BENTHIC MARINE AMPHIPODA OF SOUTHERN CALIFORNIA: FAMILIES AMPHILOCHIDAE, LEUCOTHOIDAE, STENOTHOIDAE, ARGISSIDAE, HYALIDAE

By J. Laurens Barnard

Introduction

Of the families treated herein only the Stenothoidae are widely represented on the mud bottoms of the coastal shelf. The other families are confined generally to shallow waters, especially the intertidal, except for the single argissid, *Argissa hamatipes*, widely distributed on the shelf.

Since animals of intertidal and very shallow waters stray into depths slightly greater than 30 feet, at which the inshore limit of our coastal survey was drawn, it was necessary in the process of identifying the animals to investigate intertidal regions to clarify the taxonomy of species in the families considered.

See page 3 above for acknowledgements.

Family AMPHILOCHIDAE

When Schellenberg (1938) described a *Cyproidea* bearing a large molar in contrast to the type, *C. ornata* Haswell, which lacks a molar (confirmed by Walker, 1904, in his *Gallea tecticauda* = *C. ornata*), and when Hurley (1955) described a new genus *Neocyproidea* of which the species either have a triarticulate mandibular palp or none, the usefulness of mouthparts for generic criteria in the *Cyproidea*-like section of this family deteriorated, and doubt was cast on their usefulness in the *Amphilochus*-like section of the family. In order to equate this state of affairs, the writer suggests that such mouthpart differences be used to segregate genera in the *Cyproidea*-section, as well as the *Amphilochus*-section. Thus, *Cyproidea serratipalma* Schellenberg would become the type of a new genus, and *Neocyproidea peninsulae* Hurley (1955) also would become the type of a new genus. I am unclear as to the differences between *Neocyproidea* Hurley (type *Cyproidea otakensis* Chilton) and the genus *Hoplopleon* K. H. Barnard (1932) (type *H. medusarum* K. H. Barnard). Both genera lack a mandibular palp; both have elongated first urosomal segments bearing a dorsal keel; both have similar gnathopods, except that gnathopod 2 of *Hoplopleon* has a more distinct transverse palm and the dactyls of *Neocyproidea* are bilaterally spinose, perhaps overlooked in *Hoplopleon*. Nevertheless, *Neocyproidea* may be distinguished from *Hoplopleon* by the expanded second article of peraeopod 3.

The two groups of Amphilochidae (separated in couplet one in the following key) seem distinct enough to suggest the erection of subfamilies.

Since I have not studied amphilochids in the *Cyproidea*-section of the family I can only suggest a reappraisal of the generic distinctions and proceed in the key to separate the genera as they now stand, disregarding mouthparts for the *Cyproidea*-section.

Relationship of Amphilochidae and Pleustidae

In 1906 when Stebbing's monograph of the Gammaridea summarized all known amphipods of that suborder, the Amphilochidae and Pleustidae seemed relatively distinct, especially when relying on Sars' (1895) excellent monograph of the Norwegian species. No specific differences were made in the diagnoses of these two families. In fact few similar characters are discussed, and both diagnoses could be applied to either family. Early in his key to the families Stebbing segregated the Amphilochidae especially by the uncleft, long, tapering telson. At that time most known amphilochids had only a long, tapering, triangular telson. Subsequently, numerous species have been described with a short, linguiform telson much as in the Pleustidae. In Barnard and Given (1960) it was pointed out that the Pleustidae and Calliopiidae were quite similar except for the characteristic lower lip of Pleustidae which has two tilted oval outer lobes astride two small, nearly fused inner lobes. This character might also be used to separate Pleustidae from Amphilochidae, since most amphilochid lower lips are formed of two tall outer lobes with slender mandibular processes and no inner lobes. Nevertheless, the genus *Amphilochoides* assigned to Amphilochidae since 1895 has the lower lip of a pleustid, not of an amphilochid (see Sars 1895: pl. 75, fig. 2).

Amphilochids differ from pleustids primarily in the greatly reduced size of coxa 1.

In other criteria amphilochids and pleustids are similar. From a lateral view it is almost impossible to differentiate between many species of the two families. Because of variation in the families, there are no criteria of qualitative value in head, rostra, antennae, mouthparts (other than lower lips) (especially to be noted is that the upper lip is incised in both families), gnathopods (quite variable in both families), peraeopods, uropods and telson.

KEY TO FAMILY AMPHILOCHIDAE

1. Coxae 3-4 with contiguous margins overlapping, not hiding coxa 2, not immensely enlarged 2
1. Coxae 3-4 immensely enlarged, with contiguous margins abutting, hiding the vestigial first 2 coxae 10
2. Mandibular molar large, with ridged and toothed triturating surface 3
2. Mandibular molar small, or absent, unarmed or bearing 3 spines 6
3. Palp of maxilla 1 with 2 articles ..... *Gitanopsis*
3. Palp of maxilla 1 with one article 4
4. Outer plate of maxilliped excavate medially, article 1 of palp much longer than other palp articles .... *Gitanogeiton*
4. Outer plate of maxilliped straight medially, article 1 of palp subequal to article 2 5

5. Gnathopod 2 large, subchelate ..... *Amphilochopsis*
5. Gnathopod 2 small, nearly simple ..... *Gitana*
6. Maxilla 2 composed of only one elongated plate ..... *Amphilochella*
6. Maxilla 2 composed of 2 plates 7
7. Maxilla 2 degraded, the plates tiny, subequal in width ..... *Amphilochoides*
7. Maxilla 2 normal, the inner plate much broader than outer 8
8. Telson entire 9
8. Telson split ..... *Pseudamphilochus*
9. Lateral angles of pleonal segment 6 not produced ..... *Amphilochus*
9. Lateral angles of pleonal segment 6 produced as long as telson ..... *Cyclotelson*
10. Article 2 of peraeopods 4-5 linear, slender 11
10. Article 2 of peraeopods 3-5 expanded 12
11. Palm of gnathopod 2 transverse; urosome segment 3 vaulting over telson; telson small ..... *Cyproidea*
11. Palm of gnathopod 2 oblique; urosome segment 3 not vaulting over telson; telson huge ..... *Paracyproidea*
12. Urosome segment 1 short, unkeeled 13
12. Urosome segment 1 elongated, dorsally keeled 14
13. Gnathopod 2 simple; uropod 2 shortened, failing to reach end of uropod 3 ..... *Stegoplax*
13. Gnathopod 2 subchelate, with transverse palm; uropod 2 reaching end of uropod 3 ..... *Peltocoxa*
14. Article 2 of peraeopod 3 slender, linear .... *Hoplopheonoides*
14. Article 2 of peraeopod 3 expanded 15
15. Process of urosome segment 1 vaulting over following segments ..... *Peltopes*
15. Process of urosome segment 1 not vaulting over following segments 16
16. Article 2 of peraeopod 3 expanded ..... *Neocyproidea*
16. Article 2 of peraeopod 3 slender, linear ..... *Hoplopleon*

Amphilochidae in Southern California

Species of intertidal amphilochids in southern California are difficult to identify without dissection of each animal, and they pose problems of morphology and taxonomy which cannot be resolved at this time without comparison with amphilochids of other parts of the world. Some species are known to be widely distributed, e.g. *Gitanopsis pusilloides* from the eastern Pacific and New Zealand (see Shoemaker 1942, and Hurley 1955) and *Amphilochus neapolitanus* from Europe, eastern Pacific, Australasia, and south Africa. Of the latter species it must be said that some records remain dubious unless it can be confirmed that a complete dissection and

comparison was made by the identifier. In southern California a species of *Gitanopsis* mimics *A. neapolitanus* in external criteria and differs essentially only by its generic character, the large triturating mandibular molar. In *Amphilochus* this molar is vestigial and formed into a small bump which occasionally is armed with a few spines.

The similarity of the several amphilochids in southern California raises the question again of the reliability of two criteria: the mandibular molars which form generic characters, and the shapes of gnathopods, particularly the length of the long hind lobe on article 5 of gnathopod 2. A large number of specimens have been completely dissected, mounted on slides and compared among themselves and with the literature in order to determine any criteria of stability.

The extent of variation is shown in table 1 and in figure 1. These intertidal amphilochids all show the same following characters: telson short, about half as long as peduncle of uropod 3; first gnathopods almost identical (see figures), article 5 with a long but stout hind lobe which reaches about 75% along the hind edge of article 6; hands of gnathopod 2 quite large and broad; antennae, peraeopods, head, and pleonal epimera all similar.

Of particular taxonomic value are the short telsons, well developed first gnathopods and broad hands of the second gnathopods. In contrast, a number of species in both *Amphilochus* and *Gitanopsis* have elongated telsons, simple or otherwise modified first gnathopods and small, narrow second gnathopods.

It was believed possible from initial analyses of 3 distinct animals (types A, H, B of table 1 and fig. 1) that a single species might be represented. This would require proof that (1) a radical transformation took place in the mandibular molars, either from a simple bump to a strong triturating surface or vice versa; (2) that the length of article 5 of gnathopod 2 was variable and became transformed from short to long during growth; and (3) that various minor characteristics could be keyed to specific species, such as shape of first coxa, stoutness of spine on article 2 of gnathopod 2, presence or absence of spines on the hand of gnathopod 2 and size of eyes.

By rearranging the data of table 1 into the diagrams of fig. 1, it was shown that three distinct populations are present, and that the generic differences between *Gitanopsis* and *Amphilochus* hold true in young and old animals. No transformation or intergradation were seen in mandibular molars; one would have to suppose that any transformation took place in a single molt since no intergrades were seen. On this basis large molars were sought for in the internal premolt anatomy of mandibles bearing small molars but none was seen. Indeed, it was not possible to see any evidence of the next molar stage whatsoever, although it was possible to see the development of the cutting teeth and spines. Since the length of the fifth article of gnathopod 2 was consistent for two populations in both old and young it was considered that two species of *Amphilochus* were present.

Table 1

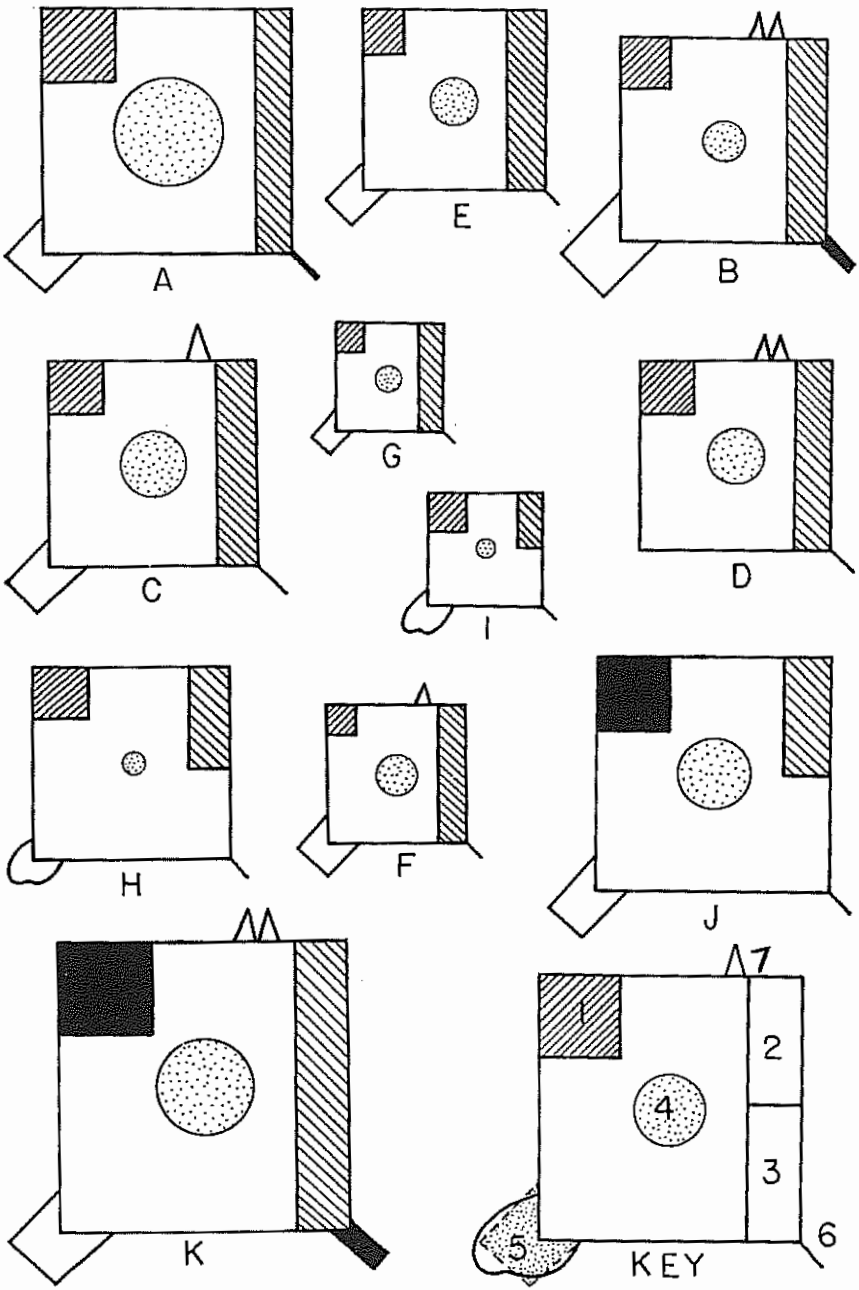
Variation in intertidal amphilochids of southern California, illustrated in diagrams of figure 1.

Letter on figure 1		Mandibular molar ridged	eyes large	gn. 2, art. 5 dev. full length	gn. 2, art. 6 with ant. spines	gn. 2, heavy spine on art. 2	coxa 1 lower edge straight
A	*Amphilochus neapolitanus*, 3.0 mm terminal adult	0	+	+	0	0	+
B	*Amphilochus neapolitanus*, 2.5 mm	0	0	+	2	+	+0
C,F	*Amphilochus neapolitanus*, 2.5 and 1.7 mm	0	+0	+	1	0	+
D	*Amphilochus neapolitanus*, 2.3 mm	0	+0	+	2	0	+
E,G	*Amphilochus neapolitanus*, 2.2 and 1.2 mm	0	0+	+	0	0	+
H,I	*Amphilochus litoralis*, 2.3, 2.0, 1.7, 1.5 mm	0	0	0	0	0	0
J	*Gitanopsis pusilloides*, original description	+	0+	0	0	0	+
K	*Gitanopsis vilordes*, n. sp., 3.5 mm	+	+	+	2	+	+
	Amphilochus litoralis, original description	0	0	0	0	0	?

A search was made for hatched juveniles still remaining in brood pouches so that confirmation could be made. Hatched juveniles of the short-form *Amphilochus* bore short fifth articles. The only juvenile discovered of the long-form *Amphilochus* also bore short fifth articles, indicating that article 5 increases in length after hatching but before the size of the smallest free juveniles collected (1.2 mm).

No sexual difference in any of these criteria were discovered. Almost all of the specimens were females; indeed no large animals lacking brood plates were found. A few small specimens lacking brood plates and associated with small females were found, but the demonstration of penial projections would have to be done with serial sectioning because of the small size of the animals.

Fig. 1. Scheme of variation in amphilochids of southern California. Each box represents an animal, the size of the box relative to its size. Key: 1 = mandibular molar, black = well developed ridged triturating molar, hatched = simple unridged, small molar; 2, 3 = length of process of article 5 on gnathopod 2, either half as long or fully as long as article 6; 4 = size of eye relative to size of animal; 5 = shape of coxa 1, whether truncate or slightly bilobed below; 6 = size of spine on posterodistal end of article 2 of gnathopod 2; 7 = number of anterior spines on article 5 of gnathopod 2. Figures are coded to table 1 for identification.


A
E
B
C
G
D
I
H
F
J
K
1
2
3
4
5
6
7
KEY

To summarize: in amphilochids larger than 1.2 mm the generic and specific criteria such as molars, first coxae, and second gnathopods as diagnosed in the following pages are stable. The size of the eyes and development of spines on the hands of gnathopod 2 are unstable and do not necessarily indicate specific identity, although they can be helpful as explained below.

Rapid Identification of Intertidal Amphilochids

The writer works not only as a taxonomist but as a census ecologist desiring the means to identify large numbers of specimens in as rapid and accurate a manner as possible. It is difficult, at best, to identify the amphilochids of southern California, but the following key has been useful. *Gitanopsis pusilloides* has not been recovered in southern California but is included for clarity.

1. Projecting lobe of article 5 of gnathopod 2 reaching only half way or less along hind edge of article 6 2
1. Projecting lobe of article 5 of gnathopod 2 reaching the full length of the hind edge of article 6 3
   2. Gnathopods 1 and 2 similar in size and structure, projecting lobe of article 5 on both gnathopods so short as scarcely to appose the hind edge of article 6 ..... *Gitanopsis pusilloides* (see figs. in Shoemaker 1942)
   2. Gnathopod 2 much larger than 1; hind lobe of article 5 on gnathopod 1 reaching about 75% along hind edge of article 6 ..... *Amphilochus litoralis*
3. Eyes small (width of eye much shorter than rostrum), usually round, occasionally slightly ovoid ..... *Amphilochus neapolitanus*
3. Eyes large (width of eye much longer than rostrum), usually oval 4
3. Eyes intermediate in size (dissect mandible for confirmation)
   4. Eyes with black centers surrounded by pale ommatidea ..... *Gitanopsis vilordes*, n. sp.
   4. Eyes generally diffuse, occasionally with pale evidence of central darkening ..... *Amphilochus neapolitanus* (dissect mandible for confirmation)

This key is useful in identifying about 95% of the specimens of amphilochids, the remaining 5% requiring mandibular dissection for specific (actually generic) confirmation.

Illustration of Amphilochids

Table 1 and fig. 1 show more variation in each of the three species of amphilochids than is drawn in the figures of each species. For instance, the figures of *Gitanopsis vilordes* n. sp. show two spines on the hand of gnathopod 2, and the figures of *A. neapolitanus* show none, but specimens of the latter often have these spines. The range of variation of each

species should be checked in table 1 and fig. 1 because the other figures of each species are not wholly discriminatory.

Genus Amphilochus Bate

Problems of species recognition have already been discussed in this genus. It remains to discuss the final nomenclatural assignments of the various species. The species herein recognized as *Amphilochus neapolitanus* Della Valle seems unquestionably to be that Mediterranean species. Were it not for Enequist's (1950) erection of *A. borealis* and his contrasting it with *A. brunneus* by very minor points I should assign the southern California *A. litoralis* Stout to the species *A. brunneus*. *Amphilochus litoralis* differs from *A. brunneus* in characters just as minor as those pointed out for *A. borealis* by Enequist, and I am not convinced that these are of value. The new species to be described is so similar to *A. spencebatei* that I have hesitated in its erection and carry the belief that it will prove to be a synonym of *A. spencebatei*. The only difference is the slightly produced anterodistal end of the hand of gnathopod 2, and this process is so transparent that it may have been overlooked in the original description of *A. spencebatei*. This difference is probably the result of the development of better microscopes. It would seem logical that if *Amphilochus neapolitanus* is present in southern California then *A. brunneus* and *A. spencebatei* also would be present there; on the other hand if *A. brunneus*-like and *A. spencebatei*-like species have differentiated in the eastern Pacific why has not *A. neapolitanus*? If the differences discovered in *A. litoralis* and the new species to follow were of greater magnitude it would be acceptable to consider them as distinct races or subspecies which had differentiated with low gene flow or high mutation rates in the eastern Pacific, whereas it would have to be supposed that *A. neapolitanus* had either some gene flow with its Mediterranean population or a low mutation rate.

I believe that examination of this problem in other parts of the world will confirm my suspicion that *A. litoralis* and *A. borealis* are indeed synonyms of *A. brunneus* and that the new species to follow is a synonym of *A. spencebatei*. For the sake of practical nomenclature the species are named as in the following pages.

KEY TO AMPHILOCHUS

References to species may be consulted in J. L. Barnard (1958).

1. Hand of gnathopod 2 projecting anterodistally 2
1. Hand of gnathopod 2 not projecting anterodistally 3
2. Coxa 1 short, square; telson triangular ..... *manudens*
2. Coxa 1 long, rectangular, telson ovate ..... *picadurus*, n. sp.
3. Telson longer than peduncle of uropod 3 ..... *tenuimanus*
3. Telson two thirds as long as peduncle of uropod 3, or less 4

4. Process of article 5 on gnathopod 2 projecting only halfway along hind edge of article 6 5
4. Process of article 5 on gnathopod 2 projecting seven eighths to fully along hind edge of article 6 7

5. Article 5 of gnathopod 1 projecting more than three fourths along hind edge of article 6 ..... *litoralis*
5. Article 5 of gnathopod 1 projecting about halfway along hind edge of article 6 6

6. Telson two thirds as long as peduncle of uropod 3, article 5 of antenna 2 subequal to article 4, mandibular palp article 3 longer than article 2 ..... *brunneus*
6. Telson half as long as peduncle of uropod 3, article 5 of antenna 2 subequal to article 4, mandibular palp article 3 shorter than article 2 ..... *borealis*

7. Hand of gnathopod 2 more than 80% as wide as long ..... *marionis*
7. Hand of gnathopod 2 less than 70% as wide as long 8

8. Antenna 1 reaching only to end of peduncle on antenna 2 ..... *spencebatei*
8. Antenna 1 exceeding end of peduncle on antenna 2 9

9. Dactyls of gnathopods attenuated at very tip ..... *filidactylus*
9. Dactyls of gnathopods not attenuated at very tip 10

10. Process of article 5 on gnathopod 2 reaching full length of article 6 ..... *neapolitanus*
10. Process of article 5 on gnathopod 2 reaching seven eighths along article 6 ..... *schubarti*

Amphilochus litoralis Stout

Fig. 2

Stout 1912: 136-140, fig. 78.
Amphilochus neapolitanus, J. L. Barnard 1959: 18 (not Della Valle).

DIAGNOSIS: Eyes always very small, round, formed of darkly pigmented centers surrounded by pale ommatidea; antenna 1 reaching beyond end of peduncle of antenna 2; gnathopod 1 subchelate, the palm slightly oblique, the projecting lobe of article 5 reaching about 75% along hind margin of article 6; gnathopod 2 considerably longer than 1, the hand quite stout but less than 70% as wide as long, the palm nearly transverse, the hind lobe of article 5 projecting only half way or less along hind edge of article 6; hands of gnathopods lacking anterodistal cusps; dactyls of gnathopods not attenuated at extreme tips; telson considerably shorter than peduncle of uropod 3; coxa 1 lobate below.

MATERIAL: 115 specimens from 11 intertidal samples at Pt. Fermin, Corona del Mar, and La Jolla, California, during the years 1947 to 1950, coll. by J. L. Barnard and one sample by R. J. Menzies, all in formalin washes of the following materials: coralline algae, rocks, the surf-grass *Phyllospadix* sp., and the algae *Egregia* sp., and *Pterocladia pyramidale*.

The species was not found in the samples collected in 12 foot depths or greater, and the deepest record is 6 feet. Reported by Stout from Laguna Beach, in *Phyllospadix*.

REMARKS: This species is very closely related to *Amphilochus brunneus* Della Valle (see Chevreux and Fage 1925) and to *A. borealis* Enequist (1950) but is distinguished by the first gnathopod which has a different appearance most easily seen when comparing figures. In essence, the hind lobe of article 5 is much longer and stouter in *A. litoralis*, enveloping more of the hind edge of article 6. *Amphilochus borealis* is very closely related to *A. brunneus* and the points of difference so well noted by Enequist are quite minor and may be subject to small genetic variables or to the genetic response in the different environments of the two species, one being from the Mediterranean, the other from the colder Skagerrak.

DISTRIBUTION: Known only from the intertidal of southern California.

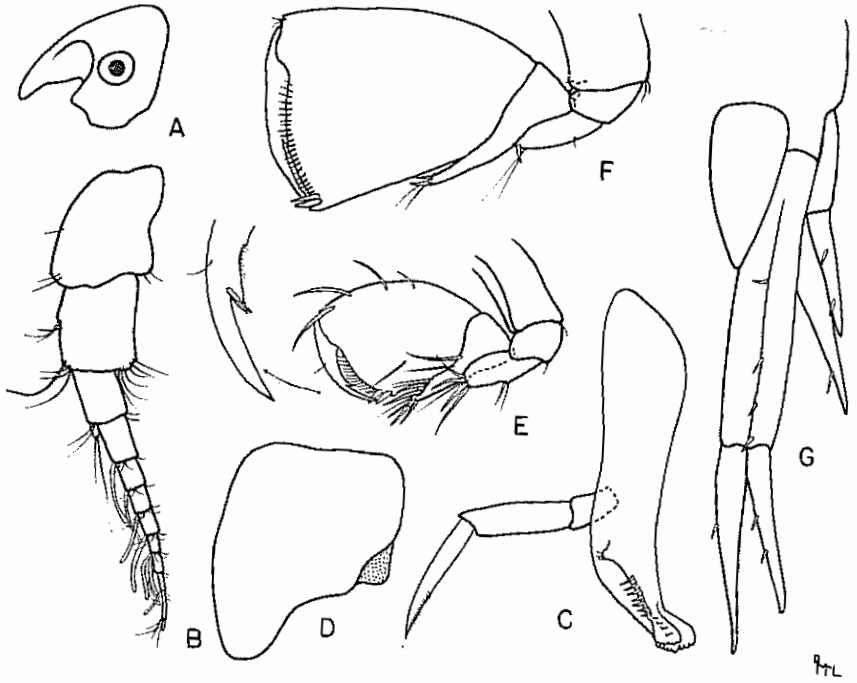


Fig. 2. *Amphilochus litoralis* Stout. Female, 2.3 mm, Barnard sta. 27: A, head; B, antenna 1; C, mandible; D, coxa 1; E,F, gnathopods 1, 2; G, telson and uropods 3 and 2.

Amphilochus ?neapolitanus Della Valle

Fig. 3

Stebbing 1906: 150; Chevreux and Fage 1925: 112-113, figs. 106-108.

DIAGNOSIS: Eyes usually small, round or slightly oval, formed of darkly pigmented centers surrounded by pale ommatidea, occasionally large (see figures), the dark centers not distinct; antenna 1 reaching beyond peduncle of antenna 2; gnathopod 1 subchelate, the palm slightly oblique, the projecting lobe of article 5 reaching about 75% along hind margin of article 6; gnathopod 2 considerably larger than 1, the hand quite stout but less than 70% as wide as long, the palm nearly transverse, the hind lobe of article 5 projecting fully along hind edge of article 6; hands of gnathopods lacking anterodistal cusps; dactyls of gnathopods not attenuated at extreme tips; telson considerably shorter than peduncle of uropod 3; coxa 1 quadrate, with straight lower edge.

MATERIAL: 108 specimens from 10 intertidal samples at Pt. Fermin, Corona del Mar, La Jolla, California and Ensenada, Baja California, during the years 1947-1950, coll. by J. L. Barnard and 2 samples by R. J. Menzies, in formalin washes of the following materials: rocks, *Phyllospadix* (surf grass), the alga *Egregia*, and various coralline algae. In 2 samples from depths of 12-30 feet and in one sample at 60 feet (total of 3 specimens from 3 samples).

REMARKS: As in all of the southern California intertidal amphilochids the first antenna bears a uniarticulate accessory flagellum not mentioned previously in *A. neapolitanus*; apparently this has been overlooked in other amphilochids because Hurley described it for *Gitanopsis pusilloides* Shoemaker.

The telson of specimens at hand is somewhat more pointed than figured by Chevreux and Fage (1925), and in the large aberrant adults with large eyes the second article of the first antenna is quite broadened and setose along one distal margin.

The first coxa has a straight lower edge in contrast to that of *Amphilochus litoralis* in which it forms an anterior lobe so that the lower edge is oblique and slightly excavate.

The anterior spination on the hand of gnathopod 2 varies from no submarginal spines to 1 or 2 spines.

This species is separated with difficulty from *Gitanopsis vilordes*, n. sp., but most of the specimens have small eyes in contrast to the large eyes of *Gitanopsis*. When in doubt, one must dissect the mandible.

DISTRIBUTION: Probably circumtropical and warm-temperate.

Amphilochus picadurus, new species

Fig. 4

DIAGNOSIS: Eyes medium size, subcircular, formed of darkly pigmented centers surrounded by pale ommatidea; antenna 1 reaching only to end of peduncle on antenna 2; gnathopod 1 subchelate, the palm oblique, the

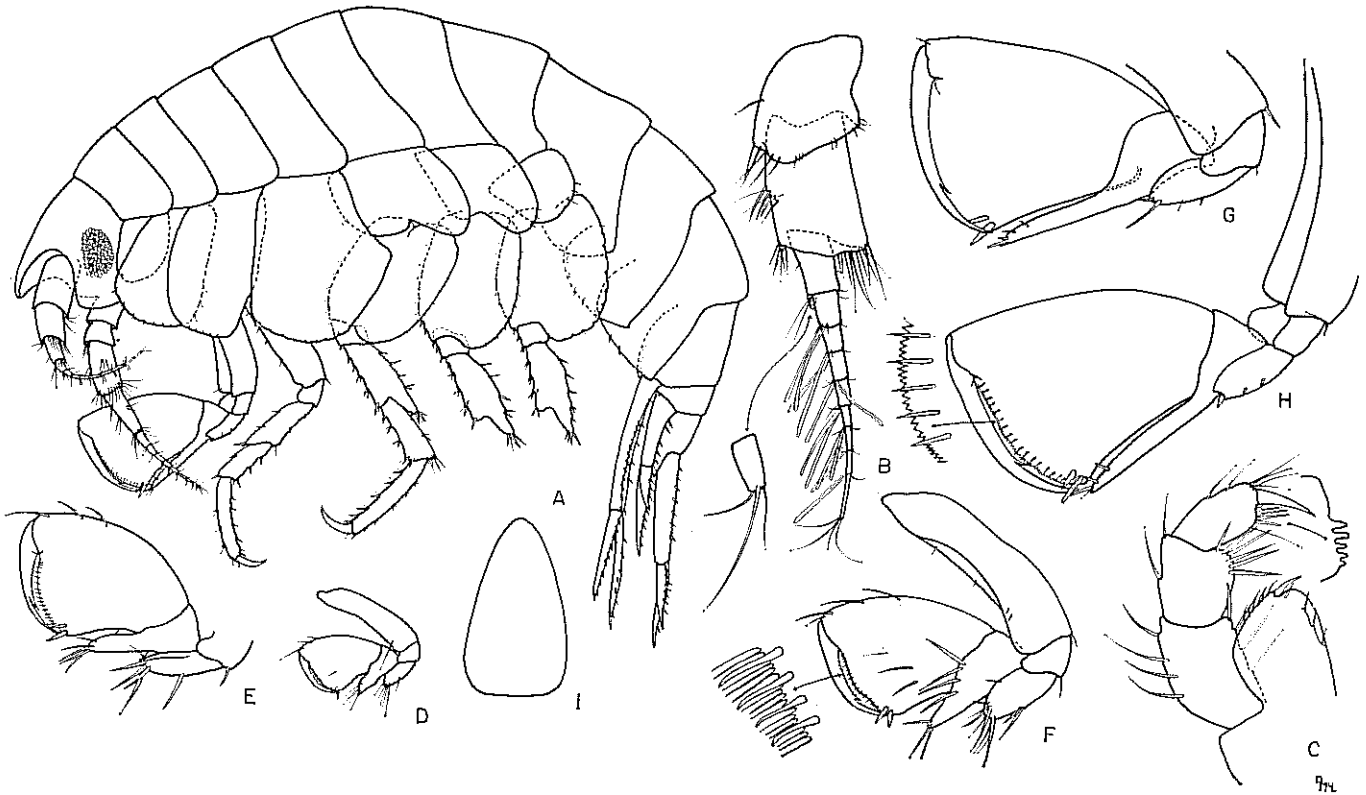


Fig. 3. *Amphilochus neapolitanus* Della Valle. Female, 2.5 mm, Barnard sta. 33: A, lateral view; B, antenna 1; C, part of maxilliped: D,E,F, views of gnathopod 1; G,H, views of gnathopod 2; I, telson.

projecting lobe of article 5 reaching about halfway along hind margin of article 6; gnathopod 2 considerably larger than 1, the hand moderately stout, less than 70% as broad as long, the palm nearly transverse, the hind lobe of article 5 projecting almost fully along hind margin of article 6; hand of gnathopod 2 bearing a small cusp at anterodistal end; dactyls of gnathopods not attenuated at extreme tips; telson considerably shorter than peduncle of uropod 3; coxa 1 long, rectangular, lobate below.

HOLOTYPE: AHF No. 5727, female, 2.5 mm.

TYPE LOCALITY: Station 4856, off Palos Verdes Pt., 33-47-30 N, 118-25-20 W, 11 fms, February 8, 1957, bottom of green mud and rock.

MATERIAL: 66 specimens from 15 stations. A subtidal species in depths of 2 to 20 fathoms, with an overall density of 0.4 animals per square meter on the coastal shelf.

RELATIONSHIP: As stated in the introduction to this genus the writer considers it probable that this species is a synonym of *A. spencebatei*, from which it differs only by the small anterodistal cusp of the hand on the second gnathopod. What is of interest is the great similarity in the first coxa, the length of the first antenna and the length of the projecting lobe on article 5 of gnathopod 1.

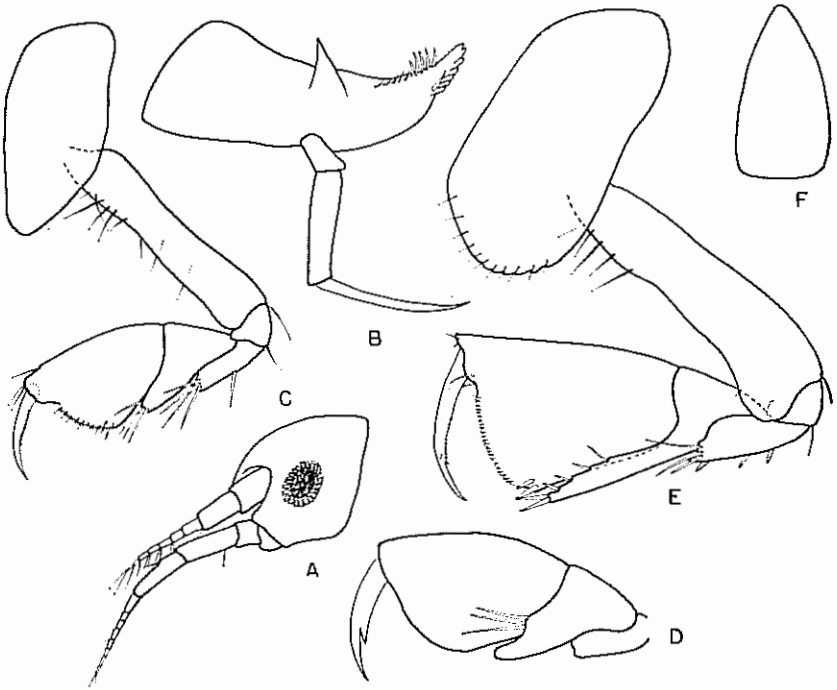


Fig. 4. *Amphilochus picadurus*, n. sp. Female, 2.7 mm, sta. 4856: A, head; B, mandible; C,D, gnathopod 1; E, gnathopod 2; F, telson.

Although simple, the mandibular molar of this species is much longer and sharper than in the other two species of *Amphilochus* described herein.

Genus Gitana Boeck

Gitana calitemplado, new species

Fig. 5

DIAGNOSIS: Sixth articles of gnathopods 1 and 2 about 1.7 times as long as fifth articles; article 5 of gnathopod 1 with posterior lobe short, not opposing hind edge of article 6; article 5 of gnathopod 2 produced into a slender but short lobe, apposed to posterior edge of article 6 for about one fourth of its length, the lobe blunt, not acute; article 6 of peraeopods 1 and 2 about 1.5 times as long as article 5.

HOLOTYPE: AHF no. 597, female, 2.2 mm.

TYPE LOCALITY: Station 6103, San Pedro Bay, 33-39-00 N, 119-09-03 W, 17 fms, February 19, 1959.

MATERIAL: 20 specimens from 10 stations.

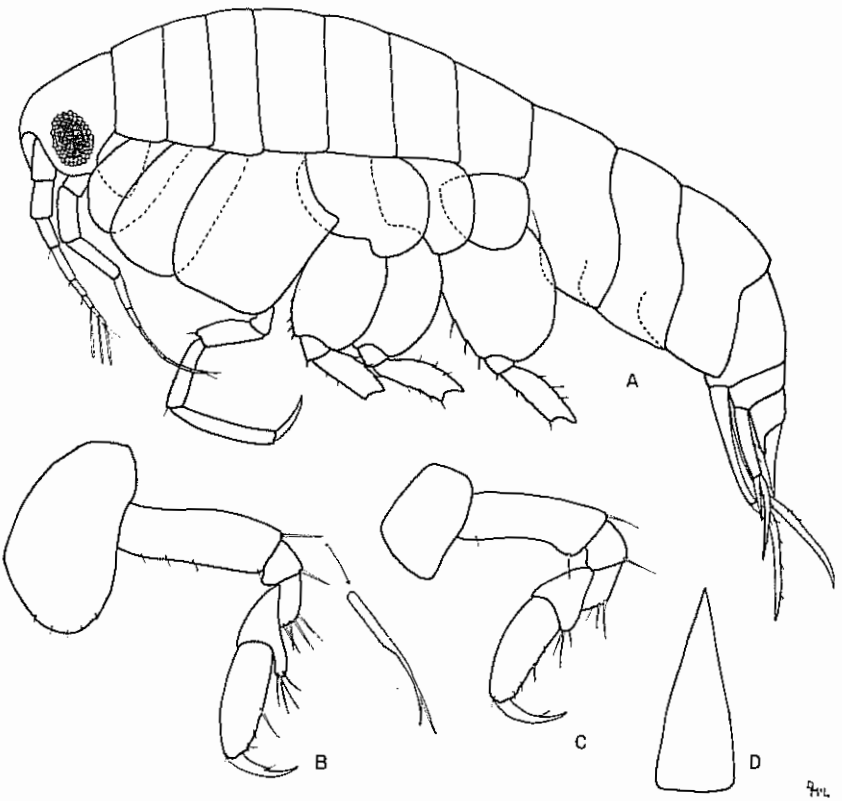


Fig. 5. *Gitana calitemplado*, n. sp. Female, 2.0 mm, sta. 4863: A, lateral view; B,C, gnathopods 2, 1; D, telson.

RELATIONSHIP: This species differs from the three other species of *Gitana*, *G. abyssicola*, *G. rostrata*, and *G. sarsi* (all in Sars 1895: pls. 78-79) by the very elongated sixth articles of the gnathopods and the first two peraeopods. The condition of the hind lobes of the fifth articles on the gnathopods also is significant, especially in distinguishing the species from *G. sarsi* which has acute hind lobes, whereas in *G. calitemplado* they are blunt.

The mouthparts are those of *Gitana*, with a large ridged mandibular molar, a uniarticulate first maxillary palp, and a non-excavate inner margin of the outer plate on the maxilliped. The third uropods are missing on all of the specimens at hand, as well as the ends of peraeopods 3-5.

ECOLOGY: A rare species, with an overall density of 0.2 animals per square meter on the coastal shelf, but limited to depths of 5 to 30 fathoms, with a frequency of 1.6 animals per square meter.

Genus Gitanopsis Sars

KEY TO GITANOPSIS

1. Pleon segments 1 and 2 each bearing a dorsal tooth ..... *bispinosa*
1. Pleon segments 1 and 2 dorsally smooth 2
2. Gnathopod 1 simple, lacking distinct palm 3
2. Gnathopod 1 subchelate, bearing distinct palm 4
3. Process of article 5 on gnathopod 2 short, not apposing hind edge of article 6 ..... *simplex*
3. Process of article 5 on gnathopod 2 long, reaching fully along hind edge of article 6 ..... *inaequipes*
4. Telson as long or longer than peduncle of uropod 3 5
4. Telson two thirds as long as peduncle of uropod 3 or less 7
5. Article 6 of gnathopod 2 large, about three fourths as wide as coxa 2, the process of article 5 reaching fully along hind edge of article 6 ..... *inermis*
5. Article 6 of gnathopod 2 small, about half as wide as coxa 2, the process of article 5 not reaching fully along hind edge of article 6 6
6. Sixth articles of gnathopods 1-2 scarcely constricted proximally ..... *squamosa*
6. Sixth articles of gnathopods 1-2 strongly constricting proximally ..... *arctica*
7. Process of article 5 on gnathopod 2 short, scarcely apposing hind edge of article 6 ..... *pusilloides*
7. Process of article 5 on gnathopod 2 long, reaching almost fully along hind edge of article 6 8
8. Hand of gnathopod 2 almost as broad as long ..... *magdai*
8. Hand of gnathopod 2 less than 70% as broad as long 9

9. Process of article 5 on gnathopod 2 reaching only half way along hind edge of article 6 ..... *pusilla** and *tortugae**
9. Process of article 5 on gnathopod 2 reaching three fourths along hind edge of article 6 ..... *vilordes*, n. sp.

*indistinguishable

Gitanopsis vilordes, new species

Fig. 6

DIAGNOSIS: Pleon segments dorsally smooth; eyes large; gnathopod 1 large, similar in structure to gnathopod 2, subchelate, the process of article 5 reaching about three fourths along hind edge of article 6; gnathopod 2 larger than 1, the posterodistal end of article 2 with stout spine, article 6 with 2 stout anterior spines, process of article 5 reaching fully along hind edge of article 6; telson much shorter than peduncle of uropod 3; coxa 1 quadrate.

HOLOTYPE: AHF No. 4920, female, 3.0 mm.

TYPE LOCALITY: Barnard station 27, intertidal of Pt. Fermin, October 21, 1949, wash of alga *Egregia* sp.

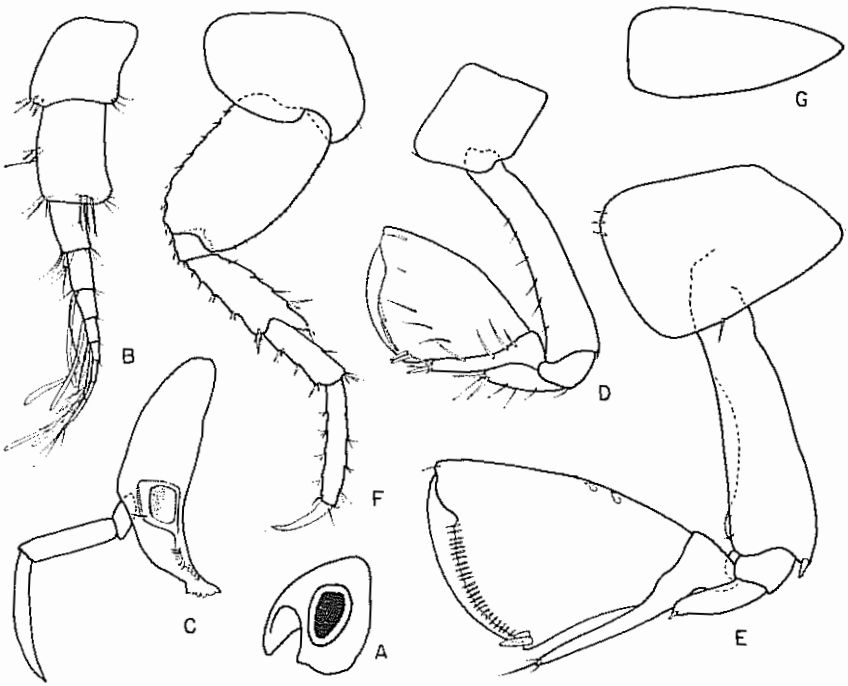


Fig. 6. *Gitanopsis vilordes*, n. sp. Holotype, female, 3.0 mm, Barnard sta. 27: A, head; B, antenna 1; C, mandible; D,E, gnathopods 1, 2; F, peraeopod 4; G, telson.

MATERIAL: 12 specimens from 2 interidal samples at Pt. Fermin, in 1949 and 1950, coll. J. L. Barnard from rock wash and alga *Egregia* sp. Three specimens from 3 subtidal samples in depths of 10 to 15 fathoms.

RELATIONSHIP: This species is closely related to both *Gitanopsis pusilla* K. H. Barnard (1916) and *G. tortugae* Shoemaker (1933). Even though Hurley (1955) refigured parts of *G. pusilla*, I am unable to distinguish it from *G. tortugae*. The new species apparently differs from both species by the slightly longer process of article 5 on gnathopod 1, and is notably different from *G. tortugae* by its large eyes. Its further relationship may be seen in the key to *Gitanopsis* above.

Family LEUCOTHOIDAE

Genus Leucothoe Leach

Leucothoe alata J. L. Barnard

Figs. 7 D, E, F

Leucothoe minima, J. L. Barnard 1952: 9-12, pl. 1 (not Schellenberg 1925).
Leucothoe alata J. L. Barnard 1959: 19-20, pl. 1.

MATERIAL: 10 specimens from 3 open-sea stations.

RECORDS: Shallow water algal bottoms from 10 fms or less near San Diego, Pt. Conception and Monterey Bay, California.

REMARKS: The sixth article of gnathopod 1 is more slender than seen in the forms of this species from Morro and Newport Bays.

Leucothoe spinicarpa (Abildgaard)

Figs. 7 A, B, C

Sars 1895: 283, pl. 100, pl. 101, fig. 1; Stebbing 1906: 165-166; Gurjanova 1951: 486-488, fig. 319.

MATERIAL: 6 specimens from 3 stations.

RECORDS: Shallow water algal stations, less than 10 fms depth, from Santa Monica Bay, Pt. Conception and Monterey Bay. A species widely distributed from subarctic waters to south temperate regions; perhaps universally distributed.

REMARKS: The palmar margin of gnathopod 2 in the present specimens is not crenulate but bears pairs of setules. In young specimens (Fig. 7A) the third article of antenna 1 is relatively longer in relation to articles 1 and 2 than in adult specimens which are figured by Sars. The length of this article has been an important distinguishing characteristic. It appears to the writer that as growth proceeds this article remains the same size while articles 1 and 2 elongate, and, thus, it is relatively smaller in adults than in juveniles. This does not appear to be the case in *L. alata*, another local species. Demonstration of such differential growth may necessitate revisions in the taxonomy of the genus.

Family THAUMATELSONIDAE

This family was erected in 1938 by Gurjanova for a group of genera split off from the Stenothoidae and the former Metopidae that are aberrant in their fused urosomal segments and in their large telson which apparently

is considerably thickened dorsoventrally. The thickened telson is most strongly developed in *Prothaumatelson nasutum* (Chevreux 1912) and perhaps least in *Thaumatelson cultricauda* K. H. Barnard (1932). Fusion lines delineating segments of the urosome are seen in some species and not in others. In 1955 Shoemaker described a new species *Prothaumatelson carinatum* in which the telson was normally stenothoid and only the last two urosomal segments were distinctly fused, the first urosomal segment being distinct. This species forms an intergrade between true stenothoids and true thaumatelsonids. In the following pages the writer describes another new species which forms a link between these two families; like Shoemaker's species it has the first urosomal segment distinct and a normal stenothoid telson, but, unlike *P. carinatum* and all other known thaumatelsonids, not all of the last 3 peraeopods have slender basal articles. Of course, many true stenothoids also have these slender peraeopods.

There should be concern over just where to split off the Thaumatelsonidae in light of Shoemaker's species and the one to follow, particularly because of the telsonic variability in described thaumatelsonids and the

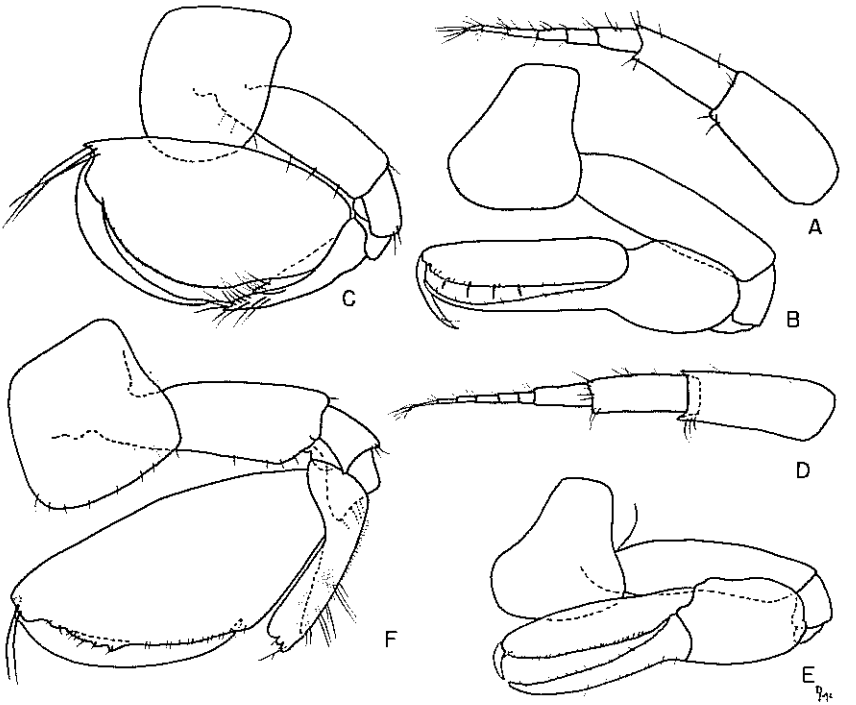


Fig. 7. *Leucothoe spinicarpa* (Abildgaard). Male, 2.75 mm, sta. 6425: A, antenna 1; B,C, gnathopods 1, 2. *Leucothoe alata* J. L. Barnard. Male, 3.0 mm, sta. 6425: D, antenna 1; E,F, gnathopods 1, 2.

variation in the degree of fusion of urosomal segments even in obvious thaumatelsonids. For the time being, the writer suggests leaving Shoemaker's species in the genus *Prothaumatelson* of the Thaumatelsonidae, because it forms a neat link to the type species of *Prothaumatelson*. Both species have chelate second gnathopods, but the type species, *P. nasutum* has the fully modified telson. Thus, *Prothaumatelson* is the only stenothoid-thaumatelsonid genus with chelate second gnathopods.

The writer prefers to assign the following new species to the Stenothoidae, and on that basis it falls into the genus *Stenothoides* Chevreux, if one ignores the fusing of the last two urosomal segments. The very great difficulty in seeing the urosomal segments in these small, shiny, translucent animals suggests the possibility that other known stenothoids also have these segments fused. The new species is quite clearly related to other species in *Stenothoides*.

It would appear to the writer that the Thaumatelsonidae are simply a group of species continuing the general degradation seen in the Stenothoidae. This degradation is marked by evanesence of the mandibular palps, linearization of the basal articles of the peraeopods, fusion of the palp articles on the first maxillae, complete loss in most cases of the accessory flagellum, etc. It is difficult to recognize a family such as the Thaumatelsonidae as more than a group of species, perhaps of polyphyletic origin, which have gone one step further in their degeneration. The obvious relationship to the Stenothoidae causes one to suggest that the Thaumatelsonidae be considered a subfamily rather than a full family. However, there is argument in the other direction: for instance, that the Liljeborgiidae are nothing more than Gammaridae with reduced mandibular molars and yet are kept as a distinct family, and Bulycheva's partitioning of the Talitridae into subtilely distinct families.

Family STENOTHOIDAE

This family has a plethora of variation involving criteria of mouthparts, gnathopods, and peraeopods. Two species which have identical male second gnathopods may be in entirely different genera and so the systematist is forced to dissect completely each species in a fauna repeatedly until he learns the extent of variation in that fauna, after which he can proceed to identify species on the basis of characters recognized without dissection.

In a fauna such as that of southern California, the initial exploration is difficult because the animals of this family are quite small, but on the other hand the diversity is quite low compared with that of the northwestern Pacific (Gurjanova 1951). It is easy to break off mandibular palps during dissection, and it is quite difficult to decide whether a first maxillary palp is biarticulate or uniarticulate because the joint lines are difficult to resolve. Furthermore, the distinctions between genera are not as great as the excellent keys of Gurjanova (1938) (1951) and Shoemaker (1955) would indicate: for instance, there is little difference in the degree

of expansion of the second article on peraeopod 5 between *Metopella longimana* and *Mesometopa extensa*, but this is the principal difference between these two genera, and the situation is intergraded by *Metopella neglecta* which has the upper half of that article expanded and the lower half narrowed.

In addition, the systematist is frustrated by such cases as *Metopella pacifica* Holmes (1908) from Monterey, California, and the new species of *Metopella* to follow from southern California which, indeed, have identical second male gnathopods and apparently the same peculiar disparity between peraeopods 1 and 2. Yet the first gnathopods are entirely different, for in *M. pacifica* the first gnathopod is subchelate and in the new species it is simple. The systematist is left with the same sense of disproportion as noted above in the case of *Leucothoe spinicarpa*, where so much variation is encountered in the same species that most previous systematic work is disarranged.

It is apparent that *Mesostenothoides* Gurjanova (1938) is a synonym of *Stenothoides* Chevreux (1900). This error probably arose when Gurjanova relied on Chevreux and Fage's (1925) incorrect assignment of their *latipes* to *Stenothoides*. The type species of *Stenothoides*, *S. perrieri* Chevreux (1900) has *both* pereaeopods 3 and 4 bearing a slender second article, and only peraeopod 5 has the expanded second article. All remaining species assigned to *Stenothoides* since that time have been like *S. latipes* Chevreux and Fage (1925) a species which has only peraeopod 3 bearing a slender article while both peraeopods 4 and 5 support an inflated article. Thus, the type of *Mesostenothoides* must fall to *Stenothoides*, and a new name must be provided for all other species previously assigned to *Stenothoides*.

Stenothoides Chevreux, new synonymy

Stenothoides Chevreux 1900: 55.
Mesostenothoides Gurjanova 1938: 280.

DIAGNOSIS: Article 2 of peraeopods 3-4 slender; article 2 of peraeopod 5 broad; palp of mandible uniarticulate or absent; palp of maxilla 1 uniarticulate.

TYPE SPECIES: *Stenothoides perrieri* Chevreux (1900).

LIST OF SPECIES:

Stenothoides (?) *bicoma*, n. sp.
Stenothoides perrieri Chevreux
Mesostenothoides pirloti Gurjanova
Mesostenothoides slastnikovi Gurjanova
Mesostenothoides smirnovi Gurjanova
Mesostenothoides uenoi Gurjanova

Stenothoides (?) bicoma, new species

Fig. 8

DIAGNOSIS OF MALE: Last two urosomal segments fused but pleon not otherwise aberrant as in some species assigned to Thaumatelsonidae (see

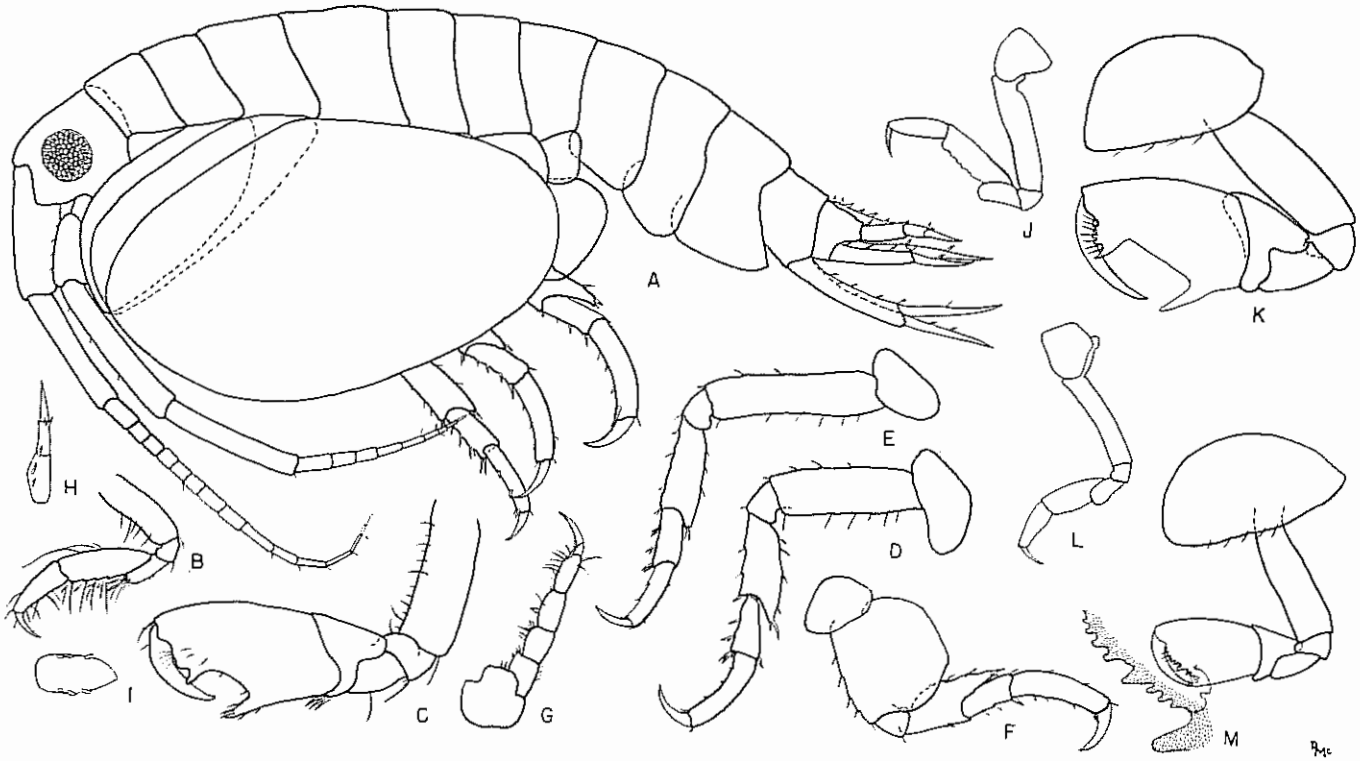


Fig. 8. *Stenothoides bicoma*, n. sp. Male, 1.5 mm, sta. 4845: A, lateral view; B,C, gnathopods 1, 2; D,E,F, peracopods 3, 4, 5; G, maxilliped; H, uropod 3; I, telson. Male, 4 mm, sta. 5202: J,K, gnathopods 1, 2, minus setae. Female, 3.5 mm, sta. 5202: L,M, gnathopods 1, 2, minus setae.

previous discussion); telson bearing three lateral spines on each side; gnathopod 1 with article 5 longer than article 6, its article 7 simple, not setose, its article 4 scarcely produced; palm of gnathopod 2 oblique, bearing a large multitoothed process near finger hinge and a large, acute defining process, with the excavation between them being quadrate; antennae subequal in length; mandible lacking palp; palp of maxilla 1 uniarticulate.

FEMALE: Palm of gnathopod 2 slightly oblique, defined by a distinct tooth at hind corner and bearing along the palmar margin well-developed teeth, one of which is larger than the others.

HOLOTYPE: AHF No. 5616, male, 3.0 mm.

TYPE LOCALITY: Station 4785, near Pt. Conception, 34-27-00 N, 120-08-30 W, 30 fms, December 18, 1956, bottom of green silt.

MATERIAL: 90 specimens from 29 stations.

RELATIONSHIP: This species is distinguished among members of the genus *Stenothoides* by the elongated fifth article of the first gnathopod, but is otherwise particularly related to *S. slastnikovi* Gurjanova (see 1951) by the male second gnathopod.

ECOLOGY: This species has an overall density of 2.2 animals per square meter on the coastal shelf. It is distributed principally between the depths of 21 and 40 fms, but is found as shallow as 6 fathoms and as deep as 60 fathoms.

Stenula, new name

Stenothoides Chevreux, Chevreux and Fage 1925: 130 (not Chevreux 1900); Gurjanova 1938: 279-280; Gurjanova 1951: 445.

DIAGNOSIS: Article 2 of peraeopod 3 slender; article 2 of peraeopods 4-5 broad; palp of mandible and palp of maxilla 1 each uniarticulate.

TYPE SPECIES: *Stenothoides latipes* Chevreux and Fage, 1925.

SPECIES ASSIGNED TO THIS GENUS:

Stenothoides angusta Shoemaker
Stenothoides arctica Gurjanova
Stenothoides bassarginensis Gurjanova
Stenothoides beringiensis Gurjanova
Stenothoides carinatus Gurjanova
Stenothoides latipes Chevreux and Fage (type)
Stenula modosa, new species
Stenothoides ratmanovi Gurjanova
Stenothoides serripes Gurjanova
Stenothoides ussuriensis Gurjanova

Stenula modosa, new species

Fig. 9

DIAGNOSIS OF FEMALE: Eyes quite large, round, occupying almost the entire side of the head; gnathopod 1 simple, the hind edge of article 6 with slender (not stout) setae, the finger bearing slender setae on its hind edge; palp of mandible as long as width of mandibular apex, slender; fourth articles of peraeopods 3-5 not strongly produced posteriorly;

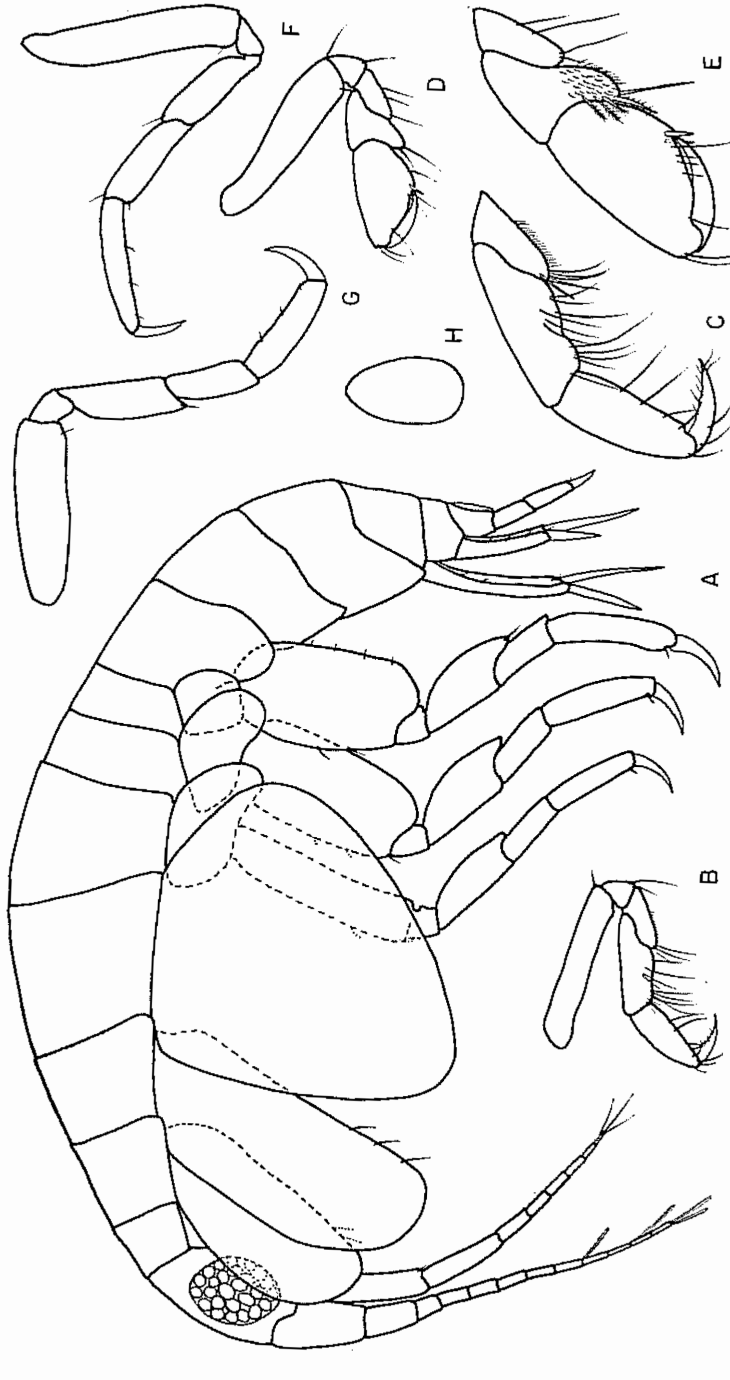


Fig. 9. *Stenula modosa*, n. sp. Female, holotype, 2.0 mm, sta. 4821: A, lateral view; B,C, gnathopod 1; D,E, gnathopod 2; F, G, peraeopods 1, 2; H, telson.

first article of ramus of uropod 3 longer than peduncle; uropod 3 lacking spines except for one at articulation of articles 1 and 2 of ramus; telson linguiform, unarmed; body not carinate.

MALE: Unknown.

HOLOTYPE: AHF No. 5728, female, 2 mm.

TYPE LOCALITY: Station 4821, near Pt. Conception, 34-25-48 N, 120-14-40 W, 50 fms, bottom of green mud, January 17, 1957.

MATERIAL: 3 specimens from 3 stations.

ECOLOGY: Recorded from depths between 31 and 50 fathoms.

RELATIONSHIP: This species resembles *Stenothoides angusta* Shoemaker (1955) by its large eyes, but differs by the shorter hind lobes on the fourth articles of peraeopods 3-5 which in *S. angusta* overextend and reach the ends of the fifth articles.

The simple first gnathopod of the new species distinguishes it from *S. carinatus* Gurjanova (1953), *S. arctica* Gurjanova (1951), *S. bassarginensis* Gurjanova (see Gurjanova 1951), and *S. serripes* Gurjanova (1955). It differs by its large eyes from *S. beringiensis* Gurjanova (1948), *S. ratmanovi* Gurjanova (1948), *S. ussuriensis* Gurjanova (1948), and *S. latipes* Chevreux and Fage (1925).

Only the female of the species is known, so that the size of the eyes is necessarily used to distinguish it from some of the species, but with the discovery of the male there may be other criteria available for distinction.

Genus **Metopa** Boeck

Metopa dawsoni, new species

Figs. 10, 11

DIAGNOSIS OF MALE: Gnathopod 1 with article 6 about half as long as article 5 and both articles with their edges parallel, its article 7 short, about a third as long as article 6, bearing 4-5 setules along inner margin, its article 2 slender, its article 4 not strongly produced behind; gnathopod 2 with nearly transverse palm defined by a large deflexed tooth which points medially when not flattened on the microscopic slide, its palm with a large excavation and a multitoothed process near finger hinge, its article 7 failing to reach the defining tooth, its article 3 produced anteriorly, its article 4 unusual in forming a thin, transparent process on the medial side of article 5 and bearing an anterior spine, its article 5 bearing minute denticulation along anterior edge; antenna 1 slightly longer than antenna 2; accessory flagellum forming a minute bump; coxa 4 not sinuate along lower margin; third pleonal epimeron slightly attenuated and quadrate at lower corner; telson with 3 lateral spines on each side; fourth article of peraeopods 4-5 stout.

FEMALE: Article 6 of gnathopod 2 longer than in the male, about two thirds as long as article 5; gnathopod 2 like that of male but principal palmar excavation much smaller, the defining tooth much smaller and not deflexed so that the palm is largely formed of the toothed portion seen

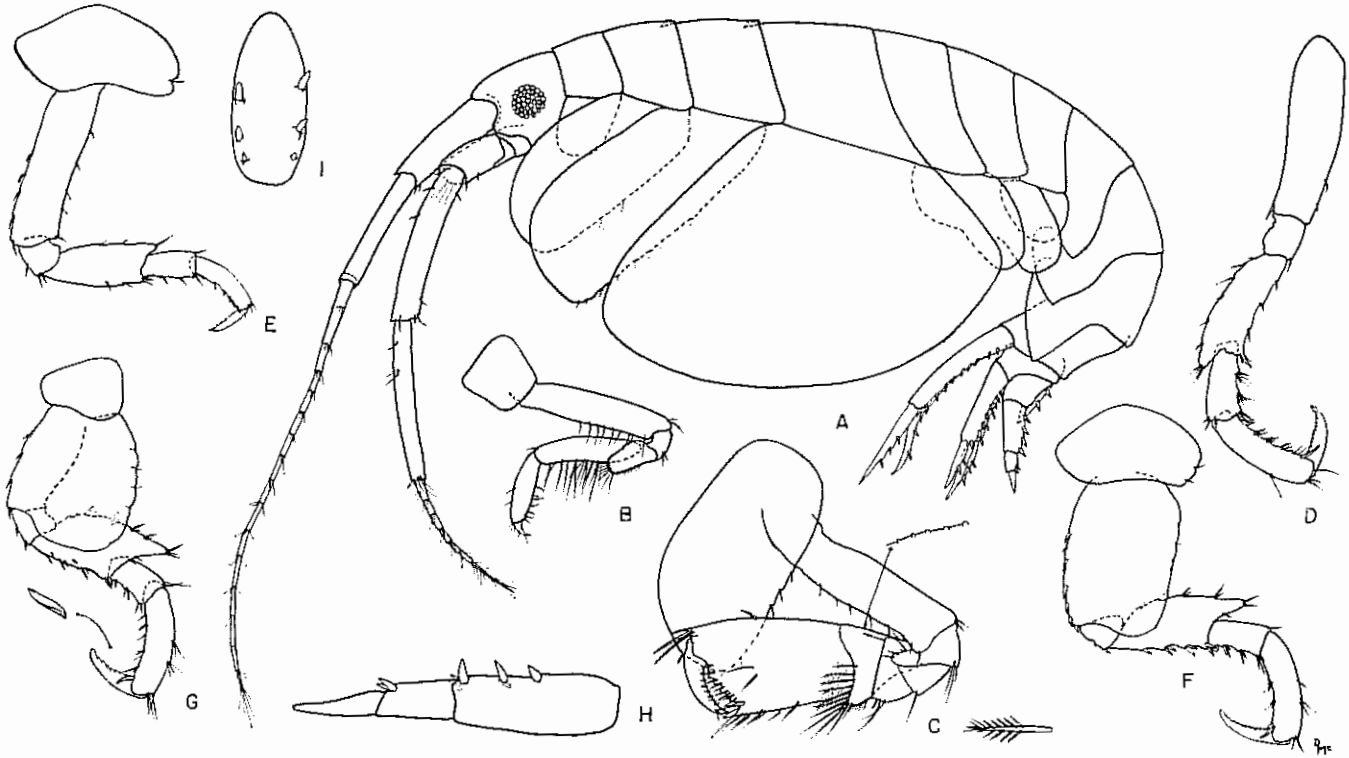


Fig. 10. *Metopa dawsoni*, n. sp. Female, 3.8 mm, sta. 5828: A, lateral view; B,C, gnathopods 1, 2; D,E,F,G, peraeopods 2, 3, 4, 5; H, uropod 3; I, telson.

in the male, the finger nearly reaching end of palm, its article 3 more strongly produced than in male.

HOLOTYPE: AHF No. 598, male, 3.0 mm.

TYPE LOCALITY: Station 6098, off Pt. Fermin, 33-38-45 N, 118-14-45 W, 24 fms, February 19, 1959.

MATERIAL: 36 specimens from 12 stations.

RELATIONSHIP: The genus *Metopa* is large, with 46 species. A key to

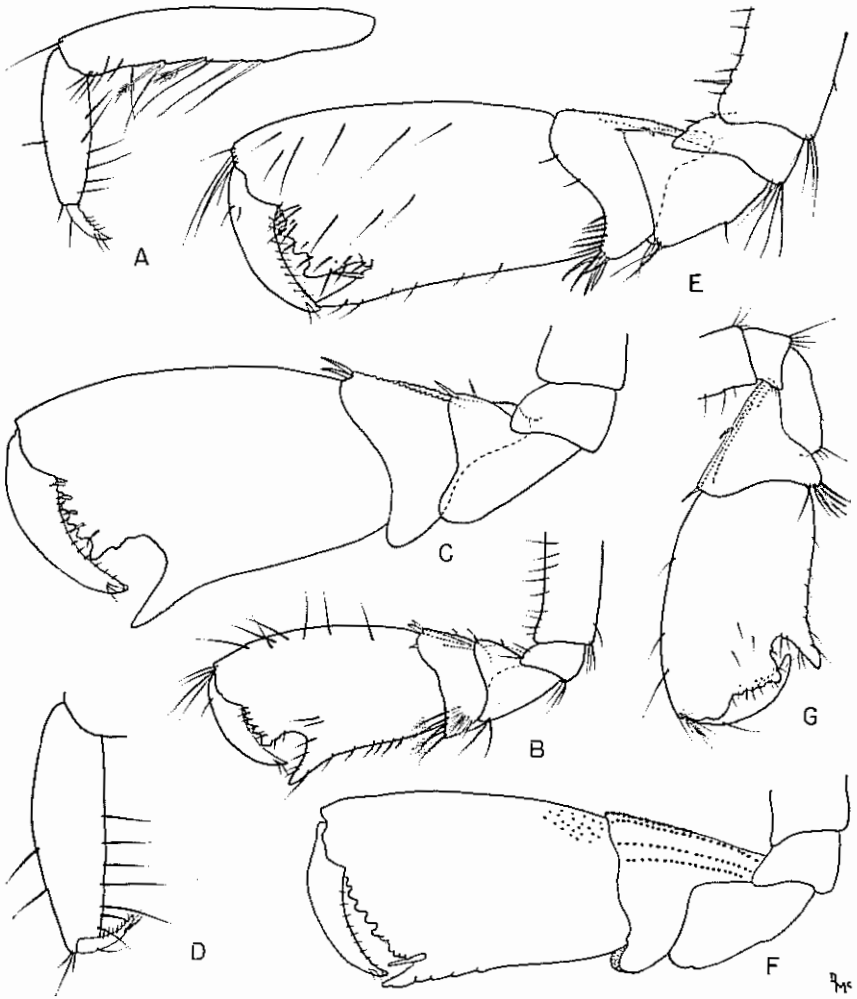


Fig. 11. *Metopa dawsoni*, n. sp. Male, 4.3 mm, sta. 6105: A,B,C, gnathopods 1, 2, 2. Female, 3.8 mm, sta. 5828: D,F, gnathopods 1, 2. Female, 5.0 mm, sta. 6132: E, gnathopod 2. Male, holotype, 3.0 mm, sta. 6098: G, gnathopod 2.

the species was published by Gurjanova (1951). The genus *Prometopa* Schellenberg (1926) was referred to *Metopa* by Gurjanova (1948) but separated in her generic key again in 1951. *Prometopa* differs from *Metopa* by the presence of an indistinctly biarticulate accessory flagellum. The new species herein has a minute, 1-jointed accessory flagellum. By retaining the genus *Prometopa*, it is possible to state that the genus *Metopa* is confined to the northern hemisphere.

Metopa dawsoni differs from several other species in the genus by minor characteristics as follows: From its closest relative, *Metopa wiesei* Gurjanova (see 1951), it differs by the different angle of projection of the last tooth on the finger-hinge process of male gnathopod 2, (in *M. wiesei* it projects posteriorly whereas in *M. dawsoni* it projects distally) and by the much more elongated fifth article of gnathopod 1 and shorter article 7. From *Metopa alderi* (Bate) (see Sars 1895: pl. 86) it differs by the much more elongated fifth article of gnathopod 1, with more slender sixth article, the shorter seventh article, and the presence of telsonic spines. In gnathopod 1, *M. dawsoni* differs in like respect from *M. spectabilis* (see Sars 1895: pl. 87) and *M. boeckii* (see Sars 1895: pl. 88). The female of *M. dawsoni* resembles closely the female of *M. robusta* Sars (1895: pl. 96, fig. 1) but differs by the stouter first gnathopod and less strongly produced fourth articles of peraeopods 4-5.

ECOLOGY: This species has an overall density of 0.9 animals per square meter on the coastal shelf. It ranges in depth from 31 to 100 fathoms.

Genus Metopella Sars

Metopella nasutigenes (Stebbing 1888) should be transferred to the genus *Probolisca*, because of its biarticulate first maxillary palp.

Metopella aporpis, new species
Figs. 12, 13

DIAGNOSIS OF MALE: Articles of antenna 1 not produced; article 6 of gnathopod 1 shorter than article 5, simple, its edges parallel, its posterior edge with 4-5 long setae; article 7 of gnathopod 1 half as long as article 6, with 3-4 setae on posterior edge; palm of gnathopod 2 oblique, formed of a shallow quadrate excavation bounded on both sides by a long, sharp tooth, the posterior one forming the defining tooth, the anterior tooth being an extension from a minutely toothed process near the finger hinge; gnathopod 2 with article 7 nearly reaching end of palm, its article 4 forming a medial translucent lobe projecting anteriorly and appressed to the side of article 5, the anterior edge of article 5 with rows of minute denticles; peraeopod 1 much longer than peraeopod 2 and poorly spinose, peraeopod 2 having numerous stout posterior spines on article 5 and 6; telson with 2 lateral spines on each side near base.

Mandibular palp long, apparently biarticulate; first maxillary palp uniarticulate.

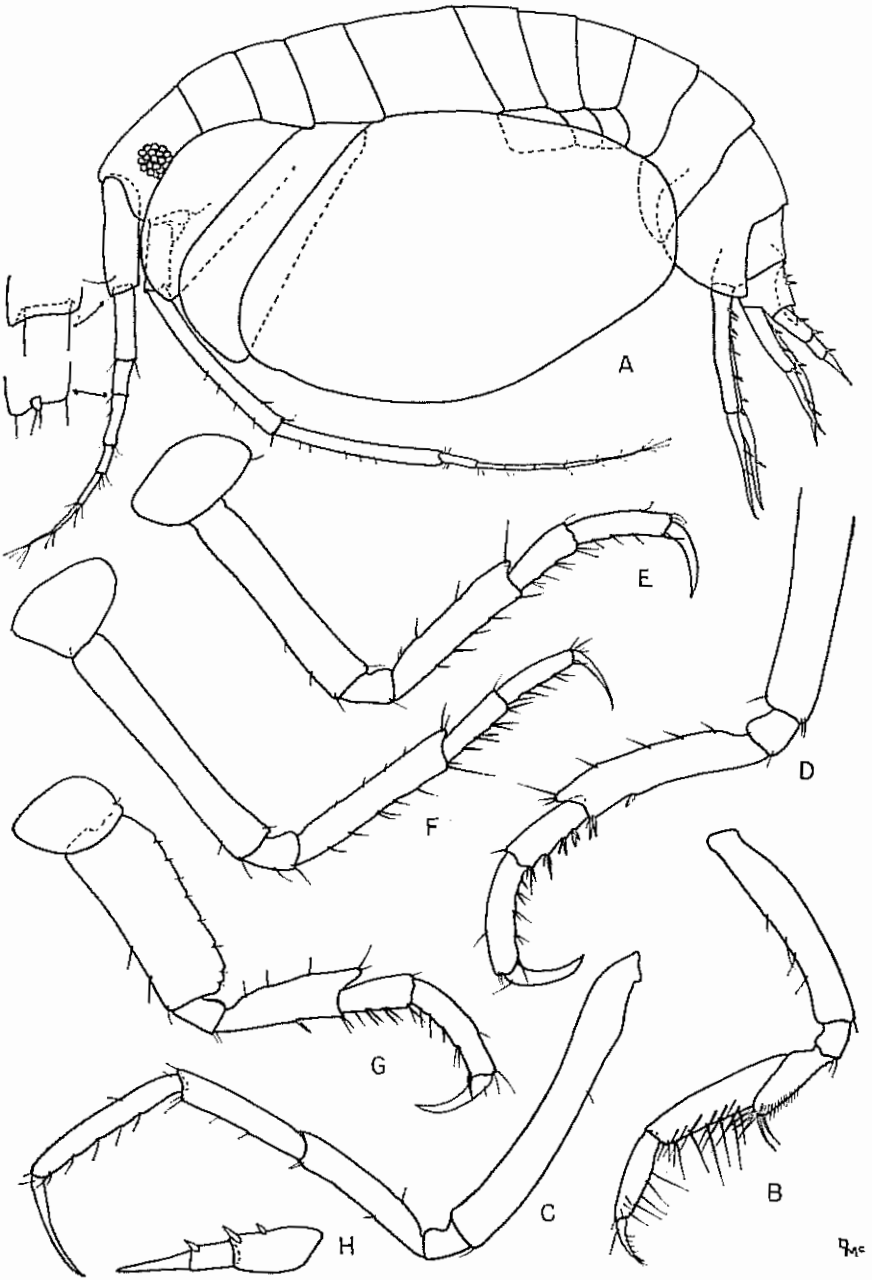


Fig. 12. *Metopella aporpis*, n. sp. Male, holotype, 2.4 mm, sta. 4834: A, lateral view; B, gnathopod 1; C,D,E,F,G, peraeopods 1, 2, 3, 4, 5; H, uropod 3.

FEMALE: Gnathopod 2 with palm oblique, irregularly toothed, with one large medial tooth and a large defining tooth, the finger failing to reach end of palm; telson with 4 spines on each side near base.

HOLOTYPE: AHF No. 5729, male, 2.4 mm.

TYPE LOCALITY: Station 4834, near Pt. Mugu, 34-00-20 N, 119-01-45 W, 77 fms, rock bottom, February 6, 1957.

RELATIONSHIP: This species is closely related to *Metopella pacifica* (Holmes 1908), from Monterey, California, but differs by the simple, not subchelate, first gnathopod. The resemblance of second gnathopods is amazing, and one wonders if the configuration of gnathopod 1 as drawn for *M. pacifica* were correct.

The new species differs from *M. buynitzkii* Gurjanova (see 1951), *M. macrochira* Gurjanova (see 1951) and *M. carinata* (Hansen) (Gurjanova 1951) by the elongated fifth article of gnathopod 1 and by the quite different configuration of male gnathopod 2. It differs from *M.*

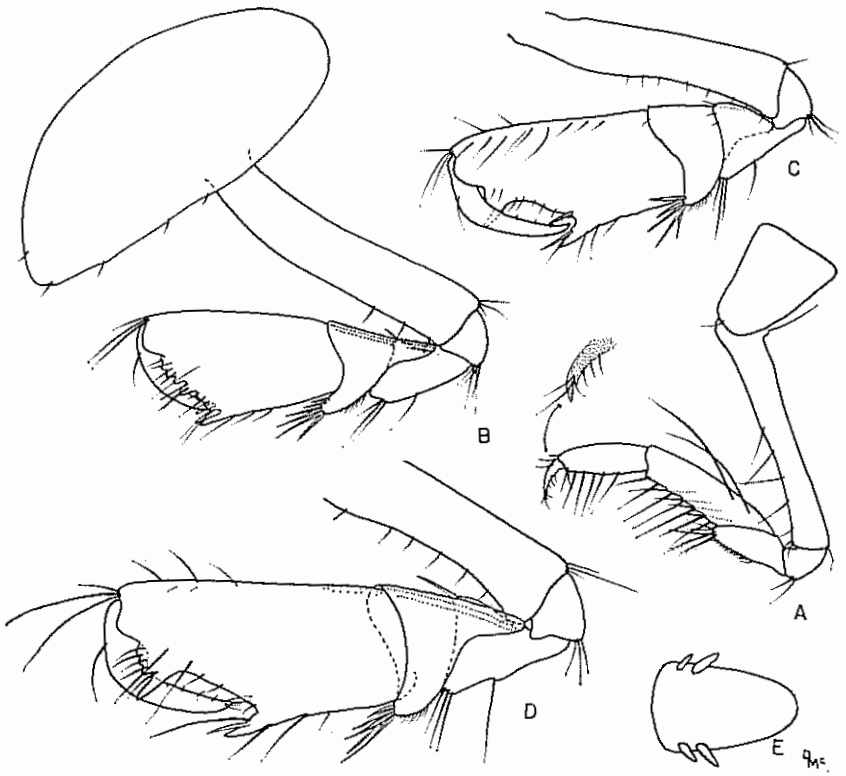


Fig. 13. *Metopella aporpis*, n. sp. Female, 2.5 mm, sta. 4834: A,B, gnathopods 1, 2. Male, holotype, 2.4 mm: C,D, medial and lateral view of gnathopod 2; E, telson.

nasuta (Boeck) (in Sars 1895) by the unproduced first article of antenna 1; from *M. neglecta* (Hansen) (see Sars 1895) by the parallel edges of article 2 on peraeopod 5; from *M. longimana* (Boeck) (see Sars 1895) by the second male gnathopod, which in *M. longimana* has a nearly transverse palm; and from *M. angusta* Shoemaker (1949) by the palmar processes on male gnathopod 2.

MATERIAL: 5 specimens from 3 stations.

ECOLOGY: Known from 2 stations in southern California at depths of 46 and 77 fms and from Monterey Bay at 14 fms.

Parametopella Gurjanova

Gurjanova 1938: 281; Gurjanova 1951: 478.

DIAGNOSIS: Mandible lacking palp; palp of maxilla 1 uniarticulate; second articles of peraeopods 3-5 slender, not expanded.

Barnard's (1958) Index erred in listing *Stenothoe minuta* Holmes (1905) as having been transferred to *Parametopella* by Gurjanova (1948). This was a technical error, and *S. minuta* rightly belongs in *Stenothoe*.

Parametopella ninis, new species

Figs. 14, 15

DIAGNOSIS OF FEMALE: Gnathopod 1 slender, simple, its articles 5 and 6 equal in length, the hind margin of article 6 with 4 slender setae, the hind margin of article 7 with 3 slender setae; gnathopod 2 small, slender, its article 5 nearly two thirds as long as article 6, with broad hind lobe, becoming subacute at apex, the palm oblique, straight, defined by 2 spines; articles of antennae simple, not produced; telson with 2 lateral spines on each side.

MALE: Unknown.

HOLOTYPE: AHF No. 586, female, 1.9 mm.

TYPE LOCALITY: Station 5711, Santa Monica Bay, 33-55-54 N, 118-31-16 W, 31 fms, April 18, 1958.

RELATIONSHIP: This species differs from *P. stelleri* (see Gurjanova 1951) by the more slender first gnathopod, the slimness of the posterior setae of article 6, and the unproduced articles of the antennae as well as the second gnathopods which are known for the male in *P. stelleri*. It differs from *P. cypris* (Holmes 1905: 484) by the slightly longer fifth article of gnathopod 2 which has a broad hind lobe, not a slender, apically rounded, slightly constricted lobe as seen in *P. cypris*.

The writer cannot clearly discern the line separating urosome segments 5 and 6. Despite the large number of specimens no male was found; all specimens have brood plates.

MATERIAL: 37 specimens from 24 stations.

ECOLOGY: This species has an overall density of 0.5 animals per square meter on the coastal shelf. It is restricted to depths between 31 and 100 fathoms.

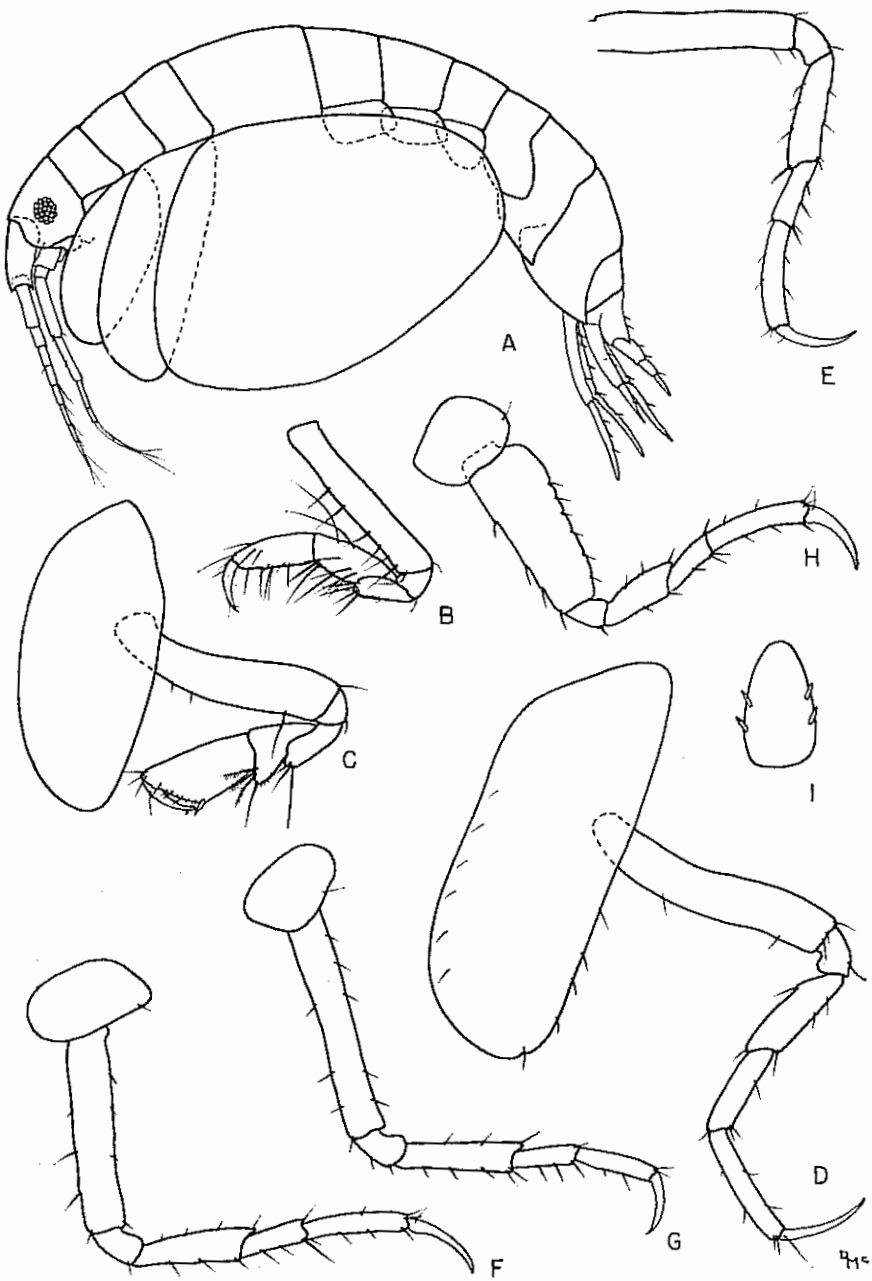


Fig. 14. *Parametopella ninis*, n. sp. Female, holotype, 1.9 mm, sta. 5711: A, lateral view; B,C, gnathopods 1, 2; D,E,F,G,H, peraeopods 1, 2, 3, 4, 5; I, telson.

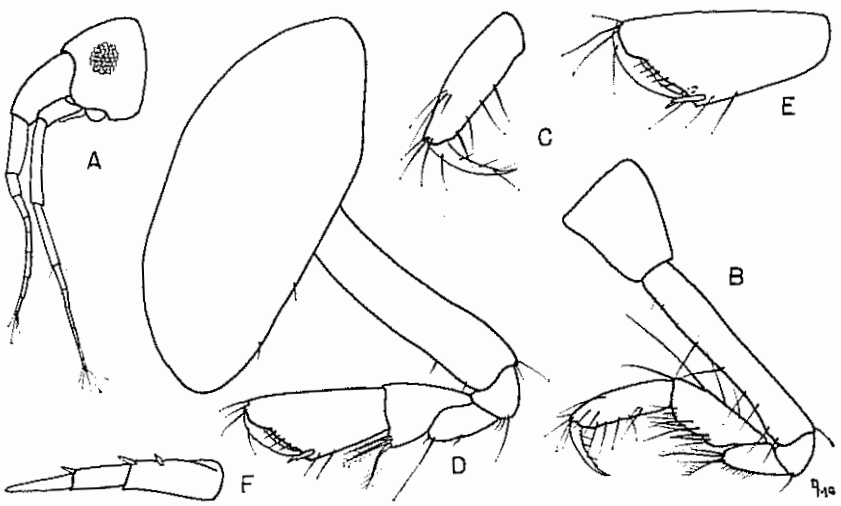


Fig. 15. *Parametopella ninis*, n. sp. Female, 2.8 mm, sta. 5163: A, head; B,C, gnathopod 1; D,E, gnathopod 2; F, uropod 3.

Genus Proboloides Della Valle

Proboloides tunda, new species

Fig. 16

DIAGNOSIS: Eyes absent; antennae quite long; article 2 of first antenna 1.6 times as long as article 1; accessory flagellum absent; first gnathopod with article 6 three fourths as long as article 5, bearing a distinct palm which is defined by a group of 5 stout dispersed spines, its article 4 not strongly produced; gnathopod 2 with medial side of article 3 sharply produced forward, its article 4 with a sharp distally produced tooth, its article 6 of intermediate slenderness, its palm quite distinct, oblique, shorter than hind margin of article 6, with a flat-bottomed excavation for half its length, the entire length sculptured into bead-like processes, defined by a slight process bearing 2 spines; fourth articles of peraeopods 3-5 narrow, scarcely produced; telson with 3 lateral spines on each side.

Palp of mandible triarticulate, palp of maxilla 1 biarticulate.

HOLOTYPE: AHF No. 5910, male, 5 mm; no brood plates, no penial projections.

TYPE LOCALITY: Station 6809, off Santa Cruz Island, 33-54-39 N, 119-46-24 W, 302 fathoms, December 22, 1959, bottom of shale, mud, sand.

MATERIAL: Station 6809, (3 specimens; the two besides the holotype are in fragments).

RELATIONSHIP: Most species of *Proboloides* are distributed in the

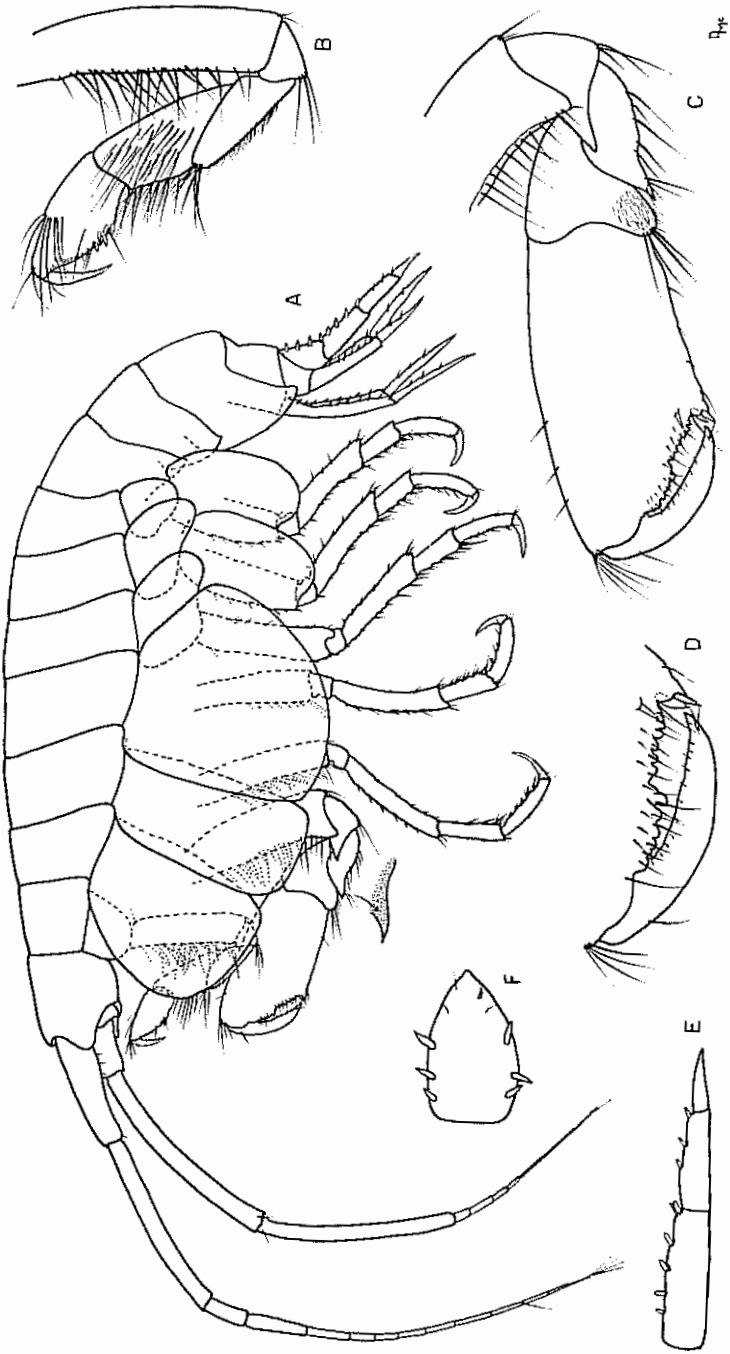


Fig. 16. *Proboloides tunda*, n. sp. ?Male, holotype, 5.0 mm, sta. 6809: A, lateral view; B,C,D, gnathopods 1, 2, 2; E, uropod 3; F, telson.

southern Hemisphere and most of them belong to the subgenus *Metopoides* which has a small accessory flagellum. In the northern Hemisphere apparently the only other species to have the narrow, unproduced fourth article of peraeopod 3 is *P. grandimanus* (Bonnier 1896, Bay of Biscay, 950 m) another deep water species like the present one. Bonnier has drawn that species with an eye on one drawing and none on the other, and mentions small round eyes in his description, but one wonders whether this might be part of the brain which resembles an eye on the present specimens. The second gnathopods of the new species differ considerably from those of *P. grandimanus*, and the latter is aberrant for its large first coxa and small second one.

Genus Stenothoe Dana

Stenothoe estacola, new species

Fig. 17

DIAGNOSIS OF MALE: Gnathopod 1 with article 4 scarcely projecting behind, with article 6 almost twice as long as article 5, the palm quite oblique but well defined by 3 spines; gnathopod 2 rather small, stout, its article 6 not elongated, the palm oblique but well defined by a large shallow bump and with 3 small blunt cusps; telson with 3 lateral spines on each side; back not carinate; peduncle of uropod 3 shorter than ramus, the second article of ramus straight, armed with rows of minute serrations; fourth articles of peraeopods 3-5 of intermediate expansion.

FEMALE: Gnathopod 1 like that of male; gnathopod 2 smaller and more slender than in male, the palm lacking ornamentation, longer than hind margin of article 6 but well defined by several spines.

HOLOTYPE: AHF No. 556, male, 3.0 mm.

TYPE LOCALITY: Barnard sta. 6, Corona del Mar, California, February 6, 1955, intertidal wash of crustaceans from reef-like beds built by the polychaete worm, *Phragmatopoma* sp.

MATERIAL: Barnard stas. 4 (29), 6 (22), 23 (1).

RELATIONSHIP: This species differs from *Stenothoe monoculoides* (Montagu) (see Sars 1895: pl. 82, fig. 1, and Chevreux and Fage 1925: fig. 132) by the stouter male second gnathopod, its palm being armed with short cusps and by the multispinose telson; the female differs by its longer palm of gnathopod 2; from *S. brevicornis* Sars (1895: pl. 82, fig. 2) it differs by the shorter peduncle of uropod 3 and the less produced fourth article of gnathopod 1. From *S. barrowensis* Shoemaker (1955) it differs by the relatively elongated sixth article of gnathopod 1 and the stouter second gnathopod with larger and fewer palmar cusps. From *S. adhaerans* Stebbing (1888: pl. 39) it differs by the defining spines on the palm of female gnathopod 2 and the much shorter peduncle of uropod 3.

ECOLOGY: An intertidal species recovered from Corona del Mar and Pt. Fermin in formalin washings of 3 kinds of materials, sponge (*Sphecio-spongia* sp.), beds of arenaceous encrusting polychaete, *Phragmatopoma* sp., and in calcareous algae.

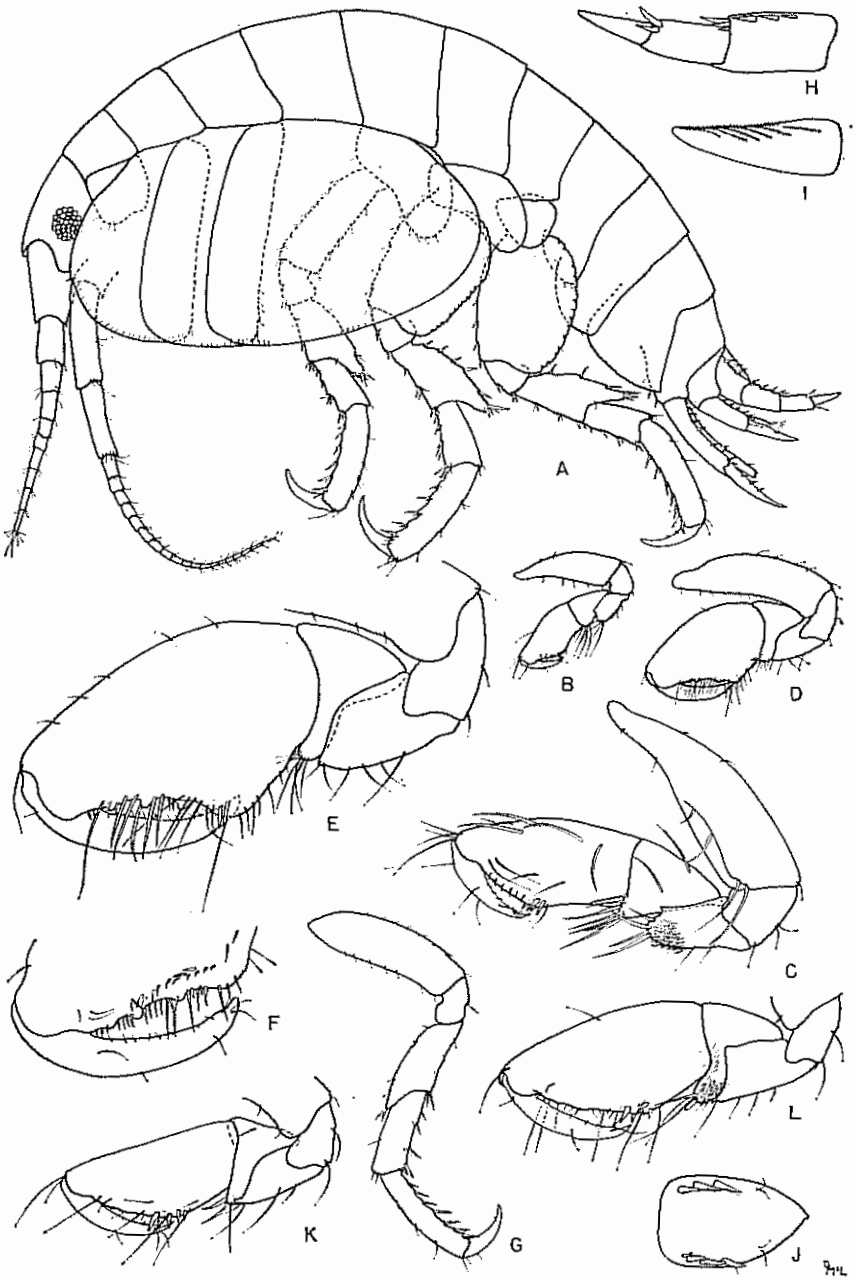


Fig. 17. *Stenothoe estacola*, n. sp. Holotype, male, 3.0 mm, Barnard sta. 6: A, lateral view; B,C, gnathopod 1; D,E,F, gnathopod 2; G, peraeopod 1; H, uropod 3; I, detail of second ramal article of uropod 3; J, telson. Female, 2.0 mm; K,L, gnathopods 1, 2.

Stenothoe frecanda, new species

Fig. 18

DIAGNOSIS: Article 4 of gnathopod 1 strongly projecting distally and behind; gnathopod 2 with palm and hind margin contiguous, bearing near finger hinge a small tent-shaped process with 2 small ones distal to it (these less well developed in female), the palm lined with short setae, not denticulate, with article 7 as long as article 6, stout, lined on inner edge with short setae; telson with 3 lateral spines on each side; back not carinate; second article of ramus on uropod 3 straight, not geniculate, the peduncle slightly longer than ramus; fourth articles of peraeopods 3-5 of intermediate expansion.

HOLOTYPE: AHF No. 587, male, 3.6 mm.

TYPE LOCALITY: Station 5632, off San Mateo Pt., 33-22-50 N, 117-39-00 W, 36 fms. February 22, 1958.

MATERIAL: 23 specimens from 6 stations.

ECOLOGY: This species has an overall density of 0.3 animals per square meter on the coastal shelf, but is confined to depths of 35-50 fathoms where its frequency is 0.8 animals per square meter.

RELATIONSHIP: This species is related to *Stenothoe valida* Dana (see J. L. Barnard 1953) but differs by the distal palmar teeth of gnathopod 2 projecting perpendicularly to the palmar axis rather than obliquely from it. It differs from *S. marina* (Bate) (see Sars 1895: pl. 80) by the terminally stout finger of the gnathopods and by the greater similarity between male and female second gnathopods, as well as the non-denticulate condition of the palms.

Family ARGISSIDAE

Genus Argissa Boeck

Argissa hamatipes (Norman)

Argissa typica Boeck, Sars 1895: 141-142, pl. 48.
Argissa hamatipes, Walker 1904: 246; Stebbing 1906: 277; Shoemaker 1930: 37-40, figs. 15-16; Stephensen 1931: 261; Stephensen 1935: 140; Stephensen 1940: 41; Stephensen 1944: 52; Gurjanova 1951: 327-328, fig. 193.

MATERIAL EXAMINED: 307 specimens from 99 stations.

ECOLOGY: This is the first eastern Pacific record. The species has an overall density of 2.4 specimens per square meter on the coastal shelf. Considering its past records of occurrence in relatively deep cold temperate waters it is strange that the species is predominatntly shallow in southern California. The following table shows the density per square meter in several depth classes:

Depth class, fms.	10	20	30	40	50	100
Density/sq. m.	11.2	5.7	1.7	1.6	0.5	1.1

DISTRIBUTION: North Atlantic in Gulf of St. Lawrence; Kattegat and northern Britain north to Kola Bay; Greenland; Chuckchi, Bering, Okhotsk and Japan Seas; California; 4-1096 m.

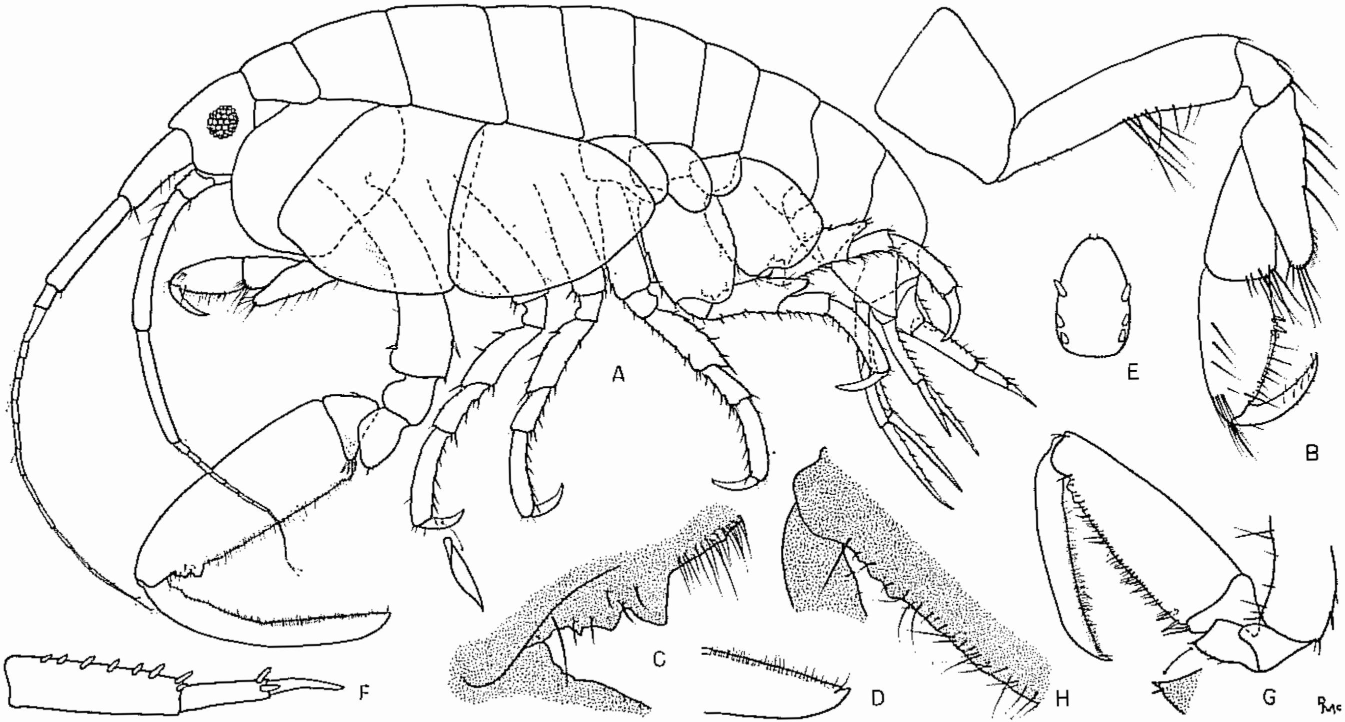


Fig. 18. *Stenothoe frecanda*, n. sp. Male, 4.0 mm, sta. 6001: A, lateral view; B, gnathopod 1; C, palmar teeth of gnathopod 2; D, apex of article 7 of gnathopod 2; E, telson; F, uropod 3. Female, 4.0 mm, sta. 4935: G, gnathopod 2; H, palmar teeth of gnathopod 2.

Family HYALIDAE

Bulycheva (1957) split this family and the Hyalellidae away from the Talitridae but did not firmly assign all of the talitrid genera to the three resulting families, as noted by J. L. Barnard (1958). She continued the fusion of *Parhyale* and *Parallorchestes* made by Gurjanova (1951), although the type of *Parallorchestes* (*P. ochotensis*) clearly bears a biarticulate first maxillary palp in contrast to the uniarticulate palp of *Parhyale*.

The family Hyalidae differs from the Talitridae, according to Bulycheva, by the uniarticulate first maxillary palp and other rather quantitative features involving first antennae, maxillipeds, branchiae and habitat. Clearly *Parallorchestes* transcends Hyalidae and Talitridae by its coincidental possession of a biarticulate first maxillary palp and a long, unguiform fourth maxillipedal palp article. It is clearly related to *Parhyale* and Hyalidae, however, in all other features except for the first maxillary palp. Unfortunately, the use of such a character as a primary point of segregation is weak when some genera lack such a palp altogether. Other students of the Talitridae have not yet published confirmation or rebuttal of Bulycheva's ideas, so the writer continues to use Bulycheva's familial designation but believes *Parallorchestes* should be segregated from *Parhyale*. As such, *Parallorchestes* is monotypic, since *Parhyale zibillina* Derzhavin has a uniarticulate first maxillary palp (see Bulycheva 1957), although Shoemaker (1956) believed it possible that *P. zibillina* was a *Parallorchestes*.

Genus Hyale Rathke

Hyale nigra (Haswell), new synonymy

Figs. 19, 20

Allorchestes niger Haswell 1879: 319-320; Haswell 1885: 96, pl. 11, figs. 1-3.
Hyale niger, Stebbing 1906: 571; Schellenberg 1928: 659-661, fig. 204; K. H. Barnard 1937: 162-163; Ruffo 1938: 170.
Allorchestes frequens Stout 1913: 650-651.
Hyale frequens, Shoemaker 1944: 187; Shoemaker 1942: 17; Hewatt 1946: 199; J. L. Barnard 1952: 23; J. L. Barnard 1954: 23.

DIAGNOSIS OF MALE: Body not carinate; antenna 2 about half as long as body, slender, not heavily setose; antenna 1 exceeding peduncle of antenna 2; gnathopod 1 with article 5 showing the posterior lobe moderately well defined and projecting, more so than described by Schellenberg (1928), with article 6 rectangular, elongated, not expanding distally, the hind edge with slight declivity armed with setae, the palm oblique and scarcely distinct but defined by a pair of stout spines, with article 7 short, stout; gnathopod 2 with article 2 bearing a large, rounded distal lobe, its article 3 with large anterior lobe, its article 6 large, less than twice as long as broad, the palm oblique, shorter than hind margin of article 6, lined with spines, not defined by a spine, the hind margin of article 6 with 2 small declivities, with article 7 stout, fitting palm; peracopods lacking a distinctly large serrated distal spine on article 6, the hind

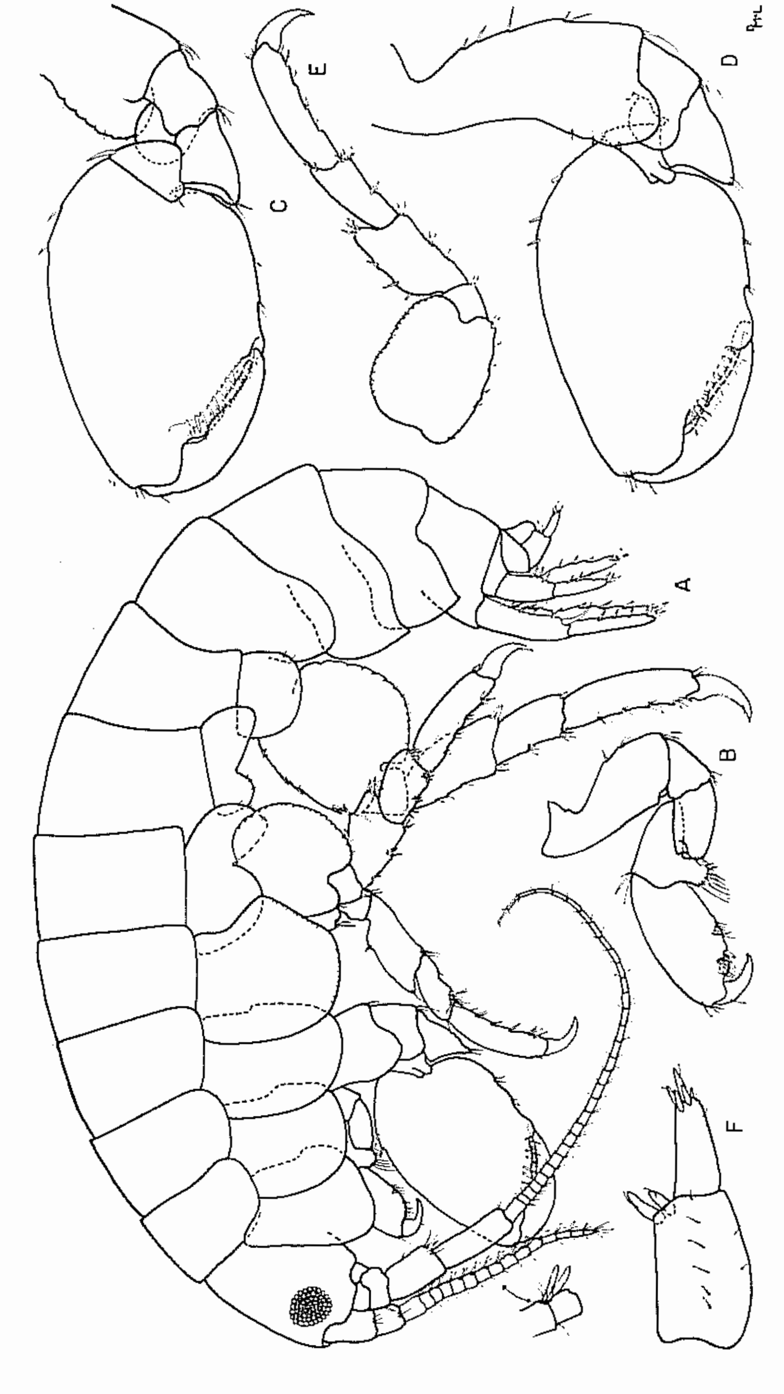


Fig. 19. *Hyale nigra* (Haswell). Male, 9 mm, Barnard sta. 32: A, lateral view; B, gnathopod 1; C,D, gnathopod 2; E, peraeopod 4; F, uropod 3.

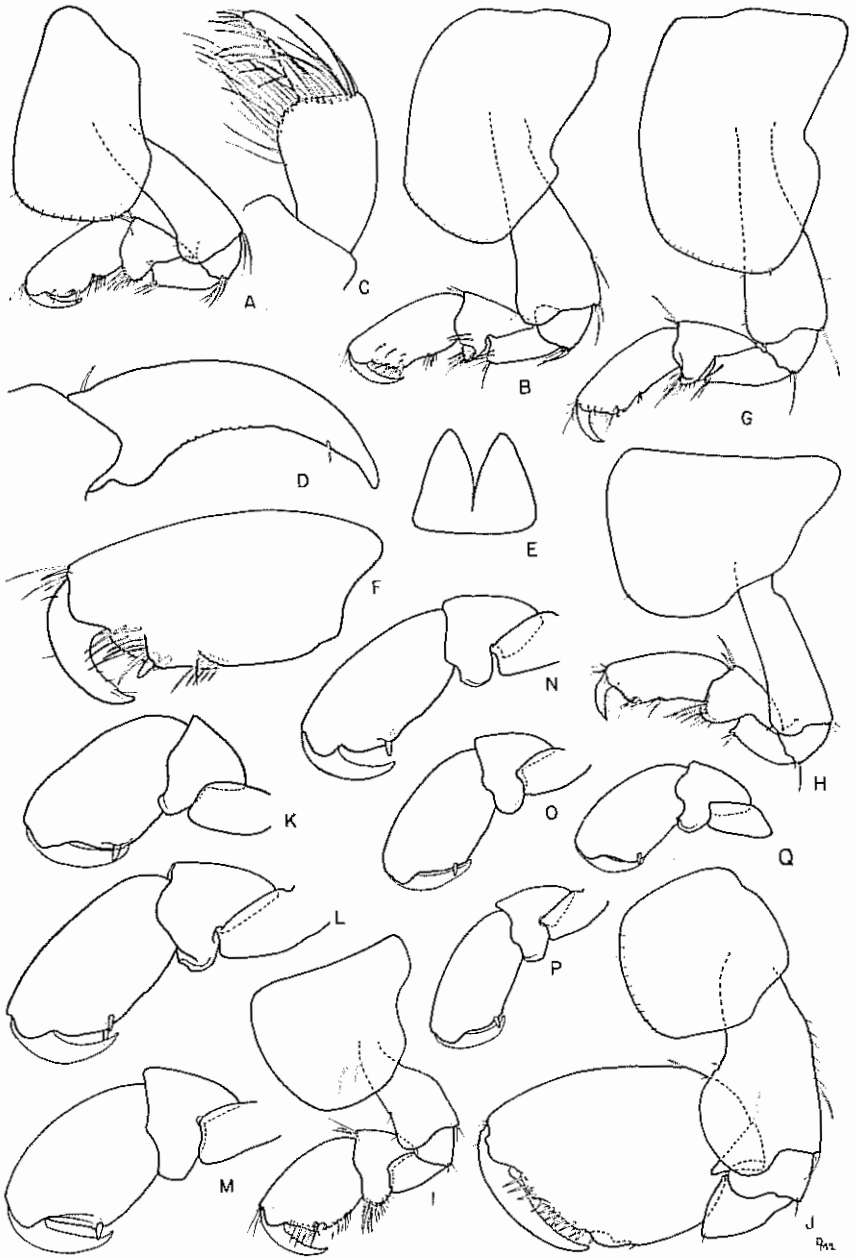


Fig. 20. *Hyale nigra* (Haswell). Female, 7 mm, Barnard sta. 32: A,B, gnathopods 1, 2. Male, 9 mm: C, end of maxillipedal palp; D, dactyl of peraeopod 5; E, telson; F, end of gnathopod 1. Female, 4 mm, Barnard sta. 24: G,H, gnathopods 2, 1. Male, 5 mm, Barnard sta. 24: I,J, gnathopods 1, 2. K,L,M,N,O,P,Q, gnathopod 1 of various males from southern California.

edges of sixth articles on peraeopods 3-5 lacking setae; dactyls very minutely pectinate on inner edges and bearing a minute distal seta; article 4 of maxillipedal palp with short, not long apical setae. Length 9.0 mm.

FEMALE: Gnathopods 1-2 like first gnathopod of male, but sixth articles more slender, the posterior declivity less setose.

REMARKS: The identification is based on Schellenberg's figures and description of the species; he compared his Red Sea specimens with some from Australia, the type area of the species. Except for the slightly better defined hind lobe of article 5 on gnathopod 1 the present specimens correspond well with Schellenberg's study.

This is the first record of this species from the eastern Pacific Ocean.

VARIANTS: In southern California some sexually mature male specimens of 4-5 mm length, mixed with specimens as described above, have the sixth article of the first gnathopod much stouter with a longer palm and longer seventh article (fig. 20 I). The hand of the second gnathopod also is stouter, shorter, and bears only one posterior declivity. The writer is inclined to believe that these are phenotypes since intermediacy can be seen in the stoutness of this article (Figs. 20 K-Q). When comparing microscopically other features of animals from the two populations there is good correspondence in all minor details, such as lengths of antennae, shapes of segments on appendages and uropods, and minute details of spination. I believe that Stout's description of *Allorchestes frequens* applies to the form bearing a slender first gnathopod, so that if breeding studies show the stout form to be a race of the species it will require a new name. The temporary acceptance of the stout form as a variety of *H. nigra* may well have systematic consequences on other species of *Hyale* since the shape of the sixth article of the first gnathopod is supposed to remain relatively uniform. The palm of gnathopod 2 in both stout and slender forms has near the finger hinge a small flat process which is scarcely distinguishable; in preserved specimens it appears distinctly pigmented with yellow-ochre and so is more conspicuous than as drawn herein.

MATERIAL: 2200 specimens from 26 intertidal samples, ranging from Dillon Beach (Marin County, central California) to La Jolla, California, and points in between such as Morro Bay (open coast), Pt. Fermin, Corona del Mar and Laguna Beach; particularly abundant on *Phyllospadix* roots, *Egregia* and coralline algae, and also collected from the sponge *Leucetta losangelensis*. Collectors: J. L. Mohr, R. J. Menzies, E. Y. Dawson and the writer in the years 1947 to 1960.

Also collected from 2 subtidal samples in southern California in depths of 12-20 feet (2 specimens).

DISTRIBUTION: Australia; Arabian Sea; Red Sea; Mediterranean; California.

Genus Najna Derzhavin

Najna ?consiliorum Derzhavin

Figs. 21, 22

Derzhavin 1937: 97, pl. 6, fig. 2 (not seen); Gurjanova 1951: 826-827, fig. 578.

REMARKS: I have figured this species completely because of discrepancies between the specimens at hand and the figures and description of Gurjanova (1951), the only reference I have to this species. These discrepancies are the shorter fourth palp article of the maxilliped, the shorter

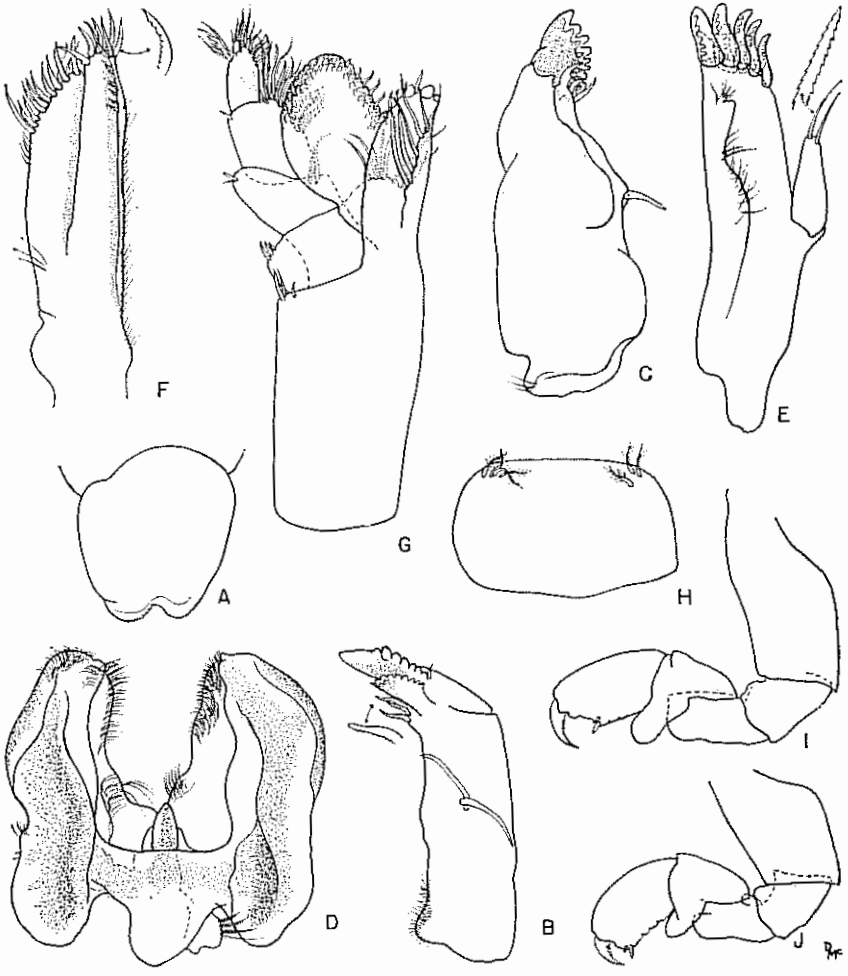


Fig. 21. *Najna ?consiliorum* Darzhavin. Male, 8 mm, sta. 4822: A, upper lip; B,C, mandibles; D, lower lip; E,F, maxillae 1, 2; G, maxilliped; H, telson; I,J, gnathopods 1, 2, minus setae.

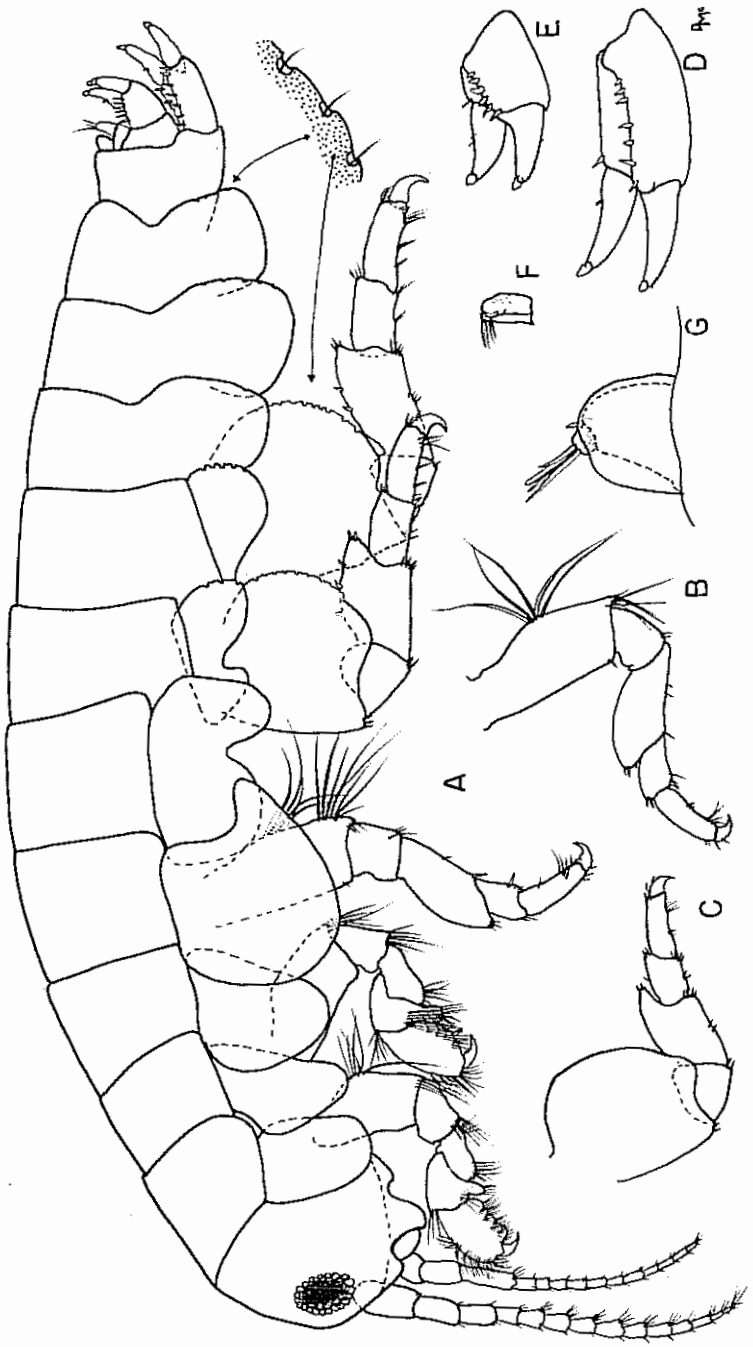


Fig. 22. *Najna consiliorum* Derzhavin. Male, 8 mm, sta. 4822: A, lateral view; B,C, peracopods 1, 3; D,E,F,G, uropods 1, 2, 3, 3.

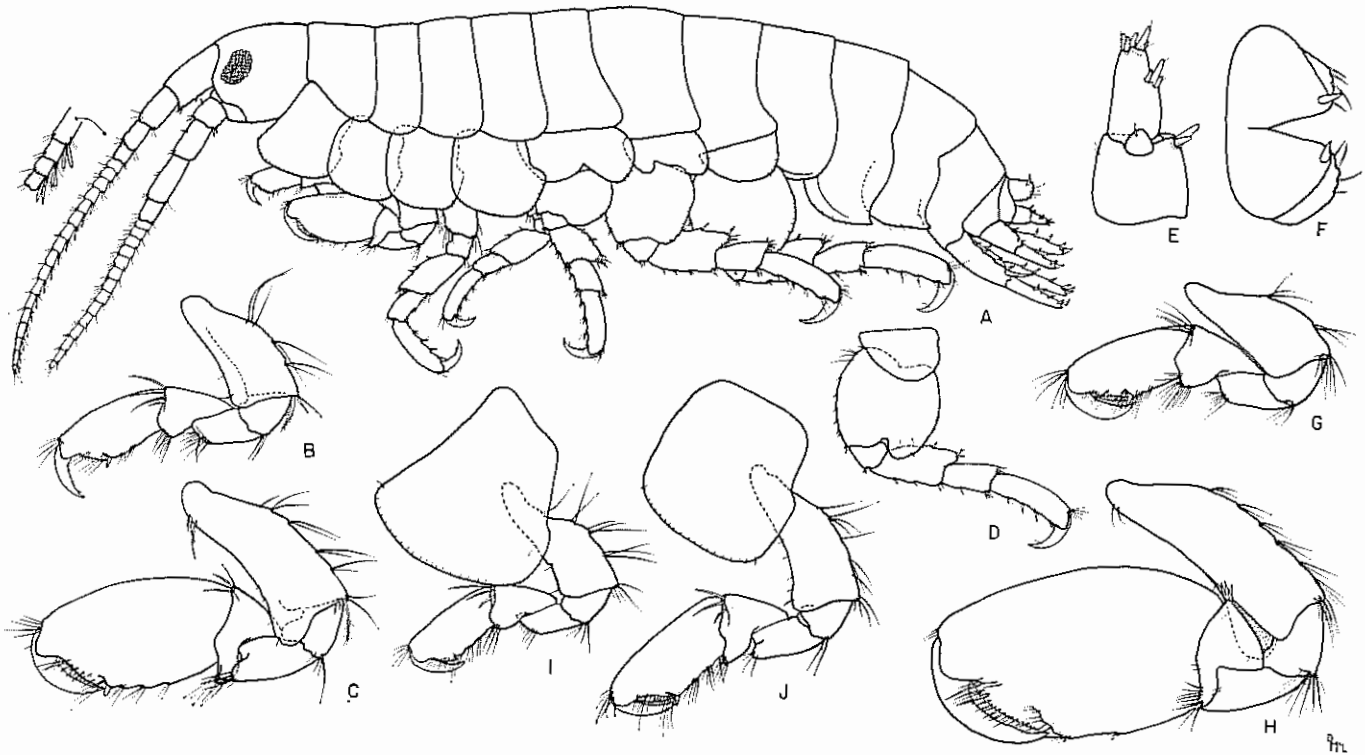


Fig. 23. *Parallorchestes ochotensis* (Brandt). Young male, 7.8 mm, Barnard sta. 12: A, lateral view; B,C, gnathopods 1, 2; D, peraeopod 5; E, uropod 3; F, telson. Male, 12 mm: G,H, gnathopods 1, 2. Female, 8 mm: I,J, gnathopods 1, 2.

third uropod (as attached to the animal, the only drawing of the third uropod being attached to the animal in Gurjanova's figure) and the different shaped inner plate of the maxilliped, which may simply be a difference of mounting technique. In Gurjanova's two figures of the maxilliped the inner plate is conical from two views, but in the present specimens it is a narrow, rectangular plate surmounted by three stout spine-teeth. It is so stiffly attached to the rest of the maxilliped it often lies with its conical aspect toward the viewer.

The third uropod is composed of a small, short peduncle with a minute scale-like ramus, whereas Gurjanova figured and described the ramus as being half as long as the peduncle.

MATERIAL: 5 specimens from 4 stations.

ECOLOGY: This species is limited to algal bottoms shallower than 10 fathoms and is quite rare in southern California.

Genus Parallorchestes Shoemaker

DIAGNOSIS: A genus either of Hyalidae or Talitridae with biarticulate first maxillary palp and long unguiform fourth palp article on the maxilliped; uropod 3 with well developed outer ramus and a small scale-like inner ramus; fifth article of male gnathopod 2 with posterior lobe separating articles 4 and 6; telson bilobed; gnathopod 1 subchelate, gnathopod 2 large, subchelate in male.

Parallorchestes ochotensis (Brandt)

Fig. 23

Allorchestes ochotensis Brandt, Holmes 1904: 233-234, fig. 118.
Parallorchestes ochotensis (Brandt), Shoemaker 1941: 184-185; J. L. Barnard 1952: 23-24, pl. 5, fig. 1; J. L. Barnard 1954: 24.
Parhyale ochotensis (Brandt), Gurjanova 1951: 814-815, fig. 568; Buycheva 1957: 82-83, fig. 28.
Parhyale kurilensis Iwasa 1934: 1-7, pls. 1-2, text fig. 1; Iwasa 1939: 284-285.

REMARKS: In cold northern waters this species reaches a length of 43 mm, and the pleon segments become rather enlarged dorsally. In southern California the species reaches a length of about 13 mm. Since Iwasa's figures (repeated by Gurjanova and Bulycheva) are not typical of southern Californian specimens I have redrawn the species for clarification of local workers.

MATERIAL: Intertidal of southern California, 4 samples.

DISTRIBUTION: Okhotsk Sea, Kuriles, Alaska; Pacific Coast of America south to southern California.

Literature Cited

Barnard, J. L.

1952. Some Amphipoda from Central California. Wasmann Jour. Biol. 10 (1): 9-36, 9 pls.

1953. On two new amphipod records from Los Angeles Harbor. So. Calif. Acad. Sci. Bull. 52 (3): 83-87, 15 pls.

1954. Marine Amphipoda of Oregon. Oregon State Monogs., Studies in Zool. 8: 1-103, 33 pls., 1 fig.

1958. Index to the families, genera, and species of the gammaridean Amphipoda (Crustacea). Allan Hancock Found. Publs., Occ. Pap. 19: 1-145.

1959. Estuarine Amphipoda, in: Ecology of Amphipoda and Polychaeta of Newport Bay, California. Allan Hancock Found. Publs. Occ. Pap. 21: 1-106, pls. 1-14.

Barnard, J. L. and R. R. Given

1960. Common pleustid amphipods of southern California, with a projected revision of the family. Pac. Nat. 1 (17): 37-48, 6 figs.

Barnard, K. H.

1916. Contributions to the crustacean fauna of South Africa. 5.—The Amphipoda. Ann. So. African Mus. 15 (3): 105-302, pls. 26-28.

1932. Amphipoda. Discovery Repts. 5: 1-326, 1 pl., 174 figs.

1937. Amphipoda. John Murray Exped. 1933-34, Sci. Repts. Brit. Mus. (Nat. Hist.) 4 (6): 131-201, 21 figs.

Bonnier, J.

1896. Edriophthalmes. Rés. Sci. Campagne du "Caudan" dans le Golfe de Gascogne. Ann. Univ. Lyon 26 (3): 527-689, pls. 28-40.

Bulycheva, A. I.

1957. Morskie bloxi morei SSSR i sopredel'nyx vod (Amphipoda-Talitroidea). Akad. Nauk SSSR, Opred. po Faune SSSR 65: 1-185, 66 figs.

Chevreux, Ed.

1900. Amphipodes provenant des campagnes de *l'Hirondelle* (1885-1888). Res. Camp. Sci. Albert Ier, Monaco 16: I-IV, 1-195, pls. 1-18.

1912. Amphipodes. Deuxième Expédition Antarctique Française (1908-1910) commandée par le Dr. Jean Charcot. Sci. Nat: Doc. Sci., 79-186, 62 figs.

Chevreux, E. and L. Fage

1925. Amphipodes. Faune de France 9: 1-488, 438 figs.

Enequist, P.

1950. Studies on the soft-bottom amphipods of the Skagerak. Zool. Bidrag från Uppsala 28: 297-492, 67 figs., 6 charts.

Gurjanova, E.

1938. Amphipoda, Gammaroidea of Siaukhu Bay and Sudzukhe Bay (Japan Sea). Reports of the Japan Sea Hydrobiological Exped. of the Zool. Inst. of the Acad. of Sci. USSR in 1934 (1): 241-404, 59 figs.

1948. Amphipoda Tixogo Okeana II. Stenothoidae dal'nevostochnyx morei. Notebooks of the Academician Sergei Alekseyich Zernov (Hydrobiologist), pp. 287-325, 21 figs.

1951. Bokoplavy morei SSSR i sopredel 'nyx vod (Amphipoda-Gammaridea). Opred. po Faune SSSR, Izd. Zool. Inst. Akad. Nauk 41: 1-1031, 705 figs.

1953. Novye dopolnenija k dal'nevostochnoi faune morskix bokoplavov. Trudy Zool. Inst. Akad. Nauk SSSB 12: 216-241, 19 figs.

1955. Novye vidy bokoplavov (Amphipoda, Gammaridea) iz severnoi chasti Tixogo Okeana. Trudy Zool. Inst. Akad. Nauk SSSR 18: 166-218, 23 figs.

Haswell, W. A.
1879. On some additional new genera and species of amphipodous crustaceans. Proc. Linn. Soc. New South Wales 4 (3): 319-350, pls. 18-24.
1885. Notes on the Australian Amphipoda. Proc. Linn. Soc. New South Wales 10 (1): 95-114, pls. 10-18.

Hewatt, W. G.
1946. Marine ecological studies on Santa Cruz Island, California. Ecol. Monog. 16: 185-210, 2 figs.

Holmes, S. J.
1904. Amphipod crustaceans of the expedition. Harriman Alaska Exped.: 233-246, figs. 118-128.
1905. The Amphipoda of southern New England. Bull. Bur. Fisheries 24: 459-529, 13 pls., numerous figs.
1908. The Amphipoda collected by the U.S. Bureau of Fisheries Steamer "Albatross", off the west coast of North America, in 1903 and 1904, with descriptions of a new family and several new genera and species. Proc. U.S. Nat. Mus. 35: 489-543, 46 figs.

Hurley, D. E.
1955. Studies on the New Zealand amphipodan fauna No. 12. The marine families Stegocephalidae and Amphilochidae. Trans. Roy. Soc. N.Z. 83 (1): 195-221, 9 figs.

Iwasa, M.
1934. A new amphipod (*Parhyale kurilensis*, n. sp.) from Urup. Jour. Fac. Sci. Hokkaido Imp. Univ. (6) Zool. 3 (1): 1-7, 2 pls., 1 fig.
1939. Japanese Talitridae. Jour. Fac. Sci. Hokkaido Imp. Univ. (6) Zool. 6 (4): 255-296, 27 figs., 1 table, pls. 9-22.

Ruffo, S.
1938. Studi sui Crostacei Anfipodi IX Gli Anfipodi marini del Museo Civico di Storia Naturale di Genova b) Gli Anfipodi del Mar Rosso. Ann. Mus. Civ. Stor. Nat. 60: 152-180, 5 figs.

Sars, G. O.
1895. Amphipoda. An account of the Crustacea of Norway with short descriptions and figures of all the species, 1: VIII and 711 pp., 240 pls., 8 suppl. pls.

Schellenberg, A.
1925. Crustacea VIII: Amphipoda. *in* W. Michaelsen. Beiträge zur Kenntnis der Meeresfauna Westafrikas 3 (4): 111-204, 27 figs.
1926. Die Gammariden der deutschen Südpolar Exped. 1901-1903. Deutschen Südpolar Exped. 18: 235-414, 68 figs.
1928. Report on the Amphipoda. Zool. Res. Cambridge Exped. Suez Canal, 1924. Trans. Zool. Soc. London 22 (35): 633-692, figs. 198-209.
1938. Litorale Amphipoden des tropischen Pazifiks. Kgl. Svenska Vetensks.-Akad. Handl. III 16 (6): 1-105, 48 figs.

Shoemaker, C. R.
1930. The Amphipoda of the Cheticamp Expedition of 1917. Cont. Canad. Biol. Fish. 5 (10): 221-359, 54 figs.
1933. Two new genera and six new species of Amphipoda from Tortugas. Carn. Inst. Wash., Pap. Tortugas Lab. 28: 245-256, 8 figs.
1941. On the names of certain California amphipods. Proc. Biol. Soc. Wash. 54: 187-188.
1942. Amphipod crustaceans collected on the Presidential Cruise of 1938. Smithson. Misc. Coll. 101 (11): 1-52, 17 figs.
1949. Three new species and one new variety of amphipods from the Bay of Fundy. Jour. Wash. Acad. Sci. 39 (12): 389-398, 5 figs.
1955. Amphipoda collected at the Artic Laboratory, Office of Naval Research, Point Barrow, Alaska, by G. E. MacGinitie. Smithson. Misc. Colls. 128 (1): 1-78, 20 figs.
1956. Observations on the amphipod genus Parhyale. Proc. U.S. Nat. Mus. 106: 345-358, 4 figs.

Stebbing, T. R. R.
1888. Report on the Amphipoda collected by H.M.S. Challenger during the years 1873-76. *In* Great Britain. Report on the Scientific Results of the Voyage of H.M.S. Challenger during the years 1873-76. Zool. 29.
1906. Amphipoda I. Gammaridea. Das Tierreich 21: 1-806, 127 figs.

Stephensen, K.
1931. Crustacea Malacostraca. VII. (Amphipoda. III). Danish Ingolf-Exped. 3 (11): 179-290, 38 figs., 20 charts.
1935. The Amphipoda of N. Norway and Spitsbergen with adjacent waters. Tromso Mus. Skrifter 3 (1): 1-140, figs. 1-19, 2 charts.
1940. Marine Amphipoda. Zool. Iceland 3 (26): 1-111, 13 figs.
1944. Amphipoda. The Zool. of East Greenland. Medd. om Grønland 121 (14): 1-165, 18 figs.

Stout, V. R.
1912. Studies in Laguna Amphipoda. Laguna Mar. Lab., First Ann. Rept.: 134-149, figs. 74-84.
1913. Studies in Laguna Amphipoda. Zool. Jahrb., Syst. 34 (5/6): 633-659, 3 figs.

Walker, A. O.
1904. Report on the Amphipoda collected by Professor Herdman, at Ceylon, in 1902. Ceylon Pearl Oyster Fisheries, Suppl. Rept. 1904. 17: 229-300, 8 pls.