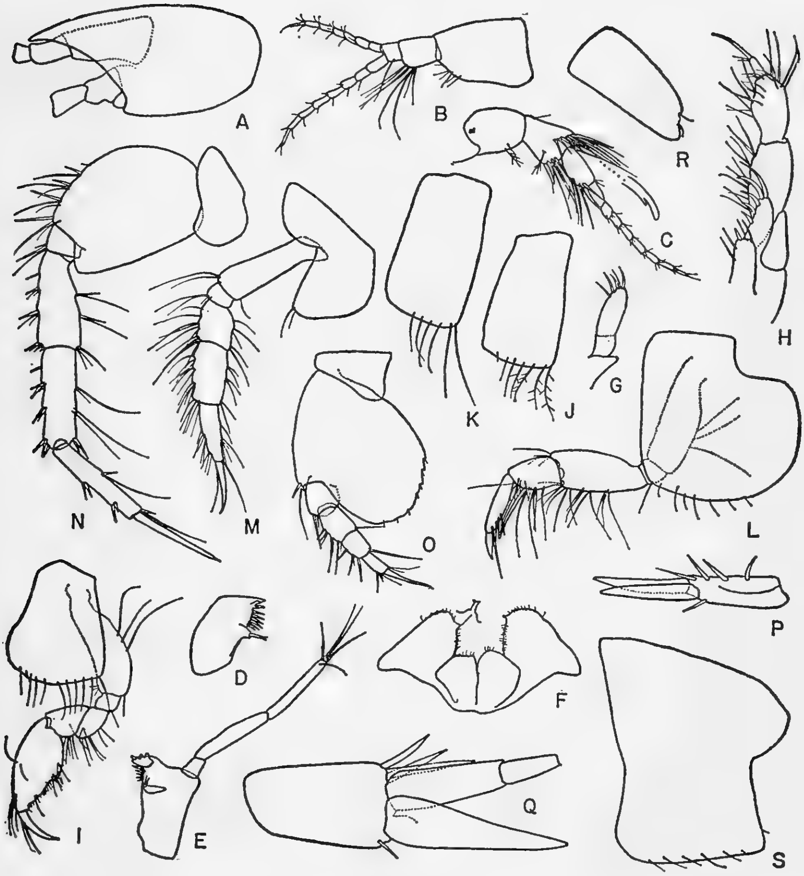

PLATE 74

Harpiniopsis sp. D. Female, 3 mm, Sta. 190.

Figs. A, head; B,C, antennae 1, 2; D,E, mandibles; F, lower lip; G, palp of maxilla 1; H, maxilliped; I, gnathopod 1; J,K, coxae 2, 3; L,M,N,O, peraeopods 2, 3, 4, 5; P, Q, uropods 2, 3; R, telson; S, pleon segment 3.

Third pleonal epimeron quadrate, posterior edge with one setule.

Material examined.—USNM Cat. No. 97310, female, 3 mm.

Locality.—Station 190-34, Galapagos Islands, east of south end of Albemarle Island, 0-55-00 S, 90-30-00 W, January 26, 1934, 58-60 fms, sand, nullipores.

Remarks.—The epistome of this species was damaged by me in dissection and its condition is unknown. In many respects the species resembles *Harpiniopsis epistomatus* n. sp. It must remain unnamed until further specimens have been collected. It is labeled "D-2" in the USNM collections.

The first uropods of the specimen were missing.

Genus **Pseudharpinia** Schellenberg

Pseudharpinia Schellenberg 1931: 81-82.

Diagnosis.—Article 4 of maxillipedal palp with 2-3 long apical setae; eyes absent; article 2 of peraeopod 3 narrow; uropods 1 and 2 with distal spines on rami; antenna 2 with ensiform process on article 2; telson stunted.

Type species.—*P. dentata* Schellenberg 1931.

Remarks.—There are no distinct qualitative features which distinguish this genus from some members of *Harpinia* or *Harpiniopsis.* The male is unknown.

However, the peculiar combination of quantitative differences the type species exhibits should be recognized, for the time being, by the retention of this category, until additional similar species are discovered.

The head crest is not unique, being found in one or more species of *Harpiniopsis.* The stunted telson, third uropods and the ensiform process of antenna 2 suggest that the type species is an eyeless *Heterophoxus.* The distally spinose rami of uropods 1 and 2 are known to a lesser degree in *Harpiniopsis sanpedroensis* n. sp.

Pseudharpinia dentata Schellenberg

(Plate 75)

Pseudharpinia dentata Schellenberg 1931: 82-83, fig. 42.

Material examined.—Swedish State Museum Cat. No. 6643, Lagotowia, 10 fd (15).

Remarks.—The epistome is rounded in front. The head is attached to the body so that the lower front edge tilts down from the axis of the body. The dorsal keel of the head is hyaline and striated.

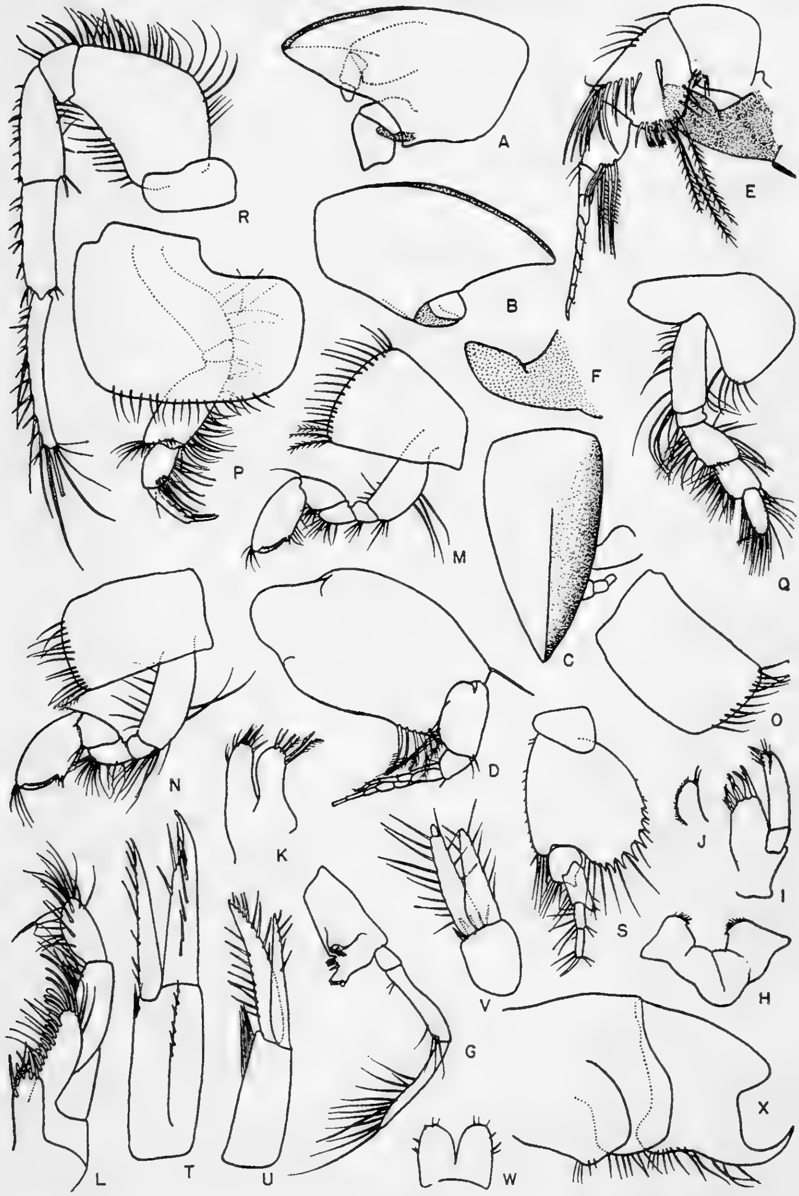

PLATE 75

Pseudharpinia dentata Schellenberg. Female, 9 mm, Lagotowia, syntype.

Figs. A,B,C, head; D,E, antennae 1,2; F, ensiform process of antenna 2; G, mandible; H, lower lip; I,J, maxilla 1; K, maxilla 2; L, maxilliped; M,N, gnathopods 1, 2; O, coxa 3; P,Q,R,S, peraeopods 2, 3, 4, 5; T,U,V, uropods 1, 2, 3; W, telson; X, pleon segments 1-3.

Proharpiniid sp.

Harpinia obtusifrons, Chilton 1909: 619 (in part); Chilton 1912: 477-478 (not Stebbing 1888).

Remarks.—Some of the materials referred to in the above references have not been clearly identified, although reference is made to harpiniids with eyes, referable to *Proharpinia* or *Heterophoxus.*

Localities.—New Zealand: Lyttelton Harbour and Bay of Islands; South Orkneys: Scotia Bay Station 325.

Genus Harpinia Boeck

Harpinia Boeck 1876: 218; Sars 1895:150; Stebbing 1906: 140.

Diagnosis.—Maxilliped palp article 4 with 2 or 3 long apical setae; eyes absent; article 2 of peraeopod 3 narrow; male and female second antennae short; male antennae of both pairs armed with large brushes of setae on basal articles.

Type species.—*Phoxus plumosus* Krøyer.

Remarks.—This genus is unusual in the Phoxocephalidae for the short second antennae of the male and the development of setal brushes on both pairs of male antennae. Only a few males of the numerous species are known and for this reason not all of the species based on females can be placed firmly in *Harpinia.* Species of the genera *Harpiniopsis* and *Pseudharpinia* have been or can be placed in or confused with *Harpinia.*

It is a debatable procedure whether to base the genus *Harpiniopsis* on a secondary sexual character such as elongated second male antennae but the systematic concept has value for morphological and zoogeographic purposes until complete pictures of all the species can be assembled (Barnard 1958). For these reasons I have restricted all harpiniids with elongated male antennae in the genus *Harpiniopsis* resulting in a body of species from the eastern Pacific Ocean and one from the North Atlantic Ocean, with possible zoogeographic implications (Barnard 1958). The males of many species from the Atlantic Ocean, North Pacific Ocean and other seas are unknown and are provisionally relegated to *Harpinia.*

Because of the confusion in these matters it has been necessary to construct a key which includes females of *Harpinia, Harpiniopsis* and *Pseudharpinia,* which follows.

This key is quite artificial, being based largely on Table 14 which lists the condition of seven major features of importance in distinguishing harpiniids.

The artificiality is imposed by the lack of knowledge for most of the species of the epistome, the structure of the lower corner of the head and the first two uropods, all of which may have more phylogenetic value than the characters which are used.

The lower head process is considered herein to be absent where not described but all of the species should be rechecked. The presence or absence of an oblique setal row on the third pleonal epimera is also unknown in many species.

Key To Female Harpiniids

1. Third pleonal epimeron lacks lower posterior tooth........................ 2
1. Third pleonal epimeron bears lower posterior tooth........................11
2. Peraeopod 5, article 2, anterior lower elge.. with an expanded setal row 3
2. Peraeopod 5, article 2, anterior lower edge with 2-5 setae............. 4
3. Head bears a process at lower corner....................................*brevirostris*
3. Head lacks a process at lower corner ....*abyssi*
4. Peraeopod 5, article 2, posterior edge with 10 small teeth..*moiseevi*
4. Peraeopod 5, article 2, posterior edge with 5 or less teeth............ 5
5. Epistome produced strongly...*epistomatus* n. sp.
5. Epistome not produced 6
6. Third pleonal epimeron bears a notch at lower posterior corner.. 7
6. Third pleonal epimeron lacks a notch at lower posterior corner.. 8
7. Peraeopod 4 long, third pleonal epimeron lacks oblique.................. setal row ....*crenulata*
7. Peraeopod 4 short, third pleonal epimeron bears oblique............... setal row ....*crenuloides*
8. Third pleonal epimeron bears oblique setal row...................*truncata*
8. Third pleonal epimeron lacks oblique setal row 9
9. Third pleonal epimeron prolonged posteriorly.................*naiadis* n. sp.
9. Third pleonal epimeron not prolonged posteriorly...........................10
10. Peraeopod 5, combined length of articles 3-7 shorter than............ anterior edge of article 2..*curtipes*
10. Peraeopod 5, combined length of articles 3-7 longer than.............. anterior edge of article 2.......................................*laevis* and sp. D

11. Peraeopod 5 bears large upward pointing spur.............................. 12
11. Peraeopod 5 lacks large upward pointing spur.............................. 14
12. Third pleonal epimeron with very long tooth, peraeopod 5..........
 lacks additional large teeth ....*mucronata*
12. Third pleonal epimeron with medium tooth, peraeopod 5............
 bears 1-2 additional large teeth.. 13
13. Peraeopod 5 bears 2 accessory large teeth and 1 small..................
 one ....*kobjakovae*
13. Peraeopod 5 bears 1 accessory large tooth and 4............................
 small ones ....*orientalis*
14. Peraeopod 5, article 2, anterior lower edge with an expanded......
 setal row 15
14. Peraeopod 5, article 2, anterior lower edge with 2-5 small setae 17
15. Peraeopod 5 bears 8 large posterior teeth...................................*latipes*
15. Peraeopod 5 bears no large posterior teeth 16
16. Peraeopod 5, posterior edge of article 2 with...................................
 numerous serrations ....*excavata*
16. Peraeopod 5, posterior edge of article 2 with about.....................
 7 small teeth ....*sanpedroensis* n. sp.
17. Peraeopod 5, article 2 bears large posterior teeth..........................18
17. Peraeopod 5, article 2 bears small posterior teeth 26
18. Head with strong process at lower corner.................*profundis* n. sp.
18. Head with small or no process at lower corner 19
19. Third pleonal epimeron with oblique setal row 20
19. Third pleonal epimeron lacks oblique setal row.............................. 22
20. Peraeopod 5, article 2 bears 2 large posterior teeth............*bidentata*
20. Peraeopod 5, article 2 bears 4 large posterior teeth..........................21
21. Dorsum of pleon not hairy; peraeopod 5, article 2 bears 2-3..........
 small teeth on lower edge ....*pectinata*
21. Dorsum of pleon hairy; peraeopod 5, article 2 lacks small............
 teeth on lower edge ....*serrata*
22. Peraeopod 5, article 2 with 7 large posterior teeth.................*schurini*
22. Peraeopod 5, article 2 with 4 or less large posterior teeth..............23
23. Peraeopod 5, article 2 with 4 large posterior teeth..........................24
23. Peraeopod 5, article 2 with 2 large posterior teeth..........................25
24. Teeth of peraeopod 5 directed posteriorly..............................*birjulini*
24. Teeth of peraeopod 5 directed ventrally..................................*tarasovi*
25. Peraeopod 5, both large teeth acute...*salebrosa*
25. Peraeopod 5, one of the large teeth blunt.........................*gurjanovae*

26. Peraeopod 5, article 2 bears large ventral teeth............................... ....*Pseudharpinia dentata*
26. Peraeopod 5, article 2 bears small or no ventral teeth......................27
27. Head with well developed process at lower corner...........................28
27. Head probably lacks well marked process at lower corner,............ occasionally with accessory process above lower corner.........33
28. Third pleonal epimeron with oblique setal row.................................29
28. Third pleonal epimeron lacks oblique setal row.................................30
29. Lower process of head large...*antennaria*
29. Lower process of head small...*cabotensis*
30. Peraeopod 5, article 2 with 10 posterior serrations.............*dellavallei*
30. Peraeopod 5, article 2 with 5 or less posterior serrations.................31
31. Third pleonal epimeron prolonged and acute.................*fulgens* n. sp.
31. Third pleonal epimeron with a definite posterior tooth...................32
32. Rami of uropods 1-2 naked...*similis*
32. Rami of uropods 1-2 spinose...*abyssalis*
33. Peraeopod 5, article 2 with posterior serrations...................*carinicepts*
33. Peraeopod 5, article 2 with 5 or less posterior serrations.................34
34. Third pleonal epimeron with oblique setal row.................................35
34. Third pleonal epimeron lacks oblique setal row.................................36
35. Third pleonal epimeron tooth short.......................................*propinqua*
35. Third pleonal epimeron tooth long.................*plumosa* and *amundseni*
36. Head with accessory projection above lower corner.................*pacifica*
36. Head lacks accessory projection above lower corner.........................37
37. Third pleonal epimeron, posterior tooth very slender..................... and elongate ....*emeryi* n. sp.
37. Third pleonal epimeron, posterior tooth stout or short....................38
38. Third pleonal epimeron, posterior tooth short, slender....*galerus* n. sp.
38. Third pleonal epimeron, posterior tooth of....................................... medium length, stout...*obtusifrons*

Harpinia abyssalis Pirlot

Harpinia abyssalis Pirlot 1932: 69-74, figs. 16-18.

Distribution.—Flores Sea and Macassar Strait, 1301 to 1310 meters depth.

TABLE 14

Condition of seven taxonomic characteristics of harpiniids.

	Pleon 3 with tooth	Peraeopod 5 with spur	Peraeopod 5 with large teeth	Peraeopod 5 with small teeth	Head with lower process	Peraeopod 5 with ant. setal edge	Pleon 3 with oblique setal row
pleon segment 3 lacks tooth							
abyssi	0	0	0	0	0	X	0
brevirostris	0	0	0	9	X	X	0
crenulata	0	0	0	5	0	0	0
crenuloides	0	0	0	5	0	0	X
curtipes	0	0	0	4	?	0	0
laevis	0	0	0	5	0	0	0
moiseevi	0	0	0	10	X	0	0
truncata	0	0	0	4	0	0	X
epistomatus n.sp.	0	0	0	4	0	0	0
naiadis n.sp.	0	0	0	4	X0	0	0
sp. D	0	0	0	3	0	0	0
pleon segment 3 with tooth, peraeopod 5 with spur or large teeth							
kobjakovae	X	X	2	1b	X	0	0
mucronata	XX	X	0	3b	0	0	X
orientalis	X	X	1	4b	X0	0	0
excavata	X	0	0	many serr.	X?	0X	0
latipes	XX	0	8	0	XX	X	0
sanpedroensis n.sp.	XX	0	0	7	X	X	0
bidentata	X	0	2	1a 3b	?	0	X
birjulini	X	0	4	6b	0X	0	0
gurjanovae	X	0	2	1a 2b	0X	0	0
pectinata	X	0	4	3b	0	0	X
salebrosa	X	0	2	1a 2b	0	0	X?
serrata	X	0	4	1a 1b	0	0	X
schurini	X	0	7	2b	0X	0	0
tarasovi	X	0	4	2b	0	0	0
profundis n.sp.	X	0	2	6a	X	0	0
peraeopod 5 with small teeth only							
abyssalis	X	0	0	4	X	0	0
amundseni	XX	0	0	2	0X	0	X
antennaria	XX	0	0	7	XX	0	X
cabotensis	X	0	0	4	X	0	X
cariniceps	X	0	0	9	?	0	0
dellavallei	X	0	0	10	X	0	0
obtusifrons	X	0	0	5	?	0	0
plumosa	XX	0	0	4	0	0	X

Condition of seven taxonomic characteristics of harpiniids (cont.)

	Pleon 3 with tooth	Peraeopod 5 with spur	Peraeopod 5 with large teeth	Peraeopod 5 with small teeth	Head with lower process	Peraeopod 5 with ant. setal edge	Pleon 3 with oblique setal row
peraeopod 5 with small teeth only (cont.)							
propinqua	X	0	0	5	0	0	X
similis	X	0	0	3	X	0	0
fulgens n.sp.	X	0	0	5	X	0	0
galerus n.sp.	X	0	0	4	X0	0	0
emeryi n.sp.	XX	0	0	4	0X	0	0
pacifica	X	0	0	4	0X	0	0
Pseudharpinia dentata	XX	0	5*	2a 3b	0X	0	0

*teeth are ventral

Abbreviations: X—positive, 0—negative, 0X and X0—intermediate, XX—very strongly developed, a—above large teeth, b—below large teeth

TABLE 14

Harpinia abyssi Sars

Harpinia abyssi Sars 1885: 157-159, pl. 13, figs. 5, 5a-m; Sars 1886: 45; Sars 1895: 160-161, pl. 56, fig. 1; Norman 1900: 338; Grieg 1914: 20; Stephensen 1925: 169; Chevreux 1935: 74; Stephensen 1938: 157; Stephensen 1944: 54; Gurjanova 1951: 375-376, fig. 226.

Harpinia abyssi Sars 1885: 157-159, pl. 13, figs. 5, 5a-m; Sars 1886: 45.

Distribution.—Widely collected in the Norwegian Sea and east and west of Greenland. Depth, 420 to 2702 meters.

Harpinia amundseni Gurjanova

Harpinia amundseni Gurjanova 1946: 281-282, fig. 13; Gorbunov 1946: 43; Gurjanova 1951: 376-377, fig. 227.

Remarks.—This species is quite closely related to *Harpinia plumosa* (Krøyer). The lower posterior corner of peraeopod 5, article 2, is marked by an excavation guarded by 2 small teeth which is simply an exaggeration of the condition found in *H. plumosa*(in Sars 1895, pl. 52). Gurjanova mentions that the dorsal surface of pleon segments 1-3 is weakly armed with setae, not found in *H. plumosa.* These are minor differences between the two species which may not prove to be of specific value.

Distribution.—Laptev and East Siberian Seas; Polar Basin. Depth: 40 to 100 m. Also found in the Polar Basin "north of the 80th parallel at 2800 meters" (Gurjanova 1951).

Harpinia antennaria Meinert

Phoxus plumosus, Bate 1857: 140 (not Krøyer 1842); Bate 1862: 99-100, pl. 16, fig. 3; Bate and Westwood 1863: 146-150, fig.

Harpinia antennaria Meinert 1893: 160, pl. 1, figs. 39-41; Norman 1895: 482; Reibisch 1905: 166; Stebbing 1906: 143; Derjugin 1915: 444; Bjorck 1915: 15; Stephensen 1925; 166-167 (in part, not Iceland material=*H. propinqua*); Chevreux and Fage 1925: 108, fig. 102; Stephensen 1926: 61-62 (in part, materials down to 150 m); Gurjanova 1928: 49; Molander 1928: 54, 65, 75, 84; Stephensen 1928: 140-142, fig. 27, 1-11; Stephensen 1929: 86, fig. 21, *103*; ?Stephensen 1929a: 4; Plymouth Marine Fauna 1931: 189; Oldevig 1933: 84; ?Stephensen 1933: 26; Moore 1937: 119; Raitt 1937: 249; Stephensen 1938: 154-155; Raitt 1938: 97; Stephensen 1940: 21; Goodhart and Harrison 1940: 109; Schellenberg 1942: 175, fig. 144; Spooner 1950: 248; Gurjanova 1951: 369-371, fig. 219.

Harpinia neglecta Sars 1895: 153-154, pl. 53, fig. 1; Schneider 1891: 104; ?Walker 1895: 297 (=*H. plumosa*?); Norman 1895: 482-483; Chevreux 1898: 477; Chevreux 1900: 36 (in part, *fide* Chevreux 1911); Norman 1900: 337; Walker 1901: 300; Meek 1901: 55; ?Graeffe 1902: 23 (probably is *H. dellavallei*); Brűggen 1906: 3; Scott 1906: 148; Norman and Brady 1909: 306; Schneider 1926: 17-18.

Harpinia plumosa, Boeck 1876: 219, pl. 8, fig. 1 (not Krøyer 1842, *fide* Meinert 1893, not seen); Schneider 1884: 70; Hansen 1887: 217.

Distribution.—(restricted) West and East Greenland; Kara Sea; White Sea, Murman Coast; Barents Sea; Iceland; Norway; British Isles; Kattegat; west coast of France; Bering Sea. Depth: West Greenland to 1096 meters; generally 20 to 150 meters.

Harpinia bidentata Stephensen

Harpinia bidentata Stephensen 1925: 163-164, fig. 48.

Distribution.—West of Greenland, 791 meters.

Harpinia birjulini Gurjanova

Harpinia birjulini Gurjanova 1953: 223-224, fig. 6.

Distribution.—Kurile Islands, Iturup, 291 meters.

Harpinia brevirostris Chevreux

Harpinia brevirostris Chevreux 1920: 578-579; Chevreux 1927: 76-79, pl. 5, figs. 14-25.

Distribution.—In the Bay of Biscay, off Santander, Spain; off Cap Blanc, French West Africa. Depth: 1283-1919 meters.

Harpinia cabotensis Shoemaker

Harpinia cabotensis Shoemaker 1930: 40-44, figs. 17-19.

Material examined.—All stations are in the Bay of Fundy: Annapolis Basin, 7-9 m, Sept. 27, 1916 (1); St. Croix River, opposite Robinston, 15 fms, sand and gravel, Aug. 10, 1912: (1); Welshpool, Campobello Island, 5-15 fms, shells and mud, July 12, 1912 (2); off Head Harbor, 70-80 fms, mud, Aug. 15, 1912 (1); station opposite St. Andrews Island, July 26, 1912 (5); Niger Reef, St. Andrews, 5-10 fms, muddy sand, August 26, 1912 (8). All materials deposited at National Museum of Canada and examined through the courtesy of Dr. E. L. Bousfield.

Distribution.—Cabot Strait; Cheticamp Island; Bay of Fundy. Depth: 7 to 378 meters.

Harpinia cariniceps K. H. Barnard

Harpinia cariniceps K. H. Barnard 1932: 99-100, fig. 49.

Distribution.—South Orkneys; South Shetlands; Palmer Archipelago. Depth: 160 to 391 meters.

Harpinia crenulata Boeck

Harpinia crenulata Boeck 1871: 136; Chevreux 1887: 578; Meinert 1893: 159; Sars 1895: 158-159, 689, pl. 55, fig. 2; Norman 1895: 483; Walker 1895: 297; Chevreux 1898: 477; Norman 1900: 337; Chevreux 1900: 36-37; Walker 1901: 300; Stebbing 1906: 141-142; Scott 1906: 148; Chevreux 1911: 189, pl. 10, figs. 14, 15; Tattersall 1913: 7; Bjorck 1915: 15; Chevreux and Fage 1925: 110-111, fig. 105; Stephensen 1925: 164-165, fig. 49, II-IV; Schneider 1926: 18; Stephensen 1926: 60-61; Stephensen 1928: 142-143, fig. 27, 12-15; Stephensen 1929: 86-87, fig. 21, *105*; Oldevig 1933: 84-86; Chevreux 1935: 74; Moore 1937: 119; Stephensen 1938: 152-153; Stephensen 1940: 20; Gurjanova 1951: 380-381, fig. 231.

?*Harpinia nana* Bonnier 1896: 633-636, pl. 37, fig. 2.

Remarks.—There seem to be two geographic varieties of this species. Specimens from Greenland and Iceland have simple serrations on peraeopod 5 while specimens from Norway to the Mediterranean have been figured with tripartite serrations.

In the figures given by Stephensen 1925 there are four types of ornamentation on the third pleonal epimera: (1) a simple rounded posterior corner in a male; (2) a slight protuberance at the lower corner; (3) an hemicircular invagination with the limbs sharply acute; (4) an invagination guarded by serrations on the upper posterior edge.

The writer is unconvinced that *Harpinia nana* Bonnier should be fused with *H. crenulata.* If one compares Bonnier's figures with those of Sars 1895 there are a number of striking differences to be seen; *H. nana* differs from *H. crenulata* in: (1) the tooth of pleon segment 3 is rather larger; (2) article 2 of peraeopod 5 is larger, broader, produced downward more and bears larger and sharper posterior teeth; (3) uropod 2 has very long peduncular setae; (4) the cusps defining the gnathopodal palms are larger and shaped differently; (5) the dactyli of the peraeopods appear longer.

Distribution.—West of Greenland; Kara Sea; Norwegian Sea; Iceland; Kattegat and Skagerrak; British Isles; Bay of Biscay; Mediterranean coast of France, Corsica and Algeria.

Harpinia crenuloides Stephensen

Harpinia crenuloides Stephensen 1925: 165-166, fig. 49, I.

Distribution.—West of Greenland and southwest of Iceland. Depth, 600 to 1505 meters.

Harpinia curtipes Stephensen

Harpinia curtipes Stephensen 1925: 170-171, fig. 50; Schellenberg 1955: 193.

Distribution.—Southwest of Greenland, 3521 meters.

Harpinia dellavallei Chevreux

Harpinia neglecta, Della Valle 1893: 747-749, pl. 5, fig. 6; pl. 35, figs. 1-18; pl. 60, fig. 19 (not Sars 1895); Chevreux 1898: 477; Chevreux 1900: 36 (in part).

Harpinia Della Vallei Chevreux 1911: 190-191, pl. 11, figs. 1-8; Chevreux and Fage 1925: 109, figs. 101, 103.

Distribution.—Atlantic Ocean on the south coast of Brittany; Mediterranean east to Naples. Depth: 19 to 40 meters.

Harpinia excavata Chevreux

Harpinia excavata Chevreux 1887: 3-5; Chevreux 1900: 37-38, pl. 6, fig. 1; Stebbing 1906: 142-143; Stebbing 1908: 73-74; Stebbing 1910: 452; K. H. Barnard 1925: 340-341; Chevreux 1927: 73; Chevreux 1935: 74; Schellenberg 1955: 193.

Distribution.—Bay of Biscay and Atlantic Ocean northwest of Spain; South Africa. Depth: 363 to 1280 meters.

Harpinia gurjanovae Bulycheva

Harpinia gurjanovae Bulycheva 1936: 251-252, figs. 20-23; Gurjanova 1951: 368-369, fig. 217.

Remarks.—It is possible that this species also includes *H. salebrosa* Gurjanova. One of the large teeth of peraeopod 5 is blunt and may be an accidental loss. The lack of an oblique setal row on the third epimera of *H. gurjanovae* may be of specific significance but it should be confiirmed by closer inspection. The two species bear a remarkable resemblance.

Distribution.—Japan Sea; Bering Sea; Chukchi Sea. Depth: 40-60 meters.

Harpinia kobjakovae Bulycheva

Harpinia kobjakovae Bulycheva 1936: 254-255, figs. 28-31; Gurjanova 1951: 379-380, fig. 230.

Distribution.—Tartar Strait (between Sakhalin and Siberia), 53-151 meters. Bering Sea.

Harpinia laevis Sars

Harpinia laevis Sars 1895: 161-162, pl. 56, fig. 2; Walker 1895: 297; Norman 1895: 483; Norman 1900: 338; Stebbing 1906: 145; Stephensen 1925: 170; Stephensen 1926: 62; Stephensen 1928: 144, fig. 27, 21-22; Stephensen 1929: 87, fig. 21, *106*; Oldevig 1933: 86; Raitt 1937: 249; Moore 1937: 119; Stephensen 1938: 156.

Distribution.—Iceland; Norway; Kattegat; British Isles. Depth: 27 to 200 meters.

Harpinia latipes Norman

Harpinia latipes Norman 1900: 338-339, 1 fig.; Stephensen 1925: 169-170; Chevreux 1927: 73-76, pl. 5, figs. 1-13.

Distribution.—North of the Outer Hebrides Islands (British Isles) 542 fms; west coast of French Morocco and south west coast of Spain in the Gulf of Cadiz.

Harpinia moiseevi Gurjanova

Harpinia moiseevi Gurjanova 1953: 221-223, fig. 5.

Distribution.—On bank of Kurile Ridge, 129 meters.

Harpinia mucronata Sars

Harpinia mucronata Sars 1885: 161-162, pl. 13, figs. 7, 7a-g; Sars 1886: 45; ?Hansen 1888: 87 (possibly is *H. bidentata, fide* Stephensen 1925); Sars 1895: 157, pl. 54, fig. 3; Stebbing 1906: 141; Brűggen 1909: 21; Stephensen 1913: 132; Stephensen 1925: 163; Schellenberg 1935: 23; Gurjanova 1935: 73; Stephensen 1938: 152; Stephensen 1940: 20; Stephensen 1944: 52-53; Gorbunov 1946: 43; Gurjanova 1951: 368, fig. 216.

Distribution.—Polar Basin north of Kara and Laptev Seas; West and East Greenland; Kara Sea; Barents Sea; Denmark Strait. Depth: 28 to 1134 meters.

Harpinia obtusifrons Stebbing

Harpinia obtusifrons Stebbing 1888: 820-824, pl. 56; ?Walker 1907: 17.

not *Harpinia obtusifrons,* Chilton 1909: 619; Chilton 1912: 477-478 (→Proharpiniid sp.); Thomson 1913: 242 (quotes Chilton 1909); Stephensen 1927: 306-307, fig. 6 (→*Proharpinia hurleyi*).

Distribution.—Kerguelen (30-120 fms); Antarctic, near McMurdo Sound, recorded by Walker 1907 but questioned herein.

Harpinia orientalis Bulycheva

Harpinia orientalis Bulycheva 1936: 255-256, figs. 32-35; Gurjanova 1951: 380, fig. 229B.

Distribution.—Tartar Strait, 59-145 meters.

Harpinia pacifica Bulycheva

Harpinia pacifica Bulycheva 1936: 252-254, figs. 24-27; Gurjanova 1951: 379, fig. 229A.

Distribution.—Japan Sea, 1800-2300 meters.

Harpinia pectinata Sars

Harpinia pectinata Sars 1895: 154-155, pl. 53, fig. 2; Norman 1895: 483; Chevreux 1898: 477; Norman 1900: 337; Reibisch 1905: 166; Stebbing 1906: 142; Chevreux 1911: 189, pl. 10, figs. 16-18; Chevreux 1925: 295-296; Chevreux and Fage 1925: 109-110, fig. 104; Schneider 1926: 18; Stephensen 1926: 61; Molander 1928: 45, 84; Stephensen 1928: 143-144, fig. 27, 16-18; Stephensen 1929: 86, fig. 21, *104;* Oldevig 1933: 84; Schellenberg 1936: 9; Gurjanova 1936a: 150; Stephensen 1938: 153; Schellenberg 1942: 176, fig. 145; Gurjanova 1951: 371-372, fig. 221; Duhig and Humphries 1955: 124.

Distribution.—Kara Sea; Bering Sea; Norway; British Isles; west coast of France; Mediterranean. Depth: 10 to 2488 meters.

Harpinia plumosa Kröyer

Phoxus plumosus Krøyer 1842: 152; Krøyer 1845: 563-574; Goës 1866: 528; ?Norman 1869: 278; ?Robertson 1888: 28.

?*Phoxus fusiformis* Stimpson 1853: 57-58; ?Smith 1876 (Trans. Conn. Acad. Sci. 3: 29; not seen).

Harpinia plumosa, Boeck 1871: 135-136; ?Schneider 1884: 70-71; Sars 1886: 45; Stuxberg 1887: 64; ?Chevreux 1887: 578; Hansen 1888: 86-87 (in part); Meinert 1893: 159; Sars 1895: 151-153, pl. 52; Norman 1900: 336; ?Holmes 1905: 478-479; Stebbing 1906: 144; Stephensen 1913: 131-132; Oldevig 1917: 18-19; Schellenberg 1924: 202; Stephensen 1925: 168; Uschakov 1931: 87; Schellenberg 1935: 23; ?Chevreux 1935: 74; Stephensen 1938: 155-156; Stephensen 1944: 53-54; Gorbunov 1946: 43; Gurjanova 1951: 373-374, fig. 223.

Remarks.—Many of the references to this species are quite uncertain, according to Stephensen 1938, who indicates that this species has been easily confused with *H. antennaria.*

Distribution.—(restricted) West and East Greenland; Kara and Barents Seas; Spitzbergen. Depth: 6 to 1423 meters.

Harpinia propinqua Sars

Harpinia propinqua Sars 1895: 156, pl. 54, fig. 2; Stebbing 1906: 143; Stephensen 1925: 166; Schellenberg 1924: 202; Stephensen 1938: 155; Stephensen 1940: 21-25, figs. 1-2; Gurjanova 1951: 374, fig. 224.

?*Harpinia* sp., Stephensen 1940: 25-27, fig. 4 (male).

Harpinia antennaria, Stephensen 1925: 166-167 (in part, includes Iceland material); Stephensen 1926: 61-62 (in part, specimens below 150 m) (not Meinert 1893).

Distribution.—West Greenland; Spitzbergen; Iceland; Norway; Faeroes; Kattegat. Depth: 11 to 1096 meters.

Harpinia salebrosa Gurjanova

Harpinia salebrosa Gurjanova 1936: 248-249, fig. 2; Gurjanova 1951: 369, fig. 218.

Distribution.—Chukchi Sea and Bering Sea. Depth: 14-20 meters.

Harpinia schurini Bulycheva

Harpinia schurini Bulycheva 1936: 250-251, figs. 16-19.
Harpinia shurini (sic), Gurjanova 1951: 378, fig. 229V.

Distribution.—Japan Sea; Tartar Strait; Bering Sea. Depth: 75 to 494 meters.

Harpinia serrata Sars

Harpinia serrata Sars 1883: 85; Sars 1885: 162-164, pl. 13, figs. 8, 8a-d; Sars 1886: 46; Schneider 1891: 104; Sars 1895: 155-156, pl. 54, fig. 1; Stebbing 1906: 142; ?Norman and Brady 1909: 306; Stephensen 1925: 166; Stephensen 1929: 86, fig. 21, *102*; Shoemaker 1930: 44; Gurjanova 1936a: 150; Stephensen 1938: 154; Stephensen 1944: 53; Gurjanova 1951: 371, fig. 220.

Distribution.—East Greenland; Kara Sea; Chukchi Sea; Jan Mayen; Norway; western Atlantic at Cheticamp Island; British Isles? Depth: 17 to 174 meters.

Harpinia tarasovi Bulycheva

Harpinia tarasovi Bulycheva 1936: 248-249, figs. 12-15; Gurjanova 1951: 377-378, fig. 228.

Distribution.—Japan Sea; Tartar Strait; Bering Sea. Depth: 30 to 205 meters.

Harpinia truncata Sars

Harpinia truncata Sars 1895: 157-158, pl. 55, fig. 1; Norman 1895: 483; Stebbing 1906: 144; Stephensen 1925: 168; Stephensen 1926: 62; Stephensen 1928: 144, fig. 27, 19-20; Stephensen 1929: 87, fig. 21, *107*; Oldevig 1933: 86; Stephensen 1938: 156; Gurjanova 1951: 374-375, fig. 225.

Material examined.—Bay of Fundy, southwest of Wolves, Sept. 9, 1912, 50 fms (3), from National Museum of Canada.

Distribution.—Iceland; Norway; Skagerrak; western Atlantic. Depth: 50 to 552 meters.

Genus **Joubinella** Chevreux

Joubinella Chevreux 1908: 8-11.

Diagnosis.—Article 2 of peraeopod 3 broad; eyes present; mandibular molar bears ridges and cusps; antenna 2 with flagellum poorly developed; gnathopods 1 and 2 are eusirid in structure, gnathopod 1 larger than 2; maxillipedal palp article 4 long, bearing a distal spine. Pelagic.

Type species.—*Joubinella ciliata* Chevreux 1908.

Remarks.—Of the four species, two are Atlantic and two are northern Pacific. The members of each pair are difficult to separate specifically and may not be distinct. The two Pacific species differ from the two Atlantic species in the lack of a large peduncular spine on uropod 1. Other minor differences of a quantitative nature are found in the gnathopods and uropods.

Joubinella ciliata Chevreux

Joubinella ciliata Chevreux 1908: 8-11, figs. 5, 6.

Distribution.—Vicinity of the Azores Islands and Canary Islands, depth 1340 to 1530 meters.

Joubinella traditor Pirlot

Joubinella traditor Pirlot 1932: 74-81, figs. 19-21.

Distribution.—Banda Sea, 310 meters.

Joubinella bychovskii Gurjanova

Joubinella bychovskii Gurjanova 1952: 173-177, figs. 1-3.

Distribution.—Iturup, Kurile Islands, 20 meters.

Joubinella strelkovi Gurjanova

Joubinella strelkovi Gurjanova 1952: 177-180, figs. 4-6.

Distribution.—Bering Sea, 660 meters.

Genus **Mandibulophoxus** J. L. Barnard

Mandibulophoxus J. L. Barnard 1957: 432.

Diagnosis.—Article 2 of peraeopod 3 broad; mandibular palp attached to a bulky process of the mandible, the articles of the palp arranged so that it appears sickle-shaped; maxilla 1 with biarticulate palp;

fourth article of maxillipedal palp styliform, armed apically with a spine; rami of uropods 1 and 2 apically spinose; head elongated.

Type species.—M. gilesi Barnard (=*Phoxus uncirostratus* Giles).

Key to the Genus **Mandibulophoxus**

1. Eyes present, third pleonal epimeron with oblique setal row .... *stimpsoni*
1. Eyes absent, third pleonal epimeron lacks oblique setal row .... *uncirostratus*

Mandibulophoxus uncirostratus (Giles)

Phoxus uncirostratus Giles 1890: 65-66, pl. 2, fig. 2.
Leptophoxus uncirostratus, Walker 1904: 249.
Pontharpinia uncirostrata, Stebbing 1906: 147.
Mandibulophoxus uncirostratus, J. L. Barnard 1957: 435-436.
Mandibulophoxus gilesi J. L. Barnard 1957: 433-435, figs. 1, 2.
Pontharpinia uncirostratus Pillai 1957: 39-41, fig. 5.

Remarks.—The original description of this species by Giles was rather sketchy and erroneously illustrated. In my 1957 paper I erected a new species for specimens from southern California on the basis of geography but Pillai's excellent paper (1957) on this species from India shows that the Californian and Indian specimens are identical. For a supposedly benthic amphipod belonging to a group which does not produce larvae this appears to be a peculiar distribution. Nevertheless the two collections are identical.

Material examined.—77 specimens at 6 stations.

Distribution.—Madras coast; Ceylon; Southern California coastal shelf, 7.5 to 10 fms.

Mandibulophoxus stimpsoni (Stebbing)

Pontharpinia stimpsoni Stebbing 1908: 75-78, pl. 11; Stebbing 1910a: 452; Reid 1951: 222, fig. 22.
Pontharpinia Stimpsoni, Chevreux 1925: 296.
Pontharpinia intermedia, Schellenberg 1925: 138-140, fig. 11; Reid 1951: 223.
Mandibulophoxus stimpsoni, J. L. Barnard 1957: 436-438, figs. 3, 4.

Distribution.—Africa: Senegal; Liberia; Ivory Coast; Cabinda; South Africa; Natal Coast. Depth, 4 to 47 fms.

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