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Studies in Laguna Beach *Isopoda*, II

BLANCHE E. STAFFORD, M.S.

Nearly everyone who frequents the seashore and is half alive to the many opportunities which the water, rocks and sand offer in a study of the manifestations of life which they can reveal, has become acquainted with the form and habits of such crustaceans as the lobsters, crabs and shrimps. There are very few, also, who do not know the lively little sand-fleas which populate so thickly the sandy beach. Not many realize, however, that these latter are relations of the big lobster and crab, as they are, and that they are of myriad forms and habits; that they live not alone in the sand, but in the shallow pools, under rocks, on the sea mosses and in the deep waters. But still less do they know of the Isopoda, the near neighbors of the sand fleas, or Amphipoda. It is with certain Isopoda, relatives of the lobster and crab and sand-flea, that this paper deals. The reason we know so little, as casual observers, of these little creatures is that they are very secretive and love to hide themselves in obscure places; their characteristic manner of crawling, instead of hopping as do the Amphipoda, makes them less conspicuous than the latter. But they are in reality very numerous and most interesting in the variety of forms they exhibit. To know them one has only to catch them at the proper time and place and to ferret them out of their retreats. Frequent the beach at a time when the tide is fast advancing and you will see along the line left by the receding water whole hosts of these little crawlers, scurrying out of their holes for the high and dry sands. Go in the very early morning when the tide is at its lowest mark to the mossy rocks which lie uncovered then. As you turn them over one by one you will find many interesting things, among them numbers of amphipods that slide around on their sides, and a great plenty of very active isopods. You may gather some of the moss on the rocks and with the help of a hand lens find that it is peopled with minuter forms which you cannot see without this careful scrutiny. And

there are still many other places in which some one or another of this isopod group dwells. Some are securely fortified within the minute chambers of the sponges; some are tube builders or excavators; some have sought the crevices of the big dry rocks where they neighbor with the shore crabs; and some are even fond of the muddy shore of a stagnant lagoon; still others inhabit the gill chambers of fish or crabs, living a parasitic and degenerate life. Though many of the Isopoda are marine there are also many terrestrial and fresh-water forms, the former known to most of us by their representative, the common sow-bug, or wood-louse, or pill-bug, as it is variously called.

Not less interesting than the numbers and habitat of these animals is their diversity in color and form as adapted to their environment. Those inhabiting the sandy and rocky places are provided with a chitinous crusty structure and are colored a dull gray or brown which favors well their characteristic love for obscurity. Those which dwell in the pools or on the moss are more delicate and are provided with special swimming organs. On the green Algæ there are elongated isopods, green in color and hardly distinguishable from the moss on which they occur, and similarly brown forms on the brown Algæ. A most interesting instance of these color adaptations which I observed in my study at Laguna Beach was that of an isopod which dwells on the oral surface of a sea urchin; it was a dark reddish-purple in color, so very like that of its host that one could scarcely distinguish it when at rest. Much might be said of the diversity and beauty of color of the marine Isopoda, but that is a study in itself.

It appears that the Isopoda and Amphipoda are somewhat closely related, since both can be grouped under the more limited division, Arthrostraca. They differ from each other as follows: the Isopoda are dorso-ventrally flattened, the Amphipoda laterally compressed. There are other differences such as modified second and third thoracic appendages and a differentiation of abdominal segments into two sets in the Amphipoda. A common and popular distinction is the crawl-

ing habit of the isopod and the hopping habit of the Amphipoda. Such a distinction is not entirely valid however, since neither of these characteristics is common to all the forms of either group.

The Isopoda body is differentiated into: (1), a head having sessile, usually compound eyes which may be contiguous or distant; antennæ of two pairs, generally; a set of delicate mouth parts, consisting of an upper and lower lip, two pairs of maxillæ, a pair of mandibles and a pair of maxillipeds; (2), a thorax of seven segments of similar structure, each bearing a pair of legs; the legs are often similar, a characteristic which led Latreille to name them Isopoda from two Greek words meaning "equal" and "foot". Latreille, however, was not acquainted with the many exceptional forms such as the modified first leg for grasping purposes or the posterior swimming legs found in some species; (3), an abdomen consisting usually of six segments, five of which bear pleopods (respiratory and natatory organs); the sixth with a pair of uropoda (natatory organs). The Isopoda do not develop through a series of larval stages but through direct development. The females are provided with marsupial plates which form a brood pouch in the sexually mature individual.

After a careful study of the complicated and finely adjusted structure of these creatures one must have gained a great respect for them and for the complete and perfect results which nature has here effected. Add to this study a knowledge of the actual service rendered by the Isopoda in the economy of nature and one's interest in them will be increasingly greater. Have you ever stopped to consider how very rich in life the sea is, with its multitudes of marine plants and animals? Have you further considered how many of these forms are constantly being destroyed in one way or another and subject to the processes of decay? If so, you have often wondered how the sea is kept ever sweet and pure. For a solution, in part, of this question I would ask you to turn to the isopods and their associates, the amphipods. These small animals, many of them almost microscopic in size, are the scavengers of the waters and it

is their service to remove the waste of ocean life. The latter are free swimmers and in their wanderings scour the surface of the waters. The former usually remain close in their native haunts and it is they who purify the substrata of the sea. Not here does their service end. So abundant are they that they form a part of the food of many fish and thus they are indirectly food providers for men. To these ends the Isopoda are very widely distributed. They are most abundant in the northern waters. Thence they extend in varying numbers to the warm southern waters and the temperate shores and from east to west. So great is their importance that we dare not speculate as to the state of unstable equilibrium in nature which their sudden and thorough destruction would cause. Suffice it to say, that at present no such calamity is pending, for the isopods are a mighty throng and well equipped by nature to survive.

In the studies which follow I have described and illustrated twelve species collected at Laguna Beach, California, in the summer of 1911. One of these is a new species, two are new varieties. A number of the others, although noted before, have not been illustrated at all before or if so not at all completely.

LIST OF THE SPECIES REPRESENTED IN THIS STUDY

Superfamily FLABELLIFERA

A. Family CIROLANIDÆ

Genus *Cirolana*

Cirolana harfordi (Lockington)

B. Family SPHÆROMIDÆ

Genus *Dynamene*

Dynamene glabra Richardson

Superfamily VALVIFERA

A. Family IDOTHEIDÆ

a. Genus *Idothea*

Idothea rectilinea (Lockington)

b. Genus *Pentidotea*

Pentidotea aculeatus n. sp.

Superfamily ASELLOTA

B. Family JANIRIDÆ

a. Genus *Janira*

Janira occidentalis Walker

Superfamily ONISCOIDEA

A. Family TYLIDÆ

a. Genus *Tylos*

Tylos punctatus Holmes and Gay

B. Family ONISCIDÆ

a. Genus *Alloniscus*

Alloniscus cornutus var. *lagunae* n. var.

Alloniscus perconvexus (Dana)

b. Genus *Philoscia*

Philoscia richardsonae Holmes and Gay

Cirolana harfordi (Lockington)

(Figs. 1, 2, and 3)

Locality—Very abundant under rocks between tides, at Laguna Beach, California.

Color—Great variation, some white with gray markings, some shaded with yellow or orange; females bearing eggs often show a bright red coloration; in alcohol the specimens always appear to be a sordid white marked with gray.

Body ovate, arched transversely and longitudinally. Specimen described measures 7 mm. by 3 mm. Head wider than long, 2 mm. by 1 mm.; rounded on anterior margin. Eyes small, composite, situated laterally and touch anterior margin of first thoracic segment. First pair of antennæ have a peduncle of three articles of which the first and second are small and subequal; third almost as long as first and second and narrower; flagellum of ten articles. Second pair of antennæ have a peduncle of five articles: first three small and subequal;

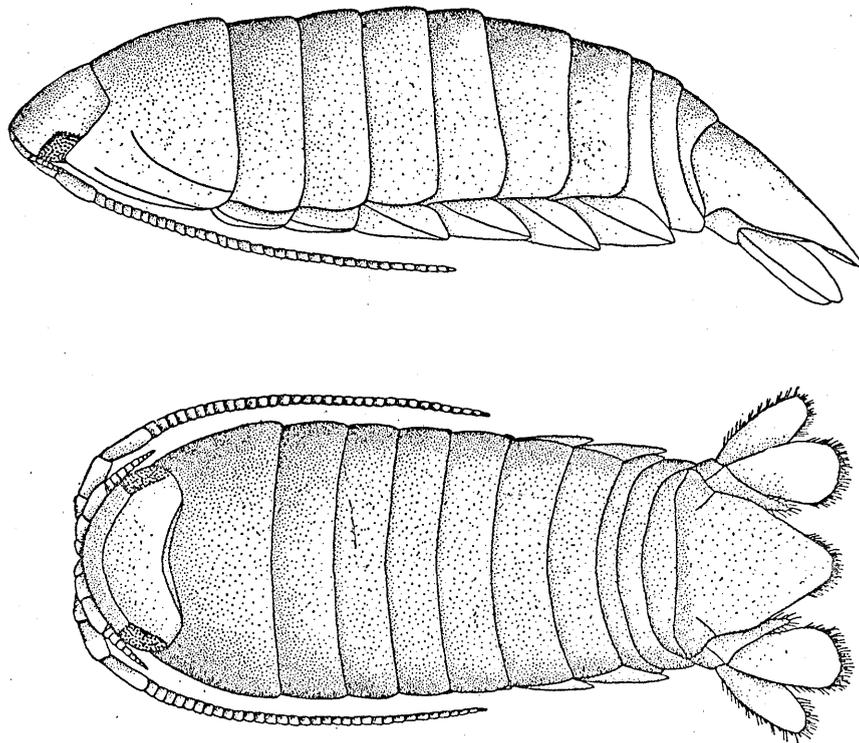


Figure 1. *Cirolana harfordi* (Lockington). Lateral and dorsal views.

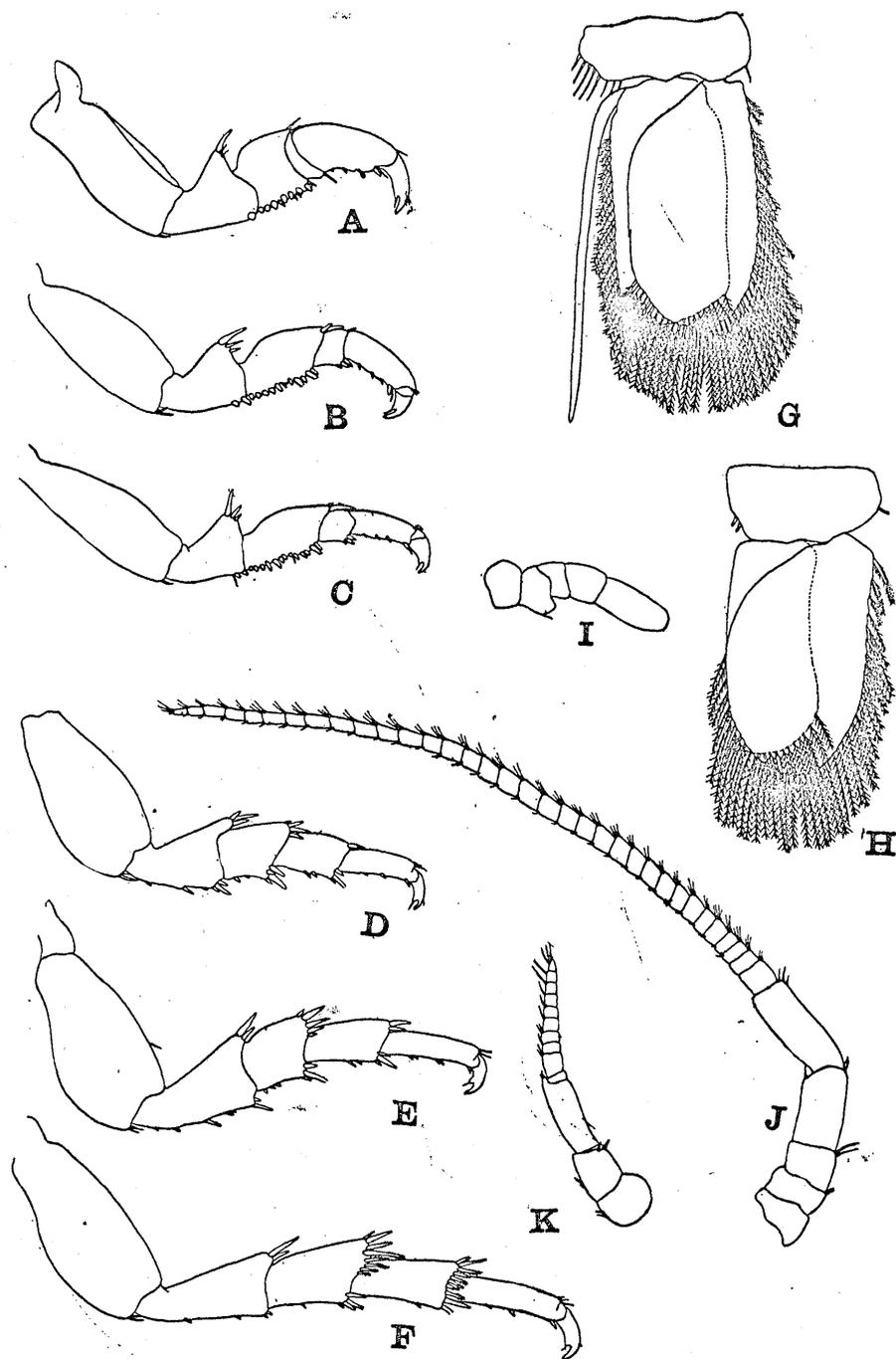


Figure 2. *Cirolana harfordi* (Lockington). A, first leg; B, second leg; C, third leg; D, fourth leg; E, fifth leg; F, seventh leg; G, second pleopod of male; H, first pleopod of male; I, frontal lamina and basal joints of antennæ; J, second antennæ; K, first antennæ.

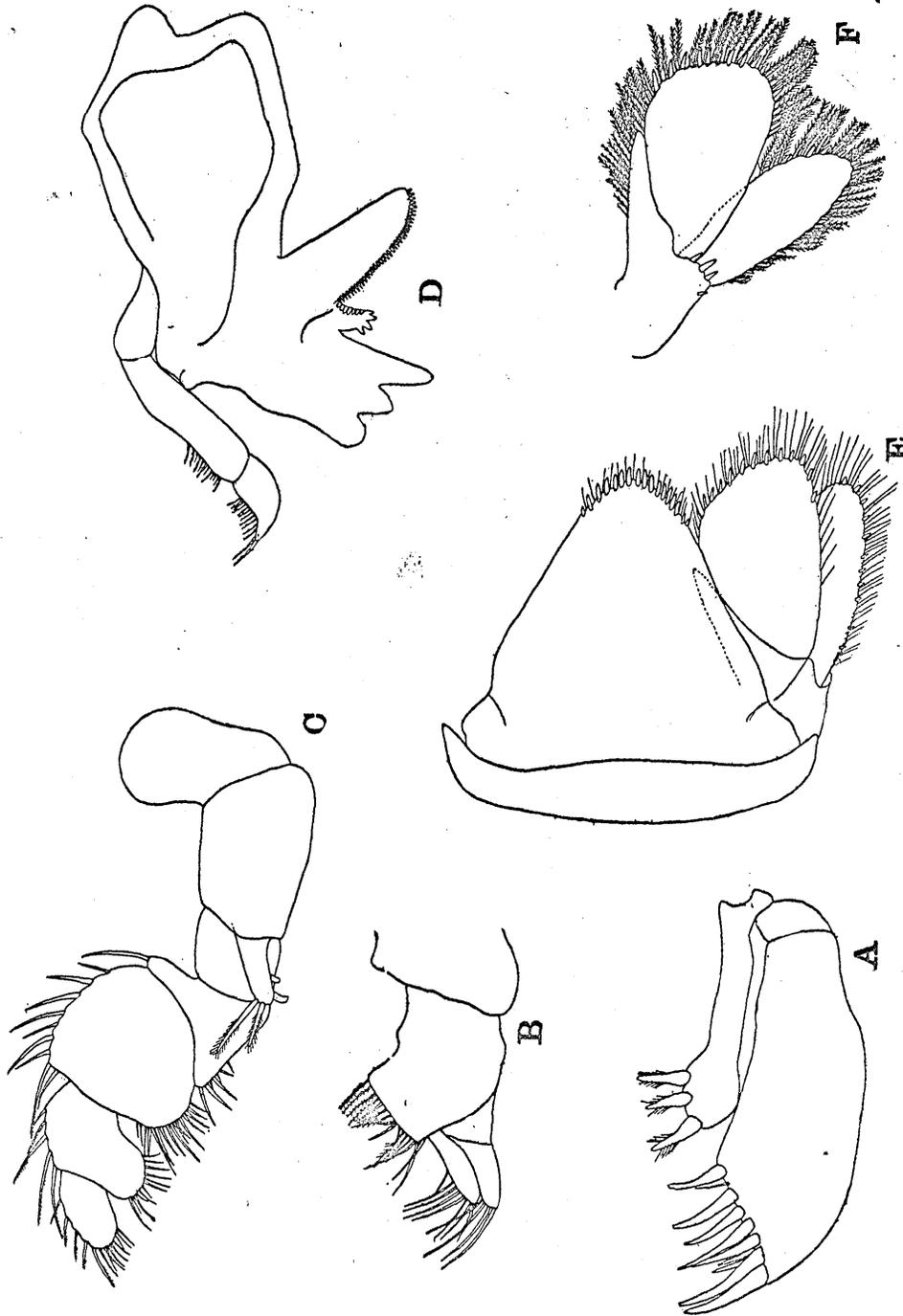


Figure 3. *Cirolana harfordi* (Lockington). A, first maxilla; B, second maxilla; C, maxilliped; D, mandible; E, telson; F, uropod.

fourth about twice as long as wide, about as long as second and third; fifth about one-fourth longer than fourth; flagellum multiculate, thirty-four articles. First antennæ extend to end of peduncle of second antennæ; the latter extend to end of fifth thoracic segment. Maxilliped composed of seven articles; the last four very plumose; third is provided with two hoops or blunt spines. Mandible carries a palp of three articles and a toothed molar. Frontal lamina, distinct, short and broad, anterior margin triangulate though not sharply so.

First segment of thorax large, twice as long as third and fourth segments. Succeeding segments almost equal in length, though second is very slightly longer than third and fourth. Epimera are very distinct on all but first segment. Last four are produced at post-lateral angles especially the sixth and seventh. A carina is apparent on all the epimera, longitudinal in the first two and oblique in the last four. First three legs prehensile, remaining ambulatory. On propodus of first there are three prominent spines; one on the carpus; on the merus seven prominent blunt spines and about three sharp ones; ischium has one blunt spine like those of the merus, also a large spine on the outer distal margin. Second leg has three or four spines on the propodus; three on the carpus; eleven blunt spines on the merus and two spines on outer distal margin; ischium has two blunt spines, one large and two small ones on outer distal margin. Ambulatory legs provided with many robust spines.

Abdomen in the specimen described shows only three segments, four or five may be visible, however, but first is usually concealed. Sixth broad at proximal end, attenuated posteriorly; apex rounded, provided with many strong spines, twelve to twenty-two. Inner branch of uropoda as long as terminal abdominal segment; broad at distal end where it is armed with spines. Outer branch is shorter than inner and narrower; also armed with spines on distal end and outer margin. Peduncle of uropoda produced to two-thirds length of inner ramus. First and second pleopoda of male provided with many compound hairs; second has a long stylet.

Alloniscus cornutus var. *lagunae* n. var.

(Figs. 4 and 5)

Locality—Margins of stagnant salt lagoon; under old sea-weed where it is associated with *Philoscia richardsonae* Holmes and Gay, at Laguna Beach, California.

Color—Dull gray-brown, resembling the old sea-weed under which it lives.

Body convex, ovate and punctate; about 10 mm. long and 5 mm. wide, 3 mm. high (dimensions of a large specimen).

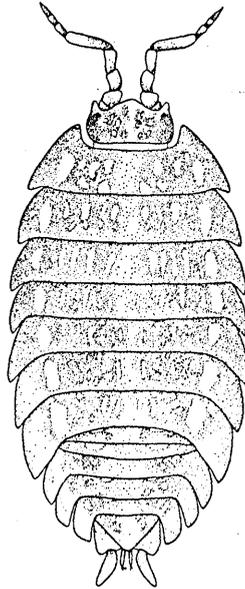


Figure 4. *Alloniscus cornutus* var. *lagunae* n. var.

Head not closely articulated with thorax; frontal margin produced medially into a prominent lobe; antero-lateral angles form distinct processes, much more prominent than in *Alloniscus perconvexus*. Eyes oval compound, longer than wide; near lateral margin. First antennæ have three articles, which are very small, rudimentary. Second antennæ extend about as far as second thoracic segment; have a peduncle of six articles and

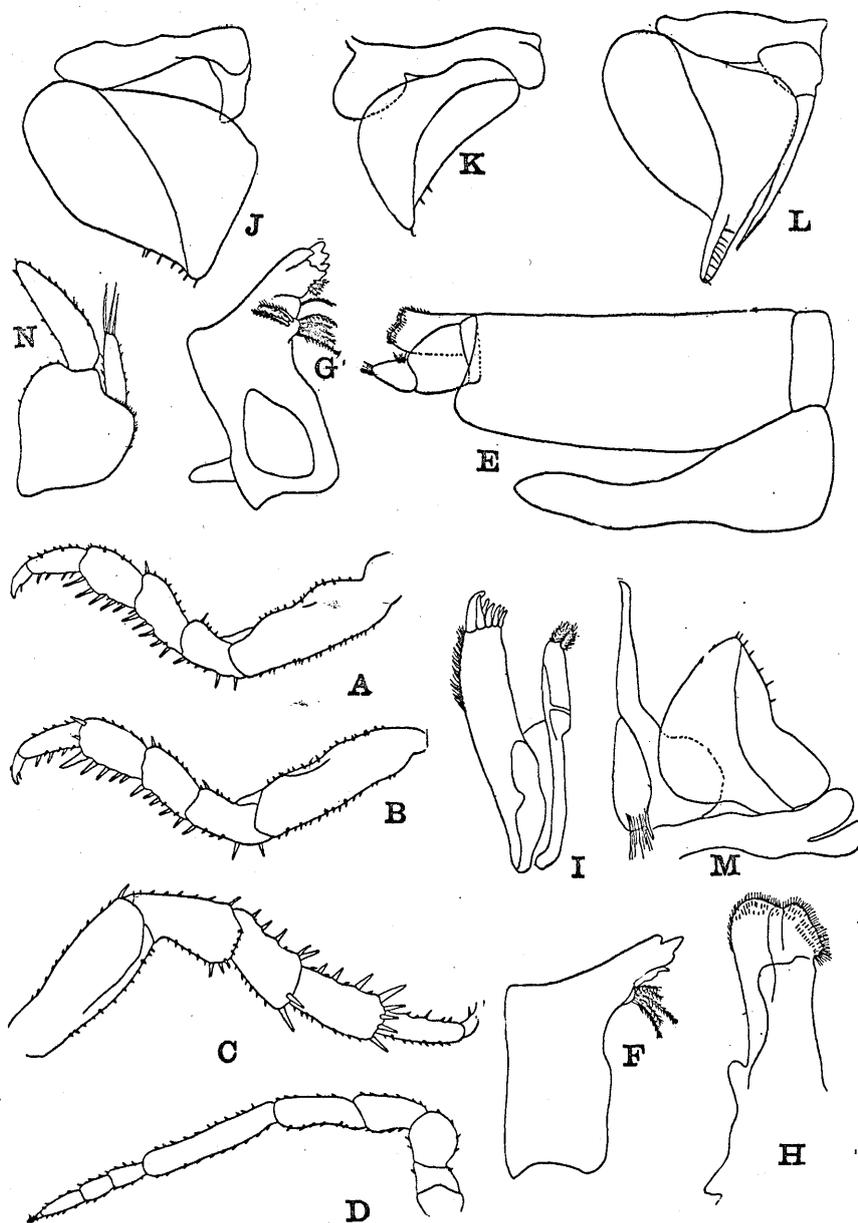


Figure 5. *Alloniscus cornutus* var. *lagunæ* n. var. A, first leg; B, second leg; C, seventh leg; D, second antennæ; E, maxillipeds; F and G, mandible; H, second maxilla; I, first maxilla; J, second pleopod of female; K, first pleopod of female; L, second pleopod of male; M, first pleopod of male; N, uropod.

a flagellum of three; flagellum about as long as fifth article of peduncle. Maxilliped has a palp of three articles.

The thoracic segments show no sinuations as described in *Alloniscus cornutus*. Epimeral sutures are only faintly indicated in some of the specimens on the second, third and fourth segments. Legs similar in structure and very much spined.

Abdomen has six segments; first two covered laterally by seventh thoracic segment. Epimera of third, fourth and fifth, large, extended posteriorly; subtetragonal in shape. Sixth, triangular, rounded posteriorly. Uropoda have basal article broad and depressed; outer ramus twice as long as inner which articulates at the inner angle of the basal article and is concealed at articulation by last abdominal segment. The outer ramus does not appear to be carinated.

These specimens evidently lie close to *Alloniscus cornutus*. Their peculiar habitat and associations should be significant. As the specific habitat of *A. cornutus* is not given it is impossible to compare them on this point. However, *A. cornutus* is described as having sinuated thoracic margins. Such is not the case with these specimens. The outer ramus of the uropoda does not appear to be carinated in this isopod as in *A. cornutus*. The flagellum of the second antennæ of the latter is shorter than the fifth article of peduncle, several specimens of this variety were examined and the flagellum appears about equal, scarcely less than fifth article. Accordingly I have made these specimens, provisionally, a variety of *A. cornutus*.

(Continued in the next number of the Journal)

Studies in Laguna Beach Isopoda II B

BLANCHE E. STAFFORD, M. S.

Tylos punctatus Holmes and Gay

(Fig. 6)

Locality—Found in the sand at Laguna Beach; on being alarmed they rolled up in a compact ball.

Color—Gray, spotted with white.

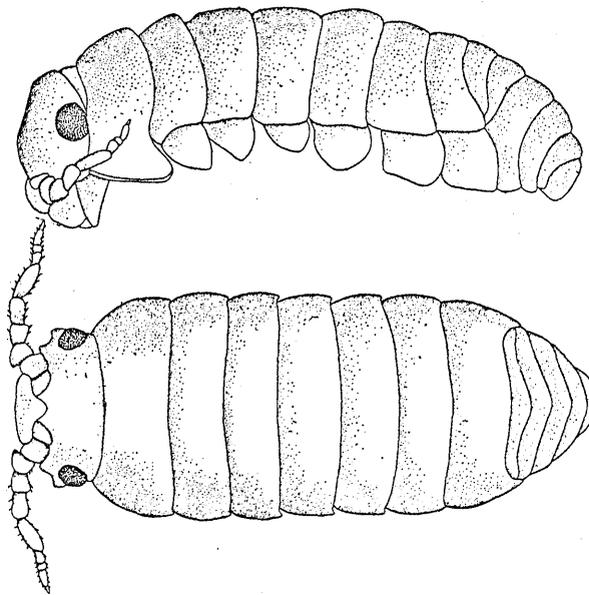


Figure 6. *Tylos punctatus* Holmes and Gay. Lateral and dorsal views.

Body oblong and very convex, manifesting very perfect ability to contract in the form of a ball. Covered with many minute spines. About twice as long as wide, 7 mm. by 3 mm. (measurements of a small specimen).

Head with lateral lobes produced into triangular projections in front of eyes. Eyes round and composite, situated post-laterally. First antennæ rudimentary, scale like. Second antennæ has peduncle of five articles: first three broad; first and

second subequal in length; second slightly shorter and has sharp projection on proximal inner angle. Fourth and fifth long and narrower; fifth, one and a third times longer than fourth. Flagellum composed of two short articles, a third equal to one and two, and a fourth short and conical. Antennæ profusely covered with spines. Extend scarcely to end of first thoracic segment.

Thoracic segments subequal: first slightly longer than those succeeding. Sutures of epimera distinct on all but first segment where epimera are indicated by a thickened margin. Epimera produced posteriorly and rounded. Legs ambulatory, all similar, very thickly spined. First leg has segments broader than those of following legs; first segment has a triangular process on exterior distal margin.

Abdomen composed of six segments. First two have lateral margins covered by seventh thoracic segment. Third broad, articulating with epimera of seventh thoracic segment on lateral margin, fourth rounded on lateral margin, slightly produced posteriorly as also the fifth which, however, is shorter and narrower. Sixth is truncate, short and broad. Uropoda have become opercular valves and have a short setose terminal joint.

Janira occidentalis Walker

(Fig. 7)

Locality—Large kelp holdfast from deep water, at Laguna Beach, Cal.

Color—White tinged with green and orange, finely spotted with brown; legs white.

Body about three times longer than wide, 6 mm. by 2 mm. Oblong, depressed along lateral margins. Slightly convexed on median line.

Head twice as wide as long, anterior margin not straight but produced into a slight median lobe; antero-lateral angles marked. Eyes large, round, composite and subdorsal in position. First antenna has first article of peduncle large, broad and long. Second and third subequal and much narrower than first. Fla-

gellum composed of twelve articles. Second antenna has first two articles subequal; third slightly larger, provided with antennal scale; fourth narrower and shorter than third; fifth and sixth long and narrow; sixth longer than fifth; flagellum multi-articulate. Maxillipeds with palp of five articles; first three subequal in width; fourth and fifth about half as wide. Mandible has a palp of three articles.

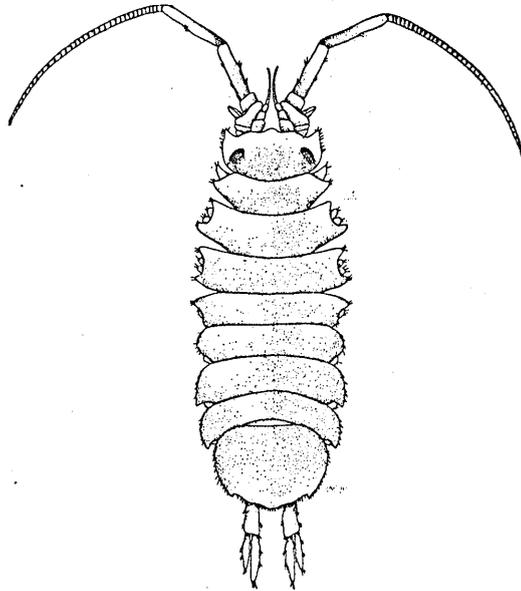


Figure 7. *Janira occidentalis* Walker.

Thoracic segments subequal in length. First segment of thorax has post-lateral angles rounded and prominent. Epimeral lobe occupies antero-lateral angles. Second and third segments have both antero- and post-lateral lobes with bilobate epimera between. Fourth segment has antero-lateral lobe prominent and rounded, post-lateral less prominent; single-lobed epimera between. Fifth similar to fourth with antero-lateral lobe much more rounded and conspicuous. Sixth and seventh have antero-lateral lobe very prominent and produced sharply at posterior extremity; post-lateral lobe obsolete, its place occupied by epimera. First pair of legs prehensile, remaining ambulatory

with bi-unguiculate dactyli. First leg has toothed propodus for half the proximal distance.

Abdomen composed of one large segment, possibly a very small anterior one though the suture was not distinct enough to make this certain. Telson is produced at post-lateral angles into a short, sharp point. Median part forms a rounded lobe. Uropoda composed of a peduncle about three times as long as inner ramus. Outer ramus slightly shorter than inner ramus.

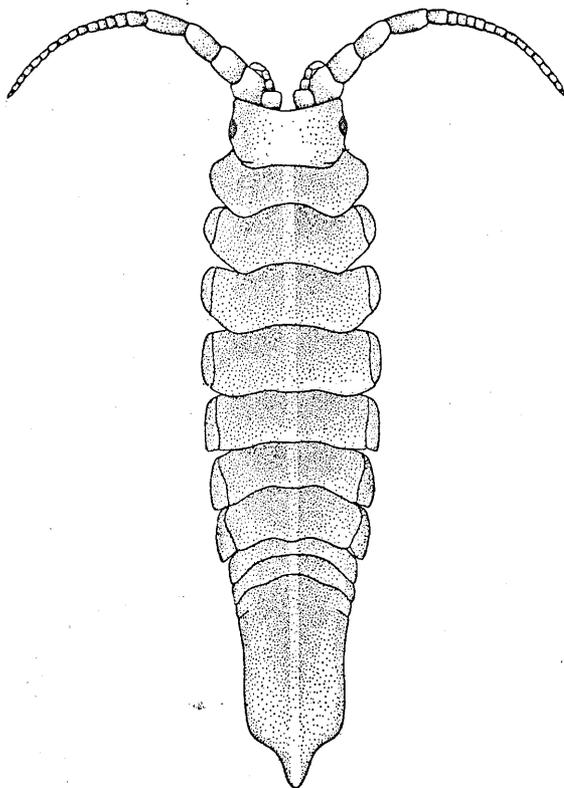


Figure 8. *Pentidotea aculeata* n. sp.

Pentidotea aculeata n. sp.

(Figs. 8, 9 and 10)

Locality—Low tide pools, Laguna Beach, California.

Color—Reddish brown in the male; female a more delicate pink with white spots along median line of back and two similar

rows of markings, each in a line half way between the median line and the lateral margin. Both male and female have all the segments and sutures outlined with a bright red line.

Body of male narrow and elongate and arched along median line. Length 23 mm., greatest width 6 mm., almost four times longer than wide.

Head about twice as wide as long, excavated on frontal margin with antero-lateral angles distinct but rounded. Posterior

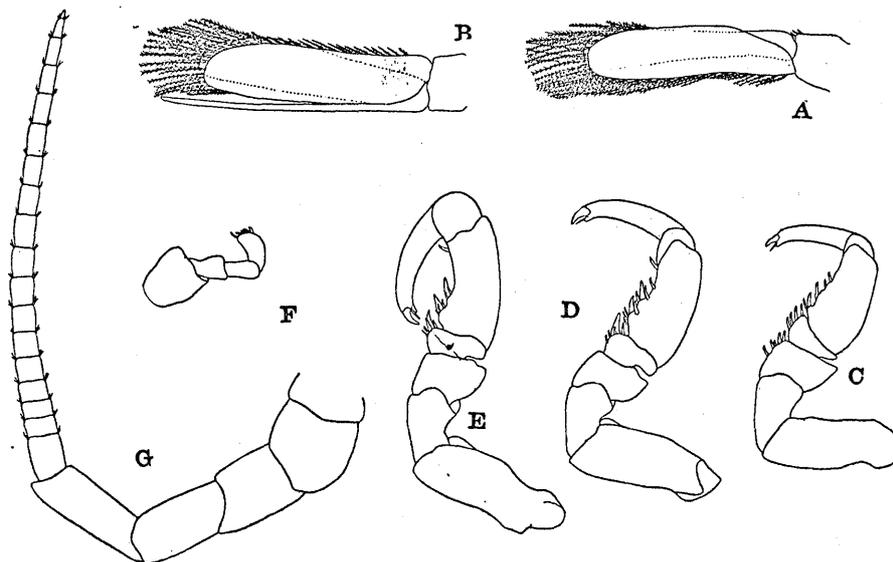


Figure 9. *Pentidotea aculeata* n. sp. A, first pleopod of male; B, second pleopod of male; C, first leg; D, second leg; E, seventh leg; F, first antenna; G, second antenna.

margin slightly concave with a short red mark extending horizontally from a post-lateral position. Eyes on lateral margin midway between anterior and posterior margins and almost round in shape. First antennæ possess four articles; first broad, almost as wide as long; following three articles not half as wide; second and third subequal; last clavate and slightly longer than the two preceding. First antennæ extend to end of second article of peduncle of second antennæ. Second antennæ have a peduncle of five articles: first short; second and third subequal, twice as

long as first; fourth not quite twice as long as third; fifth slightly longer than fourth; flagellum consists of seventeen or eighteen articles. Maxillipeds have a palp of five articles.

Sides of thorax almost parallel in male. All but first segment have epimera which extend to end of posterior margin. Epimera of second and third and fourth segments about equally wide from anterior to posterior margins. Fifth, sixth and seventh much narrower at anterior than at posterior margin. Legs alike in structure.

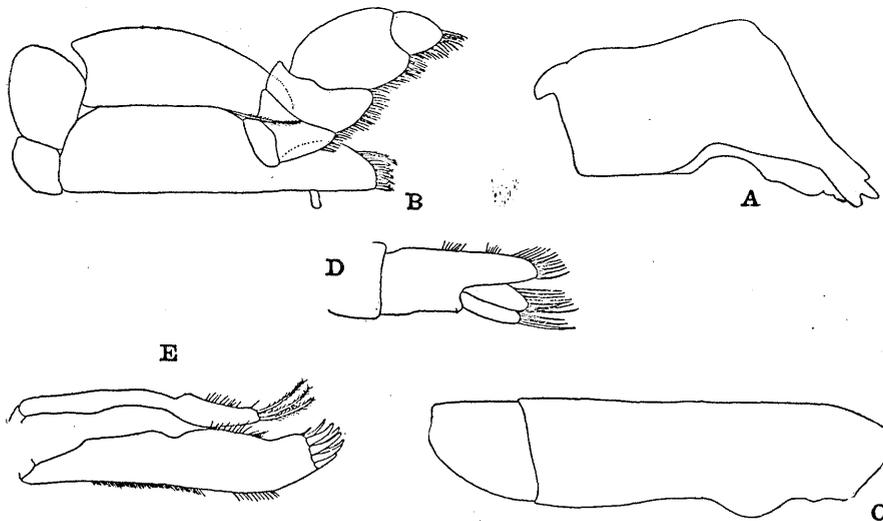


Figure 10. *Pentidotea aculeata* n. sp. A, mandible; B, maxilliped; C, opercular valve; D, second maxilla; E, first maxilla.

Abdomen 8 mm. long, 4 mm. wide at anterior end; composed of two short segments, a partially coalesced and a long terminal segment; the latter narrow and slightly excavate on the lateral margins, prolonged at median posterior extremity into a pronounced tooth, 1 mm. long. Post-lateral angles rounded. Opercular valves composed of a long anterior and a short posterior part. Carina not apparent on anterior portion.

The above description applies only to the male. Along with these a number of other specimens, all females, were collected which are slightly different in shape: have lateral margins less

parallel, more arched. They were lighter in color and more distinctly marked than the males. These differences are probably only sexual.

These specimens appear to lie close to *Pentidotea whitei* in many details, but in others are quite different. The male of *P. whitei* is described as being much larger—17 mm. by 34 mm.—and about three times as long as wide, whereas the male of these Laguna specimens is almost four times as long as wide. In *P. whitei* the epimeron of the second segment becomes narrower from the anterior to the posterior margin. Here the epimeral suture is practically vertical and the epimeron is about as wide anteriorly as posteriorly. The anterior margin of the head is more distinctly excavate and the antero-lateral angles more pronounced than in *P. whitei*. The eyes are about round, whereas in *P. whitei* they are twice as wide as long. The last abdominal segment is more elongate and the terminal process more pronounced than in *P. whitei*. It therefore seems evident that this isopod represents a new species.